

Desalinated Water Delivery System:
application for modification of Project Approval
for the Botany Bay Sector
for
Water Delivery Alliance
Sydney's Desalination Project



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GLOSSARY of TERMS

ASS	Acid Sulphate Soils
AHD	Australian Height Datum
CLT	Cardno Lawson Treloar
CSD	Cutter Suction Dredge
CSRP	Community and Stakeholder Relations Plan
dB	Decibels
dB(A)	Decibels 'A' weighted
DECC	NSW Department of Environment and Climate Change
DoP	NSW Department of Planning
DPI	NSW Department of Primary Industries
EA	Environmental Assessment
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	Environmental Protection Agency
FCSP	Framework Compensatory Seagrass Package
LAT	Lowest Astronomical Tide
MHWS	Mean High Water Springs
MLW	Mean Low Water
MLWS	Mean Low Water Springs
MSL	Mean Sea Level
PASS	Potential Acid Sulphate Soil
PPR	Preferred Project Report
TBM	Tunnel Boring Machine
WDA	Water Delivery Alliance

Executive Summary

The Water Delivery Alliance (WDA) has been established to design, construct and commission the pump station and desalinated water delivery system linking the desalination plant on the Kurnell Peninsula with the existing distribution network at Shaft 11C, Erskineville.

Sydney Water has received Concept Approval for the desalination project and Project Approval for the desalinated water delivery system. These Approvals were granted following consideration of a number of supporting documents, including the Major Project Application, Environmental Assessments (EA) and Preferred Project Reports (PPR). These documents envisaged the need to optimise the design based on additional engineering and environmental information that was to become available during detailed design. Since receipt of the Project Approval, WDA has undertaken a range of engineering and environmental investigations to inform the detailed design. WDA propose to optimise the approved project as described in the PPR and this involves changing the construction methods along the Botany Bay Sector of the route between Lady Robinsons Beach, Kyemagh and Silver Beach, Kurnell.

This application for modification has been prepared to seek modification of Conditions 1.1 and 2.19 of the Project Approval under Section 75W(2) of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act). Condition 1.1 requires that the project is carried out generally in accordance with the planning documents associated with the project. Condition 2.19 outlines the water quality monitoring requirements for the Botany Bay Sector works. This document also assesses the environmental impacts of the proposed changes to construction and concludes that overall, the proposed changes will reduce the environmental and social impacts, compared with the approved project.

1 Introduction

1.1 Background

The WDA has been established to design, construct and commission the pump station and desalinated water delivery system linking the desalination plant on the Kurnell Peninsula with the existing distribution network at Shaft 11C, Erskineville.

An EA was prepared by Sydney Water in November 2005 for the design, construction, operation and maintenance of the Sydney Desalination Project, consisting of the desalination plant, intakes and outlets, and water delivery system. In November 2006, Sydney Water received Concept Approval for the desalination project as a whole and Project Approval for all its components with the exception of the water delivery pipeline, as the system required further investigations and assessment.

An EA was prepared by Sydney Water in April 2007 for the construction and operation of the desalinated water delivery system from the desalination plant at Kurnell to Sydney's water distribution infrastructure system at Shaft 11C, Erskineville. The EA responded to the requirements of the Director-General of the Department of Planning (DOP).

Subsequent to the EA for the delivery system, a PPR was prepared to respond to issues raised in submissions made to the DOP during exhibition of the EA. The responses drew on the EA, new information gained since exhibition of the EA, and changes as a result of public inputs. The PPR also detailed refinements to the route and changes to the construction method made since completion of the EA and described the project for which approval was sought. The Minister for Planning granted Project Approval for the delivery system, subject to conditions, on 22 October 2007.

The Concept and Project Approvals were granted following consideration of the EA and PPR, and supporting documents. These documents envisaged the need to optimise the design based on additional engineering and environmental information that was to become available during detailed design.

Detailed design has been progressing and, where finalised, construction has commenced along parts of the route. It should also be noted that consistency assessments have been prepared for other sections of the project where refinements to the route or changes to the construction method have been proposed. Those consistency assessments concluded that the proposed refinements/changes were generally in accordance with the Concept and Project Approvals. In addition, an application for modification was submitted to the DOP for proposed refinements to the route within the Urban Sydney Sector. Sydney North. On 13 June 2008, a modification to the Project Approval was determined for these refinements.

1.2 Purpose of this application for modification

Since receipt of the Project Approval, WDA has undertaken a range of engineering and environmental investigations to inform the detailed design. WDA propose to optimise the approved project as described in the PPR and this involves changes to the construction method within the Botany Bay Sector between Lady Robinsons Beach, Kyeemagh and Silver Beach, Kurnell.

Section 75W of the NSW EP&A Act relates to the modification of approved projects under Part 3A of the Act. Section 75W(2) allows a proponent to request that the Minister for Planning modify a project's approval. However,

section 75W(2) also states that "...approval for a modification is not required if the project as modified will be consistent with the existing approval."

This application for modification has been prepared to:

- seek modification of Condition 1.1 of the Project Approval which requires the project to be carried out generally in accordance with a number of documents
 - seek an amendment / modification to Condition 2.19 which stipulates exact requirements that experience has demonstrated are difficult to meet due to practical constraints
 - assess the environmental impacts of the proposed changes to the construction method along the Botany Bay Sector of the route between Lady Robinsons Beach, Kyeemagh and Silver Beach, Kurnell compared with those described in the PPR and Minister's Conditions of Approval.
- Section 75W(4) allows the Minister to modify an approval (with or without conditions) or disapprove of the modification.

1.3 Approach to this application for modification

As discussed above, this application for modification has been prepared to amend Condition 1.1 and 2.19 of the Project Approval and assess the environmental impacts of the proposed changes to the construction method. This application for modification:

- Describes the proposed changes to the construction methodology (refer Section 2)
- Assesses whether the changes are permitted under the existing conditions of approval by considering:
 - whether the proposed works are generally in accordance with the documents listed in condition 1.1 of the Concept Approval "Terms of the Concept Approval" (refer Section 3)
 - whether the proposed works are generally in accordance with the documents listed in condition 1.1 of the Project Approval "Terms of the Project Approval" (refer Section 3)
- Assesses whether the changes will make a material difference to anyone or the environment (refer Section 3)
- Assesses the potential environmental impacts of the changes relative to those of the approved project (refer Section 4)
- Outlines issues relating to the changes that were raised during consultation with affected stakeholders after receipt of the Project Approval, and during finalisation of the proposed changes (refer Section 5)
- Identifies the next tasks following approval of the modification (refer Section 6).

A condition was not considered to be relevant if it required actions or the preparation of documents to manage environmental issues, unless the issues were directly related to a stipulated method that is now the subject of a proposed change.

Consideration is given to whether the proposed changes are anticipated to result in any material changes to the impacts on the social or natural environment utilising the same approach used to assess changes to the project for the PPR. It also addresses the environmental aspects assessed in the EA. This approach involves using evaluation criteria that were established for the EA for the Desalinated Water Delivery System.

2 Project descriptions and rationale for change

2.1 Description of the approved project – Water Distribution System

Chapter 10 of the PPR defined the project for which Sydney Water sought approval and states that: "Sydney Water seeks Project Approval for construction, commissioning, operation and maintenance of a desalinated water delivery system linking the desalination plant on the Kurnell Peninsula with the existing distribution network.

Project Approval is sought for construction and operation of all components of the project, including those elements described in Chapter 5 of the Environmental Assessment of the Desalinated Water Delivery System, as amended by the refinements and changes outlined in Chapter 2 of this Preferred Project Report. In summary the indicative route is described in Table 10.1 and Figures 10-1, 10-2 and 10-3."

The delivery system will:

- Be built to deliver an annual daily average of 500 ML of desalinated water per day;
- Link the desalination plant at Kurnell with Sydney's major water distribution system;
- Be generally located on the alignment indicated in Figure 10-1, Figure 10-2 and Figure 10-3;
- Be generally constructed using a combination of trenchless and trenched construction methods as indicated in Figure 10-1, Figure 10-2 and Figure 10-3;
- Require a range of construction related activities and facilities such as temporary laydown areas, temporary jetties, quays or work platforms, barges, site compounds, spoil stockpiles, connection to utility services and infrastructure, environmental controls etc;
- Include ancillary features to ensure safe operation and maintenance, including, but not limited to, air and scour valves, scour drain lines, isolation valves, pressure release valves, access chambers, cross connection pipework to the existing network, booster pump stations, surge protection equipment, and chlorine injection facilities;
- Require feasibility and pre-construction investigations, likely to include geotechnical, groundwater, soil, water and sediment studies along with other surveys and minor tasks or other activities likely to have minimal environmental impact; and
- Operate on a continuous (24 hours per day, 7 days per week) basis.

The proposed changes are considered to be generally consistent with this overall project description.

2.2 Description of the approved project – Botany Bay Sector

The Project Approval defines the Botany Bay Sector as "the water-based component of the project between Silver Beach and Kyeeemagh, including construction compounds at Silver Beach and Kyeeemagh (approximately 8.0 kilometres)". Figure 10.2 of the PPR relates to the Botany Bay Sector. Table 10.1 of the PPR describes the project for which approval was granted. The main elements of the approved Botany Bay Sector works that relate to this modification include:

- "A temporary work platform about 400 m, with the first 200 m being formed as a quay between sheet piles. The second 200 m will be a jetty." (PPR 2007) (relates to Change 1)

WDA propose to change a number of the approved construction methods for the Botany Bay Sector of the desalinated water delivery system, and amend one of the Conditions of Approval. Table 2.1 summarises the proposed changes and amendment, relative to the approved project. Further detail is provided in Sections 2.3.1 to 2.3.6. Figure 2.2 displays the proposed changes addressed in this application for modification only.

2.3 Description of the proposed changes to the construction method – Botany Bay Sector

Figure 2.1 shows the project as described in the PPR.

- "A dual launch pit at the Silver Beach compound approximately 13 m by 10 m. This would align with the tunnel route under the seagrasses. Two tunnelling machines would be launched to create tunnels for the 1,400 mm diameter pipes under the seagrass beds." (PPR 2007) "Construction of a chamber to house the manifold to connect the single 1,800 mm diameter land pipeline to the two 1,400 mm diameter pipelines that will cross the bay. This chamber will be approximately 3 x 7 m in size, and will be located within the construction compound at Silver Beach." (EA 2007) (relates to Change 4)
- "Trenchless construction under the seagrass beds to a point approximately 800 m offshore would avoid the seagrasses offshore from Silver Beach." (PPR 2007) (relates to Change 5)
- "The Proponent shall ensure that construction of the Botany Bay Sector, including all dredging, subsurface storage and reclamation works, is carried out in a manner such that turbidity outside the silt curtains (as required under condition 2.18) does not exceed the background turbidity by more than an equivalent suspended sediment concentration of 50 mg/L at a point mid-depth in the water column and a distance of two metres from the silt curtain. No visible surface plume outside the silt curtains is permitted." (Condition 2.19 of the Project Approval) (relates to Amendment 1).
- "Temporary storage of dredged material in the dredged basin to the west of the airport runway. Permanent storage of approximately 35,000 m³ in the basin." (PPR 2007) (relates to Change 2)
- "The spread of the installation operation is in the order of 1,300 m with the length of the fully formed trench being the distance between the second dredge barge and the initial dredge discharge barge, which is approximately 900 m. An exclusion zone is required around the vessels and is likely to have dimensions of 1,500 m by 800 m." "...a pipeline from Silver Beach to Kyeemagh." (PPR 2007) (relates to Change 3)

Table 2.1: Summary of proposed changes to the approved project.

Proposed change/ amendment identifier	Project as described in the PPR or as approved by Minister's Conditions of Approval	Proposed changes related to this Application for Modification	Reference in this report
Change 1	Construction of a temporary work platform into the Bay (about 400 m), comprising a quay between sheet piles (about 200 m), and a jetty (about 200 m).	Dredging of a berth pocket to accommodate lay barge fit-out and pipe load out during pipe laying operations.	2.3.1, 4.2, 4.3, 4.4, 4.5
Change 2	Temporary storage of dredged material in the existing dredged basin to the west of the existing dredged basin to the west of the airport runway. Permanent storage of approximately 35,000 m ³ in the southern end of the existing dredged basin.	Temporary storage of dredged material in the southern end of the existing dredged basin. Permanent storage of material unsuitable for re-use in the northern end of the existing dredged basin. Temporary storage of a small amount (<10,000m ³) of dredged material over the alignment of the pipe off Silver Beach.	2.3.2, 4.3
Change 3	Scale of installation and operation of the direction of the pipelaying An overall construction zone of 1,500 m x 800 m. Approximately 1,300 m of trench partially open at any one time across the Bay. Increasing the length of trench partially to approximately 1,750 m.	Increasing the overall construction zone to approximately 2,200 m x 1,950 m. Pipeline laid from Kurnell to Kyemagh. Pipeline to be laid from Kyemagh to Kurnell.	2.3.3, 4.3
Change 4	Construction of a bifurcation piece, consisting of a chamber (approximately 3 x 7 m) on Silver Beach to house the manifold to connect the single 1,800 mm diameter land pipeline to the two 1,400 mm diameter pipelines that will cross the Bay.	The bifurcation piece (no chamber) will be located approximately 800 m offshore at Silver Beach, Kurnell. A single 1,800 mm pipe from Silver Beach to the bifurcation piece	2.3.4, 4.4
Change 5	Seagrasses offshore from Silver Beach to be avoided by trenchless construction techniques.	Moorings of the lay barge within the patchy seagrasses off Silver Beach.	2.3.5, 4.2
Amendment 1	Turbidity to be monitored at a point mid-depth in the water column and 2 m from the silt curtains. Water quality monitoring requirements (not shown on Figure 2.2)	Turbidity to be monitored at a depth of 0.2 m at Silver Beach and at a point approximately 1 – 1.5 m in the water column for all other sites / equipment, within a distance of up to 10 m from the silt curtains.	2.3.6, 3.2.2, 4.5

Figure 2.1: Project as described in the PPR



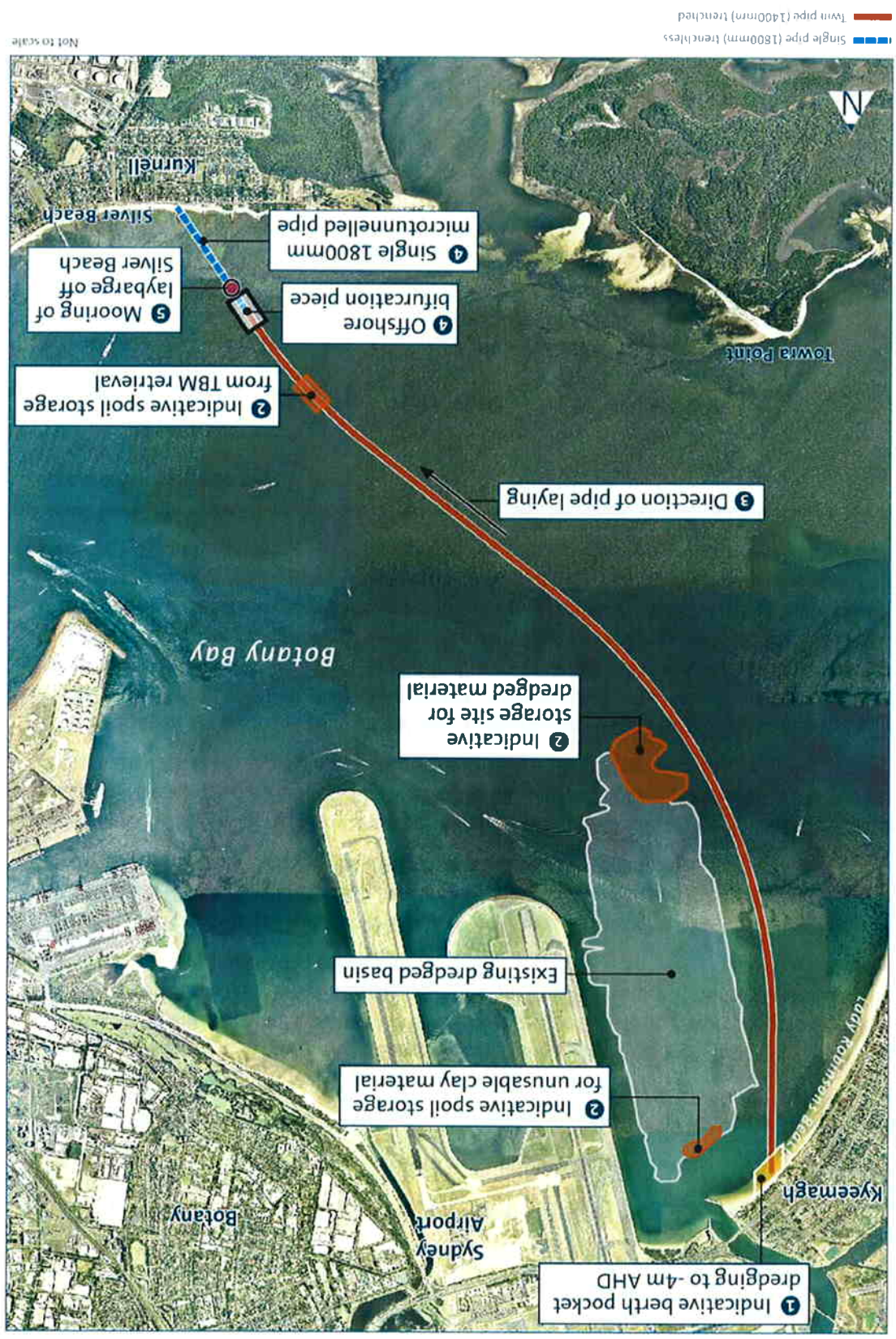


Figure 2.2: Proposed changes to the approved project

2.3.1 Change 1 – Kyeemagh beach zone construction

Change 1 relates to:

- dredging of a berth pocket at Kyeemagh instead of construction of a temporary work platform.

The PPR describes the construction method within the beach zone at Kyeemagh as:

"A temporary work platform about 400 m, with the first 200 m being formed as a quay between sheet piles. The second 200 m will be a jetty."

Further consideration of the construction method through the Kyeemagh beach zone has indicated that construction of the temporary work platform is no longer required. Instead, it is proposed to dredge a berth pocket to a level approximately 4 m Australian Height Datum (AHD) (Figure 2.3), which would allow the pipe laying barge (or 'lay barge') to be fitted-out on site.

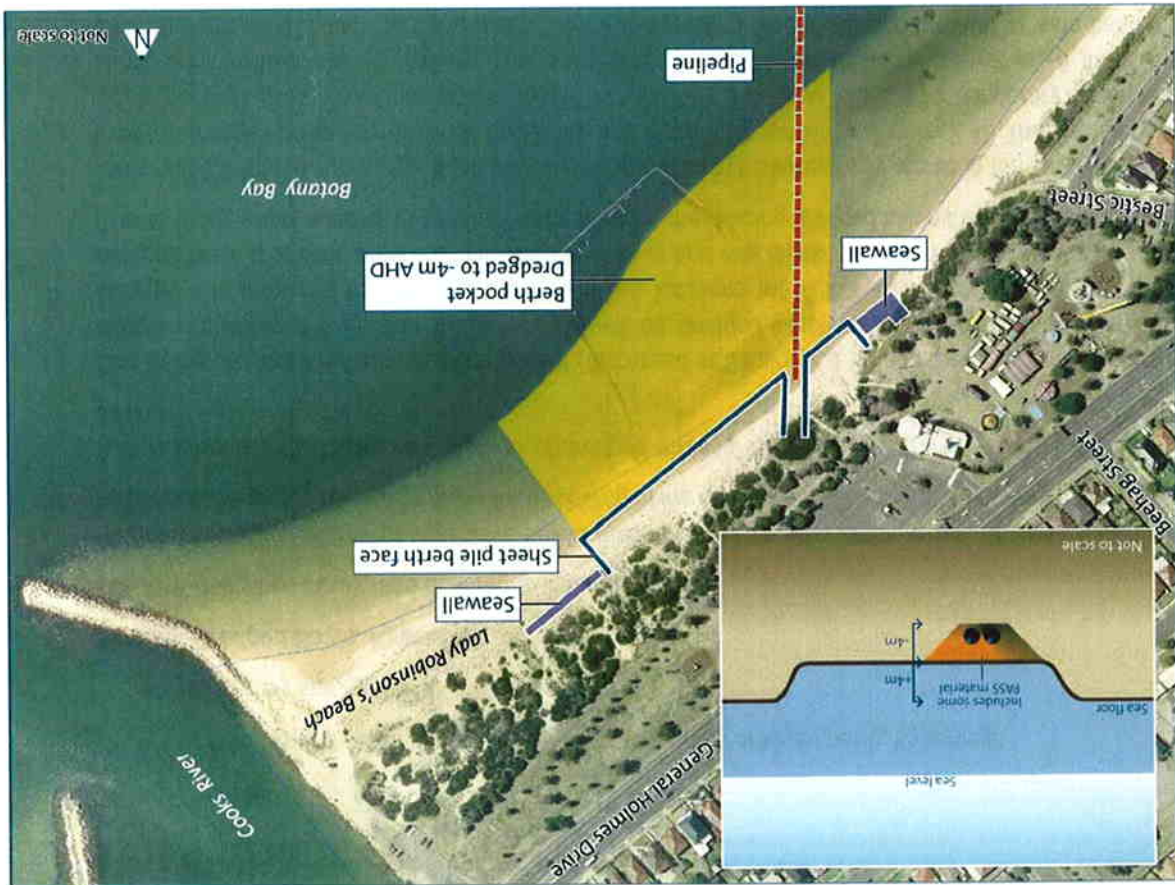
As per the PPR, a sheet piled berth face (and sea wall / rock armouring) will be installed at the 0 m AHD contour on the beach. Sheet piling of the berth face is consistent with the PPR, and does not relate to this application for modification. The berth pocket will be dredged seaward from the berth face.

Approximately 52,000 m³ of sandy material would be dredged to create the Kyeemagh berth pocket. The dredged material would be temporarily placed within the southern portion of the existing dredged basin, adjacent to the main north-south airport runway, as per the PPR (Section 2.3.2 and Figure 2.4).

The dredging of the proposed berth pocket also allows the pipe trench to be dredged directly to the sheet piled berth face (-8 m AHD), no longer requiring the twin 1,400mm pipes to be installed between the sheet piles of the temporary work platform. This is illustrated by the cross section shown in Figure 2.3, and is a much simpler process in terms of construction and amount of material requiring storage and handling. Additionally, the pipe trench will be dredged through a band of firm to stiff clays, requiring a reduced trench batter (angle), resulting in less material to be dredged, stored and managed (Section 2.3.2). This reduction in material to be handled is in the order of 8,000 to 10,000 m³.

Both the berth face and pocket are temporary and will be removed and rehabilitated at the completion of construction within the Bay.

Figure 2.3: Proposed berth pocket dredging



2.3.2 Change 2 – Storage of dredged material

Change 2 relates to:

- temporary and permanent storage within the existing dredged basin, Kyeemagh
- temporary storage off Silver Beach.

Existing Dredged Basin, Kyeemagh

The PPR describes the storage of dredged material as:

"Approximately 200,000 m³ of material removed from the initial sections of the trench off Silver Beach will need to be temporarily stored prior to its reuse for backfilling of the last section of trench off Kyeemagh."

"...it is proposed that temporary storage of dredged material occur along the north-south batter of the dredge basin."

Due to the proposed Kyeemagh berth pocket (discussed in Section 2.3.1), and the proposed reversal of the lay direction (discussed in Section 2.3.3), material will be dredged which requires both temporary and permanent storage. It is proposed to store this material in two locations within the existing dredged basin. The existing dredged basin is located adjacent to the airport runway and was identified in the PPR as a suitable storage area. Overall there is less material to be temporarily stored in the existing dredged basin than was identified in the PPR. Clean sand from the Kyeemagh berth pocket are proposed to be temporarily stored in the southern portion of the existing dredged basin for reuse for backfilling and restoration activities (Figure 2.4). The southern end of the existing dredged basin was identified in the EA and PPR as a suitable location for temporary storage of dredged sands prior to their eventual reuse. The clean sands would be placed below a level of -5 m AHD along the existing north-south batter on the western side of the existing dredged basin in a 100 m wide band with a side slope of 1:20. This is considered to be generally consistent with the approved project as described in the PPR.

As discussed in Section 2.3.1, a proportion of the dredged material from the pipe trench is made up of firm to stiff clays. This material is considered unsuitable for use in backfilling the pipe trench or restoration of the Kyeemagh berth area, as a portion of the material contains Potential Acid Sulphate Soils (PASS). It is proposed that this material would be permanently placed at the northern end of the existing dredged basin below a level of -5 m AHD in the same manner as the approved project (Figure 2.4). It is anticipated that some clean sand will be dredged with the clays. The total volume of material placed at the northern end of the borrow pit will be less than 30,000 m³.

Temporary Storage off Silver Beach

The PPR did not identify the need for small scale, temporary storage along the pipeline route off Silver Beach.

In addition to the proposed spoil storage within the existing dredged basin, approximately 10,000 m³ of dredged material is proposed to be temporarily stored along the pipeline alignment off Silver Beach (Figure 2.5). This dredged material is associated with the retrieval of the Tunnel Boring Machine (TBM). The TBM will be used to micro-tunnel under the seagrasses off Silver Beach, to a distance of 800 m, in accordance with Condition 2.1 of the Project Approval. Once the micro-tunnel has been completed, the TBM will be recovered by dredging around the machine, and then removed by crane. It is proposed to temporarily store the dredged material (spoil) in a thin veneer on the Bay floor, along 500 m of the footprint of the pipe trench alignment. This storage will remain in place for approximately 2 months. As the laying operations pass over this section of the route, it will then be dredged, pumped, and used to backfill the pipe trench.



Figure 2.4: Spoil storage as described in the PPR and the current proposed storage in the dredged basin



Figure 2.5: Indicative location of spoil storage off Silver Beach, Kurnell

2.3.3 Change 3 – Scale of the installation operation and direction of the pipe laying

Change 3 relates to:

- the scale of the installation operation
- the direction of the pipe laying operation.

Scale of installation operations

The PPR described the scale of the installation operation as:

"The spread of the installation operation is in the order of 1,300 m with the length of the fully formed trench being 900 m. A...[construction] zone is required around the vessels and is likely to have dimensions of 1,500 m by 800 m."

The proposed change increases the installation operation spread from the approved project of 1,300 m to approximately 1,750 m. The length of the fully formed trench, being the distance between the cutter suction dredge (CSD) 2 and discharge barge 2 (Figure 2.6), has now increased from 900 m to in the order of 1,100 m.

The largest change to the installation operation spread is associated with the mooring arrangement. The PPR identified an indicative mooring arrangement that was significantly smaller compared to the overall installation operations. Since preparation of the PPR, a considerable amount of marine engineering calculations have been undertaken to identify an appropriate mooring arrangement, which is approximately 1,750 m by 2,000 m (Figure 2.6). These calculations considered the:

- lay barge dimensions (140 m x 30 m, and approximately 12,000 t)
- pipe laying requirements
- potential wind and swell conditions that could be experienced on the Bay.

The proposed changes to the mooring arrangements are essential for pipe installation. An inappropriate mooring arrangement would put stresses on the pipe, compromising its structural integrity. If the mooring lines were too short in any direction, the lay barge would exert horizontal or vertical stresses on the pipe. These stresses could lead to delaminating of the internal or external concrete lining from the steel pipe, at worst the steel pipe could buckle. The change in the mooring arrangement has also meant that the distance between the CSDs and discharge barges is proposed to increase from 1,300 m to 1,700 m. This will ensure that there is no interference (tangling) between the dredging operations and the mooring arrangements.

As such, the construction zone around the vessels also increases, with likely dimensions of 1,950 m by 2,200 m (Figure 2.6). This includes a buffer of 100 m in front, behind and on the sides of the mooring arrangement. The proposed construction zone would move progressively across the Bay at a rate of approximately 108 m/day, for a period of approximately 5 months (excluding the shore crossings). This is a reduction in time taken to cross the Bay from the PPR, which identified 96 m/day over approximately 6 months.

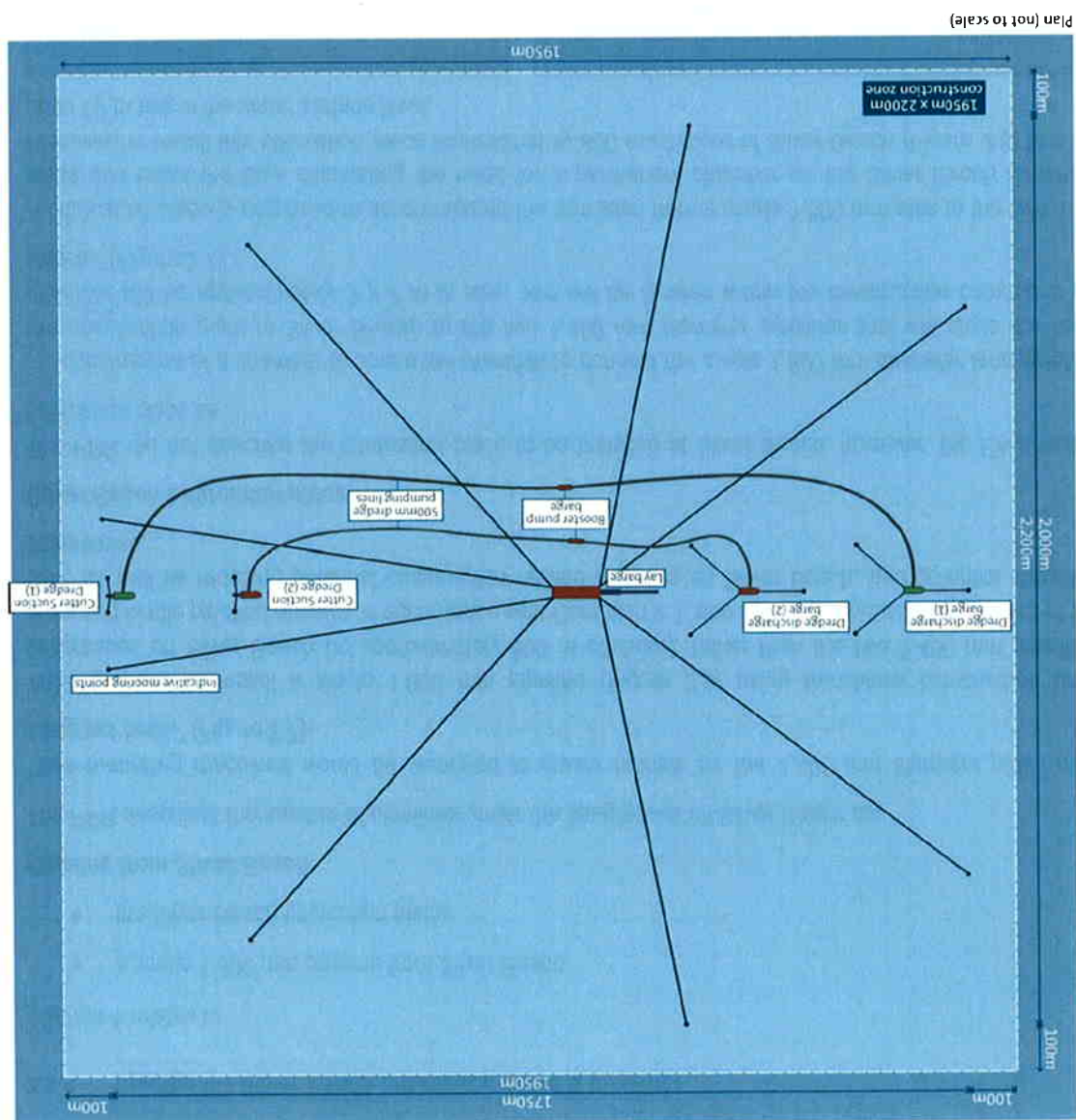
The direction of the pipe laying operations is proposed to be undertaken from Lady Robinsons Beach, Kyeemagh to Silver Beach, Kurnell as this direction eliminates the need for on-shore construction equipment (such as winches and a landing area) at Silver Beach, as well as the need for the 400 m work platform at Kyeemagh. In addition, by laying operations from Kyeemagh to Kurnell, the project is less reliant on the completion of the Silver Beach tunnel to lay the remainder of the pipeline across the Bay, reducing a large schedule risk to the project. However, the change in the lay direction has resulted in the lay barge being positioned on the landward side of the bifurcation piece over the seagrasses at Silver Beach (discussed in Section 2.3.4 and shown in Figure 2.8).

"...a pipeline from Silver Beach to Kyeemagh."

The PPR described the direction of the pipe laying operations as:

Direction of lay operations

Figure 2.6: Indicative lay barge operation



2.3.4 Change 4 – Silver Beach bifurcation piece & pipeline

Change 4 relates to:

- a single 1,800 mm pipeline from Silver Beach
- the Silver Beach bifurcation piece.

Pipeline from Silver Beach

The PPR described the number of pipelines under the seagrasses off Silver Beach as:

"Two tunnelling machines would be launched to create tunnels for the 1,400 mm diameter pipes under the seagrass beds." (Figure 2.7)

WDA propose to install a single 1,800 mm pipeline (Figure 2.8) using trenchless construction under the seagrasses off Silver Beach (to approximately 800 m offshore), rather than the two 1,400 mm pipelines. The proposed single pipeline remains in accordance with Condition 2.1, and will save a substantial amount of time and cost, as well as reducing potential construction related activities on Silver Beach, and potential impacts to the seagrasses.

Silver Beach bifurcation piece

The PPR did not describe the bifurcation piece to be installed at Silver Beach, however, the EA described the bifurcation piece as:

"...construction of a chamber to house the manifold to connect the single 1,800 mm diameter land pipeline (from the desalination plant to Silver Beach) to the two 1,400 mm diameter pipelines that will cross the bay. This chamber will be approximately 3 x 7 m in size, and will be located within the construction compound at Silver Beach." (Figure 2.7)

A bifurcation piece is proposed to accommodate the transition from a single 1,800 mm pipe to the twin 1,400 mm pipes that cross the Bay, eliminating the need for a permanent chamber on the Silver Beach foreshore. It is proposed to install this bifurcation piece approximately 800 m offshore of Silver Beach (Figure 2.8) to a depth of up to 12 m below the water surface level.

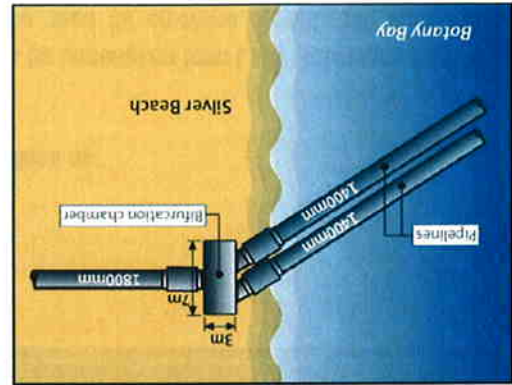


Figure 2.7: Representation of bifurcation chamber at Silver Beach, Kurnell (EA & PPR method)

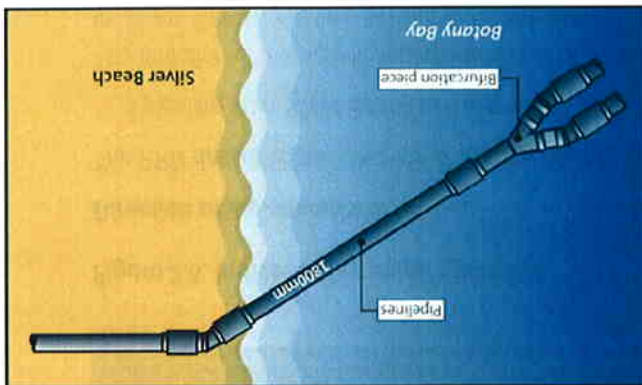


Figure 2.8: Indicative bifurcation piece off Silver Beach, Kurnell

2.3.5 Change 5 – Mooring of lay barge off Silver Beach

Change 5 relates to:

- mooring of the lay barge off Silver Beach.

The project approval (Condition 2.1) requires that trenchless construction be used under the seagrasses off Silver Beach. This construction method has been adopted. The intention of this condition is to avoid impacts to the seagrasses off Silver Beach, Kurnell. The PPR did not describe the mooring requirements off Silver Beach, however, due to the direction of lay proposed in the PPR (ie from Kurnell to Kyeeemagh), the lay barge would have started some 800 m offshore, effectively avoiding the seagrasses.

As discussed in Section 2.3.3, it is proposed to reverse the direction of the lay and lay from Kyeeemagh to Kurnell. This change in the direction has meant that the proposed lay barge operations off Silver Beach require mooring adjacent to, and over the seagrasses to lay the final sections of the twin 1,400 mm pipes and the bifurcation piece.

Following substantial investigations of possible options, and in consultation with the Department of Primary Industries (DPI), the proposed lay barge mooring system has been developed to minimise potential impacts to the seagrasses off Silver Beach. The proposed methodology involves a mooring arrangement that avoids areas of dense *Posidonia* beds off Silver Beach by using floating ropes and buried onshore anchors (as shown in Figure 2.9). This approach ensures that Mooring Lines 3 and 4 associated with the lay barge remain generally clear of the *Posidonia* seagrass. However, there is the potential for impacts, as during some low tides the *Posidonia* beds at the shoreline will become exposed, reducing the effectiveness of the floating ropes.

In addition, as the lay barge reaches Position 1, Mooring Point 2 is unable to be placed onshore due to the presence of the existing Silver Beach groynes. Consequently, it is necessary to anchor Mooring Line 2 offshore, within areas of patchy seagrass. Where practical, this anchor will be placed in a gap in the patchy seagrass to further minimise potential impacts to the seagrasses.

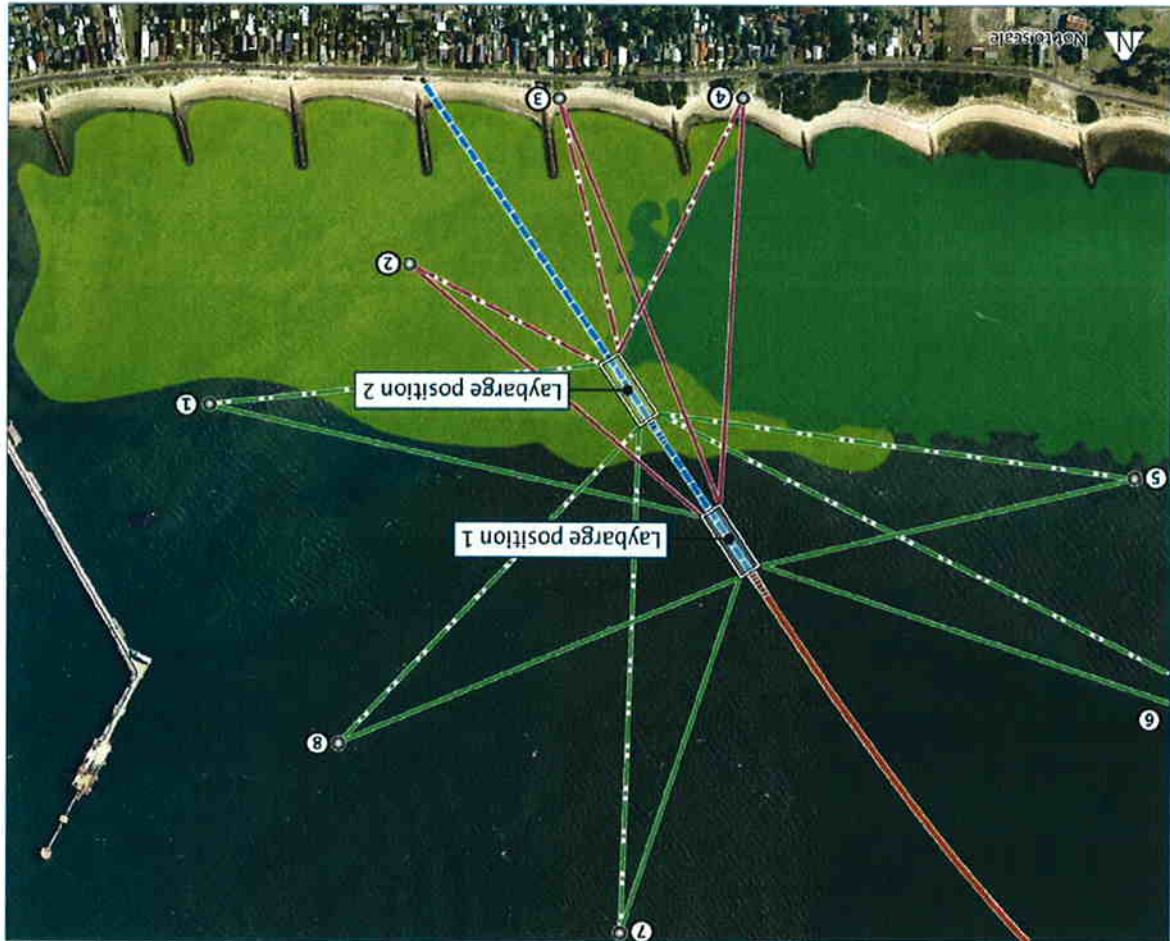
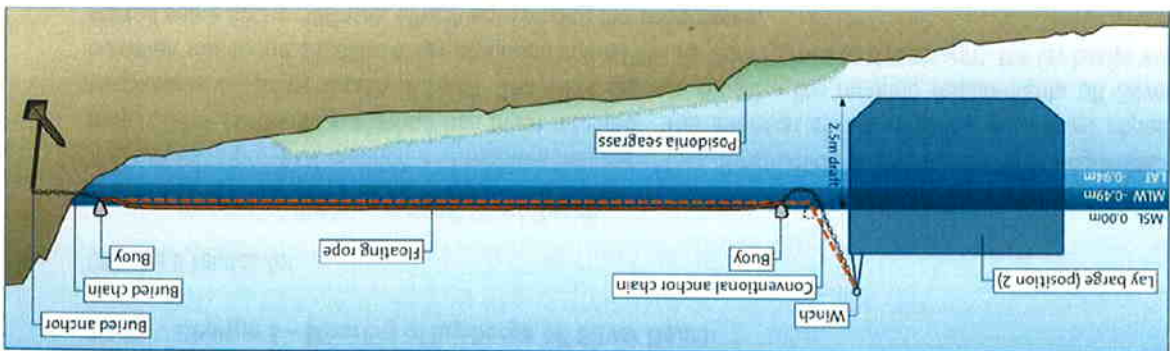


Figure 2.9: Illustration of the mooring lines (floating ropes) through the Silver Beach zone

2.3.6 Amendment 1 – Minister's Condition of Approval 2.19

Condition 2.19 of the Project Approval relates to turbidity monitoring and requires that:

"The Proponent shall ensure that construction of the Botany Bay Sector, including all dredging, subsurface storage and reclamation works, is carried out in a manner such that turbidity outside the silt curtains (as required under condition 2.18) does not exceed the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L at a point mid-depth in the water column and a distance of two metres from the silt curtain. No visible surface plume outside the silt curtains is permitted".

The intent of this condition is to ensure water quality monitoring is undertaken at a certain position (depth and distance) to provide an indication of where turbidity is approaching the specified limit. There are two relevant aspects to this Condition that WDA request be amended, they include:

- depth or level of water quality monitoring in relation to the water depth
- distance of water quality monitoring from the silt curtain.

Consultation with the Department of Environment and Climate Change (DECC) regarding this issue has indicated that while they are generally supportive of the proposed changes, the intent of the monitoring requirement at depth is to provide time to react, in effect an "early warning system" of increases in turbidity levels. The early warning then provides sufficient time to amend or halt operations to prevent a visible plume.

Depth of the water quality probe in relation to the water depth

The height of the water column across the Bay varies with tidal conditions and changes to the contours of the Bay floor. Tidal range is up to 1.5 m and the bottom depth across the Bay (along the pipeline alignment) ranges from about 0 to 4 m. As such, it is possible to have a water column range from 0 m (at Kyeeemagh, low tide) to approximately 5.5 m (at the deepest part of the pipeline crossing of the Bay, and high tide). This has implications for mounting the water quality monitoring probes on the equipment and the buoys.

Two types of water quality monitoring setups are proposed to be used for the project, depending on the equipment which the silt curtains are surrounding, as follows:

- berth dredging and lay operations (eg the discharge barges and CSD)
- shore-based construction work (eg at Silver and Lady Robinsons Beaches).

The discharge barges and CSD are able to have the water quality monitoring probes attached or mounted to the vessels, while the shore-based construction work requires water quality monitoring probes to be installed within buoys located in the Bay.

Recent experience at Silver Beach has identified a number of constraints associated with installing the water quality monitoring probes at depth. Table 2.2 shows the proposed depth for water quality monitoring along with the height of the water column for lay operations and shore based construction work. A justification for these depths is also included. Figure 2.10 shows the location of the water quality monitoring probes on the respective pieces of equipment (monitoring buoy, CSD and discharge barges). Further explanation on the equipment constraints is provided following.

Table 2.2: Water depth, proposed depth of sensor and justification

Location, equipment and instrument mounting	Approx range of water depth, inc tides (m)	Approx depth of sensor (m)	Justification for proposed depth
Silver Beach, Kurnell – Monitoring buoy	1.3 – 2.8	0.2	Silver Beach is exposed to wind waves and swell waves which can cause vigorous movement of the monitoring buoy, requiring the probe to be attached within a protective pipe, 0.2 m below the water surface. Increasing the depth of the probe increases the risk of damage from the buoy mooring chain during wave and swell movement. Attaching the probe to another part of the buoy (eg the mooring rope) also has implications in terms of surfacing the probe for maintenance, which is required every two weeks. In addition, as the water depth is shallower nearer the shore, and background monitoring suggests that the sediment is more disturbed during low tide, lowering the probe would result in the sensor obtaining false readings from the bed sediment stirred up by movement of the mooring chain. Also, as the intent is to avoid surface plumes, the low water depth at Silver Beach means plumes are generally more visible and measuring the turbidity levels closer to the surface provides useful data on the potential for visible surface plumes.
Lady Robinsons Beach, Kyeemagh – Monitoring buoy and mounted off dredge during dredging of berth pocket	0 – 3.7	1	While a water quality monitoring probe will be established on a buoy at Kyeemagh (depth 0.2 m below water surface level), during the dredging operations, a water quality monitoring probe will be attached to the dredge to ensure that turbidity is monitored at depth (1 m), and at a suitable distance from the dredging activities. During these works, the buoy will be used as a reference buoy, and located towards the Cooks River entrance. The proposed 1 m depth is to allow enough clearance during low tide but still provide sufficient early warning information during high tides (ie depth of water quality monitoring probe during high tides would be approximately one third of the water column, rather than mid-depth)
Discharge barge – Mounted off discharge barge	2 – 5.5	1 – 1.5	The sensor will initially be set at 1 m below the water surface to measure the mid-depth within the shallowest water column. Frequent adjustment of the probe is not practical, however as the barges/dredges progress to the deeper parts of the Bay, the sensor will be lowered to a depth of approximately 1.5 m. While this will not be at mid-depth for the deepest parts of the Bay during high tide, having it permanently fixed at 1.5 m would be problematic for the shallow areas. Then, as the pipeline progresses towards Silver Beach and depth decreases, the probe will again be raised to approximately 1 m. It is envisaged that the height of the probe would be adjusted on an approximately monthly basis. It is not practicable to lower the probe beyond about 1.5 m, as this would then require adjustment with tidal changes, ie approximately every 6 hours.
CSD – Mounted off	2 – 5.5	1 – 1.5	

1. The above monitoring refers to 'near-field' stations which monitor turbidity in the immediate vicinity of construction activities. Reference monitoring is also being undertaken to collect background data at locations away from construction activities (eg within the Bay, at Towra Point, etc). The Silver Beach and Kyeemagh Monitoring Stations will be 'reference' stations during dredging and construction work at the opposite end of the Bay, and 'near-field' stations while construction work occurs at their respective beaches.

Existing approval text (Condition 2.19) for depth	...at a point mid-depth in the water column
Proposed amendment to text for depth	...at a point of approximately 0.2 m depth for Silver Beach and between 1 and 1.5 m depth in the water column for all other sites and equipment....

As such it is proposed to amend the condition relating to the depth of water monitoring as follows:

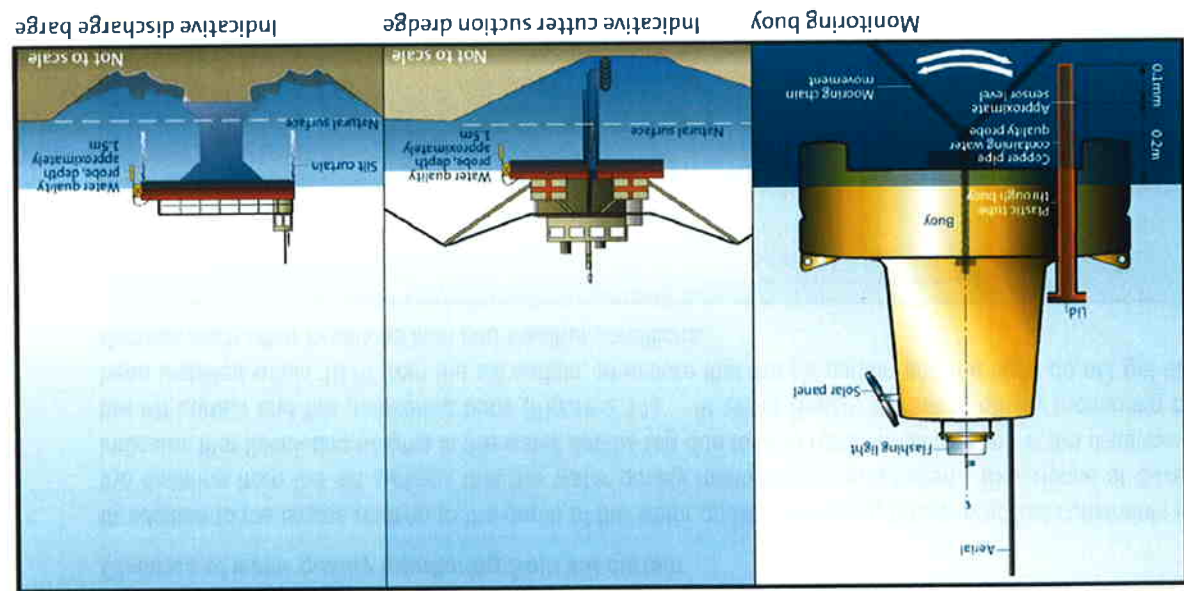
WDA proposes that Condition 2.19 be amended for the depths indicated in Table 2.2. WDA considers that the proposed amendments to the condition would not affect the outcome or the intent of the condition, ie the ability of the water quality monitoring probes to be used as an early warning device to both minimise turbidity within the water column, and prevent a visible surface plume. The amendment has been requested based on practical considerations and to ensure turbidity is appropriately monitored and compliance is achieved.

- reduces the potential for damaging the probe during rough weather, and therefore reduces monitoring down time
- provides easy access for fortnightly servicing (cleaning and calibration of probe) necessary to obtain good quality data
- increases data reliability by mounting the probe further from the bed, where the mooring chain may stir up sediment locally.

As discussed in Table 2.2, the location of the sensor for the discharge barge and CSD is somewhat flexible and the depth adjustable based on the water depth as the barge/dredge crosses the Bay. In relation to the shore-based construction sites, or where water depths are shallower and monitoring buoys are used, the depth of the water quality monitoring probe is less flexible.

The water quality monitoring probe set within the water quality monitoring buoy has been designed to minimise potential for damage and tangling with the mooring chain or silt curtain. The probe is located within a copper pipe, encased by a plastic tube that runs through the buoy. The probe sits approximately 0.2 m below the surface of the water (Figure 2.10), rather than at mid-depth in the water column. This set-up is required as it:

Figure 2.10: Indicative location of the water quality probes



Distance of water quality monitoring from silt curtain

In addition to the issues relating to the depth of the water quality monitoring probe, practical constraints influence the distance from the silt curtains that the water quality monitoring is undertaken. Experience at Silver Beach indicates that fluctuating heights in the water depths (eg due to tide) result in fluctuations in the distance between the silt curtain and the monitoring buoy (Figure 2.11). At Silver Beach, the water quality monitoring buoy has been installed within 10 m from the silt curtain, to ensure that the silt curtain and the buoy do not get tangled or damage each other in various tidal and weather conditions.

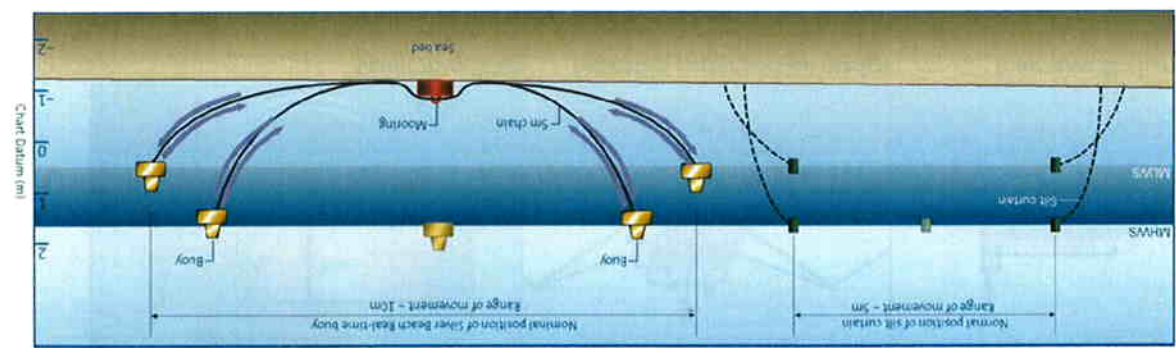


Figure 2.11: Relation of water quality buoy mooring lines to the silt curtains

Figure 2.11 shows the movement of both the silt curtain and the monitoring buoy in response to variations in the tide conditions. The figure suggests that a more practical distance to undertake water quality monitoring would consider the variable conditions of the Bay, and be say 'within 10 m of the silt curtain'. Table 2.3 identifies the likely distance associated with the water quality monitoring equipment from the silt curtains (or CSD, as relevant).

Table 2.3: Approximate distance of water quality monitoring from silt curtain or CSD.

Location / equipment	Instrument mounting	Approx distance of water monitoring probe from silt curtain (m)
Silver Beach, Kurnell	Monitoring buoy	Between 1 and 10 m of curtain.
Lady Robinsons Beach, Kyeemagh	Attached to dredge during construction (dredging) of the berth pocket	Monitoring will be undertaken between 1 and 10 m from the equipment. It should be noted that the CSD is effective at minimising turbidity and a silt curtain will only be used as required by Condition 2.18 of the Project Approval.
Discharge barge	Mounted off discharge barge	Between 1 and 10 m of curtain.
CSD	Mounted off CSD	Monitoring will be undertaken between 1 and 10 m from the equipment. It should be noted that the CSD is effective at minimising turbidity and a silt curtain will only be used as required by Condition 2.18 of the Project Approval.

Table 2.3 shows that while in some cases it is possible to meet the 2 m requirement, the variations in the Bay conditions make it difficult to meet. As such it is proposed to amend the condition in relation to distance, as follows:

Existing approval text (Condition 2.19) for distance	Proposed amendment to text for distance
... and a distance of two metres from the silt curtain.	... and a distance within ten metres from the silt curtain.

2.4 Rationale/justification for proposed changes and amendment

2.4.1 Rationale/justification for changes to the construction methods

A range of engineering and environmental investigations and stakeholder consultation have been undertaken following project approval to inform the detailed design. The availability of additional information has enabled the design in the Botany Bay Sector to be optimised by changing aspects of the construction method, and minimising overall environmental and social impacts, including:

- reduces noise impacts, with no requirement to construct temporary work platform (quay and jetty) at Kyeemagh and the bifurcation chamber on Silver Beach
- less temporary and permanent visual impacts associated with no temporary work platform at Kyeemagh, and no permanent structure on Silver Beach (ie bifurcation chamber)
- less construction requirements by eliminating need for quay/jetty, reducing traffic disruption and requirements for importing large amounts of fill and deliveries at Kyeemagh, and is more sympathetic with existing Bay conditions
- avoids potential project delays associated with the scheduling of the TBM
- avoids disturbance of less Potential Acid Sulphate Soil (PASS) and contaminated material within Botany Bay, by constructing a relatively shallow berth pocket rather than piling into PASS or contaminated sediment and provides improved method of management
- allows in situ burial and "capping" of contaminated material, avoiding previously proposed land based disposal methods
- remains consistent with DPI and WDA's Compensatory Seagrass Package
- reduces the number of micro-tunnels at Silver Beach (from a twin 1400mm to a single 1800mm), reducing potential associated impacts.

Section 4 provides additional detail and an environmental assessment of the proposed changes.

While the main reasons for the proposed changes are to reduce scheduling risks and improve engineering reliability, the proposed changes also reduce the overall environmental and social impacts. The same approach used to evaluate the methods presented in the PPR was adopted to assess the proposed changes, and ensure a consistent approach was applied to the evaluation of changes during project development. As required by Section 5.4 of the EA and 2.6 of the PPR, criteria for selection of the construction method within the Botany Bay Sector included consideration of:

- Geotechnical conditions
- Construction time
- Environmental impact.

The evaluation of the proposed changes to the construction method against these criteria is presented below.

Geotechnical conditions

Geotechnical investigations indicate that ground conditions within the Bay are suitable for the proposed changes. The proposed changes have been based on increased understanding of the coastal processes at Kyeemagh, and within the Bay. The proposed changes will have generally positive impacts on geotechnical conditions compared with the approved project by avoiding the need for land based spoil disposal, reducing the volume of PASS and potentially contaminated spoil requiring disposal and effectively allowing "capping" of contaminated spoil within the existing dredged basin.

Construction time

While not likely to reduce the Project's construction timeframe overall, the proposed changes reduce the construction timeframe for the Bay crossing. In addition, the proposed changes reduce the risk of not meeting the original timeframe, by improving the TBM scheduling.

Environmental impact

The proposed changes would result in similar impacts, and would reduce the overall environmental and social impacts by avoiding the need to undertake some of the construction methods originally proposed in the PPR. The construction methods avoided include; construction of a temporary work platform off Kyeemagh and the bifurcation chamber on shore at Silver Beach, as well as requiring less spoil to be managed. However, the proposed changes increase the potential for aquatic ecology impacts to occur at Silver Beach, compared with the approved project.

2.4.2 Rationalisation/justification for requesting amendment to Minister's Conditions of Approval

Condition 2.19 relates to the measurement of turbidity outside silt curtains and requires that turbidity be measured "at a point mid-depth in the water column and a distance of two metres from the silt curtain."

Recent experience monitoring the turbidity outside the silt curtain at Silver Beach has identified constraints in ensuring that the sensor remains at a point mid depth (due to water column fluctuations with tide changes, and the necessity of attaching the monitor to the buoy) and at a distance of two metres (due to current movements). A more practical condition would allow the variation identified in Table 2.2 (Section 2.3.6), as well as a range in distance from the silt curtain.

3 Consistency Assessment

A consistency assessment was commenced for the proposed changes to determine if the changed methods were generally in accordance with the planning approvals and associated documentation. It was found that the proposed changes were not consistent with one of the conditions of the Project Approval. At this point, preparation of the consistency assessment ceased, and this application for modification prepared. The results are summarised below.

3.1 Consistency with the Concept Approval

The proposed changes are considered to be consistent with the Concept Approval. Refer to Appendix A for further details.

3.2 Consistency with the Project Approval

The Project Approval includes a number of conditions with which the project must comply. These conditions relate to requirements such as environmental monitoring and auditing etc, or to other parts of the project, for example impacts associated with the land pipeline. Appendix A includes details of consistency of the proposed changes with the Project Approval. A copy of the Project Approval is included as Appendix B.

Condition 1.1 and 2.19 are the only conditions that relate to this application for modification.

3.2.1 Condition 1.1

Condition 1.1 - Terms of the Project Approval requires the project to be carried out in accordance with various documents including the EA and PPR and states:

The Proponent shall carry out the project generally in accordance with the:

- a) *Environmental Assessment of the Desalinated Water Delivery System, dated April 2007, and prepared by GHD on behalf of the Proponent;*
- b) *Desalinated Water Delivery System: Preferred Project Report, dated August 2007, and prepared by Sydney Water Corporation;*
- c) *Desalinated Water Delivery System: Application for Modification of Project Approval for the Urban Sydney Sector: Sydney North, prepared by the Water Delivery Alliance for Sydney's Desalination Project and dated 5 May 2008;*
- d) *the concept plan approval granted with respect to the Kurnell Desalination Plant concept plan (05_0082); and*
- e) *the conditions of this approval.*

The proposed changes are considered to be inconsistent with some aspects of the construction methods compared with the approved project and identified in the EA and PPR.

WDA considers Condition 1.1 should be modified to include this application for modification in the list of reference documents in order to approve the proposed changes to the construction methods, as follows:

The terms of the project approval are described in Condition 1.1. Condition 1.1 requires the project to be carried out in accordance with the conditions of the project approval. Of these conditions, the WDA is seeking amendment to Condition 2.19 as a result of constraints encountered in practically implementing the condition.

Condition 2.19 of the Project Approval outlines the requirements for monitoring turbidity outside the silt curtains and states:

"The Proponent shall ensure that construction of the Botany Bay Sector, including all dredging, subsurface storage and reclamation works, is carried out in a manner such that turbidity outside the silt curtains (as required under condition 2.18) does not exceed the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L at a point mid-depth in the water column and a distance of two metres from the silt curtain. No visible surface plume outside the silt curtains is permitted."

The requirements to measure turbidity at "a point mid-depth in the water column" and at a "distance of 2m from the silt curtain" are relevant to this application for modification.

As discussed in Section 2.3.6, experience with monitoring the turbidity outside the silt curtain at Silver Beach has shown it is impractical to take turbidity readings at a point mid-depth in the water column and two metres from the silt curtains. A more practical condition would allow variation of the monitoring depth, depending on the equipment (eg monitoring buoy, CSD or discharge barge), as well as a range in distance from the silt curtain.

WDA considers Condition 2.19 as impractical to meet, given the constraints of the technology available and the effect of the tides and currents in the Bay, and requests that Condition 2.1 be modified to recognise the variation proposed in Table 2.2 (Section 2.3.6) rather than "a point mid-depth" and increase the range of where measurement occurs as follows:

3.2.2 Condition 2.19

Existing approval text (Condition 1.1). Extracted from Modification of Approval 13/06/08	Proposed amendment to text
The Proponent shall carry out the project generally in accordance with the: a) Environmental Assessment of the Desalinated Water Delivery System, dated April 2007, and prepared by GHD on behalf of the Proponent; b) Desalinated Water Delivery System: Preferred Project Report, dated August 2007, and prepared by Sydney Water Corporation; c) Desalinated Water Delivery System: Application for Modification of Project Approval for the Urban Sydney Sector: Sydney North, prepared by the Water Delivery Alliance for Sydney's Desalination Project and dated 5 May 2008; d) the concept plan approval granted with respect to the Kurnell Desalination Plant concept plan (05_0082); and e) the conditions of this approval.	The Proponent shall carry out the project generally in accordance with the: a) Environmental Assessment of the Desalinated Water Delivery System, dated April 2007, and prepared by GHD on behalf of the Proponent; b) Desalinated Water Delivery System: Preferred Project Report, dated August 2007, and prepared by Sydney Water Corporation; c) Desalinated Water Delivery System: Application for Modification of Project Approval for the Urban Sydney Sector: Sydney North, prepared by the Water Delivery Alliance for Sydney's Desalination Project and dated 5 May 2008; d) Desalinated Water Delivery System: Application for Modification of Project Approval for the Botany Bay Sector, prepared by the Water Delivery Alliance for Sydney's Desalination Project and dated 15 July 2008; e) the concept plan approval granted with respect to the Kurnell Desalination Plant concept plan (05_0082); and f) the conditions of this approval.

Proposed amendment to text	Existing approval text (Condition 2.19). Extracted from original Project Approval 22/10/07
The Proponent shall ensure that construction of the Botany Bay Sector, including all dredging, subsurface storage and reclamation works, is carried out in a manner such that turbidity outside the silt curtains (as required under condition 2.18) does not exceed the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L at a point of approximately 0.2 m depth for Silver Beach and between 1 and 1.5 m depth in the water column for all other sites and equipment and a distance of within ten metres from the silt curtain. No visible surface plume outside the silt curtains is permitted.	The Proponent shall ensure that construction of the Botany Bay Sector, including all dredging, subsurface storage and reclamation works, is carried out in a manner such that turbidity outside the silt curtains (as required under condition 2.18) does not exceed the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L at a point mid-depth in the water column and a distance of two metres from the silt curtain. No visible surface plume outside the silt curtains is permitted.

3.3 Are any new conditions required?

Section 4 assesses the potential environmental impacts associated with the proposed changes and identifies the Minister's Conditions of Approval and Statements of Commitment that will be implemented to manage impacts. As the impacts can be managed by implementing the existing Minister's Conditions of Approval and Statements of Commitment, it is considered that new conditions are not required.

3.4 Assessing consistency with the approved project

When assessing consistency, it is generally accepted that the key tests must be drawn from the objectives of the project, description of the approved activity, and the described impacts of the project. The project objectives, description, and assessment of potential impacts are contained in a number of documents including:

- Major Project Application
- EA of the Concept Plan for Sydney's Desalination Project
- PPR for Sydney's Desalination Project
- EA for the Desalinated Water Delivery System
- PPR for the Desalinated Water Delivery System.

3.4.1 Objectives

The proposed changes are generally consistent with the objectives of the project (refer to Appendix A).

3.4.2 Project Description

The project descriptions in the documents listed above stated that during the course of detailed design, the construction method may need to be changed. As such, the project description provides a degree of flexibility to enable optimisation during detailed design. However, the WDA considers that the proposed changes are sufficiently different compared to the approved project, to require a modification to the project approval, rather than undertaking a consistency assessment, as permitted by section 75(2) of the EP&A Act.

3.4.3 Impacts

Section 4 assesses the potential impacts of the proposed changes. When comparing whether the proposed and approved impacts are consistent, the following issues need to be addressed:

- Are there any significant impacts?
- Are the proposed impacts similar in scale to the approved impacts?
- Will someone be affected by an impact who was not previously impacted?
- Are there any new impacts and who/what will be affected?

These issues are discussed below.

Are there any significant impacts?

The proposed changes apply to distinct areas or aspects of the project and will not result in any significant environmental impacts. The proposed changes will increase the potential for some impacts to occur, however, the proposed changes will provide an overall reduction in environmental and social impacts, compared to the approved project. Potential impacts will be managed by implementing the Minister's Conditions of Approval and Statements of Commitment (refer to Section 4).

Are the proposed impacts similar in scale to the approved impacts?

The proposed changes apply to distinct areas or aspects of the project, and will result in impacts that are similar in scale to the approved impacts. Changes in the scale of impact are associated with an increased potential to impact aquatic ecology, and reductions in potential impacts on noise, coastal processes and water quality. As described in Section 4, the changes to the construction method will reduce the overall environmental impacts. Potential impacts will be managed by implementing the Minister's Conditions of Approval and relevant Statements of Commitment (refer to Section 4).

Will someone be affected by an impact who was not previously impacted?

The proposed changes will not affect anyone that was not previously impacted. WDA has consulted with affected stakeholders (refer Section 5) including DEC and DPI, local councils and businesses to identify potential issues (refer to Section 5). Potential issues raised primarily related to access within the Bay, impacts associated with the storage of spoil, and lay barge mooring during construction. These impacts will be managed by implementing the Minister's Conditions of Approval and Statements of Commitment.

Are there any new impacts and who/what will be affected?

The proposed changes to the construction method will not result in new impacts; however it increases the potential for impacts to aquatic ecology to occur at Silver Beach. The DPI (relevant agency for seagrasses) has been consulted about the proposed mooring arrangements off Silver Beach, within the seagrasses. They requested that the WDA update the Framework Compensatory Seagrass Package (FCSP) prepared for the EA, in consultation with their Department. The updated FCSP has been included in Appendix D and is consistent with Statement of Commitment 2. WDA will manage potential impacts to the seagrasses by implementing Conditions 2.24 and 4.1 of the Project Approval, and the Statements of Commitment 1 and 2.

Based on the above considerations of consistency with objectives, project description and impacts, the proposed changes are considered to be consistent with the approved project.

4 Environmental assessment

4.1 Gap Analysis / Summary of Change in Impact

This section compares the potential impacts from the proposed changes to the construction method against the approved construction methods. The comparison uses the potential environmental impacts assessed in the EA and PPR. Table 4.1 summarises the relative change in environmental impacts associated with the proposed changes to the construction method. Additional detail is provided in Sections 4.2 to 4.5.

As well as the key environmental impacts assessed (aquatic ecology, coastal processes, noise and water quality), as per the methods used in the EA and PPR, the proposed changes have the potential to generally reduce other impacts. These are identified in Section 4.6.

Table 4.1: Change in environmental impact due to the proposed changes

Aspect	Relative change in environmental impact		Additional management measures required
	Aquatic ecology	Coastal processes	Noise
	No change in impact at Lady Robinsons Beach, Kyemagh. Proposed changes increase the potential to impact seagrasses at Silver Beach, Kurnell by requiring mooring lines to be located near dense beds of <i>Posidonia</i> and an anchor to be placed within the patchy <i>Zostera</i>, <i>Halophila</i>, and <i>Posidonia</i> seagrass offshore.	Similar type of impact, however, reduced impact overall. The changed berth locations in the Bay will have similar impacts on the coastal processes within the Bay as per the PPR. The clays stored at the northern end of the existing dredged basin will provide a level of clean capping over the existing contaminated sediments within the basin. The storage of spoil along the pipeline route off Silver Beach and in the southern end of the existing dredged basin will be temporary.	Significantly reduced impact on noise due to proposed dredging of berth pocket (no exceedances of noise goals without mitigation) instead of construction of temporary work platform (quay and jetty) as per the PPR, which had the potential to exceed noise goals by 20dB(A) without mitigation.
	N/A	N/A	N/A
			Similar type of impact, however reduced impact overall with less spoil disturbed (dredged, moved and managed), same management practices adopted for turbidity, as well as improved management strategy for PASS.
			N/A

4.2 Aquatic Ecology

Changes 1 and 5 have the potential to impact Aquatic Ecology.

4.2.1 Summary of Approved Project

Kyeemagh beach zone

The approved project at Kyeemagh included construction of a temporary work platform from the shoreline in to the Bay (about 400 m). The work platform was to comprise a quay between sheet piles (about 200 m), and a jetty (about 200 m). Potential impacts to aquatic ecology (seagrasses) at Kyeemagh were not assessed in the EA or PPR.

Silver Beach

The PPR noted that the seagrass beds offshore Silver Beach contain three species of seagrass: *Zostera capricorni* or eelgrass; *Posidonia australis* or strapweed; and *Halophila ovalis* or paddleweed. Of these species, *Posidonia* requires the greatest management consideration due to its slow reproduction by vegetative rhizomes and poor production of flowers and propagation by seed.

The approved project at Silver Beach involved trenchless construction under the seagrass beds, to a point approximately 800 m offshore. This method avoided both the dense beds of *Posidonia* and the patchy seagrasses (*Zostera*, *Halophila*, and *Posidonia*) offshore from Silver Beach, Kurnell.

While the project was designed to avoid the seagrasses, management measures were also identified in the Statements of Commitment for potential impacts. These measures included the preparation of a Seagrass Management Plan (Statement of Commitment 1) for implementation during, and post-construction, and a Compensatory Seagrass Package (Statement of Commitment 2) to detail how any loss of seagrass at Silver Beach associated with construction will be offset.

4.2.2 Assessment of Modified Project

Kyeemagh Berth Pocket

Since project approval, a study of the aquatic vegetation has been undertaken at Kyeemagh (Figure 4.1) by The Ecology Lab. The assessment found that the proposed dredging within the berth pocket at Lady Robinsons Beach and the shallow subtidal area would avoid the seagrass areas. However, patches of *Sargassum* attached to sections of the net surrounding the swimming baths would be removed. *Sargassum* is a brown alga, rather than seagrass and impacts associated with its removal would be negligible, as the *Sargassum* would recolonise the nets following reinstatement.

While the PPR did not address the impacts of removing the *Sargassum*, the construction compound included the relocation of the swimming baths during the construction period, as well as reinstatement following completion of construction. As such, this is considered to be consistent with the project approval.

There is the potential that *Syngnathiformes* (seahorses, pipefish, sea dragons) may also be attached to the nets surrounding the swimming baths. The Construction Environmental Management Plan prepared for the works at Lady Robinsons Beach includes undertaking a visual inspection of the nets prior to their removal, and relocation of the *Syngnathiformes* to nearby seagrass areas, in the unlikely event that one is present.

- Mooring lines - the type of mooring line has been selected to minimise the potential impacts to the seagrasses off Silver Beach. As the lay barge approaches Silver Beach, the existing mooring lines will be replaced with three floating lines on the southern side of the lay barge. The floating lines are made up of

follows:

The lay barge operation near Silver Beach has the potential to impact on seagrasses off Silver Beach, associated with mooring the lay barge. The mooring lines have been selected and the arrangement / position developed to minimise the effects on the patchy seagrasses (*Zostera*, *Halophila*, and *Posidonia*) and dense *Posidonia* beds as

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Halophila is likely to recolonise.

Figure 4.1 also shows the presence of *Halophila* and *Caulerpa* located outside the proposed berth pocket. Dredging of the berth pocket will not impact these species, however construction of the pipe trench has the potential to result in some disturbance to the very sparse *Halophila* and sparse *Caulerpa*. *Caulerpa* is an invasive introduced species and measures were identified in the PPR to limit the spread of this weed. Potential impacts to the *Halophila* were not addressed in the PPR, however the seagrass survey undertaken by The Ecology Lab identified the *Halophila* as very sparse (ie single shoots) and that potential impacts would be minor, as the

Figure 4.1: Map of aquatic vegetation near Lady Robinsons Beach, Kyeemagh.



- thick nylon rope floats on the surface of the water (Figure 2.9). These have been specifically selected to limit the potential impacts to the dense *Posidonia* bed and the patchy seagrasses. Mooring arrangement - the mooring arrangement includes 8 mooring lines which will be configured to hold the lay barge steady during installation of the pipe and bifurcation piece. As the lay barge approaches the seagrasses off Silver Beach they will be positioned to avoid potential impacts to the seagrasses, where possible (Figure 2.9).

There is the potential that a small amount of seagrass in the vicinity of Silver Beach could be damaged during the lay barge operations, during the anchoring of Mooring Point 2 within the patchy seagrass. At low tides, a small section of the *Posidonia* bed, nearest to the Silver Beach shore becomes exposed, reducing the effectiveness of the floating mooring lines. In the event that damage occurs, the amount will be quantified and the below management measures will be implemented. Surveys of seagrasses in the vicinity of the works will be undertaken before and after the lay barge operations.

4.2.3 Management Measures / Conclusion

While the proposed changes have been designed to avoid impacts to seagrass, the changes increase the potential to impact the seagrass beds off Silver Beach.

In accordance with Condition 2.24, WDA will ensure that construction is undertaken in a manner that minimises the potential for impacts on seagrass beds. This will include, where practical, measures to limit potential impacts to the *Posidonia* beds from the floating ropes during low tide events, and placing the anchors in the gaps between the patchy seagrasses at Silver Beach. The WDA Ecosystem Monitoring Program (prepared in accordance with Condition 4.1) will monitor the effectiveness of the proposed management measures. Statements of Commitment 1 and 2 will be implemented to ensure appropriate management of the seagrasses off Silver Beach. In addition, a Framework Compensatory Seagrass Package (FCSP) developed during the EA, and updated in consultation with DPI to reflect the proposed changes to the construction methods, would be implemented. The updated FCSP is included as Appendix D. No additional Statements of Commitment are considered necessary for the proposed changes.

4.3 Coastal Processes

Changes 1, 2 and 3 have the potential to impact on coastal processes.

4.3.1 Summary of Approved Project

The approved project included activities with the potential to impact on coastal processes, including:

- temporary storage of approximately 200,000 m³ of material in the existing dredged basin
- permanent storage of approximately 35,000 m³ of residual spoil along the north-south batter of the existing dredged basin
- construction of the quay structure (about 200 m) component of the temporary work platform
- the 900 m open trench through Botany Bay.

Numerical modelling conducted by Cardno Lawson Treloar (CLT) for the EA and PPR, showed that both the temporary storage of the full volume of material (200,000 m³) and the long term storage of residual material (approximately 35,000 m³) would have minor or negligible impacts to the shoreline processes in terms of wave height and direction, sediment transport rates and shoreline evolution. The location of the storage areas within the dredge basin was also investigated and it was concluded that the north-south batter was the most suitable location for both the temporary and permanent storage.

CLT also undertook modelling during the PPR for the temporary work platform. The modelling showed that the temporary work platform would result in a small impact in terms of changes in swell wave activity causing sediment to be transported along the beach, resulting in small increases and reductions in areas of beaches around the platform.

In regards to the length of open pipe trench, the modelling undertaken by CLT during the EA and PPR indicated that there would be no significant shoreline impacts associated with sections of pipe trench left open temporarily, regardless of the length. The results indicate that within the accuracy of the modelling, there is little to no difference in the shoreline impacts between open or covered trenches.

4.3.2 Assessment of Modified Project

The proposed changes have the potential to result in impacts to coastal process associated with the:

- storage of dredged material
- dredged berth pocket
- amount of open trench.

Potential impacts to coastal processes relating to the storage of dredged material and amount of open trench were assessed using the findings of the previous modelling undertaken by CLT for the EA and PPR. Additional modelling was undertaken by CLT for the proposed dredging of the berth pocket.

Storage of dredged material

The volume of dredged material to be temporarily stored at the southern end of the existing dredged basin has been reduced from 200,000 m³ (PPR amount) to approximately 160,000 m³. The long term storage volume has

also been reduced from 35,000 m³ to 30,000 m³ or less. In addition, the dredged material to be stored on a long term basis will now be placed within the more sheltered northern portion of the existing dredged basin.

The northern end of the existing dredged basin was ruled out as a temporary storage bed in the PPR, due to the higher concentrations of contaminants, greater thickness of the sediments and the longer pumping distances involved. However, as it is now proposed to permanently store clay material in this location, using a shorter pumping distance (ie from Kyeeemagh rather than Kurnell) and that this clay would form a cap on the contaminated material, this proposed change is now considered to be suitable. The location of the temporary storage within the southern end of the existing dredge basin is essentially the same as the PPR. However, detailed design has slightly refined where the material would be stored (Figure 2.4).

Based on the previous modelling undertaken by CLT for the PPR, the changes to the proposed storage of dredged material (ie reduced volume of stored material and more suitable permanent location) are not expected to have significant impacts on coastal processes.

In addition to the temporary storage of approximately 160,000 m³ and the long term storage of about 30,000 m³, approximately 10,000 m³ of spoil material from the removal of the TBM over the pipeline requires temporary storage. This spoil will be placed over the top of the pipeline route, at a depth of between 500 mm and 300 mm. This method of storage, 'ribbon storage' was initially dismissed in the PPR, due to risks of storms dispersing the material. However, due to the small volume of material, short timeframe of storage (approximately 2 months), and the shorter disposal distance, it is considered that the storage of this material would not impact on the coastal processes at Silver Beach, nor on surrounding infrastructure, such as the Caltex berth area. The pipeline route will be returned to the existing bed level once work is complete.

Construction of the berth pocket

CLT has undertaken additional modelling since the PPR for the proposed berth pocket. The modelling has demonstrated that the berth pocket would not cause shoreline accretion, but some sand would be deposited in the dredged pipeline trench and vessel manoeuvring area. There would be some shoreline re-alignment of the beach in front of the seawall at either end of the berth face, and the beach would require some reinstatement following completion of the work. There would be no impacts on coastal infrastructure, such as retaining walls. This is consistent with the impacts identified in the PPR for the temporary work platform.

A comparison between the approved construction method and the proposed construction methods demonstrates that shoreline impacts would be minor in both cases, and of similar scale. However, the details would be different in terms of where shoreline erosion and deposition might occur during the construction period. As such, there would be no net changes to impacts associated with dredging the berth pocket in terms of sediment transport and shoreline recession.

Amount of open trench

The proposed changes include increasing the length of fully open trench from approximately 900 m to approximately 1,100 m.

Modelling undertaken by CLT for the PPR indicated that there would be no significant shoreline impacts associated with sections of pipe trench left open temporarily, regardless of the length. The results of that modelling indicated that within the accuracy of the modelling, there is little to no difference in the shoreline impacts between open or covered trenches. However, there may be some beneficial reduction in shoreline recession in areas of the southern shoreline. Based on the previous modelling, the proposed changes from 900 m to 1,100 m is not anticipated to result in any significant impacts to coastal processes.

4.3.3 Management Measures / Conclusion

The proposed changes will result in similar types of impacts on coastal processes, compared to the approved project in terms of effects on shoreline processes, wave height, energy and direction, sediment transport and shoreline evolution. In addition, the proposed changes reduce the temporary storage in the southern portion of the existing dredged basin (200,000 m³ down to approximately 160,000 m³) and provide a more suitable location for the material to be permanently stored.

Potential impacts on coastal processes will be monitored in accordance with the Beach and Foreshore Monitoring Program developed by WDA in consultation with DEC and DPI, and approved by the DOP. Where beach profiles have changed as a result of the works a small dredge, which will be kept on site during the works will undertake maintenance dredging. Potential impacts will also be managed by undertaking the changed construction methods in accordance with Condition 5.3 of the Concept Approval and Conditions 2.18, 2.19 (as modified by this application), 2.20, 2.21, 2.22, 2.24, 4.1, 4.2 and Condition 5.2e of the Project Approval. WDA will also continue to explore opportunities for spoil reuse by the Port Botany Expansion project (Condition 3.1 of the Project Approval). No additional Statements of Commitments are considered necessary for the proposed changes.

4.4 Noise

Changes 1 and 4 have the potential to impact on noise.

4.4.1 Summary of Approved Project

The PPR included noise modelling results, and an assessment of potential noise impacts associated with construction of the temporary work platform (quay and jetty). Table 4.2 provides a summary of the key findings from the PPR for the Kyeemagh works.

Table 4.2 Summary of PPR noise assessment findings for Kyeemagh

Location / activity	Nearest resident	Noise at residence (dB(A))	Period	Criteria (dB(A))	Exceedance	Exceedance with mitigation (dB)
Quay / sheet piling	100 m	76	Day	56	20	2

Notes: 1. Daytime criteria are based on background plus 10dB.

The noise assessment undertaken for the PPR indicated that the day time construction noise goal at the nearest residences for the quay construction at Kyeemagh would be exceeded by 20 dB(A), without mitigation.

The PPR did not assess the potential noise impacts associated with the construction of a bifurcation chamber on the foreshore at Silver Beach.

4.4.2 Assessment of Modified Project

Dredging of berth pocket at Kyeemagh

Noise modelling has been undertaken for the proposed changes to the construction method at Kyeemagh. The results are summarised in Table 4.3 for construction of the berth pocket at Lady Robinsons Beach using a single dredger and associated booster pump. Modelling was undertaken based on the dredger locations shown on Figure 4.2.

Table 4.3 Summary of the proposed noise assessment findings for dredging at Kyeemagh

Location	Distance from dredger to nearest residence	Period	Criteria (dB(A))	Noise at residence (dB(A))	Exceedance (without mitigation) (dB)
General Holmes Drive	165 m (modelling runs parallel with General Holmes Drive)	Day	64	51	0
The Grand Parade	200 m (southern end of berth pocket)	Day	55	53	0
	270 m (mid section of berth pocket)	Day	55	50	0
	350 m (northern end of berth pocket)	Day	55	48	0

Note: Criteria is based on the works being carried out between 4 and 26 weeks, and L_{10,15minute} dB(A).

Table 4.3 shows there would be no exceedance of the noise goals/criteria associated with the proposed changes.

Potential impacts for noise will be managed by implementing the WDA Construction Noise Management Plan (prepared in accordance with Condition 5.2b). Statements of Commitment 37 and 38 also require communications processes to be implemented to ensure that the community and stakeholders have a high level of awareness of all processes and activities associated with the delivery system.

Overall, the proposed changes to the construction methods will reduce the noise impacts experienced compared with the approved project. Importantly, conservative noise criteria and assessment methods have been used, and actual impacts are likely to be less than those predicted. No additional Statements of Commitment are considered necessary for the proposed changes.

4.4.3 Management Measures / Conclusion

Noise modelling has not been undertaken for the works at Silver Beach. However, it is considered that the noise impacts will be less than the approved project as the proposed change removes the need for the construction of a concrete bifurcation chamber on shore at Silver Beach (adjacent to residents). This construction would have involved the use of earth moving equipment, truck movements associated with spoil management, concrete deliveries, and the construction of the bifurcation piece. The proposed change means that activities associated with the bifurcation piece have moved offshore approximately 800 m. This distance will reduce the noise experienced by the Silver Beach residents for the last stages of the pipe laying and bifurcation piece abandonment.

Silver Beach bifurcation piece

Figure 4.1: Dredging noise modelling locations, Kyeemagh



4.5 Water Quality

Changes 1 and 2, and Amendment 1 have the potential to impact water quality, in relation to:

- turbidity
- encountering PASS.

Section 2.3.6 addressed Amendment 1 and concluded that the proposed amendments to the condition would not affect the outcome or the intent of the condition (ie the ability of the water quality monitoring probes to be used as an early warning device to both minimise turbidity within the water column, and prevent a visible surface plume). As such, only Changes 1 and 2 are addressed further.

4.5.1 Summary of Approved Project

Turbidity

The PPR identified that both the dredging and backfilling of the trench will cause increases in suspended solid concentrations in the water as a result of disturbance of seabed sediments. The majority of the sediments will settle onto the seabed in the immediate vicinity of the dredger. A proportion of the fine sediments (silt) will be transported away from the dredger by tidal currents, potentially forming a sediment plume. Potential turbidity impacts would be managed by disposing of dredged material within silt curtains. The assessment concluded that the water quality objective for the project should be an allowable increase in suspended solid concentrations of 50 mg/L above background levels (refer Section 2.3.6 in relation to the adoption of this condition).

The PPR also identified that the use of CSDs (or equivalent) will contain plume dispersion during dredging, as most of the finer sediments will be drawn into the suction head, leaving minimal suspended solids to cause a plume. Similarly, a submerged diffuser below a disposal barge will be used to input the dredged material in the existing dredged basin for storage. The barge and diffuser will be surrounded by a silt curtain to manage water quality impacts by limiting migration of fine sediments contained in the dredged material and fine sediments located on the batter which could be disturbed during the placement process. The silt curtain would extend into the water column to a depth that would prevent a visible plume at the water surface beyond the perimeter of the silt curtain.

Encountering PASS

The PPR identified that the first 190 m of dredged material off Lady Robinsons Beach would be stored on land, and identified the presence of PASS within this material. PASS can result in the generation of acid (leachate), which in turn can release metals, such as aluminium, iron, etc from the sediment. This then has the potential for adverse environmental and human health impacts.

The PPR anticipated that the timing and nature of the dredge operations would not expose PASS to air for sufficiently long to oxidise and produce ASS. However, the PPR noted that there is the potential for ASS to be generated if PASS is present.

Statement of Commitment 18, preparation of a Contaminated Soil and Acid Sulphate Soil Management as well as Condition 5.3 of the Concept Approval and Conditions 2.22 and 5.2a of the Project Approval were identified to manage PASS.