Soils report 6 – Dónal Keane, Lisselton

Introduction

This dairy farm is located near Lisselton village in Co. Kerry with the River Galey approximately 1.5 km away from the farm yard of the home farm (Figure 1). The farm is currently 52 ha. in two blocks (Inch and Oakleys) and has expanded to 90 cattle over the last number of years. There was on average, 1095 mm of rain per year, at the closest met. station which is 1 km away. The elevation on site is 0 - 10 m with an average 1-2 % slope. An existing open drain of approximately 1.9 m depth was present along the site's north-eastern boundary (Paddock 14, Inch [home farm]). This open drain is managed by the Office of Public Works.

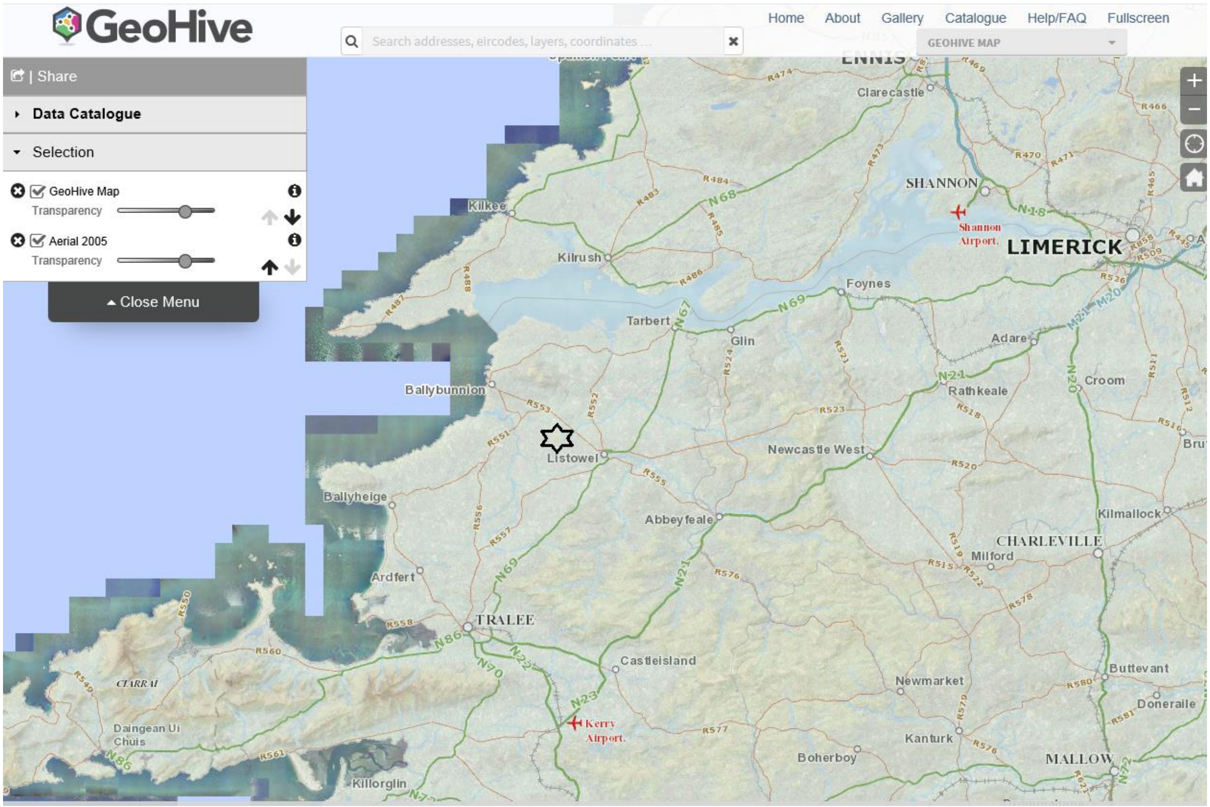

Figure 1. Location of farm (Black star) North West of Listowel, Co. Kerry

The areas rainfall which is high relative to the east of the country is low for the western sea board. The area is not in the wake of any mountain range, such as those found to the south west and east of the farm and consequently does not receive as much rain. As a result the peat which dominates the area is composed of raised peat rather than the blanket peat associated with the western sea board. In general the area is very flat and the lack of natural drainage leads to the extensive growth of the peat. In modern times drainage and extraction of the peat has reduced the depth of the peat and the previously deeper mineral soils have become a dominating influence on productivity. Many areas in the locality now have commercial forestry stands.

Mineral soils where they occur naturally close to the surface are equivalent to islands in a peat dominated landscape, which also suffer from restricted drainage. Most are derived from glacial tills that were themselves originally formed in various alluvial processes. Silt loams and Silt clay loams are the leading soil textures as a consequence of these fluvio-glacial processes and again are not conducive to good drainage conditions. It would be expected that without drainage measures the groundwater table would be close to the surface year round in the peat and would stagnate regularly in the mineral soils in the area following multi day periods of rainfall.

The main natural conduit for drainage is the River Galey and its tributaries. On the home farm (Inch) the river runs along the south eastern part of the farm, on paddocks 4, 7, 12 and 13 (Figure 2). It is also within 600 m of the eastern part of the out farm (Oakleys), paddocks 2 to 7 and 500 m off the southern paddock 10. There is an alluvial terrace in paddock 6 Inch, which indicates that the river channel was closer in the past since the last ice age and that the rest of paddock 6, and paddocks 4, 7, 12 and 13 are an alluvial floodplain. A number of decades ago the office of public works deepened the main channel of the River Galey and now longer periods of inundation are not as severe.

The river itself was formed from a melt water channel produced at the end of the most recent glaciation in the area – the Saale glaciation. The more recent Weischel glaciation did not extend this far west from central County Limerick. The Saale glaciation deposited till derived from Namurian sandstones and shales (Sleeman and Pracht, 1999). Prior to this the area was seen as a river delta with various increases and decreases in the sea level. Therefore there were alternating periods where the sediments were dominated by marine and then freshwater deposition (Alluvium). Extensive deposition of alluvium would be found along the rivers, alluvial flats were and are extensive. Along the Shannon estuary there are expanses of estuarine muds for example. The geology of the area is Carboniferous bedrock, Viséan Limestone, overlain with the Namurian till above.

Historical soil information

There was no National Soil Survey report of this area of North West Kerry. There was The Soils of County Limerick (Finch and Ryan, 1966), which described soils in the most western parts of County Limerick adjacent to North Kerry. From the accompanying map, the soil series dominating the area are Abbeyfeale, a Gley on solifucted material of sandstone and shale origin. There are relatively small amounts to the north east of the Brown Podzolic, Mountcollins derived from shale drift. There are large polygons of Blanket peat (Aughty series) throughout the area. With the updating of the national soils series list, the Abbeyfeale series has now been rationalised into the Surface-water Gley, Kilrush series. Mountcollins is now part of the Brown Podzolic series, Borrisoleigh. As clarified above the peat is more likely to be dominated by raised peat, soil series Garrynamona rather than Aughty, which is a blanket peat.

Looking to the recent Irish Soil Information System (Irish SIS, Creamer et al 2014), which is now the primary resource for investigation of the soils of the area; Peat dominates most of the area covering both Inch and Oakley sites. The course of the River Galey and its flood plains are indicated to contain Alluvial soils of the Boyne soil association (Figure 3). The Boyne association contains various texture types of river alluvium, including those that are gleyed and also those that are humic. The Irish SIS indicates that the northern two thirds of Oakleys would be covered by a small pocket of the soil association Crosstown (Figure 4. an island, relative to the general peat soils of the area). This is a Stagnic Luvisol lead association, also containing soil series of Gleyic Luvisol, Typical Luvisol, Surface-water Gleys and Groundwater Gleys.

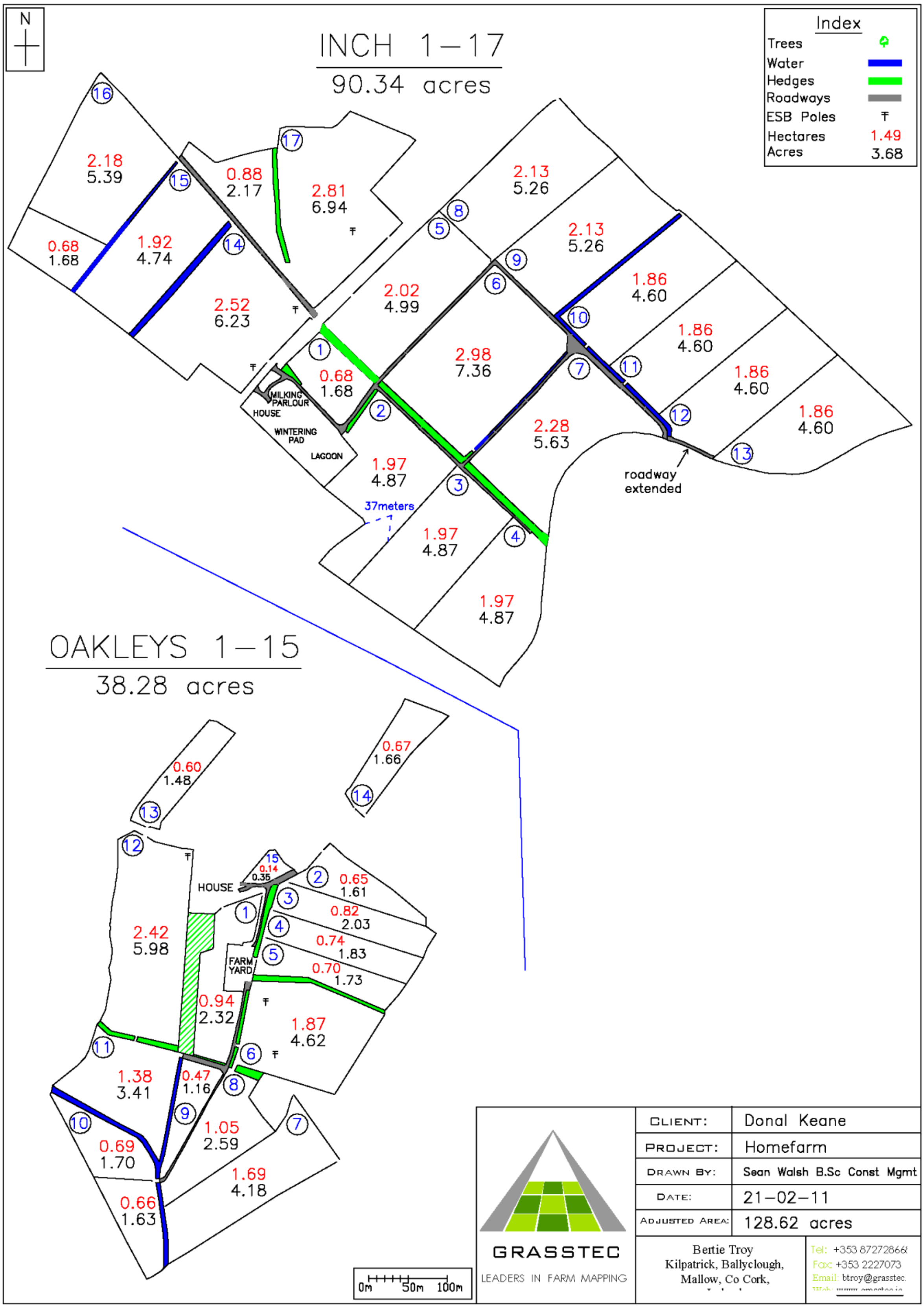

Figure 2. Paddock map of the home farm of Inch directly on the River Galey and the out farm of Oakleys approx. 1.2 km to the South East.

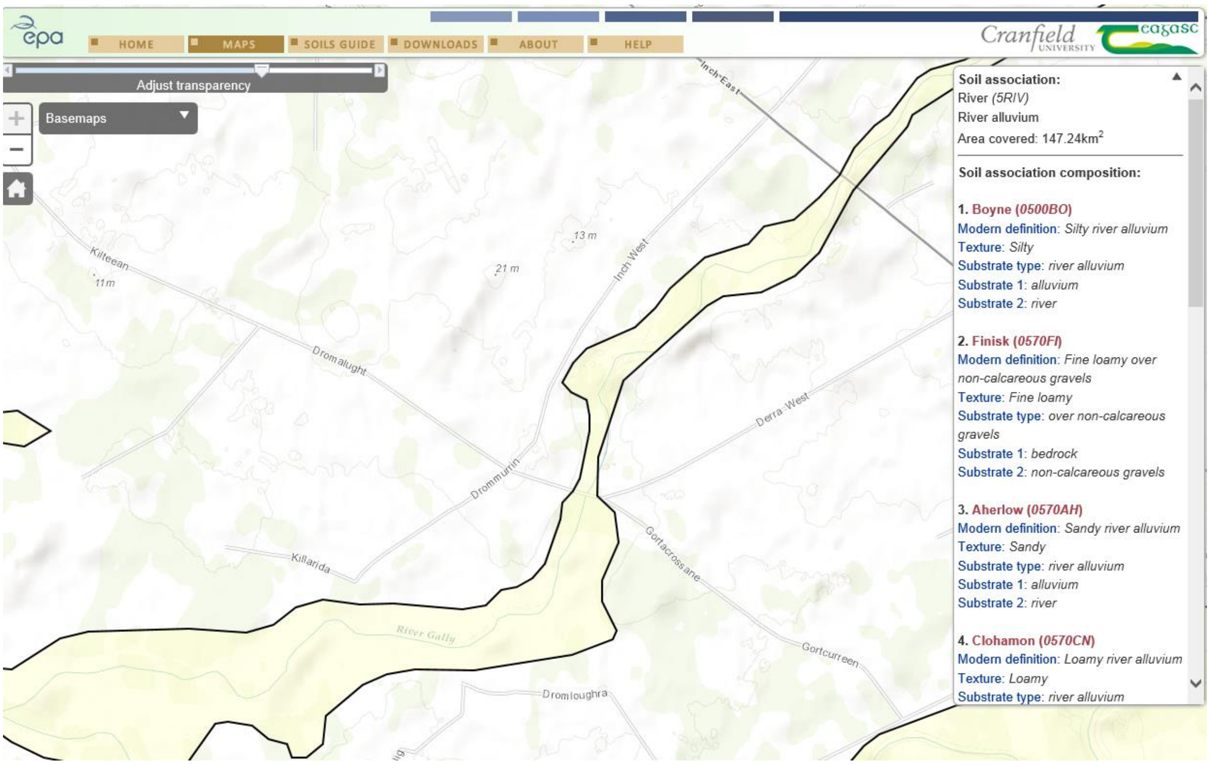

Figure 3. The Boyne association, found along the River Galey and its flood plains, from the Irish SIS. The rest of the area is peat appart from the island in Figure 4 below.

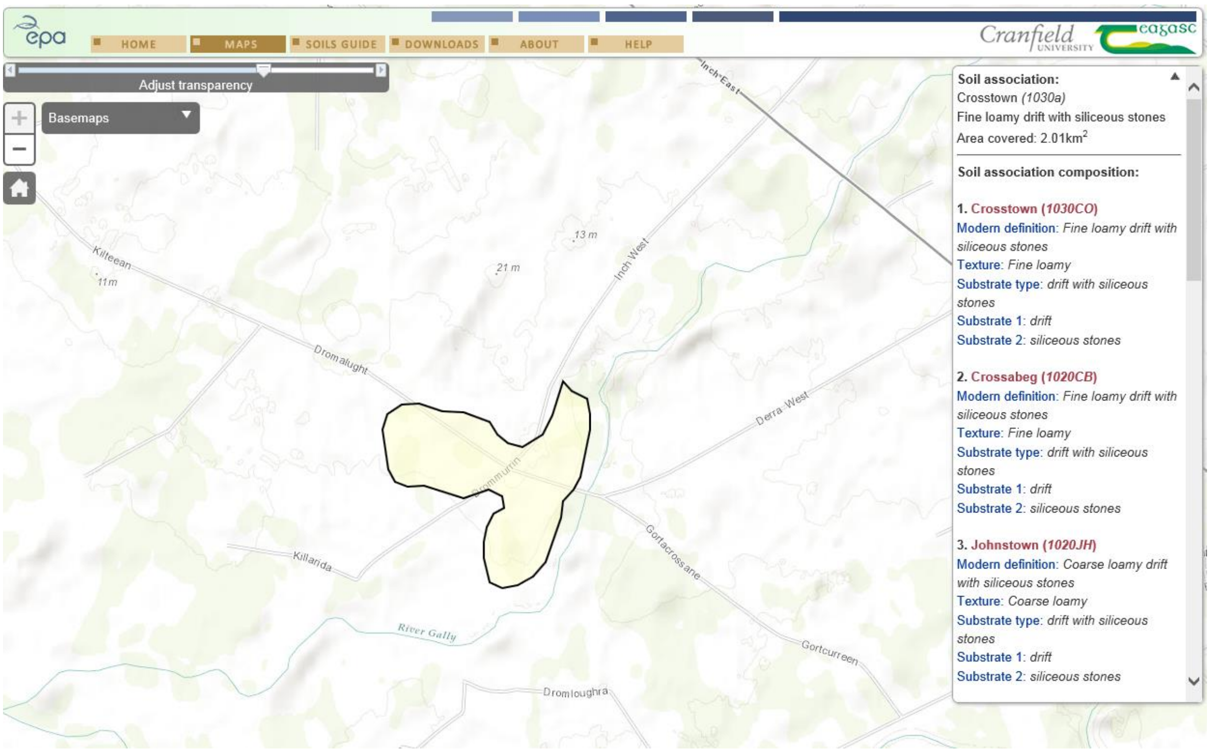

Figure 4. The island of Crosstown association covering two thirds of the out farm of Oakleys. This polygon is only 2.01 km^2. The peat can be up to 40 km^2.

Auger campaign

Method

The distribution of the farm paddocks are in Figure 2. An auger bore was carried out on average every hectare to investigate the soil physical features. In practice more or less augers were used based on landscape complexity. Their resulting distribution was a relatively even coverage in each area (Figure 5). The Dutch auger was driven into the soil to a depth of 1 metre if possible. The coordinates, landscape features and soil features were described and recorded on a field tablet. Horizon type, depth, texture, colour, mottling, structure, roots and stones were recorded along with many more physical attributes detailed in the Irish SIS soil profile handbook (Simo et al 2014).

Figure 5. Distribution of the auger bores at Oakleys (SW) and the home-farm, Inch (NW).

Histic

A histic layer (peat) was noted in 11 of the augers due to permanent periods of waterlogging, where organic material builds up as it cannot break down quickly due to anaerobic conditions and consequently accumulates in the upper horizon. The stagnation occurs due to the high amounts of rainfall in the area and the shallow inclines becoming pooling areas leading to waterlogged conditions due to lack of drainage.

The raised peat falls into two main categories on the farm, soil series Garrynamona which is a drained ombrotrophic (rain fed) peat or soil series Gortnamona which is cut over ombrotrophic peat. In most cases both managements types could have occurred at some time in the past. Inch paddock 14 has the most recent drainage measures applied by the heavy soils project. In Figure 6 a & b we can see how the control area is still permanently waterlogged and full of rushes. There is no potential for vehicle traffic and animal poaching would be significant. Whereas in the background we can see the area that is drained, which has a good sward of grass and far less problems with trafficability.

Figure 6 a & b. Inch Paddock 14 control and drained field in background. The rushes indicate the limit of the drainage measures.

The only area where the peat could be considered unmanaged and in a semi-natural state is Inch, paddock 15 and 16. Here the peat could be considered soil series Allen (Figure 7). Successional scrub is returning with bog myrtle and birch present. Sphagnum mosses have begun to fill out old shallow drains. Standing water and fibrous peat was dominating, indicating recent build-up of the organic material.

The peat in Oakleys was similar to the peat in Inch, where it had been cutover and drained over the years in the northern part of the site. The drains were open along the boundaries of the paddocks and there had been some mixing of the mineral soil with the peat in the process of reclamation. Due to the large amount of wood found in the peat, many large root crowns had been removed and brought to the paddock boundaries (Figure 8 a). Generally, the soils were designated the Garrynamona series.

The main difference in the peat between Inch and Oakleys was the mineral layer above the peat in the southern paddock 10 of Oakleys (Figure 8 b). Here the peat had been developing for centuries and then a major flood as a result of a fluvio-glacial event deposited 30 cm of mineral material over the area. The mineral material had a silt texture and lack of stones indicating alluvial origin. The peat development ceased and as a consequence is now completely amorphous (decomposed). The soil still is classified as peat due to the peat being over 60 cm thick (much greater than this in places). Technically the mineral soil can be up to 40 cm thick at the surface and the next 60 cm to 100 cm depth being composed of peat, to still qualify as a peat soil.

Figure 7. Inch P15, flowering bog myrtle was common throughout the paddock.

Figure 8. A Oakleys 14, similar to the peat in Inch**. B** Oakleys 10A, mineral soil to 30 cm then peat.

<u>Perched watertable</u>

Due to the lack of natural drainage perched watertables were common throughout the farm. Prior to reclamation efforts, the peat topsoil had some water holding capacity and high porosity. With the removal of the peat the deeper mineral soil becomes a greater influence. Most of the soil textures are of silt loam, silt clay loam or clay loams. These soils have high permeability but low porosity leading to stagnating conditions with consecutive days of rainfall. These soils are either Typical Surface-water Gleys, series Kilrush or Humic Surface-water Gleys, series Gortaclareen (Figure 9).

In some cases, the peat has been mixed into the mineral soil and is close to the soil surface. In other cases, the stagnating conditions have restarted the accumulation of organic material once again. These horizons are described as humic. Over the years management has led to paddock boundaries, access tracks, hedges and drainage channels changing and within paddocks there can be large differences in histic, humic and mineral material near the surface. However with drainage measures and reseeding, many of these paddocks have produced a good sward with careful management.

Figure 9. A Inch P1 Surface-water Gley, series Kilrush rough surface due to recent mixing. **B** Inch P2 Humic Surface-water Gley, series Gortaclareen, better condition due to reseeding and management.

In the Oakley part of the farm there is an incline leading to a pooling area in paddock 1b, 9 and 11a. here the Groundwater influence is greater than the surface-water. These soils are described as Typical Groundwater Gleys, series Kilpierce. There is also a portion of Kilpierce in paddock 6a. It is very likely that there are small sized occurrences of Groundwater Gleys within paddocks in other farm areas that were not encountered at this resolution of investigation.

The watertable itself was only encountered in a handful of augers at 70 cm for Oakleys paddocks 13, 10 b and 10 a and Inch paddocks 15, 17 b and 14 a. This is testament to the current drainage measures, however the farm was augered in April 2016 which was following a two-week dry spell. As covered above surface-water appeared to be a more persistent problem.

<u>Alluvial soils</u>

As mentioned previously there is an alluvial floodplain covering paddocks 3, 4, 7, 12 and 13 of Inch. There is an alluvial terrace in paddock 6. These soils have low stone content and high silt textures, due to the regular inundation from the River Galey. The clay content is not very high at ~20 % therefore drainage is moderately good. There was a gravel bed in P7 and 12 at 60 cm depth alluding to an old point of deposition on a meander of the river. These soils were series Suir, composed of silty river alluvium. There was an area of P13 Inch, where a pond would occur seasonally. This was more poorly drained and described as an Alluvial Gley, series Boyne (Figure 10). There were no recent alluvial soils at Oakleys.

<u>Luvisol and Anthric Brown Earth</u>

Soils which have a sharp increase in clay content within 30 cm of the surface are described as luvic. Two Luvisols were found on the farm both at Oakleys; paddock 5 and paddock 6 b (Figure 11). In both cases, there was a humic topsoil, there were very few mottles in the upper horizons, it appears that the groundwater table was leading to the accumulation of humic material after wetter periods in the year. The sward in both paddocks was weak with purple moor grass present.

The Anthric Brown Earths were created in the reclamation process. These soils are common where the soils have been inverted or mixed with some external material. They tend to have humic topsoils as the three paddocks in this farm do, paddocks 9 (Figure 12) and 17 a Inch and paddock 15 Oakleys. There are mixed subsoil horizons with A material occurring deep in the soil to 70 cm and C material occurring at the surface. The sward can be poor with many weeds if the change has been recent.

Figure 10. Inch P12, Suir series on an alluvial floodplain and looking south east to the “duck pond” in P13, an Alluvial Gley, Boyne series.

Figure 11. Oakleys P5 Humic Luvisol series Gortavoher, not Crosstown as predicted in the Irish SIS.

Figure 12. Inch P10 drained peat previously cut over in the foreground and Anthric Brown Earth looking to the background paddock 9. Note drain material spread locally over paddocks.

<u>Conclusion</u>

The auger survey description resulted in most soils suffering from water impediments (Table 1). Of the 42 augers only ten did not display severe water restrictions at some point in the year. There was the peat with waterlogging for most of the year: 11 Drained Ombrotrophic Peat Soils, series Garrynamona; three Natural Ombrotrophic Peat Soils, series Allen and two Cutover Ombrotrophic Peat Soils, series Gortnamona. The Gley soils on the farm were dominated by surface-water problems due to texture and lack of slope for natural drainage. There were five Typical Surface-water Gleys, series Kilrush and five Humic Surface-water Gleys, series Gortaclareen. There were four Groundwater Gleys, series Kilpierce at the lowest point of the out-farm Oakleys. The Alluvial Gley, series Boyne functions like the Surface-water Gleys and can be included in this group. All are currently or recently described as poorly drained.

Only the five Drained Alluvial Soils, series Suir, the two Humic Luvisols, series Gortavoher and the four Anthric Brown Earths (series Ashgrove [3] and Clashmore [1]) could be described as imperfectly to moderately drained. The soil texture classes in the mineral soils were Silt Loam, Silt Clay Loam and some of examples of Clay Loam. There was only one auger with a description of Sandy Clay Loam. The Stagnic Luvisol, Gortavoher was selected as it has a silty definition, as there was no Humic Luvisol with a silty definition to select within the Irish SIS.

In paddock 14 Inch, with the new drainage measures there was a decrease in the peat thickness of the drained part in comparison to the control part of the field. In time this peat depth is likely to shrink even more and the peat itself will become more humified as it is waterlogged less often. The bulk density of this soil/layer also increases. This pattern is noticeable in the other paddocks with peat that has had drainage measures for much longer periods of time. It is likely that the mineral soil beneath these peats will become a dominant factor in time and may require different drainage solutions to those in situ currently.

Table 1. Field observations of soil type during the auger campaign on Lisselton Heavy Soil Farm. I, Inch and O, Oakleys farms. Paddocks are listed with Subgroup and Soil series based on the Irish SIS (Creamer et al 2014). The drainage class is described in Schulte et al (2015).

Paddock	SUBGROUP	Series Name	Drainage Class
I 1a	0700 Typical Surface-water Gley	Kilrush	Poorly
I 1b	1190 Anthric Brown Earth	Clashmore Anthropic	Imperfectly
I 2	0760 Humic Surface-water Gley	Gortaclareen	Poorly
I 3	0570 Typical Drained Alluvial Soils	Suir	Imperfectly
I 4	0570 Typical Drained Alluvial Soils	Suir	Imperfectly
I 5	0760 Humic Surface-water Gley	Gortaclareen	Poorly
I 6	0760 Humic Surface-water Gley	Gortaclareen	Poorly
I 7	0570 Typical Drained Alluvial Soils	Suir	Poorly
I 8	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Poorly
I 9	1196 Anthric-Humic Brown Earth	Ashgrove Anthropic	Imperfectly
I 10	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Poorly
I 11	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Poorly
I 12	0570 Typical Drained Alluvial Soils	Suir	Imperfectly
I 13	0500 Typical Alluvial Gley	Boyne	Poorly
I 14a	0110 Natural Ombrotrophic Peat Soils	Allen	Poorly
I 14b	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Imperfectly
I 17a	0570 Typical Drained Alluvial Soils	Suir	Imperfectly
I 17b	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Poorly
I 17c	1196 Anthric-Humic Brown Earth	Ashgrove Anthropic	Imperfectly
I 15	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Poorly
I 16a	0110 Natural Ombrotrophic Peat Soils	Allen	Poorly
I 16b	0110 Natural Ombrotrophic Peat Soils	Allen	Poorly
O 5	1060 Humic Luvisol	Gortavoher	Imperfectly
O 4	0760 Humic Surface-water Gley	Gortaclareen	Poorly
O 3	0180 Cut Ombrotrophic Peat Soil	Gortnamona	Poorly
O 2	0180 Cut Ombrotrophic Peat Soil	Gortnamona	Poorly
O 1a	0700 Typical Surface-water Gley	Kilrush	Poorly
O 1b	0600 Typical Groundwater Gley	Kilpierce	Poorly
O 9	0600 Typical Groundwater Gley	Kilpierce	Poorly
O 11a	0600 Typical Groundwater Gley	Kilpierce	Poorly
O 6a	0600 Typical Groundwater Gley	Kilpierce	Poorly
O 6b	1060 Humic Luvisol	Gortavoher	Imperfectly
O7a	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Imperfectly
O7b	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Poorly
O 10a	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Imperfectly
O 10b	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Imperfectly
O 11b	0700 Typical Surface-water Gley	Kilrush	Poorly
O 12a	0700 Typical Surface-water Gley	Kilrush	Poorly
O 12b	0700 Typical Surface-water Gley	Kilrush	Imperfectly
O 13	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Imperfectly
O 15	1196 Anthric-Humic Brown Earth	Ashgrove Anthropic	Imperfectly
O 14	0170 Drained Ombrotrophic Peat Soils	Garrynamona	Imperfectly

Representative soil profile pits

Using the auger survey as a guide, three pits were selected to represent the dominant soils on the farm and to investigate the principal drainage restrictions identified. Paddock 14 Inch, was to represent the Drained Ombrotrophic Peat Soils found at both farm sites. Paddock 4 Inch, was to represent the Surface-water Gleys on both farm sites. Paddock 2 Inch, was to represent the Alluvial Soils found on Inch at the floodplain of the River Galey.

Figure 13. Position of the three soil pits excavated to represent the Lisselton Heavy Soil Farm. Paddock 14 to the North west, paddock 4 central and paddock 2 to the south near the River Galey.

Paddock 14, Drained Ombrotrophic Peat soil, 0170, series Garrynamona (Figure 14), was the most acidic on the farm with a pH of 5.3 or lower (Appendix). The mineral soil at 140 cm was pH 4.7. These conditions make many minerals unavailable to the plants roots deeper in the soil, if they can survive there at all. It appears in the past that conditions were more favourable as there are dead roots in hz 2 and hz 3 belonging to herbaceous plants rather than the woody coarse roots remaining after fen formation (Table 2). There are still many root crowns remaining in the peat along with stems and large branches, even after many rounds of removal with an excavator. As seen with many paddocks on the farm there are bog wood piles along field boundaries which contain this soil type.

The third horizon also had a high Sulphur content of 46 ppm. This could be due to the influence of the high groundwater table and formally seawater mobilising the Hydrogen ions and increasing the acidity here. There was however no smell or deposit of jarosite in this pit or any of the augers for that matter, therefore the sea water influence is from the distant past.

The peat above this horizon is permanently waterlogged and with a low bulk density of 0.10 cm^3 jumping to 1.25 cm^3, there is little scope for extra water holding capacity here outside of the new drainage measures. All the soil pore space is filled with water permanently. With the new drainage measures, there is a lowering of the water table and an increase in bulk density (hz1 vs hz2). In time this is likely to intensify as the aeration of the layers allows more decomposition. This should allow for better sward growth, far less surface waterlogging and more trafficability for machinery and livestock.

Figure 14. Paddock 14, Drained Ombrotrophic Peat soil, 0170, series Garrynamona.

Paddock 4 represents the moderately drained, Typical Drained Alluvial Soils, 0570, series Suir, Figure 15. The texture of this pit is Silt Loam as the material was deposited by alluvial means (Table 3). The gravels in hz 2 and hz 3 are sub-rounded which indicates water transportation. The gravel bed of hz 3 is a further indication of alluvial formation, due to the sorting and deposition of this gravel via waterborne means. The crumbly structure of the soil in hz 1 and 2, indicates the good soil aggregation here and balance between porosity and permeability which results in moderate

Table 2. Soil description of Paddock 14, Inch, Lisselton Heavy Soil Farm.

Horizon depth (cm)	Horizon designation	Description
40	OA	Very Dark Grey, many mottles (A hz.), few stones, Loamy peat, prismatic structure, O hz. part van Post H7.
85	Of	Dark Brown Grey, Fibrous peat, no stones, sub-angular blocky structure, medium and coarse dead roots, wet, H3, Bog pine present.
116	Om	Very Dark Brown Grey, Semi-Fibrous peat, H6, low packing density, some dead roots, wet.
141	C1	Light Bluish Grey, Silty Clay Loam, moist, firm, sticky, massive structure, high packing density, medium dead roots.
180	C2	Very high packing density, common fine and coarse gravels, plastic, massive, Silty Clay, some coarse silty patches, weathered stones, non-cemented but compacted.

drainage and good grass growth conditions. The bulk density and the pH of the first 3 horizons are similar. The major change in this soil profile occurs below the gravel bed, the structure becomes massive and the mottles increase due to intermittent waterlogging. There are no roots present and there is an increase in clay with a high packing density. This however occurs at depth and has little influence on the surface conditions even after many consecutive days of rain.

Paddock 2 represents Humic Surface-water Gley, 0760, series Gortaclareen. These soils throughout the farm have intermittent water-logging at the surface, which leads to an accumulation of organic matter over time (Figure 16). In this particular case there is a mixing at the surface of A horizon and the Bg horizon, also possible is that some material was imported for this purpose (Table 4). The original A horizon is found beneath this (Apg). This hz has luvic conditions where there is a significant clay increase from 22 % to 26 % (Appendix) which leads to reduced porosity. Once this layer reaches its water holding capacity, it leads to stagnation in the upper layer and eventually waterlogging. Prior to mixing it is likely that this was a shallow A hz above a Btg horizon. This would have stagnated in any case with the increase in clay. Of note are the very high levels of phosphorus of hz 1 (Appendix), this could allude to a recent spreading of slurry or more likely the spreading of manure/bedding from the sheds in the farm yard nearby.

Looking at the GeoHive imagery from 1995 it appears that a farm track was in this area of the pit and the paddock arrangements were different. In changing the field boundaries and paddock layout over the next 10 years, this track was infilled and smoothed out at the surface leading to the mixing (Figure 18 a). There are also old stone drains in the pit starting at 40 cm to 70 cm depth. This measure was taken many decades ago as the horizon is uniform around the drains (Figure 17) not indicating any recent disturbance. The stagnic channels 120-140 cm depth allude to serious restrictions on water movement at this depth, as water is only able to move in these areas (Figure 18 b). Without the drains action over the preceding decades it is possible that peat may have begun to form again in this area. Water entered the pit where this drain was exposed on two of the side walls at 60 cm depth, indicating they are still active. There was also water ingress at 75 cm on the profile pit wall with the transition from the Apg to the compacted Cg.

Figure 15. Paddock 2, Typical Drained Alluvial Soils, 0570, series Suir.

Table 3. Soil description of Paddock 2, Inch, Lisselton Heavy Soil Farm.

Horizon depth (cm)	Horizon designation	Description
28	Ap	Dark brown, few stones, Silt Clay Loam, crumbly structure,
75	Bw	Dark reddish brown, Common gravels sub-rounded, Silt Loam, crumbly structure, mottles in greasy lens on RHS.
100	C	Light yellowish brown, Abundant gravels sub-rounded gravel bed, Silt Loam, roots still present, Massive structure.
160	Cg	Light greyish brown, common mottles, abundant gravels & stones sub-angular, Silt Clay Loam, no roots, firm, slightly plastic, compacted clay, very high packing density.

Figure 16. Paddock 4, Humic Surface-water Gley, 0760, series Gortaclareen.

Table 4. Paddock 4 soil description, Inch, Lisselton Heavy Soil Farm.

Horizon depth (cm)	Horizon designation	Description
30	AB	Dark grey, common light yellowish brown coarse mottles (Bg material), common sub-rounded gravels, Loam, humus coats. Sub angular blocky structure.
62	Apg	Very dark grey, common root mottles, few gravels, Loam, humus coats, crumbly structure. Remnant of original Bt present.
110	Cg	Light brownish grey, many mottles, common gravels, sub-angular, gravel band top of hz. Compacted, Silt Loam, massive structure, changing textures. Dead roots.
160	2C	Compacted, Silty Clay Loam. Common mottles, many gravels, sub-rounded. Weathered stones, sand intrusion bottom of hz, Limestones, massive structure. Lithological discontinuity.

Figure 17. Old stone drains in paddock 4 Inch, which have removed water for decades.

Figure 18 a & b. a possible infilling of track with the current AB horizon above the Apg horizon. **b** Stagnic channels of preferential water flow at 120 – 140 cm depth in a compacted high clay horizon 2C.

Conclusions

The soils on this farm fit roughly into three main categories: Ombrotrophic Peat soils; Surface-water Gleys and Alluvial Soils. There are also small pockets of Luvisols, Groundwater Gleys and Anthric Brown Earths. The key factor influencing the soils here are the water-tables and their management. As mentioned previously there are restrictions on the natural drainage due to the soil textures, the conditions for raised peat formation and the shallow slopes to plain nature of the area. The drainage measures and land management has a considerable influence on where the soil exist in terms of classification at a particular time.

In dealing with the peat in the past through both removal and drainage, the deeper mineral soils become the significant influence on both drainage and productivity dynamics. If the paddock preparation for drainage is recent, there are likely to be Anthric Brown Earths and Typical Surface-water Gleys. If the measures are older there maybe humic material building up. If the drains are not maintained the peat may begin to develop once again in the future.

The newer drains in paddock 14 Inch, are proving effective with an immediate impact. This needs to be monitored in the medium term. The peat shrinkage will bring the mineral soil at depth into play which has little water holding capacity due to its poor texture of Silt Clay Loam. The drained peat as it currently stands is producing a good sward of grass. There is good porosity in the newly drained and decomposing peat. This allows aeration at most times outside of consecutive days of rain. Into the future different measures could be required to drain the mineral soil from a permeable layer at depth.

The moderate textures and the old drainage measures are proving effective with the Alluvial soils and waterlogging is not of concern for most of the area. In Oakleys (out farm), there may be scope for more drainage measures in paddock 1b and 6a with the landscapes natural incline leading to the larger open drains in paddocks 8 and 9. There is potential here for lowering of the groundwater table that may be cost effective.

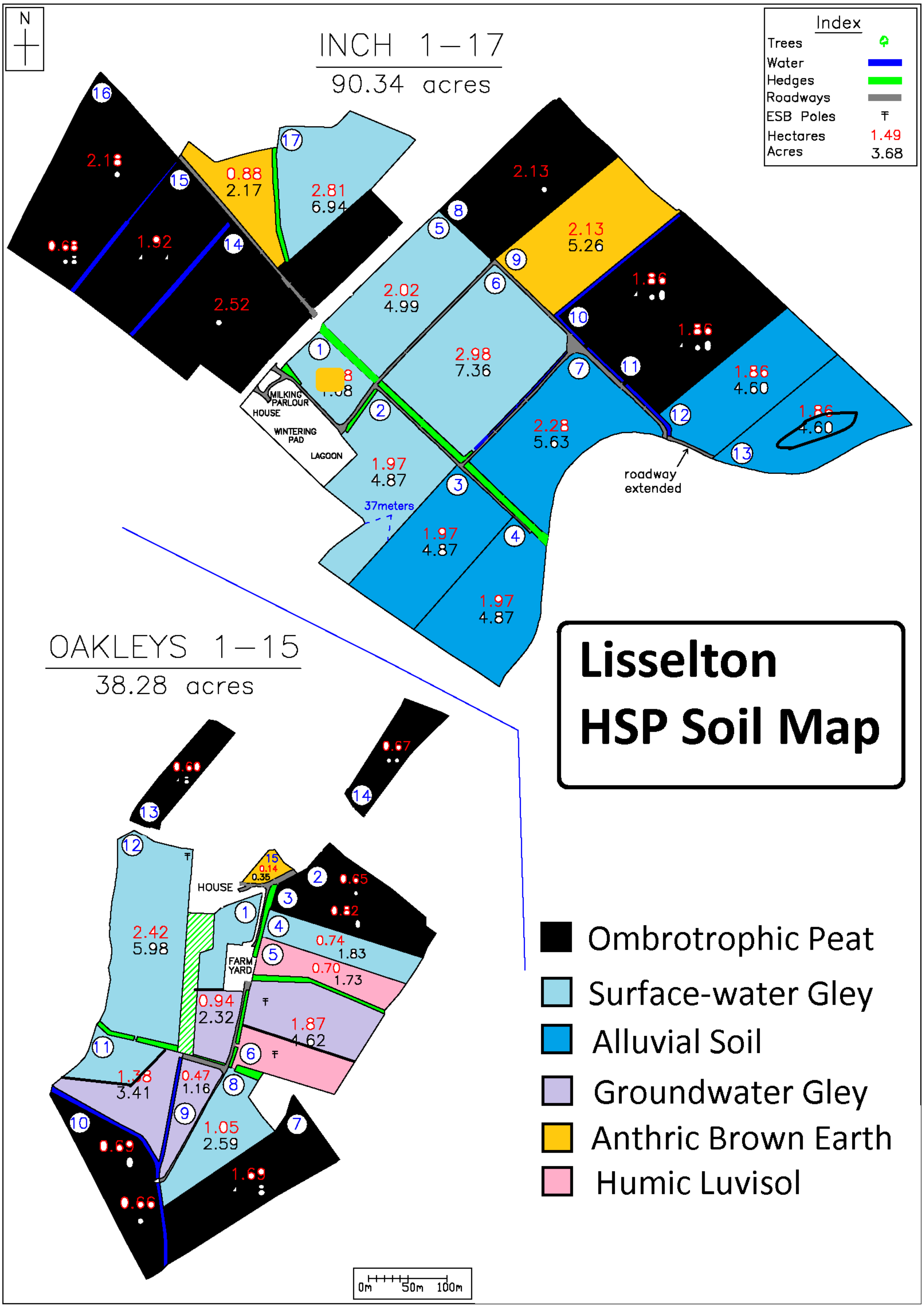

Figure 19. Map of the principle soil types found at Lisselton HSP farm. 1 to 5000 resolution approx.

Reference

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Appendix.

Table 5. Laboratory data for samples taken from soil pits at Lisselton HSP farm.

Paddock	**Sample**	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Dry Density (g/cm^3)**	**Bulk Density (g/cm^3)**	**Gravimetric Moisture Content (%)**	**Total Exchange Capacity (meq/100 g)**	**pH**	**Organic Matter (%)**	**Estimated Nitrogen Release (#'s N/acre)**
14	HZ1	Unsuitable for Texture analysis			0.28	1.08	292.34%	13.12	5.3	68.81	> 130
14	HZ2	Unsuitable for Texture analysis			0.10	1.01	965.47%	9.6	5.2	89.53	> 130
14	HZ3	28	61	11	1.25	1.79	43.29%	7.59	4.7	3.28	83
4	HZ1	19	59	22	0.98	1.48	48.78%	6.54	6.1	6.25	106
4	HZ2	20	53	27	0.96	1.46	42.59%	10.77	5.8	8.5	118
4	HZ3	23	33	44	1.05	1.29	12.25%	4.75	6.1	1.75	55
2	HZ1	22	41	37	0.95	1.38	38.59%	9.89	5.9	8.03	115
2	HZ2	26	47	27	0.97	1.52	57.51%	7.88	5.5	11.81	126
2	HZ3	23	54	23	1.80	2.12	15.46%	7.94	6.4	0.89	36

Table 5 continued…

Paddock	Sample	S* (ppm)	P* (mg/kg)	Bray II P (mg/kg)	Ca* (mg/kg)	Mg* (mg/kg)	K* (mg/kg)	Na* (mg/kg)	Ca** (%)	Mg** (%)	K** (%)	Na** (%)
14	HZ1	33	19	22	1168	145	55	73	44.51	9.21	1.07	2.42
14	HZ2	17	6	1	788	120	18	46	41.04	10.42	0.48	2.08
14	HZ3	46	40	34	434	77	42	44	28.59	8.45	1.42	2.52
4	HZ1	19	2	< 1	865	79	42	52	66.13	10.07	1.65	3.46
4	HZ2	11	14	13	1281	127	65	59	59.47	9.83	1.55	2.38
4	HZ3	22	11	15	648	45	21	44	68.21	7.89	1.13	4.03
2	HZ1	16	94	103	1212	132	53	59	61.27	11.12	1.37	2.59
2	HZ2	15	40	28	792	90	34	50	50.25	9.52	1.11	2.76
2	HZ3	9	4	50	1045	153	38	53	65.81	16.06	1.23	2.9

Paddock	Sample	Other Bases** (%)	H** (%)	B* (mg/kg)	Fe* (mg/kg)	Mn* (mg/kg)	Cu* (mg/kg)	Zn* (mg/kg)	Al* (mg/kg)
14	HZ1	6.8	36	0.53	530	59	< 0.2	2.49	473
14	HZ2	7	39	0.51	292	6	0.48	0.7	487
14	HZ3	8	51	0.31	361	4	1.32	0.56	1069
4	HZ1	5.2	13.5	0.43	224	126	0.91	0.96	709
4	HZ2	5.8	21	0.8	204	133	2.56	1.91	788
4	HZ3	5.2	13.5	0.23	245	55	0.59	0.55	814
2	HZ1	5.6	18	0.37	276	95	2.35	2.24	804
2	HZ2	6.4	30	0.23	247	8	1.7	0.58	1093
2	HZ3	5	9	< 0.20	183	9	3.49	1.81	668