RIVERINE BASELINE AND IMPACT ASSESSMENT FOR THE PROPOSED COERNEY DAM PROJECT

Addo, Eastern Cape

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CLIENT

GA Environment

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Declaration		
The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Ecological Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.		

Site along the Coerney River which is surrounded by Phragmites (January 2022)

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Declaration

I, Michael Ryan declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

MRyan

Michael Ryan

Riverine Ecologist

The Biodiversity Company

February 2022

1 Introduction and Background

The modification of land use within a river catchment has the potential to degrade local water resources (Wepener *et al*., 2005). This statement becomes further valid for infrastructure which will be constructed within a river reach. Infrastructure such as dams thus have the potential to negatively impact on local water resources and ecosystem services. In order to holistically manage water resources in South Africa, the use of standard water quality sampling methods is considered in-effective. Non-point and point source pollutants are dynamic and can fluctuate according to several factors such as rainfall, industrial discharges and extensive pollutant seepage. Aquatic ecology is permanently exposed to the dynamic conditions within water bodies and can therefore be an effective reflection of the environmental conditions within a management area. Considering this, the monitoring of aquatic ecology is regarded as an effective tool in water management strategies. This can therefore be used to assess the current state of a system.

The Biodiversity Company was commissioned by GA Environmental to conduct a riverine baseline study and impact (risk) assessment as part of the Environmental Impact Assessment (EIA), environmental authorisation process and Water Use Licence Application (WULA) for the Coerney Dam project. The following project background is as per information provided by GA Environmental as part of the Terms of Reference:

The existing Scheepersvlakte Dam was added to the Nelson Mandela Bay Municipality (NMBM) water supply when water requirements were exceeded. The capacity of this dam is however very low and additional water storage is required to limit the risk of failure to supply to NMBM. After geotechnical investigations the Coerney Dam location was recommended.

The infrastructure for the proposed project includes:

- *A new balancing dam with a capacity of 4.6 million m^3 on the farm Scheepersvlakte. The capacity includes an allowance of 100 000 m^3 for the requirements of a new citrus development on the farm.*
- *The dam will comprise an earth fill embankment. A concrete side channel spillway and an outlet works.*
- *Connecting pipelines of 1300 mm diameter and length of 940 m and 2460 m are required to supply water to the dam and connect to the existing pipeline supplying Nooitgedaght water treatment works.*
- *An access road with a length of about 1 km, following the route of an existing jeep track.*
- *An electricity supply will be required for lightning, etc. in the outlet works and around the dam wall"*.

This assessment has been completed in accordance with the requirements of the published General Notice (GN) 509 by the Department of Water and Sanitation (DWS). This notice was published in the Government Gazette (no. 40229) under Section 39 of the National Water Act (Act no. 36 of 1998) in August 2016, for a Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses. The GN 509 process provides an allowance to apply for a WUL for Section 21(c) & (i) under a General Authorisation (GA), as opposed to a full Water Use Licence Application (WULA). A water use (or potential) qualifies for a GA under GN 509 when the proposed water use/activity is subjected to analysis using the DWS Risk Assessment Matrix (RAM), provided the identified risks are all considered a low risk. This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation.

The purpose of the specialist studies is to provide relevant input into the impact assessment process and to provide a report for the proposed activities associated with the development. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

2 Document Structure

The table below provides the NEMA (2014) Requirements for Ecological Assessments, and also the relevant sections in the reports where these requirements are addressed:

GNR 326	Description	Section
Appendix 6 (a)	A specialist report prepared in terms of these Regulations must contain— details of— i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page ii. Appendix A
Appendix 6 (b)	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Page vii and viii
Appendix 6 (c)	An indication of the scope of, and the purpose for which, the report was prepared;	Section 1 & 3
Appendix 6 (cA)	An indication of the quality and age of base data used for the specialist report;	None
Appendix 6 (cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8 & 10
Appendix 6 (d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1 & 7
Appendix 6 (e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 7
Appendix 6 (f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a, site plan identifying site alternatives;	Section 4, 8, 9 & 10
Appendix 6 (g)	An identification of any areas to be avoided, including buffers;	Section 9
Appendix 6 (h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 9.4
Appendix 6 (i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 6
Appendix 6 (j)	A description of the findings and potential implications of such findings on the impact of the proposed activity [including identified alternatives on the environment] or activities;	Section 8, 9 & 10
Appendix 6 (k)	Any mitigation measures for inclusion in the EMPr;	Section 10
Appendix 6 (l)	Any conditions for inclusion in the environmental authorisation;	Section 10.4.2
Appendix 6 (m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 10
Appendix 6 (n)	A reasoned opinion— i. [as to] whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 11
Appendix 6 (o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	None
Appendix 6 (p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
Appendix 6 (q)	Any other information requested by the competent authority.	None

2.1 Terms of Reference

The following tasks were completed in fulfilment of the terms of reference for this study:

- Review of existing desktop information and literature (where available);
- Determining the Present Ecological Status (PES) of the local watercourses;
- Determine the Environmental Importance and Sensitivity (EIS) of watercourses;
- An impact assessment for the proposed activities; and
- The prescription of mitigation measures, and recommendations for identified risks.

3 Project Area and Hydrological Setting

The project is located between Kirkwood and Addo in the Sundays River Valley, about 75 km north of Port Elizabeth. It is therefore located within the Sundays River Valley Local Municipality within the Cacadu District Municipality. The proposed balancing dam site is adjacent to the existing Scheepersvlakte Dam which forms part of the Lower Sundays River Canal System. Thus the location is north (upstream) of the citrus plantations in the north of the town of Addo. The co-ordinates of the centre of the proposed Dam are 33°26'30.02"S 25°37'22.55"E, with a locality map presented in Figure 3-1.

The hydrological setting of the project area is presented in Figure 3-2 which is within the Mzimvubu - Tsitsikamma Water Management Area (WMA 7) (NWA, 2016) and the South Eastern Coastal Belt aquatic ecoregion (Dallas, 2007). The watercourses which may potentially be impacted from the construction of the Coerney Dam includes the N40D - 08561 Sub-Quaternary Reach (SQR) or Coerney River as well as the non-perennial/ephemeral tributary along which the proposed dam will be constructed, which drain the N40D quaternary catchment.

Sampling points for the study were selected to adequately assess the current state of the Coerney River as well as its tributary along which the proposed dam will be constructed to identify the potential risks that may result from the construction and operation of the Coerney Dam. This was done in order to gain a holistic image of the system and which habitat may be affected. In order to achieve this, a single site was located downstream along the Coerney River in order to assess potential downstream impacts (Coerney River). The focus was placed on the tributary along which the proposed dam will be constructed with all watercourses within the 500 m regulated area also assessed. Sites CTUS, CTDS and CTDS2 were selected along the tributary to holistically assess the reach. Sites CDL1, CDL2, CDL3, CDL4, CDL5, CDL6 and CDL7 were located along the drainage lines which feed the tributary within the 500 m regulated area. Dams located within the 500 m regulated area were also assessed and include CD0, CD1 and CD2. All sites bar Coerney River, CD0, CD1 and CD2 were however found to be dry at the time of the survey. The selected sampling location and the location of each sampling point can be seen in Table 3-1 and Figure 3-2.

Table 3-1: Photos, co-ordinates and descriptions for the sites sampled (January 2022)

	Upstream	Downstream
CDL1		
GPS	33°25'36.03"S 25°35'35.19"E	
	Upstream	**Downstream**
CDL2		
GPS	33°25'14.57"S 25°36'24.13"E	
	Upstream	**Downstream**
CDL3		
GPS	33°25'19.30"S 25°37'1.22"E	
	Upstream	**Downstream**

CDL4		
GPS	33°25'27.04"S 25°37'53.18"E	
	Upstream	**Downstream**
CTUS		
GPS	33°25'59.64"S 25°37'27.06"E	
	Upstream	**Downstream**
CDL5		
GPS	33°26'6.64"S 25°37'56.58"E	
	Upstream	Downstream

CDL6		
GPS	33°26'18.10"S 25°37'47.32"E	
	Upstream	**Downstream**
CDL7		
GPS	33°26'17.62"S 25°36'47.11"E	
	Upstream	**Downstream**
CD0		
GPS	33°27'3.97"S 25°37'44.19"E	
	Upstream	**Downstream**

CTDS		
GPS	33°27'22.34"S 25°37'46.89"E	
	Upstream	**Downstream**
CD1		
GPS	33°27'17.82"S 25°37'17.67"E	
	Upstream	**Downstream**
CTDS2		
GPS	33°28'9.66"S 25°38'10.76"E	
	Upstream	**Downstream**

CD2		
GPS	33°28'28.44"S 25°38'19.71"E	
	Upstream	**Downstream**
Coerney River		
GPS	33°29'1.92"S 25°39'33.41"E	

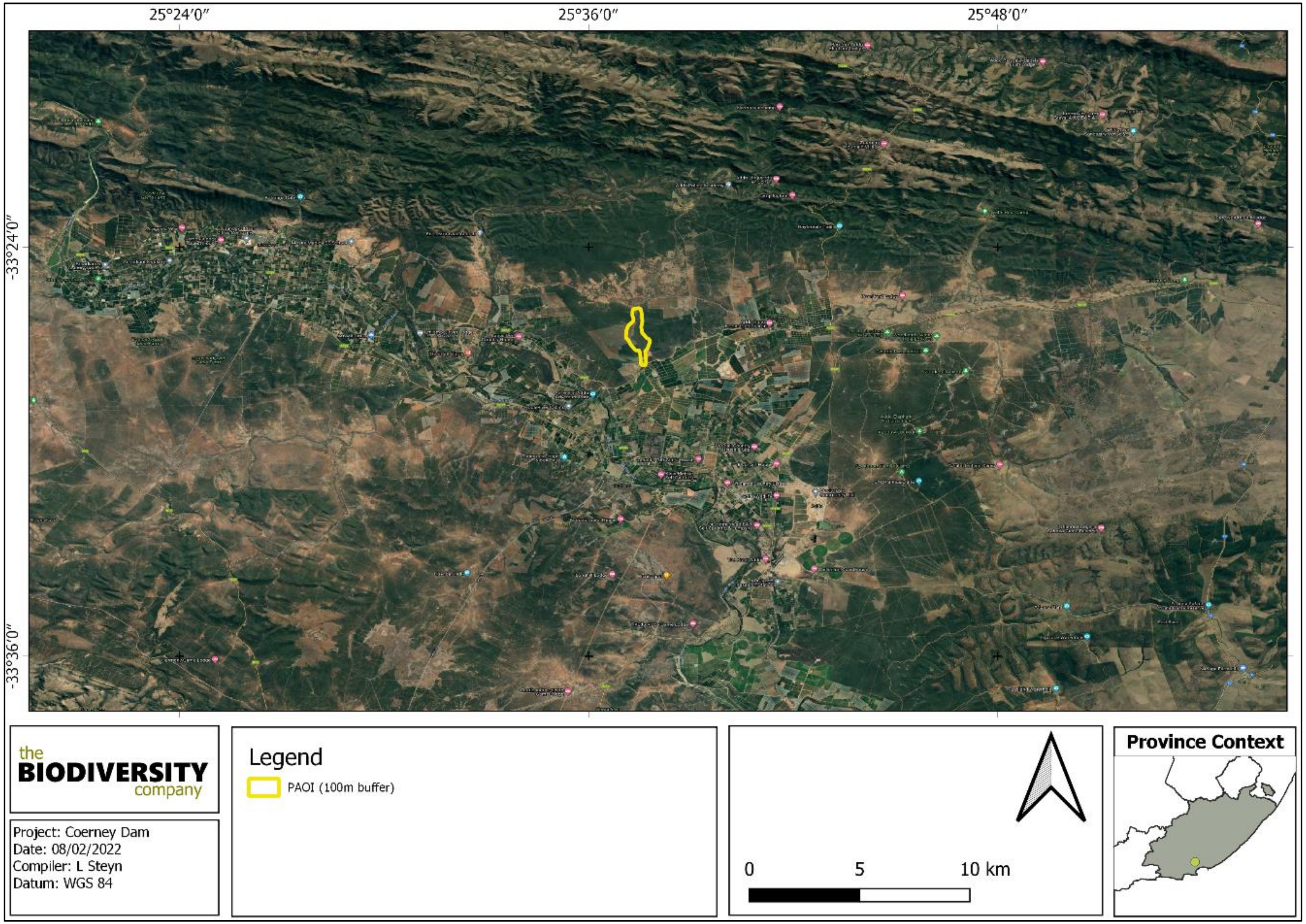

Figure 3-1: General project location (TBC, 2022)

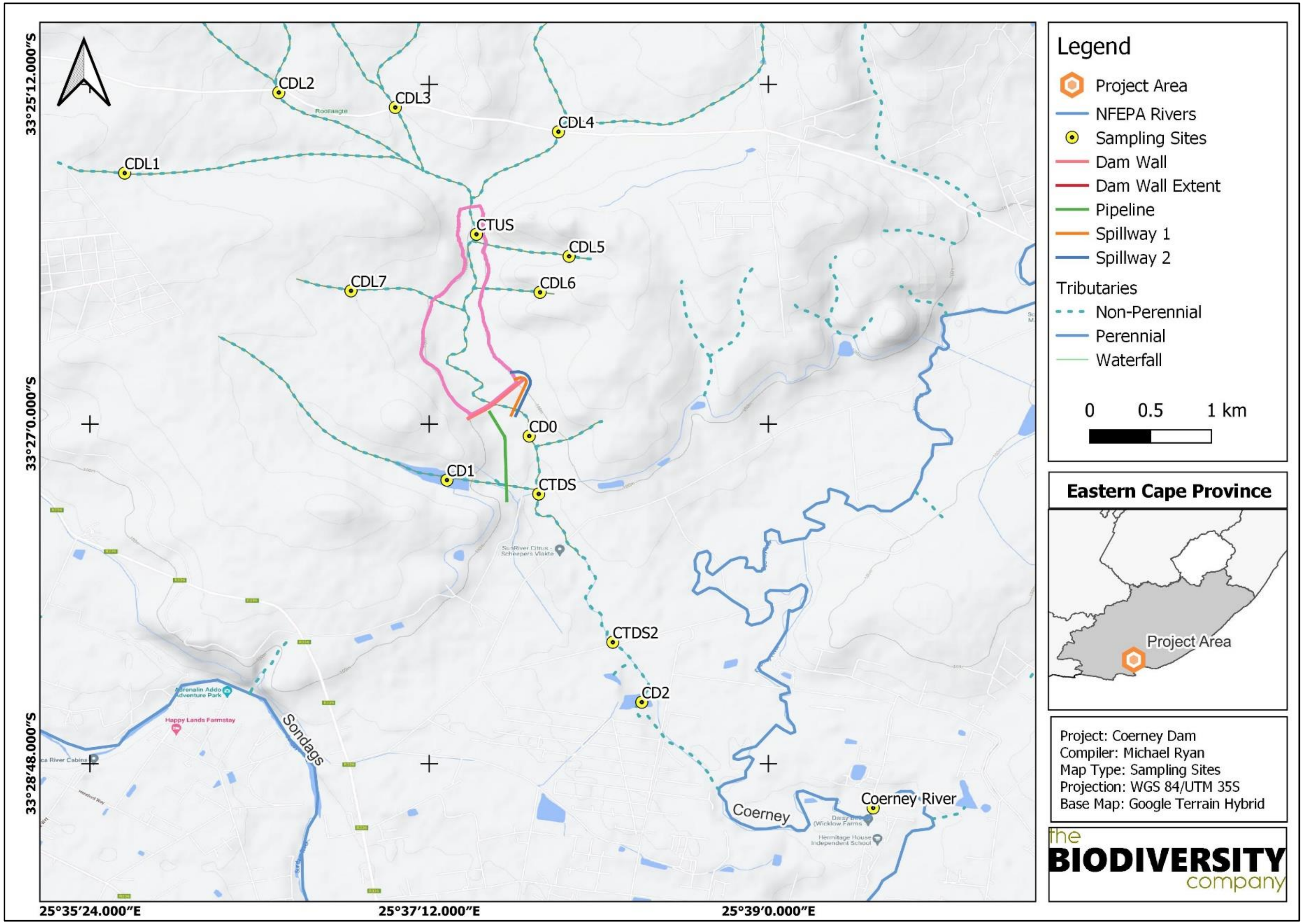

Figure 3-2: Sampling points of the project area

4 Key Legislative Requirements

4.1 National Water Act (NWA, 1998)

The DHSWS is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (Act No. 36 of 1998) (NWA) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

4.2 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in December 2014, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact.

5 Methodologies

5.1 Aquatic Assessment

A single high flow survey was conducted on the 25th of January 2022. Standard methods were used to establish the baseline conditions of the considered river reaches. Details pertaining to the specific methodologies applied are provided in the relevant sections below.

5.1.1 Water Quality

Water quality was measured in situ using a handheld calibrated Extech® DO700 multi-meter. The constituents considered that were measured included: pH, conductivity (µS/cm), water temperature (°C) and Dissolved Oxygen (DO) in mg/l.

5.1.2 Aquatic Habitat Integrity

The Intermediate Habitat Assessment Index (IHIA) as described in the Procedure for Rapid Determination of Resource Directed Measures for River Ecosystems (Section D), 1999 was used to define the ecological status of the Coerney River tributary reach defined as 5 km up and downstream of the proposed Dam.

The IHIA model will be used to assess the integrity of the habitats from a riparian and in-stream perspective. The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale which are comparable to the characteristics of natural habitats of the region (Kleynhans, 1996).

This model compares current conditions with reference conditions that are expected to have been present. Specification of the reference condition follows an impact based approach where the intensity and extent of anthropogenic changes are used to interpret the impact on the habitat integrity of the system. To accomplish this, information on abiotic changes that can potentially influence river habitat integrity are obtained from surveys or available data sources. These changes are all related and interpreted in terms of modification of the drivers of the system, namely hydrology, geomorphology and physico-chemical conditions and how these changes would impact on the natural riverine habitats. The criteria and ratings utilised in the assessment of habitat integrity in the current study are presented in Table 5-1 and Table 5-2 respectively.

Table 5-1: Criteria used in the assessment of habitat integrity (Kleynhans, 1996)

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included.
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly or alternatively agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments.
Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also, a general indication of the misuse and mismanagement of the river.

Criterion	Relevance
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river. Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochtonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the riverbank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

Table 5-2: Descriptions used for the ratings of the various habitat criteria

Impact Category	Description	Impact Score
None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

5.1.3 Riparian Habitat Delineation

The riparian delineation was completed according to DWAF (2005a; Figure 5-1). Typical riparian cross sections and structures are provided in. Indicators such as topography and vegetation were the primary indicators used to define the riparian zone. Contour data obtained from topography spatial data was also utilised to support the infield assessment.

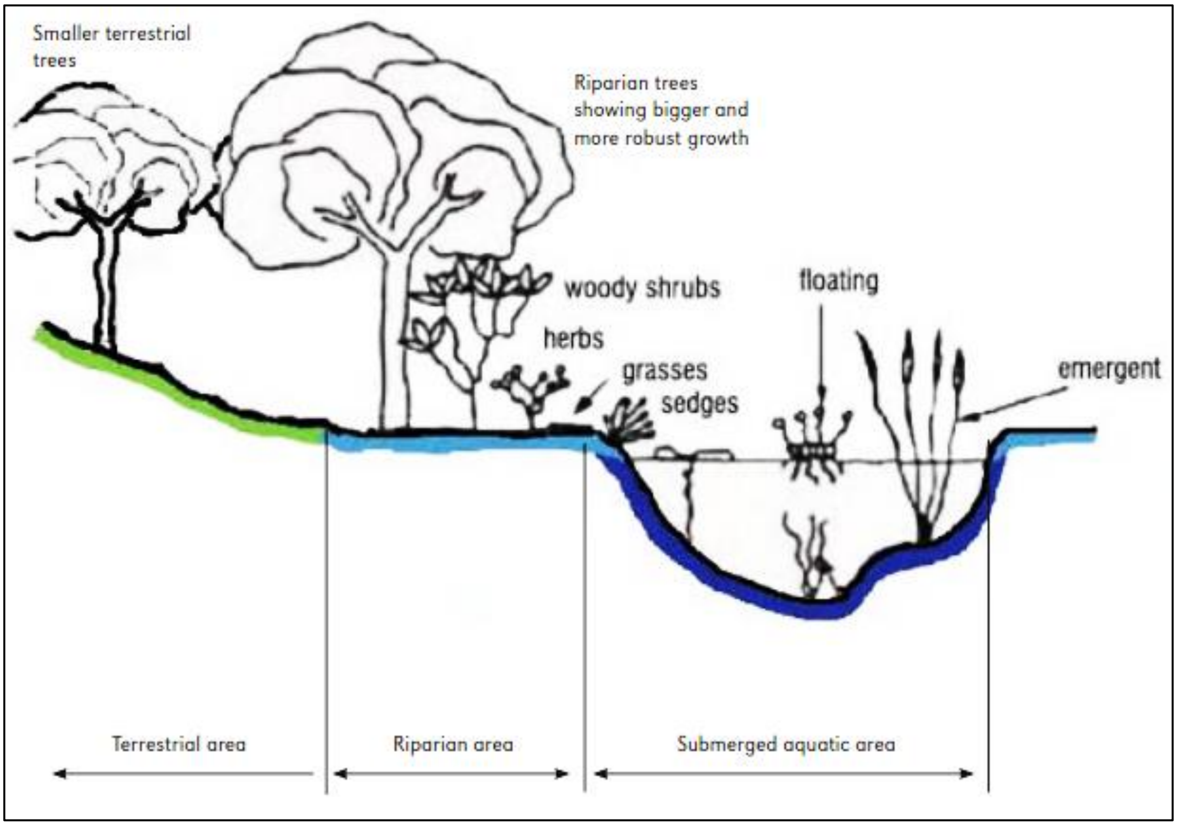

Figure 5-1: Riparian Habitat Delineations (DWAF, 2005a)

5.1.4 Buffer Determination

The “Buffer zone guidelines for wetlands, rivers, and estuaries” (Macfarlane, *et al.,* 2014) was used to determine the appropriate buffer zone for the proposed activity.

5.1.5 Aquatic Macroinvertebrate Assessment

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour *et al.,* 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.,* 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of the monitoring of the health of an aquatic ecosystem.

5.1.5.1 Invertebrate Habitat

The invertebrate habitat at the site was assessed using the South African Scoring System version 5 (SASS5) biotope rating assessment as applied in Tate and Husted (2015). A rating system of 0 to 5 was applied, 0 being not available. The weightings for lowland rivers (slope class F) were used to categorize biotope ratings (Rowntree *et al*. 2000; Rowntree & Ziervogel, 1999).

5.1.5.2 South African Scoring System

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g. Chironomidae) to highly sensitive families (e.g. Perlidae). SASS results are expressed both as an index score (SASS score) and the Average Score Per recorded Taxon (ASPT value).

Sampled invertebrates were identified using the “Aquatic Invertebrates of South African Rivers” Illustrations book, by Gerber and Gabriel (2002). Identification of organisms was made to family level (Thirion *et al.,* 1995; Dickens and Graham, 2002; Gerber and Gabriel, 2002).

All SASS5 and ASPT scores are compared with the SASS5 Data Interpretation Guidelines (Dallas, 2007) for the South Eastern Coastal Belt - Lower Ecoregion (Figure 5-2). This method seeks to develop biological bands depicting the various ecological states and is derived from data contained within the Rivers Database and supplemented with other data not yet in the database.

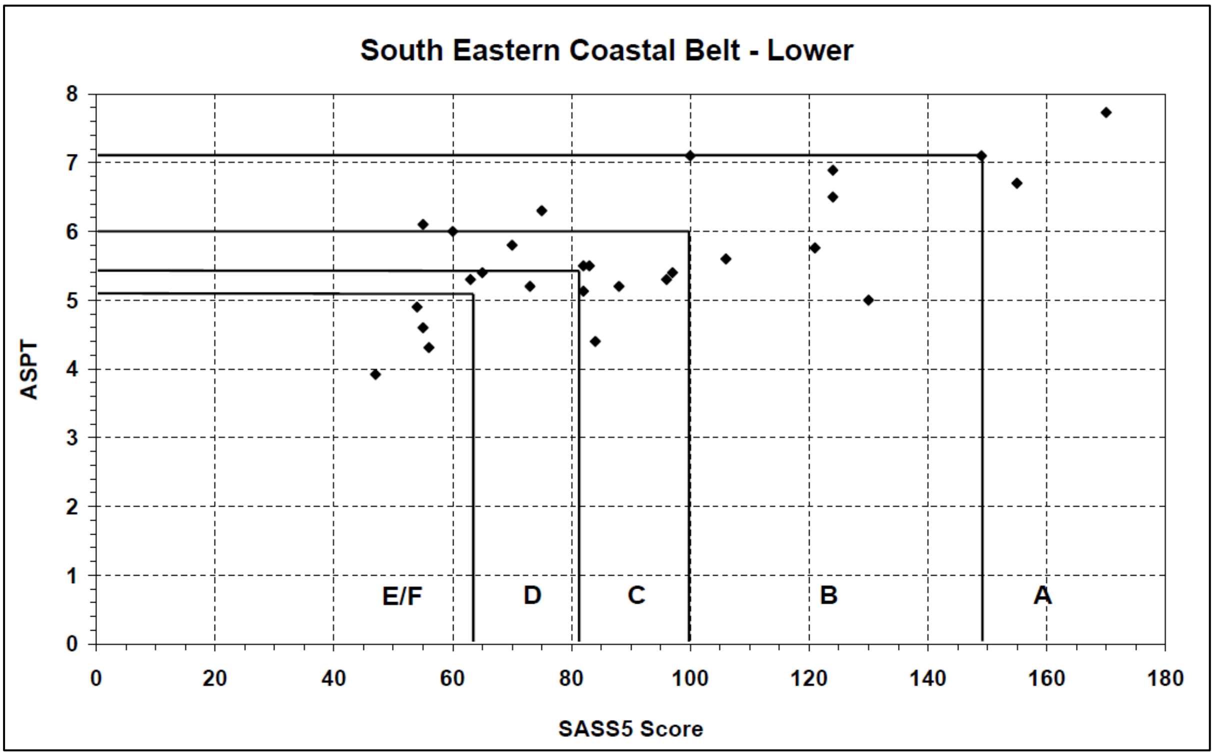

Figure 5-2: Biological Bands for the South Coastal Belt - Lower Ecoregion, calculated using percentiles

5.1.6 Fish Presence

Fish were sampled through electroshocking. All fish were identified in the field and released at the point of capture, in order not to cross fish populations. Fish species were identified using the guide Freshwater Fishes of Southern Africa (Skelton, 2001). The identified fish species were compared to those expected to be present for the quaternary catchment. The expected fish species list for the reach was developed from a literature survey to compare to the sampled species at site. Different fish species represent different sensitivities to water chemistry, habitat and flow (Kleynhans *et al*., 2007 and Skelton 2001).

5.1.7 Fish Sensitivity Index

Fish have different sensitivities or levels of tolerance to various aspects that they are subjected to within the aquatic environment. These tolerance levels are rated with a sensitivity score as presented in Table 5-3. These tolerance levels are scored to show each fish species' sensitivity to flow and physico-chemical modifications. This applies as an average of the whole class and not each individual species.

Table 5-3: Intolerance rating and sensitivity of fish species

Sensitivity Score	Tolerance/Sensitivity Level
0-1	Highly tolerant = Very low sensitivity
1-2	Tolerant = Low sensitivity
2-3	Moderately tolerant = Moderate sensitivity
3-4	Moderately intolerant = High sensitivity
4-5	Intolerant = Very high sensitivity

5.2 Risk Assessment

The risk assessment will be completed in accordance with the requirements of the DWS General Authorisation (GA) in terms of Section 39 of the NWA for water uses as defined in Section 21(c) or Section 21(i) (GN 509 of 2016). The significance of the impact is calculated according to Table 5-4.

Table 5-4: Significance ratings matrix

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s)impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

5.3 Assumptions and Limitations

The following aspects were considered as limitations of the assessment:

- It is assumed that all information received from the client is correct;
- A single aquatic ecology survey was completed for this assessment. Thus, temporal trends were not investigated;
- No baseline biomonitoring data/report(s) are available for the project area. Therefore, information presents the findings of the single aquatic survey;
- Due to the rapid nature of the assessment and the survey methods applied, fish diversity and abundance was likely to be underestimated; and
- No alternatives were provided or considered for this assessment.

6 Receiving Environment

6.1 National Freshwater Ecosystem Priority Areas (NFEPA)

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). This directly applies to the National Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al.,* 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's biodiversity goals (NEM:BA) (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011).

The project area falls within the 8561 Sub-quaternary catchment (SQC) as presented in Figure 6-1 and Figure 6-2. This catchment is not listed as a Freshwater Ecosystem Priority Area according to Nel *et al* (2011). Majority of the drainage network of the Sondags River below the confluence with the Wit River are not considered as NFEPAs. The exception to this is the 8707 Sub-quaternary catchment which is downstream of the project. This SQC is considered a wetland FEPA due to the presence of a number of wetland clusters. These clusters take the form of the wetland ecosystem type: Albany Thicket Bontveld Depression, Valley Depression and Valley Flat. Care therefore should be taken to avoid degradation to the project area to avoid placing stress on the downstream wetland FEPAs and associated estuarine system within the downstream catchments.

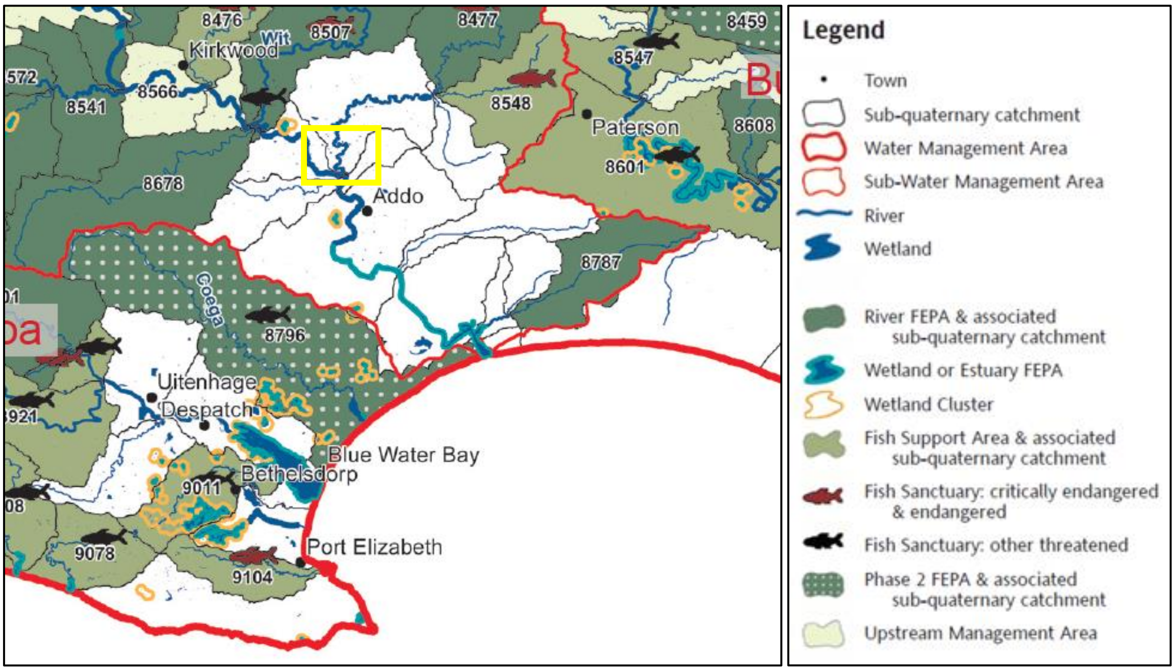

Figure 6-1: Map illustrating fish and river FEPAs for the project area, the project area is represented by the yellow square (Nel et al., 2011)

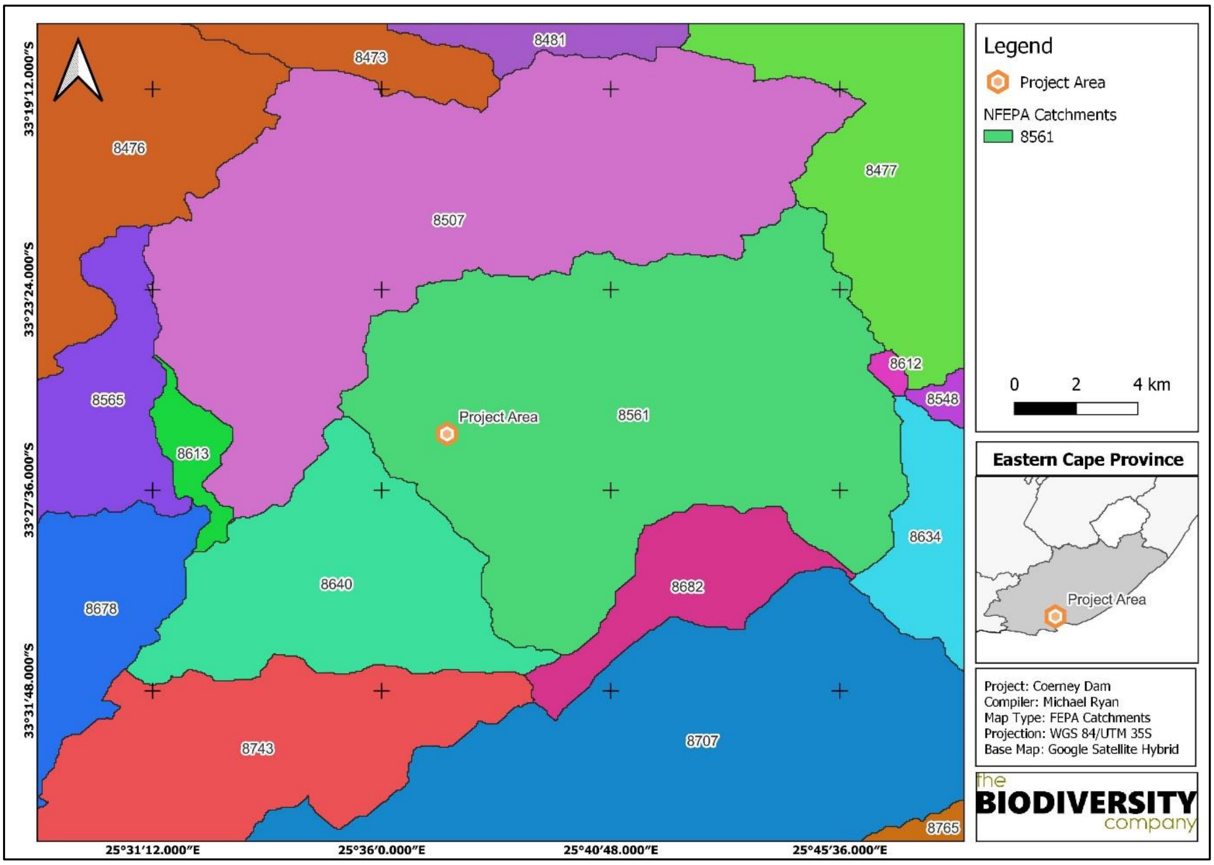

Figure 6-2: Layout of the proposed development area in relation to the riverine National Freshwater Priority Areas

6.2 Status of Sub-Quaternary Reach

Desktop information for the SQR was obtained from DWS (2014). The N40D - 08561 SQR is a 2nd order stream which spans 41.48 km. The PES category of the reach is classed as largely modified (class D) (Table 6-1). The largely modified state of these reaches is due to impacts to instream habitat, wetland and riparian zone continuity, flow modifications and moderate potential impacts on physico-chemical conditions (water quality). Anthropogenic impacts identified within the Coerney River sub-quaternary catchment include water abstraction, canal systems, agriculture and small dams.

Table 6-1: Summary of the Present Ecological State of the SQRs associated with the Coerney River reach (DWS, 2014)

SQR Importance and Sensitivity	Score
N40D - 08561 (Coerney River)	
Present Ecological Status	Largely Modified (class D)
Ecological Importance	Moderate
Ecological Sensitivity	Moderate
Default Ecological Category	class C

6.2.1 Strategic Water Source Areas

Strategic Water Source Areas (SWSAs) are areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest. The areas supplying ≥ 50% of South Africa's water supply (which were represented by areas with a mean annual runoff of ≥ 135 mm/year) represent national Strategic Water Source Areas (SANBI, 2013). According to the Strategic Water Source Areas of South Africa, Lesotho and Swaziland, the project area is not located within the SWSAs with all SWSA aligned along the coast. Despite the project area located along the coast the nearest SWSA is the Tsitsikamma SWSA which belongs to alternative drainage networks of neighbouring catchments. The project area is considered a local steppe climate that receives limited rainfall (annual 502 mm) with an average annual temperature in Addo of 18.3°C (climate-data.org, 2022).

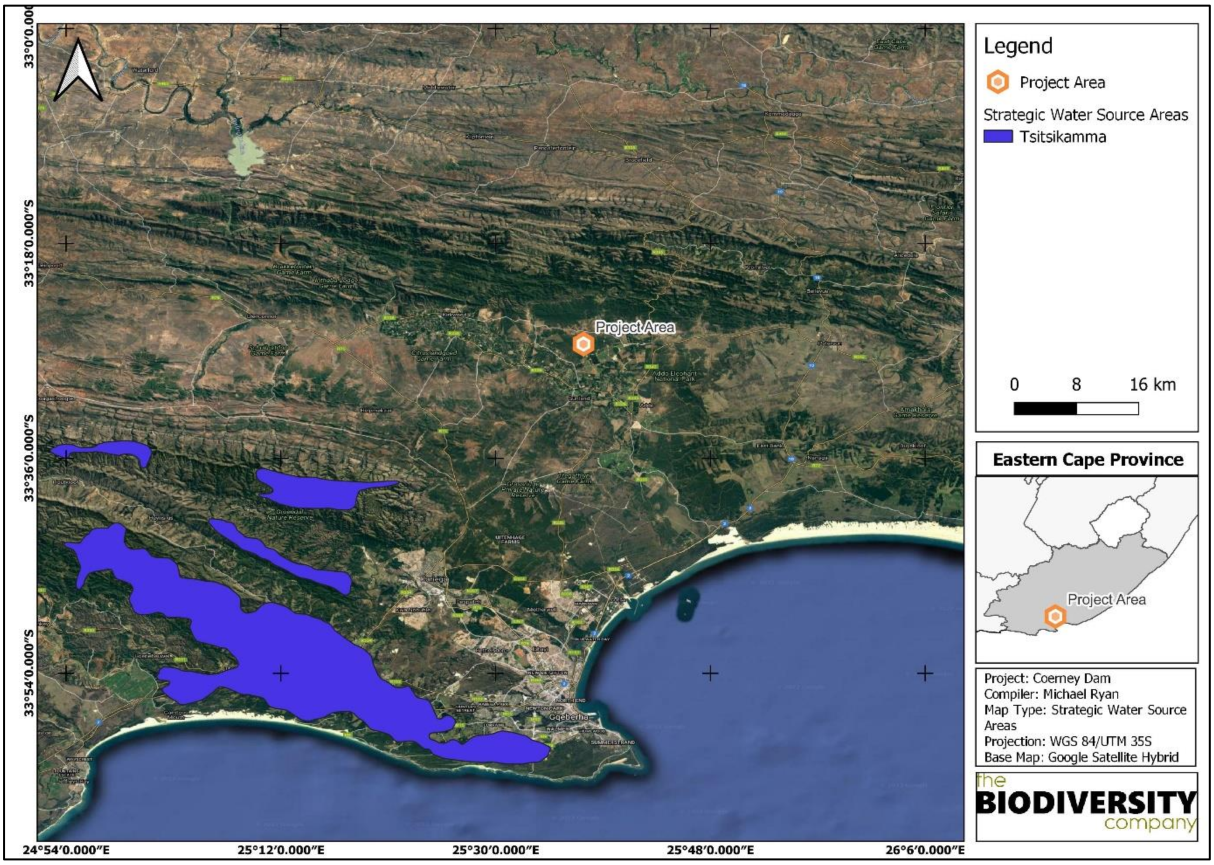

Figure 6-3: Illustration of the Strategic Water Source Areas within the project area (SANBI, 2013)

6.2.2 Freshwater Critical Biodiversity Area

According to the Eastern Cape Fine-Scale Biodiversity Planning Project for the freshwater biodiversity assessment of the Eastern Cape Province (SANBI, 2008), the Coerney River channel and all associated tributaries are Ecological Support Areas 1 (ESA), with a small section further downstream considered an Ecological Support Areas 2 (ESA). (Figure 6-4).

CBAs are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. CBAs are areas of high biodiversity value and need to be kept in a natural state, with no further loss of habitat or species. Ecological Support Areas are not considered essential for meeting biodiversity targets, however are considered import as they support the functionality of surrounding protected areas and CBA's (MTPA, 2014). These ESA's are often also vital for the ecosystem services they provide. Ecological Support areas must maintain a near natural state with some habitat loss acceptable provided that the underlying biodiversity objectives and ecological functioning are not compromised (MTPA, 2014). Thus, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses (SANBI, 2017).

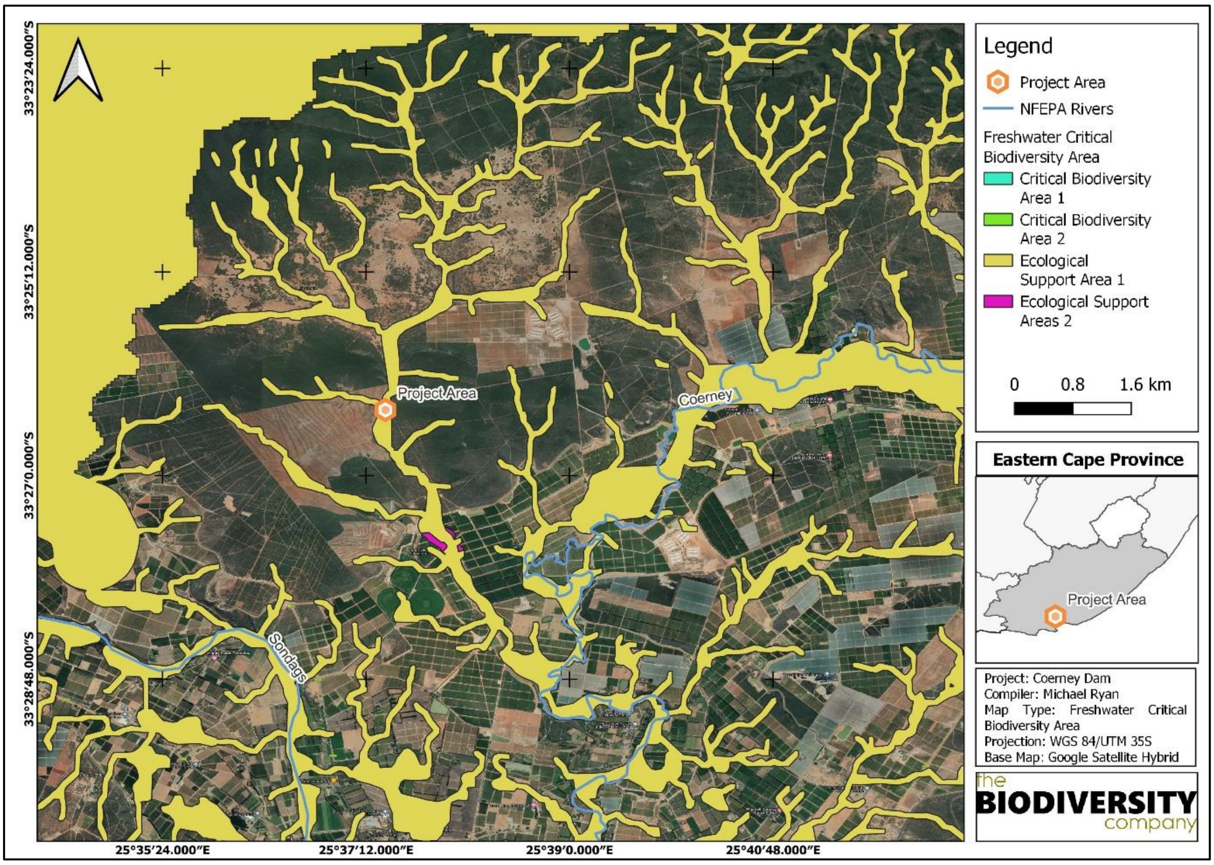

Figure 6-4: Illustration of the Freshwater Critical Biodiversity Areas within the project area (SANBI, 2008)

6.2.3 Ecosystem Threat Status

Ecosystem threat status outlines the degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function and composition, on which their ability to provide ecosystem services ultimately depends (Skowno *et al*., 2019).

Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Threatened (LT), based on the proportion of each ecosystem type that remains in good ecological condition (Skowno *et al*., 2019). The Ecosystem Threat Status (ETS) of each river assessed was based on the extent to which the system had been modified from its natural condition (SANBI, 2018). According to the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) released with the National Biodiversity Assessment (NBA) of rivers, the rivers which were superimposed on the aquatic ecosystem threat status (Figure 5 3) indicate that the project area falls along a tributary which feeds an EN ecosystem in the Coerney River (Figure 5 3).

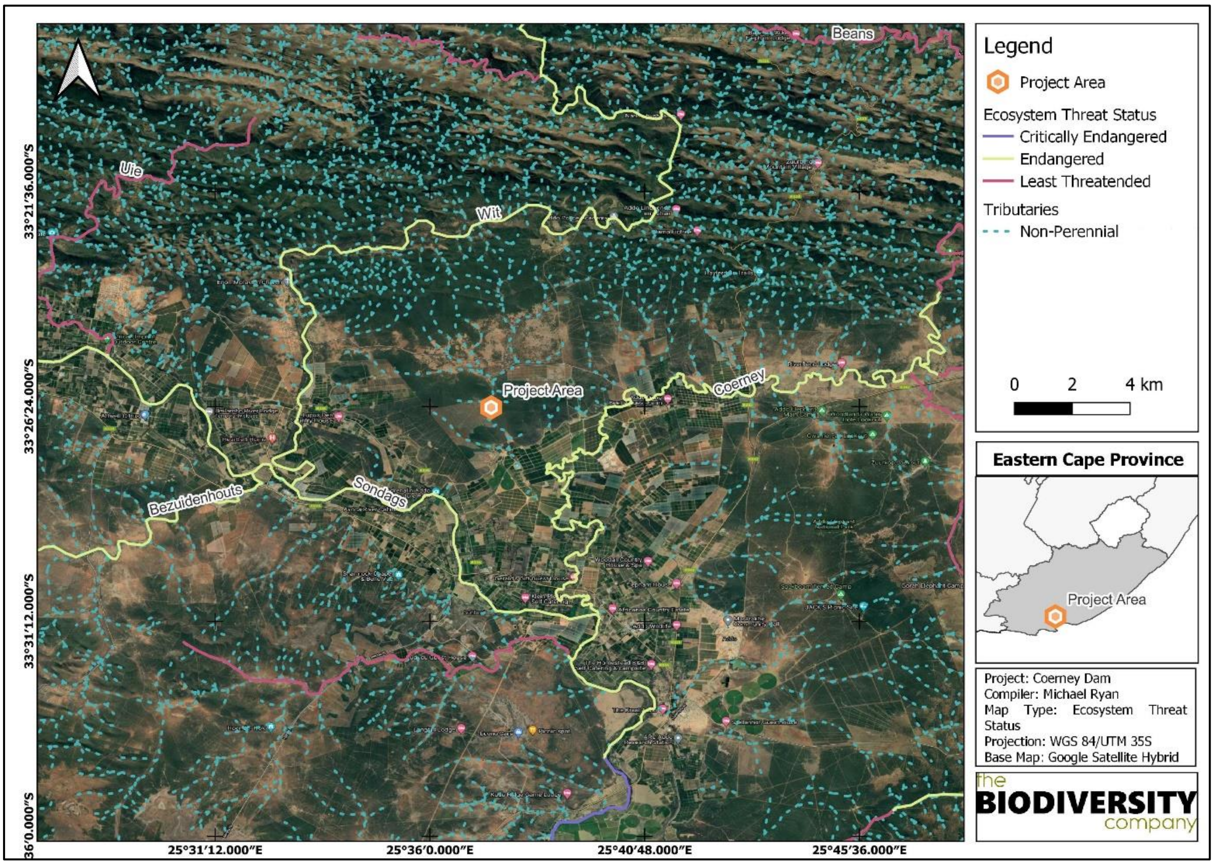

Figure 6-5: Illustration of the Ecosystem Threat Status of the project area (SANBI, 2018)

6.2.4 Ecosystem Protection Level

Ecosystem protection level tells us whether ecosystems are adequately protected or under-protected. Ecosystem types are categorised as not protected (NP), poorly protected (PP), moderately protected (MP) or well protected (WP), based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act (Skowno *et al*., 2019). The Ecosystem Protection Level (EPL) of each river assessed was based on the extent (expressed as a percentage) to which the system has their biodiversity target located within protected areas and are in a natural or near-natural ecological condition. Rivers in protected areas need to be in good condition (A or B ecological category) to be considered as protected. Well protected rivers have 100% located within protected areas, while moderately protected and poorly protected river ecosystem types have at least 50% and 5% of their biodiversity target in protected areas, respectively. Not protected rivers form less than 5% (SANBI, 2018).

The project area was superimposed on the ecosystem protection level map to assess the protection status of aquatic ecosystems associated with the development (Figure 6-6). This indicates that the aquatic ecosystems associated with the project area are rated as *moderately protected* – Coerney River.

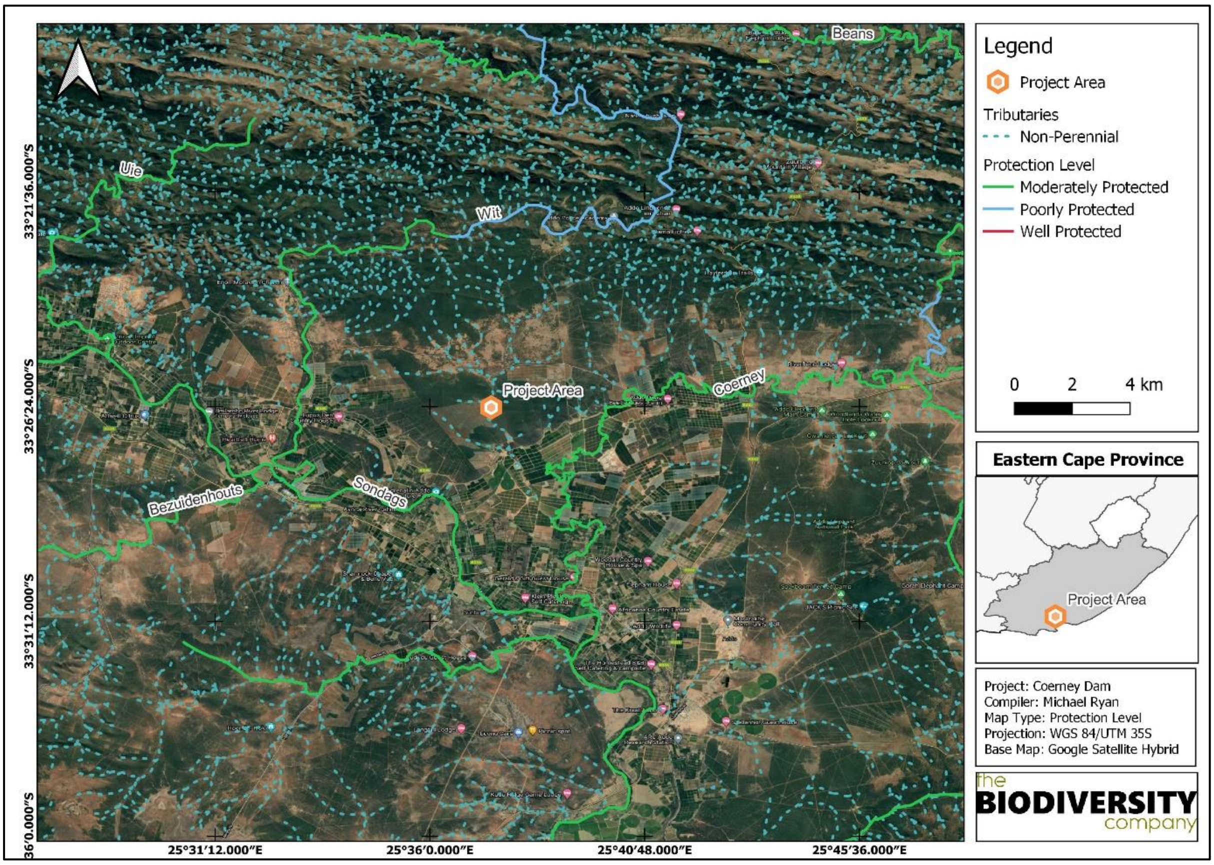

Figure 6-6: Illustration of the Ecosystem Protection Level of the project area (NBA, 2018)

6.2.5 Spatially Sensitive Mapping

The approach was informed by the Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the recently published Government Notices 320 (20 March 2020) in terms of NEMA, dated 20 March and 30 October 2020: "*Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation*" (Reporting Criteria). The National Web based Environmental Screening Tool has characterised the terrestrial sensitivity of the project area as "low" (Figure 5 1). This could be as a result of the scale of the system with the tributaries not considered by the screening tool, however the other required desktop analyses do coincide with the low sensitivity.

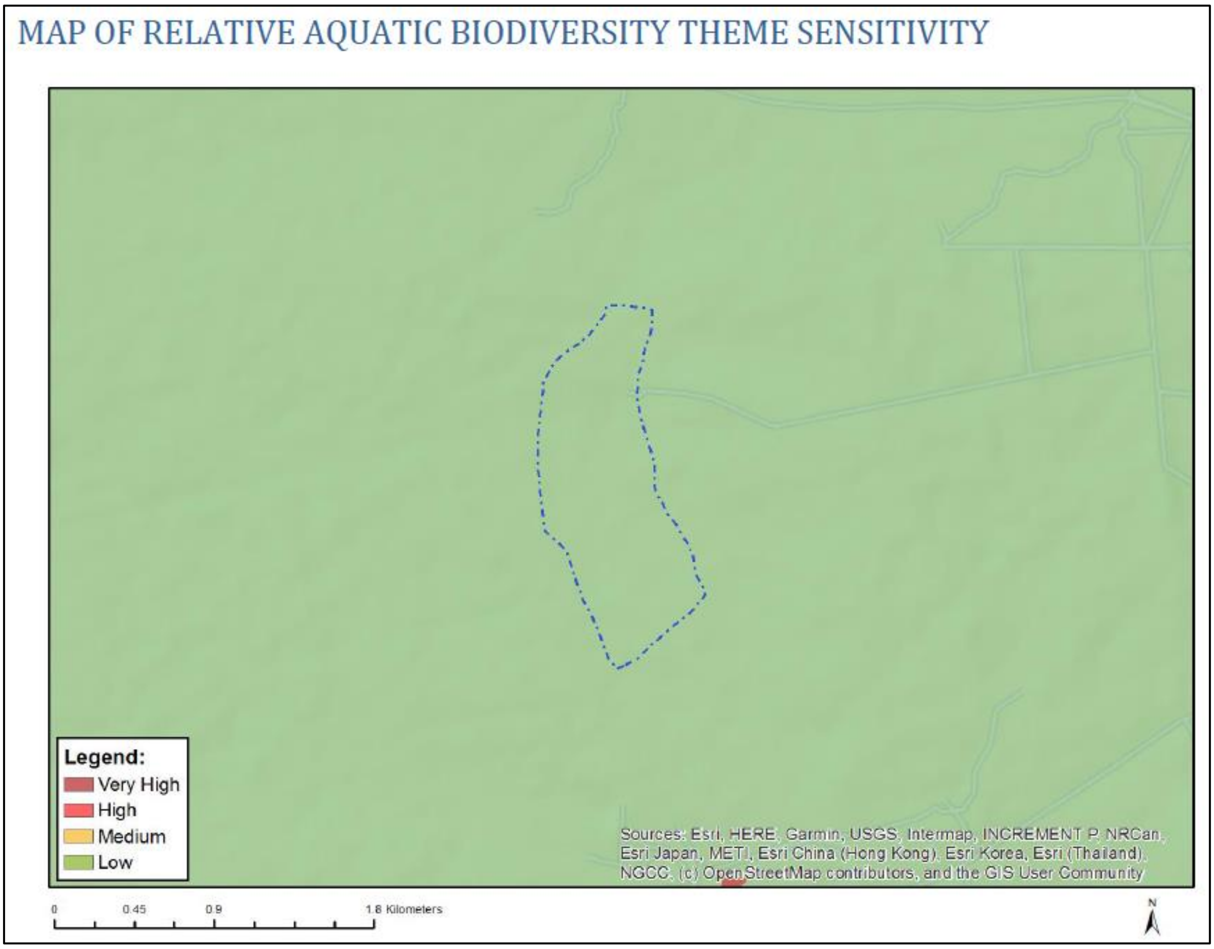

Figure 6-7: Aquatic Biodiversity Combined Sensitivity (National Web based Environmental Screening Tool)

6.3 Expected Fish Species

An expected fish species list was generated from DWS (2014), and Skelton (2011) for the N40D - 08561 SQR. A total of 10 fish species are expected to occur in the Coerney River reach which are presented in Table 6-2. The conservational status of fish species was assessed against the International Union for Conservation of Nature (IUCN) database (IUCN, 2022).

The expected species are generated on a reach basis, and the occurrence of all species in the system is unlikely as different species are specialists of different habitats which are present along a reach. The Coerney River reach does however have great diversity of habitat and therefore a wide range of fish species are expected further downstream in the reach however species such as *Gilchristella aestuaria* and *Glossogobius callidus* are not expected this far from the estuaries. This includes one Vulnerable (V) species namely *Oreochromis mossambicus* (Mozambique Tilapia) which is threatened by hybridisation.

Oreochromis mossambicus is a silvery olive to deep blue/grey in colour with a wide distribution throughout the eastern coast of Southern Africa (Figure 6-8). *O. mossambicus* occur in most systems except where there are fast flowing waters. The species thrive in standing waters and have a high tolerance to salinity. *O. mossambicus* feeds on plant matter and algae, however larger specimens have been known to be piscivorous (Skelton, 2001).

Figure 6-8: Example of an Oreochromis mossambicus from the Mfolozi River

Table 6-2: Expected fish species

Species	Common Name	IUCN Status (2022)
Anguilla mossambica	African Longfin Eel	LC
Enteromius anoplus	Chubbyhead Barb	LC
Enteromius paludinosus	Straightfin Barb	LC
Gilchristella aestuaria	Estuarine Round Herring	LC
Glossogobius callidus	River Goby	LC
Labeo umbratus	Moggel	LC
Oreochromis mossambicus	Mozambique Tilapia	VU
Total expected		**7**

LC - Least Concern, NT – Near Threatened, VU - Vulnerable

7 Results and Discussion

7.1 *In situ* Water Quality

In situ water quality analysis was conducted during the January 2022 assessment with results displayed from all sites with surface water. These results are presented in Table 7-1. Results have been compared to limits stipulated in the Target Water Quality Range (TWQR) for aquatic ecosystems (DWAF, 1996).

Table 7-1: In situ surface water quality results

Site	pH	Electrical Conductivity (µS/cm)	Dissolved Oxygen (mg/l)	Temperature (°C)
TWQR*	**6.5-9***	**-**	**>5.00***	**5-30***
CD1	8.65	920	2.83	26.5
CTD0	9.12	773	7.96	31.2
Coerney River	8.18	6890	3.76	27.1
CTDS2	8.06	7750	2.10	24.6

*TWQR – Target Water Quality Range; Levels exceeding guideline levels are indicated in red

In situ water quality for the Coerney River system indicates modified water quality when compared to Target Water Quality Ranges (TWQR). The pH within the project area is considered alkaline with the existing dam having a pH concentration elevated above the TWQR upper limit. The low water level within this dam results from evaporation which concentrates dissolved nutrients and salts within the system which could result in the elevated pH due to lack of dilution. This low water level is the result of the elevated water temperature at site CTD0. Dissolved oxygen (DO) was below the TWQR at all sites bar CTD0 with site CD1 expected to have low DO due to lack of perturbation of the standing body of water. The depleted DO within the Coerney River and site CTDS2 are poorly understood based on the limited data available. The elevated electrical conductivities recorded are considered to be of low confidence as despite literature indicating that the Lower Coerney River Valley experiences elevated salts from the Orange Transfer Scheme, they typically range from 1500 to 3000 µS/cm, excluding the site in the estuaries where 8000 µS/cm were recorded (Vuuren and Taylor, 2015; Herald, 1999). There is therefore potential for the recorded values to have resulted from a faulty water quality meter at the time of the survey. Recorded water quality parameters are considered a limiting factor for aquatic biota in the system.

7.2 Habitat Integrity Assessment

The IHIA was completed for the Coerney River reach as described in the IHIA methodology component of this study. The special framework of which constitutes a 5 km reach of the Coerney River tributary reach which would potentially be affected by the proposed dam. The results thereof are shown in Table 7-2.

Table 7-2: Intermediate Habitat Integrity Assessment for the Coerney River tributary reach (February 2022)

Criterion	Impact Score	Weighted Score
Instream		
Water abstraction	10	5.6
Flow modification	17	8.84
Bed modification	8	4.16
Channel modification	19	9.88
Water quality	12	6.72
Inundation	11	4.4
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total Instream Score		**60.4**
Instream Category		**C**
Riparian		
Indigenous vegetation removal	20	10.4
Exotic vegetation encroachment	7	3.36
Bank erosion	6	3.36
Channel modification	15	7.2
Water abstraction	20	10.4
Inundation	6	2.64
Flow modification	17	8.16
Water quality	15	7.8
Total Riparian Score		**46.68**
Riparian Category		**D**

The results of the Habitat Integrity Assessment of the Coerney River tributary indicates that instream habitat is moderately modified (class C) while the riparian habitat is largely modified (class D). This indicates that the instream habitat has experienced a loss and change of natural habitat and biota but the basic ecosystem functions are still predominantly unchanged while riparian habitat has experienced a large loss of natural habitat, biota and basic ecosystem functions. The surrounding land use of the Coerney River tributary is presented in Figure 7-1 which is dominated by agriculture in the form of citrus plantations (Figure 7-2). The altered landuse is the source of the largest influence on the system resulting from vegetation removal and encroachment as well as resulting in riparian/wetland zone discontinuity. General physico-chemical modification results from runoff (return water) from the surrounding and extensive agriculture.

The absence of surface flow within the reach hinders the applicability of many parameters considered in the IHIA for instream habitat assessment. The lack of flow results from the regional climate along with the lack of subsurface flow and allows for greater degrees of infiltration within the channel and therefore no surface flow which has resulted in the non-perennial/ephemeral nature of the system. This is therefore the reason for the required dams in the system to store water. The reach does however already contain multiple dams as seen in Figure 7-3 and Figure 7-4, which result in channel, bed and flow modifications as well as inundation with alterations of the riparian area location and extent as a result of existing habitat inundated. CD2 also indicates evidence of large scale abstraction for surrounding plantations (Figure 7-4). The reach was also found to contain small scale weirs as seen in Figure 7-5, and results in the same impacts at a smaller scale. Lastly, the reach is heavily impacted on by road networks which cross the reach whether they are farm roads running through the open channel or tar roads downstream crossing the channel with instream culverts. The largest impact of these crossings result from channel modification which hinders natural migrations of meanders (Figure 7-6).

The area of Port Elizabeth has been a water scarce area over the long term with water supplied to Port Elizabeth from the Sundays River Valley since 1992. This was achieved through the construction of an intricate canal system which connects the Great Fish River and Nelson Mandela Bay. The Skoenmakers Canal links the Great Fish River to Darlington Dam. Water from Darlington Dam and Sundays River irrigation canals flows to the Scheepersvlakte Dam (main balancing dam). After this, the water moves via a gravity pipeline to the NMB municipality’s reservoir in Motherwell. The Nooitgedacht Water Scheme is the last connection between Scheepersvlakte and the Motherwell reservoir (News24, 2019). The inflow of water into these systems which are not naturally full results in channel, bed and flow modifications and inundations at the dams which store the water. Evidence of these canal systems are presented in Figure 7-7.

Figure 7-1: Arial imagery of the project area (Google Earth, 2022)

Figure 7-2: Lemon trees (Citrus limon) at CTD5 (January 2022)

Figure 7-3: Instream dam and artificially modified catchment at CTDS which is near empty (January 2022)

Figure 7-4: Instream dam at CD2 (January 2022)

Figure 7-5: Small scale deteriorated instream weir across the channel at CTUS (January 2022)

Figure 7-6: Instream road bridge and culvert to allow water pass-through at CDDS2 with bank erosion (September 2021)

Figure 7-7: Canal systems leaving the Dam at CD1 (January 2022)

7.3 Riparian Habitat – Watercourse Extent

The project area is situated within the Albany Alluvial Vegetation type (Figure 7-17) within the Albany Thicket Biome. It is made up of two major vegetation patterns: riverine thicket and thornveld (*Vachellia natalitia*). The riverine thicket tends to occur in the narrow floodplain zones in regions close to the coast or further inland, whereas the thornveld occurs on the wide floodplains further inland (Mucina & Rutherford, 2006). The riparian areas of the watercourses considered were highly varied. Upstream along the Coerney River tributary the riparian area is limited by lack of surface flow with no vegetation indicating wet soils (Figure 7-8). As a result, terrestrial vegetation has encroached and taken over the channels in the upper reaches. Therefore, the vegetation is comprised of grasses and small shrubs in the channel with trees such as *Portulacaria afra* and *Grewia sp* tree species forming the marginal vegetation (Figure 7-9). *Plumbago auriculata* was also observed in the marginal zone (Figure 7-10). Alien invasives were also observed in the upper reaches in the form of *Datura ferox* (Figure 7-11) in the channel and *Opuntia sp.* (Figure 7-12) in the marginal zones. Mesembryanthemaceae (Aizoaceae) was observed downstream at the existing dam (CTD0) which are protected and should be avoided by the proposed project footprint (Figure 7-14). Further downstream of the existing dam there is evidence of wet soils despite no surface flows, through the large wetland which has formed which is dominated by *Phragmites australis* (Figure 7-13). At site CTDS2 far downstream the riparian area changes where there is minimal flowing water. *Phragmites australis* dominate the channel which has been narrowed and straightened with the alien invasive *Pennisetum clandestinum* planted along the banks (Figure 7-15). The riparian area of the Coerney River is dominated by a combination of *Cyperus sp* and *Phragmites australis* along the banks with *Vachellia natalitia* and *Salix mucronata subsp. mucronata* as the large trees in the outer marginal zone (Figure 7-16).

Figure 7-8: Typical section of the riparian area along the Coerney River tributary at CTUS (January 2022)

Figure 7-9: Portulacaria afra and Grewia sp. (January 2022)

Figure 7-10: Plumbago auriculata (January 2022)

Figure 7-11: Datura ferox – Alien Invasive (January 2022)

Figure 7-12: Opuntia sp. – Alien Invasive (January 2022)

Figure 7-13: Phragmites australis downstream at CTDS (January 2022)

Figure 7-14: Mesembryanthemaceae (Aizoaceae) at CTD0 along the top of the dam wall (January 2022)

Figure 7-15: Phragmites australis surrounded by Pennisetum clandestinum at CTDS2 (January 2022)

Figure 7-16: Typical section of the riparian area along the Coerney River (January 2022)

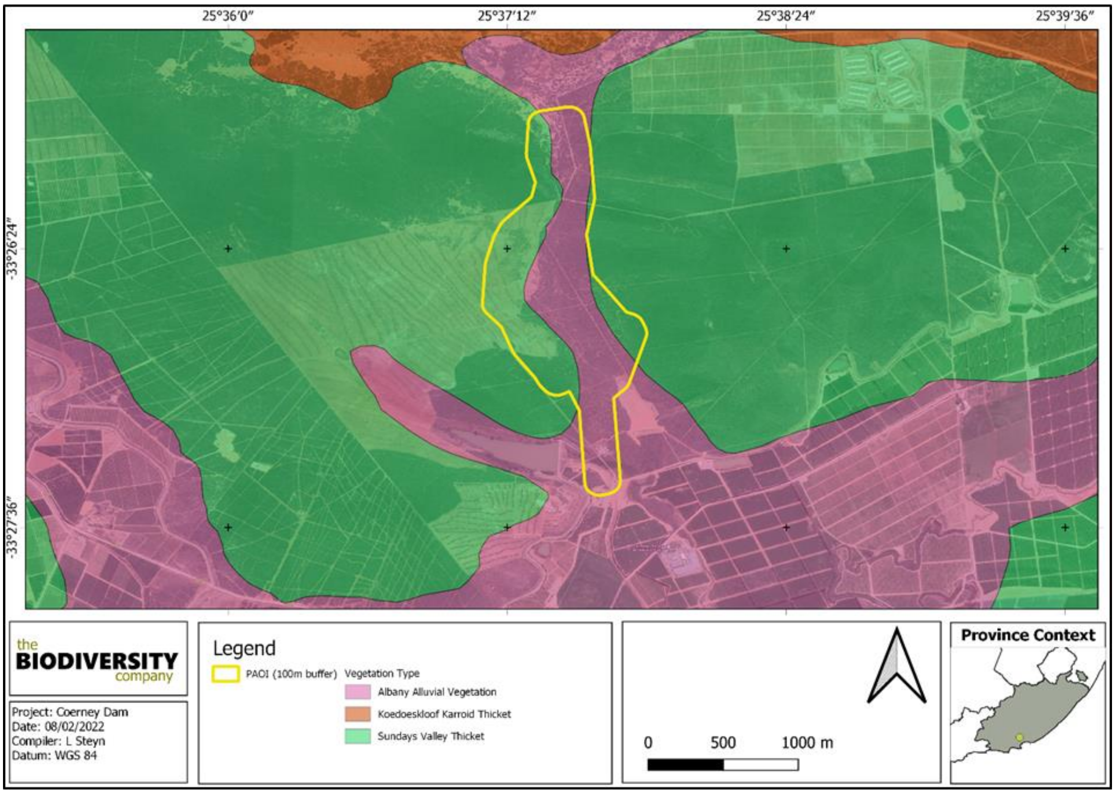

Figure 7-17: The vegetation type of the project area (TBC, 2022)

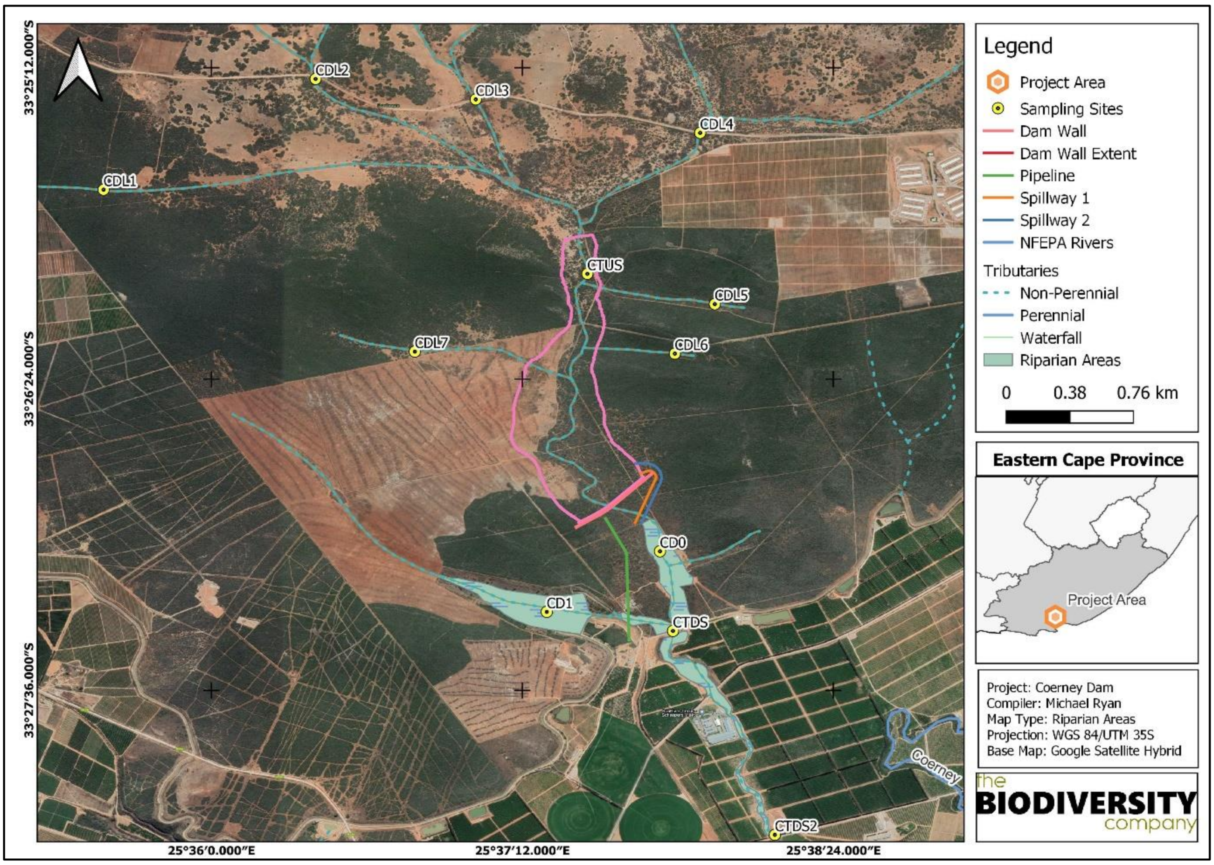

Figure 7-18: Riparian delineation of the watercourses associated with the project area

7.4 Buffer zones

Riparian areas have high conservation value and can be considered most important part of a watershed for a wide range of values and resources. They provide important habitat for a large volume of wildlife and often forage for domestic animals. The vegetation they contain are an important part of the water balance for the hydrological cycle through evapotranspiration. They are crucial for riverbank stability and in preventing erosion within the channel (Elmore and Beschta, 1987). Buffer areas further offer phytoremediation capacity against adjacent land use activities limiting impacts to the local watercourse. Therefore, they are considered as high priority areas and should be avoided at all costs. According to the buffer guidelines the maximum required buffer should be applied to a system (Macfarlane, *et al*., 2014). Despite this however the system extent is minimal with terrestrial vegetation encroachment is extensive due to the non-perennial/ephemeral nature of the system, resulting in the minimal extent of the riparian area. As a result, the recommended buffer of 18 m was used as recommended by Palone and Todd (1997) and Dosskey (2000) to maintain species diversity. Using this sensitivity, a conservative buffer zone was suggested of 18 m for the construction phases of the project with all non-essential sections of the development such as the laydown yard forbidden from being located within the buffer. The delineation of the watercourse extents riparian zone observed in the study area are presented in Figure 7-18 with the associated buffers presented in Figure 7-19.

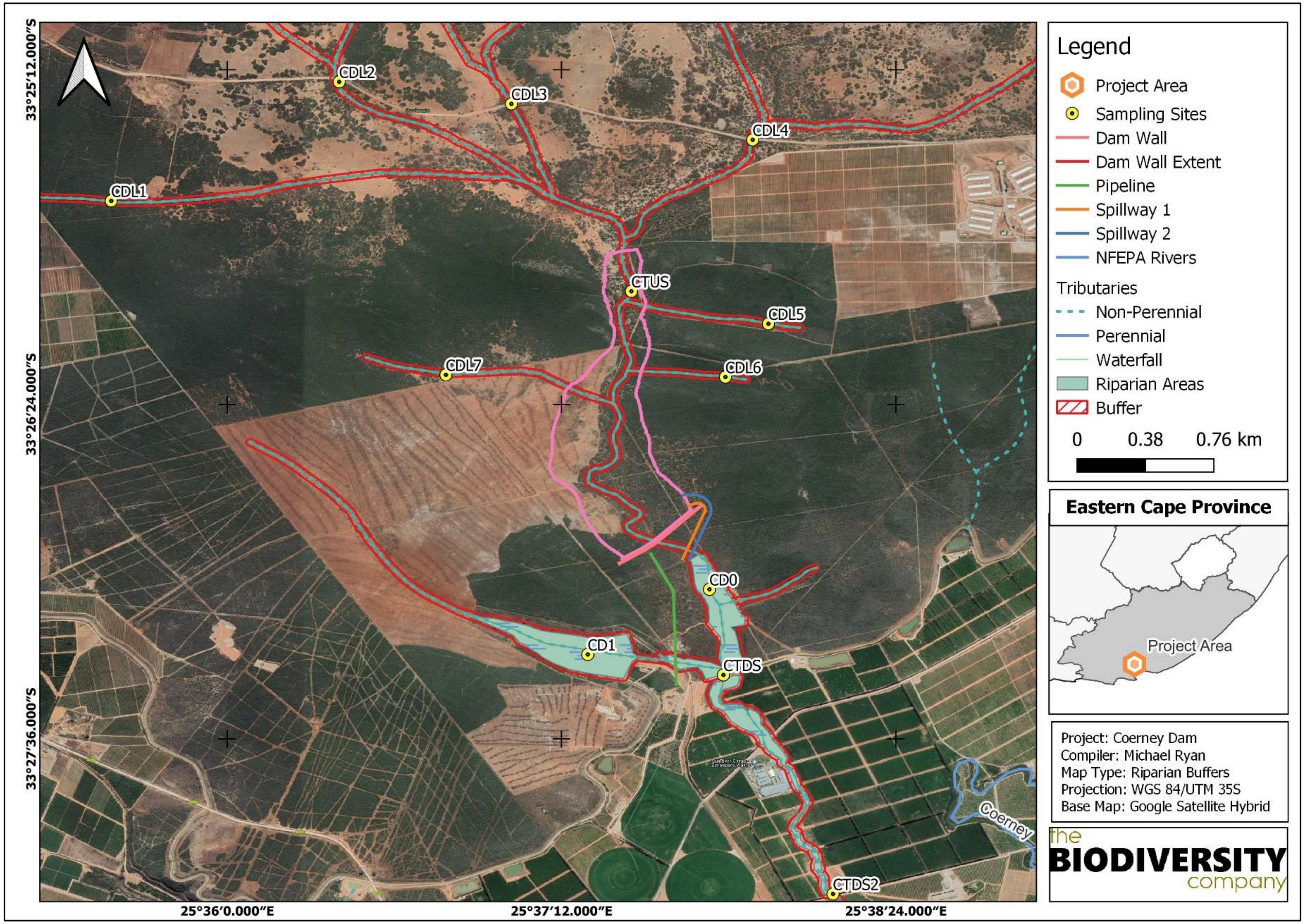

Figure 7-19: Riparian delineation and associated buffer of the watercourses associated with the project area

7.5 Aquatic Macroinvertebrate Assessment

7.5.1 Macroinvertebrate Habitat

Biological assessments were completed at representative sites in the considered river reach. The results of the biotope assessment are provided below (Table 7-3).

Table 7-3: Biotope availability at the sites (Rating 0-5)

Biotope	Weighting (Lower Foothills)	Coerney River
Stones in current	18	2.5
Stones out of current	12	2
Bedrock	3	1
Aquatic Vegetation	1	2
Marginal Vegetation In Current	2	2
Marginal Vegetation Out Of Current	2	3
Gravel	4	1
Sand	2	1
Mud	1	2
Biotope Score		16.5
Weighted Biotope Score (%)		41
Biotope Category (Tate and Husted, 2015)		D

The habitat availability within the Coerney River represents moderate instream habitat diversity conditions (class D) within each reach. These lower foothill systems flow at gentle gradients within wide linear channels where all habitat types are poorly represented. The channel however is restricted by surrounding landuse and has resulted in a channel of uniform depth and width with high flow focussed at the existing road bridge. Available habitat for macroinvertebrate families constituted of marginal vegetation which lacked vegetation species diversity as well as a mixture or stones which were all located around the culvert. The present biotope results within the reach indicate that the habitat availability would be a limiting factor for diverse macroinvertebrate communities.

7.5.2 South African Scoring System

The aquatic macroinvertebrate results for the survey along the Coerney River are presented in Table 7-4. SASS5 was conducted at all appropriate sites with surface flow in the project area.

Table 7-4: Macroinvertebrate assessment results recorded during the survey

Site	SASS Score	No. of Taxa	ASPT*	Category (Dallas, 2007)**
Coerney River	43	11	3.9	E/F

*ASPT: Average score per taxon;

The SASS5 assessment results generated a SASS score that was categorised as a class E/F for the project area (Dallas, 2007) which indicates seriously modified conditions within the sampled reach. There was a low diversity of taxa sampled with low relative sensitivity (ASPT).

The sampled macroinvertebrate families sampled are tolerant (ASPT score between 1-5) bar the presence of Ancylidae (6) and included taxa such as Potamonautidae (3), Coenagrionidae (3), Belostomatidae (3), Corixidae (3), Chironomidae (2), to name a few. Despite indicated poor habitat within the watercourse, there are multiple sensitive families which would be expected within the present habitat which were found to be absent within the reach. The source of modification is therefore suggested to be water quality within the reach, where increased nutrients have resulted in physiochemical changes such as eutrophic conditions which many macroinvertebrate families are unable to tolerate. This results from large scale agriculture in the region and the immediate river catchment.

7.6 Fish Communities

The results of the ichthyofauna assessment from the 2022 survey are presented Table 7-5. Photographs of the fish species sampled within the project area are presented in Table 7-6. A total of two fish species were sampled in the Coerney River, one of which is an alien invasive species - *Gambusia affinis.* This indicates a presence of 14% of the expected fish species list. Sampling efforts were in line with rapid assessment methodologies, however if efforts were increased, more species are expected within the reach. The extent to which this is true is however unknown due to apparent modification of the system.

Table 7-5: Fish sampled in the Coerney River.

Species	Common Name	IUCN Status (2022)	Sampled
Anguilla mossambica	African Longfin Eel	LC	
Enteromius anoplus	Chubbyhead Barb	LC	X
Enteromius paludinosus	Straightfin Barb	LC	
Gilchristella aestuaria	Estuarine Round Herring	LC	
Glossogobius callidus	River Goby	LC	
Labeo umbratus	Moggel	LC	
Oreochromis mossambicus	Mozambique Tilapia	VU	
Alien Invasive species			
Gambusia affinis	Mosquito Fish	Alien Invasive	X

Red text indicates alien invasive species

Table 7-6: Fish species collected in the Coerney River

Scientific name	Photo
Enteromius anoplus	

Scientific name	Photo
Gambusia affinis	

Red text indicates alien invasive species

The sensitivity of the expected fish species as well as the sampled fish population for the Coerney River is presented in Table 7-7. Fish have different sensitivities or levels of tolerance to various aspects that they are subjected to within the aquatic environment. These tolerance levels are rated with a sensitivity score which indicate each fish species sensitivity to flow and physico-chemical modifications. The results indicate that both the fish expected in the Coerney River as well as the community sampled in the reach are moderately tolerant to flow and physicochemical modifications, while the sampled population within the reach are tolerant to flow and physicochemical modifications.

Table 7-7: Fish community sensitivity

Species/Site	Expected Species		Sampled species	
	Sensitivity		Sensitivity	
	No-flow	Phys-chem	No-flow	Phys-chem
Anguilla mossambica	2.8			
Enteromius anoplus	2.3	2.6	2.3	2.6
Enteromius paludinosus	2.3	1.8		
Gilchristella aestuaria	2.7			
Glossogobius callidus	2.3			
Labeo umbratus	2.7	1.6		
Oreochromis mossambicus	0.9	1.3		
Alien Invasive Species				
Gambusia affinis	+	+	2	
Overall Intolerance Rating	2.2	2.2	2.2	2.3

+ - not expected; * - not sampled.

8 Risk / Impact Assessment

The proposed balancing storage dam is intended to assist with water requirements from the Nelson Mandela Bay Municipality (NMBM) as part of the Lower Sundays River Government Water Scheme which receives water via the Orange-Fish-Sundays Transfer Scheme. This is due to the available Scheepersvlakte Dam being the only source for the NMBM and for fear of supply failures an alternative is required to insure uninterrupted water supply. The concern is due to the limited capacity of the Scheepersvlakte Dam. As a result, the proposed Coerney Dam will include (Table 8-1):

- A new balancing dam with a capacity of 4.6 million m^3 on the farm Scheepersvlakte. The capacity includes an allowance of 100 000 m^3 for the requirements of a new citrus development on the farm;
- The dam will comprise an earth fill embankment. A concrete side channel spillway and an outlet works;
- Connecting pipelines of 1300 mm diameter and length of 940 m and 2460 m are required to supply water to the dam and connect to the existing pipeline supplying Nooitgedaght water treatment works;
- An access road with a length of about 1 km, following the route of an existing jeep track; and
- An electricity supply will be required for lightning, etc. in the outlet works and around the dam wall".

Table 8-1: Summary of parameters of the proposed Coerney Dam (DWS. 2020)

Characteristic	Coerney Dam
Dam type	Earthfill Embankment
Non-overspill crest (NOC) (masl)	RL102.9
Full supply level (FSL) (masl)	RL98.1
Freeboard (m)	4.8
Crest width (m)	5.0
Downstream slope (V: H)	1Vertical: 2.0Horizontal
Upstream slope (V: H)	1Vertical: 3.0Horizontal
Embankment fill volume (m^3)	378 600
Core trench volume (m^3)	52 200
Crest length (m)	420
Total gross dam capacity (m^3)	4 600 000
Surface area at FSL (ha)	71.1
Maximum wall height (m)	21.4
Catchment area (km^2)	34
Safety Evaluation Flood (m^3/s)	890
Access road length (km)	1.0
Spillway configuration: A 35 m wide side channel spillway with a 7 m high ogee overflow structure. Trapezoidal reinforced concrete discharge channel with 5 m base width and 9 m deep, with 1V:0.5H side slopes, and a flip bucket energy dissipater in the river.	
Outlet works: A 22 m high dry well tower with inside dimensions of 4 m square. Three off-take levels controlled by valves.	

The proposed dam therefore is motivated by the clear requirement of uninterrupted water supply by communities which form part of the NMBM. The current intended dam wall design to be used is presented in Figure 8-1. There were no alternatives provided for this project with regards to design or location and therefore the outline instance was examined.

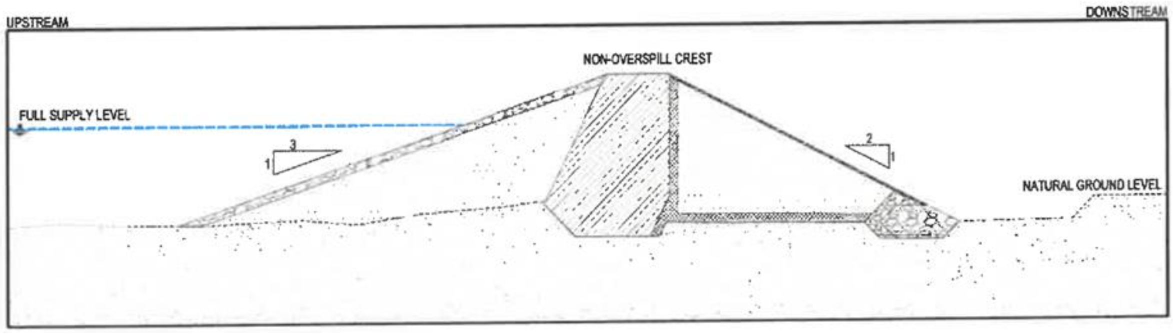

Figure 8-1:Cross section of the intended dam wall design (DWS. 2020)

The impact assessment considered both direct and indirect impacts, to the watercourses which are potentially affected by the proposed Coerney Dam project. The legal definition of the extent of a watercourse is defined in the amendment of the General Authorisation for section 21 (c) and (i) water uses. The extent of the watercourse is defined as:

- A river, spring or natural channel in which water flows regularly or intermittently “within the outer edge of the 1 in 100-year flood line or riparian habitat measured from the middle of the watercourse from both banks”; and
- Wetlands and pans “within 500 m radius from the boundary (temporary zone) of any wetland or pan” (DWA, 2012).

The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 8-2). In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts. The section on buffer requirement illustrates the extent of the recommended buffer zones for the identified watercourses. It is evident from these illustrations that the dam is located within the extent of a delineated watercourse. This is unavoidable due to the nature of the project and therefore results in the use of the minimise tier of the hierarchy.

This section represents the DWS risk / impact assessment required for a Water Use Licence (WUL) and therefore considered the direct and indirect impacts, if any, to the wetland and riverine systems. The proposed project is aimed to identify current and ongoing impacts towards the relevant watercourses posed by the proposed Coerney Dam during the construction and operational phase.

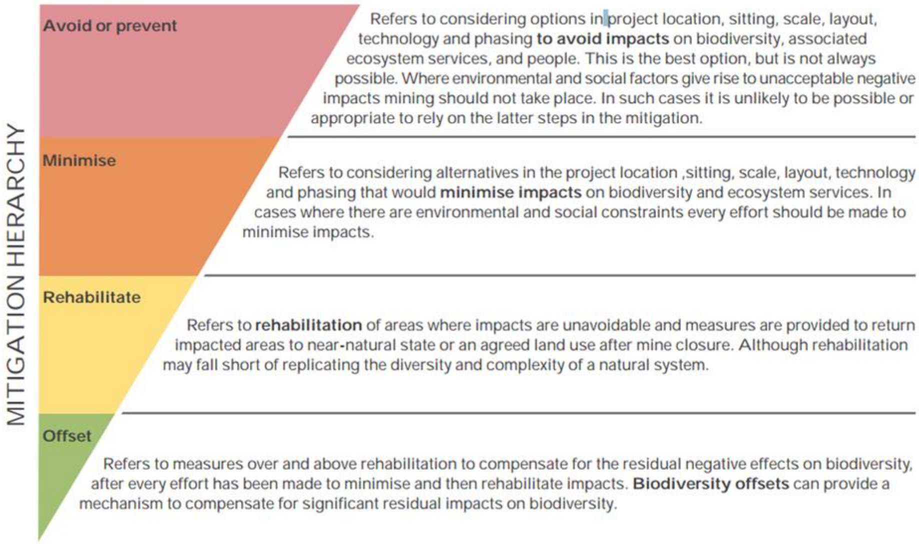

Figure 8-2: The mitigation hierarchy as described by the DEA (2013)

8.1 Assessed risks

The construction and operation of any infrastructure in proximity to a watercourse creates potential for negative effects to downstream waterbodies. The expected activities as well as their anticipated impacts for the project area are provided in Table 8 5 and are expected for the Coerney Dam. The standardised DWS risk assessment for the project is presented in Table 8-3 and Table 8-4. Due to the proximity of the proposed dam (within the watercourse) to the tributary as well as the Coerney River, risks range from low to high despite adequate mitigation measures implemented. In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, setting, scale, layout, technology, and phasing to avoid impacts. These activities cannot avoid direct contact with the sensitive spatial features of the considered watercourse. Therefore, mitigation actions have been recommended.

Table 8-2: Expected activities, the aspects and impacts identified

Activity	Aspect	Impact
Phase	**Aspect**	**Impact**
Construction	Removal of vegetation	• Indirect loss of watercourse; • Erosion of watercourse; • Loss of aquatic and riparian habitat • Elevation of water temperature • Loss of aquatic biodiversity • Upstream inundation • Loss of vegetation; • Decrease in functionality; • Water quality impairment; • Compaction; • Altering hydromorphic soils; • Drainage patterns change; and • Altering overland flow characteristics.
	Physical construction of dam walls	
	Use of machinery/vehicles within watercourse	
	Earthworks and alteration of river banks	
	Ablution facilities	
	Stripping and stockpiling of soil	
	Domestic and industrial waste	
	Storage of chemicals, mixes and fuel	
Operation	Permanent inundation	
	Invasion of hydrophytic species	
	Channel, flow and bed modification	
	Maintenance	

Table 8-3: DWS Risk Impact Matrix for the proposed dam (Andrew Husted Pr Sci Nat 400213/11)

Severity								
Aspect	Flow Regime	Physiochemical (Water Quality)	Habitat (Geomorphological and Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase								
Removal of vegetation	4	4	5	5	4.5	1	1	6.5
Physical construction of dam walls	5	2	4	5	4	2	2	8
Use of machinery/vehicles within a watercourse	5	5	5	5	5	2	2	9
Earthworks and alteration of river banks	5	5	5		5	2	2	9
Ablution facilities	1	2	2	1	1.5	2	2	5.5
Stripping and stockpiling of soil	1	1	2	2	1.5	1	2	4.5
Domestic and industrial waste	1	2	1	1	1.25	2	2	5.25
Storage of chemicals, mixes and fuel	1	3	2	2	2	3	2	7
Operational Phase								
Permanent inundation	5	3	5	5	4.5	3	5	12.5
Invasion of hydrophytic species	1	3	3	3	2.5	2	4	8.5
Channel, flow and bed modification	5	3	5	5	4.5	3	5	12.5
Maintenance	5	5	5	5	5	2	1	8

Table 8-4: DWS Risk Assessment Continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Removal of vegetation	1	3	5	2	11	71.5	Moderate	Low
Physical construction of dam walls	3	3	5	2	13	104	Moderate	Moderate
Use of machinery/vehicles within a watercourse	2	3	5	2	12	108	Moderate	Moderate
Earthworks and alteration of river banks	3	3	5	2	13	117	Moderate	Moderate
Ablution facilities	2	3	1	2	8	44	Low	Low
Stripping and stockpiling of soil	2	3	1	3	9	40.5	Low	Low
Domestic and industrial waste	3	3	1	2	9	47.25	Low	Low
Storage of chemicals, mixes and fuel	2	2	1	2	7	49	Low	Low
Operation Phase								
Permanent inundation	5	5	5	1	16	200	High	High
Invasion of hydrophytic species	2	2	1	1	6	51	Low	Low
Channel, flow and bed modification	4	5	5	2	16	200	High	High
Maintenance	1	2	5	2	10	80	Moderate	Low

(*) denotes - In accordance with General Notice 509 “Risk is determined after considering all listed control / mitigation measures. Borderline Low / Moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to listing of additional mitigation measures detailed below.”

8.2 Potential Impacts

The risks associated with the Coerney Dam along the tributary of the Coerney River and associated tributaries have the potential to degrade water and habitat quality and modify flow regimes within the system. The potential impacts identified during the construction phase of the project include eight different aspects. Of these eight, four were identified to be moderate risks with three remaining moderate after the ascribing of the prescribed mitigation measures. These include: physical construction of dam walls, use of machinery/vehicles within a watercourse and earthworks and alteration of river banks. It is assumed that construction will occur during the dry season and therefore no channel/water diversion will be required for the project and thus was not considered for the risk assessment. The spatial scale of the construction is considered large but due to the temporal scale the risks are mitigated by their period of influence. The operational risks of modification are therefore considered greater due to their associated temporal scale – influencing the system for the lifetime of the dam. Four potential risks to modification to the system were identified with one risk considered low and another only considered low after considering the ascribed mitigation measures. The remaining two risks are considered high risks as they will cause large scale influence for a great period. These include: permanent inundation as well as channel, flow and bed modification. As a result of the calculated risks during the construction and operational phase, the project will require a full water use licence in order to receive environmental authorisation (EA) for the project to continue.

8.3 Mitigation measures

Given the fact that impacts could not be avoided [which is the first step in the mitigation hierarchy - Figure 8-2: The mitigation hierarchy as described by the DEA (2013)], the next step is to decrease the expected impacts by means of relevant recommendations and mitigation measures. Despite these mitigation measures not lowering the risk categories they remain useful in minimising environmental degradation and therefore remain pertinent. Should this application be successful, it is recommended that mitigation and remedial measures be taken as outline in this section.

8.3.1 Dam Mitigation Measures and Rehabilitation

The following mitigation actions are applicable to the Coerney Dam:

- Construction should be limited to the dry season when the channel is dry to limit potential modification to the system;
- All spillways must be regularly monitored and maintained/vegetated;
- These spillways must be fitted with infrastructure such as gabions or flow dissipation to remedy point source erosion at the end of the spillway;
- The designed dam should be built according to the capacity of a 1:100-year flood as dam collapse in this non-perennial system will result in extensive damage to downstream systems which include the highly sensitive estuary;
- A storm water management plan must be compiled for both the construction and operation of the dam;

- This plan must attempt to reduce erosion and sedimentation of the watercourse, and preventing erosion of the receiving environment. It is preferable that run-off velocities be reduced with energy dissipaters and flows discharged into the local watercourse downstream;
- Revegetating eroded areas downstream of the dam with indigenous vegetation. Inundation will result in large scale vegetation loss. These species could be relocated downstream;
- If required, fertilizers should be responsibly applied to increase the rate of revegetation;
- The buffer zone of 18 m along the delineated riparian area must be established as a no-go area for all farming activities/clearing as well as associated aspects of the development which aren't directly related to the watercourse such as laydown yards;
- Alien vegetation management must take place in the established 18 m buffer zone during construction and thereby allow for the natural succession of native riparian species in the future. As construction ends all remaining disturbed land should be revegetated with indigenous species as outlined by TBC (2022), as disturbed land is easily invaded by invasive species;
- Stabilisation of banks and outlet channels through the use of gabions or Reno mattresses, and the re-vegetation of any disturbed areas will be required directly downstream of the dam wall;
- Dredging may be required and should be monitored on a long term basis to avoid the dam silting up, however due to the dam's catchment size is unlikely; and
- Silt traps and fences must be placed in the preferential flow paths to prevent sedimentation of the watercourse and the proposed dam, these should be monitored and serviced regularly.

8.3.2 General mitigations

- The contractors used for the construction should have spill kits available prior to construction to ensure that any fuel, oil or hazardous substance spills are cleaned-up and discarded correctly;
- All construction activities must be restricted to the development footprint area. This includes laydown and storage areas, ablutions, offices, etc.;
- No construction activities such as laydown yards may be placed within the delineated buffer zone along the riparian or wetland area which must be established as a no-go area;
- During construction activities, all rubble generated must be removed from the site;
- Construction vehicles and machinery must make use of existing access routes;
- All chemicals and toxicants to be used for the construction must be stored in a bunded area;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;

- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping";
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- All removed soil and material stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- No dumping of construction material on site may take place; and
- All waste generated on site during construction must be adequately managed. Separation and recycling of different waste materials should be supported.

9 Conclusion

9.1 Aquatic Ecology

The Coerney River tributary (N40D – 08561 SQR) across which the proposed dam will be constructed is considered largely modified (class D) at a desktop level. Desktop sensitivity indicates the system to be of low sensitivity within an ecological support area which is moderately protected. The tributary was observed to be dry and therefore the only aspect considered for the tributary was habitat availability which was limited and heavily encroached upon by terrestrial vegetation. Further downstream of the proposed dam, the Coerney River was assessed and water quality indicated a modified catchment with a tolerant macroinvertebrate assemblage sampled. Sampled fish communities comprised two fish species with moderate tolerances to both physicochemical and flow modification of which one was an alien invasive species namely *Gambusia affinis*.

9.2 Impact Assessment and Statement

In terms of the anticipated impacts on receiving watercourses, implementation of the mitigation measures will effectively reduce the anticipated impacts however moderate risks remain for the construction phase of the project as well as high risks for the operation phase. The risks are associated with the physical construction of a dam wall, use of machinery/vehicles within a watercourse, earthworks and alteration of river banks during construction as well as the permanent inundation above the dam wall and channel, flow and bed modification during operation.

Professional Opinion

It is the specialist's opinion that no fatal flaws were identified for the proposed activity. The identified risks were of moderate severity for the construction phase and high severity for the operational phase therefore a full Water Use Licence Application will be required.

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