THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED

KOROAMA-008 WELL CLEAN-UP/TEST PROPOSAL

September 2016

Well No	KOROAMA-008
Reservoir	KOROAMA-008 (E9000X and F1000X)
Estimated Duration	10 days
Cost	$2,238,293.41

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1.0 BACKGROUND

KOROAMA – 008

Koroama-008 is a gas development well that was drilled to provide drainage points on the E9000X and F1000X reservoirs and develop a total of 67.8 Bscf of gas and 1.9 MMstb of condensate at an initial combined production potential of 70 MMscf/d.

Table 1: Koroama 008 Volumes

Reservoir	Gas UR (Bscf) Base case	Condensate UR (MMbbl) Base case	Gas Rate (MMscf/day)
E9000	11.4	0.3	40
F1000	56.4	1.6	30

The well was spudded on the 6th of November 2013, drilled to a TD of 12,113 ftah (10,985 ftss), and completion operation ended on 23rd of June 2016.

The well penetrated the E9000 and F1000 sands at 10,690 ftss and 10,913 ftss, encountering a gross gas column of 62 ft and 72 ft tvd respectively. It was completed as a Single String Dual (SSD) SMART gas producer on the E9000X and F1000X gas reservoirs with both sands to be commingled through the 3-1/2" x 5-1/2" 13Cr tubing equipped with Interval Control Valves (ICVs), dual-sensor Permanent Down Hole Gauges (PDHGs), feed-through swell packer, HF1 production packer and Tubing Retrievable Surface-Controlled Subsurface Safety Valve (TRSCSSSV). Expandable Sand Screens (ESSs) combined with blanks and swell-able packers (for zonal isolation) were installed across the sand face for effective sand control.

Production started in the F1000 reservoir in July 2013 with Koroama-003 well. As at May 2016, the cumulative production from the reservoir was 59.35 Bscf. There is No production from the E9000X reservoir.

It is proposed to clean up the E9000X and F1000X intervals to 40 MMscf/d and 30 MMscf/d respectively to remove drilling and completion debris and fluids. Multi-rate test will be conducted a rate of 40 MMscf/d on the E9000X and 30 MMscf/d on the F1000X intervals.

1.1 Clean-Up/Test Objectives

The objectives of the well clean-up and test are as follows:

- Clean up the well to get rid of mud filter cake, completion fluids and debris.
- Confirm zonal isolation from pressure profiles of the dual PDHGs
- Conduct multi-rate test per interval for the wells:
    - KOMA008 (40 MMscf/d on E9000X and 30 MMscf/d on F1000X)
- To validate the promised well potential of about 70 MMscf for KOMA008
- Conduct Build up test to obtain data required for reservoir characterization

1.2 Justification

The well's objective is to provide gas to the Gbaran CPF as part of the wells delivering gas to the NLNG T1 – T6. The cleanup is required to remove any remaining fluid and debris (cuttings, dope, weighting agent etc.) resulting from both drilling and completion operations, which might lead to impairment, thus, resulting to a compromise of the well's potential and expected recovery. Results from the MRT will be used in updating the well models and evaluating the potential in combined production mode.

1.3 Work Summary

The high level summary of the clean-up/well test work scope is given as follows:

- Clean-up F1000X interval
- Clean-up E9000X interval
- Carry out MRT on F1000X interval
- Carry out MRT on E9000X interval

2.0 WELL CLEAN-UP DESIGN

Solids free oil based mud was used at the sand face for the lower completion. During the clean-up operation, a specially formulated oil mud breaker solvent system will be pumped through the ICV openings to dissolve the POBM in the tubing casing annulus. The treatment fluid would be injected to contact the ESS and dislodge any filter cake and mud left behind. All injected fluids would be flowed back after required soaking time is observed. The flow back well effluent (completion brine) will be evacuated with vacuum truck to the Gbaran Central Processing Facility (CPF) for disposal.

During the clean-up operation, the well should be flowed long enough to allow sufficient time to offload well on each bean while monitoring sand production (using sand monitors e.g clamp-on). After every bean change, sand trap will be purged for inspection of well effluents. If there is significant sand production (>0.5 lbs/MMscf), flow will be stopped pending review of operation. See Appendix 3D for detailed contingency plan. All produced hydrocarbon (gas & condensate) will be burnt via the flare pit.

Note: No Open trucking of condensate is permitted.

2.1 Clean-Up/Test Requirements

- Liquid knock out vessel
- Well Test Skid equipped with sand traps
- Clamp on sand monitors
- Surface Tanks - to receive initial well effluent (completion and kill brine, mud etc.)
- Coiled Tubing/Nitrogen
- Slick line
- Flare head burner (Compulsory requirement)
- Mono- Ethyl Glycol (To mitigate hydrates at low rates)

2.2 Well Clean-Up Operation

The well cleanup operation will follow the scope stated below. Clean-up parameters are not predictable; however, the Tables 2 and 3 below give a fair guide. Appendix 2 are snapshots from PROSPER showing a graphical display of the wellbore model results. The flow rates, WGR, sand production and FTHP will be measured and recorded to ensure adequate well clean-up until a stabilized FTHP and WGR ca. 0 bbl/MMscf is achieved. Thereafter, shut-in the well for 24 hours for the reservoir pressure to stabilize, prior to conducting the Multirate test.

2.3 Clean-Up Work Scope

KOROAMA – 008

- RIH CT, wash and displace tubing string to treatment fluid
- Cycle open F1000X ICV at 11,951 ftah and pump treatment fluid to dissolve POBM in tubing casing annulus as well as POBM filter cake in sand face.
- Cycle close F1000X ICV and allow treatment fluid to soak for required period.
- Cycle open E9000X ICV at11,420 ftah and pump treatment fluid to dissolve POBM in tubing casing annulus as well as POBM filter cake in sand face.
- Cycle close E9000X ICV and allow treatment fluid to soak for required period.

- Clean-up F1000X interval as per program (Table 2), pump nitrogen to lift the well if it does not flow naturally. Cycle close F1000X ICV after clean up.
- Clean-up E9000X interval as per program (Table 3), pump nitrogen to lift the well if it does not flow naturally. Cycle close E9000X ICV after clean up.

NOTE:

- Initial opening of well must be during daylight.
- Bean-up must be done gradually.
- Bean-up should be carried out when flow stabilizes. At each stage, record bean size, gas flow rate, FBHP, FBHT, estimated drawdown, FTHP, FTHT, CGR, WGR, and sand rate.
- Flow well until well is properly cleaned, not exceeding a specified maximum gas rate. Well is properly cleaned-up when at least 80% of expected FTHP is achieved on any bean shown in Tables 2 and 3 below
- All temporary pipe connections must be properly secured and tested to expected pressures

KOMA008 Clean-up: F1000X

The clean-up of F1000X interval will commence from choke 22/64th, however the interval will be gradually beaned up in steps. Due to unexpanded ESS on this interval, a 10 minute flow period should be observed at each change in variable bean size to allow for sand production monitoring.

Table 2: KOMA008 F1000X Well Clean-up Guide

Expected Bean Size (1/64th)	Estimated Rate (MMscf/d)	Assumed WGR (bbl/MMscf)	Expected FTHP (psia)	Flow Period (hr)	Expected Drawdown (psi)	Comments
22	10	0	2964	2*	6	Take sample, check for sand, measure FTHP
28	15	0	2945	2*	10	Take sample, check for sand, measure FTHP
32	20	0	2952	2*	13	Take sample, check for sand, measure FTHP
40	30	0	2906	4**	19	Take sample, check for sand, measure FTHP

* Stabilized flow on each bean
**Recommended flow period however well to be flowed on this bean until clean-up criteria is achieved.

Clean up criteria

Stabilized THP for 1 hour
BSW </= 5%
Tolerance Qg: ± 5 MMscf/d, Tolerance FTHP: ± 20 psia

KOMA008 Clean-up: E9000X

The clean-up of E9000X interval will commence from choke 22/64th (Note bean should be very gradually increased for each change in bean size).

Table 3: KOMA008 E9000X Well Clean-up Guide

Expected Bean Size (1/64th)	Estimated Rate (MMscf/d)	Assumed WGR (bbl/MMscf)	Expected FTHP (psia)	Flow Period (hr)	Expected Drawdown (psi)	Comments
22	10	0	3261	2*	60	Take sample, check for sand, measure FTHP
34	20	0	3168	2*	146	Take sample, check for sand, measure FTHP
40	30	0	3088	2*	243	Take sample, check for sand, measure FTHP
48	40	0	2944	4**	286	Take sample, check for sand, measure FTHP

* Stabilized flow on each bean
**Recommended flow period however well to be flowed on this bean until clean-up criteria is achieved.

Clean up criteria
Stabilized THP for 1 hour
BSW </= 5%
Tolerance Qg: ± 5 MMscf/d, Tolerance FTHP: ± 20 psia

3.0 MULTI-RATE TEST AND FLOWING/BUILD-UP/SG SURVEY

3.1 Initial Build-up Period

- Close each interval with the ICV for 24 hours for an initial build-up after well clean-up to allow for reservoir stabilization prior to multirate test. Record CITHP.
- Monitor surface read-out of SBHP for pressure stabilization before proceeding to MRT. Also KOMA003T which is producing from the F1000X reservoir should be shut-in to minimize interference.

3.2 Flowing Period

- Open up each interval to carry out multi-rate test. See Tables 4 and 5 below for guide on production parameters during the flow period, for each interval.

Table 4: KOMA008 F1000X MRT data

Expected Bean Size (fixed choke) (1/64th	Estimated Rate (MMscf/d)	Assumed WGR (bbl/MMscf)	Expected FTHP (psia)	Flow Period (hr)	Expected Drawdown (psi)	Comments
22	10	0	2964	4	6	Take sample, check for sand, measure FTHP
28	15	0	2945	4	10	Take sample, check for sand, measure FTHP
32	20	0	2952	4	13	Take sample, check for sand, measure FTHP
40	30	0	2906	4	19	Take sample, check for sand, measure FTHP
-	0	-	-	24	0	Build-up

Table 5: KOMA008 E9000X MRT data

Expected Bean Size (fixed choke) (1/64th	Estimated Rate (MMscf/d)	Assumed WGR (bbl/MMscf)	Expected FTHP (psia)	Flow Period (hr)	Expected Drawdown (psi)	Comments
22	10	0	3261	4	60	Take sample, check for sand, measure FTHP
34	20	0	3168	4	146	Take sample, check for sand, measure FTHP
40	30	0	3088	4	243	Take sample, check for sand, measure FTHP
48	40	0	2944	4	286	Take sample, check for sand, measure FTHP
-	0	0	-	24	0	Build-up

Bean up should be carried out when flow stabilizes and FTHP & BSW are stable for at least 1 hour.

- At each choke, collect and analyze sample every 15 minutes, record gas flow rate, FTHP, FTHT, CGR, WGR, and sand rate.
- After the last flow period, shut in well for build-up as specified in the Table 7 (Final Buildup duration determined from section 4.0).
- The pressures will be recorded with the PDHG.

4.0 SAPHIR TEST DESIGN

The focus of the test design is to determine the duration of the flow and optimal build up time, such that there is appreciable amount of data to enable the determination of reservoir properties (Permeability-height product-kh, skin, etc) and possible existence and nature of any boundary(ies)/discontinuity(ies) (fault/Baffles/GWC).

Kappa's Ecrin Saphir Software was used in this design. The models were built based on the well and reservoir data as detailed in Table 6. Pressure simulations were generated based on the wells intervals potentials of Tables 4 and 5. The generated pressure responses were subsequently analyzed using derivative plots to determine the time taken for the pressure perturbations to be felt at the possible boundaries and also achieve stabilization of 0.01 psi/hr (as seen in SAPHIR). Various scenarios (sensitivities) were built to test what the pressure response would be given the uncertainties in permeability, and skin. These sensitivities were collectively analyzed, and the optimal test time selected.

4.1 Input Data

The test design input data are as detailed in the table 4 below:

Table 6: Test Design Input Parameters

Parameter	KOMA008 (F1000)	KOMA008 (E9000)	Comment
a. Reservoir Data			
Pay Zone Thickness (ft)	115	62	Based on well data
Average Formation Porosity (frac)	0.24	0.21	Based on well data
Formation Compressibility (1/psi)	3.32E-06	3.32E-06	Estimated using Hall correlation.
Reservoir Pressure (psia)	4027	469	RCI/MBAL
Reservoir Temperature (F)	185	172	Based on well data
Reservoir Permeability (mD)	1280	613	Mean reservoir permeability calculated from FZI analysis using logs acquired from Wells
b. Well Data			
Well Orientation	Vertical	Vertical	
Well Radius (ft)	0.35	0.35	Hole size
Well bore Storage (WBS) Coefficient (bbl/psi)	0.059	0.050	Estimated using the total volume of fluids expected in the wellbore if the shut-in was carried out at the surface.
c. Fluid data			
Fluid Type	Gas	Gas	
d. Others			
Reservoir Model	Homogeneous		
Wellbore Model	Constant storage		
Boundary Model	Based on structure		
Modelling Approach	Numerical		To capture complexities (fault count and orientation) in the reservoir structure.

4.2 Scenario/Sensitivity Formulation

PERMEABILITY:

The permeability values used in this design were based on FZI analysis which utilizes the porosity logs acquired from the well. A minimum, most likely and maximum values derived from logs have been used in the design.

BOUNDARY MODEL:

The TOP structure Map (Appendix 5) was digitized and used in the design. A review of the structure shows that the reservoir is fault/dip bounded. The respective reservoir configurations formed the basis for digitizing of each the reservoir maps. There were generally no intra reservoir faults, the outer boundary to be seen by the well pressure responses will likely be the boundary faults.

SKIN:

No data was available to evaluate the possible skin values that may exist in reality. However actual skin values were obtained from MRT of producing wells in the field.

WELLBORE STORAGE:

Wellbore storage coefficients were estimated for surface shut in at the wellhead. The well test design was carried out using these well bore storage values. From the derivative plot generated in this test design, this wellbore storage effect (where the well is shut-in at surface), will not mask the reservoir pressure response. However, PDHGs are available in the wells and the production intervals would be shut in at the sand face using ICV. As a result the wellbore storage is expected to be minimal.

Given the above, the scenarios as shown in Figure 1 and 2 below were simulated and the generated pressure responses analyzed.

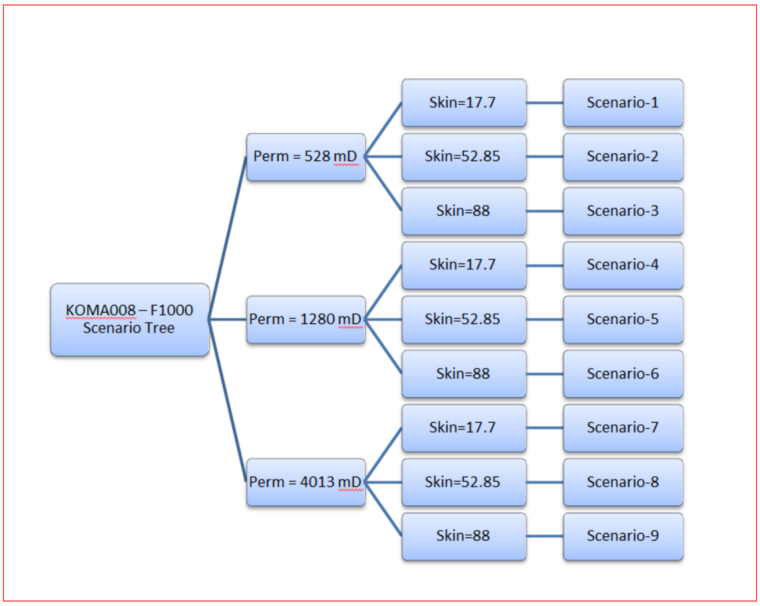


Figure 1: KOMA008 (F1000X) Scenarios

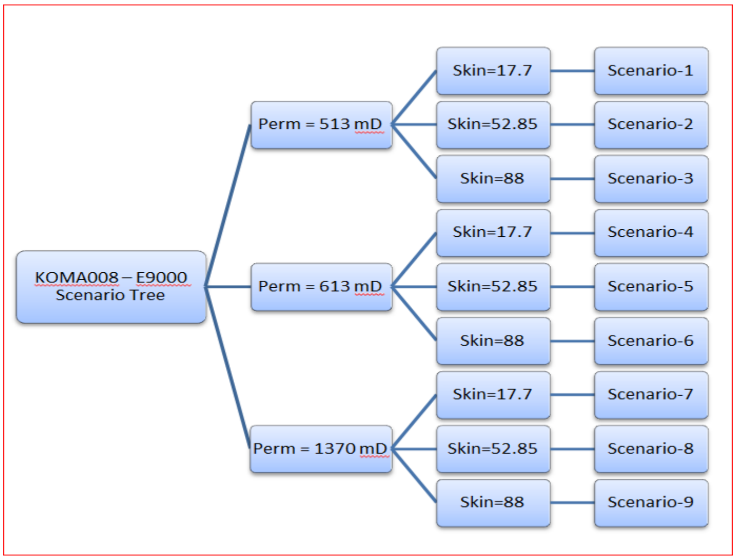


Figure 2: KOMA008 (E9000X) Scenarios

4.3 ANALYSIS

Numerical method was used in the test design. The top structure map was digitized and imported into the design model. This ensures that the structural configuration of the reservoir is captured adequately, accounting for the details often approximated in the analytical method.

Simulated pressure responses were generated for the test design using 4-hourly four stepped rates (see Tables 4 and 5).

The derivative plots for the different scenarios can be seen in figures 3 and 4. From the figures, the following can be deduced

1. The variation in the skin values will not result in any significant distortion to the expected reservoir behaviour and no impact on the time to the outer boundary from the test.
2. The late time pressure response indicated an outer boundary primarily dominated by mainly parallel fault boundary effect for various permeability cases.
3. The estimated build-up duration for KOMA008 intervals are about 24 hours each. A summary of the optimal durations for the production interval build-up are shown in Table 7.

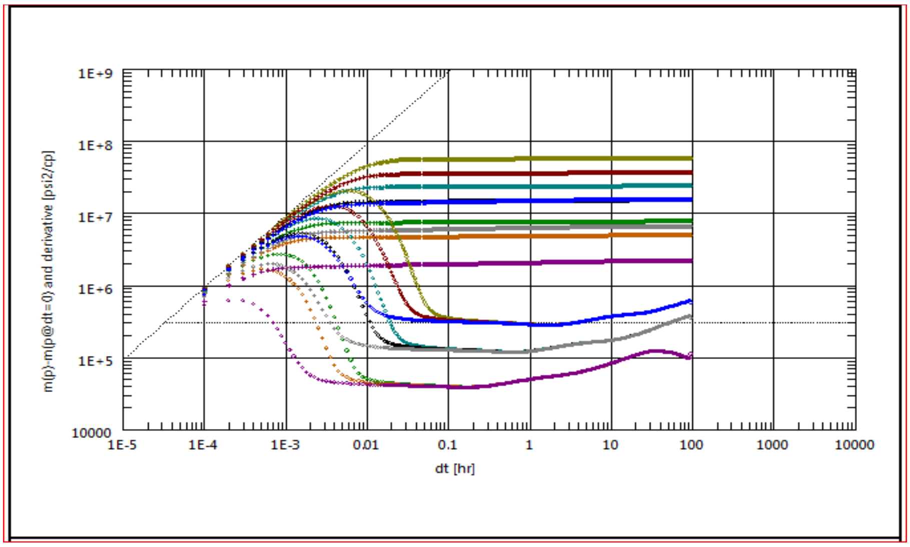


Figure 3: Log-Log plot for KOMA008 (F1000X) Sensitivities

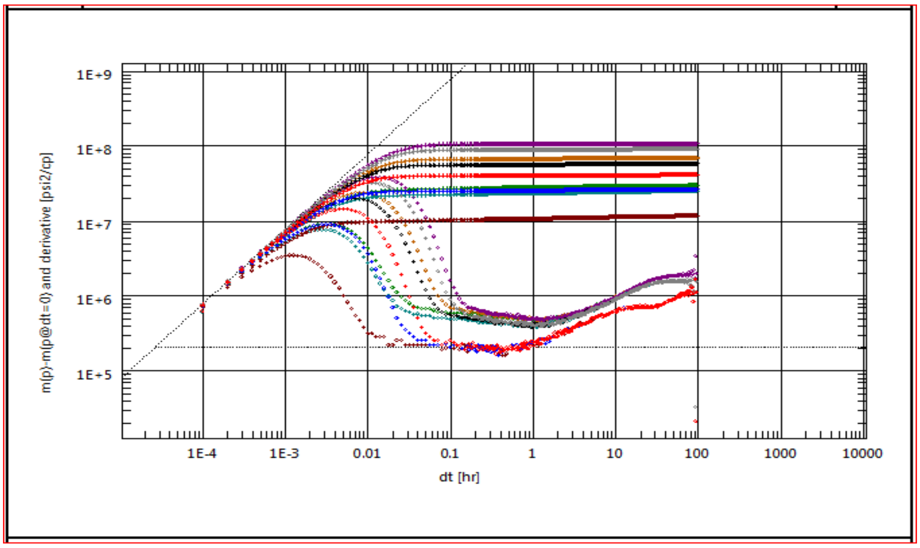


Figure 4: Log-Log plot for KOMA008 (E9000) Sensitivities

The optimal time for the final build-up was selected based on the need to ensure that the objectives of the test are achieved regardless of the scenario experienced during the actual test. The optimal test time selected is as detailed in the table below.

Table 7: Optimal Test Timing

Scenario	Initial Buildup (Pre Test) Hrs	1st Flow Period Hrs	2nd Flow Period Hrs	3rd Flow Period Hrs	4th Flow Period Hrs	Final Build Up (Time to boundary) Hrs	Total Time Hrs
KOMA008: F1000	24	4	4	4	4	24	64
KOMA008: E9000	24	4	4	4	4	24	64

5.0 MRT WORKSCOPE SUMMARY

The summary of the MRT work scope for each interval is given as follows:

- After well clean-up, shut-in interval for 24 hours for initial reservoir stabilization
- Open up interval and conduct Multirate test (Tables 4 and 5)
- Shut in well for specified number of hours for final build-up test (Table 7).
- Secure well.
- RD equipment.

6.0 SUPERVISING PERSONNEL

Full time representatives from SPDC, made up of Completion/well test Supervisor and Land East Asset team Production Technologist or Reservoir Engineer will be on site. This is to ensure the well is properly cleaned prior to the Multi-rate test and that acquired data are of top quality and meet the objectives of the clean-up/well test operations.

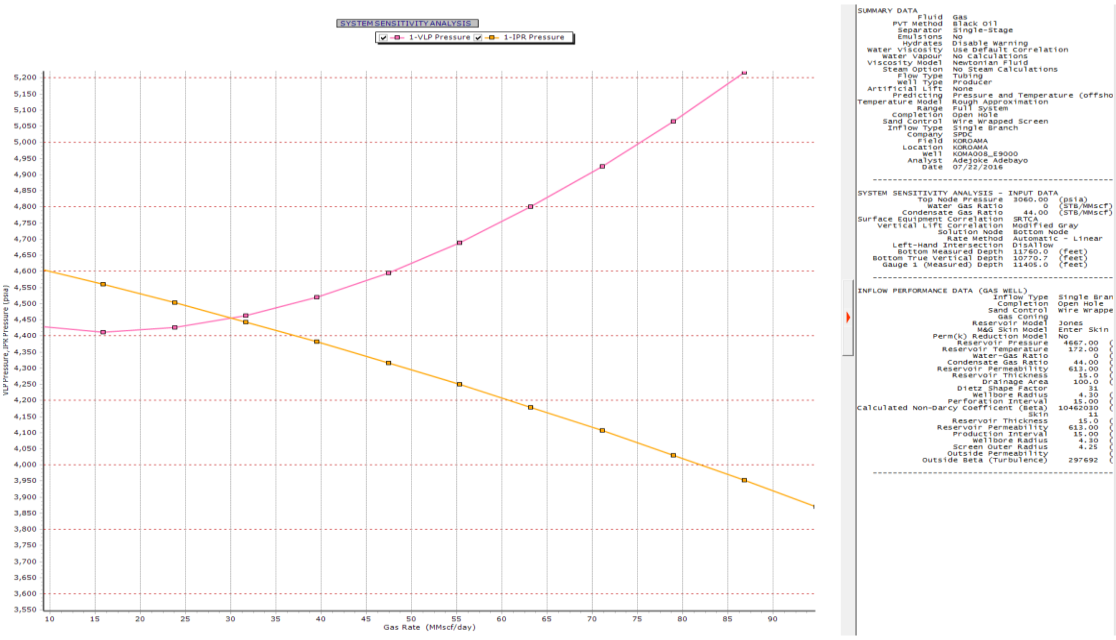
APPENDIX 1: RESERVOIR & COMPLETION DATA

KOROAMA – 008 Reservoir and Completions

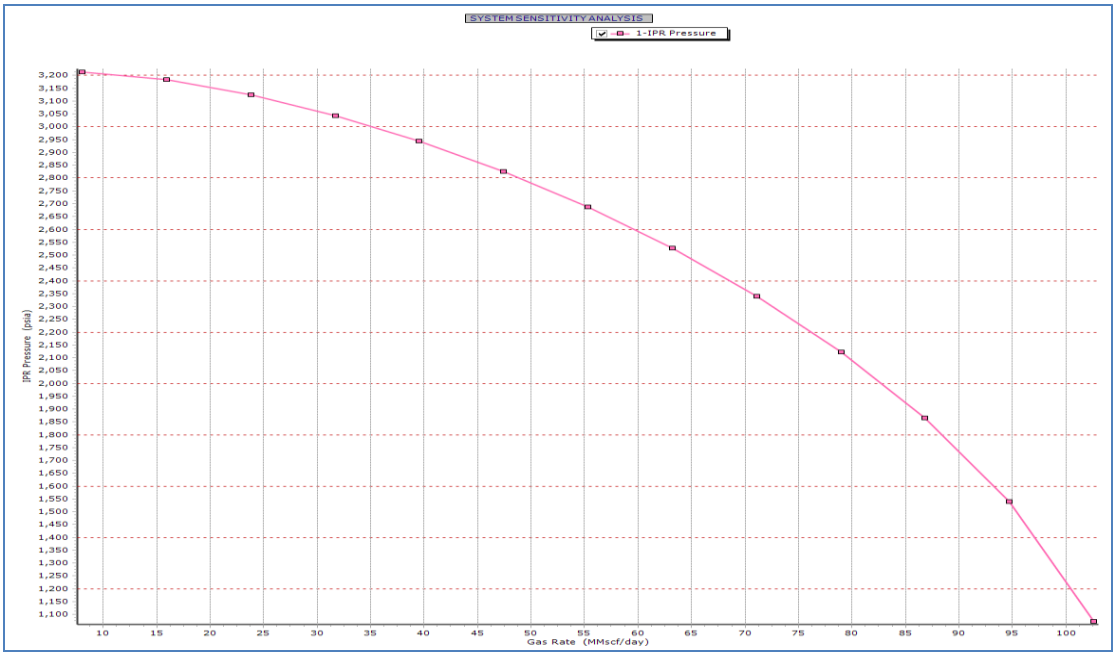
Target Reservoir	E9000X	F1000X
1. Casing size and Type	$9\text{-}^{5}/_{8}$''/Production casing	
2. Casing Setting Depth (ftah)	11,752	
3. Top of Sand [ftss/ftah]	10,696/ 11,748	10,913 / 12,204
4. Gross Sand Thickness (Gross) penetrated by Koroama-008(ft tv)	62	72
5. Well TD (ftss/ftah)	10,985/ 12,113	
6. a) Completion interval (ftss) b) Completion interval (fttv) c) Completion interval (ftah)	10,700 – 10,715 11,760 – 11,780	10,920 – 10,982 12,033 – 12,109
7. Length of Completion Interval (ftah)	20	76
8. a) Top of competent cement (ftah) b) Source of data	6,486 CBL	
9. a) Was hole directionally drilled? b) Max deviation angle and depth (ftah)	Yes 37.770 @ 8,259	
10. Deviation at completion zone	37.37	
11. a) Original reservoir pressure @ datum depth (psia) b) Datum Depth (ftss) c) Present reservoir pressure (psia) @ datum d) Reservoir Temperature (deg F) e) Top of Sand (ftss) f) Reservoir Pressure @ Top of Sand (psia)	4,696 10,793 4,696 (KOMA010 RCI) 172 10,690 4,667	4,827 11,014 4,599 (MBAL) 185 10,913 4,117
12. Did RCI indicate abnormal pressures?	No	No
13. Pressure gradient @ top of sand (psi/ft)	0.437	0.377
14. a) Is the reservoir fully gas-bearing?	No	Yes
15. a) Is there original GWC in the reservoir b) What depth (ftss)? c) Change in PGWC from original OGWC(ft)	Yes 10,745 (GWC) N/A	No 11,108 (GDT) 11,110 (WUT) N/A
16. Distance between lowest completion interval and estimated GWC in well / reservoir (ftss), ref GDT	30	N/A
17. Gas S.G. (air=1)	0.74	0.66
18. Condensate gravity (API)	45.9	44
19. Expected FTHP (psia)	3150	2893
20. Expected CITHP (psia)	3210	2940
21. Expected Drawdown (psi)	139	20
22. Is sand exclusion installed?	Yes OHESS	Yes OHESS

APPENDIX 2: WELL PERFORMANCE PLOTS

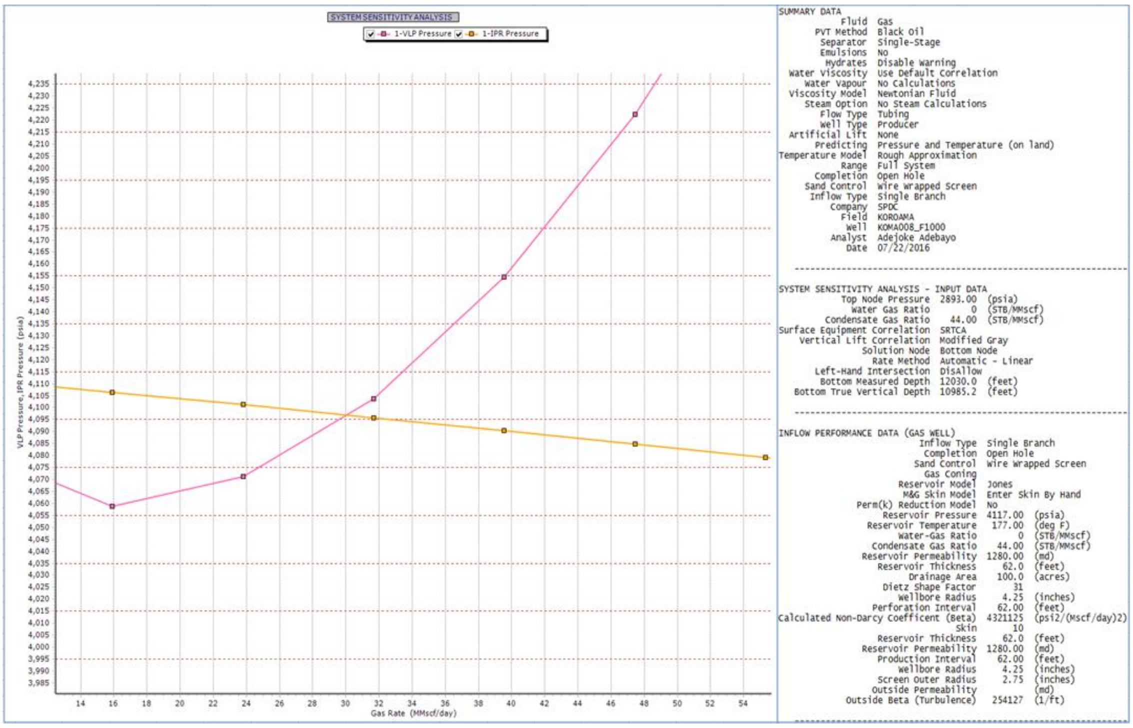
KOROAMA 008 E9000 MRT Well Performance



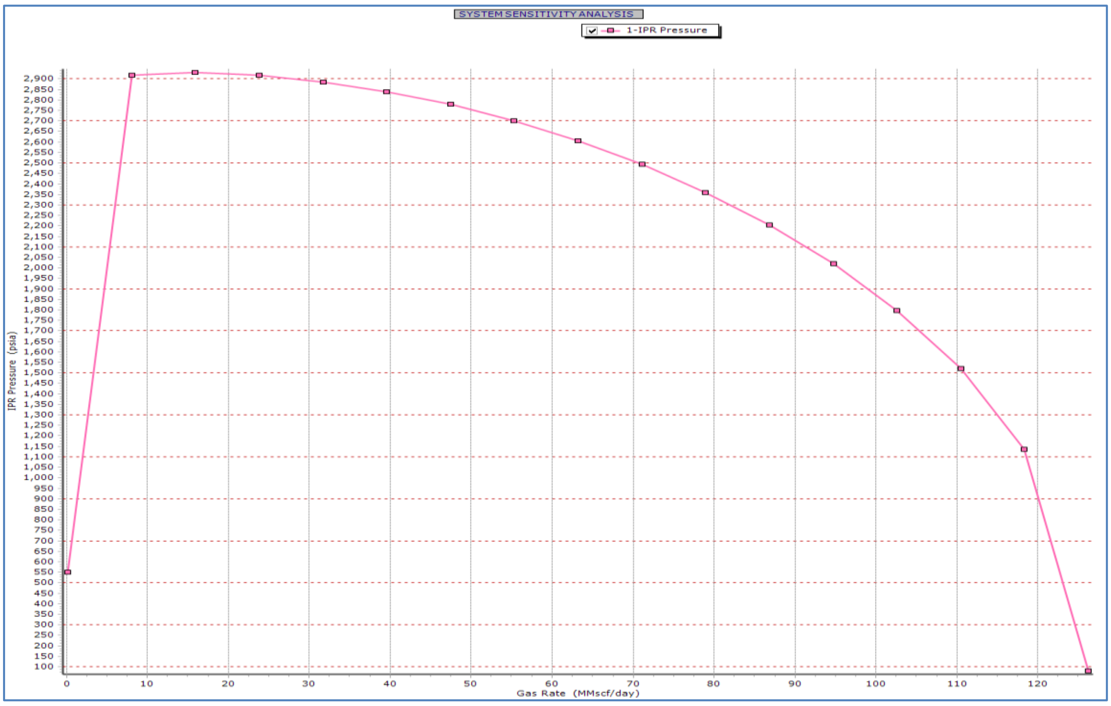
KOROAMA 008 E9000 P-Q Curve



KOROAMA 008 F1000 MRT Well Performance



KOROAMA 008 F1000 P-Q Curve



APPENDIX 3A: CRITICAL WELL TEST OPERATIONS RISKS/MITIGATION

Risk/Description	Consequence	Likelihood / Impact (L/M/H)	Mitigation
Inappropriately sized coiled tubing tools	Downhole components/tools may not get to desired depths	L/M	Ensure the dimensions of the tools to be RIH are appropriately sized for 3-1/2" tubing accessories/profiles ID
Emergency to spill, loss of containment	Loss of order, injury, fatality, loss of equipment	L/H	Ensure presence of 3-barriers at all time during clean-up/MRT operations. Also ensure all HAZID actions are closed-out prior to commencing operation
Hydrocarbon under pressure from kick or blowout	Explosion, loss of containment, injury, fatality and environmental pollution	L/H	Check integrity of the valves on the wellhead and WRSCSSV are integrity. Install surface readout gauges to monitor pressures and ensure BOP for the coil tubing unit is fully functional
Corrosive cleaning chemicals	Corrosion, environmental contamination.	L/H	Confirm that Nitrogen for lifting is tolerated by tubing/casing material.

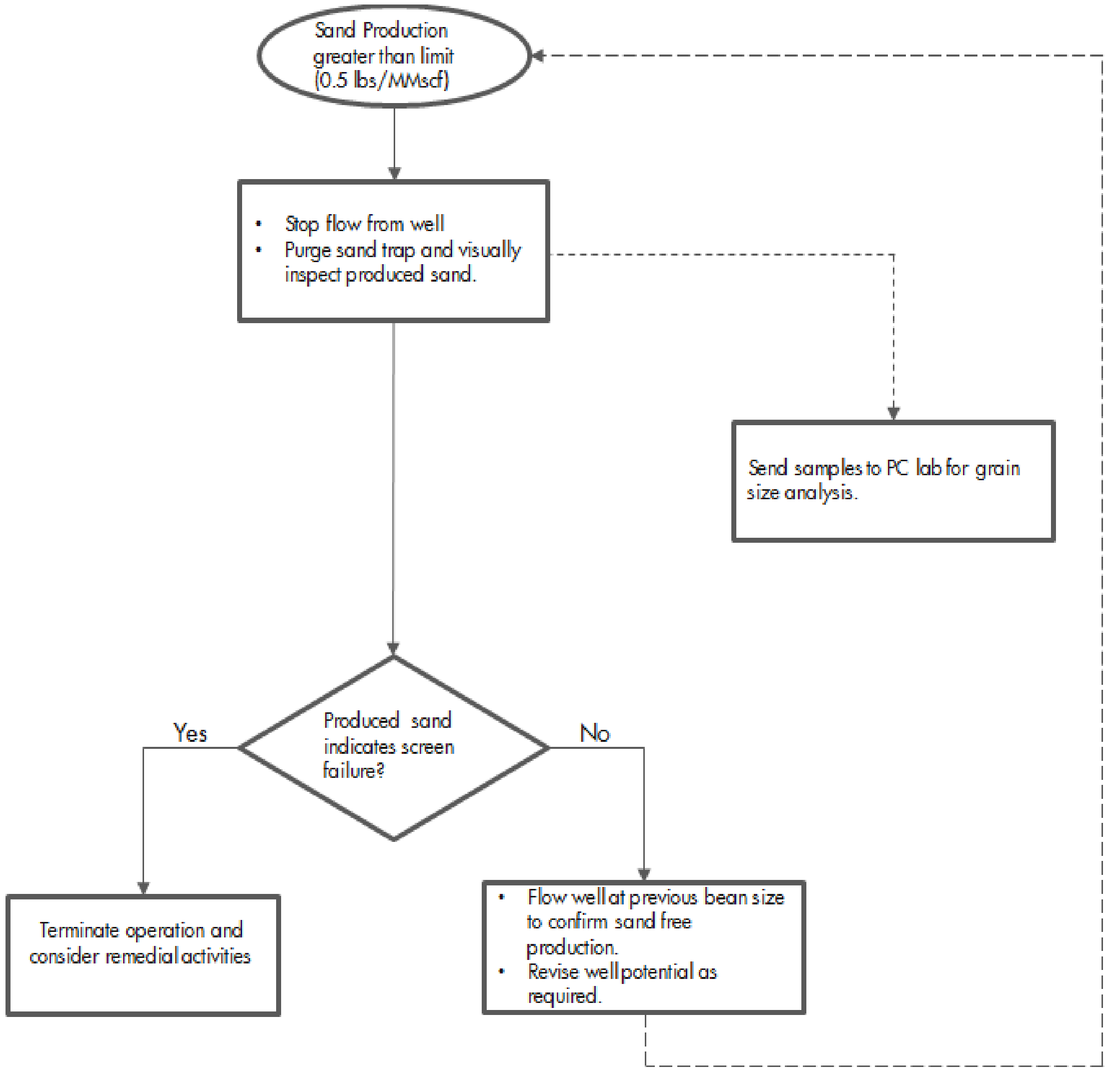
APPENDIX 3B: GAS WELL TEST RISKS/MITIGATION

Risk	Consequence	Mitigation
Hydrate Formation	Blocked tubulars, increased pressure, blow-out, injury, and fatality.	Glycol will be injected at low gas rates to combat possible hydrate formation. At gas high rates, tubing temperatures are high enough to combat hydrate.
Noise (Flare)	Damage to personnel eardrum, partial or permanent deafness.	Certified earplugs to be worn by personnel on site.
Radiation/Heat	Unconducive work environment, environmental degradation (loss of economic trees, scotching of flora, fauna migration & death).	Conduct pre-well test modelling of wind flow and speed for optimal location of flare boom. Wear appropriate personal protective equipment at all times in the location. Mobilize water-spraying machines to reduce impact of heat radiation.
Corrosion	Compromised well integrity, uncontrolled emission, harm to flora & fauna population, loss of well, injury, fatality, loss of reputation.	13%Cr, completion material eliminates the need for corrosion inhibitor injection. Also wellhead have stainless steel clads.
Fire Source	Fire outbreak, injury, and loss of equipment, fatality.	Barricade work area, prohibit use of cell phone & smoking around well's perimeter fence, restrict movement of unauthorized persons around work area.
Night Operations	Poor emergency response, damage to asset, injury, fatality	Obtain night operation approvals, Deploy Emergency Shut Down (ESD) system. Appoint competent Night operations Supervisor.
Emergency	Loss of order, injury, fatality, loss of equipment.	Presence of 3-barrier containment Emergency Shut Down (ESD) system for wellhead, wellsite & test skid. Adopt MOPO (Manual of Permitted Operations) specifying when operations should be stopped if hazard mitigation is not being met. Emergency phone contact will be displayed on site.
Temporary pipe work failure	Uncontrolled flow of hydrocarbon into the environment	Ensure all temporary pipe works are properly secured and tested

APPENDIX 3C: DEP Table

DEP	Title	Remarks	Accountable DP
25.80.10.10-Gen	Formation Pore Pressure, Fracture Gradient (PP/FG) and Borehole Stability Prediction.	No drilling activity would be carried out during the operation	RE/PP
25.80.10.11-Gen	Formation Tops, Fault Intersections and Fluid Fill Prediction.	Well already drilled and cased off. Formation tops and fluid prediction were done prior to drilling.	PG
25.80.10.12-Gen	Prepare and Maintain Data in Support of Well Emergencies.	The data to support well emergencies are stored in SharePoint. (See Link) Worst case discharge for KOMA008 is estimated at 700 MMscf/d	PT/WE
25.80.10.14-Gen	Geohazard Assessment for Onshore Exploration, Appraisal and Development.	No geohazard risk. Well is already completed.	PG
25.80.10.15-Gen	Design Logging Program.	No logging operation is planned	PP
25.80.10.18-Gen	Hydrogen Sulphide Prediction for Produced Fluids from New and Existing Wells in Oil and Gas Fields.	H_2S Prediction carried out and signed off. Please refer to Appendix 8.	PG/PT
25.80.10.19-Gen	Sand Failure Assessment for Wells to be Completed and Produced.	Sand failure assessment has been done as an input to the Well proposal. Well has been completed with OHESS installed for sand control. Sand monitoring would be done during the well test.	PT

APPENDIX 3D: Sand production contingency plan



APPENDIX 4: Koroama-008 Final Completion Status Diagram

KOROAMA 8 (EX-TBUV-3) COMPLETIONS SCHEMATIC

CASING

SIZE	GRADE	WT (lbs/ft)	DEPTH (ft)	CEMENT	Conn	
24"	Stove Pipe		3500	Driven		Stovepipe
13-3/8"	K55	68	5,800	Class G	SLX	Surf Csg
9-5/8"	N80	47	8,240	Class G	SLX	Prod Csg

WELLHEAD (Surface Metal Seal 6 ported System)

ITEM	TYPE	SIZE	WP
XMAS TREE	Compact	7-1/16" x 11" Flange block x 4-1/16" outlet	5,000 psi
TREE CAP	Cameron	7-1/16" c/w 4-1/16" Bore	5,000 psi
GATE VALVE	Cameron	7-1/16" c/w 4-1/16" Bore	5,000 psi
ACTUATOR VALVE	Cameron	7-1/16" c/w 4-1/16" Bore	5,000 psi
TUBING HANGER	Cameron	7-1/2" 6 Single Ported w/CL & PDHG Prep	5,000 psi
STARTER HEAD (CHH)	Cameron	13-3/8 x 13-5/8"	5000 psi
WELLHEAD HOUSING	Adapter spool	13-5/8" X 13-3/8"	5,000 psi
GATE VALVE	Cameron	2-1/16" c/w 2.060" Bore	5,000 psi

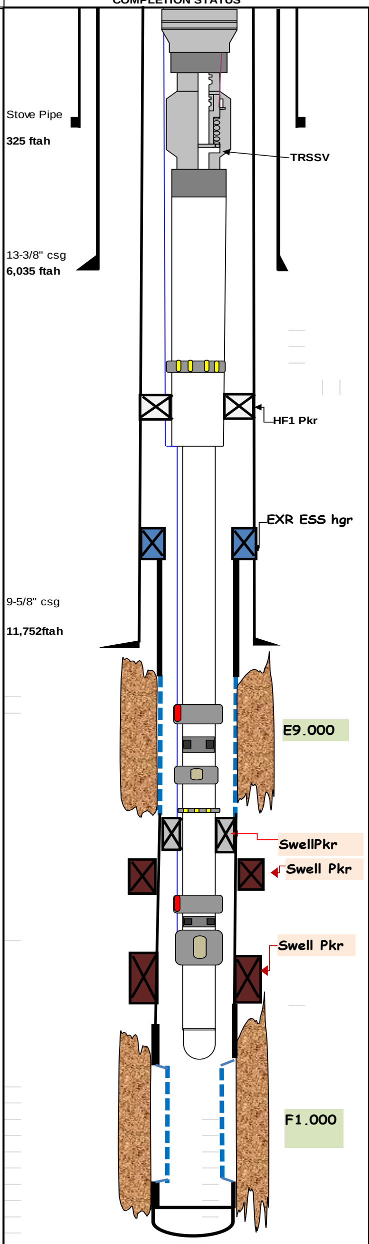
TUBING

STRING	SIZE	WT.	GRAD.	TYPE		
					MAX Deviation:	37.9°
					RT - Top XMT =	
	3-1/2"	9.3#	N80	HCS	DFE (RT - Compact Housing)= 28.80ft	
	5-1/2"	17#	N80	HCS	XMT =	

HOLE	DESCRIPTION	RESERVOIR
	CHESS/SMART Completions	E9.000 & F1.000

Drill-in Fluid Type / Properties	POBM (10.0ppg) 0.52psi/ft	Max inclination 37.9deg @ 6,268ftah
Completion Fluid Type / Properties:	KCl Brine (0.48 psi/ft)	
Gas Pressure Gradient / Pressure:	0.705 sg/0.45psi/ft	

SAND | COMPLETION STATUS

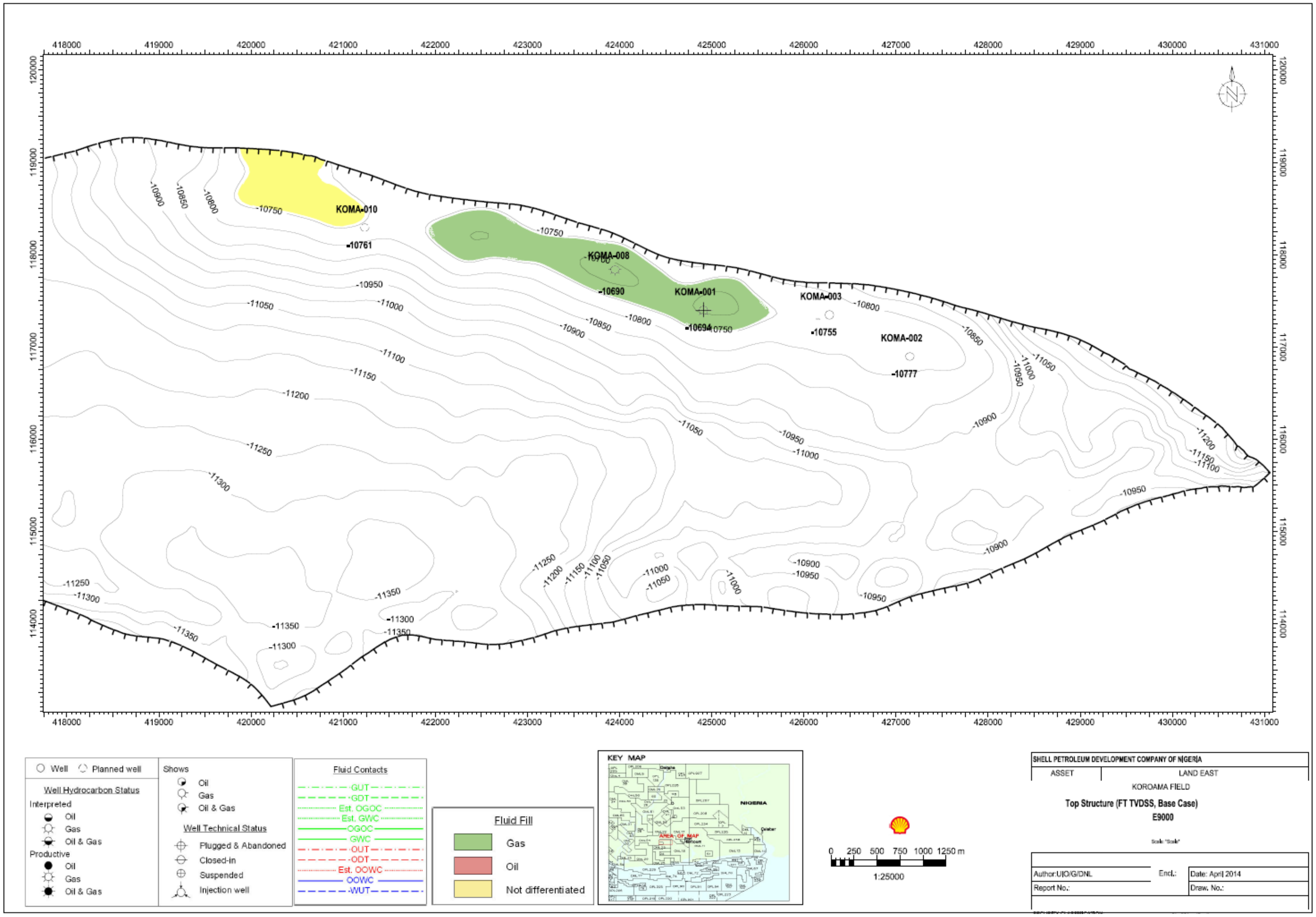


Top Depth	Length	O.D.	I.D.	DESCRIPTION
	34.66			Elevation
34.66	1.01	13.38	6.184	7" x 13-3/8" 5k psi prep for 6 ported Tubing Hanger
35.67	0.82	7.000	4.892	Crossover sub 7" 29# X5-1/2" 17# L-80 Hydri, 563 pin x pin
36.49	6.31	6.050	4.892	Pup Joint; 5-1/2" 17# L-80 Hydri,563 box x pin
42.80	105.00	6.050	4.892	**3 Joints**; 5-1/2" 17# Hydril,563 N-80 tubing
147.80	6.49	6.050	4.892	Pup Joint; 5-1/2" 17# L-80 Hydri, 563 box x pin
154.29	5.71	6.083	4.840	Flow Coupling, 5-1/2" 17" Hydril, 563 Box x Pin
160.00	8.31'	7.690	4.582	**TRSV; SP 5-1/2" x 4.562" Seal Bore. 7.69" Max OD 13Cr H2S Service. 5-1/2" 17# TSH563**
168.31	5.74'	6.083	4.840	Flow Coupling, 5-1/2" 20" Hydril 563 Box x Pin
174.05	3.98'	6.050	4.892	Pup Joint; 5-1/2" 13Cr 20# FJE box x pin
178.03	11,185.69	6.050	4.892	295 Joints; 5-1/2" 20# 13Cr L-80 FJE Bear tubing & 2jts H563
11,363.72	10.25	6.050	4.892	5 1/2" Pup Joint TSH 563 box x pin
11,373.97	2.01	6.050	3.812	Adapter Sub; 5-1/2" 17# TSH 563 Box x 4-1/2 12.6#Vam Top Pin
11,375.98	1.20	6.050	3.812	Adapter Sub, 5 1/2" 17# Vamtop Box X 4 1/2" Vamtop pin
11,377.18	15.02	8.440	3.812	**HF-1 Packer, 9 5/8" 47#, 5- 1/2" 17# VAM top Box x Pin.**
11,392.20	1.04	4.250	2.992	Adapter Sub; 4-1/2 12.6#Vam Top Box x 3-1/2" 9.3# TSH 563 Pin
11,393.24	6.10	4.250	2.992	Pup Joint Joint 3-1/2" 17# TSH 563 Pin x Pin,
11,399.34	3.95	4.250	2.992	Pup Joint 3-1/2" 9.3# TSH 563 Box x Pin,
11,403.29	1.20	4.250	2.992	Adapter Sub; 3-1/2 9.3# TSH 563 Box x3-1/2" 9.3# Hydril CS Pin
11,404.49	6.62	5.226	2.949	**Permanent Monitoring Gauge Integrations, 3 1/2 OD, 9.30 lb/ft TUBING WEIGHT**
11,411.11	1.14	4.250	2.992	Adapter Sub; 3-1/2 9.3# Hydril CS Box x 3-1/2" 9.3# TSH 563 Pin
11,412.25	1.38	3.970	2.750	**Landing Nipple ,2.813,R,13CR,3 1/2-9.20 TSH 563,Box x Pin**
11,413.63	4.06	4.250	2.992	Pup Joint 3-1/2" 9.3# TSH 563 Pin x Pin,
11,417.69	2.17'	4.250	2.992	Pup Joint 3-1/2" 9.3# TSH 563 Pin x Pin,
11,419.86	1.13'	4.250	2.992	Adapter Sub; 3-1/2" 9.3# TSH 563 Box x 3-1/2 9.3# Vam Top Pin
11,420.99	**11.25**	5.865	2.750	**VALVE, HS, 3-1/2,10.20 VAMTOP BOX, 3 1/2-10.20 VAMTOP PIN,**
11,432.24	1.13'	4.250	2.992	Adapter Sub; 3-1/2" 12.6# Vam Top Box Box x 3-1/2 9.3# TSH 563 Pin
11,433.37	3.98'	4.250	2.992	Pup Joint 3-1/2" 9.3# TSH 563 Box x Pin
11,437.35	375.05	4.250	2.992	**Tubing Joint, 3-1/2" 9.3# TSH 563 Box x Pin (12 Joints)**
11,812.40	6.05	4.250"	2.992"	Pup Joint 3-1/2" 9.3# TSH 563 Box x Pin
11,818.45	1.33	4.260"	2.915"	Adapter Sub;3-1/2 9.3# TSH 563 Box x 4-1/2" 12.6# Vam Top Pin
11,819.78	3.14	4.945"	3.958"	Pup Joint 4-1/2" 12.6# VamTop Box x Pin
11,822.92	**39.56**	**6.380"**	**3.958"**	**Halliburton FT Swell Packer 7 5/8 in., 24-29.7 lb/ft Weight Range Vam Top**
11,862.48	3.14	4.945"	3.958"	Pup Joint 4-1/2" 12.6# VamTop Box x Pin
11,865.62	1.24	4.250"	2.992"	Adapter Sub; 4-1/2 9.3# Vam Top Box x 3-1/2" 9.3# TSH 563 Pin
11,866.86	4.19	4.250"	2.992"	Pup Joint 3-1/2" 9.3# TSH 563 Box x Pin
11,871.05	62.45	3.915	2.920	**Tubing Joint, 3-1/2" 9.3# TSH 563 Box x Pin (**
11,933.50	4.07'	4.250"	2.992"	Pup Joint Joint 3-1/2" 9.3# TSH 563 Pin x Pin,
11,937.57	1.21'	4.250"	2.992"	Adapter Sub; 3-1/2 9.3# TSH 563 Box x3-1/2" 9.3# Hydril CS Pin
11,938.78	**6.63**	**5.226"**	**2.949"**	**Permanent Monitoring Gauge Integrations, 3 1/2 OD, 9.30 lb/ft**
11,945.41	1.10'	4.250"	2.992"	Adapter Sub; 3-1/2 9.3# Hydril CS Box x 3-1/2" 9.3# TSH 563 Pin
11,946.51	1.91'	4.250"	2.992"	Pup Joint Joint 3-1/2" 9.3# TSH 563 Pin x Pin,
11,948.42	1.73	3.922	2.750	Pup Joint Joint 3-1/2" 9.3# TSH 563 Pin x Pin,
11,950.15	1.13	3.915	2.920	Adapter Sub; 3-1/2" 9.3# TSH 563 Box x 3-1/2 9.3# Vam Top Pin
11,951.28	**11.24**	**3.915**	**2.920**	**VALVE, HS, 3-1/2,10.20 VAMTOP BOX, 3 1/2-10.20 VAMTOP PIN,**
11,962.52	1.15	4.250	2.992	Adapter Sub; 3-1/2" 12.6# Vam Top Box Box x 3-1/2 9.3# TSH 563 Pin
11,963.67	3.78	5.865	2.992	Pup Joint Joint 3-1/2" 9.3# TSH 563 Pin x Pin,
11,967.45	6.32	4.250	2.992	Pup Joint 3-1/2" 9.3# TSH 563 Box x Pin
11,973.77	0.70	4.250	2.992	Bull Plug Assembly; 3-1/2" 9.3# TSH 563 Box x Pin, Alloy 80
11,974.47				**End of upper completion Tubing**
			LOWER COMPLETIONS ESS ASSY	
11,540.88	5.17	8.130	7.375	**PBR**
11,546.05	**6.24**	**8.400**	6.800	**Cardium EXR 7-5/8" x 9-5/8 " Hanger**
11,552.29	9.76	7.625	6.875	Pup 7-5/8" 29.7# Vam FJL box x pin
11,562.05	189.77	7.625	6.875	7-5/8" 29.7# Vam FJL box x pin Spacer Tubing (6jts)
11,751.82	5.74	7.625	6.875	Pup 7-5/8" 29.7# Vam FJL box x pin
11,757.56	2.90	8.681	6.805	5-1/2" Mark II ESS ETC, 230 micron with 7 5/8" 29.7# FJL box x MKII pin
11,760.46	**19.74**	**8.681**	**7.381**	**5-1/2" E.S.S Mark II, ESS 230 micron with ESS MKII box x pin**
11,780.20	3.21	8.681	6.805	5-1/2" Mark II ESS EBC, 230 micron with ESS MKII box x 7 5/8" 29.7# FJL pin
11,783.41	19.74	7.625	6.875	7-5/8" 29.7# Vam FJL box x pin Spacer Tubing (**20ft pup**)
11,803.15	**18.74**	**8.681**	**6.640**	**7 5/8" 29.7# Hybrid Swell Packer with 7 5/8" 29.7# FJL box x pin**
11,821.89	189.78	7.625	6.875	7-5/8" 29.7# Vam FJL box x pin Spacer Tubing (5jts)
12,011.67	**18.74**	**8.681**	**6.640**	**7 5/8" 29.7# Hybrid Swell Packer with 7 5/8" 29.7# FJL box x pin**
12,030.41	2.90	8.681	4.805	5-1/2" Mark II ESS ETC, 230 micron with 7 5/8" 29.7# FJL box x MKII pin
12,033.31	**75.32**	**8.681**	4.805	**5-1/2" E.S.S Mark II, ESS 230 micron with ESS MKII box x pin**
12,108.63	3.22	8.681	4.805	5-1/2" Mark II ESS EBC, 230 micron with ESS MKII box x 7 5/8" 29.7# FJL pin
12,111.85	1.15	7.625		7-5/8" Bull Nose with 7 5/8" 29.7# FJL box
12,113.00				

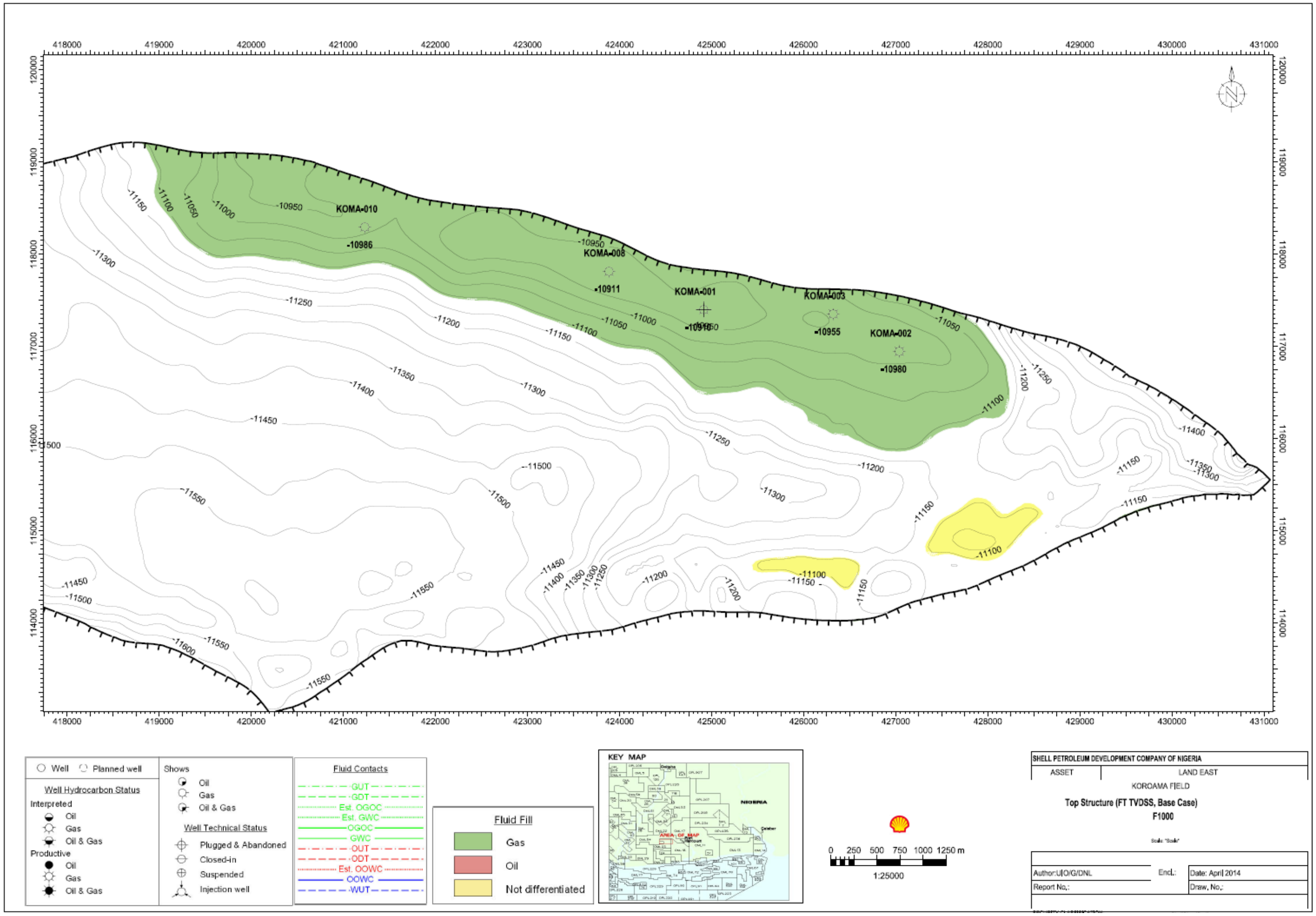
TD	12,113ftah	AUTHOR: Chuka Ofulue PTW/O/NG	DATE COMPLETED:	26-Jun-16

APPENDIX 5: Top Depth Map of the KOMA008 E9000X & F1000 sands

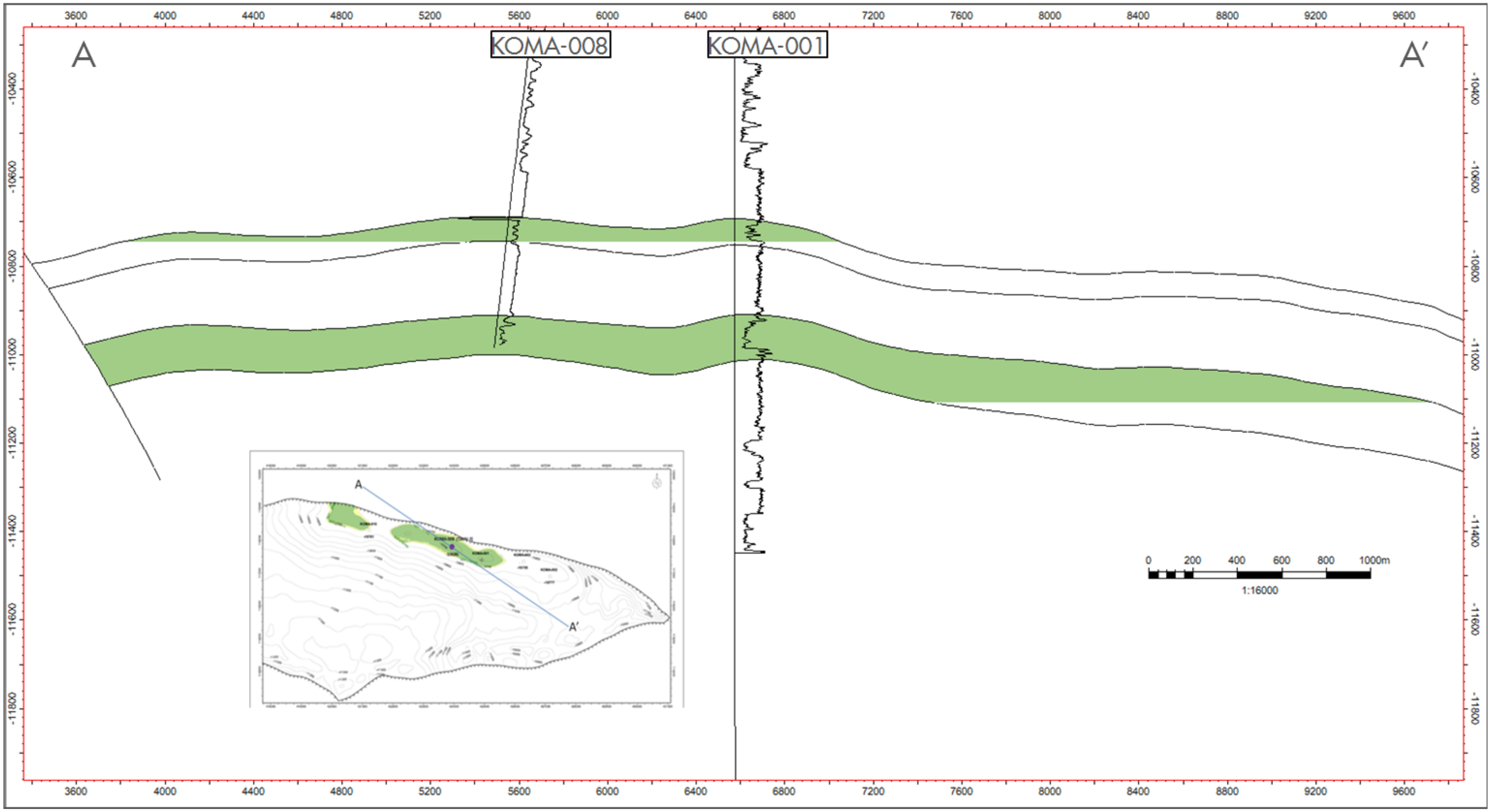
Top Depth Map of the KOMA008 E9000X sand



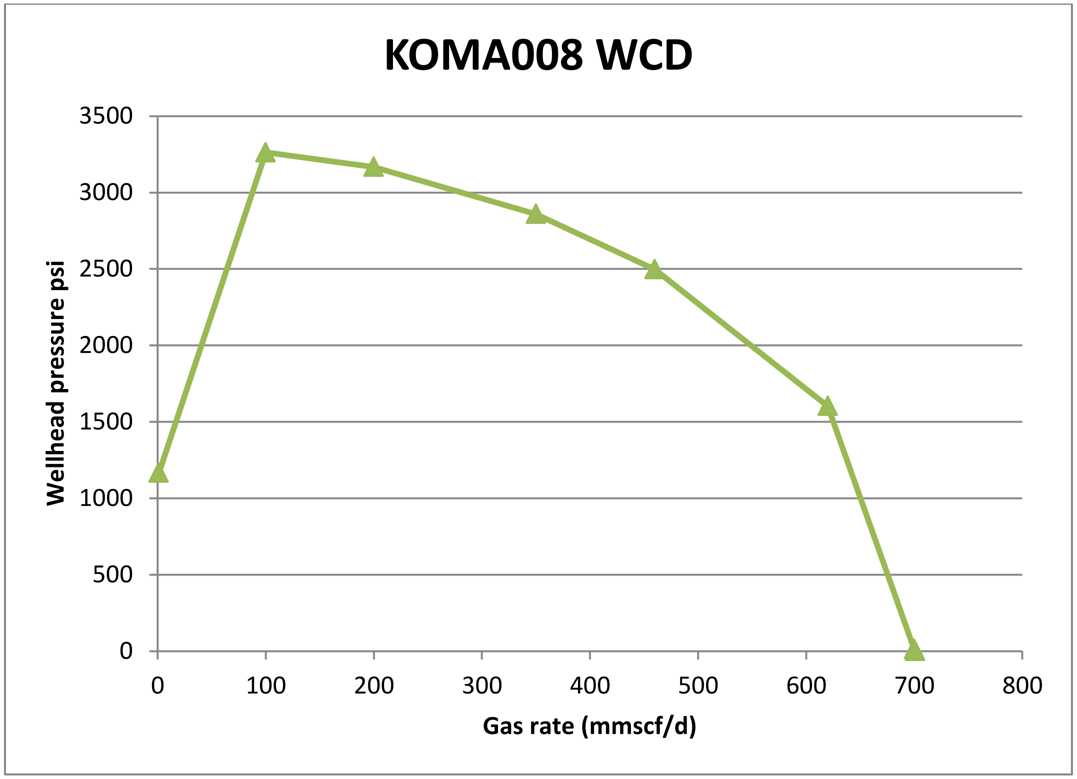
Top Depth Map of the KOMA008 F1000X sand



APPENDIX 6: Cross section along KOMA008 well path



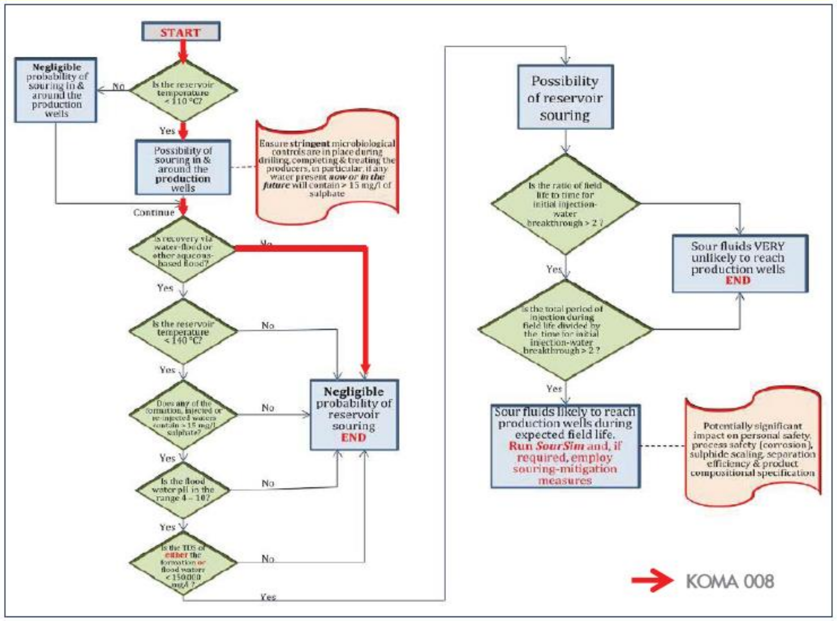
APPENDIX 7: Worst Case Discharge plot for KOMA008



APPENDIX 8: KOMA008 H_2S Prediction

KOMA 008 H_2S PREDICTION (E9000 AND F1000)

- KOMA008 is planned to be completed on E9000 and F1000.
- PVT data available for C9400, D6000, E7000 and F1000 reservoirs indicate no presence of H_2S.
- There is no PVT data available for E9000, however D7000, E1000 and F1000 reservoirs are currently producing with no H_2S production recorded.
- Production Operations and Production Chemist have not encountered H_2S in the Gbaran nodal area.
- Expected Reservoir Temperatures in E9000 and F1000 are 78°C and 81°C respectively
- No water-flood is planned for the field
- Hence, the souring potential is negligible.
- Gas testers and appropriate PPE's will be utilized during completion and well open up as additional mitigation.



Prepared by: Adejoke Adebayo, Somtochi Nwandu	Approved by:		
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	Digitally signed by cosmas. nwankwo@shell.com DN: cn=cosmas. nwankwo@shell.com Date: 2016.05.25 15:31:50 +01'00'	Nkonyeasu a Oghene Digitally signed by Nkonyeasua Oghene Date: 2016.05.25 15:27:34 +01'00'	NLI5UGBC Digitally signed by NLI5UGBC DN: cn=NLI5UGBC Date: 2016.06.01 15:15:09 +01'00'

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Date: 5/5/2016 1