SECTION 2

Project Description

PowerWater

2 Description of the Proposed Development

This section presents a description of the Proposed Development, under the following headings:

- A summary of the project history (**Section 2.1, Project History**).
- Objectives, benefits and justification for the Proposed Development (**Section 2.2, Objectives, Benefits and Justification for the Proposal)**.
- Proposed action including and description of the proposed design, construction and operation of the duplicated effluent rising main (**Section 2.3, Proposed Action**).
- Actions related to the Proposed Development, including upgrading the Ludmilla Wastewater Treatment Plan, extending the proposed East Point outfall and the closure of the Larrakeyah outfall (**Section 2.4, Related Actions**).

2.1 Project History

Power and Water Corporation is undertaking a program of works to allow the closure of the Larrakeyah sewage outfall by October 2011, in accordance with the requirements of its wastewater discharge licence, WDL 149 (NRETAS, 2006a).

The LOCP forms part of Power and Water's broader Darwin Region Sewerage Strategy that 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 Larrakeyah Outfall Closure Plan supports the elimination of untreated sewage discharges to the Darwin Harbour (PWC, 2008a). The plan aims to ensure that all sewage discharged to Power and Water's sewerage systems is treated prior to eventual discharge to the environment. The plan will also provide improvements in the discharge performance of the East Point outfall reducing the potential to impact on local recreational activity.

The proposed works were initially identified in the Power and Water Corporation – 2008/09 Statement of Corporate Intent (SCI) and includes (PWC, 2008b):

- Diversion of Larrakeyah's sewage catchment.
- Duplication of the Ludmilla WWTP effluent rising main and extension of the East Point outfall.
- Augmentation of the Ludmilla WWTP.

The LOCP works programme (both completed and planned) for the Larrakeyah outfall closure are graphically presented in **Figure 2-1**.

2.2 Objectives, Benefits and Justification for the Proposal

Sewage generated within the Larrakeyah catchment is macerated (that is larger solids reduced to smaller particles through a mechanical process) and discharged into a deep-water outfall off Larrakeyah without further treatment. Closure of the Larrakeyah outfall is a long-term objective, formalised under the LOCP (see **Section 2.1, Project History**). Through the LOCP, which includes the Proposed Development, PWC aims to (PWC, 2008a):

- Comply with relevant NT legislative requirements, including licencing conditions.
- Reduce / mitigate 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.

2 Description of the Proposed Development

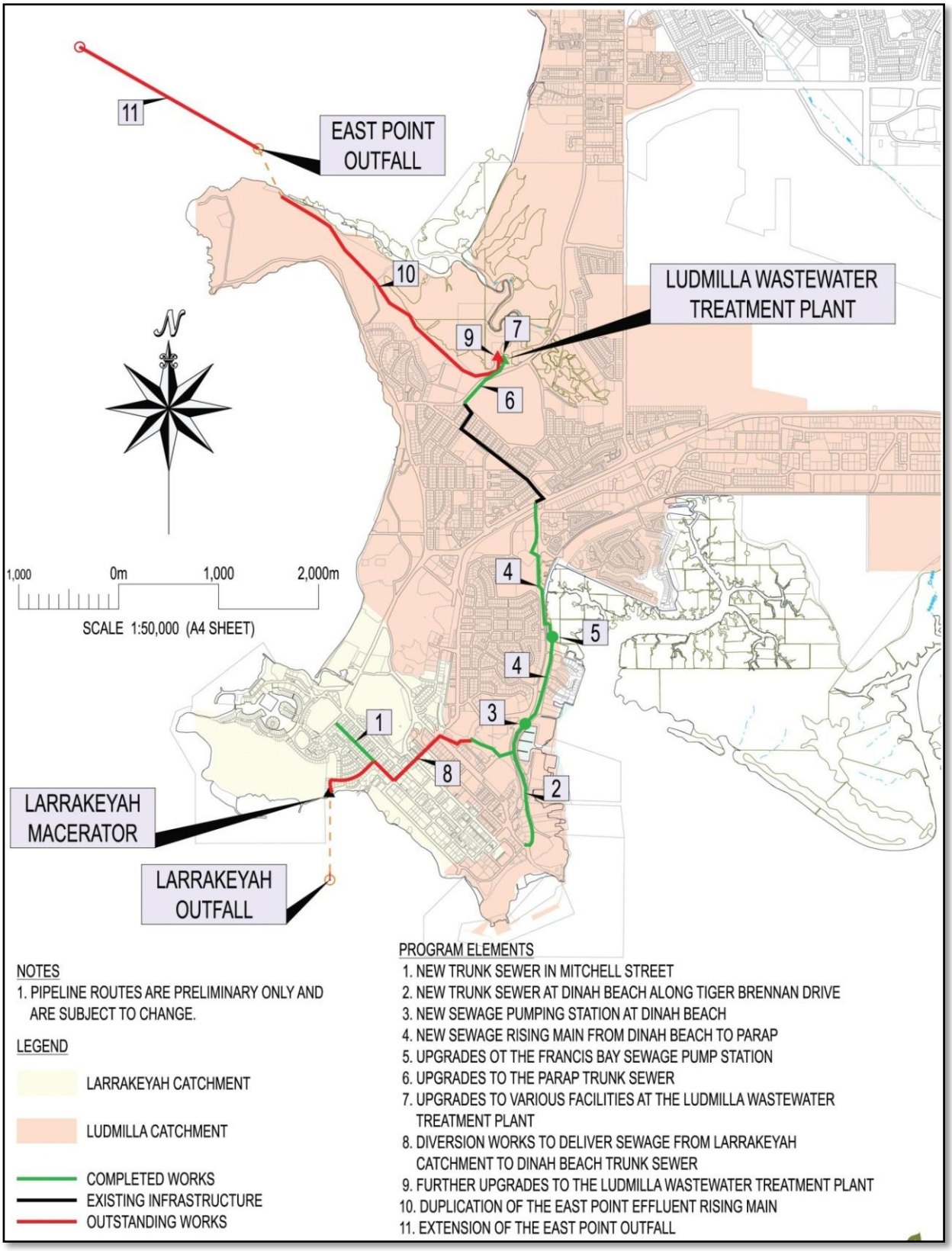

Figure 2-1 Larrakeyah Outfall Closure Plan Works Program

Source: PWC, 2008a

2 Description of the Proposed Development

2.2.1 Increased Sewerage Treatment Capacity

As at June 2009, the population of Darwin City was 75,908 people (approximately 34% of the NT Population), and the area experienced growth of 2.6% for the period 2008 to 2009. The Greater Darwin Region Land Use Plan Towards 2030 Consultation Paper identifies the Darwin City Centre, Darwin City Inner Suburbs, and Darwin Northern Suburbs as potential growth precincts (DLP, 2011), which comprise much of the existing Larrakeyah and Ludmilla sewage catchments. NT Treasury predicts that the population of Darwin, Palmerston and Litchfield region will increase by approximately 50,000 – 70,000 by 2025 (DLP, 2011). The projected increase in population within the Larrakeyah and Ludmilla catchments, and associated industrial and commercial growth, presents the need for increased sewage treatment capacity.

The Proposed Development caters for the projected growth anticipated in the Darwin City Centre, Darwin City Inner Suburbs, and Darwin Northern Suburbs precincts for the next 20 years.

The primary objective of the Proposed Development is to increase both the hydraulic and treatment capacity of Ludmilla WWTP, necessary due to the planned closure of the Larrakeyah outfall. In accordance with LOCP, sewage which was previously disposed of through the Larrakeyah outfall, will be diverted to the Ludmilla WWTP. Construction of the diversion pipeline from the Larrakeyah outfall to the Ludmilla WWTP is currently underway and is expected to be completed by the last quarter 2011.

2.2.2 Compliance with NT Legislative Requirements

Discharge of macerated sewage through the Larrakeyah outfall is authorised through a WDL 149 (NRETAS 2006a), due to expire in October 2011. Section 24 of the WDL requires PWC to undertake works to redirect Larrakeyah catchment sewage flows to an alternate facility, and closure of the Larrakeyah outfall, by 31 October 2011. An extension to WDL 149 was granted to PWC, allowing construction of infrastructure proposed under the LOCP.

The Proposed Development is an integral element of the LOCP, and will provide the extra hydraulic capacity at the Ludmilla WWTP necessary to allow closure of the Larrakeyah outfall and compliance with NRETAS WDL requirements.

2.2.3 Improved Sewage Treatment Performance

PWC propose to divert sewage from the Larrakeyah catchment to the Ludmilla WWTP, where it will be treated to a higher quality prior to discharge, and the Larrakeyah outfall and macerator will be decommissioned. Ludmilla WWTP is currently operating at capacity (Hunter Water, 2009). One of the factors limiting sewage treatment capacity of the Ludmilla WWTP is the capacity of the existing effluent rising main from Ludmilla to the EPO. When effluent inflows exceed the plant's capacity (typically during the wet season), a number of flow bypass points allow for the controlled discharge of partially treated sewage to Ludmilla Creek.

The Proposed Development will allow for the elimination of sewage discharge at Larrakeyah and considerable minimise discharges of treated sewage to Ludmilla Creek. The disinfection capacity of Ludmilla WWTP will be increased, resulting in fewer treated discharges to Ludmilla Creek, improved water quality in Darwin Harbour, and a reduction of environmental impacts associated with sewerage operations.

2 Description of the Proposed Development

2.3 Proposed Action

The Proposed Development consist of constructing a duplicate effluent rising main from the Ludmilla WWTP East Point, where it will be connected to an existing terminal manhole. The effluent rising main is a pressurised pipe that will transport effluent, for final disposal through the EPO.

The existing EPO will be extended to deeper water as downstream component of the Proposed Development. Extending the East Point outfall will be subject to environmental approval under the EA Act and EPBC Act. Accordingly, approval will be sought by PWC prior to construction of the EPO.

2.3.1 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. Further information on the WSAA suite of codes can be obtained at:

http://www.powerwater.com.au/business/for_business_and_developers/water_services_connection_code/technical_requirements

Concept designs have been developed for the Proposed Development and detailed design will likely commence after the draft PER has been submitted. Power and Water has current licences to discharge effluent at the Larrakeyah and East Point outfalls.

The proposed alignment for the duplicated effluent rising main to transfer effluent from to Ludmilla WWTP to the East Point outfall was currently being developed in cooperation with the DCC and other stakeholders to ensure the lowest possible impact on landscaping, infrastructure and areas of cultural significance.

Various studies have been conducted as part of this PER to identify design, construction and operation constraints that may be encountered (see **Section 4, Existing Environment**). 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 raising main easement and along the alignment of the Proposed Development.
- Occurrence of ASS and Potential Acid Sulphate Soils (PASS).
- Proximity of existing infrastructure to the Proposed Development.
- Areas of cultural heritage.

The location of the existing and proposed duplicated effluent rising main is illustrated in **Figure 2-2**, with further detail of the proposed alignment for the duplicated effluent rising main provided as **Appendix C** (drawing number B09-1687 to B09-1694).

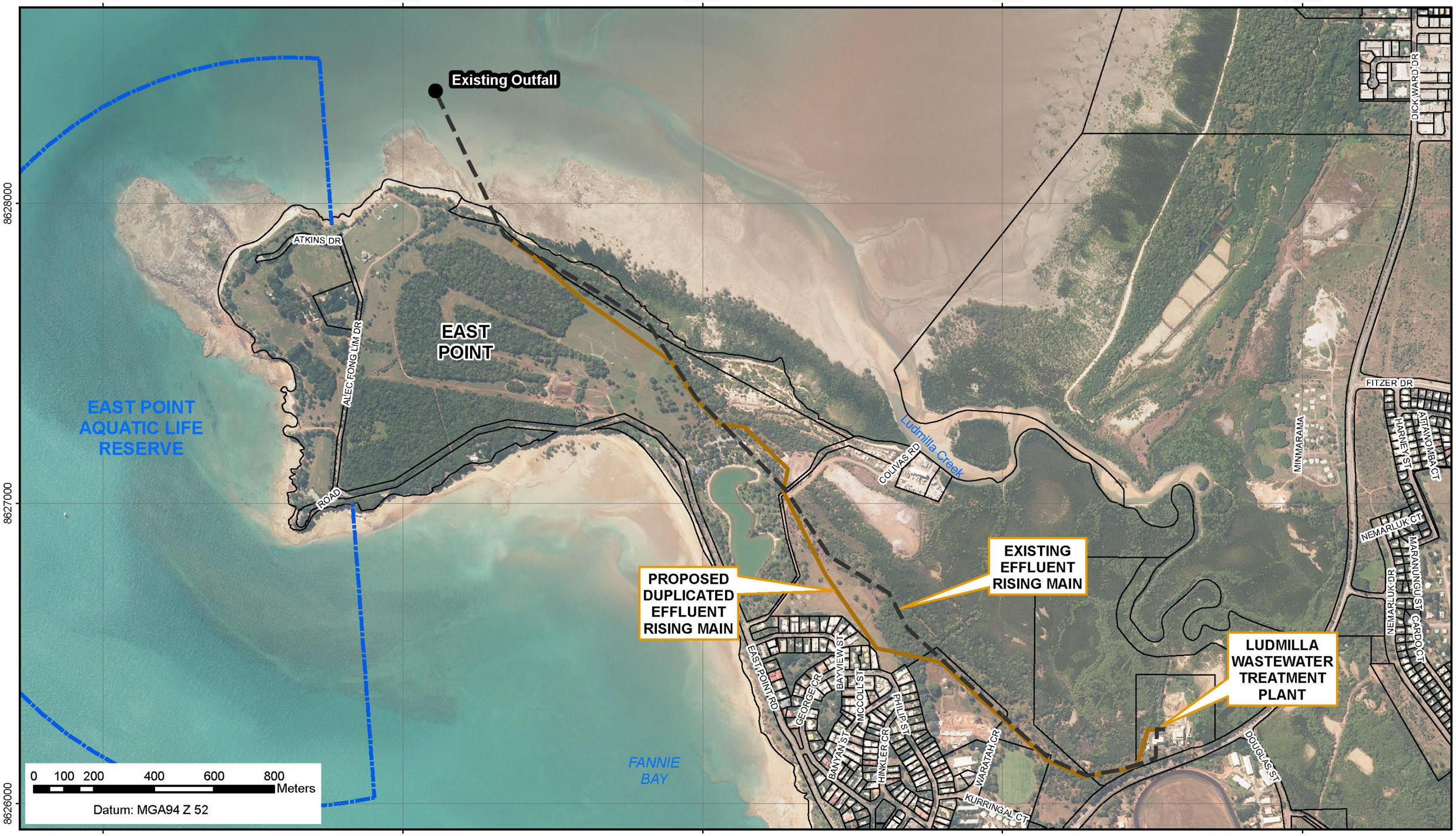

Figure 2-2 Proposed Alignment for the Duplicated Effluent Rising Main

Key elements of the Proposed Development's design include:

- The most economical solution is likely to be a dual rising main using the existing main as a duty standby (redundancy).
- The construction corridor will be 10 m wide to accommodate construction material, trenching and equipment.
- A laydown area (approximately 100 m^2) will be required for construction of the Proposed Development and will likely be located along the alignment.
- 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 i.e. lime treatment of excavated soils must be adhered to.
- Subject to time constraints, the expected workforce is approximately 10 people on site for the pipe laying stage.

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.

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

- Access requirements will be incorporated into design, which include roads, access tees and manholes.
- 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 on 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, reducing power costs.

2.3.2 Construction

Standards and technical specifications for the construction of the duplicated effluent rising main will align with PWC's technical requirements as described under **Section 2.3.1, Design**.

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) (see **Section 7.1, Environmental Management Framework**). The IMS includes an environmental management system (EMS) and environment, safety and quality procedures pertaining to all PWC activities (see **Section 7, Mitigation, Management and Monitoring**).

In addition to operating in accordance with the PWC EMPs 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:

2 Description of the Proposed Development

- Sediment, Erosion and Drainage Management Plan.
- Dust Control 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, including:

Access and Vehicle Movement

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. The selection of access track routes will be based on the pipeline route and gates will be installed where fence lines are breached.

Hours of construction will be specified in the construction contracts to minimise adverse impacts due to noise and disturbance. Construction activities will align with NRETAS Noise Guidelines for Development Sites, June 2011.

Estimated vehicle movements during the construction of approximately 12 weeks include:

- 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

A range of temporary facilities are required during the pipeline construction. These include work areas for equipment and pipe delivery and storage. The location of the temporary facilities is based on logistical requirements. Typical temporary facilities along the effluent rising main alignment may include:

- A site office and portable toilet facilities.
- Storage for construction material, e.g. pipes.
- Parking area for construction equipment, e.g. excavator and other site vehicles.
- Storage area excavated material.

Worker accommodation will not be required during the construction activities, since the project will be located in Darwin City close to the required facilities.

Existing Services

Prior to construction and clearing activities existing services will be identified along the proposed effluent rising main alignment. A notification will be issued to operators / owners of services that may be impacted by the construction activity. It is anticipated that the effluent rising main will only cross a minor road, specifically Colivas Road. The method used for crossing this road will be dependent on environmental factors and geotechnical constraints, but will most likely consist of open trenching. The proposed alignment will also intersect a section of the bicycle path at East Point. Both the road and bicycle path will be repaired after construction of the Proposed Development.

2 Description of the Proposed Development

Clearing and Grading

The proposed pipeline corridor was selected in consultation with key stakeholders to minimise the removal of trees and limit exposure to potential areas of ASS. It is anticipated that a 10 m corridor will be cleared, including a small portion of the East Point bicycle path. Typically root stock will be left in the ground where practicable to stabilise the area and reduce erosion. Some vegetation will be stockpiled for re-spreading as part of the restoration process. Large trees will be preserved wherever practicable. The works area will be levelled to the required gradient using graders, backhoes and bulldozers. Topsoil removed from pipeline routes during construction will be stockpiled and replaced during rehabilitation.

Excavation

A trench will be dug using excavators, trenching machines, rock saws or by drilling as required by the nature of the ground. The extent of excavations will be kept to a practicable minimum during construction of the effluent rising main. Typical top of pipe to finished surface level depths in all areas are 750 mm and at road crossings 1,200 mm.

Areas where the excavation impacts improved surfaces such as the bicycle path, road surface and rehabilitated areas will be re-instated.

Trenching will be completed in accordance with NT WorkSafe guidelines and regulations. Methods will be adopted to prevent fauna entrapment, although this is anticipated to be highly unlikely to occur.

Surplus material will be promptly removed and disposed of at an authorised location if not required for reuse. Acid sulphate soils and soil erosion management will be used to manage acid generating soils and mitigate potential soil erosion (see **Section 7.2, Mitigation of Impacts on the Physical Environment**)

Pipe Bedding and Piping for the Effluent Rising Main

Pipe line bedding and piping will be in accordance with the PWC Master Hydraulic Specification. Suitable bedding will be placed in the excavated trench to support the pipeline. Bedding will be compacted uniformly along the whole length of the pipeline. Pipe will be transported to site on trucks and unloaded at stockpile sites.

As the work progresses the pipes will be strung out adjacent to the trench and set on supports to protect the pipe coating from damage. Pipe will be stored along the proposed alignment. Construction of the duplicated effluent rising main will commence from the terminal manhole, downstream of the Ludmilla WWTP.

Line-Up and Welding/Joining of Pipes

Once the pipe is strung, a line-up crew will position the pipe using side boom tractors, cranes or excavators and line-up clamps. The pipes are then either welded together or jointed using rubber ring joints. Welds are subjected to an inspection to test for compliance to specification, thus ensuring the integrity of each weld. Welded pipes will be jointed both above and below ground. In the case of reinforced concrete the pipe sections will be joined via a rubber seal. All rubber sealed pipes will be joined in the trench.

2 Description of the Proposed Development

Lowering In and Backfilling

Pipe line bedding and piping will be in accordance with the PWC Master Hydraulic Specification (see **Section 2.3.1, Design**). Imported graded material is placed in the bottom of the trench and the pipe is lifted off the skids and lowered into the trench using side-boom tractors, cranes or excavators. The pipeline is then covered with more graded material. The trench is then filled by returning the remaining excavated material, if suitable, or suitable imported fill.

Testing

The pipeline will be hydrostatically tested for potential leaks by being filled with water and pressurised to a pressure greater than its maximum operating pressure.

Restoration and Rehabilitation

Clean up and rehabilitation measures will be applied to the effluent rising main corridor and access tracks in consultation with the relevant land holder/owner. Generally clean up and rehabilitation will involve removal of foreign material (construction material and waste), surface contouring, re-spreading topsoil, re-spreading vegetation. In certain areas a low 'formed camber' of material may be allowed to remain over the trench line to allow for possible subsidence. Given that the pipeline will be underground, land users are able to resume previous land use activities on top of the pipeline provided that this does not include excavation or building activities.

Material Options for Construction of the Duplicated Effluent Rising Main

The rising main will most likely be constructed from either steel or reinforced concrete pipes of a diameter 1050 mm. However, construction materials and methods used 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 (described under **Section 2.5, Related Actions**) is shown at **Figure 2-3**.

2 Description of the Proposed Development

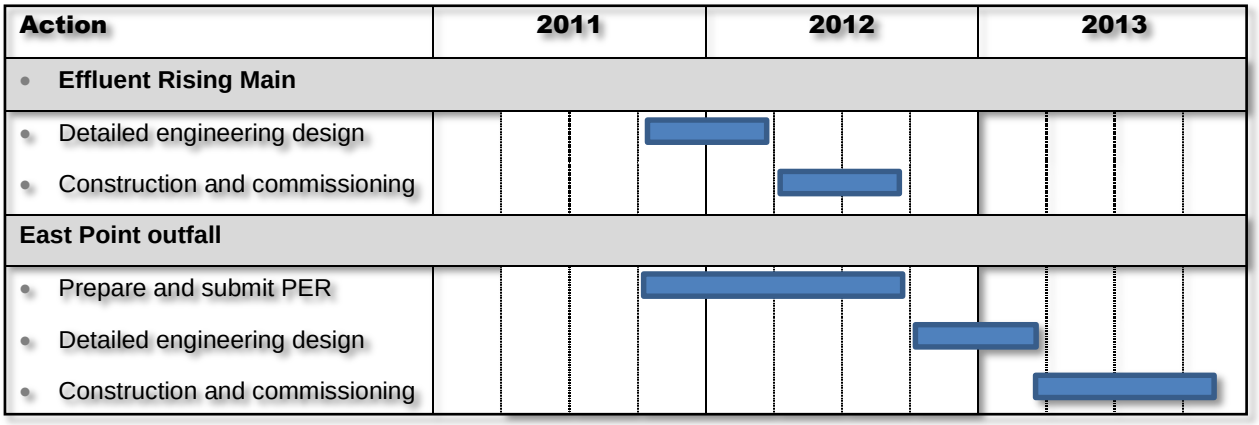

Figure 2-3 Key Components of Construction Program

The upgrades to the Ludmilla WWTP are currently being undertaken and will be completed by the time construction of the proposed duplicated effluent rising main and EPO extension is completed (see **Section 2.5.1, Upgrade of Ludmilla Wastewater Treatment Plant**).

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, can 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.

2.3.3 Operations

The effluent rising main will be used to transfer effluent from the Ludmilla WWTP to the existing East Point outfall (see **Figure 2-2**).

The duplicated effluent rising main will become the primary rising main transporting effluent from Ludmilla WWTP to the EPO. The existing pipeline will be rehabilitated and used for redundancy to the new effluent rising main, when maintenance is required.

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.

Wastewater characteristics are further discussed under **Section 2.5.1, Upgrade of Ludmilla Wastewater Treatment Plant**.

2 Description of the Proposed Development

2.4 Related Actions

Duplication of the effluent rising main represents only one component of the LOCP, discussed in more detailed under **Section 2.1, Project History**.

Actions related to the Proposed Development are shown in **Figure 2-1**, with related actions currently underway including:

- 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.

2.4.1 Upgrade of Ludmilla Wastewater Treatment Plant

The site arrangement for the upgraded Ludmilla WWTP is shown in **Figure 2-4**, supported by a schematic of key treatment process units of the upgraded Ludmilla WWTP shown in **Figure 2-5**.

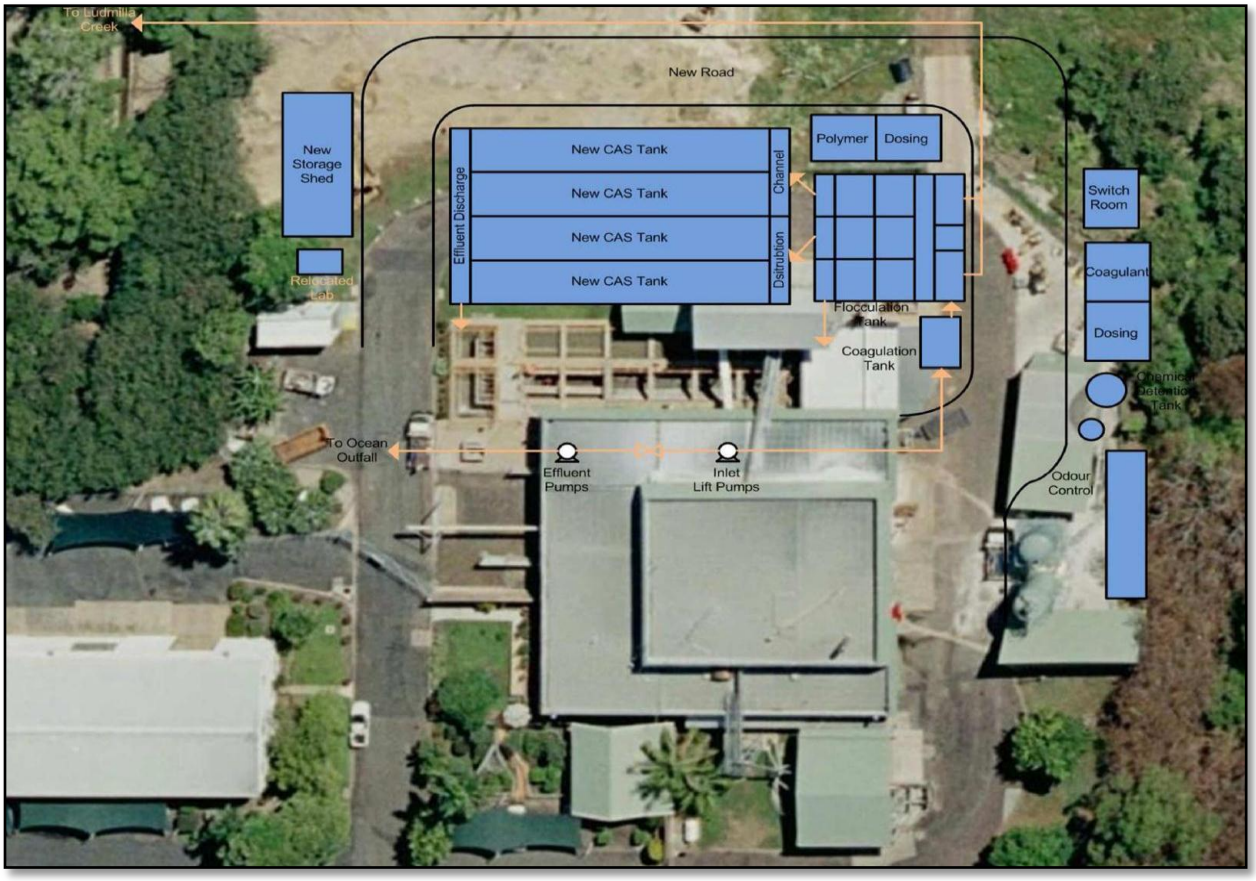

Figure 2-4 Site Arrangement for the Upgraded Ludmilla WWTP

Source: Hunter Water, 2011

2 Description of the Proposed Development

The projected increase in sewage flow through the effluent rising main will require upgrades to the Ludmilla WWTP. Treatment of wastewater at Ludmilla WWTP is currently by Chemically Assisted Sedimentation (CAS). The key treatment process units at the Ludmilla WWTP are:

- Inlet works (screening, grit removal and associated conveyors and girt classifier).
- Chlorination.
- Chemical dosing (lime and polymer).
- Chemically Assisted Sedimentation.
- Sludge handling (dewatering).
- Effluent discharge.

Raw sewage enters the plant and is passed through an automated step screen and a grit removal chamber and is then dosed with chlorine for disinfection, odour control is also assisted through the dosing of chlorine. The screened sewage is then dosed with lime and polymer to aid in particle sedimentation in the settling chambers (i.e. CAS tanks).

The treatment plan was originally designed for operation with lime doses up to 140 mg/L and maximum pH of 10.5. However, in the period after commissioning, the effluent discharge pipeline started to show signs of excessive calcium based scaling which reduced the discharge capacity. To reduce the impact of calcium scaling, the process was operated at lower lime dose rates, in the order of 80 mg/L (Hunter Water, 2011).

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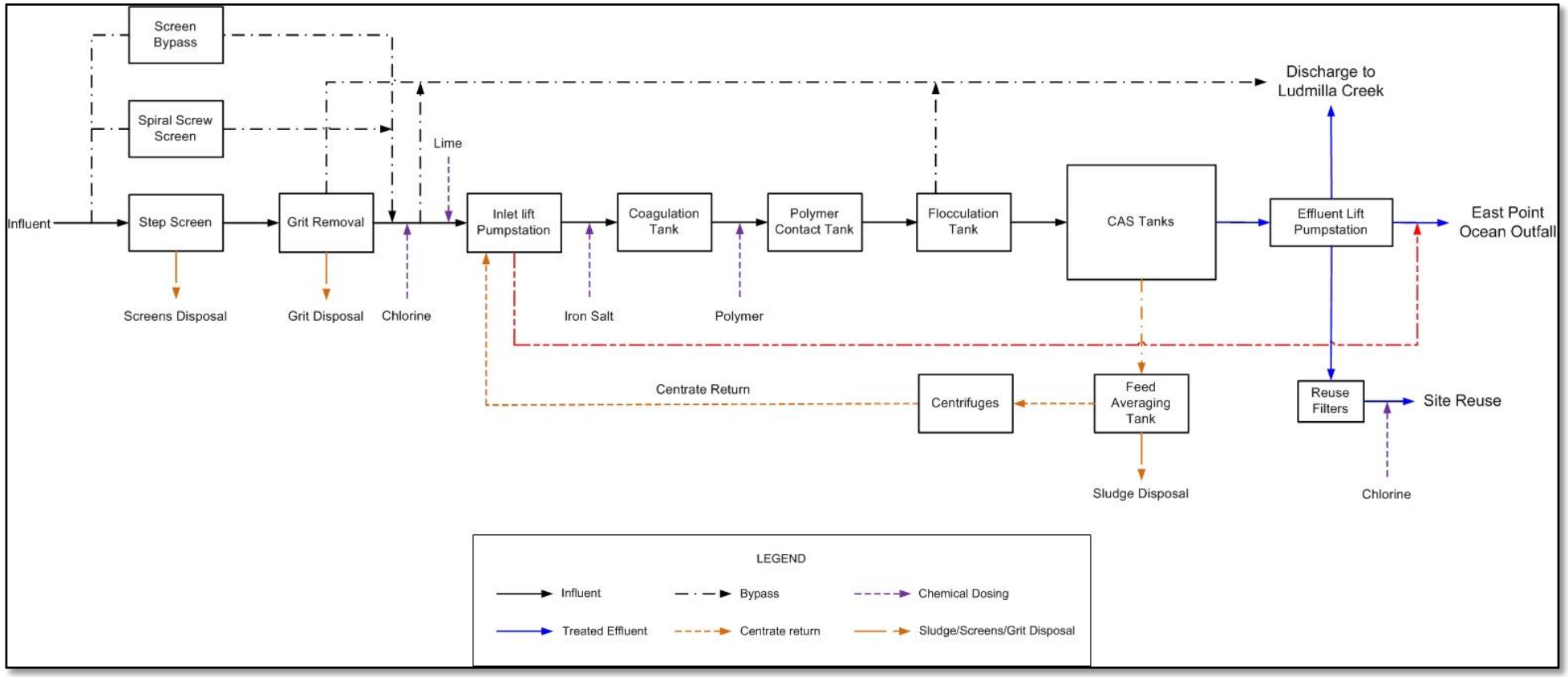

Figure 2-5 Proposed Alignment for the Duplicated Effluent Rising Main

Wastewater Characteristics

Ludmilla WWTP influent (raw sewage) and effluent water quality monitoring data is included at **Section 8, Marine Water and Sediment Monitoring Program**. The results of the Ludmilla WWTP influent and effluent water quality monitoring program are summarised below.

Influent

Under the existing WDL for Ludmilla WWTP, PWC is required to undertake water quality monitoring of influent and the inlet works (WWTP ponds). Ludmilla WWTP average influent (water quality parameters for the period 2005-2009) are summarised in **Table 2-2.**

Table 2-1 Ludmilla WWTP influent water quality parameters 2005-2009

Parameter	Average (mg/L)	Median (mg/L)	90%ile (mg/L)
pH	7.1	7.1	7.4
BOD	165	150	290
TSS	265	165	640
E. Coli	4×106 (cfu/100mL)	4×106 (cfu/100mL)	1×107 (cfu/100mL)
Total Nitrogen	45	45	65
Free Ammonia	30	35	40
Total Phosphorus	7.5	7	11.5
Orthophosphate	5	5	8

Unit = Colony Forming Unit (CFU)

Effluent

Discharge to Darwin Harbour from the Ludmilla WWTP is regulated under the NT *Water Act, 1992* and Waste Discharge Licence 150. The licence contains concentration limits for treated effluent which is summarised below in **Table 2-2**.

Table 2-2 Existing Ludmilla WWTP Waste Discharge Licence (150) Effluent Quality Requirements

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

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PWC has undertaken a regular programme of monitoring in accordance with the requirements of the WDL 150. Under its existing WDL, PWC is authorised to discharge wastewater from Ludmilla WWTP with an annual median *Escherichia coli* count of one million Colony Forming Units (CFU) per 100 mL of water (10^6 cfu/100mL).

Under the current disinfection regime bacterial levels at the WWTP outlet point generally remain orders of magnitude below this concentration (10^2 - 10^4 cfu/100mL). This is further diluted at the ocean discharge point (i.e. the EPO), typically to below the guideline value for recreational waters of 100 cfu/100 mL, but exceeding the cultural guideline of 14 cfu/100 mL typically by a factor of less than one order of magnitude.

Ludmilla Wastewater Treatment Plant Upgrade Strategy

Hunter Water (2009) concluded that there is insufficient capacity at the Ludmilla WWTP to accept flows diverted from the Larrakeyah outfall (for a total connected load of approximately 43,000 Estimated Population [EP]). It is therefore proposed that the Ludmilla WWTP is to be upgraded not only to accept the diversion of sewage from the Larrakeyah outfall, but also to cater for projected growth in both the Ludmilla and Larrakeyah catchments.

Ludmilla WWTP upgrades will be centred on expansion of the existing CAS process with dedicated coagulation and flocculation facilities with design capacity sufficient for project demand growth to 2030, when the Average Dry Weather Flow (ADWF) is predicted to be approximately 17.5 ML/day (Hunter Water, 2009). The upgraded WWTP will be able to provide treatment capacity up to 5 × ADWF. A treatment capacity of 5 × ADWF will reduce the number of days that a process bypass (i.e. treated discharge to Ludmilla Creek) occurs at year 2030, thereby reducing the risk that 90th percentile limits will be breached during exceptionally wet years whilst also reducing the impact on receiving environments.

Chlorination Upgrade

Full chlorination capacity of 365 L/s will be achieved after the proposed WWTP upgrade. This will be sufficient for disinfection of up to 1.7 x ADWF.

Upgraded Plant Effluent Quality

Effluent quality from the upgraded Ludmilla WWTP during normal weather will be improved compared to the current plant configuration. Improvements include:

- Significant reduction in BOD and TSS.
- Significant (40-55%) reduction in phosphorous concentrations.
- Significant decrease in *E. coli* concentrations.

Nitrogen (TN and ammonia) concentrations will be be slightly improved. Key aspects of upgraded plant performance during extreme weather events are:

- Dilution of raw sewage in the order of 5-7 times.
- Significantly reduction of nutrient concentrations (by up to 85%).
- Significant decrease of *E. coli* concentrations (by up to 85%).

Accurate predictions of treated effluent quality from the upgraded treatment plant are difficult due to fluctuating influent chemical characteristics and flows rates.

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2.4.2 Proposed East Point Outfall

PWC discharges treated sewage effluent from the LWWTP into the Darwin Harbour via the EPO. Under the LOCP PWC is considering options to replace and extend the existing. The options being assessed by 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 the 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.

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.

Construction options under consideration include:

- Bottom Towed Pipeline.
- Surface Towed Pipeline.
- Install in Sections.
- Horizontal Directional Drilling.

PWC has commissioned various investigations to inform the EPO design and construction including:

- Geotechnical assessment.
- Assessment of oceanic processes and dispersion modelling to determine the optimal location of the EPO diffuser.
- Study to describe the existing marine water quality and to assess the potential impacts upon water quality arising from the project.
- Assessment to describe the marine and estuarine flora and fauna
- Cultural heritage assessment.
- Review of construction methodology.

Results from these studies are forthcoming and will inform the environmental assessment and EPO design.

2.4.3 Larrakeyah Ocean Outfall

Currently wastewater generated from the CBD and adjacent suburbs is macerated and discharged via the Larrakeyah Outfall to the Darwin Harbour without further treatment. 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.

Decommissioning of the Larrakeyah outfall will eliminate the discharge of untreated (macerated) sewage to Darwin Harbour. Works associated with the closure of the Larrakeyah outfall are shown graphically in **Figure 2-1.**