PCI ET AL TWEED LAKE M-47

ENGINEERING DATA

1. Casing and Cementing
2. Bit Program
3. Hydraulics
4. Drill Stem Testing

508 mm Conductor Barrel and Cementing Details

1. Conductor Barrel:

Run 1 joint of 508 mm, 140 kg/m, K-55, BT&C casing (landed at approximately 10 m drilled depth).

Accessory Equipment

1 - 508 mm, 140 kg/m, K-55, BT&C landing joint

Conductor Barrel Data

Internal Diameter:	485.7 mm
Drift Diameter:	481.0 mm
Coupling Diameter:	533.4 mm
Capacity:	0.1854 m^3/m
75% Displacement:	2.8 m^3

2. Cementing:

Cement conductor barrel full length with "Arctic-Set" permafrost cement.

Cement Properties:

Density:	1860 kg/m^3
Cement Yield:	0.750 m^3/tonne
Mix Water:	0.361 m^3/tonne (10°C recommended)

Thickening Time:

Temp (°C)	-10	0	5	15	25
Time	4:20	4:30	4:35	4:15	2:25

Example Calculation:

Conductor Barrel setting depth: 10 m

10 m x .0892 m^3/m = 0.892 m^3

0.892 m3 x 2 (100% excess) = 1.784 m^3

25% of Displacement = 5 m x .1854 m3/m = 0.927 m^3

2.711 m^3

$$\frac{2.711\ m^3}{0.750\ m^3/\text{tonne}} = 3.61 \text{ tonnes or } \underline{4 \text{ tonnes}}$$

NOTE: Cement amounts, type and additives may change as warranted by hole conditions such as lost circulation, bottom-hole temperature, and temperature of the mix water. If lost circulation or excessive washouts are suspected, a larger excess factor may be required. The 75% displacement volume is to be re-calculated on-site based on 75% of the actual lengths of the barrel and landing joint.

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340 mm Conductor Casing and Cementing Details

1. Casing:

Run 60 m of 340 mm, 101 kg/m, K-55, BT&C casing.

Accessory Equipment

1 - 340 mm BT&C float shoe
2 - 340 mm centralizer
2 - 340 mm stop collar
1 - 346 mm, 21,000 kPa x 340 mm slip-on casing bowl

Casing Performance Properties (including PCI safety factors)

Internal Diameter:	315.3 mm	Internal Yield:	18,120 kPa
Drift Diameter:	311.4 mm	Collapse:	11,950 kPa
Coupling Diameter:	365.1 mm	Jt. Strength:	321,220 daN
		Tensile Limit:	264,160 daN
		Capacity:	0.0781 m^3/m
			(4.7 m^3 in 60 m)

2. Cementing:

Cement casing full length with "Arctic Set" permafrost cement.

Cement Properties:

Density: 1860 kg/m^3
Cement Yield: .750 m^3/tonne
Mix Water: .361 m^3/tonne (10°C recommended)

Thickening Time:

Temp (°C)	-10	0	5	15	25
Time	4:20	4:30	4:35	4:15	2:25

Example Calculation:

Casing Setting Depth: 60 m
Conductor Barrel: 10 m

10 m x .0947 m^3/m = 0.947 m^3
50 m x .0645 m^3/m = 3.225 m^3
4.172 m^3

4.172 m^3 x 2.5 (150% excess) = 10.43 m^3

$$\frac{10.43\ m^3}{0.750\ m^3/\text{tonne}} = 13.9 \text{ tonnes or } \underline{14 \text{ tonnes}}$$

NOTE: Cement amounts, type and additives may change as warranted by hole conditions such as lost circulation, bottom-hole temperature, and temperature of the mix water. If lost circulation or excessive washouts are suspected, a larger excess factor may be required.

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245 mm Casing and Cementing Details

1. Casing:

Run 500 m of 245 mm, 60 kg/m, L-80, LT&C casing

Accessory Equipment

1 - 245 mm float shoe
1 - 245 mm float collar
8 - 245 mm centralizers
8 - 245 mm stop collar
1 - 279 mm, 21,000 kPa x 245 mm slip-on casing bowl

Casing Performance Properties

Internal Diameter:	224.4 mm
Drift Diameter:	220.4 mm
Coupling Diameter:	269.9 mm
Capacity:	0.0396 m^3/m (19.8 m^3 in 500 m)
Collapse Strength:	18,940 kPa
Internal Yield:	30,200 kPa
Tensile Strength:	226,330 daN
Joint Strength:	179,660 daN

NOTE: PCI safety factors are included in the above numbers.

Recommended Make-up Torque

Minimum:	7,500 N-m
Optimum:	9,990 N-m
Maximum:	12,490 N-m

2. Cementing:

Cement casing full length with "Arctic Set" permafrost cement.

Cement Properties:

Density: 1860 kg/m^3
Cement Yield: .750 m^3/tonne
Mix Water: .361 m^3/tonne (10°C recommended)

Thickening Time:

Temp (°C)	-10	0	5	15	25
Time	4:20	4:30	4:35	4:15	2:25

Example Calculation:

Casing Setting Depth: 500 m
Conductor Casing: 60 m

60 m x .0311 m^3/m = 1.866 m^3
440 m x .0290 m^3/m = 12.760 m^3
14.626 m^3

14.626 m^3 x 2 (100% excess) = 29.252 m^3

$$\frac{29.252\ m^3}{0.750\ m^3/\text{tonne}} = 38.9 \text{ tonnes or } \underline{39 \text{ tonnes}}$$

NOTE: Cement amounts, type and additives may change as warranted by hole conditions such as lost circulation, bottom-hole temperature, and temperature of the mix water. If loss of circulation or excessive washouts are suspected, a larger excess factor may be required.

178 mm Casing and Cementing Details

1. Casing:

Run 1483 m of 178 mm, 43 kg/m, SOO-95, LT&C casing.

Accessory Equipment

1 - 178 mm float shoe
1 - 178 mm float collar
16 - 178 mm centralizers
16 - 178 mm stop collar
20 - 178 mm scratchers

Recommended Make-up Torque

Minimum: 6,940 N-m
Optimum: 9,260 N-m
Maximum: 11,580 N-m

Casing Performance Properties

Internal Diameter:	157.1 mm
Drift Diameter:	153.9 mm
Coupling Diameter:	194.5 mm
Capacity:	0.0194 m^3/m (28.8 m^3 in 1483 m)
Collapse Strength:	56,380 kPa
Internal Yield:	50,900 kPa
Tensile Strength:	198,920 daN
Joint Strength:	171,420 daN

NOTE: PCI safety factors are included in the above numbers.

2. Cementing

Cement casing full length with Class "G" cement + 0.5% D-65 turbulence inducer + 0.1% D-13 retarder.

Cement Properties

Density:	1893 kg/m^3
Cement Yield:	0.758 m^3/tonne
Mix Water:	0.440 m^3/tonne
Thickening Time:	5.0 hrs

Example Calculation

Casing Setting Depth: 1483 m
Surface Casing: 500 m

983 m x 0.0118 m^3/m = 11.60 m^3 x 1.5 = 17.4 m^3
500 m x 0.0151 m^3/m = 7.6 m^3
25.0 m^3

$$\frac{25.0\ m^3}{0.758\ m^3/\text{tonne}} = 32.9 \text{ tonnes or } \underline{33 \text{ tonnes}}$$

NOTE: Cement amounts, types and additives may change as warranted by hole conditions such as lost circulation, bottom-hole temperature, and temperature of the mix water. If loss of circulation or excessive washouts are suspected, a larger excess factor may be required.

PCI ET AL TWEED LAKE M-47

ALTERNATE PROGRAM A

245 mm Casing and Cementing Details

1. Casing:

Run 883 m of 245 mm, 60 kg/m, L-80, LT&C casing

Accessory Equipment

1 - 245 mm float shoe
1 - 245 mm float collar
8 - 245 mm centralizers
8 - 245 mm stop collar
1 - 245 mm External Casing Packer
1 - 245 mm DV tool
1 - 279 mm, 21,000 kPa x 245 mm slip-on casing bowl

Casing Performance Properties

Internal Diameter:	224.4 mm
Drift Diameter:	220.4 mm
Coupling Diameter:	269.9 mm
Capacity:	0.0396 m^3/m (19.8 m^3 in 500 m)
Collapse Strength:	18,940 kPa
Internal Yield:	30,200 kPa
Tensile Strength:	226,330 daN
Joint Strength:	179,660 daN

NOTE: PCI safety factors are included in the above numbers.

Recommended Make-up Torque

Minimum:	7,500 N-m
Optimum:	9,990 N-m
Maximum:	12,490 N-m

ALTERNATE PROGRAM A

2. Cementing:

Cement casing in two stages as follows:

First Stage:

Cement:	Class "G" + 0.5% turbulence inducer (D-65) + 0.1% retarder (D-13)
Density:	1893 kg/m^3
Cement Yield:	0.758 m^3/tonne
Mix Water:	.440 m^3/tonne (min. 25°C recommended)
Thickening Time:	5 hours

Second Stage:

Cement:	"Arctic Set" permafrost cement					
Density:	1860 kg/m^3					
Cement Yield:	0.750 m^3/tonne					
Mix Water:	0.361 m^3/tonne (10°C recommended)					
Thickening Time:	Temp (°C)	-10	0	5	15	25
		4:20	4:30	4:35	4:15	2:25

Example Calculation:

First Stage: cover 100 m of competent formation at TD (plus 200% excess)

100 m x 0.0290 m^3/m = 2.90 m^3

2.90 m x 3 (200% excess) = 8.70 m^3

$$\frac{8.70\ m^3}{0.758\ m^3/\text{tonne}} = 11.5 \text{ tonnes or } \underline{12 \text{ tonnes}}$$

Second Stage: through DV tool to surface above ECP at conductor casing shoe (plus 20% excess)

60 m x 0.0781 m^3/m = 4.686 m^3

4.686 m^3 x 1.2 (20% excess) = 5.623 m^3

$$\frac{5.623\ m^3}{0.750\ m^3/\text{tonne}} = 7.5 \text{ tonnes or } \underline{8 \text{ tonnes}}$$

PCI ET AL TWEED LAKE M-47

178 mm Casing and Cementing Details

1. Casing:

Run 1483 m of 178 mm, 43 kg/m, SOO-95, LT&C casing.

Accessory Equipment

1 - 178 mm float shoe
1 - 178 mm float collar
16 - 178 mm centralizers
16 - 178 mm stop collar
20 - 178 mm scratchers

Recommended Make-up Torque

Minimum: 6,940 N-m
Optimum: 9,260 N-m
Maximum: 11,580 N-m

Casing Performance Properties

Internal Diameter:	157.1 mm
Drift Diameter:	153.9 mm
Coupling Diameter:	194.5 mm
Capacity:	0.0194 m^3/m (28.8 m^3 in 1483 m)
Collapse Strength:	56,380 kPa
Internal Yield:	50,900 kPa
Tensile Strength:	198,920 daN
Joint Strength:	171,420 daN

NOTE: PCI safety factors are included in the above numbers.

ALTERNATE PROGRAM A

2. Cementing

Cement casing to 100 m above the 245 mm surface casing shoe (approximately 783 m) with Class "G" + 0.5% D-65 turbulence inducer + 0.1% D-13 retarder.

Cement Properties

Density:	1893 kg/m^3
Cement Yield:	0.758 m^3/tonne
Mix Water:	0.440 m^3/tonne
Thickening Time:	5.0 hrs

Example Calculation

Casing Setting Depth: 1483 m
Surface Casing: 883 m

$600\ m \times 0.0118\ m^3/m = 7.08\ m^3 \times 1.5 = 10.6\ m^3$
$100\ m \times 0.0151\ m^3/m = 1.5\ m^3$
$12.1\ m^3$

$$\frac{12.1\ m^3}{0.758\ m^3/\text{tonne}} = 15.9 \text{ tonnes or } \underline{16 \text{ tonnes}}$$

NOTE: Cement amounts, types and additives may change as warranted by hole conditions such as lost circulation, bottom-hole temperature, and temperature of the mix water. If loss of circulation or excessive washouts are suspected, a larger excess factor may be required.

PCI ET AL TWEED LAKE M-47

RECOMMENDED BIT PROGRAM

BIT#	SIZE (mm)	BIT TYPE	JETS (mm)	DEPTH OUT (m)	METERS DRILLED	WEIGHT (daN) (1000)	RPM
1A	445	1-1-4	3 x 12.7	10 (GL)	10	3 - 4	60 - 80
1B	610	H.O.	-	10 (GL)	10	2 - 3	60 - 80
2A	445	2-1-1	3 x 12.7	60	50	5 - 6	60 - 80
3	311	6-2-7	3 x 12.7	330	270	8 - 12	80 - 120
4	311	5-2-7	3 x 12.7	500	170	12 - 15	80 - 120
5	216	6-3-7	Open	750	250	15 - 18	90 - 110
6	216	6-3-7	Open	1000	250	18	90 - 110
7	216	6-2-7	Open	1288	288	10 - 18	90 - 100
8	171	DIA	-	1306	18	6	85
9	216	6-2-7	3 x 8.7	1483	177	18	90

RECOMMENDED BIT PROGRAM
ALTERNATE

BIT#	SIZE (mm)	BIT TYPE	JETS (mm)	DEPTH OUT (m)	METERS DRILLED	WEIGHT (daN) (1000)	RPM
1A	445	1-1-4	3 x 12.7	10 (GL)	10	3 - 4	60 - 80
1B	610	H.O.	-	10 (GL)	10	2 - 3	60 - 80
2A	445	2-1-1	3 x 12.7	60	50	5 - 6	60 - 80
3	311	6-2-7	Open	330	270	12	90 - 100
4	311	5-2-7	Open	600	270	19	80 - 100
5	311	6-3-7	Open	883	283	17	80 - 100
6	216	6-2-7	Open	1140	257	18	90 - 110
7	216	6-2-7	Open	1288	148	10 - 18	90 - 100
8	171	DIA	-	1306	18	6	85
9	216	6-2-7	3 x 8.7	1483	177	18	90

PCI ET AL TWEED LAKE M-47

RECOMMENDED HYDRAULICS

Pumps:	2 - Emsco D-500 Duplex (152 mm x 406 mm liner)
Output:	0.0230 m^3/stk at 85% volumetric efficiency (each pump)
Liner Pressure Rating:	10,800 KPa
Recommended Max. Pump Pressure:	9,000 KPa

SPM:	40	45	50	55	60	65
Output (l/min): at 85%	920	1035	1150	1265	1380	1495

HOLE SIZE mm	DEPTH (m)	MUD DENSITY (kg/m^3)	OUTPUT	SPM	NOZZLES (mm)	ANN. VEL. (m/min)	PUMP PRESS. (KPa)
445	60	1020	2990 l/m	2 x 65	3 x 12.7	20	2000
311	500	1060	2530 l/m	2 x 55	3 x 12.7	40	6000
216	1288	Air	28 m^3/m	-	Open	-	1700
216	1483	1090	1265	55	3 x 10.3	50	7000

PCI ET AL TWEED LAKE M-47

RECOMMENDED HYDRAULICS

ALTERNATE

Pumps:	2 - Emsco D-500 Duplex (152 mm x 406 mm liner)						
Output:	0.0230 m^3/stk at 85% volumetric efficiency (each pump)						
Liner Pressure Rating:	10,800 KPa						
Recommended Max. Pump Pressure:	9,000 KPa						
SPM:	40	45	50	55	60	65	
Output (l/min): at 85%	920	1035	1150	1265	1380	1495	

HOLE SIZE mm	DEPTH (m)	MUD DENSITY (kg/m^3)	OUTPUT	SPM	NOZZLES (mm)	ANN. VEL. (m/min)	PUMP PRESS. (KPa)
445	60	1020	2990 l/m	2 x 65	3 x 12.7	20	6000
311	150	1060	2530 l/m	2 x 55	3 x 12.7	40	6000
311	883	Air	45 to 15 m^3/m	-	Open	-	800 - 4900
216	1288	Air	28 m^3/m	-	Open	-	1700
216	1483	1090	1265	55	3 x 10.3	50	7000

PCI ET AL TWEED LAKE M-47

DST PROGRAM

Well Name:	PCI et al Tweed Lake M-47 (66° 56' 47.11" N, 125° 54' 09.42" W)	
Rig:	Atco/Equtak #76	
Total Depth:	1483 m	
Open Hole Size:	216 mm	
Casing Size: Interval:	245 mm 0 - 500 m or 0 - 883 m	
Test String:	Drill Pipe (114 mm x 89 mm XH, 24.7 kg/m)	
Drill Collars:	171 mm x 127 mm H90	
Test Type:	Conventional Bottom-hole (possibly closed chamber)	
Test #:	One (1)	Two (2)
Formation: Depth:	Mt. Clark 1306 m	Proterozoic Clastic 1351 m
Est. Fm. Pressure:	15,000 KPa	15,500 KPa
Expected Recovery:	Oil	Oil