Report

Notice of Intent for the Proposed Extension or Replacement of East Point Outfall

17 AUGUST 2011

Prepared for

Water Services

Power and Water Corporation

PO Box 37471
Winnellie
NT, 0821

URS

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Abbreviations

Abbreviation	Description
ABS	Australian Bureau of Statistics
AHPI	Australian Heritage Places Inventory
approx.	Approximately
ASS	Acid Sulfate Soils
BoM	Bureau of Meteorology
CAS	Chemically Assisted Sedimentation
CBD	Central Business District
CP	Community Purpose
DCC	Darwin City Council
DSS	Darwin Sewerage Strategy
EMU	Environmental Management Units
EP	Estimated Population
EPALR	East Point Aquatic Life Reserve
EPBC	Environmental Protection and Biodiversity Conservation Act
EPO	East Point Outfall
ERIN	Environmental Resources Information Network
ERM	Effluent Rising Main
ETA	Electronic Transactions Act
GBRMP Act	*Great Barrier Reef Marine Park Act 1975*
HDPE	High Density Polyethylene
IMS	Integrated Management System
kL/day	Kilolitre per day
L/s	Litre per second
LOCP	Larrakeyah Outfall Closure Plan
LWWTP	Ludmilla Wastewater Treatment Plant
MDPE	Moderate Density Polyethylene
MNES	Matters of National Environmental Significance
MSDS	Material Safety Data Sheet
NOI	Notice of Intent
NRETAS	Department of Natural Resources, Environment, the Arts and Sport
NT	Northern Territory

Abbreviation	Description
PASS	Potential Acid Sulfate Soils
PER	Public Environmental Report
PS	Public Space
PWC	Power and Water Corporation
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities
the Authority	Great Barrier Reef Marine Park Authority
TPWCA	Territory Parks and Wildlife Conservation Act
WDL	Waste Discharge Licence
WWTP	Wastewater Treatment Plant

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Proponent and Contact Details

1.1 The Proponent

The proponent is Power and Water Corporation (PWC), established under the Power and Water Corporation Act, 2002. Power and Water is a Northern Territory (NT) Government Owned Corporation under the Government Owned Corporations Act, 2001.

The Australian Business Number (ABN) for Power and Water is 15 947 352 360.

1.2 Contact Details

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Location of the Proposal

Darwin is the capital city of the NT, Australia and is situated on Darwin Harbour in the Timor Sea (Figure 2-1). The permanent resident population according to the Australian Bureau of Statistics is 127 500 (ABS, 2011). Regular influx of tourists during dry season (May to September) temporarily increases the total population by up to 20 000 people during this period.

Power and Water Corporation (PWC) is responsible for power, water and sewerage services in Darwin and other urban areas in the NT. Sewage generated in the city is managed through several Wastewater Treatment Plants (WWTPs), including the Ludmilla Wastewater Treatment Plant (LWWTP).

The LWWTP currently discharges treated sewage effluent into Darwin Harbour via the East Point Outfall (EPO). The proponent, PWC, is considering options to replace the EPO as part of the upgrade of the LWWTP and closure of the Larrakeyah Outfall.

The operator, PWC, is proposing to either:

- Replace the existing EPO, and extend the EPO to a point 500 m to 2,500 m beyond the extent of the existing outfall using a pipeline installed in a trench on the sea floor
- Replace the existing EPO with a pipeline installed inside a directionally drilled tunnel, extending to a point approximately 1000 m to 2,500 m offshore.

Within each of these pipeline options various potential methodologies will be fully investigated as part of engineering design for the EPO. These options and the proposed works are briefly described under Section 3.2.

Figure 2-1 shows Darwin and the location of East Point, with Figure 2-2 showing the proposed alignments for both the existing and proposed EPO options.

Figure 2-1 Regional Location of Darwin (NT Government, 2004)

2 Location of the Proposal

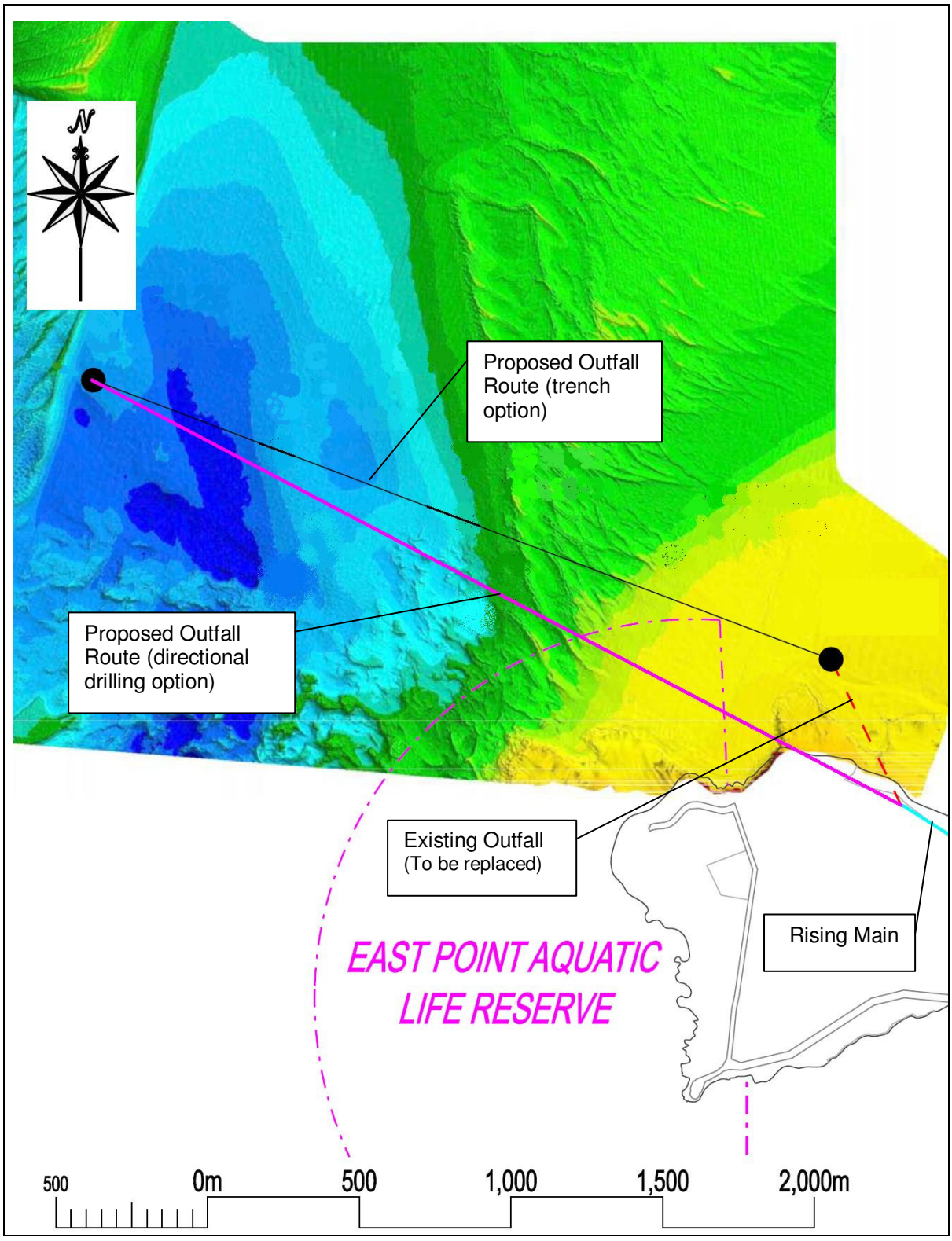

Figure 2-2 Proposed site layout for EPO (trench and directional drilling options shown)

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Description of the Proposal

3.1 Background

The Darwin Sewerage Strategy (DSS) was first developed in 1994 focusing on the central Darwin area including the Central Business District (CBD), Parap, Fannie Bay, Ludmilla and Stuart Park areas (PWC, 2006). In developing the strategy, all present and future sites for treatment plants were reviewed. The review established that the preferred sites for wastewater treatment plants in Darwin were Ludmilla, Leanyer, Berrimah and Hudson Creek (SKM, 1998a). The DSS aims to:

- Operate a waste treatment and disposal network that conforms to nationally accepted environmental standards and accepted best practice
- Increase sewer capacity to handle continued population and industrial growth
- Reduce system overflows during high rainfall
- Reduce the impact of effluent discharges to Darwin Harbour
- Generate increased opportunities for effluent reuse.

The strategy has progressively been implemented, and an estimated $14 million of capital works has been spent to upgrade the sewer reticulation system in the CBD, Frances Bay and Parap, as well as progressive upgrade of LWWTP. The major works remaining are:

- Decommissioning of existing Larrakeyah Ocean Outfall
- Diversion of sewage from the Larrakeyah catchment to the LWWTP
- Duplication of the East Point ERM
- Replacement and or extension of the EPO
- Upgrading of the current treatment facility at LWWTP to augment the existing treatment system to cater for increased flows across a 20 year horizon, with an expected infrastructure life of 25 years (Hunter Water, 2011).

Currently wastewater generated from the CBD and adjacent suburbs is macerated and discharged via the Larrakeyah Outfall to the Darwin Harbour without further treatment. However, since the development of the DSS over 15 years ago, PWC also developed the Larrakeyah Outfall Closure Plan (LOCP), which forms part of PWC's broader Darwin Region Sewerage Strategy. The LOCP aims to:

- Provide capacity for a growing population and industry base
- Improve the performance of the region's sewage treatment and disposal facilities
- Reduce potential impacts on the environment from sewerage operations.

The LOCP project supports the elimination of untreated sewage discharges to Darwin Harbour from the Larrakeyah Ocean Outfall and aims to ensure that all sewerage discharged through PWC's sewerage systems is treated prior to discharge to the environment (PWC, 2008).

Works completed under the LOCP include:

- A new trunk sewer in Mitchell Street
- A new trunk sewer at Dinah Beach along Tiger Brennan Drive
- A new sewage pumping station at Dinah Beach
- A new sewage rising main from Dinah Beach to Parap
- Upgrades to the Frances Bay sewage pumping station
- Upgrades to the Parap trunk sewer
- Upgrades to the various facilities at LWWTP.

3 Description of the Proposal

Works yet to be undertaken under the LOCP include:

- New switchboards and pumps at the Frances Bay sewage pumping station (currently underway)
- Diversion works to deliver sewage from the Larrakeyah catchment to the Dinah Beach trunk sewer (currently underway).
- Upgrades to the LWWTP (currently being assessed)
- Duplication of the East Point ERM (currently undergoing environmental assessment)
- Extension / replacement of the EPO (i.e. the proposed development).

The LOCP works program (both completed and planned) is graphically presented in Figure 3-1, which includes the proposed alignment for both the ERM and EPO.

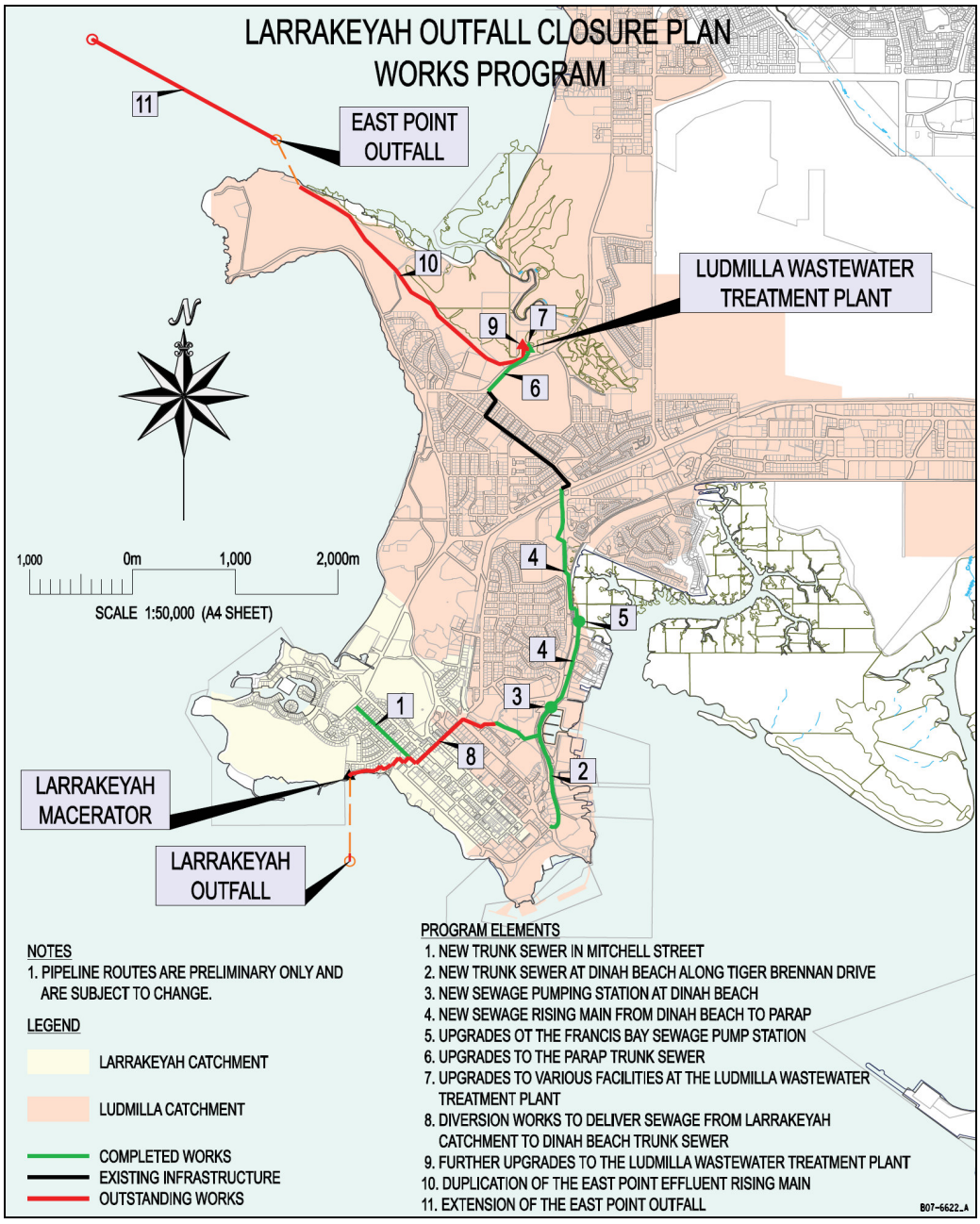


Figure 3-1 Larrakeyah Outfall Closure Plan Works Program

3 Description of the Proposal

3.1.1 Ludmilla Wastewater Treatment Plant

LWWTP was commissioned in 1977, handling flows from residential areas and commercial establishments of the inner suburbs of Darwin. The existing catchment draining to the LWWTP comprises (Figure 3-1):

- Frances Bay
- Stuart Park
- Winnellie
- Mindil Beach
- The Gardens
- Fannie Bay
- Darwin Central Business District.
- Larrakeyah
- The Narrows
- RAAF Base
- Ludmilla
- Coconut Grove
- Nightcliff

The LWWTP treatment process (Drawing 3-1) consists of:

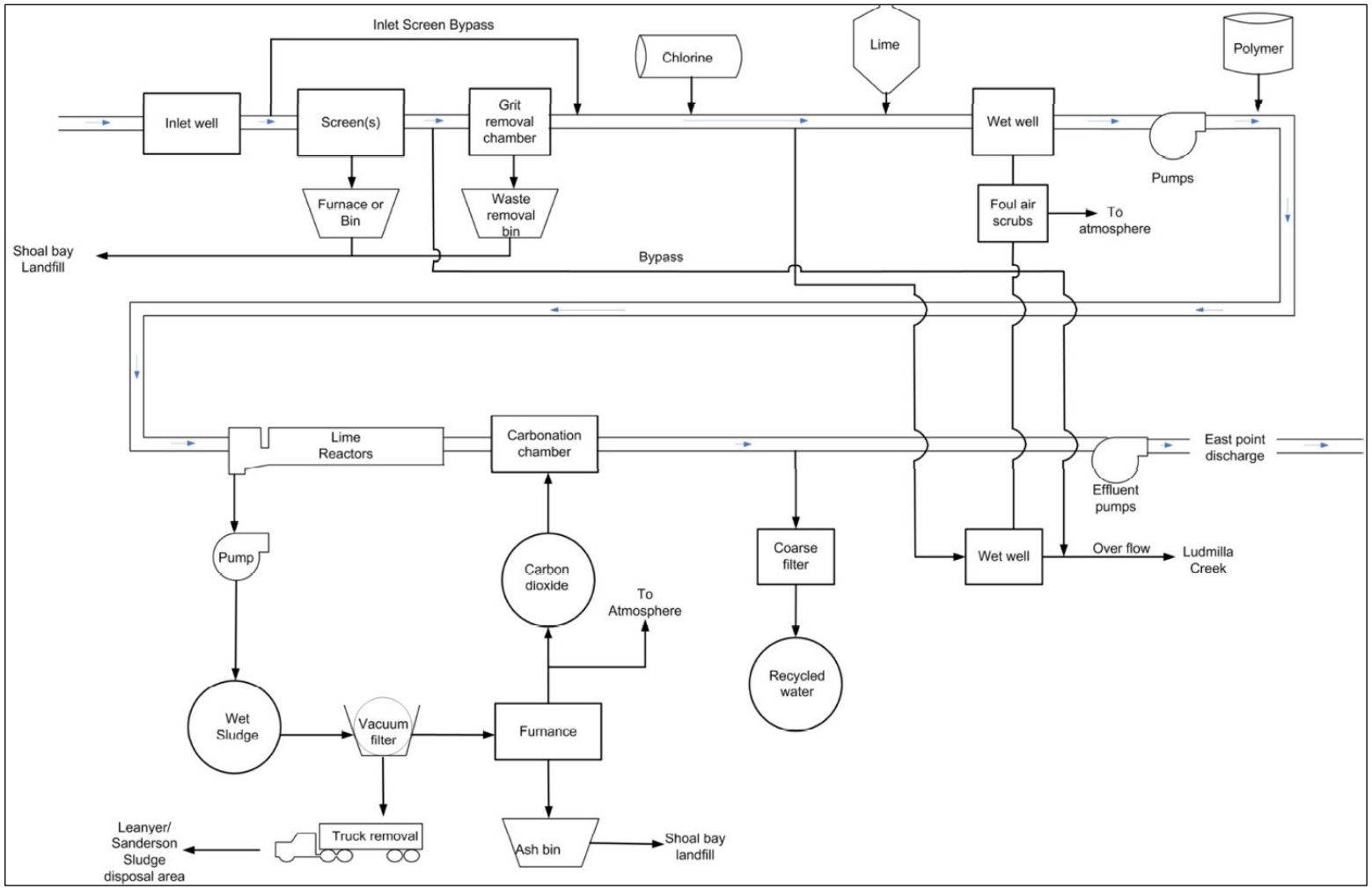
- Inlet works (screening, grit removal and associated conveyor and girt classifier)
- Chlorination, chemical dosing (lime / polymer addition)
- Chemically Assisted Sedimentation (CAS), sludge handling (dewatering)
- Effluent discharge via the existing EPO.

Under the current treatment process raw sewage enters the plant and is passed through an automated step screen and a grit removal chamber. The screens and grit are removed and disposed of off site. The sewage is dosed with chlorine for disinfection and odour control. The screened sewage is then dosed with lime and polymer to aid in particle sedimentation in the settling chambers (i.e., CAS tanks). The plant was originally designed for operation with lime doses up to 140 mg/L and pH up to 10.5. However, in the period after commissioning, the effluent rising main started to show signs of excessive calcium based scaling which reduced the discharge capacity and increased the frequency of wetland overflow discharge. To reduce the impact of calcium scaling, the process was operated at lower lime dose rates, in the order of 80 mg/L, maintaining a residual pH of 7.5 – 8.0. CAS tank supernatant is discharged to Darwin Harbour at East Point via an effluent rising main. CAS sludge is dewatered onsite using vacuum drum filters and is then managed offsite at another Power and Water facility (HunterWater, 2011).

It must be noted that the furnace, recarbonation chamber and ashbin shown in Drawing 3-1 have been made redundant and removed off site as a part of a continual plant upgrade process.

During severe storm events, when flows considerably exceed the capacity of the East Point discharge facility, some flow may bypass the LWWTP and discharge via an open channel to Ludmilla Creek.

3 Description of the Proposal



Drawing 3-1 Existing LWWTP Process Flowchart

Source: HunterWater, 2011

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The current operating regime provides suspended solids removal efficiency in the order of 50% with a corresponding BOD removal efficiency of 35%. The current effluent quality is summarised below in Table 3-1.

Table 3-1 Summary of Existing Effluent Quality Discharged from the LWWTP (January 2005 to October 2009)

Assessable Parameter	No. of Samples	Average (mg/L)	Median (Mg/L)	90%ile (mg/L)	Min (mg/L)	Max (mg/L)
pH	52	7.7	7.6	8.6	6.7	9.0
Biochemical Oxygen Demand (BOD)	45	124	117	201	3	281
Total Suspended Solids (TSS)	52	103	93	138	18	444
E. coli (cfu/100mL)	15	2×10^6	5×10^4	5×10^6	65	16×10^6
Total Nitrogen	32	37	41	46	12	50
Free Ammonia	47	27	30	36	4	39
Total Phosphorus	47	5.4	5.8	7.5	1.1	10.9

Existing discharge of effluent to the Darwin Harbour is licensed by NRETAS under Waste Discharge License (WDL) 150. The WDL contains concentration limits for treated effluent (Table 3-2). The licence is due for renewal on October 31, 2011.

Table 3-2 Quality limits from WDL150 for the LWWTP

Assessable Parameter	Units	Median	90%ile
Dry Weather Flow	kL/day	8,000	11,000
Wet Weather Flow	kL/day	15,000	30,000
Temperature	ºC	-	± 5 ºC ambient
pH	-	-	> 6
BOD	mg/L	100	180
TSS	mg/L	110	170
E. coli	cfu/100mL	$1x10^6$	$1x10^7$
Total Nitrogen	mg/L	37	47
Free Ammonia	mg/L	28	33
Total Phosphorus	mg/L	10	15

In an assessment of the plant, commissioned by PWC, HunterWater (2011) concluded that the existing LWWTP plant capacity is currently limited to approximately 32,000 Equivalent Population. Accordingly, the LWWTP will be upgrade by expanding the existing CAS process with dedicated coagulation and flocculation facilities for a design horizon of 20 years, i.e., 2030 when the average dry weather flow (ADWF) is predicted to be approximately 17.5 ML/day. The upgraded plant must be able to provide hydraulic treatment up to 5 × ADWF.

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Following the upgrade of the LWWTP, overflows to Ludmilla Creek will only occur once the inflow exceeds 5 x ADWF (based on 2030 flows) during extreme weather events. It is important to note that this will only occur once the treatment plant capacity is fully utilised (Design Horizon of 2030). At the early stages of the project life there will actually be significant spare capacity at the plant and any overflows to Ludmilla Creek will be unlikely until this capacity is utilised. The LWWTP upgrade will aim to accommodate the Larrakeyah sewerage diversion and projected population growth within the catchment.

3.1.2 The Existing East Point Effluent Rising Main and Ocean Outfall

The existing rising main (Figure 3-2) comprises of 3,040 m of 610 mm diameter reinforced concrete pipe, leading to a pit (terminal manhole) on the north of East Point. From the pit, effluent is discharged through the existing EPO, a 910 mm concrete pipeline (700 m long), which extends northwest across the intertidal mudflats. The end of the outfall is a vertical discharge at approximately neap tide low water level and 2.2 m below mean sea level.

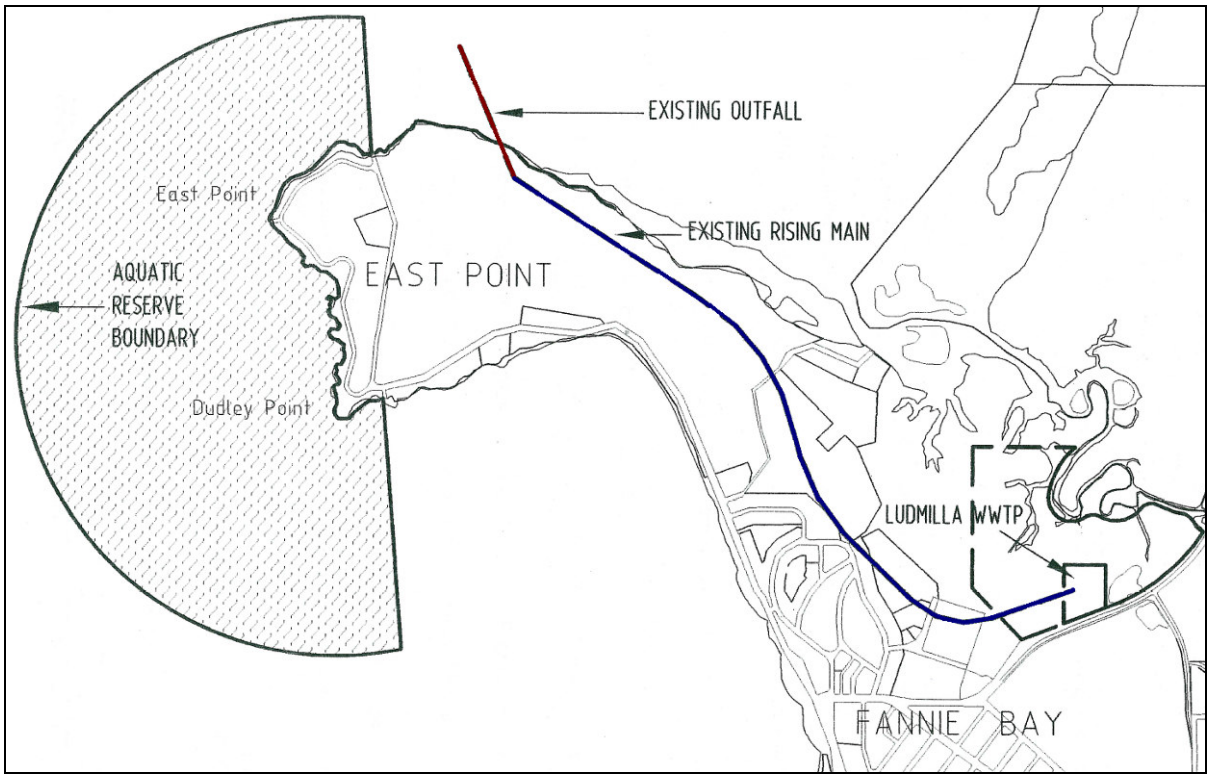

Figure 3-1 Existing ERM and EPO (adapted from SKM 1998b)

3.1.3 Related Project Components

In addition to the proposed EPO replacement and extension, PWC also propose to upgrade the LWWTP and duplicate the existing Effluent Rising Main (ERM). The following summary provides additional information on these components.

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Duplication of the Effluent Rising Main

PWC is planning to duplicate the existing ERM as part of a wider upgrade and amplification of the LWWTP.

The proposed East point ERM duplication and EPO extension were referred to SEWPAC in a referral dated 18 September 2009. A Notice of Intent (NOI) was also submitted to NRETAS for the project on 5 October 2009. NRETAS advised that the proposal will be assessed under the bilateral agreement between the NT and Australian Governments. Guidelines for the preparation of a PER were issued by NRETAS in February 2010.

Following is a brief overview of the proposed duplication of the ERM.

- The duplicate ERM will consist of buried high tensile steel or reinforced concrete with a proposed diameter of 1050 mm, subject to engineering design. The proposed new ERM will extend approximately 3 km in a north westerly direction, broadly aligned with the existing effluent rising main. The alignment for the proposed ERM upgrade has been selected to minimise the potential for clearing of vegetation. It traverses an area of mostly cleared land, roadsides and grassed reserves. Construction of the rising main will typically involve a number of sequential activities outlined below:
  - establishment of temporary facilities
  - access tracks
  - clearing and grading, including the removal and stockpiling of existing top soil and vegetation for later reuse
  - trenching for the pipeline, typically 1.5 m to 2.0 m below the surface
  - bedding and laying of the pipes
  - backfilling the trench
  - testing of pipeline for potential leaks
  - clean-up and rehabilitation of the site.
- The construction corridor will be approximately 15 m wide to accommodate construction material, trenching, access and equipment. Cleared vegetation will be placed in this corridor or an agreed previously cleared area. A staging area for construction of the EPO will also be established at the end of the ERM corridor in the East Point reserve. This area will be approximately 100 m^2. Above ground facilities at intervals along the pipeline route will include meter station, mainline valves and other ancillary facilities.

The rising main has a hydraulic capacity of 30 ML/d at a velocity of 1.2 m/s and the existing concrete EPO has a diameter of 910 mm, with a designed hydraulic capacity of 60 ML/d at a velocity of 1.1 m/s.

Currently, there exists restriction in the rising main due to years of calcium deposition from the past practices of elevated pH dosing upstream at the plant. This has reduced the flow through the rising main to a peak of 200 l/s (17ML/day). If the proposed additional rising main is constructed [refer Section 2.7(b)], hydraulic capacity of 60 ML/day at a velocity of 1.1 m/s will be achieved. This will have an immediate benefit as an increased capacity in the rising main will reduce the potential overflows into Ludmilla Creek at peak wet weather flow events.

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Expansion of Ludmilla Wastewater Treatment Plan

Engineering designs for the proposed expansion are currently being developed. The proposed expansion of the LWWTP aims to accommodate increase inflow from the Larrakeyah catchment by installing four new CAS tanks.

The expansion of the LWWTP aligns with the Public Environmental Report previously assessed by the Environment and Heritage Division of the NT Department of Lands, Planning and Environment.

Figure 3-3 and Figure 3-4 shows the existing layout and the proposed additional CAS tanks. The planned Ludmilla WWTP expansion will be accommodated within the existing cleared area of the plant.

Figure 3-2 Existing layout of Ludmilla WWTP (Google Maps, 2011)

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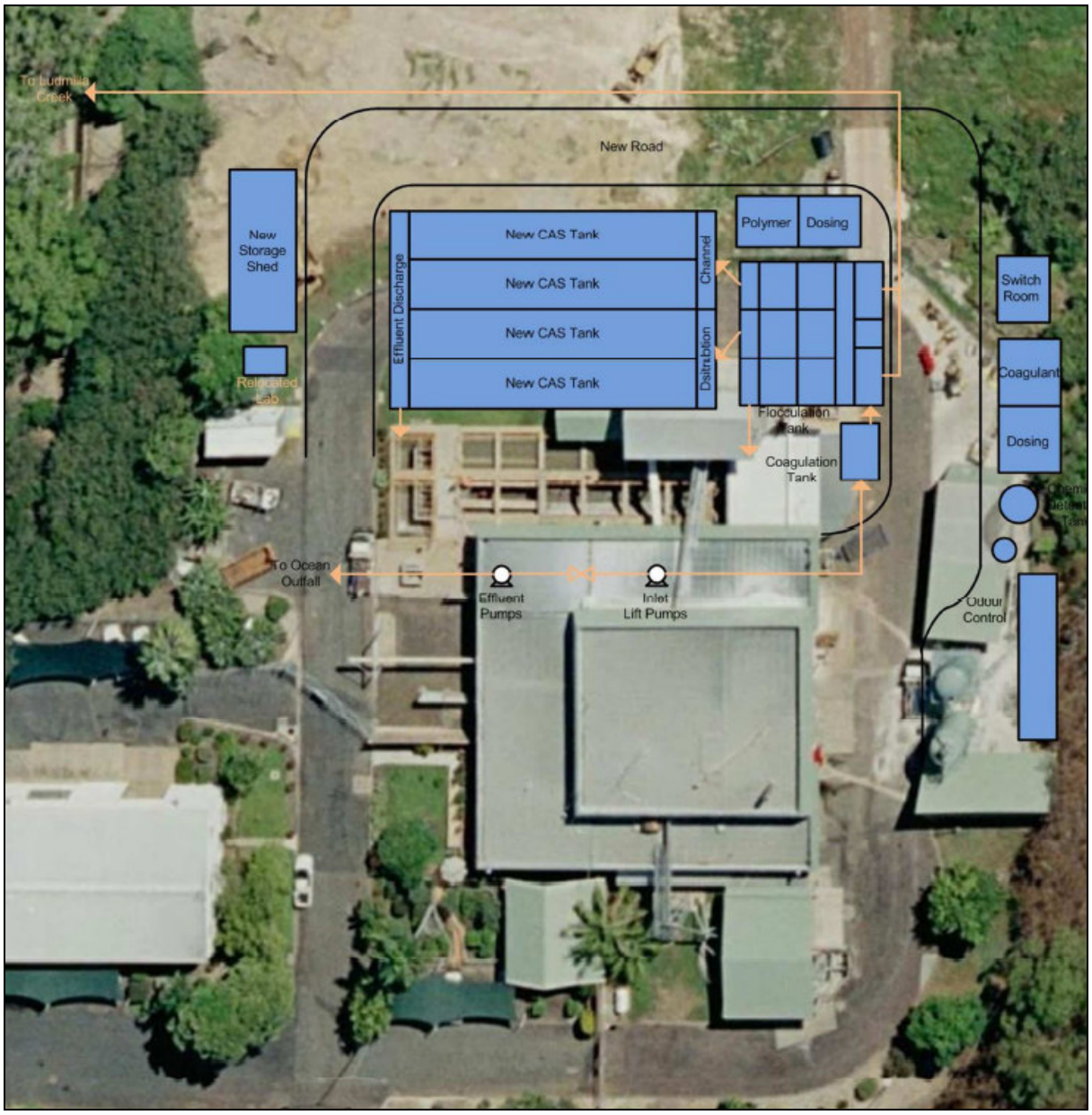

Figure 3-3 Project components of planned Ludmilla WWTP expansion (HunterWater, 2011)

3.2 Proposed Action

PWC discharges treated sewage effluent from the LWWTP into the Darwin Harbour via the EPO. The proponent, PWC, is considering options to replace and extend the existing EPO as part of a wider upgrade of the Darwin sewage network which includes closure of the Larrakeyah Ocean Outfall, diversion of the sewage now discharging through this outfall to the LWWTP and upgrading the LWWTP to manage the additional flows. Components of the LWWTP upgrade and Larrakeyah outfall closure are summarised under Section 3.1.

This NOI applies to the proposed augmentation of the EPO. Initially it was proposed to extend the existing outfall but recent assessment as indicated hat the existing pipe has a limited life so a decision has been made to install a new outfall pipe. A number of options are being considered by the proponent for construction of the EPO (refer Figures 2-2), which can be categorised as either:

- Replacement and extension of existing EPO with pipeline installed in a seabed trench (excavated prior to pipeline installation).
- Installation of a sub-seabed pipeline within a horizontal directional drilled tunnel to replace the existing pipe. The construction concept of this method is based on pre-fabrication of pipeline string onshore, drilling a pilot hole from onshore to a point offshore, and then reaming the pilot hole to a diameter which can accommodate the pipeline.

Within each of these pipeline options various potential methodologies will be fully investigated as part of engineering design for the EPO. These options are briefly described under Section 3.2.1. Operational considerations for the LWWTP and propose EPO are presented under Section 3.2.3, with the rehabilitation and decommissioning described under Section 3.2.4.

3.2.1 Construction works required

PWC plans to augment the existing sewerage system by replacing and extending the existing EPO (the Proposed Development), as recommended in the Larrakeyah Outfall Closure Plan (LOCP).

As previously indicated above, a number of constructions methodologies options are being considered by the proponent for construction of the EPO. These options are currently summarised below and subject to further investigation and engineering design.

If replacement (along the current alignment) and extension of the existing EPO is selected as the final design, excavation of a seabed trench will be required. The material excavated will be stockpiled alongside the trench for backfilling once the pipe is installed. Any excess material will be removed and disposed of on land.

Although the proposed action will occur within NT waters the National Assessment Guidelines for Dredging will be utilised for assessing the impacts from the dredging operation as there are no local guidelines. A range of management options will be considered to reduce or control impacts associated with the dredging operation including:

- Dredged material assessment – to identify any contaminant concentrations
- Management of stockpiled material and monitoring sediment plumes – to reduce dispersal of turbid plumes in sensitive environments
- Changing the location and / or timing of dredging – to avoid or reduce impacts on sensitive benthic communities

- Altering the time of year of dredging – to avoid critical life-cycle phases such as coral spawning
- Use of specialised dredge equipment – such as 'turtle excluding devices', to reduce potential impacts on marine species.

These options will be considered prior to construction and appropriate measures will be implemented to reduce or control potential impacts associated with the activity, if EPO replacement and extension is selected as the preferred design option.

Construction options under consideration include:

Option 1 – Bottom Towed Pipeline

The bottom towed method (refer Figure 3-4) involves constructing the pipeline on shore and towing it on the seabed into position. The trench across the seabed is excavated before the pipe is towed. The net weight of the pipeline is adjusted by filling the pipe with air and adding floats or weight to achieve a new weight in the range of 20 to 50 kg/m. This method is commonly used to install steel outfalls.

The advantage of the bottom tow method is that pipe sections can be assembled on land independent of sea conditions and that towing operations can be timed for a relatively short period of favourable sea conditions. The disadvantage is that the whole trench must be kept open and that large towing forces are involved for long pipelines in exposed areas.

This method is applicable at East Point (particularly for the sections of outfall at greater depths). It is noted that additional piles or weights would be required to secure the pipeline after towing.

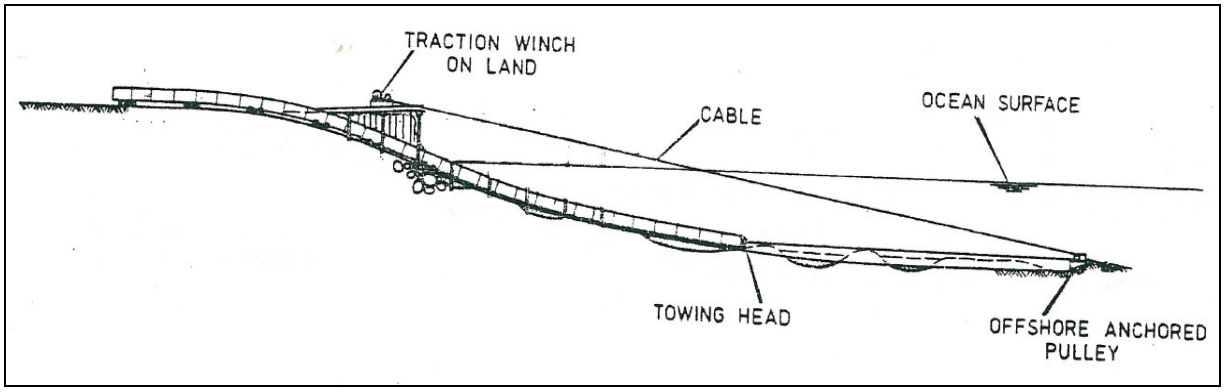

Figure 3-4 Graphical Representation of Bottom Towed Pipeline Installation

Option 2 - Surface Towed Pipeline

The surface towed construction methodology option (refer Figure 3-5) involves constructing the pipeline on the shore, attaching floats or creating sufficient buoyancy to float, towing the pipe on the ocean surface and then sinking the pipe into position. This method is commonly used to install High Density Polyethylene (HDPE) outfalls.

The trench across the seabed is excavated before the pipe is towed and kept open until the pipe is installed. Concrete weights are normally strapped to the HDPE pipe at intervals to provide the necessary weight.

The advantages of the surface tow method are that the pipe can be assembled on land independent of sea conditions and that towing operations can be timed for a relatively short period of favourable sea

conditions. The disadvantages are that the whole trench must be kept open and that it may be difficult to sink and secure the pipe in strong tidal currents. The Larrakeyah outfall was constructed using this method.

Surface towed construction could be applicable for an outfall at East Point with a specialised design. For example, twin HDPE pipes on concrete skids could achieve the necessary weight and stability to resist the wave and current forces. Similar outfalls have been constructed at Dunedin and Waiter, in New Zealand. Additional piles would need to be driven into the concrete skids to secure the pipeline after installation. The main challenge at East Point would be to match the base of the skids to the surface of the rock profile.

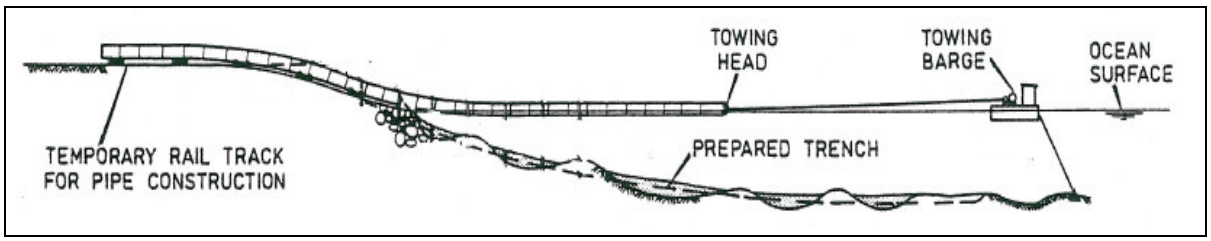

Figure 3-5 Graphical Representation of Surface Towed Pipeline Installation

Option 3 - Install in Sections

The EPO pipeline can be installed in sections (refer Figure 3-6). This method involves constructing the outfall extension using floating equipment. Sections of the pipeline, each approximately 100 m long, would be fabricated onshore, towed to the site, and sunk into position. The pipes would be joined with flanged and bolted joints. This method requires relatively large diameter steel pipelines to achieve the necessary strength for the towing and sinking operations.

The advantages of this method are that only a relatively short length of trench need be kept open any time, the pipe can be assembled on land independent of sea conditions, and that relatively small marine equipment is involved with repeated use of barges and winches.

The disadvantage is that a dredge must be kept onsite for the duration of the installation. This method could be applicable for an outfall at East Point, particularly as it may not be feasible to keep a long length of trench open for a lengthy period.

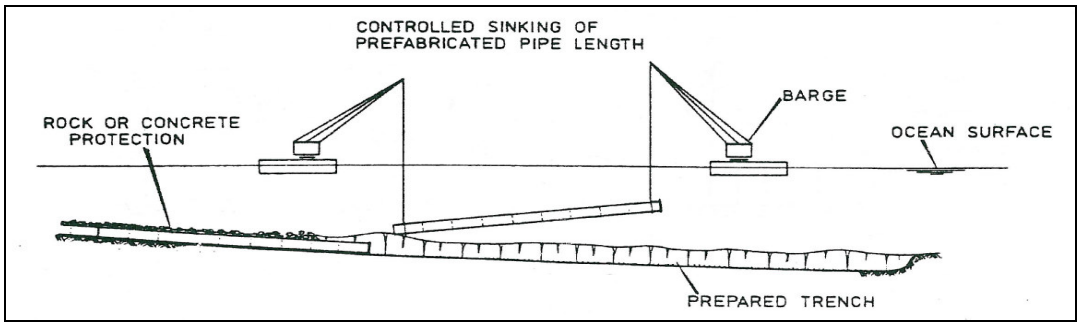

Figure 3-6 Graphical Representation of Prefabricated Length Pipeline Installation

3 Description of the Proposal

Option 4 - Horizontal Directional Drilling

If the existing EPO is replaced by a new pipeline installed within a horizontal directionally drilled tunnel, trenching will not be required.

This method involves directional drilling of a pilot hole below the seabed in suitable material, enlarging the initial pilot hole by back reaming, pulling the pipe through the hole into position, and finally connecting the pipe to the diffuser (refer Figure 3-7).

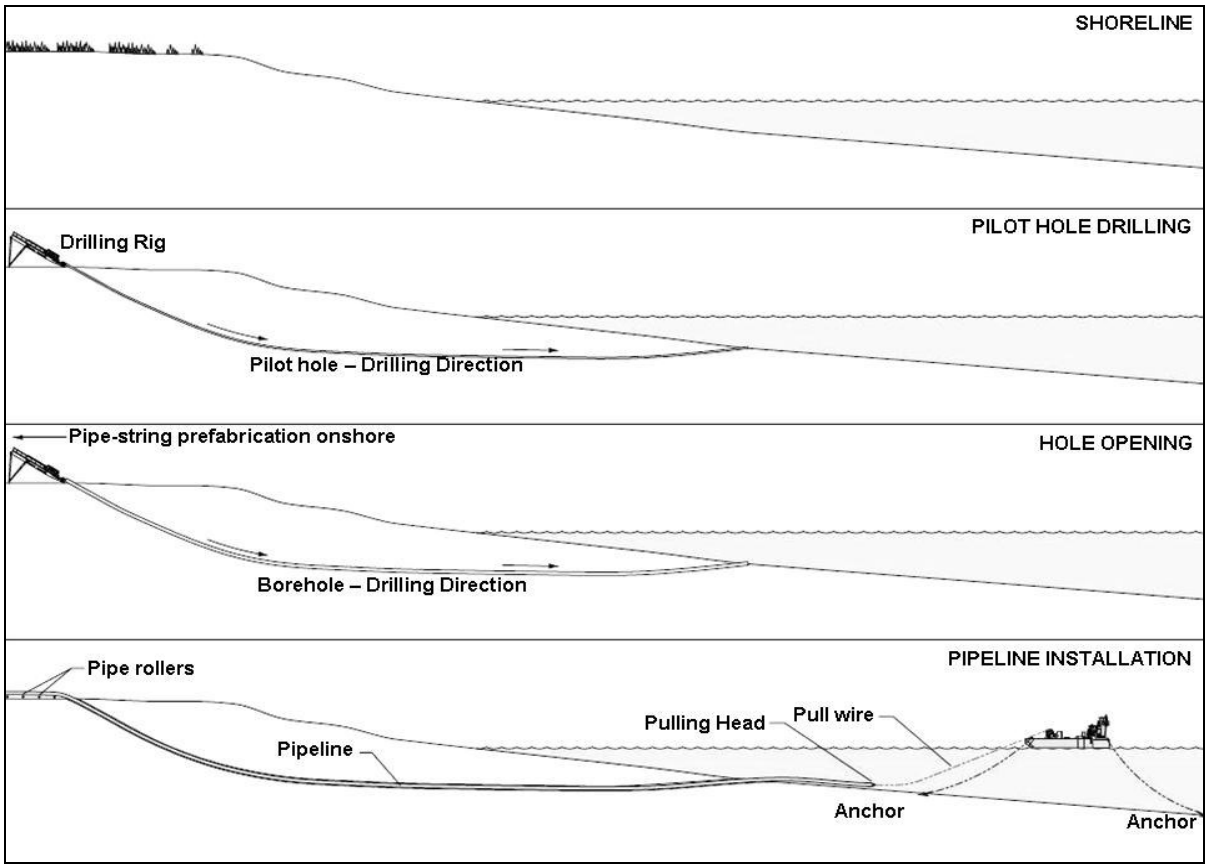

Figure 3-7 Graphical representation of directional drilling (adapted from Atteris, 2005)

The construction concept of this method is based on the following main activities (Atteris, 2005):

- Pre-fabrication of pipeline string onshore
- Drilling a pilot hole from onshore to a point offshore, of a diameter between 254 mm and 304 mm, using a slant drilling rig (the pilot hole drilling operation is steerable)
- Reaming the pilot hole to a size which can accommodate the pipeline, usually between 203 mm and 406 mm greater than the pipeline diameter (depending on pipe diameter and geotechnical conditions)

- Installation of the pipeline into the reamed borehole. This methods have all been applied successfully on pipeline projects worldwide and broadly consist the following actions:
  - a winch pontoon pulls the pipe into the borehole from onshore to offshore using a steel wire rope.
  - an onshore thrusting machine pushes the pipe inside the borehole from onshore to offshore.
  - the pipeline string is towed out over the beach and seabed surface, positioned behind the subsea exit point of the borehole, and subsequently pulled back inside the borehole from offshore to onshore using the drilling rig.

Site conditions which greatly affect the feasibility of horizontal directional drilling are (Atteris, 2005):

- Presence of gravel banks, cobbles, fractured rock and / or cavities in the drilling trajectory. The drilled and reamed borehole is supported by a drilling fluid only and the described ground conditions will cause fluid to seep away from the borehole, with a consequential very high risk of borehole collapse.
- Where onshore topography and near shore bathymetry requires the drilling length to be in excess of approximately 1,000-1,500 m, depending on sub-surface geological conditions and pipeline (borehole) diameter. Drilled pipeline installations across shorelines fit into a category of their own because one end of the crossing is located under water, in often hostile sea state or storm conditions (large waves and / or strong currents, which reduces achievable drilling length.

Construction Material for the East Point Outfall

Construction materials that will be considered for the EPO extension include reinforced concrete, prestressed concrete, steel, polyethylene (HDPE or medium density polyethylene (MDPE)) and glass or fibre reinforced resin.

The following material options for the EPO feasibility study will be considered during the engineering design of the EPO. During the engineering design the most appropriate material for the EPO will be selected.

- **Reinforced Concrete:** The existing offshore pipeline has been constructed from short lengths of jointed reinforced concrete pipe. This construction option offers little support from pipe to pipe, and allows galloping failure in the event of the loss of one pipe. Hence a reinforced concrete pipe is not currently the favoured option for the seabed conditions offshore of East Point.
- **Steel Pipe:** Steel pipe has been used successfully in similar outfalls. The principal advantages of steel are the strength of the material, the high tensile strength and the density (which creates stability). The disadvantage is the corrosion potential, which must be controlled by suitable coatings and galvanic and / or cathodic protection. Steel pipelines are an attractive option in cyclonic areas.
- **High Density Polyethylene Pipe:** The advantage of HDPE is that it has excellent resistance to corrosion from both effluent and seawater. The material is naturally buoyant which makes it easy to handle but creates a high risk in the wave climate at Darwin, where stability must be maintained in cyclonic conditions. The large diameter required to extend the EPO would require large concrete weights to be added to a HDPE pipeline to resist inertial forces, and this would create a greater risk than placing or towing a steel pipeline into position. The problem of air pockets forming in a partly buried HDPE pipeline would be difficult to overcome because of the intermittent pattern of the discharge.

- **Glass and Fibre Reinforced Resin:** Glass and fibre reinforced resin have been used for a small number of outfalls (e.g. Suva, Shell Harbour) but are easily damaged during installation and do not have the tensile strength necessary for this location.

3.2.2 Operational Considerations

LWWTP currently treats sewage from Nightcliff, Winnellie, Parap, Fannie Bay, Stuart Park and most of the inner city. The construction of the rising main from Larrakeyah (not addressed in this Referral) and the subsequent closure of the Larrakeyah Ocean Outfall will result in increased sewage and effluent volumes and effluent in and out of LWWTP respectively. Additional information on the LWWTP and its operation is presented under Sections 3.1 and 3.2.

Potential operational issues associated with the operation of the EPO and rising main are briefly summarised below.

Public Health Issues: Risks of disease transmission are primary issues to consider when discharging treated wastewater. Primary operational issues, although unlikely to occur, include:

- Dispersal of pathogenic micro-organisms from the discharge point and their possible ingestion or inhalation by persons harvesting molluscs and fish; or swimming/diving in proximity of the discharge point. The likelihood of exposure to sewage effluent exists, however, such exposure is considered low.
- Possible contamination of the person or clothing of persons during maintenance of the effluent system.

Discharging of Untreated or Poorly Treated Effluent: The potential of this issue occurring is considered low. The LWWTP is designed to treat sewage to quality standards as defined under its Waste Discharge Licence (WDL). Effluent from the LWWTP is regularly monitored to ensure the quality standards stipulated in the WDL are maintained.

Effects on Marine Organisms: Sewage impacts on marine organisms result directly from impacts on water quality and may include:

- Reduction in growth of light dependent species including hard corals, sessile macroalgae and seagrasses due to increased turbidity
- Death of sessile marine organisms and avoidance by mobile organisms of areas with reduced oxygenation, reduction of light to, and overgrowth of, sessile marine organisms including corals and seagrasses by phytoplankton and sessile microalgae
- De-oxygenation of the water column due to bacterial die-off and decay and potential disease transmission to marine organisms
- Acute and chronic toxicity impacts from metals.

Effects on Marine Water Quality: Discharge of waste water from sewage treatment plants into the marine environment can have a number of adverse impacts depending on the composition of the sewage received at the treatment facility (e.g. whether it contains industrial wastewater in addition to domestic wastewater), the level of treatment within the plant and the capacity of the receiving environment. Adverse water quality impacts can arise where the capacity of the receiving water is exceeded. These include:

- Aesthetic impacts on water quality due to floating rubbish and the presence of a visible (oily) slick

- Reduction water clarity due to presence of particulates in the water column; reduction in dissolved oxygen levels
- Increased nutrient levels (leading to microalgal and phytoplankton blooms, including blue-green algal) when present in excess, elevated metal concentrations, high bacterial counts and presence of a range of other sewage borne microorganisms
- Elevated concentrations of a range of hydrocarbons, with some that may have toxic effects on marine organisms.

Corrosion and Fouling: Screenings and grit are removed at the waste water treatment plant, preventing them from entering the rising main and subsequently the EPO. The screenings are collected into a hopper and disposed to land fill.

3.2.3 Rehabilitation and Decommissioning

The minimum design life of the proposed project is 50 years. Decommissioning of the proposed sewerage infrastructure is not likely to occur for some time. Appropriate rehabilitation of disturbed areas along the pipeline will be undertaken in the final stages of the proposed works. Rehabilitation activities are likely to consist of:

- Removal and appropriate disposal of construction wastes and redundant materials.
- Reinstatement / repair of infrastructure (e.g. roads, tracks, fencing, etc.) that may be disturbed / damaged during construction works
- Rehabilitation of disturbed terrestrial areas will consist of spreading of saved topsoil and previously cleared vegetation. The area will then be left to revegetate naturally. This process will be monitored and actioned as required by PWC
- The disturbed areas of the intertidal zone will be reinstated to replicate the natural slope and water flow
- Disturbed submerged areas will be reinstated to replicate the shape/slope of the surrounding area, with the exception of the actual pipeline alignment which may be raised above the natural surface (depending on the construction method used), with any excess excavated material removed from the site.

Plate 3-1 is a photograph of the rehabilitated intertidal zone, approx. 10 years after construction of the existing EPO. Plate 3-2 indicates rehabilitation after construction of the existing ERM from LWWTP.

3 Description of the Proposal

Plate 3-1 Rehabilitated Intertidal Zone

Plate 3-2 Rehabilitated Effluent Rising Main Alignment

4

Legislation and Licensing Requirements

4.1 Legislation

The Commonwealth and NT Government have jurisdiction over environmental and other legislation relating to the location, construction and operation of the proposed ERM duplication and EPO (presented under this NOI). The list of legislation below provides a summary overview of the legislation that may be relevant to the proposed project and activities undertaken as part of the project.

Environmental Assessment Act 1982 (NT)

The NT environmental assessment process is administered under the *Environmental Assessment Act 1982* and the *Environmental Assessment Amendment Act 1994* (together referred to here as the EA Act) and their Administrative Procedures. The Act and Procedures establish the framework for the assessment of potential or anticipated environmental impacts of development. The object of the Act is to ensure that matters affecting the environment to a significant extent are fully examined and taken into account in decisions by the NTG.

A NOI was also submitted to the NRETAS for the proposed ERM duplication and EPO on 5 October 2009. NRETAS advised that the proposal will be assessed under the bilateral agreement between the NT and Australian Governments. Guidelines for the preparation of a Public Environmental Report (PER) were issued by NRETAS in February 2010.

A variation to the proposed ERM duplication and EPO project has been sent to NRETAS requesting a variation in accordance with Clause 14A of the NT Environmental Assessment Administrative Procedures 2003 (EAAP), supported by this NOI.

Under the requested variation it was proposed to vary the proposed action by removing the EPO component from this proposal, meaning that the PER required under the NRETAS guidelines of February 2010 will only cover the ERM duplication. PWC still intends to extend and replace the EPO as described under this NOI.

Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth)

The proposed East ERM duplication and EPO were referred to the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) in a referral dated 18 September 2009. Similar to the above, PWC have submitted a variation to the ERM duplication and EPO project to SEWPAC in accordance with Section 156A of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The EPBC Referral has been developed concurrently with this NOI.

Territory Parks and Wildlife Conservation Act, 2000 (NT)

The *Territory Parks and Wildlife Conservation Act 2000* classifies the conservation status of wildlife species in the Northern Territory. The list of threatened species in the NT was reviewed in 2006 and gazetted in February 2007.

Heritage Conservation Act 1991 (NT)

All prescribed archaeological places and objects are protected under Sections 29 and 39 of the Heritage Conservation Act. It is an offence to damage, disturb, destroy or alter such material without written consent of the Minister for Environment and Heritage.

4 Legislation and Licensing Requirements

Northern Territory Aboriginal Sacred Sites Act 1989 (NT)

This Act establishes procedures for the protection and registration of sacred sites, providing for entry to sacred sites and the conditions to which such entry is subject, and procedures for the avoidance of sacred sites in the development and use of land.

An Aboriginal Area Protection Authority (AAPA) Certificate for the proposed works was obtained by the proponent, PWC.

The AAPA certificate is attached as Appendix B.

Planning Act 2005 (NT)

The objective of the Planning Act, as amended and enforced at 1 July 2009, is to provide a framework of controls for the orderly use and development of land. The Planning Act provides for a consolidated NT Planning Scheme, which aims to achieve the objectives of the Planning Act, by:

a) strategic planning of land use and development and for the sustainable use of resources;
b) strategic planning of transport corridors and other public infrastructure;
c) effective controls and guidelines for the appropriate use of land, having regard to its capabilities and limitations;
d) control of development to provide protection of the natural environment, including by sustainable use of land and water resources;
e) minimising adverse impacts of development on existing amenity and, wherever possible, ensuring that amenity is enhanced as a result of development;
f) ensuring, as far as possible, that planning reflects the wishes and needs of the community through appropriate public consultation and input in both the formulation and implementation of planning schemes; and
g) fair and open decision making and appeals processes.

A conservation area zoned (Figure 5-6) under the Planning Act as part of the Planning Scheme is located adjacent to the proposed development area. The primary purpose this zone is to conserve and protect the flora, fauna and character of natural areas. Development in these areas is to be sensitive to the natural features and habitats of the zone and be so sited and operated as to have minimal impact on the environment. No works are planned to occur inside the zoned conservation area during the construction of the proposed ERM and EPO.

Fisheries Act 1988, (NT)

The Fisheries Act, as amended and enforce at 18 June 2009, provide for the regulation, conservation and management of fisheries and fishery resources so as to maintain their sustainable utilisation, to regulate the sale and processing of fish and aquatic life, and for related purposes.

The East Point Aquatic Life Reserve (EPALR) was established under this Act to protect the marine biological assemblages in the area of East Point and Dudley Point, which were threatened by collectors in the early 1980's (SKM 1998a).

The proposed alignment options for the EPO are presented in Figure 2-2 and would not pass through the EPALR. However, if selected the directionally drilled option would likely pass under a section of the EPALR.

4 Legislation and Licensing Requirements

Depending on the construction methodology, this area may be impacted on by sedimentation associated with dredging. Appropriate mitigation measures will be investigated to reduce or control potential impacts associated with construction of the EPO on the EPALR.

Waste Management and Pollution Control Act 1998 (NT)

This Act imposes a general duty of care to minimise any pollution or environmental harm and reduce the amount of waste produced. It also stipulates that the Environment Heritage and Arts (EHA) Division of NRETAS must be notified within 24 hours if an incident such as a spill has caused, or is likely to cause, moderate (material) or serious environmental harm.

Water Act 1992 (NT)

The *Water Act 1992* (Water Act) prohibits a waste discharge, including sewage pond effluent, to natural surface and ground waters if it causes the water to be polluted, unless it is a licensed discharge.

Effluent discharge from the LWWTP is authorised through Waste Discharge License (WDL) number 150 issued by NRETAS on 13/10/2006 (which expires on 31/10/2011). The licence water quality limits are provided in Table 3-1.

5

Existing Environment

5.1 Climate

Darwin is located 12° south of the equator in the seasonally dry monsoon tropics. Rainfall seasonality and intense tropical storm activity are the most distinguishing features of the local and regional climatic pattern. The wet season brought on by the North West monsoon weather pattern runs between September and May. The dry season brought on by the south east trade weather pattern across the Australian continent runs between June and August.

Localised thunderstorms occur during transitional periods at the start of the wet from September to November and the end of the wet From March to May. General monsoonal rain associated with the monsoon trough (intertropical convergence zone) falls across the Top End region between December and March. Large low pressure systems associated with the monsoon trough can produce severe tropical cyclones that lead to significant damage to above ground structures.

Climatic observations are made by the Bureau of Meteorology (BoM) at the Darwin Airport, site number 014015. Darwin Airport is located in close proximity to East Point and Ludmilla (approx. 2 km and 5 km respectively).

Long term averages for the period 1941 to 2009, based on observations made by BoM, are presented in Table 5-1. The major climatic observations include information on temperature, rainfall, humidity and wind speed.

Following is a brief description of the major climatic observations made by BoM (2009).

5.1.1 Temperature

Ambient temperature at Darwin has an annual mean daily maximum of 32°C and daily minimum of 23.2°C. The mean annual temperatures for 9 am to 3 pm are 26.7°C and 30.8°C respectively. November is recorded as having the highest mean maximum temperature (30.5°C) and July the lowest mean minimum temperature (19.2°C).

The monthly mean maximum and minimum temperatures recorded at Darwin during 1941 to 2009 are presented at Figure 5-1.

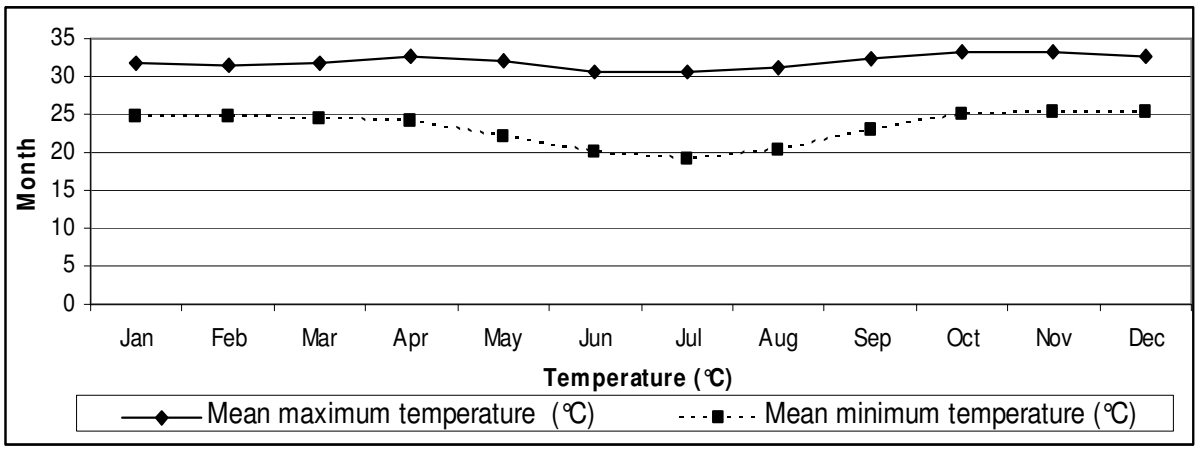

Figure 5-1 Mean Maximum and Minimum Temperatures

5 Existing Environment

Table 5-1 Long-Term Climate Data - Darwin Airport (1941 - 2009)

STATISTICS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Temperature													
Mean maximum temperature (°C)	31.8	31.4	31.9	32.7	32	30.6	30.5	31.3	32.5	33.2	33.3	32.6	32
Mean minimum temperature (°C)	24.8	24.7	24.5	24	22.1	19.9	19.2	20.4	23	25	25.4	25.3	23.2
Rainfall													
Mean rainfall (mm)	420	365	321	99.8	20.4	2	1.3	5.3	15.2	69.2	139	247	1708.7
Decile 5 (median) rainfall (mm)	410	355	289	73.2	4	0	0	0	6.1	52.8	141	224	1700.9
Mean number of days of rain ≥ 1 mm	18.8	18.1	16.8	7	1.6	0.3	0.2	0.4	1.5	4.9	9.9	14	93.5
Other daily elements													
Mean daily sunshine (hours)	5.7	5.7	6.8	8.8	9.6	9.9	10.1	10.3	9.9	9.5	8.4	6.9	8.5
Mean number of clear days	0.6	0.7	2	6.3	12.3	16.3	17.7	19.1	15.3	9.1	3.6	0.9	103.9
Mean number of cloudy days	24.1	21.6	19.5	11.3	6.3	3.8	3.4	2.6	3.2	5.6	11.5	20.3	133.2
9 am conditions													
Mean 9am temperature (°C)	28	27.7	27.6	27.4	25.6	23.3	22.8	24.4	26.9	28.7	29.2	28.8	26.7
Mean 9am relative humidity (%)	81	83	82	74	65	60	60	64	68	69	72	76	71
Mean 9am wind speed (km/h)	11.3	11	8.9	10.4	13.5	14.6	12.8	10.6	8.9	8.7	8.6	9.8	10.8
3 pm conditions													
Mean 3pm temperature (°C)	30.2	29.9	30.5	31.8	31.2	29.9	29.5	30.2	31.2	32	31.9	31.2	30.8
Mean 3pm relative humidity (%)	70	72	67	52	43	38	37	40	47	52	58	65	54
Mean 3pm wind speed (km/h)	17.7	18.5	16.3	16.5	17	16.2	17	18.9	20.8	19.8	17.6	17.5	17.8

5.1.2 Rainfall

Over 80% of the average annual rainfall occurs as general monsoon rain during the period from December to February. The mean annual rainfall is approximately 1,708.7 mm, with January statistically being the wettest month and July the driest. Relatively short duration, high intensity events, associated with afternoon and evening showers and thunderstorms dominate the rainfall pattern.

The mean monthly rainfall for the period 1941 to 2009 is presented at Figure 5-2.

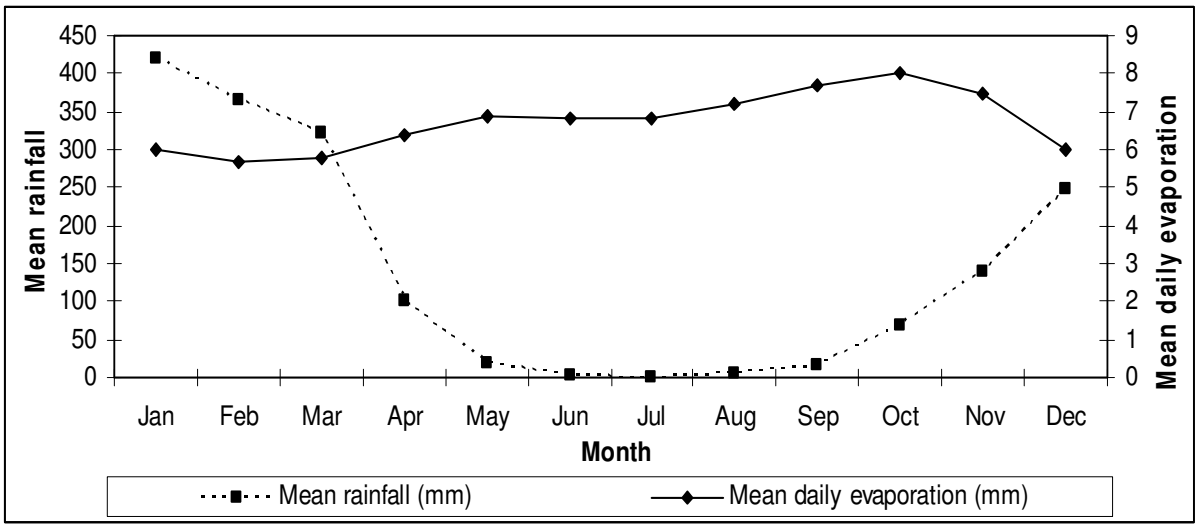

Figure 5-2 Mean Monthly Rainfall and Mean Daily Evaporation (1941 - 2009)

5.1.3 Humidity and Evaporation

Humidity is highest during February, when the mean 9 am value at Darwin Airport is 83 % and the lowest mean humidity is in July and August at 37 % at 3 pm. The annual mean daily evaporation for Darwin is indicated by BoM (2009) as between 6.8 mm, with the monthly average daily evaporation ranging between 1.3 mm in July to 420.3 mm in January (refer Figure 5-2).

5.1.4 Wind Speed

Prevailing winds during the wet season (November to March) are light west to north-westerly, freshening in the afternoon due to sea breezes. During the day, the wind direction is variable, with a predominant easterly flow (BoM, 2009).

The predominant winds during the dry season (April to October) are light to moderate and from the north-east to south-east quadrants. During the day, winds blow mainly from the south-east quadrant. At night the wind direction is mainly from the south south-east and north east.

5.2 Flora, Fauna and Habitats

5.2.1 Listed Threatened and Migratory Species

A search of the ERIN database of the Commonwealth Department of Environment, Water, Heritage and the Arts indicates the potential presence of 54 migratory species, including seven terrestrial bird species, 28 wetland birds, four migratory marine birds, eight marine mammals, six marine reptiles and one shark, as outlined below (Tables 5-2 and 5-3).

Table 5-2 Listed threatened species (or their habitat) that may occur within the project area

Group	Scientific Name	Common Name	Status
Birds	*Erythrotriorchis radiatus*	Red Goshawk	Vulnerable
	Erythrura gouldiae	Gouldian Finch	Endangered
	Geophaps smithii smithii	Partridge Pigeon (eastern)	Vulnerable
Mammals	*Balaenoptera musculus*	Blue Whale	Endangered
	Conilurus penicillatus	Brush-tailed Rabbit-rat, Brush-tailed Tree-rat	Vulnerable
	Megaptera novaeangliae	Humpback Whale	Vulnerable
	Dasyurus hallucatus	Northern Quoll	Endangered
	Xermomys myoides	Water Mouse, False Water Rat	Vulnerable
Reptiles	*Caretta caretta*	Loggerhead Turtle	Endangered
	Chelonia mydas	Green Turtle	Vulnerable
	Dermochelys coriacea	Leathery Turtle, Leatherback Turtle, Luth	Vulnerable
	Eretmochelys imbricata	Hawksbill Turtle	Vulnerable
	Narator depressus	Flatback Turtle	Vulnerable
Sharks	*Pristis zijsron*	Green Sawfish, Dindagubba, Narrowsnout Sawfish	Vulnerable
	Rhincodon typus	Whale Shark	Vulnerable
	Pristis microdon	Freshwater Sawfish	Vulnerable

Table 5-3 Listed migratory species (or their habitat) that may occur within the project area

Group	Scientific names	Common name
Birds	*Charadrius mongolus*	Gouldian Finch
	Charadrius veredus	White-bellied Sea-Eagle
	Glareola maldivarum	Barn Swallow
	Heteroscelus brevipes	Rainbow Bee-eater
	Limicola falcinellus	Derby White-browed Robin
	Limosa lapponica	Rufous Fantail
Migratory Wetland Species - Birds	*Limosa limosa*	Common Sandpiper
	Numenius madagascariensis	Great Egret, White Egret
	Numenius minutus	Cattle Egret
	Numenius phaeopus	Ruddy Turnstone

5 Existing Environment

Group	*Scientific names*	Common name
Migratory Wetland Species – Birds (cont.)	*Pluvialis fulva*	Sharp-tailed Sandpiper
	Pluvialis squatarola	Sanderling
	Tringa glareola	Red Knot, Knot
	Tringa nebularia	Curlew Sandpiper
	Tringa stagnatilis	Red-necked Stint
	Xenus cinereus	Great Knot
	Apus pacificus	Double-banded Plover
	Ardea alba	Greater Sand Plover, Large Sand Plover
	Ardea ibis	Lesser Sand Plover, Mongolian Plover
	Sterna albifrons	Oriental Plover, Oriental Dotterel
	Balaenoptera edeni	Oriental Pratincole
	Balaenoptera musculus	Grey-tailed Tattler
	Dugong dugon	Broad-billed Sandpiper
	Megaptera novaeangliae	Bar-tailed Godwit
	Orcaella brevirostris	Black-tailed Godwit
	Orcinus orca	Eastern Curlew
	Sousa chinensis	Little Curlew, Little Whimbrel
	Tursiops aduncus	Whimbrel
	Caretta caretta	Pacific Golden Plover
	Chelonia mydas	Grey Plover
	Crocodylus porosus	Wood Sandpiper
	Dermochelys coriacea	Common Greenshank, Greenshank
	Eretmochelys imbricata	Marsh Sandpiper, Little Greenshank
	Natator depressus	Terek Sandpiper
Migratory Marine Birds	*Rhincodon typus*	Fork-tailed Swift
	Charadrius leschenaultii	Great Egret, White Egret
	Charadrius mongolus	Cattle Egret
	Charadrius veredus	Little Tern
Migratory Marine Mammals	*Glareola maldivarum*	Bryde's Whale
	Heteroscelus brevipes	Blue Whale
	Limicola falcinellus	Dugong
	Limosa lapponica	Humpback Whale
	Limosa limosa	Irrawaddy Dolphin
	Numenius madagascariensis	Killer Whale, Orca
	Numenius minutus	Indo-Pacific Humpback Dolphin
	Numenius phaeopus	Spotted Bottlenose Dolphin (Arafura/Timor)
Reptiles	*Pluvialis fulva*	Loggerhead Turtle
	Pluvialis squatarola	Green Turtle
	Tringa glareola	Estuarine Crocodile, Salt-water Crocodile
	Tringa nebularia	Leatherback Turtle, Leathery Turtle, Luth
	Tringa stagnatilis	Hawksbill Turtle
	Xenus cinereus	Flatback Turtle
Sharks	*Apus pacificus*	Whale Shark

5 Existing Environment

5.2.2 Territory Threatened Species

The search of the NTG databases for the area lists 17 threatened species (Table 5-4) that may occur or have been recorded in the area. A copy of this database search is included in **Appendix D.** It is important to note that some of these records of threatened species are historical or are generated from data from the wider region.

Table 5-4 Threatened species recorded in the grid cell(s) in which East Point, Darwin occurs

Group	Scientific Name	Common Name	NT Status
Cycads	*Cycas armstrongii*	Armstrong`s Cycad	Vulnerable (VU)
Insects	*Attacus wardi*	Atlas Moth	Endangered (EN)
Fish	*Pristis clavata*	Dwarf Sawfish	Vulnerable (VU)
	Pristis zijsron	Green Sawfish	Vulnerable (VU)
	Varanus mertensi	Mertens' Water Monitor	Vulnerable (VU)
	Varanus panoptes	Yellow-spotted Monitor	Vulnerable (VU)
Birds	*Dromaius novaehollandiae*	Emu	Vulnerable (VU)
	Erythrotriorchis radiatus	Red Goshawk	Vulnerable (VU)
	Ardeotis australis	Australian Bustard	Vulnerable (VU)
	Rostratula australis	Australian Painted Snipe	Vulnerable (VU)
	Tyto novaehollandiae	Masked Owl	Endangered (EN)
	Tyto novaehollandiae kimberli	Masked Owl (northern mainland)	Vulnerable (VU)
	Erythrura gouldiae	Gouldian Finch	Endangered (EN)
Mammals	*Dasyurus hallucatus*	Northern Quoll	Critically Endangered
	Phascogale pirata	Northern Brush-tailed Phascogale	Data Difficient
	Balaenoptera musculus	Blue Whale	Data Difficient
	Megaptera novaeangliae	Humpback Whale	Data Difficient

5.2.3 Marine Habitat

In 2007 and 2008, PWC commissioned an extensive benthic survey (Attachment C) of the area in proximity to the planned extension of the EPO. The benthic survey at East Point collected benthic data:

- Along the proposed outfall alignment.
- Adjacent to the principal pipeline route option.
- At nearby and remote reference sites.
- At previous benthic survey sites (to compare data from previous studies).

The benthic survey aimed to:

- Determine the diversity and density if benthos along the proposed pipeline route options.
- Identify remote and nearby reference sites and survey their benthos for comparison with proposed pipeline route benthos.
- Confirm preliminary substrate information along potential pipeline route options.

5 Existing Environment

A summary of the benthic habitat in the survey area is provided below:

- Characterised by sand and mud habitats (refer Figure 5-3, sites B2 and B3) with low to very low benthic diversity and abundance compared to sand and reef locations in the Darwin Harbour region.
- The seagrass *Halophila decipiens* is anticipated to be prevalent throughout the inshore area to the north of the proposed pipeline alignment. It covered less than 1% of the sand substratum at site A2 and 22% at site B3. The seagrass is a fast coloniser and would recolonise following a linear disturbance such as installation of the outfall pipeline. Dugongs, a large marine mammal, feed on this seagrass. It is unlikely that any substantial populations of dugong are feeding on the small seagrass patch site B3.
- Rich benthic communities dominated by sponges and gorgonians occurred in both sand reference sites (ERF1 and ERF2). Compared with the sand living communities surveyed along the outfall alignment are relatively sparse and with a low diversity.
- All the reef reference communities supported rich benthic communities at least an order of magnitude higher in benthic density and diversity compared to the communities recorded along the proposed outfall alignment.

Figure 5-3 indicates the survey sites, benthic density data documented during the commissioned benthic surveys and the East Point Marine Reserve.

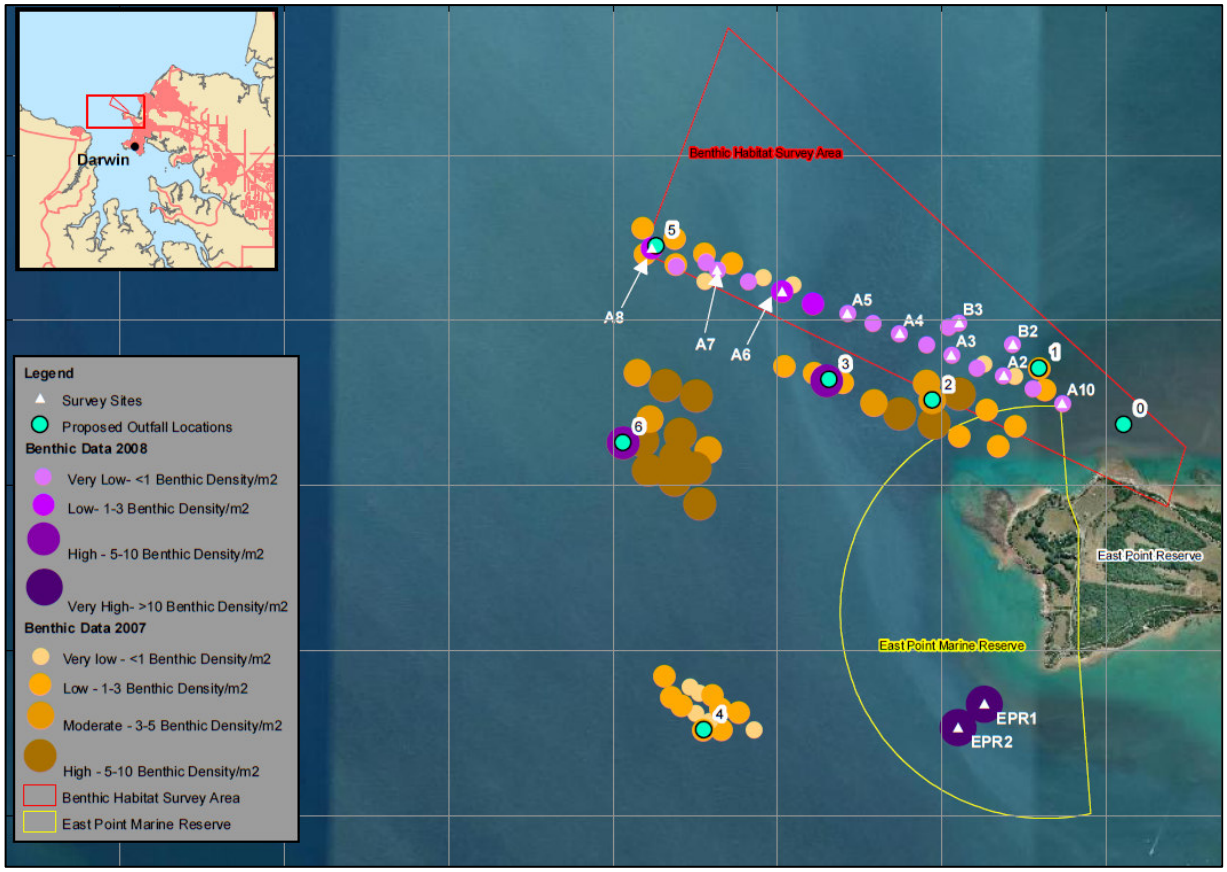

Figure 5-3 Bathymetric and Benthic Survey Area (adapted from GHD, 2009)

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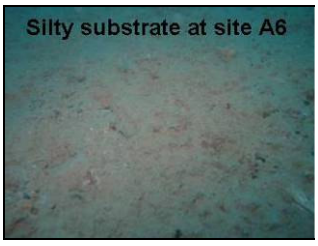
The benthic habitats, described by GHD (2009), are presented in Table 5-5.

Table 5-5 Summary of Benthic Habitat along Effluent Outfall Alignment

Survey Sites	Description
A10 to A3	The substrate of this inshore area of the proposed effluent outfall alignment was fine rippled or consolidated sand with very low benthic diversity. A species of solitary ascidian was the only common benthic organism encountered. Patches of the seagrass *Halophila decipiens* covered approximately 1% of the sand substratum at site A2.  Sandy substrate at site B2  *Halophila decipiens* at site A2  Solitary ascidian between A10 and A2
A3 to A4	A major depth discontinuity (between sites A3 and A4) along the proposed pipeline alignment marked the point where a wide dune of mobile sand crossed the route. The large mobile sand waves run from the northern edge of East Point north up toward Nightcliff. There were no benthic organisms recorded on the mobile sand wave.
A4 to A7	West (seawards) of the sand wave system recorded at sites A3-A4 the depth increased rapidly and the substratum became increasingly muddy with deep, easily re-suspended silt covering the bottom. From approximately A5though to halfway between A6-A7 along the proposed pipeline alignment the bottom was smooth soft sandy mud with some embedded pebbles and numerous worm and crustacean holes. This mud habitat supported a low diversity benthic community dominated by small communities of sponge species with occasional gorgonians, bryozoans and ascidians. Mean densities of benthic organisms in this habitat ranged from 0.5 to 1.0 per square metre.  Silty substrate at site A6  Silty substrate at site A6  Gorgonians, sponges and bryozoans in mud habitat
A7	Approximately 2700m along the preferred pipeline corridor the depth began to decrease and the substratum became firmer and sandier with numerous small pebbles and low silt content. This habitat supported a low density benthic community dominated by sponges with some gorgonians, bryozoans and ascidians.  Pebbly sand substrate on seaward side  Zoanthids growing on sponges in sand pebble habitat
A7 to A8	Approximately four large mobile sand wave systems between 3 and 5m high crossed the proposed pipeline alignment that show up as distinct features on the bathymetric map (refer Figure 2-2). These mobile sand waves did not support any benthic organisms.
B2 and B3	These sites adjacent to the proposed pipeline alignment sites (A2 and A3) recorded habitat similar to the inshore 800m of the proposed pipeline alignment. The substratum was fine rippled or consolidated sand with very low benthic diversity. A species of solitary ascidian

5 Existing Environment

Survey Sites	Description
	was the only organism encountered at site B2. A very low abundance of sponges, hydroids and soft corals were encountered at site B3. Patcjes of the seagrass *Halophila decipiens* covered 22% of the sand substratum at adjacent sand site B3 and less than 1% of the sand substratum at site A2. This seagrass species needs stable sand and light in order to survive. It is anticipated to be prevalent throughout the inshore area to the north of the proposed pipeline alignment. This species is a grazing resource for animals such as Dugongs, and is known as a fast coloniser able to quickly recolonise following a linear disturbance such as the outfall pipeline instalment.
ERF 1 and 2	EPR 1, the first reference site, was located on the shallow reef slope and was dominated by hard corals, which covered over 40% of the substratum. The families Faviidae and Pectiniidae were the most abundant coral families and accounted for more than half of the cover of hard corals recorded. Sponges were also common with a diverse range of species covering a total of 13% of the substratum. Combined benthic abundance was very high with almost 60% cover and an estimated density of over 10 organisms per square metre. Benthic diversity was very high with over 100 species recorded in four transects. The deeper East Point Reserve site (EPR 2) had numerous reef patches on a sand substratum and supported a benthic community dominated by a diverse array of sponges. The sponges covered 15% of the substratum, and accounted for almost three quarters of the overall benthic cover. Hard corals were rare at this site and only covered 1% of the substratum. Benthic diversity was very high at the site with over 100 species recorded.  Hard corals and sponges at EPR1  Hard corals and sponges at EPR1  Sponges and gorgonians at EPR2

5.2.4 Weeds and Feral Animals

A report generated through the EPBC database (Appendix A) list the following Invasive Species and Weeds of National Significance (WoNS) that may occur with in the proposed project area (Table 5-6).

Both *Leucaena leucocephala* and *Stachytarpheta spp* are evident at the site. However, it is unlikely that *Cenchrus ciliaris* and *Salvinia molesta* listed by the EPBC referral tool report exist in the project area. It is also unlikely, although listed, that *Bubalus bubalis* and feral pigs inhabit there area. However, *Bufo marinus* have been noted in the project area.

Table 5-6 Weeds and Feral Animals

Plants		
Andropogon gayanus	Invasive	Species or species habitat likely to occur within area
Brachiaria mutica	Invasive	Species or species habitat likely to occur within area
Cenchrus ciliaris	Invasive	Species or species habitat may occur within area
Lantana camara	WoNS	Species or species habitat may occur within area
Mimosa pigra	WoNS	Species or species habitat likely to occur within area
Pennisetum polystachyon	Invasive	Species or species habitat likely to occur within area
Salvinia molesta	WoNS	Species or species habitat may occur within area

Animals		
Bubalus bubalis	Feral	Species or species habitat likely to occur within area
Felis catus	Feral	Species or species habitat likely to occur within area
Sus scrofa	Feral	Species or species habitat likely to occur within area
Bufo marinus	Invasive	Species or species habitat likely to occur within area

5.3 Oceanographic Features

5.3.1 Bathymetry

PWC commissioned a bathymetric survey to the north west of East Point encompassing the proposed outfall alignment. Key findings from the survey can be summarised as:

- Bathymetric data were collected according to a 2 m grid, which means that objects smaller than 2 m would not be identified on the 3D bathymetric overly. Two sets of regular shaped sand waves were identified during the survey (Figure 5-4). The most easterly and inshore are suspected to be mobile and the offshore sand waves being less likely to be mobile. Areas that appear flat or featureless would indicate compacted sand similar to that observed in the intertidal zone.
- Scattered rocks and patches of reef or rock structures, similar to those in the intertidal zone (Plate 5-1) were identified to the south of the proposed outfall alignment (Figure 5-4).
- Tides in Darwin Harbour are semi-diurnal, i.e. two high and two low tides each day and ranges from up to 8m at spring tide. Photographs of the intertidal zone viewed at low tide are presented Plates 5-1, 5-2 and 5-3.

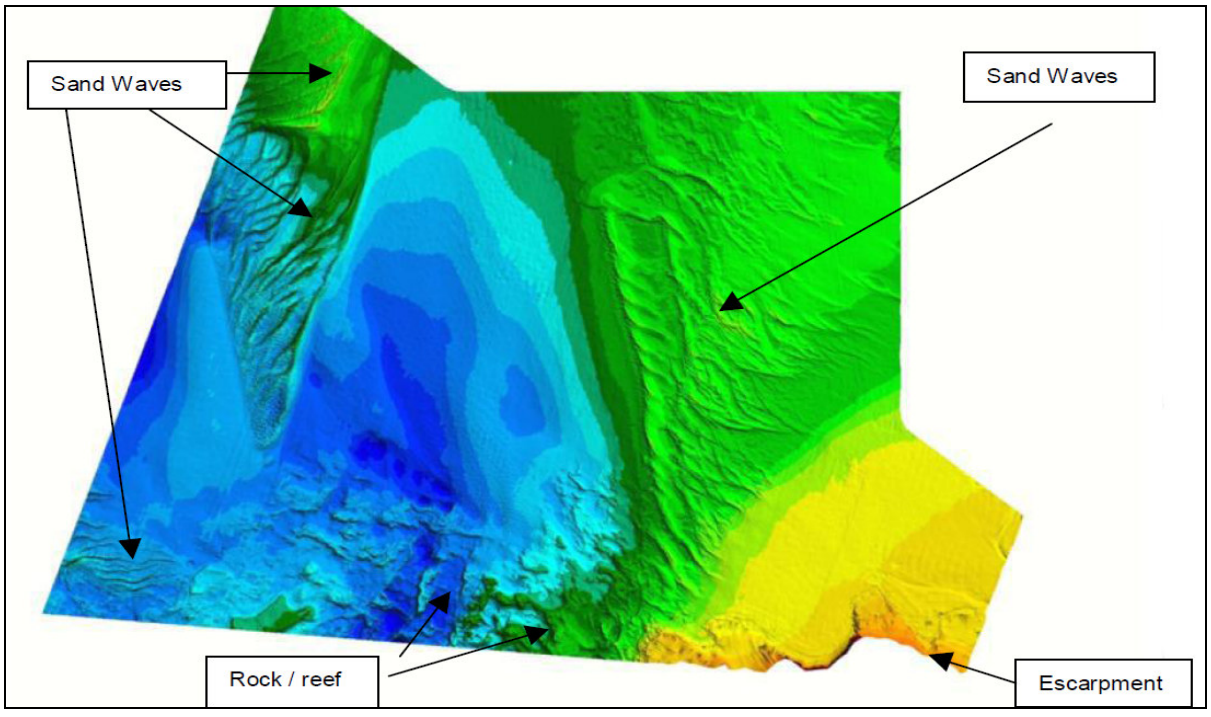


Figure 5-4 3D image of the bathymetric data

5 Existing Environment

Plate 5-1 Exposed Intertidal Area at East Point

Plate 5-2 Scattered Rocks Visible at Low Tide

Plate 5-3 Exposed intertidal area at East Point - Intertidal zone mud

5.3.2 Tides

Darwin Harbour is characterised by a macro-tidal regime with a maximum range of 8.1 m (Harper, 2010). The highest expected tidal level at any location is termed Highest Astronomical Tide (HAT); it is 4.0 m AHD (Australian Height Datum) in Darwin Harbour. Depending on the super-position of the Sun's and Moon's gravitational attractions, HAT occurs once each 18.6 year period, although at some sites tide levels similar to HAT may occur several times a year. The mean neap tidal range is 1.9 m, while spring tides have an average range of 5.5 m.

Tides are predominantly semidiurnal (two highs and two lows per day), with a slight inequality between the successive tides during a single day. Nearly diurnal tides occur for a two day period during the neaps. The lowest spring tides of the year occur during October, November and December, while the highest spring tides take place in June and July. Tidal excursions range from 8 to 15 km during springs and 2 to 8 km during neaps (Semeniuk, 1985; Hanley & Caswell, 1995). Peak spring tide flows measured along a line from East Point to Mandorah are in the order of 120,000 m^3/s (Williams et al., 2006).

5.3.3 Currents

The physical processes that typically drive water movement in coastal marine environments are tidal and wind induced currents. Due to the above-mentioned macro-tidal regime of the Harbour, prevailing currents are of tidal origin. One of the most recent studies of currents in Darwin Harbour, which included both field measurements and numerical simulations using two different hydrodynamic models, was financed by INPEX for the Ichthys Gas Field Development Project (INPEX 2010a; INPEX 2010b).

The produced numerical modelling results were consistent with the collected current records and reflected the following: maximum flood current speeds near the entrance to the Harbour varied from 0.3 m/s (neaps) to 1 m/s (springs); while the maximum ebb speeds varied from 0.5 m/s (neaps) to 1.6 m/s (springs). Williams *et al*. (2006) indicate that speeds can peak at 2–2.5 m/s during spring tides.

At the inner-harbour locations, differences between the flood and ebb currents were not as pronounced with maximum spring current speeds from 0.7 to 1.3 m/s and maximum neap speeds from 0.1 to 0.4 m/s, depending on the bathymetry and proximity to the shore (INPEX 2010b).

Figures 5-5 and 5-6 shows typical flood and ebb current vectors respectively with colour-coded surface elevation.

5 Existing Environment

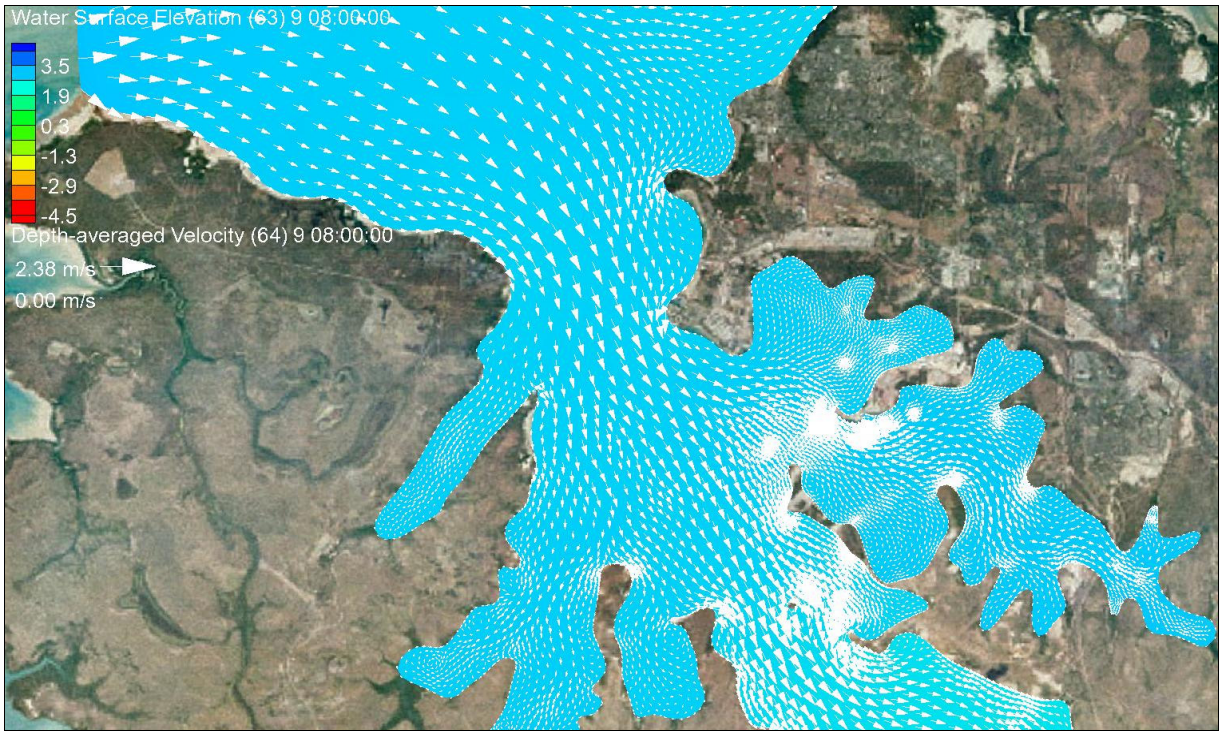


Figure 5-5 Typical flood current vectors with colour coded water surface elevation

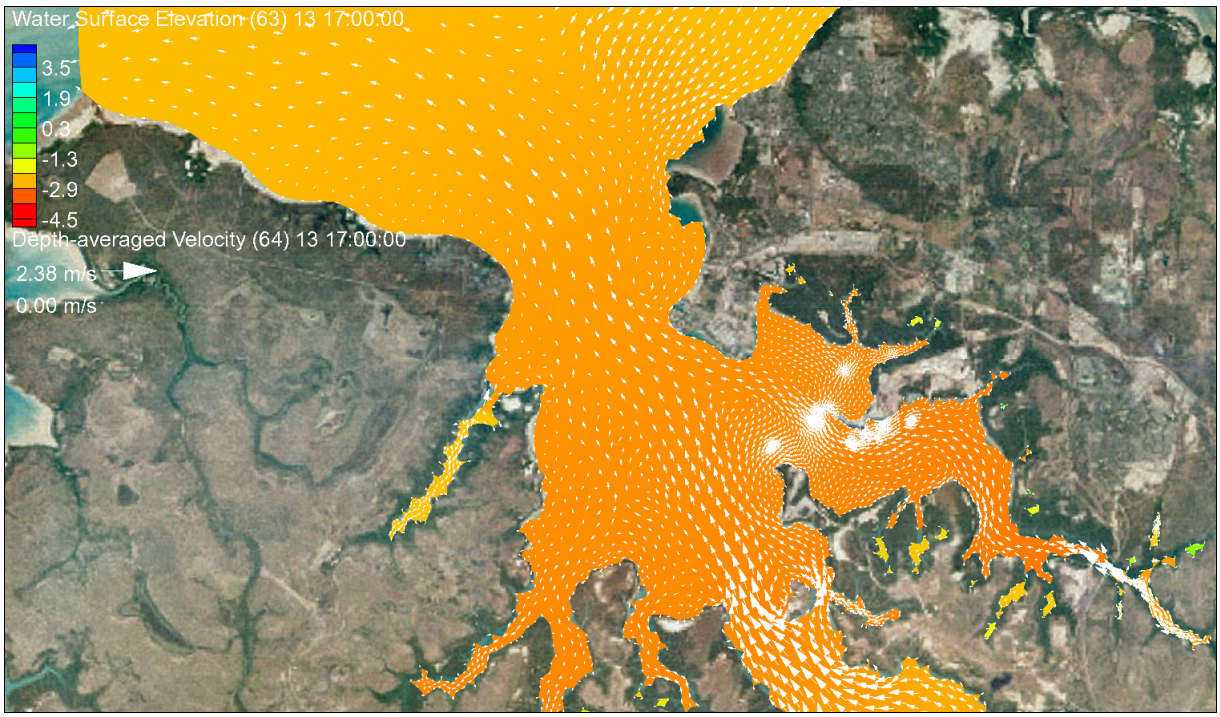


Figure 5-6 Typical edd current vectors with colour coded water surface elevation

5.3.4 Waves

Darwin Harbour is well sheltered from long period tsunami and ocean swell waves by the Tiwi (Melville and Bathurst) Islands. Due to the harbour orientation, bathymetry and coastline configuration, energy of long period waves entering the Harbour quickly dissipates and thus wave heights decrease dramatically. Recent studies based on wave measurements ranging from Beagle Gulf to East Arm (e.g. INPEX 2010a) as well as wave modelling studies (e.g. GHDM, 1997) consistently demonstrated that waves within the Harbour are generally of short (3-5 s) mean periods with heights well below 1.0 m under non-cyclone conditions. According to the study of INPEX (2010a), low-energy long-period waves, with significant wave height less than 0.5 m and peak period of 9 s, were observed in the vicinity of Fannie Bay in May-June 2008. This might be the case of attenuated swell projecting in from deeper offshore waters.

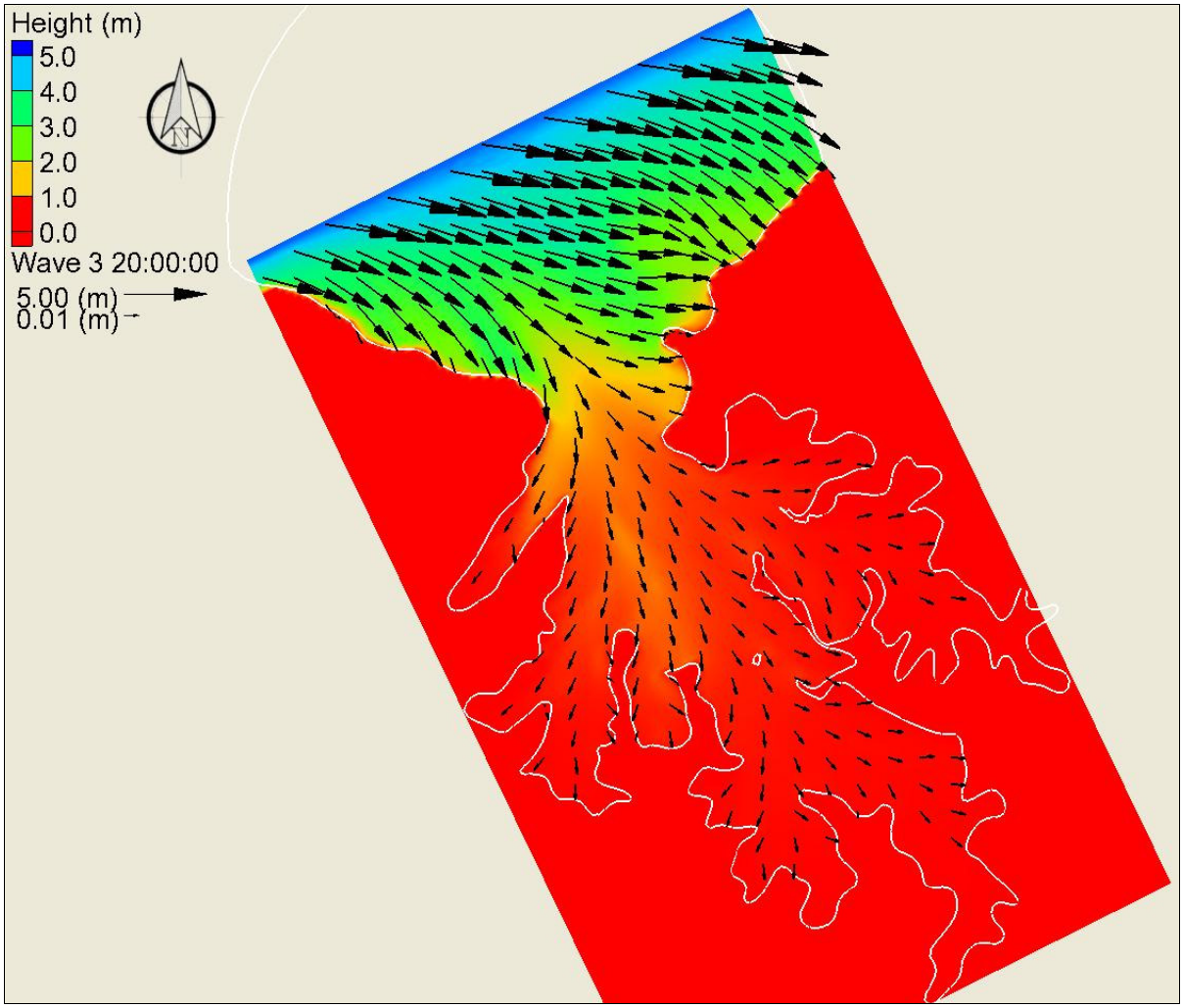


Figure 5-7 Wave field modelling results for 5 m westerly waves

5.4 Geology and Soils

A geotechnical investigation completed at East Point, along the alignment of the existing EPO found that (Douglas Partners, 1998):

- The Burrell Creek formation meta-sediments dip steeply and comprise meta-siltstone, claystone, phyllite, minor occasional shale beds and quartizite / meta-sandstone.
- Remnant outcrops of siltstone and claystone form the shallow shoreline and overlay the Burrell Creek Formation and are part of the overlying Tertiary sedimentary rocks of the Darwin Member of the Bathurst Island formation.
- A geotechnical investigation for the proposed EPO alignments is scheduled for completion during 2011.

The intertidal zone (the area exposed at high and low tides) at East Point is characterised by areas of sand, mud, rocky reef and areas where the rock layer below the sand is exposed (BoM via Oceanographic Services Program).

5.5 Heritage

The proponent will undertake a cultural heritage and marine archaeological assessment during the project planning and design phases.

5.6 Existing Adjacent Land Uses

Land ownership rests to a large extent with DCC and a variety of stakeholders and leaseholders, including the Fannie Bay Equestrian Club, Larrakia Nation Aboriginal Corporation, Royal Australian Artillery Association, Pee Wee's at the Point, East Point Aero modellers Club and the NT Government. The northern coastal strip of mangrove habitat is vacant Crown land (DCC, 2009a, DCC 2009b).

DCC divided the city into various Environmental Management Units (EMU). The proposed project will extend through EMU's 10, which is described as (DCC, 2009a, DCC 2009b):

- The East Point/ Dudley Point Environmental Management Unit (Emu 10) is essentially dedicated to conservation and recreational activities. There is no residential or industrial estate within the boundaries of EMU 10 which includes the East Point recreation reserve, the military museum, Fannie Bay equestrian club and aero-modellers club.

Land uses through which the EPO will extend include:

- Public Space (PS) for recreational purposes, including the East Point Reserve
- Marine area off East Point.

Land-use in the vicinity of the Proposed Development is shown Figure 5-8.

5 Existing Environment

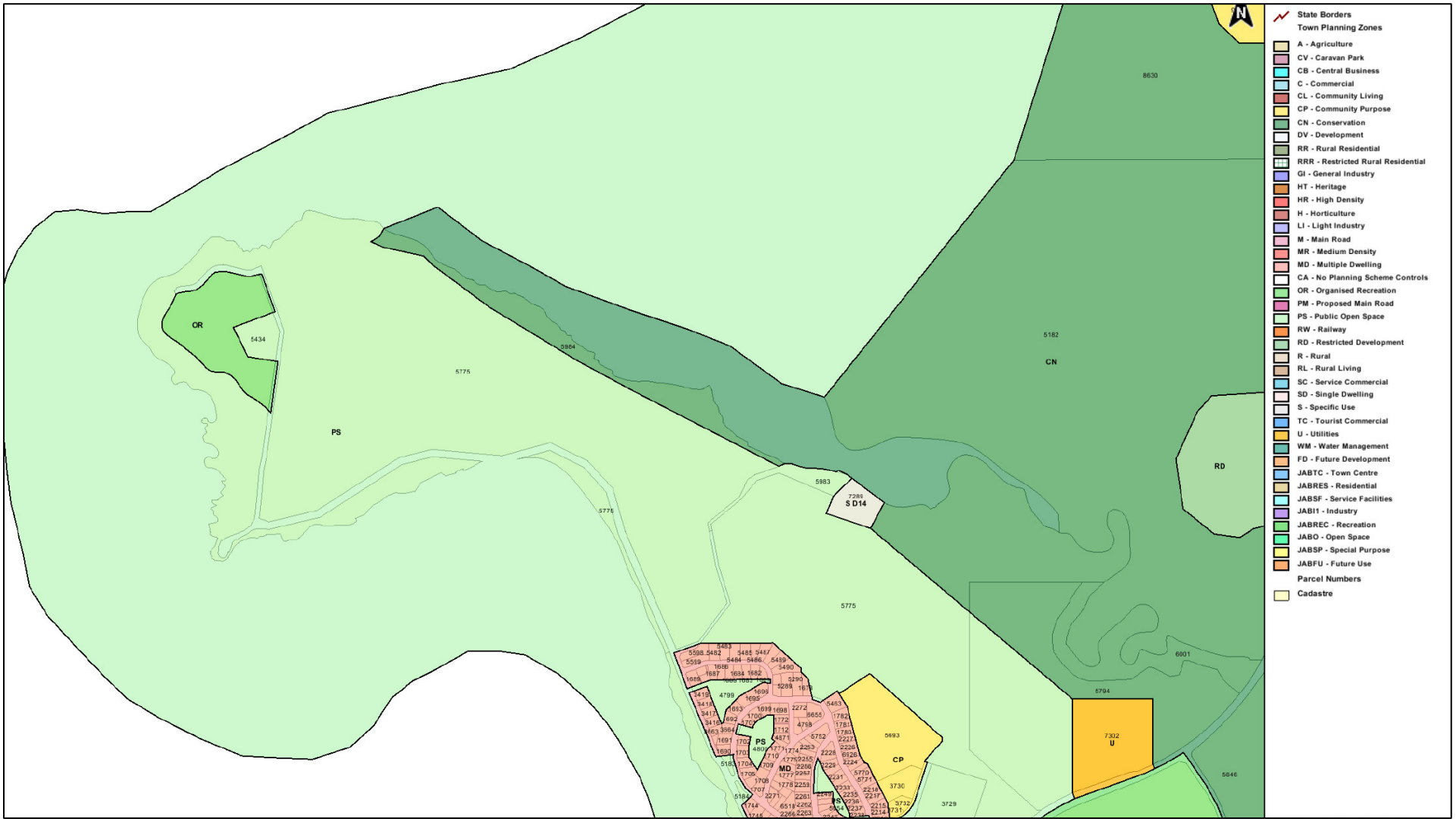


Figure 5-8 Land use Map (NTLIS, 2009)

6

Environmental Risk Assessment and Management

The management systems implemented by PWC aligns with the three recognised International and Australian Standards for Occupational Health and Safety, Environmental Protection, and Quality of Products and Services. These operate as an integrated system, the Integrated Management System (IMS).

Environmental risk assessment of activities associated with new projects and ongoing operations underpins the processes within the IMS. Risk management techniques employed by PWC aim to ensure that risks are either eliminated or controlled to a level that is considered "As Low as Reasonably Practicable" (PWC, 2007). Power and Water will accomplish this by (PWC, 2007):

- Identifying reasonably foreseeable risks caused by, or that affect Power and Water
- Analysing and evaluating the risks
- Reducing any unacceptable risks, or ceasing the operations that create them
- Implementing risk treatments to reduce risks to a level so that the exposure to risk is consistent with Power and Water's social and moral obligations and its business requirements
- Regularly monitoring risks and their controls to ensure they are in place and effective
- Communicating risk information to the relevant parties.

The risk assessment for this project was undertaken in accordance with Power and Water Corporation's Risk Management Procedure. This procedure is located at:

http://www.powerwater.com.au/__data/assets/pdf_file/0020/8822/qdoc2007_63_risk_management_procedure.pdf

Relevant PWC procedures and work instructions include:

Land Management Procedure

This procedure covers land management practices that are to be undertaken by PWC employees on all lands occupied by Power and Water. It applies to new projects and existing facilities. Land management parameters covered by this procedure include:

- Weed management
- Vegetation management
- Soil conservation
- Acid sulphate soil management
- Fire management.

This procedure is located at:

http://www.powerwater.com.au/__data/assets/pdf_file/0018/8820/qdoc2008_444_land_management_procedure.pdf

Hydrocarbon Spill Response Procedure

This procedure provides guidance pertaining to the control, containment, clean up and reporting of hydrocarbon spillage. It can be viewed at:

http://www.powerwater.com.au/__data/assets/pdf_file/0003/8823/qdoc2008_168_hydrocarbon_spill_response.pdf

Sewage Overflow Response Work Instruction

This work instruction provides guidance for the management of sewage overflows. It describes measures to contain, control and clean up of sewage spills. Reporting requirements are also defined by the work instruction. This document can be viewed at:

http://www.powerwater.com.au/__data/assets/pdf_file/0008/8819/qdoc2008_403_sewage_overflow_response.pdf

Contractor OHS&E Management Procedure

This procedure provides guidelines to PWC personnel and contractors to manage the OHS and environmental aspects of contracts, contract works and contractor personnel. This includes specifications, evaluations, management, monitoring and review. This procedure is available at:

http://www.powerwater.com.au/__data/assets/pdf_file/0011/1532/contractor_ohs_env_mang_procedure.pdf

The following sections outline the potential environmental risks associated with the proposed project and management strategies to mitigate those risks.

6.1 Impact Area: Atmospheric

Activity	Risk Assessment/ Management Strategy
CONSTRUCTION PHASE	
Plant operation during construction – Fuel usage	**Risk:** Contributing to local air pollution by operating plant and equipment. **Description**: Construction is expected to take **20 weeks**. During this period an estimated **15,000l** of diesel may be used. **15kL x 2.7** (p. 10 AGO Workbook Dec 2006) = **40.5t CO2-e**. In comparison to NT's 2005 total emissions (13.5Mt). **Mitigation measures**: Vehicle emissions will be minimised by ensuring plant and equipment is well maintained and in good working order.
Plant operation during construction – Dust generation	**Risk:** Dust generated during excavation and construction activities **Description**: During construction of the pipeline, earthworks will be undertaken. This includes excavation of material and breaking of stone with impact hammers and vehicle movement, resulting in dust generation. **Mitigation measures**: Dust generation can be effectively managed by applying water to construction areas.

Activity	Risk Assessment/ Management Strategy
OPERATIONAL PHASE	
Discharge effluent from the EPO	**Risk:** Odour associated with operation of EPO. **Description**: Effluent released though the EPO is chemically treated. The potential exist for odour associated with the operation of the EPO is considered very low since the effluent will be discharged under water allowing for effective dilution. **Mitigation measures**: Continued treatment of effluent discharged via the EPO.

6.2 Impact Area: Water, Marine Water Quality

Activity	Risk Assessment/ Management Strategy
CONSTRUCTION PHASE	
Plant operation during construction activities	**Risk:** Hydrocarbon spills during refuelling/servicing or hydraulic line rupture. **Description**: Construction may require the temporary on-site storage and use of small volumes of various fuels and lubricants. Fuel will generally be transported to the construction sites for refuelling machinery. **Mitigation measures**: A manifest and MSDSs of all chemicals stored and used for the project will be maintained on site. Spill clean-up equipment appropriate to the type and quantities of chemicals used will be kept on site. In the event of a spill, Power and Water's Hazard, Incident Recording, Reporting and Investigation Procedure will be implemented.
Excavation to install EPO pipeline	**Risk:** Sedimentation associated with pipeline trenching (if selected as a construction methodology) impacting on the marine environment. **Description**: A potential construction methodology considered by PWC is excavation of a trench for installation of the EPO pipeline. Trenching may result in sediment being suspended and deposited in sensitive areas such as the East Point Reserve and mangroves. Impacts associated with sedimentation are considered limited as it may only occur during the construction phase. **Mitigation measures**: Modelling of the potential outfall of sediment associated with the construction of the trench. Turbidity will be monitored during trenching works and the work schedule will be modified if unacceptable levels are detected near sensitive receptors. PWC will apply for a Waste Discharge Licence under the water Act if trenching is planned. PWC will also investigate alternative construction methods.

6 Environmental Risk Assessment and Management

Activity	Risk Assessment/ Management Strategy
OPERATIONAL PHASE	
Discharge of treated effluent	**Risk:** Poor dilution of effluent resulting in pollution of the marine environment **Description**: Mixing zone compromised leading to poorer quality dilution in the bay area and failure to understand the mixing zone leading to unexpected effluent quality. The initial dilution of the existing outfall is only about 5:1 at high tide, 2:1 at low tide and negligible at very low tides (Sinclair Knight Merz, 1998b). With the extension of the outfall the dilution of effluent from the rising main will increase due to tidal currents and wave action, thereby reducing the current impact associated with the operation of the EPO. Further effluent discharged via the EPO is treated in line with PWC's Waste Water Discharge License. **Mitigation measures**: Prior to the construction of the EPO, the mixing zone will be modelled to prevent poor dilution of wastewater discharged through the EPO. The discharge location and the diffuser design will be chosen based on the modelling outcomes. Monitoring of water quality and treated effluent from the LWWTP and the mixing zone will detect any abnormalities in quality or mixing.
Discharge of treated effluent	**Risk:** Water quality impacts **Description**: Discharge of waste water from sewage treatment plants into the marine environment can have a number of adverse impacts depending on the composition of the sewage received at the treatment facility (e.g. whether it contains industrial wastewater in addition to domestic wastewater), the level of treatment within the plant and the capacity of the receiving environment. Adverse water quality impacts can arise where the capacity of the receiving water is exceeded. These include: aesthetic impacts on water quality due to floating rubbish and the presence of a visible (oily) slick; reduction water clarity due to presence of particulates in the water column; reduction in dissolved oxygen levels; increased nutrient levels (leading microalgal and phytoplankton, including blue-green algal) blooms when present in excess, elevated metal concentrations, high bacterial counts and presence of a range of other sewage borne microorganisms; and elevated concentrations of a range of hydrocarbons, some of which may have toxic effects on marine organisms. **Mitigation measures**: Monitoring of water quality and treated effluent from the LWWTP.

6.3 Impact Area: Land, Terrestrial

Activity	Risk Assessment/ Management Strategy
CONSTRUCTION PHASE	
Plant operation during construction activities	**Risk:** Hydrocarbon spills during refuelling/servicing or hydraulic line rupture. **Description**: Construction may require the on-site storage and use of small volumes of various chemicals (fuels and lubricants). Chemical/fuel storage should not occur and chemical/fuel handling should be minimised in vicinity of waterways and drainage lines. **Mitigation measures**: A manifest and MSDSs of all chemicals stored and used for the project will be maintained on site. Spill clean-up equipment appropriate to the type and quantities of chemicals used will be kept on site. In the event of a spill, Power and Water's Hazard, Incident Recording, Reporting and Investigation Procedure will be implemented.

6.4 Impact Area: Biodiversity

Activity	Risk Assessment/ Management Strategy
CONSTRUCTION PHASE	
Construction of the EPO	**Risk:** Disturbance of the benthic environment and impacting on the East Point Aquatic Life Reserve and marine environment **Description**: The benthic environment is described under section 3.3(a). The benthic survey completed by GHD 2009 concluded that "There are no obvious ecological constraints within the footprint of the proposed pipeline alignment. It is likely that the introduction of a solid structure to this generally unconsolidated environment may provide an anchor point for colonisation and lead to an increase in density of benthic organisms in the future". Construction impacts on marine organisms result directly from impacts on water quality and may include: reduction in growth of light dependent species including hard corals, sessile macroalgae and seagrasses due to increased turbidity; death of sessile marine organisms and avoidance by mobile organisms of areas with reduced oxygenation, and reduction of light to, and overgrowth of, sessile marine organisms including corals and seagrasses by phytoplankton and sessile microalgae.
	Impacts on marine mammals (dolphins and dugongs) and reptiles (turtles) during the construction period may include avoidance of the construction area due to increased noise and vibration and the presence of turbidity

6 Environmental Risk Assessment and Management

Activity	Risk Assessment/ Management Strategy
	plumes due to pipeline trench excavation and installation activities. The increased noise and turbidity may also impact on echo location by dolphins, potentially impacting on feeding and navigation. There may also be an increased risk of vessel strikes by workboats associated with the construction program, including survey vessels, and refuelling and anchor handling vessels. **Mitigation measures**: Monitoring of potential impacts associated with the EPO on the benthic organisms. EPO alignment selection that extends through area with relatively low benthic diversity when compared to EPALR and marine biodiversity. Machinery and noise may also act as a natural deterrent.
Transportation of equipment & materials; excavation & stockpiling of soil.	**Risk:** Promoting the growth and spread of weed species. **Description**: The site already contains a range of weeds as previously described. Works will not enhance the spread of weeds currently at the site or result in the introduction of further declared weed species. **Mitigation measures**: Land management post construction will revert to the existing arrangements agreed to by the landholder (DCC). If the landholder believes the construction works had resulted in the introduction of new weeds then management options will be agreed to between PWC and the landholder.
OPERATIONAL PHASE	
Discharge of treated effluent	**Risk:** Adverse effects on marine organisms resulting from effluent discharge **Description**: Sewage impacts on marine organisms result directly from impacts on water quality and may include: reduction in growth of light dependent species including hard corals, sessile macroalgae and seagrasses due to increased turbidity; death of sessile marine organisms and avoidance by mobile organisms of areas with reduced oxygenation, reduction of light to, and overgrowth of, sessile marine organisms including corals and seagrasses by phytoplankton and sessile microalgae; de-oxygenation of the water column due to bacterial die-off and decay and potential disease transmission to marine organisms; and acute and chronic toxicity impacts from metals and hydrocarbon contamination. Impacts on marine mammals (dolphins and dugongs) and reptiles (turtles) as a result of wastewater discharges may include avoidance of the discharge area due to chemicals within the effluent, but may include attraction to the wastewater

Activity	Risk Assessment/ Management Strategy
	plume if prey species are attracted to the area (e.g. dolphins). Dugongs may be disadvantaged if seagrasses decline in the vicinity of the discharge. All species may be potentially be adversely impacted by the presence of chemicals within the effluent if present at concentrations that may do long term harm. **Mitigation measures**: Monitoring of water quality and treated effluent from the LWWTP.

6.5 Impact Area: Resources

Activity	Risk Assessment/ Management Strategy
CONSTRUCTION PHASE	
Generation of wastes	**Risk:** Inappropriate disposal of wastes **Description**: Wastes produced during construction are likely to be: • Steel and plastic off-cuts • Excess concrete and bitumen • Felled timber and excess spoil • Packaging materials • Excess dredge spoils • General refuse. **Mitigation measures**: It will be a condition of the construction contract that all other wastes are delivered to a licensed landfill for reuse and/or disposal as appropriate. Material such as excess spoil may be used elsewhere if suitable sites can be found.
OPERATIONAL PHASE	
Discharge of treated wastewater through the EPO	**Risk:** Poor dilution of effluent resulting in water quality degradation Refer sections 6.2 and 6.4

6.6 Impact Area: Community

Activity	Risk Assessment/ Management Strategy
CONSTRUCTION PHASE	
Vegetation clearing and construction	**Risk:** Noise and dust effects on members of the public. **Description**: Dust and noise will be generated during the construction phase of the project, primarily through the operation of equipment such as dredges, trucks and light vehicles. **Mitigation measures**: Noise dredging is expected to be short term and of minimal intensity. There is unlikely to be any impact on residences. Noise shall be controlled by operating during certain hours if required and by ensuring plant and equipment is regularly serviced. Dust should be monitored and if it poses a problem appropriate control measures will be put in place such as wetting.
OPERATIONAL PHASE	
Discharge of treated effluent	**Risk:** Primary contact to treated effluent **Description**: Effluent will be discharged through the EPO. Due to the recreational value at East Point, in particular fishing, members of the public may come into contact with treated effluent. **Mitigation measures**: The effluent will be disinfected prior to release and bacteria counts will be performed as part of the monitoring. In the event that there is a risk to human health the Dept of Health will be notified.

7

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ABS *refer* Australia Bureau of Statistics

AHPI *see* Australian Heritage Places Inventory

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Limitations

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The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between 30/07/2009 – 30/10/2009, updated on 5/08/2011 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

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A

Appendix A EPBC Act Protected Matters Report

B

Appendix B AAPA Certificate

C

Appendix C Benthic and Bathymetric Survey

D

Appendix D NT NRM Snapshot

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