Cape Environmental Assessment Practitioners (Pty) Ltd
Reg. No. 2008/004627/07
Telephone: (044) 874 0365
Facsimile: (044) 874 0432
Web: www.cape-eaprac.co.za
17 Progress Street, George
PO Box 2070, George, 6530

INFORMATION DOCUMENT

WITSAND SOLAR DESALINATION PLANT

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Introduction

Hessequa Municipality intends to implement a 72.3Kwh solar operated reverse osmosis (RO) desalination plant situated across Portions 1/490, 723 & 2/485 located approximately 6km upstream from the Breede River mouth.

Figure 1: Location of the proposed solar RO Plant in relation to the river mouth.

Witsand experiences water shortages, most notably during the peak periods, but the ongoing drought in the Western Cape and the region have exacerbated the water supply and demand challenges. Most notably borehole supply has become less reliant which impacts on the water supply for Witsand.

As a result, the Hessequa Municipality approached the Western Cape Department of Environmental Affairs & Development Planning (DEADP) with a request for a **Section 30A Directive** in terms of the National Environmental Management Act (NEMA) to address the situation which they believe requires emergency intervention.

In considering the Municipality's request for a Section 30A Directive the Department had to take into account the following criteria:

- The nature of the emergency situation;
- The motivation for the request for a Directive;
- Whether or not the emergency was caused by, or the fault of, a person that can be held responsible;
- The risk of the impacts on the environment as a result of the emergency and the cost of the measures considered;
- The risk of the impact on the environment of the emergency situation, prevention, control or mitigation measures and the post-event mitigation or rehabilitation measures that may be required.

The DEADP considered these factors and issued the Section 30A Directive to the Hessequa Municipality on 19 June 2017. Hessequa Municipality since joined forces with the French Treasury enabling a venture whereby funding and expertise could be accessed for the proposed RO/solar plant. The project will be funded by Drought Relief Funding (50%) and by the French Treasury (50%).

Location & Site context

The site was selected for the following main reasons:

- Existing municipal borehole infrastructure with pumps within a secure area;
- Existing connection to the municipal water network and reservoirs;
- Existing electrical connection;
- Transformed landscape with limited natural vegetation;
- Accessibility to the Breede River.

Figure 2: Site where the solar RO Plant is proposed at the existing municipal borehole.

Figure 3: Image taken of the site location.

As a result of the location and infrastructural requirements, the design provides for a direct intake and discharge at the location. Discharge into the sea is therefore not a feasible alternative.

The proposed abstraction site is located on a rocky platform on the eastern bank of the estuary and is accessed via an existing gravel road that runs through Rolhoek Farm (ERF No. 2/485). Intertidal mudflats with scatterings of loose rock overlying shallowly buried bedrock are found to either side of the rocky bank. The western bank consists of an extensive mudflat approximately 3.5 km in length, which is accessed by recreational fishers for prawn harvesting. Bands of ecologically important seagrass beds lie opposite these mudflats and are exposed at low tide.

Typically, a seasonal horizontal salinity gradient occurs within the estuary as a result of the permanently open mouth, although the River Estuary Interface may shift 8 to 10 km between tides, depending on fluvial input. During optimal river flow, a strong halocline is expected with dense seawater just above the river bottom pushing upstream on a rising tide and buoyant freshwater from the catchment areas flowing out to sea above this layer.

Due to the lack of rainfall in the area during the recent drought, the salt wedge had pushed upriver past the proposed RO site and currently dominates the water column. Salinities in the estuary vary with rainfall, with a dry season salinity of 30 to 40 PSU.

Proposal

The design of the RO Plant allows for a maximum product water volume of 300kl/day and a daily product water volume of 100kl/day. All designs and assessments were based on the maximum volume.

The Plant will be connected to an on-site solar facility that will provide sufficient energy for the 100kl/day operations. Night time connection to the grid (or for prolonged periods when the sun doesn't shine) can increase the capacity to 300kl/day.

The solar panels, supporting infrastructure and electrical components will be prefabricated and brought to site via transport vehicles. The existing vegetation at the solar farm site will be left undisturbed to limit dust generation which is detrimental to solar panel performance and increases maintenance. Holes will be created with an auger machine. The support columns will then be placed inside the hole and then cast into place with mass concrete as per the required design specification and to SABS methods and standards. The development footprint of the solar facility is designed at 153 m^2.

The existing secure area at the borehole will be expanded to accommodate the Plant with the solar facility immediately adjacent thereto.

A. Desalination building

The characteristics of the building are as follows:

- Brick building with NUTEC type roof
- Overall dimension 6 m x 14 m (84 m2)
- Access to building via large roller door and secondary personal door (fire exit)
- The building accommodates the following:
- Intake water pre-treatment (sand filter)
- OSMOSUN 100 desalination system
- Water treatment (remineralisation)
- Storage area
- Electrical control systems

B. Storage tanks

Up to three storage tanks will be installed on concrete bases adjacent to the OSMOSUN. Plastic tanks such as the Rototank or JoJo tank are proposed.

Intake seawater storage, 40 m^3 is required for the raw water intake works is constructed. The development footprint of the RO Plant is 6 m x 14 m (84 m^2).

C. Outfall discharge

To ensure minimal negative environmental impact the discharge is jetted through a diffuser port (jet nozzle) with internal diameter of 100 mm to enable rapid dilution. The so-called Bank Discharge location on the rock shelf upstream of the intake structure was shown to be the preferred location by the Effuent Modelling study (Laird et al. 2018).

The site characteristics include:

- Access via an existing gravel track along the estuary bank shared with that of the intake works;
- solid anchoring of the outfall infrastructure to the natural rock face thereby mitigating the flood damage risk;
- the ability for easy inspection and maintenance of the outfall structure; and
- a sufficient water depth to enable sufficient jet mixing and subsequent dispersion.

If the outfall pipeline is bolted to the rock shelf at the estuary water side, commercial divers will be needed for construction. The diffuser will be a structural element which is connected to the concrete pipeline encasing via a bolted interface. The pipe along the rock-shelf on the river bank will be encased in concrete. The concrete encasing is anchored to the rock shelf. The concrete encasing is for protection against flood events.

The development footprint for the pipeline and outlet assembly is 14 m x 0.5 m = 7m^2.

D. Intake

The pipe along the rock-shelf on the river bank will be encased in concrete. The concrete encasing is anchored to the rock shelf. The concrete encasing is for protection against flood events. An excavator with hydraulic pecker will be used to create a trench in the rock face at low spring tide over a number of days; The intake assembly will be placed into the trench.

A prefabricated galvanised steel rail assembly will be brought to site on a truck and placed into position using an excavator adapted for lifting. Labourers will use ropes to guide the assembly into position in the excavated trench and on the rock shelf. The assembly will be bolted into the rock surface making use of non-toxic chemical anchors. This work will be done by commercial divers.

The intake and discharge infrastructure run down the steep hill towards the river bank from where it enters at water level.

Environmental Impacts

The main concern relates to the **impact of effluent** (and its associated contaminants) i.e. brine on the receiving estuarine environment. Furthermore the disturbance during construction on the river bank as well as the removal/disturbance of **indigenous vegetation** along the slope to accommodate the intake/discharge infrastructure. Because the RO Plant and solar facility is situated on transformed agricultural lands the impact of these facilities are limited to **loss of agricultural areas**.

The Breede River Estuary is a large, highly productive estuary that provides important habitat for estuarine and marine biota. The system has a relatively high level of biodiversity within a region of high endemism. The Estuary is especially important as a nursery and refuge area for marine and coastal fish species, with a total of 59 species recorded in the system, 65% of which are South African endemics and 40% of which are estuarine species.

The Breede River Estuary has been classified as a 'Highly Important' estuary, the fifth most important in terms supporting estuarine vegetation communities, particularly intertidal saltmarsh, and is ranked as the 19th most important estuary within South Africa due to its size, the diversity of habitats, and their respective biota. The Breede also ranks among the top 20 most important estuaries in South Africa in terms of overall conservation importance for fish, with mark-recapture experiments demonstrating intrinsic connectivity between the Breede and neighbouring estuaries for the movement and dispersion of fish along the coastline.

The Estuary is also the most southerly known habitat for *Carcharhinus leuca*, the near threatened Zambezi shark (IUCN Red List). The Breede River Estuary is considered critical habitat for this species, and is suspected to be a pupping and nursery ground. The Estuary is also utilised by two Red Data bird species, the African Black Oystercatcher (*Haematopus moquini*) and the Caspian Tern (*Hydroprogne caspia*).

Anchor Environmental Consultants were appointed as the marine specialists to conduct a **near field effluent plume analysis** and do the subsequent **marine impact assessment** for effluent generated by the Plant on the Estuary.

Effluent modelling studies are used to derive area-specific estimates for a range of water quality parameters at the edge of the mixing zone and recommendations of maximum limits at pipe end with the objective of reducing potential negative impacts to acceptable levels for the lifetime of the operation. Recommendations on the best location for the proposed outfall as well as operational requirements formed part of the investigation.

Anchor Environmental used specific models to consider the effluent discharge quantity, qualify and area of influence. Minimum design flow was set at 138.4 m^3/day and maximum flow at 233.6 m_3/day total effluent. Maximum flow was modelled to simulate a worst case discharge scenario.

The density of brine generated by desalination plants is always greater than that of the surrounding ambient water, thus, the effluent will be negatively buoyant and will tend to sink towards the river bottom.

According to the revised "Assessment Framework for Effluent Discharged from Land Based Sources" (Anchor 2015a), a RMZ of 0 m is applicable in estuaries. In the Breede River Estuary, the marine salt wedge pushes upstream beyond the proposed discharge site and impacts of brine discharge are expected to be less pronounced than in the freshwater section of a river course. In addition, effluent discharge salinity is expected to be low (45 PSU) for a discharge of this nature when compared to traditional brine effluent (>60 PSU). It will not be possible to meet the RMZ of 0 m in this instance, thus an RMZ with a radius of 5 m (the smallest achievable RMZ) is proposed for this study.

The recommended outfall position (Option A) will maximise dilution and dispersion after initial discharge jet mixing. As it is a requirement to meet WQGs at the edge of the RMZ of 5 m (which seems to be easily achievable for the RO plant discharge), the brine effluent is not expected to result in deterioration of intake water quality over time since the intake and discharge points are set apart.

It was found that pollutant levels at the edge of the recommended mixing zone (RMZ) are expected to comply with Department of Water Affairs's Receiving Water Quality Guidelines (WQGs) and also with the Resource Quality Objectives (RQO) defined for the Breede Estuary as part of the Classification Study for the Breede-Gouritz WMA.

After mitigation, none of the impacts are assessed as being above 'very low' significance. Cumulative marine environmental impacts emanating from the proposed project are primarily related to physiological responses of estuarine biota due to effluent discharge and these are not expected to be significant.

The following mitigation measures must be implemented:

- strict enforcement of a comprehensive Environmental Management Plan (EMP);
- construction in line with the near field dispersion study to limit the possibility that that the effluent plume exceeds that modelled;
- design of the intake pipe to reduce the impingement and entrainment of organisms;
- aeration of the effluent prior to discharge if and,
- monitoring of effluent before discharge to ensure compliance with end of pipe design parameters. If discharged effluent exceeds the end of pipe values at any time, the operation will be in violation of the CWDP and the cause of poor effluent quality must be identified, reported and rectified immediately.

Monitoring can be achieved effectively by mooring a data logging instrument capable of measuring conductivity, temperature and depth (CTD) 1 m above the river bottom starting one month preceding outflow up until one year after operation of the RO plant.

Furthermore it is recommended that conductivity (salinity), temperature, pH, dissolved oxygen and TSS levels in the effluent samples are tested on a weekly basis and compared with end of pipe limits in the CWDP condition. Monitoring (water column profile measurements) should be conducted at the edge of the RMZ and tested for TSS, salinity and temperature within one month of the plant being commissioned and annually (at the peak of the low flow season) thereafter. It is also recommended that benthic macrofaunal samples be collected and analysed both pre- and post-discharge. Benthic macrofauna biological indicators, such as species abundance, biomass and diversity, provide a direct measure of the state of the ecosystem in space and time and tend to be directly affected by pollution/disturbance.

It is recommended that six sites be monitored in the vicinity of the outfall with three samples collected per site. Two control sites are recommended to confirm that any detected change is not due to broader influences in the system.

In addition, the following deliverables should be produced for the monitoring program:

1. A baseline report describing the pre-discharge temperature, salinity, TSS, sediment trace metals, and benthic macrofaunal community.
2. A three-monthly impact phase report outlining whether WQGs are met at the edge of the RMZ, based on the modelled discharge plume (effluent modelling validation).
3. An annual impact phase report outlining changes in water quality, sediment quality, and macrofaunal community structure and composition at the site.

With regards to botanical impact the ecologist appointed from Simon Todd Consulting confirmed that the steep slope from the RO Plant to the river bank contains indigenous vegetation including protected species. The remainder of the site for the RO Plant and solar facility itself is transformed and not considered sensitive.

Infrastructure for intake and discharge should ideally be positioned above-ground to reduce the impact of typical trench excavations.

The necessary Forestry Permits will have to be obtained for the removal/trimming/damaging of protected species.

Cost of water

An operational contract will cover the maintenance of the plant for the first three (3) years. The plant will be owned by the Hessequa Municipality. The Municipality will therefore not purchase the water.
The present operational agreement will result in a cost of about R6.50/kl when only the 100kl produced from solar is taken into account. This is less than the present tariff from water supplied by Overberg Water.

Regulatory framework

Typically a solar / desalination plant would require prior Environmental Authorisation in terms of the National Environmental Management Act (NEMA).

The process of either a Basic Assessment or Full Scoping & Impact Assessment would be followed to (a) investigate the proposed activity, (b) identify and assess the anticipated impacts, (c) mitigate the impacts through design alterations and/or management conditions and (d) ensure compliance with conditions of approval.

Since the activity proposed is being considered in terms of the Section 30A Directive issued by the Provincial Department of Environmental Affairs & Development Planning (DEADP), a different process is prescribed although the outcome of the process is still used to inform a decision by the DEADP.

The main differences between the process being followed ito the Directive vs a 'typical' environmental application is the timeframe (which is shorter given that it is considered an emergency procedure) and specified stakeholder engagement which focuses on authority consultation.

However, the S30A Directive still required the submission of an Intervention Plan by the Municipality detailing the need and desirability of the activity as well as provisions for environmental impact management. The approved Intervention Plan was followed-up with a detailed Method Statement for the implementation, construction and maintenance of the plant. Once approved the Department must consider a detailed Environmental Management Plan (EMP) for final decision-making.

Other Authorities involved in the process include the National Department of Environmental Affairs: Oceans & Coast (responsible for the discharge permit), Heritage Western Cape, Department of Water Affairs & Sanitation and CapeNature.

Only in the event that the EMP and Coastal Waters Discharge Permit (CWDP) are approved, may the Plant be implemented.

Way-Forward

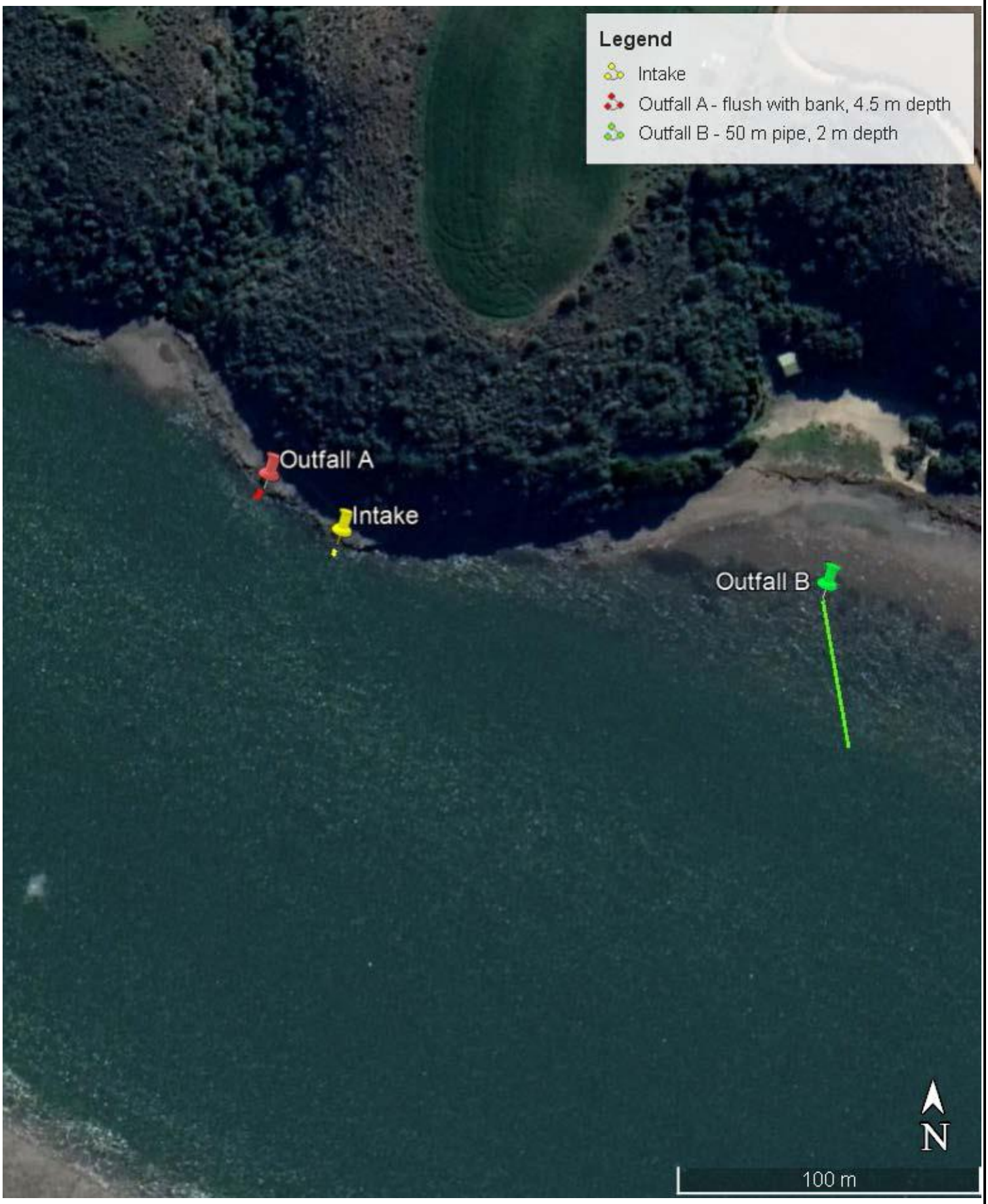
The various specialist studies have been concluded and the Environmental Management Plan (EMP) is currently being finalised at the same time as the CWDP application.

It is anticipated that a decision will be taken on these applications before end of the year. In the event that the applications are authorised, the Municipality wishes to implement the Plant without delay.

FOR FURTHER DETAILS OR ENQUIRIES YOU ARE WELCOME TO CONTACT:

Cape-EAPrac

ATT: Louise-Mari van Zyl
PO Box 2070 George 6530
Telephone: 044 874 0365 Fax: 044 874 0432
E-mail: louise@cape-eaprac.co.za


Legend
Intake
Outfall A - flush with bank, 4.5 m depth
Outfall B - 50 m pipe, 2 m depth
Outfall A
Intake
Outfall B
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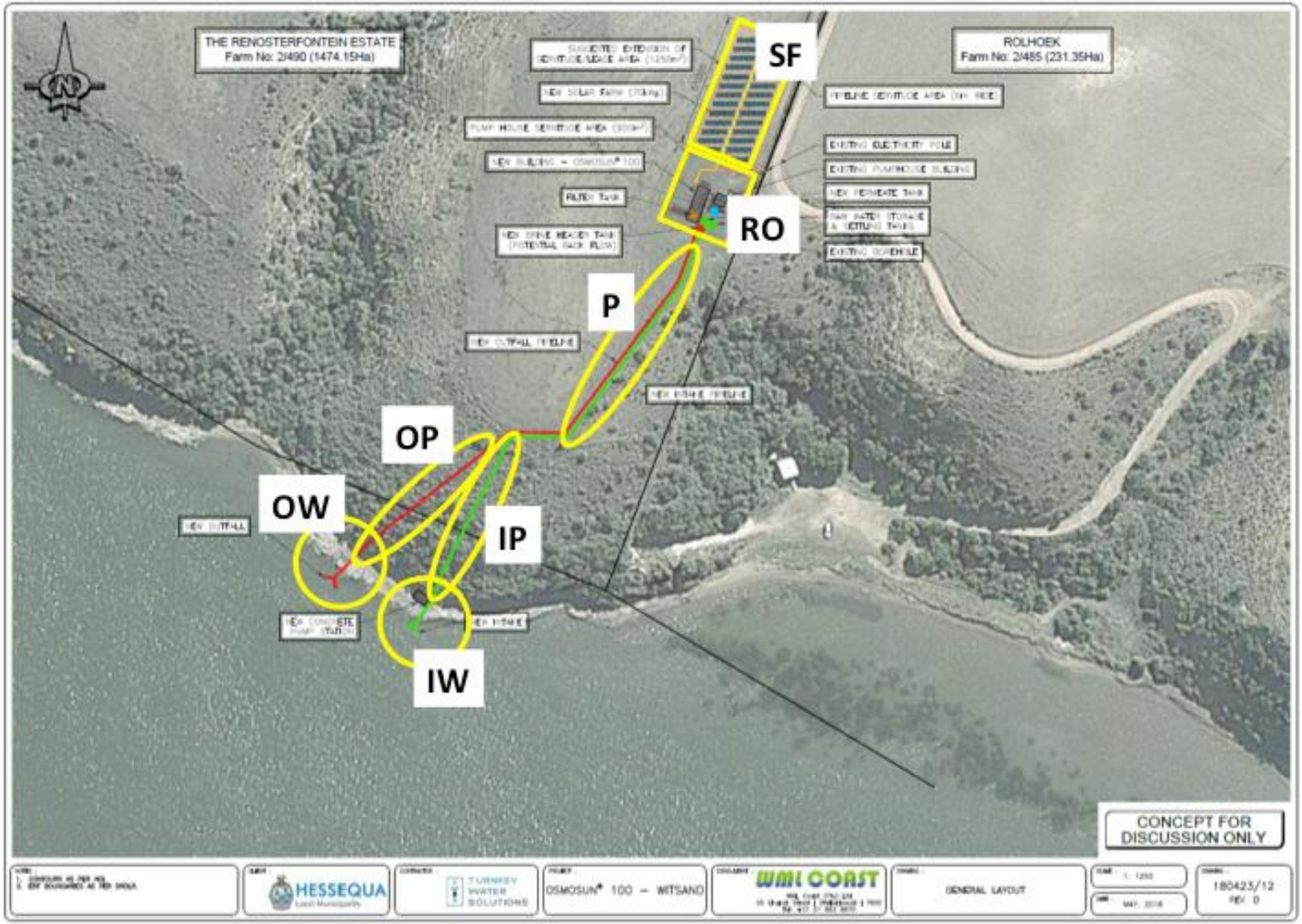
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