Infrastructural Landscape as Praxis: Technical Artifact Adaptations in Alberta's Eastern Irrigation District

by

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Dalhousie University is located in Mi'kma'ki,
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We are all Treaty people.

Contents

Abstract

Debates surrounding the continued development of Irrigation infrastructure within Southern Alberta's Eastern Irrigation District focus on technological approaches to reducing water consumption by irrigation agriculture to alleviate strain on Alberta's over-allocated river basins. However these methods of addressing consequences of industrial systems of production often escape comprehension and remove engagement at the human scale. The infrastructural frameworks that support these systems must be thought of not only as tools for production, but as mechanisms for representation, engagement, and questioning these consequences.

Considering the mediating role that technical artifacts play in human engagement with the world, this thesis proposes that irrigation infrastructure can be designed as mechanisms for making visible the often overlooked relationships between infrastructural artifacts and the landscapes they constitute. In doing so, technologically focused solutions to the current water crisis can be called into question, allowing alternative paths of development to be explored.

Acknowledgements

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Michelle and Kirk, I could not have done this and would not be where I am today without the lessons you taught me, thank you.

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Chapter 1: Introduction

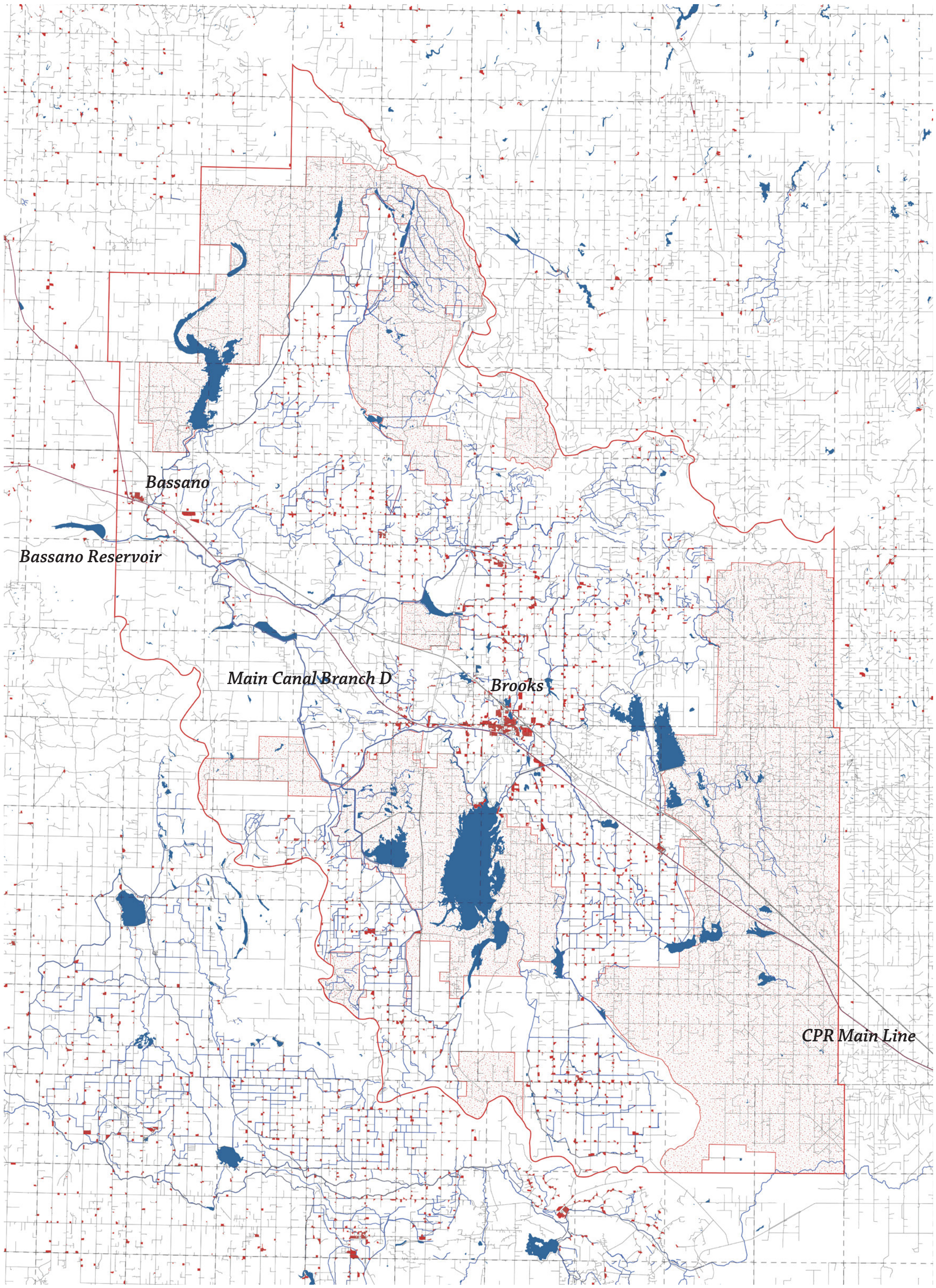
Impending Crisis

Continued development of industrial agriculture practices, and the infrastructural artifacts that support it, has led to tensions in southern Alberta over the allocation of water, and its distribution between agricultural, environmental, municipal, and recreational uses. As extreme environmental conditions become more frequent representatives of these uses the South Saskatchewan River Basin (SSRB), which has been closed to additional water license allocation for over a decade, must find alternative means of distributing the existing water within the basin. The current system for water allocation restricts uses to those that generate productive agricultural and economic output, forcing ecological and recreational uses to exist at the margins of these productive systems.

Crowsnest River flows into Oldman Reservoir during drought conditions, 2023. Photograph by Barb Glen (Western Producer 2023).

Agricultural production has played a central role in the development of Alberta's economy since its settlement began over a century ago, and its role in shaping ways of life has become so ingrained in the perceptions of those who live there that it is rarely questioned. The Eastern Irrigation District (EID) lies along the Canadian Pacific Railway (CPR) main line between Medicine Hat and Calgary, and is home to 20% of Alberta's irrigated farmland. Developed as a part of the CPR land grants at the beginning of the 20th century the CPR Eastern Section as it was then referred to was host to a series of settlement practices that sought to represent the region as a fertile agricultural region, countering the

EID's location within southern Alberta's South Saskatchewan River basin (SSRB)


Bassano
Bassano Reservoir
Main Canal Branch D
Brooks
CPR Main Line

EID map.

dominant perception at the time that it was unsuitable for settlement or agricultural production. These practices included the construction of irrigation infrastructure and ready-made farms or homesteads that the CPR hoped would attract settlers to populate the region. The practices employed by the CPR in their irrigation scheme continue to have implications for inhabitation of the region today.

The current policy frameworks that dictate water allocation and distribution within the EID have led to a tendency for water allocations to concentrate around its most economically productive uses, resulting in environmental conservation and recreational uses of water to be pushed to the margins. The agency to decide water uses by inhabitants is removed and instead placed with the mechanisms of agricultural production. Record setting temperatures and lack of precipitation during the 2023 growing season, followed by low snowpack accumulation in the headwaters of Alberta's river basins through the first half of the winter season have resulted in record low reservoir and river levels. Water license holders across the Bow (SSRB), Red Deer, and Old Man River basins met in February to negotiate water sharing measures to mitigate anticipated low water supply levels in the 2024 season (CBC 2024). Irrigators hold between 73% and 83% of all water allocations within the license system are held by irrigators, who must voluntarily share water with municipal, industrial, and all other water users as there is no legislation in place to ensure the sharing of water during periods of reduced supply (CBC 2024).

Infrastructural Brutalism

Michael Truscello represents a growing subset of infrastructural discourse centered around the totalizing effects that modern industrial capitalist systems have had on the environment and our societal organization. The continued development of industrial capitalist systems of extraction and production have pushed beyond the capacity of the natural environment, and the historical representation of infrastructure as symbol of human progress is being brought into question (Wakefield 2018; Truscello 2020).

Wakefield, Truscello, and Evenden share the proposition that societies, and subsequently the infrastructure they create, tend to focus on solutions and the overcoming of challenges presented by their surroundings, while ignoring the question of why society needs these problems addressed and the subsequent problems that arise from the typically technologically focused solutions that are proposed (Wakefield 2018; Truscello 2020; Evenden 2006). Wakefield stresses that in the continued management and development of infrastructures that have contributed to the current state of environmental catastrophe, we are perpetuating the position that they are the solution to the same critical conditions that they have created (Wakefield 2018, section 4). In the case of Alberta's irrigation agriculture system, proposed solutions to the increased strain on water sheds and natural water courses focus on increasing the efficiency of its technical components as a means of freeing portions of water supply for future use and agricultural expansion.

Globally, modern industrial capitalist systems of production, including irrigation agriculture, extort a level of extraction on the natural environment and its resources that perpetuate environmental degradation in the name of productivity. The large-scale and far-reaching consequences that result are difficult to grasp at the human scale, and typical approaches to rendering them visible rely on representational methods that fail to communicate these outcomes on a level that is visible within the daily lives of people that inhabit landscapes of industrial production. Additionally, the environmental crisis is not a product of technical systems alone, but also the attitudes of public perception. As described by Rhania Ghosn and El Hadid Jazairy in their book *Geostories: Another Architecture for the Environment*;

> The environmental crisis can be seen not only as a crisis of the physical and technological environments; it is also a crisis of the cultural environment – of the modes of representation through which society relates to the complexity of environmental systems (2018, 11).

If we are to begin to address the outcome of these global scale systems of production, we must first address the relation between infrastructures of production and the people that inhabit them.

Human Technology Relations

To understand how humans interact with their environment, its systems, and the objects that constitute it, we can look toward Science and Technology Studies and the post-phenomenological approach to human-world relations. In this avenue of study, it is argued that our experiences of the world depend on our interactions with it and the possibilities for action that are provided by our environment. These human-world interactions form a two-way relationship, with humans acting on, and constructing the world around them while the world simultaneously acts on and shapes its inhabitants (Yiannoudes 2016, 158). Peter-Paul Verbeek furthers the complexity of this framework by building on the work of Heidegger and Ihde, and proposes that the human-world relationship is mediated by technological artifacts with humans and the world they experience being the product of mediation (Verbeek 2015, 130). Applying this line of thought to the context of the EID and the irrigation infrastructure that supports it allows for the attitudes of public perception described by Ghosn and Jazairy to be thought of as products of interactions between inhabitants and technical artifacts, thereby providing an avenue for addressing large scale consequences of infrastructural brutalism through human scale architectural interventions. That is to say that the perception of these consequences can stem from the interactions between inhabitants of the irrigation agriculture landscape and the infrastructural artifacts that constitute it.

Thesis Question

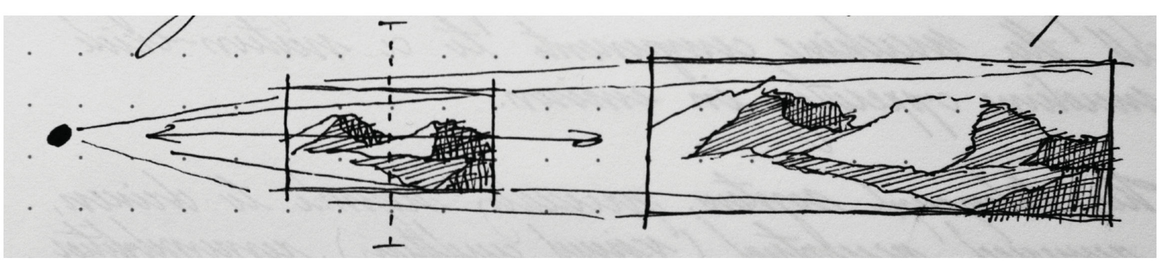
How can infrastructural artifacts, themselves technological objects, be mobilized as tools of mediation for human perceptions of industrial irrigation practices as a means of bringing current environmental conditions they exacerbate to a level that allows them to be engaged and challenged by inhabitants of infrastructural landscapes?

Chapter 2: Settlement

Theory

Perception and Dwelling

Industrial development and mechanization that occurred over the course of the 19th century detached human experience from the relationships that had previously governed it. The patterns of society were no longer determined by natural phenomena and cycles, but mechanized power. Travel no longer implied reliance on weather systems and wind patterns or animal power, but mechanized power from internal combustion which shrunk what had once been weeks long journeys into mere days. With relations between time and distance broken, the observer's relationship to the environment underwent a similar shift. Journeys that previously required a traveller to be immersed within their environment while traversing a bumpy carriage path were now seen as a passing series of panoramas through train car windows (Schivelbusch 2014). The environment becomes a passing vignette to be observed rather than an inhabitable environment. Though technological assemblies and processes can initiate change in the human perception and experience, the inverse is also true as Larkin proposes, and infrastructural objects are also subject to the preconditioned perspectives of the observer (Larkin 2013, 333). The



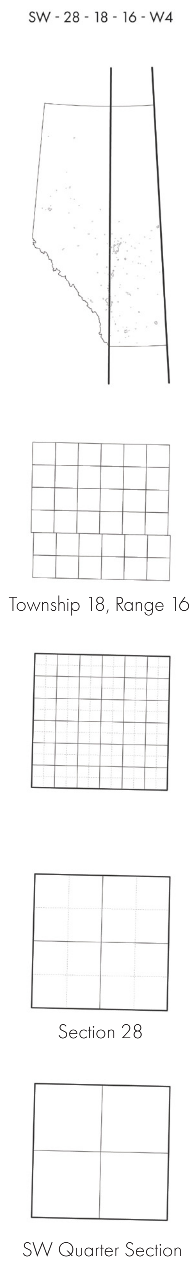
Removal of traveller from engagement with the landscape and panorama created by landscape - train car - traveller relationship as described by Schivelbusch.

aforementioned phenomena are given a more technical representation by Slavoj Zizek and the concept of parallax, which he proposes constitutes a mediation between object and subject that inherently links epistemological shifts in the observer to ontological shifts in the object (Lahiji 2011, 255).

Engaging the Environment; Creation and Participation

The traditional western thought that we first build environments, and then inhabit them, is challenged by Tim Ingold through the concept of the "Dwelling Perspective." In this framework human intervention in the environment comes out of, and is a product of, the ongoing engagement between the two (Ingold 2000). Building is inevitably a product of dwelling. The emphasis throughout Ingold's text is placed on the human-environment procedural relationship, and it is evident that in his mind intervention within the built environment can not be separated from and must follow from the physical actions, relationships, and interactions that take place within it. On the other side of the debate are more traditional concepts of human construction. Within these the assemblies of human construction first enable, then dictate the modes of inhabitation and interaction that occur within them. J. B. Jackson proposes that designed landscapes are the structure that enables its own inhabitation (Jackson and Zube 1970).

Between these two modes of thought lies a circularity that although problematic to defining a single methodological approach, does provide a conceptual framework for understanding the implications of interventions in the built environment on human inhabitation. Framing Ingold's Dwelling Perspective and Jackson's more traditional stance on landscape inhabitation through the lens of post-phenomenology's Technological Mediation, we can consider the construction of the Canadian Pacific Railways Western Block irrigation project as an ongoing process of mediation that simultaneously shaped a manner dwelling within the region and the built forms that support it. The procedural relationships that Ingold describes, I propose, did not come before the construction of the landscape. The two were collectively shaped through interaction with infrastructural artifacts that mediated their relationship.



Dominion Land Survey land divisions.

The Dominion Land Survey

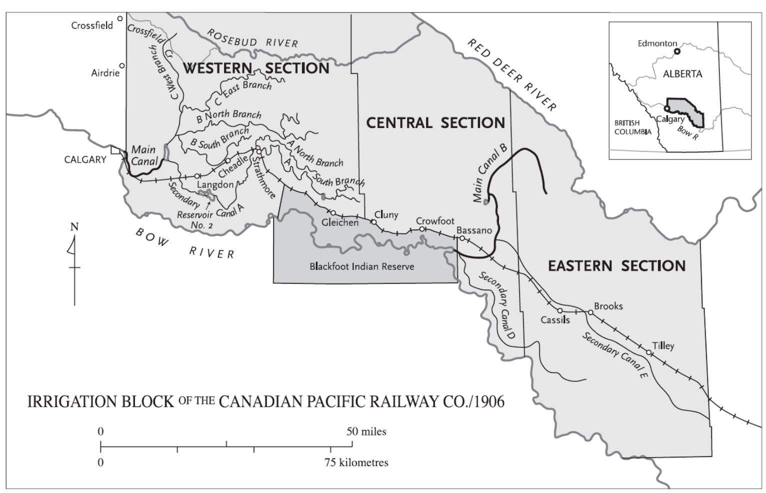
In order for westward expansion of European settlement to continue across the Canadian prairies the vast swaths of land that make up modern day Alberta, Saskatchewan, and Manitoba first had to be explored, charted, surveyed, and mapped in preparation for the rush of settlers that nineteenth century optimism predicted would soon flood these lands. The system employed to accomplish these goals was the Dominion Land Survey, a derivation of the township survey system that was based on the United Stated Public Land Survey System first proposed by Thomas Jefferson. Within the Dominion Land Survey land divisions are organized by ranges (north-south) and townships (east-west), each spaced at six-mile intervals. The base township unit was further divided into sections, quarter sections, and legal subdivisions. Each parcel of land as defined by this system was assigned a numerical designation (ie. SW-28-18-16-W4) referencing its quarter section (SW), section (28), township (18), range (16), and relation to the nearest meridian (W4). These parcels of land, primarily the quarter section, would become the base unit with which the CPR's settlement scheme would be executed.

Bantjes describes the Dominion survey as creating a space without particularity, and a map drawn without consulting the landscape (Bantjes 2005, 119). By heeding no attention to natural features, the survey grid abstracted the natural environment and transformed it into a numerical representation that only developed meaning when referenced to its position within the larger survey. Division of land through the survey grid and numerical designation of parcels served as tools for transforming the natural environment into a commodity for consumption (Bantjes 2005, 119). Land grants were given to the CPR by the Canadian Government in facilitation of the company's transcontinental railway project. The grants came in the form of alternating sections along the route of the CPR main line. Due to hesitation from the company regarding their ability to successfully settle the arid lands of southeastern Alberta, it was proposed that the remaining unsettled lands in the rea being transferred to the company as a single block in return for the company developing irrigation infrastructure in the region (Armstrong, Evenden and Nelles 2009, 156; Dempsey 1984, 259-260). Parcels of land created by the Dominion Land Survey became the currency used to propagate continued development of Canadas westward expansion, and his method of land division set up the framework through which settlement and development could occur. The granting of land to a private company in exchange for railway development, particularly land which was deemed to be of questionable agricultural value (Warkentin 1964, 232), marks the transition of economic value from existing natural resources on a piece of land to the speculated future production that could be created on the land.

Canadian Pacific Railway Western Block

This commodification of land through legal divisions was the tool with which the CPR, and by extension the Canadian Government, hoped generated the revenue necessary to fund the ongoing operation of railway services between the population centers of central Canada and the west coast. The company viewed the establishment of a productive agricultural region, and a sizeable population of settlers within it, as critical to generating the volume of traffic required to sustain this goal (Canadian Pacific Railway Company 1900, 60).

In order to attract the population of settlers that would serve as this economic resource a series of promotional activities was undertaken. Ranging from promotional pamphlets developed by the CPR and Government organizations including Facts Concerning the Bow River Valley (Canadian Pacific Railway Company 1900) and Irrigation Farming in Sunny Alberta (Canadian Pacific Railway 1919) that promoted the potential agricultural production of the prairie landscape, both natural and artificially created through



CPR Western Block irrigation project (Dempsey 1984, 217).

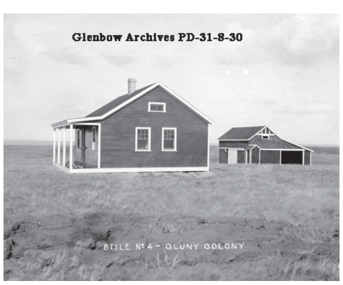
irrigation projects, to prospective settlers in eastern Canada, the United States, and England (Lam 2011, 141). These activities served as the apparatus through which perceptions of the region would be constructed in the minds of prospective settlers.

Import of Technical Artifacts

Neither the settlement practices of the CPR nor the infrastructural assemblies that supported them were native to the Western Block Irrigation Project. William Pearce, a senior official with the department of the interior and early proponent of irrigation projects in southern Alberta, became invested in the notion through contact with American irrigation publications and proponents, seeking to import techniques from south of the boarder (Armstrong, Evenden and Nelles 2009, 155) eventually employing an American engineer in the initial preparation of the CPR irrigation scheme (Dempsey 1984, 260; Den Otter 1986, 176). In accordance with Larkins description of technical assembly migration, they existed within other contexts and were subsequently adapted and translated to the context of the bow River Valley (Larkin 2013, 330). Of particular interest in the context of settlement practices are the methods employed not in adapting these technologies to their new context, but in shaping the inhabitants and their perception of their environment into productive components of agricultural production.

Ready-made Farms

To aid in the transition of settlers from their former contexts to the prairie landscape the CPR produced a series of "ready-made-farms" during the first decade of the irrigation project (1910-1920). These farms were often concentrated



Ready made farm buildings, CPR Western Irrigation Block (Pollard 1912).

in settlement clusters, which were thought of as being insulated from the “hostile” prairie environment, reduced feelings of isolation presented by the large distances that could be found between individual homesteads during the early settlement period (Lam 2011, 148-149). These farms were intended to provide self-contained units with the basic provisions needed for newly arrived settlers, with original examples typically featured a house, barn, implement shed, outbuildings, well, and 50 acres of plowed and sown land (Lam 2011, 5). While providing the basic necessities required by settlers upon arrival was the primary role of these homesteads, they were also designed to portray European, particularly English, landscape ideals with tree planting strategies focused on aesthetic arrangements as primary and their function as a windbreak being secondary (Lam 2011, 144). Trees that were provided by the CPR for

Windbreak at Brooks demonstration farm representing English landscape ideals to visiting homesteaders. (Canadian Pacific Railway Land Settlement and Development fonds 1924).

this purpose had the added benefit of providing reminders of home for residents (Evenden 2006, 80).

Demonstration and Experimental Farms

Demonstration farms were constructed to illustrate dry and irrigated farming techniques to farmers, as well as provide examples of the desirable aesthetic ideals that should be deployed on homesteads (Lam 2011, 145). These farms and their staff were touted by the company as being at the disposal of settlers for obtaining assistance with the preparation and operation of their homesteads (Canadian Pacific Railway 1908, 8).

Social Organization

Within discussion of the network made up of infrastructural constructions and management practices outlined above it is important to remember that apart from dictating the physical distribution of resources, these assemblies constitute the underlying structure that supports the societies that inhabit them. The space-making practices of resource distribution have implications for our inhabitation of spaces, the activities, and the social formations that develop within them. It is not the spaces themselves that render certain actions possible and others not, but the spatial managers (Easterling 2016, 14), in this context, irrigation infrastructure and management practices.

The social formations that developed within newly established agricultural regions on the prairies adapted to the survey grid and large geographic distances of the landscape, which were far greater than the typical village settings and plot sizes found in settlers homeland. Subsequently newly settled homesteaders began to consider themselves a constituent piece in a much larger agricultural machine (Bantjes 2005, 120). The resulting social and political relations that developed within this view, that in which humans were an integral piece of the larger system functionality, became rooted not in geographic location but representations of abstract relationships that converged at predefined physical locations (Bantjes 2005, 124). Political presence and community-oriented activity was removed from everyday routines of inhabitants and was replaced by organizations specifically tailored to participation within the agricultural industry and life within the irrigation district.

Transition from CPR operation as the eastern Block to the current organization of the Eastern Irrigation District marks the first large-scale social organization in the region. Local irrigators, displeased with the land contracts between themselves and the CPR, banded together in an attempt to renegotiate these contracts.

The EID retains ownership of approximately 600,000 acres of land within the district boundaries, which it maintains as native prairie grassland and is managed as community grazing leases (EID 2023). Access to these lands for grazing purposes are limited to members of community grazing associations, and each association is given administration over a geographic area and individuals wishing to apply to the associations must reside or own land within these boundaries (EID 2021).

For the EID these social structures, which have historically been agricultural communities of farmers and ranchers, have evolved to include an increasing number of recreational and ecologically oriented concerns. These land uses require public access to or use of typically private or district owned land and infrastructures. These activities, wetland and prairie conservation, hiking, birdwatching, hunting, and fishing, all take place primarily on publicly accessible grazing leases or along the margins of reservoirs, canals, drainage ditches, and ponds. These uses, although permitted by the EID's public access policy, are contingent on the maintenance of spaces leftover from water transport or agricultural production, and are not enshrined in any bylaw or legal framework according to the Eastern Irrigation District Public Access Guidelines web page.

Chapter 3: The Irrigation System

Theory

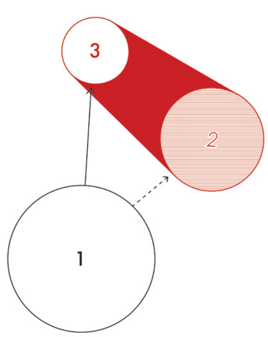
Infrastructure

In its most basic definition, infrastructure is the physical network of built forms that facilitate the flow of material, goods, information, and people in modern society. In their operation they shape dictate the direction, speed, and vulnerabilities of the networks that they form (Larkin 2013, 328). Paul N. Edwards furthers the emphasis placed on infrastructure as defining flows Larkin, Easterling, Truscello, and Hallers all define the technical functionality of infrastructure as being a moderator of information flows across distances. For these authors information is not limited to digital flows, telephone communications, or radio waves but includes the material resources and their exchanges that govern the operation of modern industrial societies. One of the common threads throughout infrastructural discourse is its portrayal as being so ubiquitous within our everyday lives that it "generate(s) the ambient environment of everyday life" (Larkin 2013, 328). Beyond this backdrop for society that largely goes unnoticed, Edwards proposes that infrastructures provide a sense of stability without the need for intervention by users to perpetuate its operation (Edwards 2003, 188). Stephanie Wakefield succinctly summarizes the potential created by infrastructures ability to organize material flows while remaining outside conscious thought; they "are understood to be powerful political devices because often they do not appear to be doing anything and even appear 'natural' or simply 'there'." (Wakefield 2018, section 1)

Infrastructure as Societal Organization

Beyond its role in organizing the material flows within society, infrastructure also plays a role in shaping relationships between individuals, social structures, and ecosystems that occupy the infrastructural environment. Michael Osman uses infrastructure's ability to disrupt time-space relationships to illustrate the effect that refrigeration has had on social and economic organization. By delaying the effects of decomposition in meat packing facilities and distribution networks, the ability for speculation in perishable food was enabled, thereby breaking the traditional relationship between product seasonality, consumption habits, and market systems (Osman 2012). J. B. Jackson also proposes that modified landscapes, including the physical infrastructure of roads, pipelines, and power grids, are the determining factor that allows for the functional operation of modern society (Jackson and Zube 1970). This proposition generally paints infrastructural organization as a necessary underpinning of modern society, and does not take a critical stance on its position within this role.

The "Realms" of Infrastructure



Divergence between the technical (1), administrative (2), and poetic (3) infrastructural realms as proposed by Larkin.

Brian Larkin advocates for an understanding of infrastructure that recognizes the separation of implied meaning from technical function; an object of technical infrastructure may have desires and connotations attached to it that develop effectual commitments that are autonomous from technical functionality (Larkin 2013, 329-332). This separation of meaning from functionality manifests in two ways; firstly, the Poetic Function in which aesthetic values are foregrounded above the technical function to offer specific representations of infrastructures to observers; and second, the Doubling of infrastructure in which the technical function is foregrounded while a secondary functionality withdraws into the background (Larkin 2013, 334-335). These differing constructed meanings of infrastructural artifacts may be openly portrayed, as in the CPR ready made farms promoting the poetic function by visually portraying European landscape ideals, or they may remain hidden from public view, as is the case when the demonstration farms were constructed not only to educate farmers on cultivation techniques useful for their own land but to further shape inhabitants of the irrigation project into productive components of a larger agricultural ideal. As proposed by Easterling, the cultural persuasion developed around infrastructural systems can serve to obscure underlying organizational practices (Easterling 1999, 8), or in this case, the poetics of infrastructure can mask its doubling.

Infrastructural Artifacts

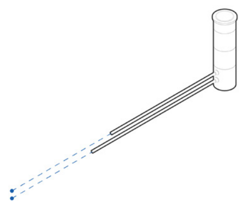
Applying Larkin's understanding of infrastructure as described above, the EID and its infrastructural artifacts can be framed as follows according to their three "realms;"

Technical Realm

The components within an irrigation systems distribution system can be generally broken down into three categories; diversion and conveyance, storage, and application. These are broad categories that can apply to most irrigation systems across north America, and there are regional variances between systems that have been developed in response to distinct conditions related to climate, geography, managerial processes, and agricultural practices and techniques. The following descriptions will be oriented toward the western Canadian context, specifically south-eastern Alberta.

Check Well

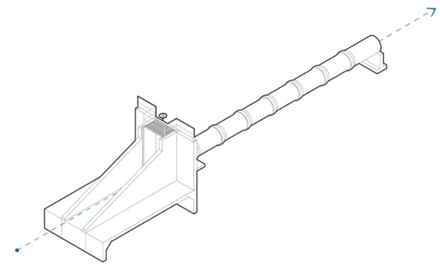
Automated or manual monitoring of water level in canal, typicall upstream of check structure, to ensure adequate depth for diversion.



Pipeline Turnout

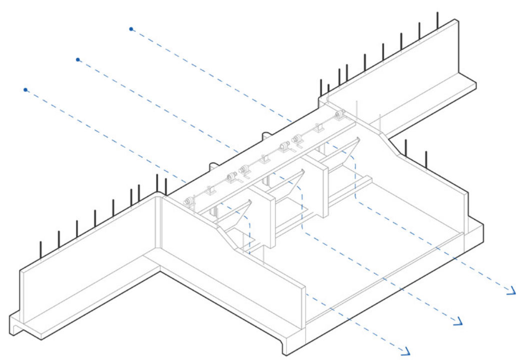
Diversion Structure Type 01

Automated or manual diversion gate to regulate volume of water diverted from main or secondary canals into secondary canals or pipelines.



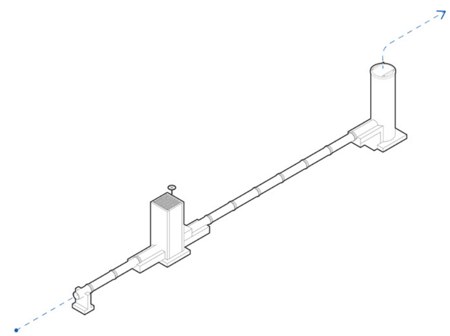
Check Structure Type 01

Automated or manual control or up-stream water level in canal while maintaining adequate down-stream flow rates.



Diversion Structure Type 02

Automated or manual diversion gate to regulate volume of water diverted from main or secondary canals into pump-wells for on-farm applications.

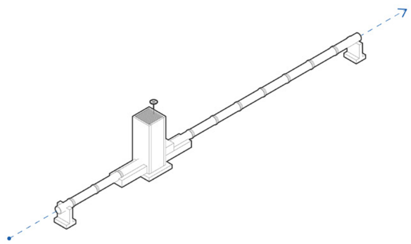


Control infrastructural artifacts found within the EID.

Pipeline Turnout

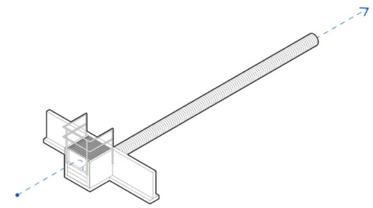
Diversion Structure Type 03

Automated or manual diversion gate to regulate volume of water diverted from main or secondary canals into secondary canals or pipelines.



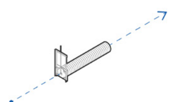
Check Structure Type 03

Manual regulation of up-stream water levels on lateral canals for diversion through farm gates or in-stream livestock watering. Culvert for conveyance under service road or earth dam.



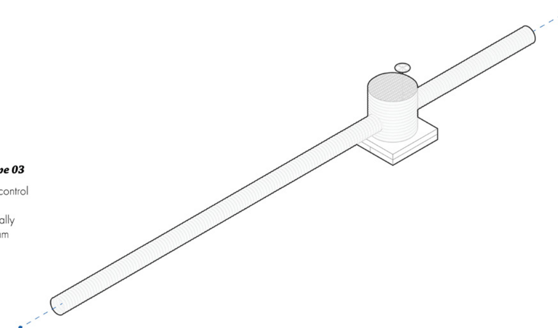
Diversion Structure Type 04 (Farm Gate)

Automated or manual diversion gate to regulate volume of water diverted from secondary canals or secondary canals into on-farm lateral canals or dugouts.



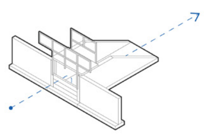
Check Structure Type 03

Automated or manual control of water diversion from storage reservoir, typically located within earth dam structure.

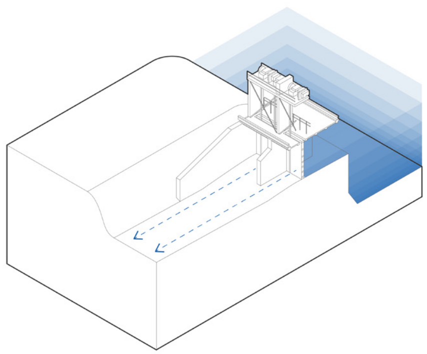


Check Structure Type 02

Manual regulation of up-stream water levels on lateral canals for diversion through farm gates or in-stream livestock watering.



Control infrastructural artifacts found within the EID.

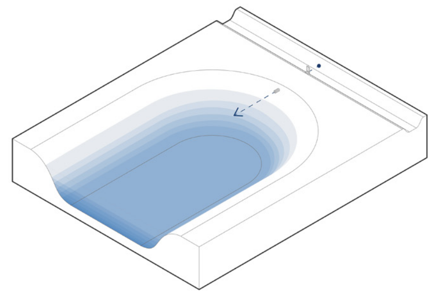


Reservoir

Primary water storage structures within the Irrigation District. Vary in capacity and can be located both on-stream (Basanno Reservoir) and off-stream (Snake Lake Reservoir).

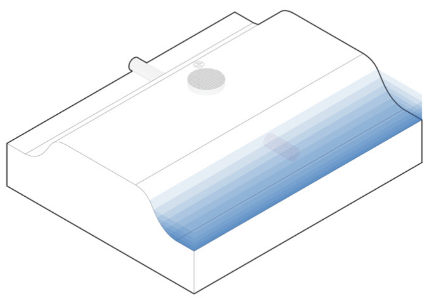
Dam + Headworks

Restrict flow of water either in-stream or off-stream to build water level within reservoirs. Typically located within valleys or depressions to take advantage of natural topography. Divert stored water into conveyance works.



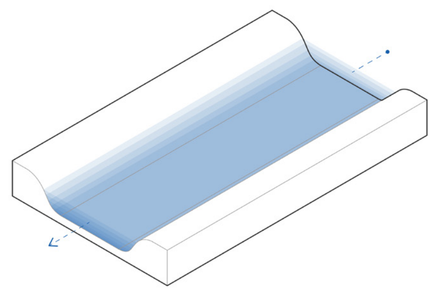
Dugout

Secondary water storage structures typically located allongside Primary/Secondary Canals and Pipelines.



Earth Dam

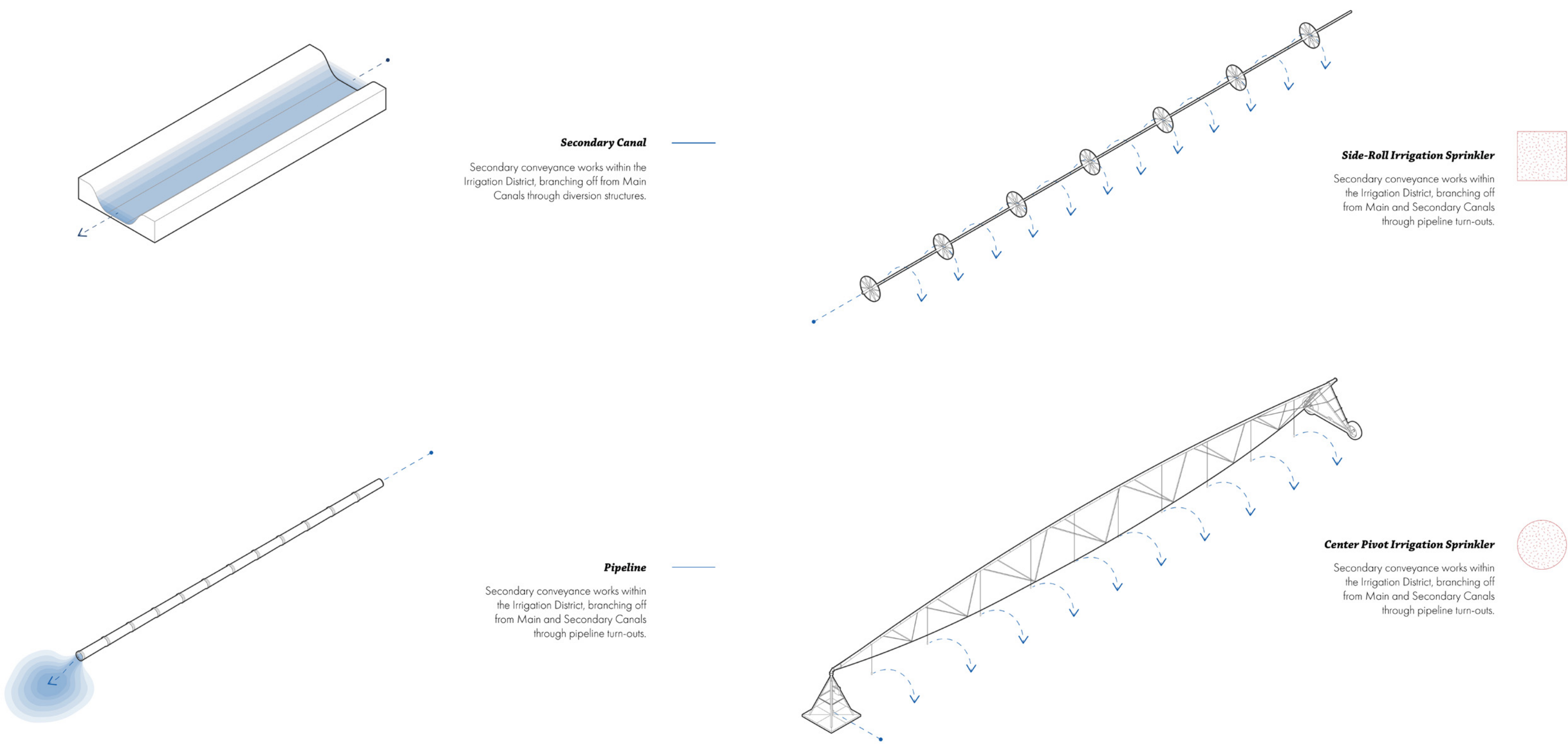
Automated or manual control or up-stream water level in canal while maintaining adequate down-stream flow rates.



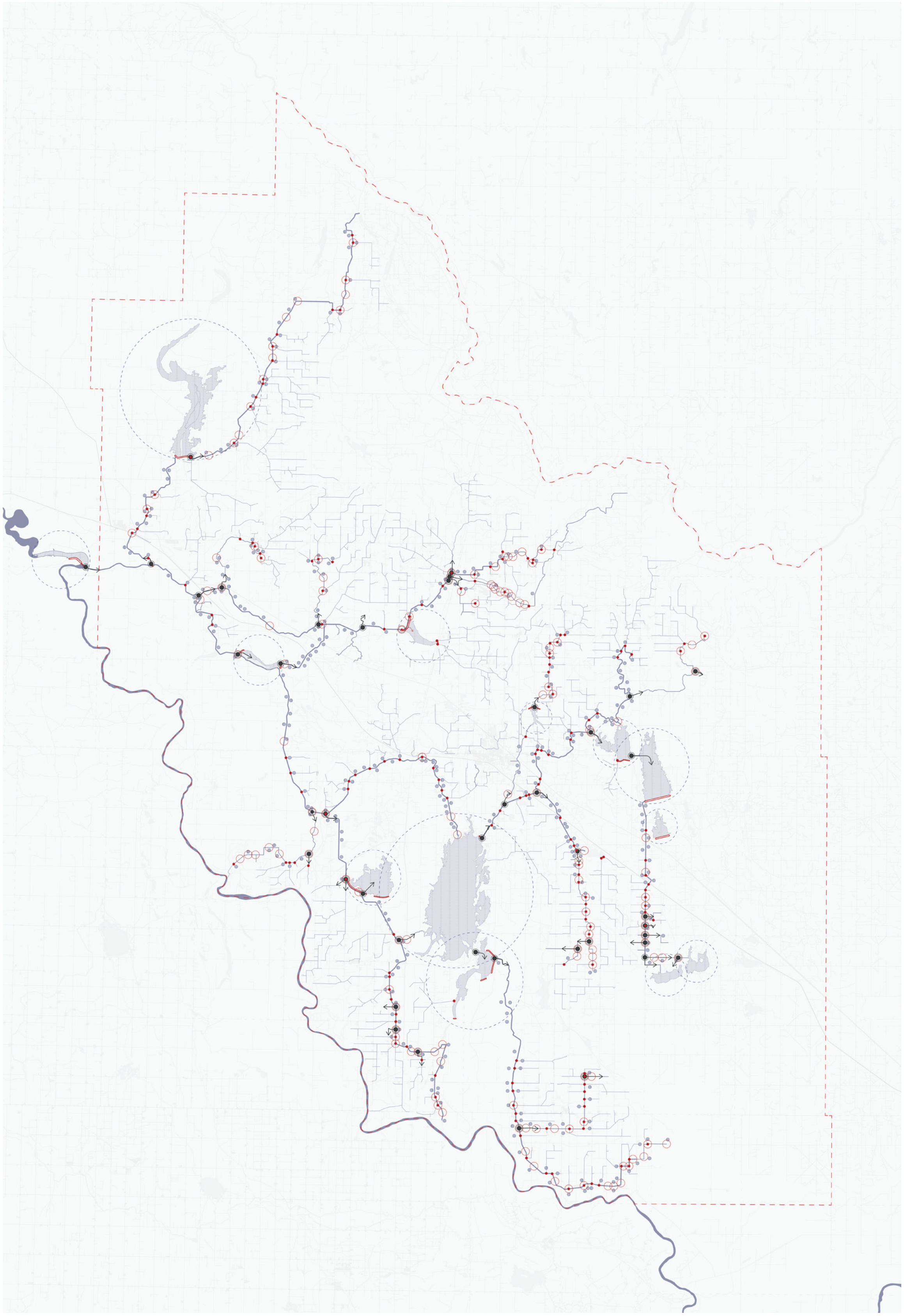
Main Canal

Primary conveyance works within the Irrigation District, stemming from the district headworks at the Basanno Dam and Reservoir.

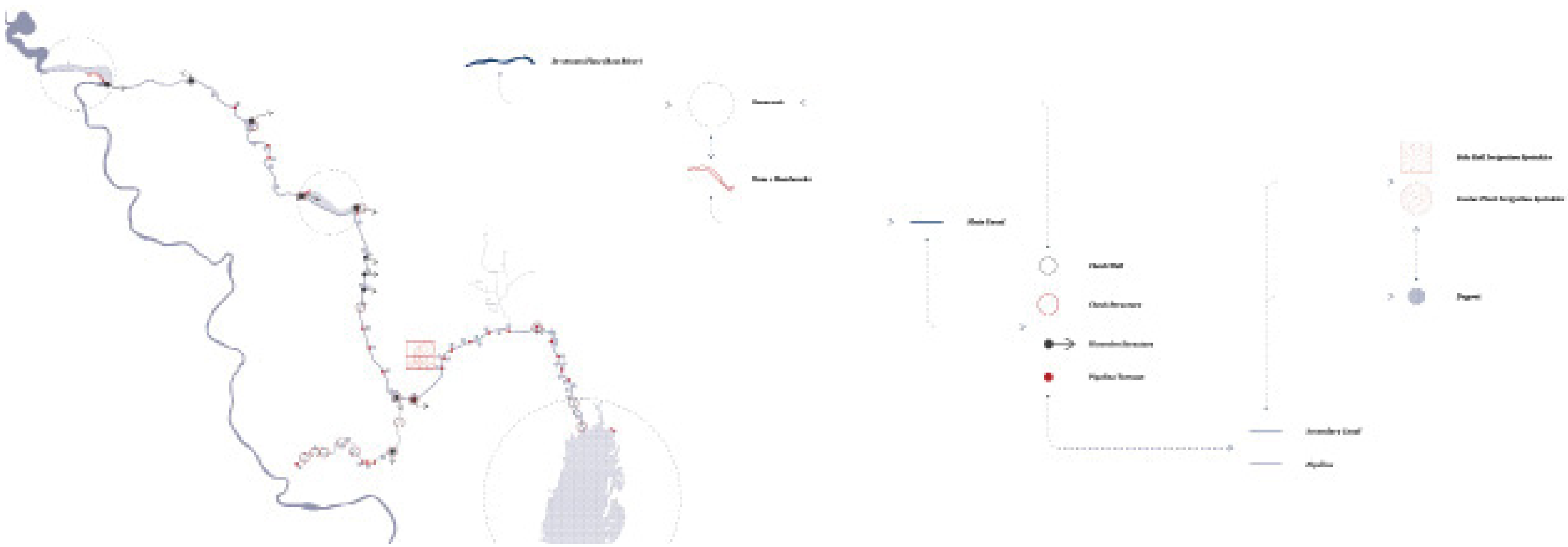
Storage, conveyance, and application infrastructural artifacts found within the EID.



Conveyance and application infrastructural artifacts found within the EID.



Infrastructural artifacts and irrigation system mapped across the EID.



Flow of diverted water from Bow River to irrigated fields.

Conveyance and Diversion

Diversion structures redirect water from one in-stream flow to another (ie. from main to secondary canal or lateral), or from storage structure to in-stream flow (ie. reservoir to main canal). They create the ability to enable or disable the flow of water from one water body to another, and regulate this flow in accordance to down-stream water demand. Main canals are the primary conveyance apparatus used to transport water from one location to another. They generally consist of a large central channel with earthen embankments raised above the surrounding grade, and are lined with a waterproof membrane to prevent seepage. They are a gravity driven conveyance method, and subsequently must follow the topography of the region from diversion to delivery point. Distributed along main canals are a series of control structures that are used to regulate up-stream water levels (check-structures) for diversion structures and manage difficult elevation changes in the terrain (drop-structures). Turn-outs are smaller scale diversion structures that transfer irrigation water from canal to irrigated parcel, and come in two general forms; multi-point pipeline turnouts with motorized gates, and on-farm turnouts which are generally manually operated gated culverts. The final two distribution structures take water from the point of delivery along canals to point of consumption on irrigated parcels, these are in ground pipelines and distribution ditches.

Storage

Reservoirs are the primary storage and supply structures for irrigation, and are typically a natural coulee, valley, or lake that is dammed in order to increase storage capacity. Dams are usually constructed of earth or rock filled embankments that host diversion structures and spillways to moderate reservoir levels and outflows either into the irrigation system via canals or back into the natural in-stream flow when on a river or stream. On-farm storage structures are used to store water for primarily residential/farmyard and livestock consumption. They provide farmers with on-demand access to water without necessitating access to the distribution system.

Application

Once delivered to points of consumption on irrigated parcels, water must be applied to cultivated land. There are two broad categories of on farm irrigation systems: surface and sprinkler. The former involves applying water by flooding the entire field and allowing gravity and deep furrows to direct water down-slope. The latter used pumps to bring water from the point of delivery to sprinkler and sprinkler heads. The primary sprinkler types used in the district are side roll (linear arrangement of sprinkler heads distributed along a rigid central pipeline acting as an axle for large wheels), and center pivot (rigid lateral pipeline is fixed to a stationary pivot pad and rotates on a central pivot point).

Administrative Realm

Operating behind this system of physical components is a management employed by the administrative body that oversees the irrigation district. In the case of the EID this governance structure takes the form of a board of directors, elected from the resident irrigators within the district. In accordance with the Irrigation Districts Act the duties of this management structure are as follows; i) to construct and maintain the irrigation works of the district, ii) convey and deliver water through these irrigation works,

Technical Realm

Reservoir
Stores build-up of diverted water for downstream distribution

Dam
Restricts flow of river course, containment structure for reservoir

Diversion Structure: Reservoir
Controls outflow of reservoir into main canal, can completely restrict flow.

1 *Main Canal*
Primary water conveyance assembly, moves water from reservoir diversion structure to secondary structures

Check Structure
Restricts flow of water in canal, ensuring sufficient volume for upstream diversion structures

Diversion Structure: Canal
Diverts water from canals to secondary conveyance assemblies, does not completely restrict water flow in primary assembly

2 *Lateral Canal*
Secondary conveyance assembly, carries water flow from main canal to irrigated parcels

Turn-out: Farm Gate
Manual gate opens diversion flow from canal to irrigated or domestic parcel

Turn-out: Pipeline
Automated diversion from canal to irrigated parcel

Dugout
Secondary storage assemble, located after point of delivery

Technical realm of infrastructural artifacts

iii) divert and use quantities in accordance with its water license agreement, iv) promote and maintain the economic viability of the district (Province of Alberta 2023, part 6). The volume of water diversion into the districts irrigation works is determined by the amount of Irrigable acres on the districts assessment roll, which is an ongoing count of the total number of irrigable acres contained within the district. Irrigable acres are classified as those which are suitable for irrigation purposes under their current state, without major impediments such as poor soil conditions, poor or inadequate drainage, excessive alkali content (harmful salts), or limiting topographic features (Alberta Agriculture and Irrigation 2022, 3). Water allotment for each parcel of land is determined according to the number of irrigable acres within it, with typical allotment across the district being 18” of water per season per irrigable acre under typical conditions (no drought status in effect) (EID 2022, Article 6). Irrigable acres are also subject to the method of application being used, with more efficient methods allowing additional irrigable acres to be assigned to the same physical area of land. These are known as “efficiency Acres. (EID 2023, Article 8).

On a district wide level, the primary goal of water managers, who manage the diversion storage level, and distribution of water through the irrigation works, is to maximize the economic value of water within the system which means prioritizing current water use over future potential use. This means maximizing the quantity of water available at any given point in time, and facilitating the speed of water delivery to down-stream uses (Jean and Davis 2016, 956). For daily water requests irrigators contact a “ditch rider” who is responsible for operating the diversion and control structures along canals, the ditch rider then relays the volume of water requested to district managers who regulate the level of diversion and reservoir outflow to meet the aggregate demand of the district at any given point in time (Jean and Davis 2016, 955). Irrigators and other water users ARE restricted from accessing or intervening in the distribution works of the district, and must rely on the Ditch Rider to serve as intermediary between themselves and the district (EID 2016, General Provision 4).

The total water allocation for each district is made up not only of water that is applied directly to fields or consumed for other uses, but includes canal seepage, evaporation, and field run-off that is returned to the river basin via drainage channels. This results in the continual development and rehabilitation of conveyance works and application methods in attempt to limit these “inefficiencies’”, thereby increasing the volume of water that can be put to productive uses.

From the moment water was diverted from the Bow River and began to flow into the CPR’s Eastern section in 1914, nature began to populate the newly created environment that canals, reservoirs, and ditches provided. This “encroachment” in the eyes of irrigators and irrigation staff represented a detriment to the efficient distribution of water, and they set about immediately to eradicate muskrats, beavers, and aquatic weeds growth from canals and ditches (Evenden 2006, 81-82). The high monetary and labor costs associated with maintaining these infrastructures initiated a war against inefficiency and near constant rehabilitation and upgrading efforts over the next century.

To reduce loss from seepage and evaporation earthen canals were first stabilized with rock and later lined with membranes. Later more minor canals, distribution ditches, and laterals were replaced with pipelines and buried to further streamline the distribution process. Following from the in-stream Bassano reservoir at the diversion point from the Bow River, The CPR, and later the EID, continued to construct secondary off-stream storage and distribution reservoirs to increase the storage capacity of the district. Distribution reservoirs serve to provide water sources closer to points of delivery throughout the district, and reduce conveyance times from head works to irrigators. To reduce the wastage from inefficient on-farm irrigation methods, irrigators have adopted ever more efficient technologies and application practices moving from early flood methods to side roll and eventually center pivot assemblies, each more efficient than the last.

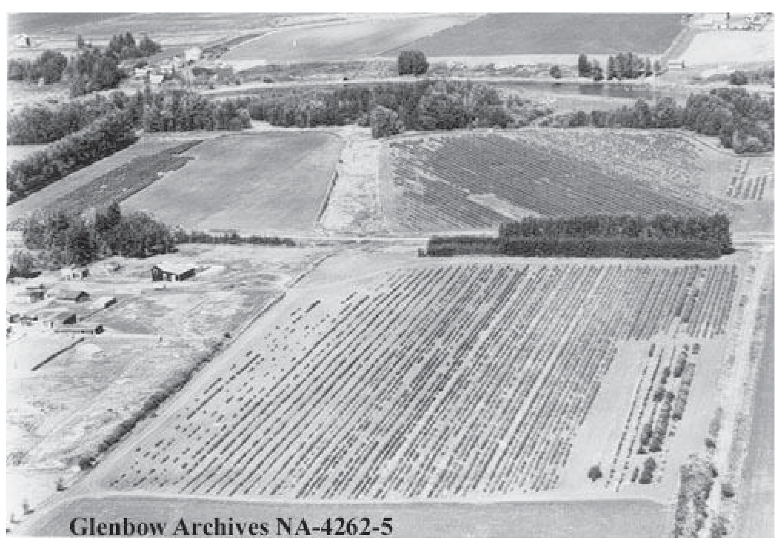
Evolving technologies and irrigation practices have driven the need for more advanced management and monitoring systems in order to collect, analyze, and use the data required to achieve high efficiency water usage. The most prominent transition has been away from manually operated control structures to remote controlled and automated systems. Remote systems refer to those that monitor the status of the site (flow rate, water level, gate position etc.) or allow remote control of the site via radio or satellite. Automated sites monitor and respond to conditions independently of and without the need for human intervention for regular operation (Ring 2006).

Evolution of Demonstration Farms and Research Facilities

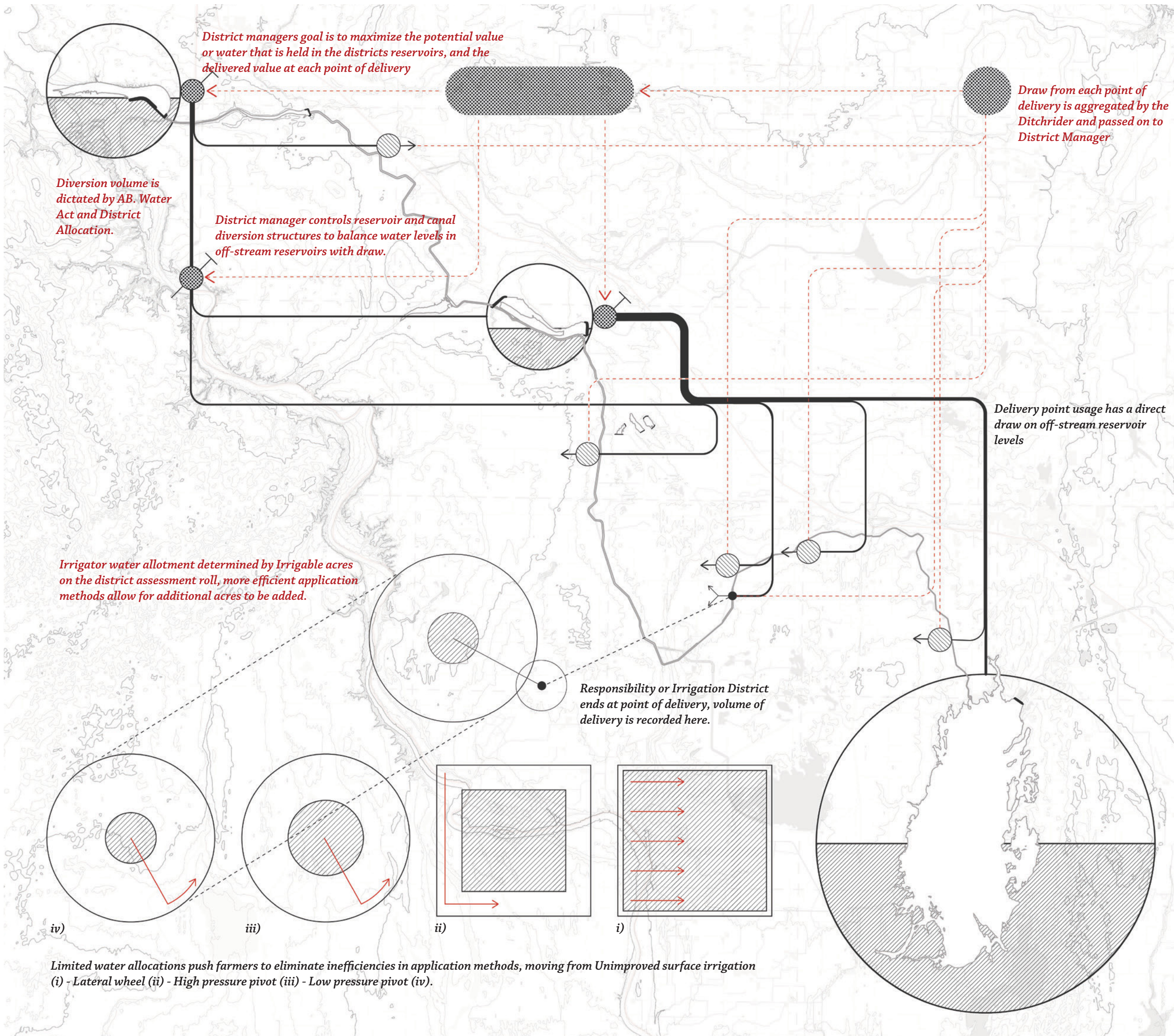
Demonstration farms were not abandoned after the CPR irrigation schemes were turned over to irrigation districts, but were adapted to serve other uses for the districts. The irrigation farm at Brooks was turned over to the provincial government as the Horticultural Research Center, later transitioning to its current status as the Crop Diversification Center South. This marks a transition from a focus on education and support for local farmers and irrigators to the development of specialty crops varieties and crop management techniques for southern Alberta's climate.

Research into sustainable land management practices and native prairie restoration are the focus of the Antelope Creek Ranch, located 15km west of Brooks. Here the focus is on integrating land management with livestock grazing, and the ranch welcomes researchers from local education institutions as well as the general public for tours of the operation. The ranch's 5500 acres of rangeland are open to public access for hiking, bird watching, or hunting activities (ACR n.d.).

The maintenance, development, and evolution of irrigation infrastructures and institutions over the last century have centered on removing impediments to the distribution of water from source to consumption. This development has



Horticultural research center, Brooks AB. (Glenbow Archives 1948).



Administrative realm of infrastructural artifacts

Administrative Realm

Reservoir
Creates the potential for economic production in the future, hedges the agriculture industry against extreme environmental conditions

Dam
Restricts flow of river course, containment structure for reservoir

Diversion Structure: Reservoir
Controls outflow of reservoir into main canal, can completely restrict flow.

1 *Main Canal*
Primary water conveyance assembly, moves water from reservoir diversion structure to secondary structures

Check Structure
Restricts flow of water in canal, ensuring sufficient volume for upstream diversion structures

Diversion Structure: Canal
Diverts water from canals to secondary conveyance assemblies, does not completely restrict water flow in primary assembly

2 *Lateral Canal*
Secondary conveyance assembly, carries water flow from main canal to irrigated parcels

Turn-out: Farm Gate
A physical interface between the districts representative - *Ditchrider* - and the delivery of water - a material enaction of governance

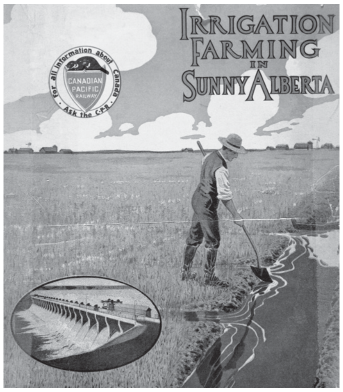
Turn-out: Pipeline
A remote interface between the districts representative - *District Manager* - and the delivery of water

Dugout
Delays the useful value of water at the point of delivery from time of delivery to time of application

primarily taken the form of increased reliance on technological systems as a means of increasing efficiency and reducing water loss as a means of increasing the productive output of the irrigation district and maximize the area under irrigation. Although the aim of improved application technology adoption has been to reduce overall water consumption, and more efficiently use the limited water supply in the South Saskatchewan River basin, some argue that incentives such as efficiency acres and the role played by irrigation districts as promoters of economic viability, has in reality resulted in increased water consumption. These developments have been presented as a technically focused solution aimed at reducing water consumption within the irrigation districts of Alberta, what is not immediately apparent however is that these reductions represent an increase in irrigable land and productive value for the district and its irrigators.

Poetic Realm

The construction of infrastructural artifacts into aesthetic vehicles that carry meaning beyond their technical functionality is a process that began with the promotional efforts of the CPR in attracting prospective settlers at the turn of the 20th century and continues within the current practices of the Eastern Irrigation District. Illustrations of irrigation farmers amidst cultivated fields and clear skies presented a picturesque and idyllic landscape. Similarly, the irrigation works that supported this landscape were promoted with equal enthusiasm. Infrastructural development was presented through photographs that depicted them as an extension of the natural environment with foliage encroaching on canal banks. The movement and distribution of water through the irrigation works was secondary within these portrayals, and the aesthetic image

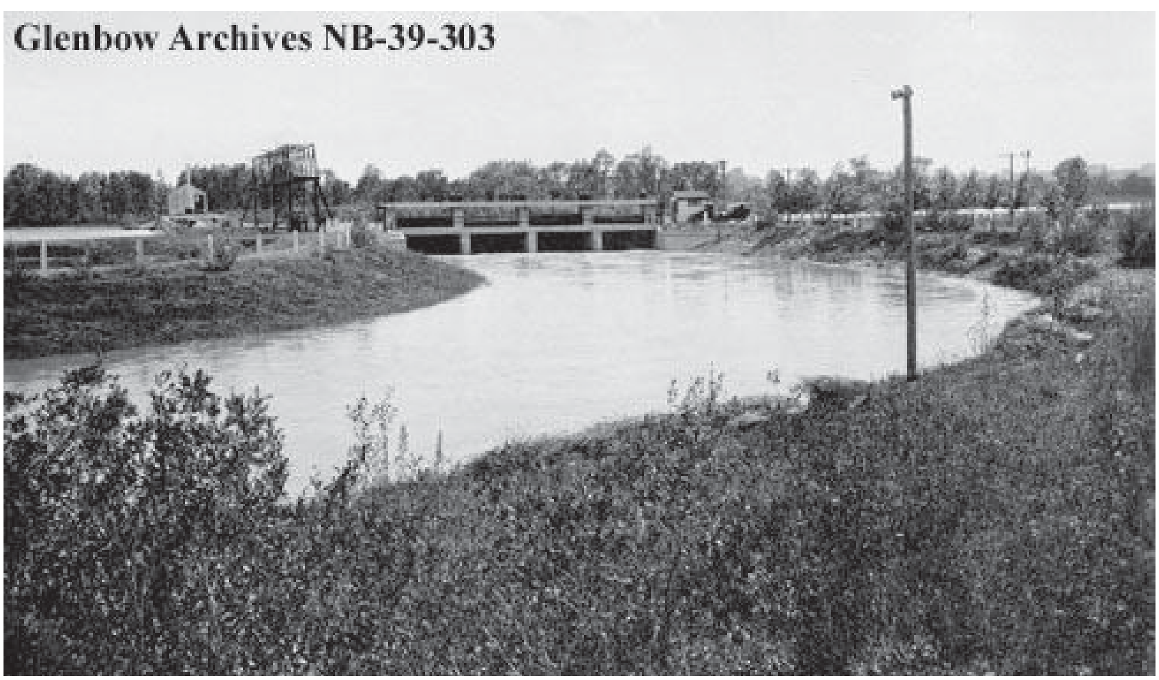


Cover of Irrigation Farming in Sunny Alberta, Canadian Pacific Railway promotional pamphlet (Glenbow Archives 1921).

of the constructed environment being natural and productive was foregrounded without note of its reliance upon the aforementioned technical function.

Promotional pamphlets touting the prospects of the Canadian prairies were distributed throughout Canada, Eastern and Mid-western United Stated, and United Kingdom. The presentation of the Canadian prairies as an expansive and fertile landscape is the perpetuation of what Dennis Cosgrove describes as the “ancient European dream” (Cosgrove 1984, 171) that is to say that the often-fictitious presentation of idyllic landscapes was intended to play off of the European settler’s desire for access to land that was unobtainable in their native countries.

This method of representation continues today in the development goals of Alberta’s irrigation industry - Promotion of public access to EID lands with multi-use philosophy (hunting, fishing, wildlife viewing/birding).

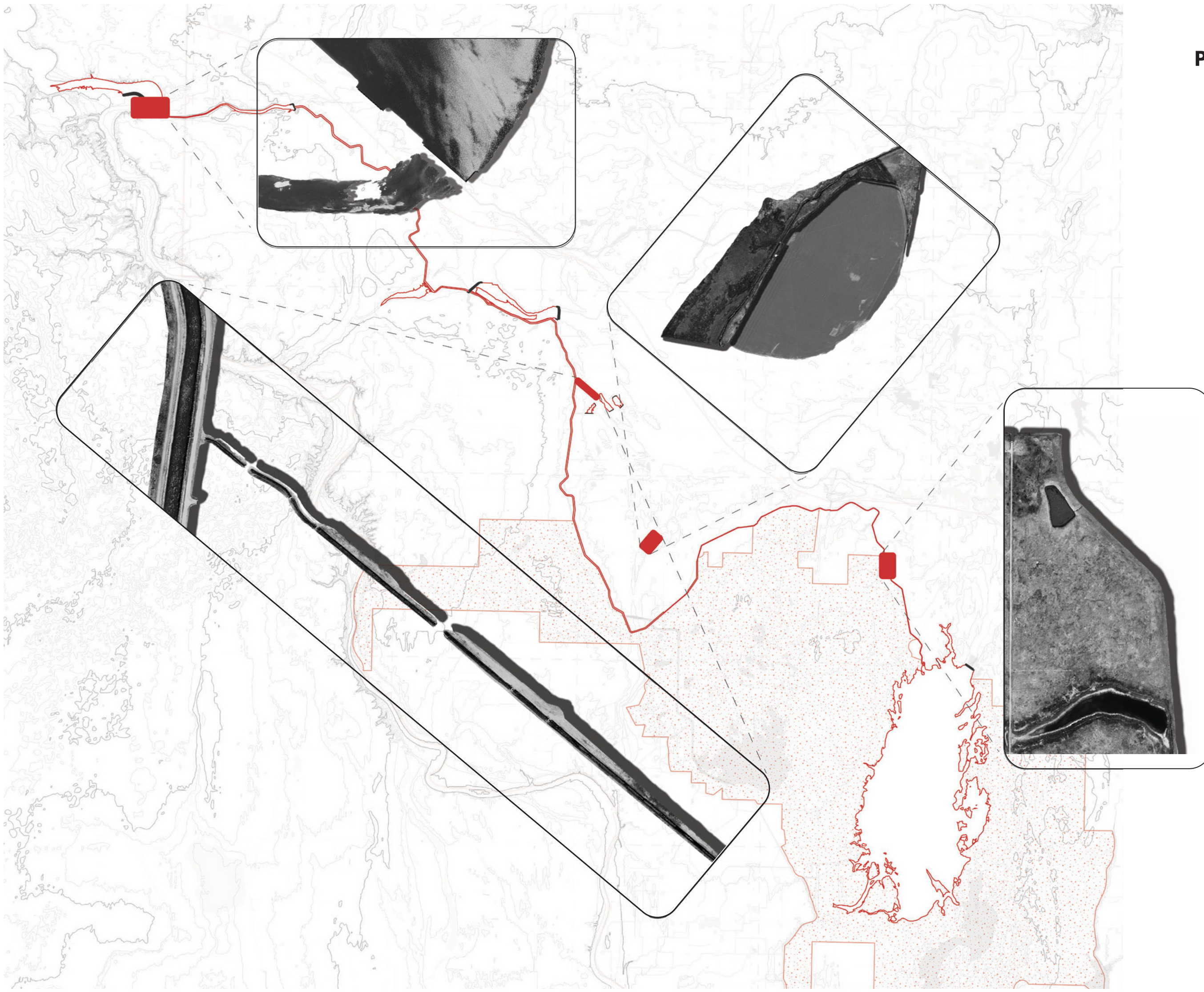


Calgary head works and main canal, Western section, Calgary Alberta (Western Irrigation District 1922).

Alongside the recreational aspects of the irrigation landscape organizations, including the EID, produce material touting the ecological diversity that is present within the region. The EID publishes a wildlife guide that promotes the plant and animal habitats that line canals, marshes, and grazing pastures within the district (EID 2024).

The idea of poetics within infrastructure assemblies is evident in the public use of space for recreational activities which have little reference or involvement with the technical functions or doubling of infrastructure that occur in the background. The technical function of water distribution has been replaced in the eyes of the public by the idea of public resources for recreation, hunting, fishing, and transportation. The aesthetic qualities of infrastructure space as a natural environment have been promoted and foregrounded in the perceptions of users over its technical functionality as tool for resource control and extraction.

Each of the realms outlined above have moments of overlap, where the technical function, Administrative duality, and poetic meaning converge into a unified understanding of reality. This is not to say that for certain material constructions there is a universally agreed upon reality, but rather that for every individual being, human and non-human, there may be specific instances where an infrastructural objects technical and administrative function aligns with its conceived representation in the mind. The consequences of industrial agriculture outlined in chapter 1 are more evident at the macro scale, news articles discussing seasonal drought conditions, water sharing agreements, and the introduction of market structures for water allocations, depict these outcomes at a provincial and regional scale that does not make itself evident to water users that interact



Poetic realm of infrastructural artifacts

Poetic Realm

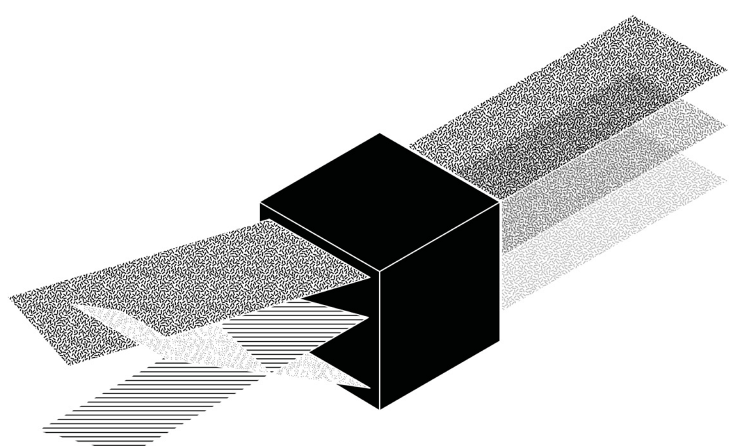
with the landscape and its infrastructures on a daily basis. like the abstraction of land and resources into economically productive devices that took place during the settlement of the CPR western Block, the consequences of these actions are now abstracted to a level that removes them from realm direct engagement and critique.

Chapter 4: Methodology

Matters of Concern – Building the Scales

Opening Infrastructure's Black Box

The concept of a "black box" denotes the reduction of complex processes or operations executed by a piece of machinery to the point where only knowledge of its inputs and outputs are required to operate it (Latour 1987, 3). The processes of water distribution, both the technical and doubling realms of infrastructure, can be thought of as existing within this black box for those that engage infrastructural artifacts within the landscape. For a bird watcher on EID lands all that is required to know is that constructed marshes and wetlands provide habitat for migratory birds, while the reliance of these environments on water stored for future agricultural production remains hidden within the box. Similarly, irrigators are required to know that a request for water must be placed with the ditch rider who then delivers the allotted volume at the specified time. The regulation of canal water levels by check structures and check wells that is needed to facilitate these processes, orchestrated by ditch riders and



Understanding of input complexity reduced through Black Boxing Process water managers is not apparent to either the irrigator or the naturalist in their engagements with the irrigation system.

The process of “Black Boxing” removes these processes and practices from the realm of interaction between human, nature, and landscape. By removing the shroud that conceals these processes within both the infrastructural artifacts and the administrative processes of the EID they are re-introduced to the apparent landscape that we inhabit, allowing for them to be engaged with and transition toward becoming matters of concern. Each of the infrastructural “Realms” do not exist as distinct and parallel entities, but have moments of overlap, convergence, and divergence. By re-instating human and non-human engagement with irrigation practices the currently segregated realms can be re-entangled and presented as matters of concern to those who inhabit the irrigation landscape. Matters of fact that have dominated the continual search for greater efficiency may begin be called into question by constructing the “scales” that present these concerns and their relationships to one-another.

Technological Mediation

Three lines of Inquiry.

Imbedded within the Poetics and Doubling of infrastructure proposed by Larkin is the mediation of human-world relations by technology. Paramount to the understanding of mediation theory in the context of this thesis is to understand that mediation does not exist as an interaction between two predefined “poles” (humans and technology), but rather they are constructed through the process of mediation (Verbeek 2015, 27). That is to say that the infrastructural artifacts within the irrigation system do not simply serve as

1 Mediation Theory

Mediation Theory → study of the interactions between humans and technological artifacts, and technologies mediating role in human-world relations....

Three lines of inquiry;

i) Types of Relations
ii) Points of Contact
iii) Types of Influence

i) Types of Relations;

Embodiment....	(Human - Technology) → World
Hermaneutic....	Human → (Technology - World)
Alterity....	Human → Technology (World)

ii) Points of Contact

....Verbeek		....Dorrestijn	
To the Hand....	physical interactions with technologies	Physical....	physical encounters, how technology steers physical behaviour
Before the Eye....	interpreting information provided by technology		
Behind the Back....	material constructions that impact our experiences	Contextual....	influence of the technological environment on actions
Above the Head....	role technology plays in our thinking	Cognitive....	impacts to cognitive decision-making, steering toward intended use

iii) Types of Influence

	Hidden	Apparent
Weak	*Seductive*	*Persuasive*
Strong	*Decisive + Implicative*	*Coersive*

	Hidden	Apparent
Weak	*Physical ....embodiment* *Cognitive ....image* *Contextual ....technical determination ....side effects*	*Cognitive ....guidance ....persuasion*
Strong	*Contextual ....background conditions*	*Physical ....coercion ....embodiment* *Cognitive ....guidance ....persuasion*

Summary of concepts within mediation theory.

a lens through which inhabitants interpret and interact with the surrounding landscape but play a role in the constitution of inhabitant and landscape, subject and object, through the mediation process.

Types of relations

As proposed by Verbeek, building off of the work of Martin Heidegger and Don Ihde, there are three primary lines of inquiry within mediation theory; Embodiment relations, in which technologies and humans form a unified entity through which the world is viewed; Hermeneutic relations, technology and the world for a unity, with humans interpreting technologies representation of the world; Alterity relations, humans interact with technology, with the world constituting the background.

Points of contact

Mediation theory can be further broken down according to where the point of contact or application through which technological mediation occurs. These points are; Physical, how technology alters or influences our physical behaviour; Cognitive, how technology impacts our cognitive decision making, steering it towards an intended outcome; Contextual, the contextual impact of technological environments on our actions and experiences (Verbeek 2015, Voordijk 2023).

Types of Influence

The mediation that is applied through these points of contact exist within a continuum of force, or magnitude, of influence along one axis, and visibility along the other (Voordijk 2023).

Transparency and Opacity

Yoni Van den Eede offers a framework for situating the role of mediation theory within Larkins Technical/Dualism/Poetic depiction of infrastructures, and provides a possible method for understanding how they can be reconstituted into a more holistic understanding of the role that infrastructure plays in shaping our understanding of the world. Van den Eede frames mediation in terms of transparency and opacity in the following terms;

When transparent, something is not perceived, it becomes transparent or escapes conscious attention. It remains there in some form, but we see through it as if it were not; When opaque, something is clearly in view, and deliberate attention is paid to it. (Van den Eede 2011, 154)

These two states relate to both the technology itself (transparency/opacity in use) as well as its surroundings (transparency of context) (Van den Eede 2011). Technology becomes transparent in use when its operation does not require focused thought in operation or when they function seamlessly. Likewise, transparency of context occurs when awareness of the conditions, context, and consequences of technology recedes into the background (Verbeek 2015, 393). In this framework the technical functionality of infrastructure, the “use” of infrastructural artifacts, become transparent when automated systems are employed that remove focused engagement in their operation and maintenance. Similarly, the Administrative doubling of infrastructure remain transparent to recreational users of the irrigated landscape because it remains absent from the physical environment that they interact with and perceive.

Shifting Perspectives

Consideration of the mediating qualities of technology, and its ability to construct both subject and object through the mediation process, the black box surrounding infrastructural artifacts can begin to be opened.

Wolfgang Schivelbusch in The Railway Journey, though not explicitly working with mediation theory, describes its effects through the development of mechanized travel and industrialization through the 19th century. Particularly useful to understanding the construction of subject-object relationship is the transformation of the traveller and landscape that was initiated by the switch from carriage to locomotive transportation. Drastic increases in the speed of travel, reduction of traveller engagement with the surrounding environment and natural elements, and shift of visual orientation to the countryside resulted in traveller (subject) being removed from a central and experiential position within the environment and being placed within the role of passenger alongside freight and steerage, a process of commodification. Similarly the landscape (object) was party to the same perspective shift as the subject, transformed from a surrounding environment with which a traveller engaged to a rolling panorama of distant vistas and flitting trees close to the railway tracks; something to be viewed rather than experienced and engaged with (Schivelbusch 2014). In this scenario the train car, locomotive, and railway system act as a mediator between traveller and landscape. They do not mediate between two existing poles as described by Verbeek, but rather reconstitute a new relationship through which passenger and panorama emerge.

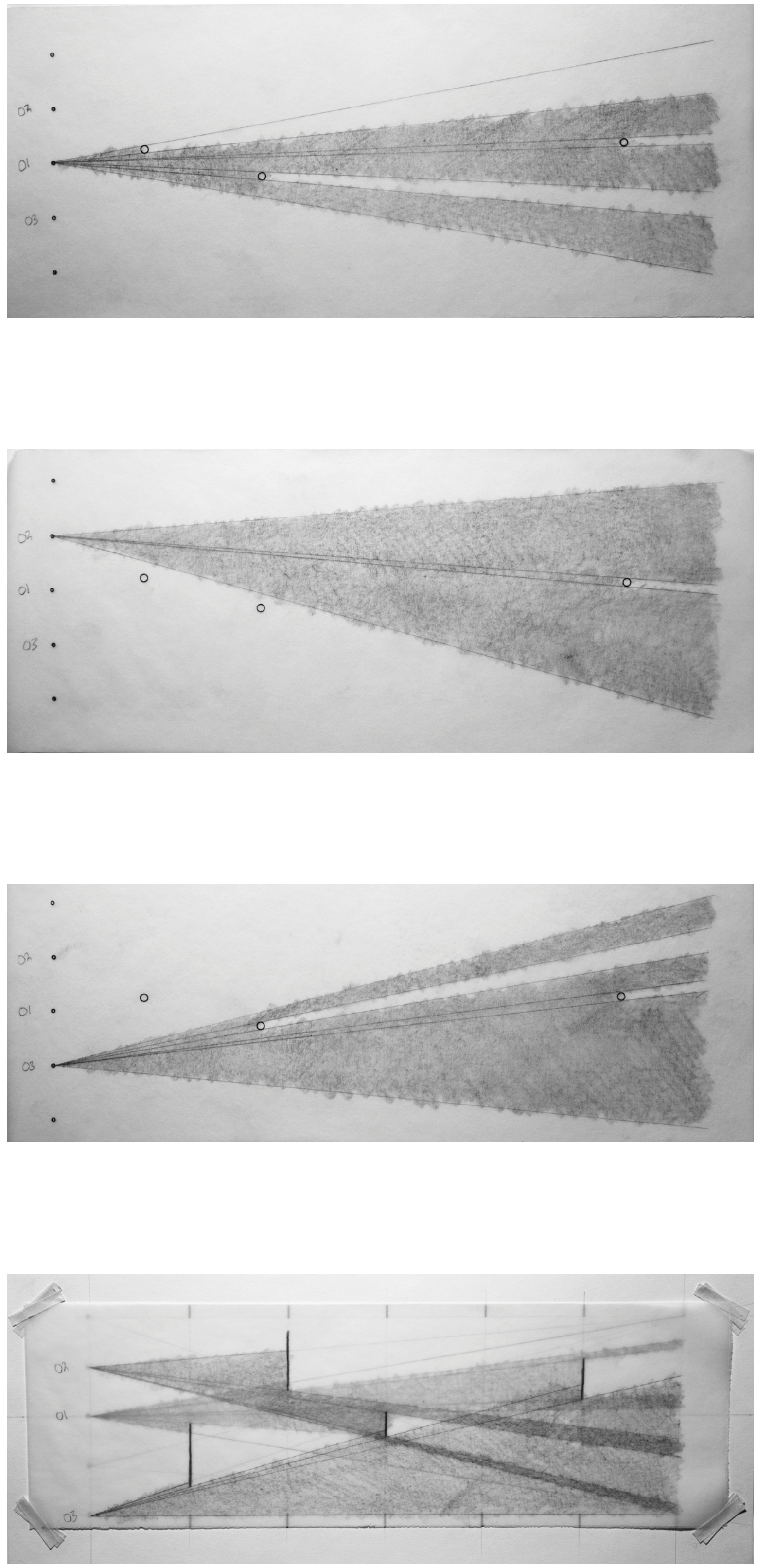
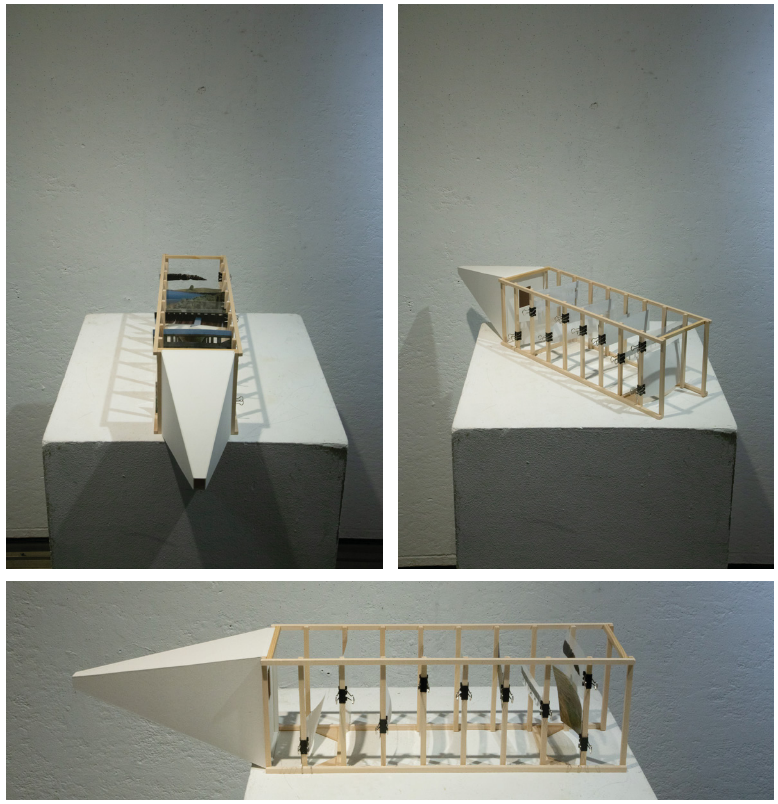


Diagram of parallax due to shifting position of viewer relative to objects within field of view.



Viewfinder concept model.

Scenes from within viewfinder, foregrounding infrustructural artifacts found within the landscape.

This process is further explained by Slavoj Zizek through the concept of parallax, in which the displacement of an object against its background results in a new perspective or line of sight being generated. He further expands parallax beyond visual phenomena to include epistemological and ontological shifts in subject and object respectively (Zizek 2011, 255). The building in his construction of parallax may be altered not only by a shift in viewpoint perspective, but also the ideological perspectives of the viewer (Zizek 2011, 255). This notion moves the concept of parallax into alignment with the multi-stable properties of technological artifacts and their subjectivity to varying cultural perspectives and attitudes.

These concepts of parallax, multi-stability, and mediation lead to the working method of design process through the viewfinder. This apparatus allows for varying viewpoints to be constructed with interventions inserted between the subject and object as a means to test their mediating qualities. Each focal plane within the field of view serves to highlight an intersection between conditions within the landscape, be that between intersecting realms, system cycles, uses, or physical conditions.

Matters of Care – Creating Affordances

If creating matters of concern entails bringing established matters of fact into a space where they can be engaged with and brought into question, introducing Matters of Care necessitates establishing deep affectual commitments to these infrastructures, their processes, and the subsequent landscapes that they create. As advocated by Maria Puig de la Bellacasa, Matters of Care provoke us toward a material doing (de la Bellacasa 2011, 90). In the context of this thesis this requires a movement beyond representing the effects of infrastructural artifacts on (natural watershed processes, ecological health, and human inhabitation), and toward developing means of directly engaging with these effects. Ingrained within matters of care is the necessity to not only address the current conditions in which we find ourselves, but to speculate on how they may be different (de la Bellacasa 2011, 100).

Understanding the way that living things, both human and non-human, engage with their environment through the theory of affordances provides an avenue through which we can begin to engage with infrastructural artifacts.

Designing for Affordances

The theory of affordances proposed by James Gibson in which environments afford, or offers, the substrates that allow for animals (including humans) to execute certain actions while prohibiting others (Gibson 2015, 119) has been further categorized into “actual affordances” and “perceived affordances.”

Actual Affordances – Physical Engagement

Actual affordances are what an object or environment physically provides, or what it allows an animal to do, regardless of weather or not the animal has knowledge of the affordance existing (Yiannoudes 2016, 158). Designing for actual affordances within the material construction of irrigation infrastructures that allow for users to alter or redirect the inputs and outputs typically withheld within the black boxing process will enable matters of care to be enacted within the landscape by providing means for making material change.

Perceived Affordances

Perceived affordances are what an animal perceives an object or environment provides. This concept was amended by Donald Norman to specify the perceivable portion of affordances as "social Signifiers" which give contextual clues as to what an object or environment may afford (Yiannoudes 2016, 158).

This perception of artifacts is not a quality inherent to artifacts themselves as they can only be understood through their relation to humans, and can have different interpretations and identities when viewed from alternate perspectives (Verbeek 2005, 117-118). In this framework, the activities typically associated with an artifact or landscape within a cultural context is directly related to how inhabitants perceive them, and what they afford. Continually using an irrigation pond/marsh for birdwatching will further engrain that infrastructural as a part of the natural environment in the perceptions of birdwatchers. Bringing activities and practices associated with each realm of infrastructure, the technical, administrative, and poetic with infrastructural artifacts that they are not typically associated with can provide opportunities for the realms to become re-entangled by creating new socially signified affordances.

(2) Affordances

i) Types of Affordances;	Actual Affordances....	physical affordances provided by material constructions
	Social Signifiers....	percieved affordances that provide information about what an object might do

Summary of concepts within the theory of affordances

Connecting Affordances

Relationships as Architectural Site

To allow affordances created by individual infrastructural artifacts to move beyond their immediate geographic context, it is necessary to expand the concept or architectural intervention beyond the typical idea of site. The traditional concept of “site” within architectural practice as a self-contained, singular entity is challenged by Easterling by proposing a shift toward an approach to site that considers the root of urban organization as the interconnected relationships between multiple, dispersed sites (Easterling 1999, 2). The way we think of site and project as being separate entities must also be adjusted in this framework as well, as when relationships between sites are altered through the design process the “site” is reconstructed alongside the intervention (Hogue 1984, 54).

This has its basis in Fritz Hallers work on systems thinking which a further development of Konrad Wachsmanns work based on mechanical production and automation. Haller expanded the architectural understanding of “system” to encompass the scale of the city, with infrastructure serving as the mediator of its internal flows (Heuvel, Martens and Munoz 2020, 85). Hallers concept of network, similar to Easterlings, envisioned the structure of environments being dictated by relationships between individual elements (nodes), with infrastructure serving as mediating element. The control structures of the irrigation distribution network act much in the same way, with an input at one location (an irrigator requesting water delivery or a manager raising the level of a reservoir) has consequences for locations distributed both up and downstream. The application of water to a field has effects on both the levels of water in its upstream supply reservoir, and the outflow levels in drainage channels returning to the river.

Yaneva, though not explicitly discussing networks, proposes that the influential political power between elements lies within their spatial relationships only insofar that these relationships promote or restrict exchange between them (Yaneva 2017). In this way, the most influential site for intervention are those that have the ability to affect the condition of others, and not those that have a proximity relationship.

When taken together, the dispersed sites within a network and their relationships constitute what is referred to as its “disposition.” This is the potential relationship between two entities that lend agency to the organization as a whole (Easterling 2016, 72)

Network Thinking

Both Michael Truscello and Keller Easterling note the importance specific qualities of network components that have the capacity to increase the effects of a relatively small act as it reverberates through the interconnected system, or to alter its disposition. These are their “active form,” and include; Doubles, Remote Controls, Multipliers, Switches, Governors.

Doubles; the double acts as a proxy, hijacking the role or the power of the original.

Remote Controls; affect change indirectly or from some distance away.

Multipliers; amplifies the effect of an intervention through replicability across the network.

Switches; act as a valve to supress, initiate, or redirect flows within the system.

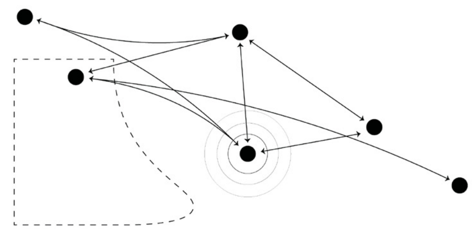
Governors; the spatial rules that set the growth pattern of a network or network nodes.

These active forms of individual sites, or nodes, have the capacity to alter or redirect the disposition of the larger network when their design is thought of not as a means of shaping form, but of shaping relationships (Easterling 2016, 80).

(3) Network Thinking

Expansion of the architectural site beyond its traditional conceptualization as a single contained site....

to include the interconnected relationships between multiple and dispersed sites, or “nodes.”

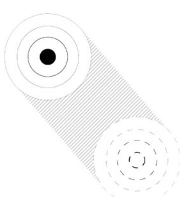


When taked together the relationship between nodes forms the disposition, or latent tendancy, of the overall network.

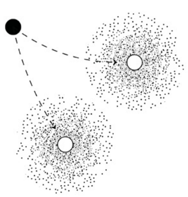
Altering the disposition of a network requires a taking advantage of the interconnected nature of its nodes, with the qualities of each node having the capacity to amplify effects throughout the system....

these qualities are the nodes “Active Form.”

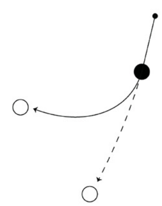
Doubles



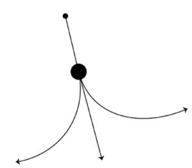
Remote Control



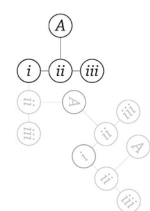
Switches



Multipliers



Governors



Summary of concepts within network thinking

Chapter 5: Design

Antelope Creek Ranch Site

The Antelope Creek Ranch (ACR) site is a 5500-acre rangeland property 15km west of Brooks AB that will serve as a test site for this thesis. Operating as a habitat development area since 1986 the ACR is managed as a joint venture between the Alberta Fish and Game Association, Ducks Unlimited Canada, Wildlife Habitat Canada, the Province of Alberta, and in collaboration with the EID, with the aim of demonstrating integration of livestock grazing, recreation, rangeland and wildlife research, education, and industrial use (ACR n.d.). The ACR hosts a mix of native prairie grassland, grazing pastures, wetlands, lakes, and small irrigated parcels used for cattle feedstock.

Existing Technical Artifacts

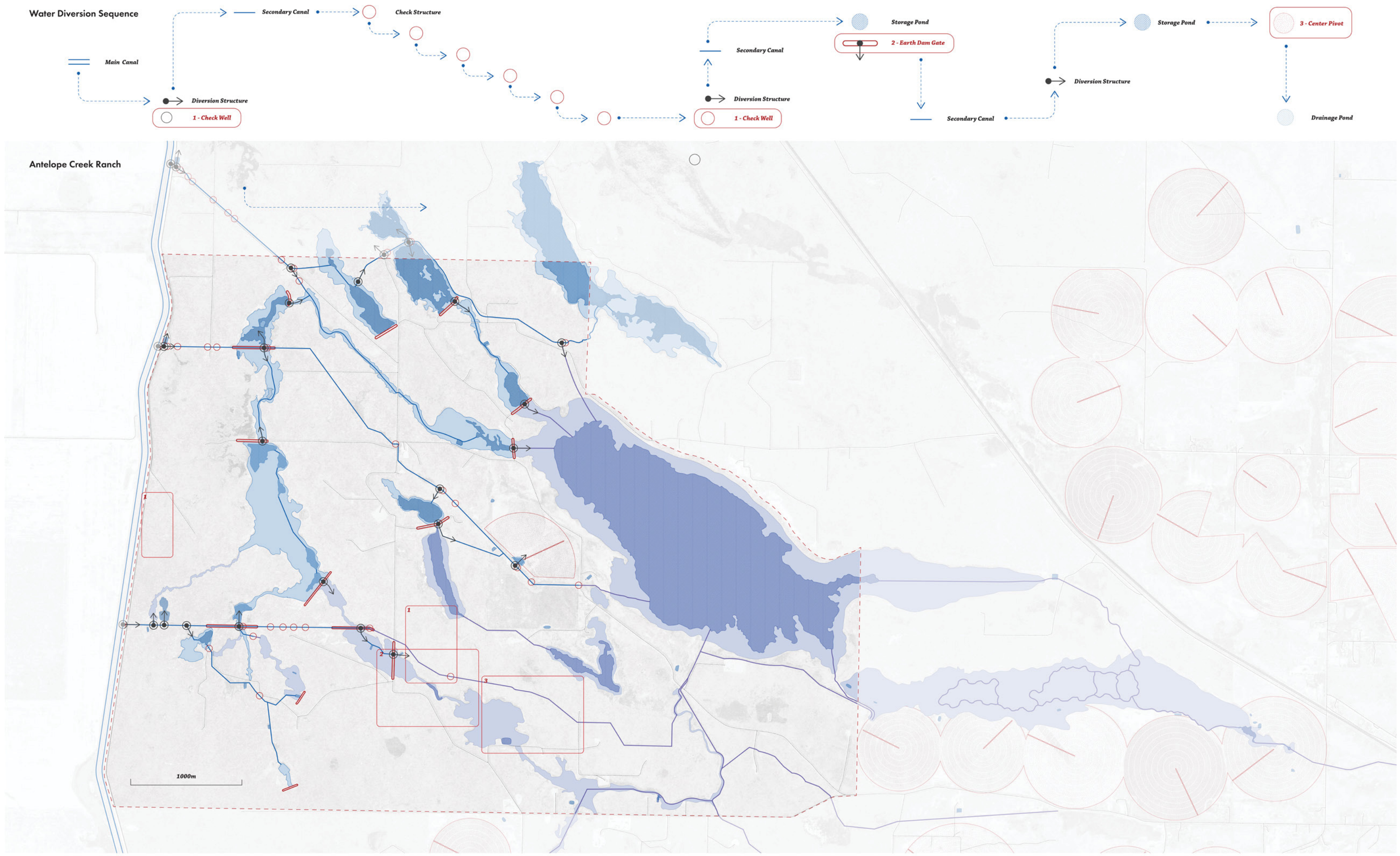
Water for the sites hydrologic features is provided by three lateral canals branching off from the main EID canal on the western edge of the property through automated diversion structures under EID management. The laterals are lined with check structures to regulate water levels for livestock watering along the canal itself, or for diversion through farm gates to dugouts or supply reservoirs. Supply reservoirs are constructed by locating earth dams across the down-slope portion of natural depressions in the landscape. Water is supplied to these reservoirs both from natural precipitation and drainage channels as well as via lateral canal diversion with water levels being regulated by drainage structures built into the earth dams. Through these drainage structures outflow water enters drainage canals or natural drainage channels, converging to form wetlands, marshes, and shallow lakes within depressions in the landscape. Within the ACR are two irrigated fields providing additional feedstock for grazing operations. Their center pivot sprinklers are supplied by water diverted from one of the lateral canals into a dugout, which is in turn pumped via pipeline to pivot heads in the center of each field. Excess runoff from these fields along with other irrigated parcels in the vicinity flows into drainage canals and channels, eventually joining the outflow from supply reservoirs.

The three classes of infrastructure previously discussed in Chapter 3; conveyance, storage, and application, will form the basis for three types of re-imagined technical artifacts within the test site. By approaching the design of check structures, earth dam gates, and center pivot irrigation Sprinklers as technical artifacts that have the capacity to mediate the constitution of inhabitant and landscape, provide affordances to materially alter the environment, and develop network connections between dispersed sites, the currently disparate realms of infrastructure can begin to be re-entangled.

Site Programming

Grazing

The economically productive function of the ACR is as grazing rangeland for cattle from within the EID. The ranch is home to 4 native pastures and two tame pastures under irrigation. Using a differed rotational grazing system, native pasture is allowed to mature through the early season, typically until early July, while herds graze tame pastures with the intent of building native range health early in the early season and reduce over-grazing (ACR 2020, 5). These tame pastures, irrigated via center pivot sprinklers, typically



Site map of Antelope Creek Ranch with locations of adapted infrastructural artifacts integrated within the existing water delivery system.

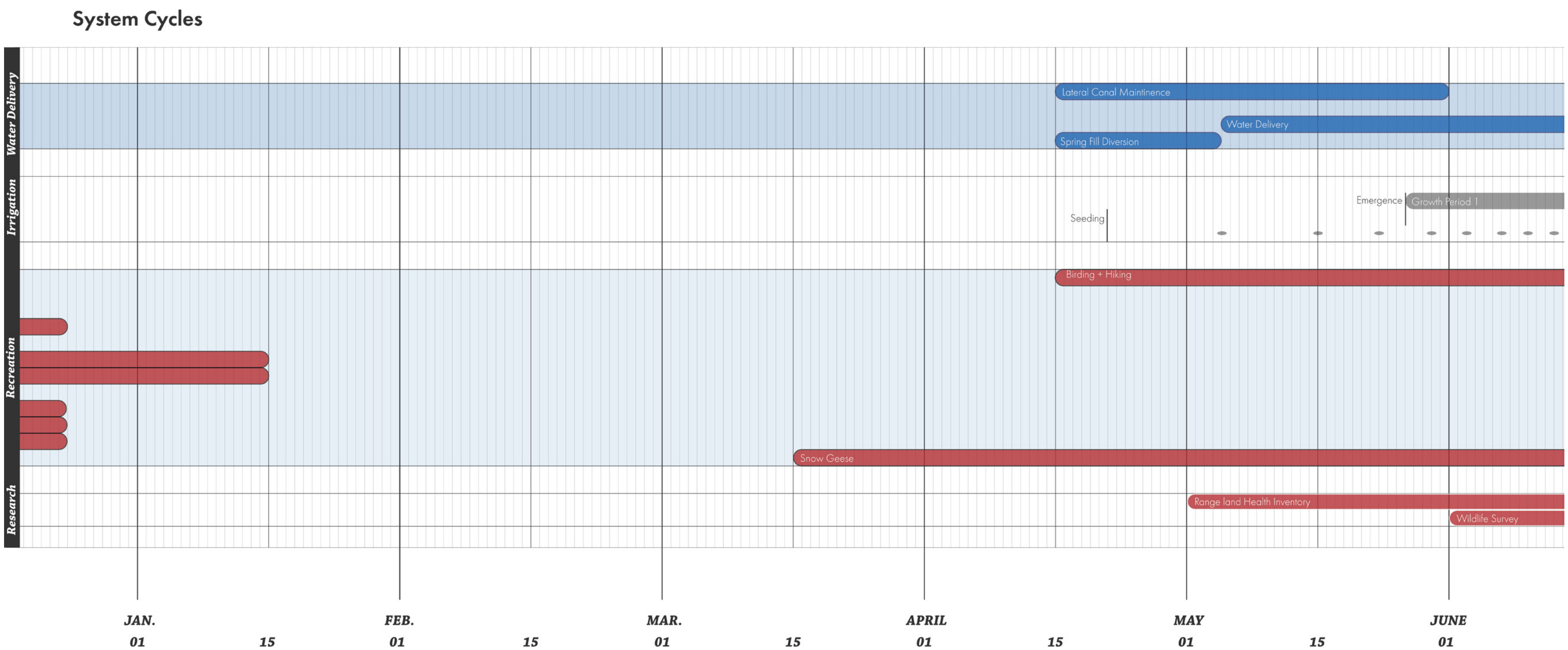
provide two grazing cycles before herds are turned out to native pasture (ACR 2018, 7). Selectively grazing is used in the early season along roadways, ditches, canals, and pipelines in an effort to manage the spread of crested wheat grass, an invasive species that was historically seeded during reclamation efforts. Grazing is typically concluded around mid – late October when cattle return to their home ranches (ACR 2020, 6).

Recreation

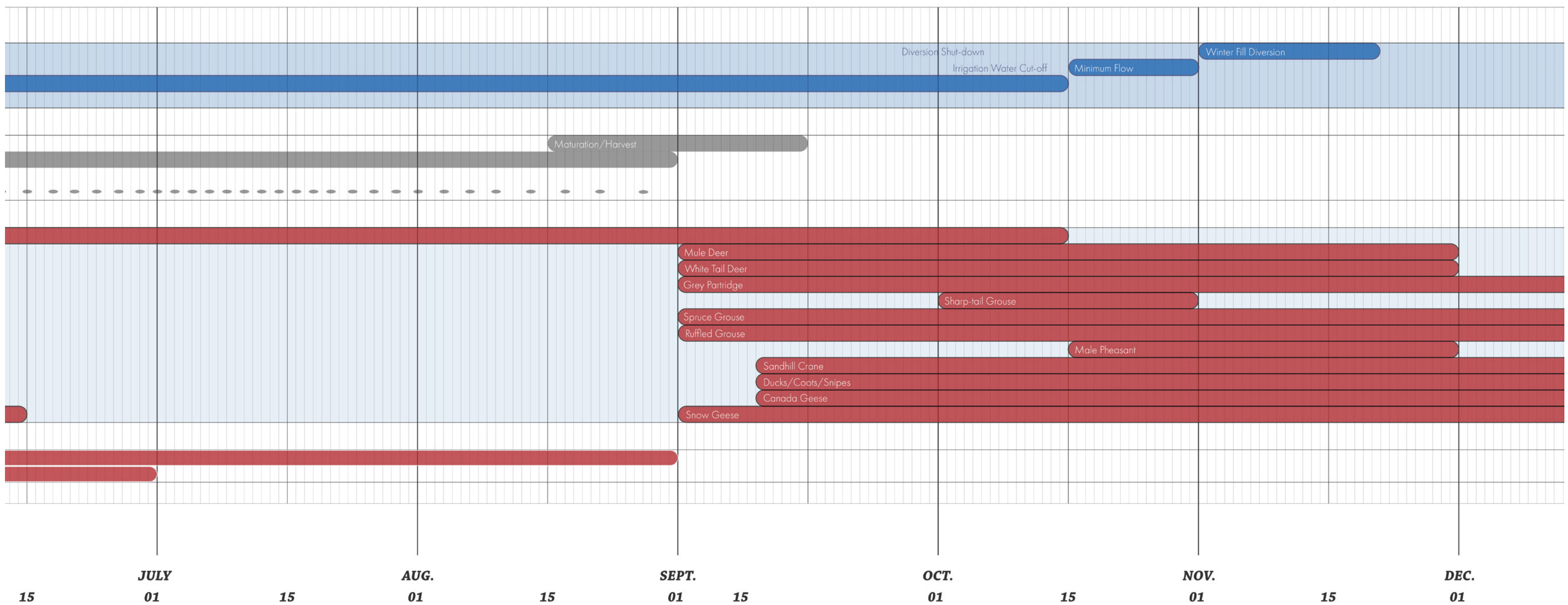
Similar to grazing leases operated by the EID, the ACR is accessible for day-use and non-motorized recreational use by the public. Throughout the spring and summer canals, wetlands and reservoirs are frequented by hikers and birders. These hydrological features also attract waterfowl, upland birds, deer, and pronghorn antelope which are hunted during their respective hunting seasons. Due to the concentration of grass, brush, and aquatic plant growth in low-lying areas and along the edges of water bodies, recreational use of the ACR tends to concentrate around conveyance and storage infrastructure as well as the drainage channels and ponds they feed into.

Research

Alongside grazing and recreational activities the ACR site hosts research activities from independent organizations, universities, and in-house studies undertaken by ranch management and summer students. The aim of this research is to monitor changes in range health assessments (vegetation conditions, plant populations, litter reserves, invasive species), water and soil conditions, and wildlife diversity (ACR 2022, 2). Range health assessments undertaken by the ACR take the form of vegetation inventories used to



ACR system cycles, January - June.



ACR system cycles, June - December.

identify plant communities and their health across the ACR's rangeland. Using a 1m by 1m plot researchers assess the shrub cover at 5m intervals a 50m transect, nested within this large plot is a smaller 20cm by 50cm Daubenmire frame used for the assessment of smaller grasses and Forbes (ACR 2020, 21). These plots and transects are erected by researchers over a representative portion of the ACR's rangeland before being transferred to the next location, meaning that these activities are only temporarily visible to other users of the site during the duration of active research activities. Additionally, this research is focused primarily on the rangeland portion of the ranch, with canals, ditches, and wetland sites being left in a marginal position.

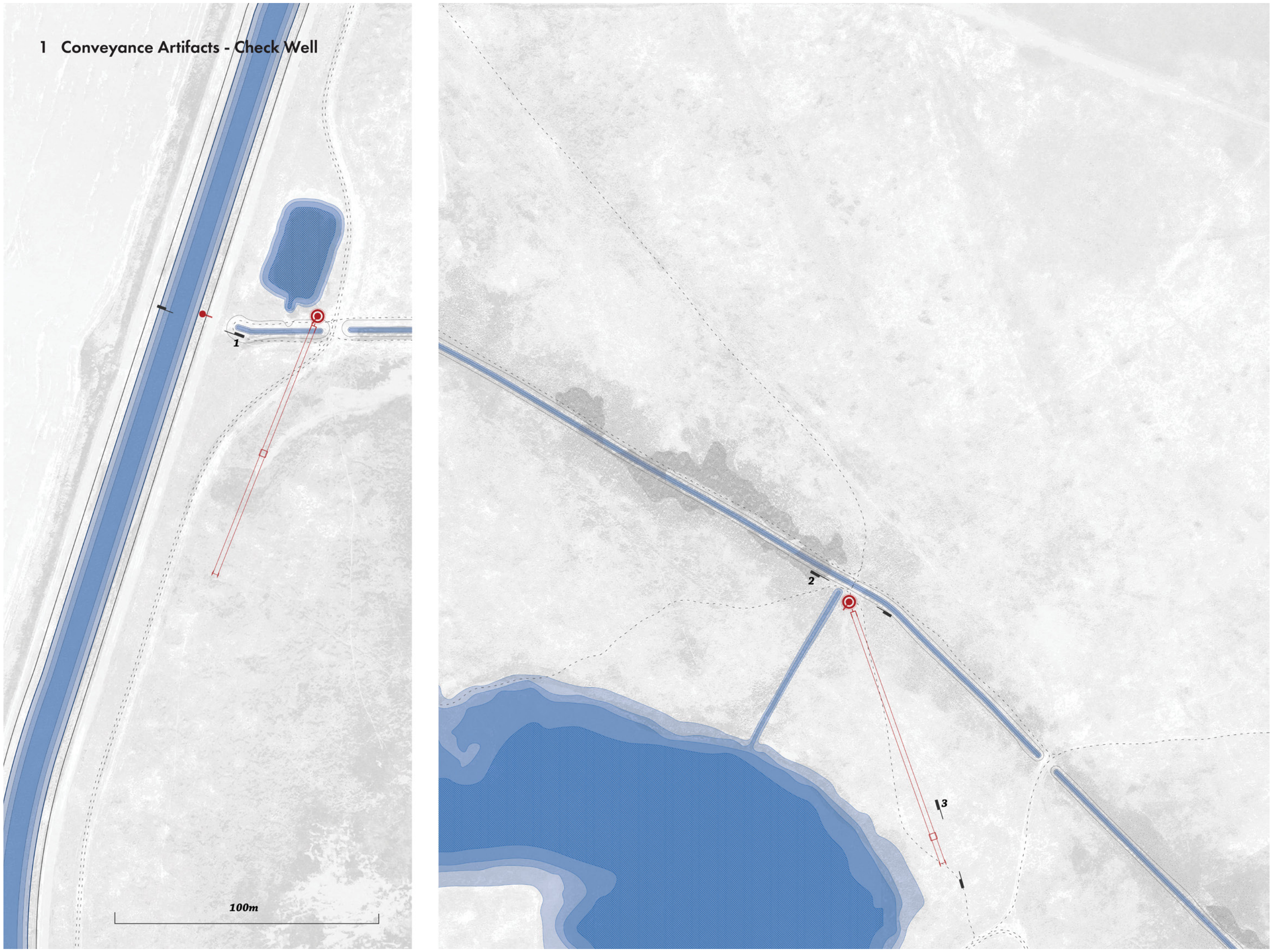
System Cycles

Cyclical Activities across the district have been plotted over the course of a year to determine possibilities for overlap (see system cycles diagram).

Each of the activities described above, grazing, recreation, and research, occur on a cyclical basis throughout the year. By providing affordances for the activities within each cycle through infrastructural artifacts, cycles that do not currently have spatial or perceptual connections are brought into contact, provoking users of the landscape to question both the historical and newly created network connections between technical, administrative, and poetic functions of the irrigation system.

Conveyance Artifacts

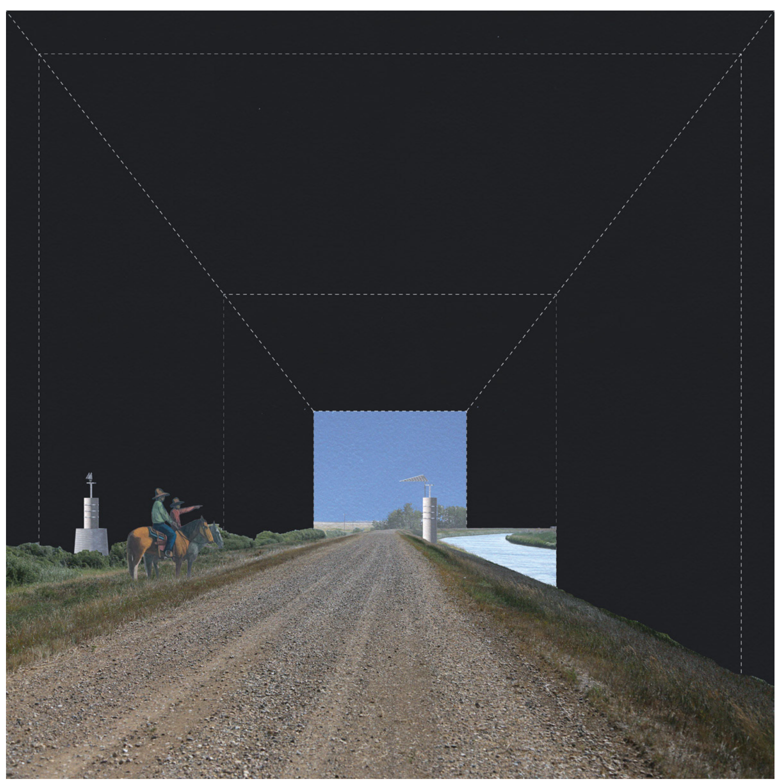
The check structure artifact serves as an intermediary between the technical function of the water delivery system and its operational management by the EID, providing



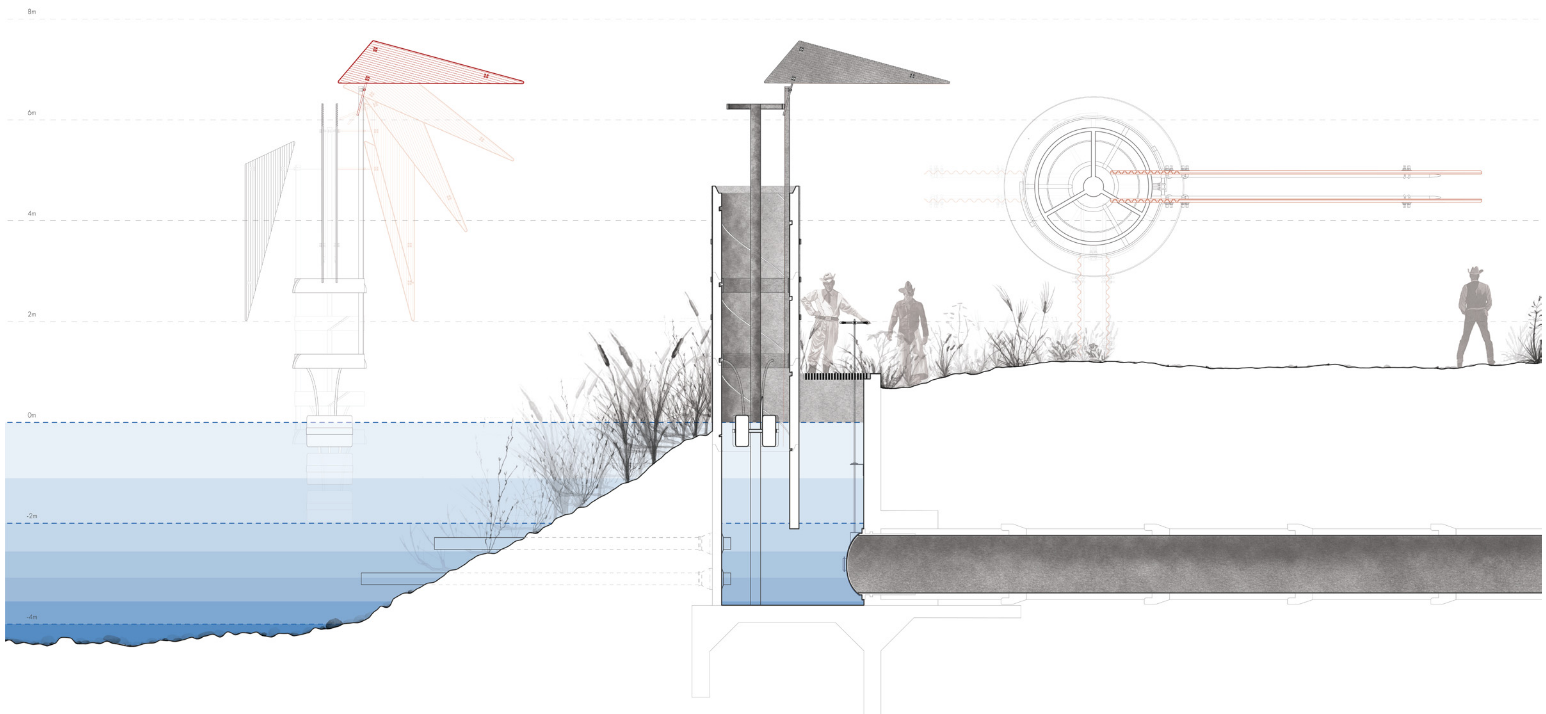
Conveyance artifact adaptations plan.

information on canal water levels to ditch riders on site or water managers via remote sensors. Due in part to their material characteristics and location imbedded within the canal banks these artifacts, their role within the irrigation system, and the information they transmit, currently lie within the peripheries of perception for those who inhabit the infrastructural landscape. Within this arrangement, the regulation of canal water levels, points of diversion from canals, and the effects of these actions on the landscape remain hidden within the infrastructural "Black Box." Adaptation to the check well artifact bring these operational actions and their resulting effects on the landscape to a level that allows them to be observed, engaged with, and questioned at the human scale of inhabitation.

Introducing the check structure to diversion points along the main EID canal that feed into the ACR provides visual markers for typically hidden diversion gates. Extending the



View of check well adaptation from main canal service road.



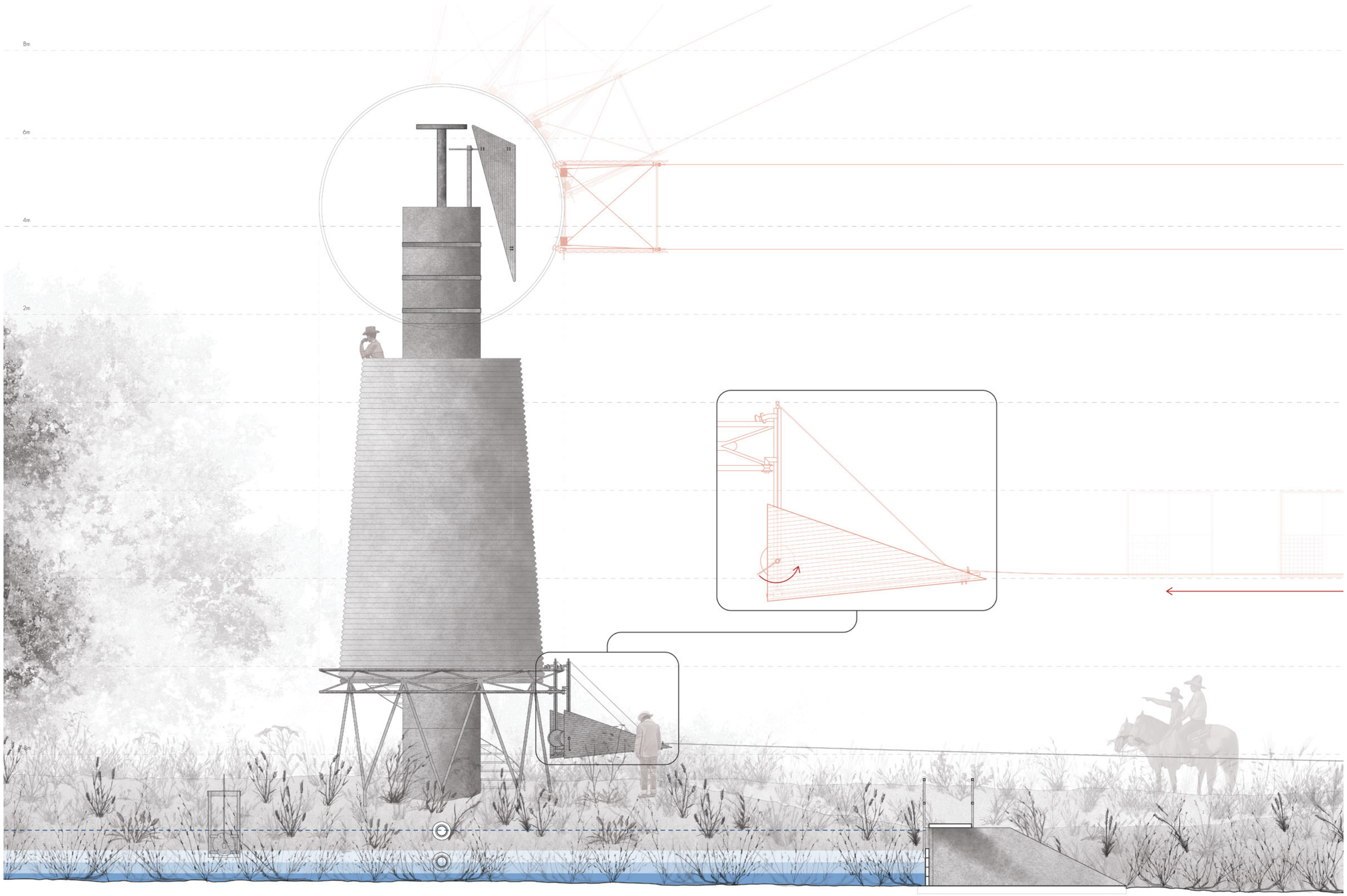
1

Conveyance artifact adaptations section 1.

below grade concrete pipe segments make-up the structures foundation up to a height of 4m inserts these artifacts into the visual perception of inhabitants when contrasted against the gradually sloping canal walls and horizontal datums constructed by the service roads that parallel them. While travelling down these access routes, the pairing of check structures along main canals with those on adjacent secondary canals allows for a visual connection between diversion point and downstream conveyance structures that is typically only visible from the air or while viewing secondary canals from the point of view of the diversion structure itself.

In order to publicize and make accessible information on canal water levels and diversion events that are typically only available to EID ditchriders and water managers, the adapted check wells translate this information into visual signals via internal mechanisms. Using a float housed within

View of check well adaptations looking down lateral canal.

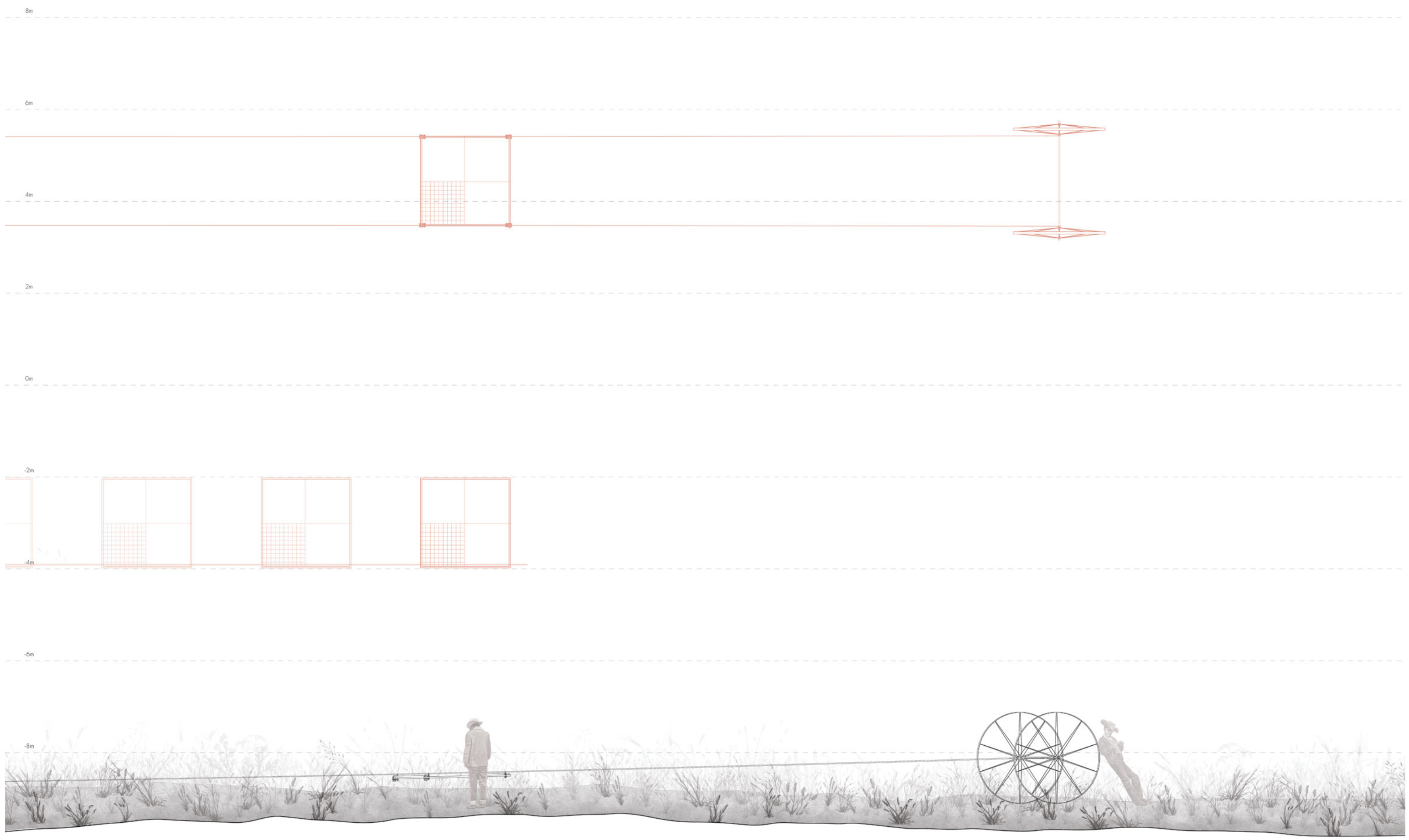


2

Conveyance artifact adaptations section 2.

the concrete pipe segments, changes in canal fill levels are translated into vertical movement of the mechanism. These changes in the volume of water held within the canal are indicated on the exterior of the check well structure with three corresponding registration marks, indicating minimum canal flow (late season), typical flow (mid season/regular water demand), and high flow (during diversion or irrigation events along that section of canal). In this way, the operational management of the conveyance works are made visible through the display of fluctuating water levels represented through the movement of the check well mechanism. Rotating as water levels rise for diversion, the mechanism arm indicates the direction of water diversion into the ACR secondary canals, registering inputs from water managers as visual signals accessible outside the Operational realm of this infrastructure system.

Looking down the secondary canal within the ACR, check structures placed at each check structure and diversion gate transmit visual signals along the 5km canal, indicating the differing water levels along its length as check structures are opened or closed as water is delivered throughout the irrigation season. As the elevation gradually drops moving away from the main canal, check well structures gain height to maintain a consistent elevation with the source diversion point, maintaining visibility from the main canal service road, and enforcing a forced perspective as one looks down the secondary canal. In this way, the path of water flow can be traced from main canal, through the secondary canal system, and finally to delivery point as indicated by raised mechanism arms. Within this viewport, increased vegetation and biomass that accumulates within and alongside the canal banks is framed by the receding check



3

Conveyance artifact adaptations section 3.

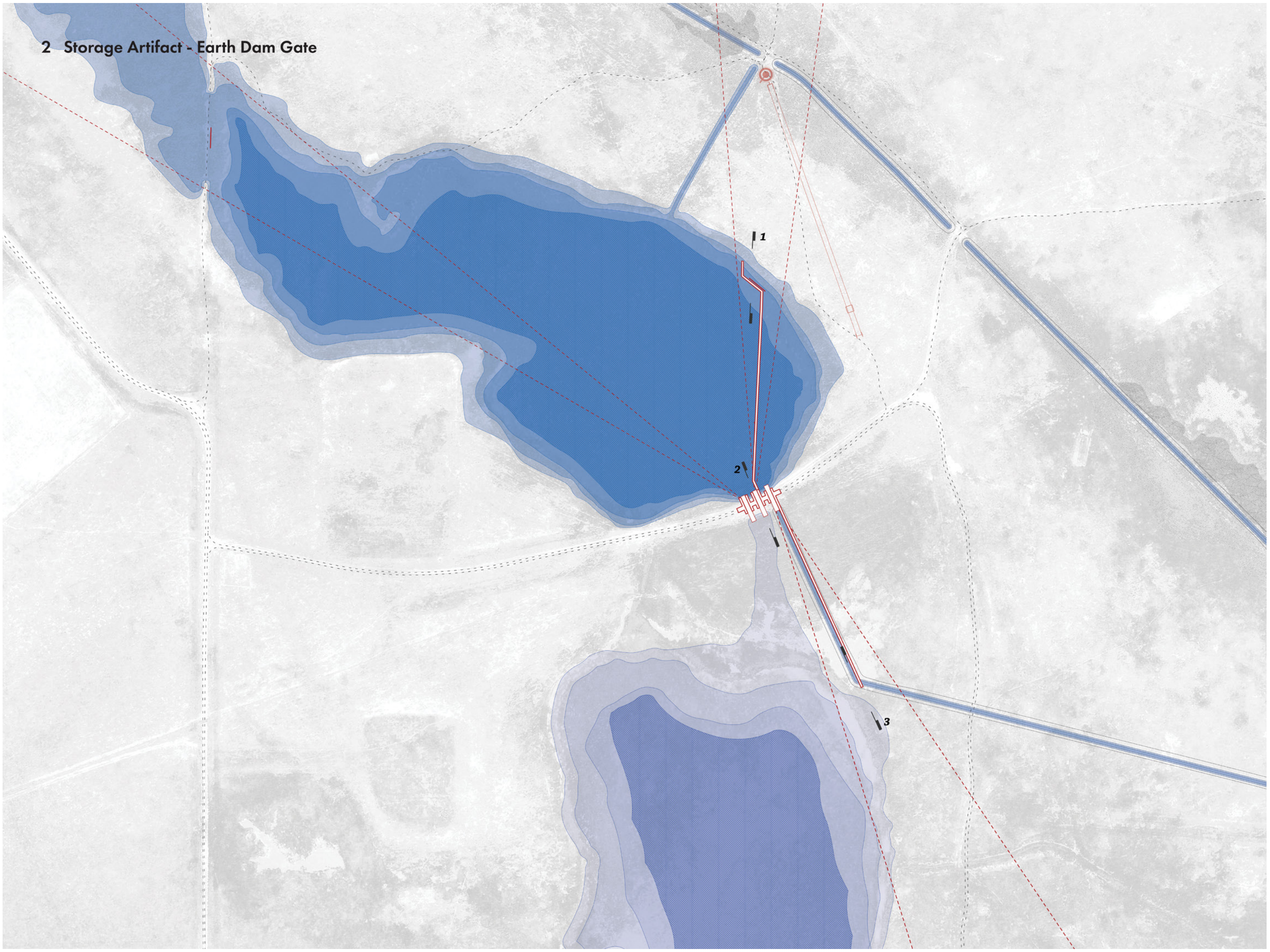
wells, highlighting the contrast between typical rangeland beyond and the effects that irrigated water supply has on plant communities.

Built into the design of the check well adaptations are affordances that present individuals the opportunity to directly engage with the landscape, the infrastructures that support it, and their processes as a way of beginning to develop matters of care within the infrastructural landscape. Incorporated into each check well along the ACR secondary canal are mechanisms for facilitating rangeland plant community surveys. 100m transect cables extend from a manual winch and frame mounted to the check well superstructure, allowing it to pivot 360 degrees. This moves the focal point of the surveys to be centered around the canals and conveyance infrastructure, allowing the health and density of plant communities along canal banks, those that receive water from conveyance artifacts, and those on the adjacent rangeland that do not.

As the primary access routes through the infrastructural landscape for users engaging with the recreational, technical, and operational realms of infrastructural artifacts the check well adaptations serve as points of convergence between these realms. The check well superstructure allows for bird watchers and hikers traversing canals the opportunity for viewpoints not afforded at ground level, not only does this increase the range of sightlines across the landscape, but brings into focus the concentration of species along corridors of habitat created by the canal system. By creating these points of convergence between recreational use of conveyance infrastructure and the representation of fluctuations in water levels by the check wells, the infrastructural artifacts become multi-stable in the perception of those that use them. Similarly, making permanent the transect mechanisms that afford research activities brings them into to perception of all users that engage with the check well artifacts, asking them to consider the connections between technical artifacts, water distribution, the management systems that control them. Allowing those outside the research field to operate the transect mechanisms, observe plant communities, and engage in their own studies asks them to question the impact on ecological health that technical artifacts have and the resulting role that they play in constructing the infrastructural landscape.

Storage Artifacts

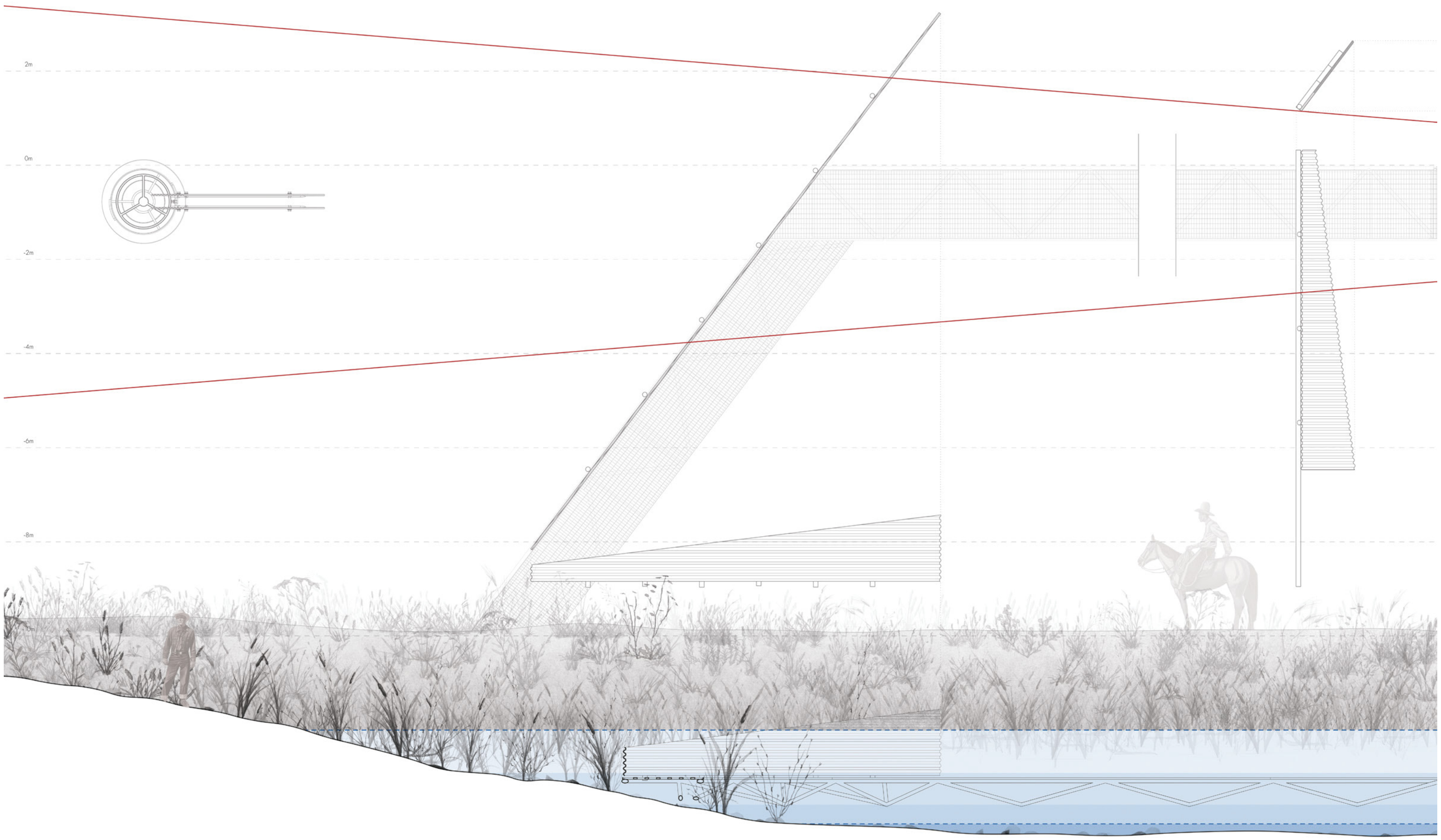
The fluctuations in canal water levels represented through check structure adaptations are the result of downstream draws for storage and applications structures. Following water flow east down the ACR secondary canal, we reach the diversion point for an off-stream storage pond, created by an earth dam stretching across a low depression in the landscape. This pond and its control structure, an earth dam gate, constitutes the second infrastructural artifact adaptation. Similar to canals water levels in this pond fluctuate based on the EID's water delivery cycle with the initial water delivery date in early May flooding the basin which has remained empty over the winter months. Throughout the irrigation season fill levels are maintained to ensure steady supply to downstream draws, primarily irrigated parcels and the sprinklers that irrigate them, with excess water being released periodically into the downstream drainage pond and ditches. At the end of the irrigation season, and corresponding reduction to draws, the earth dam gates are opened to drain the remaining water and once again reduce



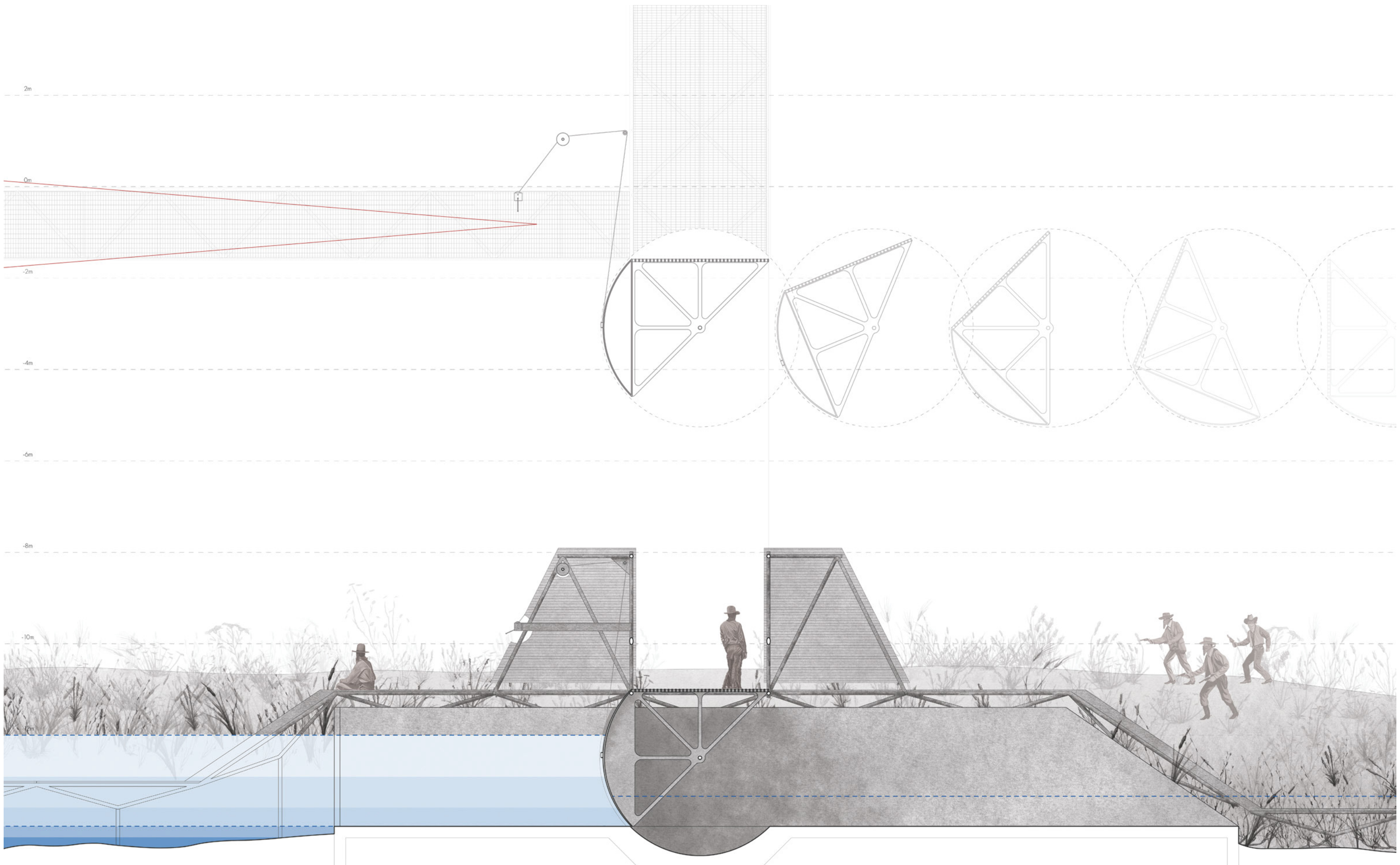
Storage artifact adaptation plan.

the pond to its minimum storage capacity. These varying fill levels drastically alter the composition of not only the storage pond itself, but its margins, the plant and animal habitat it supports, and the downstream conditions that rely on its excess water. When encountered at singular points in time, these relationships between the earth dam artifact and the landscape conditions it effects are not apparent to those that engage with it. By creating registers that provide a point of reference to read these fluctuations over the course of the season allows them to be observed by inhabitants of the landscape. Viewpoints from the earth dam gates are framed by panels within the pond, revealed and hidden as water levels rise and fall throughout the irrigation season, directing those operating the gates toward the check well marking water diversion into the storage pond, paths of access across the pond only accessible during minimum fill levels, and the drainage canal downstream from the dam

View of earth dam gate adaptation and storage pond.



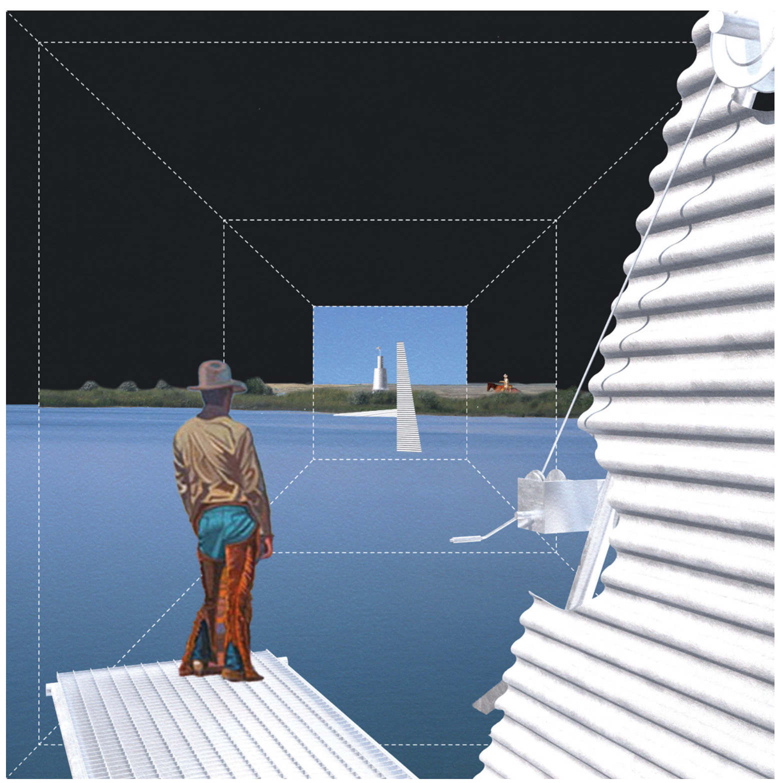
Storage artifact adaptation section 1.



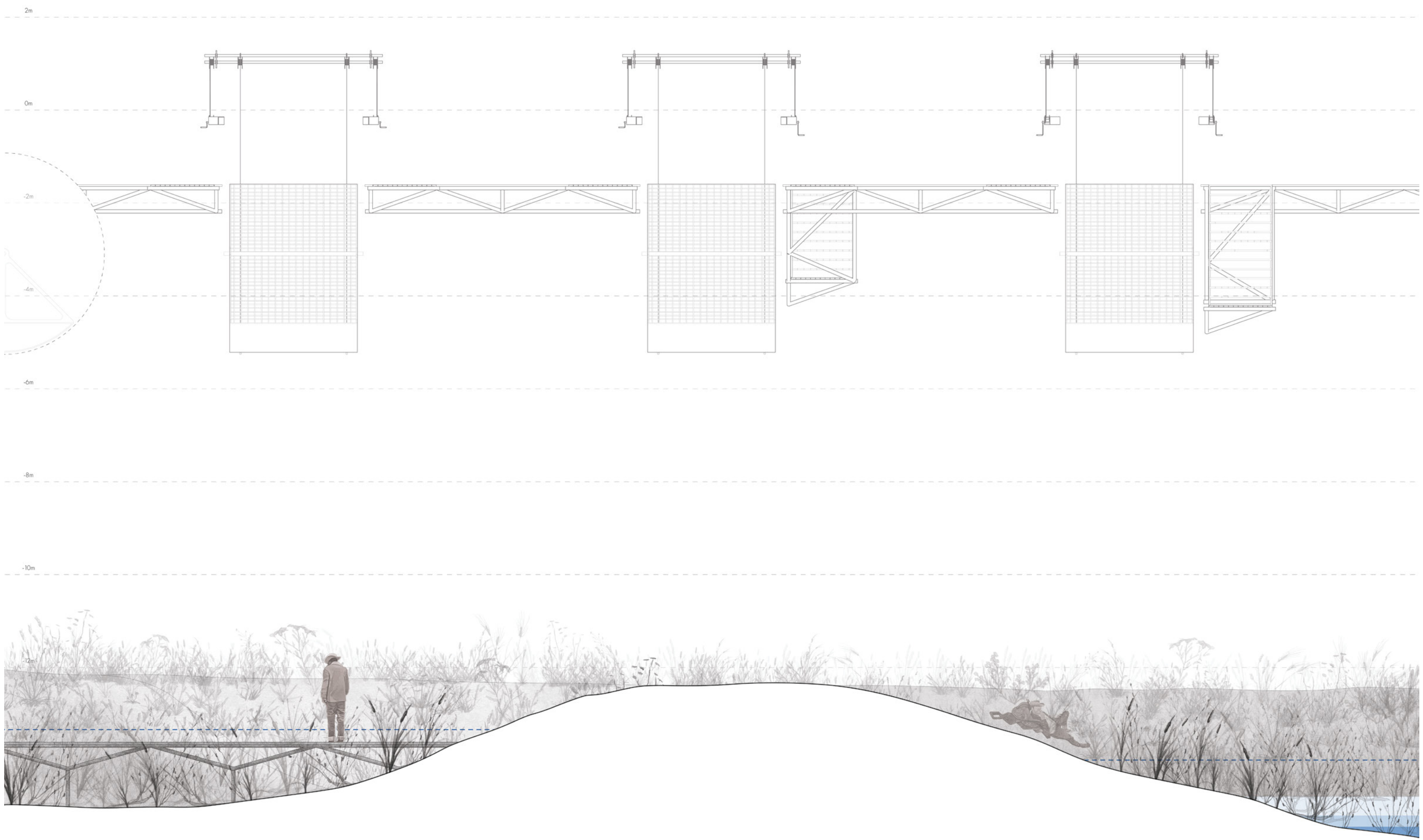
Storage artifact adaptation section 2.

gates. When approached from the periphery of the pond, these panels serve only as makers of pathways and routs of access across the body of water, with the relation between diversion point, access paths, drainage, and the dam gates themselves only becoming frames when viewed from the earth dam gates themselves.

Removing earth dam gates from their hidden location within the earth, and placing their control mechanisms along the pathways of travel opens engagement to all users of the site, not only those employed in their technical operation. Each of the framed views mentioned previously are only revealed when operating each of the three dam gate mechanisms, asking those engaging with them to consider the relation between the operation of technical artifact and its subsequent effects on the landscape conditions it creates. Use of the trail that traverses the crest of the earth dam is afforded only while the dam gates are closed, with



View across storage pond from earth dam gate.

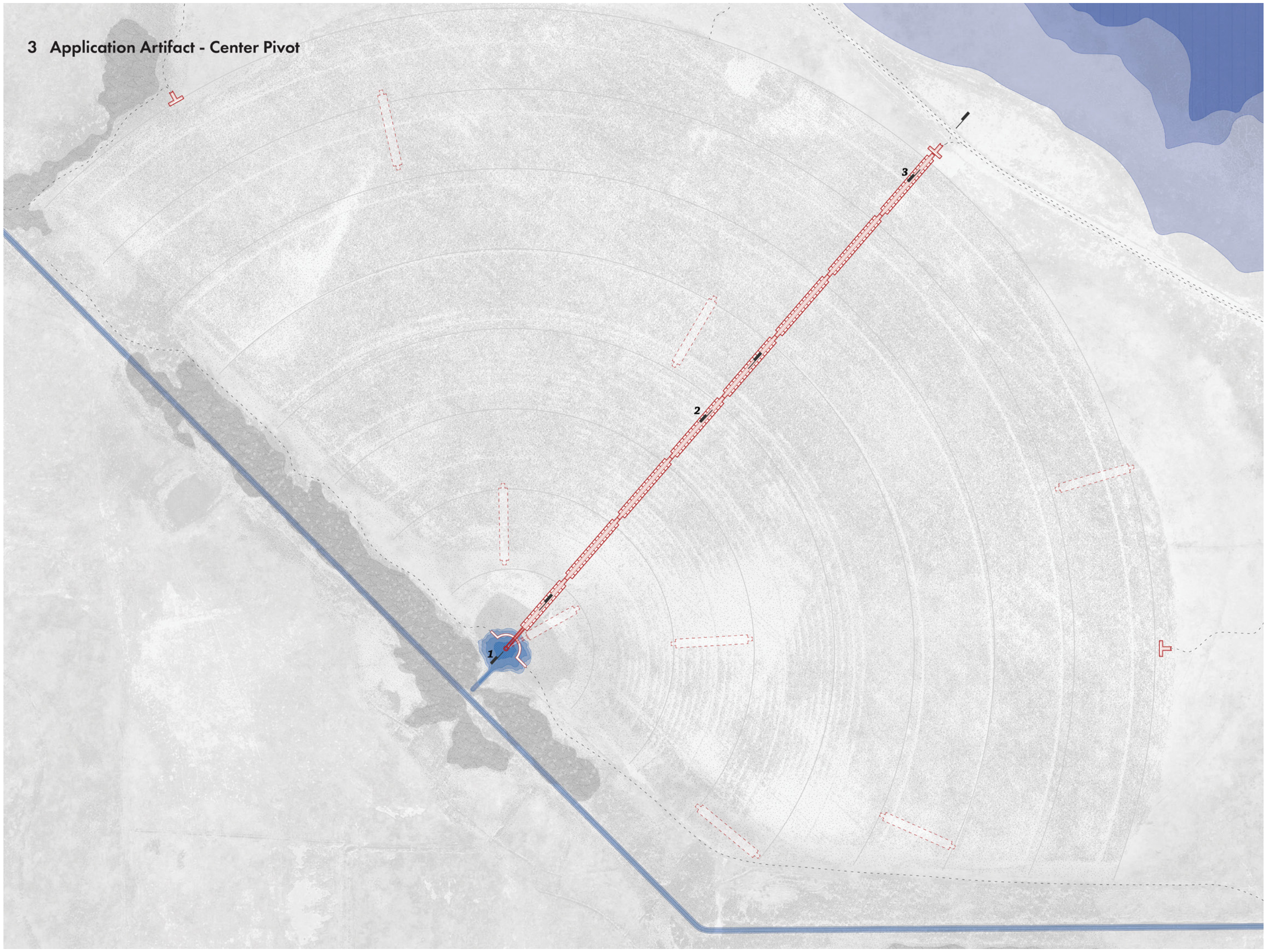


Storage artifact adaptation section 3.

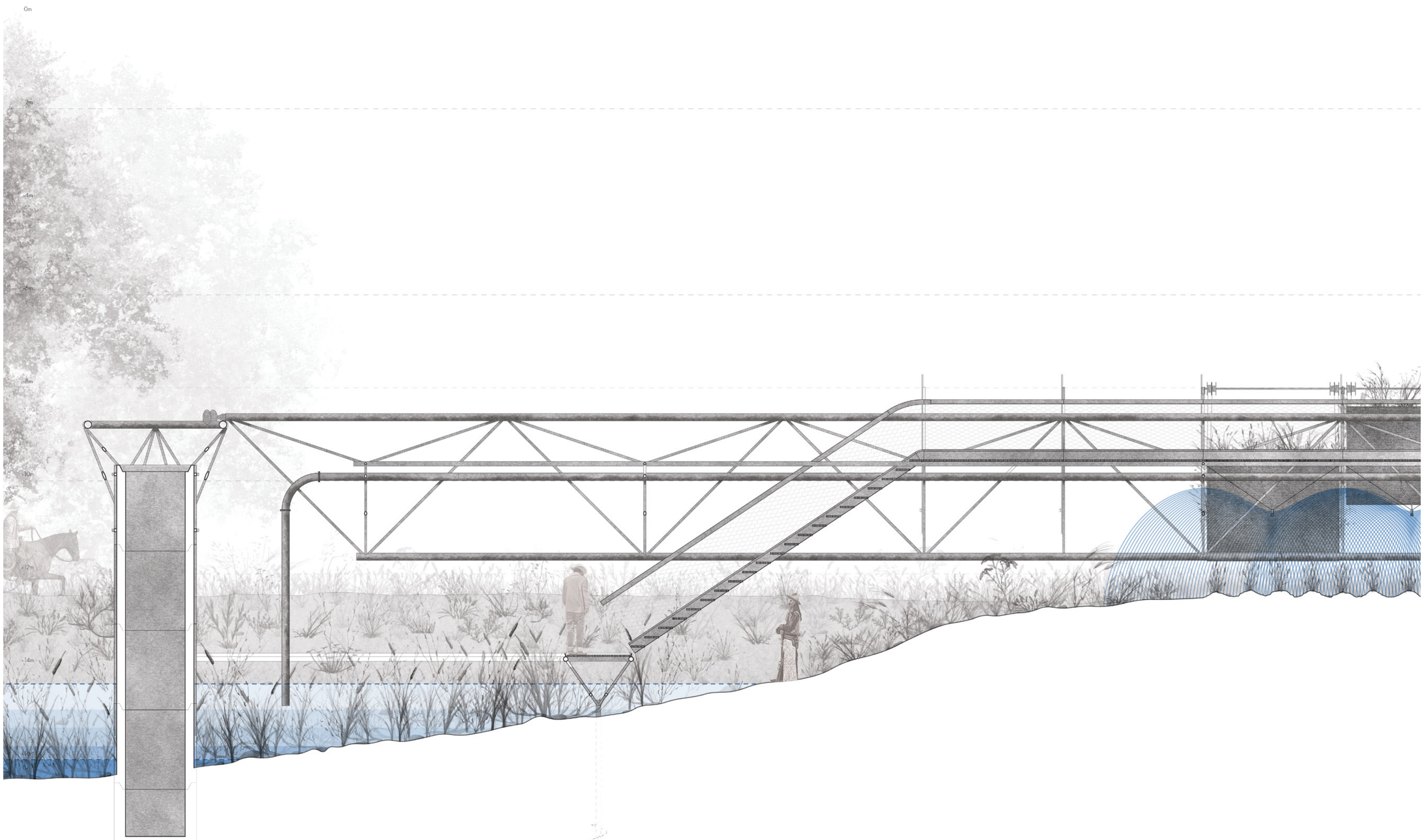
the platform affording access across the structure being incorporated into the gate mechanism itself. In this way use of the trail, and the access across the storage infrastructure it creates, is only afforded during points in the water delivery cycle that require the storage pond to remain at capacity. By doing so, the earth dam drain mediates physical access to and across the landscape, tying recreational use of the infrastructural artifacts to the operational management of water delivery.

Application Artifacts

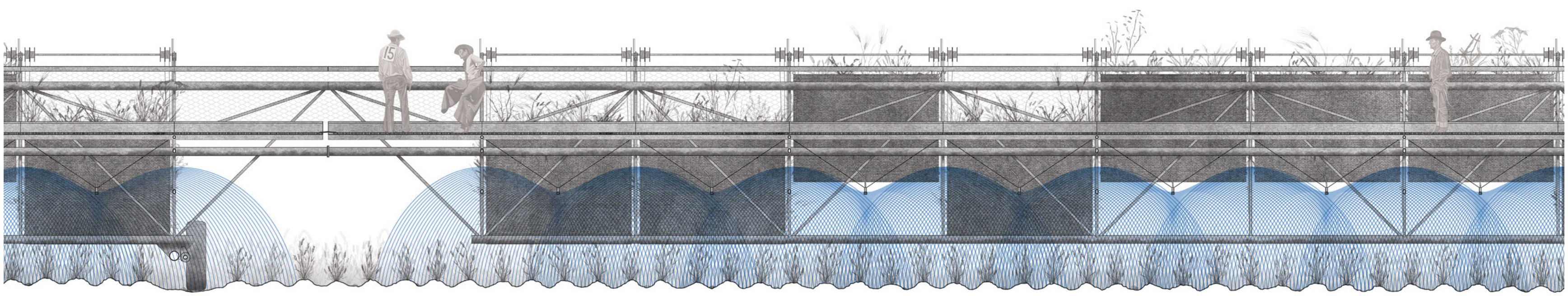
Fed by water held within the storage pond, a supply canal leads from the earth dam gates toward the ACR's cultivated parcel. Here water is diverted and fed into a dugout where it is siphoned by an adapted center pivot irrigation sprinkler. The center pivot artifact provides users of the site with alternative pathways for moving across cultivated fields, providing new routes of access that are temporarily afforded based on the irrigation cycles of the sprinkler, mediating the relationship between inhabitants of the site and the infrastructural landscape constructed by center pivot irrigation. Three points of access are dispersed around the periphery of the cultivated field, connecting existing pathways circumventing the field to the elevated platform atop the pivot structure. These new routes and the elevated perspectives they afford allow for the contrast between cultivated field of industrial agricultural agriculture and surrounding vegetation that exists only at its margins. Operable growing panels that support native plant species are supported by the pivots frame and fed by excess water and wind drift resulting from sprinkler application. The pursuit of increased efficiencies demanded by water allocations and increased strain on watersheds that supply the EID's irrigation system



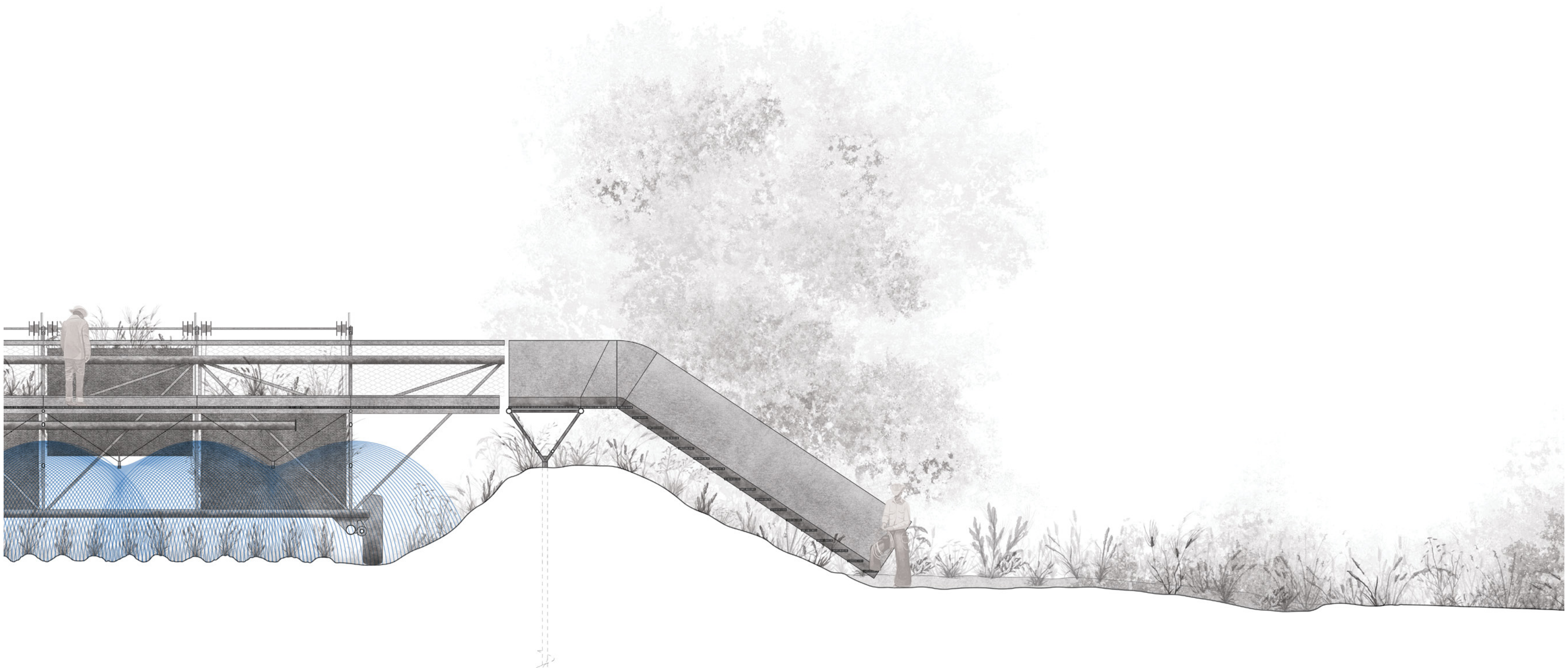
Application artifact adaptation plan.



Application artifact adaptation section 1.



Application artifact adaptation section 2.

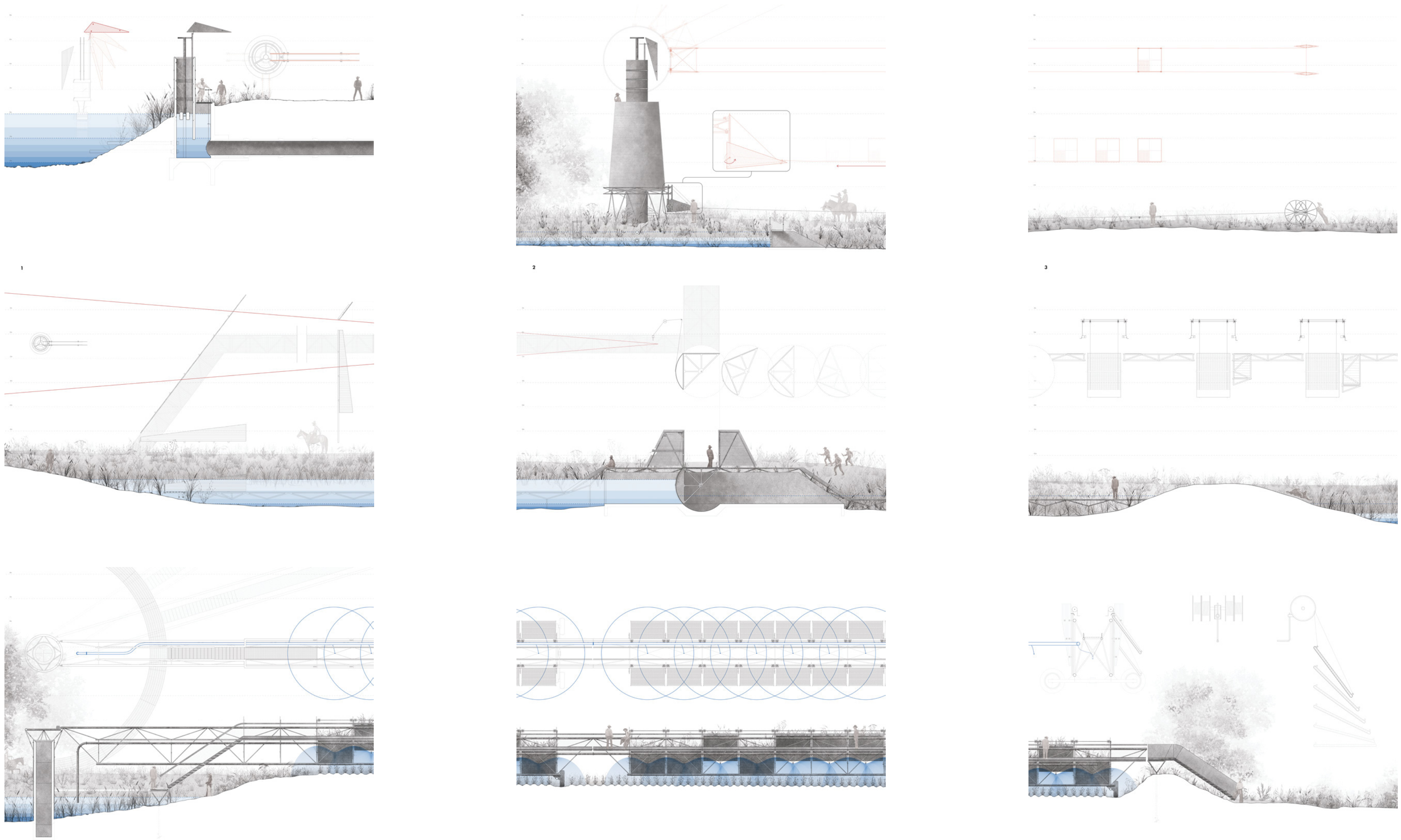


Application artifact adaptation section 3.

(transition from less efficient water application methods to center pivot sprinklers) leads to a reduction in field run-off that supports these communities of marginal vegetation. By placing these panels on the pivot structure, a direct reliance on the infrastructural artifact by vegetation created and foregrounded, mirroring the clusters of growth that concentrate around irrigated fields and rely on the run-off from water application. The historically and systematically constructed perception of the infrastructural landscape as extension of the natural world is challenged, with native plant communities now directly presented to inhabitants as being an appendage of infrastructural artifacts, un-able to be separated. The position of these panels, controlled by winches placed along the walkway platform and allowing operation by users, locate plant growth between the viewer and surrounding landscape, opening and screening views depending on their position. At the conclusion of the

View of center pivot adaptation from perifery of cultivated field.

growing season and harvest of the crops fed by the pivot, these panels are lowered onto the earth, affording habitat for upland game bird and animal species within the now barren field. This action requires direct engagement by those that frequent the site, they must take an active role in the construction of this landscape formation.



Artifact adaptation complete sections: conveyance (top); storage (middle); application (bottom).

Chapter 6: Conclusion

The research behind this thesis was, and continues to be, an attempt to understand the complexities of how landscapes are constructed, inhabited, managed, and perceived by those that inhabit them. The Eastern Irrigation District, and its place in Alberta's water crisis, serve as a case study on infrastructural landscapes and how their historic development, evolution, and current operation can construct a perception of the world that influences the trajectory of their continued development. The adapted infrastructural artifacts seek to challenge this trajectory and bring into consideration aspects of the infrastructural landscape that go beyond its technical efficiencies.

The mediation of human – world relationships by technical artifacts (conveyance, storage, and application) serves as a starting point for understanding how our perceptions of the landscape are constructed through engagement with infrastructural assemblies. Historically separate realms of the infrastructural system, the technical, operational, and poetic, can be revealed and entangled by adapting the formal and functional composition of infrastructural artifacts in a way introduces inhabitants of the landscape to aspects of it they would not typically engage. The check well foregrounds the operational management of water conveyance infrastructure to recreational users who rely on it for access routes across the EID. Research initiatives that record the effects of irrigation water on plant communities are permanently imbedded along canal banks, presenting the criticality of water supply for plant communities to water managers, ditch riders, and hikers. The earth dam gate redirects perspectives toward storage infrastructures from natural waterbodies and habitats to temporal landscapes reliant on water delivery schedules for their very existence. Intertwining access to and across these sites with their technical function asks us to consider how public access to infrastructural landscapes is dependant on its continued refrain from impeding on its productive value. The center pivot presents us with a representation of cultivated fields that does not attempt to mask the true nature of the landscape with planted stands of vegetation as has been the historic mode of operation, but with the reliance of plant communities and animal habitats on the marginal conditions surrounding irrigated parcels. In this case inefficiencies in water application are celebrated as providing the necessary conditions for these communities to exist, rather that as a drain on the system. Affording occupants of the infrastructural landscape opportunities to directly engage with the control of water flows through the earth dam gate, participate in research on rangeland and canal plant community health with the check well, and use excess water to re-introduce clusters of habitat to cultivated fields with the center pivot allows them to actively participate in the constitution of their environment. In doing so, possible outcomes for future irrigation infrastructures are introduced that do not default to technical solutions, but ask the question of what might infrastructural landscapes look like if they engrain public access, recreation, ecology, and alternatives modes of management together with their technical functionality rather than leaving them at the margins.

References

Alberta Agriculture and Irrigation. 2022. “Land Classification for Irrigation in Alberta.” https://open.alberta.ca/publications/2406282

ACR (Antelope Creek Ranch). n.d. “History.” Accessed Nov 20, 2023. https://www.antelopecreekranch.ca/history.html

ACR (Antelope Creek Ranch). 2018. *Annual Report 2018*. https://www.antelopecreekranch.ca/pdf/2018-Annual-Report.pdf

ACR (Antelope Creek Ranch). 2020. *Range Management Review 2020*. https://www.antelopecreekranch.ca/pdf/RangeManagementReview-for-Antelope-Creek%20Ranch-March-31-2020.pdf

ACR (Antelope Creek Ranch). 2022. *Annual Report 2022*. https://www.antelopecreekranch.ca/pdf/2022-year-end-report.pdf

Armstrong, Christopher, Matthew Evenden, and H. V Nelles. 2009. *The River Returns: An Environmental History of the Bow River*. 1st ed. Montreal: McGill-Queen’s University Press.

Bantjes, Rod. 2005. *Improved Earth: Prairie Space as Modern Artefact, 1869-1944*. Toronto: University of Toronto Press.

Canadian Pacific Railway. 1908. *Settler’s Guide: A Handbook of Information for Settlers in the Canadian Pacific Railway Irrigation Block*. Canadian Pacific Railway, Colonization Dept.

Canadian Pacific Railway. 1919. *Irrigation Farming in Sunny Alberta*. Calgary: Dept. of Colonization and Development, Canadian Pacific Railway.

Canadian Pacific Railway Company. 1900. *Facts Concerning the Bow River Valley, Southern Alberta, Canada*. Calgary: Canadian Pacific Railway Company, Colonization Dept.

Canadian Pacific Railway Land Settlement and Development fonds. 1924. Glenbow Archives, AB. https://digitalcollections.ucalgary.ca/CS.aspx?VP3=DamView&VBID=2R3BXZZC3A9KL&SMLS=1&q=ready+made+Farm+House+Western+Irrigation+Block&RW=1536&RH=791#/DamView&VBID=2R3BXZZC3UIMC&PN=1&WS=SearchResults

CBC. 2024. “Alberta to launch ‘unprecedented’ water-sharing negotiations Thursday amid drought fears.” https://www.cbc.ca/news/canada/calgary/alberta-water-sharing-negotiations-rebecca-schulz-old-man-river-1.7100450

Cosgrove, Denis E. 1984. *Social Formation and Symbolic Landscape*. London, UK: Croom Helm.

de la Bellacasa, Maria Puig. 2011. “Matters of Care in Technoscience: Assembling Neglected Things.” *Social Studies of Science* 41, no. 1: 85–106. https://doi.org/10.1177/0306312710380301.

Dempsey, Hugh A. (Hugh Aylmer). 1984. *The CPR West : The Iron Road and the Making of a Nation*. Vancouver: Douglas & McIntyre.

Den Otter, A. A. 1986. “Adapting the Environment: Ranching, Irrigation, and Dry Land farming in Southern Alberta, 1880 – 1914.” *Great Plains Quarterly* 6, no. 3: 171-189.

Easterling, Keller. 1999. Organization Space : *Landscapes, Highways, and Houses in America*. Cambridge, MA: MIT Press.

Easterling, Keller. 2016. *Extrastatecraft : The Power of Infrastructure Space*. Paperback edition. London: Verso.

Edwards, Paul N. 2003. “Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems” In *Modernity and Technology*, edited by Thomas J. Misa, Philip Brey, and Andrew Feenberg, 185–225. Cambridge, MA: MIT Press.

EID (Eastern Irrigation District). n.d. “Public Access Guidelines.” Accessed October 18, 2023. https://www.eid.ca/public_access.html

EID (Eastern Irrigation District). 2016. “Bylaw 906; Delivery and Distribution of Water Bylaw.”

EID (Eastern Irrigation District). 2021. “Access Policy for District Owned Lands.” https:www.eid.ca/documents/policy/Access_Policy_for_District_Owned_Lands.pdf

EID (Eastern Irrigation District). 2022. “Bylaw 959; Maximum Water Delivery Bylaw.” https://www.eid.ca/documents/bylaws/Maximum_Water_Delivery_Bylaw.pdf

EID (Eastern Irrigation District). 2023. “Bylaw 968; Irrigation Acres Bylaw.” https://www.eid.ca/documents/bylaws/Irrigation_Acres_Bylaw.pdf

EID (Eastern Irrigation District). 2024. “Eastern Irrigation District; Wildlife Guide - 2024.” https://www.eid.ca/documents/publications/Brochure_Wildlife_Guide.pdf

Evenden, Matthew. 2006. “Precarious Foundations: Irrigation, Environment, and Social Change in the Canadian Pacific Railway’s Eastern Section, 1900–1930.” *Journal of Historical Geography* 32, no. 1: 74–95.

Ghosn, Rania, and El Hadi Jazairy. 2018. *Geostories : Another Architecture for the Environment*. New York: Actar.

Gibson, James J. (James Jerome). 2015. *The Ecological Approach to Visual Perception*. Classic edition. New York: Psychology Press.

Glenbow Archives. 1921. https://digitalcollections.ucalgary.ca/CS.aspx?VP3=DamView&VBID=2R3BXZZC3A9KL&SMLS=1&q=ready+made+Farm+House+Western+Irrigation+Block&RW=1536&RH=791#/DamView&VBID=2R3BXZZC366TT&PN=1&WS=SearchResults

Glenbow Archives. 1948. https://digitalcollections.ucalgary.ca/CS.aspx?VP3=DamView&VBID=2R3BXZZC3A9KL&SMLS=1&q=ready+made+Farm+House+Western+Irrigation+Block&RW=1536&RH=791#/DamView&VBID=2R3BXZZC3VTZ6&PN=1&WS=SearchResults

Heuvel, Dirk van den, Janno Martens, Victor Munoz. 2020. *Habitat: Ecology Thinking in Architecture*. Rotterdam: nai010 publishers.

Hogue, Martin. 1984. "The Site as Project: Lessons from Land Art and Conceptual Art." *Journal of Architectural Education* 57, no. 3 (2004): 54–61.

Ingold, Tim. 2000. *The Perception of the Environment : Essays on Livelihood, Dwelling and Skill*. London: Routledge.

Jackson, John Brinckerhoff, and Ervin H. Zube. 1970. *Landscapes: Selected Writings of J. B. Jackson*. Amherst: University of Massachusetts Press.

Jean, Marie-Ève, and Evan G.R Davies. 2016. "Towards Best Water Management Policies: How Current Irrigation Reservoir Operation Practices Compare with Theory in Alberta." *Water International* 41, no. 7: 948–65. https://doi.org/10.1080/02508060.2016.1210562.

Lahiji, Nadir. 2011. *The Political Unconscious of Architecture : Re-Opening Jameson's Narrative*. Farnham, Surrey: Ashgate.

Lam, Elsa. 2011. "Wilderness Nation: Building Canada's Railway Landscapes, 1885–1929." Doctor of Philosophy, Columbia University. ProQuest Dissertations Publishing.

Lam, Elsa. 2020. "A Fertile Wilderness." *Journal of the Society for the Study of Architecture in Canada*: 3-16.

Larkin, Brian. 2013. "The Politics and Poetics of Infrastructure." *Annual review of anthropology* 42, no. 1: 327–343.

Latour, Bruno. 1987. *Science in Action : How to Follow Scientists and Engineers through Society*. Cambridge, Mass: Harvard University Press.

Nature Alberta. 2021. "Concerns Regarding a Proposed Irrigation Expansion Project in Southern Alberta." https://naturealberta.ca/concerns-regarding-a-proposed-irrigation-expansion-project-in-southern-alberta/

Osman, Michael. 2012. “Preserved Assets” in *Governing by Design : Architecture, Economy, and Politics in the Twentieth Century*, 1-20. Pittsburgh, Pa: University of Pittsburgh Press

Otter, Chris. 2022. “Socializing the Technosphere.” *Technology and culture* 63, no. 4: 953–978.

Pollard, Harry. 1912. Canadian Pacific Railway Land Settlement and Development fonds. Glenbow Archives, AB. https://digitalcollections.ucalgary.ca/CS.aspx?VP3=DamView&VBID=2R3BXZZC3A9KL&SMLS=1&q=ready+made+Farm+House+Western+Irrigation+Block&RW=1536&RH=791

Province of Alberta. 2023. *Irrigation Districts Act.* Edmonton: Alberta King’s Printer, 2023.

Ring, Len. 2006. “Irrigation Infrastructure Rehabilitation in Alberta; 38 Years of Government/Industry Cooperation.” American Society of Agricultural and Biological Engineers, St. Joseph: 451-478.

Schivelbusch, Wolfgang. 2014. *The Railway Journey : the Industrialization of Time and Space in the Nineteenth Century*. Berkeley, CA: University of California Press.

Truscello, Michael. 2020. *Infrastructural Brutalism: Art and the Necropolitics of Infrastructure.* Cambridge: MIT Press.

Van Den Eede, Yoni. 2011. “In Between Us: On the Transparency and Opacity of Technological Mediation.” *Foundations of Science* 16, no. 2–3: 139–59. https://doi.org/10.1007/s10699-010-9190-y.

Verbeek, Peter-Paul. 2005. *What Things Do : Philosophical Reflections on Technology, Agency, and Design*. University Park, PA: Pennsylvania State University Press.

Verbeek, Peter-Paul. 2015. “Beyond Interaction: A Short Introduction to Mediation Theory.” *Interactions*. 22. *ACM*.

Voordijk, Hans. 2023. “Technical Mediation and Digital Technologies in Construction Practice.” *Architectural Engineering and Design Management* 19, no. 2: 110–124.

Wakefield, Stephanie. 2018. “Infrastructures of Liberal Life: From Modernity and Progress to Resilience and Ruins.” *Geography Compass* 12, no. 7.

Warkentin, John. 1964. *The Western Interior of Canada : A Record of Geographical Discovery*, 1612-1917. Toronto: McClelland and Stewart.

Western Irrigation District. 1922. Western Irrigation District fonds. Glenbow Archives, AB. https://digitalcollections.ucalgary.ca/CS.aspx?VP3=DamView&VBID=2R3BXZZC3A9KL&SMLS=1&q=ready+made+Farm+House+Western+Irrigation+Block&RW=1536&RH=791#/DamView&VBID=2R3BXZZC36363&PN=1&WS=SearchResults

Western Producer. 2023. “Situation is not ideal.” https://www.producer.com/news/situation-is-not-ideal/

Yaneva, Albena. 2017. *Five Ways to Make Architecture Political: An Introduction to the Politics of Design Practice*. London: Bloomsbury Publishing.

Yiannoudes, Socrates. 2016. *Architecture and Adaptation : From Cybernetics to Tangible Computing*. New York: Routledge, Taylor & Francis Group.

Zizek, Slavoj. 2011. “The Architectural Parallax” In *The Political Unconscious of Architecture : Re-Opening Jameson’s Narrative*, Edited by Nadir Lahiji, 255-297. Farnham, Surrey: Ashgate.