SOCIAL
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ENVIRONMENTAL

THE ROYAL CANAL

Revival of the Royal Canal and its potential to facilitate a Green Industrial Revolution

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B.Arch 2023

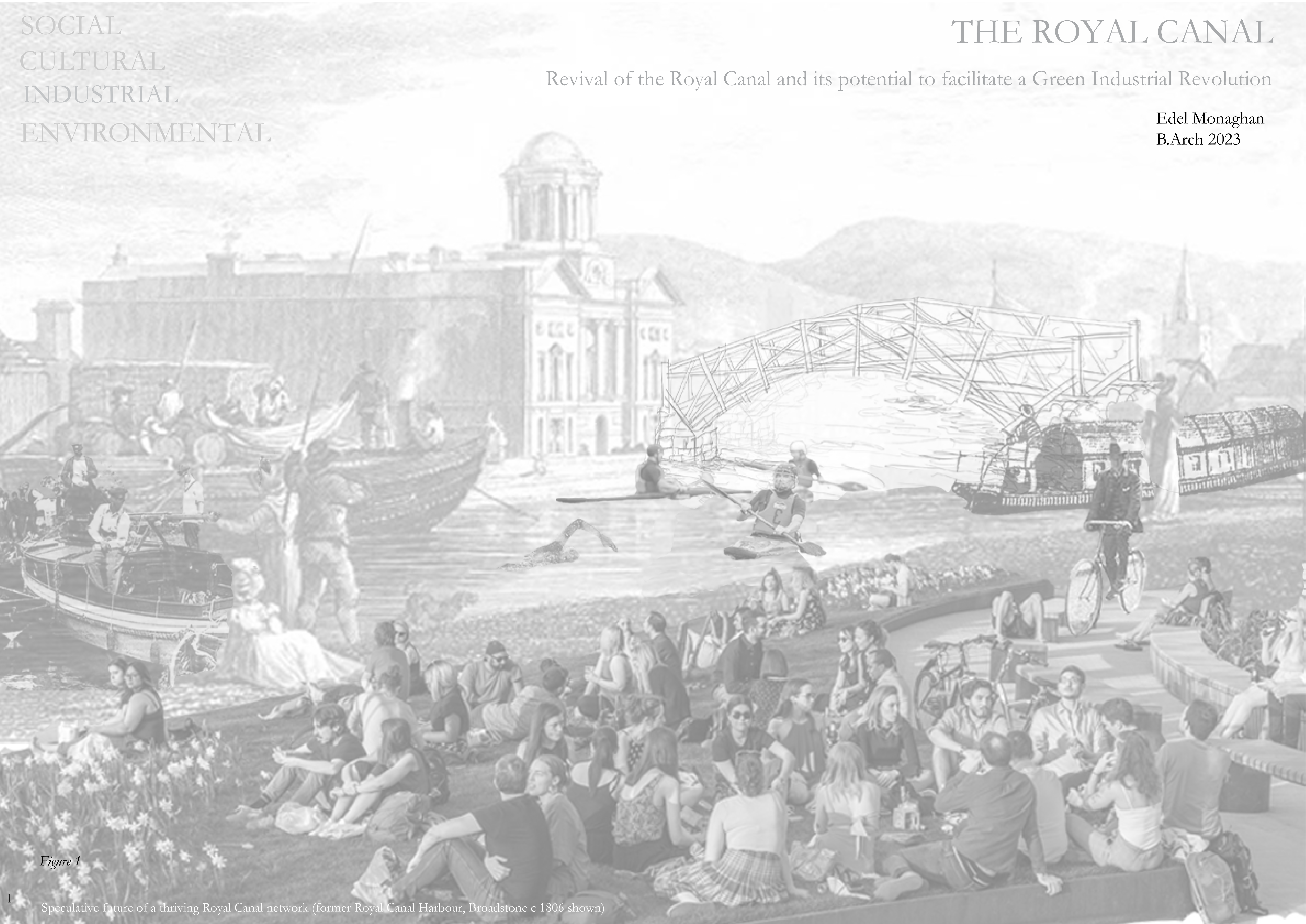


Figure 1

Speculative future of a thriving Royal Canal network (former Royal Canal Harbour, Broadstone c 1806 shown)

Contents

Acknowledgements

I would like to express my sincerest gratitude and appreciation to my tutors Johanna Cleary and Calbhac O' Carroll for their continuous guidance, support and inspiration. They encouraged me to not hold back with my ideas and instilled confidence in me to progress my design through to the end. As well as Kevin Donovan, thesis advisor, for his enthusiasm and advice, it is greatly appreciated. Thank you to all of SABE faculty for my invaluable time in TU Dublin.

To the class of 2023 and all friends made over the last 5 years. Thank you for the infinite conversations, your thoughtfulness, words of wisdom, and for the endless memories. I wish you all the best for the future.

Lastly but not least, to my wonderful family: I cannot express my thanks and appreciation enough for all that you do. Thank you for your endless support and for always being there.

Figure 2: The Royal Canal in the 19th century

"The proper meaning of tradition is not to live in the past but to follow those who have gone before you into the future" (Ingold, 2022).

Abstract

The Royal canal: Innovative infrastructure built for a particular purpose no longer in existence but how it has shaped the present and could inform the future. How can I reimagine its future state, learning from its past functions, to realise potential as resilient infrastructure in a world of imminent energy descent. My thesis will examine the history of the Canal with a view to projecting a future for it that is as relevant for today's and tomorrow's questions, in relation to fossil fuels and climate change, as the previous innovations in the canal were for past moments in its history. In addition, how can we reuse and reimagine redundant structures adjacent to the canal. I explore the potential of the Industrial-Aged Canal and associated industries in facilitating a Green Industrial Revolution.

Key events of the Royal Canal

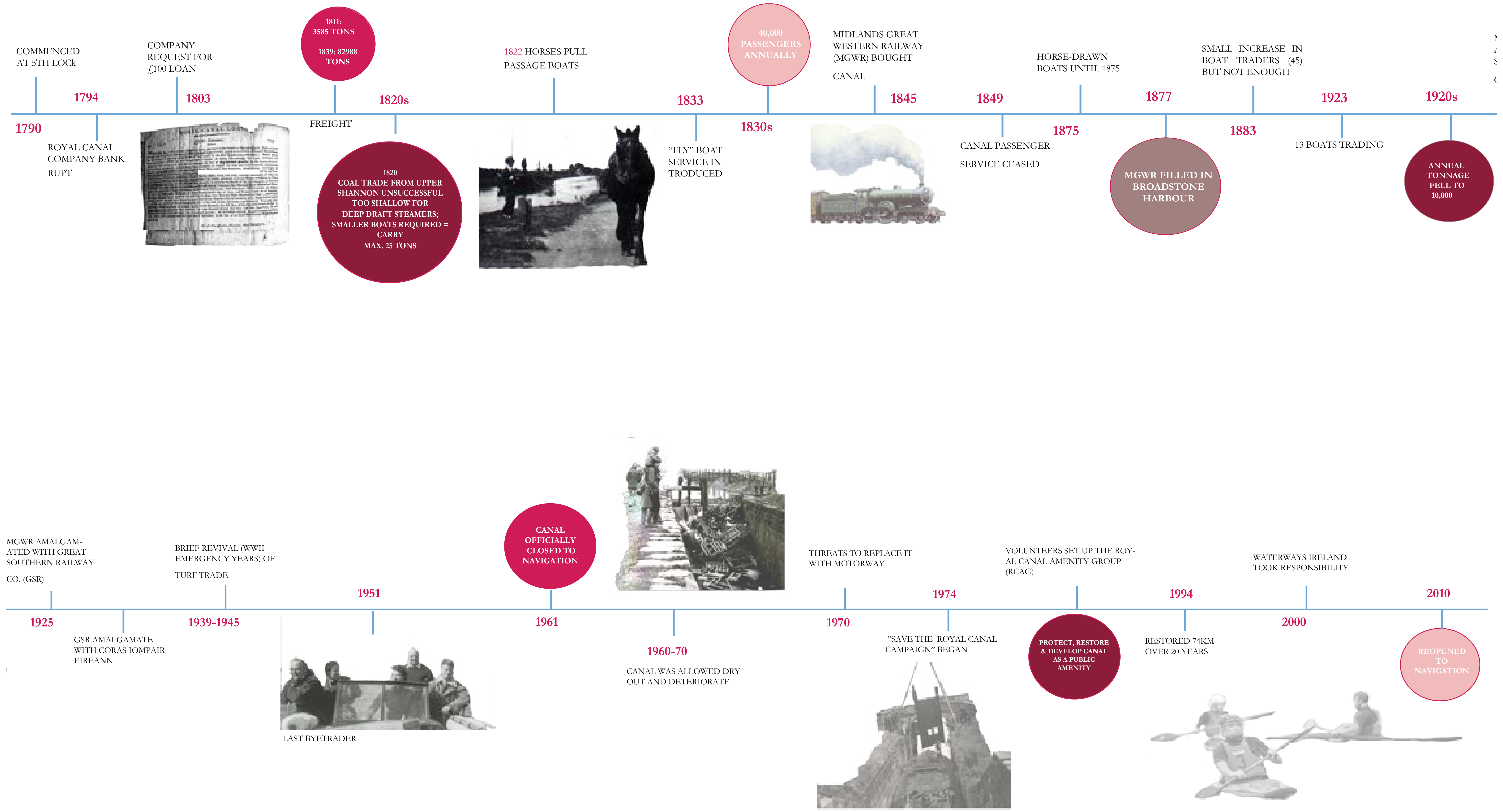


Figure 3

A brief history of the Royal Canal and Introduction to thesis topic

The Royal Canal (1790-1817) followed the Grand Canal, built 1756-1804 (Clarke, 1992), as an innovative earth-extracting piece of infrastructure built to provide freight and passenger transportation between Dublin and rural towns in the heart of Ireland. It enabled increased transport inland by water, with its main water supply sourced from a natural reservoir: Lough Owel, County Westmeath. The latter enters the summit of the Royal Canal through a 2 mile long feeder (Rolt, 1949, p.128). The Canal extends from Spencer Dock in Dublin where it meets the River Liffey, to 307 feet above sea level at Richmond harbour in County Longford. There it meets the River Shannon, providing a significant new artery connecting rural communities and the capital city.

In my thesis, I will explore the Royal Canal as an instrument of economic and societal progress in Ireland during the 19th century; a revolutionary transportation system facilitating the expansion of trade industries across the country, and research its decline to become a redundant navigational corridor. I will review the global impact of energy expansion and industrialisation (from wood to coal burning) on infrastructure, and its subsequent contribution to the current climate crisis.

I will examine the construction and functions of the canal, including its materiality; which has existed for over two centuries and what has survived of the original infrastructure. I will explore new uses, learning from the Canal's past to inform a sustainable future. What positive innovations can we borrow or adapt from our predecessors, when imagining a sustainable future?
An overarching theme is: How do I imagine a future for the royal canal – its purpose within a forward-thinking sustainable society? Away from our reliance on fossil fuels, what happens in a future of energy descent and how might the canal be used to facilitate this? These are the questions I intend to investigate and test through my architectural design studio project.

1.0 What was transported along the Royal Canal?

"Human and animal muscle provided almost all mechanical force before the steam engine" (Calder, 2021, p.16).

Before canals, transportation of commodities was difficult, arduous and slow. Prior to the steam combustion engine, which burns fossil fuels to release heat energy, horses and carts were the main mode of transport for both goods and passengers (Woodford, 2007). Horses were still necessary to tow barges carrying freight along Canal towpaths. This method proved less taxing on the horse compared to travel by road and proved more efficient. *"This offered up to twenty fold cheaper transport of materials than that of same quantity by road"* (Calder, 2021, p.231).

Horse-drawn boats were used until the introduction of steamers (steam-powered boats) on the Canal in 1875, which were faster therefore facilitating increased trade. However steamers had been on the Canal long before; principally transporting wool to and from "the greatest mart in the country" in Mullingar (Ireland waterways history, 2011). According to Calder (2021), by the beginning of 20th century, steam engines in Britain could do the equivalent of 90 million extra labourers working continuously. Additionally, Coal powered trains and steamships, and millions of domestic and industrial fires across the country (p.231).

"By 1900 human and animal muscle together provided only 4 percent of energy used in England and Wales… coal furnished 95.5 per cent…the country was now coal powered" (Calder, 2021, p.231). Ireland followed this energy shift thereafter.
Hence, the Canal system was considered a vital part of the development of trade and industry in Ireland (The Waterways Trust, 2017).

Figure 4: Ireland's waterways.

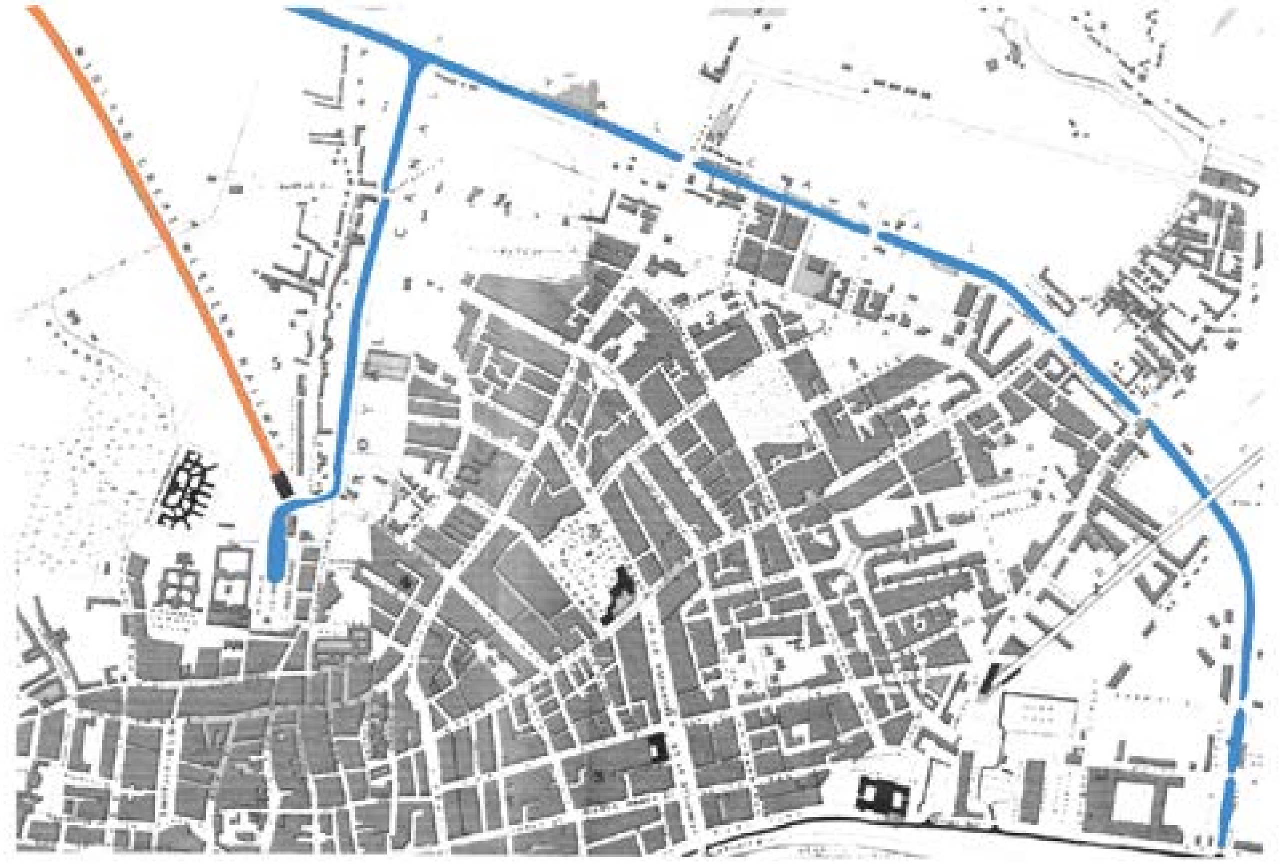


Figure 5: 1836 map showing Royal Canal Branch line, with the later (1848) infrastructural development : Midland Great Western Railway overlayed (orange), with terminus also at Broadstone.

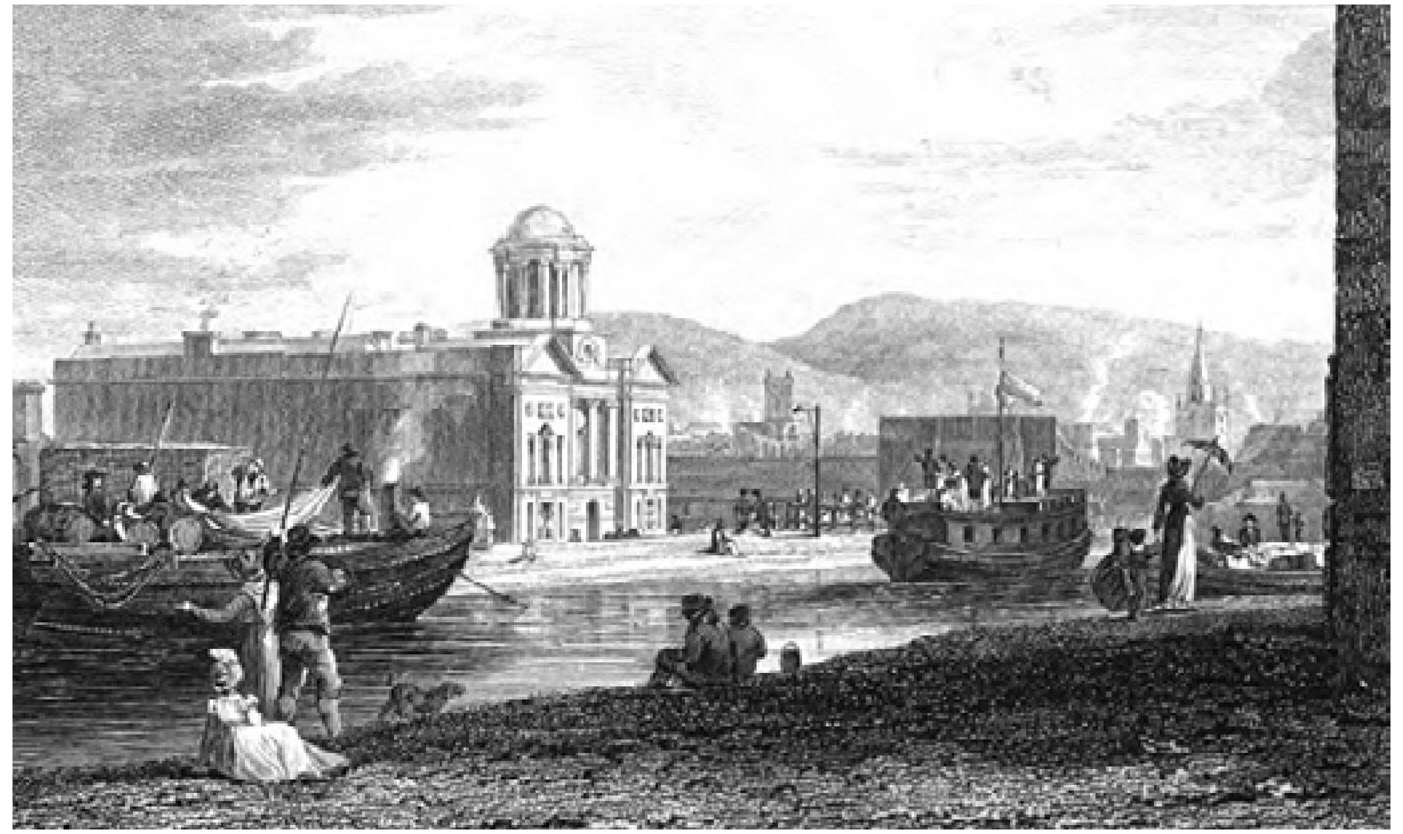


Figure 6: The Former Royal Canal Harbour at Broadstone c.1825, stemming from the Royal Canal branch line, prior to the MGWR line construction.

1.1 Transport of objects for trade

The Royal Canal provided employment and greater opportunities for tradesmen in particular. Coal, for example, could be transported from Mullingar to the capital thereby increasing their markets and therefore greater revenue (Clarke, p.95).

The Canal was vital for the transportation of freight for trade. The latter included live animals: pigs, cattle and sheep, food products such as potatoes, butter, beef, flour, oatmeal, (grain and bran were also used in distilleries), and liquids such as porter. Malt barley was also transported to the Guinness Brewery, Dublin (Watervaysireland.org, 2019a).

Additionally, building materials such as slate, bricks, stone, lime, round timber, and heating materials including turf, were all transported by Canal. Turf trade fell into decline except for a brief revival during WWII. Other commodities included manure, flags, gypsum, and mill dust. During the canal's declining years from 1905 onward, coal, coke, porter and bog ore were the main tonnage (Delany and Bath, 2010, p.325-326), (Clarke, 1992, p.104).

In order to facilitate all of this trade, harbours and warehouses were built in many of the villages and towns through which the Canal passed. Vessels could load and offload their items and passengers could be greeted and wish farewells. There are numerous beautiful Canal-side mill buildings remaining, with many requiring a new purpose.

Many of these industries and various forms of agriculture, were made possible by the canal's ability to transport these materials and products. The canal was the lifeblood for these industries.

1.2 Transport of people

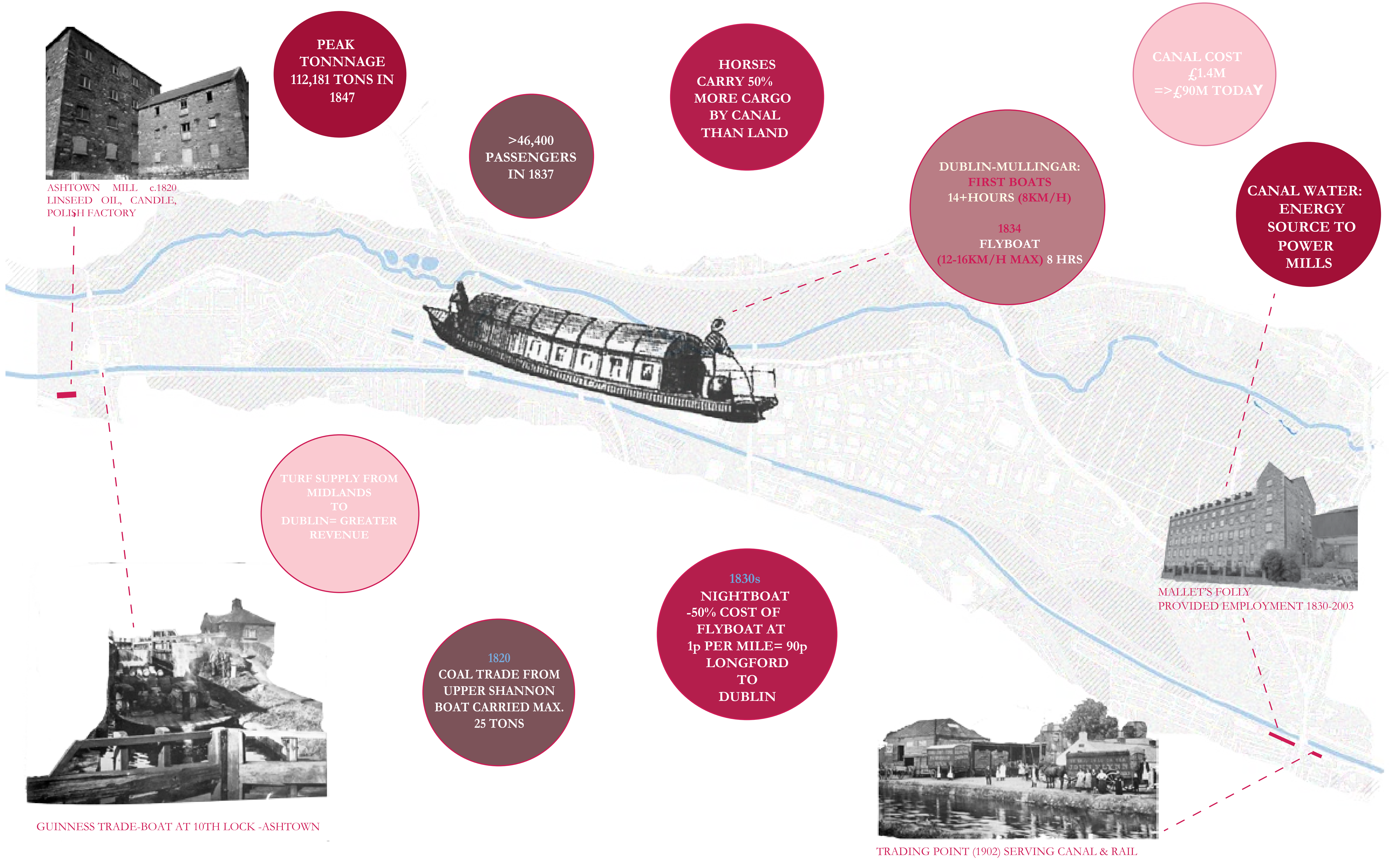
The (new) royal canal company saw passenger numbers reach 46,450 by 1937. Annual tonnage carried peaked at 112,181 tonnes in 1847, however it could never compete with the Grand Canal for trade, which peaked at an astonishing 239,000 tonnes (Neary, 2016, p.217).

However, shortly afterward there was a dramatic decline in canal passenger and trade usage following the construction of railway lines along the canal's banks by the Midland and Great Western Railway Company (MGWR), who purchased the Royal Canal in 1845. This sounded the death knell of the Canal(s) and eventually led to its closure in 1961 as its train service boomed (Delany and Bath, 2010, p.322).

The steam train was powered by combustible materials, predominantly coal and oil, rather than wood, which had previously been the primary material burned for global energy production (Wikipedia Contributors, 2022). These fossil fuels were easily resourced due to their abundancy and low cost. The world became hungry for cheap materials, with little knowledge about the impact for future generations. This was groundbreaking; trains and steamships connected people, towns, and the globe. The industrial revolution changed the world, fundamentally changing the way humans interact with their environment. However it was an innovation that could no longer be contained.

Figure 7

Industries of the Royal Canal



2.0 Construction, infrastructure and functions

The first stone of the Royal Canal was laid in 1790 by John Fayne, Earl of Westmoreland, at the fifth lock (previously called the first lock) at Cross Guns Bridge; more formally known as Westmoreland Bridge (Delany and Bath, 2010, p.39). Two years later the canal reached Ashtown, a suburb of Dublin. However it did not meander its way 146km to the 46th and final lock in Longford until 1817. There were numerous delays including the Royal Canal Company declaring bankruptcy, and financial aid had to be sought from the Government and beneficiaries of the canal (Delany and Bath, 2010, p.34-36).

It is not a simply engineered navigation system; canals "required the transformation of the earth itself to facilitate movement" (Breen, 2016, p.8). The Royal Canal was led by Engineer Richard Evans, who had overseen the construction of the Boyne Navigation and previously designed the Grand Canal before, which includes the impressive 1783 Leinster Aqueduct in Sallins, Kildare (archiseek, 2022, Fig. 8).
The Royal Canal featured 46 locks, lock chambers, no less than 86 bridges and four major aqueducts built to carry the Canal over rivers including Ryewater, Boyne and Inny (Clarke, 1992).
Notably, the Rye Water Aqueduct; a 30.5m high man-made embankment, with a central stone bridge which carries the canal over the River Rye (Waterways Ireland, 2019, Fig. 9). The aqueduct also carries the Dublin to Sligo railway line over the river. This wonderful 18th century earthen structure below is visible more clearly from a distance.

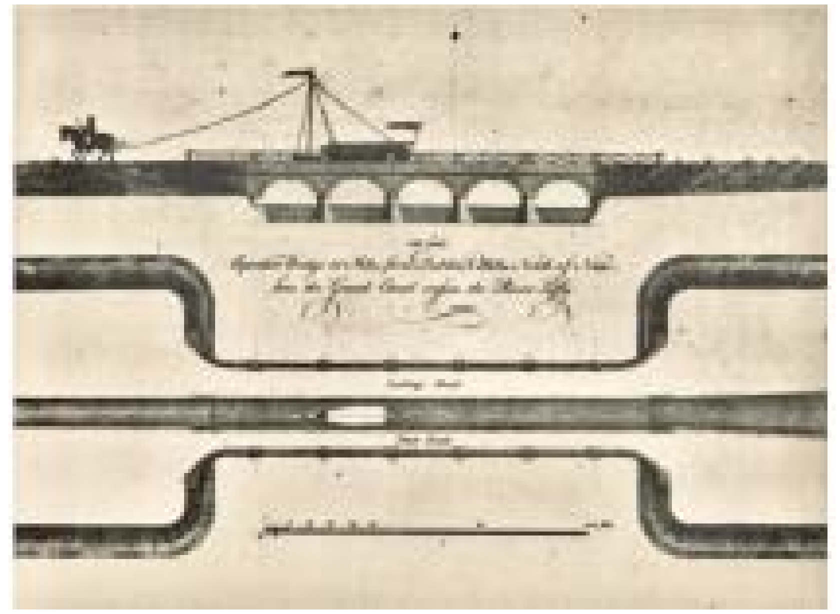


Figure 8

Figure 9

A technical piece of engineering on the Boyne Aqueduct (Fig. 10) noted in 1973 (Delany and Bath, p. 66-69) is the design of wooden stop-gates to swing shut if the aqueduct should develop a leak, exemplifying the advanced forward-thinking by the engineers. Future-proofing is of utmost importance particularly now in the current climate crisis.
Interesting bathing pools, built of finely cut limestone, were recreational features on the canal, such as the bathing pool (Fig. 11) fed from the spa next to the Rye Water Aqueduct, now disused (Delany and Bath, 2010, p.11). The innovation was based on the needs of middle-class persons living nearby, for leisure activities. Could such features have a new use informed by the needs of the people in the 21st century and further into the future?

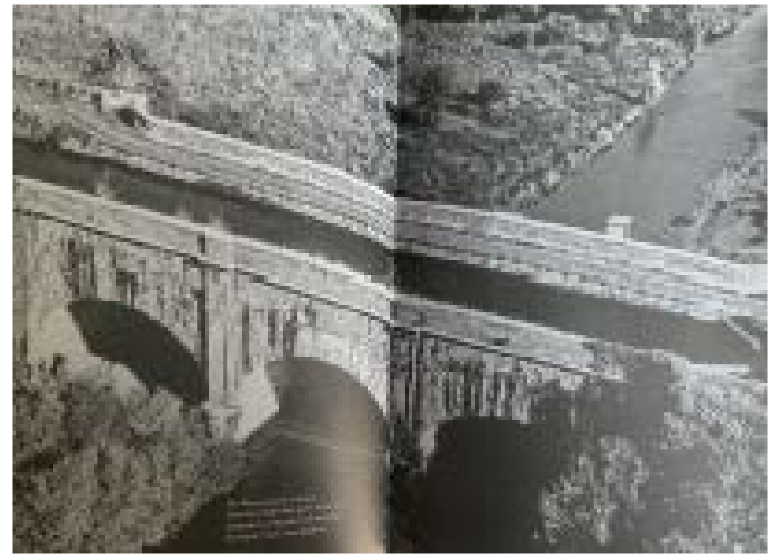


Figure 10

Figure 11

3.0 Materiality

Several of the materials transported along the canal were used in its construction and in the building of canal-side mills. This transpired when it was discovered that the canal's water could be used as an energy source to power the mills through their water wheels, such as Ashtown Mill and Mallet's Folly (formerly flour mill then Iron Mill) near lock six in Phibsborough (Reynolds, 2018) (Leaney and Byrne, 2012). Mallet's Folly was nicknamed after John Mallet (1780–1868), plumber, hydraulic-engine maker, and iron founder (Enda and Patricia M., 2012).
The materials included in the mill and canal's construction were primarily limestone, gravel, and timber: locally available materials, constructed by local labourers. Like the Romans, we relied upon local craftsmen, and engineers, using locally sourced materials to build our navigational channels. Although time-consuming, it was resourceful and built to last.

Blue marl clay was used to retain water and was also used for the bed of Blessington Basin. Situated on the route of the Royal Canal linear park, previously the Royal Canal branch line which travelled to the original main Royal Canal Harbour of Broadstone, an all too often forgotten past (Fig. 5). This heavy impervious clay lined the bed and sides of the canal, and was readily available (Clarke, 1992). Limestone quarries provided the stone for bridges and locks. One quarry was located at Carpenterstown (Clarke, 1992, p.38.) Lime kilns and forges were built along the canal to provide mortar and racking equipment, respectively.
Timber, principally native oak, was used for the lock gates. There were ashlar limestone chamber walls with gate recesses, and cast-iron mooring rings with dressed limestone coping (Clarke, 1992, Fig. 12). Many locks have required replacement timber and mild steel lock gates with timber balance beams, and replacement stone steps at harbours (National Inventory of Architectural Heritage, 2019).

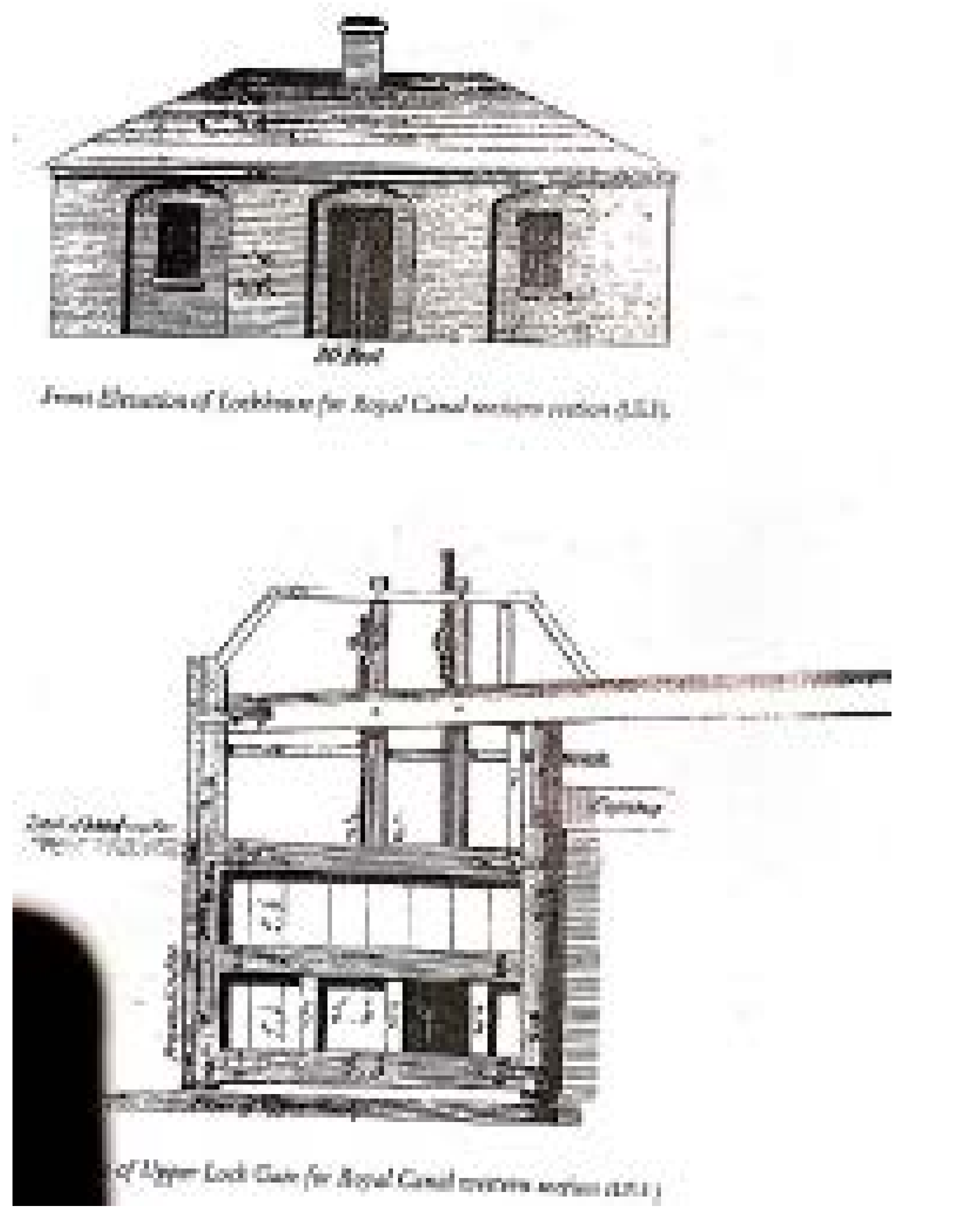


Figure 12

3.1 Materiality and future orientations

Mild steel is not locally produced in Ireland, most likely transported from England or further. Larger global connections become possible through energy expansion, relating back to the move from timber to coal (Calder, 2021). Whilst steel is durable and cost-effective, it carries the environmental issue of high carbon emissions in its production, and through its transportation method (Kindy, 2021). Materials used in the canal's construction and nearby buildings, were carried along it. However steel and other replacement materials are now transported globally by polluting modes of transport such as by air. According to recent studies, *"approximately 14 percent of [global] steel companies' potential value is at risk if they are unable to decrease their environmental impact. Consequently, decarbonisation should be a top priority for remaining economically competitive and retaining the industry's license to operate."* (Hoffmann, Michel Van Hoey and Benedikt Zeumer, 2020). This demonstrates that environmental impact has a consequence on economy, and we must act now to address this challenge.
Steel production is seen as the *"backbone of today's modern economy"*, used for bridges, buildings to cars and consumer goods. However many feel that its current energy requirements are unsustainable (Kindy, 2021).

Can we ensure that future canal maintenance is done using locally sourced materials, or if imported, that they are manufactured sustainably with minimal carbon footprint? Can imagine its future possibilities and future-proof our canal's structural integrity? (AplApollo, 2020)

Interestingly, it is possible to produce fossil-free steel, as demonstrated by a Swedish metal-making company: SSAB. They have produced *"the world's first customer delivery of steel produced without using coal as it looks to revolutionise an industry that accounts for around 8% of global greenhouse gas emissions."* Their ambition is *"to replace coking coal, traditionally needed for ore-based steel making, with fossil-free electricity and hydrogen"* (Reuters, 2021). The EU's aim to achieve net-zero greenhouse gas emissions by 2050 includes hydrogen as a significant component (European Comission, 2018). Could this be an exemplar for future maintenance of Ireland's canals and an example of green energy for a sustainable future in the construction sector?

Thomas Rhode's design for a lock gate in 1845 and his process for making gates is the same as it was when canals were originally built in Ireland (Waterways Ireland, 2019, Fig. 13). What has changed is the materiality: lockgates must be replaced every 25 to 30 years, and local oak is now seen as too fragile given the wet conditions. Instead, hardwoods such as greenheart and ekki (red ironwood) are imported from Central and West Africa (iNaturalist Canada, 2018) (Sara, 2020), which have greater longevity and are used as replacements, with steel brackets to fortify gate joints (Waterways Ireland, 2019). As with the mild steel, internationally sourced materials are being used to replace original materials- but if this continues, what will be left of its original structure? Global energy expansion has brought materials from across the planet, as they are cheaper to manufacture and import than locally source.

"The age-old practical pressure to use local materials was starting to give way to the might of coal-fuelled industry, establishing a pattern that is still dominant worldwide, where cheap, bulky materials routinely travel thousands of kilometres in fossil-fuelled ships and lorries, to be delivered to construction sites" (Calder, 2021, p.230). This is not sustainable.

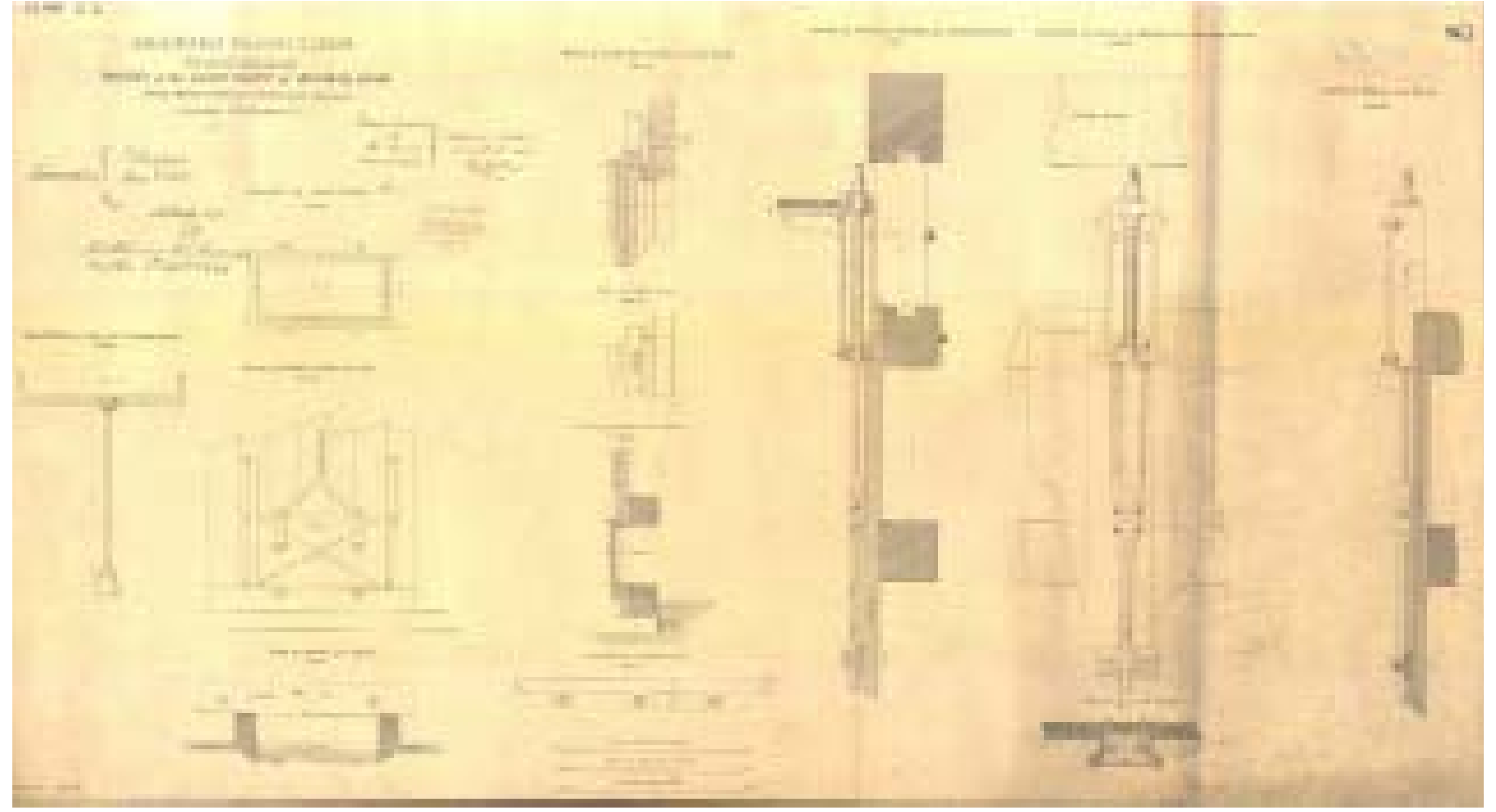


Figure 13

3.2 Canal Operation

All locks were, and many still are, manually operated under the management of lockkeepers. Few lockkeepers operate the canal today, as the canal is solely for recreational boat use. However, each lockkeeper authorise and control several locks on their own, with Billy Dixon operating 22 locks (locks 18 – 40) (Royal Canal Amenity Group, 2014).
Lock dimensions varied significantly, with lengths of 81-75 feet, and breadths of 14 feet 10 inches down to 13 feet 3 ¾ inches. The smallest dimensions made up lock number 19, Killucan Bottom (Rolt, 1949, p.263).

20 of the locks are double locks, 5 of which feature along the Dublin city stretch of the Canal (Rolt, 1949, p.111-112). In a double lock, the walls of the lower chamber slope up to the middle gate, recesses for stop gates to eastern end and walls to east end expand to form a canal harbour with dressed limestone walls, such as at the sixth lock in Phibsborough. At such locks, one can find remains of a three-bay, single-storey lock keeper's house with snecked limestone walls and dressed limestone quoins to north (National Inventory of Architectural Heritage, 2019).
"Sneck: a small, squared stone used in a rubble wall to fill spaces between stones of a different height" (TheFreeDictionary.com, 2014).

The Purpose-built cottage, or lock-house (Clarke, 1992, Fig. 12) was occupied by the lockkeepers, from where they could keep a close eye on passing traffic and control the water levels of the locks and levels. Many lockhouses have fallen into disrepair or been demolished, however some have been repurposed as canoe club house for example, and at lock 1 it has been renovated by the Adventure Project, a non-profit organisation, to serve as the headquarters for its innovative adventure therapy programs
(Waterwaysireland.org, 2019b). We should aim to try to reuse all the fine lock-houses which are such a crucial part of our history.

Generally, workmanship was of a high standard, notably the sixth lock. *"The chambers exhibit good quality stonework, with attractive sloping edges to cope with the change in height between the lower and higher levels, a testament to the skill of the craftsmen involved."* It is one of many double-chambered locks along this part of the Canal. Here, the adjacent lock-keeper's house and mill still stand, which are reminders of the area's historical industrial character. (National Inventory of Architectural Heritage, 2019).

Conversely, according to Clarke (1992), surprisingly some original workmanship was poor in areas with Evans overseeing construction sparingly. Thus, several bridges and locks had to be demolished and rebuilt. Newcomen Bridge on the Summerhill road collapsed when near completion, killing four workmen. The collapse was due to the insufficient bonding of stonework. In Phibsborough, the lock had to be partially demolished and reconstructed. Sluice frames of the seventh lock began to rot before being fitted (Clarke, 1992, p.40).

The canal-side mills, and industries were about providing a better future. The materials informed this future. The canals were visionary projects to transport people and products through the centre of Ireland. As Cohen (2012) talks about in *'The Future of Architecture Since 1889'*, architectural developments stem from sociological, cultural and (industrial) economic patterns of the past in order to inform and form the future; a world of constant change and growth.

Figure 14: Fossil Fuel (coal) extraction

4.0 Global energy expansion

However, until the mid-twentieth century, sustainability was about economic resilience, with reliance on fossil fuels for industry and trade. There was no anticipation of such commodities becoming scarce.
The emergence of coal (as energy) in the late 17th century fostered commercial growth, industrial and technological advancements that resulted in a boom that proved too popular to contain. "When the energy is available, the ingenuity will follow..." (Calder, 2021, p.221).
Calder (2021, p.230) notes that (historically) energy typically referred to the heat produced by freshly created fire fuels or food. Despite their growth, fossil fuel power surpassed these biological energy sources in the nineteenth century in terms of scale.

"With rising demand came rising prices for a finite local supply and expensive transport costs for firewood further away. The industry's very success was prone to strangle its future growth. With coal, this logic was reversed. The more you used, the more investment coalmine [Fig. 14] owners could afford to make in mining infrastructure, so the price of coal could remain similar or even drop (Calder, 2021, p.222).

It had a profound impact on every element of human existence, with architecture and urbanisation at the forefront of the changes. Coal heated homes, and powered ships, trains (along railways constructed on the banks of the royal canal the early 1840s) (Delany and Bath, 2010, p.167). So (fossil) fuel was used for transportation networks which connected people, and enabled materials for construction, and food for people to be transported to their destination.

Calder (2021) discusses the transformational nature of fossil fuels in the construction world due to their powerful and low-cost energy production. Coal was used to fire kilns, which made the bricks and lime for mortar, which made up our buildings. In the 18th to early 20th centuries, we used such fuels at a large scale, to ultimately build entire cities. (Giddings, 2021) (Moore, 2021).
Coal, which was transported along the canals in Ireland increasingly, was burned to heat homes. Additionally, lime produced from kilns was used in the construction of the Canal.

Burning of fossil fuel was the start of mass production and construction. The rate of consumption together with a lack of awareness of the consequences - most crucially, the impact on our natural environment, have led to the current worldwide climate crisis.

"Agrarian growth was prone to contain the seeds of its own destruction, whereas fossil fuel growth could (it seemed until we became aware of the greenhouse effect) continue until the world's reserves of coal, and later oil and natural gas, ran out" (Calder, 2021, p.222).

Carbon dioxide, a greenhouse gas, is released into the atmosphere in massive quantities when fossil fuels are burned. Global warming is caused by greenhouse gases, predominantly from fossil fuel emissions, which trap heat in our atmosphere. Already, there has been a 1°C rise in the average world temperature, with coal to blame for more than 0.3°C of this increase. As a result, it is the primary cause of the rise in global temperatures (ClientEarth, 2020). *"In 2018, 89% of global CO2 emissions came from fossil fuels and industry"* (ClientEarth, 2020). Ritchie, Roser and Rosado (2020) calculated that Ireland's cumulative CO2 emissions from fossil fuels and industry has increased exponentially over the last century (Fig. 15):

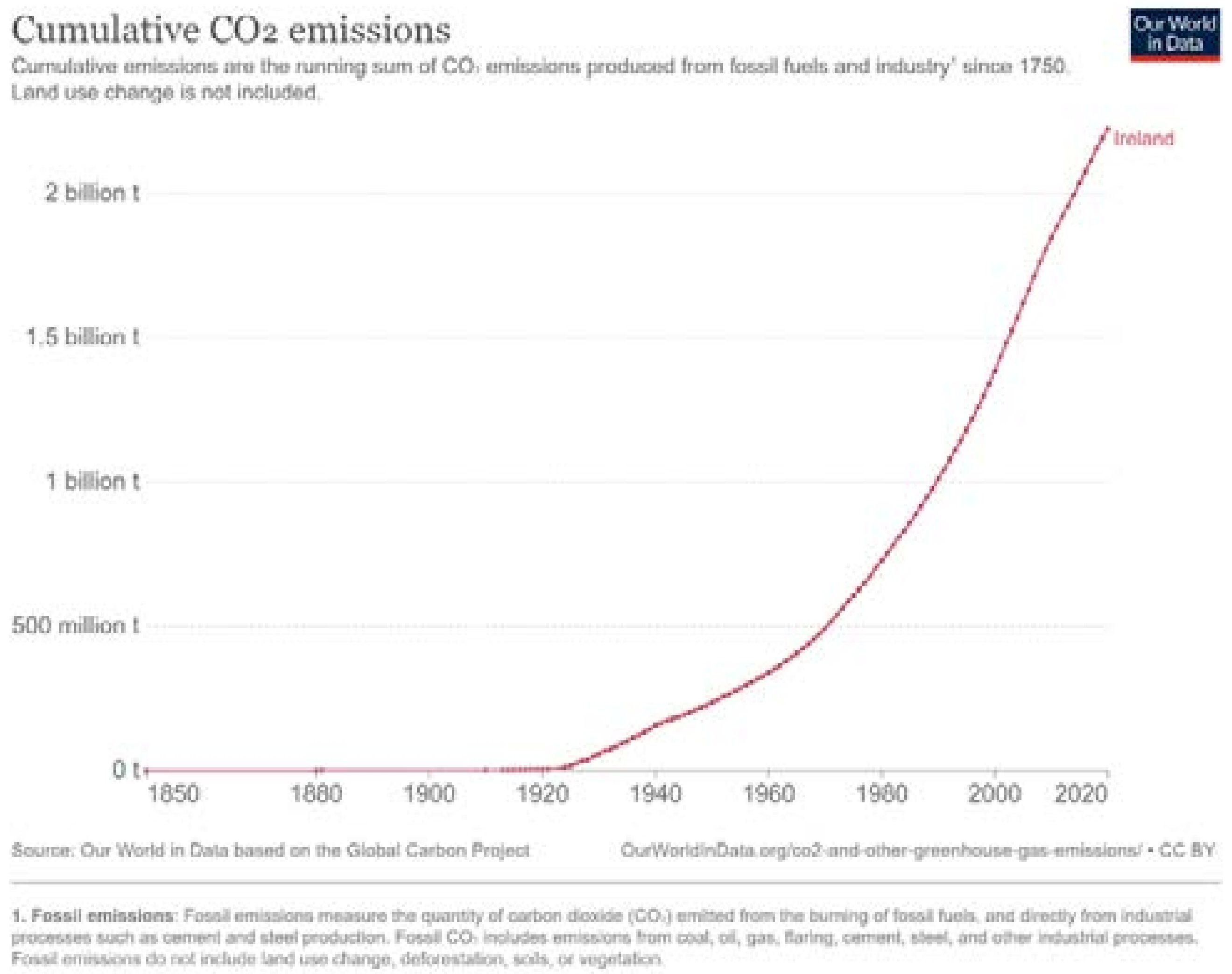


Figure 15

Our reliance on fossil fuels for energy, particularly in the construction sector has become so overwhelming that we are causing our planet to burn. United Nations Environment Programme report (2019) stated that when combined with operational emissions, the building sector accounted for 38% of total global energy-related CO2 emissions, 80 per cent of which is from fossil fuels (Neill, 2020), (UN Environment Programme, 2022). This is unsustainable if we are to reach UN goals to decarbonise by 2050 and save our atmosphere from irreversible catastrophe (UN Environment Programme, 2022). But how do we move away from something we relied so heavily on for so long?

Figure 16

Historically, materials were carried by people and animals in a laborious and slow process (such as the Romans). At that time, it required the burning of an enormous quantity of timber to heat a kiln to ultimately build walls, buildings, and cities compared to that of coal. But it was possible, with far less impact on the environment. And many of these buildings and pieces of infrastructure, still survive today. A testimony to the grit and determination by people (Hays, 2012, Fig. 16) with few resources, to produce lasting architecture and infrastructure. (Calder, 2021, p.16). It was a life with less energy.

"Every generation, then, is fated to live among the ruins of outmoded futures" (Ingold, 2022).

5.0 Future Orientations

Without fundamental change in orientation, the canal may remain as a fixed, (largely) immobile infrastructure; a failed transportation system. A lengthy corridor of extracted earth, structurally held together by the laborious hours of work by local engineers and craftsmen, which no one quite knows what to do with, apart from the occasional kayaker or angler on the weekend. Its banks are aptly used as greenway (*Fig. 17*) for cycling and walking over 130km from Maynooth to Clondara, but the canal itself is seldom used, particularly with boats: few rentable boats and cruisers exist. It lies as a redundant transportation artery (Waterwaysireland.org, 2019). How can we maximise its use and see its potential in the twenty-first century? How might canals in the future look in a world of energy descent? How can I make a climate-oriented architectural intervention for the canal? We must look to combat the climate crisis by addressing *"the complexities and threats of the anthropocene"* on nature (Breen, 2016).

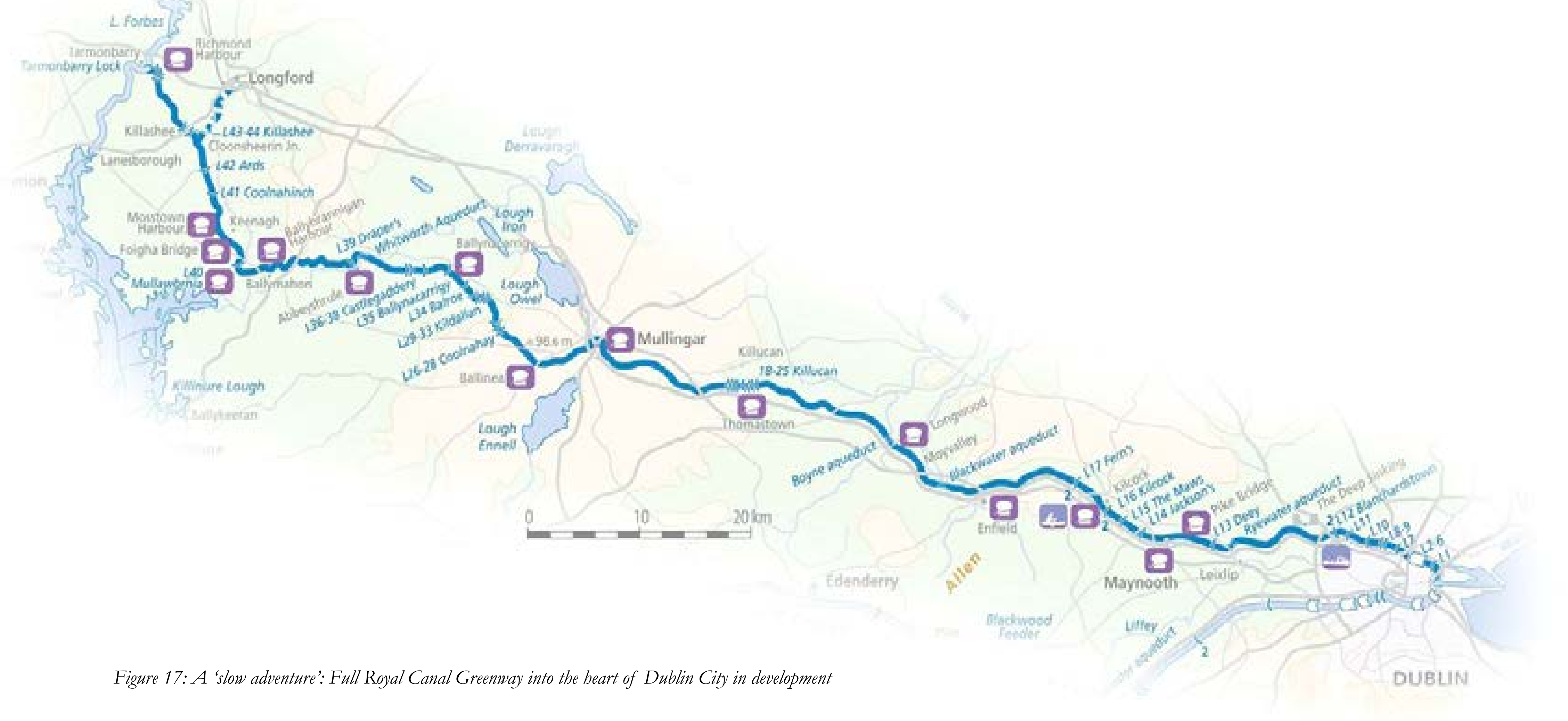


Figure 17: A 'slow adventure': Full Royal Canal Greenway into the heart of Dublin City in development

Globally, we are battling to limit temperature rises to 1.5C pre-industrial levels, in accordance with UN Environment Programme (Harvey, 2022). However there has been a proposal for the first new coalmine in 30 years in Cumbria, UK, which would completely negate the progress we are making on renewable energy. This coalmine is estimated to produce 400,000 tonnes of greenhouse gas emissions annually: *"the equivalent of putting 200,000 cars on the road"* (Harvey, 2022). Instead, we should develop alternative 'green' energy and implement it through innovative architecture to minimise our carbon footprint. Waterways such as canals could be an integral part of this (future).

"Following dereliction and decline in the 20th century, today's canals are enjoying a second golden age to help drive the 'Green Industrial Revolution'" (Canal & River Trust, 2021).

Studies have been done by The University of Manchester and on Yorkshire's Canals to show how *"historic water ways can play an important role in mitigating the impact of climate change and can help to reduce the levels of greenhouse gas emissions, which are driving global warming"* (Canal & River Trust, 2021).
McDonald et al. (2019) calculated that canals contributed to urban cooling in summer by above 1°C, which is a growing concern given climate change, such as in Dublin city and UK cities due to Urban Heat Island effect (Dalby, 2022). Which is *"set to worsen as temperatures rise. By 2050, extreme heatwaves are expected to happen every other year in the UK causing difficult living conditions…particularly in urban areas"* (Canal & River Trust, 2022).

5.1 Industrial-Aged Canals and 21st Century Green Energy

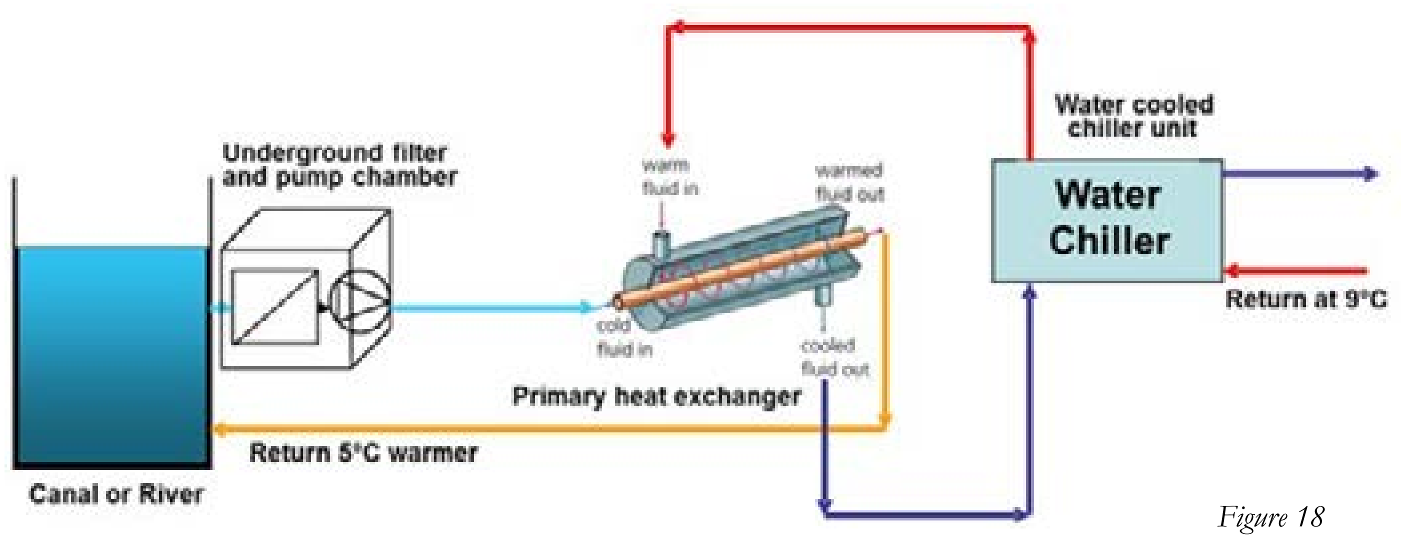


Figure 18

McGinley (2021), in an interview with the Yorkshire Times, stated that *"Although the great canal engineers of the industrial age could never have envisaged it, our network of canals and river navigations in the hearts of our towns and cities are perfectly placed to provide 'net zero' solutions and climate change mitigation"* (Yorkshire Times, 2021).

"Bodies of water have a natural cooling effect through evaporation and provide resilience to the urban infrastructure. This makes urban areas next to waterways more pleasant spaces to live and work" (Canal & River Trust, 2022).

The water of 19th century canals have the potential to heat and cool buildings through heat pumps (Fig. 18), without disturbing local ecology. According to a report in the Yorkshire Times (2021), this would save substantially over a million tonnes per year of CO2 entering the atmosphere compared to more traditional energy sources. *"The water flowing through our waterways contains enough thermal energy to produce approximately 640 MW of energy"* (Canal & River Trust, 2020). This could be a game changer for Ireland's waterways. The GlaxoSmithKline headquarters in Brentford, Middlesex is an example of a large commercial canal-side industry that uses this technological process (Canal & River Trust, 2020).

Sir David MacKay of University of Cambridge maintains that *"The combination of heat pumps and low carbon electricity is the future of building heating."* He also stated that "Water remains warmer than air on the coldest days which means they can be more efficient than air source heat pumps, and as water is much more dense than air" (Aqualor Energi, 2016). This highlights how important waterways are in future-proofing our cities.

Canals can also generate electricity through micro hydro-electric power schemes (Fig. 19): low carbon technologies which could power thousands of homes and help us reach renewable energy targets of *"80% renewable electricity by 2030"* (Government of Ireland, 2021). In England, hydro-schemes currently generate over 20MWh annually, *"equivalent energy for around 10,000 homes"*. They have the potential to produce significantly more power for nearby buildings, particularly those located near locks, where the water's velocity increases (CCiP, 2018) (Yorkshire Times, 2021).

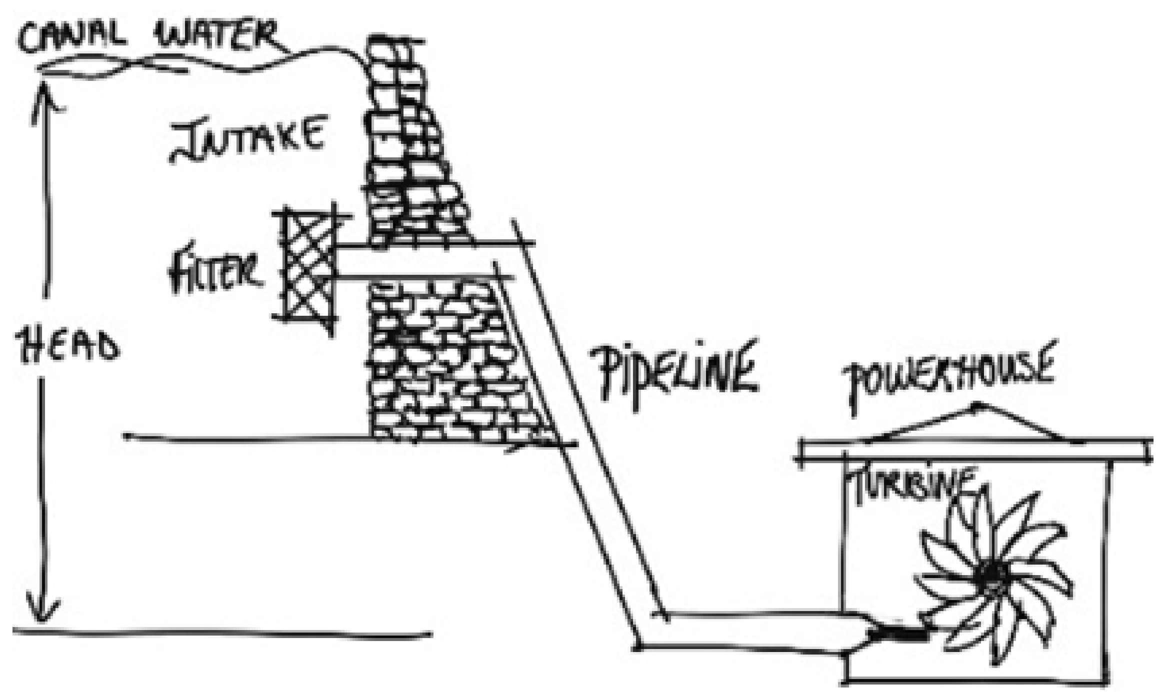


Figure 19

Another type of sustainable green energy being researched in Amsterdam is aqua-thermal energy (Fig. 20). By 2050, they hope to have decreased CO2 emissions by 95% and phased out fossil fuels. Other objectives include eliminating natural gas consumption by 2040 and having solar and wind energy generate 80% of household electricity by 2030 (Amsterdam Institute for Advanced Metropolitan Solutions, 2021). We must follow in their footsteps.

In relation to aqua-thermal solutions, *"it is possible to convert temperatures from surface water, wastewater and drinking water into energy"* (Amsterdam Institute for Advanced Metropolitan Solutions, 2021). Dang (2021) describes it as an energy-saving alternative that also conserves its built heritage. *"Biogas and hydrogen are limited, expensive, and dependent on regional production… and transport capacities…Aqua-thermal energy from surface water could be a feasible alternative to natural gas... since this city counts a large number of canals... The heat from the canal water could be collected in the summer, stored in the subsurface, to use it in the winter when Amsterdam is heating itself"* (Amsterdam Institute for Advanced Metropolitan Solutions, 2021). Could aqua-thermal energy be a viable option in Ireland's waterways?

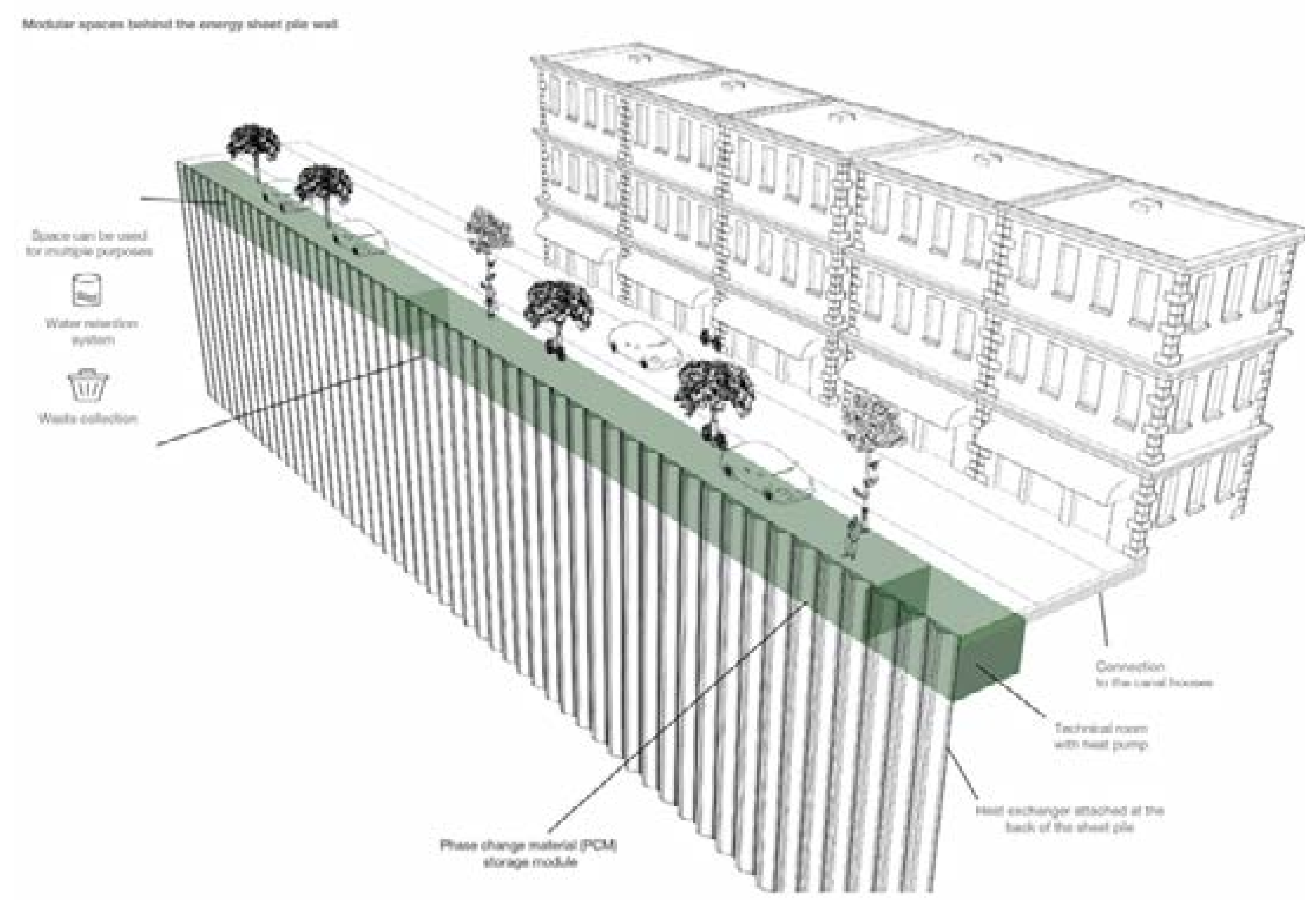


Figure 20: An innovative quay wall to tackle the city's energy ambitions

5.2 Approach to Architectural Design Studio project

My Architectural Design Studio project will test these new 'green' methods of energy production, and advocate the important role of our Industrial-Age Canal in this. The re-evaluation of current energy sources using the canal as the resource will facilitate the decarbonisation of heating and could ultimately establish a sustainable future. This new future for the canal could also allow communities to reconnect with their historically important waterways as well as helping mitigate climate change.

Dr Joanne Tippett, from University of Manchester, noted that *"The canals in our cities were a product of the Industrial Revolution, a time of great innovation…Bringing together our industrial heritage with new technologies and cutting-edge research like this can help us create urban areas where people and nature thrive in a more sustainable future."* (Yorkshire Times, 2021)

I intend to test the heating and cooling capabilities of the Royal Canal and maximise its potential to generate green energy for both existing and new buildings. The aforementioned Swedish fossil-free steel is an exemplar of how we can move closer towards net-zero materials within the construction industry. Can we enhance these innovative, sustainable ingenuities and create resilient architecture that combats our current climate crisis, whilst nurturing the canal's historic past?

"Instead of notions of mastery and our technological enframing of nature, our future architectures and infrastructures will only become responsibly embedded, and adaptable to their environments when they accept that neither man or nature is in command" (Breen, 2016, p.36).

We can utilise our canal network in order to meet the new challenges of the twenty-first century.

Architecture is constantly tested by natural forces, and by social, historical and environmental issues. We can address our uncertain future by responding imaginatively to the climate challenges.
I want to adapt and create programmes for existing structures such as the derelict c.1820 Ashtown canal-side (former) mill (Fig. 23). A new harbour for the city could reactivate the canal and its relationship to its environs and enliven local communities (National Inventory of Architectural Heritage, 2019). Dublin lacks a destination for recreational (boat) users of the Canal, with few mooring sites after Maynooth (Fig. 22). The last moorning location towards the city is situated before the twelfth lock of Castleknock This would encourage 'floating visitors' into the city and enhance the Canal corridor (Fig. 21) (Fig. 22).

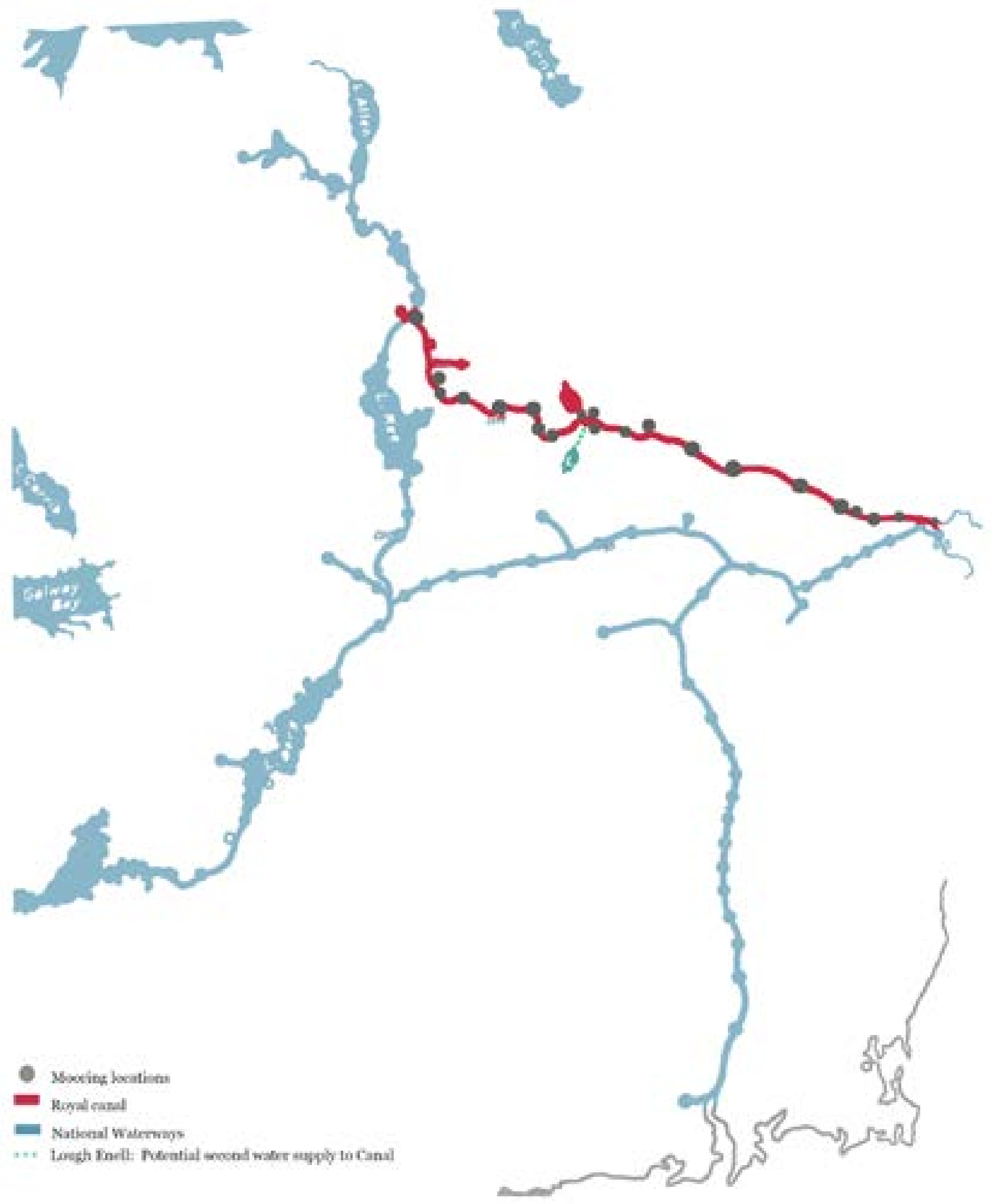
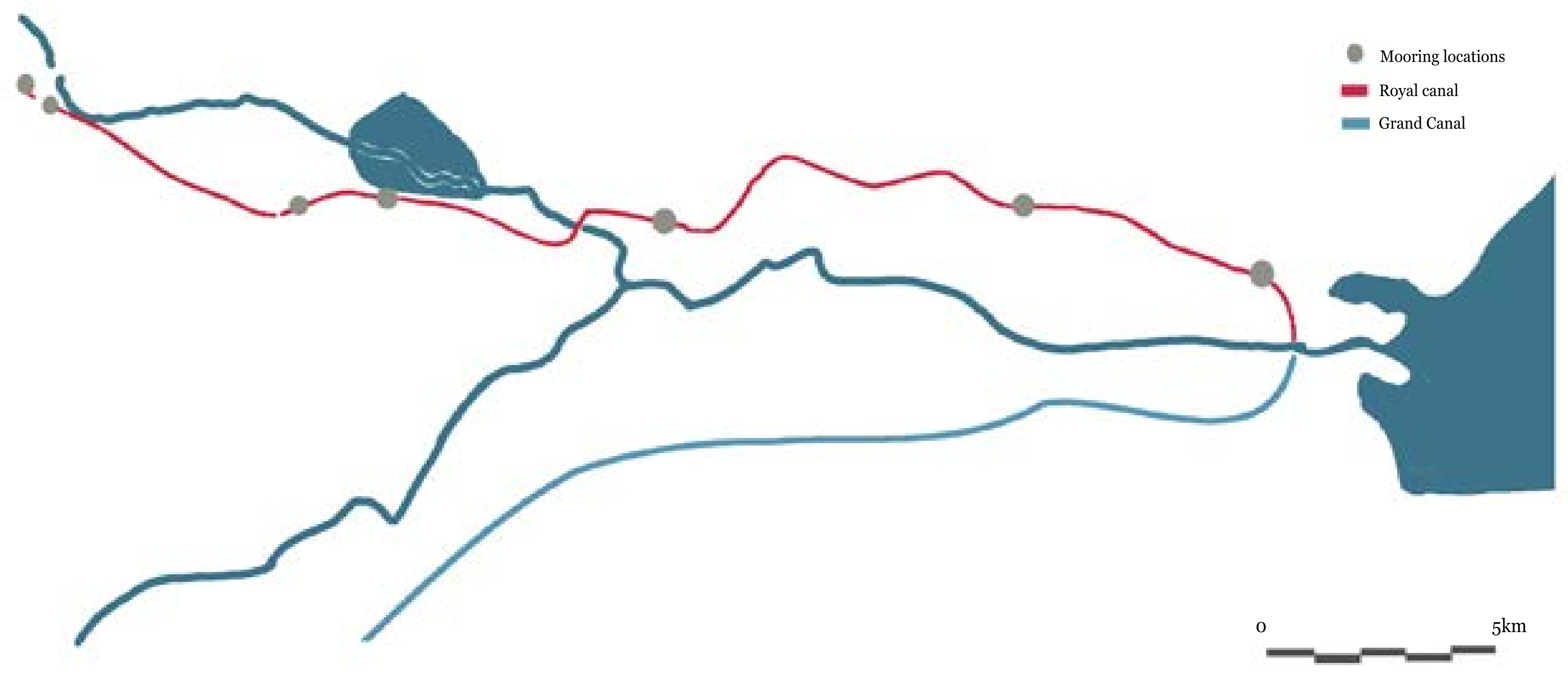


Figure 21: National scale Royal Canal network

Figure 22: The infrequent mooring locations from Maynooth to Dublin Bay



"…canals reflect a desire to direct nature and its flows. Today, these fluid spaces are opening up to new programs, projects that explore modern life and urban vitality" (Baldwin, 2021).

6.0 Context: Site location and History

The (former) Ashtown Mill is in close proximity to Ashtown train station, which serves the Dublin- Sligo railway line, and is adjacent to the Canal (Fig. 24).
It is beautifully crafted from limestone of early 19th century (National Inventory of Architectural Heritage, 2019). Materials transported along the canal were used in its construction and in the building of canal-side mills. This transpired when it was discovered that the canal's water could be used as an energy source to power the mills, through their wheels, such as Ashtown Mill: an historic detached four-bay five-storey former mill on banks of Royal Canal at Ashtown.

Figure 23: *Ashtown Mill when fully activated c.1952, incl. many outhouse developments which have since been demolished/ or fallen into disrepair*

Though a short-lived power source, it shows the Canal's potential to facilitate not just trade and travel but energy. My project will explore 21st century sustainable energy solutions using the Canal's water.
The Mill was originally a linseed oil mill, owned by Robert Mc Garry and family. He owned 130 acres of the adjoining land, and cultivated the seed crushed at their mill there (Canals of Dublin, 2019).
The factory had sizeable storerooms, capable of storing 600 tons of seeds: which made 500 tons of oil, and 1200 tons of cake. It contained (oil) tanks ranging in capacity from 3500 – 10,000 gallons.

It was then Ronuk wax polish factory and candle-making by the Rathborne firm until c. 1950. Thomas Burke Sr. and family took ownership of the hisoric site therafter and built Ashtown Wholesale Trading industrial compex on the edge of the former mill pond. The Mill has since been redundant (Reynolds, 2018) (Burke Brothers, 2023).
I look to reimagine its future possibilities in a sustainable, forward-thinking society.

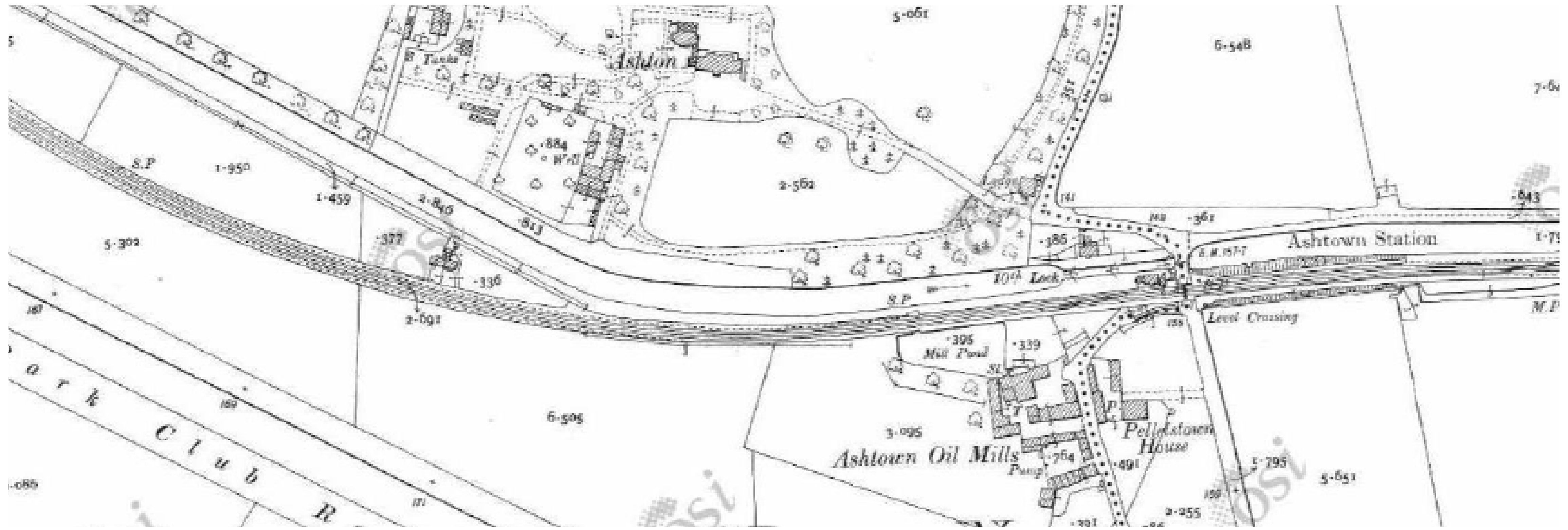


Figure 24: 1897 - 1913

Current Condition/ overlayed ideas of how to reactivate it & restore openings

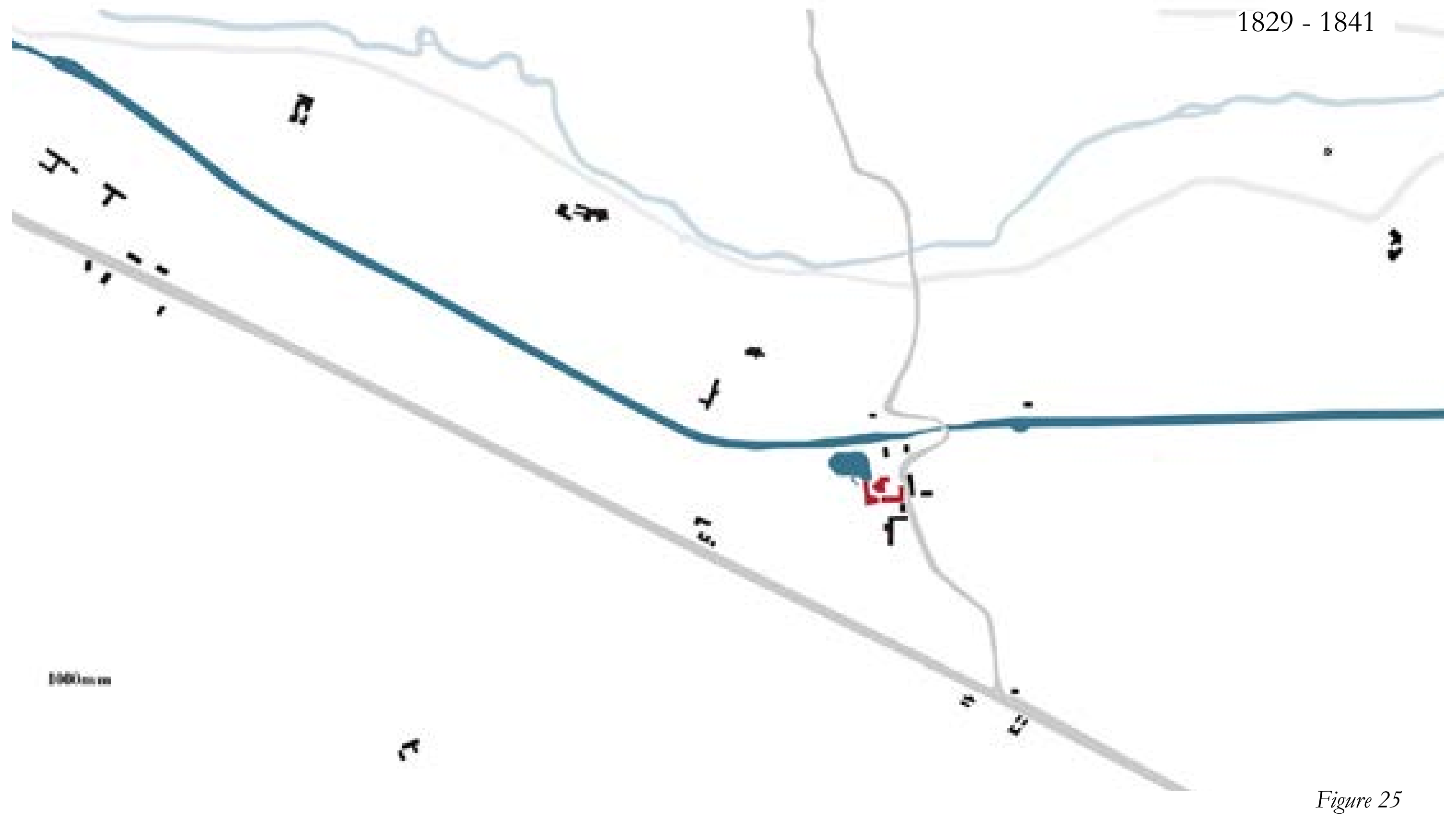


Figure 25

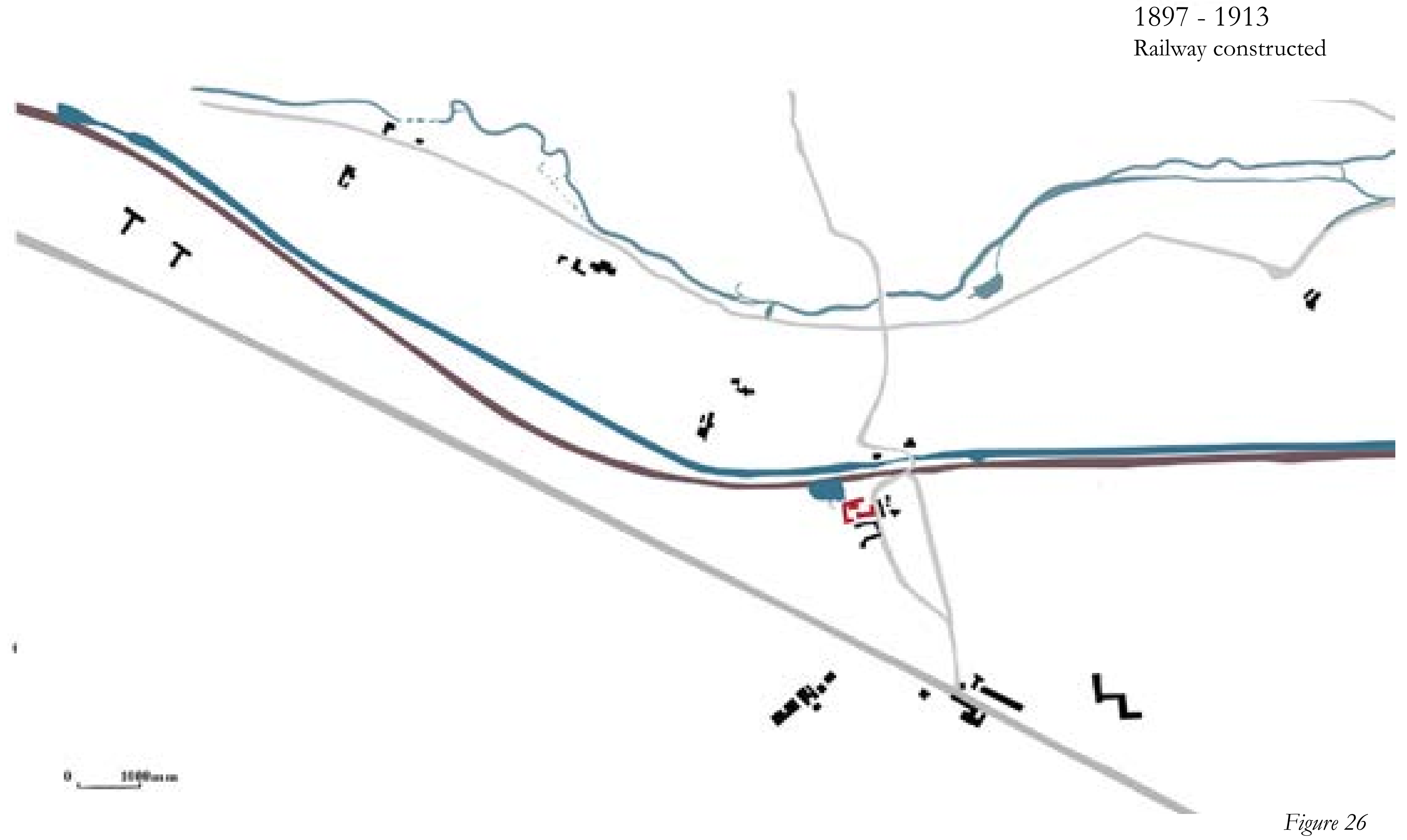


Figure 26

Changes to Site from 19th - 21st century

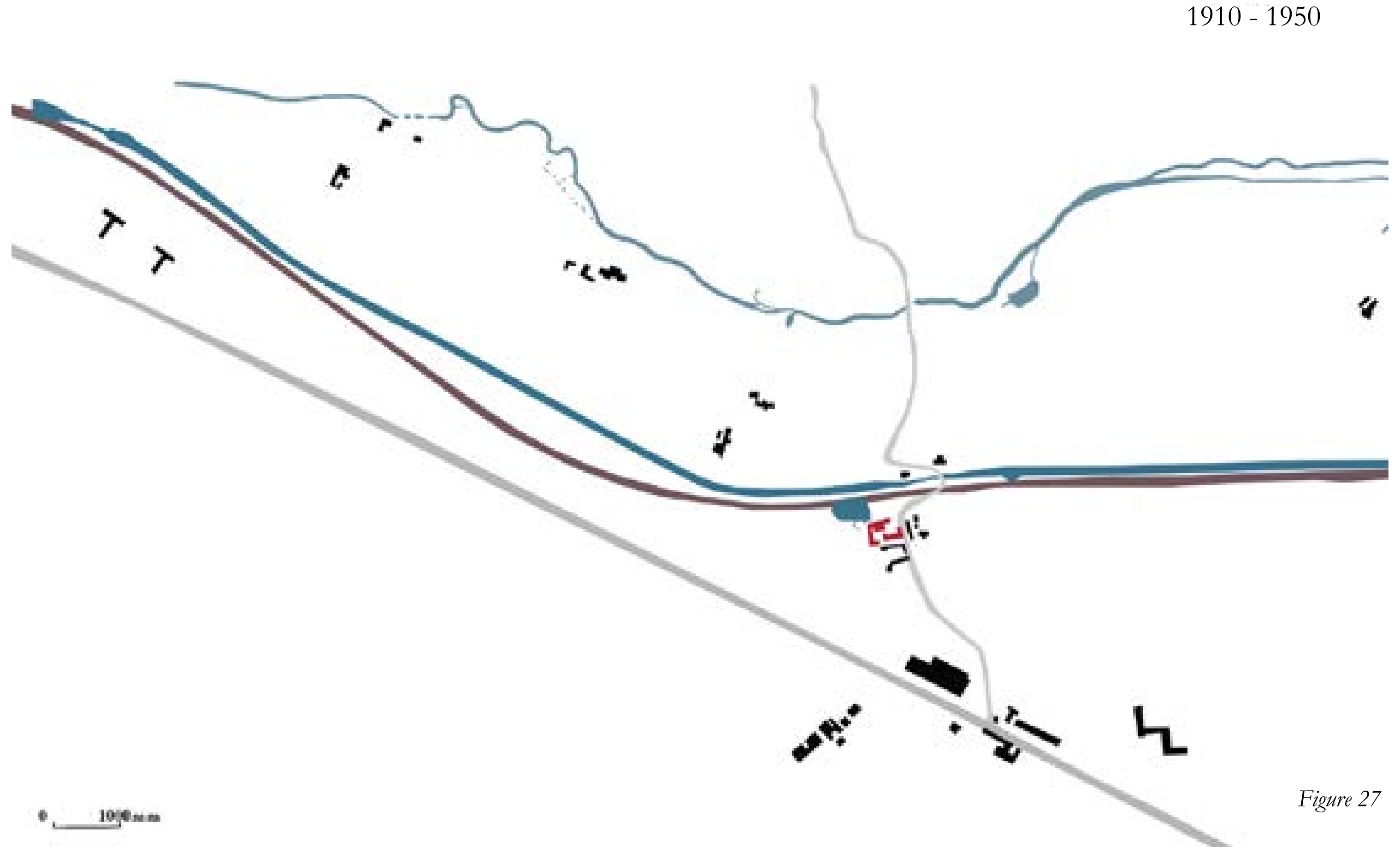


Figure 27

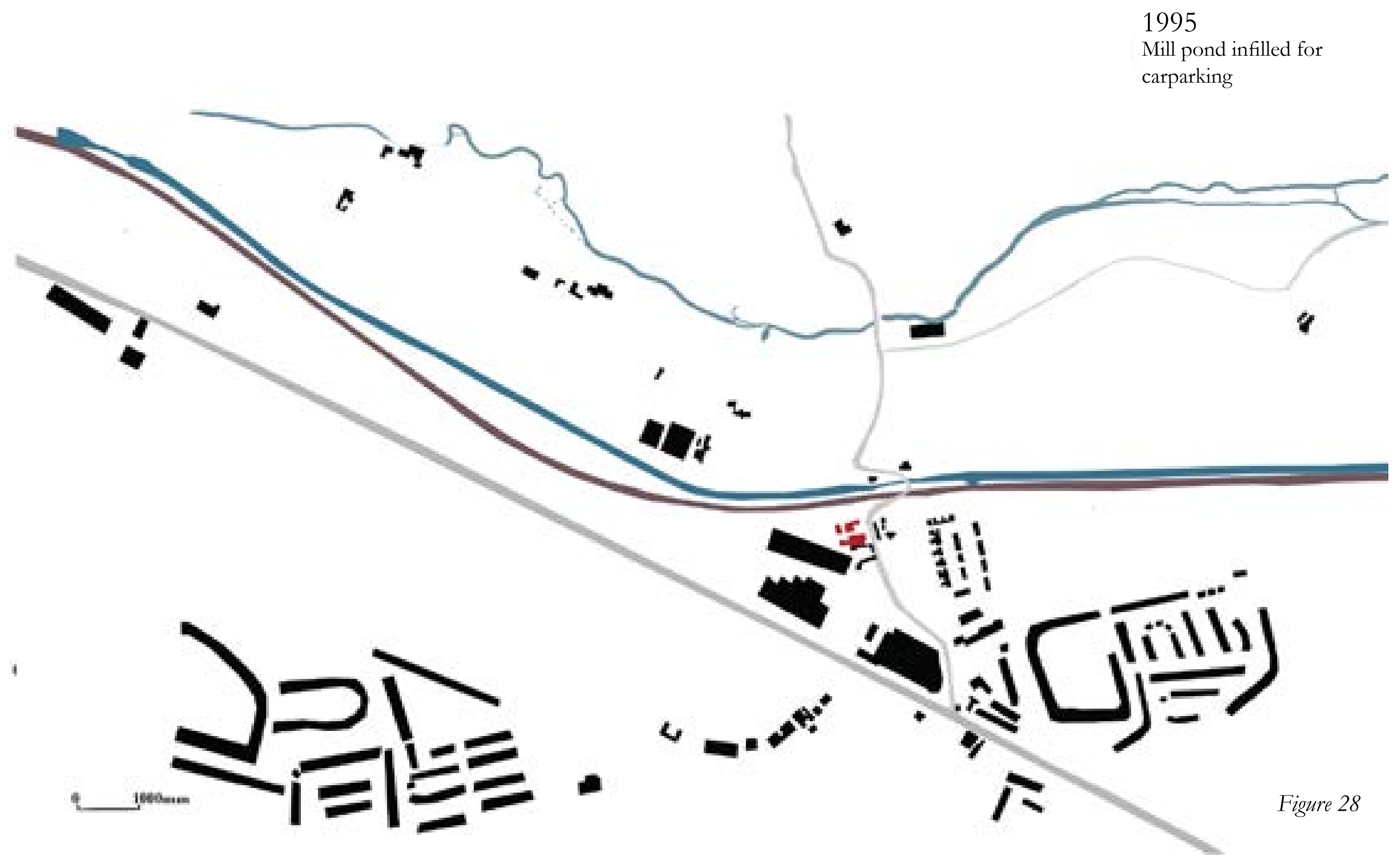


Figure 28

6.2 Engaged Writing; a letter to the Council

Observations

My concerns regarding the Dublin City Council Development Plan 2022-28 specifically relate to Chapter 11: Built Heritage and Archaeology. This is in relation to the Industrial-Age Royal Canal, and related canal-side historic buildings. This is the focus of my Thesis.

The development plan appropriately emphasises how *"our built, cultural and natural heritage has intrinsic value in defining the character of urban and rural areas and adding to their liveability, attractiveness and sense of place."* However, guidelines are vague in regard to any works on historic sites; this includes restorative and preservative works carried out on such. Specific guidelines and considerations when approaching historic sites would be helpful rather than the vague outline of the importance of protecting and preserving our built heritage and related industrial-era canals. Sensitively future-proofing our historic structures and waterways should be of utmost importance.

Early 19th century mills such as Ashtown Mill, built 1820-1830 , has lay derelict for over half a century. It is one of many examples of redundant or underused heritage buildings throughout Dublin and nationally. Action is needed for DCC's strategy *"Promote the reuse of redundant and underused heritage buildings and continue to promote active land measures"*. This is necessary to prevent total disrepair. (National Inventory of Architectural Heritage, 2019) (Dublin City Council, 2022).
In addition, the "curtilage" of the Mill contained a millrace and mill pond (Fig. 29). However the millpond was concreted over for car parking in recent decades (Fig. 30). This is not in keeping with the objective (BHA17) to *"support and promote a strategy for the protection and restoration of the industrial heritage of the city's waterways, canals and rivers, including retaining features such as walls, weirs, millraces…"* Could the millpond, and others be recovered to restore its original state? Furthermore, these works are contrary to national legislation regarding the curtilage of protected structures and therefore it could be argued that these works are illegal. It is not just the structure that is protected but its context.

Figure 29: 1829 - 1841 (OS map)

Watercourse cut from Royal Canal, with a pond, mill race & a fall of 18ft apon a wheel of 28 ft. diameter, 20ft wide, turning upon its axle non-stop.

The stream of water that supplied so much power to the machinery within, entered an arched channel (on the city side of Longford Bridge), and returned to its original source through a 1200 ft "tail race". Some parts of the mill-race are still visible from the towpath; the mill pond to rear of the premises is now overgrown and mostly concreted over for carpark space.

Figure 30: 2013 Aerial View

Furthermore objective BHA17 states, it is important to maintain our canals, and revive the towpaths along them. However, could the Council advocate the use of locally sourced materials in the restoration of our historic canals such as the Royal Canal and buildings as opposed to imported materials? Recent restorative measures of the Royal Canal include replacement of locks and lock gates with mild steel and hardwoods such as greenheart and ekki, imported from places such as Central and West Africa (iNaturalist Canada, 2018) (Sara, 2020).
Promoting the use of suitable locally sourced materials would also help retain the original beautiful craftsmanship and overall character of the Canal. Primarily the use of Irish limestone and timber (native oak). These Irish materials were used for the construction of the Royal Canal and associated mills, by local engineers and labourers. This was a resource built to last. To this end, perhaps a greater use of conservation grants or awards could incentivise these measures: native materials and craftsmanship. This would stress the importance of retention instead of replacement, in our aim to become a sustainable nation, built for generations to come.

I seek a viable future for the historic rubblestone Ashtown Oil Mill (Reg. No 11362067), as a sustainable rapeseed oil industry. I want to celebrate the significance of this Industrial-Aged structure that was built following the opening of the Royal Canal (National Inventory of Architectural Heritage, 2019). This was a revolutionary transportation system facilitating the expansion of trade industries across the country. Hence, I have also proposed a Royal Canal Heritage Museum in the adjoining building- which aptly looks onto the Canal beyond. I hope such interventions will have a positive economic and social impact as well as provide employment, and promote the importance of our built heritage.

Currently however, the roof is not structurally sound, and the windows damaged. Therefore, further guidance in the DCC policy on how to carefully replace such materials, in order to make the building usable and reduce its vulnerability, without "affecting the Protected Structure itself or its setting" (BHA2) whole be helpful. This building has stood for 200 years, and I want to ensure its future. BHA11 states *"Encourage the retention and/or reinstatement of original fabric of our historic building stock such as windows"*, I will endeavour to retain all key features. However, some elements may be beyond repair and may need to be replaced, therefore I do not fully agree with the aforementioned policies. Unsuitable recent concrete blocks infill (Fig. 32) (Fig. 33) in the lower window openings, will have to be carefully removed. Any damage to the original structure will have to be made good to comply with BHA11 and BHA2. Some fabric may unfortunately need to be replaced, and damage to the original structure will have to be assessed to ascertain if it can be made good. The structure will also have to be assessed in relation to fire separation between floors and thermal upgrades. Sensitive techniques and methods must be used to ensure any thermal improvements are suitable for an historic structure.


Figure 31

Interestingly policy 11.5.1 states: "if architectural features are damaged or stolen, they must be re-instated; this is likely to require a new planning application." The large copper clock of Ashtown Mill, dating back to the early 19th century, was stolen in 2012 (Fig. 32 shows a hole in the facade where clock was located). However it was never reinstated, showing that the Council failed to acknowledge its significance.

Chapter 11 highlights the importance of the conservation of our historically-rich City in terms of sustainability and in the reduction of climate change. It just needs clearer guidelines in how to best to sensitively conserve, adapt, reuse, and strengthen our important buildings; for architects and those who wish to make a positive impact on our city, and world. This information is only available through National Guidance documents and not through the Council (Dublin City Council, 2022) (Department of Arts, Heritage and the Gaeltacht, 2011).


Figure 32: Current unmaintained condiiton


Figure 33

The site is in close proximity to two railway stations: Navan Rd parkway to the left (image 1) & Ashtown Station (image 8)

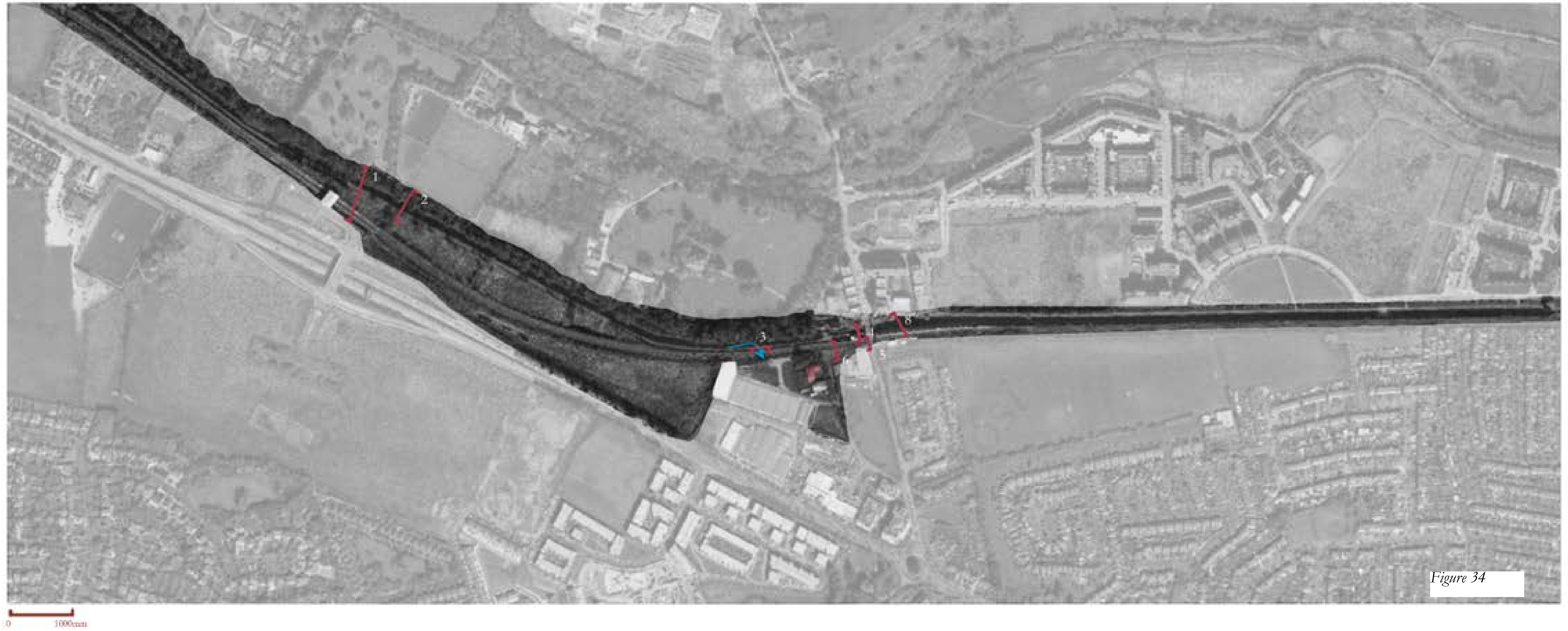
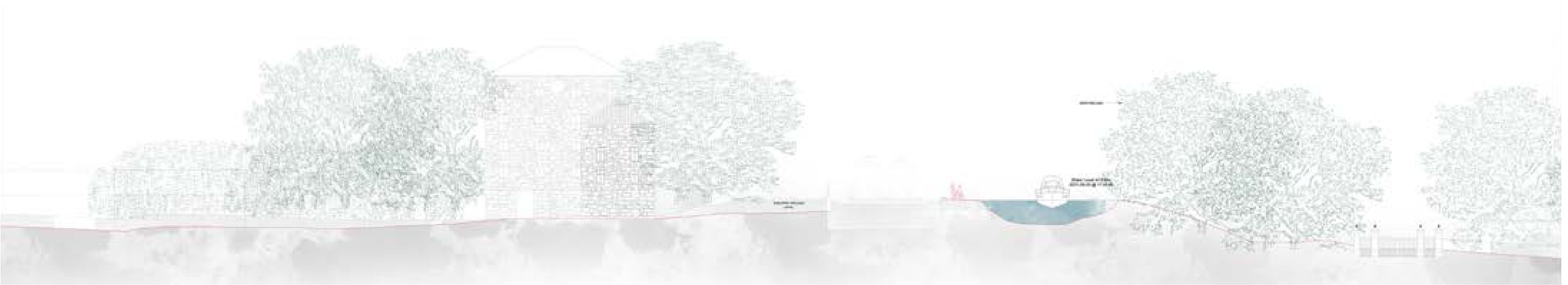
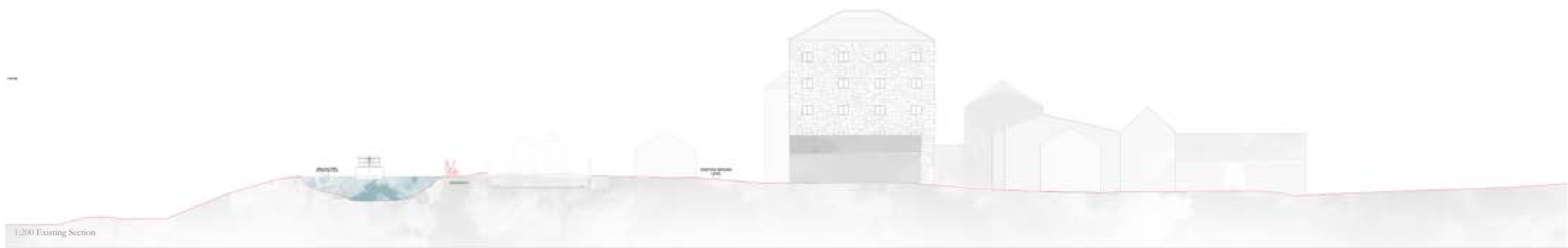


Figure 34

Site Images



Existing Elevations of Ashtown Mill, through the Canal



7.0 Proposal

Any intervention will have minimal environmental impact with *"as knowledgeably light a touch as possible"* (Calder, 2021, p. 449). I wish to preserve, respect, and improve what is there: the Royal Canal and Mill; as a recreational and industrial resource and source of green energy to power buildings, and shape our future.

"Architecture is critically connected to the ways we plan, reuse and build well now and in the future to mitigate and adapt to climate change and sustain our planet" (Government of Ireland, 2022, p.10).

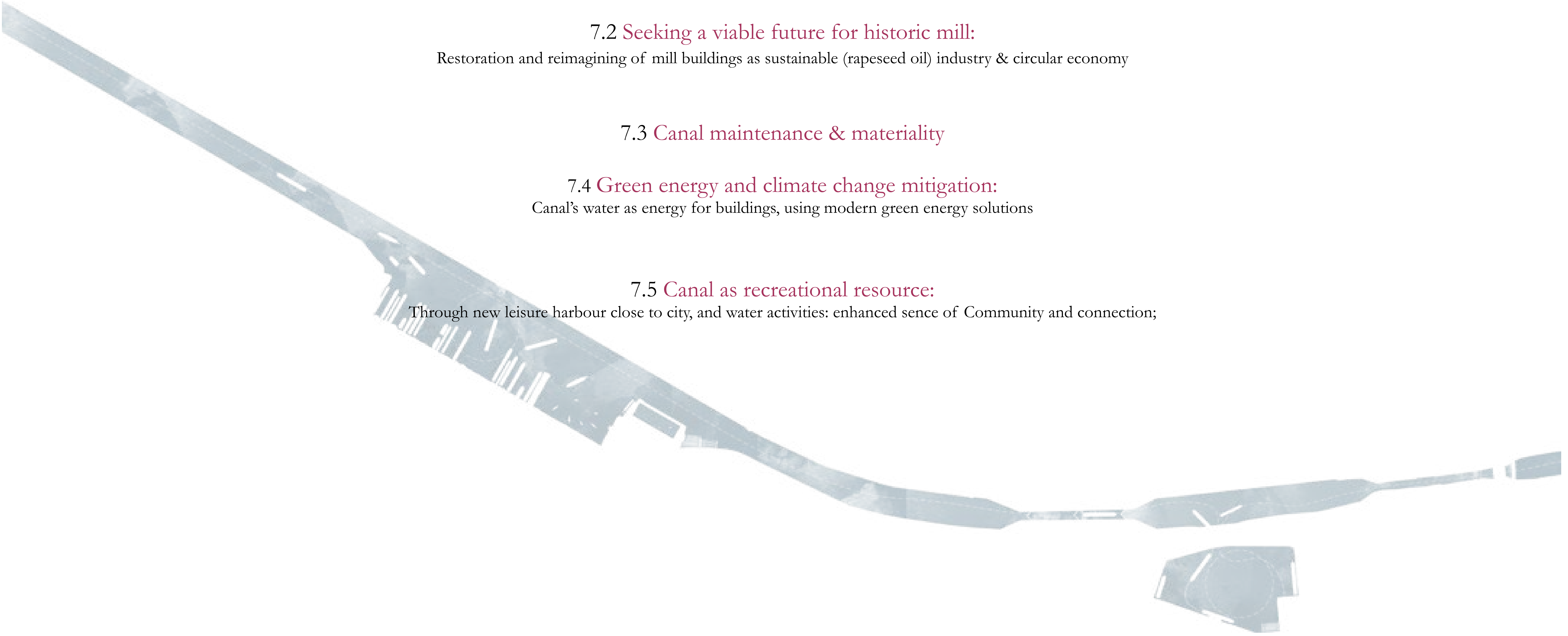
UN Sustainable Development Goals will be at the heart of my project, notably Goal 9: *"Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation"*, Goal 7: *"Affordable and Clean Energy"*, Goal 11: *"Sustainable cities and communities"*, and Goal 12: *"Climate Action"* (United Nations, 2023).

From my thesis research I identified objectives to develop a design proposition/ programme(s) that reimagine the canal and mill's future possibilities as resilient, sustainable infrastructure and architecure.

Objectives

7.1 Reactivating life on the Royal Canal

Harbours enabling trade & travel along the historic waterway, into the Capital



7.2 Seeking a viable future for historic mill:

Restoration and reimagining of mill buildings as sustainable (rapeseed oil) industry & circular economy

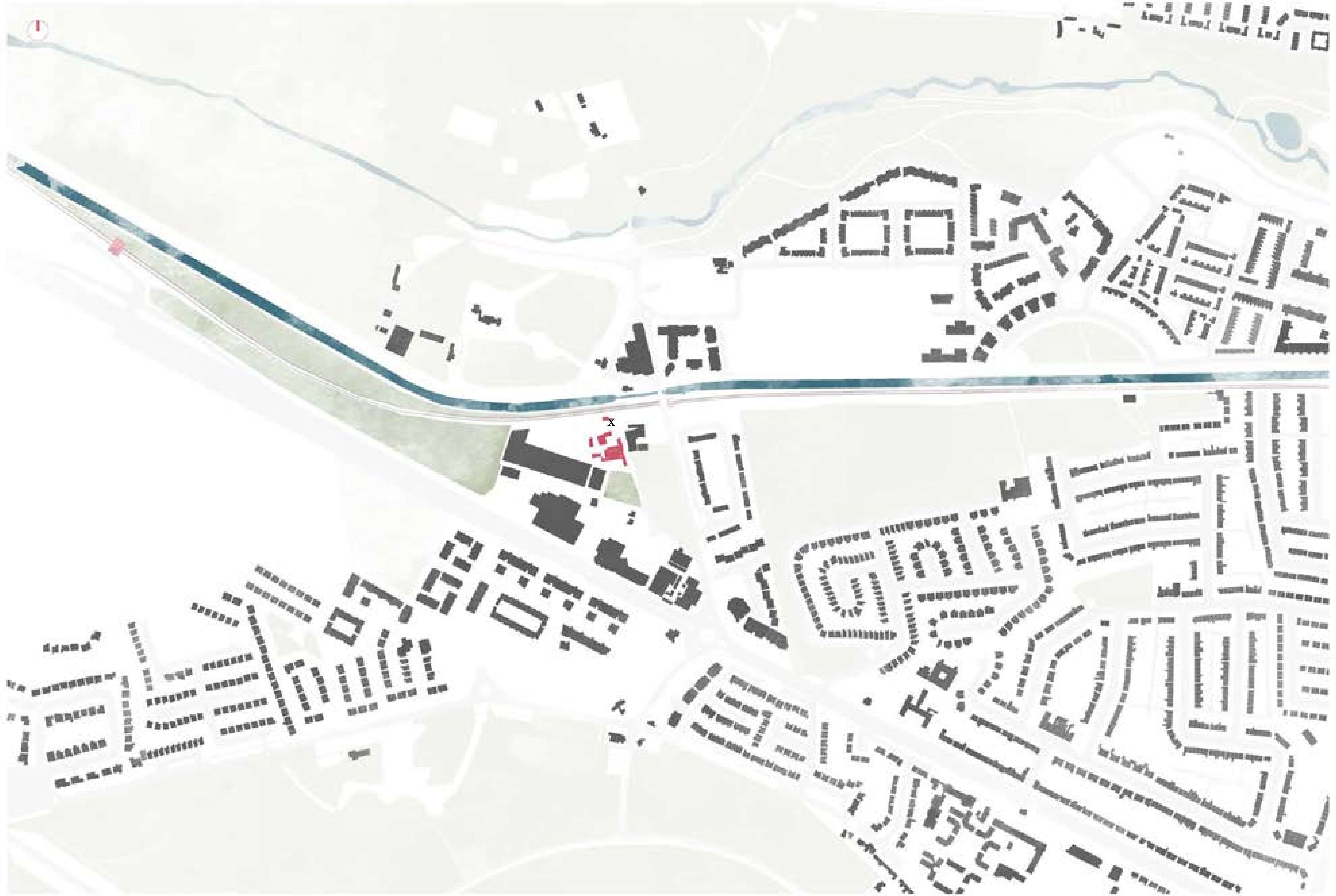
7.3 Canal maintenance & materiality

7.4 Green energy and climate change mitigation:

Canal's water as energy for buildings, using modern green energy solutions

7.5 Canal as recreational resource:

Through new leisure harbour close to city, and water activities: enhanced sence of Community and connection;



Existing Site Map

My proposal of the industrial harbour next to the mill required the relocation of the double-lock chambers of the tenth lock at Longford Bridge (marked 'x')

7.1 Reactivating life on the Royal Canal

Rapeseeds grow on site, processed in the mill, ready for distribution by boat along the canal from the proposed industrial harbour at the footsteps of the mill.

Planning the network; *Earlier sketch iteration of new harbours for leisure & industrial use will reactivate the canal corridor, with connections between such along an enhanced greenway & through an informal leisurely walk through the rapeseed fields.*

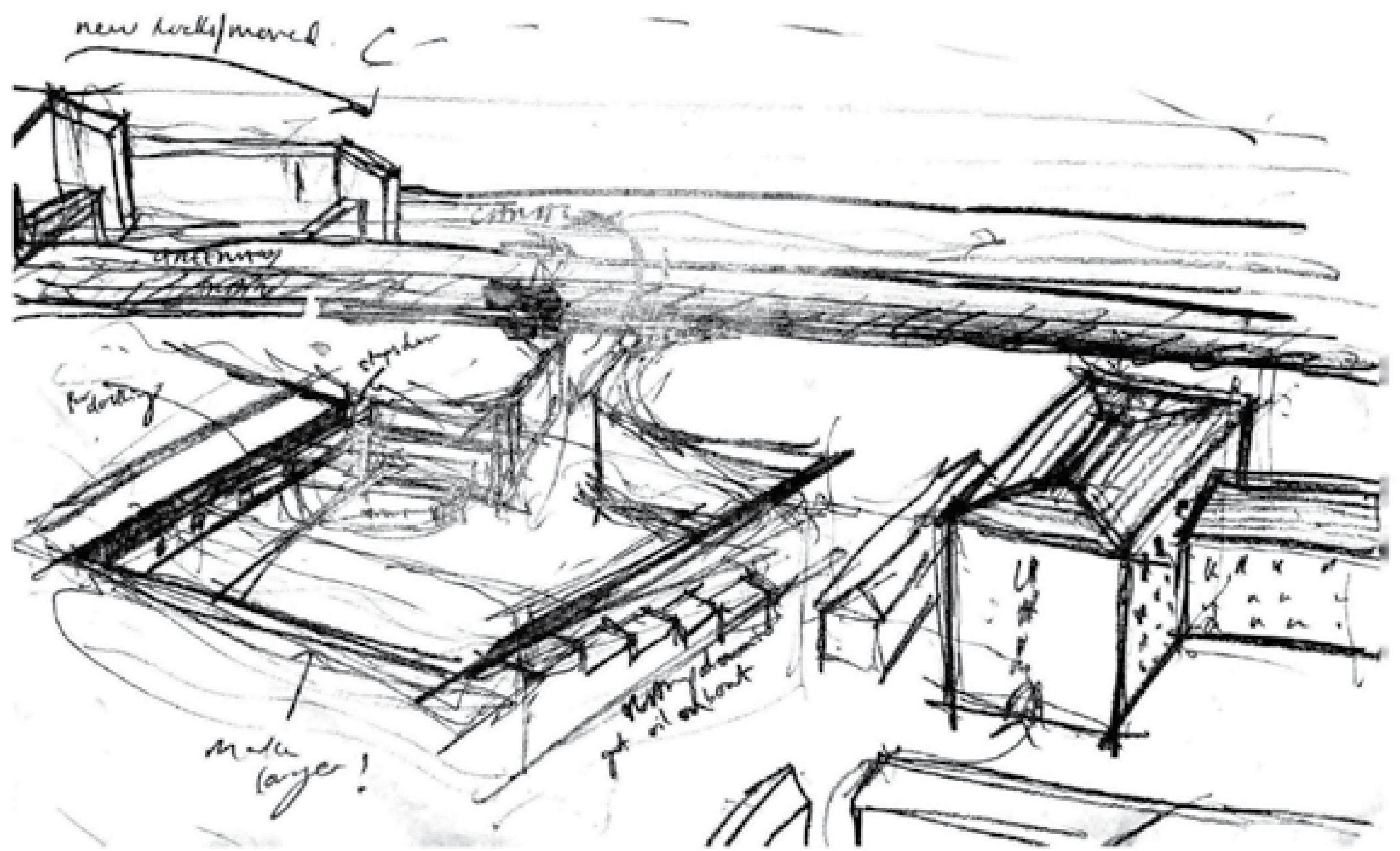
New harbour locations- leisure harbour and industrial harbour

Proposed Site Plan

1:1000

1. Rapeseed Oil Mill & Industrial Harbour
2. Recreational Harbour, Pool & facilties

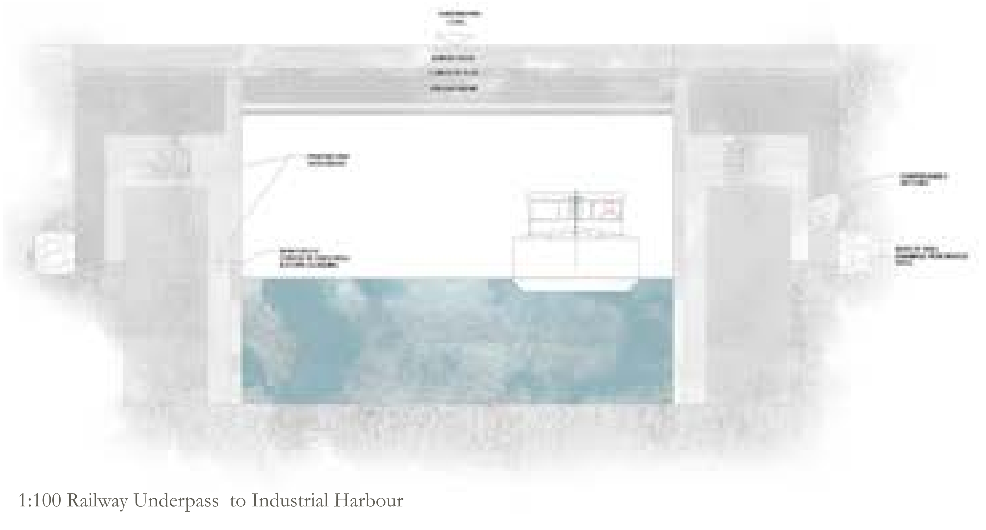
Rapeseed will be cultivated in the adjoining fields of both the Industrial and Leisure sites.



In my thesis research, I looked at the innovative infrastructural features along the Royal canal, such as aqueducts. What can I design that equals the innovatons of our predecessors? The underpass into the industrial harbour is a feature that explores such.

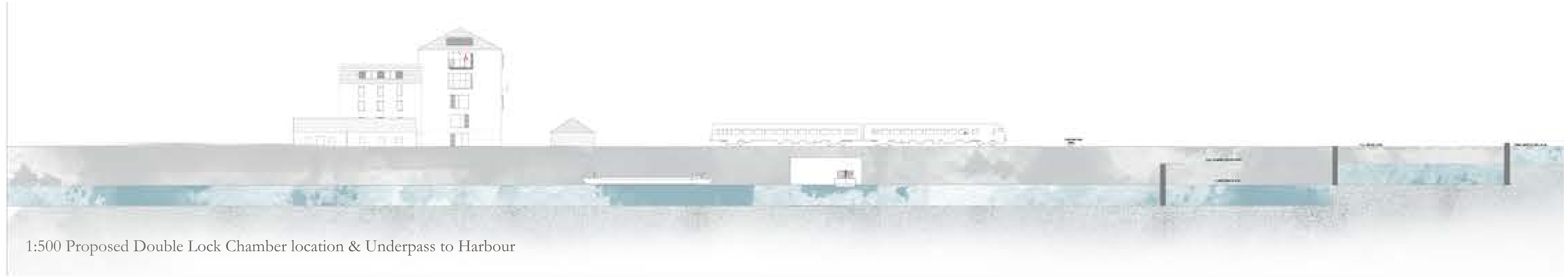
Relocation of the Tenth lock

1:500 Existing Lock location



1:100 Railway Underpass to Industrial Harbour

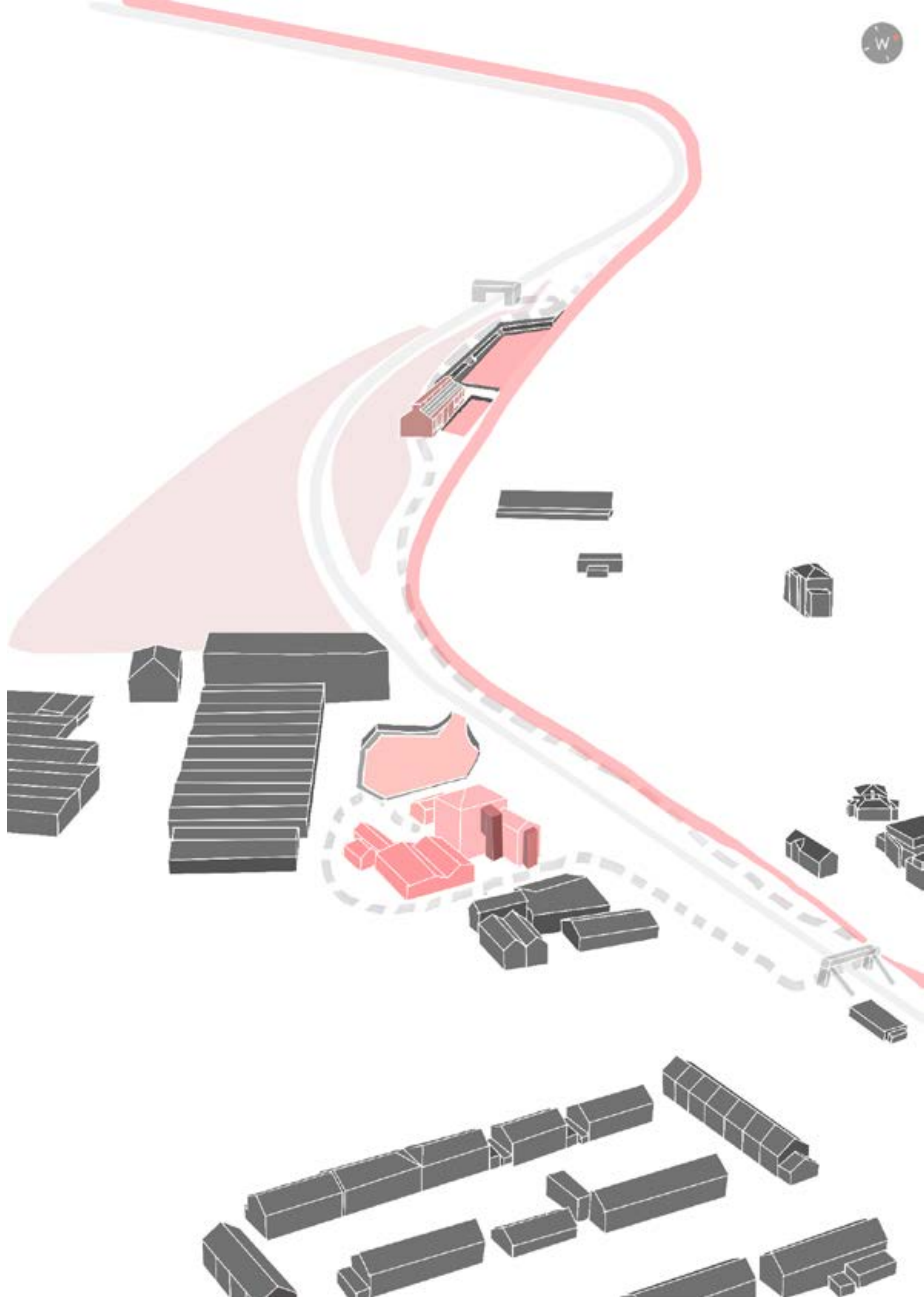
Having explored and tested many locations for the Industrial/ 'Working' harbour, including adjacent to the mill in the grounds of Ashtown House, due to level changes it was unsuitable (See Appendix) and my design resulted in extracting earth from the current carpark beside the Mill. This was formerly a Mill Pond, and there is an existing water outlet from the canal in this location, so it seemed the apt design decision. It did require me to move the locks of lock 10 by c.1810 Longford Bridge, to allow a level drop great enough for barges to pass beneath the railway line parallel to my proposed harbour.



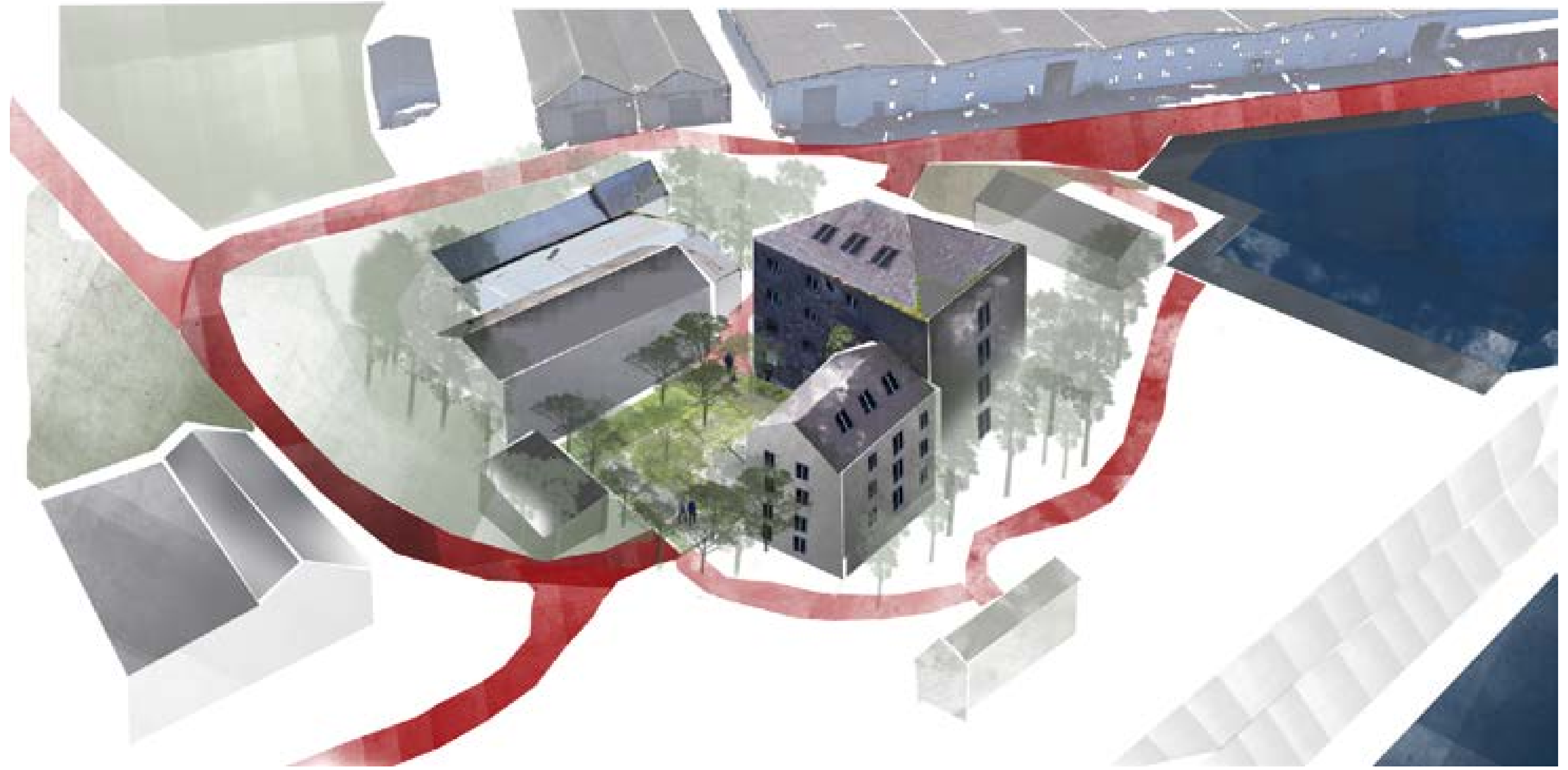
1:500 Proposed Double Lock Chamber location & Underpass to Harbour

The journey

I envisage an active and pro active landscape, where leisure and industry meet, along the Canal network.

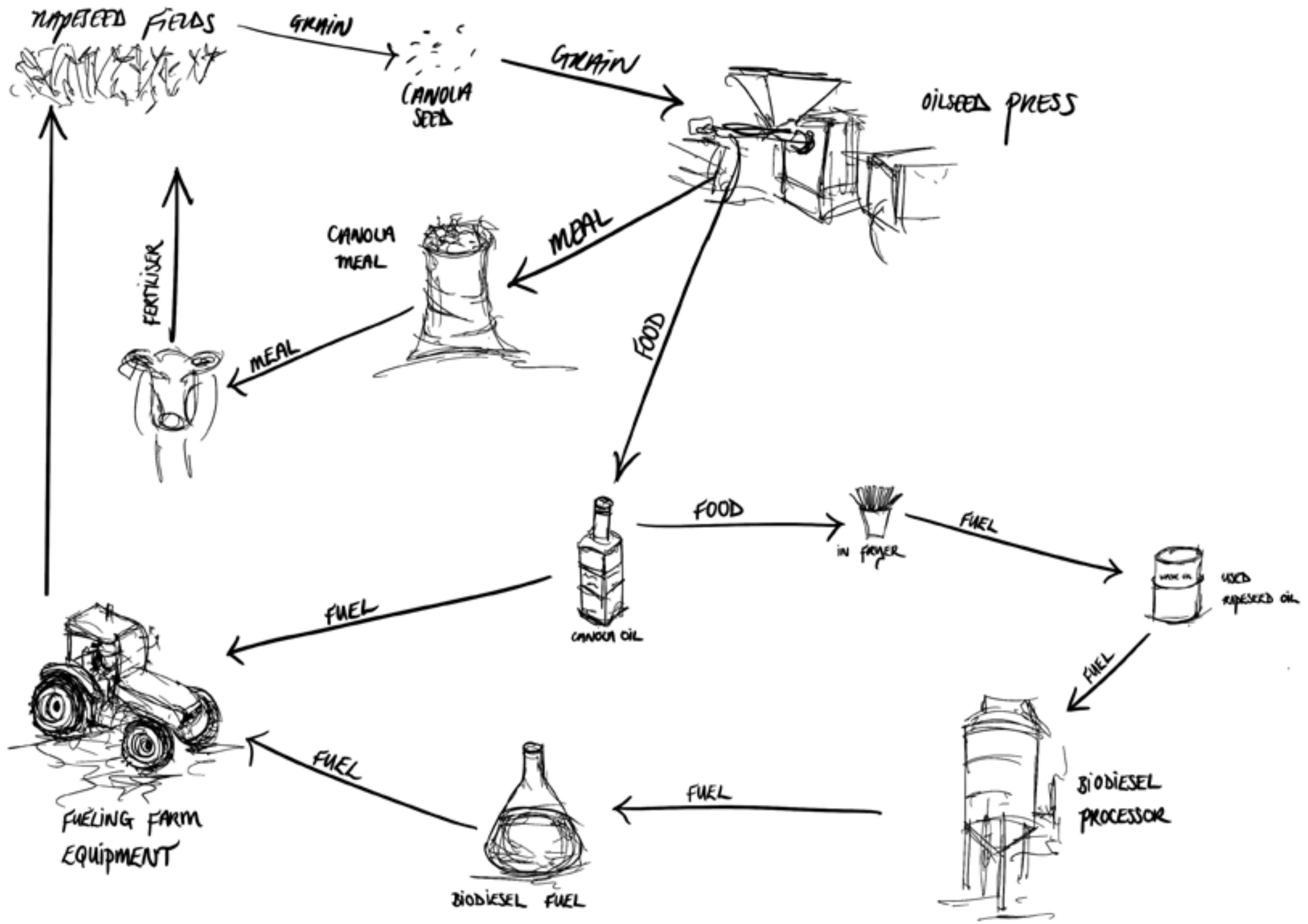


7.2 Seeking a viable future for historic mill



Reactivated Mill as Rapeseed Oil Industry & proposed Industrial Harbour in location of former mill pond

Red indicates access/connections to & from the site.



Learning from Ashtown Mill's past industrial uses to identify a need for a new sustainable industry; a circular economy

A leisurely walk through the rapeseed fields

Seeking a viable future for historic mill: Restoration of mill buildings as a Sustainable (Rapeseed Oil) Industry

Rapeseed (*Brassica*) Growth

"The proper meaning of tradition is not to live in the past but to follow those who have gone before you into the future" (Ingold, 2022).

As shown below, Ireland's climate is ideal conditions for cultivation of Rapeseed. According to Zahoor and Forristal (2015), with good yield potential (4-6 t/ha for winter and 2.5-4 t/ha for spring varieties.

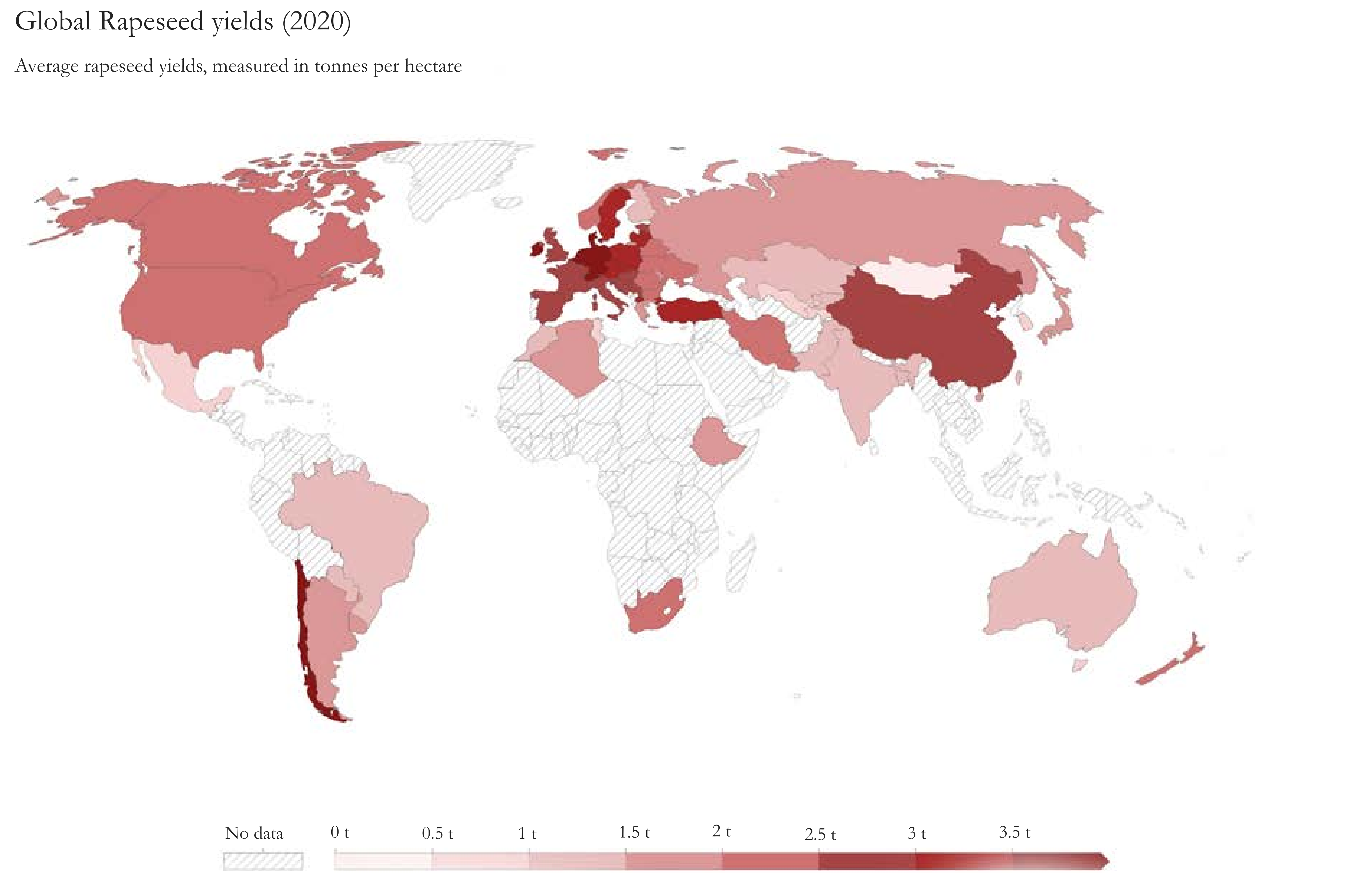


Figure 35

Source: Food and Agriculture Organisation of the United Nations

Rapeseeds cultivated on site, processed in restored mill, and distributed along the water.

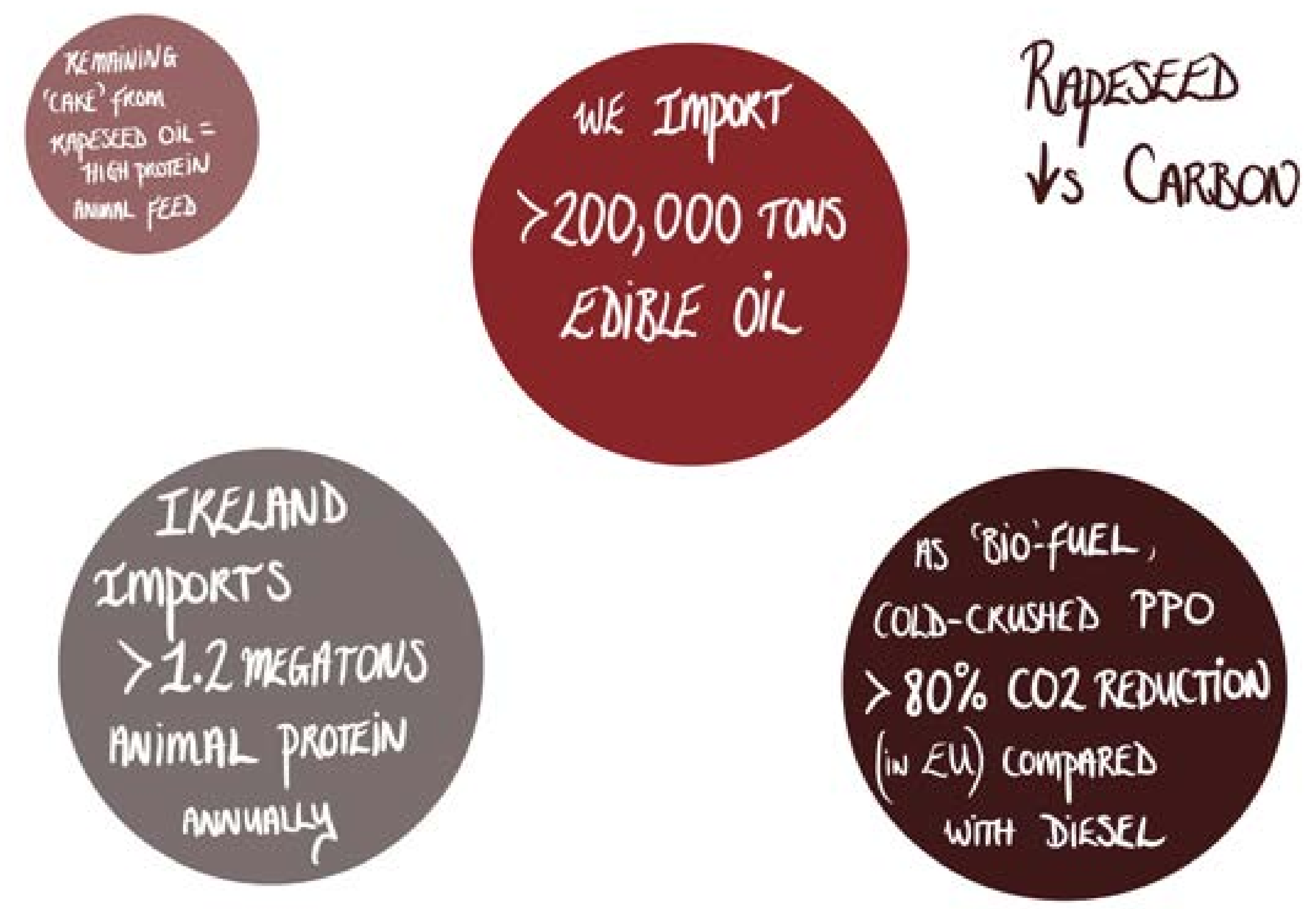


Figure 36

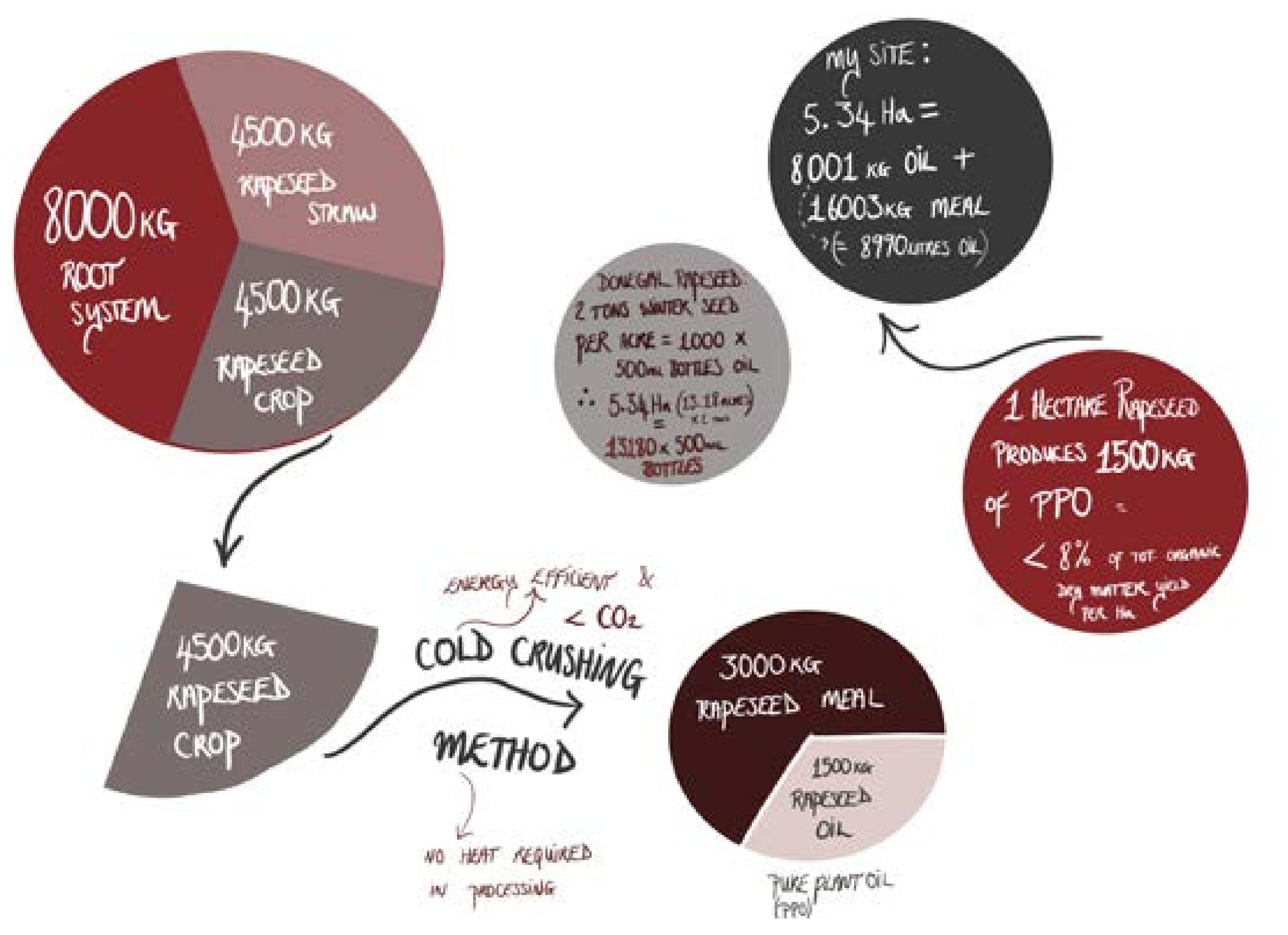


Figure 37

A need for Local Vegetable Oil Industry; Reducing unneccessary importation of vegetable oils and thus Ireland's carbon footprint.

Global Vegetable Oil Imports to Ireland

500g CO2 emissions per tonne of cargo per km

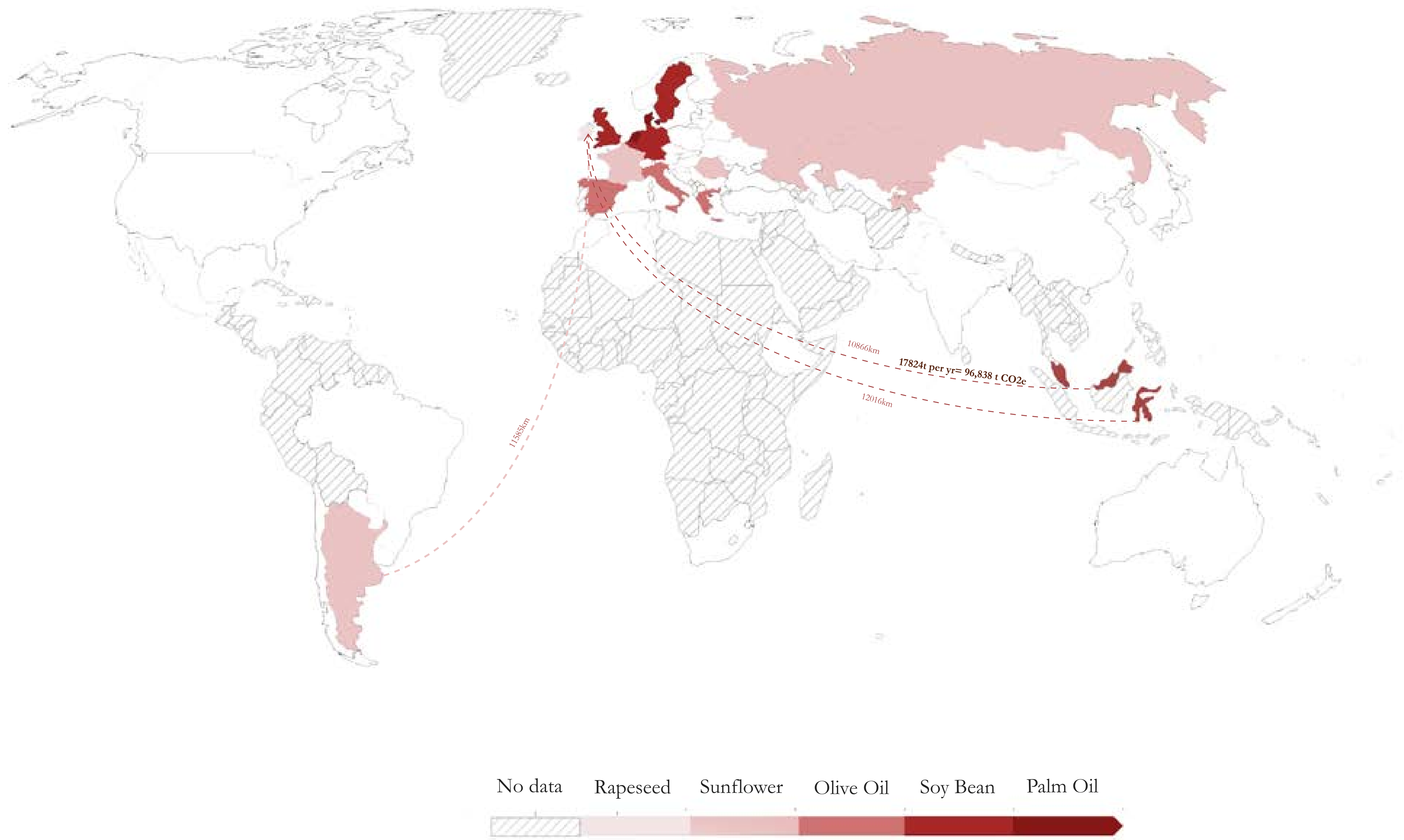


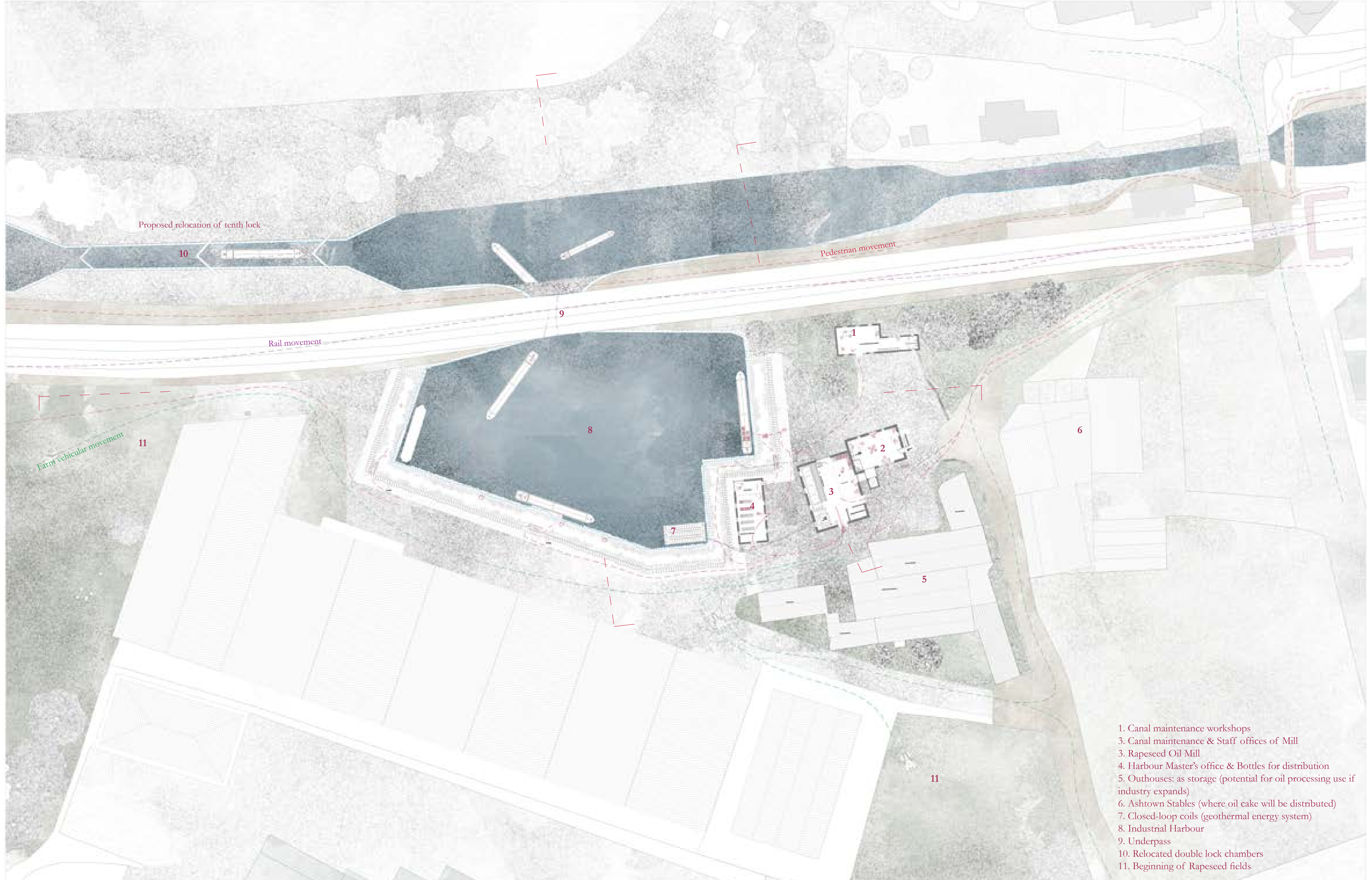
Figure 38

Figure 39

The Network

The fields neighbouring Ashtown Mill have the potential to produce both Oil and oilcake- a great source of protein for animals. This, I hope to distribute to the neighbouring Ashtown Stables. The refined cold-pressed cooking oil will be distributed along the Canal by barge.

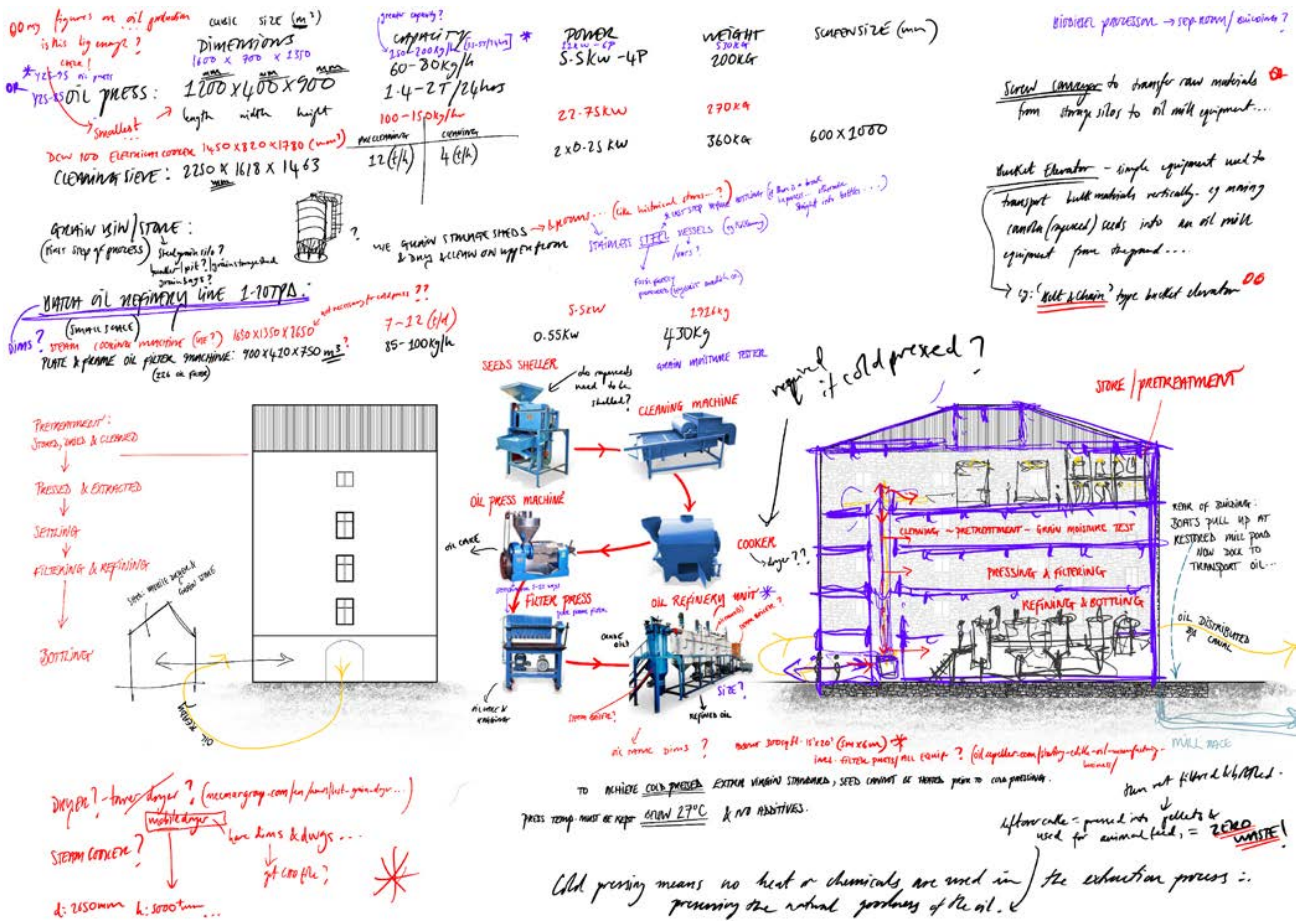
New cold-pressed Rapeseed Oil industries across the country are thriving as of Ireland's ideal grwoing conditions, as well as the health benefits of the oil, and sustainability of local industry. According to research (Power, 2016), we can determine that 2 ton of winter crop seed per acre can produce 1000 x500ml bottles of Donegal Rapeseed Oil. Based on this, and information gathered from the Oil seed crop report by Zahoor and Forristal (2015), I calculated that my industry will produce up to 13,000 x 500ml bottles of rapeseed oil per annum. The mill site has the capacity to expand, in which case, fields futher North along the canal will be used for seed cultivation, and brought to site for processing.



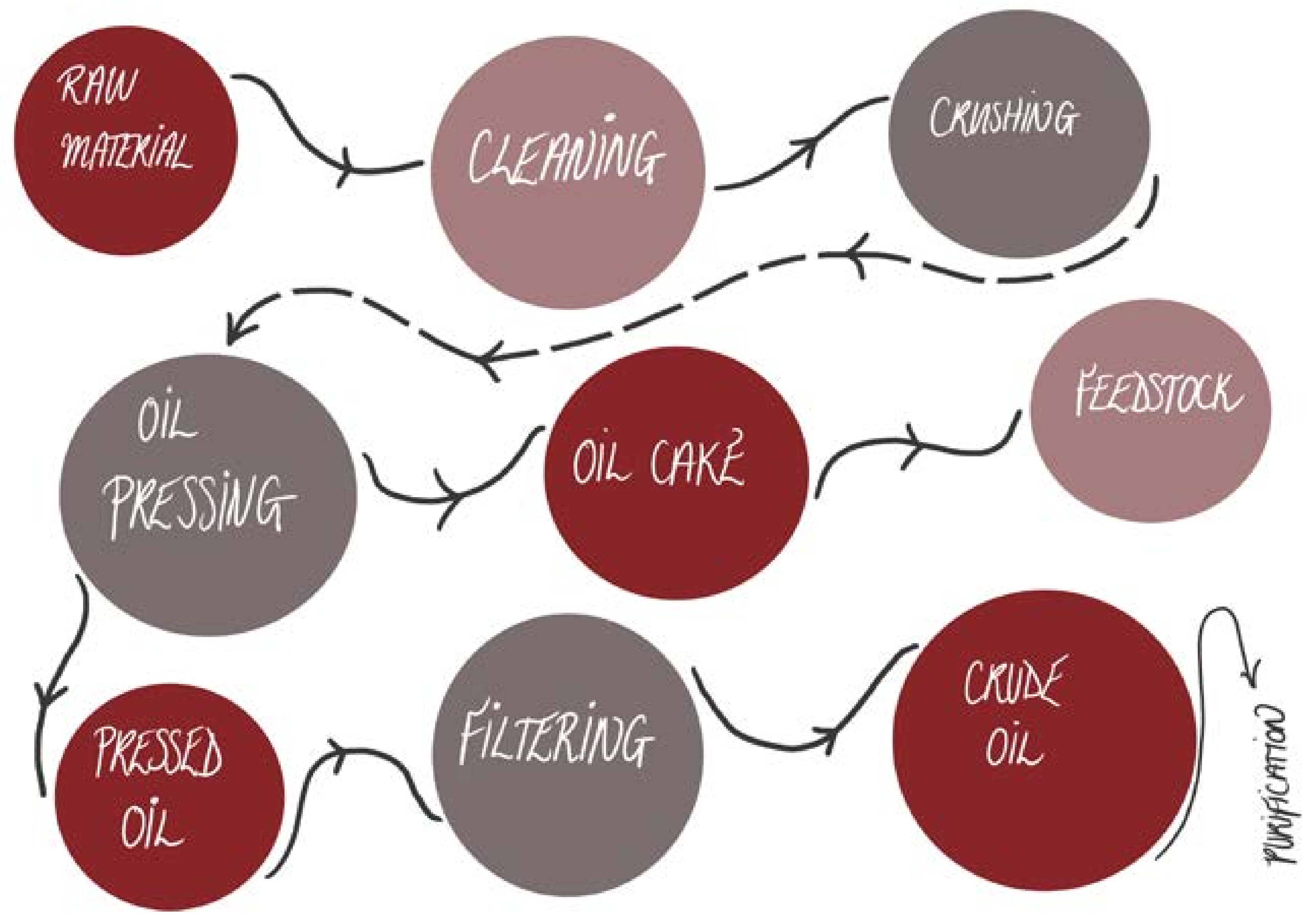
Rapeseed Oil Industry
1:500

New locks to the left allow for barges to pass underneath the existing railway line into the industrial harbour where bottled oil and oil products are collected by barge and distributed along the canal.

Ashtown Mill & Industrial Harbour



Rapeseed Oil process



Cold-pressed= no heat is required in its production. friction during pressing creates the heat

Rapeseed Oil Production Process

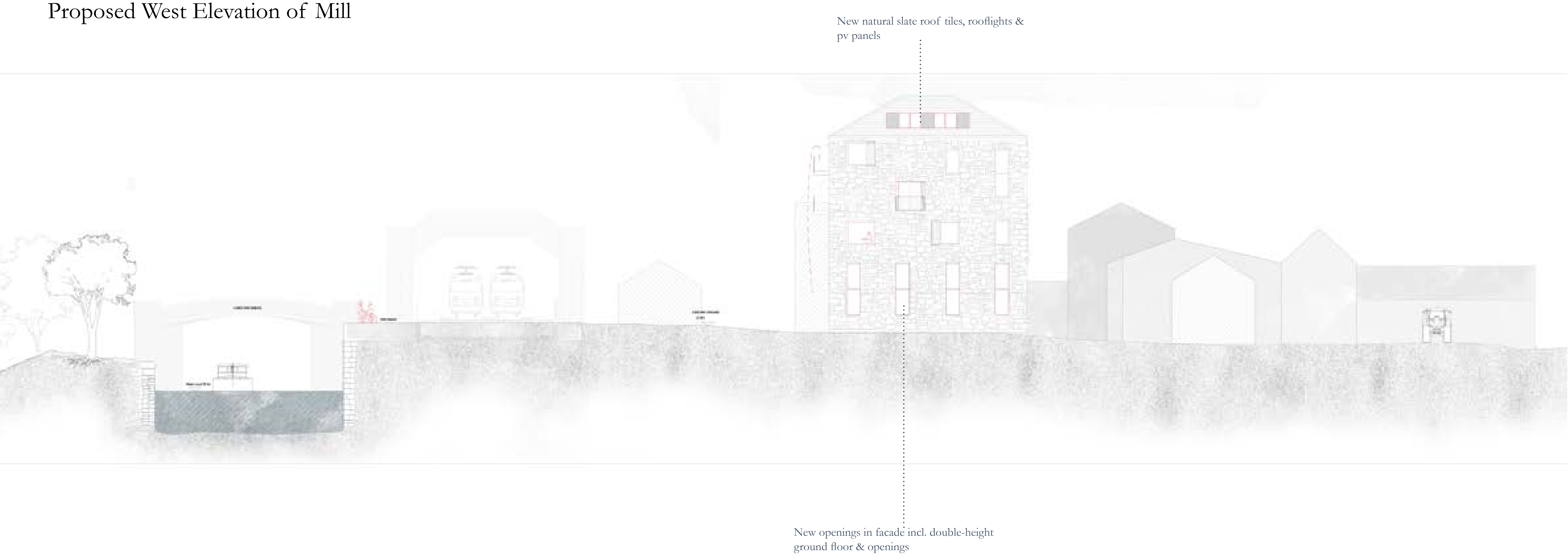
Section through Rapeseed Oil Mill

1:100

Rapeseed Oil Production Process:

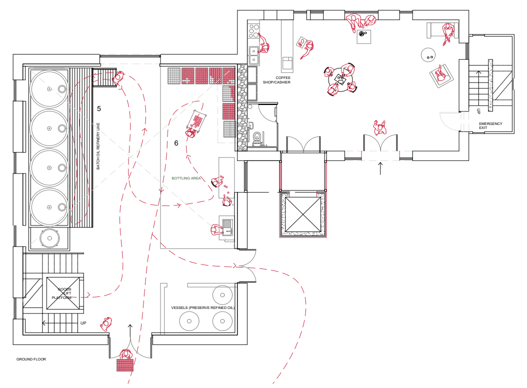
1. External Pulley System hoists seeds to top floor
2. Drying & Storing
3. New internal goods lift to process goods
4. Pretreatment Cleaning & Moisture Test
5. Pressing
6. Filtration
7. Purification/Refining
8. Bottling
9. Distribution of Oil by barge

Proposed West Elevation of Mill



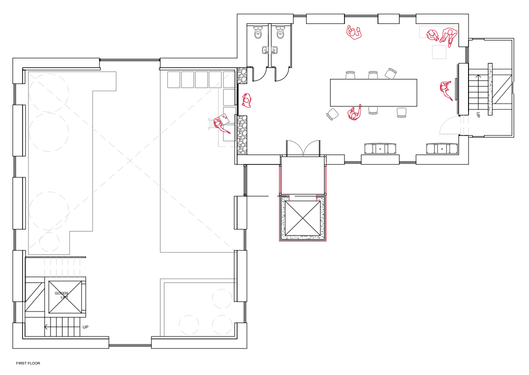
Proposed Industry floor plans

Cafe/shop



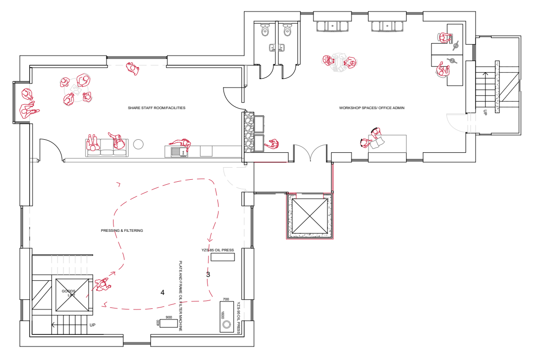
Refinery & Bottling

Workshop/canal maintenance



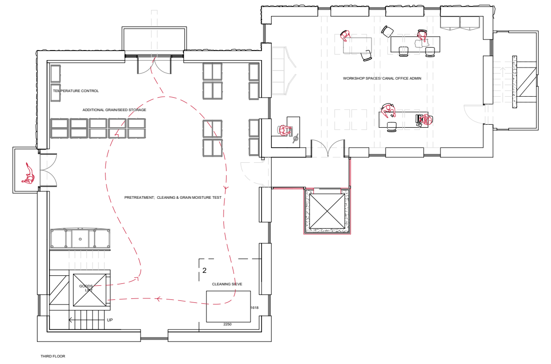
Bottling continues over double height space

Staff offices

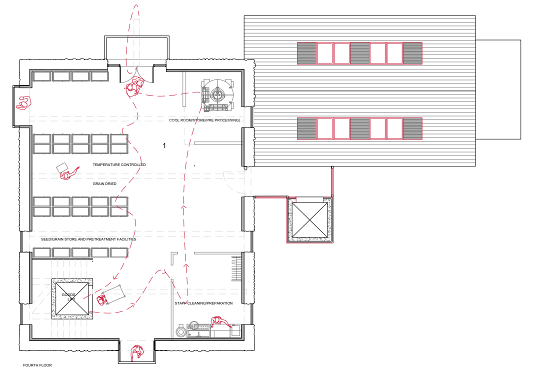


Pressing & Filtering. Staff Rm to rear.

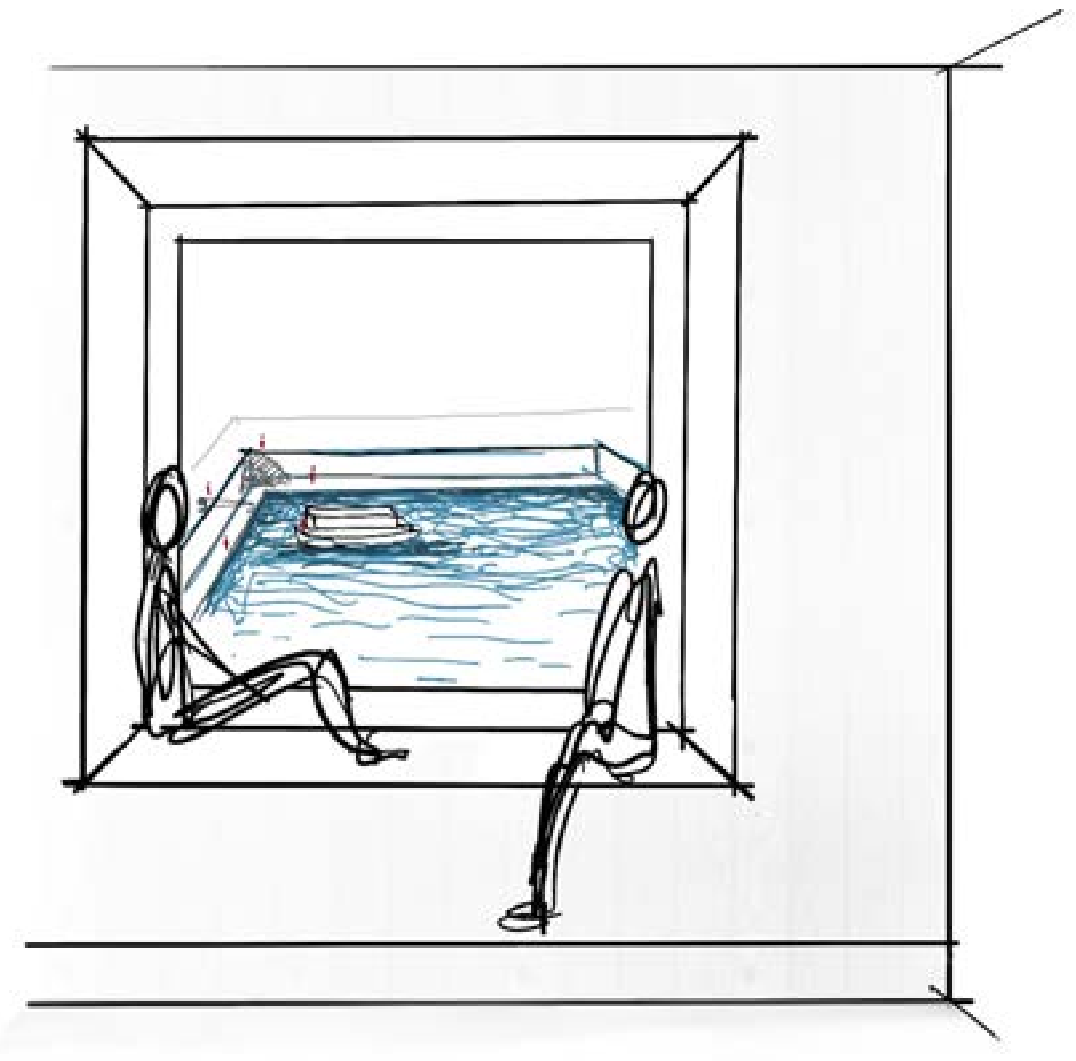
Workshops



Cleaning Sieve & Storage



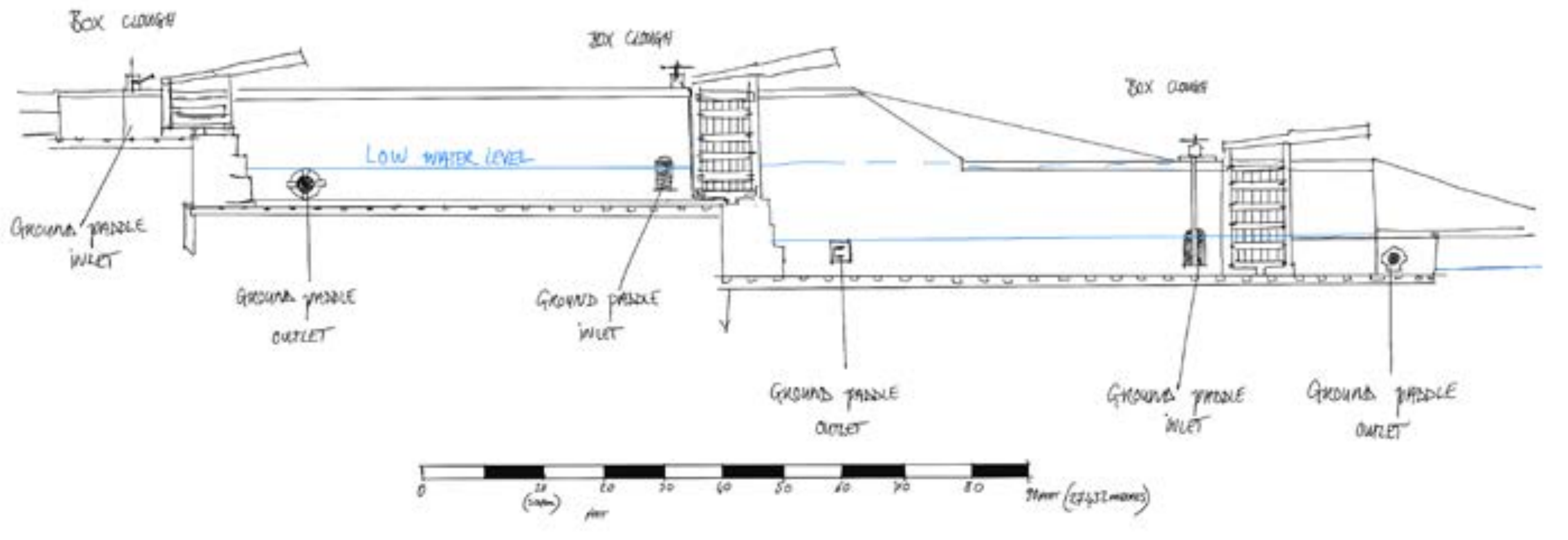
Grain/Seeds drying & storage



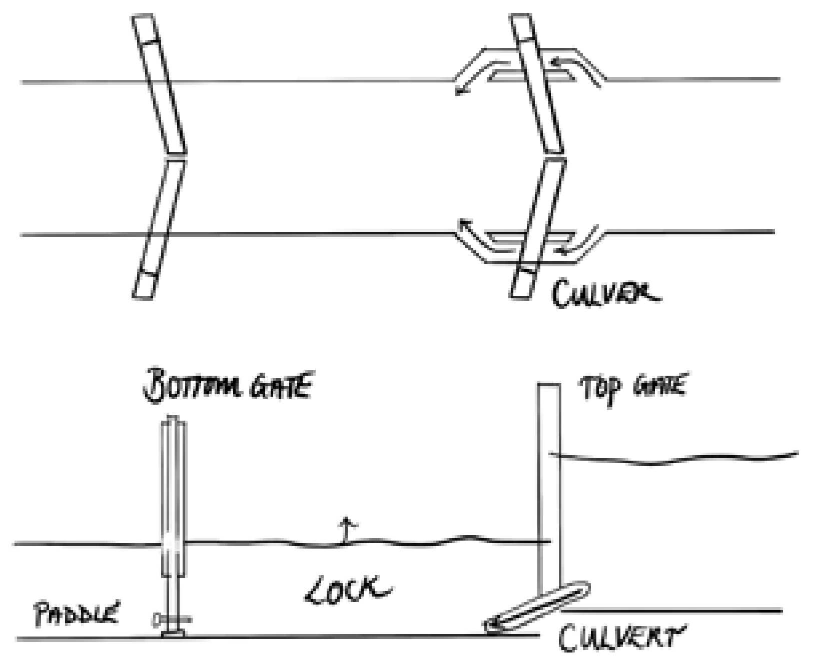
View from new projecting box window onto Industrial Harbour

Pulley System in action, Fourth Floor of mill; Roof Structure now exposed

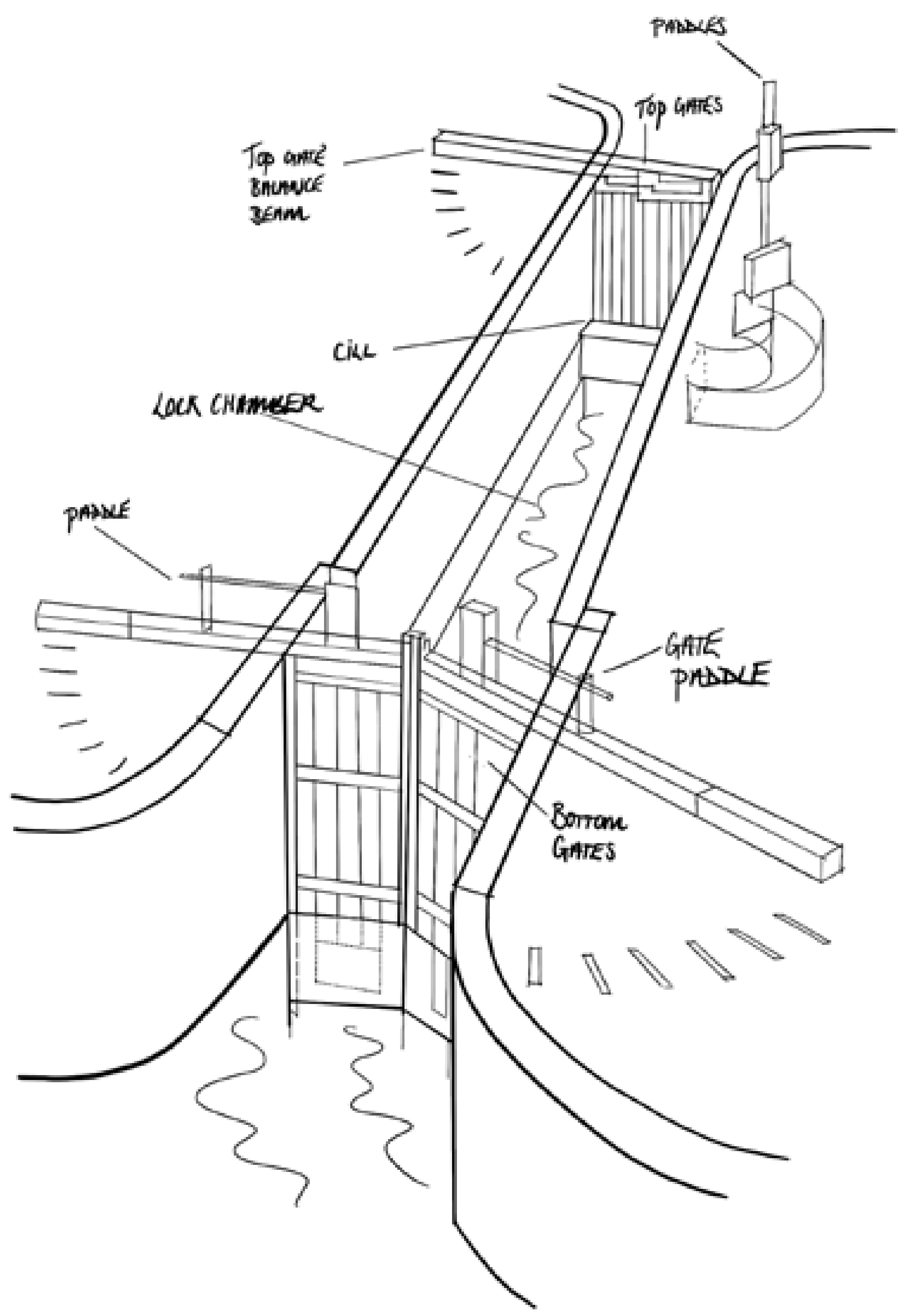
7.3 Maintenance & materiality



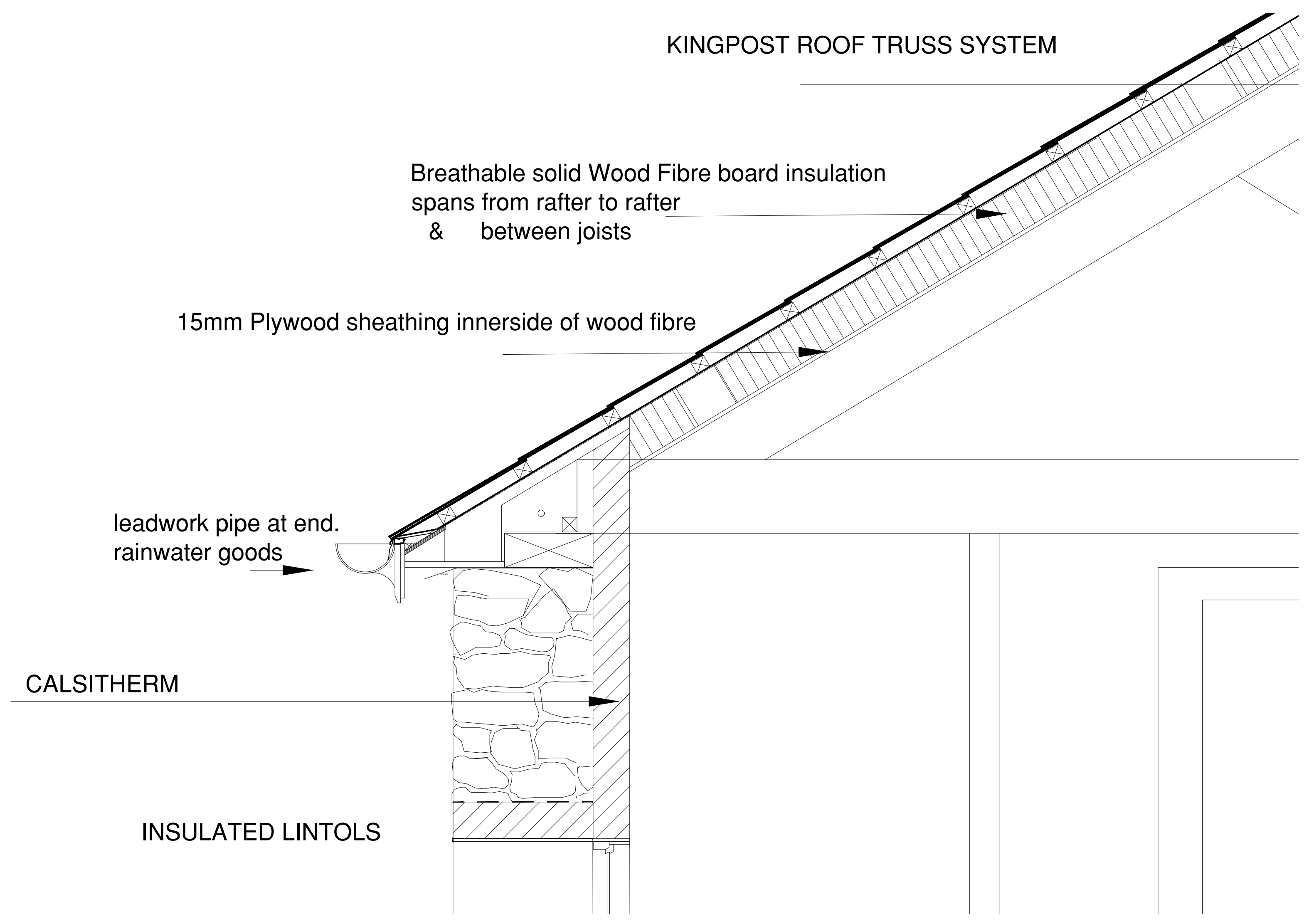
Traditional Double Lock chambers

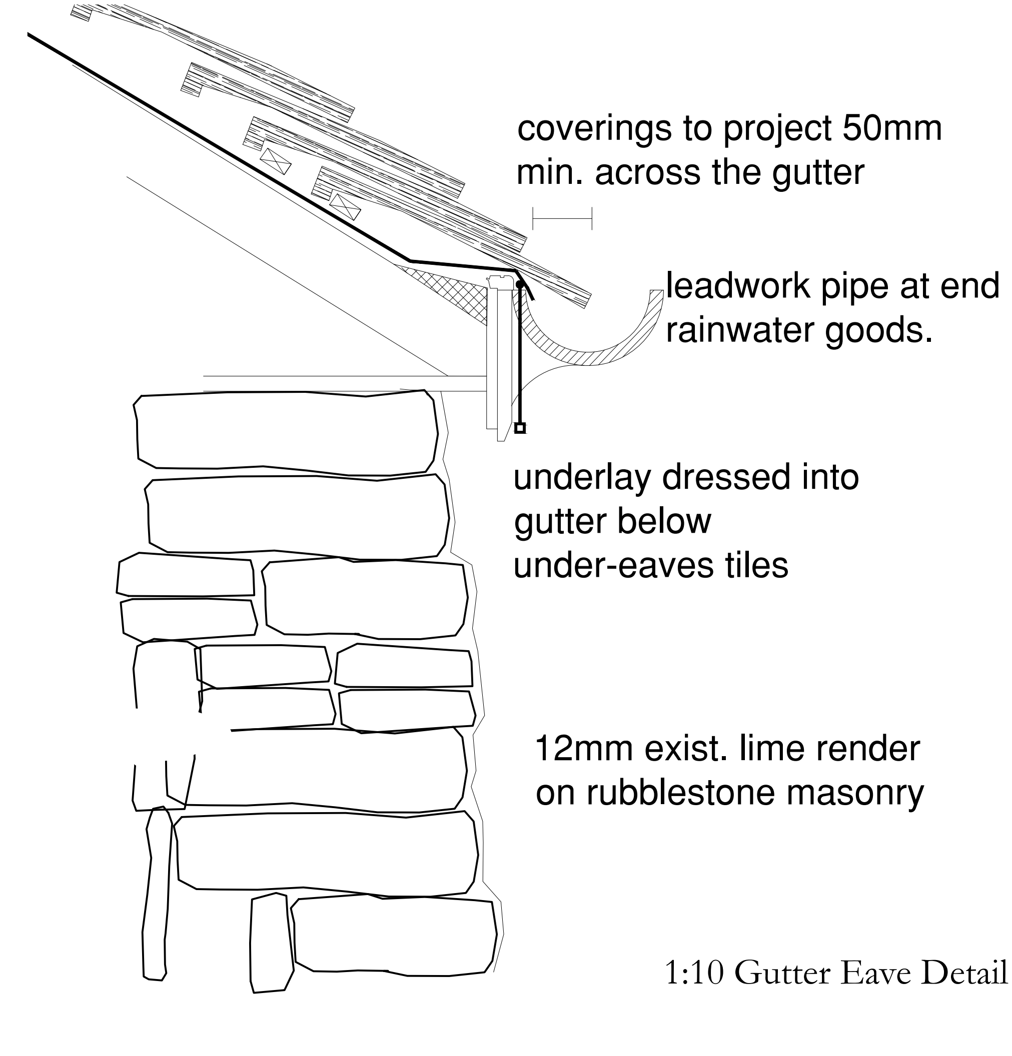


The intricate lock mechanisms and maintenance of the Canal is of great importance in my thesis project. Prior to the refining of the Rapeseed Oil, as crude oil it can be used to maintain the Irish oak of the canal's lock chambers and beams, as well as the original oak floors of the Mill buildings. Hence, I have included a canal maintenance workshops to continue Thomas Rhodes' lock design technique (Fig. 13) and also to retain as much original canal infrastructure and mill structure as posssible.

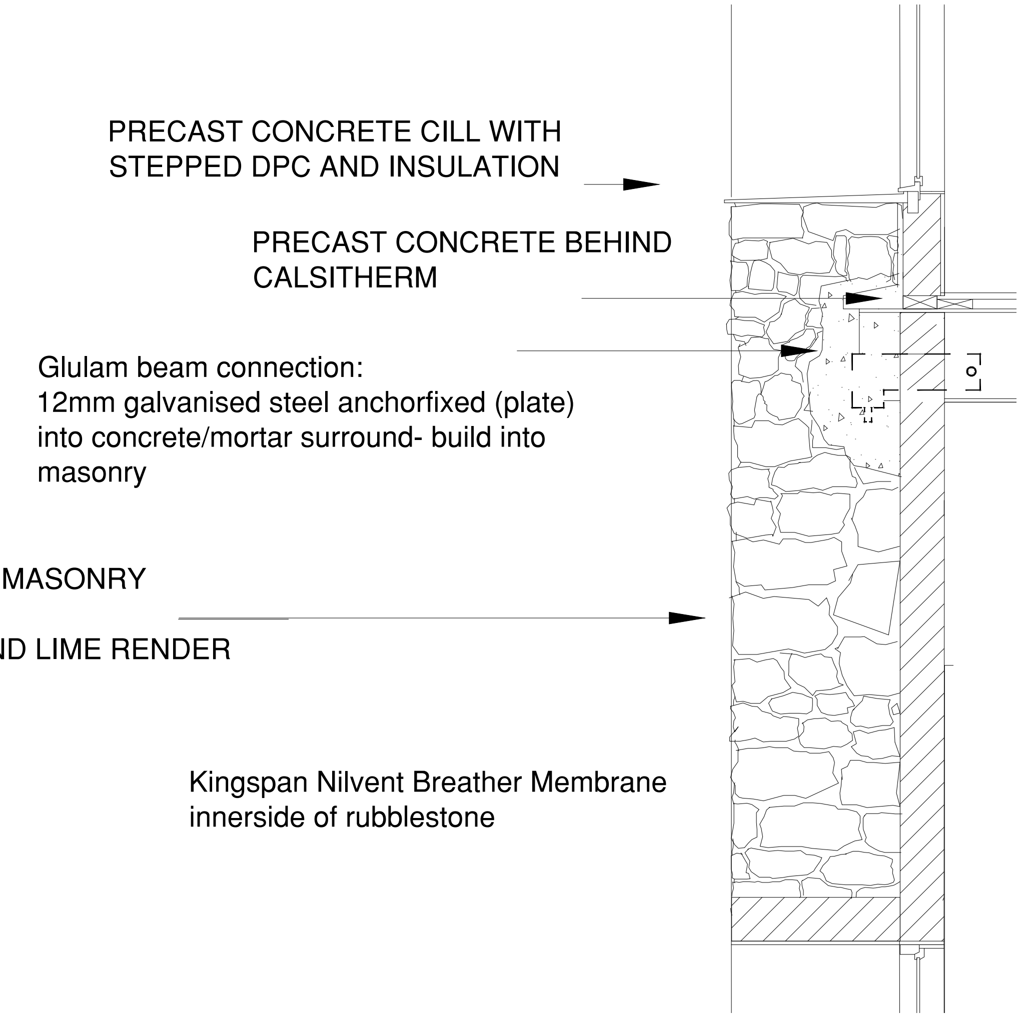


Mill materiality & Maintenance





1:10 Gutter Eave Detail



Restored and retrofitted Mill:
New breathable materials and structural supports to enhance the 19th century stone masonry. As much of the original structure will be retained as possible, with some adaptions; new openings to cater for a 21st century sustainable industry.
For details of the new Breathable Floor of Mill, see p. 62.

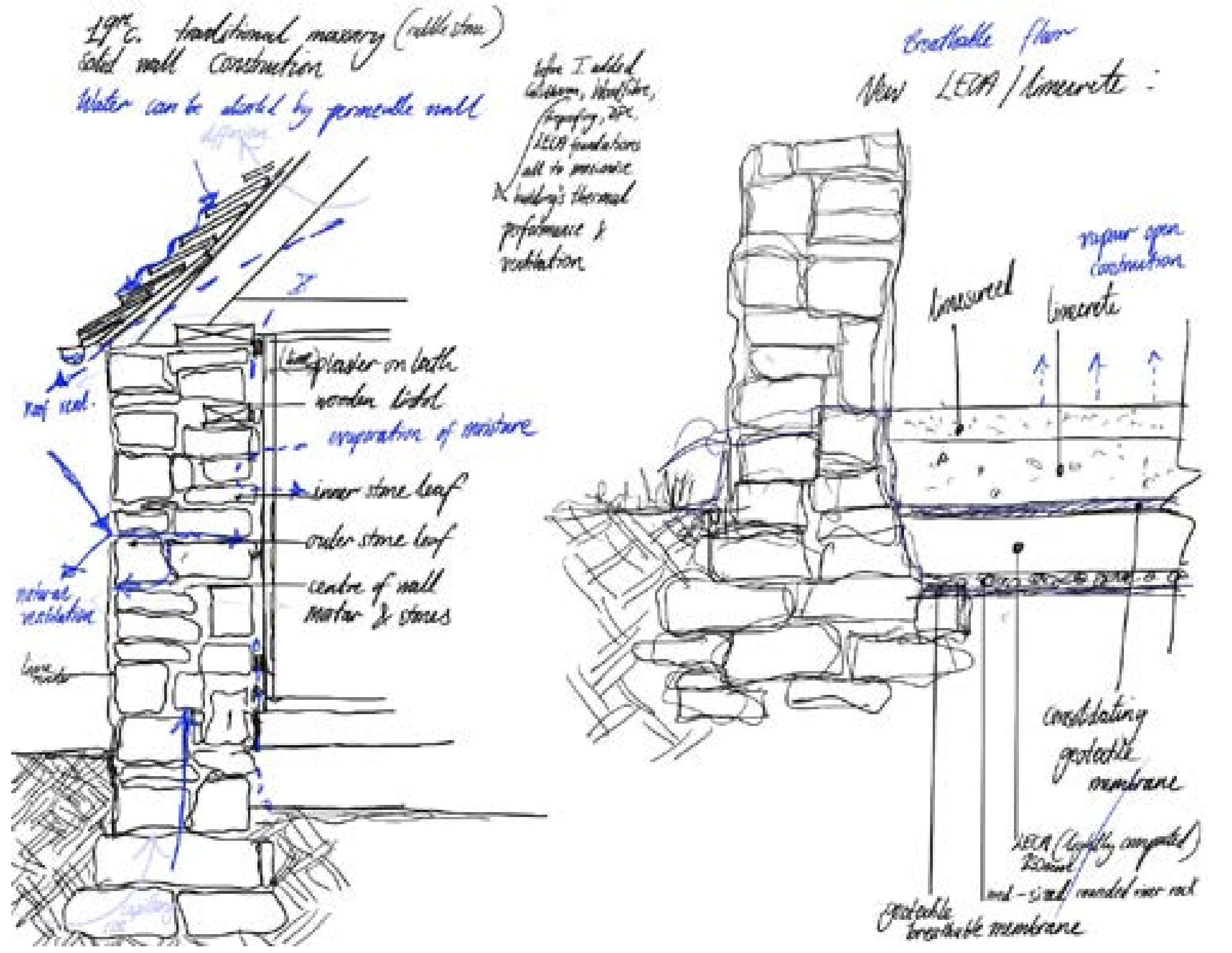
Creating conection between main production building & workshops/canal maintenance building

balconies & projecting windows overlook industrial harbour

New rooflights & larger openings: increased natural light & ventillation

additional MOE

Model of new insertions and changes (red) to Mill to cater for 21st century industry/change of



Greater breathibility and ventillation through new materials

Materiality

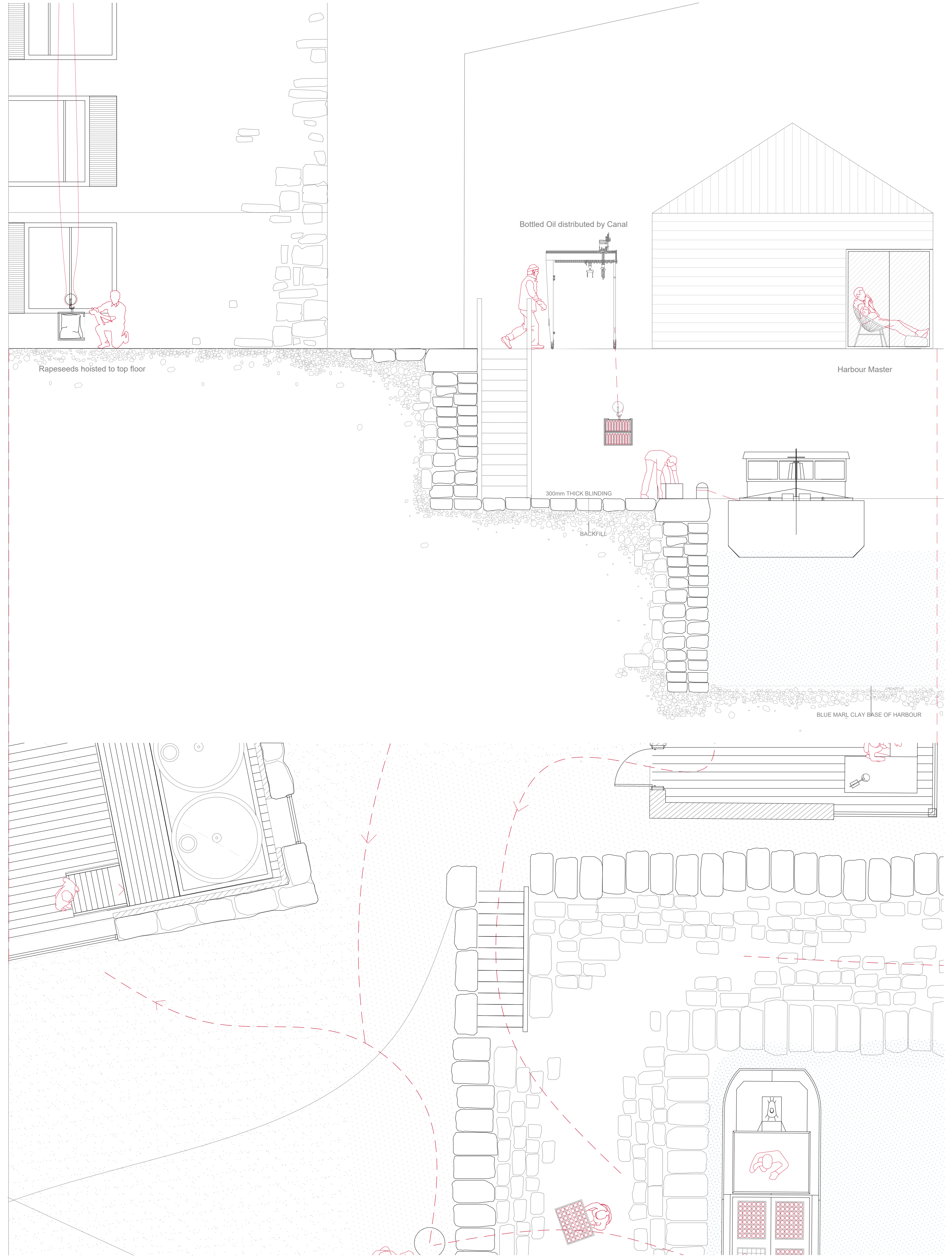
Locally sourced materials to enhance interior structure of Mill and of new Leisure Harbour facility building

I will retain as much as possible. Any new materials will be sustainable and for the enhancement of the original structure and make the builidng fit-for purpose and there for future generations.

Figure 40: Models of the original Mill replicating the dense rubblestone masonry, lime wash render & Irish Oak floor

Edge condition of Rapeseed Oil industry;

Stone Harbour walls &pier, >300mm backfill, blue marl clay bed as was original bed of canal (clarke, 1992).
-Rapeseeds brought to top floor via External Pulley system
-Bottled Oil hoisted by crane to barge for distribution.



7.4 Green Energy

My project aims to answer how can we utilise the 'free', new green energy technologies of our Industrial-Aged canals, as is being done in English Canals, to enhance our builidngs. Through reuse and reimagining redundant structures adjacent to the canal, such as Ashtown Mill (c.1820). I can capitalise on this and facilitate a 'Green Industrial Revolution'.

"The canals in our cities were a product of the Industrial Revolution, a time of great innovation…Bringing together our industrial heritage with new technologies and cutting-edge research like this can help us create urban areas where people and nature thrive in a more sustainable future." (Yorkshire Times, 2021)

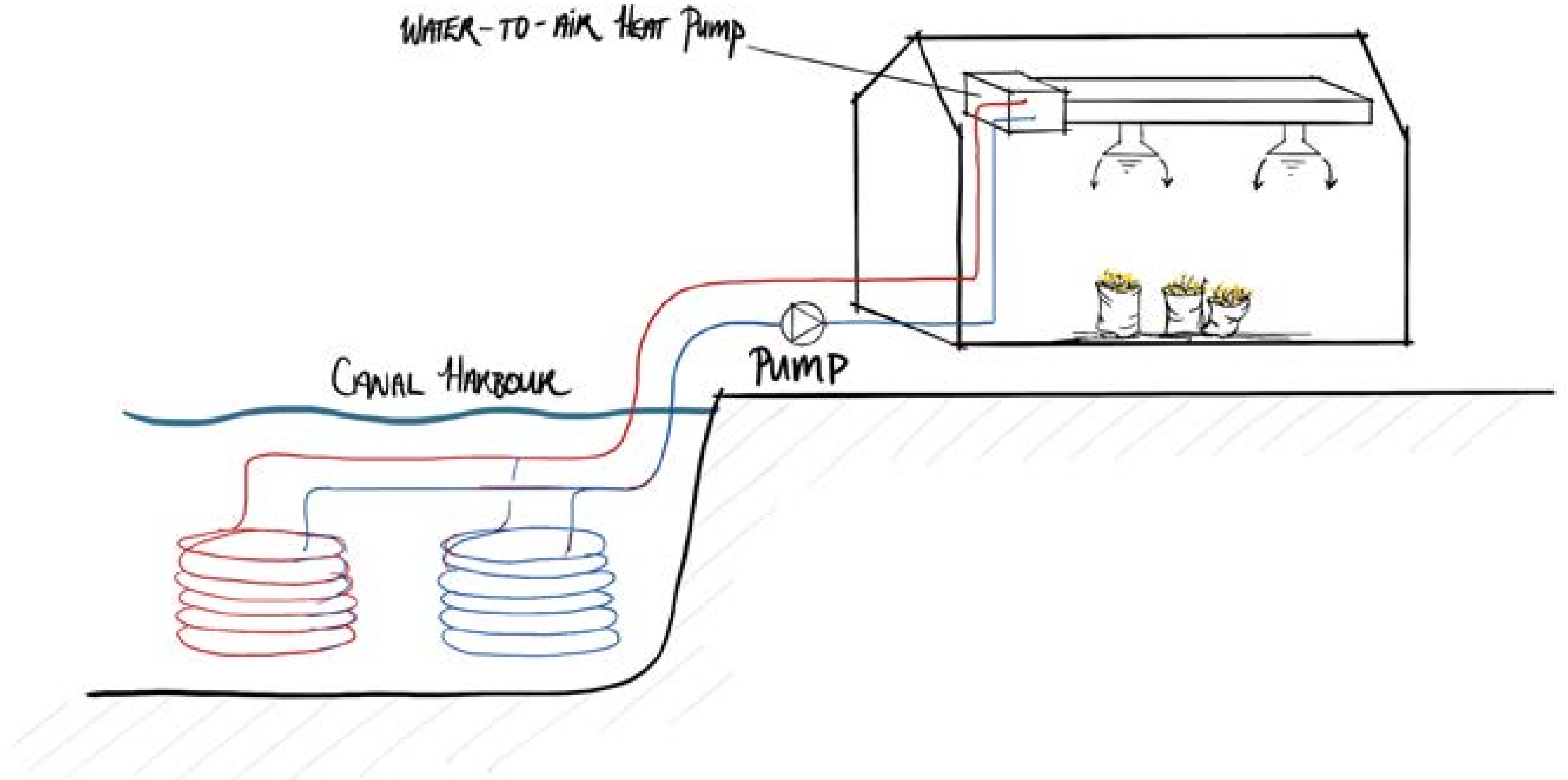
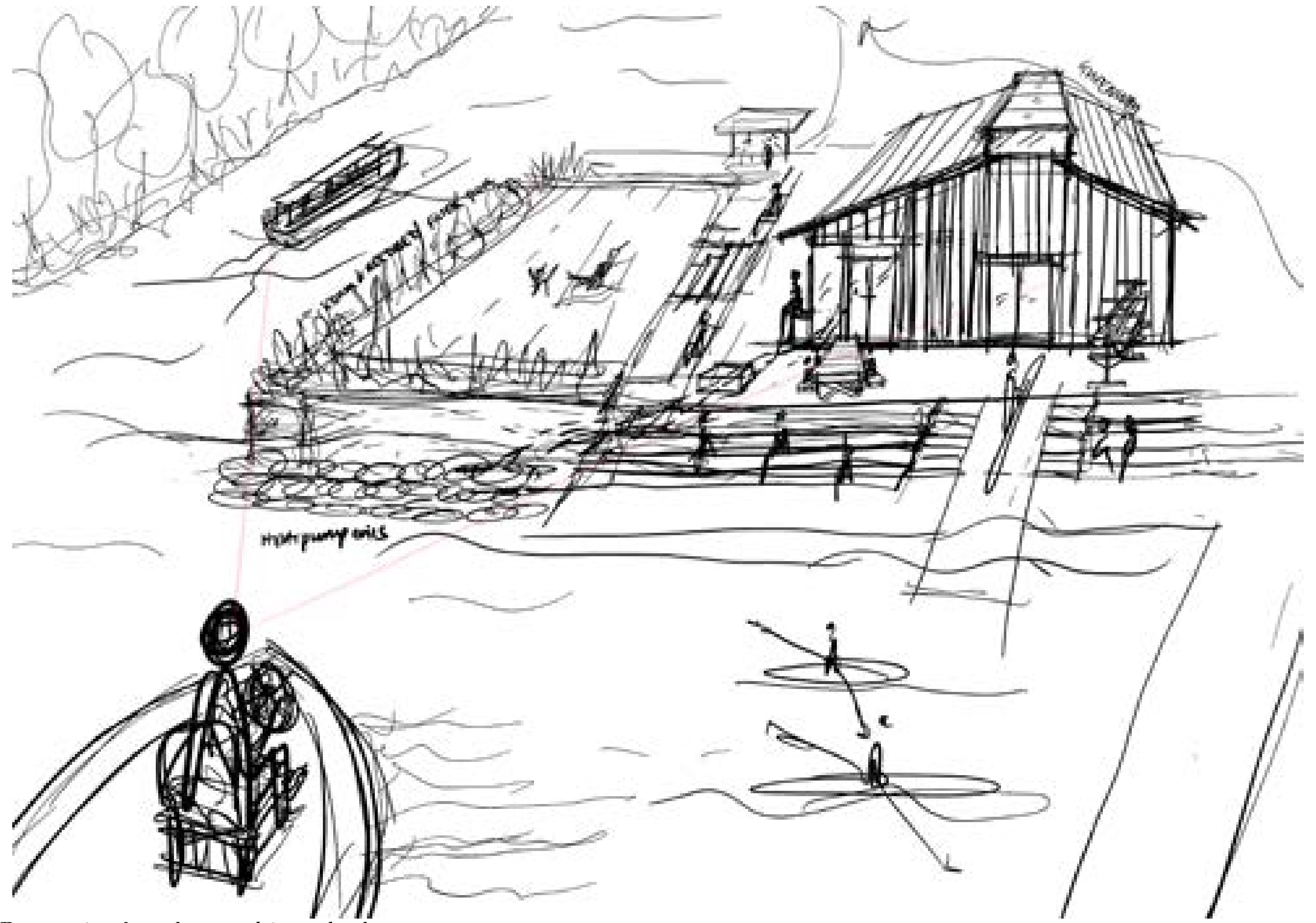


Diagram of Closed loop coil geothermal energy system

Having explored the aforementioned green-energy innovatons (Fig. 18) (Fig. 19) (Fig. 20), closed-loop coils geothermal energy solution was most appropriate- with heat pump system. Such works well in static water such as canals, ponds and lakes. It can convert water to air, therefore has the potential to dry rapeseeds in preparation for processing (as in above diagram).

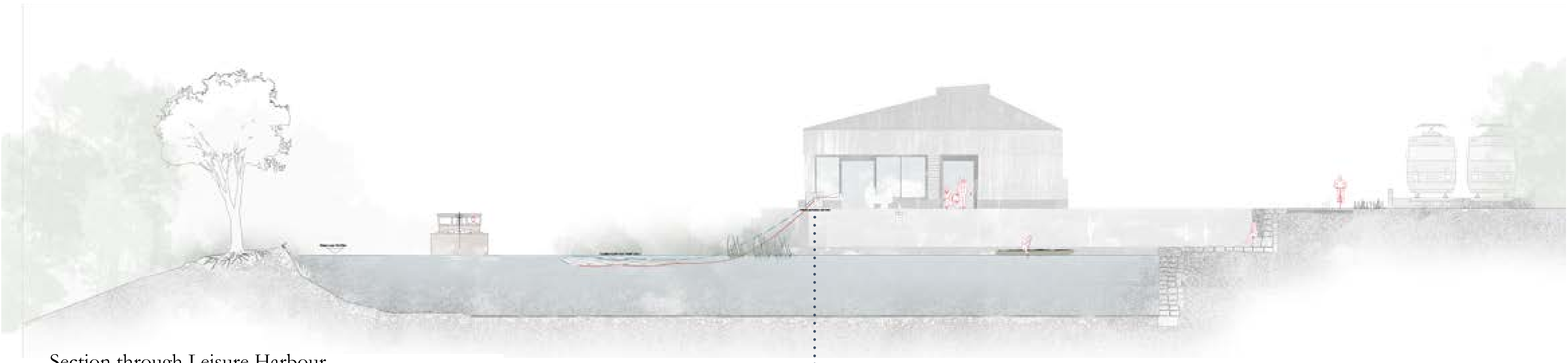
Section through Industrial Harbour
1:200

7.5 Canal as a Recreational Resource: Leisure Harbour



Perspective from boat to leisure harbour

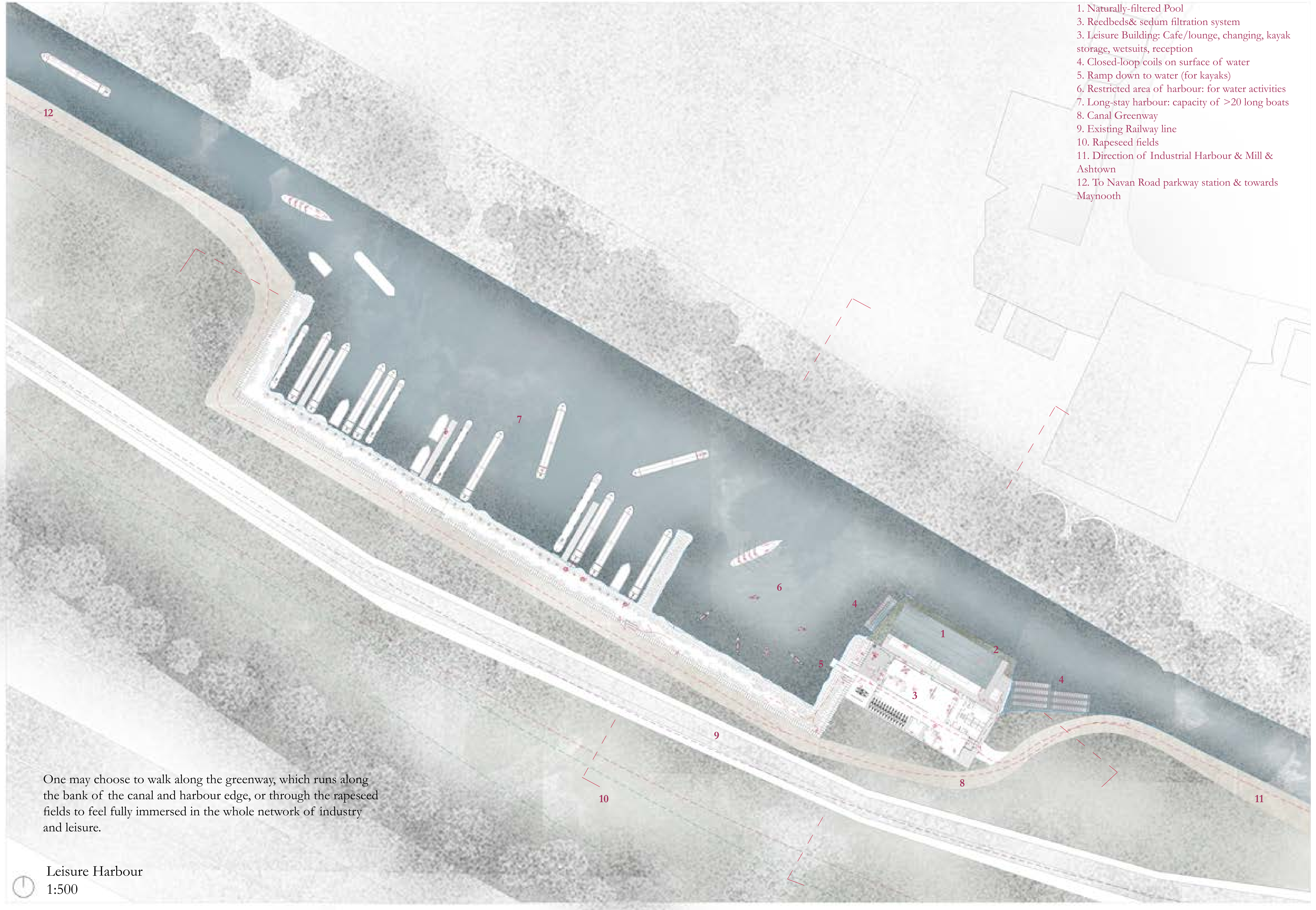
My project explores the recreational potential of the Royal Canal: how can I utilise its water to create greater connectivity between Dublin and its historic waterway. Despite Waterways Ireland reopening the canal for recreational navigation in 2010, there are currently no mooring locations (Fig. 22) past the twelfth lock at Castleknock (which allows for no more than 12 boats to moore parallel on either bank of the canal. Therefore, unlike Grand Canal dock, the royal canal proibits long-stay boats as you reach closer to the city. I want to enable greater connection between the Royal Canal, people and heart of the capital. Through the establishment of a leisure harbour with water activities, and a new-build changing/shop facility, it wil create a destination for floating visitors to come and local communities to benefit from.



Section through Leisure Harbour

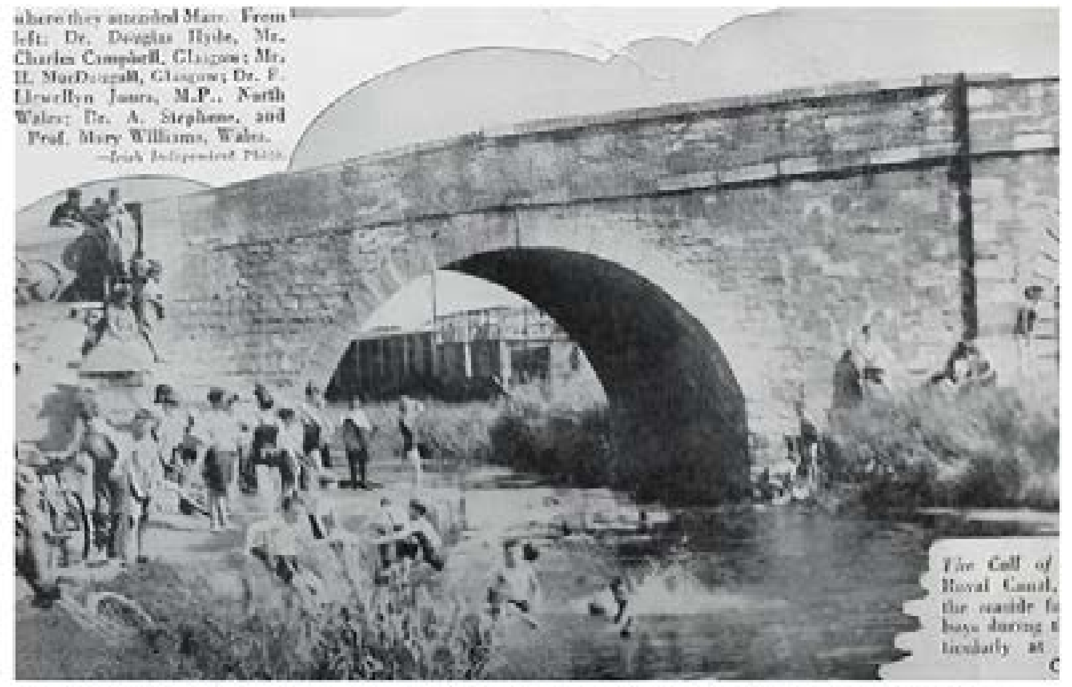
Closed loop coils & heat pump system- which will be a source of geothermal energy for the new building.

Leisure Harbour will be built of cut stone, with seats carved out of the pier wall for one to stop and watch boats arrive and depart. Gradual steps down to the lesiure harbour, by the Leisure building facility allow a gradual approach from ground level to water's edge.



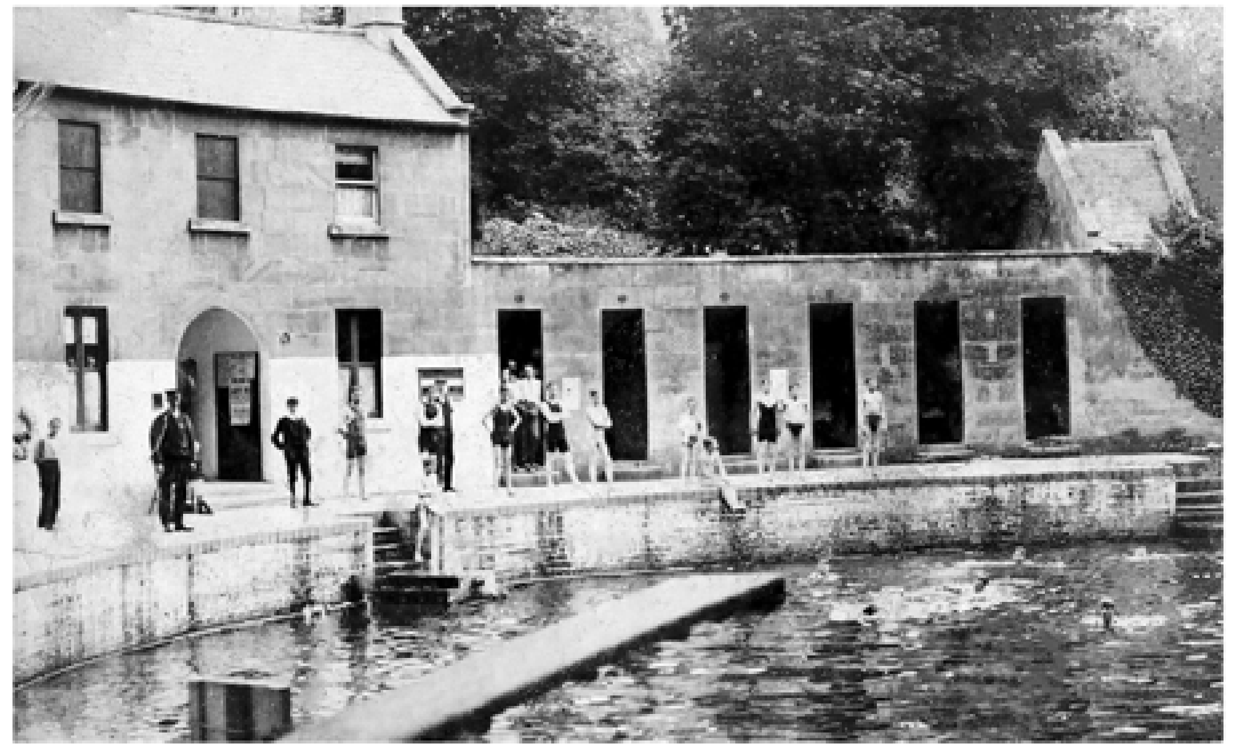
One may choose to walk along the greenway, which runs along the bank of the canal and harbour edge, or through the rapeseed fields to feel fully immersed in the whole network of industry and leisure.

Leisure Harbour
1:500



The Royal Canal, Broombridge, Finglas, Dublin (Image c.1932). The Canal, particularly in Cabra, rivalled the seaside for popularity during the weekend. *Figure 41*

Built of finely cut limestone, were recreational features on the canal, such as the Romanesque bathing spa (c.1794) in Leixlip next to the Rye Water Aqueduct, now disused. It was a popular health spa in the late 18th and early 19th century. *Figure 42*



Cleveland Baths, Bath, Somerset England. c.1815 *Figure 43*

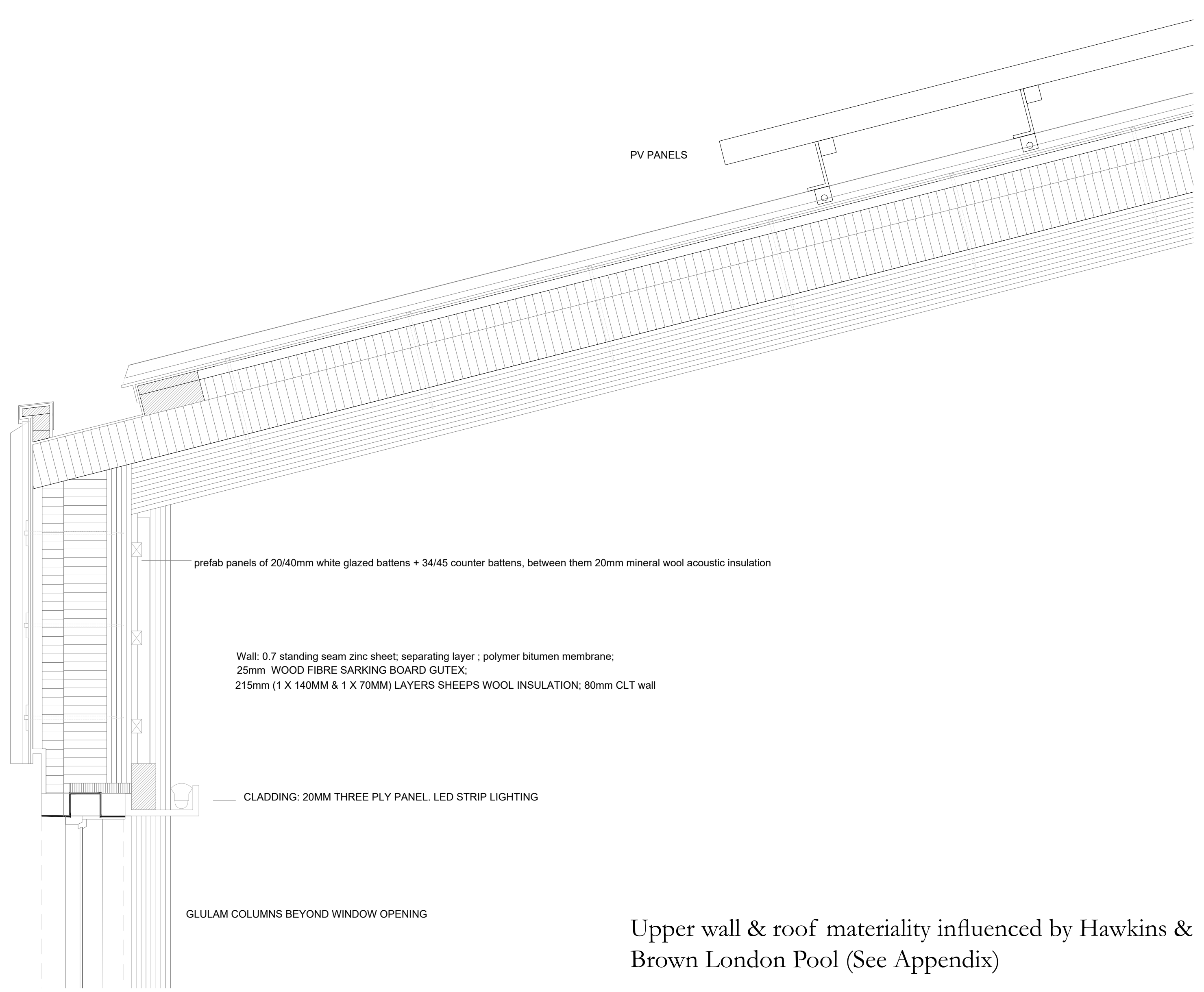
Cabra Baths, Tolka Valley, Finglas, Dublin (Image c.1944) *Figure 44*

A rich history of open water swimming in the Royal Canal & Tolkva Valley River, and in English waterways

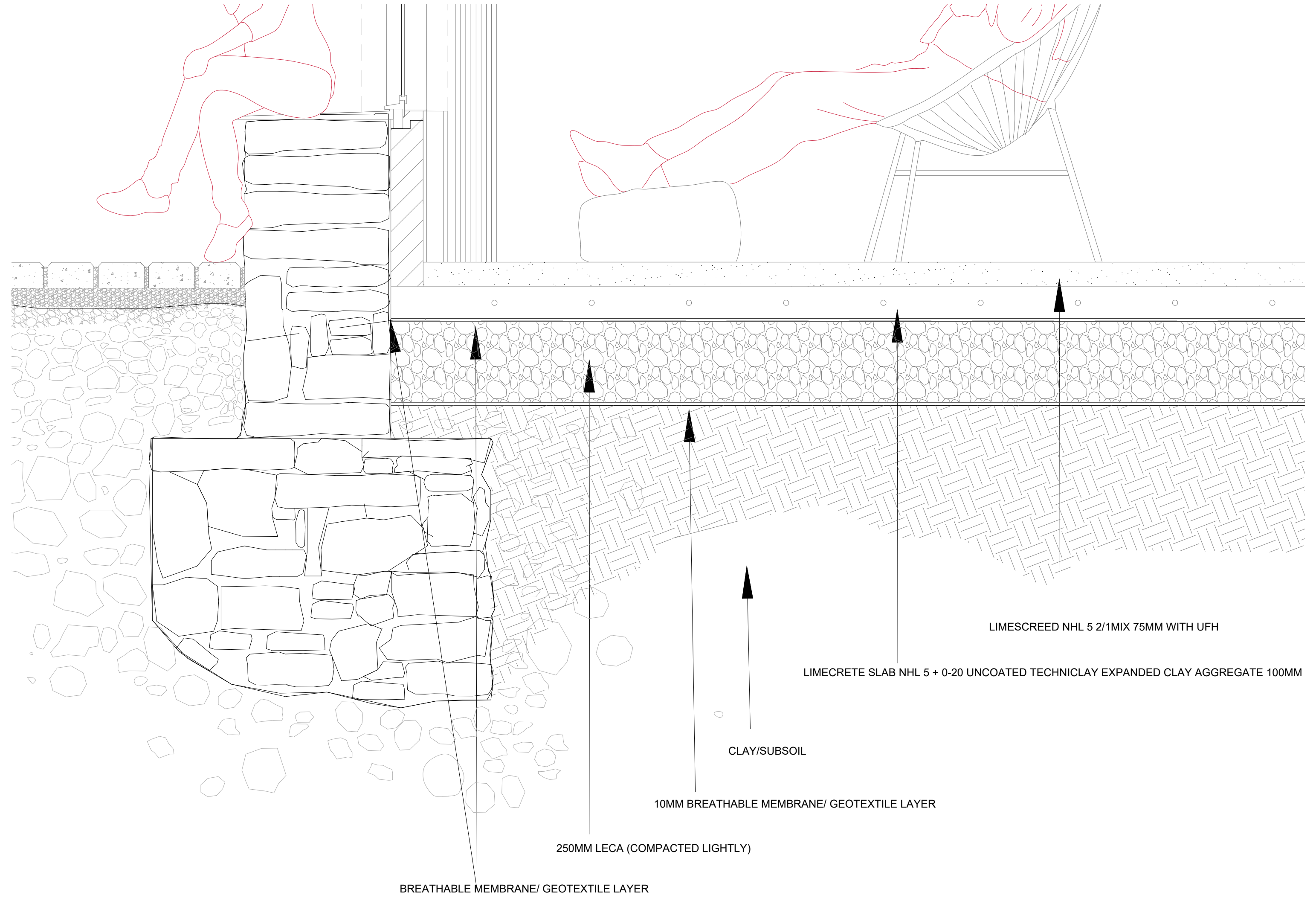
Section through Canal, proposed naturally-filtered pool & leisure facility

1. Reed beds & Sedum natural-filtration system
2. Limecrete tiles line pool, with
3. SUDs permable pavers
4. Leca/limecrete floor build up

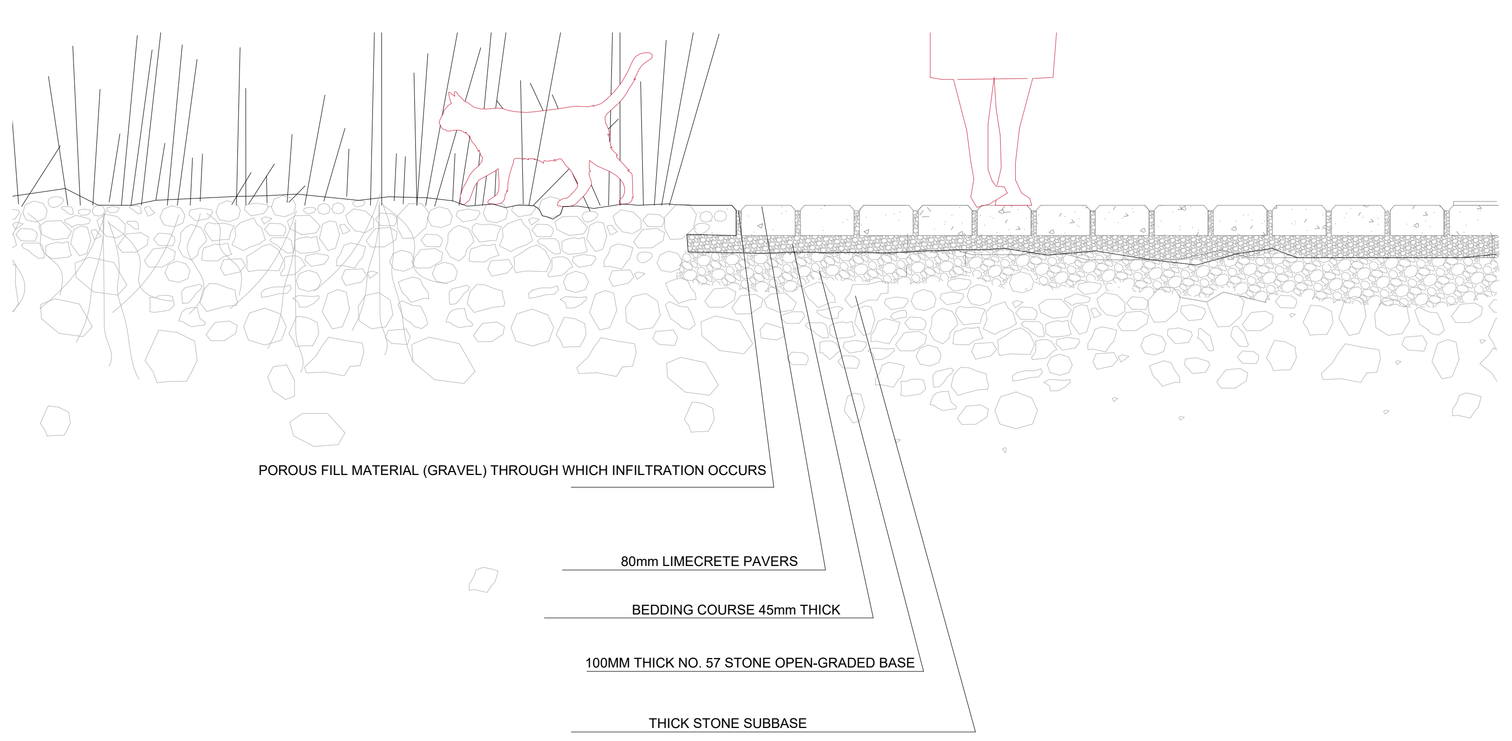
Details of the proposed leisure facility



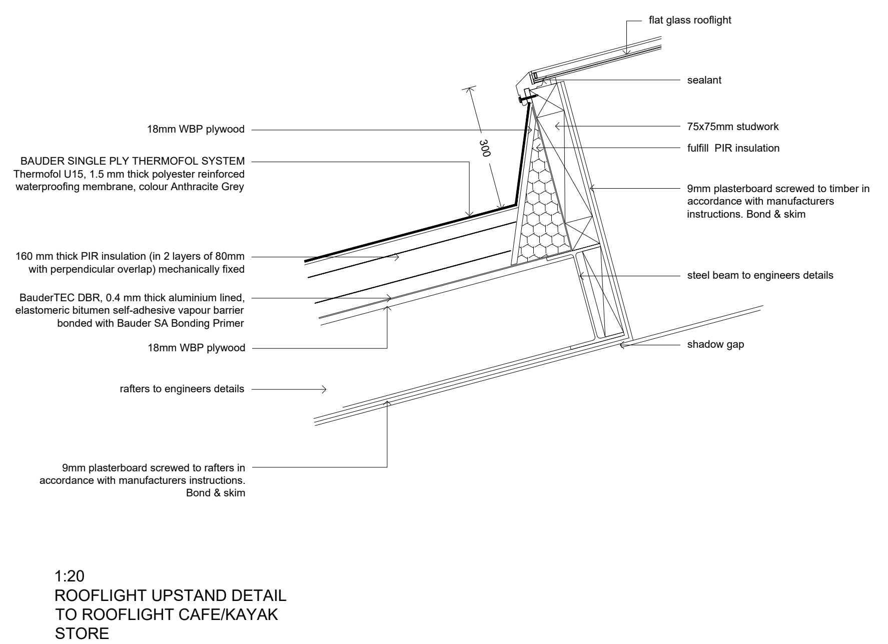
Upper wall & roof materiality influenced by Hawkins & Brown London Pool (See Appendix)



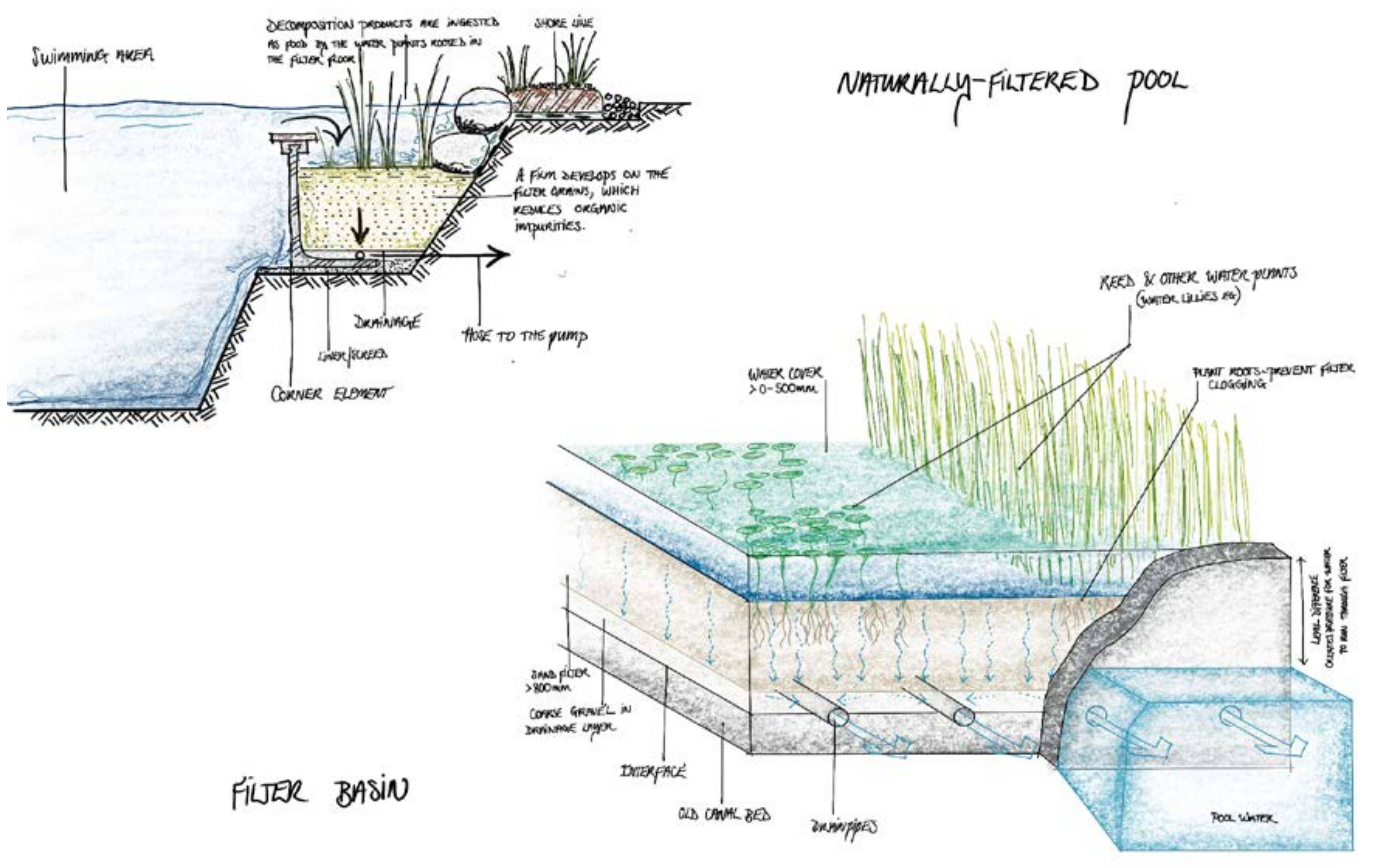
Traditional stone masonry lower wall, in keeping with the historic characteristics of the canal, and mill, with new breathable Limecrete flooring system.



Sustainable Urban Drainage system pavement for the Canal Greenway.



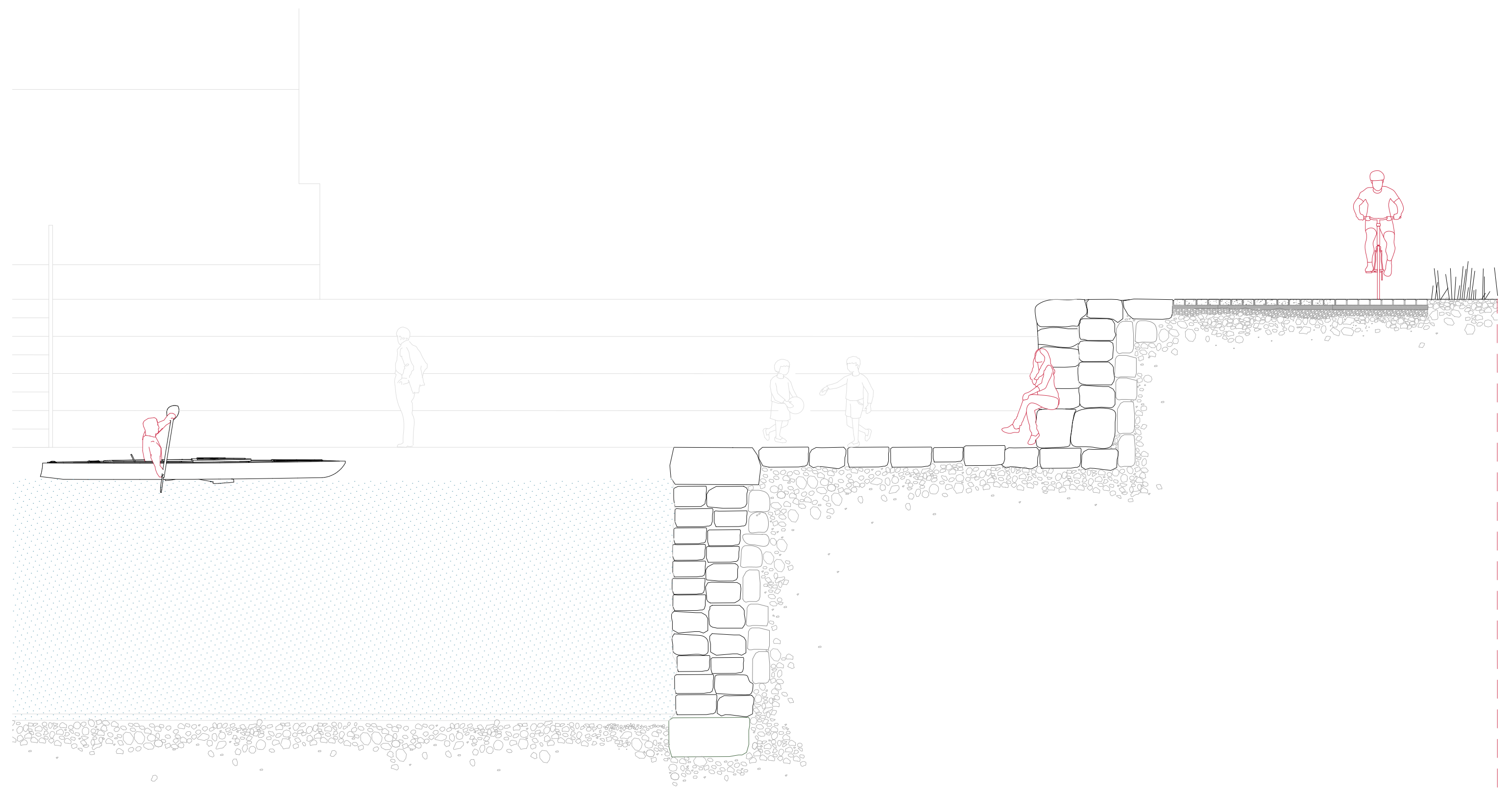
Rooflit corridor extending end-to-end of the new leisure building.

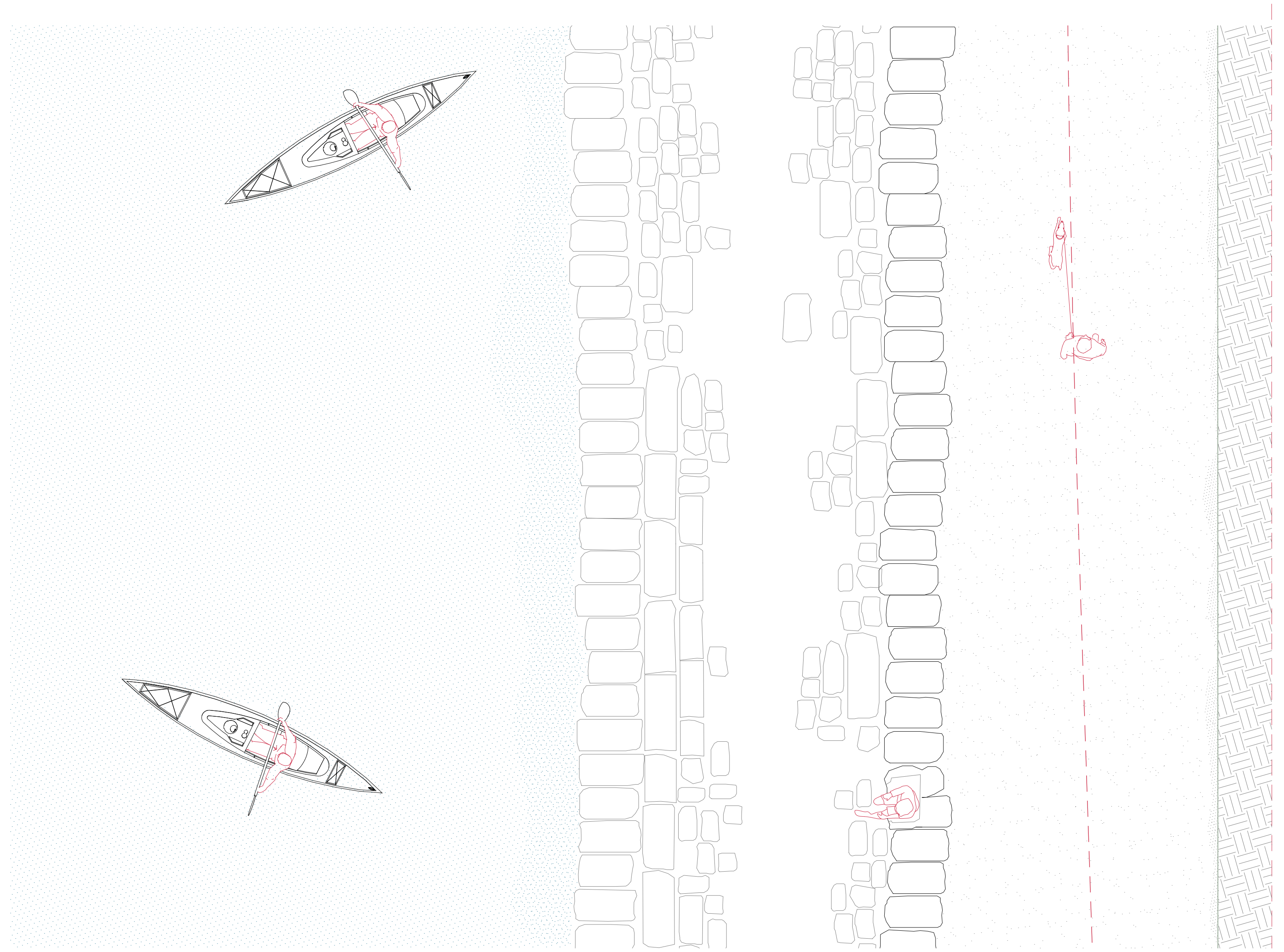


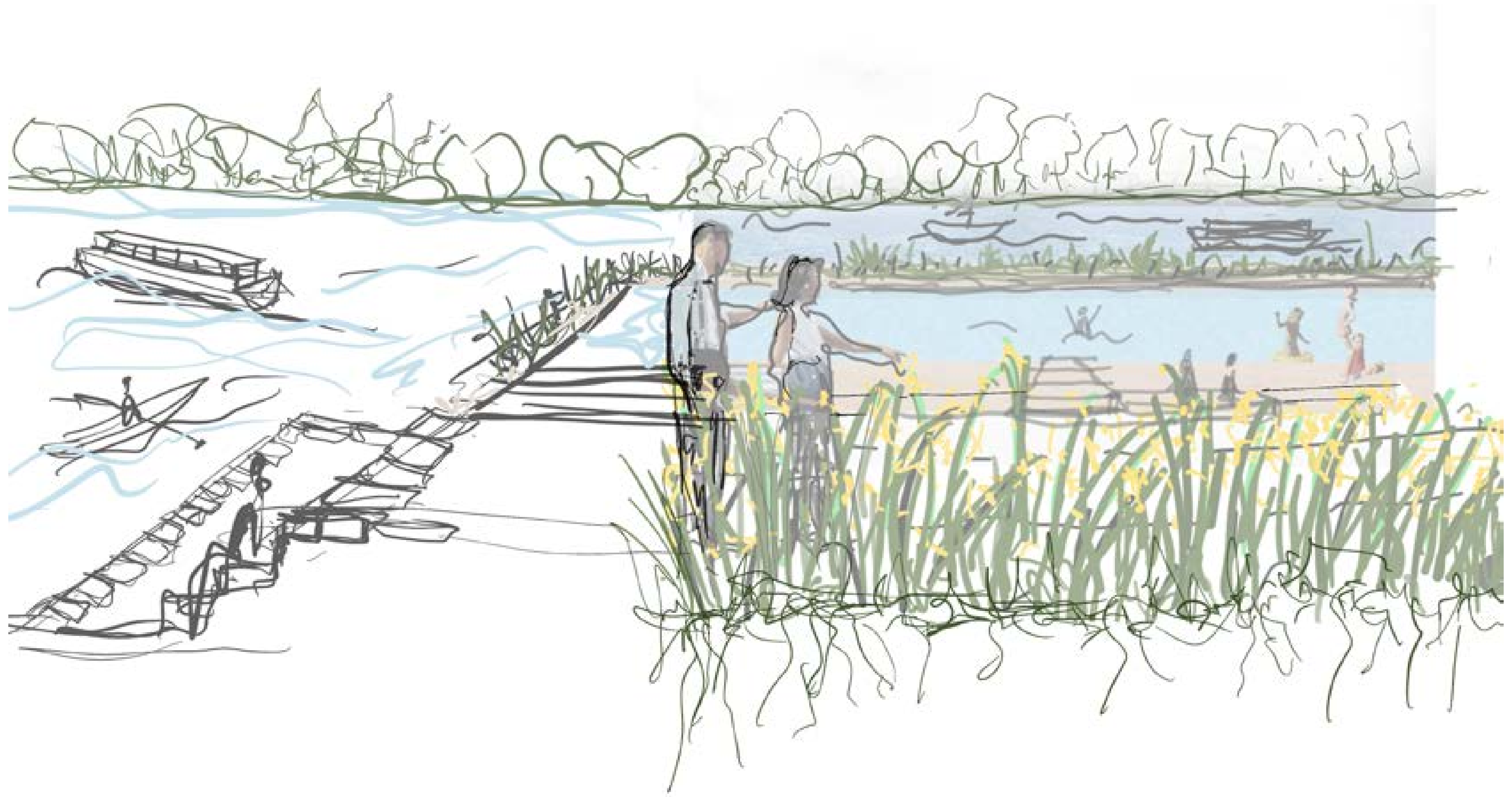
Filtration system of the Canal leisure pool

Edge condition of Leisure Harbour;

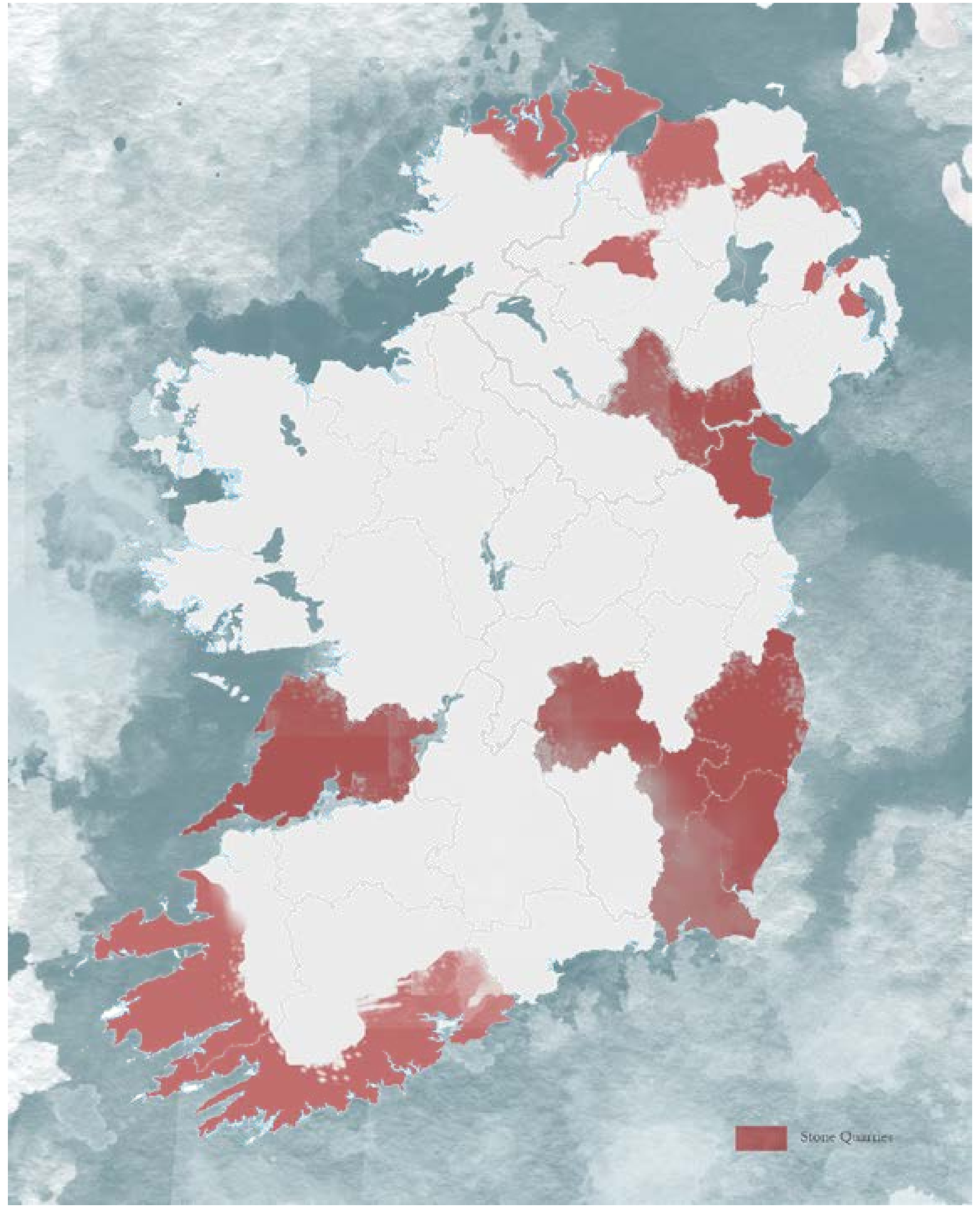
Seating in background of section from leisure building, to water's edge: a gradual approach.
Stone edge, seating at lower level pier carved from wall, enhanced Royal Canal Greenway at ground level, and field to right of this.







Walking along the Greenway, by-passing the leisure harbour, pool, and rapeseeds in bloom.



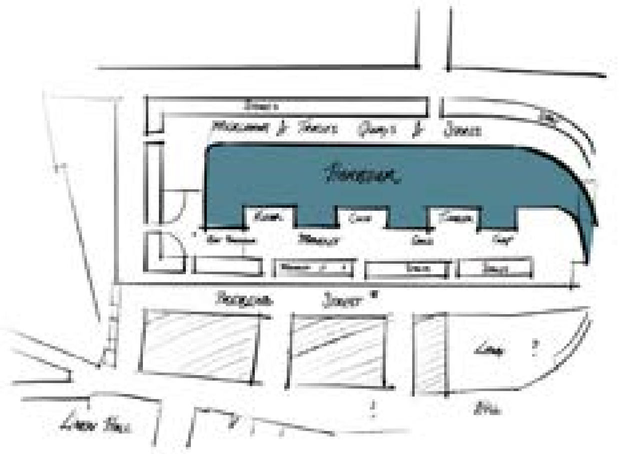
Limestone Quarries in Ireland

My Proposed harbours will be made of stone, locally sourced, and manufactured.

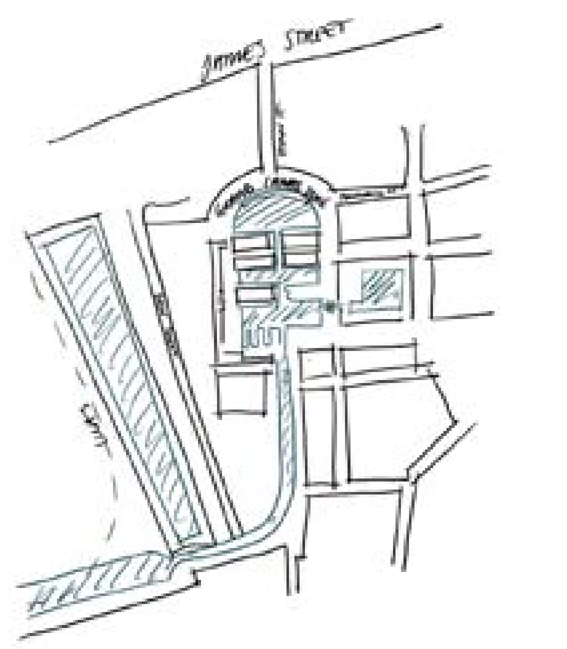
Figure 45:
A typical lime kiln that made the limestone, built near the Canal used to build the royal canal itself and Mills such as Ashtown mill.

Harbours provide a destination for floating visitors, a meeting place & allow for the expansion of Trade Industries across the canal network (Clarke, 1992)

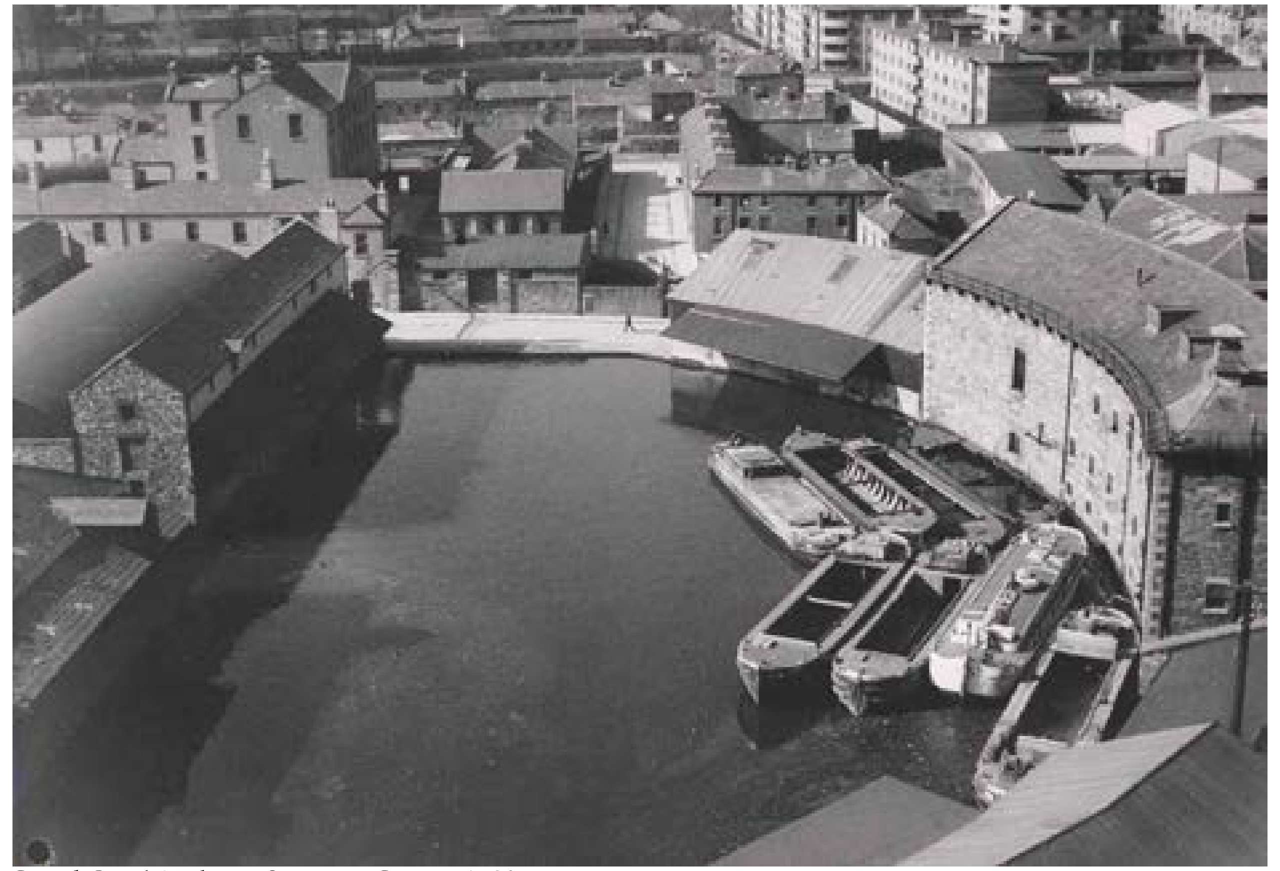
The historic former harbours of Dublin's two Industrial-Aged man-made canals influenced my decision to design harbours as part of my project.



The Former Royal Canal Harbour at Broadstone, which stemmed from the Royal Canal branch line (later infilled)as Rail and road took over (with global energy expansion and industrialisation).

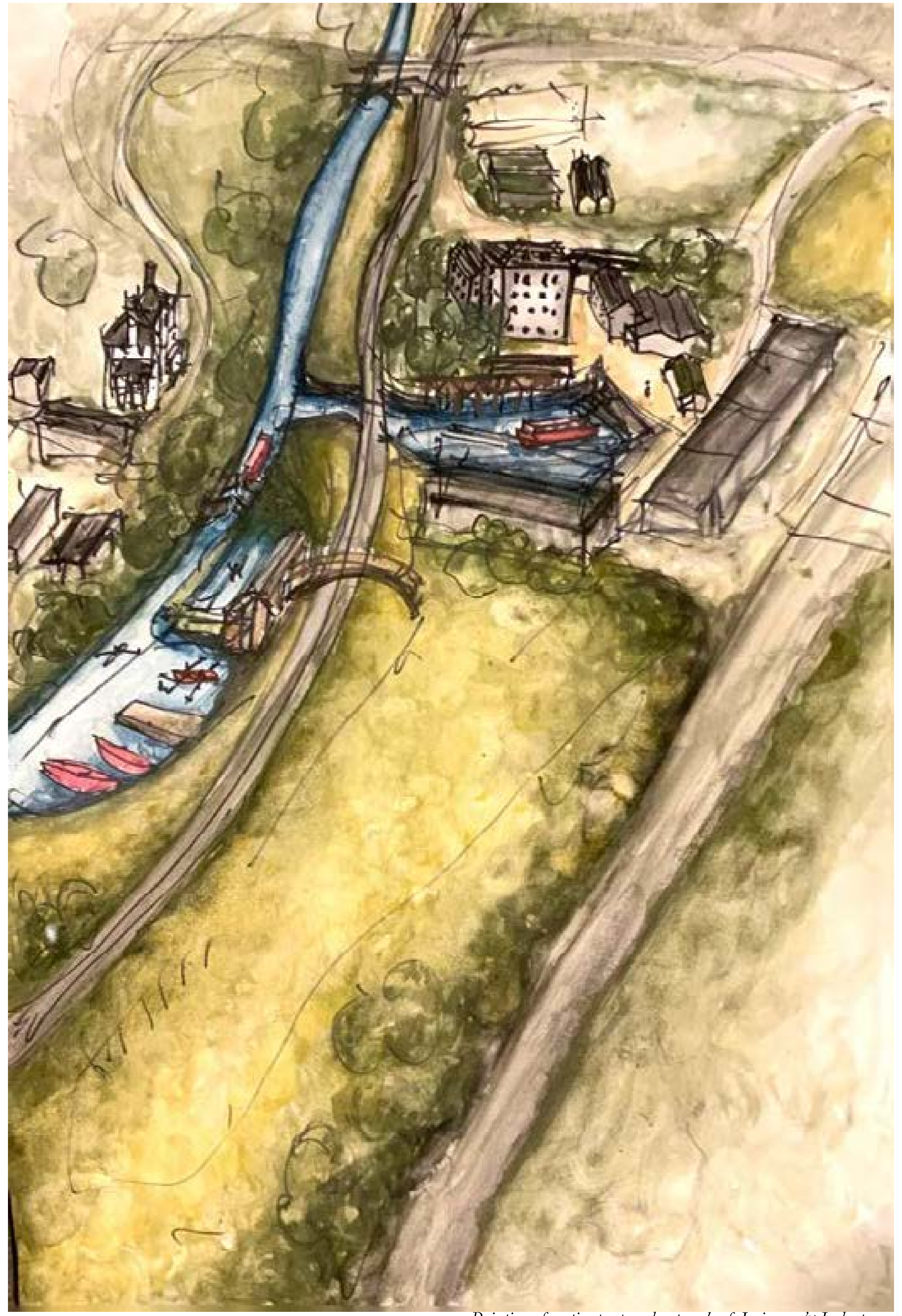


GRAND CANAL HARBOUR & CITY BASIN



Grand Canal Harbour, St. James Gate, c. 1780.

Figure 46



Painting of entire proposed network of Leisure & Industry

Conclusion

The Royal Canal has the potential to facilitate a climate-adaptive city and nation, and propel a 'Green Industrial Revolution' (Canal & River Trust, 2021). The thesis investigates radical interventions that strive to redefine the Canal corridor as one which integrates its industrial heritage with a thriving 21st century. It sets a precedent by bringing together leisure, industry and energy innovations to build a sustainable future.

"And while the generation that proposes these solutions—that is, our generation—will pass, the effects of their imposition can linger, as have the impositions of generations preceding ours, leaving long-lasting scars not just on hearts and minds but on the world around us" (Ingold, 2022).

It is up to us to envision a positive new future for the Royal Canal. The objectives set out in the design of the revived Canal network could serve as an example for other waterways and for generations to come. We must continue to adopt new ways of thinking and working to adapt to climate change, so that we can look forward to a future to be welcomed.

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Canal Corridor, King's Cross by Townshend Landscape Architects

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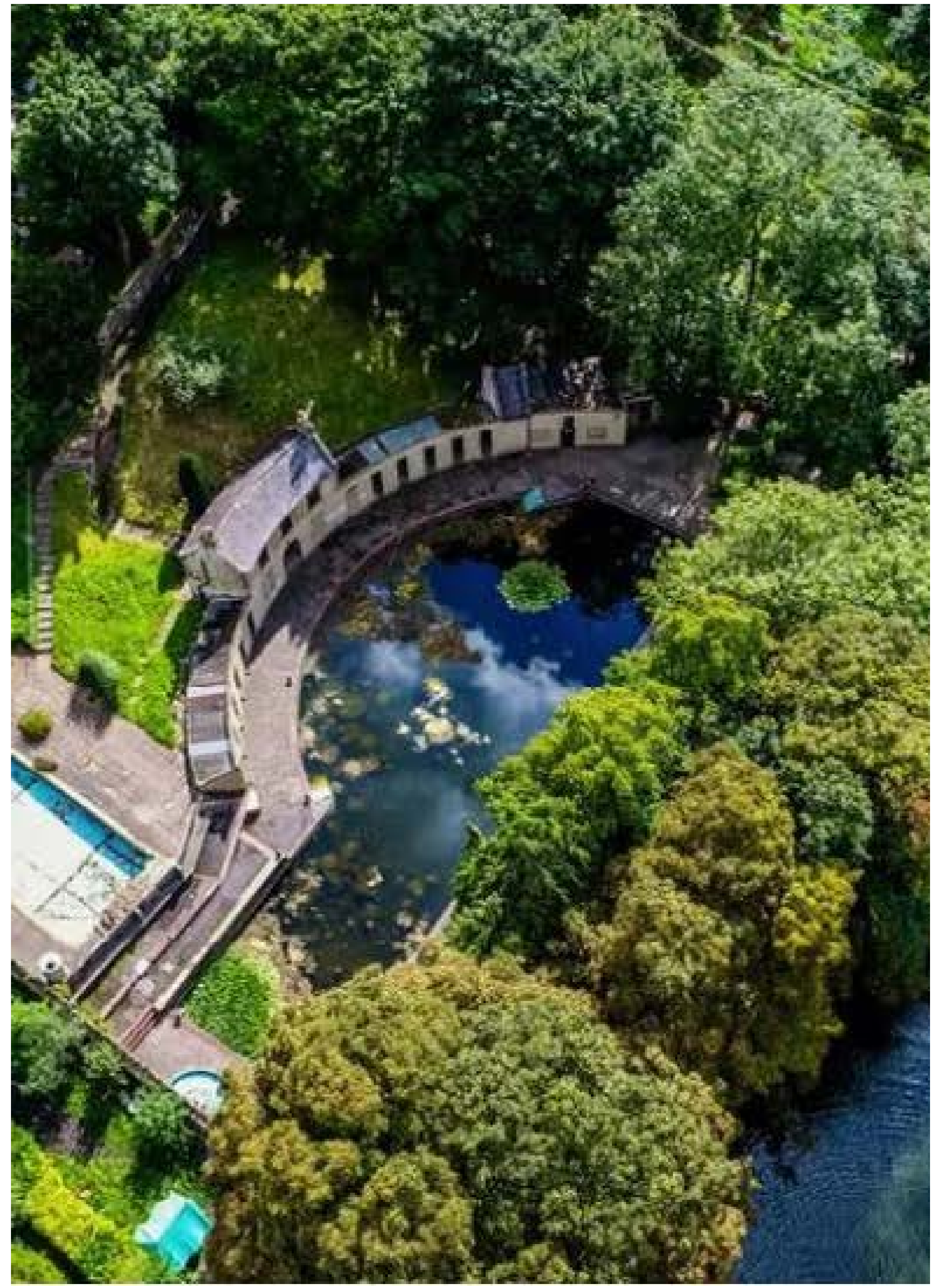
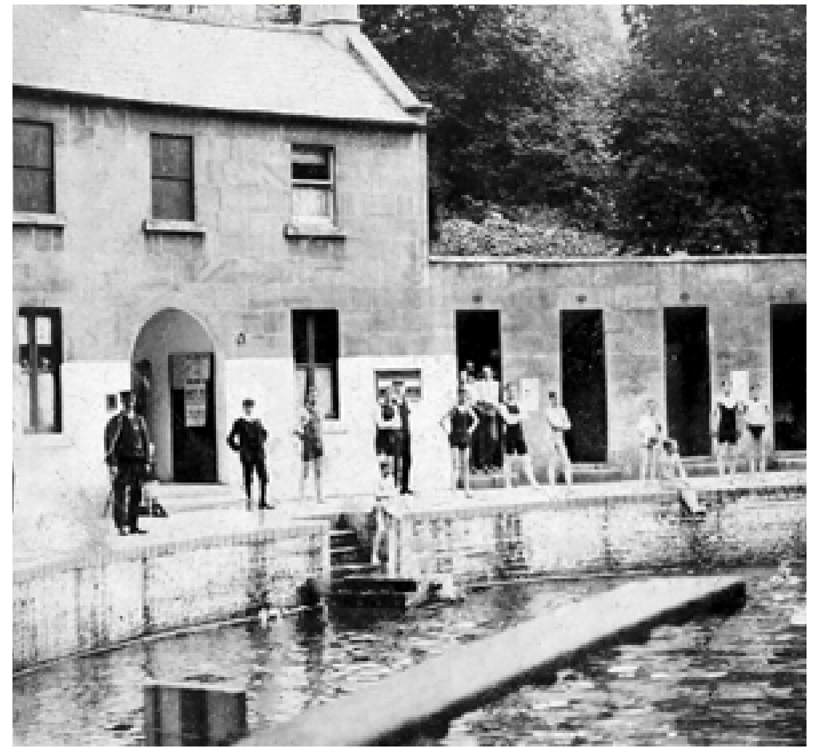
Precedent





Precedent

The Cleveland Pools in Bath is a beautiful hidden gem, the oldest outdoor pool or lido in England.

It was Bath's favourite public amenity for more than 200 years.

Itis currently being restored and renewed to cater for 21st century recreational use. The heating system at the main pool with be carbon efficient and eco friendly. It will pump and heat water from the River Avon next to the pool.

This is said to save around 1,400 tonnes of carbon over 10 years compared to a gas system.

Cleveland Pools' Project Director Anna Baker said: *"Typically, lidos are heated using gas boilers, but the project wanted to find a more sustainable option.*

"We've therefore developed plans, and received specific funding, for the installation of a ***Water Source Heat Pump****, which will take energy from the adjacent River Avon to heat the pools."* (Connolly, 2021)

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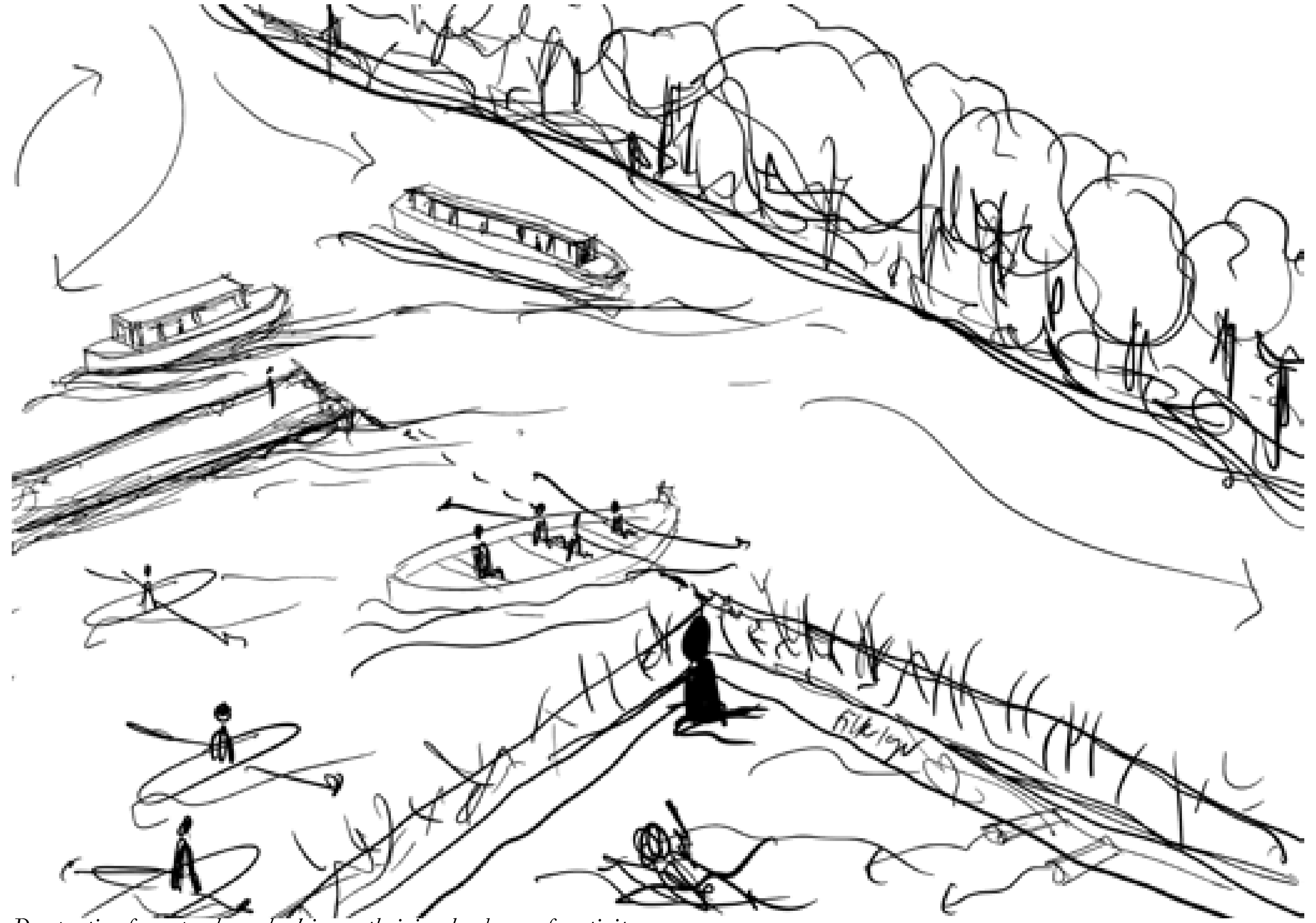
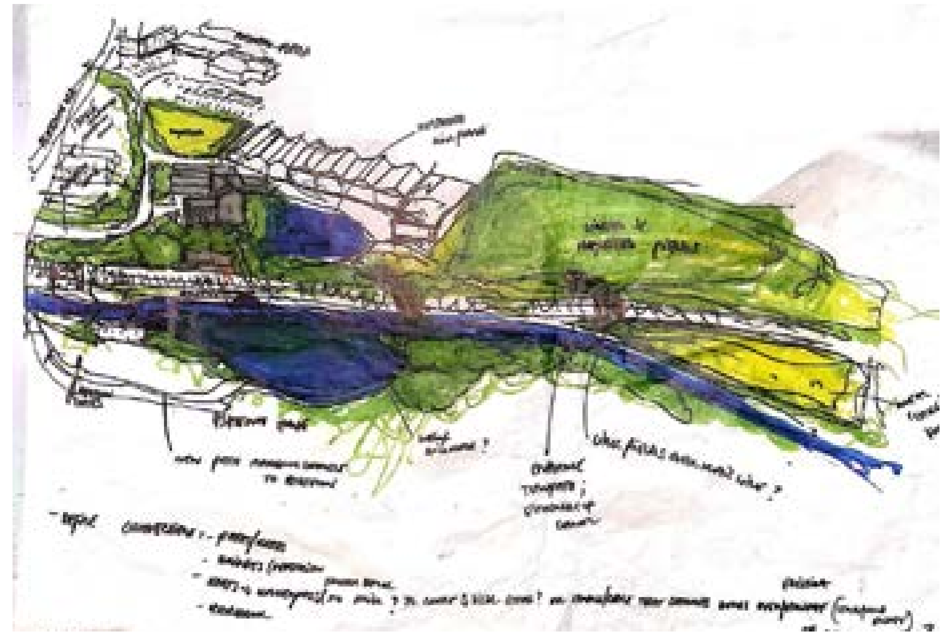
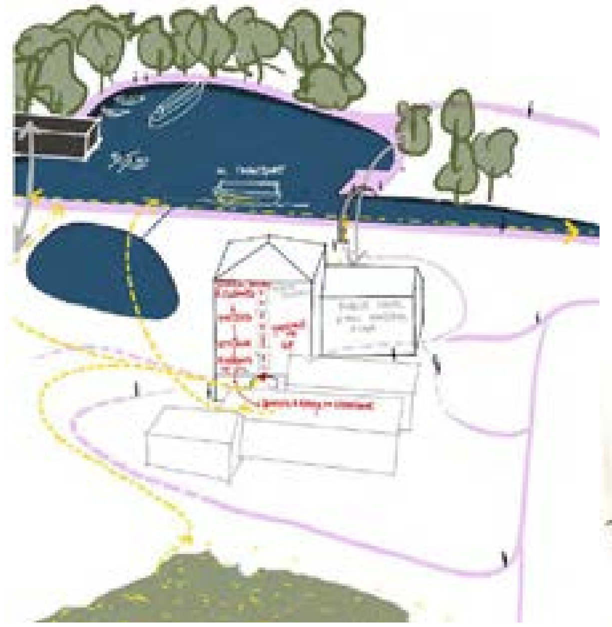


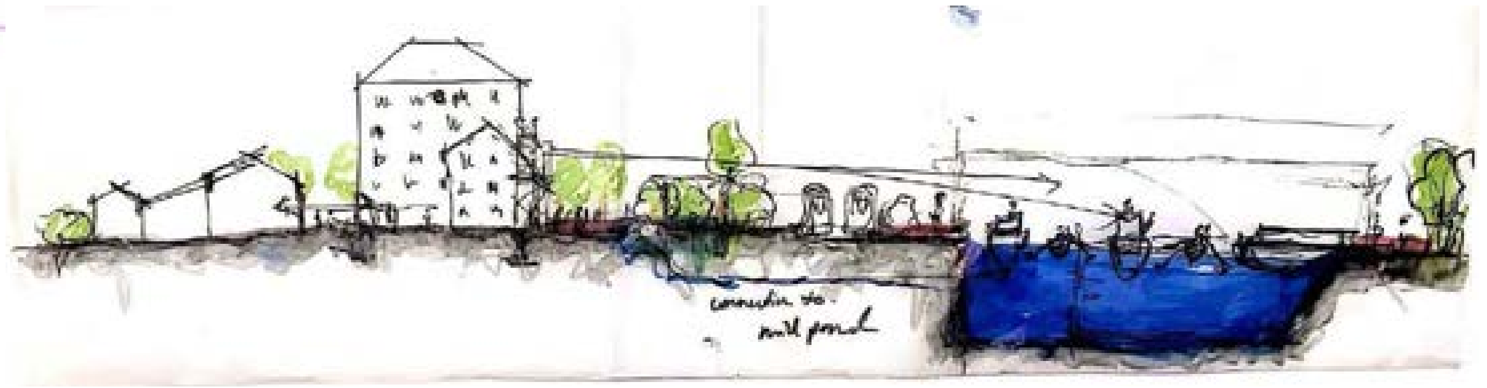
Perspective from pool overlooking a thriving harbour of activity

Initial concept sketches and overlays

I want to enhance recreationaluse along the canal water- such as kayaking, canoeing, boat day-trips, and along its banks: appropriate greenway for pedestrians and cyclists, regular resting points, and with increased crossing points (bridges) to connect
communities. With the creation of a harbour and Lido, this will allow the reactivation of the canal and connect communities, through activity.

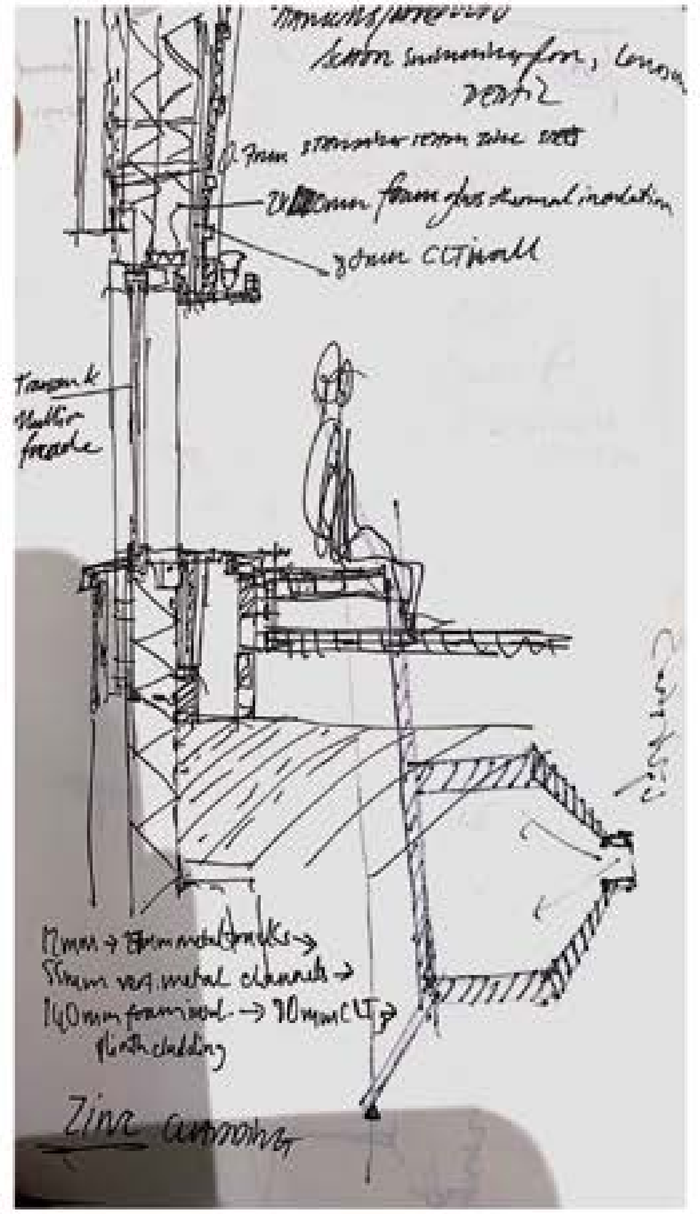


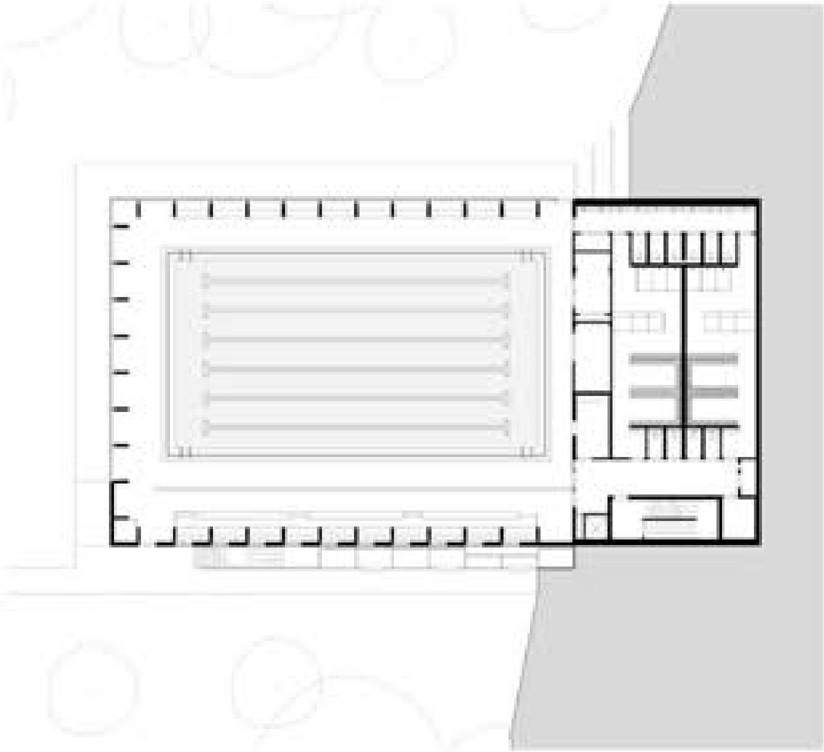


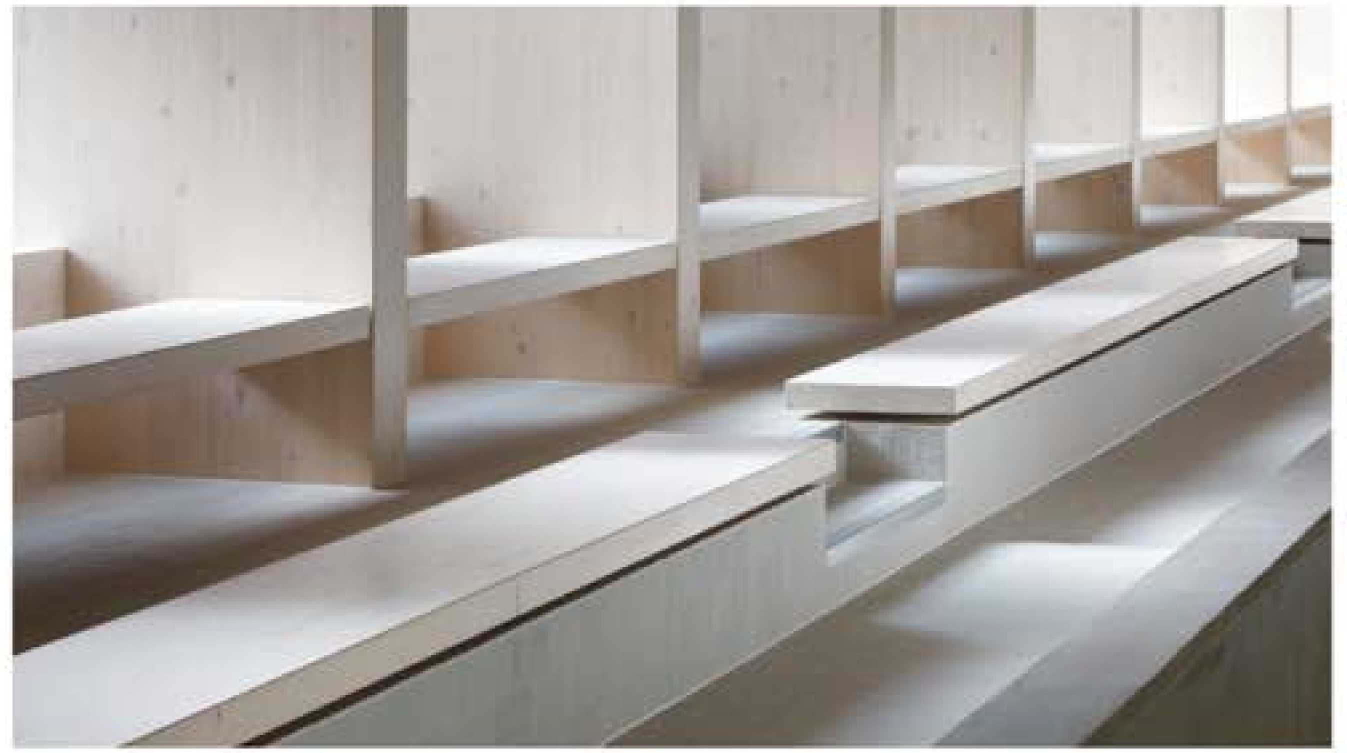


Freeman's Swimming Pool, London by Hawkins Brown Architects

Timber construction and offsite fabrication methods to create a sustainable building that sits gently within its context. (glulam) portal frame, braced with cross-laminated timber (CLT) panels. The use of engineered timber provides a fast, efficient, carbon neutral method of construction that provides both structure and internal finish.







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Butler's Gallery, KIlkenny, by McCullough Mulvin Architects

Adaptive Reuse and Historic Preservation.

The existing building has been sensitively restored and combined with contemporary interventions in the form of two, two-storey bronze coloured extensions to form an aggregate of the old and the new. These extensions are connected to the restored almshouse through light-filled glazed passageways, and together form a seamless set of routes and spaces.

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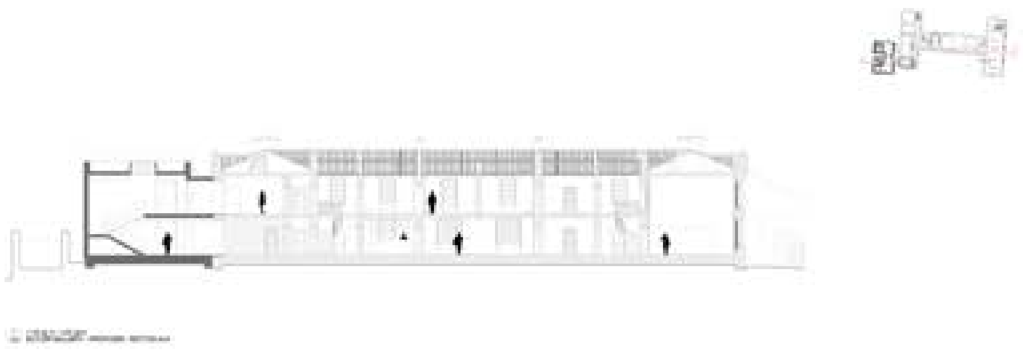

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B. Arch 2023