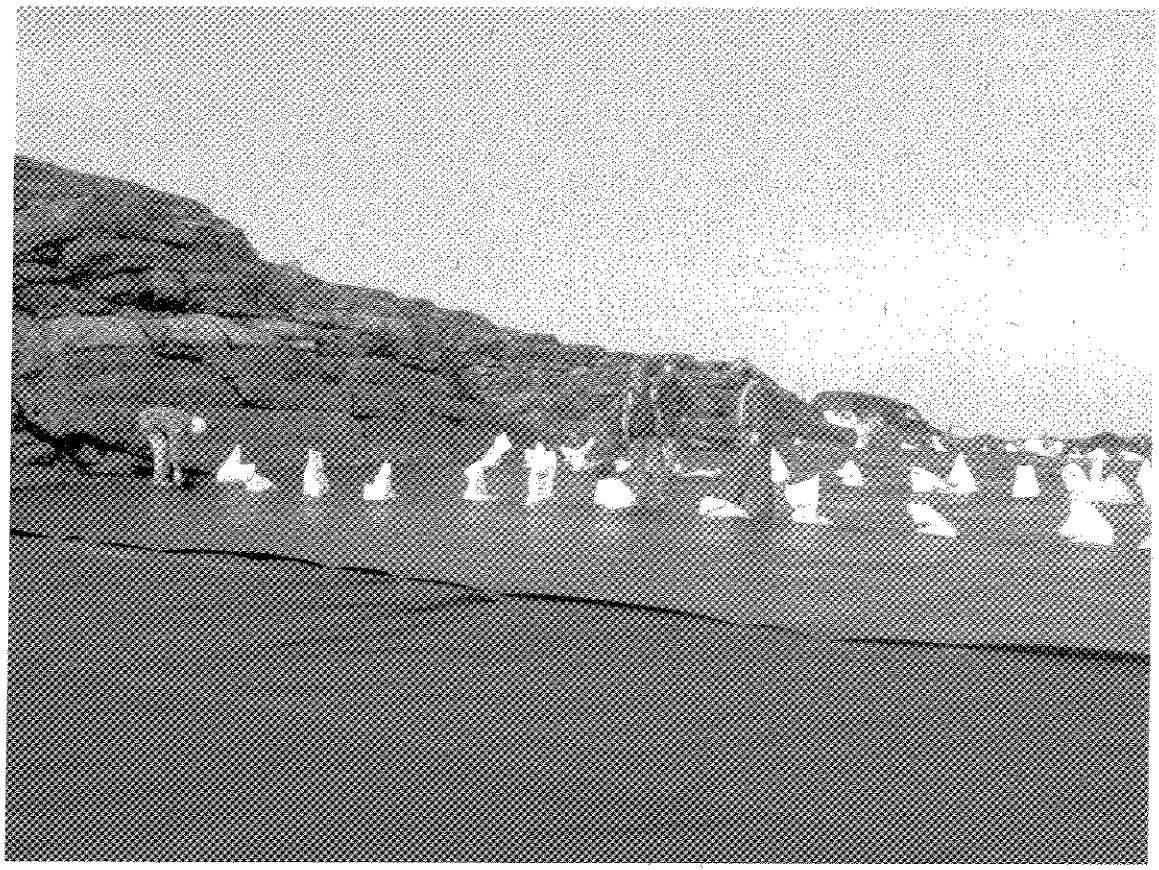
Appendix 4

Geomembrane installation QA/QC report

PREPARED FOR:
QIKIQTAALUK ENVIRONMENTAL
QUEEN MARY
MONTREAL, QC.
H3V 1A2

QUALITY CONTROL REPORT

LAND FILL SEALING
RESOLUTION ISLAND
NUNAVUT



INSTALLATION OF GEOSYTHETICS PRODUCTS
HDPE 1,5 MM (60 MIL) SMOOTH

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Introduction

This report was prepared by Z-Tech/Geogard Inc. for Qikiqtaaluk Environmental concerning the sealing of the landfill site at Resolution island.

This report gives, a brief description of the work, step by step. A resume of the techniques for quality control, the manufacturers' quality insurance, the certification of the work done and an as built plan.

The work realised during the month of August 2005, consisted of the installing of a smooth high density polyethylene (HDPE) geomembrane liner of 1.5mm in thickness.

The assembly procedures of the liner were realised with due art of the geosynthetics industries.

Hopping everything is to your entire satisfaction.

L'Équipe Z-Tech/Geogard Inc.

Intervenants

The installation of the geomembrane liner was done over a period of 7 days from the 7th of August till the 13th of August 2005

Intervening parties;

QIKIQTAALUK CORP., **General contractor**
- M. Harry Flaherty

QIKIQTAALUK ENVIRONEMENTAL, **Consultant**
- M. Greg Johnson

Z-TECH/GEOGARD INC., **geomembrane liner installer**
- M. Denis Bolduc, foreman;
- M. Jerry Pigeon, welding technician;

3.1 Collaboration from the general contractor

Responsibilities regarding the general contractor towards the geomembrane installer (ZTG) before and during the work:

- Preparation and cleaning of the surface to cover. Such as removing garbage, compacting the foundation, etc…
- Surveying
- Preparing access roads to the site.
- Removal of water or snow from the site during installation
- Transport and disposal of wastes from the work (left over geomembrane, sand bags, etc…)
- Anticipating the need for a digger capable of lifting 5000 pounds for the duration of the work.

3.2 Installation procedures of the geomembrane

3.2.1 Foundation inspection & acceptation

The work surface was inspected upon arrival. The members of the installation team made sure no objects were found that could damage the geomembrane liner. See the foundation inspection & acceptation certificate in annex A.

3.2.2 Installation conditions

Wind, humidity and temperature have a direct effect on the efficiency of the welds. As such, the weather must be ideal. No deployment shall be done in bad or unreliable weather. A strong gust of wind can lift a panel during installation, sand bags or other material may be used to keep the panels from lifting.

3.2.3 Panel deployment

During panel deployment a digger or other heavy machinery lifts the geomembrane roll that was previously installed on a reel made for this purpose. The extremity of the roll is then secured to an all-terrain vehicle to be deployed. This all terrain vehicle is the only vehicle authorised to circulate on the geomembrane. Any other vehicle that needs to circulate on the geomembrane must be approved by our foreman.

The panels must be deployed in the same direction as the slopes. No welds shall run across a slope. The panel must be at least 1.5 meters away from the slope. Each panel shall be positioned side by side with an overlapping of 100mm to 200mm depending on the atmospheric conditions. This tolerance is needed for HDPE reacts vividly with temperature a variation which implies strong expansion or contraction. These effects are very important to consider, especially at the bottom of the slopes where the geombrane line can do a trampoline effect as it contracts. An appropriate installation method will help counteract these effects.

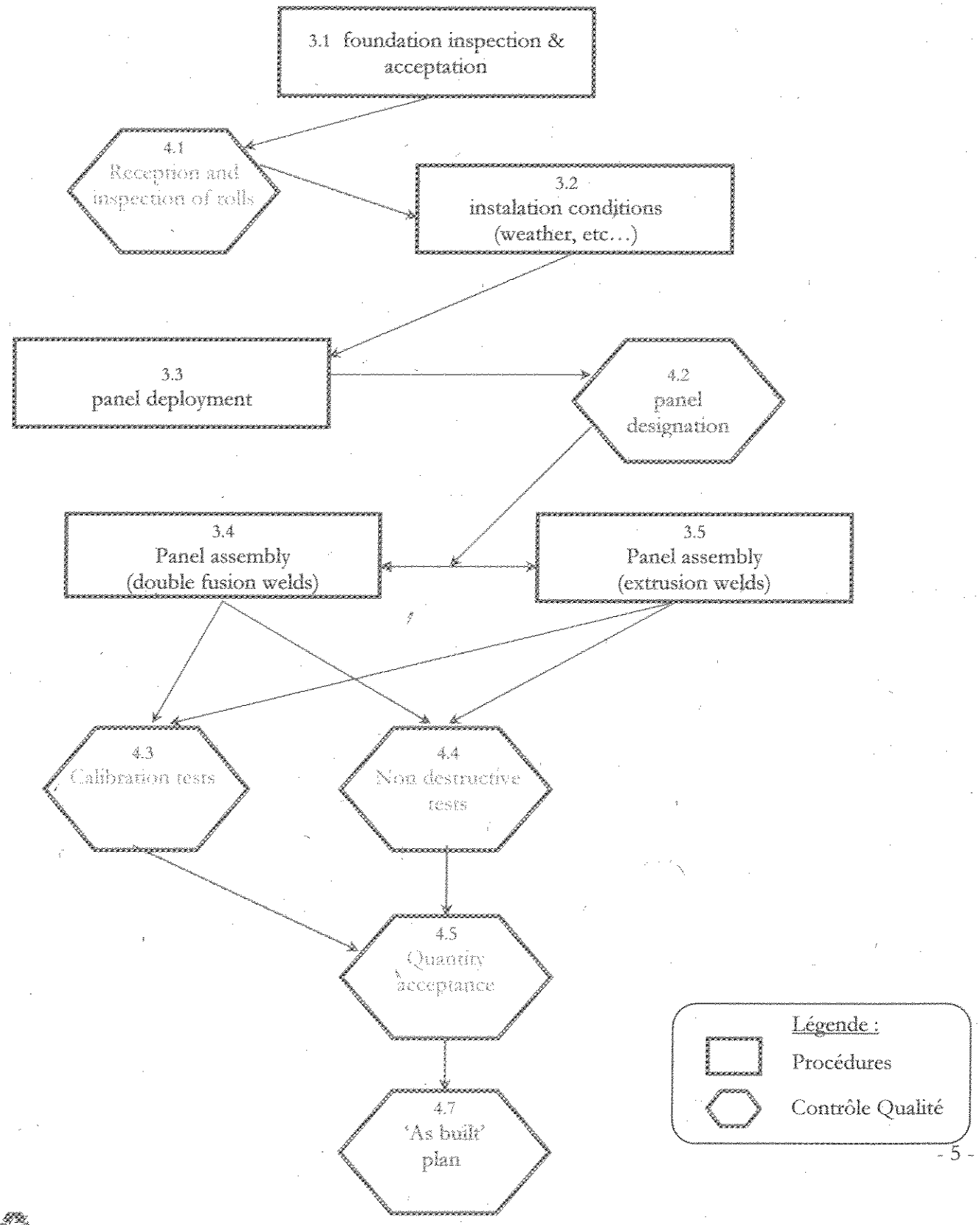
3.2.4 Panel assembly (double fusion welds)

When preparing to weld the geomembrane liner. Particular attention must be paid to the welding surface. No dirt, mud or moisture will be tolerated on it. A protection liner may be placed under the welding surface to protect the face from dirt from below which can interfere with the welding process. The assembly of panels is done with a dge welding machine operated by a qualified technician. The wedge welding machine is a mobile machine that welds the panels' bye controlling the temperature, pressure and the speed at which it moves. This procedure creates a continues weld 40mm wide with an empty channel between the two welds. The channel will later be used for air pressure testing of the weld.

3.2.5 Panel assembly (extrusion welding)

This type of weld is used primarily at the intersection of three or more panels, around any object that must go through the geomembrane liner and for general repairs of the liner. Prior to extrusion welding the extruder must be purged of left over resin still in the machine. All solvents and tapes are banned. For repairs where the geomembrane is perforated by a hole larger than 12mm a replacement part with a diameter of at least 300mm is used for the repair. The surface to be welded must be prepared by lightly sanding the area where the extrusion shall be done. The area must not be sanded more than one hour prior to the welding and the sanded area must be no larger then 7mm on either side of the weld.

Quality control



4.1 Reception and inspection of geomembrane rolls

The quality control (QC) technician inspects and identifies each roll as he arrives at the work site. Transportation and loading/unloading should not affect the integrity of the rolls. Quality insurance given bye the manufacturer is also checked to confirm that the right rolls have been sent to the work site.

4.2 Panel designation

As each panel is deployed the QC technician or the foremen do a visual inspection to find any defect on the panel. A number is given to each panel and is the reproduced on the 'as built' drawing.

4.3 Calibration tests

The welding equipments are tested daily a test is done on all machines that are to be used every 4 hours and following any drastic change in temperature. A weld sample is done in the new conditions with the same materials that are to be used that day.
The samples are 25mm in width and 150mm in length with the weld being in the center of the sample. These samples are then tested for there strength in peeling and tearing. The technician is authorised to start welding only after the positive results of these tests

4.4 Non destructive tests

4.4.1 Leak testing of the welds

All welds are visually inspected and tested. Either by air pressure testing or vacuum box testing. These tests are to confirm that the welds do not leak.

4.4.2 Pressure testing

This type of testing is done on all longitudinal welds that have a central channel. The method for this type of test is to inject air in the channel at a controlled pressure (20 to 40 PSI) and to verify that the pressure remains unchanged. If the pressure drops then the leak is then localised by visual inspection or with vacuum box.

4.4.3 Vacuum box testing

This type of testing is confined to areas where air pressure tests can not be done or where extrusion welds were used. This method requires spreading soapy water over the welds to be tested. A vacuum box is then position over the area. The vacuum creates a negative pressure zone. If there is a leak the soapy water will create bubbles which will then confirm a leak.

4.5 Quantity acceptance

These are the quantities obtained by a common accord between the installer (ZTG) and the person representing the owner. These are the sum of the measured panel and welds as written in the job registries in annex A

4.6 Realisation of the « As built » plan»

The 'as built' plans are a representation of the assembly of the panels and construction detail (walls, junctions, etc…) and repairs.

As each panel was deployed a number was given to them by the quality control technician or the foreman. This number is then put in the 'as built' plans. This way each panel is easily retraceable.

Acceptation of the work

This document, prepared by Z-Tech/geogard Inc. in regards to a contract given by Qikiqtaaluk Environmental., certifies that the installation of the geomembrane liner was installed with due art in accordance with the geosynthetics industries and are in accordance with the emitted plans.

Jean-Marc Brunet,
Technical director
Z-Tech/Geogard Inc.

List of annexes

Annexes

« A » job site registry
- foundation inspection & acceptation
- Reception and inspection of geomembrane rolls
- Panel deployment
- Calibration tests
- Welding registry

« B » « As built » plan

RECEPTION INSPETION

Project : Resolution Island

File Number : ZTG-05-003

Work site : Nunavut

Q.C. Technician : **Denis Bolduc**

Material HDPE 1,5 mm smooth | Manufacturer: GSE | Factory: **X** | Work site : **X**

Roll number	Dimensions (m)	Other
115 139 679	6,85 X 171	
115 141 100	6,85 X 171	
115 143 432	6,85 X 171	
	6,85 X 87	Balance ZTG
	6,85 x 171	Balance 2004
	6,85 x 171	Balance 2004

PANEL POSITIONING

Project : Resolution Island File number: ZTG-05-003

Work site : Nunavut

Q.C. Technician. :Denis Bolduc

Panel number	Roll Number	Deployment date	width Lin. M.	Length m.lin.	Area m^2
1	115 139 679	8-Aug-05	6,7	40	268
2	115 139 679	8-Aug-05	6,7	40	268
3	115 139 679	8-Aug-05	6,7	41	274,7
4	115 139 679	8-Aug-05	6,7	43	288,1
5a	115 139 679	8-Aug-05	6,7	7	46,9
5b	115 141 100	8-Aug-05	6,7	36	241,2
6	115 141 100	9-Aug-05	6,7	45	301,5
7	115 141 100	9-Aug-05	6,7	46	308,2
8	115 141 100	9-Aug-05	6,7	46	308,2
9a	115 143 432	9-Aug-05	6,7	42	281,4
9b	115 141 100	9-Aug-05	6,7	6	40,2
10	115 143 432	9-Aug-05	6,7	51	341,7
11	115 143 432	9-Aug-05	6,7	54	361,8
12	115 143 432	9-Aug-05	6,7	56	375,2
13	Balance 2004	9-Aug-05	6,7	56	375,2
14	Balance 2004	10-Aug-05	6,7	59	395,3
15a	Balance 2004	10-Aug-05	6,7	53	355,1
15b	Balance 2004	10-Aug-05	6,7	7	46,9
16	Balance 2004	10-Aug-05	6,7	62	415,4
17	Balance 2004	10-Aug-05	6,7	62	415,4
18a	Balance 2004	10-Aug-05	6,7	35	234,5
18b	Balance ZTG	10-Aug-05	6,7	32	214,4
19	Balance ZTG	10-Aug-05	6,7	72	482,4
				TOTAL:	6 639,70

CALIBRATION REGISTRY

Project : Resolution Island

File number : ZTG-05-003

Work site : Nunavut

Q.C. technician : **Denis Bolduc**

Material: HDPE 1,5 mm smooth

Minimum peel: 75%

Minimum tear: 95%

Calib. no.	Date	Time	Tech.	Equip. no.	T°	T° preheat. Speed	Peal break. (lbs)	Peal break. (lbs)	tear (lbs)	tear (lbs)	Parent (lbs)
1	8 août 2005	AM	JP	W4	350	3,5	105/103	106/104	133	134	135
2	8 août 2005	PM	JP	W4	350	3,5	100/106	101/103	131	130	132
3	9 août 2005	AM	JP	W4	350	3,5	105/103	98/100	132	132	136
4	9 août 2005	PM	DB	W4	350	3,5	101/106	105/106	131	129	133
5	10 août 2005	AM	DB	W4	350	3,5	102/103	101/105	134	130	135
6	10 août 2005	PM	DB	W4	350	3	100/102	106/104	133	133	134
7	12 août 2005	AM	JP	W4	350	3	103/102	103/103	134	132	135
8	12 août 2005	PM	DB	W4	350	3,5	106/100	100/101	130	133	132
9	13 août 2005	AM	JP	EXG	225	210	110	112	131	131	133
10	14 août 2005	AM	DB	EXG	225	210	109	110	134	134	137

WELD REGISTRY

Project : Resolution Island

File number : ZTG-05-003

Work site : Nunavut

Q.C. Technician : **Denis Bolduc**

Weld number	Date	Time	Length (m)	Welding technician	Machine number	Calibration number	air test (PSI)
S1/2	08-August-2005	AM	40	JP	W4	1	35
S2/3	08-August-2005	AM	40	JP	W4	1	35
S3/4	08-August-2005	PM	41	JP	W4	2	35
S5A/5B	08-August-2005	PM	6,8	JP	W4	2	35
S4/5	08-August-2005	PM	43	JP	W4	2	35
S5/6	09-August-2005	AM	43	JP	W4	3	35
S6/7	09-August-2005	AM	45	JP	W4	3	35
S7/8	09-August-2005	AM	46	DB	W4	3	35
S9A/9B	09-August-2005	AM	6,8	DB	W4	3	35
S8/9	09-August-2005	PM	46	DB	W4	4	35
S9/10	09-August-2005	PM	48	DB	W4	4	35
S10/11	09-August-2005	PM	51	DB	W4	4	35
S11/12	09-August-2005	PM	54	DB	W4	4	35
S12/13	09-August-2005	PM	56	DB	W4	4	35
S13/14	10-August-2005	AM	56	DB	W4	5	35
S15A/15B	10-August-2005	AM	6,8	DB	W4	5	35
S14/15	10-August-2005	AM	59	DB	W4	5	35
S15/16	10-August-2005	AM	60	DB	W4	5	35
S16/17	10-August-2005	PM	62	DB	W4	6	35
S18A/18B	10-August-2005	PM	6,8	DB	W4	6	35
S17/18	10-August-2005	PM	65	DB	W4	6	35
S18/19	10-August-2005	PM	67	DB	W4	6	35
SP1	12-August-2005	AM	72	JP	W4	7	35
SP2	12-August-2005	PM	129	JP	W4	8	35
SP3	12-August-2005	PM	40	JP	W4	8	35