



26) Bedrock exposure in South West of the Site in September showing a profile generally confirming V/O no greater than 2/2.



27) Commencement of the removal of overburden prior to excavation of material failing visual and olfactory criteria in SW of the site.



28) Exposure of highly odorous and viscous 'tarry' material prior to removal



29) Underlying surface following removal of the visual and olfactory failures. Comprising predominantly natural soil (clayey sandy gravel/gravelly sandy clay)



30) Overburden removal on the north west of the site showing indicative pre and post reclamation depth in this area in the south of the site.



31) Visual and olfactory validation pits across the southern pitch area



32) Looking north over IP4076 RBSL failure excavation. Pit was extended to 10m by 10m by 1.5m bgl.



33) Looking north over IP4076 RBSL failure excavation.



34) IP4082 RBSL failure excavation.

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Coed Darcy

Site Wide Open Space Validation

St. Modwen Developments Limited

October 2015
Monitor Phase 39

ATKINS

Plan Design Enable

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Glossary of Terms

Term	Meaning / Definition
CSM	Conceptual Site Model
RBSL	Risk Based Screening Level
ACM	Asbestos Containing Material
TPH	Total Petroleum Hydrocarbons
PAH	Polycyclic Aromatic Hydrocarbons
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
FFL	Finished Floor Level
mAOD	metres Above Ordnance Datum
RAP	Remedial Action Plan
VO	Visual/Olfactory Observations
BGL	Below Ground Level

1. Introduction

1.1. Background

Atkins Limited has been commissioned by St. Modwen Developments Ltd to provide consultancy advice with regard to the redevelopment of the former Llandarcy Oil Refinery as Coed Darcy.

The purpose of this report is to provide a summary of information relating to a number of areas of proposed Open Space (OS) as shown on the current Masterplan, predominantly areas of existing and proposed woodland and heathland within the final development. For the purpose of Monitor sign off, the extent of these areas is proposed as Monitor Phase 39 as shown on Drawing 5041216-REM-DWG-1661 P4.

For ease of reference, Monitor Phase 39 has been split up into a number of Zones (A-G) as shown on Drawing 5041216-REM-DWG-1661 P4.

Each zone is addressed separately on Technical Notes presented within appendices A-G and have due regard for the following sections.

1.2. Aims and Objectives

This report provides an overview of Monitor Phase 39, including information regarding the site setting, local geology and hydrogeology, identified contamination and details of remedial works undertaken, where required.

This information will be presented in such a way that it will enable the Monitor to sign off this phase as suitable for its proposed future use.

Because of the absence of detailed information relating to finished levels for these areas and unless otherwise stated within the individual Technical Notes, the following assessment assumes that existing ground levels will be maintained within the final development.

1.3. Scope of Work

The scope of works for each of the identified zones includes:

- A review of all readily available information for Monitor Phase 39 including geological, hydrogeological, historical site plans, Environment Agency and British Geological Society (BGS) records.
- A review of historical information relating to each OS Zone in Monitor Phase 39 and adjacent areas;
- A review of historical and recent ground investigation information, where available, relating to each OS Zone in Monitor Phase 39;
- Development of a Conceptual Site Model (CSM), based on the information available, and comparison with the requirements of the S106;
- Conclusions and details of long term receptor works that may be required when each zone is developed i.e. placement of clean cover and/or restricted access/planting for these areas within the final development

1.4. Soil Quality Assessment Standards

To maintain consistency of approach, the assessment standards for historical and recent data are those indicated in the S106 Agreement for Coed Darcy. The visual and aesthetic classification system defined within the S106, is provided as Table 1.

Atkins proposes to continue this system for the classification of aesthetic impact to aid assessment of each area in terms of the required remediation requirements. Where relevant, these values are quoted on each investigation log.

Table 1. Scale of Aesthetic Criteria

Class	Visual	Olfactory
0	No visible staining of soil, no visible suspect ACM*.	No detectable odour on soil.
1	Occasional staining of soil, no visible suspect ACM*.	Faint odour on soil.
2	Frequent staining of soil.	Distinct but not strong odour on soil.
3	Occasional heavy staining of soil.	Strong odour on soil.
4	Heavy staining of soil.	Strong odour discernible in ambient air.
5	Visible hydrocarbon present.	Overwhelming odour.

* visible suspect ACM refers to asbestos containing material visible to the naked eye which a reasonable and prudent person used to managing asbestos may suspect to be asbestos-containing.

The S106 for the proposed development presents a series of Risk Based Screening levels (RBSLs) which are defined as being the 'minimum base level standard' for redevelopment remediation works (Schedule 8, Part 2, Paragraph 2,5).

In order to update the assessment of contamination in line with current UK guidance, these RBSLs are also now supplemented by a series of Remedial Target Concentrations (RTCs) derived by Atkins (Atkins reference: 5041216-REM-REP-000216 v3). A summary of the adopted thresholds are presented in Appendix I.

1.5. Validation Frequency

The existing S106 for the proposed redevelopment does not provide specific details for remediation requirements for areas of Open Space, but states that:

The Developer shall remediate areas of Property which will not be developed for residential or commercial end-uses based on those areas falling into one of the following three broad categories of land-use:

Well managed parks and public gardens;

More lightly managed areas where public access is encouraged;

Areas to which access is discourages but occasional access and/or trespassing is possible.

The degree of protection that will need to be afforded to people will be largely dependent upon how the access to these areas is encouraged/discouraged and managed. For guidance only, access may be discouraged by physical barriers such as fencing, or vegetation or actively managed by the provision of walkways along which controlled access is encouraged. The topography of the site may encourage children to use bikes, potentially causing rutting of the ground surface and exposing soils at depth. Detailed designs in this regard will be prepared by the Developer approved by CDL and agree with the Environmental Authorities to (i) protect human health considering the reasonably anticipatable use of the land (ii) achieve the relevant RBSLs (recreational RBSLs being provided in Table 1 above) to an appropriate depth and (iii) include an appropriate scheme of validation testing.

A walkover of the OS zones by Atkins was undertaken on the 19th February 2015. Table 2 presents the agreed validation frequency for all OS zones based on an initial review of the information

available. The agreed frequencies vary to accommodate a tighter validation frequency in higher risk areas (i.e locations of potential historical contaminative sources based on the available information and visual evidence obtained during the walkover).

1.6. Information Sources

Information has been obtained from the following sources:

- URS BP Llandarcy Refinery Desk Study 44382742/BRRP0001, July 2007
- URS Report FR1287 Final Factual Report for Ground Investigation, August 2005
- Section 106 Deed of Planning Obligations (Dewey & LeBoeuf report GNP/NJR/13773-2), February 2008

Table 2. Zone Description and Agreed Validation Frequencies

C	Name	Approximate area (m ²)	Historical Use	Proposed Use	Sampling Strategy	Exploratory Hole	Frequency
A	North Site Woodland Margin	44924	Open fields, trackway, OWS, Tanks of NSR	Woodland - Access to area by defined paths/walkways	In footprint of former tanks/OWS	Trial Pits/Hand Dug Pits	1 per 400m ²
					Areas of no previous refinery history	Hand Dug Pits	1 per 2500m ²
B	SSR Woodland	67021	Open field, 2no. pump house, OWS, railway sidings	Woodland - Access to area by defined paths/walkways	In footprint of former tanks/OWS	Trial Pits/Hand Dug Pits	1 per 400m ²
					Areas of no previous refinery history	Hand Dug Pits	1 per 2500m ²
				Open Field - Open access for recreation	Historically open field	Hand Dug Pits	1 per 400m ²
C	Western Margin Woodland	39031	Western margin, Ash bank, OWS	Woodland - Access to be restricted by fencing	Throughout phase where access is safe	Hand Dug Pits	1 per 2500m ²
D	Railhead and Upper Terrace Margins	67909	Pipetrack, railway sidings and tracks, LP Gas storage, Propane and Butane Tank storage, Tank storage.	Woodland - Access to area by defined paths/walkways	In footprint of former tanks/gas storage	Trial Pits/Hand Dug Pits	1 per 400m ²
					Rail sidings	Hand Dug Pits	1 per 1600m ²
					Areas of no previous refinery history	Hand Dug Pits	1 per 2500m ²
E	Upper Tank Farm	154526	Tanks, Tank bases, Tank infrastructure	Woodland - Access to area by defined paths/walkways	In footprint of former tanks	Trial Pits/Hand Dug Pits	1 per 400m ²
					Areas of no previous refinery history	Hand Dug Pits	1 per 2500m ²
F	Ancient Woodland Flank	75716	None	Woodland - Access to area by defined paths/walkways	Areas of no previous refinery history	Hand Dug Pits	1 per 2500m ²
G	Southern Margin Woodland	152929	Tanks, Tank bases, Tank infrastructure	Woodland - Access to area by defined paths/walkways	In footprint of former tanks/OWS	Trial Pits/Hand Dug Pits	1 per 400m ²
					Areas of no previous refinery history	Hand Dug Pits	1 per 2500m ²
H	Rocky Knoll	14610	Adjacent to tank bases	Woodland - Access to area by defined paths/walkways. Some areas fenced off due to proximity to cliff face	In footprint of former tanks/OWS	Trial Pits/Hand Dug Pits	1 per 400m ²
					Areas of no previous refinery history	Hand Dug Pits	1 per 2500m ²

2. Environmental Setting

2.1. Published Geology

A review of published geological information (BGS map 247, Swansea (1:50,000 scale) indicates Monitor Phase 39 to be underlain by varying geology of:

- Till (Diamicton) is found partially in seven zones and is a heterogeneous deposit of glacial origin.
- Peat is found partially in four zones which are described as *'may be an organic-rich clay; humic deposits...accumulation of wet, dark brown, partially decomposed vegetation'*.
- Pennant Sandstone Formation, specifically the Hughes Member, Brithdir Member and the Rhondda Member which are described by the BGS as *'green-grey, lithic arenites ("Pennant sandstones") with thin mudstone/siltstone and seatearth interbeds and mainly thin coals'*.

Where superficial deposits are noted to be present on the geological map, they are not shown as pervasive across any of the zones. Some zones are indicated to have more than one superficial deposit and/or bedrock member within the area. The published geology for each zone is listed in Table 3.

Table 3. Open Space Zone Geology

Zone	Name of Phase	Superficial Deposits	Bedrock Geology
A	North Site Woodland	Till	Hughes Member
B	SSR Woodland	Till	Hughes Member
C	Western Margin Woodland	Till	Hughes Member
D	Railhead and Upper Terrace Margins	Till	Hughes Member
		Peat	Brithdir Member
E	Upper Tank Farm	Till	Hughes Member
		Peat	Brithdir Member
F	Ancient Woodland	Till	Hughes Member
		Peat	Brithdir Member
			Rhondda Member
G	Southern Margin Woodland	Till	Hughes Member
		Peat	Brithdir Member
			Rhondda Member
H	Rocky Knoll	N/A	Hughes Member

2.2. Groundwater

The underlying sandstone bedrock, which underlies all of Monitor Phase 39 at varying depths, is classified as a 'Secondary A Aquifer'. This is defined as:

'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.'

Environment Agency data suggests that the Till (Diamicton) and Peat deposits present beneath some of Monitor Phase 39 to be classified as 'Unproductive Strata'. These are defined as:

'...rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.'

Groundwater flow within each zone varies and is addressed in the separate assessment reports in Appendices A-H.

2.3. Landfills and Waste Management Facilities

Atkins is currently in the process of remediating the landfill associated with the former Llandarcy Oil Refinery and are in ongoing discussion with Natural Resources Wales relating to the surrender of Environmental Permit No. EPR/AP3990LR. The location of the licenced area in relation to Monitor Phase 39 open space zones is shown on drawing 5041216-REM-DWG-1842.

2.4. Sensitive Land Uses

Crymlyn Bog SSSI lies within the flood plain of the Neath river estuary and represents the most extensive area of lowland fen in Wales. The location of Crymlyn Bog SSSI in relation to Monitor Phase 39 open space zones is shown on drawing 5041216-REM-DWG-1842.

Crymlyn Bog SSSI is internationally important for its very wet mires often identified by an unstable `quaking` surface. Bottle sedge and bogbean are important components of some stands, together with common cottongrass, water horsetail, star sedge, mud sedge, and in places, the nationally rare slender cottongrass. Crymlyn Bog supports the largest area of calcium-rich fen dominated by great fen sedge vegetation in south Wales. Some of these stands are dominated by great fen sedge, but other areas display a more diverse vegetation in which tufted-sedge, royal fern and a range of tall-herb fen species are prominent. Some of these stands are unique in a Welsh context. In addition there are areas of wet woodland with alder and willow being the dominant species (<http://www.ccg.gov.uk/landscape--wildlife>).

Appendices

Appendix A. North Site Woodland (Zone A)

Technical Note 1363

Subject:	Coed Darcy – Open Space Zone A (North Site Woodland Margin)		
Reference:	5041216-REM-TN-1363	Revision:	A
Author:	Alex Mann	Checker:	Matthew Timmins
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Date:	October 2015	Authoriser:	Mike Poland

1. Introduction

This Technical Note relates to the assessment and validation of an area of open space known as the 'North Site Woodland Margin', which forms one part of Monitor Phase 39 (refer to Atkins Drawing 5041216-REM-DWG-1661 P4) within the former Llandarcy Oil Refinery, Neath. Based on the current Masterplan, this area is shown to remain as Open Space (woodland) within the final development.

For ease of reference, the 'North Site Woodland Margin' is referred to as 'Zone A' to correspond with the areas set out in the overarching Monitor Phase 39 report (5041216-REM-RPT-1340 Rev A).

2. The Site

Zone A is an irregular shaped parcel of land covering 4.73ha (hectares) and forms part of a swathe of existing green space along the north and eastern boundaries of the Northern part of the former refinery. The extent of the area under consideration is shown on Atkins Drawing 5041216-REM-DWG-1785.

Existing vegetation within this area comprises grassland, dense semi mature and mature woodland with scrub rough grasses and gorse dominating the remaining areas. The topography in Zone A varies but is broadly governed by a plateau, located to the south of the site. Levels fall from this point to the north towards North Site Reservoir (NSR) and the south east towards the railway. The topography ranges from approximately 50 metres above ordnance datum (mAOD) nearest the plateau to 21m AOD along the south eastern boundary and to 30.1 mAOD along the north eastern boundary of Zone A. Selected photographs are attached for reference (Appendix A).

Zone A is bound to the south and west by proposed residential phases of the wider Coed Darcy site, to the east by the M4 Motorway and to the north by the NSR and East Bay.

The final design for this area has not yet been defined but is anticipated to remain as an area of proposed woodland. Strategic proposals for these woodland and heathland areas, within the final development, are discussed in Atkins report 5041216-ECO-RPT-486.

3. Site History

Construction of Llandarcy Oil refinery commenced in 1917 but was temporarily suspended during the war due to the lack of men and resources. Construction started again in 1919 with production beginning in 1921. The refinery was officially opened in 1922.

The purpose of the refinery was to produce motor spirit, kerosene, gas fuel oil, fuel residue and lubricating oil and wax from imported crude oil. Between the wars, the oil industry developed rapidly. By 1939, the refinery had little of the original plant in operation.

In the mid 1980's a number of rationalisations occurred with the closure of the refinery being formally announced in 1997.

Based on the desk study for the former refinery (URS Report BRRP0001), historical activities within Zone A included part of an access road and part of the bowling green (still active) in the east of the site, with more refinery based activities in the north and west.

Eight tanks are recorded to have been historically located along part of the southern boundary of Zone A, with six of these indicated to have had associated bunding. The tanks are recorded to have been used for 'SO₂/Paraffin', with four of the tanks (NB series) specifically indicated to have stored '*middle distillates (paraffin/kerosene)*' historically.

The site boundary, does not include but, wraps around the north west and south east edges of the NSR No. 1&2 separators. The separators are known to be predominately brick lined with some concrete and have been cleaned out between January to June 2011 by Celtic Technologies Ltd (see Atkins report 5041216-RAP-TN-678). The effluent from the separators ran along the concrete channel from west to east in to the East Bay separators, which were located in the north east of the site. It is anticipated that these separators are to remain in the short term.

Akin to the NSR separators, the East Bay oil water separators processed effluent which was then discharged in to East Bay itself and consequently the NSR. The concrete separators were cleaned out and demolished between November 2010 to May 2011 by Celtic Technologies Ltd (see Atkins report 5041216-RAP-RPT-654), as part of the wider remedial works on East Bay. A draft RAP works certificate was issued by the monitor in October 2011 for these works.

The southern boundary of the site bisects a biological filter which is thought to have cleaned the water taken from the NSR prior to it being pumped to the cooling towers. This structure contains a significant amount of plastic filters and is planned for removal as part of ongoing reclamation works.

Land to the south and west of Zone A is predominately shown to comprise tanks and associated infrastructure with open land/ fields to the south east of the site.

The location of known historical refinery activities within Zone A is shown on Drawing 5041216-REM-DWG-1820.

4. Site Walkover

Atkins undertook a site walkover of Zone A in February 2015 to assess the potential for any proposed ground investigation and to also look for any obvious visual indicators of contamination or possible sources of contamination. A selection of photographs, taken during the walkover, are presented as Appendix A and the corresponding location drawing is shown as 5041216-REM-DWG-1785.

During the walkover, approximately 25 percent of the site area within Zone A was not accessible for ground investigation due to proximity to open water and/or the presence of existing dense vegetation. The remainder of Zone A comprises mainly sloping topography comprising overgrown scrub and gravelly, disturbed ground.

Details of all constraints to any proposed investigation within Zone A are highlighted on drawing 5041216-REM-DWG-1795. Breakouts of ochre and historic ochreous staining were identified in three places within Zone A and a number of concrete structures were also present as shown on drawing 5041216-REM-DWG-1795. No obvious evidence of gross contamination was noted within this area during the walkover.

5. Historical Ground Investigation

Historical ground investigation data for Zone A (URS Report FR1287) suggests a total of 19 exploratory holes representing 12 locations (4 locations with multiple installations) within this area, as shown on drawing 5041216-REM-DWG-1804. Copies of available exploratory hole logs (MSTP235 not found) for these locations are collated in Appendix B.

A review of the available logs indicate Made Ground was present overlying natural soils in six locations, which is consistent with the historical uses of these locations (tank bases, bunds and infrastructure). The Made Ground generally comprises soft to firm clays and loose gravels/sands of ash, clinker, concrete, and brick fragments. Made Ground ranged in thickness from 0.05m bgl in NSTP020 to 3.1m bgl in MSMW079 S&D.

Underlying the Made Ground (where present), the near surface soils comprised varying sequences of silts, clays, sands and gravels which extended, where proven, to depths between 1.4m (NSMW011a) and 7.2m bgl (MSMW88d).

Bedrock is reported in five locations where the base of near surface soils was proven, however, gravelly horizons were encountered at a number of locations above the bedrock and is considered to represent weathered bedrock. The bedrock comprised sandstone with an interbedded 0.2m thick coal seam intercepted in MSMW088d at 8.2m bgl.

A review of the available logs indicates that mild to moderately strong hydrocarbon odours were encountered historically in nine locations within Zone A. A VO classification of 3 is reported to have been recorded in NSTP003 at around 1m bgl. Free product is not noted to have been encountered on any of the exploratory hole logs.

A summary of the results of historical laboratory analysis on seven samples from Zone A (3 shallow and 4 deep) is presented in Appendix C. These indicate the following exceedances of the adopted thresholds for retention at shallow depth within in area of Public Open Space.

The depth of relevant samples beneath the current surface is given in brackets for reference.

- NSTP003 Chromium 90mg/kg (0.3m).
- MSMW232 Cadmium 4mg/kg (0.5m).

Reference to historic borehole monitoring in URS Report FR1287 indicates that groundwater levels are recorded to lie at approximate depths of between 0.021 m bgl (MSMW87s) to 15.6m bgl (MSMW81). Product was noted to have been recorded in two wells (MSMW79s&d and RFSW038) with a maximum thickness of 0.001m. Subsequent monitoring rounds undertaken by URS (FR1287) did not record product in these holes

6. S106 Remediation Redevelopment Requirements

The existing S106 (Dewey and LeBoeuf, GNP/NJR/13773-2) does not provide specific details for remediation requirements for areas of proposed Open Space, but states the following:

The Developer shall remediate areas of Property which will not be developed for residential or commercial end-uses based on those areas falling into one of the following three broad categories of land-use:

Well managed parks and public gardens;

More lightly managed areas where public access is encouraged;

Areas to which access is discouraged but occasional access and/or trespassing is possible.

Assuming the retention of existing topography within the final development, it is considered that Zone A falls within the latter category where public access will be generally restricted.

In line with the absence of specific details relating to remediation requirements for proposed areas of open space, the S106 states the following with regard to the scope of remedial and/or mitigation works in these areas:

The degree of protection that will need to be afforded to people will be largely dependent upon how the access to these areas is encouraged/discouraged and managed. For guidance only, access may be discouraged by physical barriers such as fencing, or vegetation or actively managed by the provision of walkways along which controlled access is encouraged. The topography of the site may encourage children to use bikes, potentially causing rutting of the ground surface and exposing soils at depth. Detailed designs in this regard will be prepared by the Developer approved by CDL and agree with the Environmental Authorities to (i) protect human health considering the reasonably anticipatable use of the land (ii) achieve the relevant RBSLs (recreational RBSLs being provided in Table 1 above) to an appropriate depth and (iii) include an appropriate scheme of validation testing.

The Risk Based Screening Levels (RBSLs), listed in the S106 for the site, have been combined with Atkins derived Risk Target Concentrations (RTCs) for an open space end use, to assess chemical results in these areas. Details of the adopted thresholds are shown/presented in Appendix I of the overarching Monitor Phase 39 Report, Site wide open space validation, 5041216-REM-RPT-1340.

The general validation sampling frequency agreed with the monitor for Zone A (Table 1) is based upon the absence of significant historic refinery activities across much of this area (See drawing 5041216-REM-DWG-1922).

Table 1 –Agreed Validation Frequency

Sampling Strategy	Exploratory Hole	Frequency
Areas of Historical Process Operations and Storage*	Trial Pits/Hand Dug Pits	1 per 400m ²
Areas of little or no development*	Hand Dug Pits	1 per 2500m ²

**only where safe access and egress is possible*

7. Recent Ground Investigations

With the aim of supplementing and updating the limited historical investigation within Zone A, a total of 55 machine excavated trial pits and 14 hand excavated pits were undertaken by Atkins between October 2014 and April 2015. In line with the site walkover and the presence of dense semi mature/mature woodland and proximity to open water bodies in of Zone A, trial pits were only excavated where safe access and egress was possible, as shown on drawing 5041216-REM-DWG-1820. Copies of all relevant exploratory holes logs are presented in Appendix D.

Ground conditions encountered during the recent ground investigations were similar to that found in previous investigations and generally confirm Zone A to be underlain predominantly by natural soils (silts, sands and gravels) overlying sandstone bedrock (where encountered). Topsoil was found in 18 locations and cohesive soils were not encountered during the additional ground investigation.

Made Ground, comprising reworked natural soils containing ash, clinker, brick, concrete, cement etc., was identified in seven locations. The locations were located in, or immediately adjacent to, former tank bases (POS6, NSW406 and NSW407) infrastructure (NSE0141 and ZAHPO02) or the East Bay separators (POS9 and POS10) as shown on Drawing 5041216-REM-DWG-1820.

The depth to sandstone bedrock, where encountered, in Zone A, was found to vary between ground level (NSE0145) and 2.85m depth (POS9).

The maximum recorded VO class noted during recent investigation was a visual class 4 in Made Ground (POS10). Generally, however, soils encountered in Zone A were recorded to possess VO classes of between 0-2.

A total of 78 environmental samples (54 shallow and 24 deep) were taken from in situ soils within these exploratory holes during the Atkins investigation. The results of the chemical analysis relating to the recent investigation in Zone A are presented in Appendix E. These indicate the following exceedances of the adopted thresholds for retention at shallow depth within in area of Public Open Space.

The depth of relevant samples beneath the current surface is given in brackets for reference.

- NSE012 Arsenic 77 mg/kg, Copper 158mg/kg (0.1m)
- NSW407 Benzo(a)Pyrene 2.02mg/kg (0.5m)
- ZAHPO10 Arsenic 67.4mg/kg, Cadmium 3.6 mg/kg, Copper 154mg/kg (0.5m)
- ZAHPO11 Arsenic 81.1mg/kg, Cadmium 2.95 mg/kg, Copper 172mg/kg (0.5m)
- ZAHPO12 Arsenic 80.8mg/kg, Copper 154mg/kg (0.5m)
- ZAHPO13 Arsenic 94.70mg/kg, Copper 201mg/kg (0.5m)
- ZAHPO14 Arsenic 118mg/kg, Cadmium 3.61mg/kg, Copper 269mg/kg (0.5m)

- ZAFP5 Arsenic 68.4mg/kg, Cadmium 4.74mg/kg, Lead 3650mg/kg, Zinc 826mg/kg (0.5m)
- ZAFP9 Mercury 1.97mg/kg (0.5m)
- POS005 Arsenic 71.2mg/kg, Cadmium 3.77mg/kg, Copper 149mg/kg, Lead 748mg/kg, Zinc 1620mg/kg (0.5m)
- POS009 Arsenic 123mg/kg, Cadmium 3.35mg/kg, Copper 361mg/kg, Lead 1400mg/kg, Zinc 2360mg/kg (0.5m)
- POS009 Copper 149mg/kg (0.5m)

Asbestos was detected in sixteen of the samples tested from across Zone A and were subsequently scheduled for quantitative assessment. The highest analysed concentration was 0.0105% in POS007 (0.5m bgl) which lies below the asbestos RBSL threshold (0.02%) for retention in the top metre below finished floor level in an open space end use.

7.1 East Bay Shoreline Improvement

Hawk Group Ltd undertook improvement works around the southern edge of East Bay on the 2nd October 2015. The works entailed the removal of hydrocarbon impacted materials along a short section of land between East Bay and the former separators.

Approximately 25m³ of impacted materials were removed and moved elsewhere within the refinery for treatment (bioremediation). As with other water bodies across the Coed Darcy site, East Bay will continue to be monitored for 'seeps and sheens' although the likelihood of significant impacts in this respect is considered low. The works are more comprehensively covered in Atkins Technical note (5041216-REM-TN-1462) in Appendix G.

8. Validation

Based on the presence or absence of historical operations, Tables 2 and 3 detail the validation frequencies using the corresponding samples/exploratory holes from each area as discussed in section 6 (See drawing 5041216-REM-DWG-1922).

Table 2 –Exploratory Hole Validation Frequency

Sampling Strategy	Agreed Frequency	Area within Zone A	Number of Exploratory Holes	Validation Frequency
Areas of Historical Process Operations and Storage*	1 per 400m ²	10,172m ²	23	1 per 442m ²
Areas of little or no development*	1 per 2500m ²	37,141m ²	46	1 per 807m ²

**only where safe access and egress is possible*

Table 3 –Sampling Validation Frequency

Sampling Strategy	Area within Zone A	Number of Samples	Validation Frequency
Areas of Historical Process Operations and Storage*	10,172m ²	29	1 per 351m ²
Areas of little or no development*	37,141m ²	49	1 per 758m ²

**only where safe access and egress is possible*

The validation frequency for the area with little or no previous refinery history is below the agreed value. In line with restricted access, however, the validation frequency for the area with previous refinery history exceeds the agreed value.

As previously indicated (section 4), access to much of Zone A was found to be restricted by the presence of dense semi mature/mature woodland and proximity to open water bodies, thus the extent of the area available for further investigation was limited. The total extent of restricted access for the area with previous refinery

history equates to approximately 1,294m². When subtracted from the total area (10,172m²) for this historical use, the validation frequency is below agreed values at 1 exploratory hole per 386m².

A comparison of the results of recent laboratory analysis with the permitted thresholds for Parks and Open Spaces, indicate exceedances of the adopted thresholds for a number of inorganic determinands as listed in Section 7. The exceedances generally correlate with disturbed areas of ground within Zone A with the exception of ZAHP9, ZAHP13 and ZAHP14.

9. Conceptual Site Model (CSM)

Zone A lies in the northern part of the former Llandarcy refinery and comprises grassland, dense semi mature and mature woodland with scrub, rough grasses and gorse dominating the remaining areas. The site lies downslope of the North Site tank farm /API separators and in turn, lies upslope of the NSR and East Bay. Access to the northern part of the former refinery is currently restricted by the presence of the live railway, fencing across the bridge from the main site, fencing along northern, eastern and western boundaries.

Historical refinery operations, including the storage of hydrocarbons, were located upslope of the site while two oil water separators were located downslope. In line with RAP works defined in the S106, remedial works have been undertaken to remove hydrocarbon impacted sludges from within both the NSR and East Bay.

Historical ground investigation (refer to section 5) confirms the presence of localised Made Ground but predominantly natural soils underlying Zone A, consistent with the absence of significant historical development across the majority of the site. More recent investigation has confirmed the presence of localised Made Ground and elevated concentrations of inorganic metals/metalloids (arsenic, copper, nickel, lead mercury and zinc), an exceedance of benzo(a)pyrene and the presence of asbestos fibres within the near surface soils (section 7).

Key exposure pathways to the receptors include:

- Dermal contact with contaminants in soil, soil-derived dust and entrained surface water run-off from any areas where soil (and contaminants) is exposed at the surface or in perched water/ groundwater if excavation takes place;
- Ingestion of contaminants in soil, soil-derived dust and entrained surface water run-off from any areas where soil (and contaminants) is exposed at the surface or in perched water/ groundwater if excavation takes place;
- Inhalation of contaminants in soil-derived dust from any areas where soil (and contaminants) is exposed at the surface or excavation takes place;
- Migration and inhalation of outdoor and indoor vapours
- Migration of contaminants and permeation into plastic drinking water pipes.
- Passive and active uptake through roots of contaminants in migrating perched water/ groundwater and leaf contact with contaminants in windblown, soil-derived dust.

Detailed proposals relating to the final design for this area are not yet defined. Due to the presence of dense vegetation, the NSR separators and the proximity to both the NSR and East Bay, it is anticipated that this area will fall within '*Areas to which access is discouraged but occasional access and/or trespassing is possible*', as defined in the S106. As this area represents areas of existing scrub and woodland and are anticipated to remain as areas of woodland in the final development then the frequency of exposure of both current site users and future residents to identified contamination within shallow soils across this area is considered to be low

It should be noted that NSR and East Bay lie outside of direct SMD ownership, this land being currently leased off the landowner. As such, long term proposals for these areas cannot be defined at the time of writing. In line with the proposed retention of the existing API Separators in the short to medium term then this feature is fenced (refer to Atkins report 5041216-REM-TN-1245).

The risk to receptors in the short term is deemed to be mitigated by the presence of 24hour security, secure site perimeter fencing and the wet and marshy ground associated with Crymlyn Bog SSSI. However, to mitigate the risk to long term receptors, the proposed fencing works and new planting is likely to significantly reduce the frequency of receptors entering the site. The works proposed to protect long term receptors will be required upon the development of Zone A and are detailed on drawing 5041216-ATK-REM-DWG-2014. The above CSM and envisaged low frequency of use, suggests the reduced sampling frequency is sufficient for this assessment and the remaining risk to present and future receptors is considered low.

10. Conclusions

Atkins Limited has been commissioned by St. Modwen Developments Ltd to provide a summary of information relating to an area of proposed Open Space known as Zone A of Monitor Phase 39.

Planning condition 41 of the Outline Planning Permission for the redevelopment of the former refinery states that:

No works shall commence on each development area until a scheme detailing the temporary means of enclosure for each development phase as agreed under Condition 9 of this consent (including details of the means to prevent unauthorised access to a service track or restricted access point) together with full details of temporary protective fencing to safeguard trees, hedgerows and habitat and ecological areas of importance giving full consideration to measures which will allow or restrict wildlife access to areas have been submitted to and approved in writing by the Local Planning Authority. The submitted details shall have due regard for the Environmental Management Plan and include the specifications of the fencing; details of signage stating that the fencing should not be removed; together with plans showing the location of the fencing and the extent of the areas to be protected. The approved details shall be fully implemented on site and shall be retained as such for the duration of the works within these areas.

In line with the above, details of fencing etc relating to any proposed redevelopment within the vicinity of Zone A would need to be agreed with the relevant regulatory authorities prior to any proposed construction. Within the current site, unauthorised access to this area is restricted by ongoing 24hr security at the site perimeter. Ongoing reclamation works removing remnant structures will be subject to an engineers watching brief to ensure compliance with the S106 requirements.

Subject to the agreement of long term proposals for this area in line with the requirements of Planning Condition 41, Zone A is considered suitable for ongoing use as Open Space (Woodland).

Drawings

5041216-REM-DWG-1661 (P4)

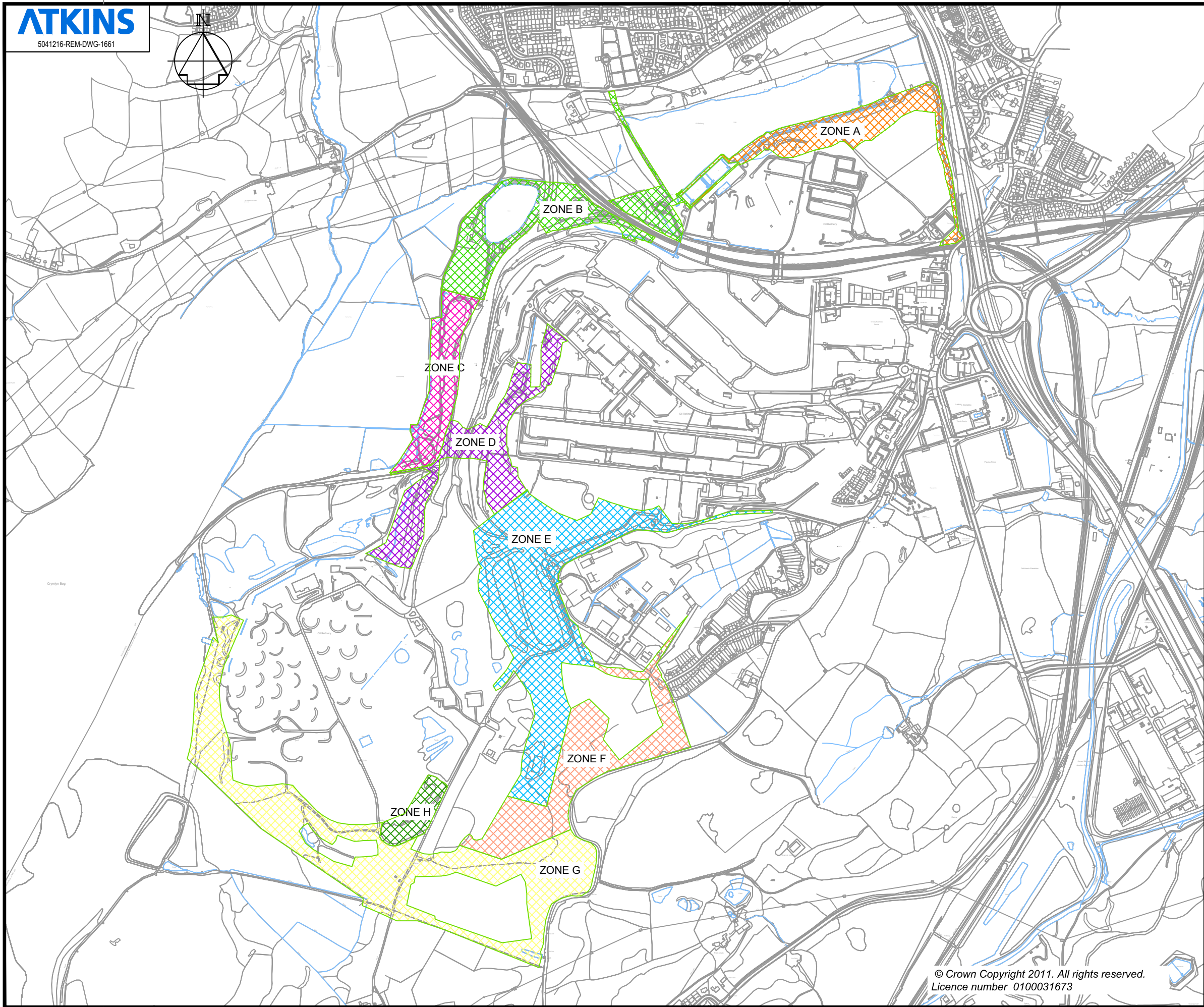
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5041216-ATK-REM-DWG-2014



KEY

P4	BOUNDARY AMENDMENT	HS	MT	26.10.15
P3	REVISED BOUNDARIES	NR	MT	19.08.15
P2	REVISED BOUNDARIES	MB	MT	31.03.15
P1	FIRST ISSUE	MJ	MT	23.02.15

REVISIONS	Drawn By	Checked By	Date
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PURPOSE OF ISSUE	Rev.	Authorised for issue	Date
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ST.MODWEN

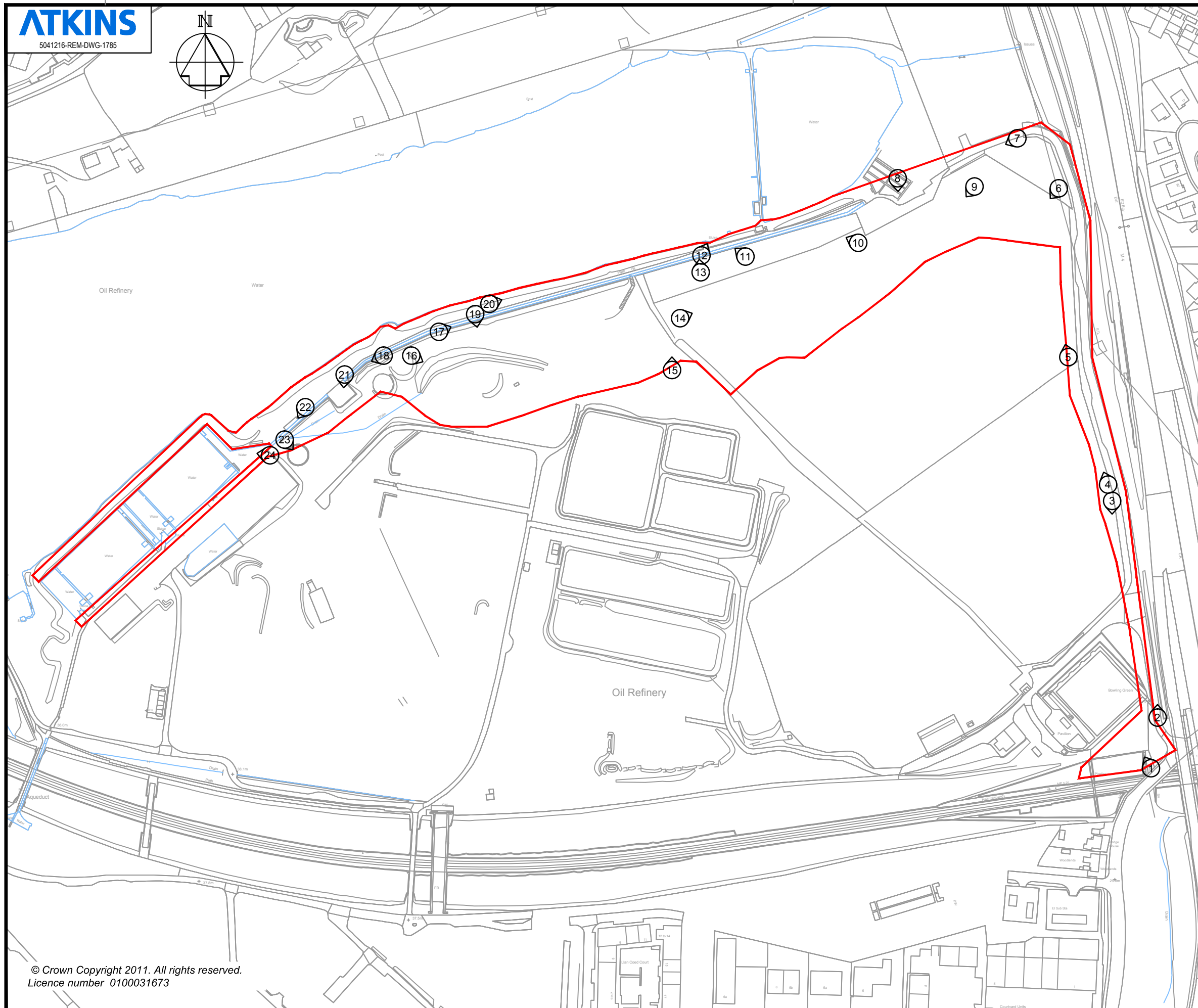
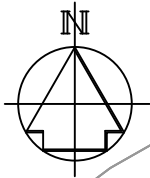
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COED DARCY

DRAWING TITLE
MONITOR PHASE 39

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	DATE 27.03.15	DATE 27.03.15	DATE

0	SHEET A3	PLOT DATE 29.10.15
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DRAWING NO 5041216-REM-DWG-1661	REV P4
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KEY



PUBLIC OPEN SPACE ZONE A -

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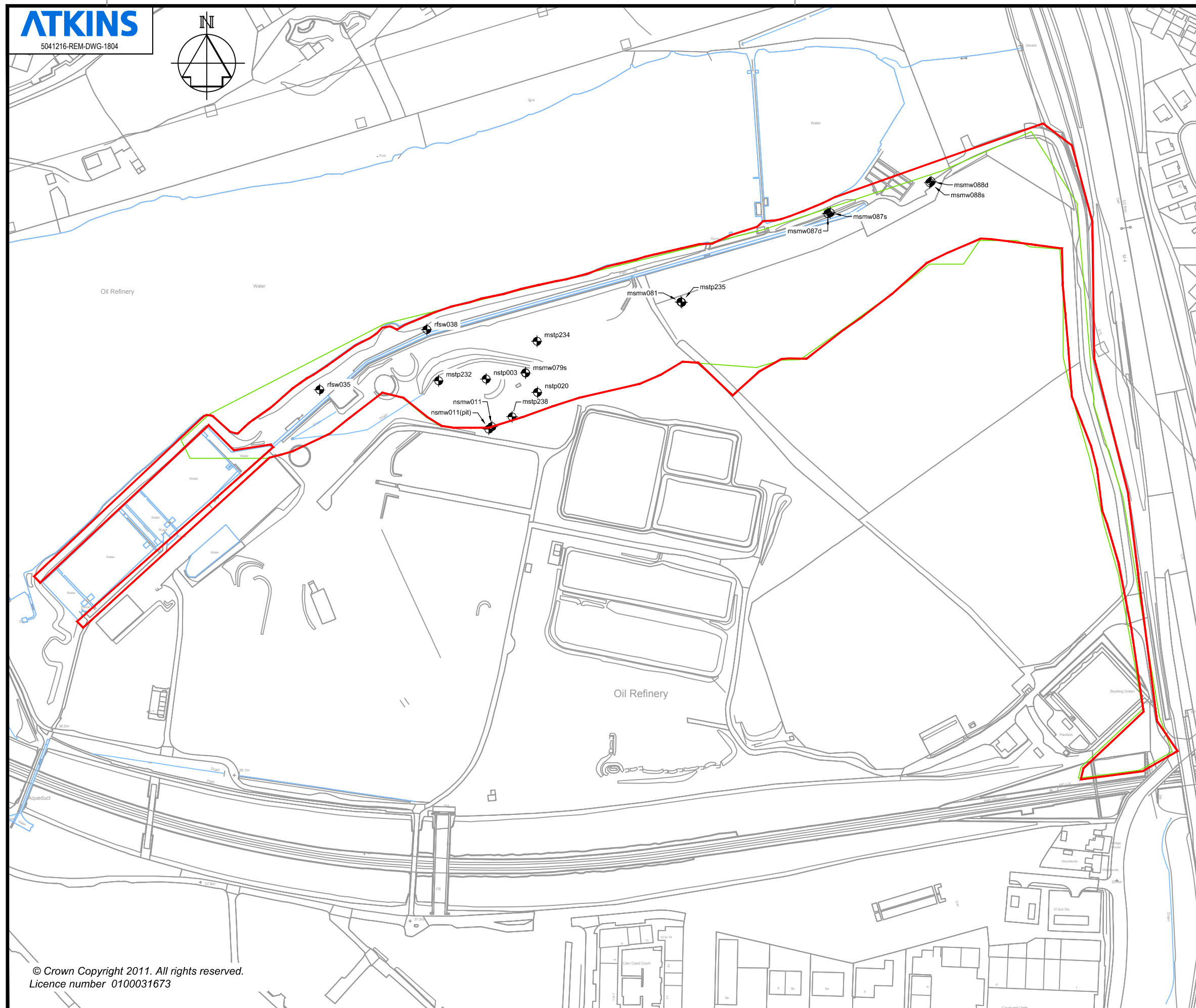
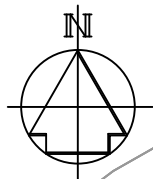
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CLIENT	ST.MODWEN
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DRAWING TITLE	PUBLIC OPEN SPACE ZONE A PHOTOGRAPH LOCATIONS
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SCALES	DRAWN	CHECKED	CO-ORD CHECK
1:2,500	MJ	MT	
	DATE	DATE	DATE
	23.02.15	23.02.15	
DRAWING NO	SHEET	PLOT DATE	REV
5041216-REM-DWG-1785	A3	05.05.15	P1



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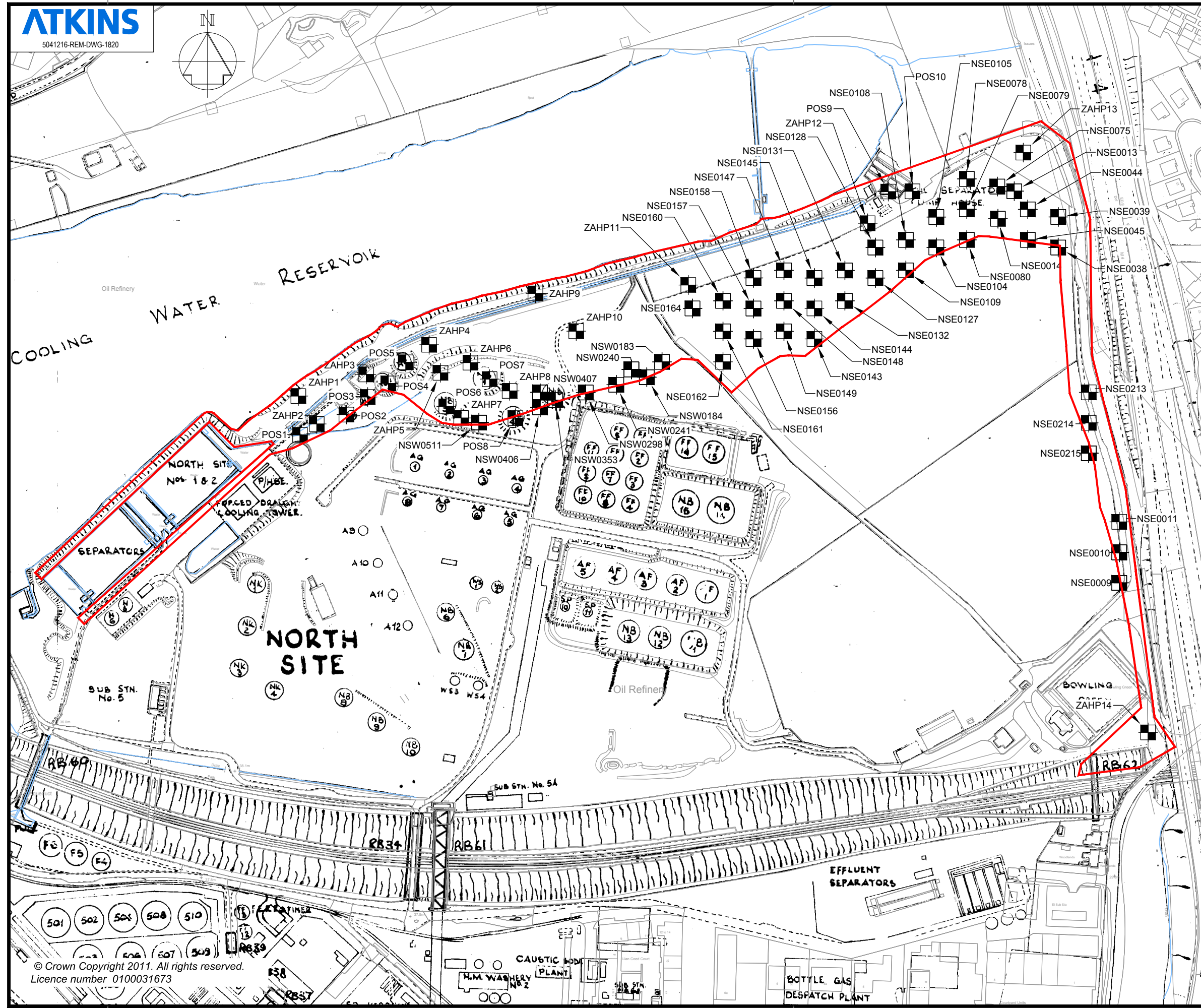


PUBLIC OPEN SPACE ZONE A



HISTORIC EXPLORATORY HOLE

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DRAWING TITLE PUBLIC OPEN SPACE ZONE A HISTORICAL EXPLORATORY HOLE LOCATIONS				
SCALES 1:2,500	DRAWN MJ	CHECKED MT	CO-ORD CHECK	
	DATE 05.03.15	DATE 05.03.15	DATE	
0 		SHEET A3	PLOT DATE 05.05.15	
DRAWING NO			REV P1	



 PUBLIC OPEN SPACE ZONE A

 TRIAL PIT LOCATION

P1	FIRST ISSUE	MJ	MT	19/03/2019
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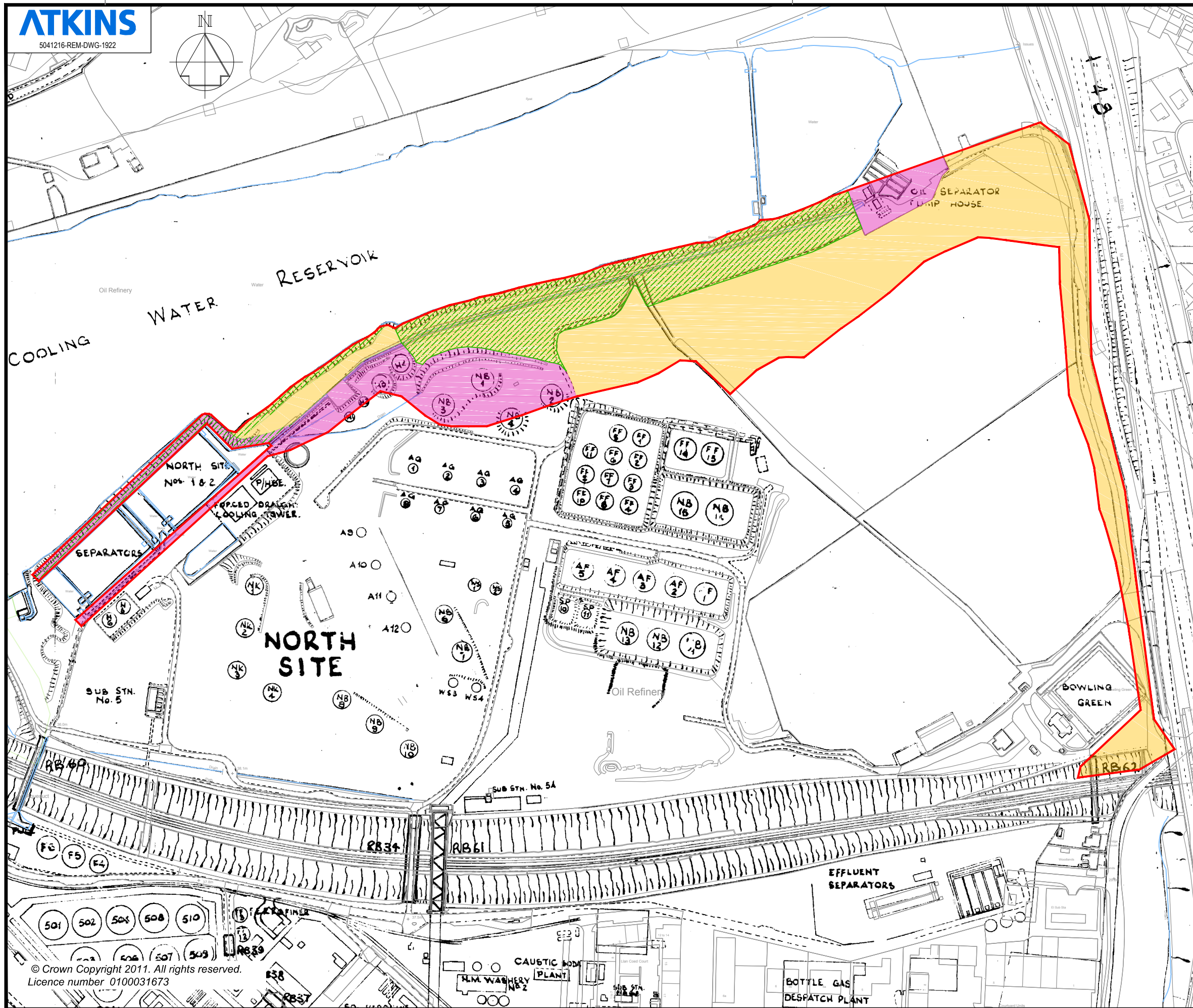
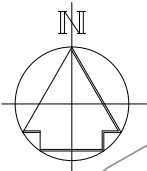
PROJECT
COED DARC

DRAWING TITLE
PUBLIC OPEN SPACE ZONE A
NORTH SITE WOODLAND
HISTORICAL LAYOUT

SCALES 1:2,500	DRAWN MJ	CHECKED MT	CO-ORD CHECK
	DATE 19/03/15	DATE 19/03/15	DATE
		SHEET A 3	PLOT DATE 12.05.15

5041216-REM-DWG-1820

REV
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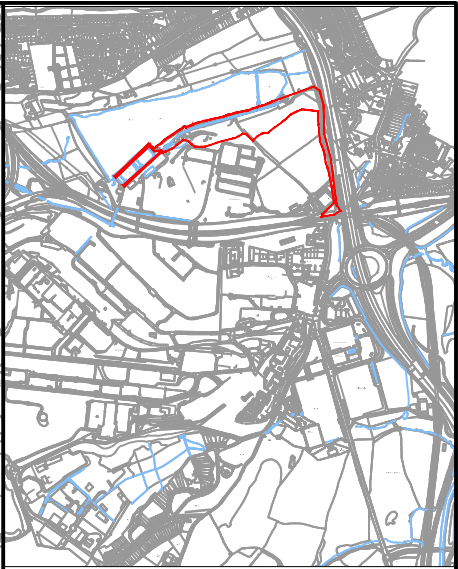
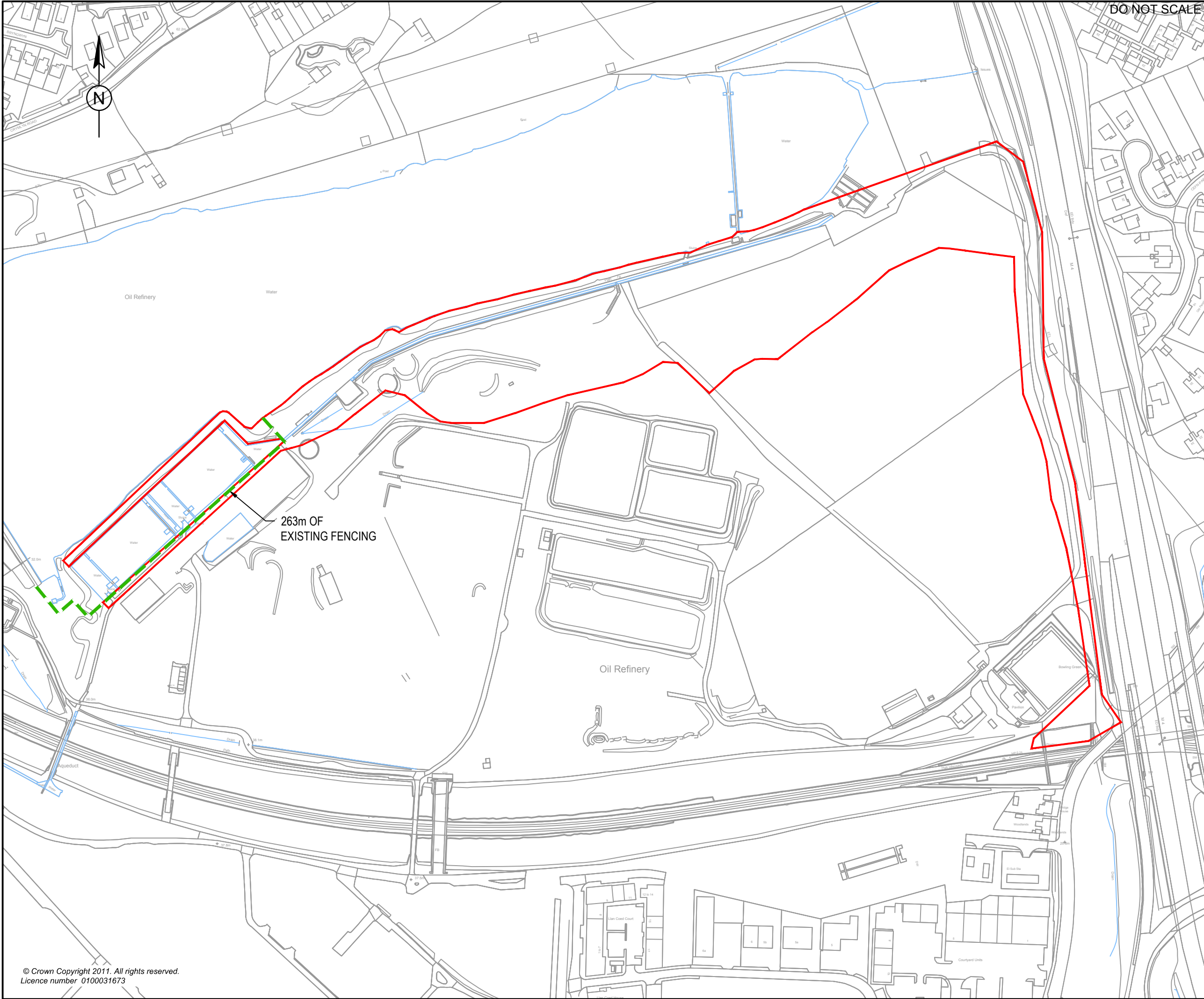


- KEY**
- PUBLIC OPEN SPACE ZONE A
 - AREA OF RESTRICTED ACCESS
 - AREAS OF LITTLE OR NO DEVELOPMENT
 - AREA OF HISTORICAL PROCESS OPERATIONS AND STORAGE

P1	FIRST ISSUE	MJ/CK	MT	18/05/15
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CLIENT ST.MODWEN			
PROJECT COED DARCY			
DRAWING TITLE PUBLIC OPEN SPACE ZONE A NORTH SITE WOODLAND HISTORICAL LAYOUT			
SCALES 1:2,500	DRAWN MJ	CHECKED MT	CO-ORD CHECK
DATE 19/03/15	DATE 19/03/15	DATE	DATE
DRAWING NO 5041216-REM-DWG-1922		SHEET A3	PLOT DATE 20.05.15
REV P1			



LOCATION PLAN
SCALE 1:25,000

KEY	
—	PUBLIC OPEN SPACE ZONE A
- - -	263m OF EXISTING FENCING

Rev.	Date	Description	By	Chk'd	App'd
P1	03/09/15	FIRST ISSUE	MJ	MT	ML

FOR INFORMATION					S2
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Client

Project Title

COED DARCY

Drawing Title

PUBLIC OPEN SPACE ZONE A
LONG TERM RECEPTOR
ACCESS AND LANDSCAPING PROPOSALS

Scale	Designed	Drawn	Checked	Authorised
1:2500	MT	MJ	MT	ML
Original Size	Date	Date	Date	Date
A3	03/09/15	03/09/15	03/09/15	03/09/15
Drawing Number				Revision
5041216-ATK-DR-C-REM-002014				P 1

Appendix A – Photographs



Photograph 1: Heavily overgrown scrubland fenced off due to proximity to railway.



Photograph 2: Concrete/asphalt track leading to entrance to bowling green (left hand side of photo) and up to east bay to the north.



Photograph 3: Pole mounted transformer on the north site fields area..



Photograph 4: North site fields viewing north, note the disturbed ground on the left hand side of the photo due to the wider site trial pitting works.



Photograph 5: North site fields and asphalt track to east bay.



Photograph 6: Dense woodland and thick bramble scrub.



Photograph 7: Track leading to east bay to the south west with dense semi mature woodland either side.



Photograph 8: Open excavation currently flooded in the area of the former east bay oil water separators. Remnant concrete boulders along the edges from the demolition of the former structure.



Photograph 9: North site fields and dense scrubland to the north (Photo viewing west).



Photograph 10: Mature Oak woodland adjacent to with low lying scrub.