Salt of the Earth: Redeveloping Saskatoon's Waterfront to Promote Heritage and Community

by

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Contents

Abstract

Saskatoon's development over the 20th century has severed the urban core from its river and potash mining has left a legacy of environmental degradation caused by salt waste. This thesis draws from Saskatoon's origins as an integrated community to reconnect citizens to their river using urban landscape infrastructure. Focusing on interactions between actors, areas, and flows, it aims to reconnect industry, river and city at multiple scales. The design strategy proposes a shared language between existing programs such as a farmer's market and river stewardship, and introduces complimentary programs such as a maker's space and leisure activities to enrich the city's relationship to its river and industrial past. It does not solve the problem of industrial waste, but raises public awareness through transforming waste into useful materials. It also aims to increase the river's use as a civic amenity and contribute to altering perceptions about industry's relationship to the city.

Acknowledgements

To Sarah Bonnemaison, Christine Macy and James Forren, for your guidance and encouragement to pursue my interests. Your critical perspectives strengthened this project.

To Malcome Leggett and the people at NSC Minerals for entertaining outlandish questions about potash salt and for seeing the potential in such a wonderful material.

To my friends and family for supporting and encouraging me throughout this journey.

Thank you.

Chapter 1: Introduction

The common ethos towards selecting building materials prioritizes economy and rarely considers other values. However, if you pay attention, building materials can tell stories of material origins and local histories. Saskatchewan is not known for its abundance of locally-sourced construction materials, yet its “building blocks” are the river landscape and potash mining industry, both of which enabled the city’s growth and continue to be central to its identity.

Although the Saskatchewan river and the potash industry contributed to Saskatoon’s development, these three elements — city, river and industry are no longer meaningfully linked to each other and in fact, negatively affect one another. The river is the main water source for much of the province and it is valued by locals as an aesthetic feature, giving the city its moniker ‘The City of Bridges’. Yet the river has been over-consumed and polluted by extractive industries such as potash mining. Potash, which is the common name for potassium chloride, is used in ammunition, soap and fertilizer. It is obtained through conventional mining which uses a large amount of water and degrades the land with the by-product of potash production, common salt (NaCl).

This thesis explores the potential of architecture to reinvigorate the reciprocal relationship between the potash industry, river and the city. A small step in showing potential alternative uses for salt waste, the thesis incorporates salt as a building material, in a community-oriented mixed-use waterfront development that supports local economies, connects to the river and the city, and celebrates the histories of Saskatoon.

This thesis begins with a study of what has contributed to Saskatoon's disconnect with its river, and what the impacts of this disconnect have been at the global, provincial and city scales. The design portion of the thesis uses the practice of urban landscape infrastructure to reconnect industry, river and city at several scales, through siting, program and historic connection. It also uses the idea of "transformations", so common in industrial process engineering, to think about different programs in a common language, and to consider how they might be linked through shared processes. As the design developed, additional values of connectivity, visibility and celebrating local materials were included.

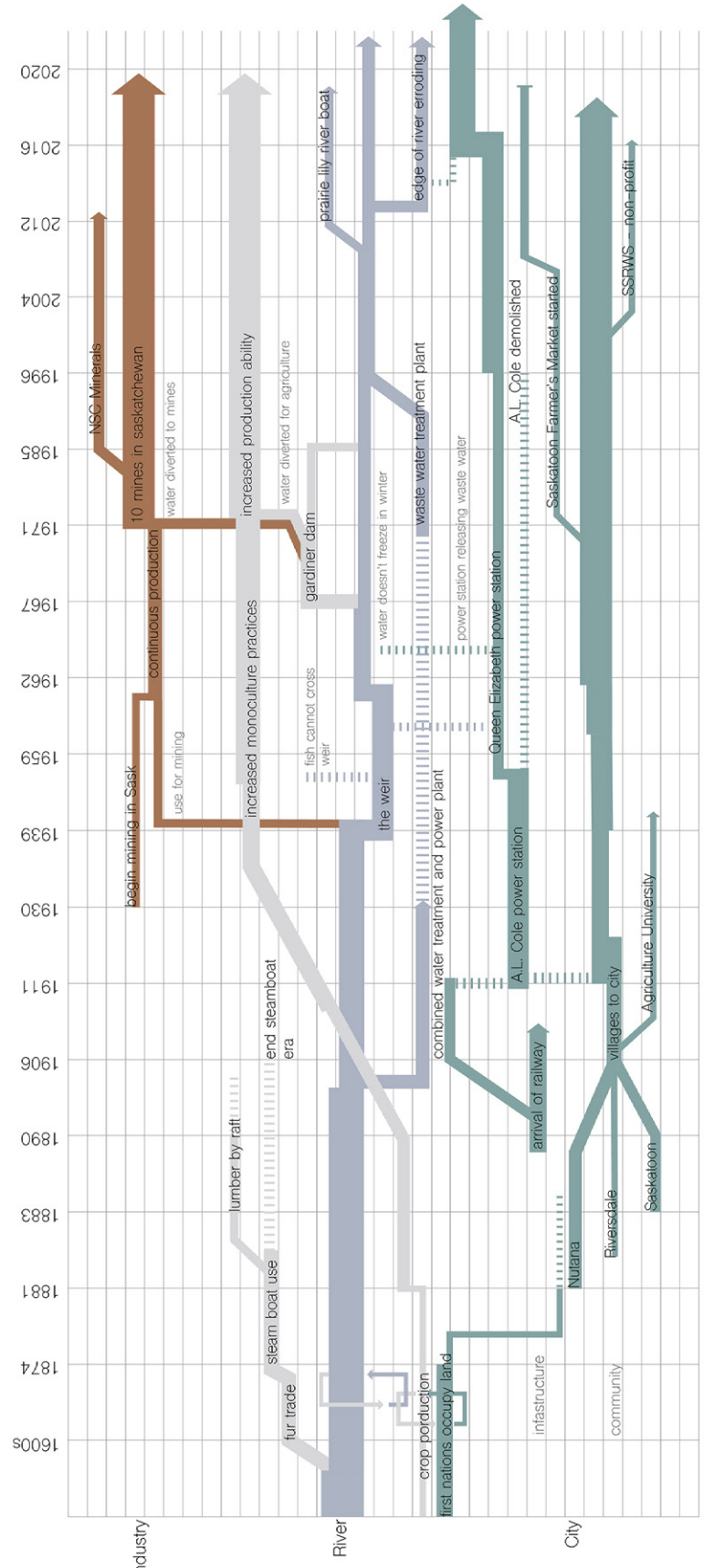
Chapter 2: Analyzing Relationship Structures

This section explores the history of Saskatoon, its industries and its river – how they used to be closely intertwined and how they gradually, over time, lost their connections. It also explores the consequences of this severed relationship. This multi-scaled analysis of relationship patterns is drawn from structuralism. While the theory's application to buildings is contested for its non-inclusion of individuality, lack of hierarchy and tendency towards over-deterministic structures (Valena, Avermaete and Vrachliotis 2011, 15), it provides a foundation of thought for examining the context of the city. Structuralism originated in linguistics and Levi-Strauss postulated that it is the relationship of a word to its language that gives the word meaning (Kurzweil 1996, 15). The other relevant feature from structuralism is that there is a dynamic relationship between individual parts and these connections make up a system (Kurzweil 1996, 15). Following this frame of thought, significance is derived by looking at entities in relation to the larger whole, the city, river and industry are part of the system of Saskatoon and are therefore examined as such.

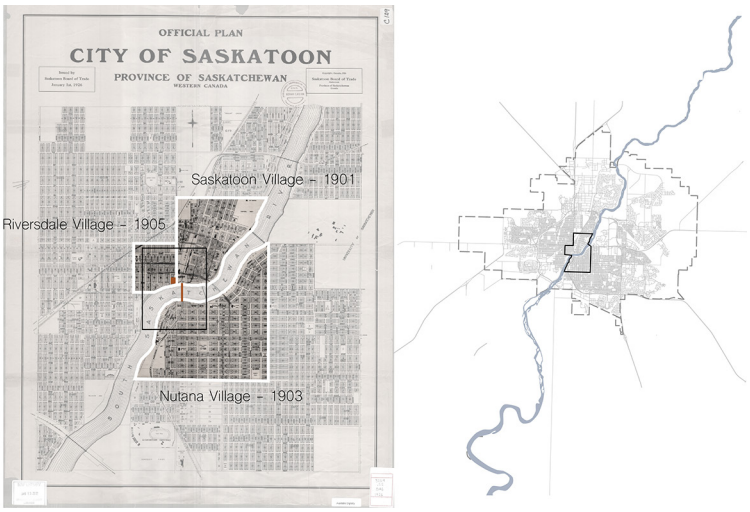
City Context

Saskatoon began as a garden city where the land provided settlement, people grew crops on the land and the river nourished the crops and the people. Advertising by the Saskatoon Board of Trade in 1916 boasted:

> Would it have been possible to select a more favorable strategic, geographical location for this city? For not only is it on a beautiful river in the middle of the West of Saskatchewan, but also in the very heart of the largest and most fertile expanse of agricultural country in the entire world. (CIHM 1916, 2)



The fracturing of the integrated relationship between industry, river and city where the industry and city have grown, the river has suffered and the relationship between elements predominantly results in negative consequences.



Power plant and rail bridge as the connection point that facilitated the transformation of three villages into the city of Saskatoon (base map from Saskatoon Board of Trade 1926).

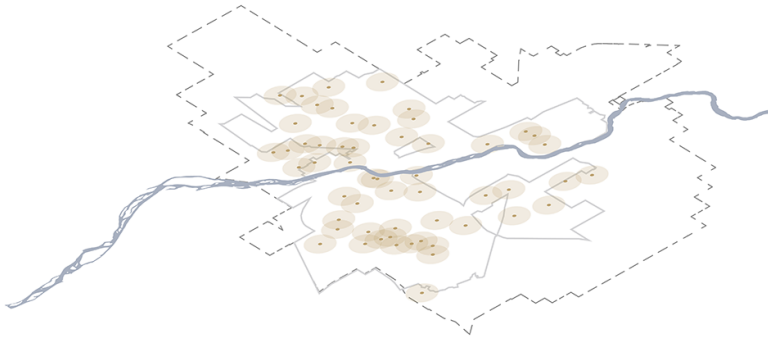
Settlers arriving in 1881 built a community based on the surrounding rich land. Agriculture was and remains at the heart of the city's development.

As the community grew, and industries were established, the settlement's three original villages – of Riversdale, Nutana, and Saskatoon – were connected by a shared industrial core and a rail bridge. In 1906, the three villages amalgamated to form the city of Saskatoon. The industrial heart also contained the city's second electrical generating station – A.L. Cole power station – that was constructed in anticipation of a population boom. Its siting on the river was critical to cool the electrical pumps. The rail lines, rail yard and power plant were demolished in 1996, leaving the power plant's pumphouse as the only remaining structure on this significant site, where industry, city and river co-existed.

With expansion and specialization, Saskatoon, its agriculture and its industry moved away from the river, abandoning their history as an integrated community. According to Nina-Marie Lister, "it is only through the industrial era that city, country,

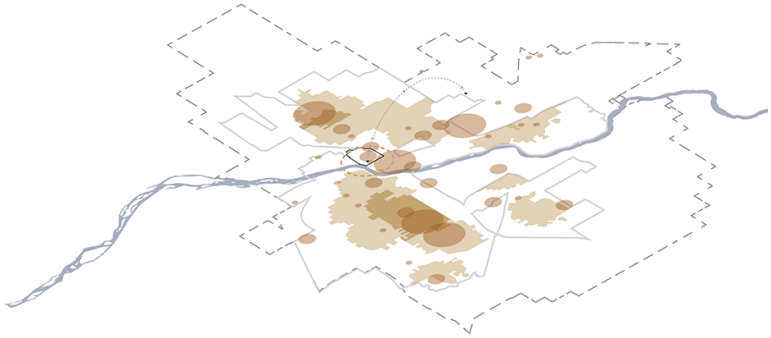
Community Gardens

- Residential area
- Garden locations with 1km radius



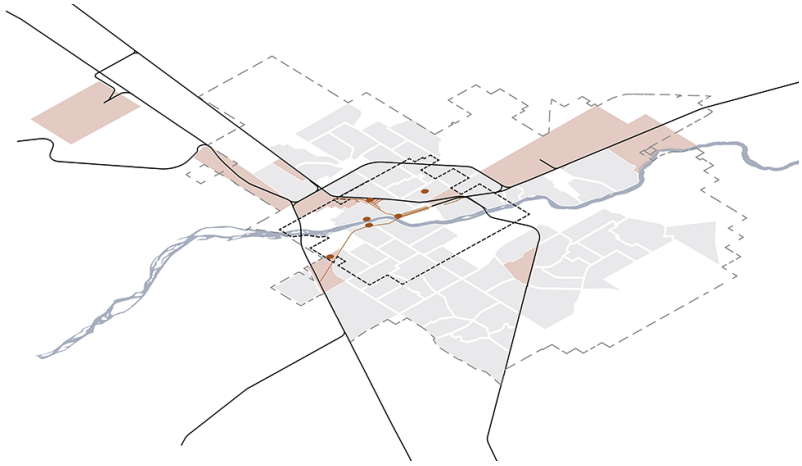
Food Access

- Residential area
- 1-2 Supermarkets within 1 km
- 3-5 Supermarkets within 1 km
- 10 Restaurants
- 5 Restaurants
- 1 Restaurant



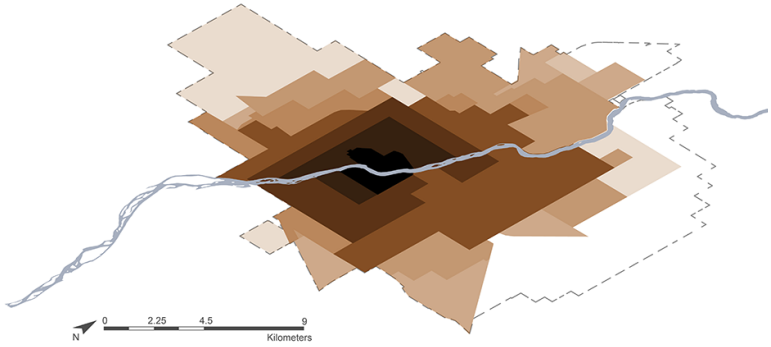
Shifting Industry

- Designated residential neighborhoods
- Current industrial area
- Industrial area removed
- Industrial ammenity removed
- Rail line removed
- Operating railline
- Developed area 1926



City Growth

- 1906
- 1910
- 1920
- 1960
- 1970
- 1980
- 1990
- 2000
- 2005

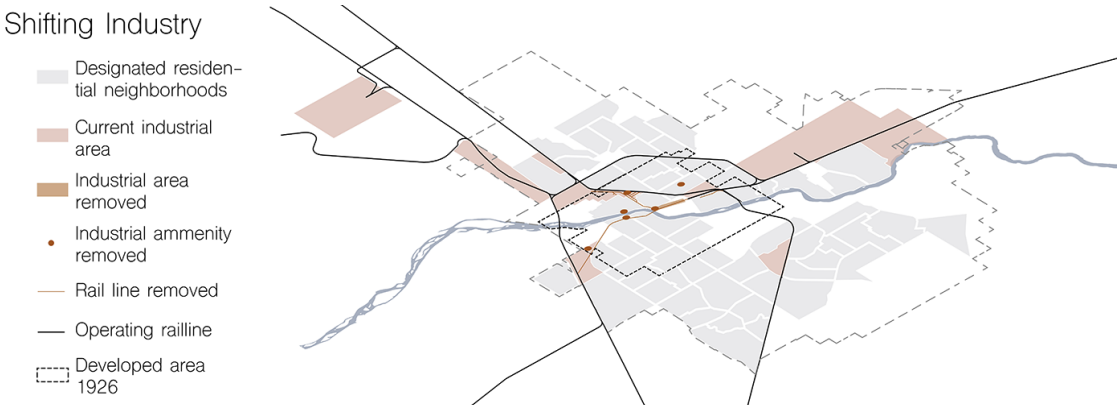


The layers of Saskatoon demonstrate the importance of the core yet it has a lack of food access, removed industry and the oldest infrastructure.

and landscape (and their attendant disciplines of practice) became isolated, discrete zones of practice" (Lister 2010, 525). The result is monoculture crops for export, a potash industry that provides the world with fertilizer but wastes its own land, and a river that is over-consumed.

The result is disconnect that is evident in the city, as industry has been removed from the downtown core and placed out of sight and out of mind. The city once proclaimed that "Honest industry and ability have placed many of lowly origin among Canada's greatest and most useful men of today" (CIHM 1916, 4). The downtown used to be diverse with retail and service industries creating a hub, with rail lines through the center of the city. These have since been removed. With the advent of the automobile, major roads were routed around the urban core.

Similarly, the community has been separated from the river, as once-diverse community areas were transformed into economically inaccessible private property. The river is increasingly being valued as an aesthetic feature to be monetized. Kulshreshtha and Gillies estimated in 1993 that "property owners are willing to pay an additional $100,565 in property taxes per annum for river view" (Kulshreshtha



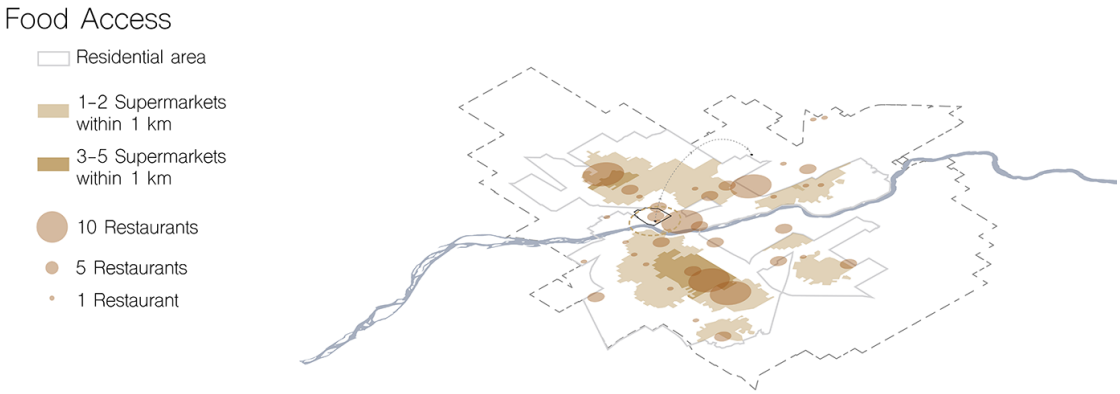
Displacement of Saskatoon's industry from the core to designated industrial areas on the outskirts and the removal of the central rail line.

and Gillies 1993, 212). The value of riverfront property is reduced to a view for expensive condos and a backdrop for summer festivals.

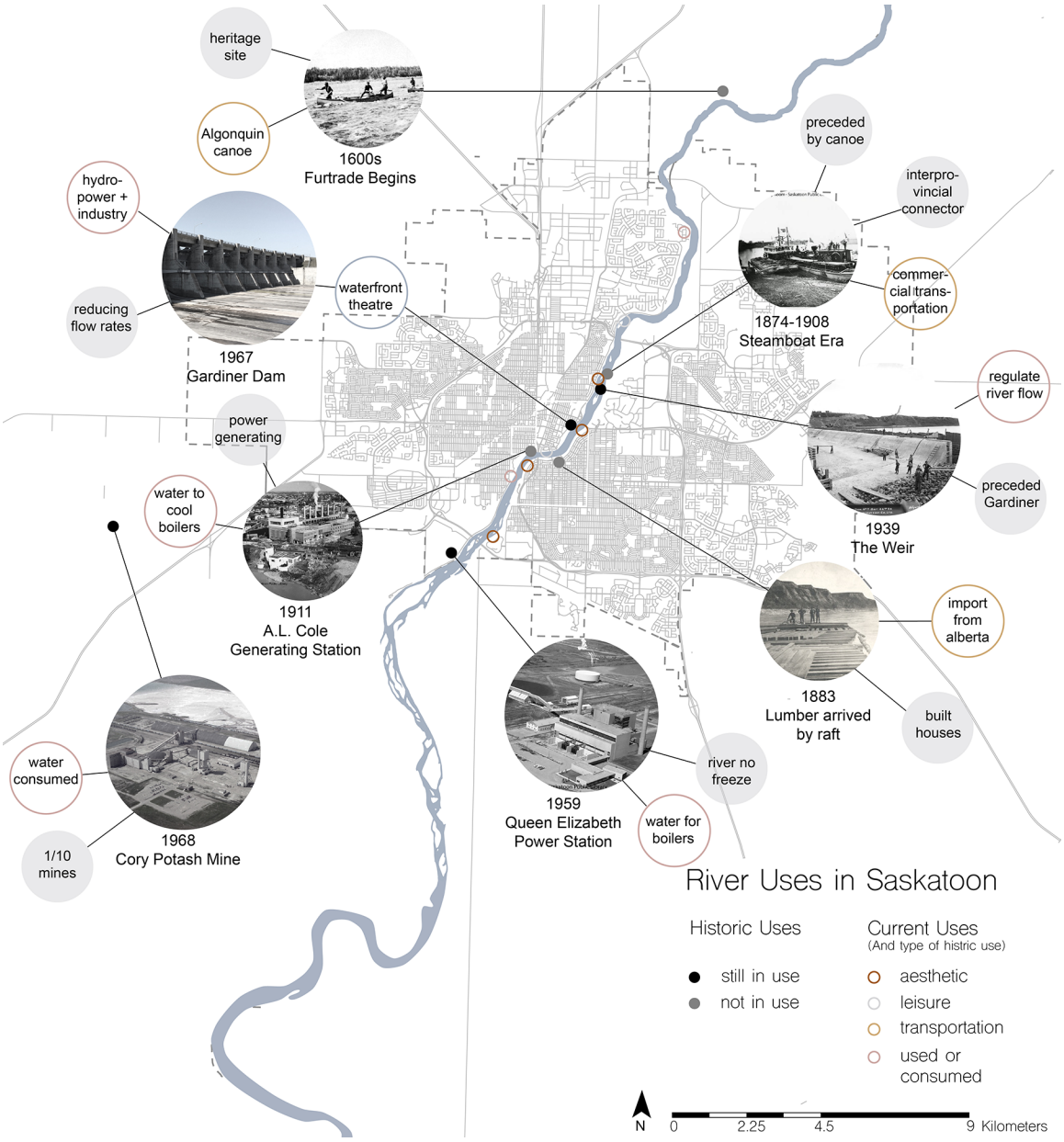
With privatization, the riverfront redevelopment has displaced important community buildings. The Riversdale area – one of the original villages – has small blocks with limited public amenity, and no open park spaces (McLoughlin 2005, 63). It is a site of high gentrification due to its proximity to the river and downtown which results in high property costs. The farmer's market at the intersection of Riversdale and downtown was evicted in the summer of 2020 because it only occupied the location one day a week. The removal of the market re-establishes this area as a food desert, while the market's new location is in a primarily industrial zone, outside any residential neighborhood. The city's intent is to redevelop the old market's prime riverfront location as condos, but that negates the rich social activities of the market program downtown.

Provincial Resources

The river in Saskatchewan was historically harnessed for power generation, transportation, and commerce. It was a resource to import materials, connect interprovincially and



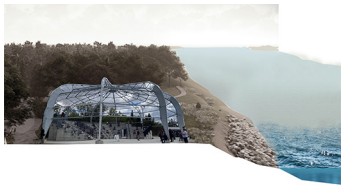
Re-established food desert in the Riversdale neighborhood due to the shift of the market from the downtown core to a non residential area.



Saskatoon's varied uses throughout history can be seen in fragments within the city but these uses have significantly declined.

grow communities. River transportation began with the fur trade in the 1600s, it was used to float logs for the construction of houses beginning in 1883 and the steamboat traffic from 1874-1908. This declined following the introduction of the railway. The Gardiner dam completed in 1967 remains in use today to divert water for hydropower, supply industrial

water needs and regulate flow rates of the river. Today the river primarily serves industrial needs, and people use it for leisure.



River as a backdrop for festivals, little interaction created.

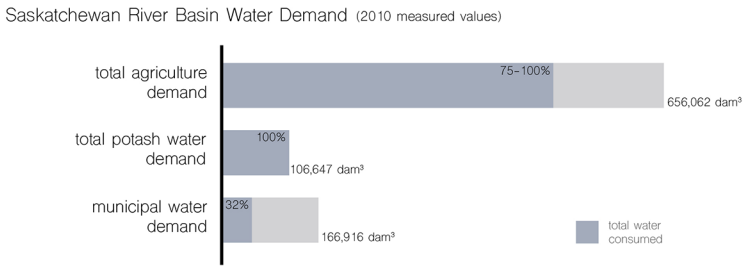
Because the Saskatchewan river flows through three provinces from Alberta to Manitoba there is uncertainty about who is responsible for the care of this resource. As the number of users increases and its water is over-consumed, stewardship becomes a larger issue. The river provides 50% of Saskatchewan with fresh water, but policy is unclear about who is responsible for ensuring its continuing viability (Corkal, Inch and Adkins 2007, 9). The federal government takes little responsibility in the control of the resource and municipal entities often take the role of water stewardship. Municipal care can be difficult because the river is shared amongst three provinces.

Trails create a safety barrier to water leaving river as a view.

With regulation of the river levels by the Gardiner dam, overconsumption by industries goes unnoticed and the perception of the river as an endless resource contributes to this. A 1916 monograph read: “Our [water] supply is absolutely unlimited because it is drawn from the South Saskatchewan, a mighty river” (CIHM 1916, 8). However, in a report from 2015 the World Wildlife Federation (WWF) of Canada estimated that the Lower South Saskatchewan watershed was at very high risk of pollution, habitat loss, overuse of water, and habitat fragmentation (WWF 2015, 1). Overconsumption should create a visible drop in water levels, but due to the upstream Gardiner dam regulating water throughout the year, this overall reduction becomes invisible. Overconsumption is more apparent in flow rate, as evident in the city turning down a proposal for hydroelectric power in 2010 due to inadequate river flow (Van Pul 2019).

Leisure water activity that is disconnected from the river.

Condo development project along riverfront prioritizes economic growth.



High water intake levels by municipalities offset by the amount of water that is returned (data from Kulshreshtha, Bogdan and Nagy 2012).

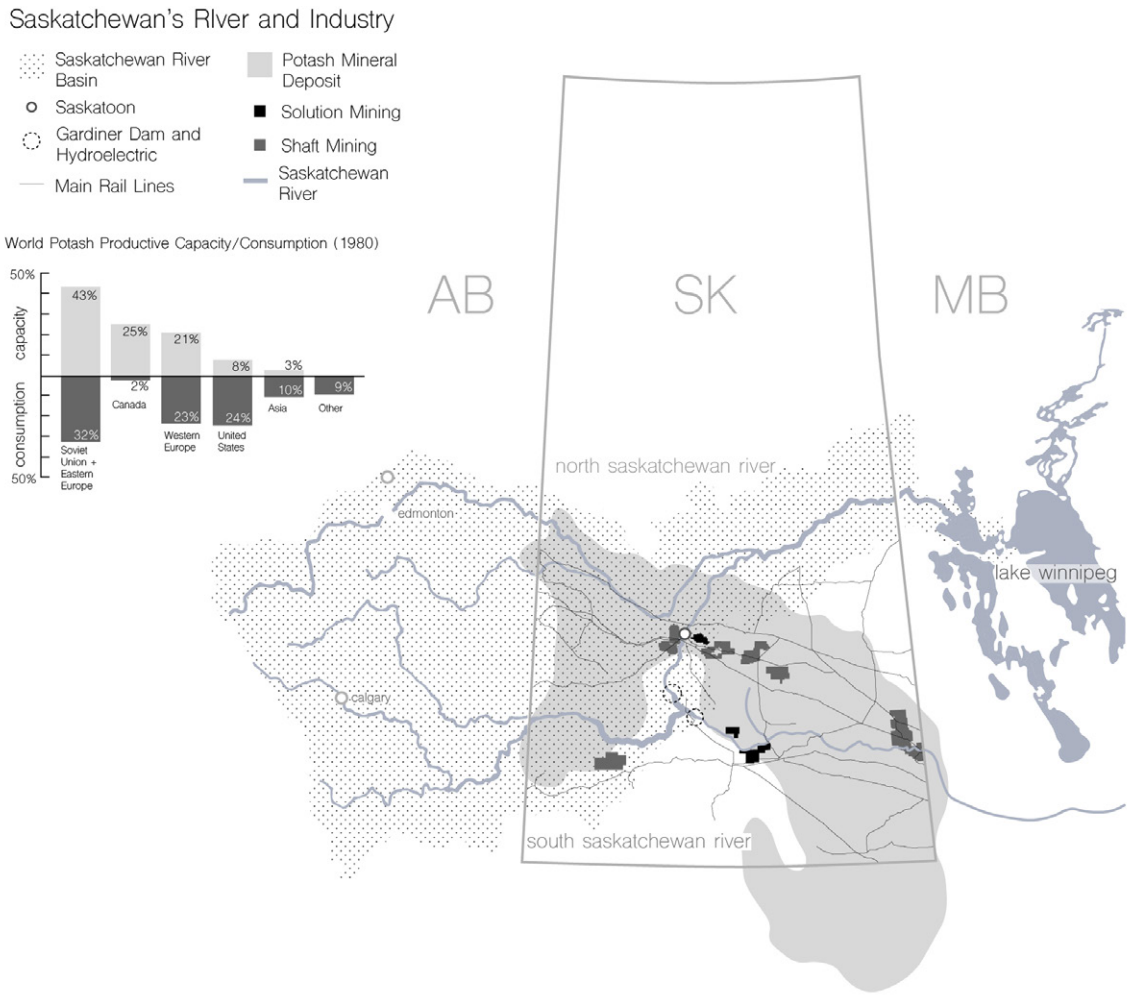
The main consumers of the river resource are industries because they have large operations with high production rates. The industries in the province include mining for potash and uranium, oil production – both crude and canola oil – and agriculture. The river attracted industry because the groundwater in the area is of lower quality and more expensive (Kulshreshtha and Gillies 1993, 202). Although municipalities use more water than mining does, the dominant consumers are agriculture and mining because they have zero return rates while municipalities return 70% of their water intake.

As the river itself has been transformed into an extractive industry, peoples' relationship to the riverine landscape has declined. Kulshreshtha and Gillies performed a survey of residents in Saskatoon. 97% of participants agreed that the South Saskatchewan river contributes to a positive quality of life in Saskatoon and over 60% of people disliked the river for its insufficient water levels and low water quality. (Kulshreshtha and Gillies 1993, 214). When presented with the survey, a high amount of people acknowledged water issues in the city, however nothing is done because people no longer interact with the river on a daily basis beyond a faucet in their homes which has no visible link to the river. By encouraging people to interact with the river and by

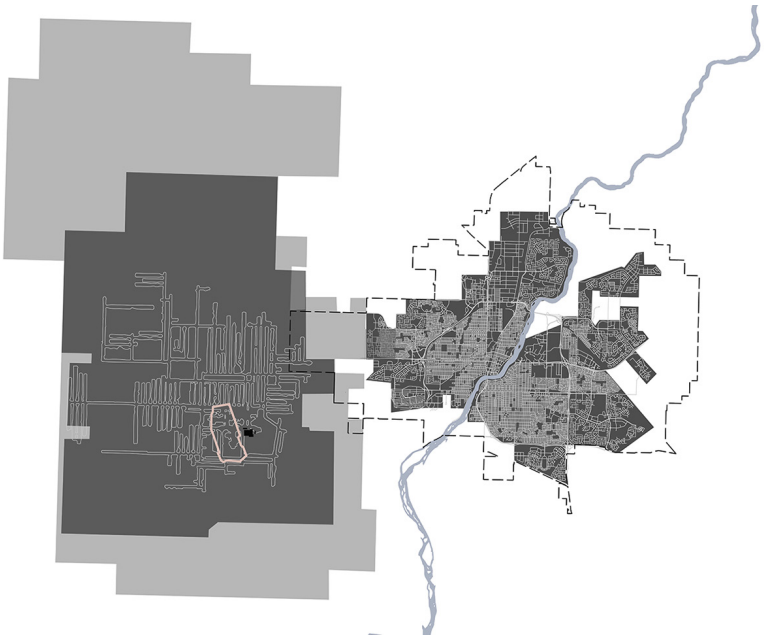
drawing on the history of its uses people are more inclined to address the issues.

Global Influences

The ability of Saskatchewan's agriculture and mining industries to contribute to the global market have consistently reinforced a sense of pride, feeding into Saskatoon's identity. Saskatchewan possesses 1/3 of the world's potash reserve (Broughton 2019, 1). This stake in the global market is a source of pride for producers and city residents. In 1909 Saskatoon opened the provincial university and agriculture



Saskatoon sits at the intersection of the potash reserve and the South Saskatchewan river (data from Fuzesy 1982).

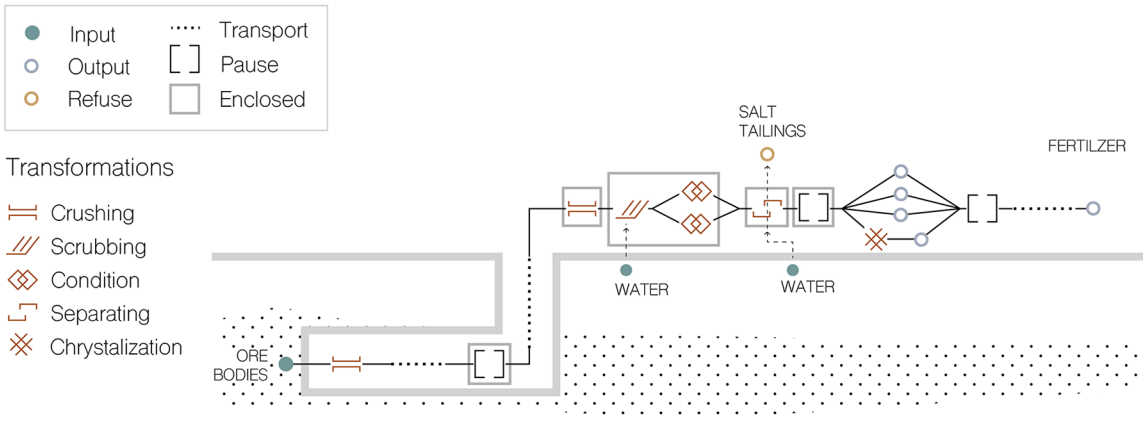


Cory potash mine splits ownership between the mine and the crown and the land area is almost double the size of the Saskatoon.

college, which remain prosperous programs. Today, agriculture in the Saskatchewan prairies predominantly consists of cereal crops such as wheat, rye and barley rather than produce; due to environmental conditions these are the most efficient crops. The global impact is evident in a monograph from 1915 which says: “Our farmers have done well for the country and the country has done well for them the crop of 1915 far more than paid for innumerable farms” (CIHM 1915, 5). The ability to contribute to the national economy was a sign of prestige and this continues to drive agriculture and mining operations today.

Plan of the potash’s surface waste in relation to the mining operation (base map from Google Maps 2021).

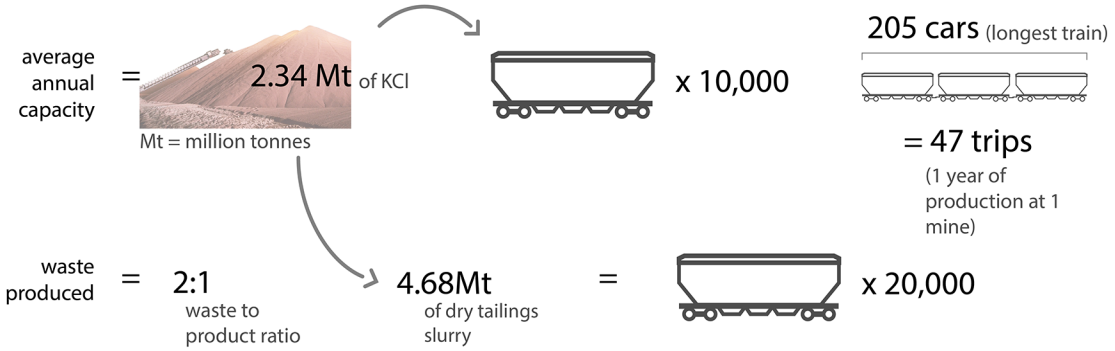
Connectivity to the global market makes these industries possible and ultimately governs them, resulting in the potash industry serving the surrounding city solely economically. Potash is the common name for a variety of naturally occurring potassium salts that are mined from deposits roughly 1000m deep in the earth. Potassium’s



The conventional mining process organized as a process of transformations, identifying the output of salt waste that can be reused.

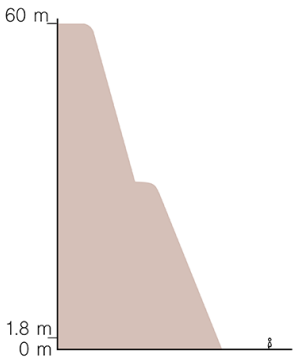
uses include: ammunition and soap but the main product is industrial grade fertilizers which accounts for 96% of total potash production (Fuzesy 1982, 4). However, Canada has no shortage of nutrient-rich land, which leads to exporting 95% of potash products (Broughton 2019, 1). The mineral was found in the Saskatchewan prairies in the 1930s and continuous production began in 1962 when market demand rose.

The mining process in Saskatchewan was adopted from Mexico, along with their by-product disposal techniques. Mexico benefits from little rainfall and high evaporation rates, whereas Saskatchewan has more rainfall and limited evaporation which compounds the amount of surface waste (Fuzesy 1982, 24). Conventional potash mining uses deep shafts to access the ore, boring machines break down the product and conveyor belts bring it to the main shafts to transport it to the surface. Once above ground the milling process consists of crushing, scrubbing, desliming, sizing, flotation and drying, and can include compaction and crystallization based on product type (Fuzesy 1982, 23). The average mine in Saskatchewan intakes 2.34 million



One potash mine will produce 4.68 metric tonnes of salt waste in one year that sits on the landscape with no intended use (data from Hart 1989).

cubic meters of water in one year and generates twice as much salt tailing waste as potash product (Hart 1989, 545). The water intake is from the river and cannot return due to salinization during flotation resulting in a slurry of salt waste and brine being pumped to tailing piles. Of the 11 mines in Saskatchewan, 8 use conventional mining techniques and 3 use solution mining. The solution mining process is becoming popular because it reduces surface waste, however it requires a larger water input due to the process of dissolving the minerals below ground and floating it back to the surface.



Height of potash tailing pile compared to human height.

The potash industry produces a large amount of waste but retains public pride because, removed from the city limits, it is out of public view. The tailing piles degrade the landscape and cannot return underground while rainfall compounds surface disposal, resulting in piles up to 60 m high (Hart 1989, 546). The disposal practice of this salt degrades the land. However salt has the potential for alternative uses. By incorporating industry which is already part of civic pride and transforming the negative waste product into something positive it can benefit the community. This approach encourages people who are already proud of an industry to get involved.

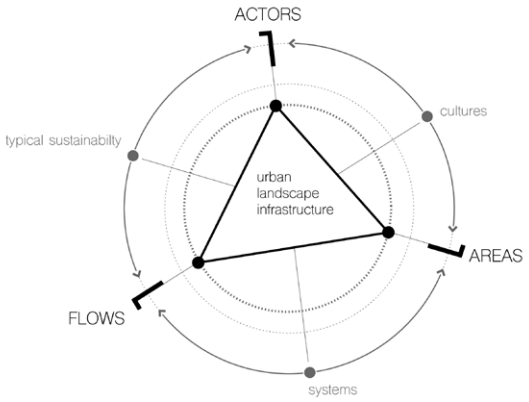
Chapter 3: Multi-Scalar Reconnection

This section outlines how the city, river and industry could be reconnected at some level, through design of urban landscape infrastructure at an important strategic spot in the city center. It addresses the river, community, and industry at multiple scales to connect to existing activities and to strengthen the network, through public program, a renewed river connection and the transformation of waste.

Integrated Systems Approach

Through the analysis of the dynamic relationship between the potash industry, the river and Saskatoon, it is clear that reinvigorating the downtown core must comprise a layered solution that ensures the large network and the human scale work. Landscape urbanism is “multiscaled and multilayered urbanism involving cultural, social, political, economic, infrastructural, and ecological conditions that are layered, tangled, and mutually dependent” (Lister 2010, 526), making this approach the optimal choice.

Urban landscape infrastructure focuses on the connection between actors, areas and flows as a triad where each has its own value and they work in unison. The key writers on this topic are Nijhuis, Jauslin and van der Hoeven (2016) and Stan Allen (1999). This approach considers spaces, people and material flows as moving parts that facilitate the positive creation of space (Nijhuis, Jauslin and van der Hoeven 2016; Allen 1999). By designing the relationship of flows and areas that prioritize people it can “facilitate aesthetic, functional, social and ecological relationships between natural and human systems” (Nijhuis, Jauslin and



The Urban landscape infrastructure approach combines all relationships between actors, areas and flows rather than focusing on one relationship set.

van der Hoeven 2016, 7) resulting in dynamic spaces. The goal is to create multi-scalar entities that disrupt the typical linear fashion of infrastructure (Allen 1999), changing from the current single focus production mindset into integrated entities. Urban landscape infrastructure integrates elements from cultures and systems approaches to better design meaningful interactions and sustainable networks.

Adjacent approaches based on one relationship set: behaviours, systems or cultures would not address the complexity of the industry-to-city relationship. Current sustainability approaches are embedded in metric-based behaviors perspective that focus on individual member's actions (DeKay and Bennett 2011, 49). This approach can be considered as focusing on the actors and flows relationships, which can appear overly prescriptive in implementation. The systems approach looks at patterns of form that order ecological and social relationships that prioritize a network (Haney [1984] 2001; Hebel, Wisniewska and Heisel 2014; Meadows 2008). It focuses on flows and areas but has the potential to neglect the human scale. The cultures perspective successfully considers subjective qualities of space, that encompass the actors

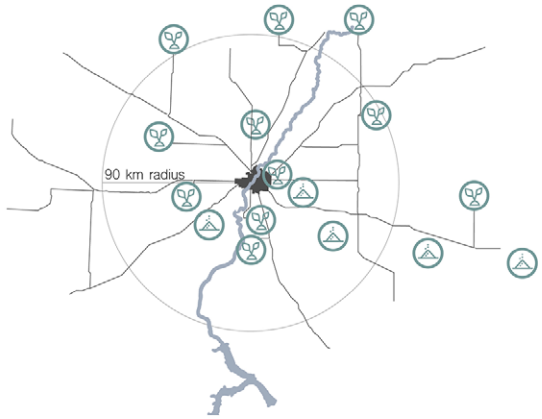
and areas relationship. It focuses on shared meaning and understanding through people interacting with each other and the environment (DeKay and Bennett 2011). However, it lacks the consideration of flows to create a cohesive network.

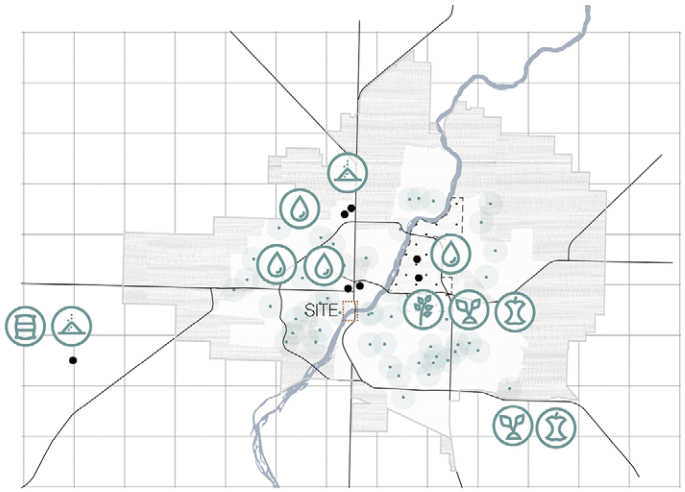
Granville Island in Vancouver is an example of reintegrating industry, water and community, and is the primary reference for implementation of this project. Granville island successfully intersects productive industry, water and social space through connecting histories, visibility, and adaptability, contributing to the goals for this project. Granville Island intersects industry with public space, and re-uses existing buildings wherever possible. Following this lead, industry in Saskatoon can re-enter the public realm of downtown. The public spaces on Granville island orient towards subcultures of the local area through the programs for ‘foodies’, boaters, and artists (Holland 2018). Views into workshops and out to the water allows people to locate themselves and creates continued interest by experiencing industry at work. Granville island is an example of how active programs generate public involvement and that histories can be celebrated both in buildings and activities.

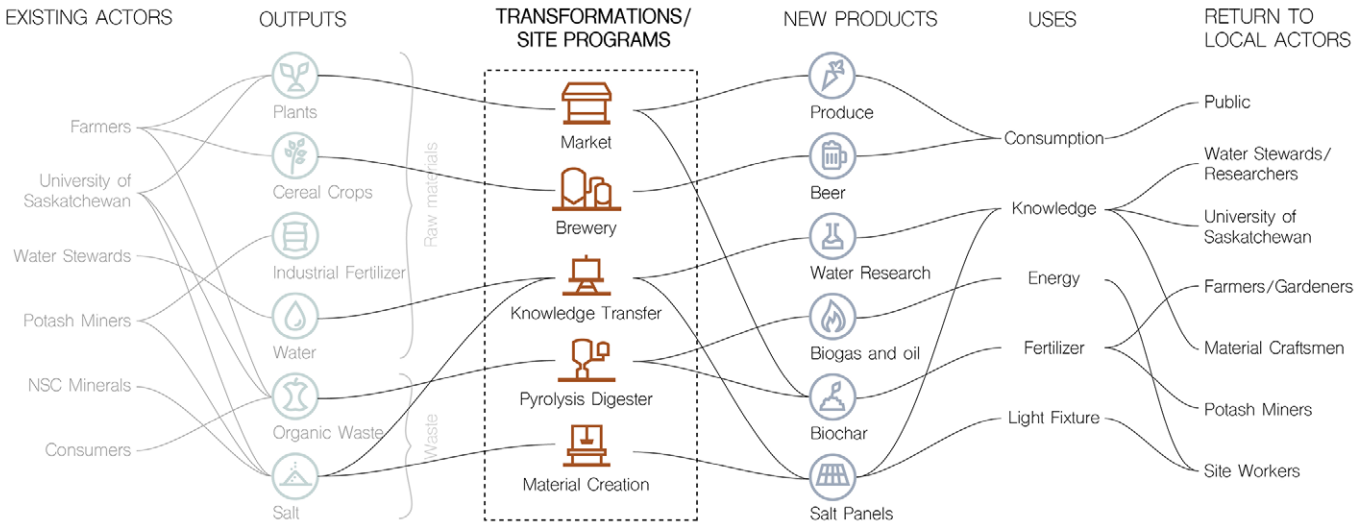
Granville island mediates between water, industry and public program (images from Google Maps 2017).

Community Connection Through Program

Building on existing programs and local actors in Saskatoon, this project will act as a node for reconnecting at the city scale. The dominant programs identified as contributors to relinking are: the potash industry and NSC minerals (a potash waste company which processes road salt); a local farmer’s market and municipal water stewards. Finally, the university, which is active in both agriculture and water stewardship initiatives would provide learning on site.







Identifying the existing actors and products in and around the city of Saskatoon to connect actors to each other through the reuse of their outputs and link to the existing netwrok.

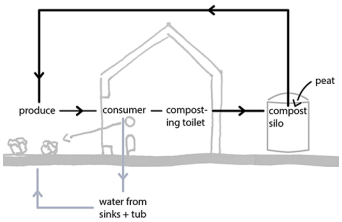
Outputs from existing actors are identified and brought into the site to contribute to the local network. This approach connects people from diverse backgrounds while the inclusion of existing actors ensures the projects use.

The programs that transform products are the following:

- a market to sell local farmer's produce;
- a brewery which uses one of the main agriculture products wheat;
- a pyrolysis digester that transforms compost from the market and farmer's excess produce into biochar, which can be used as fertilizer;
- material creation which transforms salt from potash mines;
- and finally, a program of knowledge transfer which incorporates the university, NSC Minerals, water stewards and other researchers to foster learning about different aspects of the processes, the history and the opportunities of the site.

The program of public market creates links to the history of Saskatoon as a garden city, and connects the existing network of farmers to the city creating deeper community connections. The non-profit organization Saskatoon's Farmer's Market has coordinated the connection between small-scale farmers and the city for over 45 years (Saskatoon Farmers Market 2019). Infrastructure fosters the networks of movement, communication and exchange (Allen 1999). Summer 2020 was the last season that the Saskatoon Farmer's Market spent at its location downtown. It inhabited the site north of the A.L. Cole power plant and a portion of the adjacent parking lot for 13 years, serving the area of Riversdale. Flows must suit the local situation (Nijhuis, Jauslin and van der Hoeven 2016, 59). The market

worked to counteract the food desert status of the area and this central location in the core of the city as the site of the market should be re-established.



Lebrechte Migge's closed loop garden design.

At the one-to-one scale, the market can provide returns to farmers through the creation of biochar. The closed loop market process draws inspiration from Lebrechte Migge's zero waste garden-to-house cycle to create a closed loop system. The notion that matter cannot be consumed and is instead in a state of transformation is echoed in McHarg's writing and Migge's garden design (McHarg 1971). The proposal for the New Frankfurt garden ensured zero space was wasted and focused on limiting external inputs (Haney [1984] 2001 153). Following this approach, the farmer's market provides produce for locals and returns compost. The compost is transformed into biochar and then used as soil nutrients for agriculture, feeding the produce that supplies the market and it can also be used to remediate degraded soil from potash waste.

Connection to Natural River Through Siting

Reconnecting the river at the city scale involves amplifying the river as a key protagonist in the project. "The value of a living world, above its inherent right to being, is obviously that all higher beings depend on it. Destroy Nature and culture tumbles" (DeKay and Bennett 2011, 81). Nature, or in this case the river, is the building block of the city. It enabled development and continues to be the only large viable water source for the area. It therefore requires higher consideration and maintenance. As climate change intensifies, Saskatoon will experience inconsistencies in river conditions, such as storm surges and droughts. Existing river advocacy includes the Water Security Agency (WSA) and the South

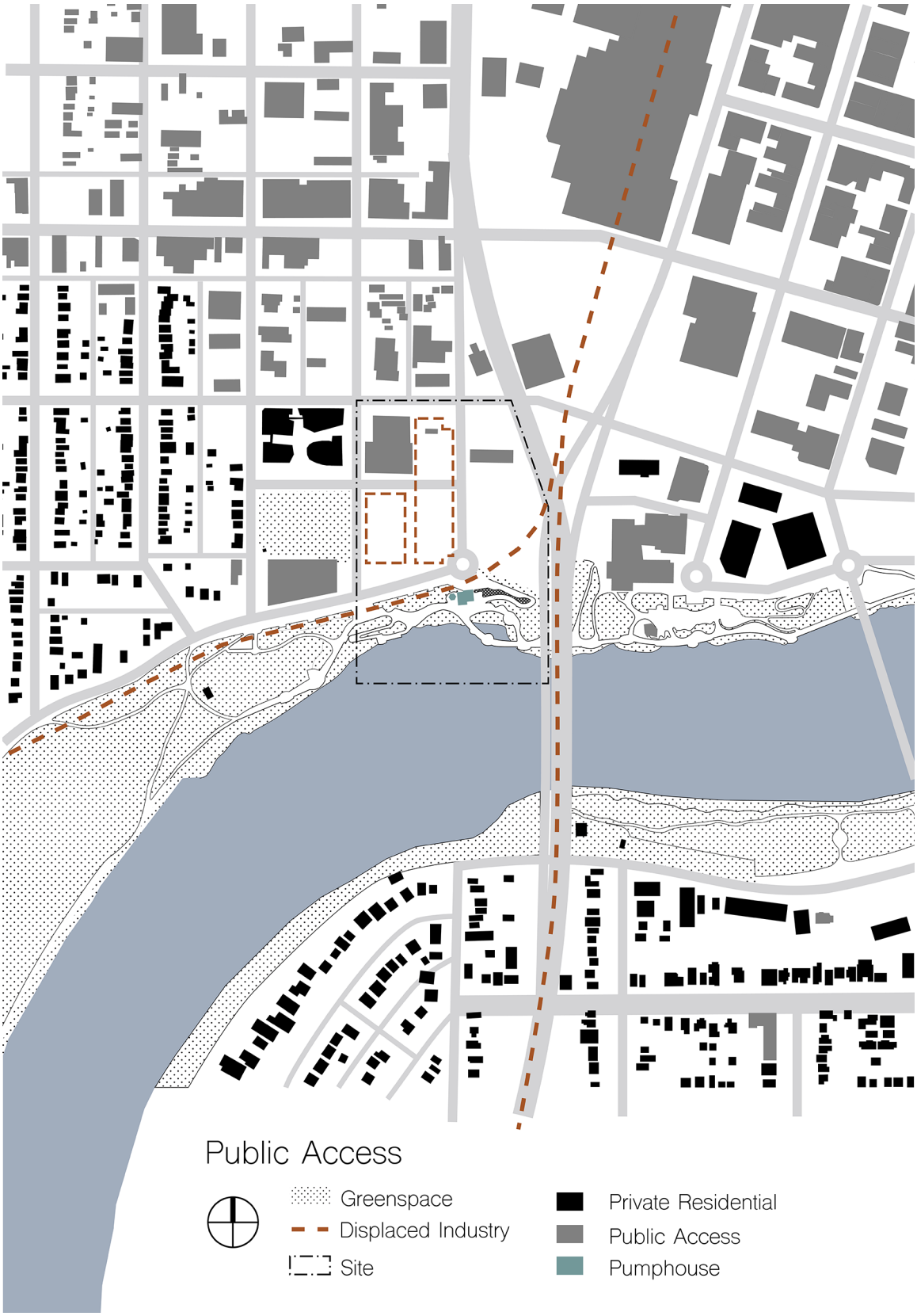
Saskatchewan River Watershed Stewards (SSRWS), but they are both located away from the river. These programs should be relocated along the river to generate public interaction with the process of water advocacy.

To create meaningful integration between the community and the river, histories need to be included while responding to current community needs. The goal for architecture is to exhibit ties to the region while establishing its local identity (Nijhuis, Jauslin and van der Hoeven 2016, 23). Integrating histories can be done through siting the project at the original connection point of the three villages. This site is adjacent to the previous market location, historic water uses can be reinserted and the site is currently underutilized occupied by a parking lot. The site borders the river, downtown and residential neighborhood, providing access from multiple points.

Interactions at the human scale involve broadening the perceptions of nature. By providing different river interactions it allows each person to have a relationship to nature no matter their perspective on it, and allows them to change their own relationship to the feature (DeKay and Bennett 2011, 348). To do this, the river's direct use and value as a view is acknowledged while reintroducing the historic uses as pathway, resource, and social gathering. If people have a stronger personal connection to the river it will hopefully lead to higher consideration for the resource.

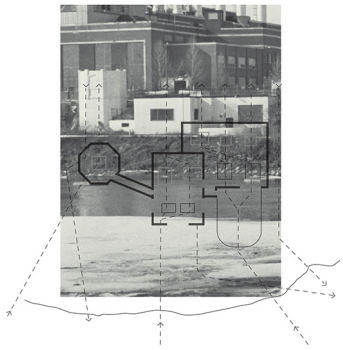
Linking Industry Through Historic Connection

At the city level potash mining and NSC minerals create the connection of industry to Saskatoon. The potash waste in Saskatchewan is already used by NSC Minerals. They transform tailings into: highway de-icing, feed salt



Site on the edge of downtown and a residential neighborhood, highlighting displaced industry and the remaining pumphouse.

for livestock, hide curing, drilling mud, water softening, road stabilization, and wellness products (NSC Minerals n.d.). However the production by NSC does not keep up with yearly waste rates and the process of transformation is machine driven. There is opportunity to incorporate the expertise from NSC Minerals in creating new transformation processes that would involve the public.



Collage of the pumphouse's connectivity to the water (base image from Crosby, Kindrachuck Agrey Architecture and Aldrichpears Associates 2008).

At the scale of the site, historic, present and goals for the future connect industry to the community. Incorporating the expertise from NSC Minerals to transform wasted salt materials connects to current industry. Converting the A.L. Cole pumphouse into a useable public building connects to historic industry. Finally working processes paralleled with community spaces downtown becomes the goals for the future relationship between industry and the community.

Using salt from the potash industry can raise awareness for environmental issues. The definition of waste is often linked to emotions and clouds the ability to imagine something new (Hebel, Wisniewska and Heisel 2014). By using potash waste as a building material, and displaying it people can see and interact with waste as something useful. Hebel, Wisniewska and Heisel argue for waste's potential as a building material:

> Their use, continued reuse, and capacity of substituting other materials could become crucial factors in creating identity and local spirit as well as resource efficiency, and in making urban systems resilient by introducing local value chains and decreasing the dependency on foreign imports. (Hebel, Wisniewska and Heisel 2014, 19)

Although the project cannot fully address the amount of waste from the potash industry, providing interactions with salt and displaying it can raise awareness of the waste issues.

Through direct handling of the material, users take pride in making salt products. People are the actors that facilitate change and their integration within the project and role in the process is central (Nijhuis, Jauslin and van der Hoeven 2016, 59). Providing agency for people to transform waste contributes to social value through the process of collective making and environmental value by developing alternative uses for waste.

Chapter 4: Exploration

This section explores the creation process of salt materials and following this uses a language of transformations that develop the design strategy. The material application of salt within the context of this project develop through a series of experiments. The design strategy translates the process of material creation along with the other site programs to spatialize the programs on site.

Craftsmanship of Salt

The experiments aim to develop an application for the salt that creates intrigue and gives new life to this waste product. Although the use of potash tailings as a building material is not practiced, the substance consists of 90-96% salt (NaCl), therefore the approach to material testing draws from salt architecture. Some applications of salt are as phase change materials, cut blocks from compressed salt flats occurring in Bolivia, and 3-D printed salt structures. The critical features of salt materials are its compressive strength, thermal properties but its weaknesses are water and tensile forces. Two designers that use salt are Emerging Objects and the MIT Mediated Matter Lab. Emerging Objects through 3-D printing created a waterproof salt structure and a self-growing salt structure (Rael and San Fratello 2018). The Mediated Matter Lab's work with water based digital fabrication provides insights for planned biodegradability.

The salt from potash mines is up to 96% salt, the remaining composition has minerals such as potassium, calcium and magnesium. These are common minerals in clay and create the pink hue of the salt. The salt products vary by mine because of the mines' different processes and

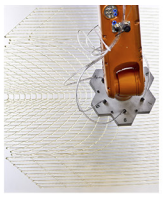
Salt Hotel, Salar de Uyuni, Bolivia

Alireza Emtiaz Restaurant in Shiraz

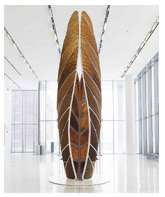
Emerging Objects Saltygloo

GLASSXchrystal phase change windows Domat/Ems

Emerging Objects



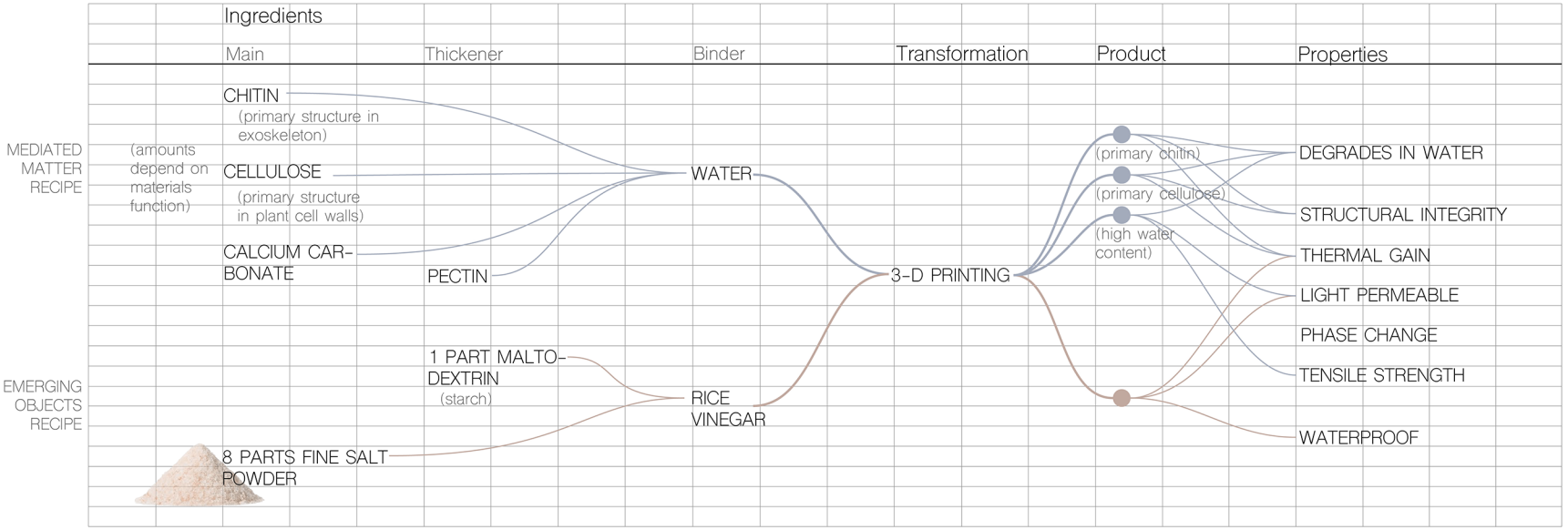
Mediated Matter Lab Water based digital fabrication



Mediated Matter Lab Aguahoja

SALT — WATER

Densified — Reconfigured — Transformed — Cultivated — Designed



The variety of applications and opportunities of salt as architecture; photography by Emerging Objects (Rael and San Fratello 2018).

soil conditions. NSC minerals also performs additional processing on the salt for their own uses. The variety of salt consistencies were considered during the creation process.

The three experiments use different methods and binding agents. One approach from Rael and San Fratello (2018) and one from Materiom (Gillies 2018). The experiments are done in sequence, intentionally building on the last. This progression emulates the maker space program were the material opportunities would develop as knowledge grows.

Experiment 1: Coarse Grain and Gelatin

The first experiment explores the lighting qualities of salt and uses a gelatin composite recipe from Materiom (Gillies 2018).

Vanscoy Coarse (Compacted) | Vanscoy Standard | Rocanville Coarse | Rocanville Standard

Salt from mines near Saskatoon provided by NSC Minerals, variety in color and consistency based on the mine of origin.

Materials: glycerol, gelatin, water, coarse grind salt and a mould.

Method

1. Dissolve gelatin and glycerol in cold water.

2. Heat the mixture until it thickens.

3. Add the gelatin mixture to coarse salt until just coated, over pouring will create inconsistencies in the texture of the block.

4. Pour mixture into mould.

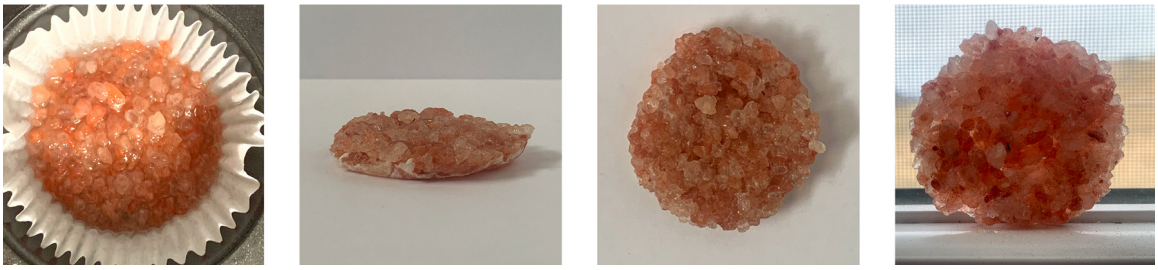
5. Let harden for at least 24 hours.

Findings

The mixture was slow to dry, taking over a week to completely harden. This can be avoided by using less glycerol mixture relative to salt. Additionally, removing the substance from the mould earlier to expose more surface area would speed up drying time. The resulting composite is weaker than expected and more opaque than desired. It allows limited amounts of natural light through the surface.

Experiment 2: Fine Grain and Rice Wine

This experiment uses fine ground salt and a 3-D printing material list. It explores the compressive strength of the composite, in response to the weakness in the first



Salt mixing process, the results and a light study (Dimensions 2” x 2” x 0.25”).

experiment. Experiment two casts a variety of thicknesses and tests the addition of course salts.

Materials: Vanscoy Standard (fine ground) salt, maltodextrin powder, rice wine, Rocanville Coarse salt, and a mould.

Method

1. Mix finely ground salt (8 parts) with maltodextrin (1 part) thoroughly.

2. Slowly add rice wine until mixture is wet but not overly saturated.

3. Add the mixture to the mould:

a) Experiments 2.1. and 2.3. No additions, press mixture into desired mould, compress block as much as possible.

b) Experiment 2.2. Mix in coarse ground salt, then press mixture into mould.

c) Experiment 2.4. Press fine ground salt and rice wine substance into mould. Add a layer of coarse salt, followed by another layer of fine salt mixture. Repeat layering, pressing between each round. Finish with fine salt mixture.

4. Let composite dry for 48 hours.

5. Pull off exterior edges of mould carefully and allow the composite to dry for additional time, at minimum 24 hours.

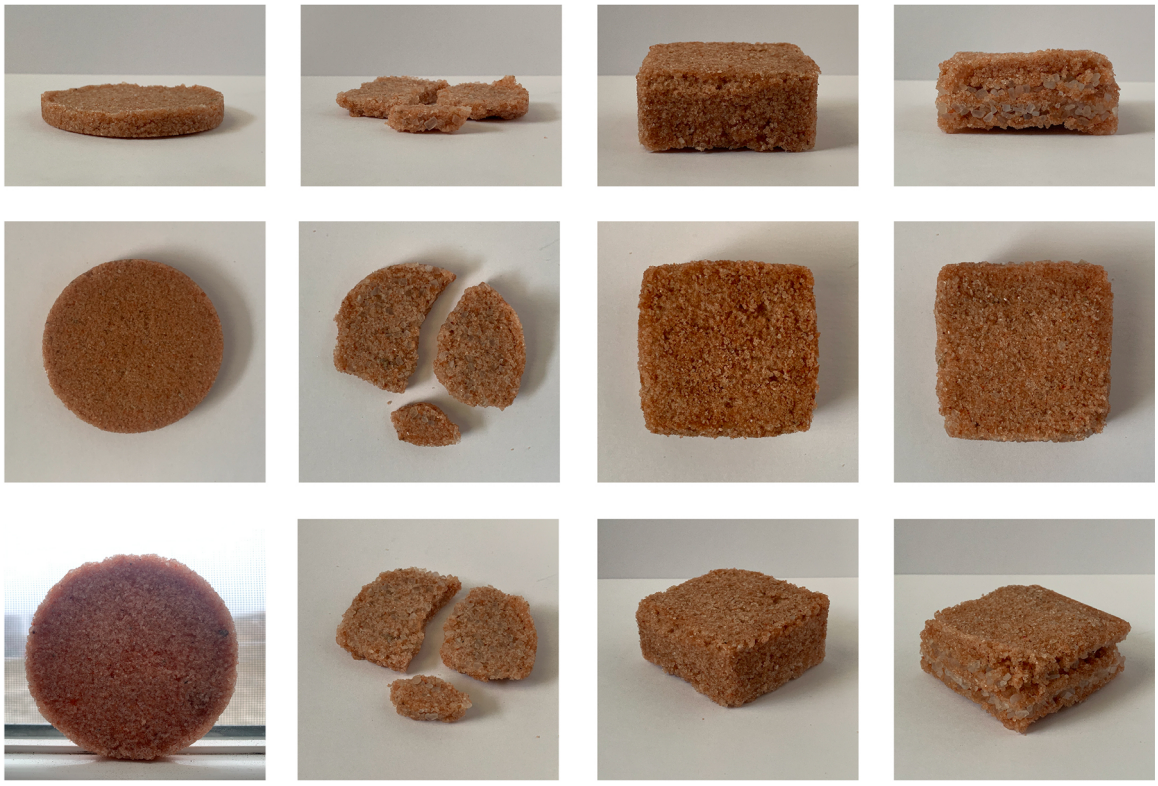
Mixing salt, maltodextrin and rice vinegar then placing in moulds.

6. The final product is left natural but a finish could make the material waterproof or increase compressive strength.

Findings

Experiment 2.1. The object de-moulds successfully because it is thinner than the other composites which allowed it to dry thoroughly. It has less transparency than experiment one due to the fine grain salt and the opaque maltodextrin.

Experiment 2.2. The piece broke due to the addition of course salt. The rice wine is not a successful binder with course salt so the composite became brittle.



2.1. Vanscoy Standard only.
Dimensions:
3” x 3” x 0.25”

2.2. Vanscoy Standard and Rocanville Coarse Mixed.
Dimensions:
3” x 3” x 0.25”

2.3. Vanscoy Standard only.
Dimensions:
3” x 3” x 1.25”

2.4. Vanscoy Standard and Rocanville Coarse Layered.
Dimensions:
3”x 3”x 1.25”

Fine grain salt bordering on opaque in the sunlight but has potential as a thick brick structure while the application of adding coarse salt is less successful.

Experiment 2.3. It retains its shape although it takes significantly longer to harden because of the thickness.

Experiment 2.4. The brick loses its shape around the edges because the layers are too thin. The layer of course salt does not stick to itself as the binding agent does not bond to the coarse grind. In the future the course salt would benefit from its own binding agent to retain shape.

Experiment 3: Layering Grains and Binders

Building on experiment one and two the third experiment uses multiple salt sizes, incorporates the light qualities in the first experiment and uses both material palettes with the different binding approaches to create a layering that effectively supports multiple grain sizes.

Materials: Vanscoy Standard (fine ground) salt, maltodextrin powder, rice wine, Rocanville Coarse and Standard salt, glycerol, gelatin, water, and a mould.

Method

1. Dissolve Rocanville standard salt in water that is just below boiling point. This removes the clay and other material particles that give the salt its pink color.

2. Remove as many clay bodies as possible from water and leave the mixture for 48 hours. This allows the water to

The process of separating salt from clay bodies using warm water to get white salt.

evaporate while the salt multiplies, resulting in a primarily white salt.

3. Grind the white salt and Vanscoy Standard salt to a fine powder, keeping them separate.

4. Using 3 different bowls create the salt mixtures:

a) Following instructions for experiment one create the glycerol, gelatin and water mixture. Then apply this to the first bowl with course grind Rocanville salt.

b) Mix together the ground Vanscoy Standard salt (8 parts) with maltodextrin (1 part), then add rice wine until salt is wet.

c) Mix together white salt (8 parts) with maltodextrin (1 part), then add rice wine until salt is wet, careful not to oversaturate.

5. Using a flatbed mould spoon one mixture at a time in, compressing each layer as it progresses.

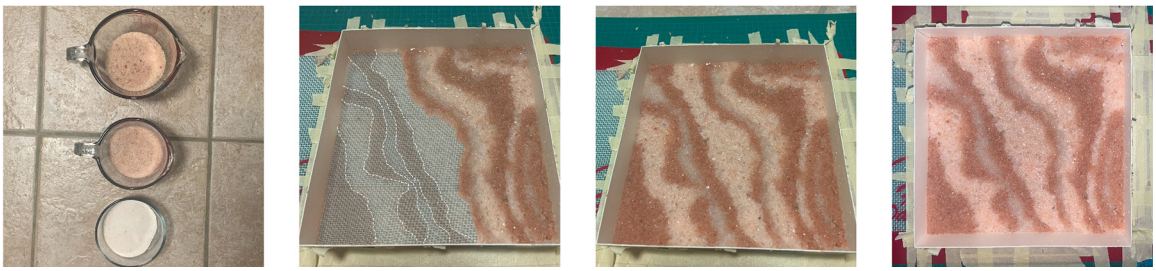
6. Continue layering the different salt mixtures to create desired patterns.

7. Allow mixture to dry for 48 hours.

8. Remove sides of mould, gently flip the panel over and leave for an additional 24 hours to ensure proper drying.

Findings

The two different material methods layer well and bond together. The different salt coarse successfully create



The process of layering the three different salt colors in a flat mould, layer by layer.

3.1. Dimensions:
3” x 3” x 0.25”

3.2. Dimensions:
3” x 3” x 0.25”

3.3. Dimensions:
5” x 5” x 0.25”

3.4. Dimensions:
6” x 6” x 0.5”

Variety in patterning demonstrates the ability to create unique panels, the last two rows demonstrate the superior light effect from artificial light compared to ambient daylight.

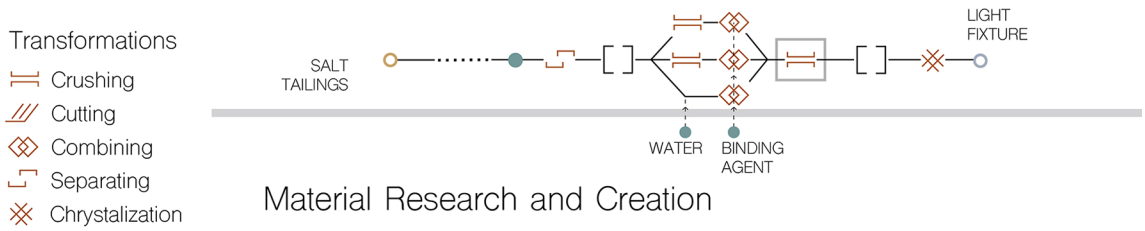
multiple qualities of light within the panel. The thicker grain allows more light through than the fine grain. Also the panels are more vibrant when using artificial light rather than daylight.

If the experiment were redone it may be more successful if the mould was upright to allow direct pressure down on each layer and easy removal of the long sides to improve drying time.

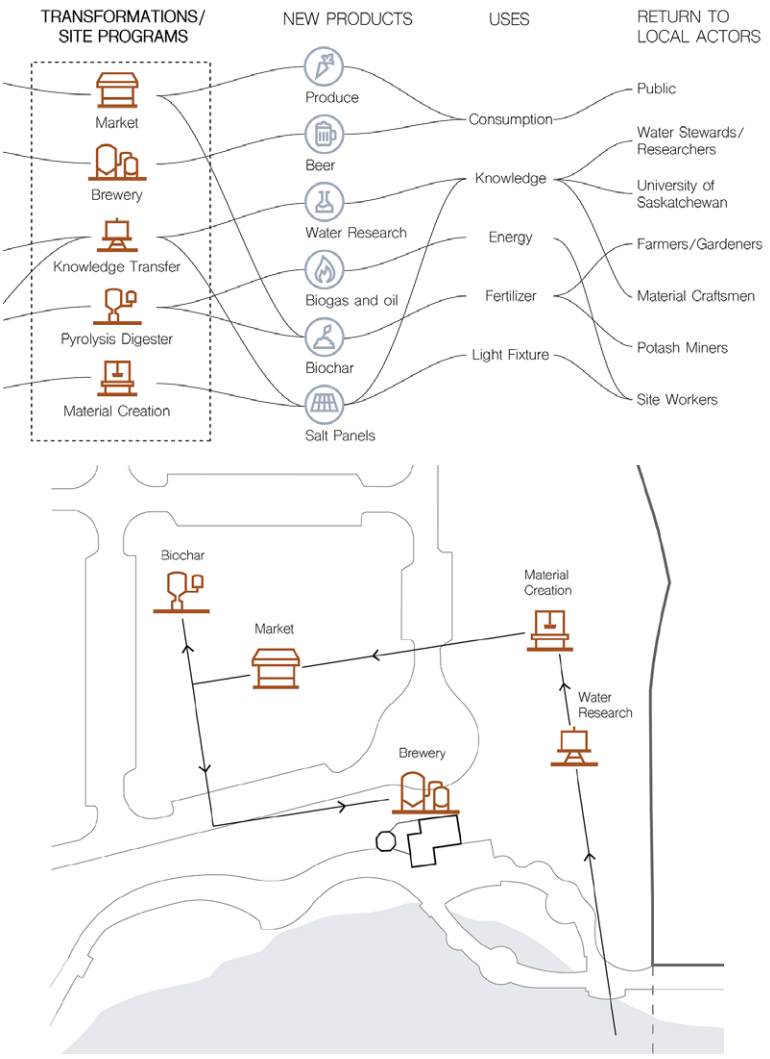
Transformations as Design Strategy

The design strategy involves translating processes from different programs into a common language. The project is the area of transformations, where inputs from various actors – established in the previous chapter – are brought to site and remade to contribute to the local economy. This follows the influence of Stan Allen to create a hierarchy in patches of programs and corridors that circulate flows of movement, services and functions (Allen 1999, 74). The products of resource outputs flow between individual program pieces to connect the site.

By aggregating the processes as transport, pause, and transformations such as crushing or combining, the programs can easily map onto the site to find intersections between the diverse processes. Salt waste from mining comes to

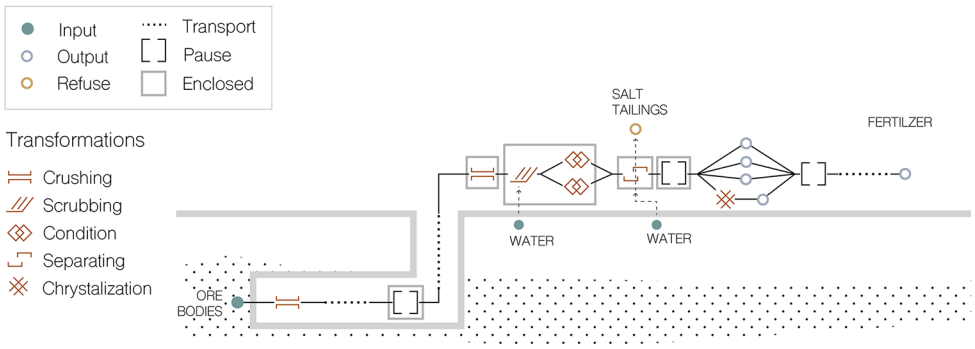


Process of creating salt panels as a series of transformations, used to develop the program of the maker space.

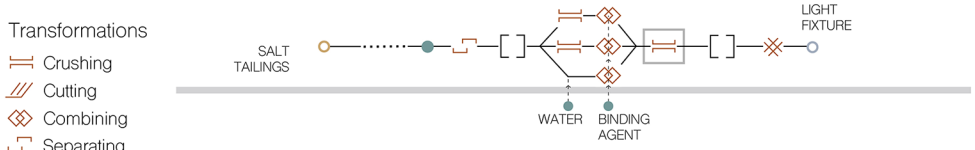


Revisiting the transformation programs to place them on site based on major product flows.

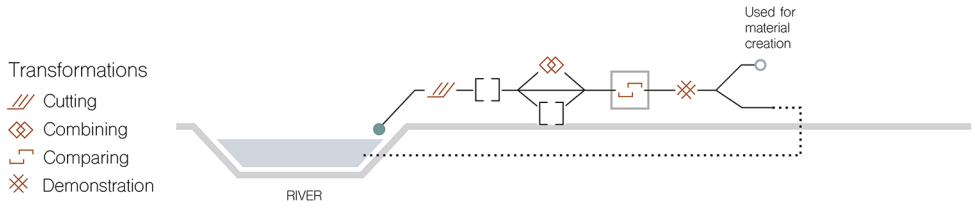
site and goes through research run by the university or the material creation. The maker space is laid out according to the processes in experiment three and the space develops as knowledge about salt grows. The water stewardship lab takes water from the river for research that contributes to material creation, to improve the river's water quality and they create exhibitions for public interaction. The farmer's market circulates fresh produce to people and the compost goes through a pyrolysis digester. Here the biomass is heated with little or no oxygen to drive off gases and leave



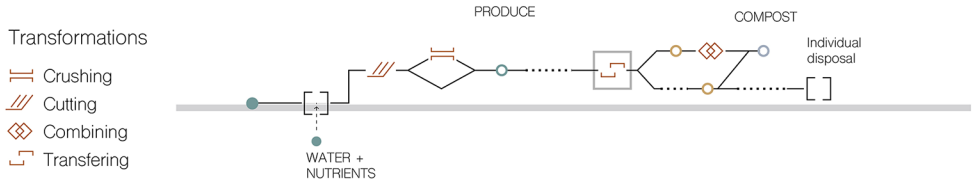
Conventional Potash Mining



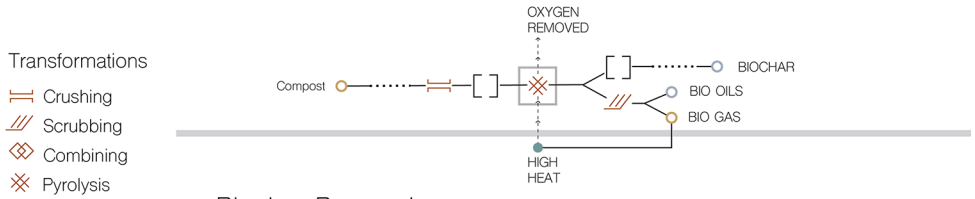
Material Research and Creation



Water Research



Farmer's Market



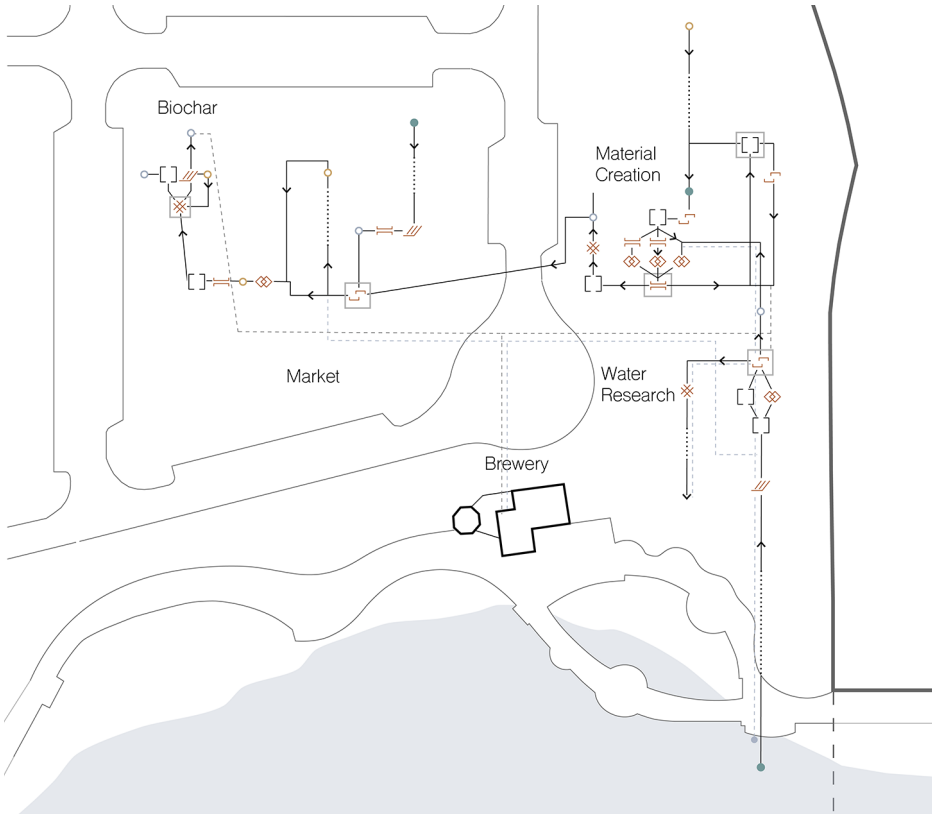
Biochar Processing

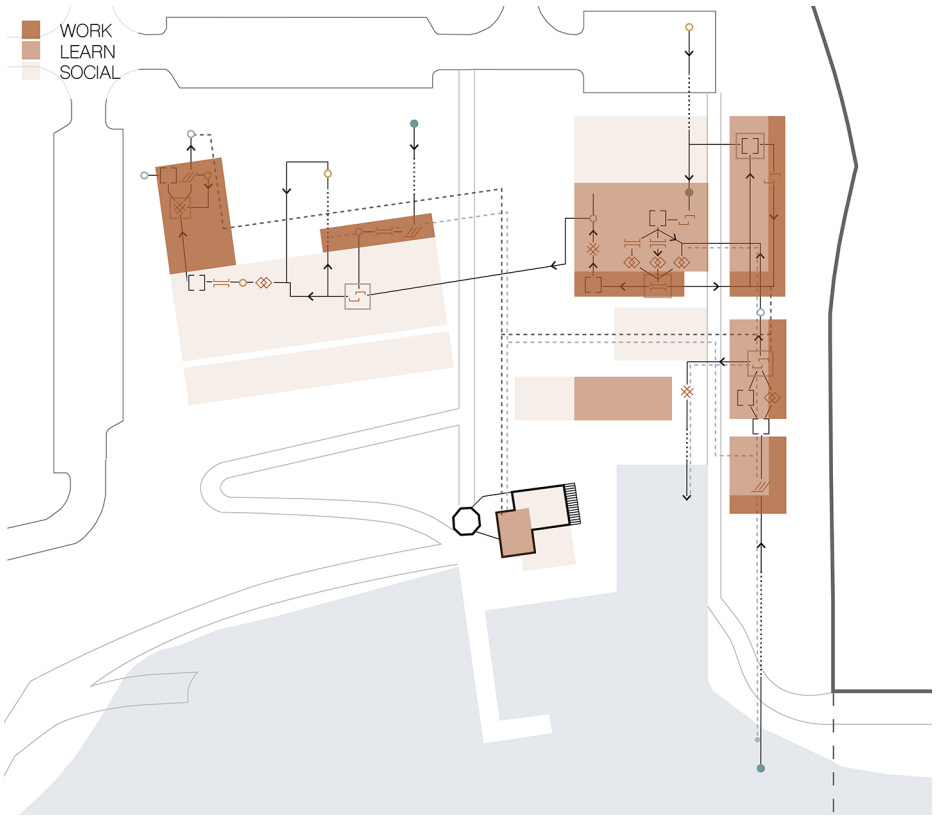
The process of each program focusing on their unique inputs and outputs while the transformations are have a consistent language.

behind carbon, which serves as a good soil nutrient. The process also results in bio-gas and bio-fuel which are clean energy products that can be reused for the biochar's heating process and some of it can be used elsewhere on site.

The programs integrate waste cycles, transform perceptions and connect people to the environment. During the design of space program plays a key role in ensuring the project is used by the public. "Individual patches are programmed in relation to access, adjacency, and proximity to service" (Allen 1999, 74). The primary programs of market, water research, material creation and brewery connect through the input of resources and each provide a useable output from their process. The closed loop on site focuses on the reuse of waste while the programs are intended as an extension of the city's existing networks.

The different program areas are additionally zoned for levels of public interaction characterized as working, learning and social activities. This provides different activity types for actor groups of workers, consumers, or engaged public to come together. These programs respond to the city context, interact with each other and involve local actors while design links these programs to the context of the site.





Spatializing the process flows on the site creating further links between programs and categorizing areas based on levels of public interaction.

Chapter 5: Design

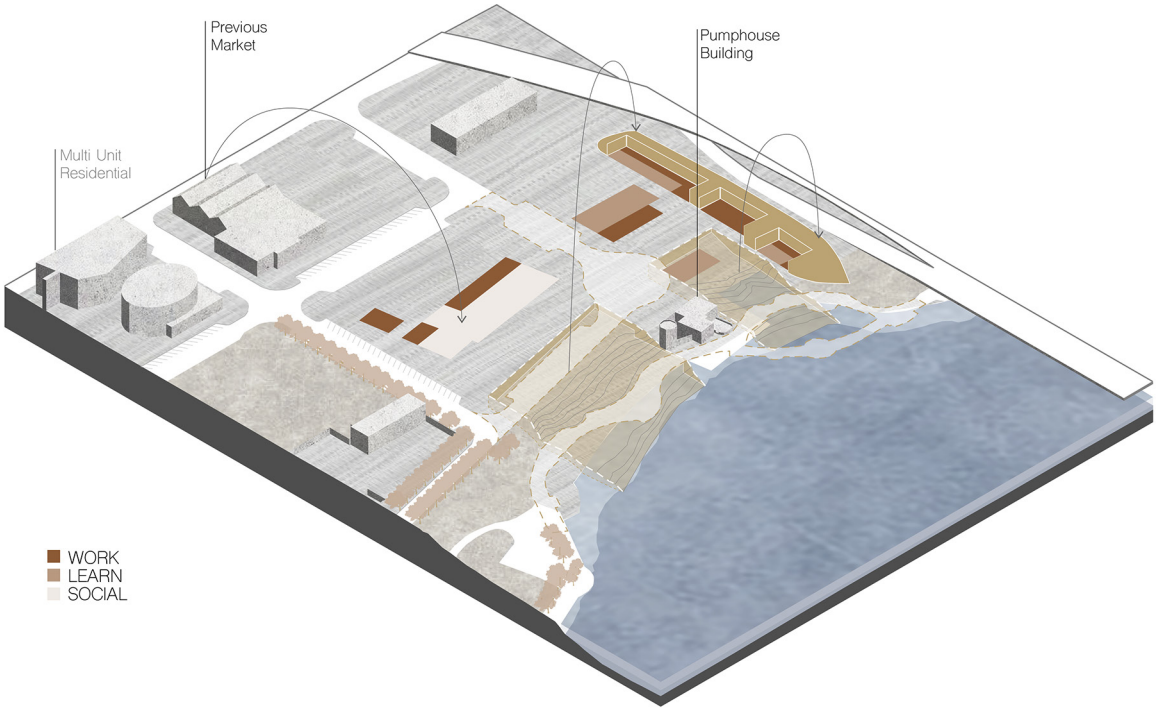
Wish image of the potash industry and river trickling down into programs at the bottom that support the community.

This section is the architectural response to re-linking industry and the river to the community. The design prioritizes circulation and access, creates transparency between program areas and provides the space for local materials to tell stories, adapt over time and foster social connections.

Access and Connection

The first part of the proposed intervention amplifies existing pathways and connects to nearby buildings to reinforce connections to the city. The main access roads surrounding the site and the pedestrian path bordering the river are accommodated. Revising the river bank to create direct access to the water while incorporating the pedestrian throughway creates new interactions with the river that do not disrupt the parallel flows. Earth excavated from the river bank is moved to the east of the site creating a berm that acts as a buffer to the bridge traffic. The old market and pumphouse further root the project in this site. The displaced farmer's market is located directly north of the site, again serving the neighborhood affected by its removal, while the pumphouse building to the south is reused as part of circulation, a lookout point and public program element.

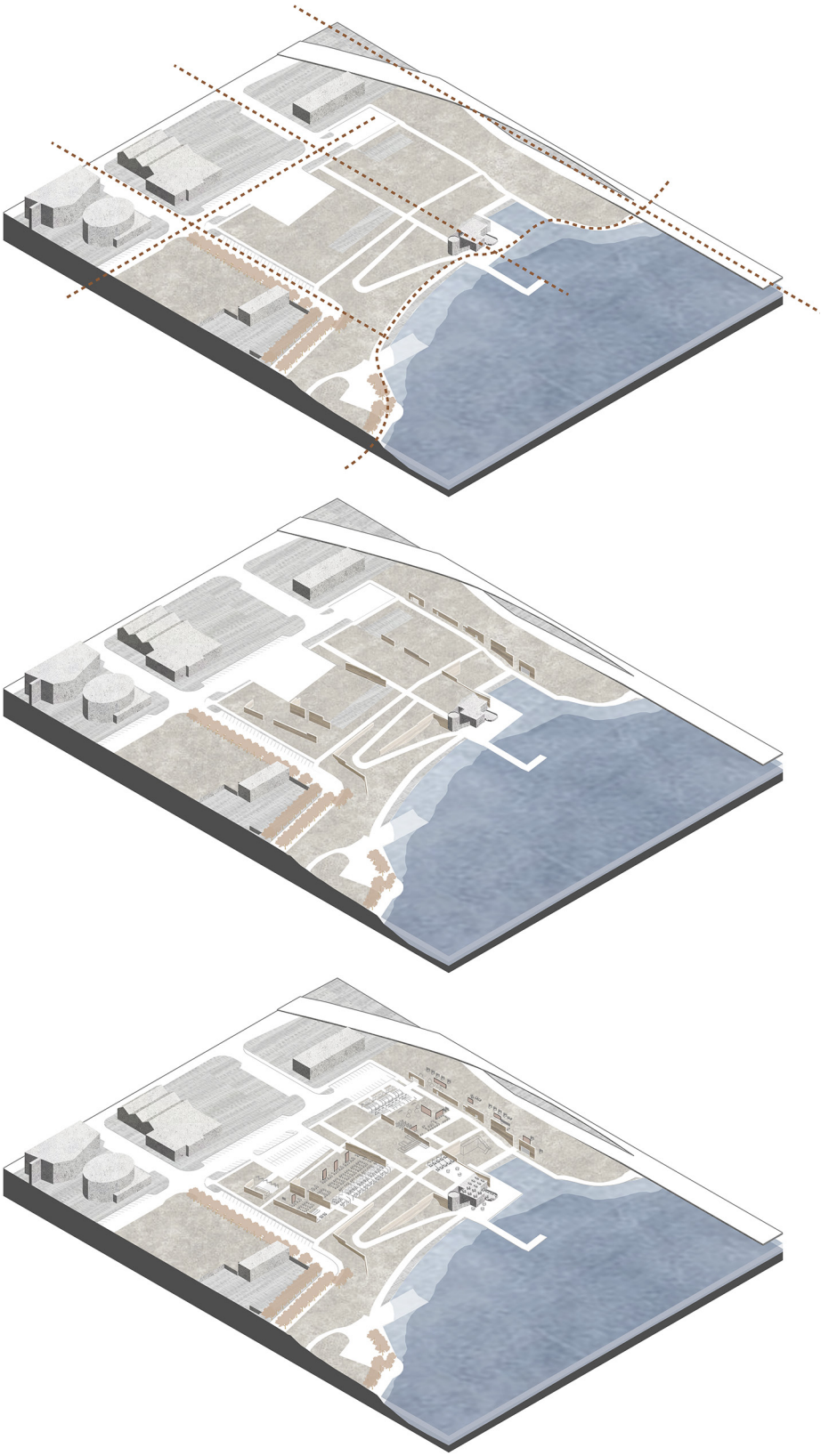
Reconnection strategies build on the existing conditions to guide the implementation of new features. The roadway down the center of the site becomes a pedestrian pathway slowing the pace of traffic on the way to the pumphouse, while still maintaining this axis. The pumphouse becomes a brewery dubbed the 'salt cellar' and beyond this a loading dock extends into the water continuing the central



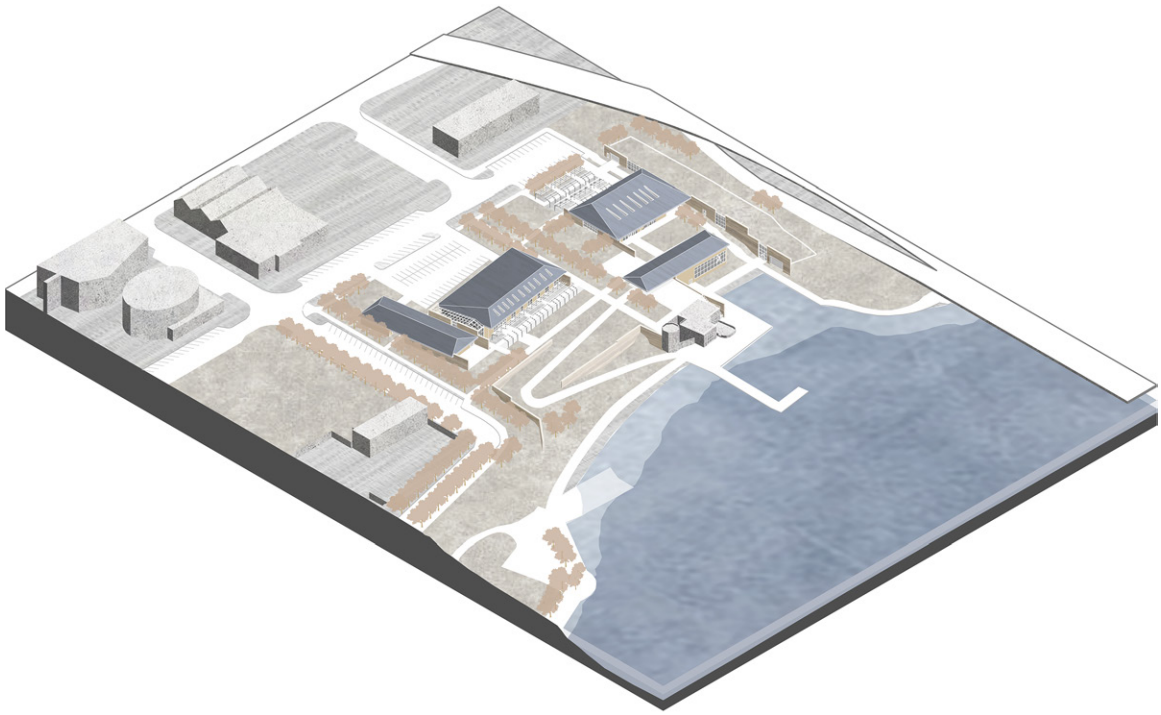
Excavation of the site to create perpendicular access to the river while respecting existing paths and surrounding structures.

procession. Additional paths cross the site providing access between programs and multiple site entry points. Respecting the circulation flows, rammed earth walls orient areas towards the river and create continuity between interior and exterior spaces. Fixtures, furniture and equipment (FFE) slot in-between the walls to facilitate program. The roofs sit lightly on the rammed earth walls and extend past in certain locations, which helps create areas of program that are not restricted to interior spaces.

The program requirements and their relationships to each other develop the remaining details of the site. Access is provided from both ends of the site; to the north, car parking accommodates city traffic while the south provides boat docking. The public market to the east borders the residential neighborhood Riversdale and is skewed towards the pumphouse. The orientation also relates to the



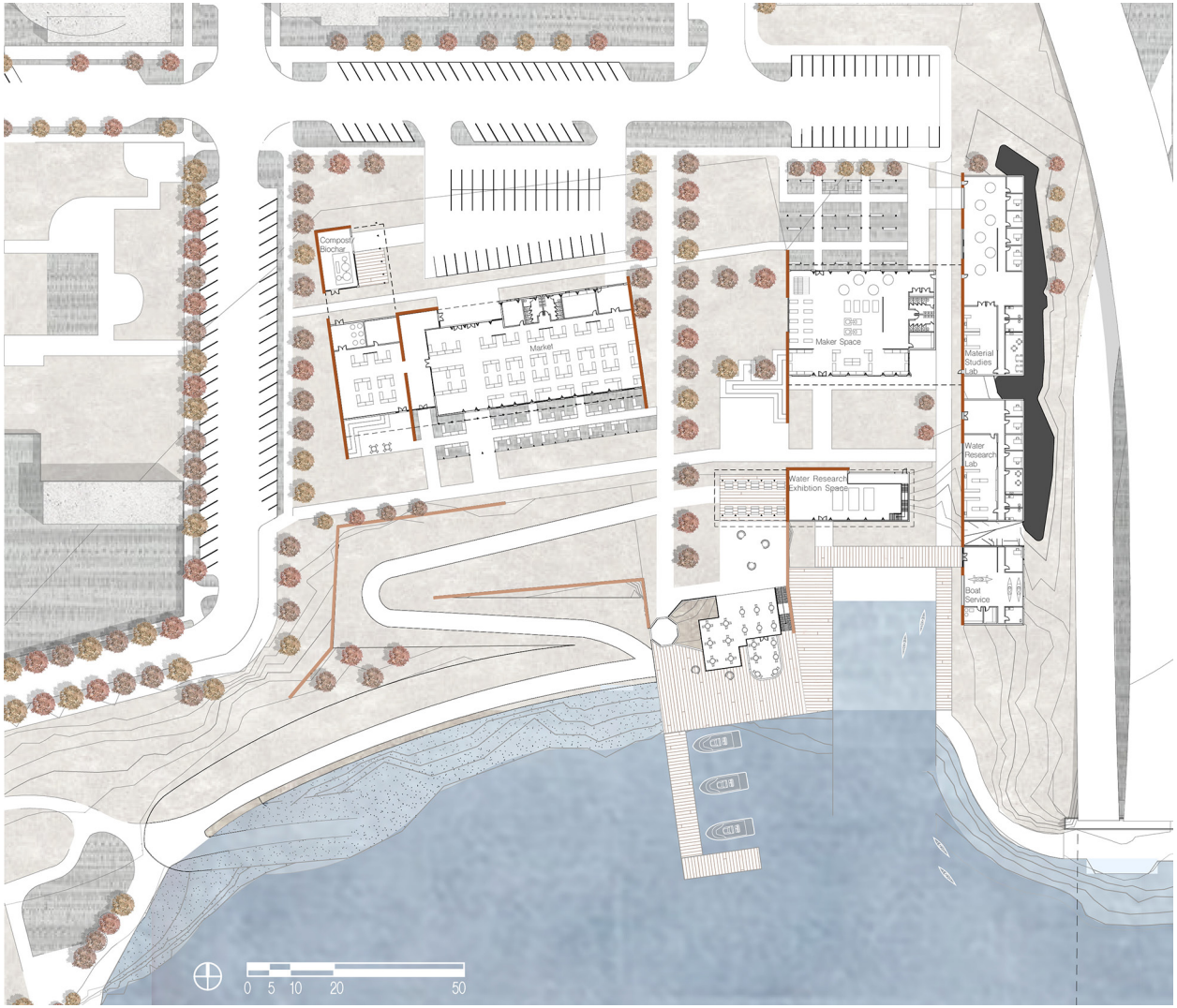
Strategies for reconnection build on circulation, then rammed earth walls and furniture, fixtures and equipment slot in to organize the design.



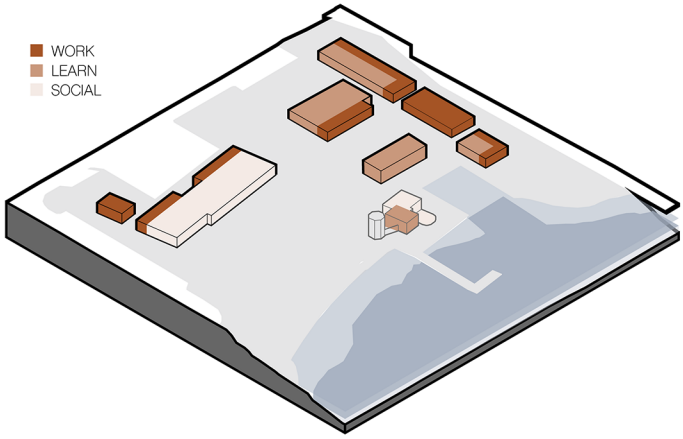
Prioritizing the outdoor spaces to create a cohesive experience on the site that fluidly transitions from interior to exterior spaces.

landscape path that brings people up from the river level into the site. A market extension between the main market and biochar, along with the outdoor vendor space creates levels of opening depending on market size needs. This ensures smaller markets do not feel engulfed by a large space. There is also covered access from the market's back of house into the biochar building to make moving compost easier, while maintaining the biochar area as a separate space. To the east of site nestled into the berm the programs of salt research, water research and boat services frame the edge of the site. These spaces are quieter for working and have limited public interactions. In front of those are the permeable programs of maker space and water exhibition.

The program categories of work, learn and community reinforce the integrated approach to the site by providing year-round programs in support of temporal programs.



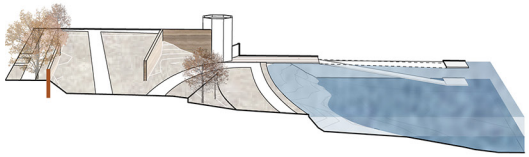
The market and meadow pathway orient towards the river while the right of the site respects the city grid, the central pumphouse becomes the pivot point.

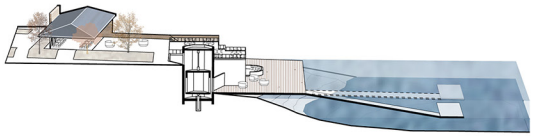


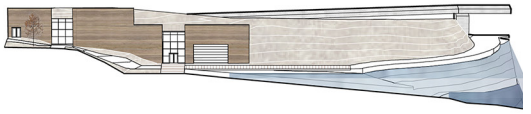
Organization of work, learn and social spaces that provide different public interactions.

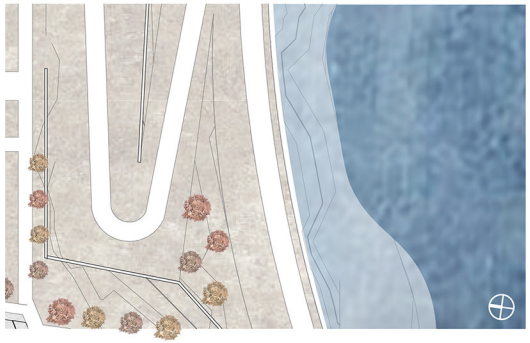
These program distinctions also create levels of public interaction similar to Granville Island. The working zones of water research, material research, biochar production and storage zones are continuously in use and public interaction is limited to focused views. The learning zones of maker space, water exhibitions and the brewery are the interface between public and research that brings people into the process. The remainder of the site aims to encourage social interaction connecting people to each other. These include the market, exterior seating areas and the brewery decks. The working program areas attach to learning zones and learning to social spaces, to encourage fluid crossover.

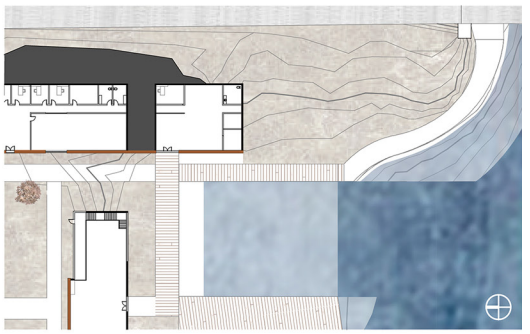
Three interaction points of beach, boardwalk, and boat launch provide different activities along the river's edge condition. The beach access is a lounging meadow leading to the partially enclosed base which protects from the current to provide safe swimming. The boardwalk is an extension of the central axis to create area for fishing, leisure and boat docking. The pumphouse tower becomes a lift to bring people from street level to water level. Finally, the ramped launch provides access in and out of the river for kayaks and

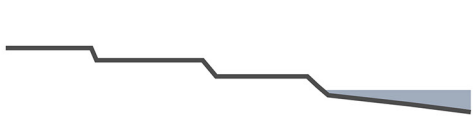


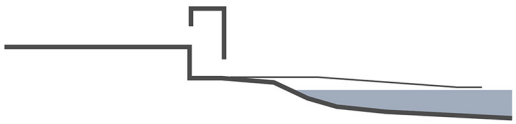












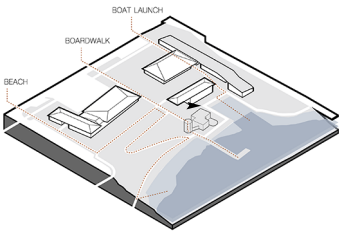
Meadow and Beach

Boardwalk

Boat Launch

River access opportunities vary the edge condition along the site to create interactions with the water as people desire.

The river is made accessible supported by boat services and the brewery deck while accommodating city pathways along the waterfront.



Direction of view for the river perspective in relation to the site's critical water approaches.

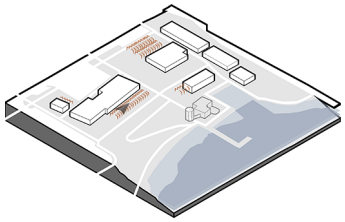
other boats. These changes to the edge condition provide multiple interaction opportunities allowing individuals to build their own perception of the river's value.

The river is made accessible again while the circulation path adjacent to the water connects to the existing pedestrian flows. The upper deck of the brewery provides views of the site and the river, acknowledging the river's value as an aesthetic feature. The site also highlights changing water levels rather than working against the river. The buildings are high on site above the projected flood level while the landscaping most prominent near the beach accepts water. The boardwalk floats to follow the changing water levels and the boat launch begins at an elevation safe from complete flooding.

Local Construction

The project acknowledges that community needs change over time and it attempts to accommodate this through providing diverse programs, use of scaffolding structures

and focus on actor engagement. Urban landscape infrastructure should not be a static entity (Allen 1999). The architecture intends to be open ended rather than prescriptive and focuses on the community, because locals are the key players in the use and continued reuse of the space. The scaffolding outside relates to the folded plate structure within the buildings but they are left uncovered to accept alterations. They extend from the public market, maker space, biochar process and brewery but can serve any desired program.

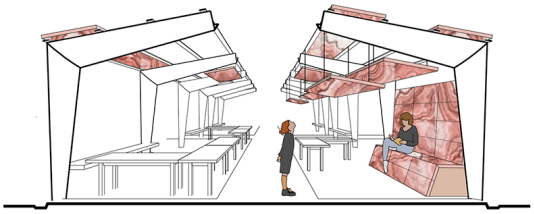


Direction of view for the scaffolding perspective in relation to other scaffolding on the site.

The scaffolding's secondary purpose beyond shifting community needs is adapting to seasonal cycles. Two examples of the scaffolding's cyclical uses are: open-air and enclosed. The open structure in spring hosts a learning event providing gathering and display space and accepts adaptations like the installation of salt panels. In the summer the market traffic increases and the outdoor space provides vendor stalls. This requires tables for vendors and panel inserts to protect from the weather. In the fall, the scaffolding takes on the role of a secure construction area where the

Heated refuge for the winter market supported by the scaffolding structure.

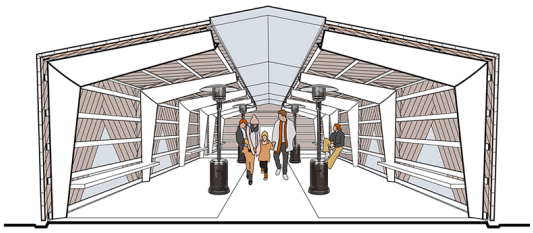
Open-air



Learning Event

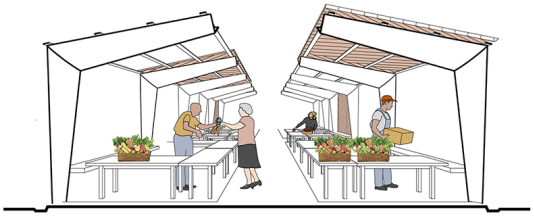
Spring
gather/display

Enclosed



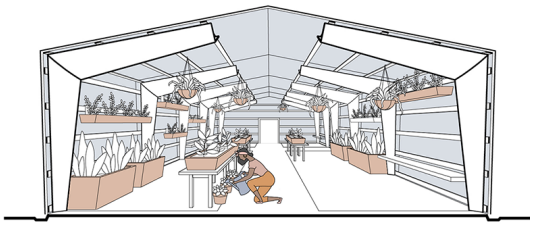
Heated Enclosure

Fall-Winter
gather



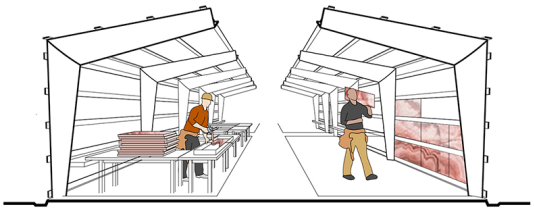
Market Vendors

Summer
sell



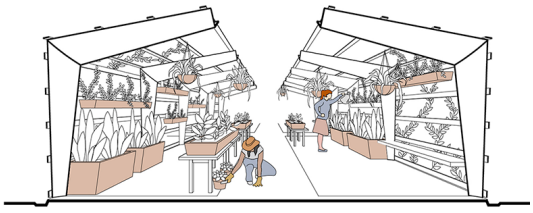
Greenhouse

Spring
seed



Maker/Building

Fall
construct/test



Growing Structure

Summer
grow

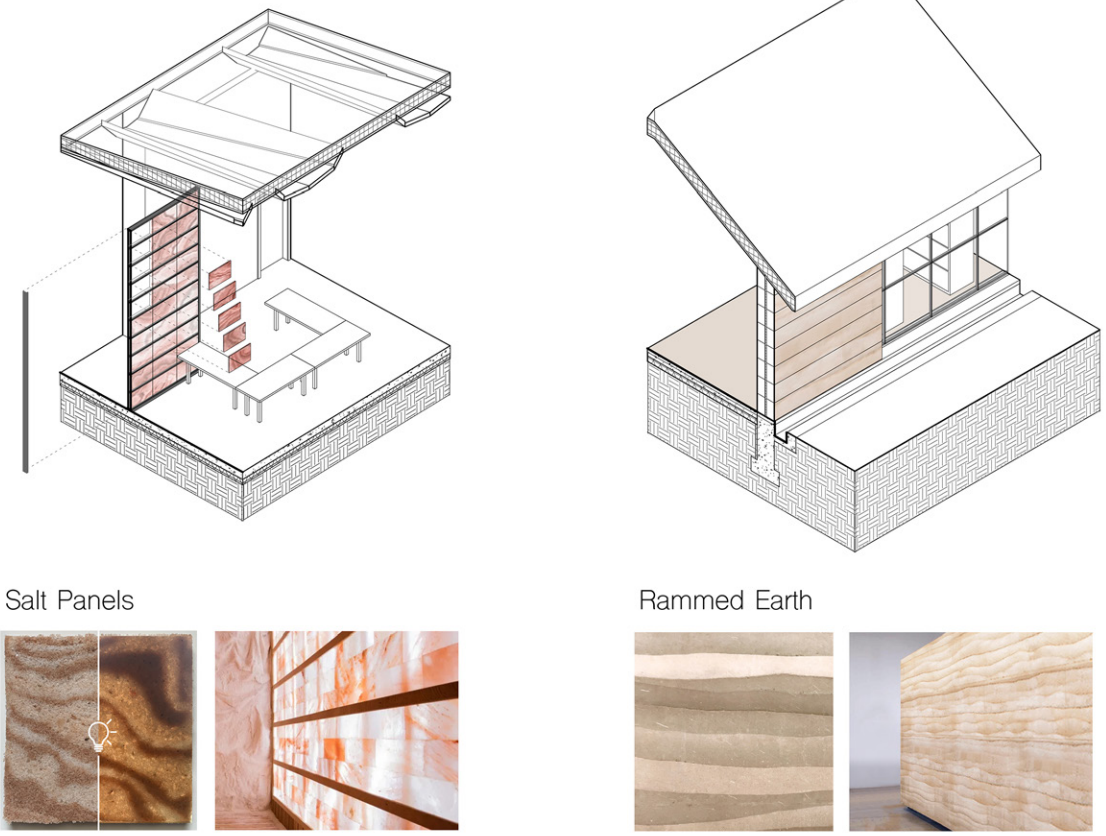
Seasonal use of the scaffolding structures in two applications demonstrates the variability of the structures programming.

salt material can be tested adjacent to the maker space, providing an installation structure and the ability to secure the area in the evenings.

The enclosed condition covers the scaffold in a tensile material overlaid with wood to provide warmth in winter. This space is heated and can be used for events or general gatherings. In spring the wood is removed, leaving the tensile structure to create a greenhouse environment where plants are seeded and easily maintained. In the summer the tensile fabric is removed and the plants continue to grow up the scaffolding. The plants have their final harvest in the fall and the process can restart as winter approaches.

The scaffolding is not limited to these two applications but it demonstrates the varied uses and aspiration for seasonal changeover. It is important that “the fabric of the building responds fluidly to circumstance without giving up any of its solidity” (Allen 2008, 130). The scaffold structure helps maintain the viability of each program because the site as a whole can mediate between these temporal spaces as needed.

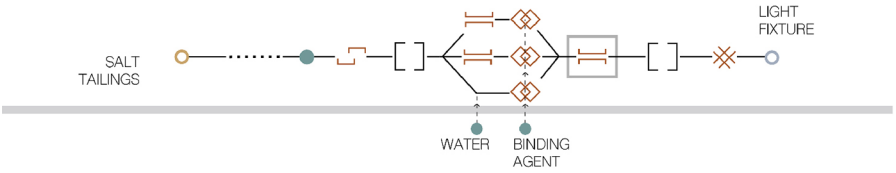
Rammed earth walls and potash salt are the critical materials used in this project because they reuse local waste and the process of building up earth reflects digging down for mining. Rammed earth is a monolithic expression that pairs well with the light salt panels and it has been tested in the Canadian prairies with the main considerations being insulation and drainage. As this is a learning site the implementation of rammed earth provides another opportunity to gain knowledge. Both the earth and salt were extracted by the mining industry and can be reused. The variety in color of both the rammed earth and potash

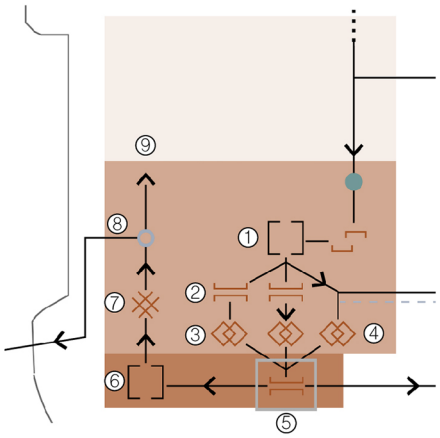


Earth materials of salt and rammed earth are complimentary halves where salt is light, used sparingly and within buildings while the rammed earth is heavy, encloses the buildings and organizes at the site scale.

salt relates to the location the material was sourced, which allows people to learn about different regions by exploring the colors and textures of the materials.

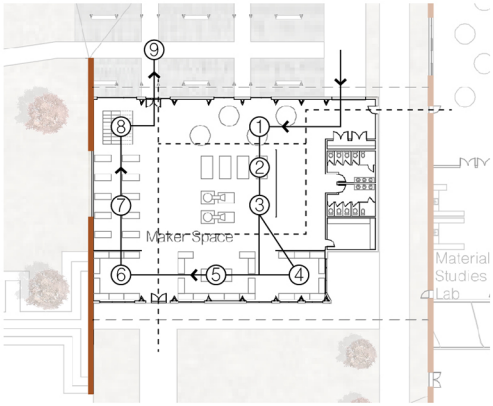
Creating the salt walls builds on experiment three in the previous section. The process begins with separating the raw potash salt by location and salt grain size. Then it is further ground and some of it is cleaned to create a white salt. The creators add a binding agent to the salt before pressing it in to flat panels. The different salt consistencies and chosen binding agent create levels of opacity that are layered within the panel to create unique patterns. The panels dry then are mounted onto a metal frame with an embedded light fixture. Though this application is focused on the aesthetic





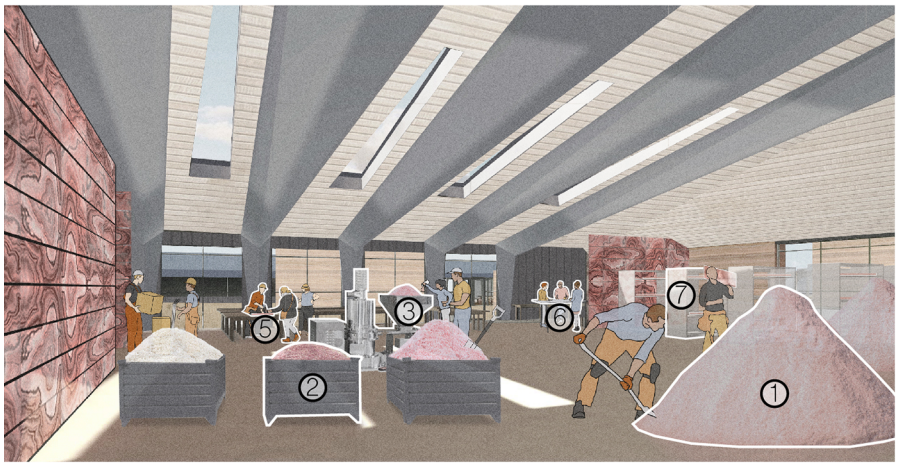
Program Areas

work
learn
social



Making Process

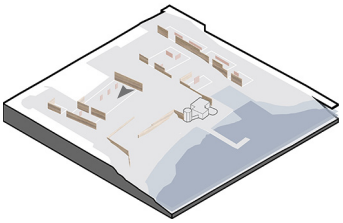
1. raw salt
2. sorting
3. grinding
4. cleaning salt
5. mixing
6. pressing
7. drying
8. assembly
9. testing



The transformation of salt aggregated to develop the maker space layout and the events occurring within the space.

qualities of salt, it intends to create a deeper connection to the potash waste. The use of salt panels is an expression of the beauty of salt that sparks interest to develop a strategy for mass implementation of salt materials to address the large amount of potash waste.

The material selection celebrates local resources of; salt, earth and water to activate social programs through participation. Displayed in the market space and consistent in the buildings throughout the site, salt walls are lit up at night visible at breaks in the rammed earth walls, drawing people in from outside. The pink tint from the salt provides a distinctly local material experience that defines the space. The connection to earth is the rammed earth walls and earthen floors while the market hosts the produce from the earth. Water allows everything to function on site, permeating into each program. Architecture should move from smallest part to the whole focusing on how it joins to the next element, rather than a top down approach (Allen 2008, 129). When close attention is paid to the materials chosen they can feed



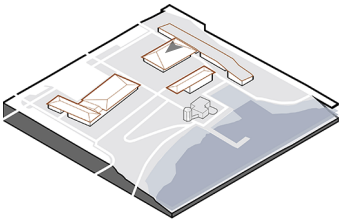
Direction of view for the market perspective in relation to the rammed earth and salt walls on site.

Glowing salt wall lights up the market space at night reflecting off the roof structure and are aligned to be visible through the glazed facade.

local economies and encourage social interaction as people come together to transform products.

Transparency and Visibility

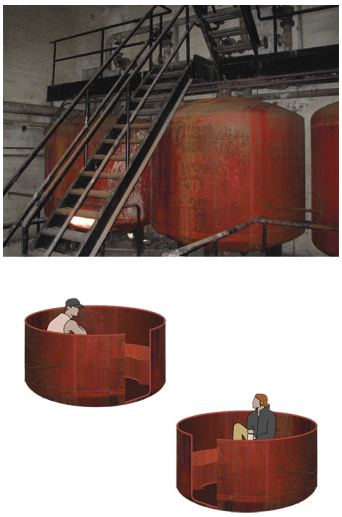
Visibility into programs creates public interest and encourages involvement in working processes that are brought back downtown. The main interfaces created in the project are the maker space, the water exhibition zone and the biochar process. These programs allow people to participate either visually or physically in changing: potash waste, the river and market waste. Within the maker space large openings in the façade creates views of the wasted salt from potash industry, that is reimagined by knowledgeable researchers and the curious public. The biochar and water exhibition space similarly include large openings to view the processes within the spaces.



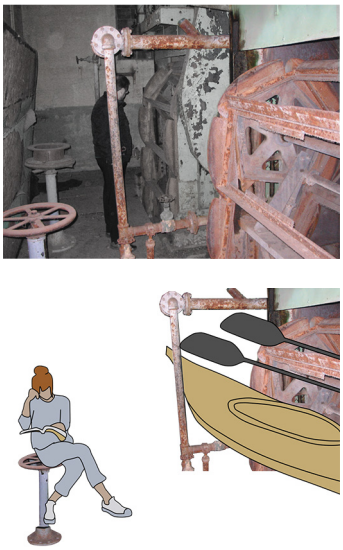
Direction of view for the maker space perspective in relation to the roof orientations on the site.

The pumphouse as a public space allows people to interact with this piece of history, rather than sitting vacant. The

The busy maker space demonstrating some of the process flows from raw salt to crushing, pouring and drying while finished panels are on display.



Transforming water pumps into seating for public use (base images from Crosby, Kindrachuck Agrey Architecture and Aldrichpears Associates 2008).

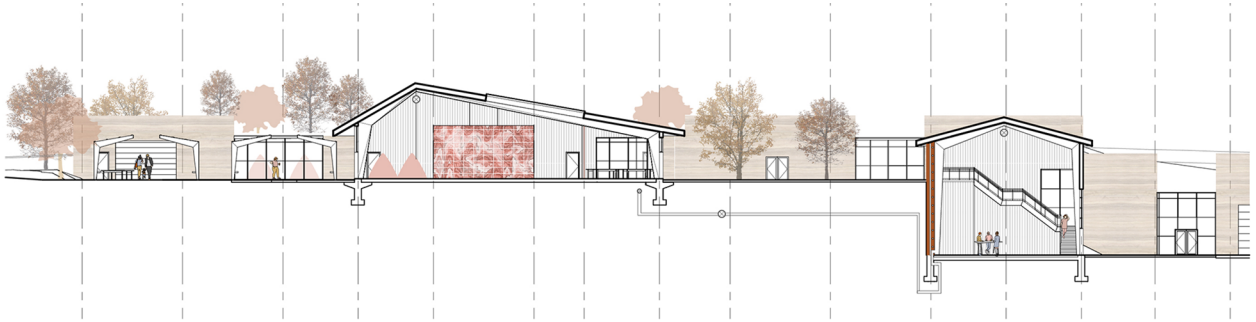


Transforming industrial features from pumphouse into kayak holder and stools within the brewery (base images from Crosby, Kindrachuck Agrey Architecture and Aldrichpears Associates 2008).

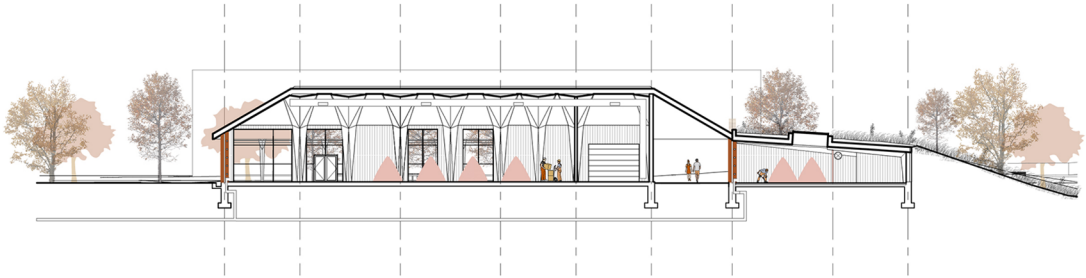
industry of the pumphouse is celebrated through the renewed building use and transforming its artifacts into furniture. A brewery program suits the building as brewing equipment replaces the large pumps but maintains the industrial feeling of the space. The brewery provides a social gathering space at the bar and a learning program that teaches about the history of the building and the brewing process. This building becomes a critical point on the site that brings together water, history, industry, and public programming.

Breaking the distinction of interior and exterior spaces creates continuity between different buildings across the site, to ensure spaces are welcoming to the public. The sections demonstrate the layering of interior and exterior spaces, while earthen floors flow from inside to outside further reinforcing the continuity. The separate buildings on site connect through system flows. Heat from south orienting rammed earth walls and the biochar process is collected and circulated across the site. This tempered air passes through tubes in the rammed earth walls to help offset the load for mechanical heating and cooling. The roof slopes orient light in to spaces according to program needs. The market has direct light in to the space while the maker space has diffuse light over the area that accommodates exhibition events and the working environment.

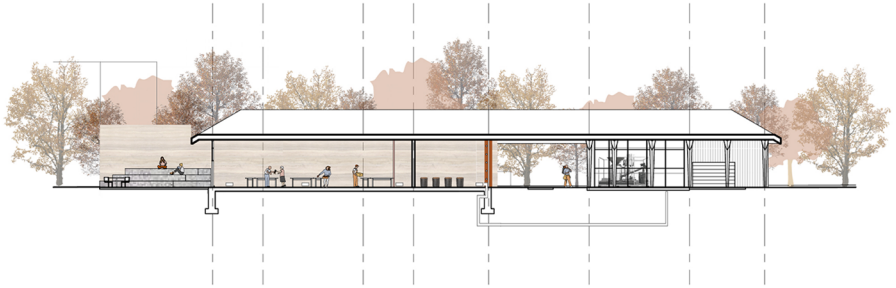
This intervention respects the surrounding context while making visible the city's histories. Approaching from the city provides views of the low roof lines and pockets of program along the front that invite pedestrians to enter. The central circulation axis is framed by trees, mirroring the lit from above condition within the buildings and provides a view directly to the pumphouse tower. The berm towards the traffic bridge is faced with a rammed earth wall that frames



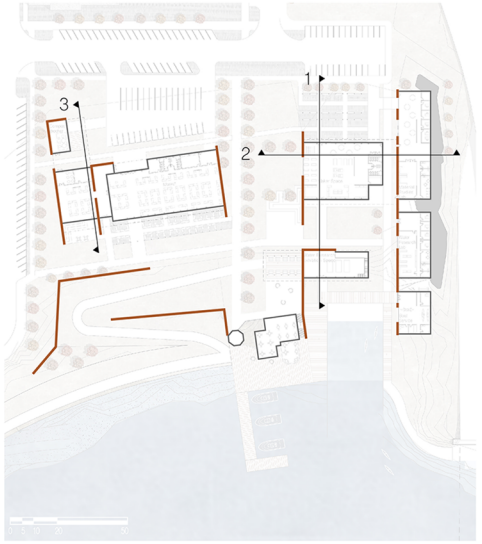
1. Maker space and water exhibition



2. Maker space and research



3. Market and biochar



Layering of interior and exterior spaces and the continuity of systems in a campus set up connects individual buildings to the rest of the site.

the outdoor maker space and breaks for focused views into the research areas. Towards Riversdale there is a loading area for farmers into the market and the biochar building loads fertilizer that leaves the site, visible through large portions of glazing along the building. The project draws on existing programs and the history of mining, river use and the industrial core to add supporting programs that celebrate and strengthen the community.

Entering the site from the city, the central axis frames the view to the pumphouse while programs of maker space, market and biochar are visible from the street.

View from the bridge of the overall project that aims to fosters connection to the river, community and city providing social opportunities and working industries knitted together.

Chapter 6: Conclusion

The dichotomy of pride in an industry that creates mountains of waste was the motivation that began this project. It became evident that responding to disconnect requires a multilevel reconnection strategy to addresses the complexity of the city's relationship to industry and the environment. The project aims to foster reciprocal interactions that can develop over time by layering programs that address waste, the river and industry. Industry, instead of being separate from the city can foster social connectivity. While perceptual shifts are laid out including: the river as a valuable natural resource needing conservation, salt shifts from waste into a social catalyst and higher consideration is placed on locating social programs such as the market next to working industry in the heart of downtown.

The project creates both closed loops within the site and connections to the city through its focus on inputs and outputs. The applicability of this project is the design strategy of breaking down individual processes as a common language of transformations. This strategy prioritizes a relationship based architecture, that is scalable to include the human, community and city context.

The intent of the project is to renegotiate how industries relate to the community by bringing awareness to the hyper efficiency of parts that contributes to the lack of visibility of waste. Potash waste becomes part of reconnecting the diverse local network, this project is not a solution for entirely removing potash waste but focuses on raising awareness by demonstrating the beauty of this pink salt. The project aims to encourage higher consideration for resource use

and celebrate local materials rather than relying so heavily on imports.

Moving forward the application of salt as a material could be explored in a larger capacity. One potential way forward is briefly touched on in the experiments, where the compressive abilities of salt lends well to the application as bricks. This along with the limitations of water and good thermal properties begin to lay out parameters for the materials application. Further exploration can focus on how it is placed relative to exterior elements, ensuring the salt is in a controlled environment, awareness for how the salt can be renewed, and additive materials to take the tensile load and push this material further. Salt waste is not a localized issue and large scale implementation of the waste product is applicable beyond Saskatchewan. To realize mass implementation of potash waste in any context requires participation from researchers, policy shifts and the desire to effect change.

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