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SECTION 5.12: WATER SUPPLY

Author's declaration: I declare that appropriate diligence and quality assurance was applied in the compilation of this report. As such I am confident in the results here described and the conclusions drawn.

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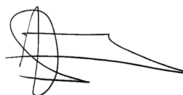
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AMENDMENT RECORD			
Rev	Draft	Date	Description
0		April 2015	New section. Thyspunt Site Safety Report compiled in support of Eskom's Nuclear Installation Site Licence for the Thyspunt site and submitted to the NNR.
0a		January 2025	Section updated with the latest numerical model predictions of local groundwater availability and to address NNR comments.
0b		March 2026	Section updated to correct minor editorial issues.

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EXECUTIVE SUMMARY

This section of this Site Safety Report (SSR) presents the assessment (the approach, activities and results) of potential local and regional water sources to meet the fresh water supply demands of:

- a planned nuclear installation(s) with maximum total electrical capacity of 33 000 MWth (see **Chapter 3**, Overview of Planned Activities), e.g. pre-construction, construction, potable, boiler and feed-water (demineralised) purposes;
- the population associated with the planned nuclear installation(s).

This section complements the evaluation of water use by the population around the site and the hydrological and geohydrological studies, as discussed in **Section 5.5**. (Land and Water Use), **Section 5.10** (Hydrology and Hydraulics) and **Section 5.11** (Geohydrology) of this SSR.

The main conclusions regarding fresh water supply at the site are the following:

- requirements vary between 23 l/s during site establishment, 104 l/s for construction and 69.4 l/s during normal operation of the nuclear installation(s). This is for reactor units to supply an initial 13 200 MWth electrical power.
- supply requirement for the total potential site capacity of 33 000 MWth is estimated at about 173 l/s.
- the site establishment requirements of 23 l/s can be met from site groundwater sources in the Algoa and Table Mountain Group aquifers under dry climatic conditions. This should be done in conjunction with the Kouga Local Municipality.
- local surface water and groundwater quality has deteriorated during the period 2007 – 2024, probably as a result of the droughts affecting the area.
- apart from establishment requirements, the water requirements cannot be sourced or guaranteed from existing conventional water supply schemes or from groundwater resources at and around the site.
- securing a reliable fresh water supply from other sources such as new schemes, re-use of wastewater, site storm water run-off and/or water trading is not considered to be viable due to existing and future demand and the risk of water deficits due to droughts.
- desalination of seawater offers the best short and long-term option for fresh water

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supply to support the safe operation of the nuclear installation with least environmental impact and highest assurance of supply, and is the preferred option.

- desalination plants will be established in phases with several water treatment plants with permanent reservoirs established for the construction and operational phases.
- desalination plants, reservoirs and intake/discharge structures will all be established within the enveloping footprint area.
- with desalination of seawater being the preferred option there are no uncertainties associated with construction peak and operational fresh water supply, as long as the quality of the intake water and membranes are monitored adequately.
- should conventional supply sources, either existing or new, ever be considered for fresh water supply, then agreement would need to be reached with the local authority, Kouga Municipality, Nelson Mandela Bay Municipality and the Department of Water and Sanitation to secure the required supply. Groundwater sources could be developed on site to supply initial construction supply requirements.
- uncertainties associated with conventional fresh water supply are:
 - effects of drought/climate change on security and availability of supply;
 - long-term regional planning priorities.

In terms of site location and nuclear installation safety, it can be concluded that an adequate water supply can be sourced for short-term construction and long-term operational requirements.

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5.12 WATER SUPPLY

5.12.1 Introduction

This section of this Site Safety Report (SSR) presents the assessment (the approach, activities and results) of potential local and regional water sources to meet the fresh water supply demands of:

- a planned nuclear installation(s) with maximum total electrical capacity of 33 000 MWth (see **Chapter 3**, Overview of Planned Activities), e.g. pre-construction, construction, potable, boiler and feed-water (demineralised) purposes;
- the population associated with the planned nuclear installation(s).

This section complements the evaluation of water use by the population around the site and the hydrological and geohydrological studies, as discussed in **Section 5.5**. (Land and Water Use), **Section 5.10** (Hydrology and Hydraulics) and **Section 5.11** (Geohydrology) of this SSR.

5.12.2 Purpose and Scope

The purpose of this section of this SSR is to present the approach to the activities and the results of the fresh water supply investigation at and around the proposed site in terms of:

- determining the nuclear installation fresh water supply requirements at various development/operational stages;
- existing supply from municipal and community sources;
- chemical quality of existing supplies;
- potential surplus allocation from existing sources;
- potential new sources of water supply and the preferred option;
- security of supply;
- constraints on development of new supply sources.

The focus of the section is on identification and evaluation of a secure and adequate supply of fresh water to the nuclear installation(s) and ancillary structures/activities for the planned generating capacity during construction,

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operation, shutdown and decommissioning, whilst also taking into account the public and the environment.

5.12.3 Regulatory Framework

The key legislation in South Africa relevant to water supply is comprised of the National Water Act, 1998, Act No. 36 of 1998 (Republic of South Africa, 1998). This Act is the principal legal instrument that applies to water resource management in South Africa and contains comprehensive provisions for the protection, use, development, conservation, management and control of the country's water resources. The provisions of the Act are implemented and monitored by the Department of Water and Sanitation (DWS). However, compliance with the above Act will only be required if a decision is made to develop such a source.

In addition, the management of water as a renewable resource is required to be carried out within the framework of the relevant environmental legislation, i.e. the National Environmental Management Act, 1998, amended Act No. 8 of 2004 (Republic of South Africa, 2004). Site work for this SSR, i.e. on-site drilling and testing of exploration boreholes, was carried out within the scope of this Act.

The Interim Guidelines for the Siting of New Nuclear Installations (National Nuclear Regulator, 2016) are generally applicable, and in particular Regulation 4 (2): *"Factors considered in the evaluation of sites must include...the proposed nuclear installation design(s) and the characteristics specific to the site..."*.

5.12.4 Guidelines

Relevant national and international guidelines were consulted in the preparation of the Technical Specification (Eskom, 2022) that underpins this SSR but are not referenced again herein. These included:

- South African National Standard Guidelines for Drinking Water No. 241-2015 of 2015 (South African National Standards, 2015) - This guideline and the one following are self-explanatory and provide recommended and upper limits for various key constituents of natural waters.
- The Department of Water Affairs and Forestry's (DWAF's) Water Quality Guidelines of 1996 (Department of Water Affairs and Forestry, 1996).
- Eskom's Water Supply Specification for the envisaged nuclear power

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station (Eskom, 2008) - This document gives details of nuclear installation fresh water requirements through the various stages of development.

- Electric Power Research Institute, Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Energy Generation Facilities (Siting Guide) (Electric Power Research Institute, 2022; Eskom, 2008) - This guide gives an example of criteria used in the evaluation of fresh water supply for a nuclear installation.

5.12.5 Approach to Evaluation

The water supply investigation included a desk study, evaluation of field work from complimentary studies and data analysis.

5.12.5.1 Desk Study

A desk study was carried out involving detailed review of the national legal and regulatory requirements and guidelines, and national and international guidelines, review and collation of available information on fresh water supply, liaison with the meteorology, geohydrology, hydrology and land and water use SSR investigations and development of a project quality plan and method statement.

Fresh water requirements for a conventional nuclear installation(s), based on a likely phased approach to installation of units of 13 200 MWth, are estimated to be (Eskom, 2008):

- site establishment: 23 l/s;
- excavation for nuclear installation foundations: 104 l/s;
- construction peak: 19 l/s;
- commissioning: 24 l/s;
- operation: 69 l/s;
- full site capacity operation: 173 l/s.

Water supply is required for potable and construction purposes during construction and for potable, demineralised and industrial purposes during operation. Housing of temporary and permanent staff will be established in or near Humansdorp or St. Francis Bay (Eskom, 2008). The required

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amounts for these staff vary from 46 l/s initially to 12 l/s permanently. It is assumed that this water will be sourced from the local municipal supply (Eskom, 2008).

The following temporary reservoirs will need to be established on the site (Eskom, 2008) for the excavation and construction phase:

- seawater reservoir (pre-desalination): 1 x 9 000 m³;
- desalinated construction water (two days standby): 2 x 9 000 m³.

The following permanent reservoirs will be required for the operational phase:

- demineralised water: 2 x 800 m³ and 4 x 2 200 m³;
- potable water: 2 x 9 000 m³;
- fire water: 2 x 1 800 m³.

5.12.5.2 Field Work

Field work was not specifically carried out for this section but that of relevance, carried out for **Section 5.11**, included the following:

- a hydrocensus (approximate 5 km radius of the site centroid – see **Section 5.11**) in December 2007, October 2017 and February 2024 and water use survey in 2024 (up to 50 km radius of the site centroid – see **Section 5.5**);
- drilling of 38 geohydrological exploration, test and monitoring boreholes within the nuclear installation site;
- test pumping of selected higher yielding of these boreholes to assess yield potential;
- chemical analysis of water samples to check for suitability for various uses;
- monitoring of groundwater levels and quality and wetlands.

5.12.5.3 Data Analysis

The following data analysis activities were carried out specifically for

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Sections 5.11 and **5.10** but have relevance to this section and included:

- determination of local and regional groundwater and surface water potential;
- numerical groundwater flow modelling to assist *inter alia* in assessing a water balance to determine an estimate of the exploitable groundwater potential;
- comparison of the feasibility and environmental implications of the different supply options, including desalination of seawater - A comparison of costing of the different options has not been carried out as the preferred option both environmentally and from assurance of supply is desalination. The environmental impacts and comparisons thereof have been evaluated in the Environmental Impact Report (Eskom, 2010a).

5.12.5.4 Municipal Strategic Initiatives

Of direct influence on any decisions regarding use of local water resources for supply to the site are local DWS and municipal strategic initiatives/entities. These include the Algoa Status Report (Department of Water and Sanitation, 2023), Fish to Tsitsikamma Catchment Management Agency and the development of a Catchment Management Strategy and the Reconciliation Strategy for the Algoa Water Supply System (Nelson Mandela Bay Municipality, 2021). Water use licenses and allocations will be/have been allocated through these agencies.

The above information has been applied in the evaluation of the potential supply of fresh water to the nuclear installation(s) planned to be built at the site. This evaluation was also performed taking into account the water supply requirements for a nuclear installation as determined by Eskom (Eskom, 2008).

5.12.6 Existing Water Supply

The site falls within the Fish-Tsitsikamma Water Management Area but large quantities of water are imported from the Gariep Dam in the Upper Orange River Water Management Area via the Sundays River and the Nooitgedacht Water Supply Scheme (Nelson Mandela Bay Municipality, 2021). The existing infrastructure and areas of interest for the development of a nuclear installation at the site are presented in **Drawing 5.12.1**. The various water storage and transfer systems that supply the local area and the Nelson Mandela Bay Metropolitan Area (NMBMA) are called the Algoa Water

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Supply System (AWSS). This is divided into Western, Central and Eastern systems.

The greatest use of water in the area is for irrigation, being about 55 per cent of total use (see **Section 5.5**). According to the water requirement projections outlined in (Nelson Mandela Bay Municipality, 2021), no allowance has been made for any possible water requirements for power generation in this water management area.

The Nelson Mandela Bay Municipality (NMBM) supplies water to the population at Humansdorp and St. Francis Bay via the Churchill Pipeline from the Churchill and Impofu (formerly Elandsjagt) dams with holding capacities of 26.3 and 32.1 Mm³, respectively. These form part of the Western System and the Churchill Dam is owned by the NMBM while the other dams are owned by the DWS. The bulk supply from this system is 167 Ml/day under unrestricted conditions.

The Churchill Pipeline runs in an easterly direction to the south of the N2 freeway from the abovementioned dams to Gqeberha (previously known as Port Elizabeth), with the offshoot to St. Francis Bay linking up with the Humansdorp-St. Francis tar road (R330) just before the Krom River bridge (**Drawing 5.12.1**). The water is treated before distribution at the Elandsjagt Water Treatment Works as shown in **Drawing 5.12.1**.

The local towns all obtain a portion of their water supply from groundwater sources. For example, Oyster Bay is currently totally reliant on groundwater supply and falls under the Kouga Local Municipality (KLM). Three new boreholes were drilled in late 2017 and two more in late 2018 (Murray, 2020). The town is now (2024) supplied from the sources shown in **Table 5.12.1**.

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On the basis of the hydrocensuses carried out (see **Section 5.11**), it is apparent that groundwater is extensively used in the area surrounding the site. Numerous farms, homesteads and villages use groundwater for domestic consumption, crop and stock watering. Springs to the north of Humansdorp are utilised for municipal water consumption. Borehole water in the Table Mountain Group (TMG) fractured rock aquifer and also from the intergranular aquifer surrounding the non-perennial Sand River (between Ashton Bay and Cape St. Francis) is utilised for domestic consumption and for golf course irrigation purposes.

A strong coastal spring yielding 8 l/s occurs west of Cape St. Francis at Mostert's Hoek (**Drawing 5.12.1**) and is currently used on a limited basis. Small seeps and springs commonly occur along the coast from the base of the Algoa Group but no high yielding springs are reported from the immediate area surrounding or on the site. The majority of these seeps and springs flow directly onto rocky outcrops or sandy beaches and then directly into the ocean.

A summary of selected results of the chemical analyses of the groundwater from the site (SSR geohydrological drilling) and the surrounding area (2024 hydrocensus) is shown in **Table 5.12.2**.

The sample locations are shown in **Drawing 5.12.1**.

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Table 5.12.2
Groundwater Chemical Analyses February 2024

Borehole Number	Aquifer	Determinand*									
		Ca	Mg	Na	K	CaCO ₃	Cl	SO ₄	NO ₃	pH**	EC***
SSR boreholes											
THY-SP7	Algoa	72.0	14.0	88.0	1.9	204.0	155	25	1.9	8.3	88.1
THY-RP7	TMG	70.0	11.0	52.0	1.3	200.0	90	22	6.3	7.8	68.4
THY-RP8	TMG	107.0	26.0	216.0	4.0	184.0	431	123	1.3	6.9	181
THY-RP10	TMG	98.0	21.0	169.0	3.4	252.0	280	45	5.2	7.8	140
THY-RP12	TMG	85.0	10.0	47.0	1.3	212.0	91	47	< 0.1	7.8	73
THY-MR2	Algoa	87.7	9.5	52.5	2.2	-	85.7	26.7	-	7.6	72
THY-MR5	TMG	94.6	9.9	60.4	2.6	-	96.4	23.8	-	7.8	78
THY-MR6	TMG	88.0	8.2	54.0	2.4	-	89.3	18.8	-	8.0	76
THY-RP8	TMG	129.4	23.2	265.7	4.8	-	473.2	41.8	-	8.0	215
2024 Hydrocensus Sources											
OystSp8	Algoa	130.5	35.2	311.4	8.4	278	533.9	99.2	<0.2	7.62	236
Strydom5	TMG	13.0	16.6	130.8	1.6	40	240.5	24.3	0.7	6.42	93
Strydom6	TMG	11.4	15.1	123.5	1.3	38	223.4	22.3	<0.2	6.4	91.3
Strydom7	TMG	10.1	19.2	130.1	1.2	26	257.1	23.3	6.0	6.24	100.1
Strydom9	TMG	14.4	15.2	154.7	2.0	62	285.3	9.4	<0.2	6.74	111.1
Welgelegen6	TMG	3.2	7.5	53.2	0.8	18	93.2	16.0	<0.2	6.05	41.9
Oeloff1	TMG	14.7	20.3	154.4	1.5	36	304.1	27.0	3.1	6.38	116.8
Oeloff2	TMG	20.8	38.3	245.3	1.1	30	458.6	28.6	7.3	6.31	172.2
Pepler	TMG	125.6	17.0	104.4	3.4	394	194.7	50.9	<0.2	7.73	127.1
Milagro1	TMG	12.1	11.7	92.3	6.6	36	149.8	16.8	<0.2	6.39	63.3
Milagro2	TMG	14.6	18.2	119.1	1.4	20	229.1	23.3	10.4	6.19	90.4
* All determinands in mg/l unless otherwise stated and excluding pH.											
** pH value at 22 °C											
*** EC measured in mS/m at 25 °C											

The above results show that the water is of a sodium-chloride-calcium-bicarbonate type. The electrical conductivity (EC) of the TMG Aquifer groundwater is between 41.9 and 181 mS/m and it is mostly of good quality and suitable for domestic consumption.

The quality of groundwater originating from the Algoa Aquifer is generally good with EC from about 72 to 236 mS/m and pH in the 7.6 to 8.3 range (for

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further details see **Section 5.11** of this SSR).

A comparison of ECs is made in **Table 5.12.3** for those water points that were sampled on multiple occasions.

Table 5.12.3
Groundwater Electrical Conductivity (mS/m)

<i>Date Water Point</i>	<i>Aquifer</i>	<i>December 2007</i>	<i>October 2017</i>	<i>February 2024</i>
GRUN1	TMG	-	94	91
KKSIP	TWG	-	97	131
Mans	TWG	-	101	141
MunBH	TMG	-	116	165
OystSp8	Algoa	-	314	283
Oeloff 1	TMG	-	128	145
Oeloff 2	TMG	-	137	211
Pepler	TMG	-	107	164
Pennisands 1	TMG	79	104	158
Pennisands 2	TMG	78	98	136
Vuli Ndela 4	TMG	31	-	161
Vuli Ndela 5	TMG	56	-	162
Welgelegen 1	TMG	73	66	95

The data show a clear increase in EC between 2007 and 2024, indicating deteriorating groundwater quality, although most readings are still below the limit of 170 mS/m for potable water (Department of Water Affairs and Forestry, 1996). This deterioration is attributed to the drought conditions experienced in the NMBM area over this period.

The surface water originating from supply dams on the inland TMG catchments is of similar quality, i.e. at the lower end of the EC range. Examples of chemical analyses of the local surface water, represented by the raw water intake at the Elandsjagt Water Treatment Works for May 2010 and February 2024, are shown in **Table 5.12.2**. These are for illustrative purposes only for this assessment but show a deterioration with respect to Na and Cl most likely attributable to the drought conditions experienced in

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the catchment area prior to 2024 and increased evaporation and lowering of supply levels in the dam.

Table 5.12.4
Summary of Chemical Analysis of Local Surface Water

Elandsjagt Water Treatment Works	Determinand*									
	Ca	Mg	Na	K	CaCO ₃	Cl	SO ₄	NO ₃ (as N)	pH**	EC***
May 2010	31.0	35.0	58.0	3.2	17.0	105.0	17.0	-	7.2	43.7
February 2024	32.0	67.0	94.0	4.26	7.0	164.0	23.0	0.17	6.8	61.7

* All determinands in mg/l unless otherwise stated and excluding pH.

** pH value at 22 °C

*** EC measured in mS/m at 25 °C

These ground and surface waters all fall within the South African National Standard (South African National Standards, 2015) Class 1 (recommended limit) for drinking water (EC < 150 mS/m).

5.12.7 Potential Water Supply

The estimated annual fresh water demand of about 5.45 Mm³ for the full nuclear installation development is relatively small in comparison with the estimated demand of about 300 Mm³ as of the year 2021 for the Tsitsikamma to Kouga sub-region (Nelson Mandela Bay Municipality, 2021). Nevertheless, it represents a significant amount in terms of the local water supply. Climate, i.e. precipitation and evaporation, also plays a key role in local water supply potential.

During the 39-year historical period of data from the Cape St. Francis weather station (1985-2023), five “extremely dry” years (1989, 2004, 2005, 2017 and 2018) were observed with two “extremely wet” years (1997 and 2012). “Near normal” rain years account for 33 per cent (13 years) of the historical period, followed by “very wet” years (18 per cent, i.e., 7 years), “severely dry” years and “extremely dry” years (14 per cent, i.e., 5 years), and “moderately dry” years (10 per cent, i.e., 4 years). “Moderately wet” and “extremely wet” years account for 8 per cent (3 years) and 5 per cent (2 years), respectively (for details see **Section 5.8**).

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The catchment areas for the NMBM dams rely on cut-off low weather systems that produce rainfall events of >50 mm in 24 hours. These need to be followed by regular rainfalls of more than 10 mm in 24 hours to provide significant run-off. However, since November 2017, the catchments have not had a single 50 mm event. The area has been in the grip of a severe drought since 2012 (Nelson Mandela Bay Municipality, 2021), which only showed signs of breaking from 2022.

The Churchill Pipeline to St. Francis Bay has a design capacity of 93 l/s, which could possibly be extended to a maximum of about 120 l/s (Nelson Mandela Bay Municipality, 2021).

The supply from the Impofu Dam has been increased by the installation of barges to access dead storage water below the existing intake but this resource is fully committed to the NMBMA (Nelson Mandela Bay Municipality, 2021).

The potential for groundwater use at the site for the construction phase is considered to be good (see **Section 5.11** of this SSR). The underlying TMG Aquifer is of medium potential while the major intergranular aquifer of the Algoa Group is considered to be of high potential, as presented in detail in **Section 5.11** of this SSR. The KLM have (South African National Standards, 2015) requested that they be notified before any groundwater abstraction takes place from the site and that it be coordinated with them (Hofmyr, 2024).

A water balance simulation run as part of the numerical flow modelling performed for the site has indicated that up to 30 l/s could be abstracted from the Algoa Aquifer (13 l/s) and TMG Aquifer (17 l/s) under dry climatic conditions (see **Section 5.11**).

Concerns about the possible impact of the nuclear installation on the important wetlands occurring on the site, e.g. the Langefonteinvelei, led to further drilling and monitoring. This has shown that the parts of these wetlands closest to the footprint area are perched above the water table. Groundwater levels monitored in THY-RP5-M1 (see **Drawing 5.12.1**) show a c.2 m drop during the drought period of 2012-2022 and then the start of a recovery. It is likely therefore that use of local groundwater sources for the site establishment/construction phases should not have adverse environmental affects even during climatic extremes if managed correctly.

Since 2011, the NMBM has commissioned the drilling of 200 boreholes on properties owned by them, including around Churchill Dam. It is estimated

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that c.27 Ml/day could be obtained from these groundwater sources (Department of Water and Sanitation, 2023). These boreholes are outside of the site catchment area.

Other sources of fresh water include construction of a new dam(s), buying out and consolidation of existing water use licenses/allocations, treated waste water and storm water run-off from the site. However, none of these are considered to be viable in terms of securing a sufficient and reliable source of supply because:

- There are a limited number of good dam sites available for further water resource development. The proposed Guernakop Dam on the Kouga River and raising of the Kouga Dam wall were identified as major schemes to meet the future requirements of the NMBMA once water demand management and other measures have been implemented (Nelson Mandela Bay Municipality, 2021). However, neither scheme was found to be feasible. The timescale for development of new schemes must also be considered and as this may take six to 10 years to implement, security of supply from any proposed new scheme could not be guaranteed in time to meet the site licensing programme.
- Buying out of existing water use licences (water trading) would take too long, be fraught with potential obstacles and would be unlikely to realise the supply quantities required.
- Quantities of site waste-water and stormwater run-off would be too small to meet demand (see **Section 5.10**). Opportunities exist for additional use of reclaimed effluent in the Water Management Area, mostly from the NMBM's wastewater works. Increased efficiencies in this regard will be incorporated into the AWSS Reconciliation Strategy to help meet future demands and power supply use is not currently included in this strategy. Pilot studies are scheduled to be carried out (Department of Water and Sanitation, 2023).

The only other viable supply option is use of desalinated seawater. There is a ready supply of seawater at the site and there will be a ready supply of power once the nuclear installation(s) is in operation. In terms of nuclear installation safety and assurance of supply, which are paramount considerations for this SSR and licensing, and given:

- the periodic droughts that affect the site area and region;
- the already scarce water supply situation;

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- concerns over environmental impacts of groundwater abstraction;
- potential impacts of global warming;
- ready availability of tried and tested desalination technology/equipment.

Desalination (reverse osmosis) is the preferred option to provide the necessary long-term fresh water supply to the site (Eskom, 2008). However, initial requirements for site establishment may be sourced from on-site groundwater, specifically from the Algoa Aquifer in the vicinity of MR11.

Seawater desalination plants (reverse osmosis) will be used for the main water supply to the site and will be deployed in phases during the lifecycle of the project, typically as follows (Eskom, 2008):

- Phase 1: Not required; local groundwater will be used.
- Phase 2: 3 x 3 000 m³/day desalination systems during the excavation phase, housed in a permanent building with an area of approximately 1 700 m², with the seawater intake from beach wells;
- Phase 3: Operational phase which will require only two of the three units, with one unit spare/under preventive maintenance - All desalination plant infrastructure will be located within the enveloping footprint area.

The seawater requirements and brine discharge throughout the stages of the nuclear installation(s) lifecycle, assuming a conservative 40 per cent fresh water recovery (Eskom, 2008), would be approximately:

- site establishment: not required;
- peak construction: 260 l/s input and 156 l/s brine;
- operation: 175 l/s input and 105 l/s brine;
- full site capacity operation: 432 l/s input and 259 l/s brine.

During construction the estimated maximum brine discharge will be 156 l/s, for which a number of discharge options exist (Eskom, 2010a):

- through a pipe located on the upper beach profile;
- from a pipe located in the surf zone at a depth of 5 m;

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- from a pipe located beyond the surf zone at a depth of 10 m.

The specialist report on Marine Biology for the EIA (Eskom, 2010b) states that any impacts will be extremely localised and it is rated as low consequence and medium significance. During operation the brine will be mixed with the very large volumes of cooling water discharged from the nuclear installation(s) (about 430 000 l/s at full site capacity) to minimise such impacts. Discharge will be approximately 500 m offshore (Eskom, 2008).

5.12.8 Management of Uncertainties

The main uncertainties for conventional fresh water supply to the site are:

- source of long-term supply to the site;
- effects of drought and global warming on security of supply;
- impact of groundwater abstraction on wetlands, although additional drilling and monitoring of the Langefonteinvelei has shown that these wetlands are perched above the water table in their southern areas (Eskom, 2011). They are thus very unlikely to be impacted by controlled and short-term (<1 year) pumping from supply boreholes to the southwest for the site establishment phase.
- assumptions made for input to the numerical flow model to obtain the site groundwater balance of 30 l/s.

However, based on the scarcity of conventional local and regional fresh water supplies in the site region and environmental concerns, it is proposed to use desalination as the means to secure a reliable long-term fresh water supply to the site. Assuming that desalination does form the supply source, the above uncertainties will fall away. The EIA carried out for 'Nuclear-1' (Eskom, 2010c) covered desalination and so a separate EIA will not be required for establishment of a desalination plant(s) at the site.

5.12.9 Monitoring

With fresh water supply being sourced from site groundwater for the establishment phase, monitoring of groundwater will be required. This will take the form of measurement of groundwater levels and quality in selected existing boreholes and piezometers and purpose-drilled and equipped new boreholes/piezometers, depending on the siting of abstraction boreholes in the vicinity of MR11. Liaison with the KLM will be required.

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Prior to the construction phase and discharge of brine takes place, modelling studies on the effluent plume dispersion, baseline surveys on benthic habitats will be done to determine if mitigation measures such as monitoring will be required.

During operation, the influence of the brine discharge will be virtually undetectable in the cooling water outfall (Eskom, 2010a) and specific monitoring will therefore not be required during nuclear installation(s) operation. However, monitoring of the desalination plant membranes will be required to ensure that blockages do not occur.

5.12.10 Management System

Investigation of fresh water supply at the site has been classified as a level D activity according to Eskom's safety classification methodology. This is based on desalination of seawater being the preferred supply source. A level D classification means that an Eskom approved quality management system must be followed for execution of this work and this requirement was implemented.

Detailed records of the work carried out and databases established were kept by the consultant, e.g. hydrocensus, water quality analyses and geohydrological monitoring. These records were obtained from **Section 5.11** of this SSR and data validated by means of reference to the management system implemented for that section. Chemical analysis records obtained from the NMBM for the Elandsjagt Water Treatment Works are produced by their Scientific Services laboratory. Duplicate samples are taken during the weekly sampling runs. However, the absolute accuracy of the analytical data is not crucial to this SSR as the data presented herein are only for illustrative purposes to show the general suitability of fresh water sources for site supply.

Electronic records have been stored in a secure central repository with regular off-site back-up procedures and subject to Eskom's approval. The overall quality management system complied with that set-out in **Chapter 10** (Management System) and additional supporting information can be accessed through the references to that chapter.

All references cited are saved on the central repository. Although the preferred fresh water supply source is desalination of seawater all relevant data are presented as back-up documentation in the form of appendices to this section of this SSR, viz.:

- **Appendix 5.12.A**: Hydrocensus data;

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- **Appendix 5.12.B:** Certificate of analysis.

Table 5.12.5 lists the activities carried out, the links to other SSR sections/chapters and the relevant quality control requirements.

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Table 5.12.5
Summary of Activities, Links and Quality Requirements

Activity	Links		Quality Requirements
	Inputs	Outputs	
Hydrocensus	Position of all water points such as boreholes, springs, dams from <u>Section 5.11</u> (Geohydrology)	<u>Section 5.5</u> and <u>Section 5.10</u> ; Information on existing groundwater use from boreholes and springs (additional to the Geohydrology hydrocensus area) will provide essential input into the Land Use and Hydrology sections, mainly on quantities used and quality.	Check methodologies used, Project Quality Plan, method statement of supplying organisation(s) to ensure valid data are acquired
Water quality	Chemical analyses from municipal water treatment works	<u>Section 5.5</u> and <u>Section 5.10</u> ; Water quality data will be used as input to the Land Use and Hydrology sections	Check certificate of accreditation for laboratories used
Development of new sources	Integrated study including comparison of costs and environmental issues	Source location and status. Assured supply	
Desalination	<u>Section 5.9</u> (Oceanography) for sea water intake and outfall details.	<u>Section 5.9</u> (Oceanography), <u>Section 5.3</u> (Ecology). Brine discharge quantities, temperature and quality.	
Monitoring	From <u>Section 5.10</u> (Hydrology and Hydraulics) and <u>Section 5.11</u> , (Geohydrology)		Check monitoring protocols used by supplying organisation(s)

A regulatory compliance summary is given in **Table 5.12.6** to show what Acts/regulations are relevant to water supply and where in this SSR they

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have been dealt with.

Table 5.12.6
Regulatory Compliance Matrix

Act/Regulation	Regulation	Issue	Section where covered
The Regulations on Licensing of Sites for New Nuclear Installations (Department of Energy, 2011)	4 (2)	Site characteristics	5.12.5; 5.12.6

5.12.11 Conclusions

The main conclusions regarding fresh water supply at the site are the following:

- requirements vary between 23 l/s during site establishment, 104 l/s for construction and 69.4 l/s during normal operation of the nuclear installation(s). This is for reactor units to supply an initial 13 200 MWth electrical power.
- supply requirement for the total potential site capacity of 33 000 MWth is estimated at about 173 l/s.
- the site establishment requirements of 23 l/s can be met from site groundwater sources in the Algoa and TMG aquifers under dry climatic conditions.
- local surface water and groundwater quality has deteriorated during the period 2007 – 2024, probably as a result of the droughts affecting the area.
- apart from establishment requirements, these quantities cannot be sourced or guaranteed from existing conventional water supply schemes or from groundwater resources at and around the site.
- water supply for nuclear installation site establishment purposes can be sourced from local groundwater sources, specifically from the Algoa Aquifer in the vicinity of MR11. This should be done in coordination with

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the Kouga Local Municipality.

- securing a reliable fresh water supply from other sources such as new schemes, re-use of wastewater, site storm water run-off and/or water trading is not considered to be viable due to existing and future demand and the risk of water deficits due to droughts.
- desalination of seawater offers the best short and long-term option for fresh water supply to support the safe operation of the nuclear installation with least environmental impact and highest assurance of supply and is the preferred option.
- desalination plants will be established in phases with several water treatment plants with permanent reservoirs established for the construction and operational phases.
- desalination plants, reservoirs and intake/discharge structures will all be established within the enveloping footprint area.
- with desalination of seawater being the preferred option there are no uncertainties associated with construction peak and operational fresh water supply, as long as the quality of the intake water and membranes are monitored adequately.
- should conventional supply sources, either existing or new, ever be considered for fresh water supply, then agreement would need to be reached with the local authority, Kouga Municipality, NMBM and the DWS to secure the required supply. Groundwater sources could be developed on site to supply initial construction supply requirements.
- Uncertainties associated with conventional fresh water supply are:
 - effects of drought/climate change on security and availability of supply;
 - long-term regional planning priorities.

In terms of site location and nuclear installation safety, it can be concluded that an adequate water supply can be sourced for short-term construction and long-term operational requirements.

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5.12.12 References

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APPENDICES

Data in the following appendixes are provided in electronic format.

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Appendix 5.12.A: **Hydrocensus Data**

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**Appendix 5.12.B:
Certificates of Analysis**