

The Financial Risk of Developing Brownfield Land

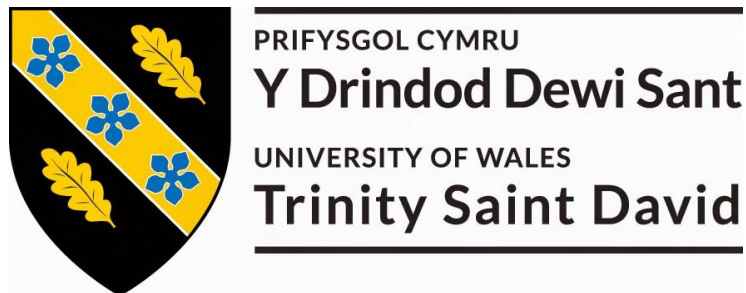
**Nathan Daniel
P144299**

BSc Quantity Surveying & Commercial Management

University of Wales Trinity Saint David

Swansea

Supervisor: Dr. Juan Ferriz-Papi



**Submitted to The School of Architecture, Built & Natural
Environment**

Abstract

The UK Government is committed to tackling the housing crisis that faces this country. To solve this problem, the aim is to address another issue faced in the form of surplus brownfield land which has polluted the country since the decline following the industrial revolution. Policies and Guidance have been released showing plans to develop this Brownfield Land into thousands of affordable homes.

However, Brownfield land is renowned for the problems it uncovers during development, which raises the question as to how can affordable homes be built on land that carries such a high financial risk?

The policies blindly guide developers towards this form of development with insufficient incentives and little information regarding the potential risks that accompany brownfield development.

To examine this risk the case study of redeveloping BP Llandarcy Oil Refinery into 4,000 homes has been utilised. This land, once labelled the most contaminated in Europe, is now earmarked to be home to a new village. Targets set upon its inception suggested that 2,000 of the promised homes would be completed by 2016, however 4 years past this deadline, much of the land still lies vacant. The original developer of the site went into administration only halfway in to their 140-unit scheme, which highlights the risks of developing on such volatile land.

This research aims to uncover the true extent of the risk that is imposed by developing on such land, and suggests alternative solutions on how affordable homes can be built and the surplus of land utilised, to ensure the financial security within the construction industry.

List of Contents

Chapter 1: Introduction.....	1
Chapter 2: Literature Review.....	5
2.1: Government Documentation	5
2.2: Existing Research on Developing Brownfield/Contaminated Land	9
Chapter 3: Research Methodology	13
3.1: Case Study	14
3.2: Methods of Data Collection.....	18
3.3: Documentary Analysis	19
3.4: Semi Structured Interviews.....	20
3.4.1 Interview 1	20
3.4.2: Interview 2	21
3.4.3: Interview 3	21
3.5: Ethical Considerations	22
3.5.1: Semi Structured Interviews	22
3.6: Cost Data.....	22
3.7: Data Analysis.....	22
Chapter 4: Results & Analysis.....	24
4.1: Documentary Analysis	24
4.1.1: Asbestos.....	29
4.1.2: Localised Hydrocarbons	29
4.1.3: Residual Solvent Contamination.....	30
4.1.4 Heavy Metal Contamination.....	30
4.2: Remediation Strategy	32
4.2.1: Asbestos, PAH and Metal Contamination	32
4.2.2 Contamination Other Than Asbestos in Soil	33
4.2.3 Residual Solvent Contamination.....	33
4.3: Cost Analysis.....	34
4.4: Risk v Return on Greenfield v Brownfield Development.	36
Chapter 5: Conclusions & Recommendations.....	39
5.1 Conclusions	39
5.2 Recommendations.....	40
Bibliography	42
Appendices	44

List of Figures

Figure 1 – Flow Chart of Intended Research Techniques	13
Figure 2 - BP Llandarcy Oil Refinery Locations with Pipe Routes.....	15
Figure 3 - Map of Landfill area of BP Llandarcy Oil Refinery.....	16
Figure 4 - BP Oil Refinery Location Plan, Highlighting Area 1, Source: BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729. Appendix C.....	25
Figure 5 - Historic Map showing the former layout of Area 1.....	26
Figure 6 - Map of Boreholes, Trial Pits and Wells for Site Investigation	27
Figure 7 - Chart showing number of Boreholes showing signs of Contamination	28
Figure 8 - Map of Area 1, Highlighting Position of Asbestos Grave.....	31
Figure 9 - Map of Area 1, Highlighting Positions of Residual Solvent Contamination & Knotweed	31
Figure 10 - Graph showing Build Cost v Profit, on Greenfield v Brownfield Development of Coed Darcy Project X.....	37

List of Tables

Table 1 – Aims & Objectives.....	3
Table 2 – Methods of Data Collection for Aims & Objectives.....	19

Chapter 1: Introduction

In the early 1700's, the United Kingdom led the way in the industrial revolution. By the late 1800's and early 1900's, the Industrial Revolution had rapidly spread across Europe, creating a more competitive market that the United Kingdom could not withstand. This caused the decline in the Industry that was once at the forefront of the world. (History.com Editors, 2019)

The Industrial Revolution saw the U.K. become leaders in the manufacturing of cotton, silk and wool, later expanding into the mineral exportation of coal, copper, iron and steel. Due to the lack of knowledge at this time, there were no measures in place to prevent pollutants spreading into the ground, thus resulting in the contamination risk of today's brownfield sites.

Brownfield Land is defined as land which has been previously developed. This could be anything from a small dwelling to scrap yards, factories to oil refineries, in a rural location or the centre of a major city. Whatever the previous use of the location, there is a high risk associated with this type of land being infected with contamination, therefore adding more risk to developers and end user. Contaminated land is land which presents a hazard in the form of material that has the potential to harm immediately or after long exposure. The contaminants which are ever so present and to be aware of are as follows;

- Carcinogenic Chemicals
- Phytotoxic Metals
- Organic Contaminants
- Corrosive Substances
- Combustible Material
- Asbestos
- Radioactive Substances

Despite these risks, the government are introducing numerous policies with the aim being to put the Brownfield Land to good use. This has come into fruition due to a number of different issues.

Arguably, the primary reason is the current UK Housing Shortage. The true number is unknown, as many experts and government officials have differing figures. However, some would argue that the number of homes is sufficient but the state of the housing market is to blame, due to the increase in house prices rising much quicker than that of salaries. To address this issue, in 2015 the Prime Minister pledged to double the number of starter homes to 200,000. This would allow the planning system to release under-used or unviable brownfield land, freeing them from planning fees to allow them to be sold below market value. (Edgar, 2015)

In 2017, the government confirmed what was pledged in 2015 by giving Local Authorities new tools to speed up development and to unlock land for thousands of new homes. In addition, further funds were set aside to allow for 30,000 new starter homes on these brownfield sites. (GOV UK, 2017)

Other contributing factors that have encouraged the government to begin the abovementioned policies on Brownfield redevelopment includes the current public attitude towards Climate Change and the Conservation of Greenfield Sites. In order to reduce expansion of large cities and focus on nature and wildlife conservation, the government have the Green Belt policy in place to ensure that expansion of these cities is kept under control.

Despite the government policies, registers and funding in place, there must be a limit to the remediation solutions that can be done to fix the true extent of these brownfield sites. The list of contaminants above indicates the risk these land parcels carry and why the construction industry has been avoiding them for years. Due to the awareness of the housing shortage, combined with climate change becoming more apparent, local authorities are reluctant to allow planning permission on the limited number of greenfield sites remaining. They are encouraging developers towards the vacant land, unaware of the risk that these types of development can impose on developers.

There is knowledge within the construction industry surrounding the risks associated with the aspects of developing on brownfield and contaminated land, however this knowledge is limited to the most commonly raised questions surrounding health, technical and design risks. By researching the redevelopment of Brownfield land, trends surrounding the research published became apparent, as countless similar

reports are published with very little mention on what can be classified as one of the most important risks of all, Financial Risk.

It is important to mention that all industries are risk conscious, but at present there is a lot of financial risk within the construction industry after seeing a number of large construction companies collapse over the last five years. Therefore, this research is essential to ensure that addressing the housing shortage can be done within a manageable risk and does not place developers in situations where the financial risk puts the future of the business in jeopardy.

AIMS & OBJECTIVES	
Aim	To investigate the extent of Financial Risk associated with Brownfield Land.
Objective 1	Compile information and studies about the impact of brownfield sites in urban development.
Objective 2	Analyse one specific case study, the former BP Llandarcy Oil Refinery, to identify the extent of contamination and abnormalities present, final implications and risks associated with land remediation.
Objective 3	Compare the viability of redeveloping this case study to that of greenfield development within the same vicinity, calculating the increased financial risk in the form of 'risk vs return' of each development.
Objective 4	Obtain conclusions that can be applied to the analysis of financial risk for other Brownfield Developments.

Table 1 – Aims & Objectives

To achieve these Aims & Objectives the research will be divided into Five Chapters. Following the Introduction in Chapter 1, Chapter 2 reviews the relevant literature relating to the research aims and objectives. Chapter 3 provides an outline of the research methods and strategy that will be applied to reach the aims and objectives. Chapter 4 displays the results along with a thorough analysis into the findings from the research proposed. The research concludes in Chapter 5 with the culmination and interpretation of the research, along with recommendations to developers working with brownfield and contaminated land.

The research will be carried out based on a case study (discussed further in chapter 3) of a development project near to the university. The research will be undertaken on the development itself or within the UWTSD Waterfront Campus, and it will be conducted through the Spring of 2020. Interviews will be conducted with up to 5 people from the industry, along with an analysis of site investigative material on the chosen case study.

Chapter 2: Literature Review

An increase of Literature surrounding the topic of Brownfield Development is beginning to be published, with a lot of the attention being focused on policies and procedures to encourage more development on this type of land. Risk is the most popular topic, with plenty of material on the health risks and technical risks associated with this type of development.

To provide an informative picture of the current situation of the industry and the pressures around housing development today, this chapter will be split into two sections to review all relevant literature surrounding the topic. These will be as below;

- **Section 1** will be focused upon the review of Government Documentation and Policies which is driving the movement of development on Brownfield and Contaminated Land.
- **Section 2** will review other literature and research that has been produced on the topic by analysing its content and make judgement on where this current material is lacking in information required by developers today.

2.1: Government Documentation

From the Mid 1990's to the present day, each government has attempted to introduce targets and policies to bring change to the type of land which is developed, and utilise the surplus of derelict and vacant land over the limited greenfield sites available. As mentioned in the literature of *'Greenfields, Brownfields, and Housing Development'* "Brownfield redevelopment is now at the heart of the UK Governments urban land policy. By 2008, it is intended that 60% of new all new homes in England should be constructed on previously developed land." (Watkins, 2002) This just one of the targets set out by government over the last two decades.

In February 2017, the UK Government made a milestone announcement which came in the form of the Housing White Paper, a collection of documents setting out Government plans to reform the housing market and boost the supply of new homes in England.

Upon its release the Secretary of State, Sajid Javid, spoke in the House of Commons, announcing to MP's and the Nation that 'Our housing market is broken'; (Gov UK, 2017). He continued by recognising that since the 1970's, house price inflation has far outstripped the rise in salaries (Gov UK, 2017), and that the reality of owning your own home in this generation is merely a distant dream. He also admitted that the government of the past 7 years had done little to help. This statement from Javid was a bold one, the introduction of a revolutionary policy that is hoped to transform the housing market and the construction industry in the UK is a positive one but does raise some concerns as to how it will be executed.

The main document in the collection is titled, 'Fixing our broken housing market'. This report highlights the true extent of the crisis which is facing the housing industry in England and further afield in the UK. In 2017, the Council of Mortgage Lenders predicted that by 2020 only a quarter of 30 Year olds will own their own home. This is supported by statistics that show home ownership among 25 - 34-year olds has fallen from 59% in 2007 to 37% in 2017. (Department for Communities and Local Government, 2017). To tackle this issue and make home ownership more accessible to the younger generations, the White Paper proposes to address the three major problems which have led to this. Firstly, the main problem to address is the planning process. The report shows that over '40% of local planning authorities do not have a plan that meets the projected growth in households in their area'. (Department for Communities and Local Government, 2017) This is down to a number of factors within these authorities and the way decision makers respond to public response on new housing, where many people in these situations would reject planning as they don't want their local town or village to be impacted by the increase in population a new development will bring.

Therefore, to tackle this issue, the government are turning their focus towards derelict and underused land, these more often coming with the risk of being contaminated. In the Government's Press Release on April 3rd, 2017, *New measures to unlock brownfield land for thousands of homes*, (GOV UK, 2017) the government announced the new authority given to local councils to speed up the development of derelict and underused land for new homes. The ideology is for local authorities to produce and maintain up to date, publicly available registers of brownfield sites that they see fit for

housing. Thus, follows on from the February 2017 publication of the Housing White Paper, where these land registers were introduced to speed up the house building process, and promote brownfield sites for development. In addition to these registers and policies, a '£3 Billion Home Builders Fund will be used to get these developments off the ground, and a further £1.2 Billion provided to unlock at least 30,000 Starter Homes on brownfield land'. (GOV UK, 2017)

Contrary to the UK Government's proposals in the Housing White Paper, the Welsh Government's document, Planning Policy Wales, Edition 10, published in December of 2018, takes a somewhat different approach to the redevelopment of Brownfield Land. Item 3.51 titled Previously Developed Land, recognises the opportunity presented with the high number of vacant brownfield land available and promotes its reuse, 'previously developed land should, wherever possible, be used in preference to greenfield sites'. (Welsh Government, 2018) This follows a similar attitude as that presented by the UK Government as a whole, but the Welsh government itself has its concerns by continuing to say, 'It is recognised, however, that not all previously developed land is suitable for development'. Thus, being aware that some sites are not destined to be reused and even more so, will present more of a risk than reward. The items focused for the suitability are its location, protected wildlife or valuable habitats of other wildlife, but more importantly if the land is too highly contaminated.

These new policies from the UK Government are a positive step towards increasing the number of homes to tackle the housing crisis, along with protecting local towns and villages and their green belts by making the recycling of land more attractive to developers. However, does this tackle the true problem affecting the housing market? Or does this push the problem elsewhere?

As previously mentioned, in 2017 only 37% of 25- 34-year olds can afford to get on the housing ladder, the inequality of inflation between house prices and salaries is a true concern and the deficit is only set to grow more if affordable homes are not built. Over the last 20 years, there have been numerous different figures and targets announced by governments which all seem to contradict one-another, and unrealistic goals have been set. As mentioned in 'Greenfields, brownfields, and Housing Development' by David Adams and Craig Watkins, 'This suggests that too much

concentration on targets and potential capacities may serve to distract the attention from what needs to be done in practice to promote more brownfield development'. (Watkins, 2002) This statement summarises the situation we are currently in with the government pushing policies and targets, some of which are unachievable, without thought given to the true risk that comes with these types of development. Therefore, how does the government intend for these housebuilders and developers to produce affordable homes on brownfield land?

The added risk of developing on Brownfield Land only pushes up the build cost of properties in turn lowering the return and viability of a development, or in some instances the risk could have such a high impact that it could completely obliterate the reward and rendering these parcels of land unviable and risk the future of businesses and the industry.

Welsh Government Planning Policy also has similar positives to that of the UK Government. As we see from the policy, they are encouraging developers to use this land which in return boosts sustainability within the industry. (Welsh Government, 2018) Furthermore, it is encouraging to see the Welsh Government being aware that some brownfield land contains too high a risk for developers and the end user. This raises the question of what is deemed as highly contaminated when there are plans in place to transform the former BP Llandarcy Oil Refinery, which was once labelled as the most contaminated piece of land in Europe, (Pentreath, 2014) into a new town of 4,000+ homes. However, has this development fallen through the net due to the influence upon it from royalty?

Research carried out by Natural Resources Wales in 2016 focused on the way Local Authorities dealt with contaminated land, its reclamation and remediation in order for it to be re-used in a safe manner. During the study, local authorities were questioned on the identification process of this land, the inspection and investigations times, prioritisation, cost of the inspections, the number of contaminants present on these sites, methods of remediation and more importantly the cost of the remediation itself. The research looked at sites from 2000 – 2013. In total there were 113 remediation projects (size not declared) from 11 local authorities. The total cost of this remediation was £4,937,609. On the whole, this averages to £43,695 which on a single

development is a manageable abnormal cost, but the concerns are raised when looking at the research where in 2012, one development itself cost over £1.2 Million on the remediation. (Natural Resources Wales, 2016)

These figures give a good indication on the financial impact that can come with contaminated land. If some or even all of these costs are unable to be recovered and the sales values in these areas cannot cover the additional build cost, then it carries high financial risk.

2.2: Existing Research on Developing Brownfield/Contaminated Land

Contaminated Land is now a worldwide issue for the construction industry, and it has a lot of people discussing the topic and carrying out research into its effects. There is a theme developing in the types of research being published on the topic. There is a lot of informative literature on methods of developing, increasing sustainability and risks to health, but not much has been published around the topic of financial risk.

The CPRE Group (Campaign to Protect Rural England) are a charity set up to protect against development on the green belt and countryside, and also campaign for the government to put policies in place to develop brownfield sites. The CPRE are focused on pushing the motive 'Right Homes in the Right Places' and argue that 'the homes we need can be built in the places we need them, while our beautiful countryside is allowed to thrive' (CPRE, 2019)

Furthermore, the CPRE conduct a lot of research into the current situation of brownfield development and have published a number of reports. In September 2014 a report was published titled 'Removing Obstacles to Brownfield Development.' (Burroughs, 2014)

This report found that in 2010, there were 70,000 hectares of brownfield land which was unused or maybe available for redevelopment, and approximately 35,000 of this was in existing urban areas and considered suitable for housing. This available land had the capacity to support over 1.8million new homes, however despite the identified high housing capacity, government figures show that the proportion of dwellings

delivered on brownfield land had fallen significantly between 2008 and 2011 from 81% to 68%, with further decline expected up to 2014. (Burroughs, 2014)

Another approach that is being considered to increase brownfield development whilst addressing the housing shortage is the use of small sites that have been previously developed. Thus, meaning the construction of fewer than 10 homes. From the 2019 CPRE Report, it was identified that 6,960 of these sites were registered with the minimum capacity for 38,152 Homes. (CPRE, 2019)

The approach from the CPRE is good for addressing the issues around the mass greenfield and green belt construction, and to support local towns and communities who are passionate about keeping these areas unscathed to protect wildlife. Their motive on Right Homes in the Right Places is one which is widely supported, as society is currently in an era where the government want new homes. Large PLC Developers will construct poorly designed homes in inconvenient locations in order for the government to meet the target number of new homes delivered and for the PLC's to obtain their large profit margins. These methods are unfair on communities and infrastructures whilst also being unsustainable for the planet.

Statistics published in the 2014 report, 'Removing Obstacles to Brownfield Development' are a very good indication of the current attitude of developers towards Brownfield redevelopment. The decrease of 13% during the period researched highlights that there are some underlying issues which are making the developers want to avoid these sites. Further to these figures, the most recent government report concerning Land Use Change Statistics (LUCS) shows that there has been a fall in the number of new residential addresses being created on previously developed land. (GOV UK, 2019) This drop is from 59% to 53%, again highlighting an issue surrounding the attraction of these land parcels to developers, and inevitably this comes down to the Risk v Reward, as no developer would voluntarily embark on unviable land. (GOV UK, 2019)

As well as the statistics surrounding the redevelopment of brownfield and contaminated land, there are many factors to consider that influence the financial risks. These are the individual characteristics surrounding brownfield and contamination that

can heavily inflate the cost of a build. In an article written by Sheperd Wedderburn, a leading Scottish Law Firm, it is mentioned that 'While generally lower land values for brownfield sites in comparison to greenfield land may present an opportunity for developers in terms of high potential profits, the nature of brownfield sites means that there are many more obstacles in the developers way in realising their profits and there are a number of specific issues and concerns which developers must take account of when considering whether developing on a brownfield site is in fact viable' (Shepherd wedderburn, 2005)

The Sheperd Wedderburn article is one of the limited pieces of literature out there that supports the proposed research of this project. Wedderburn is aware of the issues and policies in place to focus development on brownfield rather than the greenfield sites and is also aware of the unspoken truth surrounding the topic and that is the viability.

In addition to understanding the risk factors that come with contaminated land, it is important for developers who choose to pursue this type of redevelopment to know how to manage the risks. CGL, a leading specialist in Geotechnical and Geoenvironmental consultancy, carried out a presentation in May 2017 to discuss this topic. CGL defined "*Contaminated Land*" as "...any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land that, A) significant harm is being caused or there is significant possibility of such harm being caused; or B) pollution to controlled waters is being, or is likely to be caused;..." (CGL, 2017)

Thinking of this definition and the history surrounding the case study of the Coed Darcy redevelopment, questions begin to rise regarding the high contamination that is deep within this land, its water courses and the risks it poses. Will this land ever be safe enough to house families?

Obstacles and Risks to developing brownfield land were discussed in CGL's presentation. These are as follows;

- Cost and programme implications to the development?
- Technical knowledge to deliver?
- Implication for unforeseen ground conditions?
- Planning and regulator/building warrantor approval for a viable scheme?
- Security of funding?
- Marketability and divestment?
- Potential long-term liability if development does not go ahead?

(CGL, 2017)

All of the above factors discussed are just a few of the extremely important issues that can tip the viability scale of any project. An important factor to consider here that could potentially add high cost to the project is the technical knowledge to deliver. The policies driving the redevelopment of brownfield and potentially contaminated land are relatively new, therefore there is limited knowledge surrounding this area. A 'learn as you go' approach is where the industry is currently at, and with this increases the risk of the project. Similarly, all projects carry a lot of risk in the groundwork's element, but this is significantly increased on contaminated land because of the implication on unforeseen ground conditions.

Chapter 3: Research Methodology

This chapter will provide a detailed account of the research strategies adopted, along with the data collection methods and analysis best suited to address the aims and objectives of this research study.

The primary basis of the research will be a case study. The case study is a Current Major Brownfield Development project of the former BP Llandarcy Oil Refinery into the highly anticipated urban village of Coed Darcy. The following flow chart as shown [Figure 1] below demonstrates the anticipated techniques that are to be used to gather and analyse the data to achieve the aims and objectives as set out in chapter 1 of this paper.

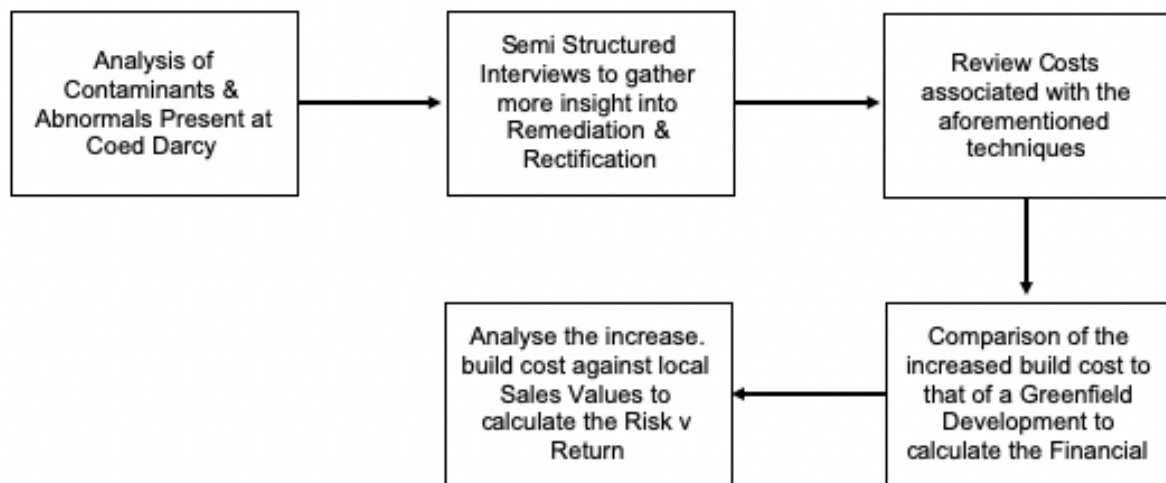


Figure 1 – Flow Chart of Intended Research Techniques

To gather the most concise information to support the research, a structured approach will be conducted based entirely on a real-life current case study scenario as it is felt that this would provide the most accurate and up to date information to support the research.

3.1: Case Study

The redevelopment of the former BP Oil Refinery at Llandarcy, South Wales, has been heavily influenced by Prince Charles and his passion for construction and the involvement in a high-profile development. (Pentreath, 2014) Due to the royal involvement, the eyes of the construction industry worldwide are on this development as it being the first at this scale.

The BP Llandarcy Refinery was situated 3km inland of Swansea Bay, and had kilometres of pipe transporting crude oil back and forth to the docklands for import and export. *[Figure 2]*. The site itself is sat on complex geological sequence, with glacial tilt sequence, overlying fractured sandstone bedrock and drains in-to Crymlyn Bog; this alone has its own risks when coming to the redevelopment of the site. (Atkins, 2010) During its peak, the refinery became the largest in the UK, producing motor spirits, kerosene, gas oil, fuel residue, lubricating oil and wax from the importing of crude oil transported through the kilometres of pipelines. The plant employed over 3,500 employees, contractors and service providers. As well as this major growth in production by the 1980's, it had also become known as one of the most polluted sites in Europe. (The Prince's Foundation, n.d.)

Following the closure announcement of the BP Llandarcy Refinery in 1997, BP were keen to leave a positive legacy on the land that had seen such heavy manufacturing for the previous 75 years. The initial exit options were to transform this site into a country park or retail facility (URS, 2004), but in 1999 the Welsh Development Agency invited the Prince's Foundation to advise on this large-scale residential and business development. It was from here that an 'Enquiry by Design' workshop led to the creation of the masterplan and town code by design consultants Alan Baxter & Associates. (Pentreath, 2014) The model was to replicate the Prince's development of Poundbury in Dorset, except here on an infinitely more complex and challenging scale due to the remediation of the brownfield land. As reported by the financial times, this site is due to be the guinea pig of large-scale brownfield reclamation, with the eyes of the world upon it. (The Prince's Foundation, n.d.)

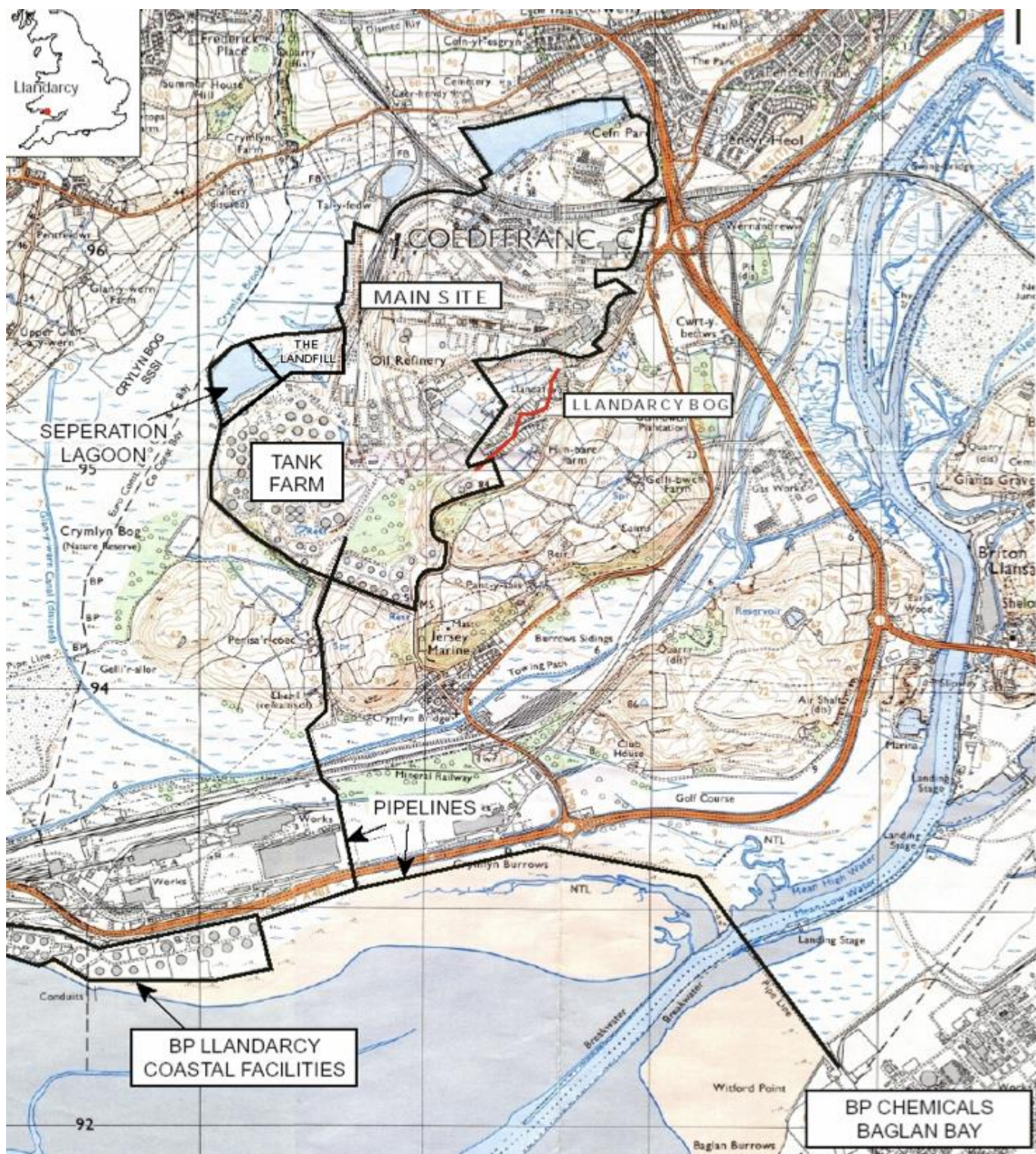


Figure 2 - BP Llandarcy Oil Refinery Locations with Pipe Routes. Source: BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729. Appendix C

The BP Llandarcy Refinery rose to its huge scale prior to the knowledge, policies and legislation in place to protect the environment and the public. Therefore containment of contamination and prevention methods were slim to non-existent during the operational period of the site. As shown in *Figure 3* of the 'Landfill area' of the refinery, materials being disposed of and methods of waste disposal allowed during its operation would not be legal now, for example the burial of asbestos, and other contaminants.

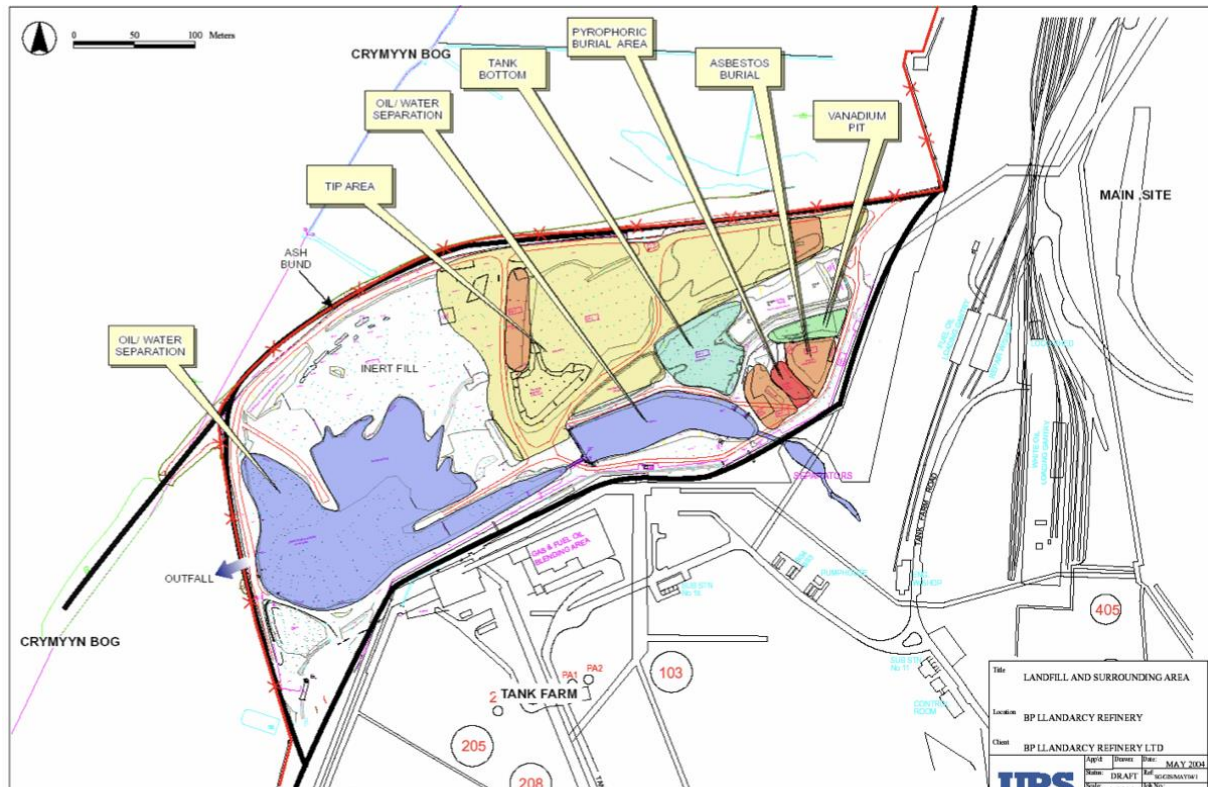


Figure 3 - Map of Landfill area of BP Llandarcy Oil Refinery. Source: BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729. Appendix C

From a study carried out by Atkins, one of the initial contractors appointed to begin the remediation works of this contaminated brownfield site; the initial development constraints were published. These include; (Atkins, 2010)

- Topography
- Rockfaces
- Peat and unstable ground
- Drainage catchments and discharge limitations
- Statutory dam
- Structural remnants
- Contamination
- Ecological Sensitivity

A development to include just a few of these constraints runs the risk of being financially unviable. To see the report including all of the above for just one site raises the question as to how a development of this magnitude with such a financial risk attached has been allowed to proceed? Is this due to the power and reputation of those involved trying to upsell an irreparable piece of land?

The findings of this review highlight that there is a significant push from the UK Government to tackle the housing crisis by creating more affordable homes, and intends on doing so by utilising its surplus brownfield land as seen from the housing white paper and multiple other targets and statistics set by government. Despite the multiple policies and targets in place, statistics indicate a decline in the developments and residential homes being developed on this type of land. Therefore, this raises concerns as to why developers aren't making the most of the opportunities given to them through the methods of easy planning processes. The way that the policies are being enforced makes it seem as though the government are ignoring the realistic approach, which is that a site with high risk tends to come with a higher build cost, therefore increasing the plot selling price making it difficult to build affordable homes in these areas. It is also apparent that the government is unaware of all the risk that can be associated with the redevelopment of brownfield sites, and the literature portrays that they are pushing developers into the risk. If the developer is not aware of these risks, this can land them in significant difficulty financially and potentially legally.

Despite the government literature, there are a few sources that share a similar outlook on the development of brownfield land. Comparing Coed Darcy to that of other brownfield sites and the risks this poses on such a large scale, it's only right to wonder how a site with such a high-risk label attached has been allowed to progress this far, despite the royal association. It has the characteristics of being damaging for any developer, therefore the question that has to be asked is, what is the Financial Risk of Developing Brownfield Land?

3.2: Methods of Data Collection

A Qualitative methodology has been utilised to investigate the research aims and objectives of this study. It is felt that a qualitative approach is the most relevant for this type of research. (Bowen, 2017) Qualitative Methods provide a more in-depth understanding of key documents. It is argued that to understand the status of the development and the solutions reached to rectify issues, this form of research is best suited to provide the data required. To ensure that these methods are utilised to their full capacity and the most information rich data is retrieved, there will be two main types of qualitative methods used. These will be documentary analysis and semi-structured interviews. The way these will be applied to the Aims and objectives is stated below;

Number	Research Objectives	Data Required	Data Collection Method
1.	Compile information and studies about the impact of brownfield sites in urban development.	Qualitative	Documentary Analysis.
2.	Analyse one specific case study, the former BP Llandarcy Oil Refinery, to identify the extent of contamination and abnormalities present, final implications and risks associated with land remediation.	Qualitative	Documentary Analysis & Semi Structured Interviews.
3.	Compare the viability of redeveloping this case study to that of greenfield development within the same vicinity, calculating the increased financial risk in the form of 'risk vs return' of each development.	Qualitative	Documentary Analysis, and review of Local Housing Market, and Build Cost Data from BCIS.
4.	Obtain conclusions that can be applied to the analysis of financial risk for other Brownfield Developments.	Qualitative	Review of the findings of the Cost Analysis and Viability Studies.

Table 2 – Methods of Data Collection for Aims & Objectives

3.3: Documentary Analysis

To begin the research, a thorough analysis of the site investigative reports that have already been carried out on the abovementioned case study shall be conducted.

The analysis of these documents will provide the best information required for the study. As Bowen (2009) argues, documentary analysis is well suited for the extensive examination of a single case study due to the advantage it provides by producing rich information. Carrying out this documentary analysis is beneficial due to the fact it will provide a good understanding of the current situation of the contamination and abnormalities on site.

The documents which shall be analysed are as follows:

- BP Llandarcy Refinery – URS Factual Report, Area 1 Site Investigation, 9th June 2006, Issue No 1, 44382624/ 1395. *[Appendix A]*
- Final Report, Asbestos Delineation Works, Former BP Car Park Area. *[Appendix B]*
- BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729. *[Appendix C]*

3.4: Semi Structured Interviews

To elaborate further on the information that comes from documentary analysis, a small number of semi-structured interviews were conducted for the research study. The semi-structured interviews intended to delve deeper into the information sourced from the documentary analysis, as semi-structured interviews provide more detailed content on the subject. All interviewees have the same characteristics as they each have had first-hand experience of the remediation of BP Llandarcy Oil Refinery. In order to achieve a variation of experiences, the interviewees came from differing backgrounds as listed below.

- Interview 1 – Director of Remediation Company
- Interview 2 – Technical Manager of a Housebuilder Developing at Coed Darcy
- Interview 3 – Commercial Director of a Housebuilder Developing at Coed Darcy.

3.4.1 Interview 1

This individual has experience of key involvement during the remediation of the BP Llandarcy Refinery. By having the semi structured interview with this individual, it is hoped that a further insight into the remediation strategies utilised on sight along with the obstacles that were faced in the planning, operational and completion phases of

these works. The positive experiences and knowledge gained from carrying out these works, and how they intend to use this on projects in the future are more goals surrounding this interview. In addition to this, it is key to identify from first-hand experience the true extent of contamination within the ground along with financial risk imposed on their own business during the remediation along with contractual difficulties of dealing with such a contaminated site.

3.4.2: Interview 2

Interviewee 2 has been selected to provide further insight into the extent of works having to be carried out post remediation to ensure that dwellings are designed to the highest of standards with above average quantity of ventilation methods and the introduction of substructure membranes etc. The role that this individual undertakes in line with the development is ever so important to provide the extra layer of protection required to protect the end user of the land. Further to this, information will also be gathered on methods used to overcome the site specific abnormalities such as the topography, and rock content of the site.

3.4.3: Interview 3

Interviewee 3 selection is intended to be one of the most important interviews as from this, accurate data will be provided to carry out the cost analysis and financial risk assessments. Interviewee 3 is the commercial director of a housing developer currently working at Area 1 of the BP Oil Refinery. Having the opportunity to discuss the matters surrounding the costings with an individual who has first-hand experience of the works going on to create a development on a complicated site allows the cost analysis and financial risk assessments to be of the utmost accuracy. In addition to this, the intention is to gather an understanding on how a developer has come to the decision to pursue such a risky development.

Overall, these interviews will provide a well-rounded data set to assist in achieving the aims and objectives of the research project, but also having the facts from first-hand sources has the ability to boost the credibility and reliability of the financial impact of developing contaminated land.

3.5: Ethical Considerations

Due to the importance of ethical considerations within research, below are a breakdown of the measures that have been put in place to ensure that each stage of the research has addressed the appropriate ethical considerations and consistency across the research.

3.5.1: Semi Structured Interviews

Each interviewee will be briefed beforehand about the aim and objectives of this research and informed consent was received prior to beginning the discussion. Each interviewee was aware that they had the opportunity to stop at any given time, and in order to protect participants confidentiality each will remain anonymous during the analysis. The information that will be sourced from these interviews will be stored correctly in line with the Data Protection Act and will only be published in this paper as agreed with the interviewees.

3.6: Cost Data

For the purpose of ensure coherence within this research, it is important that the cost data obtained to carry out the analysis is as up to date and accurate as possible.

Standard Build Cost Data will be obtained via first-hand experience of working on housing developments within the south wales area, thus giving the most up to date data from the area on which the research case study is based.

The abnormal cost data required will be sourced from interviewee 3 as discussed above.

3.7: Data Analysis

From the data collected through the abovementioned methods, there will be an analysis process for each of the contaminants and abnormalities that have been identified on the redevelopment of BP Llandarcy Oil Refinery.

Step 1 – Carry out a cost analysis based on a Mock development. This will be done by applying rates to remediation techniques required to eliminate and overcome each of the contaminants and abnormalities that are present on the land at BP Llandarcy Refinery Site, which have previously been identified through the works of Step 1 and 2.

Step 2 – A comparison will be made using the Mock Development to identify the increased build cost if it was to be built on a Greenfield Site or at the Brownfield Site, BP Llandarcy Refinery, allowing the true financial risk to be calculated. Upon completion of this, sales research will be carried out into the housing market in this area to determine the Risk v Return of the comparison between Greenfield & Brownfield developments.

Chapter 4: Results & Analysis

Chapter 4 will systematically review the results of the research in a step by step manner as previously set out in the research methodology. Analysing the results in this manner brings coherence to the research and understanding of the case study, thus allowing more accurate examination of the financial risk imposed on developers.

4.1: Documentary Analysis

Documentary analysis was the primary method of collecting the data required for this step. A thorough documentary analysis was undertaken on the following documents.

- BP Llandarcy Refinery – URS Factual Report, Area 1 Site Investigation, 9th June 2006, Issue No 1, 44382624/ 1395. *[Appendix A]*
- Final Report, Asbestos Delineation Works, Former BP Car Park Area. *[Appendix B]*
- BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729. *[Appendix C]*

These available documents are focused primarily upon the area known as Area 1. Coed Darcy is the area of redevelopment that this research and case study will be focused upon, but this research can then be addressed for the entire scheme if required. Area 1 is as shown *[Figure 4]* below.

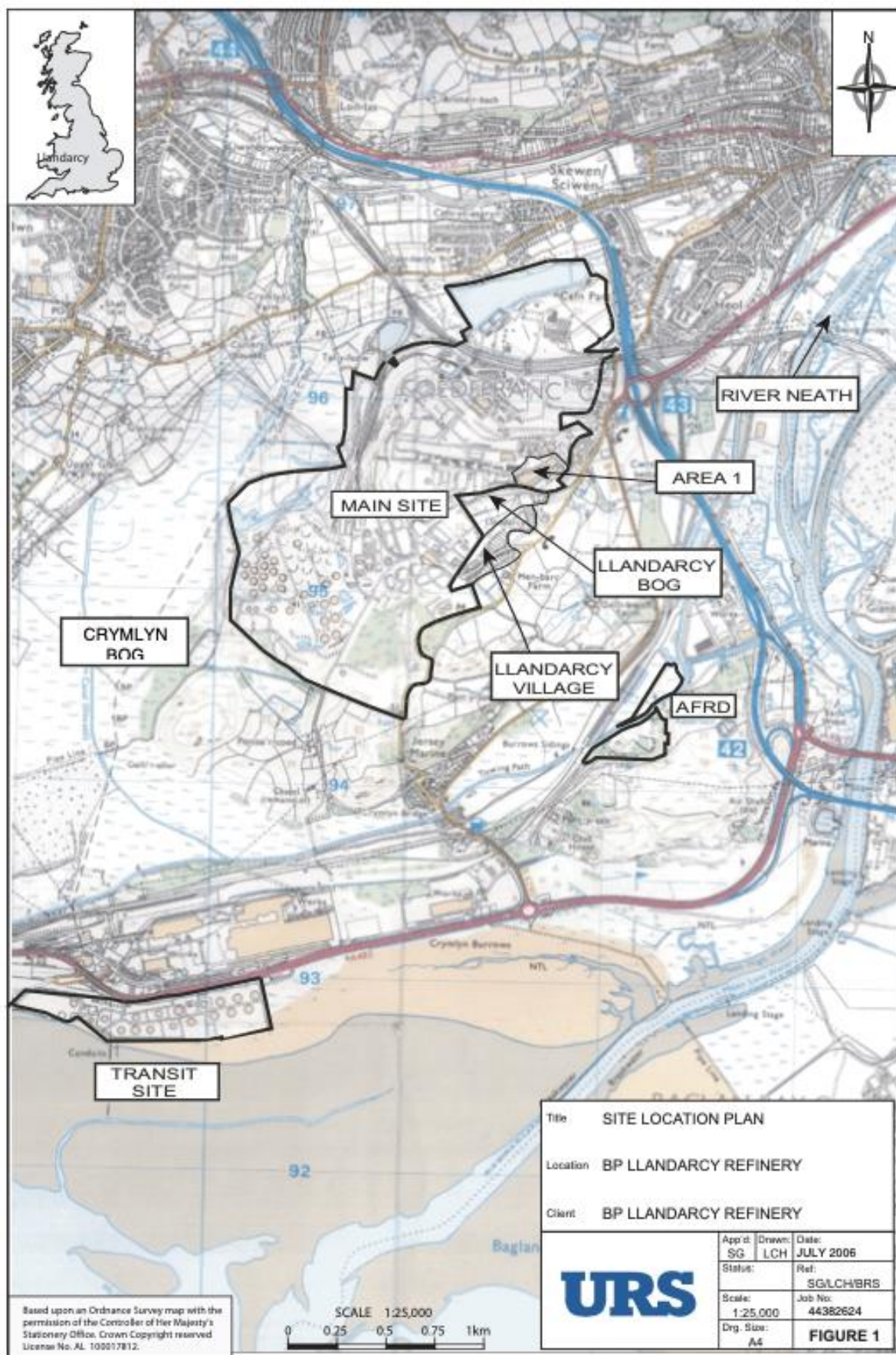


Figure 4 - BP Oil Refinery Location Plan, Highlighting Area 1, Source: BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729. Appendix C

Following initial analysis of the documentation, it was found that Area 1 of the BP Llandarcy Refinery is most likely one of the least contaminated areas of the 5 Hectare redevelopment project. This due to its previous use being less intrusive than the remainder of the land. Area 1 did not include major process plant or bulk storage of hydrocarbons; its use was as workshops to carry out repairs and maintenance, warehousing stores, training centres and other administration offices, including carparking for the employees. [Figure 5]. Following the closure of the BP Llandarcy Refinery, the warehouses and stores were still in use being occupied by EG Lewis, a Transco Gas Compound, and use of the carparks, this being around the year 2003 when the field work was undertaken for the initial 2006 remediation report. [Appendix A].

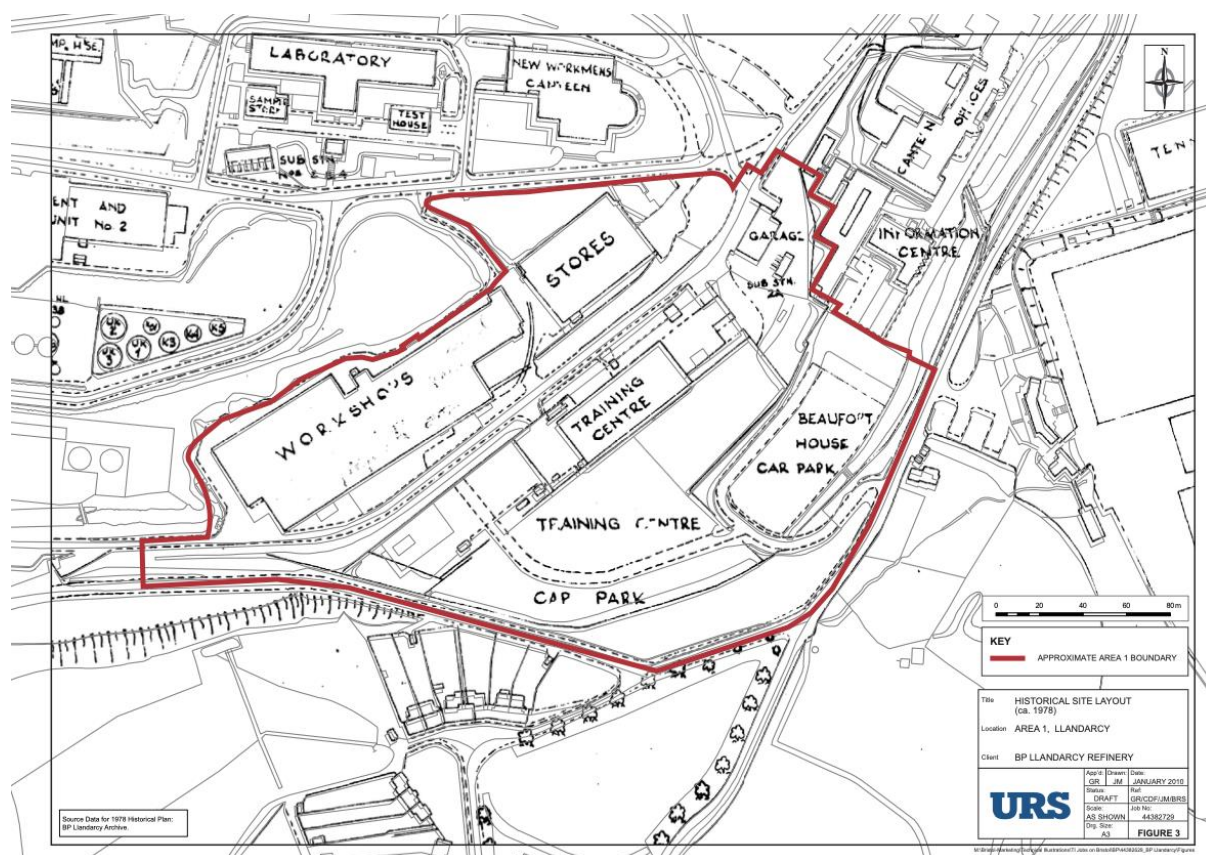


Figure 5 - Historic Map showing the former layout of Area 1. Source: BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729. Appendix C

Despite the less intrusive usage in comparison to the wider development, analysis of the abovementioned reports indicates a concerning quantity of contaminants, abnormalities present in this area.

The 2006 URS Factual Report used the following methods to conduct a thorough site investigation of Area 1.

- Percussive borehole drilling.
- Monitoring Well Levelling and Positioning Survey
- Gas Sampling

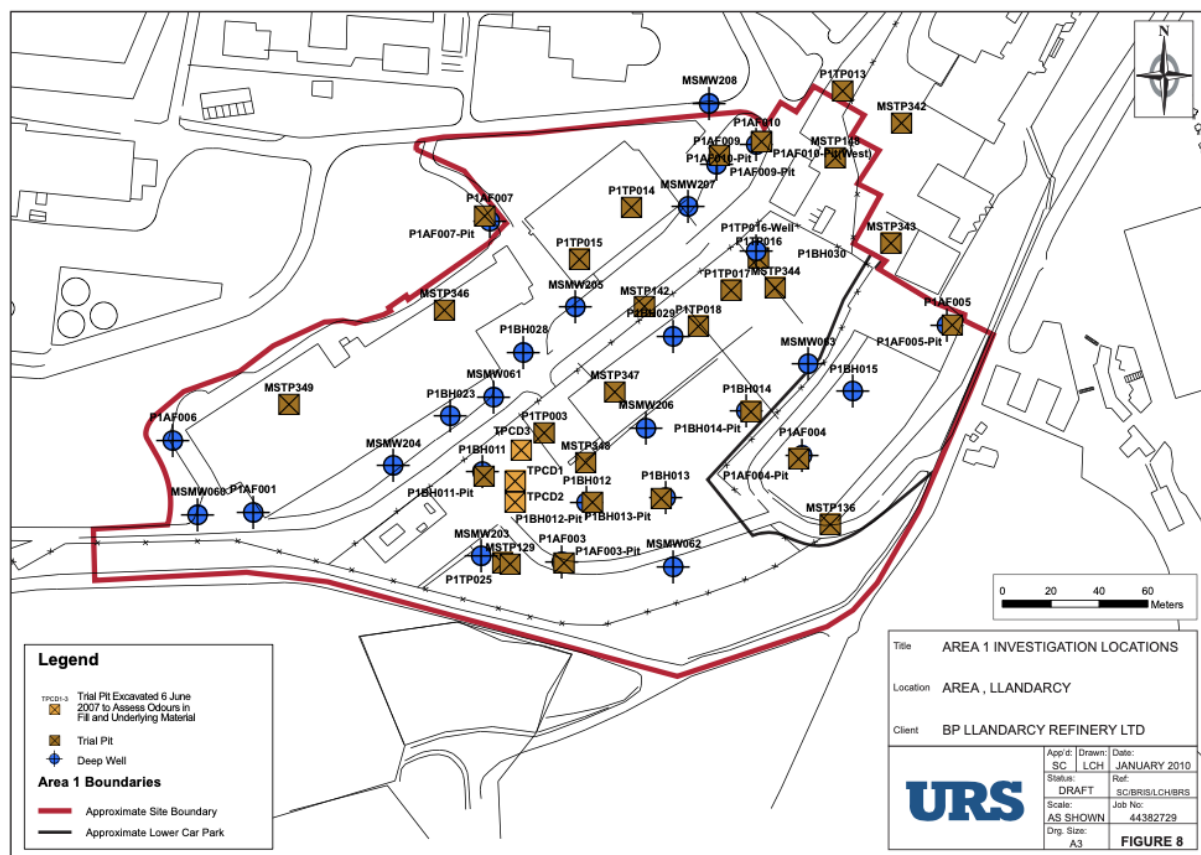


Figure 6 - Map of Boreholes, Trial Pits and Wells for Site Investigation. Source: BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729. Appendix C

Unfortunately, due to the poor quality on the 2006 URS Factual Report, it is difficult to interpret the information provided in the majority of the tables published, although what we can take from the initial report is Appendix A – Borehole and Trial Pit Logs.

26 Boreholes were investigated on Area 1, the first in Appendix A, Borehole Number MSMW61 this is shown [Figure 6] above. The situation at the development became apparent upon the investigation of these boreholes. Comments indicate a strong fuel

odour, increasing with depth up to 3.8M. At this depth, rockhead is reached and an odour of hydrocarbon is sourced. At approx. 5m in depth, a sheen of contaminants is visible on the surface of water found within the borehole. This initial borehole creates concerns over the remainder of the development with fuel and hydrocarbon levels being ever so present even in excessive depths, indicating that control measures over the years of usage were non-existent to allow such contaminants to penetrate into the ground like this. Further analysis of the borehole data demonstrates that 46.2% of the boreholes that were carried out on site were found to have a visual and/or high odour presence of hydrocarbons up to 8M in depth. 34.6% of the boreholes conducted were terminated short of expected depth, all of which within 1.2M of existing ground level due to the borehole hitting the rockhead. This highlights another risk and abnormality in its own right to any developer looking to build on this land.

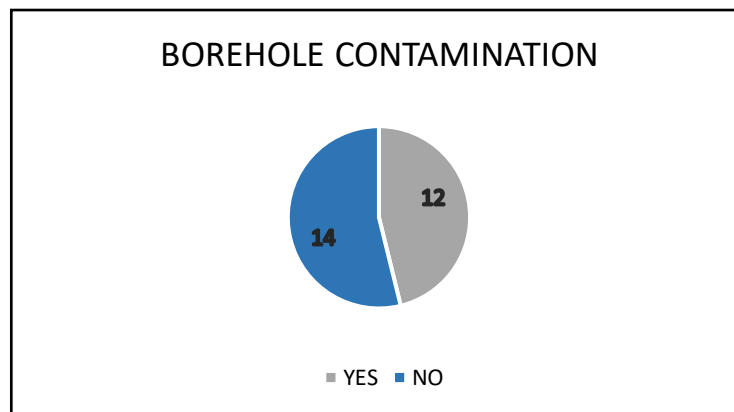


Figure 7 - Chart showing number of Boreholes showing signs of Contamination

Further to the above, it is important to highlight the results of borehole number P1AF009 – PIT, as shown [Figure 7] above. This borehole was terminated at 0.8m, due to the presence of fibrous material and the suspicion of the area being home to a possible asbestos dump. Therefore, this pit was abandoned and backfilled due to this risk. This particular borehole was not checked for the possible odours of hydrocarbons.

Due to the identification of the abovementioned borehole suspected of being the location of an asbestos dump, the subsequent follow up report on the Asbestos Delineation Works was produced and Appended to the rear of the 2006 URS Factual Report. This further report was produced with the results of trial pits in 71 locations, to identify the asbestos containing materials (ACM) in soils. These were analysed by Anchem Laboratories Ltd, using the industry Standard Bulk Material Analytical

Technique (MHDS 77). Seventeen soil samples from Area 1 were positively identified to contain asbestos, further to this samples of the initial boreholes were also tested for the presence of ACM, inclusive of borehole P1AF009-PIT. Five (19.2%) of these boreholes also identified positive for the presence of ACM. These were later identified as containing chrysotile (white), amosite (brown) and crocidolite (blue) asbestos.

Further documentary analysis was carried out on the URS Validation Report, 2010. Through this analysis more information has been discovered on the past use of Area 1. The workshop operations were understood to have included 'hydroblast' operations to clean heat exchanger bundles, including the use of chlorinated hydrocarbon trichloroethylene (TCE) in a pit at the rear of the building known as the solvent pit. These works are believed to have been terminated around 1970. Items 1.6 & 2.3 of the 2010 URS Report provide a breakdown of the Identified Contamination present on Area 1 at BP Llandarcy Refinery, which are further elaborated below.

4.1.1: Asbestos

The main contaminant of which the remediation driver for area 1 was considered is the asbestos contamination. The presence of pieces of ACM in the form of gasket, rope, lagging, and cemented material but also within granular and fill materials were fibrous materials. The two main areas that the asbestos was located on site were within what became known as the Asbestos Grave *[Figure 8]* but also in the lower car park area (Area A), which is believed to have been built up using the crushed material of an old power station.

4.1.2: Localised Hydrocarbons

The secondary contaminants of concern which would remain in-situ post granular fill removal were the Total Petroleum Hydrocarbons (TPH) in one location, and Polycyclic Aromatic Hydrocarbons (PAHs) in two locations on Area 1.

4.1.3: Residual Solvent Contamination

Principally trichloroethylene, with assumed degradation products, dichloroethylene and vinyl chloride, were identified within the solvent area of the workshops as mentioned and shown above *[Figure 5]*.

4.1.4 Heavy Metal Contamination

During the investigations, a high level of metal contamination was located throughout the site. This includes arsenic, copper, lead and zinc. In addition to the above, the site investigation also identified the risks posed by an existing Cliff Face at the Northern edge of the site, which is known to have hydrocarbon seepage or sheens which have been discovered from the western end of the cliff face. This is presumed to have been associated with the historical operations which were undertaken in the refinery situated above the cliff face. For the purposes of this research, this has not been included in the cost analysis due to it only being an influence for a small number of plots on Area 1.

Knotweed was also discovered in areas of the site as per *[Figure 9]*. It is known from the URS Reports that approximately 312m³ of ground and knotweed had to be removed from site. These abnormal elements are very complicated matters which require expert planning and specialist contractors to remediate and make safe.

The volume of contamination and abnormals present on this land raises the questions of the suitability of this land, as mentioned previously by the CPRE who believe that the industry should be focusing their efforts on building the 'Right Homes in the Right Places'. Does a development with such a high density of issues qualify for the best place to put a home?

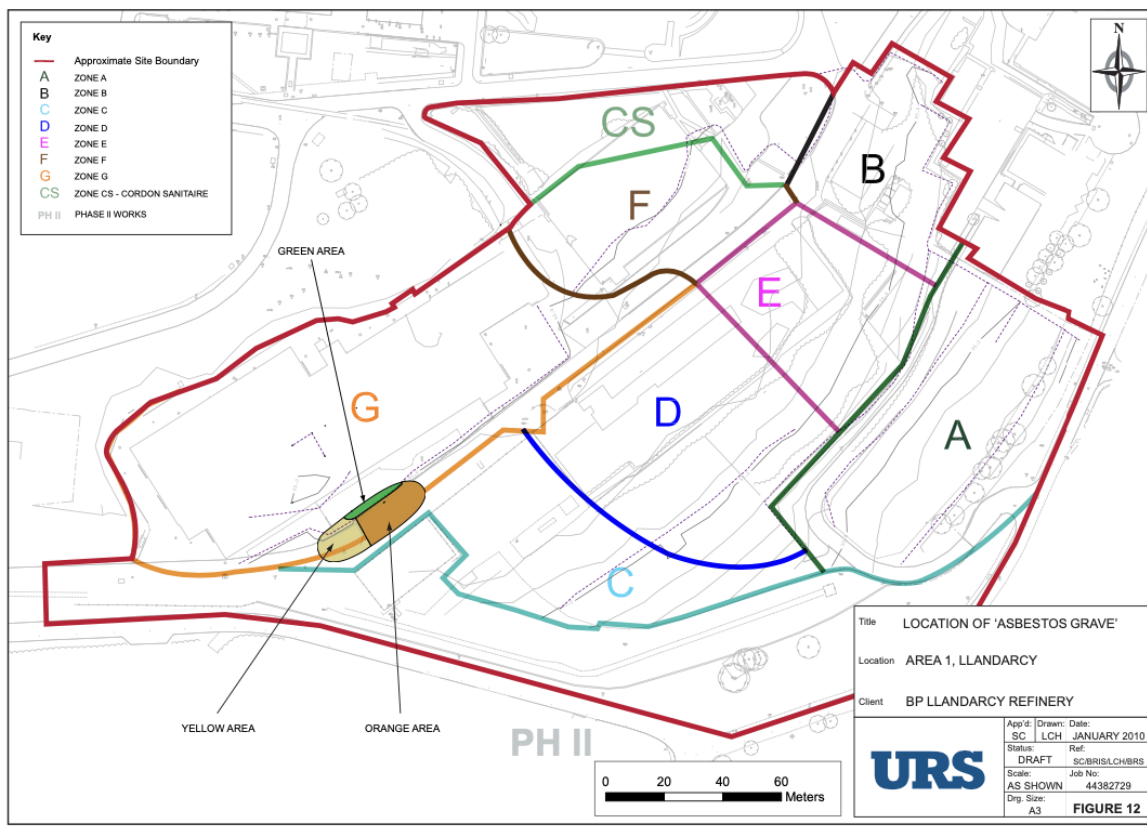


Figure 8 - Map of Area 1, Highlighting Position of Asbestos Grave Source: BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729. Appendix

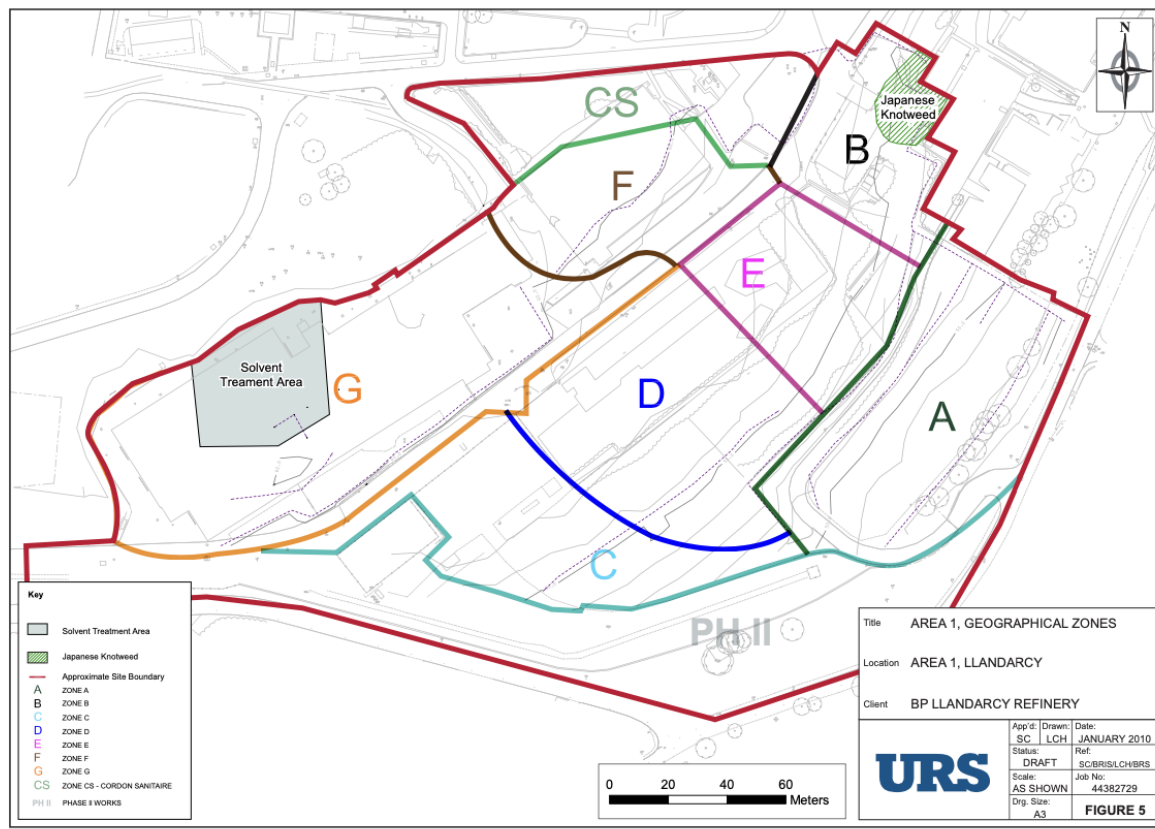


Figure 9 - Map of Area 1, Highlighting Positions of Residual Solvent Contamination & Knotweed. Source: BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729. Appendix C

4.2: Remediation Strategy

Following the documentary analysis of Step 1 above, despite the history of Area 1, it still poses a lot of difficulty in the form of contaminants and abnormalities present, which increase the financial risk imposed on developers and contractors.

This step was unable to be executed as planned in the research methodology due to the Coronavirus covid-19 pandemic. Therefore, in order to give an understanding on how the abovementioned contaminants were each dealt with in order to reclaim the land to be safe for housing development, a documentary analysis approach will be required to discuss the options available and the most effective strategy to use with the present contaminants.

The documentary analysis will be based on the 2010 URS Report as used in step 1, and the Remediation Strategy of *[Appendix A]* of the 2010 report.

4.2.1: Asbestos, PAH and Metal Contamination

As mentioned in step 1, asbestos contamination and ACM are the main driver of the remediation. The lower car park area of Area 1 was found to contain reworked material as fill, which had a consistent yielding of asbestos in fibrous and solid form. The strategy of remediation to deal with the ACM present at area 1, given the end use of a residential development and the undesirability of uncovering asbestos pieces, was to excavate and remove all granular fill from Area 1. By doing so, this had a positive effect on addressing the large majority of identified Polycyclic Aromatic Hydrocarbons (PAHs) and Metal Contamination on the development.

According to the data available, the decision was made based on reducing the environmental impact of the redevelopment by minimising the disposal and consumption of landfill space. In order to do so, the area must be excavated and sorted in a manner which permits continuous visual inspection and manual removal of pieces of observed asbestos material. The intention is that all removed ACM will be bagged for disposal at an appropriate off-site facility. Once sorted the material will be retested

for its content of contamination and, once meeting required validation criteria, transported to another area of the Coed Darcy redevelopment for use. This strategy was to be agreed by the local authority of Neath Port Talbot, and the Environment Agency now known as Natural Resources Wales.

4.2.2 Contamination Other Than Asbestos in Soil

Due to the volume of TPH Contamination in one Area and the PAHs in two locations, it is difficult to provide a strategy on this until all fill material is removed. Once the fill material is stripped to expose the natural soil, samples can be taken to understand the extent of this contamination. If the material fails to reach the validation criteria, then further excavation will be required until this criterion is met.

4.2.3 Residual Solvent Contamination

A strategy for the actions to make the development is safe of RSC has been difficult to develop due to the volume on site. Future residents could, in principle, be exposed to VOC Contaminated groundwater and the inhalation of vapours. The initial action to deal with this is to incorporate gas vapour membranes into the substructure of every plot, as well as passive venting. In one area of the site, known as the solvent pit in the workshop shown in *[Figure 6 & 9]*, due to high volumes of contamination there is little that can be done to achieve a remediated area which can meet the safety criteria to allow residential dwellings to be constructed here.

Further to the abovementioned contaminants and the strategy in place to remove these from site, other issues such as the knotweed presence will need to be removed and the ground treated to ensure that all remanence of the knotweed is removed to prevent further growth and contamination.

All of the above needs to be completed to ensure that the land at Area 1 of the BP Refinery is renewed to a safe and healthy place for residential housing. The works associated with these remediation strategies are extremely complicated which require expert planning, specialist contractors and as a result are time consuming. For

example, dealing with the ACM's are complicated as there are only 2 registered facilities within the UK who are licensed to process this type of waste, the closest of which to the case study is at Cheltenham, meaning that this operation is a time-consuming high cost exercise. The rates used in the following cost analysis, accommodate these types of remediation and disposal.

4.3: Cost Analysis

A cost analysis has been produced and in order to provide an accurate research model, a mock development has been set up as shown in *Appendix D*. As previously mentioned, this mock development will be known as Coed Darcy Project X and will consist of 5 Semi Detached Blocks, which will make up 10 Plots of approximately 1,279 SqFt each. Each of these plots has a driveway to fit 2 vehicles and approximately 50m² of usable garden space. This design is to replicate the average size dwelling that has been plotted on the redevelopment, as well as to comply with the standards for social housing.

To begin, research was carried out into the current housing market. The research was conducted by searching current plots for sale and sold prices through housing sales websites Rightmove.co.uk and Zoopla.co.uk. The search was focused on streets of Phase 1 of the Coed Darcy Redevelopment as built by Heritage Gate and Persimmon Homes. The search was narrowed down by filtering the searches to 3 Bed Semi-Detached plots thus ensuring a like for like comparison on house prices. From the analysis as set out in *Appendix E*, only 7 houses that met these criteria were available, 2 of which are currently for sale and a further 5 sold second hand over the past 3 years. This analysis gives an average selling price in the area of **£184,135**. This data has been considered and, as with any new housing scheme, a premium has been added to take the house price for the Project X to **£195,000**. This is shown in *Appendix F* and gives a total Revenue of **£1,950,000** for the Coed Darcy Project X development.

As discussed in chapter 3, the rates used to calculate the standard build cost have been obtained through build costs from development projects within the South Wales area. These rates are correct as of the time of publishing and have been applied to the quantities taken from the house type and site layouts as shown in *Appendix D*.

The total clean build cost of £1,622,542.03, is calculated from a cost plan analysis as shown in *Appendix G*. A breakdown of this is displayed below;

Item A – Substructure. Each dwelling has a footprint of 59m². A build rate of £160/m² has been applied to this which covers the excavation of trenches to accommodate strip foundations, with substructure blockwork, block and beam suspended floors with insulation and concrete to complete the floor slab.

Item C – Plot development. These are further costs associated with groundworks in the form of plot specific drainage and plot footprint completions, and are broken down in Item C of *Appendix G*.

Item D – Superstructures. These are calculated by using the internal floor area for the dwelling and multiplied against a rate of £68/SqFt. In addition to this a provisional sum of £3,000 per plot is used to cover the inclusion of sprinkler systems to meet new Welsh Building Regulations on fire safety.

Item E – Standard External Development. The roads and drainage have been taken into consideration for the purpose of this analysis. These rates have also been obtained through the analysis of build costs for other developments within the South Wales area.

To ensure coherence and accuracy of the rates relating to the rectification of abnormal issues on site, the decision was made to continue with one of the original 3 semi structured interviews remotely via telephone calls. This was to be with interviewee 3 and results are demonstrated in the costings in item 4.4.

4.4: Risk v Return on Greenfield v Brownfield Development.

The research model is to compare costings of Coed Darcy Project X as both Greenfield v Brownfield projects.

As we can see in *Appendix H* the analysis has been broken down into the following;

- Land Costs
- Clean Build Costs
- Abnormals
- Contingency

A Land Value of £100,000 has been derived through the appraisal system for the greenfield land and a land value of £0 for the Brownfield due to the abnormal value. The clean build cost has been derived through local build costs and abnormalities as follows.

On the greenfield development, an allowance of £1,500 per plot has been made giving a total allowance of £15,000. This is in place as an allowance because even on Greenfield developments, unforeseen abnormalities can arise.

Whereas, the Brownfield analysis has a cost to rectify abnormalities at £664,138.80, which is made up as per the breakdown in item G of *Appendix G*. These are a total cost of the works associated with the remediation required to reclaim this land by removing contaminated granular fill from site, removal of asbestos, removal and treatment of knotweed, the introduction of capping layers, membranes etc., as well as the costs associated with the site specific abnormalities in the forms of topography and geological issues. These are based on assumptions and minimum allowances per plot for research purposes.

In comparison, the abnormalities cost for the brownfield development is an increase of 44% as demonstrated below [*Figure 10*], compared to that of a Greenfield development. The evidence proves that despite the increase in build cost, sales revenues are somewhat capped due to its location and therefore stay the same, meaning that a reduction in profit is inevitable

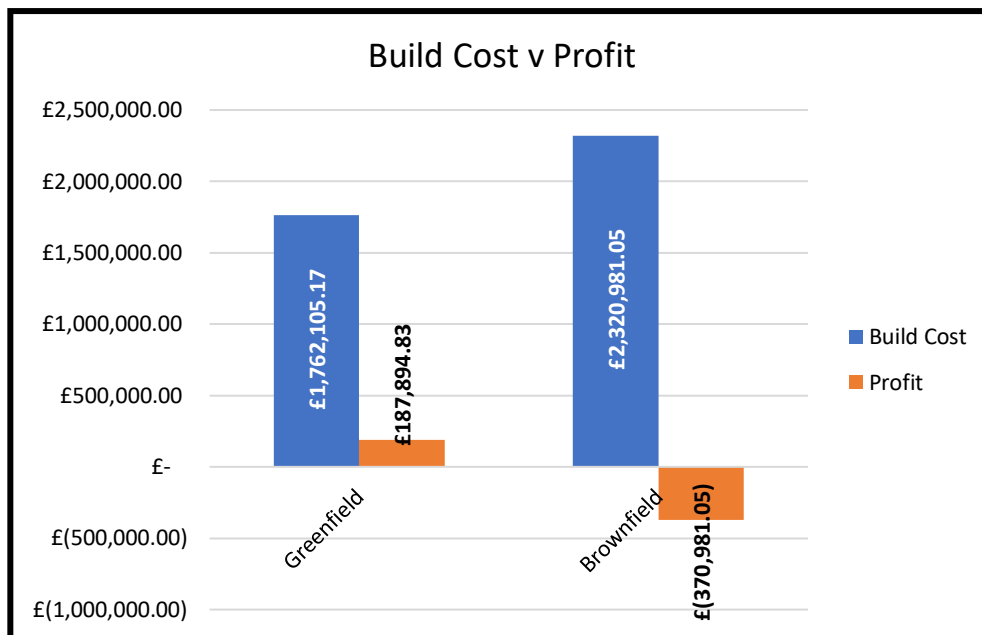


Figure 10 - Graph showing Build Cost v Profit, on Greenfield v Brownfield Development of Coed Darcy Project X

As shown above [Figure 10], the greenfield projected profit is 9.64%, this translates to £187,894.83.

In comparison, if the development was built on the brownfield site of the case study, there would be a significant drop of 28.66% which would reduce the Profit Margin of the Coed Darcy Project X to a loss of -19.02%, equating to an operating loss of £370,981.05. This makes the development significantly uneconomical and unviable to complete.

These results highlight a grave concern when considering that the Government Housing White Paper's intention was to promote these brownfield sites for development and enabling this land to construct 30,000 affordable starter homes. These findings show that it is financially unviable to construct homes at a regular market value on these developments, let alone construct homes at lower market value.

Whilst conducting this research, it was found that the original developer Heritage Gate, who began the redevelopment of BP Oil Refinery, had gone into administration halfway through constructing the first phase of works. They began to construct the initial 140 homes of the Coed Darcy development. Following the initial infrastructure works, which included a large number of retaining structures and an increased

specification to meet the requirements of The Princes Foundation Poundbury vision, the business was unable to carry the costs associated with the development.

This raises the questions of should this development have been allowed to proceed? How many more of these brownfield sites are scattered across the UK waiting to pull down more small developers with their financial risk?

In order to overcome these issues and successfully construct the homes required to tackle the housing crisis, a review of the brownfield land must be completed and only those with a reduced risk factor be released for development.

Other brownfield developments that have smaller volumes of contamination have the ability to utilise simpler remediation strategies. For example, a simple turn and compact method of remediation would significantly reduce the cost and offer a saving of up to £350,000 based on the Coed Darcy Project X development. Other opportunities come in the form of the development being of a more accommodating topography and ground make up as this could produce savings of £54,580.

Other options are for these types of development to be purely government funded through social housing, but this method would not solve the problem of the unaffordability of homes in the UK. To support this, it is important to note that not all brownfield developments have the same volume of financial risk. This case study simply acts as a worst-case scenario for most developments within the UK.

Whatever the way forward for the industry, it is important that the risks are managed sooner rather than later.

Chapter 5: Conclusions & Recommendations

5.1 Conclusions

The purpose of this research has been to identify the extent of financial risk that is associated with the redevelopment of Brownfield Land. The research aimed to highlight the issues surrounding brownfield development in its entirety by systematically reviewing the range of contaminants and abnormalities that are present, which in turn result in complicated remediation strategies and techniques. Then, the final step of the research was to calculate the financial risk which dominates these types of development.

The main driver for this research were the findings of the literature review, which have covered a great volume of government policies and procedures associating the shortage of housing and affordable homes with the surplus of brownfield land. This then incentivised brownfield development and steered developers towards this type of construction, with a significant lack of factual information regarding the risk that these developments may impose upon them. Therefore, this research provides factual information which challenges the Government policy and procedures. By providing an analysis of similar developments to highlight the financial risk associated with brownfield development, developers who are being steered down the avenue of brownfield development by government documents can be made aware of issues that could be encountered if they blindly proceed with only the incentive of guaranteed planning permission.

To achieve the aims and objectives of the research a well-structured methodology was set up to gather the most coherent data set possible, which in turn would allow for the most accurate cost analysis to challenge the Government documentation. The approach of using the case study of BP Llandarcy Oil Refinery was best suited for this research, and as a result gave a worst-case scenario for the majority of vacant brownfield land within the UK. Following completion of this research it is felt that the methodology was well planned and provided the most accurate data set possible. Some limitations were encountered during the research due to the Global Pandemic of Coronavirus Covid-19. This resulted in 2 of the 3 planned semi structured interviews

to be cancelled and the 3rd interview to be conducted remotely via telephone calls and emails. Further limitations came with sourcing build cost data as BCIS Log In information was unattainable. The decision was taken to utilise previous industry experience from other construction projects and use cost data collected from developments within the South Wales area. Upon reflection, obtaining cost data through these methods provided more accuracy, as they are as up to date as possible from local supply chain.

The methodology has allowed for clear and concise findings from this research in the form of the contamination on the development itself and the ability to access the information on how this issue was resolved. The research clearly illustrates the financial risk of developing brownfield land is rather a great danger to developers and their supply chains in the construction industry.

The research proves that Brownfield Development is unsustainable for the construction industry as a whole, and if the developers are being encouraged to take the burden of these extra costs, it runs the risk of them cutting corners further down the line and creating developments that are substandard in order to keep their business in a financially stable position. The results inform us that even within a competitive housing market, these forms of development struggle to provide a comfortable return for the risk on which they impose. The viability of brownfield land would struggle with the development of affordable homes, therefore alternative solutions would need to be sought after to achieve the targets that have been set for the housing industry.

5.2 Recommendations

The findings of this research address the aims and objectives. The research highlighted the risk of the governments drive to tackle the housing crisis by developing surplus brownfield land. To allow the construction industry to safely meet the targets that have been set, further research must be carried out. Feasibility assessments on all brownfield land which is ear marked for housing developments and as per the proposals from the CPRE, will ensure that the right homes are being built in the right places and best suited for the land on which they sit to ensure the build cost is kept

within reason and affordability of the homes is the main driver. To ensure that affordability is the main objective, further financial aid should be introduced to protect the construction industry and its supply chain from these risks. Government Publications such as *"New measures to unlock brownfield land for thousands of homes"* are only increasing a detriment on the industry by burdening businesses with financial risk, causing their collapse. The Housing White Paper discusses a £3 Billion House Builders Fund, yet there is no evidence of this being materialised within the industry. Therefore, a middle ground must be met between government officials and industry leaders to ensure that more affordable homes are built but at a fair cost. Additionally, the surplus of brownfield land must be reviewed for other uses such as more public open spaces and landscaped areas. This will have a softer impact on the ever-growing concrete world in which we live, by doing so will have a positive impact on the construction industry's carbon footprint.

Another solution to this could be to construct less dense build on brownfield land and create more residential blocks type construction amongst large green spaces. By increasing the building floor area but reducing the footprint on the ground reduces build cost and remediation requirements by maximising the potential of the brownfield sites and increasing the return income per m² of the land. This form of development can offer a different form of living and affordability, whilst landscaped areas assist in cleaning the air and land of the brownfield sites.

The purpose of this research is to bring awareness to the issue that has been covered within the construction industry for years. The vision of Coed Darcy was to have 2000 homes by 2016. (Atkins, 2010) However, 10 years on from the start with Heritage Gate, only 500 of the promised 4000 homes have been built. There is no sign of schools, retail, leisure or the acres of green open space as promised by the Coed Darcy vision. All that is currently present is a small development on the acres of remediated land which is described by many to be like the surface of the moon because of its derelict feel. This is brownfield development on a large scale, but how many more of these are scattered across the UK in varying sizes, with the ability to damage the developers and the industry? If the government continue to drive for this type of development, common ground between industry leaders and the government must be achieved to ensure the stability of the industry.

Bibliography

- Atkins, 2010. *Coed Darcy - A Beginning*. [Online]
Available at:
http://www.sclf.co.uk/conference/2012/05_Coed_Darcy_Redevelopment.pdf
[Accessed January 2020].
- Bowen, G. A., 2017. *Document Analysis as a Qualitative Research Method*, Western Carolina University: Glenn A Bowen.
- Burroughs, L., 2014. *Removing obstacles to Brownfield Development*, London: CPRE.
- CGL, 2017. *Managing Risks on Brownfield Sites*, Exeter: CGL.
- CPRE, 2014. *Removing Obstacles to Brownfield development*. [Online]
Available at: <https://www.cpre.org.uk/wp-content/uploads/2019/11/removing-obstacles-to-brownfield-development.pdf>
[Accessed 1 March 2020].
- CPRE, 2019. *State of Brownfield 2019*, London: CPRE.
- Department for Communities and Local Government, 2017. *Fixing our broken housing market*, London: GOV UK.
- Edgar, L., 2015. *200,000 starter homes promised by Cameron*, UK: The Planner.
- Financial Times, 2014. *How a polluted oil plant in Wales became a model housing project*. [Online]
Available at: <https://www.ft.com/content/2e224768-f70a-11e3-8ed6-00144feabdc0>
[Accessed 1 March 2020].
- Gov UK, 2017. *Housing White Paper: Statement*. [Online]
Available at: <https://www.gov.uk/government/speeches/housing-white-paper-statement>
[Accessed Jan 2020].
- GOV UK, 2017. *New measures to unlock brownfield land for thousands of homes*. [Online]
Available at: <https://www.gov.uk/government/news/new-measures-to-unlock-brownfield-land-for-thousands-of-homes>
[Accessed Jan 2020].
- GOV UK, 2017. *New measures to unlock brownfield land for thousands of homes*. [Online]
Available at: <https://www.gov.uk/government/news/new-measures-to-unlock-brownfield-land-for-thousands-of-homes>
[Accessed JAN 2020].
- GOV UK, 2019. *Land Use Change Statistics in England: 2017-2018*. [Online]
Available at:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/805435/Land_Use_Change_Statistics_England_2017-18.pdf
[Accessed Jan 2020].
- History.com Editors, 2019. *Industrial Revolution*. [Online]
Available at: <https://www.history.com/topics/industrial-revolution/industrial-revolution>
[Accessed January 2020].
- Natural Resources Wales, 2016. *The State of Contaminated Land in Wales*. [Online]
Available at: <https://naturalresources.wales/media/677708/nrw26759-contaminated->

land-in-wales-pdf_english-1.pdf

[Accessed Jan 2020].

Pentreath, B., 2014. *How a polluted oil plant in Wales became a model housing project*, London: Financial Times .

Shepherd wedderburn, 2005. *Factors to Consider in relation to Brownfield Sites*. [Online]

Available at: <https://shepwedd.com/knowledge/factors-consider-relation-brownfield-sites>

[Accessed February 2020].

The Planner, 2015. *200,000 starter homes promised by Cameron*. [Online]

Available at: <https://www.theplanner.co.uk/news/200000-starter-homes-promised-by-cameron>

[Accessed January 2020].

The Prince's Foundation, n.d. *SOUTH WALES REGENERATION: FROM OIL REFINERY TO SUSTAINABLE COMMUNIT*. [Online]

Available at: <https://princes-foundation.org/practice/coed-darcy>

[Accessed January 2020].

URS Corporation Ltd, 2006. *BP Llandarcy Refinery – URS Factual Report, Area 1 Site Investigation, 9th June 2006, Issue No 1, 44382624/ 1395.*, Bristol: URS.

URS Corporation Ltd, 2006. *Final Report, Asbestos Delineation Works, Former BP Car Park Area*, Bristol: URS Corporation Ltd.

URS Corporation Ltd, 2010. *BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729*, Bristol: URS Corporation Ltd.

URS, 2004. *Assessment and Restoration of the BP Llandarcy Refinery Landfill*. [Online]

Available at: [Assessment and Restoration of the BP Llandarcy Refinery Landfill](#)

[Accessed January 2020].

Watkins, D. A. & C., 2002. *Greenfields, Brownfields & Housing Development*. 1st Edition ed. s.l.:Blackwell Publishing.

Welsh Government, 2018. *Planning Policy Wales*. [Online]

Available at: <https://gov.wales/sites/default/files/publications/2018-12/planning-policy-wales-edition-10.pdf>

[Accessed Jan 2020].

Appendices

Appendix A - BP Llandarcy Refinery – URS Factual Report, Area 1 Site Investigation, 9th June 2006, Issue No 1, 44382624/ 1395. *Email Copy.*

Appendix B – Final Report, Asbestos Delineation Works, Former BP Car Park Area.

Appendix C – BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729.

Appendix D - COED DARCY PROJECT X – MOCK DEVELOPMENT DESIGN

Appendix E – COED DARCY PROJECT X – HOUSING MARKET RESEARCH

Appendix F – COED DARCY PROJECT X – PLOT REVENUE SCHEDULE

Appendix G – COED DARCY PROJECT X – COST PLAN ANALYSIS

Appendix H - COED DARCY PROJECT X – COST PLAN APPRAISAL

APPENDIX A

BP Llandarcy Refinery – URS Factual Report, Area 1 Site Investigation, 9th June 2006, Issue No 1, 44382624/ 1395.

APPENDIX B

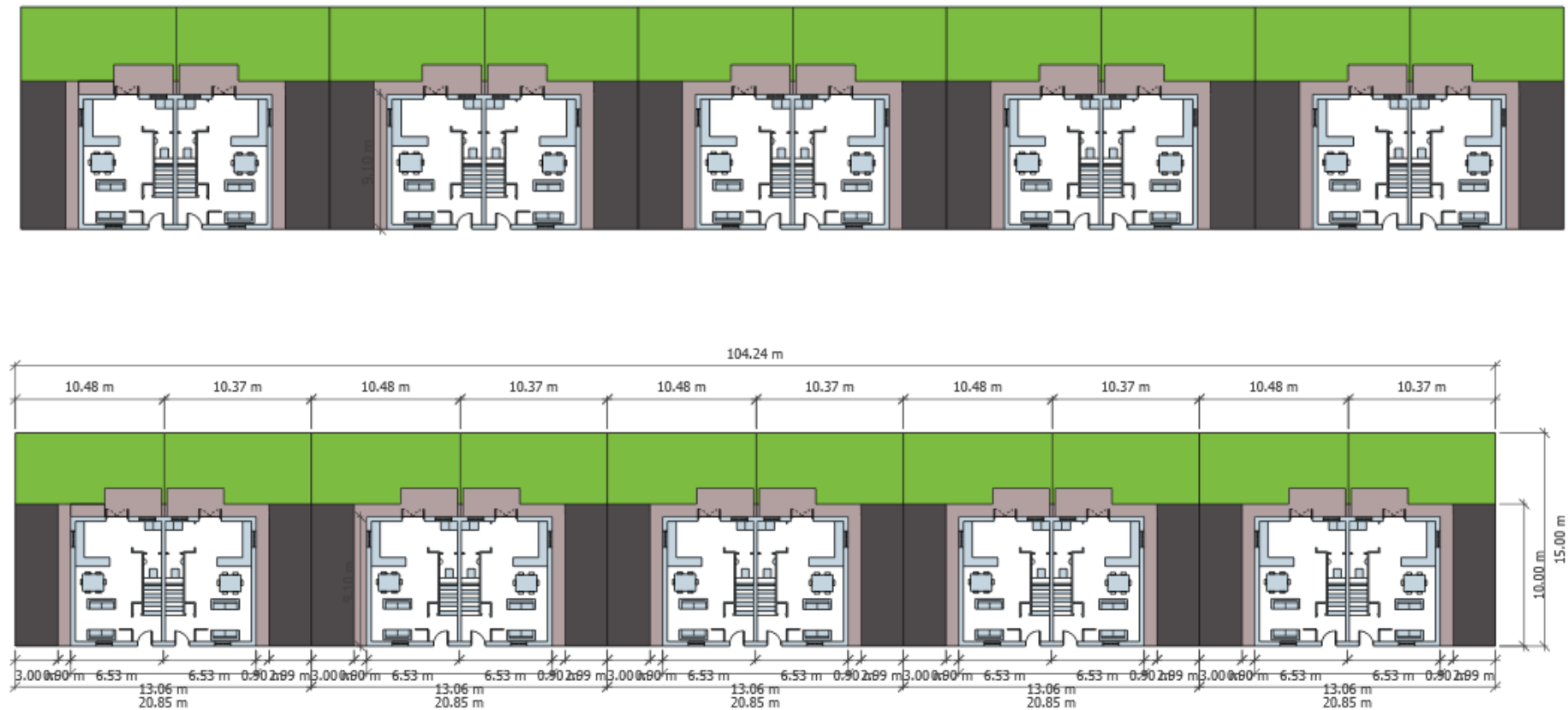
Final Report, Asbestos Delineation Works, Former BP Car Park Area.

APPENDIX C

BP Area 1 Remediation, URS Validation Report, 18 January 2010, Issue No 1, 44382729.

EACH OF THE ABOVE ARE TOO LARGE TO BE APPENDED TO THIS DOCUMENT. EMAIL COPIES HAVE BEEN ISSUED TO LARA HOPKINSON

COED DARCY PROJECT X – MOCK DEVELOPMENT DESIGN



APPENDIX E**COED DARCY PROJECT X – HOUSING MARKET RESEARCH**

Property Type	Beds	Address		Cost	Sold In
1 Semi-Detached	3	Lon-Y-Grug, Coed Darcy	£	183,000.00	FOR SALE
2 Detached	3	Lon-Y-Grug, Coed Darcy	£	199,950.00	FOR SALE
3 Semi-Detached	3	Lon-Y-Grug, Coed Darcy	£	177,000.00	2019
4 Semi-Detached	4	Heathland Way, Coed Darcy	£	182,500.00	2019
5 Semi-Detached	3	Lon-Y-Grug, Coed Darcy	£	154,000.00	2017
6 Semi-Detached	3	Y Gilfach, Coed Darcy	£	172,500.00	2017
7 Detached	3	Heathland Way, Coed Darcy	£	219,995.00	2018

TOTAL	£ 1,288,945.00
AVERAGE	£ 184,135.00

** The above data is correct as of March 2020

APPENDIX F**COED DARCY PROJECT X – PLOT REVENUE SCHEDULE**

Site: COED DARCY PROJECT X
Date: SPRING 2020

PLOT	TYPE	MIX	SqFt	£/SqFt	PLOT PRICE
1	HOUSETYPE A	1	1279	152	£ 195,000
2	HOUSETYPE A	1	1279	152	£ 195,000
3	HOUSETYPE A	1	1279	152	£ 195,000
4	HOUSETYPE A	1	1279	152	£ 195,000
5	HOUSETYPE A	1	1279	152	£ 195,000
6	HOUSETYPE A	1	1279	152	£ 195,000
7	HOUSETYPE A	1	1279	152	£ 195,000
8	HOUSETYPE A	1	1279	152	£ 195,000
9	HOUSETYPE A	1	1279	152	£ 195,000
10	HOUSETYPE A	1	1279	152	£ 195,000
		10	12,790	1,525	£ 1,950,000

APPENDIX G

COED DARCY PROJECT X – COST PLAN ANALYSIS PAGE 1

SITE: COED DARCY PROJECT X
 DATE: SPRING 2020
 REVISION: A
 ESTIMATOR: ND
 BUILD COST REVISION:

TOTAL CONSTRUCTION COST £ 2,286,680.83 £ 178.79
 CLEAN BUILD £ 1,622,542.03 £ 126.86
 ABNORMALS £ 664,138.80 £ 51.93

SCHEDULE OF ACCOMODATION

HOUSE TYPE	BEDS	Nr	FT2	M2	TOTAL FT2	TOTAL M2	NUMBER OF PLOTS 10 NUMBER OF FOOTPRINTS 5 GROSS ACRES 0.39 NON DEVELOPABLE AREA 0.00 NET DEVELOPABLE ACRES 0.39 DEVELOPABLE AREA M2 1,564 FT2 PER NET ACRE 33,104 PLOTS PER NET ACRE 26
HOUSETYPE A	3	10	1279	119	12,790	1,188	
		10			12,790	1,188	

PLOT WORKS

A STANDARD FOUNDATIONS

HOUSE TYPE	FT2	MIX	FOUNDAT ION AREA m2	RATE	FOUNDATION COST	TOTAL M2	TOTAL
HOUSETYPE A	1279	10	59	£ 160.00	£ 9,505.76	594	£ 95,057.60
TOTAL STANDARD FOUNDATION COST:							£ 95,057.60

C PLOT DEVELOPMENT

ITEM	QUANTITY	UNIT	RATE	TOTAL	TOTAL
Plot Drainage	10	Number	£ 4,000.00	£ 40,000.00	£ 40,000.00
Service Entries	10	Number	£ 500.00	£ 5,000.00	£ 5,000.00
Driveways to Base	300.00	M2	£ 27.65	£ 8,295.00	£ 8,295.00
Scaffold Bases	0.00	M2	£ 6.50	£ -	£ -
Paths & Patios on 100mm sub base	191.42	M2	£ 49.67	£ 9,507.83	£ 9,507.83
Topsoil @ 150mm thick from on site	521	M2	£ 5.00	£ 2,606.00	£ 2,606.00
Clean Plot	10	Number	£ 200.00	£ 2,000.00	£ 2,000.00
Plot Fencing	263.5	Meters	£ 45.00	£ 11,857.50	£ 11,857.50
Plot Turfing	521	M2	£ 5.00	£ 2,606.00	£ 2,606.00
Plot Landscaping	0	Item	£ 500.00	£ -	£ -
TOTAL PLOT DEVELOPMENT COST:					£ 81,872.33

COED DARCY PROJECT X – COST PLAN ANALYSIS PAGE 2

D SUPERSTRUCTURES

HOUSE TYPE	FT2	MIX		£/FT2	TOTAL COST		TOTAL
HOUSE TYPE A	1279	10		£ 68.00	£ 86,972.00		£ 869,720.00
Sprinklers - Allowance Per Plot		10	Nr		£ 3,000.00		£ 30,000.00
TOTAL SUPERSTRUCTURE COST:						£	899,720.00

E STANDARD EXTERNAL DEVELOPMENT ALLOWANCE

ITEM	QUANTITY	UNIT		RATE	TOTAL	TOTAL
SITE CLEARANCE						
Formulated Strip topsoil & stockpile for re-use	235	M3		£ 8.00	£ 1,876.32	£ 1,876.32
Formulated Earthworks to form levels	625	M3		£ 7.50	£ 4,690.80	£ 4,690.80
Formulated Excavate & cartaway (allow 200mm)	313	M3		£ 22.00	£ 6,879.84	£ 6,879.84
Formulated Plots	178	M3		£ 22.00	£ 3,921.13	£ 3,921.13
Formulated Road	633	M3		£ 22.00	£ 13,915.00	£ 13,915.00
Formulated Patios	54	M3		£ 22.00	£ 1,179.15	£ 1,179.15
Formulated Landscaped areas	0	M3		£ 22.00	£ -	£ -
						£ 32,462.23
FOUL DRAINAGE						
Manual 100mm Adoptable lateral drainage	40.00	meters		£ 36.00	£ 1,440.00	£ 1,440.00
Manual 150mm Adoptable mains drainage	115.00	meters		£ 60.85	£ 6,997.75	£ 6,997.75
Manual Adoptable manholes avg depth 2.5m	5	Nr		£ 1,950.00	£ 9,750.00	£ 9,750.00
Manual PPIC inspection chambers avg depth 1.0m	0	Nr		£ -	£ -	£ -
Manual Foul Drainage Connection	1	Item		£ 5,000.00	£ 5,000.00	£ 5,000.00
						£ 23,187.75
STORM DRAINAGE						
Manual 100mm Lateral Drainage	40.00	meters		£ 72.85	£ 2,914.00	£ 2,914.00
Manual 150mm Adoptable storm drainage	115.00	meters		£ 115.00	£ 13,225.00	£ 13,225.00
Manual Road Gullies	23	Nr		£ 375.00	£ 8,625.00	£ 8,625.00
Manual Mains drainage connection	1	Item		£ 5,000.00	£ 5,000.00	£ 5,000.00
Manual Attenuation	0	M3		£ 185.00	£ -	£ -
Manual Hydrobrake	0	Item		£ 4,000.00	£ -	£ -
						£ 29,764.00
ROADS TO BASE						
Manual Main adoptable highway - 200mm sub base, 150mm Road base, 50mm Binder	632.5	M2		£ 49.00	£ 30,992.50	£ 30,992.50
Manual Kerbs; 125 x 255mm (Type HB2); laid on Class 20/20 concrete bed and haunch; country setts	115	meters		£ 22.50	£ 2,587.50	£ 2,587.50
						£ 33,580.00

COED DARCY PROJECT X – COST PLAN ANALYSIS PAGE 3

FOOTPATHS TO BASE									
Manual	Main estate footpaths 1.8m x 100mm sub base, 50mm base	230	M2	£	24.76	£	5,694.80	£	5,694.80
Manual	Edgings; 50 x 150 mm precast concrete edging laid on class 20/20 concrete bed and haunch	115	meters	£	13.95	£	1,604.25	£	1,604.25
								£	7,299.05
FINAL SURFACING									
	30mm wearing course to adoptable highway	632.5	M2	£	12.00	£	7,590.00	£	7,590.00
	80mm formpave blocks to adoptable highway	0	M2	£	-	£	-	£	-
	20mm wearing course to adoptable footpaths	230	M2	£	9.00	£	2,070.00	£	2,070.00
	20mm wearing course to private drives	300	M2	£	9.00	£	2,700.00	£	2,700.00
	20mm wearing course to shared drives	0	M2	£	9.00	£	-	£	-
	Road Markings	1	Item	£	500.00	£	500.00	£	500.00
								£	12,860.00
BOUNDARY TREATMENTS - NOT INCLUDING PLOT FENCING									
	Brick Pillars	20	Nr	£	800.00	£	16,000.00	£	16,000.00
	Single gates	10	Nr	£	105.00	£	1,050.00	£	1,050.00
	Double Gates (Driveways)	10	Nr	£	1,000.00	£	10,000.00	£	10,000.00
								£	27,050.00
SERVICES & SUNDRIES									
	Combined service trenches	100	meters	£	23.40	£	2,340.00	£	2,340.00
	Service connections	100	meters	£	10.80	£	1,080.00	£	1,080.00
	Junction boxes	10	Nr	£	150.00	£	1,500.00	£	1,500.00
	Street lighting	1	Item	£	5,000.00	£	5,000.00	£	5,000.00
	BWIC in connection with street lighting	0	meters	£	23.40	£	-	£	-
	Street Signage	1	Item	£	1,500.00	£	1,500.00	£	1,500.00
								£	11,420.00
TOTAL STANDARD EXTERNAL DEVELOPMENT:								£	177,623.00

COED DARCY PROJECT X – COST PLAN ANALYSIS PAGE 4

F *PLOTABNORMALS*

ITEM	QUANTITY	UNIT	RATE	TOTAL	TOTAL
Underbuild to plots; 300mm high	0	meters	£ 75.00	£ -	£ -
Underbuild to plots; 450mm high	0	meters	£ 112.50	£ -	£ -
Underbuild to plots; 600mm high	0	meters	£ 150.00	£ -	£ -
Underbuild to plots; 750mm high	0	meters	£ 187.50	£ -	£ -
Underbuild to plots; 900mm high	0	meters	£ 225.00	£ -	£ -
Underbuild to plots; 1200mm high	0	meters	£ 300.00	£ -	£ -
Underbuild to plots; 1500mm high	0	meters	£ 375.00	£ -	£ -
Extra over for raft foundations	0	M2	£ 55.00	£ -	£ -

£	-
---	---

G EXTERNAL ABNORMALS

ITEM	QUANTITY	UNIT		RATE	TOTAL		TOTAL
Remediation of Contaminated Land, Excavate and Remove Contaminated Ground up to 1M in Depth, and Backfill with Clean Material	1725	TONNE	£	280.00	£ 483,000.00	£	483,000.00
Knorweed- Safe Removal and Disposal, to hazardous waste centre	1	Item	£	15,000.00	£ 15,000.00	£	15,000.00
Asbestos- Safe Removal and Disposal, to hazardous waste centre	117.2	TONNE	£	390.00	£ 45,708.00	£	45,708.00
450mm imported Capping layer to soft areas	521	M2	£	28.00	£ 14,593.60	£	14,593.60
Hard dig to plots	10	Nr	£	1,500.00	£ 15,000.00	£	15,000.00
Warning Membrane (1 Metre Below Finished GL) Excluding Plots	1,575	M2	£	25.00	£ 39,375.00	£	39,375.00
Gas Protection Membrane as per Site Investigation Advice	594	M2	£	20.00	£ 11,882.20	£	11,882.20
Underbuild to plots; 450mm high	221.60	meters	£	112.50	£ 24,930.00	£	24,930.00
Retaining walls; Masonry; (assume max 600mm high)	50	meters	£	293.00	£ 14,650.00	£	14,650.00

£	664,138.80
---	------------

TOTAL ABNORMAL COSTS	£	664,138.80
----------------------	---	------------

TOTAL STANDARD DEVELOPMENT COSTS: £	1,254,272.96
-------------------------------------	--------------

COED DARCY PROJECT X – COST PLAN ANALYSIS PAGE 5

H DESIGN & TECHNICAL FEES

CODE	DESCRIPTION				TOTAL
7.5% of Overall Build Cost					
TOTAL FEES: £					136,290.62

I PRELIMINARIES

ITEM	QUANTITY	UNIT		RATE	TOTAL			TOTAL
Site preliminary costs	52	Weeks		£ 4,000.00	£ 208,000.00			£ 208,000.00
TOTAL PRELIMINARY COSTS: £								208,000.00

J CUSTOMER CARE

ITEM	QUANTITY	UNIT		RATE	TOTAL		TOTAL
TOTAL COST OF CUSTOMER CARE £							-

TOTAL MEASURED WORKS: £ 1,598,563.58

1.50% CONTINGENCY: £ 23,978.45

TOTAL CLEAN PROJECT COST: £ 1,622,542.03

TOTAL ABNORMALS: £ 664,138.80

COMBINED TOTAL: £ 2,286,680.83

TOTAL COST OF CUSTOMER CARE £ -

TOTAL MEASURED WORKS: £ 1,598,563.58

1.50% CONTINGENCY: £ 23,978.45

TOTAL CLEAN PROJECT COST: £ 1,622,542.03

TOTAL ABNORMALS: £ 664,138.80

COMBINED TOTAL: £ 2,286,680.83

APPENDIX H**COED DARCY PROJECT X – COST PLAN APPRAISAL****GREENFIELD V BROWNFIELD APPRAISAL**

Project Coed Darcy Project X

Date Spring 2020

Proposal 10 Plots

Construction Period 52 Weeks

	GREENFIELD	BROWNFIELD
Land Cost	£ 100,000.00	£ -
CLEAN BUILD COST	£ 1,622,542.03	£ 1,622,542.03
ABNORMALS	£ 15,000.00	£ 664,138.80
CONTINGENCY of 1.5%	£ 24,563.13	£ 34,300.21
TOTAL OUTGOING	£ 1,762,105.17	£ 2,320,981.05
REVENUE (SALES)	£ 1,950,000.00	£ 1,950,000.00
TOTAL PROFIT MARGIN (£)	£ 187,894.83	£ (370,981.05)
TOTAL PROFIT MARGIN (%)	9.64%	-19.02%

PROFIT DROP 28.66%
