

Appendix 1

REHABILITATION INTERVENTION DETAIL

APPENDIX 1: REHABILITATION INTERVENTION DETAILS

This appendix provides a summary of details pertaining to the interventions proposed for the wetland rehabilitation plan. The summary includes an overall layout of the proposed rehabilitation plan (provided in **Figure 1 and Figure 2**) and a summarised implementation cost estimation for each of the interventions using typical Working for Wetlands rates and private contractor rates (provided in **Table 1**). The details of each proposed intervention are also provided in this Appendix, which includes a table with the following relevant information:

- Intervention type;
- Intervention objectives;
- Co-ordinate locations;
- Dates of when the structure was planned; and
- Intervention drawing numbers.

In addition to the tabulated relevant information, a photograph, Bill of Quantities and intervention specific implementation notes for each of the proposed intervention have been provided.

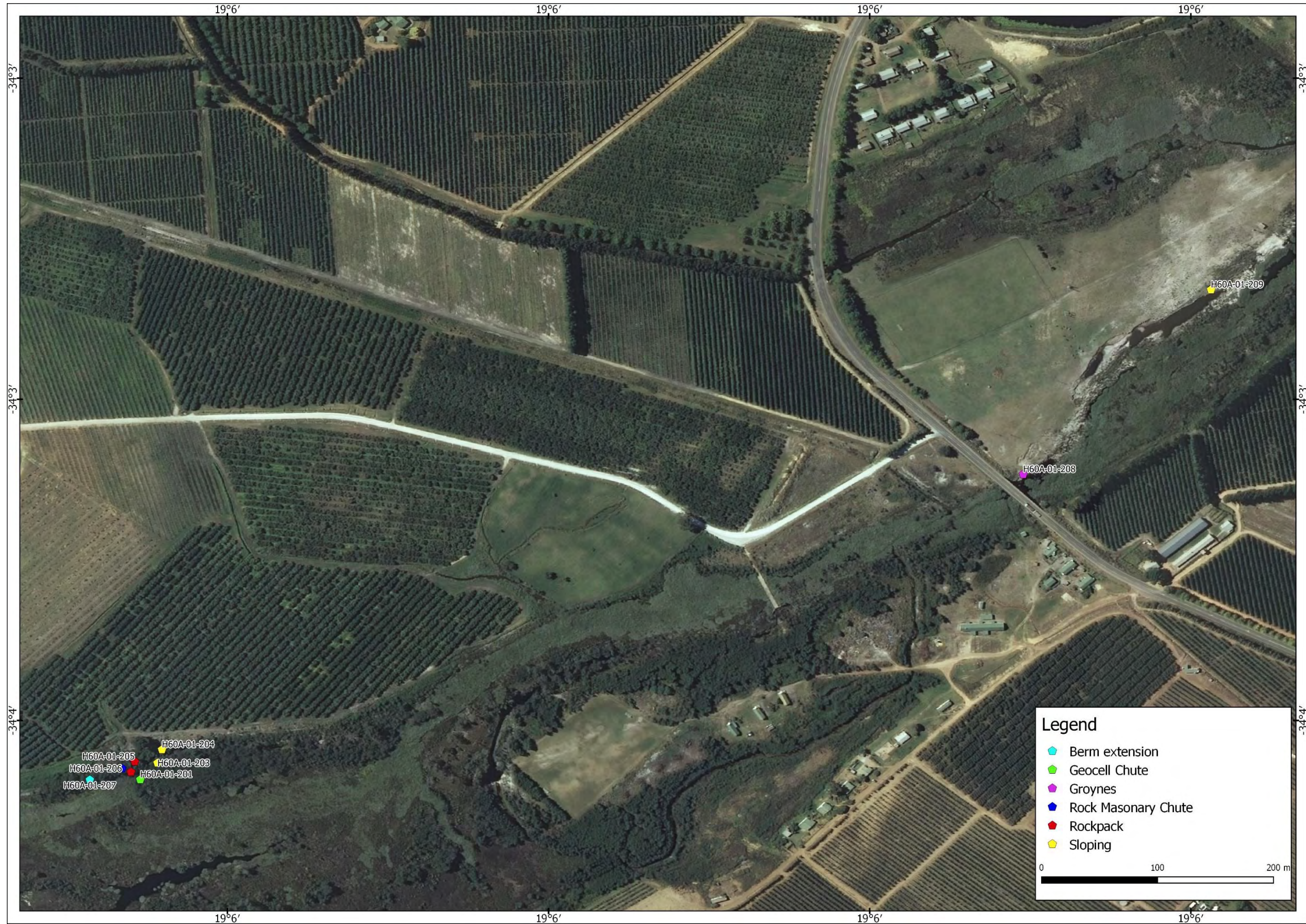


Figure 1: Layout of the upstream 9 interventions out of the total 20 interventions proposed

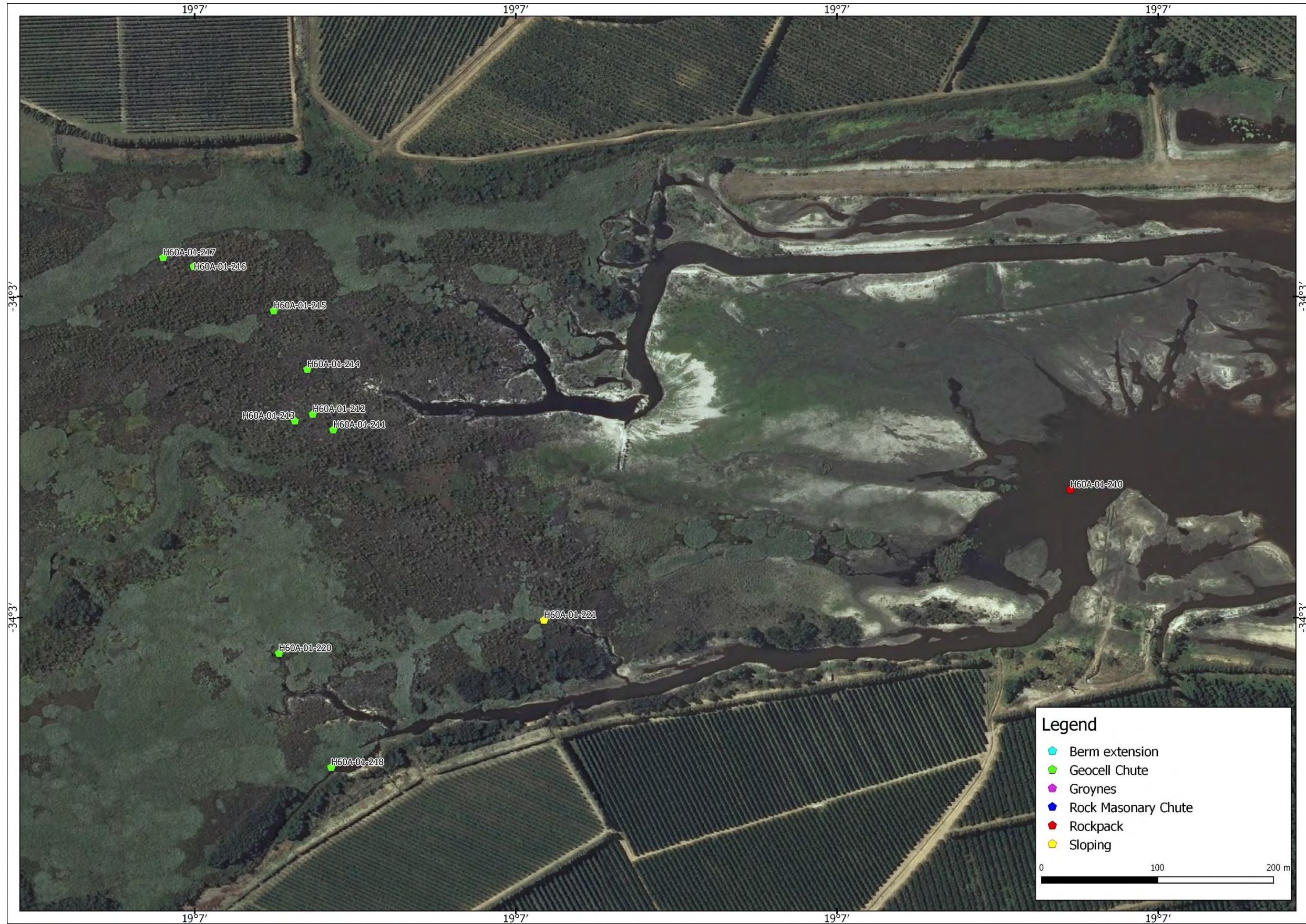


Figure 2: Layout of the downstream 11 interventions out of the total 20 interventions proposed

Table 1: Cost estimate for implementation of interventions based on Working for Wetlands (WFW) and private contractor rates

INTERVENTION	DESCRIPTION	COST ESTIMATE WFW RATES	COST ESTIMATE PRIVATE CONTRACTOR RATES
H60A-01-201	Geo-cell concrete chute	R 142,702.00	R 53,576.10
H60A-01-202	Rock pack	R 21,381.50	R 8,799.42
H60A-01-203	Sloping and stabilisation	R 3,266.51	R 1,826.71
H60A-01-204	Sloping and stabilisation	R 28,274.02	R 13,132.01
H60A-01-205	Rock pack	R 11,540.00	R 5,341.30
H60A-01-206	Rock Masonry Chute	R 49,493.75	R 21,157.78
H60A-01-207	Earthworks	R 35,335.00	R 11,430.00
H60A-01-208	Sloping with Groynes	R 1,576,730.00	R 339,605.60
H60A-01-209	Sloping and stabilisation	R 52,102.00	R 25,662.00
H60A-01-210	Sloping with rock pack	R 12,175.00	R 5,742.00
H60A-01-211	Geo-cell concrete chute	R 660,235.00	R 272,147.20
H60A-01-212	Geo-cell concrete chute	R 549,305.00	R 226,415.60
H60A-01-213	Geo-cell concrete chute	R 520,955.00	R 221,801.60
H60A-01-214	Geo-cell concrete chute	R 749,400.00	R 317,710.00
H60A-01-215	Geo-cell concrete chute	R 875,755.00	R 368,903.60
H60A-01-216	Geo-cell concrete chute	R 470,535.00	R 202,721.20
H60A-01-217	Geo-cell concrete chute	R 241,310.00	R 104,505.20
H60A-01-218	Geo-cell concrete chute	R 92,425.00	R 41,306.00
H60A-01-220	Geo-cell concrete chute	R 269,170.00	R 116,166.40
H60A-01-221	Sloping and stabilisation	R 2,883.50	R 2,088.50
Sub Total		R 6,365,329.28	R 2,360,038.22

1.1 Intervention H60A-01-201

Intervention Type	Geocell chute
Rehabilitation Objective	Stabilise the head-cut and prevent further erosion and soil mobilisation
Latitude	34° 03' 34.36" S
Longitude	19° 05' 28.27" E
Designed By	Trevor Pike
Date	June 2018
Alternatives Considered	Drop Inlet Weir
Design Drawing Number	H60A-01-201



Figure 1.1.1 Proposed location of geocell chute

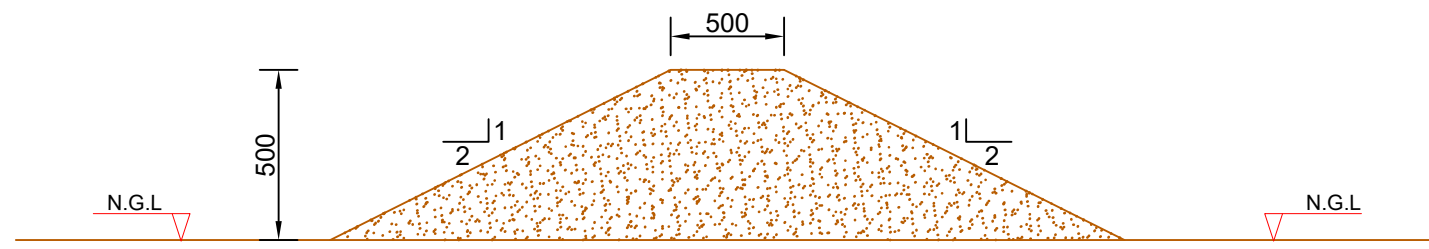
1.1.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01201.1	Excavation	m ³	74
H60A01201.2	Earthworks for earthen berms	m ³	19
H60A01201.3	Concrete		
H60A01201.3.1	Concrete for infilling Geocells	m ³	12
H60A01201.3.2	Concrete for velocity breaker blocks	m ³	1
H60A01201.4	150 mm Geocells. Rate to allow for installation as per supplier instruction. Concrete not to be included in rate.	m ²	79
H60A01201.5	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	79

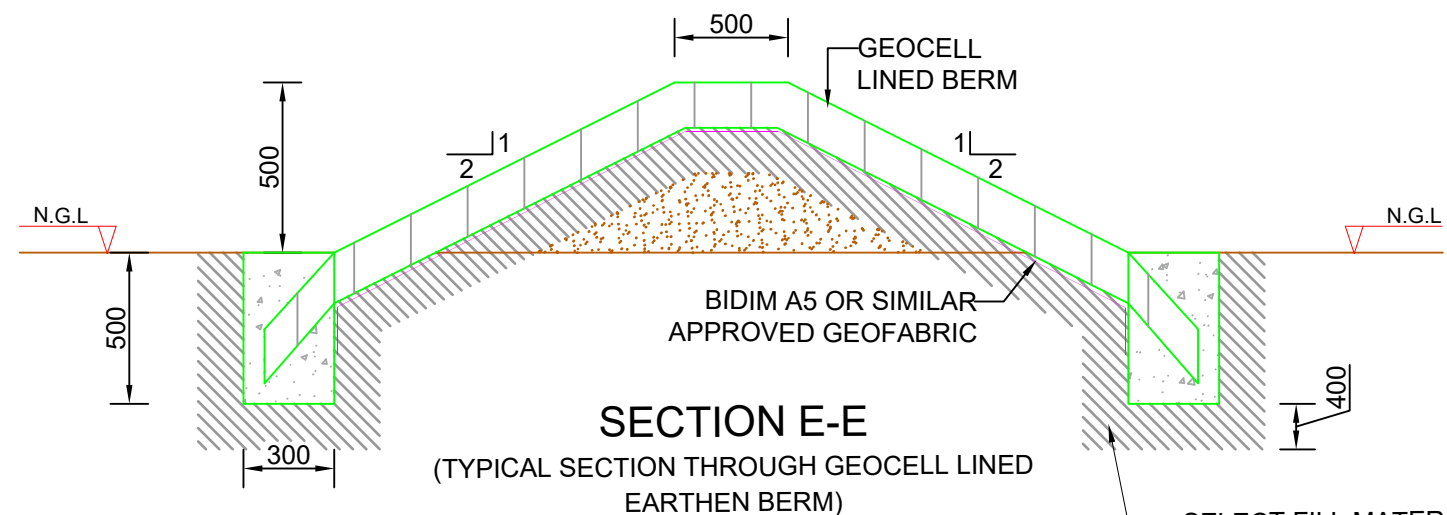
1.1.2 Construction notes for intervention H60A-01-201

The following construction notes apply to the proposed concrete filled geocell chute intervention:

- The side banks are to be sloped back to a 1:2 slope (V:H);
- Vegetation and topsoil is to be removed from the footprint of the earthen berms (associated with the chute) prior to their construction. Topsoil is not to be used in the construction of the earthen berm;
- The base of the excavation is to be well compacted and any unsuitable material removed and replaced with gravel or suitable material prior to construction;
- The geocells (and concrete fill) are to be installed according to the supplier's specifications.
- The geocells are to be laid on cut insitu material and not fill material;
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.

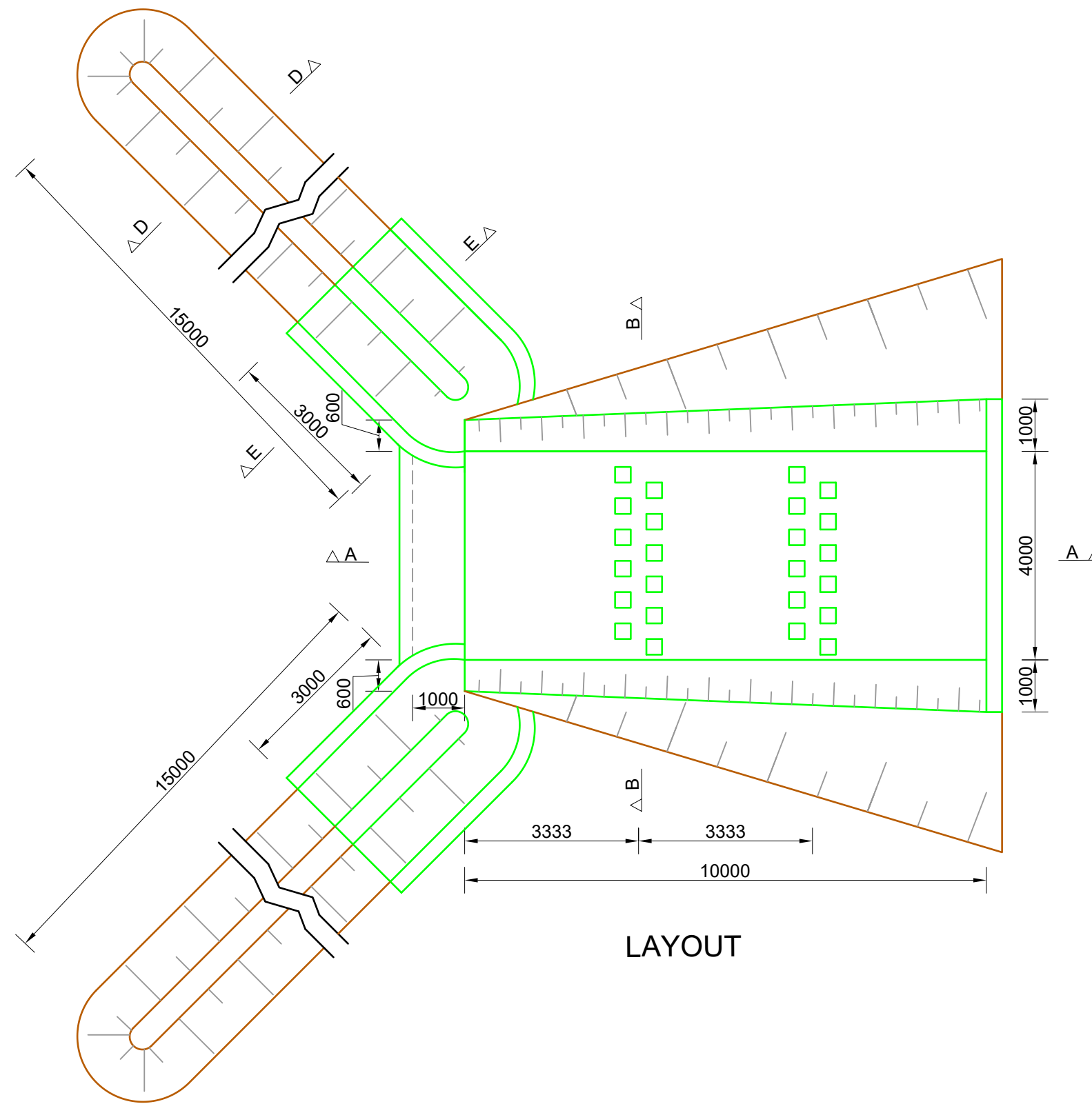


SECTION D-D
(TYPICAL SECTION THROUGH
EARTHEN BERM)

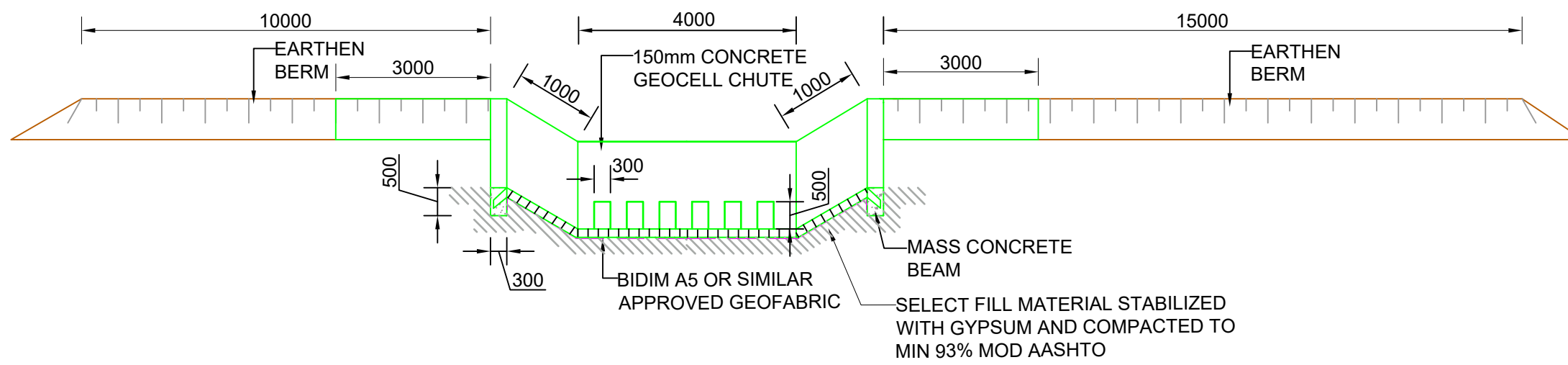


SECTION E-E
(TYPICAL SECTION THROUGH GEOCELL LINED
EARTHEN BERM)

SELECT FILL MATERIAL STABILIZED
WITH GYPSUM AND COMPACTED TO
MIN 93% MOD AASHTO

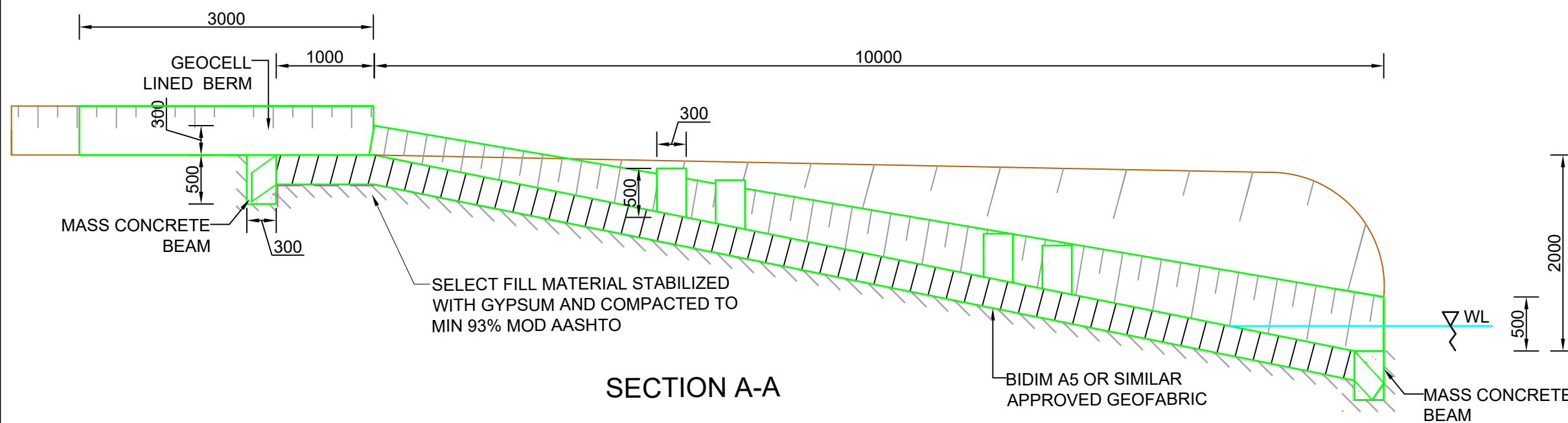


LAYOUT



SECTION B-B

SELECT FILL MATERIAL STABILIZED
WITH GYPSUM AND COMPACTED TO
MIN 93% MOD AASHTO



SECTION A-A

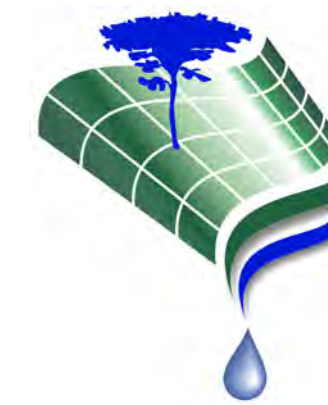
BIDIM A5 OR SIMILAR
APPROVED GEOFABRIC

MASS CONCRETE
BEAM

NOTES:

1. Min 28 day concrete compressive strength of 30MPa unless otherwise stated.
2. Grade 30/19 or 30/26 concrete can be used.
3. Min concrete 28 day flexural strength of 4.1MPa.
4. Max concrete slump of 70mm.
5. Min concrete cement content of 310kg/m².
6. Water : cement ratio not more than 0.52.
7. Wood float finish to all concrete surfaces.
8. All dimensions shown in mm.
9. Geocells are to be installed as per supplier specification, with stakes at the specified spacing/ intervals.

**PRELIMINARY DRAWING
NOT FOR CONSTRUCTION**



GroundTruth

*Water, Wetlands and
Environmental Engineering*

P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:

**THE NATURE CONSERVANCY PROJECT
CONCRETE GEOCELL CHUTE
H60A-01-201**

DATE: JUNE 2018

DRAWN: T. HARVEY

DRAWING CHECKED: T. PIKE

DESIGNED: T. HARVEY

DESIGN CHECKED: T.PIKE

Longitude	Latitude	SCALE:	1:100 ON A2L	REV:
19° 05' 28.27" E	34° 03' 34.36" S	DRAWING NUMBER:	H60A-01-201	00

1.2 Intervention H60A-01-202

Intervention Type	Rock pack
Rehabilitation Objective	Reduce high energy flow through the channel and prevent further erosion of the head-cut
Latitude	34° 03' 34.10" S
Longitude	19° 05' 27.95" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-202



Figure 1.2.1 Proposed location of rock pack

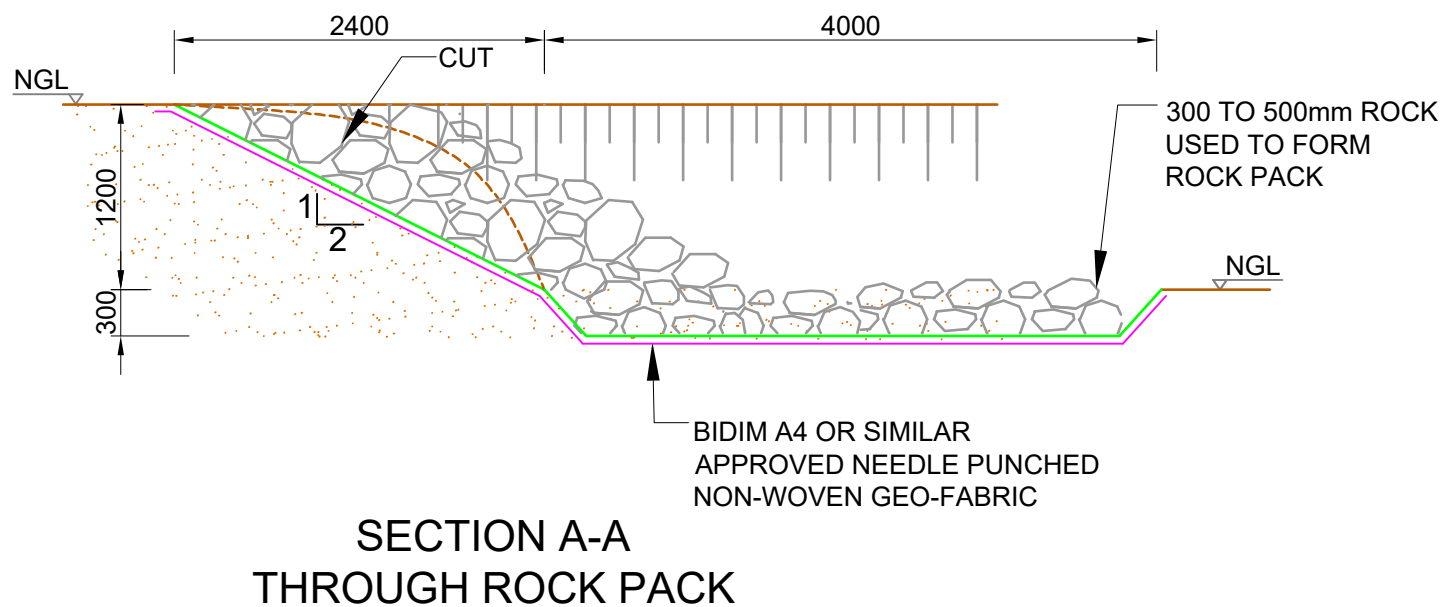
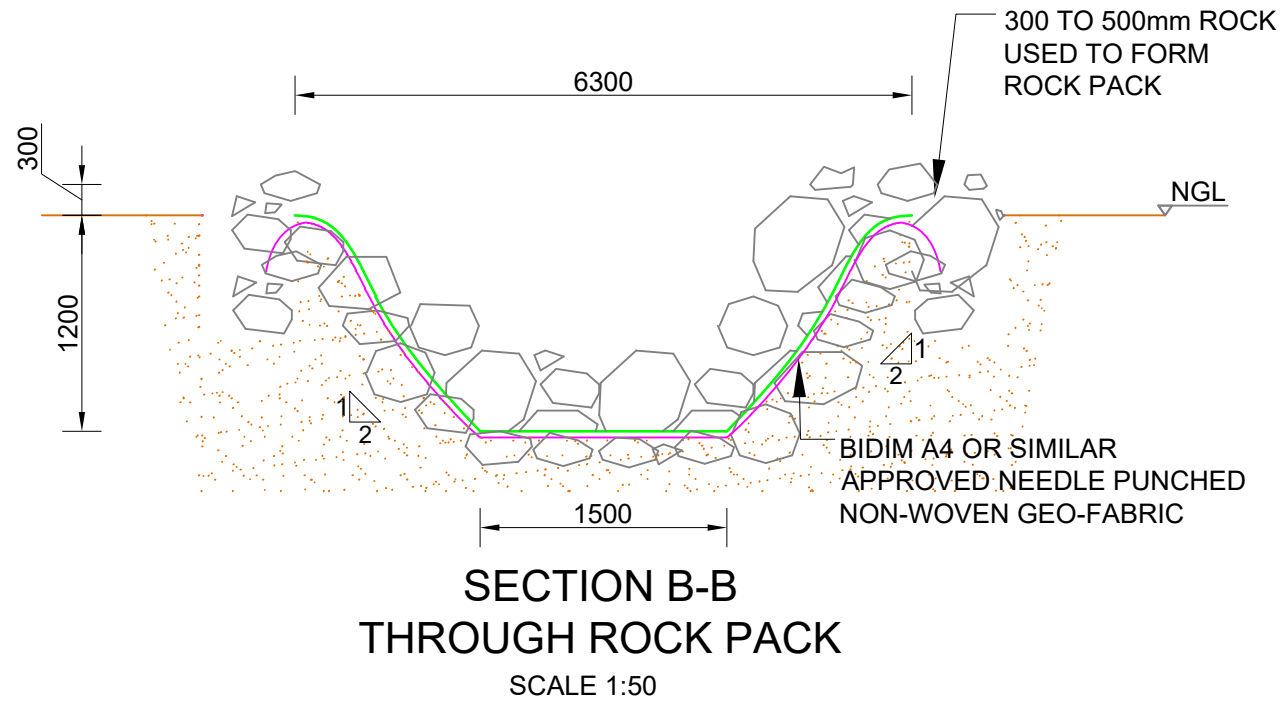
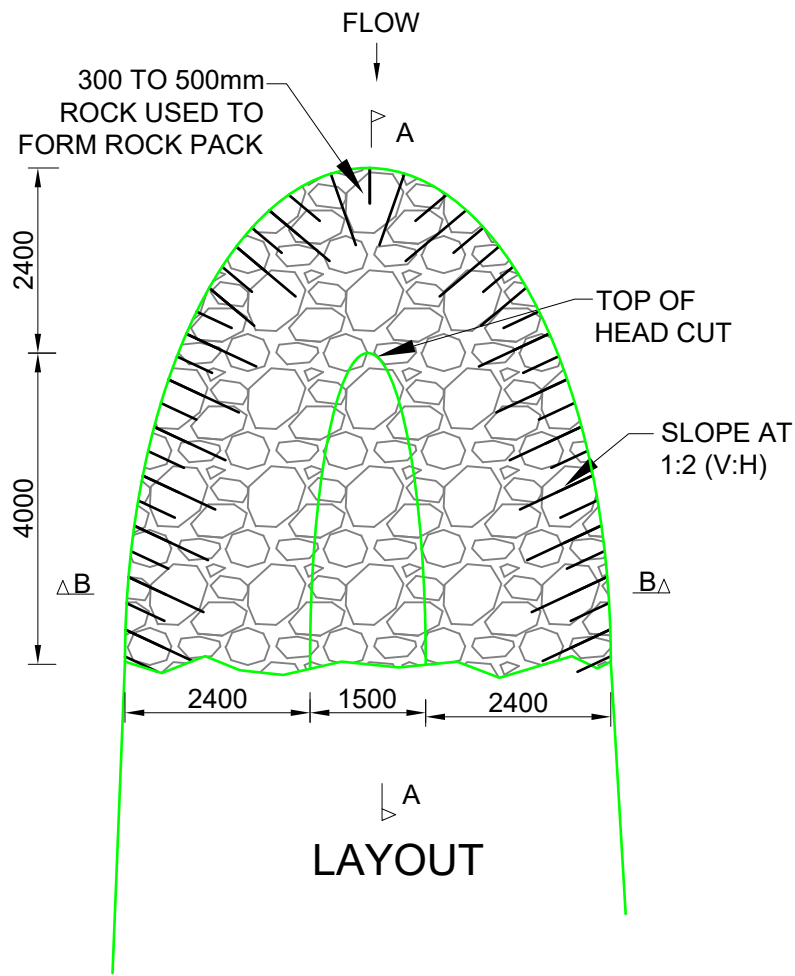
1.2.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01202.1	Excavation	m ³	15.8
H60A01202.2	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	37.41
H60A01202.3	Rockpack using 300mm-500mm diameter hand rock	m ³	10.44
H60A01202.4	Revegetation between rocks with indigenous wetland vegetation	m ²	25

1.2.2 Construction notes for intervention H60A-01-202

The following construction notes apply to the proposed intervention:

- The head-cut and side banks are to be sloped back to a 1:2 slope (V:H);
- Needle-punched non-woven geofabric material is to be placed between all soil-rock interfaces;
- Geo-fabric is to be tucked into soil trenches as per supplier's recommendations;
- Rockpack is to be constructed using larger rocks of 300-500 mm diameter that are tightly packed to ensure the structure is able to withstand increased flow velocities during higher flow periods;
- Revegetation is to be carried out by tightly packing top soil into rock crevices and planting with harvested local indigenous wetland vegetation.



- NOTES:**
1. Needle-punched non-woven geofabric material is to be placed between all soil-rock interfaces;
 2. Geo-fabric in to be tucked into soil trenches of 300x300 mm;
 3. Rockpack is to be constructed using 300-500 mm diameter rocks that are tightly packed to ensure the structure is not washed away during high flow periods;
 4. All banks are to be sloped at a slope of 1:2 (V:H) where possible and compacted to a minimum of 93% ModAASHTO;
 5. Revegetation to be carried out by tightly packing top soil into rock crevices and planting with harvested local indigenous wetland vegetation.

**PRELIMINARY DRAWING
NOT FOR CONSTRUCTION**



TITLE:
THE NATURE CONSERVANCY PROJECT
ROCK PACK
H60A-01-202

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T. PIKE

LONGITUDE	LATITUDE	SCALE:	1:100 ON A3L	REV:
19° 05' 27.95" E	34° 03' 34.10" S	DRAWING NUMBER:	H60A-01-202	00

1.3 Intervention H60A-01-203

Intervention Type	Sloping with bio-jute blanket and backfilling depressions as well as revegetation with <i>Restio multiflorus</i> along bank
Rehabilitation Objective	To stabilise the banks in order to prevent further erosion and soil mobilisation
Latitude	34 ⁰ 03' 33.81" S
Longitude	19 ⁰ 05' 28.88" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-203



Figure 1.3.1 Proposed stabilisation of unstable bank to be sloped with bio-jute

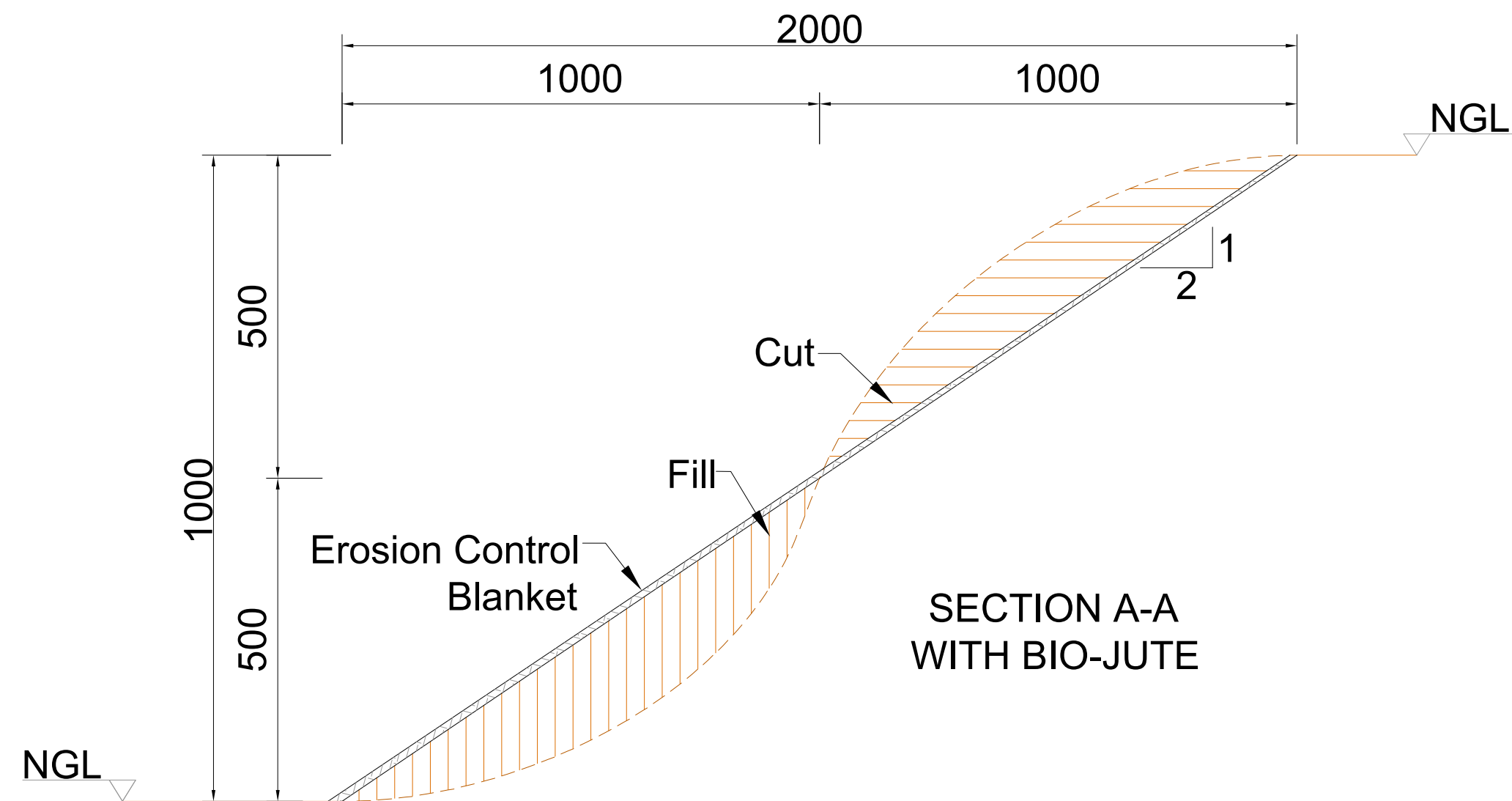
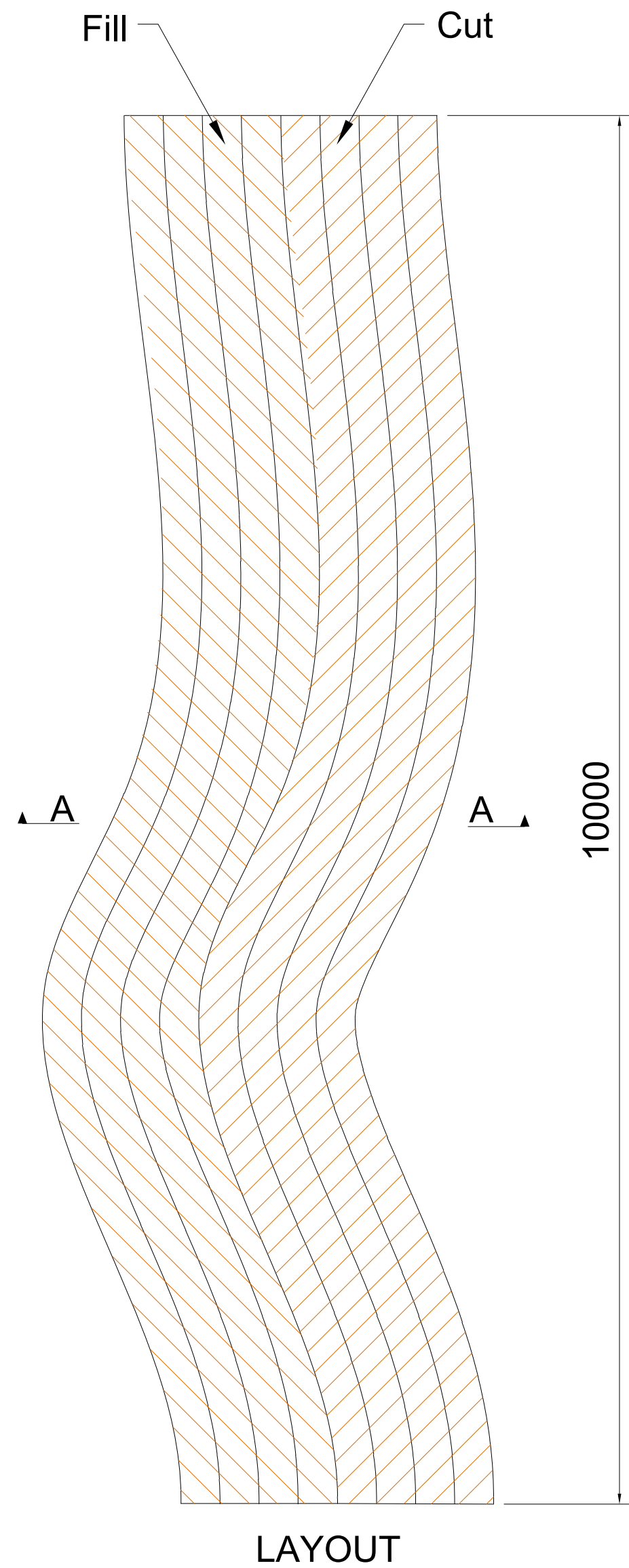
1.3.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01203.1	Remove vegetation and top soil to nominal depth of 150 mm	m ²	22.36
H60A01203.2	Sloping cut to fill	m ³	2.25
H60A01203.3	Erosion control Blanket	m ²	22.36
H60A01203.4	Revegetation with mosaic harvested <i>Restio multiflorus</i>	m ²	22.36

1.3.2 Construction notes for intervention H60A-01-203

The following construction notes apply to the proposed intervention:

- Where vegetation is present, the top 150 mm of top soil is to be removed with vegetation and stockpiled in a designated area;
- Any vegetation along the toe of the bank/ along the water line of the channel must remain undisturbed;
- Sloping of banks must be carried out by cutting material from the top half of the bank at a 1:2 (V:H) slope (where possible) and filling the bottom half to create a cut to fill balance;
- Any additional cut material must be used to backfill any depressions in the natural ground behind the sloped surface;
- Fill material to be compacted in 150mm layers at optimum moisture content;
- Once the fill material is compacted, top soil can be returned from the top soil stock pile and spread over the surface;
- Revegetation is to be carried out by mosaic harvesting of *Restio multiflorus* tussocks locally from site and planting at density of 9 tussocks per m² across the sloped bank surface;
- Erosion control blankets are to be placed on the sloped face and secured with wooden stakes placed at a minimum of 1 m centres.



NOTES:

1. Where vegetation is present, the top 150 mm of top soil is to be removed with vegetation and stockpiled in a designated area for reuse later;
2. Sloping of banks must be carried out by cutting material from the top half of the bank at a 1:2 (V:H) slope (where possible) and filling the bottom half to create a cut to fill balance;
3. The cut and fill surfaces must be well compacted;
4. Once the fill material is compacted and sloping is completed, top soil can be returned from the top soil stock pile and spread over the surface;
5. Revegetation is to be undertaken by planting of *Restio multiflorus* locally from site at a density of 9 tussocks per m² across the sloped surface;
6. Erosion control blankets are to be placed on the sloped face and secured with wooden stakes placed at a minimum of 1 m centres.
7. Fill surfaces to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
8. All dimensions shown in mm.

**PRELIMINARY DRAWING
NOT FOR CONSTRUCTION**



GroundTruth

*Water, Wetlands and
Environmental Engineering*

P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:

THE NATURE CONSERVANCY PROJECT

STANDARD SLOPING AND STABILISATION
H60A-01-203

DATE: JUNE 2018

DRAWN: T. HARVEY

DRAWING CHECKED: T. PIKE

DESIGNED: T. HARVEY

DESIGN CHECKED: T. PIKE

SCALE: NTS

DRAWING NUMBER: H60A-01-203

REV:
00

LONGITUDE	LATITUDE
19° 05' 28.88" E	34° 03' 33.81" S

1.4 Intervention H60A-01-204

Intervention Type	Sloping with bio-jute blanket and erosion control logs, as well as revegetation with <i>Restio multiflorus</i> along bank
Rehabilitation Objective	To stabilise the banks in order to prevent further erosion and soil mobilisation
Latitude	34 ⁰ 03' 33.3" S
Longitude	19 ⁰ 05' 29.09" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-204



Figure 1.4.1 Proposed stabilisation of unstable bank to be sloped with bio-jute and ecologs

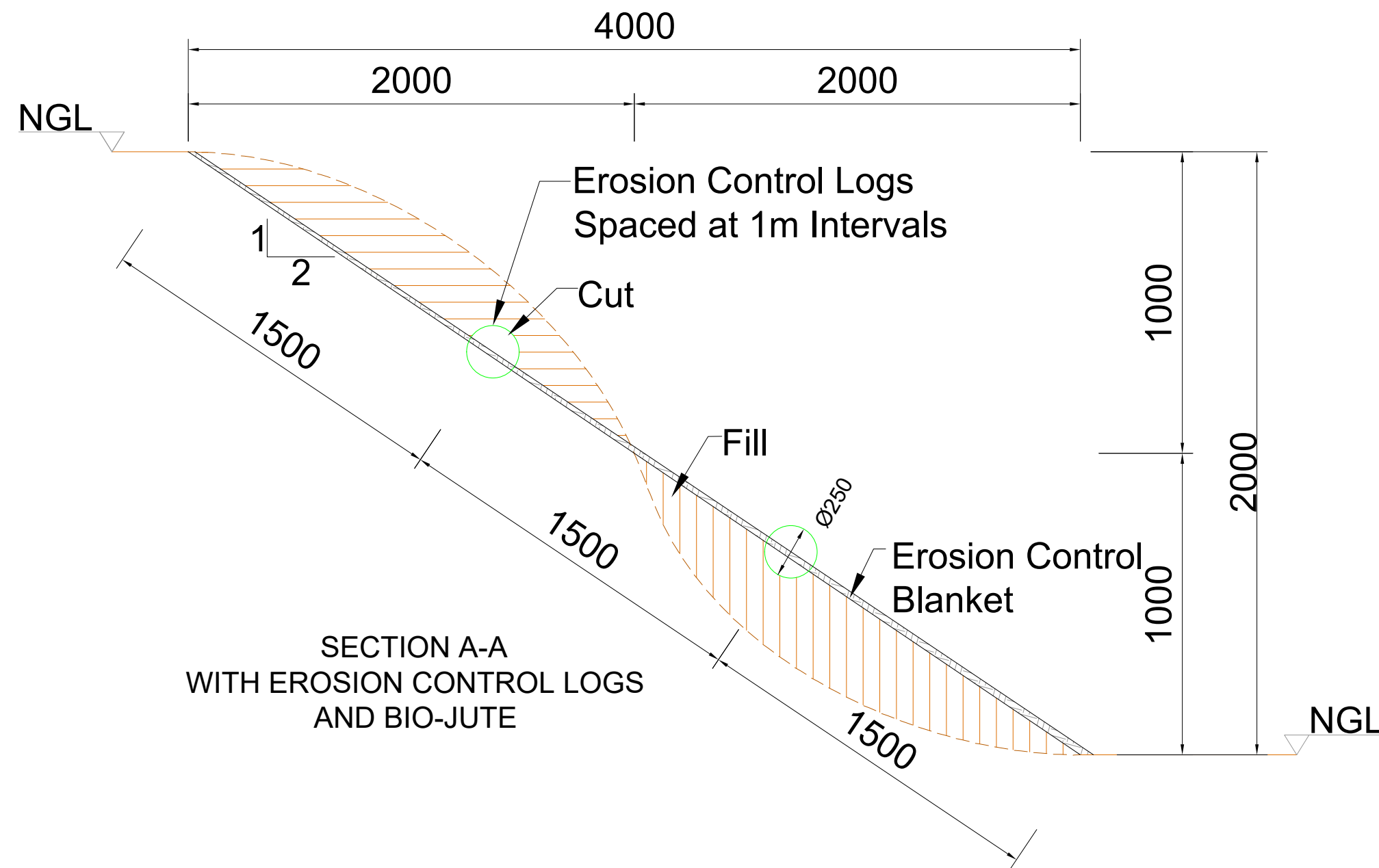
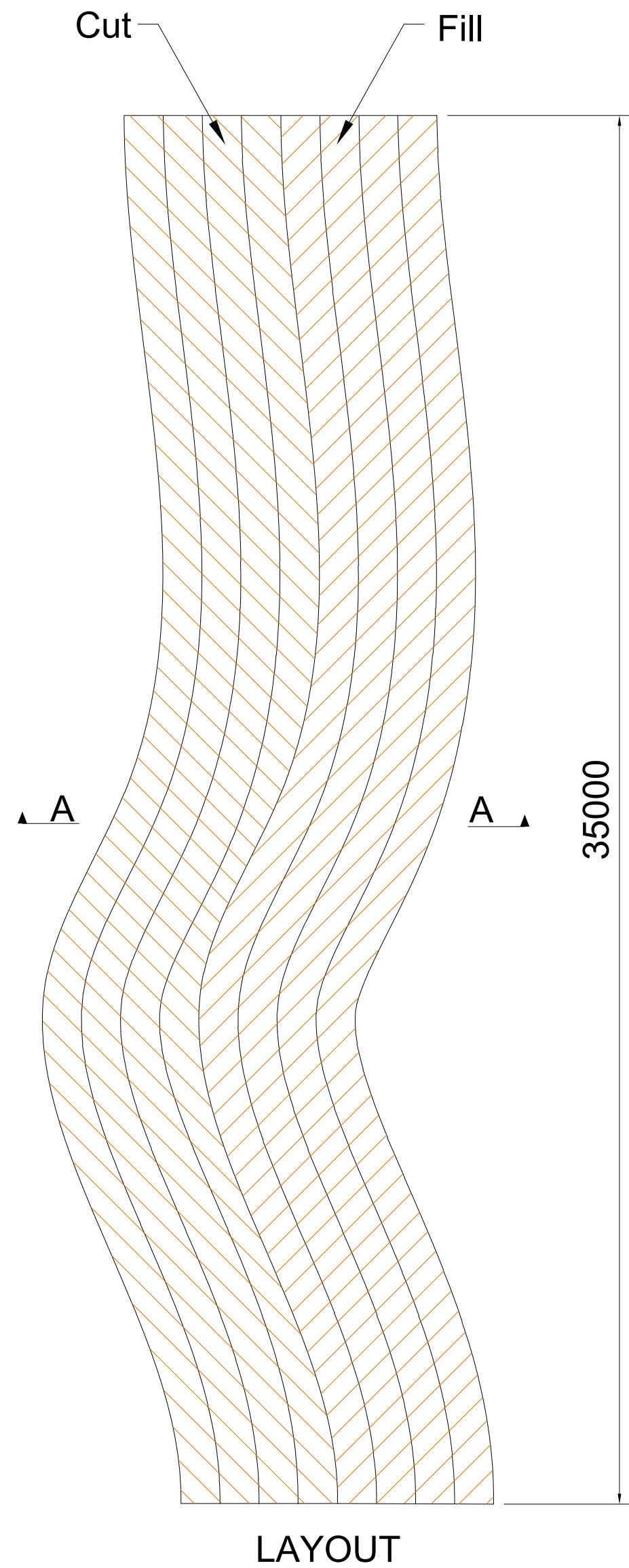
1.4.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01204.1	Remove vegetation and top soil to nominal depth of 150 mm	m ²	142.44
H60A01204.2	Sloping cut to fill	m ³	21.74
H60A01204.3	Erosion control Blanket	m ²	142.44
H60A01204.4	Erosion control Logs	m	70
H60A01204.5	Revegetation with <i>Restio multiflorus</i>	m ²	142.44

1.4.2 Construction notes for intervention H60A-01-204

The following construction notes apply to the proposed intervention:

- Where vegetation is present, the top 150 mm of top soil is to be removed with vegetation and stockpiled in a designated area;
- Any vegetation along the toe of the bank/ along the water line of the channel must remain undisturbed;
- Sloping of banks must be carried out by cutting material from the top half of the bank at a 1:2 (V:H) slope (where possible) and filling the bottom half to create a cut to fill balance;
- Any additional cut material must be used to backfill any depressions in the natural ground behind the sloped surface;
- Fill material to be compacted in 150mm layers at optimum moisture content;
- Once the fill material is compacted, top soil can be returned from the top soil stock pile and spread over the surface;
- Revegetation is to be carried out by mosaic harvesting of *Restio multiflorus* tussocks locally from site and planting at density of 9 tussocks per m² across the sloped bank surface;
- Erosion control blankets are to be placed on the sloped face and secured with wooden stakes placed at a minimum of 1 m centres;
- Erosion control logs are to be placed in lines **on contour** at 1.5 m centres on the sloped face. Erosion control logs are to be secured with wooden stakes placed at a minimum of 1 m centres.



NOTES:

1. Where vegetation is present, the top 150 mm of top soil is to be removed with vegetation and stockpiled in a designated area for reuse later;
2. Sloping of banks must be carried out by cutting material from the top half of the bank at a 1:2 (V:H) slope (where possible) and filling the bottom half to create a cut to fill balance;
3. The cut and fill surfaces must be well compacted;
4. Once the fill material is compacted and sloping is completed, top soil can be returned from the top soil stock pile and spread over the surface;
5. Revegetation is to be undertaken by planting of *Restio multiflorus* locally from site at a density of 9 tussocks per m² across the sloped surface;
6. Erosion control logs are to be placed in lines **on contour** at 1.5m centres on the sloped face. Erosion control logs are to be secured with wooden stakes placed at a minimum of 1 m centres; and
7. Erosion control blankets are to be placed on the sloped face and secured with wooden stakes placed at a minimum of 1 m centres.
8. Fill surfaces to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
9. All dimensions shown in mm.

**PRELIMINARY DRAWING
NOT FOR CONSTRUCTION**



GroundTruth

*Water, Wetlands and
Environmental Engineering*

P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:

THE NATURE CONSERVANCY PROJECT

STANDARD SLOPING AND STABILISATION
H60A-01-204

DATE: JUNE 2018

DRAWN: T. HARVEY

DRAWING CHECKED: T. PIKE

DESIGNED: T. HARVEY

DESIGN CHECKED: T. PIKE

LONGITUDE	LATITUDE	SCALE:	NTS	REV:
19° 05' 29.09" E	34° 03' 33.3" S	DRAWING NUMBER:	H60A-01-204	00

1.5 Intervention H60A-01-205

Intervention Type	Rock pack
Rehabilitation Objective	To reduce high energy flows through channel and prevent further erosion of the head-cut
Latitude	34 ⁰ 03' 33.75" S
Longitude	19 ⁰ 05' 28.13" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-205



Figure 1.5.1 Proposed location for rockpack

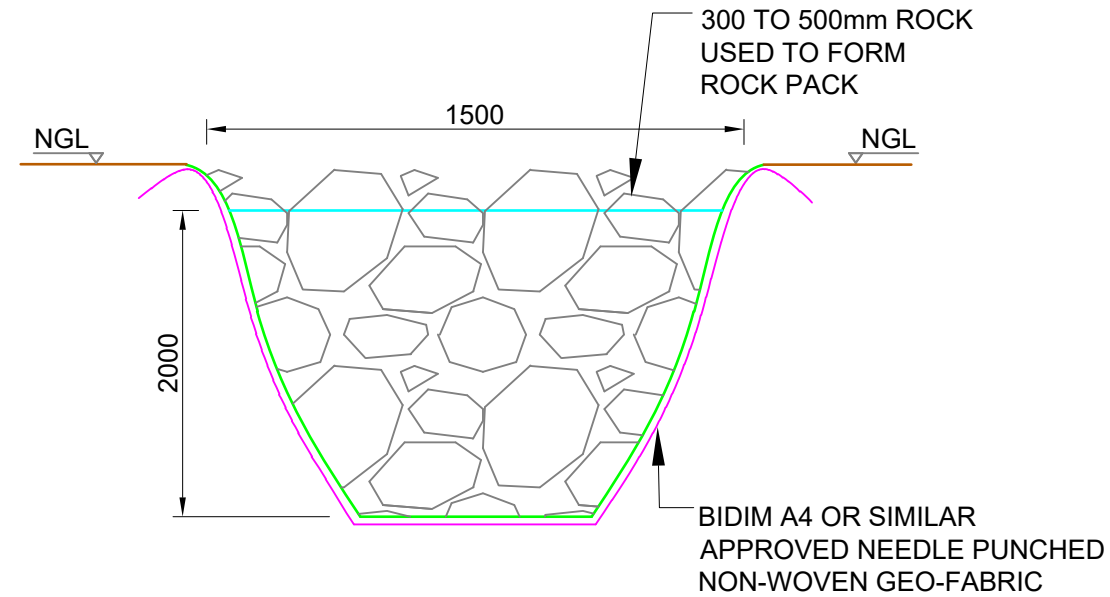
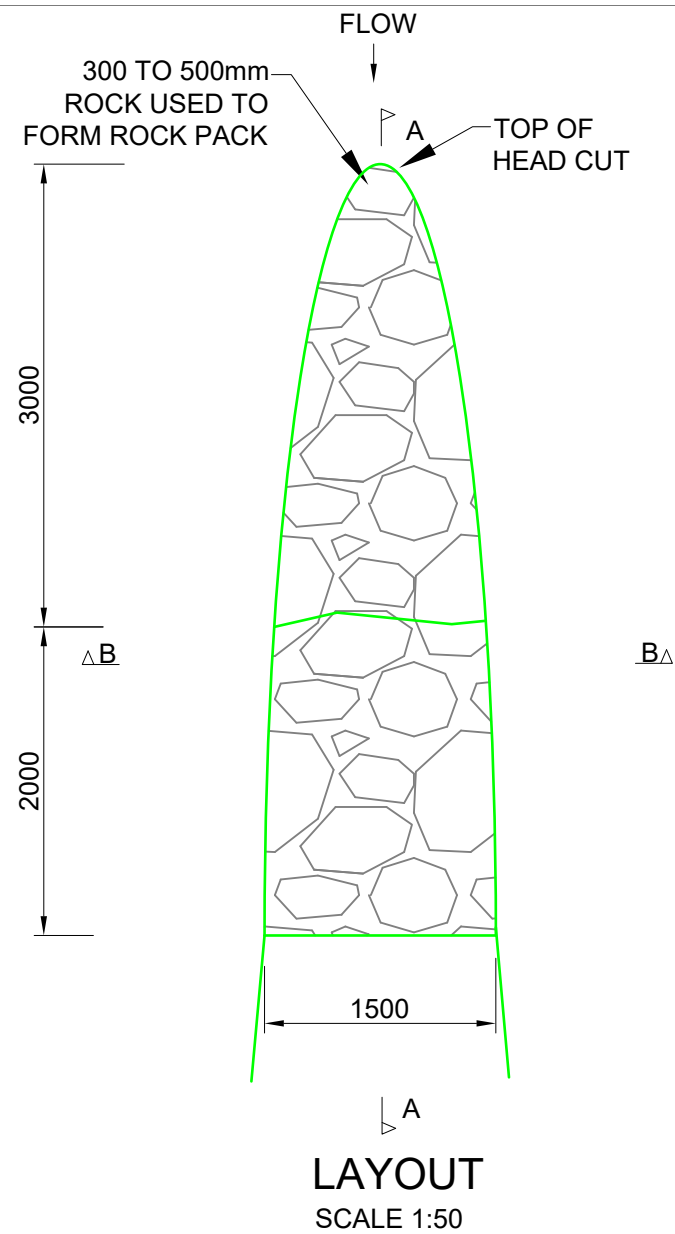
1.5.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01205.1	Excavation	m ³	4.5
H60A01205.2	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	28.25
H60A01205.3	Rockpack using 300mm-500mm diameter hand rock	m ³	7.5
H60A01205.4	Revegetation of indigenous wetland vegetation	m ²	8

1.5.2 Construction notes for intervention H60A-01-205

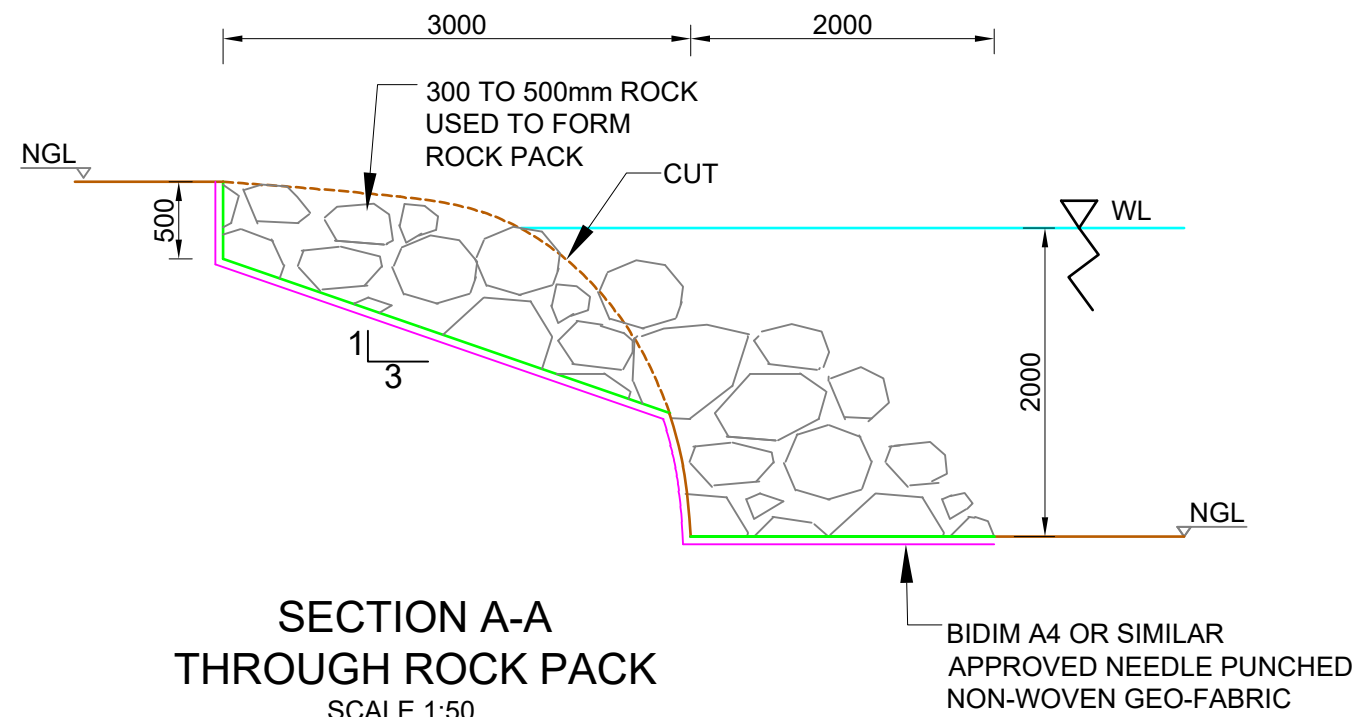
The following construction notes apply to the proposed intervention:

- The head-cut and side banks are to be sloped back to a 1:2 slope (V:H);
- Needle-punched non-woven geofabric material is to be placed between the soil-rock interfaces;
- Geofabric is to be tucked into soil trenches as per supplier's recommendations;
- Rockpack is to be constructed using larger rocks of 300-500 mm diameter that are tightly packed to ensure the structure is able to withstand increased flow velocities during higher flow periods;
- Revegetation is to be carried out by tightly packing top soil into rock crevices and planting with harvested local indigenous wetland vegetation.



SECTION B-B
THROUGH ROCK PACK

NTS



SECTION A-A
THROUGH ROCK PACK

SCALE 1:50

NOTES:

1. Needle-punched non-woven geofabric material is to be placed between all soil-rock interfaces;
2. Geo-fabric in to be tucked into soil trenches of 300x300 mm;
3. Rockpack is to be constructed using 300-500 mm diameter rocks that are tightly packed to ensure the structure is not washed away during high flow periods;
4. Revegetation to be carried out by tightly packing top soil into rock crevices and planting with harvested local indigenous wetland vegetation.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION



TITLE:
THE NATURE CONSERVANCY PROJECT
ROCK PACK
H60A-01-205

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T. PIKE

LONGITUDE	LATITUDE	SCALE:	1:100 ON A3L	REV:
19° 05' 28.13" E	34° 03' 33.75" S	DRAWING NUMBER:	H60A-01-205	00

1.6 Intervention H60A-01-206

Intervention Type	Rock masonry chute
Rehabilitation Objective	To stabilise the head-cut and prevent further erosion of the wetland
Latitude	34° 03' 33.98" S
Longitude	19° 05' 27.69" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-206



Figure 1.6.1 Proposed location for rock masonry chute

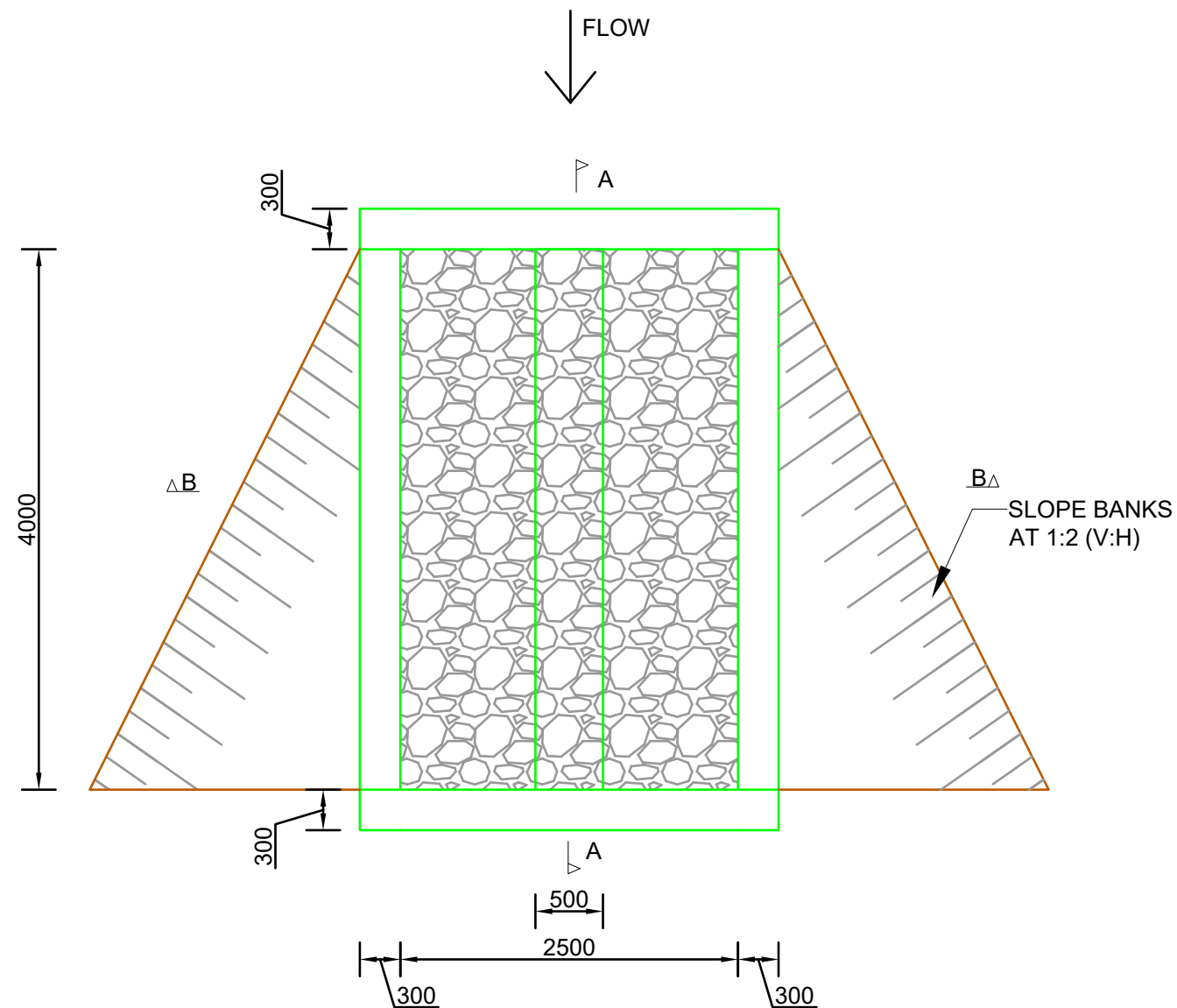
1.6.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01206.1	Clearing intervention site of debris	m ²	12.4
H60A01206.2	Excavation	m ³	9
H60A01206.3	Concrete	m ³	6
H60A01206.4	Rockpack (200-250 mm hand rock)	m ³	5

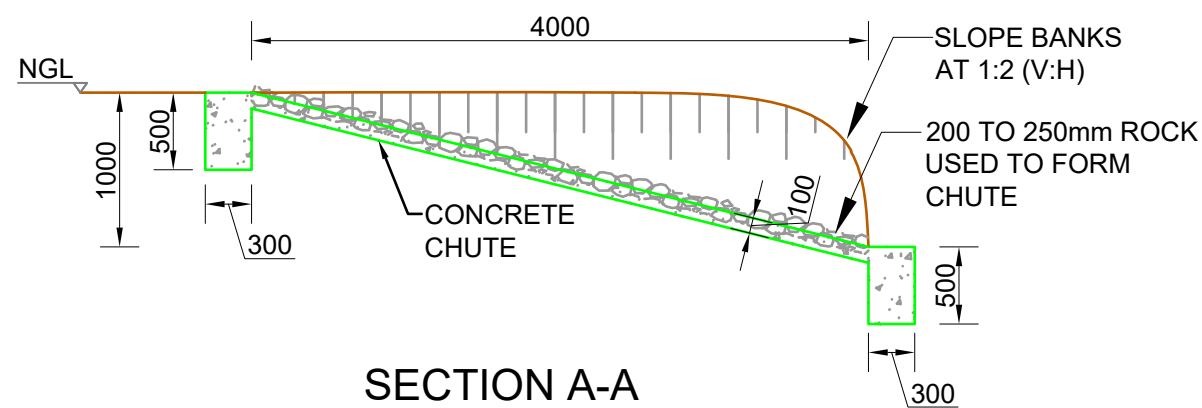
1.6.2 Construction notes for intervention H60A-01-206

The following construction notes apply to the proposed intervention:

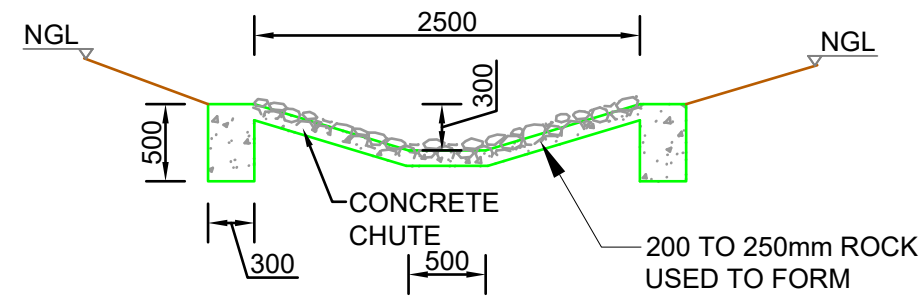
- The intervention site is to be cleared of all debris and vegetation before earthworks commence;
- The head-cut is to be sloped back to a 1:4 slope (V:H);
- 100 mm layer of concrete is to first be laid on the compacted material;
- Rocks with a minimum diameter of 200-250mm are to first be used for the intervention;
- The rocks are to be thoroughly cleaned by means of scrubbing prior to use;
- Cleaned rocks are to then be wetted and placed in wet concrete before it dries;
- Additional concrete to be poured in between rock crevices;
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.



LAYOUT
SCALE 1:50



SECTION A-A
SCALE 1:50



SECTION B-B
SCALE 1:50

NOTES:

1. Min 28 day concrete compressive strength of 30Mpa unless otherwise stated.
2. Grade 30/19 or 30/26 concrete can be used.
3. Min cover to all reinforcement steel is 40mm unless otherwise stated on section details.
4. Min concrete 28 day flexural strength of 4.1Mpa.
5. Max concrete slump of 70mm.
6. Min concrete cement content of 310kg/m².
7. Water : cement ratio not more than 0.52.
8. Wood float finish to all concrete surfaces.
9. Backfill material behind structure to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
10. All dimensions shown in mm.
11. 100 mm layer of concrete to be laid before rocks;
12. Rockpack is to be constructed using a minimum of 200-250mm diameter rocks that are tightly packed;
13. Once rocks have been laid, concrete to be poured inbetween rock crevices.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION



TITLE:
THE NATURE CONSERVANCY PROJECT
HEAVY DUTY ROCK MASONRY CHUTE
H60A-01-206

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T. PIKE

LONGITUDE	LATITUDE	SCALE:	1:100 ON A3L	REV:
19° 05' 27.69" E	34° 03' 33.98" S	DRAWING NUMBER:	H60A-01-206	00

1.7 Intervention H60A-01-207

Intervention Type	Extension of an existing earthen berm
Rehabilitation Objective	To prevent any lateral erosion into the channel and divert water into a controlled re-entry point
Latitude	34° 03' 34.45" S
Longitude	19° 05' 26.01" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-207



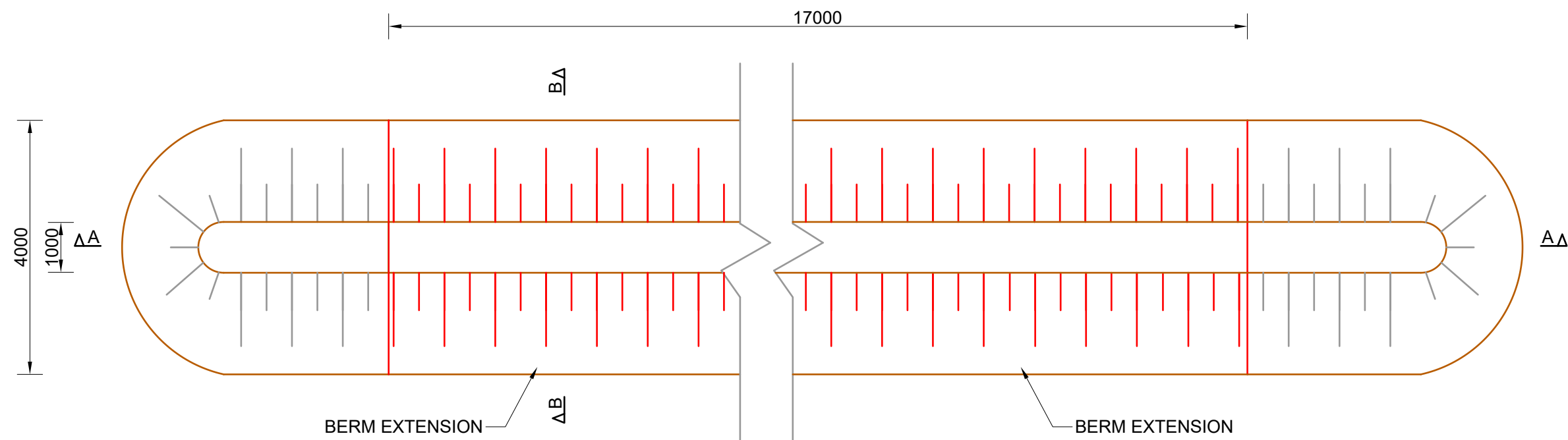
Figure 1.7.1 Proposed location of earthen berm to be extended

1.7.1 Bill of quantities

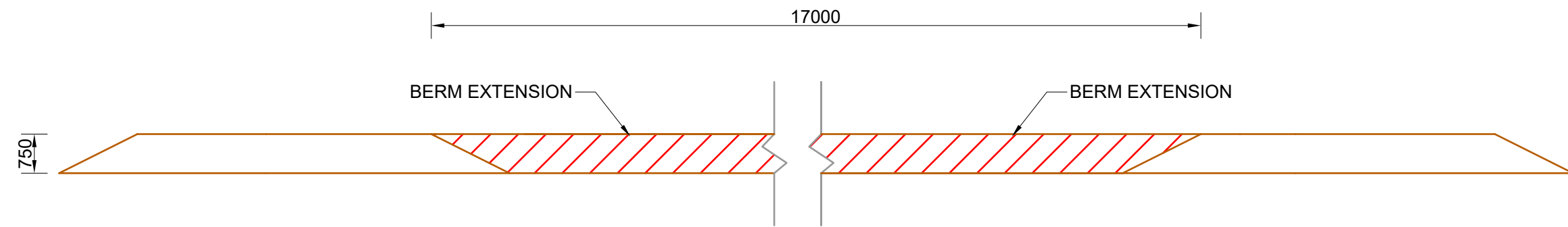
REF	DESCRIPTION	UNIT	QTY
H60A01207.1	Earthworks	m ³	32
H60A01207.2	Clearing of vegetation, stripping of topsoil to nominal depth of 150 mm, stockpiling and replacing on berm	m ²	68
H60A01207.3	Excavation for 400mm cut-off trench	m ³	17
H60A01207.4	Revegetation of berm with indigenous wetland vegetation	m ²	68

1.7.2 Construction notes for intervention H60A-01-207

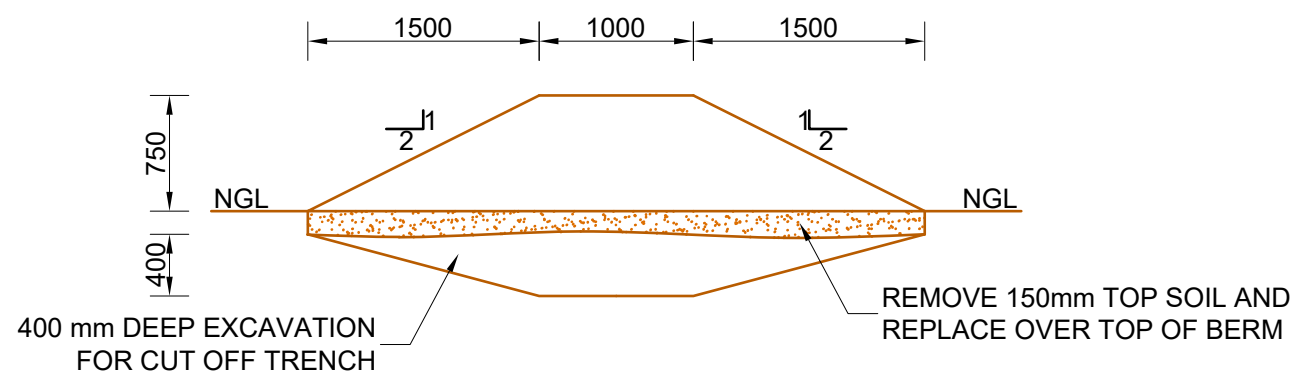
- Vegetation and topsoil is to be removed from the footprint of the earthen berm prior to its construction;
- The berm is to be constructed with well compacted insitu material with a cut off trench at least 400mm deep;
- Earth material to be moistened if necessary and compacted in 150mm layers at 93% Mod AASHTO;
- Topsoil material is not to be used for the construction of the berm;
- The berm is to be top dressed with topsoil and planted with indigenous wetland vegetation.



LAYOUT



SECTION A-A



SECTION B-B

SCALE 1:50

NOTES:

1. Remove 150mm layer of top soil at footprint of berm
2. Insitu material to be used for berm and cut off trench
3. Insitu material for berm to be compacted in 150mm layers to a minimum of 93% Mod AASHTO unless otherwise indicated
4. Revegetation is to be carried out by planting local indigenous wetland vegetation
5. All dimensions shown in mm

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION



TITLE:
THE NATURE CONSERVANCY PROJECT
EARTHEN BERM EXTENSION
H60A-01-207

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T. PIKE

LONGITUDE	LATITUDE	SCALE:	1:100 ON A3L	REV:
19° 05' 26.01" E	34° 03' 34.45" S	DRAWING NUMBER:	H60A-01-207	00

1.8 Intervention H60A-01-208

Intervention Type	Sloping of the left bank and installation of groynes as well as revegetation with Palmiet, (<i>Prionium serratum</i>) along the toe of the bank and indigenous wetland vegetation along bank
Rehabilitation Objective	To stabilise the bank and prevent further erosion as well as to divert water to the right of the channel
Latitude	34° 03' 24.19" S
Longitude	19° 05' 58.02" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-208



Figure 1.8.1 Proposed unstable bank to be stabilised with sloping and installation of groynes

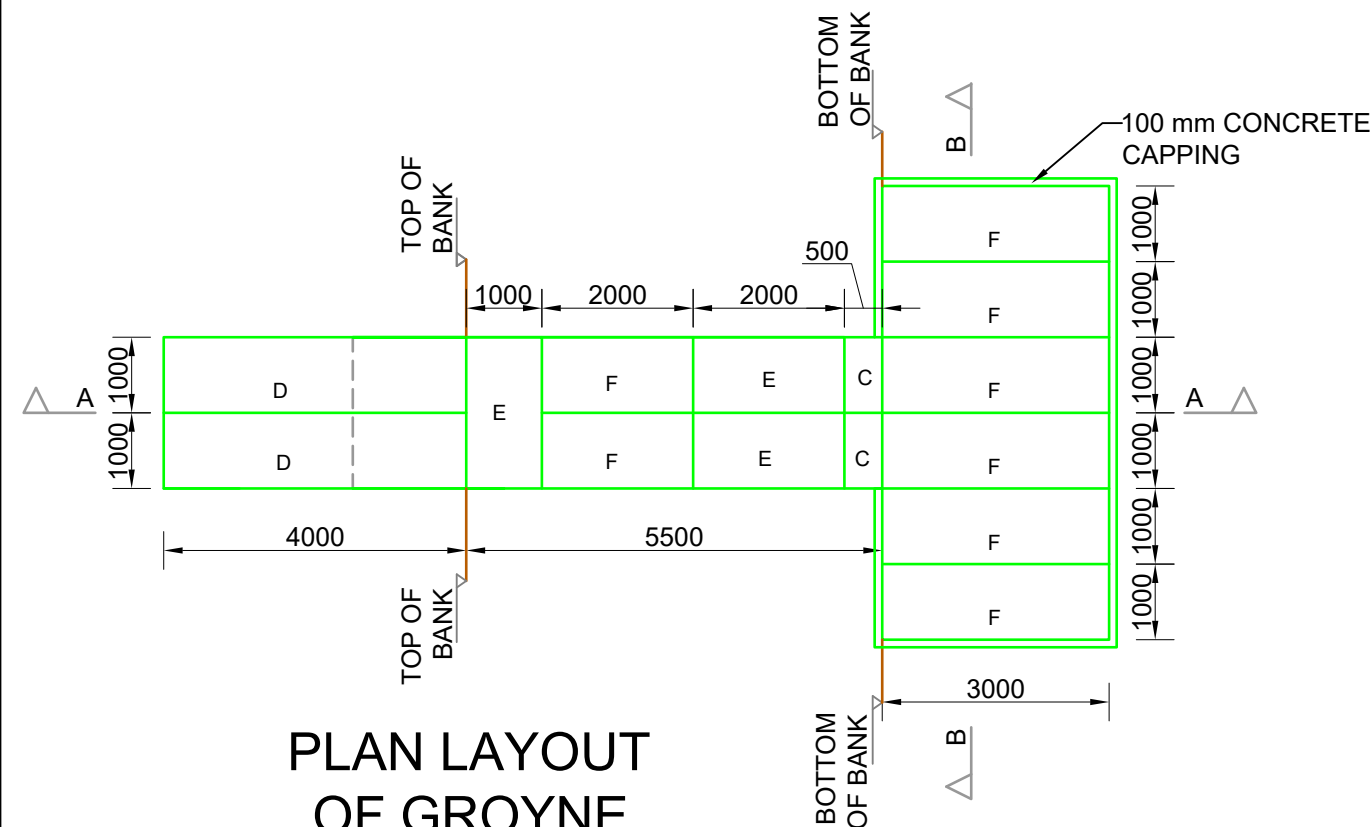
1.8.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01208.1	Excavation	m ³	259
H60A01208.2	Concrete	m ³	6
H60A01208.3	Volume of gabions	m ³	170
H60A01208.4	Revegetation	m ³	431
H60A01208.5	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	275.6

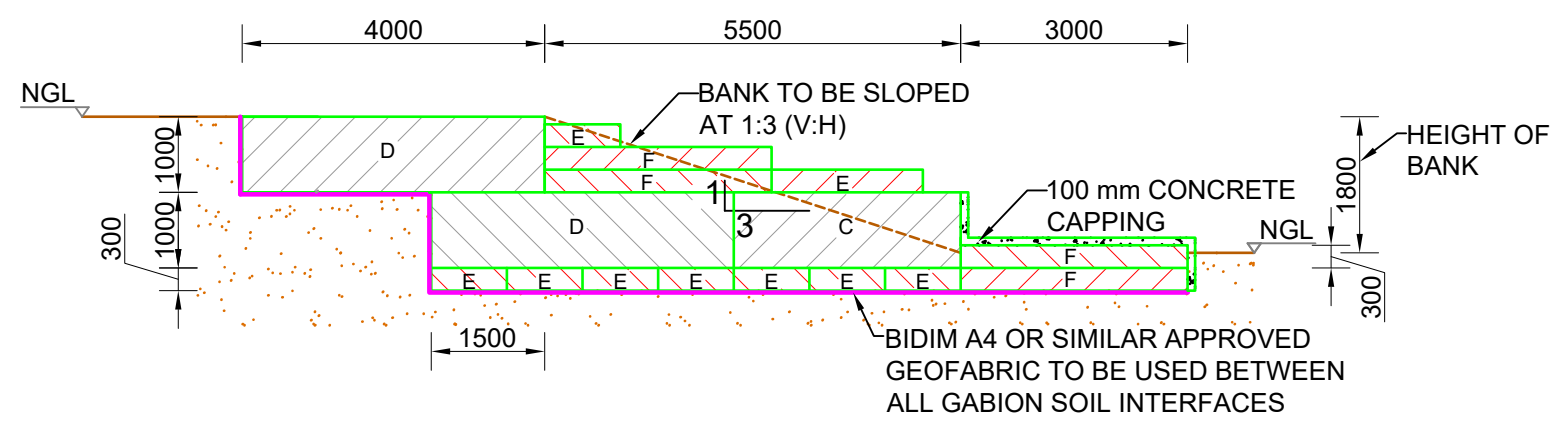
1.8.2 Construction notes for intervention H60A-01-208

The following construction notes apply to the proposed intervention:

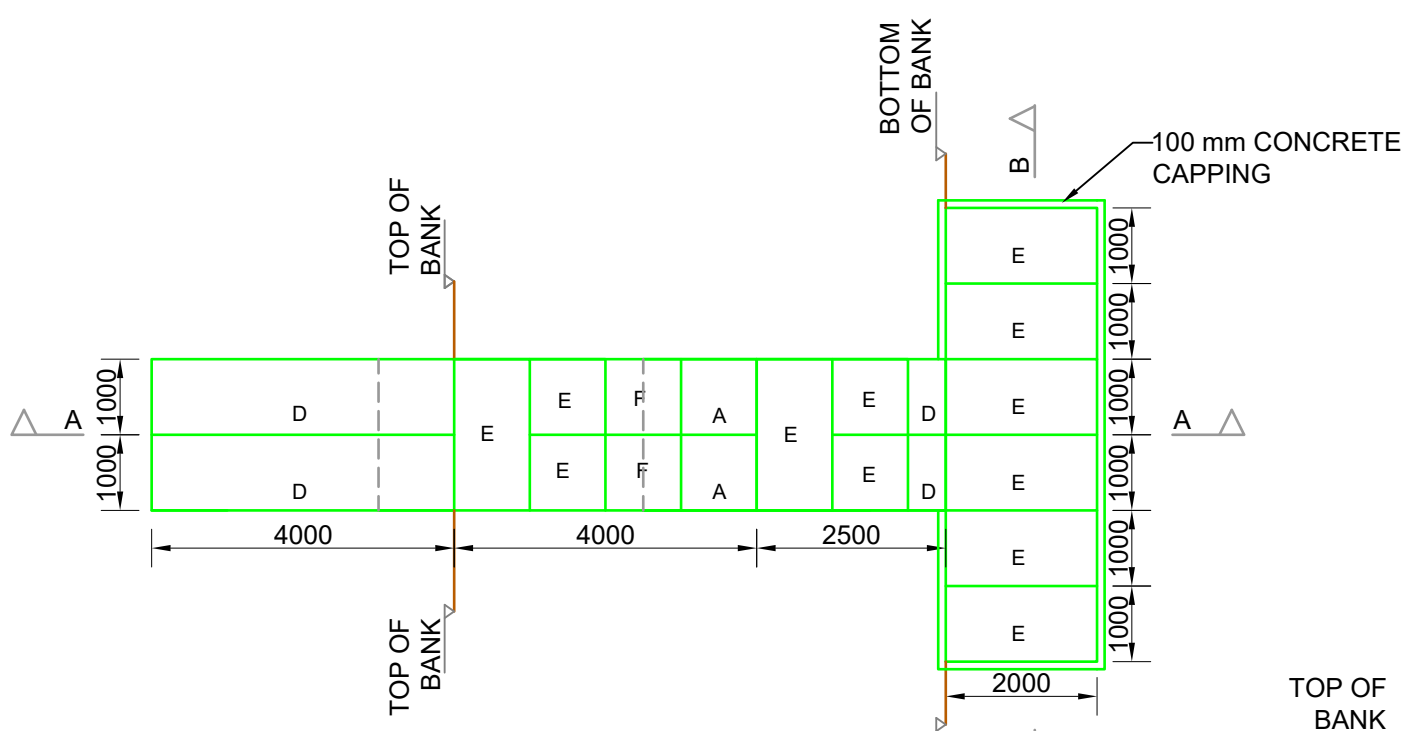
- Where vegetation is present, the top 150 mm of top soil is to be removed with vegetation and stockpiled in a designated area;
- Sloping of banks must be carried out by cutting material from the top half of the bank at a 1:2 (V:H) slope (where possible) or 1:3 (V:H) slope where bank becomes more gradual and filling the bottom half to create a cut to fill balance;
- The cut and fill surfaces must be well compacted;
- Excavation for the groynes must include an additional 500mm surrounding the groyne, which is to be backfilled and well compacted around the structure;
- Needle punched, non-woven geo-fabric to be placed at all contact surfaces between the gabions and soil;
- Gabions are to be installed according to supplier's specifications;
- The baskets are to have a PVC coating and must be fastened together as specified by the manufacturers;
- Gabion hand rock is to be packed neatly to achieve a minimum density of 1800 kg/m³;
- 100mm capping of concrete is to be placed over the bottom gabions of each groyne, where water is to come into contact with the gabions;
- Once the slope is compacted, top soil can be spread over the surface as well as the gabions;
- Revegetation is to be carried out by planting of indigenous wetland vegetation along the sloped bank and Palmiet, (*Prionium serratum*) along the toe of the bank.



PLAN LAYOUT OF GROYLE DETAIL 2

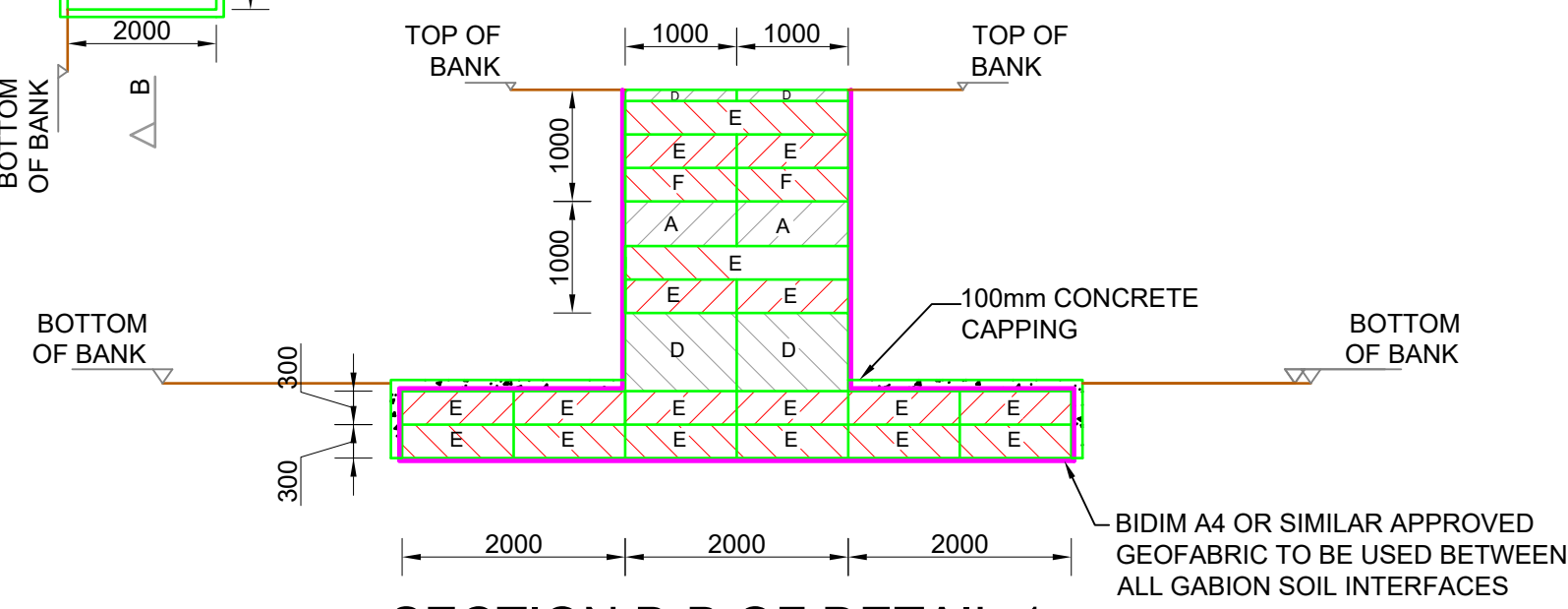


SECTION A-A OF DETAIL 2



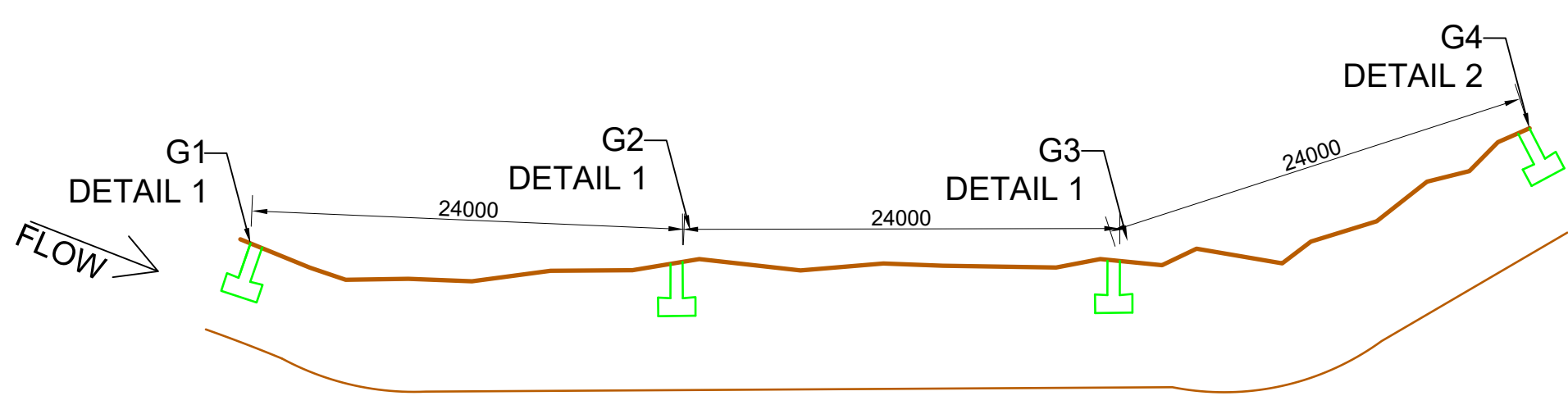
PLAN LAYOUT OF GROYLE DETAIL 1

1x1x1	A
2x1x1	B
3x1x1	C
4x1x1	D
2x1x0.3	E
3x1x0.3	F

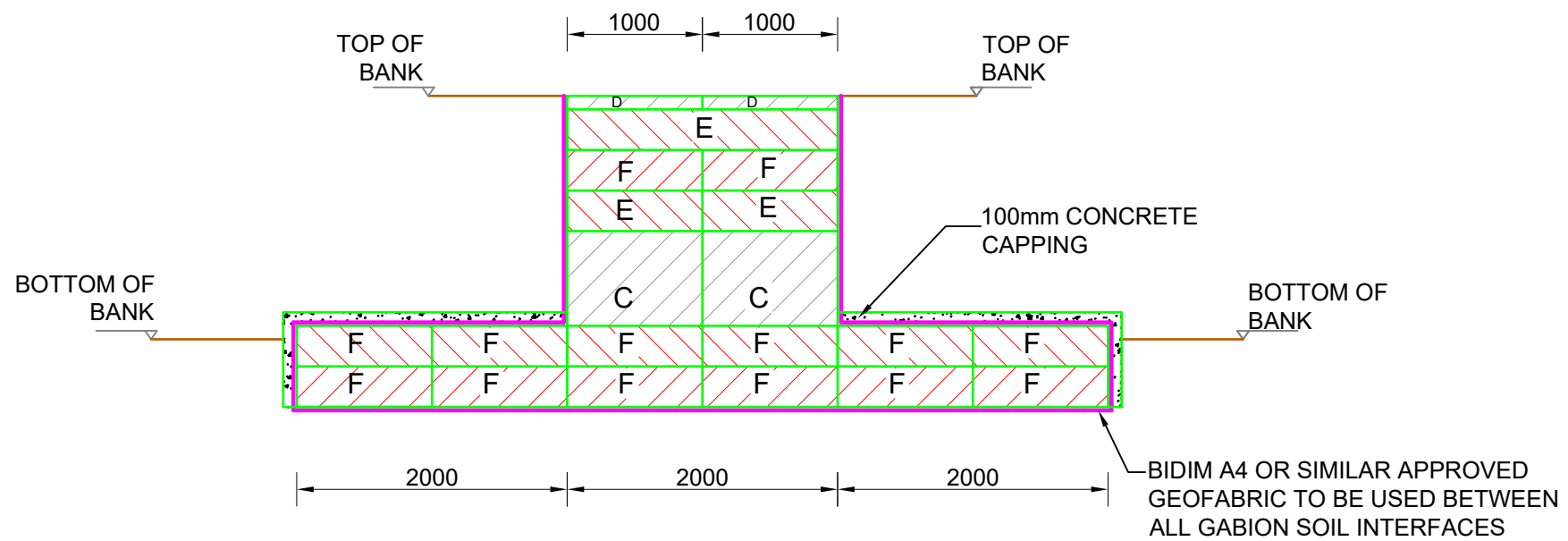


SECTION B-B OF DETAIL 1

SCALE 1:75

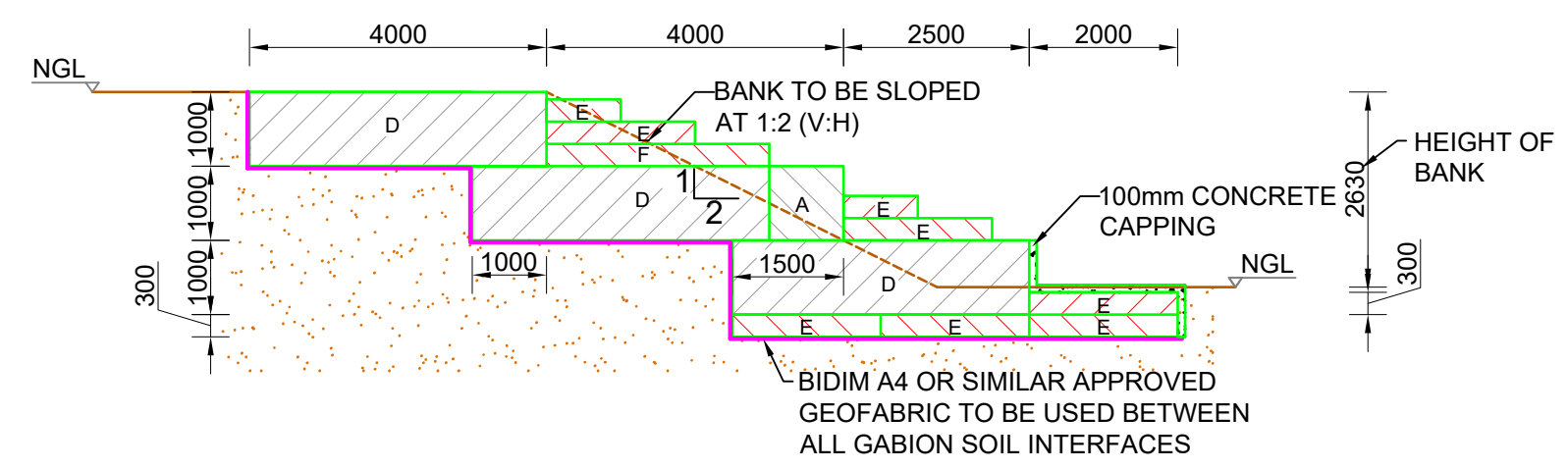


LAYOUT



SECTION B-B OF DETAIL 2

SCALE 1:50



SECTION A-A OF DETAIL 1

- NOTES:
1. Backfill material behind structure to be compacted to a minimum of 93% Mod AASHTO in 150mm layers unless otherwise indicated.
 2. All dimensions are shown in mm.
 3. Bidim A4, or similar approved needle-punched nonwoven geofabric is to be used between all gabion-soil interfaces.
 4. Gabion hand rock is to be uniformly graded between 150mm and 200mm and neatly packed, ensuring that gabion structure has a minimum specific gravity of 2.3.
 5. Lacing wire to be Class A zinc coated, or alternatively 3.4mm pre-formed wire can be used.
 6. Lacing wire is to secure top corners of the panels to be joined and laced from the top down. Lace the edges using double and single loop technique along wire mesh openings allowing for 100mm between loops.
 7. Maximum length of edge to be tied at one time must not exceed 1m.
 8. Ensure min overlap of 300mm when laying geotextiles.
 9. All gabion units are to be laced on all contact surfaces.
 10. Min of 4 bracing wires per m² of gabion front face.
 11. The difference in height of gabion rock between adjacent cells should not exceed 300mm;
 12. All gabion baskets are to be PVC coated.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

Ground Truth
Water, Wetlands and Environmental Engineering
P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:
THE NATURE CONSERVANCY PROJECT
GABION GROYLE DETAIL
H60A-01-208

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T.PIKE
SCALE:	1:100 ON A2L
DRAWING NUMBER:	H60A-01-208
REV:	00

	LONGITUDE	LATITUDE
CO-ORDINATES OF G1	19° 05' 58.02" E	34° 03' 24.19" S
CO-ORDINATES OF G4	19° 05' 59.74" E	34° 03' 22.39" S

1.9 Intervention H60A-01-209

Intervention Type	Sloping of the right bank and active revegetation with Palmiet, (<i>Prionium serratum</i>) along toe of banks and wetland vegetation along bank
Rehabilitation Objective	Prevent further erosion along the right bank
Latitude	34 ⁰ 03' 20.77" S
Longitude	19 ⁰ 05' 59.8" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-209



Figure 1.9.1 Bank and island to be sloped and revegetated

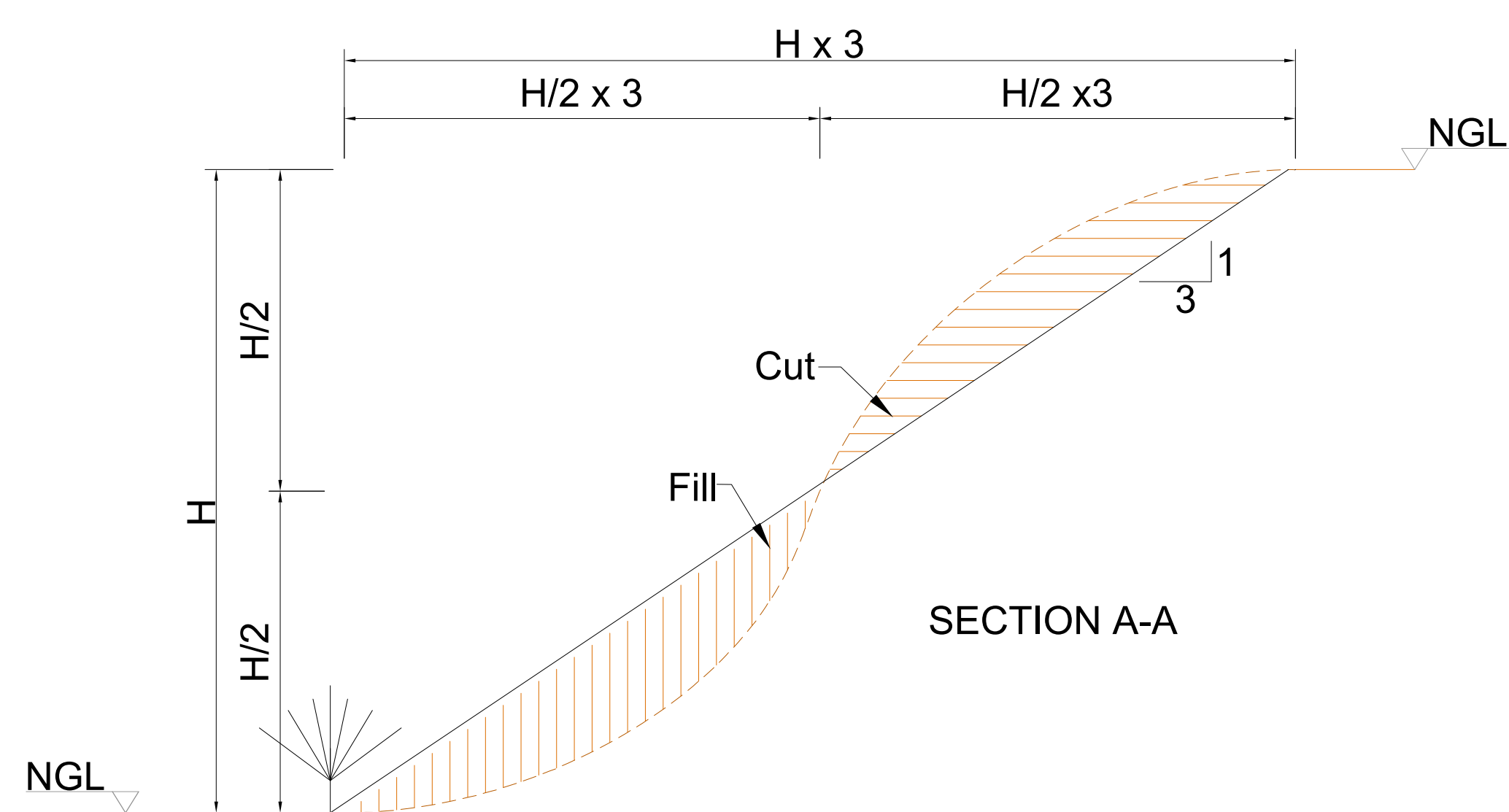
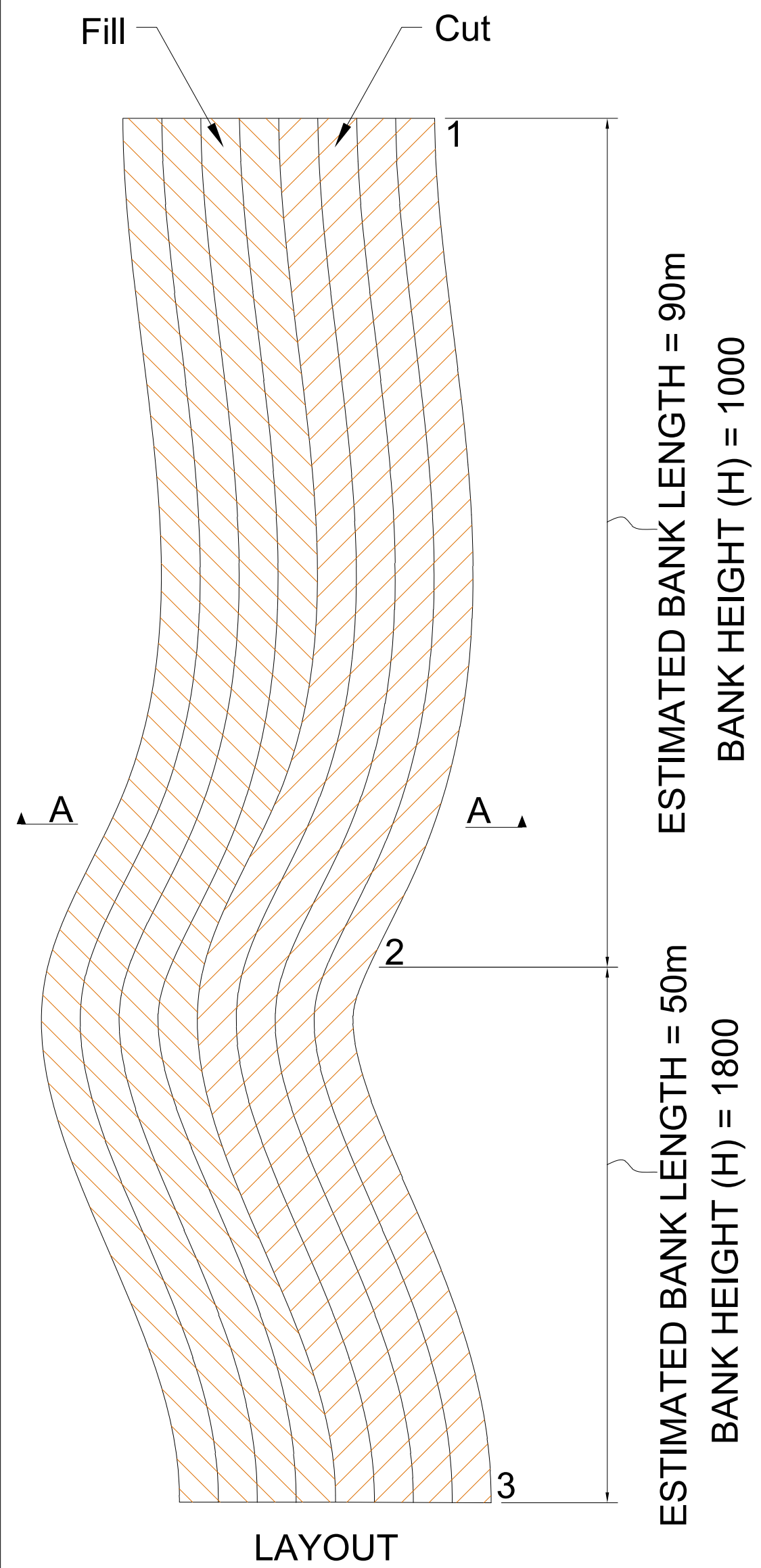
1.9.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01209.1	Sloping cut to fill	m ³	52.88
H60A01209.2	Revegetation with Palmiet, (<i>Prionium serratum</i>) along toe of bank	m	70.00
H60A01209.3	Revegetation with indigenous wetland vegetation along bank	m ²	284.6

1.9.2 Construction notes for intervention H60A-01-209

The following construction notes apply to the proposed intervention:

- Where vegetation is present, the top 150 mm of top soil is to be removed with vegetation and stockpiled in a designated area;
- Any vegetation along the toe of the bank/ along the water line of the channel must remain undisturbed;
- Sloping of banks must be carried out by cutting material from the top half of the bank at a 1:3 (V:H) slope (where possible) and filling the bottom half to create a cut to fill balance;
- Fill material to be compacted in 150mm layers at optimum moisture content;
- Once the fill is compacted, top soil can be returned from the top soil stock pile and spread over the surface;
- Revegetation is to be carried out by planting of Palmiet, (*Prionium serratum*) along the toe of the bank and local indigenous wetland vegetation along bank.



- NOTES:
1. Where vegetation is present, the top 150 mm of top soil is to be removed with vegetation and stockpiled in a designated area for reuse later;
 2. Sloping of banks must be carried out by cutting material from the top half of the bank at a 1:3 (V:H) slope (where possible) and filling the bottom half to create a cut to fill balance;
 3. The cut and fill surfaces must be well compacted;
 4. Once the fill material is compacted and sloping is completed, top soil can be returned from the top soil stock pile and spread over the surface;
 5. Revegetation is to be undertaken by planting Palmiet (*Prionium serratum*) along the toe of the banks and local indigenous wetland vegetation along bank;
 6. Fill surfaces to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
 7. All dimensions shown in mm.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

GroundTruth
Water, Wetlands and
Environmental Engineering

P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:
THE NATURE CONSERVANCY PROJECT
STANDARD SLOPING AND STABILISATION
H60A-01-209

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T. PIKE
SCALE:	NTS
DRAWING NUMBER:	H60A-01-209
REV:	00

	Longitude	Latitude
1	19° 06' 04.25" E	34° 03' 17.84" S
2	19° 06' 01.03" E	34° 03' 19.44" S
3	19° 05' 59.80" E	34° 03' 20.77" S

1.10 Intervention H60A-01-210

Intervention Type	Rock pack
Rehabilitation Objective	Stabilise the head-cut and prevent further erosion and soil mobilisation
Latitude	34° 03' 06.31" S
Longitude	19° 07' 16.58" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-210



Figure 1.10.1 Headcut to be sloped with rock pack

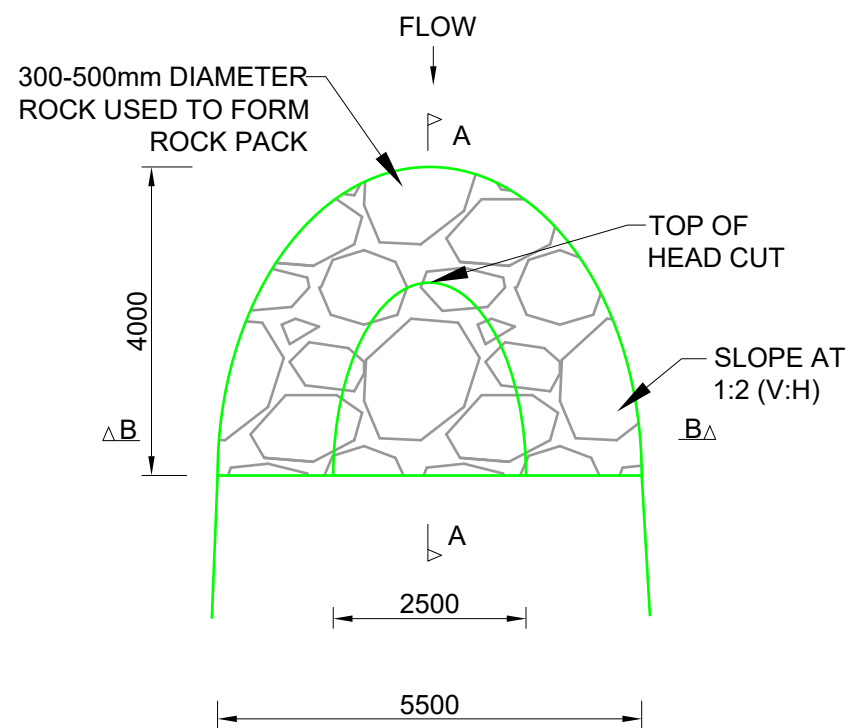
1.10.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01210.1	Excavation	m ³	5
H60A01210.2	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	17
H60A01210.3	300-500 mm diameter hand rock packed tightly	m ³	8
H60A01210.4	Revegetation between rocks using indigenous wetland vegetation	m ²	17

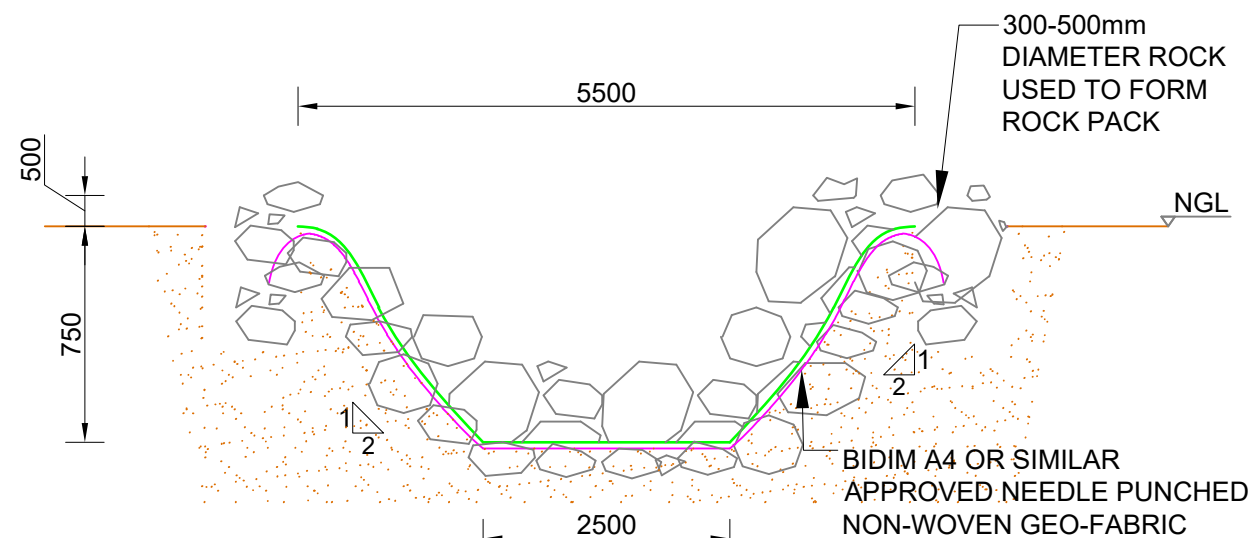
1.10.2 Construction notes for intervention H60A-01-210

The following construction notes apply to the proposed intervention:

- The head-cut and side banks are to be sloped back to a 1:2 slope (V:H);
- Needle-punched non-woven geofabric material is to be placed between the soil-rock interfaces;
- Geofabric is to be tucked into soil trenches as per supplier's recommendations;
- Rockpack is to be constructed using 300-500 mm diameter rocks that are tightly packed to ensure the structure is not washed away during high flow periods;
- Revegetation is to be done between rocks with indigenous wetland vegetation.

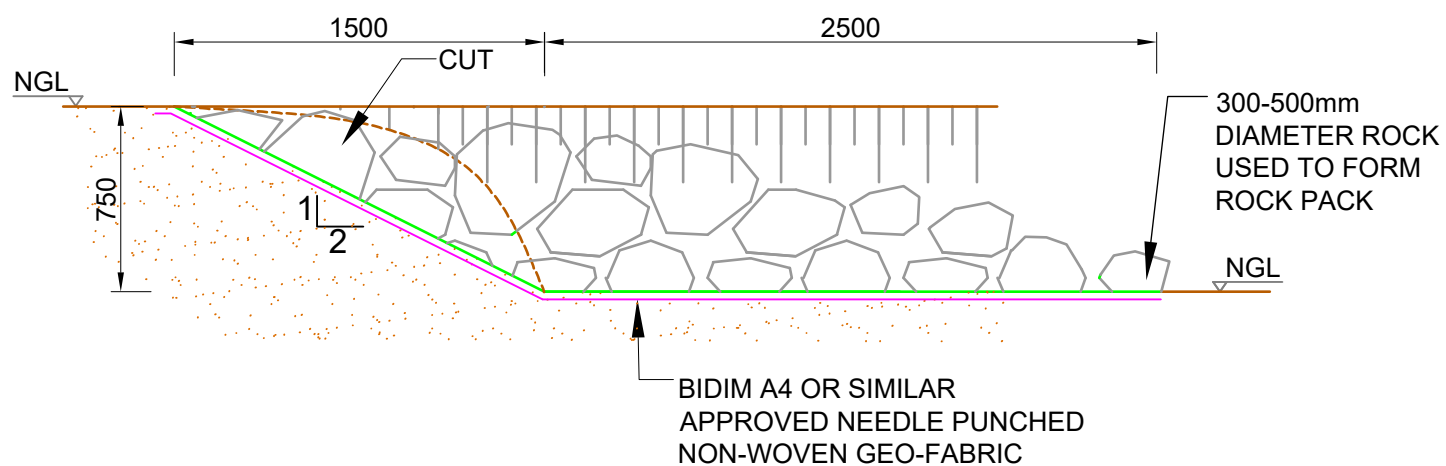


LAYOUT



SECTION B-B
THROUGH ROCK PACK

SCALE 1:50



SECTION A-A
THROUGH ROCK PACK

NOTES:

1. Needle-punched non-woven geofabric material is to be placed between all soil-rock interfaces;
2. Geo-fabric is to be tucked into soil trenches of 300x300 mm;
3. Rockpack is to be constructed using 300-500 mm diameter rocks that are tightly packed to ensure the structure is not washed away during high flow periods;
4. All banks are to be sloped at a slope of 1:2 (V:H) where possible and compacted to a minimum of 93% ModAASHTO;
5. Revegetation to be carried out by tightly packing top soil into rock crevices and planting with harvested local indigenous wetland vegetation.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION



TITLE:
THE NATURE CONSERVANCY PROJECT
ROCK PACK
H60A-01-210

DATE: JUNE 2018

DRAWN: T. HARVEY

DRAWING CHECKED: T. PIKE

DESIGNED: T. HARVEY

DESIGN CHECKED: T. PIKE

LONGITUDE	LATITUDE	SCALE:	1:100 ON A3L	REV:
19° 07' 16.58" E	34° 03' 06.31" S	DRAWING NUMBER:	H60A-01-210	00

1.11 Intervention H60A-01-211

Intervention Type	Geocell chute
Rehabilitation Objective	Stabilise the head-cut that is threatening the upstream wetland and prevent further erosion and soil mobilisation that would contribute to sediment loads entering Theewaterskloof Dam
Latitude	34 ⁰ 03' 04.40" S
Longitude	19 ⁰ 06' 51.57" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-211



Figure 1.11.1 Proposed location of geocell chute

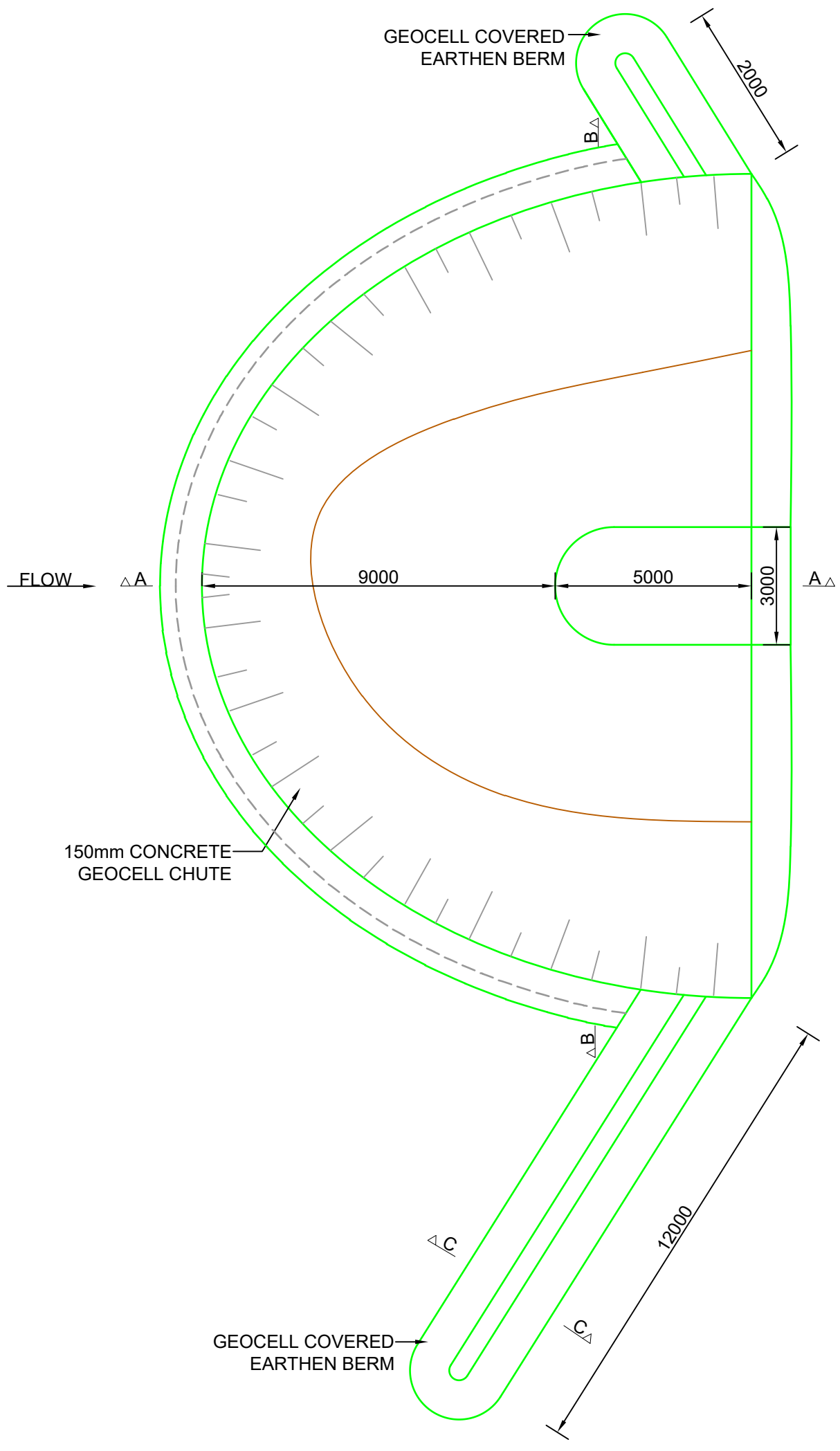
1.11.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01211.1	Excavation	m ³	273
H60A01211.2	Earthworks for earthen berms	m ³	11
H60A01211.3	Concrete for infilling Geocells	m ³	71
H60A01211.4	150 mm Geocells. Rate to allow for installation as per supplier instruction. Concrete not to be included in rate.	m ²	458
H60A01211.5	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	458

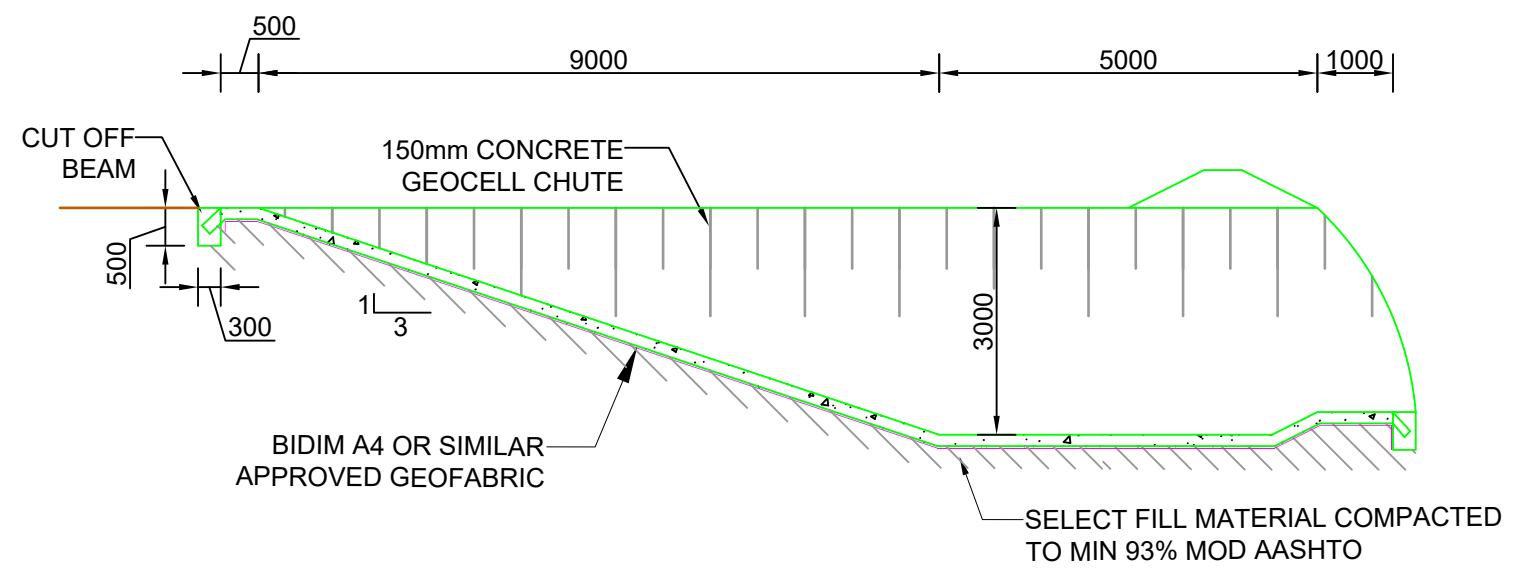
1.11.2 Construction notes for intervention H60A-01-211

The following construction notes apply to the proposed concrete filled geocell chute intervention:

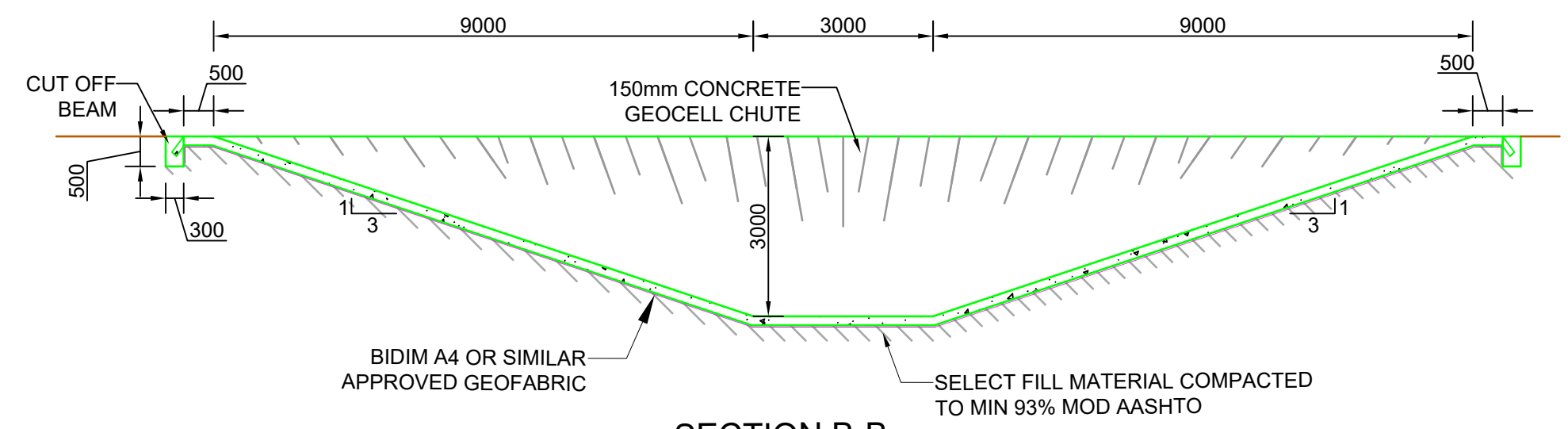
- Vegetation and topsoil is to be removed from the footprint of the earthen berms (associated with the chute) prior to their construction. Topsoil is not to be used in the construction of the earthen berm;
- The base of the excavation is to be well compacted and any unsuitable material removed and replaced with gravel or suitable material prior to construction;
- The geocells (and concrete fill) are to be installed according to the supplier's specifications.
- The geocells are to be laid on cut insitu material and not fill material;
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.



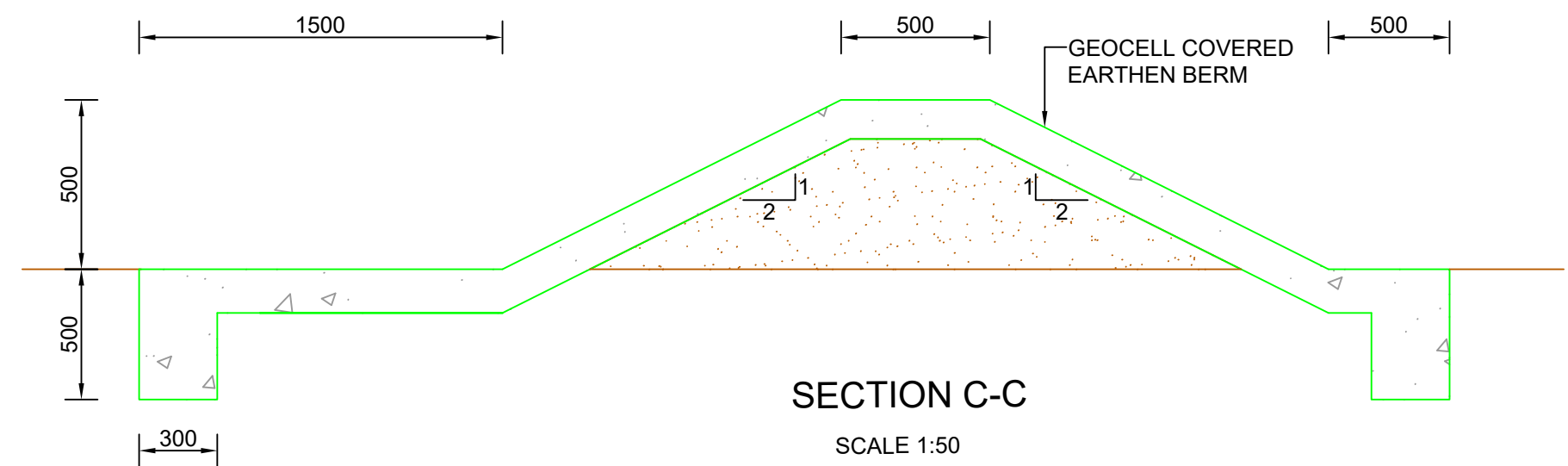
LAYOUT



SECTION A-A



SECTION B-B



SECTION C-C

SCALE 1:50

- NOTES:
1. Min 28 day concrete compressive strength of 30MPa unless otherwise stated.
 2. Grade 30/19 or 30/26 concrete can be used.
 3. Min concrete 28 day flexural strength of 4.1MPa.
 4. Max concrete slump of 70mm.
 5. Min concrete cement content of 310kg/m².
 6. Water : cement ratio not more than 0.52.
 7. Wood float finish to all concrete surfaces.
 8. Backfill material behind structure to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
 9. All dimensions shown in mm.
 10. Geocells are to be installed as per supplier specification, with stakes at the specified spacing/ intervals.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

Ground Truth
Water, Wetlands and Environmental Engineering
P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:
THE NATURE CONSERVANCY PROJECT
CONCRETE GEOCELL CHUTE
H60A-01-211

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T.PIKE

LONGITUDE	LATITUDE	SCALE:	NTS	REV:
19° 06' 51.57" E	34° 03' 04.40" S	DRAWING NUMBER:	H60A-01-211	00

1.12 Intervention H60A-01-212

Intervention Type	Geocell chute
Rehabilitation Objective	Stabilise the head-cut that is threatening the upstream wetland and prevent further erosion and soil mobilisation that would contribute to sediment loads entering Theewaterskloof Dam
Latitude	34 ⁰ 03' 03.87" S
Longitude	19 ⁰ 06' 50.91" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-212



Figure 1.12.1 Proposed location of geocell chute

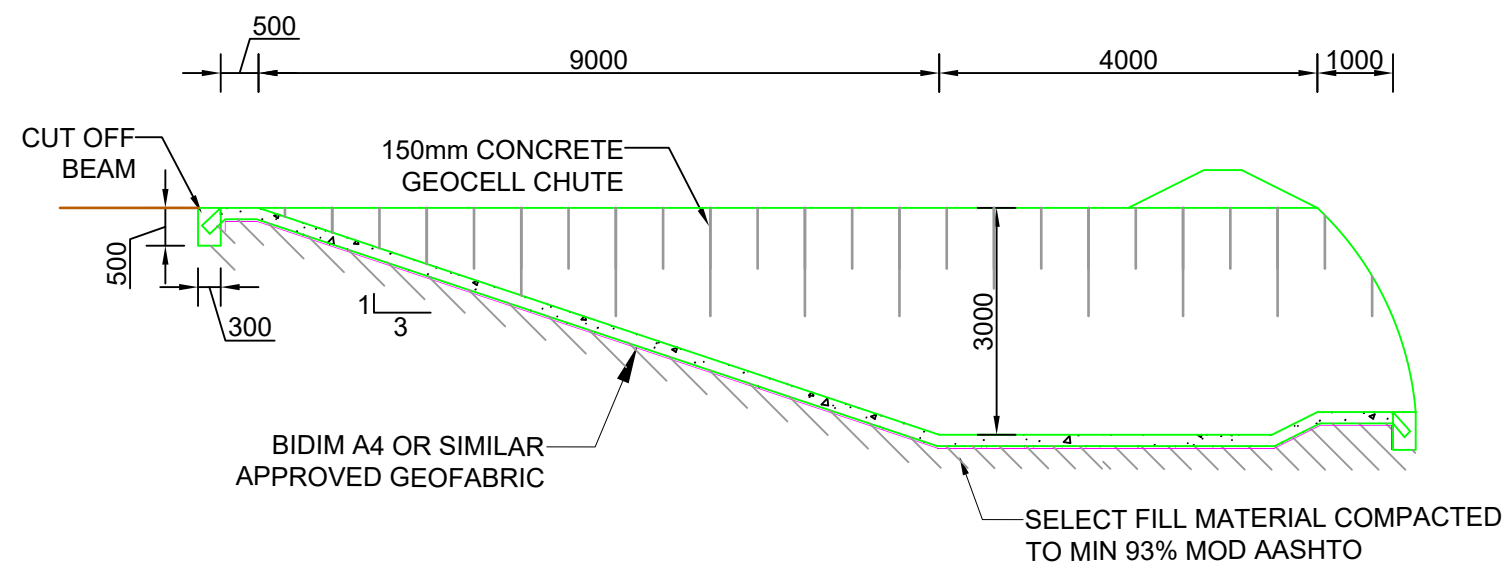
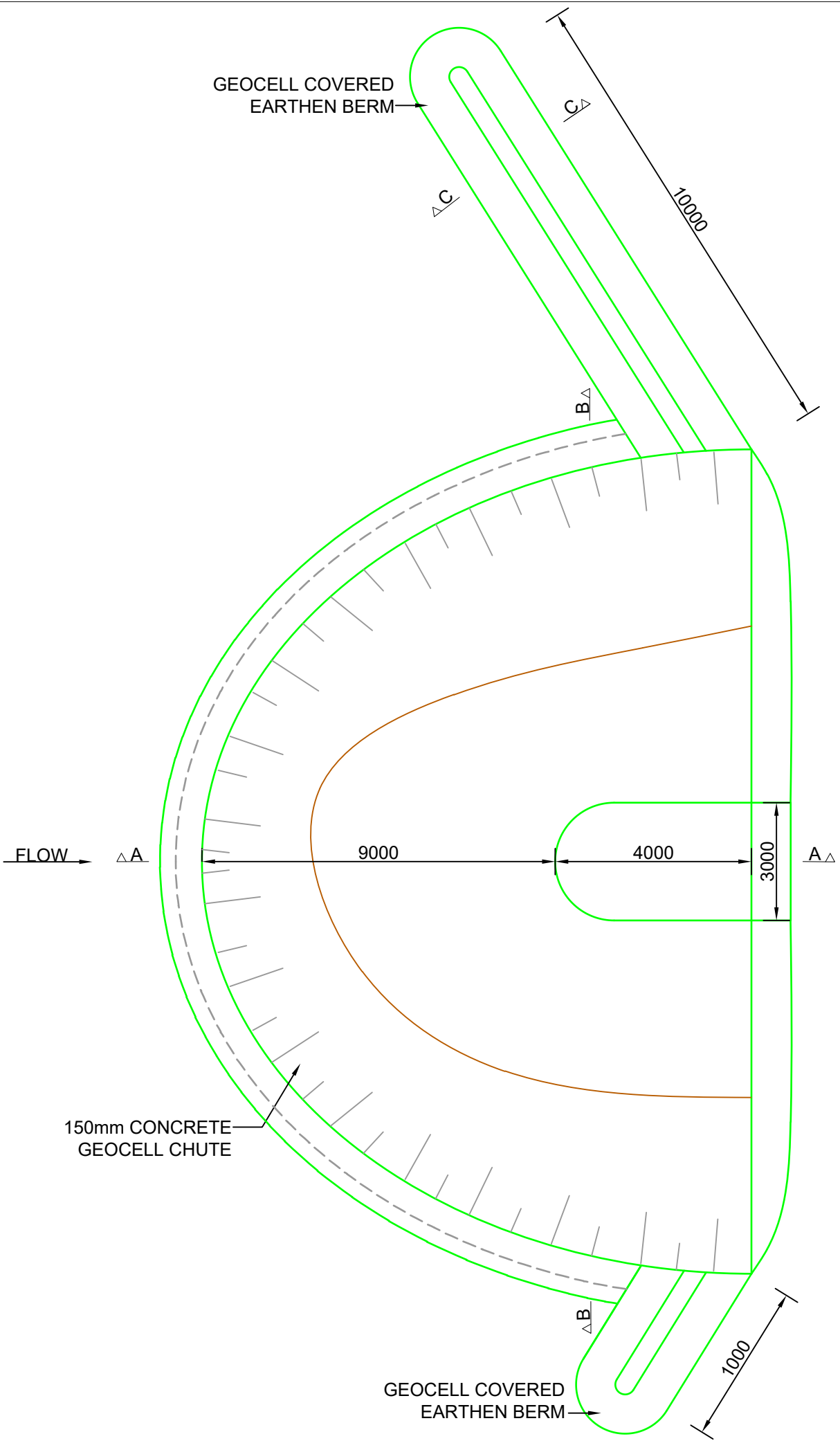
1.12.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01212.1	Excavation	m ³	229
H60A01212.2	Earthworks for earthen berms	m ³	8
H60A01212.3	Concrete for infilling Geocells	m ³	59
H60A01212.4	150 mm Geocells. Rate to allow for installation as per supplier instruction. Concrete not to be included in rate.	m ²	384
H60A01212.5	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	384

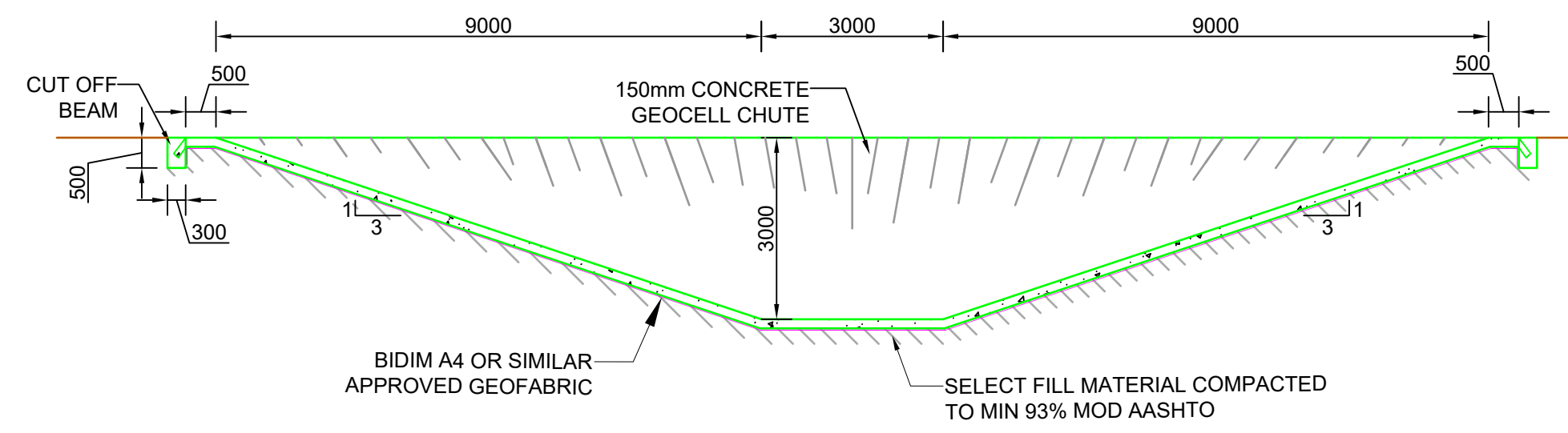
1.12.2 Construction notes for intervention H60A-01-212

The following construction notes apply to the proposed concrete filled geocell chute intervention:

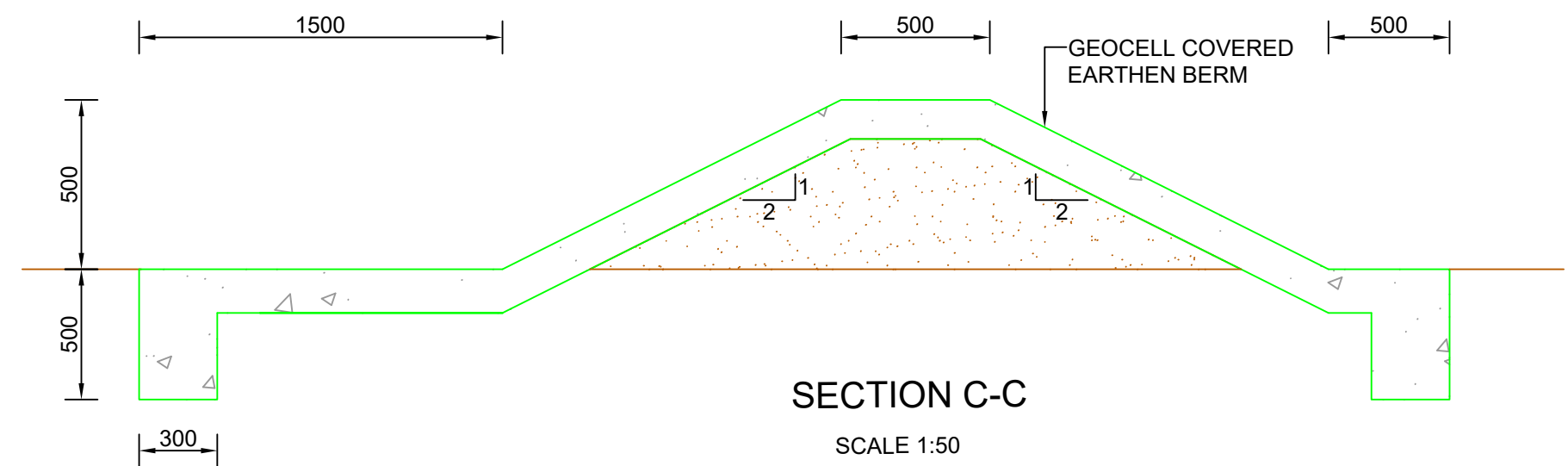
- Vegetation and topsoil is to be removed from the footprint of the earthen berms (associated with the chute) prior to their construction. Topsoil is not to be used in the construction of the earthen berm;
- The base of the excavation is to be well compacted and any unsuitable material removed and replaced with gravel or suitable material prior to construction;
- The geocells (and concrete fill) are to be installed according to the supplier's specifications.
- The geocells are to be laid on cut insitu material and not fill material;
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.



SECTION A-A



SECTION B-B



SECTION C-C

SCALE 1:50

- NOTES:
1. Min 28 day concrete compressive strength of 30MPa unless otherwise stated.
 2. Grade 30/19 or 30/26 concrete can be used.
 3. Min concrete 28 day flexural strength of 4.1MPa.
 4. Max concrete slump of 70mm.
 5. Min concrete cement content of 310kg/m².
 6. Water : cement ratio not more than 0.52.
 7. Wood float finish to all concrete surfaces.
 8. Backfill material behind structure to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
 9. All dimensions shown in mm.
 10. Geocells are to be installed as per supplier specification, with stakes at the specified spacing/ intervals.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

TITLE:
THE NATURE CONSERVANCY PROJECT
CONCRETE GEOCELL CHUTE
H60A-01-212

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T.PIKE

LONGITUDE	LATITUDE	SCALE:	NTS	REV:
19° 06' 50.91" E	34° 03' 03.87" S	DRAWING NUMBER:	H60A-01-212	00

1.13 Intervention H60A-01-213

Intervention Type	Geocell chute and backfilling of adjacent headcut
Rehabilitation Objective	Stabilise the head-cut that is threatening the upstream wetland and prevent further erosion and soil mobilisation that would contribute to sediment loads entering Theewaterskloof Dam
Latitude	34 ⁰ 03' 03.09" S
Longitude	19 ⁰ 06' 49.67" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-213



Figure 1.13.1 Proposed location of geocell chute

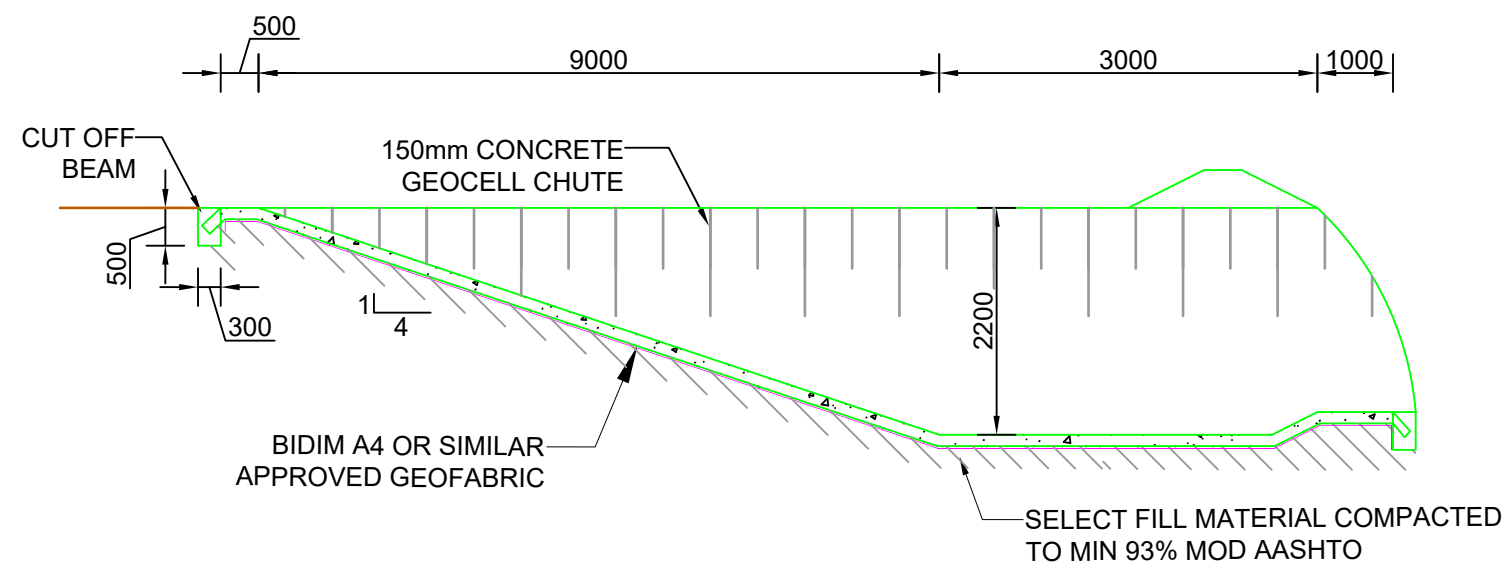
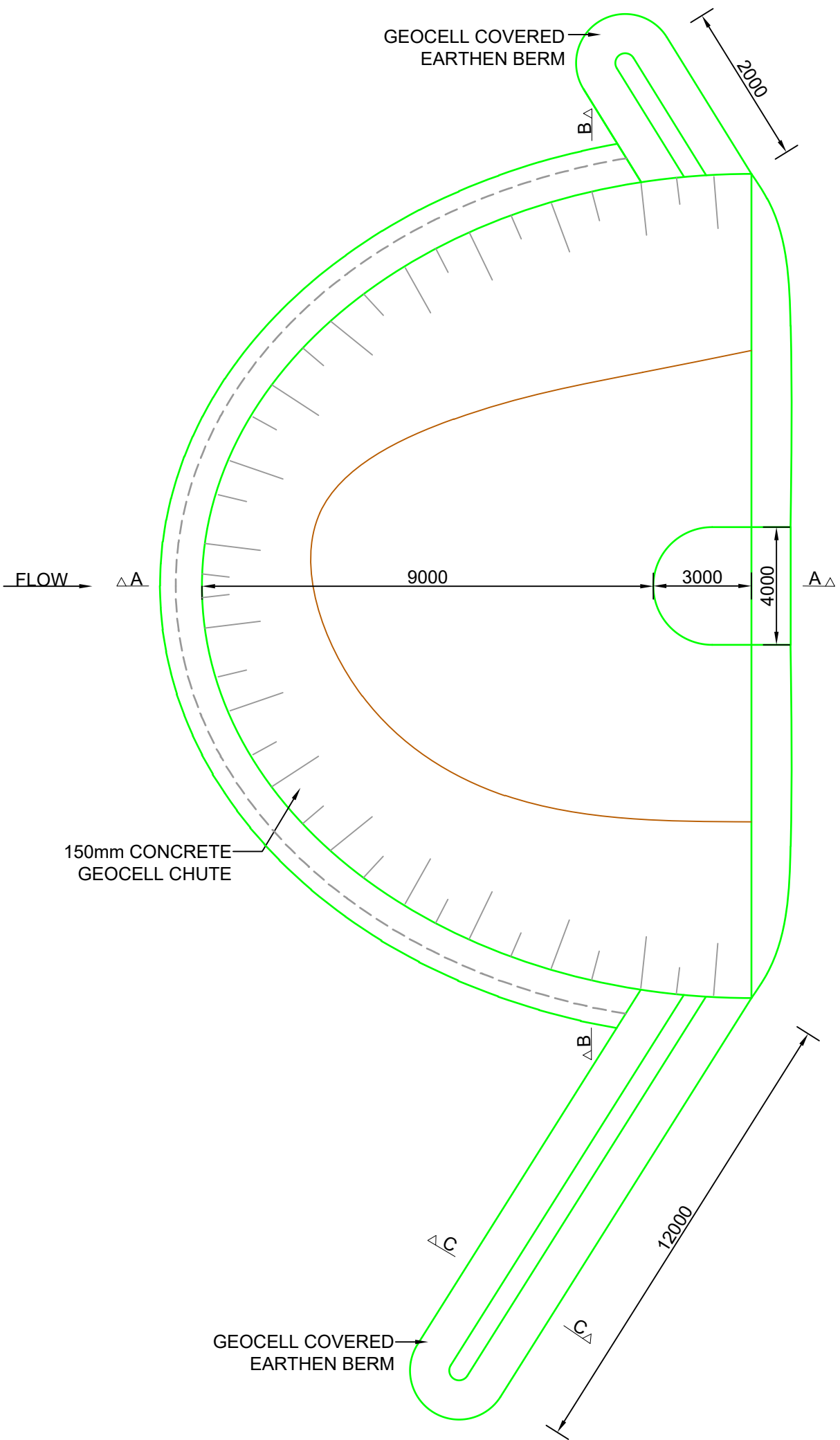
1.13.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01213.1	Excavation	m ³	169
H60A01213.2	Earthworks for earthen berms	m ³	11
H60A01213.3	Concrete for infilling Geocells	m ³	59
H60A01213.4	150 mm Geocells. Rate to allow for installation as per supplier instruction. Concrete not to be included in rate.	m ²	378
H60A01213.5	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	378

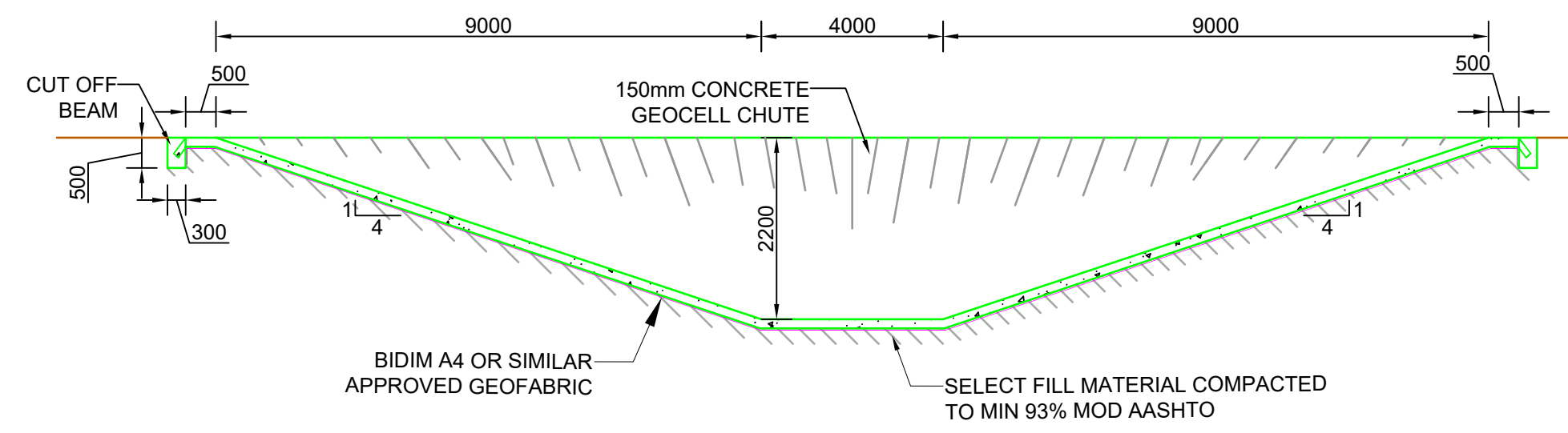
1.13.2 Construction notes for intervention H60A-01-213

The following construction notes apply to the proposed concrete filled geocell chute intervention:

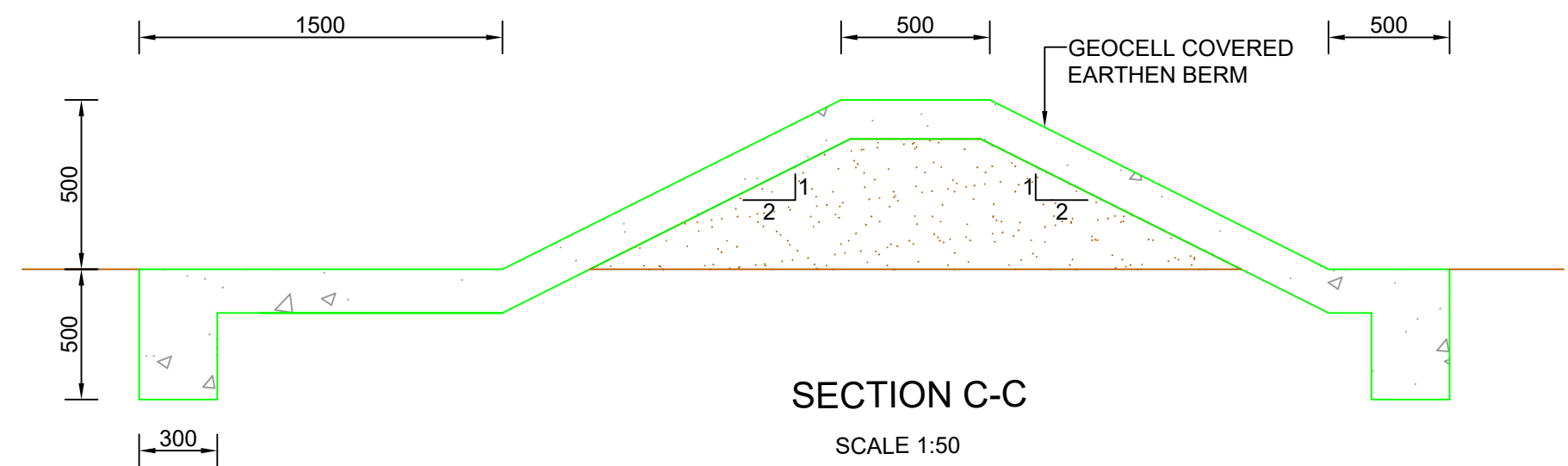
- Vegetation and topsoil is to be removed from the footprint of the earthen berms (associated with the chute) prior to their construction. Topsoil is not to be used in the construction of the earthen berm;
- The base of the excavation is to be well compacted and any unsuitable material removed and replaced with gravel or suitable material prior to construction;
- The geocells (and concrete fill) are to be installed according to the supplier's specifications.
- The geocells are to be laid on cut insitu material and not fill material;
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.
- Backfill head-cut in front of right hand berm with material from sloping.



SECTION A-A



SECTION B-B



SECTION C-C

SCALE 1:50

- NOTES:
1. Min 28 day concrete compressive strength of 30MPa unless otherwise stated.
 2. Grade 30/19 or 30/26 concrete can be used.
 3. Min concrete 28 day flexural strength of 4.1MPa.
 4. Max concrete slump of 70mm.
 5. Min concrete cement content of 310kg/m².
 6. Water : cement ratio not more than 0.52.
 7. Wood float finish to all concrete surfaces.
 8. Backfill material behind structure to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
 9. All dimensions shown in mm.
 10. Geocells are to be installed as per supplier specification, with stakes at the specified spacing/ intervals.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

GroundTruth
Water, Wetlands and
Environmental Engineering
P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:
THE NATURE CONSERVANCY PROJECT
CONCRETE GEOCELL CHUTE
H60A-01-213

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T.PIKE

LONGITUDE	LATITUDE	SCALE:	NTS	REV:
19° 06' 49.67" E	34° 03' 03.09" S	DRAWING NUMBER:	H60A-01-213	00

1.14 Intervention H60A-01-214

Intervention Type	Geocell chute
Rehabilitation Objective	Stabilise the head-cut that is threatening the upstream wetland and prevent further erosion and soil mobilisation that would contribute to sediment loads entering Theewaterskloof Dam
Latitude	34 ⁰ 03' 02.48" S
Longitude	19 ⁰ 06' 50.34" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-214



Figure 1.14.1 Proposed location of geocell chute

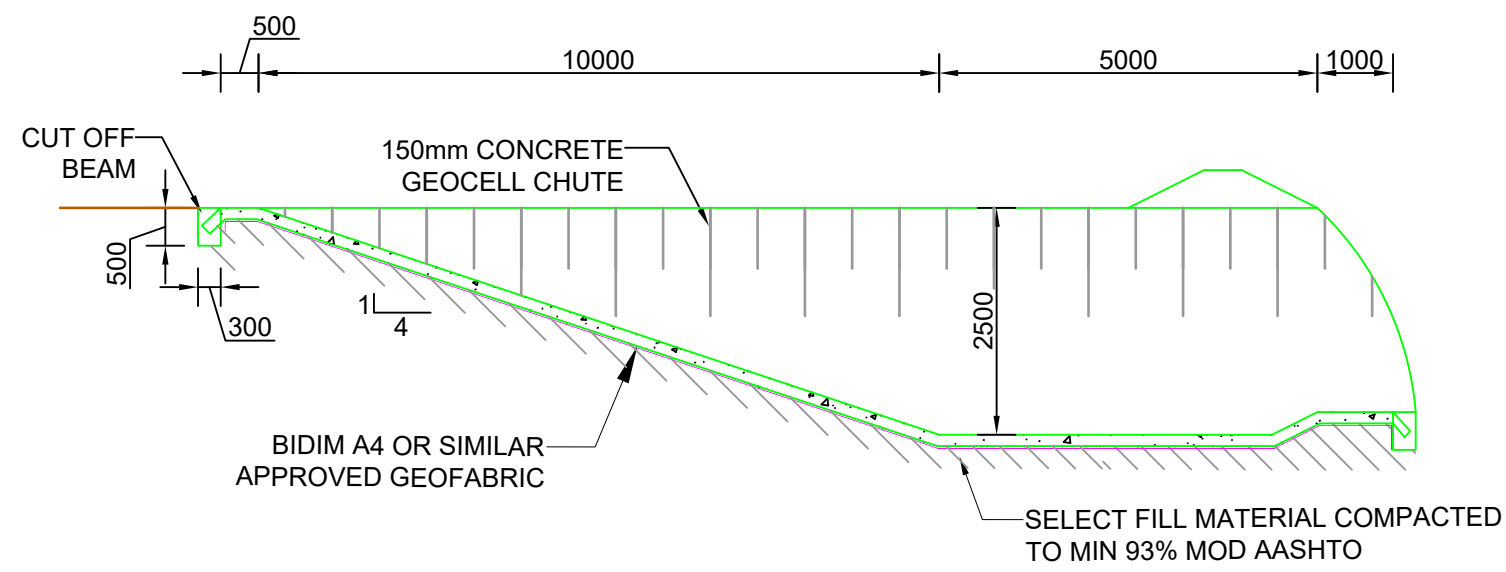
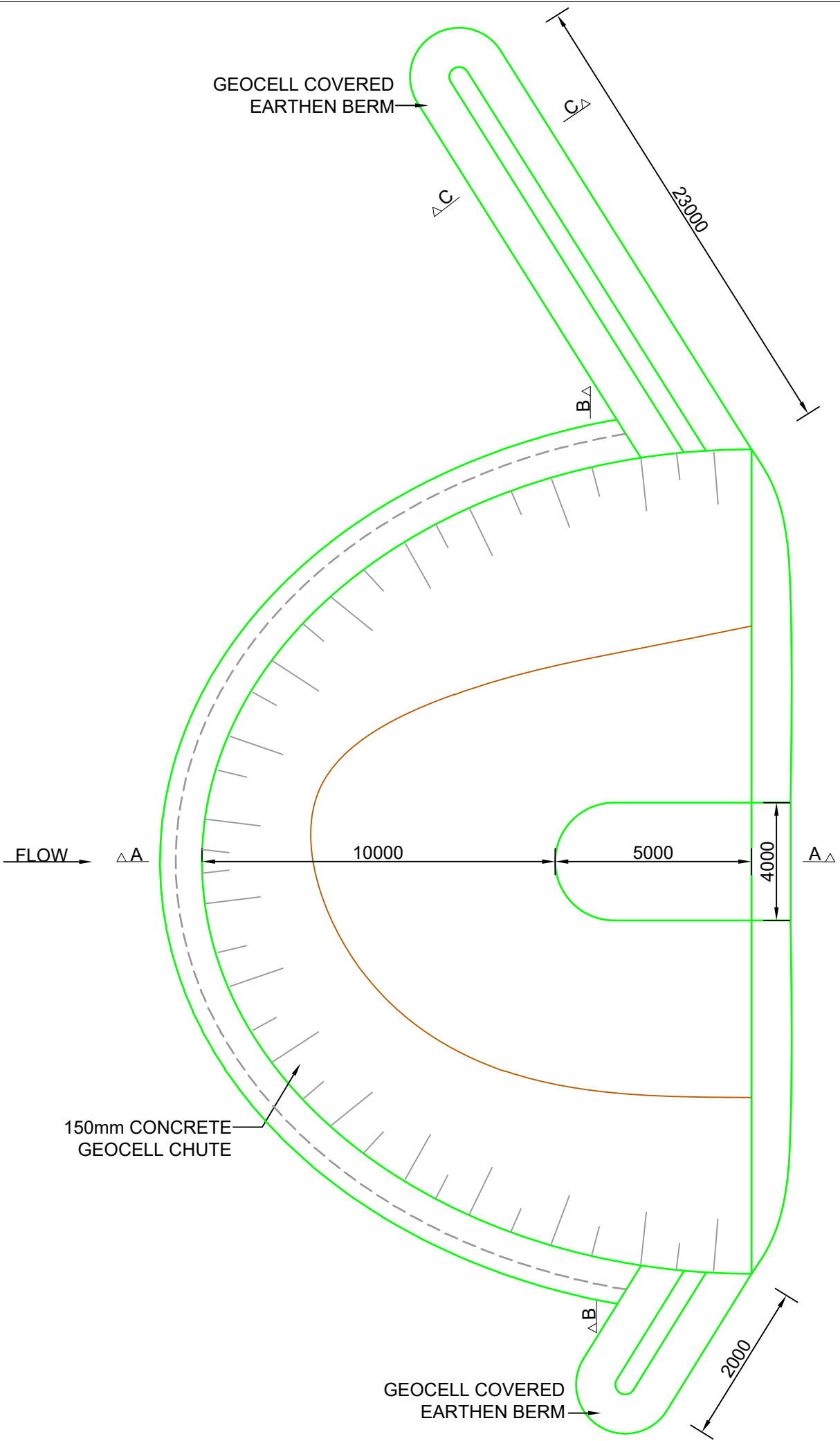
1.14.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01214.1	Excavation	m ³	250
H60A01214.2	Earthworks for earthen berms	m ³	19
H60A01214.3	Concrete for infilling Geocells	m ³	84
H60A01214.4	150 mm Geocells. Rate to allow for installation as per supplier instruction. Concrete not to be included in rate.	m ²	547
H60A01214.5	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	547

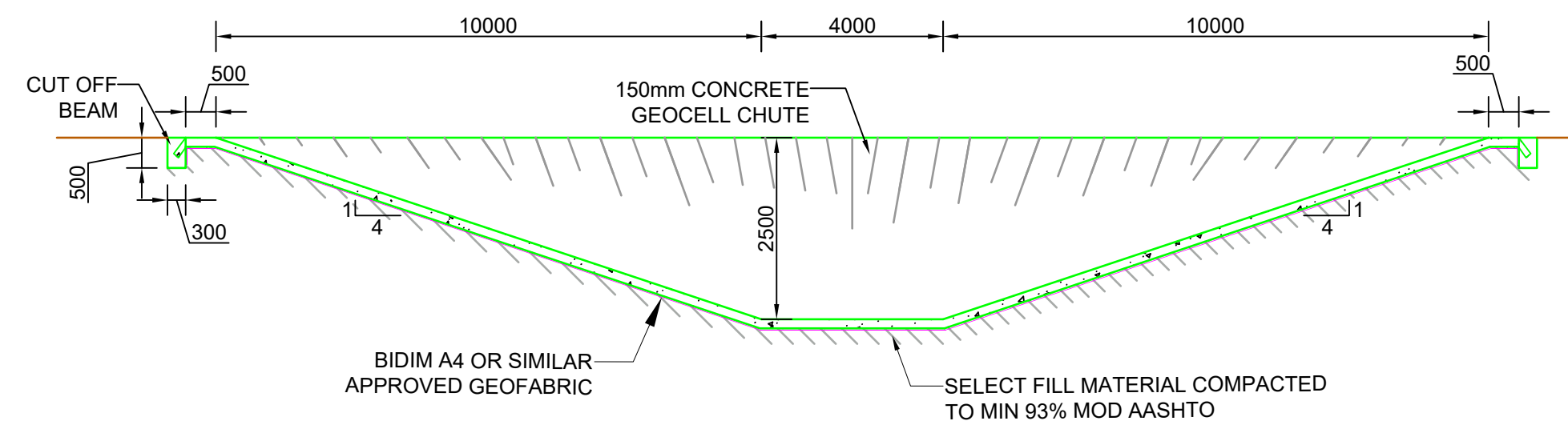
1.14.2 Construction notes for intervention H60A-01-214

The following construction notes apply to the proposed concrete filled geocell chute intervention:

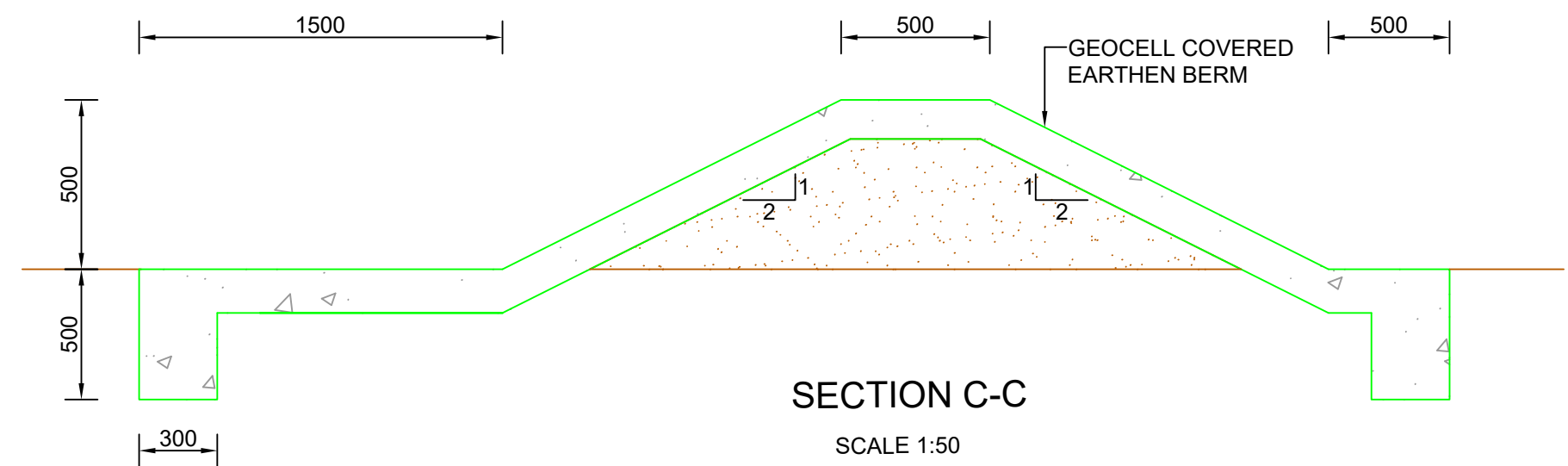
- Vegetation and topsoil is to be removed from the footprint of the earthen berms (associated with the chute) prior to their construction. Topsoil is not to be used in the construction of the earthen berm;
- The base of the excavation is to be well compacted and any unsuitable material removed and replaced with gravel or suitable material prior to construction;
- The geocells (and concrete fill) are to be installed according to the supplier's specifications.
- The geocells are to be laid on cut insitu material and not fill material;
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.



SECTION A-A



SECTION B-B



SECTION C-C

SCALE 1:50

- NOTES:
1. Min 28 day concrete compressive strength of 30MPa unless otherwise stated.
 2. Grade 30/19 or 30/26 concrete can be used.
 3. Min concrete 28 day flexural strength of 4.1MPa.
 4. Max concrete slump of 70mm.
 5. Min concrete cement content of 310kg/m².
 6. Water : cement ratio not more than 0.52.
 7. Wood float finish to all concrete surfaces.
 8. Backfill material behind structure to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
 9. All dimensions shown in mm.
 10. Geocells are to be installed as per supplier specification, with stakes at the specified spacing/ intervals.

**PRELIMINARY DRAWING
NOT FOR CONSTRUCTION**

Ground Truth
Water, Wetlands and
Environmental Engineering
P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:
**THE NATURE CONSERVANCY PROJECT
CONCRETE GEOCELL CHUTE
H60A-01-214**

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T.PIKE

LONGITUDE	LATITUDE	SCALE:	NTS	REV:
19° 06' 50.34" E	34° 03' 02.48" S	DRAWING NUMBER:	H60A-01-214	00

1.15 Intervention H60A-01-215

Intervention Type	Geocell chute
Rehabilitation Objective	Stabilise the head-cut that is threatening the upstream wetland and prevent further erosion and soil mobilisation that would contribute to sediment loads entering Theewaterskloof Dam
Latitude	34 ⁰ 03' 00.36" S
Longitude	19 ⁰ 06' 49.54" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-215



Figure 1.15.1 Proposed location of geocell chute

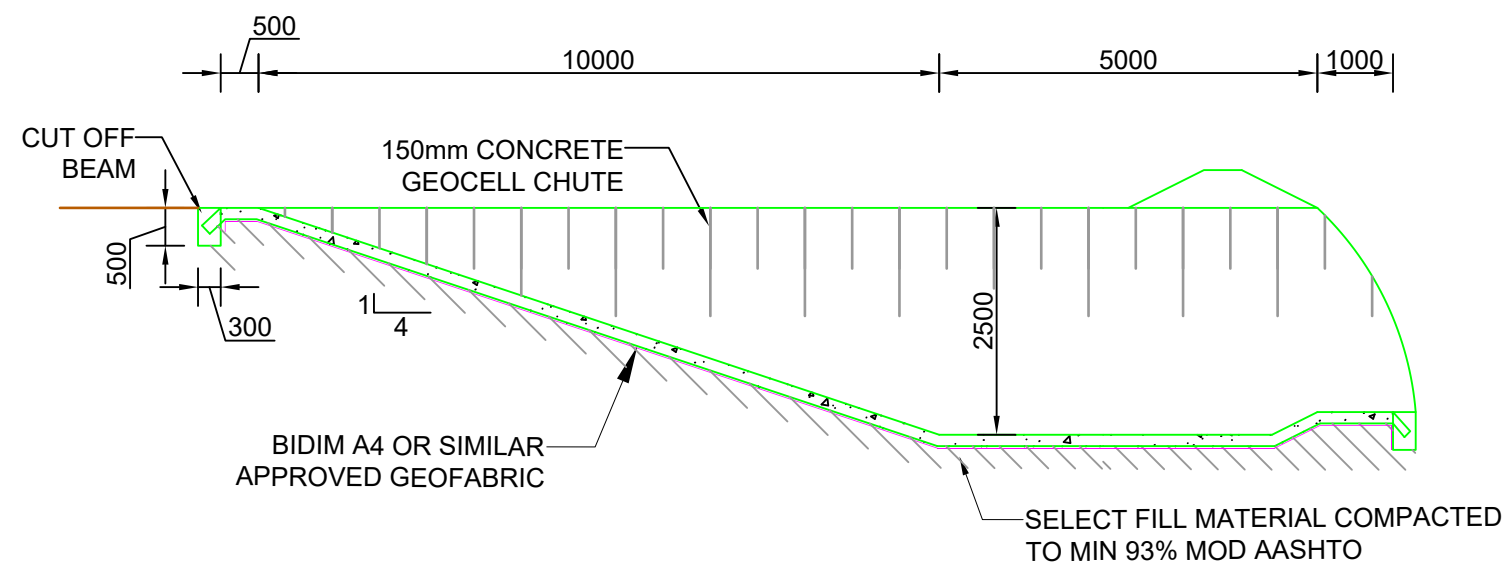
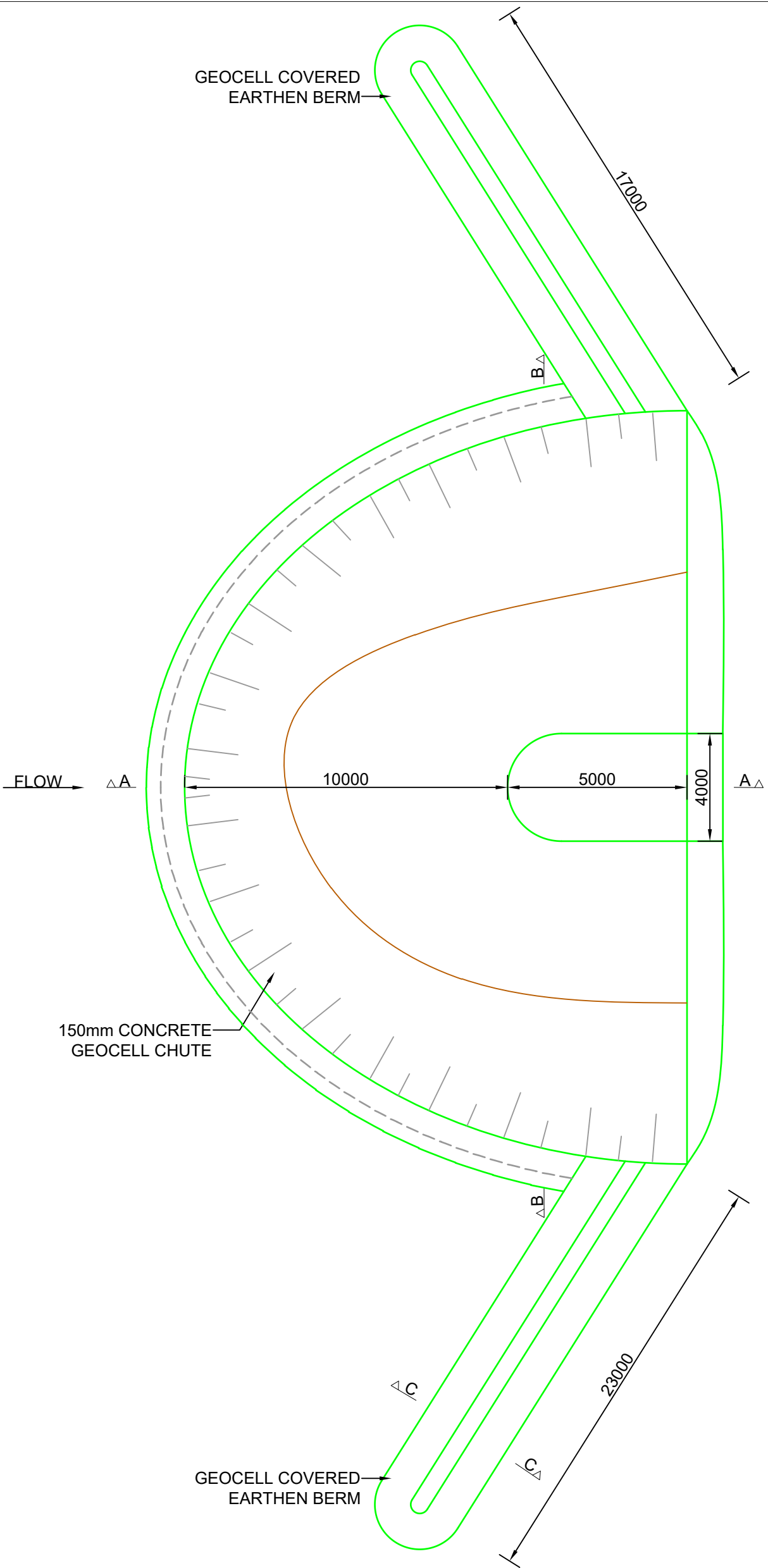
1.15.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01215.1	Excavation	m ³	299
H60A01215.2	Earthworks for earthen berms	m ³	30
H60A01215.3	Concrete for infilling Geocells	m ³	97
H60A01215.4	150 mm Geocells. Rate to allow for installation as per supplier instruction. Concrete not to be included in rate.	m ²	632
H60A01215.5	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	632

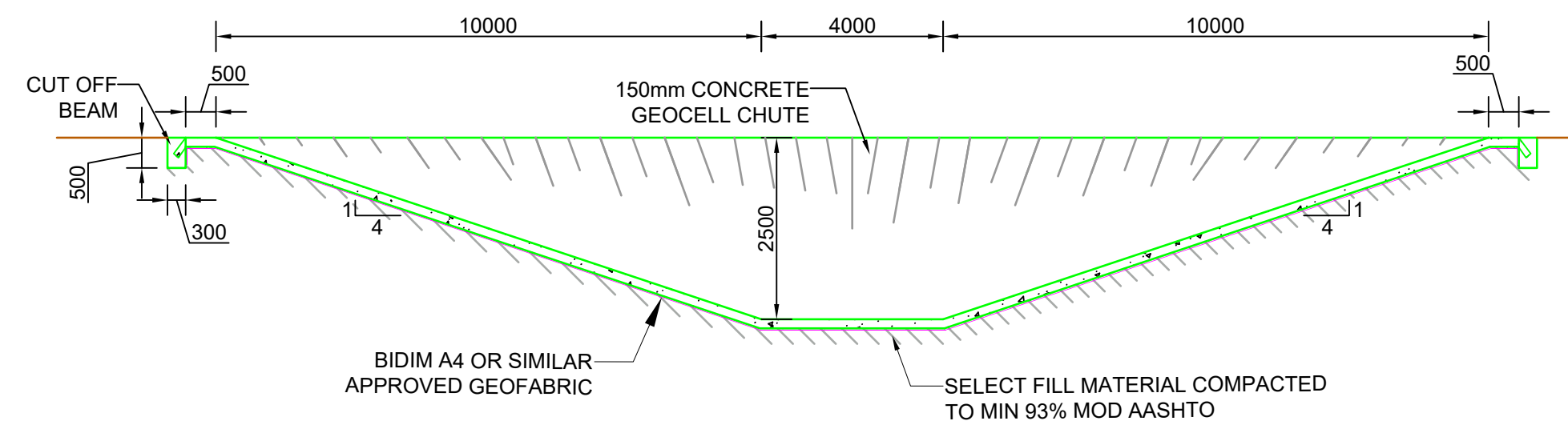
1.15.2 Construction notes for intervention H60A-01-215

The following construction notes apply to the proposed concrete filled geocell chute intervention:

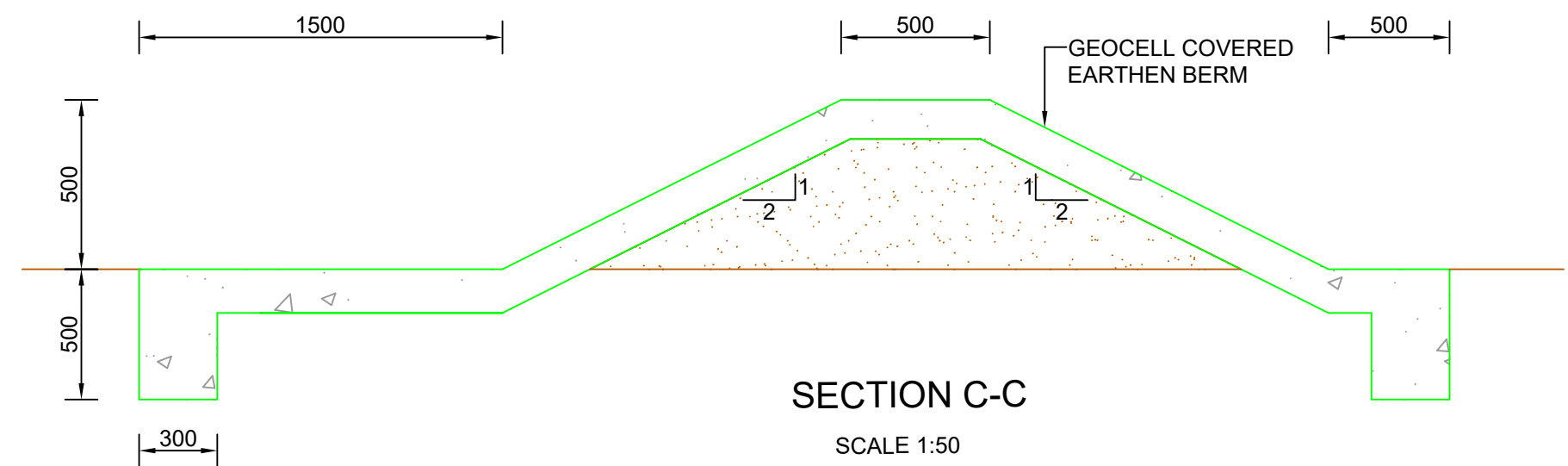
- Vegetation and topsoil is to be removed from the footprint of the earthen berms (associated with the chute) prior to their construction. Topsoil is not to be used in the construction of the earthen berm;
- The base of the excavation is to be well compacted and any unsuitable material removed and replaced with gravel or suitable material prior to construction;
- The geocells (and concrete fill) are to be installed according to the supplier's specifications.
- The geocells are to be laid on cut insitu material and not fill material;
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.



SECTION A-A



SECTION B-B



SECTION C-C

SCALE 1:50

- NOTES:
1. Min 28 day concrete compressive strength of 30MPa unless otherwise stated.
 2. Grade 30/19 or 30/26 concrete can be used.
 3. Min concrete 28 day flexural strength of 4.1MPa.
 4. Max concrete slump of 70mm.
 5. Min concrete cement content of 310kg/m².
 6. Water : cement ratio not more than 0.52.
 7. Wood float finish to all concrete surfaces.
 8. Backfill material behind structure to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
 9. All dimensions shown in mm.
 10. Geocells are to be installed as per supplier specification, with stakes at the specified spacing/ intervals.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

GroundTruth
Water, Wetlands and
Environmental Engineering
P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:
THE NATURE CONSERVANCY PROJECT
CONCRETE GEOCELL CHUTE
H60A-01-215

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T.PIKE

LONGITUDE	LATITUDE	SCALE:	NTS	REV:
19° 06' 49.54" E	34° 03' 00.36" S	DRAWING NUMBER:	H60A-01-215	00

1.16 Intervention H60A-01-216

Intervention Type	Geocell chute
Rehabilitation Objective	Stabilise the head-cut that is threatening the upstream wetland and prevent further erosion and soil mobilisation that would contribute to sediment loads entering Theewaterskloof Dam
Latitude	34 ⁰ 02' 59.00" S
Longitude	19 ⁰ 06' 46.84" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-216



Figure 1.16.1 Proposed location of geocell chute

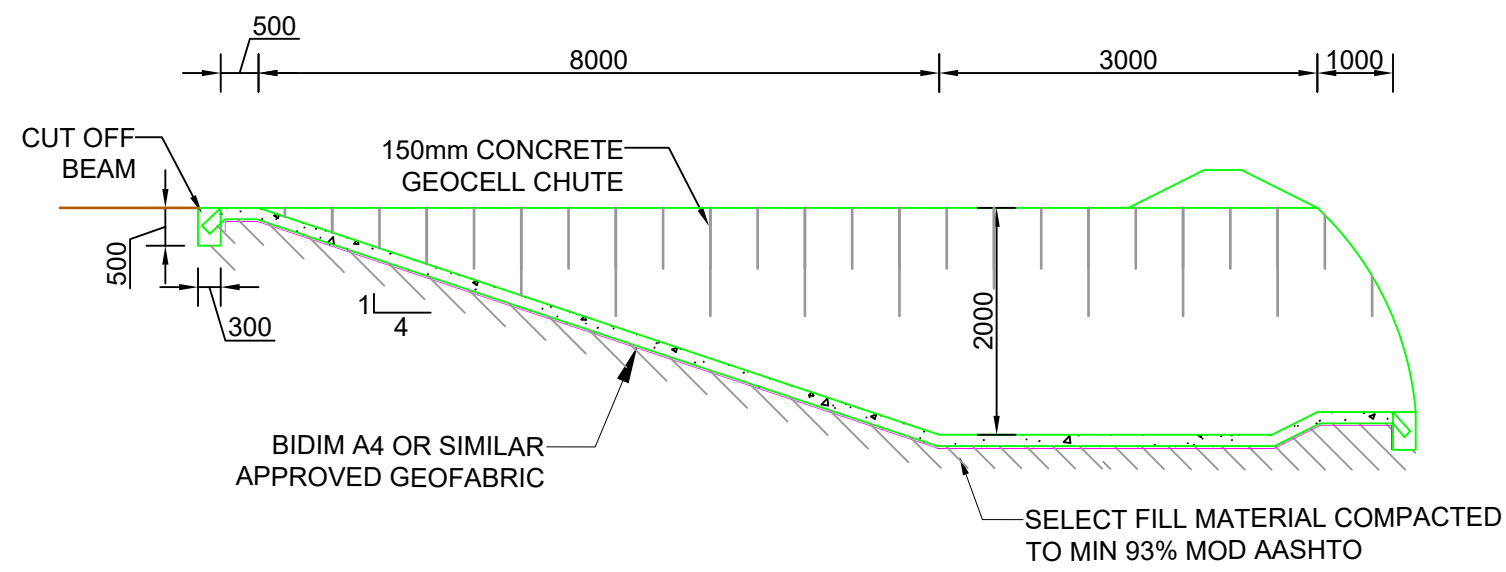
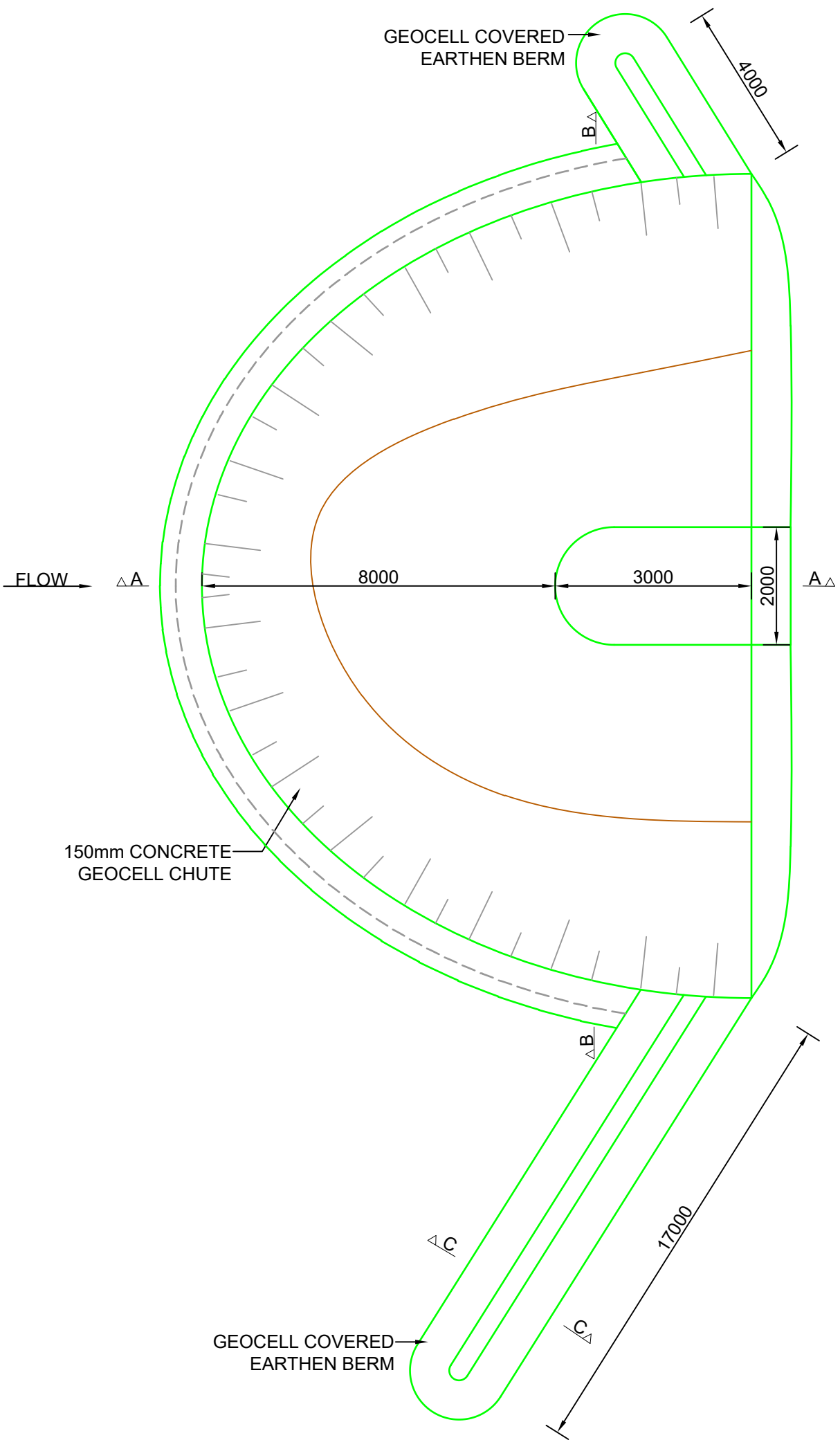
1.16.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01216.1	Excavation	m ³	133
H60A01216.2	Earthworks for earthen berms	m ³	16
H60A01216.3	Concrete for infilling Geocells	m ³	54
H60A01216.4	150 mm Geocells. Rate to allow for installation as per supplier instruction. Concrete not to be included in rate.	m ²	352
H60A01216.5	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	352

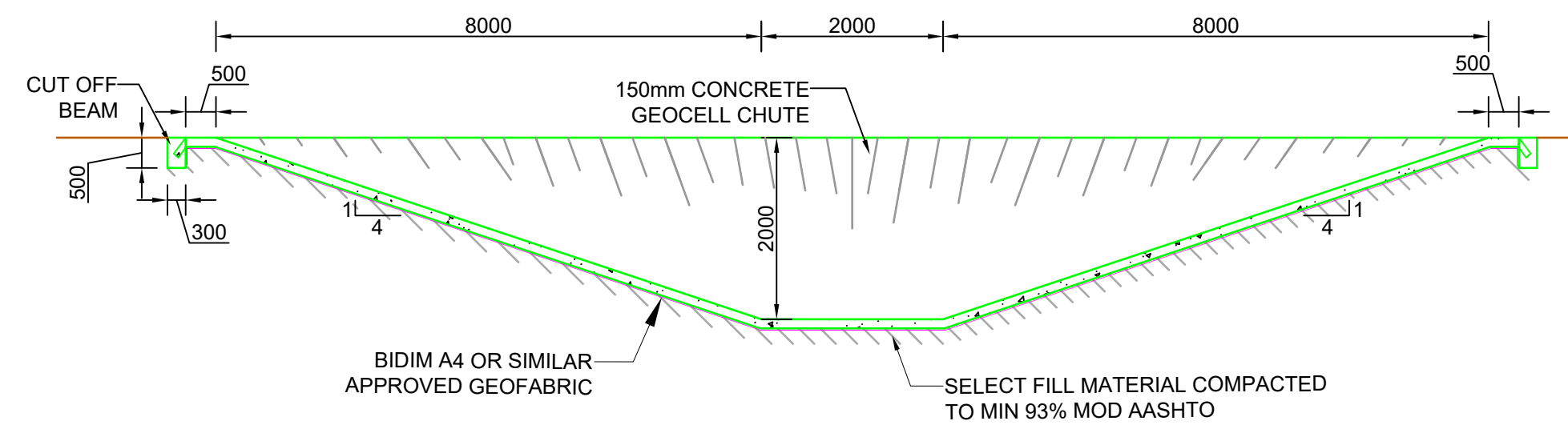
1.16.2 Construction notes for intervention H60A-01-216

The following construction notes apply to the proposed concrete filled geocell chute intervention:

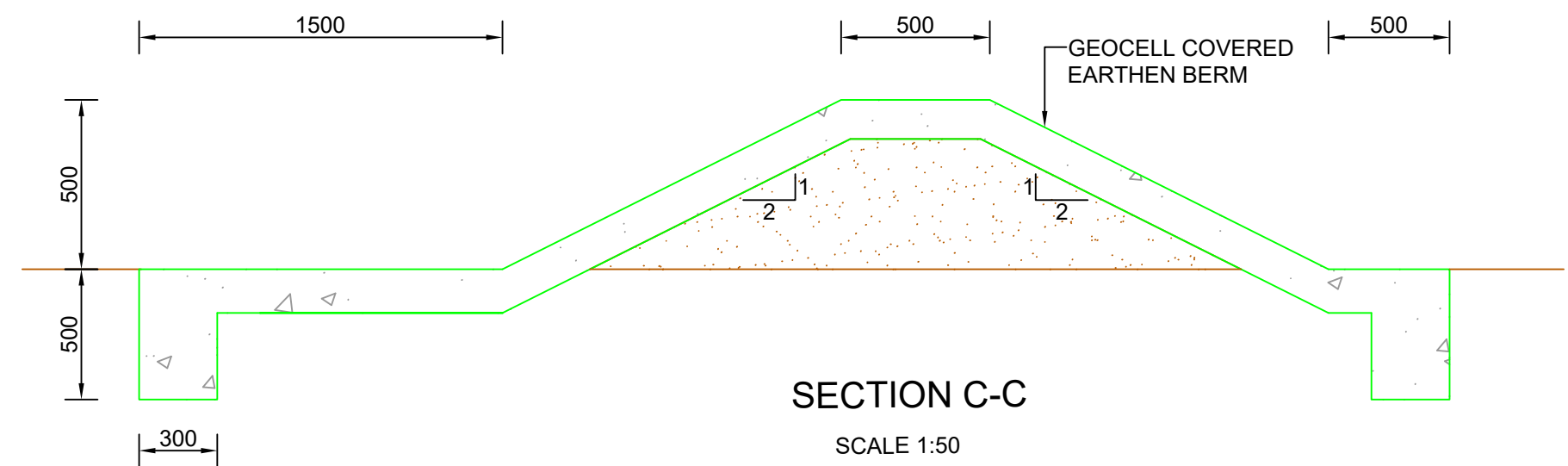
- Vegetation and topsoil is to be removed from the footprint of the earthen berms (associated with the chute) prior to their construction. Topsoil is not to be used in the construction of the earthen berm;
- The base of the excavation is to be well compacted and any unsuitable material removed and replaced with gravel or suitable material prior to construction;
- The geocells (and concrete fill) are to be installed according to the supplier's specifications.
- The geocells are to be laid on cut insitu material and not fill material;
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.



SECTION A-A



SECTION B-B



SECTION C-C
SCALE 1:50

- NOTES:
1. Min 28 day concrete compressive strength of 30MPa unless otherwise stated.
 2. Grade 30/19 or 30/26 concrete can be used.
 3. Min concrete 28 day flexural strength of 4.1MPa.
 4. Max concrete slump of 70mm.
 5. Min concrete cement content of 310kg/m².
 6. Water : cement ratio not more than 0.52.
 7. Wood float finish to all concrete surfaces.
 8. Backfill material behind structure to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
 9. All dimensions shown in mm.
 10. Geocells are to be installed as per supplier specification, with stakes at the specified spacing/ intervals.

**PRELIMINARY DRAWING
NOT FOR CONSTRUCTION**

GroundTruth
Water, Wetlands and
Environmental Engineering
P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:
**THE NATURE CONSERVANCY PROJECT
CONCRETE GEOCELL CHUTE
H60A-01-216**

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T.PIKE

LONGITUDE	LATITUDE	SCALE:	NTS	REV:
19° 06' 46.84" E	34° 02' 59.00" S	DRAWING NUMBER:	H60A-01-216	00

1.17 Intervention H60A-01-217

Intervention Type	Geocell chute
Rehabilitation Objective	Stabilise the head-cut that is threatening the upstream wetland and prevent further erosion and soil mobilisation that would contribute to sediment loads entering Theewaterskloof Dam
Latitude	34 ⁰ 02' 58.63" S
Longitude	19 ⁰ 06' 45.83" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-217



Figure 1.17.1 Proposed location of geocell chute

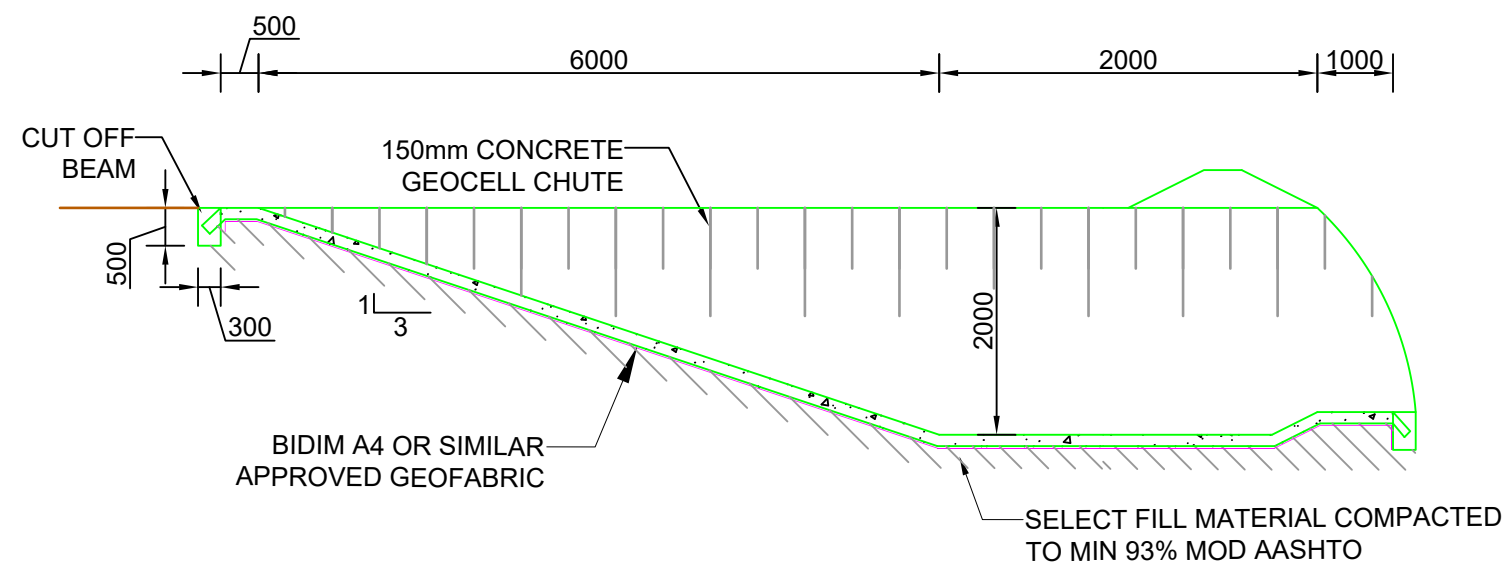
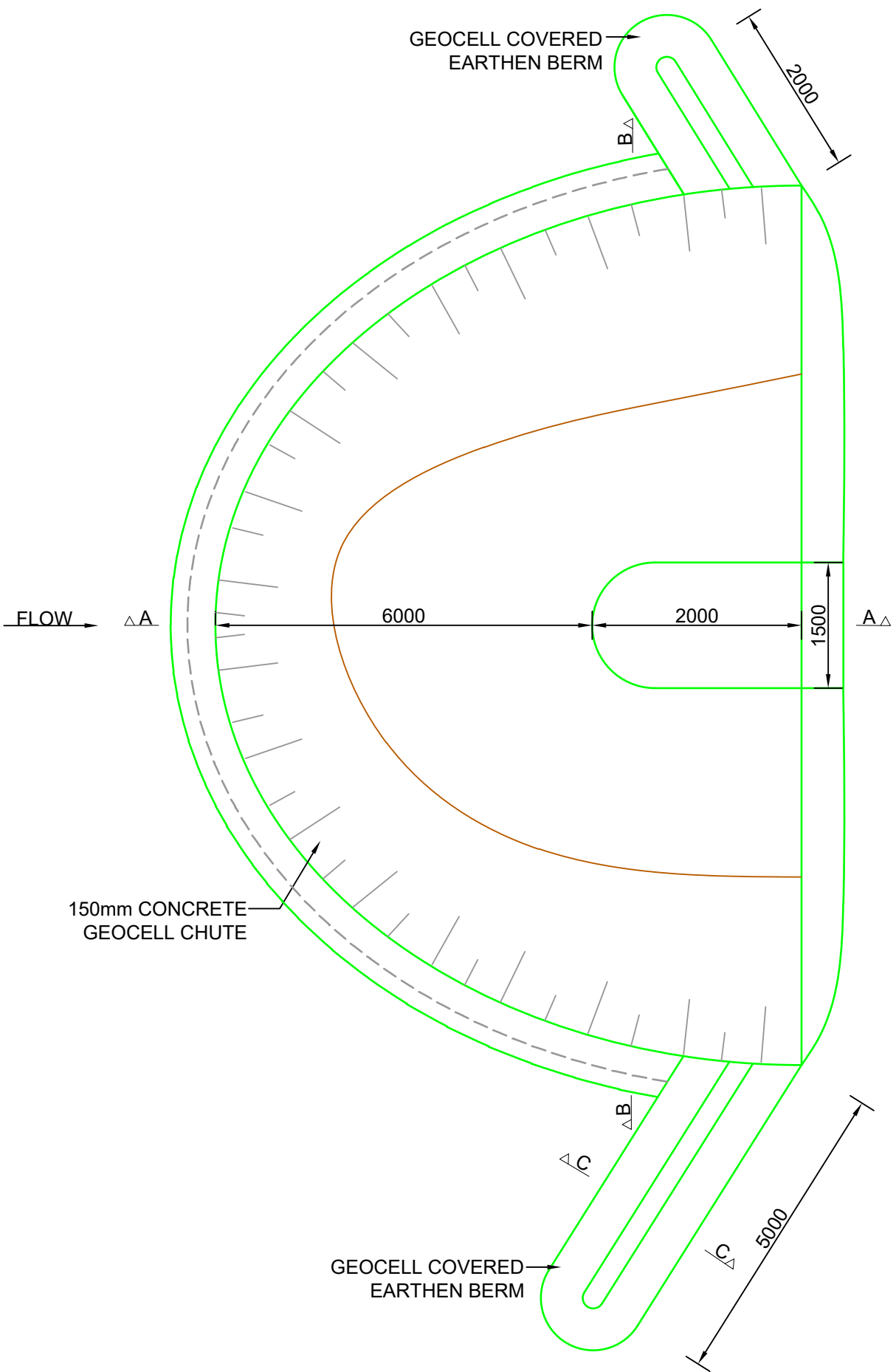
1.17.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01217.1	Excavation	m ³	68
H60A01217.2	Earthworks for earthen berms	m ³	5
H60A01217.3	Concrete for infilling Geocells	m ³	28
H60A01217.4	150 mm Geocells. Rate to allow for installation as per supplier instruction. Concrete not to be included in rate.	m ²	182
H60A01217.5	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	182

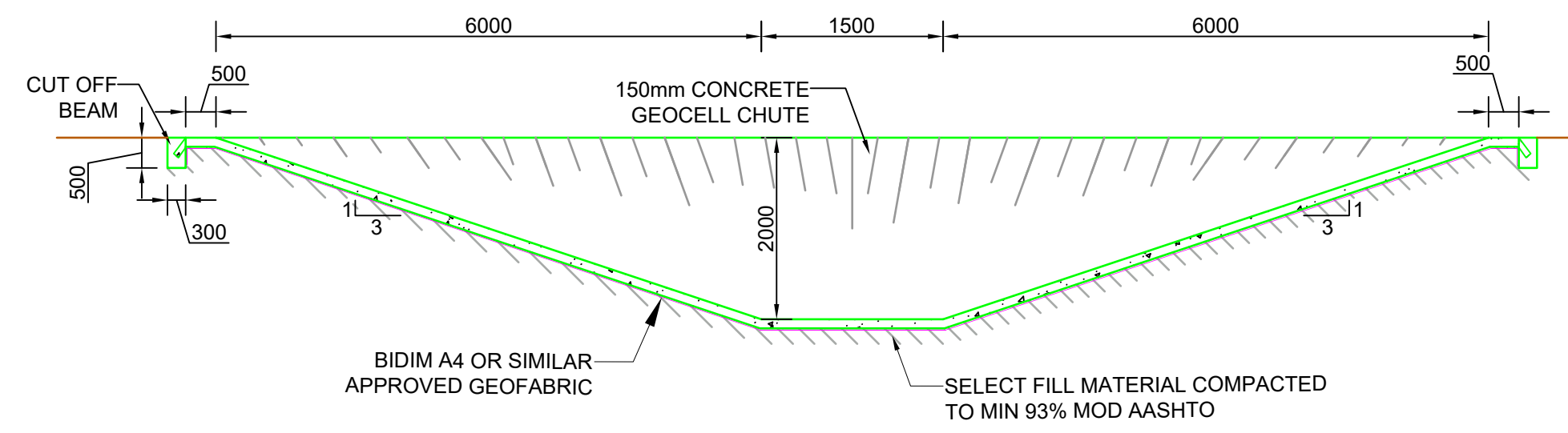
1.17.2 Construction notes for intervention H60A-01-217

The following construction notes apply to the proposed concrete filled geocell chute intervention:

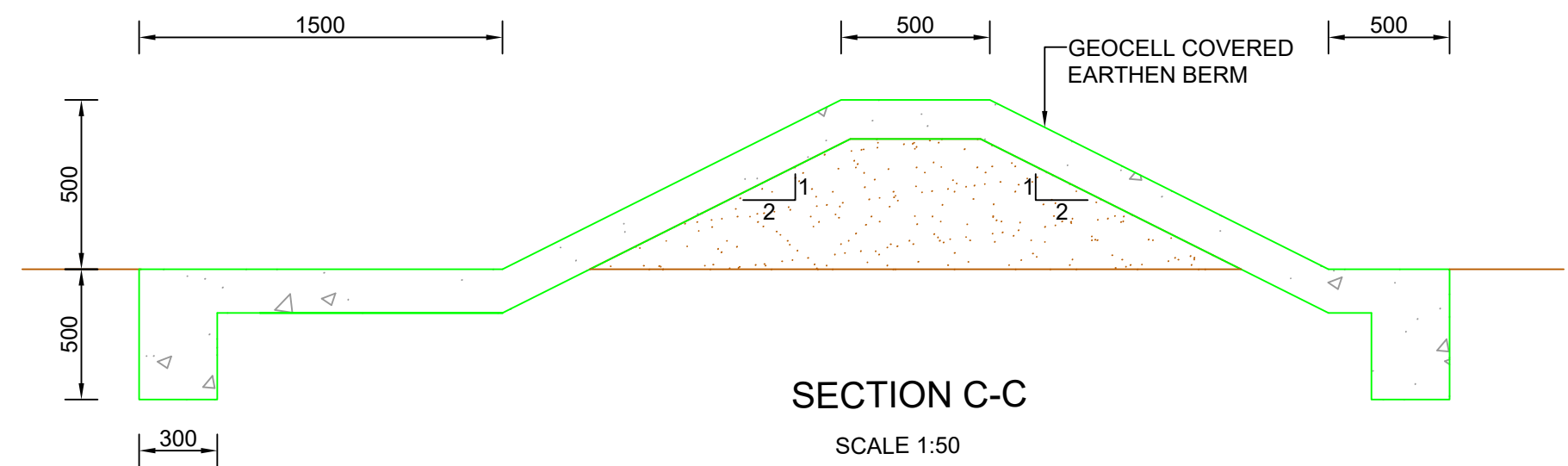
- Vegetation and topsoil is to be removed from the footprint of the earthen berms (associated with the chute) prior to their construction. Topsoil is not to be used in the construction of the earthen berm;
- The base of the excavation is to be well compacted and any unsuitable material removed and replaced with gravel or suitable material prior to construction;
- The geocells (and concrete fill) are to be installed according to the supplier's specifications.
- The geocells are to be laid on cut insitu material and not fill material;
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.



SECTION A-A



SECTION B-B



SECTION C-C

SCALE 1:50

- NOTES:
1. Min 28 day concrete compressive strength of 30MPa unless otherwise stated.
 2. Grade 30/19 or 30/26 concrete can be used.
 3. Min concrete 28 day flexural strength of 4.1MPa.
 4. Max concrete slump of 70mm.
 5. Min concrete cement content of 310kg/m².
 6. Water : cement ratio not more than 0.52.
 7. Wood float finish to all concrete surfaces.
 8. Backfill material behind structure to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
 9. All dimensions shown in mm.
 10. Geocells are to be installed as per supplier specification, with stakes at the specified spacing/ intervals.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

GroundTruth
Water, Wetlands and
Environmental Engineering
P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:
THE NATURE CONSERVANCY PROJECT
CONCRETE GEOCELL CHUTE
H60A-01-217

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T.PIKE

LONGITUDE	LATITUDE	SCALE:	NTS	REV:
19° 06' 45.83" E	34° 02' 58.63" S	DRAWING NUMBER:	H60A-01-217	00

1.18 Intervention H60A-01-218

Intervention Type	Geocell chute
Rehabilitation Objective	Stabilise the head-cut that is threatening the upstream wetland and prevent further erosion and soil mobilisation that would contribute to sediment loads entering Theewaterskloof Dam
Latitude	34 ⁰ 03' 15.74" S
Longitude	19 ⁰ 06' 51.64" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-218



Figure 1.18.1 Proposed location of geocell chute

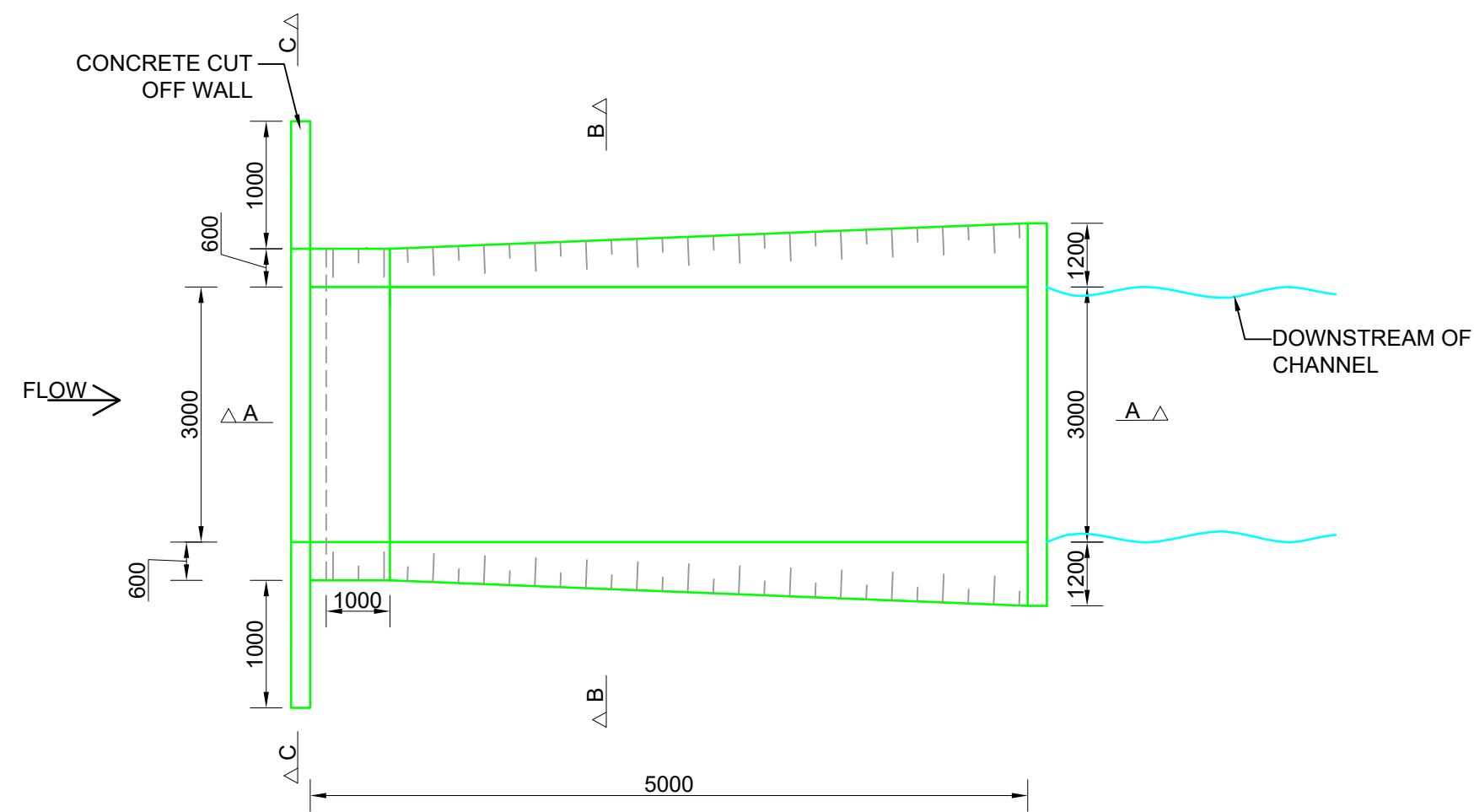
1.18.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01218.1	Excavation	m ³	15
H60A01218.2	Concrete for cut-off beams and cut-off wall	m ³	4
H60A01218.3	Concrete for infilling Geocells	m ³	8
H60A01218.4	150 mm Geocells. Rate to allow for installation as per supplier instruction. Concrete not to be included in rate.	m ²	52
H60A01218.5	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	52

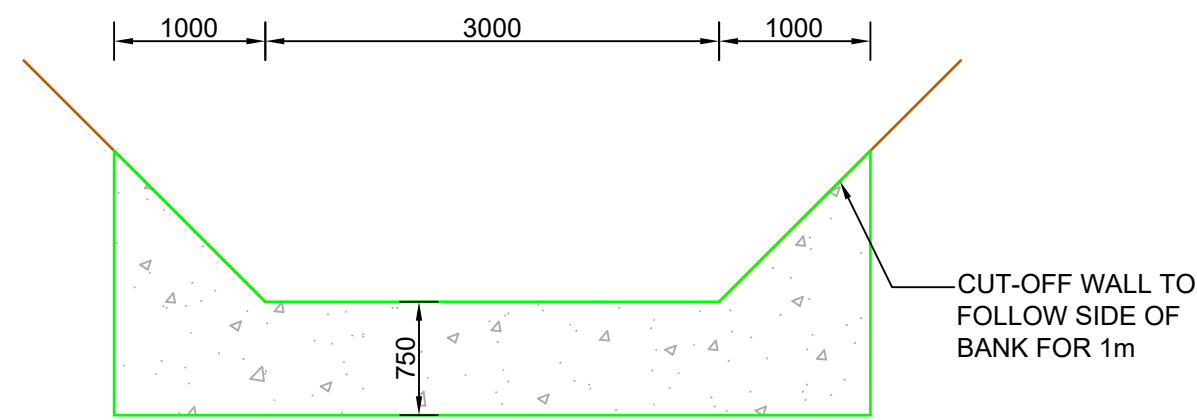
1.18.2 Construction notes for intervention H60A-01-218

The following construction notes apply to the proposed concrete filled geocell chute intervention:

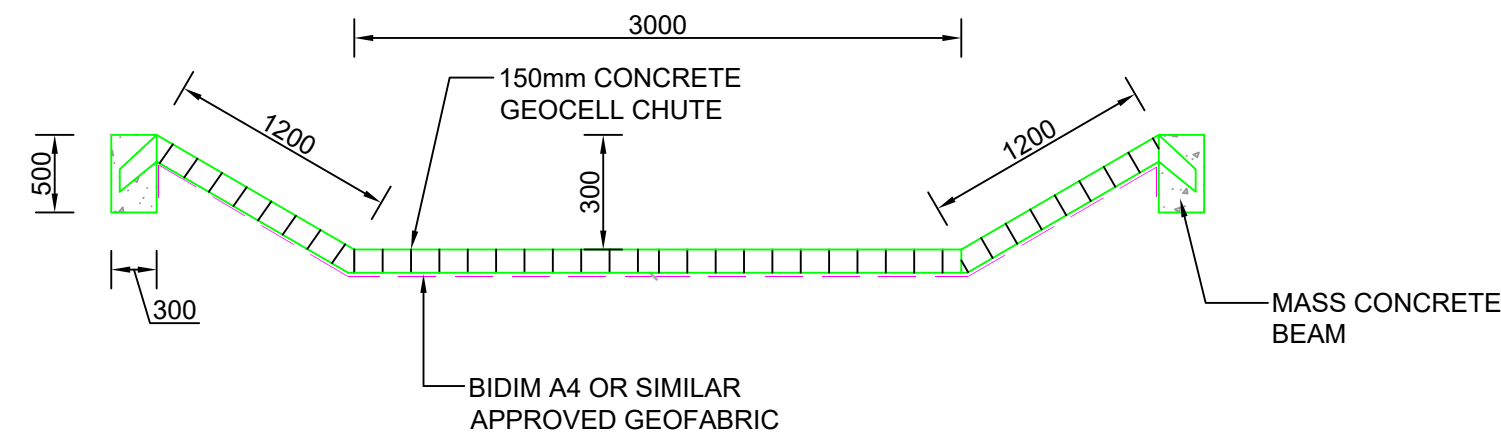
- Vegetation and topsoil is to be removed from the footprint of the earthen berms (associated with the chute) prior to their construction. Topsoil is not to be used in the construction of the earthen berm;
- The base of the excavation is to be well compacted and any unsuitable material removed and replaced with gravel or suitable material prior to construction;
- The geocells (and concrete fill) are to be installed according to the supplier's specifications.
- The geocells are to be laid on cut insitu material and not fill material;
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.



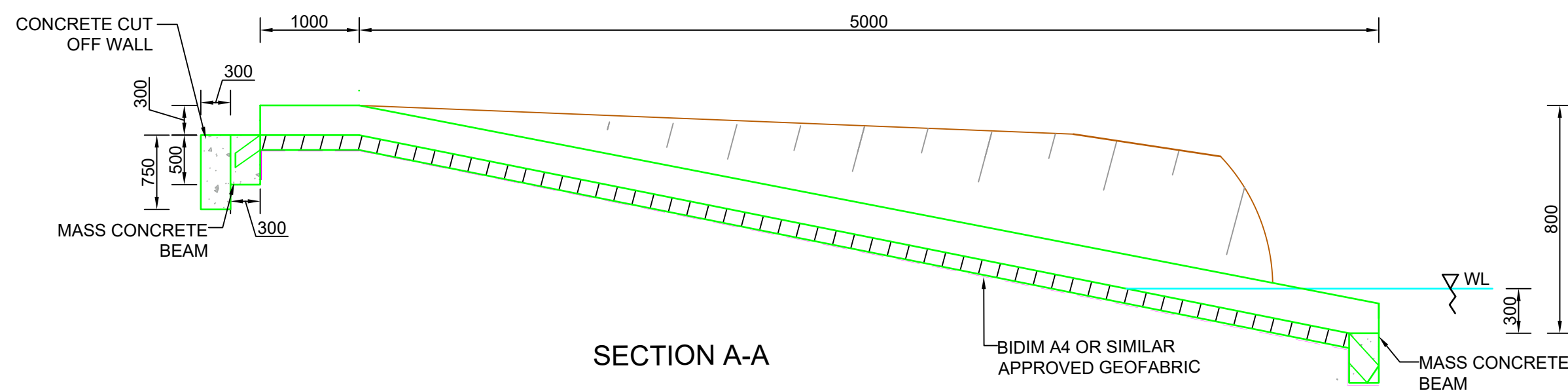
LAYOUT



SECTION C-C



SECTION B-B

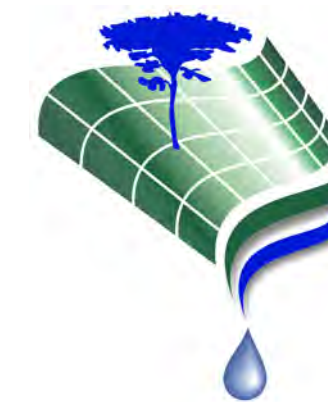


SECTION A-A

NOTES:

1. Min 28 day concrete compressive strength of 30MPa unless otherwise stated.
2. Grade 30/19 or 30/26 concrete can be used.
3. Min concrete 28 day flexural strength of 4.1MPa.
4. Max concrete slump of 70mm.
5. Min concrete cement content of 310kg/m².
6. Water : cement ratio not more than 0.52.
7. Wood float finish to all concrete surfaces.
8. All dimensions shown in mm.
9. Geocells are to be installed as per supplier specification, with stakes at the specified spacing/ intervals.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION



Ground Truth

*Water, Wetlands and
Environmental Engineering*

P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:

THE NATURE CONSERVANCY PROJECT
GEOCELL CHUTE
H60A-01-218

DATE: JUNE 2018

DRAWN: T. HARVEY

DRAWING CHECKED: T. PIKE

DESIGNED: T. HARVEY

DESIGN CHECKED: T.PIKE

LONGITUDE	LATITUDE	SCALE:	NTS	REV:
19° 06' 51.64" E	34° 03' 15.74" S	DRAWING NUMBER:	H60A-01-218	00

1.19 Intervention H60A-01-219

Intervention Type	Monitoring Site
Rehabilitation Objective	To monitor the head-cut to make sure the Palmiet, (<i>Prionium serratum</i>) surrounding the head-cut deactivates it, instead of the head-cut causing further erosion into the wetland
Latitude	34 ⁰ 03' 11.97" S
Longitude	19 ⁰ 06' 49.9" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	N/A



Figure 1.19.1 Site to be monitored

1.20 Intervention H60A-01-220

Intervention Type	Geocell chute
Rehabilitation Objective	Stabilise the head-cut that is threatening the upstream wetland and prevent further erosion and soil mobilisation that would contribute to sediment loads entering Theewaterskloof Dam
Latitude	34 ⁰ 03' 11.97" S
Longitude	19 ⁰ 06' 49.9" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-220



Figure 1.20.1 Proposed location of geocell chute

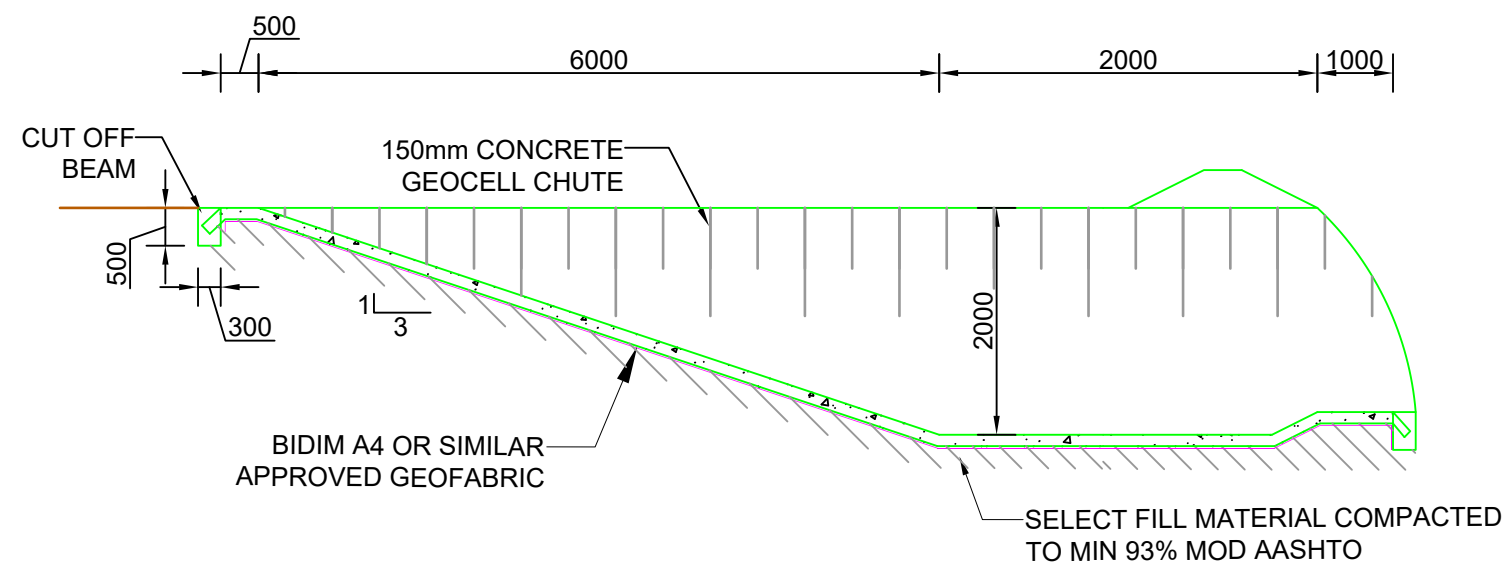
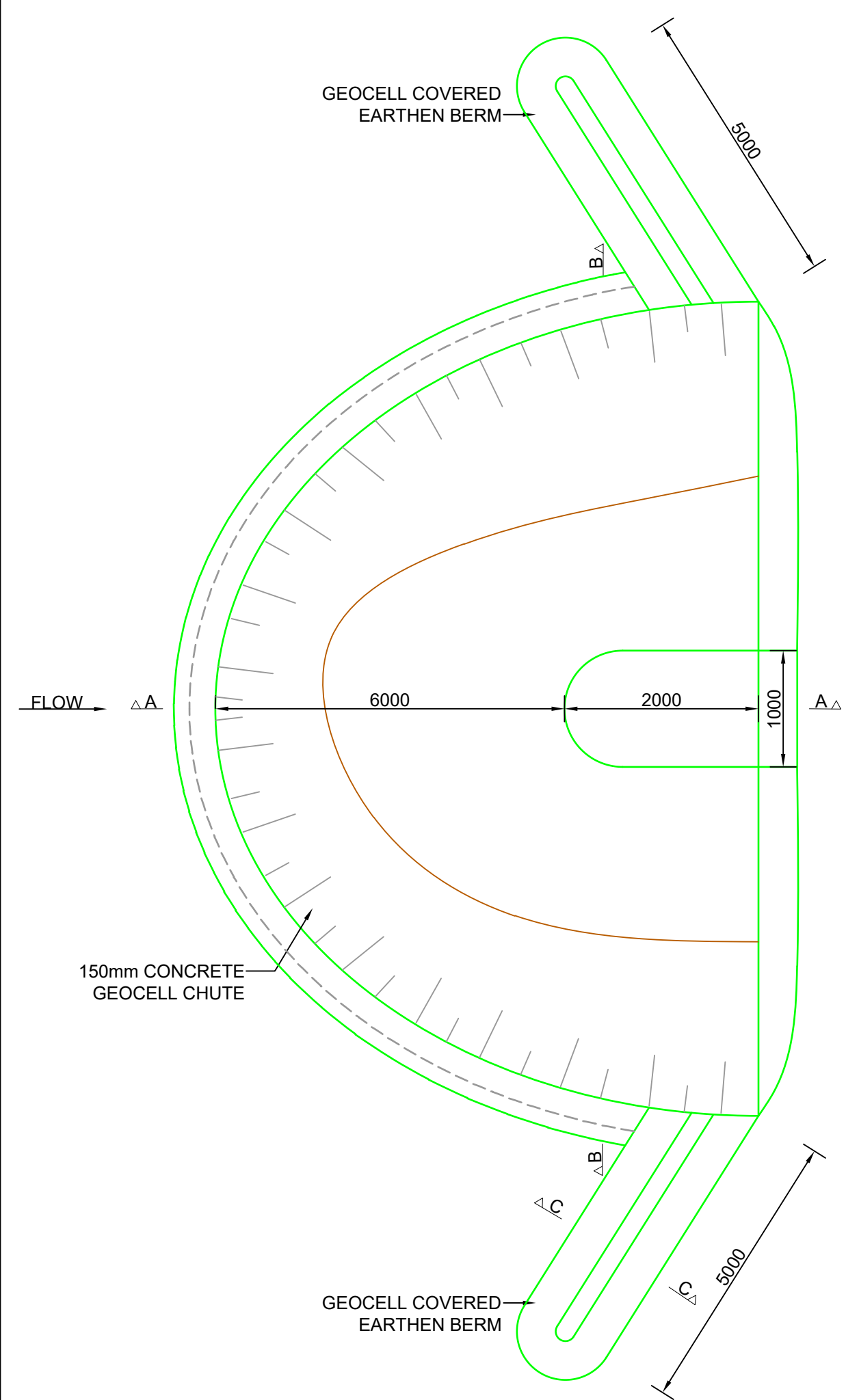
1.20.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01220.1	Excavation	m ³	76
H60A01220.2	Earthworks for earthen berms	m ³	8
H60A01220.3	Concrete for infilling Geocells	m ³	31
H60A01220.4	150 mm Geocells. Rate to allow for installation as per supplier instruction. Concrete not to be included in rate.	m ²	202
H60A01220.5	Needle-punched non-woven geofabric such as Bidim A4 or similar approved geofabric	m ²	202

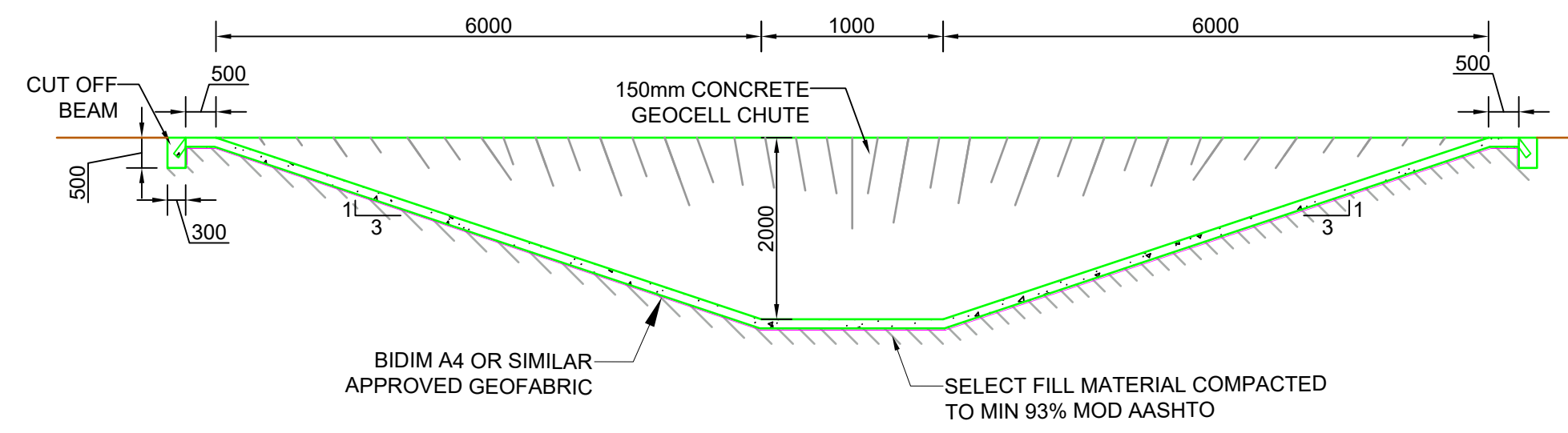
1.20.2 Construction notes for intervention H60A-01-220

The following construction notes apply to the proposed concrete filled geocell chute intervention:

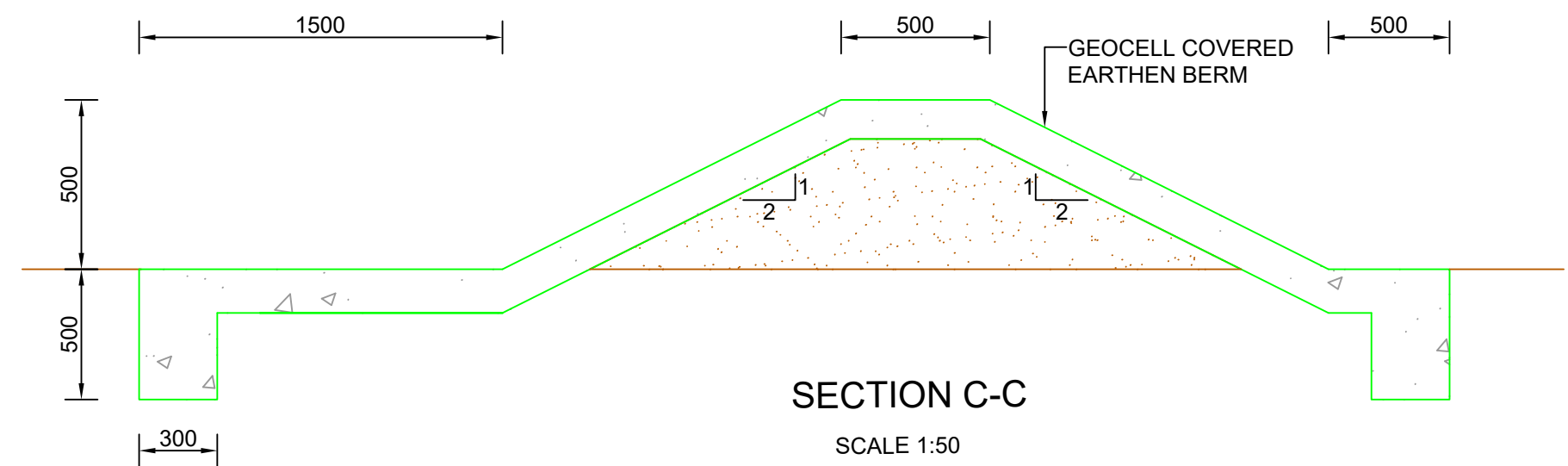
- Vegetation and topsoil is to be removed from the footprint of the earthen berms (associated with the chute) prior to their construction. Topsoil is not to be used in the construction of the earthen berm;
- The base of the excavation is to be well compacted and any unsuitable material removed and replaced with gravel or suitable material prior to construction;
- The geocells (and concrete fill) are to be installed according to the supplier's specifications.
- The geocells are to be laid on cut insitu material and not fill material;
- Exposed concrete surfaces should be kept moist for at least 7 days after construction to allow for curing.



SECTION A-A



SECTION B-B



SECTION C-C

SCALE 1:50

- NOTES:
1. Min 28 day concrete compressive strength of 30MPa unless otherwise stated.
 2. Grade 30/19 or 30/26 concrete can be used.
 3. Min concrete 28 day flexural strength of 4.1MPa.
 4. Max concrete slump of 70mm.
 5. Min concrete cement content of 310kg/m².
 6. Water : cement ratio not more than 0.52.
 7. Wood float finish to all concrete surfaces.
 8. Backfill material behind structure to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
 9. All dimensions shown in mm.
 10. Geocells are to be installed as per supplier specification, with stakes at the specified spacing/ intervals.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

TITLE:
THE NATURE CONSERVANCY PROJECT
CONCRETE GEOCELL CHUTE
H60A-01-220

DATE:	JUNE 2018
DRAWN:	T. HARVEY
DRAWING CHECKED:	T. PIKE
DESIGNED:	T. HARVEY
DESIGN CHECKED:	T.PIKE

LONGITUDE	LATITUDE	SCALE:	NTS	REV:
19° 06' 49.9" E	34° 02' 11.97" S	DRAWING NUMBER:	H60A-01-220	00

1.21 Intervention H60A-01-221

Intervention Type	Sloping and revegetation of bank
Rehabilitation Objective	To stabilise the banks in order prevent further erosion and soil mobilisation
Latitude	34° 03' 10.87" S
Longitude	19° 06' 58.76" E
Designed By	Trevor Pike
Date	June 2018
Design Drawing Number	H60A-01-221



Figure 1.21.1 Bank to be sloped and revegetated

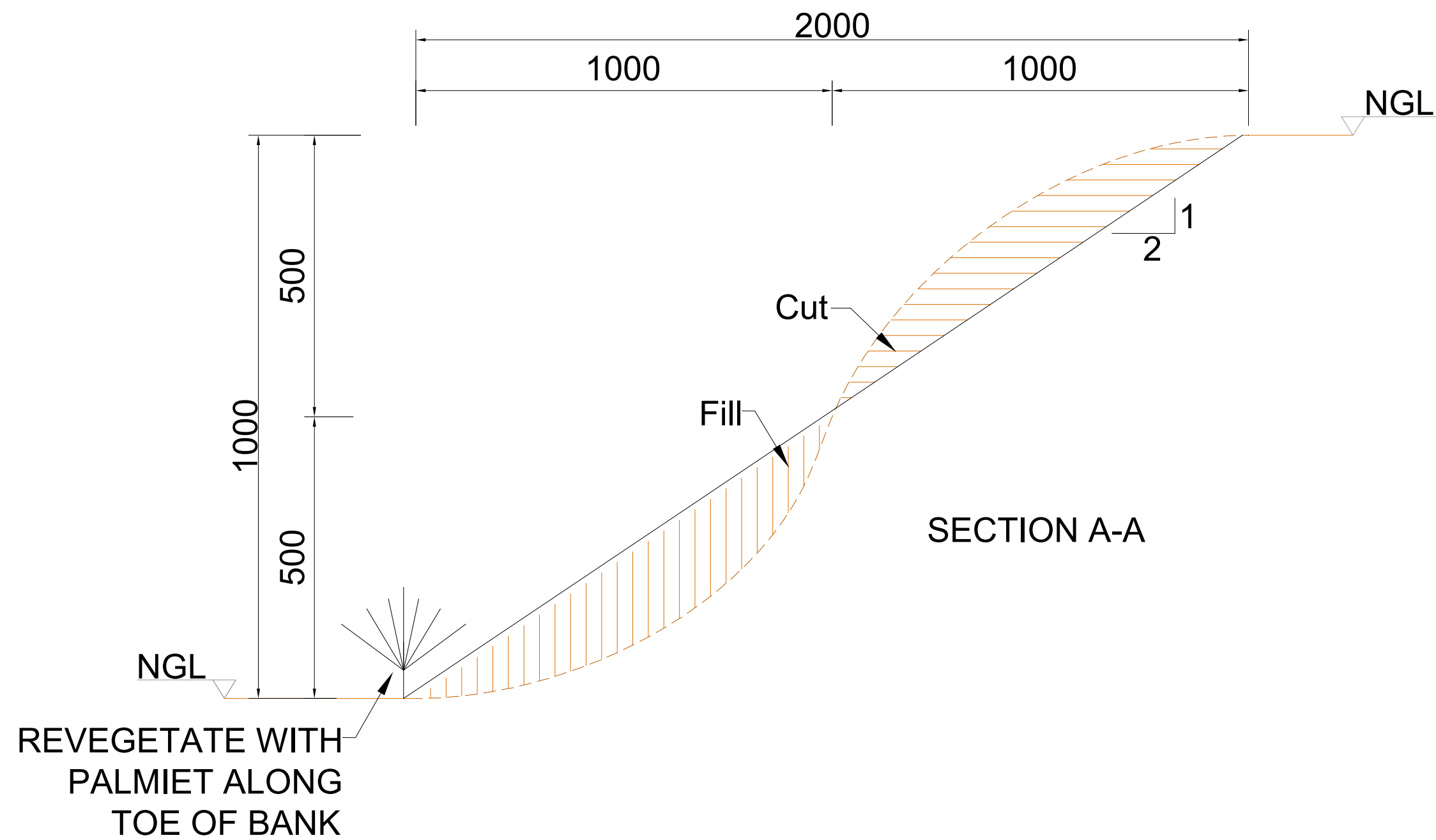
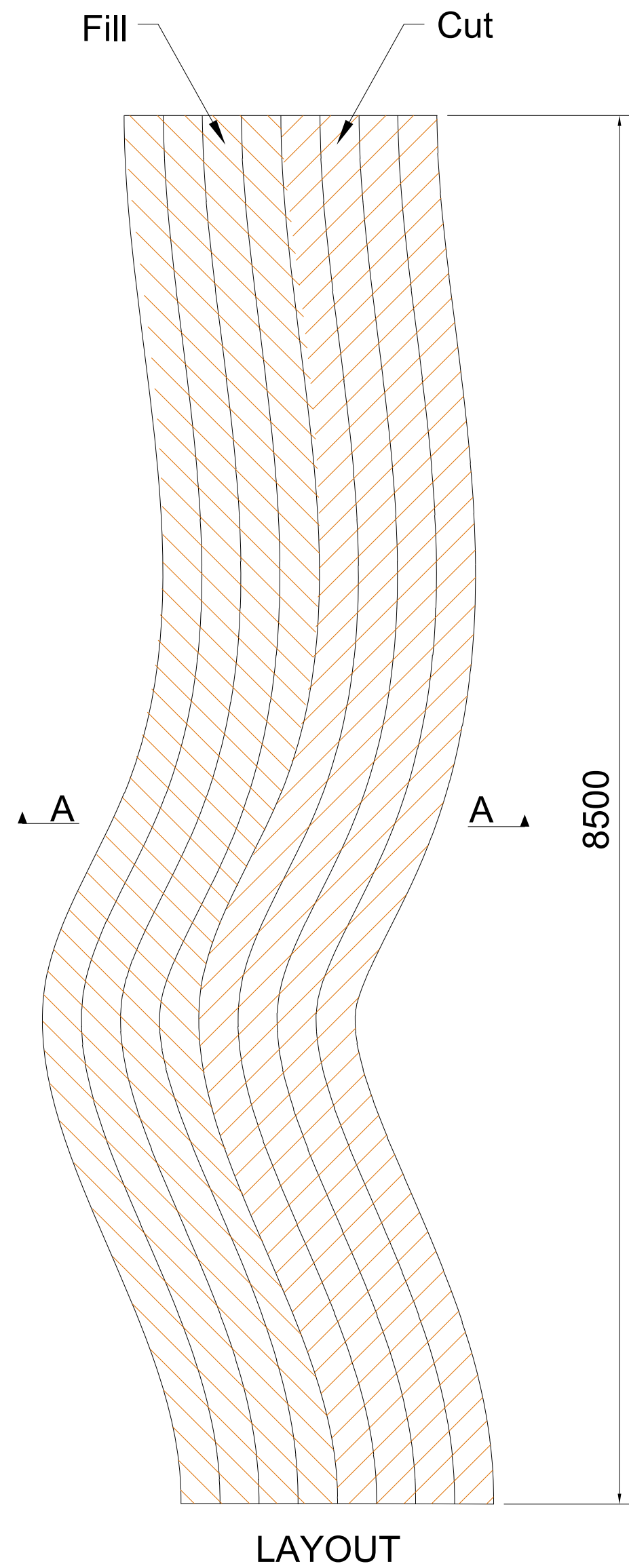
1.21.1 Bill of quantities

REF	DESCRIPTION	UNIT	QTY
H60A01221.1	Sloping cut to fill	m ³	1.59
H60A01221.3	Revegetation with Palmiet along toe of bank	m	17.00
H60A01221.3	Revegetation with indigenous wetland vegetation along bank	m ²	20

1.21.2 Construction notes for intervention H60A-01-221

The following construction notes apply to the proposed intervention:

- Where vegetation is present, the top 150 mm of top soil is to be removed with vegetation and stockpiled in a designated area;
- Any vegetation along the toe of the bank/ along the water line of the channel must remain undisturbed;
- Sloping of banks must be carried out by cutting material from the top half of the bank at a 1:3 (V:H) slope (where possible) and filling the bottom half to create a cut to fill balance;
- Fill material to be compacted in 150mm layers at optimum moisture content;
- Once the fill is compacted, top soil can be returned from the top soil stock pile and spread over the surface;
- Revegetation is to be carried out by planting of Palmiet, (*Prionium serratum*) along the toe of the bank and local indigenous wetland vegetation along bank.



NOTES:

1. Where vegetation is present, the top 150 mm of top soil is to be removed with vegetation and stockpiled in a designated area for reuse later;
2. Sloping of banks must be carried out by cutting material from the top half of the bank at a 1:2 (V:H) slope (where possible) and filling the bottom half to create a cut to fill balance;
3. The cut and fill surfaces must be well compacted;
4. Once the fill material is compacted and sloping is completed, top soil can be returned from the top soil stock pile and spread over the surface;
5. Revegetation is to be undertaken by planting Palmiet (*Prionium serratum*) along the toe of the banks and local indigenous wetland vegetation along bank;
6. Fill surfaces to be compacted to a minimum of 93% Mod AASHTO unless otherwise indicated.
7. All dimensions shown in mm.

**PRELIMINARY DRAWING
NOT FOR CONSTRUCTION**



GroundTruth

*Water, Wetlands and
Environmental Engineering*

P. O. Box 916, Hilton, 3245, South Africa
Tel: 033 343 2229 • Fax: 086 688 6297
E-mail: admin@groundtruth.co.za
Web: www.groundtruth.co.za

TITLE:

THE NATURE CONSERVANCY PROJECT

STANDARD SLOPING AND STABILISATION
H60A-01-221

DATE: JUNE 2018

DRAWN: T. HARVEY

DRAWING CHECKED: T. PIKE

DESIGNED: T. HARVEY

DESIGN CHECKED: T. PIKE

LONGITUDE	LATITUDE	SCALE:	NTS	REV:
19° 06' 58.76" E	34° 03' 10.87" S	DRAWING NUMBER:	H60A-01-221	00