July 2020

Environmental Impact Assessment Report (EIAR) Volume 3 Appendices

Abbey Quarter – Urban Park and Street

Kilkenny County Council

County Hall, Kilkenny

MALONE O'REGAN

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Title: Environmental Impact Assessment Report (EIAR) Volume 3 Appendices, Abbey Quarter – Urban Park and Street, Kilkenny County Council, County Hall, Kilkenny

Job Number: E1518

Prepared By: Various **Signed:** J McD

Checked By: Janette McDonald **Signed:** J McD

Approved By: Kevin O'Regan **Signed:** K O'R

Revision Record

Issue No.	Date	Description	Remark	Prepared	Checked	Approved
01	29/07/'20	EIAR	Final	Various	JMcD	KOR

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Our Case Number: ABP-306275-19

Your Reference: E1618

An Bord Pleanála

Kilkenny County Council
County Hall
John Street
Kilkenny
Co. Kilkenny

KILKENNY COUNTY COUNCIL
PLANNING SECTION
05 MAY 2020
RECEIVED

Kilkenny County Council
5 MAY 2020
Received

Date: 01 May 2020

Re: Environmental Impact Assessment Scoping Report.
The Abbey Quarter, Kilkenny City.

Dear Sir / Madam,

In response to your request please now be advised that the following constitutes the Board's written opinion on the information to be contained in the environmental impact statement to be prepared in respect of the above-mentioned proposed development.

1. ***The Proposed Development*** - to include information on the site, design, size and other relevant features of the proposed development. The description of the project should make specific reference to demolition works that may be required as part of or to facilitate the development. In the case of the subject development, the description of development should include its context with regard to other permitted and proposed developments on the overall St. Francis Abbey site and the extent of any demolition works required, including removal of the

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existing concrete slab. The proposed development should be described in scaled drawings, photographs and photomontages.

2. ***The Existing Environment*** - The existing environment and the impacts of the development are explained by reference to its possible impact on the following environmental factors:-
   - Population, and Human Health,
   - Biodiversity with particular attention to species and habitats protected under the Habitats and Birds Directive.
   - Land, Soil, Water, Air and Climate,
   - Material Assets, Cultural Heritage and the landscape,
   - The interaction between the above factors

In terms of the receiving environment, the EIS shall include all areas that would be impacted upon, directly or indirectly, by the proposed development. The information contained in the EIAR should therefore be based on comprehensive surveys of the area and have regard to updated data bases which may exist in terms of architectural heritage and ecology. The EIAR should accurately describe the receiving environment in terms of geology, geomorphology and hydrology, as well as a physical description of the site proposed for development.

3. ***The Likely Significant Effects of the Proposed Development*** - Impacts should address direct, indirect, secondary, cumulative, short, medium and long-term, permanent, temporary, positive and negative effects as well as impact interactions. None of the topics outlined above (Population and Human Health etc.) should be omitted, although their level of detail may differ depending on the likelihood of impacts.

   In accordance with the requirements of Article 94 of the Planning and Development Regulations, 2001 (as amended), the EIAR shall contain a reference list detailing the sources used for the impact descriptions and assessments used in the EIAR.

   The EIAR should also contain a list of experts who contributed to the development of the report, identifying for each expert, the part of the EIAR for which he / she is responsible, his /

her experience or expertise and any additional information considered relevant to demonstrate the persons competence in the preparation of the EIAR.

An assessment of the impact of the proposed street and park is required, with an assessment of the cumulative impact of existing and permitted developments in the vicinity. Such developments would include permitted works to the Mayfair Ballroom and Brewhouse buildings. The assessment of cumulative impacts in the EIAR should also have regard, as far as is practicable, to the likely effects arising from future phases of development of the Abbey Quarter Masterplan.

Further to the above, details of the environmental impacts of the development during the demolition, excavation, construction and operational phases of the development should also be described and assessed by reference to baseline information which should be collated and presented within the EIAR. The environmental impact of the aforementioned phases, including in particular noise and vibration impacts arising from the removal of the existing concrete slab and construction phase impacts in terms of materials storage and containment within the site should also be described and assessed.

The EIAR will be required to provide information regarding the nature, quantities and source of materials to be used in the overall development. Information will also be required on volumes and nature of waste materials likely to be generated in the demolition phase and proposed means for disposal of same.

The EIAR should also provide an assessment of the expected effects arising from the vulnerability of the project to major accidents and disasters that are relevant to the project. These risks should be considered in the context of the factors of the environment.

4. ***The Measures to Mitigate Adverse Impacts*** - The EIAR shall give a description of the features of the proposed development and measures envisaged to avoid, prevent, reduce and, if possible, offset likely significant adverse effects on the environment. Where adverse impacts are likely to result, appropriate mitigation measures shall be identified where necessary – and shall clearly indicate where and with whom responsibility for the implementation of the mitigation measures lies. The EIAR shall also provide information relating to the monitoring of the impacts of the development on the environment.

5. ***Consideration of Alternatives***: The consideration of alternatives, in terms of location and design, as well as proposed uses, should also be addressed in the EIAR and should comprise a description of the reasonable alternatives relevant to the proposed development which were studied and the reason for the option chosen having regard to the effects on the environment. In undertaking this assessment of alternatives, the following should be borne in mind:

- It is not a requirement to requirement to revisit issues considered in the formulation of policy that has been the subject of SEA.
- Alternatives should be relevant to the project and its specific characteristics.
- The assessment of alternatives should include a description of the current state of the environment without implementing the project, i.e. the Do-Nothing scenario. This assessment should be the starting point for the consideration of impacts in the EIAR.
- In the assessment of alternatives the level of detail provided should be reasonable and commensurate with the project.

6. ***A Non-Technical Summary*** - The EIS must contain a non-technical summary of the detailed information contained within the EIAR. The language of this summary shall be non-technical in nature and should provide clear details of the environmental effects the development will have, as well as all significant effects and mitigation measures proposed. The description of the development in this summary should clearly explain and describe all aspects of the proposed development such that the EIAR is accessible in terms of public understanding of the process and to facilitate full public participation and consultation in the process.

In terms of specific environmental topics the development is likely to impact upon, the EIAR should, in particular, address the following matters:

- Population, and Human Health
- Biodiversity (for example fauna and flora),

- Land (for example land take), Soil (for example organic matter, erosion, compaction, sealing), Water (for example hydromorphological changes, quantity and quality), Air and Climate (for example greenhouse gas emissions, impacts relevant to adaptation),
- Material Assets, Cultural Heritage, (including architectural and archaeological aspects) and Landscape.
- Interactions between the above factors.

An outline of the specific issues considered relevant to the EIAR under these headings is given in the following sections:

7. Population, and Human Health

- As identified in the submitted screening assessment, current advice regarding the scope of human health and the consideration of associated impacts is that the assessment should refer to the assessment of those environmental factors which might lead to effects on human health, e.g. air, water etc.
- Given the nature of the existing site the EIAR should specifically address the likely effects on the health and safety of surrounding populations during all phases of the development, including demolition, excavation, construction and operational phases, including the operation of plant equipment.
- An assessment of the impact of the proposed development on the availability of local recreational facilities and overall level of amenity and the potential impacts arising for population and human health should be addressed in the EIAR.

8. Biodiversity.

- Given the brownfield nature of the site, and its location within an urban setting, the EIAR should provide a clear baseline assessment of the existing receiving environment and the impact of the development on the ecology of the receiving environment.

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- The EIAR should address any potential for disturbance arising from the construction activity and particularly any works required to remove the existing concrete slab. In particular, the potential for disturbance to any species using the adjoining river channels (Nore and Breagagh) or banks to these watercourses should be assessed. .
- The proximity of the site to the River Nore SPA and SAC sites is noted and there is therefore a need to carry out an Screening for Appropriate Assessment under the Habitats Directive and further assessment if necessary. The results of such assessments will inform the Biodiversity section of the EIAR. It is noted that the level of detail submitted with regard to the exact site boundary and relationship with the European sites is not very clear and the appropriate assessment will need to focus on the potential impacts arising on the adjacent European sites arising from the operational and particularly the construction phases of the development.
- The scope and nature surveys, including aquatic surveys, as outlined in the submitted EIA Scoping Report (Malone O'Regan Consulting, December, 2019) should be reviewed with the Development Applications Unit of the NPWS in the Department of Culture Heritage and the Gaeltacht. Survey work should comply with best practice for seasonality and scope and the comments of the Development Applications Unit on these issues should be sought.
- The EIAR should address the potential for the enhancement of the biodiversity of the site arising from the development and the measures undertaken to maximise these impacts.

9. Land, Soil, Water, Air and Climate.

Soil

- The EIAR should also provide information relating to the amount and description of materials disturbed or excavated on the site and proposals for the storage, reuse and disposal of material excavated or otherwise generated during the demolition and construction phases of development. Given the previous industrial use of the site, particular attention should be paid to the identification, removal and management of any contaminated soil.

- The impact of excavations required as part of the development should describe, assess and mitigate the potential impact of the proposed development on existing sub surface services that may be present on the site.
- An assessment of the impact of such excavations or other ground disturbances on surface waters should be provided.
- Provide details of the types and nature of materials imported to the site during construction together with construction methods to be employed and measures to prevent the importation of invasive species.
- Mitigation measures to prevent or minimize emissions from the site during demolition and construction phases, should also be provided.

Water

- The impact of materials to be excavated and/or stored on the site will require to be considered in terms of the potential impact on surface and ground waters in the area of the site, in particular impacts on the adjoining River Breagagh and River Nore. Changes to the existing hard surface will lead to alterations in surface water drainage patterns and the existing on site surface water drainage system should be clarified as part of the EIAR and application documentation and the impacts of the proposed development on these existing drainage networks clearly set out. .
- There is no indication that the site is prone to flooding however given the proximity to two watercourses, the EIAR should assess potential flooding impacts and risks in accordance with the document "The Planning System and Flood Risk Management – Guidelines for Planning Authorities" published by the OPW in November 2009.
- Also with regard to flooding, the EIAR should detail how sustainable drainage methods are proposed to be incorporated into the design and the impact of the development on existing surface water discharges from the site to the local drainage network.
- The EIAR should provide information relating to the coordinated provision of physical infrastructure and services, in terms of the cumulative impact of any other proposals contained in the Abbey Quarter Masterplan for the surrounding area.

- Assessments regarding flood risk and drainage should detail and make provision for the accommodation of climate change impacts.

Air and Climate

- Impacts on air, it is considered that this will be potentially relevant during the demolition phase of development. The EIAR should therefore provide appropriate and up-to-date baseline data and describe any mitigation measures deemed necessary to minimise adverse impacts on air quality in the vicinity of the site and to mitigate dust and airborne pollution.

10. Material Assets, Cultural Heritage and Landscape.

Material Assets

- Given the city centre location of the site, a description of the ***traffic impacts*** resulting from the proposed development shall be provided. The EIAR should address traffic generated by the development, during demolition, construction and operational phases of the development, and should include information on the volume and type of traffic (including details of any unusually heavy, high or wide loads) likely to be generated during these phases of the development and the impact on main junctions in the vicinity of the site, notably the junction of the proposed street and St. Francis Bridge and Batemans Quay.
- The EIAR should consider the environmental effects of such heavy traffic, and should clearly provide details regarding proposed routes to and from the site, in particular during the demolition and construction phases of the development.
- In considering traffic-related issues, the EIAR should address any cumulative issues which may/will arise in the overall development of Masterplan site, and should have regard to other major developments in the vicinity of the site.
- The development shall be described in terms of its permeability with surrounding areas and the traffic arrangements which will facilitate such permeability, including pedestrian and cycle traffic.

Cultural Heritage

- The site and the adjoining lands are located within the City Centre ***Architectural Conservation Area*** and the ACA takes in all of the Abbey Quarter Masterplan lands located to the south of the River Breagagh. The EIAR should assess the impact of the proposed development and potential cumulative impacts with other developments on the masterplan lands on the character of the ACA.
- The impact of the proposed development on the character and setting of St Francis Abbey which is included on the NIAH and other similar structures including Evans Turret and the city walls should be included in the EIAR.
- Consideration should also be given to structures of architectural merit which are at a remove from the site but which may be affected due to works associated with the proposed development. Structures of architectural merit should include those buildings which contribute to the character of the area and which may or may not be included in the RPS for Kilkenny. The impact of the development on the setting of the Mayfair Ballroom building is specifically noted in this regard.
- Given the nature and location of the subject site in the centre of Kilkenny City, it is likely that development on site would have potential impacts on the ***archaeological heritage*** of the area. It is recommended that this issue be specifically investigated and the results presented in the EIAR.
- Baseline archaeological data should be provided for the site including location, extent and nature of any existing archaeological finds. Proposed mitigation measures to be undertaken, where such archaeological remains will be affected, shall be described. The significant extent of the baseline archaeological assessment already undertaken (detailed in 3.3.8.1 of the submitted EIA Scoping Report) is noted. Notwithstanding this, it is recommended that prior to finalization and submission of the EIAR that the National Monument Section of the Department of Culture Heritage and the Gaeltacht would be consulted with regard to extent and methodology of archaeological investigations at the site appropriate to inform the EIAR.

Landscape

- The EIAR should include description of the proposed planning and landscaping of the site, both hard and soft to include materials, levels and plant species. This information should be augmented by a detailed landscaping and planting plan for the development.
- An assessment of the proposed development on the receiving urban landscape will be required to be undertaken as part of the EIAR. This assessment should address existing visually prominent and functional features in the urban landscape and should provide an assessment of the visual impact of the development as it relates to the surrounding heritage areas including St Francis Abbey and Evans Turret.
- The landscape section of the EIAR should include a series of photomontages or other forms of visual aid, and the views should be taken to and from the surrounding locations including St. Francis Bridge, St. Francis Abbey surrounding streets including Batemans Quay and other identified sensitive receptors.

11. Interactions between the above factors.

The EIAR should include detailed consideration between the above factors where considered relevant.

Attached for your information is a copy of the Board Direction and the Inspector's report and copies of submissions received from prescribed bodies on this case.

Yours faithfully,

EW

pp

Maeve Williams
Executive Officer
Direct Line: 01-8737287

ES14

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An Bord Pleanála

Board Direction
BD-005661-20
ABP-306275-19

At a meeting held on 28/04/2020, the Board considered the documents and submissions on the file, including the Environment Impact Assessment Scoping Report submitted by Kilkenny County Council and the responses received from prescribed bodies, as well as the report of the Inspector.

The Board considered that the written opinion of the inspector provides appropriate scoping for the Environmental Impact Assessment Report to be prepared in relation to the proposed development within the Abbey Quarter, Kilkenny. Accordingly, the Board instructed that a copy of the written opinion, and copies of the submissions received under Article 95(2) of the Planning and Development Regulations 2001, as amended, be sent to Kilkenny County Council for their information and attention.

Board Member: Dave Walsh **Date:** 28/04/2020

An Bord Pleanála

Inspector's Report
ABP-306275-19

Development	Development at the Abbey Cultural Quarter, Kilkenny City.
Location	The Abbey Quarter, Kilkenny City.
Planning Authority	Kilkenny County Council.
Planning Authority Reg. Ref.	
Applicant(s)	Kilkenny County Council.
Type of Application	EIA Scoping under Article 117 of the Planning and Development Regulations, 2001 as amended.
Date of Site Inspections	8th March, 2018 30th March, 2016, and 12th March, 2015 in connection with previous EIA and AA Direction cases on the site. .
Inspector	Stephen Kay

1.0 Site Location and Description

1.1. The site the subject of this scoping request is located within the site of the former St. Francis Abbey brewery site located at the northern end of High Street and on an overall site that is bounded by High Street and Horse Barrack Lane to the west, by the River Nore to the east and by the R695 and new central access scheme bridge over the River Nore and the River Breagagh channel, which runs immediately to the north of the Mayfair Ballroom building, to the north. The River Breagagh separates the main part of the site from an additional area to the north with an existing bridge connection. To the south, the site is bounded by a number of commercial sites that from Parliament Street and Green Street. This overall site has been the subject of a masterplan called the Abbey Cultural Quarter Masterplan.

1.2. The site has been largely cleared of the former industrial buildings that were present with only three main structures remaining. These are the Mayfair Ballroom building located at the northern end close to the entrance of the site from Horsebarrack Lane, the Brewhouse and Maturation buildings located to the south and the remain of St Francis Abbey which is included on the NIAH and is a national monument.

1.3. The bulk of the wider site is covered in a concrete slab which was laid on the site at the time of its use as a brewery. Information from previous AA and EIA direction cases indicates that there is significant historical services infrastructure located within this concrete slab.

1.4. The area of the site which is the subject of works for which the EIA scoping request relates is 1.3 ha.

2.0 Proposed Development

2.1. The submission on file from Kilkenny County Council describes the proposed works as follows:

2.2. The development which is the subject of this scoping request is proposed to comprise two main elements, an urban park and street. The street is proposed to run from Batemans Quay at the southern end of the overall St Francis Abbey site north, crossing the River Breagagh at the position of the existing bridge connecting the two parts of the site, and terminating to the north at the Central Access Scheme bridge, now known as St. Francis Bridge. The street is proposed to be primarily a pedestrian and cycle space, though controlled vehicular access will be available to facilitate deliveries to future developments adjoining the street.

2.3. The park element of the project is located to on either side of the road at the northern end of the road. It would be bounded by the bank of the River Nore to the east, proposed future new development to the south including riverside park and by the Mayfair Ballroom and Brewhouse buildings to the west. To the north, the park would adjoin the River Breagagh. The ruin of St. Francis Abbey is located entirely within the park area. Surfaces to the park are proposed to consist of a variety of grassed areas, trees, paved surfaces and water features. The submitted documentation indicates that it is intended that the park would provide space to accommodate seasonal markets and other events.

2.4. The EIA Scoping Report submitted with the request, prepared by Malone O'Regan Environmental, states that the development is considered to be sub threshold with regard to Class 10 of Part 2 of the Fifth Schedule of the *Planning and Development Regulations, 2001 (as amended)*. Section 2.1 of the submission states that a screening assessment undertaken determined that the preparation and submission of an EIAR was necessary given the archaeological and historical significance of the site, its proximity to the River Breagagh and River Nore including the River Nore SAC and SPA and to the visual prominence and impact on the cultural identity of Kilkenny City Centre.

3.0 ARTICLE 95(2) PLANNING & DEVELOPMENT REGULATIONS, 2001 as AMENDED by Article 24 of the 2006 REGULATION.

3.1.1. On the 19th February, 2020, and in accordance with Article 95(2) of the Planning and Development Regulations, 2001 (as amended) the Board requested submissions or observations from the following prescribed bodies:

- Department of Communications, Climate Action and Environment,
- Department of Housing Planning and Local Government,
- Environmental Protection Agency.

3.1.2. Subsequently, by letter dated 27th February, 2020 the following additional prescribed bodies were invited to make comments or observations on the request. These additional requests for submissions in regard to the proposed development were made to the following:

- An Chomhairle Ealaion,
- Bord Failte,
- An Taisce,
- The Heritage Council, and
- The Development Applications Unit of the Department of Culture, Heritage and the Gaeltacht.

3.1.3. The following responses were received:-

The ***Environmental Protection Agency*** had no observations or submission to make.

Response received from the ***Geological Survey of Ire***land (Department of Communications, Climate Action and the Environment stating that it had already made submissions on the scoping request directly to the project agent (Malone O'Regan Environmental) and enclosing a copy of this correspondence. The following is a summary of the main issues raised in this correspondence:

- That there are no geological sites recorded in close proximity to the subject site.
- Suggested that the national geotechnical database would be consulted as part of any baseline geological assessment of the site contained in the EIAR.
- That groundwater and flooding related data are available on the GSI Mapviewer and it is recommended that these are used in the EIAR process.
- That geohazards and particularly flooding should be taken into consideration and information on the GSI website used as source material.
- That GSI information on geothermal suitability should be consulted in the preparation of the EIAR.

4.0 LEGISLATIVE CONTEXT:

4.1.1. It is noted that notwithstanding that the proposed development is being considered as sub-threshold, the Planning Authority is proposing the preparation and submission of an Environmental Impact Assessment Report (EIAR). This decision is stated by the Requestor to have been taken following an EIAR screening assessment undertaken in accordance with the criteria contained in Schedules 7 and 7A of the Planning and Development Regulations.

4.1.2. Given the location of the site within an urban area and on a historic site within an area of significant archaeological heritage, together with the proximity of the site to adjacent watercourses, including the River Nore which is designated as a SAC and SPA in this location, it is considered by the Council that the development would have potential for significant effects on the environment, and that the preparation of an EIAR is therefore warranted.

4.2. Planning and Development Act, 2000 (as amended) and Planning and Development Regulations, 2001 (as amended).

4.2.1. The formal Scoping Request from Kilkenny County Council on the information to be contained within the EIAR was submitted under Section 173(3)(a) of the Planning and Development Act, 2000 and Articles 95 and 117 of the Planning and Development Regulations, 2001(as amended).

4.2.2. ***Section 173(3) (a)*** of the Act states as follows:

"Where a person is required by or under this Act to submit an environmental impact statement to the Board, he or she may, before submitting the statement, request the Board to provide him or her with its opinion as to the information that should be contained in such statement, and the Board shall on receipt of such a request provide such opinion in writing."

4.2.3. ***Article 95*** of the Regulations (as amended by Article 24 of the 2006 Planning and Development Regulations) deals with the procedures for Scoping Requests, and provides details of the level of information to be submitted in order for the Board to provide a written opinion pursuant to the request.

4.2.4. ***Article 117*** of the Regulations relates to Local Authority Development and provides that before making an application for approval to the Board under section 175(3) of the Act, a local authority may, in accordance with article 95, request the Board to provide a written opinion on the information to be contained in the EIAR.

4.2.5. ***Schedule 6*** of the *Planning and Development Regulations, 2001*, sets out the information required to be contained within an EIAR. The EIAR must contain the information specified in section 1 and the information specified in section 2 to the extent that the information is relevant to the nature of the development in question and to the environmental features likely to be affected.

4.2.6. In providing such a '*written opinion on the information to be contained in the EIS*', it is considered appropriate to have regard to the following Guidelines:

4.3. EPA Guidelines on the Information to be contained in Environmental Impact Statements, 2002 and EPA Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR), 2017.

4.3.1. Section 1.4 of the ***2002 Guidelines*** deals with scoping and provides that the scoping process identifies the issues and emphasizes those that are likely to be important during EIA and eliminates those that are not. The Guidelines provide that scoping must be focused on issues and impacts which are environmentally based, are likely to occur, and are significant and adverse.

4.3.2. Section 3.0 of the ***2017 Draft Guidelines*** relates to scoping and includes 3.3.4 Key Scoping Criteria, 3.3.5 Consideration of Other Assessments and 3.3.6 Selection of Headings Under Which to Arrange Issues. Section 3.3.4 states that all parties should be aware of the need to keep the EIAR as tightly focussed as possible and that scoping is usually guided by criteria including the use of 'Likely' and 'Significant' as the principal criteria for determining what should be addressed. Any issues that do not pass this test should be omitted (scoped out) from further assessment.

4.3.3. Section 3.3.6 of the guidelines identifies the headings under which to arrange issues and states that the prescribed environmental factors must all be addressed in an EIAR. As they are a necessary simplification of the relevant components of the environment, each factor is typically explored by examining a series of headings and/or topics relevant to that factor, as indicated by the examples included in Annex IV of the Directive. These headings and topics are generally identified during the scoping process. Some typical headings and topics and their arrangement within an EIAR are shown below.

Annex IV(4) of amended Directive *'A description of the factors specified in Article 3(1) likely to be significantly affected by the project: population, human health, biodiversity (for example fauna and flora), land (for example land take), soil (for example organic matter, erosion, compaction, sealing), water (for example hydromorphological changes, quantity and quality), air, climate (for example greenhouse gas emissions, impacts relevant to adaptation), material assets, cultural heritage, including architectural and archaeological aspects, and landscape.'*

4.4. EPA 'ADVICE NOTES ON CURRENT PRACTICE (in the preparation of Environmental Impact Statements)', 2003

4.4.1. These Advice Notes are designed to accompany the *Guidelines on the Information to be contained in Environmental Impact Statements*, also published by the EPA. The Advice Notes contain greater detail on many of the topics covered by the Guidelines and offer guidance on current practice for the structure and content of Environmental Impact Statements. The Advice Notes are divided into five sections, each providing detailed guidance on specific aspects to be considered in the preparation of an EIS.

5.0 Planning History

There is an extensive planning history relating to the site and environs primarily connected with the use of the site and adjoining lands as a brewery. There are no recent planning applications for the development of adjoining lands to the site.

Planning Applications

Kilkenny County Council Ref. 13/990045 – Permission granted to Diageo Ireland for demolition of structures on the current site and adjoining lands which include the removal of equipment and structures that were contiguous to the Brewhouse Building. It also provided for the demolition of the bottling plant located to the east of the current site.

ABP EIA / AA Determinations

An Bord Pleanala Ref. 10.JD0025 – Referral by SA O'Brien and Katharine Larkin regarding the necessity to prepare an EIS in respect of the proposed redevelopment of the Brewhouse Building. The Board determined that the preparation of an EIS was not required.

An Bord Pleanála Ref. 10.JD0024 – referral by Peter Sweetman and Associates regarding the necessity to prepare an EIS in respect of the proposed redevelopment of the Mayfair Ballroom located on former Diageo Ireland lands at Irishtown Kilkenny. The Board determined that the preparation of an EIS was not required.

An Bord Pleanála Ref. 10.JN0011 – referral by Peter Sweetman and Associates regarding the necessity to prepare an Appropriate Assessment in respect of the proposed redevelopment of the Mayfair Ballroom located on former Diageo Ireland lands at Irishtown Kilkenny. The Board determined that appropriate assessment was not required.

An Bord Pleanala Ref. ABP-300610-18 – Appropriate assessment direction case relating to the proposed redevelopment of the Brewhouse building, gardens, Kilkenny. The Board determined that appropriate assessment was not required.

Kilkenny County Council Part VIII Applications

- Part VIII procedure for the redevelopment of the Brewhouse Building was approved by the Council in February, 2016 and further amended in December, 2017.

- Part VIII procedure for the redevelopment of the former Mayfair Ballroom was approved by the council in July, 2016 and further amended in July, 2019.
- Part VIII procedure for the development of the River Garden Project which comprises the removal of the existing concrete slab, the raising of the existing ground levels and the construction of a 3 metre wide shared pedestrian / cycle way along a landscaped strip of c. 15 metres in width and 600 metres in length. The approved project also provides for a skate park and the section of walkway in the vicinity of St Francis Abbey and Evans Tower would be temporary pending the outcome of future archaeological investigations of this area.

6.0 Policy Context

6.1. Development Plan

The site is located within the area covered by the *Kilkenny City and Environs Development Plan, 2014-2020*. The site and adjacent lands on the former St Francis Abbey Brewery site are zoned '*General Business*' under the provisions of the *Kilkenny City and Environs Development Plan, 2014-2020*. The proposed uses on the site, educational and office are permitted under the General Business land use zoning objective.

The site and the adjoining lands are located within the City Centre Architectural Conservation Area. The extent of the ACA takes in all of the Abbey Quarter Masterplan lands located to the south of the River Breagagh.

The Plan has been the subject of ***Variation No. 1 (July, 2015)*** which had the stated purpose '*to ensure a statutory basis for high level principles which are required to underpin the future development of the Bateman Quay / Market Yard and surrounding area which will consolidate the city centre and contribute towards its vitality and viability*'. This variation was the subject of SEA and AA and it is on foot of this Variation that the Abbey Creative Quarter Masterplan was prepared. Nine new high level development objectives were inserted into the CDP on foot of Variation No.1 including:

- To provide for a riverside linear park (Objective 3H)
- To provide for an urban park in the vicinity of St Francis Abbey (Objective 3L)
- To provide for park and walk facilities for car and bus / coach parking at a site or sites in close proximity to the ACQM area.
- To finalise and adopt the Abbey Creative Quarter Masterplan and to incorporate it into the Kilkenny City and Environs Development Plan, 2014-2020 as a separate future variation (Objective 3L).

The Plan has also been the subject of ***Variation No.5*** which states that it would be an objective of the Council:

> *'to provide the necessary overarching policy framework to allow for temporary car parking in the Abbey Quarter Masterplan area notwithstanding the text of the Masterplan in section 4.1.6'.*

Variation (No.5) also provides for the additional objectives to be added to section 3.4.3 of Kilkenny City & Environs Development Plan and these include the following which are of specific relevance to the proposed development:

- 3H - To provide for a linear park along the western bank of the River Nore connecting to the existing River Nore linear park north of Green's Bridge and the existing River Nore linear park south of the Masterplan area (Canal Walk) (as indicated on Fig 3.4) subject to compliance with the Habitats and Birds Directives and the provisions of the Abbey Creative Quarter Masterplan.
- 3I - To provide for an urban park in the vicinity of St. Francis Abbey (National Monument) incorporating the City Walls, Evan's Turret and St. Francis' Well taking into account the recommendations of the archaeological strategy developed in the preparation of the Abbey Creative Quarter Masterplan (as indicated on Fig 3.4) and subject to compliance with the Habitats and Birds Directives and the provisions of the Abbey Creative Quarter Masterplan.
- 3P - To provide for an urban street of pedestrian and cyclist priority between the Central Access Scheme and Bateman Quay crossing the River Breagagh at the existing bridge crossing. To provide for traffic management measures on the street such as to inhibit the flow of through traffic and heavy goods vehicles.

6.2. Urban Design Framework Masterplan for the Abbey Creative Quarter

6.2.1. The Plan, which covers a total stated area of 8.25 ha., provides for a number of individual projects of which the current proposal for the construction of the urban park and street is one element. The Plan also identifies a riverside walkway / landscaped area along the eastern boundary of the site adjoining the River Nore and connecting with existing riverside access to the south of the Masterplan lands. To the south of the proposed park and located on both sides of the southern section of the proposed street, the Masterplan indicates a number of blocks stated to be primarily 3 and 4 storey in height. Residential development is envisaged for blocks located at the northern end of the street and north of the Breagagh River. Access to the Masterplan lands is indicated as being available via a connection from the CAS which would run north south through the site. Overall development of the Masterplan lands is indicated in the Plan as being developed over 9 phases.

6.2.2. The EIA scoping Report submitted with the current request states that the Masterplan (the Abbey Cultural Quarter Masterplan) is has been incorporated into the Kilkenny City and Environs Development Plan by way of variation. The Masterplan has been the subject of SEA and screening for Appropriate Assessment.

6.2.3. The information submitted with the current request (EIA Screening Report) indicates that the Masterplan and Urban Design Framework has been the subject of further update by Loci Consultants and Kilkenny County Council in 2018.

6.3. Natural Heritage Designations

6.3.1. The site is located such that it is not within any European site. The closest European sites to the site of the proposed redevelopment are located around the adjacent River Nore, the boundary of which is located immediately adjoining the project site to the east. The sites centred on the River Nore are the River Barrow and River Nore SAC and the River Nore SPA.

7.0 Scoping Opinion

7.1. General Requirements

7.1.1. Schedule 6 of the *Planning and Development Regulations, 2001 (as amended)*, sets out the information required to be contained within an EIAR. The EIAR must contain the information specified in section 1 and the information specified in section 2 to the extent that the information is relevant to the nature of the development in question and to the environmental features likely to be affected.

7.1.2. In terms of the requirements of Schedule 6, and to assist assessment and increase clarity, the Environmental Impact Assessment Report (EIAR) should be systematically organized to provide sections describing the following:

The Proposed Development - to include information on the site, design, size and other relevant features of the proposed development. The description of the project should make specific reference to demolition works that may be required as part of or to facilitate the development. In the case of the subject development, the description of development should include its context with regard to other permitted and proposed developments on the overall St. Francis Abbey site and the extent of any demolition works required, including removal of the existing concrete slab. The proposed development should be described in scaled drawings, photographs and photomontages.

The Existing Environment - The existing environment and the impacts of the development are explained by reference to its possible impact on the following environmental factors:-

- Population, and Human Health,
- Biodiversity with particular attention to species and habitats protected under the Habitats and Birds Directive.
- Land, Soil, Water, Air and Climate,
- Material Assets, Cultural Heritage and the landscape,
- The interaction between the above factors

In terms of the receiving environment, the EIS shall include all areas that would be impacted upon, directly or indirectly, by the proposed development. The information contained in the EIAR should therefore be based on comprehensive surveys of the area and have regard to updated data bases which may exist in terms of architectural heritage and ecology. The EIAR should accurately describe the receiving environment in terms of geology, geomorphology and hydrology, as well as a physical description of the site proposed for development.

The Likely Significant Effects of the Proposed Development - Impacts should address direct, indirect, secondary, cumulative, short, medium and long-term, permanent, temporary, positive and negative effects as well as impact interactions. None of the topics outlined above (Population and Human Health etc.) should be omitted, although their level of detail may differ depending on the likelihood of impacts.

In accordance with the requirements of Article 94 of the Planning and Development Regulations, 2001 (as amended), the EIAR shall contain a reference list detailing the sources used for the impact descriptions and assessments used in the EIAR.

The EIAR should also contain a list of experts who contributed to the development of the report, identifying for each expert, the part of the EIAR for which he / she is responsible, his / her experience or expertise and any additional information considered relevant to demonstrate the persons competence in the preparation of the EIAR.

An assessment of the impact of the proposed street and park is required, with an assessment of the cumulative impact of existing and permitted developments in the vicinity. Such developments would include permitted works to the Mayfair Ballroom and Brewhouse buildings. The assessment of cumulative impacts in the EIAR should also have regard, as far as is practicable, to the likely effects arising from future phases of development of the Abbey Quarter Masterplan.

Further to the above, details of the environmental impacts of the development during the demolition, excavation, construction and operational phases of the development should also be described and assessed by reference to baseline information which should be collated and presented within the EIAR. The environmental impact of the aforementioned phases, including in particular noise and vibration impacts arising from the removal of the existing concrete slab and construction phase impacts in terms of materials storage and containment within the site should also be described and assessed.

The EIAR will be required to provide information regarding the nature, quantities and source of materials to be used in the overall development. Information will also be required on volumes and nature of waste materials likely to be generated in the demolition phase and proposed means for disposal of same.

The EIAR should also provide an assessment of the expected effects arising from the vulnerability of the project to major accidents and disasters that are relevant to the project. These risks should be considered in the context of the factors of the environment.

The Measures to Mitigate Adverse Impacts - The EIAR shall give a description of the features of the proposed development and measures envisaged to avoid, prevent, reduce and, if possible, offset likely significant adverse effects on the environment. Where adverse impacts are likely to result, appropriate mitigation measures shall be identified where necessary – and shall clearly indicate where and with whom responsibility for the implementation of the mitigation measures lies. The EIAR shall also provide information relating to the monitoring of the impacts of the development on the environment.

Consideration of Alternatives: The consideration of alternatives, in terms of location and design, as well as proposed uses, should also be addressed in the EIAR and should comprise a description of the reasonable alternatives relevant to the proposed development which were studied and the reason for the option chosen having regard to the effects on the environment. In undertaking this assessment of alternatives, the following should be borne in mind:

- It is not a requirement to requirement to revisit issues considered in the formulation of policy that has been the subject of SEA.
- Alternatives should be relevant to the project and its specific characteristics.

- The assessment of alternatives should include a description of the current state of the environment without implementing the project, i.e. the Do-Nothing scenario. This assessment should be the starting point for the consideration of impacts in the EIAR.
- In the assessment of alternatives the level of detail provided should be reasonable and commensurate with the project.

A Non-Technical Summary - The EIS must contain a non-technical summary of the detailed information contained within the EIAR. The language of this summary shall be non-technical in nature and should provide clear details of the environmental effects the development will have, as well as all significant effects and mitigation measures proposed. The description of the development in this summary should clearly explain and describe all aspects of the proposed development such that the EIAR is accessible in terms of public understanding of the process and to facilitate full public participation and consultation in the process.

In terms of specific environmental topics the development is likely to impact upon, the EIAR should, in particular, address the following matters:

- Population, and Human Health
- Biodiversity (for example fauna and flora),
- Land (for example land take), Soil (for example organic matter, erosion, compaction, sealing), Water (for example hydromorphological changes, quantity and quality), Air and Climate (for example greenhouse gas emissions, impacts relevant to adaptation),
- Material Assets, Cultural Heritage, (including architectural and archaeological aspects) and Landscape.
- Interactions between the above factors.

An outline of the specific issues considered relevant to the EIAR under these headings is given in the following sections:

7.1.3. **Population, and Human Health**

- As identified in the submitted screening assessment, current advice regarding the scope of human health and the consideration of associated impacts is that the assessment should refer to the assessment of those environmental factors which might lead to effects on human health, e.g. air, water etc.
- Given the nature of the existing site the EIAR should specifically address the likely effects on the health and safety of surrounding populations during all phases of the development, including demolition, excavation, construction and operational phases, including the operation of plant equipment.
- An assessment of the impact of the proposed development on the availability of local recreational facilities and overall level of amenity and the potential impacts arising for population and human health should be addressed in the EIAR.

7.1.4. **Biodiversity**.

- Given the brownfield nature of the site, and its location within an urban setting, the EIAR should provide a clear baseline assessment of the existing receiving environment and the impact of the development on the ecology of the receiving environment.
- The EIAR should address any potential for disturbance arising from the construction activity and particularly any works required to remove the existing concrete slab. In particular, the potential for disturbance to any species using the adjoining river channels (Nore and Breagagh) or banks to these watercourses should be assessed. .
- The proximity of the site to the River Nore SPA and SAC sites is noted and there is therefore a need to carry out an Screening for Appropriate Assessment under the Habitats Directive and further assessment if necessary. The results of such assessments will inform the Biodiversity section of the EIAR. It is noted that the level of detail submitted with regard to the exact site boundary and relationship with the European sites is not very

clear and the appropriate assessment will need to focus on the potential impacts arising on the adjacent European sites arising from the operational and particularly the construction phases of the development.

- The scope and nature surveys, including aquatic surveys, as outlined in the submitted EIA Scoping Report (Malone O'Regan Consulting, December, 2019) should be reviewed with the Development Applications Unit of the NPWS in the Department of Culture Heritage and the Gaeltacht. Survey work should comply with best practice for seasonality and scope and the comments of the Development Applications Unit on these issues should be sought.
- The EIAR should address the potential for the enhancement of the biodiversity of the site arising from the development and the measures undertaken to maximise these impacts.

7.1.5. **Land, Soil, Water, Air and Climate.**

Soil

- The EIAR should also provide information relating to the amount and description of materials disturbed or excavated on the site and proposals for the storage, reuse and disposal of material excavated or otherwise generated during the demolition and construction phases of development. Given the previous industrial use of the site, particular attention should be paid to the identification, removal and management of any contaminated soil.
- The impact of excavations required as part of the development should describe, assess and mitigate the potential impact of the proposed development on existing sub surface services that may be present on the site.
- An assessment of the impact of such excavations or other ground disturbances on surface waters should be provided.
- Provide details of the types and nature of materials imported to the site during construction together with construction methods to be employed and measures to prevent the importation of invasive species.

- Mitigation measures to prevent or minimize emissions from the site during demolition and construction phases, should also be provided.

Water

- The impact of materials to be excavated and/or stored on the site will require to be considered in terms of the potential impact on surface and ground waters in the area of the site, in particular impacts on the adjoining River Breagagh and River Nore. Changes to the existing hard surface will lead to alterations in surface water drainage patterns and the existing on site surface water drainage system should be clarified as part of the EIAR and application documentation and the impacts of the proposed development on these existing drainage networks clearly set out. .
- There is no indication that the site is prone to flooding however given the proximity to two watercourses, the EIAR should assess potential flooding impacts and risks in accordance with the document "The Planning System and Flood Risk Management – Guidelines for Planning Authorities" published by the OPW in November 2009.
- Also with regard to flooding, the EIAR should detail how sustainable drainage methods are proposed to be incorporated into the design and the impact of the development on existing surface water discharges from the site to the local drainage network.
- The EIAR should provide information relating to the coordinated provision of physical infrastructure and services, in terms of the cumulative impact of any other proposals contained in the Abbey Quarter Masterplan for the surrounding area.
- Assessments regarding flood risk and drainage should detail and make provision for the accommodation of climate change impacts.

Air and Climate

- Impacts on air, it is considered that this will be potentially relevant during the demolition phase of development. The EIAR should therefore provide appropriate and up-to-date baseline data and describe any mitigation measures deemed necessary to minimise adverse impacts on air quality in the vicinity of the site and to mitigate dust and airborne pollution.

7.1.6. **Material Assets, Cultural Heritage and Landscape.**

Material Assets

- Given the city centre location of the site, a description of the ***traffic impacts*** resulting from the proposed development shall be provided. The EIAR should address traffic generated by the development, during demolition, construction and operational phases of the development, and should include information on the volume and type of traffic (including details of any unusually heavy, high or wide loads) likely to be generated during these phases of the development and the impact on main junctions in the vicinity of the site, notably the junction of the proposed street and St. Francis Bridge and Batemans Quay.
- The EIAR should consider the environmental effects of such heavy traffic, and should clearly provide details regarding proposed routes to and from the site, in particular during the demolition and construction phases of the development.
- In considering traffic-related issues, the EIAR should address any cumulative issues which may/will arise in the overall development of Masterplan site, and should have regard to other major developments in the vicinity of the site.
- The development shall be described in terms of its permeability with surrounding areas and the traffic arrangements which will facilitate such permeability, including pedestrian and cycle traffic.

Cultural Heritage

- The site and the adjoining lands are located within the City Centre ***Architectural Conservation Area*** and the ACA takes in all of the Abbey Quarter Masterplan lands located to the south of the River Breagagh. The EIAR should assess the impact of the proposed development and potential cumulative impacts with other developments on the masterplan lands on the character of the ACA.

- The impact of the proposed development on the character and setting of St Francis Abbey which is included on the NIAH and other similar structures including Evans Turret and the city walls should be included in the EIAR.
- Consideration should also be given to structures of architectural merit which are at a remove from the site but which may be affected due to works associated with the proposed development. Structures of architectural merit should include those buildings which contribute to the character of the area and which may or may not be included in the RPS for Kilkenny. The impact of the development on the setting of the Mayfair Ballroom building is specifically noted in this regard.
- Given the nature and location of the subject site in the centre of Kilkenny City, it is likely that development on site would have potential impacts on the ***archaeological heritage*** of the area. It is recommended that this issue be specifically investigated and the results presented in the EIAR.
- Baseline archaeological data should be provided for the site including location, extent and nature of any existing archaeological finds. Proposed mitigation measures to be undertaken, where such archaeological remains will be affected, shall be described. The significant extent of the baseline archaeological assessment already undertaken (detailed in 3.3.8.1 of the submitted EIA Scoping Report) is noted. Notwithstanding this, it is recommended that prior to finalization and submission of the EIAR that the National Monument Section of the Department of Culture Heritage and the Gaeltacht would be consulted with regard to extent and methodology of archaeological investigations at the site appropriate to inform the EIAR.

Landscape

- The EIAR should include description of the proposed planning and landscaping of the site, both hard and soft to include materials, levels and plant species. This information should be augmented by a detailed landscaping and planting plan for the development.

- An assessment of the proposed development on the receiving urban landscape will be required to be undertaken as part of the EIAR. This assessment should address existing visually prominent and functional features in the urban landscape and should provide an assessment of the visual impact of the development as it relates to the surrounding heritage areas including St Francis Abbey and Evans Turret.
- The landscape section of the EIAR should include a series of photomontages or other forms of visual aid, and the views should be taken to and from the surrounding locations including St. Francis Bridge, St. Francis Abbey surrounding streets including Batemans Quay and other identified sensitive receptors.

7.1.7. **Interactions between the above factors.**

The EIAR should include detailed consideration between the above factors where considered relevant.

8.0 Conclusion

8.1. I consider that the above written opinion provides appropriate scoping for the EIS to be prepared in relation to the proposed development, in accordance with the requirements of Section 173 of the Planning and Development Act, 2000 and Article 177 of the Planning and Development Regulations, 2001.

I recommend that Kilkenny County Council be furnished with a copy of this written opinion, and also copies of the submissions received under Article 95(2) of the Planning and Development Regulations, 2001, as amended.

Stephen Kay
Planning Inspector

2nd April, 2020

Maeve Williams

From:	SIDS
Sent:	Wednesday 18 March 2020 11:48
To:	Maeve Williams
Subject:	FW: 20_58_ An Bord Pleanála re: EIAR Scoping Report, The Abbey Quarter, Kilkenny City
Attachments:	20_62_Pre-Planning EIAR Consultation - Proposed Urban Park and Street Kilkenny City.pdf

LDG-025443-20

From: procbordemail
Sent: Wednesday 18 March 2020 09:24
To: SIDS <sids@pleanala.ie>
Subject: FW: 20_58_ An Bord Pleanála re: EIAR Scoping Report, The Abbey Quarter, Kilkenny City

From: Bord
Sent: Monday 16 March 2020 16:30
To: procbordemail <procbordemail@pleanala.ie>
Subject: FW: 20_58_ An Bord Pleanála re: EIAR Scoping Report, The Abbey Quarter, Kilkenny City

From: Clare Glanville <Clare.Glanville@DCCAE.gov.ie>
Sent: Monday 16 March 2020 16:19
To: Bord <bord@pleanala.ie>
Cc: John Butler <John.Butler@gsi.ie>
Subject: 20_58_ An Bord Pleanála re: EIAR Scoping Report, The Abbey Quarter, Kilkenny City

Re: 20_58_ An Bord Pleanála re: EIAR Scoping Report, The Abbey Quarter, Kilkenny City

Your Ref: EI1518
Our Ref: 20/62

Dear Sir / Madam
With reference to your email received on 24 February 2020, concerning the EIAR Scoping Report, The Abbey Quarter, Kilkenny City, please note that geological Survey Ireland has already responded on this matter and in relation to this report directly to the Authors; a copy of which is attached. We have no further comment in addition to those made to the authors at this stage.

If you need any further information please do not hesitate to contact me (Clare.Glanville@gsi.ie).

Yours Sincerely,
Dr. Clare Glanville

Dr Clare Glanville Senior Geologist Geoheritage & Geological Mapping.
Geological Survey Ireland, Beggars Bush, Haddington Road, Dublin D04 K7X4, Ireland.
T +353 (0)1 678 2837 E clare.glanville@DCCAE.gov.ie **www.gsi.ie**
A division of the Department of Communications, Climate Action & Environment.

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Tá eolas sa teachtaireacht leictreonach seo (agus b'fhéidir sa chomhaid ceangailte leis) a d'fhéadfadh bheith príobháideach nó faoi rún. Is le h-aghaidh an duine/na ndaoine nó le h-aghaidh an aonáin atá ainmnithe thuas agus le haghaidh an duine/na ndaoine sin amháin atá an t-eolas. Murab ionann tusa agus an té a bhfuil an teachtaireacht ceaptha dó bíodh a fhios agat nach gceadaítear nochtadh, cóipeáil, scaipeadh nó úsáid an eolais agus/nó an chomhaid seo. Más trí earráid a fuair tú an teachtaireacht leictreonach seo cuir, más é do thoil é, an té ar sheol an teachtaireacht ar an eolas láithreach. Deimhnítear leis seo freisin nár aims odh víreas sa phost seo tar éis a scanadh.

Maeve Williams

From: SIDS
Sent: Friday 13 March 2020 10:09
To: Maeve Williams
Subject: FW: Case Number: ABP-306275-19
Attachments: Scoping Opinion Request - ABP.pdf

From: Bord <bord@pleanala.ie>
Sent: Friday 13 March 2020 09:40
To: SIDS <sids@pleanala.ie>
Subject: FW: Case Number: ABP-306275-19

From: EIAPlanning <eiaplanning@epa.ie>
Sent: Friday 13 March 2020 09:32
To: Bord <bord@pleanala.ie>
Subject: Case Number: ABP-306275-19

Attn: Maeve Williams

Dear Ms Williams,

In response to An Bord Pleanala's letter of 19th February 2020, the Agency has no observation or submission to make in relation case reference ABP-306275-19.

Regards

EIA Planning,
Environmental Licensing Programme
Environmental Protection Agency

275
306 ~~383~~ - 20

LDG- 025206-20

Roinn Cumarsáide, Gníomhaithe
ar son na hAeráide & Comhshaoil
Department of Communications,
Climate Action & Environment

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

Malone O'Regan Environmental
Ground Floor - Unit 3
Bracken Business Park
Bracken Road, Sandyford
Dublin 18
D18 V32Y

16 March 2020

Re: 20_62_Pre-Planning EIAR Consultation - Proposed Urban Park and Street Kilkenny City

Your Ref: EI1518
Our Ref: 20/62

Geological Survey Ireland is the national earth science agency and has datasets on Bedrock Geology, Quaternary Geology, Geological Heritage Sites, Mineral deposits, Groundwater Resources and the Irish Seabed. These comprise maps, reports and extensive databases that include mineral occurrences, bedrock/mineral exploration groundwater/site investigation boreholes, karst features, wells and springs. Please see our website for data availability and we recommend using these various data sets, when undergoing the EIAR, planning and scoping processes. Geological Survey Ireland should be referenced to as such and should any data or geological maps be used, they should be attributed correctly to Geological Survey Ireland.

Dear Allison,

With reference to your email and letter received on 04 of March 2020, concerning the pre-planning EIAR consultation for a proposed urban park and street in Kilkenny City, Co. Kilkenny. I refer you to the above abstract of services and data provided by Geological Survey Ireland (a division of Department of Communications, Climate Action and Environment) and information available to support the EIAR process.

Geological Survey Ireland welcomes the opportunity to provide input to the process at this early stage of the planning and the EIAR process.

Geoheritage

Geological Survey Ireland (GSI) is in partnership with the National Parks and Wildlife Service (NPWS, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs) to identify and select important geological and geomorphological sites throughout the country for designation as geological NHAs (Natural Heritage Areas). This is addressed by the Irish Geoheritage Programme (IGH) of GSI, under 16 different geological themes, in which the minimum number of scientifically significant sites that best represent the theme are rigorously selected by a panel of theme experts.

County Geological Sites (CGS), as adopted under the National Heritage Plan are now included in County Development Plans and in the GIS of planning departments, to ensure the recognition and appropriate protection of geological heritage within the planning system. CGSs can be viewed online under the Geological Heritage tab on the online Map Viewer. The audit for Co. Clare was completed in 2007 and revised in 2012. A published version is available and can be downloaded from here. **Our records show that there are no CGS located in close proximity of the proposed development site.**

Geotechnical Database Resources

Geological Survey Ireland continues to populate and develop our national geotechnical database and viewer with site investigation data submitted voluntarily by industry. The current database holding is over 7500 reports with 134,000 boreholes; 31,000 of which are digitised whish can be accessed through downloads from our Geotechnical Map Viewer. We would strongly recommend that this database be consulted as part of any baseline geological assessment of the proposed development as it can provide invaluable baseline data for the region or vicinity of the proposed development area. This information may be beneficial and cost saving for any site specific investigations that may be designed as part of the development.

Groundwater
Groundwater is important as a source of drinking water, and it supports river flows, lake levels and ecosystems. It contains natural substances dissolved from the soils and rocks that it flows through, and can also be contaminated by human actions on the land surface. As a clean, but vulnerable, resource, groundwater needs to be understood, managed and protected. Through our Groundwater Programme, Geological Survey Ireland provides advice and maps to members of the public, consultancies and public bodies about groundwater quality, quantity and distribution. Geological Survey Ireland monitors groundwater nationwide by characterising aquifers, investigating karst landscapes and landforms and by helping to protect public and group scheme water supplies. With regard to Flood Risk Management, there is a need to identify areas for integrated constructed wetlands. We recommend using the GSI's National Aquifer and Recharge maps on our Map viewer to this end. We recommend that other groundwater related data available on our online databases is also used within the EIAR assessment in terms of groundwater wells and springs, aquifer vulnerability, subsoil permeability, and drinking water protection areas.

Geohazards
Geohazards can cause widespread damage to landscapes, wildlife, human property and human life. While in Ireland, landslides are the most prevalent of these hazards flooding is becoming an increasing risk. Geological Survey Ireland has information available on past landslides for viewing as a layer on our Map Viewer. Geological Survey Ireland also engages in national projects such as Landslide Susceptibility Mapping and GWFlood Groundwater Flooding, and in international projects, such as the Tsunami Warning System, coordinated by the Intergovernmental Oceanographic Commission of UNESCO. **We recommend that geohazards and particularly flooding be taken into consideration, especially when developing areas where these risks are prevalent, and we encourage the use of our data when doing so.**

Natural Resources (Minerals/Aggregates)
Geological Survey Ireland is of the view that the sustainable development of our natural resources should be an integral part of all development plans from a national to regional to local level to ensure that the materials required for our society are available when required and potential recourses do not suffer from inadvertent sterilisation. The Active Quarries, Mineral Localities and the Aggregate Potential maps are available on our Map Viewer. Geological Survey Ireland highlights the consideration of mineral resources and potential resources as a material asset which should be explicitly recognised within the environmental assessment process. Geological Survey Ireland provides data, maps, interpretations and advice on matters related to minerals, their use and their development in our Minerals section of the website. **The EIAR should also consider potential for resource sterilisation as part of the planning process, and if further information is required beyond that available on our website please do not hesitate to contact us.**

Geothermal Energy
Geothermal energy harnesses the heat beneath the surface of the Earth for heating applications and electricity generation, and has proven to be secure, environmentally sustainable and cost effective over long time periods. Geothermal applications can range in depth from a few metres below the surface to several kilometres. Ireland has widespread shallow geothermal resources for small and medium-scale heating applications, which can be explored online through Geological Survey Ireland's Geothermal Suitability maps for both domestic and commercial use. We recommend use of our Geothermal Suitability maps to determine the most suitable type of ground source heat collector for use with heat pump technologies. Ireland also has recognised potential for deep geothermal resources. Geological Survey Ireland currently supports and funds research into this national energy resource.

Other Comments
Should development go ahead, all other factors considered, Geological Survey Ireland would much appreciate a copy of reports detailing any site investigations carried out. The data would be added to GSI's national database

of site investigation boreholes, implemented to provide a better service to the civil engineering sector. Data can be sent to Beatriz Mozo, Geological Mapping Unit, at Beatriz.Mozo@gsi.ie, 01-678 2795.

I hope that these comments are of assistance, and if we can be of any further help, please do not hesitate to contact me, Dr. Clare Glanville (clare.glanville@dccae.gov.ie).

Yours Sincerely,

Dr. Clare Glanville
Planning and Geoheritage Programmes Lead

Appendix 1.2

March 2020

KILKENNY
COUNTY COUNCIL

EIAR Consultation Document

Abbey Quarter – Urban Park and Street

Kilkenny County Council

County Hall, Kilkenny

MALONE O'REGAN
ENVIRONMENTAL

QUALITY
ISO 9001:2008
NSAI Certified

MALONE O'REGAN

Form ES - 04

MALONE O'REGAN ENVIRONMENTAL

Ground Floor – Unit 3
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Tel: +353- 1- 567 76 55
Email: enviro@mores.ie

Title: EIAR Consultation Document, Abbey Quarter – Urban Park and Street, Kilkenny County Council, County Hall, Kilkenny

Job Number: E1518

Prepared By: Janette McDonald **Signed:** JMcD

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EIAR Consultation Document

Abbey Quarter – Urban Park and Street

Kilkenny County Council

County Hall, Kilkenny

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1 INTRODUCTION

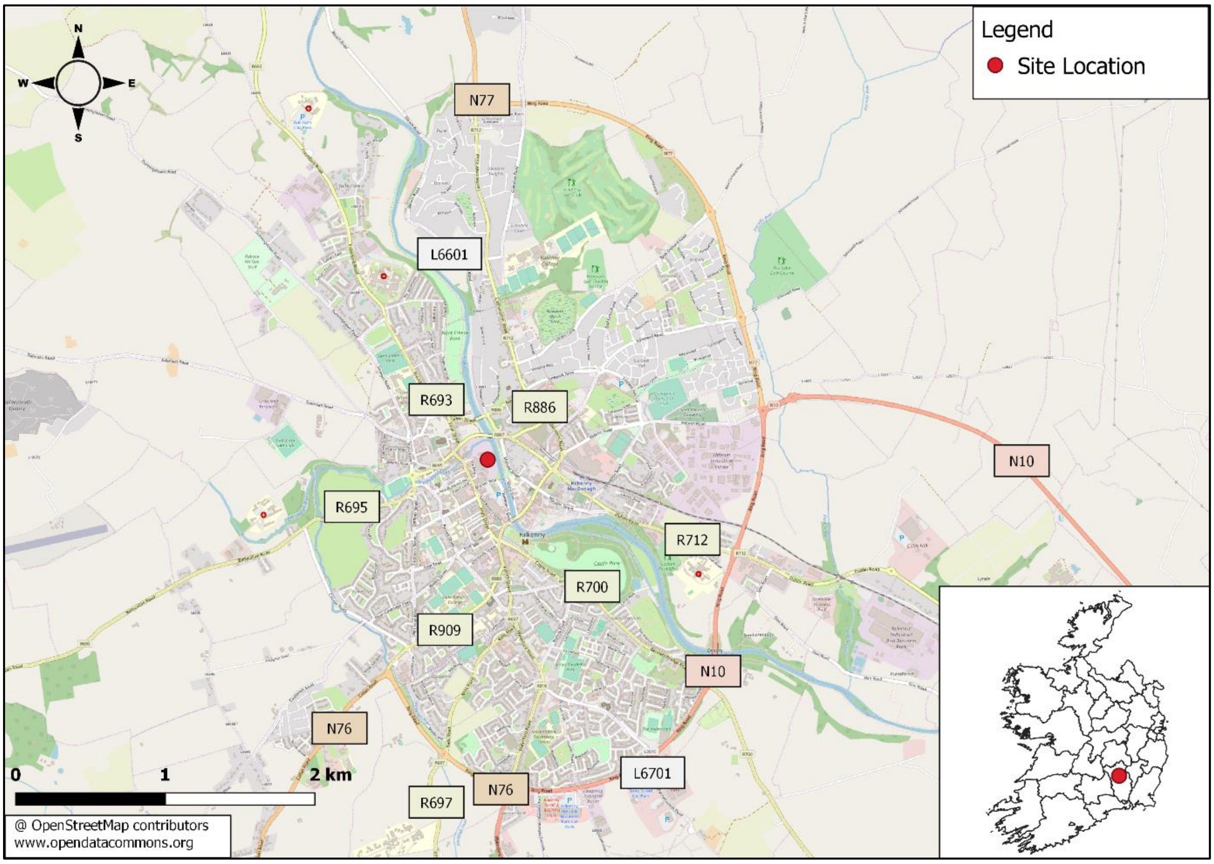
Malone O'Regan Environmental (MOR) has been commissioned by Kilkenny County Council (KCC) to prepare an Environmental Impact Assessment Report (EIAR) for the proposed Urban Park and Street (proposed development) to be located within the former Smithwick Brewery Lands (St Francis Abbey Brewery).

It is the intention of KCC to develop the Abbey Quarter for mixed land use with a combination of creative, knowledge intensive business services, retail, residential, commercial, educational, hotel and civic land uses in a proportion set out in the urban design code for the area (Loci and Kilkenny Co Co, 2018). The Abbey Quarter is currently an area of undeveloped and underdeveloped land comprising approximately 8.25 hectares just off the centre of Kilkenny City, which includes the former brewery lands (4.64 ha) (Kilkenny Co Co, 2015). It should be noted that the proposed development will form an integral part of the proposed Abbey Quarter Project (See Section 1.1.1).

The location of the site for the proposed development ('the Site') is shown in Figure 1-1.

This document outlines details on the proposed development and the methodology that MOR will utilise to prepare the EIAR.

Figure 1-1: Site Location



1.1.1 The Abbey Quarter Masterplan

The high-level objectives of the Masterplan and Urban Design Framework were subsequently adopted in 2015 through Variation no. 1 of the Kilkenny City and Environs Development Plan 2014 – 2020. A Strategic Environmental Assessment (SEA) and Appropriate Assessment Screening (AA) have been conducted on this Variation No.1 of the Kilkenny City and Environs Development Plan the Masterplan (Kilkenny Co Co, 2015).

Projects approved to date associated with the implementation of the Abbey Quarter Masterplan include the following:

- The Riverside Gardens Project – approved under Part 8 of the Planning and Development Regulations, 2001, as amended, in February 2016;
- The redevelopment of the Mayfair Ballroom – Part 8 Development initially approved in July 2016 and amended in July 2019; and
- The redevelopment of the former Smithwicks Brewery Brewhouse building – Part 8 Development initially approved in February 2016 and subsequently amended in December 2017.

It should be noted that all future projects related to the Abbey Quarter will be subject to their own statutory consent procedures. Depending on the scale and type of developments these may include AA screening and assessment, traffic impact assessment, landscape and visual impact assessment among others. The proposed approximate Site boundary in the context of the Masterplan is presented in Appendix A.

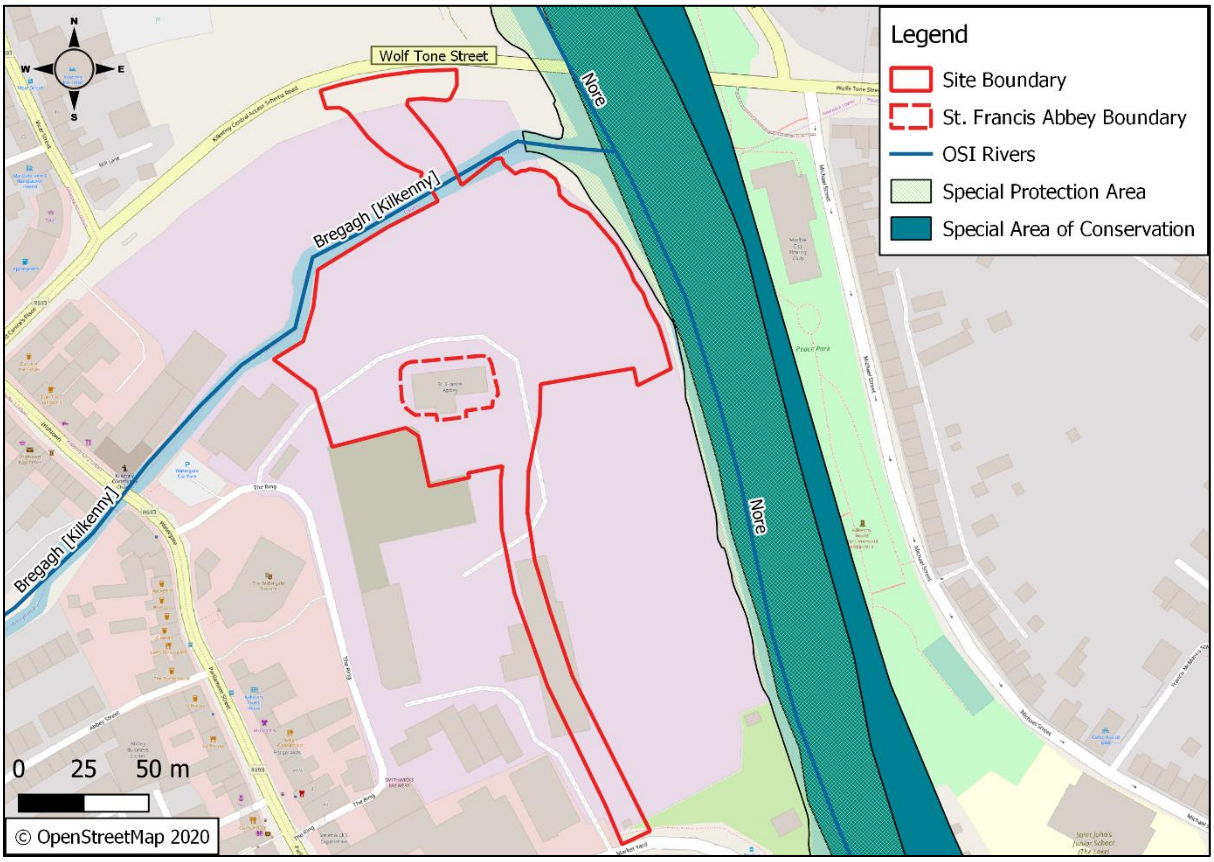
1.2 Site Context

The proposed development is located within the former Smithwick's Brewery lands just off the centre of Kilkenny City. The Site is a 'Brownfield Site' and is primarily covered in concrete slab following the removal of the former brewery buildings in the area.

The Urban Street boundaries extend across the Breagagh River to Wolfe Tone Street (which forms part of the central access scheme) in the north and to St John's Bridge to the south (Bateman Quay). The northern boundary of the Site is adjacent to the Breagagh River (and the old City Wall) and the eastern boundary of the Site is adjacent to the River Nore. To the south and west, the Site is bounded by a mix of well-established commercial and residential developments, serving Parliament Street, Horse Barrack Lane, and Green Street.

The most notable hydrological features with potential to be directly and / or indirectly affected by the proposed development will be the Breagagh River and the River Nore, primarily due to their proximity to the works. The Breagagh River flows in a general north-easterly direction along the northern boundary of the proposed park and drains into the River Nore. The River Nore, is a designated Special Area of Conservation (SAC) and Special Protected Area (SPA) (site codes: 004233 and 002162 respectively). The River Nore flows in a general south-easterly direction (See Figure 1-2).

Figure 1-2: Site Context



The proposed development occurs within the National Monument Boundary Line associated with St Francis's Abbey and the "Zone of Notification of Recorded Monuments" (ASI, 2019) (Kilkenny Co Co, 2015). In addition, the proposed development occurs within the 'City Centre Architectural Conservation Area' and 'St. Canice's Architectural Conservation Area'. The majority of the proposed park is located within the area identified as having the highest archaeological sensitivity within the masterplan area (Kilkenny Co Co, 2015). There are numerous known archaeological features located within the proposed development boundary including the following:

- Saint Francis's Abbey (NIAH Reg. 12000008 and NMS Reg. KK019-101) which included the following additional registered monuments:
    - Religious House (NMS Reg. KK019-026101);
    - Wall Monument (NMS Reg. KK019-026183);
    - Font (NMS Reg. KK019-026150);
    - Inscribed Slab (NMS Reg. KK019-026151); and
    - Associated burial grounds.
- The City Walls and Evan's Turret (NMS Reg. KK019-026);
- Saint Francis's Well;
- The Abbey Precinct Boundary; and,
- Horse Barracks Cobbles.

In addition, there is significant evidence that the remains of major features associated with the Abbey, such as a graveyard, a chapter house and living quarters are present below the ground within the Site. Archaeological test works at the Site and consultation with the Department are ongoing with much of the baseline studies already completed (refer to section 2.3.8).

1.3 Description of the Proposed Development

The proposed development covers an area of approximately 1.3ha and consists of two components;

- Urban Park; and,
- Street.

The Urban Street will link Bateman Quay to the recently opened St. Francis Bridge (formally referred to as the Central Access Scheme). The street will cross over the Breaghagh River, using the existing bridge previously utilised by the former Smithwicks brewery site approximately 40m upstream of the River Nore confluence.

The Urban Street will be a pedestrian and cyclist dominated space that will facilitate access to adjoining components of the Abbey Quarter. It should be noted that only limited access to other vehicular through traffic will be available, namely goods and services delivery vehicles serving future buildings. This will be controlled by use of traffic barriers and a permitting system. The Urban Street is required to incorporate all utility services required for development of potential future building plots adjoining the Urban Street. These services include foul water drainage, surface water drainage, electricity, broadband, gas and public lighting. However, these services for the wider masterplan will not be commissioned as part of this development.

The Park will consist of a variety of grassed areas, trees, paved surfaces, water features and meeting points. It is proposed that the Park will express known historical features in the area. In addition, the park will provide space to accommodate seasonal markets and other events. There will be no works as part of the proposed development within the Abbey itself.

This project will provide the public space and infrastructure to facilitate the continued implementation of the Abbey Quarter Masterplan. An artistic model of the preliminary draft design, as prepared by Mitchell and Associates Architects for the park is presented in Figure 1-3 below.

Figure 1-3: Preliminary Draft Design - Artistic Impressions (© Mitchell & Associates)

2 ENVIRONMENTAL IMPACT ASSESSMENT

2.1 Proposed Structure and Contents of EIAR

The EIAR will be prepared in accordance with the following guidance documents:

- Circular letter PL 1/2017; Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive) - Advice on Administrative Provisions in Advance of Transposition; issued by the Department of Housing, Planning, Community and Local Government, dated 15 May 2017;
- European Commission (EC, 2017) Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report;
- Department of Housing, Planning and Local Government (DHPLG, 2018) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment;
- EPA Guidelines on the Information to be contained in Environmental Impact Assessment Reports Draft (EPA, 2017); and,
- EPA Draft Advice notes on current practice in the preparation of Environmental Impact Statements (EPA, 2015).

The EIAR will contain the following key sections:

<u>Non-Technical Summary</u>

An overview of the proposed development, its location, the identity of the applicant, and the reason why the EIAR was prepared. The Non-Technical Summary will be a review of the main EIAR text to enable clear identification of significant impacts, and where relevant mitigation measures required and the residual impacts.

<u>Description of the Proposed Development</u>

A full description of the proposed development in physical and functional terms during both the construction and operation phases.

<u>Main Alternatives Considered</u>

A summary of the alternatives considered in respect of the proposal and environmental aspects will be included within the EIAR, including alternative site layout and site use.

<u>Assessment of Environmental Impacts</u>

The significance of the impact of the proposed development on various aspects of the environment will be assessed under the headings set out in section 3.2.

2.2 Aspects of the Environment Considered in the EIAR

The EIAR will address the following environmental aspects:

- Population and Human Health;
- Biodiversity;
- Land and Soils;
- Water;
- Noise;
- Climate;
- Landscape and Visual; and,
- Archaeology and Cultural Heritage.

Given that there will be no significant emissions to air as part of the proposed development an assessment on the impacts on air quality has been screened out and therefore will not be assessed further as part of the EIA.

There will be limited additional traffic, telecommunications, gas, energy and water demand or wastewater arising as a result of the proposed development. Impacts on material assets have therefore been screened out and therefore will not be assessed further as part of the EIA.

As far as practicable, the examination of each aspect of the environment will be undertaken as follows:

- The Receiving Environment ("baseline") - A description of the specific receiving environment into which the proposed development will fit.
- The Characteristics of the Proposed Development - A projection of the specific "load" on each particular aspect of the environment which the proposed development would be likely to generate.
- The Potential Impacts of the Proposed Development - A general description of the probable or 'likely' impacts which the proposed development would be likely to produce.
- Cumulative Impacts of the proposed development – the cumulative impacts of the development in relation to landscape and visual, archaeology and cultural heritage, impacts on biodiversity and receiving water quality will be assessed where relevant.
- Remedial or Reductive Measures - A description of any specific remedial or reductive measures considered necessary and practicable resulting from the assessment of potential impacts.
- Residual Impacts of the Proposed Development - The assessment of the specific direct and indirect impacts of the proposed development arrived at after mitigation measures have been employed.
- Interactions - A description of interactions of each environmental discipline with other environmental attributes.
- Monitoring - A description of any monitoring of effects on the environment which might be necessary, covering the monitoring methods and the agencies responsible for their implementation.
- Reinstatement - Where required, a description of reinstatement measures and the agencies responsible for their implementation.
- Difficulties Encountered - An indication of the difficulties encountered, if any, during the compilation of information.

2.3 Description of the Proposed Assessments

2.3.1 Population and Human Health

The EIAR will assess the potential social and economic implications of the proposed development on human beings, at local and regional levels during both the construction and operation phases. Impacts on human health and population in terms of nuisance, noise, dust, traffic generation, visual and social amenity will be addressed separately in other sections of the EIAR.

The key areas of assessment will be the potential impacts of the proposed development, both positive and negative, in terms of its effects on local services, amenities and employment.

The assessment will include a desk-based review of all relevant plans and policies at a local, regional and national level including the Capital Investment Plan 2016-2022, the National Spatial Strategy 2002-2020, the Kilkenny County Development Plan 2014-2020, Abbey Quarter Masterplan and information from the Central Statistics Office (CSO).

The assessment of impacts on human beings will be conducted in accordance with all relevant guidelines, and suitable mitigation measures will be outlined where necessary.

2.3.2 Biodiversity

The EIAR will assess the potential for impacts to biodiversity and opportunities for biodiversity enhancements related to the proposed development. Although the biodiversity assessment will focus on the Natura 2000 sites (River Nore SPA and River Nore SAC), all potential impacts on all other habitats, flora and fauna onsite and in the vicinity of the Site will be also addressed.

Given the Site's proximity and direct links to the River Nore SPA and SAC, a Natura Impact Statement will also be prepared separately to the EIA (as required under the EU Habitats Directive) and submitted with the planning application to assess the impacts on the Natura 2000 sites.

The approach to this topic will be as follows:

- Desk review of existing ecological information relating to the area that will potentially be affected by the proposed development.
- Site visit by a qualified ecologist to allow characterisation of the existing habitats in accordance with standard guidance (Fossitt, 2000) and the identification of any areas of particular ecological interest;
- Aquatic ecological survey including the following:
  - Biological water quality assessments (Q-values) of both the Breagagh River and the River Nore which are adjacent the proposed development;
  - Assessment of habitat quality and suitability for white-clawed crayfish by the criteria of (Holdich, D., 2003) for 1km downstream of the subject site. A licensed crayfish survey will be undertaken by the standard survey method, as described by (Peay, 2003).
  - Assessment of habitat quality and suitability for freshwater pearl mussel and by the criteria of (Skinner, 2003) for 1km downstream of the subject site will be carried out. Any potentially suitable habitat for mussels will be surveyed by standard methods, using a bathyscope or by snorkelling.
  - Assessment of habitat quality and suitability for salmon (Salmo salar), based on the criteria outlined by Kennedy (Kennedy, 1984) and by Bardonnet and Baglinière (Bardonnet, 2000) for the physical instream requirements of this species for spawning, nursery and adult habitat for 1km downstream of the subject site and more generally in the entire river system. Information from Inland Fisheries Ireland will supplement this assessment.
  - Assessment of habitat quality and suitability for three species of lamprey, the brook lamprey (Lampetra planeri), river lamprey (Lampetra fluviatilis), sea lamprey (Petromyzon marinus), based on the criteria outlined by Maitland (1980) and by Johns (2002) for the physical instream requirements of these species for spawning, nursery and adult habitat for 1km downstream the subject site and more generally in the entire river system. Information from Inland Fisheries Ireland will supplement this assessment.
- Specialist ecological surveys for the following species:
  - Kingfisher in accordance with Royal Society for the Protection of Birds guidance (Gilbert, Gibbons, & Evans, 1998) and Birdwatch Ireland Guidance (NPWS, 2010); and,
  - Otter in accordance with NRA (now TII) guidance (NRA, 2009).
- Assessment of the potential impacts on the existing area during both the construction and operation phases.
- Potential adverse effects will be detailed and mitigation measures recommended.

2.3.3 Land and Soils

The EIAR will assess the potential impacts of the proposed development on soils and geology during both the construction and operation phases. Both a desk-based and field evaluation on soils and geology will be undertaken. The assessment will involve:

- Characterisation of the receiving environment by completing a desk-based review of the existing ground conditions utilising published Geological Survey of Ireland (GSI) information and other publicly available information;
- Review site investigations of information made available by DIAGEO as part of their licence surrender process;
- Supplementary site investigations including the installation of 4-6 No. probe-holes;
- Site visit by a suitability qualified geologist to inform a quantitative risk assessment of the proposed project; and,
- The impact assessment will examine any proposed cut and fill operations, particularly foundations and proposed ground levels for the Site, the removal of this material and the removal of areas of hardstanding.

The soils and geology assessment will be conducted in accordance with all relevant guidelines, and suitable mitigation measures will be outlined where necessary. Guide to Geology in Environmental Impact Statements, published by the Institute of Geologists of Ireland will be used for this assessment (IGI, 2002) and Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (IGI, 2013).

2.3.4 Water

The EIAR will assess the potential impacts of the proposed development on surface water drainage and resources during both the construction and operation phases. Given that there will be no specific wastewater or water supply requirements for this project it is not proposed to assess the impact of these items.

The receiving environment will be characterised by identifying existing water courses on, and in the vicinity of the Site. Existing drainage patterns will be identified. A desk-based study will also be carried out characterising the receiving water quality and will refer to published EPA documents on water quality. This will be supplemented by biological water quality assessments (Q-values) of both the Breagagh River and the River Nore which are adjacent the proposed development. Proposals under the Water Framework Directive will be identified where relevant to the proposed development.

The key area of the assessment will be to characterise any proposed storm water discharges from the Site to the local drainage network.

The proposed development will be designed to maintain the volume of surface water run-off at the current levels through measures taking account of Sustainable Drainage Systems (SuDS). Therefore, the potential for downstream flooding is not anticipated. A flood risk assessment was carried out for the entire Abbey Quarter Masterplan (Kilkenny Co Co, 2015). The conclusions of this assessment and desk-based sources will be used to inform a site-specific flood risk assessment in accordance with the Planning System and Flood Risk Management Guidelines (OPW, 2009). Furthermore, the potential effects of climate change with regard to determining the drainage design within the development will also be assessed.

The surface water assessment will be conducted in accordance with all relevant guidelines, and suitable mitigation measures will be outlined where necessary.

In order to avoid impact on underlying archaeology the existing concrete slab will, for the most part, remain in place. The site is and will therefore remain largely impermeable. There will also be no proposed groundwater abstractions as part of the proposed development. Impacts on hydrogeology have therefore been screened out and therefore will not be assessed further as part of the EIA.

2.3.5 Climate

On its own, the proposed urban park and street, in combination with the proposed Abbey quarter Masterplan is unlikely to have any significant impact on the climate on either a micro or macroscale. However, anthropogenically induced climate change is the biggest global challenge to the current generation; "*decarbonisation is now a must if the world is to contain the damage and build resilience in the face of such a profound challenge*" (DCA&E, 2019). The EIAR will assess the potential impacts of the proposed development on climate, this will be divided into the following key assessments:

- An estimate of the indirect impacts from the construction materials to be used for the proposed development;
- An estimate of operation greenhouse gas emissions for the project during the operational phase; and,
- An estimate of the carbon that might be sequested as a result of proposed landscaping at the site.

2.3.6 Acoustics

The EIAR will assess the potential impacts of the proposed development on acoustics (vibration and noise) during the two key stages of the development – construction and operational.

2.3.6.1 Baseline Assessment

To characterise the baseline acoustic environment, noise monitoring will be conducted in the locality for both day and night-time hours in accordance with ISO 1996 Parts 1 & 2. This will involve short duration (15 to 30 minute) noise measurements at locations close to sensitive receptors. The Noise Monitoring Programme will include a desk-based assessment of the locality and a review of Strategic Noise Mapping and the Kilkenny Noise Action Plan.

2.3.6.2 Construction Noise

Construction noise sources will be directly related to the specific type of plant and construction methodologies utilised by the selected contractor. Utilising standard values for generic plant outlined within BS5228, an assessment of the likely noise arising from the construction stage will be developed. Potential impact from the construction stage noise will be assessed utilising the methodology within BS5228.

2.3.6.3 Operational

The operational stage of the proposed development will assess the likely impact, if any, the proposed future use of the land will bring in relation to noise nuisance and/or loss of amenity due to noise. The assessment of impact will take into consideration the existing ambient acoustic environment, the predicted change associated with the proposed development.

The operational noise assessment will take cognisance of the methodology outlined within BS4142, Methods for rating and assessing industrial and commercial sound, (British Standard, 2014). To assess the overall noise associated with the proposed development estimated noise values will be compared against existing ambient noise values obtained during the baseline assessment. Vibration

Noise and vibration impact assessments are closely related. Vibrational impacts arising from the construction phase are not expected to be significant given the intervening distance to the nearest sensitive receptors. However, the potential for vibrational effects will be identified and mitigation measures derived where necessary. No operational vibration impacts are deemed likely and therefore operational stage vibration impact has been screened out of further assessment within the EIAR.

2.3.6.1 Vibration

Noise and vibration impact assessments are closely related. Vibrational impacts arising from the construction phase are not expected to be significant given the intervening distance to the nearest sensitive receptors, local subsoils and the type of works currently envisaged. However, the potential for vibrational effects will be identified and mitigation measures derived where necessary. No operational vibration impacts are deemed likely and therefore operational stage vibration impact has been screened out of further assessment within the EIAR.

2.3.7 Landscape and Visual

The EIAR will examine the potential landscape and visual impact of the proposed development during the short-term construction phase and the long-term operational phase.

The landscape and visual impact of the proposed development will be considered and addressed as appropriate at an early stage in the design and informed by the landscape and visual impact assessment process.

The landscape and visual impact assessment will describe the receiving environment in terms of landscape character and sensitivity. Representative viewpoints from the zone of visual influence will be assessed with photomontages prepared to visually present the existing and proposed views from these locations. The interactive landscape and visual impacts on this area of specific archaeological and cultural sensitivity will also be assessed. The interaction of the landscape and visual impacts of the proposed development on human beings will be addressed in terms of their amenity value. Avoidance, enhancement, reinstatement and mitigation measures, where relevant, will be outlined within the EIAR.

The assessment will be carried out in accordance with the Landscape Institutes' Guidelines for Landscape and Visual Impact Assessment (Landscape Institute, 2013) and Landscape and Landscape Assessment Consultation Draft Guidelines for Planning Authorities (DELG, 2000).

2.3.8 Archaeology and Cultural Heritage

The EIAR will assess the potential impact of the proposed development on archaeology and cultural heritage. The site is particularly sensitive from an archaeological and cultural heritage perspective. In the Republic of Ireland, archaeological sites and monuments are protected under the *National Monuments Act 1930* (as amended) through inclusion in the Record of Monuments and Places (RMP), the Register of Historic Monuments (RHM) and/ or by being declared a National Monument.

2.3.8.1 Baseline Assessment

An archaeological baseline has largely been compiled for the Abbey Quarter Masterplan, including a comprehensive archaeological and historical overview by Courtney Deery Ltd for the Abbey Quarter (Consultancy, Courtney Deery Heritage, 2014) .

Archaeological Management Solutions (AMS) were subsequently commissioned to prepare a series of archaeological assessment strategies for the Masterplan area, including the public realm areas (AMS, 2016a) (AMS, 2016b) (AMS, 2017a). This involved significant additional archaeological and historical background research for each of the areas, including detailed historical map analysis and the development of an historical geographical information system (GIS) for the proposed development area.

A series of archaeological test excavations was implemented in 2018, with ACSU carrying out the test excavations and AMS acting as KCC's Project Archaeologists. The test excavations were carried out across the former brewery site, including the public park and street areas (ACSU et al., 2018a) (ACSU et al., 2018b). Additional archaeological works were carried out in the immediate vicinity of the public park and street, including archaeological assessments for the Mayfair Building and adjacent town wall ((Drisceoil, 2014) (AMS, 2017c) (AMS, 2017b) (AMS, 2018) (ACSU et al., 2018c) (AMS, 2019) (Flynn, 2019); archaeological excavations to facilitate the construction of an ESB substation; and archaeological investigations in advance of the development of the Brewhouse Building (C. Flynn, 2015) (C. Flynn, 2017) (C. Flynn, 2018). Investigations took place in relation to the adjacent Riverside Garden Project (Courtney, 2015). Archaeological investigations to date have been comprehensive and AMS does not anticipate undertaking any further invasive archaeological test excavations in the area of the proposed development in advance of the development. Site investigations in advance of planning will archaeologically monitored.

2.3.8.2 Impact Assessment Methodology

Building on these previous archaeological and historical investigations, the archaeological contribution to the Archaeology and Cultural Heritage chapter of the EIAR will consist of the preparation by qualified archaeologists of an archaeological impact assessment, including an overview of the archaeological and historical significance of the proposed development area.

The assessment will determine the likely significant effects of the proposed development on archaeology during construction and operation. The methodology employed will include an analysis of the baseline situation, including the location, extent, depth and significance of archaeological deposits and features in the public realm works area; the likely impact of the proposed development on the identified archaeology, including indirect, cumulative and residual impacts; and an outline of reasonable alternatives to the proposed development.

The archaeological contribution to the EIAR will outline how the design is being undertaken so as to anticipate, avoid, reduce and offset significant adverse effects on archaeology, and the likely positive effects of the development (e.g., where the setting and amenity of surrounding archaeological monuments are being enhanced). A specialist conservation architect has been commissioned to conduct an assessment of the impacts on remaining above ground structures within and adjacent to the site namely Evan’s Turret and the City Walls.

Relevant statutory authorities (e.g., the National Monuments Service and National Museum of Ireland) shall be consulted during the assessment process. Finally, KCC’s commitments for the archaeological mitigation of any significant negative impacts by way of avoidance, prevention, reduction and offsetting during construction and operation will be prepared for inclusion in the Schedule of Commitments section of the EIAR.

3 CONCLUSION

Responses to the project, specifically in relation to the scope and extent of the proposed environmental assessment are requested to be sent to Malone O'Regan Environmental offices within 4 weeks i.e. by Wednesday 1st April.

Correspondence should be submitted to the following address:

Malone O'Regan Environmental

Ground Floor - Unit 3

Bracken Business Park

Bracken Road, Sandyford

Dublin 18, D18 V32Y

Or alternatively please email to: enviro@mores.ie

To ensure that the response finds the relevant persons, in all correspondence ensure to reference the project as: *Abbey Quarter - Urban Park and Street*

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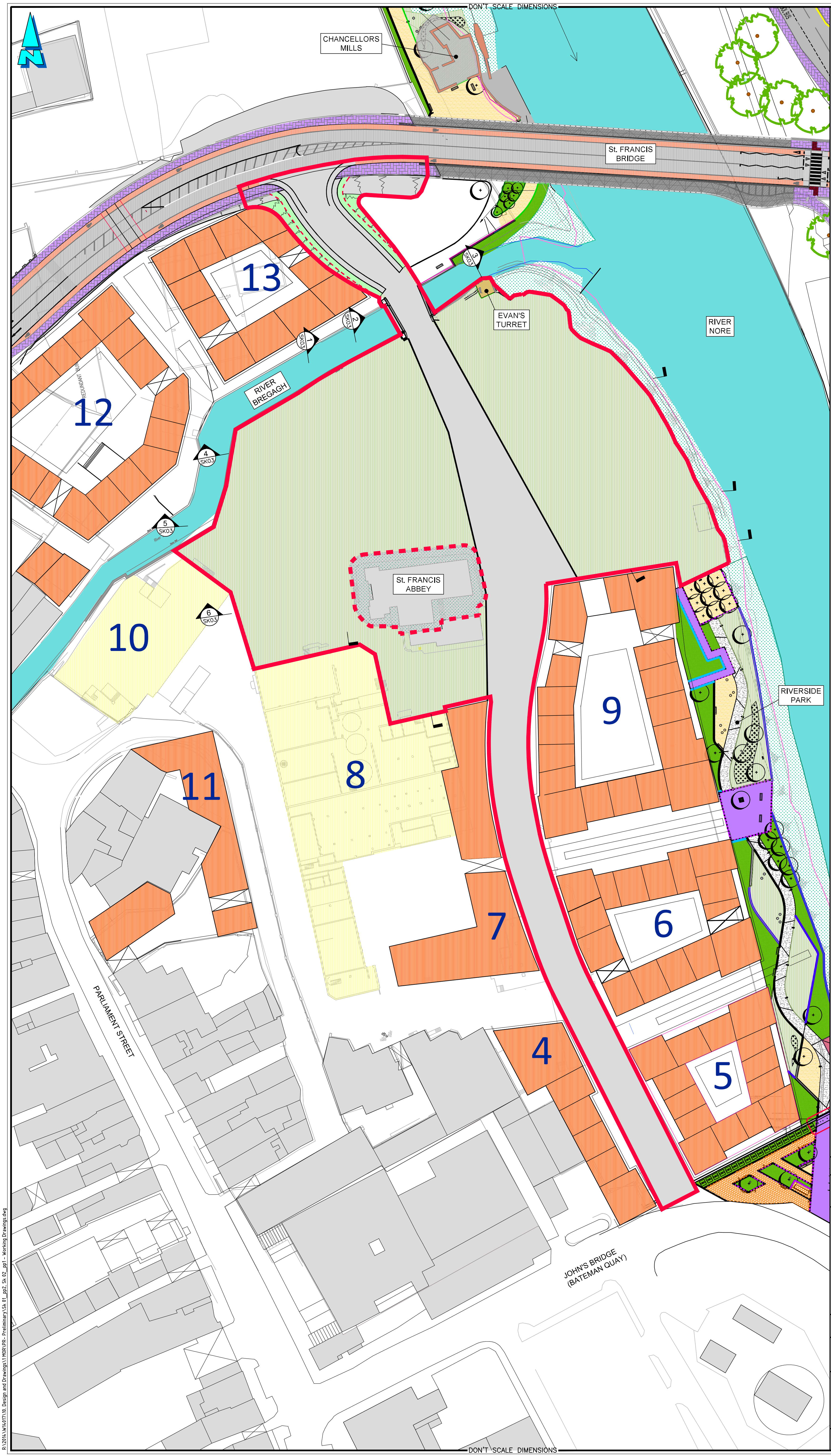
APPENDICES

APPENDIX A



Health and Safety:

THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, THE SPECIFICATION AND THE SAFETY AND HEALTH PLAN.

THE APPOINTMENT OF THE PROJECT SUPERVISOR DESIGN PROCESS IS THE CLIENT'S RESPONSIBILITY.

TEMPORARY WORKS PROPOSALS AND/OR METHOD STATEMENTS TO BE SUBMITTED TO THE PSDP AND THE PSCS FOR WORKS WHICH INVOLVE PARTICULAR RISKS.

Notes:

1. NO PART OF THIS DRAWING MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR STORED IN ANY RETRIEVAL SYSTEM OF ANY NATURE WITHOUT THE WRITTEN PERMISSION OF MALONE O'REGAN CONSULTING ENGINEERS AS COPYRIGHT HOLDER EXCEPT AS AGREED FOR USE ON THE PROJECT FOR WHICH THE DRAWING WAS ORIGINALLY ISSUED.
2. THE APPOINTMENT OF THE PROJECT SUPERVISOR DESIGN PROCESS IS THE CLIENT'S RESPONSIBILITY.
3. ALL DIMENSIONS IN mm UNLESS NOTED OTHERWISE.
4. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS PRIOR TO COMMENCEMENT OF CONSTRUCTION. DISCREPANCIES SHALL BE REPORTED TO THIS OFFICE IN WRITING.
5. THIS DRAWING TO BE READ IN ACCORDANCE WITH ALL RELEVANT ENGINEERS' DRAWINGS AND SPECIFICATIONS.

LEGEND

PROPOSED DEVELOPMENT BOUNDARY

ST. FRANCIS ABBEY BOUNDARY

ABBEY QUARTER MASTERPLAN EXISTING BUILDINGS

ABBEY QUARTER MASTERPLAN FUTURE BUILDING DEVELOPMENT

4	BUILDING No. 4
5	BUILDING No. 5
6	BUILDING No. 6
7	BUILDING No. 7
8	BREWHOUSE BUILDING
9	BUILDING No. 9
10	MAYFAIR BUILDING
11	EXTENSION TO WATERGATE THEATRE
12	BUILDING No. 12
13	BUILDING No. 13

PRELIMINARY
14.02.2020

Rev.	Description	Date	Drawn	Chkd	Appr

THIS DRAWING TO BE USED FOR PRELIMINARY PURPOSES ONLY

MALONE O'REGAN
CONSULTING ENGINEERS

St. Catherine's House,
Catherine Street,
WATERFORD.
X91 WYH4

Tel: +353 51 876 855
Email: waterford@morce.ie
Web: www.maloneoregan.com

Offices also in:
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GALWAY: Tel: +353 91 531 069 Email: galway@morce.ie
LONDON: Tel: +44 208 5281685 Email: london@morce.ie

Client KILKENNY COUNTY COUNCIL

Job ABBEY QUARTER URBAN PARK AND STREET

Drawing
PROPOSED SITE BOUNDARY LAYOUT

Job No	Drg No	Stage	Revision	Scale
W14017	Sk–01	PP	PP2	A1 1:500 A3 1:1000

Appendix 1.3

An Roinn Cultúir,
Oidhreachta agus Gaeltachta
Department of Culture,
Heritage and the Gaeltacht

National Monuments Service,
Department of Culture, Heritage and the Gaeltacht,
Custom House,
Dublin 1

Collette Byrne
Chief Executive
Kilkenny County Council
County Hall
John Street
Kilkenny
secretar@kilkennycoco.ie

July 2020

Re: Abbey Quarter Redevelopment, Kilkenny

Dear Ms. Byrne,

We wish to put on record our appreciation of the extensive efforts your local authority has made over the past several years to address archaeological and architectural heritage issues in the course of progressing this important project.

Our heritage division staff will remain in ongoing liaison with your local authority to ensure that all archaeological impacts of the redevelopment are fully addressed; indeed, the detailed liaison and extensive discussion to date has ensured that the archaeological impact will likely be minimal.

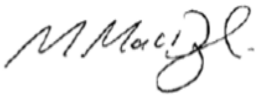
Given that the development site surrounds a national monument in the ownership of our Minister and managed by the OPW (St Francis Abbey), the remains of which are also present subsurface in a wider area, heritage will continue to be at the core of this project, which presents a major opportunity to improve access to, and the wider amenity of, St Francis Abbey. As a statutory consultee in the planning process, our Department must of course reserve a right to comment on the detail of any formal applications and proposals (including issues relating to visual amenity and architectural style and detailing).

Our Department is very grateful for the constructive and forward looking commitment by your local authority (in consultation with this Department and the OPW) to the establishment and implementation of a long term management plan for St Francis Abbey and its surrounds, and we look forward to working with you on that in the time ahead.

Throughout our mutually constructive engagement we have stressed that appropriate management of vehicular access to the redeveloped Abbey Quarter is a priority, essential to ensure that the redevelopment improves the amenity and long terms conservation of St Francis Abbey and other heritage features. In that regard, we very much welcome that necessary steps will be taken by the local authority to ensure only limited access compatible with such amenity and conservation and, in particular, that there will be no circulation of traffic across the site.

In conclusion, we welcome the substantial progress so far in regard to delivering this key regeneration project in a manner which not only protects but also enhances the heritage of Kilkenny City and we look forward to continued engagement with you on that basis.

Yours sincerely,



____

Michael MacDonagh
Chief Archaeologist
National Monuments Service

Cc Tony Lauhoff

Cc Terry Allen, National Monuments Service

Cc Catriona Ryan, Built Heritage Policy

Gerard McCormack

From: esbnetworks@esb.ie
Sent: Thursday 5 March 2020 16:30
To:
Subject: Fwd: Pre-Planning EIAR Consultation - Proposed Urban Park and Street, Kilkenny City, Co. Kilkenny [#454870]
Attachments: 20 03 04 E1518 - Abbey Qtr Consultation Doc FINAL.pdf

Good Afternoon Allison,

Thank you for your email.

I have sent your correspondence to our Kilkenny office for their attention.

Please contact me again if I can be of further assistance.

Kind regards,

Rachel

ESB Networks Customer Care | T: 1850372757 | +353 21 2386555 | F: +353 21 4844261 | www.esbnetworks.ie

--Original Message--
From:
Date: 04/03/2020 11:19 AM
To: esbnetworks@esb.ie
Subject: Pre-Planning EIAR Consultation - Proposed Urban Park and Street, Kilkenny City, Co. Kilkenny

Dear Sir / Madam,

Malone O'Regan Environmental (MOR) has been commissioned by Kilkenny County Council (KCC) to prepare an Environmental Impact Assessment Report (EIAR) for the proposed Urban Park and Street (proposed development) to be located within the former Smithwick Brewery Lands (St. Francis Abbey Brewery) just off the centre of Kilkenny City, Co. Kilkenny.

Please find attached a copy of the Consultation Document which outlines the proposed development and methodology that MOR Environmental will utilise to prepare the EIAR.

From: DIG <Dig@gasnetworks.ie>
Sent: Thursday 5 March 2020 09:28
To:
Subject: RE: Pre-Planning EIAR Consultation - Proposed Urban Park and Street, Kilkenny City, Co. Kilkenny
Attachments: St Francis Abbey Brewery Kilkenny.pdf; GNI A5 Safety Advice Booklet April 2019.pdf

Thank you for your enquiry to the Gas Networks Ireland ***Dial Before You Dig*** service, please find the attached network map for your area of interest.

Gas Networks Ireland has ***Distribution Gas Network*** within your area of interest.

Before you start work, you must have a current gas network map (or maps) for the work location. A current gas network map (or maps) must always be kept on site while work is under way.

Reading your Map

- High pressure transmission gas pipe is shown **Red.**
- Medium pressure distribution gas pipe is shown **Blue.**
- Low Pressure distribution gas pipe is shown **Green.**

The gas network map is indicative only. You must conform to the safety and legal notices printed on the map. For further information on reading this map refer to the ***Safety Information.***

Breaking Ground

- Supervision by Gas Networks Ireland is **not** required when working in the vicinity of Distribution gas pipes (unless noted otherwise). Safe digging practices **must** be followed. All work in the vicinity of a gas transmission pipeline **must** be carried out in compliance with:
    - Health and Safety Authority, ***Code of Practice for Avoiding Danger from Underground Services.***
    -

Critical Activity

Quarrying or blasting must not be carried out within 400 m of the gas network until Gas Networks Ireland has been consulted on **1850 42 77 47**

Aurora Telecom

- Part of the Aurora Telecom Network may be present on your network map. For further information, Aurora can be contacted on **01 892 6166** (Office Hours) or auroralink@gasnetworks.ie.

Service Pipes

- Service pipes feeding individual properties are not generally shown but their presence should always be anticipated. For further information on domestic gas services refer to the ***Safety Information.***

Safety Information

- Before starting work any work in the vicinity of the gas network, please refer to the Gas Networks Ireland safety booklet, ***Safety advice for working in the vicinity of natural gas pipelines***, available at https://www.gasnetworks.ie/home/safety/dial-before-you-dig/

  This booklet contains important safety information, including advice on how to read the gas network maps you have requested.

  If you did not request this map. please contact Customer Service on 1850 42 77 47.

Thank you for your enquiry to Gas Networks Ireland.

T 1850 20 50 50 (Emergency)
T 1850 42 77 47 (Dial Before You Dig enquiries)

E dig@gasnetworks.ie

Gas Networks Ireland Networks Services Centre, St. Margaret's Road, Finglas, D11 Y895
gasnetworks.ie | Find us on Twitter

Useful Publications

- Health and Safety Authority, ***Code of Practice for Avoiding Danger from Underground Services***
- Health and Safety Authority, ***Guide to Safety in Excavations***

Both are available free of charge from: Health and Safety Authority on **1890 289 389** www.hsa.ie

---

From: Allison Flaherty [mailto:aflaherty@mores.ie]
Sent: 04 March 2020 11:36
To: DIG <Dig@gasnetworks.ie>; Networksinfo <Networksinfo@gasnetworks.ie>
Subject: Pre-Planning EIAR Consultation - Proposed Urban Park and Street, Kilkenny City, Co. Kilkenny

Dear Sir / Madam,

Malone O'Regan Environmental (MOR) has been commissioned by Kilkenny County Council (KCC) to prepare an Environmental Impact Assessment Report (EIAR) for the proposed Urban Park and Street (proposed development) to be located within the former Smithwick Brewery Lands (St. Francis Abbey Brewery) just off the centre of Kilkenny City, Co. Kilkenny.

Please find attached a copy of the Consultation Document which outlines the proposed development and methodology that MOR Environmental will utilise to prepare the EIAR.

Responses and comments to the project, specifically in relation to the scope and extent of the proposed environmental assessment are requested to be sent to Malone O'Regan Environmental offices within 4 weeks from the date of the issue i.e. by Wednesday 1st April, 2020.

Please provide your comments via e-mail (enviro@mores.ie), or optionally by post to:

Malone O'Regan Environmental
Ground Floor - Unit 3
Bracken Business Park
Bracken Road, Sandyford
Dublin 18, D18 V32Y

To ensure that the response finds the relevant persons, please reference your correspondence as: *Abbey Quarter – Urban Park and Street*

Thank you,

Kind Regards,

, BA, MSc
Environmental Consultant

for and on behalf of
Malone O'Regan Environmental
Ground Floor - Unit 3
Bracken Business Park
Bracken Road, Sandyford
Dublin 18, D18 V32Y
☎ +353 1 5677655
✉:
Web: www.maloneoregan.ie

Gas Networks Ireland

Safety advice

for working in the vicinity of natural gas pipelines

Important safety information

When planning any excavation works dial

1850 42 77 47

to obtain up to date gas network maps.

Monday to Friday 9am – 5.30pm

You can also contact us on

dig@gasnetworks.ie

If you have damaged a gas pipe call

1850 20 50 50

immediately, even if you do not suspect that gas is leaking

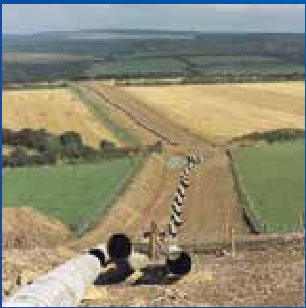
24 hours, 7 days a week

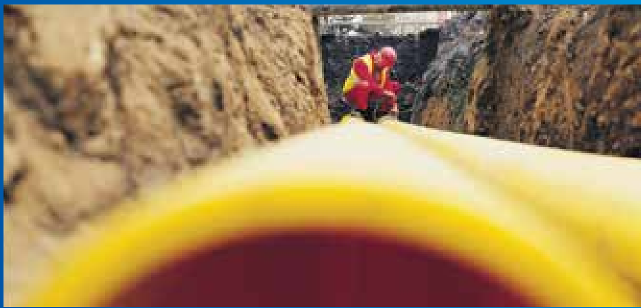
If you smell gas call

1850 20 50 50

24hr emergency service

Contents





This booklet contains important safety advice. Please read the following before you start work:

Natural gas **characteristics and behaviour**

Characteristics

Natural gas is:

- a highly flammable gas;
- lighter than air and will rise when released;
- nontoxic (but can suffocate in enclosed or confined spaces); and
- made up mostly of methane and has a smell added for safety purposes.

Behaviour

During an uncontrolled escape, natural gas will behave in the following ways:

- In open excavations, where there is a clear path to the atmosphere, natural gas will rise, dilute and disperse into the air.
- If the path to the atmosphere is blocked, the gas will travel through soil, ducts, drains, sewers and voids. It can also follow the line of other buried utility services. This can lead to gas entering a building or other confined spaces, and may lead to a fire or explosion.

Note: Never cover a damaged gas main or service; or attempt to carry out a repair. Call 1850 20 50 50 immediately.

Risks of **damaging a gas pipe**

The risks of damaging a gas pipe can be classified as:

Highest Risk

Mechanical excavators pose the highest risk and "should not be used within 500 mm of a gas distribution pipe."

(HSA Code of Practice)

Mechanical excavators must not be used within 3 metres of a Transmission pipeline.

(Refer to Code of Practice for Working in the Vicinity of the Transmission Network - AO/PR/127)

High Risk

Hand held power tools should not be used directly over the line of a gas pipe, unless the gas pipe has been positively located by hand and a safe working distance has been established.

Use of handheld power tools is not permitted within 1.5 m of a Transmission pipeline.
(Refer to Code of Practice for Working in the Vicinity of the Transmission Network - AO/PR/127)

Damage to gas pipes from power tools presents a high risk to the operatives involved in the work.

Low Risk

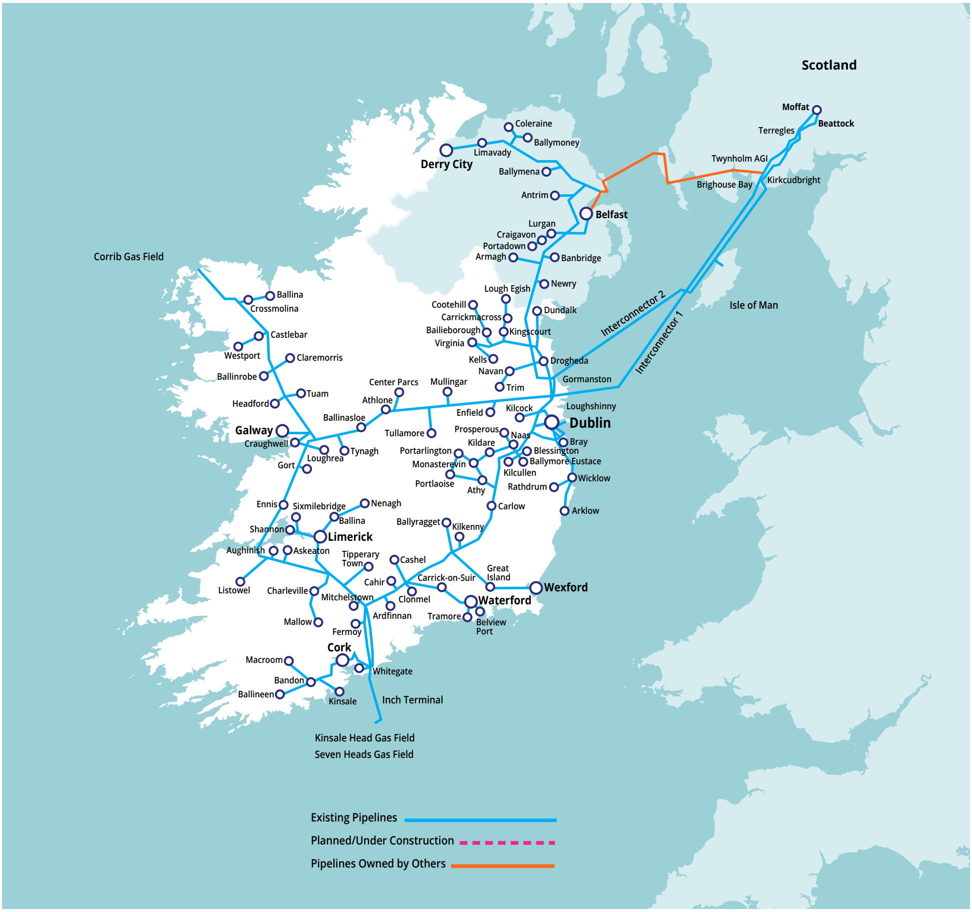
Hand digging using shovels and spades presents the lowest risk of damaging a gas pipe.

This is the method that should be used where the presence of gas pipes is suspected or close to a known gas pipe.

Risks from a **damaged gas pipe**

- Remember when gas escapes, or is released in an uncontrolled way; it can fuel a fire, give rise to an explosive atmosphere or cause asphyxiation.
- If you suspect there is a gas leak, immediately call Gas Networks Ireland's 24hr Emergency Service on **1850 20 50 50**.
- Gas can quickly fill underground cavities and travel into buildings through soil, or following the line of other buried utilities.
- Gas can only burn if exposed to an ignition source:
  - Do not turn electrical switches on or off
  - Do not operate any plant or equipment
  - Do not use naked flames or smoke
  - Do not use mobile phones in the vicinity.
- Move people away from, and upwind of, the affected area.
- If gas has entered a confined space or building:
  - Open doors and windows
  - Turn off the gas supply at the meter
  - Do not expose to an ignition source.

Gas Networks Ireland **transmission network**



Gas Networks Ireland transports gas in Ireland through a network of steel and polyethylene (PE) pipes. The network operates at pressures between 20 mbar and 85 bar and is split between Transmission and Distribution pipelines.

The **Transmission** system is made up of steel pipes and operates from 7 bar to 85 bar.

The **Distribution** system is made up mostly of polyethylene pipes and operates from 20 mbar to 7 bar.

The **network**

The network is made up of three elements:

- Transmission pipes
- Distribution pipes
- Pressure Regulating Installations

Transmission pipes

These are high pressure pipelines that transfer gas across the country. They are constructed from steel, with a black, white, cream, yellow or concrete coating, and may have marker posts at intervals along their length, particularly at field boundaries and road crossings.

If a transmission pipeline is identified near intended excavations then work must not proceed until Gas Networks Ireland Transmission has been consulted on 1850 42 77 47.

Distribution pipes

These are medium or low pressure pipelines within urban areas. They are mainly constructed from Polyethylene (PE) and are predominantly yellow in colour, but may have brown or black stripes. There are two types – Mains and Services.

Mains gas pipes usually run parallel to property in the footpath, grass verge or road and range in size from 63 mm to 400 mm diameter.

Service gas pipes are connected to mains and run to a meter position at the property, and range in size from 20 mm to 63 mm diameter.

Note: There is a limited use of steel pipes in areas like bridges or where only shallow depths can be achieved.

There are still a small number of ductile and cast iron gas mains in use, ranging in size from 3 inch (75 mm) to 24 inch (600 mm) in diameter (these mains are similar in appearance to metal water mains). Steel and PE gas services are run from these metal mains to the meter location at each building.

These ductile and cast iron mains and services have been largely replaced with PE pipes. In urban areas a large number of redundant ductile or cast iron pipes are utilised as carrier pipes for new PE pipelines.

District Regulating Installation (DRI)

Pressure Regulating Installations

There are two types: Above Ground and Under Ground

Above Ground Installations (AGI) / District Regulating Installations (DRI)

An AGI/DRI is a fenced area containing a visible arrangement of pipework and ancillary equipment and will be clearly marked with Gas Networks Ireland signage. Some DRI's can be housed in a steel unit with no fencing surround.

Under Ground Installations (UGI /DRIug)

Gas Networks Ireland also have underground pressure regulating installations which have metal or concrete cover plates. There will be no visible arrangement of pipework etc, as this will be contained within the chamber.

If an AGI/DRI or UGI/DRIug is identified near intended works, then work must not proceed until Gas Networks Ireland has been consulted.

Gas Networks Ireland **construction methods**

Gas Networks Ireland use three main construction methods:

'Dig' Technique

Open Cut – installing pipe using standard trenching techniques. Pipe is laid with a sand or pea gravel surround and gas marker tape is laid above the sand.

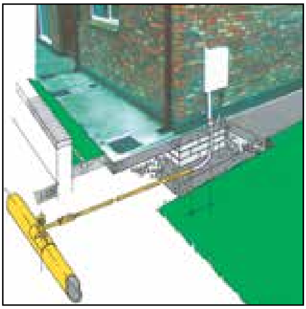
'No-Dig' Techniques

Insertion – utilising existing metal gas mains / services as a carrier for new PE pipes. Inserted PE may be a close or loose fit. The carrier pipe is broken out at connection points, i.e. at pipe joints or where a gas service pipe is connected.

Moling/Directional Drilling – installing mains/ services where a 'moling' machine drills from one location to another pulling the pipe behind it using "no-dig" technology.

Note: Where pipe has been installed using "no-dig" techniques, the gas pipe will not have sand surround or marker tape.

Gas Networks Ireland construction – **depth of cover**



Typical service arrangement

Service Connection

Purge Point

New Mains – Normally 750 mm in roads and 600 mm in footpaths. (1.1 m in open fields)

New Services – 450 mm rising to 375 mm within 1.5 m of the building line. In some cases these depths are not achievable.

Note:

Older mains and services may have reduced cover.

Services and other connections are taken from the top of the main and will therefore have a reduced depth of cover.

Alteration since original installation – roads, footpaths and grass verges may have been altered since the gas main or service was laid and reduced the depth of cover.

Purge Points and Test Caps – Mains are laid with “purge points” and/or test caps at the ends. These may also rise above the top of the main.

Gas Valve Covers –Gas valves are a key safety component part of the gas network.

Some gas mains and services have valves installed below ground with valve covers marked “GAS”.

Do not cover over or remove gas valve covers.

The risk of a gas valve cover being removed or covered over is particularly high during resurfacing or reinstatement works.

Even shallow excavation techniques such as road planing can damage gas pipelines with reduced cover.

Requesting **Gas Networks Ireland maps**

Gas Networks Ireland operates a **Dial Before You Dig** service to enable those involved in excavations to obtain natural gas network maps prior to starting work.

This service operates from 9am to 5.30pm, Monday to Friday.

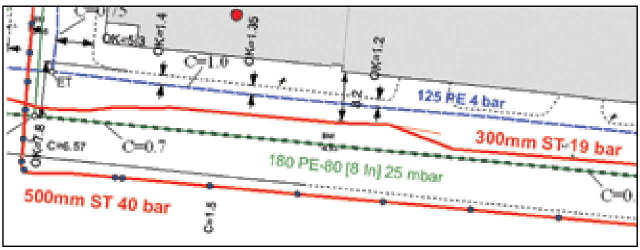
You can also email your enquiry to: **dig@gasnetworks.ie**

Maps will be sent out by post or by email where appropriate. When you contact Gas Networks Ireland to request a map, ensure you give the precise location of the intended works. You may be required to give some information regarding the nature of the planned work, i.e. start date, any high risk activity, etc.

Ensure you have allowed enough time for the maps to be obtained and to organise for the pipe location to be marked out if transmission pipelines are involved.

Note: Typical turnaround for maps is five working days.

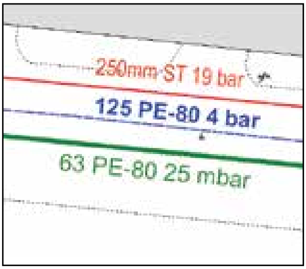
Organisers or planners of any work should ensure that the map is made available to personnel on-site.



Excerpt from a Gas Networks Ireland map.

Reading **Gas Networks Ireland maps**

Note: Natural Gas Network maps will only show mains and not services.
See page 16 for more information on service pipe locations.



The colour coding is as follows:

Red = Transmission Main*
= 7 to 85 bar.

Blue = Distribution Medium Pressure
= 100 mbar to 7 bar.

Green = Distribution Low Pressure
= up to 100 mbar.

Typical AGI

Pressure regulating installations are marked as:

DRI – District Regulating Installation (Above Ground).

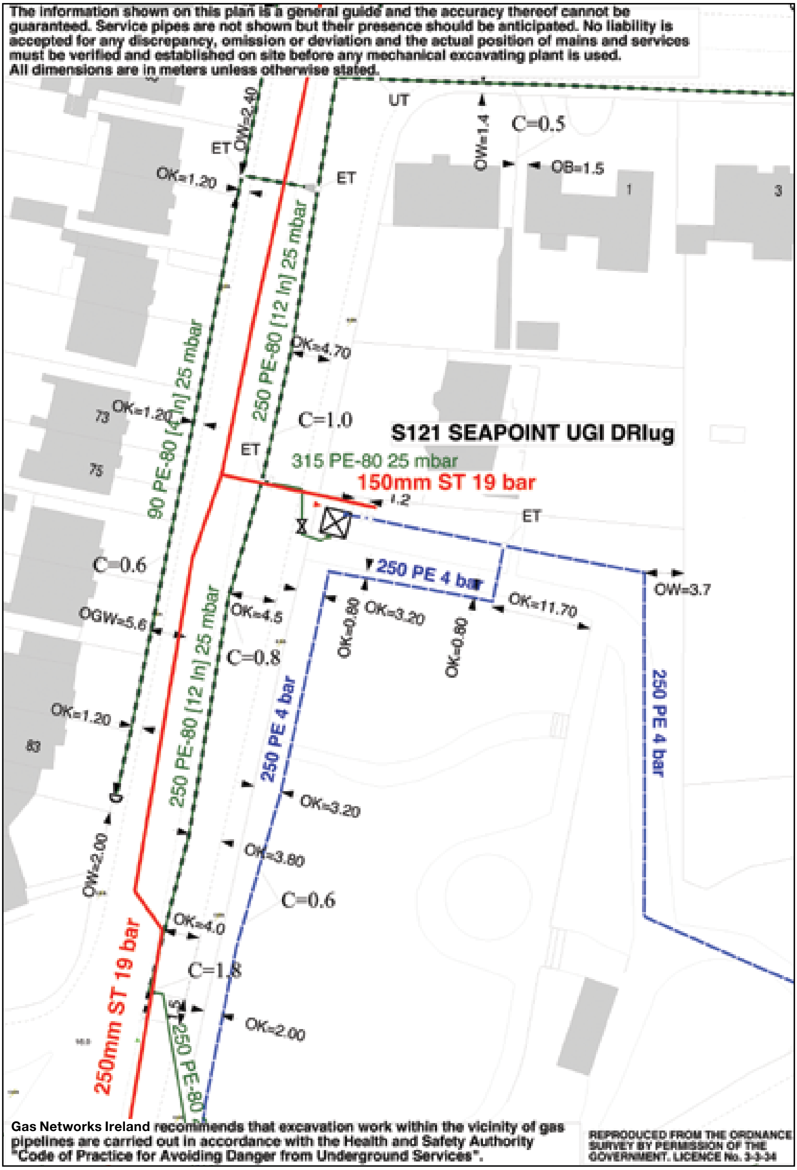
DRIug - District Regulating Installation (Under Ground).

UGI – Under Ground Installation.

AGI – Above Ground Installation.

** If you obtain a natural gas network map that shows a **red** Transmission main in the area of the proposed works, consultation with Gas Networks Ireland **must** take place **before** starting works. Gas Networks Ireland will advise you on the safety measures required and will arrange for the exact location of the pipe to be marked out on site.*

Reading **Gas Networks Ireland maps**

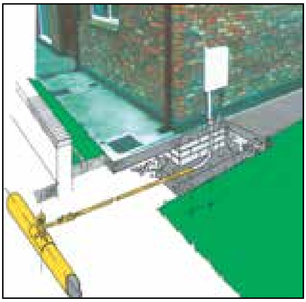


Example of a Gas Networks Ireland map

Abbreviations

OK = Kerb, Curb
ORE = Road Edge
ORB = Rail Base
OB = Building
OW = Wall
OF = Fence
ODW = Dividing Wall
OGW = Garden Wall
RD = Road
BR = Branch
RED = Reducer
C = Cover to top of pipe
LH = Left Hand
RH= Right Hand
SWP = Sweep
CNR = Corner
S = South
N = North
E = East
W = West
No. = Number
Ctr = Centre
CL = Centre Line
Trans = Transition
DIV = Dividing
PK = Park
Conn = Connection
Opp = Opposite
Cplg = Coupling
ST = Steel
PE = Polyethylene

Gas **services**



Typical service arrangement

Service riser cover

Natural gas services are not normally identified on network maps, but their presence should be assumed. Services will normally, but not always, run at right angles from the main to the meter point.

To assist in determining the approximate position of gas services ensure you:

- Obtain a natural gas network map to identify the position of the gas main.
- Complete a site survey looking for gas meter boxes/cabinets, house entry points, service risers and gas valve covers.
- Older buildings may have no visible signs of a service, as the service may run directly into the building underground, with the meter fitted internally. In these cases a check should be made inside the building to identify the meter position.

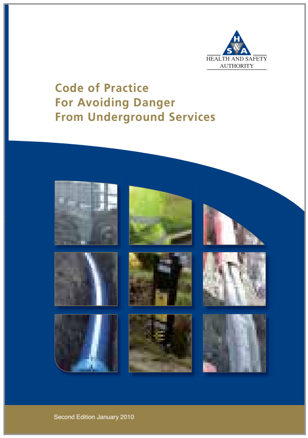
Note: Ensure you utilise safe digging practices to locate the exact position of gas services.

Domestic meter box

Six meter cabinet

Purpose built multi-meter house (apartment complex).

Safe systems of work



Safe systems of work, as recommended by the Health and Safety Authority (HSA) should be employed on all projects.

Guidance on this can be found in the:

HSA: Code of Practice for Avoiding Danger from Underground Services.

Available from HSA website: **www.hsa.ie**

A safe system of work will include the following elements:

- Planning.
- Obtaining and using utility maps.
- Identifying pipes/services.
- Safe digging practices.
- Explosives must not be used within 30 m of any gas pipe (400 m for Transmission Pipelines), without prior consultation with Gas Networks Ireland.
- Piling, directional drilling or boring must not take place within 15 m of a gas pipe unless Gas Networks Ireland has been consulted.
- Extra care should be exercised when performing 'hot work' (such as welding) where a gaseous atmosphere could exist. If this potential exists Gas Networks Ireland must be consulted.
- Extra care should also be taken when using welding equipment, burners, torches or other heat generating equipment near pipelines (even if there is no potential for a gaseous atmosphere to exist) to ensure that the heat or sparks generated do not lead to the melting of polyethylene pipes or damage to pipeline coatings.

Contact Gas Networks Ireland for general enquiries on:
1850 20 06 94

Planning

- Early contact should be made with Gas Networks Ireland to obtain a Natural Gas Network map.
  Dial Before You Dig 1850 42 77 47
- Work involving piling, demolition, directional drilling, use of explosives or 'hot works' should be mentioned, as this may necessitate a site visit from Gas Networks Ireland personnel.
- Ensure you have allowed enough time to obtain the maps.

Maps

- Gas Networks Ireland will issue maps as outlined in this booklet. It is imperative that these maps are available for the operatives on-site for the duration of any works.
  The responsible person should ensure that operatives on-site understand the maps.

Identifying Pipes

- Steel, cast iron and ductile iron gas pipes can usually be traced using a conventional pipe/cable locating device set to "R" (Radio) mode.
- Polyethylene mains and services cannot be traced using conventional devices, so it is essential that maps are used and site surveys for meter boxes, valve covers, service risers, reinstatement scarring and other signs are completed.
- During the progress of works ensure no gas valve covers or markers are covered over.
- The position of gas mains and services should be marked out as they are located.

Note: Transmission pipelines must be marked out by a Gas Networks Ireland inspector.

Safe Digging Practices:

- As per the HSA Code of Practice, gas mains and services should be located by digging trial holes by hand. Mechanical excavators should not be used within 500 mm of any gas main.
  Mechanical excavators MUST NOT be used within 3 m of a Transmission pipeline.
  (Refer to Code of Practice for Working in the Vicinity of the Transmission Network - AO/PR/127)
- Never use hand held power tools directly over gas pipes unless precautions to prevent damage have been made and the pipe has been positively located.
  Use of handheld power tools is not permitted within 1.5 m of a Transmission pipeline.
  (Refer to Code of Practice for Working in the Vicinity of the Transmission Network - AO/PR/127)
- Do not leave a polyethylene gas pipe exposed.
- Provide adequate support for any gas pipe uncovered during the work.
- Report any damage, no matter how minor it may appear, to **1850 20 50 50.**
- If you have any concerns regarding safety around gas pipes contact Gas Networks Ireland for advice on **1850 20 06 94**.

What to do if a gas pipeline is damaged
(or if you smell gas in the area)

- Do not turn any electrical switches on or off, e.g. ignition switches.
- Do not operate any plant or equipment.
- Move people away from, and upwind of, the affected area. Restrict employee and public access to the affected area.
- Prevent smoking, the use of naked flames, the use of mobile phones and other ignition sources in the vicinity of the leak.
- Report the leak/damage immediately to:
  Gas Networks Ireland 24hr Emergency Service on 1850 20 50 50.
- Provide accurate information on your location and the nature of the incident.
- Do not attempt to repair the damage.
- Do not cover up a damaged main or service, this may lead to the gas travelling through soil, ducts, sewers, chambers or voids and potentially building up inside a premises or confined space.
- Do not turn off any gas valves in the road or footpath (you may be causing further problems by doing so).
- Assist Gas Networks Ireland emergency personnel as required.
- Remember any damage to gas pipes, even if the pipe does not appear to be leaking, must be reported to Gas Networks Ireland.

If you smell gas call

1850 20 50 50

24hr emergency service

Gas Networks Ireland contacts

The main contact numbers for Gas Networks Ireland are

24hr Emergency Service

1850 20 50 50

24 hours, 7 days a week

Dial Before You Dig

1850 42 77 47

Monday to Friday 9am – 5.30pm

General Enquiries

1850 200 694

Monday to Friday 8am – 8pm
Saturday 9am – 5.30pm

gasnetworks.ie

For “Dial Before You Dig” posters or stickers for your workplace call: **1850 20 06 94**

Other useful publications

HSA: Code of Practice for Avoiding Danger from Underground Services

HSA: Guide to Safety in Excavations

both are available free of charge from:
Health and Safety Authority on **1890 289 389**
www.hsa.ie

ESB Networks: Avoidance of Electrical Hazards When Digging

available free of charge from:
ESB Networks on **1850 37 27 57**
esb.ie/esbnetworks

The main contact details for Gas Networks Ireland are:

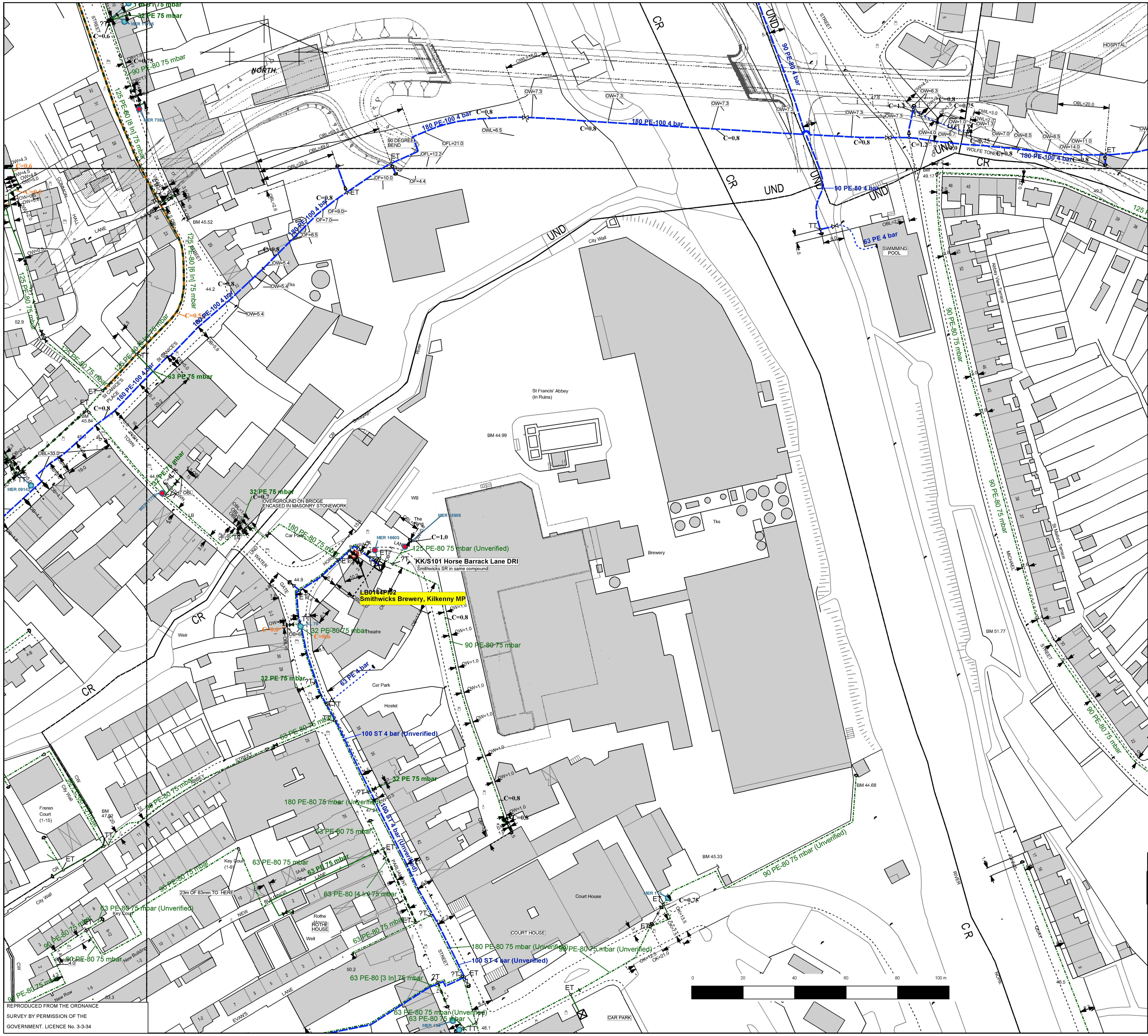
General Enquiries
1850 200 694

Dial Before You Dig
1850 42 77 47

24hr Emergency Service
1850 20 50 50

networksinfo@gasnetworks.ie

gasnetworks.ie



Important Safety Notice:
Damage to gas pipelines can result in serious injury or death. Gas network information is provided as a general guide. The exact location and depth of medium or low pressure distribution gas pipes must be verified on site by carrying out necessary investigations, including, for example, hand digging trial holes along the route of the pipe.
Service pipes are not generally shown but their presence should always be anticipated.

High pressure transmission pipelines are shown in red. If a transmission pipeline is identified within 10m of any intended excavations then work must not proceed before GNI has been consulted. The true location and depth of a transmission pipeline must be verified on site by a representative of GNI. Contact can be made through 1850 427 747.

All work in the vicinity of the gas network must be completed in accordance with the current edition of the Health & Safety Authority publication, Â Code of Practice For Avoiding Danger From Underground ServicesÂ which is available from the Health and Safety Authority (1890 289 389) or can be downloaded at www.hsa.ie.

Legal Notice:
Gas Networks Ireland (GNI) and its affiliates, accept no responsibility for the accuracy of any information contained in this document including data concerning location and technical designation of the gas distribution and transmission network (the Â InformationÂ). The Information should not be relied on for accurate distance or depth of cover measurements.

Any representations and warranties, express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect or consequential loss, arising out of or in connection with the use or re-use of the Information.

Aurora Telecom Fibre Optic Cable
Aurora Telecom Duct
Aurora Telecom Sub-duct
Aurora Telecom Inserted Gas Pipe

Contact Aurora Telecom on 1850-427-399 or (01)203-0120.

Transmission Pipe (High Pressure)
Transmission Pipe (Construction Issue)
Distribution Pipe (Medium Pressure)
Distribution Pipe (Low Pressure)
Service Pipe (Medium Pressure)
Service Pipe (Low Pressure)
Strategic Pipe (Medium Pressure)
Strategic Pipe (Low Pressure)
Inserted Pipe (Medium Pressure)
Inserted Pipe (Low Pressure)
Distribution Pipe (Abandoned)

C=?	Cover (depth in meters)		Pressure Monitor
	CP Test Point		Protection (Sleeve)
	End Cap		Protection (Slabbing)
	Hot Tap		Reducer
	Installation		Service Terminator
	Valve		Tee
	Mains Verification **		Transition

** Please contact GNI on 1850-427747 for specific information.

Design Department - CORK

Gas Networks Ireland

GAS NETWORK INFORMATION

Issue: Malone O' Regan Environmental	
Location: St Francis Abbey Brewery Kilkenny	
Plot Date: 05/03/2020	Contact: A Flaherty
Plotted by: KOC	Scale: 1:1000

Not Archived - Alternative : [Network Maintenance Dublin]2020_Kevin_Plots

Janette McDonald

From: MORES
Sent: Tuesday 17 March 2020 15:19
To: Janette McDonald
Subject: FW: Pre-Planning EIAR Consultation - Proposed Urban Park and Street, Kilkenny City, Co. Kilkenny
Attachments: 20_62_Pre-Planning EIAR Consultation - Proposed Urban Park and Street Kilkenny City.pdf

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From: Clare Glanville <
Sent: Monday 16 March 2020 12:48
To: MORES <enviro@mores.ie>
Cc: John Butler
Subject: Pre-Planning EIAR Consultation - Proposed Urban Park and Street, Kilkenny City, Co. Kilkenny

Re: 20_62_Pre-Planning EIAR Consultation - Proposed Urban Park and Street Kilkenny City

Your Ref: EI1518
Our Ref: 20/62

Dear Sir / Madam
With reference to your email received on 04 March 2020, concerning the Pre-Planning EIAR Consultation - Proposed Urban Park and Street Kilkenny City, please find attached Geological Survey Ireland's response.

If you need any further information please do not hesitate to contact me (Clare.Glanville@gsi.ie).

Yours Sincerely,
Dr. Clare Glanville

Dr Clare Glanville Senior Geologist Geoheritage & Geological Mapping.
Geological Survey Ireland, Beggars Bush, Haddington Road, Dublin D04 K7X4, Ireland.
T +353 (0)1 678 2837 E www.gsi.ie
A division of the Department of Communications, Climate Action & Environment.

Malone O'Regan Environmental
Ground Floor - Unit 3
Bracken Business Park
Bracken Road, Sandyford
Dublin 18
D18 V32Y

16 March 2020

Re: 20_62_Pre-Planning EIAR Consultation - Proposed Urban Park and Street Kilkenny City

Your Ref: EI1518
Our Ref: 20/62

Geological Survey Ireland is the national earth science agency and has datasets on Bedrock Geology, Quaternary Geology, Geological Heritage Sites, Mineral deposits, Groundwater Resources and the Irish Seabed. These comprise maps, reports and extensive databases that include mineral occurrences, bedrock/mineral exploration groundwater/site investigation boreholes, karst features, wells and springs. Please see our website for data availability and we recommend using these various data sets, when undergoing the EIAR, planning and scoping processes. Geological Survey Ireland should be referenced to as such and should any data or geological maps be used, they should be attributed correctly to Geological Survey Ireland.

Dear Allison,

With reference to your email and letter received on 04 of March 2020, concerning the pre-planning EIAR consultation for a proposed urban park and street in Kilkenny City, Co. Kilkenny. I refer you to the above abstract of services and data provided by Geological Survey Ireland (a division of Department of Communications, Climate Action and Environment) and information available to support the EIAR process.

Geological Survey Ireland welcomes the opportunity to provide input to the process at this early stage of the planning and the EIAR process.

Geoheritage

Geological Survey Ireland (GSI) is in partnership with the National Parks and Wildlife Service (NPWS, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs) to identify and select important geological and geomorphological sites throughout the country for designation as geological NHAs (Natural Heritage Areas). This is addressed by the Irish Geoheritage Programme (IGH) of GSI, under 16 different geological themes, in which the minimum number of scientifically significant sites that best represent the theme are rigorously selected by a panel of theme experts.

County Geological Sites (CGS), as adopted under the National Heritage Plan are now included in County Development Plans and in the GIS of planning departments, to ensure the recognition and appropriate protection of geological heritage within the planning system. CGSs can be viewed online under the Geological Heritage tab on the online Map Viewer. The audit for Co. Clare was completed in 2007 and revised in 2012. A published version is available and can be downloaded from here. **Our records show that there are no CGS located in close proximity of the proposed development site.**

Geotechnical Database Resources

Geological Survey Ireland continues to populate and develop our national geotechnical database and viewer with site investigation data submitted voluntarily by industry. The current database holding is over 7500 reports with 134,000 boreholes; 31,000 of which are digitised whish can be accessed through downloads from our Geotechnical Map Viewer. We would strongly recommend that this database be consulted as part of any baseline geological assessment of the proposed development as it can provide invaluable baseline data for the region or vicinity of the proposed development area. This information may be beneficial and cost saving for any site specific investigations that may be designed as part of the development.

Groundwater

Groundwater is important as a source of drinking water, and it supports river flows, lake levels and ecosystems. It contains natural substances dissolved from the soils and rocks that it flows through, and can also be contaminated by human actions on the land surface. As a clean, but vulnerable, resource, groundwater needs to be understood, managed and protected. Through our Groundwater Programme, Geological Survey Ireland provides advice and maps to members of the public, consultancies and public bodies about groundwater quality, quantity and distribution. Geological Survey Ireland monitors groundwater nationwide by characterising aquifers, investigating karst landscapes and landforms and by helping to protect public and group scheme water supplies. With regard to Flood Risk Management, there is a need to identify areas for integrated constructed wetlands. We recommend using the GSI's National Aquifer and Recharge maps on our Map viewer to this end. We recommend that other groundwater related data available on our online databases is also used within the EIAR assessment in terms of groundwater wells and springs, aquifer vulnerability, subsoil permeability, and drinking water protection areas.

Geohazards

Geohazards can cause widespread damage to landscapes, wildlife, human property and human life. While in Ireland, landslides are the most prevalent of these hazards flooding is becoming an increasing risk. Geological Survey Ireland has information available on past landslides for viewing as a layer on our Map Viewer. Geological Survey Ireland also engages in national projects such as Landslide Susceptibility Mapping and GWFlood Groundwater Flooding, and in international projects, such as the Tsunami Warning System, coordinated by the Intergovernmental Oceanographic Commission of UNESCO. **We recommend that geohazards and particularly flooding be taken into consideration, especially when developing areas where these risks are prevalent, and we encourage the use of our data when doing so**.

Natural Resources (Minerals/Aggregates)

Geological Survey Ireland is of the view that the sustainable development of our natural resources should be an integral part of all development plans from a national to regional to local level to ensure that the materials required for our society are available when required and potential recourses do not suffer from inadvertent sterilisation. The Active Quarries, Mineral Localities and the Aggregate Potential maps are available on our Map Viewer. Geological Survey Ireland highlights the consideration of mineral resources and potential resources as a material asset which should be explicitly recognised within the environmental assessment process. Geological Survey Ireland provides data, maps, interpretations and advice on matters related to minerals, their use and their development in our Minerals section of the website. **The EIAR should also consider potential for resource sterilisation as part of the planning process, and if further information is required beyond that available on our website please do not hesitate to contact us.**

Geothermal Energy

Geothermal energy harnesses the heat beneath the surface of the Earth for heating applications and electricity generation, and has proven to be secure, environmentally sustainable and cost effective over long time periods. Geothermal applications can range in depth from a few metres below the surface to several kilometres. Ireland has widespread shallow geothermal resources for small and medium-scale heating applications, which can be explored online through Geological Survey Ireland's Geothermal Suitability maps for both domestic and commercial use. We recommend use of our Geothermal Suitability maps to determine the most suitable type of ground source heat collector for use with heat pump technologies. Ireland also has recognised potential for deep geothermal resources. Geological Survey Ireland currently supports and funds research into this national energy resource.

Other Comments

Should development go ahead, all other factors considered, Geological Survey Ireland would much appreciate a copy of reports detailing any site investigations carried out. The data would be added to GSI's national database *of site investigation boreholes, implemented to provide a better service to the civil engineering sector. Data can be sent to Beatriz Mozo, Geological Mapping Unit, at Beatriz.Mozo@gsi.ie, 01-678 2795.*

I hope that these comments are of assistance, and if we can be of any further help, please do not hesitate to contact me, Dr. Clare Glanville (clare.glanville@dccae.gov.ie).

Yours Sincerely,

Dr. Clare Glanville
Planning and Geoheritage Programmes Lead

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Ms. Allison Flaherty
Malone O'Regan Environmental
Ground Floor - Unit 3
Bracken Business Park
Bracken Road, Sandyford
Dublin 18
D18 V32Y

Dáta | Date	Ár dTag | Our Ref.	Bhur dTag | Your Ref.
10 March 2020	**TII20-109115**	

Re: EIAR Scoping Request Abbey Quarter – Urban Park and Street on behalf of Kilkenny County Council.

Dear Ms. Flaherty,

Transport Infrastructure Ireland (TII) acknowledges receipt of your EIAR Scoping request in respect of the above proposed project, received by email 4 March 2020.

The issuing of this correspondence is provided as best practice guidance only and does not prejudice TII's statutory right to make any observations, requests for further information, objections or appeals following the examination of any valid application referred.

The approach to be adopted by TII in making such submissions or comments will seek to uphold official policy and guidance as outlined in the Spatial Planning and National Roads Guidelines for Planning Authorities (2012). Regard should also be had to other relevant guidance available at www.TII.ie.

With respect to EIAR Scoping issues, the recommendations indicated below provide only general guidance for the preparation of EIAR, which may affect the national road network. The developer should have regard, *inter alia*, to the following;

1. As set down in the Spatial Planning and National Roads Guidelines (2012), the primary purpose of the national road network is to provide strategic transport links between the main centres of population and employment, including key international gateways such as the main ports and airports, and to provide access between all regions. The EIAR should identify the methods/techniques proposed for any works traversing/in proximity to the national road network in order to demonstrate that the development can proceed complementary to safeguarding the capacity, safety and operational efficiency of that network.

2. There is no stated intention to prepare a Traffic and Transport Assessment (TTA) as part of the EIAR in the Scoping Document. Where appropriate, subject to meeting the appropriate thresholds and criteria and having regard to best practice, a Traffic and Transport Assessment should be carried out in accordance with relevant guidelines, noting traffic volumes attending the site and traffic routes to/from the site with reference to impacts on the national road network, including junctions of lower category roads with those networks. TII's TTA Guidelines (2014) should be referred to in relation to proposed development with potential impacts on

the national road network. The scheme promoter is also advised to have regard to Section 2.2 of the TII TTA Guidelines which addresses requirements for sub-threshold TTA.

3. The designers are asked to consult TII Publications to determine whether a Road Safety Audit is required.

4. Assessments and design and construction and maintenance standards and guidance are available at TII Publications that replaced the NRA Design Manual for Roads and Bridges (DMRB) and the NRA Manual of Contract Documents for Road Works (MCDRW).

5. Environmental Impact Assessment shall include provision for travel planning / mobility management planning in the interests of protecting national roads capacity in accordance with sustainable travel policy.

Notwithstanding, any of the above, the developer should be aware that this list is non-exhaustive, thus site and development specific issues should be addressed in accordance with best practice.

I hope that the above comments are of use in your EIAR preparation.

Yours sincerely,

pp

Michael McCormack
Senior Land Use Planner

An tOifig Náisiúnta um Sláinte Chomhshaoil
Feidhmeannacht na Seirbhíse Sláinte,
Urlár 2, Teach na Darach, Ascaill na Teile
Páirc na Mílaoise, An Nás, Co. Chill Dara.

National Office for Environmental Health Services
2nd Floor, Oak House, Lime Tree Avenue
Millennium Park, Naas, Co. Kildare
Eircode: W91KDC2

T: 045 880 442
ehnationaloffice@hse.ie

29th March 2020

Malone O'Regan Environmental
Ground Floor Unit 2
Bracken Business Park
Bracken Road
Sandyford
Dublin
D18 V32Y

Consultation on Environmental Impact Assessment (EIA) for the Abbey Quarter- Urban Park and Street, Kilkenny County Council

Ref: E1518
EHIS ref: ID1124

Reference is made to the scoping document for the EIA of the above development.

The following HSE stakeholders were made aware of the consultation on the 5th March 2020:

- Emergency Planning – David O'Sullivan
- Estates – Helen Maher
- Assistant National Director for Health Protection – Kevin Kelleher / Laura Murphy
- CHO – Kate Killeen White

The following are observation by the Environmental Health Service (EHS)

General

The nature of the development has the potential to support a number of key national health strategies and objectives of the national Healthy Ireland Strategy in the context of health and the built environment.

In particular:

a) Get Ireland Active – National Physical Activity Plan for Ireland
http://health.gov.ie/wp-content/uploads/2016/01/Get-Ireland-Active-the-National-Physical-Activity-Plan.pdf
b) Smarter Travel Policy
http://www.smartertravel.ie/sites/default/files/uploads/2012_12_27_Smarter_Travel_english_PN_WEB%5B1%5D_0.pdf
c) Research 195: Health Benefits from Biodiversity and Green Infrastructure
http://www.epa.ie/pubs/reports/research/health/research195.html

Some of the following recommendations should be considered for the landscaping of the proposed development:

Green spaces should be co-designed with communities and reflect local needs.
Areas should be as large as possible with connections through flowery verges or linear habitats alongside paths and roads.
Areas should be relatively open, but grass does not all have to be the same length. This design could suggest careful, rather than a lack of, management. Interpretative signage can explain the practice and highlight signs of nature to look out for.
A few scattered trees or clumps of trees are preferable to dense planting of trees.
Exercise areas, trails and paths need to provide maximum contact with green space, as this made exercise accessible and nature contact motivated people to walk more.
Not all areas should be managed to the same intensity. Some parts near paths could be managed more to look tidy, whereas stakeholders recognised the value of incorporating wild areas, which could be further away from paths.
It is recommended that a pollinator plan is implemented as part of the landscape design to further promote biodiversity throughout the site.

Directive 2014/52/14

Directive 2014/52/EU has an increased requirement to assess likely significant impacts on Population and Human Health. In the experience of the EHS the impacts on human health are generally inadequately assessed in EIA in Ireland and are not being focused as development specific. It is recommended that the wider determinants of health and wellbeing are considered in a proportionate manner when considering the EIA. Guidance on wider determinants of health can be found at: www.publichealth.ie

It should be noted that the positive likely significant impacts should be identified and assessed, not just any likely negative significant impacts from the proposed development.

The EHS considers this an important aspect of a development of this nature and due to this being a public funded project, if the developer considers it appropriate, the EHS is prepared to offer further support and advice in the area of the built environment and health and the EIA process and what is considered proportionate. Any further discussions should be directed to the Environment Operational Unit: Andrew.sulley@hse.ie

Generally the EHS will consider the EIAR and the EIA carried out to have examined all likely significant impacts and provide the following information for each:

a) Description of the receiving environment;
b) The nature and scale of the impact;
c) An assessment of the significance of the impact;
d) Proposed mitigation measures;
e) Residual impacts.

The HSE will consider the final EIAR accompanying the planning application and will in particular make comments to the Planning Authority on the methodology used for assessing the likely significant impacts and the evaluation criteria used in assessing the significance of the impact.

Public consultation is an important aspect of EIA and this should be demonstrated in the final EIAR Meaningful public consultation with the local community should be carried out. All legitimate concerns from the public shall be fully addressed and evaluated. The EIAR should clearly demonstrate how the outcome of consultation with the public influenced decision making within the EIA.

Section 2.1 Proposed Structure and Content of EIA

The EHS has considered the proposed guidance to be used in the EIA process and does not have an additions to those detailed.

The following comments are made:

a) In the description of the Non-Technical Summary it is stated that it is a review of the main document. The EHS considers it should be a summary of the main document with clear linkage between the summary and the detailed text in the EIAR.

b) The assessment criteria of 'likely significant impacts' seems to being interchanged in wording in the proposal. In the experience of the EHS the level of assessment and identification of what should, or should not have been assessed, is often basis for challenges to the EIA process. It is recommended that the criteria for 'likely significant impacts' is established and clear in the EIAR and this term is used throughout the EIAR, to avoid any ambiguity.

c) Remedial or Reductive measures – clarification if this is the same as mitigation measures.

d) Monitoring – the EHS cannot identify previous EIARs that have identified Agencies that are responsible for post development monitoring as part of the EIA process. The EHS recommends that the developer is very clear what this proposal entails and the consequencies of including this in the EIAR.

Section 2.3.1 Population and Human Health

The assessment of population and human health should be considered in the context of the proposed development. It is noted that the scoping document states that all relevant plans and policies will be considers and then names a number of these, none of which are health plans or policies. As stated above, there is clear evidence base around health and the built environment and this should be the basis for the project specific assessment.

The EHS considers there are three elements to this:

a) The assessment of likely significant impacts on population and human health from direct emissions into the environment as a consequence of the development, for example into ground and surface water or air.
b) The assessment of likely significant impacts on population and human health through socio economic changes, for example increased employment or the change in land use with particular reference to impacts on health inequalities,
c) The assessment of the likely significant impacts on population and human health with regard to the opportunity for health gain through the design of the built environment, for example designed for increased physical exercise or access to green spaces.

The EHS emphasises the recommendation for a proportionate and specific assessment using appropriate available health data and information. The EHS does not consider a wide ranging socio economic assessment is required for this project or assessment of population trends or regional economic activity.

It is noted that a Strategic EIA has already been carried out for the Master Plan and it is recommended that linkage is made to this to avoid duplication in the assessment of population and human health.

Health profiles for Kilkenny can be accessed at:
https://www.hse.ie/eng/services/list/5/publichealth/publichealthdepts/pub/profiles.html

Section 2.3.5 Climate
The EIA should consider the current Kilkenny Climate Adaptation Plan in the EIA process.
https://www.kilkennycoco.ie/eng/Services/Environment/Climate-Change/Climate-Change-Adaptation-Strategy-2019-2024/

Artificial Lighting
An assessment should be carried out into any likely significant impacts from artificial lighting as a result of construction and operation of the proposed development.

Construction Phase
A construction management plan should be included with the EIAR that identifies the likely impacts from the construction phase and the mitigation required to protect surface and ground water, mitigate emissions into air, including noise and dust, and includes a waste management plan.

Clarification on the Content of this Submission

Under the current exceptional circumstances, all submissions in the planning process are being co-ordinated from the EHS Environment Operational Unit.

All correspondence or communication should be directed, in the first instance, to Andrew Sulley at Andrew.sulley@hse.ie or where it cannot be dealt with by e-mail, to the EHS head Office at the above address, quoting reference ID1124,

Caroline Hueston
Environment Operational Unit
Environmental Health Services

Appendix 1.4

Appendix 5: Summary of Public Consultations Undertaken in the Preparation of the Abbey Quarter Masterplan 2012-2018

Date	Action
April 2012	Kilkenny Local Authorities agree to purchase the Smithwick's Brewery Site upon Diageo's commercial decision to relocate operations.
June 2012	A public meeting was convened by Kilkenny Local Authorities in the Town Hall to discuss the future of the site. Approximately 100 people attended this open session.
December 2012- February 2013	In conjunction with the Department of Arts Heritage and Gealtacht and the Royal Institute of Architects in Ireland (RIAI), a range of architects, planners and other property experts were invited to participate in a colloquium on the future of the site. An Urban Design Review Report was published as a result of the colloquium.
May 2013	A special Joint Meeting of Kilkenny Borough Council and Kilkenny County Council was held to outline the results of the Urban Design Review Report. Tender for consultants to prepare a Masterplan for the former brewery site were issued.
July 2013	Reddy Architecture and Urbanism were appointed to prepare the Masterplan.
	A joint meeting of Kilkenny County Council and Kilkenny Borough Council was held in July 2013 at which the decision to retain and refurbish the Mayfair and Brewhouse buildings and to temporarily retain the Maturation building was made to support early interest from business start-ups.
November 2013	A draft Masterplan document was published in November 2013 and put on public display with submissions invited up to 13th December. A public meeting was held in the Town Hall on the 5th November presenting the draft Masterplan. 38 submissions were received to the initial draft Masterplan from members of the public and statutory authorities.
November 2014	Following these consultation events, a Chief Executive's report was brought to Kilkenny County Council in November 2014. The Chief Executive's report recommended the retention of the Mayfair and Brewhouse buildings, the creation of a linear park by the river Nore, the creation of a street to link Bateman Quay and the Central Access Scheme and to engage in further public consultation to revision the Masterplan.
January 2015	The Planning Department of Kilkenny County Council embarked on a public consultation exercise in January 2015 called 'The Brewery: Re-Visioning'. Members of the public were invited to attend a two-day public event to express their views and suggestions for the future development of the brewery site through a workshop format. Due to the high level of interest from members of the public, a second two-day workshop was organised. A half day workshop with Comhairle na nÓg was also held. 222 people participated in these workshops. The work focused on Visioning the area and Guidelines to implement the vision. The Council also received 71 written submissions during this consultation period.
March 2015	A Chief Executive's Report was published outlining the issues raised and the work carried out at the workshops. A Vision Statement and suggested Guidelines were put forward as a direct result of the consultation workshops. The report also included a suite of recommendations on the process, such as completing a detailed archaeological strategy, environmental assessments and to hold a further feedback public event.

Appendix 5: Summary of Public Consultations Undertaken in the Preparation of the Abbey Quarter Masterplan 2012-2018

May 2015	Following completion of the Archaeological Strategy and the draft Environmental Reports, a Feedback and Public Engagement event was held on the 16th May 2015. A total of 54 people attended this follow-up session. An emerging draft Masterplan layout was presented having regard to the archaeological and environmental reports, and to the changes made on foot of the public consultation events. Members of the public carried out a SWOT analysis (Strengths, Weaknesses, Opportunities & Threats) of the emerging Masterplan layout. A report outlining the work carried out at this event is also published on http:\\ourplan.kilkenny.ie
	A special meeting of Kilkenny County Council was held on 27th May to discuss the Draft Masterplan for the Abbey Quarter. The Council approved the Draft Masterplan for public display. A proposed Variation to the Kilkenny City & Environs Development Plan 2014-2020 to enshrine high level principles for the Masterplan area was approved to proceed to public consultation.
June/July 2015	The Draft Masterplan with draft Strategic Environmental Report (SEA), Appropriate Assessment (AA) and Archaeological Strategy were placed on public display on 22nd June for a period of 4 weeks and circulated to statutory agencies, government departments and relevant stakeholders for consultation.
17th Nov. 2015	Part 8 for Brewhouse building approved by Kilkenny County Council.
10th Dec 2015	Part 8 for Riverside Garden approved by Kilkenny County Council.
18th July 2016	Part 8 for Mayfair building approved by Kilkenny County Council.
30th Nov. 2017	Revised Part 8 for Brewhouse building approved by Kilkenny County Council.
April 2017	Pre Draft Public Consultation event for the "Urban Design Criteria and Recommendations for Development Code for the implementation of the Abbey Quarter Masterplan".
Nov/ Dec 2017	November/December Public Consultation on Draft Urban Design Code.
Thursday 30th November 2017	Information Evening on the Draft Urban Design Code.
15th January 2018	Urban Design Code for the Abbey Quarter Masterplan Area is adopted by Kilkenny County Council.

Appendix 6.1

<u>Baseline Aquatic Ecology Study</u>
<u>Abbey Quarter Urban Park and Street, Kilkenny</u>

Revised

Prepared by:
Pascal Sweeney M.Sc., MCIEEM,
Sweeney Consultancy,
Rahan,
Mallow
Co. Cork.
Tel. 022/26780

Date: 30 June, 2020

TABLE OF CONTENTS

1. INTRODUCTION

The present report was commissioned by Malone O'Regan Consulting Engineers. It summarises the findings of baseline aquatic surveys, carried out adjacent to and downstream of the proposed Abbey Quarter Urban Park and Street development in Kilkenny City.

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2. DESKTOP REVIEW

The proposed development site is bounded on its eastern side by the River Nore and on its northern side by the Breagagh River. This part of the River Nore channel, but not the adjoining land, is within the River Barrow and River Nore Special Area of Conservation (SAC 002162), designated under the EU Natural Habitats Regulations (Special Areas of Conservation) for the protection of a variety of aquatic and semi-aquatic habitats and species. Some of these are estuarine or only occur in other parts of SAC and are therefore not relevant to the current project.

The possible presence of the following aquatic Qualifying Interests of SAC 002162 warrant further investigation:
Floating River Vegetation (Habitat Code 3260).
Nore Freshwater Pearl Mussel (*Margaritifera m. durrovensis*) (Species Code 1990).
White-Clawed Crayfish (*Austropotamobius pallipes*) (Species Code 1092).
Atlantic Salmon (*Salmo salar*) (Species Code 1106).
Brook Lamprey (*Lampetra planeri*) (Species Code 1096)
Sea Lamprey (*Petromyzon marinus*) (Species Code 1095)
River Lamprey (*Lampetra fluviatilis*) (Species Code 1099).

Because the presence and vulnerability to impacts of protected aquatic species is dependant not only on the physical conditions within the river, but also on the prevailing water quality, the biological water quality of the Rivers Nore and Breaghagh need to be considered.

Within SAC 002162, the Nore freshwater pearl mussel is a sub-species which is known to occur only in a 10km stretch of the main channel of the River Nore upstream of Tallyho Bridge in Co. Laois. However, individual mussels can be transported downstream in flood conditions and surveying is therefore advisable.

The white-clawed crayfish was formerly abundant throughout much of the River Nore and tributaries (J. Lucey, *pers. comm.*). A decline in the crayfish population was first noted in 2001. Information from local anglers indicates that a considerable kill occurred around this time, with accumulations of dead crayfish reported in areas of slack water in the main channel of the Nore. Low numbers of crayfish have since been recorded in several tributaries and in July 2019, one was found in the upper reaches of the Nore main channel during sampling for the EPA River Monitoring Programme (*pers. obs.*).

The main channel of the River Nore is a Salmonid Water, designated under the European Communities (Quality of Salmonid Waters) Regulations of 1988 (S.I. No. 293 of 1988). Some of the tributaries are important for salmon spawning. However, salmon ideally need EPA Class A water: Q values Q4 to Q5 (Curtis *et al.,* 2009).

Sea lamprey usually spawn in the lower reaches of the River Nore between Thomastown and Inistioge, but sometimes as far up as Ballyragget (Kurz and Costello, 1999). In a survey of the River Nore main channel in 2013, Rooney *et al.* (2014) identified sea lamprey redds at several locations between Bennettsbridge and Inistioge.

Available information indicates that brook and river lampreys are widespread throughout the Nore system. The juvenile stage of these two species are very difficult to tell apart. Adult brook lamprey have been recorded in the Nore main channel between Abbeyleix and Ballyragget and unspecified lampreys have been observed in several of the tributaries (Kurz and Costello, 1999).

3. CONSULTATIONS

Issues relating to fish in the Rivers Nore and Breagagh were discussed with Jane Gilleran, Fisheries Environmental Officer, Inland Fisheries Ireland (IFI), by telephone on 08/08/2019.

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4. FIELD SURVEY

Field work was carried out on 07/08/2019. The deep section of rives adjacent to the subject site was surveyed by boat. Shallow areas were surveyed on foot. To illustrate the general habitat quality, photographs were taken using a digital camera (photographs are presented in Appendix 1). Grid references were recorded using a GPS handset.

4.1 Biological Water Quality

Biological water quality assessments were carried out at two sites, one in Nore and one in the Breagagh, by the Q-scheme methodology (EPA, 2019). As the Nore adjacent to the subject site is deep and unsuitable for this methodology (Photo 1), the sampling was carried out in a stretch of riffle farther downstream at ITM 65148 65777 (Photo 2). As the bed of the Breagagh adjacent to the subject site is lined with gabion mattresses (Photo 3), sampling was carried out just upstream of these mattresses at ITM 65053 65644 (Photo 4). Sampling locations are shown in Appendix 2.

4.2 Qualifying Interest Habitats Assessment Methods

The floating river vegetation habitat was assessed, based on the criteria outlined by Hatton-Ellis and Grieve (2003).

4.3 SAC 002162 and SPA 004233 Qualifying Interest Species Assessment Methods

The status of protected species possibly occurring in the rivers adjacent to and for 1km downstream of the subject site was assessed as follows:

- The presence of the Nore freshwater pearl mussel (*Margaritifera m. durrovensis*) was checked for by a survey carried out under a Stage 1/2 licence (Licence No. C24/2019) from the National Parks and Wildlife Service. The riverbed was searched visually, using a Perspex-bottomed viewer.

- White-clawed crayfish were surveyed for in the Nore and Breagagh under Licence No. C042/2019. Hand search of suitable crayfish refuges in shallow water in proximity to the Q-value sampling sites were carried out following the methodology of Peay (2003).
- The habitat quality for salmon (*Salmo salar*) was assessed, based on the criteria outlined by Kennedy (1984) and by Bardonnet and Baglinière (2000) for the physical instream requirements of this species for spawning, nursery and adult habitat. The contents of the net at Q-value sites was checked immediately after the kick-sampling and any fish species found were identified and immediately returned to the water.
- The habitat quality for of lamprey species, was assessed, based on the criteria outlined by Maitland (1980) and by Johns (2002) for the physical instream requirements of these species for spawning, nursery and adult habitat. Where suitable nursery habitat was found, sand/silt was dredged with a hand-net (mesh size 2mm) to check for lamprey ammocoete presence.
- Records of Twaite shad (*Alosa fallax*) were checked in available literature.

The presence and extent of any invasive alien plant species listed in Part 1 of the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) was checked for visually.

5. RESULTS

5.1 Biological Water Quality

The Q-values ascribed to the two sites were:

- Breagagh: Q3
- Nore: Q3-4

At both sites assessed, the biological water quality is unsatisfactory and is below the standard which must be achieved in accordance with the European Communities Environmental Objectives (Surface Waters) Regulations 2009.

5.2 SAC 000781 Qualifying Interest Habitats

5.2.1 Floating River Vegetation (Habitat Code 3260).

Downstream of the weir the River Nore supports vegetation that could be classified as being of the Callitricho-Batrachion vegetation habitat type (Photo 5).

5.3 SAC 000781 Qualifying Interest Species

5.3.1 Nore Freshwater Pearl Mussel (*Margaritifera m. durrovensis*) (Species Code 1990).

No mussels were found.

5.3.2 White-Clawed Crayfish (*Austropotamobius pallipes*) (Species Code 1092).

A single moribund crayfish was found in the Nore (Photo 6). This specimen was sent to the Marine Institute, where crayfish plague was confirmed. This was the first confirmed case of crayfish plague in the Nore catchment (although it is suspected that there was an outbreak that went undetected in 2000). The possibility of live crayfish in the rivers adjacent to the subject site when works commence is highly unlikely, but the spores of the microorganism that causes plague could be present.

5.3.3 Atlantic Salmon (*Salmo salar*) (Species Code 1106).

The River Nore contains suitable physical habitat for salmon spawning and nursery downstream of the weir, but not adjacent to the subject site, where the river has been dredged. However, adult salmon must migrate upstream past the site and salmon parr must migrate downstream. In the kick-sample in the Breagagh, two salmon parr were found (Photo 7). This is at odds with the statement by Curtis *et al.*, (2009) that salmon need EPA Class A water: Q values Q4 to Q5.

5.3.4 Sea Lamprey (*Petromyzon marinus*) **(Species Code 1095)**, **Brook Lamprey** (*Lampetra planeri*) **(Species Code 1096)** and **River Lamprey** (*Lampetra fluviatilis*) **(Species Code 1099)**.

Riffle areas in the River Nore are suitable for lamprey spawning, while depositions of finer material are suitable for burrowing ammocoetes (juveniles). The presence of juvenile lampreys was confirmed in sand/silt deposits by the riverbank near the Q-value site (Photo 8).

5.3.5 Twaite Shad (*Alosa fallax*) **(Species Code 1103)**.

Twaite shad is an anadromous fish which enters large estuaries in early summer to spawn in gravels near the end of the freshwater reaches. Rooney *et al.* (2014) recorded juvenile shad in the River Nore downstream of Inistioge in summer 2013, over 30km downstream of the proposed development site. There are no records of Twaite shad occurring upstream of this point.

5.4 Invasive alien Plant Species

Two invasive alien plant species Japanese knotweed (*Fallopia japonica*) and Himalayan balsam (*Impatiens glandulifera*) were recorded on the riverbank at the subject site at ITM 65059 65633 (Photo 9), as shown in Appendix 2.

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6. CONSTRAINTS

An Invasive Alien Plant Species Management Plan will have to be prepared and implemented to avoid spreading Japanese knotweed and Himalayan balsam from the site.

Biosecurity measures to avoid spreading crayfish plague to other sites will have to be put in place.

All discharges from the site to the Nore and the Breagagh will have to have silt & hydrocarbon traps installed and maintained.

APPENDIX 1

PHOTOGRAPHS

Photo 1: River Nore adjacent to subject site

Photo 2: River Nore Q-value Sampling Site

Photo 3: Gabion mattresses on bed of Breagagh River

Photo 4: Breagagh River Q-value Sampling Site

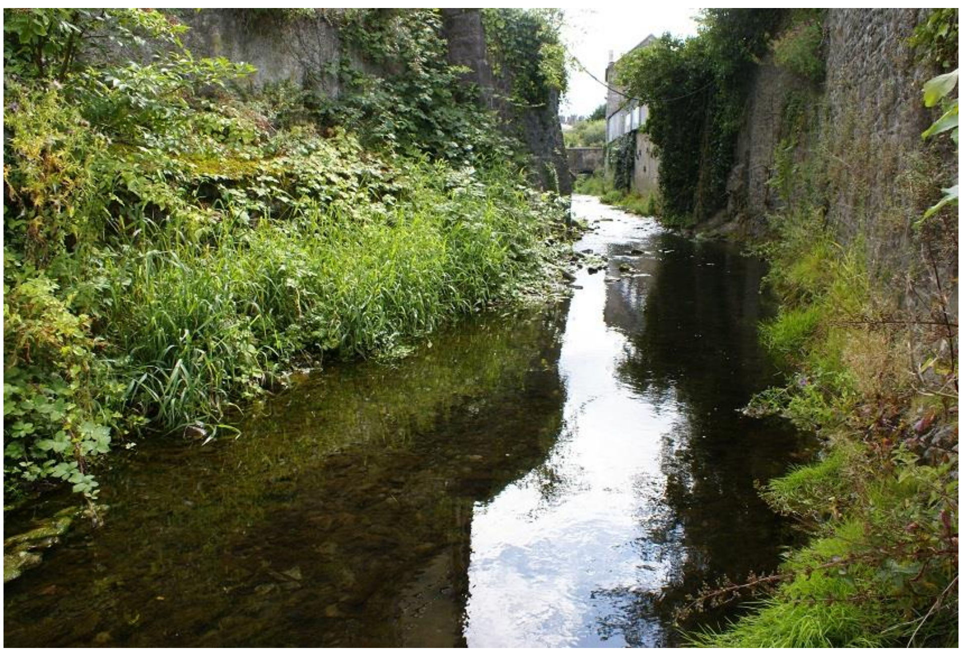


Photo 5: Vegetation in River Nore downstream of weir

Photo 6: Moribund crayfish, River Nore

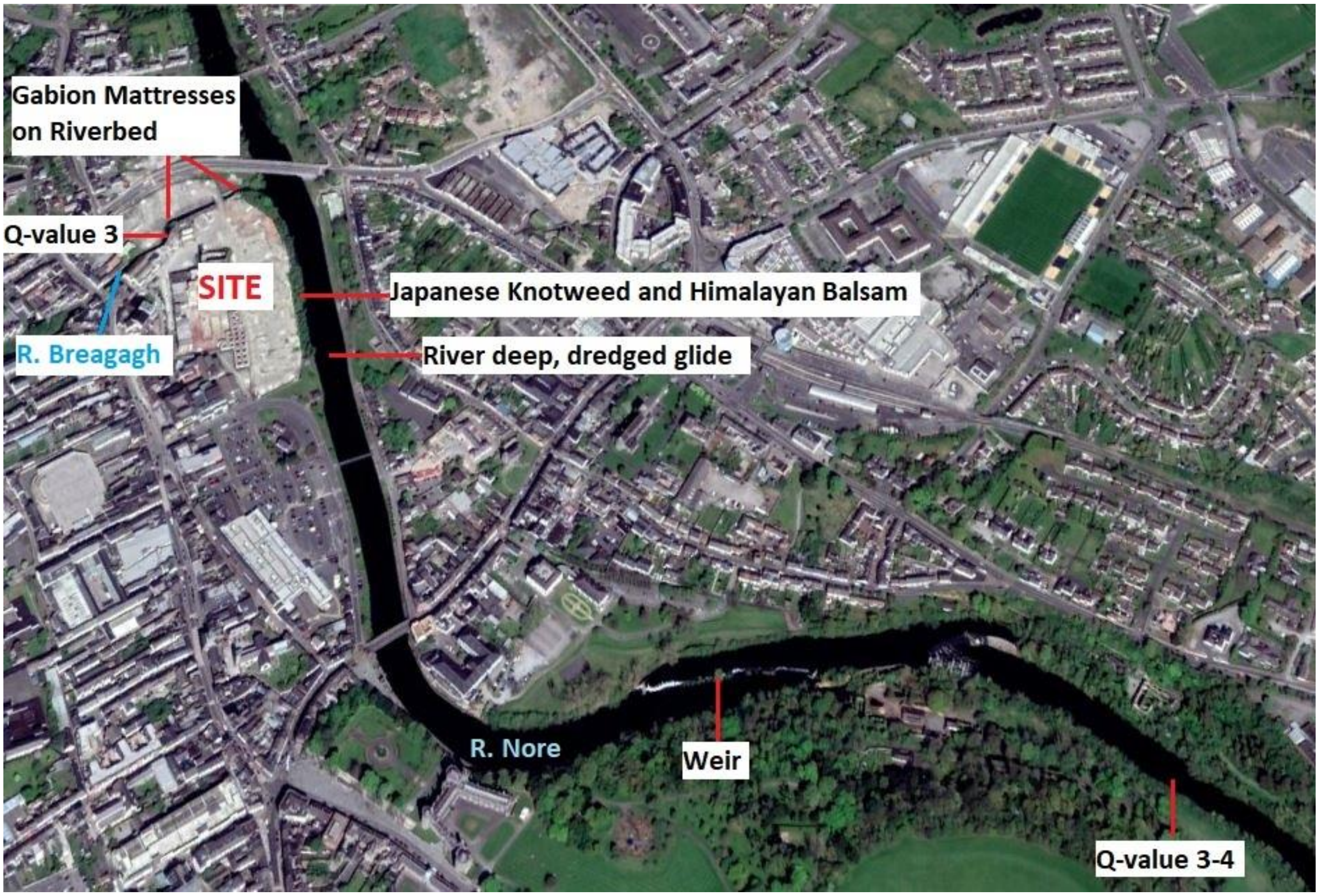
Photo 7: Salmon Parr, Breagagh River

Photo 8: Lamprey, River Nore

Photo 9: Japanese Knotweed and Himalayan Balsam on riverbank at Subject Site.

APPENDIX 2

SUBJECT SITE AND RIVERS



APPENDIX 3
REFERENCES

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Appendix 6.2

ABBEY QUARTER KILKENNY – LIGHTING DESIGN

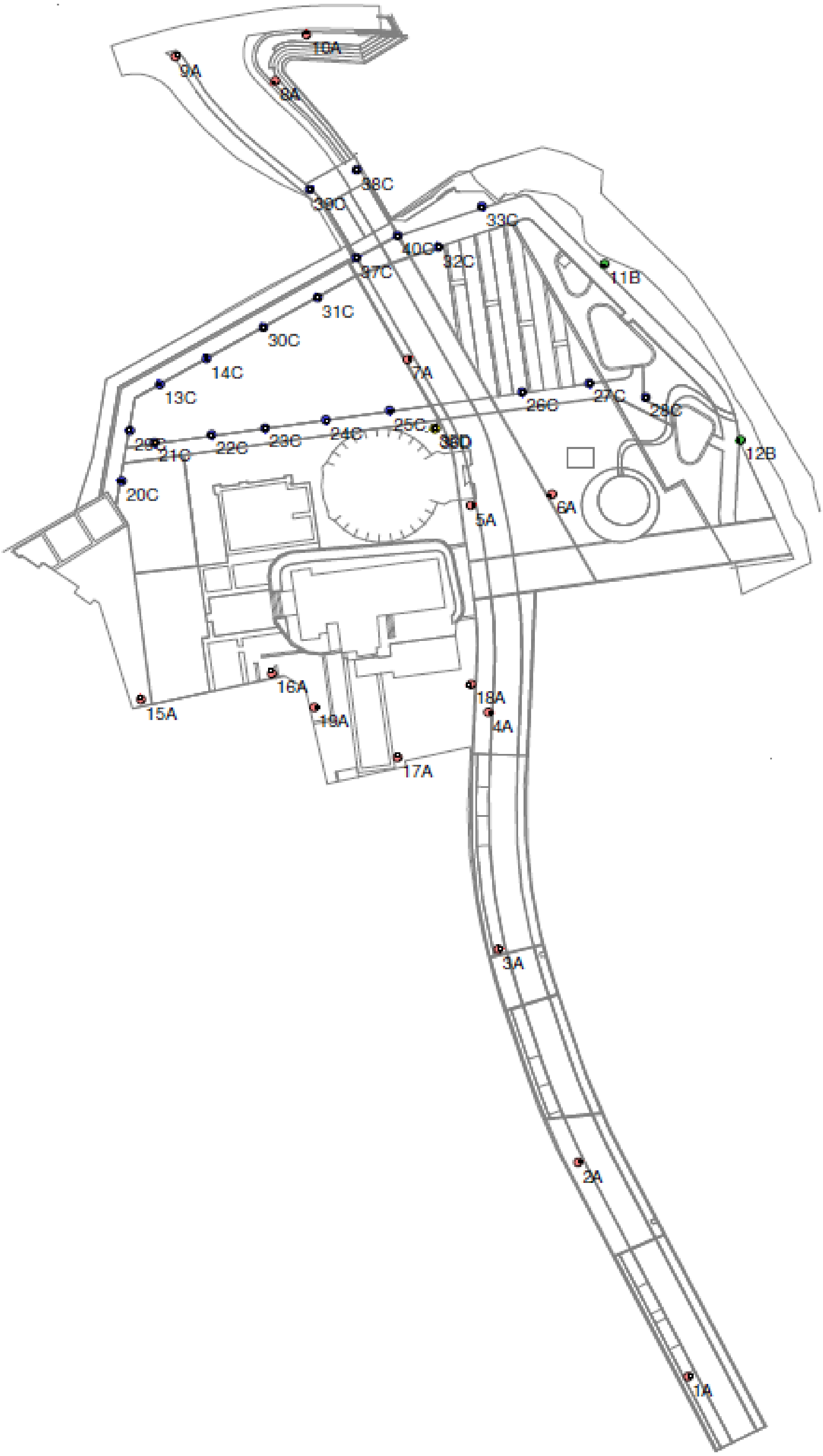
The following document outlines the specification of each light fitting type, the locations of each fitting and information on specific fitting selection, location of the light fittings and associated lux levels can be seen on the drawings below.

The lighting design was cogniscent of the need to minimise light spill to the Rivers Bregagh and Nore while catering for wildlife in the area.

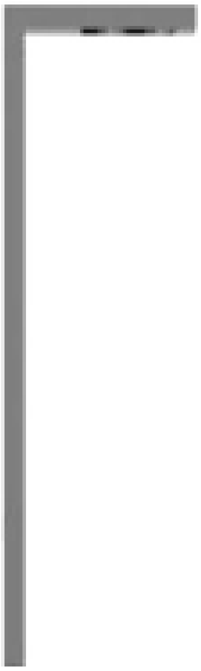
Examples of how this was achieved are outlined below.

- Selection of suitable light fittings with flat glass, wide angle optics and zero tilt angle
- Softer colour temperatures (2700K) to the walkway along the River Nore to minimise light spillage
- A maximum of 6m high lighting columns throughout the site
- Low level targeted lighting used where practical

An overview of the proposed light fitting locations is outlined below.



The following is detailed information about each selected light fitting, the locations of each fitting type (Referenced as A,B,C & D) can be seen on the layout drawing above.



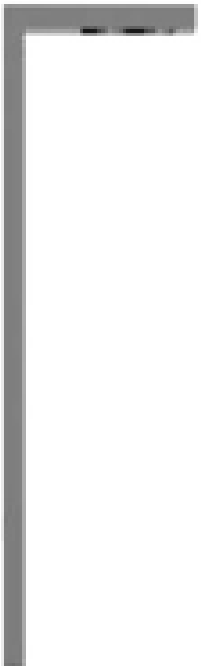
Luminaire A Data

Supplier	
Type	Veelite Vista 52w LED Street Optic Wide A13
Lamp(s)	32LED 4000K 500mA
Lamp Flux (klm)	6.24
File Name	5VSTX1050-A13.ies
Maintenance Factor	0.75
Imax70,80,90(cd/klm)	783.9, 437.7, 24.1
Lamp S/P Ratio	1.40
No. in Project	15

Fitting type A are located along the spine roadway through the site. Mounted on 6m high poles these light fittings use high efficiency LED's and have a colour temperature of 4000K.

These fittings use a street optic wide which allows excellent spread of light while minimising light spillage, the light fitting is set at a zero degree tilt.

The average lux level along the road is 10.6 lux which is in compliance with Class P2 of IS EN13201 for pedestrian areas and subsidiary roads.



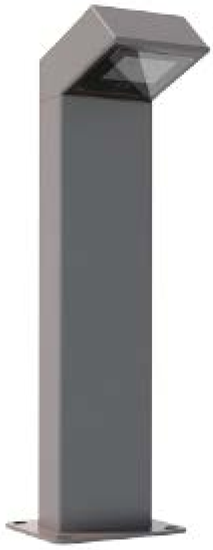
Luminaire B Data

Supplier	
Type	Veelite Vista 38w LED Street Optic Wide A13
Lamp(s)	16LED 2700K 700mA
Lamp Flux (klm)	3.33
File Name	5VSTX1040-A13 2700K.ies
Maintenance Factor	0.72
Imax70,80,90(cd/klm)	784.2, 437.8, 0.0
Lamp S/P Ratio	1.20
No. in Project	2

Fitting type B are located along the walkway to the River Nore, they utilise a colour temperature of 2700K which is a softer light and is in line with KCC recommendations for wildlife.

These fittings are a flat glass type and are set at a zero degree tilt which helps minimise light spill and glare.

There is a maximum of 0.5lux light spill to the River Nore which is confined to 1 area.



Luminaire C Data

Supplier	
Type	Veelite Kassio Bollard 11w LED Asymmetric A13
Lamp(s)	8LED 4000K 350mA
Lamp Flux (klm)	1.15
File Name	5KAS00010-A13.ies
Maintenance Factor	0.76
Imax70,80,90(cd/klm)	597.0, 963.7, 122.8
Lamp S/P Ratio	1.40
No. in Project	20

The Kassio bollard fitting is used in two areas, along the River Bregagh walk and on the bridge crossing the River Bregagh. The fitting has a colour temperature of 4000K to match the roadway lighting.

The bollards are 1.2m in height and are rated for 11w, as the fittings are low in heights they offer targeted lighting to the river walkway and courtyard areas, as can be seen on the lux level draiwngs below light soill is minimised using these fittings.

Luminaire D Data

Supplier	
Type	Veelite Faro Mast 47w LED 4K
Lamp(s)	LED 4K
Lamp Flux (klm)	6.92
File Name	Faro G-1107.FMF.T 47W Led 4K flood 62°. IES
Maintenance Factor	0.76
Imax70,80,90(cd/klm)	2.7, 0.5, 0.1
Lamp S/P Ratio	1.40
No. in Project	2

The final fitting type is a pole mounted floodlight which will be used as a feature light to the courtyard area of the Abbey, the pole height will be 6m.

The fitting used has a colour temperature of 4000K which matches the bollard and roadway lighting.

The light fittings will be angled so as to avoid light spill to surrounding areas

The following drawing indicates the Horizontal Illuminance of the proposed lighting scheme. It also demonstrates the minimal light spillage to both Rivers along with maximum lux levels to all areas of the proposed development. The numbers signify the maximum lux level in that area.

The average light level for the site is 10.6 lux with a minimum of 1.8 lux. This complies with Class P2 of IS EN 13201 / BS 5489 for pedestrian areas/subsidiary roads with S/P ratio of 1.4 applied

(Minimum requirements of 8.4 lux average, 1.7 lux minimum)

DATE:	**23 April 2020**
DESIGNER:	**Dan Staunton**
PROJECT No:	**16-04-03-01F**
PROJECT NAME:	**Abbey Quarter**

Veelite

Abbey Quarter, Kilkenny

IS EN 13201 / BS 5489
Class P2
S/P Ratio 1.4

Outdoor Lighting Report

Based On:
Lumen Output at 100,000 hours
Spot Lamp Replacement
Normal Environment
6 Year Cleaning Cycle
Ground is Level

PREPARED BY:

Dan Staunton
Veelite Lighting Ltd
Waterford, Ireland
+353 (0)51 875399
design@light.ie
www.light.ie

Layout Report

General Data

Dimensions in Metres Angles in Degrees
Grid Origin -26.6m x -21.9m
Area 211.6m x 354.5m
Sample Spacing 1.49m x 1.50m

Luminaires

Luminaire A Data

Supplier	
Type	Veelite Vista 52w LED Street Optic Wide A13
Lamp(s)	32LED 4000K 500mA
Lamp Flux (klm)	6.24
File Name	5VSTX1050-A13.ies
Maintenance Factor	0.75
Imax70,80,90(cd/klm)	783.9, 437.7, 24.1
Lamp S/P Ratio	1.40
No. in Project	15

Luminaire B Data

Supplier	
Type	Veelite Vista 38w LED Street Optic Wide A13
Lamp(s)	16LED 2700K 700mA
Lamp Flux (klm)	3.33
File Name	5VSTX1040-A13 2700K.ies
Maintenance Factor	0.72
Imax70,80,90(cd/klm)	784.2, 437.8, 0.0
Lamp S/P Ratio	1.20
No. in Project	2

Luminaire C Data

Supplier	
Type	Veelite Kassio Bollard 11w LED Asymmetric A13
Lamp(s)	8LED 4000K 350mA
Lamp Flux (klm)	1.15
File Name	5KAS00010-A13.ies
Maintenance Factor	0.76
Imax70,80,90(cd/klm)	597.0, 963.7, 122.8
Lamp S/P Ratio	1.40
No. in Project	20

Luminaire D Data

Supplier	
Type	Veelite Faro Mast 47w LED 4K
Lamp(s)	LED 4K
Lamp Flux (klm)	6.92
File Name	Faro G-1107.FMF.T 47W Led 4K flood 62°. IES
Maintenance Factor	0.76
Imax70,80,90(cd/klm)	2.7, 0.5, 0.1
Lamp S/P Ratio	1.40
No. in Project	2

Layout

ID	Type	X	Y	Height	Angle	Tilt	Cant	Out-reach	Target X	Target Y	Target Z
1	A	133.04	22.55	6.00	29.00	0.00	0.00	0.50			
2	A	111.61	65.95	6.00	26.00	0.00	0.00	0.50			
3	A	96.01	109.14	6.00	11.00	0.00	0.00	0.50			
4	A	94.09	157.06	6.00	355.00	0.00	0.00	0.50			
5	A	90.68	198.97	6.00	14.00	0.00	0.00	0.50			
6	A	106.48	201.20	6.00	204.00	0.00	0.00	0.50			
7	A	78.35	228.56	6.00	33.00	0.00	0.00	0.50			
8	A	52.65	284.91	6.00	220.00	0.00	0.00	0.50			
9	A	33.15	289.87	6.00	41.00	0.00	0.00	0.50			
10	A	58.69	294.28	6.00	92.00	0.00	0.00	0.50			

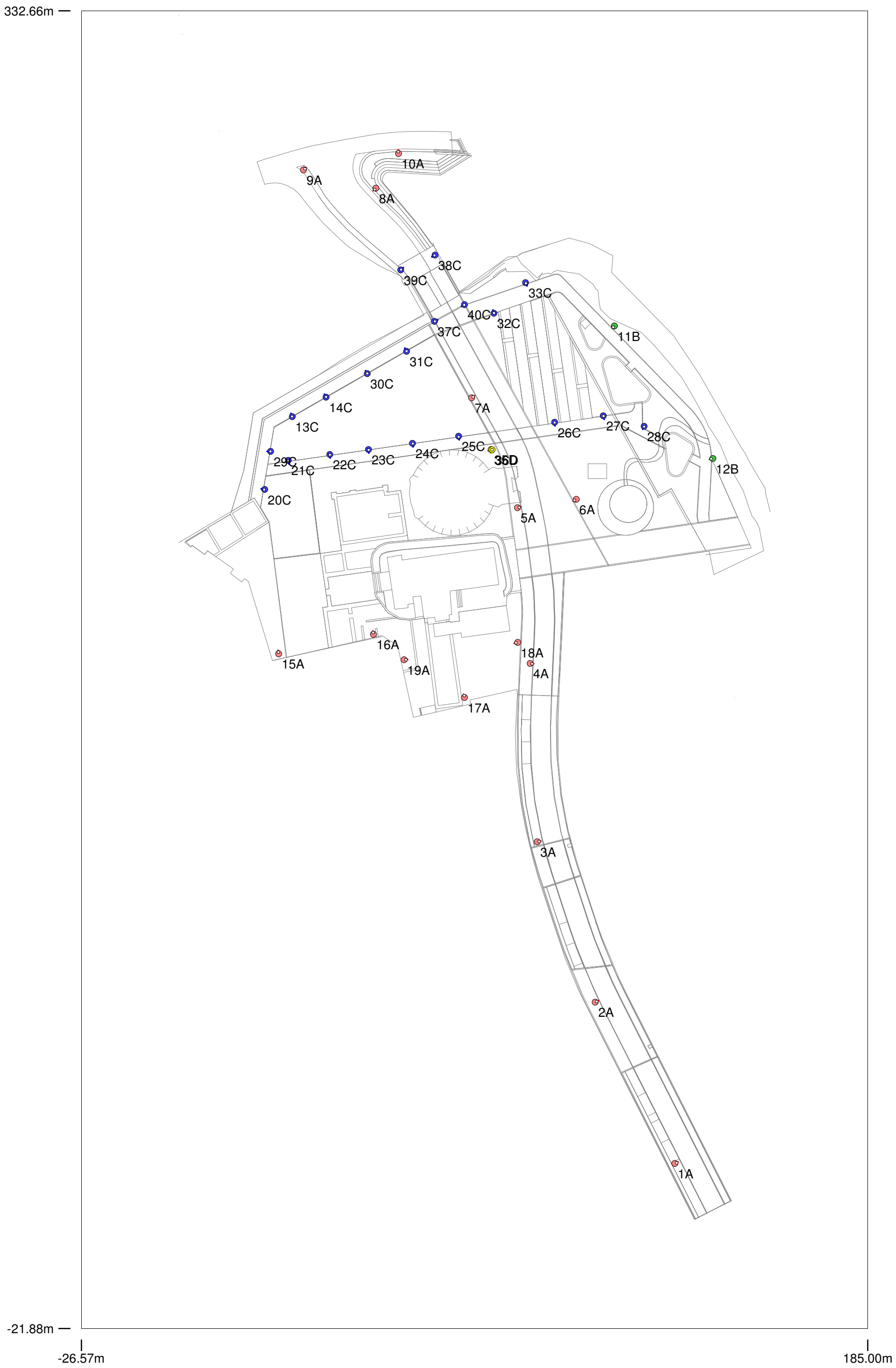
Layout Continued

ID	Type	X	Y	Height	Angle	Tilt	Cant	Out-reach	Target X	Target Y	Target Z
11	B	116.80	247.88	6.00	225.00	0.00	0.00	0.50			
12	B	143.25	212.24	6.00	195.00	0.00	0.00	0.50			
13	C	30.14	223.49	1.20	117.00	0.00	0.00	0.10			
14	C	39.26	228.69	1.20	120.00	0.00	0.00	0.10			
15	A	26.49	159.67	6.00	101.00	0.00	0.00	0.50			
16	A	51.95	164.89	6.00	100.00	0.00	0.00	0.50			
17	A	76.49	147.93	6.00	105.00	0.00	0.00	0.50			
18	A	90.74	162.78	6.00	194.00	0.00	0.00	0.50			
19	A	60.23	158.09	6.00	5.00	0.00	0.00	0.50			
20	C	22.70	203.93	1.20	172.00	0.00	0.00	0.10			
21	C	29.10	211.73	1.20	278.00	0.00	0.00	0.10			
22	C	40.20	213.29	1.20	277.00	0.00	0.00	0.10			
23	C	50.64	214.67	1.20	277.00	0.00	0.00	0.10			
24	C	62.49	216.31	1.20	279.00	0.00	0.00	0.10			
25	C	74.86	218.20	1.20	278.00	0.00	0.00	0.10			
26	C	100.67	222.01	1.20	275.00	0.00	0.00	0.10			
27	C	113.79	223.75	1.20	281.00	0.00	0.00	0.10			
28	C	124.78	220.92	1.20	243.00	0.00	0.00	0.10			
29	C	24.35	214.11	1.20	176.00	0.00	0.00	0.10			
30	C	50.34	235.07	1.20	125.00	0.00	0.00	0.10			
31	C	60.89	241.07	1.20	118.00	0.00	0.00	0.10			
32	C	84.38	251.26	1.20	108.00	0.00	0.00	0.10			
33	C	92.90	259.50	1.20	294.00	0.00	0.00	0.10			
35	D	83.58	214.69	5.50	208.00	45.00	0.00	0.00			
36	D	83.84	214.60	6.00	252.00	45.00	0.00	0.00			
37	C	68.38	249.11	1.20	26.00	0.00	0.00	0.10			
38	C	68.50	266.93	1.20	208.00	0.00	0.00	0.10			
39	C	59.27	262.95	1.20	41.00	0.00	0.00	0.10			
40	C	76.46	253.61	1.20	211.00	0.00	0.00	0.10			

7211824079

Horizontal Illuminance (lux)

Road and Paths



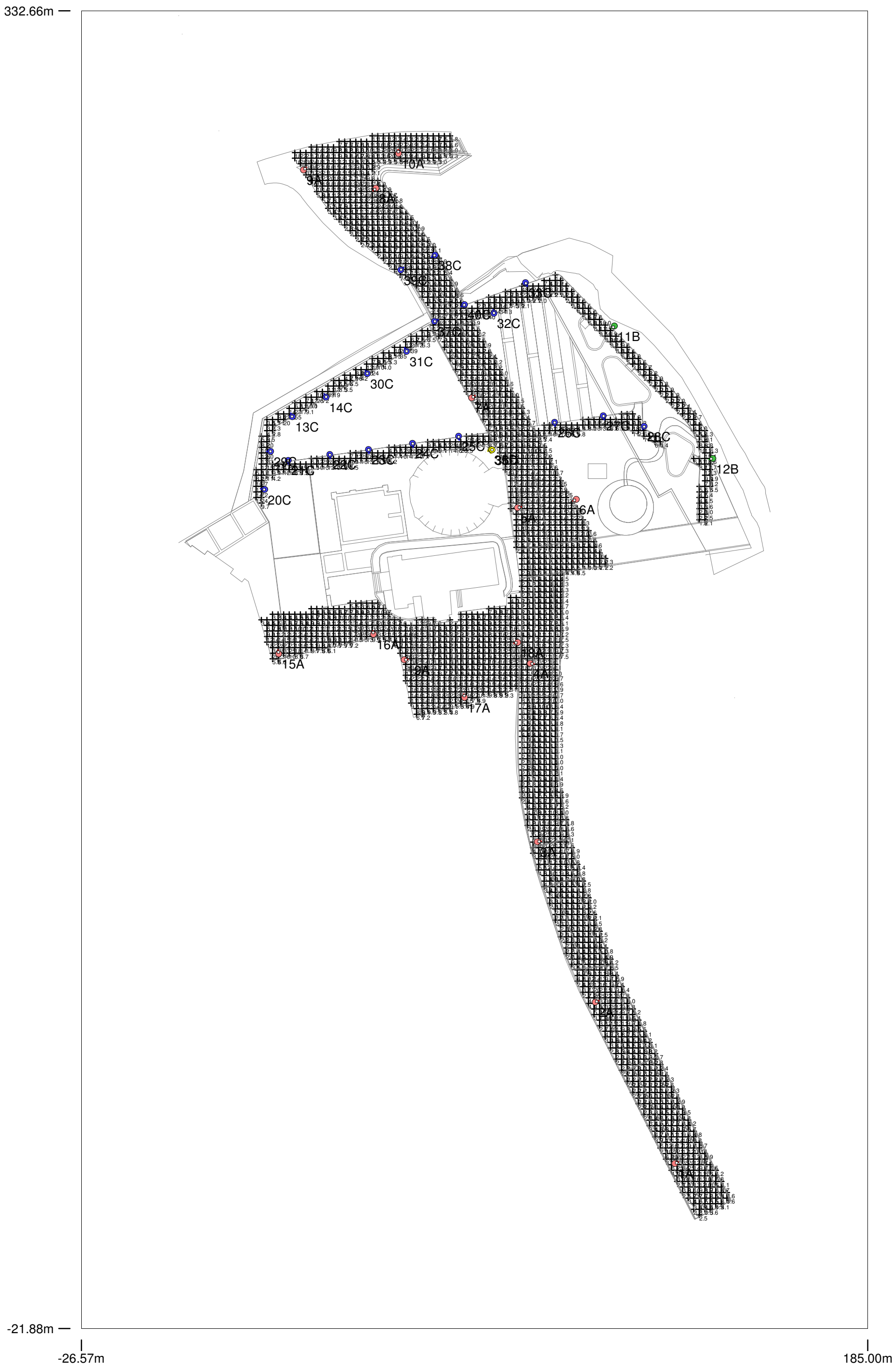
Results

Eav	10.66
Emin	1.83
Emax	120.82
Emin/Emax	0.02
Emin/Eav	0.17

7211824079

Horizontal Illuminance (lux)

Road and Paths



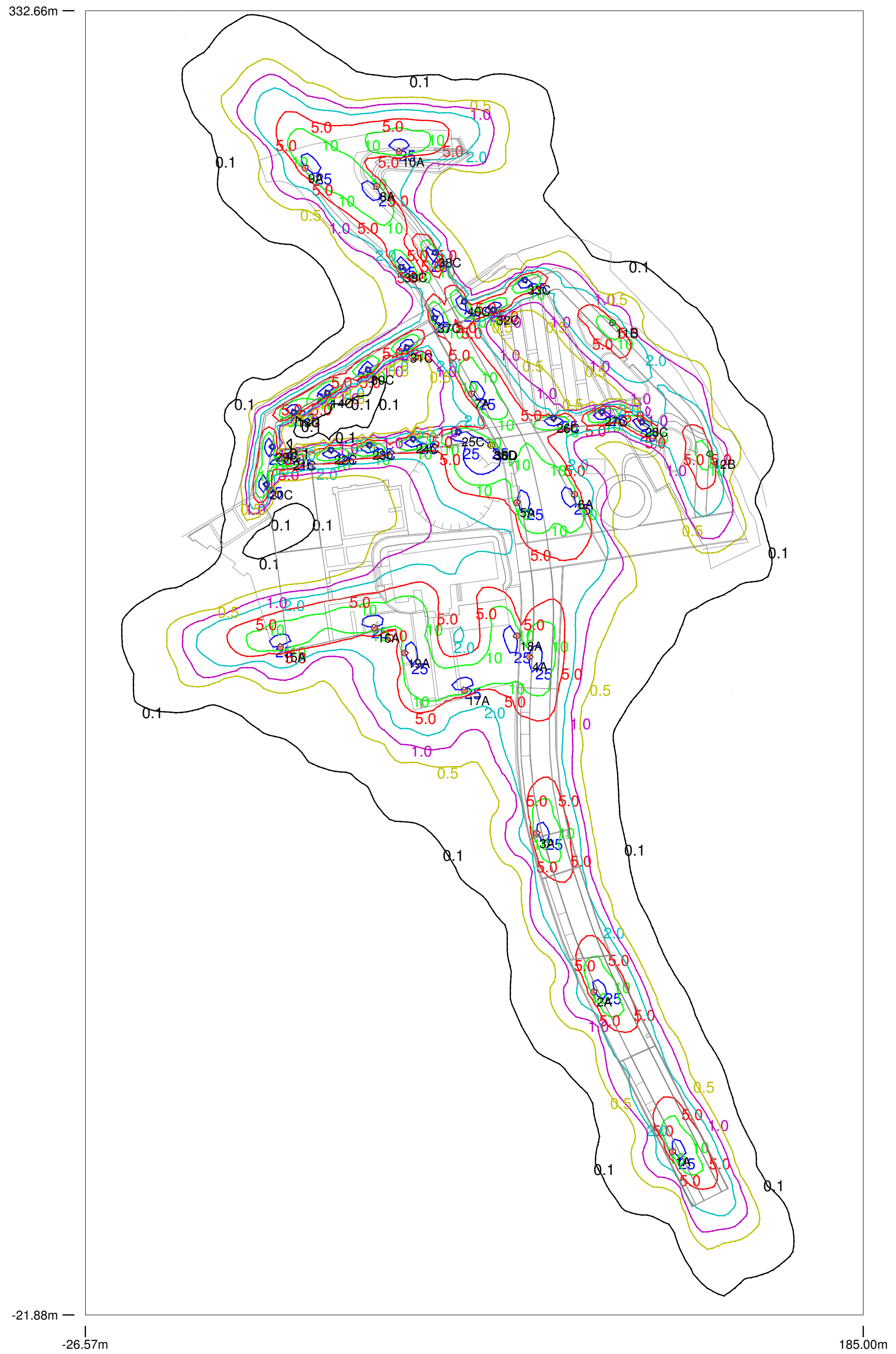
Results

Eav	10.66
Emin	1.83
Emax	120.82
Emin/Emax	0.02
Emin/Eav	0.17

7211824079

Horizontal Illuminance (lux)

Road and Paths



Results

Eav	10.66
Emin	1.83
Emax	120.82
Emin/Emax	0.02
Emin/Eav	0.17

7211824079

Faro Mast

Floodlighting

Architectural floodlight array available in a range of LED wattages, beam types and floodlight accessories.

Column Construction:
Galvanised Steel, Constant Diameter with Painted Finish (Flanged or Rooted). Typical Height 6m or 8m with an array of Floodlights (2/4/6/8 etc) as required.

Luminaire Construction:
Aluminium. IP65. IK06. Internal Driver.

Lens: Clear tempered glass as standard. Other types on request.

Finish: Grey RAL 9006 as standard. Anthracite Grey on request.

LED: Available in 7w-47w LED. 4K as standard, 3K on request.

Optics: 6 Beam Angles available: 14° Spot to 62° Flood. Medium (24°) beam as standard.

Options: DALI, beam angles, RAL, Anti-glare louver, Anti vandal Screen, Microprismatic lens, Directional flaps.

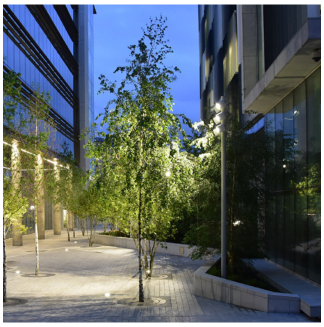
Manufactured: EU.

Product Compliance: EN 60598; CE.

Size 1

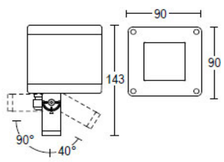
Size 2

Size 3

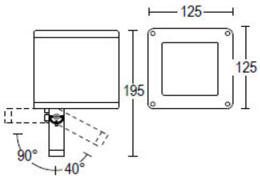


DIMENSIONS

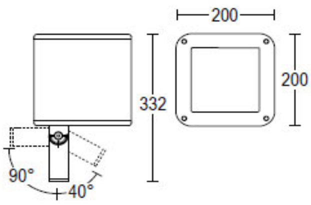
Size 1



Size 2



Size 3



All dimensions in mm.

ORDERING CODE

Wattage	Type	Size	Code	Description	Lumens
7w	LED	1	G-1132.ALM.T	Faro Floodlight, 26° Beam, 4k	1080 lm
7w	LED	1	G-1132.ALF.T	Faro Floodlight, 32° Beam, 4k	1080 lm
16w	LED	2	G-1133.DHS.T	Faro Floodlight, 14° Beam, 4k	2340 lm
16w	LED	2	G-1133.DHM.T	Faro Floodlight, 24° Beam, 4k	2340 lm
16w	LED	2	G-1133.DHF.T	Faro Floodlight, 35° Beam, 4k	2340 lm
29w	LED	2	G-1133.FPS.T	Faro Floodlight, 14° Beam, 4k	3990 lm
29w	LED	2	G-1133.FPM.T	Faro Floodlight, 24° Beam, 4k	3990 lm
29w	LED	2	G-1133.FPF.T	Faro Floodlight, 35° Beam, 4k	3990 lm
32w	LED	3	G-1107.EDS.T	Faro Floodlight, 16° Beam, 4k	5070 lm
32w	LED	3	G-1107.EDM.T	Faro Floodlight, 30° Beam, 4k	5070 lm
32w	LED	3	G-1107.EDF.T	Faro Floodlight, 62° Beam, 4k	5070 lm
39w	LED	3	G-1107.CES.T	Faro Floodlight, 16° Beam, 4k	5820 lm
39w	LED	3	G-1107.CEM.T	Faro Floodlight, 30° Beam, 4k	5820 lm
39w	LED	3	G-1107.CEF.T	Faro Floodlight, 62° Beam, 4k	5820 lm
47w	LED	3	G-1107.FMS.T	Faro Floodlight, 16° Beam, 4k	6920 lm
47w	LED	3	G-1107.FMM.T	Faro Floodlight, 30° Beam, 4k	6920 lm
47w	LED	3	G-1107.FMF.T	Faro Floodlight, 62° Beam, 4k	6920 lm

+ Mast (Constant Diameter column) - please specify - height - rooted/flanged - qty of Luminaires per Mast.

OPTIONS

3K: 3000K Colour Temperature
.05: Anthracite Grey Finish
.13: Light Grey Finish
DALI: DALI on request
G-125: Directional Flaps
G-180: Anti-glare louvre
G-181: Anti vandal screen
G-182: Microprismatic lens

Kassio Bollard

External lighting

LED Bollard with simple design shape offered in 3 heights suitable for paths, gardens or plaza areas.

Construction: Cast Aluminium Head, IP66, IK10.
Galvanised Steel Shaft. 900mm high as standard. Height 1.2M or 1.5M on request.

Installation: Flanged as standard.
Access Door on rear of Shaft.

LED: 11w (8 LED) to 27w (16 LED).
CRI 70+. 4K as standard. 3K on request.
Cree LED, Life L70 B10 > 100,000 hours.

Optics: Symmetric (C6 optic) as standard.
Asymmetric (A13) on request is designed to light pathways.

Finish: Black RAL 9005 as standard.
Other RALs on request including Wooden Effect Finish on Shaft.

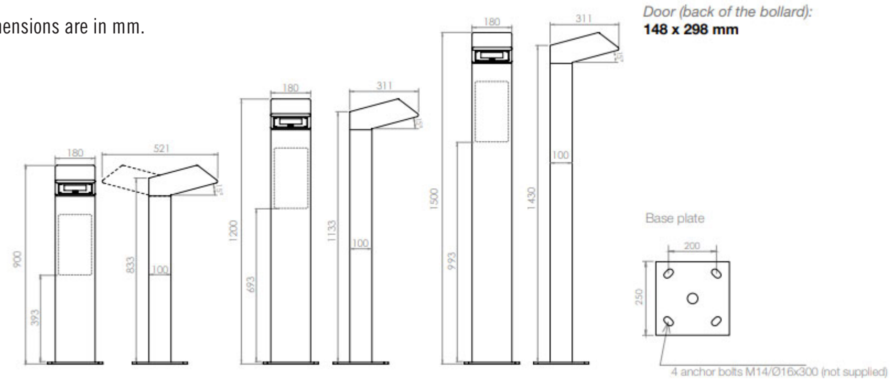
Options: Twin head, Symmetric/ Asymmetric, Different Heights, Wooden Effect Finish, DALI.

Manufactured: EU.

Product Compliance: EN 60598, CE.

DIMENSIONS

All Dimensions are in mm.

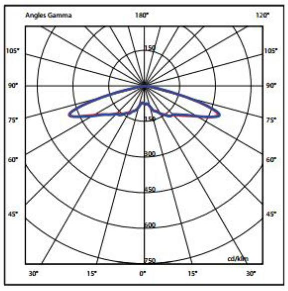


Weight: 20 / 25 / 30 Kgs. - One Head version

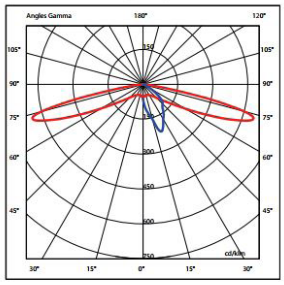
Weight: 23 / 28 / 33 Kgs. - Two Head version

OPTICS

Symmetric - C6



Asymmetric - A13



SIZES & FINISH EXAMPLES

ORDERING CODE

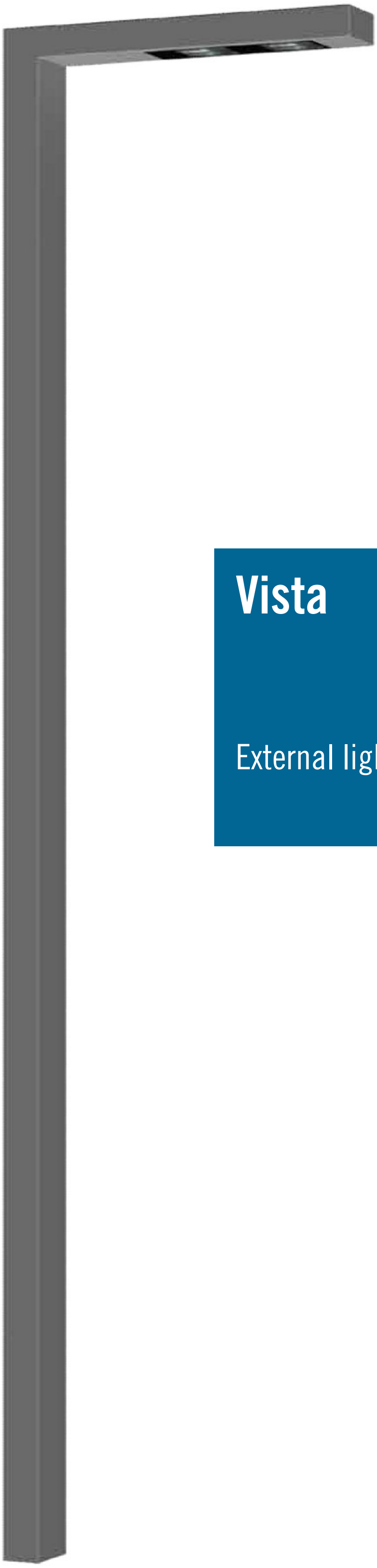
Wattage*	Type	Code - Single	Code - Twin	Details	Optic	Option	Lumens*
11w	8LED	5KAS00010	5KAS00210	Flanged Bollard 900mm, 350mA Driver, 4K	C6	A13	1150
15w	8LED	5KAS00011	5KAS00211	Flanged Bollard 900mm, 500mA Driver, 4K	C6	A13	1560
20w	8LED	5KAS00012	5KAS00212	Flanged Bollard 900mm, 700mA Driver, 4K	C6	A13	2050
19w	16LED	5KAS00015	5KAS00215	Flanged Bollard 900mm, 350mA Driver, 4K	C6	A13	2300
27w	16LED	5KAS00016	5KAS00216	Flanged Bollard 900mm, 500mA Driver, 4K	C6	A13	3120

*Per Single Head version. (Twin Head version will be double).

OPTIONS

- RAL: Pls specify
- 1.2m: Height 1.2m
- 1.5m: Height 1.5m
- DALI: DALI Dimmable
- 1-10V: 1-10V Dimmable
- CLO: Constant Lumen Output
- PRO: Programmed Dimming
- STW: Street Optic Wide (A8)
- 3K: 3000K, Warm White
- MRN: Marine Finish

Single Version Twin Version



Vista

External lighting

Designer range Luminaire with LED optics and integrated pole, for road or pathway applications. Single or Twin Head.

Construction: Die Cast and Extruded Aluminium, aluminium Reflector, tempered glass. IP66 optics, IP55 Housing. IK08. Galvanized steel Pole. Tilt on Luminaires - 0°, 10°, 20° or 30° options. Other Tilts on Request.

Finish: Black as Standard. Other RALs on request. Wooden Effect on request.

LED: Max 146W (or 2 x 146W on Twin version).

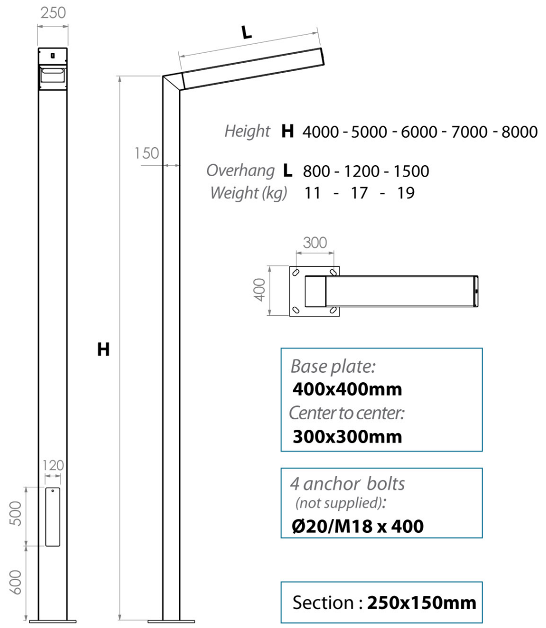
Options: Tilt, heights, Different Wattages/ Luminaires at different heights, Wall Mounting.

Manufactured: EU.

Product Compliance: EN60598, CE.

DIMENSIONS

All Dimensions in mm



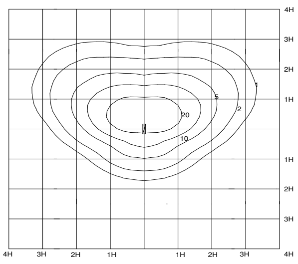
Base plate:
400x400mm
Center to center:
300x300mm

4 anchor bolts
(not supplied):
Ø20/M18 x 400

Section : **250x150mm**

APPLICATION GUIDE

Vista 100w Asymmetric
Height 6m
2 x 50w LED, 4.5K - 10° Tilt
Contours in Lux
M. Factor = 0.90

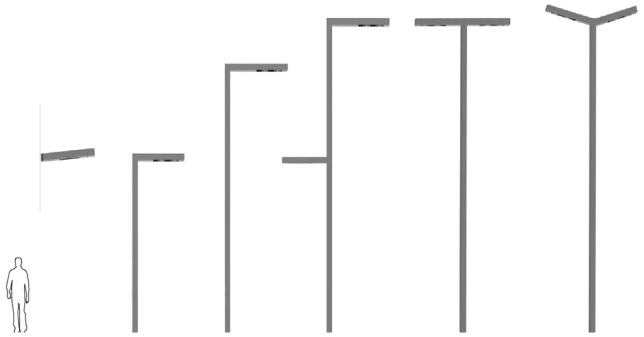


ORDERING CODE - Pole with 1 Luminaire on Top

Watt	Type	Code - 4m	Code - 5m	Code - 6m	Code - 7m	Code - 8m	Details	Lumens
38w	LED	5VST41040	5VST51040	5VST61040	5VST71040	5VST81040	1 Vista with Pole, No Tilt	4105 lm
52w	LED	5VST41050	5VST51050	5VST61050	5VST71050	5VST81050	1 Vista with Pole, No Tilt	6235 lm
73w	LED	5VST41070	5VST51070	5VST61070	5VST71070	5VST81070	1 Vista with Pole, No Tilt	8205 lm
2x36w	LED	5VST41240	5VST51240	5VST61240	5VST71240	5VST81240	1 Vista with Pole, No Tilt	8210 lm
2x52w	LED	5VST41250	5VST51250	5VST61250	5VST71250	5VST81250	1 Vista with Pole, No Tilt	12470 lm
2x73w	LED	5VST41270	5VST51270	5VST61270	5VST71270	5VST81270	1 Vista with Pole, No Tilt	16410 lm

OPTIONS

RAL:	Please specify
TWIN:	Twin Head
3K:	3000 K



Appendix 6.3

Independent Tree Surveys

Tree Survey Report
Abbey Quarter
Kilkenny
Co. Kilkenny

June 2020

Independent Tree Surveys
Our Lady's Cottage,
Drummond
Rosenallis
Co. Laois
T: 057 8628597
M: 087 1380687
www.independenttreesurveys.ie

Arboricultural Association Professional Member

Contents

1.0 Introduction

It is planned to redevelop land within the Abbey Quarter area of Kilkenny City. The site contains a number of trees and so this report has been prepared to provide an arboricultural assessment of the trees to input into the design and layout of the project and to form part of the planning package for the project.

2.0 Instruction

To carry out a Tree Survey and prepare an Arboricultural Impact Assessment, Method Statement and Tree Protection Plan in accordance with BS5837: *Trees in relation to design, demolition and construction (2012)* of the significant trees on the development lands within the Abbey Quarter area of Kilkenny City.

3.0 Report Limitations

- The inspection has been carried out from ground level using visual observation methods only.
- Trees are living organisms whose health and condition can change rapidly. Trees should be checked on a regular basis, preferably once a year. The conclusions and recommendations of this report are valid for one year.
- The fruiting bodies of some important species of decay fungi only emerge at certain times of the year and may not have been visible during this inspection.
- There is no such thing as a 100% safe tree in all conditions, since even perfectly healthy trees may fall or suffer branch break.
- Climbing plants such as Ivy can obscure structural defects and some symptoms of disease, where such plants prevent a thorough examination it is recommended that the climber be cut at ground level and the tree re-inspected when it has died back.

Report Prepared by

John Morgan
BSc (Hons) Tech Cert (Arbor A)
M Abor A (Membership number PR407)

June 12th 2020

4.0 Survey Methodology

The significant individual trees inside the site were assessed from ground level using Visual Tree Assessment (VTA) techniques and relevant observations and findings were recorded in compliance with the industry standard document BS5837: *Trees in relation to design, demolition and construction (2012)*.

4.1 Survey Key

Tree Numbers
Individual trees around the site were allocated numbers. These numbers identify the trees and tree groups in the survey schedule and on the supporting survey drawings.

Tree Species
Common and botanical names of the tree species were recorded.

Tree Crown Dimensions
Tree height (Ht), crown clearance (Cl) and crown-spread (NESW cardinal points) measurements are in metres and are estimated.

Stem Diameter (Dbh)
Measurements are in millimetres and taken at 1.5m from ground level, multiple stems (St) are recorded as a function of the BS:5837 RPA formulae described below.

Tree age classes
Age classes were recorded as:

Y	Young	Recently planted (with 5 years or so)
SM	Semi-Mature	Well established young tree
EM	Early Mature	Established tree not yet fully grown
M	Mature	Full or near full grown tree
LM	Late Mature	Older specimen in full maturity
OM	Over Mature	Reached full maturity now declining through natural causes
Vet	Veteran	Notable due to large size, old age, ecological importance

Tree Physiological and Structural condition
Tree condition was graded as

Good:	No obvious defects visible, vigour and form of tree good.
Fair:	Tree in average condition for its age and the environment.
Poor:	Tree shows signs of ill health/structural defect
Bad:	Tree in seriously bad health/major structural problem

Work Recommendations
Preliminary management recommendations are made where necessary and pertain to current site conditions unless otherwise stated.

Estimated Remaining Contribution (ERC)
The approximate number of years that a tree should continue to live and contribute amenity, conservation or landscape value to the site under current site conditions.

4.2 Tree Retention Category (Cat) (BS5837: 2012 Trees in relation to design, demolition and construction – Recommendations)

The tree retention category system grades a tree's suitability for retention within a development:

A Indicates a tree of high quality and value. These are trees that are particularly good examples of their species, which also provide landscape value. These trees are in such a condition as to be able to make a substantial contribution. (A minimum of 40 years is suggested)

B Indicates a tree of moderate quality and value. Trees that might be included in the high category, but are downgraded because of impaired condition. These trees are in such a condition as to make a significant contribution. (A minimum of 20 years is suggested)

C Indicates a tree of low quality and value - trees with an estimated remaining life expectancy of at least 10 years, or trees with a stem diameter of below 150mm and/or <10m in height.

U Trees that are in such a condition that they cannot realistically be retained as living trees in the context of the current land use for longer than 10 years.

Sub Categories
Tree categories may be further categorised using the following sub-categories (e.g. C1, C2 or C3) - 1 mainly Arboricultural qualities, 2 mainly landscape qualities, 3 mainly cultural values.

4.3 Root Protection Area

The Root Protection Area **(**RPA) is the minimum area around individual trees to be protected from disturbance during construction works; RPA is recorded as a radius in metres measured from the tree stem and is shown on the tree survey/constraints drawing as a circle with the tree stem in the centre.

For single stem trees, the root protection area (RPA) should be calculated as an area equivalent to a circle with a radius 12 times the stem diameter.

For trees with more than one stem, one of the two calculation methods below should be used.
The calculated RPA for each tree should be capped to 707 m2.

a) For trees with two to five stems, the combined stem diameter should be calculated as follows:
√ ((stem diameter 1)2 + (stem diameter 2)2 ... + (stem diameter 5)2)
b) For trees with more than five stems, the combined stem diameter should be calculated as follows:
√ ((mean stem diameter)2 × number of stems)

5.0 Findings

The trees were assessed during a site visit on the 5th of June 2020; the field data for the trees is contained in the accompanying Tree Survey Schedule. Approximate tree location, BS5837 category, RPA and approximate crown shape are shown on the Tree Survey Drawing 20020_TS.

Full details of the individual trees assessed on the site are listed in the Tree Survey Schedule in the appendices of the report. A total of 12 individual trees were assessed as part of the survey fieldwork; of these none was graded category A (high value), one was graded category B tree (moderate value), 10 trees were category C trees (low value) and one tree was classed as category U (<10 years ULE).

The survey site covered the old brewery lands proposed for redevelopment and grounds in the immediate vicinity of the old abbey buildings. All of the trees surveyed appear to have been deliberately planted in the past as part of a landscape scheme, rather than to have arisen from natural regeneration. All of the trees are characterised by being located in positions with very limited space for both crown and root development. The trees have been planted into narrow landscape verges very close to the existing structures, and this restricted growing space is now limiting tree growth and creating conflict between the trees and the heritage buildings.

The Willow tree T9 is the largest tree on the site and seems to be in relatively good health; unfortunately, this tree is only 2m or so from the gable end of the building and requires regular pruning to keep branching away from the window structures etc. It is quite likely that root spread from this tree extends out underneath the concrete slab to the east, although this has not been confirmed.

6.0 Preliminary Management Recommendations

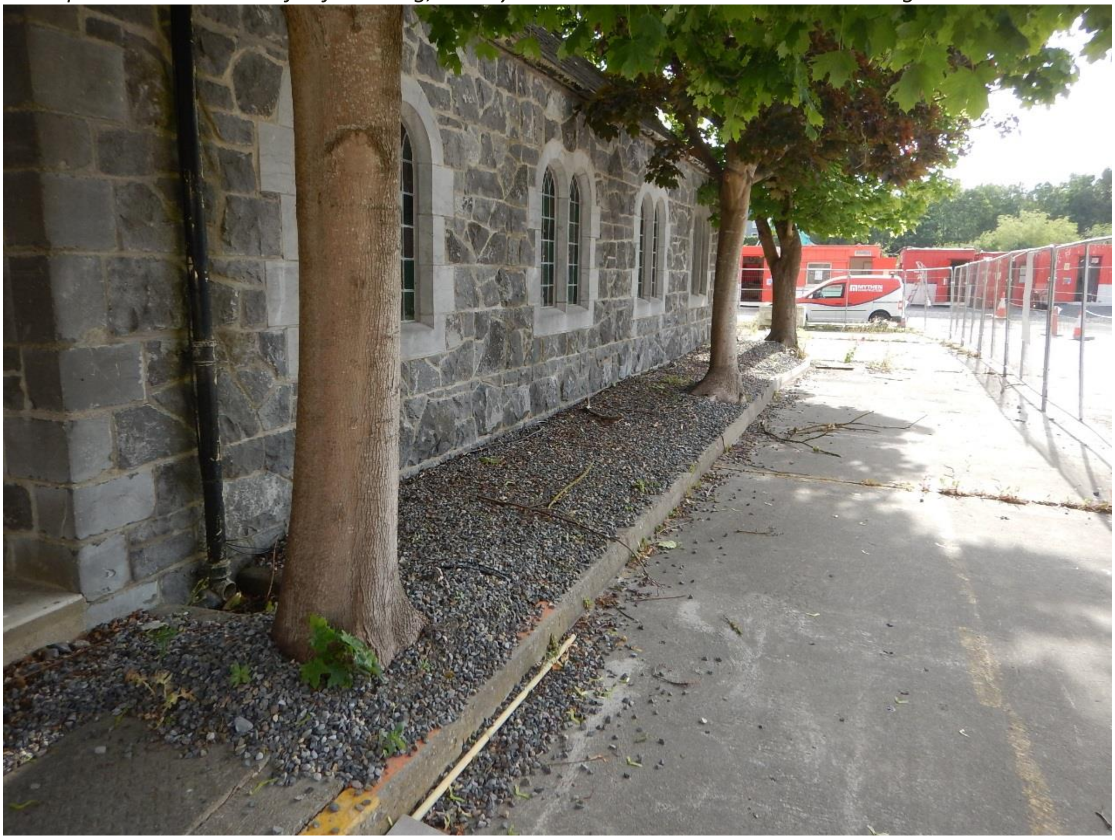
Preliminary management recommendations for the trees assessed are listed in the tree survey schedule in the appendices; these pertain to *current* site conditions unless otherwise stated.

All tree work should be carried out by qualified and experienced tree surgeons.

All tree work should be in accordance with *BS3998 (2010) Tree Work – Recommendations.*

7.0 Site Photographs

1. Maple trees T1-T3 to left of building, Cherry trees T7-T8 visible between buildings



2. Trees T1-T3 showing close proximity of tree stems to building and very narrow verge in which the trees have been planted

3. Cherry trees T4-T8 viewed from the east; note proximity to old building

4. Mature Willow tree T9 to east of gable end of old building

5. Maple trees T11 and T12 close to boundary wall

6. Crack in wall close to the base of tree T12

8.0 Arboricultural Impact of the New Development

The site is to be developed from disused industrial premises into a new urban amenity area, which will include extensive tree planting as part of a comprehensive new landscape plan. The development will entail considerable changes to the site, including the replacement of some of the existing surfacing and alterations to ground levels in places. The development will enable the establishment of more appropriate tree planting within a layout that is more compatible for long-term tree growth into maturity.

As part of the scheme, the five Maple trees labelled T1-T3 & T11-T12 will be removed and replaced with fresh planting in positions with more space for both root and crown development; this will have a positive impact on the arboricultural value of the site.

The five Cherry trees (T4-T8) will be unaffected by the works, however, trees T9 and T10 will be vulnerable to root and above ground damage unless works in the adjacent areas is well planned and managed. Measures recommended to mitigate the risk of damage during the development works are described below.

9.0 Arboricultural Method Statement

9.1 Tree Work Operations

The individual trees T1-T3 & T11-T12 will be felled to facilitate the new development.

All of the above trees will be felled to stump and the arisings removed to a suitable green waste facility or recycled as mulch on the site. The stumps of the trees felled will be removed by stump grinder where practicable.

Willow tree (T9) will be pruned to increase the clearance from the branching to ground level over the work area to the east of the tree; this will help reduce the likelihood of accidental branch damage from construction activity.

All tree work should be carried out by qualified and experienced tree surgeons; and be in accordance with *BS3998 (2010) Tree Work – Recommendations.*

9.2 Tree Protection Measures

Sturdy tree protection fencing (see figure 1 below) or suitable site hoarding will be erected along the lines shown on the Tree Protection Plan Drawing 20020_TPP to prevent construction work encroaching into the root protection areas of the trees to be retained. The tree protection measures will be put in place *before* demolition or construction work commences and should remain in place until their removal or re-location is authorised by a qualified arborist.

The works to lift the existing concrete slab within the RPAs of trees T9 & T10 will be carried out machinery or operators working with care from hard surfacing outside the RPAs where practicable. Where there is an existing sub-base, this should be left intact and re-used underneath the new concrete slab wherever possible. Where there is no existing sub-base and a compact surface is required beneath the new concrete slab within the RPAs of trees T9 and T10, the slab should be poured upon a layer of engineering product (such as *Arborraft, Cellweb* or *Terram* for example) designed to minimise soil compaction. The area that may require such engineered ground protection systems is shown on the Tree Protection Plan Drawing 20020_TPP.

The area of new concrete slab adjacent to trees T9 and T10 should be lined with an approved geotextile prior to pouring to limit the caustic effects of wet concrete affecting the adjacent tree roots. Where it is considered appropriate, smaller roots of 25mm or less should be pruned back by a qualified arborist.

All new underground services such as water, foul water and electricity will be routed away from the RPAs of trees to be retained; where this is not practical the services will be installed under any significant tree roots into trenches excavated by compressed air lance (*Airspade*) or other approved tree root friendly system such as Air-Vacuum truck, Mole drilling etc.

All exposed roots and/or soil profiles containing roots of trees to be retained will be kept damp in dry conditions by regular watering and be covered with a double layer of hessian fabric to prevent desiccation. Backfill should be of good quality topsoil, structural soil or clean sand.

Where machinery access has to encroach the RPAs of the trees to be retained for reasons unforeseen and unavoidable; suitable ground protection will be put in place to prevent any significant soil compaction or root damage near the trees; this should take the form of suitable strength ground protection mats or cellular confinement system capable of supporting the appropriate weight.

All site offices, materials storage, staff parking etc. will located outside of the RPAs of the trees.

The tree protection measures and specialist work methods will be overseen and directed on-site by a dedicated site arborist. The arborist should also make regular visits to the site during the construction process to ensure compliance and be available to provide advice and guidance where necessary.

The retained trees will be assessed by a qualified arborist following the completion of the construction works.

10.0 Appendices

Tree Protection on Construction Sites – General Recommendations

Tree Survey Schedule

Tree Survey Drawing 20020_TS (Tree Constraints Plan)

Tree Protection Drawing 20020_TPP

Tree Protection on Construction Sites – General Recommendations

Trees being retained should be protected from unnecessary damage during the construction process by effective construction-proof barriers that will define the limits for machinery drivers and other construction staff. Ground protected by the fencing will be known as the Construction Exclusion Zone (CEZ). Sturdy protective fencing will be erected along the points identified in the Tree Protection Plan **prior** to any soil disturbance and excavation work starting; this is essential to prevent any root or branch damage to the retained trees. The British Standard BS5837: *Trees in relation to design, demolition and construction (2012)* specifies appropriate fencing; see figure 1 below.

Figure 1. Protective fence specification

For light access works within the CEZ the installation of suitable ground protection in the form of scaffold boards, woodchip mulch or specialist ground protection mats/plates may be acceptable.
All weather notices will be erected on the fence with words such as: "Tree Protection Fence — Keep Out". When the fencing has been erected, the construction work can commence. The fencing will be inspected on a regular basis during the duration of the construction process and shall remain in place until heavy building and landscaping work has finished and its removal is authorised by a qualified arborist.

Trench digging or other excavation works for services etc. will not be permitted in the CEZ unless approved and supervised by a qualified arborist using methods outlined in BS5837: *Trees in relation to design, demolition and construction (2012)*.

Care will be taken when planning site operations to ensure that wide or tall loads or plant with booms, jibs and counterweights can operate without coming into contact with retained trees. Such contact can result in serious damage to them and might make their safe retention impossible.

Materials, which can contaminate the soil, e.g. concrete mixings, diesel oil and vehicle washings, will not be discharged within 10 m of a tree stem.

Fires will not be lit in a position where their flames can extend to within 5 m of foliage, branches or trunk. This will depend on the size of the fire and the wind direction.

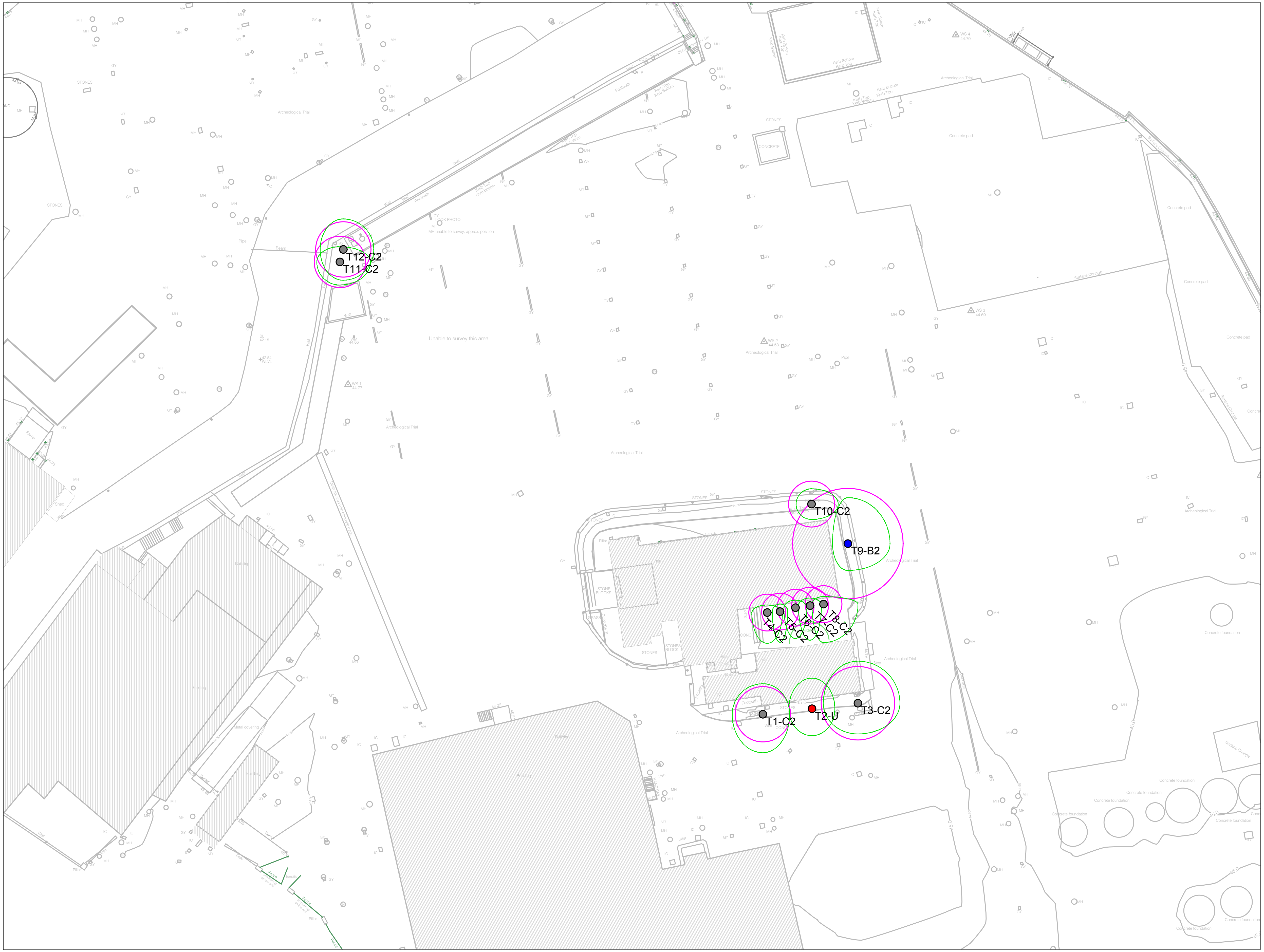
Notice boards, wires and such like will not be attached to any trees. Site offices, materials storage and contractor parking will all be outside the CEZ.

Tree Survey Schedule
Abbey Quarter
Kilkenny City, Co. Kilkenny
June 2020

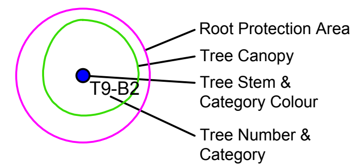
Type	No.	Species	Age	Ht m	Dbh mm	St	Cr	N	S	E	W	ERC	Phys Cond	Structural Condition/Comments	Preliminary Recommendations	RPA m	Cat
T	1	Acer platanoides (Norway Maple)	SM	9.5	300	1	2	4	5	3.5	4	10	Fair	Fair. Fair vitality. Small Maple tree growing in tight verge between kerb and building. Very limited rooting area that is now restricting growth. Tree is becoming oversized for site with branches encroaching upon building. Scattered minor deadwood. Limited potential to develop into maturity.	Prune back from building roof if retained. Consider removal as part of good management.	3.6	C2
T	2	Acer platanoides 'Crimson King' (Norway Maple)	SM	9	300	1	2	4	3.5	3	3	<10	Poor	Fair/Poor. Small Maple tree now declining in health. Significant dieback in crown. Minor deadwood in crown. Restricted rooting area between kerb and building. Branches encroaching upon building. Very limited future potential.	Consider removal as part of good management.	3.6	U
T	3	Acer platanoides (Norway Maple)	SM	11	400	1	2	5.5	4	5.5	4.5	10	Poor	Fair. Low vitality. Slightly larger Maple in linear group of three trees by building. Very restricted rooting area limiting potential for growth. Main stem divides at 1.5m. Branches encroaching upon building. Some dieback in crown indicating stress. Some deadwood in crown.	Crown clean to remove weak deadwood and prune back from building roof if retained. Consider removal as part of good management.	4.8	C2
T	4	Prunus spp. (Flowering Cherry)	EM	7	200	1	1.5	1	4	2	2	10	Fair	Fair. Small Cherry tree in linear group of 5 trees. Asymmetric crown and leaning habit due to shaded planting position close to old building. Limited potential to develop in well-structured mature tree.	No urgent works needed.	2.4	C2
T	5	Prunus spp. (Flowering Cherry)	EM	7	200	1	1.5	1	4	1	1	10	Fair	Fair. Small Cherry tree in linear group of 5 trees. Asymmetric crown and leaning habit due to shaded planting position close to old building. Limited potential to develop in well-structured mature tree.	No urgent works needed.	2.4	C2
T	6	Prunus spp. (Flowering Cherry)	EM	7	200	1	1.5	1	4	1.5	1.5	10	Fair	Fair. Small Cherry tree in linear group of 5 trees. Asymmetric crown and leaning habit due to shaded planting position close to old building. Limited potential to develop in well-structured mature tree.	No urgent works needed.	2.4	C2
T	7	Prunus spp. (Flowering Cherry)	EM	9.5	200	1	1.5	1	4.5	1.5	1.5	10	Fair	Fair. Small Cherry tree in linear group of 5 trees. Asymmetric crown and leaning habit due to shaded planting position close to old building. Limited potential to develop in well-structured mature tree.	No urgent works needed.	2.4	C2

Tree Survey Schedule
Abbey Quarter
Kilkenny City, Co. Kilkenny
June 2020

Type	No.	Species	Age	Ht m	Dbh mm	St	Cr	N	S	E	W	ERC	Phys Cond	Structural Condition/Comments	Preliminary Recommendations	RPA m	Cat
T	8	Prunus spp. (Flowering Cherry)	EM	9	200	1	1.5	1	5	4.5	1.5	10	Fair	Fair. Small Cherry tree in linear group of 5 trees. Asymmetric crown and leaning habit due to shaded planting position close to old building. Limited potential to develop in well-structured mature tree.	No urgent works needed.	2.4	C2
T	9	Salix spp. (Willow)	M	11.5	600	1	0	6	3.5	5.5	2	20+	Fair	Fair. Good vitality. Medium sized tree growing in narrow bed between old Abbey building and concrete yard. Restricted rooting area, however tree seems to be in good health. Asymetric crown due to recent pruning works to cut back branching from the old building. Recently crown reduced. Some old pruning wounds on stem. Pendulous branching hanging down to ground level.	No urgent works needed.	7.2	B2
T	10	Prunus lusitanica (Portugal Laurel)	EM	6	250	1	0	2	2	3.5	2	10+	Fair	Fair. Smaller sized tree in narrow landscape bed. Large surface root extends to south east; indicating how restricted the rooting environment is around the tree.	No urgent works needed.	3	C2
T	11	Acer platanoides 'Crimson King' (Norway Maple)	SM	9	280	1	1	2	3	4	3	10	Fair	Fair/Poor. Restricted rooting area. Branch weakened by decay at 5m in crown. Some other branches with bark wounds.	Crown clean to remove weak deadwood and damaged or diseased branches.	3.36	C2
T	12	Acer platanoides (Norway Maple)	SM	10	300	1	1	4	4	4	3	10	Fair	Fair. Good vitality. Restricted rooting area with tree very close to stone wall (1m). Woody surface root (40mm diameter) visible close to crack in the masonry wall.	Review impact of tree on adjacent wall. Consider removal if tree proven to be damaging wall.	3.6	C2



LEGEND



Category A Trees (high value)

Category B Trees (moderate value)

Category C Trees (low value)

Category U Trees (unsuitable for retention)

NOTES:
Please see Tree Survey Report for further detail.
All drawings to be read in conjunction with the consulting architects and engineers drawings.

Independent Tree Surveys

Our Lady's Cottage
Drummond
Rosenallis
Co. Laois
057 8628597 * 087 1380687
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Project Name: Abbey Quarter, Kilkenny City, Co. Kilkenny

Drawing Title: Tree Survey

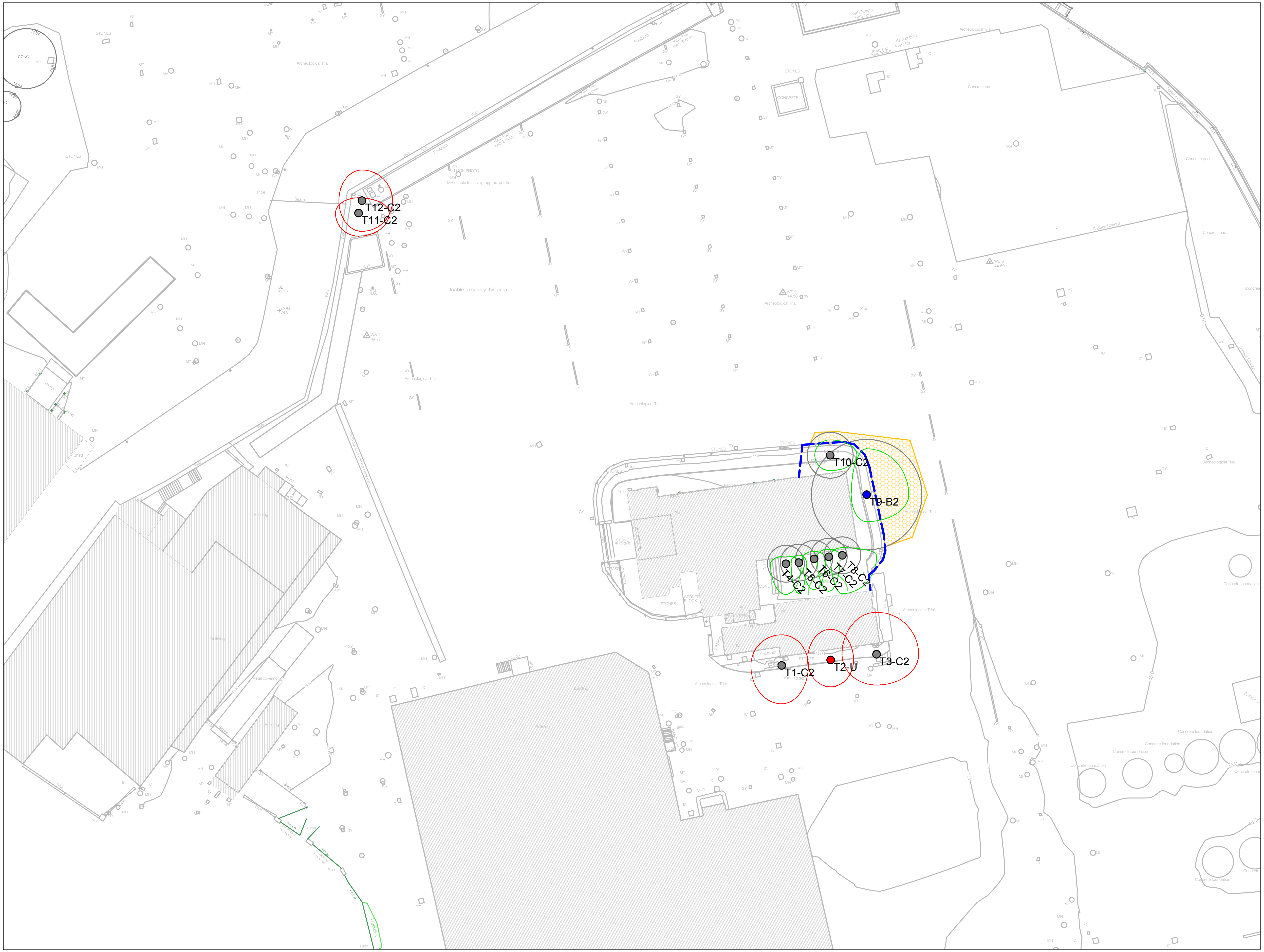
Drawing Number: 20020_TS

Client: Kilkenny County Council

Agent:

Date: 12/06/2020

Scale: 1:500@A3



LEGEND

- Root Protection Area
- Tree Canopy
- Tree Stem & Category Colour
- Tree Number & Category

T9-B2

- Tree Proposed for Removal

T3-C2

- Category A Trees (high value)
- Category B Trees (moderate value)
- Category C Trees (low value)
- Category U Trees (unsuitable for retention)
- Area Requiring Special Attention Regarding Tree Roots
- Tree Protection Fence - Indicative Line

N O T E S:
Please see Tree Survey Report for further detail.
All drawings to be read in conjunction with the consulting architects and engineers drawings.

Independent Tree Surveys

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Project Name: Abbey Quarter, Kilkenny City, Co. Kilkenny

Drawing Title: Tree Protection Plan

Drawing Number: 20020_TPP

Client: Kilkenny County Council

Agent:

Date: 12/06/2020

Scale: 1:500@A3

Appendix 7.1

July 2020

Detailed Quantitative Risk Assessment

Abbey Quarter – Urban Park and Street

Kilkenny County Council

County Hall, Kilkenny

MALONE O'REGAN

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MALONE O'REGAN ENVIRONMENTAL

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Title: Detailed Quantitative Risk Assessment, Abbey Quarter – Urban Park and Street, Kilkenny County Council, County Hall, Kilkenny

Job Number: E1620

Prepared By: Ursula Daly **Signed:** Ursula Daly

Checked By: Thomas Vainio-Mattila **Signed:** Thomas Vainio-Mattila

Approved By: Kevin O'Regan **Signed:** K O'R

Revision Record

Issue No.	Date	Description	Remark	Prepared	Checked	Approved
00	29/06/20	Report	DRAFT	UD	TVM	KO'R
00	27/07/20	Report	FINAL	UD	TVM	KO'R

Detailed Quantitative Risk Assessment

Abbey Quarter – Urban Park and Street

Kilkenny County Council

County Hall, Kilkenny

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TABLES (ATTACHED)

APPENDICES

1 INTRODUCTION

Malone O'Regan Environmental (MOR) was commissioned by Kilkenny County Council (KCC) to undertake a Detailed Quantitative Risk Assessment (DQRA) for the Proposed Development of an Urban Park and Street within the former Smithwick Brewery Lands (St Francis Abbey Brewery), Co. Kilkenny. Refer to Figure 1-1. The Urban Park and Street will herein be referred to as the 'Proposed Development'. The Proposed Development will be located within part of the Abbey Quarter Masterplan area (herein referred to as 'the Site'). Refer to Figure 1-2.

Figure 1-1: Site Location

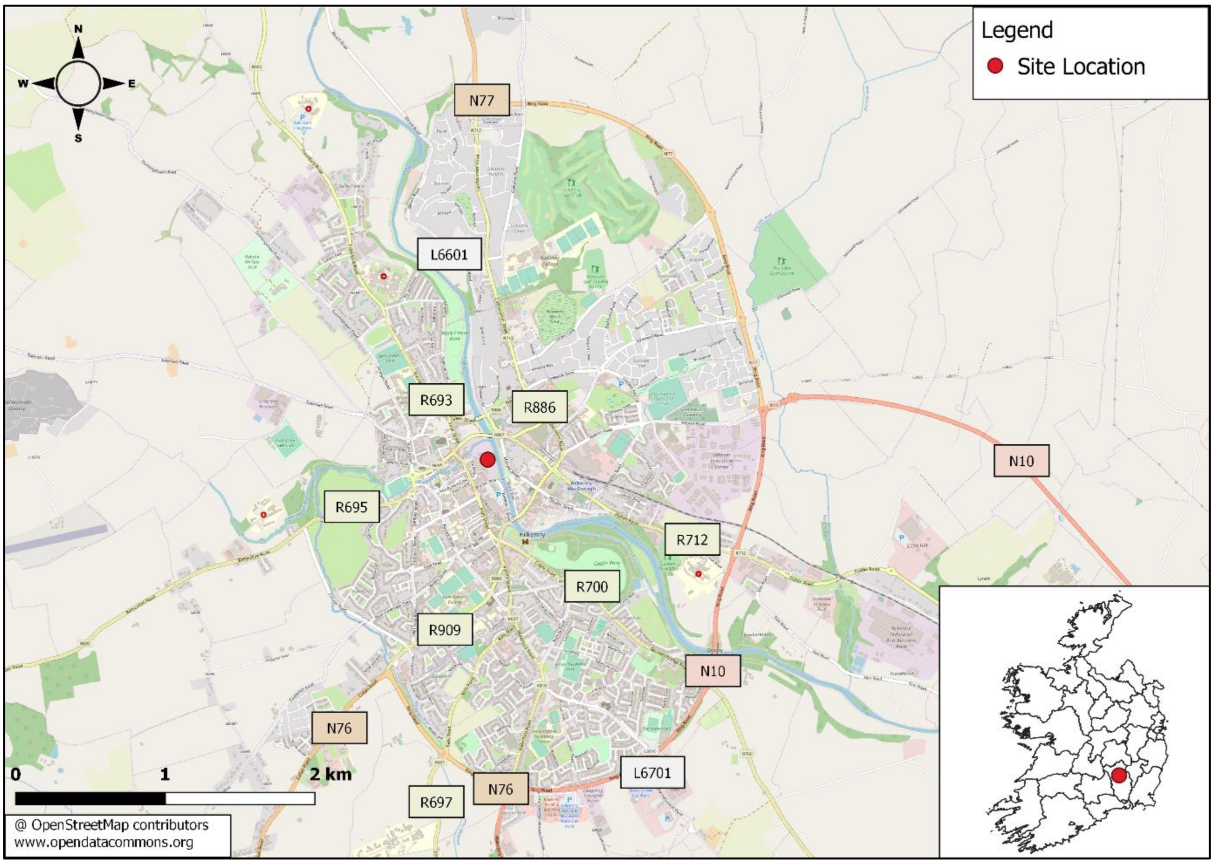
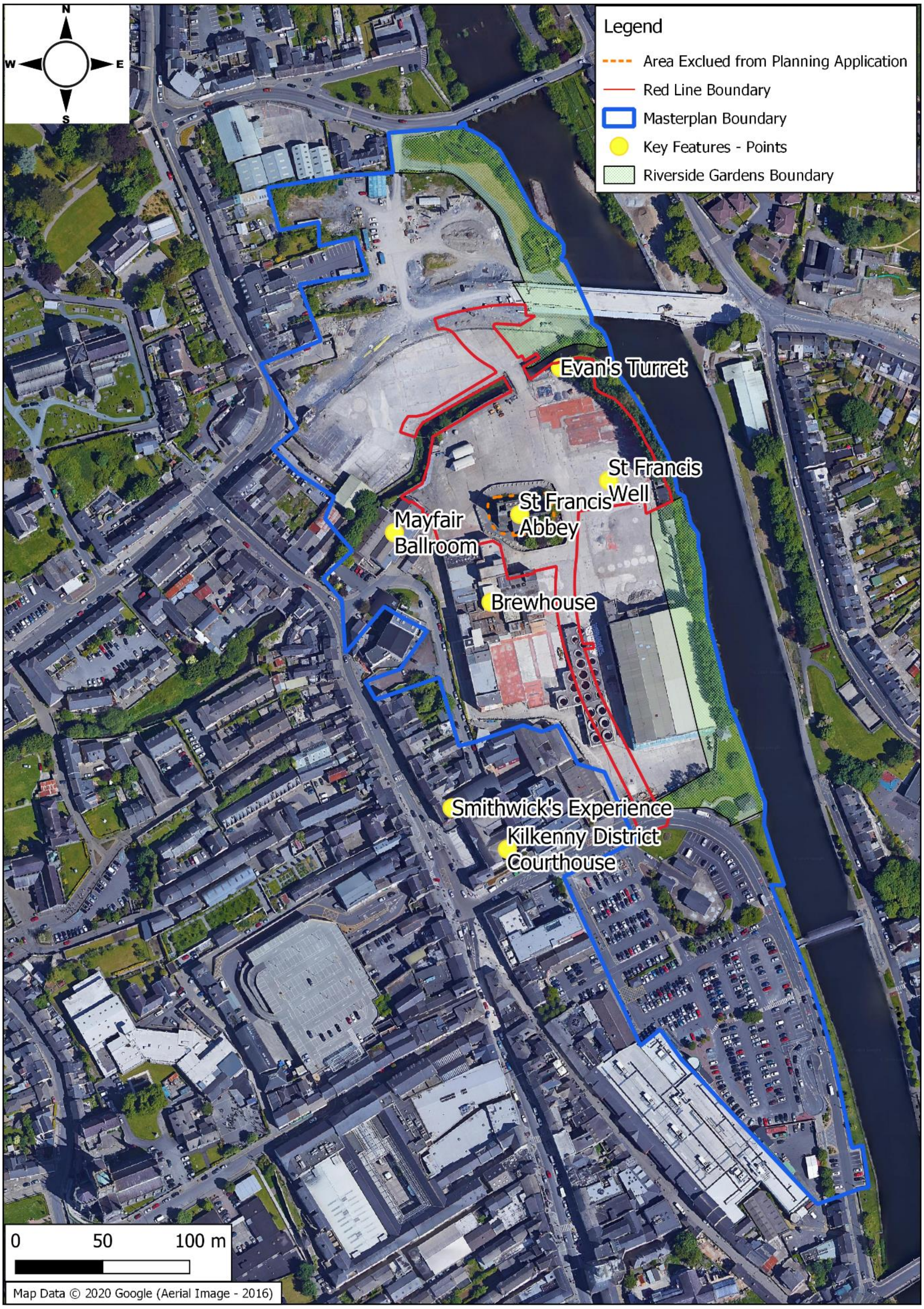


Figure 1-2: Site Context



1.1 Project Understanding

Historically, Diageo operated the St Francis Abbey Brewery in the Masterplan area which comprises the Site. As part of the process to surrender Integrated Pollution Prevention and Control (IPPC) Licence for the St Francis Abbey Brewery (Register No. P0448-01), the EPA requested the following from Diageo:

"Identify how any remaining environmental liabilities will be dealt with post-closure".

In response to this request, it was recommended by Arup on behalf of Diageo (Arup, 2014) as part of the Licence surrender submissions that:

"…a Risk Assessment would need to be conducted if a change in land use that involves disturbance of the hard standing were to be proposed. This could result in exposure of the soil based contaminants or the leaching or liberation of contaminants which may previously have been bound in the soils allowing them to impact the groundwater beneath the site."

This approach to addressing future environmental liabilities was approved by the EPA when they agreed to accept the surrender of the licence. The EPA also noted in their Surrender Memo dated 28th May 2015 (EPA, 2015) that:

"The EPA considers that the investigations have demonstrated that the site is in a 'satisfactory state' and that no further investigation or remedial action is necessary. However, this is a 'brownfield' site and Kilkenny County Council should take this into account during future development works."

The Proposed Development will entail a change of land use at the Site from a brownfield site to a public open space and street. Therefore, in accordance with the EPA's recommendation, KCC commissioned this DQRA to assess the risk to environmental and human health receptors due to the change in land use at the Site.

Construction of the Proposed Development will require the temporary removal of some of the existing concrete hardstanding to facilitate utility installation and construction works. Some of the existing concrete hardstanding will be permanently removed to allow for soft landscaping works and the infiltration of surface water from soft landscaped areas.

This DQRA will solely relate to the Site as depicted in Figure 1-2.

1.2 Project Objective

A key design principle of the Proposed Development was to minimise the removal of the existing concrete hardstanding. Furthermore, replacement of hardstanding was included as part of the design so far as was reasonably practicable. Given that the nature of the Proposed Development includes utility installation and landscaping works, it will not be feasible to completely avoid removal of the existing concrete hardstanding. The principal objective in undertaking this DQRA was to assess whether the temporary removal of some concrete hardstanding at the Site to facilitate utility installation and construction works (over an estimated period of nine (9 No.) months), as well as the permanent removal of some concrete hardstanding to facilitate drainage and landscaping works, would cause any unacceptable impact on the identified sensitive human health and environmental receptors. It should be noted that the construction works will take approximately fourteen (14 No.) months to complete, however it is anticipated that the temporary removal of existing concrete hardstanding will be undertaken over a maximum period of nine (9 No.) months.

1.3 Scope of Work

The scope of work undertaken comprised the following elements:

- Client liaison to confirm the project objectives.

- A review of design plans for the Proposed Development.
- A desk-based review of available data pertaining to the Masterplan area, in particular:
    - St Francis Abbey Brewery CRAMP–Detailed Risk Assessment Report (Arup, 2014) and associated Conceptual Site Model (CSM);
    - MOR Due Diligence Assessment Report for the St Francis Abbey Brewery site (MOR, 2015);
    - Soil monitoring data compiled by MOR for the Site from 2017 – 2020 (MOR, 2020); and,
    - Groundwater monitoring data compiled for the Site from 2018 to 2020 (MOR / TE Laboratories, 2020).
- Completion of a gap analysis to determine if sufficient data was available to complete this DQRA;
- Collection of nine (9 No.) additional samples from soils beneath the existing concrete hardstanding at five (5 No.) selected locations via probeholing.
- Installation of one additional (1 No.) groundwater well.
- Monitoring of groundwater level fluctuations beneath the Site through the installation of two (2 No.) data loggers and one (1 No.) barometric pressure logger in selected groundwater wells.
- Topographical survey of all Site investigation locations by KCC.
- Project meetings and liaison with the design team during the design process to ensure risk-based design measures could be incorporated without compromising the overall design.
- Assessment of any potential risks associated with the Proposed Development to both human health and environmental receptors.
- Development of risk-based Site-specific assessment criteria (SSAC).
- Assessment of the impact of the Proposed Development on the hydrogeological regime.
- Assessment of the cumulative impacts of the Proposed Development and the adjoining Riverside Gardens development.
- Presentation of the findings of the DQRA in a comprehensive report.

1.4 Disclaimer

The conclusions presented in this report are professional opinions based solely on the tasks outlined herein and the information made available to MOR. They are intended for the purpose outlined herein and for the indicated Site and project. The report is for the sole use of KCC. This report may not be relied upon by any other party without explicit agreement from MOR. Opinions and recommendations presented herein apply to the Site conditions existing at the time of the assessment. They cannot apply to changes at the Site of which MOR is not aware and has not had the opportunity to evaluate. This report is intended for use in its entirety; no excerpt may be taken to be representative of this assessment. All work carried out in preparing this report has utilised and is based on MOR professional knowledge and understanding of the current relevant Irish and European Community standards, codes and legislation.

2 RELEVANT BACKGROUND INFORMATION

2.1 Background

Following Diageo's decision to terminate brewing activities at the St Francis Abbey Brewery, KCC agreed to purchase the site in May 2012. A purchase contract was agreed, which ensured Diageo completed the following items prior to handover:

- Demolition of all non-historical / protected buildings to concrete slab level; and,
- Surrender of the existing IPPC Licence (Register No. P0448-01) for the St Francis Abbey Brewery.

The IPPC licence was formally surrendered by the EPA on the 29th May 2015. In surrendering the licence, the EPA stated that they were "*satisfied the condition of the installation is not causing or likely to cause environmental pollution and the site of the activity is in a satisfactory state*" (EPA, 2015). Following the successful completion of these works, KCC took ownership of the lands in November 2016.

In order to identify options for the redevelopment of the lands, KCC commissioned an urban design process, commencing with a public meeting and colloquium in 2012, an urban design review in 2013, a Brewery Vision workshop in 2015, followed by various public consultations. During this time, a Masterplan outlining the 'Abbey Creative Quarter' was created (Kilkenny Co Co, 2015).

It is the intention of KCC to develop the area, now known as the Kilkenny Abbey Quarter, for mixed land use with a combination of creative, knowledge intensive business services, retail, residential, commercial, educational, hotel and civic land uses in a proportion set out in the urban design code for the area (Loci and Kilkenny Co Co, 2018). The Abbey Quarter comprises approximately 8.25 hectares just off the centre of Kilkenny City, which includes the former brewery lands (4.64 ha) (Kilkenny Co Co, 2015). It should be noted that the Proposed Development will form an integral part of the proposed Abbey Quarter project.

2.1.1 The Abbey Quarter Masterplan

Following public consultation, the Masterplan was refined 2015. The key objectives of the Masterplan were accepted by KCC in 2016 through Variation No.1. of the Kilkenny City and Environs Development Plan in 2016. The provision of "*an urban park in the vicinity of St. Francis Abbey (National Monument) incorporating Evan's Turret and St. Francis' Well*" was included as one of these key objectives.

The Masterplan includes the following elements:

- Seven (7 No.) new blocks on the former brewing site and seven (7 No.) other new blocks just outside of the former brewing site with the aim of creating a new urban quarter to complement the existing city centre;
- Capacity for almost 60,000m^2 of mixed use residential, commercial, retail, education and civic spaces;
- Refurbishment of the old Brewhouse to provide almost 4,450m^2 of office space;
- A new linear park (now known as the Riverside Gardens) running along the banks of the River Nore;
- Conservation of historic buildings on the site including St. Francis Abbey and Evan's Turret;
- Refurbishment of the old Mayfair Ballroom building into a modern public library, and,
- The Proposed Development forms a key element of this Masterplan, providing access to the Site as well as a link to the city centre.

Projects associated with the Masterplan (and stated objectives of the Kilkenny City and Environs Development Plan 2014 - 2020) already approved include the following:

- The Riverside Gardens– approved under Part 8 of the Planning and Development Regulations, 2001, as amended, in February 2016;
- The redevelopment of the Mayfair Ballroom into the City Library – Part 8 Development approved in July 2016; and
- The redevelopment of the former Brewhouse building into primarily office space – Part 8 Development approved in December 2017.

At the time of writing, construction works on these projects are all ongoing.

2.2 Site Setting

The Site is located within a sensitive environmental setting due to the adjacent River Nore Special Area of Conservation (SAC), the fact that the Site is intersected by the River Breagagh and the fact that the Site overlies regionally important gravel and karst aquifers. In addition, the Site is located within a Zone of Archaeological Potential.

2.3 Description of the Proposed Development

The Proposed Development covers an area of approximately 1.36ha of the Masterplan area and consists of three (3 No.) main components:

- The Urban Park;
- The Street – a pedestrian and cyclist dominated street; and,
- The provision of services beneath the Site to facilitate nearby future developments.

The context of the Site is outlined in Figure 1-2. The Street will provide a link for pedestrians and cyclists from Bateman Quay in the south to the recently opened Wolf Tone Street in the north. The street will cross over the River Breagagh, using an existing bridge located approximately 40m upstream of the River Nore confluence.

The Street will be a pedestrian and cyclist dominated space that will facilitate access to adjoining components of the Abbey Quarter. It should be noted that only limited access to other vehicular traffic will be available, namely goods and service delivery vehicles serving future buildings. This will be controlled by the use of traffic bollards and a permitting system. The Street is required to incorporate all utility services required for development of potential future building plots adjoining the Street. These services include foul water drainage, surface water drainage, electricity, broadband, natural gas and public lighting. However, these services, provided for the wider Masterplan, will largely not be commissioned as part of this development. The Proposed Development itself will only require electricity for lighting, and a small water supply for maintenance and the proposed water feature.

The Urban Park will consist of a variety of grassed areas, trees, paved surfaces, a water feature, meeting points, walking paths, playgrounds and exercise areas. It is proposed that the Urban Park will express known historical features in the area and provide space to accommodate seasonal markets and other events.

Refer to Appendix A - (Mitchell & Associates, 2019) Landscape Masterplan Reference LKIL050 – Drawing No. 100).

2.4 Concrete Hardstanding Removal

Construction of the Proposed Development will require the removal of approximately 3,052m^2 of the existing 13,658m^2 concrete hardstanding to facilitate utility installation, construction works and landscaping works. Of this, approximately 370m^2 of existing concrete hardstanding will be permanently removed to allow for landscaping works and infiltration of surface water from soft landscaped areas. Approximately 2,682m^2 will be reinstated with hardstanding as part of the proposed design. It has been estimated that approximately 3,052m^2 of the existing concrete hardstanding at the Site may be removed for up to nine (9 No.) months during the construction of the Proposed Development. The areas of concrete hardstanding removal are presented in Appendix B. It should be noted that the construction works will take approximately fourteen (14 No.) months to complete, however it is anticipated that the temporary removal of existing concrete hardstanding will be undertaken over a maximum period of nine (9 No.) months.

Taking a precautionary approach, this assessment is conservatively based on the 'worst-case scenario' assumption that approximately 3,052m^2 of the existing concrete hardstanding will be removed permanently. This approach was adopted to account for the temporary removal of concrete hardstanding during the construction phase.

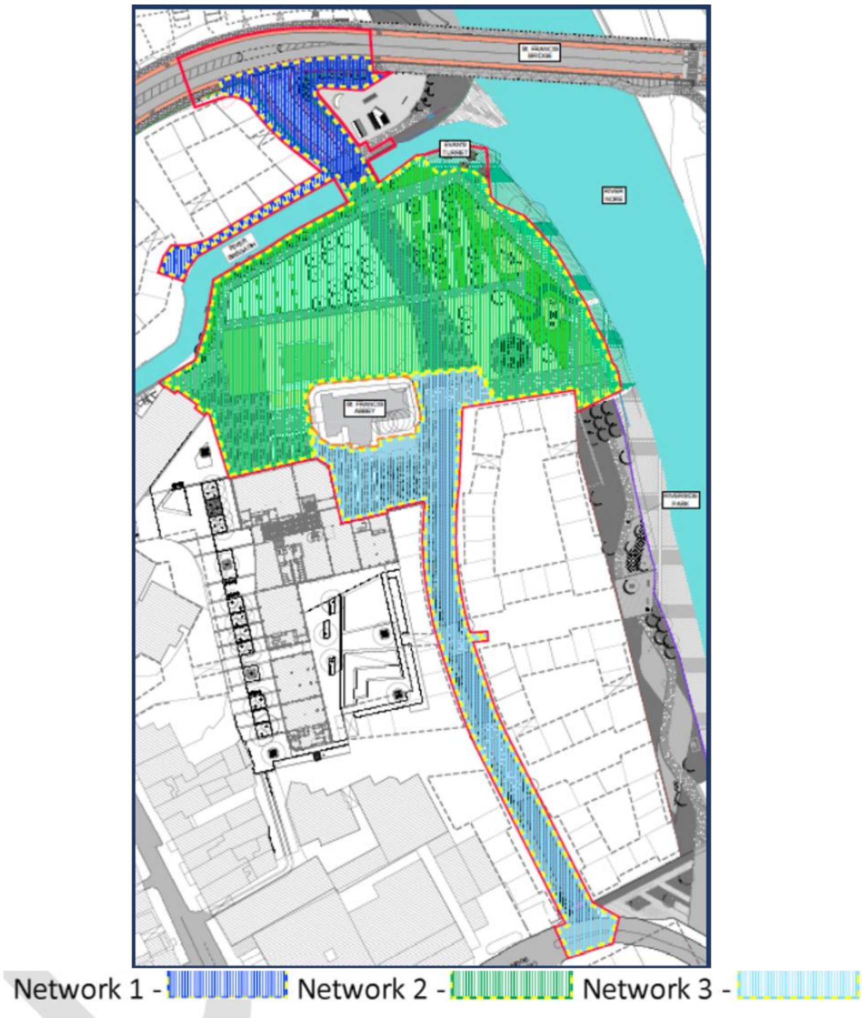
2.5 Surface Water Drainage Strategy

It is proposed that the drainage infrastructure for the Proposed Development will comprise of three (3 No.) drainage networks:

- Network 1 – North of the River Breagagh
- Network 2 – South of River Breagagh
- Network 3 – Proposed Street

Figure 2-1 presents the proposed drainage networks.

Figure 2-1: Proposed Drainage Network Areas



2.5.1 Network 1 – North of the River Breagagh

Drainage Network 1 will be located to the north of the River Breagagh will include temporary removal of existing concrete hardstanding to facilitate utility installation. Limited permanent removal of concrete hardstanding will be required to facilitate landscaping in this area. Refer to Appendix B.

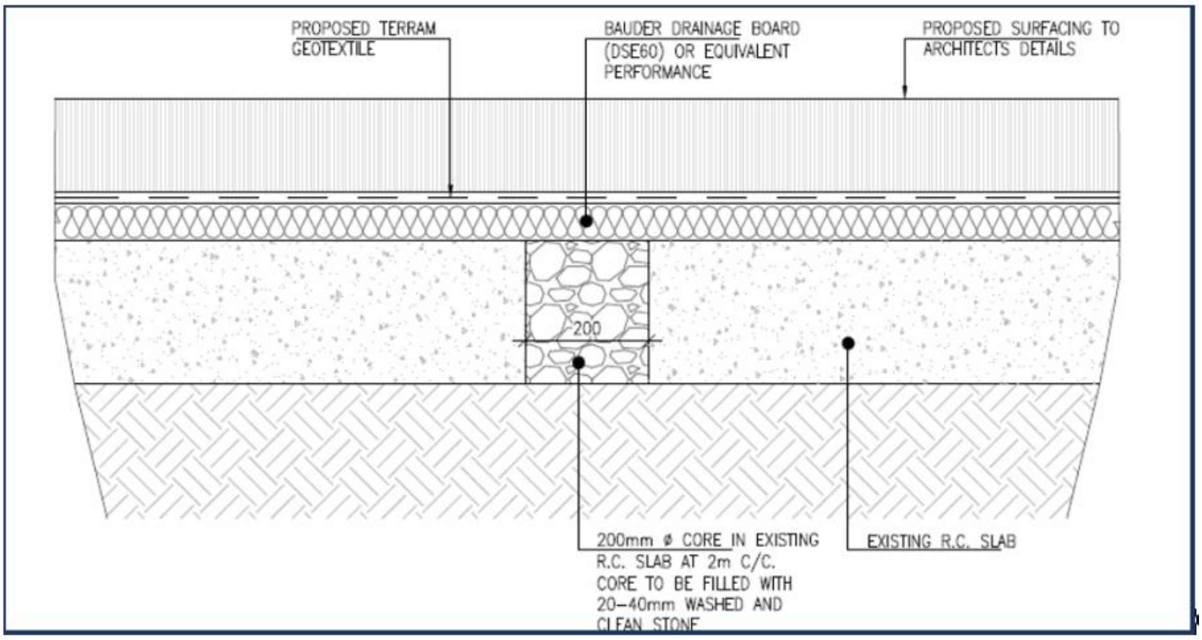
Areas of soft landscaping will drain via infiltration. Areas of hardstanding will drain to road gullies and discharge to a proposed network of watertight manholes and drainage lines. The proposed storm drains will connect to an existing storm drainage outfall to the north west of the Site and will pass through an oil / silt separator before discharging to the existing outfall to the River Breagagh.

2.5.2 Network 2 – South of the River Breagagh

Drainage Network 2 will include temporary removal of existing concrete hardstanding to facilitate construction works and utility installation. Some permanent removal of concrete hardstanding will be required to facilitate soft landscaping and infiltration in the grassed areas in this drainage Network. Refer to Appendix B.

The surface water in the grassed areas will drain by infiltration through cores in the existing concrete hardstanding. An indicative infiltration detail design is illustrated in Figure 2-2.

Figure 2-2: Proposed Infiltration Detail



Areas of hardstanding will drain to proposed surface channels (ACO drain) and enter a proposed storm drainage line. A silt bucket will form part of the ACO drain which will reduce silt discharge to the drainage pipelines. The surface water will discharge to a network of watertight manholes and sealed pipework. The surface water from the hardstanding areas in Network 2 will flow through a new oil / silt separator before discharging through the existing outfall to the River Breagagh in the north western corner of the zone via an oil / silt separator.

2.5.3 Network 3 – Proposed Street

Drainage Network 3 will serve the remaining section of the Proposed Development. Some existing concrete hardstanding will be temporarily removed to facilitate utility installation and cons. Limited permanent removal of concrete hardstanding will occur to allow for soft landscaping. Refer to Appendix B.

Areas of soft landscaping will drain via infiltration. Areas of hard landscaping will drain to proposed surface channels (ACO drain) and enter a proposed storm drainage line. A silt bucket will form part of the ACO drain which will reduce silt discharge to the drainage pipelines. The surface water will discharge to a network of watertight manholes and sealed pipework. The surface water from the hardstanding areas in Network 3 will flow through a new oil / silt separator before discharging through the existing outfall to the River Nore via an oil / silt separator.

3 CONCEPTUAL SITE MODEL

A Risk Assessment is undertaken to provide an understanding of the risk associated with the presence of any potentially contaminating materials and/or activities on a site. The CSM for a site identifies all potential contamination sources, migration pathways and receptors that could be associated with a site. These pollutant linkages then form the basis for the Quantitative Risk Assessment (QRA). If one or more of the three elements of the source-pathway-receptor scenario are missing, the pollutant linkage is considered incomplete and there is no risk associated with the activity/contaminant source (i.e. it does not present a means of exposure).

The CSM developed for the wider Masterplan area, that incorporates the Site, was reviewed as part of this assessment to take account of the Proposed Development.

3.1 Current Conceptual Site Model

A CSM for the for the wider Masterplan area was developed by Arup for the post-decommissioning phase as part of a detailed site assessment (Arup, 2014).

The CSM was developed on the assumption that the concrete hardstanding would remain in place across the Site and act as a barrier for the remaining pollutant linkages (associated with volatile organic compounds in soil / and or groundwater and petroleum hydrocarbons in soil).This assumption therefore removed the pathway in the pollutant linkages and thus the potential risk was considered to be minimal for the identified linkages as follows:

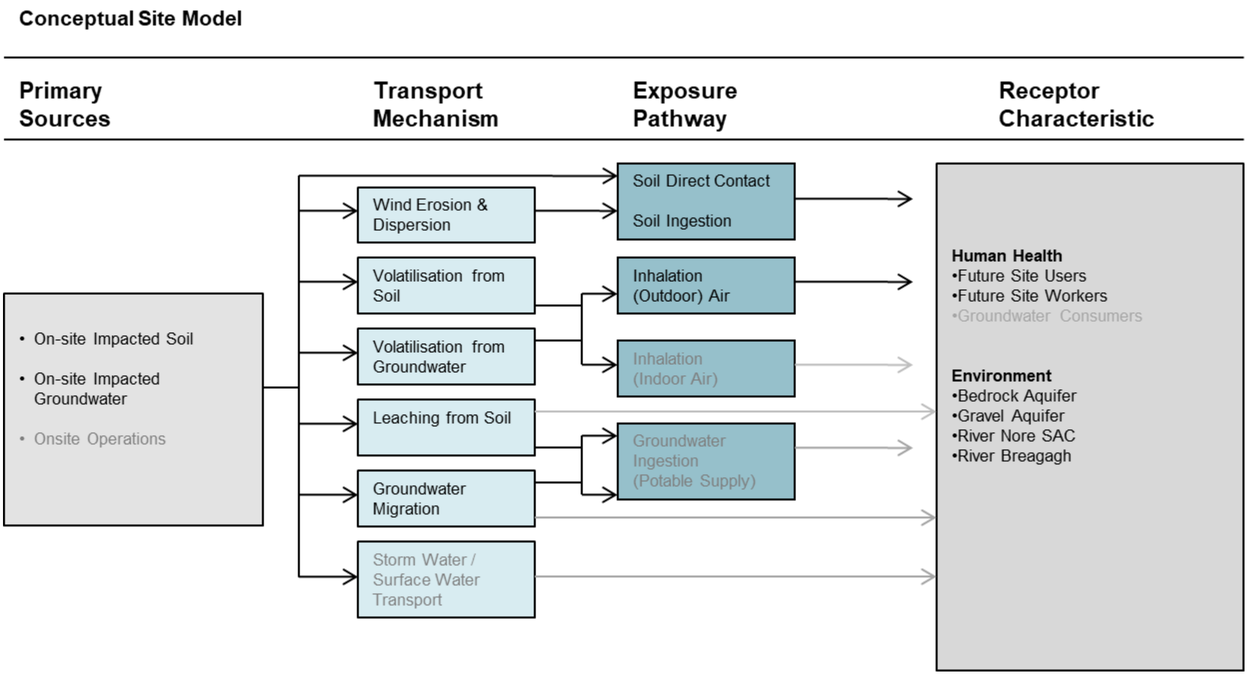
- Human Health - The presence of the concrete hardstanding would prevent direct contact with any contaminants present in the shallow subsurface.
- Environmental - Leaching of any potential residual contaminants from the soil to groundwater via rainfall infiltration would be minimised.

3.2 Revised Conceptual Site Model

The revised CSM takes account of the design of the Proposed Development. Refer to Appendix A –- (Mitchell & Associates, 2019) Landscape Masterplan Reference LKIL050 – Drawing No. 100) and Appendix B - Concrete Hardstanding Removal Plan.

Specifically, the proposed removal of some of the concrete hardstanding warranted a review of the Arup risk assessment to evaluate plausible pollutant linkages for the Site. The CSM is outlined in Table 3-1.

Table 3-1: Revised Conceptual Site Model



3.3 Risk Screening

Based on the revised CSM and taking cognisance of the EPA risk screening procedures (EPA, 2011) it was considered that the following pollutant linkages would be plausible and the associated risks warranted further assessment:

Human Health – Future workers and Site users could be exposed to contamination in the subsurface as a result of the removal of some concrete hardstanding via direct contact with exposed soils and inhalation of vapours/dusts arising from subsurface contamination. Specifically, the following three (3 No.) receptor scenarios required evaluation in this revised CSM:

- Construction workers for the development of the Site.
- Future users of the proposed Site (members of the public).
- Future site workers at the Site e.g. maintenance staff.

Environmental – Removal of some concrete hardstanding will potentially result in increased infiltration of rainfall into the subsurface and therefore the CSM incorporating the following scenarios required evaluation:

- Potential increased leaching of soil contaminants to groundwater following the removal of some concrete hardstanding that could impact on the receiving water environment (the River Nore).
- Potential impact on the local hydrogeological regime including the water balance at the Site due to increased infiltration of rainwater at the Site following removal of some concrete hardstanding that could impact on local groundwater flow and existing groundwater contamination issues.

4 GAP ANALYSIS

4.1 Review of Existing Data

4.1.1 Availability of Soils Data

Based on a review of existing site investigation results for the Masterplan area, it was determined that there was a need to compile some additional soil data from locations within the Site to supplement existing data. Five (5 No.) probehole locations were selected (PH1 – PH5). Refer to Drawing 1 for probehole locations.

4.1.2 Availability of Groundwater Data

Groundwater monitoring has been carried out at twelve (12 No.) monitoring locations, of which five (5 No.) are located within the Site, for the Masterplan area on six (6 No.) occasions since the groundwater monitoring events noted in the Arup report (Arup, 2014):

- 16th January 2018 by MOR;
- 7th March 2019 by TE Laboratories;
- 5th June 2019 by TE Laboratories;
- 18th September 2019 by TE Laboratories;
- 12th December 2019 by TE Laboratories; and,
- 18th February 2020 by TE Laboratories.

It was concluded that the existing dataset of groundwater monitoring results was sufficient to complete this DQRA and no additional groundwater data therefore was deemed to be warranted.

The groundwater monitoring locations are presented in Drawing 1 and the groundwater monitoring results from the events outlined above are presented in Table 3.

4.1.2.1 Historic Groundwater Analytical Results

Assessment Criteria

Field measured parameters and laboratory analytical results for groundwater were compared, where applicable, to the following groundwater generic assessment criteria (referred to hereafter as GAC):

- Statutory Instrument S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended 2012 (S.I. No. 149 of 2012) as amended 2016 (S.I. No.366 of 2016).

In the absence of Groundwater Regulation Values for specific parameters, the following assessment criteria were used for indicative purposes.

- The Interim Guideline Values (IGVs) for Groundwater from the Environmental Protection Agency (EPA) (2003), 'Towards setting guideline values for the protection of groundwater; Interim Report'.

Given the proximity of the Site to the River Nore and River Breagagh, the following surface water assessment criteria (referred to hereafter as SWAC) were also considered:

- Statutory Instrument S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Water) Regulations 2009 (S.I. No. 272 of 2009) as amended 2016 (S.I. No.327 of 2012 and S.I. No.386 of 2015 and S.I. No.77 of 2019).

Summary of Key Findings

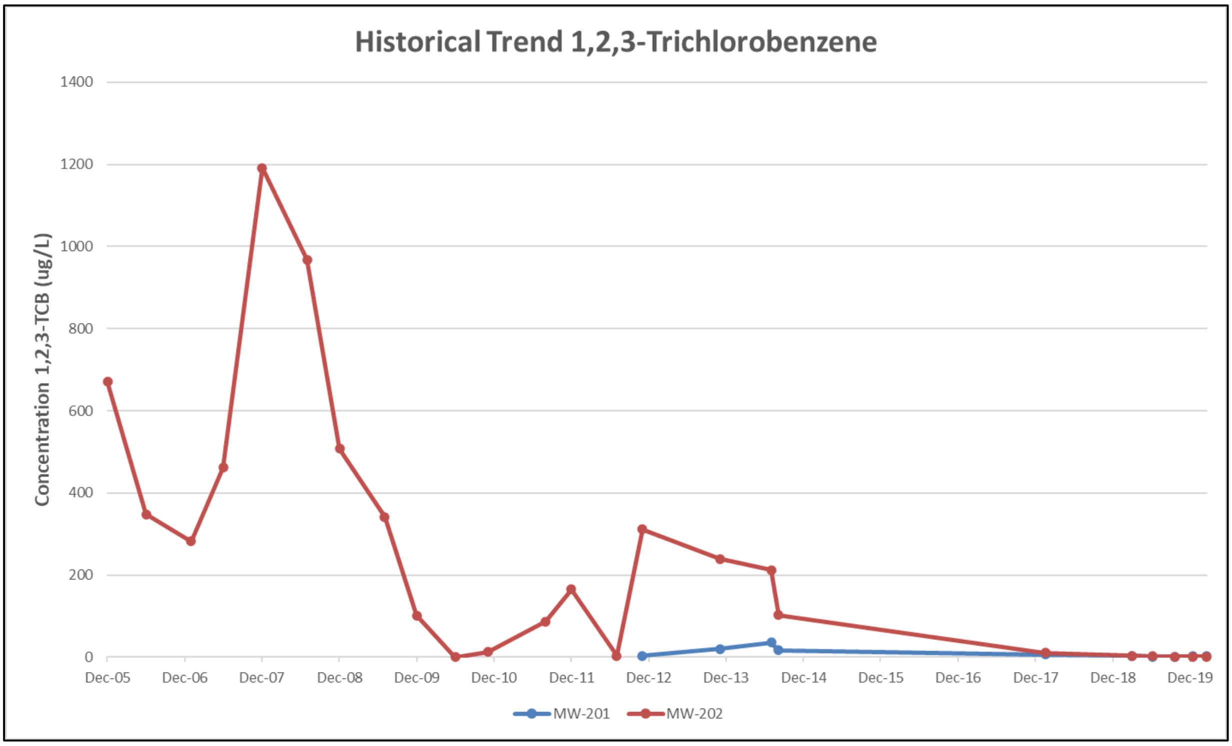
A summary of the key findings of the groundwater monitoring events outlined above (2018 – 2020) based on the key historic parameters of concern is provided below.

Groundwater conditions generally remained stable or improved since the termination of brewing activities in the Masterplan area.

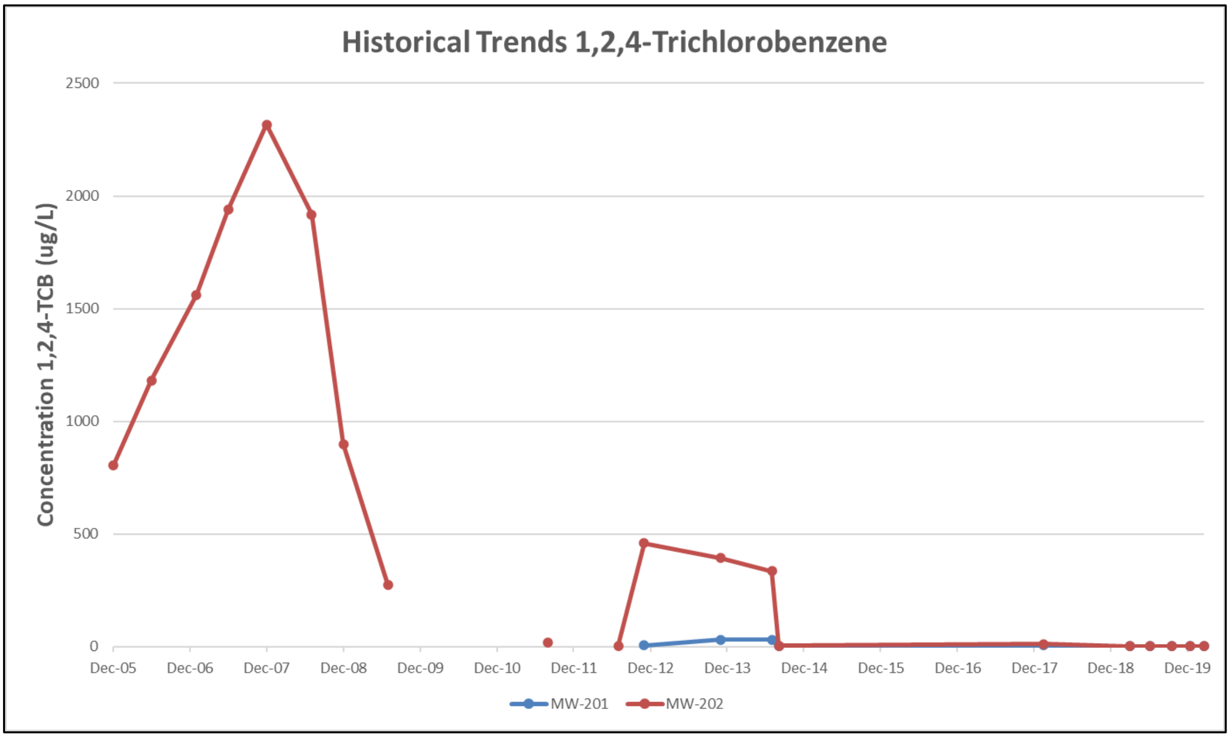
PCB concentrations were below the MDL during all applicable monitoring events (January 2018 and June 2019).

Concentrations of the volatile organic compounds (VOCs) 1,2,3-trichlorobenzene and 1,2,4-trichlorobenzene have continued to be detected occasionally in MW201 and MW202. However, the detected concentrations are much lower than those noted in the Arup report (Arup, 2014). The maximum concentration of 1,2,3-trichlorobenzene detected during the recent six (6 No.) monitoring events was 11µg/l (MW202 – January 2018). This concentration represents a decrease from the historic maximum at this location (1,191µg/l – December 2007). Refer to Graph 4-1. The maximum concentration of 1,2,4-trichlorobenzene detected during the recent six (6 No.) monitoring events was 11µg/l (MW202 – January 2018). While this concentration represents an exceedance of the GAC of 0.4µg/l, it also represents a continued decrease from the historic maximum concentration recorded at this location (2,317µg/l – December 2007). Refer to Graph 4-2.

Graph 4-1: Historical Trends of 1,2,3-Trichlorobenzene



Graph 4-2: Historical Trends of 1,2,4-Trichlorobenzene



Total aliphatic and aromatic concentrations have generally remained below the MDL at all monitoring locations across the Site. Several low-level detections were noted during the March 2019 monitoring event which exceeded the relevant GAC of 7.5µg/l: BHD – 150µg/l, BHE – 90µg/l, MW201 – 370µg/l and MW202 - 250µg/l. However, in subsequent monitoring events, the total aliphatic and aromatic concentrations remained below the MDL and as such, these detections can be viewed as isolated incidents.

Concentrations of microbiological parameters (faecal and total coliforms) exceeded the GAC at several monitoring locations when analysed for in January 2018 and June 2019. The maximum concentration of faecal coliforms recorded in the Masterplan area was >100CFU/100ml. This concentration was recorded at all monitoring locations during June 2019 except for BHD (48CFU/100ml) and MW301 (66CFU/100ml). During the two (2 No.) monitoring events, there were several exceedances of the GAC (0 counts/100ml). The maximum concentration of total coliforms recorded in the Masterplan area was 1,119.9MPN/100ml (BHA – January 2018). During the two (2 No.) monitoring events, there were several exceedances of the GAC (0 counts/100ml).

Concentrations of polycyclic aromatic hydrocarbons (PAHs) during the six (6 No.) monitoring events have consistently been below the applicable MDL at all monitoring locations.

Metals have generally been below the GAC with the exception of occasional elevated concentrations of arsenic. The maximum concentration of arsenic recorded in the Masterplan area was 30µg/l (BHD - February 2020). This concentration exceeded the GAC of 7.5µg/l.

4.1.3 Availability of Groundwater Level Data

Groundwater level monitoring has been carried out in the Masterplan area on six (6 No.) occasions since the groundwater monitoring events noted in the Arup report (Arup, 2014):

- 16th January 2018 by MOR;
- 7th March 2019 by TE Laboratories;
- 5th June 2019 by TE Laboratories;

- 18th September 2019 by TE Laboratories;
- 12th December 2019 by TE Laboratories; and,
- 18th February 2020 by TE Laboratories.

It was concluded that the existing dataset of groundwater level results was sufficient to complete this DQRA and no additional data was collected. However, it was determined that there was a need to install a groundwater monitoring well at a probehole location (PH5) to further characterise groundwater flow in the vicinity of the historic St Francis Well. Refer to Drawing 1.

4.1.3.1 Historic Groundwater Level Results

Depth to groundwater across the Masterplan area generally ranges from 1 – 3 metres below ground level (mbgl). Groundwater in the sands and gravels flows to the east / north-east and is assumed to discharge to the River Breagagh / River Nore. Groundwater in the bedrock (Ballyadams Formation) is noted to be artesian (Arup, 2014) with upwards hydraulic gradient to the overlying sands and gravels and River Nore. Therefore, the bedrock aquifer is not considered to be a plausible receptor of on-site contamination.

4.2 Summary of Geology at the Site

The CSM prepared by Arup (Arup, 2014) identified the presence of boulder clay beneath Site as well as sand and gravels adjoining the River Nore.

According to the GSI, the bedrock beneath the Site consists of the Ballyadams Formation. This comprises thick-bedded crinoidal wackestone / packstone limestone with clay wayboards (GSI, 2020). According to the Arup report (Arup, 2014), the bedrock was encountered in the Masterplan area at depths of approximately 15mbgl. According to the EPA, the Ballyadams Formation is at least 200m thick (EPA, 2011).

5 SITE INVESTIGATION AND METHODOLOGY

This Section outlines the additional Site investigation works undertaken in 2020 i.e the installation of five (5 No.) additional probehole locations, installation of a groundwater monitoring well in one (1 No.) of these locations, soil sampling and groundwater level monitoring.

5.1 Preparatory Works

Approval for all Site investigation locations was granted by the National Monuments Service and KCC prior to mobilising to the Site.

5.2 Intrusive Site Investigations

The intrusive Site investigation works were undertaken in accordance with Section 7.6.2 of BS10175 – 2011+A1:2013 "Investigation of Potentially Contaminated Sites – Code of Practice'' and supervised on a full-time basis by MOR environmental personnel to ensure that all works were completed to best practice procedures.

Drilling and installation of the probeholes (PH1 – PH5) with a light percussion rig was undertaken by Causeway Geotech Limited on the 30th January 2020. Probehole logs are presented in Appendix C. Details of the geological profile, water ingress and any visual or olfactory evidence of contamination were noted by the MOR consultant. All probehole locations were subsequently reinstated according to best practice procedures, with the exception of PH5 where a groundwater well was installed.

The groundwater well design was determined by borehole depth, taking into account visual observations and the available background information. The well was constructed of 50mm diameter slotted PVC/HDPE casing with gravel pack targeting a screen across the water table and finished to the surface with 50mm diameter blank PVC/HDPE casing and bentonite seal. The wellhead consisted of a flush cover. The well log is presented in Appendix C.

5.3 Groundwater Level Monitoring

A data logger and barologger were installed in BHD (an existing groundwater well) and a data logger was installed in PH5 to assess if there were localised variations in groundwater flow in the vicinity of the historic St Francis Well.

5.4 Topographical Survey

A topographical survey of all probehole and the new groundwater well locations was undertaken by KCC. All locations were surveyed to Ordnance Datum. The survey was carried out during March 2020. Results of the topographical survey are presented in Appendix D.

5.5 Soils Laboratory Analysis

Nine (9 No.) soil samples were collected during the Site investigation. Samples were sealed in appropriate laboratory supplied containers and stored in cool dark conditions before being transferred to Element, a UKAS accredited laboratory for analysis. Sample details including location and depth of samples were recorded on chain of custody (COC) records and kept for tracking purposes.

The soil samples were analysed for the following criteria:

- Asbestos screening and quantification as required;
- Fraction organic carbon;
- Metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc;
- Polycyclic aromatic hydrocarbons (PAHs);
- Polychlorinated biphenyls (PCBs);

- Total petroleum hydrocarbons (TPH CWG); and,
- MTBE, Benzene, toluene, ethylbenzene and total xylenes (BTEX).

Soil Leachate (CEN 2:1):

- Metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc.

5.6 Assessment Criteria

The laboratory analysis for soil samples were compared, where applicable, to the following generic assessment criteria:

- LQM/CIEH 'Suitable 4 Use Levels' for Human Health Risk Assessment – Public Open Space Criteria (Nathanail, McCaffrey, Gillett, & Ogden, 2015).
- Defra Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination– Public Open Space Criteria (Defra , 2014).

Field measured parameters and laboratory analytical results for soil leachate analysis were compared, where applicable, to the GAC (as referenced in Section 4.1.2.1).

Given the proximity of the Site to the River Nore and River Breagagh, the SWAC (as referenced in Section 4.1.2.1) were also considered.

6 RESULTS

6.1 Subsurface Conditions

The final depths of the probeholes ranged from 0.45 to 5.00mbgl. Concrete hardstanding exists across the entire Site and consisted of ca. 0.25 – 0.35m of reinforced concrete hardstanding underlain by up to 2.3m of made ground. The made ground encountered by MOR during the 2020 investigation typically comprised sandy, gravelly fill with stones and occasional construction and demolition waste. Natural ground was encountered in two (2 No.) locations (PH2 – 1.40mbgl and PH5 – 2.30) and comprised sandy / silty clay underlain by gravels (gravels detected at PH5 only).

A summary of the subsurface conditions is provided in Table 6-1. Detailed probehole logs are provided in Appendix C.

Table 6-1: Subsurface Conditions

Probehole	Subsurface conditions	Soil Sample Depths
PH1	0.0 – 0.25mbgl: Reinforced concrete 0.25 – 0.45mbgl: Made ground 0.45mbgl: Refusal on concrete	0.25 - 0.45mbgl
PH2	0.0 – 0.30mbgl: Reinforced concrete 0.30 – 1.40mbgl: Made ground 1.40 – 2.00mbgl: Natural sandy / silty clay	0.30 - 1.00mbgl 1.00 - 1.40mbgl
PH3	0.0 – 0.30mbgl: Reinforced concrete 0.30 – 2.00mbgl: Made ground 2.00mbgl: Refusal on concrete	0.30 - 1.00mbgl 1.00 - 2.00mbgl
PH4	0.0 – 0.23mbgl: Reinforced concrete 0.23 – 1.00mbgl: Made ground 1.00mbgl: Refusal on concrete	0.25 - 1.00mbgl
PH5 (Groundwater well installation)	0.0 – 0.35mbgl: Reinforced concrete 0.35 – 2.30mbgl: Made ground 2.30 – 3.80mbgl: Natural silty clay 3.80 – 5.00mbgl: Natural gravels with pebbles	0.35 - 1.00mbgl 1.00 - 2.00mbgl 2.00 - 2.30mbgl

6.2 Soils Analytical Results

For the purpose of this report, only soil samples taken by MOR during 2020 are described in the sections below. All historic sampling results are referred to in Section 7.1.1.

The results of the soils analysis are summarised below and are presented alongside historic results in Table 1 (attached). Laboratory reports are presented in Appendix E.

Asbestos

Asbestos fibre bundles comprising crocidolite and chrysotile were visually identified in six (6 No.) of the nine (9 No.) soil samples analysed:

- PH2 (0.30 – 1.00mbgl);

- PH2 (1.00 - 1.40mbgl);
- PH3 (1.00 – 1.20mbgl);
- PH5 (0.35 – 1.00mbgl);
- PH5 (1.00 – 2.00mbgl); and,
- PH5 (2.00 – 2.30mbgl).

Gravimetric quantification of asbestos was identified as <0.001% of the sample mass in each of the samples.

Indicators

Fraction Organic Carbon

Fraction organic carbon in the soil samples ranged from 0.002% (PH1 (0.25 – 0.45mbgl) and PH4 (0.25 – 1.00mbgl)) to 0.003% (PH3 (0.30 – 1.00mbgl)). No detection of fraction organic carbon was available in the remaining soil samples due to the laboratory analysis method utilised.

Metals

Arsenic

Arsenic concentrations ranged from 4mg/kg (PH1 (0.25–0.45mbgl) and PH2 (1.00–1.40mbgl)) to 10mg/kg (PH5 (2.00–2.30mbgl)).

Cadmium

Cadmium concentrations ranged from 0.2mg/kg (PH1 (0.25 – 0.45mbgl), PH3 (0.30 – 1.00mbgl), PH3 (1.00 – 2.00mbgl), PH4 (0.25 – 1.00mbgl), PH5 (0.35 – 1.00mbgl) and PH5 (1.00 – 2.00mbgl)) to 0.4mg/kg (PH5 (2.00 – 2.30mbgl)).

Chromium

Chromium concentrations ranged from 10mg/kg (PH5 (1.00 – 2.00mbgl)) to 56.7mg/kg (PH1 (0.25 – 0.45mbgl)).

Copper

Copper concentrations ranged from 11mg/kg (PH5 (1.00 – 2.00mbgl)) to 66mg/kg (PH5 (2.00 – 2.30mbgl)).

Lead

Lead concentrations ranged from 7mg/kg (PH4 (0.25 – 1.00mbgl)) to 130mg/kg (PH5 (2.00 – 2.30mbgl)).

Mercury

Mercury concentrations were below the laboratory minimum detection limit (MDL) in all soil samples (<0.1mg/kg).

Nickel

Nickel concentrations ranged from 11.4mg/kg (PH5 (1.00 – 2.00mbgl)) to 23.7mg/kg (PH5 (2.00 – 2.30mbgl)).

Selenium

Selenium concentrations were below the MDL (<1mg/kg) in all soil samples.

Zinc

Zinc concentrations ranged from 30mg/kg (PH2 (1.00 – 1.40mbgl)) to 98mg/kg (PH5 (2.00 – 2.30mbgl)).

Petroleum Hydrocarbons

Total Aliphatics and Aromatics

Concentrations of total aliphatic and aromatics (C5-C35) were below the MDL (<38mg/kg) in all soil samples except for PH3 (1.00 - 2.00mbgl) where a concentration of 51mg/kg was detected.

Benzene, Toluene, Ethylbenzene and Xylene (BTEX) / Methyl tert-butyl ether (MTBE)

Concentrations of MTBE were below the MDL (<2mg/kg) in all soil samples. Concentrations of BTEX were below the applicable MDLs in all soil samples except for PH1 (0.25 – 0.45mbgl) and PH5 (2.00 – 2.30mbgl). Toluene was detected in both PH1 (8mg/kg) and PH5 (6mg/kg) and m/p-xylene and o-xylene were detected in PH1 (9mg/kg and 4mg/kg respectively).

Polychlorinated Biphenyls (PCBs)

Concentrations of total 7 PCBs were below the MDL (<35mg/kg) in all soil samples.

Polycyclic Aromatic Hydrocarbons (PAHs)

Concentrations of total PAHs were below the applicable MDLs (<0.6mg/kg) in all soil samples.

Volatile Organic Compounds (VOCs)

Concentrations of VOCs were below the applicable MDLs in all soil samples with the exception of trichlorofluoromethane and 1,2,4-trimethylbenzene. Trichlorofluoromethane was detected in PH3 ((1.00–2.00mbgl) 5µg/kg) and 1,2,4-trimethylbenzene was detected in PH1 ((0.25–0.45mbgl) 85µg/kg).

6.3 Soil Leachate Analytical Results

The results of the soil leachate analysis are summarised below and are presented in Table 2 (attached).

Metals

Arsenic

Arsenic concentrations were below the MDL (<2.5µg/l) in all soil leachate samples.

Cadmium

Cadmium concentrations were below the MDL (<0.5µg/l) in all soil leachate samples.

Chromium

Chromium concentrations ranged from below the MDL (<1.5µg/l) in WS5 (1.00 – 2.00mbgl and 2.00 – 2.30mbgl) to 58µg/l in WS5 (0.35 – 1.00mbgl). The concentration recorded in WS5 (0.35 – 1.00mbgl) exceeded the relevant GAC (37.5µg/l) and SWAC (32µg/l).

Copper

Copper concentrations ranged from below the MDL (<7µg/l) in WS2 (1.00 – 1.40mbgl), WS4 (0.25 – 1.00mbgl) and WS5 (1.00 – 2.00mbgl and 2.00 – 2.30mbgl) to 57µg/l in WS3 (0.30 – 1.00mbgl). The concentrations recorded in WS1 ((0.25 – 0.45mbgl) 41µg/l), WS2 ((0.30 – 1.00mbgl) 35µg/l), WS3 ((0.30 – 1.00mbgl) 57µg/l), WS3 ((1.00 – 2.00mbgl) 48µg/l) and WS5 ((0.35 – 1.00mbgl) 44µg/l) exceeded the relevant GAC (30µg/l) and SWAC (5µg/l).

Lead

Lead concentrations were below the MDL (<5µg/l) in all soil leachate samples.

Mercury

Mercury concentrations were below the MDL (<1µg/l) in all soil leachate samples.

Nickel

Nickel concentrations ranged from below the MDL (<2µg/l) in WS4 (0.25 – 1.00mbgl) and WS5 (1.00 – 2.00mbgl and 2.00 – 2.30mbgl) to 15µg/l in WS3 (1.00 – 2.00mbgl). The recorded concentrations were below the relevant GAC (20µg/l) and SWAC (4µg/l).

Selenium

Selenium concentrations were below the MDL (<3µg/l) in all soil leachate samples.

Zinc

Zinc concentrations were below the MDL (<3µg/l) in all soil leachate samples.

6.4 Soil and Groundwater Data Selection

Table 6-2 below highlights the soil and groundwater data results utilised as part of the human health and environmental risk assessment in the following Sections.

Table 6-2: Soil and Groundwater Data Selection

Sample Type	Sample collected by	Date Range of Sample Collection	No. of samples collected within Site	No. of samples collected outside of Site in Masterplan Area	Total Number of Samples Utilised for Environmental and Human Health Risk Assessment
Groundwater	Arup	September – October 2013	9	24	N/A[1]
		June – July 2014	3	2	N/A[1]
	MOR	January 2018	5	7	12
	T.E Laboratories	March 2019 – February 2020	25	33	58
Soil	Arup	September 2013 – June 2014	49	67	116
	Arup	March 2014 – October 2014	-	72	72
	MOR	March 2017	-	11	11
		February – March 2018	6	12	18
		January 2020	9	-	9

Note 1: A review of groundwater data contained within the Arup Detailed Site Assessment (Arup, 2014) from various previous studies at the Site and the wider Masterplan area was completed as part of this assessment.

For this assessment, soil concentrations across the entire Masterplan area (which includes the Site) were utilised. This highly conservative approach was adopted to ensure a 'worst-case scenario' was assessed.

7 HUMAN HEALTH RISK ASSESSMENT

The refined CSM identified the potential human health pollutant linkages that warranted further assessment, which were those associated with future users of the Site (members of the public) and future Site workers (construction and maintenance workers) and the plausible exposure scenarios of direct contact with potentially contaminated soil and inhalation of dusts/vapours arising from contaminated soil/water.

7.1 Future Site Users (Members of the Public)

7.1.1 Generic Quantitative Risk Assessment

The results of the soils analysis were screened against the LQM/CIEH S4ULs and Defra C4SLs for public open space (park) land-use (1% soil organic matter) in order to further assess the risks to future Site users (members of the public).

No exceedances of the public open space criteria were noted in any of the nine (9 No.) soil samples collected during January 2020.

Based on a review of all historic soil analytical data collected for the Masterplan area, there have been three (3 No.) noted exceedances of the public open space criteria. These are presented in Table 7-1. Full historic soil analytical results are presented in Table 1.

Table 7-1: Exceedances of Public Open Space Criteria

Contaminant	Public Open Space Criteria (1% soil organic matter) - mg/kg	Maximum Concentration Recorded in Masterplan area– mg/kg	Location of Maximum Concentration
Benzo(b)fluoranthene	13	19	TP3A (1.00 - 1.25mbgl)
Benzo(a)pyrene	11 / 21	16	TP3A (1.00 - 1.25mbgl)
Dibenzo(ah)anthracene	1.1	1.9	TP3A (1.00 - 1.25mbgl)

It should be noted that TP3A is located outside of the Site. Regardless of the fact that these exceedances are not within the Site, the area where they were detected forms part of the wider Masterplan area and will be covered by hardstanding or a geotextile membrane to prevent direct contact.

While asbestos was identified in several soil samples collected from the Site, gravimetric analysis showed that the concentration of asbestos in these samples was below the method detection limit of 0.001%. Nevertheless, it is considered that in the absence of any mitigation measures that a potential risk to future users of the Proposed Development (members of the public) would exist due to the detection of asbestos in soils beneath the existing concrete hardstanding.

7.2 Future Site Workers

7.2.1 Site Workers – Construction Phase and Operational Phase

As outlined above, a risk to Site workers (during the construction and operational phase) also exists due to the detection of asbestos in soils beneath the existing concrete hardstanding. Furthermore, as with any brownfield site, there remains a potential to encounter unknown contaminated materials.

7.3 Remedial Measures

7.3.1 Future Site Users (Members of the Public)

A key design principle of the Proposed Development was to minimise the removal of the existing concrete hardstanding. Furthermore, replacement of hardstanding was included as part of the design so far as was reasonably practicable.

Based on a review of the Proposed Development in the context of the CSM and all available data, the optimum approach to address any potential human health risks would be to reinstate a barrier that could be readily incorporated into the design where areas of concrete hardstanding are to be permanently removed. This would be considered a precautionary measure and is discussed further below.

The soils where asbestos has been detected will be covered in hardstanding or by a layer of clean inert imported fill materials (e.g. soil and/or stone), with a minimum depth of 600mm, to achieve the proposed finished ground levels. This is considered to be sufficient to prevent human exposure to contamination potentially present in deeper soils.

Based on the above, the risk to future Site users (members of the public) from inhalation exposure to any asbestos fibres in the existing soils will be negligible. Nevertheless, it may be prudent to install a geotextile membrane below clean topsoil in open grassed areas to ensure that the risks are further reduced. The barrier to be incorporated into the design can readily be achieved by installing a geotextile membrane below clean topsoil in open grassed areas. The geotextile membrane will be covered with inert imported fill materials (e.g. soil and/or stone) to achieve the proposed finished ground levels. The final specification of the geotextile membrane and the depth of fill materials will be such to meet with the requirements of the design for the Proposed Development (e.g. not impeding drainage) as well as the requirements of providing a barrier to any potential direct contact with existing soil.

7.3.2 Site Workers – Construction Phase and Operational Phase

Based on the available data it is considered that there is a risk to Site workers (during the construction phase) due to the detection of asbestos in soils. As with any brownfield site, there remains a potential to encounter unknown contaminated materials. Therefore, this potential risk and associated issues of concern for construction workers will be documented in the Safety File for the Site. Any potential construction health and safety issues will be addressed in the appropriate risk assessment method statements for works that will need to be prepared by the appointed contractor in accordance with relevant Health and Safety Regulations.

The risk to Site workers (during the operational phase) is considered to be negligible due to the remedial measures outlined in Section 7.3.1. In the event that any Site workers need to undertake deeper excavations outside of / beneath the hardstanding or geotextile membrane, then appropriate health and safety measures as outlined above will need to be implemented.

8 ENVIRONMENTAL RISK ASSESSMENT

8.1 Leaching of Soil Contaminants and Migration Offsite

The potential risk to the water environment from leaching of soil contamination and migration in groundwater following removal of some concrete hardstanding was evaluated using the UK Environment Agency Remedial Targets Methodology (RTM) (EA, 2006).

The Site is located immediately adjacent to the River Nore and is intersected by the River Breagagh. Groundwater in the gravels (and underlying limestone) is assumed to discharge to these rivers (principally the River Nore). Given that the River Nore is a SAC and that the River Breagagh flows into the River Nore adjacent to the Site, the River Nore is considered the principal receptor of concern and has been assumed as the receptor for this assessment. There are no plans to use groundwater beneath the Site for water supply in the Masterplan developments and therefore groundwater has been considered as a pathway rather than a receptor.

For the purposes of this assessment the RTM was used to derive a set of soil Site Specific Assessment Criteria (soil SSAC) protective of surface water (the River Nore). The SSACs are the theoretical on-site soil concentrations (across the entire Site) that are predicted to result in water concentrations at a compliance point being equal to the relevant target concentrations.

For this assessment, the highest soil concentration of each modelled contaminant across the wider Masterplan area (which includes the Site) was selected for comparison with the SSACs. This highly conservative approach was adopted to ensure a 'worst-case scenario' of each contaminant was modelled.

Note that for this assessment it was not necessary to derive groundwater SSAC for comparison with the measured groundwater concentrations. This is because the risk assessed was leaching from soil contamination arising from the removal of existing concrete hardstanding. The risk from groundwater contamination is discussed further in Section 8.2.

For this assessment, the River Nore was selected as the compliance point and the surface water quality standards presented in the Surface Water Regulations 2009 (S.I. No. 272 of 2009) as amended (S.I. No.327 of 2012, S.I. No.386 of 2015 and S.I. No. 77 of 2019) were adopted as the target concentrations. Provided that on-site soil concentrations are below the SSACs it can be assumed that on-site soil contamination does not pose an unacceptable risk to the receiving waterbody.

8.1.1 RTM Approach

The RTM is based on up to four (4 No.) levels of analysis for the assessment of risks from contamination in soils:

Level 1 considers the partitioning of contaminants between soil, pore-water and vapour. Level 1 SSAC are based on achieving the target concentrations in the pore water of the unsaturated zone.

Level 2 considers dilution by leachate generated in the unsaturated zone mixing with groundwater flowing beneath the Site. Level 2 SSAC are based on achieving the target concentrations in groundwater below the source zone.

Level 3 considers natural attenuation occurring within the saturated zone between the source area and the compliance point at some distance down hydraulic gradient from the source zone and is used for assessing risks from concentrations of contaminants in groundwater. Level 3 SSAC are based on achieving the target concentrations in groundwater at a compliance point down-hydraulic gradient from the source.

Level 4 considers dilution in the receptor and can be used where considered appropriate for situations including dilution at an abstraction well or, as applied in this assessment, dilution in the receiving surface water body. The RTM model does not include the Level 4 analysis and therefore this must be conducted externally to the model. Level 4 SSAC are based on achieving the target concentrations in the receiving surface water body or abstracted groundwater.

For the purposes of this assessment, taking account of the CSM, it was considered that a combined Level 1 and Level 4 analysis would be the most appropriate approach to derive the soil SSACs. The Level 4 analysis used for this assessment incorporates the Level 2 dilution. The highly conservative assumption has been made that there is no attenuation along the groundwater pathway and so the Level 3 assessment has not been conducted.

It is worth noting that the CSM prepared by Arup (Arup, 2014) identified the presence of boulder clay beneath the Site as well as sand and gravel adjoining the River Nore. However, for the purposes of this assessment and to ensure a worst case scenario was evaluated, in revising the CSM it was considered that there was no boulder clay and that the gravel aquifer beneath the Site was in hydraulic continuity with the directly adjoining River Nore. Therefore, groundwater in the gravel is assumed to discharge directly to the River Nore.

The Level 4 SSAC is derived by applying a dilution factor (DF) to the Level 1 SSAC. The Level 4 analysis was undertaken in accordance with the approach described in the EA Remedial Targets Methodology (EA, 2006) and taking cognisance of the Department of the Environment Heritage and Local Government approach (DoEHLG, 2010)

As the Level 4 SSAC values are calculated outside the RTM model sheets, the calculations are outlined below:

Level 4 SSAC (soil as mg/kg) =Level 1 SSAC x DF

$DF = Q_{River} / Q_{Infiltration}$

Where,

Q_{River} = flow rate in the receiving water body; and

$Q_{Infiltration}$ = A.Inf, where A = area of infiltration (m^2) and Inf = infiltration rate (m/d)

For the purposes of this assessment, the area of infiltration is assumed to be the area of concrete hardstanding that will be removed temporarily for utility installation and hard landscaping as well as that removed permanently to facilitate landscaping works and infiltration of surface water from soft landscaped areas. This area will consist of approximately $3{,}052m^2$.

This equates to approximately 22% of the total Site area ($13{,}658m^2$). The infiltration rate is conservatively assumed to be 100% of effective rainfall, i.e. 489 mm/yr = 0.00134 m/d (GSI, 2020). In accordance with the Environment Agency RTM guidance (EA, 2006), the 95^{th} percentile low flow rate in the receiving waterbody i.e. the River Nore has been used as the river flow rate. Based on flow data for hydrometric Station 15002 located on the River Nore at John's Bridge for the period 1971 to 2013 this is estimated to be 3.67 m^3/s (317,088 m^3/d). In accordance with the EA RTM guidance, the dilution factor has been divided by a factor of 10 to take account of other potential inputs of contaminants to the river from other sources/sites. Thus, a dilution factor of 7,753 (317,088 / 3,052 x [0.00134 x 10]) was used for the Level 4 assessment.

8.1.2 Source – Contaminants of Potential Concern

The potential sources or Contaminants of Potential Concern (COPC) selected for this assessment and rationale for selection based on a review of available groundwater and soil data for the Site and wider Masterplan area are summarised in Table 8-1.

Table 8-1: Contaminants of Potential Concern

Contaminant	Justification
Metals: arsenic, cadmium, chromium, copper and lead.	Elevated concentrations of specific metals recorded in soil and/or groundwater in Masterplan area.
Polycyclic Aromatic Hydrocarbons (PAHs): Anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Fluoranthene, Indeno(123cd)pyrene, Benzo(ghi)perylene and Naphthalene.	Elevated concentrations recorded in soil and/or groundwater in Masterplan area.
Petroleum Hydrocarbons (TPH-CWG): aliphatic C10-12, C12-C16, C16-C21 and C21-C35, aromatic EC10-EC12; EC12-EC16, EC16-EC21 and EC21-EC35.	Historical issues in the Masterplan area, primarily to the north of the River Breagagh with elevated concentrations of specific TPH fractions recorded in soil and/or groundwater.
Polychlorinated Biphenyls (PCBs)	Historical issues in Masterplan area.
Volatile Organic Compounds (VOCs): 1,2,3-Trichlorobenzene and 1,2,4-Trichlorobenzene.	Elevated concentrations recorded for specified parameters identified in groundwater in Masterplan area. Other VOC parameters not of concern.

A number of parameters including inorganics (e.g. ammonia, nitrate and phosphates) were considered not to be COPCs as the potential source of these contaminants was identified to be process effluent which has been removed since decommissioning was completed (Arup, 2014).

8.1.3 RTM Model Input Criteria

Level 1

The input criteria selected for this RTM assessment including the target concentrations together with references are presented in the table below and the RTM Model Sheets (Refer to Appendix F). A total porosity of 0.35 has been assumed which is the porosity calculated by the RTM porosity calculator assuming a dry bulk density of 1.8 g/cm^3 which is considered a reasonable estimate for the soils at the Site. The worst-case assumption is made that the water porosity in the unsaturated zone is equal to the total porosity. This results in the lowest Level 1 SSAC albeit that there is very little sensitivity in the results if a lower water porosity and corresponding higher air-filled porosity are used.

The RTM spreadsheet models partitioning between soil sorbed and dissolved phase constituents in pore water using the soil-water partition coefficient. Literature values have been used for the soil-water partition coefficient (Kd) for inorganic constituents (metals). The RTM spreadsheet calculates Kd for the organic constituents by multiplying the constituents organic carbon partition coefficient (Koc) by the fraction of organic carbon (foc) in the source soils. Literature values have been used for the Koc values and the average fraction of organic carbon coefficient measured in soil samples from the Site (2.2%, excluding outliers with >10% foc) has been used as the foc. Refer to Table 8-2.

Table 8-2: Chemical Specific Input Parameters

Contaminant	Target Concentration [1] (ug/L)	Soil – Water Partition Coefficient (Kd) [2] (L/kg)	Organic Carbon Partition Coefficient (Koc) [2] (L/kg)
Metals			
Arsenic	25	500	-
Cadmium	0.08	100	-
Chromium	32	18	-
Copper	5	100	-
Lead	14	1000 [6]	-
Mercury	0.07	500	-
BTEX/MTBE			
MTBE	10 [3]	-	33.9 [7]
Benzene	10	-	67.6
Toluene	10	-	204
Ethylbenzene	10 [4]	-	447
Xylenes	10		427
Polycyclic Aromatic Hydrocarbons			
Anthracene	0.1	-	5620
Benzo(b)fluoranthene	0.017 (MAC)	-	105000
Benzo(k)fluoranthene	0.017 (MAC)	-	148000
Benzo(a)pyrene	1.70E-04	-	128000
Fluoranthene	0.0063	-	18200
Indeno(123cd)pyrene	0.05 [4]	-	87100
Benzo(ghi)perylene	0.05 [4]	-	417000
Naphthalene	2	-	646
Petroleum Hydrocarbons (TPH-CWG):			
Aliphatic C10-12	0.94 [5]	-	240000
Aliphatic C12-16	0.94 [5]		5.01E+06
Aliphatic C16-C21	0.94 [5]	-	5.75E+08
Aliphatic C21-C35	0.94 [5]	-	5.75E+08
Aromatic EC10-EC12	0.94 [5]	-	2510
Aromatic EC12-EC16	0.94 [5]		5.01E+03
Aromatic EC16-EC21	0.94 [5]	-	14100
Aromatic EC21-EC35	0.94 [5]	-	126000
Polychlorinated Biphenyls (PCBs)			

Contaminant	Target Concentration [1] (ug/L)	Soil – Water Partition Coefficient (Kd) [2] (L/kg)	Organic Carbon Partition Coefficient (Koc) [2] (L/kg)
Total 7 PCBs	0.01 [4]	-	5.37E+06 [8]
Volatile Organic Compounds (VOCs)			
1,2,3-Trichlorobenzene	0.4	-	2570
1,2,4-Trichlorobenzene	0.4	-	2290

Notes:

1. Surface Water Regulations 2009 SI No. 272 of 2009, SI No 327 of 2012, SI No. 386 of 2015, and SI No. 77 of 2019 Annual Mean, unless stated otherwise.
2. Taken from LQM, 2015 unless stated otherwise.
3. Groundwater Regulations (S.I. No. 9 of 2010, SI No. 149 of 2012, SI No. 366 of 2016).
4. EPA Interim Guideline Value (IGV) for Groundwater, 2003.
5. Groundwater Regulations (S.I. No. 9 of 2010, SI No. 149 of 2012, SI No. 366 of 2016) for total TPH is 7.5 µg/L. This has been equally distributed throughout all eight TPH fractions modelled.
6. Kd for lead taken from CL:AIRE (2014)
7. Taken from EIC AGS CL:AIRE, 2010
8. Taken from Environment Agency, 2009. Supplementary information for the derivation of SGVs for dioxins, furans and dioxin-like PCBs. Science report: SC050021/Technical Review dioxins, furans and dioxin-like PCBs. Value used is for PCB118:

8.1.4 Site Specific Assessment Criteria

The derived SSACs were compared to the maximum soil concentrations recorded across the entire Masterplan area. Refer to Table 8-3. As discussed above the Level 4 SSACs have been calculated by multiplying the Level 1 SSAC by the dilution factor of 7,753. The Level 4 SSAC have then been compared with the maximum measured soil concentrations from across the entire Masterplan area in order to characterise the ‘worst-case scenario’ risk to surface water.

Note that the Level 4 SSAC are the theoretical concentrations in soil beneath the Site that are predicted to result in the concentrations in surface water equalling one tenth of the relevant water quality standards. For this reason, an exceedance of the Level 4 SSAC at one or two locations does not necessarily mean that there will be an unacceptable risk to surface water. Indeed, provided that the average concentration of each contaminant in soil below areas where existing concrete hardstanding is to be removed is below the SSAC the risk will be acceptable.

Furthermore, as discussed above, the Level 4 SSAC do not account for attenuation along the groundwater flow path. Attenuation processes such as retardation and biodegradation can be significant and this adds another layer of conservatism to the risk assessment.

Table 8-3: Contaminant Site Specific Assessment Criteria

Contaminant	Level 1 SSAC (mg/kg) [1]	Level 4 SSAC (mg/kg) [2]	Maximum recorded soil concentration in Masterplan area. (mg/kg) [3]
Metals			
Arsenic	12.5	96,913	66
Cadmium	0.008	62	7.4
Chromium	0.58	4,497	63

Contaminant	Level 1 SSAC (mg/kg) [1]	Level 4 SSAC (mg/kg) [2]	Maximum recorded soil concentration in Masterplan area. (mg/kg) [3]
Copper	0.50	3,877	616
Lead	14	108,542	855
Mercury	0.035	271	27
BTEX/MTBE			
MTBE	0.0094	73	<0.002
Benzene	0.017	132	0.027
Toluene	0.047	364	0.11
Ethylbenzene	0.10	775	0.12
Xylenes	0.096	744	0.29
Polycyclic Aromatic Hydrocarbons			
Anthracene	0.012	93	3
Benzo(b)fluoranthene	0.039	302	19
Benzo(k)fluoranthene	0.055	426	7.8
Benzo(a)pyrene	0.00048	4	**16**
Fluoranthene	0.025	194	37
Indeno(123cd)pyrene	0.096	744	10
Benzo(ghi)perylene	0.46	3,566	9.3
Naphthalene	0.029	225	6.9
Petroleum Hydrocarbons (TPH-CWG):			
Aliphatic C10-12	4.96	38,455	160
Aliphatic C12-16	104	806,312	570
Aliphatic C16-C21	11891	92,190,923	760
Aliphatic C21-C35	11891	92,190,923	390
Aromatic EC10-EC12	0.052	403	34
Aromatic EC12-EC16	0.10	775	220
Aromatic EC16-EC21	0.29	2,248	110
Aromatic EC21-EC35	2.6	20,158	180

Contaminant	Level 1 SSAC (mg/kg) [1]	Level 4 SSAC (mg/kg) [2]	Maximum recorded soil concentration in Masterplan area. (mg/kg) [3]
Polychlorinated Biphenyls (PCBs)	1.2	9,304	4.726 Note: PCB impacted soil was only identified at the bank of River Breagagh adjoining the Masterplan area.. All of this identified PCB impacted soil was removed and validated to the EPA's satisfaction.
Volatile Organic Compounds (VOCs)			
1,2,3-Trichlorobenzene	0.023	178	Not identified in soil
1,2,4-Trichlorobenzene	0.020	155	Not identified in soil

Notes:

1. Level 1 SSAC are the theoretical soil concentrations at which the predicted leachate concentrations equal the surface water quality standards.
2. Level 4 SSAC = Level 1 SSAC x Dilution Factor of 7,753
3. Measured concentrations that exceed Level 4 SSAC are shown in **bold**

The maximum recorded concentrations in soil in the Masterplan area are all below the Level 4 SSAC with the exception of benzo(a)pyrene. As discussed above, natural attenuation along the groundwater flow path has not been considered in the assessment. This is likely to be significant for PAHs such as benzo(a)pyrene which are strongly retarded by soil particles. As such, the SSAC for benzo(a)pyrene is likely to be highly conservative (by orders of magnitude). In addition, the SSAC is based on all the soil beneath the Site having a concentration equal to the SSAC. The exceedance for benzo(a)pyrene was noted in one isolated soil sample in outside of the Site boundary (TP3A). For these reasons, this exceedance of the SSAC is not considered significant.

Based on the available soil data, it is considered unlikely that there would be a significant risk to the River Nore, associated with the known condition of the Site.

8.2 Impact to Hydrogeological Regime

The removal of some concrete hardstanding will result in an increased infiltration of rainfall to ground which previously was directed to the surface water drainage at the Site or as runoff to the riverbank. The increase in infiltration will increase groundwater flow beneath the Site which could impact on groundwater levels.

Groundwater flow beneath the Site can be calculated using Darcy's Law:

$Q_{gw} = K.i.W.b$

Where,

Q_{gw} = groundwater flow (m^3/d)

K = hydraulic conductivity (m/d)

i = hydraulic gradient

W = width perpendicular to groundwater flow direction

b = saturated aquifer thickness

Arup (Arup, 2014) presented hydraulic conductivity estimates obtained from testing monitoring wells BHA to BHE. These ranged from 0.292 m/d to 3.35 m/d and averaged 1.8 m/d. Based on monitoring data for the Masterplan area, the average hydraulic gradient in the sands and gravels at the Site is estimated to be 0.005. The width of the Site (perpendicular to groundwater flow direction) is approximately 260m and the saturated aquifer thickness is typically 6m (based on lithological logs compiled by Arup). Using these (average) values the groundwater flow beneath the Site is estimated to be approximately 14 m^3/d.

Approximately 3,052m^2 of existing concrete hardstanding at the Site will be removed as part of the construction of the Proposed Development. The majority of this (approximately 2,682m^2) will be re-instated within an estimated period of nine (9 No) months. Approximately 370m^2 will be permanently removed to allow for drainage of surface water in grassed areas or soft landscaping.

During the construction works, on the assumption that approximately 3,052m^2 of existing concrete hardstanding is removed and that the additional infiltration across this area is equal to the GSI estimated aquifer recharge for Kilkenny City of 0.489 m/year, infiltration would be increased by approximately 1500m^3/year (4.1m^3/day). Thus, groundwater flow would be temporarily increased from 14 m^3/d to 18.1 m^3/d.

The increase in groundwater flow would cause a corresponding increase in hydraulic gradient to 0.0065 (0.005 x 18.1/14), i.e. an increase of 0.0015. As a result, groundwater levels would rise on-site by a maximum of approximately 0.21m (length of Site parallel to groundwater flow direction of 140m x 0.0015), with the maximum rise expected to occur in the west, furthest from the River Nore. Given that groundwater levels in the Masterplan area vary seasonally by approximately 0.5m, this predicted temporary rise in groundwater levels is not considered significant.

Longer term, with approximately 370m^2 of existing concrete hardstanding permanently removed, infiltration will increase by approximately 181m^3/year (370m^2 x 0.489 m/yr), i.e. 0.50m^3/day. Thus, groundwater flow would be increased from 14 m^3/d to 14.5 m^3/d. The increase in groundwater flow would cause a corresponding increase in hydraulic gradient to 0.0052 (0.005 x 14.5/14), i.e. an increase of 0.0002. As a result, groundwater levels would rise on-site by a maximum of approximately 0.03m (length of Site parallel to groundwater flow direction of approximately 140m x 0.0002), with the maximum rise expected to occur in the west, furthest from the River Nore. Given that groundwater levels at the site vary seasonally by approximately 0.5m, this predicted long-term rise in groundwater levels is not considered significant.

The increase in groundwater flow beneath the Site could also potentially increase risk to the water environment from existing groundwater contamination. However, given that the long-term increase in groundwater flow is minimal and that there are relatively few and minor exceedances of water quality standards in groundwater (see Section 4.1.2), the increase in risk to the water environment from existing groundwater contamination will be negligible.

While a flood risk assessment is outside the scope of this assessment, the potential flood impact on the Site was reviewed in the context of an environmental risk i.e. where any unidentified contaminants could be mobilised from the soil by floodwater. Based on this review, it is considered that the removal of some concrete hardstanding will not have a significant impact on the Site in terms of potential flood risk. In addition, regardless of any potential flood risk for the Site as identified by the OPW (OPW, 2020), it is unlikely that there would be any significant risk to human health or environmental receptors associated with a flood event at the Site.

8.3 Cumulative Effect of the Proposed Development and Riverside Garden

This section considers the combined risk from the removal of concrete hardstanding in both the Site and the wider Masterplan area.

Table 8-3 above shows that, with the exception of benzo(a)pyrene, the Level 4 SSAC derived for the Site are at least twice (and generally more than one order of magnitude above) the maximum measured concentrations in soil across the wider Masterplan area. Thus, with the possible exception of benzo(a)pyrene (discussed further below), the combined risk from both areas is highly unlikely to cause a significant risk to receiving waters.

The average concentration of benzo(a)pyrene across the whole Masterplan area is 0.29mg/kg, which is approximately one order of magnitude below the SSAC for the Site (4mg/kg). Also, as discussed above, the Level 4 SSAC do not account for attenuation in groundwater which will be significant for benzo(a)pyrene. Thus, it is considered highly unlikely that the cumulative risks from benzo(a)pyrene would be significant.

In terms of impacts to the hydrogeological regime, it is concluded that the impacts will be low. Even accounting for the removal of concrete hardstanding in both areas (temporary and permanent) the impact on groundwater levels is unlikely to be significant, particularly as groundwater levels in the Riverside Gardens area will be strongly controlled by surface water levels in the adjoining River Nore.

9 REVIEW OF CONCEPTUAL SITE MODEL

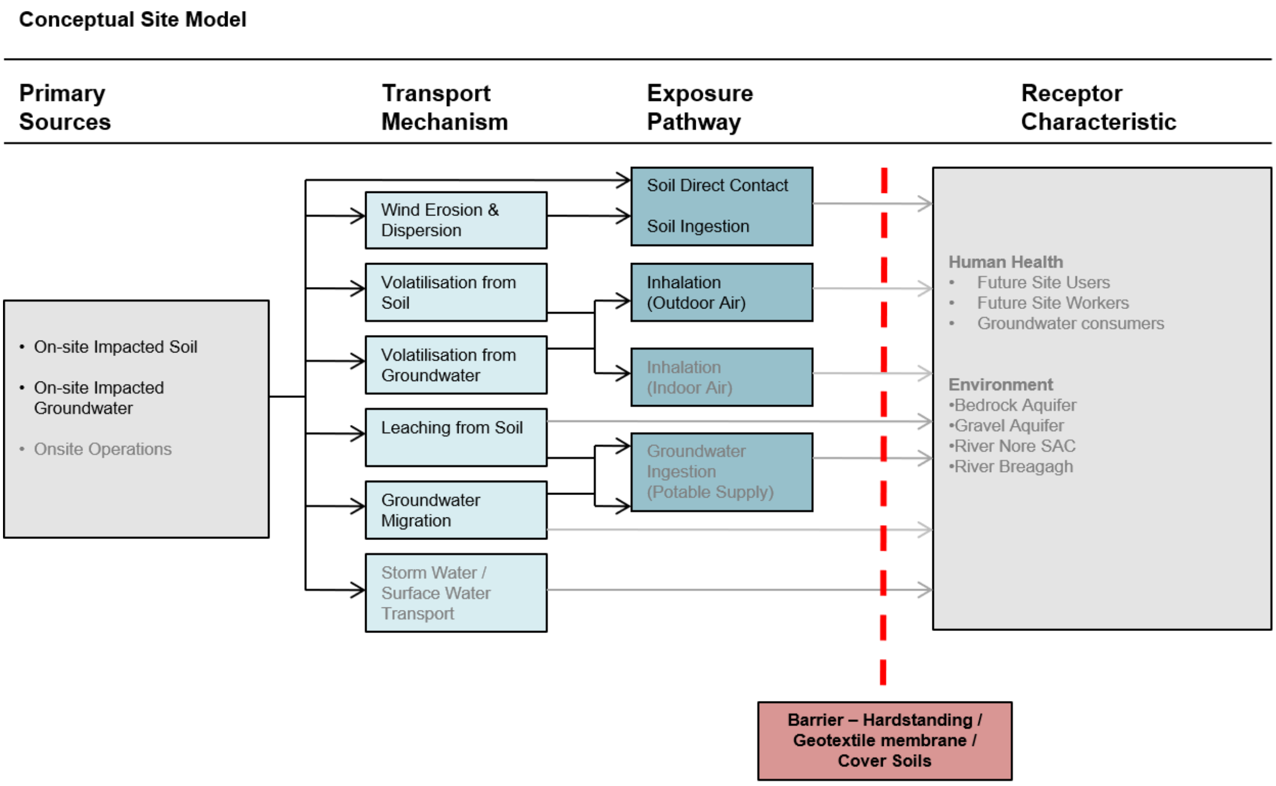
Based on the results of the risk assessment, which included modelling of the identified contaminant sources for environmental receptors and a detailed evaluation of the potential human health risks, the CSM and identified pollutant linkages for the Site were revised.

There were no identified unacceptable environmental risks associated with the removal of the concrete hardstanding based on the known condition of the Site. As with any brownfield site there may be potentially unknown contaminant issues of concern at the Site, however based on available historical data the potential for such issues is considered low.

The human health exposure scenario of direct contact with potentially contaminated material has been removed from the CSM based on the proposed installation of a ‘barrier’ as part of the proposed design.

The Revised CSM is presented in Table 9-1.

Table 9-1: Revised Conceptual Site Model



10 CONCLUSIONS

Based on the DQRA undertaken for the Site including the RTM Model assessment and development of SSAC, it is considered reasonable to conclude the following:

- The Site is located within a sensitive environmental setting due to the proximity of the River Nore SAC, the River Breagagh, the two (2 No.) underlying regionally important aquifers and its location within a Zone of Archaeological Potential.
- The key assumption of the existing CSM and risk assessment completed as part of the IPPC Licence surrender was that the concrete hardstanding in the Masterplan area (including the Site) would remain in place and act as a barrier for the remaining pollutant linkages.
- A key design principle for the Proposed Development was to minimise the removal of existing concrete hardstanding and as such only 370m^2 (approximately 3%) will be permanently removed.
- A DQRA was considered to be warranted as the Proposed Development will necessitate the temporary and permanent removal of some of the existing concrete hardstanding at the Site.
- The findings of a gap analysis confirmed sufficient groundwater data was available from the ongoing groundwater monitoring programme. Supplementary soils data was determined to be needed from within the Site.
- A highly conservative approach was adopted for this assessment in order to assess a “worst case scenario” that included the following assumptions:
    - Areas where existing concrete hardstanding will only be removed temporarily were assumed to be areas where existing concrete hardstanding would be removed permanently; and,
    - The highest soil concentrations detected anywhere with the Masterplan area, regardless of whether the sample was collected in the Site or not, were used for each contaminant when deriving SSAC.
- It is considered that there would be no unacceptable risk to the health of future users of the Site (members of the public) as a result of the Proposed Development due to the presence of a ‘barrier’. The barrier will consist of hardstanding, a geotextile membrane or a layer of clean inert imported fill materials (e.g. soil and/or stone), with a minimum depth of 600mm, to achieve the proposed finished ground levels. This precautionary approach will prevent any direct contact with the existing soil beneath the Site and remove any associated potential human health issues.
- The potential risk to future Site workers associated with the Site condition should be managed during the construction and operational phase of the Proposed Development through adherence to relevant Health and Safety Regulations.
- It is considered that there would be no unacceptable risk to the identified sensitive environmental receptors as a result of the Proposed Development.
- There will be no likely significant impact on the hydrogeological regime at the Site as a result of the Proposed Development.
- It is considered that the cumulative impact on hydrogeological regime as a result of the Proposed Development and the wider Masterplan area will not be significant.

11 RECOMMENDATIONS

Based on the conclusions of this DQRA, the following recommendations should be implemented:

- As per any development of a brownfield site, some consideration must be given to the potential for unknown issues to arise during the construction works. Therefore, a Construction Environmental Management Plan should be prepared for the works to ensure that there will be no adverse impacts on the adjoining sensitive surface waterbodies i.e. River Nore / River Breagagh. This plan should also incorporate a waste management strategy to ensure that all surplus materials generated during the construction works will be removed offsite in accordance with all legislative requirements.
- Existing groundwater monitoring wells (MW203, BHD, BHE, MW201, MW202 and PH5) located within the Site, that will obstruct the development works, should be decommissioned in accordance with industry standards in order to ensure that they do not present a conduit for any potential contaminants to enter the underlying aquifer.

12 REFERENCES

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DRAWINGS


Legend
Site Boundary
Area Excluded from Planning Application
Probehole Locations
Existing Groundwater Wells
BHC
PH4
BHE
MW203
MW202
MW201
BHA
PH1
BHD
PH2
PH3
PH5
St. Francis Abbey
MW7
BH03
MW301
MW6
BH01
Saint Francis Bridge
Breagagh River
Peace Park
Marble City Boxing Club
Watergate Car Park
The Watergate Theatre
The Ring
Parliament Street
Market Yard
Smithwick's Brewery Experience
Kilkenny Court House
0
25
50 m
©OpenStreetMap Contributors 2020
Ground Floor –Unit 3, Bracken Business Park, Bracken Road, Sandyford, Dublin 18, D18 V32Y
Tel: +353 1 567 7655
Email: enviro@mores.ie
MALONE O'REGAN ENVIRONMENTAL
Client
Kilkenny County Council
Description
2020 Probehole Locations and Existing Groundwater Monitoring Wells
Job
Abbey Creative Quarter – Urban Park and Street
Job Number
E1620
Drawing Number
1
Status
Final
Sht. Size
A4
Scale
1:1,300
Date
Jul 2020
Drawn
UD

TABLES

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	446-448	449-451	474-476	320-322	323-325	460-462	463-465	147-149	150-152	153-155	164-166	167-169	170-172	107-109	110-112	184-186	187-189	190-192
Sample ID					BH01		BH02A			BH03		WS01			WS02			WS03		WS04		
Depth (m)			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	0.5	1.5	0.5	1.5	3	0.5	2.7	0.8	1.8	2.85	0.8	1.8	2.8	0.9	1.9	1.5	2	2.5
Sample Date					25/09/2013	25/09/2013	27/09/2013	30/09/2013	30/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	25/09/2013	25/09/2013	26/09/2013	26/09/2013	26/09/2013
Soil Characteristic Parameters																						
Natural Moisture Content	%	<0.02	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Indicators																						
Total Organic Carbon	%	<0.02			1.39	9.79	0.13	0.8	0.17	1.43	0.09	32.95	3.42	1.23	5.01	1.57	0.85	4.14	5.74	3.28	0.82	0.13
Fraction of Organic Carbon		0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Organic Carbon (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos																						
ACM Type			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~																		
Metals																						
Antimony	mg/kg	<1	~	~	<1	1	<1	1	<1	<1	1	2	2	4	1	1	5	6	2	1	2	<1
Arsenic	mg/kg	<0.5	170	170	7.6	11	3.8	6.3	2.6	5.2	5.2	16	12.3	15.2	11.2	8.3	12.4	51.9	21	24.2	6.2	1.9
Barium	mg/kg	<1	~	~	48	69	24	49	24	112	283	228	148	541	136	167	850	134	100	42	72	14
Cadmium	mg/kg	<0.1	560	880	0.4	0.5	0.3	0.2	0.2	0.2	0.5	0.3	1.3	7.4	0.3	1.2	5.1	2.1	0.6	0.7	0.5	0.2
Chromium	mg/kg	<0.5	220	250	8.2	11.8	7.1	10.8	7.1	8.8	8.2	15.7	22.5	50.3	12.8	20.9	47.6	19	15	11.8	32.8	6.4
Copper	mg/kg	<1	44000	~	26	52	8	18	8	13	5	208	75	68	86	72	53	84	56	616	36	6
Lead	mg/kg	<5	~	1300	53	86	10	33	15	72	9	484	86	34	102	76	25	211	157	85	42	8
Mercury	mg/kg	<0.1	240	~	<0.1	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	1.4	0.3	<0.1	0.3	0.6	<0.1	0.7	1	0.4	0.2	0.4
Molybdenum	mg/kg	<0.1	~	~	0.7	0.9	0.5	0.6	0.5	0.5	0.6	3.2	1.9	5.2	1.6	1.6	4.3	7.7	1.4	1	1.1	0.3
Nickel	mg/kg	<0.7	800	~	14.2	20.7	11.5	15.2	10.8	16.7	15.1	57.5	32.4	78.7	21.1	27	81.4	58.1	23.2	14.3	41.9	7.5
Selenium	mg/kg	<1	1800	~	<1	<1	<1	<1	<1	<1	<1	<1	1	6	<1	<1	9	<1	<1	<1	<1	<1
Zinc	mg/kg	<5	170000	~	58	133	31	64	26	54	28	143	176	297	66	149	216	261	149	203	97	19
TPH CWG																						
Aliphatics																						
>C5-C6	mg/kg	<1.0	95000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C6-C8	mg/kg	<1.0	150000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C8-C10	mg/kg	<1.0	14000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C10-C12	mg/kg	<1.0	21000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C12-C16	mg/kg	<1.0	25000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C16-C21	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C21-C35	mg/kg	<1.0		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C35-C44	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Aromatics																						
>EC5-EC7	mg/kg	<1.0	76000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC7-EC8	mg/kg	<1.0	87000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC8-EC10	mg/kg	<1.0	7200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC10-EC12	mg/kg	<1.0	9200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC12-EC16	mg/kg	<1.0	10000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC16-EC21	mg/kg	<1.0	7600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC21-EC35	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC35-EC44	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PETROLEUM HYDROCARBONS																						
BTEX/MTBE																						
MTBE	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Benzene	ug/kg	<5	90000	230000	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Toluene	ug/kg	<5	87000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
m/p-Xylene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
o-Xylene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Polychlorinated Biphenyls (PCBs)																						
PCB 28	ug/kg	<5			<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 52	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 101	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 118	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 138	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 153	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 180	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total 7 PCBs	ug/kg	<35	~	~	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35
Polycyclic Aromatic Hydrocarbons (PAHs)																						
Naphthalene	mg/kg	<0.04	1200	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.07	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Acenaphthylene	mg/kg	<0.03	29000	~	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Acenaphthene	mg/kg	<0.05	29000	~	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluorene	mg/kg	<0.04	20000	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Phenanthrene	mg/kg	<0.03	6200	~	<0.03	<0.03	<0.03	0.07	<0.03	<0.03	<0.03	0.59	<0.03	<0.03	0.05	<0.03	<0.03	0.09	0.07	<0.03	<0.03	<0.03
Anthracene	mg/kg	<0.04	150000	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.11	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04

E1620

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	446-448	449-451	474-476	320-322	323-325	460-462	463-465	147-149	150-152	153-155	164-166	167-169	170-172	107-109	110-112	184-186	187-189	190-192
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	BH01		BH02A			BH03		WS01			WS02			WS03		WS04		
Depth (m)					0.5	1.5	0.5	1.5	3	0.5	2.7	0.8	1.8	2.85	0.8	1.8	2.8	0.9	1.9	1.5	2	2.5
Sample Date					25/09/2013	25/09/2013	27/09/2013	30/09/2013	30/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	25/09/2013	25/09/2013	26/09/2013	26/09/2013	26/09/2013
Fluoranthene	mg/kg	<0.03	6300	~	<0.03	<0.03	<0.03	0.12	<0.03	<0.03	<0.03	0.65	<0.03	<0.03	0.09	<0.03	<0.03	0.18	0.21	<0.03	<0.03	<0.03
Pyrene	mg/kg	<0.03	15000	~	<0.03	<0.03	<0.03	0.1	<0.03	<0.03	<0.03	0.54	<0.03	<0.03	0.08	<0.03	<0.03	0.16	0.19	<0.03	<0.03	<0.03
Benzo(a)anthracene	mg/kg	<0.06	49	~	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.29	<0.06	<0.06	0.08	<0.06	<0.06	0.1	0.11	<0.06	<0.06	<0.06
Chrysene	mg/kg	<0.02	93	~	0.02	<0.02	<0.02	0.05	<0.02	0.03	<0.02	0.31	<0.02	<0.02	0.06	<0.02	<0.02	0.1	0.11	<0.02	<0.02	<0.02
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	<0.05	<0.05	<0.05	0.07	<0.05	<0.05	<0.05	0.4	<0.05	<0.05	0.1	<0.05	<0.05	0.17	0.17	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	0.15	<0.02	<0.02	0.04	<0.02	<0.02	0.06	0.07	<0.02	<0.02	<0.02
Benzo(bk)fluoranthene	mg/kg	<0.07		~	<0.07	<0.07	<0.07	0.1	<0.07	<0.07	<0.07	0.55	<0.07	<0.07	0.14	<0.07	<0.07	0.23	0.24	<0.07	<0.07	<0.07
Benzo(a)pyrene	mg/kg	<0.04	11	21	<0.04	<0.04	<0.04	0.05	<0.04	<0.04	<0.04	0.28	<0.04	<0.04	0.05	<0.04	<0.04	0.11	0.11	<0.04	<0.04	<0.04
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.18	<0.04	<0.04	<0.04	<0.04	<0.04	0.11	0.09	<0.04	<0.04	<0.04
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.06	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.21	<0.04	<0.04	0.05	<0.04	<0.04	0.11	0.07	<0.04	<0.04	<0.04
Coronene	mg/kg	<0.04	~	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
PAH 17 Total	mg/kg	<0.64	~	~	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	3.88	<0.64	<0.64	<0.64	<0.64	<0.64	1.19	1.2	<0.64	<0.64	<0.64
Volatile Organic Compounds (VOC MS)																						
Dichlorodifluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Vinyl Chloride	µg/kg	<1	4.8	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromomethane	µg/kg	<20	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichlorofluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromochloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloromethane	µg/kg	<1	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroform	ug/kg	<3	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1-Trichloroethane	µg/kg	<1	57000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloromethane	µg/kg	<1	190	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloropropene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Carbon tetrachloride	µg/kg	<4		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloroethene (TCE)	µg/kg	<1	70	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloropropane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromodichloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-3-Dichloropropene	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-3-Dichloropropene	µg/kg	<10		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,2-Trichloroethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloroethene (PCE)	µg/kg	<1	810	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichloropropane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromochloromethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromoethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chlorobenzene	µg/kg	<1	1300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Styrene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tribromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Isopropylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromobenzene	µg/kg	<2		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Propylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
2-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
tert-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
sec-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Isopropyltoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichlorobenzene	µg/kg	<1	390	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,4-Dichlorobenzene	µg/kg	<1	36000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
n-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichlorobenzene	µg/kg	<1	24000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Hexachlorobutadiene	µg/kg	<1	48	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~

Notes:
1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3548. All rights reserved."
2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.
~ - denotes comparison criteria not available

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Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

					ARUP CRAMP - PHASE 1																	
Sample No.	**Units**	**LOD**	**LQM/CIEH (Generic Assessment Criteria)[1]**	**Category 4 Screening Levels[2]**	124-126	127-129	133-135	426-428	429-431	435-437	438-440	1-3	4-6	7-9	24-26	27-29	30-32	33-35	47-49	50-52	53-55	56-58
Sample ID			**Public Open Space 2 (Park) 1% SOM**	**Public Open Space 2 (Park) 1% SOM**	WS05			WS06				WS07			WS08				WS09			
Depth (m)					0.5	1.5	3	0.5	1.5	3.5	4.5	0.5	1.7	2.5	0.5	1.5	2.5	3.5	0.5	1.5	2.8	3
Sample Date					25/09/2013	25/09/2013	25/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	23/09/2013	24/09/2013	24/09/2013	23/09/2013	24/09/2013	24/09/2013	24/09/2013	23/09/2013	24/09/2013	24/09/2013	24/09/2013
Soil Characteristic Parameters																						
Natural Moisture Content	%	<0.02	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Indicators																						
Total Organic Carbon	%	<0.02			3.56	0.45	0.62	0.35	7.57	0.39	0.14	1.67	15.89	3.08	2.47	4.78	4.85	0.21	2.38	6.91	11.4	0.14
Fraction of Organic Carbon		0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Organic Carbon (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos																						
ACM Type			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~																		
Metals																						
Antimony	mg/kg	<1	~	~	1	<1	3	<1	1	1	<1	1	4	1	1	2	2	<1	1	2	2	1
Arsenic	mg/kg	<0.5	170	170	9.6	5.2	10.1	4.4	14.4	11.9	3.8	8.8	30.7	7.6	7.2	13	14.1	3.6	14.3	23.3	13.3	4.3
Barium	mg/kg	<1	~	~	73	42	171	31	55	51	20	87	204	110	100	94	132	29	103	111	78	27
Cadmium	mg/kg	<0.1	560	880	0.5	0.4	2.6	0.2	0.6	0.2	0.2	0.5	0.9	0.8	0.3	0.6	0.9	0.2	0.7	0.9	1.6	0.2
Chromium	mg/kg	<0.5	220	250	14.9	10.2	37.3	6.2	7.7	8.7	7.2	13	14.4	21.4	14.3	11.8	18	11.2	13.7	16.7	12.4	15.5
Copper	mg/kg	<1	44000	~	57	22	40	11	21	13	7	18	63	47	17	57	75	10	36	83	63	13
Lead	mg/kg	<5	~	1300	98	75	23	29	66	20	8	99	138	45	69	152	855	10	101	127	16	46
Mercury	mg/kg	<0.1	240	~	0.5	0.7	<0.1	<0.1	<0.1	1.6	<0.1	<0.1	0.2	0.3	<0.1	0.2	<0.1	<0.1	0.3	0.4	<0.1	<0.1
Molybdenum	mg/kg	<0.1	~	~	0.9	0.5	1.3	0.5	0.7	0.7	0.5	0.8	2.2	0.9	0.7	0.9	1.4	0.3	0.8	1.2	8	0.3
Nickel	mg/kg	<0.7	800	~	30.9	11.8	52.8	9.5	13.5	13.6	11.4	15.1	24.7	24.5	17.3	18.6	27.6	12.8	18.7	24.6	23.7	18.8
Selenium	mg/kg	<1	1800	~	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1
Zinc	mg/kg	<5	170000	~	138	51	151	32	198	47	33	113	229	118	90	126	202	38	180	240	239	46
TPH CWG																						
Aliphatics																						
>C5-C6	mg/kg	<1.0	95000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C6-C8	mg/kg	<1.0	150000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C8-C10	mg/kg	<1.0	14000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C10-C12	mg/kg	<1.0	21000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C12-C16	mg/kg	<1.0	25000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C16-C21	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C21-C35	mg/kg	<1.0		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C35-C44	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Aromatics																						
>EC5-EC7	mg/kg	<1.0	76000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC7-EC8	mg/kg	<1.0	87000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC8-EC10	mg/kg	<1.0	7200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC10-EC12	mg/kg	<1.0	9200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC12-EC16	mg/kg	<1.0	10000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC16-EC21	mg/kg	<1.0	7600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC21-EC35	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC35-EC44	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PETROLEUM HYDROCARBONS																						
BTEX/MTBE																						
MTBE	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Benzene	ug/kg	<5	90000	230000	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Toluene	ug/kg	<5	87000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	7	<5	<5	<5	<5	<5	<5	<5
m/p-Xylene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	87	<5	<5	<5	<5	<5	<5	<5
o-Xylene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	87	<5	<5	<5	<5	<5	<5	<5
Polychlorinated Biphenyls (PCBs)																						
PCB 28	ug/kg	<5			<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 52	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 101	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 118	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 138	ug/kg	<5	~	~	<5	<5	<5	<5	11	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 153	ug/kg	<5	~	~	<5	<5	<5	<5	20	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 180	ug/kg	<5	~	~	<5	<5	<5	<5	28	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total 7 PCBs	ug/kg	<35	~	~	<35	<35	<35	<35	59	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35
Polycyclic Aromatic Hydrocarbons (PAHs)																						
Naphthalene	mg/kg	<0.04	1200	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.22	<0.04	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Acenaphthylene	mg/kg	<0.03	29000	~	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.03	0.56	<0.03	0.11	<0.03	<0.03	<0.03	<0.03	0.05	<0.03	<0.03
Acenaphthene	mg/kg	<0.05	29000	~	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluorene	mg/kg	<0.04	20000	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.41	<0.04	0.09	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Phenanthrene	mg/kg	<0.03	6200	~	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.22	3.51	<0.03	0.51	0.04	<0.03	<0.03	0.06	0.11	<0.03	<0.03
Anthracene	mg/kg	<0.04	150000	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.08	1.32	<0.04	0.16	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

					ARUP CRAMP - PHASE 1																	
Sample No.	**Units**	**LOD**	**LQM/CIEH (Generic Assessment Criteria)[1]**	**Category 4 Screening Levels[2]**	124-126	127-129	133-135	426-428	429-431	435-437	438-440	1-3	4-6	7-9	24-26	27-29	30-32	33-35	47-49	50-52	53-55	56-58
Sample ID			**Public Open Space 2 (Park) 1% SOM**	**Public Open Space 2 (Park) 1% SOM**	WS05			WS06				WS07			WS08				WS09			
Depth (m)					0.5	1.5	3	0.5	1.5	3.5	4.5	0.5	1.7	2.5	0.5	1.5	2.5	3.5	0.5	1.5	2.8	3
Sample Date					25/09/2013	25/09/2013	25/09/2013	26/09/2013	26/09/2013	26/09/2013	26/09/2013	23/09/2013	24/09/2013	24/09/2013	23/09/2013	24/09/2013	24/09/2013	24/09/2013	23/09/2013	24/09/2013	24/09/2013	24/09/2013
Fluoranthene	mg/kg	<0.03	6300	~	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	0.52	5.32	<0.03	0.85	0.12	<0.03	<0.03	0.12	0.63	<0.03	<0.03
Pyrene	mg/kg	<0.03	15000	~	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	0.46	4.35	<0.03	0.97	0.1	<0.03	<0.03	0.11	0.59	<0.03	<0.03
Benzo(a)anthracene	mg/kg	<0.06	49	~	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.27	2.99	<0.06	0.6	0.11	<0.06	<0.06	0.11	0.33	<0.06	<0.06
Chrysene	mg/kg	<0.02	93	~	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	0.31	2.71	<0.02	0.64	0.07	<0.02	<0.02	0.08	0.38	<0.02	<0.02
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	0.35	2.64	<0.05	0.5	0.09	<0.05	<0.05	0.1	0.45	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.14	1.02	<0.02	0.19	0.03	<0.02	<0.02	0.04	0.18	<0.02	<0.02
Benzo(bk)fluoranthene	mg/kg	<0.07		~	<0.07	<0.07	<0.07	<0.07	0.08	<0.07	<0.07	0.49	3.66	<0.07	0.69	0.12	<0.07	<0.07	0.14	0.63	<0.07	<0.07
Benzo(a)pyrene	mg/kg	<0.04	11	21	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.31	2.33	<0.04	0.48	0.07	<0.04	<0.04	0.08	0.41	<0.04	<0.04
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.17	1.01	<0.04	0.26	<0.04	<0.04	<0.04	0.06	0.25	<0.04	<0.04
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.04	0.57	<0.04	0.11	<0.04	<0.04	<0.04	<0.04	0.1	<0.04	<0.04
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.2	0.91	<0.04	0.25	<0.04	<0.04	<0.04	0.06	0.23	<0.04	<0.04
Coronene	mg/kg	<0.04	~	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.08	0.16	<0.04	0.07	<0.04	<0.04	<0.04	<0.04	0.05	<0.04	<0.04
PAH 17 Total	mg/kg	<0.64	~	~	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	3.18	30.12	<0.64	5.93	<0.64	<0.64	<0.64	0.82	3.76	<0.64	<0.64
Volatile Organic Compounds (VOC MS)																						
Dichlorodifluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Vinyl Chloride	µg/kg	<1	4.8	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromomethane	µg/kg	<20	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichlorofluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromochloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloromethane	µg/kg	<1	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroform	ug/kg	<3	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1-Trichloroethane	µg/kg	<1	57000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloromethane	µg/kg	<1	190	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloropropene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Carbon tetrachloride	µg/kg	<4		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloroethene (TCE)	µg/kg	<1	70	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloropropane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromodichloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-3-Dichloropropene	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-3-Dichloropropene	µg/kg	<10		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,2-Trichloroethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloroethene (PCE)	µg/kg	<1	810	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichloropropane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromochloromethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromoethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chlorobenzene	µg/kg	<1	1300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Styrene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tribromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Isopropylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromobenzene	µg/kg	<2		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Propylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
2-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
tert-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
sec-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Isopropyltoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichlorobenzene	µg/kg	<1	390	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,4-Dichlorobenzene	µg/kg	<1	36000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
n-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichlorobenzene	µg/kg	<1	24000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Hexachlorobutadiene	µg/kg	<1	48	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~

Notes:

1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N

2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.

~ - denotes comparison criteria not available

E1620

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	201-203	204-206	221-223	227-229	96-98	99-101	235-237	238-240	241-243	252-254	258-260	261-263	269-271	272-274	275-277	286-288	289-291	292-294
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	WS10		WS11		WS12		WS13			WS14			WS15			WS16		
Depth (m)					0.5	1.5	1.5	3.3	2.5	3.5	0.5	1.5	2.5	0.5	2.5	3.5	0.5	1.5	2.5	0.5	1.5	2.5
Sample Date					27/09/2013	27/09/2013	27/09/2013	27/09/2013	25/09/2013	25/09/2013	25/09/2013	25/09/2013	25/09/2013	24/09/2013	24/09/2013	24/09/2013	25/09/2013	25/09/2013	25/09/2013	25/09/2013	25/09/2013	25/09/2013
Soil Characteristic Parameters																						
Natural Moisture Content	%	<0.02	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Indicators																						
Total Organic Carbon	%	<0.02			0.8	1.67	0.87	0.1	0.26	0.13	2.17	2.55	0.16	0.54	0.5	0.06	0.17	4.01	0.46	0.77	0.63	0.17
Fraction of Organic Carbon		0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Organic Carbon (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos																						
ACM Type			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~																		
Metals																						
Antimony	mg/kg	<1	~	~	<1	<1	<1	<1	<1	<1	1	1	<1	<1	1	<1	<1	<1	1	<1	<1	<1
Arsenic	mg/kg	<0.5	170	170	9.7	4.7	5.8	3.0	5.1	1.3	10.2	8.1	1.7	5.1	5.8	2.9	3	13.8	5	4.9	4.4	1.8
Barium	mg/kg	<1	~	~	48	209	41	23	37	18	89	113	19	87	79	38	29	60	44	71	82	19
Cadmium	mg/kg	<0.1	560	880	0.6	1.6	0.3	0.3	0.6	0.3	0.6	1.1	0.2	0.4	0.3	<0.1	0.5	0.3	0.4	0.2	0.6	0.2
Chromium	mg/kg	<0.5	220	250	8.7	15.8	10.2	8.3	7.4	7	13.1	14.4	8.6	11.3	14.9	10.3	7.1	13.2	11.6	15.8	11.8	7.9
Copper	mg/kg	<1	44000	~	24	54	18	7	17	8	59	74	7	18	15	8	7	55	21	27	35	7
Lead	mg/kg	<5	~	1300	57	16	26	10	50	12	72	84	8	51	14	7	13	192	30	25	45	8
Mercury	mg/kg	<0.1	240	~	0.7	<0.1	0.4	0.4	0.5	0.3	2.1	0.8	0.2	0.4	<0.1	0.2	0.3	0.6	0.2	<0.1	0.5	0.3
Molybdenum	mg/kg	<0.1	~	~	1.2	1.3	0.8	0.7	0.5	0.2	1	1	0.5	0.7	0.6	0.3	0.4	1.2	0.7	0.7	0.8	0.4
Nickel	mg/kg	<0.7	800	~	14.7	24	14.9	11.8	12.6	11.5	18.4	19.8	8.2	16	21.2	12.4	10.9	18.8	19	23.3	17.1	7.6
Selenium	mg/kg	<1	1800	~	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	mg/kg	<5	170000	~	89	205	41	24	46	32	136	224	20	63	53	26	78	145	84	70	78	21
TPH CWG																						
Aliphatics																						
>C5-C6	mg/kg	<1.0	95000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C6-C8	mg/kg	<1.0	150000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C8-C10	mg/kg	<1.0	14000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C10-C12	mg/kg	<1.0	21000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C12-C16	mg/kg	<1.0	25000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C16-C21	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C21-C35	mg/kg	<1.0		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C35-C44	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Aromatics																						
>EC5-EC7	mg/kg	<1.0	76000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC7-EC8	mg/kg	<1.0	87000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC8-EC10	mg/kg	<1.0	7200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC10-EC12	mg/kg	<1.0	9200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC12-EC16	mg/kg	<1.0	10000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC16-EC21	mg/kg	<1.0	7600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC21-EC35	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC35-EC44	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PETROLEUM HYDROCARBONS																						
BTEX/MTBE																						
MTBE	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Benzene	ug/kg	<5	90000	230000	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Toluene	ug/kg	<5	87000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
m/p-Xylene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
o-Xylene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Polychlorinated Biphenyls (PCBs)																						
PCB 28	ug/kg	<5			<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 52	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 101	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 118	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 138	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	7	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 153	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	8	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 180	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	11	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total 7 PCBs	ug/kg	<35	~	~	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35
Polycyclic Aromatic Hydrocarbons (PAHs)																						
Naphthalene	mg/kg	<0.04	1200	~	0.14	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Acenaphthylene	mg/kg	<0.03	29000	~	0.34	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Acenaphthene	mg/kg	<0.05	29000	~	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluorene	mg/kg	<0.04	20000	~	0.2	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Phenanthrene	mg/kg	<0.03	6200	~	3.47	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	<0.03	<0.03	0.03	0.09	<0.03	<0.03	<0.03	<0.03
Anthracene	mg/kg	<0.04	150000	~	0.9	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	201-203	204-206	221-223	227-229	96-98	99-101	235-237	238-240	241-243	252-254	258-260	261-263	269-271	272-274	275-277	286-288	289-291	292-294
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	WS10		WS11		WS12		WS13			WS14			WS15			WS16		
Depth (m)					0.5	1.5	1.5	3.3	2.5	3.5	0.5	1.5	2.5	0.5	2.5	3.5	0.5	1.5	2.5	0.5	1.5	2.5
Sample Date					27/09/2013	27/09/2013	27/09/2013	27/09/2013	25/09/2013	25/09/2013	25/09/2013	25/09/2013	25/09/2013	24/09/2013	24/09/2013	24/09/2013	25/09/2013	25/09/2013	25/09/2013	25/09/2013	25/09/2013	25/09/2013
Fluoranthene	mg/kg	<0.03	6300	~	7.31	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.11	<0.03	<0.03	<0.03	0.17	<0.03	<0.03	<0.03	<0.03
Pyrene	mg/kg	<0.03	15000	~	5.92	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.09	<0.03	<0.03	0.04	0.13	<0.03	<0.03	<0.03	<0.03
Benzo(a)anthracene	mg/kg	<0.06	49	~	3.04	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.08	<0.06	<0.06	<0.06	0.08	<0.06	<0.06	<0.06	<0.06
Chrysene	mg/kg	<0.02	93	~	2.45	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.07	<0.02	<0.02	<0.02	0.08	<0.02	<0.02	<0.02	<0.02
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	3.77	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	<0.05	<0.05	<0.05	0.12	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	1.46	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	<0.02	<0.02	0.05	<0.02	<0.02	<0.02	<0.02
Benzo(bk)fluoranthene	mg/kg	<0.07		~	5.23	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	0.13	<0.07	<0.07	<0.07	0.17	<0.07	<0.07	<0.07	<0.07
Benzo(a)pyrene	mg/kg	<0.04	11	21	2.34	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.04	<0.04	<0.04	<0.04	0.08	<0.04	<0.04	<0.04	<0.04
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	1.31	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.07	<0.04	<0.04	<0.04	<0.04
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	0.5	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	1.19	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.04	<0.04	<0.04	<0.04	0.05	<0.04	<0.04	<0.04	<0.04
Coronene	mg/kg	<0.04	~	~	0.11	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
PAH 17 Total	mg/kg	<0.64	~	~	34.45	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	0.92	<0.64	<0.64	<0.64	<0.64
Volatile Organic Compounds (VOC MS)																						
Dichlorodifluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Vinyl Chloride	µg/kg	<1	4.8	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromomethane	µg/kg	<20	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichlorofluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromochloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloromethane	µg/kg	<1	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroform	ug/kg	<3	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1-Trichloroethane	µg/kg	<1	57000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloromethane	µg/kg	<1	190	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloropropene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Carbon tetrachloride	µg/kg	<4		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloroethene (TCE)	µg/kg	<1	70	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloropropane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromodichloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-3-Dichloropropene	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-3-Dichloropropene	µg/kg	<10		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,2-Trichloroethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloroethene (PCE)	µg/kg	<1	810	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichloropropane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromochloromethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromoethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chlorobenzene	µg/kg	<1	1300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Styrene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tribromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Isopropylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromobenzene	µg/kg	<2		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Propylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
2-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
tert-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
sec-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Isopropyltoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichlorobenzene	µg/kg	<1	390	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,4-Dichlorobenzene	µg/kg	<1	36000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
n-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichlorobenzene	µg/kg	<1	24000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Hexachlorobutadiene	µg/kg	<1	48	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~

Notes:
1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N
2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.
~ - denotes comparison criteria not available

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Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

											ARUP - PHASE 2 SOILS											
Sample No.	**Units**	**LOD**	**LQM/CIEH (Generic Assessment Criteria)[1]**	**Category 4 Screening Levels[2]**	67-69	70-72	73-75	303-305	306-308	312-314	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-30	31-33	34-36
Sample ID			**Public Open Space 2 (Park) 1% SOM**	**Public Open Space 2 (Park) 1% SOM**	WS17			WS18			TP01	TP02		TP03	TP04	TP05	TP06		TP07	TP08	TP09	TP10
Depth (m)					0.5	1	2	0.5	1.5	2.5	1	0.8	1	1.8	0.55	2.5	1.8	2.05	0.6	1	2.3	1.5
Sample Date					24/09/2013	24/09/2013	24/09/2013	26/09/2013	26/09/2013	26/09/2013	11/12/2013	10/12/2013	10/12/2013	10/12/2013	11/12/2013	10/12/2013	10/12/2013	10/12/2013	11/12/2013	11/12/2013	11/12/2013	12/12/2013
Soil Characteristic Parameters																						
Natural Moisture Content	%	<0.02	~	~	~	~	~	~	~	~	45.1	12.8	32	29.9	3.3	23.5	26.3	31.8	5.6	31.2	22	26.1
Indicators																						
Total Organic Carbon	%	<0.02			1.9	1.58	0.22	0.94	7.47	0.59	6.18	1.18	5.05	10.74	0.14	5.36	5.78	2.61	0.17	3.93	5.31	4.29
Fraction of Organic Carbon		0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Organic Carbon (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos																						
ACM Type			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~																		
Metals																						
Antimony	mg/kg	<1	~	~	<1	1	1	<1	1	2	<1	2	1	2	<1	2	2	1	<1	2	2	1
Arsenic	mg/kg	<0.5	170	170	8.3	7.9	4.7	11.3	13	6.1	12.9	11.9	23.8	29.5	2.2	9.2	22.5	8.1	3.7	18.9	18.7	13.8
Barium	mg/kg	<1	~	~	42	67	84	62	75	163	71	132	169	208	21	45	99	115	26	126	117	126
Cadmium	mg/kg	<0.1	560	880	0.4	0.5	0.4	0.2	0.5	1.6	0.7	0.4	0.7	1	0.2	0.3	0.6	0.9	0.3	0.9	0.6	0.8
Chromium	mg/kg	<0.5	220	250	9	12.9	13.6	10.9	12.4	26.8	13.1	25.6	26	20.6	19.5	30.1	21.7	19.2	9.1	16.5	16.2	21.9
Copper	mg/kg	<1	44000	~	29	35	14	18	45	25	68	31	45	71	4	42	72	58	6	50	36	65
Lead	mg/kg	<5	~	1300	506	44	7	35	133	20	61	181	232	353	8	94	91	44	9	156	90	52
Mercury	mg/kg	<0.1	240	~	<0.1	<0.1	<0.1	0.3	1	<0.1	0.2	0.2	0.7	0.3	<0.1	0.2	1.2	0.2	<0.1	0.6	0.3	0.2
Molybdenum	mg/kg	<0.1	~	~	1.3	0.9	1.5	0.7	1	1.7	3.5	1.4	2.2	2.6	1.4	1.2	2.4	1.6	0.7	1.3	1.5	1.8
Nickel	mg/kg	<0.7	800	~	15.9	18.4	17.2	14.9	18.7	36.5	17.2	23.4	21.3	34.2	7.2	23.2	27.8	20.7	6.9	18.8	17.7	22
Selenium	mg/kg	<1	1800	~	<1	<1	<1	<1	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	mg/kg	<5	170000	~	75	95	50	53	123	113	144	159	262	249	17	107	184	151	29	274	223	156
TPH CWG																						
Aliphatics																						
>C5-C6	mg/kg	<1.0	95000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C6-C8	mg/kg	<1.0	150000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C8-C10	mg/kg	<1.0	14000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C10-C12	mg/kg	<1.0	21000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C12-C16	mg/kg	<1.0	25000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C16-C21	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C21-C35	mg/kg	<1.0		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C35-C44	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Aromatics																						
>EC5-EC7	mg/kg	<1.0	76000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC7-EC8	mg/kg	<1.0	87000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC8-EC10	mg/kg	<1.0	7200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC10-EC12	mg/kg	<1.0	9200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC12-EC16	mg/kg	<1.0	10000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC16-EC21	mg/kg	<1.0	7600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC21-EC35	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC35-EC44	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PETROLEUM HYDROCARBONS																						
BTEX/MTBE																						
MTBE	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Benzene	ug/kg	<5	90000	230000	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Toluene	ug/kg	<5	87000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
m/p-Xylene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
o-Xylene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Polychlorinated Biphenyls (PCBs)																						
PCB 28	ug/kg	<5			<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 52	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 101	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 118	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 138	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 153	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 180	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total 7 PCBs	ug/kg	<35	~	~	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35
Polycyclic Aromatic Hydrocarbons (PAHs)																						
Naphthalene	mg/kg	<0.04	1200	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.08	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.07	<0.04	<0.04
Acenaphthylene	mg/kg	<0.03	29000	~	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.18	0.48	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.16	0.05	<0.03
Acenaphthene	mg/kg	<0.05	29000	~	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.18	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluorene	mg/kg	<0.04	20000	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.09	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Phenanthrene	mg/kg	<0.03	6200	~	0.04	<0.03	<0.03	0.11	<0.03	<0.03	<0.03	0.59	0.74	0.19	<0.03	<0.03	0.08	0.07	<0.03	0.71	0.24	<0.03
Anthracene	mg/kg	<0.04	150000	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.27	0.16	0.06	<0.04	<0.04	<0.04	<0.04	<0.04	0.16	0.09	<0.04

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Table 1: Soils Analytical Results

											ARUP - PHASE 2 SOILS											
Sample No.	**Units**	**LOD**	**LQM/CIEH (Generic Assessment Criteria)[1]**	**Category 4 Screening Levels[2]**	67-69	70-72	73-75	303-305	306-308	312-314	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-30	31-33	34-36
Sample ID			**Public Open Space 2 (Park) 1% SOM**	**Public Open Space 2 (Park) 1% SOM**	WS17			WS18			TP01	TP02		TP03	TP04	TP05	TP06		TP07	TP08	TP09	TP10
Depth (m)					0.5	1	2	0.5	1.5	2.5	1	0.8	1	1.8	0.55	2.5	1.8	2.05	0.6	1	2.3	1.5
Sample Date					24/09/2013	24/09/2013	24/09/2013	26/09/2013	26/09/2013	26/09/2013	11/12/2013	10/12/2013	10/12/2013	10/12/2013	11/12/2013	10/12/2013	10/12/2013	10/12/2013	11/12/2013	11/12/2013	11/12/2013	12/12/2013
Fluoranthene	mg/kg	<0.03	6300	~	0.04	<0.03	<0.03	0.16	<0.03	<0.03	<0.03	1.25	2.14	0.47	0.03	<0.03	0.13	0.24	0.1	1.31	0.61	<0.03
Pyrene	mg/kg	<0.03	15000	~	0.04	<0.03	<0.03	0.16	<0.03	<0.03	0.04	1.75	1.94	0.44	0.03	<0.03	0.14	0.22	0.1	1.13	0.52	<0.03
Benzo(a)anthracene	mg/kg	<0.06	49	~	<0.06	<0.06	<0.06	0.07	<0.06	<0.06	<0.06	0.51	1.57	0.57	<0.06	<0.06	0.14	0.16	0.07	0.67	0.37	<0.06
Chrysene	mg/kg	<0.02	93	~	0.03	<0.02	<0.02	0.09	<0.02	<0.02	0.04	0.63	1.65	0.61	0.03	0.02	0.13	0.17	0.05	0.7	0.4	0.04
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	<0.05	<0.05	<0.05	0.13	<0.05	<0.05	<0.05	0.77	2.94	1.57	<0.05	<0.05	0.08	0.17	0.09	0.9	0.49	<0.05
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	<0.02	<0.02	<0.02	0.05	<0.02	<0.02	<0.02	0.3	1.15	0.61	<0.02	<0.02	0.03	0.07	0.04	0.35	0.19	<0.02
Benzo(bk)fluoranthene	mg/kg	<0.07		~	<0.07	<0.07	<0.07	0.18	<0.07	<0.07	<0.07	1.07	4.09	2.18	<0.07	<0.07	0.11	0.24	0.13	1.25	0.68	<0.07
Benzo(a)pyrene	mg/kg	<0.04	11	21	<0.04	<0.04	<0.04	0.06	<0.04	<0.04	<0.04	0.56	2.46	0.91	<0.04	<0.04	0.08	0.13	0.05	0.66	0.43	<0.04
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	<0.04	<0.04	<0.04	0.06	<0.04	<0.04	<0.04	0.23	1.27	0.88	<0.04	<0.04	<0.04	<0.04	<0.04	0.29	0.13	<0.04
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.15	0.24	0.17	<0.04	<0.04	<0.04	<0.04	<0.04	0.08	0.06	<0.04
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	<0.04	<0.04	<0.04	0.07	<0.04	<0.04	<0.04	0.37	1.25	1.14	<0.04	<0.04	<0.04	0.08	<0.04	0.28	0.24	<0.04
Coronene	mg/kg	<0.04	~	~	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.09	0.34	0.45	<0.04	<0.04	<0.04	<0.04	<0.04	0.07	<0.04	<0.04
PAH 17 Total	mg/kg	<0.64	~	~	<0.64	<0.64	<0.64	0.96	<0.64	<0.64	<0.64	7.92	18.41	8.07	<0.64	<0.64	0.81	1.31	<0.64	7.54	3.82	<0.64
Volatile Organic Compounds (VOC MS)																						
Dichlorodifluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Vinyl Chloride	µg/kg	<1	4.8	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromomethane	µg/kg	<20	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichlorofluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromochloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloromethane	µg/kg	<1	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroform	ug/kg	<3	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1-Trichloroethane	µg/kg	<1	57000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloromethane	µg/kg	<1	190	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloropropene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Carbon tetrachloride	µg/kg	<4		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloroethene (TCE)	µg/kg	<1	70	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloropropane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromodichloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-3-Dichloropropene	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-3-Dichloropropene	µg/kg	<10		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,2-Trichloroethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloroethene (PCE)	µg/kg	<1	810	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichloropropane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromochloromethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromoethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chlorobenzene	µg/kg	<1	1300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Styrene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tribromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Isopropylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromobenzene	µg/kg	<2		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Propylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
2-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
tert-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
sec-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Isopropyltoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichlorobenzene	µg/kg	<1	390	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,4-Dichlorobenzene	µg/kg	<1	36000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
n-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichlorobenzene	µg/kg	<1	24000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Hexachlorobutadiene	µg/kg	<1	48	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~

Notes:
1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N
2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.
~ - denotes comparison criteria not available

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	ARUP -PHASE 3 SOILS 1-3	4-6	7-9	13-15	182-184	185-187	188-190	191-193	194-196	197-199	200-202	203-205	101-103	104-106	107-109	110-112	113-115	116-118	119-121	125-127
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	TPA				BHA								BHB							
Depth (m)					0.5	1	1.8	3.2	0.5	1	1.5	2	2.5	3	4	5	0.75	1	1.5	2	2.5	3	4	7
Sample Date									27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	25/06/2014	25/06/2014	25/06/2014	25/06/2014	25/06/2014	25/06/2014	25/06/2014	25/06/2014
Soil Characteristic Parameters																								
Natural Moisture Content	%	<0.02	~	~	2.7	4.9	25.3	28.9	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Indicators																								
Total Organic Carbon	%	<0.02			0.15	0.17	5.54	0.37																
Fraction of Organic Carbon		0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Organic Carbon (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos																								
ACM Type			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~																				
Metals																								
Antimony	mg/kg	<1	~	~	<1	<1	2	2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Arsenic	mg/kg	<0.5	170	170	2.2	3	9.8	6.9	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Barium	mg/kg	<1	~	~	29	27	65	101	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Cadmium	mg/kg	<0.1	560	880	0.3	0.3	0.4	0.9	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chromium	mg/kg	<0.5	220	250	6.1	8.1	10.9	19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Copper	mg/kg	<1	44000	~	7	10	60	26	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Lead	mg/kg	<5	~	1300	6	10	88	13	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Mercury	mg/kg	<0.1	240	~	0.4	0.3	0.5	0.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Molybdenum	mg/kg	<0.1	~	~	0.4	0.6	0.9	2.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Nickel	mg/kg	<0.7	800	~	9.1	11.1	16.2	24.9	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Selenium	mg/kg	<1	1800	~	<1	<1	<1	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Zinc	mg/kg	<5	170000	~	28	31	114	73	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
TPH CWG																								
Aliphatics																								
>C5-C6	mg/kg	<1.0	95000	~	~	~	~	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>C6-C8	mg/kg	<1.0	150000	~	~	~	~	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>C8-C10	mg/kg	<1.0	14000	~	~	~	~	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>C10-C12	mg/kg	<1.0	21000	~	~	~	~	~	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
>C12-C16	mg/kg	<1.0	25000	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
>C16-C21	mg/kg	<1.0	450000	~	~	~	~	~	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
>C21-C35	mg/kg	<1.0		~	~	~	~	~	<7	<7	<7	<7	<7	<7	<7	<7	27	<7	<7	<7	<7	<7	<7	<7
>C35-C44	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C44	mg/kg	<5.0	~	~	~	~	~	~	<19	<19	<19	<19	<19	<19	<19	<19	27	<19	<19	<19	<19	<19	<19	<19
Aromatics									~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC5-EC7	mg/kg	<1.0	76000	~	~	~	~	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>EC7-EC8	mg/kg	<1.0	87000	~	~	~	~	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>EC8-EC10	mg/kg	<1.0	7200	~	~	~	~	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>EC10-EC12	mg/kg	<1.0	9200	~	~	~	~	~	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
>EC12-EC16	mg/kg	<1.0	10000	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
>EC16-EC21	mg/kg	<1.0	7600	~	~	~	~	~	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
>EC21-EC35	mg/kg	<1.0	7800	~	~	~	~	~	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
>EC35-EC44	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-44	mg/kg	<5.0	~	~	~	~	~	~	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	~	~	~	~	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38
PETROLEUM HYDROCARBONS																								
BTEX/MTBE																								
MTBE	ug/kg	<5	~	~	<5	<5	<5	<5	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzene	ug/kg	<5	90000	230000	<5	<5	<5	<5	<3	<3	21	<3	<3	<3	<3	<3	<3	10	11	<3	27	<3	<3	<3
Toluene	ug/kg	<5	87000000	~	<5	<5	<5	<5	<3	<3	18	<3	<3	<3	<3	<3	<3	10	10	<3	8	<3	<3	<3
Ethylbenzene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
m/p-Xylene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
o-Xylene	ug/kg	<5	17000000	~	<5	<5	<5	<5	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Polychlorinated Biphenyls (PCBs)																								
PCB 28	ug/kg	<5			<5	<5	<5	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 52	ug/kg	<5	~	~	<5	<5	<5	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 101	ug/kg	<5	~	~	<5	<5	<5	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 118	ug/kg	<5	~	~	<5	<5	<5	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 138	ug/kg	<5	~	~	<5	<5	<5	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 153	ug/kg	<5	~	~	<5	<5	<5	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 180	ug/kg	<5	~	~	<5	<5	<5	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total 7 PCBs	ug/kg	<35	~	~	<35	<35	<35	<35	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Polycyclic Aromatic Hydrocarbons (PAHs)																								
Naphthalene	mg/kg	<0.04	1200	~	<0.04	<0.04	<0.04	<0.04	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthylene	mg/kg	<0.03	29000	~	<0.03	<0.03	<0.03	<0.03	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthene	mg/kg	<0.05	29000	~	<0.05	<0.05	<0.05	<0.05	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluorene	mg/kg	<0.04	20000	~	<0.04	<0.04	<0.04	<0.04	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenanthrene	mg/kg	<0.03	6200	~	0.08	<0.03	<0.03	<0.03	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anthracene	mg/kg	<0.04	150000	~	<0.04	<0.04	<0.04	<0.04	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	ARUP -PHASE 3 SOILS 1-3	4-6	7-9	13-15	182-184	185-187	188-190	191-193	194-196	197-199	200-202	203-205	101-103	104-106	107-109	110-112	113-115	116-118	119-121	125-127
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	TPA				BHA								BHB							
Depth (m)					0.5	1	1.8	3.2	0.5	1	1.5	2	2.5	3	4	5	0.75	1	1.5	2	2.5	3	4	7
Sample Date									27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	25/06/2014	25/06/2014	25/06/2014	25/06/2014	25/06/2014	25/06/2014	25/06/2014	25/06/2014
Fluoranthene	mg/kg	<0.03	6300	~	<0.03	<0.03	<0.03	<0.03	0.013	0.099	<10	<10	<10	<10	<10	<10	0.028	<10	<10	<10	<10	<10	<10	<10
Pyrene	mg/kg	<0.03	15000	~	<0.03	<0.03	<0.03	<0.03	<10	0.082	<10	<10	<10	<10	<10	<10	0.032	<10	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene	mg/kg	<0.06	49	~	<0.06	<0.06	<0.06	<0.06	<10	0.081	<10	<10	<10	<10	<10	<10	0.053	<10	<10	<10	<10	<10	<10	<10
Chrysene	mg/kg	<0.02	93	~	<0.02	<0.02	<0.02	<0.02	<10	0.08	<10	<10	<10	<10	<10	<10	0.028	<10	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	<0.05	<0.05	<0.05	<0.05	<10	0.083	<10	<10	<10	<10	<10	<10	0.033	<10	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	<0.02	<0.02	<0.02	<0.02	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(bk)fluoranthene	mg/kg	<0.07		~	<0.07	<0.07	<0.07	<0.07	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(a)pyrene	mg/kg	<0.04	11	21	<0.04	<0.04	<0.04	<0.04	<10	0.036	<10	<10	<10	<10	<10	<10	0.015	<10	<10	<10	<10	<10	<10	<10
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	<0.04	<0.04	<0.04	<0.04	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	<0.04	<0.04	<0.04	<0.04	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	<0.04	<0.04	<0.04	<0.04	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Coronene	mg/kg	<0.04	~	~	<0.04	<0.04	<0.04	<0.04	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PAH 17 Total	mg/kg	<0.64	~	~	<0.64	<0.64	<0.64	<0.64	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Volatile Organic Compounds (VOC MS)																								
Dichlorodifluoromethane	µg/kg	<1	~	~	~	~	~	~	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/kg	<1	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl Chloride	µg/kg	<1	4.8	~	~	~	~	~	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/kg	<20	~	~	~	~	~	~	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/kg	<2	~	~	~	~	~	~	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichlorofluoromethane	µg/kg	<1	~	~	~	~	~	~	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	~	~	~	~	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
trans-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethane	µg/kg	<1	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Bromochloromethane	µg/kg	<5	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Trichloromethane	µg/kg	<1	2600	~	~	~	~	~																
Chloroform	ug/kg	<3	2600	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1,1-Trichloroethane	µg/kg	<1	57000	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloromethane	µg/kg	<1	190	~	~	~	~	~																
1,1-Dichloropropene	µg/kg	<1	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Carbon tetrachloride	µg/kg	<4		~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2-Dichloroethane	µg/kg	<2	~	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Trichloroethene (TCE)	µg/kg	<1	70	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloropropane	µg/kg	<1	~	~	~	~	~	~	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
Dibromomethane	µg/kg	<1	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Bromodichloromethane	µg/kg	<5	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1-3-Dichloropropene	µg/kg	<10	~	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
trans-1-3-Dichloropropene	µg/kg	<10		~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1,2-Trichloroethane	µg/kg	<10	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloroethene (PCE)	µg/kg	<1	810	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropane	µg/kg	<2	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dibromochloromethane	µg/kg	<10	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dibromoethane	µg/kg	<5	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chlorobenzene	µg/kg	<1	1300	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/kg	<1	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tribromomethane	µg/kg	<1	~	~	~	~	~	~																
Isopropylbenzene	µg/kg	<1	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Bromobenzene	µg/kg	<2		~	~	~	~	~	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2,3-Trichloropropane	µg/kg	<50	~	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Propylbenzene	µg/kg	<1	~	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
2-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
tert-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
sec-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
4-Isopropyltoluene	µg/kg	<1	~	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,3-Dichlorobenzene	µg/kg	<1	390	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,4-Dichlorobenzene	µg/kg	<1	36000	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
n-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2-Dichlorobenzene	µg/kg	<1	24000	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	~	~	~	~	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
Hexachlorobutadiene	µg/kg	<1	48	~	~	~	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	~	~	~	~	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7

Notes:

1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N

2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.

~ - denotes comparison criteria not available

E1620

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Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	ARUP - PHASE 4 SOILS															
					128-130	131-133	134-136	137-139	140-142	143-145	146-148	152-154	155-157	158-160	161-163	164-166	167-169	170-172	173-175	179-181
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	BHC								BHD							
Depth (m)					0.5	1	1.5	2	2.5	3	4	6	0.5	1	1.5	2	2.5	3	4	5.5
Sample Date					26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014
Soil Characteristic Parameters																				
Natural Moisture Content	%	<0.02	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Indicators																				
Total Organic Carbon	%	<0.02																		
Fraction of Organic Carbon		0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Organic Carbon (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos																				
ACM Type			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~																
Metals																				
Antimony	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Arsenic	mg/kg	<0.5	170	170	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Barium	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Cadmium	mg/kg	<0.1	560	880	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chromium	mg/kg	<0.5	220	250	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Copper	mg/kg	<1	44000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Lead	mg/kg	<5	~	1300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Mercury	mg/kg	<0.1	240	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Molybdenum	mg/kg	<0.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Nickel	mg/kg	<0.7	800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Selenium	mg/kg	<1	1800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Zinc	mg/kg	<5	170000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
TPH CWG																				
Aliphatics																				
>C5-C6	mg/kg	<1.0	95000	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>C6-C8	mg/kg	<1.0	150000	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>C8-C10	mg/kg	<1.0	14000	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>C10-C12	mg/kg	<1.0	21000	~	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
>C12-C16	mg/kg	<1.0	25000	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
>C16-C21	mg/kg	<1.0	450000	~	24	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
>C21-C35	mg/kg	<1.0		~	69	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
>C35-C44	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C44	mg/kg	<5.0	~	~	93	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19
Aromatics					~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC5-EC7	mg/kg	<1.0	76000	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>EC7-EC8	mg/kg	<1.0	87000	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>EC8-EC10	mg/kg	<1.0	7200	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>EC10-EC12	mg/kg	<1.0	9200	~	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
>EC12-EC16	mg/kg	<1.0	10000	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
>EC16-EC21	mg/kg	<1.0	7600	~	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
>EC21-EC35	mg/kg	<1.0	7800	~	57	<7	52	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
>EC35-EC44	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-44	mg/kg	<5.0	~	~	57	<19	52	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	150	<38	52	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38
PETROLEUM HYDROCARBONS																				
BTEX/MTBE																				
MTBE	ug/kg	<5	~	~	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzene	ug/kg	<5	90000	230000	<3	<3	<3	<3	<3	<3	<3	<3	<3	11	<3	<3	<3	<3	<3	<3
Toluene	ug/kg	<5	87000000	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	15	<3	<3	<3	<3	<3	<3
Ethylbenzene	ug/kg	<5	17000000	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
m/p-Xylene	ug/kg	<5	17000000	~	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
o-Xylene	ug/kg	<5	17000000	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Polychlorinated Biphenyls (PCBs)																				
PCB 28	ug/kg	<5			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 52	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 101	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 118	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 138	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 153	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PCB 180	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total 7 PCBs	ug/kg	<35	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Polycyclic Aromatic Hydrocarbons (PAHs)																				
Naphthalene	mg/kg	<0.04	1200	~	0.015	<10	0.019	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthylene	mg/kg	<0.03	29000	~	0.024	<10	0.035	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthene	mg/kg	<0.05	29000	~	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluorene	mg/kg	<0.04	20000	~	<10	<10	0.026	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenanthrene	mg/kg	<0.03	6200	~	0.082	<10	0.259	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anthracene	mg/kg	<0.04	150000	~	0.014	<10	0.042	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	ARUP - PHASE 4 SOILS															
					128-130	131-133	134-136	137-139	140-142	143-145	146-148	152-154	155-157	158-160	161-163	164-166	167-169	170-172	173-175	179-181
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	BHC								BHD							
Depth (m)					0.5	1	1.5	2	2.5	3	4	6	0.5	1	1.5	2	2.5	3	4	5.5
Sample Date					26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014
Fluoranthene	mg/kg	<0.03	6300	~	0.448	0.065	0.587	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pyrene	mg/kg	<0.03	15000	~	0.431	0.06	0.562	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene	mg/kg	<0.06	49	~	0.192	0.063	0.318	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chrysene	mg/kg	<0.02	93	~	0.267	0.049	0.406	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	0.401	0.054	0.486	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(bk)fluoranthene	mg/kg	<0.07		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(a)pyrene	mg/kg	<0.04	11	21	0.221	0.039	0.304	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	0.084	<10	0.119	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	0.016	<10	0.027	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	0.111	0.014	0.143	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Coronene	mg/kg	<0.04	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PAH 17 Total	mg/kg	<0.64	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Volatile Organic Compounds (VOC MS)																				
Dichlorodifluoromethane	µg/kg	<1	~	~	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl Chloride	µg/kg	<1	4.8	~	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/kg	<20	~	~	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/kg	<2	~	~	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichlorofluoromethane	µg/kg	<1	~	~	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
trans-1-2-Dichloroethene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethane	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1-2-Dichloroethene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Bromochloromethane	µg/kg	<5	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Trichloromethane	µg/kg	<1	2600	~																
Chloroform	ug/kg	<3	2600	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1,1-Trichloroethane	µg/kg	<1	57000	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloromethane	µg/kg	<1	190	~																
1,1-Dichloropropene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Carbon tetrachloride	µg/kg	<4		~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2-Dichloroethane	µg/kg	<2	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Trichloroethene (TCE)	µg/kg	<1	70	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloropropane	µg/kg	<1	~	~	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
Dibromomethane	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Bromodichloromethane	µg/kg	<5	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1-3-Dichloropropene	µg/kg	<10	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
trans-1-3-Dichloropropene	µg/kg	<10		~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1,2-Trichloroethane	µg/kg	<10	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloroethene (PCE)	µg/kg	<1	810	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropane	µg/kg	<2	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dibromochloromethane	µg/kg	<10	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dibromoethane	µg/kg	<5	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chlorobenzene	µg/kg	<1	1300	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tribromomethane	µg/kg	<1	~	~																
Isopropylbenzene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Bromobenzene	µg/kg	<2		~	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2,3-Trichloropropane	µg/kg	<50	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Propylbenzene	µg/kg	<1	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
2-Chlorotoluene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
tert-Butylbenzene	µg/kg	<1	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
sec-Butylbenzene	µg/kg	<1	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
4-Isopropyltoluene	µg/kg	<1	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,3-Dichlorobenzene	µg/kg	<1	390	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,4-Dichlorobenzene	µg/kg	<1	36000	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
n-Butylbenzene	µg/kg	<1	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2-Dichlorobenzene	µg/kg	<1	24000	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
Hexachlorobutadiene	µg/kg	<1	48	~	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7

Notes:

1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N

2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.

~ - denotes comparison criteria not available

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Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	212-214	215-217	218-220	221-223	224-226	227-229	230-232	233-235	16	77	79	80	82	83	87	91	92	93	106	108
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	BHE								BHAA				BHAB1		BHAB2	BHAB3		BHAB4	BHC	
Depth (m)					1	1.6	2	2.6	3	4	5	7	0.5	0.50	1.50	2.00	0.50	1.00	0.50	0.50	1.00	0.50	0.50	1.50
Sample Date					27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	11/03/2014	13/03/2014	13/03/2014	13/03/2014	12/03/2014	12/03/2014	13/03/2014	13/03/2014	13/03/2014	13/03/2014	14/03/2014	14/03/2014
Soil Characteristic Parameters																								
Natural Moisture Content	%	<0.02	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Indicators																								
Total Organic Carbon	%	<0.02																						
Fraction of Organic Carbon		0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Organic Carbon (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos																								
ACM Type			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~																				
Metals																								
Antimony	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Arsenic	mg/kg	<0.5	170	170	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Barium	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Cadmium	mg/kg	<0.1	560	880	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chromium	mg/kg	<0.5	220	250	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Copper	mg/kg	<1	44000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Lead	mg/kg	<5	~	1300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Mercury	mg/kg	<0.1	240	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Molybdenum	mg/kg	<0.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Nickel	mg/kg	<0.7	800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Selenium	mg/kg	<1	1800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Zinc	mg/kg	<5	170000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
TPH CWG																								
Aliphatics																								
>C5-C6	mg/kg	<1.0	95000	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	~	~	~	~	~	~	~	~	~	~	~	~
>C6-C8	mg/kg	<1.0	150000	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	~	~	~	~	~	~	~	~	~	~	~	~
>C8-C10	mg/kg	<1.0	14000	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	~	~	~	~	~	~	~	~	~	~	~	~
>C10-C12	mg/kg	<1.0	21000	~	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	~	~	~	~	~	~	~	~	~	~	~	~
>C12-C16	mg/kg	<1.0	25000	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
>C16-C21	mg/kg	<1.0	450000	~	<7	<7	<7	<7	<7	<7	<7	<7	~	~	~	~	~	~	~	~	~	~	~	~
>C21-C35	mg/kg	<1.0		~	<7	<7	<7	<7	<7	<7	<7	<7	~	~	~	~	~	~	~	~	~	~	~	~
>C35-C44	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C44	mg/kg	<5.0	~	~	<19	<19	<19	<19	<19	<19	<19	<19	~	~	~	~	~	~	~	~	~	~	~	~
Aromatics					~	~	~	~	~	~	~	~												
>EC5-EC7	mg/kg	<1.0	76000	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	~	~	~	~	~	~	~	~	~	~	~	~
>EC7-EC8	mg/kg	<1.0	87000	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	~	~	~	~	~	~	~	~	~	~	~	~
>EC8-EC10	mg/kg	<1.0	7200	~	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	~	~	~	~	~	~	~	~	~	~	~	~
>EC10-EC12	mg/kg	<1.0	9200	~	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	~	~	~	~	~	~	~	~	~	~	~	~
>EC12-EC16	mg/kg	<1.0	10000	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
>EC16-EC21	mg/kg	<1.0	7600	~	<7	<7	<7	<7	<7	<7	<7	<7	~	~	~	~	~	~	~	~	~	~	~	~
>EC21-EC35	mg/kg	<1.0	7800	~	<7	<7	<7	<7	<7	<7	<7	<7	~	~	~	~	~	~	~	~	~	~	~	~
>EC35-EC44	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-44	mg/kg	<5.0	~	~	<19	<19	<19	<19	<19	<19	<19	<19	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	<38	<38	<38	<38	<38	<38	<38	<38	~	~	~	~	~	~	~	~	~	~	~	~
PETROLEUM HYDROCARBONS																								
BTEX/MTBE																								
MTBE	ug/kg	<5	~	~	<2	<2	<2	<2	<2	<2	<2	<2	~	~	~	~	~	~	~	~	~	~	~	~
Benzene	ug/kg	<5	90000	230000	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Toluene	ug/kg	<5	87000000	~	11	15	7	<3	<3	<3	7	<3	~	~	~	~	~	~	~	~	~	~	~	~
Ethylbenzene	ug/kg	<5	17000000	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
m/p-Xylene	ug/kg	<5	17000000	~	<6	<6	<6	<6	<6	<6	<6	<6	~	~	~	~	~	~	~	~	~	~	~	~
o-Xylene	ug/kg	<5	17000000	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Polychlorinated Biphenyls (PCBs)																								
PCB 28	ug/kg	<5			~	~	~	~	~	~	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 52	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	<5	<5	<5	<5	31	<5	<5	<5	<5	<5	<5	<5
PCB 101	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	<5	<5	9	<5	169	7	<5	77	<5	<5	<5	<5
PCB 118	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	<5	<5	<5	<5	33	<5	<5	11	<5	<5	<5	<5
PCB 138	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	<5	12	33	9	534	20	17	177	18	25	<5	<5
PCB 153	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	<5	12	29	10	639	32	17	190	21	28	<5	<5
PCB 180	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	<5	16	37	20	885	30	14	106	16	32	<5	<5
Total 7 PCBs	ug/kg	<35	~	~	~	~	~	~	~	~	~	~	<35	40	108	39	2291	89	48	561	55	85	<35	<35
Polycyclic Aromatic Hydrocarbons (PAHs)																								
Naphthalene	mg/kg	<0.04	1200	~	0.03	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Acenaphthylene	mg/kg	<0.03	29000	~	0.016	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Acenaphthene	mg/kg	<0.05	29000	~	<10	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Fluorene	mg/kg	<0.04	20000	~	<10	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Phenanthrene	mg/kg	<0.03	6200	~	0.033	0.019	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Anthracene	mg/kg	<0.04	150000	~	<10	0.014	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~

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Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	212-214	215-217	218-220	221-223	224-226	227-229	230-232	233-235	16	77	79	80	82	83	87	91	92	93	106	108
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	BHE								BHAA				BHAB1		BHAB2	BHAB3		BHAB4	BHC	
Depth (m)					1	1.6	2	2.6	3	4	5	7	0.5	0.50	1.50	2.00	0.50	1.00	0.50	0.50	1.00	0.50	0.50	1.50
Sample Date					27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	11/03/2014	13/03/2014	13/03/2014	13/03/2014	12/03/2014	12/03/2014	13/03/2014	13/03/2014	13/03/2014	13/03/2014	14/03/2014	14/03/2014
Fluoranthene	mg/kg	<0.03	6300	~	0.137	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Pyrene	mg/kg	<0.03	15000	~	0.137	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(a)anthracene	mg/kg	<0.06	49	~	0.11	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Chrysene	mg/kg	<0.02	93	~	0.122	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	0.197	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(bk)fluoranthene	mg/kg	<0.07		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(a)pyrene	mg/kg	<0.04	11	21	0.103	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	0.029	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	<10	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	0.054	<10	<10	<10	<10	<10	<10	<10	~	~	~	~	~	~	~	~	~	~	~	~
Coronene	mg/kg	<0.04	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PAH 17 Total	mg/kg	<0.64	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Volatile Organic Compounds (VOC MS)																								
Dichlorodifluoromethane	µg/kg	<1	~	~	<2	<2	<2	<2	<2	<2	<2	<2	~	~	~	~	~	~	~	~	~	~	~	~
Chloromethane	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Vinyl Chloride	µg/kg	<1	4.8	~	<2	<2	<2	<2	<2	<2	<2	<2	~	~	~	~	~	~	~	~	~	~	~	~
Bromomethane	µg/kg	<20	~	~	<1	<1	<1	<1	<1	<1	<1	<1	~	~	~	~	~	~	~	~	~	~	~	~
Chloroethane	µg/kg	<2	~	~	<2	<2	<2	<2	<2	<2	<2	<2	~	~	~	~	~	~	~	~	~	~	~	~
Trichlorofluoromethane	µg/kg	<1	~	~	<2	<2	<2	<2	<2	<2	<2	<2	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	<6	<6	<6	<6	<6	<6	<6	<6	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-2-Dichloroethene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethane	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-2-Dichloroethene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Bromochloromethane	µg/kg	<5	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Trichloromethane	µg/kg	<1	2600	~									~	~	~	~	~	~	~	~	~	~	~	~
Chloroform	ug/kg	<3	2600	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1-Trichloroethane	µg/kg	<1	57000	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloromethane	µg/kg	<1	190	~									~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloropropene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Carbon tetrachloride	µg/kg	<4		~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloroethane	µg/kg	<2	~	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
Trichloroethene (TCE)	µg/kg	<1	70	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloropropane	µg/kg	<1	~	~	<6	<6	<6	<6	<6	<6	<6	<6	~	~	~	~	~	~	~	~	~	~	~	~
Dibromomethane	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Bromodichloromethane	µg/kg	<5	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-3-Dichloropropene	µg/kg	<10	~	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-3-Dichloropropene	µg/kg	<10		~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
1,1,2-Trichloroethane	µg/kg	<10	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloroethene (PCE)	µg/kg	<1	810	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichloropropane	µg/kg	<2	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Dibromochloromethane	µg/kg	<10	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromoethane	µg/kg	<5	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Chlorobenzene	µg/kg	<1	1300	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Styrene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Tribromomethane	µg/kg	<1	~	~									~	~	~	~	~	~	~	~	~	~	~	~
Isopropylbenzene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
Bromobenzene	µg/kg	<2		~	<2	<2	<2	<2	<2	<2	<2	<2	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichloropropane	µg/kg	<50	~	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
Propylbenzene	µg/kg	<1	~	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
2-Chlorotoluene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
4-Chlorotoluene	µg/kg	<1	~	~	<3	<3	<3	<3	<3	<3	<3	<3	~	~	~	~	~	~	~	~	~	~	~	~
tert-Butylbenzene	µg/kg	<1	~	~	<5	<5	<5	<5	<5	<5	<5	<5	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	<6	<6	<6	<6	<6	<6	<6	<6	~	~	~	~	~	~	~	~	~	~	~	~
sec-Butylbenzene	µg/kg	<1	~	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
4-Isopropyltoluene	µg/kg	<1	~	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichlorobenzene	µg/kg	<1	390	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
1,4-Dichlorobenzene	µg/kg	<1	36000	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
n-Butylbenzene	µg/kg	<1	~	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichlorobenzene	µg/kg	<1	24000	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	<7	<7	<7	<7	<7	<7	<7	<7	~	~	~	~	~	~	~	~	~	~	~	~
Hexachlorobutadiene	µg/kg	<1	48	~	<4	<4	<4	<4	<4	<4	<4	<4	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	<7	<7	<7	<7	<7	<7	<7	<7	~	~	~	~	~	~	~	~	~	~	~	~

Notes:
1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N
2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.
~ - denotes comparison criteria not available

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Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	ARUP - RIVERBANK SITE INVESTIGATION																			
Sample No.					109	112	21	25	26	114	117	32	120-122	123	128	129	131	38	133	139	140	45	142	143
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	BHCC		BHD	BHD	BHE	BHF		BHG	BHH		BHI			BHJ	BHK	BHL		BHM	BHN	
Depth (m)					0.50	2.00	0.5	2.5	0.5	0.50	2.00	0.5	0.2-2.75	0.50	0.50	1.00	2.00	0.5	0.50	0.50	1.00	0.5	0.50	1.00
Sample Date					13/03/2014	13/03/2014	11/03/2014	11/03/2014	11/03/2014	13/03/2014	13/03/2014	11/03/2014	13/03/2014	13/03/2014	13/03/2014	13/03/2014	13/03/2014	11/03/2014	13/03/2014	12/03/2014	12/03/2014	11/03/2014	12/03/2014	12/03/2014
Soil Characteristic Parameters																								
Natural Moisture Content	%	<0.02	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Indicators																								
Total Organic Carbon	%	<0.02																						
Fraction of Organic Carbon		0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Organic Carbon (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos																								
ACM Type			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~																				
Metals																								
Antimony	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Arsenic	mg/kg	<0.5	170	170	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Barium	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Cadmium	mg/kg	<0.1	560	880	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chromium	mg/kg	<0.5	220	250	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Copper	mg/kg	<1	44000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Lead	mg/kg	<5	~	1300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Mercury	mg/kg	<0.1	240	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Molybdenum	mg/kg	<0.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Nickel	mg/kg	<0.7	800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Selenium	mg/kg	<1	1800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Zinc	mg/kg	<5	170000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
TPH CWG																								
Aliphatics																								
>C5-C6	mg/kg	<1.0	95000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C6-C8	mg/kg	<1.0	150000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C8-C10	mg/kg	<1.0	14000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C10-C12	mg/kg	<1.0	21000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C12-C16	mg/kg	<1.0	25000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C16-C21	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C21-C35	mg/kg	<1.0		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C35-C44	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Aromatics																								
>EC5-EC7	mg/kg	<1.0	76000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC7-EC8	mg/kg	<1.0	87000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC8-EC10	mg/kg	<1.0	7200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC10-EC12	mg/kg	<1.0	9200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC12-EC16	mg/kg	<1.0	10000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC16-EC21	mg/kg	<1.0	7600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC21-EC35	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC35-EC44	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PETROLEUM HYDROCARBONS																								
BTEX/MTBE																								
MTBE	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzene	ug/kg	<5	90000	230000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Toluene	ug/kg	<5	87000000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Ethylbenzene	ug/kg	<5	17000000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
m/p-Xylene	ug/kg	<5	17000000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
o-Xylene	ug/kg	<5	17000000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Polychlorinated Biphenyls (PCBs)																								
PCB 28	ug/kg	<5			<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<100
PCB 52	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<100
PCB 101	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	20	<5	<5	<5	<100
PCB 118	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<100
PCB 138	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	9	6	<5	<5	<5	105	<5	<5	10	<100
PCB 153	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	8	<5	<5	<5	<5	108	<5	<5	9	<100
PCB 180	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	9	7	<5	<5	<5	135	<5	<5	10	<100
Total 7 PCBs	ug/kg	<35	~	~	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	368	<35	<35	<35	<100
Polycyclic Aromatic Hydrocarbons (PAHs)																								
Naphthalene	mg/kg	<0.04	1200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Acenaphthylene	mg/kg	<0.03	29000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Acenaphthene	mg/kg	<0.05	29000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Fluorene	mg/kg	<0.04	20000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Phenanthrene	mg/kg	<0.03	6200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Anthracene	mg/kg	<0.04	150000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~

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Table 1: Soils Analytical Results

					ARUP - RIVERBANK SITE INVESTIGATION																			
Sample No.	**Units**	**LOD**	**LQM/CIEH (Generic Assessment Criteria)[1]**	**Category 4 Screening Levels[2]**	109	112	21	25	26	114	117	32	120-122	123	128	129	131	38	133	139	140	45	142	143
Sample ID			**Public Open Space 2 (Park) 1% SOM**	**Public Open Space 2 (Park) 1% SOM**	BHCC		BHD	BHD	BHE	BHF		BHG	BHH		BHI			BHJ	BHK	BHL		BHM	BHN	
Depth (m)					0.50	2.00	0.5	2.5	0.5	0.50	2.00	0.5	0.2-2.75	0.50	0.50	1.00	2.00	0.5	0.50	0.50	1.00	0.5	0.50	1.00
Sample Date					13/03/2014	13/03/2014	11/03/2014	11/03/2014	11/03/2014	13/03/2014	13/03/2014	11/03/2014	13/03/2014	13/03/2014	13/03/2014	13/03/2014	13/03/2014	11/03/2014	13/03/2014	12/03/2014	12/03/2014	11/03/2014	12/03/2014	12/03/2014
Fluoranthene	mg/kg	<0.03	6300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Pyrene	mg/kg	<0.03	15000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(a)anthracene	mg/kg	<0.06	49	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chrysene	mg/kg	<0.02	93	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(bk)fluoranthene	mg/kg	<0.07		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(a)pyrene	mg/kg	<0.04	11	21	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Coronene	mg/kg	<0.04	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PAH 17 Total	mg/kg	<0.64	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Volatile Organic Compounds (VOC MS)																								
Dichlorodifluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Vinyl Chloride	µg/kg	<1	4.8	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromomethane	µg/kg	<20	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichlorofluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromochloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloromethane	µg/kg	<1	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroform	ug/kg	<3	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1-Trichloroethane	µg/kg	<1	57000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloromethane	µg/kg	<1	190	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloropropene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Carbon tetrachloride	µg/kg	<4		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloroethene (TCE)	µg/kg	<1	70	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloropropane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromodichloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-3-Dichloropropene	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-3-Dichloropropene	µg/kg	<10		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,2-Trichloroethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloroethene (PCE)	µg/kg	<1	810	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichloropropane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromochloromethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromoethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chlorobenzene	µg/kg	<1	1300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Styrene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tribromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Isopropylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromobenzene	µg/kg	<2		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Propylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
2-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
tert-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
sec-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Isopropyltoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichlorobenzene	µg/kg	<1	390	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,4-Dichlorobenzene	µg/kg	<1	36000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
n-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichlorobenzene	µg/kg	<1	24000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Hexachlorobutadiene	µg/kg	<1	48	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~

Notes:
1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N
2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.
~ - denotes comparison criteria not available

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Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	144	149	150	151	53	59	61	66-68	153	154	155	156	158	159	160	164	166	171	172	174
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	BHO	BHP			BHQ		BHR	BHR (WAC)	BHS	BHT					BHU		BHV	BHW		
Depth (m)					0.50	0.50	1.00	1.50	0.5	3.5	0.5	0.3-3.0	0.50	0.50	1.00	1.50	2.50	3.00	0.50	2.50	0.50	0.50	1.00	2.00
Sample Date					12/03/2014	12/03/2014	12/03/2014	12/03/2014	11/03/2014	11/03/2014	11/03/2014	11/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014
Soil Characteristic Parameters																								
Natural Moisture Content	%	<0.02	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Indicators																								
Total Organic Carbon	%	<0.02																						
Fraction of Organic Carbon		0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Organic Carbon (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos																								
ACM Type			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~																				
Metals																								
Antimony	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Arsenic	mg/kg	<0.5	170	170	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Barium	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Cadmium	mg/kg	<0.1	560	880	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chromium	mg/kg	<0.5	220	250	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Copper	mg/kg	<1	44000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Lead	mg/kg	<5	~	1300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Mercury	mg/kg	<0.1	240	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Molybdenum	mg/kg	<0.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Nickel	mg/kg	<0.7	800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Selenium	mg/kg	<1	1800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Zinc	mg/kg	<5	170000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
TPH CWG																								
Aliphatics																								
>C5-C6	mg/kg	<1.0	95000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C6-C8	mg/kg	<1.0	150000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C8-C10	mg/kg	<1.0	14000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C10-C12	mg/kg	<1.0	21000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C12-C16	mg/kg	<1.0	25000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C16-C21	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C21-C35	mg/kg	<1.0		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>C35-C44	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Aromatics																								
>EC5-EC7	mg/kg	<1.0	76000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC7-EC8	mg/kg	<1.0	87000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC8-EC10	mg/kg	<1.0	7200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC10-EC12	mg/kg	<1.0	9200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC12-EC16	mg/kg	<1.0	10000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC16-EC21	mg/kg	<1.0	7600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC21-EC35	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC35-EC44	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PETROLEUM HYDROCARBONS																								
BTEX/MTBE																								
MTBE	ug/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzene	ug/kg	<5	90000	230000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Toluene	ug/kg	<5	87000000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Ethylbenzene	ug/kg	<5	17000000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
m/p-Xylene	ug/kg	<5	17000000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
o-Xylene	ug/kg	<5	17000000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Polychlorinated Biphenyls (PCBs)																								
PCB 28	ug/kg	<5			<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<100
PCB 52	ug/kg	<5	~	~	<5	10	<5	<5	<5	<5	<5	<5	<5	9	<5	<5	<5	<5	<5	<5	<5	<5	<5	<100
PCB 101	ug/kg	<5	~	~	<5	247	32	6	<5	<5	<5	<5	19	136	<5	<5	17	<5	<5	<5	<5	54	<5	<100
PCB 118	ug/kg	<5	~	~	<5	58	7	<5	<5	<5	<5	<5	<5	22	<5	<5	<5	<5	<5	<5	<5	9	<5	<100
PCB 138	ug/kg	<5	~	~	16	1243	159	22	<5	<5	<5	<5	112	440	27	8	33	10	<5	<5	<5	198	8	<100
PCB 153	ug/kg	<5	~	~	15	1276	164	23	<5	<5	<5	<5	104	457	25	8	33	11	<5	<5	<5	198	8	<100
PCB 180	ug/kg	<5	~	~	7	1892	248	31	<5	<5	<5	<5	154	571	42	12	35	9	<5	<5	<5	259	10	<100
Total 7 PCBs	ug/kg	<35	~	~	38	4726	610	82	<35	<35	<35	<35	389	1635	94	<35	118	<35	<35	<35	<35	718	<35	<100
Polycyclic Aromatic Hydrocarbons (PAHs)																								
Naphthalene	mg/kg	<0.04	1200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Acenaphthylene	mg/kg	<0.03	29000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Acenaphthene	mg/kg	<0.05	29000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Fluorene	mg/kg	<0.04	20000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Phenanthrene	mg/kg	<0.03	6200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Anthracene	mg/kg	<0.04	150000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~

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Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	144	149	150	151	53	59	61	66-68	153	154	155	156	158	159	160	164	166	171	172	174
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	BHO	BHP			BHQ		BHR	BHR (WAC)	BHS	BHT					BHU		BHV	BHW		
Depth (m)					0.50	0.50	1.00	1.50	0.5	3.5	0.5	0.3-3.0	0.50	0.50	1.00	1.50	2.50	3.00	0.50	2.50	0.50	0.50	1.00	2.00
Sample Date					12/03/2014	12/03/2014	12/03/2014	12/03/2014	11/03/2014	11/03/2014	11/03/2014	11/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014	12/03/2014
Fluoranthene	mg/kg	<0.03	6300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Pyrene	mg/kg	<0.03	15000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(a)anthracene	mg/kg	<0.06	49	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chrysene	mg/kg	<0.02	93	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(bk)fluoranthene	mg/kg	<0.07		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(a)pyrene	mg/kg	<0.04	11	21	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Coronene	mg/kg	<0.04	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PAH 17 Total	mg/kg	<0.64	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Volatile Organic Compounds (VOC MS)																								
Dichlorodifluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Vinyl Chloride	µg/kg	<1	4.8	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromomethane	µg/kg	<20	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichlorofluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromochloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloromethane	µg/kg	<1	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroform	ug/kg	<3	2600	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1-Trichloroethane	µg/kg	<1	57000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloromethane	µg/kg	<1	190	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloropropene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Carbon tetrachloride	µg/kg	<4		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloroethene (TCE)	µg/kg	<1	70	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloropropane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromodichloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-3-Dichloropropene	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-3-Dichloropropene	µg/kg	<10		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,2-Trichloroethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloroethene (PCE)	µg/kg	<1	810	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichloropropane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromochloromethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromoethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chlorobenzene	µg/kg	<1	1300	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Styrene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tribromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Isopropylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromobenzene	µg/kg	<2		~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Propylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
2-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
tert-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
sec-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Isopropyltoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichlorobenzene	µg/kg	<1	390	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,4-Dichlorobenzene	µg/kg	<1	36000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
n-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichlorobenzene	µg/kg	<1	24000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Hexachlorobutadiene	µg/kg	<1	48	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~

Notes:

1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N

2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.

~ - denotes comparison criteria not available

E1620

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

									ARUP - RIVERBA							
Sample No.	**Units**	**LOD**	**LQM/CIEH (Generic Assessment Criteria)[1]**	**Category 4 Screening Levels[2]**	175	178	181	184	1	2	3	1	2	3	4	5
Sample ID			**Public Open Space 2 (Park) 1% SOM**	**Public Open Space 2 (Park) 1% SOM**	BHX		BHY		COFFER DAM A	COFFER DAM C	SHALLOW SAMPLE	HAND DIG AREA A	S1 COFFERDAM 10 X 4	S2 COFFERDAM 10 X 4	S3 COFFERDAM 10 X 4	S4 COFFERDAM 10 X 4
Depth (m)					0.50	2.00	0.50	2.00				0.50	4.00	4.00	4.00	4.00
Sample Date					12/03/2014	12/03/2014	12/03/2014	12/03/2014	16/09/2014	16/09/2014	16/09/2014	26/09/2014	28/09/2014	28/09/2014	28/09/2014	28/09/2014
Soil Characteristic Parameters																
Natural Moisture Content	%	<0.02	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Indicators																
Total Organic Carbon	%	<0.02														
Fraction of Organic Carbon		0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Organic Carbon (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos																
ACM Type			~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~												
Metals																
Antimony	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Arsenic	mg/kg	<0.5	170	170	~	~	~	~	~	~	~	~	~	~	~	~
Barium	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Cadmium	mg/kg	<0.1	560	880	~	~	~	~	~	~	~	~	~	~	~	~
Chromium	mg/kg	<0.5	220	250	~	~	~	~	~	~	~	~	~	~	~	~
Copper	mg/kg	<1	44000	~	~	~	~	~	~	~	~	~	~	~	~	~
Lead	mg/kg	<5	~	1300	~	~	~	~	~	~	~	~	~	~	~	~
Mercury	mg/kg	<0.1	240	~	~	~	~	~	~	~	~	~	~	~	~	~
Molybdenum	mg/kg	<0.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Nickel	mg/kg	<0.7	800	~	~	~	~	~	~	~	~	~	~	~	~	~
Selenium	mg/kg	<1	1800	~	~	~	~	~	~	~	~	~	~	~	~	~
Zinc	mg/kg	<5	170000	~	~	~	~	~	~	~	~	~	~	~	~	~
TPH CWG																
Aliphatics																
>C5-C6	mg/kg	<1.0	95000	~	~	~	~	~	~	~	~	~	~	~	~	~
>C6-C8	mg/kg	<1.0	150000	~	~	~	~	~	~	~	~	~	~	~	~	~
>C8-C10	mg/kg	<1.0	14000	~	~	~	~	~	~	~	~	~	~	~	~	~
>C10-C12	mg/kg	<1.0	21000	~	~	~	~	~	~	~	~	~	~	~	~	~
>C12-C16	mg/kg	<1.0	25000	~	~	~	~	~	~	~	~	~	~	~	~	~
>C16-C21	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~
>C21-C35	mg/kg	<1.0		~	~	~	~	~	~	~	~	~	~	~	~	~
>C35-C44	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Aromatics																
>EC5-EC7	mg/kg	<1.0	76000	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC7-EC8	mg/kg	<1.0	87000	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC8-EC10	mg/kg	<1.0	7200	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC10-EC12	mg/kg	<1.0	9200	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC12-EC16	mg/kg	<1.0	10000	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC16-EC21	mg/kg	<1.0	7600	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC21-EC35	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~
>EC35-EC44	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~
PETROLEUM HYDROCARBONS																
BTEX/MTBE																
MTBE	ug/kg	<5	~	~	~	~	~	~	<5	<5	<5	~	~	~	~	~
Benzene	ug/kg	<5	90000	230000	~	~	~	~	<5	<5	<5	~	~	~	~	~
Toluene	ug/kg	<5	87000000	~	~	~	~	~	<5	<5	<5	~	~	~	~	~
Ethylbenzene	ug/kg	<5	17000000	~	~	~	~	~	<5	<5	<5	~	~	~	~	~
m/p-Xylene	ug/kg	<5	17000000	~	~	~	~	~	<5	<5	<5	~	~	~	~	~
o-Xylene	ug/kg	<5	17000000	~	~	~	~	~	<5	<5	<5	~	~	~	~	~
Polychlorinated Biphenyls (PCBs)																
PCB 28	ug/kg	<5			<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 52	ug/kg	<5	~	~	<5	<5	<5	<5	<5	15	<5	<5	<5	<5	<5	<5
PCB 101	ug/kg	<5	~	~	<5	<5	<5	<5	19	165	<5	137	<5	<5	<5	<5
PCB 118	ug/kg	<5	~	~	<5	<5	<5	<5	<5	32	<5	23	<5	<5	<5	<5
PCB 138	ug/kg	<5	~	~	<5	<5	<5	<5	70	666	18	607	<5	<5	<5	<5
PCB 153	ug/kg	<5	~	~	<5	<5	<5	<5	73	705	17	593	<5	<5	<5	<5
PCB 180	ug/kg	<5	~	~	<5	<5	<5	<5	81	949	20	768	<5	<5	<5	<5
Total 7 PCBs	ug/kg	<35	~	~	<35	<35	<35	<35	243	2532	55	2128	<35	<35	<35	<35
Polycyclic Aromatic Hydrocarbons (PAHs)																
Naphthalene	mg/kg	<0.04	1200	~	~	~	~	~	<0.04	6.90	<0.04	~	~	~	~	~
Acenaphthylene	mg/kg	<0.03	29000	~	~	~	~	~	<0.03	0.08	0.08	~	~	~	~	~
Acenaphthene	mg/kg	<0.05	29000	~	~	~	~	~	<0.05	<0.05	<0.05	~	~	~	~	~
Fluorene	mg/kg	<0.04	20000	~	~	~	~	~	<0.04	0.08	<0.04	~	~	~	~	~
Phenanthrene	mg/kg	<0.03	6200	~	~	~	~	~	0.09	0.23	0.29	~	~	~	~	~
Anthracene	mg/kg	<0.04	150000	~	~	~	~	~	<0.04	<0.04	0.09	~	~	~	~	~

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Table 1: Soils Analytical Results

									ARUP - RIVERBA							
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Sample ID			**Public Open Space 2 (Park) 1% SOM**	**Public Open Space 2 (Park) 1% SOM**	BHX		BHY		COFFER DAM A	COFFER DAM C	SHALLOW SAMPLE	HAND DIG AREA A	S1 COFFERDAM 10 X 4	S2 COFFERDAM 10 X 4	S3 COFFERDAM 10 X 4	S4 COFFERDAM 10 X 4
Depth (m)					0.50	2.00	0.50	2.00				0.50	4.00	4.00	4.00	4.00
Sample Date					12/03/2014	12/03/2014	12/03/2014	12/03/2014	16/09/2014	16/09/2014	16/09/2014	26/09/2014	28/09/2014	28/09/2014	28/09/2014	28/09/2014
Fluoranthene	mg/kg	<0.03	6300	~	~	~	~	~	0.15	0.09	0.48	~	~	~	~	~
Pyrene	mg/kg	<0.03	15000	~	~	~	~	~	0.13	0.11	0.39	~	~	~	~	~
Benzo(a)anthracene	mg/kg	<0.06	49	~	~	~	~	~	0.13	<0.06	0.31	~	~	~	~	~
Chrysene	mg/kg	<0.02	93	~	~	~	~	~	0.13	0.06	0.28	~	~	~	~	~
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	~	~	~	~	0.14	<0.05	0.28	~	~	~	~	~
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	~	~	~	~	0.06	<0.02	0.11	~	~	~	~	~
Benzo(bk)fluoranthene	mg/kg	<0.07		~	~	~	~	~	0.20	<0.07	0.39	~	~	~	~	~
Benzo(a)pyrene	mg/kg	<0.04	11	21	~	~	~	~	0.11	<0.04	0.24	~	~	~	~	~
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	~	~	~	~	0.07	<0.04	0.11	~	~	~	~	~
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	~	~	~	~	<0.04	<0.04	<0.04	~	~	~	~	~
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	~	~	~	~	0.07	<0.04	0.11	~	~	~	~	~
Coronene	mg/kg	<0.04	~	~	~	~	~	~	<0.04	<0.04	<0.04	~	~	~	~	~
PAH 17 Total	mg/kg	<0.64	~	~	~	~	~	~	1.08	7.55	2.77	~	~	~	~	~
Volatile Organic Compounds (VOC MS)																
Dichlorodifluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Vinyl Chloride	µg/kg	<1	4.8	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromomethane	µg/kg	<20	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichlorofluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromochloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloromethane	µg/kg	<1	2600	~	~	~	~	~	~	~	~	~	~	~	~	~
Chloroform	ug/kg	<3	2600	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1-Trichloroethane	µg/kg	<1	57000	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloromethane	µg/kg	<1	190	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1-Dichloropropene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Carbon tetrachloride	µg/kg	<4		~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Trichloroethene (TCE)	µg/kg	<1	70	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloropropane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromodichloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~
cis-1-3-Dichloropropene	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~
trans-1-3-Dichloropropene	µg/kg	<10		~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,2-Trichloroethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tetrachloroethene (PCE)	µg/kg	<1	810	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichloropropane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Dibromochloromethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromoethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Chlorobenzene	µg/kg	<1	1300	~	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	~	~	~	~	~	~	~	~	~	~	~	~
Styrene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Tribromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Isopropylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Bromobenzene	µg/kg	<2		~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Propylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
2-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
tert-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
sec-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4-Isopropyltoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,3-Dichlorobenzene	µg/kg	<1	390	~	~	~	~	~	~	~	~	~	~	~	~	~
1,4-Dichlorobenzene	µg/kg	<1	36000	~	~	~	~	~	~	~	~	~	~	~	~	~
n-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichlorobenzene	µg/kg	<1	24000	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	~	~	~	~	~	~	~	~	~	~	~	~
Hexachlorobutadiene	µg/kg	<1	48	~	~	~	~	~	~	~	~	~	~	~	~	~
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	~	~	~	~	~	~	~	~	~	~	~	~

Notes:
1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N
2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.
~ - denotes comparison criteria not available

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	NK REMEDIATION VALIDATION REPORT -NOV 2014 6	7	1	2	1	2	3	4
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	S5 COFFERDAM 10 X 4	S6 COFFERDAM 10 X 4	SMALL COFFERDAM SAMPLE A	SMALL COFFERDAM SAMPLE B	HAND DIG AREA A 2	SLOPE SAMPLE A	SLOPE SAMPLE B	TOP OF BANK
Depth (m)					4.00	4.00			1.00	0.50	0.50	0.50
Sample Date					28/09/2014	28/09/2014	06/10/2014	06/10/2014	06/10/2014	06/10/2014	06/10/2014	08/10/2014
Soil Characteristic Parameters												
Natural Moisture Content	%	<0.02	~	~	~	~	~	~	~	~	~	~
Indicators												
Total Organic Carbon	%	<0.02										
Fraction of Organic Carbon		0.001	~	~	~	~	~	~	~	~	~	~
Total Organic Carbon (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	~	~	~	~	~	~	~	~
Asbestos												
ACM Type			~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	~	~
			~	~								
Metals												
Antimony	mg/kg	<1	~	~	~	~	~	~	~	~	~	~
Arsenic	mg/kg	<0.5	170	170	~	~	~	~	~	~	~	~
Barium	mg/kg	<1	~	~	~	~	~	~	~	~	~	~
Cadmium	mg/kg	<0.1	560	880	~	~	~	~	~	~	~	~
Chromium	mg/kg	<0.5	220	250	~	~	~	~	~	~	~	~
Copper	mg/kg	<1	44000	~	~	~	~	~	~	~	~	~
Lead	mg/kg	<5	~	1300	~	~	~	~	~	~	~	~
Mercury	mg/kg	<0.1	240	~	~	~	~	~	~	~	~	~
Molybdenum	mg/kg	<0.1	~	~	~	~	~	~	~	~	~	~
Nickel	mg/kg	<0.7	800	~	~	~	~	~	~	~	~	~
Selenium	mg/kg	<1	1800	~	~	~	~	~	~	~	~	~
Zinc	mg/kg	<5	170000	~	~	~	~	~	~	~	~	~
TPH CWG												
Aliphatics												
>C5-C6	mg/kg	<1.0	95000	~	~	~	~	~	~	~	~	~
>C6-C8	mg/kg	<1.0	150000	~	~	~	~	~	~	~	~	~
>C8-C10	mg/kg	<1.0	14000	~	~	~	~	~	~	~	~	~
>C10-C12	mg/kg	<1.0	21000	~	~	~	~	~	~	~	~	~
>C12-C16	mg/kg	<1.0	25000	~	~	~	~	~	~	~	~	~
>C16-C21	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~
>C21-C35	mg/kg	<1.0		~	~	~	~	~	~	~	~	~
>C35-C44	mg/kg	<1.0	450000	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~
Aromatics												
>EC5-EC7	mg/kg	<1.0	76000	~	~	~	~	~	~	~	~	~
>EC7-EC8	mg/kg	<1.0	87000	~	~	~	~	~	~	~	~	~
>EC8-EC10	mg/kg	<1.0	7200	~	~	~	~	~	~	~	~	~
>EC10-EC12	mg/kg	<1.0	9200	~	~	~	~	~	~	~	~	~
>EC12-EC16	mg/kg	<1.0	10000	~	~	~	~	~	~	~	~	~
>EC16-EC21	mg/kg	<1.0	7600	~	~	~	~	~	~	~	~	~
>EC21-EC35	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~
>EC35-EC44	mg/kg	<1.0	7800	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~	~	~	~	~	~	~	~	~
Total aromatics C5-44	mg/kg	<5.0	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	~	~	~	~	~	~	~	~
PETROLEUM HYDROCARBONS												
BTEX/MTBE												
MTBE	ug/kg	<5	~	~	~	~	~	~	~	~	~	~
Benzene	ug/kg	<5	90000	230000	~	~	~	~	~	~	~	~
Toluene	ug/kg	<5	87000000	~	~	~	~	~	~	~	~	~
Ethylbenzene	ug/kg	<5	17000000	~	~	~	~	~	~	~	~	~
m/p-Xylene	ug/kg	<5	17000000	~	~	~	~	~	~	~	~	~
o-Xylene	ug/kg	<5	17000000	~	~	~	~	~	~	~	~	~
Polychlorinated Biphenyls (PCBs)												
PCB 28	ug/kg	<5			<5	<5	<5	<5	<5	<5	<5	<5
PCB 52	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5
PCB 101	ug/kg	<5	~	~	<5	<5	14	<5	<5	<5	<5	<5
PCB 118	ug/kg	<5	~	~	<5	<5	<5	<5	<5	<5	<5	<5
PCB 138	ug/kg	<5	~	~	<5	<5	60	<5	<5	<5	<5	<5
PCB 153	ug/kg	<5	~	~	<5	<5	66	<5	<5	<5	<5	<5
PCB 180	ug/kg	<5	~	~	<5	<5	75	<5	<5	<5	<5	<5
Total 7 PCBs	ug/kg	<35	~	~	<35	<35	215	<35	<35	<35	<35	<35
Polycyclic Aromatic Hydrocarbons (PAHs)												
Naphthalene	mg/kg	<0.04	1200	~	~	~	~	~	~	~	~	~
Acenaphthylene	mg/kg	<0.03	29000	~	~	~	~	~	~	~	~	~
Acenaphthene	mg/kg	<0.05	29000	~	~	~	~	~	~	~	~	~
Fluorene	mg/kg	<0.04	20000	~	~	~	~	~	~	~	~	~
Phenanthrene	mg/kg	<0.03	6200	~	~	~	~	~	~	~	~	~
Anthracene	mg/kg	<0.04	150000	~	~	~	~	~	~	~	~	~

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Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

					NK REMEDIATION VALIDATION REPORT -NOV 2014							
Sample No.	**Units**	**LOD**	**LQM/CIEH (Generic Assessment Criteria)[1]**	**Category 4 Screening Levels[2]**	6	7	1	2	1	2	3	4
Sample ID			**Public Open Space 2 (Park) 1% SOM**	**Public Open Space 2 (Park) 1% SOM**	S5 COFFERDAM 10 X 4	S6 COFFERDAM 10 X 4	SMALL COFFERDAM SAMPLE A	SMALL COFFERDAM SAMPLE B	HAND DIG AREA A 2	SLOPE SAMPLE A	SLOPE SAMPLE B	TOP OF BANK
Depth (m)					4.00	4.00			1.00	0.50	0.50	0.50
Sample Date					28/09/2014	28/09/2014	06/10/2014	06/10/2014	06/10/2014	06/10/2014	06/10/2014	08/10/2014
Fluoranthene	mg/kg	<0.03	6300	~	~	~	~	~	~	~	~	~
Pyrene	mg/kg	<0.03	15000	~	~	~	~	~	~	~	~	~
Benzo(a)anthracene	mg/kg	<0.06	49	~	~	~	~	~	~	~	~	~
Chrysene	mg/kg	<0.02	93	~	~	~	~	~	~	~	~	~
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	~	~	~	~	~	~	~	~
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	~	~	~	~	~	~	~	~
Benzo(bk)fluoranthene	mg/kg	<0.07		~	~	~	~	~	~	~	~	~
Benzo(a)pyrene	mg/kg	<0.04	11	21	~	~	~	~	~	~	~	~
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	~	~	~	~	~	~	~	~
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	~	~	~	~	~	~	~	~
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	~	~	~	~	~	~	~	~
Coronene	mg/kg	<0.04	~	~	~	~	~	~	~	~	~	~
PAH 17 Total	mg/kg	<0.64	~	~	~	~	~	~	~	~	~	~
Volatile Organic Compounds (VOC MS)												
Dichlorodifluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
Chloromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
Vinyl Chloride	µg/kg	<1	4.8	~	~	~	~	~	~	~	~	~
Bromomethane	µg/kg	<20	~	~	~	~	~	~	~	~	~	~
Chloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~
Trichlorofluoromethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
trans-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
1,1-Dichloroethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
cis-1-2-Dichloroethene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
Bromochloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~
Trichloromethane	µg/kg	<1	2600	~	~	~	~	~	~	~	~	~
Chloroform	ug/kg	<3	2600	~	~	~	~	~	~	~	~	~
1,1,1-Trichloroethane	µg/kg	<1	57000	~	~	~	~	~	~	~	~	~
Tetrachloromethane	µg/kg	<1	190	~	~	~	~	~	~	~	~	~
1,1-Dichloropropene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
Carbon tetrachloride	µg/kg	<4		~	~	~	~	~	~	~	~	~
1,2-Dichloroethane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~
Trichloroethene (TCE)	µg/kg	<1	70	~	~	~	~	~	~	~	~	~
1,2-Dichloropropane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
Dibromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
Bromodichloromethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~
cis-1-3-Dichloropropene	µg/kg	<10	~	~	~	~	~	~	~	~	~	~
trans-1-3-Dichloropropene	µg/kg	<10		~	~	~	~	~	~	~	~	~
1,1,2-Trichloroethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~
Tetrachloroethene (PCE)	µg/kg	<1	810	~	~	~	~	~	~	~	~	~
1,3-Dichloropropane	µg/kg	<2	~	~	~	~	~	~	~	~	~	~
Dibromochloromethane	µg/kg	<10	~	~	~	~	~	~	~	~	~	~
1,2-Dibromoethane	µg/kg	<5	~	~	~	~	~	~	~	~	~	~
Chlorobenzene	µg/kg	<1	1300	~	~	~	~	~	~	~	~	~
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	~	~	~	~	~	~	~	~
Styrene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
Tribromomethane	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
Isopropylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
Bromobenzene	µg/kg	<2		~	~	~	~	~	~	~	~	~
1,2,3-Trichloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~
Propylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
2-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
4-Chlorotoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
tert-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
sec-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
4-Isopropyltoluene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
1,3-Dichlorobenzene	µg/kg	<1	390	~	~	~	~	~	~	~	~	~
1,4-Dichlorobenzene	µg/kg	<1	36000	~	~	~	~	~	~	~	~	~
n-Butylbenzene	µg/kg	<1	~	~	~	~	~	~	~	~	~	~
1,2-Dichlorobenzene	µg/kg	<1	24000	~	~	~	~	~	~	~	~	~
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	~	~	~	~	~	~	~	~
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	~	~	~	~	~	~	~	~
Hexachlorobutadiene	µg/kg	<1	48	~	~	~	~	~	~	~	~	~
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	~	~	~	~	~	~	~	~

Notes:
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~ - denotes comparison criteria not available

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Kilkenny City

Table 1: Soils Analytical Results

					MOR Soil Sampling During Archaeological Works - 2017										
Sample No.	**Units**	**LOD**	**LQM/CIEH (Generic Assessment Criteria)[1]**	**Category 4 Screening Levels[2]**	17-07854	17-07854	17-07854	17-07854	17-08100	17-07854	17-08100	17-08100	17-07854	17-07854	17-07854
Sample ID			**Public Open Space 2 (Park) 1% SOM**	**Public Open Space 2 (Park) 1% SOM**	TP1	TP1	TP1	TP3	TP3	TP3	TP3A	TP3B	TP4	TP4	TP4
Depth (m)					1.30-1.35	1.60-1.65	2.20	1.00	1.7-1.9	1.80	1.1-1.25	1.1-1.2	1.25-1.3	2.10-2.20	2.95-3.10
Sample Date					29/03/2017	29/03/2017	29/03/2017	29/03/2017	30/03/2017	29/03/2017	30/03/2017	31/03/2017	29/03/2017	29/03/2017	29/03/2017
Soil Characteristic Parameters															
Natural Moisture Content	%	<0.02	~	~	17	28	24	8.8	15	13	13	22	13	22	23
Indicators															
Total Organic Carbon	%	<0.02													
Fraction of Organic Carbon		0.001	~	~	0.21	0.066	0.012	0.015	0.12	0.038	0.0089	0.16	0.13	0.02	0.022
Total Organic Carbon (MOR calculation)	%	-	~	~	21	6.6	1.2	1.5	12	3.8	0.89	16	13	2	2.2
Soil Organic Matter (MOR calculation)	%	-	~	~	36.21	11.38	2.07	2.59	20.69	6.55	1.53	27.59	22.41	3.45	3.79
Asbestos					NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD
ACM Type			~	~	~	~	~	~	~	~	Insulation	Cement+Gasket+Clumps	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	Chrysotile	Chrysotile Crocidolite	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	~	~	~	-	-	~	~	~
Total Asbestos			~	~	~	~	~	~	~	~	-	-	~	~	~
			~	~											
Metals															
Antimony	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~
Arsenic	mg/kg	<0.5	170	170	45	29	13	20	25	22	24	44	34	29	18
Barium	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~
Cadmium	mg/kg	<0.1	560	880	0.73	0.49	0.3	0.45	0.29	0.6	0.36	0.39	0.54	0.33	0.41
Chromium	mg/kg	<0.5	220	250	15	19	18	9.6	12	13	18	16	14	14	16
Copper	mg/kg	<1	44000	~	120	85	25	11	40	18	34	100	68	33	33
Lead	mg/kg	<5	~	1300	470	190	34	14	93	31	46	580	210	110	73
Mercury	mg/kg	<0.1	240	~	0.23	0.43	< 0.10	< 0.10	0.3	< 0.10	< 0.10	0.39	0.41	0.19	0.4
Molybdenum	mg/kg	<0.1	~	~	~	~	~	~	~	~	~	~	~	~	~
Nickel	mg/kg	<0.7	800	~	~	~	~	~	~	~	~	~	~	~	~
Selenium	mg/kg	<1	1800	~	~	~	~	~	~	~	~	~	~	~	~
Zinc	mg/kg	<5	170000	~	~	~	~	~	~	~	~	~	~	~	~
TPH CWG															
Aliphatics															
>C5-C6	mg/kg	<1.0	95000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C6-C8	mg/kg	<1.0	150000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C8-C10	mg/kg	<1.0	14000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C10-C12	mg/kg	<1.0	21000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C12-C16	mg/kg	<1.0	25000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C16-C21	mg/kg	<1.0	450000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C21-C35	mg/kg	<1.0		~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	41	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C35-C44	mg/kg	<1.0	450000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total aliphatics C5-C35	mg/kg	<19	~	~											
Total aliphatics C5-C44	mg/kg	<5.0	~	~	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	41	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatics															
>EC5-EC7	mg/kg	<1.0	76000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>EC7-EC8	mg/kg	<1.0	87000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>EC8-EC10	mg/kg	<1.0	7200	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>EC10-EC12	mg/kg	<1.0	9200	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>EC12-EC16	mg/kg	<1.0	10000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	21	< 1.0	< 1.0	< 1.0	< 1.0
>EC16-EC21	mg/kg	<1.0	7600	~	4.4	< 1.0	< 1.0	< 1.0	31	< 1.0	54	< 1.0	< 1.0	< 1.0	< 1.0
>EC21-EC35	mg/kg	<1.0	7800	~	44	< 1.0	< 1.0	< 1.0	< 1.0	7.6	5.6	< 1.0	< 1.0	< 1.0	< 1.0
>EC35-EC44	mg/kg	<1.0	7800	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total aromatics C5-C35	mg/kg	<19	~	~											
Total aromatics C5-44	mg/kg	<5.0	~	~	48	< 5.0	< 5.0	< 5.0	31	7.6	80	< 5.0	< 5.0	< 5.0	< 5.0
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~											
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	48	< 10	< 10	< 10	31	48	80	< 10	< 10	< 10	< 10
PETROLEUM HYDROCARBONS															
BTEX/MTBE															
MTBE	ug/kg	<5	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	ug/kg	<5	90000	230000	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	ug/kg	<5	87000000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	ug/kg	<5	17000000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m/p-Xylene	ug/kg	<5	17000000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	ug/kg	<5	17000000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Polychlorinated Biphenyls (PCBs)															
PCB 28	ug/kg	<5			< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PCB 52	ug/kg	<5	~	~	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PCB 101	ug/kg	<5	~	~	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PCB 118	ug/kg	<5	~	~	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PCB 138	ug/kg	<5	~	~	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PCB 153	ug/kg	<5	~	~	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PCB 180	ug/kg	<5	~	~	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total 7 PCBs	ug/kg	<35	~	~	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Polycyclic Aromatic Hydrocarbons (PAHs)															
Naphthalene	mg/kg	<0.04	1200	~	0.27	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.32	< 0.10	0.18	< 0.10	< 0.10
Acenaphthylene	mg/kg	<0.03	29000	~	< 0.10	< 0.10	< 0.10	< 0.10	0.46	< 0.10	3.3	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	mg/kg	<0.05	29000	~	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	mg/kg	<0.04	20000	~	< 0.10	< 0.10	< 0.10	< 0.10	0.74	< 0.10	0.54	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	mg/kg	<0.03	6200	~	0.93	0.29	< 0.10	< 0.10	6.1	< 0.10	8.6	0.59	0.34	< 0.10	< 0.10
Anthracene	mg/kg	<0.04	150000	~	0.13	< 0.10	< 0.10	< 0.10	1.4	< 0.10	3	< 0.10	< 0.10	< 0.10	< 0.10

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	17-07854	17-07854	17-07854	17-07854	17-08100	17-07854	17-08100	17-08100	17-07854	17-07854	17-07854
					MOR Soil Sampling During Archaeological Works - 2017										
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	TP1	TP1	TP1	TP3	TP3	TP3	TP3A	TP3B	TP4	TP4	TP4
Depth (m)					1.30-1.35	1.60-1.65	2.20	1.00	1.7-1.9	1.80	1.1-1.25	1.1-1.2	1.25-1.3	2.10-2.20	2.95-3.10
Sample Date					29/03/2017	29/03/2017	29/03/2017	29/03/2017	30/03/2017	29/03/2017	30/03/2017	31/03/2017	29/03/2017	29/03/2017	29/03/2017
Fluoranthene	mg/kg	<0.03	6300	~	1.2	0.21	< 0.10	< 0.10	8.1	< 0.10	37	1.3	0.32	< 0.10	< 0.10
Pyrene	mg/kg	<0.03	15000	~	1.1	0.2	< 0.10	< 0.10	6.6	< 0.10	34	1	0.31	< 0.10	< 0.10
Benzo(a)anthracene	mg/kg	<0.06	49	~	0.44	< 0.10	< 0.10	< 0.10	2.5	< 0.10	16	0.36	0.11	< 0.10	< 0.10
Chrysene	mg/kg	<0.02	93	~	0.55	< 0.10	< 0.10	< 0.10	2.4	< 0.10	16	0.48	0.1	< 0.10	< 0.10
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	0.69	< 0.10	< 0.10	< 0.10	2.6	< 0.10	**19**	0.62	< 0.10	< 0.10	< 0.10
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	0.19	< 0.10	< 0.10	< 0.10	0.94	< 0.10	7.8	0.18	< 0.10	< 0.10	< 0.10
Benzo(bk)fluoranthene	mg/kg	<0.07		~	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	<0.04	11	21	0.4	< 0.10	< 0.10	< 0.10	2.2	< 0.10	**16**	0.38	< 0.10	< 0.10	< 0.10
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	0.32	< 0.10	< 0.10	< 0.10	1.4	< 0.10	10	0.27	< 0.10	< 0.10	< 0.10
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	< 0.10	< 0.10	< 0.10	< 0.10	0.18	< 0.10	**1.9**	< 0.10	< 0.10	< 0.10	< 0.10
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	0.43	< 0.10	< 0.10	< 0.10	1.3	< 0.10	9.3	0.35	< 0.10	< 0.10	< 0.10
Coronene	mg/kg	<0.04	~	~	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
PAH 17 Total	mg/kg	<0.64	~	~	6.7	< 2.0	< 2.0	< 2.0	37	< 2.0	180	5.5	< 2.0	< 2.0	< 2.0
Volatile Organic Compounds (VOC MS)															
Dichlorodifluoromethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl Chloride	µg/kg	<1	4.8	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	µg/kg	<20	~	~	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
Chloroethane	µg/kg	<2	~	~	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
trans-1-2-Dichloroethene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis-1-2-Dichloroethene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	µg/kg	<5	~	~	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	µg/kg	<1	2600	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroform	ug/kg	<3	2600	~	~	~	~	~	~	~	~	~	~	~	~
1,1,1-Trichloroethane	µg/kg	<1	57000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	µg/kg	<1	190	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Carbon tetrachloride	µg/kg	<4		~	~	~	~	~	~	~	~	~	~	~	~
1,2-Dichloroethane	µg/kg	<2	~	~	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene (TCE)	µg/kg	<1	70	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromodichloromethane	µg/kg	<5	~	~	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1-3-Dichloropropene	µg/kg	<10	~	~	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
trans-1-3-Dichloropropene	µg/kg	<10		~	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	µg/kg	<10	~	~	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethene (PCE)	µg/kg	<1	810	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	µg/kg	<2	~	~	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	µg/kg	<10	~	~	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	µg/kg	<5	~	~	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	µg/kg	<1	1300	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Styrene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromobenzene	µg/kg	<2		~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	µg/kg	<50	~	~	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Propylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
tert-Butylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
sec-Butylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Isopropyltoluene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	µg/kg	<1	390	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	µg/kg	<1	36000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
n-Butylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	µg/kg	<1	24000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	µg/kg	<1	48	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N

2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.

~ - denotes comparison criteria not available

E1620

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Kilkenny City

Table 1: Soils Analytical Results

					MOR Soil Sampling During Archaeological Works - 2018														
Sample No.	**Units**	**LOD**	**LQM/CIEH (Generic Assessment Criteria)[1]**	**Category 4 Screening Levels[2]**	18-05241	18-05241	18-05817	18-05241	18-05679	18-05679	18-05679	18-05817	18-05817	18-06969	18-06969	18-06969	18-09055	18-06971	18-06505
Sample ID			**Public Open Space 2 (Park) 1% SOM**	**Public Open Space 2 (Park) 1% SOM**	TP5	TP6	TP7	TP8	TP9	TP10	TP11	TP12	TP13	TP14	TP15	TP16	TP17	TP18	TP19
Depth (m)					0.30	0.77	0.70	1.40	Composite (0.2 - 1.10m)	1.00	1.30	Composite (0.2-3.0m)	0.80	0.90	0.80	0.90	1.00	1.00	0.80
Sample Date					21/02/2018	21/02/2018	27/02/2018	21/02/2018	22/02/2018	22/02/2018	26/02/2018	27/02/2018	27/02/2018	12/03/2018	12/03/2018	12/03/2018	28/03/2018	28/03/2018	05/03/2018
Soil Characteristic Parameters																			
Natural Moisture Content	%	<0.02	~	~	7.4	14	25	13	14	10	12	17	11	7.2	12	13	7.6	7.8	10
Indicators																			
Total Organic Carbon	%	<0.02																	
Fraction of Organic Carbon		0.001	~	~	0.025	0.014	0.071	0.021	0.024	0.015	0.011	0.029	0.051	0.0011	0.035	0.019	0.0029	0.0100	0.018
Total Organic Carbon (MOR calculation)	%	-	~	~	2.5	1.4	7.1	2.1	2.4	1.5	1.1	2.9	5.1	0.11	3.5	1.9	0.29	1	1.8
Soil Organic Matter (MOR calculation)	%	-	~	~	4.31	2.41	12.24	3.62	4.14	2.59	1.90	5.00	8.79	0.19	6.03	3.28	0.50	1.72	3.10
Asbestos					Chrysotile	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD
ACM Type			~	~	Fibres/Clumps	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos identification			~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Asbestos by Gravimetry	mass %	<0.001	~	~	0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Total Asbestos			~	~	0.001	~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~															
Metals																			
Antimony	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Arsenic	mg/kg	<0.5	170	170	42	34	29	29	27	24	21	33	30	21	38	21	25	34	27
Barium	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Cadmium	mg/kg	<0.1	560	880	0.28	0.36	0.65	0.44	1.4	0.45	0.55	0.51	0.41	0.26	0.55	0.36	0.15	0.19	0.39
Chromium	mg/kg	<0.5	220	250	11	11	15	14	14	16	14	14	15	7.7	17	9.0	15.0	10.0	12
Copper	mg/kg	<1	44000	~	240	31	49	50	45	39	28	42	35	10	55	37	9.8	12	39
Lead	mg/kg	<5	~	1300	180	99	170	120	320	140	160	320	260	20	190	130	14	18	170
Mercury	mg/kg	<0.1	240	~	1.3	0.59	0.99	0.87	0.51	0.23	0.38	0.49	0.47	< 0.10	0.41	0.34	< 0.10	< 0.10	1.6
Molybdenum	mg/kg	<0.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Nickel	mg/kg	<0.7	800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Selenium	mg/kg	<1	1800	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Zinc	mg/kg	<5	170000	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
TPH CWG																			
Aliphatics																			
>C5-C6	mg/kg	<1.0	95000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C6-C8	mg/kg	<1.0	150000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C8-C10	mg/kg	<1.0	14000	~	< 1.0	< 1.0	< 1.0	< 1.0	14	< 1.0	< 1.0	< 1.0	6.9	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C10-C12	mg/kg	<1.0	21000	~	< 1.0	< 1.0	< 1.0	< 1.0	160	< 1.0	< 1.0	< 1.0	2.7	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C12-C16	mg/kg	<1.0	25000	~	< 1.0	< 1.0	< 1.0	< 1.0	570	< 1.0	< 1.0	< 1.0	14	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C16-C21	mg/kg	<1.0	450000	~	< 1.0	< 1.0	< 1.0	< 1.0	760	< 1.0	< 1.0	< 1.0	34	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C21-C35	mg/kg	<1.0		~	22	< 1.0	< 1.0	< 1.0	390	< 1.0	< 1.0	< 1.0	53	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C35-C44	mg/kg	<1.0	450000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total aliphatics C5-C35	mg/kg	<19	~	~															
Total aliphatics C5-C44	mg/kg	<5.0	~	~	22	< 5.0	< 5.0	< 5.0	1900	< 5.0	< 5.0	< 5.0	110	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatics																			
>EC5-EC7	mg/kg	<1.0	76000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>EC7-EC8	mg/kg	<1.0	87000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>EC8-EC10	mg/kg	<1.0	7200	~	< 1.0	< 1.0	< 1.0	< 1.0	1.8	< 1.0	< 1.0	< 1.0	42	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>EC10-EC12	mg/kg	<1.0	9200	~	< 1.0	< 1.0	< 1.0	< 1.0	27	< 1.0	< 1.0	< 1.0	34	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>EC12-EC16	mg/kg	<1.0	10000	~	< 1.0	< 1.0	< 1.0	< 1.0	220	< 1.0	< 1.0	< 1.0	1.9	< 1.0	1.9	2.3	< 1.0	< 1.0	< 1.0
>EC16-EC21	mg/kg	<1.0	7600	~	< 1.0	< 1.0	< 1.0	< 1.0	110	< 1.0	2.3	< 1.0	1.5	< 1.0	2.7	5.2	< 1.0	< 1.0	8.8
>EC21-EC35	mg/kg	<1.0	7800	~	57	< 1.0	< 1.0	< 1.0	150	< 1.0	7.5	< 1.0	180	< 1.0	26	28	< 1.0	< 1.0	3.4
>EC35-EC44	mg/kg	<1.0	7800	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1	1.7	< 1.0	< 1.0	< 1.0
Total aromatics C5-C35	mg/kg	<19	~	~															
Total aromatics C5-44	mg/kg	<5.0	~	~	57	< 5.0	< 5.0	< 5.0	520	< 5.0	11	< 5.0	260	< 5.0	32	37	< 5.0	< 5.0	12
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~															
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	78	< 10	< 10	< 10	2400	< 10	11	< 10	370	< 10	32	37	< 10	< 10	12
PETROLEUM HYDROCARBONS																			
BTEX/MTBE																			
MTBE	ug/kg	<5	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	ug/kg	<5	90000	230000	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	15	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	ug/kg	<5	87000000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	110	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	ug/kg	<5	17000000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	120	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m/p-Xylene	ug/kg	<5	17000000	~	< 1.0	< 1.0	3.2	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	290	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	ug/kg	<5	17000000	~	< 1.0	< 1.0	1.9	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	120	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Polychlorinated Biphenyls (PCBs)																			
PCB 28	ug/kg	<5			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 52	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 101	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 118	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 138	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 153	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 180	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total 7 PCBs	ug/kg	<35	~	~	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Polycyclic Aromatic Hydrocarbons (PAHs)																			
Naphthalene	mg/kg	<0.04	1200	~	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.12	< 0.10	< 0.10	< 0.10	0.36	0.12	< 0.10	< 0.10	< 0.10
Acenaphthylene	mg/kg	<0.03	29000	~	< 0.10	< 0.10	0.42	< 0.10	< 0.10	< 0.10	0.23	0.52	0.57	< 0.10	0.70	0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	mg/kg	<0.05	29000	~	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.15	0.12	0.19	< 0.10	0.17	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	mg/kg	<0.04	20000	~	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.22	0.29	0.16	< 0.10	1.1	0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	mg/kg	<0.03	6200	~	0.27	0.28	0.49	< 0.10	< 0.10	< 0.10	3.8	1.4	1.2	< 0.10	5.5	0.85	< 0.10	< 0.10	< 0.10
Anthracene	mg/kg	<0.04	150000	~	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	1.0	0.51	0.42	< 0.10	2.3	0.31	< 0.10	< 0.10	< 0.10

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Table 1: Soils Analytical Results

	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	MOR Soil Sampling During Archaeological Works - 2018														
Sample No.					18-05241	18-05241	18-05817	18-05241	18-05679	18-05679	18-05679	18-05817	18-05817	18-06969	18-06969	18-06969	18-09055	18-06971	18-06505
Sample ID					TP5	TP6	TP7	TP8	TP9	TP10	TP11	TP12	TP13	TP14	TP15	TP16	TP17	TP18	TP19
			Public Open Space 2 (Park) 1% SOM	**Public Open Space 2 (Park) 1% SOM**															
Depth (m)					0.30	0.77	0.70	1.40	Composite (0.2 - 1.10m)	1.00	1.30	Composite (0.2- 3.0m)	0.80	0.90	0.80	0.90	1.00	1.00	0.80
Sample Date					21/02/2018	21/02/2018	27/02/2018	21/02/2018	22/02/2018	22/02/2018	26/02/2018	27/02/2018	27/02/2018	12/03/2018	12/03/2018	12/03/2018	28/03/2018	28/03/2018	05/03/2018
Fluoranthene	mg/kg	<0.03	6300	~	0.43	0.39	0.80	< 0.10	< 0.10	< 0.10	5.9	2.6	1.9	< 0.10	5.3	1.9	< 0.10	< 0.10	< 0.10
Pyrene	mg/kg	<0.03	15000	~	0.60	0.44	0.94	< 0.10	< 0.10	< 0.10	5.6	2.6	2.0	< 0.10	4.9	1.8	< 0.10	< 0.10	< 0.10
Benzo(a)anthracene	mg/kg	<0.06	49	~	0.41	0.32	0.59	< 0.10	< 0.10	< 0.10	2.6	1.6	1.2	< 0.10	2.7	1.2	< 0.10	< 0.10	< 0.10
Chrysene	mg/kg	<0.02	93	~	0.38	0.35	0.53	< 0.10	< 0.10	< 0.10	3.1	1.3	1.0	< 0.10	2.8	2.0	< 0.10	< 0.10	< 0.10
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	0.66	0.55	0.57	< 0.10	< 0.10	< 0.10	3.2	1.9	0.81	< 0.10	0.95	0.69	< 0.10	< 0.10	< 0.10
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	0.14	0.21	0.27	< 0.10	< 0.10	< 0.10	1.4	0.68	0.43	< 0.10	0.96	0.55	< 0.10	< 0.10	< 0.10
Benzo(bk)fluoranthene	mg/kg	<0.07		~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	<0.04	11	21	0.33	0.25	0.46	< 0.10	< 0.10	< 0.10	2.4	1.1	0.77	< 0.10	2.2	1.2	< 0.10	< 0.10	< 0.10
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	0.51	0.38	0.39	< 0.10	< 0.10	< 0.10	1.5	0.68	0.6	< 0.10	1.1	0.85	< 0.10	< 0.10	< 0.10
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	< 0.10	< 0.10	0.27	< 0.10	< 0.10	< 0.10	0.6	0.36	0.44	< 0.10	0.15	0.19	< 0.10	< 0.10	< 0.10
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	0.27	0.26	0.45	< 0.10	< 0.10	< 0.10	1.3	0.88	0.46	< 0.10	1.1	0.88	< 0.10	< 0.10	< 0.10
Coronene	mg/kg	<0.04	~	~	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
PAH 17 Total	mg/kg	<0.64	~	~	4	3.4	6.2	< 2.0	< 2.0	< 2.0	33	17	12	< 2.0	32	13	< 2.0	< 2.0	< 2.0
Volatile Organic Compounds (VOC MS)																			
Dichlorodifluoromethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl Chloride	µg/kg	<1	4.8	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	µg/kg	<20	~	~	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
Chloroethane	µg/kg	<2	~	~	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
trans-1-2-Dichloroethene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis-1-2-Dichloroethene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	µg/kg	<5	~	~	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	µg/kg	<1	2600	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroform	ug/kg	<3	2600	~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1,1-Trichloroethane	µg/kg	<1	57000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	µg/kg	<1	190	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Carbon tetrachloride	µg/kg	<4		~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	µg/kg	<2	~	~	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene (TCE)	µg/kg	<1	70	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromodichloromethane	µg/kg	<5	~	~	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1-3-Dichloropropene	µg/kg	<10	~	~	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
trans-1-3-Dichloropropene	µg/kg	<10		~	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	µg/kg	<10	~	~	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethene (PCE)	µg/kg	<1	810	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	µg/kg	<2	~	~	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	µg/kg	<10	~	~	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	µg/kg	<5	~	~	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	µg/kg	<1	1300	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Styrene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	14	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromobenzene	µg/kg	<2		~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	µg/kg	<50	~	~	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Propylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	40	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	350	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
tert-Butylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	1.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	820	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
sec-Butylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	6.3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Isopropyltoluene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	31	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	µg/kg	<1	390	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	µg/kg	<1	36000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
n-Butylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	µg/kg	<1	24000	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	µg/kg	<1	48	~	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:
1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N
2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.
~ - denotes comparison criteria not available

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 1: Soils Analytical Results

Sample No.	Units	LOD	LQM/CIEH (Generic Assessment Criteria)[1]	Category 4 Screening Levels[2]	18-06505	18-06505	18-06505	MOR - Probehole Investigation 2020 20/1608	20/1608	20/1608	20/1608	20/1608	20/1608	20/1608	20/1608	20/1608
Sample ID			Public Open Space 2 (Park) 1% SOM	Public Open Space 2 (Park) 1% SOM	TP20	TP21	TP22	PH1	PH2	PH2	PH3	PH3	PH4	PH5	PH5	PH5
Depth (m)					0.90	1.60	1.55	0.25 - 0.45mbgl	0.30 - 1.00mbgl	1.00 - 1.40mbgl	0.30 - 1.00mbgl	1.00 - 2.00mbgl	0.25 - 1.00mbgl	0.35 - 1.00mbgl	1.00 - 2.00mbgl	2.00 - 2.30mbgl
Sample Date					05/03/2018	07/03/2018	07/03/2018	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020
Soil Characteristic Parameters																
Natural Moisture Content	%	<0.02	~	~	20	13	12	8.6	10	9	10.2	19.4	7	7	13	25
Indicators																
Total Organic Carbon	%	<0.02														
Fraction of Organic Carbon		0.001	~	~	0.41	0.074	0.038	0.0020	NDP	NDP	0.0030	NDP	0.002	NDP	NDP	NDP
Total Organic Carbon (MOR calculation)	%	-	~	~	41	7.4	3.8	0.2	~	~	0.3	~	0.2	~	~	~
Soil Organic Matter (MOR calculation)	%	-	~	~	70.69	12.76	6.55	0.34	~	~	0.52	~	0.34	~	~	~
Asbestos					NAD	NAD	NAD	NAD	Crocidolite + Chrysotile	Chrysotile	NAD	Chrysotile	NAD	Crocidolite	Chrysotile	Chrysotile
ACM Type			~	~	~	~	~	NAD	Fibre Bundles	Fibre Bundles	NAD	Fibre Bundles	NAD	Fibre Bundles	Fibre Bundles	Fibre Bundles
Asbestos identification			~	~	~	~	~	NAD	Crocidolite + Chrysotile	Chrysotile	NAD	Chrysotile	NAD	Crocidolite	Chrysotile	Chrysotile
Asbestos by Gravimetry	mass %	<0.001	~	~	~	~	~	NA	<0.001	<0.001	NA	<0.001	NA	<0.001	<0.001	<0.001
Total Asbestos			~	~	~	~	~	~	~	~	~	~	~	~	~	~
			~	~												
Metals																
Antimony	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Arsenic	mg/kg	<0.5	170	170	66	32	46	4	8	4	6	5	5	6	6	10
Barium	mg/kg	<1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Cadmium	mg/kg	<0.1	560	880	0.59	0.41	0.35	0.20	0.30	0.40	0.20	0.20	0.20	0.20	0.20	0.30
Chromium	mg/kg	<0.5	220	250	22	16	14	56.7	16	16.2	47.2	16.0	63	13	10	16
Copper	mg/kg	<1	44000	~	200	87	32	16	21	13	12.0	13	14	14	11	66
Lead	mg/kg	<5	~	1300	440	220	79	9	29	8	37	24	7	16	12	130
Mercury	mg/kg	<0.1	240	~	27	0.66	0.18	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	mg/kg	<0.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Nickel	mg/kg	<0.7	800	~	~	~	~	12.9	22	13.5	12.8	13.4	17.8	17.5	11.4	23.7
Selenium	mg/kg	<1	1800	~	~	~	~	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	mg/kg	<5	170000	~	~	~	~	35	65	30	43	51	42	48	37	98
TPH CWG																
Aliphatics																
>C5-C6	mg/kg	<1.0	95000	~	< 1.0	< 1.0	< 1.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>C6-C8	mg/kg	<1.0	150000	~	< 1.0	< 1.0	< 1.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>C8-C10	mg/kg	<1.0	14000	~	< 1.0	< 1.0	< 1.0	0.1	0.3	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1
>C10-C12	mg/kg	<1.0	21000	~	< 1.0	< 1.0	< 1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
>C12-C16	mg/kg	<1.0	25000	~	< 1.0	< 1.0	< 1.0	<4	<4	<4	<4	<4	<4	<4	<4	<4
>C16-C21	mg/kg	<1.0	450000	~	< 1.0	< 1.0	< 1.0	<7	<7	<7	<7	<7	<7	<7	<7	<7
>C21-C35	mg/kg	<1.0		~	< 1.0	< 1.0	< 1.0	<7	<7	<7	19	51	<7	<7	<7	16
>C35-C44	mg/kg	<1.0	450000	~	< 1.0	< 1.0	< 1.0	~	~	~	~	~	~	~	~	~
Total aliphatics C5-C35	mg/kg	<19	~	~				<19	<19	<19	19	51	<19	<19	<19	<19
Total aliphatics C5-C44	mg/kg	<5.0	~	~	< 5.0	< 5.0	< 5.0	~	~	~	~	~	~	~	~	~
Aromatics																
>EC5-EC7	mg/kg	<1.0	76000	~	< 1.0	< 1.0	< 1.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>EC7-EC8	mg/kg	<1.0	87000	~	< 1.0	< 1.0	< 1.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>EC8-EC10	mg/kg	<1.0	7200	~	< 1.0	< 1.0	< 1.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>EC10-EC12	mg/kg	<1.0	9200	~	< 1.0	< 1.0	< 1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
>EC12-EC16	mg/kg	<1.0	10000	~	< 1.0	< 1.0	< 1.0	<4	<4	<4	<4	<4	<4	<4	<4	<4
>EC16-EC21	mg/kg	<1.0	7600	~	5.7	< 1.0	< 1.0	<7	<7	<7	<7	<7	<7	<7	<7	<7
>EC21-EC35	mg/kg	<1.0	7800	~	9.1	< 1.0	< 1.0	<7	<7	<7	<7	<7	<7	<7	<7	<7
>EC35-EC44	mg/kg	<1.0	7800	~	< 1.0	< 1.0	< 1.0	~	~	~	~	~	~	~	~	~
Total aromatics C5-C35	mg/kg	<19	~	~				<19	<19	<19	<19	<19	<19	<19	<19	<19
Total aromatics C5-44	mg/kg	<5.0	~	~	15	< 5.0	< 5.0	~	~	~	~	~	~	~	~	~
Total aliphatics and aromatics(C5-C35)	mg/kg	<38	~	~				<38	<38	<38	<38	51	<38	<38	<38	<38
Total aliphatics and aromatics(C5-C44)	mg/kg	<10	~	~	15	< 10	< 10	~	~	~	~	~	~	~	~	~
PETROLEUM HYDROCARBONS																
BTEX/MTBE																
MTBE	ug/kg	<5	~	~	< 1.0	< 1.0	< 1.0	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzene	ug/kg	<5	90000	230000	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Toluene	ug/kg	<5	87000000	~	< 1.0	< 1.0	< 1.0	8	<3	<3	<3	<3	<3	<3	<3	6
Ethylbenzene	ug/kg	<5	17000000	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
m/p-Xylene	ug/kg	<5	17000000	~	< 1.0	< 1.0	< 1.0	9	<5	<5	<5	<5	<5	<5	<5	<5
o-Xylene	ug/kg	<5	17000000	~	< 1.0	< 1.0	< 1.0	4	<3	<3	<3	<3	<3	<3	<3	<3
Polychlorinated Biphenyls (PCBs)																
PCB 28	ug/kg	<5			< 0.010	< 0.010	< 0.010	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 52	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 101	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 118	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 138	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 153	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	<5	<5	<5	<5	<5	<5	<5	<5	<5
PCB 180	ug/kg	<5	~	~	< 0.010	< 0.010	< 0.010	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total 7 PCBs	ug/kg	<35	~	~	< 0.10	< 0.10	< 0.10	<35	<35	<35	<35	<35	<35	<35	<35	<35
Polycyclic Aromatic Hydrocarbons (PAHs)																
Naphthalene	mg/kg	<0.04	1200	~	< 0.10	< 0.10	< 0.10	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Acenaphthylene	mg/kg	<0.03	29000	~	< 0.10	< 0.10	< 0.10	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Acenaphthene	mg/kg	<0.05	29000	~	< 0.10	< 0.10	< 0.10	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluorene	mg/kg	<0.04	20000	~	< 0.10	< 0.10	< 0.10	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Phenanthrene	mg/kg	<0.03	6200	~	< 0.10	< 0.10	< 0.10	<0.03	0.1	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.08
Anthracene	mg/kg	<0.04	150000	~	< 0.10	< 0.10	< 0.10	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04

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Table 1: Soils Analytical Results

								MOR - Probehole Investigation 2020								
Sample No.	**Units**	**LOD**	**LQM/CIEH (Generic Assessment Criteria)[1]**	**Category 4 Screening Levels[2]**	18-06505	18-06505	18-06505	20/1608	20/1608	20/1608	20/1608	20/1608	20/1608	20/1608	20/1608	20/1608
Sample ID			**Public Open Space 2 (Park) 1% SOM**	**Public Open Space 2 (Park) 1% SOM**	TP20	TP21	TP22	PH1	PH2	PH2	PH3	PH3	PH4	PH5	PH5	PH5
Depth (m)					0.90	1.60	1.55	0.25 - 0.45mbgl	0.30 - 1.00mbgl	1.00 - 1.40mbgl	0.30 - 1.00mbgl	1.00 - 2.00mbgl	0.25 - 1.00mbgl	0.35 - 1.00mbgl	1.00 - 2.00mbgl	2.00 - 2.30mbgl
Sample Date					05/03/2018	07/03/2018	07/03/2018	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020
Fluoranthene	mg/kg	<0.03	6300	~	0.18	< 0.10	< 0.10	<0.03	0.1	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.08
Pyrene	mg/kg	<0.03	15000	~	0.14	< 0.10	< 0.10	<0.03	0.1	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.06
Benzo(a)anthracene	mg/kg	<0.06	49	~	0.27	< 0.10	< 0.10	<0.06	0.1	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Chrysene	mg/kg	<0.02	93	~	0.39	< 0.10	< 0.10	<0.02	0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.06
Benzo(b)fluoranthene	mg/kg	<0.05	13	~	< 0.10	< 0.10	< 0.10	<0.05	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06
Benzo(k)fluoranthene	mg/kg	<0.02	370	~	< 0.10	< 0.10	< 0.10	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03
Benzo(bk)fluoranthene	mg/kg	<0.07		~	-	-	-	<0.07	0.1	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	0.09
Benzo(a)pyrene	mg/kg	<0.04	11	21	< 0.10	< 0.10	< 0.10	<0.04	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Indeno(123cd)pyrene	mg/kg	<0.04	150	~	< 0.10	< 0.10	< 0.10	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Dibenzo(ah)anthracene	mg/kg	<0.01	1.1	~	< 0.10	< 0.10	< 0.10	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Benzo(ghi)perylene	mg/kg	<0.04	1400	~	< 0.10	< 0.10	< 0.10	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Coronene	mg/kg	<0.04	~	~	< 0.10	< 0.10	< 0.10	~	~	~	~	~	~	~	~	~
PAH 17 Total	mg/kg	<0.64	~	~	< 2.0	< 2.0	< 2.0	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Volatile Organic Compounds (VOC MS)																
Dichlorodifluoromethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl Chloride	µg/kg	<1	4.8	~	< 1.0	< 1.0	< 1.0	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/kg	<20	~	~	< 20	< 20	< 20	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/kg	<2	~	~	< 2.0	< 2.0	< 2.0	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichlorofluoromethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<2	<2	<2	<2	5.00	<2	<2	<2	<2
1,1-Dichloroethene (1,1 DCE)	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<6	<6	<6	<6	<6	<6	<6	<6	<6
trans-1-2-Dichloroethene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1-2-Dichloroethene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Bromochloromethane	µg/kg	<5	~	~	< 5.0	< 5.0	< 5.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Trichloromethane	µg/kg	<1	2600	~	< 1.0	< 1.0	< 1.0	~	~	~	~	~	~	~	~	~
Chloroform	ug/kg	<3	2600	~	-	-	-	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1,1-Trichloroethane	µg/kg	<1	57000	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloromethane	µg/kg	<1	190	~	< 1.0	< 1.0	< 1.0	~	~	~	~	~	~	~	~	~
1,1-Dichloropropene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Carbon tetrachloride	µg/kg	<4		~	-	-	-	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2-Dichloroethane	µg/kg	<2	~	~	< 2.0	< 2.0	< 2.0	<4	<4	<4	<4	<4	<4	<4	<4	<4
Trichloroethene (TCE)	µg/kg	<1	70	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloropropane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<6	<6	<6	<6	<6	<6	<6	<6	<6
Dibromomethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Bromodichloromethane	µg/kg	<5	~	~	< 5.0	< 5.0	< 5.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1-3-Dichloropropene	µg/kg	<10	~	~	< 10	< 10	< 10	<4	<4	<4	<4	<4	<4	<4	<4	<4
trans-1-3-Dichloropropene	µg/kg	<10		~	< 10	< 10	< 10	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1,2-Trichloroethane	µg/kg	<10	~	~	< 10	< 10	< 10	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloroethene (PCE)	µg/kg	<1	810	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropane	µg/kg	<2	~	~	< 2.0	< 2.0	< 2.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dibromochloromethane	µg/kg	<10	~	~	< 10	< 10	< 10	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dibromoethane	µg/kg	<5	~	~	< 5.0	< 5.0	< 5.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chlorobenzene	µg/kg	<1	1300	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1,1,2-Tetrachloroethane	µg/kg	<2	1500	~	< 2.0	< 2.0	< 2.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tribromomethane	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	~	~	~	~	~	~	~	~	~
Isopropylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
Bromobenzene	µg/kg	<2		~	< 1.0	< 1.0	< 1.0	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2,3-Trichloropropane	µg/kg	<50	~	~	< 50	< 50	< 50	<4	<4	<4	<4	<4	<4	<4	<4	<4
Propylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<4	<4	<4	<4	<4	<4	<4	<4	<4
2-Chlorotoluene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3,5-Trimethylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<3	<3	<3	<3	<3	<3	<3	<3	<3
tert-Butylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,2,4-Trimethylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	8.00	<6	<6	<6	<6	<6	<6	<6	<6
sec-Butylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<4	<4	<4	<4	<4	<4	<4	<4	<4
4-Isopropyltoluene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,3-Dichlorobenzene	µg/kg	<1	390	~	< 1.0	< 1.0	< 1.0	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,4-Dichlorobenzene	µg/kg	<1	36000	~	< 1.0	< 1.0	< 1.0	<4	<4	<4	<4	<4	<4	<4	<4	<4
n-Butylbenzene	µg/kg	<1	~	~	< 1.0	< 1.0	< 1.0	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2-Dichlorobenzene	µg/kg	<1	24000	~	< 1.0	< 1.0	< 1.0	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2-Dibromo-3-chloropropane	µg/kg	<50	~	~	< 50	< 50	< 50	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2,4-Trichlorobenzene	µg/kg	<1	1700	~	< 1.0	< 1.0	< 1.0	<7	<7	<7	<7	<7	<7	<7	<7	<7
Hexachlorobutadiene	µg/kg	<1	48	~	< 1.0	< 1.0	< 1.0	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,2,3-Trichlorobenzene	µg/kg	<2	770	~	< 2.0	< 2.0	< 2.0	<7	<7	<7	<7	<7	<7	<7	<7	<7

Notes:
1 - LQM/CIEH , December 2015: S4ULs for Human Health Risk Assessment) "Copyright Land Quality Management Limited reproduced with permission; Publication N
2 - DEFRA, 2014: Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination - Policy Companion Document.
~ - denotes comparison criteria not available

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Table 2: Leachate Analytical Results

	Units	LOD	Groundwater Standards	EPA IGV's	Surface Water Standards	MOR - Window Sample Investigation 2020								
Sample No.			**Groundwater Regulations 2010 (S.I. No. 9 of 2010) as amended 2012 (SI 149 of 2012) as amended 2016 (S.I. No. 366 of 2016)**	Towards Setting Guideline Values for the Protection of Groundwater in Ireland	*Surface Water Regulations 2009 (S.I. No. 272 of 2009) as amended (S.I. No.327 of 2012, S.I. No.386 of 2015 and S.I. No. 77 of 2019)*	20/1608	20/1608	20/1608	20/1608	20/1608	20/1608	20/1608	20/1608	20/1608
Sample ID						PH1	PH2	PH2	PH3	PH3	PH4	PH5	PH5	PH5
Depth (m)						0.25 - 0.45mbgl	0.30 - 1.00mbgl	1.00 - 1.40mbgl	0.30 - 1.00mbgl	1.00 - 2.00mbgl	0.25 - 1.00mbgl	0.35 - 1.00mbgl	1.00 - 2.00mbgl	2.00 - 2.30mbgl
Sample Date						30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020
Sample Type						Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate
Metals														
Arsenic	ug/l	<2.5	7.5	10	25	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Cadmium	ug/l	<0.5	~	5	0.08	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	ug/l	<1.5	37.5	30	32	3.2	12	14.7	27	14.6	8	***58***	<1.5	<1.5
Copper	ug/l	<7	~	30	5	*41*	*35*	<7	*57*	*48*	<7	*44*	<7	<7
Lead	ug/l	<5	7.5	10	1.2	<5	<5	<5	<5	<5	<5	<5	<5	<5
Mercury	ug/l	<1	0.75	1	0.07	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	ug/l	<2	~	20	4	6	8	3	4	15	<2	3	<2	<2
Selenium	ug/l	<3	~	~	~	<3	<3	<3	<3	<3	<3	<3	<3	<3
Zinc	ug/l	<3	75	100	8	<3	<3	<3	<3	<3	<3	<3	<3	<3

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Table 3: Groundwater Analytical Results

Sample Identity			Groundwater Standards	EPA IGV's	Surface Water Standards	BH01					
Laboratory Report No.			Groundwater Regulations 2010 (S.I. No. 9 of 2010) as amended 2012 (SI 149 of 2012) as amended 2016 (S.I. No. 366 of 2016)	Towards Setting Guideline Values for the Protection of Groundwater in Ireland	Surface Water Regulations 2009 (S.I. No. 272 of 2009) as amended (S.I. No.327 of 2012, S.I. No.386 of 2015 and S.I. No. 77 of 2019)	Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297
Sample Date						16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020
Parameters	**Unit**	**MDL**									
Field Measured Parameters											
pH	pH units	♦	~	6.5-9.5	6-9	7.17	7.20	7.10	7.20	7.30	6.57
Electrical Conductivity	µS/cm	♦	800 / 1875	1,000	~	492.68	590.00	610.00	710.00	150.00	430.00
Dissolved Oxygen	%	♦	~	NAC	>80 % - <120%	55.65	67.00	48.00	43.00	44.00	59.50
Dissolved Oxygen	mg/l	♦	~	NAC	~	6.05	-	-	-	-	-
Temperature	°C	♦	~	25	~	11.29	11.00	13.00	14.00	12.00	12.00
Oxidation Reduction Potential	mV	♦	~	~	~	75.70	106.90	108.00	146.00	95.00	118.40
Colour	N/A	♦	~	NAC	~	Brown	-	-	-	-	-
Odour	N/A	♦	~	~	~	-	-	-	-	-	-
Other observations	N/A	♦	~	~	~	Debris / S.S / NEC	-	-	-	-	-
Metals (dissolved and total)											
Arsenic (As) (diss. Filt)	µg/l	<2.5	7.5	~	25	<2.5	0.66	0.37	0.43	0.11	**27**
Arsenic (As) (tot. unfilt)	µg/l	<2.5	~	10	~	23.20	1.25	1.31	-	-	-
Barium (B) (diss.filt)	µg/l	<3	~	~	~	38	-	-	-	-	-
Barium (B) (tot.unfilt)	µg/l	<3	~	100	~	368	-	-	-	-	-
Boron (B) (diss.filt)	µg/l	<100	~	~	~	-	33	58	26	1.7	25
Boron (B) (tot.unfilt)	µg/l	<12	~	1000	~	-	44	640	-	-	-
Cadmium (Cd) (diss.filt)	µg/l	<0.5	~	~	0.45	<0.5	<0.03	<0.03	<0.03	25	0.06
Cadmium (Cd) (tot. unfilt)	µg/l	<0.5	~	5	~	7.20	0.08	0.26	-	-	-
Chromium (Cr) (diss.filt)	µg/l	<0.25	37.5	~	32	-	0.52	0.45	<0.25	11	0.56
Chromium (Cr) (tot. unfilt)	µg/l	<0.25	~	30	~	-	2.6	2.9	-	-	-
Hexavalent Chromium	mg/l	<0.007	0.0075	0.03	0.0034	-	-	<0.007	-	-	-
Copper (Cu) (diss.filt)	µg/l	<7	~	~	5	<7	0.5	1	<0.4	< 0.01	5.2
Copper (Cu) (tot.unfilt)	µg/l	<7	~	30	~	78	3	7.6	-	-	-
Iron (Fe) (diss.filt)	µg/l	<20	~	~	~	<20	-	-	-	-	-
Iron (Fe) (tot.unfilt)	µg/l	<20	~	200	~	92350	-	-	-	-	-
Magnesium (Mg) (diss.filt)	mg/l	<0.1	~	~	~	18.8	-	-	-	-	-
Magnesium (Mg) (tot.unfilt)	mg/l	<0.1	~	50	~	42.1	-	-	-	-	-
Manganese (Mn) (diss.filt)	µg/l	<2	~	~	~	97	-	-	-	-	-
Manganese (Mn) (tot.unfilt)	µg/l	<2	~	50	~	3057	-	-	-	-	-
Mercury (Hg) (diss. Filt)	µg/l	<0.01	0.75	~	0.07		0.02	<0.01	<0.01	0.54	< 0.01
Mercury (Hg) (tot. unfilt)	µg/l	<0.01	~	1	~		0.04	<0.01	-	-	-
Nickel (Ni) (diss.filt)	µg/l	<2	~	~	34	<2	<0.5	0.60	<0.5	30	1
Nickel (Ni) (tot.unfilt)	µg/l	<2	~	20	~	128	3.3	2.2	-	-	-
Lead (Pb) (diss.filt)	µg/l	<5	7.5	~	14	<5	<0.09	0.33	<0.09	1.3	3.7
Lead (Pb) (tot.unfilt)	µg/l	<5	~	10	~	45	2	5.2	-	-	-
Selenium (Se) (diss.filt)	µg/l	<0.3	~	~	~	<3	0.37	0.61	0.44	<1	< 0.25
Selenium (Se) (tot.unfilt)	µg/l	<0.3	~	~	~	<3	0.37	0.61	-	-	-
Zinc (Zn) (diss.filt)	µg/l	<3	75	~	100	<3	5.9	1.8	14	13	45
Zinc (Zn) (tot.unfilt)	µg/l	<3	~	100	~	195	9.9	26	-	-	-
Potassium (K) (diss.filt)	mg/l	<0.1	~	~	~	4.7	-	-	-	-	-
Potassium (K) (tot.unfilt)	mg/l	<0.1	~	5	~	14.9	-	-	-	-	-
Inorganics											
Ammoniacal Nitrogen as N	mg/l	<0.03	0.065 - 0.175	0.15 (NH4)	0.14 (N)	0.03	<0.08	<0.08	<0.08	0.09	<0.08
Biochemical Oxygen Demand (BOD) Settled.	mg/l	<1	~	~	1.5	<1	-	<2	-	-	-
Dissolved solids, Total	mg/l	<35	~	1000	~	457	-	576	-	-	-
Nitrite as NO2	mg/l	<0.02	0.375	0.1	~	0.2	<0.20	<0.20	<0.20	<0.20	<0.20
Nitrate as NO3	mg/l	<0.2	37.5	25	~	19.8	20.0	19.0	22.0	13.0	14.0
Phosphate (ortho) as PO4	mg/l	<0.06	35	0.075	~	0.06	<1	<1	<1	<1	<1
Total Organic Carbon (TOC)	mg/l	<2	~	NAC	~	<2	-	-	-	-	-
Nutrients & Indicators											
Sulphate as SO4	mg/l	<0.5	187.5	200	~	38.4	-	35.0	-	-	-
Chloride	mg/l	<0.3	24-187.5	30	~	27.4	-	28.0	-	-	-
Fluoride	mg/l	<0.3	~	1	0.5	<0.3	-	<0.10	-	-	-
Chemical Oxygen Demand (COD)	mg/l	<4	~	~	~	-	-	<4	-	-	-
Total Petroleum Hydrocarbon - Criteria Working Group (TPH-CWG)											
Aliphatics											
>C5-C6	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1
>C6-C8	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1
>C8-C10	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	9	< 0.1
>C10-C12	µg/l	<5	~	~	~	<5	<1.0	<1.0	<1.0	< 1.0	< 1.0
>C12-C16	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
>C16-C21	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
>C21-C35	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
Total aliphatics C5-35	µg/l	<10	~	~	~	<10	<10	<10	<10	< 10	< 10
Aromatics			~								
>C5-EC7	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1
>EC7-EC8	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1
>EC8-EC10	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1
>EC10-EC12	µg/l	<5	~	~	~	<5	<1.0	<1.0	<1.0	< 1.0	< 1.0
>EC12-EC16	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
>EC16-EC21	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
>EC21-EC35	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
Total aromatics C5-35	µg/l	<10	~	~	~	<10	<10	<10	<10	< 10	< 10
Total aliphatics and aromatics C5-35	µg/l	<10	7.5	10	~	<10	<10	<10	<10	< 10	< 10
Polycyclic Aromatic Hydrocarbons (PAHs)											
2-Chloronaphthalene	µg/l	<1	~	0.1	~	<1	-	<2.0	-	-	-
2-Methylnaphthalene	µg/l	<1	~	0.1	~	<1	-	<2.0	-	-	-
1-Methylnaphthalene	µg/l	<2	~	~	~	-	-	<2.0	-	-	-
Naphthalene	µg/l	<1	~	1	130	<1	<0.05	-	<0.05	< 0.05	< 0.05
Acenaphthylene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<2.0	<0.01	< 0.01	< 0.01
Acenaphthene	µg/l	<1	~	0.1	~	<1	<0.01	<2.0	<0.01	< 0.01	< 0.01
Fluorene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<2.0	<0.01	< 0.01	< 0.01
Phenanthrene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<2.0	<0.01	< 0.01	< 0.01
Anthracene	µg/l	<0.5	~	10000	0.1	<0.5	<0.01	<2.0	<0.01	< 0.01	< 0.01
Fluoranthene	µg/l	<0.5	~	1	0.12	<0.5	<0.01	<2.0	<0.01	< 0.01	< 0.01
Pyrene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<2.0	<0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<2.0	<0.01	< 0.01	< 0.01
Chrysene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<2.0	<0.01	< 0.01	< 0.01
Benzo(bK)fluoranthene	µg/l	<1	~	0.05 / 0.5	0.017	<1	-	-	-	-	-
Benzo(b)fluoranthene	µg/l	<0.01	~	0.05 / 0.5	0.017	-	<0.01	<2.0	<0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	<0.01	~	0.05 / 0.5	0.017	-	<0.01	<2.0	<0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	<1	0.0075	0.01	0.27	<1	<0.01	<2.0	<0.01	< 0.01	< 0.01
Indeno(123cd)pyrene	µg/l	<1	~	0.05	~	<1	<0.01	<2.0	<0.01	< 0.01	< 0.01
Dibenzo(ah)anthracene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<2.0	<0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	<0.5	~	0.05	0.00082	<0.5	<0.01	<2.0	<0.01	< 0.01	< 0.01
PAH Total	µg/l	<0.2	~	0.1	~	-	-	-	<0.20	< 0.20	< 0.20
Semi-Volatile Organic Compounds (SVOCs)											
Speciated Phenols (MS - SVOC)											
2-Chlorophenol	µg/l	<1	~	200	~	<1	-	<2.0	-	-	-
2-Methylphenol	µg/l	<0.5	~	0.5	~	<0.5	-	<2.0	-	-	-
2-Nitrophenol	µg/l	<0.5	~	0.5	~	<0.5	-	-	-	-	-
2,4-Dichlorophenol	µg/l	<0.5	~	0.5	~	<0.5	-	<2.0	-	-	-
2,4-Dimethylphenol	µg/l	<1	~	0.5	~	<1	-	<2.0	-	-	-
2,4,5-Trichlorophenol	µg/l	<0.5	~	0.5	~	<0.5	-	<2.0	-	-	-
2,4,6-Trichlorophenol	µg/l	<1	~	200	~	<1	-	<2.0	-	-	-
4-Chloro-3-methylphenol	µg/l	<0.5	~	0.5	~	<0.5	-	<2.0	-	-	-
4-Methylphenol	µg/l	<1	~	0.5	~	<1	-	<2.0	-	-	-
4-Nitrophenol	µg/l	<10	~	0.5	~	<10	-	<2.0	-	-	-
Pentachlorophenol	µg/l	<1	~	2	1	<1	-	<2.0	-	-	-
Phenol	µg/l	<1	~	0.5	46	<1	-	<2.0	-	-	-
2,3,4,6-Tetrachlorophenol	µg/l	<2	~	0.5	~			<2.0			
2,3,5,6-Tetrachlorophenol	µg/l	<2	~	0.5	~			<2.0			
Phtalates											
Bis(2-ethylhexyl) phthalate	µg/l	<5	~	5	~	<5	-	<2.0	-	-	-
Butylbenzyl phthalate	µg/l	<1	~	5	~	<1	-	<2.0	-	-	-
Di-n-butyl phthalate	µg/l	<1.5	~	2	~	<1.5	-	-	-	-	-
Di-n-Octyl phthalate	µg/l	<1	~	5	~	<1	-	-	-	-	-
Diethyl phthalate	µg/l	<1	~	5	~	<1	-	<2.0	-	-	-
Dimethyl phthalate	µg/l	<1	~	5	~	<1	-	<2.0	-	-	-
Other SVOCs											
1,2-Dichlorobenzene	µg/l	<1	~	10	~	<1	-	-	-	-	-
1,2,4-Trichlorobenzene	µg/l	<1	~	0.4	0.4	<1	-	<2.0	-	-	-
1,3-Dichlorobenzene	µg/l	<1	~	~	~	<1	-	-	-	-	-
1,4-Dichlorobenzene	µg/l	<1	~	~	~	<1	-	-	-	-	-
2-Nitroaniline	µg/l	<1	~	~	~	<1	-	<2.0	-	-	-
2,4-Dinitrotoluene	µg/l	<0.5	~	~	~	<0.5	-	<2.0	-	-	-
2,6-Dinitrotoluene	µg/l	<1	~	~	~	<1	-	<2.0	-	-	-
3-Nitroaniline	µg/l	<1	~	~	~	<1	-	<2.0	-	-	-
4-Bromophenylphenylether	µg/l	<1	~	~	~	<1	-	<2.0	-	-	-
4-Chloroaniline	µg/l	<1	~	~	~	<1	-	-	-	-	-
4-Chlorophenylphenylether	µg/l	<1	~	~	~	<1	-	<2.0	-	-	-
4-Nitroaniline	µg/l	<0.5	~	~	~	<0.5	-	<2.0	-	-	-
Azobenzene	µg/l	<0.5	~	~	~	<0.5	-	<2.0	-	-	-
Bis(2-chloroethoxy)methane	µg/l	<0.5	~	~	~	<0.5	-	<2.0	-	-	-
Bis(2-chloroethyl)ether	µg/l	<1	~	~	~	<1	-	-	-	-	-
Carbazole	µg/l	<0.5	~	~	~	<0.5	-	<2.0	-	-	-
Dibenzofuran	µg/l	<0.5	~	~	~	<0.5	-	<2.0	-	-	-
Hexachlorobenzene	µg/l	<1	~	0.03	0.05	<1	-	<2.0	-	-	-
Hexachlorobutadiene	µg/l	<1	~	0.1	0.6	<1	-	-	-	-	-
Hexachlorocyclopentadiene	µg/l	<1	~	~	~	<1	-	<2.0	-	-	-
Hexachloroethane	µg/l	<1	~	~	~	<1	-	-	-	-	-
Isophorone	µg/l	0.5	~	~	~	<0.5	-	-	-	-	-
N-nitrosodi-n-propylamine	µg/l	0.5	~	~	~	<0.5	-	-	-	-	-
Nitrobenzene	µg/l	<1	~	10	~	<1	-	-	-	-	-
Surrogate Recovery 2-Fluorobiphenyl	%	0	~	~	~	112	-	-	-	-	-
Surrogate Recovery p-Terphenyl-d14	%	0	~	~	~	125	-	-	-	-	-
Bis(2-chloroisopropyl)ether	ug/l	<2	~	~	~	-	-	<2.0	-	-	-
1,2-Dinitrotoluene	ug/l	<2	~	~	~	-	-	<2.0	-	-	-
Diphenylamine	ug/l	<2	~	~	~	-	-	<2.0	-	-	-

Sample Identity	BH03						MW6				
Laboratory Report No.	Exova 18/513	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/513	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961
Sample Date	16/01/2018	07/03/2019	05/06/2019	27/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019
Parameters											
Field Measured Parameters											
pH	7.01	7.50	7.20	7.10	7.30	7.40	7.01	7.10	6.80	7.00	6.90
Electrical Conductivity	492	550.00	600.00	540.00	580.00	450.00	407.17	470.00	770.00	710.00	640.00
Dissolved Oxygen (%)	37.83	67.70	53.00	54.00	48.00	68.10	46.25	44.50	43.00	68.00	29.00
Dissolved Oxygen (mg/l)	4.12	-	-	-	-	-	4.97	-	-	-	-
Temperature	10.54	10.00	12.00	14.00	12.00	10.00	10.86	11.00	12.00	15.00	12.00
Oxidation Reduction Potential	175.50	102.70	93.00	155.00	116.00	120.00	158.3	88.60	119.00	168.00	123.00
Colour	Brown	-	-	-	-	-	Clear	-	-	-	-
Odour	-	-	-	-	-	-	-	-	-	-	-
Other observations	Lot of S.S / NEC	-	-	-	-	-	S.S / NEC	-	-	-	-
Metals (dissolved and total)											
Arsenic (As) (diss. Filt)	<2.5	3.8	4.3	3.6	0.09	3.4	<2.5	0.33	0.48	0.3	0.42
Arsenic (As) (tot. unfilt)	8.3	6.68	7.66	-	-	-	<2.5	1.03	0.48	-	-
Barium (B) (diss.filt)	27	-	-	-	-	-	17	-	-	-	-
Barium (B) (tot.unfilt)	186	-	-	-	-	-	20	-	-	-	-
Boron (B) (diss.filt)	-	23	74	52	1	40	-	18	23	13	21
Boron (B) (tot.unfilt)	-	43	690	-	-	-	-	20	540	-	-
Cadmium (Cd) (diss.filt)	<0.5	<0.03	0.16	0.07	3.3	0.04	<0.5	<0.03	<0.03	<0.03	<0.03
Cadmium (Cd) (tot. unfilt)	<0.5	0.61	1.7	-	-	-	<0.5	0.14	<0.03	-	-
Chromium (Cr) (diss.filt)	-	0.29	0.98	0.45	3	< 0.25	-	0.5	0.41	0.31	0.67
Chromium (Cr) (tot. unfilt)	-	8.1	4.4	-	-	-	-	1.6	0.62	-	-
Hexavalent Chromium	-	-	<0.007	-	-	-	-	-	<0.007	-	-
Copper (Cu) (diss.filt)	<7	1.2	5.9	2.2	< 0.01	1.6	<7	0.6	0.5	<0.4	0.4
Copper (Cu) (tot.unfilt)	29	13	38	-	-	-	<7	6.4	0.5	-	-
Iron (Fe) (diss.filt)	<20	-	-	-	-	-	<20	-	-	-	-
Iron (Fe) (tot.unfilt)	26210	-	-	-	-	-	1019	-	-	-	-
Magnesium (Mg) (diss.filt)	12.2	-	-	-	-	-	19.1	-	-	-	-
Magnesium (Mg) (tot.unfilt)	17.7	-	-	-	-	-	21.6	-	-	-	-
Manganese (Mn) (diss.filt)	9	-	-	-	-	-	<2	-	-	-	-
Manganese (Mn) (tot.unfilt)	4234	-	-	-	-	-	99	-	-	-	-
Mercury (Hg) (diss. Filt)		0.02	0.02	<0.01	0.31	< 0.01	-	<0.01	<0.01	<0.01	<0.01
Mercury (Hg) (tot. unfilt)		0.08	0.07	-	-	-	-	0.05	<0.01	-	-
Nickel (Ni) (diss.filt)	<2	1	2.3	1.3	5.1	0.7	<2	<0.5	<0.5	<0.5	<0.5
Nickel (Ni) (tot.unfilt)	33	16	7.5	-	-	-	<2	2.2	<0.5	-	-
Lead (Pb) (diss.filt)	<5	<0.09	3.70	<0.09	1.9	0.13	<5	<0.09	<0.09	<0.09	<0.09
Lead (Pb) (tot.unfilt)	27	16	44	-	-	-	6	7.4	0.17	-	-
Selenium (Se) (diss.filt)	<3	0.41	1.1	0.25	2.4	0.97	<3	<0.25	0.64	0.37	0.54
Selenium (Se) (tot.unfilt)	<3	0.59	1.9	-	-	-	<3	0.3	0.64	-	-
Zinc (Zn) (diss.filt)	<3	9.6	6.3	13	14	1.8	<3	16	<1.3	<1.3	14
Zinc (Zn) (tot.unfilt)	76	38	50	-	-	-	15	26	1.8	-	-
Potassium (K) (diss.filt)	10.9	-	-	-	-	-	2.5	-	-	-	-
Potassium (K) (tot.unfilt)	16.1	-	-	-	-	-	3.6	-	-	-	-
Inorganics											
Ammoniacal Nitrogen as N	0.09	0.09	<0.08	0.14	**0.28**	**0.19**	<0.03	<0.08	<0.08	<0.08	<0.08
Biochemical Oxygen Demand (BOD) Settled.	<1	-	<2	-	-	-	<1	-	<2	-	-
Dissolved solids, Total	512	-	566	-	-	-	442	-	591	-	-
Nitrite as NO2	0.04	<0.2	<0.20	<0.20	**0.59**	<0.20	<0.02	<0.2	<0.20	<0.20	<0.20
Nitrate as NO3	11.6	13.0	13.0	14.0	14.0	15.0	20.9	22	24	23	21
Phosphate (ortho) as PO4	5.71	5	3	3	2.4	4	0.29	<1	<1	<1	<1
Total Organic Carbon (TOC)	<2	-	-	-	-	-	<2	-	-	-	-
Nutrients & Indicators											
Sulphate as SO4	32.1	-	35.0	-	-	-	22.6	-	20.0	-	-
Chloride	30.6	-	31.0	-	-	-	25.7	-	27.0	-	-
Fluoride	<0.3	-	<0.10	-	-	-	<0.3	-	<0.10	-	-
Chemical Oxygen Demand (COD)	-	-	14	-	-	-	-	-	<4	-	-
Total Petroleum Hydrocarbon - Criteria Working Group (TPH-CWG)											
Aliphatics											
>C5-C6	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1
>C6-C8	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1
>C8-C10	<10	<0.1	<0.1	<0.1	3.6	<0.1	<10	<0.1	<0.1	<0.1	0.6
>C10-C12	<5	<1.0	<1.0	<1.0	< 1.0	<1.0	<5	<1.0	<1.0	<1.0	< 1.0
>C12-C16	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
>C16-C21	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
>C21-C35	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
Total aliphatics C5-35	<10	<10	<10	<10	< 10	<10	<10	<10	<10	<10	< 10
Aromatics											
>C5-EC7	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1
>EC7-EC8	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1
>EC8-EC10	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1
>EC10-EC12	<5	<1.0	<1.0	<1.0	< 1.0	<1.0	<5	<1.0	<1.0	<1.0	< 1.0
>EC12-EC16	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
>EC16-EC21	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
>EC21-EC35	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
Total aromatics C5-35	<10	<10	<10	<10	< 10	<10	<10	<10	<10	<10	< 10
Total aliphatics and aromatics C5-35	<10	<10	<10	<10	< 10	<10	<10	<10	<10	<10	< 10
Polycyclic Aromatic Hydrocarbons (PAHs)											
2-Chloronaphthalene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
2-Methylnaphthalene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
1-Methylnaphthalene	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Naphthalene	<1	<0.05	-	<0.05	< 0.05	< 0.05	<1	<0.05	-	<0.05	< 0.05
Acenaphthylene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Acenaphthene	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01
Fluorene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Phenanthrene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Anthracene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Fluoranthene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Pyrene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Benzo(a)anthracene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Chrysene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Benzo(bK)fluoranthene	<1	-	-	-	-	-	<1	-	-	-	-
Benzo(b)fluoranthene	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01
Benzo(k)fluoranthene	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01
Benzo(a)pyrene	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01
Indeno(123cd)pyrene	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01
Dibenzo(ah)anthracene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Benzo(ghi)perylene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
PAH Total	-	-	-	<0.20	< 0.20	< 0.20	-	-	-	<0.20	< 0.20
Semi-Volatile Organic Compounds (SVOCs)											
Speciated Phenols (MS - SVOC)											
2-Chlorophenol	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
2-Methylphenol	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
2-Nitrophenol	<0.5	-	-	-	-	-	<0.5	-	-	-	-
2,4-Dichlorophenol	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
2,4-Dimethylphenol	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
2,4,5-Trichlorophenol	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
2,4,6-Trichlorophenol	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
4-Chloro-3-methylphenol	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
4-Methylphenol	<10	-	<1.0	-	-	-	<10	-	<1.0	-	-
4-Nitrophenol	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Pentachlorophenol	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Phenol	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
2,3,4,6-Tetrachlorophenol			<1.0						<1.0		
2,3,5,6-Tetrachlorophenol			<1.0						<1.0		
Phtalates											
Bis(2-ethylhexyl) phthalate	<5	-	<1.0	-	-	-	<5	-	<1.0	-	-
Butylbenzyl phthalate	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Di-n-butyl phthalate	<1.5	-	-	-	-	-	<1.5	-	-	-	-
Di-n-Octyl phthalate	<1	-	-	-	-	-	<1	-	-	-	-
Diethyl phthalate	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Dimethyl phthalate	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Other SVOCs											
1,2-Dichlorobenzene	<1	-	-	-	-	-	<1	-	-	-	-
1,2,4-Trichlorobenzene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
1,3-Dichlorobenzene	<1	-	-	-	-	-	<1	-	-	-	-
1,4-Dichlorobenzene	<1	-	-	-	-	-	<1	-	-	-	-
2-Nitroaniline	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
2,4-Dinitrotoluene	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
2,6-Dinitrotoluene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
3-Nitroaniline	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
4-Bromophenylphenylether	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
4-Chloroaniline	<1	-	-	-	-	-	<1	-	-	-	-
4-Chlorophenylphenylether	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
4-Nitroaniline	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
Azobenzene	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
Bis(2-chloroethoxy)methane	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
Bis(2-chloroethyl)ether	<1	-	-	-	-	-	<1	-	-	-	-
Carbazole	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
Dibenzofuran	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
Hexachlorobenzene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Hexachlorobutadiene	<1	-	-	-	-	-	<1	-	-	-	-
Hexachlorocyclopentadiene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Hexachloroethane	<1	-	-	-	-	-	<1	-	-	-	-
Isophorone	<0.5	-	-	-	-	-	<0.5	-	-	-	-
N-nitrosodi-n-propylamine	<0.5	-	-	-	-	-	<0.5	-	-	-	-
Nitrobenzene	<1	-	-	-	-	-	<1	-	-	-	-
Surrogate Recovery 2-Fluorobiphenyl	123	-	-	-	-	-	112	-	-	-	-
Surrogate Recovery p-Terphenyl-d14	124	-	-	-	-	-	123	-	-	-	-
Bis(2-chloroisopropyl)ether	-	-	<1.0	-	-	-	-	-	<1.0	-	-
1,2-Dinitrotoluene	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Diphenylamine	-	-	<1.0	-	-	-	-	-	<1.0	-	-

Sample Identity	MW7						BHA					
Laboratory Report No.	Exova 18/513	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297
Sample Date	16/01/2018	07/03/2019	05/06/2019	27/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020
Parameters												
Field Measured Parameters												
pH	6.90	7.30	6.80	6.90	7.20	7.30	7.04	7.00	6.90	7.00	7.10	7.10
Electrical Conductivity	492	420.00	730.00	650.00	650.00	590.00	457.15	410.00	720.00	690.00	610.00	520.00
Dissolved Oxygen (%)	30.76	33.90	21.00	23.00	35.00	60.00	26.69	48.90	37.00	47.00	23.00	53.40
Dissolved Oxygen (mg/l)	8.37	-	-	-	-	-	2.91	-	-	-	-	-
Temperature	10.25	10.00	12.00	15.00	10.00	9.00	10.55	11.00	12.00	14.00	12.00	10.00
Oxidation Reduction Potential	186.60	95.00	60.00	114.00	118.00	122.00	82.4	95.70	133.00	163.00	48.00	121.00
Colour	Dark grey	-	-	-	-	-	Light brown	-	-	-	-	-
Odour	-	-	-	-	-	-	-	-	-	-	-	-
Other observations	Lot of S.S / NEC	-	-	-	-	-	S.S / NEC	-	-	-	-	-
Metals (dissolved and total)												
Arsenic (As) (diss. Filt)	<2.5	2.4	**8.5**	4.3	2	2.3	5.5	2.4	2.5	2.2	< 0.03	2.9
Arsenic (As) (tot. unfilt)	31.3	4.5	8.64	-	-	-	12.5	4.18	2.92	-	-	-
Barium (B) (diss.filt)	76	-	-	-	-	-	10	-	-	-	-	-
Barium (B) (tot.unfilt)	477	-	-	-	-	-	86	-	-	-	-	-
Boron (B) (diss.filt)	-	36	290	57	39	25	-	32	24	46	< 0.25	28
Boron (B) (tot.unfilt)	-	37	570	-	-	-	-	33	690	-	-	-
Cadmium (Cd) (diss.filt)	<0.5	<0.03	0.05	0.06	<0.03	0.04	<0.5	<0.03	<0.03	<0.03	< 0.4	< 0.03
Cadmium (Cd) (tot. unfilt)	<0.5	0.12	0.14	-	-	-	2.00	0.09	0.03	-	-	-
Chromium (Cr) (diss.filt)	-	1.4	0.83	0.83	1.5	1.5	-	0.52	<0.25	<0.25	< 0.09	1
Chromium (Cr) (tot. unfilt)	-	2.8	0.83	-	-	-	-	3.3	1.3	-	-	-
Hexavalent Chromium	-	-	<0.007	-	-	-	-	-	<0.007	-	-	-
Copper (Cu) (diss.filt)	<7	1.9	2.1	1.8	1.9	3.6	<7	0.8	0.9	<0.4	< 0.01	1.4
Copper (Cu) (tot.unfilt)	97	7.9	5.5	-	-	-	62	9.3	1.7	-	-	-
Iron (Fe) (diss.filt)	<20	-	-	-	-	-	<20	-	-	-	-	-
Iron (Fe) (tot.unfilt)	45230	-	-	-	-	-	27180	-	-	-	-	-
Magnesium (Mg) (diss.filt)	10.7	-	-	-	-	-	12.7	-	-	-	-	-
Magnesium (Mg) (tot.unfilt)	18.4	-	-	-	-	-	20	-	-	-	-	-
Manganese (Mn) (diss.filt)	186	-	-	-	-	-	<2	-	-	-	-	-
Manganese (Mn) (tot.unfilt)	2114	-	-	-	-	-	1131	-	-	-	-	-
Mercury (Hg) (diss. Filt)	-	0.03	<0.01	<0.01	<0.01	< 0.01	-	0.01	<0.01	<0.01	**0.97**	< 0.01
Mercury (Hg) (tot. unfilt)	-	0.07	<0.01	-	-	-	-	0.05	<0.01	-	-	-
Nickel (Ni) (diss.filt)	<2	0.6	1.7	1	0.5	1.1	<2	0.7	0.7	<0.5	2.1	0.5
Nickel (Ni) (tot.unfilt)	30	2	1.5	-	-	-	27	3.8	0.9	-	-	-
Lead (Pb) (diss.filt)	<5	0.18	0.38	0.2	2.8	5.7	<5	<0.09	0.37	<0.09	< 0.5	0.92
Lead (Pb) (tot.unfilt)	174	15	4.9	-	-	-	116	24	3.1	-	-	-
Selenium (Se) (diss.filt)	<3	1.3	0.41	0.44	0.67	1.5	<3	<0.25	0.69	0.53	2.2	2.5
Selenium (Se) (tot.unfilt)	<3	0.56	0.41	-	-	-	<3	0.94	0.86	-	-	-
Zinc (Zn) (diss.filt)	<3	2.1	4.1	11	15	9.7	<3	11	2.8	<1.3	24	4.7
Zinc (Zn) (tot.unfilt)	203	17	140	-	-	-	159	30	2.8	-	-	-
Potassium (K) (diss.filt)	10.1	-	-	-	-	-	9.9	-	-	-	-	-
Potassium (K) (tot.unfilt)	14.4	-	-	-	-	-	15.1	-	-	-	-	-
Inorganics												
Ammoniacal Nitrogen as N	0.16	<0.08	0.08	0.1	<0.08	<0.08	<0.03	<0.08	<0.08	<0.08	<0.08	<0.08
Biochemical Oxygen Demand (BOD) Settled.	<1	-	<2	-	-	-	<1	-	<2	-	-	-
Dissolved solids, Total	459	-	554	-	-	-	417	-	564	-	-	-
Nitrite as NO2	<0.02	<0.2	<0.20	<0.20	<0.20	<0.20	<0.02	<0.2	<0.20	<0.20	<0.20	<0.20
Nitrate as NO3	9.9	15	3	6	19	20	25.1	26	25	24	24	25
Phosphate (ortho) as PO4	2.34	<1	2	1.61	<1	<1	2.56	<1	2	<1	2.2	2
Total Organic Carbon (TOC)	<2	-	-	-	-	-	<2	-	-	-	-	-
Nutrients & Indicators												
Sulphate as SO4	30.7	-	38.0	-	-	-	23.7	-	25.0	-	-	-
Chloride	27.5	-	27.0	-	-	-	27.8	-	31.0	-	-	-
Fluoride	<0.3	-	<0.10	-	-	-	<0.3	-	<0.10	-	-	-
Chemical Oxygen Demand (COD)	-	-	<4	-	-	-	-	-	<4	-	-	-
Total Petroleum Hydrocarbon - Criteria Working Group (TPH-CWG)												
Aliphatics												
>C5-C6	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1
>C6-C8	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1
>C8-C10	<10	<0.1	<0.1	<0.1	5.6	<0.1	<10	<0.1	<0.1	<0.1	12	< 0.1
>C10-C12	<5	<1.0	<1.0	<1.0	< 1.0	<1.0	<5	<1.0	<1.0	<1.0	< 1.0	< 1.0
>C12-C16	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
>C16-C21	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
>C21-C35	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
Total aliphatics C5-35	<10	<10	<10	<10	< 10	<10	<10	<10	<10	<10	< 10	< 10
Aromatics												
>C5-EC7	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1
>EC7-EC8	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1
>EC8-EC10	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1
>EC10-EC12	<5	<1.0	<1.0	<1.0	< 1.0	<1.0	<5	<1.0	<1.0	<1.0	< 1.0	< 1.0
>EC12-EC16	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
>EC16-EC21	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
>EC21-EC35	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0
Total aromatics C5-35	<10	<10	<10	<10	< 10	<10	<10	<10	<10	<10	< 10	< 10
Total aliphatics and aromatics C5-35	<10	<10	<10	<10	< 10	<10	<10	<10	<10	<10	12	< 10
Polycyclic Aromatic Hydrocarbons (PAHs)												
2-Chloronaphthalene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
2-Methylnaphthalene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
1-Methylnaphthalene	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Naphthalene	<1	<0.05	-	<0.05	< 0.05	< 0.05	<1	<0.05	-	<0.05	< 0.05	< 0.05
Acenaphthylene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Acenaphthene	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01
Fluorene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Phenanthrene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Anthracene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Fluoranthene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Pyrene	<0.5	<0.01	<1.0	0.02	< 0.01	0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Benzo(a)anthracene	<0.5	<0.01	<1.0	0.02	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Chrysene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Benzo(bK)fluoranthene	<1	-	-	-	-	-	<1	-	-	-	-	-
Benzo(b)fluoranthene	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01	< 0.01
Benzo(a)pyrene	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01
Indeno(123cd)pyrene	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01
Dibenzo(ah)anthracene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Benzo(ghi)perylene	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
PAH Total	-	-	-	<0.20	< 0.20	< 0.20	-	-	-	<0.20	< 0.20	< 0.20
Semi-Volatile Organic Compounds (SVOCs)												
Speciated Phenols (MS - SVOC)												
2-Chlorophenol	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
2-Methylphenol	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
2-Nitrophenol	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-
2,4-Dichlorophenol	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
2,4-Dimethylphenol	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
2,4,5-Trichlorophenol	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
2,4,6-Trichlorophenol	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
4-Chloro-3-methylphenol	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
4-Methylphenol	<10	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
4-Nitrophenol	<1	-	<1.0	-	-	-	<10	-	<1.0	-	-	-
Pentachlorophenol	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Phenol	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
2,3,4,6-Tetrachlorophenol			<1.0	-	-				<1.0			
2,3,5,6-Tetrachlorophenol			<1.0	-	-				<1.0			
Phtalates												
Bis(2-ethylhexyl) phthalate	<5	-	<1.0	-	-	-	<5	-	<1.0	-	-	-
Butylbenzyl phthalate	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Di-n-butyl phthalate	<1.5	-	-	-	-	-	<1.5	-	-	-	-	-
Di-n-Octyl phthalate	<1	-	-	-	-	-	<1	-	-	-	-	-
Diethyl phthalate	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Dimethyl phthalate	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Other SVOCs												
1,2-Dichlorobenzene	<1	-	-	-	-	-	<1	-	-	-	-	-
1,2,4-Trichlorobenzene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
1,3-Dichlorobenzene	<1	-	-	-	-	-	<1	-	-	-	-	-
1,4-Dichlorobenzene	<1	-	-	-	-	-	<1	-	-	-	-	-
2-Nitroaniline	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
2,4-Dinitrotoluene	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
2,6-Dinitrotoluene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
3-Nitroaniline	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
4-Bromophenylphenylether	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
4-Chloroaniline	<1	-	-	-	-	-	<1	-	-	-	-	-
4-Chlorophenylphenylether	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
4-Nitroaniline	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
Azobenzene	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
Bis(2-chloroethoxy)methane	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
Bis(2-chloroethyl)ether	<1	-	-	-	-	-	<1	-	-	-	-	-
Carbazole	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
Dibenzofuran	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
Hexachlorobenzene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Hexachlorobutadiene	<1	-	-	-	-	-	<1	-	-	-	-	-
Hexachlorocyclopentadiene	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Hexachloroethane	<1	-	-	-	-	-	<1	-	-	-	-	-
Isophorone	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-
N-nitrosodi-n-propylamine	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-
Nitrobenzene	<1	-	-	-	-	-	<1	-	-	-	-	-
Surrogate Recovery 2-Fluorobiphenyl	113	-	-	-	-	-	116	-	-	-	-	-
Surrogate Recovery p-Terphenyl-d14	126	-	-	-	-	-	122	-	-	-	-	-
Bis(2-chloroisopropyl)ether	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
1,2-Dinitrotoluene	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Diphenylamine	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-

E1620

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 3: Groundwater Analytical Results

Sample Identity			Groundwater Standards	EPA IGV's	Surface Water Standards	BH01					
Laboratory Report No.			Groundwater Regulations 2010 (S.I. No. 9 of 2010) as amended 2012 (SI 149 of 2012) as amended 2016 (S.I. No. 366 of 2016)	Towards Setting Guideline Values for the Protection of Groundwater in Ireland	*Surface Water Regulations 2009 (S.I. No. 272 of 2009) as amended (S.I. No.327 of 2012, S.I. No.386 of 2015 and S.I. No. 77 of 2019)*	Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297
Sample Date						16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020
Parameters	Unit	MDL									
Bis(2-ethylhexyl)ether	ug/l	<2	~	~	~	-	-	<2.0	-	-	-
Di-n-butylphthalate	ug/l	<2	~	2	~	-	-	<2.0	-	-	-
Di-n-octylphthalate	ug/l	<2	~	~	~	-	-	<2.0	-	-	-
1,4-Dinitrobenzene	ug/l	<2	~	~	~	-	-	<2.0	-	-	-
1,3-Dinitrobenzene	ug/l	<2	~	~	~	-	-	<2.0	-	-	-
Aniline	ug/l	<2	~	~	~	-	-	<2.0	-	-	-
Benzyl Alcohol	ug/l	<2	~	~	~	-	-	<2.0	-	-	-
Polychlorinated Biphenyls											
PCB 28 + PCB 31	µg/l	<0.3	~	~	~			<0.3			
PCB 77	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-
PCB 81	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-
PCB 105	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-
PCB 114	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-
PCB 118	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-
PCB 123	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-
PCB 126	µg/l	<0.1	~	~	~	<0.1	-	<0.5	-	-	-
PCB 156	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-
PCB 157	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-
PCB 167	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-
PCB 169	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-
PCB 189	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-
Total 12 PCBs	µg/l	<1.2	~	0.01	~	<1.2	-	<1.0	-	-	-
PCB 28	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-
PCB 52	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-
PCB 101	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-
PCB 118	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-
PCB 118 + PCB 123	µg/l	<0.6	~	~	~			<0.6			
PCB 138	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-
PCB 153	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-
PCB 180	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-
Total 7 PCBs	µg/l	<0.7	~	0.01	~	<0.7	-	<1.0	-	-	-
VOLATILE ORGANIC COMPOUNDS (VOCs)											
Dichlorodifluoromethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
Methyl Tertiary Butyl Ether	µg/l	<0.1	10	30	~	<0.1	<1	<1	<1	<1	< 1
Chloromethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
Vinyl Chloride	µg/l	<0.1	0.375	~	~	<0.1	<1	<1	<1	< 1	< 1
Methylene Chloride	µg/l	<27	~	~	~	-	<27	<27	<27	< 27	< 27
Bromomethane	µg/l	<1	~	~	~	<1	<1	<1	<1	< 1	< 1
Chloroethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
Trichlorofluoromethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
1,1-Dichloroethene	µg/l	<3	~	~	~	<3	-	-	-	-	-
1,1-dichloroethylene	µg/l	<1	~	~	~	-	<1	<1	<1	< 1	< 1
Dichloromethane	µg/l	<5	~	15	20	<5	-	-	-	-	-
trans-1-2-Dichloroethene	µg/l	<3	~	~	~	<3	-	-	-	-	-
Trans-1,2-dichloroethylene	µg/l	<1	~	~	~	-	<1	<1	<1	< 1	< 1
1,1-Dichloroethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
cis-1-2-Dichloroethene	µg/l	<3	~	~	~	<3	-	-	-	-	-
cis-1,2-dichloroethylene	µg/l	<1	~	~	~	-	<1	<1	<1	< 1	< 1
2,2-Dichloropropane	µg/l	<1	~	~	~	<1	<2	<2	<2	< 2	< 2
Bromochloromethane	µg/l	<2	~	~	~	<2	<4	<4	<4	< 4	< 4
Chloroform	µg/l	<2	~	12	2.5	<2	<1	<1	1	< 1	< 1
1,1,1-Trichloroethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
1,1-Dichloropropene	µg/l	<3	~	~	~	<3	<1	<1	2	< 1	< 1
Carbon tetrachloride	µg/l	<2	~	~	12	<2	<1	<1	*4*	< 1	< 1
1,2-Dichloroethane	µg/l	<2	2.25	~	10	<2	<1	<1	<1	< 1	< 1
Benzene	µg/l	<0.5	0.75	~	50	<0.5	<1	<1	<1	< 1	< 1
Trichloroethene	µg/l	<3	7.5	70	10	<3	-	-	-	-	-
Trichloroethylene	µg/l	<1	~	10	~	-	<1	<1	<1	< 1	< 1
1,2-Dichloropropane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
Dibromomethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
Bromodichloromethane	µg/l	<2	~	~	~	<2	<4	<4	<4	< 1	< 1
cis-1-3-Dichloropropene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 4	< 4
Toluene	µg/l	<5	525	10	10	<5	<1	<1	<1	< 1	< 1
trans-1-3-Dichloropropene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
1,1,2-Trichloroethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
Tetrachloroethene	µg/l	<3	7.5	40	~	<3	-	-	-	< 1	< 1
Tetrachloroethylene	µg/l	<1	~	10	~	-	<1	<1	<1	-	-
1,3-Dichloropropane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
Dibromochloromethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
1,2-Dibromoethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
Chlorobenzene	µg/l	<2	~	1	1.5	<2	<1	<1	<1	< 1	< 1
1,1,1,2-Tetrachloroethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
Ethylbenzene	µg/l	<1	~	10	10	<1	<1	<1	<1	< 1	< 1
p/m-Xylene	µg/l	<2	~	10	10	<2	<2	<2	<2	< 2	< 2
o-Xylene	µg/l	<1	~	10	10	<1	<1	<1	<1	< 1	< 1
Styrene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
Bromoform	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
Isopropylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
1,1,2,2-Tetrachloroethane	µg/l	<4	~	~	~	<4	<1	<1	<1	< 1	< 1
Bromobenzene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
1,2,3-Trichloropropane	µg/l	<3	~	~	~	<3	<1	<1	18	< 1	< 1
Propylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
2-Chlorotoluene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
1,3,5-Trimethylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
4-Chlorotoluene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
tert-Butylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
1,2,4-Trimethylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
sec-Butylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
4-Isopropyltoluene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
1,3-Dichlorobenzene	µg/l	<3	~	~	~	<3	<2	<2	<2	< 2	< 2
1,4-Dichlorobenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
n-Butylbenzene	µg/l	<3	~	~	~	<3	<1	1	<1	< 1	< 1
1,2-Dichlorobenzene	µg/l	<3	~	10	~	<3	<1	<1	<1	< 1	< 1
1,2-Dibromo-3-chloropropane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1
1,2,4-Trichlorobenzene	µg/l	<3	~	0.4	0.4	<3	<1	<1	<1	< 1	< 1
Hexachlorobutadiene	µg/l	<3	~	0.1	0.6	<3	<1	<1	<1	< 1	< 1
Naphthalene	µg/l	<2	~	1	130	<2	-	-	-	-	-
1,2,3-Trichlorobenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1
Surrogate Recovery Toluene D8	%	<0	~	~	~	98	-	-	-	-	-
Surrogate Recovery 4-Bromofluorobenzene	%	<0	~	~	~	102	-	-	-	-	-
Microbiological											
Faecal Coliforms	CFU/100ml	0	~	0 Counts/100ml	~	<1	-	>100	-	-	-
Total Coliforms	MPN/100ml	0	~	0 Counts/100ml	~	<1	-	>100	-	-	-

Sample Identity	BH03						MW6				
Laboratory Report No.	Exova 18/513	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/513	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961
Sample Date	16/01/2018	07/03/2019	05/06/2019	27/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019
Parameters											
Bis(2-ethylhexyl)ether	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Di-n-butylphthalate	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Di-n-octylphthalate	-	-	<1.0	-	-	-	-	-	<1.0	-	-
1,4-Dinitrobenzene	-	-	<1.0	-	-	-	-	-	<1.0	-	-
1,3-Dinitrobenzene	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Aniline	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Benzyl Alcohol	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Polychlorinated Biphenyls											
PCB 28 + PCB 31			<0.3						<0.3		
PCB 77	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
PCB 81	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 105	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 114	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
PCB 118	<0.1	-	-	-	-	-	<0.1	-	-	-	-
PCB 123	<0.1	-	-	-	-	-	<0.1	-	-	-	-
PCB 126	<0.1	-	<0.5	-	-	-	<0.1	-	<0.5	-	-
PCB 156	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
PCB 157	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 167	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
PCB 169	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 189	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
Total 12 PCBs	<1.2	-	<1.0	-	-	-	<1.2	-	<1.0	-	-
PCB 28	<0.1	-	-	-	-	-	<0.1	-	-	-	-
PCB 52	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 101	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
PCB 118	<0.1	-	-	-	-	-	<0.1	-	-	-	-
PCB 118 + PCB 123			<0.6						<0.6		
PCB 138	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 153	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 180	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
Total 7 PCBs	<0.7	-	<1.0	-	-	-	<0.7	-	<1.0	-	-
VOLATILE ORGANIC COMPOUNDS (VOCs)											
Dichlorodifluoromethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Methyl Tertiary Butyl Ether	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1
Chloromethane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Vinyl Chloride	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1
Methylene Chloride	-	<27	<27	<27	< 27	< 27	-	<27	<27	<27	< 27
Bromomethane	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1
Chloroethane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Trichlorofluoromethane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,1-Dichloroethene	<3	-	-	-	-	-	<3	-	-	-	-
1,1-dichloroethylene	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1
Dichloromethane	<5	-	-	-	-	-	<5	-	-	-	-
trans-1-2-Dichloroethene	<3	-	-	-	-	-	<3	-	-	-	-
Trans-1,2-dichloroethylene	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1
1,1-Dichloroethane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
cis-1-2-Dichloroethene	<3	-	-	-	-	-	<3	-	-	-	-
cis-1,2-dichloroethylene		<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1
2,2-Dichloropropane	<1	<2	<2	<2	< 2	< 2	<1	<2	<2	<2	< 2
Bromochloromethane	<2	<4	<4	<4	< 4	< 4	<2	<4	<4	<4	< 4
Chloroform	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,1,1-Trichloroethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,1-Dichloropropene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Carbon tetrachloride	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,2-Dichloroethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Benzene	<0.5	<1	<1	<1	< 1	< 1	<0.5	<1	<1	<1	< 1
Trichloroethene	<3	-	-	-	-	-	<3	-	-	-	-
Trichloroethylene	-	<1	<1	<1	< 1	< 1		<1	<1	<1	< 1
1,2-Dichloropropane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Dibromomethane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Bromodichloromethane	<2	<4	<4	<4	< 1	< 1	<2	<4	<4	<4	< 1
cis-1-3-Dichloropropene	<2	<1	<1	<1	< 4	< 4	<2	<1	<1	<1	< 4
Toluene	<5	<1	<1	<1	< 1	< 1	<5	<1	<1	<1	< 1
trans-1-3-Dichloropropene	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,1,2-Trichloroethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Tetrachloroethene	<3	-	-	-	< 1	< 1	<3	-	-	-	< 1
Tetrachloroethylene	-	<1	<1	<1	-	-	-	<1	<1	<1	-
1,3-Dichloropropane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Dibromochloromethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,2-Dibromoethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Chlorobenzene	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,1,1,2-Tetrachloroethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Ethylbenzene	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1
p/m-Xylene	<2	<2	<2	<2	< 2	< 2	<2	<2	<2	<2	< 2
o-Xylene	<1	<1	1	<1	< 1	< 1	<1	<1	<1	<1	< 1
Styrene	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Bromoform	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Isopropylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,1,2,2-Tetrachloroethane	<4	<1	<1	<1	< 1	< 1	<4	<1	<1	<1	< 1
Bromobenzene	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,2,3-Trichloropropane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Propylbenzene	<3	<1	1	<1	< 1	< 1	<3	<1	<1	<1	< 1
2-Chlorotoluene	<3	<1	1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,3,5-Trimethylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
4-Chlorotoluene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
tert-Butylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,2,4-Trimethylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
sec-Butylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
4-Isopropyltoluene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,3-Dichlorobenzene	<3	<2	<2	<2	< 2	< 2	<3	<2	<2	<2	< 2
1,4-Dichlorobenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
n-Butylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,2-Dichlorobenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,2-Dibromo-3-chloropropane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,2,4-Trichlorobenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Hexachlorobutadiene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Naphthalene	<2	-	-	-	-	-	<2	-	-	-	-
1,2,3-Trichlorobenzene	<3	<1	3	<1	< 1	< 1	<3	<1	<1	<1	< 1
Surrogate Recovery Toluene D8	101	-	-	-	-		102	-	-	-	-
Surrogate Recovery 4-Bromofluorobenzene	109	-	-	-	-		111	-	-	-	-
Microbiological											
Faecal Coliforms	<1	-	>100	-	-	-	<1	-	>100	-	-
Total Coliforms	1	-	>100	-	-	-	21.1	-	>100	-	-

Sample Identity	MW7						BHA					
Laboratory Report No.	Exova 18/513	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297
Sample Date	16/01/2018	07/03/2019	05/06/2019	27/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020
Parameters												
Bis(2-ethylhexyl)ether	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Di-n-butylphthalate	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Di-n-octylphthalate	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
1,4-Dinitrobenzene	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
1,3-Dinitrobenzene	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Aniline	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Benzyl Alcohol	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Polychlorinated Biphenyls												
PCB 28 + PCB 31			<0.3						<0.3			
PCB 77	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
PCB 81	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 105	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 114	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
PCB 118	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-
PCB 123	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-
PCB 126	<0.1	-	<0.5	-	-	-	<0.1	-	<0.5	-	-	-
PCB 156	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
PCB 157	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 167	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
PCB 169	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 189	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
Total 12 PCBs	<1.2	-	<1.0	-	-	-	<1.2	-	<1.0	-	-	-
PCB 28	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-
PCB 52	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 101	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
PCB 118	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-
PCB 118 + PCB 123			<0.6						<0.6			
PCB 138	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 153	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 180	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
Total 7 PCBs	<0.7	-	<1.0	-	-	-	<0.7	-	<1.0	-	-	-
VOLATILE ORGANIC COMPOUNDS (VOCs)												
Dichlorodifluoromethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Methyl Tertiary Butyl Ether	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1	< 1
Chloromethane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Vinyl Chloride	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1	< 1
Methylene Chloride	-	<27	<27	<27	< 27	< 27	-	<27	<27	<27	< 27	< 27
Bromomethane	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1
Chloroethane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Trichlorofluoromethane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,1-Dichloroethene	<3	-	-	-	-	-	<3	-	-	-	-	-
1,1-dichloroethylene	-	<1	<1	<1	< 1	< 1		<1	<1	<1	< 1	< 1
Dichloromethane	<5	-	-	-	-	-	-	-	-	-	-	-
trans-1-2-Dichloroethene	<3	-	-	-	-	-	<3	-	-	-	-	-
Trans-1,2-dichloroethylene	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1
1,1-Dichloroethane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
cis-1-2-Dichloroethene	<3	-	-	-	-	-	<3	-	-	-	-	-
cis-1,2-dichloroethylene	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1
2,2-Dichloropropane	<1	<2	<2	<2	< 2	< 2	<1	<2	<2	<2	< 2	< 2
Bromochloromethane	<2	<4	<4	<4	< 4	< 4	<2	<4	<4	<4	< 4	< 4
Chloroform	<2	<1	<1	<1	< 1	< 1	<2	2	1	<1	2	2
1,1,1-Trichloroethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,1-Dichloropropene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Carbon tetrachloride	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,2-Dichloroethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Benzene	<0.5	<1	<1	<1	< 1	< 1	<0.5	<1	<1	<1	< 1	< 1
Trichloroethene	<3	-	-	-	-	-	<3	-	-	-	-	-
Trichloroethylene	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1
1,2-Dichloropropane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Dibromomethane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Bromodichloromethane	<2	<4	<4	<4	< 1	< 1	<2	<4	<4	<4	< 1	< 1
cis-1-3-Dichloropropene	<2	<1	<1	<1	< 4	< 4	<2	<1	<1	<1	< 4	< 4
Toluene	<5	<1	<1	<1	< 1	< 1	<5	<1	<1	<1	< 1	< 1
trans-1-3-Dichloropropene	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,1,2-Trichloroethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Tetrachloroethene	<3	-	-	-	< 1	< 1	<3	-	-	-	< 1	< 1
Tetrachloroethylene	-	<1	<1	<1	-	-	-	<1	<1	<1	-	-
1,3-Dichloropropane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Dibromochloromethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,2-Dibromoethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Chlorobenzene	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,1,1,2-Tetrachloroethane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Ethylbenzene	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1
p/m-Xylene	<2	<2	<2	<2	< 2	< 2	<2	<2	<2	<2	< 2	< 2
o-Xylene	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1
Styrene	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Bromoform	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Isopropylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,1,2,2-Tetrachloroethane	<4	<1	<1	<1	< 1	< 1	<4	<1	<1	<1	< 1	< 1
Bromobenzene	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,2,3-Trichloropropane	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Propylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
2-Chlorotoluene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,3,5-Trimethylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
4-Chlorotoluene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
tert-Butylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,2,4-Trimethylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
sec-Butylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
4-Isopropyltoluene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,3-Dichlorobenzene	<3	<2	<2	<2	< 2	< 2	<3	<2	<2	<2	< 2	< 2
1,4-Dichlorobenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
n-Butylbenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,2-Dichlorobenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,2-Dibromo-3-chloropropane	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,2,4-Trichlorobenzene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Hexachlorobutadiene	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Naphthalene	<2	-	-	-	-	-	<2	-	-	-	-	-
1,2,3-Trichlorobenzene	<3	<1	3	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Surrogate Recovery Toluene D8	100	-	-	-	-	-	100	-	-	-	-	-
Surrogate Recovery 4-Bromofluorobenzene	109	-	-	-	-	-	107	-	-	-	-	-
Microbiological												
Faecal Coliforms	7	-	>100	-	-	-	48	-	>100	-	-	-
Total Coliforms	12	-	>100	-	-	-	1119.9	-	>100	-	-	-

Notes:

Bold denotes value exceeds relevant Groundwater Regulation.

Underlined denotes value exceeds IGV where no groundwater regulation is available.

Italics denotes value exceeds Surface Water EQS (MAC inland surface waters / AA inland surface waters)

~ denotes water quality standard unavailable

E1620

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 3: Groundwater Analytical Results

Sample Identity			Groundwater Standards	EPA IGV's	Surface Water Standards	BHC						BHD						BHE						MW201					
Laboratory Report No.			Groundwater Regulations 2010 (S.I. No. 9 of 2010) as amended 2012 (SI 149 of 2012) as amended 2016 (S.I. No. 366 of 2016)	Towards Setting Guideline Values for the Protection of Groundwater in Ireland	Surface Water Regulations 2009 (S.I. No. 272 of 2009) as amended (S.I. No.327 of 2012, S.I. No.386 of 2015 and S.I. No. 77 of 2019)	Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/516	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/516	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297
Sample Date						16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020
Parameters	**Unit**	**MDL**																											
Field Measured Parameters																													
pH	pH units	♦	~	6.5-9.5	6-9	6.88	7.20	7.00	7.10	7.10	6.94	6.7	7.31	7.20	7.20	7.30	6.95	6.77	7.05	6.90	7.10	6.90	7.10	6.9	6.88	6.90	6.80	7.00	6.80
Electrical Conductivity	µS/cm	♦	800 / 1875	1,000	~	493.93	340.00	710.00	640.00	680.00	670.00	406.8	310.00	560.00	680.00	480.00	350.00	488.99	517.00	710.00	760.00	620.00	540.00	486.92	300.00	680.00	780.00	610.00	230.00
Dissolved Oxygen	%	♦	~	NAC	>80 % - <120%	30.43	28.20	27.00	62.00	25.00	38.60	21.88	28.40	15.00	46.00	2.30	30.70	39.78	40.40	46.00	58.00	25.00	46.40	21.03	32.40	47.00	44.00	31.00	61.00
Dissolved Oxygen	mg/l	♦	~	NAC	~	3.34	-	-	-	-	-	2.55	-	-	-	-	-	4.35	-	-	-	-	-	2.33	-	-	-	-	-
Temperature	°C	♦	~	25	~	10.22	11.00	12.00	15.00	12.00	11.00	10.17	10.00	11.00	15.00	11.00	10.00	10.51	11.00	12.00	14.00	11.00	10.00	10.49	12.00	12.00	14.00	11.00	12.00
Oxidation Reduction Potential	mV	♦	~	~	~	74.3	32.00	22.00	113.00	102.00	101.20	-50.2	-88.00	-99.00	43.00	-43.00	-30	-8.6	58.00	113.00	114.00	99.00	135.00	486.92	-10.00	84.00	220.00	104.00	157.00
Colour	N/A	♦	~	NAC	~	Light brown / cloudy	-	-	-	-	-	Dark Grey	-	-	-	-	-	Orange / Cloudy	-	-	-	-	-	Brown	-	-	-	-	-
Odour	N/A	♦	~	~	~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other observations	N/A	♦	~	~	~	S.S / NEC	-	-	-	-	-	S.S / NEC	-	-	-	-	-	S.S / NEC	-	-	-	-	-	S.S / NEC	-	-	-	-	-
Metals (dissolved and total)																													
Arsenic (As) (diss. Filt)	µg/l	<2.5	7.5	~	25	4.1	1.6	2.3	1.4	< 0.03	3.6	<2.5	7.4	5.6	10	< 0.03	30	<2.5	<0.16	0.28	0.47	< 0.03	1.9	5.1	0.65	0.6	0.67	6.1	0.88
Arsenic (As) (tot. unfilt)	µg/l	<2.5	~	10	~	20.6	5.26	4.78	-	-	-	3.5	31.06	37.32	-	-	-	<2.5	1.83	1.04	-	-	-	5	1.01	0.86	-	-	-
Barium (B) (diss.filt)	µg/l	<3	~	~	~	27	-	-	-	-	-	55	-	-	-	-	-	13	-	-	-	-	-	11	-	-	-	-	-
Barium (B) (tot.unfilt)	µg/l	<3	~	100	~	229	-	-	-	-	-	56	-	-	-	-	-	18	-	-	-	-	-	26	-	-	-	-	-
Boron (B) (diss.filt)	µg/l	<100	~	~	~	-	20	29	98	< 0.25	26	-	23	34	<12	< 0.25	35	-	12	18	260	0.35	14	-	14	16	<12	100	14
Boron (B) (tot.unfilt)	µg/l	<12	~	1000	~	-	24	540	-	-	-	-	28	670	-	-	-	-	12	480	-	-	-	-	20	510	-	-	-
Cadmium (Cd) (diss.filt)	µg/l	<0.5	~	~	0.45	<0.5	0.07	0.08	0.09	< 0.4	0.12	<0.5	<0.03	<0.03	<0.03	0.7	0.05	<0.5	<0.03	<0.03	<0.03	< 0.4	0.06	<0.5	0.32	<0.03	<0.03	2.7	0.06
Cadmium (Cd) (tot. unfilt)	µg/l	<0.5	~	5	~	2.90	0.13	0.12	-	-	-	<0.5	0.09	0.16	-	-	-	<0.5	<0.03	0.09	-	-	-	<0.5	0.28	0.07	-	-	-
Chromium (Cr) (diss.filt)	µg/l	<0.25	37.5	~	32	-	<0.25	<0.025	<0.25	< 0.09	0.58	-	<0.25	<0.25	<0.25	< 0.09	0.72	-	0.31	0.41	8.4	< 0.09	0.85	-	<0.25	<0.25	0.36	29	0.31
Chromium (Cr) (tot. unfilt)	µg/l	<0.25	~	30	~	-	2.8	0.78	-	-	-	-	1.1	0.98	-	-	-	-	1.8	0.9	-	-	-	-	0.81	0.57	-	-	-
Hexavalent Chromium	mg/l	<0.007	0.0075	0.03	0.0034	-	-	<0.007	-	-	-	-	-	<0.007	-	-	-	-	-	<0.007	-	-	-	-	-	<0.007	-	-	-
Copper (Cu) (diss.filt)	µg/l	<7	~	~	5	<7	1.1	1.8	1.4	< 0.01	3	<7	0.5	0.7	<0.4	< 0.01	5.6	<7	0.7	0.7	<0.4	< 0.01	2.9	<7	<0.4	0.50	2.8	27	1.5
Copper (Cu) (tot.unfilt)	µg/l	<7	~	30	~	38	4.7	4.3	-	-	-	<7	1.9	6	-	-	-	<7	2.5	3.1	-	-	-	8	2.2	1.8	-	-	-
Iron (Fe) (diss.filt)	µg/l	<20	~	~	~	<20	-	-	-	-	-	<20	-	-	-	-	-	50	-	-	-	-	-	<20	-	-	-	-	-
Iron (Fe) (tot.unfilt)	µg/l	<20	~	200	~	42880	-	-	-	-	-	379	-	-	-	-	-	2610	-	-	-	-	-	6044	-	-	-	-	-
Magnesium (Mg) (diss.filt)	mg/l	<0.1	~	~	~	19.8	-	-	-	-	-	10.8	-	-	-	-	-	18.6	-	-	-	-	-	22.7	-	-	-	-	-
Magnesium (Mg) (tot.unfilt)	mg/l	<0.1	~	50	~	30.3	-	-	-	-	-	12.8	-	-	-	-	-	23.1	-	-	-	-	-	30.6	-	-	-	-	-
Manganese (Mn) (diss.filt)	µg/l	<2	~	~	~	2	-	-	-	-	-	1482	-	-	-	-	-	<2	-	-	-	-	-	5	-	-	-	-	-
Manganese (Mn) (tot.unfilt)	µg/l	<2	~	50	~	8134	-	-	-	-	-	1482	-	-	-	-	-	55	-	-	-	-	-	160	-	-	-	-	-
Mercury (Hg) (diss. Filt)	µg/l	<0.01	0.75	~	0.07	-	0.02	<0.01	<0.01	0.52	0.01	-	0.02	<0.01	<0.01	< 0.25	< 0.01	-	0.02	<0.01	<0.01	0.4	< 0.01	-	<0.01	<0.01	<0.01	0.16	< 0.01
Mercury (Hg) (tot. unfilt)	µg/l	<0.01	~	1	~	-	0.06	0.01	-	-	-	-	0.03	<0.01	-	-	-	-	0.03	0.01	-	-	-	-	0.02	<0.01	-	-	-
Nickel (Ni) (diss.filt)	µg/l	<2	~	~	34	<2	1.9	1.7	1.5	1.4	1.6	<2	0.6	0.6	<0.5	4.4	1.1	<2	<0.5	0.70	1.7	2.2	0.7	<2	<0.5	0.60	5.5	27	< 0.5
Nickel (Ni) (tot.unfilt)	µg/l	<2	~	20	~	28	5.1	1.8	-	-	-	2	1.7	2	-	-	-	3	2.1	0.7	-	-	-	8	1.1	1.2	-	-	-
Lead (Pb) (diss.filt)	µg/l	<5	7.5	~	14	<5	<0.09	1.50	0.3	1.5	3.5	<5	<0.09	0.18	0.09	0.5	3.4	<5	<0.09	<0.09	0.11	< 0.5	5.7	<5	<0.09	<0.09	<0.09	29	1.5
Lead (Pb) (tot.unfilt)	µg/l	<5	~	10	~	71	8.5	5.5	-	-	-	<5	1.6	8	-	-	-	<5	3.4	4.8	-	-	-	<5	1.9	2.3	-	-	-
Selenium (Se) (diss.filt)	µg/l	<0.3	~	~	~	<3	<0.25	0.52	0.4	<1	2.5	<3	<0.25	<0.25	<0.25	<1	5	<3	<0.25	0.43	<0.25	<1	1.6	<3	<0.25	0.37	0.47	6	0.94
Selenium (Se) (tot.unfilt)	µg/l	<0.3	~	~	~	<3	0.62	0.62	-	-	-	<3	<0.25	<0.25	-	-	-	<3	0.37	0.43	-	-	-	<3	0.73	0.37	-	-	-
Zinc (Zn) (diss.filt)	µg/l	<3	75	~	100	<3	5.9	2.4	<1.3	14	7.3	<3	5	2.2	2.4	<0.50	49	<3	2.5	<1.3	5.8	26	12	<3	5.7	3.4	4.2	26	6.6
Zinc (Zn) (tot.unfilt)	µg/l	<3	~	100	~	129	22	8.6	-	-	-	<3	30	45	-	-	-	5	6.7	4.7	-	-	-	23	8.6	9.8	-	-	-
Potassium (K) (diss.filt)	mg/l	<0.1	~	~	~	10.1	-	-	-	-	-	7.1	-	-	-	-	-	2	-	-	-	-	-	2.6	-	-	-	-	-
Potassium (K) (tot.unfilt)	mg/l	<0.1	~	5	~	17.1	-	-	-	-	-	7.6	-	-	-	-	-	2	-	-	-	-	-	5.2	-	-	-	-	-
Inorganics																													
Ammoniacal Nitrogen as N	mg/l	<0.03	0.065 - 0.175	0.15 (NH4)	0.14 (N)	0.05	<0.08	<0.08	<0.08	<0.08	<0.08	0.4	0.25	<0.08	0.29	<0.08	0.15	<0.03	<0.08	<0.08	0.13	<0.08	<0.08	<0.03	<0.08	<0.08	<0.08	<0.08	<0.08
Biochemical Oxygen Demand (BOD) Settled.	mg/l	<1	~	~	1.5	<1	-	28	-	-	-	<1	-	<2	-	-	-	<1	-	<2	-	-	-	1	-	<2	-	-	-
Dissolved solids, Total	mg/l	<35	~	1000	~	432	-	567	-	-	-	425	-	520	-	-	-	459	-	587	-	-	-	413	-	589	-	-	-
Nitrite as NO2	mg/l	<0.02	0.375	0.1	~	<0.02	<0.2	<0.20	<0.20	<0.20	<0.20	<0.02	<0.2	<0.20	<0.20	<0.20	<0.20	<0.02	<0.2	<0.20	<0.20	<0.20	<0.20	<0.02	<0.2	<0.20	<0.20	<0.20	<0.20
Nitrate as NO3	mg/l	<0.2	37.5	25	~	14.9	13	16	16	14	17	<0.2	1	<0.50	<0.50	<0.50	1	25.1	23	28	28	26	26	21.9	23.0	24.0	23.0	22.0	23.0
Phosphate (ortho) as PO4	mg/l	<0.06	35	0.075	~	1.02	<1	<1	<1	<1	1	<0.06	<1	<1	<1	<1	<1	<0.06	<1	<1	<1	<1	<1	0.17	<1	<1	<1	<1	<1
Total Organic Carbon (TOC)	mg/l	<2	~	NAC	~	<2	-	-	-	-	-	<2	-	-	-	-	-	<2	-	-	-	-	-	<2	-	-	-	-	-
Nutrients & Indicators																													
Sulphate as SO4	mg/l	<0.5	187.5	200	~	25.7	-	29.0	-	-	-	35.4	-	36.0	-	-	-	18.6	-	14.0	-	-	-	24.4	-	20.0	-	-	-
Chloride	mg/l	<0.3	24-187.5	30	~	22.8	-	27.0	-	-	-	24.4	-	25.0	-	-	-	28.7	-	27.0	-	-	-	25.3	-	26.0	-	-	-
Fluoride	mg/l	<0.3	~	1	0.5	<0.3	-	<0.10	-	-	-	<0.3	-	<0.10	-	-	-	<0.3	-	<0.10	-	-	-	<0.3	-	<0.10	-	-	-
Chemical Oxygen Demand (COD)	mg/l	<4	~	~	~	-	-	43	-	-	-	-	-	14	-	-	-	-	-	<4	-	-	-	-	-	<4	-	-	-
Total Petroleum Hydrocarbon - Criteria Working Group (TPH-CWG)																													
Aliphatics																													
>C5-C6	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	2.8	<0.1	<0.1	< 0.1	<0.1
>C6-C8	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	7.4	<0.1	<0.1	< 0.1	< 0.1	<10	3.4	<0.1	<0.1	< 0.1	< 0.1	<10	23	<0.1	<0.1	< 0.1	<0.1
>C8-C10	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	3.3	< 0.1	<10	140	<0.1	<0.1	3.8	< 0.1	<10	95	<0.1	<0.1	2.9	< 0.1	<10	340	<0.1	<0.1	0.5	<0.1
>C10-C12	µg/l	<5	~	~	~	<5	<1.0	<1.0	<1.0	< 1.0	< 1.0	<5	<1.0	<1.0	<1.0	< 1.0	< 1.0	<5	<1.0	<1.0	<1.0	< 1.0	< 1.0	<5	<1.0	<1.0	<1.0	< 1.0	<1.0
>C12-C16	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0
>C16-C21	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0
>C21-C35	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0
Total aliphatics C5-35	µg/l	<10	~	~	~	<10	<10	<10	<10	< 10	< 10	<10	140	<10	<10	< 10	< 10	<10	99	<10	<10	< 10	< 10	<10	370	<10	<10	< 10	<10
Aromatics			~		-																								
>C5-EC7	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	2.2	<0.1	<0.1	< 0.1	<0.1
>EC7-EC8	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	1.8	<0.1	<0.1	< 0.1	< 0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	3.7	<0.1	<0.1	< 0.1	<0.1
>EC8-EC10	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	<0.1	<0.1	<0.1	< 0.1	< 0.1	<10	<0.1	<0.1	<0.1	< 0.1	<0.1
>EC10-EC12	µg/l	<5	~	~	~	<5	<1.0	<1.0	<1.0	< 1.0	< 1.0	<5	<1.0	<1.0	<1.0	< 1.0	< 1.0	<5	<1.0	<1.0	<1.0	< 1.0	< 1.0	<5	<1.0	<1.0	<1.0	< 1.0	<1.0
>EC12-EC16	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0
>EC16-EC21	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0
>EC21-EC35	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	< 1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0
Total aromatics C5-35	µg/l	<10	~	~	~	<10	<10	<10	<10	< 10	< 10	<10	<10	<10	<10	< 10	< 10	<10	<10	<10	<10	< 10	< 10	<10	<10	<10	<10	< 10	<10
Total aliphatics and aromatics C5-35	µg/l	<10	7.5	10	~	<10	<10	<10	<10	< 10	< 10	<10	150	<10	<10	< 10	< 10	<10	99	<10	<10	< 10	< 10	<10	370	<10	<10	< 10	<10
Polycyclic Aromatic Hydrocarbons (PAHs)																													
2-Chloronaphthalene	µg/l	<1	~	0.1	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
2-Methylnaphthalene	µg/l	<1	~	0.1	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
1-Methylnaphthalene	µg/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Naphthalene	µg/l	<1	~	1	130	<1	<0.05	-	<0.05	< 0.05	< 0.05	<1	<0.05	-	<0.05	< 0.05	< 0.05	<1	<0.05	-	<0.05	< 0.05	< 0.05	<1	<0.05	-	<0.05	< 0.05	< 0.05
Acenaphthylene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Acenaphthene	µg/l	<1	~	0.1	~	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01
Fluorene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Phenanthrene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Anthracene	µg/l	<0.5	~	10000	0.1	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	0.01
Fluoranthene	µg/l	<0.5	~	1	0.12	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Pyrene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Chrysene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Benzo(bK)fluoranthene	µg/l	<1	~	0.05 / 0.5	0.017	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-
Benzo(b)fluoranthene	µg/l	<0.01	~	0.05 / 0.5	0.017	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	<0.01	~	0.05 / 0.5	0.017	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	<1	0.0075	0.01	0.27	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	0.02	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01
Indeno(123cd)pyrene	µg/l	<1	~	0.05	~	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01
Dibenzo(ah)anthracene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	<0.5	~	0.05	0.00082	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01
PAH Total	µg/l	<0.2	~	0.1	~	-	-	-	<0.20	< 0.20	< 0.20	-	-	-	<0.20	< 0.20	< 0.20	-	-	-	<0.20	< 0.20	< 0.20	-	-	-	<0.20	< 0.20	< 0.20
Semi-Volatile Organic Compounds (SVOCs)																													
Speciated Phenols (MS - SVOC)																													
2-Chlorophenol	µg/l	<1	~	200	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
2-Methylphenol	µg/l	<0.5	~	0.5	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
2-Nitrophenol	µg/l	<0.5	~	0.5	~	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-
2,4-Dichlorophenol	µg/l	<0.5	~	0.5	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
2,4-Dimethylphenol	µg/l	<1	~	0.5	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
2,4,5-Trichlorophenol	µg/l	<0.5	~	0.5	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
2,4,6-Trichlorophenol	µg/l	<1	~	200	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
4-Chloro-3-methylphenol	µg/l	<0.5	~	0.5	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
4-Methylphenol	µg/l	<1	~	0.5	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
4-Nitrophenol	µg/l	<10	~	0.5	~	<10	-	<1.0	-	-	-	<10	-	<1.0	-	-	-	<10	-	<1.0	-	-	-	<10	-	<1.0	-	-	-
Pentachlorophenol	µg/l	<1	~	2	1	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Phenol	µg/l	<1	~	0.5	46	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
2,3,4,6-Tetrachlorophenol	µg/l	<2	~	0.5	~			<1.0						<1.0						<1.0						<1.0			
2,3,5,6-Tetrachlorophenol	µg/l	<2	~	0.5	~			<1.0						<1.0						<1.0						<1.0			
Phtalates																													
Bis(2-ethylhexyl) phthalate	µg/l	<5	~	5	~	<5	-	<1.0	-	-	-	<5	-	<1.0	-	-	-	<5	-	<1.0	-	-	-	<5	-	<1.0	-	-	-
Butylbenzyl phthalate	µg/l	<1	~	5	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Di-n-butyl phthalate	µg/l	<1.5	~	2	~	<1.5	-	-	-	-	-	<1.5	-	-	-	-	-	<1.5	-	-	-	-	-	<1.5	-	-	-	-	-
Di-n-Octyl phthalate	µg/l	<1	~	5	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-
Diethyl phthalate	µg/l	<1	~	5	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Dimethyl phthalate	µg/l	<1	~	5	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Other SVOCs																													
1,2-Dichlorobenzene	µg/l	<1	~	10	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-
1,2,4-Trichlorobenzene	µg/l	<1	~	0.4	0.4	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
1,3-Dichlorobenzene	µg/l	<1	~	~	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-
1,4-Dichlorobenzene	µg/l	<1	~	~	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-
2-Nitroaniline	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
2,4-Dinitrotoluene	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
2,6-Dinitrotoluene	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
3-Nitroaniline	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
4-Bromophenylphenylether	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
4-Chloroaniline	µg/l	<1	~	~	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-
4-Chlorophenylphenylether	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
4-Nitroaniline	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
Azobenzene	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
Bis(2-chloroethoxy)methane	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
Bis(2-chloroethyl)ether	µg/l	<1	~	~	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-
Carbazole	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
Dibenzofuran	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-
Hexachlorobenzene	µg/l	<1	~	0.03	0.05	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Hexachlorobutadiene	µg/l	<1	~	0.1	0.6	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-
Hexachlorocyclopentadiene	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-
Hexachloroethane	µg/l	<1	~	~	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-
Isophorone	µg/l	0.5	~	~	~	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-
N-nitrosodi-n-propylamine	µg/l	0.5	~	~	~	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-
Nitrobenzene	µg/l	<1	~	10	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-	-
Surrogate Recovery 2-Fluorobiphenyl	%	0	~	~	~	117	-	-	-	-	-	114	-	-	-	-	-	128	-	-	-	-	-	123	-	-	-	-	-
Surrogate Recovery p-Terphenyl-d14	%	0	~	~	~	118	-	-	-	-	-	120	-	-	-	-	-	128	-	-	-	-	-	125	-	-	-	-	-
Bis(2-chloroisopropyl)ether	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
1,2-Dinitrotoluene	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Diphenylamine	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-

E1620

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 3: Groundwater Analytical Results

Sample Identity			**Groundwater Standards**	**EPA IGV's**	**Surface Water Standards**	**BHC**						**BHD**						**BHE**						**MW201**					
Laboratory Report No.						Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/516	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/516	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297
Sample Date																													
Parameters	**Unit**	**MDL**	**Groundwater Regulations 2010 (S.I. No. 9 of 2010) as amended 2012 (SI 149 of 2012) as amended 2016 (S.I. No. 366 of 2016)**	Towards Setting Guideline Values for the Protection of Groundwater in Ireland	*Surface Water Regulations 2009 (S.I. No. 272 of 2009) as amended (S.I. No.327 of 2012, S.I. No.386 of 2015 and S.I. No. 77 of 2019)*	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020
Bis(2-ethylhexyl)ether	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Di-n-butylphthalate	ug/l	<2	~	2	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Di-n-octylphthalate	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
1,4-Dinitrobenzene	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
1,3-Dinitrobenzene	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Aniline	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Benzyl Alcohol	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-
Polychlorinated Biphenyls																													
PCB 28 + PCB 31	µg/l	<0.3	~	~	~			<0.3						<0.3						<0.3						<0.3			
PCB 77	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
PCB 81	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 105	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 114	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
PCB 118	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-
PCB 123	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-
PCB 126	µg/l	<0.1	~	~	~	<0.1	-	<0.5	-	-	-	<0.1	-	<0.5	-	-	-	<0.1	-	<0.5	-	-	-	<0.1	-	<0.5	-	-	-
PCB 156	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
PCB 157	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 167	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
PCB 169	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 189	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
Total 12 PCBs	µg/l	<1.2	~	0.01	~	<1.2	-	<1.0	-	-	-	<1.2	-	<1.0	-	-	-	<1.2	-	<1.0	-	-	-	<1.2	-	<1.0	-	-	-
PCB 28	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-
PCB 52	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 101	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-
PCB 118	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-
PCB 118 + PCB 123	µg/l	<0.6	~	~	~	-	-	<0.6	-	-	-	-	-	<0.6	-	-	-	-	-	<0.6	-	-	-	-	-	<0.6	-	-	-
PCB 138	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 153	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
PCB 180	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-
Total 7 PCBs	µg/l	<0.7	~	0.01	~	<0.7	-	<1.0	-	-	-	<0.7	-	<1.0	-	-	-	<0.7	-	<1.0	-	-	-	<0.7	-	<1.0	-	-	-
VOLATILE ORGANIC COMPOUNDS (VOCs)																													
Dichlorodifluoromethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Methyl Tertiary Butyl Ether	µg/l	<0.1	10	30	~	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1	< 1
Chloromethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Vinyl Chloride	µg/l	<0.1	0.375	~	~	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1	< 1
Methylene Chloride	µg/l	<27	~	~	~	-	<27	<27	<27	< 27	< 27	-	31	<27	<27	< 27	< 27	-	30	<27	<27	< 27	< 27	-	<27	<27	<27	< 27	< 27
Bromomethane	µg/l	<1	~	~	~	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1
Chloroethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Trichlorofluoromethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,1-Dichloroethene	µg/l	<3	~	~	~	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-	-
1,1-dichloroethylene	µg/l	<1	~	~	~	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1
Dichloromethane	µg/l	<5	~	15	20	<5	-	-	-	-	-	<5	-	-	-	-	-	<5	-	-	-	-	-	<5	-	-	-	-	-
trans-1-2-Dichloroethene	µg/l	<3	~	~	~	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-	-
Trans-1,2-dichloroethylene	µg/l	<1	~	~	~	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1
1,1-Dichloroethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
cis-1-2-Dichloroethene	µg/l	<3	~	~	~	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-	-
cis-1,2-dichloroethylene	µg/l	<1	~	~	~	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1
2,2-Dichloropropane	µg/l	<1	~	~	~	<1	<2	<2	<2	< 2	< 2	<1	<2	<2	<2	< 2	< 2	<1	<2	<2	<2	< 2	< 2	<1	<2	<2	<2	< 2	< 2
Bromochloromethane	µg/l	<2	~	~	~	<2	<4	<4	<4	< 4	< 4	<2	<4	<4	<4	< 4	< 4	<2	<4	<4	<4	< 4	< 4	<2	<4	<4	<4	< 4	< 4
Chloroform	µg/l	<2	~	12	2.5	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,1,1-Trichloroethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,1-Dichloropropene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Carbon tetrachloride	µg/l	<2	~	~	12	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,2-Dichloroethane	µg/l	<2	2.25	~	10	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Benzene	µg/l	<0.5	0.75	~	50	<0.5	<1	<1	<1	< 1	< 1	<0.5	<1	<1	<1	< 1	< 1	<0.5	<1	<1	<1	< 1	< 1	<0.5	<1	<1	<1	< 1	< 1
Trichloroethene	µg/l	<3	7.5	70	10	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-	-
Trichloroethylene	µg/l	<1	~	10	~	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1
1,2-Dichloropropane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Dibromomethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Bromodichloromethane	µg/l	<2	~	~	~	<2	<4	<4	<4	< 1	< 1	<2	<4	<4	<4	< 1	< 1	<2	<4	<4	<4	< 1	< 1	<2	<4	<4	<4	< 1	< 1
cis-1-3-Dichloropropene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 4	< 4	<2	<1	<1	<1	< 4	< 4	<2	<1	<1	<1	< 4	< 4	<2	<1	<1	<1	< 4	< 4
Toluene	µg/l	<5	525	10	10	<5	<1	<1	<1	< 1	< 1	<5	<1	<1	<1	< 1	< 1	<5	<1	<1	<1	< 1	< 1	<5	<1	<1	<1	< 1	< 1
trans-1-3-Dichloropropene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,1,2-Trichloroethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Tetrachloroethene	µg/l	<3	7.5	40	~	<3	-	-	-	< 1	< 1	<3	-	-	-	< 1	< 1	<3	-	-	-	< 1	< 1	<3	-	-	-	< 1	< 1
Tetrachloroethylene	µg/l	<1	~	10	~	-	<1	<1	<1	-	-	-	<1	<1	<1	-	-	-	<1	<1	<1	-	-	-	<1	<1	<1	-	-
1,3-Dichloropropane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Dibromochloromethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,2-Dibromoethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Chlorobenzene	µg/l	<2	~	1	1.5	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,1,1,2-Tetrachloroethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Ethylbenzene	µg/l	<1	~	10	10	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1
p/m-Xylene	µg/l	<2	~	10	10	<2	<2	<2	<2	< 2	< 2	<2	<2	<2	<2	< 2	< 2	<2	<2	<2	<2	< 2	< 2	<2	<2	<2	<2	< 2	< 2
o-Xylene	µg/l	<1	~	10	10	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1
Styrene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Bromoform	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
Isopropylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,1,2,2-Tetrachloroethane	µg/l	<4	~	~	~	<4	<1	<1	<1	< 1	< 1	<4	<1	<1	<1	< 1	< 1	<4	<1	<1	<1	< 1	< 1	<4	<1	<1	<1	< 1	< 1
Bromobenzene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,2,3-Trichloropropane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Propylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
2-Chlorotoluene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,3,5-Trimethylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
4-Chlorotoluene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
tert-Butylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,2,4-Trimethylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
sec-Butylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
4-Isopropyltoluene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,3-Dichlorobenzene	µg/l	<3	~	~	~	<3	<2	<2	<2	< 2	< 2	<3	<2	<2	<2	< 2	< 2	<3	<2	<2	<2	< 2	< 2	<3	<2	<2	<2	< 2	< 2
1,4-Dichlorobenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
n-Butylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,2-Dichlorobenzene	µg/l	<3	~	10	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
1,2-Dibromo-3-chloropropane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1
1,2,4-Trichlorobenzene	µg/l	<3	~	0.4	0.4	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<u>*6*</u>	<u>*2*</u>	<1	<1	< 1	< 1
Hexachlorobutadiene	µg/l	<3	~	0.1	0.6	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1
Naphthalene	µg/l	<2	~	1	130	<2	-	-	-	-	-	<2	-	-	-	-	-	<2	-	-	-	-	-	<2	-	-	-	-	-
1,2,3-Trichlorobenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	6	3	<1	<1	2	2
Surrogate Recovery Toluene D8	%	<0	~	~	~	97	-	-	-	-	-	99	-	-	-	-	-	95	-	-	-	-	-	94	-	-	-	-	-
Surrogate Recovery 4-Bromofluorobenzene	%	<0	~	~	~	102	-	-	-	-	-	106	-	-	-	-	-	102	-	-	-	-	-	104	-	-	-	-	-
Microbiological																													
Faecal Coliforms	CFU/100ml	0	~	<u>0 Counts/100ml</u>	~	<u>3</u>	-	<u>>100</u>	-	-	-	<1	-	<u>48</u>	-	-	-	<1	-	<u>>100</u>	-	-	-	<1	-	<u>>100</u>	-	-	-
Total Coliforms	MPN/100ml	0	~	<u>0 Counts/100ml</u>	~	<u>18.9</u>	-	<u>>100</u>	-	-	-	<1	-	<u>60</u>	-	-	-	<1	-	<u>>100</u>	-	-	-	<1	-	<u>>100</u>	-	-	-

Notes:

Bold denotes value exceeds relevant Groundwater Regulation.

<u>Underlined denotes value exceeds IGV where no groundwater regulation is available.</u>

Italics denotes value exceeds Surface Water EQS (MAC inland surface waters / AA inland surface waters)

~ denotes water quality standard unavailable

E1620

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 3: Groundwater Analytical Results

Parameters	Unit	MDL	Groundwater Standards	EPA IGV's	Surface Water Standards	MW202						MW203						MW301				
Laboratory Report No.			Groundwater Regulations 2010 (S.I. No. 9 of 2010) as amended 2012 (SI 149 of 2012) as amended 2016 (S.I. No. 366 of 2016)	Towards Setting Guideline Values for the Protection of Groundwater in Ireland	*Surface Water Regulations 2009 (S.I. No. 272 of 2009) as amended (S.I. No.327 of 2012, S.I. No.386 of 2015 and S.I. No. 77 of 2019)*	Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/513	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961
Sample Date						16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019
Field Measured Parameters																						
pH	pH units	♦	~	6.5-9.5	6-9	6.73	6.93	6.90	7.10	7.00	6.90	7.61	7.17	6.90	7.10	7.30	7.00	6.92	7.10	6.90	7.20	7.00
Electrical Conductivity	µS/cm	♦	800 / 1875	1,000	~	546.43	410.00	640.00	690.00	630.00	640.00	387.34	380.00	630.00	580.00	550.00	630.00	572.56	650.00	800.00	850.00	710.00
Dissolved Oxygen	%	♦	~	NAC	>80 % - <120%	*38.27*	*32.50*	*26.00*	*43.00*	*8.40*	*35.00*	*24.55*	*21.00*	*14.00*	*36.00*	*7.40*	*32.00*	*22.25*	*19.70*	*16.00*	*53.00*	*3.40*
Dissolved Oxygen	mg/l	♦	~	NAC	~	4.28	-	-	-	-	-	2.75	-	-	-	-	-	2.4	-	-	-	-
Temperature	°C	♦	~	25	~	9.55	11.00	12.00	13.00	11.00	12.00	9.03	11.00	12.00	14.00	12.00	10.00	10.96	12.00	12.00	16.00	12.00
Oxidation Reduction Potential	mV	♦	~	~	~	218.5	50.00	83.00	119.00	74.00	121.00	74.1	79.00	25.00	39.00	-11.00	122.00	166.4	86.00	121.00	152.00	113.00
Colour	N/A	♦	~	NAC	~	Brown	-	-	-	-	-	Brown	-	-	-	-	-	Clear	-	-	-	-
Odour	N/A	♦	~	~	~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other observations	N/A	♦	~	~	~	S.S / NEC	-	-	-	-	-	S.S / NEC	-	-	-	-	-	NEC	-	-	-	-
Metals (dissolved and total)																						
Arsenic (As) (diss. Filt)	µg/l	<2.5	7.5	~	25	5.9	0.68	0.55	0.77	0.19	0.67	5.9	2.6	2.7	2.9	2.6	2.7	<2.5	2	1.2	1	1.1
Arsenic (As) (tot. unfilt)	µg/l	<2.5	~	10	~	29.4	3.34	2.13	-	-	-	13.1	3.33	2.74	-	-	-	<2.5	1.48	1.29	-	-
Barium (B) (diss.filt)	µg/l	<3	~	~	~	14	-	-	-	-	-	19	-	-	-	-	-	17	-	-	-	-
Barium (B) (tot.unfilt)	µg/l	<3	~	100	~	133	-	-	-	-	-	148	-	-	-	-	-	15	-	-	-	-
Boron (B) (diss.filt)	µg/l	<100	~	~	~	-	13	15	45	20	15	-	21	37	4400	27	21	-	16	37	210	32
Boron (B) (tot.unfilt)	µg/l	<12	~	1000	~	-	15	720	-	-	-	-	24	660	-	-	-	-	28	680	-	-
Cadmium (Cd) (diss.filt)	µg/l	<0.5	~	~	0.45	<0.5	0.06	<0.03	<0.03	< 0.03	< 0.03	<0.5	<0.03	<0.03	<0.03	< 0.03	< 0.03	<0.5	0.09	0.06	0.06	0.06
Cadmium (Cd) (tot. unfilt)	µg/l	<0.5	~	5	~	6.00	0.28	0.39	-	-	-	1.50	0.08	0.05	-	-	-	<0.5	0.06	0.07	-	-
Chromium (Cr) (diss.filt)	µg/l	<0.25	37.5	~	32	-	0.43	<0.25	1.5	< 0.25	< 0.25	-	0.25	0.5	1.1	< 0.25	0.42	-	<0.25	<0.25	<0.25	<0.25
Chromium (Cr) (tot. unfilt)	µg/l	<0.25	~	30	~	-	5.5	1.5	-	-	-	-	1.4	0.5	-	-	-	-	0.26	0.34	-	-
Hexavalent Chromium	mg/l	<0.007	0.0075	0.03	0.0034	-	-	<0.007	-	-	-	-	-	<0.007	-	-	-	-	-	<0.007	-	-
Copper (Cu) (diss.filt)	µg/l	<7	~	~	5	<7	1.8	0.6	1.4	< 0.4	< 0.4	12	0.6	1	1.8	< 0.4	1	<7	1.5	1.2	0.8	0.7
Copper (Cu) (tot.unfilt)	µg/l	<7	~	30	~	89	20	12	-	-	-	166	3.8	3.4	-	-	-	<7	2.9	1.3	-	-
Iron (Fe) (diss.filt)	µg/l	<20	~	~	~	<20	-	-	-	-	-	<20	-	-	-	-	-	<20	-	-	-	-
Iron (Fe) (tot.unfilt)	µg/l	<20	~	200	~	72830	-	-	-	-	-	18600	-	-	-	-	-	35	-	-	-	-
Magnesium (Mg) (diss.filt)	mg/l	<0.1	~	~	~	24.3	-	-	-	-	-	19.1	-	-	-	-	-	14.2	-	-	-	-
Magnesium (Mg) (tot.unfilt)	mg/l	<0.1	~	50	~	43.6	-	-	-	-	-	27.1	-	-	-	-	-	16.8	-	-	-	-
Manganese (Mn) (diss.filt)	µg/l	<2	~	~	~	5	-	-	-	-	-	43	-	-	-	-	-	1173	-	-	-	-
Manganese (Mn) (tot.unfilt)	µg/l	<2	~	50	~	1334	-	-	-	-	-	1905	-	-	-	-	-	1150	-	-	-	-
Mercury (Hg) (diss. Filt)	µg/l	<0.01	0.75	~	0.07	-	0.02	<0.01	0.02	< 0.01	< 0.01	-	0.01	<0.01	0.01	< 0.01	< 0.01	-	*0.11*	<0.01	<0.01	<0.01
Mercury (Hg) (tot. unfilt)	µg/l	<0.01	~	1	~	-	0.05	<0.01	-	-	-	-	0.02	<0.01	-	-	-	-	<0.01	<0.01	-	-
Nickel (Ni) (diss.filt)	µg/l	<2	~	~	34	<2	0.5	<0.5	<0.5	< 0.5	< 0.5	<2	<0.5	0.70	3.7	< 0.5	0.9	2	1.6	1.2	<0.5	1.2
Nickel (Ni) (tot.unfilt)	µg/l	<2	~	20	~	92	10	1.7	-	-	-	32	1.8	0.9	-	-	-	2	47	1.2	-	-
Lead (Pb) (diss.filt)	µg/l	<5	7.5	~	14	<5	<0.09	<0.09	0.37	< 0.09	< 0.09	<5	<0.09	0.15	0.51	< 0.09	1.3	<5	0.55	0.11	0.18	0.11
Lead (Pb) (tot.unfilt)	µg/l	<5	~	10	~	53	9.2	8.2	-	-	-	26	6.6	6.2	-	-	-	<5	0.64	0.3	-	-
Selenium (Se) (diss.filt)	µg/l	<0.3	~	~	~	<3	1.2	1.2	2.2	1.2	1.6	<3	<0.25	0.81	0.65	0.63	1.1	<3	1.4	0.7	0.6	0.47
Selenium (Se) (tot.unfilt)	µg/l	<0.3	~	~	~	<3	1.9	1.6	-	-	-	<3	0.47	0.81	-	-	-	<3	0.77	0.7	-	-
Zinc (Zn) (diss.filt)	µg/l	<3	75	~	100	<3	3.8	<1.3	7.4	< 1.3	3.5	6	2.4	<1.3	11	5.1	17	<3	8.9	3	3.3	2.5
Zinc (Zn) (tot.unfilt)	µg/l	<3	~	100	~	203	25	14	-	-	-	138	85	22	-	-	-	<3	8.9	3	-	-
Potassium (K) (diss.filt)	mg/l	<0.1	~	~	~	2.5	-	-	-	-	-	6.6	-	-	-	-	-	7	-	-	-	-
Potassium (K) (tot.unfilt)	mg/l	<0.1	~	5	~	10.6	-	-	-	-	-	10.8	-	-	-	-	-	8.1	-	-	-	-
Inorganics																						
Ammoniacal Nitrogen as N	mg/l	<0.03	0.065 - 0.175	0.15 (NH4)	0.14 (N)	<0.03	<0.08	<0.08	<0.08	<0.08	<0.08	<0.03	<0.08	<0.08	0.08	<0.08	<0.08	0.07	<0.08	<0.08	<0.08	<0.08
Biochemical Oxygen Demand (BOD) Settled.	mg/l	<1	~	~	1.5	<1	-	<2	-	-	-	<1	-	<2	-	-	-	<1	-	<2	-	-
Dissolved solids, Total	mg/l	<35	~	1000	~	352	-	598	-	-	-	412	-	500	-	-	-	520	-	637	-	-
Nitrite as NO2	mg/l	<0.02	0.375	0.1	~	<0.02	<0.2	<0.20	<0.20	<0.20	<0.20	<0.02	<0.20	<0.20	<0.20	<0.20	<0.20	<0.02	<0.20	<0.20	<0.20	<0.20
Nitrate as NO3	mg/l	<0.2	37.5	25	~	23.5	22	25	24	25	24	16.4	14	17	15	17	18	12.7	14	19	18	17
Phosphate (ortho) as PO4	mg/l	<0.06	35	0.075	~	0.16	<1	<1	<1	<1	<1	1.83	<1	2	<1	1.3	2	1.31	<1	<1	<1	<1
Total Organic Carbon (TOC)	mg/l	<2	~	NAC	~	<2	-	-	-	-	-	<2	-	-	-	-	-	<2	-	-	-	-
Nutrients & Indicators																						
Sulphate as SO4	mg/l	<0.5	187.5	200	~	24	-	20.0	-	-	-	17.7	-	23.0	-	-	-	32.9	-	33.0	-	-
Chloride	mg/l	<0.3	24-187.5	30	~	25.7	-	27.0	-	-	-	22.3	-	25.0	-	-	-	30.9	-	32.0	-	-
Fluoride	mg/l	<0.3	~	1	0.5	<0.3	-	<0.10	-	-	-	<0.3	-	<0.10	-	-	-	<0.3	-	<0.10	-	-
Chemical Oxygen Demand (COD)	mg/l	<4	~	~	~	-	-	<4	-	-	-	-	-	10	-	-	-	-	-	<4	-	-
Total Petroleum Hydrocarbon - Criteria Working Group (TPH-CWG)																						
Aliphatics																						
>C5-C6	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1
>C6-C8	µg/l	<10	~	~	~	<10	10	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1
>C8-C10	µg/l	<10	~	~	~	<10	240	<0.1	<0.1	3.4	<0.1	<10	<0.1	<0.1	<0.1	2.9	<0.1	<10	<0.1	<0.1	<0.1	3.4
>C10-C12	µg/l	<5	~	~	~	<5	<1.0	<1.0	<1.0	< 1.0	<1.0	<5	<1.0	<1.0	<1.0	< 1.0	<1.0	<5	<1.0	<1.0	<1.0	< 1.0
>C12-C16	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
>C16-C21	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
>C21-C35	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
Total aliphatics C5-35	µg/l	<10	~	~	~	<10	250	<10	<10	< 10	<10	<10	<10	<10	<10	< 10	<10	<10	<10	<10	<10	< 10
Aromatics			~																			
>C5-EC7	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1
>EC7-EC8	µg/l	<10	~	~	~	<10	2.5	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1
>EC8-EC10	µg/l	<10	~	~	~	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1	<0.1	<10	<0.1	<0.1	<0.1	< 0.1
>EC10-EC12	µg/l	<5	~	~	~	<5	<1.0	<1.0	<1.0	< 1.0	<1.0	<5	<1.0	<1.0	<1.0	< 1.0	<1.0	<5	<1.0	<1.0	<1.0	< 1.0
>EC12-EC16	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
>EC16-EC21	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
>EC21-EC35	µg/l	<10	~	~	~	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0	<1.0	<10	<1.0	<1.0	<1.0	< 1.0
Total aromatics C5-35	µg/l	<10	~	~	~	<10	<10	<10	<10	< 10	<10	<10	<10	<10	<10	< 10	<10	<10	<10	<10	<10	< 10
Total aliphatics and aromatics C5-35	µg/l	<10	7.5	10	~	<10	**250**	<10	<10	< 10	<10	<10	<10	<10	<10	< 10	<10	<10	<10	<10	<10	< 10
Polycyclic Aromatic Hydrocarbons (PAHs)																						
2-Chloronaphthalene	µg/l	<1	~	0.1	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
2-Methylnaphthalene	µg/l	<1	~	0.1	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
1-Methylnaphthalene	µg/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Naphthalene	µg/l	<1	~	1	130	<1	<0.05	-	<0.05	< 0.05	< 0.05	<1	<0.05	-	<0.05	< 0.05	< 0.05	<1	<0.05	-	<0.05	< 0.05
Acenaphthylene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Acenaphthene	µg/l	<1	~	0.1	~	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01
Fluorene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Phenanthrene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Anthracene	µg/l	<0.5	~	10000	0.1	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Fluoranthene	µg/l	<0.5	~	1	0.12	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Pyrene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Benzo(a)anthracene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Chrysene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Benzo(bK)fluoranthene	µg/l	<1	~	0.05 / 0.5	0.017	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-
Benzo(b)fluoranthene	µg/l	<0.01	~	0.05 / 0.5	0.017	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01
Benzo(k)fluoranthene	µg/l	<0.01	~	0.05 / 0.5	0.017	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01	< 0.01	-	<0.01	<1.0	<0.01	< 0.01
Benzo(a)pyrene	µg/l	<1	0.0075	0.01	0.27	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01
Indeno(123cd)pyrene	µg/l	<1	~	0.05	~	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01	< 0.01	<1	<0.01	<1.0	<0.01	< 0.01
Dibenzo(ah)anthracene	µg/l	<0.5	~	0.1	~	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
Benzo(ghi)perylene	µg/l	<0.5	~	0.05	0.00082	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01	< 0.01	<0.5	<0.01	<1.0	<0.01	< 0.01
PAH Total	µg/l	<0.2	~	0.1	~	-	-	-	<0.20	< 0.20	< 0.20	-	-	-	<0.20	< 0.20	< 0.20	-	-	-	<0.20	< 0.20
Semi-Volatile Organic Compounds (SVOCs)																						
Speciated Phenols (MS - SVOC)																						
2-Chlorophenol	µg/l	<1	~	200	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
2-Methylphenol	µg/l	<0.5	~	0.5	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
2-Nitrophenol	µg/l	<0.5	~	0.5	~	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-	<0.5	-	-	-	-
2,4-Dichlorophenol	µg/l	<0.5	~	0.5	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
2,4-Dimethylphenol	µg/l	<1	~	0.5	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
2,4,5-Trichlorophenol	µg/l	<0.5	~	0.5	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
2,4,6-Trichlorophenol	µg/l	<1	~	200	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
4-Chloro-3-methylphenol	µg/l	<0.5	~	0.5	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
4-Methylphenol	µg/l	<1	~	0.5	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
4-Nitrophenol	µg/l	<10	~	0.5	~	<10	-	<1.0	-	-	-	<10	-	<1.0	-	-	-	<10	-	<1.0	-	-
Pentachlorophenol	µg/l	<1	~	2	1	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Phenol	µg/l	<1	~	0.5	46	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
2,3,4,6-Tetrachlorophenol	µg/l	<2	~	0.5	~			<1.0						<1.0						<1.0		
2,3,5,6-Tetrachlorophenol	µg/l	<2	~	0.5	~			<1.0						<1.0						<1.0		
Phtalates																						
Bis(2-ethylhexyl) phthalate	µg/l	<5	~	5	~	<5	-	1.1	-	-	-	<5	-	1.1	-	-	-	<5	-	<1.0	-	-
Butylbenzyl phthalate	µg/l	<1	~	5	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Di-n-butyl phthalate	µg/l	<1.5	~	2	~	<1.5	-	-	-	-	-	<1.5	-	-	-	-	-	<1.5	-	-	-	-
Di-n-Octyl phthalate	µg/l	<1	~	5	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-
Diethyl phthalate	µg/l	<1	~	5	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Dimethyl phthalate	µg/l	<1	~	5	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Other SVOCs																						
1,2-Dichlorobenzene	µg/l	<1	~	10	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-
1,2,4-Trichlorobenzene	µg/l	<1	~	0.4	0.4	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
1,3-Dichlorobenzene	µg/l	<1	~	~	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-
1,4-Dichlorobenzene	µg/l	<1	~	~	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-
2-Nitroaniline	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
2,4-Dinitrotoluene	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
2,6-Dinitrotoluene	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
3-Nitroaniline	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
4-Bromophenylphenylether	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
4-Chloroaniline	µg/l	<1	~	~	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-
4-Chlorophenylphenylether	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
4-Nitroaniline	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
Azobenzene	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
Bis(2-chloroethoxy)methane	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
Bis(2-chloroethyl)ether	µg/l	<1	~	~	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-
Carbazole	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
Dibenzofuran	µg/l	<0.5	~	~	~	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-	-	<0.5	-	<1.0	-	-
Hexachlorobenzene	µg/l	<1	~	0.03	0.05	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Hexachlorobutadiene	µg/l	<1	~	0.1	0.6	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-
Hexachlorocyclopentadiene	µg/l	<1	~	~	~	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-	-	<1	-	<1.0	-	-
Hexachloroethane	µg/l	<1	~	~	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-
Isophorone	µg/l	0.5	~	~	~	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-	<0.5	-	-	-	-
N-nitrosodi-n-propylamine	µg/l	0.5	~	~	~	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-	<0.5	-	-	-	-
Nitrobenzene	µg/l	<1	~	10	~	<1	-	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	-
Surrogate Recovery 2-Fluorobiphenyl	%	0	~	~	~	120	-	-	-	-	-	115	-	-	-	-	-	122	-	-	-	-
Surrogate Recovery p-Terphenyl-d14	%	0	~	~	~	120	-	-	-	-	-	115	-	-	-	-	-	125	-	-	-	-
Bis(2-chloroisopropyl)ether	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-
1,2-Dinitrotoluene	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Diphenylamine	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-

E1620

Urban Park and Street
Kilkenny County Council
Kilkenny City

Table 3: Groundwater Analytical Results

		Sample Identity	**Groundwater Standards**	**EPA IGV's**	**Surface Water Standards**	**MW202**						**MW203**						**MW301**				
		Laboratory Report No.	**Groundwater Regulations 2010 (S.I. No. 9 of 2010) as amended 2012 (SI 149 of 2012) as amended 2016 (S.I. No. 366 of 2016)**	Towards Setting Guideline Values for the Protection of Groundwater in Ireland	*Surface Water Regulations 2009 (S.I. No. 272 of 2009) as amended (S.I. No.327 of 2012, S.I. No.386 of 2015 and S.I. No. 77 of 2019)*	Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/587	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961	TE Lab L/20/0297	Exova 18/513	TE Lab L/19/0420i	TE Lab L/19/0969A	TE Lab L/19/1466	TE Lab L/19/1961
		Sample Date																				
Parameters	**Unit**	**MDL**				16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019	18/02/2020	16/01/2018	07/03/2019	05/06/2019	18/09/2019	12/12/2019
Bis(2-ethylhexyl)ether	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Di-n-butylphthalate	ug/l	<2	~	2	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Di-n-octylphthalate	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-
1,4-Dinitrobenzene	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-
1,3-Dinitrobenzene	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Aniline	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Benzyl Alcohol	ug/l	<2	~	~	~	-	-	<1.0	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0	-	-
Polychlorinated Biphenyls																						
PCB 28 + PCB 31	µg/l	<0.3	~	~	~			<0.3						<0.3						<0.3		
PCB 77	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
PCB 81	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 105	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 114	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
PCB 118	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-
PCB 123	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-
PCB 126	µg/l	<0.1	~	~	~	<0.1	-	<0.5	-	-	-	<0.1	-	<0.5	-	-	-	<0.1	-	<0.5	-	-
PCB 156	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
PCB 157	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 167	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
PCB 169	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 189	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
Total 12 PCBs	µg/l	<1.2	~	0.01	~	<1.2	-	<1.0	-	-	-	<1.2	-	<1.0	-	-	-	<1.2	-	<1.0	-	-
PCB 28	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-
PCB 52	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 101	µg/l	<0.1	~	~	~	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-	-	<0.1	-	<0.3	-	-
PCB 118	µg/l	<0.1	~	~	~	<0.1	-	-	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-
PCB 118 + PCB 123	µg/l	<0.6	~	~	~			<0.6						<0.6						<0.6		
PCB 138	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 153	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
PCB 180	µg/l	<0.1	~	~	~	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-	-	<0.1	-	<0.2	-	-
Total 7 PCBs	µg/l	<0.7	~	0.01	~	<0.7	-	<1.0	-	-	-	<0.7	-	<1.0	-	-	-	<0.7	-	<1.0	-	-
VOLATILE ORGANIC COMPOUNDS (VOCs)																						
Dichlorodifluoromethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Methyl Tertiary Butyl Ether	µg/l	<0.1	10	30	~	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1
Chloromethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Vinyl Chloride	µg/l	<0.1	0.375	~	~	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1	< 1	<0.1	<1	<1	<1	< 1
Methylene Chloride	µg/l	<27	~	~	~	-	28	<27	<27	< 27	< 27	-	<27	<27	<27	< 27	< 27	-	<27	<27	<27	< 27
Bromomethane	µg/l	<1	~	~	~	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1
Chloroethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Trichlorofluoromethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,1-Dichloroethene	µg/l	<3	~	~	~	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-
1,1-dichloroethylene	µg/l	<1	~	~	~	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1
Dichloromethane	µg/l	<5	~	15	20	<5	-	-	-	-	-	<5	-	-	-	-	-	<5	-	-	-	-
trans-1-2-Dichloroethene	µg/l	<3	~	~	~	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-
Trans-1,2-dichloroethylene	µg/l	<1	~	~	~	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1
1,1-Dichloroethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
cis-1-2-Dichloroethene	µg/l	<3	~	~	~	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-
cis-1,2-dichloroethylene	µg/l	<1	~	~	~	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1
2,2-Dichloropropane	µg/l	<1	~	~	~	<1	<2	<2	<2	< 2	< 2	<1	<2	<2	<2	< 2	< 2	<1	<2	<2	<2	< 2
Bromochloromethane	µg/l	<2	~	~	~	<2	<4	<4	<4	< 4	< 4	<2	<4	<4	<4	< 4	< 4	<2	<4	<4	<4	< 4
Chloroform	µg/l	<2	~	12	2.5	<2	<1	<1	<1	< 1	< 1	<2	<1	2	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,1,1-Trichloroethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,1-Dichloropropene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Carbon tetrachloride	µg/l	<2	~	~	12	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,2-Dichloroethane	µg/l	<2	2.25	~	10	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Benzene	µg/l	<0.5	0.75	~	50	<0.5	<1	<1	<1	< 1	< 1	<0.5	<1	<1	<1	< 1	< 1	<0.5	<1	<1	<1	< 1
Trichloroethene	µg/l	<3	7.5	70	10	<3	-	-	-	-	-	<3	-	-	-	-	-	<3	-	-	-	-
Trichloroethylene	µg/l	<1	~	10	~	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1	< 1	-	<1	<1	<1	< 1
1,2-Dichloropropane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Dibromomethane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Bromodichloromethane	µg/l	<2	~	~	~	<2	<4	<4	<4	< 1	< 1	<2	<4	<4	<4	< 1	< 1	<2	<4	<4	<4	< 1
cis-1-3-Dichloropropene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 4	< 4	<2	<1	<1	<1	< 4	< 4	<2	<1	<1	<1	< 4
Toluene	µg/l	<5	525	10	10	<5	<1	<1	<1	< 1	< 1	<5	<1	<1	<1	< 1	< 1	<5	<1	<1	<1	< 1
trans-1-3-Dichloropropene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,1,2-Trichloroethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Tetrachloroethene	µg/l	<3	7.5	40	~	<3	-	-	-	< 1	< 1	<3	-	-	-	< 1	< 1	<3	-	-	-	< 1
Tetrachloroethylene	µg/l	<1	~	10	~		<1	<1	<1	-	-	-	<1	<1	<1	-	-	-	<1	<1	<1	-
1,3-Dichloropropane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Dibromochloromethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,2-Dibromoethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Chlorobenzene	µg/l	<2	~	1	1.5	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,1,1,2-Tetrachloroethane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Ethylbenzene	µg/l	<1	~	10	10	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1
p/m-Xylene	µg/l	<2	~	10	10	<2	<2	<2	<2	< 2	< 2	<2	<2	<2	<2	< 2	< 2	<2	<2	<2	<2	< 2
o-Xylene	µg/l	<1	~	10	10	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1	< 1	<1	<1	<1	<1	< 1
Styrene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Bromoform	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
Isopropylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,1,2,2-Tetrachloroethane	µg/l	<4	~	~	~	<4	<1	<1	<1	< 1	< 1	<4	<1	<1	<1	< 1	< 1	<4	<1	<1	<1	< 1
Bromobenzene	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,2,3-Trichloropropane	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Propylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
2-Chlorotoluene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	1	<1	< 1
1,3,5-Trimethylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
4-Chlorotoluene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	1	<1	< 1
tert-Butylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,2,4-Trimethylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
sec-Butylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
4-Isopropyltoluene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,3-Dichlorobenzene	µg/l	<3	~	~	~	<3	<2	<2	<2	< 2	< 2	<3	<2	<2	<2	< 2	< 2	<3	<2	<2	<2	< 2
1,4-Dichlorobenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
n-Butylbenzene	µg/l	<3	~	~	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,2-Dichlorobenzene	µg/l	<3	~	10	~	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
1,2-Dibromo-3-chloropropane	µg/l	<2	~	~	~	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1	< 1	<2	<1	<1	<1	< 1
1,2,4-Trichlorobenzene	µg/l	<3	~	0.4	0.4	*11*	2	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Hexachlorobutadiene	µg/l	<3	~	0.1	0.6	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Naphthalene	µg/l	<2	~	1	130	<2	-	-	-	-	-	<2	-	-	-	-	-	<2	-	-	-	-
1,2,3-Trichlorobenzene	µg/l	<3	~	~	~	11	3	2	<1	1	1	<3	<1	<1	<1	< 1	< 1	<3	<1	<1	<1	< 1
Surrogate Recovery Toluene D8	%	<0	~	~	~	101	-	-	-	-	-	99	-	-	-	-	-	106	-	-	-	-
Surrogate Recovery 4-Bromofluorobenzene	%	<0	~	~	~	106	-	-	-	-	-	106	-	-	-	-	-	110	-	-	-	-
Microbiological																						
Faecal Coliforms	CFU/100ml	0	~	0 Counts/100ml	~	<1	-	>100	-	-	-	4	-	>100	-	-	-	<1	-	66	-	-
Total Coliforms	MPN/100ml	0	~	0 Counts/100ml	~	1	-	>100	-	-	-	10.9	-	>100	-	-	-	<1	-	>100	-	-

Notes:

Bold denotes value exceeds relevant Groundwater Regulation.

Underlined denotes value exceeds IGV where no groundwater regulation is available.

Italics denotes value exceeds Surface Water EQS (MAC inland surface waters / AA inland surface waters)

~ denotes water quality standard unavailable

APPENDICES

APPENDIX A

- TREE PLANTING EXISTING
- TREE PLANTING NEW
- SRHRUB PLANTING NEW
- GRANITE PAVING COLOR - BLACK
- GRANITE PAVING 300 X 100X 100 mm COLOR SILVER AND MID GREY TO TIE IN HORSE BARRACKS LANE
- GRANITE PAVING 600 X 200X 100 mm COLOR SILVER AND MID GREY
- CONCRETE SURFACING WITH EXPOSED AGGREGATE TO TIE IN RIVER GARDENS PARK
- GRANITE COBBLE STONE
- CLIPPED HEDGE PLANTING OF LONICERA PILEATA
- COMPACTED GRAVEL SURFACING
- PLAYGROUND SAFETY SURFACING
- RIVERBANK NATURAL PLANTING - TIE IN EXISTING PLANTING
- PERENNIAL GROUNDCOVER PLANTING MINIMUM 400MM TOPSOIL DEPTH
- GRASS SEEDING WITH BULBS MINIMUM 200MM TOPSOIL DEPTH
- TIMBER FENCE ALONG RIVER NORE
- LINEAR DRAIN
- FILTER DRAIN
- CIRCULAR DRAIN SLOT
- EXISTING LEVELS
- NEW LEVELS
- LIGHTING POLE VEELITE VISTA 6M, BOLLARD LIGHTING FEATURE LIGHTING ESCOFET FUL
- AUTOMATED RETRACTABLE BOLLARDS
- STREET SEATS
- MOVABLE SCULPTURAL SEATS
- BICYCLE STANDS
- PROPOSED PLANNING AREA
  AREA OF THE ABBEY CHOIR EXCLUDED FROM PLANNING

NORTH

1:500 @ A1

MITCHELL + ASSOCIATES

LANDSCAPE ARCHITECTURE URBAN DESIGN

Unit 5, Woodpark, The Rise, Glasnevin, Dublin 9, Ireland t. + 353 1 454 5066 e.info@mitchellassoc.net

PROJECT
KILKENNY ABBEY PARK AND STREET

CLIENT

JOB NO.
LKIL050

DRAWING
LANDSCAPE MASTERPLAN

DRAWING NO.
100

DRAWN BY	CHECKED	DATE
VERONIKA KUNCLOVA	VK	18.05.2020
STATUS:	**SCALE**	**REVISION**
PLANNING	1:500 @ A1	01

NOTES:
All dimensions are in millimeters unless otherwise stated and shall be checked and confirmed by the contractor on site. Any discrepancies shall be immediately reported to the landscape architects. Work to figured dimensions only - Do not scale from drawing. Do Not Scale. Use Figured Dimensions Only. Not for Construction Purposes unless Specifically Marked.

APPENDIX B

DON'T SCALE DIMENSIONS

Health and Safety:

THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, THE SPECIFICATION AND THE SAFETY AND HEALTH PLAN.

THE APPOINTMENT OF THE PROJECT SUPERVISOR DESIGN PROCESS IS THE CLIENT'S RESPONSIBILITY.

TEMPORARY WORKS PROPOSALS AND/OR METHOD STATEMENTS TO BE SUBMITTED TO THE PSDP AND THE PSCS FOR WORKS WHICH INVOLVE PARTICULAR RISKS.

Notes:

1. NO PART OF THIS DRAWING MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR STORED IN ANY RETRIEVAL SYSTEM OF ANY NATURE WITHOUT THE WRITTEN PERMISSION OF MALONE O'REGAN CONSULTING ENGINEERS AS COPYRIGHT HOLDER EXCEPT AS AGREED FOR USE ON THE PROJECT FOR WHICH THE DRAWING WAS ORIGINALLY ISSUED.
2. THE APPOINTMENT OF THE PROJECT SUPERVISOR DESIGN PROCESS IS THE CLIENT'S RESPONSIBILITY.
3. ALL DIMENSIONS IN mm UNLESS NOTED OTHERWISE.
4. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS PRIOR TO COMMENCEMENT OF CONSTRUCTION. DISCREPANCIES SHALL BE REPORTED TO THIS OFFICE IN WRITING.
5. THIS DRAWING TO BE READ IN ACCORDANCE WITH ALL RELEVANT ENGINEERS' DRAWINGS AND SPECIFICATIONS.

LEGEND

PROPOSED PLANNING AREA ($13,658m^2$)

AREA EXCLUDED FROM PLANNING

EXISTING CONCRETE YARD TO BE SAW CUT AND REMOVED FOR SERVICES INSTALLATION ($2682m^2$)

EXISTING CONCRETE YARD TO BE SAW CUT AND REMOVED (FOR TREES) ($350m^2$)

INFILTRATION CORES IN EXISTING R.C. SLAB (650 CORES). REFER TO DRAWING NO. P815 FOR DETAILS ($20.42m^2$)

REFER TO PAVEMENT LAYOUT FOR EXTENT OF NEW CONCRETE SLAB UNDER PAVED AREAS

PRELIMINARY
18.06.2020

Rev.	Description	Date	Drawn	Chkd	Appr

THIS DRAWING TO BE USED FOR PRELIMINARY PURPOSES ONLY

MALONE O'REGAN
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Client KILKENNY COUNTY COUNCIL

Job ABBEY QUARTER URBAN PARK AND STREET

Drawing CONCRETE SLAB REMOVAL

Job No	Drg No	Stage	Revision	Scale
W14017	Sk–01	PL	PP5	A1 1:500 A3 1:1000

DON'T SCALE DIMENSIONS

APPENDIX C

BOREHOLE LOG

MALONE O'REGAN
ENVIRONMENTAL SERVICES Ltd.
Ground Floor - Unit 3
Bracken Business Park
Bracken Road,
Sandyford
Dublin 18, D18 V32Y

Project Number: E1620	**Client:** Kilkenny CoCo
Project Title: Abbey Quarter Urban Park	**Site Location:** Kilkenny

BOREHOLE NO: PH01

Depth (mbgl)	SYMBOL	DESCRIPTION	Elev (mAOD)	COMMENTS	WATER (mbgl)	SAMPLE Depth (mbgl)	SAMPLE PID (ppm)	INSTALLATION DETAILS
0		0.00 - 0.25mgbl: REINFORCED CONCRETE.	0.0 0.0					
		0.25 - 0.45mbgl: MADE GROUND - Grey, fine sandy GRAVEL with fragments of concrete.	-0.3 0.3	Borehole terminated at 0.45mbgl: Refusal on concrete.				
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Drill Date: 30/01/20
Drill Method: Light Percussion
Drilled By: Causeway Geotech Ltd

Logged By: UD
Checked By: TVM

Reference Datum:
Elevation: 0
Easting: 650453
Northing: 656367

Water Strike: N/A
Strike: **Level:**

Revision: **Final**

DISCLAIMER: This log is for environmental purposes only.

BOREHOLE LOG

MALONE O'REGAN
ENVIRONMENTAL SERVICES Ltd.

Ground Floor - Unit 3
Bracken Business Park
Bracken Road,
Sandyford
Dublin 18, D18 V32Y

Project Number: E1620	**Client:** Kilkenny CoCo	**BOREHOLE NO: PH02**
Project Title: Abbey Quarter Urban Park	**Site Location:** Kilkenny	

SUBSURFACE CONDITIONS | **SAMPLE** | **INSTALLATION DETAILS**

Depth (mbgl)	SYMBOL	DESCRIPTION	Elev (mAOD)	COMMENTS	WATER (mbgl)	Sample Depth (mbgl)	PID (ppm)	INSTALLATION DETAILS
0		0.00 - 0.30mgbl: REINFORCED CONCRETE.	0.0 0.0 -0.3					
		0.30 - 1.00mbgl: MADE GROUND - Grey, fine sandy GRAVEL with fragments of brown brick and some stones. One (1 No) piece of plastic C+D waste.	0.3 -1.0					
1		1.00 - 1.40mbgl: MADE GROUND - Grey, fine sandy GRAVEL with pebbles and some stones.	1.0 -1.4					
		1.40 - 2.00mbgl: NATURAL GROUND: Grey, sandy, silty CLAY layer.	1.4					
2				Borehole terminated at 2.00mbgl.				
3								
4								
5								
6								
7								
8								
9								
10								

Drill Date: 30/01/20 **Drill Method:** Light Percussion **Drilled By:** Causeway Geotech Ltd	**Reference Datum:** **Elevation:** 0 **Easting:** 650507 **Northing:** 656370	**Water Strike:** N/A **Strike:** ▽ **Level:** ▼
Logged By: UD **Checked By:** TVM		**Revision:** **Final** **Page:** 1 of 1

BOREHOLE LOG

MALONE O'REGAN
ENVIRONMENTAL SERVICES Ltd.
Ground Floor - Unit 3
Bracken Business Park
Bracken Road,
Sandyford
Dublin 18, D18 V32Y

Project Number: E1620

Client: Kilkenny CoCo

Project Title: Abbey Quarter Urban Park

Site Location: Kilkenny

BOREHOLE NO: PH03

SUBSURFACE CONDITIONS						SAMPLE		INSTALLATION DETAILS
Depth (mbgl)	SYMBOL	DESCRIPTION	Elev (mAOD)	COMMENTS	WATER (mbgl)	Depth (mbgl)	PID (ppm)	
0		0.00 - 0.30mgbl: REINFORCED CONCRETE.	0.0 0.0 -0.3					
		0.30 - 1.00mbgl: MADE GROUND - Damp grey/brown, sandy gravelly CLAY with pebbles.	0.3 -1.0					
1		1.00 - 2.00mbgl: MADE GROUND - Grey sandy GRAVEL with cobbles towards 2mbgl.	1.0	Water strike at 1.00mbgl. Water level rose to 0.70mbgl in ten (10 No) minutes.				
2				Borehole terminated at 2mbgl due to refusal on concrete.				
3								
4								
5								
6								
7								
8								
9								
10								

Drill Date: 30/01/20
Drill Method: Light Percussion
Drilled By: Causeway Geotech Ltd

Logged By: UD
Checked By: TVM

Reference Datum:
Elevation: 0
Easting: 650534
Northing: 656374

Water Strike: 1.00mbgl
Strike: **Level:**

Revision: **Final**

DISCLAIMER: This log is for environmental purposes only.

BOREHOLE LOG

MALONE O'REGAN
ENVIRONMENTAL SERVICES Ltd.
Ground Floor - Unit 3
Bracken Business Park
Bracken Road,
Sandyford
Dublin 18, D18 V32Y

Project Number: E1620	**Client:** Kilkenny CoCo	**BOREHOLE NO: PH04**
Project Title: Abbey Quarter Urban Park	**Site Location:** Kilkenny	

SUBSURFACE CONDITIONS

Depth (mbgl)	SYMBOL	DESCRIPTION	Elev (mAOD)	COMMENTS	WATER (mbgl)	SAMPLE Depth (mbgl)	SAMPLE PID (ppm)	INSTALLATION DETAILS
0		0.00 - 0.23mgbl: REINFORCED CONCRETE.	0.0 0.0 -0.2					
		0.23 - 1.00mbgl: MADE GROUND - Grey/brown, clayey SAND and GRAVEL.	0.2					
1				Borehole terminated at 1.00mbgl due to refusal on concrete.				
2								
3								
4								
5								
6								
7								
8								
9								
10								

Drill Date: 30/01/20 **Drill Method:** Light Percussion **Drilled By:** Causeway Geotech Ltd	**Reference Datum:** **Elevation:** 0	**Water Strike:** N/A **Strike:** ▽ **Level:** ▼
Logged By: UD **Checked By:** TVM	**Easting:** 650532 **Northing:** 656410	**Revision:** Final **Page:** 1 of 1

DISCLAIMER: This log is for environmental purposes only.

BOREHOLE LOG

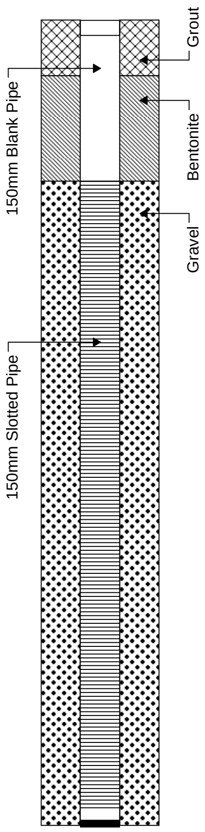
MALONE O'REGAN
ENVIRONMENTAL SERVICES Ltd.
Ground Floor - Unit 3
Bracken Business Park
Bracken Road,
Sandyford
Dublin 18, D18 V32Y

Project Number: E1620	**Client:** Kilkenny CoCo
Project Title: Abbey Quarter Urban Park	**Site Location:** Kilkenny

BOREHOLE NO: PH05

SUBSURFACE CONDITIONS / **SAMPLE** / **INSTALLATION DETAILS**

Depth (mbgl)	SYMBOL	DESCRIPTION	Elev (mAOD)	COMMENTS	WATER (mbgl)	Depth (mbgl)	PID (ppm)
0		0.00 - 0.35mgbl: REINFORCED CONCRETE.	0.0 / 0.0 / -0.3				
		0.35 - 1.00mbgl: MADE GROUND - Brown, sandy GRAVEL with pebbles and occassional cobble. Some polythene C+D waste.	0.3 / -1.0				
1		1.00 - 2.00mbgl: MADE GROUND - Wet, grey, gravelly SAND with pebbles, stones and some cobbles.	1.0 / -2.0				
2		2.00 - 2.30mbgl: MADE GROUND - Wet, grey, gravelly SAND with pebbles, stones, some cobbles and brick fragments.	2.0 / -2.3				
3		2.30 - 3.80mbgl: NATURAL GROUND - Grey, silty CLAY.	2.3 / -3.8	Water strike at 3.30mbgl. Water level rose quickly to 1.50mbgl. Water level rose to 0.38mbgl within six (6No) hours			
4		3.80 - 5.00mbgl: NATURAL GROUND - Gravels with pebbles.	3.8				
5				Borehole terminated at 5.00mbgl.			
6							
7							
8							
9							
10							



Drill Date: 30/01/20 **Drill Method:** Light Percussion **Drilled By:** Causeway Geotech Ltd	**Reference Datum:** **Elevation:** 0	**Water Strike:** 3.3mbgl **Strike:** **Level:**
Logged By: UD **Checked By:** TVM	**Easting:** 650569 **Northing:** 656361	**Revision:** **Final** **Page:** 1 of 1

DISCLAIMER: This log is for environmental purposes only.

APPENDIX D

Unable to survey this area
MH unable to survey, approx. position
LOOK PHOTO
Archeological Trial
Concrete pad
CONCRETE
STONES
Footpath
Wall
Kerb Top
Kerb Bottom
Beam
Ditch covered with concrete grates
STN st1 E 650514.819 N 656375.654 H 44.638
STN st5 E 650469.625 N 656344.263 H 44.844
WS 1
WS 2
WS 3
WS 4
Building

APPENDIX E

Element Materials Technology
Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

P: +44 (0) 1244 833780
F: +44 (0) 1244 833781

W: www.element.com

Malone O'Regan
Ground Floor - Unit 3
Bracken Business Park
Bracken Road
Sandyford
Dublin 18
D18 V4K6

4225

Attention :	Ursula Daly
Date :	13th February, 2020
Your reference :	E1620
Our reference :	Test Report 20/1608 Batch 1
Location :	
Date samples received :	3rd February, 2020
Status :	Final report
Issue :	1

Nine samples were received for analysis on 3rd February, 2020 of which nine were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Bruce Leslie
Project Manager

Please include all sections of this report if it is reproduced

Element Materials Technology

Client Name: Malone O'Regan
Reference: E1620
Location:
Contact: Ursula Daly
EMT Job No: 20/1608

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27				
Sample ID	WS5	WS5	WS5	WS3	WS3	WS2	WS2	WS4	WS1				
Depth	0.35-1.00 mbgl	1.00-2.00 mbgl	2.00-2.30 mbgl	0.30-1.00 mbgl	1.00-2.00 mbgl	0.30-1.00 mbgl	1.00-1.40 mbgl	0.25-1.00 mbgl	0.25-0.45 mbgl				
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T				
Sample Date	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020				
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil				
Batch Number	1	1	1	1	1	1	1	1	1		LOD/LOR	Units	Method No.
Date of Receipt	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020				
Arsenic #	-	-	-	5.7	-	-	-	4.6	3.8		<0.5	mg/kg	TM30/PM15
Cadmium #	-	-	-	0.2	-	-	-	0.2	0.2		<0.1	mg/kg	TM30/PM15
Chromium #	-	-	-	47.2	-	-	-	63.0	56.7		<0.5	mg/kg	TM30/PM15
Copper #	-	-	-	12	-	-	-	14	16		<1	mg/kg	TM30/PM15
Lead #	-	-	-	37	-	-	-	7	9		<5	mg/kg	TM30/PM15
Mercury #	-	-	-	<0.1	-	-	-	<0.1	<0.1		<0.1	mg/kg	TM30/PM15
Nickel #	-	-	-	12.8	-	-	-	17.8	12.9		<0.7	mg/kg	TM30/PM15
Selenium #	-	-	-	<1	-	-	-	<1	<1		<1	mg/kg	TM30/PM15
Zinc #	-	-	-	43	-	-	-	42	35		<5	mg/kg	TM30/PM15
Arsenic	5.7	6.1	9.7	-	5.0	8.3	3.8	-	-		<0.5	mg/kg	TM30/PM62
Cadmium	0.2	0.2	0.3	-	0.2	0.3	0.4	-	-		<0.1	mg/kg	TM30/PM62
Chromium	12.8	9.5	15.8	-	16.0	15.7	16.2	-	-		<0.5	mg/kg	TM30/PM62
Copper	14	11	66	-	13	21	13	-	-		<1	mg/kg	TM30/PM62
Lead	16	12	130	-	24	29	8	-	-		<5	mg/kg	TM30/PM62
Mercury	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	-		<0.1	mg/kg	TM30/PM62
Nickel	17.5	11.4	23.7	-	13.4	22.0	13.5	-	-		<0.7	mg/kg	TM30/PM62
Selenium	<1	<1	<1	-	<1	<1	<1	-	-		<1	mg/kg	TM30/PM62
Zinc	48	37	98	-	51	65	30	-	-		<5	mg/kg	TM30/PM62
PAH MS													
Naphthalene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	<0.03	0.08	<0.03	<0.03	0.06	<0.03	<0.03	<0.03		<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	<0.03	0.08	<0.03	<0.03	0.09	<0.03	<0.03	<0.03		<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	<0.03	0.06	<0.03	<0.03	0.09	<0.03	<0.03	<0.03		<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	<0.06	<0.06	<0.06	<0.06	0.08	<0.06	<0.06	<0.06		<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	<0.02	0.06	<0.02	<0.02	0.06	<0.02	<0.02	<0.02		<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	<0.07	0.09	<0.07	<0.07	0.10	<0.07	<0.07	<0.07		<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	<0.04	<0.04	<0.04	<0.04	0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
PAH 16 Total	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6		<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05	0.06	<0.05	<0.05	0.07	<0.05	<0.05	<0.05		<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02	0.03	<0.02	<0.02	0.03	<0.02	<0.02	<0.02		<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	109	102	96	94	97	109	107	108	96		<0	%	TM4/PM8
Methyl Tertiary Butyl Ether #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/kg	TM15/PM10
Benzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Toluene #	<3	<3	6	<3	<3	<3	<3	<3	8		<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10

Element Materials Technology

Client Name: Malone O'Regan
Reference: E1620
Location:
Contact: Ursula Daly
EMT Job No: 20/1608

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27				
Sample ID	WS5	WS5	WS5	WS3	WS3	WS2	WS2	WS4	WS1				
Depth	0.35-1.00 mbgl	1.00-2.00 mbgl	2.00-2.30 mbgl	0.30-1.00 mbgl	1.00-2.00 mbgl	0.30-1.00 mbgl	1.00-1.40 mbgl	0.25-1.00 mbgl	0.25-0.45 mbgl				
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T				
Sample Date	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020				
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil				
Batch Number	1	1	1	1	1	1	1	1	1		LOD/LOR	Units	Method No.
Date of Receipt	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020				
m/p-Xylene [#]	<5	<5	<5	<5	<5	<5	<5	<5	9		<5	ug/kg	TM15/PM10
o-Xylene [#]	<3	<3	<3	<3	<3	<3	<3	<3	4		<3	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	104	96	86	111	85	116	96	109	113		<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	111	109	71	112	103	91	101	93	113		<0	%	TM15/PM10
TPH CWG													
Aliphatics													
>C5-C6 [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	mg/kg	TM36/PM12
>C6-C8 [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1	<0.1	<0.1	<0.1	0.2	0.3	<0.1	<0.1	0.1		<0.1	mg/kg	TM36/PM12
>C10-C12 [#]	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2	mg/kg	TM5/PM8/PM16
>C12-C16 [#]	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	mg/kg	TM5/PM8/PM16
>C16-C21 [#]	<7	<7	<7	<7	<7	<7	<7	<7	<7		<7	mg/kg	TM5/PM8/PM16
>C21-C35 [#]	<7	<7	16	19	51	<7	<7	<7	<7		<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-35	<19	<19	<19	19	51	<19	<19	<19	<19		<19	mg/kg	TM5/TM36/PM8/PM12/PM16
Aromatics													
>C5-EC7 [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	mg/kg	TM36/PM12
>EC7-EC8 [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	mg/kg	TM36/PM12
>EC8-EC10 [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	mg/kg	TM36/PM12
>EC10-EC12 [#]	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2	mg/kg	TM5/PM8/PM16
>EC12-EC16 [#]	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	mg/kg	TM5/PM8/PM16
>EC16-EC21 [#]	<7	<7	<7	<7	<7	<7	<7	<7	<7		<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 [#]	<7	<7	<7	<7	<7	<7	<7	<7	<7		<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-35 [#]	<19	<19	<19	<19	<19	<19	<19	<19	<19		<19	mg/kg	TM5/TM36/PM8/PM12/PM16
Total aliphatics and aromatics(C5-35)	<38	<38	<38	<38	51	<38	<38	<38	<38		<38	mg/kg	TM5/TM36/PM8/PM12/PM16
PCB 28 [#]	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/kg	TM17/PM8
PCB 52 [#]	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/kg	TM17/PM8
PCB 101 [#]	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/kg	TM17/PM8
PCB 118 [#]	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/kg	TM17/PM8
PCB 138 [#]	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/kg	TM17/PM8
PCB 153 [#]	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/kg	TM17/PM8
PCB 180 [#]	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/kg	TM17/PM8
Total 7 PCBs [#]	<35	<35	<35	<35	<35	<35	<35	<35	<35		<35	ug/kg	TM17/PM8
Natural Moisture Content	6.9	13.0	25.4	10.2	19.4	10.0	8.6	6.5	8.6		<0.1	%	PM4/PM0
Fraction Organic Carbon	NDP	NDP	NDP	0.003	NDP	NDP	NDP	0.002	0.002		<0.001	None	TM21/PM24

Element Materials Technology

Client Name: Malone O'Regan
Reference: E1620
Location:
Contact: Ursula Daly
EMT Job No: 20/1608

Report : **CEN 2:1**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27				
Sample ID	WS5	WS5	WS5	WS3	WS3	WS2	WS2	WS4	WS1				
Depth	0.35-1.00 mbgl	1.00-2.00 mbgl	2.00-2.30 mbgl	0.30-1.00 mbgl	1.00-2.00 mbgl	0.30-1.00 mbgl	1.00-1.40 mbgl	0.25-1.00 mbgl	0.25-0.45 mbgl				
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T				
Sample Date	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020				
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil				
Batch Number	1	1	1	1	1	1	1	1	1		LOD/LOR	Units	Method No.
Date of Receipt	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020				
Dissolved Arsenic	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5		<2.5	ug/l	TM30/PM14
Dissolved Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM30/PM14
Dissolved Chromium	58.3	<1.5	<1.5	27.0	14.6	11.7	14.7	7.5	3.2		<1.5	ug/l	TM30/PM14
Dissolved Copper	44	<7	<7	57	48	35	<7	<7	41		<7	ug/l	TM30/PM14
Dissolved Lead	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM30/PM14
Dissolved Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM30/PM14
Dissolved Nickel	3	<2	<2	4	15	8	3	<2	6		<2	ug/l	TM30/PM14
Dissolved Selenium	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM30/PM14
Dissolved Zinc	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM30/PM14

Client Name: Malone O'Regan
Reference: E1620
Location:
Contact: Ursula Daly
EMT Job No: 20/1608

VOC Report : **Solid**

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27				
Sample ID	WS5	WS5	WS5	WS3	WS3	WS2	WS2	WS4	WS1				
Depth	0.35-1.00 mbgl	1.00-2.00 mbgl	2.00-2.30 mbgl	0.30-1.00 mbgl	1.00-2.00 mbgl	0.30-1.00 mbgl	1.00-1.40 mbgl	0.25-1.00 mbgl	0.25-0.45 mbgl				
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T				
Sample Date	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020	30/01/2020				
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil				
Batch Number	1	1	1	1	1	1	1	1	1				
Date of Receipt	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020	03/02/2020		LOD/LOR	Units	Method No.
VOC MS													
Dichlorodifluoromethane	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/kg	TM15/PM10
Methyl Tertiary Butyl Ether #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/kg	TM15/PM10
Chloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Vinyl Chloride	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/kg	TM15_A/PM10
Bromomethane	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/kg	TM15/PM10
Chloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/kg	TM15/PM10
Trichlorofluoromethane #	<2	<2	<2	<2	5	<2	<2	<2	<2		<2	ug/kg	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<6	<6	<6	<6	<6	<6	<6	<6	<6		<6	ug/kg	TM15/PM10
Dichloromethane (DCM) #	<30	<30	<30	<30	<30	<30	<30	<30	<30		<30	ug/kg	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
2,2-Dichloropropane	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
Bromochloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Chloroform #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
1,1,1-Trichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Carbon tetrachloride #	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
1,2-Dichloroethane #	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
Benzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
1,2-Dichloropropane #	<6	<6	<6	<6	<6	<6	<6	<6	<6		<6	ug/kg	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Bromodichloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
cis-1-3-Dichloropropene	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
Toluene #	<3	<3	6	<3	<3	<3	<3	<3	8		<3	ug/kg	TM15/PM10
trans-1-3-Dichloropropene	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
1,1,2-Trichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
1,3-Dichloropropane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Dibromochloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
1,2-Dibromoethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Chlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
1,1,1,2-Tetrachloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
m/p-Xylene #	<5	<5	<5	<5	<5	<5	<5	<5	9		<5	ug/kg	TM15/PM10
o-Xylene #	<3	<3	<3	<3	<3	<3	<3	<3	4		<3	ug/kg	TM15/PM10
Styrene	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15_A/PM10
Bromoform	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
1,1,2,2-Tetrachloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
Bromobenzene	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/kg	TM15/PM10
1,2,3-Trichloropropane #	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
Propylbenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
2-Chlorotoluene	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
4-Chlorotoluene	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/kg	TM15/PM10
tert-Butylbenzene #	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/kg	TM15/PM10
1,2,4-Trimethylbenzene #	<6	<6	<6	<6	<6	<6	<6	<6	8		<6	ug/kg	TM15/PM10
sec-Butylbenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
4-Isopropyltoluene #	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
1,3-Dichlorobenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
1,4-Dichlorobenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
n-Butylbenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
1,2-Dichlorobenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
1,2-Dibromo-3-chloropropane #	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
1,2,4-Trichlorobenzene #	<7	<7	<7	<7	<7	<7	<7	<7	<7		<7	ug/kg	TM15/PM10
Hexachlorobutadiene	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/kg	TM15/PM10
Naphthalene	<27	<27	<27	<27	<27	<27	<27	<27	<27		<27	ug/kg	TM15/PM10
1,2,3-Trichlorobenzene #	<7	<7	<7	<7	<7	<7	<7	<7	<7		<7	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	104	96	86	111	85	116	96	109	113		<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	111	109	71	112	103	91	101	93	113		<0	%	TM15/PM10

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Malone O'Regan
Reference: E1620
Location:
Contact: Ursula Daly

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Date Of Analysis	Analysis	Result
20/1608	1	WS5	0.35-1.00 mbgl	2	05/02/2020	**General Description (Bulk Analysis)**	soil.stones
					05/02/2020	**Asbestos Fibres**	Fibre Bundles
					05/02/2020	**Asbestos ACM**	NAD
					05/02/2020	**Asbestos Type**	Crocidolite
					05/02/2020	**Asbestos Level Screen**	less than 0.1%
					06/02/2020	**Total ACM Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Detailed Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Gravimetric Quantification (ACM + Detailed) (% Asb)**	<0.001 (mass %)
20/1608	1	WS5	1.00-2.00 mbgl	5	05/02/2020	**General Description (Bulk Analysis)**	soil.stones
					05/02/2020	**Asbestos Fibres**	Fibre Bundles
					05/02/2020	**Asbestos ACM**	NAD
					05/02/2020	**Asbestos Type**	Chrysotile
					05/02/2020	**Asbestos Level Screen**	less than 0.1%
					06/02/2020	**Total ACM Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Detailed Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Gravimetric Quantification (ACM + Detailed) (% Asb)**	<0.001 (mass %)
20/1608	1	WS5	2.00-2.30 mbgl	8	05/02/2020	**General Description (Bulk Analysis)**	soil-stones
					05/02/2020	**Asbestos Fibres**	Fibre Bundles
					05/02/2020	**Asbestos ACM**	NAD
					05/02/2020	**Asbestos Type**	Chrysotile
					05/02/2020	**Asbestos Level Screen**	less than 0.1%
					06/02/2020	**Total ACM Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Detailed Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Gravimetric Quantification (ACM + Detailed) (% Asb)**	<0.001 (mass %)
20/1608	1	WS3	0.30-1.00 mbgl	11	05/02/2020	**General Description (Bulk Analysis)**	soil-stones
					05/02/2020	**Asbestos Fibres**	NAD
					05/02/2020	**Asbestos ACM**	NAD
					05/02/2020	**Asbestos Type**	NAD
					05/02/2020	**Asbestos Level Screen**	NAD
20/1608	1	WS3	1.00-2.00 mbgl	14	05/02/2020	**General Description (Bulk Analysis)**	soil-stones
					05/02/2020	**Asbestos Fibres**	Fibre Bundles
					05/02/2020	**Asbestos ACM**	NAD
					05/02/2020	**Asbestos Type**	Chrysotile
					05/02/2020	**Asbestos Level Screen**	less than 0.1%

Client Name: Malone O'Regan
Reference: E1620
Location:
Contact: Ursula Daly

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Date Of Analysis	Analysis	Result
20/1608	1	WS3	1.00-2.00 mbgl	14	06/02/2020	**Total ACM Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Detailed Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Gravimetric Quantification (ACM + Detailed) (% Asb)**	<0.001 (mass %)
20/1608	1	WS2	0.30-1.00 mbgl	17	05/02/2020	**General Description (Bulk Analysis)**	soil/stones
					05/02/2020	**Asbestos Fibres**	Fibre Bundles
					05/02/2020	**Asbestos Fibres (2)**	Fibre Bundles
					05/02/2020	**Asbestos ACM**	NAD
					05/02/2020	**Asbestos ACM (2)**	NAD
					05/02/2020	**Asbestos Type**	Crocidolite
					05/02/2020	**Asbestos Type (2)**	Chrysotile
					05/02/2020	**Asbestos Level Screen**	less than 0.1%
					06/02/2020	**Total ACM Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Detailed Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Gravimetric Quantification (ACM + Detailed) (% Asb)**	<0.001 (mass %)
20/1608	1	WS2	1.00-1.40 mbgl	20	05/02/2020	**General Description (Bulk Analysis)**	soil/stones
					05/02/2020	**Asbestos Fibres**	Fibre Bundles
					05/02/2020	**Asbestos ACM**	NAD
					05/02/2020	**Asbestos Type**	Chrysotile
					05/02/2020	**Asbestos Level Screen**	less than 0.1%
					06/02/2020	**Total ACM Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Detailed Gravimetric Quantification (% Asb)**	<0.001 (mass %)
					06/02/2020	**Total Gravimetric Quantification (ACM + Detailed) (% Asb)**	<0.001 (mass %)
20/1608	1	WS4	0.25-1.00 mbgl	23	05/02/2020	**General Description (Bulk Analysis)**	soil/stones
					05/02/2020	**Asbestos Fibres**	NAD
					05/02/2020	**Asbestos ACM**	NAD
					05/02/2020	**Asbestos Type**	NAD
					05/02/2020	**Asbestos Level Screen**	NAD
20/1608	1	WS1	0.25-0.45 mbgl	26	05/02/2020	**General Description (Bulk Analysis)**	soil/stones
					05/02/2020	**Asbestos Fibres**	NAD
					05/02/2020	**Asbestos ACM**	NAD
					05/02/2020	**Asbestos Type**	NAD
					05/02/2020	**Asbestos Level Screen**	NAD

Element Materials Technology

NDP Reason Report

Client Name: Malone O'Regan
Reference: E1620
Location:
Contact: Ursula Daly

Matrix : Solid

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Method No.	NDP Reason
20/1608	1	WS5	0.35-1.00 mbgl	1-3	TM21/PM24	Asbestos detected in sample
20/1608	1	WS5	1.00-2.00 mbgl	4-6	TM21/PM24	Asbestos detected in sample
20/1608	1	WS5	2.00-2.30 mbgl	7-9	TM21/PM24	Asbestos detected in sample
20/1608	1	WS3	1.00-2.00 mbgl	13-15	TM21/PM24	Asbestos detected in sample
20/1608	1	WS2	0.30-1.00 mbgl	16-18	TM21/PM24	Asbestos detected in sample
20/1608	1	WS2	1.00-1.40 mbgl	19-21	TM21/PM24	Asbestos detected in sample

Client Name: Malone O'Regan
Reference: E1620
Location:
Contact: Ursula Daly

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 20/1608						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 20/1608

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

EMT Job No: 20/1608

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details	Yes		AR	Yes
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM17	Modified US EPA method 8270. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.			AD	Yes

EMT Job No: 20/1608

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.			AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM62	Acid digestion of as received solid samples using Aqua Regia refluxed at 112.5 °C.			AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM131	Quantification of Asbestos Fibres and ACM, based on HSG248 and SCA method.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	Yes
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.			AR	
TM15_A	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds, Vinyl Chloride & Styrene by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes

APPENDIX F

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Cadmium**		
Target concentration	C_T	**0.00008**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.00E+02	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	[redacted]	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	[redacted]	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg	
pH value	pH	[redacted]	pH units	
Acid dissociation constant	pKa	[redacted]		
Fraction of organic carbon (in soil)	foc	[redacted]	fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.00E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**8.02E-03**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00008	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
Version:	E1620

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Arsenic**	
Target concentration	C_T	**0.025**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	5.00E+02	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc		l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**5.00E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.25E+01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.025	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
Version:	E1620

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**1,2,4-Trichlorobenzene**		
Target concentration	C_T	**0.0004**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	[redacted]	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	2.29E+03	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**5.04E+01**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.02E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.0004	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
Version:	E1620

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**1,2,3-Trichlorobenzene**		
Target concentration	C_T	**0.0004**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	2.57E+03	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**5.65E+01**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.27E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.0004	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
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Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Total PCBs**		
Target concentration	C_T	**0.00001**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	5.37E+06	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.18E+05**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.18E+00**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00001	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Aromatic EC21-EC35**		
Target concentration	C_T	**0.00094**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	1.26E+05	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**2.77E+03**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.61E+00**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00094	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Aromatic EC16-EC21**		
Target concentration	C_T	**0.00094**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	1.41E+04	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**3.10E+02**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.92E-01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00094	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Aromatic EC12-EC16**		
Target concentration	C_T	**0.00094**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	[redacted]	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	5.01E+03	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg	
pH value	pH	[redacted]	pH units	
Acid dissociation constant	pKa	[redacted]		
Fraction of organic carbon (in soil)	foc	[redacted]	fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.10E+02**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.04E-01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00094	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Aromatic EC10-EC12**		
Target concentration	C_T	**0.00094**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	2.51E+03	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**5.52E+01**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**5.21E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00094	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Aliphatic C21-C35**		
Target concentration	C_T	**0.00094**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	[redacted]	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	5.75E+08	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.27E+07**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.19E+04**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00094	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Aliphatic C16-C21**		
Target concentration	**C_T**	**0.00094**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	5.75E+08	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.27E+07**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.19E+04**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00094	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Aliphatic C12-16**		
Target concentration	C_T	**0.00094**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	5.01E+06	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.10E+05**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.04E+02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00094	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
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Environment Agency

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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Aliphatic C10-12**	
Target concentration	C_T	**0.00094**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	2.40E+05	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**5.28E+03**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**4.96E+00**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00094	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
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Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Naphthalene**		
Target concentration	C_T	**0.002**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	6.46E+02	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.42E+01**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.88E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.002	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Benzo(ghi)perylene**	
Target concentration	C_T	**0.00005**	**mg/l**

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	4.17E+05	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**9.17E+03**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**4.59E-01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00005	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
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Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Indeno(123cd)pyrene**		
Target concentration	C_T	**0.00005**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	[redacted]	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	8.71E+04	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.92E+03**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**9.58E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00005	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
Version:	E1620

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Fluoranthene**		
Target concentration	C_T	**0.000063**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	1.82E+04	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**4.00E+02**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.52E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.000063	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
Version:	E1620

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Benzo(a)pyrene**		
Target concentration	C_T	**0.00000017**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	[redacted]	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	1.28E+05	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**2.82E+03**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**4.79E-04**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00000017	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Benzo(k)fluoranthene**		
Target concentration	C_T	**0.000017**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	[redacted]	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	1.48E+05	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**3.26E+03**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**5.54E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.000017	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
Version:	E1620

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Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Benzo(b)fluoranthene**		
Target concentration	C_T	**0.000017**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	1.05E+05	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**2.31E+03**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**3.93E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.000017	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
Version:	E1620

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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Anthracene**	
Target concentration	C_T	**0.0001**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	5.62E+03	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.24E+02**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.24E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.0001	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Xylenes**		
Target concentration	C_T	**0.01**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	[redacted]	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	4.27E+02	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg	
pH value	pH	[redacted]	pH units	
Acid dissociation constant	pKa	[redacted]		
Fraction of organic carbon (in soil)	foc	[redacted]	fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**9.39E+00**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**9.59E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.01	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
Version:	E1620

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Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Ethylbenzene**		
Target concentration	C_T	**0.01**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	4.47E+02	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**9.83E+00**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.00E-01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.01	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
Version:	E1620

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Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Toluene**		
Target concentration	C_T	**0.01**	**mg/l**	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	2.04E+02	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**4.49E+00**	**l/kg**	*Calculated value*

Level 1 Remedial Target

Level 1 Remedial Target	**4.68E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.01	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**Benzene**		
Target concentration	C_T	**0.01**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	[redacted]	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	6.76E+01	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.49E+00**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.68E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.01	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		**MTBE**		
Target concentration	C_T	**0.01**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	2.20E-02	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	3.39E+01	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**7.46E-01**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**9.40E-03**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.01	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Mercury**		
Target concentration	C_T	**0.00007**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	5.00E+02	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc		l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**5.00E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**3.50E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00007	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Lead**		
Target concentration	C_T	**0.014**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.00E+03	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	[redacted]	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc		l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.00E+03**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.40E+01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.014	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
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Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Copper**		
Target concentration	C_T	**0.005**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.00E+02	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	[redacted]	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc	[redacted]	l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg	
pH value	pH	[redacted]	pH units	
Acid dissociation constant	pKa	[redacted]		
Fraction of organic carbon (in soil)	foc	[redacted]	fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.00E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**5.01E-01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.005	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
Version:	E1620

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Chromium**	
Target concentration	**C_T**	**0.032**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.50E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.80E+00	g/cm^3	EPA 1999
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.80E+01	l/kg	*Literature Value LQM 2015*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	[redacted]	fraction	Average (ARUP / MOR Data)
Organic carbon partition coefficient	Koc		l/kg	*LQM 2015*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$	[redacted]	l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.80E+01**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**5.82E-01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.032	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Urban Park and Street
Completed by:	UD
Date:	30-Apr-20
Version:	E1620

Appendix 9.1

METHODOLOGY FOR ASSESSMENT OF RISK OF DUST IMPACTS FROM CONSTRUCTION AND DEMOLITION

This methodology is taken from:

Holman *et al* (2014). *IAQM Guidance on the assessment of dust from demolition and construction,* Institute of Air Quality Management, London. www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf.

1 STEP 2A: DEFINE POTENTIAL DUST EMISSION MAGNITUDE

Table 1: Sensitivity of the Area to Dust Soiling Effects on People and Property (IAQM, 2016)

Dust Emission Magnitude:	Demolition: examples of works associated with each emission magnitude	Earthworks: examples of works associated with each emission magnitude	Construction: examples of works associated with each emission magnitude	Trackout: examples of works associated with each emission magnitude
Large	Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level.	Total site area >10,000 m2 , potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes.	Total building volume >100, 000 m^3 on site concrete batching, sandblasting.	>50 HDV (>3.5t) outward movements[1] in any one day[2], potentially dusty surface material (e.g. high clay content), unpaved road length >100 m.
Medium	Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level.	Total site area 2,500 m^2 – 10,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m - 8 m in height, total material moved 20,000 tonnes – 100,000 tonnes.	Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), on site concrete batching.	10-50 HDV (>3.5t) outward movements[1] in any one day[2], moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m.
Small	Total building volume <20,000 m^3 construction material with low potential for dust release (e.g. metal, cladding or timber), demolition activities <10m above ground, demolition during wetter months.	Total site area <2,500 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <20,000 tonnes, earthworks during wetter months.	Total building volume <25,000 m^3 construction material with low potential for dust release (e.g. metal, cladding or timber.)	<10 HDV (>3.5t) outward movements[1] in any one day, surface material with low potential for dust release, unpaved road length <50m

Notes: [1] denotes a vehicle movement is a one way journey i.e. A to B and excludes the return journey. [2] denotes HDV movements during a construction project vary over its lifetime, and the number of movements is the maximum not the average.

2 STEP 2B DEFINE SENSITIVITY OF THE AREA

Table 2: Receptor Sensitivity to dust soiling

Receptor Sensitivity	Indicative examples
High	• Dwellings; • Museums; • Culturally important collections; • Medium and long term car parks; and • Car show rooms.
Medium	• Parks; and • Places of work.
Low	• Playing fields; • Farmland; • Footpaths; • Short term carparks; and • Roads.

Table 3: Receptor Sensitivity to the Health Effects of PM10 Indicative Examples

Receptor Sensitivity	Indicative examples
High	• Dwellings; • Schools; • Hospitals; and • Residential care homes
Medium	• Places of work i.e offices & shops
Low	• Playing fields; • Footpaths; • Parks; and • Shopping Streets.

Table 4: Sensitivity of Receptors to Ecological Effects Indicative Examples

Receptor Sensitivity	Indicative examples
High	• Acid heathland; • Dust sensitive vascular plants; and • Lichens.
Medium	• Site of special Scientific Interest with dust sensitive features.
Low	• Local nature reserve with dust sensitive features.

able 5: Sensitivity of the Area to Dust Soiling Effects on People and Property (IAQM, 2016)

Receptor Sensitivity	Number of Receptors	Distance from the source (m)			
		<20	<50	<100	<350

High	**>100**	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	**>1**	Medium	Low	Low	Low
Low	**<1**	Low	Low	Low	Low

Table 6: Sensitivity of people to the health effects of PM10 (IAQM, 2016)

Receptor Sensitivity	Annual Mean PM_{10} Concentration	No. of Receptors	Distance from Source (m)				
			<20	>50	<100	<200	>350
High	>32 µg/m^3 (>18 µg/m^3 in Scotland)	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m^3 (16-18 µg/m^3 in Scotland)	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m^3 (14-16 µg/m^3 in Scotland)	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m^3 (<14 µg/m^3 in Scotland)	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m^3 (>18 µg/m^3 in Scotland)	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 µg/m^3 (16-18 µg/m^3 in Scotland)	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 µg/m^3 (14-16 µg/m^3 in Scotland)	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 µg/m^3 (<14 µg/m^3 in Scotland)	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	≥1	Low	Low	Low	Low	Low

Table 7: Sensitivity of the Area to Ecological Impacts (IAQM, 2016)

Receptor Sensitivity	Distance from the source (m)	
	<20	<50
High	High	High
Medium	Medium	Low
Low	Low	Low

3 STEP 2C DEFINE THE RISK OF IMPACT – MATRIX FOR EACH CONSTRUCTION ACTIVITY

3.1 Define the Risk of Impacts – Matrix for Each Construction Activity

Table 8: Risk Matrix Impacts - Demolition (IAQM, 2016)

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table 9: Risk Matrix Impacts - Earthworks (IAQM, 2016)

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 10: Risk Matrix Impacts - Construction (IAQM, 2016)

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 11: Risk Matrix Impacts – Track-out (IAQM, 2016)

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

3.2 Risk of Impact from Construction Activity to Human Receptors from Dust Soiling

Table 12: Sensitivity of Human Receptors to Dust Soiling from Demolition

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Demolition
R 1	Low	Large	Medium Risk
R 2	Low	Large	Medium Risk
R 3	Low	Large	Medium Risk
R 4	Low	Large	Medium Risk
R 5	Low	Large	Medium Risk
R 6	Low	Large	Medium Risk
R 7	Low	Large	Medium Risk
R 8	Low	Large	Medium Risk

Table 13: Sensitivity of Human Receptors to Dust Soiling from Earthworks

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Earthworks
R 1	Low	Large	Low Risk
R 2	Low	Large	Low Risk
R 3	Low	Large	Low Risk
R 4	Low	Large	Low Risk
R 5	Low	Large	Low Risk
R 6	Low	Large	Low Risk
R 7	Low	Large	Low Risk
R 8	Low	Large	Low Risk

Table 14: Sensitivity of Human Receptors to Dust Soiling from Construction

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Construction
R 1	Low	Medium	Low Risk
R 2	Low	Medium	Low Risk
R 3	Low	Medium	Low Risk
R 4	Low	Medium	Low Risk
R 5	Low	Medium	Low Risk
R 6	Low	Medium	Low Risk
R 7	Low	Medium	Low Risk
R 8	Low	Medium	Low Risk

Table 15: Sensitivity of Human Receptors to Dust Soiling from Track-out

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Track-out
R 1	Low	Small	Low Risk
R 2	Low	Small	Low Risk
R 3	Low	Small	Low Risk
R 4	Low	Small	Low Risk
R 5	Low	Small	Low Risk
R 6	Low	Small	Low Risk
R 7	Low	Small	Low Risk
R 8	Low	Small	Low Risk

3.3 Risk of Impact from Construction Activity to Human Health from PM_{10}

Table 16: Risk of Impact on Human Health from PM_{10} - Demolition

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Demolition
R 1	Low	Large	Medium Risk
R 2	Low	Large	Medium Risk
R 3	Low	Large	Medium Risk
R 4	Low	Large	Medium Risk

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Demolition
R 5	Low	Large	Medium Risk
R 7	Low	Large	Medium Risk
R 8	Low	Large	Medium Risk

Table 17: Risk of Impact on Human Health from PM_{10} - Earthwork

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Earthworks
R 1	Low	Medium	Low Risk
R 2	Low	Medium	Low Risk
R 3	Low	Medium	Low Risk
R 4	Low	Medium	Low Risk
R 5	Low	Medium	Low Risk
R 7	Low	Medium	Low Risk
R 8	Low	Medium	Low Risk

Table 18: Risk of Impact on Human Health from PM_{10} - Construction

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Construction
R 1	Low	Medium	Low Risk
R 2	Low	Medium	Low Risk
R 3	Low	Medium	Low Risk
R 4	Low	Medium	Low Risk
R 5	Low	Medium	Low Risk
R 7	Low	Medium	Low Risk
R 8	Low	Medium	Low Risk

Table 19: Risk of Impact on Human Health from PM_{10} - Track-out

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Track-out
R 1	Low	Medium	Low Risk
R 2	Low	Medium	Low Risk

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Track-out
R 3	Low	Medium	Low Risk
R 4	Low	Medium	Low Risk
R 5	Low	Medium	Low Risk
R 7	Low	Medium	Low Risk
R 8	Low	Medium	Low Risk

3.4 Risk of Impact from Construction Activity to Ecological Receptors

Table 20: Risk of Impact on Ecological Receptors - Demolition

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Demolition
ER 1	Low	Large	Medium Risk
ER 2	Low	Large	Medium Risk

Table 21: Risk of Impact on Ecological Receptors - Earthworks

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Earthworks
ER 1	Low	Medium	Low Risk
ER 2	Low	Medium	Low Risk

Table 22: Risk of Impact on Ecological Receptors - Construction

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Earthworks
ER 1	Low	Medium	Low Risk
ER 2	Low	Medium	Low Risk

Table 23: Risk of Impact on Ecological Receptors - Track-out

ID	Receptor Sensitivity	Dust Emission Magnitude Category	Risk of Impact from Earthworks
ER 1	Low	Medium	Low Risk
ER 2	Low	Medium	Low Risk

Appendix 10.1

NOISE PLATES

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INTRODUCTION

Malone O'Regan has been commissioned to conduct noise monitoring at a site in Kilkenny City. The survey was undertaken on the 25th March 2020. This document supplies the plates each monitoring event.

CALIBRATION OF SOUND LEVEL METER

The sound level meter used was:

- NTi XL2 Audio Acoustic Hand-held Analyser SLM, a Type 1 SLM equipped with Frequency Analysis Software.

The monitoring equipment was calibrated prior to and following the measurement period using a:

- BRUEL & KJAER Sound Level Calibrator Type 4231.

Broadband noise levels were measured using the A-weighted network, and a fast sampling interval, unless otherwise stated.

Table 1: Sound Level Meter Specifications

SLM	Application	[System] Serial Number	[System] User	[System] Instrument Type	[Transducer] Name	[System] Serial Number	[Transducer] Preamplifier ID No	[Transducer] Transd Descr
Nti XL2	XL2	A2A-15639-E0	n/a	M2230	n/a	SNo. 8112	M2220	Free-field 1/2"

The Sound level meter calibration details are below in Table 2.

Table 2: Calibration of the Sound Level Meter

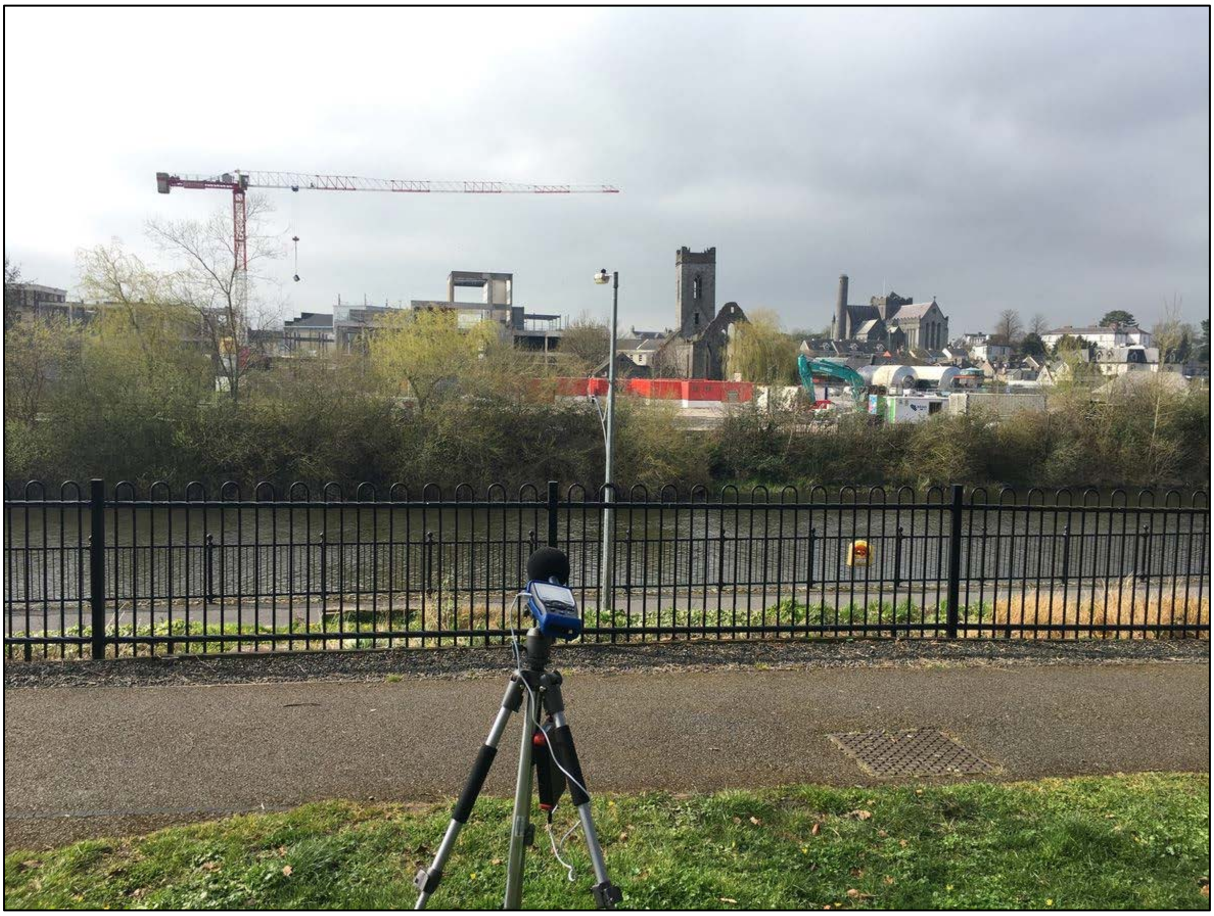
SLM	Calib. Time	Calib. Input	Calib. Type	Sensitivity [mV/Pa]	Deviation from last [dB]	Calib. User	Serial No.	Calib. Preamp ID No
Nti XL2	25/03/2020 09:45	TopSocket	External reference	44.0 mV/Pa	n/a	n/a	n/a	M2220

NM1

Plate 1: NM1 Noise Monitoring Location

NM2

Plate 2: NM2 Noise Monitoring Location



NM3

Plate 3: NM3 Noise Monitoring Location

Appendix 10.2

CAMPBELL ASSOCIATES
SOUND & VIBRATION SOLUTIONS

Sonitus House, 5b Chelmsford Road Industrial Estate
Great Dunmow, Essex, CM6 1HD

Sales Tel: 01371 871033 Hire Tel: 01371 871037
Admin Tel: 01371 871030 Fax Tel: 01371 879106
E-Mail: info@campbell-associates.co.uk
Website: www.campbell-associates.co.uk

Technical Report

Customer: Malone O'Regan Environmental Services

Contact: Gus Egan

Order No: G001

Comments: Require UKAS calibration

Technical log No: 20939

Report Date: 07 May 2020

Internal ref: 24735/MAL425

Service Req'd: Calibration

Equipment ID:- B&K-4231.2217952

Service Request:- Please calibrate to UKAS standard

Report: UKAS calibration complete.

Certificate number: U34730

Accessories supplied: C/w - Leather case & adapter

Important

Please note, our calibration and/or repair process may involve changing several parameters in your equipment. We endeavour to restore the original setting wherever possible, however, we cannot guarantee the equipment has been returned with your original settings. On receipt, please ensure that the settings meet your requirements prior to use.

Technician: ____

Certificate Cover Sheet

CAMPBELL ASSOCIATES
SOUND, VIBRATION & AIR SOLUTIONS

Malone O'Regan Environmenta MAL425

Equipment	*SOP*	*Tech Log*	*Bin No*	*Group No*	*Cal Number / Period*		*Cover Flag*
B&K-4231.2217952	**24735**	**20939**	**159**	**1**	**2**	**12 Months**	☑

CustomerID:	MAL425
EquipmentID:	B&K-4231.2217952
EquipmentType:	Cal
CertificateNo:	U34730
IssueDate:	07-May-20
ExpiryDate:	07-May-21
CalComments:	

NEW! Calibration Certificate Platform – Coming Soon

You may have noticed this new cover sheet with your certificates; it is in preparation for our exciting calibration project which is now in beta testing. Coming soon for our calibration customers is a free, cloud-based Calibration Certificate Platform. Watch this space for more information on its launch.

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, CM6 1HD, England
www.campbell-associates.co.uk
info@campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CALIBRATION

0789

Certificate number: U34730

Certificate of Calibration

Test object:	**Sound Calibrator**
Manufacturer:	**Brüel and Kjær**
Type:	**4231**
Serial no:	**2217952**
Customer:	Malone O'Regan Environmental Services Ltd
Address:	Unit 3, Bracken Business Park, Bracken Road, Sandyford, Dublin 18.
Contact Person:	Gus Egan.

Measurement Results:	Level	Level Stability	Frequency	Frequency Stability	Distortion
1:	94.16 dB	0.02 dB	999.98 Hz	0.00 %	0.42 %
2:	94.16 dB	0.03 dB	999.98 Hz	0.00 %	0.43 %
3:	94.16 dB	0.02 dB	999.98 Hz	0.00 %	0.43 %
Result (Average):	**94.16 dB**	**0.02 dB**	**999.98 Hz**	**0.00 %**	**0.43 %**
Expanded Uncertainty:	0.10 dB	0.02 dB	1.00 Hz	0.01 %	0.10 %
Degree of Freedom:	>100	>100	>100	>100	>100
Coverage Factor:	2.00	2.00	2.00	2.00	2.00

The stated level is relative to 20µPa. The level is traceable to National Standards.
The stated level is valid at reference conditions. The following correction factors have been applied during the measurement: Pressure: 0.0008 dB/kPa Temperature: 0.0015 dB/°C Relative humidity: 0.001 dB/%RH Load volume : 0.0003 dB/mm3
The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.
Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2020\BNK4231_2217952_M1.nmf

Environmental conditions:	Pressure:	Temperature:	Relative humidity:
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	101.445 ± 0.042 kPa	23.9 ± 0.1 °C	34.7 ± 0.8 %RH

Date received for calibration:	05/05/2020
Date of calibration:	07/05/2020
Date of issue:	07/05/2020

Engineer

Michael Tickner

Supervisor

Darren Batten TechIOA

Template UKAS_NoSTD v2.4 DocR Cert-C0002

Certificate number: U34730

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Measurements
The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Instruments and program
A complete list of equipment, hardware and software that has been used in this calibration is available from the calibration laboratory on request.

Traceability
The measured values are traceable to an accredited national physical laboratory within the EU or EFTA.

Comment
Plus 20dB spot check = 114.14dB. Note this is not UKAS data.

Notes:
The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in **BOLD** are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Sonitus House, 5b Chelmsford Road Industrial Estate, Great Dunmow, GB-CM6 1HD
Tel (+44) 01371 871030 Fax (+44) 01371 879106
email calibration@campbell-associates.co.uk

Manufacturer Calibration Certificate

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3. All tests are traceable in accordance with ISO/IEC 17025.

This model of sound level meter submitted for periodic testing successfully completed the applicable pattern-evaluation tests given in IEC 61672-2. The pattern approval certificate is available at www.nti-audio.com/XL2.

Sound Level Meter

Manufacturer	NTi Audio		
Type	XL2-TA	S/N	A2A-15639-E0
Firmware	V3.11		
Reference Level Range	mid		
Microphone Model	M2230		
Preamplifier	MA220	S/N	8112
Microphone Capsule	MC230A	S/N	A16684
Performance class	Class 1		
Customer Inventory Nr.			

Customer

Date 15 February 2019

Certificate FL-19-109

Results **PASSED**
(for detailed report see next pages)

Operator

Markus Frick

Measurement equipment

Test System

Model	NTi Audio FX100, S/No. 11094
Last Calibration	14 August 2018
Cal Certificate	NTI Cal #3393
Next Calibration	14 August 2019

Reference Microphone

Model	MTG MV203 S/N #630, Mic Capsule, MK221 S/N #16502
Last Calibration	08 December 2017
Cal Certificate	METAS #259-16159
Next Calibration	08 December 2019

Sound Calibrator

Model	Norsonic 1251 S/N #30930
Reference Level	114 dB
Calibration Frequency	1000 Hz
Last Calibration	06 December 2018
Cal Certificate	METAS #259-17305
Next Calibration	05 December 2020

Environmental conditions

Temperature	21.7 °C
Humidity	27 %
Pressure	981 hPa

Notes

- This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the international Systems of Units (SI).
- The user is obliged to have the object recalibrated at appropriate intervals.
- This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature are not valid.
- All limits listed in this report are acceptance limits in accordance with IEC61672.
- The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the regulations of the GUM.

NTi AUDIO

1. Indication at the calibration check frequency

The indication of the sound level meter at the calibration check frequency is checked by application of the sound calibrator and adjusted, if necessary, to indicate the required sound level for the environmental conditions under which the tests are performed. All levels in [dB].

Sensitivity before calibration	Sensitivity after calibration	Meas level	Limit -	Limit +	Uncert.	Status
44.4 mV/Pa	44.8 mV/Pa	114	113	115	0.2	Passed

2. Self-generated noise

2.1 Microphone cartridge installed

The self-generated noise is measured in the most-sensitive level range as a time-averaged sound pressure level with frequency-weighting A and an averaging time of 30 seconds. All levels in [dB].

Weight-ing	Meas level	Limit +	Uncert.	Status
A	15.9	18.0	0.1	Passed

2.2 Microphone cartridge replaced by the capsule replacement NTI-K65-15

The self-generated noise is measured in the most-sensitive level range as a time-averaged sound pressure level for all frequency-weightings and an averaging time of 30 seconds. All levels in [dB] referenced to S = 42 mV/Pa.

Weight-ing	Meas level	Limit +	Uncert.	Status
A	9.6	13.0	0.1	Passed
C	13.6	16.0	0.1	Passed
Z	20.2	24.0	0.1	Passed

3. Acoustic signal tests of a frequency weighting

The frequency weighting is tested for frequency-weighting A, using an acoustic test facility. The sound level meter is set to a fast time-weighted sound level in the reference level range. All levels in [dB].

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
125	77.7	78.1	0.4	-1.0	1.0	0.4	Passed
250	85.3	85.8	0.5	-1.0	1.0	0.4	Passed
500	90.8	91.2	0.4	-1.0	1.0	0.4	Passed
1000	94.0	94.3	0.3	-0.7	0.7	0.4	Passed
2000	95.2	95.5	0.3	-1.0	1.0	0.4	Passed
4000	95.0	95.3	0.3	-1.0	1.0	0.4	Passed
8000	92.8	93.4	0.6	-2.5	1.5	0.4	Passed

4. Electric signal tests of frequency weightings

Frequency weightings are determined relative to the response at 1 kHz using steady sinusoidal electrical input signals. The sound level meter is set to display F-time-weighted sound level in the reference level range. All available frequency weightings provided in the sound level meter are verified. All levels in [dB].

4.1 A-Weighting

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
1000	80.0	80.0	0.0	-0.7	0.7	0.1	Passed
63	106.2	79.9	-0.1	-1.0	1.0	0.1	Passed
125	96.1	79.9	-0.1	-1.0	1.0	0.1	Passed
250	88.6	80.0	0.0	-1.0	1.0	0.1	Passed
500	83.2	80.0	0.0	-1.0	1.0	0.1	Passed
2000	78.8	80.0	0.0	-1.0	1.0	0.1	Passed
4000	79.0	80.0	0.0	-1.0	1.0	0.1	Passed
8000	81.1	80.0	0.0	-2.5	1.5	0.1	Passed
12500	84.3	80.0	0.0	-2.5	1.5	0.1	Passed
16000	86.6	79.9	-0.1	-2.5	1.5	0.1	Passed

4.2 C-Weighting

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
1000	80.0	80.0	0.0	-0.7	0.7	0.1	Passed
63	80.8	79.9	-0.1	-1.0	1.0	0.1	Passed
125	80.2	80.0	0.0	-1.0	1.0	0.1	Passed
250	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
500	80.0	80.1	0.1	-1.0	1.0	0.1	Passed
2000	80.2	80.1	0.1	-1.0	1.0	0.1	Passed
4000	80.8	80.0	0.0	-1.0	1.0	0.1	Passed
8000	83.0	79.9	-0.1	-2.5	1.5	0.1	Passed
12500	86.2	79.9	-0.1	-2.5	1.5	0.1	Passed
16000	88.5	79.9	-0.1	-2.5	1.5	0.1	Passed

4.3 Z-Weighting

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
1000	80.0	80.0	0.0	-0.7	0.7	0.1	Passed
63	80.0	79.9	-0.1	-1.0	1.0	0.1	Passed
125	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
250	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
500	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
2000	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
4000	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
8000	80.0	80.0	0.0	-2.5	1.5	0.1	Passed
12500	80.0	80.0	0.0	-2.5	1.5	0.1	Passed
16000	80.0	80.1	0.1	-2.5	1.5	0.1	Passed

5. Frequency and time weightings at 1kHz

While injecting a constant steady signal at the reference frequency of 1 kHz the F-time-weighted sound level, S-time-weighted sound level and time-averaged sound level are verified with frequency weighting A. Additionally the F-time-weighted sound level for frequency weightings C and Z is measured. The first measurement serves as reference and differences in the reading with respect to this first one are determined. All levels in [dB].

Level	Exp level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
LAF	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LAS	114.0	113.8	-0.2	-0.7	0.7	0.1	Passed
LAeq	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LCF	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LCeq	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LZF	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LZeq	114.0	114.0	0.0	-0.7	0.7	0.1	Passed

6. Level linearity on the reference level range

The level linearity on the reference level range is determined by applying steady sinusoidal electrical signals at a frequency of 8 kHz with the sound level meter set for frequency-weighting A and fast time-weighting. All levels in [dB].

Exp abs level	Meas. level	Abs dev	Abs Limit -	Abs Limit +	Exp rel level	Rel dev	Rel Limit -	Rel Limit +	Uncert.	Status
114.0	114.0	0.0	-0.8	0.8	0.0	0.0	-0.3	0.3	0.1	Passed
119.0	119.0	0.0	-0.8	0.8	119.0	0.0	-0.3	0.3	0.1	Passed
124.0	124.0	0.0	-0.8	0.8	124.0	0.0	-0.3	0.3	0.1	Passed
114.0	114.0	0.0	-0.8	0.8	0.0	0.0	-0.3	0.3	0.1	Passed
109.0	109.0	0.0	-0.8	0.8	109.0	0.0	-0.3	0.3	0.1	Passed
104.0	104.0	0.0	-0.8	0.8	104.0	0.0	-0.3	0.3	0.1	Passed
99.0	99.0	0.0	-0.8	0.8	99.0	0.0	-0.3	0.3	0.1	Passed
94.0	94.0	0.0	-0.8	0.8	94.0	0.0	-0.3	0.3	0.1	Passed
89.0	89.0	0.0	-0.8	0.8	89.0	0.0	-0.3	0.3	0.1	Passed
84.0	84.0	0.0	-0.8	0.8	84.0	0.0	-0.3	0.3	0.1	Passed
79.0	79.0	0.0	-0.8	0.8	79.0	0.0	-0.3	0.3	0.1	Passed
74.0	74.0	0.0	-0.8	0.8	74.0	0.0	-0.3	0.3	0.1	Passed
69.0	69.0	0.0	-0.8	0.8	69.0	0.0	-0.3	0.3	0.1	Passed
64.0	64.0	0.0	-0.8	0.8	64.0	0.0	-0.3	0.3	0.1	Passed
59.0	59.0	0.0	-0.8	0.8	59.0	0.0	-0.3	0.3	0.1	Passed
54.0	54.0	0.0	-0.8	0.8	54.0	0.0	-0.3	0.3	0.1	Passed
49.0	49.0	0.0	-0.8	0.8	49.0	0.0	-0.3	0.3	0.1	Passed
44.0	44.0	0.0	-0.8	0.8	44.0	0.0	-0.3	0.3	0.1	Passed
39.0	39.1	0.1	-0.8	0.8	39.0	0.1	-0.3	0.3	0.1	Passed
34.0	34.1	0.1	-0.8	0.8	34.1	0.0	-0.3	0.3	0.1	Passed
33.0	33.2	0.2	-0.8	0.8	33.1	0.1	-0.3	0.3	0.1	Passed
32.0	32.2	0.2	-0.8	0.8	32.2	0.0	-0.3	0.3	0.1	Passed
31.0	31.2	0.2	-0.8	0.8	31.2	0.0	-0.3	0.3	0.1	Passed
30.0	30.3	0.3	-0.8	0.8	30.2	0.1	-0.3	0.3	0.1	Passed

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7. Level linearity including the level range control

The test is performed with steady sinusoidal electrical input signals at a frequency of 1 kHz and with the sound level meter set for frequency weighting A and fast time weighting. With the input signal level kept constant, the indicated signal level is recorded for all level ranges where the applied signal level is displayed. All levels in [dB].

		Low Range		Mid Range		High Range			
Starting Range	Source level	Dev	Limit +/-	Dev	Limit +/-	Dev	Limit +/-	Uncert.	Status
Low	94	0.0	0.40	0.0	0.15	0.0	0.15	0.1	Passed
Mid	114			0.0	0.30	0.0	0.55	0.1	Passed
High	134					0.0	0.30	0.1	Passed
Low	29	0.1	0.30					0.1	Passed
Mid	36			0.1	0.30			0.1	Passed
High	58					0.1	0.30	0.1	Passed

8. Toneburst response

The response of the sound level meter to short-duration signals is tested on the reference level range with 4 kHz tonebursts that start and stop at zero crossings and are extracted from steady 4 kHz sinusoidal electrical input signals. The sound level meter is set for frequency weighting A. All levels in [dB].

The continuous signal level is 123 dB.

Burst signal	Burst duration [ms]	Exp level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
LAF	200	122.0	121.9	-0.1	-0.5	0.5	0.2	Passed
LAF	2	105.0	104.9	-0.1	-1.5	1.0	0.2	Passed
LAF	0.25	96.0	95.8	-0.2	-3.0	1.0	0.2	Passed
LAS	200	115.6	115.5	-0.1	-0.5	0.5	0.2	Passed
LAS	2	96.0	95.9	-0.1	-3.0	1.0	0.2	Passed
LAeq10s	200	106.0	105.9	-0.1	-0.5	0.5	0.2	Passed
LAeq10s	2	86.0	85.9	-0.1	-0.5	0.5	0.2	Passed
LAeq10s	0.25	77.0	76.8	-0.2	-0.5	0.5	0.2	Passed

9. C-weighted peak sound level

The sound level meter is tested on the least-sensitive level range with fast time weighting and C frequency weighting. The test signals are a single complete cycle of an 8 kHz sinusoid starting and stopping at zero crossings and positive and negative half cycles of a 500 Hz sinusoid that also start and stop at zero crossings. All levels in [dB].

Burst signal	Source level	Exp LCp-LCF	Meas LCp-LCF	Dev	Limit -	Limit +	Uncert.	Status
8kHz	129.0	3.4	3.2	-0.2	-2.0	2.0	0.2	Passed
500Hz +	132.0	2.4	2.2	-0.2	-1.0	1.0	0.2	Passed
500Hz -	132.0	2.4	2.2	-0.2	-1.0	1.0	0.2	Passed

10. Overload Indication

Overload indication is tested on the least-sensitive level range with the sound level meter set to A-weighted, time-averaged sound level. Positive and negative one-half-cycle sinusoidal electrical signals at a frequency of 4 kHz are used. All levels in [dB].

Start level	OV +	OV -	Dev	Limit -	Limit +	Uncert.	Status
136.4	138.5	138.6	0.1	-1.5	1.5	0.3	Passed

Appendix 10.3

DAILY DATA

Weather station Data is available from 16/10/2015 to 25/06/2020

Select Station & Date:

Station

Oak Park

Date

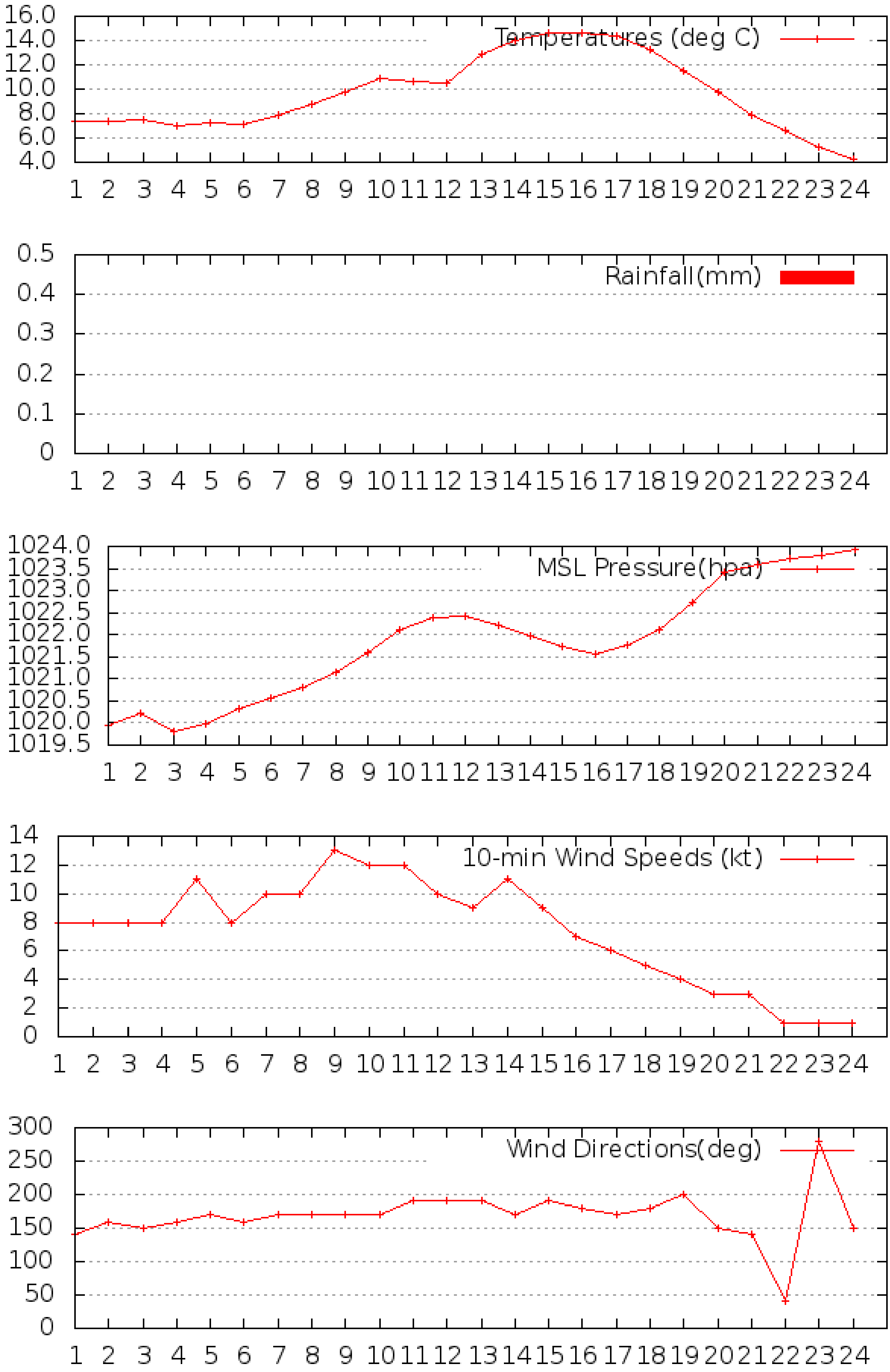
25/03/2020

GO

WEATHER STATION REPORTS FROM OAK PARK

Date	**Rainfall** (mm)	**Max Temp** (°C)	**Min Temp** (°C)	**Grass Min Temp** (°C)	**Mean Wind Speed** (knots)	**Max Gust** (>= 34 knots)	**Sunshine** (hours)
25/03/2020	0.0	15.0	4.2	-1.9	7.3		

HOURLY VALUES (UTC) 25 Mar 2020 OAK PARK



(https://www.met.ie)

(https://www.housing.gov.ie/)

(https://www.met.ie/forecasts/worldweather)

Appendix 11.1

Kilkenny Abbey Park & Street - Verifiable Photomontage Report

Project:	Prepared by:	On behalf of:	Date of issue
Kilkenny Abbey Park & Street	3rd Eye	Kilkenny County Council	July 2020

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9 Rocklands
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Methodology for creation of verifiable photomontage views for the proposed development,

Kilkenny Abbey Park and Street.

1.0 Overview

This document has been prepared by 3RD Eye to explain the methodology used for producing photomontage images for the proposed development, Kilkenny Abbey Park and Street. The purpose of this appendix is to present an accurate overview of the proposed development which enables its effect on the skyline and important settings and sensitive locations to be objectively evaluated with regard to relevant planning policy criteria. During this document, you will be guided through a step-by-step description of how 3RD Eye produced an accurate representation of the proposed building in pictorial form and to explain the process used.

2.0 Site Photography

The photomontage photographs were taken with a Canon EOS 5D Mark 3 full sensor camera using 24mm and 50mm dedicated prime lenses. At each viewpoint location the camera was setup at a height above ground of 1.65m using a professional heavy-duty tripod. A bubble level fixed to the camera head was used to ensure that the camera is perfectly horizontal. The choice of photographic method used for each base line photograph has been determined in order to reflect as closely as possible the view as seen by the human eye. In each case, the lens that has been used has been chosen in order to avoid distortion and to provide an impartial and objective view of the proposed development in relation to existing views that will accurately reflects its scale, form, massing, proportion and silhouette and relationship to other structures. The views therefore reflect a realistic perspective of how the views are seen by the human eye in relation to the existing environment. The date and time of each photograph was recorded by the camera to allow for accurate lighting conditions to be recreated in the computer model as required. Additional detail photographs of the site area and surrounds were taken for reference purposes using a variety of lenses.

3.0 Survey Information

A detailed survey of the site and surrounds was supplied by the architects enabling a block model of the existing building and immediate landscape to be modelled. Each camera viewpoint location was surveyed by 3rd Eye using a Trimble RTK GPS Rover system (+/- 1cm accuracy) and identified by Ordnance Survey co-ordinates. The heights and distances of significant points within each view that are easily distinguishable have also been recorded as Ordnance Survey grid and level datum and their accuracy has been checked relative to the fixed camera position. The number of survey points that have been identified in each view range from 8 to 12 separate points dependent upon the particular view. These survey points provide an effective check for ensuring that the 3d model and existing views are accurately merged together.

4.0 Modeling

The development was modelled in 3d Studio Max from imported AutoCad drawings supplied by the architects. The provided site survey and proposed site layout were over-laid and aligned to create a 'Base' model file to include all relevant information. This Base model allowed for the laying out of the proposed development's, camera positions and reference points. The individual models were then placed into the base model at the orientation and levels indicated. At each viewpoint location a virtual camera was set up in the 3D software using the surveyed coordinates. The 3D coordinates of the verification points were used to create an accurate model of the surveyed parts of the scene. The scene was verified by matching generated polygons between the digital model and the background photograph. The control survey points were used to confirm the target position and the field of view of the virtual camera.

5.0 Camera matching and rendering

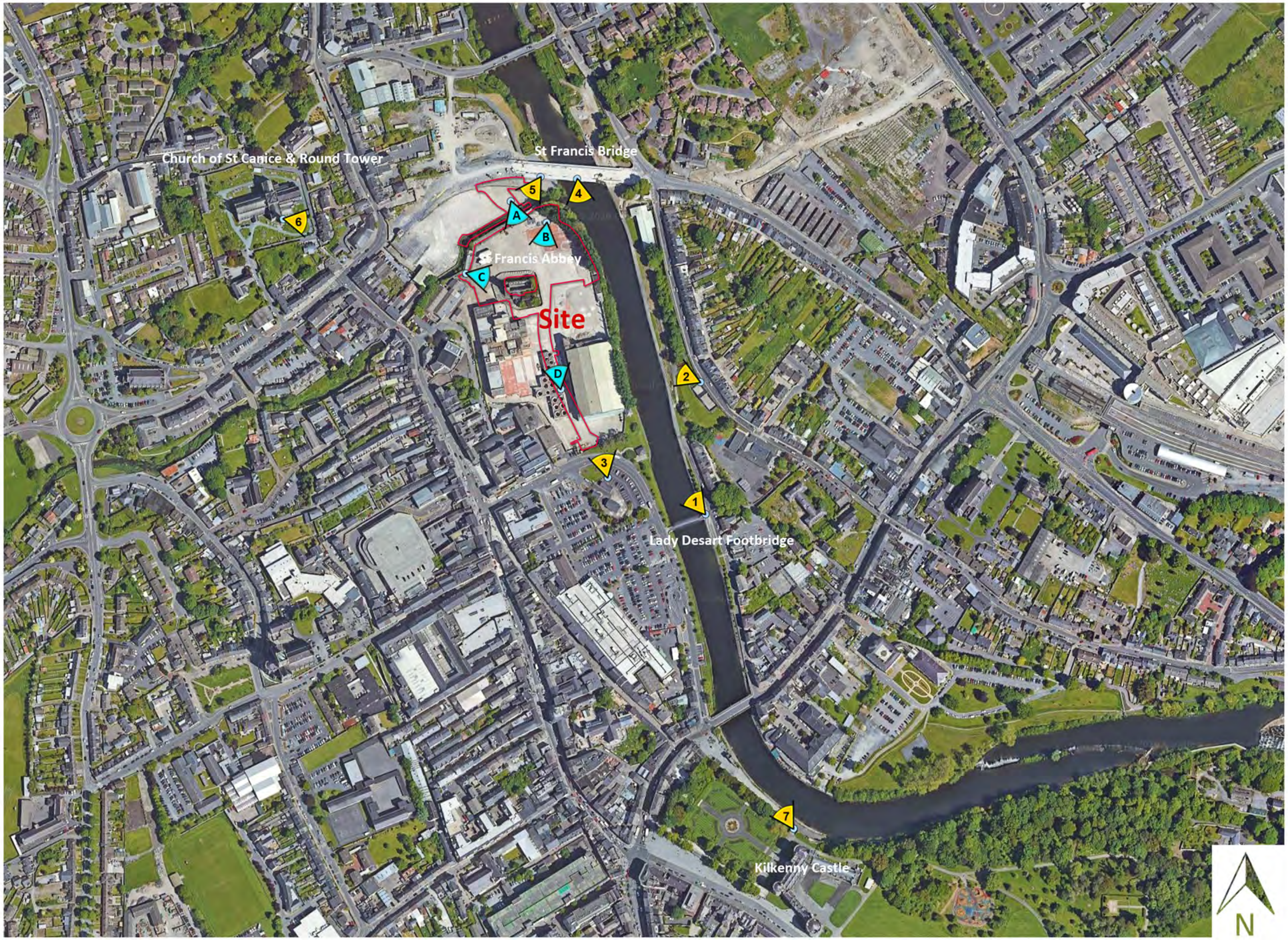
The next step in the process involves accurately positioning the 3d model of the proposed development within each existing view. The central horizon line in each of the existing views is then calculated and imported into 3D Studio Max as a backdrop to the 3D model. The survey points as well as the specifications of the lens type relating to each existing view is also entered into 3D Studio Max. The survey points of the camera position and those relating to specified objects within each particular baseline image are then highlighted on the digitised image. A further check of the accuracy of the survey points in each digitised existing view is carried out by overlaying the central horizon line of each existing view with the digitised survey points prepared in 3D Studio Max. This additional check ensures that the survey points match precisely. This exercise requires meticulous attention to detail. Once the process of camera matching is complete, the 3d model of the proposed development is accurately positioned within each of the existing views. This is achieved by rendering the camera matched 3d model of the proposed development within 3D Studio Max at the same size as the digitised existing view.

6.0 Post production

The render of the 3d model is then superimposed on the existing still views in Adobe Photoshop. The foreground of the existing views i.e. trees, lampposts, cars, buildings etc, are then copied and placed over the rendered model in order to ensure that the depth is accurate within the photomontage view between the foreground, background and the rendered model. At this stage, the textured model can be further adjusted to match the resolution, colouring and saturation of the photograph taken to create a close impression of what the textures of the building would look like. This is a qualitative exercise and requires interpretation by the designer on how the building will look, and guidance from the architect. A final qualitative check of all of the photomontage images has been carried out to ensure that they provide objectively accurate views of the proposed development.

7.0 General information

Only trees from the proposed Abbey Park and Street development have been rendered to be viewed as seen from year 0. All other trees from the adjoining schemes currently under construction have a generic age to illustrate those developments having reached maturity (approximately 25 years).



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Carrigtwohill
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Drawing Title

View Camera Location Map

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July '20

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Carrigtwohill
Co Cork
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Drawing Title

1a Existing View

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	13:22

Camera coordinates

Easting:	650605
Northing:	656135
Elevation:	45.42m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

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Drawing Title

1b Baseline
(Existing & representation of schemes currently under construction)

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	13:22

Camera coordinates

Easting:	650605
Northing:	656135
Elevation:	45.42m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

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Drawing Title

1c Proposed View
(at year 0)

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	13:22

Camera coordinates

Easting:	650605
Northing:	656135
Elevation:	45.42m

Job Title
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Drawing Title

1d Proposed View
(at year 25)

Photography information	
Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	13:22

Camera coordinates	
Easting:	650605
Northing:	656135
Elevation:	45.42m

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Drawing Title

1e Proposed View
(at year 25) with future Abbey Creative Quarter buildings

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	13:22

Camera coordinates

Easting:	650605
Northing:	656135
Elevation:	45.42m

Job Title
Kilkenny Abbey Park & Street

Client
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Drawing Title
2a Existing View

Photography information	
Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	11:33

Camera coordinates	
Easting:	650692
Northing:	656244
Elevation:	50.56m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
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Drawing Title
2b Baseline
(Existing & representation of schemes currently under construction)

Photography information	
Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	11:33

Camera coordinates	
Easting:	650692
Northing:	656244
Elevation:	50.56m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

3RD · EYE 9 Rocklands Carrigtwohill Co Cork 087 2065839 www.3rd-eye.ie	Drawing Title 2c Proposed View (at year 0)	Photography information Camera: Canon 5d M3 Lens: 24mm Photography Date: 25-06-20 Photography Time: 11:33	Camera coordinates Easting: 650692 Northing: 656244 Elevation: 50.56m	Job Title Kilkenny Abbey Park & Street Client Kilkenny Co. Council	Page No. 11 Date. July'20

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Drawing Title

2d Proposed View
(at year 25)

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	11:33

Camera coordinates

Easting:	650692
Northing:	656244
Elevation:	50.56m

Job Title
Kilkenny Abbey Park & Street

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Drawing Title

2e Proposed View

(at year 25) with future Abbey Creative Quarter buildings

Photography information	
Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	11:33

Camera coordinates	
Easting:	650692
Northing:	656244
Elevation:	50.56m

Job Title
Kilkenny Abbey Park & Street

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Drawing Title

3a Existing View

Photography information	
Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	13:22

Camera coordinates	
Easting:	650605
Northing:	656135
Elevation:	45.42m

Job Title
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Drawing Title

3b Baseline
(Existing & representation of schemes currently under construction)

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	13:22

Camera coordinates

Easting:	650605
Northing:	656135
Elevation:	45.42m

Job Title
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3c Proposed View
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Camera:	Canon 5d M3
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Drawing Title
3d Proposed View
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Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	13:22

Camera coordinates

Easting:	650605
Northing:	656135
Elevation:	45.42m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Page No. 17

Date.
July'20

3RD EYE

9 Rocklands
Carrigtwohill
Co Cork
087 2065839
www.3rd-eye.ie

Drawing Title

3e Proposed View
(at year 25) with future Abbey Creative Quarter buildings

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	13:22

Camera coordinates

Easting:	650605
Northing:	656135
Elevation:	45.42m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

3RD · EYE

9 Rocklands
Carrigtwohill
Co Cork
087 2065839
www.3rd-eye.ie

Drawing Title

4a Existing View

Photography information	
Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	11:18

Camera coordinates	
Easting:	650514
Northing:	656453
Elevation:	47.69m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

3RD · EYE

9 Rocklands
Carrigtwohill
Co Cork
087 2065839
www.3rd-eye.ie

Drawing Title

4b Baseline
(Existing & representation of schemes currently under construction)

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	11:18

Camera coordinates

Easting:	650514
Northing:	656453
Elevation:	47.69m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

3RD · EYE 9 Rocklands Carrigtwohill Co Cork 087 2065839 www.3rd-eye.ie	Drawing Title 4c Proposed View (at year 0)	Photography information Camera: Canon 5d M3 Lens: 24mm Photography Date: 25-06-20 Photography Time: 11:18	Camera coordinates Easting: 650514 Northing: 656453 Elevation: 47.69m	Job Title Kilkenny Abbey Park & Street Client Kilkenny Co. Council	Page No. 21 Date. July'20

3RD · EYE 9 Rocklands Carrigtwohill Co Cork 087 2065839 www.3rd-eye.ie	Drawing Title **4d Proposed View** (at year 25)	Photography information Camera: Canon 5d M3 Lens: 24mm Photography Date: 25-06-20 Photography Time: 11:18	Camera coordinates Easting: 650514 Northing: 656453 Elevation: 47.69m	Job Title Kilkenny Abbey Park & Street Client Kilkenny Co. Council	Page No. 22 Date. July'20

3RD·EYE	9 Rocklands Carrigtwohill Co Cork 087 2065839 www.3rd-eye.ie	Drawing Title **4e Proposed View** (at year 25) with future Abbey Creative Quarter buildings	Photography information Camera: Canon 5d M3 Lens: 24mm Photography Date: 25-06-20 Photography Time: 11:18	Camera coordinates Easting: 650514 Northing: 656453 Elevation: 47.69m	Job Title Kilkenny Abbey Park & Street Client Kilkenny Co. Council	Page No. 23 Date. July'20

3RD · EYE 9 Rocklands Carrigtwohill Co Cork 087 2065839 www.3rd-eye.ie	Drawing Title 5a Existing View	Photography information Camera: Canon 5d M3 Lens: 24mm Photography Date: 25-06-20 Photography Time: 11:09	Camera coordinates Easting: 650477 Northing: 656452 Elevation: 46.86m	Job Title Kilkenny Abbey Park & Street Client Kilkenny Co. Council	Page No. 24 Date. July'20

3RD EYE

9 Rocklands
Carrigtwohill
Co Cork
087 2065839
www.3rd-eye.ie

Drawing Title

5b Baseline
(Existing & representation of schemes currently under construction)

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	11:09

Camera coordinates

Easting:	650477
Northing:	656452
Elevation:	46.86m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

3RD EYE	9 Rocklands Carrigtwohill Co Cork 087 2065839 www.3rd-eye.ie	Drawing Title **5c Proposed View** (at year 0)	Photography information Camera: Canon 5d M3 Lens: 24mm Photography Date: 25-06-20 Photography Time: 11:09	Camera coordinates Easting: 650477 Northing: 656452 Elevation: 46.86m	Job Title Kilkenny Abbey Park & Street Client Kilkenny Co. Council	Page No. 26 Date. July'20

3RD EYE

9 Rocklands
Carrigtwohill
Co Cork
087 2065839
www.3rd-eye.ie

Drawing Title
5d Proposed View
(at year 25)

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	11:09

Camera coordinates

Easting:	650477
Northing:	656452
Elevation:	46.86m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Page No. 27

Date.
July'20

3RD EYE

9 Rocklands
Carrigtwohill
Co Cork
087 2065839
www.3rd-eye.ie

Drawing Title

5e Proposed View
(at year 25) with future Abbey Creative Quarter buildings

Photography information	
Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	11:09

Camera coordinates	
Easting:	650477
Northing:	656452
Elevation:	46.86m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

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Carrigtwohill
Co Cork
087 2065839
www.3rd-eye.ie

Drawing Title

6a Existing View

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	14:44

Camera coordinates

Easting:	650257
Northing:	656404
Elevation:	85.08m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

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9 Rocklands
Carrigtwohill
Co Cork
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Drawing Title

6b Baseline
(Existing & representation of schemes currently under construction)

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	14:44

Camera coordinates

Easting:	650257
Northing:	656404
Elevation:	85.08m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

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9 Rocklands
Carrigtwohill
Co Cork
087 2065839
www.3rd-eye.ie

Drawing Title
6c Proposed View
(at year 0)

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	14:44

Camera coordinates

Easting:	650257
Northing:	656404
Elevation:	85.08m

Job Title
Kilkenny Abbey Park & Street
Client
Kilkenny Co. Council

Date.
July'20

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Co Cork
087 2065839
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Drawing Title

6d Proposed View
(at year 25)

Photography information

Camera:	Canon 5d M3
Lens:	24mm
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Camera coordinates

Easting:	650257
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Job Title
Kilkenny Abbey Park & Street

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Date.
July'20

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Carrigtwohill
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Drawing Title

6e Proposed View
(at year 25) with future Abbey Creative Quarter buildings

Photography information

Camera:	Canon 5d M3
Lens:	24mm
Photography Date:	25-06-20
Photography Time:	14:44

Camera coordinates

Easting:	650257
Northing:	656404
Elevation:	85.08m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

3RD EYE

9 Rocklands
Carrigtwohill
Co Cork
087 2065839
www.3rd-eye.ie

Drawing Title

7a Existing View

Photography information

Camera:	Canon 5d M3
Lens:	50mm
Photography Date:	25-06-20
Photography Time:	12:09

Camera coordinates

Easting:	650795
Northing:	655782
Elevation:	55.23m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Page No. 34

Date.
July'20

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Co Cork
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Drawing Title

7b Baseline
(Existing & representation of schemes currently under construction)

Photography information

Camera:	Canon 5d M3
Lens:	50mm
Photography Date:	25-06-20
Photography Time:	12:09

Camera coordinates

Easting:	650795
Northing:	655782
Elevation:	55.23m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

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Carrigtwohill
Co Cork
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Drawing Title

7c Proposed View
(at year 0)

Photography information

Camera:	Canon 5d M3
Lens:	50mm
Photography Date:	25-06-20
Photography Time:	12:09

Camera coordinates

Easting:	650795
Northing:	655782
Elevation:	55.23m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

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July'20

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Carrigtwohill
Co Cork
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Drawing Title

7d Proposed View
(at year 25)

Photography information

Camera:	Canon 5d M3
Lens:	50mm
Photography Date:	25-06-20
Photography Time:	12:09

Camera coordinates

Easting:	650795
Northing:	655782
Elevation:	55.23m

Job Title
Kilkenny Abbey Park & Street

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Date.
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Co Cork
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Drawing Title

7e Proposed View

(at year 25) with future Abbey Creative Quarter buildings

Photography information

Camera:	Canon 5d M3
Lens:	50mm
Photography Date:	25-06-20
Photography Time:	12:09

Camera coordinates

Easting:	650795
Northing:	655782
Elevation:	55.23m

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Date.
July'20

Methodology for creation of non-verifiable photomontage views for the proposed development,

Kilkenny Abbey Park and Street.

1.0 Overview

This document has been prepared by 3RD Eye to explain the methodology used for producing the following non-verifiable photomontage images for the proposed development, Kilkenny Abbey Park and Street.

The following views titled from 'A' to 'D' are representative of the proposed scheme with future and adjoining developments currently under construction as viewed from within the proposed site boundary. These views were considered necessary in order to fully illustrate the nature of the development and the context within which it will sit. However, whilst these four views accurately represent the proposed development and are useful illustrations, they cannot be considered to be 'verified views' since the relevant 'proposed' illustrations no longer retain enough of the existing visual context to be able to confirm their accuracy. For this reason, whilst these four 'internal' views (A-D) are included in the assessment and are assessed relative to the baseline, they cannot be afforded the same importance in the assessment as the verified views (1-7 inc.).

2.0 Site Photography

For each view location for views 'A – D' the existing photographs are only approximate to the preferred baseline position. It was not possible to take photographs form the preferred baseline positions due to onsite construction material in these locations. The photographs were taken as close to the preferred locations as possible and give a good representation of how the site currently appears from the photomontage views. The same care and procedure as used when photographing the views used for the verifiable photomontages was taken for these views also. A Canon EOS 5D Mark 3 full sensor camera using 24mm and 50mm dedicated prime lenses was used in each case. At each viewpoint location the camera was setup at a height above ground of 1.65m using a professional heavy-duty tripod. A bubble level fixed to the camera head was used to ensure that the camera is perfectly horizontal. The date and time of each photograph was recorded by the camera to allow for accurate lighting conditions to be recreated in the computer model as required. Additional detail photographs of the site area and surrounds were taken for reference purposes using a variety of lenses. These photos were used as part of the photomontage process to allow the background landscape representative to the view to be built up when the actual view was obscured due to temporary site building materials.

3.0 Survey Information

For these views only survey information supplied by the architects and used in the development of the accurate 3d model were used. It was not necessary to survey the positions of these photos as they differ from there preferred baseline positions anyway.

4.0 Modeling

The development was modelled in 3d Studio Max from imported AutoCad drawings supplied by the architects. The provided site survey and proposed site layout were over-laid and aligned to create a 'Base' model file to include all relevant information. This Base model allowed for the laying out of the proposed development's, camera positions and reference points. The individual models were then placed into the base model at the orientation and levels indicated. At each preferred viewpoint location a virtual camera was set up in the 3D software.

5.0 Lighting and rendering

Rendering is the process of generating a 2-dimensional digital image from the 3D model. The 3D model was first assigned textures, lighting and shading information. The computer then uses these parameters to generate the rendered digital image. These parameters attempt to mimic the conditions representative to its corresponding real-world conditions.

6.0 Post-production

The render of the 3d model was brought into Adobe Photoshop for post processing. As part of this process stock images of people were inserted to add a degree of real-life activity to further illustrate the intended use of the proposed park and street. Photos that were taken from approximate locations to the renders were also used to build up background plates that were superimposed over the render to represent the background landscape as closely as possible.

7.0 General information

Only trees from the proposed Abbey Park and Street development have been rendered to be viewed as seen from year 0. All other trees from the adjoining schemes currently under construction have a generic age to illustrate those developments having reached maturity (approximately 25 years).

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Co Cork
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Drawing Title
Aa Existing
(Approximate to view only)

Artist illustration only

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Page No. 40

Date.
July'20

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Drawing Title

Ab Baseline
(Existing & representation of schemes currently under construction)

Artist illustration only

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Page No. 41

Date.
July'20

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Drawing Title
Ad Proposed View
(at year 25)

Artist illustration only

Job Title
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Page No. 42

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Drawing Title
Ae Proposed View
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Artist illustration only

Job Title
Kilkenny Abbey Park & Street
Client
Kilkenny Co. Council

Date.
July'20

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Drawing Title
Ba Existing
(Approximate to view only)

Job Title
Kilkenny Abbey Park & Street

Client
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Date.
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Drawing Title
Bb Baseline
(Existing & representation of schemes currently under construction)

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Client
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Drawing Title

Bd Proposed View
(at year 25)

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Client
Kilkenny Co. Council

Date.
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Drawing Title

Be Proposed View
(at year 25) with future Abbey Creative Quarter buildings

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Client
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Drawing Title

Ca Existing
(Approximate to view only)

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Drawing Title
Cb Baseline
(Existing & representation of schemes currently under construction)

Artist illustration only

Job Title
Kilkenny Abbey Park & Street
Client
Kilkenny Co. Council

Page No. 53

Date.
July'20

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Drawing Title
Cd Proposed View
(at year 25)

Artist illustration only

Job Title
Kilkenny Abbey Park & Street
Client
Kilkenny Co. Council

Page No. 54
Date.
July'20

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Drawing Title
Ce Proposed View
(at year 25) with future Abbey Creative Quarter buildings

Artist illustration only

Job Title
Kilkenny Abbey Park & Street
Client
Kilkenny Co. Council

Page No. 55

Date.
July'20

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Co Cork
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Drawing Title
Da Existing
(Approximate to view only)

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Page No. 52

Date.
July'20

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Drawing Title
Db Baseline
(Existing & representation of schemes currently under construction)

Artist illustration only

Job Title
Kilkenny Abbey Park & Street
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Page No. 53
Date.
July'20

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Drawing Title
Dd Proposed View
(at year 25)

Artist illustration only

Job Title
Kilkenny Abbey Park & Street
Client
Kilkenny Co. Council

Page No. 54
Date.
July'20

3RD EYE

9 Rocklands
Carrigtwohill
Co Cork
087 2065839
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Drawing Title

De Proposed View
(at year 25) with future Abbey Creative Quarter buildings

Artist illustration only

Job Title
Kilkenny Abbey Park & Street

Client
Kilkenny Co. Council

Page No. 55

Date.
July'20

Appendix 12.1

APPENDIX 12.1 Legal Framework and Key Sources – Archaeology

Archaeology includes known archaeological monuments, areas of archaeological potential and underwater archaeology. In the Republic of Ireland, archaeological sites and monuments are protected under the *National Monuments Act 1930* (as amended) through inclusion in the Record of Monuments and Places (RMP), the Register of Historic Monuments (RHM) and/ or by being declared a National Monument or being made subject to a Preservation Order. A National Monument, as defined in Section 2 of the *National Monuments Act* (1930),[1] means a monument 'the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto…'. The National Policy on Town Defences also designates town walls as National Monuments (DoEHLG 2008). Section 8 (1) of the *National Monuments Act* (1930) provides for the Minister placing a Preservation Order on a monument which the Minister considers to be a National Monument under threat (Duchas 1999, 39).[2] A list of Preservation Orders is published by the NMS.[3]

The Sites and Monuments Record (SMR), as revised in light of fieldwork, formed the basis for the establishment of the Record of Monuments and Places (RMP). The RMP, which comprises the results of the Archaeological Survey of Ireland, is a statutory list of all recorded archaeological monuments known to the National Monuments Service of the Department of Culture, Heritage and the Gaeltacht. The RMP files record upstanding archaeological monuments and their original location (in cases of destroyed monuments), in addition to the position of possible sites identified as cropmarks on vertical aerial photographs. The information held in the RMP files is read in conjunction with published constraint maps.[4] The proposed development is located within the RMP for Kilkenny City (RMP KK019-026----).

Archaeological sites identified since 1994 have been added to the non-statutory SMR database of the Archaeological Survey of Ireland,[5] which includes both RMP and SMR sites. Those designated as SMRs have not yet been added to the statutory record, but are scheduled for inclusion in the next revision of the RMP where it is considered that statutory protection is warranted. In addition, the Urban Archaeology Survey (UAS) contained reports on historic towns dating to before AD 1700 with a view to delineating zones of archaeological potential.

The Topographical Files of the Antiquities Division of the National Museum of Ireland record the find spots of artefacts housed in the National Museum. The archive also includes references to monuments and records for historic excavations.

The Development Plan for Kilkenny City 2014–2020 describes the archaeological significance of archaeology and built heritage to the city (Kilkenny County Council 2014a, 105–110). Policies to protected these values include:

7H **Protect archaeological sites and monuments (including their setting), underwater archaeology, and archaeological objects, including those that are listed in the Record of Monuments and Places, and in the Urban Archaeological Survey of County Kilkenny or newly discovered sub-surface and underwater archaeological remains.**

---

[1] http://www.irishstatutebook.ie/eli/1930/act/2/section/2/enacted/en/html#sec2 (accessed 11/11/2019)

[2] http://www.irishstatutebook.ie/eli/1930/act/2/section/8/enacted/en/html#sec8 (accessed 11/11/2019)

[3] https://www.archaeology.ie/sites/default/files/media/publications/po19v1-all-counties.pdf (accessed 30/7/2019).

[4] https://www.archaeology.ie/publications-forms-legislation/record-of-monuments-and-places (accessed 1/7/2020)

[5] http://www.archaeology.ie (accessed 1/7/2020)

7I **To facilitate and support the implementation of the existing (and any further) conservation plans.**

The Development Plan also notes St Francis' Abbey as one of twelve historic graveyards in the city and its environs (Kilkenny County Council 2014a, 108).

References

DoEHLG. 2008. National Policy on Town Defences. Dublin: Department of Environment, Heritage and Local Government. Available at: https://www.archaeology.ie/sites/default/files/media/publications/national-policy-on-town-defences.pdf [Accessed January 7, 2017].

Duchas. 1999. Framework and Principles for the Protection of the Archaeological Heritage. Dublin: Department of Arts Heritage and the Gaeltacht. Available at: http://www.archaeology.ie/sites/default/files/media/publications/framework-and-principles-for-protection-of-archaeological-heritage.pdf [Accessed March 26, 2016].

Kilkenny County Council. 2014. Kilkenny City & Environs Development Plan 2014-2020. Kilkenny: Kilkenny County Council. Available at: https://www.kilkennycoco.ie/eng/Services/Planning/Development-Plans/Development_Plans_2014-2020/Kilkenny-City-Plan-2014-2020-Adopted-Plan-for-printing.pdf [Accessed June 28, 2020].

Appendix 12.2

APPENDIX 12.2 Legal Framework and Key Sources – Architectural Heritage

Under Section 51 of the *Planning and Development Act 2000*,[6] local planning authorities are required to maintain a Record of Protected Structures (RPS) which includes all structures or parts of structures in their functional areas which, in their opinion, are of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest. Wherever the phrase "special architectural interest" is used in this report it should be taken as including special interest in any one or more of these eight categories. No work can be carried out affecting those features of a protected structure which contribute to its special interest without approval from the planning authority.

Similarly, Section 81 of the *Planning and Development Act 2000* makes provision for the creation of Architectural Conservation Areas (ACAs) to preserve the character of a place, area, group of structures or townscape, taking account of building lines and heights, that is of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest or value, or contributes to the appreciation of Protected Structures.[7] The RPS and lists of ACAs are maintained and updated by the Local Authority as part of their County Development Plan (Kilkenny County Council 2014a).

The Kilkenny City Development Plan 2014–2020 sets out the significance of architectural heritage to the environment of Kilkenny city, including the urban structure of the city, the public realm, and views and prospects (Kilkenny County Council 2014a, 110–112). The Plan lists the Record of Protected Structures (Kilkenny County Council 2014b) which was updated with additions and deletions in 2018 (Kilkenny County Council 2018), and the Architectural Conservation Areas in the city (Kilkenny County Council 2014a, 113–129). The Development Plan also sets out the following objectives for architectural heritage:

7J To ensure the protection of the architectural heritage of Kilkenny City & Environs by including all structures considered to be of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest in the Record of Protected Structures.

7K To respond to the Ministerial recommendation to include in the Record of Protected Structures, structures which have been identified as being of Regional, National or International significance in the National Inventory of Architectural Heritage survey of the city and county published in 2006.

7L To carry out a review of the Record of Protected Structures for the functional area of Kilkenny City and Environs.

7M To ensure the preservation of the special character of each ACA particularly with regard to building scale, proportions, historical plot sizes, building lines, height, general land use, building materials, historic street furniture and paving.

7N To designate ACAs where appropriate and provide a local policy framework for the preservation of these areas.

The Development Plan also sets out Development Management Standards including:

- To have regard to the Architectural Heritage Protection Guidelines (DoEHLG 2004) when assessing proposals for development affecting a Protected Structure.

[6] http://www.irishstatutebook.ie/eli/2000/act/30/section/51/enacted/en/html#sec51 (accessed 11/11/2019)

[7] http://www.irishstatutebook.ie/eli/2000/act/30/section/81/enacted/en/html#sec81 (accessed 11/11/2019)

- To promote principles of best practice in conservation in terms of use of appropriate materials and repair techniques through the administration of the Structures at Risk Fund, provided by the Department of Arts, Heritage and the Gaeltacht.
- To require the sympathetic retention, reuse and rehabilitation of Protected Structures and their settings.
- To require an architectural impact assessment/conservation method statement for developments within the grounds of country house estates which are Protected Structures.

The National Inventory of Architectural Heritage (NIAH) is a nationwide survey of architectural heritage including buildings, structures and historic landscapes and gardens, carried out under the *Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act 1999*.[8] These surveys are published online,[9] and are used to advise Local Authorities in relation to structures of interest within their functional areas.

The structures identified on or near the site were examined to assess the potential effects of the proposed urban park and street and to consider potential for mitigation where necessary. In each case the structures identified are rated in accordance with the system adopted the National Inventory of Architectural Heritage (NIAH) wherein a structure is rated as being of International, National, Regional or Local interest, or, if a structure is of no special interest, the NIAH includes a category of "Record only" (NIAH 2012)[10]. The definitions for each of these categories is as follows:

International

Structures or sites of sufficient architectural heritage importance to be considered in an international context. Examples include St Fin Barre's Cathedral, Cork. These are exceptional structures that can be compared to and contrasted with the finest architectural heritage in other countries.

National

Structures or sites that make a significant contribution to the architectural heritage of Ireland. These are structures and sites that are considered to be of great architectural heritage significance in an Irish context. Examples include Ardnacrusha Power Station, Co. Clare; the Ford Factory, Cork; Carroll's Factory, Dundalk; Lismore Castle, Co. Waterford; Sligo Courthouse, Sligo; and Emo Court, Co. Laois.

Regional

Structures or sites that make a significant contribution to the architectural heritage within their region or area. They also stand in comparison with similar structures or sites in other regions or areas within Ireland. Examples would include many Georgian terraces; Nenagh Courthouse, Co. Tipperary; or the Bailey Lighthouse, Howth. Increasingly, structures that need to be protected include structures or sites that make a significant contribution to the architectural heritage within their own locality. Examples of these would include modest terraces and timber shopfronts.

Local

These are structures or sites of some vintage that make a contribution to the architectural heritage but may not merit being placed in the RPS separately. Such structures may have lost much of their original fabric.

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8 http://www.irishstatutebook.ie/eli/1999/act/19/enacted/en/html?q=Architectural+Heritage+&years=1999 (accessed 11/11/2019)

9 & http://Data.gov.ie (11/11/2019)

10 National Inventory of Architectural Heritage *NIAH Handbook* edition June 2006 pp. 22-23

Record only

These are structures or sites that are not deemed to have sufficient presence or inherent architectural or other importance at the time of recording to warrant a higher rating. It is acknowledged, however, that they might be considered further at a future time.

Each building or structure considered in this assessment was assigned a rating in accordance with the NIAH system above, or is stated to be not of special architectural interest. Where the rating is deemed to be higher than "Record only" the category of special interest is noted. It should be noted that the term "special architectural interest" applies only in the context of this assessment of architectural heritage and does not imply that those buildings and other structures that are not considered to be of special architectural interest are in any way inferior or are of lower value.

While the *Planning and Development Act 2000* gives no criteria for assigning a special interest to a structure, the National Inventory of Architectural Heritage (NIAH) offers guidelines to its fieldworkers (NIAH 2017). This offers guidance by example rather than by definition, and is the system adopted for the present assessment. The guidance for each the eight categories set down in the Act (archaeological, architectural, historical, technical, cultural, scientific, social and artistic,) as set out in pages 14 to 18 of the guidance.

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Appendix 12.3

APPENDIX 12.3 Archaeological and Historical Background

Prehistory

The River Nore and its environs have been the site of prehistoric settlement since the Mesolithic period (c.7000–4000 BC), with settlement along the river in the Neolithic and Bronze Age also (Devine et al. 2009a, 10–14). Archaeological monitoring of the Kilkenny Main Drainage works in 2000 and 2002 discovered prehistoric artefacts within the river, including an early Mesolithic microlith (part of a composite tool and typical of the period) in the vicinity of Greensbridge Weir,[11] and a flint blade, possibly Neolithic, was found by the river bank at Bateman Quay (Doyle 2003).[12] No prehistoric sites have been previously identified within the study area, and no prehistoric artefacts were discovered during recent archaeological test excavations (ACSU et al. 2018a; ACSU et al. 2018b; ACSU et al. 2018d; ACSU et al. 2018e; ACSU et al. 2018g; ACSU et al. 2018i; ACSU et al. 2018j). However, it is possible that prehistoric remains may be found within the lower waterlogged layers of archaeological deposits identified in test excavations (AR-16 and AR-17).

Early Medieval

Kilkenny gets its name from the early medieval monastic centre of *Cill Chainnigh*, Canice's Church, founded in the seventh century and centred on the site of Saint Canice's Cathedral, to the northeast of the proposed development (Bradley 2000, 1). Over the following centuries, Cill Chainnigh became the principal church in the kingdom of Ossory known as *Mag Roigne*, and from the late ninth century it was the seat of power of King Cerball Mac Dúnlainge (died AD888), founder of the Mac Gilla Phádraig dynasty. All of this activity appears to have been centred on what is today Irishtown and the hill area surrounding Saint Canice's Cathedral north of the River Breagagh, and approximately 165m west of the proposed development.

A major ford point on the River Nore was located to the immediate east of Canices' Church, just north of the present Green's Bridge (Bradley 2000, 1; Ó Drisceoil et al. 2008, 80) and 150m north of the proposed development. By the late twelfth century, a significant settlement appears to have grown up around Saint Canice's Church (BH-12), and included craftwork and enclosing banks and ditches (Ó Drisceoil 2013, 19). Only the eleventh-century round tower, approximately 180m west of the proposed development, survives from this pre-Norman church phase.

The proposed development area extends north of the River Breagagh into an area of Irishtown which appears to have primarily been floodplain at the confluence of the Breagagh and Nore, away from the early medieval settlement which primarily concentrated on the higher ground around St Canice's Cathedral between Vicar Street, St Canice's Place, Dean Street and Thomas Street, with a possible extension southward along Irishtown (Bradley 2000, 1). No early medieval finds were recovered during test excavations in the Abbey Quarter.

Medieval

Kilkenny became the centre of the diocese of Ossory following the Synod of Raith Breasail in 1111 (Erlean 1914). In 1169, the settlement at Kilkenny hosted Anglo-Norman knights in inns and hostels, presumably indicating that some form of service centre and urban space existed around the episcopal centre of Saint Canice's Cathedral (BH-12) (Bradley 2000, 1). Kilkenny became part of the Lordship of Leinster granted to Richard fitz Gilbert de Clare (Strongbow). De Clare's daughter married William Marshall, who established Kilkenny as a centre for his lordship in Ireland. The Anglo-Normans established their castle south of the Breagagh at the site of the current Kilkenny Castle (BH-13), 470m south of the proposed development. Separate boroughs developed around Saint Canice's Cathedral (Irishtown) and between Kilkenny Castle and James' Street (Hightown), expanding north to the River Breagagh

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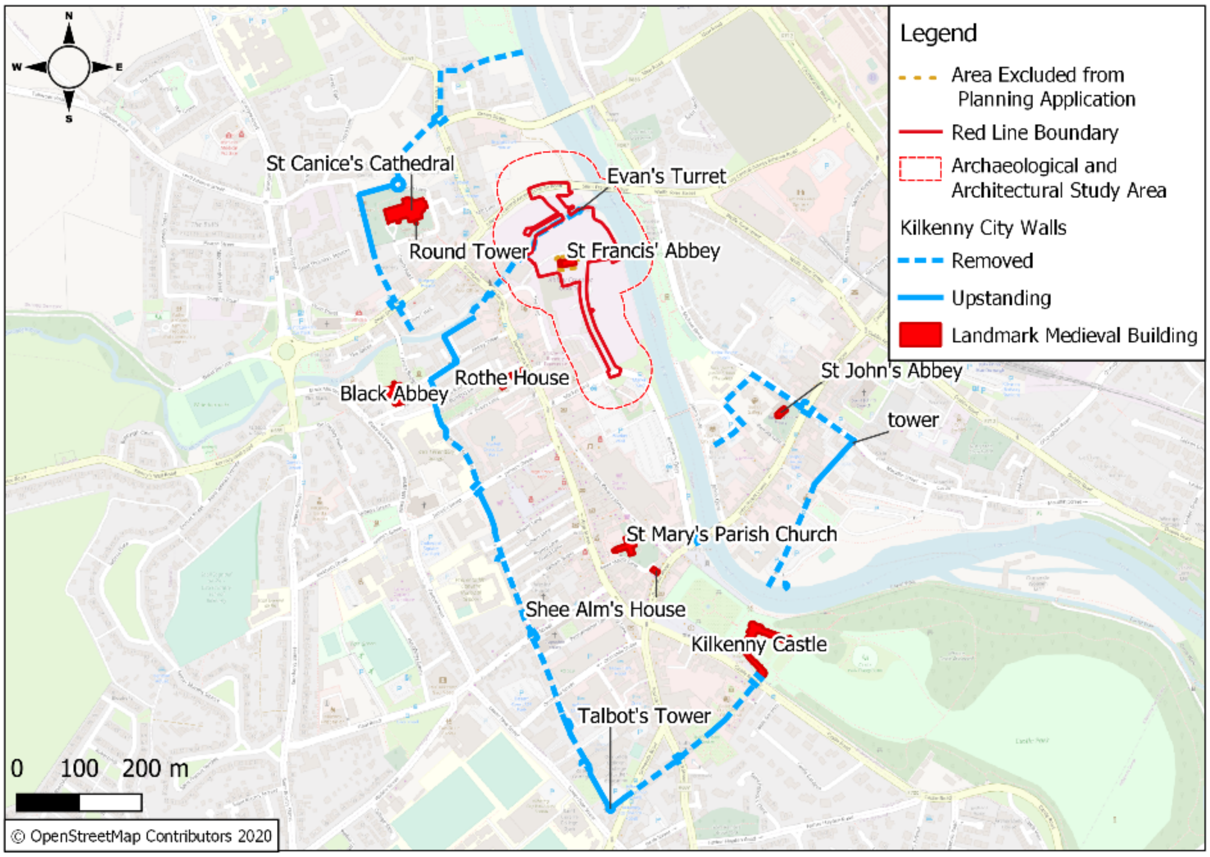
[11] 01E0909: 1917, found at ITM 650529, 656504.
[12] 0IE0909: 1916, found at ITM 650650, 656134.

following a purchase of land by William Marshall in 1207 (Bradley 2000, 2). This area of Hightown, measuring approximately 800m by 350m, on the west bank of the River Nore, was subsequently enclosed with a defensive wall (Thomas 1992, 126–132; Bradley 2000, 2; Oxford Archaeology 2005) (Figure 1).

Figure 1: Kilkenny City Walls and Significant Medieval Buildings



The circuit of the City Wall (BH-01) for Kilkenny was c.2.9km in total. This consisted of 1.6km surrounding the 'Hightown' (54%), 0.7km surrounding Irishtown north of the River Breagagh (25%), and 0.6km (22%) surrounding the suburb of St John's, on the east bank of the River Nore (Bradley 2000, 200; Oxford Archaeology 2005). Several 'murage' grants – the right to levy taxes to pay for defensive walls – were made starting in 1250 and continuing into the fifteenth century (Bradley 2000, 14). The city's defensive walls appear to have been predominantly completed in the thirteenth century, and were between 1.2m and 1.4m thick and up to 4.5m high in places (higher over the River Breagagh), with evidence for an external fosse (ditch) up to 5.5m wide (Bradley 2000, 2). Street names like James's Street Sconce (off James's Street, outside the study area) also indicate another feature of medieval town defences – a sconce was an internal path or route which provided access to the town wall defences. Avril Thomas indicates a possible wall flanking the River Nore south of Evans Turret (Thomas 1992, 129). However, Bradley stated that there is no evidence for a defensive wall flanking the river (Bradley 2000, 2). Recent test excavations specifically targeted the postulated line of a river wall, and did not identify it (ACSU et al. 2018a).

The proposed development area includes 125m of the City Wall (BH-01), which runs along the south side of the River Breagagh, and terminates at a mural tower called Evans Turret (BH-02). The site of the Watergate and bridge between Hightown and Irishtown is located outside and 75m southwest of the proposed development area. Evans Turret (BH-02) has been subject to several surveys and archaeological investigations during a programme of conservation (Courtney Deery Heritage Consultancy 2015). AMS undertook a survey of a 90m section of the City Wall from Irishtown Bridge east to the Mayfair Building site in advance of the redevelopment of the Mayfair Building (AMS 2018), whilst an archaeological test excavation was carried out beside the City Wall to the rear of the Mayfair Building (ACSU et al. 2018j).

Following the growth of Hightown north to the River Breagagh, in 1207 there appears to have been a concerted effort to take in and reclaim land from the rivers Nore and Breagagh. Along with the construction of the enclosing defensive wall and mural tower, this land was granted to the Order of Friars Minor Conventual or simply the Franciscan Order, also known as Franciscans of the First Order or the Grey Friars (Mooney 1955). These were a mendicant order following the rule of Saint Francis of Assisi (d.1226) whose purpose was to provide pastoral care to the community and relied on donations and alms. Arriving first in Dover in 1224, the Franciscans established houses in the major towns of Norman Britain and Ireland in a very short period. In all, thirty-two Franciscan houses were established in Ireland by 1325 (The Discovery Programme 2014). Being a mendicant order, the Franciscans relied on alms and donations, which meant the Conventual Franciscans gravitated to the towns where this was more readily available, and where their services were needed (Gallagher 2013). A separate fraternity of Franciscans, the Observant or Third Order Franciscans, were predominantly associated with the rural monasteries in the Gaelic west of Ireland, largely founded after the later fourteenth and fifteenth centuries (Clabaigh 2002).

St Francis' Abbey in Kilkenny (BH-04 & AR-03), as the friary came to be called, was founded on a grant from Richard Marshall, Lord of Kilkenny, in 1231–34, although the first mention of the monastery was in 1245 when the Crown provided funds for its construction (Carrigan 1905, 104; Bradley 2000, 3–4; O'Keeffe 2016, 10–11). Saint Francis' Abbey with its approximately 3 hectare precinct, along with the construction of the town wall to the Nore, effectively reclaimed this part of Kilkenny from low-lying land at the confluence of the rivers Nore and Breagagh (O'Keeffe 2016, 12), although in 1338 significant flooding carried away bridges and mills and flooded St Francis' Abbey up to the level of the high altar (Carrigan 1905, 104). Gerry O'Keeffe suggests that the complete area of the precinct was defined following a grant from Earl Gilbert de Clare in 1274, along with a right to grind corn toll-free in his mill (O'Keeffe 2016, 12–13). The buildings were complete enough to host the Franciscan's Provincial Chapters in 1267, 1308 and 1332, and appears to have been quite similar in plan to Castledermot friary, although larger (Conlon 1975, 84).

The monasteries of the religious orders such as the Franciscans, Dominicans and Augustinians (all of whom had houses in Kilkenny) were all constructed to a roughly similar design and proportions, based on transseptal (cross-shaped) church and ranges of buildings surrounding a cloister (Greene 1994). The choir and chancel at the east end of the church was the most important part of the complex, generally the first part to be constructed, and was where the religious community celebrated the mass, separated from the attendants by a rood screen. Transepts with small chapels were built on one or both sides of the choir, with a sacristy off the south transept. The nave and aisles to the west accommodated the lay community. The cloister was generally located to the north of the church (in St Francis' Abbey it is to the south) and consisted of an open space or garth surrounded by an ambulatory (covered walkway) which also provided access to the surrounding ranges. The east range ground floor generally contained a chapter house where a chapter of the Order's rule was read every day, and a warming room with a fireplace; the first floor contained dormitories, chambers and lavatories for the monks. The south range generally consisted of the kitchens and the refectory where meals were prepared and eaten, whilst the west range generally contained the cellars on the ground floor and dormitories and chambers on the first floor. Certain areas of the monastery were favoured for burials, with the choir and chancel and then transepts being most favoured by benefactors; the chapter house, ambulatory and cloister garth were frequently used to inter monks; the townspeople were often buried in the nave and the exterior cemetery. Medieval monasteries were generally set within a precinct with gardens and orchards, mills, infirmaries for treating the sick, and cemeteries (Greene 1994, 4–11). Each religious order might require subtle changes to this general design. Furthermore, in the decades it took to construct monasteries this design and plan often changed during their piecemeal construction as the religious order and its requirements and endowments waxed or waned. However, whilst there might have been variation in their detail, the constituent parts of these complex medieval buildings remained remarkably consistent.

Historical records provide some detail on the construction of St Francis' Abbey. A provincial chapter of the Franciscans was held at Kilkenny in 1267 (Ledwich 1804a, 494), presumably indicating that at least some of the structures of the monastery were present at this time, most likely the choir. Over its history St Francis' Abbey enjoyed the Royal patronage of King Henry III, as well as the support of significant landowners including Earl Richard Marshal, Earl Gilbert de Clare and significant merchants, burgesses and locally landed and aristocratic families including the Palmers, Freignes, Oweyns, Kilberrys, Shortalls, Archdeacons and Butlers (O'Keeffe 2016, 45). Lady Isabella Palmer funded the extension of the choir further to the east completed around 1324, and was most likely responsible for the seven-light east window (Leask 1960, 124, plate 56). Friar John Clyn, the Franciscan chronicler from St Francis' Abbey, recorded that Lady Palmer was buried in the choir in 1321 (Clyn et al. 1849, xxvii, 34, 67–68). In the same year, Friar Clyn records the establishment of a fraternity of guilds to fund the construction of a belfry and repair the church (Clyn et al. 1849, xxvii, 34, 67). However, the Black Death appears to have delayed its completion until later that century. Friar Clyn's famous description of the Black Death in Kilkenny in 1349 concludes with the statement:

…. and lest the writing should perish with the writer, and the work fail together with the workman, I leave parchment for continuing the work, if haply any man survive, and any of the race of Adam escape this pestilence and continue the work I have commenced (Clyn et al. 1849, vii).

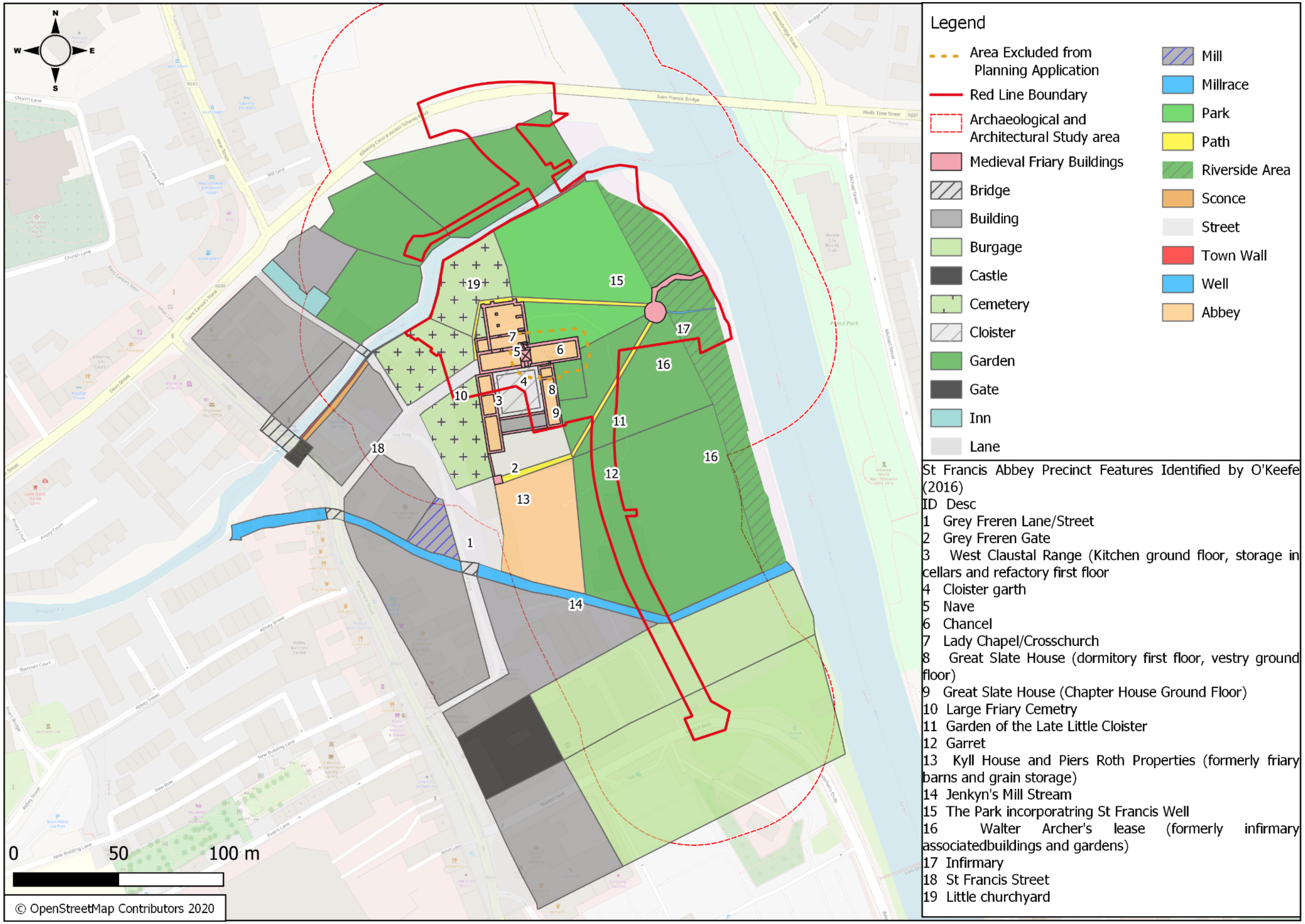
It appears Friar Clyn died of the Plague shortly after, and was most likely buried within St Francis' Abbey. Construction in St Francis' Abbey continued with the completion of the bell tower in the later fourteenth century and the construction of a northern transept with chapels in the fifteenth century (O'Keeffe 2016, 25–26).

The most detailed early description of St Francis' Abbey and its precinct comes from shortly after it was dissolved in 1540. An extent was taken in January 1541 and described the House of the Franciscan Friars as having a church with the cemetery, four old 'tecture' (roofed buildings?), and a small orchard with two small closes, containing 2 acres and worth 6 shillings and 8 pence (White 1943, 199). Other properties owned by the Franciscans are listed in the town, including a mill called the "Grefryrs mylle" (AR-11), leased to Isabella Drom for 27 shillings (White 1943, 200). When St Francis' Abbey was granted to the sovereign and corporation of Kilkenny in 1544, it was described as containing a "Church Belfry Dormitory, Hall, Chapter House, three Chambers a Kitchen, a House called the Garnen with three cellars under same House, and an enclosure within the Site of said late monastery or House, and all Edifices Messuages Gardens Lands tenements Orchards and heredutaments whats occurs with this appertaining in or within the Site Bounds Circuit and precincts of said late Monastery or House" (Archdall 1873, 342).

The extent and composition of the buildings and precinct of St Francis' Abbey were explored in some detail in Gerry O'Keeffe's recent article on St Francis' Abbey which has greatly assisted in determining the medieval characteristics of the site (O'Keeffe 2016, 28–39, fig.5) (Figure 2). The precinct was enclosed by a wall and was accessed from Grey Freren Lane (1) by the 'grey freren gate' (2). The church and its associated buildings occupied the north part of the precinct, and included the chancel (6), crossing tower and nave (5) all measuring 47m by 8m, with the fifteenth-century transept to the north containing three chapels (7), and measuring 20m by 18m. This transept partly replaced an earlier aisle on the north side of the nave. The claustral ranges extended south of the nave, with a cloister garth 18m by 17m and an ambulatory 1.8m wide. The east range was called the 'greate sclate house' with a vestry and the chapter house on the ground floor (8) and dormitories on the first floor (9). For the western range (3) some of the most revealing details come from post-dissolution rentals. In 1581, James Gerrot leased a room adjoining the southwestern nave wall, and Patrick Archer a room further south of that, and in 1594 Ann Walshe leased a room also in this area, whilst Arthur Shee leased a room at the most southern extent of west range, and John Seix, in 1573, occupied a ‘sclate chamber’, suggesting this was a first floor room. These leases suggest that the western range of buildings was divided into individual chambers and rooms. The presence of a south range is suggested by the description of a ‘void room’, and may have housed guest accommodation (O’Keeffe 2016, 30–37).

The only upstanding elements of St Francis’ Abbey are the choir and belfry (BH-04), which also contain an inscribed slab (KK019-026151-), wall monument commemorating Mrs Agnes Bankes (d. 1687; KK019-026183-), a graveslab reused as a lintel (KK019-026150-), and a font (KK019-026190-) with flutes in Romanesque pairs and fleur-de-lis in relief on its surface, said to be from Kytler’s Inn. The upstanding remains of St Francis Abbey (BH-04) are within the study area but are excluded from the proposed development. However, significant subsurface remains of the monastery (AR-03), including the nave, cloister and surrounding ranges, and an extensive north transept survive and are preserved *in-situ* beneath the concrete, as are the remains of the friary’s cemetery (AR-05) and St Francis’ Well (AR-04).

Figure 2: St. Francis Abbey Precinct Features (O'Keefe, 2016)



Early Modern

Kilkenny, both Hightown and Irishtown, was made a city in 1609 (Bradley 2000, 6). Prominent Catholic merchant families including the Archers, Langtons, Rothes and Shees prospered under the protection of the Butler lordship and came to dominate secular and religious life in Kilkenny. Whilst remaining Catholic, they benefited from the dissolution of the monasteries and the subsequent distribution of property (Bradley 2000, 5–6). These families built substantial renaissance-style town houses, of which ten survive in Kilkenny, the finest surviving example being Rothe House on Parliament Street (outside the study area). The former buildings and precincts of the dissolved Black Abbey (Dominicans) and St Francis' Abbey were leased out piecemeal by the Corporation of Kilkenny (Bradley 2000, 6). The area around the River Breagagh in both the Hightown and Irishtown boroughs became associated with industry and manufacture, particularly wool manufacture, milling, malting and brewing, quite likely using the buildings and facilities of the dissolved monasteries, including cellars, kilns, barns, mils and millraces and gardens. The Franciscans attempted to return to their former friary in Kilkenny after the dissolution, briefly during the reign of Queen Mary, and again at the start of King James' reign when it appears the friary – possibly in the north transept – was rededicated (O'Keeffe 2016, 41–42). However, the rest of the friary complex appears to have been divided and rented out by the Corporation.

A rental of the friary in 1628 listed a number of parts of the former friary leased to members of prominent families, including Jenkin Roth who rented a void room in 'Gray Freren' park, Richard Roth a chamber and void room in the cloister, Peter Roth a kill-house and messuage next to the choir, Patrick Murphy a house in Gray Freren park and a stone house near the Freren gate, presumably the gate at the entrance from Jenkin's Lane into St Francis' Abbey precinct, whilst Robert Archer appears to have rented the rest of the upstanding remains of the friary proper, including the chapter house, steeple and body of the abbey (Ledwich 1804b, 462). The church was again rededicated in 1640 (Carrigan 1905, 108), and in 1647 the friary was designated a house for the formation of theology and philosophy (Conlon 1975, 82), all a consequence of the general renaissance in Catholic fortunes during the period of the Confederation (1642–1650) when Kilkenny was the capital of Catholic Ireland (Siochrú 1994; Bradley 2000, 6). During the siege of Kilkenny by Cromwellian forces in 1650, the city wall (BH-01) separating the precinct of St Francis' Abbey from the River Breagagh was breached, although the Cromwellians were unsuccessful in forcing entry at this point on the 27th March. It seems that this breach was located close to Evans Turret (BH-02), with an area of repaired wall now occupied by a modern concrete bridge across the River Breagagh as the likely location of the breach (D. M. 1875; Carrigan 1905, 110).

Following the surrender or Kilkenny city on 28th March 1650, the Franciscans were again ejected from the friary. By the middle of the seventeenth century, the Civil Survey recorded a complex arrangement of buildings and gardens in the area of St Francis' Abbey, a sector of the Hightown of Kilkenny called the North Quarter. These buildings included "One great Abby of a small distance from ye said houses Called ffrancises (Francis) with two small buildings on the side thereof", a "vault Joyning to ye said Abbey used for a stable", a "house Joyning and belonging to ye said Abbey fitt to be made for a Mault house and Granaryes walls stone and ye Roofe slates" indicating beer brewing on site. A substantial area of the former precinct also appears to have been used as gardens: "Gard[en] on the East side of the said house Joyning to the said Abbey Conteyning 44 perches small measure … In the East side of which yard stands a house convenient for a small family ye walls stone and the Roofe slate". Further indications of the arrangement of buildings in the former friary precinct include "The Abbey Yard lying betwixt the said Abbey and Capt. Evans and Mr Wilsons house conteyning 76 perches small measure …. One Garden and Orchard lying on ye north and East side of the said Abbey and Joyning to the river Noer Conteyning one Acker [acre] & a half and 25 perches small measure" (Simington 1942, 517–519). Jenkins Mill, located in the car park beside the present Watergate theatre (outside the study area) had previously been owned by St Francis'

Abbey and had been used to grind corn (AR-11). In 1650 this mill appears to have been used to grind bark for a surrounding tannery (Simington 1942, 522). Whilst most of the former friary appears to have been given over to purely secular use, the church may have continued as a place of burial into the later seventeenth century. The latest burial memorial was recorded as a plaque to Mrs Agnes Banckes alias Smith, who died 8th January 1687 (Carrigan 1905, 109–110). It seems likely that the construction of a military barracks, the Horse Barracks (AR-08), after 1698 put an end to any further burials on the site.

Eighteenth and Nineteenth Centuries

Despite Kilkenny being the seat of the Butlers, one of the most powerful families in Ireland in the late seventeenth and early eighteenth centuries, Kilkenny was dominated by up to twenty prominent families represented in the Corporation, including the Evans (Kilkenny Borough Council 2014), most of whom acquired their property during the Cromwellian period (Dickson 1990, 336). The area around the Breagagh was the centre of industrial and trade activity in Kilkenny city, with the woollen mills, workshops, tanneries, starch manufactories and breweries. Kilkenny was one of the most industrious places in the country in the early nineteenth century (Dickson 1990, 342–343).

The Clasped Book of the Corporation of Kilkenny recorded that on the 19th September 1698 the former St Francis Abbey was to become a barracks, and on the 5th April 1700 the "waste of Francis' Abbey" was given for the building of the barracks (Carrigan 1905, 108). This barracks (AR-08) appears to have occupied two buildings: an L-shaped building in the west, and a range of stables with overhead accommodation in the east, occupying the former site of the north transept. Detailed descriptions of the barrack buildings with measurements are given in the accounts of their repair in 1751 and 1752 (Ireland Parliament House of Commons 1763). These describe ten rooms, four for officers including a Captain's Room and Lieutenant's room, each with a closet, a Cornets' room and Quarter-Masters' room, one room for a corporal and five for the men. The complex also included four stables in poor condition, with the accommodation for men over these, and an infirmary. Repairs to these buildings in 1749 included 275 yards of pavement (cobbles?) in the stables costing £4 1s. 1d., and 8s. 6d. for slating on the infirmary carried out by Denis Hogan of Clonmel (Ireland Parliament House of Commons 1763, 647–648). The Horse Barracks closed in 1800 after a new barracks was constructed in Kilkenny, and the former barracks buildings were acquired by the Corporation.

The River Nore had been a significant source of power for milling from the medieval period. Large grain mills on the River Nore were multi-storey structures powered by large undershot paddle wheels, purpose-built in the eighteenth century to take advantage of the large surpluses in grain arising from government incentives and supplying Britain during its wars with France (Hammond 1990, 37). A series of mills were located on either side of a large weir (AR-01) across the Nore at Green's Bridge, including mills for grinding corn (AR-02) and woollen mills (BH-11).

St Francis' Abbey became one of seven breweries in County Kilkenny in the eighteenth and nineteenth century (Hammond 1990, 43). Whilst brewing may have been carried out on site from the medieval period, the first recorded brewery was started by Richard Cole in partnership with John Smithwick, who came to Kilkenny in 1710 (AR-09) (Courtney Deery Heritage Consultancy 2014, 32). Brewing grew in Kilkenny through the eighteenth century, so that by the early nineteenth century St Francis' Abbey brewery was exporting beer to Britain. In 1827 Edmund Smithwick purchased the brewery at St Francis' Abbey (Halpin 1989). At the time of the Primary Valuation in 1850 Edmund Smithwick occupied a substantial property on Jenkins' Lane (lots 1 to 5), including the brewery, offices, store and yards, gardens, mill and gardens, nearly all of which was leased from the estate of Shearman and Brennan, whilst he also leased a starch yard and offices from Joseph Empson (Ask About Ireland 2003). The brewery buildings were concentrated at the south end of the property, with gardens beside the River Nore, whilst the starch yard occupied the site immediately south of St Francis' Abbey in the area of the former cloister. The brewery and brewing process were described in detail in a

Guide to the Great Southern & Western Railway from 1866, including an illustration of the brewery buildings (Measom 1866, 32–36). The brewery had a north gate beside St Francis' Abbey and a south gate where the main offices were located. Within the brewery there were ale cellars, corn and barley lofts, vat houses with pontoons, boilers, coppers and tuns, mash tuns, a water mill and 24 horse-power steam engine, cooler rooms with refrigerators, furnaces and steam washing and drying facilities for casks, an engineer's shop, a substantial maltings and a cooperage which was located beside St Francis' Abbey choir. Outside the north gate the brewery had stables for fifty dray horses, occupying the former stables of the Horse Barracks. The brewery was separated from the River Nore by gardens. North of St Francis Abbey, the Primary Valuation of 1850 shows that the estate of Ambrose Evans owned the garden and turret (BH-02) (Ask About Ireland 2003).

Twentieth Century

In 1902 St Francis' Abbey Brewery was one of two breweries in Kilkenny city, the other being Sullivan's on St James' Street. St Francis' Abbey Brewery was owned by Messrs. E. Smithwick and Sons Ltd, a Limited Liability Company with capital of £75,000, malting about 20,000 barrels per annum, and delivering bottled and timber-barrelled beer to the surrounding district by dray horse (Ireland. Dept. of agriculture and technical instruction 1902, 483). Smithwick's continued to grow the brewery around St Francis' Abbey, expanding the operations to the River Nore in the 1950s and 1960s with the construction of bottling stores, and the demolition of some of their older nineteenth-century brewery buildings south of St Francis' Abbey, and the stables north of the Abbey, followed by Marcus Ó hEochaidhe's archaeological excavations c.1963. The Mayfair Ballroom (BH-14) opened in 1943 and became a popular dance hall, hosting acts including Ray Charles, The Everly Brothers, Dusty Springfield, The Tremeloes, Engelbert Humperdink, Chubby Checker and Jim Reeves (Blake 2008; Ó Drisceoil 2014). Guinness bought the Smithwick's brewery in 1964, followed shortly by the demolition of most of the remaining nineteenth-century brewery and construction of industrial brewery buildings, including the kegging plants beside the River Nore, new grain silos c.1964, and expanded Brewhouse Building in 1970 and 1971 which were archaeologically monitored by David Sweetman. The brewery also purchased the Mayfair Building (BH-14) after 1973, converting it to a canteen and offices. The brewery also expanded north of the River Breagagh in the 1970s, with the construction of machinery sheds, the hops store and squash court and fuel stores. The Maturations Buildings were constructed in the 1990s, following archaeological investigations. Diageo ceased brewing at the site in 2013.

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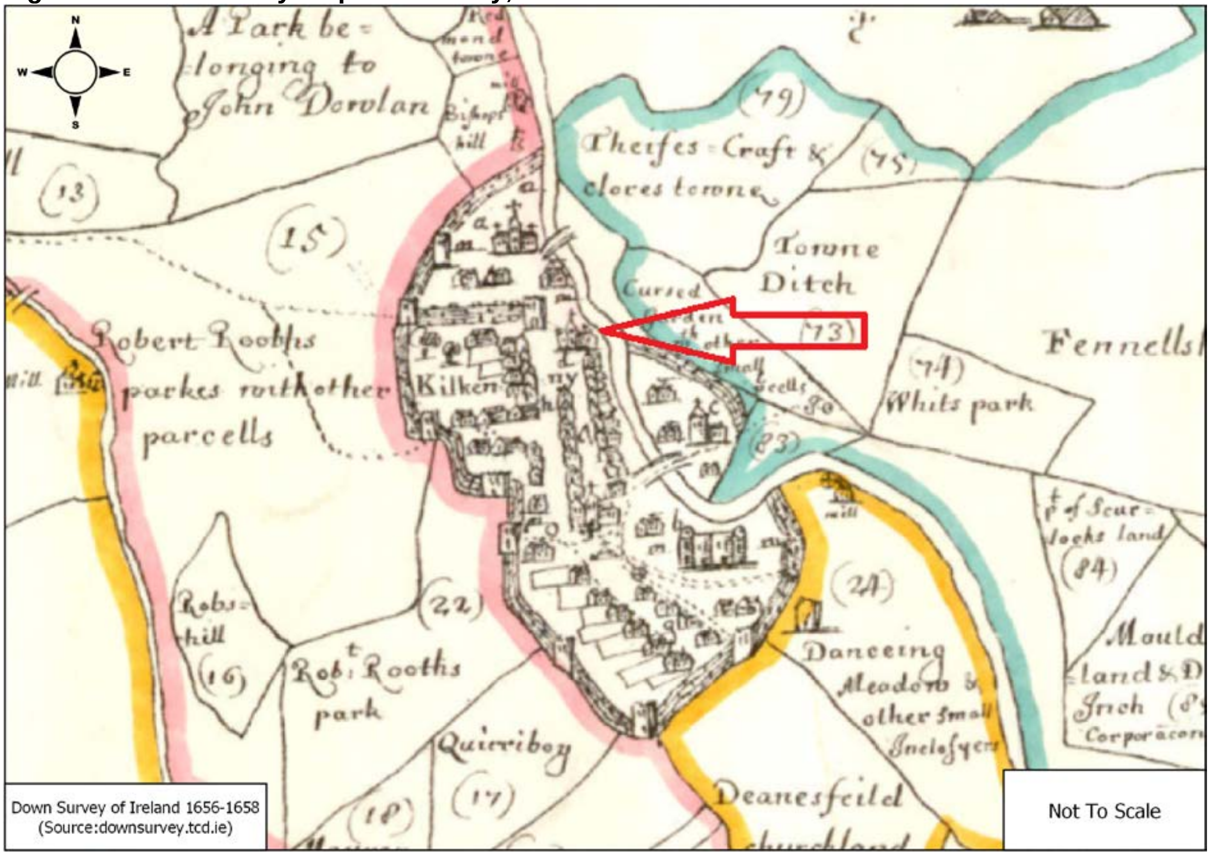
Appendix 12.4

APPENDIX 12.4 Overview of Historical Maps

Down Survey c.1655 (Figure 1)

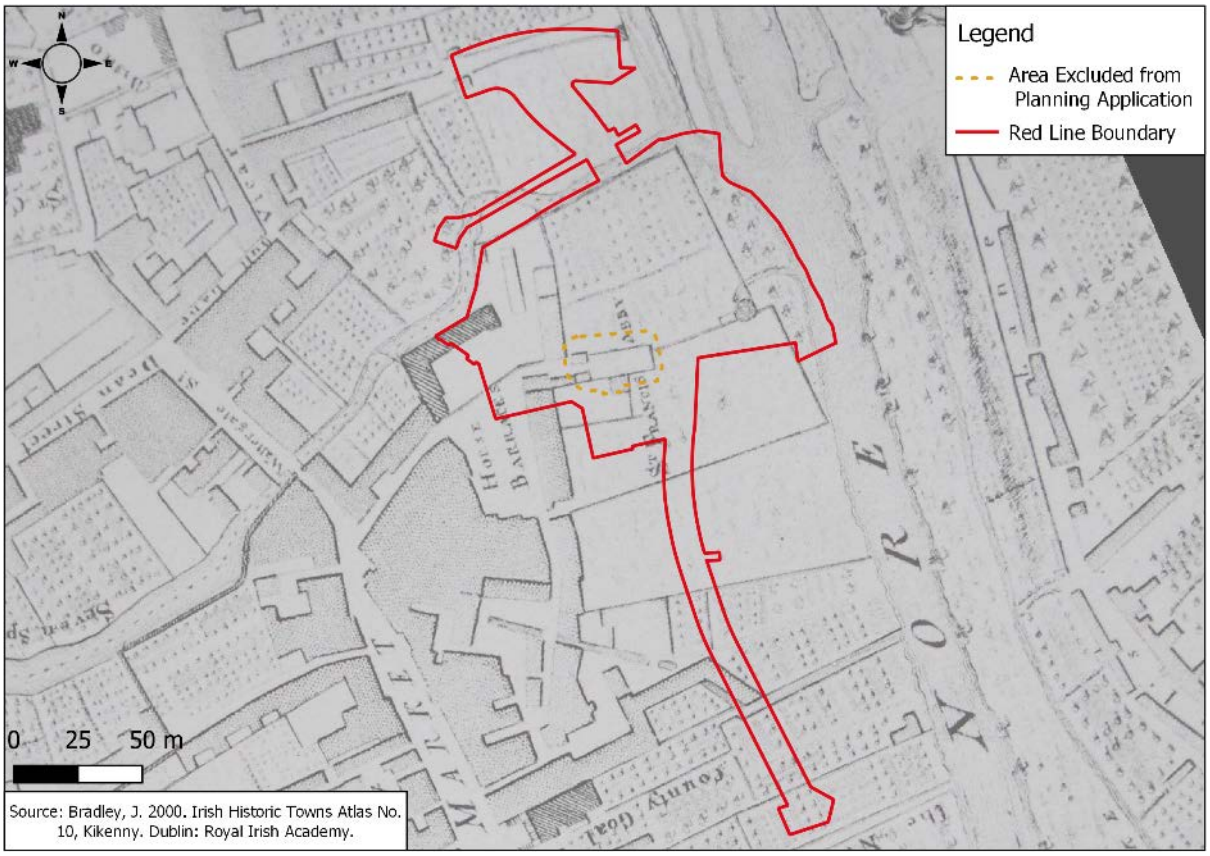
Figure 1: Down Survey map of Kilkenny, 1650



William Pettys’ map of the liberties of Kilkenny City, also known as the Down Survey (Bradley 2000, Map 4), is the earliest map where the shape of Kilkenny City is recognisable, although the map is for the most part pictographic. The walled Hightown, and walled Irishtown, and the walled suburb of St Johns are clearly visible, as are the major civic buildings including Kilkenny Castle [BH-13], St Canice’s Cathedral [BH-12], High Street, St James’ Street, St Marys’ Parish Church, and John’s Bridge and Green’s Bridge, and the Watergate on the River Breagagh. St Francis’ Abbey [BH-04 & AR-03] is recognisable as a church symbol beside the River Nore.

Rocque's map, 1758 (Figure 2)

Figure 2: Rocque's Map of Kilkenny 1756



John Rocque was an English cartographer from a Huguenot family who produced a large number of significant county, town and estate maps in Ireland between 1754 and 1760. His map of Kilkenny City was made in 1758 (Bradley 2000, Map 5) and shows the area of the proposed development. At the north end of the proposed development, Rocque's map shows the area as open fields bordering the rivers Nore and Breagagh, with orchards bordering the Breagagh further west, and face onto Vicar Street (including AR-13) and Canice's Place. A lane (called Mill Lane on later maps) runs from Vicar Street east to a building beside the Nore, [AR-02], outside the proposed development. Bull Inn (AR-12) is unnamed, but is depicted as a range of buildings with gardens to the rear running to the River Breagagh. Greens Bridge Weir [AR-01] and its associated mills [BH-11] are clearly visible, as is the millrace [AR-15] on the east bank of the River Nore.

The River Breagagh appears to have much more sinuous than today, suggesting it flowed more freely across the land to the north. South of the Breagagh the Horse Barracks [AR-08] is highlighted with cross-hatching, as Rocque did for most civic buildings. The building ranges to the immediate east of the Horse Barracks appear to be the stables and soldiers' accommodation, whilst the highlighted building would appear to be the officers' quarters; both are enclosed by walls. St Francis' Abbey [BH-04] is also clearly marked, though as a simple outline for the choir and blocks for the tower. The nave is depicted as partly built over on its south side [AR-03], whilst the north side of the nave is depicted as a simple line, suggesting that it was still standing in 1758, in agreement with Oben's drawing [Oben 1779] reproduced in Grose's *Antiquities of Ireland* (Grose 1795). To the east of St Francis' Abbey Rocque depicts a number of enclosed gardens separated from the River Breagagh to the north and the River Nore to the east. He does not show EvansTurret [BH-02], but he does depict St Francis' Well [AR-04] as a circular area within an enclosed garden, with a stream flowing north and east to the River Nore through a garden boundary. Rocque depicts the remaining buildings in block form, including the buildings south of friary building probably incorporating St Francis' Abbey brewery [AR-09], and is thought likely to also incorporate the remains of the medieval claustral buildings, whilst the enclosed gardens may incorporate the former precinct of the friary (O'Keeffe 2016).

An open area to the immediate west of St Francis' Abbey possibly corresponds with the Bull Ring (called The Ring today), and may also have been used by the Horse Barracks as a parade ground. From this open space a narrow unnamed street (part of Horse Barrack Lane today) runs west (to modern Watergate Street), whilst another ran south skirting the former friary precinct (also part of Horse Barrack Lane). Rocque depicts block buildings between these lanes and Coal Market (modern Parliament Street), which include the site of Watergate Theatre [BH-10] and the Greyfriars' Mill [AR-11]. The millrace [AR-06] is depicted running diagonally across this map before taking a turn to the east and the Nore; the second millrace [AR-10] is not depicted, indicating it post-dates 1758. Block buildings flanking the millrace may also be associated with St Francis' Abbey Brewery [AR-09], but the brewery is not named on the map. The Court House [BH-09] is depicted as a civic building and called 'County Gaol'. Rocque depicts a number of gardens between the county gaol and the River Nore, as well as a building which may be a precursor for the tea house [BH-07]. Finally, at the south end of the proposed development, Rocque depicts a street running from Coal Market to the River Nore, and named The New Quay (corresponding roughly with the line of modern Market Yard and Bateman's Quay).

Loughnan's map, undated, probably between 1766 & 1827 (Figure 2)

Figure 3: Loughnan's map of Kilkenny c.1800

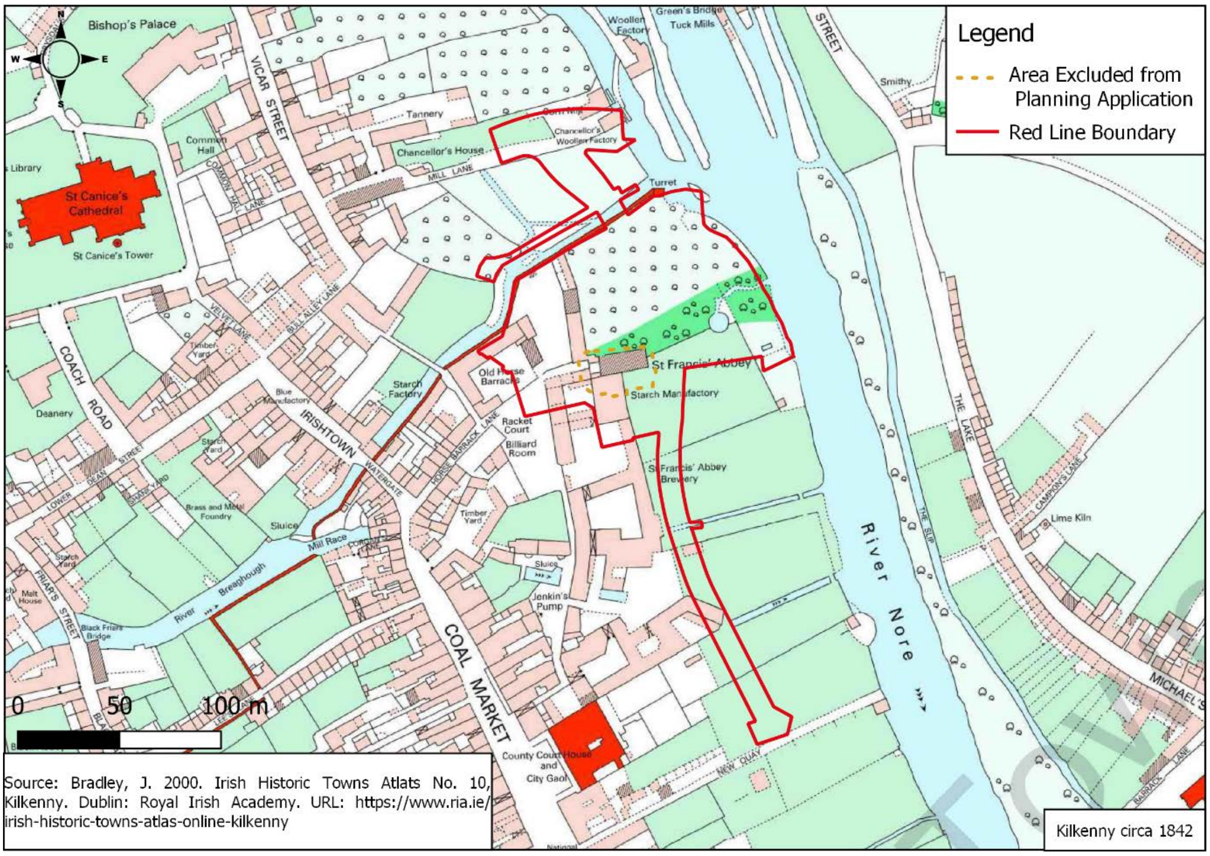
A copy of a map titled 'Loughnan's Estate' depicts a portion of Kilkenny City from St Canice's Cathedral [BH-12] in the north to the Court House [BH-09] in the south, and from Parliament Street in the west to Michael Street and the River Nore in the east, with the central focus of the map around St Francis' Abbey and Brewery. The map details in the top left corner are mostly illegible. However, the map appears to date to after 1766 as it depicts Greens' Bridge, and most likely before 1827 when the brewery freehold was purchased by Smithwick. The purpose of the map appears to have been to depict and locate the buildings, gardens and spaces in and surrounding St Francis' Abbey Brewery as these are numbered (the accompanying terrier or list is not available). The map is to a scale of 5 perches to an inch, but is not planimetrically correct. Significant buildings are drawn as isometric views roughly representative of the actual structures; streets are drawn as elevations of rows of multi-storied buildings without distinction, each having chimneys, and returns depicted to the building's rear.

Starting at the north, the map clearly depicts Greens' Bridge Weir [AR-01] and associated mills [BH-11]. The millrace [AR-15] on the east bank of the River Nore is also depicted. An unnamed road (Mill Lane on later maps) runs from Vicar Street (unnamed) to a large building corresponding with Chancellors' Mill [AR-02]. The space behind the buildings depicted on Vicar Street, Dean Street and Irishtown is without detail, other than narrow regular stylised gardens. Neither does the map depict the River Breagagh. However, it does depict Evans' Turret [BH-02] and includes the name Mr Evans in an area of unenclosed garden to the east of the depiction of St Francis' Abbey [BH-04]. The abbey's choir and bell tower are depicted in oblique elevation, whilst buildings on the south side and a wall on the north side of the nave area [AR-03] are drawn as elevations; a gable to the north of the nave appears to indicate the range of stables and accommodation associated with the Horse Barracks [AR-08]. The Horse Barrack's main building is depicted in elevation with six bays and up to four chimneys. The map depicts elevations of buildings along an east–west street (modern Horse Barracks Lane) leading to an open area (now called The Ring) to the south of the Horse Barracks and west of St Francis' Abbey. Ranges of buildings around courtyards are depicted to the southwest of St Francis' Abbey, most likely associated with the brewery [AR-09], whilst elaborately laid-out gardens are depicted to the east, bordering the River Nore. A boundary wall appears to run from the east end of St Francis' Abbey to the River Nore, with a curving indent appearing to indicate the location of St Francis' Well [AR-04], unnamed.

A range of buildings are depicted around the site of the mill [AR-11] whilst the millrace [AR-10] is clearly visible running west to east under Horse Barrack Lane (unnamed) and beneath a complex of multi-storied buildings corresponding with St Francis' Abbey Brewery [AR-09]. The earlier millrace [AR-06] is less distinct but still depicted as sections of open channel running to the River Nore through the brewery and gardens. The Court House is depicted as a two-storey seven-bay structure with steps; 'gaol yard' [AR-14] is written behind this. Two small buildings are depicted beside the Nore: one a small single-bay two-storey structure [BH-07], the other single-storey and two-bay structure [BH-08], both corresponding with tea houses on the River Nore.

OS Town Plan c.1842 (Figure 4)

Figure 4: Town Plan of Kilkenny, c.1840 (after Bradley 2000, Map 2).



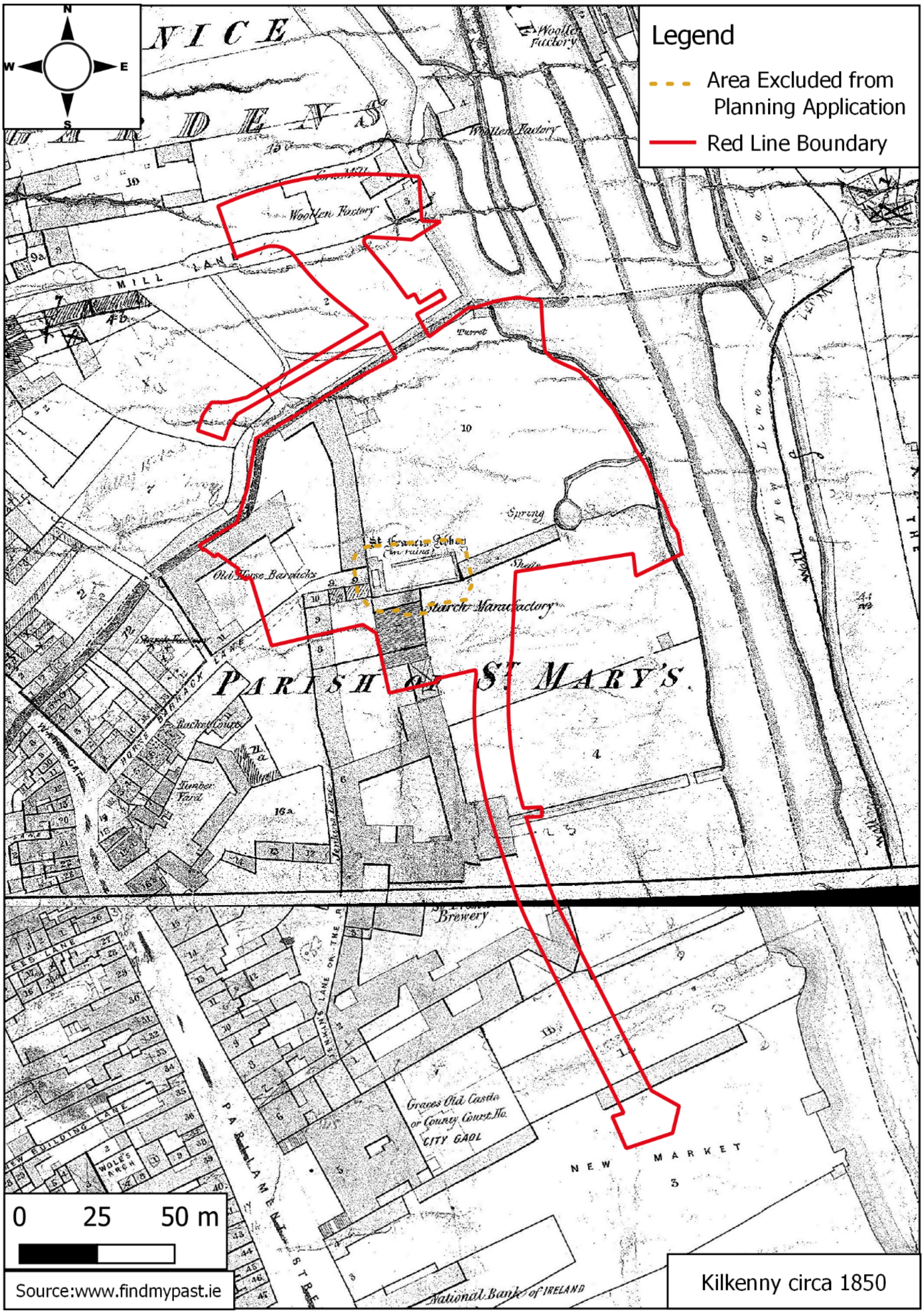
The Ordnance Survey of Ireland (OSI) prepared detailed maps of Kilkenny in 1841 and 1843 (1:1056), and the first edition six-inch map Sheet 19 (1:10,560; published 1842), which were used to prepare Map 2 of the Irish Historic Town Atlas (1:2500) (Bradley 2000, map 2). Starting at the north, Greens' Bridge Weir [AR-01] and its associated mills and Woollen Factory [BH-11] are depicted. The Corn Mill and Chancellor's Woollen Factory [AR-02] are depicted also, at the east end of Mill Lane, which runs from Vicar Street to the mills. The complex of buildings, yard and rear gardens at the Bull Inn [AR-12] are clearly visible if unnamed, but front onto a narrow Bull Alley Lane (now St Canice's Place). A path is visible running south to Cotteral's Bridge [BH-05], but there is no indication of a gate here [AR-07] other than a gap in the depicted City Wall [BH-01]. To the immediate east and parallel to the River Nore, the channel of a millrace [AR-15] is also clearly depicted. The River Breagagh is depicted with a number of channels, including one running from Mill Lane in the north, suggesting that this was a low-lying area at the time. EvansTurret [BH-02] is simply called 'Turret', part of the City Wall, and the enclosed garden or orchard is depicted to the south with St Francis' Well [AR-04] having an outfall to the River Nore. St Francis' Abbey [BH-04] is named and depicted as a roofless building, with structures built in the nave area [AR-03]. A range of buildings to the north of the abbey were the stables (unnamed) and part of the 'Old Horse Barracks' [AR-08], but also overly the area of the former cemetery [AR-05], of which there is no indication on the map. Horse Barrack Lane connected the Old Horse Barracks to Watergate Street, lined with houses; a Starch Factory is located on the south side of the River Breagagh, whilst a large open area lay to the south of the Horse Barracks, bounded by a Racket Court and Billiard Room.

The buildings to the south of St Francis' Abbey are named as a Starch Manufactory, and gardens are depicted between these and the River Nore. St Francis' Abbey Brewery [AR-09] is depicted as a series of courtyards surrounded by buildings, with passages between each courtyard. A Timber Yard is depicted on the site of the Watergate Theatre [BH-10], whilst a number of buildings are depicted around the mill site [AR-11]. The millrace [AR-06] is clearly visible as a discontinuous channel in areas culverted beneath Horse Barrack Lane and the brewery buildings before crossing the gardens beneath a footbridge and emptying into the River Nore. The second millrace [AR-10] is also culverted beneath the brewery buildings before crossing the gardens as an open channel with a footbridge and emptying into the River Nore. A gate (unnamed) into the Brewery is apparent off Horse Barrack Lane, which widens at this point south of the millrace where Jenkins' Pump (no longer extant) is depicted. The County Court House and City Gaol [BH-09] is depicted clearly set back from Parliament Street, whilst the space behind [AR-14] is separated into a series of yards.

At the south end of the proposed development, New Quay (modern Market Yard) leads from Coal Market (modern Parliament Street) to an unnamed building corresponding with the Tea House [BH-08] on the River Nore. The second unnamed building corresponding with a Tea House [BH-07] is located further to the north and with a semi-circular space overlooking the River Nore.

Valuation Map, 1850 (Figure 5)

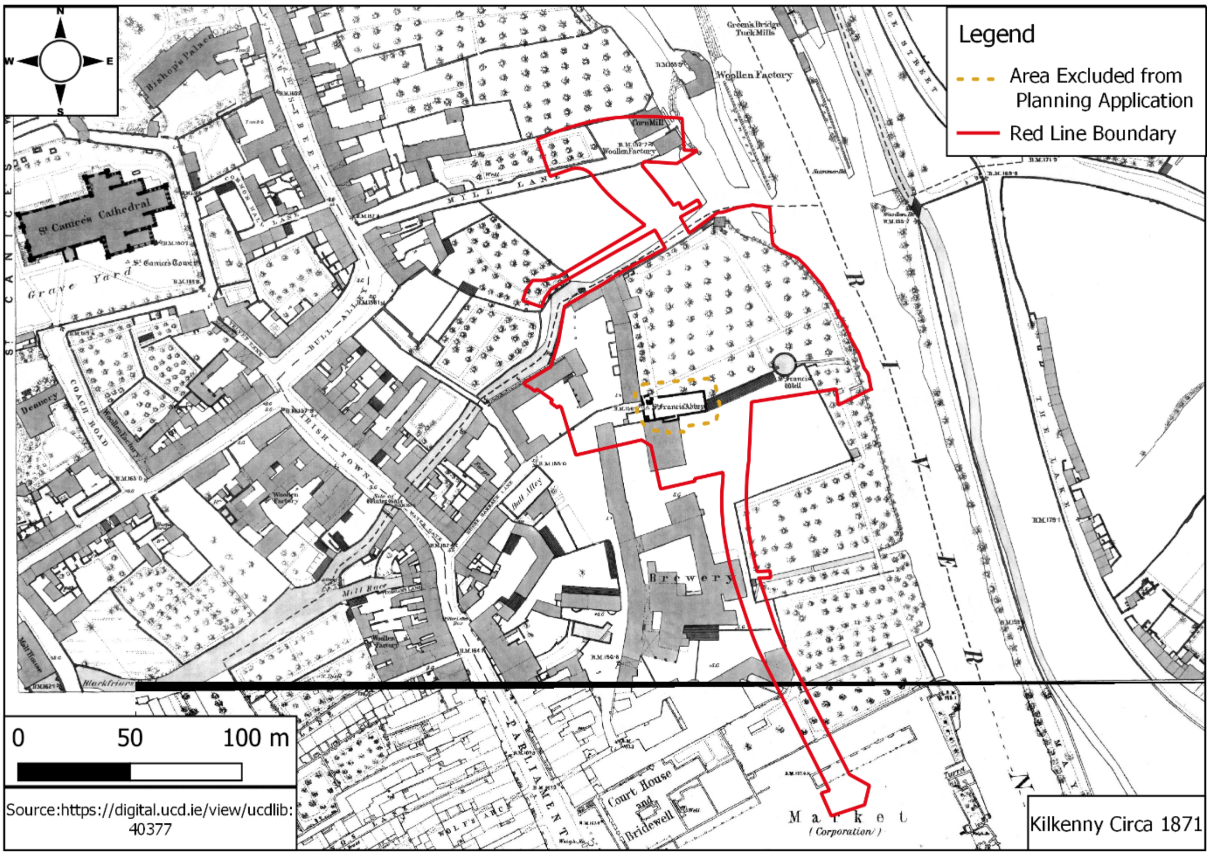
Figure 5: Valuation map of Kilkenny c.1850



The OSI produced a series of manuscript town plan maps for the valuation of properties in the 1830s and 1840s, which were periodically updated with each valuation. A set of these maps from c.1850 shows how the urban landscape changed in a very short period of time. The mills [BH-11 & AR-02] are depicted as is the weir [AR-01] that provided their water power. The land on the north bank of the River Breagagh [AR-20] is still open, with a channel running to it from the north again suggesting that this is low-lying and wet ground. The properties on Vicar Street [including AR-13] and Bull Lane [AR-12] are depicted with gardens to their rear. The Horse Barracks [AR-08] is depicted, as are the former stable buildings north of St Francis' Abbey, but with additional buildings. EvansTurret [BH-02] is labelled 'Turret'; St Francis' Well [AR-04] is labelled 'Spring', whilst a second pool to its south is labelled 'Spring Bath', suggesting this was a place for bathing. St Francis' Abbey [BH-04] is depicted, but now with an apparent breach in its north wall for which there is no evidence today, and appears to be a mistake on the map. The nave of the friary contains four buildings. To the south of the friary's choir and bell tower, a courtyard of buildings stand in the site of the cloister, labelled 'Starch Manufactory' and 'yard'; a hand drawn addition is made to the map on a boundary wall between gardens to the immediate east of the St Francis' Abbey choir, labelled 'sheds'. 'St Francis' Brewery' [AR-09/BH-06] is labelled next to a collection of buildings, whilst the lane outside brewery is labelled 'Jenkin's Lane or the Ring'. The Court House [BH-09] is labelled 'Graces Old Castle or County Court Ho.' and 'City Gaol', separated into yards. Regular gardens with paths are depicted next to the River Nore; the millraces [AR-06 & AR-10] are clearly depicted running through these gardens. At the south end of the proposed development a long building is depicted [AR-18] facing onto an area labelled 'New Market'. The tea house [BH-08] is depicted; the other [BH-07] is not, but this appears to be an omission.

OS Town Plan, 1871 (Figure 6)

Figure 6: Town Plan of Kilkenny from 1871



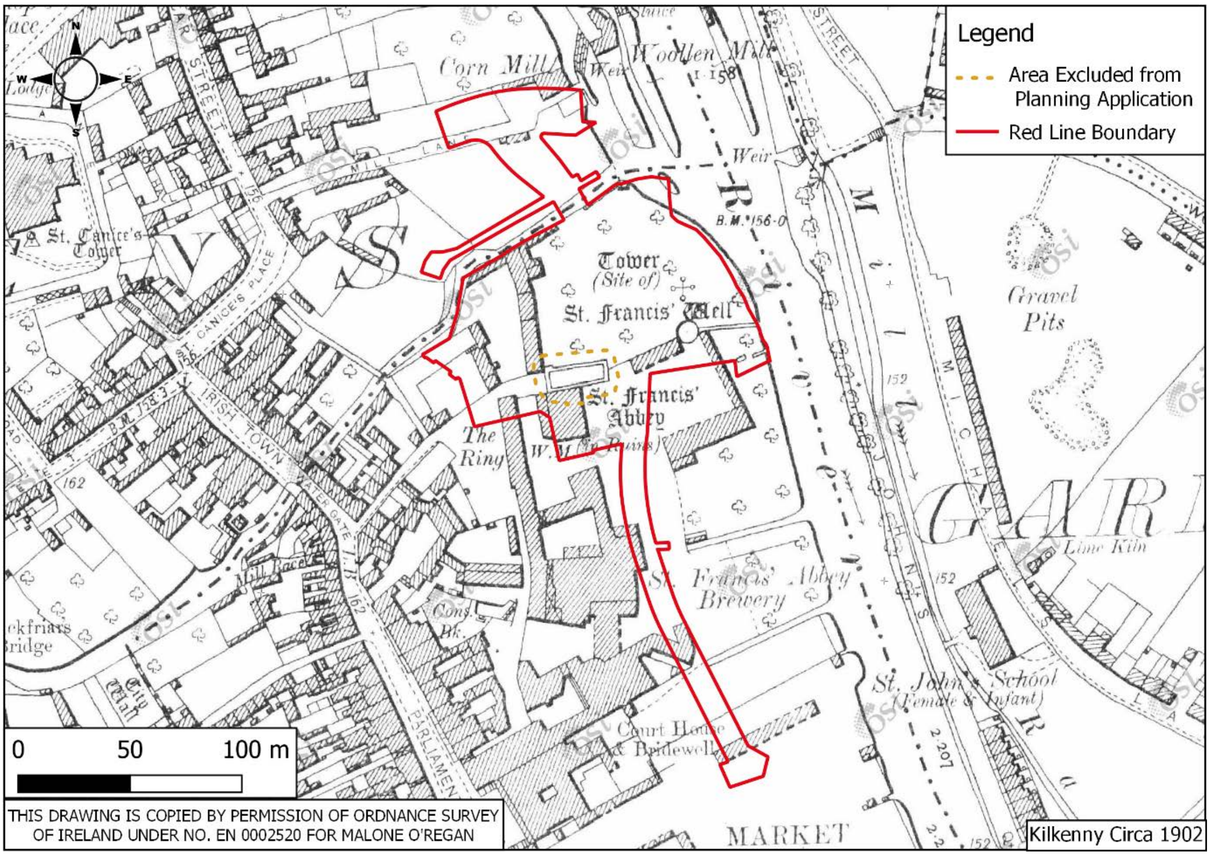
The OS prepared a detailed map (1:1056) of Kilkenny in 1871 in two sheets. Starting at the north, Green's Bridge Weir [AR-01] is depicted in detail with its associated mills, including the Woollen Factory [BH-11], and the stone weirs designed to direct water into each of the mills. Tenters for stretching woollen cloth are depicted to the south of the woollen factory. The millrace on the east bank of the Nore [AR-15] is clearly visible. Mill Lane is depicted running from Vicar Street to the Corn Mill and Woollen Factory [AR-02]. The Bull Inn [AR-12], unnamed on the map, is depicted as an unroofed building fronting onto Bull Alley, with a path leading to gardens through it. The walled gardens to its rear appear to be laid out with paths and planting. A narrow unnamed lane runs from Bull Alley south across Cotterals' Bridge [BH-05] through the City Wall [BH-01], with no indication of a gate [AR-07]. 'City Wall' is written beside the south boundary wall with the River Breagagh between a number of buildings fronting onto the river. The map also depicts steps to a wall walk leading to Evans Turret [BH-02] (unnamed). The enclosed garden south of Evans Turret (Evans Garden) consists of trees with paths leading from the entrance – through the bell tower of St Francis' Abbey [BH-04] – to Evans Turret, the River Nore and to 'St Francis' Well' [AR-04], named and depicted as a circular walled area with an outfall east to the River Nore. The garden extends to the bank of the River Nore to the east.

St Francis' Abbey [BH-04] is depicted as a roofless structure with a roofless building in the nave area [AR-03]. The range of buildings depicted to the north of St Francis' Abbey were by 1871 used as stables by St Francis' Abbey Brewery and appears to have expanded, as had the buildings in the former Horse Barracks [AR-08] where external steps are depicted presumably leading to a first floor. Both these buildings are enclosed by walls from the rest of St Francis' Abbey and Horse Barracks Lane. Horse Barrack Lane is depicted as a narrow street leading from 'Water Gate' to the open area in front of the Horse Barrack, with a Ball Alley to one side. St Francis' Abbey Brewery [AR-09 & BH-06], indicated as 'Brewery' on the map is depicted as four courtyards with surrounding buildings interconnected by access passages, and stretching from St Francis' Abbey south to the Court House [BH-09]. The map depicts the area to the south of St Francis' Abbey as an enclosed walled yard area, taking in what had previously been gardens, with a timber shed facing the boundary wall with Evans Garden.

The site of the Watergate Theatre [BH-10] is depicted in a courtyard leading onto Parliament Street, whist the mill site [AR-11] has a building. The millrace [AR-06] runs as a discontinuous line, presumably through culverts beneath the brewery to emerge in orchard gardens before flowing into the River Nore. The map depicts a small weir where the second millrace [AR-10] forks from it, presumably to deflect a water flow to this. This millrace also flows through culverts beneath the brewery – partly emerging in one courtyard where the water-powered mill was located – before emerging fully in the enclosed gardens to the east of the brewery and flowing into the River Nore. The Court House and Bridewell [BH-09] is depicted in plan, with enclosed yards [AR-14] to its rear, and walled gardens to the River Nore. The Tea House [BH-07] is depicted with a semi-circular wall to the River Nore, whilst the second Tea House [BH-08] is called 'Turret'. The area at the south end of the proposed development is depicted as 'Market (Corporation)', with a long building, presumably for market stalls, and includes a building divided into bays facing onto the market [AR-18].

OS 25-inch map, 1900 (Figure 6)

Figure 12-13 Ordnance Survey map of Kilkenny from 1900.



The OS 25-inch map of Kilkenny City (published in 1902) depicts the Green's Bridge Weir [AR-01], Woollen Mill [BH-11] and Corn Mill [AR-02], whilst the millrace [AR-15] on the east bank of the Nore is called 'Michael's Race'. Mill Lane is depicted running from Vicar Street east to the corn mill, whilst the Bull Inn [AR-12] is depicted as fronting onto St Canice's Place, unroofed, but with a small long building (shed?) in its interior. The unnamed lane leading south from St Canice's Place to Cotteral's Bridge [BH-05] is still apparent, though with no indication of a gate [AR-07] or the City Wall [BH-01], except for the wall walk with steps leading up to Evans Turret [BH-02], unnamed in this map.

The River Breagagh is more or less located in its current course. The garden south of Evans Turret is depicted with trees indicating this was an orchard. However, the 'Tower (Site of)' with cross symbol is incorrect, possibly a case of mistaken identity where the circular outline of St Francis' Well [AR-04] was assumed to be a tower. St Francis' Abbey [BH-04] is depicted as a simple rectangular unroofed structure, with no indication of the bell tower. The buildings formerly depicted in the nave [AR-03] are no longer apparent in the 25-inch map, showing that they have been fully removed by 1902. The ranges of buildings to the north of the friary are roofed, and historically associated with the brewery's stables. The former Horse Barracks [AR-08] is substantially unroofed. A narrow unnamed street leads from Watergate to 'The Ring', an open area in front of the old Horse Barracks and St Francis' Abbey.

St Francis' Abbey Brewery [AR-09] is depicted as occupying a collection of buildings around courtyards, with some new buildings since the 1871 map. The yard to the east of St Francis' Abbey is depicted with a number of buildings against the boundary walls. The space between St Francis' Abbey Brewery and the River Nore is still depicted as gardens. The Watergate Theatre site [BH-10] is depicted as an open yard, whilst there are buildings on the site of the mill [AR-11]. The millrace [AR-06] is depicted as a discontinuous channel running beneath the modern Horse Barrack Lane and brewery in culverts before emerging and flowing into the

River Nore. Similarly, the second millrace [AR-10] runs by culverts under Horse Barrack Lane and the brewery to flow through the gardens into the River Nore. A weir is depicted at the junction of the two millraces, designed to divert water from the older millrace [AR-06] into the northern millrace [AR-06]. The Court House and Bridewell [BH-09] is named, with enclosed yards [AR-14] to its rear. The two tea houses [BH-07 and BH-08] are also depicted as free-standing buildings beside the River Nore. These are located within an area called 'Market', which contains a long, detached building [AR-18] apparently divided into open bays, presumably for market stalls, at the southern end of the proposed development.

References:

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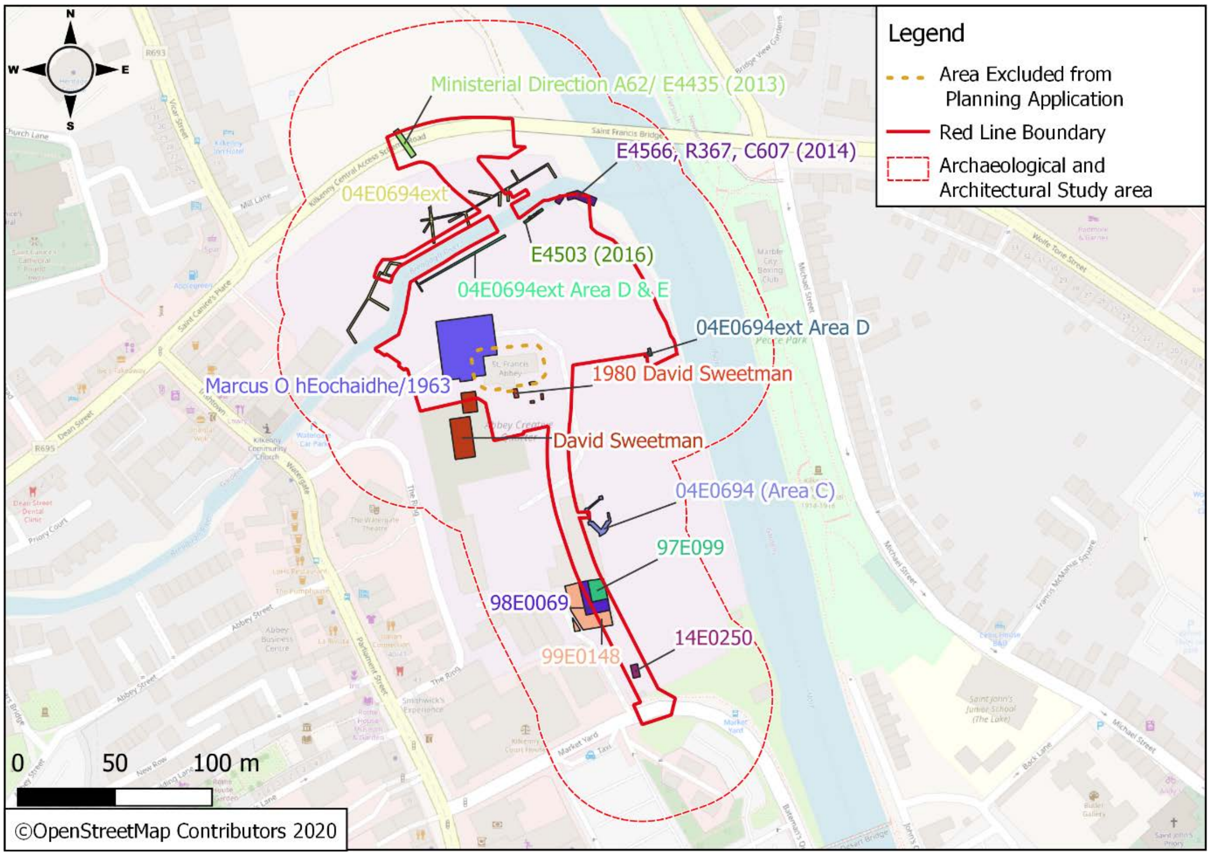
Appendix 12.5

APPENDIX 12.5 Previous archaeological excavations

This appendix summarises the relevant details of previous archaeological excavations and test trenches within the proposed development area, moving from north to south (Figure 1).

Figure 1: Location of previous archaeological excavations in the proposed development



A62/ E4435 Central Access Scheme (Flynn 2013)

Test excavations were carried out in advance of the Central Access Scheme where the new road crossed the former Diageo brewery site. Flynn excavated six test trenches. One test trench (Trench V) was located within the area of the proposed development.

Test Trench V was 15m long, 2.4m wide and a maximum 2m deep. The trench stratigraphy is summarised as follows:

- 0–0.15m: Concrete;
- 0.15–0.35m: Hardcore;
- 0.35–0.95m: Building rubble and garden soil with finds of modern glass, ceramics and metal;
- 1–1.4m: Natural dark grey silt alluvial deposits.

The test excavations indicate a general depth to natural of c.1m to the north of the proposed development. No archaeological material was found.

A survey of ground levels in 2020 shows that the layers described by Flynn in 2013 are beneath 1.2m of made ground for St Francis' Street (Central Access Scheme).

04E0694 Ext. Diageo Brewery (O'Meara 2007)

In 2007, Brenda O'Meara monitored the excavation of service trenches in the Diageo Brewery north of the River Breagagh. A trench 60m long with intersecting trenches totalling 20m long, 1m wide and 2m deep was archaeologically monitored. The ground level ranged from 44.7m to 44.4m OD west to east. The stratigraphic sequence consisted of the following:

- 44.7–44.6m: Concrete yard surface;
- 44.6–44.05m: Mid grey brown sandy gravel, sterile imported hardcore;
- 44.05–43.9m: Second concrete yard surface;
- 43.9–43.4m: Grey gravel sand and mixed red brick and mortar building rubble;
- 43.4–42.7m+: Dark grey black silt with occasional inclusions of red brick.

No archaeological material was found. The excavation identified a second modern concrete yard surface *c*.0.65m below the modern ground surface. This overlay a *c*.0.50m layer of made ground which in turn overlay a silty layer with brick inclusions.

E4566, R367, C607, Evans Turret and Riverbank (Courtney Deery Heritage Consultancy 2015)

In 2014, archaeological monitoring of riverbank remediation works involving the removal of contaminated soil at the junction of the River Nore and the River Breagagh beside Evans Turret was carried out on behalf of Diageo Limited. This work was carried out in conjunction with conservation works on Evans Turret.

Two trenches were excavated. The riverbank soil proved to be very disturbed with the upper c.1.3m comprising a mix of organic river silts, rubbish and stones. A stone wall river revetment at least five courses (c.1.1m) deep, oriented northwest–southeast, adjoined the northeastern corner of Evans Turret. At the end of this test excavation, this wall was covered in a layer of terram and the excavation area was backfilled with clean stone. The inspection and metal detection of the excavated spoil did not produce any finds of archaeological interest. No adverse impacts resulting from piling were observed on the tower.

E4503, City Wall and Evans Turret (Shaffrey Architects 2016a; Shaffrey Architects 2016b; Shaffrey Architects 2016c)

In 2016, three evaluation pits each measuring 1m by 1m and 1.1m deep were excavated under archaeological supervision beside the City Wall during the conservation of Evans Turret and the adjoining remains of the City Wall. The first trench (EP1) encountered modern concrete at 0.60m depth. EP2 encountered the base of the wall for Evans Turret at 1.1m below ground level. EP3 encountered loose stone and possible remnants of render, a wall pier, the main wall and the parapet steps support structure. The evaluation trenches determined that this area had been disturbed in the past.

The three test trenches were joined up with an evaluation trench (ET1) measuring 1.2m by 11.75m long along the face of the City Wall to Evans Turret. This trench was dug to a depth of 1.2m to allow conservation work to proceed on the wall and Evans Turret. Archaeological excavations uncovered the City Wall, and revealed that the wall construction within this location consists of an outer wall with parapet with buttressing piers to inner face with masonry arches between to support the wall-walk between the piers. Of the three arches of the original City Wall structure uncovered, only one arch remained intact. Excavation works at the intact masonry arch uncovered the embrasure to the arrow loop whose dressed surround stone remains visible on the outer wall face along the river. The initial excavation to depth of 1.2m uncovered sections of missing masonry at pier locations. Further excavation was required to establish a sound masonry base to complete repairs. Excavation works uncovered evidence of previous disturbance within the area of excavations such as drains, and a section of poured concrete was uncovered abutting the arrow loop embrasure reveal.

99E0385, River Breagagh (Gowen 2000)

Archaeological monitoring of geotechnical trial pits and test excavations along the eastern section of the River Breagagh was carried out in advance of removal of contaminated riverbed. The excavations also examined the condition of the city wall in 1999. Relatively little of archaeological significance, other than some sherds of medieval pottery, was recovered from monitoring geotechnical investigations in the riverbed. The report identified significant structural issues with the town wall which were subsequently addressed during the River Nore Drainage Scheme (2001–04).

01E0821, River Nore (Phelan 2003)

Archaeological monitoring of works in the riverbed of the Nore during the Kilkenny Main Drainage project uncovered a wide variety of artefacts from the river immediately outside the proposed development, including a nineteenth-century bayonet, a halfpenny coin, two door knockers, horseshoe, four keys, four nails, a padlock, two iron shoe heels and a knife handle. Most of these finds were nineteenth- or twentieth-century in date, with a few possibly medieval. All were recovered during large-scale works in the river.

01E0909, River Nore (Doyle 2003)

Archaeological monitoring of works in the riverbed of the Nore during the Kilkenny Main Drainage project uncovered a wide variety of artefacts from the river outside the proposed development, including sixteen architectural fragments including window sill stones, quoin stones, bollards, ashlar capstones, window jams, buckles, buttons, clay pipes, coins, dress pins, horse bits, knives, jew's harps, three guns, a medieval cross bow bolt, an iron cannon, and prehistoric lithics, including a Mesolithic flint microlith and a flint blade. All finds were recovered during large-scale works in the river.

01E0632, River Breagagh (Doyle 2002)

Archaeological monitoring of the removal of c.1.7m depth of riverbed contaminated with PCB in the River Breagagh was carried out in 2001 along c.150m of the river from the River Nore in the east to the rear of the Horse Barracks in the west. Fragments of cut stone, dressed ashlar blocks from the medieval wall and the Horse Barracks, and an iron sword were recovered during monitoring. The medieval wall flanking the excavation was conserved as part of the works.

04E0694ext Area E (O'Meara 2007)

From 2004–06, Brenda O'Meara archaeologically monitored of the installation of trenches for services to the north of St Francis' Abbey adjacent and parallel to the City Wall. The following stratigraphy was reported:

- 44.70–44.60: Concrete slab;
- 44.60–44.30: Steel reinforced concrete slab;
- 44.30–43.70: Mixed reddish-brown silt and river pebbles. Inclusions of glass, red brick and stone. Made ground;
- 43.70–43.50: Very mixed layer of stone, mortar and red brick. Building rubble; Possibly part of Horse Barracks building or imported builders' rubble used as fill;

- 43.60–43.20: Dark brown silt alluvium. Natural river deposit;
- 43.30–42.80: Yellow brown silty clay. Very compacted, slightly “plastic”. No inclusions. This layer is shallower on the yard (south) side of the trench, getting thicker towards the River Breagagh;
- 42.80–41.90: Mid-grey clay silt alluvium;
- 41.90–40.60: Clean river gravel. Shingle. Natural river deposit;
- 40.60–40.50m OD+: Mid yellow clay.

Excavations by Marcus Ó hEochaidhe, 1963 (unpublished; Conlon 1975; Courtney Deery 2014, 60–62)

Marcus Ó hEochaidhe carried out archaeological excavations to the north of St Francis’ Abbey in 1963, over the area of the nave, north aisle and north transept (AR-03). These have the recorded E number E751 (NMI Topographical Files). The results of the excavations are unpublished, and available reports and archives were not available to consult for this assessment. However, several photographs and a plan of the buildings excavated are available and have been consulted; a brief summary of the excavations were published (Conlon 1975; Lanigan et al. 1987); and the available archives from the excavation are summarised in Courtney Deery’s 2014 report for the Abbey Creative Quarter Masterplan (Courtney Deery Heritage Consultancy 2014).

The excavation appears to have concentrated to the immediate north and west of the upstanding remains of St Francis’s Abbey (BH-04), and uncovered the large fifteenth-century transept measuring 20m by 18m, with internal burials. This transept partly replaced an earlier aisle on the north side of the nave. The Delahunty grave slab was recovered during the excavation within the north transept, with text in a Gothic style and a date of 1624; it is now located inside St Francis’ Abbey (KK019-026151-). Other architectural fragments stored inside the abbey also came from this excavation. Subsequent archaeological excavations in 2018 (summary below) confirmed that the archaeology uncovered by Ó hEochaidhe is preserved beneath the concrete yard surrounding St Francis’ Abbey (ACSU et al. 2018a).

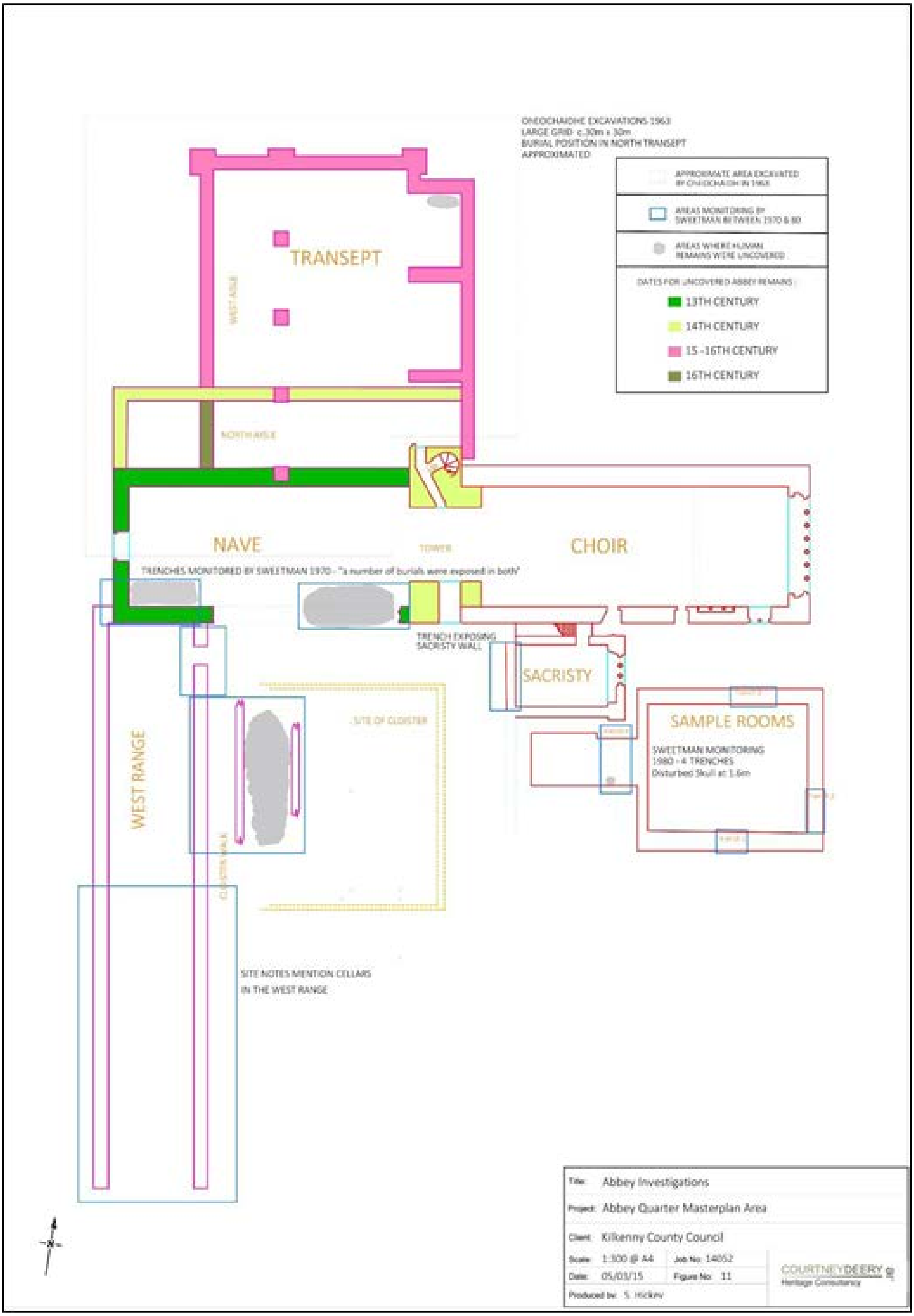
Excavations by David Sweetman, 1970, 1971 & 1980 (unpublished; Conlon 1975; Courtney Deery 2014, 62–64)

David Sweetman monitored the construction of the Brewhouse Building (1970 and 1971) and the Tasting Room (1980). Monitoring for the Brewhouse uncovered remains of the west claustral range extended south of the nave, with a cloister garth 18m by 17m and an ambulatory 1.8m wide, with frequent *in-situ* burials in the cloister ambulatory (AR-03). Pottery discovered was predominantly seventeenth-century English and German imports, with a few sherds of thirteenth-century English and French wares. The northwest corner of the cloister was disturbed by nineteenth-century construction.

Sweetman also investigated the site of the Tasting Room (BH-03) in advance of construction, discovering in 1m-deep trenches (the depth of the foundations for the Tasting Room) cobbling over brick and ash-rich soils. Another trench south of the Sacristy discovered a 4.5m length of the east range chapter room to a depth of 1.6m, with *in-situ* burials (Courtney Deery Heritage Consultancy 2014, 64).

Finds from the archaeological excavations are in the National Museum of Ireland (see Appendix 12-6).

Figure 2: Plan of St. Francis' Abbey (after Courtney Deery Heritage Consultancy 2014, fig. 19)



04E0694 Area C (O'Meara 2007)

In 2004, archaeological monitoring was carried out for the construction of an effluent drainage system, which involved the excavation of a series of interconnected trenches. The predevelopment ground level was 44.45m OD. Archaeological works identified the following stratigraphic sequence:

- 44.45–44.20m: Steel reinforced concrete;
- 44.20–43.60m: Mixed rubble and imported clay land fill;
- 43.60–43.10m: Brown black sandy silt with inclusions of limestone and gravel. Mixed river gravels and bank material;
- 43.10–42.60m: Mixed brown sand and gravel. River deposits.

An arched culvert for the millrace (AR-10) was exposed 0.8m below modern ground surface (43.65m OD). The arch appears to have been constructed in the nineteenth century and was 2.4m wide. The millrace was fully culverted to the river in the late twentieth century (O'Meara 2007).

98E0069 Fermenter Block (Gowen 1998)

Margaret Gowen carried out a test excavation in advance of the development of the fermenter block of the Maturation Building in 1998. The development would be constructed on piled foundations. Two test trenches were excavated. The stratigraphic sequence for the first trench was:

- 0–0.70m: Hardcore and dry compacted heavy gravel fill;
- 0.70–1.20m: Bedding clay and rubble fill;
- 1.20–1.50m: Clay fill;
- 1.50m+: Grey-brown organic silt with very occasional and fragmentary animal bone. No structures or other inclusions. Cut by a wall;
- Two interconnecting defunct sewers over a limestone wall 0.6–0.7m deep;
- A live pipe-run was encountered at 0.9m depth.

The stratigraphic sequence of the second trench was similar to the first. Possible live services or walls were encountered in this trench also and left *in situ*. The director interpreted base organic silts as possible medieval garden soils, and the walls as likely post-medieval in date. These defunct sewers and walls would appear to correspond with buildings associated with the eighteenth- and nineteenth-century St Francis' Abbey Brewery (AR-09) and the medieval millrace (AR-06).

99E0148 Fermenter Block (O'Donovan 1998b)

Following up on Margaret Gowen's excavation, further excavations by Ed O'Donovan explored the archaeological impact of the Maturation Building fermenter block development. O'Donovan noted the following stratigraphic sequence:

- 0–0.35m: Reinforced concrete at 44.5m OD;
- 0.35–0.81m: Limestone cobbles and gravel imported fill;
- 0.81–0.92m: Thin lens of compact black clay and cobbles (occupation surface);
- 0.92–1.52m: Grey organic clay containing shell, butchered animal bone, post-medieval pottery in a deposit;
- 1.52–2.13m: Grey organic clay containing shell, butchered animal bone, post-medieval pottery in a deposit;
- 2.13–2.79m: Black soft organic silt containing shell, wooden roundwoods, butchered animal bone, few other inclusions, with the exception of fragment of medieval glazed roof tile;

- 2.79m+: Hard gravel from natural river deposits, below water table.

99E0148 Fermenter Block (O'Donovan 1998a)

Further test excavations by O'Donovan on the site of the Maturation Building fermenter block under the same licence (99E0148) uncovered this sequence of archaeology:

- 0–0.35m: Reinforced concrete modern floor;
- 0.35–0.90m: Limestone cobbles and gravel imported fill;
- 0.90–1.40m: Mixed limestone and red-brick rubble with mortar;
- 1.40–2.90m: Black soft organic silt containing some stone, red-brick fragments, slate, butchered animal bone, shells and the remains of rounded wood stakes;
- 2.90–3.10m: Grey gravelly clay and water table;
- 3.10m+: Yellow gravelly clay from natural river deposits.

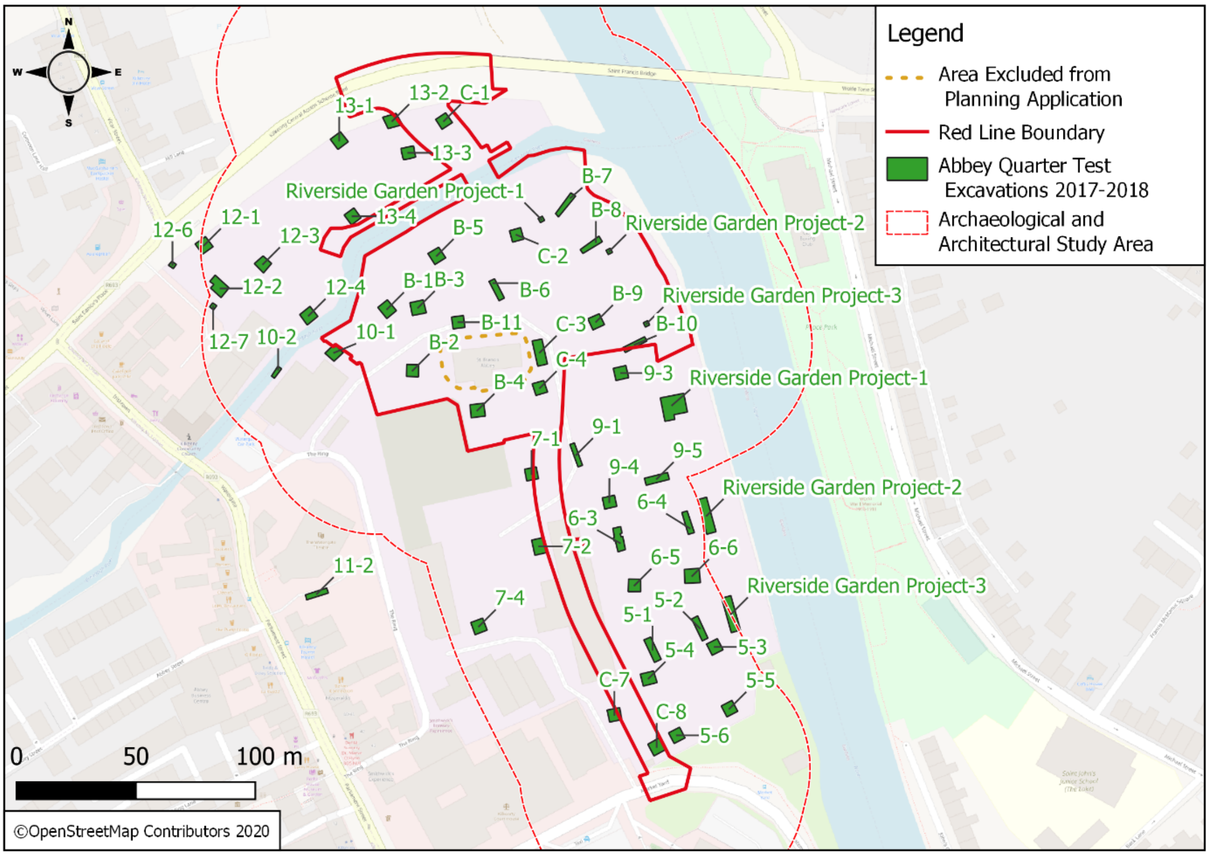
The test pit uncovered a limestone rubble wall 0.90m wide and 0.95m deep.

14E0250 Diageo Brewery (Courtney Deery Heritage Consultancy 2014, 73)

Service trenches excavated in the former Diageo Brewery site were archaeologically monitored by Gill McLoughlin in 2014. This included an outfall upgrade at the south end of the brewery yard. This excavation examined an area 7 x 4m and over 3m deep. The area had been previously extensively disturbed due to two existing manholes and no archaeological features or finds were revealed. A possible riverine deposit (a dark grey brown silt) was detected below c.1.5m.

C853/E4950, C798/ E4822, 17E0108 & 17E0642 Abbey Quarter Test Excavations 2017 & 2018 (AMS/ACSU) (Figure 3)

Figure 3: Location of ACSU test excavations 2017-2018



The most recent archaeological excavations in St Francis' Abbey Brewery consisted of test excavations specifically designed to investigate the archaeological potential of the Abbey Quarter development area, as set out in Courtney Deery's 2014 archaeological report (Courtney Deery Heritage Consultancy 2014) and specified in strategy documents prepared by AMS for Kilkenny County Council (AMS 2016a; AMS 2016b; AMS 2016c; AMS 2016d; AMS 2016e; AMS 2016f; AMS 2016g). The excavations were carried out by ACSU with Jon Stirland as the excavation director. Separate reports were prepared for each area of the Abbey Quarter Masterplan areas.

Test trenches in the area of the National Monument of St Francis' Abbey were carried out under Ministerial Consent C853/E4950; test trenches carried out adjacent to the City Wall were excavated under Ministerial Consent C798/4822; test trenches outside the National Monument were carried out under licence 17E0642. A total of 53 archaeological test trenches were excavated over an extensive area of the Abbey Quarter Masterplan; 39 of these test trenches were within or immediately adjacent to the proposed development. These investigations are outlined separately below.

C853/E4950 Public Realm B (ACSU et al. 2018a) [13]

Public Realm B corresponds with the area of the Urban Park, the area surrounding the upstanding remains of St Francis' Abbey (BH-04) within the National Monument, and including

[13] The levels have been updated to correspond with the most recent topographical survey of the Abbey Quarter in 2020.

the subsurface remains of the friary excavated by Marcus Ó hEochaidhe and David Sweetman.

Trench B-1:

- Top of Trench 44.72m
- Top of Archaeology 43.93m
- Base of Archaeology -
- Base of Trench 42.84m
- Depth to Top of Archaeology 0.79m
- Thickness of Archaeology -

Archaeology was found beneath 0.3m of concrete and 0.58m of hardcore fill. The 1.09m of archaeology investigated in this trench consisted of mixed deposits with seventeenth- to nineteenth-century ceramics and animal bones over a cobble surface and the substantial walls of a building associated with the Horse Barracks (AR-08), 0.9m wide and 1m high, with an associated stone and brick drain. Finds from the lower layers included sixteenth- to eighteenth-century pottery and iron nails, tile and brick fragments and animal bone. *In-situ* human remains from St Francis' Abbey cemetery (AR-05) were found and, following advice from the osteoarchaeologist, the trench was stopped before the base of archaeology was reached. These deposits, walls and cemetery have high archaeological significance.

Trench B-2:

- Top of Trench 44.82m
- Top of Archaeology 43.96m
- Base of Archaeology -
- Base of Trench 43.25m
- Depth to Top of Archaeology 0.86m
- Thickness of Archaeology -

This area was archaeologically excavated by Marcus Ó hEochaidhe in 1963 and is located in the area of St Francis' Abbey's nave (AR-03). Archaeology was found beneath 0.30m of reinforced concrete, 0.50m of modern hardcore and c.0.55m of mixed soils backfilled on the site. The outline of Ó hEochaidhe's excavation trenches were identified. The interior edge of the west wall of the friary nave were identified (extending outside the excavation area), as were four *in-situ* burials. The overlying deposits were mixed with medieval and post-medieval ceramics and tiles, indicating that Ó hEochaidhe's excavations were backfilled with the spoil from his excavation. The *in-situ* human remains were located inside the nave; following advice from the osteoarchaeologist, the trench was stopped before the base of archaeology was reached. These deposits, walls and cemetery have high archaeological significance.

Trench B-3:

- Top of Trench 44.63m
- Top of Archaeology 43.51m
- Base of Archaeology -
- Base of Trench 43.14m
- Depth to Top of Archaeology 1.12m
- Thickness of Archaeology -

This area was archaeologically excavated by Marcus Ó hEochaidhe in 1963 and is located in the area of St Francis' Abbey's fifteenth-century transept (AR-03). Archaeology was found beneath 0.28m of concrete, 0.6m of modern hardcore and 0.58m of mixed backfilled deposits, all containing a mixture of medieval and post-medieval ceramics, tile, glass, clay pipes, iron, brick and animal bones, all very mixed. The archaeology consisted of the 1.3m wide north wall of the fifteenth-century transept uncovered by Ó hEochaidhe in 1963, with interior *in-situ* burials, including a slab-lined grave with two *in-situ* burials. Following advice from the osteoarchaeologist, the trench was stopped before the base of archaeology was reached. These deposits, walls and cemetery have high archaeological significance.

Trench B-4:

- Top of Trench 44.78m
- Top of Archaeology -
- Base of Archaeology -
- Base of Trench 41.91m
- Depth to Top of Archaeology -
- Thickness of Archaeology -

This trench was excavated in the area of St Francis' Abbey's cloister (AR-03). The test trench revealed that the area was substantially disturbed with backfilled cellars from the nineteenth- and twentieth-century brewery (AR-09) cut into natural subsoil; no significant archaeology was identified.

Trench B-5:

- Top of Trench 44.59m
- Top of Archaeology 43.52m
- Base of Archaeology -
- Base of Trench 42.66m
- Depth to Top of Archaeology 1.07m
- Thickness of Archaeology -

This test trench was excavated on the site of post-medieval buildings to the north of St Francis' Abbey (AR-03), associated with the stables of the Horse Barracks (AR-08) and, later, St Francis' Abbey Brewery (AR-09). Test excavations found archaeology beneath 0.24m of concrete, 0.44m of hardcore and 0.36m of demolition rubble. The archaeology consisted of c.0.6m wide walls of a post-medieval building in garden soils with finds of seventeenth- to nineteenth-century post-medieval pottery, mortar, glass, clay pipe fragments, oyster shells and animal bone, disarticulated human bone and one sherd of medieval pottery. Further excavation found *in-situ* human burials beneath the levels of the post-medieval buildings and garden soils, most likely part of the cemetery of St Francis' Abbey (AR-05). Following advice from the osteoarchaeologist, the trench was stopped before the base of archaeology was reached. These deposits, walls and cemetery have high archaeological significance.

Trench B-6:

- Top of Trench 44.59m
- Top of Archaeology 42.54m
- Base of Archaeology 41.61m
- Base of Trench 41.61m
- Depth to Top of Archaeology 2.05m
- Thickness of Archaeology 0.93m

The 0.93m of archaeology consisted of waterlogged garden soils with no finds. The deposits are archaeologically significant because of their potential to preserve archaeological material.

Trench B-7:

- Top of Trench 44.69m
- Top of Archaeology 42.87m
- Base of Archaeology -
- Base of Trench 42.87m
- Depth to Top of Archaeology 1.82m
- Thickness of Archaeology -

The trench encountered waterlogged loose rubble and hardcore deposits which collapsed into the trench. Excavations were stopped for health and safety reasons at the top of gardens soils (AR-17) because the edges of the trench were collapsing. The garden soils are archaeologically significant because of their potential to preserve archaeological material.

Trench B-8:

- Top of Trench 44.94m
- Top of Archaeology 43.21m
- Base of Archaeology -
- Base of Trench 43.21m
- Depth to Top of Archaeology 1.73m
- Thickness of Archaeology -

The trench encountered waterlogged loose rubble and hardcore deposits which collapsed into the trench. Excavations were stopped for health and safety reasons at the top of gardens soils because the edges of the trench were collapsing. The garden soils (AR-17) are archaeologically significant because of their potential to preserve archaeological material.

Trench B-9 was not excavated because of the water-filled chamber below the concrete surface.

Trench B-10:

- Top of Trench 44.78m
- Top of Archaeology 42.97m
- Base of Archaeology 41.5m
- Base of Trench 41.5m
- Depth to Top of Archaeology 1.81m
- Thickness of Archaeology 1.47m

The 1.47m of archaeological deposits consisted of waterlogged garden soils (AR-17), a possible stone revetment, and a possible timber revetment of hazel round woods and worked split oak stakes, one with a mortice slot. No finds were made in association with these, but they may represent medieval revetments to reclaim the friary's precinct from the River Nore floodplain after the thirteenth-century foundation of St Francis' Abbey. The garden soils are archaeologically significant because of the revetment, the preservation of timbers, and their potential to preserve archaeological material.

Trench B-11:

- Top of Trench 44.75m
- Top of Archaeology 43.18m
- Base of Archaeology 41.48m
- Base of Trench 41.46m
- Depth to Top of Archaeology 1.57m
- Thickness of Archaeology 1.7m

Trench B-11 was excavated on the site of the east wall of the north transept (AR-03), in an area excavated by Marcus Ó hEochaidhe in 1963. The archaeology was found beneath 0.26m of reinforced concrete, 0.54m of modern hardcore and 0.77m of mixed modern deposits backfilled onto the area of Ó hEochaidhe's excavation, mixed with plastic, brick and aluminium. Ó hEochaidhe's excavation cuttings were apparent. The excavation identified a number of *in-situ* burials in what would have been the interior of the transept. Further investigations did not discover the north transept's east wall as anticipated, indicating that it has been robbed out. Disturbed deposits in its anticipated location contained mixed soils with medieval pottery, tile and kiln waste. The archaeology in this trench is highly significant because of the presence of *in-situ* burials and the probable line of the fifteenth-century transept.

17E0642 Public Realm C (ACSU et al. 2018c)[14]

Public Realm C corresponds with the proposed street and runs from St Francis' Street south to Market Yard and Bateman Quay. Trench 1 in Public Realm C north of the River Breagagh, and trenches 7 and 8 south of St Francis' Abbey National Monument were excavated under the licence 17E0642. The portions of Public Realm C within the designated National Monument for St Francis' Abbey (the area of the proposed Urban Park) were carried out under Ministerial Consent C853/E4950 (ACSU et al. 2018b).

Trench C-1 (at the north end of the proposed street) was abandoned for health and safety reasons without reaching archaeology.

Trench C-7 (at the south end of the proposed development):

- Top of Trench 44.58m
- Top of Archaeology 43.46m
- Base of Archaeology 41.38m
- Base of Trench 41.38m
- Depth to Top of Archaeology 1.12m
- Thickness of Archaeology 2.08m

The 2.08m of archaeology consists of mixed garden soils (AR-17) and layers of demolition rubble; finds included post-medieval ceramics, clay pipe stems, broken glass, brick and slate fragments. The deposits are archaeologically significant because of their potential to preserve archaeological material.

Trench C-8 (at the south end of the proposed development):

- Top of Trench 44.69m
- Top of Archaeology 43.16m
- Base of Archaeology 41.87m
- Base of Trench 41.87m
- Depth to Top of Archaeology 1.53m
- Thickness of Archaeology 1.29m

The 1.29m of archaeology consisted of garden soils and the foundations of a market building depicted on historical Valuation's maps from c.1850 (AR-18). The deposits are archaeologically significant because of the presence of this structure and their potential to preserve archaeological material.

C853/E4950 Public Realm C (ACSU et al. 2018b)[15]

Trench C-2

- Top of Trench 44.94m
- Top of Archaeology 43.28m
- Base of Archaeology 42.14m
- Base of Trench 42.14m
- Depth to Top of Archaeology 1.66m
- Thickness of Archaeology 1.14m

[14] The levels have been updated to correspond with the most recent topographical survey of the Abbey Quarter in 2020.
[15] The levels have been updated to correspond with the most recent topographical survey of the Abbey Quarter in 2020.

The 1.14m of archaeology consisted of waterlogged garden soils over alluvial soils (AR-16), but no finds. The deposits are archaeologically significant because of their potential to preserve archaeological material.

Trench C-3:

- Top of Trench 44.8m
- Top of Archaeology 44.38m
- Base of Archaeology 43.62m
- Base of Trench 43.4m
- Depth to Top of Archaeology 0.42m
- Thickness of Archaeology 0.76m

This trench was excavated immediately east of St Francis' Abbey choir (BH-04). A modern large-diameter service pipe ran north to south through this trench and the archaeological deposits. A post-medieval boundary wall (0.6m wide, 1m high) apparent in historical maps was identified in post-medieval garden deposits (AR-17). No finds or evidence for burials or medieval features was identified. The garden deposits are archaeologically significant because of their potential to preserve archaeological material.

Trench C-4:

- Top of Trench 44.62m
- Top of Archaeology 42.99m
- Base of Archaeology 41.81m
- Base of Trench 41.81m
- Depth to Top of Archaeology 1.63m
- Thickness of Archaeology 1.18m

This trench was excavated immediately east of the Tasting Room (BH-03). The 1.18m of archaeological deposits consisted of mixed garden deposits over alluvial soils. Finds included seventeenth-, eighteenth- and nineteenth-century pottery and animal bone fragments. No medieval archaeology was identified. The deposits are archaeologically significant because of their potential to preserve archaeological material.

17E0108 Riverside Gardens (Murphy 2017)

Three very small shallow investigations (Trenches 1, 2 and 3) were carried out to assess the depth of screed over concrete in the area of the recently demolished Diageo brewery buildings. None penetrate the level of the concrete surface. No archaeology was identified.

17E0642 Urban Block 5 (ACSU et al. 2018d)[16]

Urban Block 5 is located at the southeast corner of the former Diageo Brewery, between the proposed development street and the River Nore and adjacent to the Market Yard and Bateman Quay. This was an area of gardens, and contained a market building from the later nineteenth century.

Trench 5-1:

- Top of Trench 44.63m
- Top of Archaeology 42.35m
- Base of Archaeology 40.47m
- Base of Trench 40.47m

[16] The levels have been updated to correspond with the most recent topographical survey of the Abbey Quarter in 2020.

- Depth to Top of Archaeology 2.28m
- Thickness of Archaeology 1.88m

Trench 5-1 was designed to investigate the millrace (AR-06). Archaeology was found beneath 0.15m to 0.25m of concrete and modern made ground. The millrace was found to be encased in a concrete culvert. Archaeology consisted of 1.88m of garden soil over alluvial deposits (AR-17); no finds were made. The garden soils are archaeologically significant because of their potential to preserve archaeological material.

Trench 5-4:

- Top of Trench 45m
- Top of Archaeology 43.3m
- Base of Archaeology 42.44m
- Base of Trench 42.44m
- Depth to Top of Archaeology 1.7m
- Thickness of Archaeology 0.86m

Trench 5-4 was excavated in an area depicted as gardens on historical maps. Archaeology was found beneath 0.15m of concrete and 2m of made ground. The 0.86m of archaeology consisted of garden soils over alluvial deposits (AR-17), with no archaeological finds. The garden soils are archaeologically significant because of their potential to preserve archaeological material.

Trench 5-6:

- Top of Trench 44.63m
- Top of Archaeology 43.05m
- Base of Archaeology 40.78m
- Base of Trench 40.78m
- Depth to Top of Archaeology 1.58m
- Thickness of Archaeology 2.27m

Trench 5-6 was excavated to investigate a market building depicted on historical Valuations maps from 1850 (AR-18). Archaeology was found beneath 0.15m of concrete and 1.43m of modern made ground. The archaeology consisted of a wall from a market building constructed c.1850, measuring 0.98m wide and 1.1m high. The remaining archaeology consisted of garden soils (AR-17) over alluvial deposits, with nineteenth-century glass bottle fragments. The market building wall (AR-18) is archaeologically significant; the garden soils are also archaeologically significant because of their potential to preserve archaeological material.

17E0642 Urban Block 6 (ACSU et al. 2018e)[17]

Urban Block 6 is located southeast of St Francis' Abbey, between the proposed street and the River Nore. This was an area of enclosed gardens crossed by the eighteenth-century millrace (AR-10).

Trench 6-3:

- Top of Trench 44.65m
- Top of Archaeology 43.41m
- Base of Archaeology 41.69m
- Base of Trench 41.69m
- Depth to Top of Archaeology 1.24m
- Thickness of Archaeology 1.72m

[17] The levels have been updated to correspond with the most recent topographical survey of the Abbey Quarter in 2020.

Trench 6-3 was designed to investigate the millrace (AR-10). Archaeology was found beneath 0.20m of concrete and 0.22m of hardcore. The millrace was found to be encased in a concrete culvert 3.50m wide and 2m deep, which was found 1.10m below the present ground surface. To the side of this culvert, the excavation found deposits of garden soil (AR-17) with a 0.20m-thick layer of dumped furnace waste which appears to have been used to raise or reclaim the ground. No finds were made. The garden soils are archaeologically significant because of their potential to preserve archaeological material.

Trench 6-5:

- Top of Trench 44.63m
- Top of Archaeology 42.83m
- Base of Archaeology 41.2m
- Base of Trench 41.2m
- Depth to Top of Archaeology 1.8m
- Thickness of Archaeology 1.63m

Test trench 6-5 was excavated in an area of gardens depicted on historical maps. Archaeology was found beneath 0.44m of reinforced concrete and 1.4m of modern deposits. The 1.72m of archaeology consisted of garden soils mixed with industrial waste over alluvial deposits (AR-17). The garden soils are archaeologically significant because of their potential to preserve archaeological material.

C853/ E4950 Urban Block 7 (ACSU et al. 2018f) [18]

Urban Block 7 is located south of St Francis' Abbey on the site of the former St Francis' Abbey Brewery (AR-09) and gardens (AR-17). Test trenches within the St Francis' Abbey National Monument were excavated under Ministerial Consent C853/E4950; those outside the National Monument were excavated under licence 17E0642 (ACSU et al. 2018g).

Trench 7-1:

- Top of Trench 45.02m
- Top of Archaeology 43.89m
- Base of Archaeology 41.82m
- Base of Trench 41.82m
- Depth to Top of Archaeology 1.13m
- Thickness of Archaeology 2.07m

The archaeology in this trench was found beneath 0.60m of reinforced concrete and 0.53m of modern made ground. The 2.07m of archaeology consisted of a garden boundary wall depicted on historical maps, 0.92m wide and 1.01m deep, and mixed garden soils with medieval and post-medieval pottery. The garden wall is archaeologically significant; the garden soils are also archaeologically significant because of their potential to preserve archaeological material.

17E0642 Urban Block 7 (ACSU et al. 2018g)[19]

Trench 7-2:

- Top of Trench 45.13m
- Top of Archaeology 44.01m

[18] The levels have been updated to correspond with the most recent topographical survey of the Abbey Quarter in 2020.

[19] The levels have been updated to correspond with the most recent topographical survey of the Abbey Quarter in 2020.

- Base of Archaeology 40.75m
- Base of Trench 40.75m
- Depth to Top of Archaeology 1.12m
- Thickness of Archaeology 3.26m

This trench was positioned to investigate the remains of buildings associated with St Francis' Abbey Brewery (AR-09). The archaeology was found beneath a 0.90m thick layer of reinforced concrete and 0.22m of modern hardcore. The 3.26m of archaeology consisted of the remains of buildings associated with the brewery depicted on historical maps. The walls were from 0.30m to 0.80m thick and 1.3m high, with a drain containing eighteenth- to nineteenth-century pottery. Garden soils to the side of the wall contained some animal bone and a preserved wooden plank of split oak and a wooden stake. The structural remains of the brewery are archaeologically significant; the garden soils are also archaeologically significant because of their potential to preserve archaeological material, including timbers.

C0853/ E4950 Urban Block 9 (ACSU et al. 2018h)[20]

Urban Block 9 is located to the southeast of St Francis' Abbey National Monument, between the proposed development street and the River Nore. Trenches which fell within the area of the National Monument (Trenches 9-1 and 9-3) were excavated under Ministerial Consent C853.

Trench 9-1:

- Top of Trench 44.35m
- Top of Archaeology 43.84m
- Base of Archaeology -
- Base of Trench 42.85m
- Depth to Top of Archaeology 0.51m
- Thickness of Archaeology -

Test Trench 9-1 was designed to investigate a garden boundary wall (AR-17) depicted on historical maps. The remains of the garden boundary wall were found 0.51m below the surface of the trench; the wall was 0.50m wide and 1.10m high. A large modern service pipe was discovered running the length of the trench, meaning the trench did not reach subsoil. The garden wall is archaeologically significant.

Trench 9-2 was not excavated.

Trench 9-3:

- Top of Trench 45.21m
- Top of Archaeology 42.86m
- Base of Archaeology 42.32m
- Base of Trench 41.96m
- Depth to Top of Archaeology 2.35m
- Thickness of Archaeology 0.54m

The 0.54m of archaeology in this trench consisted of waterlogged garden soils over alluvial deposits. The garden soils are archaeologically significant because of their potential to preserve archaeological material.

[20] The levels have been updated to correspond with the most recent topographical survey of the Abbey Quarter in 2020.

C798/4822 Urban Block 10 (The Mayfair Building) (ACSU et al. 2018j)[21]

Urban Block 10 corresponds with the site of the Mayfair Building to the northwest of St Francis' Abbey and in proximity to the City Wall National Monument. Archaeological excavations here were carried out in advance of the redevelopment of the Mayfair Building as a new county library. One test trench was carried out adjacent to the proposed development:

Trench 10-1:

- Top of Trench 44.7m
- Top of Archaeology 44.06m
- Base of Archaeology -
- Base of Trench 42.9m
- Depth to Top of Archaeology 0.64m
- Thickness of Archaeology 1.26m

Trench 10-1 was excavated in the area of the Horse Barracks (AR-08), where part of the Mayfair Building had been demolished under archaeological supervision in 2017 (AMS 2017). Archaeological excavations uncovered the stone walls and cobble surfaces associated with the Horse Barracks 0.64m beneath the surface. The walls were 0.6m thick and included a threshold for a door and internal divisions. Further investigations encountered *in-situ* human remains 1.9m below the ground level, most likely part of St Francis' Abbey cemetery (AR-05). Following advice from the osteoarchaeologist, the trench was stopped before the base of archaeology was reached. These deposits, the Horse Barracks walls and cobbled surfaces, and the cemetery are of high archaeological significance.

17E0642 Urban Block 12 (ACSU et al. 2018k)[22]

Urban Block 12 is located in the northwest sector of the proposed development area, north of the River Breagagh. Four test trenches were excavated, of which one is in proximity to the proposed development.

Test Trench 12-4

- Top of Trench 44.79m
- Top of Archaeology 43.52m
- Base of Archaeology 40.89m
- Base of Trench 40.89m
- Depth to Top of Archaeology 1.27m
- Thickness of Archaeology 2.63m

The 2.63m of archaeological deposits consist of waterlogged garden soils (AR-16) containing shell, brick and animal bone, and a possible stone revetment with the River Breagagh. The waterlogged deposits are archaeologically significant because of their potential to preserve archaeological material.

[21] The levels have been updated to correspond with the most recent topographical survey of the Abbey Quarter in 2020.

[22] The levels have been updated to correspond with the most recent topographical survey of the Abbey Quarter in 2020.

17E0642 Urban Block 13 (ACSU et al. 2018l)[23]

Urban Block 13 is located in the north sector of the proposed development area, between the River Breagagh and St Francis' Street. Four test trenches were excavated, all in proximity to the proposed development.

Test trench 31-1

- Top of Trench 44.76m
- Top of Archaeology 41.97m
- Base of Archaeology 41.72m
- Base of Trench 41.72m
- Depth to Top of Archaeology 2.79m
- Thickness of Archaeology 0.25m

The 0.25m of archaeological deposits consisted of waterlogged peaty soils (AR-16), which contained no finds, but the deposits are archaeologically significant because of their potential to preserve archaeological material.

Test trench 13-2

- Top of Trench 44.63m
- Top of Archaeology 43.26m
- Base of Archaeology 41.18m
- Base of Trench 41.18m
- Depth to Top of Archaeology 1.37m
- Thickness of Archaeology 2.08m

The 2.08m of archaeological deposits consist of relatively simple garden soils over peaty silty waterlogged deposits (AR-16), with no archaeological finds, but deposits are archaeologically significant because of their potential to preserve archaeological material.

Test trench 13-3

- Top of Trench 44.69m
- Top of Archaeology 43.23m
- Base of Archaeology 40.75m
- Base of Trench 40.75m
- Depth to Top of Archaeology 1.46m
- Thickness of Archaeology 2.48m

The 2.48m of archaeological deposits consist of waterlogged reclamation soils, preserved gardens soils and marl deposits (AR-16); it contained a single sherd of medieval pottery. The deposits are archaeologically significant because of their potential to preserve archaeological material.

Trench 13-4

- Top of Trench 44.75m
- Top of Archaeology 43.04m
- Base of Archaeology 42.08m
- Base of Trench 42.08m
- Depth to Top of Archaeology 1.71m
- Thickness of Archaeology 0.96m

The 0.96m of archaeological deposits consist of waterlogged reclamation deposits with brick and glass, gardens soils (AR-16), and modern building foundations. No archaeologically

[23] The levels have been updated to correspond with the most recent topographical survey of the Abbey Quarter in 2020.

significant finds were retrieved, but the deposits are archaeologically significant because of their potential to preserve archaeological material.

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Appendix 12.6

APPENDIX 12.6 Artefacts catalogued in the National Museum of Ireland

The Topographical Files of the National Museum of Ireland were consulted for records of artefacts from within or associated with St Francis' Abbey and surrounding streets. Only one record directly associated with St Francis' Abbey was found:

Table 1: Artefacts catalogued in the National Museum of Ireland

NMI Reg No	Simple name	Component	Townland	ID	Find Place	County
NMI Reg No: X4596	Tile	Floor tile with heraldic shields	Gardens	N/A	Franciscan Friary	Kilkenny

Courtney Deery reviewed the finds from St Francis' Abbey held in stores in the National Museum of Ireland from the unpublished archaeological excavation by David Sweetman. These comprised fourteen boxes of conserved material at Swords. Three boxes were listed as being from the investigations that Sweetman undertook on site:

- SCRC.A1.C3.R9.P14.S5 E0096 St. Francis' Friary, Kilkenny Pottery, Tiles
- SCRC.A1.C3.R10.P1.S1 E0096 St. Francis' Friary, Kilkenny Pottery, Whole Vessels
- SCRC.A1.C3.R10.P1.S1 E0096 St. Francis' Friary, Kilkenny Floor tiles

A further twelve boxes containing floor tiles, medieval pottery and modern pottery were reviewed and photographed. These finds had been sorted and prefaced with the No. 4 and then the find number. No metal finds were retrieved and only one loose vertebra (possibly human) with no identification tag was noted within these finds; no further skeletal remains were uncovered (Courtney Deery Heritage Consultancy 2014, 8–9).

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Appendix 12.7

APPENDIX 12.7 Catalogue of Archaeological Sites

Site: AR-01 – Green's Bridge weir

Plate 1: Green's Bridge Weir

Description: A V-shaped weir, seventeenth-century and possibly medieval in origin, designed to divert water flow to four mills: two mills on the east bank (outside the study area), and two on the west [BH-11] to the west; a fifth mill was also located adjacent to these [AR-02]. The weir also diverted water to a millrace on the east side of the Nore. The weir was excavated and partly removed by the Nore Flood Relief Scheme works.

Street/ Townland: Gardens Td (St Canice's Pr.); Friarsinch Td.

ITM Coordinates: 650513, 656545

RMP: KK019-026----

SMR: KK019-026041-

UAS: UAS-41

National Monument: -

Distance from application site: c.30m outside the development

Significance: High: this is a significant site associated with milling and industrial activity in Kilkenny, possibly from the medieval period.

Site:	AR-02 – Chancellor's Mill (site of)
Description:	Site of a water powered mill fed by a headrace off the River Nore. This is a possible mill site from the late medieval period, associated with the ecclesiastical estate of St Canice's Cathedral. It is recorded as a corn mill in the Civil Survey in 1654 (Simington 1942) and in the nineteenth-century historical maps (1840, 1871, 1900), and also as Chancellor's Woollen Factory (1840) and Woollen Factory (1871). The mill site is preserved *in-situ* beneath St Francis's Street and c.1.5m of made ground.
Street/ Townland:	Gardens Td. (St Canice's Parish)
ITM Coordinates:	650494, 656466
RMP:	KK019-026----
SMR:	KK019-026124-
UAS:	UAS-124
National Monument:	-
Distance from application site: 0m	
Significance:	High: this is the site of a recorded archaeological monument associated with milling and industrial activity in Kilkenny, possibly from the medieval period; it is now preserved beneath St Francis' Abbey Street.

Site:	AR-03 – St Francis' Abbey (site of)
Description:	The subsurface remains of St Francis' Abbey [the upstanding remains being BH-04] consist of the nave, north aisle and north transept, partly excavated by Marcus Ó hEochaidhe for the OPW (1963, unpublished) (Conlon 1975). The cloistral range extended to the south of the church and consisted of a cloister garth and ambulatory, and ranges of buildings to the east, west and south. The friary had a cemetery to the north and west [AR-05], and St Francis' Well to the east [AR-04]. Historical accounts describe other elements of the friary's precinct including a precinct wall, gate, gardens, barns and stores. The only upstanding element of these ranges is the sacristy [BH-04]. The former St Francis' Abbey brewery buildings, demolished in the 1960s and 1970s [AR-09], may have incorporated elements of the medieval building. Archaeological monitoring by David Sweetman in 1970 and 1980 uncovered part of the west range and the cloister ambulatory, as well as a large numbered of burials, both preserved *in-situ* beneath the Brewhouse Building. Test excavations in 2018 confirmed the surviving structure of the north transept and the nave, with *in-situ* burials (ACSU et al. 2018a). Archaeological monitoring in 2019 confirmed the presence of *in-situ* structural remains beneath the Brewhouse Building corresponding with the nineteenth-century brewery buildings which may incorporate elements of the west claustral range (Flynn 2019a).

Street/ Townland:	Gardens Td. (St Mary's Pr.)
ITM Coordinates:	650478, 656336
RMP:	KK019-026----
SMR:	KK019-026101-
UAS:	-
National Monument:	Part of National Monument Ref. 72

Distance from application site: Within the proposed development

Significance:	Very High: these are the subsurface remains of a National Monument, a site of historical and archaeological significance in the townscape of Kilkenny, and an archaeological counterpoint to the upstanding medieval monastic buildings [BH-04]. Archaeological test excavations in 2018 confirmed that the subsurface remains of the friary, with internal burials, excavated by Marcus Ó hEochaidhe in 1963 are preserved beneath modern concrete surfaces to the north and west of the upstanding remains of St Francis' Abbey.

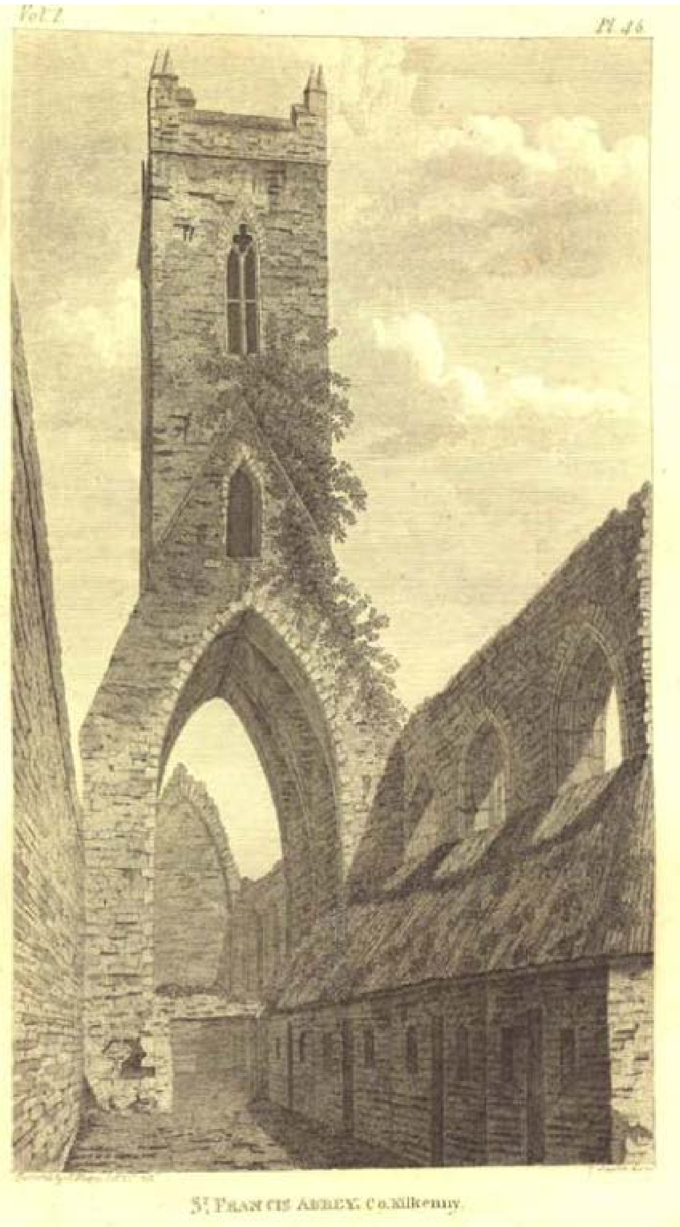

Plate 2: Drawing of St Francis' Abbey nave with cabins built inside (Grose 1791)

Plate 3: Marcus Ó hEochaidhe's excavation c.1963, looking south across the excavation of the transept, north aisle and nave (© National Monuments Service)

Plate 4: Marcus Ó hEochaidhe's excavation c.1963, looking north across the excavation of the nave, north aisle and transept (© National Monuments Service)

Plate 5: Test Trench B-11 (ACSU et al. 2018), investigating the site of the transept, looking west

Plate 6: Walls of the north transept with internal slab-lined graves in-situ, Test Trench B-3 (ACSU et al. 2018) looking west

Plate 7: In-situ burials in slab lined grave, test trench B-3 (ACSU 2018).

Plate 8: The west wall of the nave and in-situ burials in trench B-2 (ACSU 2018)

Site:	AR-04 – St Francis' Well (site)
Description:	Site of St Francis' Well, located east of St Francis' Abbey [BH-04 & AR-03]. The remains of the well are inaccessible, encased in an underground concrete chamber (15m by 11.4m and c.3m deep) now filled with water, the limits of which are visible in a geophysical survey (Nicholls 2017). In the medieval period, the well's waters are thought to have been piped to the friary complex. The well was used as a bathing place in the eighteenth and nineteenth centuries. Historical maps depict the well as a circular enclosed area with outfalls to the River Nore. Bathing springs are depicted in the Valuation map from c.1850. The well appears to have been closed in the mid-1960s when the brewery buildings and yards expanded east towards the Nore.
Street/ Townland:	Gardens Td. (St Mary's Pr.)
ITM Coordinates:	650552, 656358
RMP:	KK019-026----
SMR:	KK019-026189-
UAS:	UAS-101
National Monument:	Part of National Monument Ref. 72

Distance from application site: Within the proposed development

Significance:	High: this site is located within the area of St Francis' Abbey National Monument; it was a significant part of the medieval precinct of the friary and likely its source of clean water which remained open and in use until the twentieth century. The site of the well is encased in a deep, water-filled, underground concrete chamber, and is inaccessible for inspection. Any archaeological remains of the well are preserved *in-situ* in this chamber.

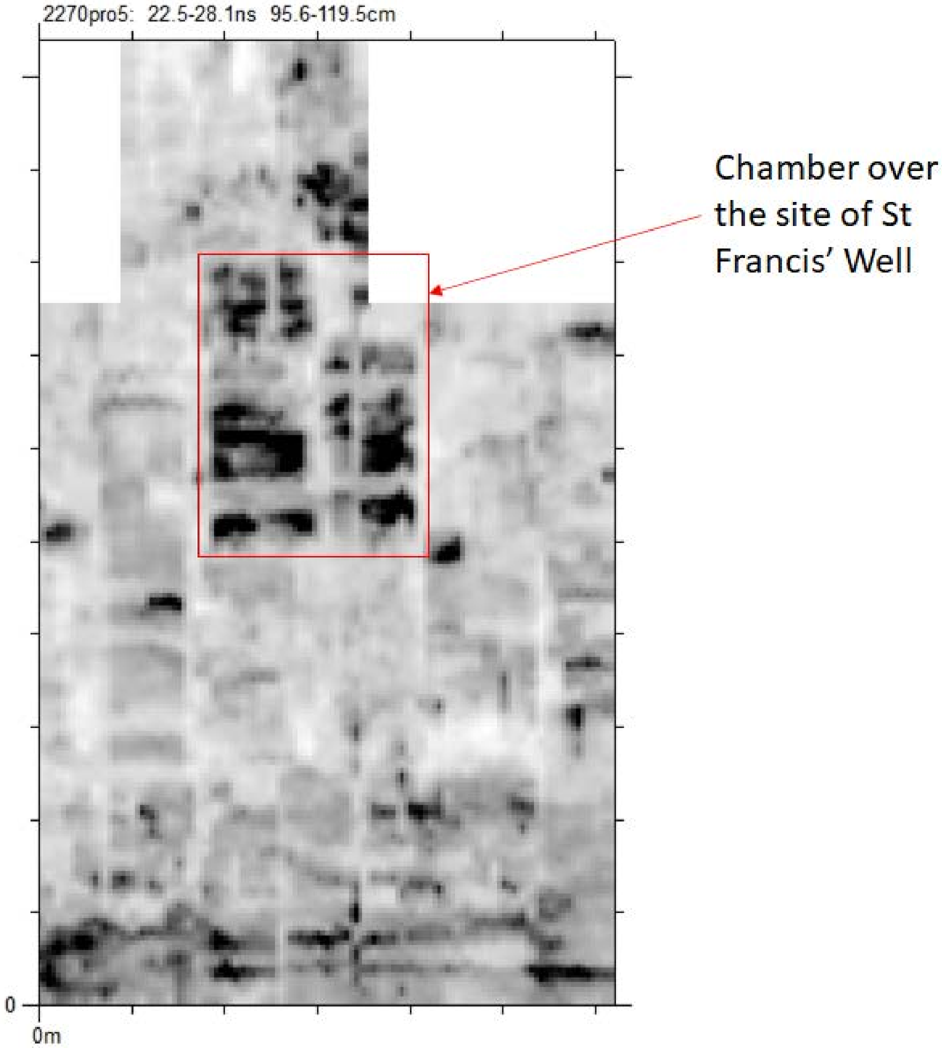

Plate 9: A timeslice of the GPR survey of St Francis' Well for a depth between 95.6cm and 119.5cm (Nicholls 2017)

Plate 10: 'Lady's bath at Evans Francis Abbey', sketch by George Miller c.1815 held in the RSAI

Site	AR-05 – St Francis' Abbey Graveyard (site)
Description	The site of the graveyard of St Francis' Abbey [BH-04 & AR-03] is located to the north and east of the friary buildings within the former precinct of the friary. A new cemetery without the church was consecrated by Nicholas, Lord Bishop of Waterford in November 1331 (Carrigan 1905, 104). O'Keeffe determined that there were two cemeteries: the larger cemetery lying to the west of the nave as far as the area of the Horse Barracks [AR-08] and extending southward, bisected by a path leading to the nave of the friary; the second, perhaps older cemetery (also called the 'little churchyard') located to the north, between the friary and the River Breagagh (O'Keeffe 2016, 38). Test excavations in 2018 confirmed that the cemetery still remains *in-situ* beneath the concrete yard surfaces of the Diageo Brewery north and east of the upstanding remains of the friary, beneath the remains of the Horse Barracks, and at least partly beneath the Mayfair Building (ACSU et al. 2018a; ACSU et al. 2018j) (see Appendix 13.5).
Street/ Townland:	Gardens Td. (Kilkenny City By., St Mary's Pr.)
ITM Coordinates:	650456, 656354
RMP:	KK019-026----
SMR:	-
UAS:	-
National Monument:	Part of National Monument Ref. 72
Distance from application site: Within the proposed development	
Significance:	Very High: this graveyard lies partly within the National Monument of St Francis' Abbey, and is an historically recorded place of burial for the wider community of Kilkenny city from the thirteenth century to the later seventeenth century. Archaeological test excavations in 2018 confirmed its presence and its levels, preserved to the north and west of the standing remains of St Francis' Abbey.

Plate 11: In-situ burials beneath post-medieval buildings in trench B-5 (ACSU 2018)

Site:	AR-06 – Millrace (site)
Description:	The site of a millrace which remained in use into the 20th century. The millrace ran for c.285m from the River Breagagh in the west to the River Nore in the east. This was medieval in origin, and was also known as Jenkin's Millstream in the Early Modern period. The millrace serviced a medieval mill [AR-11] belonging to St Francis' Abbey. The millrace may have been created shortly after a grant by Earl Gilbert de Clare to St Francis' Abbey in 1274 of toll-free milling rights and land in the town for their precinct. The millrace formed the south boundary of the friary's precinct. An additional millrace [AR-10] was constructed off this millrace in the later eighteenth century to service a mill located within the brewery [AR-09]. Rocque's map of 1758 and the Ordnance Survey's maps from 1840 to the 1940s, as well as contemporary photographs, show this millrace open and flowing. The millrace appears to have been closed in and built over following the purchase of the Smithwick's Brewery by Guinness' in 1964. Excavations beside the Watergate Theatre uncovered part of this millrace watercourse, which consisted of a stone arched culvert, the apex of which was found at c.1.08m depth beneath the modern car park surface (Reid 1998). Test excavations in the Abbey Quarter in 2018 confirmed that the millrace is encased in a concrete culvert (ACSU et al. 2018d).
Street/ Townland:	Gardens Td. (St Mary's Pr.)
ITM Coordinates:	650349, 656253 to 650620, 656240
RMP:	KK019-026----
SMR:	-
UAS:	-
National Monument:	-
Distance from application site:	Within the proposed development
Significance:	Medium: this appears to be the site of a millrace from at least the later thirteenth century which continued to function as a water channel into the twentieth century; we can trace its location confidently from historical maps. However, test excavations in 2018 confirmed that the millrace has been significantly disturbed, replaced or encased in an underground concrete culvert, which has compromised its archaeological significance.

Plate 12: Concrete-encased millrace in Test Trench 5-1 (ACSU 2018)

Site:	AR-07 – Grey Freren Gate (possible site)
Description:	The possible site of a gate called the Grey Freren Gate, providing access from St Francis' Abbey across the River Breagagh on Cotteral's Bridge [BH-05]. A survey of the town wall identified an eighteenth- or nineteenth-century segmental arch, now blocked, providing access to Cotteral's Bridge. No upstanding remains of a medieval gate are apparent in surveys of the City Wall (AMS 2018). Alternatively, Grey Freren Gate may have been located on Jenkins Lane at an entrance to the precinct to St Francis' Abbey (O'Keeffe 2016).
Street/ Townland:	Gardens Td. (Kilkenny City By., St Mary's Pr.)
ITM Coordinates:	650417, 656336

RMP: KK019-026----

SMR: KK019-026----

UAS: -

National Monument: -

Distance from application site: c.5m outside the proposed development

Significance: Medium: there is no definite archaeological evidence that this site existed at this location, and its position is postulated based on ambiguous historical references.

Site: AR-08 – Horse Barracks

Description: The Horse Barracks consists of the subsurface remains of the barracks building and the upstanding remains of a wall incorporated into the boundary wall with the River Breagagh (and is therefore also assessed as part of the city wall National Monument [BH-01]). The Horse Barracks was built around 1700 to accommodate cavalry soldiers following the end of the Nine Years War (1697). The overall complex consisted of two buildings, a yard and surrounding wall. These were described in 1752 as consisting of ten rooms, four for officers including a Captain's Room and Lieutenant's room, each with a closet, a Cornets' room and Quarter-Masters' room, one room for a corporal and five for the men, and four stables in poor condition, with the accommodation for men over these and an infirmary in a separate building (Ireland Parliament House of Commons 1763). These were in poor condition and underwent substantial renovations; William Colles built an extension to the barracks between 1753 and 1755. The Horse Barracks closed c.1800 when a new infantry barracks was opened in Kilkenny, and was bought by Kilkenny Corporation in 1829. The barracks building was subsequently reused as store houses for meal, whilst the former stables were used as stables by St Francis' Abbey Brewery. Both were demolished in the early 20th century, with just the façade wall facing the Breagagh upstanding. Excavations by ACSU (ACSU et al. 2018j) and AMS (AMS 2019) identified the walls and cobble surface of the Horse Barracks officers' buildings at a level of c.44.29m OD. These remains are preserved *in-situ* beneath the redevelopment of the Mayfair Building (Flynn 2019b). The remaining Horse Barracks façade is upstanding to c.4m in height over ground (AMS 2018).

Street/ Townland: Gardens Td. (Kilkenny City By., St Mary's Pr.)

ITM Coordinates 650429, 656345

RMP KK019-026----

SMR -

UAS -

National Monument -

Distance from application site: Within the proposed development

Significance:

High: this is an archaeologically and historically significant site for the city of Kilkenny. The standing remains of the Horse Barracks are considered part of the City Wall National Monument [BH-01]. Archaeological test excavations in 2018 and 2019 confirmed that the subsurface remains of the Horse Barracks walls and cobble surfaces are well preserved beneath the existing concrete surface; these are also being preserved in-situ beneath the redeveloped Mayfair Building.

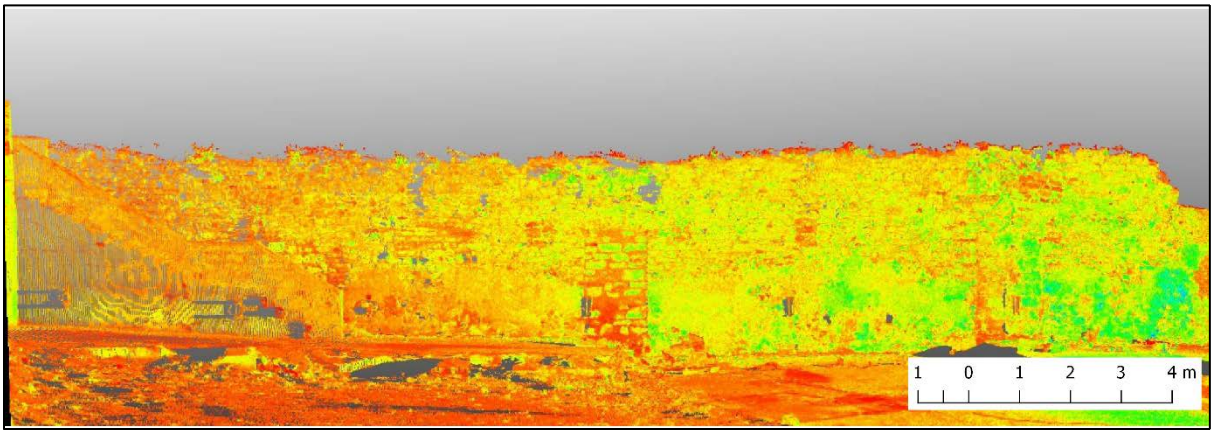

Plate 13: Laser scan of the Horse Barracks Building upstanding wall (AMS 2018)

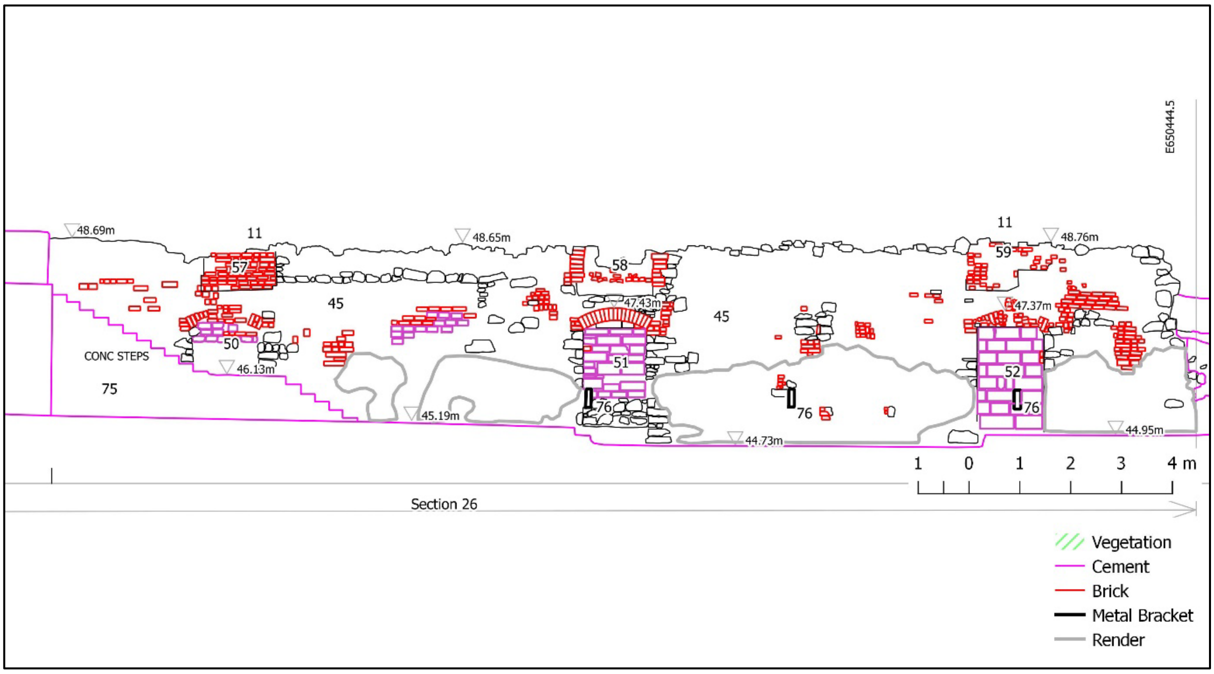

Plate 14: Elevation drawing of the upstanding remains of the Horse Barracks Building (AMS 2018)

Plate 15: Photograph of Test Trench 10-1 (ACSU 2018) showing the exposed cobble surface and walls of the Horse Barracks, looking north

Site:	AR-09 – St Francis' Abbey Brewery (site)
Description:	Site of the eighteenth- and nineteenth-century St Francis' Abbey Brewery, owned and operated by the Smithwicks family. Most of the original brewery buildings were replaced in the later twentieth century, with some surviving at the south end of Horse Barrack Lane. Beer had probably been brewed by the Franciscans at St Francis' Abbey, as it was in most large households in medieval Kilkenny, whilst some of the buildings in the former friary were used for malting in the mid-seventeenth century (Simington 1942). The first recorded brewery was started by Richard Cole in partnership with John Smithwick, who came to Kilkenny in 1710 (Courtney Deery Heritage Consultancy 2014, 32). Brewing grew in Kilkenny through the eighteenth century, so that by the early nineteenth century St Francis' Abbey brewery was exporting beer to Britain. In 1827 Edmund Smithwick purchased the brewery at St Francis' Abbey (Halpin 1989). At the time of the Primary Valuation in c.1850, Edmund Smithwick occupied a substantial property on Jenkins' Lane (now called the Ring) consisting of a brewery, offices, stores, a mill and yards concentrated on the south end of Jenkin's Lane; his property included gardens backing onto the River Nore, whilst Smithwick also operated a starch yard and offices in buildings

immediately south of the upstanding remains of the friary [BH-04] in the area of the former cloistral ranges and garth. The brewery and brewing process were described in detail in a Guide to the Great Southern & Western Railway from 1866, including an illustration of the brewery buildings (Measom 1866, 32–36). It continued to operate profitably into the twentieth century, expanding and modernising. The brewery was sold to Guinness in 1964, and the older buildings associated with the nineteenth century brewery were replaced with modern brewery buildings, with modern kegging and bottling plants beside the River Nore, and expanding north of the Breagagh to include fuel storage, mechanics' buildings, parking, squash court and hops store. St Francis' Well [AR-04] and the millraces [AR-06 and AR-10] were covered over. The site of St Francis' Abbey friary buildings were partly excavated by Marcus Ó hEochaidhe in about 1963, but his excavation is unpublished (Conlon 1975), whilst David Sweetman monitored the construction of the Brewhouse Building in 1970 and 1971, and the construction of the Tasting Room [BH-03] in 1980 (unpublished report) (Courtney Deery Heritage Consultancy 2014, 60–64). The Brewery also purchased the Mayfair Building in 1970 and converted it from a ballroom to a canteen and offices (Ó Drisceoil 2014). Diageo moved the brewery operations to Dublin in 2013 and the site was sold to Kilkenny County Council in 2016, after which most of the modern industrial buildings of the former brewery were demolished to slab level.

Street/ Townland: The Ring, Horse Barrack Lane; Gardens Td. (St Mary's Pr.); Gardens Td. (St Canice's Pr.)

ITM Coordinates: 650500, 656270

RMP: KK019-026----

SMR: -

UAS -

National Monument -

Distance from application site: Within the proposed development

Significance: High: this is a significant site in the historical and industrial heritage of Kilkenny City, and is an archaeological counterpoint to the relatively small remaining upstanding buildings of Edward Smithwick's brewery [BH-06].

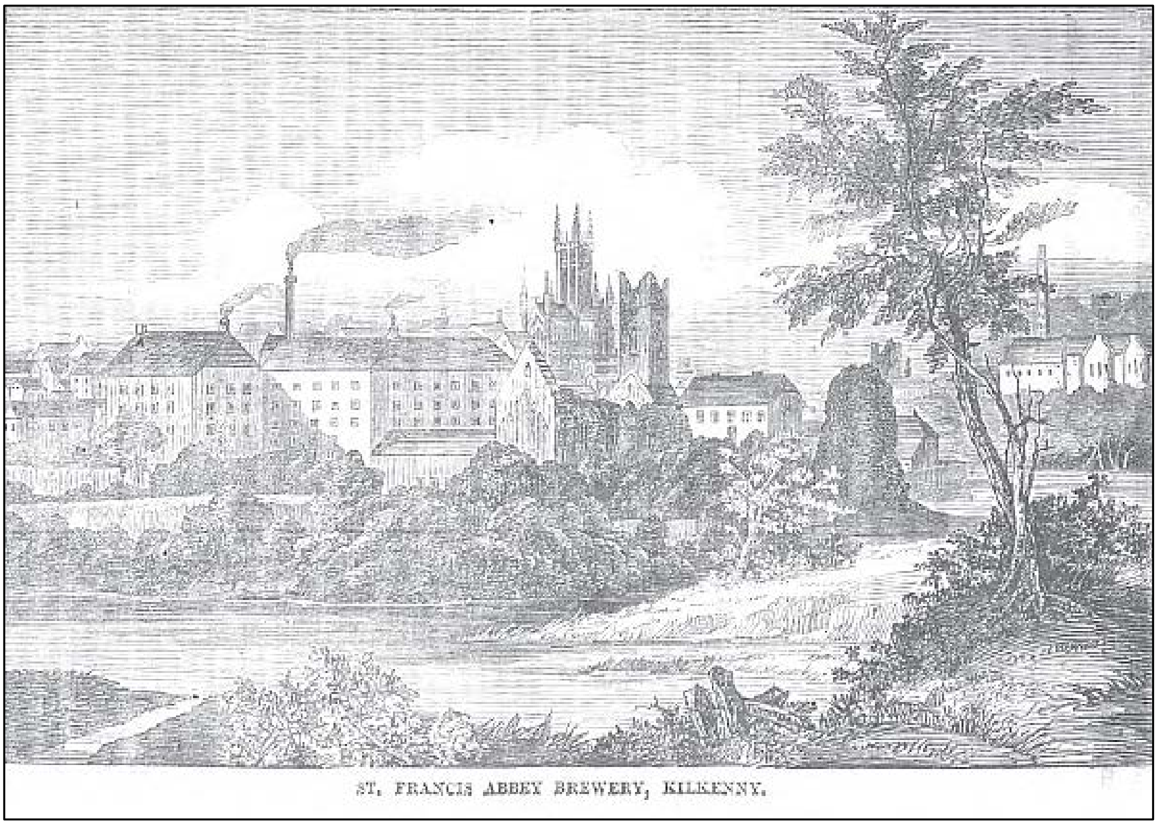

Plate 16: St Francis' Abbey Brewery c.1866 (Measom 1866)

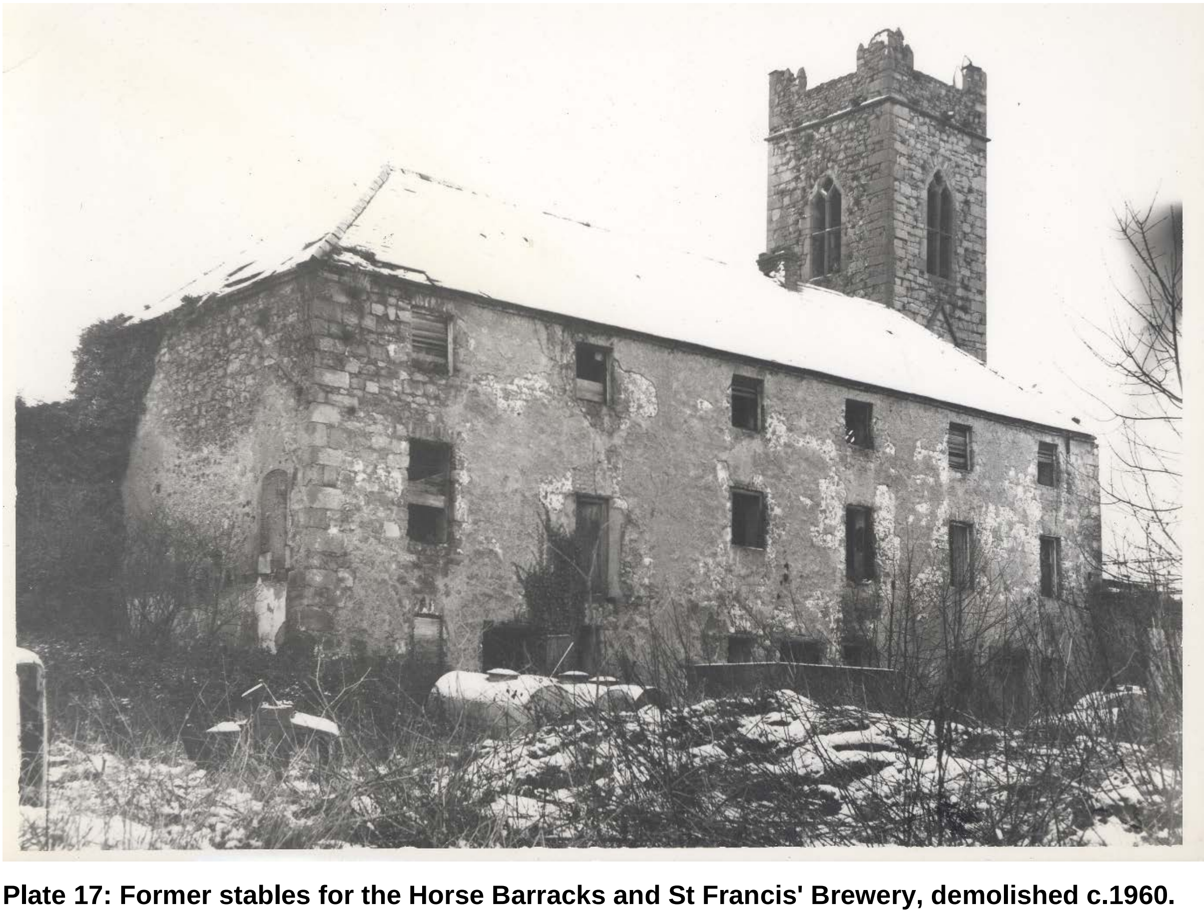

Plate 17: Former stables for the Horse Barracks and St Francis' Brewery, demolished c.1960.

Plate 18: St Francis' Abbey Brewery buildings, demolished c.1970.

Plate 19: St Francis' Abbey Brewery buildings looking north, possibly incorporating the west range of the friary, demolished c.1970 for the Brewhouse.

Site: AR-10 – Millrace (site)

Description: Millrace c.95m long, culverted and underground, flowing from the medieval millrace [AR-06] to the River Nore. This millrace was constructed in the late eighteenth or early nineteenth century to power a watermill within St Francis' Abbey Brewery [AR-09]. Test excavations in 2018 confirmed that the millrace is now contained in a concrete culvert found 1.1m below the present ground surface, and was 3.5m wide and 2m deep (ACSU et al. 2018e).

Street/ Townland: Gardens Td. (St Mary's Pr.)

ITM Coordinates: 650532, 656259

RMP: KK019-026----

SMR: -

UAS -

National Monument -

Distance from application site: Within the proposed development

Significance: Medium: this millrace, whilst more recent than the other examples in the study area [AR-06 & AR-15], is nevertheless significant because of its association with St Francis' Abbey Brewery [AR-09 & BH-06] and the industrial heritage of Kilkenny City. However, test excavations in 2018 confirmed that the millrace has been significantly disturbed, replaced or encased in an underground concrete culvert.

Site: AR-11 – Mill (site)

Plate 20: Site of the water mill in the car park beside the Watergate Theatre [AR-11]

Description	Site of Greyfriar's Mill, owned by St Francis' Abbey. In 1274 Earl Gilbert de Clare granted St Francis' Abbey the right to grind corn toll-free in his mill (O'Keeffe 2016, 12–13). An extent of the dissolved friary in January 1541 included "Grefryrs mylle", leased to Isabella Drom for 27 shillings (White 1943, 200). This was called Jenkins Mill in Early Modern rentals (O'Keeffe 2016), and appears to have been used to grind bark for a tannery by 1654 (Simington 1942, 522). Previous excavations in advance of the Kilkenny Main Drainage identified a culverted millrace and post-medieval buildings on the site (Reid 1998). In 1996, Martin Reid excavated a thrust-bore pit in Urban Block 11 for an underground section of the Kilkenny Main Drainage which ran through the lower levels of the culverted millrace [AR-10] which runs from the Breagagh River under Parliament Street to the Brewery. The excavation beneath the modern car park surface, was carried to a level of c.47.88m OD (Reid 1998, figs. 41–44). Three levels of occupation were identified in Reid's excavation Cutting 5. These consisted of a rectangular medieval building (Level 1) found c.2.4m beneath the modern surface. This building was truncated by a millrace bounded by a stone wall and dug to the level of bedrock between c.2.3m and c.3.4m depth. These medieval deposits included intact timber at between c.2.3m and 2.9m depth. Subsequent excavations recovered a considerable quantity of medieval and post-medieval pottery, bone, horn, leather and glass, which suggests the millrace was used as a rubbish dump before it was culverted in the post-medieval period (Excavation No. 97E481; www.excavations.ie: 1997:291).
Street/ Townland:	Parliament Street/ Horse Barrack Lane, Gardens Td. (Kilkenny City By., St Mary's Pr.)
ITM Coordinates:	650441, 656252
RMP:	KK019-026----
SMR:	-
UAS:	-
National Monument:	-

Distance from application site: Approximately 50m from the proposed development

Significance:	High: this site is historically recorded and has been associated with milling for St Francis' Abbey from at least the thirteenth century. Whilst archaeological evidence for the mill race has been found as well as medieval buildings, the structure of the mill itself has not been identified, but is thought to be somewhere within the Watergate Theatre car park.

Site:	AR-12 – Bull Inn
Description:	The remains of a three-storey gable-fronted inn building (dims. c. 17m N–S; c. 6.5m E–W). Drawings from the nineteenth century depict the building as gable ended to the

north, having an apex surmounted by a stone chimney with hood-moulded windows. Historical maps depict the site as being part of a courtyard arrangement of buildings. The north façade of the building was removed; the east wall (H c. 4.5m; L c. 15m) survives up to first-floor level and some of the west wall (H c. 2.5m; L c. 15m) with a small portion of the rear return. The building dates from c.1602 and was called the Bull Inn. It remained in use until the nineteenth century when it was recorded as being in a dangerous condition and the north façade and upper floors were removed. Test excavations in 2018 confirmed that the interior was disturbed, but that walls and floor surfaces associated with a range of buildings depicted on historical maps still survive on site (ACSU et al. 2018k).

Street/ Townland: Vicar Street, Gardens Td. (St Canice Pr.)

ITM Coordinates: 650376, 656372

RMP: KK019-026----

SMR: KK019-026107-

UAS: UAS-107

National Monument: -

Distance from application site: Approximately 50m from the proposed development

Significance: High: this is a recorded archaeological site, also of historical significance and associated with hospitality for visitors to Irishtown from the Early Modern period. Although substantially demolished in the nineteenth century, there are significant upstanding remains of the building's side walls, and archaeological test excavations in 2018 confirmed the survival of subsurface remains associated with the building.

Plate 21: Upstanding remains of the Bull Inn looking west

Plate 22: Archaeological features beside the Bull Inn, ACSU Trench 12-2 (2018)

Site:	AR-13 – Vicar Street house
Description:	Number 22 Vicar Street was the site of a medieval to early modern house. Survey in advance of the development of the Central Access Scheme determined that the building had been mostly rebuilt in the post-medieval period (Goodbody 2013). The house was substantially removed for the Central Access Scheme. Archaeological excavations identified a hearth next to a gable wall, a line of a post hole, and a floor surface which appears to be part of a medieval to post-medieval structure (Flynn 2015). Test excavations for the Abbey Quarter Masterplan immediately south of the building identified subsurface cobbled surfaces and wall foundations (ACSU et al. 2018k). The gable wall of this building is preserved in a metal frame.
Street/ Townland:	Vicar Street, Gardens Td. (Kilkenny City By., St Canice Pr.)
ITM Coordinates:	650376, 656399
RMP:	KK019-026----
SMR:	KK019-026122-
UAS:	UAS-122
National Monument:	-

Distance from application site: Approximately 50m from the proposed development

Significance: High: this is a recorded archaeological site, and the site of a medieval building. However, only the gable wall of this building survives upstanding, although archaeological excavations in 2018 identified subsurface archaeology next to the standing remains.

Plate 23: Braced gable of medieval to Early Modern house on 22 Vicar Street

Site: AR-14 – Gaol/ burials/ Grace's Castle (site of)

Description: The Court House was the site of a medieval castle and prison. In the thirteenth century, William le Gros built a castle here which became known as 'Grace's Castle'. In 1566, it was yielded to the Crown for use as a 'Sheire Gaol'. It seems to have served this function until c.1794, when it was probably rebuilt as a courthouse [BH-09]. Although nothing of the original castle or prison is now visible, it is possible that some early remains are incorporated in the courthouse. Archaeological excavations to the rear for the development of a new extension to the courthouse building were carried out in 2007 by Maedbh Saunderson (Courtney Deery 2014, 79–80; Licence 07E0549). Five test trenches with a total length of 50m were excavated which uncovered a burial, a number of medieval deposits, a well and some post-medieval walls.

Saunderson returned in 2008 to excavate the site. The site proved to be a rich archaeological area producing over 1,000 contexts, 4,000 sherds of medieval pottery, 2,000 sherds of post-medieval pottery, almost 500 pieces of extremely well preserved wooden stakes and timbers from the wood-lined cesspits, as well as eight wooden artefacts, eleven coins, three brass artefacts, over 200 iron artefacts, thirty bone artefacts and two copper-alloy objects with gold. Pottery provisionally dated from the late fourteenth to twentieth centuries was recovered from the site. The site consisted of remnants of medieval domestic activity typical of an urban property or burgage, albeit a relatively wealthy household. The burgage plots/property divisions were evident on the site as shallow, long ditches orientated both north–south and east–west. The site also contained evidence for the later phases of activity when Grace's Castle became a gaol and courthouse. Twenty-three inhumations were recorded to the rear of the site. The burials excavated were probably inmates executed within the confines of the prison environment. This excavation report has not been fully published (Courtney Deery 2014, 79–80).

Street/ Townland: Parliament Street, Gardens Td. (Kilkenny City By., St Mary's Pr.)

ITM Coordinates: 650513, 656171

RMP: KK019-026----

SMR: KK019-026093-

UAS: UAS-93

National Monument: -

Distance from application site: Approximately 30m from the proposed development

Significance: High: the site of medieval Grace's Castle is most likely beneath the Court House fronting onto Parliament Street; however, archaeology associated with the castle extended to the rear. Also, burials associated with the site's use as a county gaol were archaeologically identified. This archaeology was excavated in advance of the construction of a new courthouse.

Site: AR-15 – Millrace (site of)

Description: Site of millrace on the east bank of the River Nore opposite the proposed development. This millrace is depicted on historical Ordnance Survey maps as c.1.8km long, running from north of Greens Bridge in Newpark Lower Td. to Gardens Td. in the south. This millrace is possibly medieval in origin, and powered a corn mill on the east bank of the River Nore at Greensbridge Weir and another at its south end. This millrace is now covered by, and presumably preserved beneath, the riverside park.

Street/ Townland: Newpark Lower Td. to Gardens Td. (St. John's Pr)

ITM Coordinates: 650412, 657355 to 651245, 655916

RMP: KK019-026----

SMR: -

UAS: UAS-77

National Monument: -

Distance from application site: Approximately 45m from the proposed development

Significance: High: a millrace associated with milling in Kilkenny from the medieval period to the twentieth century. The remains of the millrace are preserved beneath the Peace Park.

Site Name: AR-16 – Meadows (site)

Description: Meadows and gardens over alluvial soils north of the River Breagagh. Archaeological test excavations found these to be between 0.25m and 2.63m thick, with a possible revetment wall with the River Breagagh, but that the soils are also heavily mixed with infrequent archaeological finds (ACSU et al. 2018k; ACSU et al. 2018l).

Street/Townland: Gardens Td (St Canice’s Pr.)

ITM Coordinates: 650481, 656434

RMP: KK019-026----

SMR: -

UAS: -

National Monument: -

Distance from Application Site: 0m

Significance/ Sensitivity: Medium: archaeological test excavations in 2018 confirmed that there are waterlogged garden and alluvial soils in this area, but mixed, with no significant finds. The deposits are archaeologically significant because of their potential to preserve archaeological material from the prehistoric to Early Modern periods.

Plate 24: Disturbed ground and waterlogged garden soils in Urban Block 13 (ACSU 2018)

Site Name:	AR-17 – Gardens (site)
Description:	Gardens between St Francis' Abbey [BH-04/AR-03], St Francis' Abbey Brewery [AR-09] and the River Nore. Archaeological test excavations found these to be between 0.50m and 3.2m thick, with a possible revetment with the River Nore. Walls separating the gardens were also found. The garden deposits are mixed and heavily disturbed in places, but are archaeologically significant because of their potential to preserve archaeological material. The garden walls are archaeologically significant because they are depicted on historical maps and may preserve the remains of earlier precinct walls for the medieval friary.
Street/Townland:	Gardens Td (St Mary's Pr.)
ITM Coordinates:	650529, 656339
RMP:	KK019-026----
SMR:	-
UAS:	-
National Monument:	Within the area of National Monument Ref. 72
Distance from Application Site:	0m

Significance/ Sensitivity: High: partly within the St Francis' Abbey National Monument, archaeological test excavations in 2018 confirmed that there are waterlogged garden and alluvial soils in this area, but very mixed and disturbed, particularly by the construction of industrial buildings for the former Diageo brewery in the later twentieth century. The discovery of timbers and a possible revetment wall in the garden soils indicates that there may be surviving archaeological stratigraphy in this area. The deposits are archaeologically significant because of their potential to preserve archaeological material, from the prehistoric to Early Modern periods.

Plate 25: Garden soils and alluvial deposits in test trench B-6 (ACSU 2018)

Site Name:	AR-18 – Market Building (site)
Description:	A nineteenth-century market building depicted on historical maps from the Valuation map c.1850. Excavations confirmed it survives, being 0.98m wide and 1.1m high, and lying at a depth of c.1.5m. The building was demolished c.1960 to facilitate the expansion of the St Francis' Abbey Brewery.
Street/Townland:	Gardens Td (St Mary's Pr.)
ITM Coordinates:	650573, 656173
RMP:	KK019-026----
SMR:	-
UAS:	-
National Monument:	-
Distance from Application Site:	0m
Significance/ Sensitivity:	Low: this building dates to the middle of the nineteenth century and is shown on contemporary maps. It is locally significant as the remains of a commercial building.

Plate 26: Nineteenth-century market building wall (ACSU 2018)

Site Name:	AR-19 – River Nore
Description:	The River Nore has been the focus of settlement from prehistory (Devine et al. 2009b), with the earliest evidence for human activity in the area of the city being a Mesolithic microlith (composite stone tool) found in the river during the Nore Flood Alleviation Schemes north of the proposed development (Doyle 2003; Phelan 2003). St Canice's church was founded on a hill overlooking a ford in the Nore at the present Greens' Bridge. Kilkenny city grew along the Nore's west bank, from St Canice's Cathedral [BH-12] south to Kilkenny Castle [BH-13]. The castle was positioned on a height overlooking a crossing point on the Nore to the east and St John's suburb. In 1231, St Francis' Abbey [AR-03/ BH-04] was founded on the banks of the Nore beside its confluence with the River Breagagh in the northeast corner of Hightown. The ground next to the River Nore remained as gardens and orchards from the medieval period to the twentieth century. From the mid-twentieth century, St Francis' Abbey Brewery [AR-09] covered the gardens, built the ground height up and constructed industrial buildings beside the Nore.
Street/Townland:	Gardens Td (St Mary's Pr.); Gardens Td (St Canice's Pr.); Gardens Td (St John's Pr.); Friarsinch Td
ITM Coordinates:	650578, 656402
SMR:	-
UAS:	-
National Monument:	-
Distance from Application Site:	<5m
Significance/ Sensitivity:	Medium: the River Nore Flood Relief Scheme (2000–03) resulted in extensive dredging of the river and alterations to the riverbanks under archaeological supervision, removing most of the archaeologically significant features and finds in the vicinity of the proposed development.

Site Name:	AR-20 – River Breagagh
Description:	The River Breagagh flows from west to east, joining the River Nore next to the proposed development. The River Breagagh has been a significant watercourse from the medieval period, forming the boundary between the Hightown and Irishtown. Kilkenny City Wall [BH-01] forms the south boundary with the River Breagagh, terminating at Evans Turret [BH-02] where the Breagagh meets the Nore. The City Wall constrains the River Breagagh to the south, but it appears to have flowed more freely over meadow ground to the north [AR-16] until the early twentieth century.
Street/Townland:	Gardens Td (St Mary's Pr.); Gardens Td (St Canice's Pr.)
ITM Coordinates:	650477, 656404

SMR: -

UAS: -

National Monument: -

Distance from Application Site: <1m

Significance/ Sensitivity: Medium: substantial dredging work was carried out in the River Breagagh to remove contamination in its bed c.1999–2002, resulting in the removal of c.1.7m of riverbed for c.150m, under archaeological supervision, whilst the adjacent City Wall was repaired and conserved (Gowen 2000; Doyle 2002).

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Appendix 12.8

APPENDIX 12.8 Catalogue of Architectural Heritage Sites

Site Name:	BH-01 - City Wall
Description:	The circuit of the City Wall for Kilkenny was c.2.9km in total. This consisted of 1.6km surrounding the 'Hightown' (54%), 0.7km surrounding Irishtown north of the River Breagagh (25%) and 0.6km (22%) surrounding the suburb of St John's on the east bank of the River Nore (Oxford Archaeology 2005). Approximately 120m of the length of the City Wall lies within the proposed development, all on the south side of the River Breagagh. The wall is multi-period, and is mainly constructed with rubble limestone, rising to a height of c.6m over the Breagagh and between 1m and 4m over the level of the site (AMS 2018). The wall exhibits a number of features along its length on the northern (river) side including the lower courses of the medieval wall City Wall, the springing for Cotteral's Bridge [BH-05], and a number of blocked arches (Courtney Deery Heritage Consultancy 2014). The City Wall also includes Evans Turret [BH-02] and a 14m section of intact medieval wall with a wall walk, steps and a plunging arrow loop, recently conserved (Courtney Deery Heritage Consultancy 2015, 26–29).
Street/ Townland:	Bishopsmeadows Td.; Collegepark Td.; Dukesmeadows Td. Gardens Td. (St Canice's Pr.); Gardens Td. (St Mary's Pr.); Gardens Td. (St John's Pr.); Gardens Td. (St Patrick's Pr.). Within this study area: Gardens Td. (St Mary's Pr.).
Coordinates:	650432, 656348 to 650521, 656425
Date of construction:	Thirteenth century with alterations to twentieth century
RMP:	Within KK019-026----
SMR:	KK019-026001-
UAS:	UAS-6
National Monument:	Yes, under National Policy on Town Defences (DoEHLG 2008)
Protected structure:	No
NIAH:	No
Distance from application site:	Within the proposed development
Special interest:	Architectural, archaeological, historical
Special interest rating:	National

Plate 1: City Wall, seen from the north across the Breagagh

Plate 2: Southern side of City Wall within the site

Plate 3: Section of City Wall to the west of Evans Turret

Site Name:	BH-02 – Evans Turret
Description	Evans Turret is a mural tower in the Kilkenny City Wall defences [BH-01] where the River Breagagh meets the River Nore. It was originally built in the thirteenth century, modified as a house in the eighteenth century and occupied until the middle-nineteenth century by Ambrose Evans. The building consists of a five-sided polygonal structure with an angled face to the north including a plunging arrow loop; the tower projects its long sides to the southeast. The building is now roofless with the lower remains of large rectangular window opes on the upper floor. It was at least two storeys; a string course denotes the division into two storeys, and this has weep holes on northern façade above the string course. The interior was accessed by steps on a wall walk along a c.14m upstanding section of the City Wall, recently conserved. On the southern side the lower floor is vaulted, the vaulting being semi-corbelled rather than radial, in a form typical of many medieval arches and vaults in Ireland. Paintings by Robertson (1851) show a tall ivy-covered structure with a pyramidal slate roof and large rectangular windows (Courtney Deery 2014, 54 ill. 1).
Street/ Townland:	Gardens Td. (St Mary's Pr.)
Coordinates:	650521, 656423
Date of construction:	Thirteenth century
RMP:	Within KK019-026----

SMR:	KK019-026001-
UAS:	UAS-7
National Monument:	Yes, under National Policy on Town Defences (DoEHLG 2008)
Protected structure?:	No
NIAH:	No
Distance from application site:	Within the proposed development
Special interest:	Architectural, archaeological, historical
Special interest rating:	National

Plate 4: View of Evans Turret from the north across the Breagagh

Plate 5: Evans Turret, seen from the south, adjacent to the Nore

Plate 6: Evans Turret, seen from the west, along the Breagagh

Site Name: BH-03 – Tasting Room

Description	Single-storey modern building built in a gothic style, with rubble stone with cut-stone quoins and cut-stone dressings to the window and door openings. The door has pointed segmental arch, windows are paired and mullioned with round heads. The building is in two sections, with a larger four-bay section to the east and a smaller, two-bay section to the west. This was purpose-built as a tasting room by Diageo c.1980; its construction was archaeologically monitored by David Sweetman, who discovered human remains and wall of the chapter house, preserved *in-situ* (Courtney Deery 2014, 64).
Street/ Townland:	Gardens Td. (St Mary's Pr.)
Coordinates:	650517, 656325
Date of construction:	c.1980
RMP:	Within KK019-026----
SMR:	-
UAS:	-
National Monument:	-
Protected structure?:	No
NIAH:	Reference 12000008
Distance from application site:	Within the proposed development
Special interest:	None.
Special interest rating:	Record only. NIAH assigns it a Regional rating but had misunderstood the nature of the building.

Plate 7: Tasting Room

Plate 8 Tasting Room adjacent to the sacristy chapel, looking east

Site Name:	BH-04 - Abbey of St Francis
Description	The upstanding remains of St Francis' Abbey choir or chancel (c.23m by 9m) lit by tall lancet windows, a bell tower (c. 23m high) and sacristy to its south restored and substantially rebuilt in the twentieth century as a chapel for the Diageo employees. Much of the medieval friary survives below ground [AR-03]. St Francis' Abbey (a friary of the Order of Friars Minor or Conventual Franciscans) was founded in 1231 by Richard Marshal (O'Keeffe 2016). Lady Isabella Palmer funded the extension of the choir around 1324, which includes an impressive seven-light lancet window (Leask 1960, 124, plate 56). The bell tower was completed in the latter half of the fourteenth century following the Black Death. St Francis' Abbey is associated with Friar John Clynn, a chronicler of the Black Death, and most likely it is his burial site. The building is constructed of limestone rubble with dressed limestone margins to the windows and doorways, and decorative carved figures around the bell tower. The interior of the chancel contains numerous architectural fragments from the excavated portions of the friary. It also contains a font (KK019-026150-) and inscribed stones (KK019-026151-, KK019-026183-and KK019-026190-) within the building. St Francis' Abbey buildings are between 0.8m and 0.28m lower than the surrounding concrete yards of the former Diageo brewery, with this lower area partly planted with shrubs and trees, with trees between the chancel/ choir and Tasting Room [BH-03]. This lower level abuts the Sacristy to the southwest, but extends up to five metres from the medieval buildings and defines the area of the State-owned National Monument, and the boundary of the proposed development.
Date of construction:	Thirteenth to fourteenth century
Street/ Townland:	Gardens Td. (St Mary's Pr.)
Coordinates:	650502, 656338
RMP:	Within KK019-026----
SMR:	KK019-026101- (and containing KK019-026150-, KK019-026151-, KK019-026183-, KK019-026190-)
UAS:	UAS-101
National Monument:	National Monument in State Care (Ref. No. 72)
Protected structure?:	No
NIAH:	No
Distance from application site:	Immediately adjacent to and surrounded by site
Special interest:	Architectural, archaeological, historical
Special interest rating:	National

Plate 9: Northern side of abbey of St Francis

Plate 10: View of abbey from north-east

Plate 11: View of abbey from the west

Plate 12 St Francis' Abbey c.1880; note the timbers used in the cooperage for the brewery (source: RSAI archives)

Site Name:	BH-05 - Bridge abutment
Description	Site of Cotteral's bridge. There are historical references to a postern gate called Grey Freren Gate, leading from the precinct of St Francis' Abbey on the south side of the River

	Breagagh to Irishtown north of the river. Although the location of this probable bridge is not definitively established, it is thought to have been this site. The remains consist of an abutment and spring of the arch of a masonry-arched bridge near the base of the City Wall on the southern side of the Breagagh, near the western extremity of the application site. Some stonework projects from the river wall on the northern side, but not to the extent as the southern section. The bridge was 2.59m wide, with masonry parapet walls c.1.2m high and 0.31m wide; the bridge walkway was 1.98m wide, and entered through an arch c.2.1m high which is still visible behind the Mayfair Building. This bridge carried a laneway connecting St Canice's Place to The Ring and was built at some time after 1758, as it is not shown on Rocque's map. It appears on the first-edition Ordnance Survey map and again on the map published in 1900. The bridge was mostly removed after floods c.1940.
Date of construction:	Possibly medieval origin; structure post 1758
Street/ Townland:	Gardens Td. (St Mary's Pr.); Gardens Td. (St Canice Pr.)
Coordinates:	650413, 656340
RMP:	Within KK019-026----
SMR:	KK019-026102-
UAS:	UAS-102
National Monument:	Part of the City Wall, a National Monument under the National Policy on Town Defences (DoEHLG 2008).
Protected structure?:	N/A
NIAH:	Not listed
Distance from application site:	c.20m
Special interest:	Architectural, archaeological, technical
Special interest rating:	Regional

Plate 13: Remnant of bridge on southern side of Breagagh

Plate 14 Springing for the south side of Cotteral's bridge (AMS 2018)

Site Name:	BH-06 - Brewery Gateway & Smithwick's Brewery Buildings
Description	Arched gateway that formerly gave access to Smithwick's Brewery. Segmental arch rising from rusticated piers and supporting cornice and blocking course. Faced with render and painted. The gate leads to a courtyard of nineteenth-century buildings including a three-bay, two-storey house with pitched slate roof, an eight-bay two-storey range of buildings and a three-storey building, all associated with the nineteenth- and early twentieth-century Smithwick's Brewery, now occupied by the Smithwick's Experience.
Date of construction:	Mid-19th century
Street/ Townland:	The Ring/ Horse Barrack Lane**;** Gardens Td. (St Mary's Pr.)
Coordinates:	650481, 656189
RMP:	Within KK019-026----
SMR:	-
UAS:	-
National Monument:	-
Protected structure?:	Yes – Reference B86
NIAH:	12000087
Distance from application site:	Gate c.70m from proposed street and 115m from proposed urban park; courtyard of brewery buildings c.50m from the proposed development.
Special interest:	Architectural, artistic
Special interest rating:	Regional

Plate 15: Former entrance to Smithwick's brewery

Site Name:	BH-07 – Tea House
Description	Detached tea house adjacent to the River Nore to the south of the proposed development. This structure is a rectangular single-storey over basement building constructed of random rubblestone limestone, with a projecting hipped slated roof, having a chimney to the east wall. A large south-facing doorway (blocked) is approached by steps; an exterior door to the basement is on the west side of the building; an enclosing wall to the west is partly demolished. This building has been recently restored (Courtney Deery Heritage Consultancy 2014), but is unused, its interior inaccessible.
Date of construction:	c.1800
Street/ Townland:	Bateman Quay; Gardens Td. (St Mary's Pr.)
Coordinates:	650617, 656211
RMP:	Within KK019-026----
SMR:	-
National Monument:	-

UAS: -

Protected structure?: Yes – Reference B225

NIAH: (NIAH 12000204 incorrectly located here on the Historic Environment Viewer archaeology.ie)

Distance from application site: Approximately 50m from proposed street and 150m from urban park.

Special interest: Architectural

Special interest rating: Regional

Plate 16: Tea house adjacent to the Nore

Site Name: BH-08 - Tea House

Description: A detached tea house adjacent to the River Nore to the south of the application site. This is a single-storey, two-bay structure built in limestone, with a projecting hipped slated roof; the entrance is in a corner porch; the interior (inaccessible) lit with mullioned gothic windows, recently restored. The building was restored during the Nore Flood Relief Works (Courtney Deery Heritage Consultancy 2014) and was used for retail, but is now closed.

Date of construction: c.1800

Street/ Townland:	Bateman Quay; Gardens Td. (St Mary's Pr.)
Coordinates:	650629, 656169
RMP:	Within KK019-026----
SMR:	-
UAS:	-
National Monument:	-
Protected structure?:	Yes – Reference B119
NIAH:	12000204
Distance from application site:	Approximately 50m from proposed street and 190m from urban park.
Special interest:	Architectural
Special interest rating:	Regional

Plate 17: Tea house adjacent to the Nore

Plate 18 The tea houses (BH-07-BH-08) in 2016

Site Name:	BH-09 - Courthouse
Description:	Substantial seven-bay courthouse building with a wide frontage and set back from the street behind a courtyard. The building is faced with limestone ashlar with a central tetrastyle pediment flanked by tripartite windows. The court building is raised above the ground over an arcaded prison and is accessed at either end via flights of stone stairs. Two returns run to the rear of the main frontage and are closed at the rear by a later cross block parallel to the street. The Court House was the site of medieval Grace's Castle and a prison and prison cemetery [AR-14].
Date of construction:	c.1792, remodelled c.1828 and enlarged 1870s
Street/ Townland:	Parliament Street; Gardens Td. (St Mary's Pr.)
Coordinates:	650487, 656156
RMP:	Within KK019-026----
SMR:	-
UAS:	UAS-93
National Monument:	-
Protected structure?:	Yes – Reference B133
NIAH:	12000084
Distance from application site:	Approximately 65m from proposed street and 130m from urban park, the rear extending into the 50m study area.
Special interest:	Architectural, artistic, archaeological, historical and social
Special interest rating:	National

Plate 19: Courthouse, Parliament Street

Site Name:	BH-10 – Watergate Theatre
Description:	The Watergate Theatre was built as a cinema, opening in November 1936 as the Savoy Cinema. Built in a pared-down Art Deco style in concrete, the cinema operated for almost fifty years, closing in March 1985 due to falling attendances arising from economic recession and competition from videos shown in pubs. The cinema was bought by Kilkenny Corporation and was converted for use as a theatre, opening as the Watergate Theatre in February 1993.
Date of construction:	1936
Street/ Townland:	Parliament Street; Gardens Td. (St Mary's Pr.)
Coordinates:	650429, 656266
RMP:	Within KK019-026----
SMR:	-
UAS:	-
National Monument:	-
Protected structure?:	No
NIAH:	12000098
Distance from application site:	Approximately 75 metres from proposed street and 45 metres from urban park.
Special interest:	Architectural, cultural and social
Special interest rating:	Regional

Plate 20: Watergate Theatre

Site Name: BH-11 – Walsh’s Mill and Woollen Mills

Description

The standing remains of two mills, Walsh’s Mill and Woollen Mills, built on right bank of the Nore. The remains consist of the unroofed remains of two buildings of mortared rubble stone but substantially reduced from when it was photographed in the late nineteenth century. The site of the mill wheel is visible to one side, but the head and tail races have been filled in. This mill took its power from the V-shaped weir that spans the river downstream from Green’s Bridge [AR-01]. The weir is thought to be possibly medieval in origin, and at least seventeenth-century in date, suggesting that the mills may also have an early origin. A mill is depicted on Rocque’s map of 1758, while Bradley (2000) notes its existence only from the first Ordnance Survey maps. During the nineteenth and early twentieth centuries, this was a woollen mill. A tuck and spinning mill was described in the Valuations from c.1841: the miller was Inditt Read; the building measured 37 feet (11.27m) by 22 feet 6 inches (6.85m), and 37 feet (11.27m) high, with an undershot water wheel 18 feet (5.48m) in diameter, powering two pairs of wash feet, three carding machines and one willow (Hogg 2013, Kilkenny p.12 no. 37). Photographs from the late nineteenth century show the mill complex operating.[24] It has been in ruin since the mid-twentieth century.

Date of construction:	Possibly 18th century
Street/ Townland:	Gardens Td. (St Canices' Cathedral)
Coordinates:	650516, 656487
RMP:	Within KK019-026----
SMR:	-
UAS:	-
National Monument:	-
Protected structure?:	Yes – Reference D139 & D141
NIAH:	Not listed
Distance from application site:	Approximately 25m from proposed street and 55m from urban park.
Special interest:	Technical, historical
Special interest rating:	Regional

[24] http://catalogue.nli.ie/Record/vtls000339963 (accessed 3/7/2020)

Plate 21: Woollen Mills looking north

Plate 22: Woollen mills looking south (St Francis' Bridge in the background)

Site Name:	BH-12 - St Canice's Cathedral and Round Tower
Description	St Canice's Cathedral, a thirteenth-century gothic church started shortly after the Anglo-Norman conquest. This had been a significant religious and political centre from the seventh century with the foundation of a monastery dedicated to St Canice (Bradley 2000, 1). The round tower to the cathedral's immediate south suggests that the gothic building replaced an earlier Romanesque church building. The cathedral continues to function as the centre of the Church of Ireland Diocese of Ossory, and is a nationally significant example of medieval gothic architecture and art history, containing fine examples of medieval figure sculpture. It is also a significant tourist attraction in Kilkenny city.
Date of construction:	Thirteenth century
Street/ Townland:	Church Lane; Gardens Td. (St Canice's Pr.)
Coordinates:	650243, 656423
RMP:	Within KK019-026----
SMR:	KK019-026029-; KK019-026128-; KK019-026129-; KK019-026169-; KK019-026175-
UAS:	UAS-29

Protected structure?:	Yes – References B17, B18
National Monument:	Yes
NIAH:	12005018; 12005019; 12005036
Distance from application site:	Approximately 220m from proposed street and 180m from urban park.
Special interest:	Architectural, artistic, archaeological, historical, social, technical
Special interest rating:	National

Plate 23: St Canice's Cathedral, seen from the application site

Site Name:	BH-13 - Kilkenny Castle
Description:	A nationally significant Anglo-Norman castle built in the thirteenth century on the site of an earlier earthwork castle and modified at various times since. This was founded as a de Clare castle and manorial centre, becoming the centre of the Marshall lordship in Ireland, before being purchased by the Butlers in 1391. Kilkenny Castle remained the primary Butler residence and estate centre in Ireland until the early twentieth century. The castle stands on high ground on the right bank of the Nore and is built around three sides of a trapezium, with the narrower central side facing north-west. It was substantially remodelled in the seventeenth century, and again in the nineteenth century in the neogothic style, retaining its distinctive medieval drum towers. It is now owned by the OPW and is a major tourist attraction open to the public.
Date of construction:	Thirteenth century
Street/ Townland:	The Parade; Dukesmeadows Td.
Coordinates:	650794, 655734
RMP:	Within KK019-026----
SMR:	KK019-026078-
UAS:	UAS-78
National Monument:	Yes
Protected structure?:	Yes – Reference B197
NIAH:	12001066, 12001067
Distance from application site:	Approximately 470m from proposed street and 600m from urban park.
Special interest:	Architectural, artistic, archaeological, historical, social, technical
Special interest rating:	National

Plate 24: Kilkenny Castle, seen from the application site, near the River Breagagh

Site Name:	BH-14 – Mayfair building
Description:	Single-storey hall with part two-storey elements. Constructed with concrete with gable-ended corrugated roof and with replacement uPVC windows. Built in 1940s as a ballroom and remained in that use until 1973, also hosting céilís, concerts, fencing tournaments, boxing matches and other events. Following closure, it became the canteen for the Smithwick's Brewery. Currently being converted for use as the city library.
Date of construction:	1944
Street/ Townland:	Parliament Street.
Coordinates:	650421, 656324
RMP:	Within KK019-026----
SMR:	-
UAS:	-
National Monument:	-
Protected structure?:	No
NIAH:	No
Distance from application site:	Approximately 50m from urban park.
Special interest:	Cultural
Special interest rating:	Local

Plate 25: Mayfair Building

References:

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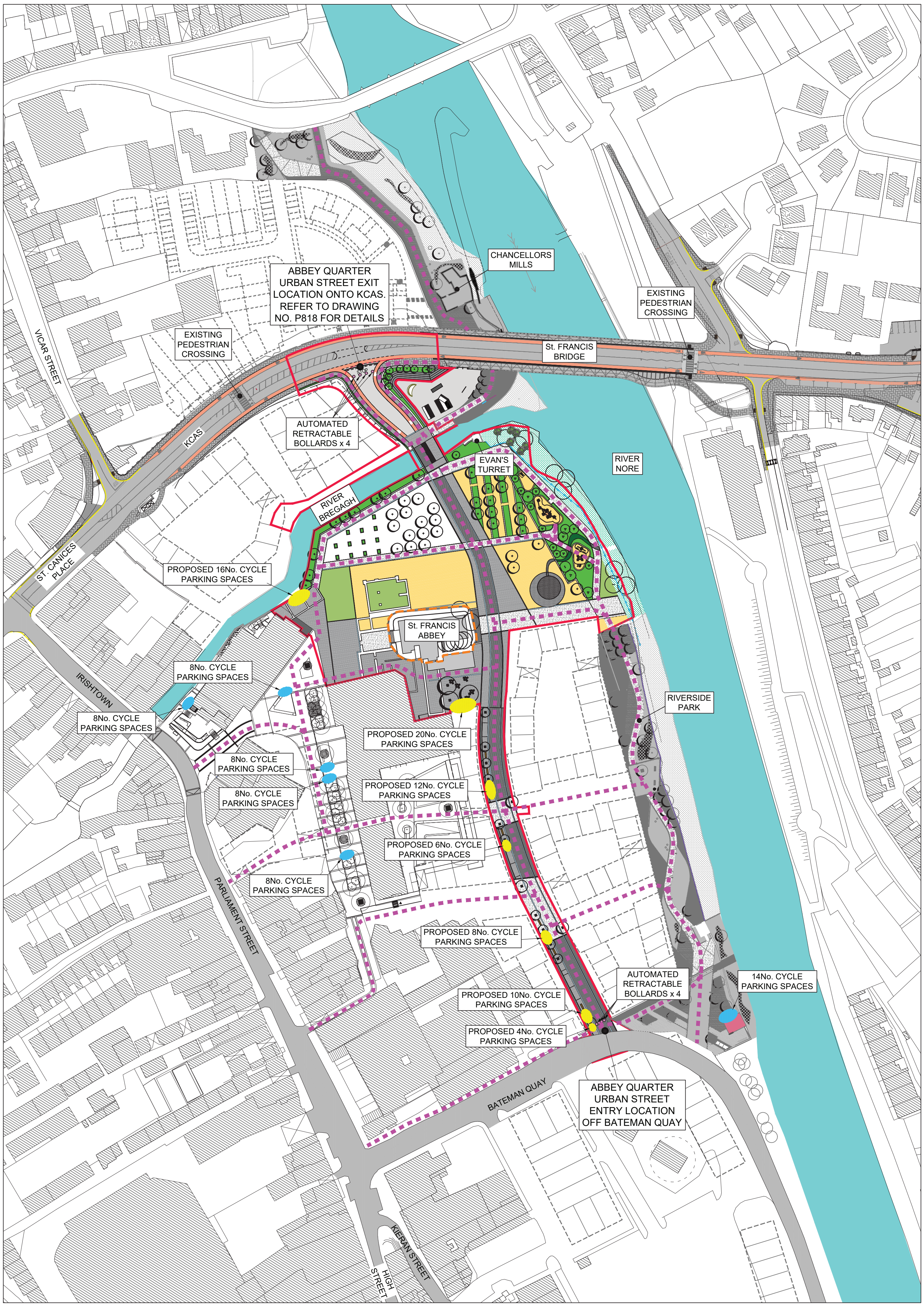
Appendix 14.1

DON'T SCALE DIMENSIONS



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5. THIS DRAWING TO BE READ IN ACCORDANCE WITH ALL RELEVANT ENGINEERS' DRAWINGS AND SPECIFICATIONS.

LEGEND

- PROPOSED PLANNING AREA ($14,416m^2$)
- AREA EXCLUDED FROM PLANNING
- PROPOSED CYCLE PARKING SPACES. REFER TO DRAWING NO. P805 FOR LOCATIONS. 76No. SPACES
- CYCLE PARKING SPACES NOT PART OF THIS PROJECT. 54No. SPACES
- INDICATES PROPOSED PEDESTRIAN PERMEABILITY ROUTES

REFER TO ARCHITECT'S DRAWINGS FOR PROPOSED SITE LEVELS AND PROPOSED SITE FINISHES

Rev.	Description	Date	Drawn	Chkd	Appr
P	PLANNING ISSUE	24.07.2020	JD	PR	PR

THIS DRAWING TO BE USED FOR PLANNING PURPOSES ONLY

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Client: KILKENNY COUNTY COUNCIL

Job: ABBEY QUARTER URBAN PARK AND STREET

Drawing: PEDESTRIAN PERMEABILITY LAYOUT

Job No	Drg No	Stage	Revision	Scale
W14017	P819	PL	P	A1 1:1000 A3 1:2000

P:\2014\W14017\10. Design and Drawings\11 MOR\PL - Planning\P819 _P - Pedestrian Permeability Layout.dwg

DON'T SCALE DIMENSIONS