Science Drilling Procedure

northeast
NATURAL ENERGY

MIP 3H
Science Pilot Well/Marcellus Horizontal
Drilling Procedure
API Number: 47-061-01707
AFE: 100333-602
8-5-15

At a Glance

	Hole Size	Size	Grade	#/ft	Drill Depth	Casing Depth
Conductor	28"	24"	NA		50	50
Surface	17 1/2"	13 3/8"	J-55	54.5	530'	500'
Intermediate	12 1/4"	9 5/8"	J-55	40	1,800'	1,770'

	Start	End
End Air	-	6,900
Nudge	6,900	7,445
Coring	7,445	7,570
TD	7,570	8,000
Sidewall	50 cores	
Lowest SF	2.22	

Elevation	**1,058'**
KB	14'

Latitude	**39.601783**
Longitude	79.976123

Northeast Natural Energy Primary Contacts

Jay Hewitt – Drilling Manager – jhewitt@nne-llc.com – (304) 382-1825
Ian Costello – Completions Engineer – icostello@nne-llc.com – (304) 610-9764
Zack Arnold – GM Operations – zarnold@nne-llc.com – (304) 203-8059
Hollie Medley – Regulatory Coordinator – hmedley@nne-llc.com - (304) 241-5752 x 7108
Brett Loflin – VP Regulatory – bloflin@nne-llc.com - (304) 414-7063

Emergency / Compliance

Refer to Emergency Response Plan for emergency protocols and contact information

Inspector – Gayne Knitowski (304) 546-8171 Gayne.J.Knitowski@wv.gov
MECCA- Michael Fortney (681) 209-5217 mfortney@mecca911.org
MECCA- Michael Wolfe (304) 598-0301
Emergency Services - Dial 911 (For Emergency Use Only)

_____ John Adams, VP Operations

_____ Brett Loflin, VP Regulatory Affairs

_____ BJ Carney, VP Geoscience

_____ Sam Sommerville, VP Finance

_____ Jeannie Johnson, VP Land Operations

_____ Zack Arnold, GM Operations

_____ Matt Daniel, Landman

_____ Hollie Medley, Regulatory Coordinator

Introduction

NNE is dedicated to developing a safe and healthy environment for all employees and contractors through the combination of engineering design, practicality, and a hands on approach. Moreover, NNE is committed to protecting our natural environment and maintains a strong anti-pollution and spill prevention program in all areas where it conducts business. The objective of this procedure is to act as a guide to drill the top hole section of the well while following all of NNE's core values.

Safety & Environmental

1. Pre-job safety meetings are to be held at the beginning of each shift and prior to any changes in operating conditions/procedures during a shift throughout the course of all operations.
2. All crews on location must have the same relief times to provide an accurate head count on location and uniform hand-over procedures and directions.
3. PJSM topics should encompass NNE core values, **stop work authority**, PPE requirements, muster areas, specific site concerns, notification processes, and specific operational concerns.
4. During PJSM, discuss NNE JSA and distribute for signature amongst all crew members. JSA must be completed relative to specific job hazards for operation.
5. NNE JSA does not replace contractor JSA. Each contractor JSA must be signed off on and collected by NNE supervisor before work may commence.
6. Any non-transient visitor to the pad not present for initial safety meeting, must report to company man upon arrival for sign-in on NNE JSA and briefing of site hazards. Non-transient visitors are defined as anyone that will leave a ten foot perimeter of their vehicle or may come within one-hundred feet of wellhead, production, or operating equipment.
7. A daily environmental inspection is required by supervisors and a NNE Environmental Checklist must be completed detailing inspection. When two supervisors are splitting oversight of an operation, the daytime supervisor is responsible for inspection/completion of such forms.
8. If an environmental/safety incident or near miss occurs, notify the NNE supervisor immediately and follow guidelines in provided Site Safety Plan for response. Complete incident report for documentation of the incident, and send to office for review.
9. All safety information, forms, JSAs, environmental checklists, and incident reports must be contained in a folder, separated daily, and turned in to NNE supervisor at the end of operations.
10. Make note of all safety meetings and incidents in daily reports.
11. During simultaneous operations, make sure that all parties performing work on the pad attend safety meetings and their presence is documented.

Pre-Rig Horizontal move

1. Get permit for well.
2. Make sure wells have been properly labeled.
3. Update all drilling plans.
4. Make sure E&S controls are in place and a paper copy is in the mail box.
5. Call DEP to set up a Pre-spud meeting 48 hours in advance.
6. Hold pre-spud meeting.
7. Call and email DEP with rig move date 24 hours before the move.

Northeast NATURAL ENERGY

8. Add liner and mats to bigger rig size.
9. RU Patterson 254 over the hole ensuring no rubbing of casing.
10. Have copy of permit, Site Reclamation Plan, and Well site 911 Address company man shack.

Pre-Drilling

1. Check the depth of the wellhead in the cellar to ensure the spacer spool is high enough to get the BOP components out of the cellar.
2. Nipple up all BOP components. All equipment should have a minimum pressure rating of 5,000 psi, including BOP stack, standpipe, kelly hoses, vibrating hoses, choke lines, and choke manifold.
3. The BOP will consist of 5,000 psi choke manifold, 5,000 psi annular preventer, 5,000 psi blind ram, and a 5,000 psi pipe ram.
4. When any component of the BOP stack is broken apart a new ring gasket needs to be used. If the components are left together while moving the rig the old seal may be used as long as it passes the pressure test.
5. Once the rig is nippled up and all the choke and Kelly lines, are hooked up call the pressure testing company.
6. The equipment that needs to be pressure tested includes the following: Lines from outlet of the mud pumps through the standpipe and Kelly hoses, casing head valves, BOP stack, TIW valve, choke lines, choke manifold, and accumulator.
7. The accumulator test needs to be performed before any other tests are conducted.
8. Test each component at a low pressure of 250 psi for 5 minutes before doing any high pressure tests.
9. After the low pressure test passes, test all lines, hoses, pipe rams, blind rams, and the choke manifold for high pressure. Hold the test for 30 minutes. The pressure test should be conducted to 90% of the MAWP. For a 5,000 psi stack they should be tested to 4,500 psi. If something leaks bleed off the pressure and fix the leak, start the time over at zero for the re-test.
10. Test the annular for 2700 psi for a 5k stack, also for 30 minutes.

Nudge

1. Assemble a 1.5 conventional short bit to bend motor with a 8 3/4" Smith 616 PDC
2. Make sure the BHA and drill pipe are torqued to specifications.
3. TIH to the bottom of the 9 5/8” shoe and conduct the shallow hole test.
4. Make sure the directional driller, tool pusher, and drillers know where the anticipated bottom of hole lies.
5. If no tight spots are encountered, stop 100 feet or 6,800’ from bottom and start circulating WBM Ream and wash from this point on.
6. Make sure that tool pusher, directional driller, and Pason pipe tallies all match.
7. Once bottom of the hole is tagged, record it on Pason and in the daily report.
8. If tight spots were encountered pump at least one sweep at the bottom of the hole to ensure it is clean and free of any fill.
9. After tagging orient the motor to the desired azimuth according to the directional plans.
10. Ensure the mud weights and rheologies are within the proper ranges and note the starting ECD if the tool is being run. Mud weight should be at 12.5 ppg when entering the Marcellus on a water based mud and should be raised as need.
11. Enough barite will be kept on hand to raise the entire system by 2 ppg and loss circulation material such as cotton seed will be kept on hand.

12. Drill ahead on the nudge plan. Ensure DLS are kept under 5 degree / 100 ft.
13. Make sure to keep a close eye on each survey and be in constant contact with entire team.
14. If deviation from the original plan contact the Drilling Manager.
15. Continue drilling until the reach of the start coring point of 7,445'

Full core

1. We will pick up enough coring equipment to core 120' of 4" core.
2. During this time the coring group will be in charge of the drilling parameters.
3. Once completed the handling will also be done strictly by the coring group and will be sent on the attached schedule.

TD/Logging

1. Stage in hole with 8 ¾" rerun tricone
2. Drill 8 ¾" to TD at. 8,000'.
   Recommended BHA:
   - 5" drill pipe
   - 1- Stabilizer
   - 1- 8 ¾" re run tricone jetted with 18's

   Recommended Drilling Parameters:
   - 500 gmp
   - 25 klb WOB
   - 90 RPM
3. TOOH while strapping out of the hole.
4. RU SLB wireline to run the following logs;
   - PEX-HRLA P-Express w/HRLA
   - Litho Scanner for Advanced Mineralogy/ Total Organic Carbon
   - Xtreme Natural Gamma Ray Spectroscopy

Sidewall

1. RU XL-rock side wall coring equipment
2. We will run to bottom, pump tracer slug and begin taking cores in the designated locations following the attached schedule.
3. Once cores have been retrieved we will RU and run the following logs
   - Sonic Scanner for mechanical properties/shear velocity anisotropy analysis/completion plus/corehole compensated sonic
   - Fullbore high contrast dynamic imager/FMI

Plug back

1. TIH open ended to 10' above TD 8,000'and break circulation with brine.
2. Pump 10% excess of Class 'H' + 1.00% CD-32 + 0.70% SMS + 0.25% R-3 until equilibrium point is reached or TOC at 6,100'.
3. TOOH slowly to 6,100'.
4. Reverse circulate with brine and watch for cement returns.
5. RD down cement
6. Circulate SBM to displace WBM
7. Prepare rig for skid.

northeast NATURAL ENERGY

Northeast Natural

Borehole:	Well:	Field:	Structure:
ST01	MIP 3H	WV Monongalia County (NAD 83)	Patterson 254

Gravity & Magnetic Parameters

Model:	HDGM 2015	Dip:	66.866°	Date:	15-Jul-2015
MagDec:	-9.543°	FS:	52542.535nT	Gravity FS:	999.345mgn (9.80665 Based)

Surface Location NAD83 West Virginia State Plane, Northern Zone, US Feet

Lat:	N 39 36 6.42	Northing:	401656.6ftUS	Grid Conv:	-0.3037°
Lon:	W 79 58 34.04	Easting:	1834344.9ftUS	Scale Fact:	0.99994083

Miscellaneous

Slot:	MIP 3H	TVD Ref:	KB(1082ft above MSL)
Plan:	Northeast Natural MIP 3H ST01 Rev0 SLS 15Jul15		

Surface Location

Northing: 401656.6 Easting: 1834344.9 Latitude: N 39 36 6.42 Longitude: W 79 58 34.04 VSec Azimuth: 319.774

Target Description			Grid Coord						Local Coord	
Target Name	Shape	Dimension	Latitude	Longitude	Northing	Easting	TVD	VSec	N(+)/S(-)	E(+)/W(-)
MIP 5H East Curve 2	Polyline	N/A	N 39 36 6.60	W 79 58 34.15	401674.90	1834336.90	1082.00	19.14	18.30	-8.00
MIP 5H BHL Hardline	Polyline	N/A	N 39 36 6.60	W 79 58 34.15	401674.90	1834336.90	1082.00	19.14	18.30	-8.00
MIP 5H West Curve 2 Hardline	Polyline	N/A	N 39 36 6.60	W 79 58 34.15	401674.90	1834336.90	1082.00	19.14	18.30	-8.00
MIP 5H NE North Hardline	Polyline	N/A	N 39 36 6.60	W 79 58 34.15	401674.90	1834336.90	1082.00	19.14	18.30	-8.00
MIP 5H West Curve 1 Hardline	Polyline	N/A	N 39 36 6.60	W 79 58 34.15	401674.90	1834336.90	1082.00	19.14	18.30	-8.00
MIP 5H West Hardline	Polyline	N/A	N 39 36 6.60	W 79 58 34.15	401674.90	1834336.90	1082.00	19.14	18.30	-8.00
MIP 3H West Hardline	Polyline	N/A	N 39 36 6.42	W 79 58 34.04	401656.60	1834344.90	1082.00	0.00	0.00	0.00
MIP 5H East Curve 1 Hardline	Polyline	N/A	N 39 36 6.60	W 79 58 34.15	401674.90	1834336.90	1082.00	19.14	18.30	-8.00
MIP 3H East Hardline	Polyline	N/A	N 39 36 6.42	W 79 58 34.04	401656.60	1834344.90	1082.00	0.00	0.00	0.00
MIP 3H BHL Hard line	Polyline	N/A	N 39 36 6.42	W 79 58 34.04	401656.60	1834344.90	1082.00	0.00	0.00	0.00

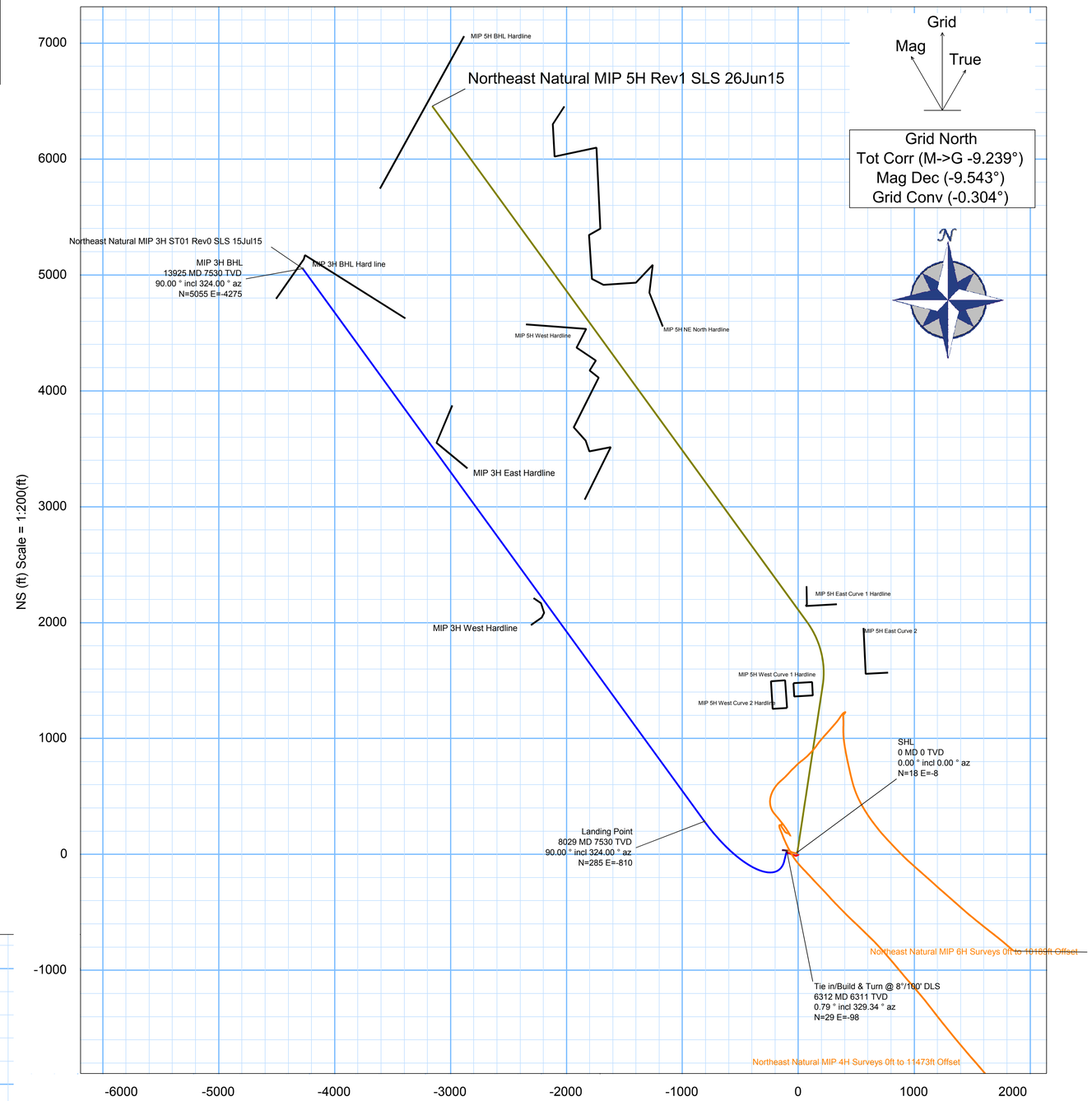
PART	Seq.	Survey Tool/ Survey Tool Code	Vendor/Tool	Hole Size (in)	Casing Size (in)	MD From (ft)	MD To (ft)	Survey Frequency (ft)	EOU Size (Semi Major) (ft)	EOU Size (Semi Minor) (ft)	Comments/ Contingency
1	1	SLB_NSG+MSHOT		17.5	13.375	0	530	Act Stns	1.87	1.34	
1	2	SLB_NSG+MSHOT		12.25	9.625	530	1770	Act Stns	5.24	2.99	
1	3	SLB_NSG+MSHOT		8.75	5.5	1770	6312	Act Stns	13.49	3.5	
1	4	SLB_MWD-STD		8.75	5.5	6312	13925.26	1/100	190.07	12.61	

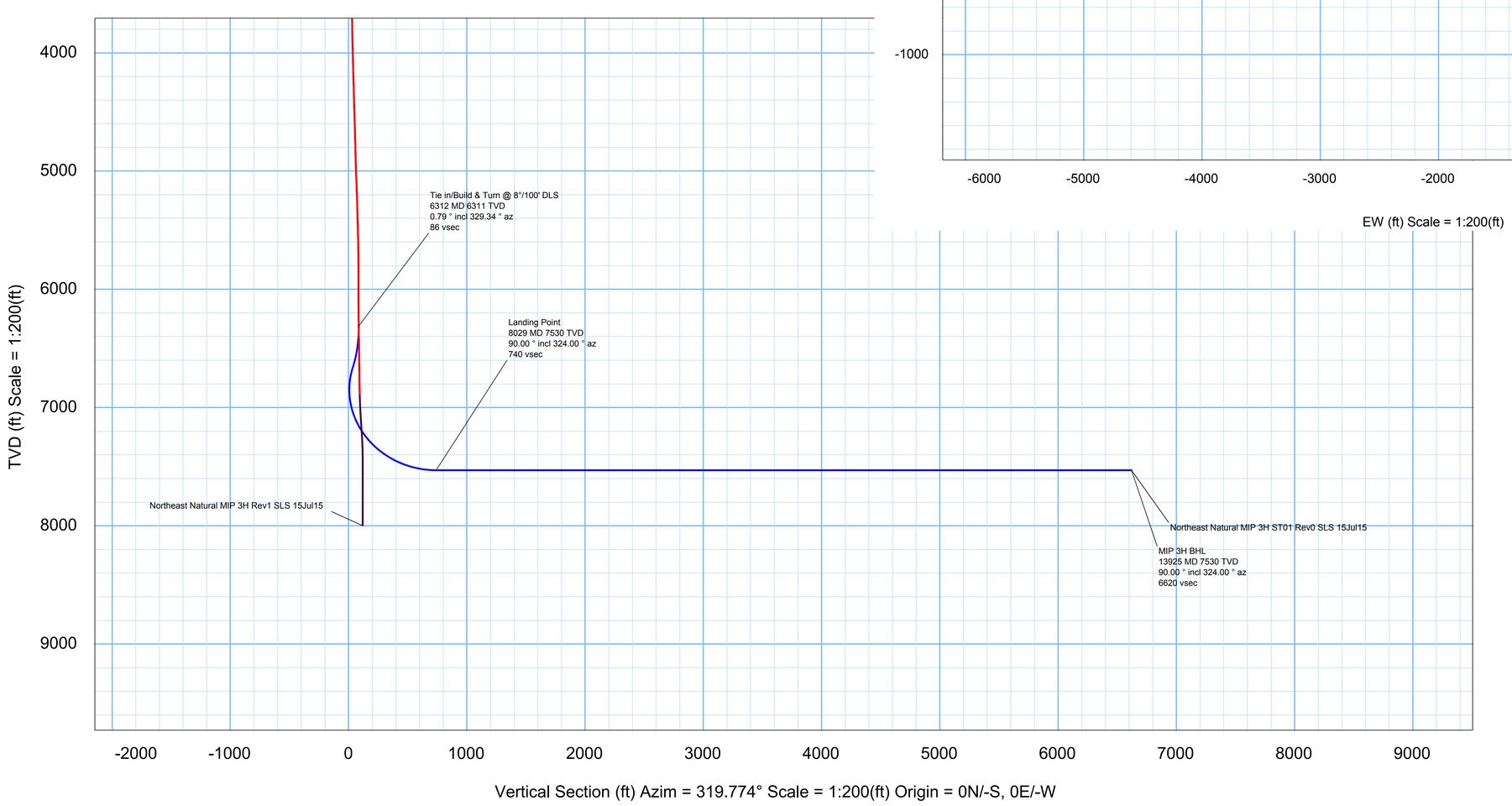
Critical Points

Critical Point	MD	INCL	AZIM	TVD	VSEC	N(+)/S(-)	E(+)/W(-)	DLS
Tie in/Build & Turn @ 8°/100' DLS	6312.00	0.79	329.34	6310.57	85.61	28.82	-98.49	
Landing Point	8029.26	90.00	324.00	7530.00	740.43	284.74	-809.88	8.00
MIP 3H BHL	13925.26	90.00	324.00	7530.00	6620.40	5054.71	-4275.46	0.00

From(ft)	To(ft)	Action
6312.00	6673.06	Curve 8.00°/100ft
		From inc 0.79° to 28.31°
		From Az 329.34° to 193.71°
		From 6310.57 ft TVD to 6657.39 ft TVD.
6673.06	6680.98	Drill Tangent
		Hold on inc 28.31°
		Hold on Az 193.71°
		From 6657.39 ft TVD to 6664.36 ft TVD.
6680.98	8029.26	Curve 8.00°/100ft
		From inc 28.31° to 90.00°
		From Az 193.71° to 324.00°
		From 6664.36 ft TVD to 7530.00 ft TVD.
8029.26	13925.26	Drill Tangent
		Hold on inc 90.00°
		Hold on Az 324.00°
		From 7530.00 ft TVD to 7530.00 ft TVD.

- Northeast Natural MIP 3H ST01 Rev0 SLS 15Jul15
- Northeast Natural MIP 3H Rev1 SLS 15Jul15
- Northeast Natural MIP 5H Rev1 SLS 26Jun15
- Northeast Natural MIP 5H Gyro+MWD 0ft to update
- Northeast Natural MIP 3H Gyro+MWD 0ft to update
- Northeast Natural MIP 6H Surveys 0ft to 10189ft Offset
- Northeast Natural MIP 4H Surveys 0ft to 11473ft Offset
- MIP 5H East Curve 2
- MIP 5H BHL Hardline
- MIP 5H West Curve 2 Hardline
- MIP 5H NE North Hardline
- MIP 5H West Curve 1 Hardline
- MIP 5H West Hardline
- MIP 3H West Hardline
- MIP 5H East Curve 1 Hardline
- MIP 3H East Hardline
- MIP 3H BHL Hard line





CONTROLLED

DEC	
Plan ref	Northeast Natural MIP 3H ST01 Rev0 SLS 15Jul15
Drawing ref	
Copy number	of 3
Date	16-Jul-2015

1	Drawn By	S. Shannon

Copy number for