

PANAMA CANAL AUTHORITY		VARIATION	PAGE 1 OF 6
1. REQUEST FOR PROPOSAL No.:		2. CONTRACT No.:	3. DATE:
RFP-76161		CMC-221427	July 8, 2013
			4. VARIATION No.:
			069

5. ISSUED BY:

PANAMA CANAL AUTHORITY
Employer's Representative
Locks Project Management Division
Building 740, Corozal
Panama, Republic of Panama

6. NAME AND ADDRESS OF CONTRACTOR (INCLUDE PHYSICAL & POSTAL ADDRESS)	7. CONTRACTOR'S TELEPHONE NUMBER:
Grupo Unidos por el Canal, S.A. Building 22B, Brujas Road Cocoli, Republic of Panama	507-316-9900
	8. CONTRACTOR'S FACSIMILE NUMBER:

9. VARIATION:

The contract referred to in item No. 2 is hereby varied as set forth in item 10, entitled "DESCRIPTION OF VARIATION".

YES. NO. The contractor shall send a copy, duly signed, of this Variation to the Employer's Representative/Contracting Officer.

	9 A. THIS VARIATION IS EXECUTED ON THE BASIS OF: (Specify the legal authority).
	<u>THE VARIATION DESCRIBED IN ITEM 10 IS HEREBY INCORPORATED AND MADE A PART OF THE CONTRACT.</u>
	9 B. THE CONTRACT REFERRED TO IN ITEM NO. 2, IS VARIED TO INCORPORATE ADMINISTRATIVE CHANGES (such as the paying office, account numbers, etc.).
X	9 C. THIS BILATERAL AGREEMENT IS SIGNED AND INCORPORATED INTO THE CONTRACT REFERRED TO IN ITEM NO. 2 OF THIS FORM, ON THE BASIS OF: (Specify the legal authority) Volume III, Conditions of Contract , Sub-Clause 1.16 [Entire Agreement], 4th Paragraph
	9 D. OTHER. (Specify manner and the legal authority).
	9 E. ACCOUNT NUMBER (If required):

10. DESCRIPTION OF THE VARIATION (List in accordance with the order of the Contract. If additional space is required, use blank sheets).

See Variation Agreement Enclosed

Except for the variation(s) herein specified, all other terms and conditions of the Contract remain unchanged.

11. NAME AND TITLE OF THE PERSON AUTHORIZED TO SIGN (Type or print)		12. NAME AND TITLE OF THE EMPLOYER'S REPRESENTATIVE/CONTRACTING OFFICER (Type or print)	
Bernardo Gonzalez Contractor's Representative		Jorge de la Guardia, Employer's Representative	
13. CONTRACTOR	14. DATE:	15. PANAMA CANAL AUTHORITY	16. DATE:
	8/07/2013		8/07/2013
(Authorized signature)		(Employer's Representative/Contracting Officer's signature)	

July 8, 2013

Design and Construction of the Third Set of Locks

This Variation Agreement Number 069, is dated as of the 8 day of July 2013 and made

Between: Autoridad del Canal de Panama, Building 740, Corozal, Panama, Republic of Panama (hereinafter called the "**Employer**") on the one part,

and

Grupo Unidos por el Canal, S.A., of Building 22B, Brujas Road, Cocoli, Panama, Republic of Panama, a corporation organized under the laws of the Republic of Panama, registered under microjacket number 682266, document number 1683284 of the Mercantile Section of the Public Registry Office of the Republic of Panama (hereinafter called the "**Contractor**" and together with Employer, the "**Parties**") on the other part.

Whereas:

- (a) The Employer and the Contractor are party to Contract CMC-221427 for the Design and Construction of the Third Set of Locks, dated August 11, 2009 (as the same has been or may be varied, amended, supplemented or otherwise modified (the "**Contract**")).
- (b) For the purposes of interim payments in Sub-Clause 14.3.3(a) of the Contract in relation to the estimated contract value of the Works executed under the Contract, and in accordance with paragraph 1.09R.2 of Section 01 31 00 [*Project Management and Co-ordination*] of the Employer's Requirements, the Contractor is paid by reference to its progress measured against the Current Programme which is based on the cost loaded Accepted Baseline Programme.
- (c) The Contractor originally cost loaded the Accepted Baseline Programme in such a manner that payments in respect of the geosynthetic material including geotextile fabrics and geocomposite drains that is to be used as part of the backfilling of the locks structures as more particularly specified in Parts 2.01 and 2.02 of technical specification "Geosynthetics for Earthwork" document G00/CICTSP-B0029, dated 15 February 2012, would be made only when the items were installed in the Works.
- (d) The Contractor:
 - (i) by letter dated November 9, 2012 (Reference GUPC-IAE-1545) informed the Employer of very serious financial problems which it contends that it is facing, that the situation was now "extremely critical" and therein requested financial support in the short to medium term from the Employer, which issues are considered in the subsequent correspondence of the Employer, including the Employer's Letters IAE-UPC-1313 of November 20, 2012, IAE-UPC-1359 of December 24, 2012, IAE-GUPC-1374 of January 9, 2013, and letter IAE-GUPC-1441 of February 25, 2013 and the Contractor's letters GUPC-IAE-

July 8, 2013

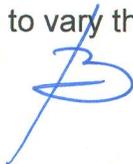
Design and Construction of the Third Set of Locks

1617 of December 21, 2012, GUPC-IAE-1716 of February 8, 2013, and GUPC-IAE-1755 of February 27, 2013; and

- (ii) requested in RFV No. 0182 dated May 09, 2013 that the Contract and Current Programme be varied so as to permit certification for payment of the following items: (i) structural backfill works; (ii) procurement, delivery and storage of geosynthetic material; and (iii) the installation of geosynthetic material, all as set out therein.
- (e) The request made pursuant to RFV No. 0182 as described in sub-paragraph (d)(ii) above also contained a budget changes proposal that included the reallocation of a structural concrete resource which was previously wrongly allocated by the Contractor under the structural backfill activities.
- (f) In reliance on the Contractor's representations and assertions regarding its financial condition, ability to obtain funding and cash flow difficulties, which the Parties agree that the Employer is not able to independently verify, the Employer considers that unless it agrees to such a modification (in addition to the various other measures already agreed such as but not limited to those provided for in Variation Agreements Nos. 042, 043, 045, 047, 048, 049, 051, 052, 055, 056, 058, 059, 060, 063, 065, 066 and 067) there could be serious risk to the completion of the Project and therefore the Employer's agreement to the terms hereof is in the best interests of the Project.
- (g) Accordingly, the Employer has responded through letter IAE-UPC-1556 dated June 3, 2013, indicating to the Contractor that the Employer confirms the cost breakdown of the locks structural backfill and budget changes proposal listed in the appendices to the Contractor's RFV No. 0182 and that such proposal is in accordance with the preliminary agreement reached during several meetings held in April and May 2013 between the Contractor's and the Employer's Project Control Teams, but subject always to the parties agreeing a formal variation to reflect such revised arrangements.
- (h) Therefore, subject to the terms of this Variation Agreement No. 069, and based upon the representations and statements made by the Contractor concerning its financial position and ability to obtain funding, in order to assist the cash flow of the Contractor and for no other reason, the Parties have agreed to a variation to the Contract as hereinafter stated, but not further or otherwise.

THE PARTIES HEREBY AGREE AS FOLLOWS:

The Employer and the Contractor agree to vary the Contract as follows:



July 8, 2013

Design and Construction of the Third Set of Locks

1. In this Variation Agreement No. 069, the words and expressions shall have the same meanings as are respectively assigned to them in the Contract, save as amended below or as expressly stated.
2. This Variation Agreement No. 069 and the modifications contained herein are approved and dated in writing by the authorized representatives of the Contractor and the Employer and in doing so the Parties acknowledge and identify that this is done in accordance with Sub-Clause 1.16 [*Entire Agreement*] of the Contract.
3. Notwithstanding and without prejudice to the merits of any claims that either Party may have against the other relating to the Contract (as to which both Parties' positions are fully reserved) the Contractor acknowledges and agrees that the Employer is not responsible for the Contractor's financial position and its need to request financial assistance. The Contractor agrees and acknowledges that it shall not make any claims against the Employer arising out of or in connection with this Variation Agreement No. 069 or in any way argue or use the fact or the terms of this Variation Agreement No. 069 in a prejudicial way against the Employer or in support of any claims or future actions. The Contractor further agrees and acknowledges that the Employer's agreement to this Variation Agreement No. 069 and the accommodation to the Contractor provided herein is not and shall not be deemed to be an agreement to grant or otherwise provide any similar or other financial accommodation as may be requested by the Contractor on or before the date hereof or in the future. All of the Contractor's existing and ongoing obligations as to the progress of the Works remain unaffected.
4. The Parties agree that the Contractor shall have no claims for additional time or money or any other relief or entitlement of any kind as a consequence of this Variation Agreement No. 069 or arising out of it or in any way in connection with it.
5. Further, the Contractor's obligations to complete the Works and comply with the Contract remain in all respects unaffected and nothing within this Variation Agreement No. 069 is intended to be a waiver or relaxation of the Contractor's obligations under the Contract, save only as expressly stated herein and the Contract shall remain fully effective as varied herein and the Contract shall have effect as though the provisions contained in this Variation Agreement No. 069 had been originally contained in the Contract. Any ambiguity or uncertainty in the meaning and effect of this Variation Agreement No. 069 shall be resolved in favour of the Employer.
6. This Variation Agreement No. 069 shall be governed by the Laws of the Republic of Panama and is deemed to be incorporated into and form an integral part of the Contract.
7. The Parties agree to amend Sub-Clause 1.1 [*Definitions*] of the Contract as follows:



The Parties agree to add the following definitions to Sub-Clause 1.1 [*Definitions*] of the Contract under the Sub-Clause 1.1.6 [*Other Definitions*] (which shall be added in proper alphabetical order but without any number):

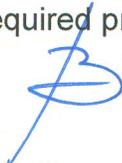
"Geosynthetic Materials" means the geosynthetic material including geotextile fabrics and geocomposite drains that is to be used as part of the backfilling of the locks structures as more particularly specified in Parts 2.01 and 2.02 of technical specification "Geosynthetics for Earthwork" document G00/CICTSP-B0029, dated 15 February 2012, which is attached at Appendix 1 to Variation Agreement No. 069."

"Variation Agreement No. 069" means Variation Agreement Number 069, dated July 8, 2013, between the Employer and the Contractor."

8. The Parties agree to add new Sub-Clauses 14.5.1.3 and 14.5.1.4 [*Plant and Materials intended for the Works*] to the Contract as follows:

"14.5.1.3 The Contractor shall be paid progress payments in respect of Geosynthetic Materials once they are delivered to and stocked on Site and verified in accordance with Part 1.07 of technical specification "Geosynthetics for Earthwork" document G00/CICTSP-B0029, dated 15 February 2012, as set out in Appendix 1 to Variation Agreement No. 069 and as stated herein. In this regard, and to reflect this general intent, the Contractor has updated the Current Programme, and an extraction of the relevant Backfill activities from the Current Programme Update is provided at Appendix 3 to Variation Agreement No. 069, to add additional activities so that progress and payment in respect of Geosynthetic Materials can be measured and valued on an interim basis as aforesaid. The Employer and the Contractor acknowledge the revised cost and activities breakdown and budget movement tables in respect of Geosynthetic Materials pursuant to this Sub-Clause 14.5.1.3 as shown in Appendix 2 to Variation Agreement No. 069 although both the Employer and the Contractor agree that, notwithstanding such revised budget allocation, the Contractor shall be paid for Geosynthetic Materials according to its actual progress against the revised Current Programme which now includes the new activities in respect of delivery to Site, stocking on Site and verification in accordance with Part 1.07 of technical specification "Geosynthetics for Earthwork" document G00/CICTSP-B0029, dated 15 February 2012, which is attached at Appendix 1 to Variation Agreement No. 069 and in all respects subject to the other terms and provisions of the Contract.

- 14.5.1.4 In assessing and certifying payments in respect of Geosynthetic Materials delivered to Site as aforesaid, the Contractor shall, in addition to establishing that the required properties of the Geosynthetic Materials



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are in all respects in accordance with the Contract and Parts 2.01 and 2.02 of technical specification "Geosynthetics for Earthwork" document G00/CICTSP-B0029, dated 15 February 2012, which is attached at Appendix 1 to Variation Agreement No. 069, provide verification that the Contractor has delivered the Geosynthetic Materials in accordance with Appendix 2 to Variation Agreement No. 069 and claimed in a Statement. Certification and payment in respect of Geosynthetic Materials in accordance with Appendix 2 to Variation Agreement No. 069 shall not be due under the Contract unless such matters are first established to the satisfaction of the Employer's Representative and in accordance with Contract Requirements."

9. For the avoidance of any doubt, the Parties acknowledge and agree that the Current Programme reflects an adjustment to the progress payments that shall be paid to the Contractor in respect of Geosynthetic Materials once they are installed as a consequence of the Contractor's requests for progress payments on delivery of the Geosynthetic Materials in RFV No. 0182 dated May 09, 2013. The Parties further acknowledge and agree that progress payments for installation of the Geosynthetic Materials shall be payable in accordance with the terms of the Contract by reference to the estimated contract value of the Works executed pursuant to Sub-Clause 14.3.3(a).
10. Nothing in this Variation Agreement No. 069 is intended to or does give the Contractor any greater entitlement in respect of payment for Geosynthetic Materials than was included within the original Contract Price and thus nothing in this Variation Agreement No. 069 is intended to or does increase the Contract Price or the sum due to the Contractor in respect of Geosynthetic Materials.
11. The Parties acknowledge and agree that the Employer's rights in relation to the processing of Interim Payments including but not limited to under Sub-Clause 14.6 [*Issue of Interim Payment Certificates*] and Sub-Clause 14.7 [*Payment*] remain unaffected by this Variation Agreement No. 069.

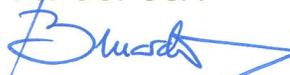
In Witness whereof the Parties hereto have caused this Variation Agreement No. 069 to be executed on the 8 day of July 2013, by their duly authorized representatives.

For ACP



Jorge de la Guardia
Employer's Representative

For GUPCSA



Bernardo Gonzalez
Contractor's Representative



**THE PANAMA CANAL
THIRD SET OF LOCKS PROJECT**

TECHNICAL SPECIFICATION

SECTION 31 05 19

GEOSYNTHETICS FOR EARTHWORK

DOCUMENT No.:

G00/CICTSP-B0029

DESIGNER OF RECORD		REGISTERED ENGINEER	Date:15-Feb-12
		<div style="border: 1px solid black; padding: 5px;"> <p align="center">MANUEL GONZALEZ D. INGENIERO CIVIL LICENCIA No. 80.008.038</p> <p align="center"><i>Manuel Gonzalez D.</i></p> <p align="center">F L R M A</p> <p align="center">Ley 18 del 28 de Enero de 1959 Junta Técnica de Ingeniería y Arquitectura</p> </div>	
AUTHORIZED REPRESENTATIVE	Date:		
<i>Michael Newbery</i>	15-Feb-12		

Status / Rev.	Date of Issue	Reason for Issue	Lead Author	Checked By	Reviewed By	Approved By	Submitted By
UB	15-Feb-12	Issued for Use	<i>Richard Morris</i> R. Morris	<i>M. Rurka</i> M. Rurka	<i>J. Hedien</i> J. Hedien	 V. Zipparro	<i>Michael Newbery</i> M. Newbery

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**VERSION CONTROL**

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Summary of Revisions between this Version and Previous Version

Reference	Description
General	Minor edits and corrections throughout.
1.03.C	Updated list of ASTM reference standards.
1.03.D	Added new reference standards from Geosynthetics Institute.
1.04	Added definition of “Geocomposite Drain”. Revised definition of “Minimum Average Roll Value” to conform to industry standard. [Changed all occurrences of abbreviation “MinARV” to “MARV” throughout document.]
1.06.D	Changed “Geotextile Products” to “Geosynthetic Products”.
2.01	Deleted “Nonwoven” from heading.
2.01.C	Corrected “Salvage” to “Selvage”.
2.02.A	Revised geocomposite drain description; added triplanar geonets. Revised Table 2 to include ply adhesion; clarify sampling & testing procedures; simplify hydraulic transmissivity criteria; correct erroneous test pressure for hydraulic transmissivity.
2.02.B	Consolidated, updated and corrected former Tables 3 and 4 as new Table 3. Relaxed carbon black and tensile strength criteria. Revised creep reduction factor consistent with GRI-GC8. Eliminated minimum geonet thickness requirement.
2.02.C	Revised to conform to requirements for geotextile drain fabric.
2.03.A	In Table 4, corrected “Peal Adhesion Test” to “Peel Adhesion Test”.
3.01.D	Replaced “geosynthetic products” to “geocomposites that include them” [geotextiles].
3.02.A	Revised and reorganized to resolve conflicting overlap lengths, delete redundant orientation requirements, and improve logical flow.





TECHNICAL SPECIFICATION – SECTION 31 05 19
GEOSYNTHETICS FOR EARTHWORK

Date: 15-Feb-12

Doc. No.:
G00/CICTSP-B0029 – UB

VERSION HISTORY

Status / Rev.	Date of Issue	Reason for Issue	Lead Author	Checked By	Reviewed By	Approved By	Submitted By
PA	06-Sep-10	Final Design 1939 Excavation Fill	<i>Rafael Morris</i>	<i>M. Rurka</i>	<i>C. Ottsen</i>	<i>N. Pansic</i>	<i>Michael Newbery</i>
			R. Morris	M. Rurka	C. Ottsen	N. Pansic	M. Newbery
UA	22-Oct-10	Approved For Construction	<i>Rafael Morris</i>	<i>M. Rurka</i>	<i>C. Ottsen</i>	<i>N. Pansic</i>	<i>Michael Newbery</i>
			R. Morris	M. Rurka	C. Ottsen	N. Pansic	M. Newbery

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PART 1 – GENERAL**1.01 SUMMARY**

- A. This specification Section covers the use of geosynthetics for the following items of work:
1. General earthwork;
 2. Site fills and drainage systems;
 3. Embankments and water retaining structures;
 4. Road construction;
 5. Water Saving Basins; and
 6. Other areas or structures where geosynthetics are shown on the Drawings.

1.02 RELATED SECTIONS

- A. Section 31 23 16 – Excavation
B. Section 31 23 23 – Fills
C. Section 31 50 13 – Excavation Support & Foundation Treatment

1.03 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of project proposal submission shall be used.
- B. Employer Requirements:
1. Section 01 33 00 Submittal Procedures
 2. Section 01 40 00 Quality Requirements
 3. Section 01 57 19.13 Environmental Management System
 4. Section 31 23 00 Excavation and Fill
- C. ASTM International:
1. ASTM D 413 Test Methods for Rubber Property – Adhesion to Flexible Substrate.
 2. ASTM D 638 Test Method for Tensile Properties of Plastics.
 3. ASTM D 751 Test Methods for Coated Fabrics.
 4. ASTM D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
 5. ASTM D 1004 Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.

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SECTION 31 05 19 – GEOSYNTHETICS FOR EARTHWORK

6. ASTM D 1203 Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods.
7. ASTM D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
8. ASTM D 1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
9. ASTM D 1505 Test Method for Density of Plastics by the Density-Gradient Technique.
10. ASTM D 1790 Test Method for Brittleness Temperature of Plastic Sheeting by Impact.
11. ASTM D 4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique.
12. ASTM D 4354 Practice for Sampling of Geosynthetics for Testing.
13. ASTM D4355 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
14. ASTM D 4437 Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
15. ASTM D 4491 Test Methods for Water Permeability of Geotextiles by Permittivity.
16. ASTM D 4533 Test Method for Trapezoid Tearing Strength of Geotextiles.
17. ASTM D 4595 Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
18. ASTM D 4632 Test Method for Grab Breaking Load and Elongation of Geotextiles.
19. ASTM D 4716 Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
20. ASTM D 4751 Test Method for Determining Apparent Opening Size of a Geotextile.
21. ASTM D 4759 Practice for Determining the Specification Conformance of Geosynthetics.
22. ASTM D 4833 Test Method for Index Puncture Resistance of Geomembranes and Related Products.
23. ASTM D 5035 Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
24. ASTM D 5261 Test Method for Measuring Mass Per Unit Area of Geotextiles.
25. ASTM D 6241 Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

26. ASTM D 6364 Test Method for Determining Short-Term Compression Behavior of Geosynthetics
 27. ASTM D 7005 Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites
 28. ASTM D 7176 Specification for Non-Reinforced Polyvinyl Chloride (PVC) Geomembranes Used in Buried Applications
 29. ASTM D 7717 Specification for Air Channel Evaluation of Polyvinyl Chloride (PVC) Dual Track Seamed Geomembranes
 30. ASTM G 154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.
- D. Geosynthetics Institute
1. GRI-GC8 Guide for Determination of the Allowable Flow Rate of a Drainage Geocomposite

1.04 DEFINITIONS

- A. Geosynthetic: Synthetic fabrics (woven or non-woven), membranes or composite materials typically used in earthworks and structures for the purpose of drainage, filter, transition, soil/earth reinforcement, and impermeable water barriers.
- B. Geotextile: A permeable geosynthetic comprised solely of textiles. Geotextiles are used with foundation, soil, rock, earth, or any other geotechnical engineering-related material as an integral part of projects, structures, or systems. Interchangeable with “fabric”.
- C. Geomembrane: A very low permeability geosynthetic liner or barrier used to control fluid migration in a structure or system.
- D. Geocomposite: A product comprised of two or more geosynthetics bonded or woven together.
- E. Geonet: A geosynthetic consisting of integrally connected parallel sets of ribs overlying similar sets at various angles for planar drainage of liquids or gases.
- F. Geocomposite Drain: A product consisting of a geonet core with geotextile bonded to one or both sides, intended for planar drainage of fluids or gases.
- G. Minimum Average Roll Value (MARV): The value of a property of a geosynthetic material established by the manufacturer such that the user/purchaser will have a 97.7% confidence that the property in question will meet that value. For normally distributed data, MARV is the typical value minus two standard deviations, calculated from documented quality control test results.
- H. Overlap: The distance measured perpendicular from an overlapping edge of one sheet to the underlying edge of the adjacent sheet.

1.05 SUBMITTALS

- A. Submit shop drawings, work plans, method statements, material specifications, test results and other information, as specified herein, in accordance with the Quality Management System.



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- B. Submit the following items to the Project Designer for review:
1. Work Plans. Submit separate Work Plans for geocomposite drains, geotextiles, and geomembranes. Include at a minimum the following information:
 - a. Manufacturer's material specifications, including quality-control certificates, product literature, installation instructions.
 - b. Description of proposed methods of installation, sequence, equipment, temporary or appurtenant installation structures and supports.
 - c. Qualifications of installers and seam welders.
 - d. Details of material delivery, storage, and handling.
 2. Shop drawings showing sheet layout, location of seams, seam connection details, anchorage details, profile and batten details, and direction of overlap.
 3. Samples. Submit separate samples for geocomposite drains, geotextiles, and geomembranes, including:
 - a. Material samples for each type and class of material to be used in the Work. Affix product information to each sample.
 - b. Samples of securing pins, washers, anchors, nuts, bolts, or other appurtenances that will be used for securing geosynthetics.
 - c. Samples of welded, sewn, or other affixed sheet-to-sheet seams.
- C. Submit the following items to the Employer's Representative:
1. Work Plans, material samples and specifications, and manufacturer's installation instructions as indicated above.
 2. Quality Control Plans including the following items:
 - a. A list and technical data of instruments and equipment for inspection and testing.
 - b. A list of the standards that govern how quality control testing will be performed.
 - c. Technical procedures and methods for performing quality-control inspections for all features of the work.
 - d. Testing criteria, procedures, methods, and other information upon which the control tests shall be made for each phase of the work.

1.06 QUALITY REQUIREMENTS

- A. All requirements contained in the Employer's Requirements Section 01 40 00 (Quality Requirements) shall apply to this Section. In the event of conflicts between Employer's Requirements Section 01 40 00 and this Section, the former shall be given precedence.
- B. The Contractor shall prepare and submit a Quality Control Plan describing the procedures, methods, equipment and testing used for performing quality control inspections to verify the work complies with the requirements of this Specification.

- C. Quality Assurance. The Contractor shall obtain the following information:
1. Material properties information for each roll, with the manufacturer's warranty that the sheet has the properties specified. The manufacturer shall indicate whether the material property values are average roll maximums or minimums. Submit prior to shipping the material.
 2. Manufacturer's Quality Control Plan covering installation specifications and techniques, acceptance, handling and storage of the materials before installation, welding and control of welding, perimeter seals and testing of systems.
 3. Names and contact information of the independent laboratories to be used for geosynthetic quality control testing.
 4. Results of all tests conducted on geosynthetics prior to installation.
- D. Geosynthetic Products Conformance Testing
1. Verification of specification conformance will be based on manufacturer's certifications.
 - a. Sampling Method: ASTM D 4354, Procedure B.
 - b. Lot Size: The smaller of the total shipment quantity of the product in question or a truckload or equivalent shipping unit of the product.
 - c. Test Procedures: In accordance with the methods referenced in this specification for the product and application in question.
 - d. Product Acceptance: ASTM D 4759, based on comparison of average test results of all specimens within a given sample to the specified MARV.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver each geosynthetic roll with sufficient information attached to identify it for inventory and quality control.
- B. Handle products in accordance with the manufacturer's recommendations and in a manner that maintains the geosynthetic in an undamaged condition.
- C. Do not store products directly on the ground. Ship and store geosynthetics with suitable wrapping for protection against moisture and ultraviolet exposure. Store geosynthetics in a way that protects them from the elements.

PART 2 – PRODUCTS

2.01 GEOTEXTILE FILTER AND DRAIN FABRICS

- A. Fabric: Non-woven, needle-punched, new, first quality, designed and manufactured specifically for intended use. Needle-free and resistant to mildew, insects, and rodents. Polypropylene materials shall be UV stabilized.
- B. Polymer: 100-percent polyester or polypropylene (except for inhibitors or carbon black added for UV resistance); use only polypropylene for geotextile placed in contact with Portland cement concrete.
- C. Physical Properties: As listed in Table 1. Selvage or otherwise finish the edges to prevent outer material from pulling away from geotextile.

Table 1 - Physical Properties

Physical Property	Test Method	Units	Requirement	
			Filter Fabric	Drain Fabric
Grab Tensile Strength	ASTM D 4632	N	900	900
Grab Elongation	ASTM D 4632	%	≥ 50	≥ 50
Wide Width Strip Tensile Strength	ASTM D 4595	N	900	900
Wide Width Strip Elongation	ASTM D 4595	%	70	70
Sewn Seam Strength	ASTM D 4632	N	810	810
Trapezoidal Tear Strength	ASTM D 4533	N	350	350
Puncture Strength	ASTM D 6241	N	1925	1925
Permittivity	ASTM D 4491	sec-1	0.02	0.5
Apparent Opening Size	ASTM D 4751	mm	0.60	0.43
Ultraviolet Stability	ASTM D 4355	% strength retained	50 % at 500 hours	50 % at 500 hours

- D. Thread: Polypropylene, with physical and chemical-resistance properties that equal or exceed those of the geotextile, approved for use by geotextile manufacturer. Color to contrast with geotextile color.
- E. Securing Pins
1. Steel Rods or Bars: 9 mm diameter, pointed at one end with head on other end sufficiently large to retain washer. Minimum Length: 25 cm.
 2. Steel Washers: Outside diameter not less than 35 mm, thickness of 3 mm.
 3. Steel Wire Staples: U-shaped, 10 gauge, minimum length 100 mm.

2.02 GEOCOMPOSITE DRAIN

- A. Geocomposite
1. General. Biplanar or triplanar high-density polyethylene (HDPE) geonet with thermally bonded, nonwoven geotextile on both sides.
 2. Physical Properties: As listed in Table 2.

Table 2 – Geocomposite Requirements

Physical Property	Test Method	Units	Requirement ¹
Ply Adhesion ²	ASTM D 7005	N/m	100 (min)
Hydraulic Transmissivity ³	ASTM D 4716	m ² /sec	1.0 × 10 ⁻³ (min)

¹ Average of five tests across the roll width. Disregarding the outer 300 mm along the roll edges, sample at the 10, 30, 50, 70, and 90 percent positions across the roll width.

² Test adhesion on both sides.

³ Test between rigid end platens after a seating period of 100 hours using a gradient of 0.1 and a normal pressure of 479 kPa.

B. Geonet Component

1. Resin: New, first-quality HDPE resin compounded and manufactured specifically for the purpose of producing geonet.
 - a. Do not intermix resin with other resin types.
 - b. Edge trim from the roll being produced may be recycled in the geonet. Return all such edge trim immediately to the process. Do not recycle edge trim that has been stored or edge trim from other manufacturing lines.
2. Physical Properties: As listed in Table 3.

Table 3 – Geonet Requirements

Physical Property	Test Method	Units	Requirement ¹
Density ²	ASTM D 1505	g/cc	0.94
Melt Flow Index	ASTM D 1238	g/10 min	1.0 (max)
Carbon Black Content	ASTM D 4218	%	1 to 3
Tensile Strength	ASTM D 5035	kN/mm	7.99
Creep Reduction Factor (479 kPa, 10,000 hours)	GRIGRI-GC8 ASTM D 6364 ³	%	1.2 (max)

¹ Required values are minimums relative to MARV unless otherwise indicated.

² Base resin density without carbon black added.

³ Test procedure modified as described in GRI-GC8.

- C. Geotextile Component: Conform to all specified requirements for nonwoven geotextile drain fabric.

2.03 GEOMEMBRANE LINER

- A. A PVC geomembrane heat coupled during extrusion to a nonwoven, needle-punched pure polyester or polypropylene geotextile. PVC extrusion shall be in a homogeneous mass from a flat die. The commercial name of an acceptable material is SIBELON System, as manufactured by C.A.R.P.I. S.r.l., Italy. Minimum PVC geomembrane thickness 2.5 mm. Minimum physical properties of the geomembrane shall be as specified in Table 4.

Table 4 - PVC Geomembrane with Polyester Geotextile Backing Reinforcement (MARV)

Property	Test Method	Units	Requirement
Thickness (Geomembrane Only)	ASTM D 7176	mil	100 ±10%
Specific Gravity (Geomembrane Only)	ASTM D 792	g/cc	1.2
Mass per Unit Area	ASTM D 5261	kg/m ²	0.45
Tensile Strength	ASTM D 638		
Geotextile Break Tension		kN/m	20
Geotextile Break Elongation		%	35
Geomembrane Break Tension		kN/m	20
Geomembrane Break Elongation		%	250

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Property	Test Method	Units	Requirement
Tear Resistance	ASTM D 1004	N	180
Puncture Resistance	ASTM D 4833	N	670
Hydrostatic Resistance (Mullen Burst)	ASTM D 751	kPa	3450
Low Temperature/Brittleness	ASTM D 1790		no failure at 0°F
Volatile Loss	ASTM D 1203 – Method A	%	0.3
Water Extraction	ASTM D 3083	%	0.2
Dimensional Stability (6 hours @ 80°C)	ASTM D 1204	%	±2.5
Bonded Seam	ASTM D 3083	%	100% of specified tensile strength
Peel Adhesion Test	ASTM D 413	N/m	1.7
UV Resistance (Maximum Change In Tensile Properties After 20 Hours of Exposure followed by 4 hours of condensation)	ASTM G 154	%	20

B. Fixtures and Appurtenances

1. **Batten Bars:** Anchorage batten bars shall be made of stainless steel. All nuts, washers, couplers, and anchor bolts and other metal items used in the perimeter anchor seal shall be made of stainless steel. The rubber gasket shall consist of a medium-density open-cell neoprene sponge rubber. The sealant applied to the face of the concrete along the perimeter profile shall be a waterproof thixotropic epoxy compound, as recommended by the membrane manufacturer.
2. **Concrete Anchors:** Concrete anchors for profiles, perimeter seals, and horizontal slab anchors shall be 125 mm stainless steel threaded rods secured during concrete placement or epoxy-bonded concrete anchors. If an epoxy capsule is used to secure the rods, the threaded rods shall have a 45-degree angle on the end inserted into the drilled hole to rupture the epoxy capsule and thorough mixing of the resins.
3. Size the spacing and embedment length of the anchor rods to provide adequate compression, attain a dependable watertight seal, and provide the shear strength required to withstand the lateral forces of the tensioned membrane.

PART 3 – EXECUTION

3.01 GENERAL

- A. Prepare the subgrade by proof rolling surfaces as indicated by the manufacturer or otherwise specified. Do not lay out geosynthetic until inspection of the subgrade is performed for soft spots, unsuitable areas, or objects or conditions that may damage the geosynthetic and until approval to proceed is documented.



- B. Promptly correct subgrade damage from settlement, ground failure, or other causes that may damage the geosynthetic. Excavate, backfill and compact or otherwise correct these areas with material as required. Fill any ruts occurring during construction with additional subbase material compacted to the specified density.
- C. Place, install and join, fasten or seam geosynthetic materials in accordance with manufacturer’s recommendations.
- D. Do not drag or otherwise damage geosynthetic products during installation. Properly secure geosynthetics for high-wind conditions with ballast or securing pins.
- E. Do not permit unprotected exposure of geotextiles or geocomposites that include them to the elements for more than 14 days (or less as specified by the manufacturer) after they are laid down.

3.02 GEOTEXTILE AND GEOCOMPOSITE DRAINS

A. Geotextile

- 1. Laying Geotextile: Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.
- 2. Securing Geotextile: Secure geotextiles during installation as needed with sandbags, securing pins, staples or other means approved by the manufacturer.
- 3. Securing Geotextile with Securing Pins or Staples (where shown or approved): Insert securing pins with washers through geotextile midway between edges of overlaps and 150 mm from free edges. Space securing pins as follows:

<u>Slope</u>	<u>Maximum Pin Spacing</u>
Steeper than 3:1	0.7 m
3:1 to 4:1	1 m
Flatter than 4:1	1.5 m

- a. Install additional pins across each geotextile sheet as necessary to prevent geotextile slippage and prevent wind from blowing geotextile out of position.
- b. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.
- c. Where staples are used instead of securing pins, install in accordance with alignment and spacing above. Push in to secure geotextile firmly to subgrade.
- 4. Geotextile Installed in Trenches and Restricted Excavations
 - a. Place geotextile to completely envelope the granular drain material to be placed in the trench, with specified overlaps. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.
 - b. Place geotextile loosely with limited wrinkles or folds, and with no void spaces between the geotextile and the excavated surface. Overlap successive sheets of geotextile 300 mm (min), with upstream sheets overlapping downstream sheets.



- c. Place drain material immediately following geotextile placement. Cover geotextile with 300 mm (min) of loosely placed material prior to compaction. Compact drain material with vibratory equipment as specified in Section 31 23 00.
- d. Geotextile Overlap After Placing Drain Material: After granular drain material is placed to required grade, fold geotextile over top of granular drain material, unless otherwise shown. Maintain overlap until overlying fill or backfill is placed.
 - 1) In trenches 300 mm or more wide: Fold geotextile over the top of backfill to produce an overlap of 300 mm (min).
 - 2) In trenches between 100 and 300 mm wide: Overlap by the full trench width.
 - 3) In trenches 100 mm or less wide: Sew or otherwise bond geotextile overlaps as shown or as recommended by manufacturer.
5. Geotextile Installed on Slopes and Extensive Surfaces
 - a. Lay out and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.
 - b. Orient geotextiles with the long dimension of each sheet parallel to the slope direction. Geotextile may be oriented with long dimension of sheet transverse to direction of slope only if sheet width, without unsewn seams, is sufficient to cover entire slope and anchor trench and extend at least 0.5 m beyond toe of slope.
 - c. Overlap, sew, or join adjacent geotextile rolls and at ends of rolls. Make overlaps in the direction indicated or specified. Overlap unseamed joints as follows unless otherwise indicated:
 - 1) Foundation and Subgrade Stabilization: Minimum 0.8 m.
 - 2) Other Applications: Minimum 0.3 m.
 - 3) Do not cover any geotextile after layout until inspection. Promptly repair or replace any damaged or improperly installed geotextile.
6. Covering Geotextile.
 - a. Place cover material by end-dumping onto geotextile from the geotextile edge or over previously placed cover. Drop height shall not exceed 0.8 m.
 - b. If cover placement damages the geotextile, repair or replaced the damaged area and modify placement procedures as required to prevent further damage.
 - c. Do not stockpile, mound, or windrow cover material over geotextile.
- B. Geocomposite Drain
 1. Placement. Unroll the geocomposite drain in the direction of maximum slope, keeping the drain flat against the subgrade to minimize wrinkles and folds.
 2. Seams and Overlaps
 - a. Geonet Side Seams. Overlap geonet side seams 100 mm (min). Side seam fastener spacing: 1.5 m (max). Anchor trench fastener spacing: 300 mm (max).

- b. Geonet End Seams. Overlap geonet end seams 300 mm (min). End seam fastener spacing: 300 mm (max). Make overlaps in the direction of flow.
 - c. Geonet Fasteners. Tie geonet rolls together with plastic fasteners of a contrasting color from the geonet and attached geotextile. Do not use metal fasteners.
 - d. Geotextile Seams. Overlap geotextile components of geocomposite drain in the direction of flow.
 - e. Geotextile Cap Strips. Place geotextile cap strips over any exposed edges of geocomposite drain. Cap strip width: 600 mm (min). Thermally bond cap strips to the geotextile component of the geocomposite drain.
3. Stacked Geocomposite Drain. When geocomposite drain layers are to be stacked, stagger roll ends and edges so that joints do not lie above one another.
 4. Penetrations.
 - a. Mechanically attach a geotextile apron to pipes and other appurtenances that penetrate geocomposite drain to prevent soil from entering the drainage layer.
 - b. Extend the apron 600 mm (min) out from the pipe or appurtenance.
 - c. Thermally bond the apron geotextile to the geotextile component of the geocomposite drain.
- C. Protection
1. Geotextiles
 - a. Do not operate equipment on the top surface of geotextile or geocomposite drain without prior review by Project Designer.
 - b. Initial loose lift thickness for cover: 300 mm (min). Use equipment with ground pressures no greater than 50 kPa to place the first lift of cover. Do not allow equipment to turn on surface of first lift. Do not use vibratory compaction equipment on surface of first lift.
 - c. Maintain 600 mm (min) of cover between geosynthetic products and construction equipment with a ground pressure greater than 50 kPa.
 2. Geocomposite Drain on Sloping Surfaces.
 - a. Place cover fill from the bottom of the slope upward.
 - b. Do not drop cover fill directly onto geocomposite drain from heights greater than 0.8 m.
 - c. Push cover fill out over geocomposite drain in an upward tumbling motion so that wrinkles in the drain do not fold over.
- D. Repair damaged geosynthetics in accordance with manufacturer's specifications unless otherwise specified.
1. Geotextiles
 - a. Repair damaged geotextile by placing a geotextile patch over the damaged area extending 300 mm (min) beyond the damage, or the specified seam overlap, whichever is greater.



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- b. Thermally bond the geotextile patch in place.
2. Geocomposite Drain
 - a. Repair of Geonet Damage
 - 1) Make repairs by placing a patch of the geocomposite drainage layer over the damaged area.
 - 2) Extend the patch 600 mm (min) beyond the edge of the damage
 - 3) Use approved fasteners, spaced every 150 mm around the patch, to hold the patch in place.
 - 4) If more than 25 percent of the roll width is damaged, repair or replace the damaged roll.
 - b. Repair of Geotextile Damage
 - 1) Repair damaged geotextile by placing a patch of geotextile over the damaged area with 300 mm (min) of overlap in all directions.
 - 2) Thermally bond the geotextile patch in place.
3. Replacing Contaminated Geotextile and Geocomposite: Protect geotextile and geocomposite from contamination that would interfere with its intended function. Remove and replace contaminated material with clean material.

3.03 GEOMEMBRANE

- A. General.
 1. Provide the proposed panel layout placement diagrams to the Project Designer for review. Do not place any geomembrane liner until the proposed panel layout diagram has been approved, including any changes made at the work site.
 2. Key trenches and perimeter seals shall be used to anchor the geomembrane at the toe and crest of slopes, and along concrete walls as shown on the drawings or as otherwise detailed by the manufacturer and reviewed by the Project Designer. Batten bars, anchoring profiles and other exposed metal fixtures shall be stainless steel.
- B. Subgrade Preparation.
 1. Prepare subgrade as specified in Part 3.01 or as otherwise required by manufacturer. The Contractor and installer shall inspect the subgrade condition each day prior to geomembrane deployment.
 2. The Contractor shall confirm that surfaces to be lined with geomembrane provide a firm, unyielding foundation with no sharp breaks in grade.
- C. Deployment.
 1. Install geomembrane sheets from the top-down, in proper alignment and unroll them with the geotextile side facing down.
 2. Check for damaged geomembrane during installation. Damage may include things such as permanent creases, folds, crimps, gouges, holes, scratches, and inadequate texturing. Any area requiring repair shall be clearly marked.
 3. Deploy only geomembrane that can be anchored and seamed together the same day.

4. Orient seams parallel to the line of maximum slope. Where seams can only be oriented across the slope, verify the upper sheet is lapped over the lower sheet.
5. Verify that each deployed geomembrane panel is given a panel number which is recorded on the daily reports and as-built drawings.
6. Some spotting (shifting) of geomembrane rolls or panels may be required before field seaming begins. Spotting of deployed geomembranes shall be done without disturbing the subgrade soil or geosynthetic materials.
7. Minimum wrinkles shall be allowed to insure the liner is installed in a “relaxed” condition. Excessive wrinkles which overlap themselves shall not be allowed. Stretching of the geomembrane shall not be allowed.
8. Geomembrane panels which have been deployed are to be secured with acceptable ballast to prevent uplift by wind. Sand bags are typically used for ballast. Place a continuous line of sand bags along all exposed edges of geomembrane.
9. Avoid contaminating or damaging the geomembrane during construction. Do not drive equipment on the liner itself. Contaminated or damaged geomembrane shall be either replaced, or patched and repaired in accordance with the manufacturer’s recommendations.

D. Trial Seams.

1. Make trial seams on test strips of excess geomembrane under field conditions to verify that seaming methods are adequate. Make sure trial seams are constructed in the same weather conditions as the actual field seams.
2. Require trial seams to be made each day prior to production seaming, whenever there is a change in seaming personnel or seaming equipment, and at least once every four to five hours.
3. Obtain six to ten 25 mm-wide specimens (coupons) from the sample for field testing. Test half of the seam specimens for shear strength and half for peel adhesion using an approved tensiometer with a digital readout. Confirm that field tensiometers used have an up to date calibration certificate. Test a second trial seam if tests from the initial trial seam fail.
4. The Contractor shall record the following information for each trial seam: sample number, date, test results, welder number, ambient temperature, welder temperature and pressure, and rate of seaming.

E. Field Seams.

1. Verify that areas to be seamed are clean and dry. Perform seaming only when the ambient temperature is in the allowable range as described in the installer’s QC manual. The location where ambient temperature is measured shall be agreed upon prior to the start of installation.
2. All geomembranes which have been deployed are to be seamed together by the end of the work day. Do not allow open seams to be left overnight.
3. Verify prior to seaming that geomembrane sheets are overlapped at least 50 mm, or as otherwise specified, and extend to the outside edge of the sheets.



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4. Welding shall be a double-track thermal fusion weld (hot wedge weld). Welding shall conform to the manufacturer's recommendations.
 5. Use leakproof T-connections wherever intersecting seams are to be joined together.
- F. Field Sampling and Testing.
1. Non-Destructive Leak Testing.
 - a. Verify and document that field seams are tested for leaks over their full length. Record the date, seam number, test unit number (if applicable), name of test person, test data, and outcome of testing.
 - b. Test all double-track hot wedge welded seams in the geomembrane in accordance with ASTM D 7717.
 2. Destructive Field Seam Testing. Conduct destructive testing of seams to provide a direct evaluation of seam strength and bonding efficiency. Destructive testing consists of shear and peel tests.
 - a. Take one destructive test sample per 250 m of field seam. Samples shall be at least 300 mm wide by 1.1 m long, with the seam centered lengthwise. Observe all production seam sample cutting.
 - b. Cut each sample into three equal pieces with one piece retained by the installer, one piece given to the laboratory, and the remaining piece retained by the Contractor. Number and cross reference each sample on a field log and also show on the record drawings. Indicate the reason for taking the sample, e.g., routine, suspicious feature, change in sheet temperature, etc.
 - c. Perform shear and peel tests to verify the seams have adequate strength. Reference the paragraph entitled "Trial Seams" for a description of the testing procedure to be used. Monitor and document all destructive seam tests performed by the geomembrane installer.
 - d. Record the following information for each seam sample tested: sample number, date, test results, welder number, ambient temperature, welder temperature and pressure, and rate of seaming.
 - e. Confirm that destructive seam sample holes are repaired and nondestructively tested for leaks the same day they are cut.
 - f. Test seams on patches and appurtenance boots around structures which protrude through the liner by the air lance method (ASTM D 4437).
- G. Defects and Repairs.
1. Cap-strip seams that fail destructive seam testing by seaming an additional strip of material over the failed seam between any two passed destructive test locations. Alternatively, the Contractor may isolate the weak area of the seam by retracing the seaming path to a location at least 3 m on either side of the failed seam location.
 2. Use patching and cap stripping to repair large holes, tears, and locations where destructive seam samples were taken. Confirm patches have rounded corners and extend a minimum of 150 mm beyond the edge of defects.
 3. Repair minor localized flaws such as pin holes by spot welding.



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4. Verify that all repairs are documented in the daily reports and recorded on the as-built drawings.

END OF SECTION

APPENDIX 1 TO VARIATION

2) Detailed breakdown of the major features of work into programme cost loaded activities - Pacific

PACÍFICO							28,291,705.24
P-42680 K_Indicator P_LUC: Backfill Walls							\$7,289,419.00
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate
Filters K06	Bedding + Filter	m3	3.70%	10,800.00	25.00	270,000.00	270,000.00
Conduit Struct. K30	Subdrainage conduit structure	m3	13.58%	3,344.00	296.05	990,000.00	1,260,000.00
Backfill K05	Rockfill	m3	71.75%	1,173,000.00	4.46	5,230,317.05	6,490,317.05
	Earthfill	m3	8.41%	137,500.00	4.46	613,101.96	7,103,419.00
Geosynthetic K31	Geosynthetics Installation	m2	2.55%	62,000.00	3.00	186,000.00	7,289,419.00
P-42120 P_LMC: Backfill Walls							\$5,624,011.14
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate
Filters K06	Bedding + Filter	m3	4.80%	10,800.00	25.00	270,000.00	270,000.00
Conduit Struct. K30	Subdrainage conduit structure	m3	17.60%	3,344.00	296.05	990,000.00	1,260,000.00
Backfill K05	Rockfill	m3	66.56%	839,500.00	4.46	3,743,266.12	5,003,266.12
	Earthfill	m3	7.73%	97,500.00	4.46	434,745.02	5,438,011.14
Geosynthetic K31	Geosynthetics Installation	m2	3.31%	62,000.00	3.00	186,000.00	5,624,011.14
P-41540 P_LLC: Backfill Walls							\$6,304,226.41
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate
Filters K06	Bedding + Filter	m3	4.28%	10,800.00	25.00	270,000.00	270,000.00
Conduit Struct. K30	Subdrainage conduit structure	m3	15.70%	3,344.00	296.05	990,000.00	1,260,000.00
Backfill K05	Rockfill	m3	69.12%	977,500.00	4.46	4,358,597.54	5,618,597.54
	Earthfill	m3	7.95%	112,500.00	4.46	501,628.87	6,120,226.41
Geosynthetic K31	Geosynthetics Installation	m2	2.95%	62,000.00	3.00	186,000.00	6,306,226.41
P-42880 P_LH1: Backfill LH1							\$909,019.01
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate
Filters K06	Bedding + Filter	m3	10.56%	3,840.00	25.00	96,000.00	96,000.00
Conduit Struct. K30	Subdrainage conduit structure	m3	31.68%	972.80	296.05	288,000.00	384,000.00
Backfill K05	Rockfill	m3	49.42%	100,740.00	4.46	449,191.93	833,191.93
	Earthfill	m3	5.89%	12,000.00	4.46	53,507.08	886,699.01
Geosynthetic K31	Geosynthetics Installation	m2	2.46%	7,440.00	3.00	22,320.00	909,019.01
P-42320 P_LH2: Backfill LH2							\$668,237.16
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate
Filters K06	Bedding + Filter	m3	14.37%	3,840.00	25.00	96,000.00	96,000.00
Conduit Struct. K30	Subdrainage conduit structure	m3	43.10%	972.80	296.05	288,000.00	384,000.00
Backfill K05	Rockfill	m3	34.99%	52,440.00	4.46	233,825.94	617,825.94
	Earthfill	m3	4.20%	6,300.00	4.46	28,091.22	645,917.16
Geosynthetic K31	Geosynthetics Installation	m2	3.34%	7,440.00	3.00	22,320.00	668,237.16
P-41740 P_LH3: Backfill LH3							\$791,035.90
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate
Filters K06	Bedding + Filter	m3	12.14%	3,840.00	25.00	96,000.00	96,000.00
Conduit Struct. K30	Subdrainage conduit structure	m3	36.41%	972.80	296.05	288,000.00	384,000.00
Backfill K05	Rockfill	m3	43.56%	77,280.00	4.46	344,585.59	728,585.59
	Earthfill	m3	5.07%	9,000.00	4.46	40,130.31	768,715.90
Geosynthetic K31	Geosynthetics Installation	m2	2.82%	7,440.00	3.00	22,320.00	791,035.90
P-41180 P_LH4: Backfill Lock Head 4							\$853,104.12
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate
Filters K06	Bedding + Filter	m1	11.25%	3,840.00	25.00	96,000.00	96,000.00
Conduit Struct. K30	Subdrainage conduit structure	m3	33.76%	972.80	296.05	288,000.00	384,000.00
Backfill K05	Rockfill	m3	46.88%	89,700.00	4.46	399,965.42	783,965.42
	Earthfill	m3	5.49%	10,500.00	4.46	46,818.69	830,784.12
Geosynthetic K31	Geosynthetics Installation	m2	2.62%	7,440.00	3.00	22,320.00	853,104.12
P-43180 P_Apprch WW: Backfill Wing Walls							\$1,655,504.77
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate
Filters K06	Bedding + Filter	m3	9.06%	6,000.00	25.00	150,000.00	150,000.00
Conduit Struct. K30	Subdrainage conduit structure	m3	26.09%	1,459.20	296.05	432,000.00	582,000.00
Backfill K05	Rockfill	m3	55.51%	206,080.00	4.46	918,894.92	1,500,894.92
	Earthfill	m3	7.54%	28,000.00	4.46	124,849.85	1,625,744.77
Geosynthetic K31	Geosynthetics Installation	m2	1.80%	9,920.00	3.00	29,760.00	1,655,504.77
P-40960 P_Entrance/Ocean WW: Backfill Wing Walls							\$3,095,887.73
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate
Filters K06	Bedding + Filter	m3	4.85%	6,000.00	25.00	150,000.00	150,000.00
Conduit Struct. K30	Subdrainage conduit structure	m3	26.16%	2,736.00	296.05	810,000.00	960,000.00
Backfill K05	Rockfill	m3	59.63%	414,000.00	4.46	1,845,994.25	2,805,994.25
	Earthfill	m3	7.56%	52,500.00	4.46	234,093.47	3,040,087.73
Geosynthetic K31	Geosynthetics Installation	m2	1.80%	18,600.00	3.00	55,800.00	3,095,887.73
P-N8500 A_Mts: Geosynthetics							\$1,099,260.00
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate
Geosynthetic s P30	P_LUC: Backfill Walls	m2	25.38%	62,000.00	4.50	279,000.00	279,000.00
Geosynthetic s P30	P_LMC: Backfill Walls	m2	25.38%	62,000.00	4.50	279,000.00	558,000.00
Geosynthetic s P30	P_LLC: Backfill Walls	m2	25.38%	62,000.00	4.50	279,000.00	837,000.00
Geosynthetic s P30	P_LH1: Backfill LH1	m2	3.05%	7,440.00	4.50	33,480.00	870,480.00
Geosynthetic s P30	P_LH2: Backfill LH2	m2	3.05%	7,440.00	4.50	33,480.00	903,960.00
Geosynthetic s P30	P_LH3: Backfill LH3	m2	3.05%	7,440.00	4.50	33,480.00	937,440.00
Geosynthetic s P30	P_LH4: Backfill Lock Head 4	m2	3.05%	7,440.00	4.50	33,480.00	970,920.00
Geosynthetic s P30	P_Apprch WW: Backfill Wing Walls	m2	4.06%	9,920.00	4.50	44,640.00	1,015,560.00
Geosynthetic s P30	P_Entrance/Ocean WW: Backfill Wing Walls	m2	7.61%	18,600.00	4.50	83,700.00	1,099,260.00

APPENDIX 1 TO VARIATION

2.) Detailed breakdown of the major features of work into programme cost loaded activities - Atlantic

ATLÁNTICO								16,600,796.69
A-42460 K Indicator A_LUC: Backfill Walls WS								\$3,793,467.15
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate	
Filters K06	Bedding + Filter	m3	7.12%	10,800.00	25.00	270,000.00	270,000.00	
Conduit Stuct. K30	Subdrainage conduit structure	m3	26.10%	3,344.00	296.05	990,000.00	1,260,000.00	
Backfill K05	Rockfill	m3	54.62%	471,500.00	4.39	2,071,878.42	3,331,878.42	
	Earthfill	m3	8.25%	71,250.00	4.39	313,088.73	3,644,967.15	
Geosynthetic K31	Geosynthetics Installation	m2	3.91%	49,500.00	3.00	148,500.00	3,793,467.15	
A-41920 A_LMC: Backfill Trench and Walls WS								\$3,390,296.75
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate	
Filters K06	Bedding + Filter	m3	7.96%	10,800.00	25.00	270,000.00	270,000.00	
Conduit Stuct. K30	Subdrainage conduit structure	m3	29.20%	3,344.00	296.05	990,000.00	1,260,000.00	
Backfill K05	Rockfill	m3	50.68%	391,000.00	4.39	1,718,143.08	2,978,143.08	
	Earthfill	m3	7.78%	60,000.00	4.39	263,653.67	3,241,796.75	
Geosynthetic K31	Geosynthetics Installation	m2	4.38%	49,500.00	3.00	148,500.00	3,390,296.75	
A-41380 A_LLC: Backfill Walls WS								\$3,317,791.99
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate	
Filters K06	Bedding + Filter	m3	8.14%	10,800.00	25.00	270,000.00	270,000.00	
Conduit Stuct. K30	Subdrainage conduit structure	m3	29.84%	3,344.00	296.05	990,000.00	1,260,000.00	
Backfill K05	Rockfill	m3	50.26%	379,500.00	4.39	1,667,609.46	2,927,609.46	
	Earthfill	m3	7.28%	55,000.00	4.39	241,682.53	3,169,291.99	
Geosynthetic K31	Geosynthetics Installation	m2	4.48%	49,500.00	3.00	148,500.00	3,317,791.99	
A-42660 A_LH1: Backfill LH1 WS								\$663,118.67
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate	
Filters K06	Bedding + Filter	m3	14.48%	3,840.00	25.00	96,000.00	96,000.00	
Conduit Stuct. K30	Subdrainage conduit structure	m3	43.43%	972.80	296.05	288,000.00	384,000.00	
Backfill K05	Rockfill	m3	34.75%	52,440.00	4.39	230,433.31	614,433.31	
	Earthfill	m3	3.98%	6,000.00	4.39	26,365.37	640,798.67	
Geosynthetic K31	Geosynthetics Installation	m2	3.37%	7,440.00	3.00	22,320.00	663,118.67	
A-42120 A_LH2: Backfill LH2 WS								\$668,391.75
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate	
Filters K06	Bedding + Filter	m3	14.36%	3,840.00	25.00	96,000.00	96,000.00	
Conduit Stuct. K30	Subdrainage conduit structure	m3	43.09%	972.80	296.05	288,000.00	384,000.00	
Backfill K05	Rockfill	m3	34.48%	52,440.00	4.39	230,433.31	614,433.31	
	Earthfill	m3	4.73%	7,200.00	4.39	31,638.44	646,071.75	
Geosynthetic K31	Geosynthetics Installation	m2	3.34%	7,440.00	3.00	22,320.00	668,391.75	
A-41580 A_LH3: Backfill LH3 WS								\$597,205.26
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate	
Filters K06	Bedding + Filter	m3	16.07%	3,840.00	25.00	96,000.00	96,000.00	
Conduit Stuct. K30	Subdrainage conduit structure	m3	48.22%	972.80	296.05	288,000.00	384,000.00	
Backfill K05	Rockfill	m3	28.43%	38,640.00	4.39	169,792.96	553,792.96	
	Earthfill	m3	3.53%	4,800.00	4.39	21,092.29	574,885.26	
Geosynthetic K31	Geosynthetics Installation	m2	3.74%	7,440.00	3.00	22,320.00	597,205.26	
A-41020 A_LH4: Backfill LH4 WS								\$579,672.29
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate	
Filters K06	Bedding + Filter	m3	16.56%	3,840.00	25.00	96,000.00	96,000.00	
Conduit Stuct. K30	Subdrainage conduit structure	m3	49.68%	972.80	296.05	288,000.00	384,000.00	
Backfill K05	Rockfill	m3	26.15%	34,500.00	4.39	151,600.86	535,600.86	
	Earthfill	m3	3.75%	4,950.00	4.39	21,751.43	557,352.29	
Geosynthetic K31	Geosynthetics Installation	m2	3.85%	7,440.00	3.00	22,320.00	579,672.29	
A-42920 A_Gatun WW: Backfill Wing Walls WS								\$1,095,276.02
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate	
Filters K06	Bedding + Filter	m3	13.70%	6,000.00	25.00	150,000.00	150,000.00	
Conduit Stuct. K30	Subdrainage conduit structure	m3	20.54%	760.00	296.05	225,000.00	375,000.00	
Backfill K05	Rockfill	m3	50.75%	126,500.00	4.39	555,869.82	930,869.82	
	Earthfill	m3	6.52%	16,250.00	4.39	71,406.20	1,002,276.02	
Geosynthetic K31	Geosynthetics Installation	m2	8.49%	31,000.00	3.00	93,000.00	1,095,276.02	
A-40780 A_Entrance/Ocean WW: Backfill Wing Walls WS								\$1,414,406.82
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate	
Filters K06	Bedding + Filter	m3	10.61%	6,000.00	25.00	150,000.00	150,000.00	
Conduit Stuct. K30	Subdrainage conduit structure	m3	15.91%	760.00	296.05	225,000.00	375,000.00	
Backfill K05	Rockfill	m3	58.95%	189,750.00	4.39	833,804.73	1,208,804.73	
	Earthfill	m3	7.96%	25,625.00	4.39	112,602.09	1,321,406.82	
Geosynthetic K31	Geosynthetics Installation	m2	6.58%	31,000.00	3.00	93,000.00	1,414,406.82	
A-N8500 A_Mts: Geosynthetics Supply								\$1,081,170.00
Recursos P6	Descripción	UOM	100.00%	Cantidad	Unit Price	Partial	Cumulate	
Geosynthetic su P30	A_LUC: Backfill Walls WS	m2	20.60%	49,500.00	4.50	222,750.00	222,750.00	
Geosynthetic su P30	A_LMC: Backfill Trench and Walls W:	m2	20.60%	49,500.00	4.50	222,750.00	445,500.00	
Geosynthetic su P30	A_LLC: Backfill Walls WS	m2	20.60%	49,500.00	4.50	222,750.00	668,250.00	
Geosynthetic su P30	A_LH1: Backfill LH1 WS	m2	3.10%	7,440.00	4.50	33,480.00	701,730.00	
Geosynthetic su P30	A_LH2: Backfill LH2 WS	m2	3.10%	7,440.00	4.50	33,480.00	735,210.00	
Geosynthetic su P30	A_LH3: Backfill LH3 WS	m2	3.10%	7,440.00	4.50	33,480.00	768,690.00	
Geosynthetic su P30	A_LH4: Backfill LH4 WS	m2	3.10%	7,440.00	4.50	33,480.00	802,170.00	
Geosynthetic su P30	A_Gatun WW: Backfill Wing Walls W:	m2	12.90%	31,000.00	4.50	139,500.00	941,670.00	
Geosynthetic su P30	A_Entrance/Ocean WW: Backfill Wi	m2	12.90%	31,000.00	4.50	139,500.00	1,081,170.00	

Activity ID	Activity Name	Current start	Current finish	\$\$ Change	Previous Budget	New Budget	Comments
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Budget Changes proposal - 9/5/2013

A-41020	A_LH4: Backfill LH4 WS	12-Jun-13	24-Feb-14	\$ (52,386.91)	\$ 632,059.20	\$ 579,672.29	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
A-41380	A_LLC: Backfill Walls WS	22-Oct-13	21-Mar-14	\$ (406,276.82)	\$ 3,724,068.81	\$ 3,317,791.99	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
A-41920	A_LMC: Backfill Trench and Walls WS	03-Apr-13 A	28-Feb-14	\$ (476,852.13)	\$ 3,867,148.88	\$ 3,390,296.75	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
A-42460	A_LUC: Backfill Walls WS	15-Feb-13 A	24-Dec-13	\$ (1,091,922.01)	\$ 4,885,389.16	\$ 3,793,467.15	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
A-40780	A_Entrance/Ocean WW: Backfill Wing Walls WS	07-Dec-13	17-May-14	\$ 490,470.73	\$ 923,936.09	\$ 1,414,406.82	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
A-42660	A_LH1: Backfill LH1 WS	14-Feb-13 A	20-Feb-14	\$ 209,957.28	\$ 453,161.39	\$ 663,118.67	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
A-41580	A_LH3: Backfill LH3 WS	31-Jan-13 A	21-Oct-13	\$ 415.78	\$ 596,789.48	\$ 597,205.26	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
A-47120	A_LH2: Backfill LH2 WS	06-Dec-12 A	21-Oct-13	\$ 93,567.81	\$ 574,823.94	\$ 668,391.75	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
A-42920	A_Gatun WW: Backfill Wing Walls WS	03-Feb-14	17-May-14	\$ 151,856.28	\$ 943,419.74	\$ 1,095,276.02	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
A-N8500	A_MHs: Supply Geosynthetics	22-Apr-13 A	30-Apr-14	\$ 1,081,170.00	\$ -	\$ 1,081,170.00	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
				\$ -	\$ 16,600,796.69	\$ 16,600,796.69	

P-43180	P_Apprch WW: Backfill Wing Walls WS	15-Feb-13 A	06-Oct-14	\$ (121,022.25)	\$ 3,171,506.21	\$ 3,050,483.96	Correction for the allocation of the Resource E30 31.06 Structural Concrete (Not including Reinforcing)
P-43160	P_Apprch WW: Install Concrete WS	01-Dec-12 A	07-Jul-14	\$ 121,022.25	\$ 20,142,024.96	\$ 20,265,047.21	

P-41540	P_LUC: Backfill Walls WS	28-Sep-13	06-Oct-14	\$ (3,008,408.59)	\$ 9,314,635.00	\$ 6,306,226.41	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
P-42120	P_LMC: Backfill Walls WS	09-Apr-13 A	06-Oct-14	\$ (815,303.86)	\$ 6,439,315.00	\$ 5,624,011.14	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
P-43180	P_Apprch WW: Backfill Wing Walls WS	15-Feb-13 A	06-Oct-14	\$ (1,394,979.19)	\$ 3,050,483.96	\$ 1,655,504.77	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
P-41180	P_LH4: Backfill LH4 WS	27-Dec-12 A	02-May-14	\$ 170,769.62	\$ 682,334.50	\$ 853,104.12	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
P-41740	P_LH3: Backfill LH3 WS	17-Sep-12 A	03-Feb-14	\$ 241,570.46	\$ 549,465.44	\$ 791,035.90	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
P-42320	P_LH2: Backfill LH2 WS	04-Feb-13 A	11-Feb-14	\$ 278,684.67	\$ 389,552.49	\$ 668,237.16	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
P-42680	P_LUC: Backfill Walls WS	09-Apr-13 A	26-Jul-14	\$ 1,572,194.00	\$ 5,717,225.00	\$ 7,289,419.00	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
P-42880	P_LH1: Backfill LH1 WS	15-Jan-13 A	13-Feb-14	\$ 461,232.76	\$ 427,786.25	\$ 909,019.01	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
P-40960	P_Entrance/Ocean WW: Backfill Wing Walls WS	24-Mar-14	06-Oct-14	\$ 1,374,980.13	\$ 1,720,907.60	\$ 3,095,887.73	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
P-N8500	A_MHs: Supply Geosynthetics	22-Apr-13 A	30-Apr-14	\$ 1,099,260.00	\$ -	\$ 1,099,260.00	To balance the budget between unit price and quantities for areas, it was necessary distribute the money through the total budget.
				\$ (0.00)	\$ 28,291,705.24	\$ 28,291,705.24	

Activity ID	Activity Name	Budgeted Total Cost	Total Float	Duration	Start	Finish	BL Start	BL Finish	% Complete
PCEP - Current Monthly Update 130520.015.MU40									
Contract for the Design Build of the Third Set of Locks									
Construction of the Atlantic Post-Panamax Locks									
Concretes and backfills									
A-42120	A_LH2: Backfill LH2 WS	668,391.75	43	205	06-Dec-12 A	14-Oct-13	10-Dec-12	30-Nov-13	34.5%
A-41580	A_LH3: Backfill LH3 WS	597,205.26	114	157	31-Jan-13 A	28-Sep-13	13-Feb-13	30-Oct-13	1.2%
A-42660	A_LH1: Backfill LH1 WS	663,118.67	161	201	14-Feb-13 A	28-Dec-13	18-Feb-13	29-Apr-14	0%
A-42460	A_LUC: Backfill Walls WS	3,793,467.15	71	191	15-Feb-13 A	16-Dec-13	26-Mar-13	12-Sep-13	6.7%
A-41920	A_LMC: Backfill Trench and Walls WS	3,390,296.75	19	174	03-Apr-13 A	16-Jan-14	14-Jun-13	11-Jan-14	1.7%
A-41020	A_LH4: Backfill LH4 WS	579,672.29	84	140	25-May-13	20-Jan-14	25-May-13	24-Feb-14	0%
A-41380	A_LLC: Backfill Walls WS	3,317,791.99	10	104	30-Sep-13	07-Mar-14	30-Sep-13	05-Mar-14	0%
A-40780	A_Entrance/Ocean WW: Backfill Wing Walls V	1,414,406.82	14	122	27-Nov-13	08-May-14	27-Nov-13	03-May-14	0%
A-42920	A_Gatun WW: Backfill Wing Walls WS	1,095,276.02	14	80	27-Jan-14	08-May-14	27-Jan-14	06-May-14	0%
Bulk materials storage / stock / production									
A-N8500	A_Mils: Supply Geosynthetics	1,081,170.00	14	218	22-Apr-13 A	07-May-14	13-May-13	16-May-13	14.92%
Construction of the Pacific Post-Panamax Locks									
Concretes and backfills									
P-41740	P_LH3: Backfill LH3 WS	791,035.90	1	331	17-Sep-12 A	17-Feb-14	26-Dec-12	15-Apr-14	1.1%
P-41180	P_LH4: Backfill LH4 WS	853,104.12	0	282	27-Dec-12 A	26-Feb-14	13-Jul-13	30-May-14	9.7%
P-42880	P_LH1: Backfill LH1 WS	909,019.01	183	222	15-Jan-13 A	27-Dec-13	29-Jan-13	28-Dec-13	18%
P-42320	P_LH2: Backfill LH2 WS	668,237.16	52	201	04-Feb-13 A	23-Dec-13	13-Feb-13	24-Mar-14	28.8%
P-43180	P_Apprch WW: Backfill Wing Walls WS	1,655,504.77	3	378	15-Feb-13 A	18-Sep-14	03-Jun-13	16-May-14	5%
P-42680	P_LUC: Backfill Walls WS	7,289,419.00	17	342	09-Apr-13 A	30-Sep-14	15-Apr-13	25-Nov-14	0.9%
P-42120	P_LMC: Backfill Walls WS	5,624,011.14	6	316	14-May-13 A	30-Sep-14	04-Jul-13	03-Mar-15	0.2%
P-41540	P_LLC: Backfill Walls WS	6,306,226.41	6	315	14-May-13 A	29-Sep-14	26-Jun-13	15-Jan-15	0.2%
P-40960	P_Entrance/Ocean WW: Backfill Wing Walls V	3,095,887.73	11	123	12-Mar-14	18-Sep-14	12-Mar-14	18-Aug-14	0%
Bulk materials storage / stock / production									
P-N8500	P_MTLS: Supply Geosynthetics	1,099,260.00	36	218	22-Apr-13 A	07-May-14	21-Feb-11	19-Oct-14	0%
21-Jun-13									