Out of Sight, Out of Mind:
Shifting Perceptions on Sanitation Through the Urban Integration of Wastewater Infrastructure

by

Andrew Carruthers

Submitted in partial fulfilment of the requirements
for the degree of Master of Architecture

at

Dalhousie University
Halifax, Nova Scotia
March 2016

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ABSTRACT

The decentralization and sanitization of industrial processes essential to the operation of our cities has contributed to the creation of sprawling waste-landscapes and a diminished connection, and perception of accountability, to the surrounding environments. These singularly efficient infrastructural and industrial processes, separated from urban centres and hidden from plain view, are afforded the opportunity to run unaccountable to their environments, both environmentally and socially. Through the urban and cultural integration of wastewater treatment infrastructure in Victoria, BC, waste and waste-landscapes are revealed and repurposed as clear and understandable resources for economic, environmental, and public benefit.

ACKNOWLEDGEMENTS

Thanks to Catherine and Talbot for your direction and inspiration, thanks to Kaitlin for your guidance and support, and thanks to everyone for putting up with 8 solid months of toilet humour.

CHAPTER 1: INTRODUCTION

> City planning and its companion, the art of city design, have not yet broken with the spacious comfort of wishes ... and have not yet embarked upon the adventure of probing the real world. (Jacobs 1961, 13)

In 2006, the B.C. Government mandated that Victoria treat its sewage. While public support for treatment has been positive in theory, discussions have been from the perspective that while the infrastructure is needed, the plant should be as unobtrusive as possible. On the contrary, to bolster understanding, reduce waste and foster community growth this thesis marries wastewater treatment to public space with a layered approach that includes an accessible, central wastewater treatment plant embedded in the urban core. Through urban ecologies (Berger 2006) and socially conscious design these infrastructural sites can form an integral part of our urban environments as social, economic, and ecological machines.

While environmental issues are typically left to the last, in many cases economic and social benefit can be found in their resolution (Mostafavi 2010, 461). Public green spaces including parks, boulevards, and empty sites operate at an environmental and economic loss but can cheaply and easily house stormwater-treating bio-swales to reduce loading on wastewater infrastructure and add moisture and critical nutrients back into the soil, all while forming attractive water-features. A treatment plant embedded in a mixed-use downtown setting maximizes the benefits reaped from our resource-rich municipal sewage by creating programmatic synergies with other occupancies in the neighbourhood: biomass boilers and potential energy in the 16-20º affluent allows massive energy savings through district heating; carbon-negative biofuels from the digestion of solids are pumped back into the grid; nearby cement plants can use the reclaimed water and fire kilns with biomass; and soil marts can sell the high quality compost and fertilizers. Locating centrally and visibly also helps to further the public's understanding about 'waste' and our place in the environment, which in turn has the potential to change people's habits around the production of waste, reducing future costs both economically and environmentally. Using environmental means to solving these urban issues can result in value-added economic and social gain.

In the interests of achieving and demonstrating value, the wastewater treatment plant

should be integrated into the community and act as a public resource. Through revealing selected elements of the machine and creating celebrated moments around elements associated with the benefits of wastewater treatment - district heat facility, biomass and biogas retention, compost, fertilizer, and reclaimed water - visitors to the site can appreciate benefits of processing waste. The recovered resources can, in turn, be used to activate public programmes on-site, creating public resources in the form of an urban park, a community centre, and public market. Through the edification and celebration of the wastewater treatment plant and the introduction of urban programme and public space, we can begin to ascribe tangible value to the process and the site.

How can wastewater treatment infrastructure be integrated into the urban landscape to increase urban efficiency, activate public space, and instill ecological understanding?

Collage - what might a public, urban, industrial ‘park’ look like?

CHAPTER 2: MOVING BEYOND SANITATION

> The city is a physical container of our culture and, as such, it is the expression of us. (Marshall 2001, 3)

Collage - a great deal of resources are applied to the infrastructure that transports waste from the city, the resultant lack of presence contributing to a reduction in our understanding of cities wastes and their effects on the environment.

Daily, the Capital Regional District of Victoria pumps 130 million litres of raw effluent into the Juan de Fuca Strait, interrupted only by a 1/4” screen. Because the outfall is well off-shore and currents off the tip of Vancouver Island are strong, this scheme has seldom exposed ill-effects to Victoria’s residents and there has been much debate about whether or not treatment is really necessary (Gordon 2014). Shockingly, this argument has remained unchallenged until 2006 when the Provincial government legally required Victoria to institute secondary-level or better treatment. Over the following ten years a suburban site was selected and a sealed-off treatment plant without connection to its neighbourhood was designed, only to be shot down by the community who, quite rightly, didn’t see the benefit of this huge industrial wastewater plant in their back yards (Meissner 2014).

The current need for sewage treatment in Victoria provides an opportunity to instigate a change in our perception of waste. Through investigation of the processes and products

of wastewater treatment we find that resources can be extracted to reduce our ecological footprint, and foster economic growth through the ecological and social design of community-integrated wastewater management.

Out Of Sight, Out of Mind

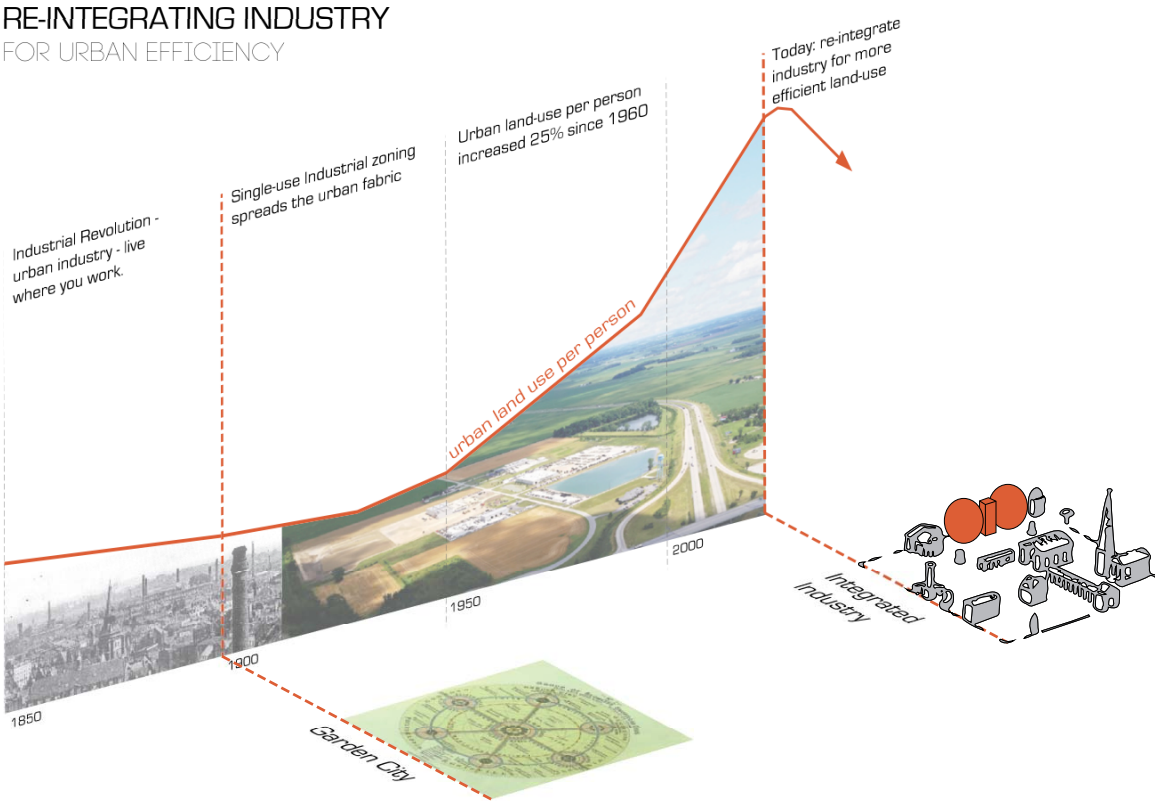
To understand the preconceptions surrounding sanitation it's helpful to look to its history. Before the nineteenth century London's sewage was stored in cesspits, but by the 1850s the sewer system, built originally for stormwater runoff, had been inundated with human wastes from the newly popularized water closet. The human waste, which had in the past been taken away by 'night-soil men' and used as fertilizer on nearby farms, was instead carried swiftly to a stinking River Thames - the source of London's drinking water. The metropolis's untreated waste infected the drinking water and gave rise to a series of massive Cholera Outbreaks that would help precipitate the Sanitation movement.

Based on the miasma theory prevalent at the time that disease was carried by airborne smells, the Sanitization movement relegated all forms of industry seen to be 'dirty' from the city. Early in the Industrial Revolution, industrial buildings were erected near the source of their raw materials, often designed as monuments to the innovative work they were now able to achieve (Ackerman 1991). The factories' airborne pollution, however, made it necessary to separate them from heavily habitated areas. Celebrated designer models like Ebeneezer Howard's Garden City (1898) and Corbusier's Radiant City (1924) used extensive buffers of green space to separate 'dirty industry' from the rest of the city, but these early ideals were borne in a time when energy was cheap, land was plentiful, and when we didn't have the technology to address the pollution of industry.

Contributing to the environmentally wasteful 'sanitization' of cities was a precedent set in a 1926 US court injunction prevented the development of an industrial block next to a residential neighbourhood and town centre (Mostafavi 2010, 334). This government-mandated zoning increased our reliance on car travel which, through a positive feedback loop, has allowed and industry to move further from the city and search out cheaper lands. The efficiency of the city decreases as a result of this planning practice through the disproportionate use of territory, energy, material, and infrastructure - both in construction and in maintenance. Taking the typical industrial park as an example: the boulevard and

the large parking lot are ‘beautified’ with a lawn and trees requiring irrigation while the rainwater from the sprawling roof and parking lot is carried away in a combined sewer; the oversized interior spaces require more material in construction as well as additional energy for lighting, heating, and cooling. The cost of our current understanding of ‘sanitation’ - that is to say hiding waste and city processes seen as unclean - is in fact compounding our waste with more waste.

> The suburban landscape is sterilized by ineffective use, (...) by restrictive zoning that inhibits human interaction and organic neighborhood evolution. (Hough 2004, 13)



The ‘sanitation’ that led to relocating industry outside the urban core has contributed to a great increase in urban land-waste. Urban-dwellers’ land-use has grown by over 25% per capita in the last 50 years (Berger 2006)

In addition to the environmental costs inherent in our current view of sanitation and separation, this perception and method of city-planning adversely affects the social qualities of suburban spaces and our understanding of environment. Vast tracts of land surrounding the urban core conceal single-purpose tenancies - industrial parks, business parks, waste-treatment plants - critical to the urban system but invisible unless sought out

specifically. These spaces are productive only in terms of their business and do nothing to foster a healthy ecology, a thriving community, or a source of public wealth. While the Sanitation Movement was originally well-intentioned to reduce disease, as we reach a period where we have the technology, as well as the impetus, to reduce our pressure on the environment, its current incarnation contributes to a critical lack of visibility, and hence understanding, of our environmental inefficiencies and waste. Operating outside of the public's perception, these city processes are an uncontested drain on our resources.

> Apart from the vast areas of inefficiently used land in city centres and urban fringes, there are enormous water, energy, and nutrient resources that are the by-products of urban drainage, sewage disposal, and other functions of city processes. Having no perceived value, those contribute instead to the pollution loads of an overstressed environment." (Hough 2004, 2)

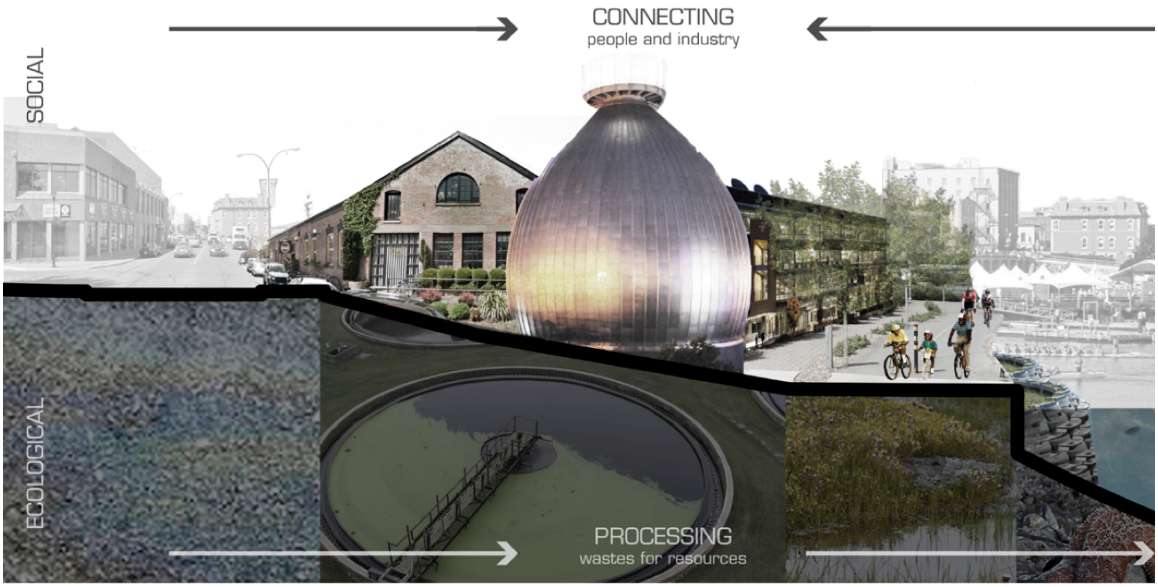
The impersonal entry to WestPoint Wastewater Treatment Plant (left), and Fosters' Fleetguard building (right): notable for its systems but, like most industrial buildings, serves only economic efficiency and adds no social or environmental value to its community (right).

Re-Evaluating Waste

> Nobody wonders where, each day, they carry their load of refuse. Outside the city, surely: but each year the city expands, and the street cleaners have to fall farther back. The bulk of the outflow increases and the piles rise higher, become stratified, extend over a wider perimeter. Imagine a future where immense amounts of trash didn't pile up on the peripheries of our cities. A future where we understand just as much about the 'removal chain' as we do about the 'supply chain'. (Mostafavi 2010, 168)

If we as a society are to succeed, we must move beyond our narrow view of sanitation to a mindset that comprehensively assesses environmental, cultural, social, and economic needs. Urban areas are ideally suited with their dense concentrations of people and inherent proximity to promote economic and environmental efficiencies and synergies. However, while it is generally felt that urban densities foster the greatest economies environmentally, suburban areas have the potential to contribute their unproductive and underused land to the purpose of decentralized ecological processes like stormwater

treatment. The application of didactic, edified, programmatically and culturally integrated wastewater treatment can help kindle public comprehension, acceptance and action towards a more environmentally sensitive society.



Urban treatment collage - connecting people to the industrial processes enabling city-life while processing waste to maintain healthy waterfront natural' ecologies.

The typical view that waste is an icky thing to be removed comes from a very pragmatic logic that has helped protect us from disease. But as our as our society grows, consumes more resources and produces more waste, we must begin to apply our developing sciences to understanding our place in the larger environment. When we hide from public view the waste and the pollutants, we conceal with them their effects on the environment. Through the lens of systems we can begin to see how, with current technology and knowledge, we can safely re-centralize many industries, utilizing what is currently understood only as 'waste' as a resource to bring us closer to economic, environmental, and cultural sustainability.

In his book, Tim Ingold refers to contrasting world-views: one view involves dwelling within the environment and another that involves building upon it (2000, 42). The 'building perspective' describes the predominant 'western' world-view, dangerously misguided in that it presents human and natural systems as distinct and autonomous. With evidence piling up around climate change and resource depletion we must graduate to what Ingold labels the 'dwelling perspective' - that all human systems exist *within* the closed system

that is our planet. This conceptual framework differs only abstractly but the results of its application are far-ranging and impactful: when it comes to ‘waste’ as David Suzuki so succinctly puts it, “On our finite planet there is no ‘away’”. (Higgs 2012, 1)

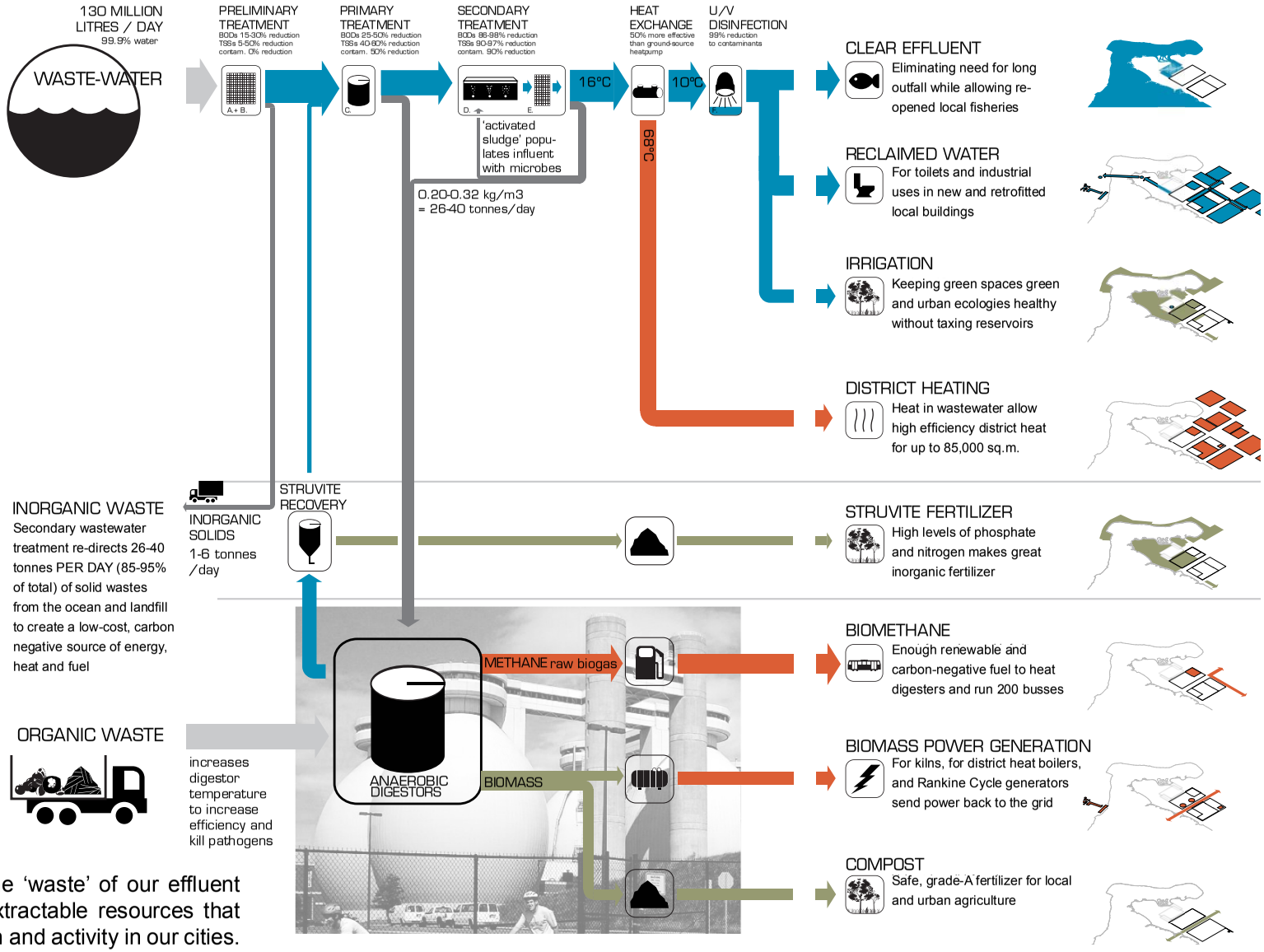
Following the flow of water in Victoria is indicative of the distinction between these views. Evaporation and transpiration produce clouds which in turn precipitate the water that sustains a plethora of ecosystems, eventually finding its way to the rivers that fill the reservoirs that fuel our urban lifestyle. The lack of public knowledge around what happens to that water after it drops down the gutter or drain is indicative of our ‘building perspective’: it’s taken through an underground sewer to a plant somewhere out of town: away. In the case of Victoria’s sewage, it flows to an outflow where a 1/4” screen removes approximately 650 tonnes annually of plastic bags, paper towels and grit that are shipped the dump. The remaining 90% of the solids suspended in our waste-water continue on with the liquid ‘effluent’ to an outfall where it is released 60m under-water, a kilometre off-shore. The plume of waste serves as nutrients for a variety of microorganisms that block life-sustaining light from reaching below the surface in a process known as eutrophication and releases human pathogens and pharmaceuticals into the sea (Higgs 2012). The only perceived impacts to most people is that local fish and shellfish in this area unsafe to eat, and occasionally beaches are closed to swimming.

The depth and distance to the outfall hides the ill-effects of our untreated sewage in all but occasional situations. (Base map from http://www.d-maps.com/carte.php?num_car=15116&lang=en 2016)

To retain our quality of life while populations increase and resources dwindle, we must begin to affect our perception and understanding of waste, replacing its current definition as ‘the remainder’ with what it really is: the component resources that fuel another system or ecology. In the case of our sewage, a series of processes involving anaerobic and aerobic digestion allow microorganisms to break down the organic materials. Enacting secondary treatment to remove the suspended solids (which make up 90% of the total solids in effluent) yields what is called ‘sludge’ which, once digested by a population of microbes at an elevated temperature in the dramatic egg-shaped-digesters, yields ‘biosolids’. These can be used by local farmers as chemical- and pathogen-free, fully natural, grade A compost. Once dried, biosolids can also be gasified in ‘Rankine Cycle’ combustion chambers to produce electricity. The solids are a great source of methane gas, a powerful ozone-depleter that if not captured would be released into the atmosphere; the energy we recover from methane is actually carbon negative, as it converts it to the relatively benign carbon dioxide. Once captured and cleaned it can be used in city busses, food trucks, stoves, and anything that uses natural gas. The disinfected effluent is safe for human contact, can be used as grey water for toilets and nearby industrial processes, and for the irrigation for urban green spaces. Excess water is of sufficient clarity and quality that it can be exposed in open de-nitrification ponds and released safely to the sensitive aquatic ecosystem of the inner harbour (MacQueen 2013).

> If one of the legacies of modern town planning is the invisible efficiency of the hygienic infrastructure, perhaps, as ecological concerns permeate the consciousness of urban dwellers, it is both psychologically and physically necessary to make urban support structures more tangible and visible. (Brown and Storey 1994, 22)

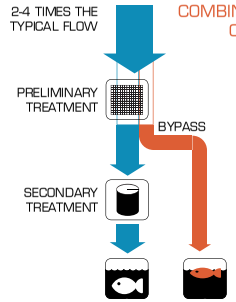
Collage - Wastewater treatment in the city.

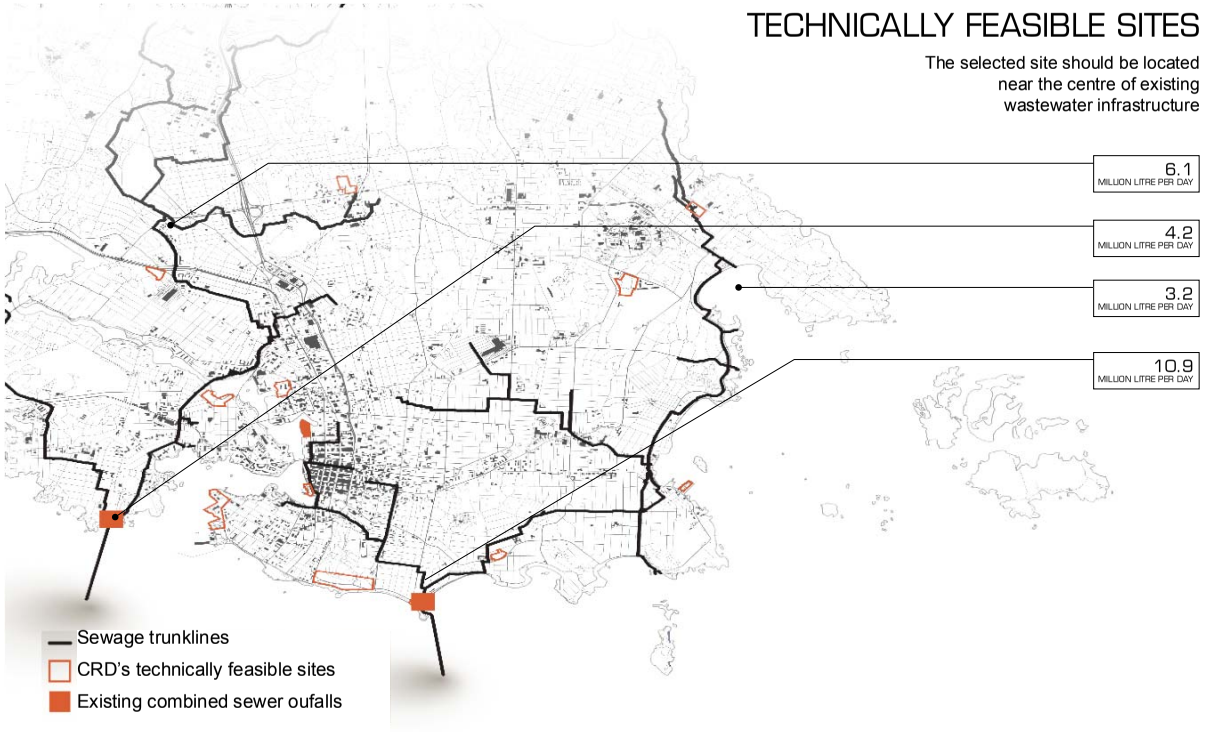


Nested within the 'waste' of our effluent is a series of extractable resources that could fuel growth and activity in our cities.

EXISTING COMBINED SYSTEM

Existing combined system prone to failure during heavy rains. resulting in untreated effluent (waste AND storm).





TECHNICALLY FEASIBLE SITES

The selected site should be located near the centre of existing wastewater infrastructure

6.1 MILLION LITRE PER DAY

4.2 MILLION LITRE PER DAY

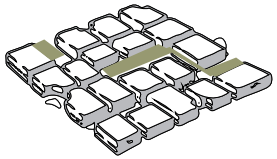
3.2 MILLION LITRE PER DAY

10.9 MILLION LITRE PER DAY

Separate storm-water from the combined system to reduce 'combined sewer overflows'. The wastewater treatment site should then be selected out of CRD's technically feasible sites to be central to the incoming sewer infrastructure.

FUNCTIONAL 'INBETWEENS'

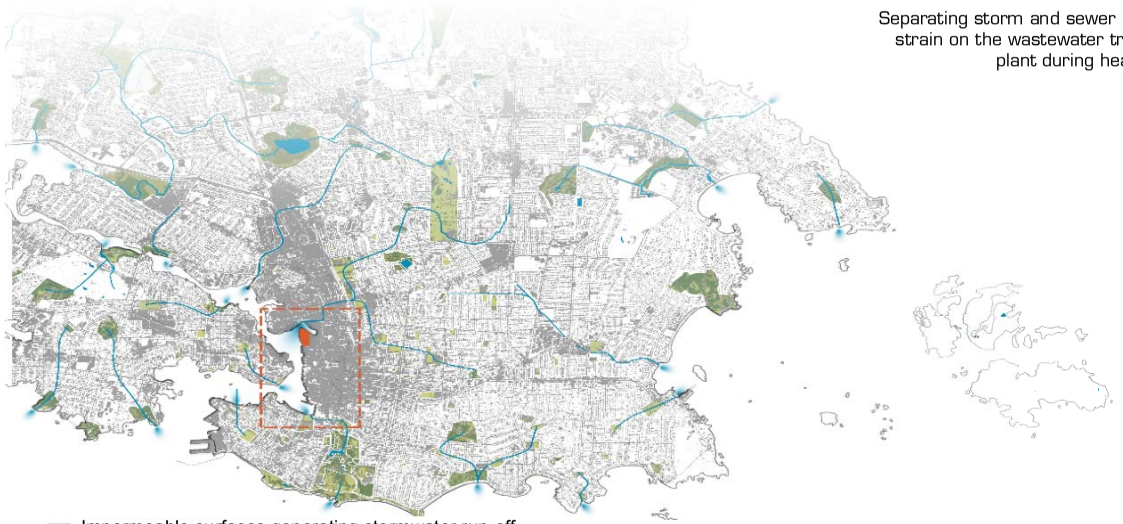
City for social and economic purposes, waste shipped out of sight



Re-exposing and re-connecting historic watercourses with natural reed-bed treatment in public greenspaces

DECENTRALIZED STORMWATER

Separating storm and sewer removes strain on the wastewater treatment plant during heavy rains



Impermeable surfaces generating stormwater run-off

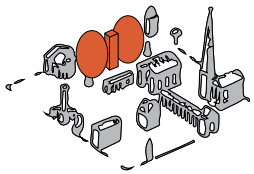
Watersheds re-connected with greenspaces treating storm-water

Naurral stormwater treatment reduces loading on wastewater treatment plant

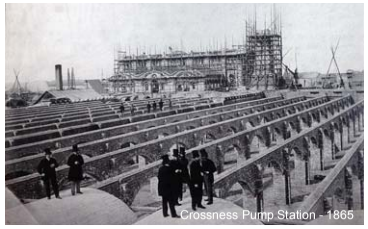
Reconnect historic watersheds with stormwater-treating green spaces. Boulevards, yards, and parks can be dual-programme, environmentally productive places while still housing park-functions.

CELEBRATED INFRASTRUCTURE

Wastewater Treatment Plant as 'Res Publica', forming public space and community hub

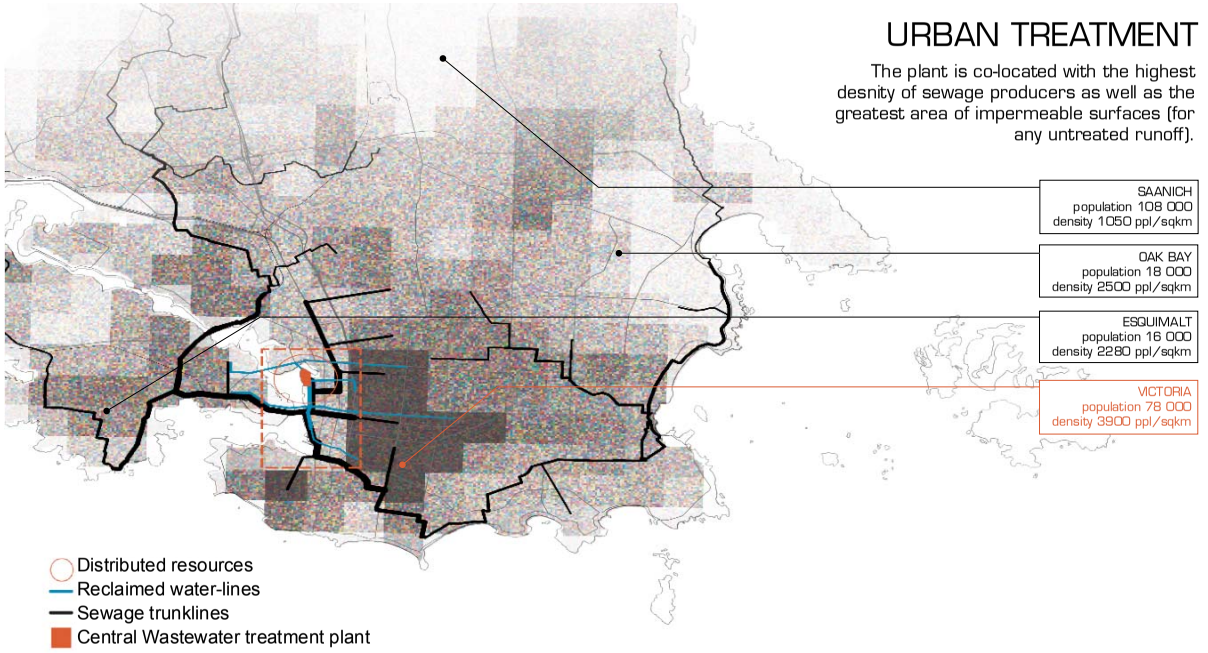


Only with the economies of scale does resource recovery from wastewater become viable



URBAN TREATMENT

The plant is co-located with the highest desnity of sewage producers as well as the greatest area of impermeable surfaces (for any untreated runoff).



Wastewater treatment should be enacted near its greatest source. This also affords the greatest return on recovered resources and yields the greatest potential for public use of this piece of celebrated infrastructure.

CHAPTER 3: URBAN SYSTEMS AND PUBLIC SPACE

> The ‘Regenerative Network’ is a new model for infrastructure development. This model increases efficiency and adds functions to the facility that benefit the local community. (Singer 2006, 12)

Public space acts in the benefit of the surrounding community, hosting amenities that foster growth. It provides a place for the social functions of gathering, recreation, and socialization, but typically does so at an economic and environmental cost: water is pumped in for irrigation, electricity for lighting, and waste is trucked or pumped away. It is proposed here that the urban systems of wastewater infrastructure be paired public space to improve efficiency while enhancing social functions. Introduction of stormwater-treating bioswales to parks helps reduce loading on the wastewater treatment facilities while creating attractive water features. Public space and programme is then integrated into civic infrastructural sites, creating a community resource that promotes both neighbourhood growht and infrastructural transparency. Rather than being forced into the periphery of our cities (and understanding), this pairing returns these spaces to the city as a urban resources that increase the clarity of city systems.

Wastewater Systems

Pairing wastewater treatment infrastructure with public space yields the potential for increased efficiencies in Victoria’s storm and sewer systems. Victoria’s wastewater infrastructure is, for the majority, a combined system that combines sewage and stormwater in a single pipe. In this system, the less harmful stormwater consumes the capacity of the wastewater treatment plant resulting Combined Sewer Overflows (CSOs) during heavy rainfalls. These events can be minimized by preventing the relatively benign stormwater from entering the sewer, instead using bio-swales in urban green spaces to treat stormwater. The separation of stormwater infrastructure could be phased over time to free the capacity of the wastewater treatment plant as the population grows.

With ample space that is programmatically and ecologically unscripted, better utilization of suburban ‘in-between’ spaces is critical to the efficient environmental functioning of the city (Berger 2006). The conglomerated area of urban parks, boulevards and medians can be converted from environmental drains to ecological machines through the integration of biological stormwater treatment swales and ponds. Re-exposing and re-connecting

historic watersheds where possible, these urban parks can perform ecological and environmental functions in tandem with the public programme they already house, the bio-swales forming attractive water features. Because of its low levels of toxins, stormwater treatment can safely take place in the open and, with the opportunity to reclaim it as grey-water, parks could benefit from locally sourced irrigation and public facilities. Separating stormwater from sewer infrastructure is a no-brainer that reduces the stresses on the more expensive central treatment, while creating attractive water-features in parks with reclaimed amenities reducing the city's reliance on its taxed reservoirs.

The reclamation and use of stormwater has additional benefits beyond reducing material and energy use of conveyance and industrial treatment, however. While the Pacific Northwest has historically enjoyed plentiful fresh water, in recent years climate change has been affecting our water resources, resulting in watering restrictions and, less noted, low water-levels in streams and rivers, which greatly reduces their capacity for spawning salmon and other aquatic life. Reclamation and use of wastewater reduces our reliance on reservoirs that interrupt natural lake-and-stream ecologies, reducing the diameter of affected land around the city.

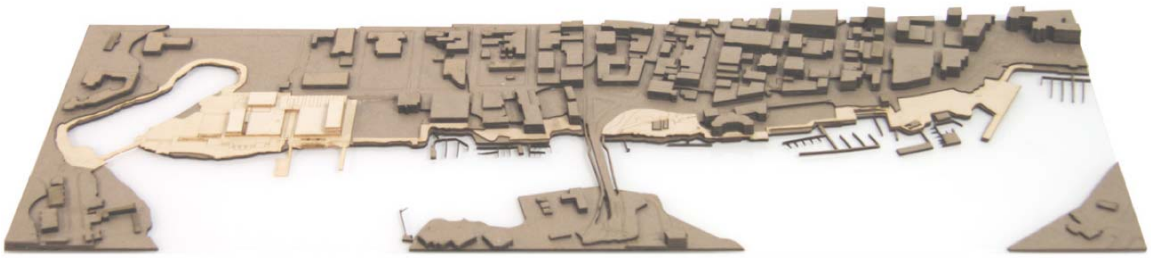
Natural wastewater treatment, as in Arcata above (Evans 2016), is land-intensive and works well in areas with low population densities.

Continuing to intensify productive ecological processes in green spaces, in rural areas septic systems and treatment marshes can be used to treat sewage naturally. These open treatment methods reduce the economic and environmental costs of conveyance infrastructure and minimize loading on the centrally processing system while helping to replenishing ground-water and soil nutrients. Small townships and some very rural

municipalities with sufficient space may be well suited to such natural sewage treatment methods.

Conversely, in the urban context, high population density and land-cost make open treatment methods infeasible; in these cases locating centrally is beneficial on a few levels. For the sake of minimizing the system's conveyance needs to reduce capital and ongoing expenditures (both financially and environmentally), it is best to co-locate sewage treatment with the greatest density of sewage production and stormwater runoff. The urban centre's high population density and high percentage of impermeable paving make it the greatest producer of wastewater. Secondly, resource recovery from wastewater is only financially feasible with the economies of scale, and the benefits of those resources (particularly district heat) can in turn reach a greater audience in a densely packed community. Most Importantly though: a public, central plant, with clear and visible synergies that link public programme to resources recovered from our waste, can begin to question and transform people's understanding of industry, and of waste.

> Waste : <noun> An action or use that results in the unnecessary loss of something valuable. (Merriam-Webster Online 2016)



A wastewater treatment plant at Rock Bay with integrated public space can connect to the downtown along an extended and rehabilitated sea-wall.

An Urban Industrial Resource

The wastewater treatment plant has the potential to form a public space activating the growth of the Rock Bay area and, through the application of recovered resources and the provision of public programme and outdoor space, it can integrate as an active part of the community. The city-owned site on Rock Bay is an underused industrial brownfield housing a small cement plant and is surrounded by light commercial and industrial. This area lacks the density of public amenities needed to maintain a lively neighbourhood, and introducing public space and programme with the treatment plant has the power to draw

in and connect to the vibrancy and life of the downtown core. Creating a node through the reclamation and use of recovered resources generates activity and vitality in a under-used part of down town while breaking down preconceptions on how we should treat industrial and waste infrastructure.

The plant, a sizeable industrial occupancy that would typically be closed from visitors, has the potential to instead be a public space that extends and enhances the harbour-front walk. According to Berger (2006), “post-World War II sentiment against ‘dirty industries’ in favour of ‘clean’ businesses such as offices, banks, and brokerages led to public policy that also catalyzed urban industrial attrition” (47). Reverting the status quo and integrating this piece of industrial infrasturcture into the city could begin to break down that preconception. While the inclusion of park and civic programmes can help bring new life and vitality to an area that currently houses more parking lots than people, it also has the potential to help remove the social and urban stigmas placed on industry and waste. Pairing wastewater treatment with public programme sets up a precedent demonstrating industry and people can co-exist in healthy, industrial mixed-used neighbourhoods. In the interests of urban efficiency, as well as the quality of space in industrial areas, it would serve us well to break down this sentiment.

The site, an industrial brownfield, from across the bay on Bay Street shows the loosely packed nature of the site and the back of the 1892 Powerhouse Building (with the chimney).

PUBLIC SPACE
IN THE CITY

CIVIC BUILDINGS
PUBLIC GROUNDFLOOR
PRIVATE GROUNDFLOOR
PUBLIC OUTDOOR SPACE

Create a public outdoor space and integrate civic space to develop and improve the personability of the industrial area on the edge of downtown. Attempt to induce a change towards ‘public industry’.

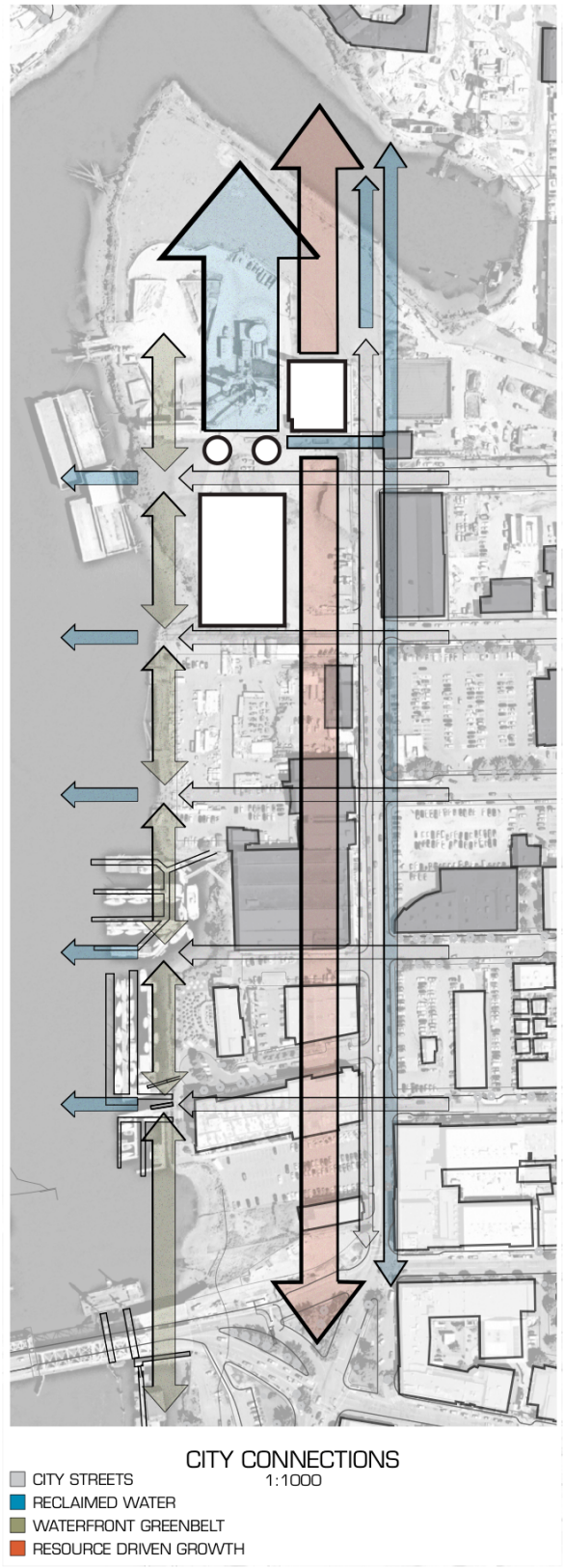
Rock Bay

Capital Iron
+ Parking

Bastion
Square

Empress
Hotel

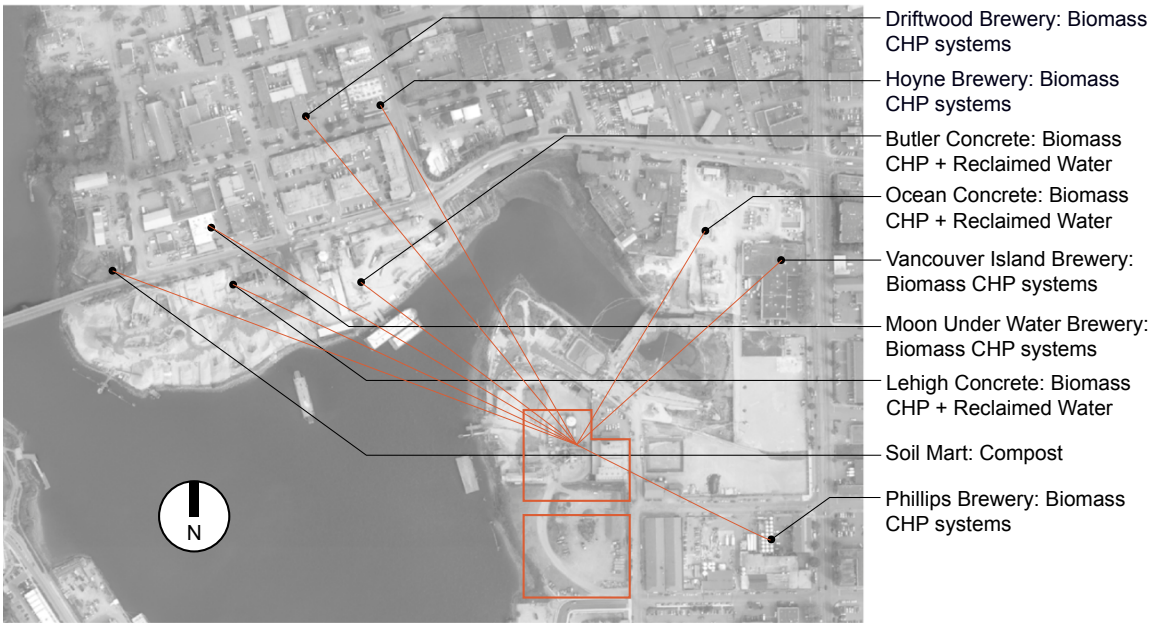
Context images extending from the proposed site (1) southward into the tourist core of downtown (4). Public amenities and civic space help to foster vibrancy and density, and their introduction to the Rock Bay site could amplify and extend the downtown.



The city is connected to the harbour with bio-swale infrastructure treating run-off from city streets. Industry is connected to the urban context through synergies of recovered resources, and people are connected to nature along a rehabilitated and extended waterfront walk.

Through the distribution of recovered resources to fuel neighbourhood growth, the wastewater treatment plant can act as a model for the effective application of urban waste-to-resource systems. Compost, fertilizer, and reclaimed water green the urban park and sea-wall. Biofuels collected from the solids digesters can be used to fuel city transit and a congregation of food trucks on-site. Through biomass boilers and potential energy harvested from the affluent via heat exchangers, district heat could greatly reduce heating costs and energy use on-site and in nearby new or retrofitted buildings. A reclaimed water tower on-site provides potential for the use of grey water in nearby developments. Grade A compost could be sold at the nearby soil mart. Highly efficient 'combined heat and power' (CHP) systems use biomass to supply up to 80% of the steam and energy needs (Greer 2016) for the five nearby breweries. Two local cement plants could use the same CHP systems in their kilns with reclaimed water in the cement mix. Once waste is re-evaluated for its constituent resources it can be revealed for its economic and environmental gains.

A waste treatment plant need not be a walled-off compound, a closed metal box around which there is no space for people. By applying the same place-making logic we use in the development of any other building, we can begin to re-imagine how industrial occupancies can make space for people and integrate into a neighbourhood. Resources hidden in what was formerly perceived only as 'waste' can be exposed and reclaimed to environmentally and economically entrench this industrial infrastructure into place.



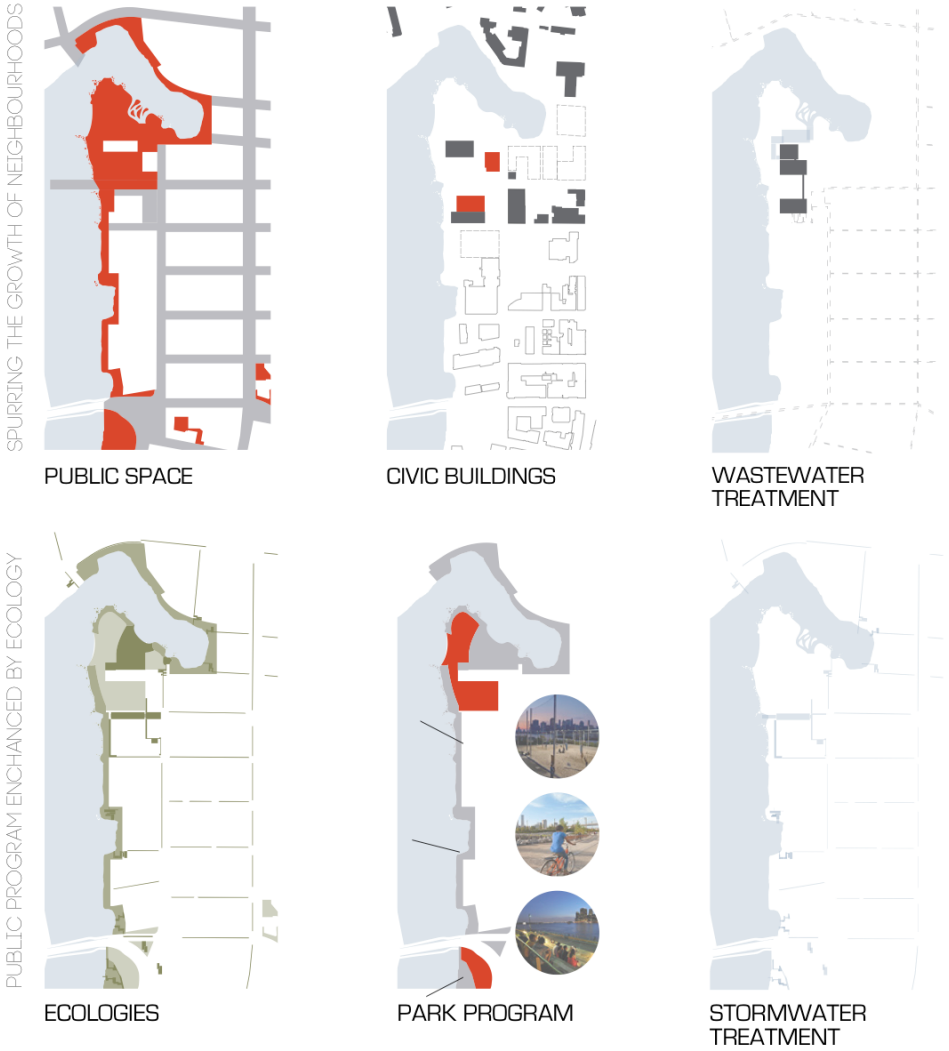
Recovered resources have the potential to fuel much of the energy and some of the material needs of nearby businesses

Collage - stormwater is treated in urban bioswales as a park feature, while human systems give way to natural ecosystems along the water's edge.

Urban Ecologies and Public Space

> Sewage disposal systems are seen as an engineering rather than a biological solution to the ultimate larger problem of eutrophication of water bodies and wasted resources. We have the paradox of the city as the centre for enormous concentration of nutrient energy, while urban soils remain sterile and non-productive. (Hough 2004, 9)

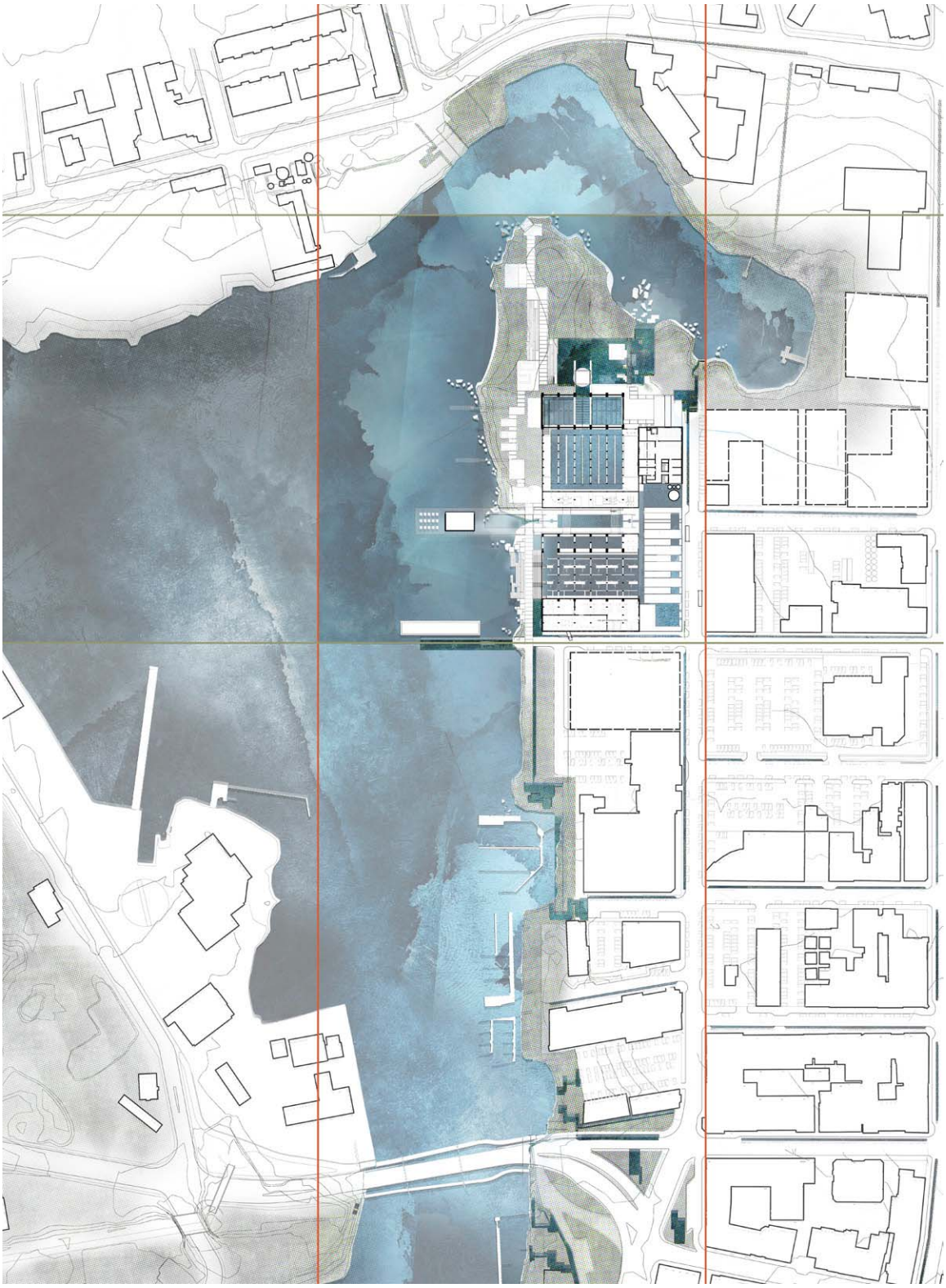
Pairing ecological infrastructure and public spaces increases the efficiency of the urban system while making visible the natural and industrial processes our cities rely on. Making use of urban parks, boulevards and other green spaces for the treatment of stormwater begins this pairing and it is carried through in a larger form at the wastewater treatment plant. The presence and visibility of these places yields the potential to educate residents and visitors alike about city systems and urban ecologies through didactic design.



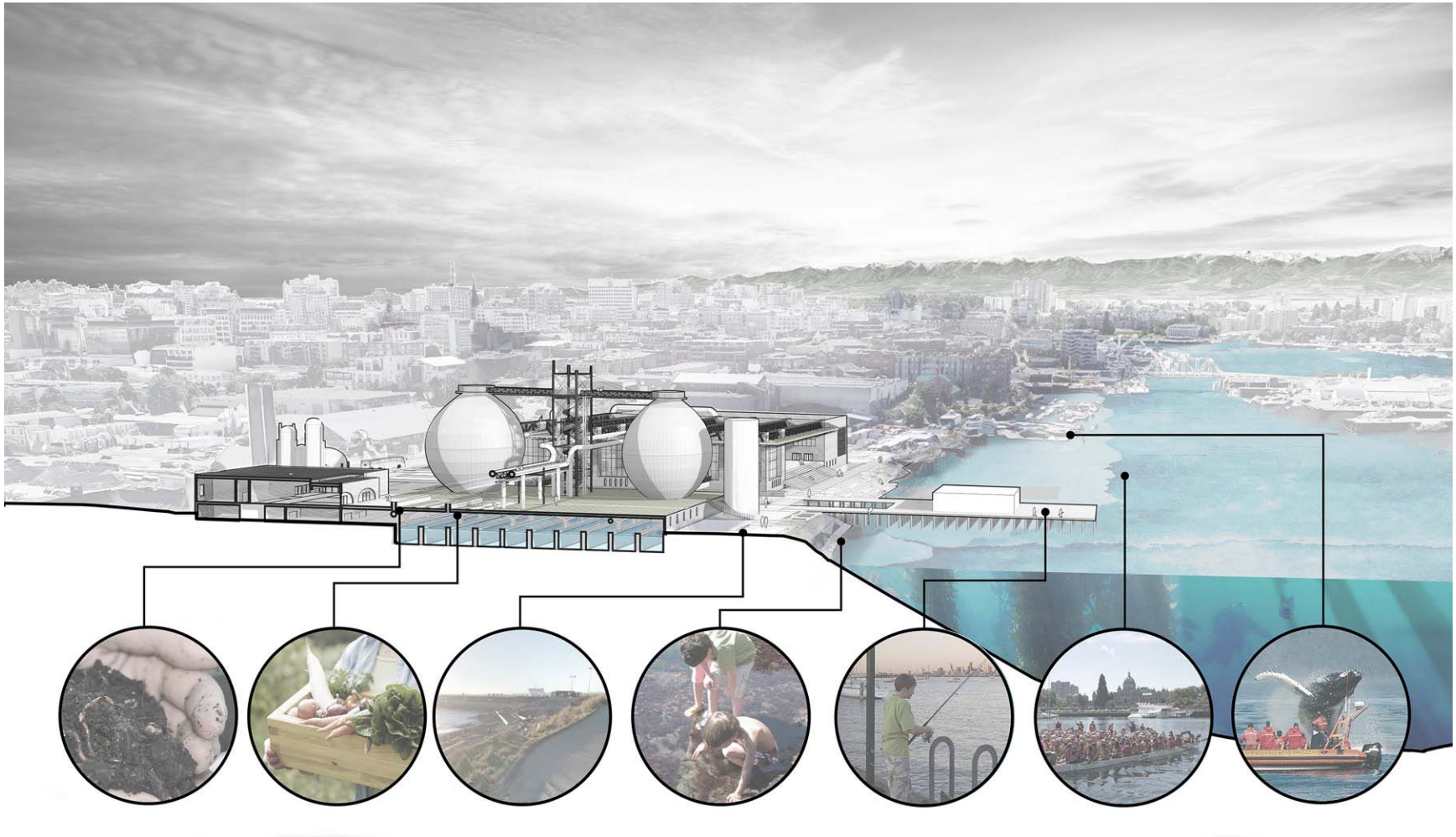
The wastewater treatment plant can be re-imagined as a civic building paired and paired with public space to instigate the growth of an industrial mixed-use neighbourhood, while public outdoor space and park programs are put to work ecologically treating stormwater and supporting recreation.

Stormwater treatment and conveyance is lifted above-ground with boulevard bio-swales capping each street as it approaches the water. Runoff from nearby non-porous surfaces is collected and treated before entering the harbour, performing a necessary task while amplifying park functions through their design as water features. In addition to helping to remove contaminants before the runoff is released into the harbour and promoting a healthy riparian ecology along the downtown waterfront, they do so on land that previously required additional servicing (light, irrigation, etc). In select locations the treated water could be reclaimed and used for irrigation of the surrounding green space, for adjacent buildings' grey water use, or for new public toilets. This system sets up a pairing that uses public green spaces to perform infrastructural work, which in turn benefits the public programmes therein.v

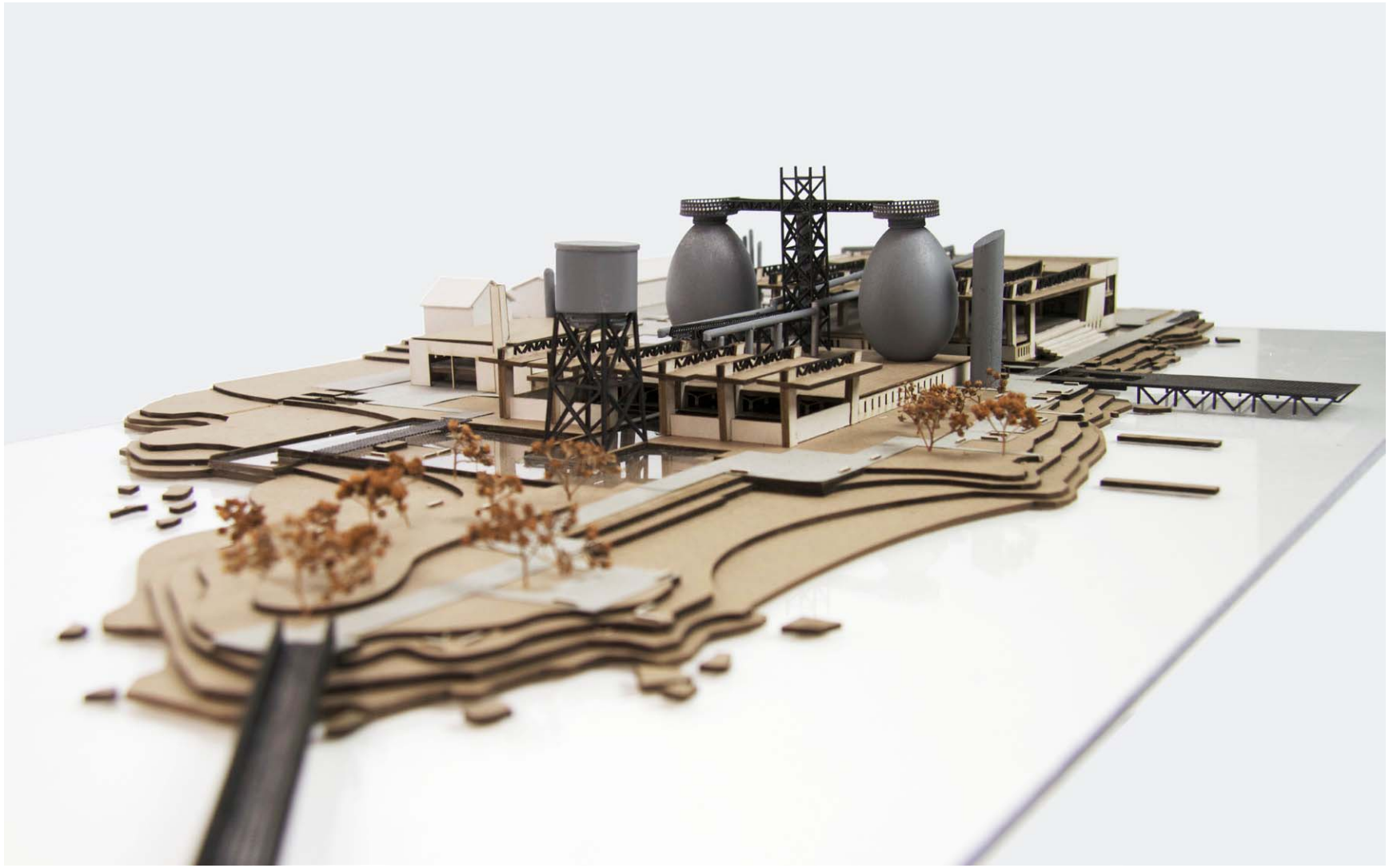
Through the efforts of treating stormwater and wastewater, as well as through the sensitive design of parks and riparian edges, the marine ecologies of the harbour are given a chance to thrive. Victoria's waterfront is home to a billion-dollar-per-year tourist industry, and if we are to maintain this resource it's necessary to prevent pollution from degrading its integrity. Ensuring water entering the harbour has been cleansed of the unnaturally high concentrations of certain components tied to dense populations of humans allows normal marine ecosystems to thrive. In addition to keeping the harbour safe for swimming, kayaking and dragon-boating, the clean waters mean that urban fishing and shell-fishing are once again possible. Healthy riparian / inter-tidal zones activate the waterfront with crabs and other creatures that indicate our connection to the surrounding environment and remind us that our waste is their food.



The city's connection to the harbour is tightened by pairing public space and water treatment. Increased porous surfaces reduce runoff and bio-swales cap each cross-street, to absorb and treat stormwater. The central treatment plant invites people in to see the work it does to keep marine ecosystems thriving.



A large-scale ecologically didactic, public outdoor space extends the urban seawall northwards past the bridge and into a typically industrial neighbourhood, activated by the strong marine ecologies it promotes.

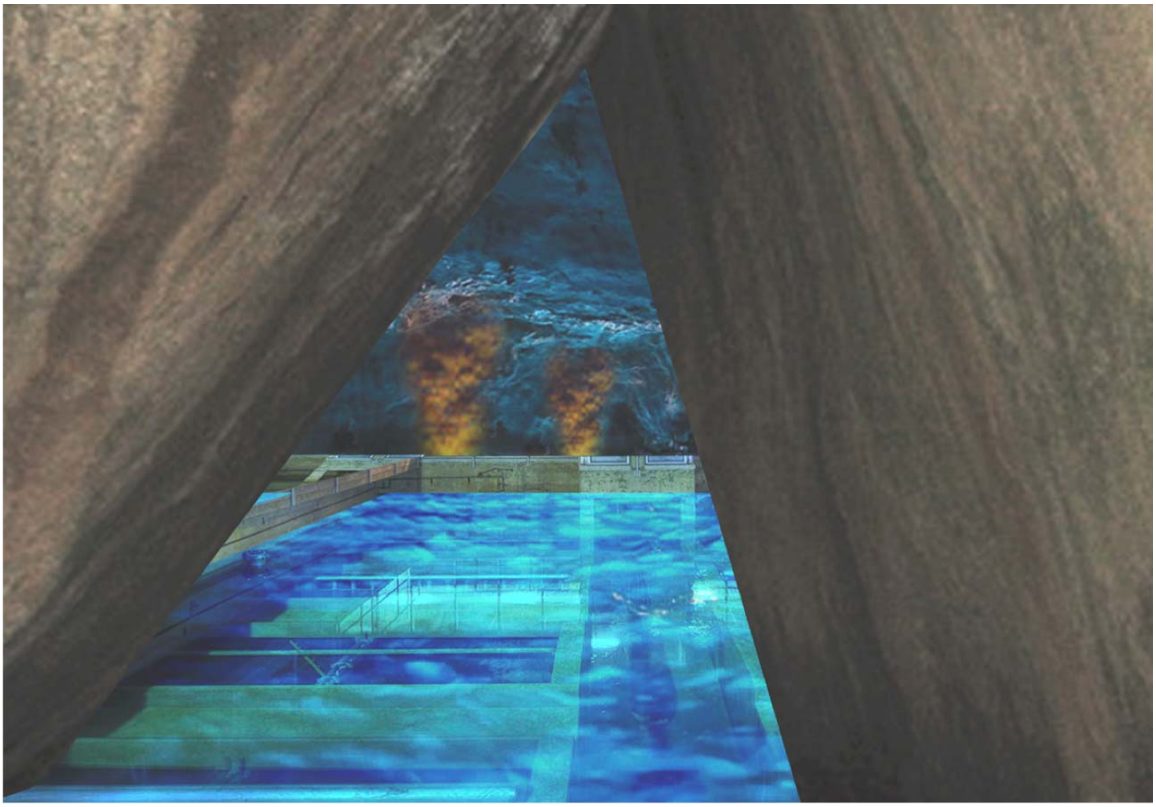


The wastewater treatment plant at Rock Bay has the potential to create a strong connection to downtown through the provision of an urban park on Rock Bay that connects along an extended public harbour-front.

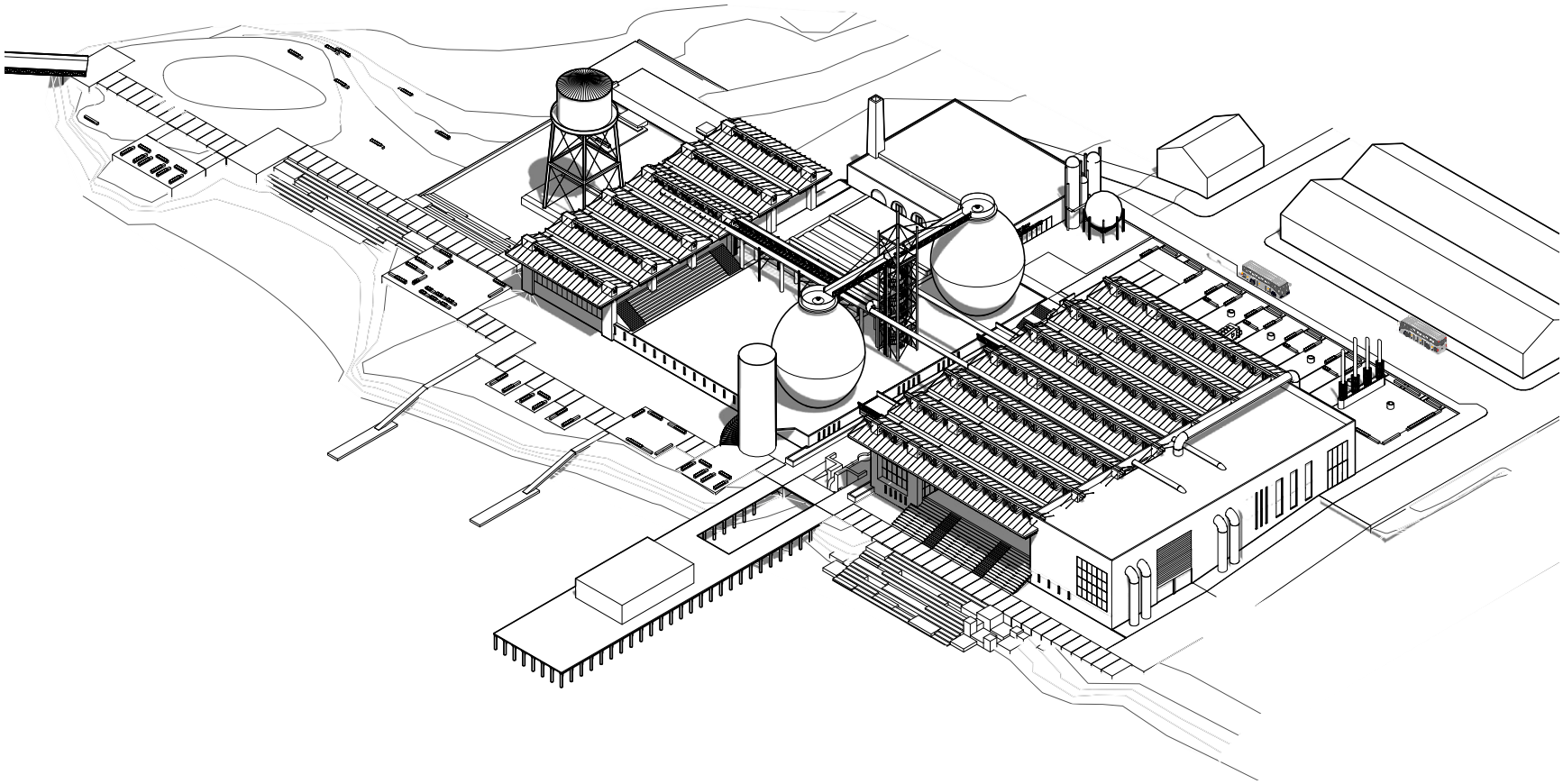
CHAPTER 4: SOCIAL RESOURCES AND A NEW PERSPECTIVE

> In the interests of ecological, economic, cultural, and social sustainability, any new discussion about industrial construction must first and foremost concern itself with formulating a new consensus, whereby industry will work in harmony with the society. (Ackerman 1991, 43)

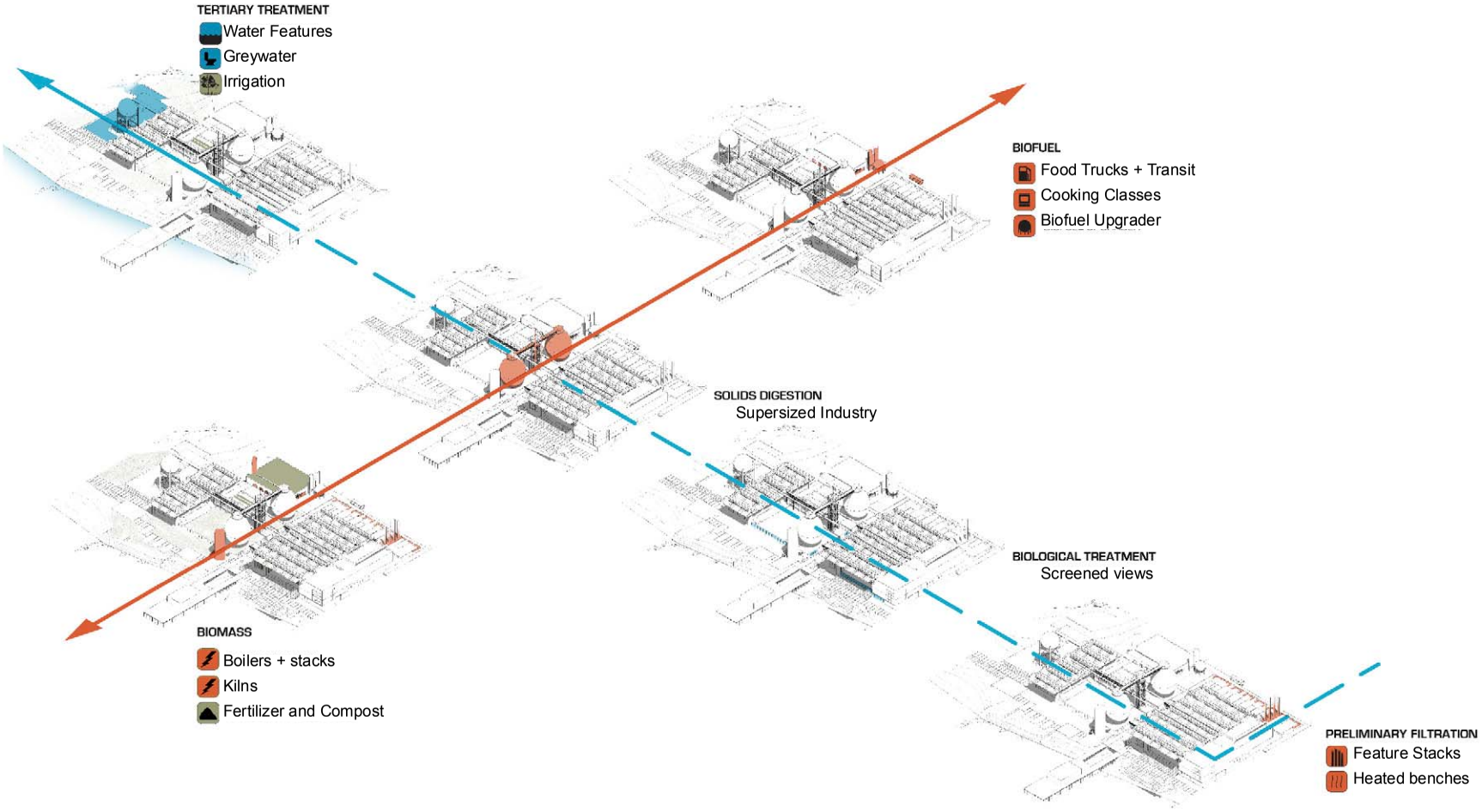
The architectural discourse on industrial buildings through most of the last century has had nothing to do with their context. Put another way, they are ‘sanitized’ out of the city and designed with a single minded functionalism, placing their values in economy and, in select architecturally distinct examples, innovative structural and mechanical systems. Few, if any, are remarkable for their place-making, their environmental, or social imperatives. The wastewater treatment plant provides the opportunity to create a public place and serve as a precedent for industrial programmes fitting into a vibrant, mixed-use community. Through the resources recovered from the wastewater’s treatment, synergies with other industrial, commercial, and residential occupancies can serve to induce sustainable growth. With public programme bringing people to the site, didactic design principles can be used to educate and inform visitors about the process, its benefits and our cities’ urban ecology as a whole.



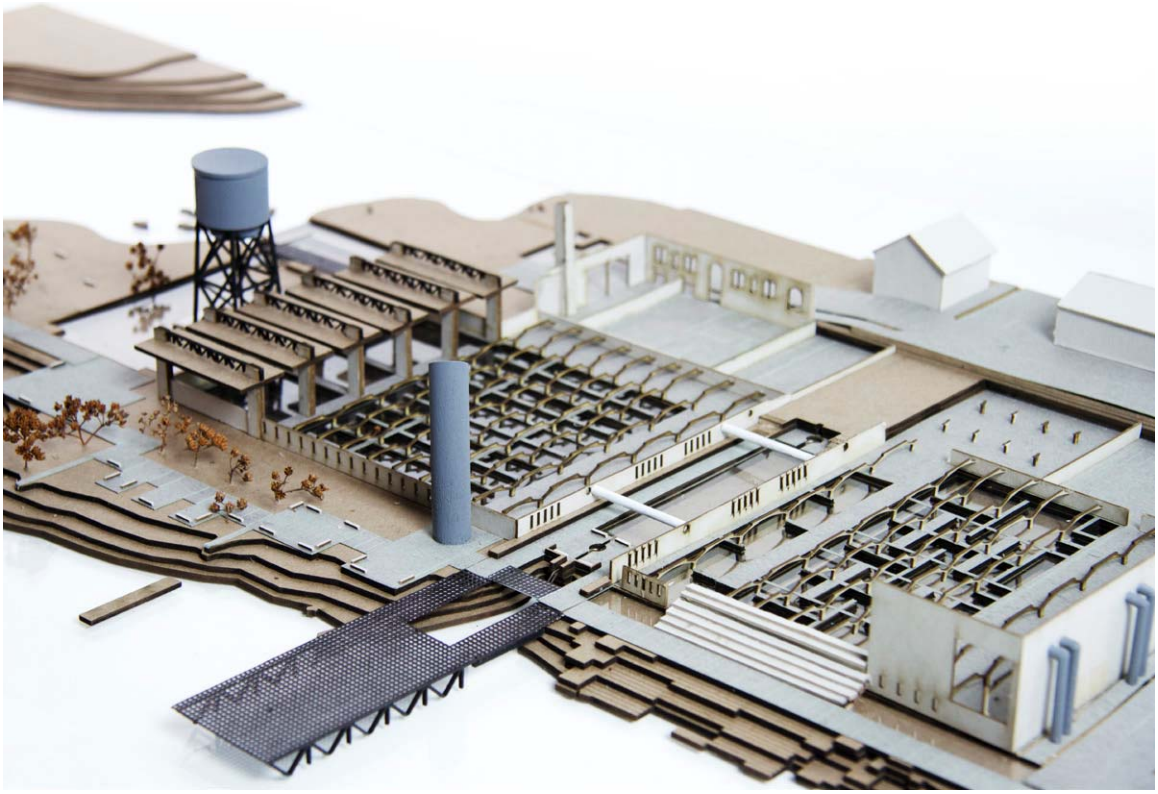
Collage - the wastewater treatment plant coudl provide a glimpse into the typically hidden processes



The civic machine, connecting to the city and to the water while extending the the public realm along Store Street and the waterfront walk.



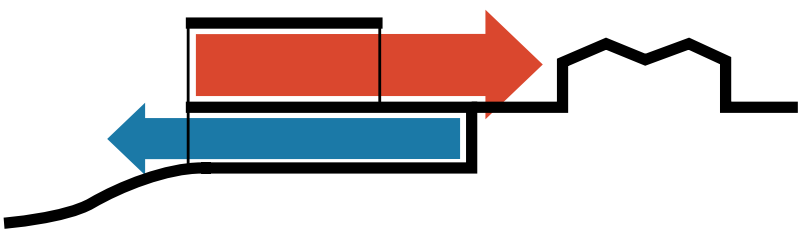
Wastewater enters the plant under the urban square at the Southeast corner and makes its way North through primary and secondary treatment being released from the disinfection stage into an open tertiary treatment pond at the north edge of the site before being reclaimed or released into Rock Bay. Solids are collected and digested centrally on-site and distributed East and West to the city and docks. Areas are highlighted that indicate aspects of the process or products.



Glimpses from the waterfront walk reveal the massive scale of the treatment spaces.

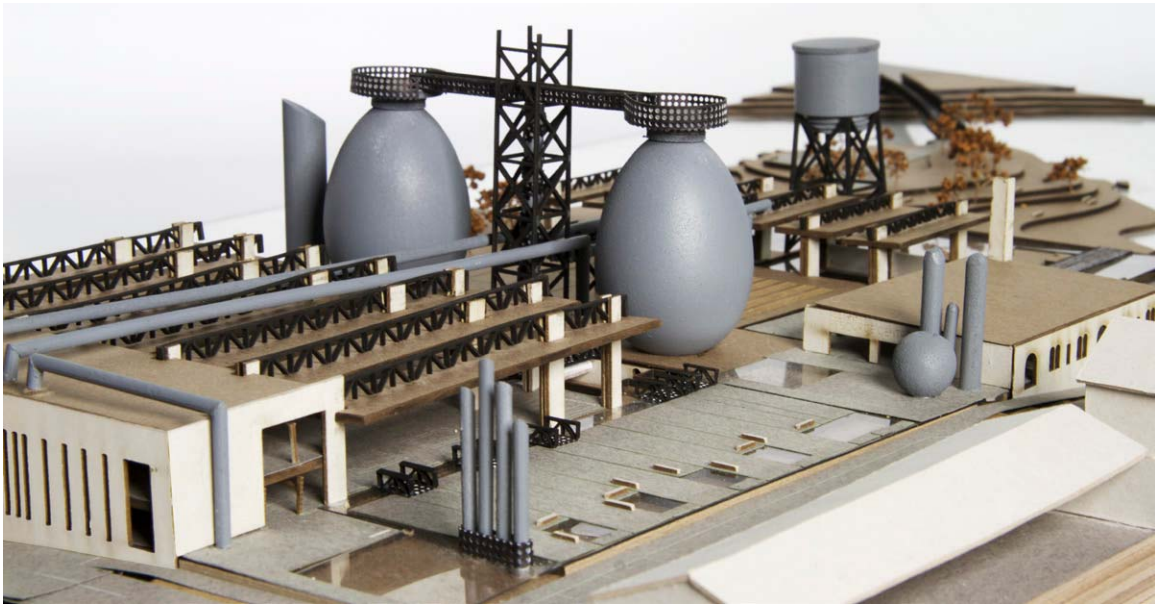
Understanding the Machine

A basic understanding of the sewage-treatment process is achieved in varying degrees of directness. Through much of the process, the qualities of the subject is not particularly appealing, and entirely revealing it would be, while informative, unpleasant. To avoid this, secondary indicators of the process and selective glimpses are key: some elements of the machine protrude into public areas; exposed duct and pipe runs allow connections to be drawn; and screened views reveal a sense of purpose without exposing distasteful content. The supersized scale the industrial machinery is celebrated, using its drama and intensity to bring a sense of excitement to the experience of the process as a whole.



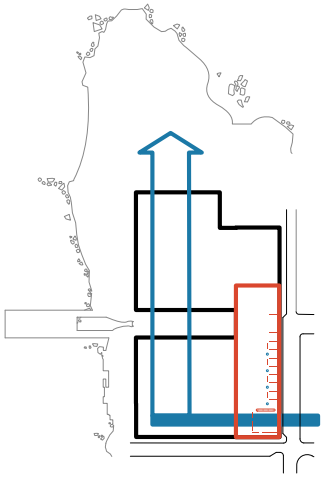
Treatment functions are located on the lower level and focused towards the waterfront, while the upper level houses public programme to address the street

The bulk of the treatment spaces are located on the lower level, forging a connection to the urban sea wall while freeing the street-level for public programme. Facing the bulk of the systems treatment towards the water's edge brings focus to the divising line formed by the plant, which acts as a filter that screens and recycles waste from the city on one side to protect the urban harbour on the other.

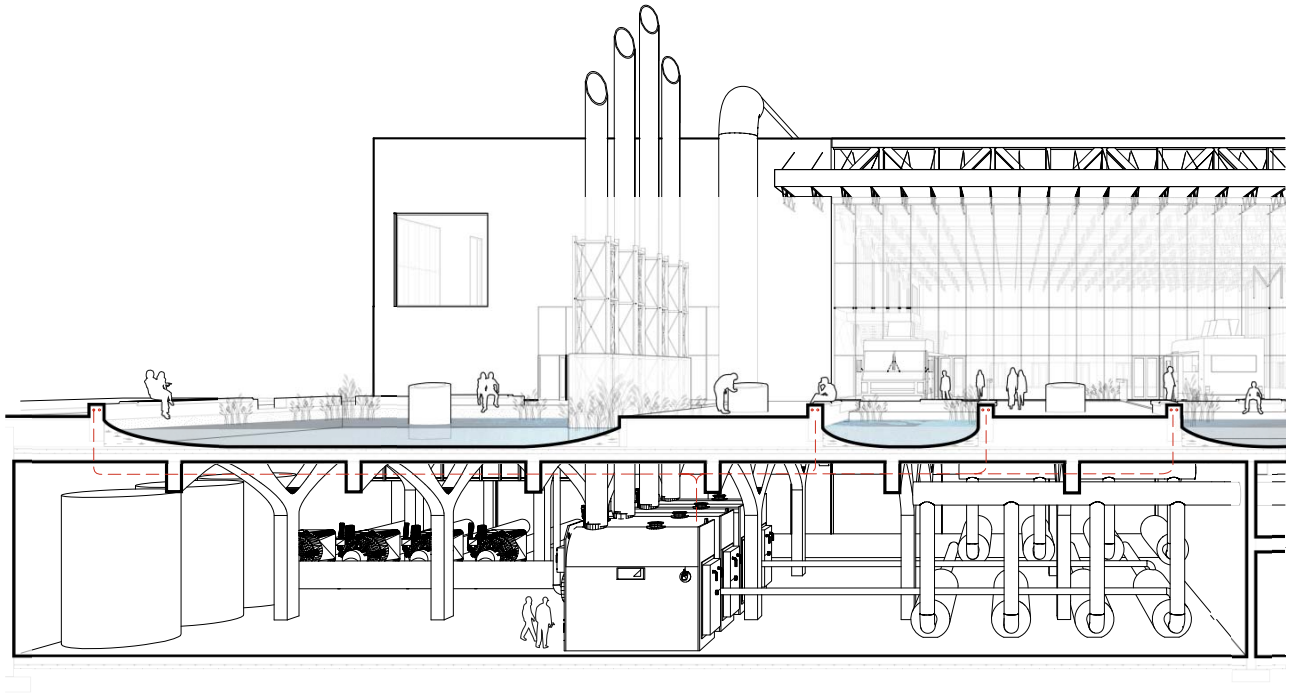


Preliminary treatment and the district heating plant populate the square and southern portion of the building with machinery indicative of their processes and products

The wastewater treatment process begins underground with grit separation chambers and preliminary screening - processes that don't lend themselves to direct observation. The function of these phases, therefor, are understood by means of carefully selecting views, and by direct connections to protruding elements of the machine. Focusing on recovered resources, skylights provide framed views down from the urban square to the headworks pumps, wastewater heat exchangers, and biomass boilers that form the district heating plant. Reinforcing the perception of the heating plant, benches in the urban square are heated in the winter, and most visibly, architecturally lit feature exhaust stacks protrude up through a feature stormwater swale into the public square. These act as a point of interest to draw people up Store Street while framing the southern edge of the square. Massive ducts connect the heating plant to the solid southern portion of the building that houses the ventilation and odour control systems, where very large grilles are integrated into the masonry cladding indicating the shear quantity of air being pulled through the machine at any given time. The focus at this stage remains on the pumps, pipes, heat exchangers and chimneys that return heat to the city from the incoming wastewater.

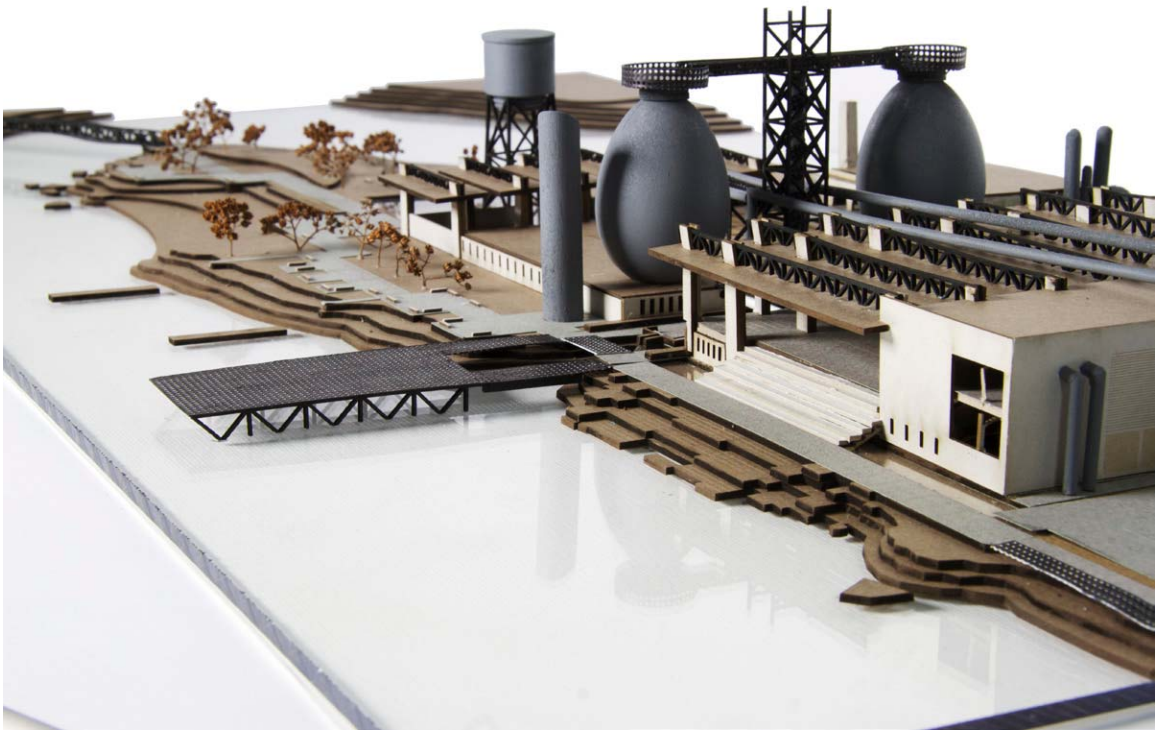


PRELIMINARY TREATMENT

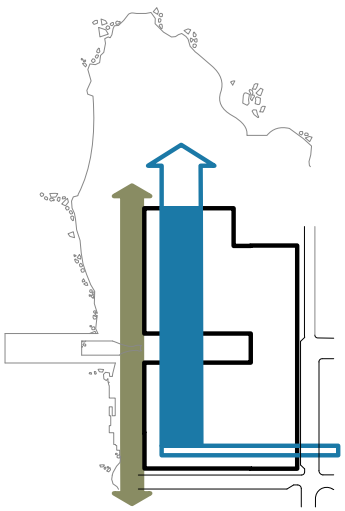


Preliminary treatment is witnessed indirectly through the presence of and screened views towards the machinery doing the work. Heated benches, feature skylights to below and the signature stacks from the biomass boilers below activate the square.

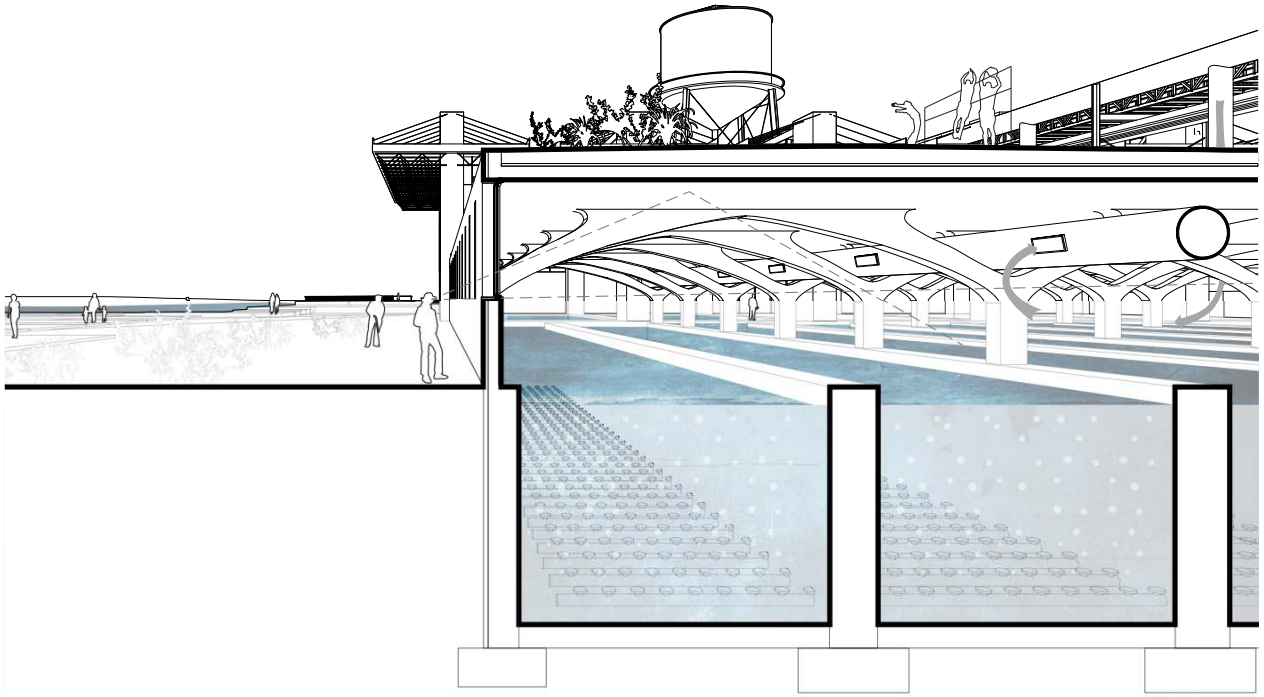
Primary and secondary treatment makes up the vast majority of the space requirements of the treatment plant, creating a dramatically scaled vault of wastewater. During primary treatment the flow is slowed to allow suspended solids to settle to the bottom or rise to the surface where they are skimmed off and collected, while during secondary treatment the water is aerated to speed the growth of microbes that metabolize the organics, which are then filtered out in a membrane bioreactor. The colour and quality of the sewage is such that direct views to it would be counterproductive to engaging public interest and understanding, but the scale of these spaces is impressive. By setting windows high in the wall, views are provided into this hidden process and showcase the arched structure that elicits the idea that you are seeing into a special and typically hidden space, like a crypt or a grotto. At night, low-level lighting allows rippled reflections on the ceiling and arches to be visible from outside, further describing the process within. A compelling presence along the waterfront is found in lending focus to the scale and visual qualities of the treatment spaces.



Narrow views into the vast treatment spaces engage harbour walkers through scale and light without revealing the brackish waters.



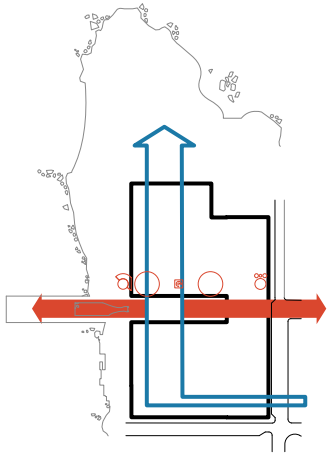
WASTEWATER TREATMENT



Primary and secondary treatment areas are lined along the the waterfront walk and provide framed views in that allow scale and reflections to be seen without the full reveal to the still-dirty water.

Solids are skimmed, filtered, and collected down the center of the site along the axis that extends off Pembroke Street and separates primary from secondary treatment. This axis, connecting the city to the water, and recovered solids-resources to street and harbour, realizes the collision point between people and industry where visitors can interact with the oversized industrial machinery that harvests resources from their waste. Connecting the dots and clarifying the workings of the machine, people are led through the site on pedways paired with the pipe-racks conveying biomass, biogas, air and water. Perforated metal decking on these bridges and helical stair tower allow views through to the pipes and ducts running parallel, making visible the connections and processes of treatment. The helical stair brings people and servicing up 80’ to the tops of the egg-shaped digesters that dominate the site, providing an exciting new view to the city. The digesters themselves are featured as the primary source of wastewater resources. Clad in opalescent titanium and lit with coloured spotlights at night, they make an exciting addition to the Victoria skyline, celebrating the infrastructure and reflecting the idea that industrial processes needn’t be hidden away. The excitement and interest generated by the scale and drama of these digesters has the potential to affect residents’ views on the industry, infrastructure, and their city’s connection to the environment.

The disinfected water exits the north end of the facility into a tertiary treatment and reflecting pool in the park before being released into Rock Bay.

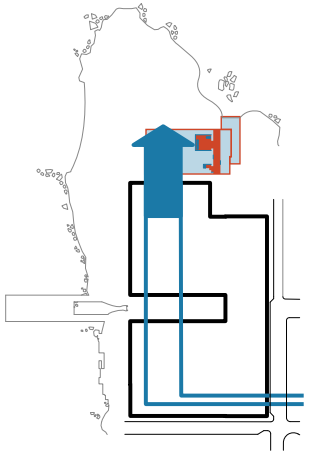


SOLIDS PROCESSING

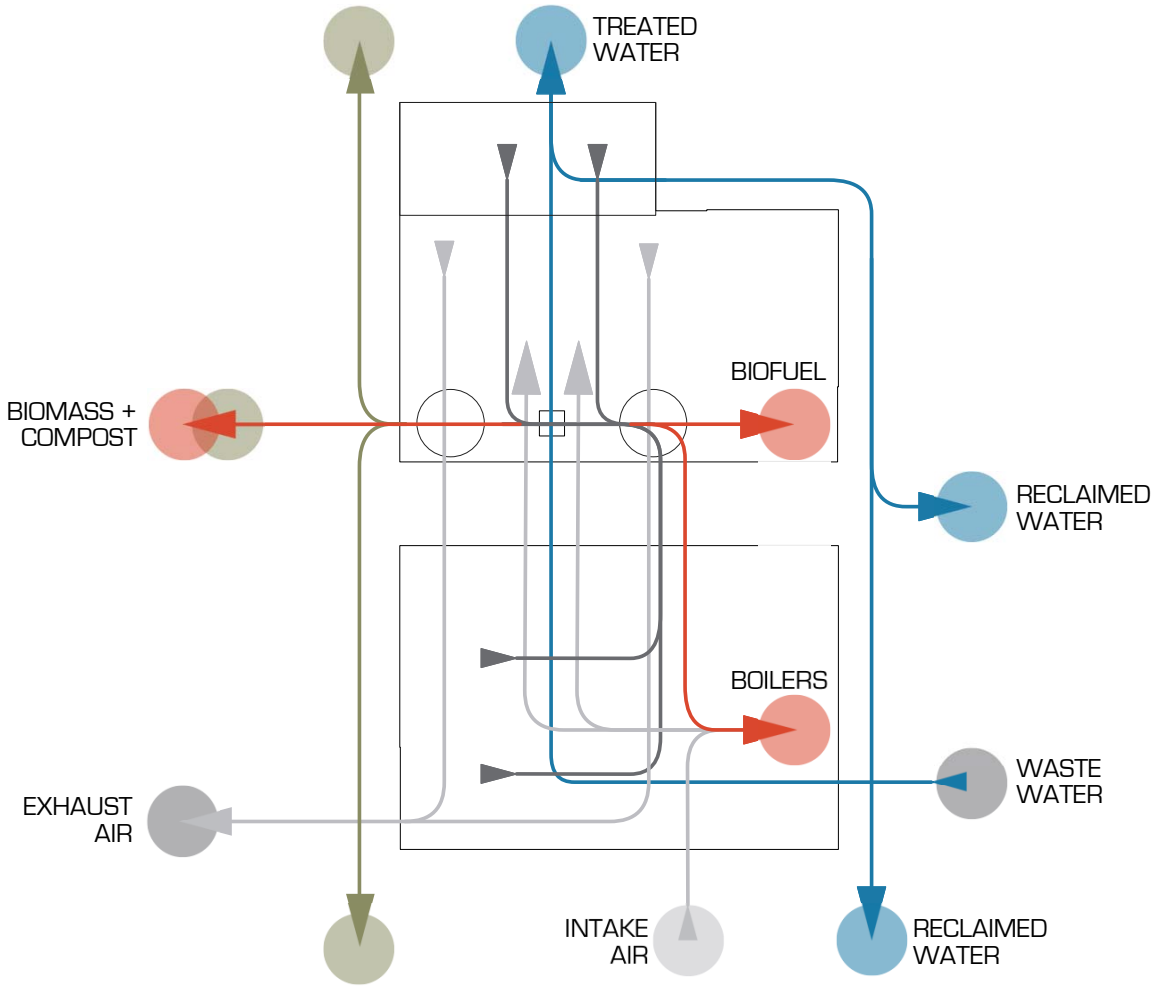
Solids processing is located centrally between preliminary screening and final filtration. The scale and reflective metal cladding and vibrant lighting on the digesters and associated infrastructure brings a dramatic presence to the site.

The final stages of wastewater treatment at the northern end of the site are celebrated as the water approaches drinkable, and people can begin to interact with it directly. The building's height rises at this point, in part to accommodate the roof-mounted cranes needed to remove and replace the final filtration units, but also to celebrate the final stage in converting what was just 'waste' into a series of resources that benefit the city and the adjacent marine ecosystem. Clerestory windows allow natural light into this volume during the day, and at night are lit to trumpet a blue/violet glow representative of the final phase within - U/V disinfection. From this celebrated moment, the water is safe for human contact and, passing seamlessly below the floor-to-ceiling glazing to the outdoors, enters an open tertiary de-nitrification pond. Above the feature outfall is a water tower that collects reclaimed water direct from the source for use on-site and in adjacent buildings for irrigation, toilets and industrial uses. Tapping into a massive source of grey-water, this tower could indeed be just the beginning of a network of grey-water distribution leading out into the city. The pond below it is populated with plinths and ringed with steps that provide seating around the reflecting pond that is the final stage of treatment. Visitors may here see the rising and falling levels of the pond as the city's water use oscillates. A perforated metal bridge reaches across the pond that brings passers-by close to the natural treatment systems below on their way to the northern point of the site, where a second bridge connects to Bay Street across Rock Bay. This second bridge carries people alongside the recovered resources (biomass and reclaimed water) that fuel industries across the bay. Feature lighting, reflecting ponds, and facilities for reclaimed water celebrate the high-quality effluent with tangible gains of park spaces and material resources.

Through exposing and extolling the 'ugly beauty' of the industrial machine and its processes, attention and understanding can be brought to its methods and goals. Using light, scale, and material qualities, elements of the machine and their relations are made comprehensible. By pairing human functions with industrial ones (benches with district heat, bridges with pipe runs, viewpoints with biogas harvesting, viewing plinths with tertiary ponds), people are given the chance to learn passively about this process typically hidden away behind the scenes and out of town. Beyond understanding wastewater treatment's goals and benefits, using design to enhance and celebrate this piece of infrastructure could indicate a re-evaluation and change to our ethics about waste.



Wastewater treatment completes at the north end of the site with a feature de-nitrifying reflecting pond and water tower, signifying the safety of the water both to use and to release to the harbour.



LOWER FLOOR SYSTEMS

Reclaimed Water

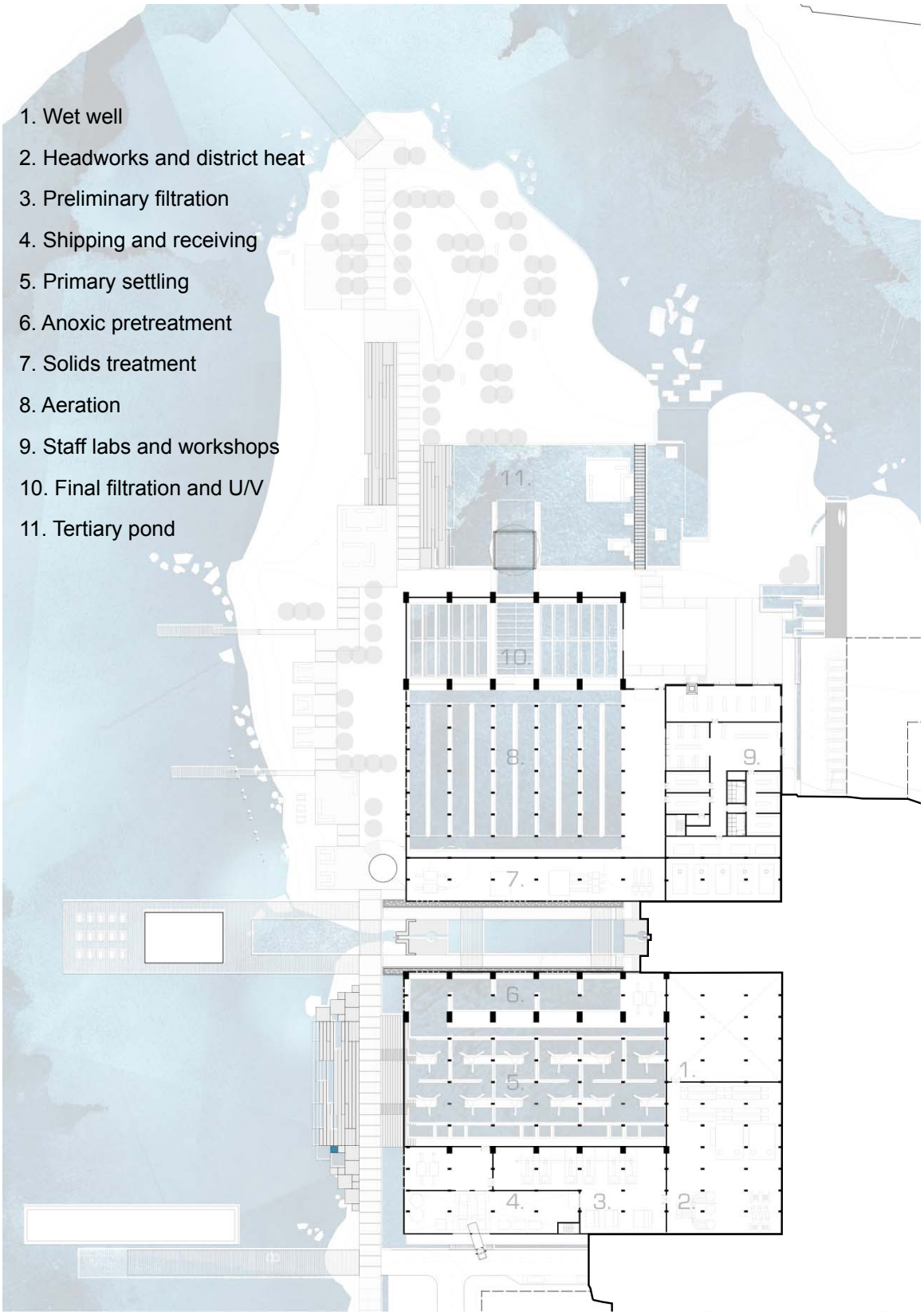
Biomass

Compost

Biofuels

Clean Air

The lower floor is arranged primarily around the efficiency of systems for water, solids, gas, and air. The diagram above follows the paths of each as it circulates through the building.



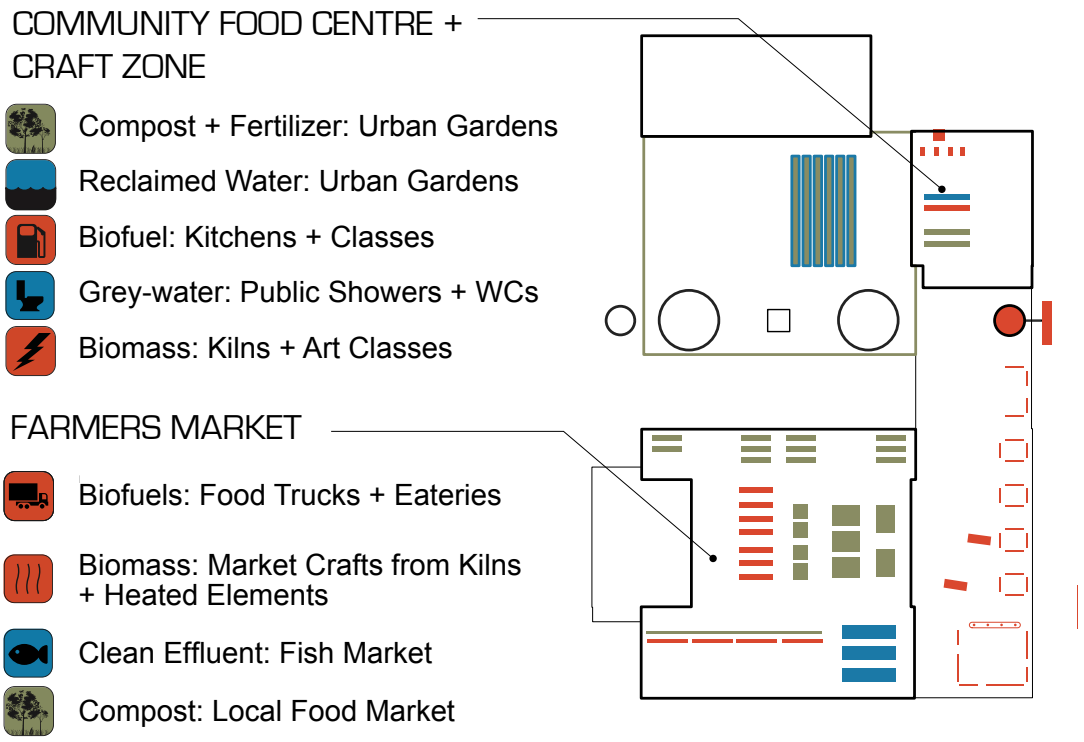
The lower ground floor contains treatment spaces and staff areas and faces out to the sea-wall

Connecting people, treatment, and the waterfront through integration across the extension of the public waterfront.

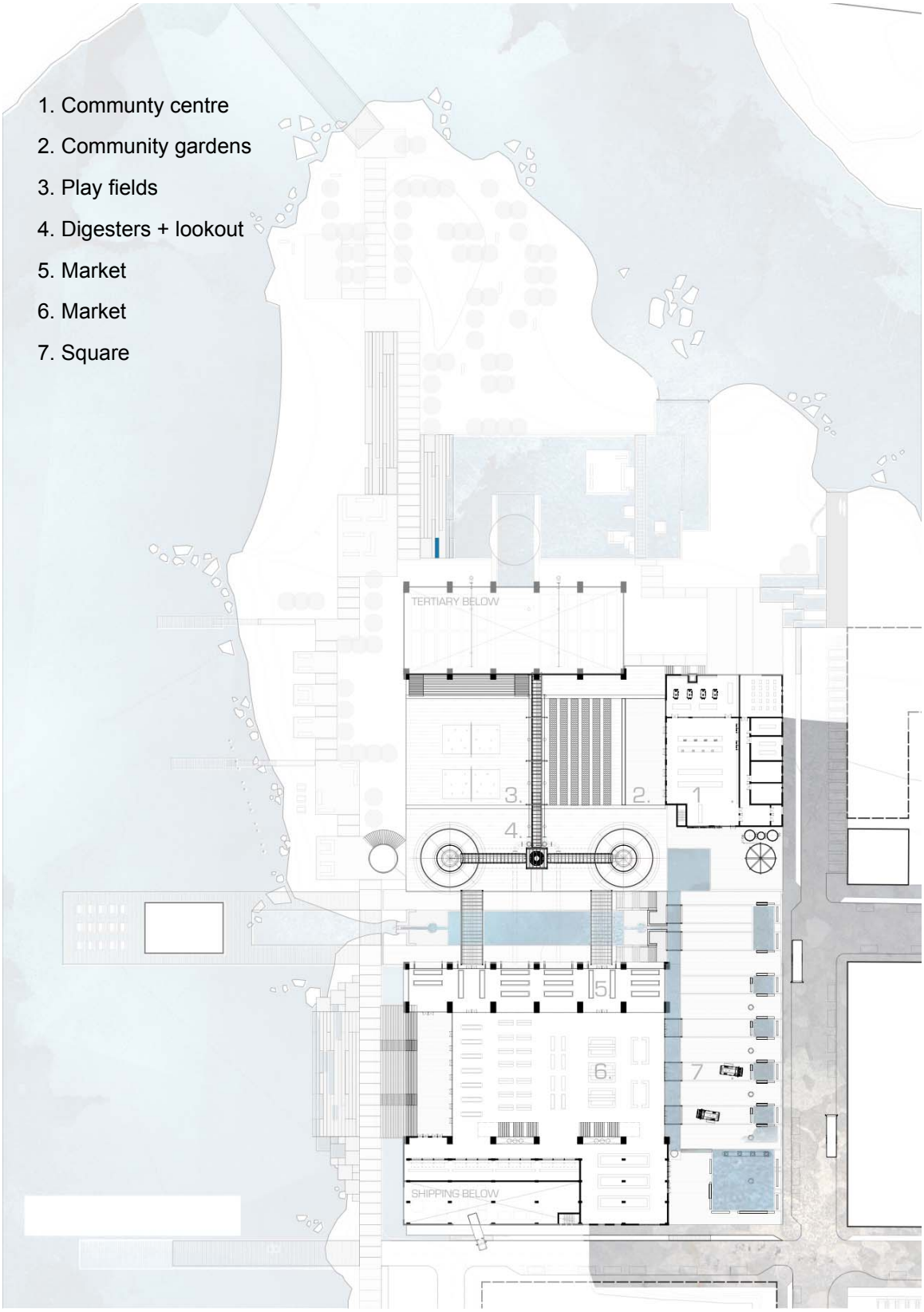
Resources for Public Programme

On the street level, programme is fueled by recovered resources and aims to promote neighbourhood presence, and neighbourhood growth, by creating public resources: agricultural classes use urban gardens that capitalize on compost, fertilizer and reclaimed water; cooking classes and a meal centre cook with captured biofuel; potting classes use biomass-fired kilns; and a public market sells food and goods produced both locally and right on-site with recovered resources. Beyond providing a public resource and civic space, by making explicit the source of these programme-fueling resources, visitors to the site can begin to appreciate the benefits of advanced treatment and resource recovery.

By integrating treatment with other occupancies, the building can begin dismantle preconceptions that exempt industrial buildings from people-centred design and social responsibility. With effort devoted to place-making and community integration, it can be shown that an industrial occupancy can not only coexist with other types of tenancies, but that it can in fact form an active and pleasant place in the city.



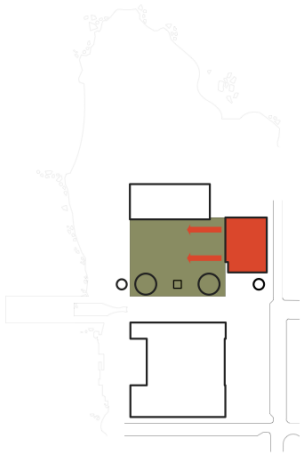
Main floor programme is built around the resources recovered through the wastewater treatment process and include a community resource centre and farmers market aiming to provide social resources for the surrounding neighbourhood.



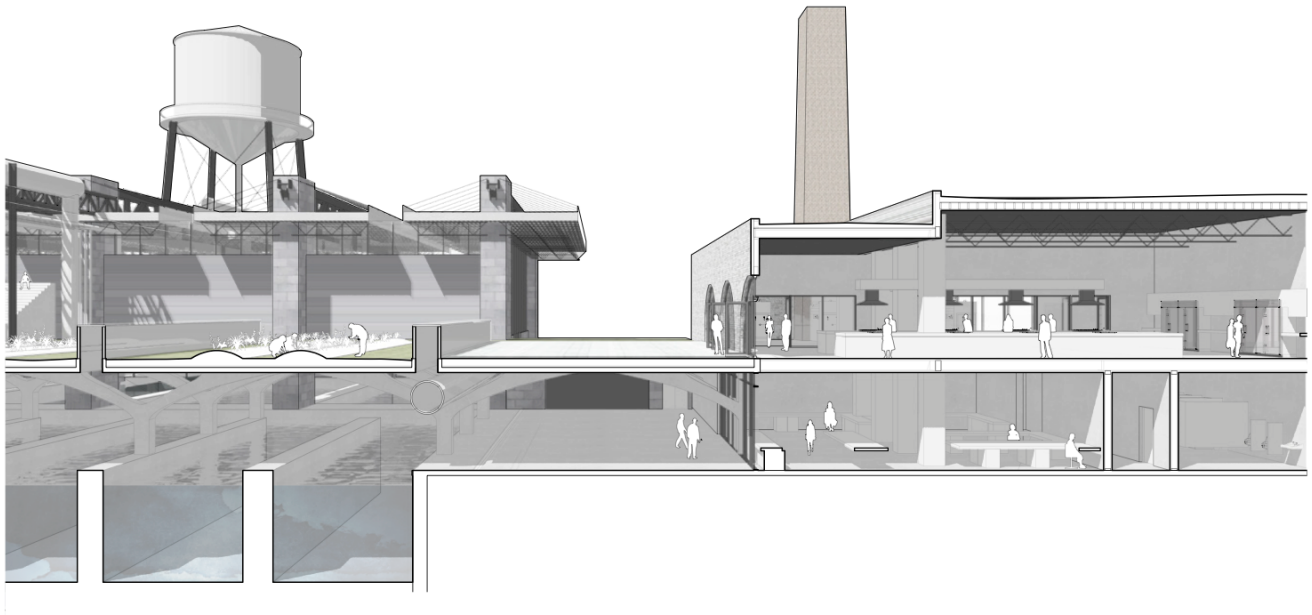
The street-level of the site contains public functions activating the street-front: a community centre, urban gardens and small field over secondary treatment and a farmers' market facing and urban square on Store Street.

On the northern half of the site, the restored and retrofitted 1892 ‘powerhouse building’ houses a resource centre above the treatment’s employee spaces and opens out onto an urban garden and play space above secondary treatment. The powerhouse building then becomes a social centre in the community providing flexible, lettable spaces for a variety of public functions currently lacking in the Rock Bay area. Enhancing and enriching the farm-to-table (-to-farm) cycle, classes on healthy living would harness the high-grade compost, reclaimed water and biofuel to teach about growing, preparing, and cooking food. Biomass-fired kilns grant the potential to host ceramics and arts classes. In addition to classes, these amenities form a great potential for hosting a local daycare in this area, labelled by the official community plan as an ‘employment zone’. The provision of a community hall serves to enhance the neighbourhood while enhancing the connection of users with their civic wastewater infrastructure and its products.

Picture of the 1892 Powerhouse Building (Wilson 2015), which is restored and converted into a community centre.

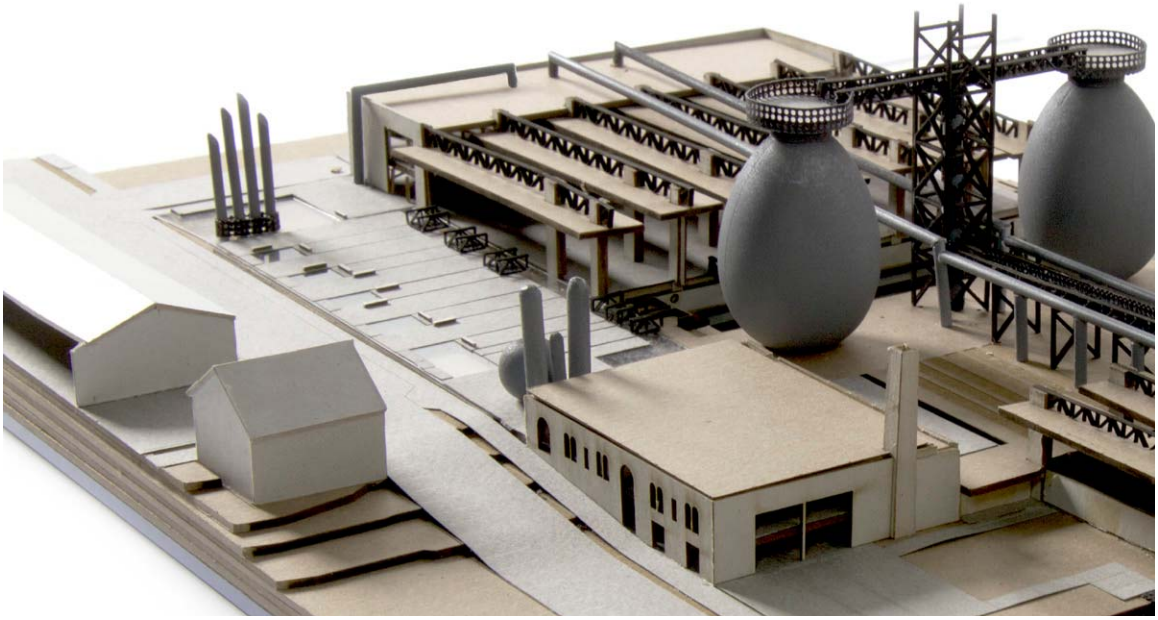


COMUNITY FOOD CENTRE

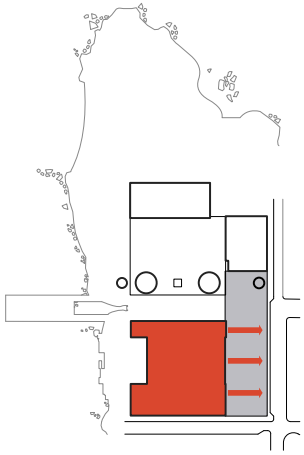


The community centre faces out onto the adjacent urban gardens and play-fields to use made-on-site products (compost, fertilizer, heat, and greywater) to provide health classes, social and community services.

Facing the street and the new urban square, a large (4000-5000) square metre, year round farmers' market (currently lacking in Victoria) creates a space for large year-round gatherings and a major draw to this dis-used portion of downtown. A destination for shopping, eating and socializing, the marketplace and its square would be a resource for residents and an attraction for tourists who visit 'green' and health-conscious Victoria. Co-locating large, indoor and outdoor civic space with the treatment plant ensures this large site doesn't become an uninhabited blight in the neighbourhood by creating a year-round destination. In selling products - locally grown vegetables, local crafts, local seafood, and fresh food - that revolve around the benefits of recovered wastewater resources, and through proximity and visibility to the treatment and recovery processes on site, a stronger understanding can be gleamed for the needs and benefits of treatment.

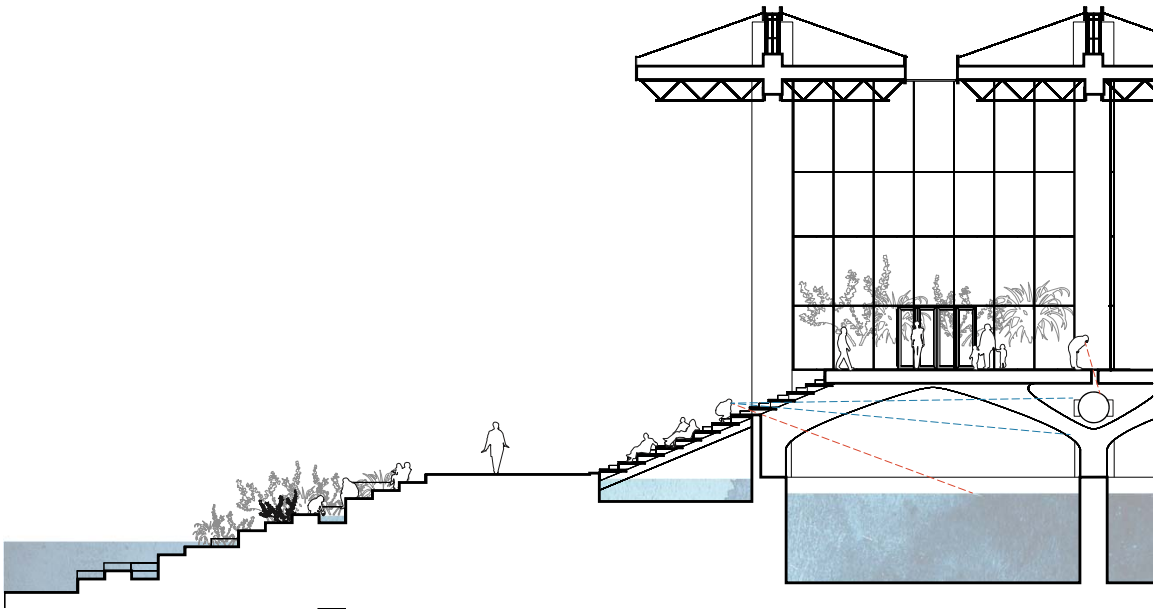


A farmers market and community centre face the street as social resources.

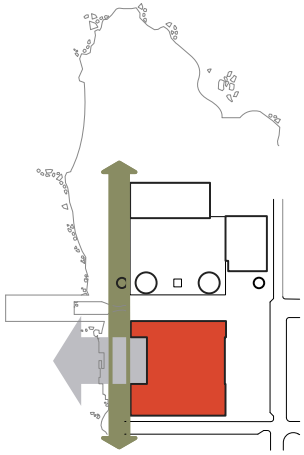


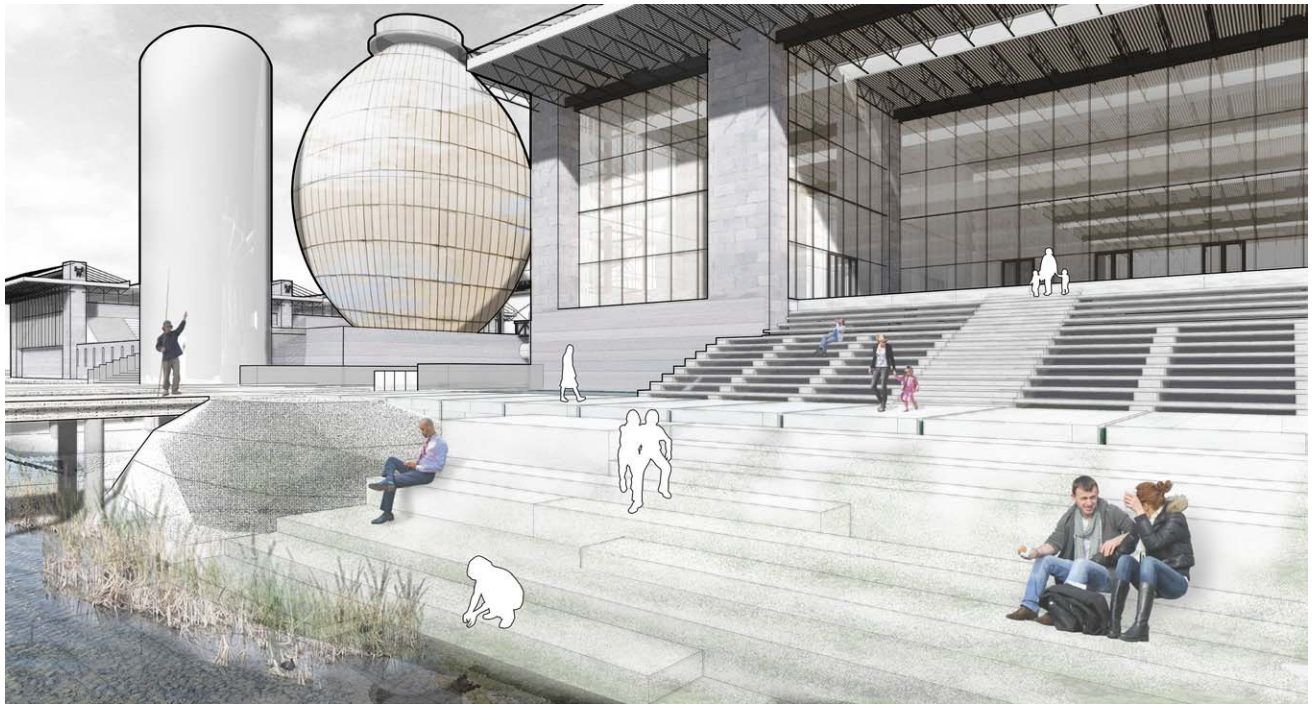
The farmers' market and urban square provide a place to gather large numbers of people to exchange goods (many made on-site), eat and socialize. Creating public, urban space on-site is critical to creating value for the people in the community.

Reinforcing the city's connection to the harbour, a grand stair descends from the market to the waterfront, linking the plant's ecological imperative (marine environment) to the city. The steps continue down from the market right into the water as a space where people can sit, eat lunch, and enjoy the harbour with its delicate riparian ecosystem. Architectural variations to the height and placement of the steps forms niches and tidal pools that reinforce its ability to hold riparian life resist coastline erosion and, looking back up towards the building, the risers in the upper steps are glazed to allow glimpses in to the primary treatment spaces below the market. At night, reflections from the partly-treated water might bounce through these slits to contrast the orange hued uplighting on the reflective metal surface of the digesters beyond. The building serves as a precedent for an mixed-use, industrial waterfront that attracts and sustains both urban and marine life.



A rich riparian ecology flanks the waterfront walk with the market and treatment spaces across. Steps up into the market have open risers that allow a view to the stormwater swale below and treatment space beyond.

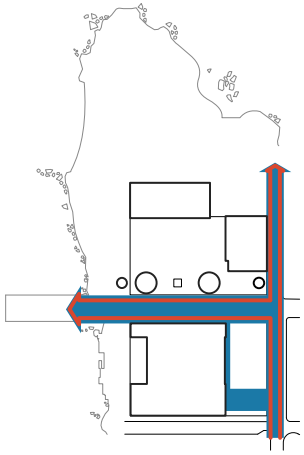




Spilling out from the market, the grand steps formalize the connection between the urban and marine environments and allow a place for people to eat lunch, sit, and enjoy the re-habilitated urban waterfront.

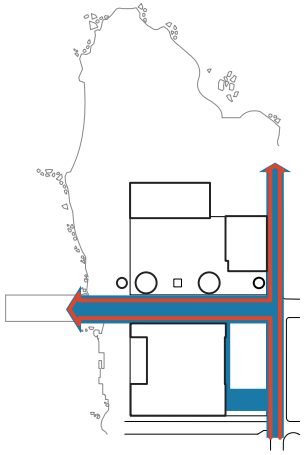
Connecting the city its run-off and the harbour, stormwater is collected from uphill streets and filtered through the site towards the harbour. Benches (heated in the winter) surround a series of architectural bioswales in the market square, creating an urban connection to the natural systems that remove contaminants from our stormwater while personalizing the square with natural materials and colour. Narrow channels trickle-feed stormwater from these ponds towards the central E-W axis extending off Pembroke Street. This axis assembles an exciting juxtaposition between people (market) to the south and, industry (digesters) to the right. Stormwater drops down a feature falls to a bio-swale centred in this linear courtyard to pass slowly through the formal treatment pools and channels. People follow the path of the water, drawn through the mall from the city to the harbour in a new access point to the neo-industrial waterfront. Along this route, people are able to follow the complete path of stormwater treatment as they walk from the city street to the harbour.

A feature bio-swale capturing and treating stormwater caps the end of Pembroke Street before releasing it beneath the waterfront walk.



STORMWATER TREATMENT

Stormwater and people filter through from the city to the harbour along this formal mall juxtaposing the industrial and urban functions on-site.



STORMWATER TREATMENT

From this vantage, at the water-front corner of the farmer's market, the stormwater makes its way to the harbour through naturally a treating bio-swale and navigates the collision of the market with industrial infrastructure including the paired duct-run/pedways and the dramatically lit and reflectively clad digesters.

Forging a public programme based around the resources retained from our wastewater generates social activity and creates a proximity that allows better understanding of urban systems and our environmental responsibilities. Developing the building with people and urban place-making in mind results in an entirely different beast, where public and industrial programmes can co-exist side by side. Ensuring that there are enough public activities and programmes to sustain the presence of people makes certain that this large and necessary programme does not form a dark, people-less hole in the city. Finally, bringing residents and visitors to the site makes it possible to celebrate the infrastructure that brings us these economic, environmental, and indeed, social gains.

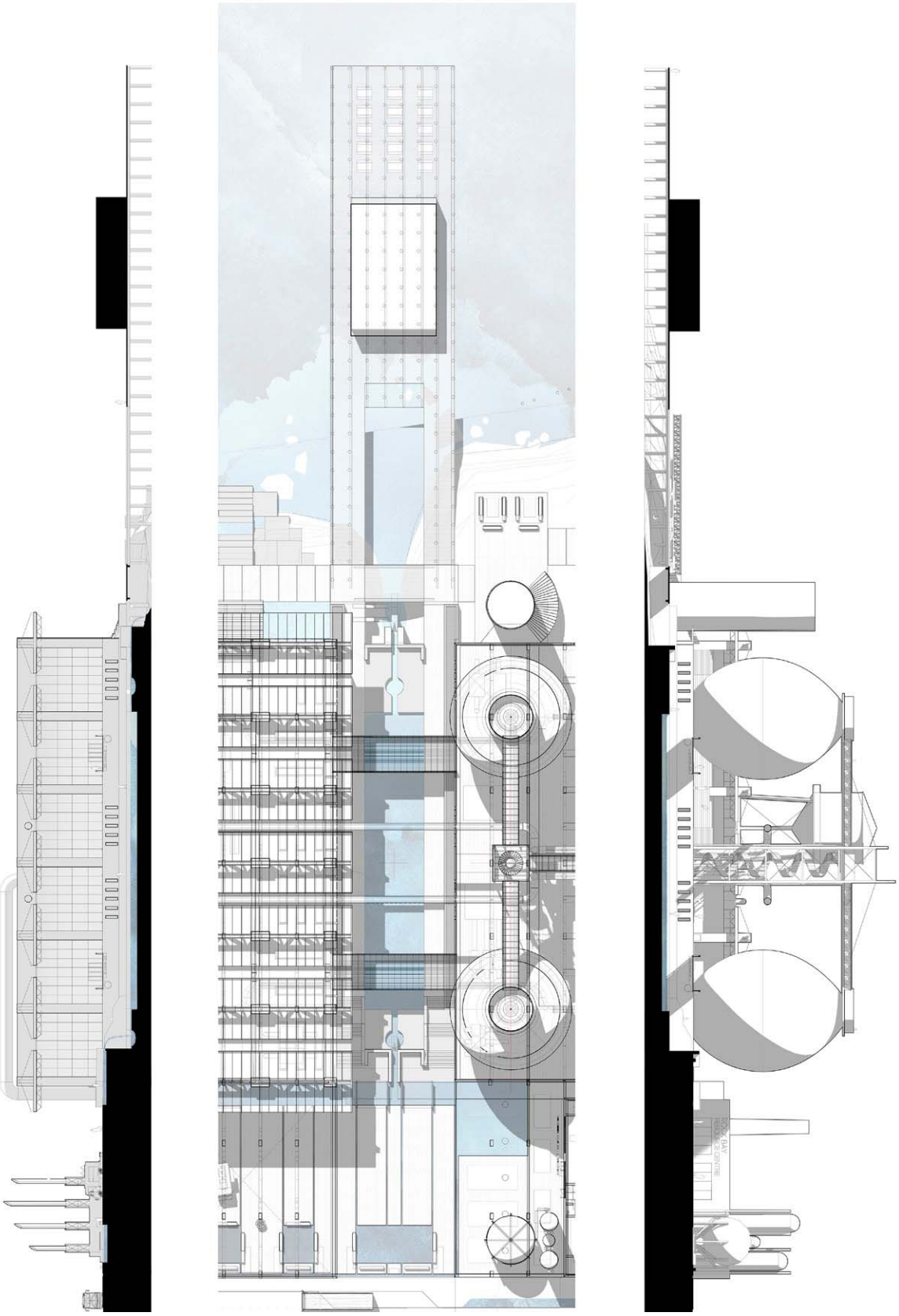
The plant has a dramatic presence on the Victoria waterfront as a reflection on the values of Victorians.

CHAPTER 5: CONCLUSION

A paradigm shift is necessary if we are to create clear, appreciable value to balance the substantial cost of wastewater treatment. While the environmental needs have been well documented (Higgs 2012, MacQueen 2013), these benefits are far from the perception of most urban-dwellers. Through a re-evaluation of how to deal with waste and industrial infrastructure, it is shown that wastewater treatment sites can be incorporated into communities and act as a public resource.

By pairing public space with wastewater infrastructure, efficiencies are found in the processes integral to the function of our cities, while simultaneously contributing ecological understanding, and value to its community. Populating public green spaces with stormwater-treating bio-swales adds environmental functionality, and adds to the spaces themselves. Urban and architectural design of an industrial, mixed-use, wastewater treatment plant incorporating public space and programme can generate urban amenities fostering community support. Meanwhile, synergies between recovered resources and other programmes reduce our reliance on imported resources, and in doing so help to develop our understanding of how we, and our urban systems, affect surrounding ecologies. By integrating urbanistically, recreationally, and programmatically, and in re-imagining the sewage treatment plant as a community resource and a public amenity, it can become an urban destination.

The use of socially conscious design principles typical to other urban structures can transform this piece of industrial infrastructure from an ugly necessity into a prized and integral component of our city. This shift in dialogue, from economic cost and environmental requirement, to urban resource and social benefit, is critical to gaining public support. That support should be indicative: a project that clearly benefits its neighbourhood, and the city, is bound to harness support, a goal that should be applied to all urban structures. Let our wastewater infrastructure enmesh itself in the city, tying itself in with the introduction of public space and program. Use of this model will grow peoples' understanding of our environmental affect while increasing urban efficiency and hosting community resources, but most importantly, it has the potential to generate a sense of pride and excitement for this monumental piece of public infrastructure and its benefits.



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