Point Busaco Revetment Technical Specifications



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Table of Contents

1. Prel	liminaries	1
1.1.	Description of the Works	1
1.2.	Australian Standards	1
1.3.	Drawings	2
1.4.	Survey and Datum	2
1.5.	As Constructed Drawings	2
1.6.	Site Access, Public Access and Traffic Management Plan	3
1.7.	Site Establishment	4
1.8.	Protection of Existing Utilities and Fixtures	5
1.9.	Environmental	6
1.10.	Safety	7
1.11.	Log Sheets	9
1.12.	Weekly Reports	9
1.13.	Construction Program	10
1.14.	Working Hours	10
1.15.	Quarrying	10
1.16.	Samples and Testing of Material	10
1.17.	Documentation	11
2. Mat	terials	12
2.1.	Rock	12
2.2.	Crest Fill	13
2.3.	Geofabric	14
2.4.	Geogrid	14
2.5.	Sand For Beach Fill (Provisional)	14
3. Con	struction of Rock Revetment	15
3.1.	Excavation	15
3.2.	Backfilling	16
3.3.	Reuse of Excavated Material in The Revetment	16
3.4.	Placement of Beach Fill	16
3.5.	Removal of Excavated Material	16
3.6.	Geofabric	17
3.7.	Core Rock (Class 3)	17
3.8.	Toe Rock (Class 1)	17
3.9.	Armour Rock (Class 2)	17
3.10.	Crest Fill	18
4. Con	struction of Short Groyne (Provisional)	19
4.1.	Excavation	19
4.2.	Geotarbic	19
4.3.	Geogrid	19
4.4.	Core Rock (Class 3)	20
4.5.	Armour Rock (Class 2)	20
5. Tole	erances and Quality Control	21
5.1.	l olerances	21
5.2.	Quality Control Documents	21
6. Reir	nstatement	22

Seashore Engineering

Appendix A	Bunbury Tides Predictions 2014	23
Appendix B	Site Photos	27
Appendix C	Drawings	29

1. Preliminaries

The purpose of this technical specification is to support the Contract to conduct foreshore stabilisation works along the eastern section of Koombana Beach, Bunbury. The Contract includes all operations, labour, plant, equipment, supervision, survey, documentation and materials required for the completion of the whole of the Works. The Contractor shall be regarded as having inspected the Site and assessed any issue for which it is to take liability and allow for such matters in its price.

1.1. DESCRIPTION OF THE WORKS

The Bunbury Port Authority is intending to construct a 230m revetment along the eastern section of Koombana Beach. The Works are outlined in Drawings DA 2296-2-1 and include;

- Supply of armour rock of minimum density 2.6 tonnes per cubic metre to Site. Rock types meeting specifications include basalt and granite.
- Supply of core rock of minimum density 2.2 tonnes per cubic metre to Site. Rock types meeting specifications include basalt, granite and lateritic ironstone;
- Construction of rock revetment, including batter slopes and placement of Geofabric, core and armour rock;
- Placement of cement stabilised and crushed limestone along the crest of the revetment;
- **Provisional** construction of a small groyne at the western extent of the revetment as outlined in Drawings DA 2296-2-2;
- **Provisional** supply and placement of beach fill to Site. Beach fill shall be sourced from sand located on the western side of the Outer Harbour breakwater and will be provided by the Principal at no cost.

1.2. AUSTRALIAN STANDARDS

The following Australian Standards listed are directly relevant to the Works and all Works shall be undertaken in accordance with them:

Standard	Title
AS 1269	Occupational Noise Management
AS 1319	Safety Signs for the Occupational Environment
AS 1742	Manual of Uniform Traffic Control Devices
AS 4000	General Conditions of Contact
AS2436	Guide to Noise Control on Construction, Maintenance and Demolition Sites.
AS 4970	Protection of Trees on Development Sites

Table 1: Relevant Standards

1.3. DRAWINGS

The following drawings are directly relevant to the Works and all works shall be undertaken in accordance with them. The drawings are provided in Appendix C:

Title	Drawing Number
POINT BUSACO REVETMENT: DETAILED DESIGN	DA 2296-2-1
PROVISIONAL GROYNE: DETAILED DESIGN	DA 2296-2-2

Table 2: Drawings

1.4. SURVEY AND DATUM

Unless stated otherwise on the Drawings, the horizontal datum for the Works shall be the based on Perth Coastal Grid (PCG 94).

Unless stated otherwise on the Drawings, the vertical datum for the Works shall be based on the Australian Height Datum (AHD), which is 3.869m below Tidal BM 2001 and 0.57m above Chart Datum (CD).

The Contractor is entirely responsible for setting out and undertaking the Works to the lines and levels shown in the drawings or as directed by the Superintendent. Setting out shall be carried out by a licensed surveyor. Surveys required to support Quality Control Documents are outlined in Section 5.2.

The Contractor shall check all dimensions on Site prior to commencement of Works and should notify the Superintendent if any discrepancy to design drawings or other Contract documentation is found. The Contractor shall be responsible, at their own expense, to correct any defect due to a discrepancy not brought to the notice of the Superintendent for clarification.

1.5. AS CONSTRUCTED DRAWINGS

The Drawing(s) shall be marked up by the Contractor to show the 'As Constructed' works, dated, signed and submitted in hard copy and digital format to the Superintendent following completion of work on that Drawing. A complete set of As Constructed Drawing(s) are required for Practical Completion.

Measurements shall be carried out by a licensed surveyor, with measurements since the previous revised As-Construction Drawings clouded. Any deviations shall be marked in red and all accepted lines, levels and dimensions underlined in red.

1.6. SITE ACCESS, PUBLIC ACCESS AND TRAFFIC MANAGEMENT PLAN

The Site is located at the eastern section of Koombana Beach in Bunbury, east of the Bunbury CBD. Access to the Site is via Koombana Drive and the eastern entrance to Anchorage Cove. Access via Anchorage Cove to the west of the Dolphin Discovery Centre will not occur without prior written approval from the Superintendent. Access within the Site may be either along the grassed access track landward of the scarp or the beach in front (Figure 1-1).

The carpark immediately west of the entrance to the grassed access track is available for the Contractor to use if required. The carpark shall not be used for material storage unless approved by the Superintendent.

The Contractor shall liaise with the Superintendent to ensure that the Works are carried out with minimal interference to others, including the highly popular Dolphin Discovery Centre located to the west of the Works.



Figure 1-1: Site Access

1.6.1. Public Access

The Contractor shall ensure members of the public are excluded from the Site, through installation of fencing and appropriate signage around the Site. This shall include fencing on the beach to the west of the revetment, to restrict access from the highly used beach in front of the Dolphin Discovery Centre. Signage shall be in accordance with AS1742.

1.6.2. Traffic Management Plan

All Works are to be undertaken in accordance with an approved Traffic Management Plan (TMP). The Contractor shall submit the TMP to the Superintendent for approval within 10 business days following Contract award.

The TMP shall address:

- The use of on-site personnel to direct the tipping of rock and for traffic and pedestrian management as required;
- Consideration of other vehicles, pedestrians, road widths and visibility;
- Minimising disruption to traffic on Koombana Drive and Anchorage Cove;
- Maintaining access to all carparks located along Anchorage Cove, except the carpark immediately west of the entrance to the access track which is available for the Contractors use as required;
- Enforcement of local road rules for construction traffic;
- The provision and maintenance of appropriate traffic signage;
- The timely and effective cleanup of any material dropped along the access route;
- The preparation of reports regarding damage to access roads (refer Section 1.8); and
- Designated areas for the parking of vehicles, plant and equipment.

The Contractor shall secure any required permits from Main Roads to allow trucks to deliver rock to the Site.

1.7. SITE ESTABLISHMENT

The Contractor shall establish all its working areas within the Site to the approval of the Superintendent. The Contractor shall submit the proposed set-out of the Site, including Site storage areas, temporary facilities and required fencing, to the Superintendent for approval within 10 business days following Contract award.

The Contractor shall provide all such offices, sheds and stores if necessary for the carrying out of the Contract. These may be sited in the carpark immediately west of the entrance to the grassed access track.

The working area shall be kept clean and tidy during the Contract period. The Contractor shall ensure that dangerous or potentially harmful substances shall be kept secure in accordance with statutory requirements and so as to prevent access by unauthorised persons.

1.7.1. Temporary Services

The Contractor is responsible for the cost of the installation of all facilities and services necessary for the execution of the Works. There are no toilet facilities on Site, with the nearest public toilet facilities located at the surfclub & kiosk building on the western foreshore of Koombana Beach.

The Principal will organise access to an onsite water source for dust suppression which the Contractor can collect as required.

1.7.2. Site Storage

The final storage areas shall be marked on Site by the Contractor, to be approved by the Superintendent prior to establishment. Materials and equipment storage areas are to be adequately fenced to prevent public access, with the loss or vandalism of any materials and/or equipment at the Contractor's expense. The carpark immediately west of the entrance to the grassed access track is not be used for materials storage unless approved by the Superintendent.

Material and equipment storage areas are to be located at sufficient distance from vegetation and infrastructure to prevent accidental damage, including a telecommunications tower located approximately 20m landward of the scarp at the western end of the revetment (Appendix B). The Contractor will be advised by the Superintendent of an appropriate minimum buffer distance to the telecommunications tower which is presently being investigated.

1.8. PROTECTION OF EXISTING UTILITIES AND FIXTURES

The Contractor shall be responsible for locating and protecting all existing service lines, pipes, cables and fixtures, whether or not such information is shown on any Drawings. The Principal has undertaken a Dial-before-you-dig search during the design process and these documents will be provided to the Contractor on request. The Contractor is required to make their own enquiries in this regard prior to commencement.

A exclusion zone may apply from a telecommunications tower located approximately 20m landward of the scarp at the western end of the revetment. The extent of any exclusion zone will be advised by the Superintendent.

All damage caused by the Contractor to services shall be the responsibility of the Contractor who shall arrange for the responsible Authority to make good any damage so caused. The Contractor shall meet the total cost of all such repairs wholly. In the event of damage to services the Authority concerned shall be immediately informed, as shall the Superintendent.

Prior to the Works commencing a road condition assessment of the access route along Anchorage Cove is to be carried out between the Superintendent and the Contractor. Existing defects, such as pavement deformations, rutting, potholes, damaged footpath and kerbing, are to be noted and photos taken. At the end of the cartage another assessment is to be carried out. Any additional road defects that may be attributable to the Works will need to be re-instated by the Contractor prior to final payment of the Contract. This will exclude normal wear and tear on the roads.

1.9. ENVIRONMENTAL

1.9.1. Noise

The Contractor shall arrange its operations and shall provide silencing equipment to its plant and/or surrounding area at its own expense to whatever extent is necessary to satisfy the statutory requirements of the Bunbury Port Authority, City of Bunbury and the Environmental Protection (Noise) Regulations 1997 in relation to the sound level arising from the Contractor's operations. The control of noise practices shall at all times be in accordance with Australian Standard 2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites".

1.9.2. Vibration

The Contractor shall arrange its operations to ensure that the Works do not cause excessive vibrations that may have an adverse impact on adjacent structures or operations.

1.9.3. Dust and Wind-Blown Material Control

The Contractor shall be responsible throughout the period of the Contract for the effective control of all dust and windborne material emanating from the Site as a result of the Works. The Contractor shall implement all dust controls which are necessary to control dust on the Site.

The Principal will organise access to an water source located within the Bunbury Port Authority Lease Area for dust suppression which the Contractor can collect as required. Water cart drivers will need to be inducted and follow the Bunbury Port Authority traffic management plan.

1.9.4. Protection of Vegetation

The Contractor shall minimise disturbance to the natural vegetation and shall keep to existing tracks as far as practicable. Tree branches located adjacent to the access track that impact on the Works may be pruned as directed by Superintendent and removed from Site.

Two trees are required to be removed, as they are located within the lines of the revetment at chainages of 105m and 145m, as shown in Drawing DA 2296-2-1 and Appendix B. The trees, including roots, shall be removed and carted from Site by the Contractor. The Stanley Road Waste Management Facility at Australind may be used by the Contractor in this regard.

1.9.5. Refuelling

Refuelling of construction plant will not be permitted on the beach. The Contractor shall ensure that any accidental spillage of fuel or lubricants is thoroughly cleaned up prior to recommencement of Works and that the necessary materials for clean-up are available on Site prior to commencement of Works.

1.9.6. Protection of the Beach Environment

Smaller rocks specified for the core of the revetment and groyne should not be stockpiled on the beach and the Contractor is required to handle any small rocks and gravel in a manner that minimises the potential for this material to move onto the beach and nearshore area during and following completion of the Works. The Contractor may be required during the Works to rake beach areas to the west of the Site, as directed by the Superintendent, if material from the works is identified on the adjacent beach.

1.10. SAFETY

The Contractor shall at all times comply with the Occupational Safety and Health Act 1984 and the Occupational Safety and Health Regulations 1996.

In accordance with OHS Reg 1996 part 3 div 12 the Works for this Contract are deemed to be "high-risk construction work" due to it being "construction work in, over or adjacent to water or other liquids if there is a risk of drowning". The Contractor shall submit a risk and an occupational health and safety management plan to the Superintendent within 10 business days following Contract award. Commencement of Works shall not occur until the Safety Management Plan is approved by the Superintendent.

The Contractor shall ensure that all workers on Site have current safety awareness training - a safety awareness training course accredited under section 27 of the Vocational Education and Training Act 1996; or a course accredited by the Commission under section 14(1)(h) of the OHS Act for the purposes of this Division.

The Contractor shall ensure that the hazard risk assessment required under OHS Reg 1996 part 3 div 12 has been carried out prior to commencing construction. The Contractor shall prepare a hazard risk assessment in the style of Table 1.3 based on the risk assessment matrix in Table 1.4.

The Contractor shall ensure that safe work method statements have been prepared by the day-to-day Site Supervisor and given to the main Contractor as per OHS Reg 1996 part 3 div 12 prior to commencing construction of each new stage of work.

The Contractors workers need to have a record of a current Bunbury Port OH&S induction which can be done online, relevant current operator tickets and a current WA construction blue or white cards. The Superintendent may undertake at least one safety audit of the Contractor during the Works.

Risk Identification	Likelihood	Consequence	Risk Rating (Uncontrolled)	Action	Risk Rating (Controlled)
Operator and	Moderate	High	1	Contractor to Work in accordance with 2005 Code of Practice for	2
machinery fall into				Excavation (WA Commission for OH&S).	
excavation.				Contractor to develop SWMS for excavation for Principals	
				approval.	
				Contractor to ensure all machinery operators suitably qualified,	
0				experienced and familiar with site and SWMSs.	-
Operator and	Unlikely	High	2 Contractor to work in accordance with 2005 Code of Practice for		2
machinery fail into				Excavation (WA commission for OH&S).	
water.				Contractor to develop a SWMS for construction of seawall toe,	
				including recovery of operator and machinery, for Principals	
				approval.	
				Contractor to ensure all machinery operators suitably qualified,	
				experienced and familiar with site and SWMSs.	
				The Principal is to supply tide predictions and as far as practicable	
I	77 1-1 1		2	schedule works for reasonable weather, seastate and tides.	2
Tipping rock	Unlikely	High	2	Principal to identify a flat, firm and secure area for tipping rock.	2
				Contractor to tip rock in the nominated secure area from a flat firm	
				surface with a spotter.	
				Driver to assess wind conditions, check spotter present and open	
				tailgate prior to tipping.	
				Contractor to use rock body trucks. Superintendent to inspect	
	77 1-1 1		2	truck trays for visible damage during the works.	2
Placement of Rock	Unlikely	High	2	SWMS for placement of rock.	2
Slipping on Rock	Moderate	Medium	2	No site personnel to walk on rock unless placed and secure.	2
	TT-11-1-	TT -L	2	All site personnel to take reasonable caution if Focks wet.	2
	Unlikely	High	2	No site personnel to be beneath or below rock.	2
Rock fall				Contractor to ensure all rock stockpiles stable during the works	
				and secure at the end of the day.	
Tuefferentident	TTulilaslas	TT:-l-	2	Limited stockpile of Fock on site.	2
affeite	Uninkely	nign	2	Contractor to work in accordance with approved frame	2
olisite				Principal to ansure traffic management suitably recoursed	
Tueffic accident	Madavata	Lligh	4	Contractor to work in accordance with approved.	2
angita	Moderate	mgn	*	Management Plan	2
onsite				Principal to ensure traffic management suitably resourced	
				Contractor to onsure all machinery operators suitably qualified	
				contractor to ensure an machinery operators suitably quanned,	
				Site to be suitably fenced and signed. Traffic controllers to monitor	
				fances and signage on beaches for damage and influence of tides	
				Contractor to ston moving machiners immediately if momber of	
				while anoite	
				Principal and Contractor to oncure appropriate PPE on-site	
				Contractor to induct all worker and accompany all site visitors	
Contact hetwoon	Unlikely	High	2	Spotters to be employed if working near nower lines	2
machinery and	onnikery	mgn	4	Contractor to undertake a Dial-before-you-dig search mice to	2
nachinery and				commonsoment of Works	
Exposure to	Unlikely	High	2	The Contractor shall cases Works and notify the Superintendent	2
Ashestos	Junkery	mgn	4	Contaminated material should under no circumstances be disposed	É
113065105				to landfill	

Table 3: Risk Assessment – Point Busaco Revetment

Table 4: Risk Assessment Matrix

Level	Description of Consequence					
High (1) (High level of harm)	Potential death, p site environmenta environmental ha	Potential death, permanent disability or major structural failure/damage. Off- site environmental discharge/release not contained and significant long-term environmental harm.				
Medium (2) (Medium level of harm)	Potential tempora On-site environm required, short-te	Potential temporary disability or minor structural failure/damage. On-site environmental discharge/release contained, minor remediation required, short-term environmental harm.				
Low (3) (Low level of harm)	Incident that has On-site environm clean up with no	the potential to cause perso ental discharge/release imr short-term environmental ha	ons to require first aid. nediately contained, minor level arm.			
Step 2: Using the followin result in the consequence	g table, the organisa identified above.	tion determines how likely it	is that the risk will occur and			
Level	Likelihood / Prob	Likelihood / Probability				
Likely	Could happen fre	Could happen frequently				
Moderate	Could happen oc	Could happen occasionally				
Unlikely	May occur only in	May occur only in exceptional circumstances.				
Step 3: Using the risk ma	rix below, the organi	sation identifies the risk clas	ss/ranking.			
0	Likelihood / Probability					
Consequence	Likely	Moderate	Unlikely			
High (1)	1	1	2			
Medium (2)	1	2	3			
Low (3)	2	3	3			
Class/Ranking	Description / Rec	uirements				
1	Will require detai Actions will be re	Will require detailed pre-planning. Actions will be recorded on a Safe Work Method Statement				
2	Will require operational planning. Actions will be recorded on a Safe Work Method Statement					
	Will require localised control measures					

1.11. LOG SHEETS

The Contractor shall submit daily log sheets to the Superintendent on the following working day outlining Works completed, truck movements, hours of use for plant on Site, tonnage of all classes of rock and crest fill delivered to Site, tonnage of excavated material removed and all safety issues and, environmental issues, complaints and corrective actions. The log sheet template shall be submitted to the Superintendent for approval prior to commencement of Works.

1.12. WEEKLY REPORTS

The Contractor shall submit a weekly report to the Superintendent by the Tuesday of each week outlining Works completed (chainage, tonnage), tonnage of all classes of rock for the week delivered to Site, placed in seawall, available on Site and available at the quarry, quality control records (including survey), an updated construction program, rock density tests and a summary of all safety issues, environmental issues, complaints and corrective actions.

1.13. CONSTRUCTION PROGRAM

The Contractor shall submit a detailed Construction Program and Methodology to the Superintendent prior to commencing the Works. Revisions to the Construction Program are required weekly and shall not defer the date for Practical Completion except where extensions of time have been approved by the Superintendent.

1.14. WORKING HOURS

Working days are Monday to Saturday, excluding public holidays, unless otherwise approved by the Superintendent. Work shall commence no earlier than 7:00am and cease no later than 6:00 pm on any day, unless otherwise approved by the Superintendent.

1.15. QUARRYING

The Contractor shall arrange for the opening up and operation of all quarries required for completion of the Works. These arrangements shall include payment of royalties and obtaining approvals or permits if required and any other charges associated with opening up, testing, excavating, operating and winning from the quarries. The Contractor shall be responsible for any construction, upgrading and maintenance of access roads required between the quarries and public roads. All such costs shall be deemed included in the rates and sums tendered in the Price Schedule.

The Contractor shall construct, upgrade and maintain as required all access roads required for the duration of the Contract between the quarries and public roads.

1.16. SAMPLES AND TESTING OF MATERIAL

Where testing of materials is called for within this Specification the Contractor shall have the tests carried on representative samples of the material at a laboratory and using a technique approved by the Superintendent. All materials shall subsequently be of similar quality or grading to the sample tested, otherwise it may be rejected.

The Contractor will be required to conduct three rock density tests (SSDD) for all material sources and rock types prior to commencement and the results shall be provided to the Superintendent.

During the Works, the Contractor is required to conduct a rock density test for each rock type on a weekly basis, with samples to be selected by the Superintendent. The results of the tests shall be provided in the weekly reports.

1.17. DOCUMENTATION

The documents required by the Principal from the Contractor is summarised in approximate chronological order in the Table below:

Document	Completed By	Section
Traffic management plan.	Within 10 business days	1.6.1
	following Contract award.	
Proposed set-out of the Site, including Site storage	Within 10 business days	1.7
areas, temporary facilities and required fencing.	following Contract award.	
Site specific occupational health and safety	Within 10 business days	1.10
management plan (including hazard risk	following Contract award.	
assessments and safe work method statements);	Note: safe work methods	
	required prior to	
	commencing construction of	
	each new stage of work	
Road inspection	Prior to the Works	1.8
	commencing	
Proposed log sheets templates	Prior to the Works	1.11
	commencing	
Detailed construction program and methodology	Prior to the Works	1.13
	commencing (and weekly	
	revisions in weekly reports)	
Rock density tests	Prior to the Works	1.16
	commencing and then weekly	
	for duration of Works (to be	
	provided in weekly reports)	
Daily log sheets	Following day	1.11
Weekly reports	Tuesday following week	1.12
As-constructed survey	During and at the Completion	1.5
	of Works	

Table 5: Required Documentation

2. Materials

Estimated quantities for all rock required for the construction of the revetment and groyne are shown in Drawing 2296-2-1 and Drawing DA 2296-2-2 respectively. The estimated quantities are based on density armour rock of 2.6 and 3.0 tonnes per cubic metre and core rock of density 2.3, 2.6 or 3.0 tonnes per cubic metre.

2.1. ROCK

There are three rock classes required for the Works. Rock shall be sorted into classes as defined below, with each class being delivered in wholly separate truckloads or sorted from existing material on Site. Rocks shall be free of rubbish, adherent soil or organic matter. Each load shall be tipped where directed by the Superintendent and delivery shall be accepted after the rocks can be seen to be unbroken after having being tipped from the truck.

All rock shall consist of individual, hard, angular, clean quarried material and be free from any significant evidence of weathering, mechanical weakness and chemical decomposition. Acceptable rock shape for new armour rock should generally be determined unambiguously by visual observation. Armour should be blocky to irregular and angular, with the ratio of greatest to least dimension of 90% of individual rocks not exceeding 3.0:1.0. Blocks judged to have poor shape may be broken down to a lower class of armour at the discretion of the Superintendent.

The Superintendent will inspect the rock stockpiles at the quarry Site prior to the commencement of carting material to Site, to ensure it meets the required specification.

Individual rocks shall be sufficiently strong to maintain their integrity from the quarry to the Site and whilst being placed by tipping from a conventional tip truck and handled by an excavator.

2.1.1. Toe Rock (Class 1)

Toe rock for the revetment is required to have a minimum density of 2.6 tonnes per cubic metre. Rock types meeting specifications include **basalt** and **granite**. Toe rock shall comprise of only individual rocks of mass between 0.85 tonnes and 1.5 tonnes with at least 50% of the mass of any delivered truckload being of rocks greater than 1.25 tonnes.

2.1.2. Armour Rock (Class 2)

Armour rock for the revetment and short groyne is required to have a minimum density of 2.6 tonnes per cubic metre. Rock types meeting specifications include **basalt** and **granite**. Armour rock shall comprise of only individual rocks of mass between 0.4 and 1.2 tonnes with at least 50% of the mass of any delivered truckload being of rocks greater than 0.85 tonnes.

2.1.3. Core Rock (Class 3)

Core rock for the revetment is required to have a minimum density of 2.2 tonnes per cubic metre. Rock types meeting specifications include **lateritic ironstone**, **basalt** and **granite**.

Core rock for the revetment and short groyne shall comprise only individual rocks of between 0.15m and 0.50m diameter with at least 50% of the mass of any delivered truckload being of rocks greater than 0.30m diameter. Core rock may be passed through a grizzly or slotted bucket to remove fine material. Contamination of core rock with finer material from the quarry floor during the loading of trucks shall be minimised as far as practicable.

2.1.4. Samples

Prior to delivery commencing from the quarry, the Contractor shall provide sample rocks for armour rock and toe rock, being the lower, median and upper range for the class, at both the quarry and the Site. Each rock shall be weighed and measured by the Contractor to give mass to an accuracy of 5kg, and the individual rocks marked and displayed on Site. Rock delivered to Site that appears to differ materially from the samples shall be rejected.

The Contractor should have the capacity to weigh selected rocks using onsite machinery, to check compliance with Specification at the Superintendent's direction.

2.1.5. Measurement and Classification of Rock

Trucks shall be tare weighed empty at the commencement of the Works and as directed by the Superintendent during the Works, with the tare docket being given to the Superintendent. The Contractor shall seek approval from the Superintendent for any replacement or addition of trucks during the Works.

Loads shall be individually weighed on a registered and certified weighbridge. The truck and trailer registration, total weights and time of weighing and class shall be recorded on a multiple copy weighbridge docket and a copy given to the Superintendent. Each docket set shall on arrival to the delivery site be given to the Superintendent who shall classify each truckload and mark the classification on and sign each docket set. Classification shall not be confirmed until the rock has been tipped from the truck at the delivery site. Rock that does not conform to the specified class shall be rejected and removed from the Site at the Contractors expense.

2.2. CREST FILL

The placement of cement stabilised crushed limestone and crushed limestone, or equivalent, is required on the surface landward of the crest of the revetment. The material shall not be rigid (i.e. not shotcrete). The Contractor shall specify the material to be used to the Superintendent for approval.

2.3. GEOFABRIC

The geofabric required for the revetment and groyne is ELCOMAX 1200R available from Geofabrics Australia. If the Contractor decides to use a geofabric equivalent to ELCOMAX 1200R, its specification will need to be verified by the supplier and samples provided to the Superintendent for inspection at least six working days prior to proposed installation. Geofabric with unsuitable specification or inadequate quality may be rejected by the Superintendent.

Following delivery to Site and prior to installation, geofabric rolls shall be stored on Site under a protective cover and supported off the ground. The Contractor shall take appropriate measures to protect the geofabric from damage. This includes adhering to any other recommendations on method of storage set by the supplier/manufacturer.

2.4. GEOGRID

Triaxial geogrid with a maximum rib width of 100mm is required for the groyne. The type of geogrid shall be specified by the Contractor to suit their construction methodology. The geogrid shall be stored according to methods of storage set by the supplier/manufacturer.

2.5. SAND FOR BEACH FILL (PROVISIONAL)

Should insufficient quantities of sand for beach fill be available from within the Site the Superintendent may direct the Contractor to import sand. The sand shall be sourced from a sand trap located western side of the Outer Harbour breakwater (Figure 2-1) and will be provided by the Principal at no cost to the Contractor. The volume of sand delivered to Site should be measured by methods approved by the Superintendent.



Figure 2-1: Beach Fill Source

3. Construction of Rock Revetment

3.1. EXCAVATION

3.1.1. General

The Contractor shall undertake all excavations in accordance with the 2005 Code of Practice for Excavation (WA Commission for Occupational Health and Safety) to the lines, levels and dimensions shown on the Drawings DA 2296-1-2. For transitional areas such as the western end of the revetment, the Contractor shall be directed by the Superintendent. Setting out shall be carried out by a licensed surveyor.

Prior to commencement, the Contractor shall undertake all necessary enquiries as to the location of services in the area of excavation as outlined in Section 1.8. The Principal has undertaken a Dial-before-you-dig search during the design process and these documents will be provided to the Contractor on request. Should any further services be identified during the Works, the Superintendent shall be notified.

Excavation depths may require the Contractor to schedule the construction program around tides and weather. Dewatering may be required. Tide predictions at Bunbury for 2014 are provided in Appendix A.

The material located along the beach and erosion scarp is largely anticipated to consist of dredge spoil including sand, silt and rock fragments. Should any contaminated material such as asbestos be encountered during excavation, work is required to cease and the Superintendent notified.

The Contractor shall verify by survey that the top and toe levels of the batter are as shown on the Drawing prior to placement of the geofabric using a method approved by the Superintendent. The results shall be provided to the Superintendent for review.

3.1.2. Trees

Two trees are required to be removed, as they are located within the lines of the revetment at chainages of 105m and 145m as shown in Drawing DA 2296-2-1 and site photographs (Appendix B). The trees, including roots, shall be removed and carted from Site by the Contractor. The Stanley Road Waste Management Facility in Australind may be used in this regard. The timing for the removal of the trees should be identified in the Construction Program.

3.1.3. Heritage

European heritage items associated with the maritime history of the area may be uncovered. The Contractor shall stop work in the vicinity of any identified objects and notify Superintendent immediately . The Contractor shall comply with all directions from the Superintendent in this regard.

3.2. BACKFILLING

Based on a recent survey, approximately 600m³ of backfill is required for construction of the revetment. The majority of the required backfill is located where the erosion scarp has encroached on the access track between chainages 60m and 140m shown in Drawing SA 2296-1-2. Backfill required for this section will be obtained from suitable material excavated from adjacent areas, requiring stockpiling.

Excavated material used for backfilling shall be free of roots and organic matter or other perishable material to the satisfaction of the Superintendent.

Backfill shall be compacted to similar density as that of the surrounding undisturbed soil or to the satisfaction of the Superintendent using the plant available onsite.

3.3. REUSE OF EXCAVATED MATERIAL IN THE REVETMENT

The Superintendent may direct the placement of excavated material according to its value as fill or reuse as core in the revetment. Reuse is anticipated to provide only a small fraction of the required core rock.

3.4. PLACEMENT OF BEACH FILL

Excavated material considered suitable for use as beach fill by the Superintendent shall be stockpiled in front of the revetment. Material shall generally be free of rubbish, roots and organic matter or other perishable material to the satisfaction of the Superintendent.

If required, on direction of the Superintendent additional sand shall be sourced by the Contractor from the beach on the western side of the Outer Harbour breakwater, refer to Section 2.5.

The Contractor shall place any beach fill in front of the revetment to the approval of the Superintendent which will be determined onsite in consultation with the Contractor and Superintendent. Where the placement of beach fill is subject to the rapid reworking by the ocean a larger tolerance for placement may be permitted.

3.5. REMOVAL OF EXCAVATED MATERIAL

Any excavated material considered unsuitable by the Superintendent for use as core for the revetment, backfill or placement along the beach in front shall be removed to a nominated disposal site by the Contractor. The Stanley Road Waste Management Facility in Australind may be used in this regard.

Payment for disposal of excavated material will be made on the basis of measured mass as determined by data on tare dockets and dayworks, which have been endorsed by the Superintendent. The Contractor shall submit one copy of all dockets included in a payment claim with each claim.

3.6. **GEOFABRIC**

Geofabric shall be placed as shown in the Drawing DA 2296-2-1. The Contractor shall verify by survey the top and toe levels of the batter prior to placement of the geofabric. The Contractor shall ensure there is sufficient length of geofabric at the toe and crest to allow for the required wrapping of fabric and deformation during placement of filter rock. The geofabric shall be pulled tight and laid on a firm surface prior to the placement of filter rock. The geofabric is required to be pre-stitched or have a minimum of 1.0m overlap between sheets.

3.7. CORE ROCK (CLASS 3)

Core rock shall be placed on geofabric according to the lines, levels and dimensions shown in the Drawing DA 2296-2-1. At the end of each day, all exposed core rock should generally be armoured with at least one layer of armour rock.

The Contractor should be aware the core rock is very abrasive and can tear the geofabric if not placed with care. A thin layer of sand may be placed on the geofabric prior to placement of core rock to reduce the risk of damage. Any damage to the fabric during placement will require replacement or additional fabric to be overlaid. The Contractor shall immediately notify the Superintendent if the geofabric is damaged.

The Contractor is required to handle small rocks and gravel so as to minimise the potential for this material to move onto the beach and nearshore area during and following completion of the Works.

3.8. TOE ROCK (CLASS 1)

Toe rock shall be placed into position according to the lines, levels and dimensions shown in the Drawing DA 2296-2-1. Each toe rock shall be individually placed in such a manner that the each rock firmly rests upon the layer below and is in contact with adjacent armour, toe or core rock such that it is securely held in place.

Toe rocks shall be surveyed for tolerance by the Contractor using a method approved by the Superintendent and the results provided to the Superintendent for review. The approved method should consists of profiles (maximum 20m spacing) conducted by a licensed surveyor.

3.9. ARMOUR ROCK (CLASS 2)

Armour rock shall be placed progressively beside and on top of core and toe rocks to the lines, levels and dimensions shown in the Drawing DA 2296-2-1.

Each armour rock shall be individually placed in such a manner that the rock armour firmly rests upon and does not displace the layers below and has a minimum 'three-point support' such that it is securely held in place by neighbouring rocks. Placement shall commence at the toe and proceed upwards towards the crest.

The Contractor shall exercise care when placing the rock armour to ensure that the rock armour of minimum mass within any class is not congregated together in one area. As far as possible, the placement of rock armour with respect to location and rotational orientation is to be random.

The surface of the armoured slope shall present an angular uneven face. Smaller pieces of rock shall not be used to fill interstices, or to prop larger rocks in order to achieve the required profile.

Armour rock broken during handling or placing shall be removed from the Works immediately at the Contractor's expense. Depending on the mass, shape and integrity of the broken pieces of rock the Contractor may be permitted to be used as core rock subject to the approval of the Superintendent.

Armour rock shall be surveyed for tolerance by the Contractor using a method approved by the Superintendent and the results provided to the Superintendent for review. The approved method should consists of profiles (maximum 20m spacing) conducted by a licensed surveyor.

3.10. CREST FILL

Cement stabilised crushed limestone and crushed limestone, or equivalent shall be placed to the lines, levels and dimensions shown in the Drawing DA 2296-2-1 or as directed by the Superintendent and to the satisfaction of the Superintendent.

4. Construction of Short Groyne (Provisional)

The construction of the short groyne is provisional. The width of the groyne as shown in Drawing DA-2296-2-2 may be varied to facilitate the ease of construction. The width appropriate for nominated plant shall be identified by the Contractor and approved in writing by the Superintendent prior to construction.

4.1. EXCAVATION

The Contractor shall undertake all excavations in accordance with the 2005 Code of Practice for Excavation (WA Commission for Occupational Health and Safety) to the lines, levels and dimensions shown in the Drawing DA 2296-2-2 unless otherwise approved by the Superintendent.

Setting out shall be carried out by a licensed surveyor. The level of excavation shall be verified by survey by the Contractor prior to the placement of Geofabric using a method approved by the Superintendent. The results shall be provided to the Superintendent for review.

Excavation depths may require the Contractor to schedule the construction program around tides and weather. Dewatering may be required. Tide predictions at Bunbury for 2014 are provided in Appendix A.

Excavated material considered suitable for distribution along the beach shall be placed to the east of the groyne. Excavated material considered unsuitable for placement along the adjacent beach in front shall be removed to a nominated disposal site. The Stanley Road Waste Management Facility in Australind may be used in this regard.

Should any contaminated material such as asbestos be encountered during excavation, work is required to cease and the Superintendent notified. Contaminated material should under no circumstances be disposed to landfill.

4.2. GEOFARBIC

Geofabric shall be placed on the excavated surface as shown in the Drawing DA 2296-2-2. The Contractor shall ensure there is sufficient length of geofabric to allow for 1.0m wrapping of fabric along the edges of the groyne and for deformation during placement of rock. The geofabric is required to be pre-stitched or have a minimum of 1.0m overlap between sheets.

4.3. GEOGRID

Triaxial geogrid will be placed on the geofabric as shown in the Drawing DA-2296-2-2A. The overlap required between sheets of geogrid is 0.5m.

4.4. CORE ROCK (CLASS 3)

Core rock shall be placed according to the approved lines, levels and dimensions using methods approved by the Superintendent. The finished core shall be dense with a low void ratio and an even distribution of rock sizes without concentrations of larger or smaller rock sizes. The standard of rock placement below water shall not be inferior to that above water. The Superintendent may direct that such material be replaced if deemed non-conforming.

Core material shall be surveyed for tolerance by the Contractor using a method approved by the Superintendent and the results provided to the Superintendent for review.

4.5. ARMOUR ROCK (CLASS 2)

Armour rock shall be placed progressively beside and on top of core to the approved lines, levels and dimensions using methods approved by the Superintendent. Each armour rock shall be individually placed in such a manner that the rock armour firmly rests upon and does not displace the layers below and has a minimum 'three-point support' such that it is securely held in place by neighbouring rocks. Placement shall commence at the toe and proceed upwards towards the crest.

The Contractor shall exercise care when placing the rock armour to ensure that the rock armour of minimum mass within any class is not congregated together in one area. As far as possible, the placement of rock armour with respect to location and rotational orientation is to be random.

The surface of the armoured slope shall present an angular uneven face. Smaller pieces of rock shall not be used to fill interstices, or to prop larger rocks in order to achieve the required profile.

Armour rock broken during handling or placing shall be removed from the Works immediately at the Contractor's expense. Depending on the mass, shape and integrity of the broken pieces of rock the Contractor may be permitted to be used as core rock subject to the approval of the Superintendent.

Amour rock shall be surveyed for tolerance by the Contractor using a method approved by the Superintendent and the results provided to the Superintendent for review. The approved method should consists of profiles (maximum 5m spacing) conducted by a licensed surveyor.

5. Tolerances and Quality Control

5.1. TOLERANCES

All armour rock shall be placed to the tolerances discussed herein and to the layers, dimensions, lines, levels and slopes as shown in the Drawings DA 2296-2-1 and DA 2296-2-2. These tolerances are not cumulative.

Description	Tolerance
Crest Level	-0, +0.2m
Rock Layer Thickness	-0, +0.2m
Rock Line	±0.1m
Rock Levels	±0.2m

Table 6: Tolerances

5.2. QUALITY CONTROL DOCUMENTS

To verify compliance with this specification, the following Quality Control Documents are required. The Contractor shall submit the required completed documents to the Superintendent at frequencies outlined below. Failure to meet the Specification shall be noted together with the Contractor's planned corrective action for the Superintendent's review and approval.

Item	Description	Record	Completed By	Frequency	
General					
1.	Rock Density Tests	Analysis	Contractor	Prior to commencement	
				of Works and then weekly	
				during the Works	
Revetn	nent				
2.	Batter	Survey	Contractor	To be approved	
3.	Geofabric	Inspection	Superintendent	20m intervals	
4.	Core Rock Lines, Levels &	Inspection	Superintendent	20m intervals	
	Grade				
5.	Armour Placement	Inspection	Superintendent	20m intervals	
	Condition				
6.	Armour and Toe Rock	Survey	¹ Contractor	¹ To be approved	
	Top Layer Survey		² Licensed Surveyor	² max. 20m intervals	
Groyne					
7.	Core Rock Top Layer	Survey	Contractor	To be approved	
	Survey				
7.	Armour Rock Top Layer	Survey	Licensed Surveyor	max. 5m intervals	
	Survey				
8.	Armour Placement	Inspection	Superintendent	5m intervals	
	Condition				

Table 7: Quality Control Documents

6. Reinstatement

Following completion of the Works, the Contractor shall remove all temporary services and facilities and leave the Site clean and tidy to the satisfaction of the Superintendent. The Contractor shall remove all rubbish and other foreign material, including rocks attributable to the Works, from the Site and ensure of its appropriate disposal.

The Contractor shall reinstate or make good any damage to the infrastructure and amenities in and surrounding the work area to the Superintendent's satisfaction. Any damage to adjacent dunes shall be repaired by the Contractor at the completion of the Works.

The Contractor shall arrange a final inspection of the Site with the Superintendent following completion of reinstatement works. The Contractor shall have the capacity to rectify any observed damage or further reinstatement required to the satisfaction of the Superintendent.

Appendix A Bunbury Tides Predictions 2014

Note: Tide predictions are to Chart Datum, which is RL -0.57mAHD

AUSTRALIA, WEST COAST - BUNBURY

LAT 33° 19' LONG 115° 39'

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

JANUARY - 2014 FEBRUARY - 2014 **MARCH - 2014 APRIL - 2014** Time m **16**⁰⁴²⁴0.36 **16** ⁰⁶⁰⁵ ^{0.26} ₁₂₄₁ _{0.56} **16** ⁰³¹⁹ ^{0.45} ₁₀₂₀ ^{0.75} **1** 0012 0.68 0257 0.55 **16** 0305 0.59 0.99 0531 0.11 1156 0.53 0629 0.23 0514 0.32 1 1 1 1239 0.62 1124 0.70 TU 1150 0.89 * 1907 0.49 WE 1311 0.52 TH 1432 0.53 SA 1502 0.51 * 2116 0.77 SU 1558 0.52 SA 1653 0.56 SU 1519 0.54 WE 1855 0.51 2106 0.89 2026 0.96 2217 078 2313 0.79 2134 078 **17** 0634 0.29 1320 0.56 FR 1517 0.52 **17** 0445 0.36 1126 0.69 MO 1637 0.52 **17** 0338 0.46 1026 0.79 MO 1556 0.52 **2** 0615 0.11 1231 0.54 TH 1410 0.50 2057 0.92 **2** 0708 0.31 1322 0.66 SU 1550 0.52 * 2151 0.69 $\begin{array}{c} 2 \\ 0.112 \\ 0.326 \\ 0.53 \\ \text{WE} \\ 1017 \\ 2016 \\ 0.49 \end{array}$ **2** ⁰⁵⁵¹ ^{0.39} ₁₂₀₂ ^{0.74} 17 0059 0.66 0.59 TH 1018 1.02 SU 1514 0.53 2147 0.86 2254 0.72 2211 0.74 1956 0.48 **18** 0508 0.38 1149 0.73 **3** 0658 0.14 1315 0.55 **18** 0503 0.30 2228 0.81 **3** 0015 0.71 0625 0.47 **18** 0358 0.47 1045 0.83 **3** 1053 0.95 2127 0.49 **18** 1046 1.04 2049 0.45 ${\color{red}{3}}^{0445}_{1407} {\color{red}{}^{0.41}_{0.69}}$ MO 1242 0.77 MO 1639 0.55 TU 1632 0.51 тң 2255 0.51 FR 1500 0.50 * 2133 0.85 TU 1715 0.53 F₽ SA 2327 0.66 2245 0.68 **4** 0509 0.39 1454 0.71 TU 1730 0.59 * 1920 0.63 **19** 0418 0.48 1105 0.87 WE 1708 0.52 2315 0.62 **19** 0300 0.63 0425 0.60 SA 1120 1.04 * 2142 0.44 **4**⁰⁷⁴¹0.21 1400 0.58 **19** 0526 0.31 1439 0.58 **19** 0528 0.39 1213 0.76 **4**⁰¹¹⁵0.62 0403 0.45 **4** 0054 0.47 0320 0.54 FR 0427 0.53 TU 1322 0.78 SA 1549 0.51 * 2212 0.77 WE 1756 0.55 SU 1639 0.55 2306 0.76 2011 0.60 1132 0.95 **20** 0440 0.49 1128 0.90 TH 2126 0.50 * 2342 0.55 **20** 0550 0.32 1229 0.61 MO 1720 0.57 **20** 0545 0.41 1236 0.79 TH 1840 0.57 * 2009 0.59 **5** 0145 0.45 1213 0.94 SA 1903 0.60 * 2012 0.61 **5** 0822 0.30 1447 0.61 SU 1638 0.55 * 2247 0.67 **5** 0145 0.43 0320 0.46 WE 0536 0.38 $5 \begin{smallmatrix} 0023 & 0.49 \\ 0215 & 0.53 \end{smallmatrix}$ 20 0358 0.62 0.61 WE 0432 0.44 * 1120 0.80 SU 1156 1.02 * 2233 0.44 2247 0.67 2341 0.70 1544 0.74 2342 0.56 21 0300 0.46 0403 0.47 **6** 0121 0.42 0319 0.47 **6** 0900 0.39 1535 0.65 21 0612 0.34 1259 0.65 **6** 0237 0.36 0426 0.40 21 0503 0.50 1155 0.92 **6** 0228 0.45 1254 0.91 21 1232 0.98 2325 0.46 MO 1729 0.60 FR 0605 0.42 * 1303 0.00 TU 1803 0.59 * 2047 0.00 TH 0502 0.43 FR 2217 0.46 TH 0603 0.37 * 1635 0.77 SU 2359 0.50 MO 1159 0.84 **22** ⁰⁰⁵⁴ ^{0.48} _{0.46} **7** 0609 0.38 1623 0.70 22 0628 0.36 1327 0.68 **7** 0325 0.31 0546 0.37 **22** 0308 0.41 0511 0.45 **7** 0212 0.37 1240 0.85 22 1226 0.93 2308 0.43 7 0110 0.51 0305 0.47 WE 1857 0.61 * 2041 0.63 SA 0624 0.44 * 1337 0.84 FR 1918 0.62 TU 1830 0.64 MO 1336 0.88 TU 1308 0.92 FR 0621 0.37 SΔ 1726 0.79 * 2006 0.67 2017 0.62 **8** 0256 0.40 0428 0.42 23 0642 0.38 1354 0.72 **8** 0408 0.29 1500 0.79 23 0326 0.35 1727 0.85 **8** 0258 0.35 1325 0.84 23 0038 0.45 0.42 **8** 0041 0.50 1100 0.81 23 0228 0.48 1345 0.85 SA 1544 0.77 TH 1508 0.71 SA 1616 0.78 1813 0.81 SU 1301 0.92 TU 1218 0.80 1423 0.84 WE 1532 0.82 1724 0.86 WE 0631 0.37 SU 1648 0.78 1710 0.75 1641 0.73 24 0700 0.39 **9** 0447 0.29 1855 0.83 **9** 0345 0.33 0547 0.37 24 0346 0.30 1813 0.90 **9** 0339 0.35 1414 0.82 24 0245 0.39 1340 0.89 **9** 0120 0.51 1121 0.79 24 0106 0.51 0.80 WE 1301 0.77 TH 0648 0.37 MO 1536 0.85 TH 1231 0.75 FR SU MO SU € 1657 0.86 1754 0.80 1823 0.83 O **10** 0414 0.37 1513 0.80 MO 1654 0.78 * 1827 0.80 **10** ⁰⁴³⁰ ^{0.29} ₁₈₃₅ ^{0.84} **10** 0517 0.31 1925 0.84 **25** ⁰³⁰⁸ ^{0.37} ₁₇₄₈ ^{0.88} **10** 0151 0.52 1054 0.76 TH 1336 0.73 **25** 0142 0.55 0910 0.82 25 0404 0.37 1756 0.85 25 0408 0.27 1900 0.93 FR 1412 0.69 1941 0.80 FR SA MO τu τu 1900 0.80 **11** 0511 0.27 1912 0.86 **26** ⁰³²⁷ ^{0.37} ₁₀₅₈ ^{0.73} 26 0420 0.31 1835 0.91 **11** 0353 0.32 1927 0.86 **11** 0433 0.40 1903 0.81 **11** 0208 0.53 0919 0.78 26 0213 0.59 0.88 **26** ⁰⁴¹⁷ ^{0.26} ₁₉₅₃ ^{0.94} SA 1532 0.62 2118 0.77 WE 1221 0.72 FR 1403 0.69 SA SU τu WF τu 1842 0.89 1942 0.81 **12** 0544 0.28 1931 0.87 27 0438 0.25 1917 0.95 27 0406 0.26 1129 0.62 **12** 0255 0.41 1926 0.83 27 0300 0.39 1047 0.71 **27** 0234 0.63 0914 0.94 12 0423 0.31 1119 0.59 12 0211 0.55 0910 0.82 WE 1219 0.58 TH 1352 0.60 TH 1323 0.67 SA 1431 0.64 SU 1622 0.56 WF SU MO 1945 0.87 2054 0.92 1942 0.87 2026 0.80 2222 075 **13** 0456 0.32 1131 0.60 TH 1347 0.56 **13** 0427 0.28 1912 0.89 28 0445 0.20 2002 0.98 **28** 0436 0.28 1053 0.65 **13** 0327 0.41 1032 0.67 TH 1327 0.64 28 0315 0.41 0953 0.73 **13** 0217 0.56 0913 0.86 **28** 0132 0.65 0949 0.98 FR 1443 0.62 SU 1504 0.60 FR 1404 0.57 2204 0.86 MO 1712 0.51 MO ΤU 2057 0.84 2110 0.78 2021 0.87 1948 0.84 2317 0.72 **29** 0349 0.45 1007 0.79 SA 1604 0.56 2210 0.80 **14** 0230 0.57 0925 0.91 MO 1542 0.56 2155 0.75 **14** 0455 0.26 1159 0.54 **29** ⁰⁴³⁷ ^{0.16} ₂₀₅₃ ^{0.97} **14** 0523 0.34 1159 0.61 **14** ⁰³⁴³ ^{0.43} ₁₀₄₃ ^{0.69} **29**⁰¹⁴⁷₁₀₁₃^{0.64}_{1.01} TU 1803 0.49 TU 1201 0.54 1945 0.90 FR 1436 0.54 2100 0.86 FR 1405 0.60 WF 2021 0.83 **15** ⁰⁴¹² ^{0.36} ₁₂₂₃ ^{0.62} **15** ⁰³¹⁵ ^{0.44} ₁₀₄₉ ^{0.71} **15** 0246 0.58 0940 0.96 TU 1625 0.54 **30** 0013 0.68 0217 0.63 $15 \begin{smallmatrix} 0530 & 0.25 \\ 2025 & 0.90 \end{smallmatrix}$ **30** 0510 0.15 1130 0.56 **30** 0424 0.51 1042 0.84 TH 1309 0.54 SA 1443 0.57 SU 1706 0.52 WE 0914 1.03 SA 1518 0.52 WF 2200 0.92 2139 0.82 2058 0.82 2313 0.74 2249 0.70 1859 0.49 **31** 0548 0.18 1200 0.59 FR 1411 0.52 **31** ⁰²⁴⁰ ^{0.56} ₁₁₁₈ ^{0.88} MO 1805 0.50 2046 0.85 © Copyright Commonwealth of Australia 2013 **Bureau of Meteorology National Tidal Centre** Height datum is Lowest Astronomical Tide * Extra Tides First Quarter ○ Full Moon C Last Quarter Moon Symbols New Moon

TIME ZONE -0800

AUSTRALIA, WEST COAST - BUNBURY

LAT 33° 19' LONG 115° 39'

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

MAY – 2014	1	JUNE	- 2014	JULY	- 2014	AUGUS	T – 2014
Time m T 1 0111 0.65 0251 0.62 TH 0948 1.05 1956 0.49 1 00 FR 0 1	ime m 053 0.71 244 0.67 940 1.14 930 0.42	Time m 1 1048 1.07 2101 0.55 SU 2356 0.64	Time m 16 1027 1.08 2039 0.45 MO	Time m 1 0309 0.71 0424 0.70 TU 1115 1.00 * 1812 0.54	$\begin{array}{ccc} \text{Time} & \text{m} \\ \textbf{16} & {}^{0217} & {}^{0.74} \\ {}^{0422} & {}^{0.65} \\ \text{WE} & {}^{1043} & {}^{0.88} \\ {}^{*} & {}^{2050} & {}^{0.54} \end{array}$	Time m 1 0031 0.75 0552 0.65 FR 1215 0.79 * 1826 0.52	Time m $0.316 \ 0.78 \ 0.558 \ 0.64 \ 0.742 \ 0.68 \ \star 1401 \ 0.47 \ 0.$
2 ¹⁰²⁸ ^{1.05} ₂₀₅₁ ^{0.51} 17 ⁰ ₀ ₀ ₀ ₁₂ ₁₂ ₁₂ ₁₂ ₁₂ ₁₂ ₁₂ ₁₂	0145 0.69 0319 0.66 014 1.13 020 0.42	2 0050 0.63 1129 1.03 MO 1838 0.58	17 0256 0.73 0425 0.70 TU 1106 1.01 * 2125 0.51	2 0400 0.73 0504 0.72 WE 1154 0.95 1841 0.55	17 0306 0.77 0510 0.69 TH 0733 0.79 * 1758 0.59	2 0103 0.78 0635 0.68 SA 0908 0.74 * 1843 0.53	17 0040 0.79 0220 0.76 SU 0409 0.80 *€ 1452 0.42
3 1108 1.04 SA 2142 0.53 2347 0.57 18 1 2 18 2 2 18 2 2 1 2 2 1 2 2 1 2	051 1.10 109 0.44	3 1208 0.99 1911 0.59 TU 2107 0.62 2225 0.61	18 0345 0.76 0509 0.74 WE 1143 0.92 * 2209 0.59	3 0103 0.73 0220 0.72 TH 1230 0.89 * 1908 0.57	18 0355 0.81 0601 0.74 FR 0804 0.80 * 1824 0.58	3 0133 0.80 0726 0.70 SU 0902 0.72 * 1900 0.54	18 0130 0.80 0308 0.77 MO 0502 0.81 1539 0.39
4 ⁰¹¹⁵ 0.55 1147 1.01 SU 2229 0.55 * 19 ⁰ MO 1 * 2	331 0.70 433 0.68 130 1.05 159 0.48	4 0944 0.93 1053 0.92 WE 1245 0.94 * 1944 0.62	19 0830 0.87 1902 0.66 TH 2051 0.69 * 2249 0.66	4 0936 0.85 1132 0.82 FR 1300 0.84 * 1928 0.59	19 0444 0.86 1514 0.55 SA 1708 0.59 * 1847 0.56	4 0505 0.83 1559 0.54 MO 1752 0.57 1922 0.55	19 0555 0.83 1622 0.39 TU 2350 0.70
5 1228 0.97 1933 0.61 MO 2051 0.62 * 2313 0.57 20 1 2 2 TU	207 0.98 247 0.53	5 1000 0.90 1145 0.88 TH 1318 0.89 2014 0.64	20 0518 0.87 1526 0.68 FR 1703 0.71 *	5 0530 0.84 0750 0.81 SA 0929 0.82 1943 0.61	20 0531 0.90 1602 0.49 SU	5 0545 0.88 1319 0.52 TU 1408 0.52 1611 0.49	20 0027 0.70 0645 0.85 WE 1700 0.40
6 0113 0.60 0231 0.59 TU 1306 0.93 2353 0.59 21 0 WE 1 *€ 2	905 0.89 040 0.87 241 0.91 333 0.58	6 0954 0.87 2036 0.66 FR ●	21 0600 0.93 1613 0.62 SA	6 0551 0.90 2003 0.62 SU	21 0619 0.94 1647 0.46 MO	6 0625 0.94 1628 0.43 WE	21 0730 0.86 1526 0.43
7 ¹³⁴⁵ 0.88 22 ⁰ 1 WE TH ¹ ♥	912 0.87 528 0.78 706 0.80	7 0640 0.91 1316 0.77 SA 1422 0.78 2058 0.68	22 0642 0.99 1659 0.57 SU	7 0619 0.96 1647 0.60 MO 1909 0.65 * 2028 0.64	22 0704 0.97 1729 0.46 TU	7 1640 1.00 TH	22 0805 0.87 1557 0.42 FR 2219 0.61
8 0026 0.61 1032 0.85 TH 1245 0.82 1423 0.84 FR 1 1	012 0.64 842 0.87 600 0.71 814 0.75	8 0657 0.97 1703 0.69 SU 1919 0.72 2128 0.70	23 0721 1.03 1741 0.53 MO	8 0651 1.02 1657 0.55 TU	23 0744 0.99 1759 0.47 WE	8 0752 1.04 1609 0.34 FR	23 0009 0.60 0814 0.88 SA 1633 0.42 2250 0.63
9 0048 0.62 0748 0.85 FR 1328 0.77 * 1507 0.78 24 0 SA 1 2	042 0.68 712 0.94 631 0.65 151 0.72	9 0721 1.03 1457 0.64 MO 2039 0.72 2207 0.71	24 0758 1.06 1808 0.52 TU	9 0727 1.07 1651 0.48 WE	24 0812 1.00 1639 0.46 TH	9 0843 1.05 1645 0.32 SA 2254 0.63	24 0133 0.57 0824 0.88 SU 1706 0.44 2322 0.63
10 0101 0.64 0747 0.90 SA 1410 0.72 1930 0.77 25 0 SU 1	046 0.71 748 1.00 620 0.60	10 0749 1.08 1556 0.56 TU	25 0816 1.08 1704 0.50 WE 2322 0.69	10 0804 1.12 1633 0.41 TH	25 0755 1.00 1715 0.45 FR 2329 0.66	10 0100 0.61 0944 1.03 SU 1726 0.32 2330 0.66	25 0223 0.54 0858 0.88 MO 1546 0.45 2344 0.64
11 0114 0.66 0802 0.95 SU 1458 0.66 2034 0.76 26 0 MO 2	825 1.05 633 0.55 240 0.71	11 0816 1.13 1648 0.49 WE 2300 0.72	26 0016 0.68 0759 1.09 TH 1743 0.48 2357 0.69	11 0845 1.14 1715 0.37 FR 2326 0.68	26 0122 0.63 0823 1.01 SA 1754 0.45	11 0200 0.57 1053 0.98 MO 1808 0.36	26 0306 0.51 0934 0.85 TU 1601 0.45 2228 0.67
12 0123 0.67 0823 1.01 MO 1554 0.60 2142 0.75 27 0 TU 1 2	015 0.70 851 1.08 713 0.51 323 0.71	12 0030 0.71 0837 1.16 TH 1735 0.43 2345 0.72	27 0125 0.68 0830 1.10 FR 1823 0.48	12 0052 0.67 0926 1.13 SA 1757 0.34	27 0007 0.66 0218 0.62 SU 0901 1.01 1831 0.47	$12^{\begin{array}{c}0011\\0.247\end{array}}_{\begin{array}{c}0.247\\1200\end{array}}^{\begin{array}{c}0.68\\0.55\end{array}}_{\begin{array}{c}1200\\850\end{array}}$	27 0346 0.50 1013 0.82 WE 1628 0.45 2253 0.70
13 0133 0.68 0843 1.05 TU 1654 0.54 2253 0.74 28 0 WE 1	100 0.69 819 1.10 758 0.49	13 0124 0.70 0848 1.17 FR 1820 0.39	28 0040 0.70 0216 0.67 SA 0911 1.09 1904 0.49	13 0903 1.10 1840 0.35 SU	28 0046 0.66 0305 0.60 MO 0943 0.98 1647 0.49	13 0055 0.71 0334 0.55 WE 1302 0.81 * 1933 0.49	28 0426 0.50 1050 0.77 TH 1654 0.45 2323 0.74
14 0148 0.68 0858 1.09 WE 1749 0.49 2357 0.72	847 1.11 845 0.49	14 0031 0.71 0212 0.68 SA 0914 1.17 1906 0.38	29 0127 0.70 0302 0.67 SU 0952 1.07 1945 0.52	14 0045 0.70 0246 0.63 MO 0930 1.04 * 1924 0.40	29 0128 0.67 0348 0.60 TU 1023 0.95 * 1709 0.49	14 0140 0.74 0421 0.57 TH 1401 0.71 * 1650 0.53	29 0504 0.51 1126 0.71 FR 1718 0.47 2353 0.76
15 0213 0.67 0914 1.12 TH 1841 0.45 FR 0 1	103 0.69 226 0.68 926 1.11 931 0.50	15 0118 0.71 0257 0.67 SU 0948 1.14 1952 0.40	30 1034 1.04 1745 0.54 MO 1922 0.55 * 2022 0.55	15 0130 0.71 0334 0.63 TU 1311 0.95 2007 0.46	30 1103 0.90 1736 0.49 WE 2358 0.72	15 0228 0.76 0508 0.60 FR 0704 0.66 * 1719 0.51	30 0542 0.52 1158 0.65 SA 1739 0.48
31 ⁰ SA ¹ ₂	159 0.69 304 0.68 007 1.10 017 0.52				31 0511 0.63 1141 0.85 TH 1803 0.50		31 0020 0.78 0620 0.55 SU 0830 0.59 * 1758 0.49
© Copyright Comm	nonwealth	of Australia 2	013	Bureau of Mete	eorology	National	Tidal Centre
Height datum is Lo	west Astr	onomical Tide					
Moon Symbols	New	Moon	First Quarter	◯ Full Mod	on 🕕 Las	t Quarter *	Extra Tides

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TIME ZONE -0800

AUSTRALIA, WEST COAST – BUNBURY

LAT 33° 19' LONG 115° 39'

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

TIME ZONE -0800

SEPTEMBER – 2014	OCTOBER – 2014	NOVEMBER – 2014	DECEMBER – 2014		
$\begin{array}{ccccccc} \text{Time} & \text{m} & \text{Time} & \text{m} \\ 1 & 0047 & 0.80 \\ 1118 & 0.50 \\ \text{MO} & 1251 & 0.52 \\ & * & 1457 & 0.48 \end{array} \begin{array}{c} \text{Time} & \text{m} \\ 16 & 0058 & 0.77 \\ 0.314 & 0.70 \\ \text{TU} & 0426 & 0.71 \\ & * & 1510 & 0.34 \end{array}$	Time m 1 0042 0.79 1127 0.36 WE 1304 0.38 1426 0.36 TH 2223 0.66	Time m 1 0125 0.66 1220 0.36 SA 2117 0.63 16 0900 0.46 1048 0.48 SU 1233 0.46 * 1910 0.68	Time m 1 0342 0.46 0954 0.50 MO 1203 0.48 * 1833 0.75 Time m 16 0517 0.45 0620 0.45 TU 0813 0.44 1842 0.77		
2 0118 0.81 17 0147 0.74 1511 0.43 TU 1749 0.51 * 1842 0.51 17 0147 0.74 0353 0.68 WE 0524 0.71 * 1548 0.36	2 0119 0.76 0331 0.71 TH 0434 0.72 1447 0.34 17 0014 0.63 FR 1258 0.41 2245 0.62	2 0014 0.55 0601 0.62 SU 1300 0.40 1905 0.66 17 0509 0.51 0655 0.52 MO 1246 0.49 1923 0.73	2 0411 0.39 1101 0.52 TU 1219 0.52 1908 0.81 17 0504 0.42 1900 0.83 WE		
3 0157 0.81 0345 0.78 WE 0510 0.79 1530 0.39 16 0245 0.71 18 0427 0.68 TH 0618 0.71 * 1617 0.40	3 0529 0.74 1304 0.33 FR 2221 0.62 18 0100 0.58 0301 0.61 SA 1332 0.42 * 2003 0.63	3 0120 0.48 0716 0.60 MO 1334 0.44 1941 0.72 18 0221 0.47 0808 0.53 TU 1246 0.50 1934 0.77	3 0432 0.33 1945 0.86 WE TH		
4 0558 0.84 1343 0.36 TH 2325 0.66 19 0709 0.73 1427 0.40 FR 2105 0.58 * 2209 0.58	4 0010 0.59 0622 0.75 SA 1350 0.33 2215 0.60 19 0142 0.54 SU 1354 0.44 2020 0.66	4 0258 0.41 0915 0.59 TU 1402 0.48 2021 0.78 19 0302 0.41 0917 0.54 WE 1252 0.51 1948 0.82	4 2012 0.28 TH FR 0.355 0.31 FR FR		
5 0013 0.65 0645 0.88 FR 1441 0.33 2335 0.62 20 0750 0.74 1500 0.41 SA 2128 0.61	5 0101 0.53 0722 0.75 SU 1431 0.35 2032 0.63 20 0215 0.50 0813 0.62 MO 1355 0.45 2025 0.69	5 0355 0.33 1014 0.58 WE 1328 0.51 2100 0.81 20 0347 0.36 1015 0.55 TH 1309 0.51 2003 0.86	5 0450 0.24 1130 0.51 FR 1214 0.51 1949 0.90 2002 0.95 SA		
6 0101 0.61 0736 0.91 SA 1524 0.31 2250 0.59 21 0145 0.55 0817 0.74 SU 1521 0.42 2152 0.63	6 0204 0.48 0835 0.74 0853 0.63 00 1512 0.39 00 1512 0.68 00 1355 0.46 00 1512 0.68 00 1355 0.46 00 1355 0.45 00 00 1355 00 00 1355 00 00 00 00 00 00 00 00 00	6 0445 0.28 1103 0.56 TH 1324 0.51 2025 0.83 21 0436 0.30 1106 0.55 FR 1330 0.52 2021 0.89	6 2012 0.91 SA SU 1249 0.53 SA 2012 0.91 SU 1249 0.53 2022 0.96		
7 0148 0.56 0835 0.90 SU 1604 0.32 2211 0.63 22 0156 0.51 MO 1451 0.44 2144 0.65	7 0328 0.42 0950 0.71 TU 1551 0.44 2200 0.72 22 0301 0.41 WE 1410 0.46 2039 0.77	7 0534 0.25 1155 0.54 FR 1351 0.49 2031 0.86 PC 2031 0.86 PC 2031 0.86 PC 2031 0.86 PC 2031 0.86 PC 2031 0.86 PC 20526 0.26 1154 0.54 SA 1356 0.51 € 2045 0.91	7 2049 0.90 22 2049 0.95 SU MO		
8 0235 0.52 0944 0.87 MO 1645 0.35 2249 0.67 23 0230 0.47 TU 1457 0.44 2126 0.68	8 0436 0.37 1054 0.67 WE 1624 0.50 2244 0.75 23 0329 0.37 1012 0.60 TH 1430 0.47 2100 0.81	8 0625 0.24 1248 0.51 SA 1426 0.48 2107 0.87 23 0614 0.22 1242 0.53 SU 1426 0.50 2113 0.92	8 0657 0.23 1333 0.51 MO 1440 0.50 2130 0.87 23 0637 0.15 1300 0.54 TU 1438 0.51 2123 0.93		
9 0415 0.49 24 0306 0.43 TU 1728 0.41 WE 1517 0.44 2331 0.70 WE 1517 0.44	9 0535 0.33 1152 0.61 TH 1434 0.48 2100 0.76 PR 1453 0.48 € 2126 0.83	9 0717 0.25 1346 0.49 SU 1500 0.47 2148 0.85 24 0700 0.20 1330 0.52 MO 1500 0.50 2146 0.91	9 0738 0.26 2212 0.83 TU 24 0721 0.17 1345 0.55 WE 1524 0.51 2200 0.87		
10 0301 0.47 1154 0.74 WE 1810 0.48 TH 1542 0.44 2213 0.75	10 ⁰⁶³³ 0.32 1250 0.55 FR 1502 0.47 2133 0.80 25 0436 0.32 1246 0.54 SA 1515 0.48 2153 0.85	10 ⁰⁸¹⁰ 0.28 25 ⁰⁷⁴⁷ 0.20 2221 0.82 TU	10 0559 0.31 WE 0817 0.31 2254 0.79 25 0804 0.21 1431 0.57 TH 1610 0.52 * 2240 0.80		
11 0015 0.73 0640 0.45 TH 1255 0.65 * 1542 0.49 26 0419 0.40 1043 0.63 FR 1606 0.45 2241 0.78	11 0734 0.32 1351 0.50 SA 1533 0.45 2215 0.81 26 0719 0.31 1350 0.52 SU 1540 0.48 2223 0.85	11 0902 0.32 1136 0.38 TU 1233 0.38 2315 0.78 26 0835 0.22 1509 0.53 WE 1617 0.52 2304 0.82	11 0613 0.32 2042 0.73 TH 26 0848 0.28 1519 0.60 FR 1657 0.56 * 2318 0.71		
12 0059 0.74 0747 0.45 FR 2244 0.76 * 27 0456 0.40 1115 0.58 SA 1628 0.46 2308 0.80	12 0840 0.34 1042 0.38 SU 1210 0.36 * 2259 0.80 27 0816 0.30 1445 0.51 MO 1607 0.49 2256 0.84	12 2059 0.73 27 0922 0.26 WE 27 1600 0.55 TH 1658 0.54 2343 0.76	12 0640 0.34 2104 0.71 FR 2303 0.67 27 0147 0.63 SA 0930 0.36 2003 0.67		
13 1243 0.42 1458 0.50 SA 1642 0.45 * 2327 0.78 28 0530 0.41 1145 0.52 SU 1650 0.47 * 2336 0.80	13 0945 0.36 1120 0.38 Mo 1308 0.34 * 2342 0.78 28 0909 0.29 1540 0.51 TU 1638 0.50 2332 0.82	13 0659 0.39 0850 0.42 TH 1041 0.39 * 2124 0.70 28 1009 0.32 FR 2232 0.64	13 0019 0.68 0710 0.36 SA 2124 0.68 * 2356 0.62 28 0637 0.40 1650 0.69 SU 1846 0.65 * 2014 0.67		
14 0552 0.53 SU 1337 0.37 * 29 0949 0.41 1555 0.50 MO 1714 0.48	14 ¹⁰⁴³ 0.37 29 ⁰⁹⁵⁹ 0.30 TU 2228 0.70 WE	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	14 0058 0.63 SU 1809 0.68 € 14 0738 0.38 SU 1809 0.68 € 129 0306 0.45 MO 0656 0.41 1730 0.75		
15 0012 0.78 0641 0.56 MO 0803 0.57 1426 0.34 30 0007 0.80 1039 0.38 TU 1236 0.42 1403 0.40	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	15 0816 0.44 1015 0.46 SA 1204 0.44 1853 0.65 30 0314 0.54 SU 1131 0.43 * 1800 0.69	15 0800 0.41 1826 0.72 MO 30 0346 0.37 TU 0702 0.40 1810 0.81		
	31 0047 0.72 1136 0.33 FR 2122 0.65 * 2323 0.62		31 0427 0.31 1848 0.86 WE		
© Copyright Commonwealt	h of Australia 2013	Bureau of Meteorology	National Tidal Centre		
Height datum is Lowest Ast	Height datum is Lowest Astronomical Tide				
Moon Symbols • Nev	w Moon 🛛 🛈 First Quarter	\bigcirc Full Moon \bigcirc Las	st Quarter * Extra Tides		

Appendix B Site Photos





Appendix C Drawings

Title	Drawing Number
POINT BUSACO REVETMENT: DETAILED DESIGN	DA 2296-2-1
PROVISIONAL GROYNE: DETAILED DESIGN	DA 2296-2-2



ROCK TYPE	SIZE RANGE	ESTIMATED QUANTITIES
TOE	0.85 - 1.5t	750t (DENSITY 2.6t/m³) or
(CLASS 1)	(50% > 1.25t)	850t (DENSITY 3.0t/m³)
ARMOUR	0.4 - 1.2t	4150t (DENSITY 2.6t/m ³) or
(CLASS 2)	(50% > 0.85t)	4550t (DENSITY 3.0t/m ³)
CORE (CLASS 3)	0.15 - 0.5m (50% > 0.3m)	1750t (DENSITY 2.3t/m ³) or 1950t (DENSITY 2.6t/m ³) or 2200t (DENSITY 3.0t/m ³)





TYPICAL SECTION A SCALE 1:100



NOTES ENGINEER G.McCORMACK . OVERLAP OF REQUIRED BETWEEN SHEETS OF GEOFABRIC IS 0.5m . AERIAL IMAGERY: BUNBURY TOWNSITE NOV 2010 . EXCAVATED MATERIAL IS ANTICIPATED TO LARGELY CONSIST OF DREDGE SPOIL INCLUDING SAND, SILT AND ROCK FRAGMENTS Seashore Engineering J.BARTLETT RAWN DRAFTING CHECK 09.04.14 DRAWING TRANSFORMED TO PERTH COASTAL GRID 94 SJM G.BEBBINGTON С B 10.12.13 AMENDMENTS FROM ENGINEERING CHECK DATUM CJL BebbCart Marine, Cadastral & Topographic Mapping. Civil Drafting. ENGINEERING CHECK A 29.10.13 ISSUED FOR CLIENT REVIEW JB VERTICAL AHD S.BARR REV DATE AMENDMENT DRN APP APPROVED PROJECT MGR ORIG SIZE ARCHIVE HORIZONTAL PCG94

1.7m

SCALE 1:100





ROCK TYPE	SIZE RANGE	ESTIMATED QUANTITIES
ARMOUR	0.4 - 1.2t (50% > 0.85t)	430t (DENSITY 2.6t/m ³) or 500t (DENSITY 3.0t/m ³)
CORE	0.15 - 0.5m (50% > 0.3m)	190t (DENSITY 2.3t/m ³) or 220t (DENSITY 2.6t/m ³) or 250t (DENSITY 3.0t/m ³)





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					NOTES 1. AERIAL IMAGERY; BUNBURY TOWNSITE NOVEMBER 2010		Seashore Engi	neering	ENGINEER	G.McCORM
									DRAWN	J.BARTLET
							1		DDAFTING	
С	09.04.14	DRAWING TRANSFORMED TO PCG94, GEOFABRICS ADDED	SJM						CHECK	G.BEBBING
В	10.12.13	AMENDMENTS FROM ENGINEERING CHECK	CJL			DATUM		ł		L
А	29.10.13	ISSUED FOR CLIENT REVIEW	JB			VERTICAL AHD	Mari Top	rine, Cadastral &	ENGINEERING CHECK	S.BARR
REV	DATE	AMENDMENT	DRN	APP			BebbCart ovi	II Drafting.		L
ORIG SIZE ARCHIVE A3					HORIZONTAL PCG94	Lenveure		APPROVED PROJECT MGR	1	