

Executive Summary



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Introduction

The Proponent, Power and Water Corporation (PWC), proposes to construct a duplicate effluent rising main at East Point, extending from the Ludmilla Wastewater Treatment Plant (WWTP) to a terminal manhole at East Point at the landward end of the East Point Outfall (EPO). The title of the proposal is the “East Point Effluent Rising Main Duplication Project”, which will hereby be referred to as the Proposed Development.

The Proposed Development is one element of a wider Larrakeyah Outfall Closure Program (LOCP), which includes closure of the Larrakeyah outfall, diversion of the Larrakeyah catchment, and upgrading the Ludmilla WWTP. The LOCP supports the elimination of untreated sewage discharges to Darwin Harbour from the Larrakeyah sewage outfall, with untreated discharges replaced by treated effluent discharged from the Ludmilla WWTP via an effluent rising main (the Proposed Development) and the outfall at East Point.

The primary objective of the Proposed Development is to increase the hydraulic treatment capacity of the existing Ludmilla WWTP. A capacity increase at Ludmilla WWTP is necessary due to the planned closure of the Larrakeyah outfall, in accordance with the LOCP. As a part of this project sewage previously discharged through the Larrakeyah outfall will be diverted to the Ludmilla WWTP. Construction of the diversion pipework from the Larrakeyah outfall to the Ludmilla WWTP is currently underway.

Preparation of the PER

This Public Environment Report (PER) was prepared to identify the environmental impacts that could potentially occur as a result of the Proposed Development. It also describes management strategies and plans that will be employed to manage and mitigate those impacts.

This PER is based on the Department of Natural Resources, Environment, The Arts and Sport (NRETAS) *Guidelines for Preparation of a Public Environmental Report: Duplication of the East Point Effluent Rising Main and Extension of the East Point Outfall, Darwin, NT, February 2010* (the Guidelines). However, PWC sought and obtained approval to vary the proposal by separating elements associated with duplicating the effluent rising main and the proposed extension of the EPO.

Accordingly, this PER addresses only aspects of the Guidelines applicable to duplication of the effluent rising main as defined in **Appendix A**. Requirements associated with the EPO replacement project will be addressed separately once NRETAS provides a decision on the Notice of Intent (NOI) submitted for the EPO replacement project. This PER has been prepared to:

- Describe the existing environment of the Proposed Development site and adjacent areas.
- Describe the Proposed Development.
- Identify and clarify potential environmental impacts from the Proposed Development.
- Describe actions proposed to prevent, manage and / or mitigate the identified potential environmental impacts.
- Provide a source of information to government agencies and the community about the proposal.
- Facilitate public consultation about the proposal.
- Establish management measures that may be necessary for the proposal to proceed.

The Environmental Impact Assessment (EIA) process is further discussed under **Section 1.3, Regulatory Framework** of the PER.

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Need for Proposal

Sewage generated within the Larrakeyah catchment is currently macerated and discharged without further treatment into a deep-water outfall offshore of Larrakeyah. Closure of the Larrakeyah outfall and hence cessation of discharge of untreated sewage to Darwin Harbour is a long-term objective of PWC. The objectives of the Proposed Development are as follows:

- Comply with relevant NT legislative requirements, including licencing conditions.
- Eliminate potential environmental impacts associated with operations at Larrakeyah.
- Improved performance of the region's wastewater treatment and disposal facilities, recognising growth in population and the industry base.

The justification for the Proposed Development is further discussed under **Section 2.2, Objectives, Benefits and Justification** of the PER.

Options Considered

The Proponent considered several alternatives to manage sewerage generated with the Larrakeyah and Ludmilla sewage catchments.

Consequences of Not Proceeding

The consequences of not proceeding with the Proposed Development are as follows:

- Macerated sewage would continue to be discharged at Larrakeyah on a 365 days per year basis
- Overflows to Ludmilla Creek would continue to occur during the wet season and potentially occur during the dry season.

In practice, under the 'No Go' option, treatment facilities and associated infrastructure at the Ludmilla WWTP would be expanded as necessary to handle increases in population in the Ludmilla WWTP catchment, and minor improvements may be made to the treatment and associated processes. However, the major improvements envisaged under the Proposed Development would not be implemented.

Alternative Pipeline Material and Installation Options

Other materials were considered for the construction of the duplicated effluent rising main. However, the longevity of the chosen material was proven over the lifetime of the current effluent rising main.

Alternative Outfall Locations and Configurations

The discharge alternatives for the secondary effluent at Ludmilla WWTP are redirecting the effluent from Ludmilla WWTP to:

- The existing Larrakeyah outfall.
- The existing East Point outfall.
- Ludmilla Creek.

To return the effluent to the existing Larrakeyah outfall does not comply with NRETAS Waste Discharge Licence requirements to redirect the Larrakeyah catchment sewage flows to an alternate facility and allow the closure of the Larrakeyah outfall.

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The existing East Point outfall is in shallow water and especially during low tide the mixing and dilution of discharge is minimal. Due to the increased organic load this can lead to algal blooms and have a negative effect on the natural environment.

There is an existing wet weather overflow beside the Ludmilla WWTP that leads to Ludmilla Creek. The existing overflow arrangement is a tidal channel which extends through the mangroves to the northern boundary of the WWTP.

Not proceeding with the Proposed Development, it is likely that the frequency of overflows will increase. That could lead to an increase in organic material, thus having a detrimental effect on the biological communities and lead to negative impacts.

Alternatives scenarios considered by PWC are discussed under **Section 3, Alternatives**.

Description of the Proposed Development

The Proposed Development consists of constructing a duplicate effluent rising main from the Ludmilla WWTP to East Point, where it will be connected to an existing terminal manhole. The effluent rising main is a pressurised pipe that will transport effluent to the EPO, from which effluent is ultimately discharged to the marine environment. Design, construction and operational considerations are discussed under **Section 2.3, Proposed Action**.

Design

PWC adopted the Water Services Association of Australia (WSAA) suite of codes and developed NT Supplements to set-out the design criteria to be applied when designing infrastructure, including the Proposed Development. Concept designs have been developed for the Proposed Development and detailed design will likely commence after the draft PER has been submitted.

The proposed alignment for the duplicated effluent rising main to transfer effluent from to Ludmilla WWTP to the East Point outfall was developed in cooperation with the Darwin City Council (DCC) and other stakeholders to ensure the lowest possible impact on landscaping, infrastructure and areas of cultural significance. Key aspects that influenced the concept design for the Proposed Development include:

- The existing easement from Ludmilla WWTP to the EPO.
- Fauna and Flora, in particular revegetated areas within the effluent rising main easement and along the alignment of the Proposed Development.
- Occurrence of acid sulphate soils (ASS) and potential acid sulphate soils (PASS).
- Proximity of existing infrastructure to the Proposed Development.
- Areas of cultural heritage.

The following details regarding the design of the EPO have so far been determined:

- The most economical solution is likely to be a dual rising main using the existing main as a duty standby (redundancy).
- The duplicated effluent rising main will be constructed of 1050 mm high tensile steel or Polyethylene (PET) pipe, with a total length of 1180 m.
- The construction corridor will be 10 m wide to accommodate construction material, trenching and equipment.
- A laydown area (approximately 100 m²) will be required for construction of the Proposed Development and will likely be located on the alignment.

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- Above ground facilities at intervals along the pipeline route will include mainline valves and other ancillary facilities.
- Pipeline material selection optimises the longevity of the Proposed Development. By ensuring the contractor installs the pipework to the manufacturer's recommendations, and in line with PWC Master Specification, the pipe will give the best performance over an extended life.
- Construction techniques as per the ASS investigation report (e.g. lime treatment of excavated soils) will be adhered to.
- Subject to time constraints, the expected workforce is approximately 10 people on site for the pipe laying stage.

Design factors considered to improve operation and minimise maintenance requirements include:

- Access requirements will be incorporated into the design, which include roads, access tees and manholes.
- A double air valve will be used for isolation during maintenance activities.
- A dual rising main system (likely solution) will give redundancy to the operation, and mean maintenance and repairs can be carried out with one main shut off from the other.
- Control valves shall be utilised to alternate between mains to ensure the flushing of solids and slime from the pipe interior.
- Variable speed capable pumps shall provide the necessary turndown to accommodate the range of flows predicted, and will be energy efficient thus reducing power costs.

Construction

Standards and technical specifications for the construction of the duplicated effluent rising main will align with PWC's technical requirements. Contractors and other parties involved in the construction of the Proposed Development will be required to operate in accordance with the PWC Integrated Management System (IMS). The IMS includes an environmental management system (EMS) and environment, safety and quality procedures pertaining to all PWC activities.

In addition to operating in accordance with the PWC EMS and Procedures, construction activities will be guided by a Construction Environmental Management Plan (CEMP) specific to the project. The CEMP for the Proposed Development includes the following project specific management plans:

- Sediment, Erosion and Drainage Management Plan.
- Air Quality Management Plan.
- Acid Sulphate Soils Management Plan.
- Biting Insect Management Plan.
- Weed Management Plan.

Construction of the rising main will typically involve a number of sequential activities over a 12 week period, including:

- Access and vehicle movement, with estimated vehicle movements of:
 - Heavy vehicles: average 1 per day; peak 5 per day.
 - Trucks: average 12 per day; peak 25 per day.
 - Light vehicles: 1 per day; peak 55 per day.
- Temporary facilities, typically including:
 - A site office and portable toilet facilities.

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- Storage for construction material, e.g. pipes.
 - Parking area for construction equipment, e.g. excavator and other site vehicles.
 - Storage area of excavated material.
- Existing services will be identified along the proposed alignment prior to construction.
 - Clearing, grubbing and grading.
 - Excavation of the trench.
 - Pipe bedding and piping for the duplicated effluent rising main.
 - Line-up and welding / joining of pipes.
 - Lowering in and backfilling.
 - Testing of the duplicated effluent rising main pipeline prior to commissioning.
 - Restoration and rehabilitation.

Final construction materials and methods will depend on the final design and the contractor appointed to complete the installation of the effluent rising main. The principal construction materials to be used are as follow:

- Large diameter pipelines: Concrete or high tensile steel from Darwin suppliers.
- Concrete: from Darwin concrete batching suppliers.
- Reinforcing steel: from Darwin suppliers.
- Gravel and sand backfill: from Darwin suppliers.

Construction Program

A detailed construction program has not been developed at this stage, however the expected timing and during for the Proposed Development (i.e. duplication of effluent rising main) and the related action (extension of then EPO) is shown in **Figure 1**.

Action	2011	2012	2013
Effluent Rising Main			
• Detailed engineering design		■	
• Construction and commissioning		■	
East Point outfall			
• Prepare and submit PER		■	
• Detailed engineering design			■
• Construction and commissioning			■

Figure 1 Key Components of Construction Program

The upgrades to the Ludmilla WWTP are currently being undertaken and will be completed by the time construction of the Proposed Development and EPO extension is completed.

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Technical studies and concept engineering designs required for the construction and operation of the Proposed Development have been completed, with detailed engineering design schedule for completion in the first quarter of 2012. As a result, construction of the Proposed Development, once approved, is scheduled to commence in the dry season of 2012. It is anticipated that construction activities would be completed prior to the onset of the 2012 wet season.

Technical studies supporting the proposed EPO Project, including those related to environmental assessment for the aforementioned project, are currently underway. It is anticipated that a PER for the EPO Project will be submitted in the 4th quarter of 2012, with construction scheduled for the dry season of 2013.

Operation of the Duplicated Effluent Rising Main

The effluent rising main will be used to transfer effluent from the Ludmilla WWTP to the EPO. A detailed preventative maintenance program will be developed including:

- Pipeline inspections.
- Maintenance activities, including maintenance at the terminal manhole and clearing of potential pipeline blockages.
- Performance monitoring of the pipeline, including flow measurement and leak detection.
- Review of pumping efficiencies.
- Vegetation removal over the pipeline that can impact on the pipeline integrity.

Related Actions

Duplication of the effluent rising main represents only one component of the LOCP. Actions related to the Proposed Development, with related actions currently underway, include:

- Upgrades to the sewage treatment infrastructure at Ludmilla WWTP
- Diversion works to deliver sewage from the Larrakeyah catchment to the Dinah Beach trunk sewer.

Planned works associated with the Proposed Development, but yet to be commenced, include:

- Replacement and extension of the EPO, which is subject to a separate development approval application.

The above items are described under **Section 2.4, Related Actions**.

Features of Surrounding Environment

East Point is located approximately 6 km north of the Darwin Central Business District (CBD). Much of East Point has been designated public open space, and is now the East Point Recreation Reserve. The Ludmilla WWTP, which is the origin of the effluent rising main, is located on Dick Ward Drive at the south east boundary of East Point, with the suburb of Ludmilla on the opposite side of Dick Ward Drive. The entire Proposed Development is located within the City of Darwin local government area.

The existing physical, biological, built and socio-economic environment is described under **Section 4, Existing Environment**.

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East Point Recreation Reserve

East Point Recreation Reserve is a popular open space recreation and conservation area. The reserve covers almost 200 ha, of which approximately 15% is native monsoon vine forest. Mangrove forests are also present, and the area provides habitat for wild populations of wallaby, bandicoot and jungle fowl.

Sections of East Point were cleared during World War II (WWII) to construct military defences. The cleared areas at East Point are now utilised for picnic areas, a horse riding school, and a military museum. Some of the original military infrastructure has also been retained. Pee Wee's at the Point restaurant is located within the reserve on the northern shore of Fannie Bay, accessed from Alec Fong Lim Drive.

An artificial salt water lake, Lake Alexander, has been constructed in the southern section of the reserve, adjacent to the junction of Alec Fong Lim Drive and Colivas Road. Management and control of East Point Reserve was passed to DCC in 1984 (DCC, undated).

The NT monsoon vine forest flora comprises some 600 plant species and 251 of these have been recorded at East Point. A walking trail through the vine forest has been constructed to provide access for visitors. A mangrove community is present at the north eastern shoreline of the reserve and borders Ludmilla Creek. There are 11 species of mangroves occurring within the community (Mangrove Watch Australia, 2010).

Within the monsoon forest there are active jungle fowl (DCC, undated), as well as other bird species. Many species of fish breed in the mangroves, as do various crustaceans and molluscs. Birds also utilise mangroves for breeding and feeding (DCC, undated).

The military structures of East Point Reserve are listed in the Register of the National Estate. Of major historic significance, the area comprises the last major 'fortress' built on Australian soil and is a reminder of a prominent element of Australia's only battleground. The Darwin Military Museum (formerly the Royal Australian Artillery Association Museum) was later established at the site.

East Point Aquatic Life Reserve

The East Point Aquatic Life Reserve (EPALR) is a marine reserve of approximately 1.5 km², offshore of and abutting East Point, which contains a fringing coral reef developed on a laterite rock platform. EPALR was established under the *Fisheries Act 1998* (Fisheries Act) to protect the marine biological assemblages in the area of East Point and Dudley Point, which were threatened by collectors in the early 1980s.

The reef is in a dynamic marine environment, subjected to prolonged exposure during spring low tide and high levels of turbidity during high tides. Adjoining the marine reserve is a large area of subtidal sponge and gorgonian beds. The offshore coral reef that is regularly exposed during low spring tides is unique in the Darwin area as it is the only accessible major reef on the Darwin side of the harbour. Being easily accessible and in close proximity to Darwin the reef has been the collection site for a number of marine organisms, including 160 species of sponge and 63 shrimp species.

Residential Receptors

The Darwin suburb of Ludmilla is adjacent to the Ludmilla WWTP, on the opposite (south) side of Dick Ward Drive. The Fannie Bay Race Course lies directly opposite the Ludmilla WWTP. The nearest residences to the Ludmilla WWTP are approximately 200 m to the south east, on Douglas Street.

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The residences closest to the proposed effluent rising main duplication corridor are located within the suburb of Fannie Bay particularly Bayview Street, Georges Crescent and Phillip Street. The proposed effluent rising main duplication corridor lies approximately 20 m away in open space located northeast (at the rear) of the nearest Bayview Street residences.

Ludmilla Creek

Ludmilla Creek lies to the north east of the East Point Recreation Reserve and forms part of the north and east boundaries of the reserve. A channel of the creek reaches the Ludmilla WWTP site. When inflow loads to the Ludmilla WWTP exceed the current plant capacity (typically during heavy wet season rainfall events) the plant sewage overflows directly into the Ludmilla Creek. There are no sewage overflows into Ludmilla Creek during the dry season. Other discharges to Ludmilla Creek include:

- Local stormwater reticulation.
- Runoff from residential and industrial areas.

Groundwater Resources

The site of the Proposed Development is low lying, and groundwater has been encountered at shallow depths within the vicinity of the proposed effluent rising main duplication corridor. Cardno Ullman & Nolan (2010) excavated 34 soil boreholes along the length of the Proposed Development corridor to varying depths. Groundwater was encountered within 13 of the 34 boreholes during the investigation. The two general areas where groundwater was encountered were at the Ludmilla WWTP end of the alignment and at the intersection of the alignment and Colivas Road.

The water table was encountered between depths of 0.4 m and 2.8 m below ground level (bgl). Cardno Ullman & Nolan (2010) considered it is likely that groundwater would fluctuate significantly under seasonal influences and also under tidal influences; however, it was also considered likely by Cardno Ullman & Nolan (2010) that groundwater may occur at the project site as a perched water table, particularly above clay soil horizons and at the soil / bedrock interface.

No chemical analysis of groundwater was undertaken by Cardno Ullman & Nolan (2010). It is most likely that groundwater in the vicinity of the Proposed Development is saline due to the close proximity of the ocean.

Potential Impacts and Management Measures

The Guidelines identified the following major risks arising from the Proposed Development (NRETAS, 2010a):

- Disturbance to terrestrial soils, in particular acid sulphate soils during construction of the duplicated rising main.
- Impacts on listed migratory species and listed threatened species and communities along the Proposed Development corridor.

Erosion and Sedimentation

The Proposed Development traverses an area that is mostly flat, with a gradient varying between 1 and 3% (DCC, 2009a; DCC, 2009b), with a low erosion potential alignment. However, the erosion potential along the alignment may increase due to the conflicting factors of very low slope and exposed soils and fill material used during construction.

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Some runoff generated within the catchment is directed to the receiving environment through drainage channels, nonetheless runoff from site may interact with workings, mobilise sediment and leading to erosion. The potential for sedimentation and erosion is further increased due to terrain disturbance during construction and rehabilitation activities post construction.

Potential effects resulting from site preparation, excavation and construction activities, which must be appropriately managed, include:

- Soil erosion as result of high rainfall and subsequent pump out of trenches and excavations.
- Mobilised sediment and sediment accumulating in the receiving environment.

Acid Sulphate Soils

Acid sulphate soils are wet anaerobic soils which when exposed to air form sulphuric acid. This lowers pH levels and may mobilise metals in the soil, producing an acid leachate with elevated metal concentrations (Sinclair Knight Merz, 1998).

An investigation into the occurrence of acid sulphate soils along the Proposed Development corridor identified four locations with acid sulphate soils. Excavation may bring these acid sulphate soils to the surface, where they could oxidise.

Without treatment excavated and / or stockpiled acid sulphate soils could result in the release of acidic leachate into the surrounding environment. Exposure of stockpiled acid sulphate soils to rainfall could mobile acid, which may impact stormwater, surface soils and the marine environment. Acid runoff and leachate may also present health risk if contact or ingestion occurs.

Contaminated Runoff

There is a potential for localised runoff from the construction site during periods of rainfall and subsequent runoff from water pumped out of trenches and excavations. In addition to potential runoff from rainfall, accidental discharges of treated effluent may also occur if construction activities damage the existing effluent rising main. However, the Proposed Development corridor was selected to minimise interaction with the existing effluent rising main, which will remain in operation during construction activities. Construction activities are scheduled to take place during the dry-season, thus decreasing runoff.

Discharges from the construction site may adversely impact on the receiving environment, in particular if the discharge contains acidic leachate or treated effluent from the Ludmilla WWTP.

Noise and Vibration

Noise and vibration associated with the Proposed Development may impact on surrounding land-users, including nearby residential premises and recreational users of East Point.

Construction activities will require heavy machinery, supported by light vehicles accessing the construction site, which may adversely impact on nearby residential premises and recreational users of East Point. Noise nuisance and vibration impacts are highest if construction is allowed to occur at night and / or on Sundays when East Point has the highest number of recreational users.

However, the potential for noise nuisance and vibration resulting from construction is considered minimal, since most of the Proposed Development corridor is distant from areas frequented by recreational users and residential buildings, limiting exposure to noise and vibration.

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Air Quality

Dust Generation

Dust may be generated during construction of the Proposed Development, due to site clearing activities, loss of vegetation, excavation and handling of soils, rock breaking, wind erosion from disturbed areas and material stockpiles, site grading activities and vehicle movements.

It is anticipated that the resultant dust impacts from construction activities would be localised and predominantly affect land-users in close proximity to the Proposed Development corridor, typically residential premises and recreational users of East Point.

Dust from construction activities is likely to comprise an aesthetic impact and is considered to have a negligible impact on human health and the biological environment.

Air Pollution

In addition to dust, relatively minor emissions of oxides of carbon (CO_x), oxides of nitrogen (NO_x) and oxides of sulphur (SO_x) are expected as a result of the operation of machinery and support vehicles during construction of the Proposed Development. Construction is expected to take 12 weeks. During this period an estimated 15,000 kL of diesel may be used. Equating to the emission of 40.5 t carbon dioxide equivalents (CO_{2-e}).

Odour

A localised odour problem may be experienced during the excavation of acid sulphate soils along the Proposed Development corridor. It is expected that odour will only persist during the construction phase of the project and will be limited to areas with acid sulphate soils. Sensitive receptors to odour are limited to residential premises in close proximity to areas with identified acid sulphate soils. The potential impact of odour on these receptors is considered low due to the distance between the potential source of odour and the receptors.

The occurrence of odour associated with operation of the effluent rising main is unlikely since no vents are planned for the pipeline.

Disturbance Area

The Proposed Development corridor (10 m in width) will result in clearing of approximately three (3) hectares (ha) of terrestrial vegetation, of which 2.54 ha (85%) is classified as Community 5 disturbed and urban areas with regrowth. The development will also result in the clearing and potential disturbance of 0.05 – 0.13 ha of Mangrove Forest area. Additional area of potential disturbance to vegetation and soil resulting from the clearing and construction activities (measured at 5 m either side of the 10 m corridor) have also been calculated to depict the maximum and minimum areas of disturbance.

Table 1 below provides the details of the disturbance of the vegetation communities as calculated in *ArcGIS*. The table illustrates that the majority of the Proposed Development corridor will pass through disturbed urban parkland and development areas with regrowth (Community 5).

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Table 1 Areas of Clearing and Disturbance of Each Vegetation Community (1 to 5)

Vegetation Community	Map unit	Cleared (ha)	Potentially disturbed (ha)	Total (ha)
Community 1: Coastal Monsoon Vine Forest	12	0.034	0.081	0.115
Community 2: Low to Mid, Mixed Species Closed Forests	6	0.363	0.379	0.742
Community 3: Low to Mid High, Mixed Species Open Woodland to Woodland	13	0.652	0.686	1.338
Community 4: Mangrove Forest	4	0.056	0.078	0.134
Community 5: Disturbed Areas with Regrowth	16	1.893	1.8	3.696
<i>Total Terrestrial Vegetation</i>	-	<i>2.94</i>	<i>2.95</i>	<i>5.89</i>
<i>Total Vegetation Marine Component</i>	-	<i>0.056</i>	<i>0.078</i>	<i>0.134</i>
Total Area	-	2.99	3.03	6.02

Terrestrial Flora, Fauna and Weeds

Noting that the area proposed for the construction of the Proposed Development was selected to minimise the potential for clearing of vegetation, potential impacts on terrestrial fauna and flora are considered to be minimal.

Potential for Impact on Fauna and Flora

Coastal Monsoon Vine Forest Community is recognised as significant vegetation under the *Northern Territory Land Clearing Guidelines* (NRETAS, 2010b). It is not listed as significant or threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Coastal Monsoon Vine Forest Community within the Proposed Development corridor is a modified rainforest community largely comprised of regrowth through self-seeding and supplementary plantings by DCC between 1974 and 1984 (Franklin *et al.*, 2010) and as a result is floristically simplified.

Whilst this vegetation community is unlikely to be providing significant habitat for wildlife, it provides habitat within the East Point Reserve for local fauna populations, such as the Agile Wallaby and Rainbow Pitta (*Pitta iris*) in the greater landscape matrix (Franklin *et al.*, 2010).

The overall area of Monsoon Vine Forests located within, or adjacent to, the Proposed Development corridor is very small and the community is bordered by managed urban parkland, management tracks and the Model Aeroplane Club grounds.

The Proposed Development corridor passes through an area of Mixed Species Open Forest and patches of Mixed Species Open Woodland regrowth and revegetation. These vegetation communities are in poor ecological condition. They are generally disturbed with evidence of weeds and impacts from adjacent urban land uses. Whilst these vegetation communities are unlikely to provide significant habitat for wildlife, the habitat value of these areas is similar to the Monsoon Vine Forest described above; that is, they provide habitat for local fauna, such as the Yellow-spotted Monitor.

A small area of *Ceriops tagal* Mangrove Forest is proposed to be cleared for the Proposed Development corridor. Mangrove communities are recognised as sensitive, or significant vegetation, under the *Northern Territory Land Clearing Guidelines* (NRETAS, 2010b). They are not listed as threatened under the EPBC Act. Species listed in the threatened species schedules of the EPBC Act and the TPWC Act

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were not observed in this community. The area of impact on the mangrove forest will be limited to the edge of this vegetation community. The impacts on terrestrial vegetation and habitat are likely to be lessened because of this, as it is likely that core areas of Mangrove Forest and Mangrove Forest zones not impacted by the pipeline are of greater significance for wildlife (Noske, 1996; Clay and Andersen, 1996).

The mangrove habitats directly adjacent to the existing sewage rising main, Ludmilla WWTP and urban areas are already impacted to some degree by edge effects associated with the land uses including drainage, sedimentation, noise and artificial light. Despite these impacts, the Mangrove Forest area continues to support a suite of mangrove and wetland specialist fauna species, including small numbers of listed migratory shorebirds (Noske, 1996; Clay and Andersen, 1996).

Mangrove and salt marsh / saline wetland habitats within and surrounding the study area support a number of listed migratory marine birds and shorebirds. Under EPBC significance criteria these areas qualify as important habitat for migratory species listed under the *EPBC Act 1999*. These areas also support a range of other mangrove specialist fauna species. It is noted that the mangrove vegetation is connected to larger tracts of remnant mangrove habitat, Ludmilla Creek, to the north and east.

Weeds

Two of the five vegetation community types recorded in the study area are regarded as sensitive, or significant vegetation, including the patches of Coastal Monsoon Vine Forest and the Mangrove Forest. The construction of the Proposed Development could potentially spread weeds already present at the East Point Reserve, thus having a negative impact through the invasion and replacement of native plant species. This could modify the existing habitats for native animals and in a larger scheme may have a negative impact on ecosystem functions, such as nutrient and water cycles, in addition to changing fire regimes.

Biting Insects

Biting insects are not just a highly irritating biting pest of man and animals, but are also carriers of debilitating viral diseases. Coastal areas and especially mangroves provide attractive habitats for mosquitoes. The construction of the Proposed Development could potentially create more breeding sites for mosquitoes if water is allowed to pool.

New biting insect breeding sites could be created due to the creation of scrapes, trenching, site clearing and reclamation, stormwater drains and water discharge sites, and inappropriate storage of artificial receptacles and materials that could pond water (Warchot and Whelan, 2011).

Impacts on the Built Environment

The Proposed Development will traverse an area from the Ludmilla WWTP to the EPO, which is largely undeveloped cleared areas, designated as Public Open Space or Community Purpose. Services and infrastructure directly impacted by the Proposed Development include:

- Existing effluent rising main from Ludmilla WWTP to the East Point outfall, which will be retained as support infrastructure although regular flow through the pipeline will cease once the Proposed Development is commissioned).
- The East Point Bicycle track along the north-eastern section of East Point Reserve.
- Colivas Road adjacent to East Point Reserve and Lake Alexander.
- East Point reserve, used for recreational purposes.

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- Areas of recent rehabilitated (i.e. tree planting by the Friends of East Point) adjacent to Colivas Road.

Land-use

The construction of the Proposed Development will occur within a new PWC easement. The Proposed Development aligns with current and future land-use planning and no changes to zoning or land-use are required. Permission will be gained from the respective property owners prior to construction. Nearby recreational and residential users will also be informed.

Impacts on adjacent land-use are considered minimal and limited to construction and maintenance activities.

Road Network and Traffic

The proposed pipeline will intersect Colivas Road and a section of the East Point bicycle track constructed for recreational purposes by the DCC. A temporary diversion will be installed at Colivas Road and a portion of the bicycle track will be closed during construction activities. Infrastructure impacted by the Proposed Development will be reinstated upon completion of the Proposed Development, with impacts limited to the construction phase. The Proposed Development will not impact on other areas of recreational use at East Point Reserve.

During construction, tracks will be required to access areas such as the pipeline corridor and work areas. Existing roads, tracks and disturbed areas will be utilised as far as practicable to minimise disturbance to the surrounding areas.

Impacts on the Socio-economic Environment

Visual Amenity, Dust and Noise Levels

Construction activities will be visible from various locations along the proposed alignment, with regular vehicle movements potentially generating nuisance dust and noise. The potential visual amenity, dust and noise nuisance impacts are considered low and are limited to the construction phase.

Employment

The Proposed Development will have a positive impact in generating local direct and indirect employment. It is estimated approximately 10 people will gain employment during construction (12 weeks) of the Proposed Development. However, due to the low maintenance design of the Proposed Development, limited employment opportunities will continue during the operational phase of the duplicated effluent rising main.

Sites of Recreational and Socio-economic Importance

The Proposed Development will have a short term impact on the recreational activities at East Point, which include limiting access along the North-Eastern section of the East Point bicycle track. However, in the medium to longer term, it is unlikely that the Proposed Development will impact on recreational activities at East Point. All construction work areas will be clearly signposted and demarcated to prevent unsolicited entry. The proposed alignment will also require removal of some small trees recently planted next to Colivas Road.

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Prevention, Mitigation and Management of Potential Impacts

Environmental Management Framework

Management of occupational health and safety (OH&S), quality, and the environment is undertaken in accordance with the PWC Integrated Management System (IMS). The IMS is a mechanism by which PWC's environmental interactions are systematically managed. Operation of the PWC IMS is externally certified to meet the relevant international / Australian standards (AS 4801 for occupational health and safety; ISO 9001 for quality; ISO 14001 for environmental management).

Aspects of the environment potentially impacted by PWC activities are monitored, monitoring results and records are documented, and the environmental performance of PWC can thus be reviewed and audited. The level of environmental management stringency applied to the proposed development will be detailed in the construction contract and will therefore meet or exceed the standards which currently apply to PWC.

The PWC IMS sets out the framework, objectives and targets for sound and responsible environmental management, OH&S performance, and quality delivery. The role and intended outcomes of the IMS are effectively defined by a high level Environment, Quality, Health and Safety Policy which specifies PWC's aims and commitments.

PWC's Environment, Quality, Health and Safety Policy and environmental goals inform the development of PWC's corporate procedures. Prevention, mitigation and management of potential impacts associated with the Proposed Development would be undertaken in accordance with these procedures.

Acid Sulphate Soils

To minimise the potential for oxidation of acid sulphate soils an Acid Sulphate Soils Management Plan (ASSMP) will be prepared in accordance with PWC's Land Management Procedure. Management of Actual Acid Sulphate Soil (AASS) and PASS will be undertaken in accordance with the following principles (Department of Natural Resources and Mines, 2002):

1. The disturbance of AASS / PASS should be avoided wherever possible.
2. Where disturbances of AASS / PASS is unavoidable, preferred management strategies are:
 - a) Minimisation of disturbance.
 - b) Neutralisation.
 - c) Hydraulic separation of sulphides, either on its own, or in conjunction with dredging.
 - d) Strategic reburial (reinterment).

Other management measures may be considered, but must not pose unacceptably high risks.

3. Works should be performed in accordance with best practice environmental management when it has been demonstrated that the potential impacts of works involving AASS / PASS are manageable to ensure that the potential short and long term environmental impacts are minimised.
4. The material being disturbed (including the in situ AASS / PASS) and any potentially contaminated waters associated with AASS / PASS disturbance, must be considered in developing a management plan for AASS / PASS and / or in complying with the general environmental duty.
5. Receiving marine, estuarine, brackish or fresh waters are not to be used as a primary means of diluting and / or neutralising AASS / PASS or associated contaminated waters.

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6. Management of disturbed AASS / PASS is to occur if the acid sulphate soil action criteria listed in Table 1 of the Department of Natural Resources and Mines (2002) guidelines is reached or exceeded.
7. Stockpiling of untreated ASS above the permanent groundwater table with (or without) containment is not an acceptable long-term management strategy. For example, soils that are to be stockpiled, disposed of, used as fill, placed as temporary or permanent cover on land or in waterways, sold or exported off the treatment site or used in earth bunds, that exceed the ASS action criteria listed in Table 1 of the Department of Natural Resources and Mines (2002) guidelines should be treated / managed.
8. The following issues should be considered when formulating ASS environmental management strategies:
 - a) The sensitivity and environmental values of the receiving environment. This includes the conservation, protected or other relevant status of the receiving environment.
 - b) Whether groundwaters and / or surface waters are likely to be directly or indirectly affected.
 - c) The heterogeneity, geochemical and textural properties of soils on-site.
 - d) The management and planning strategies of Local Government and / or the Northern Territory Government (NTG).

The ASSMP for the Proposed Development will describe measures to manage and / or mitigate the potential impacts of acid sulphate soil disturbance. Mitigation measures specified by the ASSMP will include:

- Minimise disturbance of acid sulphate soils occurring within and adjacent to the development corridor.
- Implement appropriate management techniques to reduce the potential for production of acid and / or release of acidity as run off caused by exposing acid sulphate soils to oxygen, such as liming, reinterment, and covering / bunding of stockpiles.
- Ensure that adequate OH&S measures are adopted when dealing with acid sulphate soils, and incorporation of this information into the construction and operational OH&S Plans.
- Disposal of material to a suitable secure landfill or on-site disposal if this can be shown to adequately contain the material.
- Monitoring of acid sulphate soils is regularly completed during excavation and construction activities.

Management measures which are likely to be included in the ASSMP include:

- Training and induction of any personnel involved in soil disturbance activities, advising workers of the adverse effects of acid sulphate soils to the environment and to personal health.
- Excavation activities will be carried out during the dry season to minimise leachate formation.
- Field testing of soil pH to determine potential acidity.
- Soils removed from areas with known AASS / PASS will be placed in bunded areas and subsequently disposed to a suitable secure landfill, to prevent oxidation acid sulphate soils.
- Acid sulphate soils and acidic leachate will be treated with lime.

Encounters with acid sulphate soils during construction and maintenance will be recorded and photographed, with soil sample locations and field pH test results documented on field data sheets. The approximate volume of soil placed in the bunds, the volume of lime added for treatment, the bund locations and off-site disposal information will also be documented.

Where an incident causes, or is threatening or may threaten to cause, pollution or environmental nuisance resulting in material or serious environmental harm, PWC will inform NRETAS.

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Erosion and Sedimentation

To reduce the potential risk of impacts to the environment associated with soil erosion, NRETAS has requested that an Erosion, Sedimentation and Drainage Management Plan (ESDMP) be prepared for the Proposed Development (NRETAS, 2010). The ESDMP will be prepared in accordance with the PWC Land Management Procedure. Impact prevention and management measures specified by the ESDMP will include:

- Construction activities are carried out during periods of dry weather where practicable.
- Ground disturbance is kept to a minimum when developing an area.
- Natural slopes will be maintained to the extent practicable.
- Run-off is diverted into existing drainage lines through protected entry points.
- Traffic on unsealed areas will be minimised.
- Surface hardening and / or protective cover is provided in all areas experiencing intensive use.
- Off-site disturbance is kept to the minimum required during construction activities.
- Topsoil from cleared areas is conserved for use in degraded areas

Impact management measures will include:

- Unsealed surfaces will be wetted down where dust generation is observed.
- Silt fences and / or sediment traps to capture sediment will be installed where appropriate (e.g. to treat runoff from construction zones).

After rehabilitation and once vegetation is re-established after construction of the Proposed Development management of areas above the Proposed Development will revert to the property owner. Some impacts could potentially occur during operation of the Proposed Development. The ESDMP will therefore also include the following measures with the objective of preventing erosion and sedimentation during the operational phase:

- The formation of soil or vegetation windrows at the sides of cleared lines (tracks, easements, etc.) will be avoided.
- Vegetative or protective cover will be maintained where practical. Where this is not practical, vegetative cover shall be reinstated post-disturbance.
- Drainage systems, natural and man-made, will not be blocked.
- Activity levels will be adjusted according to seasonal conditions.
- Inspections will be undertaken regularly, with maintenance and repairs carried out as quickly as possible.

Contaminated Runoff

Prevention and management of contaminated runoff will be undertaken in general accordance with PWC's Hydrocarbon Spill Response Work Instruction, Chemical Management Procedure, Land Management Procedure and Sewage Overflow Response Procedure. The following measures will be undertaken to reduce the likelihood that contaminated runoff is generated:

- Construction of the Proposed Development, in particular excavation activities, will be carried out during the dry-season.
- The extent of excavated / disturbed areas at any given time will be limited. That is, construction of each pipe section will be completed to the extent practicable prior to excavation and commencement of construction of the next section, such that the smallest practicable area is disturbed at any given time.

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- Limit the time and duration of the construction period.
- Reduce or eliminate rainfall infiltration to storage stockpiles in unsealed hardstand areas.
- In addition to clean up of spills, implement procedures to ensure general clean ups are undertaken and that catchment areas are kept free of contaminants.
- Where land clearance is no longer required, stabilisation of surface soils will be undertaken through methods such as rehabilitation.
- In the event that contaminated runoff is unavoidably generated, potential impacts to the environment will be reduced by the following management measures:
 - Fuels, lubricants, and other chemicals will be stored within bunded areas, on an impermeable base.
 - Appropriate spill response equipment will be provided to contain and clean up spills.
 - Sediment retention ponds, vegetated buffer strips or other effective measures will be installed and maintained at all potential off-site stormwater discharge points.
 - Overland drainage will be controlled to prevent channelling and sediment transport by diverting flows away from areas that are exposed.
 - Stormwater contaminant capture measures such as gross pollutant traps, sedimentation traps, and silt fences will be implemented where required.

Noise and Vibration

Noise from clearing and trenching is expected to be short term and of minimal intensity. It is anticipated that noise will not be generated during the operational phase of the Proposed Development. Construction activities will align with NRETAS Noise Guidelines for Development Sites, June 2011.

Air Quality

Air quality impact prevention and management measures regarding dust will be included in the ESDMP. These will include:

- Ground disturbance will be kept to the minimum practicable extent when developing an area.
- Access roads will be sealed as soon as practicable after clearing, and access restricted to open cleared areas, in order to minimise dust emissions from open areas and from vehicle movements.
- Traffic on unsealed areas will be minimised.
- Construction material loads on trucks travelling to and from the construction area will be covered to prevent dust releases.
- Surface hardening and / or protective cover will be provided in all areas experiencing intensive use.
- Off-site disturbance will be kept to the practicable minimum during construction activities.
- Topsoil from cleared areas will be conserved for re-use in rehabilitation.
- Stockpiles of construction materials on site will be kept to a reasonable size, and multiple handling of materials will be avoided where possible.
- Stockpiles will be covered where practicable.
- Vegetative or protective cover will be maintained where practical. Where this is not practical, vegetative cover shall be reinstated post-disturbance.
- As much naturally occurring vegetation around the proposed development as practicable will be retained.

Other air quality impact management measures will include:

- Unsealed surfaces will be wetted down where dust generation is observed.
- Uncovered stockpiles will be wetted down where continuing dust generation is observed.

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- Residues and spills will be cleaned up in a timely manner.
- All machinery will be maintained in good working order with appropriate exhaust systems fitted.

Terrestrial Flora and Fauna

Measures will be taken to minimise potential impacts on native vegetation communities, threatened fauna and migratory shorebirds and their habitats, including:

- Minimising the area of mangrove forest areas disturbed for any works.
- Undertaking significant works in the vicinity of areas where migratory shorebirds are present in the dry season when most northern hemisphere migrants are absent (May – August).
- Strict controls on sedimentation or other impacts that may impact shorebird feeding sites.
- Controls on activities or facilities that might disturb feeding and roosting birds (e.g. noise, nocturnal lighting).
- Implementing measures to minimise the potential import and / or spread of weeds during construction and rehabilitation. It is noted that both PWC and DCC have current weed management programs and procedures that involve regular weed treatment. An assessment of the weed risks in the study area will be undertaken to prioritise management responses in line with PWCs *Land Management Procedure* (2008) and DCCs current weed management program, which will involve inspection, identification and control of weeds.
- Checking the length of open trench each morning to remove any fauna that has fallen into or entered the trench.
- Putting in place controls to ensure that no cane toad breeding habitats are created during or following construction (e.g. small, still ponded freshwater or brackish areas).
- Progressive rehabilitation of areas, with suitable species, that are disturbed during construction activities or no longer required, with due consideration of the requirements of fauna species that will potentially recolonise these areas.
- Where possible clearing operations will include:
 - stockpiling of top-soil to conserve the soil seed bank (where relevant and appropriate given the level of previous disturbance)
 - stockpiling of deadwood and woody debris for later return to the rehabilitation area to provide fauna micro-habitat and increase the rate of faunal re-colonisation.

Biting Insects

Biting insect impact management measures are summarised as follows:

- Stormwater
 - Stormwater drainage for the proposed development will be constructed in accordance with the '*Guidelines for preventing biting insect problems for urban residential developments or subdivisions in the Top End of the Northern Territory*' (Medical Entomology, 2009a)
 - Roadside drains, swales and other minor drains will have concrete low flow inverts or other suitable surface when the fall of the drain would not be enough to prevent ponding
 - All roadside drains and swales will discharge to a suitable stormwater drainage system or directly to the sea
 - Any stormwater pit created as part of the Proposed Development will be free draining to prevent the creation of potential breeding sites for mosquitoes, including exotic dengue mosquitoes

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- Reclamation / Construction
 - Any cut off tidal area created during construction will have appropriate temporary drainage provisions provided, to prevent upstream ponding until the upstream area is reclaimed
 - Scrapes, and other disturbed areas will be rehabilitated to be free draining
 - Site disturbance such as wheel ruts and compacted ground will be rectified upon completion of construction, to prevent these areas from becoming perennial mosquito breeding sites.
- Ongoing Management
 - PWC will regularly check the alignment to assess potential breeding sites for mosquitoes and rectify as required.

Land-use

Use of the bike path will be restricted for a short period during the construction phase. The bicycle path will be reinstated once construction in that area is complete, and any nearby construction zones do not pose a safety risk to path users.