

**Horse Hill Developments Ltd**  
**Horse Hill-1 (LR/24-4)**  
**Extended Well Test Application - Supplemental Information**

**Introduction**

Per our WONS extended well testing (EWT) application, Horse Hill Developments Ltd (HHDL) is seeking OGA’s consent for a further EWT of the Horse Hill-1 (HH-1) well. This document provides supplemental information, namely:

- HH-1 test intervals, Portland test programme, Kimmeridge Limestone(s) test programme and testing operations sequence.

**Test Programme Objectives**

The primary objective of each of three tests is to establish that a minimum commercial volume of oil in place (OIP) is connected to each of three previously tested oil pools. To estimate connected OIP volumes a measurable pressure drop under steady state flow conditions must be achieved. Currently the plan aims to achieve a pressure drop of around 10-15 psi, i.e. large enough to be unambiguous but small enough to avoid dropping below the bubble point pressure to avoid free gas within the reservoir that may complicate any estimate of total system compressibility. The steady state pressure drop therefore requires a minimum volume of oil to be produced.

It should be noted that in order to obtain steady state flow conditions the well will be significantly choked back to below the flow rate that could be achieved during future sustainable production. The tests and outline flow rates are designed to minimise the amount of free gas in the system of each oil pool, i.e. keep the area surrounding the well bore above bubble point pressure.

**Base Case Test Sequence**

The overall base case testing programme, consist of 3 separate tests of three “independent” reservoirs/oil pools, namely:

- Test 1: Portland Sandstone conventional reservoir
- Test 2: Kimmeridge Limestone 4 - naturally fractured reservoir
- Test 3: Kimmeridge Limestone 3 - naturally fractured reservoir

Table 1 below shows the base case test intervals:

**Table 1: HH-1 Well Test Intervals**

Horse Hill-1		MD (ft)	TVD (ft)	TVDSS (ft)
<b>Test 1 Portland</b>	Top perf			
	Base perf			
<b>Test 2 KL4</b>	Top perf			
	Base perf			
<b>Test 3 KL3</b>	Top perf			
	Base perf			

Each test will utilise existing perforations. However, the programme includes provision for re-perforation and re-acidising should the need arise. To minimise possible formation damage, any re-acidising will likely utilise organic acids (i.e. acetic/citric), not hydrochloric acid.

Total duration of the three base case tests is estimated at around 180 days, in line with planning permission from Surrey County Council. The total duration includes mobilisation, demobilisation, time to remove the three well suspension plugs, time to run and pull each of completions, time to kill each test zone and re-suspend the well using suspension plugs.

**Portland Test**

The test currently aims to determine a contacted OIP of between [redacted] barrels within the Horse Hill fault block and around [redacted] barrels directly connected to the HH-1 well. Given the current assumption of around 8% primary recovery this would equate to a recoverable volume of around [redacted] barrels from HH-1. Total duration is envisaged at 50 days to include shut-in periods (Table 2 below). The well will be produced via a linear rod pump (LRP). Pressures and temperatures will be measured by high-resolution gauges within each completion zone and by a further surface read-out (SRO) gauge.

Concept and methodology:

- 
- 
- 
- 
- 
- 
- 

Table 2 below, illustrates the current outline testing sequence, flow rates, shut in periods and associated durations. It should be noted that this is an outline plan and may be modified dependent on the data gathered from the initial two short duration flow and shut-in periods.

**Table 2: Outline Portland Test**

Portland																			
Rate - bopd	Duration - hours	Cum. Production - bbo																	
█		█	See above...																
█		█	buildup to check reservoir parameters																
█		█	extended production to prove up [redacted]. This flow period will likely include a maximum rate above Bubble Point Test.																
Cumulative hours																			
Cumulative Days																			

**Kimmeridge Limestones, KL3 and KL4 Tests**

Two separate tests will be conducted within the KL3 and KL4, again utilising existing perforations. The overall methodology is per the Portland test, i.e. designed to establish the OIP connected to HH-1. The current aim is to establish a connected volume in excess of [redacted] barrels contained within a connected natural fracture system.

The programme will also seek to answer the following key questions from the 2016 tests:

- Are KL3 and KL4 connected via a fracture system away from the wellbore?

- Can KL3 and KL4 be commingled as one zone? If so, what is a sustainable flow rate?
- Why is there a difference in PI between KL3 and KL4 zones? Is it that KL4 was cleaned up via acidisation, or that KL3 was damaged due to longer acid residency?

Each KL test will follow the concept and methodology, below:

- 
- 
- 
- 
- 
- 
- 

Table 3 below, illustrates the current outline testing sequence, flow rates, shut in periods and associated durations. It should be noted that this is an outline plan and may be modified dependent on the data gathered from the initial two short duration flow and shut in periods.

**Table 3: Outline KL3 and KL4 Test Sequence**

KL3 and KL4 zones - *PER* ZONE TEST PLAN - PLUS Potential Additional Co-mingled Flow.			
Rate - bopd	Duration - hours	Cum. Production - bbo	
█		█	Get initial pressure
█		█	See above....
█		█	
█		█	
█		█	
Cumulative hours			
Cumulative Days			

Downhole gauges may be left in place as part of the well-suspension programme – this will be decided towards the end of the sequence of tests. The aim of such monitoring is to understand gravitational effects to help refine estimates of System Compressibility and possible interference testing with regional KL wells e.g. Bradford Bridge-1, Brockham, Balcombe.

**Contingent Programme**

Dependent on achieving the primary testing objectives within the time allowed under planning consent, one or more short duration contingent tests may be undertaken to include one or more of the following zones:

- Test 4: a commingled test of KL3 and KL4. If sufficient time we plan to produce from one KL completion zone and monitor the pressure in the other completion zone
- Test 5: a new short duration test of the previously untested deeper KL2 and or KL1 zones, similar in duration/scope to the early Portland/KL3 and KL4 flow periods

**Base Case Extended Well Test Operations Sequence:**

Figure 1, below illustrates the current status of HH-1, i.e. as left following well testing in 2016. Note that the test zones are as labelled in 2016. The Portland is test zone 3, KL4 test encompasses zones 2/2a and KL3 zone 1.

**Figure 1: 2016 HH-1 Test Intervals**



**Planned Portland test operations:**

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.
- 17.
- 18.

**Kimmeridge Limestone test operations (for each of KL3 and KL4):**

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.

Depending on the results of the flow tests, a decision will be made on whether to run a dedicated suspension string.

**Additional works may include:**

- 1.
- 2.
- 3.