Chapter 14:

HERITAGE IMPACTS

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Glossary

DEFINITIONS	
Archaeology:	Broadly speaking, all remains resulting from human activity older than 100 years and include artefacts, human and hominid remains, features and structures.
Early Stone Age (ESA):	The archaeology of the Stone Age between 1.5 million and 250 000 years ago.
Middle Stone Age (MSA):	The archaeology of the Stone Age between 20/30 000 - 250 000 years ago associated with early modern humans.
Late Stone Age (LSA):	The archaeology of the last 20 000 years associated with fully modern people.
Fossilised bone:	Mineralised bones of animals.
SAHRA:	South African Heritage Resources Agency – the compliance authority which protects national heritage.
Holocene:	The most recent geological time period which started 10 000 years ago.
Historical features:	Foundations of buildings or other construction features and items from domestic and military activities older than 60.
Shell middens:	Accumulations of marine shell deposited by human agents rather than the result of marine activity. The shells are concentrated in a specific locality above the high-water mark and frequently contain stone tools, pottery, bone and occasionally also human remains.

Acknowledgements Palaeontological Impact Assessment

OTGC and the CSIR (Durban) are thanked for commissioning this study and for kindly providing the necessary background information. I would also like to thank Ms Andrea von Holdt and Dr. Paul Martin of the Coega Development Corporation as well as Dr W. de Klerk of the Albany Museum, Grahamstown for promoting my original palaeontological review of the Coega IDZ.

CHAPTER 14: IMPACT ON HERITAGE (ARCHAEOLOGY AND PALAEONTOLOGY)

This Chapter presents an assessment of the potential impact of the proposed OTGC Bulk Liquid Storage and Handling Facility on features of heritage value in Zone 8 of the Coega IDZ. Heritage is considered to include palaeontological, archaeological, historical and cultural aspects.

Given the numerous development proposals within the Coega IDZ, an over-arching heritage study was conducted by the Coega Development Corporation in 2010, in consultation with the South African Heritage Resources Agency (SAHRA). This study was intended to provide a baseline reference that could be used in future EIAs, as well as an identification of areas of particular heritage value within the IDZ. The IDZ-wide study included a Palaeontological Impact Assessment by Dr. John Almond (Natura Viva cc) and an Archaeological Impact Assessment by Dr. Johan Binneman (Eastern Cape Heritage Consultants). The Historical Assessment, relating to the Built Environment and graves, was conducted by Jenny Bennie.

This IDZ-wide study excluded Zone 8 of the Coega IDZ, which is governed by Transnet National Ports Authority. This gap in literature warranted a separate Palaeontological Impact Assessment and Archaeological Impact Assessment to be conducted for the proposed Bulk Liquid Storage and Handling Facility in the Port of Ngqura.

PART A: IMPACT ON PALAEONTOLOGY

This section presents the findings of the Palaeontological Impact Assessment specialist study that was conducted by Dr. John Almond of Natura Viva as part of the EIA for the proposed OTGC Bulk Liquid Storage and Handling Facility Project.

14.1 INTRODUCTION AND METHODOLOGY

As mentioned previously, OTGC is proposing to construct a Bulk Liquid Storage and Handling Facility in Zone 8 of the Coega IDZ and the Port of Ngqura in the Eastern Cape (Figures 14.1 to 14.3). The tank farm itself will occupy an area of approximately 20 hectares while the associated infrastructure will require additional land. This additional infrastructure will mainly comprise a pipeline between the tank farm site and the existing Berth B100 at the Port of Ngqura and/or the proposed new A-series Berth to the east (Figure 14.2). In the former case, the location of the (single) pipeline crossing of the Coega River is considered to be the worst case scenario as described in Chapter 2 of this Draft EIA Report (Figure 14.2). As mentioned in Chapter 2 of this Draft EIA Report, the precise route to Berth A100 will be finalised during the detailed engineering phase.

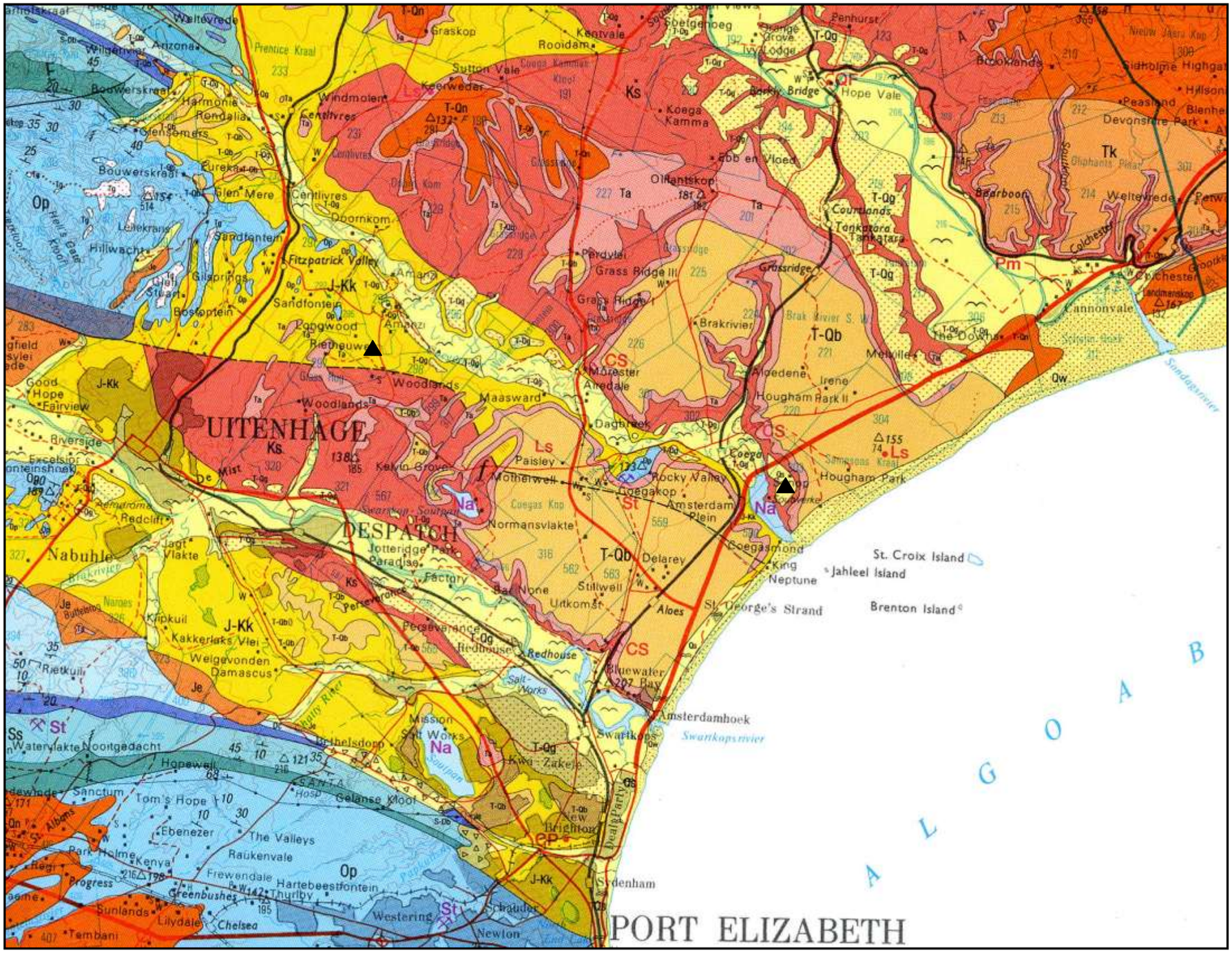
The proposed OTGC tank farm development and associated infrastructure will involve substantial excavations into potentially fossiliferous bedrocks of Mesozoic and Caenozoic age. All fossil heritage in the Republic of South Africa is protected by the South African Heritage Resources Act (Act No. 25 of 1999) which requires a palaeontological heritage assessment for the proposed development. This present report has accordingly been commissioned by the CSIR. It forms part of the EIA for the proposed OTGC tank farm development, falling under Section 38 (Heritage Resources Management) of the South African Heritage Resources Act, and it will also inform the Environmental Management Plan for this project. Minimum standards for the palaeontological component of heritage impact assessment reports are currently being developed by SAHRA.

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act include, among others:

- Geological sites of scientific or cultural importance;
- Palaeontological sites; and
- Palaeontological objects and material, meteorites and rare geological specimens.

Figure 14.1 shows an extract from 1: 250 000 scale geological sheet 3324 Port Elizabeth (Council for Geoscience, Pretoria, 1991). The position of the OTGC tank farm study area within Zone 8 of the Coega IDZ is approximately indicated by the black triangle. The outcrops of major stratigraphic units are shown including the Peninsula Formation (Op, pale blue), Kirkwood Formation (J-Kk, yellow), Sundays River Formation (Ks, cerise), Alexandria Formation (Ta, pink), “Bluewater Bay Formation” (T-Qb, buff) and coastal dune sands (Qw, pale yellow). Note that later 1:50 000 scale mapping has considerably refined this scheme (Refer to detailed geological maps in Figure 14.5). For example, the Bluewater Bay Formation is no longer regarded as a separate formation but as a residual soil developed on the Alexandria Formation. Outcrops of Sundays River Formation are now recognized on the southern margins of the Coega River Valley. Tertiary/Quaternary aeolianites of the Nanaga Formation (T-Qn, orange) are now mapped inland of the modern dune sands along the coast of the Coega IDZ.

Figure 14.2 shows the Pipeline Routings from the tank farm to the berth. Pipeline Route Option 2 shows the pipeline connection with the existing B100 berth (to the west), crossing the Coega River. Pipeline Route Option 1 shows the pipeline connection with the proposed new A-series Berth (to the east).



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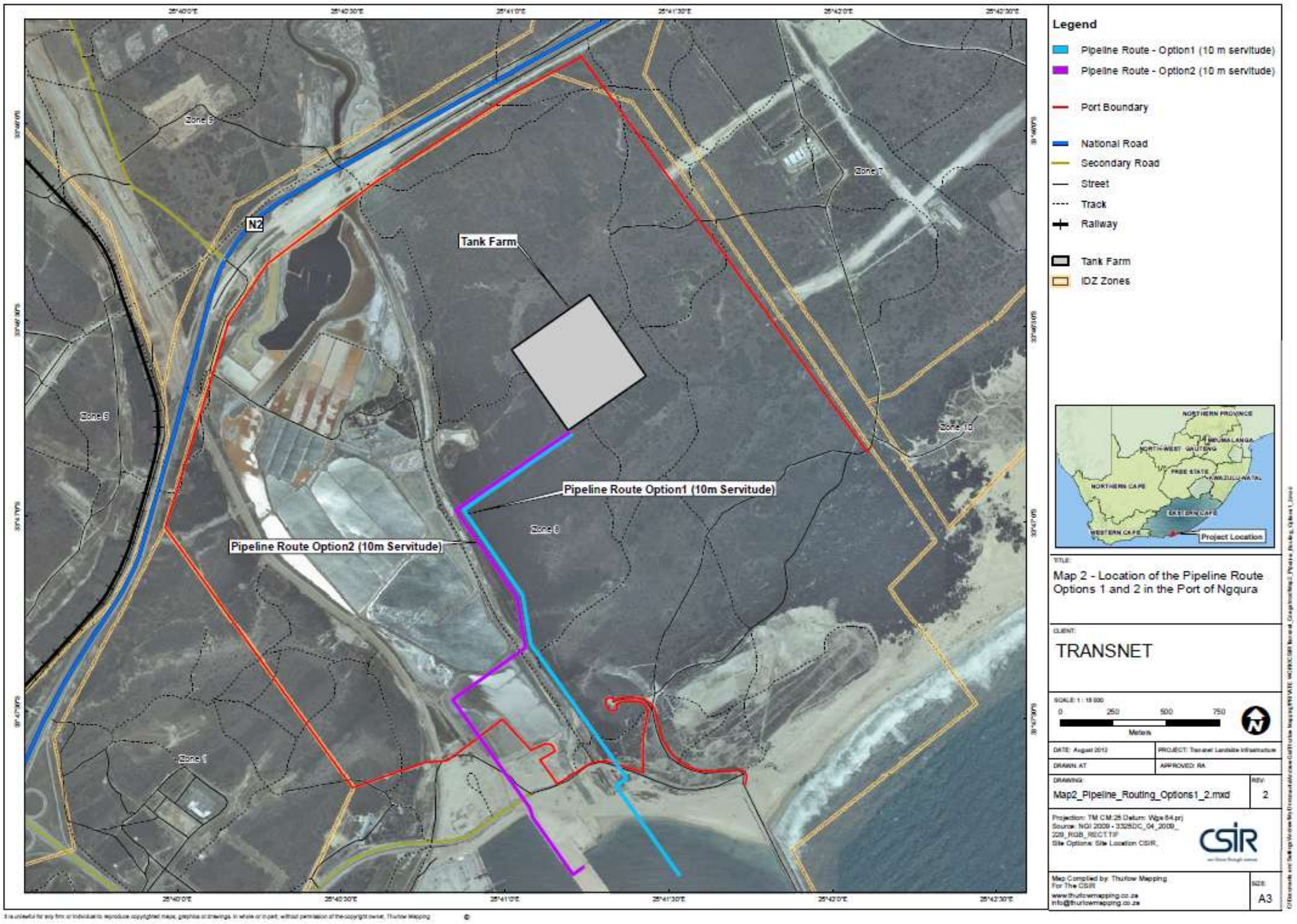

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Figure 14.3: Google Earth© satellite image of the OTGC tank farm study area (brown square) on the eastern side of the Coega River. The solid black circle shows the Stratotope D section of the Salnova Formation west of the Coega River. The dashed black circle indicated good exposures of fossiliferous Salnova sediments on the eastern bank of the estuary. Compare with Figure 14.2 for location of pipeline routes to existing or future berths in the port area.

14.1.1 Scope of Work

The scope of work for this palaeontological study is as follows:

- To prepare and undertake a desktop study on the fossil heritage of the proposed 20 hectare tank farm site, as well as the pipeline sites, based on:
  - review of all relevant palaeontological and geological literature, including geological maps and previous reports,
  - location and examination of fossil collections from the study area (e.g. museums),
  - data on the proposed development (e.g. location of footprint, depth and volume of bedrock excavation envisaged).
- To undertake a detailed field examination of representative natural and artificial exposures of potentially fossil-bearing sediments (rock outcrops, quarries, roadcuts etc) within or in the region of the development area.
- To record observed fossils and associated sedimentological features of palaeontological relevance (photos, maps, aerial or satellite images, GPS co-ordinates, and stratigraphic columns), and sample fossil material, where warranted.
- To carry out curation of any fossil material collected in an approved repository (usually a museum or geological survey collection).
- To undertake photography and provisional identification of fossils.
- To analyse the stratigraphy, age and depositional setting of fossil-bearing units.
- To specify the potential impacts, as well as cumulative impacts, of the construction, operational and decommissioning phases of the development on the palaeontological heritage within the study area.
- To identify and rate potential direct, indirect and cumulative impacts of the proposed project on the palaeontological heritage during the construction, operational and decommissioning phases of the project.
- To compile an illustrated, fully-referenced review of palaeontological heritage within the study area based on desktop study and new data from fieldwork and analysis.
- To identify and rank the highlights and sensitivities to development of fossil heritage within study area.
- To provide specific recommendations for further palaeontological mitigation (if any).
- To provide recommendations and suggestions regarding fossil heritage management on site, including conservation measures, as well as promotion of local fossil heritage (e.g. for public education, schools) to ensure that the impacts are limited.

14.1.2 Objectives of the Palaeontological Heritage Impact Assessment

The overall objectives of the specialist study are to:

- Determine the current conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured.
- Identify potential impacts that may occur during the construction, operational and decommissioning phases of development, as well as impacts associated with future environmental changes if the “no-go” option is implemented (both positive and negative).
- Assess the impacts, in terms of direct, indirect and cumulative impacts.
- Provide recommendations with regards to potential monitoring programmes.

- Determine mitigation and/or management measures which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts.
- Incorporate and address all issues and concerns raised by I&APs and the public.

The required end-product from this Paleontological Impact Assessment (PIA) is to identify any risk to palaeontological heritage that the OTGC tank farm project might pose and to suggest effective mitigation measures to mitigate or avoid such risks.

14.1.3 Approach to the Palaeontological Heritage Impact Assessment

This PIA report provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations for specialist palaeontological mitigation where this is considered necessary. This PIA report is based on:

1) a review of the relevant scientific literature, and in particular a recent comprehensive PIA for the Coega IDZ by the author (Almond 2010a; As mentioned previously, Zone 8 of the Coega IDZ was specifically excluded from this study);
2) published geological maps and accompanying sheet explanations;
3) a one-and-a-half-day palaeontological field assessment (19 - 20 May 2012) carried out by Dr. John Almond; and
4) the author's extensive field experience with the formations concerned and their palaeontological heritage.

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations etc.) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author's field experience (Consultation with professional colleagues as well as examination of institutional fossil collections may play a role here, or later following field assessment during the compilation of the final report).

This data is then used to assess the palaeontological sensitivity of each rock unit to development (Provisional tabulations of palaeontological sensitivity of all formations in the Western, Eastern and Northern Cape have already been compiled by Dr. John Almond and colleagues; e.g. Almond *et al*. 2008). The likely impact of the proposed development on local fossil heritage is then determined on the basis of:

1) the palaeontological sensitivity of the rock units concerned; and
2) the nature and scale of the development itself, most significantly the extent of fresh bedrock excavation envisaged.

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a Phase 1 field assessment study by a professional palaeontologist is usually warranted to identify any palaeontological hotspots and make specific recommendations for any mitigation required before or during the construction phase of the development.

On the basis of the desktop and Phase 1 field assessment studies, the likely impact of the proposed development on local fossil heritage and any need for specialist mitigation are then determined. Adverse palaeontological impacts normally occur during the construction rather than the operational or decommissioning phase. Phase 2 mitigation by a professional palaeontologist

normally involving the recording and sampling of fossil material and associated geological information (e.g. sedimentological data) may be required:

a) in the pre-construction phase where important fossils are already exposed at or near the land surface and/or
b) during the construction phase when fresh fossiliferous bedrock has been exposed by excavations.

To carry out mitigation, the palaeontologist involved will need to apply for a palaeontological collection permit from the relevant heritage management authority such as the Eastern Cape Provincial Heritage Resources Authority (ECPHRA). The contact details for the ECPHRA are provided in Appendix 14.A. It should be emphasized that, *providing appropriate mitigation is carried out*, the majority of developments involving bedrock excavation can make a *positive* contribution to our understanding of local palaeontological heritage.

14.1.4 Assumptions and Limitations

In inferring the palaeontological sensitivity of rock units underlying a development from field and other data obtained outside the study area it is assumed that fossil heritage is fairly uniformly distributed throughout the outcrop area of a given formation. Experience shows that this assumption does not always hold. This is because the original depositional setting across a formation that may extend over hundreds of kilometres may vary significantly, with palaeoecological implications (e.g. from a shallow to deeper water environment), while fossils are often patchy in their occurrence. Furthermore, the levels of tectonic deformation (folding, cleavage development etc.), as well as the intensity and nature of metamorphism and weathering experienced by a given formation may change markedly across its outcrop area. These factors may seriously compromise the preservation of fossil remains present within the original sedimentary rock.

In the case of the OTGC tank farm project study area a major limitation is the low level of bedrock exposure. However, in the author's opinion, field study of the available exposures within and along the margins of the study area as well as elsewhere within the Coega IDZ (e.g. Almond 2010a) has allowed an adequate assessment of palaeontological heritage resources relevant to the proposed development.

14.1.5 Specialist Expertise and Declaration of Independence

Refer to Appendix A of the Draft EIA Report for the Curriculum Vitae of Dr. John Almond, which highlights his expertise. The declaration of independence by the specialist is provided in Box 14.1 below.

BOX 14.1: DECLARATION OF INDEPENDENCE

I, John Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed OTGC Bulk Liquid Storage and Handling Project, application or appeal in respect of which I was appointed, other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

John E. Almond

DR. JOHN ALMOND

14.2 DESCRIPTION OF ASPECTS OF THE PROJECT THAT COULD RESULT IN IMPLICATIONS FOR FOSSIL HERITAGE RESOURCES

The proposed OTGC tank farm development is located in an area that is underlain by potentially fossil-rich sedimentary rocks of Mesozoic and younger, Tertiary or Quaternary age. The construction phase of the tank farm itself as well as the pipeline connection with the berth in the Port of Ngqura will entail major excavations into the superficial sediment cover as well as the underlying bedrock. In addition, substantial areas of bedrock will be sealed-in or sterilized by the tank farm as well as any new roads. All these developments may adversely affect potential fossil heritage within the study area by destroying, disturbing or permanently sealing-in fossils that are then no longer available for scientific research or other public good. Once constructed, the operational and decommissioning phases of the facility will not involve further adverse impacts on palaeontological heritage, however.

14.3 GEOLOGY AND PALAEONTOLOGY OF THE STUDY AREA

This general account of the geology of the broader study region has been abstracted from the recent PIA for the entire Coega IDZ by Almond (2010a) to which the interested reader is referred for further details, illustrations of relevant rocks and fossils, and comprehensive references.

The Coega IDZ is situated on the coastal plain inland of Algoa Bay some 20-25km to the northeast of Port Elizabeth, Eastern Cape Province. The area comprises a low-relief coastal plateau mantled by sand dunes along the coast and traversed by the shallow NW-SE valley of the Coega River and its tributaries (e.g. dry valley of the Brakrivier). The only prominent topographic feature is the rugged quartzitic hill of Coega Kop (146 m asl).

Apart from the modern coastal sand dunes, most of the Coega IDZ landscape is mantled by dense vegetation – primarily Mesic Succulent Sundays Thicket along the valley slopes and drier Coega Bontveld on the calcareous plateau. Natural exposures of bedrock are therefore confined to occasional erosional dongas and low limestone cliffs along the steeper Coega Valley sides, small craggy outcrops on Coega Kop, as well as narrow rocky benches, low calcareous sandy

cliffs and dunes in the coastal zone. Fresh exposures of the older geological units are for the most part only found in roadcuts, borrow pits, limestone quarries and clay-pits, as well as an extensive network of storm water channels and reservoirs. Most of these excavations have been made in recent years following the establishment of the Coega IDZ. Older excavations such as clay pits and limestone quarries, several of which have yielded important fossil material in the past, are in many cases already overgrown and difficult to access. Ongoing rehabilitation involving infilling of many of these excavations with rock waste, rubble and cleared vegetation further restricts opportunities to study the bedrock and to record fossils.

The geology of the Coega IDZ has been mapped at 1: 250 000 scale (sheet 3324 Port Elizabeth) and, more recently, at 1: 50 000 scale (sheets 3325DA Addo, 3325DC & DD, 3425 BA Port Elizabeth). Geological explanations to these maps, including brief palaeontological data, are provided by Toerien and Hill (1989) and Le Roux (2000) respectively. Older sheet explanations by Haughton (1928) and Engelbrecht et al. (1962) are also relevant, as is the unpublished report on the geology of the Coega IDZ by Goedhart and Hattingh (1997).

The Coega IDZ is underlain by a range of terrestrial, coastal and marine sedimentary rocks that extend from modern times back to the Early Ordovician Period, some 470 or so million years ago (Figures 14.1 and 14.4). These sediments are assigned to three major geological successions:

(1) the Early Palaeozoic **Table Mountain Group** comprising Ordovician (c. 450 Ma) fluvial sandstones and quartzites of the Peninsula Formation that are only seen at Coega Kop;
(2) the Mesozoic **Uitenhage Group** that was deposited within the Algoa Basin in a range of fluvial, estuarine and shallow marine settings during the Late Jurassic to Early Cretaceous Periods (c. 150-130 Ma); and
(3) the Late Caenozoic **Algoa Group** that accumulated along the coast of Algoa Bay over the last seven million years in estuaries, lagoons, rocky and sandy shores, and aeolian dune fields.

A rich fossil record has been found in several of the marine sedimentary formations found here, notably the Early Cretaceous Sundays River Formation, the Late Tertiary Alexandria Formation, and the Pleistocene Salnova Formation. The terrestrial formations tend to be far less fossil rich on the whole, but important fossil material – notably dinosaurs and plants in the Early Cretaceous Kirkwood Formation – may potentially be found here as well.

The distribution of outcrops of these various sedimentary formations are outlined in the published 1: 250 000 geological map sheet 3324 (Figure 14.1). Please note that modifications to this map are shown in the more recent and detailed 1: 50 000 scale geological maps listed above, a relevant extract from which is provided later on in this chapter in Figure 14.5.

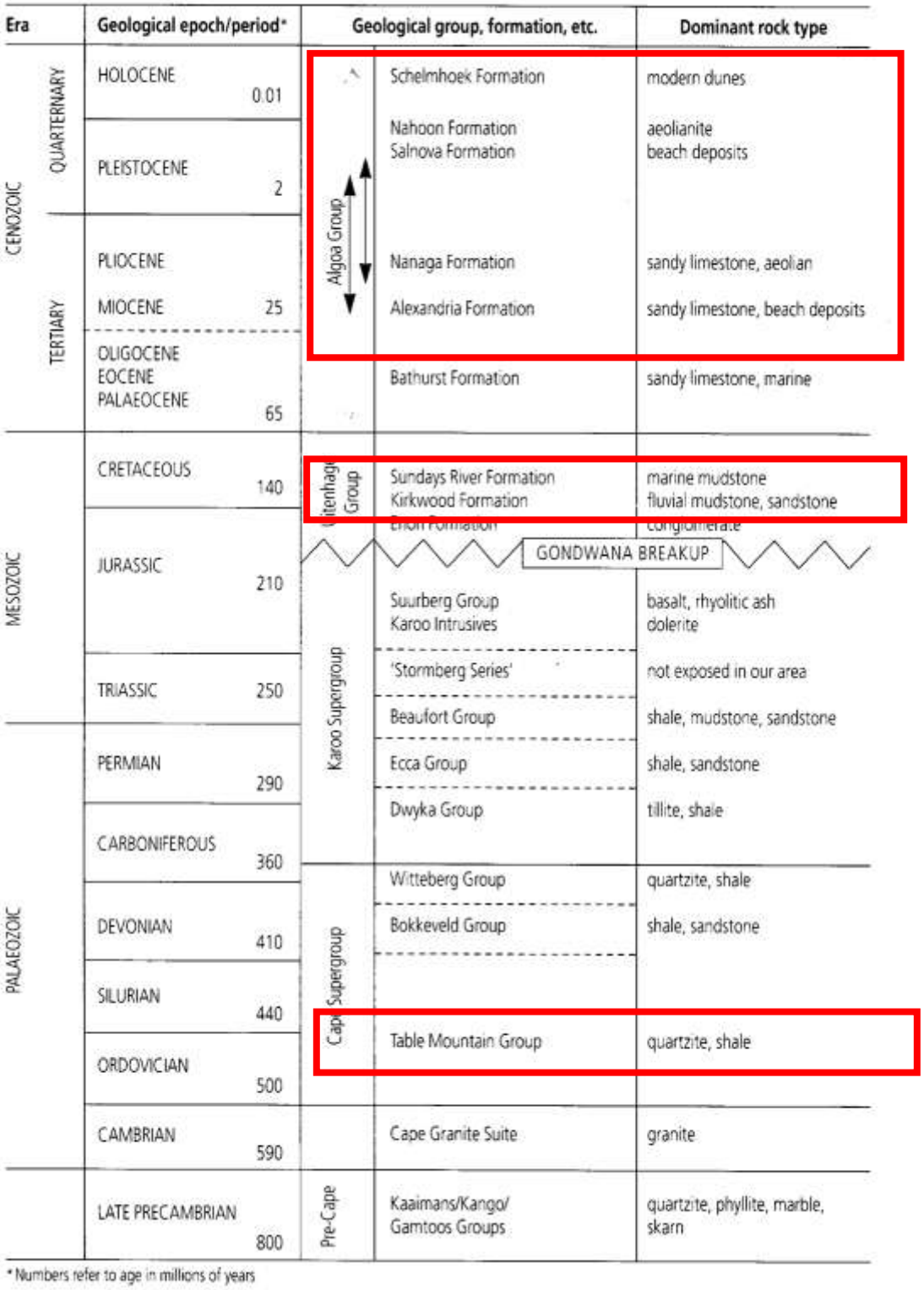


Figure 14.4: Stratigraphic table of geological units represented on the South Coast of the Eastern Cape (modified from Rust 1998). The three main sedimentary successions that occur within the Coega IDZ – the Table Mountain, Uitenhage and Algoa Groups - are outlined in red. Note that these successions are separated by significant time gaps of tens to hundreds of millions of years.

A short account of the geology of each of the main stratigraphic units represented within the Coega IDZ follows. This is abstracted from Almond (2010a) where further details and illustrations of each rock unit can be found.

14.3.1 Uitenhage Group

The **Kirkwood Formation (J-Kk)** comprises readily-weathered, silty overbank mudrocks and subordinate channel sandstones and pebbly conglomerates of fluvial origin and Early Cretaceous (Berriasian/Valanginian) age, i.e. around 140 Ma. Key geological accounts of the Kirkwood Formation include those by Rigassi & Dixon (1972), McLachlan & McMillan (1976), Tankard *et al*., (1982), Dingle *et al*., (1983) and Shone (2006).

The **Sundays River Formation (Ks)** is of Early Cretaceous (Valanginian-Hauterivian) age, i.e. around 136 Ma. It comprises a thick (up to 2km) succession of grey sandstones, siltstones and finer-grained mudrocks that are often highly fossiliferous (Shone 2006). Depositional settings range from estuarine through littoral (shoreline) to marine outer shelf (McMillan 2003). Key geological accounts of the Sundays River Formation include those by Du Toit (1954), Rigassi & Dixon (1972), Winter (1973), McLachlan & McMillan (1976), Tankard *et al*. (1982), Dingle *et al*., (1983), McMillan (2003) and Shone (1976, 2006).

14.3.2 Algoa Group

This estuarine to coastal marine **Alexandria Formation (Ta)** consists of a basal conglomerate rich in oyster shells overlain by calcareous sandstones, shelly coquinas and thin conglomerates. It represents a composite product of several marine transgression (invasion) / regression (retreat) cycles across the Algoa coastal plain in Late Miocene-Pliocene times, i.e. roughly around 7-5 Ma ago (Maud & Botha 2000, Roberts et al. 2006). The Alexandria Formation overlies a series of marine terraces incised into older (mainly Cretaceous) rocks in the hinterland of the Algoa Basin - the lower seawards Coega Plateau and the higher, landwards Grassridge Plateau (Ruddock 1968, Goedhart and Hattingh (1997). The Alexandria Bay Formation ranges from three to 13 m in thickness, with an average of 9 to 10 m (Le Roux 1987b, Goedhart and Hattingh, 1997).

Geologically recent karstic (ie solution) weathering of the lime-rich Alexandria Formation has led to the development of pebbly, reddish-brown residual soils over much of the inland outcrop area of the Alexandria Formation (Maud & Botha 2000). This was formerly identified as a separate, bipartite fluvial unit of Plio-Pleistocene age with calcrete horizons that was named the **Bluewater Bay Formation** (Le Roux 1987c, 1989a). This unit is mapped as such (**T-Qb**) on the 1: 250 000 Port Elizabeth geology sheet but not on the later 1: 50 000 scale geological maps where it is indicated as pedogenic gravels overlying the Alexandria Formation (circular symbols). Incised “channels” cutting into the Alexandria Formation and infilled with cross-bedded coarse “Bluewater Bay” gravels are illustrated by Le Roux (1989a). Maud and Botha (2000) suggest that these surface deposits comprise a composite of in situ karstic weathering products (including coarse solution-hollow infills) as well as fluvial sediments of late Neogene age. Goedhart and Hattingh (1997) have developed an explanatory scheme showing how residual pebbly and sandy weathering products of the Alexandria Formation infill solution cavities within the calcretised limestones following periods of humid climate leaching. The superficial “Bluewater Bay” deposits

average 1.2m in thickness, but this varies greatly due to the presence of numerous incised channel-fill and solution pipe structures up to 7m deep (Le Roux 1987c, 1989a, 2000).

Coastal aeolianites (ancient, wind-blown dune sands) of the **Nanaga Formation (T-Qn)** of Pliocene to Early Pleistocene age crop out extensively to the west and east of Port Elizabeth (Le Roux 1992). They have recently been mapped along the coast of the Coega region (not shown in earlier 1: 250 000 maps, cf Figures 14.1 and 14.5). The Nanaga beds comprise calcareous sandstones and sandy limestones that often display large scale aeolian cross-bedding. They may reach thicknesses of 150m or more (Maud & Botha 2000). The Nanaga aeolianites are normally partially to well-consolidated, although unconsolidated sands also occur west of Port Elizabeth (Le Roux 2000). The upper surface of the aeolianites weathers to calcrete and red, clay-rich soil, and the dune sands themselves may be profoundly reddened. The age of the palaeodunes decreases towards the modern coastline, reflecting marine regression (relative sea level fall) during the period of deposition. The oldest outcrops located furthest from the modern coast are the most elevated, having experienced some 30m of uplift in the Pliocene, and may even be Miocene in age (Roberts et al., 2006). Typically the ancient dunes are preserved as undulating ridges of rounded hills trending parallel to the modern shoreline (Le Roux 1992).

The **Salnova Formation (Qs)** in the Coega IDZ study area comprises a spectrum of poorly consolidated to well-indurated intertidal deposits, including beach sands, coquinites (= shell hash), shell-rich gravels and pebbly to bouldery conglomerates. These marine rocks typically crop out along the modern coast at low elevations - less than 18m amsl according to Le Roux (1991). Intraformational clasts of older Algoa Group coquinite and conglomerate are much commoner than in the older Alexandria Formation. Finer-grained estuarine and lagoonal sediments are also found, such as the stratotype D locality designated by Le Roux (1991) near Salnova saltworks in the Coega estuary area (Portnet land, Coega Zone 8). The Salnova sediments were formed during a series of several Mid to Late Pleistocene transgressions. Some authors now extend the scope of this formation to include shoreline sediments of post-Pleistocene (Holocene) age. These include shell-rich cobbly and bouldery beds up to 2-3m amsl that may reflect the Mid Holocene highstand (= sea level peak) of 4000 to 3000 BP. Along the Coega IDZ coast the Salnova beds overlie the Uitenhage Group and are generally overlain by aeolianites of the Nahoon and / or Schelm Hoek Formations.

The near-coastal **Nahoon Formation (Qn)** consists of well-consolidated calcareous aeolianites with sporadic, thin calcretes and palaeosols (ancient soil horizons) that are assigned a Mid to Late Pleistocene age (Le Roux 1989b). Several cycles of dune deposition separated by palaeosols may be represented and large scale aeolian cross-bedding is preserved in some areas. The high level of cementation contrasts with generally poorly-consolidated older and younger dune sands of the Nanaga and Schelm Hoek Formations respectively, while deep orange-red hues as often displayed by the Nanaga sands are not present here. The Nahoon Formation usually overlies a wave-planed surface that cuts across bedrock of the Cape Supergroup or Uitenhage Group. The Nahoon beds may in turn be cut by a Late Pleistocene (Eemian, c 120 000 BP) wave-cut platform and overlain by unconsolidated Holocene dune sands.

Modern aeolian calcareous sands of the **Schelm Hoek Formation (Qsc)** build currently active dunes of Holocene age along the South Coast (Illenberger 1992, Le Roux 2000). Deposition

probably started during regression from the Mid Holocene transgressive maximum (i.e. the Flandrian transgression of 2-3m amsl at 4000-3000 BP). The dune sands may be up to 140m thick with an average of 30m, and extend up to 6km from the coast. Active sand dunes near the coast are unvegetated while those further inland are stabilized by dense dune thicket. In addition to unconsolidated, well-sorted, calcareous aeolian sands the Schelm Hoek Formation contains abundant shell middens of the Late Stone Age (Roberts et al., 2006, Webley & Hall, 1998). Palaeosols (ancient soil horizons) and peats are absent according to Le Roux (2000) whereas Illenberger (1992) as well as Goedhart and Hattingh (1997) record the presence of fossil soils. These Holocene dune deposits may be semi-consolidated at depth, and difficult to distinguish from the generally better cemented Nahoon Formation aeolianites.

14.3.3 Caenozoic Fluvial Deposits

A variety of **Late Tertiary to Recent fluvial deposits (T-Qk etc)** is preserved along the margins of the Coega River Valley in the study area. Detailed accounts have been provided by Hattingh (1994, 1996), Goedhart and Hattingh (1997) and Hattingh and Goedhart (1997). The fluvial sediments range from "High Level Gravels" of Miocene/Late Pliocene age situated on elevated terraces (60-15m asl) through to finer-grained alluvial sands and silts of Pleistocene/Holocene age close to modern river levels (10-2m asl; Goedhart & Hattingh 1997, Le Roux 2000). In the Coega Valley terrace sediments are up to 4m thick. The highest of the river terrace gravels on the western side of the lower Coega River valley, at +60m asl and 2km to the west of the present river course, has been correlated with the +90m sea level highstand and thereby dated to the Late Pliocene (Goedhart & Hatting 1997, p. 23). This suggests that the Coega River is quite a young drainage system that has developed quickly in the recent geological past due to the low weathering resistance of the Uitenhage Group rocks in the drainage basin.

14.3.4 Geology and Palaeontological Heritage in Zone 8 of the Coega IDZ (Study area)

An outline of the known fossil record of each major geological unit that is mapped within the study area, as listed in the preceding section of this chapter, is provided in Table 14.1. This table is abstracted from the recent general review of Coega IDZ palaeontology by Almond (2010a) where further information, illustrations of typical fossils and extensive references to the relevant palaeontological literature can be found. Brief, illustrated overviews of Eastern Cape fossil heritage are provided by Rust *et al*. (1998), MacRae (1999) and Almond *et al*. (2008). Provisional identifications of Late Caenozoic marine molluscs encountered in the study area were made using the well-illustrated account of South African sea shells by Kilburn and Rippey (1982). Only a small selection of the rich variety of shelly taxa present in these beds is mentioned by name in this report.

An indication of the overall sensitivity to development of each stratigraphic unit as well as recommended mitigation in each case is given in Table 14.1. Note that, despite its rich recorded fossil heritage in the Eastern Cape, specialist palaeontological mitigation of excavations into the Alexandria Formation is not regarded as invariably necessary unless the beds concerned prove to be fossiliferous. This is because most shallow excavations into Alexandria Formation limestones in the Coega IDZ are likely to encounter highly calcretised sediments whose original fossil content has been largely destroyed by diagenesis (Almond 2010a).

A brief account of geological and palaeontological observations made during the field assessment of the OTGC tank farm and associated pipeline study areas is given below. GPS data for numbered localities mentioned in the text are provided in the Appendix 14.B. The background data presented here is largely based on the recent palaeontological study of the Coega IDZ by Almond (2010a) as well as a number of subsidiary PIAs for separate developments within the area by the author (Almond 2008a, 2008b, 2010b, 2010c, 2010d). A key earlier report on the geology of the Coega River Mouth was produced by Goedhart and Hattingh (1997). An extract from the 1: 50 000 geological map of the Port Elizabeth area published by the Council for Geoscience, Pretoria is presented in Figure 14.5, showing the geology of Zone 8 of the Coega IDZ. Note that the 1: 50 000 geological maps modify and update the older 1: 250 000 map shown in Figure 14.1, but recent extensive construction in the Ngqura Port area has considerably modified the topography close to the Coega River mouth (Compare with the 2011 satellite image, Figure 14.3).

The OTGC tank farm study area within Zone 8 of the Coega IDZ (previously farm Coegas Mouth 303) lies on flat to gently sloping ground (c. 20-35m amsl) to the south of the N2 trunk road, some 600m east of the Coega River and 1 km west of the new Cerebos buildings at Sonop (Figure 14.3). The area is densely vegetated with shrubby and grassy vegetation (Coega Bontveld, a form of Albany Thicket) and mantled with superficial sediments (calcrete hard pans plus various sandy soils) so bedrock exposure is very limited indeed (Figure 14.6). Most of the best exposures of the various geological units represented within Zone 8 are found in the eastern banks of the Coega River estuary.

Table 14.1: Fossil heritage of sedimentary formations occurring within Zone 8 of the Coega IDZ, Eastern Cape Province (from Almond 2010a)

FOSSIL HERITAGE OF SEDIMENTARY FORMATIONSOCCURRING WITHIN THE COEGA IDZ, THE EASTERN CAPE			
FORMATION & AGE	**FOSSIL HERITAGE**	**PALAEONTOLOGICAL SENSITIVITY**	**RECOMMENDED MITIGATION FOR NEW DEVELOPMENTS**
RIVER TERRACE GRAVELS (T-Qk) & ALLUVIUM **Miocene to Recent river deposits**	possibly rare rolled bones, freshwater molluscs, plant remains	LOW	mitigation not required - *unless* rich fossil assemblages exposed during excavation
SCHELM HOEK FORMATION (Qsc) **Holocene – Recent calcareous dune sands**	land snails, land vertebrate bones, peats & root casts, shell middens, LSA stone tools	LOW	mitigation not required - *unless* rich fossil assemblages exposed during excavation
NAHOON FORMATION (Qn) **Mid to Late Pleistocene calcareous dune sands**	common land snails, calcretised root casts, peats, termitaria, sparse MSA stone tools	LOW	mitigation not required - *unless* rich fossil assemblages exposed during excavation
SALNOVA FORMATION (Qs) **Mid Pleistocene to Recent** **coastal and estuarine sediments**	very rich shelly invertebrate faunas, especially molluscs but also several other groups, such as crustaceans & echinoids, possible rare vertebrate bones	HIGH	**excavations (especially those into fine-grained mudrocks) to be examined and sampled by professional palaeontologist while fresh bedrock is still exposed**
NANAGA FORMATION (T-Qn) **Pliocene – Early Pleistocene** **calcareous dune sands**	common land snails, calcretised root casts, possible termitaria	LOW	mitigation not required - *unless* rich fossil assemblages exposed during excavation
"BLUEWATER BAY FORMATION" **residual weathering product of Alexandria Fm**	rare fossil shells weathered out from underlying limestones *plus* land snails, freshwater mussels	LOW	mitigation not required - *unless* rich fossil assemblages exposed during excavation
ALEXANDRIA FORMATION (Ta) **Miocene – Pliocene** **shallow marine to estuarine sediments**	very rich shelly invertebrate faunas, especially molluscs but also several other groups, sharks teeth, possible rare vertebrate bones	LOW TO HIGH rich shelly faunas only found at some localities fossil shells often destroyed by deep weathering, calcrete formation, especially in near-surface sections	mitigation not required - *unless* rich fossil assemblages exposed during excavation
SUNDAYS RIVER FORMATION (Ks) **Early Cretaceous** **marine to estuarine/intertidal mudrocks and sandstones**	rich variety of marine molluscs (bivalves, ammonites *etc*) and other invertebrates v. rare marine reptiles (plesiosaurs)	MODERATE TO HIGH most shelly fossils associated with thin sandstones	**substantial (high volume) excavations to be examined and sampled by professional palaeontologist while fresh bedrock is still exposed**
KIRKWOOD FORMATION (J-Kk) **Early Cretaceous fluvial to estuarine mudrocks and sandstones**	rare dinosaurs, petrified wood, plants (esp. gymnosperms), charcoal, freshwater crustaceans & molluscs	MODERATE TO HIGH fossils generally sparse but may be concentrated at certain horizons (*eg* ancient soils, flood deposits)	**substantial (high volume) excavations to be examined and sampled by professional palaeontologist while fresh bedrock is still exposed**

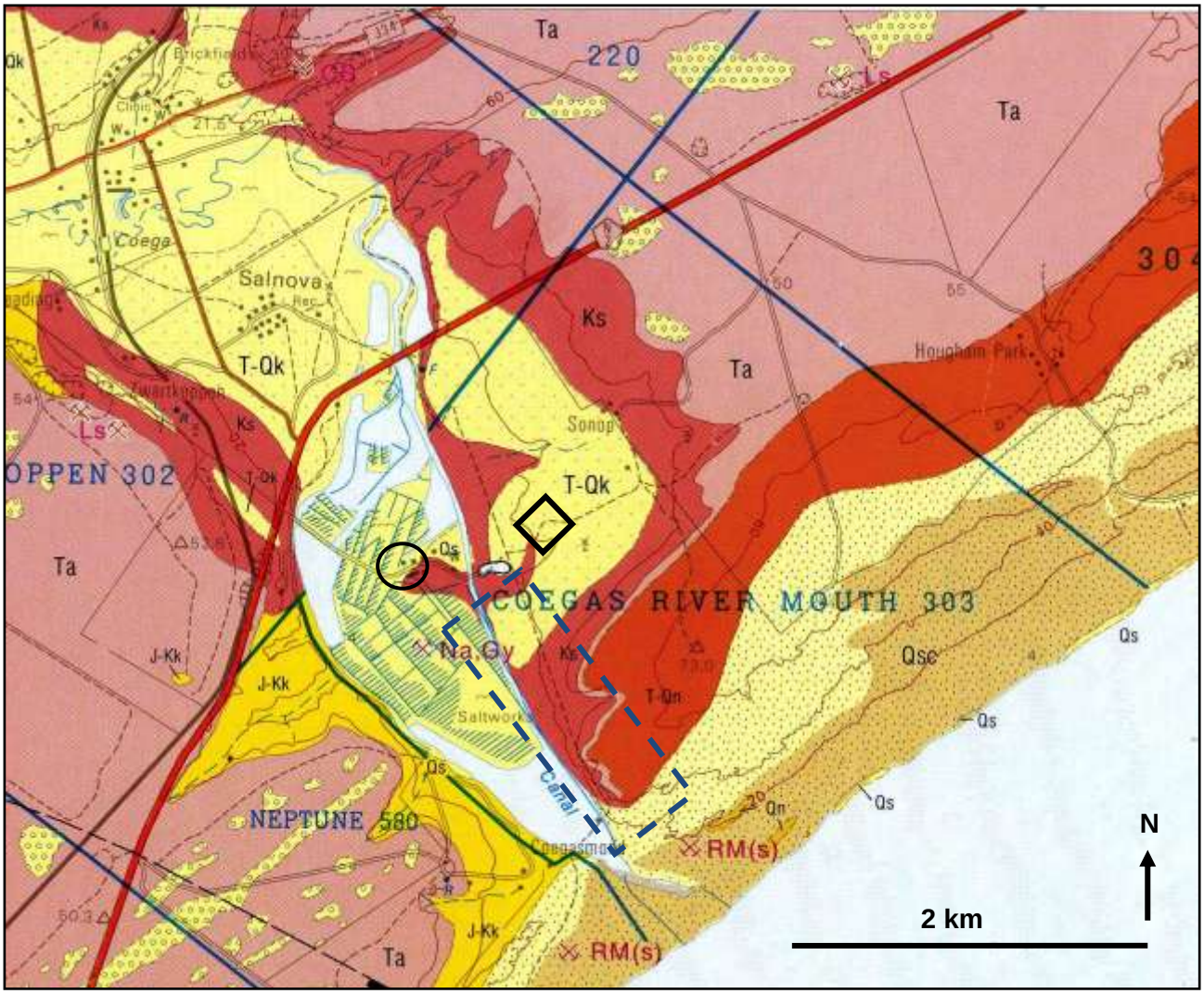


Figure 14.5: Abstract from 1: 50 000 geological map 3325DC & DD, 3425BA Port Elizabeth (Council for Geoscience, Pretoria; Le Roux 2000) showing the geology of the Coega River estuary region, including Coega IDZ Zone 8 to the east of the river. The approximate location of the proposed OTGC tank farm development is indicated by the black square (size exaggerated). The study area for the pipeline connection between the tank farm and the port is indicated approximately by the blue dashed rectangle. Please note that this map was produced before construction of Port of Ngqura.

The main geological units shown in Figure 14.5 include the Sundays River Formation (pinkish red, Ks), the Kirkwood Formation (dark yellow, J-Kk), the Alexandria Formation (pink, Ta), residual soils overlying the latter, previously known as the Bluewater Bay Formation (medium yellow with large dots), Tertiary to Quaternary fluvial deposits (pale yellow with dots, T-Qk), the Nahoon Formation (orange, T-Qn), the Salnova Formation (medium yellow, Qs), and the Schelm Hoek Formation (pale brown or pale yellow, stippled, Qsc).

Palaeontologically sensitive portions of the study area include:

1) the outcrop area of the Sundays River Formation (this extends at depth beneath the tank farm footprint) as well as;
2) a zone along the eastern bank of the Coega River estuary within 18m amsl where Pleistocene shells beds of the Salnova Formation occur.

The Salnova Formation Stratotype D section near the Salnova Saltworks is shown by the black circle (Refer also to Figure 14.7).

Figure 14.6: View south-westwards across the OTGC tank farm study area in Zone 8 towards the Port of Ngqura. Note thicket-covered lower-lying area to the west (RHS) and higher-lying, flat-topped coastal platform capped by Alexandria Formation to the south (LHS).

According to the 1: 50 000 geological map (Figure 14.5), the portion of Zone 8 of the Coega IDZ east of the Coega River estuary is underlain at depth by recessive weathering marine sediments of the **Sundays River Formation** (Ks), in contrast to the somewhat older **Kirkwood Formation** (J-Kk) bedrocks on the west side of the river. The Uitenhage Group rocks here are capped by **Alexandria Formation** "coastal limestones" that overlie a wave-cut platform at around 40 to 50m amsl. This almost flat-lying coastal platform is well seen to the south and southeast of the tank farm study area which is situated at a lower elevation with a shallow embayment eroded into the relative soft Sunday River mudrocks on the east side of the Coega River estuary (Figure 14.6). The Alexandria Formation forms a prominent-weathering cliff or krans overlooking the mouth of the estuary which is overlain by downwasted gravels derived from the underlying pebbly limestones (the so-called Blue Water Bay facies of earlier authors) and then by Plio-Pleistocene aeolianites of the **Nanaga Formation** (T-Qn). These older aeolianites form a subdued ridge up to 73m amsl parallel to the modern coastline and inshore of the modern dune sands of the

Schelm Hoek Formation (Qsc). Small relict patches of Mid to Late Pleistocene aeolianites of the **Nahoon Formation** (Qn) are mapped just east of the Coega River mouth but these have probably been destroyed by later development connected with Ngqura Port (see large, extensively disturbed area here on satellite images, Figure 14.3). The floor of the Coega estuary is mantled by **Late Tertiary to Recent estuarine muds, sands and gravels** (T-Qk). Of particular geological and palaeontological interest is a small area of Quaternary coastal conglomerates, sands and marine shell beds of the **Salnova Formation** (Qs), named after the small settlement located within the estuary just north of the N2. The formally established Stratotype D section of the Salnova Formation occurs in the vicinity of the older salt works just west of the Coega River and extends onto the eastern bank of the river about half a kilometre west of the OTGC tank farm study area (Figures 14.5 and 14.7). During the present field study shelly sediments of the Salnova Formation were traced southwards down the eastern bank of the Coega River.

The 1: 50 000 geological map indicates Late Caenozoic fluvial deposits (T-Qt) in the OTGC tank farm study area. However, during fieldwork this area is seen to be mantled with a pale grey calcrete hardpan overlain by thin buff to reddish-brown soils. Vermicular hollows within the calcrete probably reflect moulds of plant rootlets. Larger oval concentric structures infilled with sandy calcrete may be related to megarhizoliths or root systems of dune shrubs such as have been recorded from the Nanaga Formation within the Coega IDZ (Almond 2010) (Figure 14.8). The calcretes are often mantled with sparse to concentrated, poorly sorted gravels of pebble- to cobble-sized clasts. Dominant clast types include well-rounded to subangular Table Mountain Group quartzites (sometimes flaked, e.g. MSA), brownish sandstones (probably Uitenhage Group), rare vein quartz, and calcrete rubble. Some of this coarse material may have been emplaced as alluvium or sheet wash by surface flow from the edge of the surrounding, higher-lying coastal plateau, but direct evidence for fluvial deposition was not seen. Downwasting of pre-existing Alexandria Formation pebbly limestones is another possible source of gravel material. The overlying buff sandy soils contain sparse calcrete and quartzite gravels. Reddish or orange-brown, semi-consolidated older sands that are locally interposed between the calcrete and unconsolidated buff sands contain tortoise remains, terrestrial snails (e.g. *Tropidophora*), flaked quartzites (probably MSA) and calcrete gravels. They are tentatively correlated with the Plio-Pleistocene Nanaga Formation. The stratigraphic assignment of the underlying calcretes is unresolved; they may represent calcretised aeolianites or marine sands of Pleistocene age.

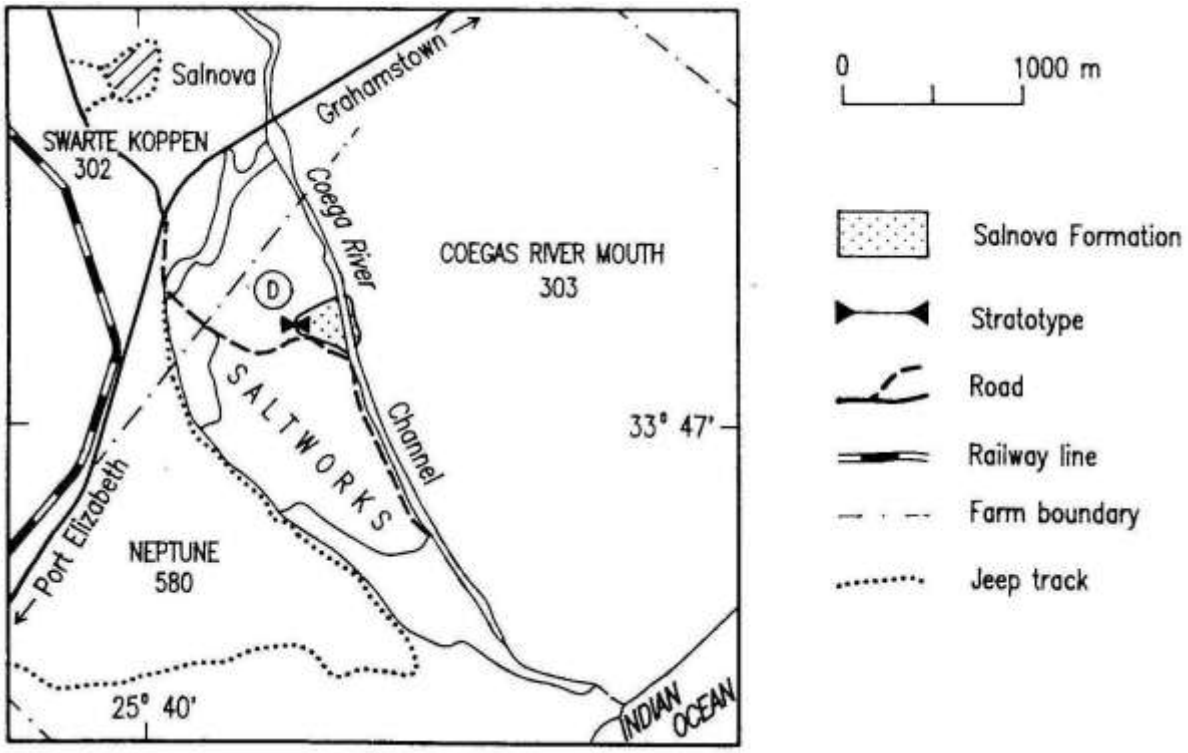


Figure 14.7: Location of the formally established Stratotype D section of the Salnova Formation close to the Coega River (From Le Roux 1991). The Salnova Formation outcrop area in fact extends down the eastern bank of the Coega River.

Figure 14.8: Large oval concentric structure within surface calcretes, close to the OTGC study area (Location 553) (Hammer = 29 cm). These structures may be diagenetic phenomena related to the root systems of dune shrubs.

Figure 14.9: Indeterminate marine shell fragments embedded within surface calcretes to the west of the OTGC study area at c. 13m amsl (Location 557) (Scale in cm and mm).

Figure 14.10: Intact, well-articulated bivalves (mainly Loripes, Tellina) washing out from silty sands of the Salnova Formation at Location 560.

To the west of the OTGC tank farm study area the ground slopes down to the Coega River estuary. Grey to buff sands and calcretes at Locations 557 and 558 at c. 13 and 10m amsl respectively contain marine shell fragments and articulated bivalves (e.g. *Loripes clausus*), occasional well-rounded quartzite cobbles, flaked quartzite artefacts, as well as terrestrial snail shells (e.g. *Tropidophora*) (Figure 14.9).These elevations fall within the range of the Salnova Formation (0 to 18m amsl). Mixed terrestrial and marine shell assemblages are also recorded from the Pleistocene aeolianites of the Nahoon Formation along the coast of the Coega IDZ (Almond 2010). Closer to the river (Location 560, c. 2m amsl) greyish buff sandy silts contain abundant disarticulated to articulated bivalves (mainly *Loripes*, accompanied by *Tellina*) and gastropods (*Cerithium*) (Figure 14.10). These Pleistocene estuarine shelly faunas can be assigned to the Salnova Formation.

Good exposures of a several meter thick succession of pale, greyish-buff silty sands, silts and conglomerates of the Salnova Formation are seen around the margins of a pan or dam at the edge of the Coega River about half a kilometre west of the OTGC tank farm study area (Location 562; and Figures 14.11 and 14.12). Here are seen dense storm accumulated shell beds dominated by the estuarine bivalve *Loripes clausus* accompanied by numerous other shelly taxa such as the common small gastropod *Cerithium scabridum*, patellid limpets, razor shells (*Solen capensis*), and a range of bivalves (e.g. *Tellina* sp., inflated shells of *Anodontia edentula*, *Venus verrucosa*) (Figures 14.13 to 14.15). Shells range from fully articulated to disarticulated or comminuted, and often show round borings of predatory naticid gastropods. Many show signs of etching, perhaps related to high salt content of the estuarine sediments. The shell beds and conglomeratic lenses contain numerous pebbles and cobbles of TMG quartzites (often showing impact crescents, some flaked) as well as shelly limestones that have probably been reworked from the older Alexandria Formation. Locally the silty sediments contain abundant calcrete nodules. Expected exposures of Sundays River Formation rocks in the neighbourhood could not be traced.

Figure 14.11: Buff silty sands of the Salnova Fomation close to the east bank of the Coega River showing lenticles of pebbly and cobbly conglomerates (Hammer = 29 cm) (Location 562).

Figure 14.12: Lenticle of Salnova Formation shelly coquina dominated by the estuarine bivalve Loripes (Location 562) (Hammer = 29 cm).

Figure 14.13: Intact and fragmentary shells of various bivalves (Loripes, Tellina) and limpets (Location 562) (Scale in cm and mm).

Figure 14.14: Well-preserved Salnova Formation bivalves (Solen capensis, Anodontia edentula, Loripes clausus) at Location 562 (Scale in cm and mm).

Figure 14.15: Semi-consolidated Salnova Formation silty sands with strongly ribbed shells of the bivalve Venus verrucosa (Scale in cm) (Location 562).

Shell-rich sands of the Salnova Formation are also exposed in low cliffs along the eastern banks of the Coega River estuary to the south of the dam described above, which is located close to the Stratotype D type section. At Locations 564 and 565 and further south grey silty sands with occasional TMG pebbles and cobbles, as well as reworked shelly limestone, contain a variety of Pleistocene shelly fauna including abundant *Cerithium* gastropods, *Loripes clausus*, elongate-shelled oysters (*Crassostrea*), small pinkish-shelled oysters, trochid "top shells" (*cf Calliostoma*), and razor shells (*Solen capensis*) (Figure 14.16). Larger subfossil taxa washed out onto the riverbanks include large cymatid gastropods (possibly *Ranella*), *Strombus*, and coral-like, annulated, tubiculous skeletons of the estuarine serpulid *Ficopomatus enigmaticus* (possibly a Recent specimen). In addition the sands contain occasional terrestrial snail shells and flaked quartzite artefacts. The shell-rich Salnova beds are overlain by reddish sandy soils with terrestrial gastropods but few marine shells, above which are buff-brown younger sands with land snails and millipede exoskeletons (Figure 14.17). Non-reddened aeolian sands with an admixture of terrestrial snails, occasional marine shells and MSA quartzite artefacts might be correlated with the Nahoon Formation as seen elsewhere along the Coega IDZ coastline (Almond 2010).

Figure 14.16: Small gastropods (Cerithium) and oysters (Crassostrea) eroding out of the Salnova Formation forming low cliffs along the eastern banks of the Coega River (Location 564) (Scale in cm).

Figure 14.17: Reddish-weathering aeolianites, possibly of the Nanaga Formation, with abundant subfossil snail shells exposed along the eastern banks of the Coega River where they overlie Salnova Formation deposits rich in marine shells (Location 365) (Hammer = 29 cm).

Figure 14.18: Reworked estuarine gravels along the margin of the Coega River including pebbly and shelly limestones of the Alexandria Formation and thick-shelled bivalves from the Sundays River Formation (Location 566) (Scale in cm).

Figure 14.19: Raised storm beach composed mainly of blocks and boulders eroded from the Sundays River Formation (Location 568) (Hammer = 29 cm).

Gravel bars observed along the margin of the Coega River (Locations 566 and 567) are predominantly composed of pebbles and cobbles of TMG quartzites (many probably reworked from the Alexandria Formation) as well as brownish sandstones of the Uitenhage Group, calcareous shelly grits (Alexandria Formation) and grey limestones or calcretes. Occasional fragments of thick-walled oyster shells probably belong to the genus *Aetostreon* reworked from the Cretaceous Sundays River Formation (Figure 14.18). A raised storm beach is seen just above modern sea level at Location 568 close to the port area an may be associated with the mid-Holocene sea level highstand. It mainly consists of poorly-sorted blocks and boulders of greenish Uitenhage Group (probably Sundays River) sandstones (Figure 14.19).

A large area of the near-coastal interior region to the east of the Coega River mouth has already been extensively disturbed by large scale excavations and earth moving activities (large pale area in Figure 14.2). To the author's knowledge, a comprehensive palaeontological heritage impact assessment of these large-scale developments related to the Ngqura Port has not been conducted (*cf* De Klerk 2007). The stratigraphy of the bedrocks and superficial sediments here is correspondingly difficult to reconstruct. *In situ* and disturbed, colour-banded, reddish-brown siltstones and olive-green sandstones probably belong to the Kirkwood Formation, but Sundays River beds might also be represented here. No Cretaceous marine shells were observed, however. It did not prove possible to relocate the small relict patches of Nahoon Formation aeolianites shown on the 1: 50 000 geological map; these may have been destroyed during development.

The Salnova Formation in this area is represented at low elevations by impressive blocks of coarse storm beach conglomerates with very well-rounded pebbly to boulder clasts – mainly of Table Mountain Group quartzites, but also minor dark sandstones – embedded in a well-consolidated calcareous sandy matrix that also contains occasional marine shells (Figure 14.20). Rich marine shell assemblages of Pleistocene aspect were also recorded on the south-facing slopes of the coastal platform at elevations of around 35 to 45m amsl – anomalously high for the Salnova Formation that is normally restricted to within 18m of present day sea levels. Shelly lenses and horizons at Locations 574, 575 and 576 are embedded in slightly pinkish to buff, well- to poorly-consolidated sandstones that also contain locally abundant, subangular to well-rounded pebble to cobble clasts of quartzite (occasionally flaked, supporting a Pleistocene or younger age), olive-brown sandstone, as well as sandy, pebbly and/or shelly calcretes (Figure 14.21). The shells vary from intact (disarticulated or articulated) to fragmentary and appear to be storm beach accumulations. Among the many marine taxa represented are barnacles, fragmentary *Echinodiscus* pansy shells (flat sand dollar-type sea urchins), barnacles, bivalves such as *Dosinia*, *Solen capensis* (razor shells), *Venus verrucosa*, *Mactra*, ribbed *pectinoids*, lots of white mussels (*Donax*) and thick-shelled large oysters, the small gastropod *Nassarius* and a narrow, high-spired form, possibly a species of *Terebra* (Figures 14.22 and 14.23). Many of the shells show predatory gastropod borings. There is also an admixture of terrestrial snail shells (e.g. *Trigonephrus, Achatina*), as seen elsewhere within Pleistocene coastal sediments in the Coega IDZ. The age and stratigraphic assignation of these Salnova-like shelly assemblages at high elevations require confirmation.

Figure 14.20: Displaced block of well-consolidated boulder beach conglomerate of the Salnova Formation (Hammer = 29 cm).

Figure 14.21: Storm-accumulated shell beds and conglomerates at anomalously high elevations to the east of the Ngqura Port area (Locations 574 - 576) (Hammer = 29 cm).

Figure 14.22: Detail of shell beds seen in previous figure showing diversity of molluscan taxa (Tellina, Solen, Loripes, oysters, Nassarius etc) (Scale in cm and mm).

Figure 14.23: Less common elements of the Salnova Formation shell beds seen in Figure 14.21 such as fragments of pansy shell (Echinodiscus, 4.5cm across) and isolated barnacle plates.

Figure 14.24: Thin-bedded cross-bedded calcarenites of the Alexandria Formation capping the coastal platform east of Ngqura Port (Location 537) (Hammer = 29 cm).

Figure 14.25: Downwasted cobbles and boulders (mainly well-rounded quartzites) of the "Bluewater Bay" facies overlying the Alexandria Formation on the outer coastal platform (Hammer = 29 cm).

Marine coastal limestones of the Alexandria Formation form a prominent scarp at 40-50m amsl facing westwards over the port area at Location 537. Here several meters of thin-bedded, often cross-bedded and locally pebbly, calcarenites (extensively lichen-covered) overlie a wave-cut platform etched across bedrocks of the Uitenhage Group (Figure 14.24). Where exposed from beneath the cover of Nanaga aeolianites the upper surface of the Alexandria Formation features abundant well-rounded, downwasted pebbles and cobbles of Table Mountain Group quarztites, blocks of reworked calcarenite, and shelly fragments (e.g. Location 538, Figure 14.25). This is the "Bluewater Bay" facies of the Alexandria Formation (Goedhart & Hatting 1997, Almond 2010 and references therein).

Within the OTGC tank farm and associated pipeline study areas older, Early Cretaceous bedrocks of the Uitenhage Group were mainly observed in low but steep cliffs forming the eastern banks of the Coega River estuary near its mouth (close to the port area). Sundays River Formation beds mapped further to the north are largely covered by dense thicket vegetation and Caenozoic coastal sediments, even along the river bank, apart from occasional exposures here of greenish-grey Sundays River sandstones. At Location 569, due east of the port, several meters of gently NE-dipping, ochre-hued, tabular bedded siltstones with thin, laterally-persistent beds of bioturbated sandstone building the lower portion of the cliffs are provisionally assigned to the Sundays River Formation (as mapped, Figure 14.26). The overlying silty beds show reddish-brown and pinkish hues, mottling and calcretes typical of the Kirkwood Formation which normally *underlies* the Sundays River succession. Interfingering of marine (Sundays River) and terrestrial (Kirkwood) facies is a possibility that needs further investigation here. The Kirkwood/Sundays River contact or transition may well lie close to the Coega River mouth since undoubted Kirkwood beds are mapped just to the west of the river (Figure 14.5). The reddish upper beds at Location 569 are incised by reddish, pebbly channel infill deposits towards the seaward end of the cliff section. No marine fossil shells, such as ammonites or thick-shelled oysters, or petrified wood were observed at this locality.

Field observations suggest that the part of the pipeline study area situated west of the Coega River is underlain by estuarine muds of Pleistocene to Recent age of low palaeontological sensitivity or by highly disturbed/build up land. Significant palaeontological heritage impacts are not expected here. The pipeline crossing the Coega River (refer to Figure 14.2) may, at most, have a small impact on shelly sediments of the Salnova Formation on the eastern bank. In addition, small, palaeontologically insignificant impacts on Sundays River Formation beds and on possible Kirkwood Formation might be anticipated.

14.4 IDENTIFICATION OF KEY ISSUES

The OTGC tank farm study area is underlain at depth by potentially fossiliferous marine sediments of the Sundays River Formation. At surface these are overlain by calcretes, thin gravels and soils that are only sparsely fossiliferous and of unknown thickness. Deeper excavations within the footprint of the tank farm may intersect the Sundays River beds and expose fossil assemblages of scientific interest.

As a precautionary measure, a representative sample of deeper excavations here (say, over 3m) should therefore be inspected by a qualified palaeontologist while they are still open. Throughout

the construction phase new excavations should be monitored for fossil material by the Environmental Control Officer (ECO).

Excavations for the pipeline between the tank farm and one or other berth at Port of Ngqura traverse the outcrop areas of several potentially fossiliferous rock units, notably the Sundays River Formation (and possibly also Kirkwood Formation) and Salnova Formation. Field assessment shows that the Uitenhage Group rocks (Sundays River and Kirkwood Formations) are largely mantled by superficial sediments along the various proposed pipeline routes. These older bedrocks and any fossils they contain are therefore unlikely to be significantly affected by pipeline excavations less than two meters deep.

Sectors of the pipeline close to the eastern bank of the Coega River at elevations of less than 20m amsl might well intersect the Salnova Formation which is richly fossiliferous (diverse marine shelly faunas) in the Coega Estuary region. The fossil-rich beds are normally blanketed by fossil-poor wind-blown sands here, so only deeper excavations (say, over 2m) here should be inspected by a qualified palaeontologist while they are still open.

Figure 14.26: Gently-dipping beds of the Uitenhage Group close to the Coega River mouth (Location 569). The lower ochre-hued silts and thin, prominent-weathering bioturbated sandstones may belong to the marine Sundays River Formation but the overlying reddish-hued, variegated siltstones with calcretes resemble terrestrial facies of the Kirkwood Formation. Note younger channel infill towards top on cliff on right hand side.

The pipeline route east of the Coega River leading to the proposed new A-series Berth (Figure 14.2) will probably skirt the outcrop area of the Alexandria Formation limestones and overlying Nanaga Formation aeolianites that lie over 40m amsl here. Much of the route overlies potentially fossiliferous rocks of the Uitenhage Group (mapped as Sundays River Formation, but possibly

including Kirkwood Formation rocks as well). As for the tank farm study area, only deeper excavations (say, over 2m) are likely to intersect bedrock here and, should this route be selected, these should be selectively monitored by a professional palaeontologist.

Sectors of the pipeline route west of the Coega River, leading to the existing Berth B100 at Ngqura Port, overlie extensively disturbed terrain and/or geologically young estuarine sediments that are generally not of high palaeontological significance. The route option for the pipeline where this crosses the Coega River has low expected impacts on fossil heritage since only short sections of the eastern bank will be affected. No specialist palaeontological monitoring or mitigation measures for any of these pipeline sectors are recommended.

14.5 PERMIT REQUIREMENTS

To carry out monitoring and mitigation, which would normally involve the judicious sampling of newly exposed fossil material together with pertinent geological data, the professional palaeontologist involved would need to apply beforehand for a palaeontological collection permit from the relevant heritage management authority. In this case this is the Eastern Cape Provincial Heritage Resources Authority (ECPHRA). Refer to Appendix 14.A for the contact details of ECPHRA.

14.6 ASSESSMENT OF PALAEONTOLOGICAL IMPACT SIGNIFICANCE

The inferred significance of the proposed OTGC tank farm development for palaeontological heritage preserved within Zone 8 of the Coega IDZ is summarized in tabular form in Table 14.2, according to the methodology outlined in Chapter 4 of this Draft EIA Report. In all cases, irrespective of its permanent nature, the palaeontological impact significance of the construction phase of the proposed development is rated as **LOW**, given its local extent (confined to the immediate development footprint) and the generally sparse occurrence of fossils in most of the sedimentary rocks concerned. High negative impacts to palaeontological heritage are only envisioned should rich fossil occurrences be exposed during construction and not mitigated as recommended within this section. On the other hand, should specialist mitigation be followed through, this would represent a significant **positive** impact since our understanding of previously hidden fossil heritage will thereby be enhanced. The operational and decommissioning phases of the tank farm facility will not involve significant additional adverse or other impacts on palaeontological heritage.

Cumulative impacts on the highly fossiliferous, but volumetrically limited, estuarine deposits of the Salnova Formation as a result of the Port of Ngqura and associated development projects within Zone 8 of the Coega IDZ are potentially significant and negative. It is therefore imperative that all future developments involving bedrock excavation within this IDZ zone (e.g. construction of proposed new berths) be adequately assessed, and where necessary professionally monitored and mitigated, in terms of fossil heritage issues.

Wherever development involving bedrock excavation occurs within the Coega IDZ the responsible ECOs should be alerted to the possibility of buried fossil heritage, for example by familiarizing themselves with the recent palaeontological report for the Coega IDZ (Almond 2010a). In this light all major bedrock excavations should be examined at intervals for fossil material by the ECOs. If any substantial fossil remains are found these should be safeguarded, preferably *in situ*, while the ECPHRA is contacted and a qualified palaeontologist is contracted to record and sample the occurrence.

As discussed in Section 14.4 of this report, professional palaeontological monitoring is only recommended for this project in the case of:

- Deeper (> 3m) excavations within the tank farm footprint, should these intersect the underlying Sundays River formation;
- Deeper (> 2m) excavations along the pipeline route that lie at less than 20m amsl and close to the banks of the Coega River;
- Deeper (> 2m) excavations along the pipeline route to the proposed new A-berth.

The palaeontologist involved in monitoring or mitigation work will require a fossil collection permit from ECPHRA. Fossil material collected must be recorded according to best academic practice and properly curated in an accredited fossil collection, such as the Albany Museum, Grahamstown.

Table 14.2: Palaeontological impact assessment for OTGC Tank Farm development, Zone 8 of the Coega IDZ

Impact Description	Spatial Extent	Duration	Intensity	Probability	Significance and Status (No Mitigation)	Mitigation/Management Actions	Significance and Status (With Mitigation)	Confidence Level
CONSTRUCTION PHASE								
Scenario: Construction of 20 ha tank farm plus pipeline connection to the Port of Ngqura								
Destruction, disturbance or sealing-in of fossils on the ground or buried beneath the surface during excavations and other construction work	**Local**, restricted to immediate development footprint	**Permanent**	**Variable (Low to High)** depending on sedimentary rock units concerned	**Probable**, since fossils occur widely within rocks represented within this zone	**Low**, since local fossil heritage is normally sparse and most fossil forms here are widely distributed (*except* for Salnova Formation).	Monitoring of deeper (>3m) excavations within tank farm and excavations (>2m) along the pipeline footprint by professional palaeontologist. ECO should alert SAHRA/ECPHRA if substantial fossil remains are found during construction so that recording & sampling by a professional palaeontologist can be arranged.	**Low**, since any mitigation measures, (*e.g.* recording and collection of newly exposed fossils) will reduce negative impacts and enhance knowledge of local fossil heritage.	**Medium**, based on extensive field experience of the rocks involved, but limited by poor exposure of potentially fossiliferous bedrocks in the study area.

PART B: IMPACT ON ARCHAEOLOGY

This section presents the findings of the Archaeological Impact Assessment specialist study that was conducted by Dr. Johan Binneman of Eastern Cape Heritage Consultants as part of the EIA for the proposed OTGC Bulk Liquid Storage and Handling Facility Project.

14.7 INTRODUCTION AND METHODOLOGY

This section follows the minimum standard guidelines required by the South African Heritage Resources Agency for compiling Archaeological Heritage Phase 1 Impact Assessment (AHIA) reports.

The proposed development includes the construction and operation of a Bulk Liquid Storage and Handling Facility. The tank farm, with a storage capacity of approximately 790 000 m^3, will be constructed on an area of approximately 20 hectares in size on the eastern side of the Coega River. Pipelines will be constructed to transport the bulk liquids from Berth B100 or the proposed A-series Berth to the tank farm. The pipeline to Berth B100 runs just below the salt pans and then crosses the Coega River (from western to eastern embankment). The second runs along the eastern embankment of the Coega River to the proposed new A-series Berth (Refer to Map 14.1 to 14.3 in Appendix 14.C).

14.7.1 Scope of Work and Objectives of the Archaeological Impact Assessment

The scope of work was to conduct a survey of possible archaeological sites in Zone 8 of the Coega IDZ for the proposed construction and operation of a Bulk Liquid Storage and Handling Facility and associated pipelines to transport the bulk liquids from the Port of Ngqura to the storage tank farm. The survey was conducted to establish:

a) the range and importance of possible exposed and in situ archaeological sites, features and materials;
b) the potential impact of the development on these resources; and
c) to make recommendations to minimize possible damage to these resources.

14.7.2 Approach to the Archaeological Impact Assessment

The Archaeological survey was conducted by two people on foot and spot checks from a vehicle. GPS readings were taken with a Garmin and all important features were digitally recorded. Three areas were investigated, namely:

- the proposed 20 hectare bulk liquid storage tank farm site (east of the Coega River); and

- the proposed pipeline routes running from Berth B100 and the proposed new A-series Berth along the western and eastern embankments of the Coega River to the tank farm, respectively.

14.7.3 Assumptions and Limitations

Zone 8 and the adjacent region have been well investigated in the past. These first hand experiences provided a high confidence level regarding the predictions and assumptions for the pre-colonial archaeology of the region. Previous investigations of Zone 8, which included a phase 2 study of the coastal region, indicated that the area is in general of low archaeological significance. The Coega River/Estuary have been severely disturbed and transformed by development in the past and there is no or little *in situ* and/or significant archaeological sites left. Previous experience of the area also assumed that the only archaeological remains will be Earlier, Middle and Later Stone Age stone tools in secondary context associated with exposed pebble/cobble gravels. However, other archaeological sites/materials (such as human remains) may be covered by soil and vegetation.

The large size of the Bulk Liquid Storage site and dense vegetation cover in most areas made a comprehensive survey difficult. On the other hand, the shallow topsoil covering the underlying calcrete throughout the region does not allow for any deep archaeological deposits/features. In general it is unlikely that significant archaeological sites will be exposed by the proposed development. The dense vegetation along the eastern embankment of the Coega River also restricted archaeological visibility and made it almost impossible to find sites. There is the possibility that archaeological sites (shell middens) may be exposed along the Coega River during development, but these will be small and of relatively low-medium significance.

14.7.4 Information Sources

A range of information sources were used for this AIA report, some of which are listed below:

- Collections and information from the region housed in the Albany Museum in Grahamstown.
- Various archaeological investigations of Zone 8 (property of the Transnet National Port Authority) of the Coega IDZ that were conducted by the specialist and his colleagues between 1994 and 1999.
- The 2010 reconnaissance AIA of the remainder of the Coega IDZ. This report only briefly refers to some of those aspects.
- Approximately 20 years of first-hand experience of the Coega and surrounding areas. This facilitates a high confidence level regarding the predictions and assumptions for the pre-colonial archaeology of the region.
- 1:50 000 3325 DC & DD 3425 BA Port Elizabeth.

14.7.5 Specialist Expertise and Declaration of Independence

Refer to Appendix A of the Draft EIA Report for the Curriculum Vitae of Dr. Johan Binneman, which highlights his expertise. The declaration of independence by the specialist is provided in Box 14.2 below.

BOX 14.2: DECLARATION OF INDEPENDENCE

I, Johannes N. F Binneman, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed OTGC Bulk Liquid Storage and Handling Project, application or appeal in respect of which I was appointed, other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

DR. JOHANNES N. F. BINNEMAN

14.8 DESCRIPTION OF THE STUDY AREA

14.8.1 Brief Archaeological Background: Literature Review

The oldest evidence for prehistoric people living in the region comes from the river gravels which line the Coega River valley/estuary. Early Stone Age (approximately 1.5 million to 250 000 years old) stone tools are found throughout the Coega IDZ. Large hand axes were reported from Coega Kop and were also collected from the banks and gravels of the Coega River and between the N2 national road and the salt works (Albany Museum collections). One of South Africa's most important Earlier Stone Age finds and excavations (Deacon 1970) was conducted a few kilometres west of the surveyed area, at Amanzi Springs. In a series of spring deposits a large number of stone tools were found in situ to a depth of 3-4 metres. Wood and seed material preserved in the spring deposits, possibly dating to between 250 000 to 800 000 years old.

Middle Stone Age (125 000 - 30 000 years ago) and Later Stone Age (30 000 years ago to historical times) stone tools are also found in the gravels and along the banks of the Coega River. These stone artefacts, like the Earlier Stone Age hand axes are in secondary context with no other associated archaeological material. Occurrences of fossil bone remains and Middle Stone Age stone tools were also reported south of Coega Kop (Gess 1969). During excavations the remains were found in the surface limestone, but the bulk of the bone remains were found some 1 – 1.5 metres below the surface. The excavations exposed a large number and variety of bones, teeth and horn corns. The

bone remains included warthog, leopard, hyena, rhinoceros and ten different antelope species. A radiocarbon date of greater than 37 000 years was obtained for the site.

The majority of archaeological sites found in the wider region date from the past 10 000 years (called the Later Stone Age) and are associated with the campsites of San hunter-gatherers and Khoi pastoralists. Some 2 000 years ago Khoi pastoralists occupied the region and lived mainly in small settlements. They were the first food producers in South Africa and introduced domesticated animals (sheep, goat and cattle) and ceramic vessels to southern Africa. These sites are poorly preserved and difficult to find because they are in the open veld and often covered by vegetation and soil. Sometimes these sites are only represented by a few stone tools and fragments of bone. Most of the proposed area for development is situated within 5 km from the coast and falls within the maximum distance shell middens are expected to be found from the beach (Binneman 2001, 2005). Many middens, ceramic pot sherds (from Later Stone Age Khoi pastoralist origin - last 2 000 years) and other archaeological material, mainly of the Holocene Later Stone Age (last 8 000 years) are located in the shifting sand dunes along the coast (Rudner 1968). Human remains have also been found in the dunes along the coast.

14.8.2 Findings of the Field Survey: The Bulk Liquid Storage and Handling Facility Site (Tank Farm)

The proposed tank farm site is approximately 20 hectares in size and situated on the relatively flat plain along the eastern side of the Coega River. Most of the area is covered by impenetrable thicket vegetation and short dense grass (Figures 14.27 to 14.30). The property has been part of a larger farm in the past and has been disturbed by small scale farming activities such as bush clearing, roads, cement dams and troughs, fences and a small cemetery (the graves have been relocated recently (Figure 14.31). The topsoil is shallow in most areas and the underlying calcrete and surface gravel are exposed throughout the area.

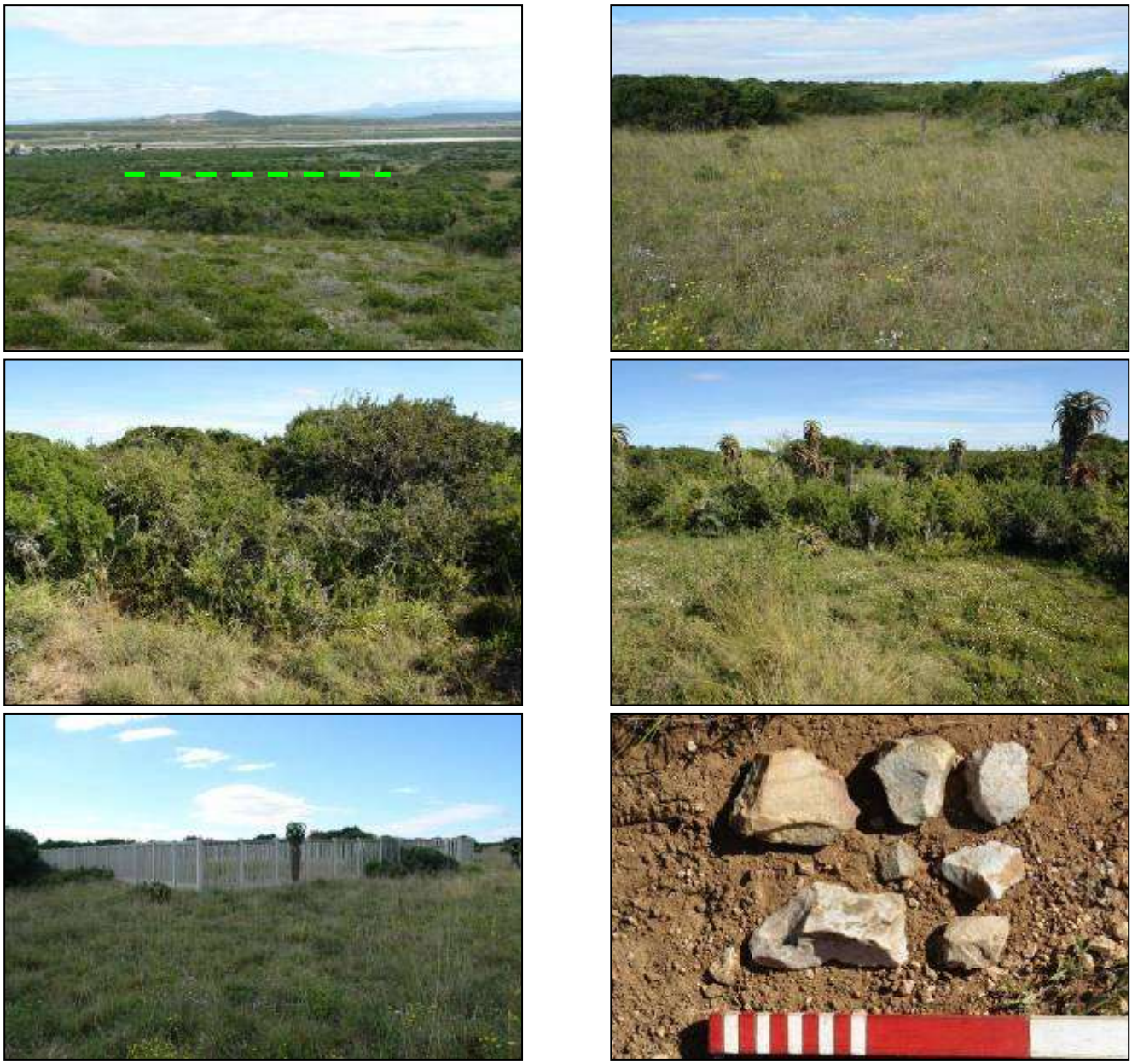
The dense vegetation made it almost impossible to survey the entire property. Areas that were cleared in the past are covered by dense short grass and bushes and made it difficult to find archaeological sites/materials. Where possible, narrow footpaths through the thicket vegetation were followed and mole heaps (areas where there is thicker topsoil) and other surface disturbances and tracks were also investigated. Nevertheless a few quartzite Middle Stone Age stone tools (dating older than 30 000 years) with typical facetted striking platforms were observed, especially where pebble/cobble gravels were exposed (Figure 14.32). The stone tools which were originally situated in the thin layer of top soil which covers the underlying hard calcrete deposits were disturbed by bush clearing and exposed in the surface gravel the tools were mainly small ‘informal’ flakes and chunks. No cores, points and blades were observed. Although some flakes displayed utilization damage, few were ‘formally’ retouched. No spatial patterning or activity areas such as ‘manufacturing’ sites were located. Such sites may exist but none were observed. All stone tools were in secondary context and not associated with any other archaeological remains.

14.8.3 Findings of the Field Survey: The proposed Western Pipeline Route

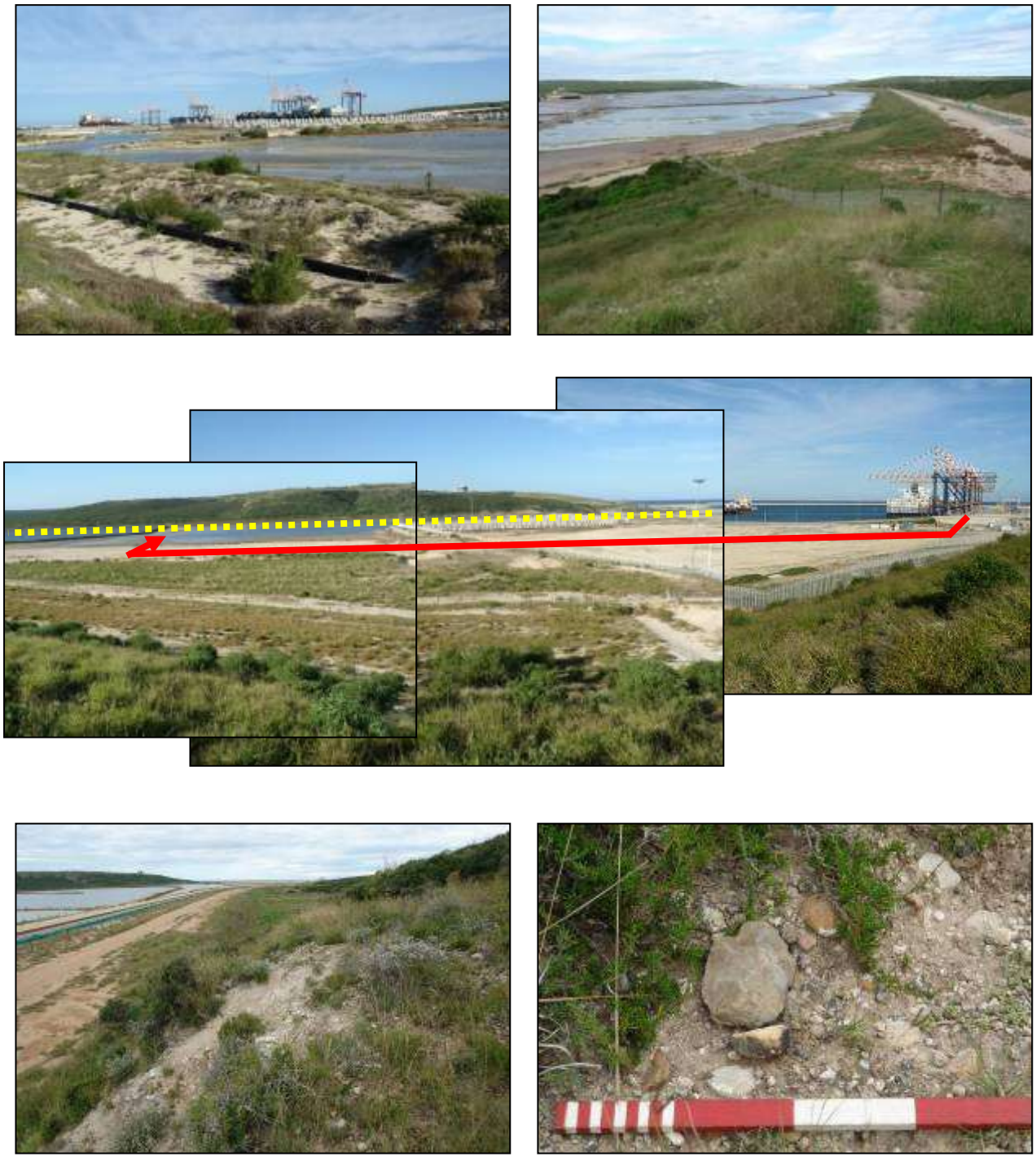
In general the entire Coega River Mouth/Estuary has been severely disturbed in the past by the infrastructure for the production of salt and recently by the Port of Ngqura development. The construction of the railway line to the harbour, roads, fences, and stormwater drainage systems adjacent to the river have also transformed the western embankment of the Coega River completely (Figure 14.33 to Figure 14.34). Due to these circumstances there is no threat to any archaeological sites/materials if the pipeline is constructed from Berth B100 to where it crosses the Coega River below the salt pans (Figure 14.35). However, if the pipeline will follow a higher elevation along the western side, then it should be taken into account that there may be Earlier and Middle Stone Age stone tools (dating between 1.5 million and 30 000 years old) embedded in the calcrete embankment. Occasional Early Stone Age hand axes and Middle Stone Age stone tools were observed in the exposed river gravel overlying the calcrete deposits a few hundred metres north of the proposed crossing of the Coega River (Map 14.3, Figure 14.36 to Figure 14.37). These stone tools may sometimes be in association with fossilised bone remains. Well-preserved bone remains were found in similar calcrete deposits in the nearby Markman Industrial Area at a depth of 1 - 1.5 metres.

14.8.4 Findings of the Field Survey: The proposed Eastern Pipeline Route

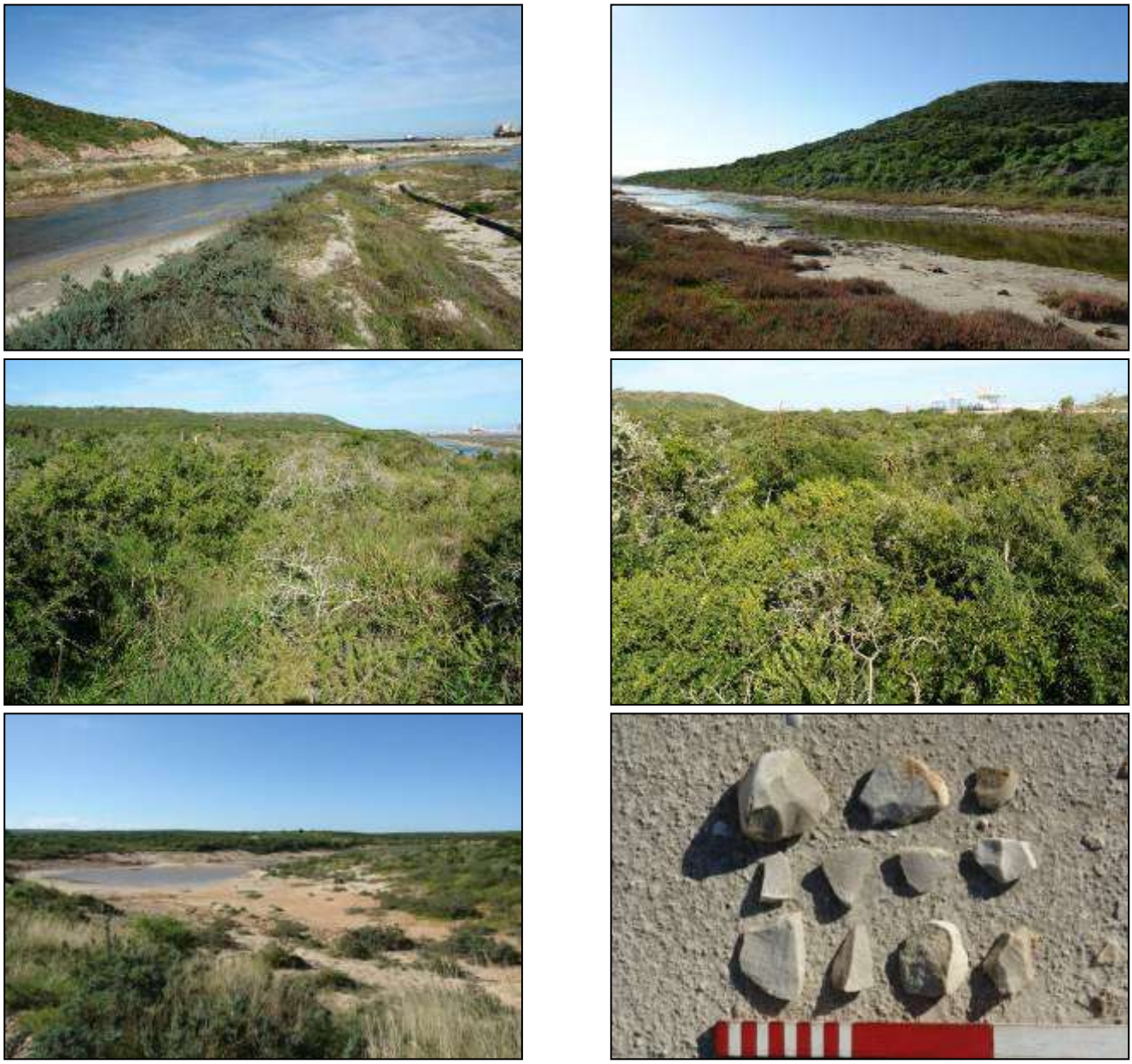
As in the case of the western pipeline route, the port section of the proposed eastern pipeline route is also severely disturbed and any archaeological sites/materials were destroyed during the construction of the harbour. The remainder of the route runs through an area covered by impenetrable thicket vegetation which made it impossible to survey for archaeological sites/materials (Figure 14.38 to Figure 14.41). However, close to the location where the proposed western and eastern pipelines converge is a large borrow pit area and many Middle Stone Age stone tools were observed exposed where the topsoil was disturbed. These stone tools are similar to those described above, but cores and small points were also observed (Figure 14.42 to Figure 14.43). These types of stone tools were observed throughout the Coega IDZ and were in secondary context and not associated with any other archaeological remains.



Figures 14.27 to 14.32:A wide angle view of the bulk liquid storage tank farm site marked by the broken green (top left), different views of the dense vegetation and grass which cover previously cleared areas (top right and middle row), a view of the old cemetery (bottom left) and a small sample of Middle Stone Age stone artefacts observed on the site.



Figures 14.33 to 14.37:Wide angle views of the Coega River and the extensive transformation of the western side by the construction of the Port of Ngqura and associated infrastructure (top row), composite view of Berth B100 and the location where the pipeline (red line) crosses the saltpans (the dotted yellow line indicates the pipeline along the eastern embankment of the Coega River to the proposed A-series Berth and the exposed calcrete deposit with Earlier and Middle Stone Age stone tools (bottom row).



Figures 14.38 to 14.43:Views of the transformation of the eastern side of the Coega River by the construction of the Port of Ngqura (top row), the dense vegetation which covers the eastern route (middle row) and the Middle Stone Age stone tools found at the borrow pit (bottom row). The bulk liquid storage tank farm site is a few hundred metres behind the borrow pit.

14.9 IDENTIFICATION OF KEY ISSUES

The main issue is the potential impact of construction activities on archaeological features (e.g. stone-age artefacts, shell middens), as well as graveyards. This is described in detail in the following sections of this chapter.

14.10 PERMIT REQUIREMENTS

Permits must be granted to a professional archaeologist by the South African Heritage Resources Agency to remove any material of archaeological significance from the site.

14.11 ASSESSMENT OF ARCHAEOLOGICAL IMPACT SIGNIFICANCE AND IDENTIFICATION OF MANAGEMENT ACTIONS/MITIGATION MEASURES

14.11.1.1 Pre-colonial Archaeology

Nature of the Impacts:

From the investigation, it would appear that the proposed Bulk Liquid Storage and Handling Facility (tank farm) site and the proposed pipeline routes running from Berth B100 and the proposed A-series Berth along the respective western and eastern embankments of the Coega River to the tank farm are of low archaeological sensitivity. Apart from occasional Earlier and Middle Stone Age stone artefacts, no other significant sites/materials were observed. The occasional stone tools observed throughout the area are in secondary context, not associated with any other archaeological material and of low cultural significance, but *in situ* material may be covered by soil and vegetation (for example, shell middens and human remains). The main direct impact on archaeological sites/remains (if any) will be the physical disturbance of the material and its context. The construction of the tank farm and the proposed pipeline may also expose, disturb and displace archaeological sites/material.

Extent of the Impacts:

Construction of the proposed tank farm and the proposed pipeline routes may impact on remains which are buried, but these impacts will be limited and restricted to the local area. The pipeline(s) will be constructed mainly in areas that have already been disturbed and may have little or no negative impact on possible archaeological sites/materials. This includes the entire western route and a few hundred metres at the Coega River Mouth area. If any material is disturbed it will be relatively small, but permanent. The construction of the Bulk Liquid Storage and Handling Facility will disturb a large area and may expose

sites/materials on a larger scale. In both cases further disturbances of sites/materials can be limited by mitigation.

Mitigation:

No mitigation is proposed for the property before construction starts because the archaeological remains are of low significance (excluding possible human remains and shell middens). However, after the vegetation has been cleared an archaeologist must inspect the footprint. Also, if concentrations of archaeological materials are exposed then all work must stop immediately for an archaeologist to investigate (see below). Further recommendations will follow from the investigation.

However, at the point where archaeological material is exposed by large scale earthworks, mitigation will have little significance in conserving the material because it will be disturbed/destroyed and removed from its context. After the construction, i.e., operational and decommissioning phases mitigation will not be irrelevant because there will be no *in situ* material left to be mitigated.

If any human remains (or any other concentrations of archaeological heritage material) are exposed during construction, all work must cease immediately and it must be reported immediately to the nearest museum/archaeologist or to the South African Heritage Resources Agency, so that a systematic and professional investigation can be undertaken. Sufficient time should be allowed to investigate and to remove/collect such material. Recommendations will follow from the investigation. The conditions will be similar to those mentioned above.

Human remains are very sensitive issues and before the remains may be removed, certain procedures must be followed and local communities must be consulted (SAHRA/ECPHRA and archaeologist will provide guidelines). Permits must be granted to a professional archaeologist by the South African Heritage Resources Agency to remove any material.

Cumulative Impacts:

The cumulative impacts will only increase if further developments are planned for adjoining areas.

Residual Impacts:

The damage caused by construction will be permanent and will never be fully rehabilitated.

14.11.1.2 Pre-colonial Archaeological Cultural Landscape

Nature of the Impact:

The visual archaeological significance of the immediate area is low and comprised of occasional Earlier and Middle Stone Age stone tools in secondary context. Information derived from shell middens along the eastern side of the Coega River Mouth has been collected and the remainder of the features have subsequently been destroyed. There are no historical buildings near the site and the graves have been relocated. The development takes place inside an industrial zone which has already transformed the local 'sense of place' in terms of the cultural landscape. Therefore, the visual impact of the development on the cultural landscape will be low as well.

Extent of Impact:

The visual impact of the development on the cultural will be restricted to the immediate area of the development and will have little negative effect on the immediate cultural landscape and 'significance/sense of place'. Notwithstanding, the 'presence' of the development will be long term to permanent, but negative impacts can be mitigated.

Cumulative Impacts:

The cumulative impacts will only increase on the wider cultural landscape if further developments are planned for adjoining areas.

Residual Impacts:

The damage caused by construction will be permanent and will never be fully rehabilitated.

Table 14.3: Impact assessment for OTGC Tank Farm development on Archaeological Remains

Impact Description	Spatial Extent	Duration	Intensity	Probability	Significance and Status (No Mitigation)	Mitigation/ Management Actions	Significance and Status (With Mitigation)	Confidence Level
CONSTRUCTION PHASE								
The potential impact of the development on above and below ground archaeology	Local	Permanent	Low	Probable	Low Negative	Follow general archaeological guidelines for developers (Appendix 14.E)	Low Negative	High
Occurrence of significant archaeological sites/material, i.e. human remains	Local	Permanent	Low	Probable	High Negative	Follow general archaeological guidelines for developers. Permit must be obtained from SAHRA and remains to be removed by a specialist archaeologist.	Low Negative	High
The potential impact of the development on the cultural landscape and 'sense of place'.	Local	Permanent	Low	Improbable	Low Negative	No mitigation is proposed because the archaeological remains are of low significance	Low Negative	High

14.11.1.3 Discussion and Mitigation

The proposed 20 hectare tank farm site (east of the Coega River) and the proposed pipeline routes running from Berth B100 and the proposed A-series Berth along the western and eastern embankments of the Coega river to the tank farm, appeared to be of low archaeological significance. Apart from occasional Earlier and Middle Stone Age stone artefacts, no other significant sites/materials were observed. The stone tools observed throughout the area are of low cultural significance. Most of the area investigated is within 5 km from the coast and falls within the maximum distance coastal archaeological remains are expected to be found from the beach. However, no such remains were found, but material may be covered by soil and vegetation. Although it would appear that it is unlikely that any sensitive archaeological remains will be exposed during the development, there is always a possibility that human remains and/or other archaeological features such as shell middens may be uncovered during the development. It is recommended that:

1) All construction work must be monitored. An archaeologist must inspect (walk through) the pipeline route(s) and bulk storage construction site when the surface vegetation has been removed to establish if there are any archaeological sites/materials.

    - Alternatively a person must be trained as a site monitor to report to the foreman when archaeological sites are found. This person must monitor all levelling and trenching activities during the construction phase.

2) If a monitor is not considered, then the construction managers/foremen should be informed, before construction starts, on the possible types of heritage sites which may be encountered during construction.

3) If any concentrations of material (especially concentrations of marine shell) are uncovered during development, it should be reported to the Albany Museum and/or the South African Heritage Resources Agency immediately so that systematic and professional investigation/excavations can be undertaken. Sufficient time should be allowed to remove/collect such material (See Appendix 14.E for a list of possible archaeological sites that maybe found in the area).

14.12 CONDITIONS FOR THE PHASE 1 AIA

This AIA Report is a Phase 1 Archaeological Heritage Impact Assessment/Investigation only and does not include or exempt other required heritage impact assessments (as described below).

The National Heritage Resources Act (Act No. 25 of 1999, section 35) (see Appendix 14.D) requires a full Heritage Impact Assessment (HIA) in order that all heritage

resources, that is, all places or objects of aesthetics, architectural, historic, scientific, social, spiritual linguistic or technological value or significance are protected. Thus any assessment should make provision for the protection of all these heritage components, including archaeology, shipwrecks, battlefields, graves, and structures older than 60 years, living heritage, historical settlements, landscapes, geological sites, palaeontological sites and objects.

It must be emphasised that the conclusions and recommendations expressed in this archaeological heritage sensitivity investigation are based on the visibility of archaeological sites/features and may not therefore, reflect the true state of affairs. Many sites/features may be covered by soil and vegetation and will only be located once this has been removed. In the event of such finds being uncovered, (such as during any phase of construction work), archaeologists must be informed immediately so that they can investigate the importance of the sites and excavate or collect material before it is destroyed. The onus is on the developer to ensure that this agreement is honoured in accordance with the National Heritage Act No. 25 of 1999.

It must also be clear that Archaeological Specialist Reports (AIA's) will be assessed by the relevant heritage resources authority. The final decision rests with the heritage resources authority, which should grant a permit or a formal letter of permission for the destruction of any cultural sites.

Appendix 14.A: Contact details for ECPHRA

Eastern Cape Provincial Heritage Resources Authority
Contact Person: Mr Sello Mokhanya
Address: 74 Alexander Road, King Williams Town, 5600
Email: smokhanya@ecphra.org.za

Appendix 14.B: GPS Locality data for sites listed in the PIA

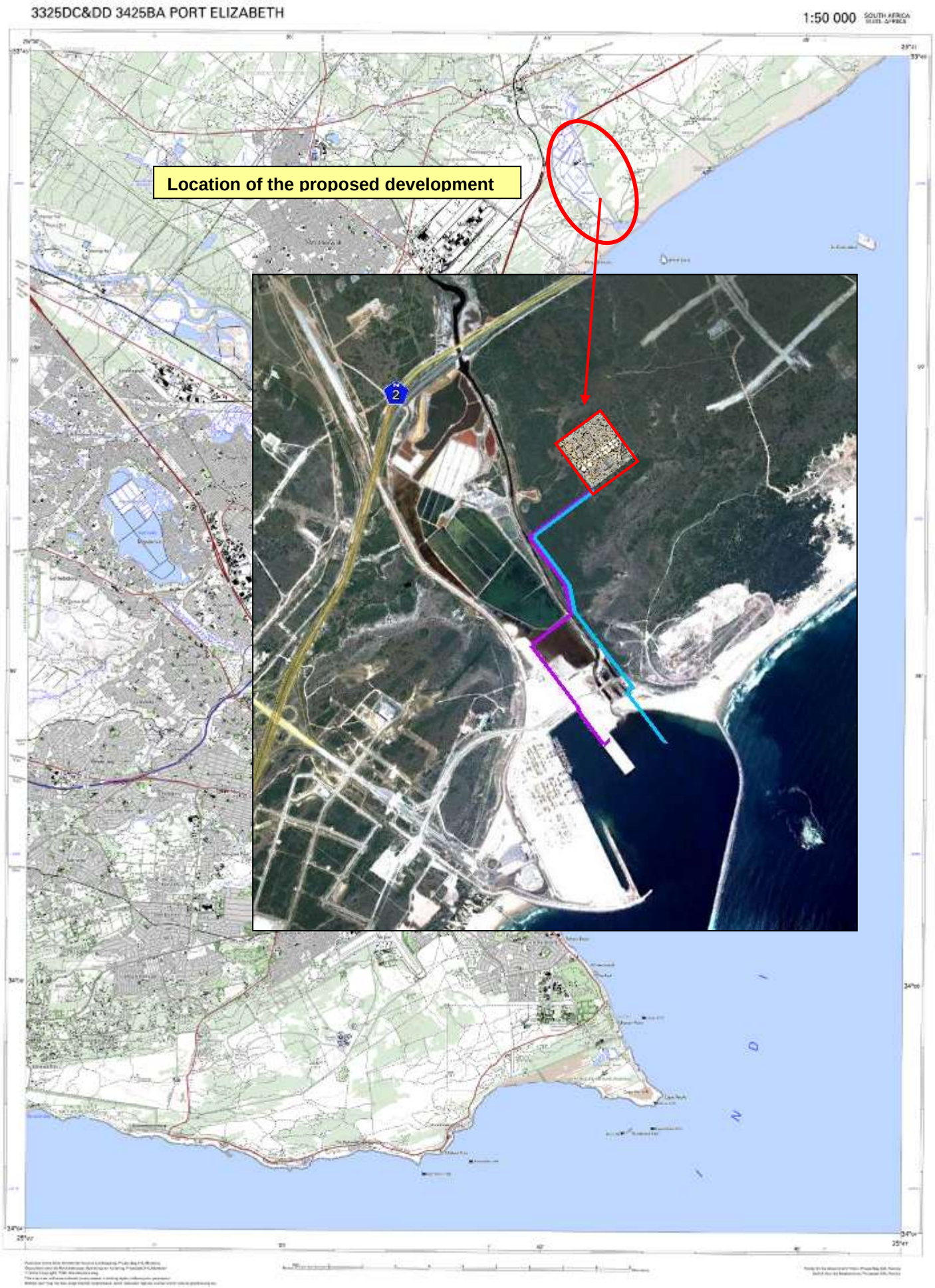
All GPS readings were taken in the field using a hand-held Garmin GPSmap 60CSx instrument. The datum used is WGS 84.

19 – 20 May 2012 – Coega IDZ

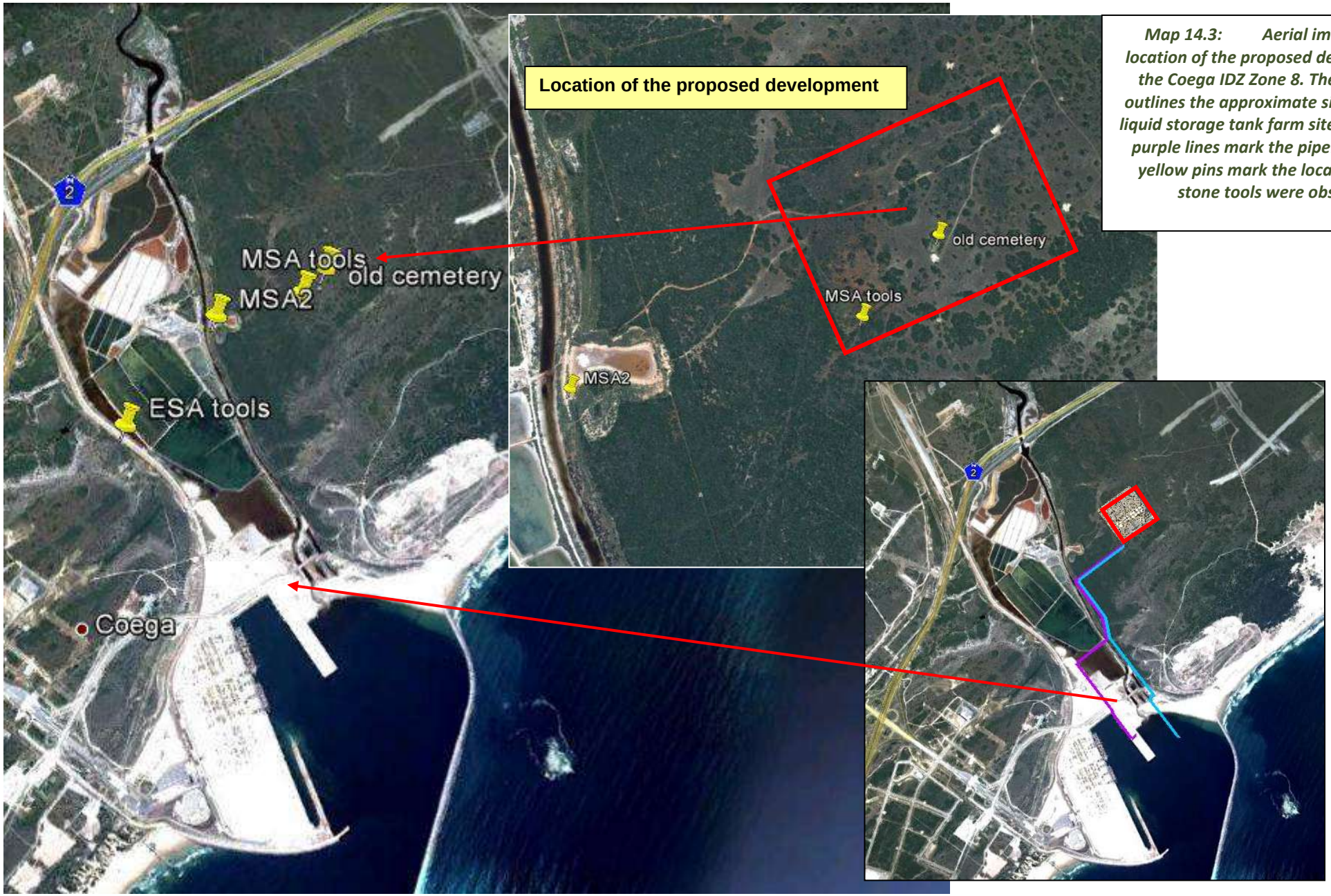
Locality number	South	East
552	S33 46 33.7	E25 41 17.3
553	S33 46 33.9	E25 41 16.2
554	S33 46 41.5	E25 41 12.1
555	S33 46 42.8	E25 41 12.7
556	S33 46 36.8	E25 41 08.8
557	S33 46 37.6	E25 41 03.7
558	S33 46 37.9	E25 41 01.0
559	S33 46 42.7	E25 40 55.4
560	S33 46 44.1	E25 40 52.5
561	S33 46 46.1	E25 40 50.2
562	S33 46 46.6	E25 40 50.0
563	S33 46 48.5	E25 40 52.5
564	S33 47 10.3	E25 40 57.0
565	S33 47 11.9	E25 40 57.9
11566	S33 47 15.2	E25 40 59.6
567	S33 47 24.4	E25 41 07.7
568	S33 47 28.1	E25 41 11.3
569	S33 47 30.9	E25 41 13.3
570	S33 47 32.8	E25 41 14.8
571	S33 47 04.6	E25 41 52.6
572	S33 47 15.9	E25 41 47.8
573	S33 47 24.2	E25 41 39.8
574	S33 47 25.2	E25 41 37.0
575	S33 47 23.9	E25 41 35.7
576	S33 47 26.4	E25 41 31.1
577	S33 47 26.0	E25 41 13.9
578	S33 47 28.6	E25 41 31.0

Appendix 14.C: Maps 14.1 to 14.3 listed in the AIA

Map 14.1: ***1:50 000 Map and aerial map indicating the location of the proposed development of the bulk liquid storage tank farm site (red square) and pipeline routes (blue and purple lines) in the Coega IDZ Zone 8.***


3325DC&DD 3425BA PORT ELIZABETH
1:50 000
Location of the proposed development
2

Map 14.2. Aerial images of the location of the proposed development of the bulk liquid storage tank farm site and pipeline routes in the Coega IDZ Zone 8.



Map 14.3: Aerial images of the location of the proposed development in the Coega IDZ Zone 8. The red square outlines the approximate size of the bulk liquid storage tank farm site, the blue and purple lines mark the pipelines and the yellow pins mark the locations where stone tools were observed.

Appendix 14.D: Brief legislative requirements

BRIEF LEGISLATIVE REQUIREMENTS

Parts of sections 35(4), 36(3) and 38(1) (8) of the National Heritage Resources Act 25 of 1999 apply:

Archaeology, palaeontology and meteorites

35 (4) No person may, without a permit issued by the responsible heritage resources authority—

a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
c) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

Burial grounds and graves

36. (3) (a) No person may, without a permit issued by SAHRA or a provincial heritage resources authority—

a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;
b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.

Heritage resources management

38. (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorized as –

a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
b) the construction of a bridge or similar structure exceeding 50m in length;

c) any development or other activity which will change the character of the site –
- *i. exceeding 5000m^2 in extent, or*
- *ii. involving three or more erven or subdivisions thereof; or*
- *iii. involving three or more erven or divisions thereof which have been consolidated within the past five years; or*
- *iv. the costs of which will exceed a sum set in terms of regulations by SAHRA, or a provincial resources authority;*

d) the re-zoning of a site exceeding 10 000m^2 in extent; or

e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must as the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

Appendix 14.E: Identification of Archaeological Features and Material from Coastal Areas: Guidelines and Procedures for Developers

Shell Middens

Shell middens can be defined as an accumulation of marine shell deposited by human agents rather than the result of marine activity. The shells are concentrated in a specific locality above the high-water mark and frequently contain stone tools, pottery, bone and occasionally also human remains. Shell middens may be of various sizes and depths, but an accumulation which exceeds 1 m2 in extent, should be reported to an archaeologist.

Human Skeletal Material

Human remains, whether the complete remains of an individual buried during the past, or scattered human remains resulting from disturbance of the grave, should be reported. In general the remains are buried in a flexed position on their sides, but are also found buried in a sitting position with a flat stone capping and developers are requested to be on the alert for this.

Fossil Bone

Fossil bones or any other concentrations of bones, whether fossilized or not, should be reported.

Stone Artefacts

These are difficult for the layman to identify. However, large accumulations of flaked stones which do not appear to have been distributed naturally should be reported. If the stone tools are associated with bone remains, development should be halted immediately and archaeologists notified.

Stone Features and Platforms

These occur in different forms and sizes, but easily identifiable. The most common are an accumulation of roughly circular fire cracked stones tightly spaced and filled in with charcoal and marine shell. They are usually 1-2 metres in diameter and may represent cooking platforms for shell fish. Others may resemble circular single row cobble stone markers. These occur in different sizes and may be the remains of wind breaks or cooking shelters.

Historical Artefacts or Features

These are easy to identify and include foundations of buildings or other construction features and items from domestic and military activities.