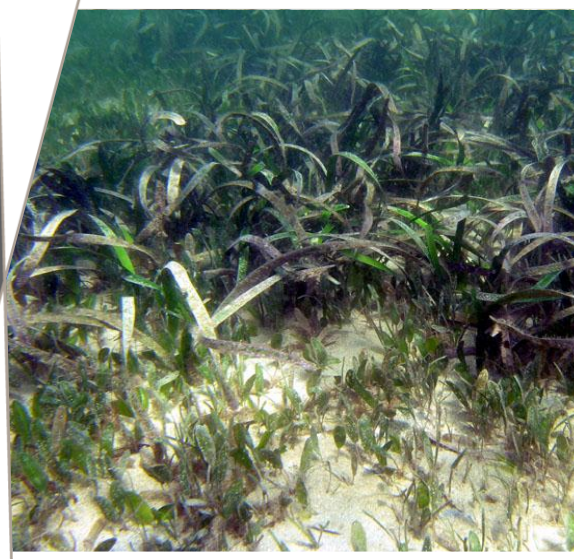
Aquatic Health Management Plan

Kurnell Ports and Berthing Facility

59914811021



Prepared for
URS on behalf of Caltex Refineries (NSW) Pty Ltd

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Cover Image: Seagrasses *Posidonia australis* with *Halophila ovalis* in the foreground in Botany Bay. Photographer: Dan Aveling, Cardno Ecology Lab.

Executive Summary

An Aquatic Health Management Plan (AHMP) is required to respond to the Conditions of Consent for the upgrade of Kurnell ports and berthing facility (the Project). The Draft Conditions of Consent for the Project were issued by the Department of Planning and Infrastructure to Caltex Refineries (NSW) Pty Ltd under Section 89E of the Environmental Planning and Assessment Act 1979. The AHMP aims to comply with the overall aims of the Conditions of Consent, mainly to:

- prevent, minimise, and/or offset adverse environmental impacts including economic and social impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the ongoing environmental management of the development.

The key focus of the AHMP are sensitive marine receivers, defined in the Conditions of Consent as:

- The seagrass communities shown on Figure 10-2 of the EIS (URS 2013);
- Aquaculture lease number ALDI/098,
- The intertidal areas around Kamay Botany Bay National Park; and
- Other intertidal habitat used by threatened and migratory shorebirds along the eastern shore of Botany Bay.

This Draft AHMP was prepared based on the draft Conditions of Consent and discussions with DPI (Fisheries) and OEH.

Seagrass beds nearest to dredging activities

The Seagrass Monitoring Plan would utilise photographic methods to establish baseline conditions and survey during and after dredging with the aim to detect any changes in seagrass distribution and condition attributable to dredging. Monitoring for broad-scale distribution would be done using fixed transects from the boundary of the dredging footprint towards the shoreline. Distribution maps, species present and condition would be determined from video footage. Condition of *Posidonia* beds to the east and west of the Caltex wharf would be assessed using drop camera methods, with species, density and condition recorded. During and after surveys using the same methods would be timed to account for seasonal variability and the dredging project timeframe.

Final reporting would compare distribution/ecological condition with summary data for water quality monitoring undertaken at nearby water quality monitoring sites as part of the Sediment and Water Quality Monitoring Program for the Project to determine if any changes in baseline health of seagrasses can be causally linked to dredging activities.

Aquaculture Lease Number ALDI/098

The aim of monitoring activities in the vicinity of Aquaculture Lease ALDI/098 is to ensure that the currently inactive lease has the capacity to resume aquaculture activities at any time and remains unaffected in the short or longer term by activities associated with dredging. This will be accomplished by assessment of data collected as part of the Sediment and Water Quality Monitoring Program and data on habitat condition collected as part of the Seagrass Monitoring Plan.

Intertidal habitats in the Kamay Botany Bay National Park

Potential impacts due to dredging activities on intertidal habitats in the Kamay Botany Bay National Park relate to impacts related to exposure to elevated turbidity and the limited potential for bioaccumulation of TBT in selected biota due to resuspension of fine sediments containing TBT. Based on the EIS assessment of low risk of impact on intertidal habitats and assemblages (URS 2013) no monitoring program is proposed.

Intertidal habitat used by threatened and migratory shorebirds along the southern shoreline of Botany Bay.

Potential impacts due to dredging activity on intertidal habitat relate to sedimentation in intertidal habits that has low potential to impact on prey items and roosting sites used by threatened and migratory shorebirds

and noise impacts associated with the installation of a sheet pile wall and rock revetment. The monitoring program would be based on observations of shorebird abundance, behaviour and condition along the Sliver Beach and Kamay Botany Bay National Park foreshore, with surveys undertaken at low tide and high tide before, during and after dredging activities. Surveys would be undertaken weekly during piling activities.

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1 Introduction, Location of Scope of Works

1.1 Background

An Aquatic Health Management Plan (AHMP) required to comply with Conditions of Consent issued by the NSW Department of Planning and Infrastructure (DP&I) under Section 89E of the *Environmental Planning and Assessment Act 1979* (EP&A Act) attached to the approval of the upgrade of Caltex's port and berthing facility ('the Project').

There are four main elements to the Project:

- The replacement and upgrade of the berthing infrastructure.
- Dredging.
- Sediment reuse/disposal within Botany Bay.
- Sediment disposal at the Sydney Offshore Spoil Ground.

The aim of the Plan is to provide the basis for aquatic health management related to the dredging works and the reuse/disposal of sediment within Botany Bay. The Plan focuses on detecting changes in mainly biotic receptors associated with dredging activities that would inform the need for mitigation or offset measures. The Plan will form part of a wider suite of management documentation that will be used to support the Project and will utilise data collected as part of those plans. Other Plans that relate to the AHMP are the Sediment and Water Quality Monitoring Program and the Dredge and Spoil Disposal Management Plan, as illustrate in **Figure 1-1** below:

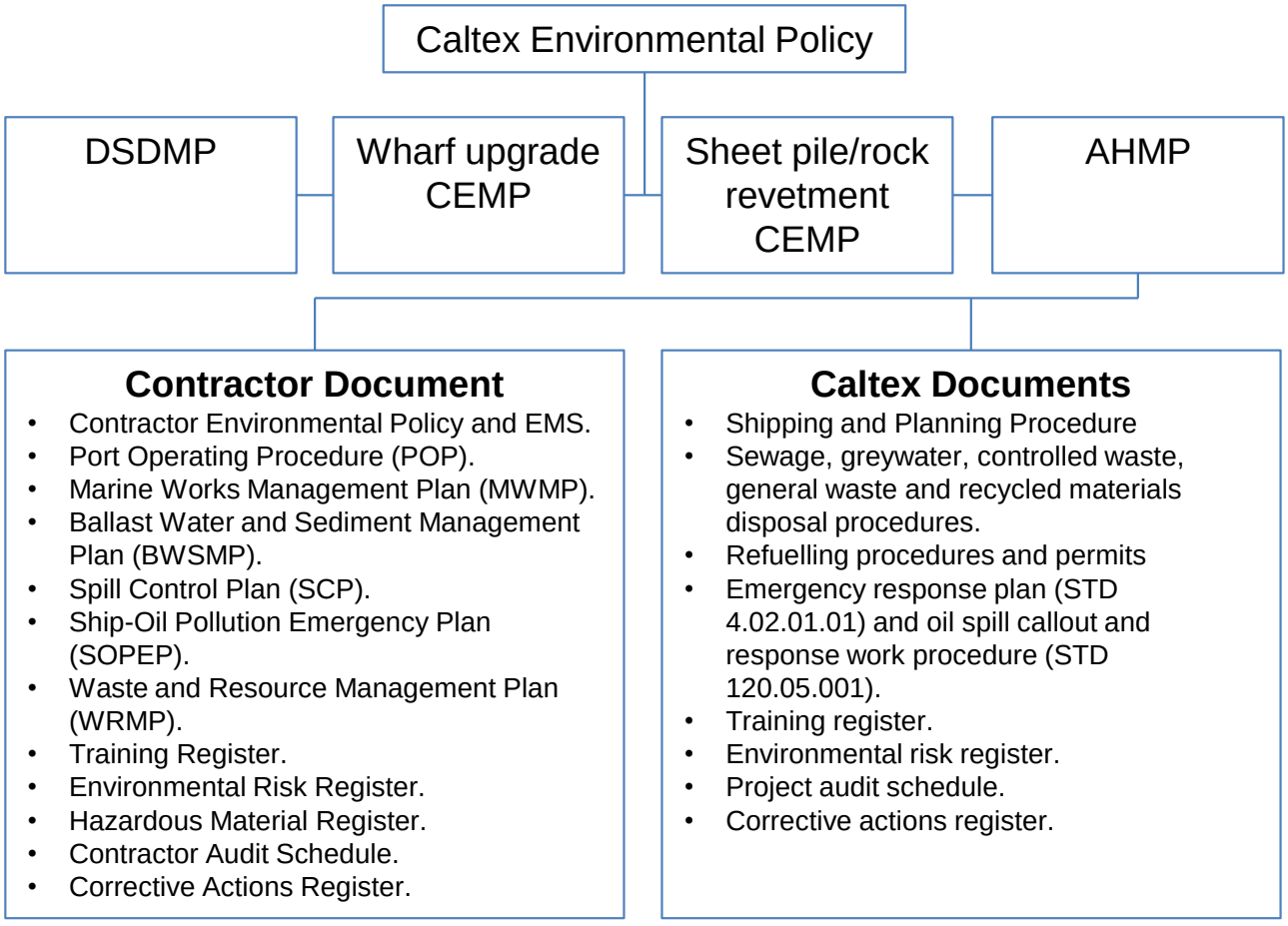

Figure 1-1 Relationship of the Aquatic Health Management Plan to Caltex and Contractor documents and within the Caltex Environmental Policy

1.2 Conditions of Consent

The AHMP must satsify the Project Conditions of Consent. Draft Conditions of Consent issued by DP&I on 8 August 2013 specify the conditions relating to aquatic health management are as follows:

*C8. Prior to commencement of construction, or as otherwise agreed by the Director-General, the Applicant shall prepare (and implement following approval) an **Aquatic Health Management Plan** in consultation with OEH and DPI (Fisheries). The Plan must:*

- *(a) be prepared by a person who has been approved in writing by the Director-General;*
- *(b) include baseline aquatic surveys and data to confirm the distribution and condition of sensitive marine receivers, with appropriate consideration of seasonal variations, and identification of potential no-go areas;*
- *(c) identify representative monitoring locations which can be used to determine the distribution and condition of sensitive marine receivers, taking into account the AusGrid seagrass rehabilitation project;*
- *(d) identify performance measures to assess the distribution and condition of the sensitive marine receivers during dredging; and*
- *(e) include an aquatic health monitoring program to be to be followed for the duration of dredging including the frequency and procedures for surveys, monitoring and visual observations.*

C9. Within twelve (12) months of completing the post dredging water quality monitoring required by Condition C3(e)[1], unless otherwise agreed to in writing by the Director-General, the Applicant shall submit a report to the Director-General, EPA, OEH, DPI (Fisheries) and SPC setting out whether dissolved and sediment-bound TBT and suspended sediment concentrations generated and dispersed by dredging are likely to have affected the distribution and condition of the sensitive marine receivers compared to baseline conditions drawing on all sediment and water quality and aquatic health monitoring data required to be collected by conditions C3[2] and C8.

C10. If considered necessary by the Director-General, the Applicant shall identify rehabilitation (and monitoring) or offset measures to be implemented to compensate for any adverse impacts to sensitive marine receivers identified in the report required by condition C9 attributable to the Development to the written satisfaction of the Director-General.

Sensitive Marine Receivers have been defined within the Draft Conditions of Consent as:

Aquaculture lease number ALDI/098, the seagrass communities shown on Figure 10-2 of the EIS, the intertidal areas around Kamay Botany Bay National Park and other intertidal habitat used by threatened and migratory shorebirds along the eastern shore of Botany Bay[3].

Figure 10-2 of the EIS (URS 2013) is reproduced below.

In addition to the Conditions of Consent the AHMP has been prepared based on discussion with representatives from relevant agencies, namely:

OEH: Caltex representatives Christina Halim and Simon Caples and URS representatives Chris Fay and Rob Blackall met with OEH representative Geoff Ross on 13 August 2013 at the Kamay Botany Bay National Park visitors centre.

DPI (Fisheries): Caltex representatives Paul Seage, Christina Halim and Khaled Elomar and URS representative Chris Fay met with DPI representative Carla Ganassin regarding the commitment to seagrass monitoring on 30 April 2013 in a meeting held at the Kurnell Refinery. Follow-up communication was initiated by Paul Seage with Carla Ganassin by telephone on 1 May 2013 to agree the approach to monitoring.

[1] C3. Prior to commencement of construction, or as otherwise agreed by the Director-General, the Applicant shall prepare (and implement following approval) a **Sediment and Water Quality Management Plan** in consultation with the EPA and DPI (Fisheries).

[2] C3(e) The Plan must include a sediment and water quality monitoring program to be followed during and post dredging including the frequency and procedures for water quality monitoring (including in real-time) of dissolved and sediment bound TBT and suspended sediment concentrations, and other water quality parameters at the identified water quality monitoring locations.

[3] The meaning of the phrase "…*the eastern shore of Botany Bay*" has been clarified based on discussions with OEH and is understood to indicate the southern shoreline of Botany Bay including Sliver Beach eastwards to include Kamay Botany Bay National Park foreshore.

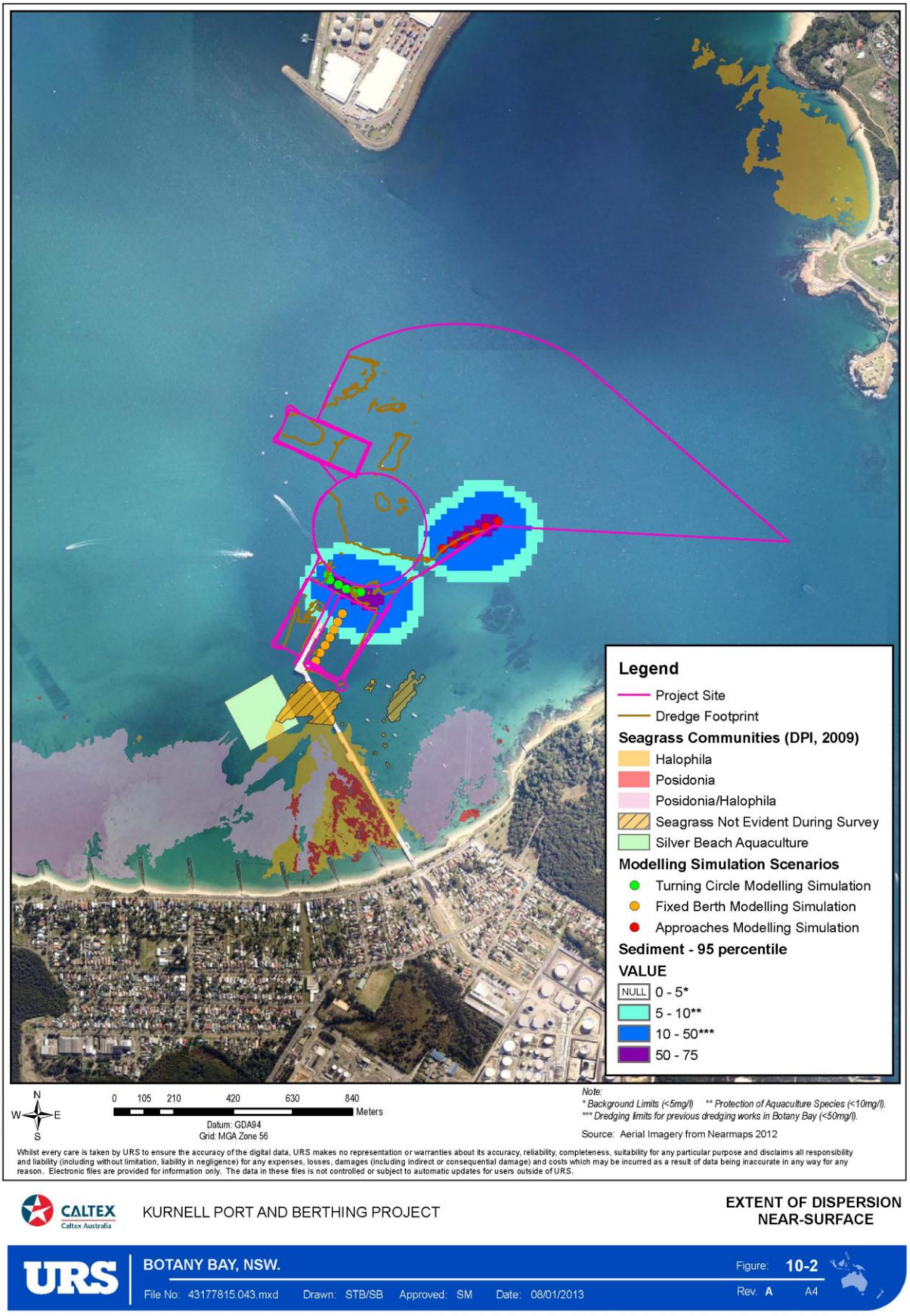

Figure 1-2 Reproduction of Figure 10-2 from the EIS. Modelled predictions of increased turbidity due to dredging and sediment disposal. (Source: URS, 2013)

2 Project Overview

2.1 Project Location

The dredging will take place in the south east corner of Botany Bay off Silver Beach north of the Kurnell Peninsula, approximately 10 km south of Sydney's Central Business District (CBD).

The total area (footprint) that will be dredged is approximately 178,000 m^2 (0.178 km^2) (see **Figure 2-1**). This includes the existing berths (one sub berth and two fixed berths), a ship turning circle and the associated shipping approaches.

The dredge footprint is bounded to the north and east by the main Botany Bay shipping channel. To the south are Silver Beach, the suburb of Kurnell and the Kurnell Refinery. Towra Point and the inner waters of Botany Bay are located to the west of the dredge footprint.

The perimeter of the dredge footprint is approximately defined by the 14 m below Chart Datum (CD) contour to the north-east (on the interface line with the shipping channel) and the 10 m below CD contour for the remaining boundaries.

2.2 Works Overview

The Project comprises the following principal components:

- Dredging approximately 153,000 m^3 of sediment from the seabed in the vicinity of the berths, turning circle and approaches.
- Loading this sediment onto split hopper barges in the dredge footprint.
- Transporting the majority of the sediments offshore for disposal, with the exception of 6,000 m^3 that will be reused/disposed in Botany Bay.

2.3 Dredging and Loading Works

The footprint will be spot dredged, resulting in a broadly flat, uniform area across the base of the footprint. The perimeter of the footprint will be profiled to create side 'batter' slopes. These will be at least to a 1-in-6 profile to the existing seabed. The exception is at the southern limit of fixed berth #1 where a rock revetment and sheet piled wall will be constructed.

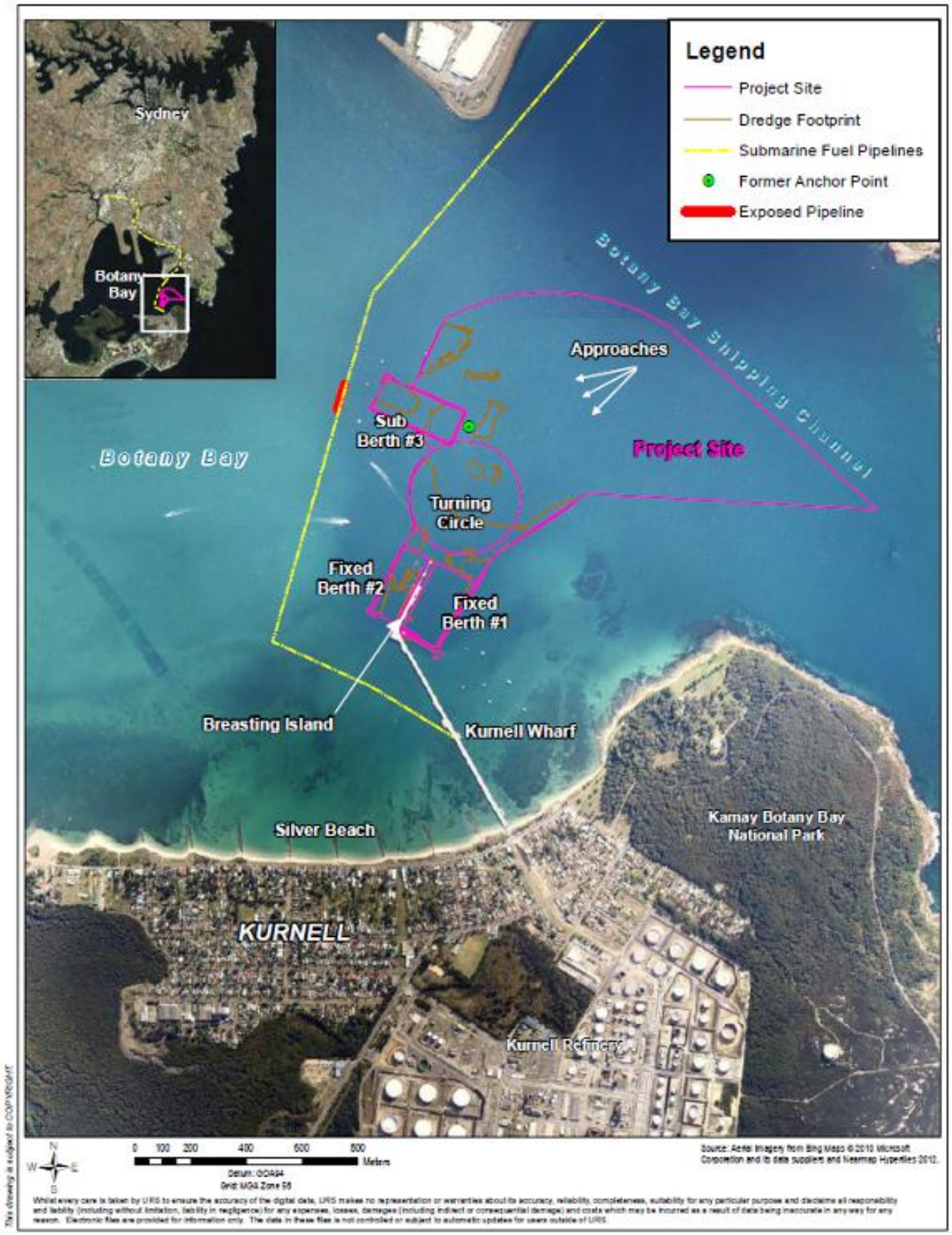

Figure 2-1 Project site and context (URS, 2013)

The dredging will return the turning circle and approaches to their design depth of 12.8 m below CD. The sub berth will be returned to its design depth of 14 m below CD. The fixed berths will be dredged to increase both the size of the berth boxes and their overall effective depth (12.8 m below CD).

The dredge area, final dredge depth and dredge volume is included in **Table 2-1** below.

Table 2-1 Proposed Dredging Area, Depth and Volume

Location	Required Dredge Depth to CD* (excluding over dredging)	Design Area (m^2)	Required Dredge Volume (m3)	Additional Dredge Volume to allow for over dredging (m^3)	Total Volume (including over dredging (m^3)
Approaches & Turning Circle	-12.8	98,750	30,500	29,750	60,250
Sub Berth	-14	16,750	7,750	5,000	12,750
Fixed Berths	-12.8	62,500	61,250	18,750	80,000
Total	-	178,000	99,500	53,500	153,000
*Note: Depth to seabed and not ship's keel.					

2.4 Proposed Dredge Method and Schedule

The dredging will be undertaken using a backhoe dredger (BHD). BHD will excavate the sediments from the seabed, lift them through the water column and slew (transfer) them into a split hopper barge. A silt boom will be placed around the dredge bucket head. The boom would extend from the surface to a depth of four metres.

Two split hopper barges and associated tugboats will be used to collect and transport the sediments. Each hopper barge will have a 1,200 m^3 holding capacity. The hopper barges will work in rotation. Whilst one barge is being filled, the second hopper barge will transit to and from the offshore spoil ground. This will allow continuous dredging to take place in Botany Bay over a 19-week period.

Excess water from the loaded sediments will be allowed to overflow from the hopper barges, except when dredging sediments in the fixed berths and in front of the sub berth.

It will take approximately 300 hopper barge movements to transfer the 147,000 m^3 of sediment offshore.

- Where overflow dredging takes place each hopper barge will hold approximately 1,000 m^3 of sediment.
- Where overflow dredging does not take place each hopper barge will hold approximately 500 m^3 of sediment.

The dredging works are planned to start in October 2013 and end in January 2014 (a 19 week period).

2.5 Sediment Disposal in Botany Bay

Up to 6,000 m^3 of sediment taken either from the area north of the sub berth or the area on the southeast side of the turning circle will be used to infill a former anchoring hold in the centre of the turning circle and cover two exposed sections of subsea fuels pipeline behind the sub berth.

The sediments would be disposed via the hopper barge positioning itself over the two areas and releasing sediment below the water surface.

2.6 Anchoring & Mooring

The BHD will be anchored via its spuds. The split hopper barges and tugboats will moor against the BHD when in use.

3 Potential Pathways for Impacts on Sensitive Receptors

Potential pathways for impacts on sensitive receptors include:

- Reduction of light penetrating the water column due to elevated turbidity, potential reducing ability of aquatic vegetation (seagrass, algae) to photosynthesize;
- Sediment deposition on blades/leaves of seagrass and marine algae, which also reduces light available for photosynthesis;
- Accumulation of sediments containing TBT in sediments below the aquaculture lease, making the location potentially unsuitable for future oyster (or other shellfish) farming;
- Impacts on intertidal organisms due to increased levels of TBT in the water column as a result of disturbance of sediments known to contain elevated concentrations of TBT;
- Potential flow-on effects to threatened and migratory shorebirds which feed on intertidal organisms and use intertidal habitats.

The green alga *Caulerpa taxifolia* is an invasive, introduced species whose distribution in Botany Bay has increased over the last decade (Creese *et al*. 2004, The Ecology Lab 2005). It is a quick growing, cold-tolerant plant that grows amongst seagrasses and alters marine habitats. It can survive out of the water in damp conditions for more than a week, and can spread quickly from small fragments. Within the patchy seagrass beds in Botany Bay it occurs mainly as an understorey species but forms dense, monospecific mats in other locations (e.g. Pittwater, Gunnamatta Bay). *C. taxifolia* is thought to be a superior competitor with seagrass in some conditions and a control plan is being implemented by the DPI (Fisheries) at various locations, but not currently within Botany Bay. Because it can be spread by activities associated with the proposed capital dredging works, its presence in the vicinity of the dredging area requires monitoring and management and is considered in the Dredge and Spoil Disposal Management Plan.

Increases in turbidity resulting from dredging associated with overflow has been modelled to be restricted to areas around the spot dredging and is located well outside the distribution of seagrass (**Figure 1-2**).

The modelled distribution of sediment (**Figure 3-1)**, taken from the Submissions Report (URS, 2013)) shows the maximum predicted impact caused by dredging and the reuse/disposal of sediment within Botany Bay. It also illustrates the modelled extent over which sediment would be deposited in the Bay to depths of greater than 1 mm. The model results indicate low levels of sediment deposition over seagrass beds, with seagrass beds on the southern edge mainly predicted to receive 1 to 2 mm of sediment deposition. Sediment deposition of up to 2 mm is predicted in areas where patches of the seagrass *Halophila ovalis* has been previously mapped but was not present during EIS investigations (URS 2013).

The predicted sediment deposition would result in sediment-bound TBT concentrations of less than 5 µg Sn/kg outside the project area (potentially around 2 µg Sn/kg or less). At these concentrations it is considered that the bioavailable fraction would be considerably lower, resulting in water concentrations substantially lower than concentrations considered acceptable for environmental protection.

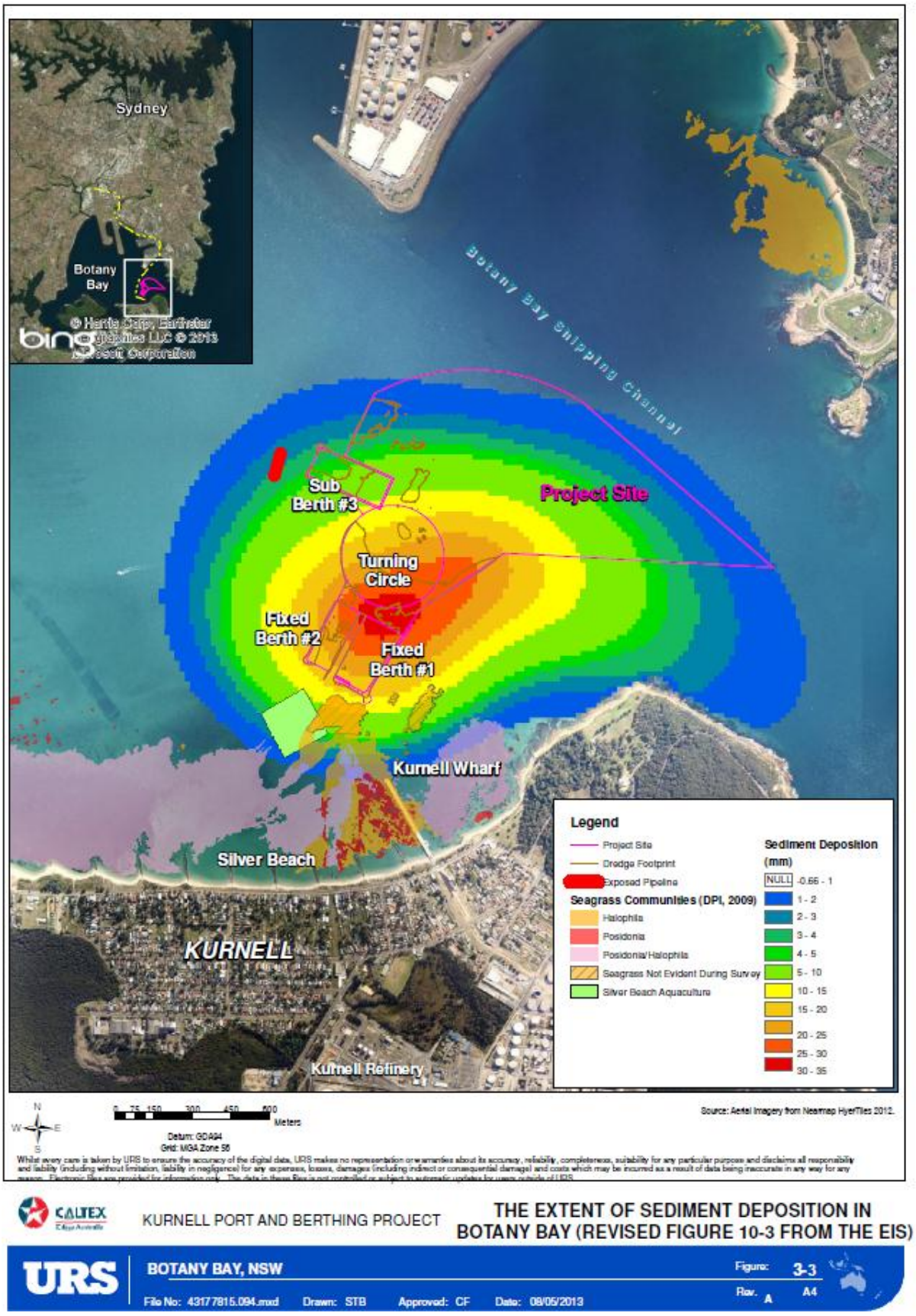

Figure 3-1 Predicted levels of sediment deposition due to dredging and spoil placement

4 Monitoring Plans

4.1 Marine Megafauna

Marine mammals and turtles have been observed in Botany Bay in low numbers at various times of the year. Green turtles (*Chelonia mydas*), dolphins (*Delphinus delphis*), humpback whales (*Megaptera novaeangliae*), Australian fur seals (*Arctocephalus forsteri*) and New Zealand fur seals (*Arctocephalus pusillus*) have been observed either within or immediately outside the bay (G Ross, 13 August 2013, pers. comm.).

Monitoring of potential impacts of the Project on marine megafauna are considered in the Fauna sub-plan of the Dredge and Spoil Disposal Management Plan (Section 8.4, Worley Parsons 2013c). The monitoring plan meets the requirements of Clause C6 of the Conditions of Consent with the aims of minimising the risk of ship collision and underwater noise generation impacts on marine fauna including cetaceans, pinnipeds, marine turtles and dugongs. The monitoring program will include:

(a) carrying out observations for cetaceans, pinnipeds, marine turtles and dugongs within 420 metres of dredging, piling or rock revetment works;

(b) temporary cessation of dredging and dredger tugboat reduced to a speed of 4 knots if the marine fauna comes within the 420 metres of dredging;

(c) the temporary cessation of underwater noise generating activities associated with piling and rock revetment where marine fauna comes within the 250 metres of these activities. Noise generating activities will not recommence until 30 minutes after the fauna has left the zone; and

(d) the temporary cessation of dredging where marine fauna comes within the 150 metres of dredging. Dredging will only recommence when marine fauna has moved out of this zone. Noise generating activities would not commence until 30 minutes following the fauna leaving the zone.

4.2 Seagrass Monitoring Plan

4.2.1 Aims and Objectives

The AHMP is required to describe the monitoring program to identify potential changes in the distribution and condition of seagrasses in the vicinity of dredging activities that allows attribution of any detected changes. It is also required to:

- Summarise baseline aquatic surveys and data to confirm the distribution and condition with consideration of seasonal variations;
- Identify potential no-go areas;
- Identify representative monitoring locations which would be used to determine the distribution and condition of seagrass beds, taking into account the AusGrid seagrass rehabilitation project;
- Identify performance measures to assess the distribution and condition of seagrass beds during dredging;
- Set out the details of aquatic health monitoring program to be to be followed for the duration of dredging including the frequency and procedures for surveys, monitoring and visual observations;
- Supply details of reporting requirements for the AHMP including;
    - Indicators to be compared before versus after dredging to determine changes in distribution and condition, if any, of seagrasses;
    - Comparison of biological/ecological condition or status with summary physiochemical data (water quality, sediment-bound TBT, suspended sediment concentrations) during and after dredging to determine if any changes in baseline health of seagrasses can be casually linked to dredging activities.

- Identify potential rehabilitation (and monitoring) or offset measures to be implemented to compensate for any adverse impacts to seagrasses in the vicinity of dredging or project activities.

4.2.2 Background

Extensive beds of seagrass occur in Botany Bay in the vicinity of the proposed capital dredging works, but few fall within the dredging footprint. The southern shoreline of Botany Bay contains contiguous seagrass meadows and patches which are valued and protected components of the estuarine environment. These beds make up the largest area of seagrass habitat in Botany Bay and the eighth largest area within NSW. Historical changes to seagrass beds near Silver Beach are likely due to multiple causes, including increased wave energy due to dredging at the entrance to Botany Bay, loss due to sea urchin grazing, construction of the oil refinery wharf and the cooling water pipeline, groyne construction and installation of pipelines and cables. More recently, seagrasses further offshore in water depths of 2 to 4 may be recovering as a result of the cessation of disturbance due to commercial trawling. The seagrass beds and patches contain three species:

- *Zostera capricorni* or eelgrass
- *Posidonia australis* or strapweed
- *Halophila ovalis* or paddleweed.

In March 2010 *Posidonia australis* in Botany Bay was declared an Endangered Population under the *Fisheries Management Act 1994* (Part 7A) under Part 2, Schedule 4 of the Act. *Posidonia* present within the extended footprint of the impact of the dredging works requires the greatest management consideration due to its slow reproduction by vegetative rhizomes, poor production of flowers and propagation by seed. *Zostera* is considered to be an early coloniser which grows more readily from rhizomes and is a more prolific producer of seed. While the presence of *Zostera* is not apparently indicated on the DPI 2009 map, it is occurs as single-species beds and in mixed beds with *Posidonia* and *Halophila*. *Halophila* is a seasonally variable understorey species that occurs within both *Zostera* and *Posidonia* beds. It also grows on its own away from other seagrasses and can be an early coloniser of bare sandy substrata. All species would be included in the broad-scale mapping as part of the monitoring plan.

Although the predicted levels of turbidity and sediment deposition are low, extended reduction in light levels due to increased turbidity associated with dredging activities has potential to reduce photosynthesis in all seagrass species, potentially leading to decreases in growth, plant condition and dieback. Reduced light levels can promote epiphytic growth on seagrass leaves; with high loads of epiphytes further reducing light available for photosynthesis (Larkum and West, 1990).

4.2.3 Monitoring Plan Summary

The seagrass monitoring plan would focus on collection data on distribution, abundance and condition in seagrass adjacent to the dredging activity before and after dredging. The spatial design of the field data collection is illustrated in **Figure 4-1**. The monitoring plan utilises remote photographic techniques to allow coverage of the extensive area in a cost efficient manner. It would consist of:

- Baseline data collection: Conduct surveys using towed video along up to 16 marked transects and drop cameras at three selected, marked sites (to verifying boundary of the large, continuous *Posidonia* bed to the west of the Project footprint and to the east of the refinery wharf). Transects would vary in length and are intended to traverse the area potentially containing seagrass from the sediment deposition footprint to the shoreward extent of seagrass (**Figure 4-1**). Divers would record GOS co-ordinates for start and end points of transects and bearing. An underwater video camera would be towed along transects with captured images every 2 m allowing identification of species present, density, condition and presence of other biota.

  At selected sites (Figure 4.1) drop cameras would be used to record photographs within 50 cm x 50 cm photoquadrats near the outer boundary of *Posidonia* beds to the east of the wharf and at the boundary of the large, contiguous bed to the west of the dredging works (approximately aligned with Groin 7, counting from the Caltex wharf). Fifteen random, replicate quadrats would be recorded at each of three sites with the three locations (Monitoring location east of the wharf, near control and far control in the large *Posidonia* bed).

The surveys would be done as late as possible in spring (October-November 2103) to allow comparability with after the dredging survey.

- During dredging survey: Repeat survey would be undertaken in February/March 2014 to identify any adverse impacts which would, if present, be apparent at the end of the summer growing season. GPS and photographic records of any observed changes would adequately document no observed changes.
- Post-dredging survey undertaken in February/March 2015, duplicating the baseline data collection as closely as possible.

Indicators recorded and outputs:

- Broad-scale mapping of *Halophila* closest to dredge footprint and changes before compared to after dredging presented as a map of differences observed;
- From video transects: species present, distribution, density (absent, sparse, medium density, dense), condition (as indicated by epiphyte load and) and changes before compared to after dredging;
- At *Posidonia* sites: per cent cover of seagrass, condition (as measured by leaf condition and epiphyte load), leaf length (short, medium, long), fauna present and changes before compared to after dredging.

Maps would be created in GIS format. Video and still images would be processed using Coral Point Cover with Excel extensions (CPCe) software with categories modified for use in seagrass habitats.

Reporting:

- Baseline report with maps to characterise seagrass conditions prior to works;
- Brief report on any obvious changes following the during dredging survey;
- Final report comparing baseline to post-dredging results, including “difference” maps.

Final reporting would compare distribution/ecological condition with summary data for water quality monitoring undertaken at Monitoring sites 2 (Aquaculture lease), 3 (mixed seagrass bed immediately west of the wharf) and 4 (*Posidonia* bed to the east of the wharf) to determine if any changes in baseline health of seagrasses can be causally linked to dredging activities. Details for water quality data to be monitored in relation to seagrass are given in **Table 4-1**.

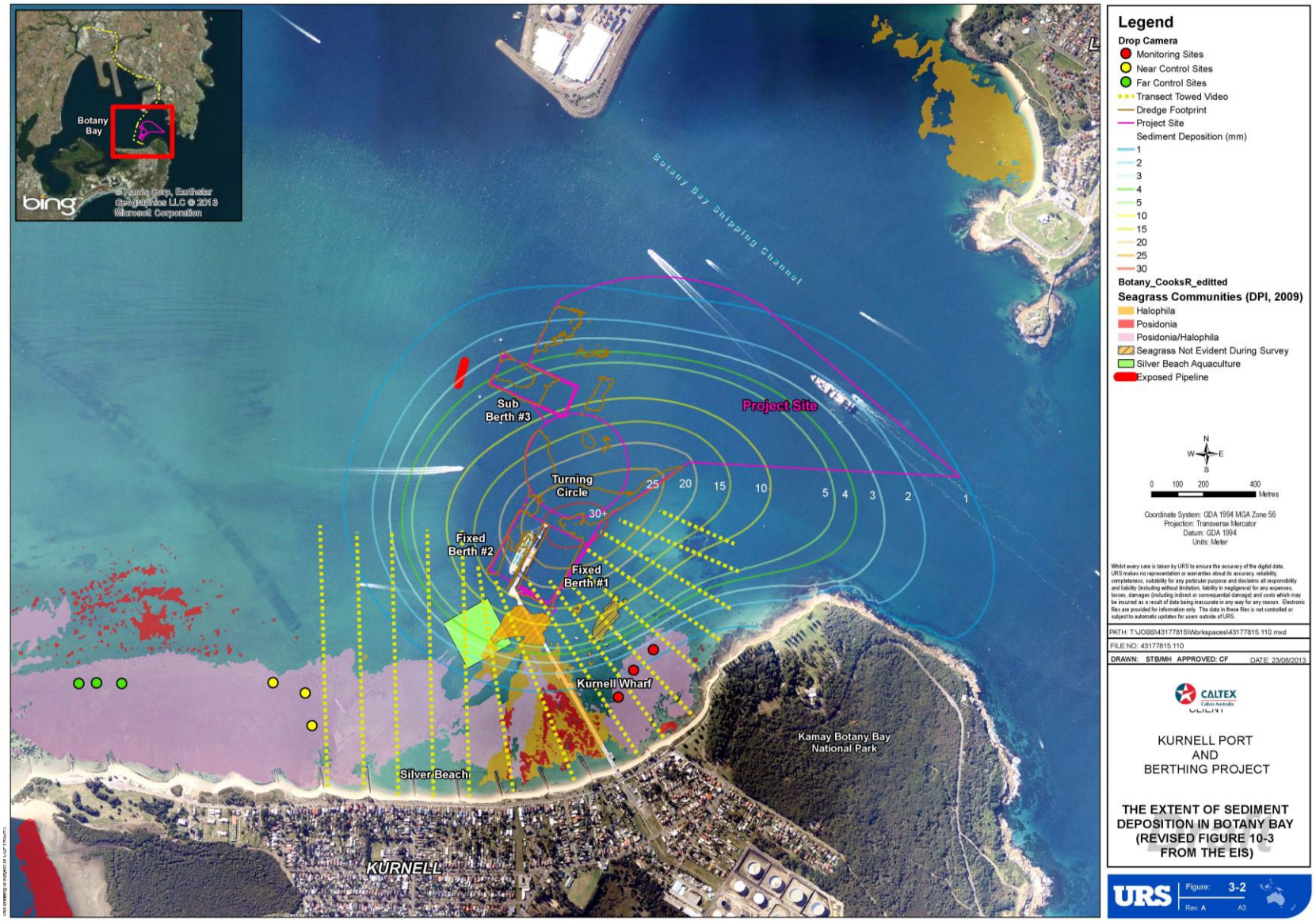

Figure 4-1. Spatial design for seagrass monitoring. (Source: Cardno and URS, 2013).

4.2.4 Criteria for Success

Success for the seagrass monitoring plan would be detecting no statistically significant changes in the species present, density, distribution and condition of seagrass prior to dredging compared to after dredging, and (for *Posidonia* beds) compared to control locations. For distribution of seagrass, success would be no statistically significant change in the extent or mapped distribution of seagrasses attributable to dredging activities. For *Posidonia* beds, success would be no significant change in the outer boundary of the beds and in density and seagrass condition.

4.2.5 "No-Go" Zones

Very little (potentially no) seagrass occurs within the dredging footprint. Some low density *Halophila ovalis* may occur at the shoreward margin, and if so would be removed as part of dredging activities. *Halophila* is an early colonising species with variable seasonal distribution and is at the limit of its depth distribution in the vicinity of the dredge footprint. Assuming that the dredging equipment is located within the dredge footprint as described in the CEMP and all vessels comply with existing RMS requirements for no anchoring near seagrass beds, no additional "no-go" zones are considered necessary.

Prior to implementation of the Seagrass Monitoring Plan information on the location of areas that have received seagrass transplants as part of habitat remediation for the recent AusGrid cable-laying project will be obtained and reviewed. These areas will be avoided for their protection, and will not be included in monitoring of distribution or condition of *Posidonia* for this project.

4.2.6 Potential Mitigation or Offset Measures

Any minor loss of the ephemeral seagrass *Halophila* is considered insignificant as regrowth of this species would be expected to occur naturally in areas near the dredge footprint that provide adequate light.

Adaptive management of turbidity and sedimentation associated with dredging will be based on water quality monitoring, as the long lag time in seagrass response to unsuitable conditions precludes its use in an adaptive management strategy. Mitigation of water quality conditions is unlikely to be necessary given the minor to negligible expected decrease in available light predicted by modelling in relation to the location of seagrasses of high conservation value. Consideration of potential mitigation measures, however unlikely, would depend on the species affected, extent and nature of impact and likelihood of recovery by natural processes.

4.2.7 Planning

4.2.7.1 Effort Required

Background monitoring:

- Field work will require 10 person days configured as 3 ecologists x 2 days and 2 ecologists x 2 days.
- Reporting would require approximately 60 hours.

During dredging monitoring:

- Field work is likely to require one less field day given that start and end markers for transects are locatable, therefore 8 person days.
- Reporting would require approximately 40 hours.

After dredging monitoring:

- Field work: 8 person days, given that start and end markers for transects are locatable;
- Reporting would require approximately 65 hours.

4.2.7.2 Access Issues and Constraints

Consideration is required regarding small boat movements during construction and observation of exclusion zones. Because the majority of areas to be investigated lie outside of the dredging footprint access can be safely managed without interfering with dredging activities.

Ideal conditions for capturing photographs and video footage are during dry period on an incoming tide. These conditions maximise water clarity which will increase the efficiency of monitoring activities.

4.2.7.3 Equipment Required

- Small boat and safety equipment
- SCUBA gear (for initial marking of transects)
- Underwater towed video rig
- Drop camera rig
- DGPS units.

4.2.7.4 Staff Qualifications and Training

Staff undertaking the monitoring programme described above would need, as a minimum, the following qualifications, experience and skills:

- Minimum undergraduate degree in a relevant discipline (Biological/Ecological/Environmental Science);
- Training and practical experience in the principles of sampling design and techniques;
- Scheduling and time management experience skills;
- Recognised commercial dive qualification (AS 2815 or equivalent);
- Training and practical experience in the use of a variety of field equipment (i.e. small boats, DGPS units, underwater cameras);
- Training and practical experience in procedures for recording field data;
- Training and practical experience in implementing QC procedures for field and data, including data checking and storage;
- Database management skills and experience;
- GIS mapping skills and experience;
- Training and practical experience in analysis of biological/ecological data; and
- Report writing skills.

Overall it is considered that approximately three years practical experience in addition to qualifications and training as listed above would be required for staff undertaking the monitoring plan under the supervision of a senior environmental scientist.

4.2.7.5 Health and Safety Requirements and Considerations

Staff undertaking the outlined monitoring programme would be required to have experience in the following HSE tasks:

- Preparation of Safe Work Methods Statements for on-water tasks for oil and gas industry;
- Training in relevant HSE procedures, including on-site induction (if required) and emergency procedures;
- Evidence of competency in boat operation (i.e. small boat license);
- Competency in swimming;
- First aid training to senior level (including oxygen administration);
- Appropriate vaccinations;
- Understanding and use of appropriate personal protection equipment (protective clothing, hat, sunscreen, etc.); and

- Planning and implementation of safe work methods for diving.

4.3 Aquaculture Lease Number ALDI/098

The Aquaculture lease ALDI/098 has previously been used to grow out several species of finfish, but is not currently active. Given the current lack of activity at the lease site, potential impacts of the proposed capital dredging activities are limited to the potential for accumulation of sediments with elevated levels of TBT on the seabed below which future fish cages or shellfish racks may be located.

The EIS has predicted the low likelihood of this occurring due to dredging (URS 2013). Consequently, the assessment of impact on the lease would be made on the basis of sediment and water quality data collected as part of the Sediment and Water Quality Management Plan (Worley Parsons 2013b).

Monitoring Point 2 is located within the boundaries of the aquaculture lease and would provide data relevant to the assessment of impacts on the water quality. Turbidity, pH and dissolved oxygen (DO) would be recorded continuously beginning 4 weeks before dredging activities, during dredging and for one week following cessation of dredging. Data for these parameters would be assessed against trigger values as per the **Table 4-1** below:

Table 4-1 Trigger values and ranges for monitored water quality parameters during dredging activities (Source: Worley Parsons 2013b: Table 9-1)

Parameter	**Location**	**Frequency**	**Trigger Value or Range**	**Source**	**Compliance Levels and Corrective Actions**
What is being measured	*Where the parameter is being measured*	*How often sampled*	*Value or range that the parameter should not exceed*	*Where the value or range has come from*	*What represents compliance or non-compliance with respect to Trigger Values and what to do if the value or range is exceeded*
Total suspended solids measured as turbidity (NTU)	• Aquaculture Site (Monitoring Point 2) • Seagrass Beds (Monitoring Points 3 and 4)	Real time monitoring approximately every 15 minutes [EPL Condition M2.1]	10 mg/L above level at Monitoring Point 1 Reference Site as equivalent turbidity NTU	EPL [EPL Condition L2] Submissions Report (URS 2013a)	• Any result >10mg/L: ○ confirm validity of results ○ confirm results are attributable to dredging • Two consecutive confirmed results >10mg/L: ○ reduce rate of overflow dredging or reduce rate of dredging (if overflow dredging is not being undertaken) • Three consecutive confirmed results >10mg/L: ○ **non-compliance with EPL [EPL Condition L2]** ○ notify EPA ○ cease dredging at that location until levels fall below the trigger value ○ investigate the cause and implement additional controls to modify levels and prevent a recurrence

Parameter	Location	Frequency	Trigger Value or Range	Source	Compliance Levels and Corrective Actions
	• Project Site (Monitoring Point 5 and 6)	Real time monitoring approximately every 15 minutes [EPL Condition M2.1]	50 mg/L above level at Monitoring Point 1 Reference Site as equivalent turbidity NTU	EPL [EPL Condition L2] Submissions Report (URS 2013a)	• Any result >50mg/L: ○ confirm validity of results ○ confirm results are attributable to dredging • Two consecutive confirmed results >50mg/L: ○ reduce rate of overflow dredging or reduce rate of dredging (if overflow dredging is not being undertaken) until levels fall below the trigger value • Three consecutive confirmed results >50mg/L : ○ **non-compliance with EPL [EPL Condition L2]** ○ cease dredging at that location until levels fall below the trigger value ○ notify EPA ○ investigate the cause and implement additional controls to reduce levels and prevent a recurrence
	• Mobile Monitoring Site (Monitoring Point 7 & 8)	Grab sample collected 3 times in the first week of overflow dredging in the Sub Berth and 3 times in the first week of dredging Berth 1 and weekly thereafter. Weekly sampling for all other dredging [EPL Condition M2.1]	NIL	EPL (EPL Condition M2.1)	Correlate results with real time monitoring at Point 1 through to Point 6.
Tributyltin (TBT) (dissolved TBT)	• Project Site (Monitoring Points 5 or 6 whichever is upstream of the dredging activity)	Grab sample collected 3 times in the first week of overflow dredging in the Sub Berth and 3 times in the first week of dredging in Berth 1 and weekly thereafter. Weekly sampling for all other dredging (same day as at Point 7 and 8) [EPL Condition M2.1]	NIL	EPL (EPL Condition M2.1)	• Any result >0.006 µg/L: ○ confirm validity of results

Parameter	Location	Frequency	Trigger Value or Range	Source	Compliance Levels and Corrective Actions
Tributyltin (TBT) (dissolved TBT)	• Mobile monitoring site • (Monitoring Point 7)	Grab sample collected 3 times in the first week of overflow dredging in Sub Berth and 3 times in the first week of dredging in Berth 1 and weekly thereafter. Weekly sampling for all other dredging [EPL Condition M2.1]	NIL	EPL (EPL Condition M2.1)	• Correlate with results of Monitoring Point 5 or 6 and Point 8
	• Mobile monitoring site (Monitoring Point 8)	Grab sample collected 3 times in the first week of overflow dredging in the Sub Berth and 3 times in the first week of dredging in Berth 1 and weekly thereafter. Weekly sampling for all other dredging [EPL Condition M2.1]	>0.006 µg/L	EPL [EPL Condition L2] Submissions Report (URS 2013a)	• Any result >0.006µg/L: ○ confirm validity of results ○ confirm results are attributable to dredging • Any confirmed result >0.006µg/L: ○ **non-compliance with EPL [EPL Condition L2]** ○ **Notify EPA** ○ If overflow dredging then is being undertaken then cease overflow dredging at that location until levels fall below the trigger value ○ If dredging without overflow is being undertaken then cease dredging at that location until levels fall below trigger value ○ Resample at that location as soon as practicable
Tributyltin (TBT) (sediment bound TBT)	• Project Site (Monitoring Points 5 or 6 whichever is upstream of the dredging activity)	Grab sample collected 3 times in the first week of overflow dredging in the Sub Berth and 3 times in the first week of dredging in Berth 1	NIL	NIL	• Correlate with results of Monitoring Point 5 or 6 and Points 7 and 8

Parameter	Location	Frequency	Trigger Value or Range	Source	Compliance Levels and Corrective Actions
	• Mobile monitoring sites • (Monitoring Points 7 and 8)	Grab sample collected 3 times in the first week of overflow dredging in the Sub Berth and 3 times in the first week of dredging in Berth 1	NIL	NIL	• Correlate with results of Monitoring Point 5 or 6 and Points 7 and 8

pH	• Aquaculture Site (Monitoring Point 2)
	• Seagrass Beds (Monitoring Points 3 and 4)
	• Project Site (Monitoring Point 5 and 6)
		Real time monitoring approximately every 15 minutes	pH1.5 higher or lower than at Monitoring Point 1 Reference Site	Submissions Report (URS 2013a)	• Any result outside range
					  ○ confirm validity of results
					  ○ confirm results are attributable to dredging
					• Two consecutive confirmed results outside range:
					  ○ reduce rate of overflow dredging
					• Three consecutive confirmed results outside range three times (nine in all) in any 24 hour period:
					  ○ cease overflow dredging until levels fall within the trigger range
					• Three consecutive confirmed results outside range more than three times (more than nine in all) in any 24 hour period, following cessation of overflow dredging:
					  ○ relocate dredge
					  ○ investigate the cause and implement additional controls to modify levels and prevent a recurrence

Parameter	Location	Frequency	Trigger Value or Range	Source	Compliance Levels and Corrective Actions

Dissolved Oxygen (DO)	• Aquaculture Site (Monitoring Point 2)
	• Seagrass beds (Monitoring Points 3 and 4)
	• Project Site (Monitoring Point 5 and 6)
		Real time monitoring approximately every 15 minutes	<6 mg/L (<80%)	Guidelines for Fresh and Marine Water Quality Table 3.3.2 Submissions Report (URS 2013a)	• Any result outside range
					  ○ confirm validity of results
					  ○ confirm results are attributable to dredging
					• Two consecutive confirmed results <6 mg/L:
					  ○ reduce rate of overflow dredging
					• Three consecutive confirmed results <6 mg/L three times (nine in all) in any 24 hour period:
					  ○ cease overflow dredging until levels rise above the trigger value
					• Three consecutive confirmed results <6 mg/L more than three times (more than nine in all) in any 24 hour period, following cessation of overflow dredging:
					  ○ relocate dredge
					  ○ investigate the cause and implement additional controls to increase levels and prevent a recurrence

Final reporting would compare ecological condition (including distribution, density and condition) within the aquaculture lease with summary data for water quality monitoring undertaken at Monitoring Point 2 (Aquaculture Site) to determine if any changes in baseline ecological condition of habitats in the lease area can be casually linked to dredging activities.

4.4 Intertidal habitats in Kamay Botany Bay National Park

Biotic assemblages in the intertidal zone within Kamay Botany Bay National Park were characterised as part of the approvals process for the construction of a new wooden jetty near the Visitors Centre (The Ecology Lab 2008). The area surrounding the remains of the historical jetty was dominated by scattered sandstone boulders overlying a large, extensive rock platform. Sand inundation of the rock platform and intertidal boulder field was evident, and no intertidal seagrass was observed (The Ecology Lab, 2008).

The intertidal boulder field and rock platforms were colonised by various algae, including: Neptune's necklace (*Hormosira banksii*), sea lettuce (*Ulva* sp.), encrusting algae (*Hildenbrandia* sp.), coralline algae (*Corallina officinalis*), funnel weed (*Padina crassa*), bubble weed (*Sargassum* sp.), dead man's fingers (*Codium fragile*), and *Dictyota dichotoma*. Scattered boulders close to the shoreline that were submerged during high tide were covered in fine green filamentous alga, and were frequented by fishes, including juvenile luderick (*Girella tricuspidata*) and stripeys (*Microcanthus strigatus*).

The invertebrate fauna inhabiting intertidal zones included: Sydney rock oysters (*Saccostrea glomerata*), barnacles (*Tesseropora rosea, Tetraclitella purpurascens*), limpets (*Cellana tramoserica, Siphonaria denticulata*), periwinkles (*Austrocochlea porcata, Bembicium nanum, Turbo undulata*), murex shells (*Thais orbita, Morula marginalba*), sea urchins (*Centrostephanus rodgersii*), calcareous tube worms (Serpulidae), and unidentified purple sponge and hermit crabs.

The adjacent subtidal habitat contained patches of high density *Posidonia australis* which varied in size from medium patches (< 10 m diameter) to continuous, extensive beds to the west of the proposed jetty structure. Most of the *Posidonia* beds were bordered by low/medium density *Zostera* and *Halophila* seagrass, with the latter two species often penetrating into the *Posidonia* beds and forming an understorey (The Ecology Lab, 2008).

The EIS (URS 2013) indicated that both turbidity levels and sediment deposition in the intertidal areas around the National Park would be too low to impact on biota, or to flow onto to higher trophic levels. Previous studies of the impacts of high concentration, point-sources of TBT have demonstrated sharp drop-offs in detectable impacts on biotic assemblages with distance away from the source, with patterns of TBT bioaccumulation similarly localised (Roach and Wilson, 2009). Hence it is considered highly unlikely that minor and distant source such as those released by resuspended sediments will be detectable in either biotic assemblages or in the tissues of intertidal animals.

On this basis no formal monitoring of assemblages of intertidal biota is proposed. Observations of the southern shoreline would be made as part of the migratory shorebird monitoring program described below, and any obvious changes to intertidal flora or fauna would be reported as part of that monitoring program.

4.5 Intertidal habitats used by threatened and migratory shorebirds along the southern shoreline of Botany Bay

4.5.1 Aims and Objectives

The aim of the threatened and migratory shorebird monitoring program is to fulfil the Conditions of Consent to determine if noise impacts or changes in intertidal habitats associated with capital dredging activities impact on the number or condition of threatened and migratory shorebirds roosting or feeding along the southern shoreline of Botany Bay.

4.5.2 Background

Intertidal habitats are used by a variety of threatened and migratory shorebirds throughout Botany Bay, but preferred habitats include Penrhyn Estuary on the northern shoreline and Quibray Bay in the south. Rocky shore habitats supply preferred food items for threatened species such as Pied and Sooty oyster catchers (*Haematopus longirostris and H fulignosus)*, which feed on oysters and cunjevoi present in the lower zones of rocky intertidal habitats. Little terns (*Sterna albifrons)* utilise sandy beach habitat to rest. Local observations suggest that the main threatened species likely to be present is the Pied oyster catcher.

The monitoring plan for shorebirds recognises that changes in populations of threatened and migratory shorebirds can have several causes, of which a number may be geographically distant from Botany Bay.

Localised changes in habitat use may be detectable and may, or may not be associated with activities in the Bay. Others, such as weather conditions along migratory paths, could reduce populations of specific migratory species, will not be identifiable. It is considered unlikely that, should changes in populations of migratory shorebirds occur, such changes could be associated with dredging activities.

The focus of the migratory shorebird monitoring program is on local threatened species that use intertidal habitats for feeding and roosting, with more frequent surveys during piling activities that may generate noise.

4.5.3 Monitoring Plan Summary

The period of dredging activities falls within the peak period for abundance of migratory shorebirds (September to April). Surveys proposed are timed to focus on detection of impacts, if any, of noise associated with piling, schedule to occur for approximately six weeks beginning in early November 2013.

Data collection will consist of two surveys prior to commencement of dredging, six weekly surveys during piling activities, two further weekly surveys during dredging and two post-dredging surveys. Shorebird surveys will be conducted at the study site indicated in **Figure 4-2** using the survey frequency as outlined in **Table 4-2**.

Data on migratory shorebirds will be collected along Silver Beach (from east to west) (**Figure 4-2**). Data collected will include:

- Observations of migratory shorebirds in the study area for an hour either side of low and high tide, recording species distribution and abundance, behavioural activity (e.g. roosting, feeding) and habitat usage. All shorebirds using the site will be counted and recorded, giving a maximum count of each species per survey ("peak counts");
- Condition of migratory shorebirds present around the Project area will be assessed (if possible) by scoring abdominal profiles using high resolution digital photographs for subset of key species.
- Any obvious, important observations or changes in shorebird abundance or behaviour would be reported as soon as is practicable should any important observations be recorded;

Table 4-2 Timing, location and frequency of shorebird monitoring

Survey Location	Project Phase			
	Pre- Dredging (Baseline)	Dredging (During Piling)	Dredging (Routine Monitoring)	Post- Construction
Silver Beach east to northern extent of Kamay Botany Bay National Park	2 surveys prior to commencement of dredging: September, October (2 days per survey)	6 x weekly surveys (1 day per survey)	2 surveys: January, February 2014 (1 day per survey)	2 surveys: March, April 2014 (1 day per survey)

Reporting:

- Four progress data reports: one at the completion of the Baseline period; 2 during the piling phase (November and December) and one at the completion of the routine monitoring phase (Jan – Feb).
- Final report will include a summary of key species recorded, peak counts, changes in abundance of key species Maps of distribution;
- Final reporting would include comparison to summary water quality data collected as part of the Sediment and water Quality Monitoring Program (Worley Parsons 2013b) as per **Table 4-1**, and noise data collected as part of the Installation of a Sheet Pile Wall and Rock Revetment Construction Environmental Management Plan (Worley Parson 2013c) to determine if any changes detected were attributable to dredging activities.

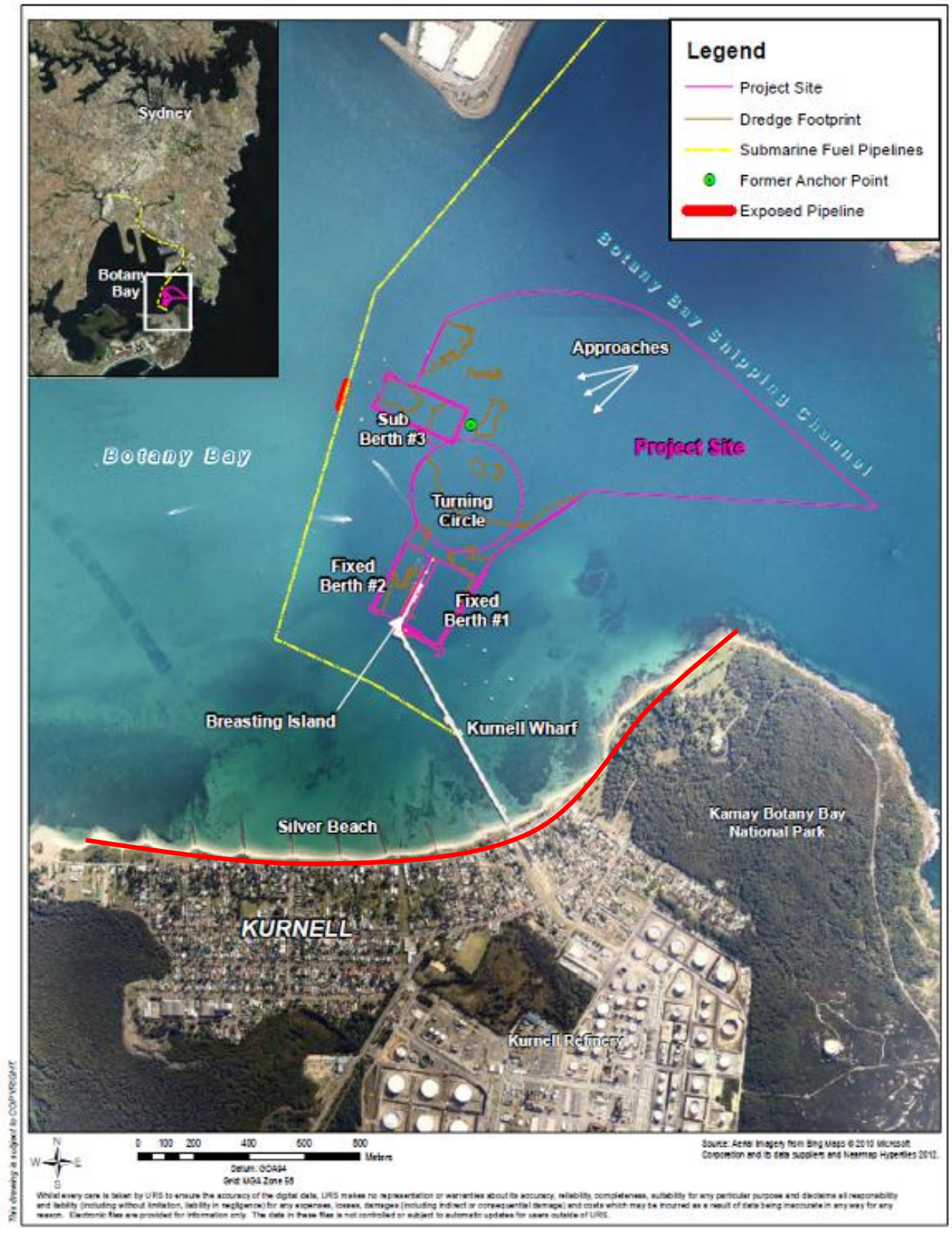

Figure 4-2 Spatial design for migratory shorebird monitoring (in red)

4.5.4 Criteria for Success

Success for the shorebird monitoring plan would be detecting no statistically significant changes in the species present, density, distribution and condition of shorebirds prior to dredging compared to during or after dredging. Additionally, lack of adverse observations during piling activities would be indicative of success of the monitoring plan.

4.5.5 Potential Mitigation Measures

Important, adverse observations of shorebirds would be reported immediately to Caltex, allowing management of noise generating activities if required.

4.5.6 Planning

4.5.6.1 Effort Required

Background monitoring:

- Field work will require preparation time, 16 person days configured as 1 ecologists x 12 days and 2 ecologists x 2 days.
- Baseline reporting would require approximately 12 hours.

During dredging monitoring:

- Field work will require 8 person days.
- Progress reports would require approximately 8 hours each.

After dredging monitoring:

- Field work will require 4 person days configured as 2 ecologists x 2 days;
- Reporting would require approximately 45 hours.

4.5.6.2 Access Issues and Constraints

No constraints to access to observation points along the foreshore are anticipated. Surveys would be undertaken during high and low tide daylight periods during good weather to maximise likelihood of accurate bird counts and ideal conditions for capturing photographs from which bird condition can be assessed.

4.5.6.3 Equipment Required

- Binoculars;
- High resolution digital camera;
- DGPS unit.

4.5.6.4 Staff Qualifications and Training

Staff undertaking the monitoring programme described above would need, as a minimum, the following qualifications, experience and skills:

- Minimum undergraduate degree in a relevant discipline (Biological/Ecological/Environmental Science);
- Scheduling and time management experience skills;
- Training and practical experience in the bird observation;
- Training and practical experience in the use of a variety of field equipment (i.e. DGPS units, digital cameras);
- Training and practical experience in procedures for recording field data;
- Training and practical experience in implementing QC procedures for field and data, including data checking and storage;
- Database management skills and experience;
- GIS mapping skills and experience;
- Training and practical experience in analysis of biological/ecological data; and
- Report writing skills.

Overall it is considered that approximately three years practical experience in addition to qualifications and training as listed above would be required for staff undertaking the monitoring plan under the supervision of a senior environmental scientist.

4.5.6.5 Health and Safety Requirements and Considerations

Staff undertaking the outlined monitoring programme would be required to have experience in the following HSE tasks:

- Preparation of Safe Work Methods Statements for oil and gas industry;
- Training in relevant HSE procedures, including on-site induction (if required) and emergency procedures;
- First aid training to senior level (including oxygen administration);
- Appropriate vaccinations;
- Understanding and use of appropriate personal protection equipment (protective clothing, hat, sunscreen, etc.); and
- Planning and implementation of safe work methods for driving and working near water.

5 References

Cardno Ecology Lab (2011). Desalinated Water Delivery System Aquatic Vegetation Monitoring Report 5 Final Post Construction Report. EL0708050 Prepared for Sydney Water June 2011.

Creese RG, Glasby TM, West G, Gallen C (2009) Mapping the habitats of NSW estuaries. NSW Industry & Investment (I&I). Accessed online -ttp://www.ozcoasts.gov.au/geom_geol/nsw/DIIMappingNSWestuaries.pdf

Creese, R.G., Davis, A.R. and Glasby, T.M (2004). Eradicating and preventing the spread of the invasive alga *Caulerpa taxifolia*. *NSW Fisheries Final Report Series* No 64, June 2004.

Larkum AWD and West RJ (1990) Long-term changes of seagrass meadows in Botany Bay, Australia. *Aquatic Biology* 37: 55-70.

Roach, A.C. and Wilson, S.P. Ecological impacts of tributyltin on estuarine communities in the Hastings River, NSW Australia. *Marine Pollution Bulletin*, 58 (12), pp. 1780-1786.

The Ecology Lab (2005). Planning for Desalination: Marine Ecological Assessment. Preliminary Site Inspections for an Inlet and Outlet and Possible Pipeline Route for Water Distribution. Prepared for GHD.

The Ecology Lab (2007). Desalination Water Delivery Infrastructure Environmental Assessment – Aquatic Ecology. Prepared for Sydney Water Corporation.

The Ecology Lab (2008). Botany Bay National Park Jetty Marine Habitat Survey. Report Prepared for Parks and Wildlife Group (NPWS) Department of Environment and Climate Change. March 2008.

URS (2013). Environmental Impact Statement - Kurnell Ports and Berthing Facility. Prepared on behalf of Caltex Refineries (NSW) Pty Ltd, February 2013.

Worley Parson (2013a). Kurnell Wharf Infrastructure Upgrade Dredge and Spoil Disposal Management Plan. Report 301015-03067 – 301015-03067-EN-REP-010, 26 April 2013.

Worley Parson (2013b). Kurnell Wharf Infrastructure Upgrade Sediment and Water Quality Monitoring Program. Report 301015-03067 – 301015-03067-EN-REP-011, 26 April 2013.

Worley Parson (2013c). Kurnell Wharf Infrastructure Upgrade -Installation of a Sheet Pile Wall and Rock Revetment Construction Environmental Management Plan. Report 301015-03067 – 301015-03067-EN-REP-007 9 April 2013.