Existing Wells Assessment

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Executive Summary

As part of the FEED study on the Hewett field CO_2 injection and storage project, a review of the existing wells was conducted, based on the available data.

The review showed that 28 platform wells penetrate the Lower Bunter reservoir. 7 sidetracks were drilled from some of these existing wells to target other reservoirs. This results in a total of 35 legs drilled through the Lower Bunter, 11 of which were continued into the Zechsteinkalk / Rotliegendes.

The wells were assessed for possible conversion into CO_2 injectors and it was concluded that they were unsuitable as injectors due to various integrity concerns. It was also concluded that all the wells will need to be abandoned with CO_2 inert materials to ensure integrity through the field life-cycle.

It was recommended that further studies be carried out to evaluate the various well abandonment options. [M5]

Nomenclature

Variable	Meaning
"	inch
API	American Petroleum Institute
Atm	Atmosphere
bara	Bar absolute
bbl	Billion barrels
BHIP	Bottomhole Injection Pressure
BHIT	Bottomhole Injection Temperature
BRT	Below Rotary Table
Bscf	Billions of standard cubic feet
BVW	Bulk Volume of Water
Bw	Formation volume factor of water
C	Centigrade
Cb	Bulk compressibility
CCS	Carbon Capture Storage
CMG	Computer Modelling Group Ltd.
CO2	Carbon dioxide
Cr	Chrome
CSMA	Advanced Multi-reference Fluid Corresponding States Model
D	Fault displacement
deg	Degrees
ECD	Equivalent Circulation Density
EMW	Equivalent Mud Weight
F	Fahrenheit
FG	Fracture Gradient
ft	Feet
ID	Inside Diameter
ISO	International Organization for Standardization
K	Permeability
lb	Pound
LWD	Logging While Drilling
m	Metres
MD	Measured Depth
MM	Millions
OBM	Oil Based Mud
PBTD	Primary Bore Total Depth
Perfs	Perforations
Pp	Pore Pressure
ppg	Pounds per gallon
psi	Pounds per square inch
psia	Pounds per square inch absolute
psig	Pounds per square inch gauge
TD	Total Depth
TOC	Top Of Cement
TOL	Top Of Liner
TVDss	True Vertical Depth Subsea (MSL or LAT)
WBHIT	Well Bottomhole Injection Temperature
WEG	Wireline Entry Guide
WHIP	Wellhead Injection Pressure

1 Scope and Functional Requirements

The depleted Lower Bunter sandstone gas reservoir of the Hewett field is targeted as a storage site for CO_2. The Hewett field also has or had production from the Upper Bunter sandstone, the Zechsteinkalk, and the Leman sandstone reservoirs. The function of this report is to examine the current status of all the wells which penetrate the Hewett Bunter reservoirs, to assess their potential for re-use, and to assess their potential to provide migration paths between formations and potential leakage paths for release of CO_2 outside the storage complex. This report also looks at methods of remediation and mitigation of the risk of CO_2 leakage.

1.1 Scope

- Review of all existing wells penetrating the Hewett reservoirs
- Preliminary assessment of potential for re-use
- Assessment of potential to provide migration/leakage pathways
- Review of methods for blocking migration/leakage pathways
- Ability to remediate by engineering methods
- Possible mitigation methods for migration/leakage pathway risks

1.2 Related Project Documents

Interdependent reports are as follows:

KCP-RDS-CRE-REP-1008	Assessment of Engineered Integrity [M3]
KCP-RDS-CRE-REP-1009	Risk Assessment and Remediation Options [M4]
KCP-RDS-CWE-REP-1009	Well Abandonment [M5]

2 Input Data

2.1 Field Stratigraphy and General Casing Scheme

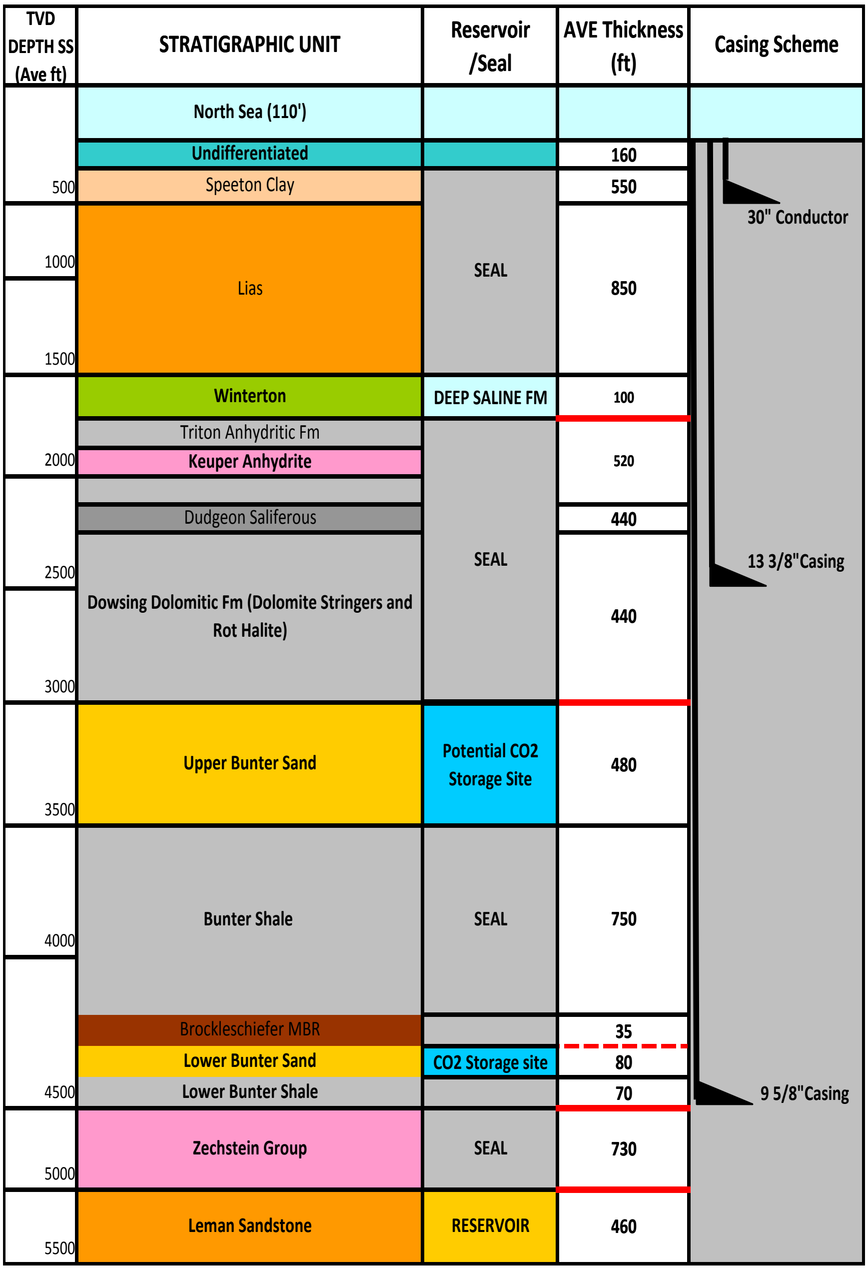


Figure 2-1: Generalised Stratigraphic Column of the Hewett Field

Figure 2-1 shows the generalised stratigraphy in the Hewett area, with the typical casing scheme used for production from the Upper and Lower Bunter reservoirs. The other reservoirs in the area are the Zechsteinkalk (which is a section of the Zechstein) and the Leman Sandstone. Also shown is the permeable deep saline formation, the Winterton. NOTE: the red lines on the figure indicate horizons which have been interpreted on seismic.

2.2 Pressure Regime

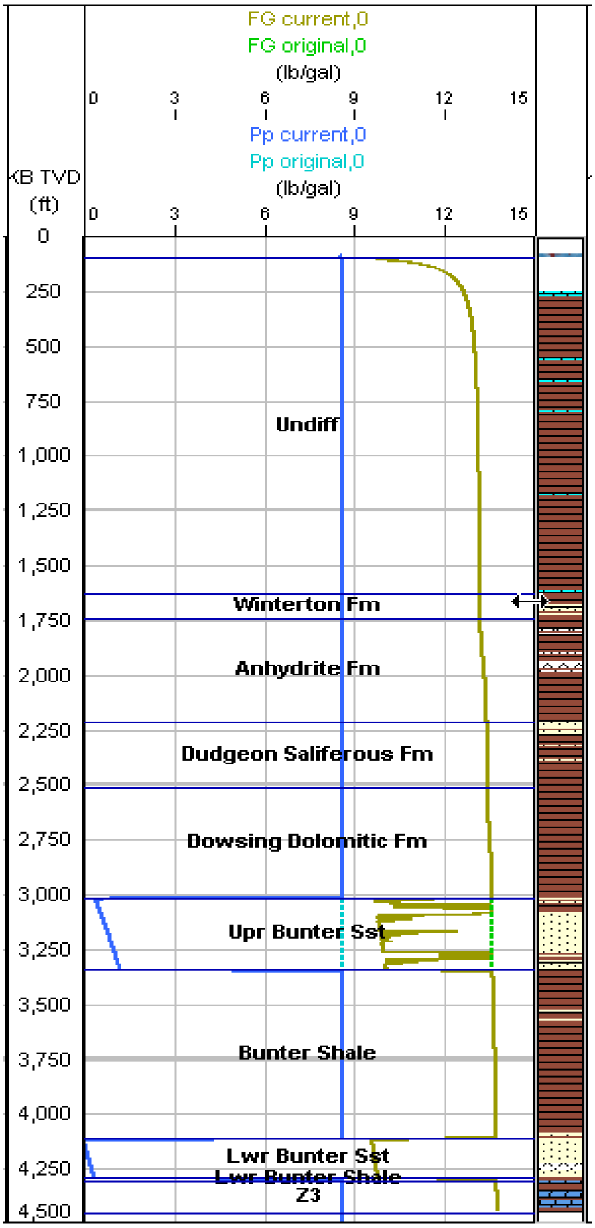


Figure 2-2: Pore Pressure and Fracture Gradient for Hewett Field; Original and Depleted

Figure 2-2 shows that the field was originally normally pressured, and that the Upper and Lower Bunters now have a severely depleted pore pressure. The Lower Bunter is estimated to have a pore pressure (Pp) of 45 psi (1 ppg). The fracture gradient (FG) in the region of the Bunter was originally 13.5ppg (2900 psi), but has been reduced with depletion in the reservoirs to around 9.5 -10.0ppg (2070 – 2180 psi). A detailed study on the pressure regime of the field is covered in a separate report on wellbore stability[M1].

2.3 Well Reports

The following data was used in this report:

- End of well reports
- Completion diagrams
- Status reports where available
- Wellhead diagrams for the three platforms

Availability of data is shown in **Table 2-1** below:

Key: Blank = not available N/A = not applicable

X = available Y = partial data only

Platform wells:	Drilling History	Casing Depths	Formation tops	Completion Diagram	Intervention History	Deviation Survey	Others
52/5 – A1		X	X	X	X	vertical	formation tops and casings from composite log and test report
52/5 – A4	X	X	X	N/A	N/A	X	sidetracked to become A12
52/5 – A5	X	X	X	N/A	N/A	X	sidetracked to become A13
52/5 – A6	X	X	X	N/A	N/A	X	sidetracked to become A14
52/5 – A7	X	X	X	X	X	X	
52/5 – A8	X	X	X	X	X	X	
52/5 – A9	X	X	X	X	X	X	
52/5 – A10	X	X	X	X	X	X	
52/5 – A11		X	X	X	X	X	formation tops/ casings from geological report
52/5 – A12	X	X	X	X	X	X	
52/5 – A13	X	X	X	X	X	X	
52/5 – A14	X	X	X	X	X	X	
52/5 – A15	X	X	X	X	X	X	
52/5 – A16	X	X	X	X	X	X	

Platform wells:	Drilling History	Casing Depths	Formation tops	Completion Diagram	Intervention History	Deviation Survey	Others
48/29-A1	X	X	X	X		X	
48/29-A2	X	X	X	X	X	X	
48/29-A3	X	X	X	X	X	X	
48/29-A4	X	X	X	X		X	sidetracked to become A9
48/29-A5	X	X	X	X	X	X	
48/29-A6	X	X	X	X	X	X	
48/29-A7	X	X	X	X	X	X	
48/29-A8	X	X	X	X	X	X	
48/29-A9	X	X	X	X	X	X	
48/29-A10	X	X	X	X	N/A	X	

Platform wells:	Drilling History	Casing Depths	Formation tops	Completion Diagram	Intervention History	Deviation Survey	Others
48/29-B1	X	X	X	X	X	X	
48/29-B2	X	X	Y	X	X	X	
48/29-B3	X	X	Y	X	X	X	
48/29-B4	X	X	Y	X	X	X	
48/29-B5	X	X	Y	N/A		X	sidetracked to become B9
48/29-B6	X	X	Y	X	X	X	
48/29-B7	X	X	Y	N/A		X	sidetracked to become B10
48/29-B8	X	X	Y	X	X	X	
48/29-B9	X	X	Y	N/A			sidetracked to become B11
48/29-B10	X	X	Y	X	X	X	
48/29-B11	X	X	Y	X	X	X	

Exploration wells:	Drilling History	Casing Depths	Formation tops	Completion Diagram	Intervention History	Deviation Survey	Others
52/5-1							completed as 52/5-A1
52/5-2				N/A	N/A		assumed abandoned- no data
52/5-3				N/A	N/A		assumed abandoned- no data
48/29-1	X	X	X	N/A	N/A	X	assumed abandoned- temporary suspension datafrom drill history
48/29-2				N/A	N/A		assumed abandoned- no data
48/29-3	X	X	X	N/A	N/A	X	assumed abandoned- temporary suspension datafrom drill history

Table 2-1: Wells Data Summary

3 Wells Assessment

The full wells stock status is shown in the schematics represented in **Appendix 1: Existing Well Stock Status Diagrams; Appendix 2: Wellhead diagram examples and Appendix 3: Existing Well Summary Diagrams**. These in general fall into 3 categories; generic production wells, special consideration production wells, and exploration/appraisal wells.

3.1 Review of All Existing Wells Penetrating the Hewett Reservoir

3.1.1 Production Wells

As mentioned earlier, there are 28 platform wells on the Hewett structure which penetrate the Lower Bunter; most of these also produced from the Upper Bunter. Some wells go deeper into the Zechstein or Leman reservoirs. The 28 wells have wellheads on platforms 48/29-A, 48/29-B, and 52/5-A. None of these platform wells have been fully abandoned.

A number of wells have been partially abandoned for sidetracking to new reservoir targets. There are 7 sidetracks from these wells to new formations, sometimes more than one from a single wellbore. This results in 35 actual penetrations of the Lower Bunter from the platform wells. 11 of these wells penetrated the Zechstein. The partial abandonments were done according to conventional abandonment guidelines[M2] for hydrocarbon wells, using conventional cement which is susceptible to CO_2 degradation.

There are 3 wells which warrant special consideration; Wells 48/29-B11 and 52/5-A13 have access restriction below 525 ft and 2000 ft, respectively. This will present complexities during abandonment planning and require customised abandonment design to maintain well integrity. Well 52/5-A14 may also fall into this category. **Section 3.4** highlights the integrity issues associated with these wells.

3.1.2 Exploration/Appraisal Wells

There are a further 5 penetrations of the Lower Bunter on the Hewett structure, by the exploration/appraisal wells 48/29-1, 48/29-2, 48/29-3, 52/5-2, 52/5-3. The remainder of the exploration/appraisal wells drilled in the area did not penetrate the Hewett structure. A sixth exploration well 52/5-1 was tied back to the platform 52/5 and completed as 52/5-A1.

Note that at the time of writing this report, there is very limited data available for these 5 exploration and appraisal wells. It is assumed that all of these wells are fully abandoned, with wellheads removed and casings cut 10 feet below the seabed, which is standard practice. Drilling data, with temporary abandonment details, are available for two of these wells only (48/29-1, 48/29-3). There is no available data on any later permanent abandonment operations, which are presumed to have occurred.

3.1.3 CO_2 Integrity Summary

From a wells perspective, the Hewett Field has some aspects which are favourable for CO_2 integrity:

1. From well reports, the Upper and Lower Bunter reservoirs have not been fractured.
2. From well reports, the Upper and Lower Bunter reservoirs have not been acidised.
3. All of the 28 platform wells can be accessed at least partially, and all of the partially abandoned wells can be designed for CO_2 integrity, at least from surface.
4. There are no slotted liners or screens across the Bunter sandstones - all Bunter sandstone reservoirs are cased and cemented. This means that zonal isolation has been provided against fluids from the permeable zones.
5. As far as can be ascertained from available data, most if not all of the conductors are driven. This is better than cement because it eliminates potential migration paths between formation and cement, through the cement itself, and between cement and casing.

However, the conductor itself will be susceptible to corrosion since the original well design will not have considered CO_2 corrosion during material selection.

The Hewett Field also has some aspects which are more challenging for CO_2 integrity:

1. As far as can be ascertained from available data, most casings are cemented to surface, at least nominally:

a) This potentially minimises the migration/leakage paths to some degree. However, the cement and casing are very old. Most wells were originally drilled in the late 1960's. The cement placement methods and cement technology at that time may mean that the cement sheath is not complete or continuous, and may have micro-annuli or poor bonding to the formation or the casing or both. Thus, without remediation, there are several potential opportunities for CO_2 to migrate from these wells out of the storage site.

b) The 9 5/8" production casing practice is variable. In some cases it is cemented to surface whereas in others the cement top has been left low. The 'filler' cement slurries, i.e. those used between the stronger cement around the shoe, and surface, commonly contain bentonite gel. Cements blended with gel have increased susceptibility to CO_2 or carbonic acid corrosion, because of decreased fluid loss in the slurry which results in increased porosity in the set cement. The set cement is roughly equal in leakage potential to open hole with no cement, where the hole has been allowed to slough[S1]. So where top of cement is unrecorded, leakage risk is probably similar.

c) Cement to surface makes the casings difficult to pull for annulus access. This, plus the fact that the casing may already be corroded means that milling of windows in the casing/cement is the most likely approach.

2. Perforations may have caused cracks in the cement.
3. Some wells are partially abandoned with no access or uncertain access to block potential migration/leakage paths in the abandoned legs.
4. There is no access to the 5 subsea exploration/appraisal wells which penetrate the Lower Bunter. Potential migration/leakage paths in these wells cannot be blocked, even to surface.

Items 3 and 4 pose the greatest challenges to the integrity of the field.

3.1.4 Completion Overview

The current completion status and design methodology of the existing wells in the Hewett Field was reviewed to develop an understanding of the existing infrastructure in support of abandonment planning and potential re-utilisation strategies. The following Hewett field well completion schematics were reviewed (**Table 3-1**).

Platform	Status	Comments
48/29 A	A1 – A10 9 completed	A9 is a sidetrack (ST) of A4
48/29 B	B1 – B11 8 completed	B10 is a sidetrack of B7 B11 is a sidetrack of B9 which in turn is a sidetrack of B5
52/5	A1 – A16 11 completed	A12 is a sidetrack of A4, A13 is a sidetrack of A5 A14 is a sidetrack of A6 , (there is no A2 or A3)

Table 3-1: Hewett Field Well Completion Schematics

The existing Hewett Field completions are all of cased and perforated design. A large majority of the wells are completed with 9 5/8" casing across the Upper and Lower Bunter formations due to the relatively shallow nature of the field (~ 1.5 kilometres); zonal isolation is achieved via cement only. When sidetracking or deepening wells 7" or 7 5/8" and 4 ½" liners were set and perforated to produce from different zones.

The following paragraph gives general information on the completions, based on data available at the time of writing this report. But it should be stressed that this is a conceptual study only; more accurate data, verified to represent the latest wells status, should be sought before making any conclusions on tubing recovery methods for each well. As a generalised statement, it can be assumed that the tubing will need to be released by cutting in all cases.

13 wells do not show a clear tubing recovery mechanism, although some have millout extensions; in these cases the tubing will require cutting (mechanically or chemically) when recovered during abandonment. 10 of the wells include a seal assembly and polished bore receptacle (PBR). These are designed to be sheared or disengaged to allow tubing recovery, but due to the age of the wells it is likely that mechanical or chemical cutting will be required. 4 wells have multiple permanent packers installed in a 7" liner, which were used for acid treatment into the deeper Zechstein formation; although some of these completions incorporate a 'ratch-latch' device for tubing recovery using a straight pull or string rotation, they will also likely require cutting due to the age of the downhole equipment. For the most recent completion (48/29-A10, completed in 2009), the completion diagram cannot be easily read, but the data should be readily available. On 3 wells, a 7 5/8" hanger is used to suspend the tubing from around 300 ft below the wellhead, making removal of the hanger challenging as there is no mill-out extension or similar device below it.

3.2 Assessment of Potential for Re-use

Limiting the amount of new wellbores penetrating the CO_2 sink is a primary objective for the Hewett re-development. To facilitate this, a review of the existing well stock as possible candidate wells for CO_2 injection duty was conducted.

The major migration/leakage modes which compromise CO_2 integrity were identified and used in assessing these wells. These include the following

- Corrosion of metals
- Degradation of cement
- Cracks in the cement
- Channels and micro-annuli in the cement.

The combination of these in the casing annuli of the wells means that this is the most likely migration/leakage pathway. This is due in part to the corrosivity of the metal tubulars and the degradation of the Portland cement when it contacts carbonic acid. The cement is particularly susceptible given the common use of gel in the filler cement slurries, which increases the cement permeability. However, much faster migration/leakage paths in the annuli will have been provided by poor cement placement in these old wells, as well as subsequent operations in the life of the field. These are likely to have caused some or all of the following:

1. Micro-annuli and/or poor bonding between casing and cement
2. Poor bonding between cement and formation
3. Cracks in the cement sheath
4. Incomplete cement sheath (channels)

The review concluded against the re-use of the existing well stock for injection of CO_2 for the following reasons:

- The high level of uncertainty regarding well integrity during the field life cycle. The age of the wells, their metallurgy and cement type (non CO_2 resistant) pose significant risk to long term integrity.
- The scarcity of data means that it is not possible to make an accurate assessment of the suitability of the existing well stock for CO_2 injection.
- In addition, most of the Hewett platform infrastructure is old, and is unlikely to be viable for the envisaged injection lifetime.
  Utilisation of existing wells for injection of CO_2 is therefore inadvisable, and new wells specifically for injection duty will be required. However, dependent on the position of the existing wells relative to the proposed injection wells, these could be used to establish the baseline conditions of the reservoir (pressure, temperature, etc) in the field (prior to injection) and also considered for monitoring during operation and post closure of the storage site. Further studies will have to be conducted to assess the feasibility of this strategy.

3.3 Assessment of Potential to Provide Migration/Leak Paths

Probably the most important aspect of CO_2 storage is the integrity of the system as a whole. Within the system, the most likely leakage pathways are the wells[S2]. The new injection wells can be designed fit for purpose, to minimise the risk of CO_2 migration/leakage. The highest risk therefore comes from the existing well stocks, which were not designed with CO_2 storage in mind, and which penetrate the CO_2 storage site (Lower Bunter and Upper Bunter).

Potential migration/leakage pathways associated with wells are shown in **Figure 3-1**.

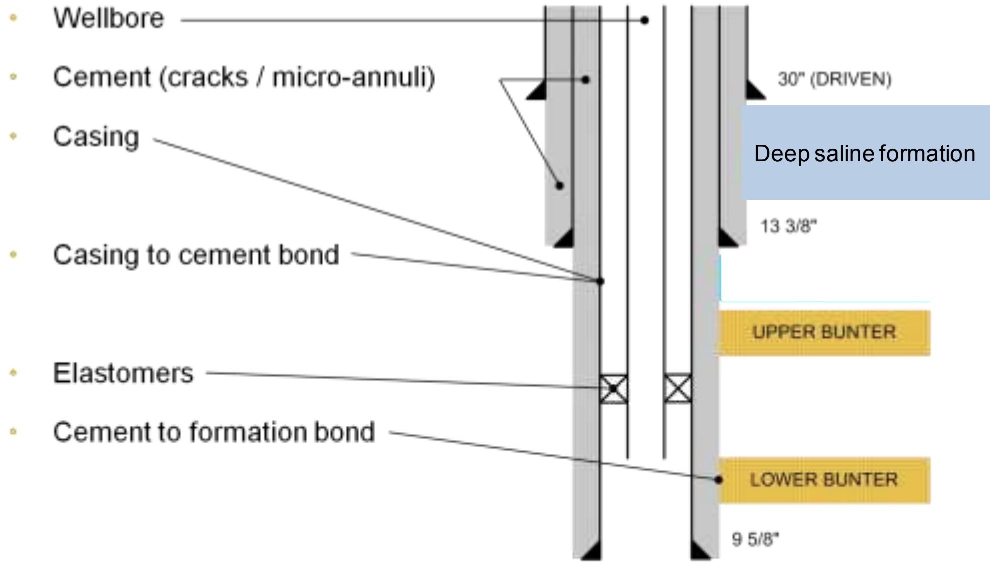


Figure 3-1: Potential Migration/Leakage Paths in Wells

3.3.1 Cement

There are many papers written on the degradation of Portland cement in the presence of carbonic acid. Portland cement is the standard cement used in wellbores. When CO_2 comes into contact with water, it forms carbonic acid. When the carbonic acid comes into contact with the two largest phases of hydrated Portland cement (calcium-silica-hydrate and calcium hydroxide), it forms calcium carbonate as a precipitate. This precipitate initially improves the sealing properties of the cement, but as the carbonic acid re-generates, it dissolves the calcium carbonate. The affected cement is then weaker and more permeable, and because this is perpetuating over time, the permanent integrity of the cement is compromised. But the process may not happen as rapidly as is generally thought. A paper by Huerta *et al.* (2008)[S3] proposes that 'leaky wells' may be self healing with time, due partly to stresses causing plastic deformation to close off leakage pathways, but also due partly to the reaction rate of intact cement being sufficiently slow such that long term degradation would not be a risk. Duguid (2008) [S4] also discusses the different results for CO_2 corrosion from field tests carried out over 30 years, versus laboratory tests, for Portland cements. The results of all laboratory studies show a very fast, days to months, degradation, whereas field results show a much more limited degradation over the course of a few decades. This is not contradictory; the extreme difference is in the conditions of exposure to CO_2 (block submerged for lab tests), and availability of an easily refreshed CO_2 source. However, this research has considered decades, whereas CO_2 integrity should be considered over much longer timescales. While some comfort may be taken from this research that a leak rate may be reduced in the near term, confirming any longer term effects requires further investigation.

However there are many potential migration/leakage paths in the wells which are not due to the action of carbonic acid on the cement[S4], i.e. cracks and micro-annuli which occur because of poor placement or stresses during operations. From field tests in geothermal wells, CO_2 is not likely to cause damage to the well by diffusing through the cement matrix vertically, but rather it will likely be transported through vertical defects in the cement and/or the annulus interfaces with the formation or casing, and then diffuse radially into the cement. Put simply, the cracks, channels and micro-annuli are a faster migration/leakage pathway than the cement itself.

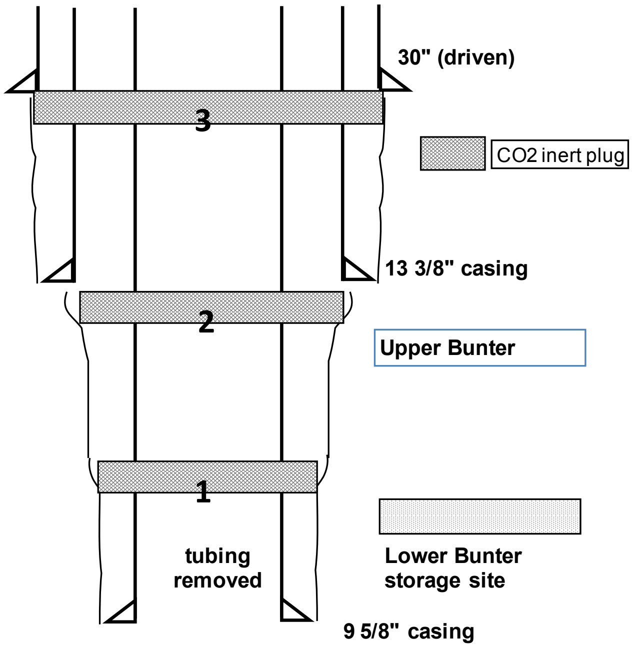
3.4 Review of Methods of Migration/Leak Path Blockage

To reduce the risk of migration through existing production wells to other formations and leakage outside the storage complex, it is recommended that they are 'plugged' with materials which are not susceptible to CO_2 degradation.

In order to seal all of the annuli which provide the potential migration/leak paths, the abandonment plugs should cover the entire wellbore from formation wall to formation wall. This requires that casing is either retrieved or milled out, and any old cement behind the casing is also milled out[S5]. A report by Randhol *et al.* (2007) [S5] recommends that this is done as a primary barrier at the depth of the caprock to the CO_2 containing reservoir. By doing this, the continuity of the caprock is maintained across the well. The identification of the caprock as the area to be plugged also means that the question of how to pump cement successfully across the depleted reservoirs is potentially not so important (losses may still occur if communication exists in the casing annulus). Borrowing from United Kingdom Offshore Operators Association (UKOOA) guidelines[M2], it is recommended to place two barriers above each reservoir to be used for CO_2 storage. The requirement for two barriers is based on the UKOOA guidelines for hydrocarbon wells, for which two pressure containment barriers are required. In the case of CO_2 integrity, a barrier must also be provided against chemical degradation. This can be provided by the pressure barriers, if possible, by making them of a material inert to CO_2. If this is not possible, due to access issues for example, at least one additional plug of CO_2 inert material must be placed where it will form a complete barrier across the entire wellbore.

For most wells, it is unlikely that CO_2 migration/leakage would be seen around the outside of the conductor, as most if not all of the conductors were driven when originally placed, with no cement involved. The formation should now be providing a tight seal around the outside of the conductors. It is still possible that the conductors themselves will corrode, if CO_2 or carbonic acid reaches them, leaving a migration/leakage path to surface. The last CO_2 tight plug set across the wellbore should therefore be set below the 30" conductor shoe. Uncertainties in data mean that there may be 3 or 4 wells which have drilled and cemented conductors; even if this is the case, this last plug should provide a sufficient physical barrier against CO_2 degradation/corrosion which would allow leakage to surface.

Figure 3-2 shows the most common well status with the abandonment plugs in place.



Hewett existing Wells (generalised case) shown abandoned. Primary Barrier is plug 1 at reservoir caprock depth, Secondary Barrier 2 above, third plug 3 as Secondary Barrier to plug 2; old casing and cement milled to formation for plug placement

Figure 3-2: Abandonment Plugs in Place

For most of the Hewett platform wells, it is possible to access cap rock or sufficient annulus to place these plugs, thus preventing communication from Lower to Upper Bunter, to other formations, and to surface. There are some exceptions, for which more detailed work is required to provide the best possible mitigation. The exceptions are:

1. 48/29-B11
2. 52/5-A13
3. 52/5-A14

In one of these (48/29-B11) the old abandoned legs cannot be accessed, as the casing has been cut. For the two others, where a window was milled for sidetracking, access may be possible, although difficult. This is further addressed in **Section 3.5**. For these 3 wells, there is a risk of CO_2 migration between permeable formations via the paths described, which must be addressed. The leakage path to surface can be physically plugged, and in this respect they are no different from the other wells.

For the 5 exploration/appraisal wells, remediation will be extremely challenging due to the difficulty of gaining well-access. However, there are likely to be methods by which these wells can be accessed and re-entered. This was not looked into at this stage, but will require investigation during the next stage of the project.

3.5 Ability to Remediate by Engineering Methods

For most of these wells, it is still possible to access sufficient annulus to prevent communication from Lower to Upper Bunter, from the Upper Bunter to the two shallower permeable formations, and to surface. Where casings have been completely cut, as in 48/29-B11, it will be virtually impossible to relocate the old abandoned part of the well, as new casings have been run and cemented across the old hole. Where a window has been cut in the original casing, as in 52/5-A13 and 52/5-A14, it may be possible to locate the old hole by milling down through the liner overlap using the uncut side of the old casing as a guide**.** These situations are illustrated in **Figure 3-3.**

The cost and risk of such an operation would need to be weighed against the environmental benefit. For all wells, sufficient CO_2 tight plugs can be set to reduce the risk of a leak path to surface to as low as practical.

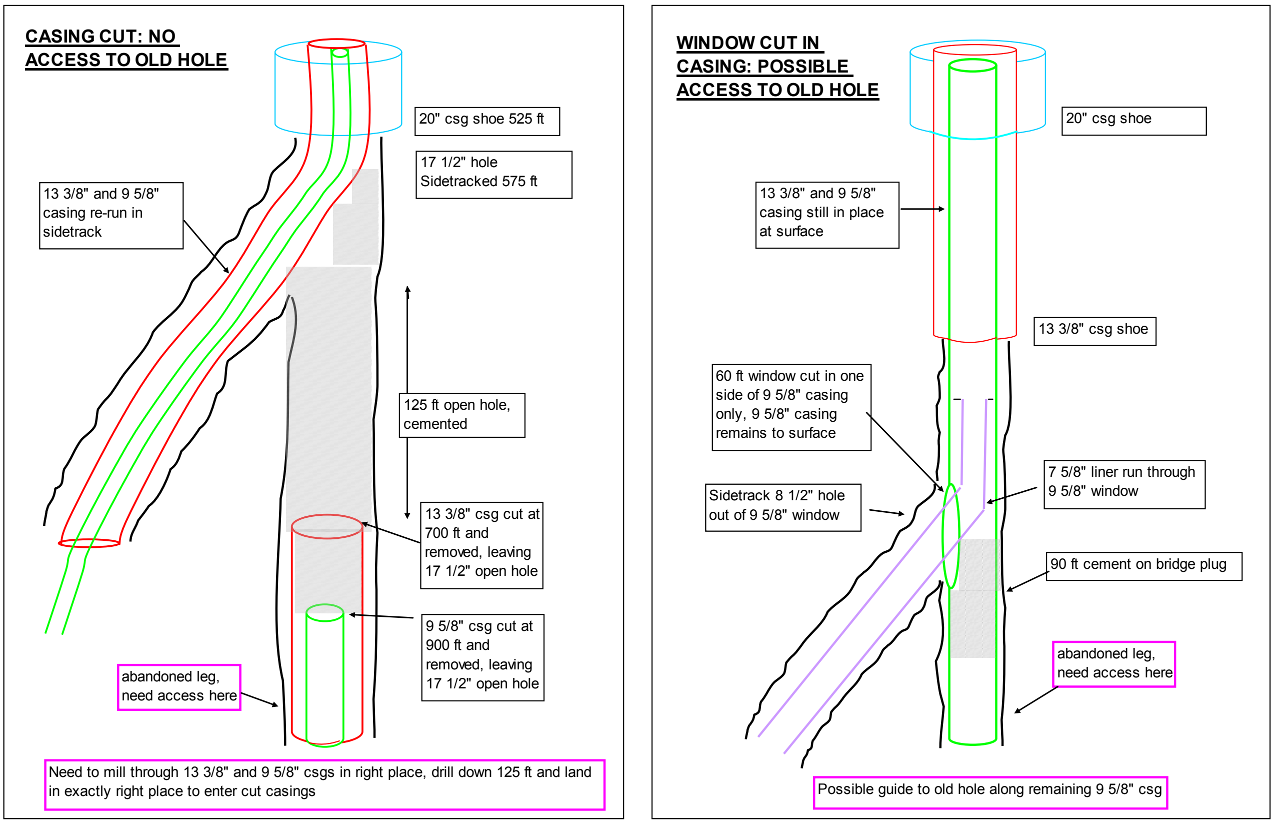


Figure 3-3: Access Issues in Old Abandoned Legs

3.6 Platform Wells with Special Considerations

Well 48/29-B11

The complex of wells and sidetracks which is now 48/29-B11 is shown in **Figure 3-4**. The original well 48/29-B5 targeted the Bunter. This was later abandoned from below the Upper Bunter and sidetracked by milling a window in the 9 5/8” casing to become 48/29-B9, which targeted the Zechstein and Leman reservoirs. Later still, 48/29-B9 was abandoned below the 20” shoe by cutting and retrieving the 13 3/8” and 9 5/8” casings; the well was then sidetracked from there to become 48/29-B11.

For this well, it would be virtually impossible to access below approximately 525 ft (160 m) BRT (20” shoe depth) to set isolation plugs in the old abandoned legs. The old 9 5/8” and 13 3/8” casings were completely cut and pulled to allow a new hole to be drilled and cased above, and there is 125 ft of cement filled open hole between the sidetrack initiation and the top of the cut casing. Any attempt to mill through the casings and drill through the cemented borehole to locate the original cut casing would most likely result in failure, and the likely construction of several additional migration/leakage paths from the failed attempts. The cement in the borehole was designed as a kick off plug which would be high density; the disadvantage of this is that straight drilling through it without sidetracking would be virtually impossible However, the advantage is that the plug does fill the borehole from formation wall to formation wall, therefore providing a barrier of the required design for CO_2. The current assumption is that the Portland cement material will degrade over time with exposure to $CO_{2,}$ although this may be slow, as discussed in **Section 3.3.1**, particularly since it is high density cement.

The most recent leg of the well, 48/29-B11, can be abandoned as recommended for the other platform wells.

If the 48/29-B5 and 48/29-B9 legs are left as is, there is a risk of CO_2 communication between the Lower and Upper Bunter, and from the Bunters to the shallower permeable formation at approximately 1300 ft (Winterton). Further design work is required to design the best possible CO_2 abandonment, but one possibility is shown in **Figure 3-5**. The ‘old’ legs of the well already have abandonment plugs installed, albeit using Portland cement, and a 325 ft high density cement plug to 900 ft. The final barrier against CO_2 degradation/corrosion can be provided by setting a CO_2 resistant plug above 525 ft.

There may also be a risk of migration between the Lower Bunter and the Zechsteinkalk Formations and a risk of leakage to the Leman Formations, if these reservoirs located at a lower stratigraphical location are at any time in the future depleted to a lower pressure than the (post injection) pressure in the Lower Bunter.

Other mitigations need to be investigated for the potential communications between formations, including any possibility of physical access to the old wellbores. One option would be to drill a relief well, if the cost and probability of success was justified by the severity of the risk. The probability of success would be influenced by an assessment of the accuracy of the directional survey data from 1967.

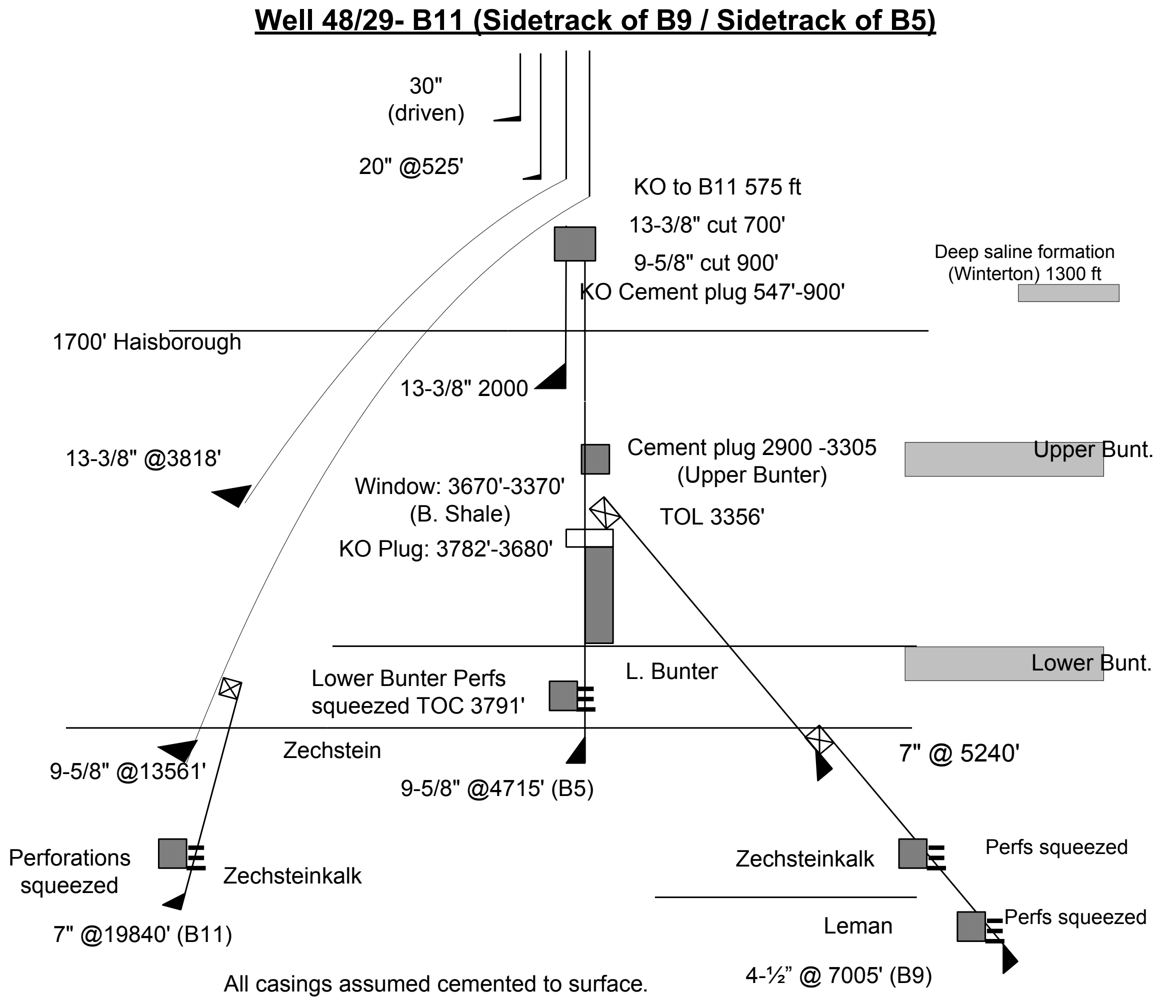


Figure 3-4: 48/29-B11 Well Showing Old Abandoned Legs and Access Shut-off at 525 ft

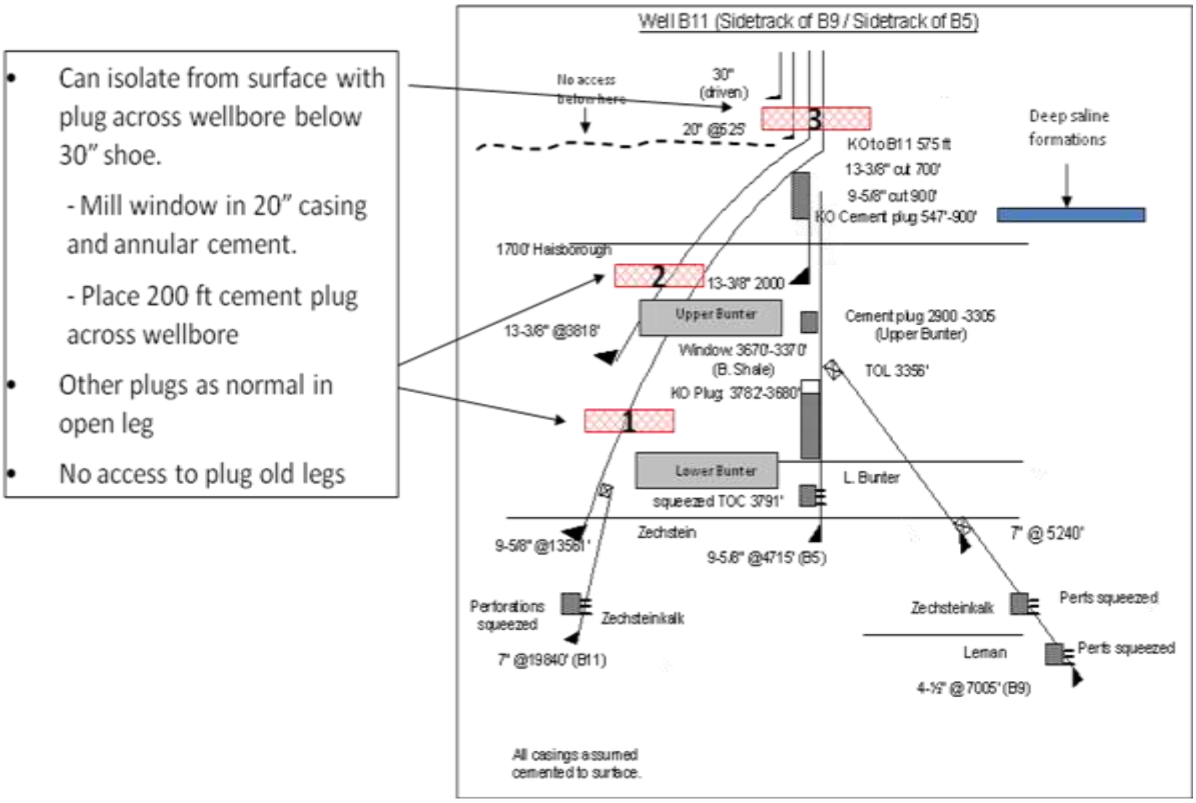


Figure 3-5: Possible Migration/Leak Path Shut-off for Well 48/29-B11

Well 52/5-A13

The complex of wells and sidetracks which is now 52/5-A13 is shown in **Figure 3-6**. The original well 52/5-A5 targetted the Bunter, but was not perforated due to operational reasons. This unused leg of 52/5-A5 was abandoned from above the Upper Bunter and sidetracked by milling a window in the 9 5/8" casing to target the Upper and Lower Bunter sandstones, still as part of 52/5-A5. Later still, 52/5-A5 was deepened to the Zechsteinkalk reservoir to become 52/5-A13.

For this well, access is difficult for isolation below 2179 ft.

The most recent leg of the well, 52/5-A5 and 52/5-A13, can be abandoned as recommended for the other platform wells.

If the 52/5-A5 unused leg is left as is, there is a risk of communication between the Lower and Upper Bunter (via non-CO_2 resistant cement and steel casing). It may be possible to mill down through the liner overlap using the remaining section of 9 5/8" as a guide, to access the annulus between the Upper Bunter and the Lower Bunter. The feasibility and benefits of this need to be investigated and justified. The considerations regarding the kick-off cement plug are similar to those for 48/29-B11, although in this case the plug does not cover the entire borehole, but sits inside casing, which is susceptible to corrosion over time.

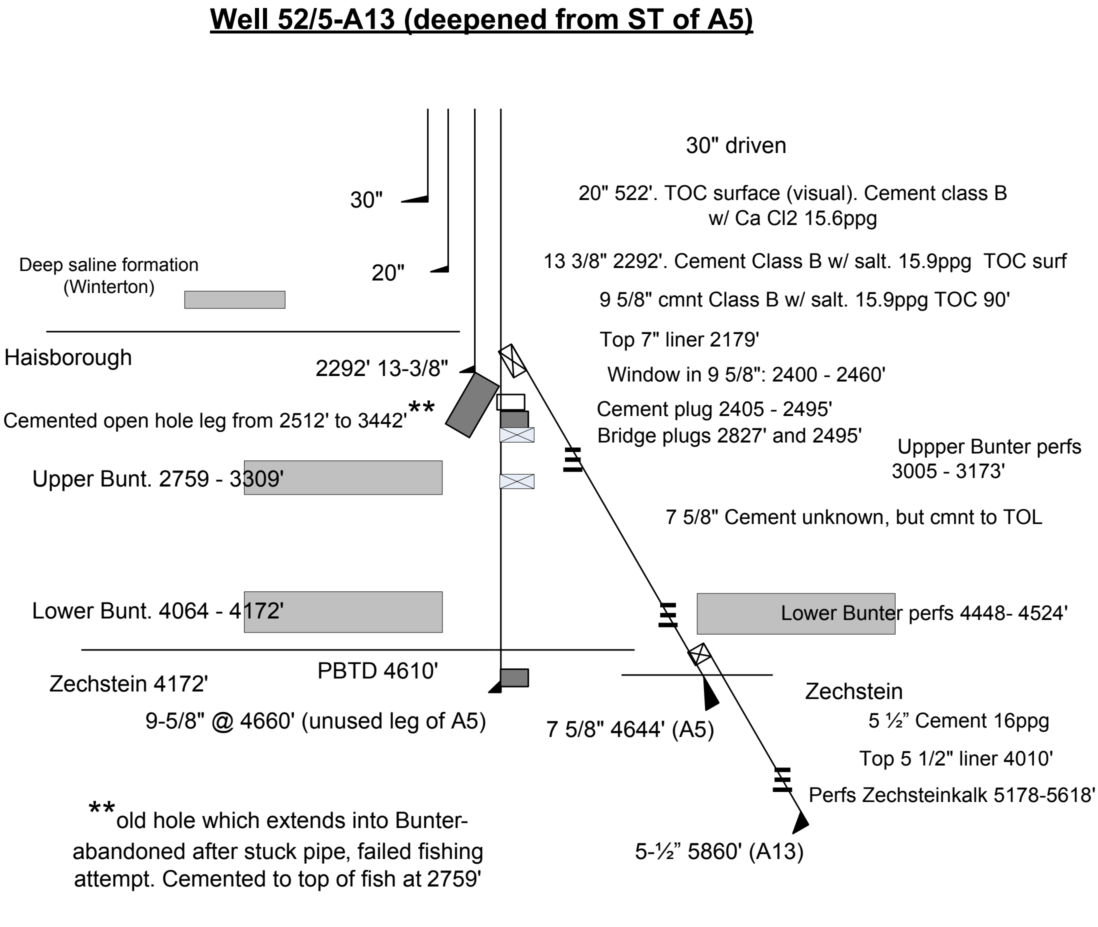


Figure 3-6: 52/5-A13 Well Showing Lack of Access to Annulus Between Upper Bunter and Lower Bunter in Old Abandoned Leg

Well 52/5-A14

The complex of wells and sidetracks which is now 52/5-A14 is shown in **Figure 3-7**. The original well 52/5-A6 targetted the Bunter. The well also extended into the Zechstein. 52/5-A6 was later abandoned from below the Upper Bunter and sidetracked by milling a window in the 9 5/8" casing to become 52/5-A14, which targetted the Zechstein reservoir.

For this well, access may be difficult below 2657 ft. Although the window in the 9 5/8" casing was cut in the Bunter Shale between the two Bunter reservoirs, the 7" liner top is above the top of the Upper Bunter.

The most recent leg of the well, 52/5-A14, can be abandoned as recommended for the other platform wells.

If the 52/5-A6 leg is left as is, there is a risk of CO_2 communication between the Upper and Lower Bunters, and from the Lower Bunter to the Zechsteinkalk. The Zechsteinkalk was not perforated and produced in this well, because of operational problems, but the liner and cemented annulus still provide a possible migration path for CO_2 from the Lower Bunter. There is also a risk of communication between the Lower and Upper Bunter reservoirs, although since the window in the 9 5/8" casing was between the two it may be possible to mill down through the liner overlap using the remaining section of 9 5/8" as a guide, to access the annulus between the Upper and Lower Bunters. To mill down further than the window to shut off communication between the Lower Bunter and the Zechsteinkalk would be more difficult because of the high density kickoff cement plug aspects discussed for 48/29-B11 and 52/5-A14. As for 52/5-A14, the plug does not cover the entire borehole, but sits inside casing, which is susceptible to corrosion over time. The feasibility and benefits of access need to be investigated and justified.

Well 52/5-A14 (ST of A6)

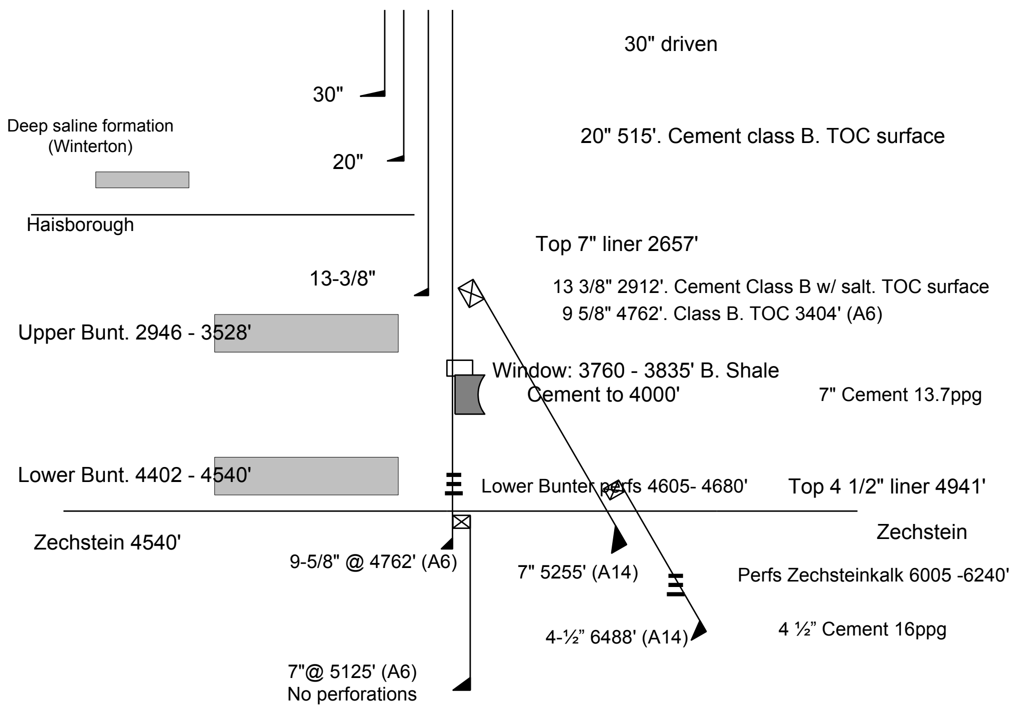


Figure 3-7: 52/5-A14 Well Showing Lack of Access to Annulus Between Lower Bunter and Zechsteinkalk in Old Abandoned Leg

3.7 Possible Mitigation Methods for Leakage Risks

A method of monitoring the well for CO_2 migration is required, as well as a remediation methodology if leakage does occur. This means that the surface casings and wellhead cannot be cut below the seabed as would happen for a standard abandonment. It is recommended that a feasibility study is conducted for design of a well stump, most likely the 30" conductor, with a connector on top and a monitoring device to identify CO_2 migration.

The remediation for any leaks arising from any of the wells would require the pumping of additional cement or other sealing material to the inside of the well, through the surface access provided. It is possible that this would require some milling out of old cement, so access for a rig or other vessel would be required.

Also, if any of the well is left sticking up from the seabed, it is likely that some protective structure will be required over the top, to avoid snagging by trawler nets or beams.

4 Conclusions & Recommendations

The following conclusions and recommendations have been made based on the design studies conducted.

4.1 Conclusions

1. There are 28 platform wells on the Hewett field drilled through the Lower Bunter. 7 sidetracks have been made from some of these wells to target other reservoirs. There are 5 exploration/ appraisal wells which are not tied back to the platform.
2. Some of the wells have been partially abandoned prior to sidetracking. 3 of these are treated as a special case because re-entry is difficult or not possible.
3. The existing wells are not suitable for re-use as CO_2 injection wells. This is mainly due to integrity issues relating to the fact that the wells were not originally designed for CO_2 operations. This means that CO_2 injection will only be feasible using new wells.
4. Potential migration/leakage paths are via casing corrosion, degradation of cement, and by cracks or faults in the cement or cement bonds.
5. The existing wells need to be abandoned using CO_2 resistant materials, including non-Portland cement. The plugs should be set above and between the permeable zones.
6. A plugging plan has been provided to shut off the potential CO_2 migration/leakage paths.
7. The greatest challenges to the integrity of the field as a CO_2 store are the 3 partially abandoned wells for which remediation is difficult or impractical, and the 5 exploration wells for which access for remedial abandonment -as recommended for the generic platform wells- will be extremely challenging. By which method this would be possible was not investigated. Additionally data is unavailable at the time of writing this report, for some of the operations on the 5 exploration wells leaving their status uncertain.

4.2 Recommendations

1. It is recommended that further studies be done on the various abandonment options.[M5]
2. It is recommended that more accurate data, verified to represent the latest wells status, is sought before making any conclusions on tubing recovery methods for each well.
3. It is recommended that further studies be performed to identify the methods suitable for monitoring potential migration/leakage of CO_2 from wells and undertake remediation in these wells after abandonment operations. [M6]
4. It is recommended that a feasibility study be conducted on the use of some of the existing wells for monitoring operations during the injection and post-injection phase of the project. Applicability depends on proximity of the injection sites to the existing well.
5. The cost and risk of re-entry operations for the 3 special case wells need to be weighed against the environmental benefit.
6. A method for possible re-entry of the exploration wells needs to be determined, and their abandonment status verified.

5 Mandatory References

[M1] *Baker RDS*; *“Wellbore Stability for New Wells”*, KCP-RDS-CWE-REP-1001

[M2] *UKOOA Guidelines for Suspension and Abandonment of Wells”*, Oil and Gas UK (2009)

[M3] *Baker RDS*; *‘’Assessment of Engineered Integrity’’,* KCP-RDS-CRE-REP-1008

[M4] *Baker RDS*; *‘’Risk Assessment and Remediation Options’’*, KCP-RDS-CRE-REP-1009

[M5] *Baker RDS*; *‘’Well Abandonment’’,* KCP-RDS-CWE-REP-1009

[M6] Baker RDS; *“Design Monitoring Programme for Well and Storage Assurance”*, KCP-RDS-CRE-REP-1010

6 Supporting References

[S1] Watson T.L. and Bachu S.; "*Identification of Wells with High CO_2 Leakage Potential in Mature Oilfields Developed for CO_2-Enhanced Oil Recovery"*, (2008) Society of Petroleum Engineers 112924.

[S2] Chadwick A., Arts R., Bernstone C., May F., Thibeai S., and Zweigel P.; *"Best Practice for the Storage of CO_2 in Saline Aquifers - Observations and Guidelines from the SACS and CO2STORE Projects",* (08.01.2007) http://www.co2store.org/TEK/FOT/SVG03178.nsf

[S3] Huerta N.J., Bryant S.L. and Conrad L.; *"Cement Core Experiments With a Conductive Leakage Pathway, Under Confining Stress and Alteration of Cements Mechanical Properties via a Reactive Fluid, as an Analogue for CO_2 Reactive Scenario"*, (2008) Society of Petroleum Engineers 113375, The University of Texas at Austin.

[S4] Duguid A.; *"The Effect of Carbonic Acid on Well Cements as Identified Through Lab and Field Studies"*, SPE119504 (2008) Society of Petroleum Engineers, Schlumberger Carbon Services.

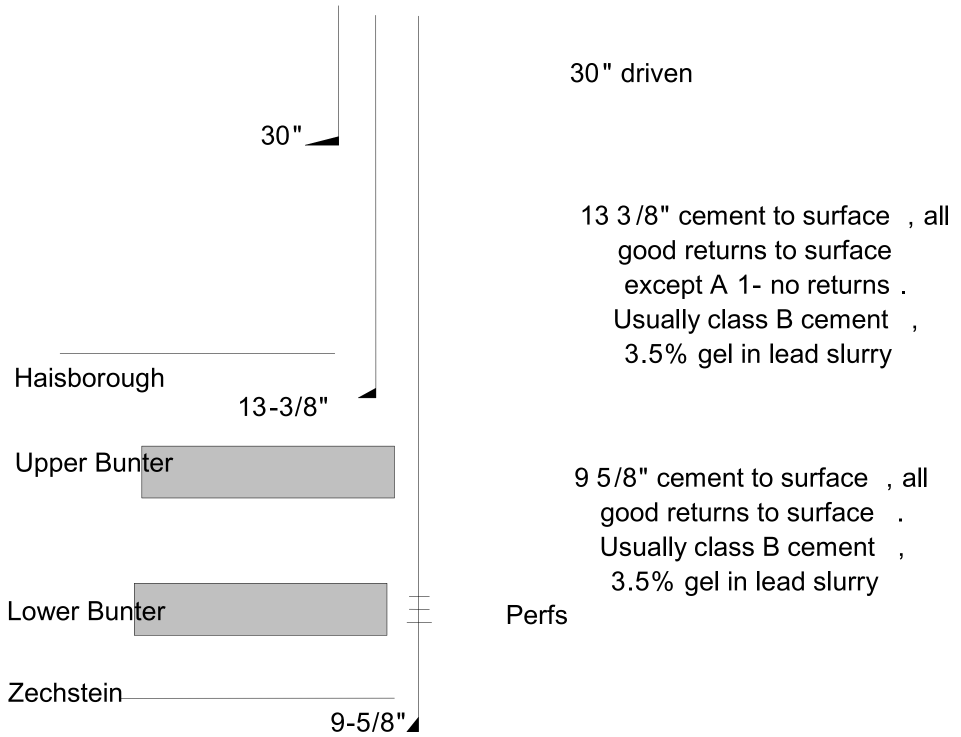
[S5] Randhol, Preben et all; *"Ensuring Well Integrity in Connection with CO_2 Injection"*, SINTEF Report 31.6920.00/02/07 (2007)

7 Conversion Factors

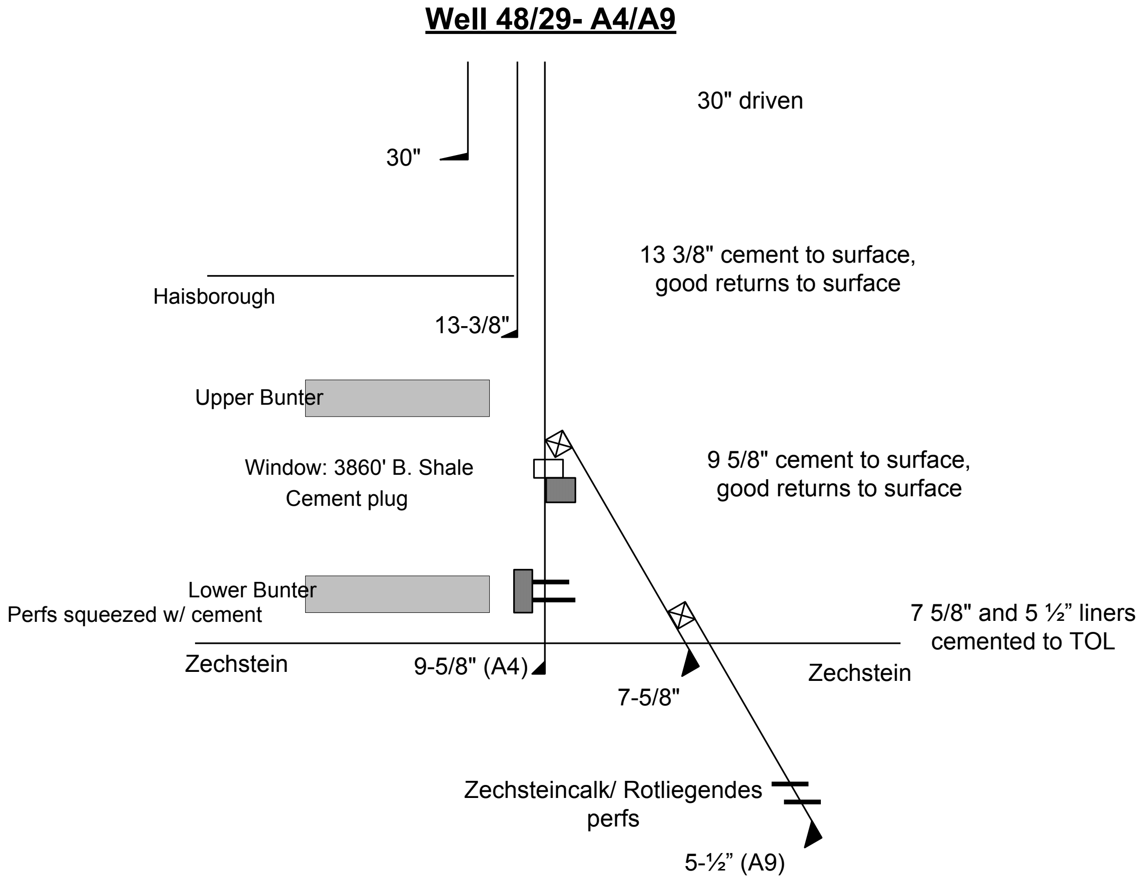
Dimension	Multiply	By	To Obtain	Comments
Length	inches	0.02540	metres	
	feet	0.30480	metres	
Area	sq inches	0.00065	sq metres	
	sq feet	0.09290	sq metres	
Volume	cubic inches	0.00002	cubic metres	
	cubic feet	0.02832	cubic metres	
	gallon	0.00379	cubic metres	
	barrel	0.15899	cubic metres	barrel = 42 US gallons
Pressure	psi	0.06895	bar	a - relative to atmosphere g - relative to gauge
Temperature	deg Fahrenheit	(Tf-32) / 1.8	deg Celsius	Tf – Temperature in deg F
Mass	lb	0.45359	kilogram	
	lb	0.00045	tonne	
Density	lb/ft3		kg/m3	
	ppg	119.82640	kg/m3	ppg = pounds per gallon in US units
	ppg	0.12	Specific Gravity	
Energy	BTU	1,055.05600	Joule	
Power	BTU/hour	0.29307	Watt	
Flowrate	scf/day	0.028317	m3/day	
	scf/day	0.000053	Tonnes/day	For CO2 only
	bbls/day	0.117347	m3/day	bbls = barrels = 42 US gallons
Thermal Conductivity	BTU-ft/hour/ft2/degF	1.73073	W/m/K	
Specific Enthalpy	BTU/lb	2,327.79000	J/kg	

8 Appendix 1: Existing Wells Stock Status Diagrams

Wells 48/29- A1, 2, 3, 5, 6, 7, 8

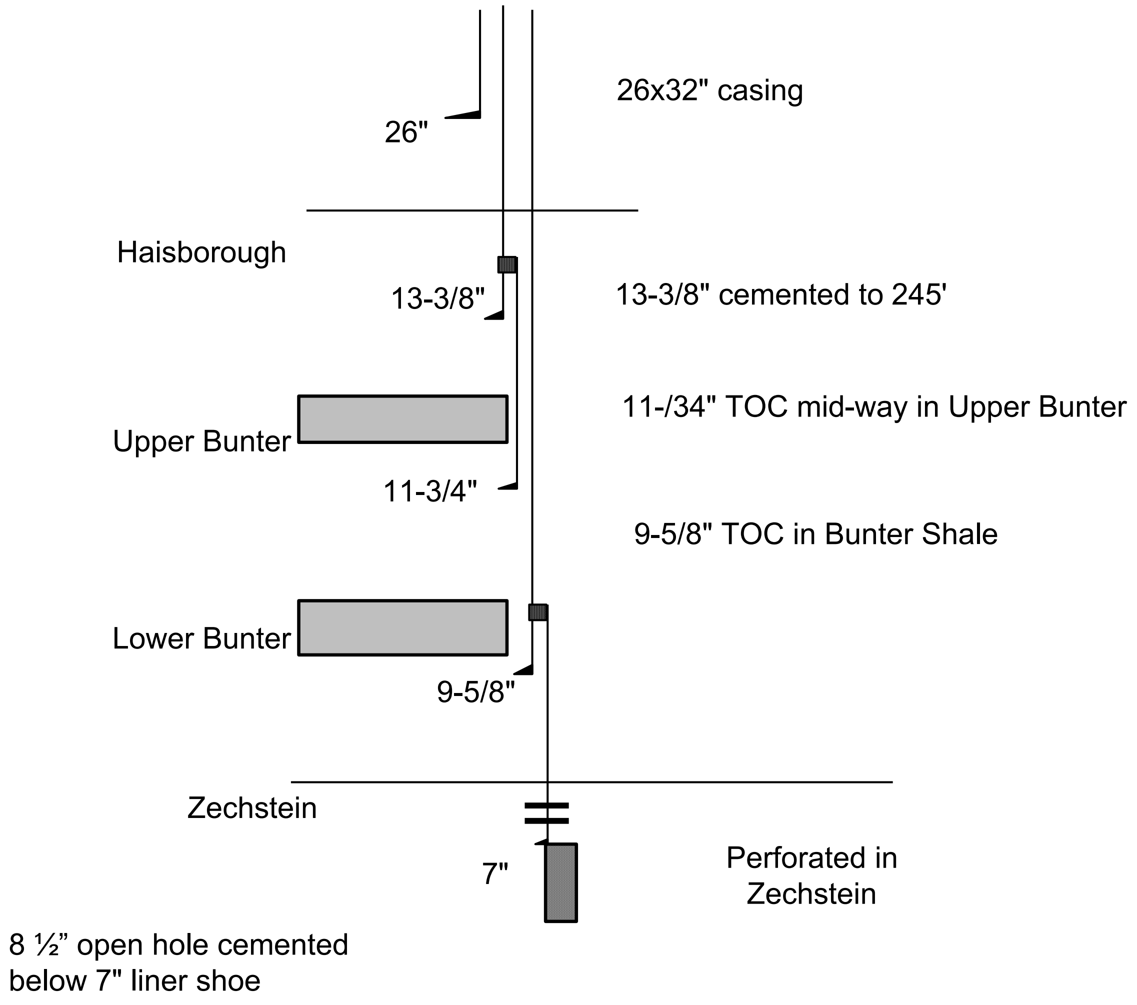


Note:
- 9-5/8" also perforated several times in Haisborough for cement squeeze, most wells due to annular gas shows.

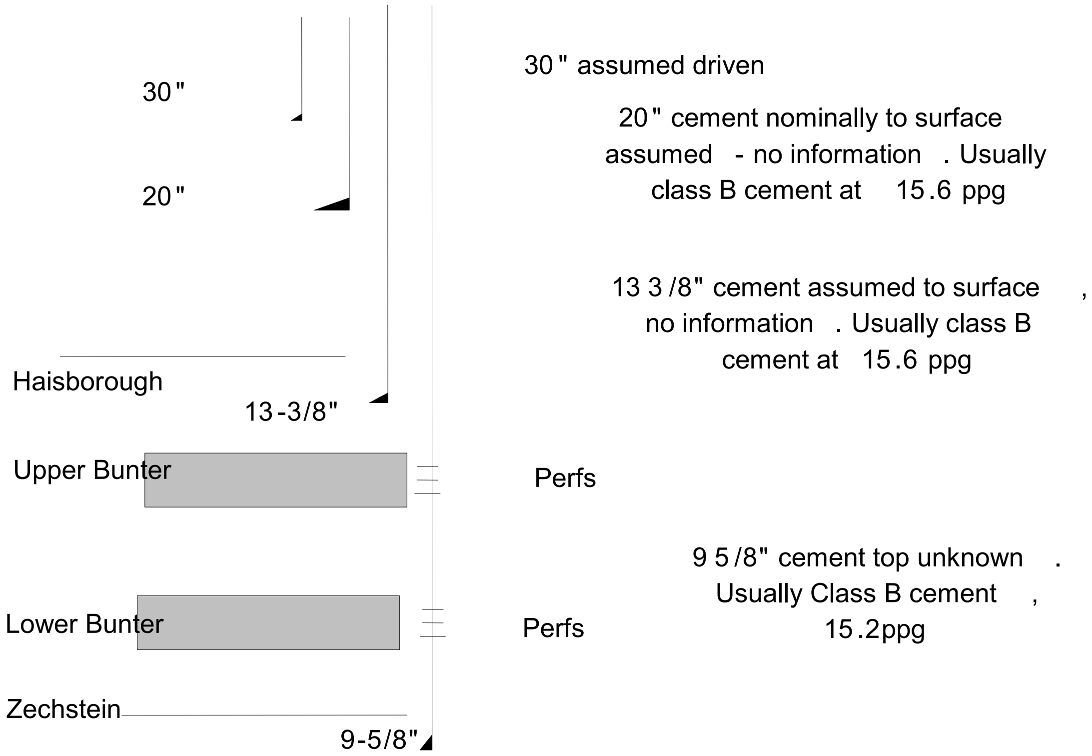


Note
- A4 ST to A9.
- A4 perforation in L.B.- cement squeezed
- A9 perforation in Zechsteinkalk

Well 48/29-A10
High angle well
Drilled 2008

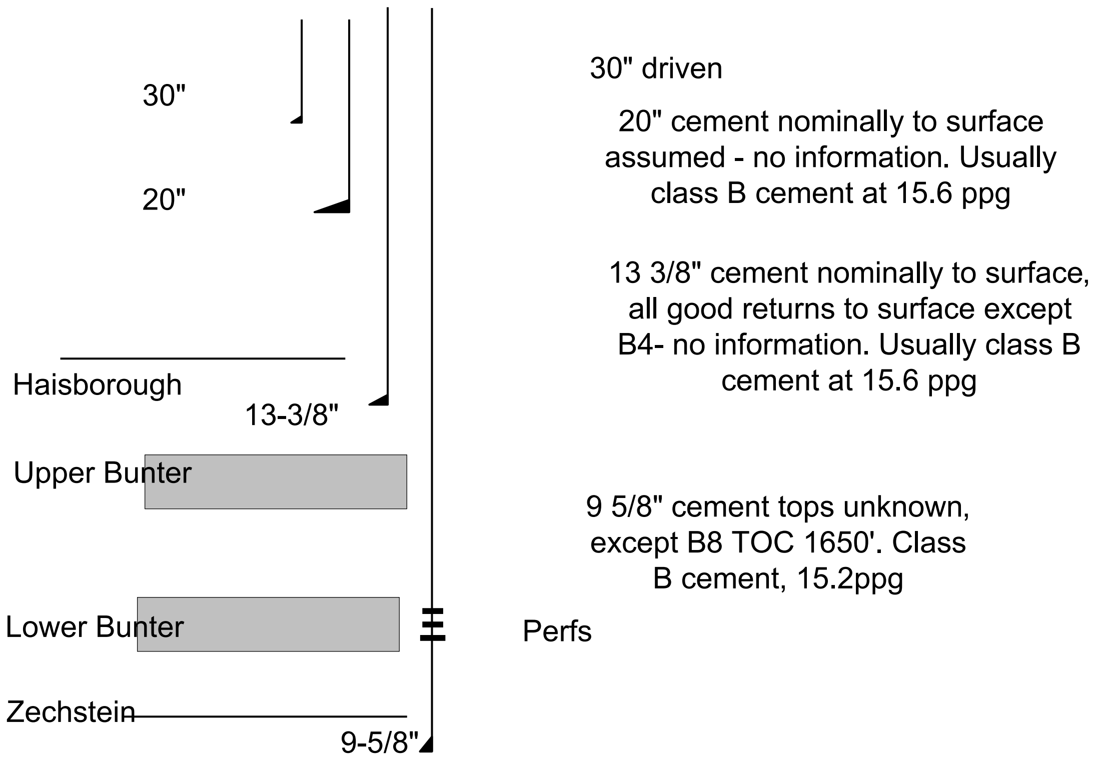


Well 48/29- B1

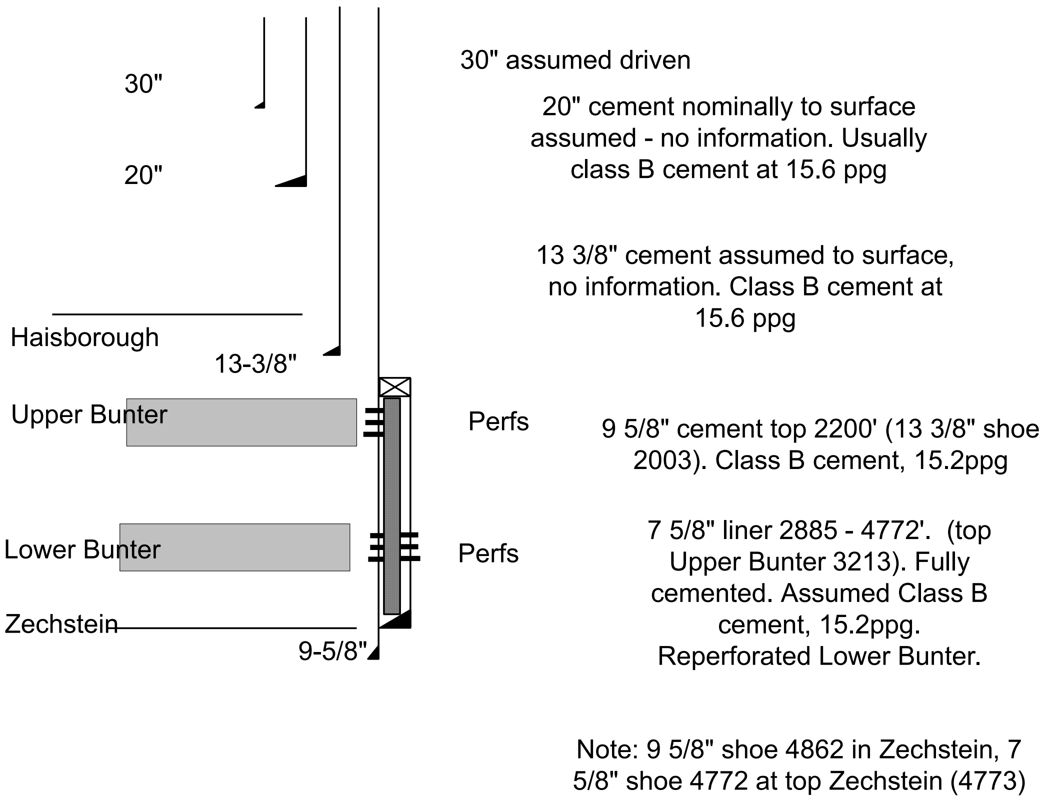


30" assumed driven
30"
20" cement nominally to surface assumed - no information . Usually class B cement at 15.6 ppg
20"
13 3/8" cement assumed to surface , no information . Usually class B cement at 15.6 ppg
Haisborough
13-3/8"
Upper Bunter
Perfs
9 5/8" cement top unknown . Usually Class B cement , 15.2ppg
Lower Bunter
Perfs
Zechstein
9-5/8"

Wells 48/29- B2, B3, B4, B8

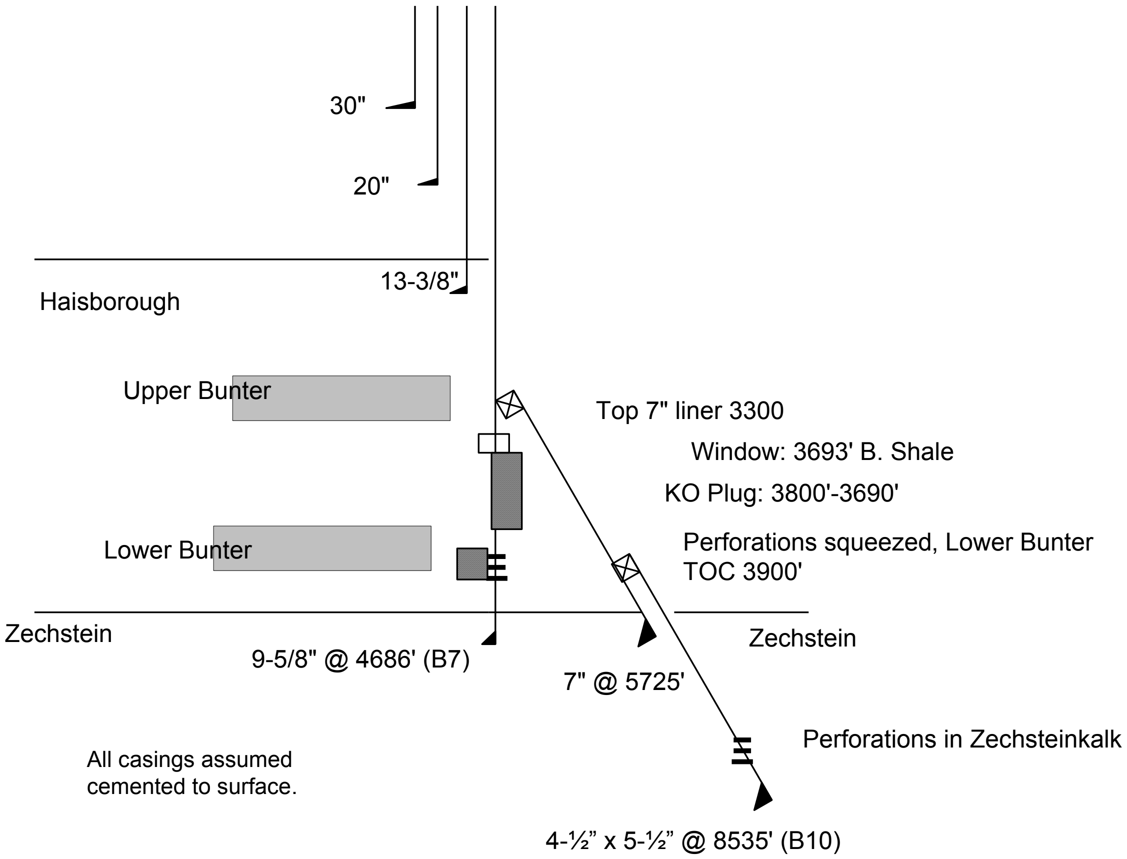


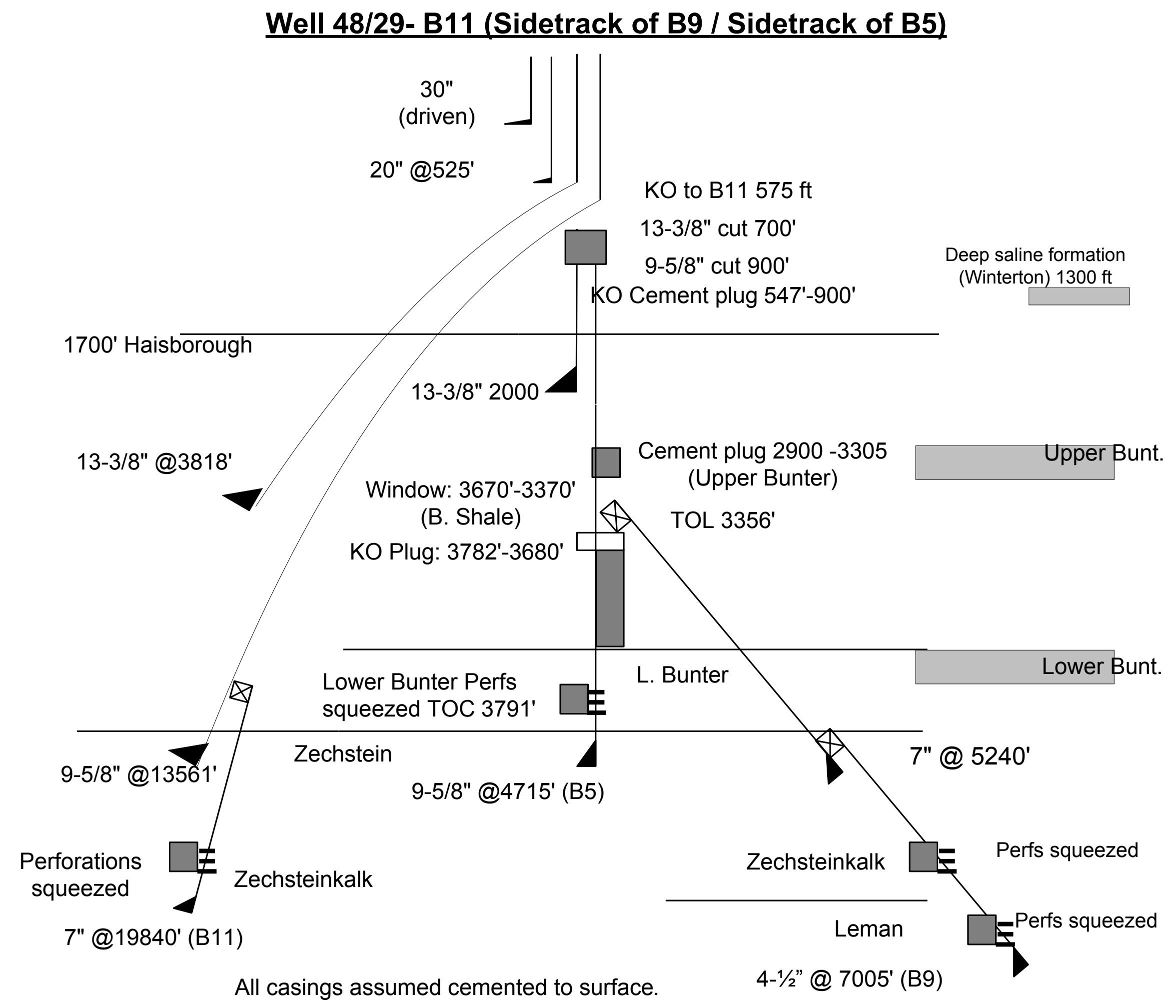
Well 48/29- B6



30"
20"
Haisborough
13-3/8"
Upper Bunter
Lower Bunter
Zechstein
9-5/8"
Perfs
Perfs
30" assumed driven
20" cement nominally to surface assumed - no information. Usually class B cement at 15.6 ppg
13 3/8" cement assumed to surface, no information. Class B cement at 15.6 ppg
9 5/8" cement top 2200' (13 3/8" shoe 2003). Class B cement, 15.2ppg
7 5/8" liner 2885 - 4772'. (top Upper Bunter 3213). Fully cemented. Assumed Class B cement, 15.2ppg. Reperforated Lower Bunter.
Note: 9 5/8" shoe 4862 in Zechstein, 7 5/8" shoe 4772 at top Zechstein (4773)

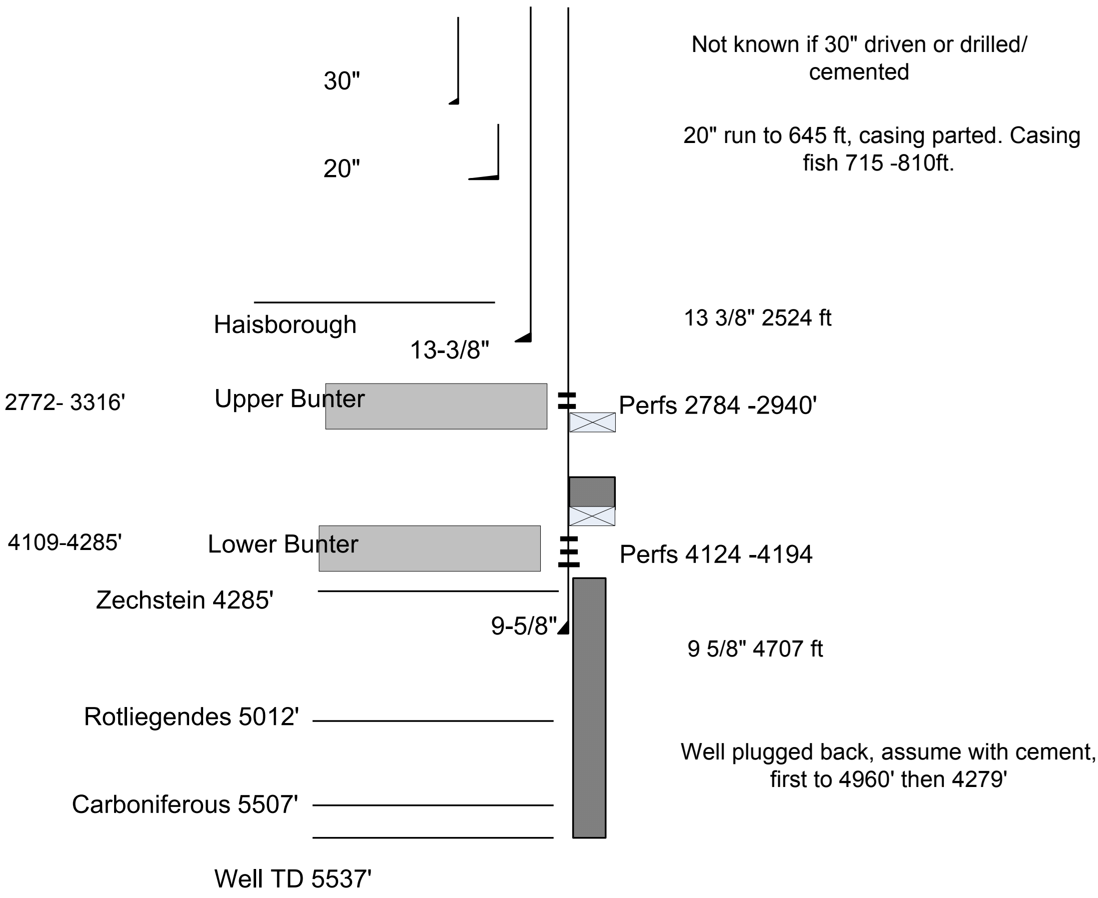
Well 48/29- B10 (Sidetrack of B7)



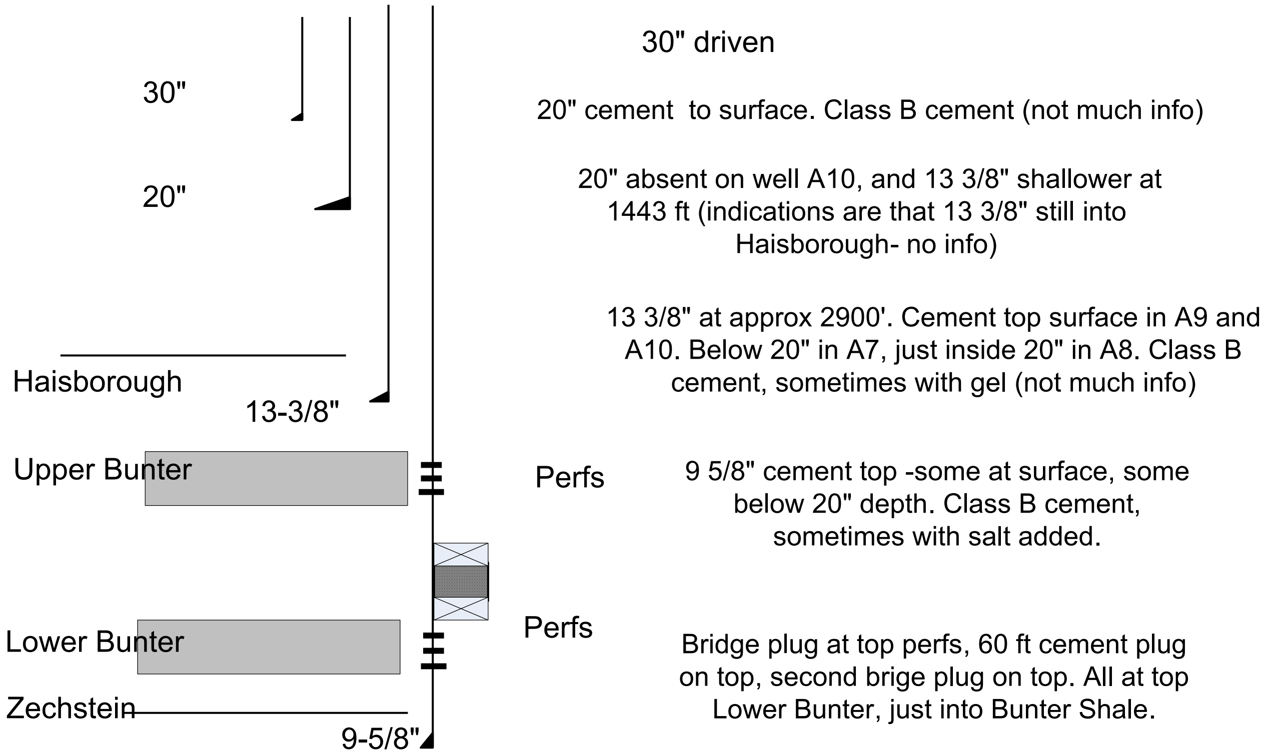

Well 48/29- B11 (Sidetrack of B9 / Sidetrack of B5)
30" (driven)
20" @525'
KO to B11 575 ft
13-3/8" cut 700'
9-5/8" cut 900'
KO Cement plug 547'-900'
Deep saline formation (Winterton) 1300 ft
1700' Haisborough
13-3/8" 2000
13-3/8" @3818'
Cement plug 2900 -3305 (Upper Bunter)
Upper Bunt.
Window: 3670'-3370' (B. Shale)
TOL 3356'
KO Plug: 3782'-3680'
Lower Bunter Perfs squeezed TOC 3791'
L. Bunter
Lower Bunt.
Zechstein
9-5/8" @13561'
9-5/8" @4715' (B5)
7" @ 5240'
Perforations squeezed
Zechsteinkalk
Zechsteinkalk
Perfs squeezed
Leman
Perfs squeezed
7" @19840' (B11)
4-½" @ 7005' (B9)
All casings assumed cemented to surface.

Well 52/5-A1

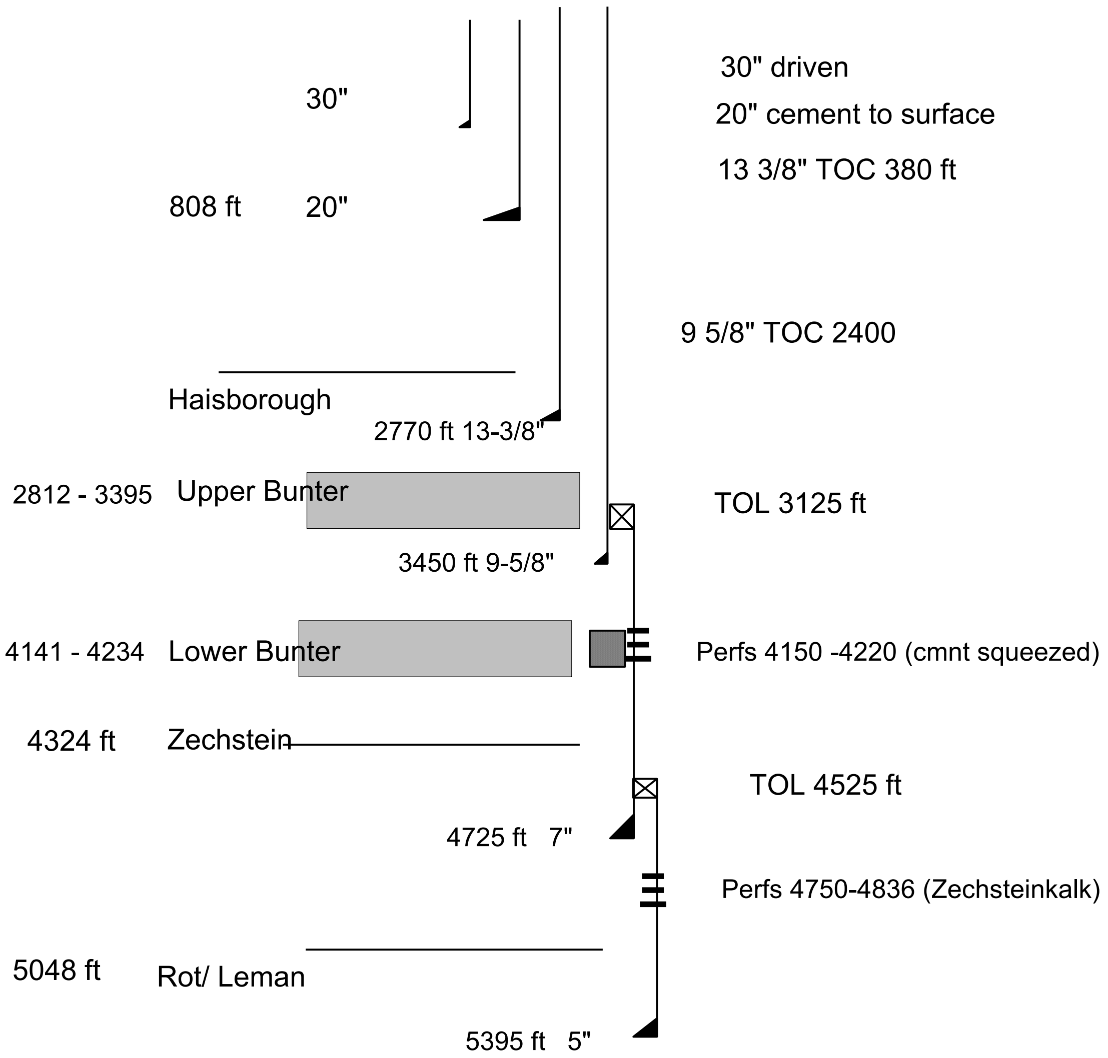
Originally exploration well 52/5-1X, suspended then completed as A1 platform well. No cement or other drilling information. Letter X suggests there may have been sidetracks in original exploration well.



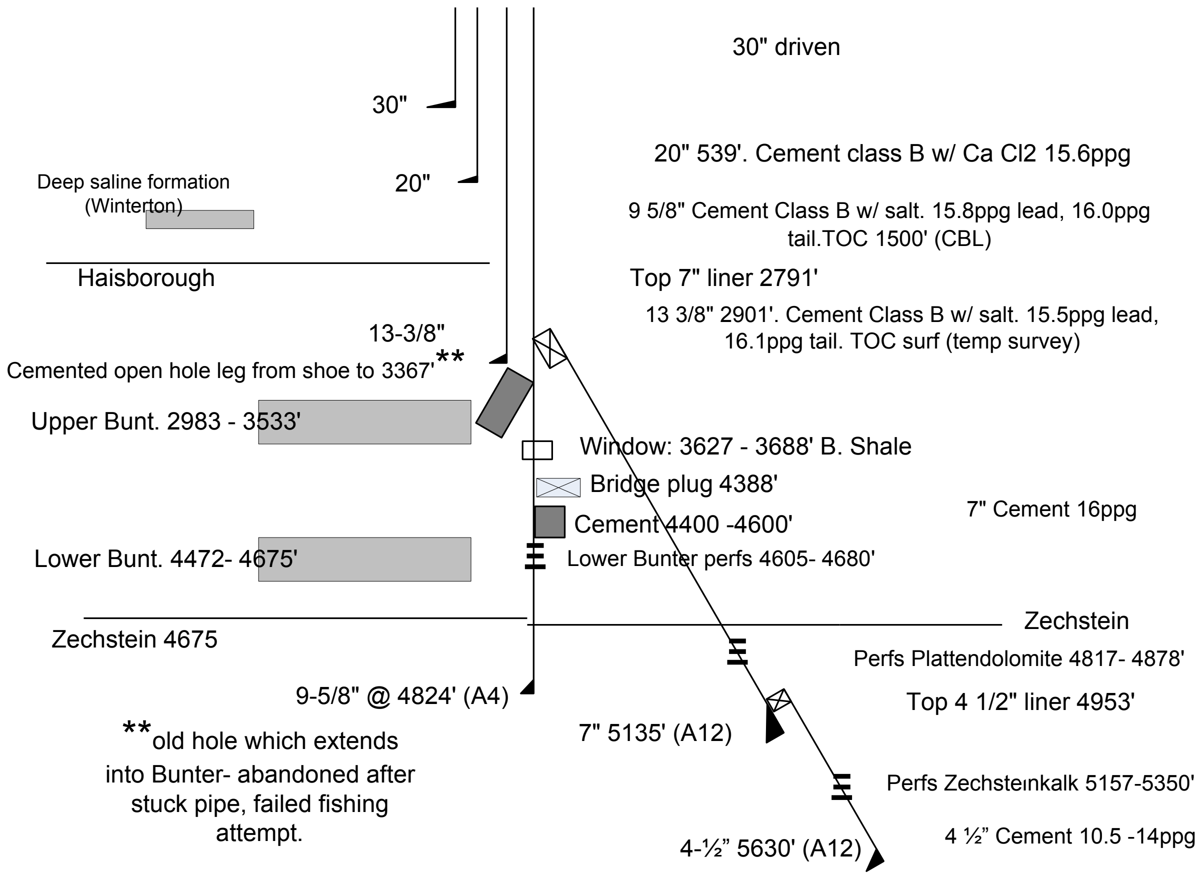
Wells 52/5-A7, A8, A9, A10



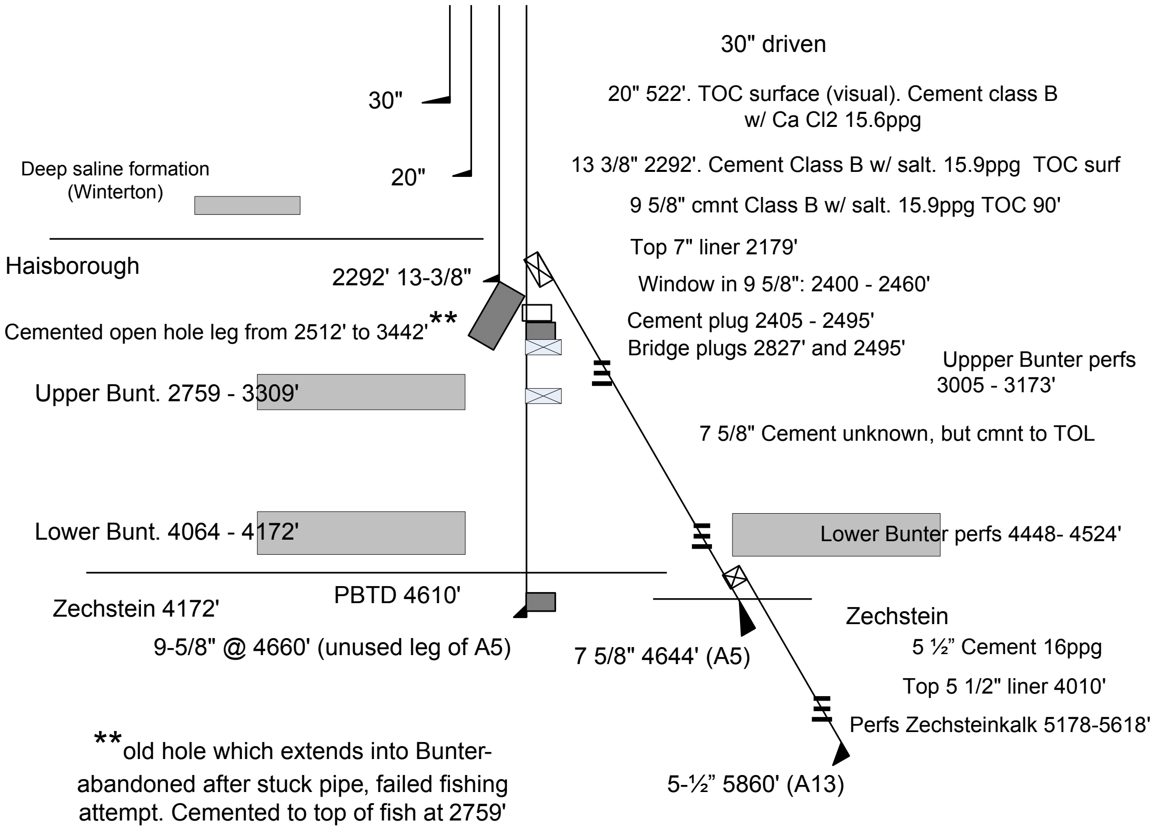
Well 52/5-A11


30" driven
20" cement to surface
13 3/8" TOC 380 ft
30"
808 ft
20"
9 5/8" TOC 2400
Haisborough
2770 ft 13-3/8"
2812 - 3395
Upper Bunter
TOL 3125 ft
3450 ft 9-5/8"
4141 - 4234
Lower Bunter
Perfs 4150 -4220 (cmnt squeezed)
4324 ft
Zechstein
TOL 4525 ft
4725 ft 7"
Perfs 4750-4836 (Zechsteinkalk)
5048 ft
Rot/ Leman
5395 ft 5"

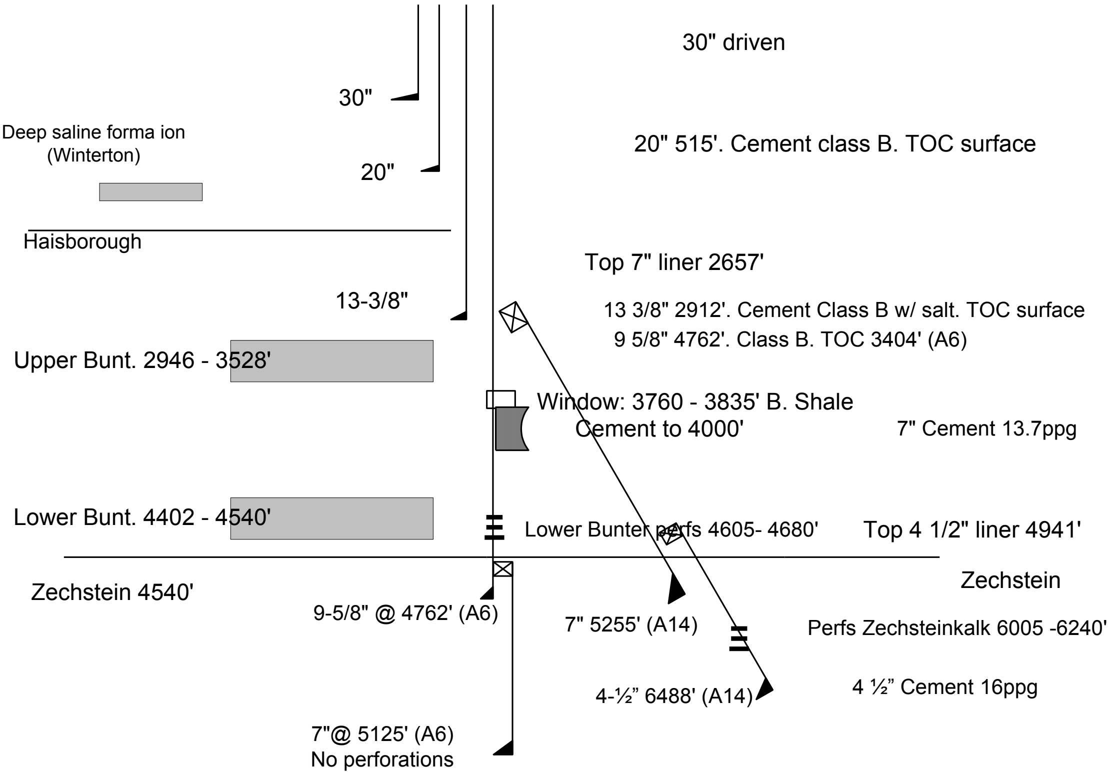
Well 52/5-A12 (ST of A4)



Well 52/5-A13 (deepened from ST of A5)

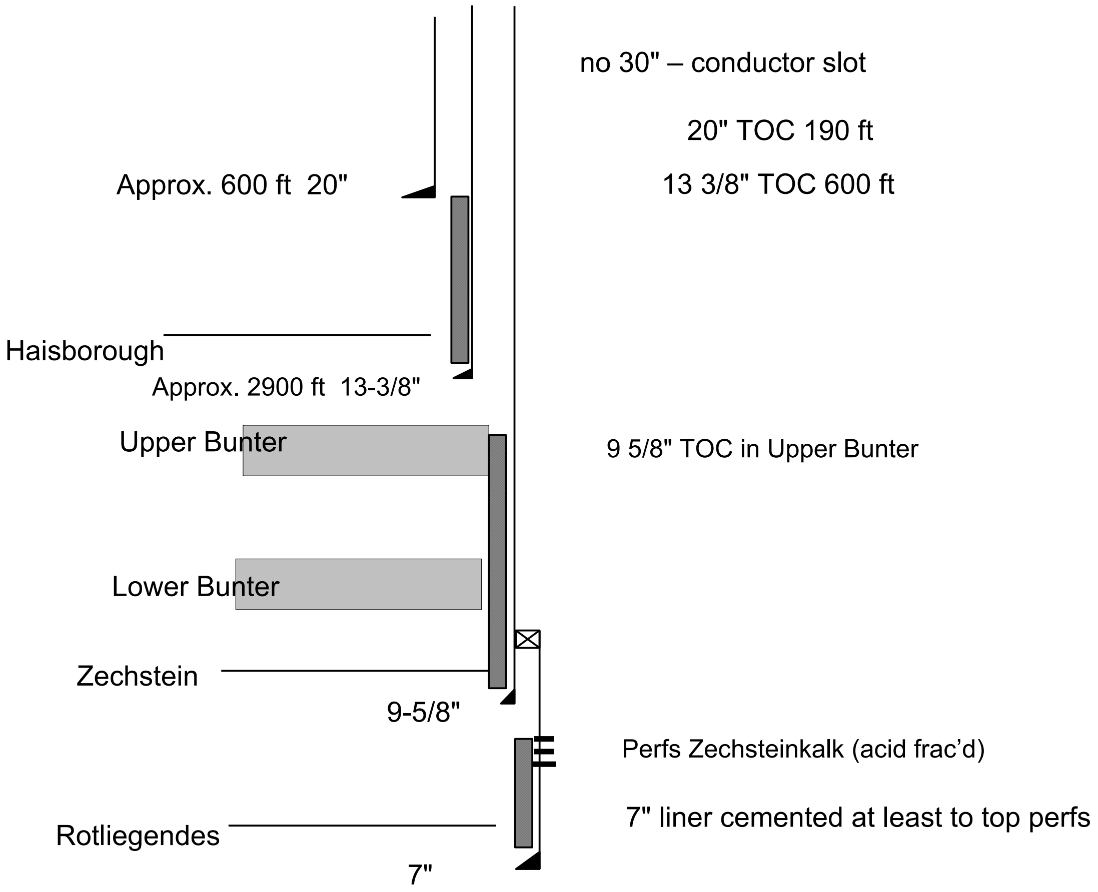


Well 52/5-A14 (ST of A6)

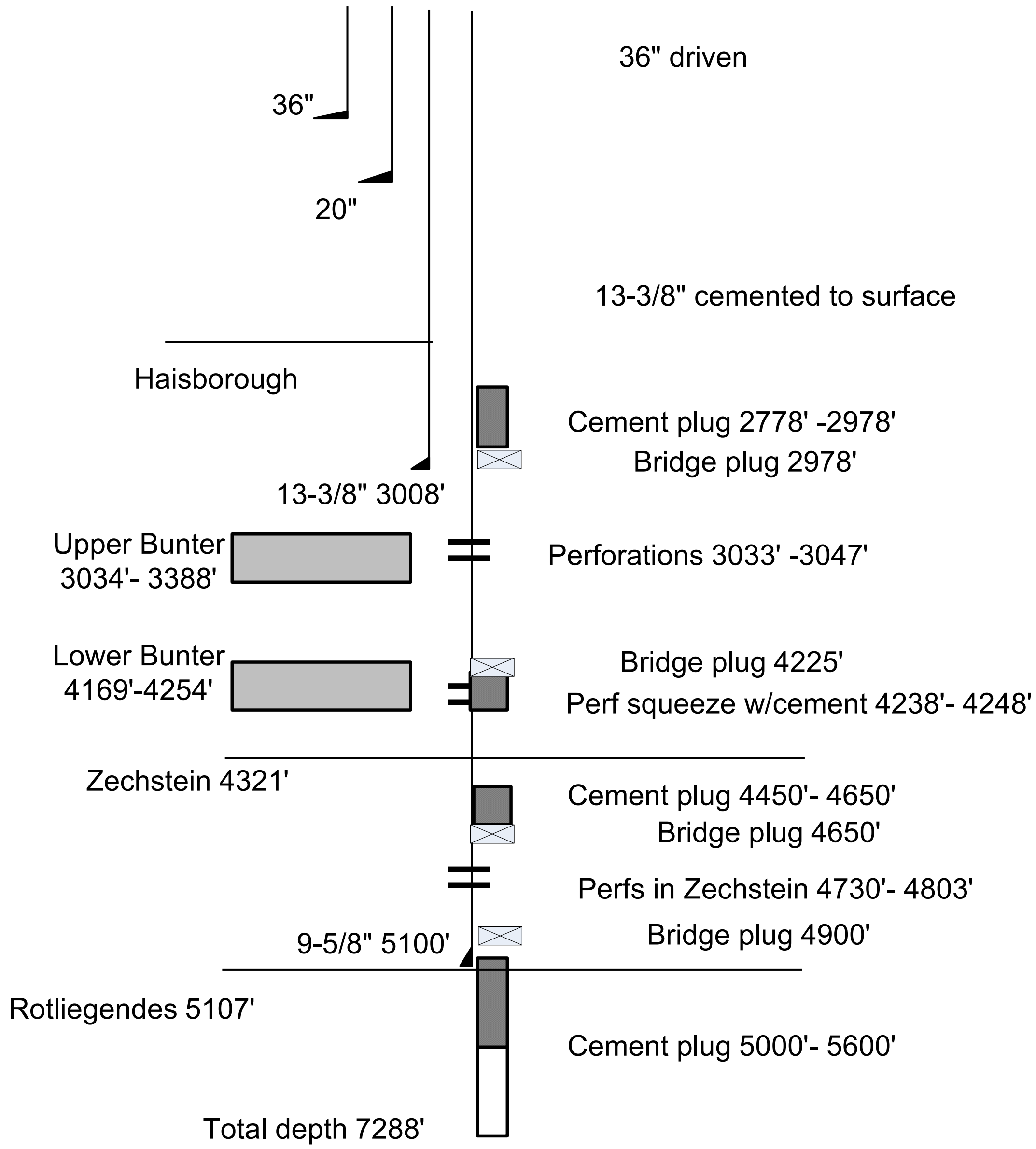


Wells 52/5-A15 and 52/5-A16

High angle wells

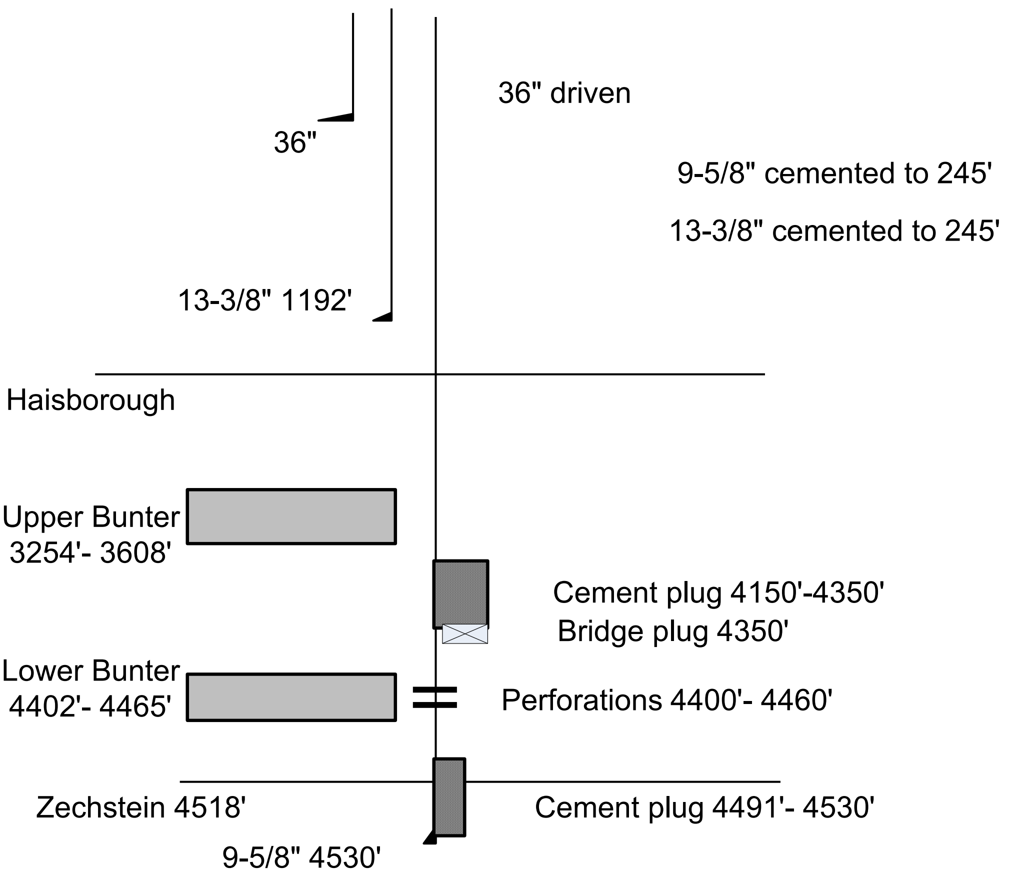


Well 48/29-1



Note that this represents the well after temporary abandonment, casings were cut above seabed and corrosion cap installed. It is assumed that this well has now been permanently abandoned, with casings cut 10ft below seabed. Other plugs may also have been set. There is no record available to RDS of this further permanent abandonment operation.

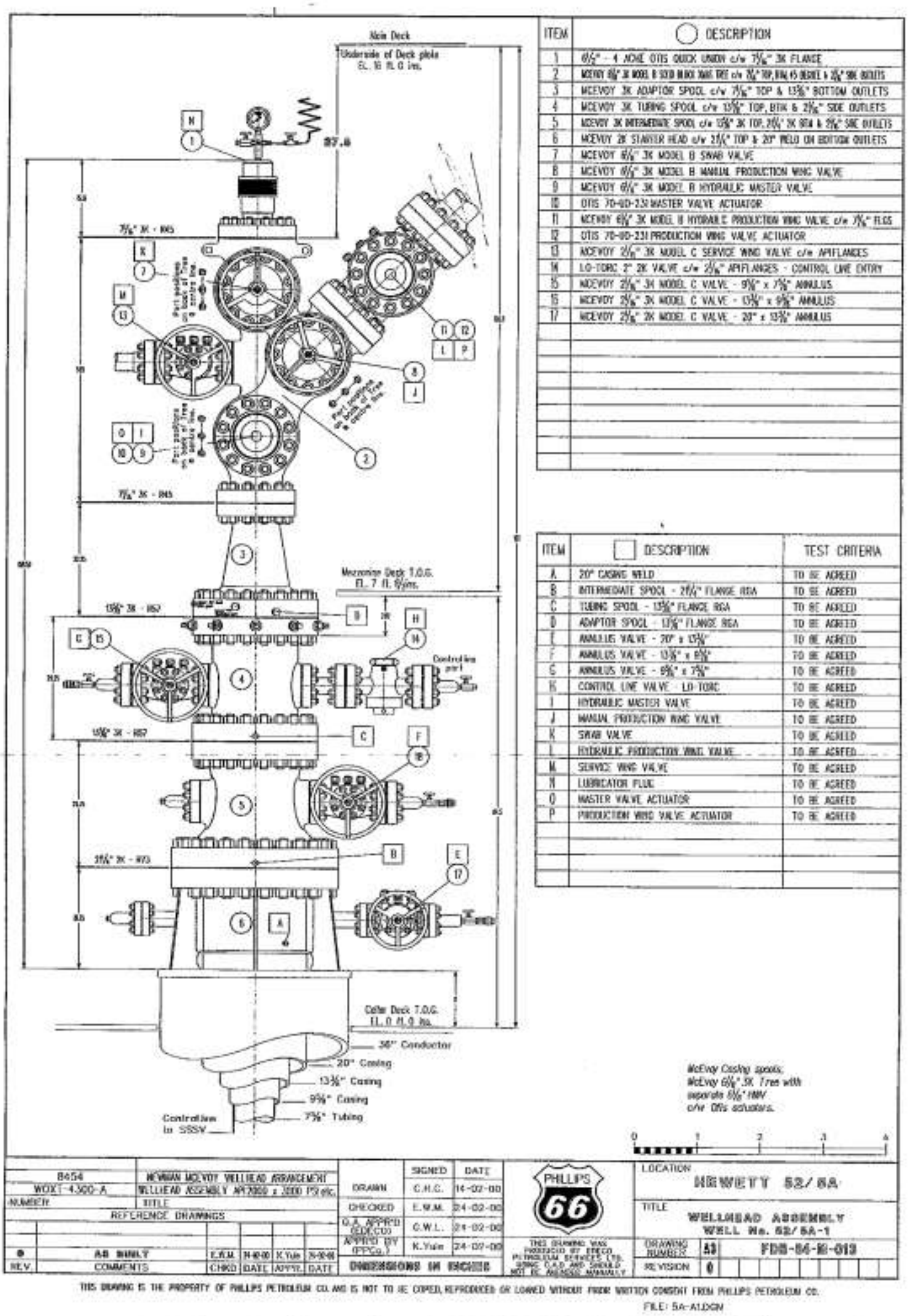
Well 48/29-3



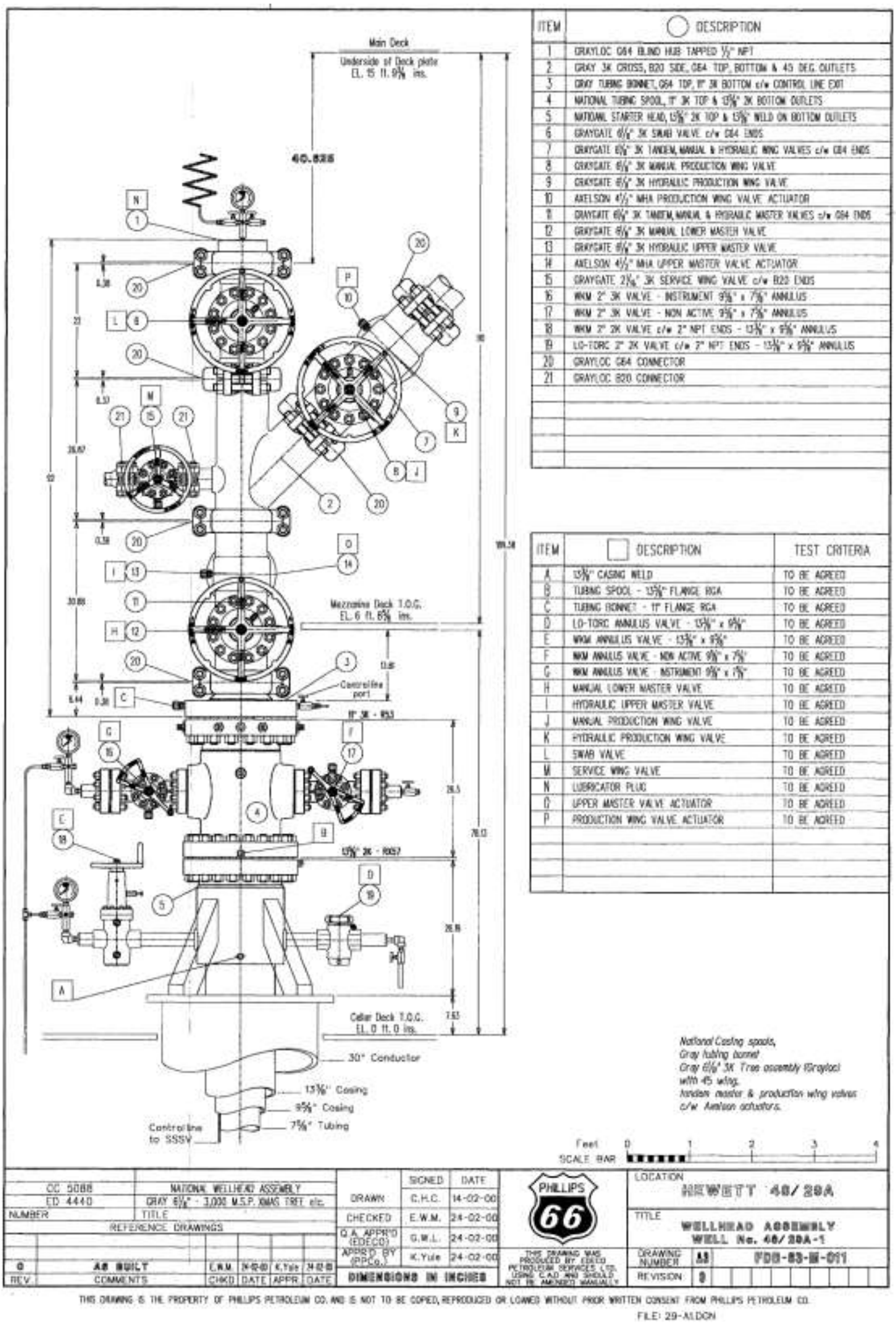
Note that this represents the well after temporary abandonment, casings were cut above seabed and corrosion cap installed. It is assumed that this well has now been permanently abandoned, with casings cut 10ft below seabed. Other plugs may also have been set. There is no record available to RDS of this further permanent abandonment operation.

9 Appendix 2: Wellhead Diagram Examples

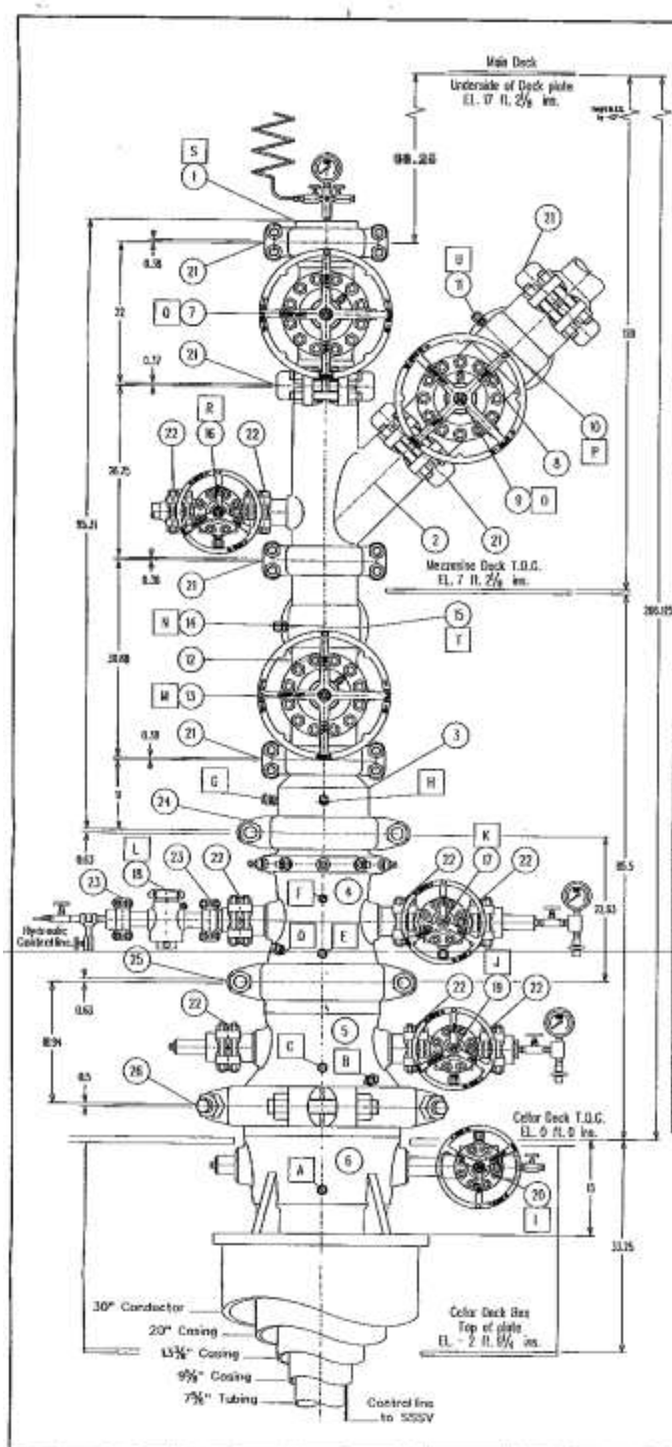
WELLHEAD DIAGRAM PLATFORM 52/5-EXAMPLE



<u>WELLHEAD DIAGRAM PLATFORM 48/29A- EXAMPLE</u>



WELLHEAD DIAGRAM PLATFORM 48/29B- EXAMPLE



ITEM	◯ DESCRIPTION
1	GRAYLOC C64 BLIND HUB TAPPED ½" NPT
2	GRAY 3K CROSS, B20 SIDE, C64 TOP, BOTTOM & 45 DEG. OUTLETS
3	GRAY TUBING BONNET 3K, C64 TOP, M112 BOTTOM c/w INJ. PORTS
4	GRAY TUBING HEAD 3K, M112 TOP, R137 BOTTOM OUTLETS c/w INJ. PORTS
5	GRAY CASING SPOOL 3K, R137 TOP, V210 BOTTOM OUTLETS c/w INJ. PORTS
6	GRAY CASING HEAD 3K, V210 TOP, 20" WELD ON BOTTOM OUTLETS
7	GRAYGATE 6⅛" 3K SWAB VALVE c/w C64 ENDS
8	GRAYGATE 6⅛" 3K TANDEM, MANUAL & HYDRAULIC WING VALVES c/w C64 ENDS
9	GRAYGATE 6⅛" 3K MANUAL PRODUCTION WING VALVE
10	GRAYGATE 6⅛" 3K HYDRAULIC PRODUCTION WING VALVE
11	AXELSON 4½" MHA PRODUCTION WING VALVE ACTUATOR
12	GRAYGATE 6⅛" 3K TANDEM, MANUAL & HYDRAULIC MASTER VALVES c/w C64 ENDS
13	GRAYGATE 6⅛" 3K MANUAL LOWER MASTER VALVE
14	GRAYGATE 6⅛" 3K HYDRAULIC UPPER MASTER VALVE
15	AXELSON 4½" MHA UPPER MASTER VALVE ACTUATOR
16	GRAYGATE 1 13/16" 3K SERVICE WING VALVE c/w B20 ENDS
17	GRAYGATE 1 13/16" 3K VALVE c/w B20 ENDS - 9⅝" x 7⅝" ANNULUS
18	LO-TORC ½" x 1" 3K VALVE c/w CR ENDS - 9⅝" x 7⅝" ANNULUS
19	GRAYGATE 1 13/16" 3K VALVE c/w B20 ENDS - 13⅜" x 9⅝" ANNULUS
20	GRAYGATE 1 13/16" 3K VALVE c/w 2" NPT ENDS - 20" x 13⅜" ANNULUS
21	GRAYLOC C64 CONNECTOR
22	GRAYLOC B20 CONNECTOR
23	GRAYLOC ½" GR CONNECTOR
24	GRAYLOC M112 CONNECTOR
25	GRAYLOC R137 CONNECTOR
26	GRAYLOC V210 CONNECTOR (3 PIECE)

ITEM	☐ DESCRIPTION	TEST CRITERIA
A	20" CASING WELD	TO BE AGREED
B	CASING SPOOL - V210 JOINT	TO BE AGREED
C	CASING SPOOL - 13⅜" CASING PACKOFF	TO BE AGREED
D	TUBING HEAD - R137 JOINT	TO BE AGREED
E	TUBING HEAD - 9⅝" CASING PACKOFF	TO BE AGREED
F	TUBING HEAD - 7⅝" HANGER TWINSEAL	TO BE AGREED
G	TUBING BONNET - M112 JOINT	TO BE AGREED
H	TUBING BONNET - 7⅝" TUBING PACKOFF	TO BE AGREED
I	GRAYGATE ANNULUS VALVE - 20" x 13⅜"	TO BE AGREED
J	GRAYGATE ANNULUS VALVE - 13⅜" x 9⅝"	TO BE AGREED
K	GRAYGATE ANNULUS VALVE - 9⅝" x 7⅝"	TO BE AGREED
L	LO-TORC HYDRAULIC CONTROL LINE VALVE	TO BE AGREED
M	MANUAL LOWER MASTER VALVE	TO BE AGREED
N	HYDRAULIC UPPER MASTER VALVE	TO BE AGREED
O	MANUAL PRODUCTION WING VALVE	TO BE AGREED
P	HYDRAULIC PRODUCTION WING VALVE	TO BE AGREED
Q	SWAB VALVE	TO BE AGREED
R	SERVICE WING VALVE	TO BE AGREED
S	LUBRICATOR PLUG	TO BE AGREED
T	UPPER MASTER VALVE ACTUATOR	TO BE AGREED
U	PRODUCTION WING VALVE ACTUATOR	TO BE AGREED

		SIGNED	DATE
FD 1340 / 3,000 W.S.P. GRAY WELLHEAD ASS'Y. (GRAYLOC)	DRAWN	C.H.C.	14-02-00
NUMBER / TITLE	CHECKED	E.W.M.	24-02-00
REFERENCE DRAWINGS	Q.A. APPR'D (DECCO)	G.W.L.	24-02-00
0 AS BUILT E.W.M. 24-02-00 K.Yule 24-02-00	APPR'D BY (PPCo.)	K.Yule	24-02-00
REV. COMMENTS CHKD DATE APPR. DATE	DIMENSIONS IN INCHES		

PHILLIPS 66

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LOCATION: HEWETT 48/29B

TITLE: WELLHEAD ASSEMBLY WELL No. 48/29B-1

DRAWING NUMBER: A3 FDB-85-M-007

REVISION: 0

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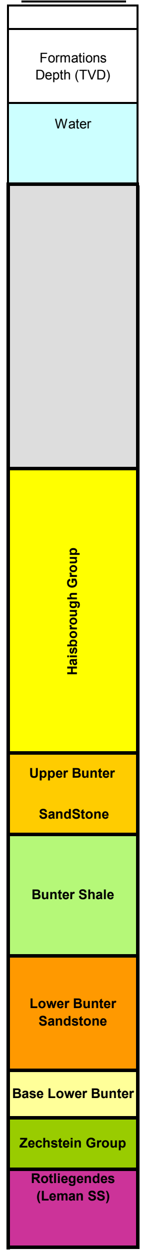
10 Appendix 3: Summary of Existing Wells

Diagrammatic drilling data which was compiled as part of the evaluation.

Hewett Wells



48/29-A1

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
93'					
driven	30"x 294'				
17-1/2"	13-3/8"x1205	TOC= no returns Class B			
*top 2955'					
*base 3363'					
*top 3363'				3960' (SQ)	lost drif assembly plugged back open 9-5/8" casing shoe
		TOC=rts		4093'-4293'	
*base 4380'		class B		4085-4223 (J98)	
12-1/4"	9-5/8"x 4441				
*base 5024'					
8-3/8"					TD=5100'

48/29-A2

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
73					
driven	30"x294'		9.4		
		TOC GRTS			
	13-3/8"x54.5ppfxJ55	Cement B with 3.5% gel & Class B Neat Cement			
17-1/2"	13-3/8"x1694'		9.4		(TVD=1627')
top 1602'					
				1680-1682' (SQ)	
				3160-3162 (SQ)	
*top 3224'					
*base 3665'					
		TOC= GRTS gel & Class B Neat Cement			
				4020-4022 (SQ)	
	TOC= GRTS				
	Hole: 12-1/4"			4485-4575 (J99)	
top 4523'	9-5/8"x40ppfxJ55			4520-4675 (J99)	
base 4696'	9-5/8"x 4807'		10.3-10.8	4506-4681 (J99)	TD=4807' (4457' TVD)

ZG top 4796'

48/29-A3

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
73					
driven	30"x294'				
		TOC GRTS			
	13-3/8"x54.5ppfxJ55	Cement B with 3.5% gel & Class B Neat Cement			
17-1/2"	13-3/8"x1750'		9.4-9.6		(TVD=1687')
				3088-3090 (SQ)	
*top 3178'					
*base 3627'					
		TOC= GRTS			
		Cement B with 3.5% gel & Class B Neat Cement			
	Hole: 12-1/4"			4418-4420 (SQ)	
top 4498'	9-5/8"x40ppfxJ55			4478-4620	
base 4633'	9-5/8"x 4775'		9.5-10.7	4478-4620 (J98) ??	TD=4775' (4396' TVD)

ZG top 4770'

48/29-A4

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
73					
driven	30"x294'				
	13-3/8"x54.5ppfxJ55	TOC GRTS			
top 1572' 17-1/2"	13-3/8"x1793'	Cement B with 3.5% gel & Class B Neat Cement	9.6		(TVD=1745')
				3000-3002 (SQ) 3080-3082 (SQ)	
*top 3159' *base 3637'					
	Hole 12-1/4"	TOC= GRTS		4420-4422 (SQ)	
top 4535' base 4657'	9-5/8"x40ppfxJ55 9-5/8"x4770'	Cement B with 3 5% gel & Class B Neat Cement	9.6-10.8	4484-4626 4484-4612 (RP)	**TD=4780' (4374' TVD)**

ZG top 4776'

48/29-A5

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
73					
driven	30"x294'				
		TOC GRTS			
top 1568' 17-1/2"	13-3/8"x1810'	Cement B with 3.5% gel & Class B Neat Cement			At 1680' plugged flowline (TVD= 1755)
				3040-3042 (SQ)	
*top 3138' *base 3590'					
	Hole 12-1/4"	TOC= GRTS		4335-4337	
top 4407' base 4599'	9-5/8"x40ppfxJ55 9-5/8"x 4720'	Cement B with 3.5% gel & Class B Neat Cement		4413-4573	**TD=4720' (4355' TVD)**

ZG top 4716'

48/29-A6

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
73					
driven	30"x294'				
		TOC GRTS			
17-1/2"	13-3/8"x1724'	Cement B with 3.5% gel & Class B Neat Cement	9.3		(TVD= 1649')
				3000-3002' (SQ2)	
*top 3286' *base 3728'					
	Hole 12-1/4"	TOC= GRTS			
top 4552' base 4712'	9-5/8"x40ppfxJ55 9-5/8"x4811'	Cement B with 3.5% gel & Class B Neat Cement	9.3-10.8	4415-4417' (SQ) 4511-4681	hole. Fish recovered **TD= 4811' (4406' TVD)**

ZG top 4806'

48/29-A7

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
73					
driven	30"x294'				
		TOC GRTS			
top 1574'	13-3/8"x54.5ppfxJ55				
17-1/2"	13-3/8"x 1760'	Cement B with 3.5% gel & Class B Neat Cement	?		(TVD= 1698')
				3047-3049 (SQ3)	
"top 3125'					
"base 3594'					
	Hole 12-1/4"	TOC= GRTS		4332-4334'	
top 4466'	9-5/8"x40ppfxJ55	Cement B with 3.5% gel		4421-4539'	
base 4561'	at 4725'	Class B Neat Cement	?	4460-4528 (J99)	**TD= 4725' (4340' TVD)**

ZG top 4718'

48/29-A8

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
73					
driven	30"x294'				
		TOC GRTS			
	13-3/8"x54.5ppfxJ55				
17-1/2"	13-3/8"x 1725'	Cement B with 3.5% gel & Class B Neat Cement	9.5		(TVD=')
				3036-3038 (SQ)	
"top 3131'				3047-3049 (SQ)*	
"base 3593'					
	Hole 12-1/4"	TOC= GRTS			
LW top 4501'	9-5/8"x40ppfxJ55	Cement B w/3.5% gel		4346-4348 (SQ)	
LW base 4629'	9-5/8"x 4749'	Class B Neat Cement	9.5-10.8	4449-4515	**TD= 4750' (4328' TVD)**

ZG top ?

* this perf does not appear on EOWR just in Status

48/29-A9 (sidetrack of A4)

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
75					
driven	30"x294'				
		TOC GRTS			
17-1/2"	13-3/8"x1793'	Cement B with 3.5% gel & Class B Neat Cement	9.6		(TVD=1745')
*top 3159'					
*base 3637'			OBM		
		TOC= GRTS			
12-1/4"	9-5/8"x3860'	Cement B with 3.5% gel & Class B Neat Cement	9.6-10.8		TVD=3577' WINDOW
	Hole 8-1/2"	Cement Pozo 13.8 ppg			
top 4560'	26&29 ppf- J55&L80	w/econolite, HR4L	OBM		
base 4780'	7-5/8"x4838'	&defoamer	9.6-10.8		TVD=4282'
top 4815'					
	17ppfxL80	Cement Pozzo	OBM	* 5620' -6265	
12-1/4"	5-1/2"x6637'	w/Halad 361A &defoamer	9.6-10.8	*5546-6191	TD=6637' (4801' TVD)

* two different reports of perforations depths

48/29-A10

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
74					
			Bent mud		
17-1/2"x26"x32"	20"x26"x30" x771	Cement 12.7 light XL cement slurry	10		
1550					
	72ppf		LTOBM		
17-1/2"	13-3/8"x3475		9.2 - 9.9		Losses while cementing
3806					
5105					
12 1/4" X	65ppf	16ppg slurry	LTOBM		
14-1/4"	11-3/4"x5596'		7.7 -8.1		shoe diff stuc at 5595'
8243					
		Lead cement 12.5ppg	LTOBM		
12-1/4"	47 ppf L80	Tail 16 ppg	8.75		
8665	9-5/8"x8777'		-8.9		
8950					
	32 ppf		LTOBM		
8-1/2"	7" x 9931'		9.1		
10890					

Well TD 11240 ft

48/29-B1					1973
Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
	30"	driven			
	20" x 615'				
top 1682'	13 3/8" x 1902'				
top 2940'				2990-3010	
top 3283'					
top 4048' shaly towards TD)				4052-4112 (4085-4223??? 1998)	
top 4255'	9-5/8"x4278'				TD= 4288' (vertical well)

Inj trial to U. Bunter failed

48/29-B2					
Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
	30"x340'	driven			
26"	20"x133ppfxJ55 20"x530'				
	13-3/8"x61ppfxJ55	TOC GRTS; 15.6 ppg class B cement			
17-1/2"	13-3/8"x1968'		8.8-9.6		(TVD= 1905')
top 3176' base 3568'					
	Hole 12-1/4"				
top 4415' base 4623'	9-5/8"x36ppfx? 9-5/8"x40ppfxJ55	TOC= ? 19.2 ppg		4455-4485 4485-4515	
top 4623'	9-5/8"x4696'	Class B cement	9.2-9.8		TD= 4715' (TVD= 4345')

top Haisborough unknown- no geol info above 13 3/8" 4430-4511 (A97)

48/29-B3					
Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
driven	30"x340'				
26"	20"x133ppfxJ55 20"x530'				
17-1/2"	13-3/8"x61ppfJ55 13-3/8"x1986'	TOC GRTS; 15.6 ppg class B cement	9.2		(TVD=1956')
top3076' base 3468'					
top 4337' base 4582'	Hole 12-1/4" 40ppf x J55&K55	TOC= ? 15.2 ppg		4432-4372 4388-4468 (Ag97)	
	9-5/8"x4691'	Class B cement	9.5-9.6		TD= 4700' (4341')

top Haisborough unknown- no geol info above 13 3/8"

48/29-B4

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
110'					
driven	30"x340'				
	20"x133ppfxJ55	15.6 ppg slurry			
26"	20"x525'	Class B Cement			
		TOC ? ; 15.6 ppg			
	13-3/8"x61ppfxJ55	class B cement			
17-1/2"	13-3/8"x1990 '		9.2-9.7		(TVD= 1894')
top 3206'					
base 3592'					
top 3474'		TOC=?			
	Hole 12-1/4"	15.2 ppg slurry		4505-4580'	
base 4712'	40ppfxJ56	Class B Cement	9.7-10.9	4500-4580 (A97)	**TD= 4776' (TVD= 4362')**
ZG top 4712'	9-5/8x 4755'				

top Haisborough unknown- no geol info above 13 3/8"

48/29-B5

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
110					
driven	30"x340'				
		15.6 ppg slurry			
26"	20"x525'	Class B Cement			
		TOC GRTS			
		15.6 ppg slurry			
17-1/2"	13-3/8"x2000'	Class B Cement			(TVD= 1889')
top 3254'					
base 3613'					
top 4423'	Hole 12-1/4"			4450-4465	
top 4662'		TOC=?		4470-4545	
top 4662'	9-5/8"x 4715'	Class B Cement	9.7-10.9		**TD= 4725' (TVD= 4371')**

later ST (B9)

top Haisborough unknown- no geol info above 13 3/8"

48/29-B6

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
110'					
driven	30"x340'				
	133ppf x J55				
26"	20"x532'				
	61ppf x J55	TOC ; 15.6ppg			
17-1/2"	13-3/8"x2003'	class B cement	9.2-9.5		(TVD= 1889')
	7 5/8" liner top 2885'				
top 3213'				3264-3320 (?)	
base 3618'					
	7 5/8" shoe 4772'				
top 4540'	Hole 12-1/4"				
	40ppfxJ55 (118 j)	TOC=2200'		4573-4648'	
	36ppfxK55 (10 j)	15.2ppg slurry		4580-4660 (A97)	
top 4773'	9-5/8"x 4862'	Class B cement	9.6-9.8		**TD= 4871' (TVD= 4374')**

top Haisborough unknown- no geol info above 13 3/8"

Aug78- recompleted to allow flow from both U and L Bunter

1982- switched from Lower to Upper Bunter

1984- ran/ cemented 7 5/8" liner to cover all perfs. Re-perf'd 4573-4648'

1997- re-perf'd 4580-4660'

48/29-B7

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
110'					
driven	30"x340'				
26"	133ppfx J55 20"x532'				
17-1/2"	61ppfx J55 13-3/8"x2001'	15.6ppg class B cement	9.2-9.5		(TVD= 1926')
top 3172' base 3570'					
top 4446' base 4651'	40ppfxJ55 (112j) 36ppfxK55(10j)	TOC=GCRS; 15.2ppg		4480-4555	
top 4651'	9-5/8"x 4686'	Class B cement	9.6-9.8		**TD= 4701' (TVD= 4313')**

top Haisborough unknown- no geol info above 13 3/8"

Later ST (B10)

48/29-B8

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
110'					
driven	30"x340'				
26"	133ppfx J55 20"x541'	TOC: surface 15.6 ppg Class B Cement	9.3		
17-1/2"	61ppfx J55 13-3/8"x2011'	TOC: surface 15.6ppg class B cement	9.6		(TVD= 1907')
top 3238' base 3633'					
	Hole 12-1/4"	TOC=1650'			
tope 4468'	40ppfxJ55 (113j) 36ppfxK55(10j)	15.2ppg Class B+ Cement		4525-4600	
top 4705'	9-5/8"x 4702'	0.7% D31	9.8	4510-4630 (Ag97)	**TD= 4750' (4327')**

top Haisborough unknown- no geol info above 13 3/8"

TD in Zech, 9 5/8" csg shoe in Bunter

48/29-B9 (sidetrack of B5)

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
110					
driven	30"x340'				
26"	20"x525'				
17-1/2"	TOC GCRS; 15.6ppg class B cement 13-3/8"x2000'				(TVD= 1889')
top 3254' base 3613'					
	9-5/8"x3670'				
					WINDOW cut in Bunter Shale 3670' to 3770'
top ~ 4640' base ~5036'	Hole 8-1/2" Hanger at 3356' 29ppf x N80	TOC~5445' 14ppg slurry			
top 5036	7"x5240'	Pozzocemoil cement	8.5-8.7		
					A total of 11 coring runs were done to get 488' of Zechsteinkalk
	Hole 6" Hanger at 4927'	TOC= hanger		6125'-6160' 6375'-6400'	
top 6591'	12.6ppf x L80 4-1/2"x7005'	14.8 ppg slurry Pozzocemoil cement	9.0-9.1	6592'-6620'	2 DPs lost in hole. Recovered. **TD= 7015' (TVD= 5313')**

top Haisborough unknown- no geol info above 13 3/8"

6066-6101?	Zechsteinkalk target
6316-6341?	Zech. Perfs killed.
6533-6561?	Completed in Rotliegendes.

48/29-B10 (sidetrack of B7)

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
110'					
driven	30"x340'				
26"	20"x532'				
	TOC ; 15.6ppg				
	class B cement				
17-1/2"	13-3/8"x2001'		9.2-9.5		(TVD= 1926')
top 3172'					
base 3570'					
	9-5/8"x3750'				WINDOW cut in Bunter Shale (3693'- 3793')
					FIT=11.7ppg
			OBM		
			8.1-8.6		
					At 4710' dynamic losses
top ~4895'					
		TOC 5631'			AT 5081' Total losses
	Hanger at 3300'	13.2 ppg slurry			
	29ppf x P110	Pozzolan cement			
top 5506'	7x5725'				
					At 7020' 90ft of core was taken. Losses while coring.
	Hole 6"			6980-6990	
	Hanger at 5225'	TOC=5000'		7040-7050	
	38&49ppf x L80	14ppg slurry	**OBM**	7100-7110	
6"	**4 1/2"x5 1/2x8435'**	Pozzolan Cement	**9.1-9.3**	7340-7360	**TD=8500' (4901')**
	TD 8500'				Zechsteinkalk target

48/29-B11 (sidetrack of B9/ B5)

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
117'					
	133ppfxJ55				
	20x559'				WINDOW was cut below the 20" shoe
			8.6 ppg		
			Plymer Flowzam		From 1000 to 1500 plugged flow line
top 1700'					
	72ppfxL80	16ppg slurry	OBM		
16"	13-3/8"x3818'	Class G Cement	8.8-9.2		
top 4350'					Losses at several points
					Excessive drag, reaming, losses, hole packed off
base 6979'					
				7340-7360 (?)	
	Hole 12-1/4"				
top 11222'		13.2 ppg slurry			
		Tail= 16ppg	OBM		
		Class G Cement	8.9-9.0		
top 11854'	53.5ppfxL81				'Total losses at TD and
	9-5/8"x13561'				when runng csg/cmnting
	Hole 8-1/2"			14565-14899	
				[illegible]	
	29ppfxL80	16 ppg	OBM	16069-17023	**Rotlieg target**
				17223-18642	**TD= 19840**
	7"x19830'	Class G Cement	8.0-8.7	19171-19550	**(TVD: 4825')**

52/5-A1

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Other info
driven?	30" or 36"			
	20" parted at 645'. 715-810'			
	13 3/8" 2524			
top 2772'			2784-2814/2856-2886	U. Bunter perforated 1973
			2902-2912 / 2918-2928	
base 3316'			2930-2940	
				Bridge plug 3000
				Cement plug 4035 -4099
				Plugs 4112 &4105
top 4109'			4124-4194	L. Bunter perforated 1968.
top 4285'				
	9-5/8"x 4707'			
top 5012'			4983- 5062'	

Carbonifeous top 5507'

Well TD 5537'

Well plugged back (presume cement) to 4960'

Well later plugged back (assume cement) to 4279', inside 9 5/8"

52/5-A4

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
77	5/8" wall				
driven	30"x301'				
	133ppfxJ55	15.6ppg slurry			
26"	20"x539'	Class B w/2%CaCl	sea water		
		no returns to surf. TOC=50 RKB (temp survey)			
	68ppfxJ55	15.5-16.1 ppg slurry			
	61ppfxJ55	Cement Class B			
	13-3/8"x2901'	w/18%NaCl 1.25%CFR2	10.2ppg		TVD=2707'
top 2983'				2909-2911(sq)	Sidetracked OH due to stuck pipe, 3367'.
				3080-3110 (73)	Set 2 cement KO plugs 3205 to 2844'
base 3533				3130 - 3324 (76)	
					1973 - 'bridge plug 4388. cmnt plug 4474 -4400
					and cmnt plug 4500 -4600. Fish between plugs.
		From CBL good cement from 1500' to TD			
top 4472'	Hole 12-1/4"	TOC=1255'		4490-4492 (SQ)	
base 4675	36ppfxJ55 (3j)	15.8-16 ppg slurry		4605-4615	
	40ppfxJ55 (93j)	Cement Class B		4615-4680	
12-1/4"	9-5/8"x4824'	w/18%NaCl 1.25%CFR2	10.9 ppg		TD=4825' (4302TVD)

52/5-A5

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
77					
driven	30"x?	5/8" wall			
	133ppfxJ55	15.6ppg slurry TOC:surf			
26"	20"x522'	Class B w/2%CaCl	sea water		
		TOC= surface (vis)			
		15.9 ppg slurry			
	61ppfx68ppf J55	Cement Class B			
17-1/2"	13-3/8"x2292'	w/18%NaCl 1.25%CFR2	11		TVD=2198'
	9 5/8" x 2400	TOC surface (visual)			Patched @100 ft window in 9 5/8" 2400 ft
				2850-2851(SQ)	
top 2759'					
base 3309'				3005-3173	
					original hole ST due to fish in hole 3442 (B. Shale)
			Saturated flosal mud		95/8" casing set 4660' (Zech), abandoned due to fish, ST in 8 1/2" fm window
top 4064'			10.8		
base 4172'	Hanger= 2179'			4325-4336(SQ)	BLOW OUT when drilling 8 1/2"
tope 4172'	Hole 8-1/2-10"			4448-4524	
	26.4ppfx grade?	TOC=top liner			
	7-5/8"x 4644'	Cement?	tvd=4256'		TD=4661

formation tops weird?

52/5-A6

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
77					
driven	30"x?				
26"	133ppfxJ55 20"x515'	TOC:6' Class B			
17-1/2"	61ppfx68ppf J55 13-3/8"x2912'	TOC= surface Cement Class B w/18%salt	10.2-10.6	2914-2915	
top 2946' **base 3528'**				2985-3045/3094-3124	
				4320-4321	
top 4402' **top 4540'**	40 & 36ppfxJ55 **9-5/8"x 4762'**	TOC = 3404' used centralizers Class B Cement	10.6-10.7	4452-4522	
	Hanger 4684' 36&40ppfxJ55 **7"x5125'**	TOC=liner top (4684') Class B Cement	10.5-10.7	Perfs?	Coring from 5250' String stuck while coring. Pulled whole fish. **TD= 5397' (?)**

52/5-A7

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
77					
driven	30"x303'				
26"	133ppfxJ55 20"x518'	TOC=Surf Class B Cement			
17-1/2"	Hole 17-1/2" 61&68ppfx J55 13-3/8"x2900'	TOC=940' Cement Class B	10-10.8		TVD=2743'
top 2957' **base 3509'**				2970-3060' 3110-3140	Recompleted- U. Bunt. Perfs 1973
					Bridge plug 4430 Cemnt plug 4442-4492
top 4410' **base 4611'** **12-1/4"**	Hole 12-1/4" 40 & 36ppfxJ55 **9-5/8"x 4686'**	TOC = 119' Class B Cement	10.2-10.4	4470-4510	Perfs 1968 **TD=4692' (TVD=4093')**

52/5-A8

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
77					
driven	30"x303"	5/8" wall			
26"	133ppfxJ55 20"x514'	TOC=Surf Class B Cement			
17-1/2"	61&68ppfx J55 13-3/8"x2922'	TOC=430' Cement Class B	9.3-10	3069-3109	tvd=2708'
top 3015' **base3665'**				3130'-3145' 3192-3222	Recompleted 1973- Perfs U. Bunt
					Bridge plug 4493 Cemnt plug 4554- 4580
top 4459' **base 4661'** **12-1/4"**	Hole 12-1/4" 40 & 36ppfxJ55 **9-5/8"x 4828**	TOC = 6.30' 18% salt 15.9ppg Class B Cement	10.5	4570-4650	Perfs 1968 **TD=4928' (TVD=4509')**

52/5-A9

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
77					
driven	30"x304'	5/8" wall			
	133ppfxJ55	TOC=Surf			
		Class B Cement			
26"	20"x510'	w/2%CaCl2			
		TOC=Surf			
	61&68ppfx J55	Diacel D			
		Cement Class B			
17-1/2"	13-3/8"x2936'	w/8%gel	10.2-10.8		TVD=2786
					Recompletion
top 2942'				2940-2942	U. Bunt. Perfs 1973
				3130-3160	
base 3550'					
					Bridge plug 4295
					Cemnt plug 4371-4344
	TOC=1600'				
				4378-4379 (SQ)	
top 4383'				4440-4522	
base 4547'	Hole 12-1/4"	TOC =1600'			
	40 & 36ppfxJ55				
12-1/4"	**9-5/8"x 4750'**	Class B Cement	10.8-11.1		**TD=4780'**

52/5-A10

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
driven	30"x303'	5/8" wall			
	61ppfx J55	TOC= surface			
17-1/2"	13-3/8"x1443'	Class B Cement	10.3		
				1450-1451(SQ)	
				2900-2901 (SQ)	
					Recompletion
top 2999'				3052- 3207	U. Bunt. Perfs 1973
base 3605'					
					Bridge plug 4374
				4340-4341 (SQ)	Cement plug 4375- 4395
		12.6-17ppg slurry			
top 4379'		TOC=surface		4410- 4500	Perfs 1968
base 4530'	36&40ppf x J55	8% gel & 18% salt			
12-1/4"	9-5/8"x 4693'	Class B Cement	10.2-10.4		**TD=4700' (TVD=4383')**

52/5-A11

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
driven	30"x325'				
	133ppfxJ55	TOC=surf	Hi-Vis Ben		
26"	20"x808'		8.6-8.7		
17-1/2"	68ppfxJ55		Seawater		
	13-3/8"x2770	TOC~380'	Drispac		
			8.6-9.6		
'top 2812'					'TVD=2759'
	Hole 12-/4"				
base 3395'	43.5ppfxL80	TOC~2400'	OBM		
	9-5/8"x3450'		6.9-7		TVD=3504'
top 4141'					
base 4234'				4150 -4220 (SQ)	
top 4324'	Hole 8.5"				
	Hanger 3125'	TOC 3125'			
	29ppfxL80		Fazekleen		
	7"x 4725'	CEMENT INFO???	8.5-9.6		TVD=4714'
	Hole 6"			4750 - 4836	
base 5048'	hanger 4525'		CaCO3		
top 5048'	18ppfxL80	TOC 4525	Drispac		
	5"x5341'		9.5-9.7		TD=5348'

52/5-A12 (sidetrack of 52/5-A4)

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
77	5/8" wall				
driven	30"x301'				
	133ppfxJ55	15.6ppg slurry			
26"	20"x539'	Class B w/2%CaCl	sea water		
		TOC=50'RKB			
	68ppfxJ55	15.5-16.1 ppg slurry			
	61ppfxJ55	Cement Class B			
	13-3/8"x2901'	w/18%NaCl 1.25%CFR2	10.2ppg		TVD=2707'
12-1/4"	9-5/8"x3688'				Window in 9-5/8" 3627' - 3686'
					KO plug details unknown
Hole 8 1/2"	Hanger 2791'				
	Hole 8-1/2"				
			OBM		
	29ppfx C75	16ppg slurry		4817'- 4898' (Platten)	
	7"x 5135'	Class G Cement			
	Hanger 4953'		Salt Saturated		FIT 11ppg
Hole 6"	11.6ppfxC75	10.5-14ppg	Polymer mud	5157-5350' (Zech'calk)	
	4-1/2"x5630'	PozMix Cement			TD=5630'

52/5-A13 (deepened from ST leg of 52/5-A5)

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other Info
driven	30"x303'				
	133ppfxJ55	15.6ppg slurry TOC:surf			
	20"x522'	Class B w/2%CaCl			
		TOC= surface (vis)			
		15.9 ppg slurry			
	61ppfx68ppf J55	Cement Class B			
	13-3/8"x2292'	w/18%NaCl 1.25%CFR2		window in 9 5/8" 2400 ft	
	9 5/8" x 2400	TOC surface (visual)			
top 2759'				2850- 2851(SQ)	
base 3309'				3005- 3173(SQ)?	
top 4064'					
base 4172'	Hanger= 2179'				
top 4172'	Hole 8-1/2-10"			4325- 4336 (SQ)	
	26.4ppfx grade?	TOC=top liner		4448 -4524 (SQ?)	
	7-5/8"x 4644'	Cement?			
					LOT=10.3ppg
				5178-5328	
				5403-5453	
				5488-5548	
	top 4010'			5578-5618	
	17ppfx L80				
	5-1/2"x5860'	Class G cement 16 ppg			TD=6030'

** there is shift of 20+ feet due to new rig or something

Note: data in well summary looks wrong re perfs etc- not same as A5.

52/5A14 (sidetrack of well 52/5 A6)

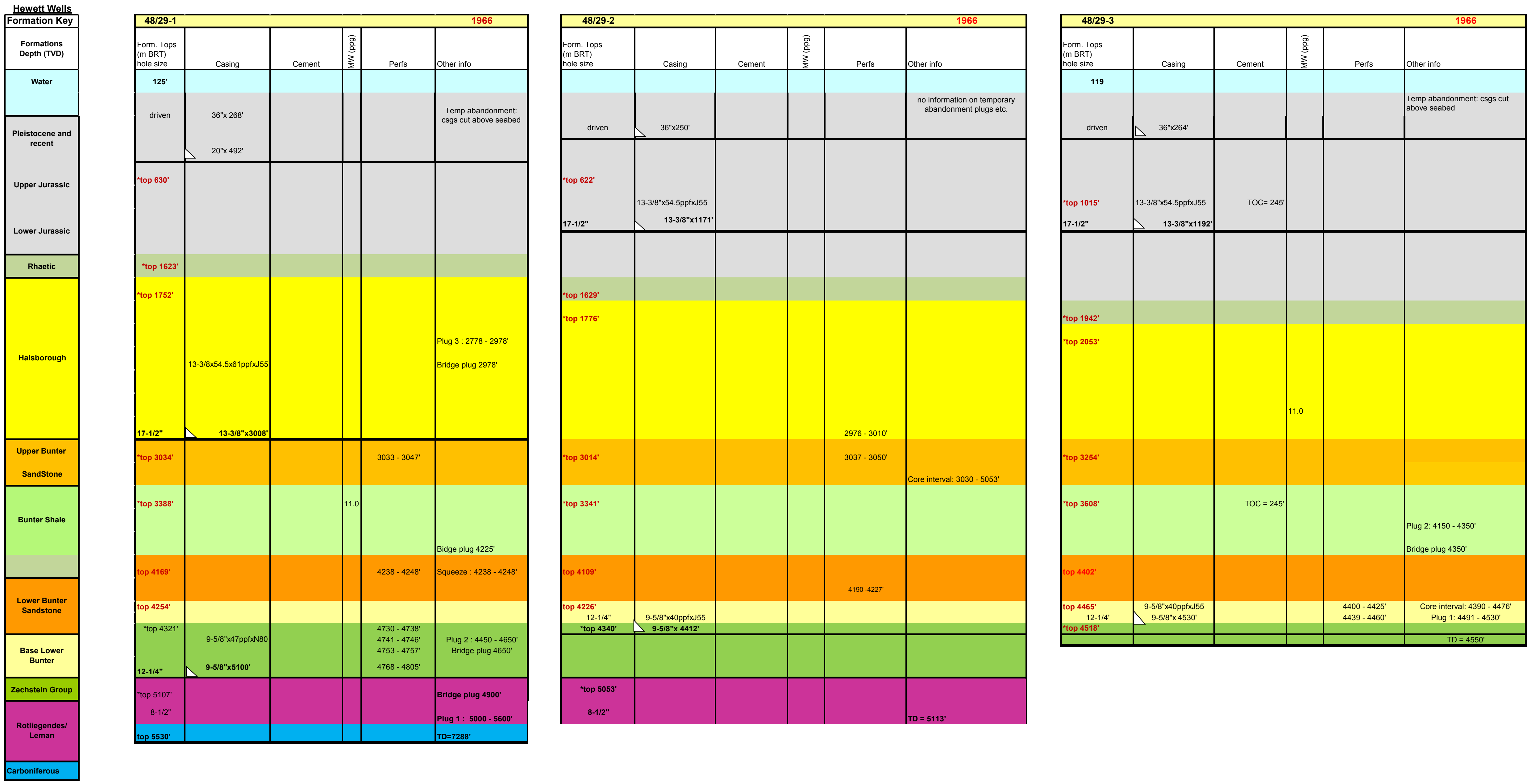
Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
77					
driven	30"x?				
	133ppfxJ55	TOC:6'			
26"	20"x515'	Class B			
		TOC= surface			
	61ppfx68ppf J55	Cement Class B			
17-1/2"	13-3/8"x2912'	w/18%salt	10.2-10.6		
				2937-2938 (SQ)	
12-1/4"	9-5/8"x3760'			3007-3067	Window at 3760' to3835'
	hanger= 2657'				
	Hole 8-1/2"				
top 4735'					
	29ppfxN80				
		13.7 ppg slurry	8.6-8.8		
base 5248'	7"x 5255'	Pozecemoil cement	Enviromul		
top 5248'					
				5440-5530	
	hanger= 4941'		10-10.3	6005-6068/6040-6340	
	Hole 6"			6098-6158	
	12.6ppfx N80	16ppg slurry	Salt Saturated	6180-6240	
	4-1/2"x6488'	Class G Cement	Polymer		TD= 6490'

52/5-A15

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
17-1/2"x26"	20"x627'	TOC= 197' Pozzo 13.2 ppg	OBM 9ppg		gas from 20" x 13 3/8" annulus- installed extra seal assy in w/head
17-1/2"	68ppfxN80 13-3/8x3020'	TOC= 607' (losses) 12.5 ppg lead/ 16 ppg tail Pozzo 2%CaCl; G neat tail	OBM 9ppg		problems bulding angle due to softness of formation tvd=2734
'top 3173' base 4217'					
top 5999' base 6270'	Hole 12-1/4" 47ppfxN80 9-5/8"x6379'	TOC= 3795' (losses) 12.5 ppg lead/ 13.8ppg tail Pozzo 2%CaCl; G neat tail	OBM 9 ppg		Losses while cementing
top 6386'	Hanger= 5901' Hole 8-1/2" 26ppfxN80	TOC =6920' (CBL) 15 ppg slurry	OBM	7190-7765	Zechsteinkalk acid frac'd Some problems logging
top 8005'	7"x8205'	Pozzocemoil	8.8-9ppg		TD=8209'

52/5-A16

Form. Tops (m BRT) hole size	Casing	Cement	MW (ppg)	Perfs	Other info
26"	20"x588'	TOC 190 Class G 16ppg tail 13.2ppg Pozz lead			gas from 20" x 13 3/8" annulus- installed extra seal assy in w/head
					FIT=9.5 ppg
top Hais 1380' 17-1/2"	13-3/8"x2838'	TOC 588 Returns pozzocemoil 12.5 ppg lead/ 14.3ppg tail	OBM 8.5-8.9		
					FIT =11ppg
top 4638' base 5927'					Total Losses at Upper Bunter SS LCM unsuccessful, Controlled w/ cement Changed to water based mud At 4693, disp back to OBM
					casing run in seawater (at 70deg!) due to losses at 2740'
top 8572' base 8835' top 9216'	Hole 12-1/4" 47ppfxN80 9-5/8"x 9294'	Pozzocemoil 12.5 ppg lead/ 14.3ppg tail TOC 4800'	OBM/ WBM 8.5-9		
	Hole 8-1/2" Hanger 8985' 29ppfxN80	TOC= 8985' 15 ppg	OB	10670-11383	FIT=14ppg Zechsteinkalk acid frac'd
top 11937'	7"x 11925'	pozzocemoil	8.5-9.5		TD= 12202' (TVD=5014')


Hewett Wells
Formation Key
Formations Depth (TVD)
Water
Pleistocene and recent
Upper Jurassic
Lower Jurassic
Rhaetic
Haisborough
Upper Bunter SandStone
Bunter Shale
Lower Bunter Sandstone
Base Lower Bunter
Zechstein Group
Rotliegendes/ Leman
Carboniferous
48/29-1
1966
Form. Tops (m BRT) hole size
Casing
Cement
MW (ppg)
Perfs
Other info
125'
driven
36"x 268'
Temp abandonment: csgs cut above seabed
20"x 492'
*top 630'
*top 1623'
*top 1752'
Plug 3 : 2778 - 2978'
13-3/8x54.5x61ppfxJ55
Bridge plug 2978'
17-1/2"
13-3/8"x3008'
*top 3034'
3033 - 3047'
*top 3388'
11.0
Bidge plug 4225'
top 4169'
4238 - 4248'
Squeeze : 4238 - 4248'
top 4254'
*top 4321'
9-5/8"x47ppfxN80
4730 - 4738'
4741 - 4746'
4753 - 4757'
4768 - 4805'
Plug 2 : 4450 - 4650'
Bridge plug 4650'
9-5/8"x5100'
12-1/4"
*top 5107'
8-1/2"
Bridge plug 4900'
Plug 1 : 5000 - 5600'
top 5530'
TD=7288'
48/29-2
1966
Form. Tops (m BRT) hole size
Casing
Cement
MW (ppg)
Perfs
Other info
no information on temporary abandonment plugs etc.
driven
36"x250'
*top 622'
13-3/8"x54.5ppfxJ55
17-1/2"
13-3/8"x1171'
*top 1629'
*top 1776'
2976 - 3010'
*top 3014'
3037 - 3050'
Core interval: 3030 - 5053'
*top 3341'
top 4109'
4190 -4227'
top 4226'
12-1/4"
9-5/8"x40ppfxJ55
*top 4340'
9-5/8"x 4412'
*top 5053'
8-1/2"
TD = 5113'
48/29-3
1966
Form. Tops (m BRT) hole size
Casing
Cement
MW (ppg)
Perfs
Other info
119
Temp abandonment: csgs cut above seabed
driven
36"x264'
*top 1015'
13-3/8"x54.5ppfxJ55
TOC= 245'
17-1/2"
13-3/8"x1192'
*top 1942'
*top 2053'
11.0
*top 3254'
*top 3608'
TOC = 245'
Plug 2: 4150 - 4350'
Bridge plug 4350'
top 4402'
top 4465'
12-1/4'
9-5/8"x40ppfxJ55
9-5/8"x 4530'
4400 - 4425'
4439 - 4460'
Core interval: 4390 - 4476'
Plug 1: 4491 - 4530'
*top 4518'
TD = 4550'