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GOVERNMENT OF YUKON ENERGY, MINES AND RESOURCES - ASSESSMENT AND ABANDONED MINES

Clinton Creek Drop Structure No. 4 Repair

Design Summary

307076-06729-00-WW-REP-0001

28 July 2015

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JULY 28 - 2015

PROJECT 307076-06729 - CLINTON CREEK DROP STRUCTURE NO. 4 REPAIR

REV	DESCRIPTION	ORIG	REVIEW	WORLEYPARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
1	Re-Issued for Use	S. Clark	A. Timmis	L. Martin	31-Mar-14		
2	Re-Issued for Use	J. Gentles	A. Timmis	L. Martin	10-Apr-15		
3	Re-Issued for Use	J. Gentles	A. Timmis	L. Martin	03-Jul-15		
4	Re-Issued for Use	J. Gentles	A. Timmis	L. Martin	28-Jul-15		

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Any questions concerning the information or its interpretation should be directed to J. Gentles or A. Timmis.

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1. INTRODUCTION

Between 2002 and 2004, four gabion drop structures were installed in Clinton Creek, Yukon (YT), at the outlet of Hudgeon Lake to control the flow of water discharging from the lake. In 2010, high flows (estimated return period of approximately 100 to 200 years) in Clinton Creek caused damage to existing Drop Structure No. 4 (DS4). The Government of Yukon Energy, Mines and Resources' Assessment and Abandoned Mines (AAM) branch is currently costing permanent repair options for DS4; however, until a permanent solution can be implemented, short-term measures are required to protect the Clinton Creek channel against erosion that may undermine the stability of the adjacent waste rock and/or cause a rapid release of water from Hudgeon Lake (the works).

AAM retained WorleyParsons Canada Services Ltd. (WorleyParsons) to assess several options and to prepare a detailed design and tender package for the repair of DS4. This project includes the following scope of work:

- Developing concept designs for three potential repair options using existing survey data;
- Assembling quantity and AACE Class 4 (±40%) cost estimates for the three options;
- Presenting the results of this options assessment to AAM and Aboriginal Affairs and Northern Development Canada (AANDC); and
- Developing construction drawings, engineering specifications, a material take-off (MTO), and an AACE Class 2 (±20%) cost estimate for the preferred option.

This report includes the results of the development of the preferred option.

1.1 Options Assessment

The following three options were presented to the AAM and AANDC on February 12, 2014:

- Option A: stabilize the waste rock slope and construct a chute downstream of DS4 using riprap (A1), gabions (A2), Armorflex® articulated concrete revetment mat (A3), or precast concrete lock blocks (A4);
- Option B: install stacked grout-filled bags downstream of DS4; and
- Option C: install a launching windrow revetment upstream of DS4.

AAM and AANDC selected Option A3 as the preferred option.

2. DESIGN SUMMARY

2.1 Description

Option A3 detailed design drawings are provided in Appendix 1. This option includes the excavation of the waste rock slope located on the south side of Clinton Creek extending approximately 44 m downstream of the existing gabion structure. The chute will be armoured with Class 60T Armorflex® articulated concrete revetment mats with a stilling basin located at the downstream transition with the existing channel.

A design life of five to ten years was assumed based on the planned, future site-wide remediation (including the reconstruction of the upper portion of the Clinton Creek channel). Based on the design life, the channel was designed to convey the estimated 25-year peak instantaneous flow: 29 m^3/s (R48, Government of Yukon Energy, Mines and Resources 2003). A previous iteration of this design was submitted to AAM in March 2014; however, an update to the design was required to incorporate survey data collected in September 2014 and to issue the drawings for tender.

2.1.1 Waste Rock Regrading

The waste rock slope on the south side of the channel will be regraded to a slope of 2H to 1V to improve stability. Excavated waste rock will be placed and compacted to infill the scoured channel to create a chute downstream of the existing gabion structure. Excess waste rock will be stockpiled at the site. The waste rock will be compacted to 93% of the Modified Proctor Maximum Dry Density (MPMDD).

2.1.2 Revetment Mat

Class 60T Armorflex® mats were recommended by the manufacturer (Armortec Canada Inc.) as being capable of withstanding the hydrodynamic forces anticipated for this channel based on the design flow.

The 190 mm-thick mats will be installed on a 150 mm-thick bedding layer comprised of 100 mm minus angular rock largely free of fines. This material should meet the gradation provided in Table A.

Table A 100 mm Minus Angular Rock Gradation

Sieve Designation (mm)	Per Cent Passing
100	100
75	90 to 100
50	60 to 100
25	35 to 80
10	0 to 50
1.25	0 to 25
0.080	0 to 10

The angular rock bedding layer will be compacted to 95% MPMDD.

The mat system consists of interlocking, precast concrete blocks connected by longitudinal cables, aligned parallel to the long edge of the mat. The longitudinal cables form a loop at both ends of the mat (along the short edge).

The mats will be installed with the longitudinal axis oriented perpendicular to the direction of flow with a 20M piece of rebar laced through these loops to connect adjoining mats (i.e., at mat to mat transitions, parallel to the channel). The mats will be placed with a 150 mm to 300 mm gap, measured from the outside edges of the last row of blocks, which will be filled with 30 MPa concrete or grout. The concrete or grout, mixed on-site, will be finished by hand flush to the top of the adjoining mats.

Each 2.4 m-wide perpendicular section of mats will consist of a 5.3 m-long section centred across the channel bottom and two 4.5 m-long sections placed on either side of the channel. Adjoining perpendicular sections will be connected by their revetment cables as discussed in subsequent sections.

2.1.3 Geotextile

Non-woven geotextile (Nilex 4553 or approved equivalent) will be installed over the compacted waste rock as follows to prevent the migration of fines into the angular rock bedding layer:

- Overlap geotextile a minimum of 600 mm at adjacent edges;
- Overlaps should be in the direction of flow (i.e., upstream piece laid over downstream piece); and
- Geotextile should be anchored a minimum of 1.5 m at the top of the channel banks except where the slope beyond the channel is greater than 2H:1V and at the upstream and downstream anchor trenches.

As per the manufacturer's instructions, Strata Microgrid™, or equivalent, will be installed over the angular rock bedding layer following the same methodology described above. This will aid in keeping the bedding gravel in place under high velocity water.

2.1.4 Anchoring

The mats will be anchored to the waste rock using Duckbill model 68-DBD ground anchors driven 900 mm into the waste rock. Each anchor will be terminated with a crimped sleeve loop and connected to the revetment cable using 6.4 mm dia. braided steel cable secured with a crimp sleeve.

The mats will be assembled with four half-blocks and one full-block removed, as shown on Drawing No. 1004 in Appendix 1. Ground anchors will be driven at each void left by the removed blocks and connected to the revetment cable. At half-block voids, the anchor will be connected to the adjoining mats. The void will be filled with hand finished 30 MPa concrete or grout flush with the top of the surrounding blocks.

Two ground anchors will also be driven 900 mm into the waste rock and connected to the revetment cable loops at the outside ends of each mat, along the top of the channel, and at each mat to mat transition.

The revetment mat will be keyed in at the upstream end using large, angular rock (average diameter of 300 mm to 800 mm) to create a stable transition with the existing gabion structure and at the downstream end to resist erosion. Ground anchors will be driven and connected to the revetment cables at each half-block void along the outer edge of the mats.

The previous iteration of the design included an anchor trench at the upstream end of the mat. A downstream trench and ground anchors connected to the mats were added to the design to increase the stability and durability of the mats. This will reduce the possibility of damage to or failure of the mat.

2.1.5 Stilling Basin

The purpose of the stilling basin is to dissipate energy and induce a hydraulic jump over the mats. The stilling basin extends from the end of the channel chute at Station 0+049.2 downstream to Station 0+058.7 at an elevation 397.3 m and a depth of 0.3 m. The armorflex mats extend 6 m downstream of this basin to approximately Station 0+064, at an elevation of 397.6 m. This provides a transition to the existing channel and a buffer against potential erosion of the downstream channel.

The previous iteration of the design included a stilling basin with precast concrete lock blocks to reduce the length of the stilling basin (i.e., the addition of lock blocks increases the efficiency of a stilling basin and can induce a hydraulic jump over a shorter length than a stilling basin alone). During recent discussions, Armortec raised concerns over the placement of the lock blocks on top of the mats believing that this may impact the performance of the mats due to increased turbulence. To address this concern, the lock blocks were eliminated from the design and the stilling basin was extended in length from 7 m to 9 m.

2.1.6 Transitions

The upstream end of the chute will about the existing gabion baskets that comprise DS4. Based on observations made during site visits in August 2014 and May 2015, it was determined that the top five courses of gabion baskets remain intact (i.e., at a relatively flat longitudinal slope and with underlying soils supported the baskets). The sixth course of baskets has been undermined and the basket mesh damaged with the baskets twisted to a steep longitudinal angle. It is anticipated that the first section of mats will abut the sixth course of baskets.

Once the Clinton Creek diversion is in service, the existing gabion baskets will be inspected to determine:

- Whether the fifth course of gabion baskets is sound;
- The extent of the gabion baskets that will require removal; and
- Which damaged baskets in the sixth course and below will require removal.

Removal will be accomplished by cutting the gabion mesh, removing connecting devices, and removing the gabion rocks. If feasible, the gabion rocks should be stockpiled near the drop structure for potential reuse.

The mats should be laid from upstream to downstream, with the first section of mats starting as close as possible to the existing edge of the downstream edge of the fifth course of gabion baskets along the channel bottom. The first two rows of blocks along the mat should be installed at a 1H to 1V slope up from the gabion baskets to create an anchor trench. The trench will be backfilled with large diameter rock, sourced on-site and with an average dimension between 300 mm and 800 mm, to create a smooth transition from the gabion baskets to the chute.

The downstream end of the mat will transition with the existing channel at Station 0+064 (approximate). The two rows of blocks at the downstream end of the mat will be installed at a 1H to 1V slope down from the channel to create an anchor trench. This trench was added to this iteration of the design to increase erosion protection at the transition to reduce the potential for scouring of the channel propagating upstream and undermining the mat. The trench will be backfilled with large diameter rock to create a smooth transition between the mat and the existing channel downstream.

2.2 Design Summary

The design parameters for Option A3 are summarized in Table B.

Table B Option A3 Design Parameter Summary

Category	Description	
Performance	Designed to withstand the 25-year peak flood event	
	Design Flow = 29 m^3/s	
	Suggested 5- to 10-year design life	
Health and Safety	Risks to workers mitigated through slope stabilization	
Key Materials Quantities	Waste rock excavation:	9,500 m^3
	Waste rock fill:	1,000 m^3
	Class 60T Armorflex® Mats:	36 (4.5 m x 2.4 m each)
	Class 60T Armorflex® Mats:	18 (5.3 m x 2.4 m each)
	Non-Woven geotextile:	900 m^2
	Woven Microgrid™:	900 m^2
	100 mm minus angular rock:	120 m^3
	Large diameter rock:	30 m^3
	Duckbill 68-DBD ground anchors:	312 units
	20M rebar:	100 m
	30 MPa grout or concrete:	10 m^3

The chute characteristics are summarized in Table C.

Table C Chute Summary

Characteristic	Description
Bottom Width	7 m
Side Slopes	2H to 1V
Depth	1.5 m
Longitudinal Slope	20%
Lay Length	42 m
Mat Class	Armorflex® 60T - 190 mm thick
Mat Weight	300 kg/m^2 to 350 kg/m^2
Mat Size	2.4 m by 4.5 m (36 pieces) and 2.4 m by 5.3 m (18 pieces)
Bedding Material	100 mm minus angular rock

2.3 Water Management

Clinton Creek conveys discharge from Hudgeon Lake downstream to the confluence with Fortymile River. To facilitate construction, it will be necessary to divert discharge from Hudgeon Lake through a pipeline discharging downstream of DS4.

Historical flow measurements recorded on Clinton Creek downstream of Hudgeon Lake between 1978 and 2004 were taken from the report "Yukon Water Resources Hydrometric Program Historical Summary 1975 – 2004", prepared by Water Resources – Environment Programs Branch, Environment Yukon in March 2005. Mean peak and 75th percentile flow rates in Clinton Creek at DS4, averaged over the month of June, were estimated from these records and are as follows:

- Mean: 0.9 m^3/s (80,000 m^3/day);
- Peak: 1.8 m^3/s (160,000 m^3/day); and
- 75th percentile: 1.2 m^3/s (110,000 m^3/day).

These values are indicative of potential average flow conditions that may be encountered at the site and are based on a statistical analysis of discontinuous flow record of monthly average flows. As flow measurements were not recorded in every year between 1978 and 2004, and flow rates were averaged over the month, peak instantaneous flow conditions will likely be greater than these values. It should be noted that Hudgeon Lake has a surface area of approximately 115 ha and will attenuate peak runoff inflows from the surrounding area.

It is anticipated that construction will take place following freshet, which usually occurs in June. Though this will avoid large freshet flows, a larger than average snowpack or late and/or extended melting of the snowpack could result in a water level in Hudgeon Lake that is greater than the seasonal average. This could result in larger than average flow rates in Clinton Creek during construction. Similarly, periods of extreme rainfall could temporarily increase flow rates in Clinton Creek.

It will be the responsibility of the contractor to determine the capacity of the diversion as well as developing protocols for responding to elevated water levels in Hudgeon Lake and provide this information to AAM in the form of a water management plan.

3. COST ESTIMATE

3.1 Cost Estimate Basis

The construction cost estimate for Option A3 was prepared using the AACE Class 2 designation with accuracy and contingency as listed in Table D. It should be noted that while WorleyParsons believes that this estimate meets the stated accuracy, at the direction of AAM, no local contractor was consulted regarding constructability of the design or cost estimates. This is generally required for this level of estimate.

Table D Estimate Classification

Category	Description
Estimate Class	Class 2
Estimate Type	Construction
Estimate Accuracy	±20%
Included Contingency	13%
Estimating Methodologies	Direct quotations, allowances, and historical data

3.2 Assumptions

The following assumptions were made during the preparation of the cost estimate:

- Work will be performed during the summer using single shifts of 10 hours per day with an average crew size of four people;
- Work can be performed using a 30- to 35-tonne excavator, a bulldozer, a single drum soil compactor, and a 40-tonne rock truck;
- Aggregate (100 mm minus angular rock) hauling costs have been developed allowing for a 60 km one-way distance;
- Diesel fuel allowance was set at $1.60/L based on the Government of Yukon Energy, Mines and Resources (October 2013);
- Upgrades and/or repairs to the Fortymile Bridge will not be required prior to construction;
- Excavated material will not require off-site disposal or on-site containment; and
- Large diameter rock can be sourced on-site.

3.3 Cost Estimate Summary

The cost estimate is summarized in Table E. A detailed construction cost breakdown is provided in Appendix 2.

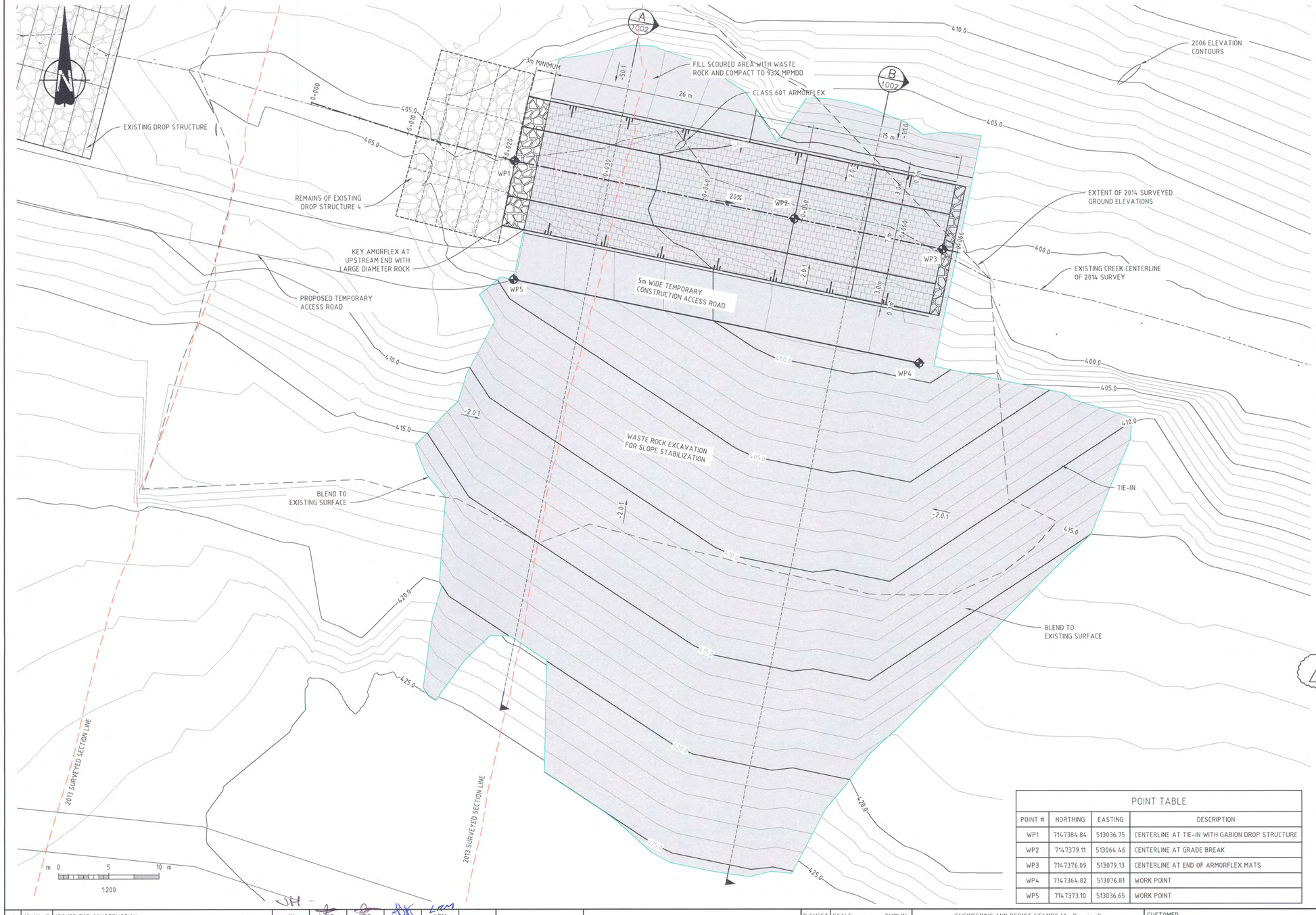
Table E Cost Estimate Summary

Category	Description	Total Cost ($CAD)
Direct Construction Costs	Supply and installation of materials, mobilization, and demobilization	428,000
Indirect Costs	Insurance, travel, camp, and environmental monitoring	240,000
Contingency	14%	91,000
Total Cost		**$759,000**

4. CONSTRUCTION SCHEDULE

A construction schedule is provided in Appendix 3. It was assumed that construction will start in the last week of July. The work is expected to last six weeks, including mobilization and demobilization.

Appendix 1 Issued for Construction Drawings



NOTES:

GENERAL NOTES

1. DIMENSIONS AND ELEVATIONS ARE IN METRES.
2. ALL COORDINATES ARE IN NAD 83. THE FOLLOWING EXISTING SURVEY CONTROL POINTS SHOULD BE USED FOR REFERENCE:

ID	NORTHING (m)	EASTING (m)	ORTHOMETRIC HEIGHT (masl)
No. 2834	7148712.673	513447.724	606.823
No. 2835	7147272.790	513147.057	432.669
No. 1086	7147972.219	513176.710	590.955
No. 1192	7147563.984	512278.758	441.231

3. SITE PLAN, CHANNEL PROFILE, CROSS SECTIONS AND EARTHWORK QUANTITIES ARE BASED ON 2006 ELEVATION DATA FOR THE SITE AS WELL AS 2013 AND 2014 SURVEY OF THE CLINTON CREEK CHANNEL.

MATERIALS

4. FILL MATERIAL SHALL CONSIST OF UNFROZEN EXCAVATED WASTE ROCK
5. ARMORFLEX MATS SHALL BE CLASS 60T
6. 100mm MINUS ANGULAR ROCK
7. LARGE DIAMETER ROCK SHOULD HAVE AN AVERAGE DIMENSION OF BETWEEN 300 AND 800 mm AND SHOULD BE SOURCED ON SITE

APPROXIMATE MATERIAL QUANTITIES

EXCAVATION	9,500 m^3
FILL	1,000 m^3
100mm MINUS ANGULAR ROCK	120 m^3
CLASS 60T ARMORFLEX MATS (2.4m X 4.5m)	36
CLASS 60T ARMORFLEX MATS (2.4m X 5.3m)	18
NON-WOVEN GEOTEXTILE	900 m^2
WOVEN MICROGRID GEOTEXTILE	900 m^2
LARGE DIAMETER ROCK (300 TO 800 mm)	30 m^3
30Mpa CONCRETE OR GROUT	10m^3
DUCKBILL 68-DBD GROUND ANCHOR	312
20m REBAR	100m

EXECUTION - GENERAL

8. SURVEY OF EXISTING AND FINISHED GRADES SHALL BE COMPLETED BY THE SURVEYOR / CONTRACTOR FOR THE DETERMINATION OF QUANTITIES AND THE PREPARATION OF AS-BUILT DRAWINGS.

EXECUTION - BULK EARTHWORKS

9. THE UNSTABLE WASTE ROCK SLOPE ON THE SOUTH SIDE OF CLINTON CREEK, DOWNSTREAM OF THE DAMAGED GABION DROP STRUCTURE, SHALL BE CUT BACK TO A 2H:1V SLOPE. THE SLOPE ON THE NORTH SIDE OF CLINTON CREEK SHALL BE FILLED AT A SLOPE OF 50H:1V AND CUT BACK TO A 1H:1V SLOPE.
10. A PORTION OF THE EXCAVATED WASTE ROCK SHALL BE USED TO FILL THE CHANNEL AND CONSTRUCT A 5 M WIDE ACCESS ROAD DOWNSTREAM OF THE DAMAGED GABION DROP STRUCTURE. FINISHED ELEVATIONS AND COMPACTION REQUIREMENTS ARE SPECIFIED ON THE CHANNEL PROFILE AND SECTIONS.
11. REMAINING (I.E. WASTE) EXCAVATED WASTE ROCK SHALL BE STOCKPILED IN A LOCATION TO BE DETERMINED BY THE ONSITE ENGINEER AT THE START OF CONSTRUCTION.

EXECUTION - CHANNEL CONSTRUCTION

12. DAMAGED GABION BASKETS DOWNSTREAM OF START OF ARMORFLEX MATS SHALL BE REMOVED PRIOR TO CHANNEL INFILLING. ENGINEER SHALL CONFIRM IN THE FIELD WHICH BASKETS SHALL BE REMOVED. BASKETS SHALL BE CUT FLUSH WITH ADJOINING BASKETS AND ROCK MATERIAL TO BE STOCKPILED ON SITE.
13. NON-WOVEN GEOTEXTILE (NILEX 4553) SHALL BE INSTALLED ON TOP OF THE WASTE ROCK WITH A MINIMUM OVERLAP LENGTH OF 600mm AND KEYED IN AT THE EDGES A MINIMUM OF 1.5m.
14. (6) 150 mm OF 100mm MINUS ANGULAR ROCK SHALL BE PLACED AND COMPACTED TO 95% MPMDD OVER THE WASTE ROCK FILL AS SHOWN ON THE PROFILE (DRAWING 1002).
15. WOVEN MICROGRID (STRATAGRID OR EQUIVALENT) SHALL BE INSTALLED ON TOP OF THE ANGULAR ROCK LAYER WITH A MINIMUM OVERLAP LENGTH OF 600mm AND KEYED IN AT THE EDGES A MINIMUM OF 1.5m.
16. CLASS 60T ARMORFLEX MATS SHALL BE INSTALLED ON TOP OF THE ANGULAR ROCK BEDDING IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS. THE ARMORFLEX MATS ARE TO BE PLACED ACROSS THE CHANNEL (I.E., WITH THE LONGEST DIMENSION ALIGNED PERPENDICULAR TO THE DIRECTION OF FLOW) WITH THE 2.4 M X 5.3 M PLACED ACROSS THE CENTER OF THE CHANNEL AND THE TWO 2.4 M X 4.5 M MATS ON MAT EITHER SIDE SLOPES AND A PORTION OF THE CHANNEL BOTTOM.
17. LARGE DIAMETER ROCK SHALL BE SOURCED ON SITE AND USED TO KEY IN THE UPSTREAM AND DOWNSTREAM ENDS OF THE ARMORFLEX AS SHOWN ON DRAWING 1002, PROFILE.
18. DUCKBILL MODEL 68-DBD SHALL BE DRIVEN INTO THE WASTE ROCK A MINIMUM OF 900 mm AT EACH VOID FULL BLOCK AND ½ BLOCK AND 2 AT EVERY MAT TO MAT CONNECTION AND AT MAT ENDS. THE ANCHORS SHALL BE SECURED TO THE REVETMENT CABLE USING FASTENERS PER MANUFACTURER'S RECOMMENDATIONS.
19. A 20M PIECE OF REBAR SHALL BE THREADED THROUGH THE REVETMENT CABLES, PARALLEL TO THE CHANNEL, TO CONNECT THE MATS AND SHALL BE BACKFILLED WITH 30 MPA CONCRETE.
20. SOME "FIELD ENGINEERING" MAY BE REQUIRED TO TIE THE PROPOSED CHANNEL INTO THE DAMAGED GABION DROP STRUCTURE UPSTREAM AND THE EXISTING CHANNEL DOWNSTREAM.

POINT TABLE

POINT #	NORTHING	EASTING	DESCRIPTION
WP1	7147384.84	513036.75	CENTERLINE AT TIE-IN WITH GABION DROP STRUCTURE
WP2	7147379.11	513064.46	CENTERLINE AT GRADE BREAK
WP3	7147376.09	513079.13	CENTERLINE AT END OF ARMORFLEX MATS
WP4	7147364.82	513076.81	WORK POINT
WP5	7147373.10	513036.65	WORK POINT

REV	DATE (DD-MMM-YY)	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
6	03-JUL-15	ISSUED FOR CONSTRUCTION	JH	JRG	JRG	AJT	LRM			
5	28-MAY-15	RE-ISSUED FOR TENDER	JRG	JH	JRG	AJT	LRM			
4	24-APR-15	RE-ISSUED FOR TENDER	JRG	JH	JRG	AJT	LRM			
3	20-APR-15	RE-ISSUED FOR TENDER	JRG	JH	JRG	AJT	AJT			
2	10-APR-15	ISSUED FOR TENDER	JH	BJM	JRG	AJT	LRM			
1	31-MAR-14	RE-ISSUED FOR CONSTRUCTION	JH		SC	AJT	LRM			
0	27-MAR-14	ISSUED FOR CONSTRUCTION	JH	BJM	SC	AT	LM			
A	06-MAR-14	ISSUED FOR CLIENT REVIEW	JH	BJM	SC	AT	LM			

D SHEET | SCALE | SHOWN

OneWay to zero harm

WORLEYPARSONS PROJECT No
307076-06729

ENGINEERING AND PERMIT STAMPS (As Required)

HYDROTECHNICAL
PROFESSIONAL ENGINEER YUKON JACOB GENTLES TERRITORY
July 3, 2015

Geotechnical
PROFESSIONAL ENGINEER YUKON LEE MARTIN TERRITORY
July 3, 2015

CUSTOMER

Yukon Government
Department of Energy, Mines and Resources
Assessment and Abandoned Mines

"This drawing is prepared for the use of the contractual customer of WorleyParsons Canada Services Ltd. and WorleyParsons Canada Services Ltd. assumes no liability to any other party for any representations contained in this drawing."

WorleyParsons resources & energy

CLINTON CREEK
DROP STRUCTURE 4 REPAIR
PLAN

DRG No 307076-06729-00-CI-DGA-1001

REV 6

LOCATION U:\YVR\307076\06729_GOY_DS4REPAIR\11_DRAWINGS\01_CIVIL\05_DS4 REPAIR\307076-06729-00-CI-DGA-1001 AND 1002.DWG
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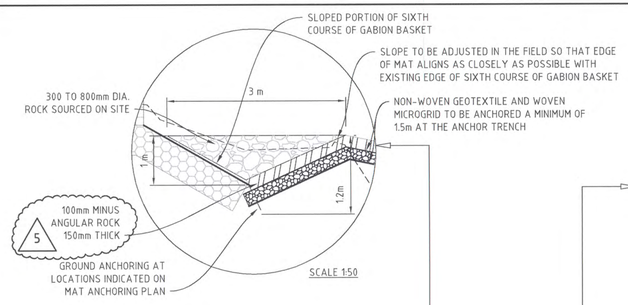
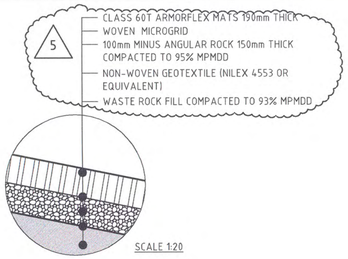
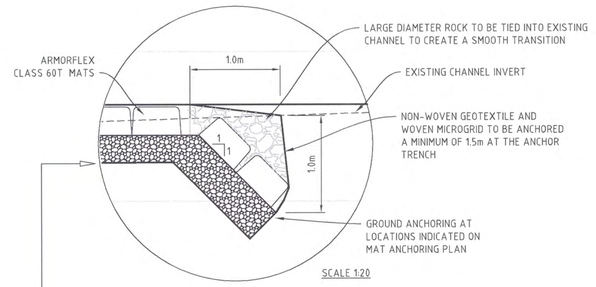
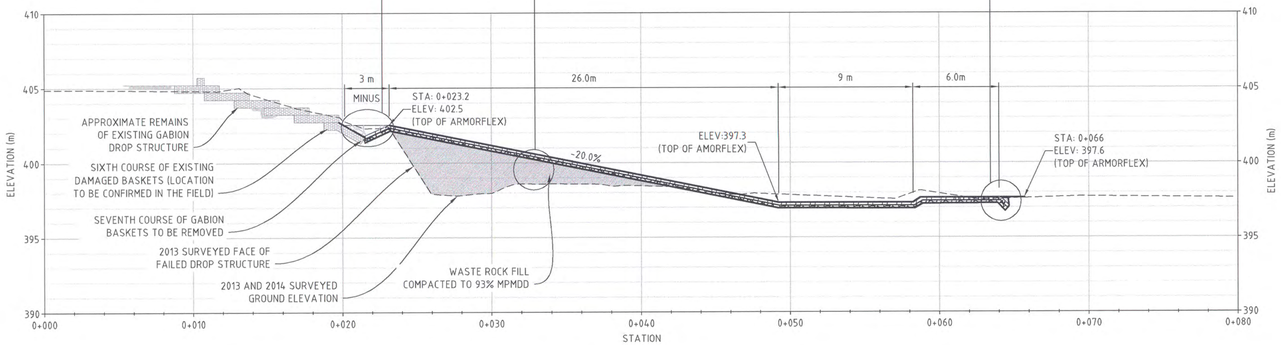
SAVE DATE & TIME 3/7/2015 9:41:49 AM









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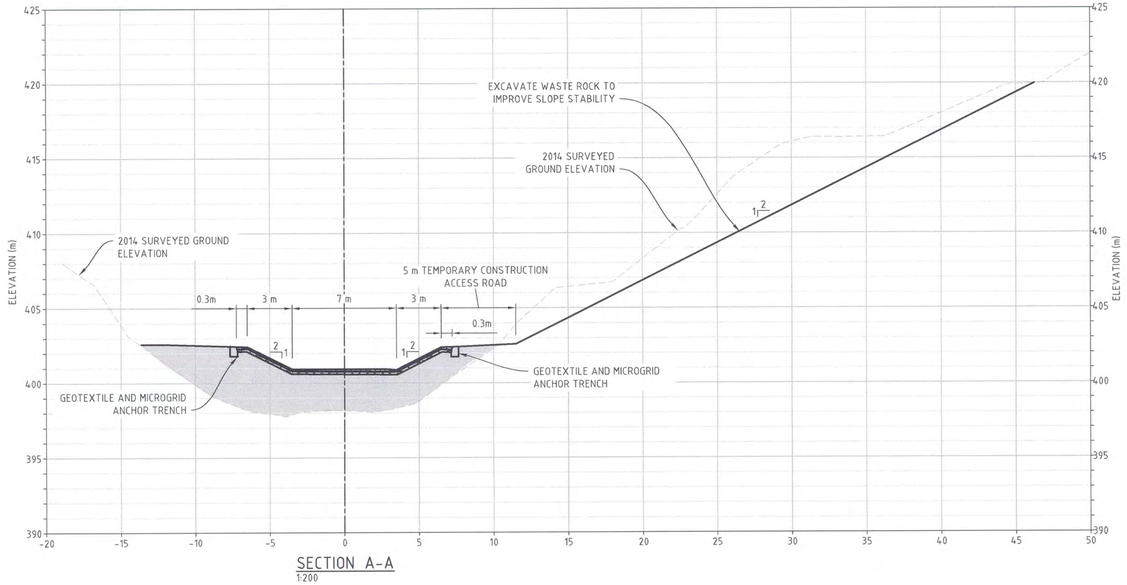
1:200



SECTION A-A
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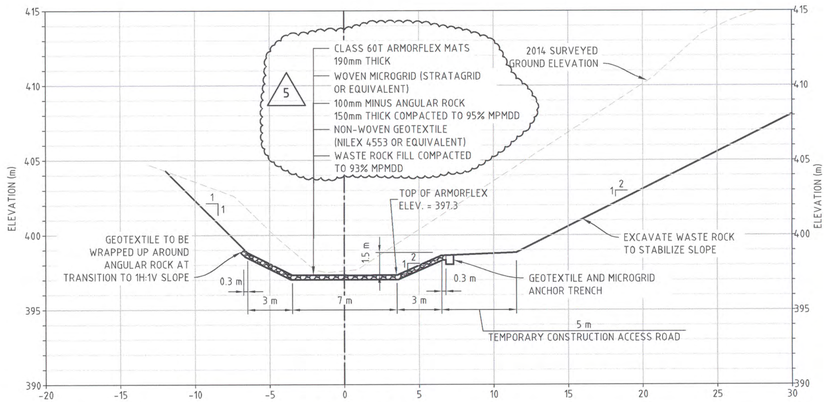


SECTION B-B
1:200

NOTES:

1. FOR GENERAL NOTES, SEE DWG. 1001.
2. DIMENSIONS AND ELEVATIONS ARE IN METRES.

mm 0 500 1000 mm
1:20

mm 0 500 1000 2500 mm
1:50

m 0 5 10 m
1:200

REV	DATE (DD-MMM-YY)	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
			JH	JRG	JRG	AJT	LRM			
5	03-JUL-15	ISSUED FOR CONSTRUCTION	JH	JRG	JRG	AJT	LRM			
4	24-APR-15	RE-ISSUED FOR TENDER	JRG	JH	JRG	AJT	LRM			
3	20-APR-15	RE-ISSUED FOR TENDER	JRG	JH	JRG	AJT	AJT			
2	10-APR-15	ISSUED FOR TENDER	JH	BJM	JRG	AJT	LRM			
1	31-MAR-14	RE-ISSUED FOR CONSTRUCTION	JH		SC	AJT	LRM			
0	27-MAR-14	ISSUED FOR CONSTRUCTION	JH	BJM	SC	AT	LM			
A	06-MAR-14	ISSUED FOR CLIENT REVIEW	JH	BJM	SC	AT	LM			

D SHEET | SCALE | SHOWN

OneWay™ to zero harm

WORLEYPARSONS PROJECT No
307076-06729

ENGINEERING AND PERMIT STAMPS (As Required)

HYDROTECHNICAL — PROFESSIONAL ENGINEER — YUKON — JACOB GENTLES — TERRITORY — JULY 3, 2015

Geotechnical — PROFESSIONAL ENGINEER — YUKON — LEE MARTIN — TERRITORY — JULY 3, 2015

CUSTOMER

Yukon
Government
Department of Energy, Mines and Resources
Assessment and Abandoned Mines

"This drawing is prepared for the use of the contractual customer of WorleyParsons Canada Services Ltd. and WorleyParsons Canada Services Ltd. assumes no liability to any other party for any representations contained in this drawing."

WorleyParsons
resources & energy

CLINTON CREEK
DROP STRUCTURE 4 REPAIR
PROFILE AND SECTIONS

DRG No: 307076-06729-00-CI-DGA-1002
REV: 5

LOCATION: U:\YR\307076\06729_GDY_DS4REPAIR\11_DRAWINGS\01_CIVIL\05_DS4 REPAIR\307076-06729-00-CI-DGA-1001 AND 1002.DWG
USER NAME: jiang.hu
PLOT DATE & TIME: 3/7/2015 9:34:36 AM
SAVE DATE & TIME: 3/7/2015 9:26:36 AM

NOTES:

1. FOR GENERAL NOTES, SEE DWG. 1001.
2. DIMENSIONS AND ELEVATIONS ARE IN METRES.
3. ACCESS ROAD AND CORRIDOR LOCATIONS ARE APPROXIMATE AND ARE TO BE CONFIRMED IN THE FIELD.
4. CONTRACTOR SHALL PREPARE A CONSTRUCTION WATER MANAGEMENT PLAN AND SUBMIT TO THE ENGINEER FOR APPROVAL PRIOR TO STARTING WORK.
5. APPROXIMATE WATER STORAGE CAPACITY IN HUDGEON LAKE IS 6,900m^3/cm INCREASE IN WATER LEVEL.
6. APPROXIMATE MONTH-AVERAGED DISCHARGE RATES FROM HUDGEON LAKE ARE SHOWN IN THE FOLLOWING TABLE:

JUNE	0.89m^3/s
JULY	0.56m^3/s
AUGUST	0.49m^3/s
SEPTEMBER	0.67m^3/s
OCTOBER	0.41m^3/s

7. FLOW RATES ARE BASED ON A DISCONTINUOUS FLOW RECORD FROM 1978 TO 2004 AND ARE PROVIDED FOR INFORMATION ONLY. AVERAGE RATES COULD BE IMPACTED BY HEAVY RAINS, LATE FRESHET, AND/OR LARGER THAN AVERAGE SNOWPACK. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO SELECT AND SIZE WATER DIVERSION INFRASTRUCTURE THAT WILL ENABLE THE TIMELY COMPLETION OF THE WORK AND TO DETERMINE LAKE WATER LEVELS AND FLOW RATES AT WHICH THE DIVERSION SHOULD BE TAKEN OUT OF SERVICE.

REV	DATE DD-MMM-YY	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
5	03-JUL-15	ISSUED FOR CONSTRUCTION	JH	JRG	JRG	AJT	AJT			
4	08-JUN-15	RE-ISSUED FOR TENDER - REMOVED MATERIAL STOCKPILES	JRG	JH	JRG	AJT	AJT			
3	20-APR-15	RE-ISSUED FOR TENDER	JRG	JH	JRG	AJT	AJT			
2	10-APR-15	ISSUED FOR TENDER	JH	BJM	JRG	AJT	LRM			
1	31-MAR-14	RE-ISSUED FOR CONSTRUCTION	JH		JRG	AJT	LRM			
0	27-MAR-14	ISSUED FOR CONSTRUCTION	JH	BJM	SC	AT	LM			
A	06-MAR-14	ISSUED FOR CLIENT REVIEW	JH	BJM	SC	AT	LM			

D SHEET | SCALE | SHOWN

OneWay™ to zero harm

WORLEYPARSONS PROJECT No 307076-06729

ENGINEERING AND PERMIT STAMPS (As Required)

HYPERTECHNICAL PROFESSIONAL YUKON JACOB GENTLES TERRITORY ENGINEER JULY 3, 2015

Geotechnical PROFESSIONAL YUKON LEE MARTIN TERRITORY ENGINEER July 3, 2015

CUSTOMER

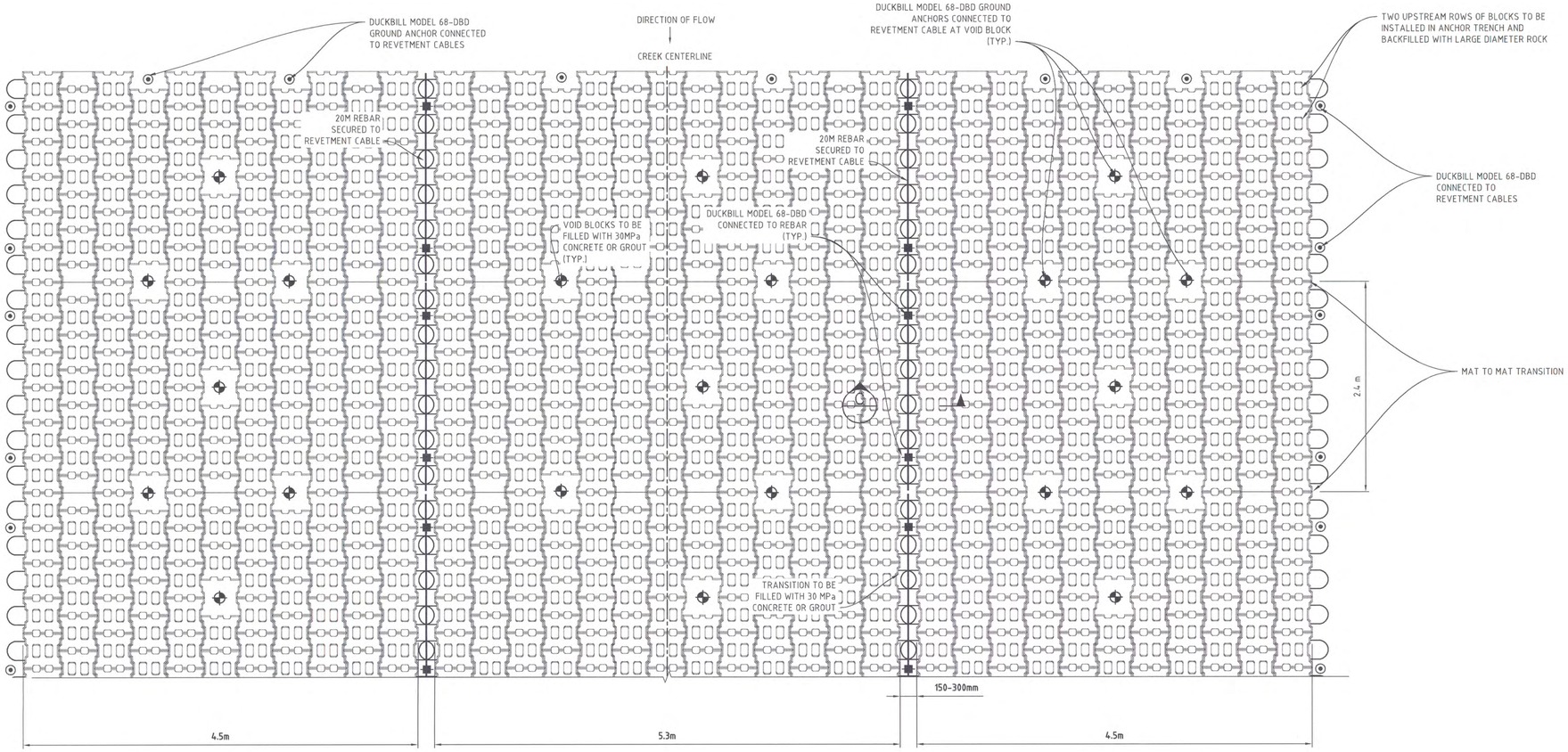
Yukon Government
Department of Energy, Mines and Resources
Assessment and Abandoned Mines

WorleyParsons resources & energy

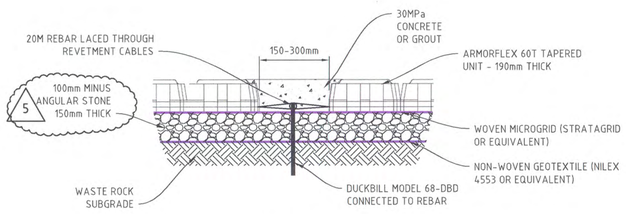
CLINTON CREEK
DROP STRUCTURE 4 REPAIR
CONSTRUCTION STAGING PLAN

DRG No 307076-06729-00-CI-DGA-1003 | REV 5

LOCATION U:\YVR\307076\06729_GOY_DSs\REPAIR\11_DRAWINGS\01_CIVIL\05_DSs_REPAIR\307076-06729-00-CI-DGA-1003.DWG
USER NAME jiang.hu
PLOT DATE & TIME 3/7/2015 9:36:37 AM
SAVE DATE & TIME 3/7/2015 8:48:20 AM



MAT ANCHORING PLAN
1:30



SECTION C-C'
1:20

LEGEND

- MAT TO MAT TRANSITION GROUND ANCHORS TO BE FILLED WITH GROUT OR CONCRETE
- OUTSIDE EDGE GROUND ANCHORS
- VOID BLOCK GROUND ANCHORS TO BE FILLED WITH GROUT OR CONCRETE

mm 0 500 1000 mm
1:20

m 0 0.5 1.0 1.5 m
1:30

NOTES:

1. FOR GENERAL NOTES, SEE DWG. 1001.
2. DIMENSIONS AND ELEVATIONS ARE IN METRES.

REV	DATE (DD-MMM-YY)	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
			CSH			AJT	LRM			
4	03-JUL-15	ISSUED FOR CONSTRUCTION	JH	JRG	JRG	AJT	LRM			
3	24-APR-15	RE-ISSUED FOR TENDER	JRG	JH	JRG	AJT	LRM			
2	20-APR-15	RE-ISSUED FOR TENDER	JRG	JH	JRG	AJT	AJT			
1	10-APR-15	ISSUED FOR TENDER	JH	JRG	JRG	AJT	LRM			

D SHEET | SCALE | SHOWN

OneWay™ to zero harm

WORLEYPARSONS PROJECT No
307076-06729

ENGINEERING AND PERMIT STAMPS (As Required)

HYDROTECHNICAL — PROFESSIONAL ENGINEER — YUKON — JACOB GENTLES — TERRITORY — July 3, 2015

Geotechnical — PROFESSIONAL ENGINEER — YUKON — LEE MARTIN — TERRITORY — July 3, 2015

CUSTOMER

Yukon
Government
Department of Energy, Mines and Resources
Assessment and Abandoned Mines

WorleyParsons
resources & energy

CLINTON CREEK
DROP STRUCTURE 4 REPAIR
MAT ANCHORING PLAN AND DETAIL

DRG No 307076-06729-00-CI-DGA-1004
REV 4

LOCATION: U:\YVR\307076\06729_GOY_DS4REPAIR\11_DRAWINGS\01_CIVIL\05_DS4 REPAIR\307076-06729-00-CI-DGA-1004.DWG
USER NAME: jiang.hu
PLOT DATE & TIME: 3/7/2015 9:39:34 AM
SAVE DATE & TIME: 3/7/2015 8:50:19 AM

Appendix 2 Cost Estimate

WorleyParsons
resources & energy

ESTIMATE - SUMMARY

CLIENT:	Assessment and Abandoned Mines	**DATE:**	7-Jul-15
PROJECT TITLE:	Clinton Creek Site Closure LCCA - DS4 Temporary Repair - Detailed Design - Waste Stabilization an	**ACCURACY:**	+/-20%
PROJECT No.:	307076-06729	**AUTHOR:**	JG
MTO No.:		**REVISION:**	

REFERENCE	DESCRIPTION		TOTAL COST
1.00	DIRECT CONSTRUCTION COSTS (see detail sheet for breakdown)		**$ 428,000**
2.00	INDIRECT COSTS (see detail sheet for breakdown)		**$ 240,000**
3.01	EPCM COSTS		**$ -**
3.02	OWNERS COSTS		**$ -**
3.03	ESCALATION		**$ -**
	SUB TOTAL COSTS		**$ 668,000**
4.01	CONTINGENCY	14%	**$ 91,000**
	TOTAL COSTS		**$ 759,000**

ESTIMATE - DIRECT/INDIRECT/OTHER CONSTRUCTION COSTS DETAIL

CLIENT:	Assessment and Abandoned Mines	**DATE:**	7-Jul-15
PROJECT TITLE:	Clinton Creek Site Closure LCCA - DS4 Temporary Repair - Detailed Design - Waste Stabilization and Rock Chute	**ACCURACY:**	+/-20%
PROJECT No.:	307076-06729	**AUTHOR:**	JG
MTO No.:		**REVISION:**	2

WorleyParsons resources & energy

Area / WBS	Sub Area	Description	Remarks	Qty	Unit	Mhr/Unit	Mhr Total	Mhr Cost ($)	Material/Unit ($)	Material Total ($)	Subcontract Costs/Unit ($)	Subcontract Total ($)	Other/Unit ($)	Other Total ($)	Allowance %	Allowance ($)	Sub Total ($)	Contingency %	Contingency ($)	Total ($)
DIRECT COSTS																				
							-	-		-		-		-		-	-		-	-
		Equipment Mob / Demob	Whitehorse to Dawson City 532km. Dawson City to Site	**6**	**EA**		-	-		-	5,586.00	33,516		-		-	33,516	20%	6,703	40,219
							-	-		-		-		-		-	-		-	-
		Bulk Earthworks					-	-		-		-		-		-	-		-	-
		Waste Rock Excavation (Slope Stabilization)	345Ex, D8 dozer, 40t rock trucks.	**9,500**	**M3**		-	-		-	6.31	59,945		-		-	59,945	20%	11,989	71,934
		Waste Rock Fill (93% MPMDD)	D8 Dozer, Single drum soil compactor	**1,000**	**M3**		-	-		-	4.05	4,050		-		-	4,050	20%	810	4,860
		Construct Access Road	5m w x 39m lg, 20% grade, on waste rock	**1**	**LS**		-	-		-	5,241.21	5,241		-		-	5,241	20%	1,048	6,289
							-	-		-		-		-		-	-		-	-
		Channel Armouring					-	-		-		-		-		-	-		-	-
		Gravel Bedding	Crushed angular rock, site-sourced, roller compacted	**120**	**M3**		-	-		-	70.00	8,400		-		-	8,400	25%	2,100	10,500
		Class 60T Armorflex Mats	2.4m x 4.5m mats, supply (U.S.) and placement, excludes delivery. Includes rebar, concrete, and manufacturer's representative	**36**	**EA**		-	-		-	3,240.00	116,640		-		-	116,640	10%	11,664	128,304
		Class 60T Armorflex Mats	2.4m x 5.3m mats, supply (U.S.) and placement, excludes delivery. Includes rebar, concrete, and manufacturer's representative	**18**	**EA**		-	-		-	3,816.00	68,688		-		-	68,688	10%	6,869	75,557
		Non-Woven Geotextile	Supply, delivery and installation	**900**	**M2**		-	-		-	12.00	10,800		-		-	10,800	20%	2,160	12,960
		Woven Microgrid Geotextile	Supply, delivery and installation	**900**	**M2**		-	-		-	15.00	13,500		-		-	13,500	20%	2,700	16,200
		Duckbill Model 68-DBD Ground Anchors	900 mm long, supply, installation, and delivery	**312**	**EA**		-	-		-	60.00	18,720		-		-	18,720	15%	2,808	21,528
		Large Diameter Rock for Tie-In to Existing Structure	Site sourced rock average dimension of 300 to 800 mm	**30**	**M3**		-	-		-	148.94	4,468		-		-	4,468	25%	1,117	5,585
							-	-		-		-		-		-	-		-	-
		Construction Water Management					-	-		-		-		-		-	-		-	-
		Aquadam	1.8m h x 30.5m lg	**1**	**EA**		-	-		-	26,000	26,000		-		-	26,000	20%	5,200	31,200
		Pumps, hoses, fuel & maintainence	150mm submersible	**2**	**EA**		-	-		-	9,287.20	18,574		-		-	18,574	20%	3,715	22,289
							-	-		-		-		-		-	-		-	-
		Support Equipment					-	-		-		-		-		-	-		-	-
		Shop truck	1ea	**35**	**DY**		-	-		-	300.00	10,500		-		-	10,500	20%	2,100	12,600
		Shop trailer	1ea	**1.2**	**MO**		-	-		-	2,000.00	2,303		-		-	2,303	20%	461	2,763
		Pick-up trucks	2ea	**35**	**DY**		-	-		-	300.00	10,500		-		-	10,500	20%	2,100	12,600
		Generator	1ea	**1.2**	**MO**		-	-		-	1,320.00	1,520		-		-	1,520	20%	304	1,824
							-	-		-		-		-		-	-		-	-
		Asbestos Equipment					-	-		-		-		-		-	-		-	-
		Equipment / vehicle heppa filters,		**1**	**LS**		-	-		-	6,000.00	6,000		-		-	6,000	25%	1,500	7,500
		PPE; respirators, overalls		**15**	**EA**		-	-		-	500.00	7,500		-		-	7,500	25%	1,875	9,375
							-	-		-		-		-		-	-		-	-
		Fuel Transportation	Transport from Dawson City to site (approx 110km one-way).				-	-		-		-		-		-	-		-	-
		Fuel truck & driver	27,000 liter tanker	**1**	**LD**		-	-		-	685.60	686		-		-	686	20%	137	823
			*fuel included in all-in rates.	24,210	liters		-	-		-		-		-		-	-		-	-
DIRECT COST SUB TOTAL							**-**	**-**		**-**		**427,551**		**-**	**0%**	**-**	**427,551**	**16%**	**67,360**	**494,911**

ESTIMATE - DIRECT/INDIRECT/OTHER CONSTRUCTION COSTS DETAIL

CLIENT:	Assessment and Abandoned Mines	**DATE:**	7-Jul-15
PROJECT TITLE:	Clinton Creek Site Closure LCCA - DS4 Temporary Repair - Detailed Design - Waste Stabilization and Rock Chute	**ACCURACY:**	+/-20%
PROJECT No.:	307076-06729	**AUTHOR:**	JG
MTO No.:		**REVISION:**	2

Area / WBS	Sub Area	Description	Remarks	Qty	Unit	Mhr/Unit	Mhr Total	Mhr Cost ($)	Material/Unit ($)	Material Total ($)	Subcontract Costs/Unit ($)	Subcontract Total ($)	Other/Unit ($)	Other Total ($)	Allowance %	Allowance ($)	Sub Total ($)	Contingency %	Contingency ($)	Total ($)
INDIRECT COSTS																				
		TEMPORARY CONSTRUCTION CAMP	RV rental (2men per unit) and single per diem.	**165**	**MDY**		-	-		-	255.00	42,075		-		-	42,075	10%	4,208	46,283
		TEMPORARY FACILITIES AND CONSTRUCTION SITE SERVICES		**3%**			-	-		-	427,550.78	12,827		-		-	12,827	10%	1,283	14,109
		SNOW REMOVAL	n/a				-	-		-		-		-		-	-		-	-
		ROAD MAINTENANCE	n/a				-	-		-		-		-		-	-		-	-
		OVERTIME PREMIUM FOR COMPRESSED WORK WEEK	n/a				-	-		-		-		-		-	-		-	-
		NON-PRODUCTIVE TIME	n/a				-	-		-		-		-		-	-		-	-
		SPOT OVERTIME	n/a				-	-		-		-		-		-	-		-	-
		CONTRACTOR LOA AND TRAVEL	Edm to Dawson City charter flight + DC to Site by charter bus. 1 roundtrip/man.	**6**	**Round Trip**		-	-		-	1,144.00	6,864		-		-	6,864	10%	686	7,550
		HEAVY LIFT	n/a				-	-		-		-		-		-	-		-	-
		TRANSPORTATION AND FREIGHT	Aquadam & pumps.	**1**	**LD**		-	-		-	9,631.00	9,631		-		-	9,631	10%	963	10,594
		TRANSPORTATION AND FREIGHT	Armourflex. Quote from supplier.	**8**	**LD**		-	-		-	14,000.00	112,000		-		-	112,000	10%	11,200	123,200
		CAPITAL SPARE PARTS	n/a				-	-		-		-		-		-	-		-	-
		FIRST FILLS	n/a				-	-		-		-		-		-	-		-	-
		ENVIRONMENTAL ASSESSMENT, MONITORING AND TESTING SERVICES		**35**	**DY**		-	-		-	1,500.00	52,500		-		-	52,500	10%	5,250	57,750
		GEOTECHNICAL INVESTIGATIONS AND RECOMMENDATIONS	n/a				-	-		-		-		-		-	-		-	-
		CONSTRUCTION INSURANCE	n/a	**1%**			-	-		-	427,551	4,276		-		-	4,276		-	4,276
		BUILDING PERMITS	n/a				-	-		-		-		-		-	-		-	-
INDIRECT COST SUB TOTAL							**-**	**-**		**-**		**240,172**		**-**	**0%**	**-**	**240,172**	**10%**	**23,590**	**263,762**
OTHER COSTS																				
		EPCM					-	-		-		-		-		-	-		-	-
		OWNERS COSTS					-	-		-		-		-		-	-		-	-
		ESCALATION					-	-		-		-		-		-	-		-	-
OTHER COST SUB TOTAL							**-**	**-**		**-**		**-**		**-**		**-**	**-**		**-**	**-**
TOTAL																	**667,723**	**14%**	**90,949**	**758,672**

Appendix 3 Construction Schedule

WorleyParsons
resources & energy

Contractor Man Power Schedule — 2015

Description	Qty	UoM	Crew Size # of Men	Equivalent Man-Days	May 1	May 2	May 3	May 4	May 5	Jun 1	Jun 2	Jun 3	Jun 4	Jul 1	Jul 2	Jul 3	Jul 4	Aug 1	Aug 2	Aug 3	Aug 4	Sept 1	Sept 2	Sept 3	Sept 4
Mob/Demob & Set-up Equip			4	12													4					3			
Waste Rock Excavation	9,500	M3	4	40														3	4						
Waste Rock Fill	1,000	M3	1	1															1						
Construct Access Rd.	39	M3	3	3															3						
Gravel Bedding	100	M3	3	24														1		3					
Class 60T Armorflex	54	EA	4	56															4	4	4				
Ground Anchors	414	EA	4	16																2	2				
Concrete/Grout	15	M3	2	4																2	2				
Place large diameter rock	30	M3	2	2																	2				
Aquadam	1	EA	4	6													4					4			
Pumps, Hose & Maintenance	2	EA	1	1													1	1	1	1	1	1			
TOTALS																									
Total Contractor Man-Days	165	Man-Days																							

Number indicates anticipated crew size

- Unproductive Time
- Support Personnel
- Construction Work