holoscene

HIGH PERFORMANCE LANDSCAPE SYSTEMS //An Integrated Solution

NORTH DAKOTA STATE UNIVERSITY | MAY 2012
Department of Landscape Architecture | dominic fischer
vc.hefti@gmail.com

0 5,000 10,000 20,000FT
1.5 3 6 MI

HOLOCENE
high performance landscape systems
// an integrated solution

A Design Thesis Submitted to the Department
of Architecture and Landscape Architecture
of North Dakota State University

By Vanessa Christine Hefti

In Partial Fulfilment of the Requirements for the
Degree of Bachelor's of Landscape Architecture

PRIMARY THESIS ADVISOR

THESIS COMMITTEE CHAIR

MAY 2012
NORTH DAKOTA STATE UNIVERSITY | FARGO, ND

signature
/ title page

permissions /
rights

STUDENT SIGNATURE

DATE 03/11/12

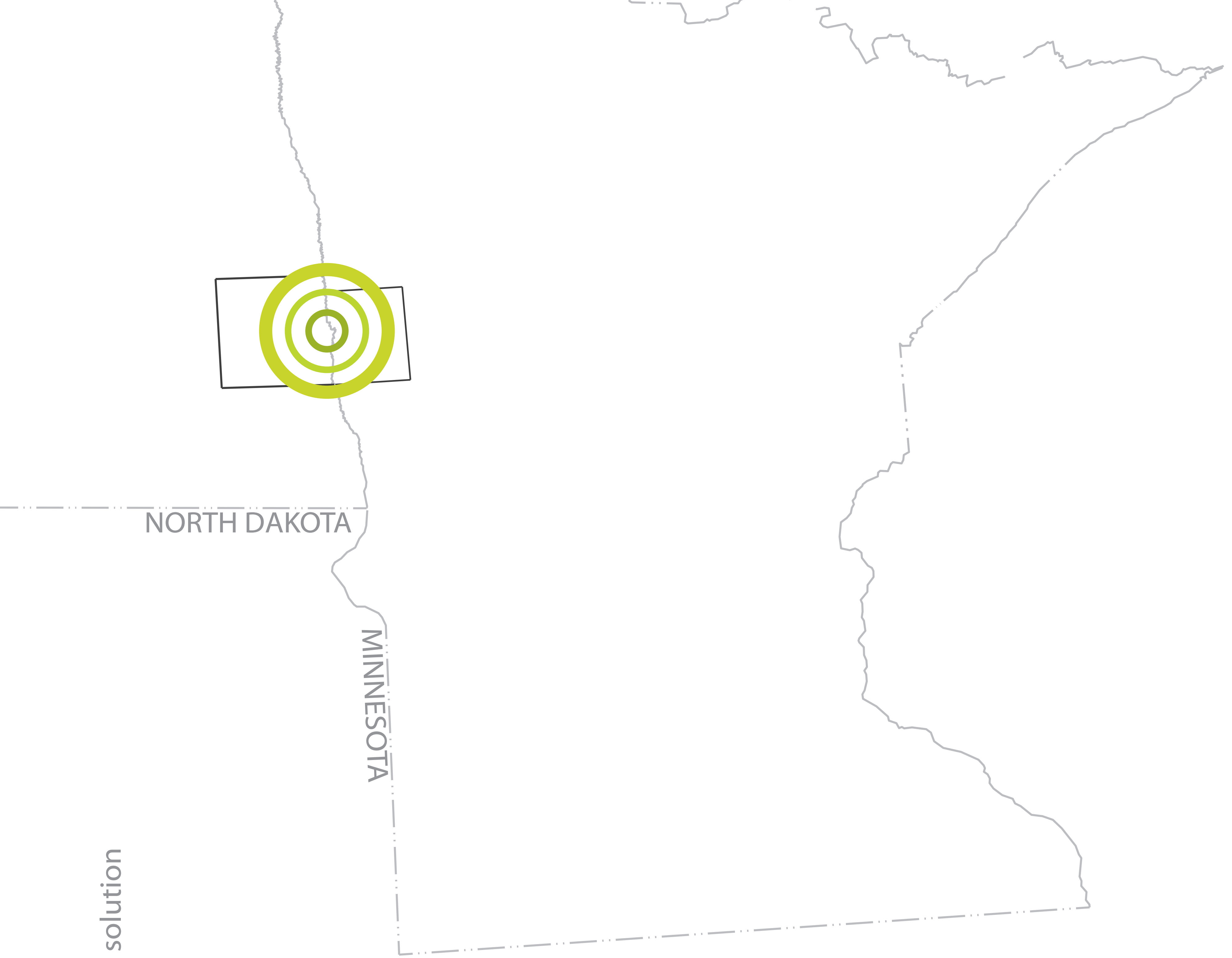
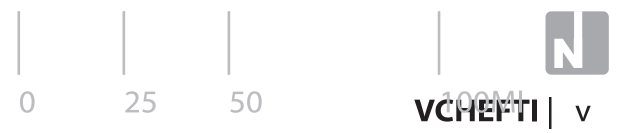


table of contents



This work studies landscape infrastructural solutions to community health. It addresses the health, sustainability, and resilience of habitated environments. The work suggests an interconnected working landscape system of soft engineering can serve as a civic asset and amenity while solving conventional infrastructural problems.

Proven through history conventional infrastructure has been an environmental liability, whereas soft infrastructure has been in demand in the form of public parks, park systems, and city planning. The needs of the present day for improved public and environmental health lend an opportunity to explore landscape systems as ecological design solutions that would otherwise be solved with hard infrastructure.

abstract

KEYWORDS}

soft infrastructure

landscape systems

ecological corridors

urban environment

working landscapes
civic amenity
environmental health

flood mitigation
renewable energy
park systems

problem statement

What if a connected system of landscape infrastructure, a working landscape, could enhance ecological functioning to serve as a civic asset rather than an environmental liability?

02 | STATEMENT OF INTENT

“No snowflake in an avalanche ever feels responsible.”

Stanisław Jerzy Lec,
poet & aphorist

Typology	Integrated park system of high performance landscapes
Claim	Working landscapes can be integrated into city planning as a networked park system of soft infrastructure providing amenity, serving as a civic asset, while improving both ecological and civic health.
Premises	Habitated areas suffer public health issues, inflicted by both urban and rural area environmental irresponsibility (Wellock, 2007). Open space and soft infrastructure have a wealth of positive benefit to public and environmental health (Newton, 1971), whereas hard infrastructure only serves a limited purpose and often leads to greater problems.
Theoretical premise/unifying idea	City planning can integrate working landscapes as connected park systems of soft infrastructure, creating resilient, dynamic solutions to many problems while serving as a highly valued civic asset.
Project justification	Issues of public and environmental health have been growing since the emergence of the Conservation Movement in the 1800’s (Wellock, 2007, p. 20). Documented by George Perkins Marsh in his studies Man vs. Nature: Physical Geography as Modified by Human Action in 1864, “All nature is linked together by invisible bonds; every organic creature ...is necessary to the well-being of some other” (Wellock, 2007, p. 25). This project suggests reconnecting a link with nature as a means of solving health issues, while improving economic, social, and environmental well-being.

user/client description

RESIDENTS/community

Residents of Fargo and the surrounding communities are the primary client, as their environment, and their interaction with it, is directly affected. The proposed alteration of aesthetic and functional surroundings result in different recreational forms, a new aesthetic, change in property value, change in environmental health, and a general shift towards a greater well being.

Residents in the communities require areas of public access with networks of circulation with variable types of recreational space including plazas, parks, and trails. The community requires economic incentive in order for any proposed action to be practical and feasible.

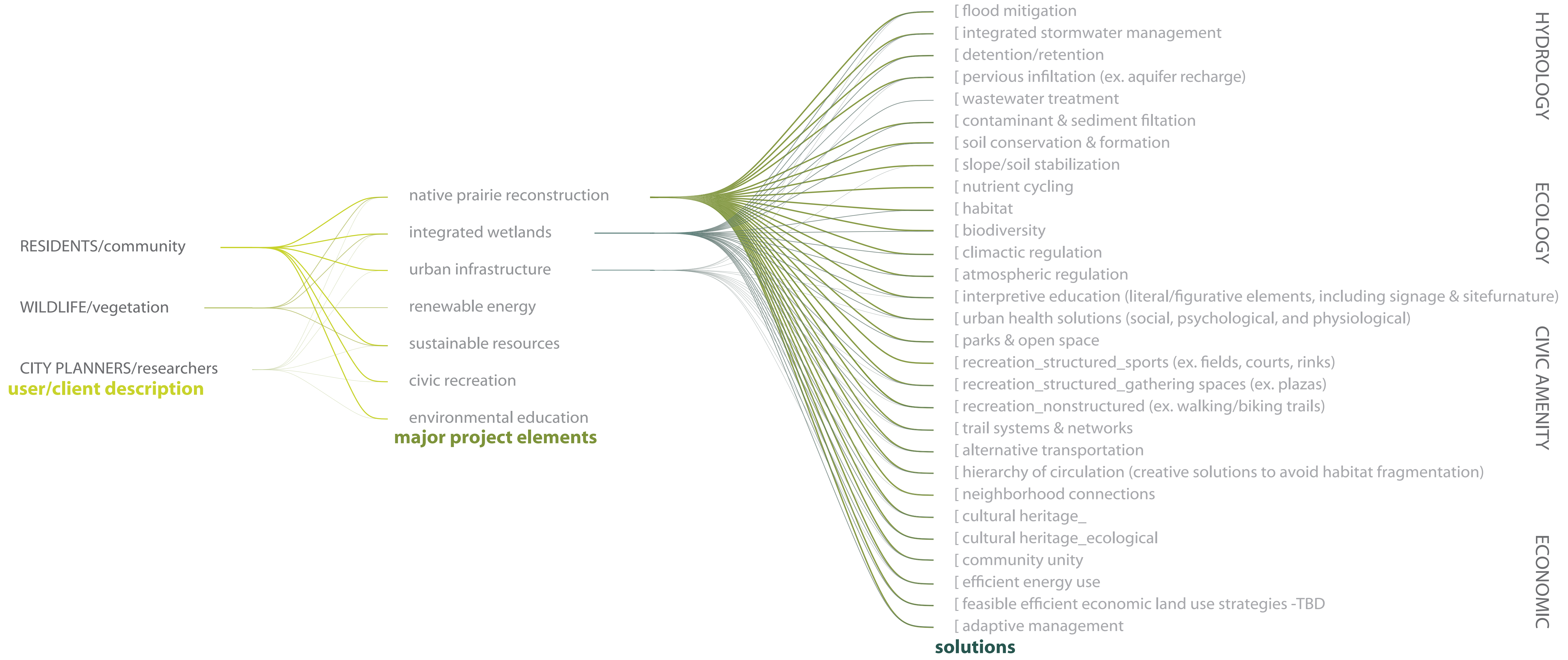
WILDLIFE/vegetation

As urban wildlife and vegetation are generally few in number and often homogenous in range, opening up ecological corridors through these spaces provides an opportunity for growth and diversity. Native flora and fauna require accessibility, nodes and networks of habitat, and proper conditions in order to establish and flourish to function for the purposed utility.

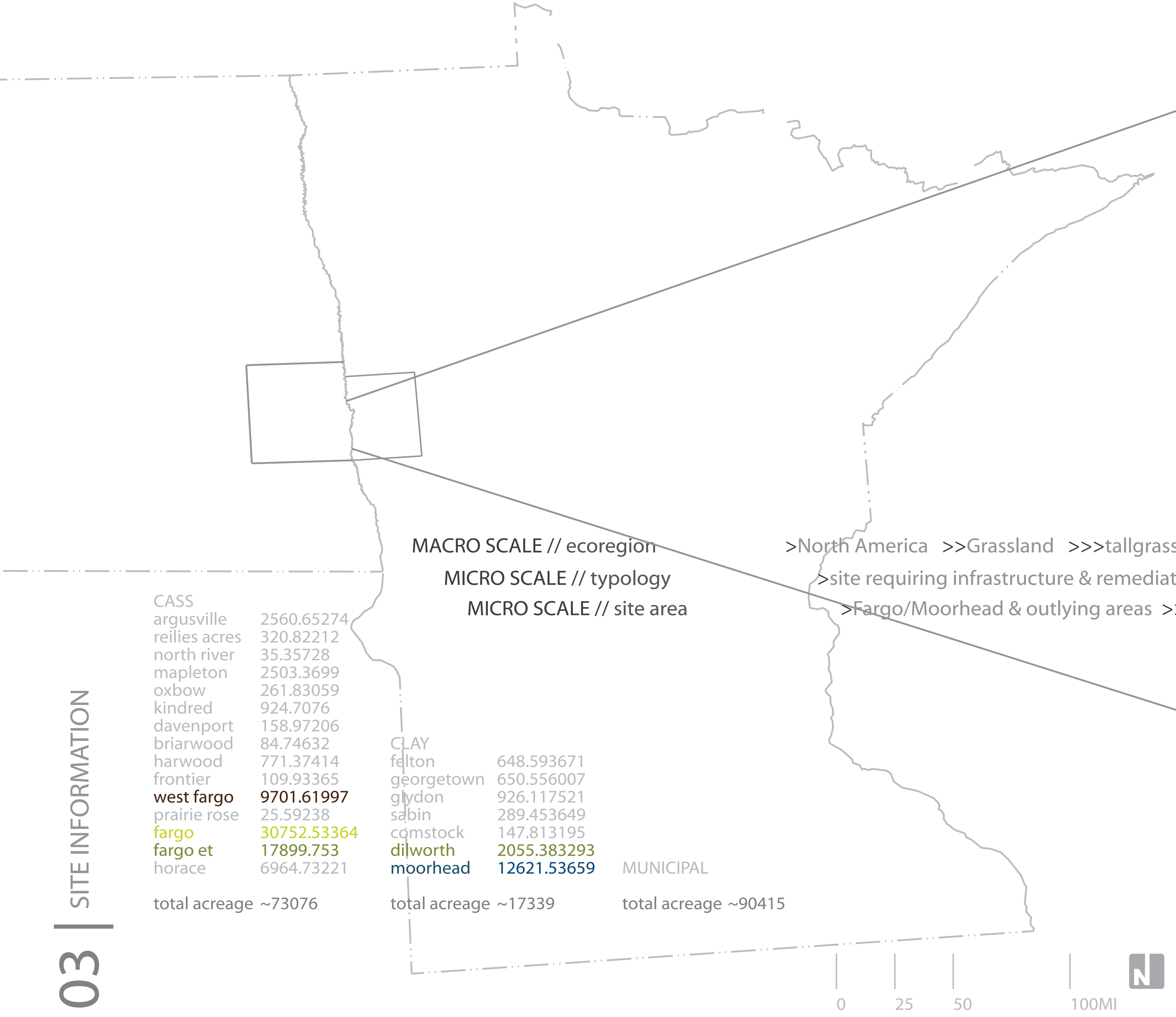
RESEARCHERS/planners

Researchers and professionals, mainly in the fields of urban design, environmental planning, public policy, and environmental law, stand to gain benefit from the study of the project. Potentially, the site may be useful as a case study or precedent for the design and implementation of related initiatives. Researchers and planners require a detailed description of the design, implementation, and adaptive management strategies performed on the site in order to learn from and further implement them.

INTEGRATED HIGH PERFORMANCE PARK SYSTEM



03 | SITE INFORMATION



CASS	
argusville	2560.65274
reilies acres	320.82212
north river	35.35728
mapleton	2503.3699
oxbow	261.83059
kindred	924.7076
davenport	158.97206
briarwood	84.74632
harwood	771.37414
frontier	109.93365
west fargo	9701.61997
prairie rose	25.59238
fargo	30752.53364
fargo et	17899.753
horace	6964.73221
total acreage	~73076

CLAY	
felton	648.593671
georgetown	650.556007
glydon	926.117521
sabin	289.453649
comstock	147.813195
dilworth	2055.383293
moorhead	12621.53659
total acreage	~17339

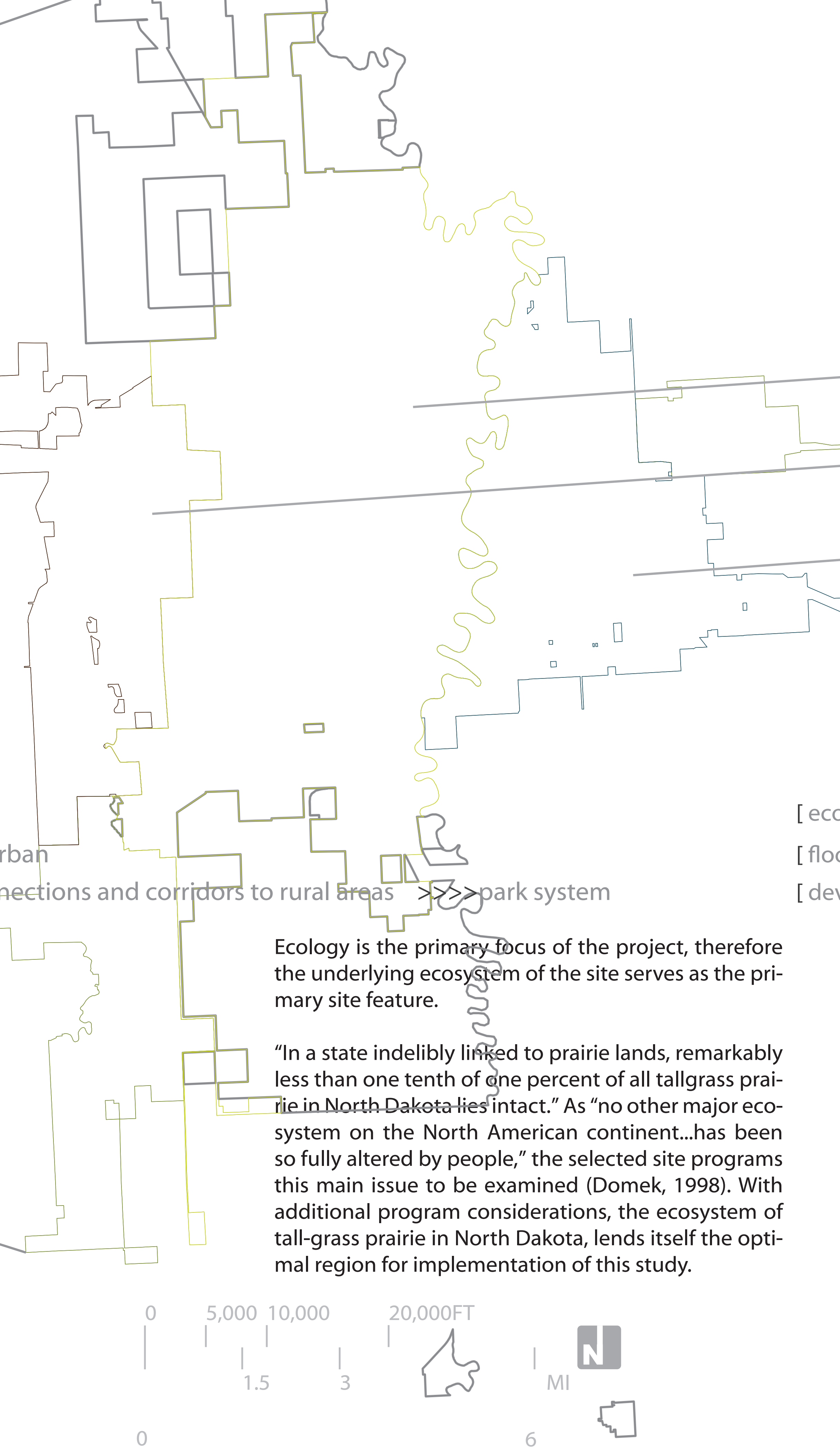
MUNICIPAL

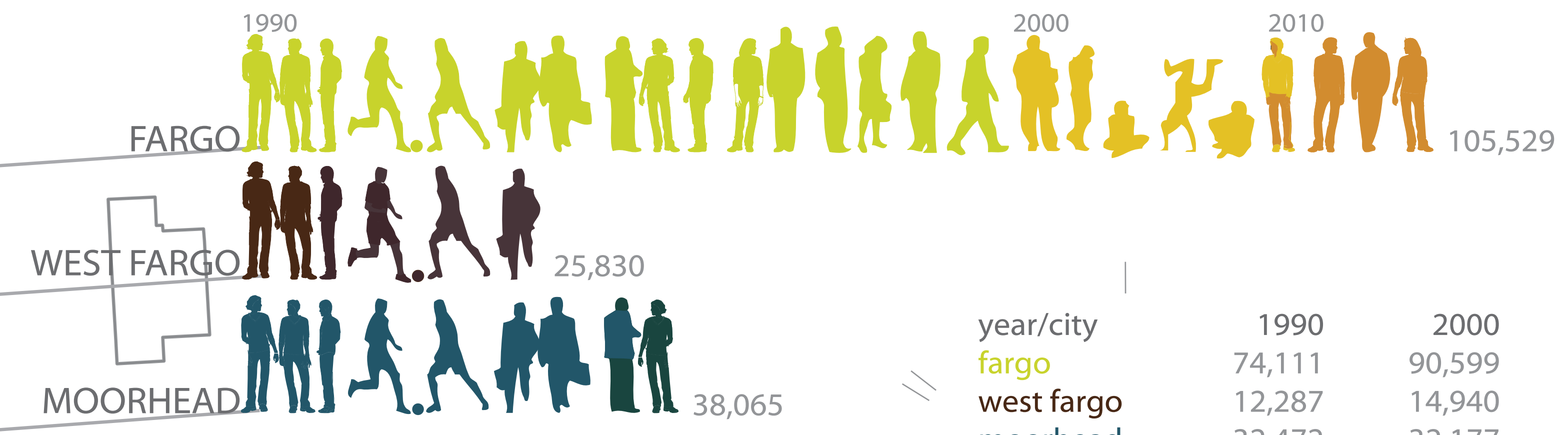
total acreage ~90415

MACRO SCALE // ecoregion >North America >>Grassland >>>tallgrass prairie >>>>mesic-wet tallgrass prairie

MICRO SCALE // typology >site requiring infrastructure & remediation >>populace demand for infrastructural solution >>>rural-urban

MICRO SCALE // site area >Fargo/Moorhead & outlying areas >>central to the downtown along the Red River >>>auxiliary connections and corridors to rural areas >>>>park system





year/city	1990	2000	2010	2050
fargo	74,111	90,599	105,529	247,360
west fargo	12,287	14,940	25,830	35,000
moorhead	32,472	32,177	38,065	

Data: US Census Bureau; 2050 est. Cities of Fargo & West Fargo, respectively.

[ecology = less than 1% of tallgrass prairie remains in the United States
[ecology] [fragmentated habitats] [biodiversity] [soft infrastructure]

[flooding = channelization, water demand = aquifer recharge, poor water quality = filtration & remediation
[community health] [urban, community, & landscape ecology] [adaptive management]

[developing/growth = *proper* city planning, preservation of natural resources, ie. ecologically sensitive zones, through park systems
[developing/growth] [infrastructural issues

Ecology is the primary focus of the project, therefore the underlying ecosystem of the site serves as the primary site feature.

"In a state indelibly linked to prairie lands, remarkably less than one tenth of one percent of all tallgrass prairie in North Dakota lies intact." As "no other major ecosystem on the North American continent...has been so fully altered by people," the selected site programs this main issue to be examined (Domek, 1998). With additional program considerations, the ecosystem of tall-grass prairie in North Dakota, lends itself the optimal region for implementation of this study.

Community health as applicable through soft engineering and landscape infrastructure is the secondary focus. Fargo-Moorhead is a relatively small urban area with rural periphery. The urban area has been increasing with steady growth over the years and has utilized conventional infrastructure as a means of problem solving.

The area is already undergoing the need to address the impacts of poor design and city planning on community health. With expansion and growth the need for ecological planning will become an increasingly important issue.

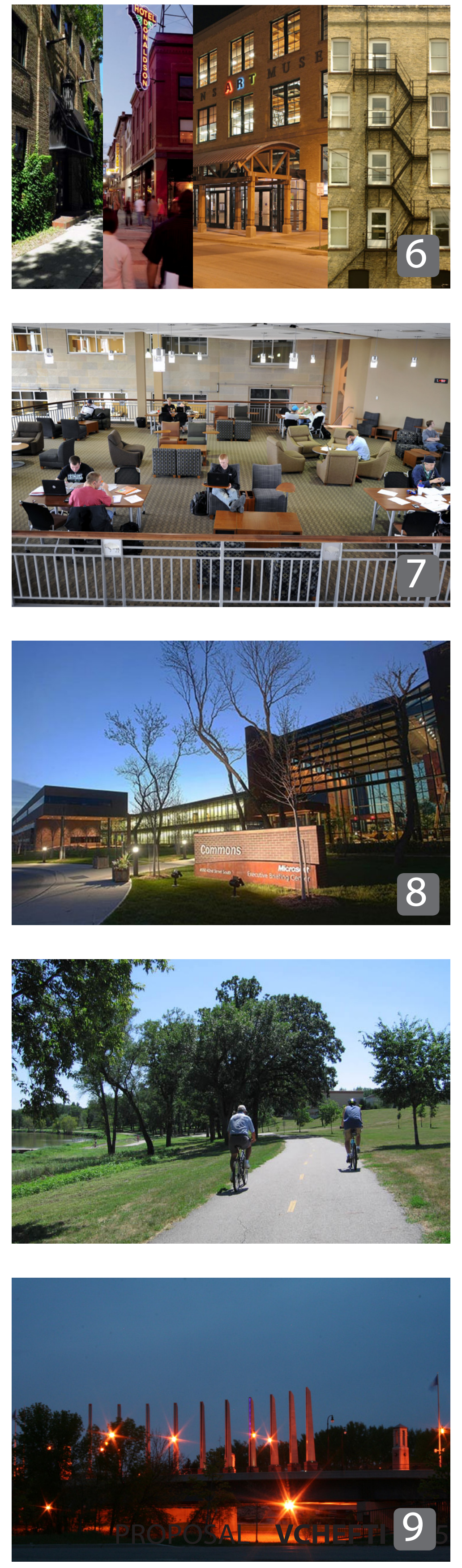
Proper planning in early stages saves time and money, avoiding many tedious cost ineffective resolutions to problems that needn't arise with proper foresight and early implementation.

Commercial, industrial, and agricultural focuses, pose common health issues and design problems, while land grant education focuses prime the site for opportunity in adaptive management and research. Issues and problems include air, water, and soil quality, sanitation, flooding, and fragmentation of habitats.

The area is relatively small and contained, however, no area is completely isolated in its effects. The Red River poses design challenges, in addition to the site's division between two states. There is the notion in ecology that all things work with and are necessary for each other's purpose. Located on a state border and encompassing several municipalities, the idea of working together to accomplish something beneficial to all, is prevalent in the nature of this project.

In addition to other considerations, the site selection is based on connectivity in addition to size and relative containment, which may allow for the effects of design alterations to be more readily monitored and measured.

sample contexts: approximate locations



The emphasis of the project is to integrate working landscapes into an urban fabric altering the form of the fabric to better serve the function. The resulting alteration aims to create a resilient public, environmental, and economic health of the local community, while reconstructing the devastated underlying ecosystem.

Specifically the project looks at design solutions for public health and amenity, environmental solutions to improving economic and urban sustainability, and the greater context of reconnecting with native ecological systems as a means of improving public and environmental health with interdependent and mutual gains.

AREAS OF FOCUS
Program elements in relation to the areas of focus:

public health/public amenity
[civic recreation
[access, parking, & maintenance

[wastewater wetlands & detention basins
[native prairie restoration
[interpretive educational components

economic sustainability
[renewable energy resources
[access, parking, & maintenance
[civic recreation

[adaptive management strategy

ecological sustainability
[native prairie restoration
[wastewater wetlands & detention basins

[renewable energy resources
[interpretive educational components

[adaptive management strategy

PLAN FOR PROCEEDING // task analysis

research direction
Research is conducted on sustainable public, environmental, and economic well-being in relation to urban spaces and ecological corridors. Research also includes case studies on major site elements, programmatic requirements and functionality, as well as a thorough site analysis. A full research schedule is located on page #.

design methodology
Research is conducted in the form of quantitative and qualitative analysis on scientific evidence, theory, case studies, and precedents in relation to the typology and major program elements. Analyzing, interpreting, and reporting results will occur throughout the research and concurrently with the design process as needed. This documentation exists in the form of data, charts, text, and graphic analysis both drafted and digital.

documentation of the design process
Documentation of the design process follows the schedule outlined on the following page. The process begins with the aforementioned areas of research. This research develops the program. A thorough site inventory follows with an analysis conducted on it. A functional diagram of the program elements in conjuncture with the site analysis informs a schematic master plan, by outlining optimal locations for program elements. The schematic evolves into the masterplan, from which, sections, elevations, and perspectives are derived to help translate the intention of the masterplan design.

specific schedule | work plan
[RESEARCH
issues
case studies
precedents
[PROGRAM
goals/objects
program -dev. w/ research
further site inventory
site analysis
[DESIGN DEVELOPMENT
theme and concept -dev. w/ research
functional diagram
schematic
masterplanning
sections/elevations
perspectives
final masterplan
[FINALIZATION/PRESENTATION
faculty reviews
editing
final printing (book and boards)
exhibits/final thesis review
commencement

“Let everyone sweep
in front of his own door, and
the whole world will be clean.”

Johann Wolfgang von Goethe,
German Playwright, Poet, Novelist and Dramatist

03 | PREVIOUS STUDIO EXPERIENCE
skill set development

COLORADO STATE UNIVERSITY
2nd year
fall| 2006
Merylin Paulson
Drawing the Landscape

spring 2007
Brad Geotz
North Shields Ponds_Ft. Collins, CO
natural area & nature center
Joe McGrane
Mountain Vista Park_Estes Park, CO
sports & recreation community park

3rd year
fall| 2007
Merylin Paulson
Walnut Street Courtyard_Ft. Collins, CO
urban courtyard/downtown plaza
Vail Village_Vail, CO
revitalization to establish local identity

spring 2008
Joe McGrane
Manhattan Project, Theory
office park & stormwater retention design

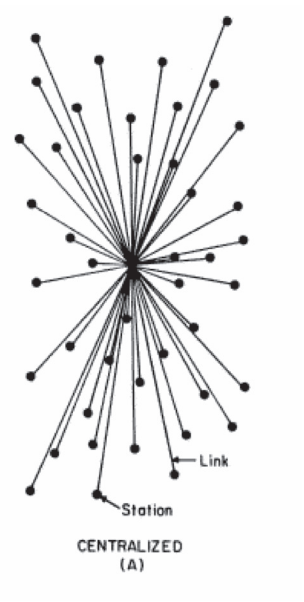
summer 2008
Merylin Paulson
Vedauwoo_Vedauwoo, WY
international school of landscape architecture
Brad Geotz
Poudre River Nature Center_ Ft. Collins, CO
environmental learning center & natural area

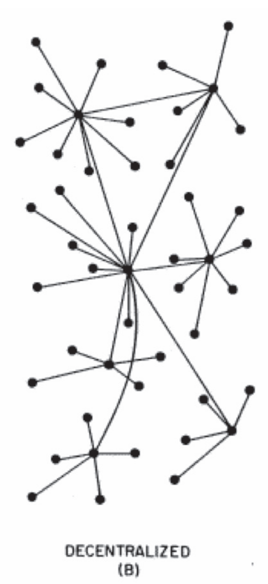
NORTH DAKOTA STATE UNIVERSITY
4th year
fall| 2010
Jay Kost
Bayfont Post-Industrial Heritage_Duluth, MN
urban design

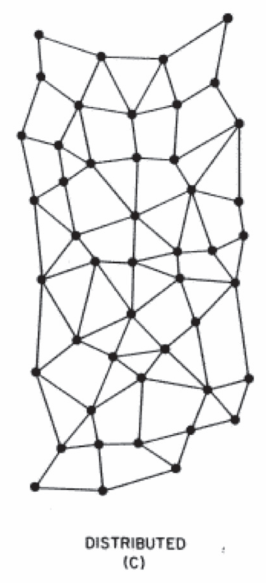
spring 2011
Kathleen Pepple
Standing Rock_Ft. Yates, ND
equestrian/civic center & community design
Dearborn Park_Printer’s Row, Chicago, IL
community & dog park

04 | PROGRAM DOCUMENTATION

from this...







to this

anthropocene

zones

mosaic

pixels

Holocene is Greek derivative. *Holos* meaning 'entire' and *cenos* meaning 'new' or 'recent.' *Scene* can be defined as 'the milieu.' Resiliency in the landscape is the most recent paradigm shift in ecological design concepts, with a deep root in environmental history. It evolved from notions of conservation and sustainability. The move has been from understanding ecology in a static stable state to seeing it for what it is, an organic and flexible system.

Scene can also be defined as a view or picture. *Eco* refers to the environment. *System* refers to the collection of related parts that function as a unit. Essentially ecology is looking at the 'entire scene.'

12,000 years ago in geologic time we entered the Holocene, an 'entirely new' era, scholars have since labelled it the Anthropocene, 'the new human' era, which implies 'nature' as belonging to a human construct.

Holoscene seeks to remedy this destructive and unsustainable paradigm, by returning nature to resilient, dynamic, time-based landscapes versus artificial, manufactured landscape objects.

I suggest we enter this new era, the Holoscene an entirely new view, which encompasses the Environmental Design problems and solutions of the past into dynamic working ecologies.

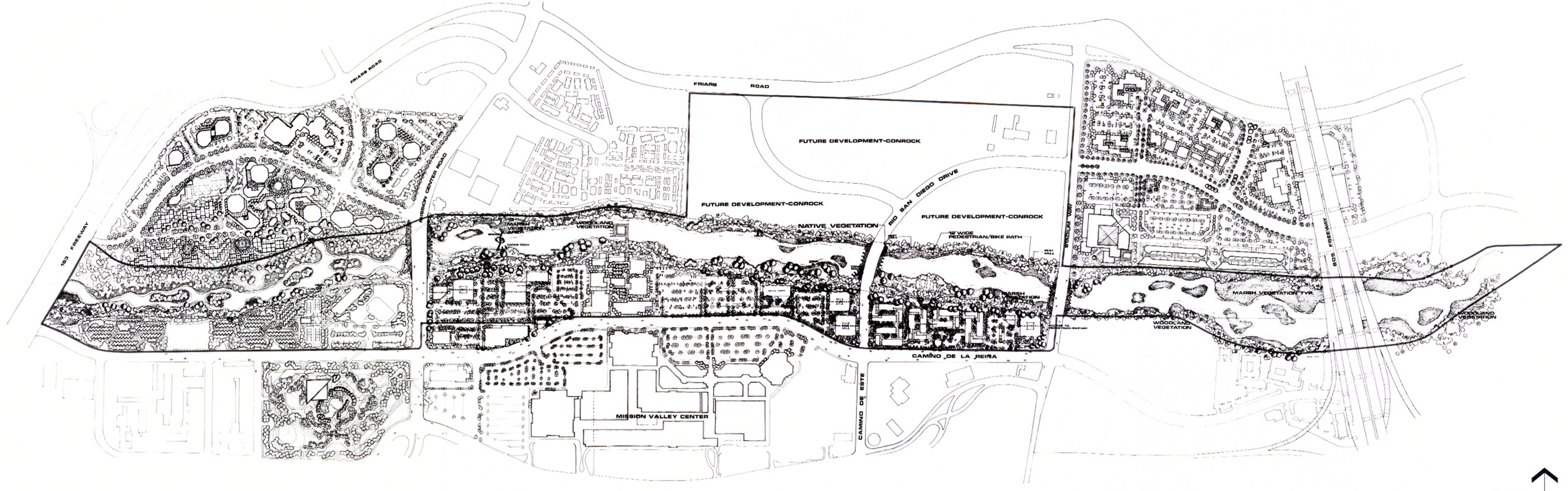
TYPE flood mitigation through ecological infrastructure

PROJECT TITLE // First San Diego River Improvement Project

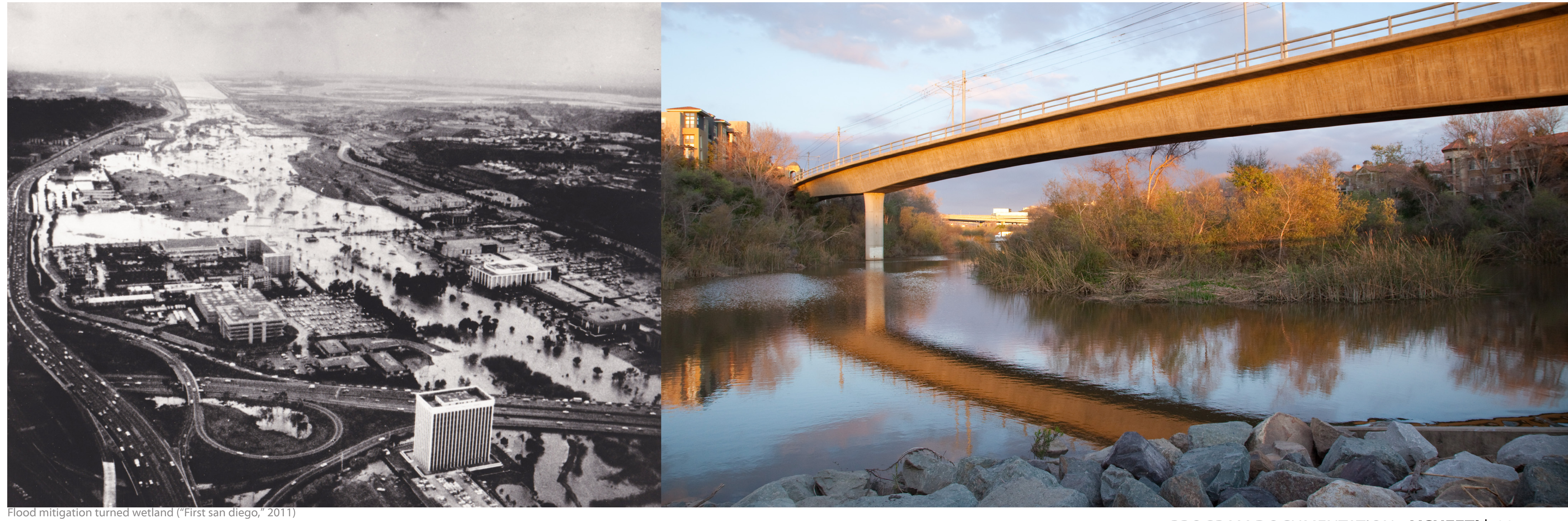
LOCATION San Diego, CA
DESIGNERS Wimmer Yamada and Caughey
DATE 1982-1990
CLIENT City of San Diego

The project site is the last segment of the San Diego River through Mission Valley. Urban sprawl had taken over the agriculture of the area narrowing the channel and impacting the natural floodplain, bringing about seasonal flooding. The Army Corps of Engineers was brought in to address the issue in 1971. Their solution, not atypical, was a concrete flood control basin. Many citizens of the Valley were against the plans. One soil scientist thought their solution would "stop the river from recharging ground water" (Jost, 2011).

The project was stalled until private investors stepped in. A coalition of private landowners and public agencies grew tired of the seasonal flooding, but weren't resolved with the Corps solution. They called a hydraulic engineer, Howard Chang, to advise them. The channel was already narrow and had little room for expansion. He informed them, "With an earthen channel, the velocity has to be far lower…to prevent the streams banks from eroding" (Jost, 2011). It wouldn't have to be 1,000 feet wide, as other engineers suggested. "It was feasible to build a vegetated channel no greater than 400 feet wide if it were deep enough and had drop structures or weir to slow down the water. Those drop structures could be integrated with traffic crossings to save money on bridges" (Jost, 2011). The group of investors hired the landscape architecture firm Wimmer Yamada Associates to work with Architects, Civil Engineers and Biologists to design the project.



LANDSCAPE DEVELOPMENT PLAN
SAN DIEGO RIVER IMPROVEMENT PROJECT



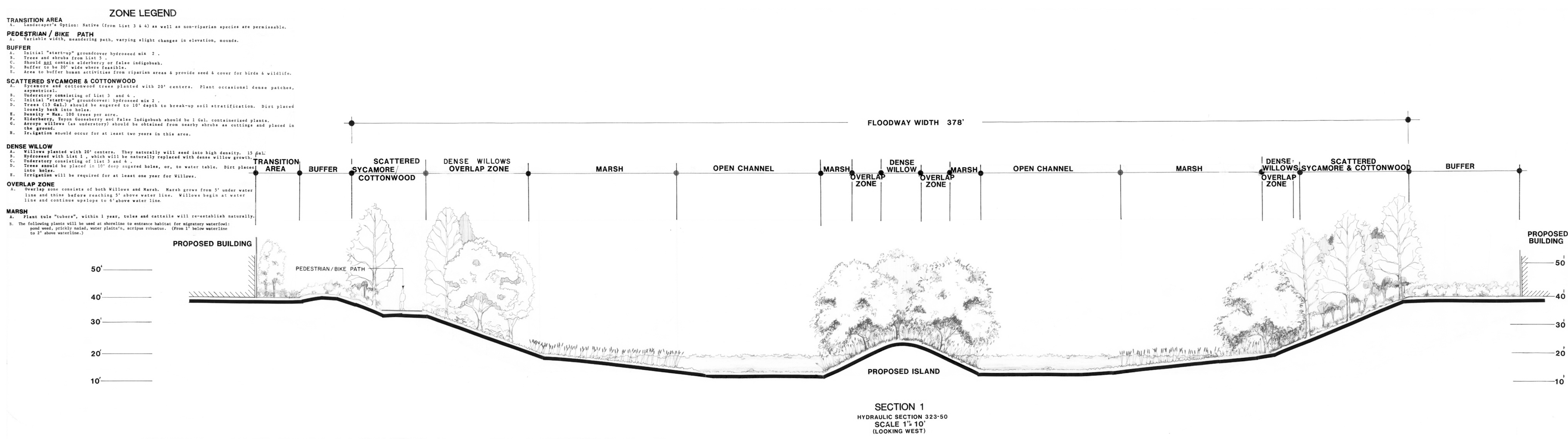
Flood mitigation turned wetland ("First san diego," 2011)

"Great examples of landscape design often go unrecognized because the finished look is so natural it is unnoticed as "man made" by the observer."

2011 ASLA Professional Awards
("First san diego," 2011)

The plan called for a series of flood control segments (to allot for the 100 yr flood) along the length of the valley incorporating recreational amenities. Due to new legislation, the team had to mitigate for lost habitat. The revitalized channel was lined with native vegetation as opposed to conventional grass or concrete. The first segment of the plan was 2.5 miles with a re-vegetated 42-acres of riparian woodland and 15 acres of freshwater marsh. It included islands for nesting bird habitat. A five-year monitoring period was instituted to monitor mitigative measures.

The landscape corridor has proven successful over the past 25 years with created wetland habitats, wildlife preserves, bikeways, pedestrian paths and has reduced and controlled the seasonal flooding. It is noted that prior to the FISDRIP, San Diego River had a long history of winter flooding, vandalism, garbage dumping and overgrown wetland areas that were filled with evasive vegetation. The project has proven to revitalize the community as not only a solution to a problem, but an embraced public amenity that has actually been expanded upon throughout the years and greatly raised local property values.



REVEGETATION SECTION 1


Flood mitigation turned wetland ("First san diego," 2011)

04 | RESEARCH CASE STUDY

TYPE renewable energy: wind
PROJECT TITLE // Windstalk

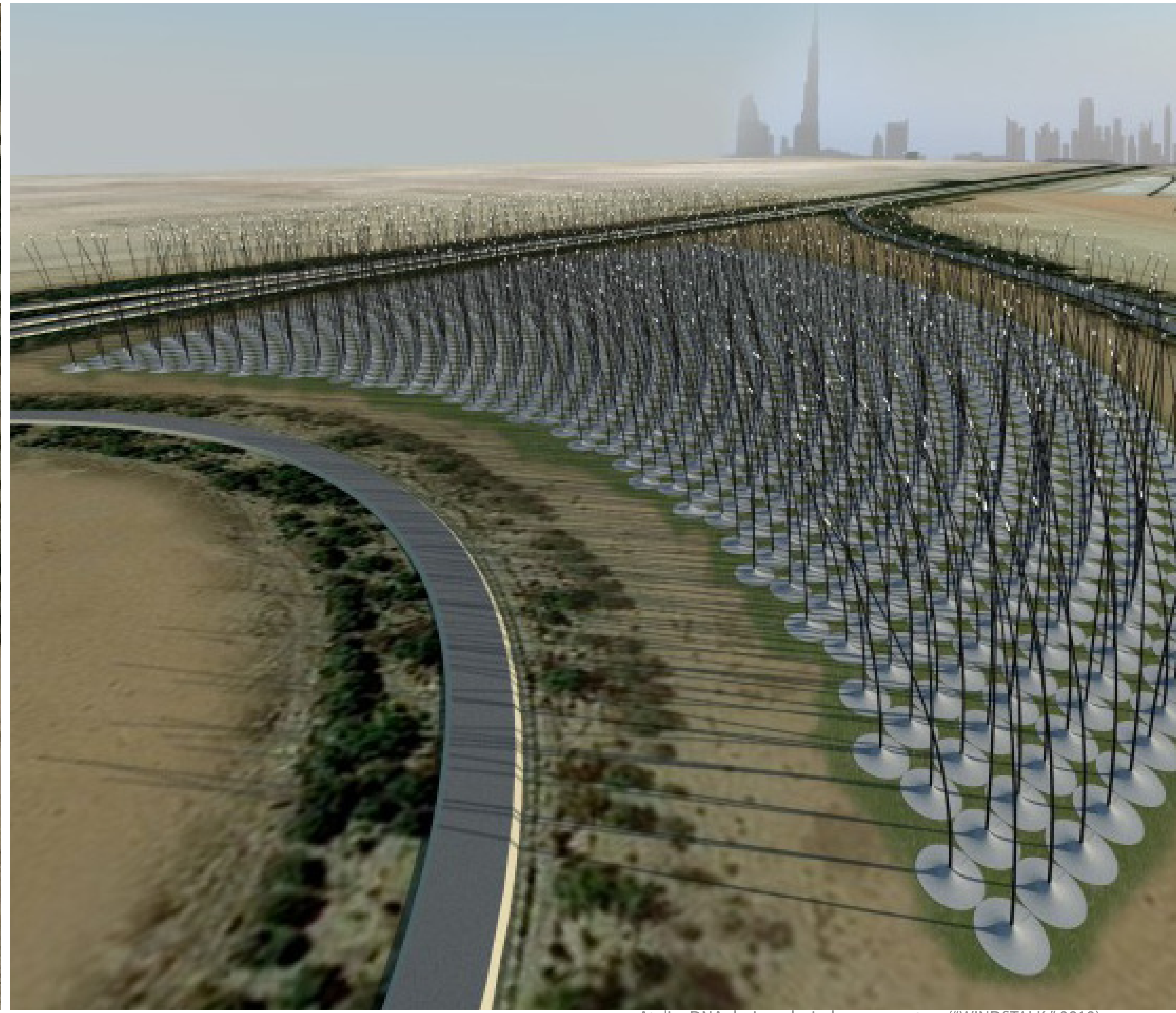
LOCATION Abu Dhabi, UEA
DESIGNERS Atelier DNA: Collaborative design laboratory
ISSE (Innovative Structural and Speciality Engineering)
eDesign Dynamics: Ecology and Renewable Energy
DATE October 2010
CLIENT 2010 Land Art Generator Initiative design competition

The Windstalk design consists of 1,203 carbon fiber reinforced resin poles. The poles stand 55m high with a 30cm diameter base and 5cm diameter tip. The top 50cm glow with an LED tip that dims or lightens in proportion to wind conditions.

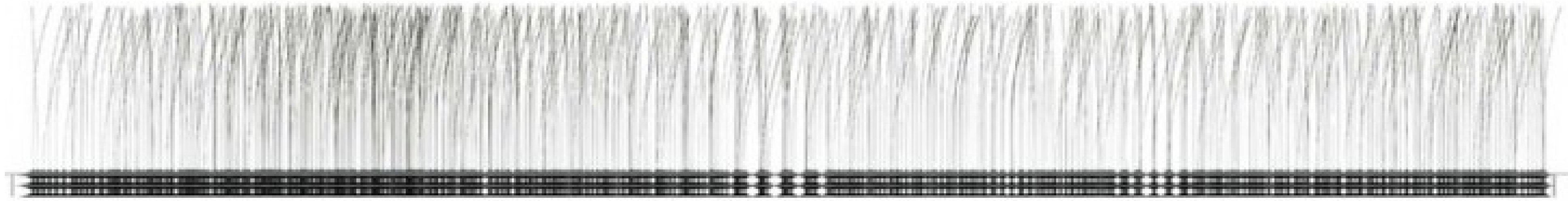
The poles are anchored to the ground with concrete bases 10-20m in diameter. In this design they are laid in a logarithmic spiral and the bases are shaped like vortices with no two alike.

The poles are electric generators utilizing the force of the wind that acts upon them, much like a wind turbine. The concept functions with a stack of piezoelectric ceramic discs within each pole. Between the discs are electrodes, every other electrode is connected by a cable, one on each side, that traverses the pole. When the poles are in motion, the discs become compressed. This compression generates current through the electrodes. The concrete bases house a torque generators, these generators convert kinetic energy into electric energy. This is done through current generating shock absorbers.

A backup system was designed for when the wind isn't in motion. Below the poles are to large chambers. Part of the electricity generated from the poles goes to power a set of pumps. The pumps move water from the lower chamber to the upper chamber. The chamber acts somewhat like a battery for the site. When the wind isn't in motion, the water from the upper chamber falls flows down to the pumps turning them into generators.



Atelier DNA designed wind energy system ("WINDSTALK," 2010)



section showing underground chambers

"Our project takes clues from the way the wind sways a field of wheat, or reeds in a marsh."

Atelier DNA,
("Windstalk," 2010)

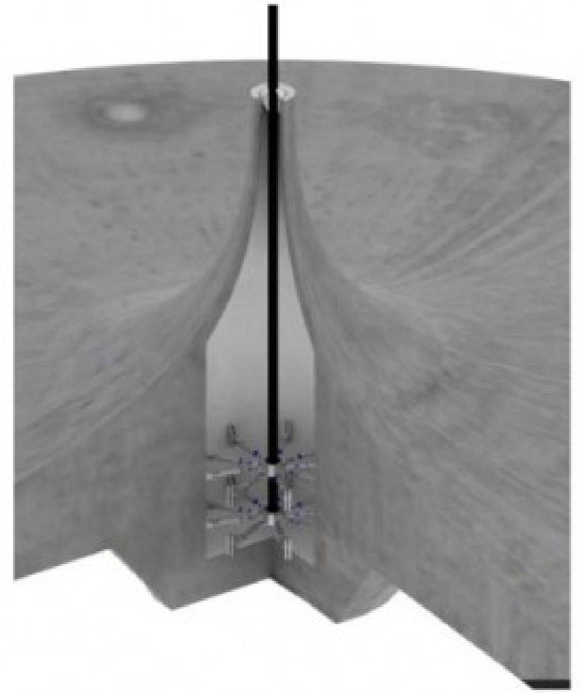
It is roughly estimated that the project is comparable to the output of that of a conventional wind turbine array. It is also noted that this system has the advantage of being packed into denser arrays then that or a traditional wind-farm, optimizing space.

The team notes that the project is conceptual, but based on a set of systems that already exist and work. It combines these systems into a "coherent synergetic whole" ("Windstalk," 2010). In addition, the layout severs environmental function as rainwater is designed to slide down the bases collecting on the base plane, watering the vegetation in the spaces below. The non-blade design of these also serves bird species. As is the argument with traditional wind power, birds and bats and migration routes would hardly be impacted.

Atelier DNA designed wind energy system ("WINDSTALK," 2010)

section through pole base

section through poles



axonometric detail showing torque generator

TYPE renewable energy: micro wind farm
PROJECT TITLE // Windspire Plaza

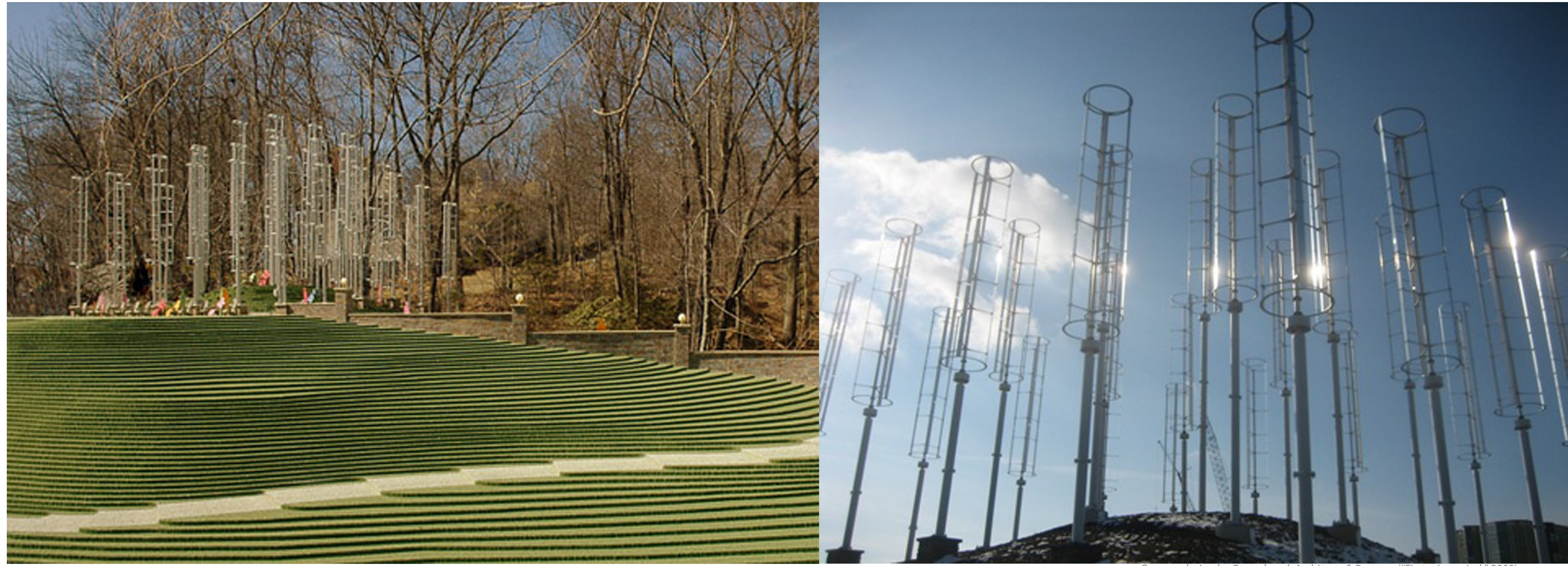
LOCATION Hamden, Connecticut
DESIGNERS Centerbrook Architects and Planners
Windspire Energy Inc.
DATE October 2009
CLIENT Quinnipiac University

The York Hill campus of Quinnipiac University is completing installation of the first micro-wind farm in the country. The Windspire design is part of the University's larger "Sustainability Strategy." They have installed 25 vertical-axis turbines, and plan on 42 total. The turbines varying in height from 35-45ft generating an estimates 84,000 kilowatt-hours of power per year, enough to power over half of the external lights on the 250acre campus. The design is set into a garden plaza on campus, appearing more like a "kinetic sculpture garden" than an obtrusive structure. The Windspire maximizes wind power regardless of changing wind speed and direction due to its propeller-free design. It is of note that the turbines are low-noise, as is one the common complaint of proximity when it comes to conventional wind turbines.

"The technology and vertical axis design of the Windspire allowed us to place wind power right in the center of campus.

The unique grouping of Windspires will serve not only as a visible symbol of sustainability, but also as an intriguing kinetic sculpture beneath which students will be able to sit and take in the panoramic views of the Connecticut hills."

Jeff Riley, Centerbrook Partner,
("Quinnipiac university," 2010)



Campus design by Centerbrook Architects & Partners ("First micro wind," 2009)

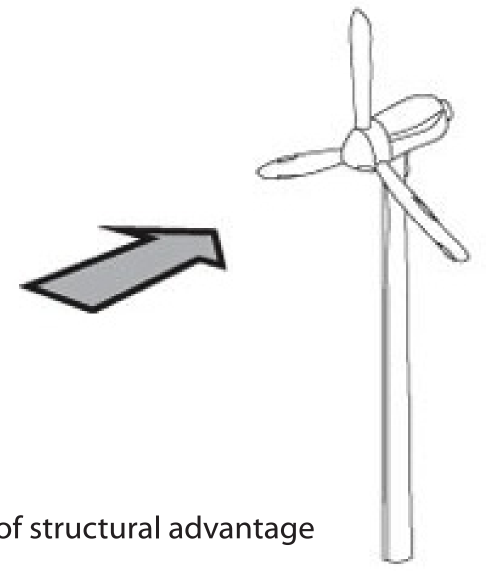
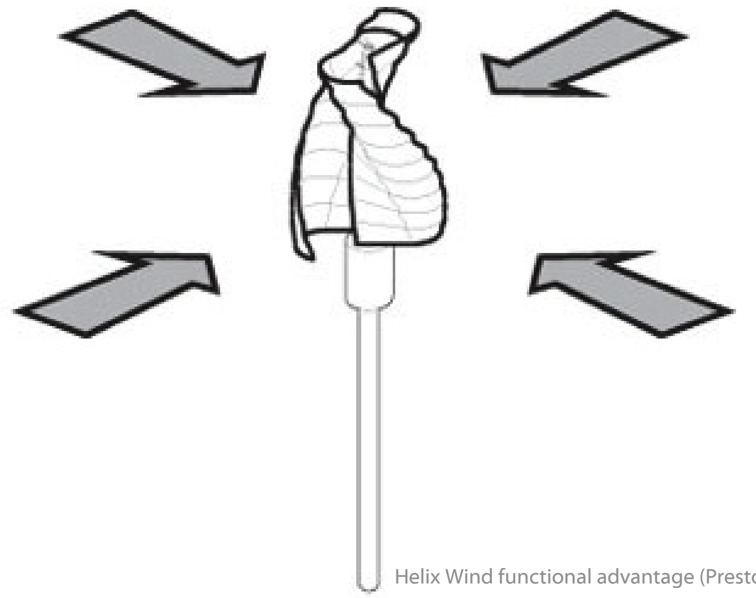


diagram of structural advantage



Helix Wind functional advantage (Preston, 2011)

TYPE brownfield remediation/ecological restoration

PROJECT TITLE // Menomonee Valley

LOCATION Milwaukee, WI

DESIGNERS Landscapes of Place, LLC, Nancy M. Aten, ASLA

DATE 2006

CLIENT The City of Milwaukee

The project is two miles from downtown Milwaukee on a linear 25acre pocket of land. To the north the site is bordered by the last stretch of natural riverway before becoming confined by sheet pile walls. The south side is bordered by the railroad.

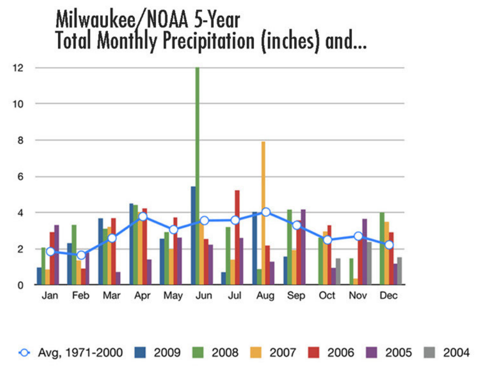
It is the final project of the 140acre revitalization project of former industrial land of the in the Menomonee Valley Master Plan of 2001. The plan called for the remediation of brownfield conditions, redevelopment to reestablish manufacturing jobs, and green space. The overarching goal this leg of the plan was to "transform the irreversibly altered land and hydrologic conditions to a mosaic of biodiverse landscapes, including forest, prairie, and ephemeral wetland, native to Milwaukee and ecologically appropriate for new conditions, with systemic and meaningful engagement of the community" ("Making a wild," 2011). The project lent itself well as the new site for the Urban Ecology Center, an environmental education and science facility. The integration of building function with landscape function would serve to enhance and facilitate the work of the organization.

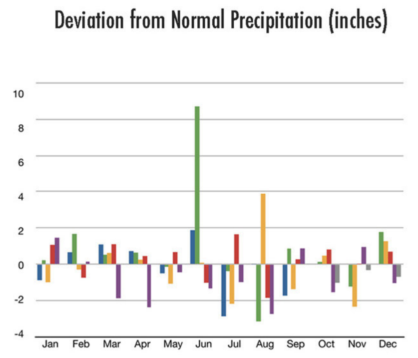
Ecological considerations were at the forefront of planning decisions. They referenced the historic river course, hydrologic conditions, and vegetation with current trends to inform quantitative biodiversity and structural goals for proposed habitats. They considered patch dynamics when deciding trail route and density as not to fragment habitat, providing a grassland mosaic with access to wet habitats and forests. Sun patterns, precipitation, and topography were assessed in addition to biotic conditions and analysis of adjoining neighborhoods to see the potential community interaction.

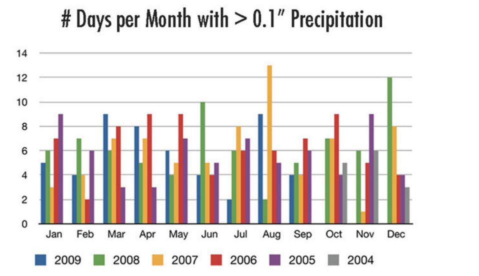
The plan articulates innovative methods to achieve un-compacted soil and micro-topographic variability. It calls for the establishment of prairie, oak savanna, and forest, describing nine community types with 479 native species, but does not neglect the notion of aesthetics numerating habitat types, character and species of visual essence. The project highlights 'urban' and 'ecology,' surrounding visitors with nature, a mere walk away.

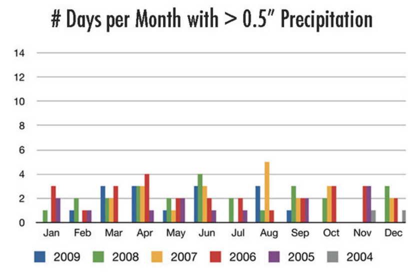
"An example of what we can and should be doing in all cities: replacing a very polluted area with a native landscape. […] A comprehensive approach to health issues."
–2011 Professional ASLA Awards Jury ("Making a wild," 2011)

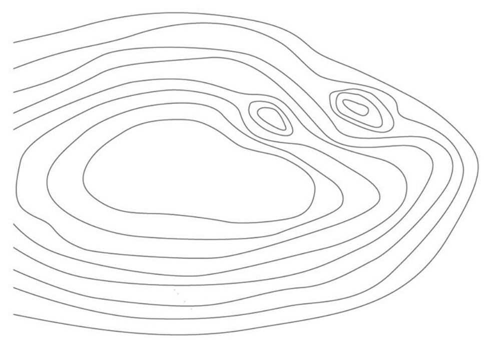
site photos (ATEN, 2011)

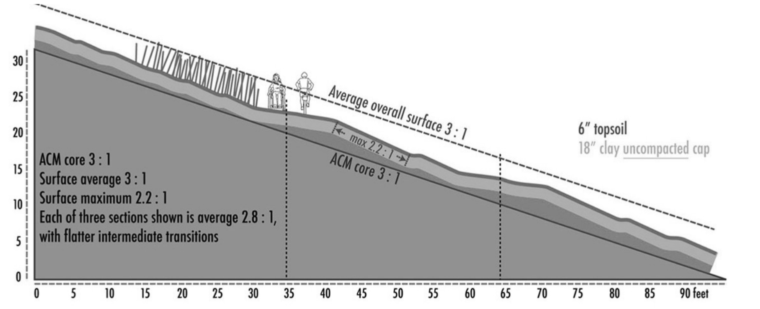


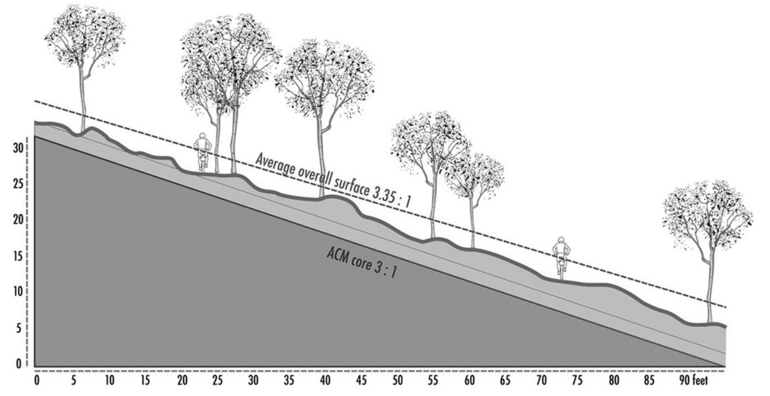












percipitation charts & sections (ATEN, 2011)

analysis of precipitation patterns in the valley illustrates importance of microtopographic variability for vegetation establishment

“Design plays a strong role in restoration within the fabric of cities…working out how to strengthen the relationships of people with nature to the sustained benefit of both.”

Landscapes of Place, LLC,
LandscapesofPlace.com, 2011

FORESTED TARGET PLANT COMMUNITIES //MP4
Forest is important to enhance the riparian corridor, reference historic conditions and maximize biodiversity. The goal is to establish the largest forested blocks possible unfragmented by trails. Intermediate shrubland serves slope stabilization and habitat, while providing a distinctive character (Aten, 2011).

PRAIRIE AND SAVANNA TARGET PLANT COMMUNITIES //MP5
Grasslands serve ecological restoration. Prairie and savanna communities are incorporated to respond to aspect, hydrology, and habitat need. The oak savanna serves as a plant community, referencing its history as native to Milwaukee. The species lists are designed to provide grasses, composites, and legumes. The overall aim is to provide character mixes of each sub-habitat, enhancing biodiversity (Aten,2011).

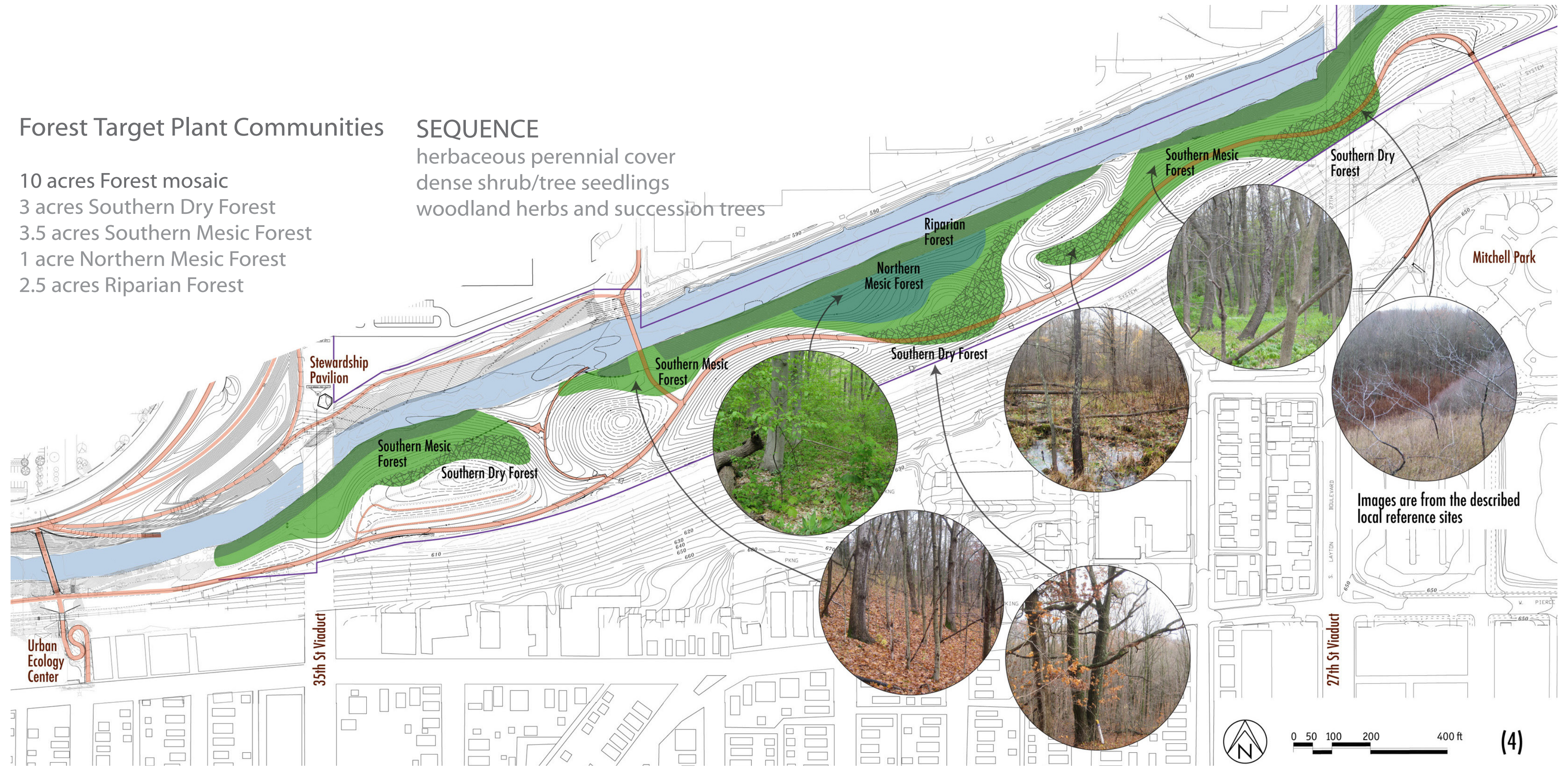
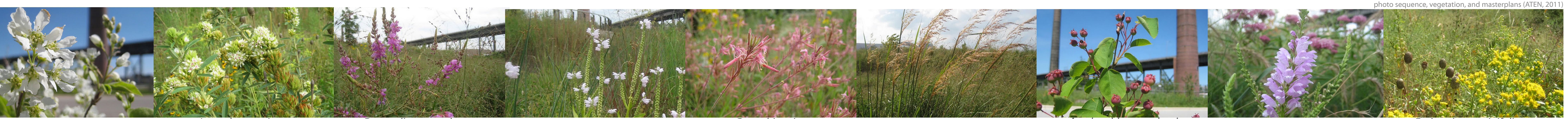
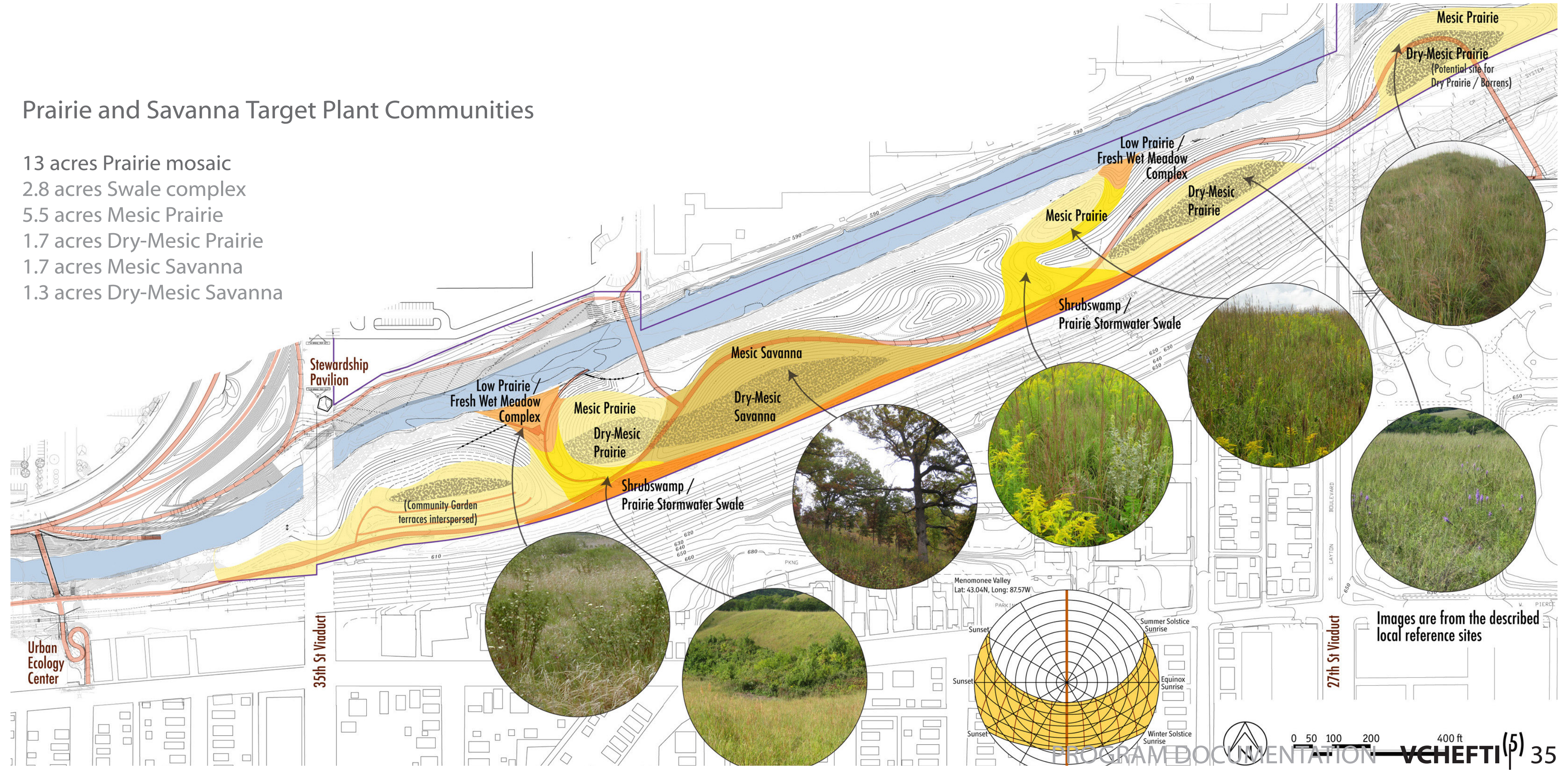


photo sequence, vegetation, and masterplans (ATEN, 2011)



Lespedeza capitata *Desmodium canadense* *Gaura biennis* *Amelanchier canadensis* *Euthamia graminifolia*

JULY 2006 OCT 2006 JUNE 2007 JUNE 2009 JUNE 2010



04 | PROGRAM DOCUMENTATION

holoscene

gr. 'holos' - 'cenos' - 'scene'

gradient

holos= 'whole/entire' *cenos*= 'new/recent'
scene= 'view/picture/where something occurs/milieu

TYPOLOGY | summary

The case studies represent various infrastructural elements in the landscape. Each one focusing on a different element, but essentially they are all part of the 'entire scene.' Each study uses ecological systems with a more integrated and multifaceted approach then that of their conventional counterpart, while solving the same problem. While the conventional methods are a solution, the ecological solutions have far greater benefit and provide more service to the community.

The San Diego River Improvement Project set a precedent for working landscapes back in the 1970s. The design incorporated a park and recreational activities, but the purpose of it was to mitigate the 100-year flood, the extra features were simply integrated benefits. Windstalk is a completely different infrastructural solution, while it may not be entirely ecological; its focus is on energy conservation. Its plan was designed with the intention of the integration of ecological systems, as well as the design to not interfere with migration routes, which is inclusive of serving ecological function and thusly becoming a working landscape.

While only one facet of Quinnipiac University's sustainable plan was studied, the part represents again, that part of a greater whole. The Windspire design is like the FSDRIP in that it serves a function, but integrates in the community for benefits of aesthetic and site character. The importance of the study however, is locality. The turbines power the lights adjacent to them, not three states away. Locality is an issue of sustainability.

In the Menomonee Valley, the site is again, multifaceted. It remediated a brownfield site that would otherwise be useless. It did this with the aim of serving the public with open space. The open space was integrated in a plan for economic development. I could pull up some facts and figures, but it doesn't take a genius to assess that aesthetic quality goes hand in hand with economic prosperity. For instance, look at the property values around Central Park. The site had a more comprehensive ecological underpinning then the others. With through analysis of the site conditions in context of establishing habitat, but much of that establishment was for the infrastructural purposes of stabilizing banks, remediating water, and cleaning the soil.

In place of a planned concrete channel as envisioned by the Army Corps of Engineers, the FISDRIP project was a collaboration of Public Agencies, Engineers, Biologists and Landscape Architects in designing a highly sustainable, ecological, and functional flood control system. Completed in the late 1980s, the project represents an example of restorative design in an urban context. Like the Menomonee Valley, it proves nature's ability to heal itself, survive within an urban environment, and provide human connections to the natural environment.

At the core, all of these case studies function as infrastructural solutions that provide great public amenity.

As somewhat of an aside, the FSDRIP project I find extremely interesting. A great deal of the wetland creation in the project wasn't due to landscape architectural environmentalists wanting a wetland. It was due to legislation. New law required that they mitigate the lost wetland area, even though it was degradated and filthy. The team decided to mitigate it back into the design. The reason I find this so interesting is because it isn't necessarily about this stereotype of 'green tree-hugging hippies.' It is about practicality. It's about the fact that these systems function to serve a purpose and while they do it, they're quite aesthetically pleasing. It is not about the tree to save the tree. It is about saving the tree because it gives oxygen, it takes in pollutants, it's roots hold the topsoil in place to allow the planting of food, and sometimes it bares the food. That is why these systems are important, because they serve humanity. However, in order to take advantage of that service we cannot destruct them, it is like a car. It only serves you as long as keep the oil clean. Kind of an ironic analogy.

04 | PROGRAM DOCUMENTATION

"Knowing is not enough; we must apply.
Willing is not enough; we must do."
Johann Wolfgang von Goethe,
German Playwright, Poet, Novelist and Dramatist

GOALS

| academic

The theoretical underpinnings of the design solution to create a high-performance landscape system is truly the thesis of my undergraduate career.

Studying Landscape Architecture, Engineering, Ecology, and Natural Resource Management, in addition to art, industrial ergonomics, and computer programming has led me to believe this is the way of future design. This thesis acts as an opprotunity to apply this synthesized theory.

| professional

My intention is to gain experience in research & application in what I feel will not only be equitable feilds of interest, but a passionate advocacy. It is my aim to work in the field creating working landscapes and functional ecology utilities that serve. Ecological concern is economically lucrative while making harmonious communities and providing a wealth of benefit, including physical, mental, and spiritual health.

It is true that we design for people, but we all too often forget that without a healthy ecosystem... There is a better way and I see that as the essence of the industry.

| personal

I honestly don't know why I do what I do…chalk it up to a higher calling and leave it at that. The Buddha said, "Your work in life is to find your work and give yourself wholeheartedly to it."

HISTORICAL CONTEXT | introduction

The trend throughout history in terms of humans with land and nature has been a combination of sociocultural mores, including aesthetic appreciation and recreation, to public health concerns, to economic land use, transitioning from conservation to sustainability to resilience. The research in environmental history aims to highlight how the concepts have evolved.

The timeline shows an evolution of Landscape Design beginning in the 1800s with royal parks designed for recreation, the emergence of public city parks aimed at public health, to the park systems for preservation, national and state parks for conservation, to town planning introducing notions of sustainability. Public health, recreation, conservation, and economics are all factors along the way. The research leads to the future of the design community, the Holoscene, with integrated working systems that feed off each other for mutual benefit and gains.

<1800 *royal parks* > recreation >

1842 *city parks* >> public health >>

1870 *park systems* >>> preservation >>>

1900 *national/state parks* >>>> conservation & economics >>>>

2010> *town planning* >>>>> sustainability >>>>>

working landscapes >>>>>> resilience >>>>>>

Urban Health |

The world's urban percentage tripled in the 1900's with the total number of urban dwellers rising from 225 million in 1900 to 2.8 billion in 1998 (Wellock, 2006). Urban impacts extend beyond the urban fabric. They travel downwind and downstream to neighbouring communities and sometimes they have global effects. Cities absorb ever-larger quantities of water, energy, and materials. In exchange they pump out goods and services, as well as pollutants, garbage, and solid wastes. This is what McNeill terms the "urban metabolism" (McNeill, 2000).

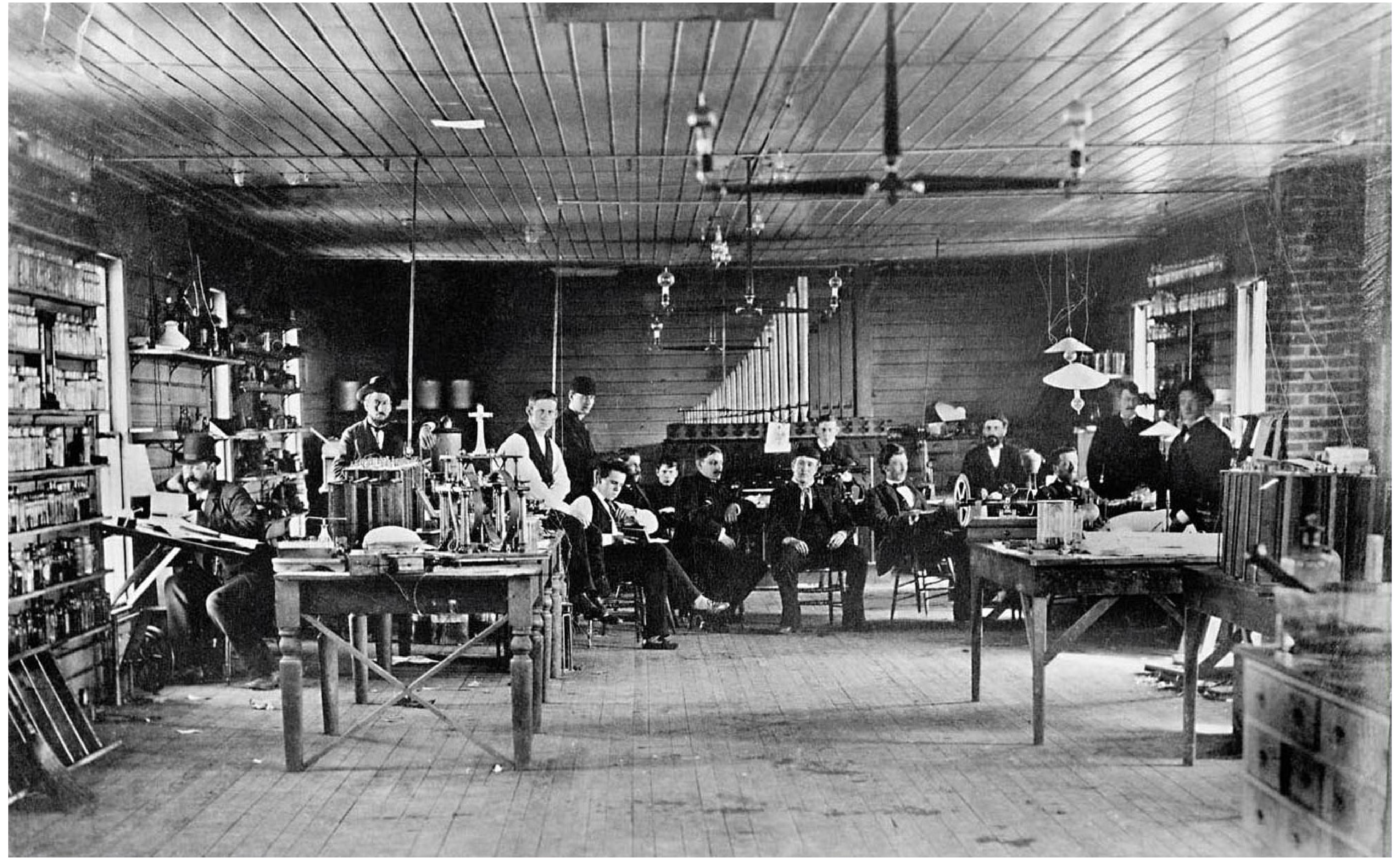
Rapid urbanization contributed to severe pollution and environmental distress. Early in the 1900s New York had garbage barges dump their contents into water outside the city's harbor. Other cities did differently, but the concept was the same: throw it in your neighbors yard. After World War II, New York City consigned its trash to Staten Island, where the world's largest landfill opened in 1948. The Japanese had enough money and ingenuity to find good uses for garbage, converting some into construction materials (McNeill, 2000). By 1940 most cities addressed these difficulties though garbage collection, sewage systems, and water treatment plants. This left them with pollution derived from industry and transport. By the 1970s, to some extent some cities "solved" their problems by shunting them off on downstream or downwind neighbors (sometimes buying land in other municipalities to dump it on) but eventually this proves less practical as neighbors eventually learned the power of litigation.

Urban Health | public parks as solutions

In the 1800s the view of the environment began to emerge as a commons where the pubic good prevailed over private interest. In 1870 the Massachusetts Board of health asserted, "all citizens have an inherent right to the enjoyment of pure and uncontaminated air, and water, and soil, that this right should be regarded as belonging to the whole community, and that no one should be allowed to trespass upon it by his carelessness and avarice" (Wellock, 2006).

The mid-1800s marked a time of emergent awareness of urban health with linkages forming between urban sanitary conditions and disease. A demand grew for government intervention and soon municipalities began creating water supply systems, sewer lines, and city parks. The Report on the Sanitary Conditions of the Labouring Population of Great Britain by Edwin Chadwick in 1842 emphasized medical authorities advocating more city parks to "absorb deleterious gases." Parks, reformers concluded, were the "lungs of the city" and promoted health (Wellock, 2006).

The sanitary movement can to be because urbanization and industrialization caused demand for a cleaner environment. More than 90 percent of America's industrial capacity was located in urban centers (Wellock, 2006). While this industrialization brought about much benefit, it also brought filth, disease, fouled air, and polluted water, damaging the health of the populace.



Industrialization: an engineering & science print company (SMITHSONIAN INSTITUTION, 1800)

Public Parks | London: evolution of the public park

The Landscape Gardening Movement moved from private to public service when two streams of progress converged. One was the rapid growth of technology, the other an increase in demand of better living and working conditions.

At the time the concept of a public park was not in existence, rather private residences or royal parks were sometimes open to the public. Reformers campaigned to improve the overall social climate of London by reducing its destitution, violence, crime, and epidemics. A petition to the Queen and pleas to Parliament called for a public park. Bills for the creation of Victoria Park were passed in 1842 with a royal grant (Newton, 1971).

Birkenhead Park followed with, some argue, greater success due to the freedom from arguments in London politics. Birkenhead grew as a merchant town with a shipyard. As business and size began to increase, city Commissioners decided to build a public park, so in the minds of a few forward-looking men the phenomenon of the "country park" was created (Newton, 2006). The park planned for plots of land around its edges for sale to those who would recognize the value of facing an open area. The income of the plots accrued as municipal revenue, covering the costs of construction and maintenance (Newton, 2006).

Noteworthy is the affect the park had on a young traveller, Fredrick Law Olmstead. The park was discussed in his book Walks and Talks of an American Farmer in England. He had never seen anything like it anywhere in complete public ownership (Newton, 2006). In this context, this park becomes significantly more important as a milestone in the history of public open spaces.

Public Parks | Cleveland: evolution & economics of the park system

Horace William Shaler Cleveland was quoted by Olmstead as being "the oldest landscape gardener in the country." Cleveland was trained in engineering and land surveying, setting up an office with Robert Morris Cleveland in Boston for the practice of what they termed "landscape and ornamental gardening" (Netwon, 2006).

As early as 1872 Cleveland began urging authorities of Minneapolis and St. Paul to be more aware of the area's natural potentials for a system of public parks. In 1883 a Board of Park Commissioners for the City of Minneapolis was created. The Board engaged Cleveland to prepare a general plan. They published his report in a pamphlet, Suggestions for a System of parks and Parkway for the City of Minneapolis with its accompanying plan for a network of parks and boulevards.

"The subject of public improvements in the form of parks and parkways is sure in its first inception to meet with opposition, owing to a natural misconception in the minds of inexperienced persons who imagine that such improvements must necessarily involve the immediate outlay of very large sums of money…the repeated experience of other cities, in this county as well as Europe…have invariably demonstrated that…a judicious expenditure for such objects is always a wise and safe investment.

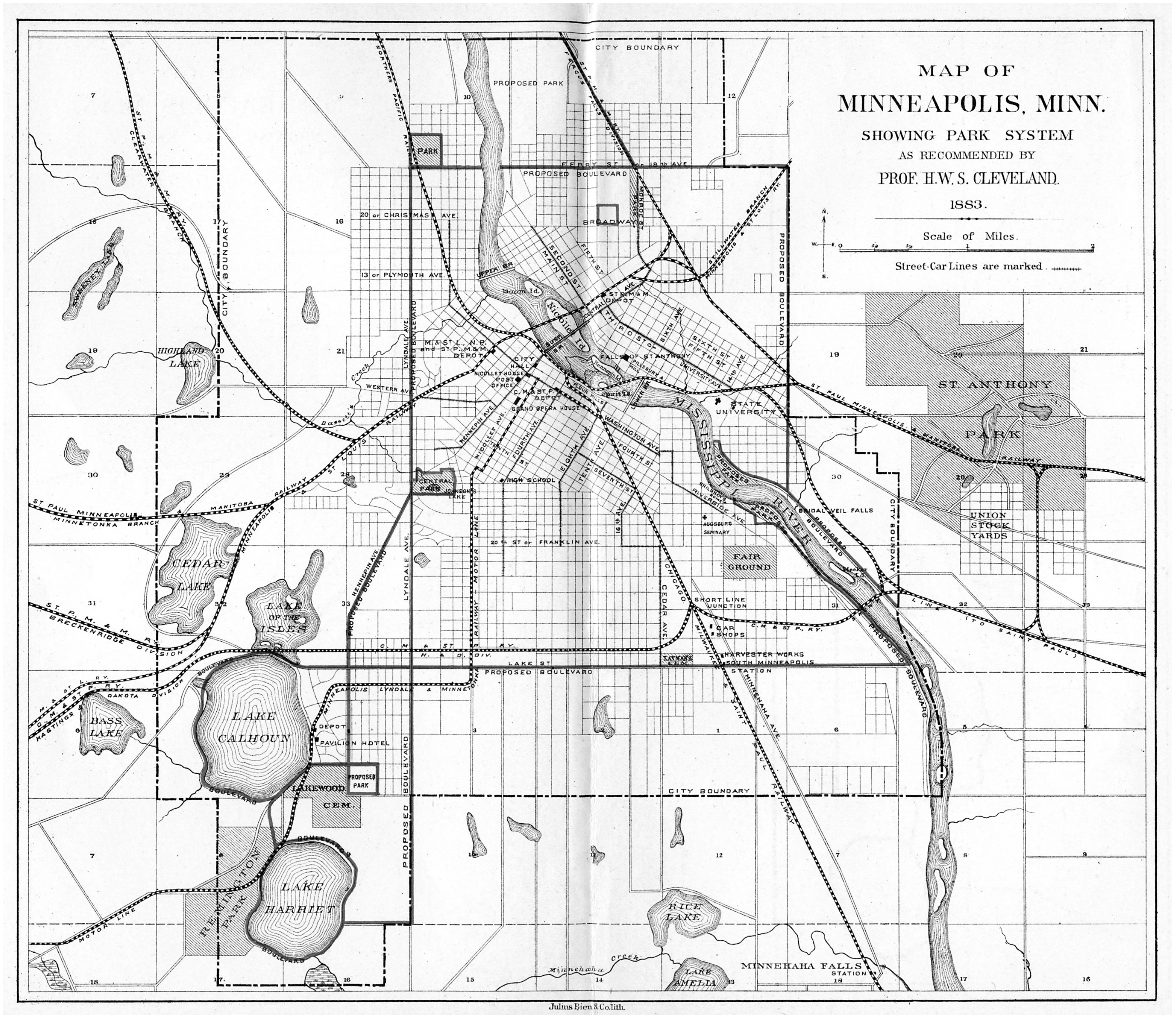
In the ten years succeeding the commencement of work on Central Park in New York, the increased valuation of taxable property in the warms immediately surrounding it was no less than $54,000,000, affording a surplus…sufficient, if used as a sinking fund, to pay the entire cost of the park in less times than was required for its construction… the expenditures which but yesterday were so bitterly denounced have proved the best investment that could possibly have been made. The popular idea, however, that the purchase of lands for parks and parkway involves the necessity of immediate large outlay for their improvement is not only erroneous, in fact, but in many cases would be inconsistent with a wise economy" (Newton, 2006).

The important point, he urged, was to anticipate future needs with a view to "securing the areas that are needed before they become so occupied or acquire such value as to place them beyond reach. Look forward for a century, to the time when the city has a population of a million, and think what will be their wants. They will have wealth enough to purchase all that money can buy, but all their wealth cannot purchase a lost opportunity" (Newton, 2006).

Cleveland further emphasized the need for a regional park system in an address entitled "Public Parks, Radial Avenues, and boulevards: Outline Plan of a Park System for the City of St. Paul." In it he expressed "It seems so evident that St. Paul and Minneapolis eventually, and at no distant day, will become virtually one city, and the interests and future welfare of each must be so intimately connected with that of the other, that it is very desirable that they should unite in the designing an arranging of improvements of the area which now separates them, by which they are to be mutually benefitted" (Newton, 2006).

His plans were never fully actualized. However, public servants and private citizens throughout the years took part in building a park system that, today, is one of the city's greatest amenities.

"…a judicious expenditure for such objects is always a wise and safe investment."



Public Parks | Charles Eliot: urban planning & preservation

One of Olmstead's apprentices, Charles Eliot was known for his writing for the advocacy of Landscape Architecture. Eliot formed the Trustees of Public Reservations in Boston. In his letters to Gardens and Forest Magazine Eliot advocated for preservation of open space and suggested "an incorporated association, composed of citizens…and empowered by the State to hold small and well-distributed parcels of land free of taxes just as the Public Library holds books and the Art Museum pictures-for the use and enjoyment of the public" (Newton, 2006). This led to the creation of the Trustees of Public Reservations in Boston.

"Compare the two maps - one showing the opportunity, the other the miserable present result. Do not the facts speak for themselves?"

One of their first goals was to establish a metropolitan system of parks. Eliot saw the growing development of Boston and the result of overcrowding in other urban areas, which often lead to the elimination of open space. His theory of a metropolitan system of parks used urban planning to protect and preserve areas for open space and recreation from development, that resulted in congestion and overcrowding. This concern led to Legislature to form the Metropolitan Park Commission of 1892, the achievement of which was highly influenced by a speech made by Eliot to park authorities (Newton, 2006).

"Here is a city interwoven with tidal marches and controlling none of them, so that the way is open for the construction upon them of cheap buildings for the housing of the lowest poor and the nastiest trades. Here is a district possessed of a charming river already much resorted to for pleasure, the banks of which are continually in danger of spoliation at the hands of their private owners.

Here is a community which must have pure drinking water, which yet up to this time has failed to secure even one water basin from danger of pollution."

"Here is a community, said to be the richest and most enlightened in America, which yet allows its finest scenes of natural beauty to be destroyed one by one, regardless of the fact that the great city of the future which is to fill this land would certainly prize every such scene exceedingly, and would gladly help to pay the cost of preserving them today. Compare the two maps -one showing the opportunity, the other the miserable present result. Do not the facts speak for themselves?" (Eliot, 1903).

The Commission began to inventory the region, developing a plan for a park system. The plan was to include: spaces on the ocean front, shores and islands of the inner bay, tidal estuaries, large areas of wild forest, and small squares, playgrounds, and parks in densely populated sections.

Although the end result was not a triumph of an implemented park system, it was a triumph of integrity. Eliot had much difficulty trying to get the city and public to comprehend the basic good sense and economy of advanced planning. Finally he resigned his firm stating in a letter to the Commission, "We asked that we might be definitely and publicly freed from all responsibility for work done in the new reservations, or else that we might be definitely engaged to draw up for the consideration of the Commission those comprehensive schemes or programmes of work which are commonly called 'general plans.' You will readily understand that we cannot professionally afford to have our names associated with work done regardless of comprehensive studies" (Newton, 1971).

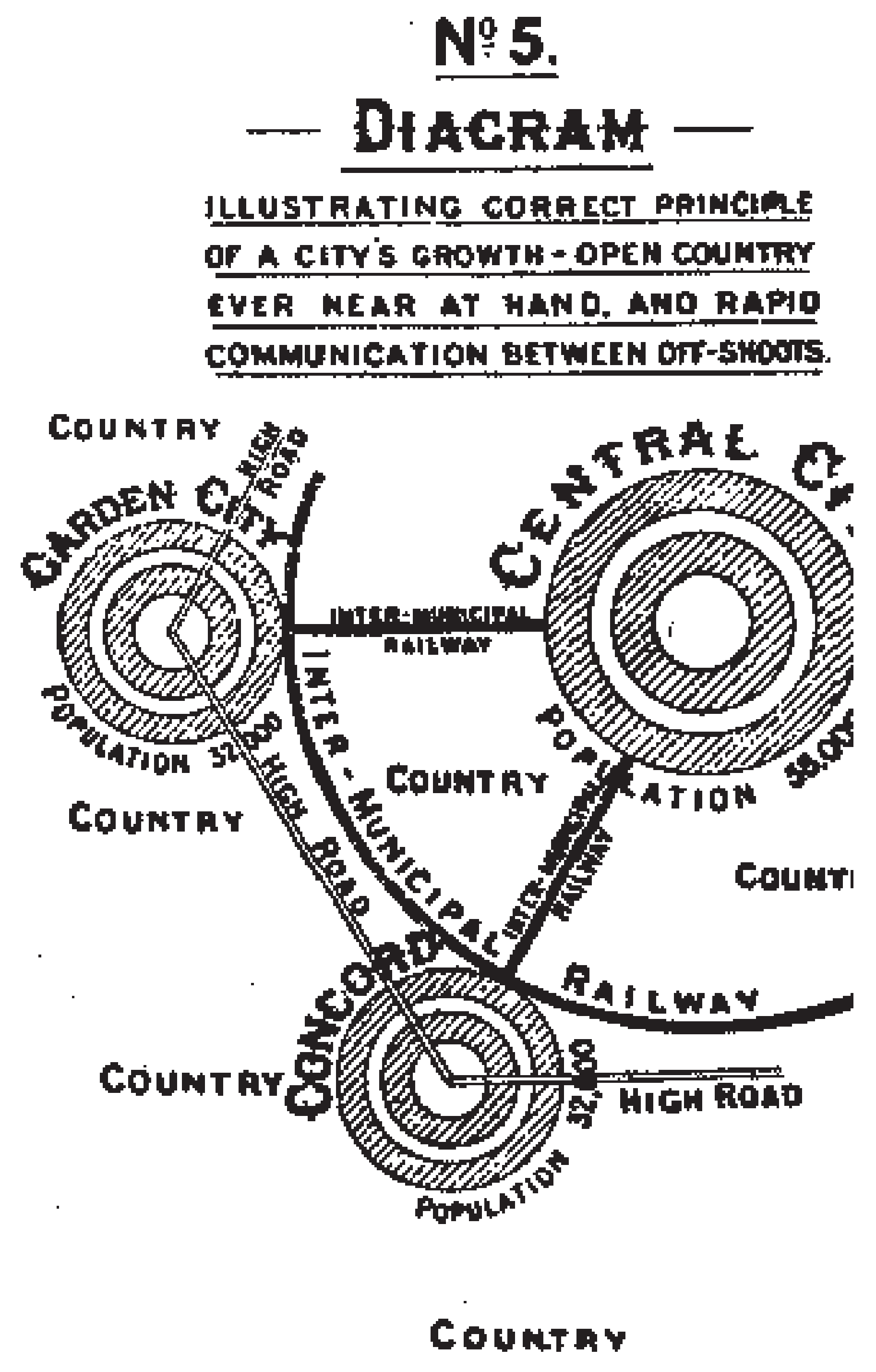
Town Planning | Howard's Garden City

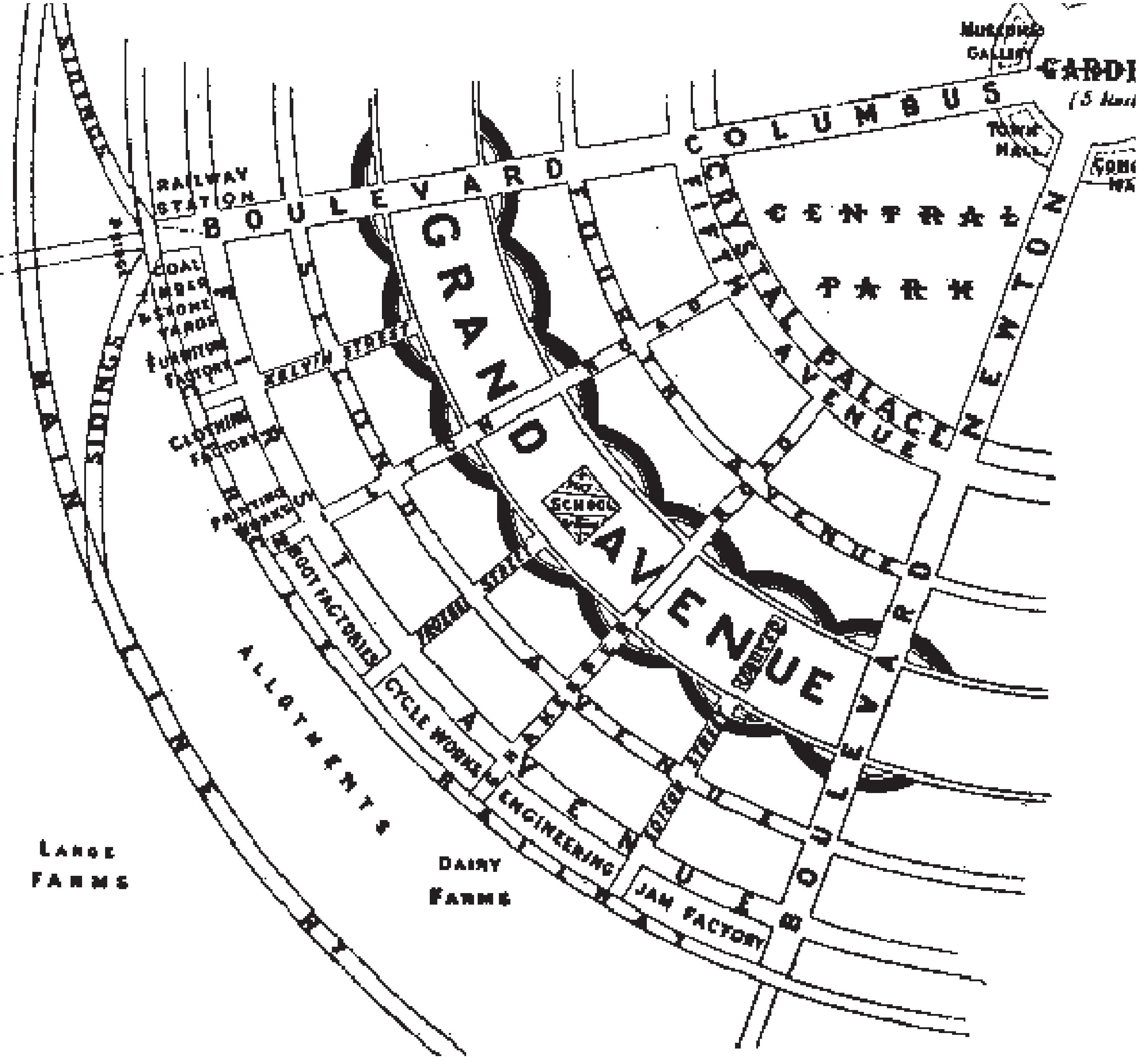
Ebenezer Howard had a radically different theory of town. He called it a "Garden City" and published it in 1898. The theory looked at organizing better communities.

He suggested there was a "Town magnet" and a "Country magnet" and argued that "neither the Town magnet nor the Country magnet represents the full plan and purpose of nature. Human society and the beauty of nature are meant to be enjoyed together. The two magnets must be made one…Town and country must be married, and out of this joyous union will spring a new…civilization" (Newton, 2006).

Howard listed components of his Garden City theory as: Town-country (advantages of both town and country: a populated center limited and surrounded by a larger agricultural zone, bringing markets of the town to the farmer and the country within to the town-dweller.), Transportation, limited size (the agricultural zone would act as a buffer against uncontrolled growth of the populated center), land held in trust (in order to retain the community, land would be leased, not sold, to occupants), control of planning (there would be fully controlled planning prior to construction, including establishment of densities and general form, allowance for desirable individuality), wards (neighbourhood districts), spaciousness (there would be for all "ample space for homes…for roads…so wide and spacious that sunlight and air may freely circulate, and in which trees, shrubs, and grass give the town a semi-rural appearance"), industrial employment (to be on the outer ring of the town), dispersal of towns (once a town hit its capacity, a new town would form a distance away, maintaining the zone of country space with satellite cities that would group around a Central City) (Howard, 1902).

Several Garden Cities were created, but results have been too varied to generalize success of the theory or not (Newton, 1971). Although his Garden City holds many flaws, including the seemingly utopian idea luster, his principles and the notion of town planning are sound.





Diagrams of Howard's Garden City (HOWARD, 1902)

National Park System | public domain & conservation

Newton articulates, "The story of the National Parks is a tale of creating something for all people from land already owned by them" (west of the original thirteen colonies, all land belonged at first to all the people, it was public domain), noting the struggle it has been to keep the people from exploiting and squandering their own best possessions, the land and what lives upon it (1971).

In 1641 the Great and General Court of the Massachusetts Bay colony passed the Great Ponds Act, stating any body of water ten acres or more in extent must be kept open to public access for purpose of "fishing and fowling" (Newton, 1971). Forms of public rights have been customary since the act. Recognition of such public rights gave rise to national parks as the country grew.

In 1870 an expedition travelled the Yellowstone River, finding it's wonders, the men discussed the financial benefit the natural area would make. One of them suggested it was clear proof that the area was a portion of public domain. It was too important for any one man or group to possess (Newton, 1971). They pursued to get the thought through Legislation. In 1872 President Grant signed legislation for the first national park in Montana and Wyoming. In 1894 a law prohibited hunting or killing wildlife on the national grounds. In the 1890's Yellowstone, Sequoia, Yosemite, and tiny General Grant National Parks, Mount Rainer National Park were created (Newton, 1971).

The Yosemite is important in environmental planning and economics as to how to open a piece of open space to the rightful enjoyment of many without ruining it for all. The Forest Reserve Act of 1891 allowed the president to set apart and reserve tracts of publicly held forested land. This act provided for the conservation of the country's lumber supply, and saving many exceptional tracts of land from homesteading. Approved in 1906 the Antiquities Act allowed the president to set aside as a national monument, any historic or scientifically important area on land already owned or controlled by the United States.

"...there was a unity in this complication."

Stephan T. Mather wrote to Secretary of the Interior Franklin K. Lane about the poor condition of the national parks. Lane responded, "If you don't like the way the national parks are being run, come on to Washington and run them yourself." Mather was appointed in 1915 and became known as "the father of the National Park Service" (Newton, 1971). Mather began a quest to fight the political favouritism that degraded the land, with underhanded deals with logging companies and the like. In 1916 he helped pass the National Parks Act, establishing the "service to promote and regulate the use of Federal areas known as national parks, monuments and reservations, to conserve the scenery and the natural and historic objects and the wild life therein, and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations" (Newton, 1971). Of note, the statement quoted was attributed chiefly to Fredrick Law Olmstead (who had involvement in the establishment of National Parks, namely Yellowstone).

In 1917 Mather was appointed director of the National Park Service. He wanted to hire a ranger force of trained naturalists to supervise the parks and appointed Charles P Punchard, Jr. as head of the division of Landscape Architecture. In 1921 Mather put energy behind establishing a state park system with the landscape architecture division drawing up master plans. Under Franklin D. Roosevelt's New Deal, the work program, the Civilian Conservation Corps was assigned under the National Park Service. The installed the plans of the landscape architect, much of which still stands today (Newton, 1971).

The problem of overcrowding became an issue in the National Parks It brought up questions of development in the areas, which brought into question the effects on ecology. There was the weighing of the problem of disruption against preservation. The reason for it being setting the area aside in the first place was presumably the basic reason for people to want to visit it. The harmful effects included soil compaction from visitors that interfered with the percolation of water, which would affect capillary action killing trees and shrubs. In addition would increase runoff of rain and erosion. This became the role of the landscape architects in the planning and dealing with the National Parks (Newton, 1971).

REGIONAL GEOLOGY // Pleistocene Epoch_1.6 million years ago_The Ice Age

Glaciers stood across much of present Canada and the northern parts of the present day United States. The glaciers acted like large earthmovers, scraping the land clean and compressing it under miles of ice. Around 12,000 years ago the glacial period was ending and they slowly retreated north. As the glaciers melted and sea levels rose, valleys cut by rivers were filled with sediment carried by melt water through swollen rivers, including the now present Red River Valley.

North draining rivers were blocked by the sheet of ice and the glacial melt left Glacial Lake Agassiz, at the time, the terminus of the Red River. As ice blocks melted to the north, Lake Agassiz drained leaving behind a nearly flat valley and thick beds of lake sediments and heavy layers of fine silt glacial till along the course of the once swollen rivers. The Red River now drains to part of what is left of the ancient lake, Lake Winnipeg. Thus marking the end of the Ice Age and the beginning of the Holocene Epoch, continuing to present time.

Headwaters:
Wahpeton, ND USA
Elv. 948ft

Mouth:
Lake Winnipeg, ON Canada
Elv. 712ft

Length: 320mi (1,689,600ft)

Width: 50mi (264,000)

Elevation Change: 233ft

REGIONAL HYDROLOGY // Red River Basin_North America_~45,000 sq mi

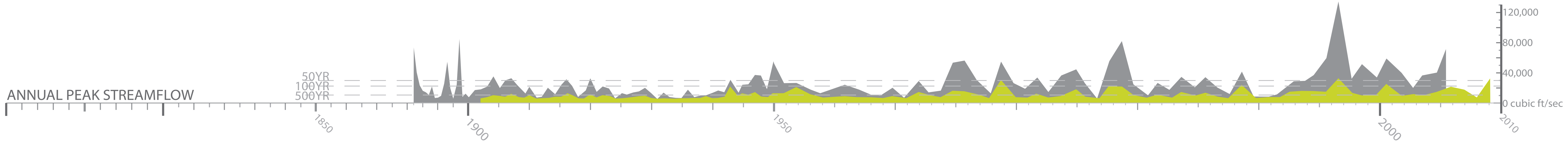
TALLGRASS PRAIRIE ECOSYSTEM

Location	Past area (ha.)	Current area (ha.)	**Decline (%)**
Manitoba	600,000	300	99.9
Minnesota	7,300,000	30,000-60,000	99.2-99.6
North Dakota	130,000	120	99.9

The Red River Valley is a young river valley in geologic terms. The river is a tributary of the Mississippi River, beginning at the confluence of the Ottertail and Bois de Sioux Rivers in Wahpeton, North Dakota and ending at Lake Winnipeg, Ontario.

Settlement of the area began in the 1800s with the expansion of the railroad. At the time, the land was a combination of thick sod and swamp. Fields were ploughed, drainage tiles put in, and ditches were constructed. The wet prairie grasses that once filtered and retained the water had been replaced by a landscape that encourages fast drainage from the field to tributaries of the Red River. With fast drainage comes increased water levels, increased water levels cause flooding.

This land cover change is not the only cause of increased water levels and discharge in the region. As the region's topography and climate prime the land to flood. Development, land use changes, and natural temperature cycles greatly increase the potential.



PRAIRIE/FLOOD CORRELATION OVER TIME

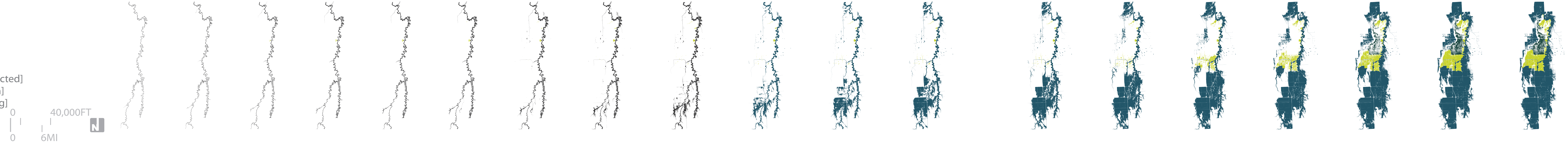
1800
One of the biggest wetland areas in the world was from Manitoba/Dakotas to Ontario/Ohio (McNeill, 2000)
settlement> *prairie grasses removed>>* *fields ploughed>>>*
landform > climate >> limited waterholding/slowing vegetative cover >>>

1870
drainage ditches>>>> *drainage tiles>>>>>*
impervious surfaces >>>> encouraged drainage >>>>>

1970>
American farmers drained 17 million hectares of wetland, United States drained half (McNeill, 2000)
increased runoff>>>>>>
upstream development >>>>>>

FLOOD PROGRESSION
flooding
ponding
protected
floodwall
levee [constructed]
levee [earthen]
levee [sandbag]

Channelization = fewer floods + invites people to settle in floodplains ∴ when it does flood causes = > damage + damages alluvial ecosystems ex. 1990_Mississippi had 26 dams 1993_flood $12 billion in damage



WET-MESIC ◂ · · · · · · · · · · · · · · · · ▸ WET

loam - silt - clay - sandy outwash
glacial till : alluvial deposits

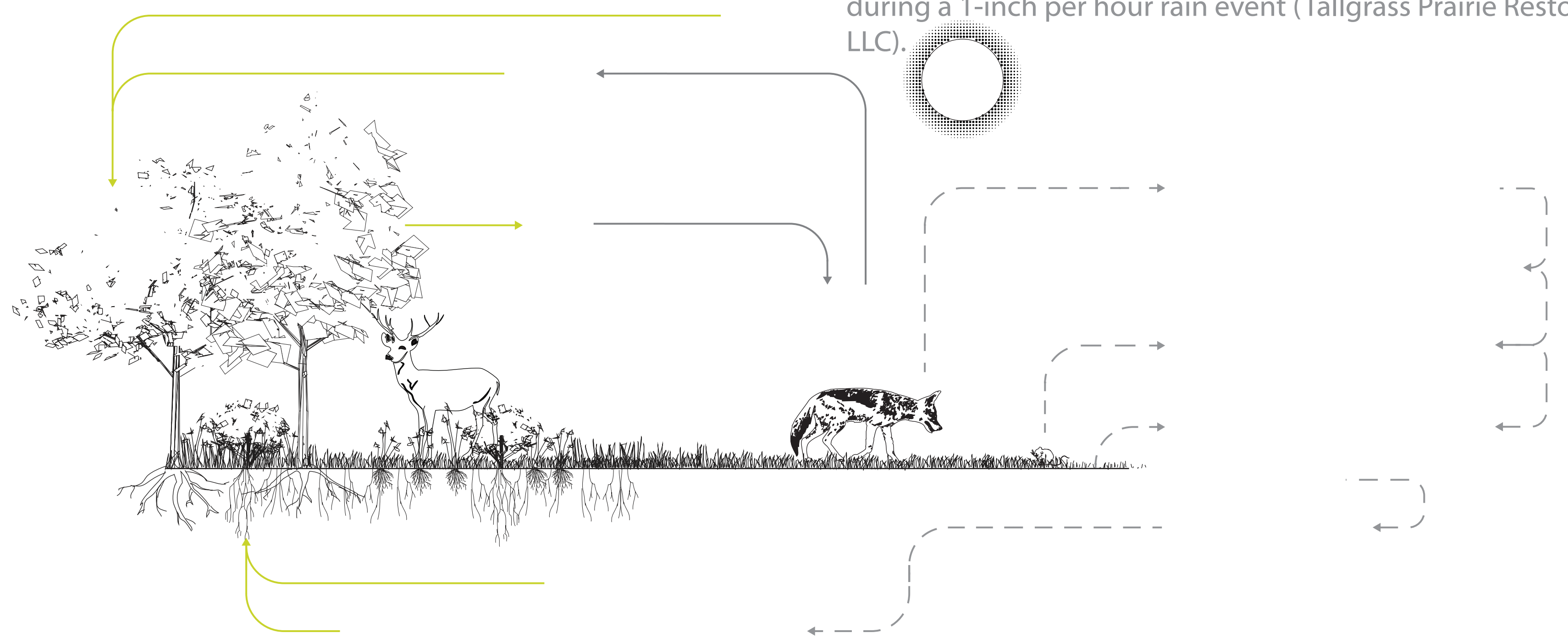
poorly drained
high groundwater table : gleying just below the A horizon
commonly ponded: winter, spring, after heavy rain

4-5yr fire regime

headwater streams
floodplains
shallow swales

Ecosystems
Ecosystems are recognized by differences in climatic regime. Climate is the source of solar radiation and moisture, acting as the primary control for the ecosystem (Smith & Smith, 2006). As this component changes, the other components change in response, like landform. Climatic effect changes with scale. Macroclimate is the climate just above the local modifying irregularities of landform and vegetation. Macroclimate defines major ecosystems. These major ecosystems are termed ecoregions.

Ecosystem components include the biologic community and the related flows of energy and nutrients make in their physical environment.



Furthermore, their deep roots help water infiltrate into the soil recharging our depleted groundwater stores. Sturdy prairie plants can even help stop erosion on slopes and shorelines. This not only prevents damage to your property, it also keeps silt from clogging our streams and rivers.

No other ecosystem in America removes as much carbon from the atmosphere as prairie grasslands (nps.gov, complex prairie ecosystem).

1 acre of established prairie can absorb 9 inches of rainfall per hour before runoff occurs, and will intercept as much as 53 tons of water during a 1-inch per hour rain event (Tallgrass Prairie Restorations, LLC).

BIODIVERSITY

"All nature is linked together by invisible bonds; every organic creature…is necessary to the well-being of some other" (Wellock, 2006).

Roughly 1 percent of the birds and mammals in existence in 1900 went extinct by 1995. Most modern extinctions occurred because of habitat loss, although some derived from hunting or predation by introduced species (McNeill, 2000).

Loss and fragmentation of prairie landscapes combined with changes in natural processes have had negative consequences for many grassland plants and associated animals. Many remnant prairie tracts were surrounded by agricultural grasslands until the 1950s. This helped support their natural structure and function (U.S. Fish & Wildlife Service, 2008). Few of these agricultural grasslands remain, causing fragmented prairie islands surrounded by row-crop fields and human development. Without proper management, these areas continue to degrade due to their size, isolation, absence of natural processes such as fire and hydrologic cycle maintenance, and inadequate buffers protecting them from surrounding agricultural and urban land uses. These islands are more vulnerable to pesticide drift and contamination, soil erosion, and general degradation (Tallgrass EA).

SITE INTEGRATION : DAKOTA TALLGRASS PRAIRIE WMA

In 2000 the US Fish & Wildlife Service enacted the Dakota Tallgrass Prairie Wildlife Management Area (WMA) Grassland Easement Program to preserve, help maintain biodiversity, and slow habitat fragmentation within the project boundary by clustering the 185,000 acres into 10,000 to 20,000 acre blocks of native tallgrass prairie in eastern North and South Dakota. Preservation was primarily through the purchase of perpetual grassland easements from willing sellers. The easements do not restrict grazing and permit haying after July 15th each year, but prohibit ploughing the prairie.

The Dakota Tallgrass Prairie Wildlife Management Area is managed as part of the National Wildlife Refuge System in accordance with the National Wildlife Refuge System Administration Act of 1966, Refuge Recreation Act of 1962 (Management and General Public Use of the National Wildlife Refuge System), National Wildlife Refuge System Improvement Act of 1997, and other relevant legislation, regulations, and policies. Conservation in Dakota Tallgrass Prairie Wildlife Management Area is consistent with the Prairie Pothole Joint Venture, North American Waterfowl Management Plan, Piping Plover Recovery Plan (USFWS 1988), Bald Eagle Recovery Plan (USFWS 1983), Whooping Crane Recovery Plan (USFWS 1994), American Burying Beetle Recovery Plan (USFWS 1991), Pallid Sturgeon Recovery Plan (USFWS 1993), and the Western Prairie Fringed Orchid Recovery Plan (1996). National Wildlife Refuge System uses grassland easements to enhance the survival of endangered and threatened species in the area while protecting and maintaining grassland and wetland habitat for migratory birds and other species of animals and plants.

The boundary of the Dakota Tallgrass Prairie WMA encompasses 2.1 million acres accounting for 80 to 90 percent of the remaining Northern Tallgrass Prairie, making the Dakotas essential to the preservation of the Northern Tallgrass Prairie ecosystem.

There are 300 species of plants, 113 butterflies, 35 reptiles and amphibians, 60 mammals, and 260 birds known to breed in or use tallgrass prairie habitat within the project boundary. According to the North and South Dakota Natural Heritage Programs, 237 species of plants and animals are considered rare within the project boundary, of those, 59 are threatened or endangered at the State level, 13 species are under consideration or listed as threatened and endangered at the Federal level. Fragmentation of habitat is thought to be one of the main causes of species decline.

The Nature Conservancy owns Brown Ranch, 1,500 acres of tallgrass prairie adjacent to the Sheyenne National Grasslands, 560-acre Pigeon Point Preserve in North Dakota, and nine preserves in South Dakota, which protect 3,400 acres of tallgrass prairie subtypes.

U.S. Department of Agriculture, Natural Resources Conservation Service has programs in North and South Dakota aimed at conserving tallgrass prairie rangeland resources. Both states have the Environmental Quality Incentives Program, which provides farmers and ranchers with information and resources for grazing systems, water development projects and educational programs. The Sheyenne River Basin has been identified as a priority area for this program. The Conservation Reserve Program has Conservation Practice 2 or CP2 under which highly erodible cropland is planted with a mixture of native grasses for 10 to 15 year contracts. Approximately 112,000 CP2 acres are within the WMA.

U.S. Forest Service manages the Sheyenne National Grasslands, the largest contiguous block of tallgrass prairie in North Dakota, with 70,000 acres.

Ducks Unlimited is working with the Tewaukon Wetland Management District in southeastern North Dakota to enhance waterfowl habitat that includes the protection of approximately 13,000 acres of habitat.

silt - clay loam
glacial till : alluvial deposits

saturated > a few days a normal year
high groundwater table
soil waterlogged within root zone for
extended periods during growing season

fire,
periodic prolonged flood events

"In a state indelibly linked to prairie lands, remarkably less than one tenth of one percent of all tallgrass prairie in North Dakota lies intact. Nationwide, just one percent remains. No other major ecosystem on the North American…has been so fully altered by people" (Domek, 1998).

In the 1800s settlement grew in the Red River Valley and the tallgrass prairie was ploughed into agricultural production (Domek, 1998). Most of the tallgrass prairie in the United States was converted to agricultural use during the last 60 to 70 years of the 1800s (Smith, 1992). As settlers became more familiar with the open prairies, there was an increased awareness of negative factors associated with prairie settlement, prairies fires, the tough, heavy, sod, formed from intertwined roots of the prairie plants, the low, marshy, and poorly drained soils. Soon they were stopping prairie fires, ploughing through the deep roots, and developed artificial drainage networks that lowered ground water throughout the central United States, destroying most of the valuable breeding ground of migratory birds (Domek, 1998) (Smith, 1992). Pasture lands on the periphery marginal soils, also had a hand in the destruction of the prairie ecosystem as stock tends not to migrate when an area is depleted (Brooks, 2011).

The rich, deep loamy soils left by glacial deposit combined with an extensive man-made drainage network to remove surface water, enabled the Red River Valley to become one of the most productive agricultural regions within the Great Plains (Domek, 1998). Two hundred and forty million acres of tallgrass prairie were converted to agricultural land in about seventy years. "Apparently the nineteenth century settlers were not aware that an entire ecosystem was being obliterated. Perhaps there was just too much; abundance tends to create an illusion of limitlessness" (Brooks, 2011).

Natural forces of disturbance regimes, like drought, fire, and grazing have combined to form what we know as prairies. Prairie is a general term for several types of grass-dominated ecosystems. It is grassland dominated by herbaceous plants, with trees either absent or only widely scattered on the landscape (U.S. Fish & Wildlife Service, 2008). Prairies receive variable amounts of precipitation and may have several years of drought, or below average precipitation.

BIRDS
summer breeding/
migration route/
yearround

blackpoll warbler Dendroica striata
Common loon Gavia immer
horned grebe Podiceps auritus
Bohemian waxwing Bombycilla garrulus
American coot Fulica Americana
American wigeon Anas Americana
American goldfinch Carduelis tristis
American bittern Botaurus lentiginosus
American redstart Setophaga ruticilla
Baird's sparrow Ammodramus bairdii
black tern Chlidonias niger
black-crowned night heron Nycticorax nycticorax
blue-winged teal Anas discors
bobolink Dolichonyx oryzivorus
burrowing owl Athene cunicularia
common yellowthroat Geothlypis trichas
Cooper's hawk Accipiter cooperii
dickcissel Spiza Americana
downy woodpecker Picoides pubescens
evening grosbeak Coccothraustes vespertinus
gadwall Anas strepera
grasshopper sparrow Ammodramus savannarum
greater prairie-chicken Tympanuchus cupido
killdeer Charadrius vociferus
kingbird Tyrannus spp.
Lapland longspur Calcarius lapponicus
lark bunting Calamospiza melanocorys
least tern Sterna antillarum
loggerhead shrike Lanius ludovicianus
mallard Anas platyrynchos
marbled godwit Limosa fedoa
marsh wren Cistothorus pallustris
mourning dove Zenaida macroura
northern harrier Circus cyaneus
northern pintail Anas acuta
northern shoveler Anas clypeata
olive-sided flycatcher Contopus cooperi
orange-crowned warbler Vermivora celata
osprey Pandion haliaetus
pine grosbeak Pinicola enucleator
piping plover Charadrius melodus
red crossbill Loxia curvirostra
red-headed woodpecker Melanerpes erythrocephalus
red-winged blackbird Agelaius phoeniceus
redhead Aythya americana
ring-billed gull Larus delawarensis
sedge wren Cistothorus platensis
short-eared owl Asio flammeus
snow bunting Plectrophenax nivalis
Sprague's pipit Anthus spragueii
Swainson's hawk Buteo swainsoni
upland sandpiper Bartramia longicauda
veery Catharus fuscescens
Virginia rail Rallus limicola
western meadowlark Sturnella neglecta
white-winged crossbill Loxia leucoptera
white-faced ibis Plegadis chihi
whooping crane Grus americana
willet Catoptrophorus semipalmatus
Wilson's phalarope Phalaropus tricolor
yellow warbler Dendroica petechia
yellow rail Coturnicops noveboracensis
yellow-bellied sapsucker Sphyrapicus varius
yellow-rumped warbler Dendroica coronata

FLOURA

INVERTEBRATES	American burying beetle	*Nicrophorus americanus*
	Dakota skipper	*Hesperia dacotae*
	Powesheik skipperling	*Oarisma poweshiek*
	Regal fritillary	*Speyeria idalia*
FISH	Brook Stickleback	*Culaea inconstans*
	Creek chub	*Semotilus atromaculatus*
	Fathead minnow	*Pimephales promelas*
	Johnny darter	*Etheostoma nigrum*
AMPHIBIANS/ REPTILES	Blanchard's cricket frog	*Acris crepitans blanchardi*
	Cope's gray treefrog	*Hyla chrysoscelis*
	Northern redbelly snake	*Storeria o. occipitomaculata*
	Plains garter snake	*Thamnophis radix*
	Prairie skink	*Eumeces septentrionalis*
	Snapping turtle	*Chelydra serpentina*
	Spiny softshell	*Trionyx spiniferus*
	Tiger salamander	*Ambystoma tigrinum*
MAMMALS	Deer mouse	*Peromyscus maniculatus*
	Eastern cottontail	*Sylvilagus floridanus*
	White-tailed jackrabbit	*Lepus townsendii*
	Plains pocket gopher	*Thomomys talpoides*
	Plains pocket gopher	*Geomys bursarius*
	American badger	*Taxidea taxus*
	Elk	*Cervus elaphus*
	American bison	*Bison bison*
	Coyote	*Canis latrans*
	Franklin's ground squirrel	*Spermophilus franklinii*
	Gray fox	*Urocyon cinereoargenteus*
	Jumping mice	*Zapus spp.*
	Meadow jumping mouse	*Zapus hudsonius*
	Least weasel	*Mustela nivalis*
	Little brown myotis	*Myotis lucifugus*
	Long-tailed weasel	*Mustela frenata*
	Meadow voles	*Microtus pennsylvanicus*
	Mink Mustela vison	*mink Mustela vison*
	Mule deer	*Odocoileus hemionus*
	Muskrat	*Ondatra zibethicus*
	Prairie vole	*Microtus orchrogaster*
	Red fox	*Vulpes vulpes*
	Richardson's ground squirrel	*Spermophilus richardsonii*
	Striped skunk	*Mephitis mephitis*
	Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
	White-tailed deer	*Odocoileus virginianus*

	WET		MESIC	
GRAMINOID	Big Bluestem	*Andropogon gerardi*	Big Bluestem	*Andropogon gerardi*
	Prairie Cordgrass	*Spartina pectinata*	Prairie Dropseed	*Sporobolus heterolepis*
	Mat Muhly Grass	*Muhlenbergia richardsonis*	Indian Grass	*Sorghastrum nutans*
	Narrow Reedgrass	*Calamagrostis stricta*	Little Bluestem	*Schizachyrium scoparium*
	Wooly Sedge	*Carex pellita*	Prairie Cordgrass	*Spartina pectinata*
	Switchgrass	*Panicum virgatum*	Kalm's Brome	*Bromus kalmii*
			Switchgrass	*Panicum virgatum*
			Porcupine Grass	*Stipa spartea* (important on drier sites)
FORB	Prairie Loosestrife	*Lysimachia quadriflora*	Northern Bedstraw	*Galium boreale*
	Northern Bedstraw	*Galium boreale*	Purple Prairie Clover	*Petalostemon purpureum*
	Tall Meadow Rue	*Thalictrum dasycarpum*	Canada Goldenrod	*Solidago canadensis*
	Wild Strawberry	*Fragaria virginiana*	Heath Aster	*Aster ericoides*
	Golden Alexanders	*Zizia aurea*	Rigid Goldenrod	*S. rigida*
	Black-eyed Susan	*Rudbeckia hirta*	Maximilian Sunflower	*Helianthus maximiliani*
	White Camas	*Zigadenus elegans*	Heart leaved Golden Alexander	*Zizia aptera*
	New England Aster	*Symphyotrichum novae-angliae*	Black-eyed Susan	*Rudbeckia hirta*
	Sawtooth Sunflower	*Helianthus grosseserratus*	Tall Meadow Rue	*Thalictrum dasycarpum*
	Cowbane	*Oxypolis rigidior*	Smooth Aster	*Aster laevis*
	Mountain Mint	*Pycnanthemum virginianum*	Wild Strawberry	*Fragaria virginiana*
	Culver's Root	*Veronicastrum virginicum*	White Camas	*Figadenus elegans*
			Mountain Mint	*Pycnanthemum virginianum*
SHRUB	Slender Willow	*Salix petiolaris*	Golden Alexanders	*Zizia aurea*
	American Willow	*Salix discolor*	Harebell	*Campanula rotundifolia*
			Wild Bergamot	*Monarda fistulosa*
TREE	Silver Maple	*Acer saccharinum*	Flodman's Thistle	*Cirsium flodmanii*
	Elm	*Ulmus Americana*	Hoary Puccoon	*Lithospermum canescens*
	Cottonwood	*Populus deltoides*	Stiff Sunflower	*Helianthus rigidus*
	Willow	*Salix alba*	Rough Blazing Star	*Liatris aspera*
			Pale Spiked Lobelia	*Lobelia spicata*
			Wood Lily	*Lilium philadelphicum*
			Prairie Onion Allium	*Allium stellatum*
			Wild Licorice	*Glycyrrhiza lepidota*
			Smooth Rattlesnake-root	*Prenanthes racemosa*
			Grass-leaved Goldenrod	*Solidago graminifolia*
			Wood Betony	*Pedicularis canadensis*
			Indian Paint Brush	*Castilleja coccinea*
			Downy Phlox	*Phlox pilosa*
			White Prairie Clover	*Dalea candidum*
			White Sage	*Artemisia ludoviciana*
SEMI-SHRUB			Prairie Rose	*Rosa arkansana*
			Fragrant False Indigo	*Amorpha nana* (common on moister sites)
			Leadplant	*Amorpha canescens* (shrub/legume)
SHRUB			Canada Wildrye	*Elymus canadensis*
			Compass Plant	*S. lacinatum*
			Fringed Gentian	*Gentianopsis crinata*
			Prairie Panic Grass	*Panicum leibergii*
			Sawtooth Sunflower	*Helianthus grosseserratus*
			Pale Purple Coneflower	*Echinacea angustifolia* (common on drier sites)
			Prairie Bird-foot Violet	*Viola pedatifida*
			Alumroot	*Heuchera richardsonii*
			Prairie Cinquefoil	*Potentilla arguta*
			Missouri Goldenrod	*S. missouriensis*
			Bicknell's Sedge	*Carex bicknellii*
			Rattlesnake Master	*Eryngium yuccifolium*

FAUNA

FIRE

Fire played a large role in the formation of the prairies. It is a natural component of the tallgrass prairie and is fundamental in its function. Typically, natural prairie fires are started by lightning, sweeping across the plains approximately every 3-5 years and most commonly in mid- to late-summer (Hays, 1994). Fires reduce plant litter and curb the growth of trees, shrubs, and other competing species, except along shorelines. Fires recycle essential minerals and nutrients into the soil, enabling prairie grasses to establish and flourish with diverse, healthy plant growth ("Tallgrass prairie ecosystem"). Most of the biomass of prairie plant species is found below ground with deep root systems that anchor to the soil and access moisture deep underground. This extensive root system allows quick recovery after burning. These prairie plants and prairie animals have evolved with the fire, some species thriving after a burn. The natural decomposition of these plants, in particular their root systems, along with burning adds layers of organic matter to the soil creating a rich, black top soil ("Tallgrass prairie ecosystem").

Historically, Native Americans used fire in the tallgrass prairies to attract grazing animals and provide natural firebreaks around their settlements (Hays, 1994).

GRAZING

Grazing is a natural component of tallgrass prairie ecosystems. An estimated 30-60 million bison roamed the prairies, along with astounding numbers of other browsers such as elk, deer, antelope, rabbits and grasshoppers that thrive on the nutritious prairie grasses (U.S. Fish & Wildlife Service, 2008). These species consumed a considerable amount of the above ground biomass. Grazing stimulates the growth of many plants and animals by recycling nitrogen through urine and feces. It aids in the dispersal of seed, distributing those caught in their hair or passed through their waste. Many plants have seeds that must be digested or broken open to allow germination. Animals also aid germination by trampling them into the soil this trampling also opened up habitat for plant species that favor disturbed soil, such as some forbs. In these ways, the prairie plants and animals form a symbiotic relationship ("Ecoregions of north," 2006).

Prior to European settlement, grazing the tallgrass prairie was primary by large herbivores such as bison, elk, and deer. Settlement converted these areas to pasture for cattle. Cattle grazing can mimic previous grazing and has been used as a part of tallgrass management to help conserve and restore tall grass prairie areas ("Tallgrass prairie ecosystem"). However, overgrazing can also be detrimental. Increased grazing can lead to invasion by annual species, soil erosion and severely decrease species diversity ("Tallgrass prairie ecosystem").

HYDROLOGY

flooding

water quality
water supply

aquifer recharge

eutrophication

69% of fresh water is locked up in ice caps and glaciers, 98% of the remaining lies in underground aquifers, mostly at inaccessible depths. Only 1-quarter of 1% of the world's fresh water is in lakes and rivers (McNeill, 2000). Cities face the problems of procuring adequate drinking water and getting rid of, or diluting, wastes.

WATER SUPPLY

Fargo	Red River		
West Fargo	West Fargo Aquifer	415 bgals	buried
Moorhead	Buffalo Aquifer	250 bgals	surficial

The "sustainable and effective management of water resources demands a holistic approach - linking socioeconomic development with the protection of natural ecosystems and appropriate management links between land and water uses" (World Meteorological Organization, 2011). A river basin is a dynamic system in which there are many interactions between land and water bodies. Therefore when problems arise, it is necessary to look at the functioning of the river basin as a whole rather than simply fixing local problems (World Meteorological Organization, 2011).

The Bureau of Reclamation did a report stating in the event of a drought the area could not sustain its water supply both West Fargo and Moorhead have planned to pipe in water from other stores. As you can see by the water loss chart below, it would be far more efficient to reconstruct tallgrass prairie wetlands to aid in recharging the aquifers.

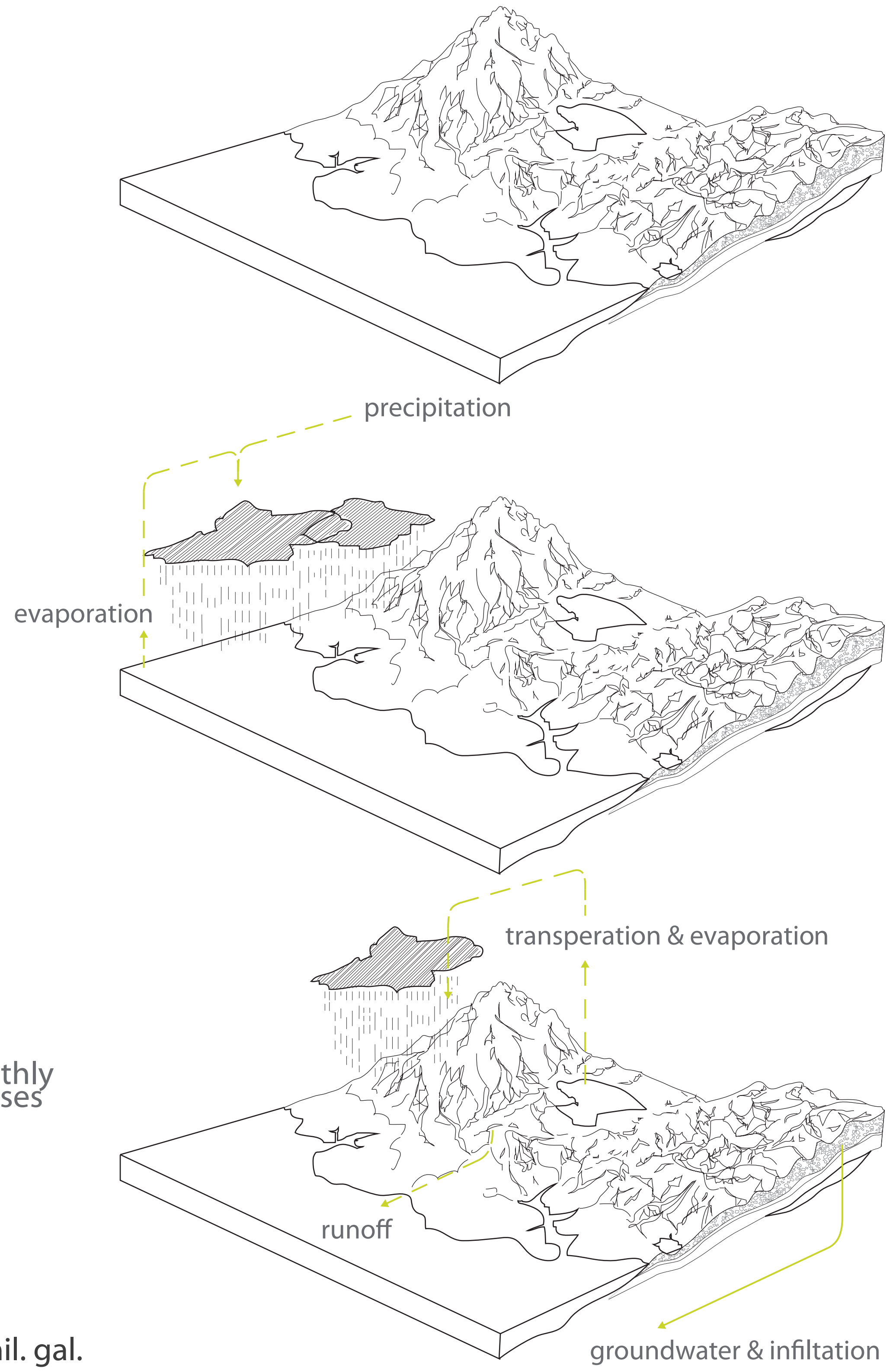
These water losses are attributed to pipe leaks>>

Distance transport suggested by the Red River Valley Water Supply Project would be far more expensive in losses and construction than acquiring land for a high performance 'Wetland Recharge' landscape.

Bureau of Reclamation's solutions range:

$28,240,000 - 150,711,000

	ave. monthly water use	ave. monthly water losses
FARGO		
1996	440	120.1
1997	326	49.6
1998	421	12.3
1999	361	39.3
2000	420	29.9
2001	415	21.1
total	~2383	~366.4 mil. gal.



04 | RESEARCH HYDROLOGY

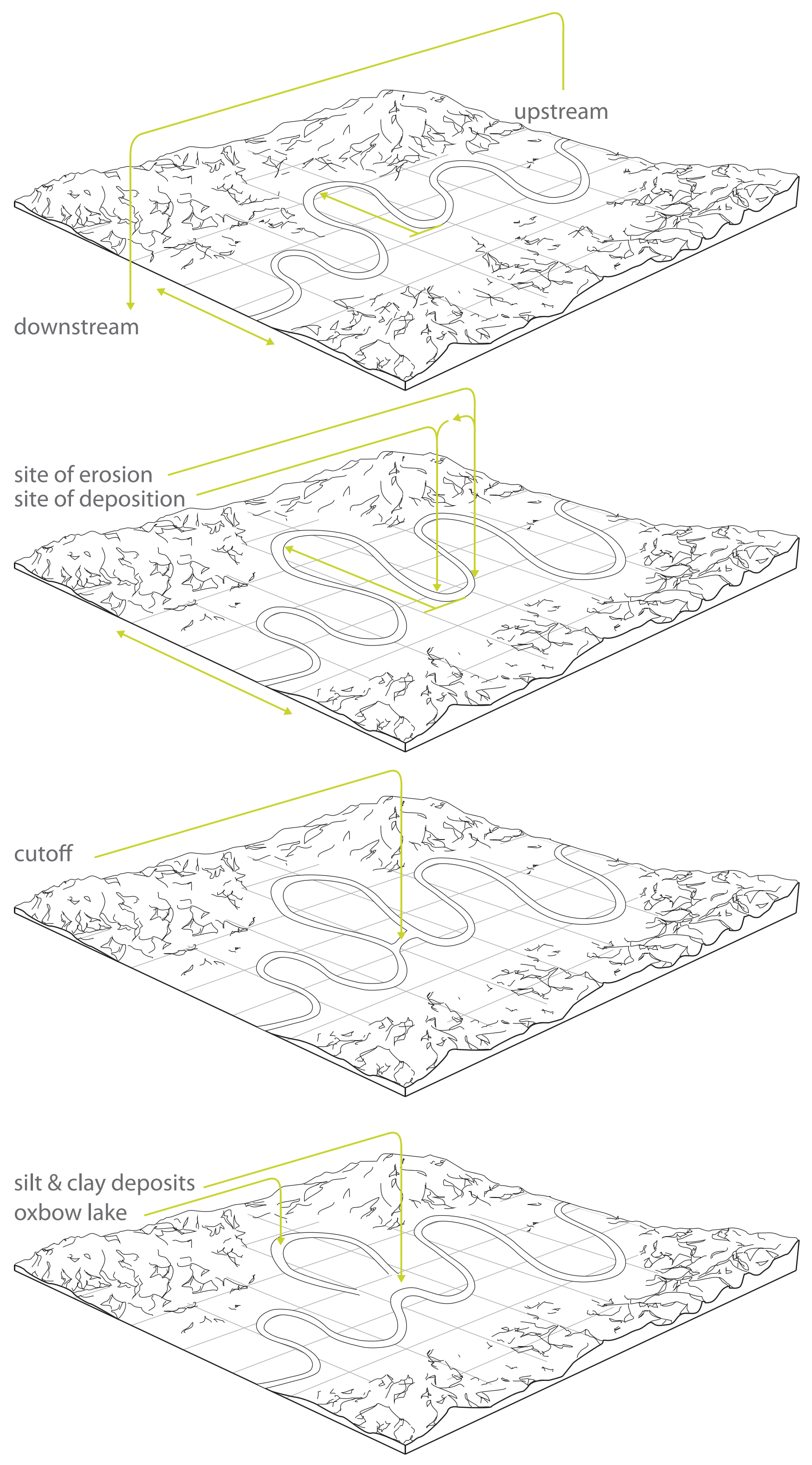
Landform

Water moves downhill at a rate to meet its base level. The base level is the lowest point to which a stream can erode. This point is the where the mouth enters another body of water, in this case, Lake Winnipeg. At this point the velocity of the river approaches zero, therefore its ability to erode ceases. Any change in base level causes a corresponding adjustment of stream activities.

The Red River's average gradient change averages 0.5 to 1.5feet per mile (Schoeneberger, 2010) and rises only two or three feet a mile for the first 10 to 15 miles on either side of the river (World Meteorological Organization, 2011). This elevation change is so slight it is not perceivable to the naked eye. The broad flat valley structure develops bends and meanders. When there are changes in the base level, the flow of the river changes. If the base level is lowered the river moves faster. The faster velocity carries sediment to the lake and cuts its channel deeper. If the base level is raised, the velocity slows down dropping sediment at its bend and meanders, expanding its channel. This will cause what people term 'overbank flooding', however it is actually just the simple natural process of a river balancing its flow and adapting.

As the river moves down stream more and more tributaries contribute to the main channel, therefore discharge increases. Moving down the stream, the stream's width, depth, and velocity change in response to the increased volume of water, which commonly leads to a larger, wider, deeper channel downstream (Lutgens & Tarbuck, 2005).

When people start messing with the structure of the river upstream, it effects what happens downstream.



WEATHER

spring

The Red River flows to the north, with the onset of spring, the southern portion of the basin has thawed while the northern portion remains frozen. This backs up the waterway from draining.

Above-average amounts of precipitation in the fall can produce high levels of soil moisture. With the onset of winter, the ground freezes limiting infiltration of runoff during snowmelt. Above-average winter snowfall in the basin, above-average precipitation during snowmelt, and above-average temperatures during snowmelt can cause increased spring water levels.

summer

In summer increased water levels can be attributed to above-average precipitation in the same area over a short duration. This saturates the ground and increases runoff. Limited vegetative cover and increased impervious surfaces plus lack of vegetative cover leads to less absorption of water and more runoff.

LANDCOVER

One of the reasons Mississippi floods were hard to manage was the draining of wetlands, which buffered floods (McNeill, 2000). Draining wetland is probably almost as old as agriculture. Until the 1960s almost no one thought a wetland was useful. In the 1800s one of the bigger wetland areas in the world was in North America, from Manitoba and the Dakotas to Ontario and Ohio (McNeill, 2000). Most of this expanse was waterlogged and impossible to farm. Locals drained the swamps, digging and dredging drainage ditches and after 1870, prairie farmers resorted to tile drains (ceramic tubes that carried water underground to the nearest stream). By 1970 American farmers drained 17 million hectares providing the United States with some of its best farmland, creating the cornbelt and obliterating wildlife (McNeill, 2000). About a third of the endangered species in the United States make their homes in wetlands. In the world, over the 1900s, people drained 15% of 10 million square kilometers of wetlands. The United States drained half its wetlands (McNeill, 2000).

LAND USE CHANGE

As discussed in other sections, agriculture and development can increase flooding and lead to changes in the water cycle.

HYDROLOGICAL PROBLEMS

flooding

water quality
water supply

aquifer recharge

eutrophication

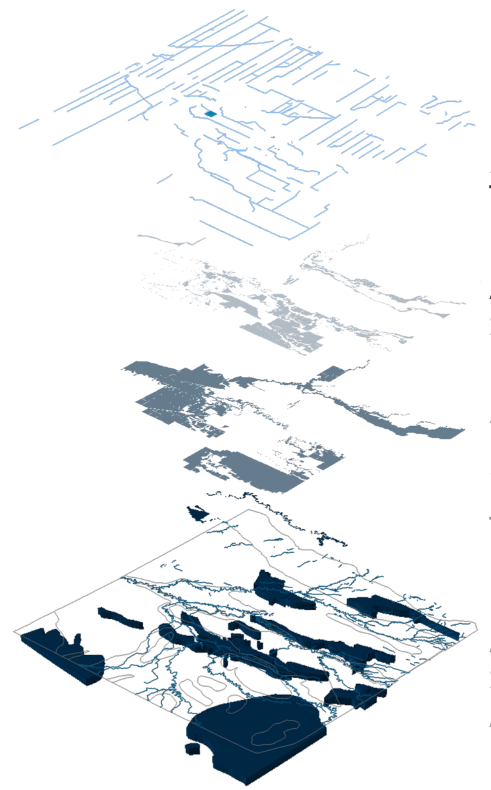
1 acre of established prairie can **absorb 9" of rainfall/hr** before runoff occurs, and will intercept as much as **53 tons of water** during a 1-inch per hour rain event (Tallgrass Prairie Restorations, LLC).

In IL, est. percentage increase in wetland area reduces downstream peak flows 3.7% average flood flows 1.4%. Study of sub-watersheds of the Mississippi River found: **deep wetlands reduce flood peaks 1-23%, shallow wetlands 5-9%.**

In Minnesota, wetland restoration costs range $95 -30,000 per acre

.·. restoring the entire acreage of Fargo to wetland would cost half as much as the proposed diversion

TALLGRASS PRAIRIE ECOSYSTEM



RED RIVER
Whapeton, ND USA — Elv. 948
Lake Winnipeg, ON Canada — Elv. 712
Elv. Change 223ft

FLOOD

base	34103
prelim	285
brkout	3269
100yr	70401
500yr	34102
total	142160 acres

Annual Fargo-Moorhead metropolitan flood damages est. **$194.8 million**

2011 Fargo submitted **FEMA** claims of **$5.9 million**. This is not a Federal problem and should not grant federal aid. This is an annual issue that locals need to solve, financed out of their own community for choosing to live in a floodzone

Army Corps of Engineers flood solutions range:
$1,032 - 1,462 million
All alternatives consist of a **>24 mile ditch** often concrete

Rochester, MN solved a similar problem with a park system and limited hard infrastructure for **$140 million**

DATASTREAM>>>

drainage ditches_cass	31.97
drainage ditches_clay	1033.09
total	135.6 miles

classified as threatened
ammonia
biological oxygen demand
dissolved oxygen
fecal coliform bacteria
sulfate concentration

agricultural chemicals
Atrazine:
average annual use:
2.152-9.855 lbs/sq. mi

lethal:750 mg/kg in rabbits

Endosulfan:
average annual use 0.26 lbs/sq. mi
lethal: 35 mg/kg in humans

The United State pays around $20 billion/year in Agricultural subsidies. Agricultural subsidies are argued necessary for National Emergency, however, wind and flood erosion in the area removee the nutrient rich topsoil formed by the prairie fire regime, requiring increasing dependence on fertilizers, in turn further contaminating waterways. Therefore, it would be more beneficial to convert the land back to prairie to rebuild the mineral and nutrient rich topsoil that makes for good agriculture.

conventional infrastructure

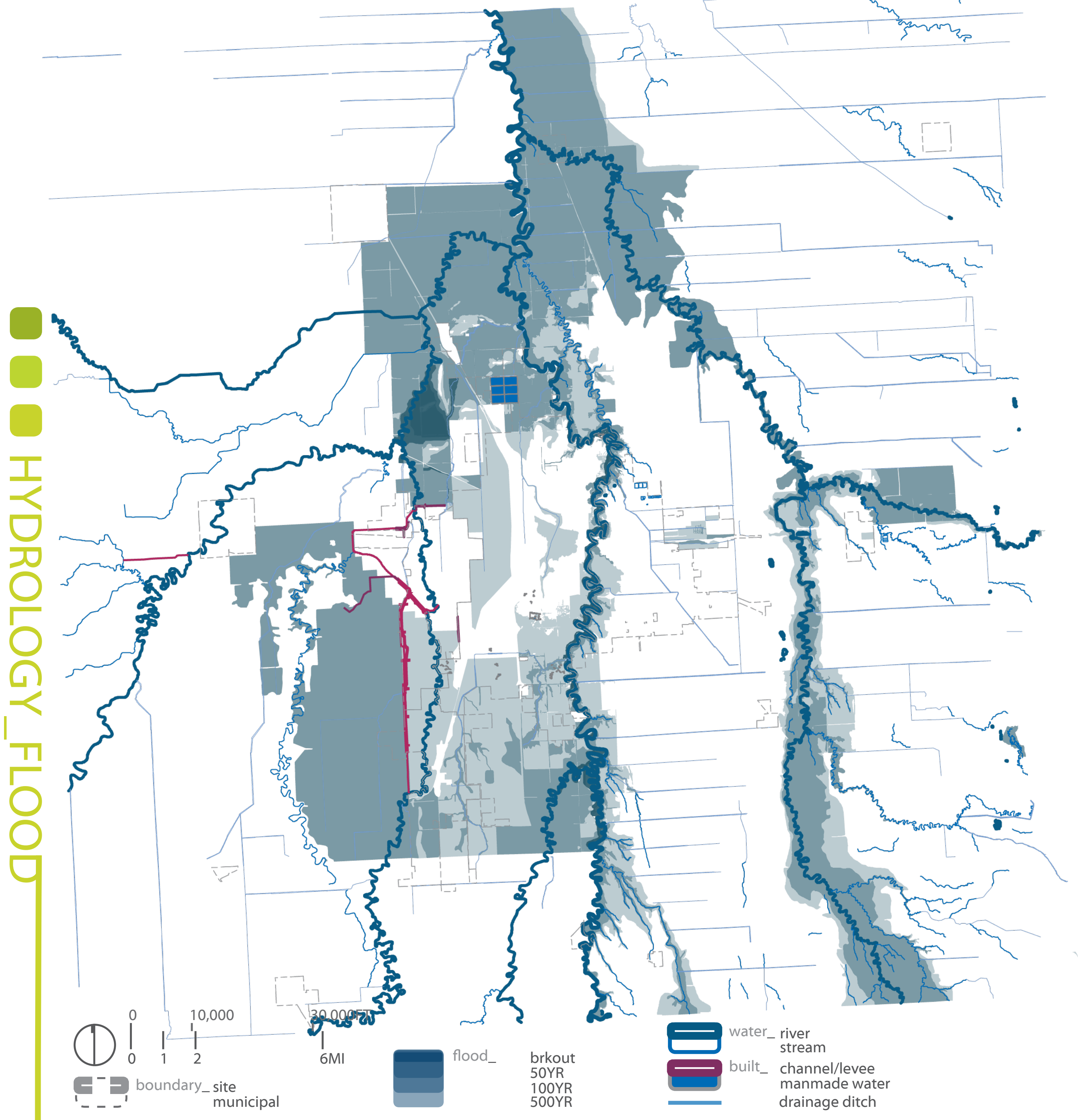
Diversions and dams account for the most important physical changes in the world's cycling of fresh water (McNeill, 2000). The point of river channelization is to tame floods, ease navigation, and farm fertile bottomlands. It is expensive because it involves building a channel for wayward rivers, confining waste to that channel, and keep them out of the floodplains. About 6 to 7 percent of the US rivers flow between man-made banks today (McNeill, 2000).

Throughout the 1800s communities tried to deflect floodwaters onto their neighbours. After a massive flood in 1927 the US Army Corps of Engineers authorized levees on almost the entire lower half of the Mississippi river, connecting local ones into one system of levees, dams and reservoirs that would in theory confine the river to a single channel. By 1990 the Mississippi have 26 dams (the Missouri had 60). But in 1993 a flood still cost $12 billion in damage (McNeill, 2000). Channelization meant fewer floods, but it invites people to settle in floodplains. The result is when it does flood it causes far greater damage. Channelization affected alluvial ecosystems. It cut the main branch of the Mississippi off from its previous banks, oxbows, and floodplains. Aquatic life lost its spawning grounds, the river's fish catch dropped dramatically, freshwater mussels, which used to filter river water and reduce pollution, declined and several species went extinct (McNeill, 2000).

eutrophication

When nitrogen and phosphorous become available then aquatic plants and bacteria (algae blooms) grow abundantly. When they die, their decomposition consumes oxygen, which then becomes unavailable for other aquatic life, resulting in suffocation. Algae blooms can also render water unfit for drinking. Excessive nitrogen and phosphorous usually come from urban sewage and chemical fertilizers from agricultural runoff (Smith & Smith, 2006).

HYDROLOGY_FLOOD



04 | RESEARCH GEOLOGY

GEOLOGICAL PROBLEMS

deformation
mass wasting
slope instability

development
vegetation

meanders
mass wasting
slope instability
erosion

stabilization
economics

structural instability

soils

Considerable engineering and environmental geologic problems form from the nature of the sediments and stratigraphic relationships of offshore lacustrine Sherack and Brenna Formations. Four specific geologic conditions are present within the area: elastic deformation of clay glaciolacustrine soils, shrink-swell properties, inadequate bearing capacity, and mass movements. The results are foundation instability and riverbank erosion and instability.

Plastic deformation, nonreversible changes of shape in response to applied forces, of clay rich soils of the Sherack and Brenna Formations occurs across the majority of the area. Where unconfined the high plasticity leads to slope instability. Channels of the Red River and tributaries incise across where the Sherack and Brenna Formations contact, this leads to weak structural properties and therefore extensive mass wasting (a geomorphic process in which geological structure moves downslope under the force of gravity). Examples are prevalent along the valley walls and channel margins throughout the valley.

The development of meanders is a natural process of rivers. Higher velocity of water through a meander is diverted toward the outside of the meander. This process retreats the cutbank by erosion and mass wasting, shifting the channel toward the outside of the meander. Seasonal flooding amplifies the process. The repeated fluctuation of water levels results in a cycle of wetting and drying soils, producing structurally weak banks. Evidence of the river's shifting channel are the parklands of eastern Fargo (Mickelson Field, "Elephant" Park, Trollwood Park, El Zagal Golf Course, Lindenwood Park, etc.) developed on abandoned meander loops. Development in these areas has led to expensive property losses, often at taxpayers' expense.

The Sherak and Brenna Formations have sufficient strength to support low-load buildings, but are incapable of supporting larger load structures, such as high rises, water towers, bridge supports, etc. High-load structures are supported by concrete piers (caissons) or steel pilings that transmit structural weight to firmer sediment material of glacial till at depths of 100ft or greater. For instance, the FargoDome rests on 240ft or greater caissons, some with diameters greater than 5ft. The Fargo Water Treatment Plant on 300ft caissons. Even the skywalks downtown are supported by caissons.

Caissons are constructed by massive augers boring through the weak clay strata, temporary iron casings placed in the hole to keep it open, a cage of steel rod is placed into the cased hole, and cement is poured in, as the cement is poured casings are lifted out. The cement solidifies to concrete and this steel-reinforced concrete caisson is set to support I-beams and other supports for a high-load bearing structure.

This structural necessity increases the cost of living in the area. While, it is too late to change the path of history suggesting this was not an appropriate place to habitat in the first place, for this among other reasons, it proves the additional need for appropriate and strategic city planning.

DEFORMATION

Development// Developmental structure adds weight, increasing pressure on soils. Impermeable surfaces increase stormwater runoff and therefore soil hydration. Irrigation and septic systems add extra weight and excessive water. The resulting soil saturation decreases strength of already weak soil structure. This leads to accelerated slope slumping.

Vegetation// Commonly with development, deep-rooted, native vegetation along the bank is replaced with shallow-rooted vegetation, such as lawn. Deep roots help hold soil like a mesh adding structural strength while shallow roots of turf grass provide little soil stability. In addition, trees and deep-rooted vegetation aid in water removal from soils while shallow rooted vegetation allows increased saturation adding weight, furthering slope failure.

Stabilization Techniques// Attempts to stop slumping have typically proven unsuccessful. Techniques have included lime stabilization and homeowner constructed retaining walls. Often slumping is misdiagnosed as erosion, in which riprap, concrete, or other materials are placed on the slope, the added weight of which accelerates slumping. Engineered techniques such as riprap or sheet piling typically require application to large stretches of the riverbank to be successful. The design and construction of these techniques are costly and most often cost prohibitive.

Mass wasting induced damages to infrastructure has cost taxpayers millions of dollars, as property owners make claims forcing taxpayers to foot the bill of property buyouts. These damages are largely avoidable given proper zoning and planning. Many properties and houses currently bordering the river are susceptible of failing due to unstable slopes.

MEANDERS

While dams seem an effective structure at reducing mass wasting rates, dam construction is expensive, they have a negative impact on both marine and terrestrial habitat, they inhibit the development of recreational uses on the river, and can negatively impact water quality.

There is a large consensus among geologists and engineers that a river has the need to meander and therefore such engineering projects are not the solution.

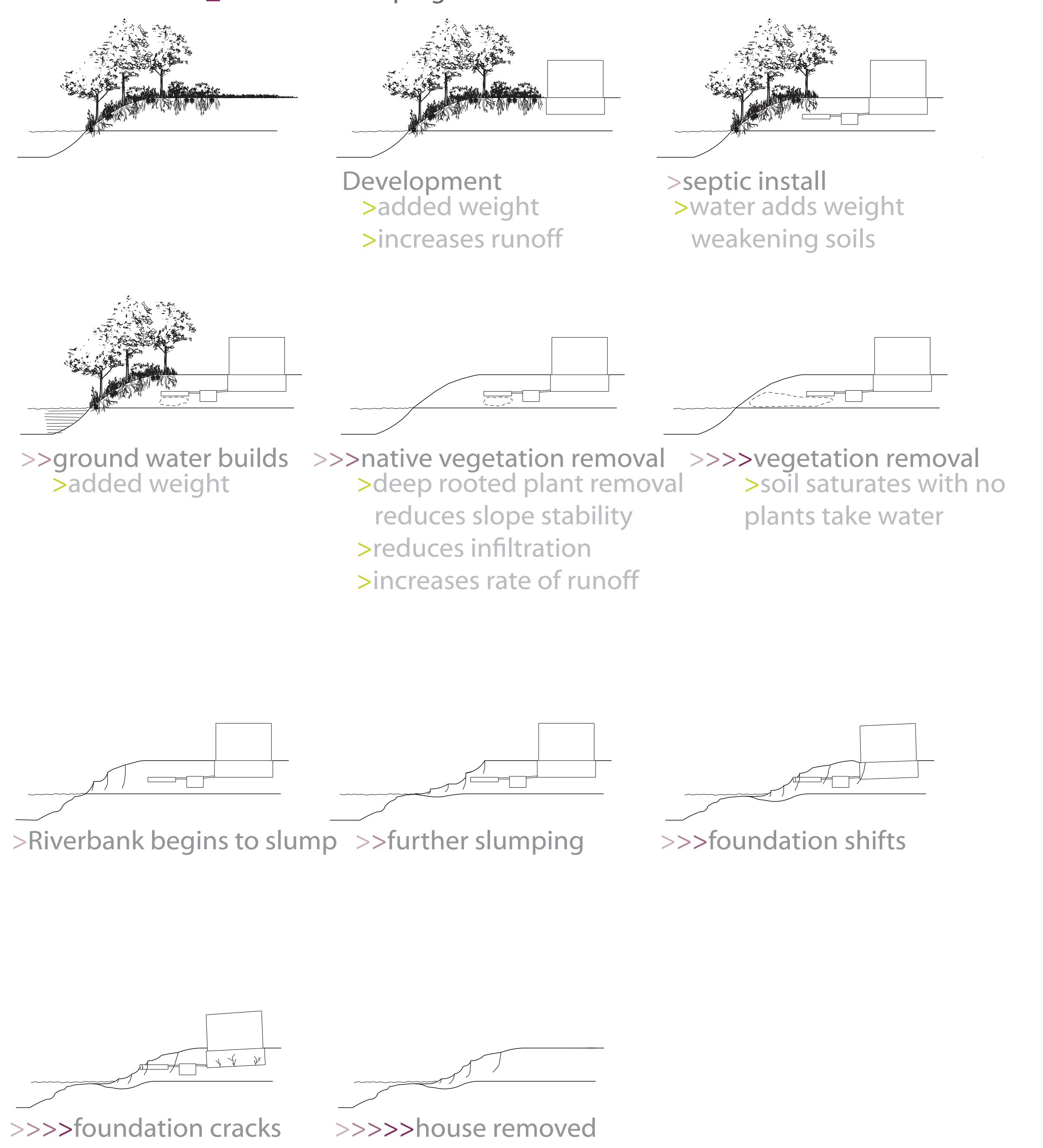
Over the years, failure of many slope stabilization structures has been related to not addressing the basic processes inducing mass wasting.

While not particularly aesthetic in appearance, one of the more successful and expensive approaches is the dike east of the V.A. Hospital in north Fargo. Positioned above the weak cutbank slope, the prior earthen dike failed. Sheet piling was then used to serve as the dike. The sheet piling dike is relatively low load compared to the earthen dike. The sheets were driven to depths where they remain stable.

In 2001, the city and Corps of Engineers shared expenses in installing riprap at vulnerable locations. Whether this technique (costing $1 million in taxpayer funds for three locations) is effective remains to be seen: the riprap is a high load material and is placed on weak, unconfined sediments. The quality of its aesthetic appearance and effect on riparian habitats are arguable.

< HYDROLOGY_DRAINAGE

MASS WASTING _riverbank slumping

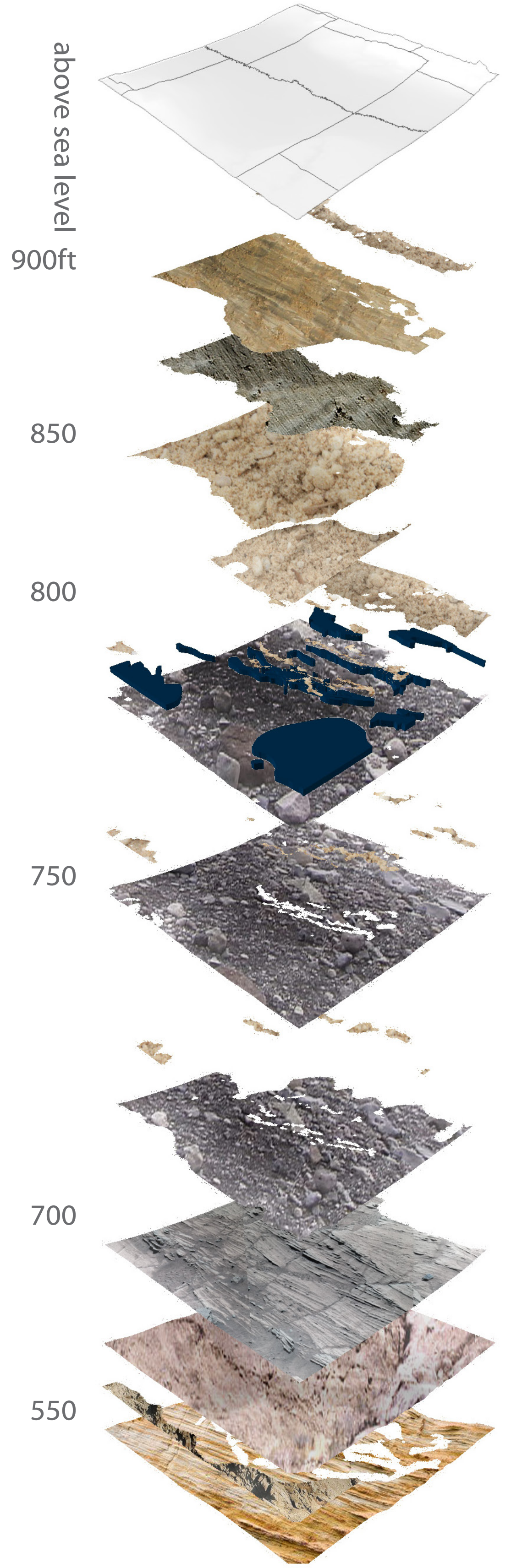


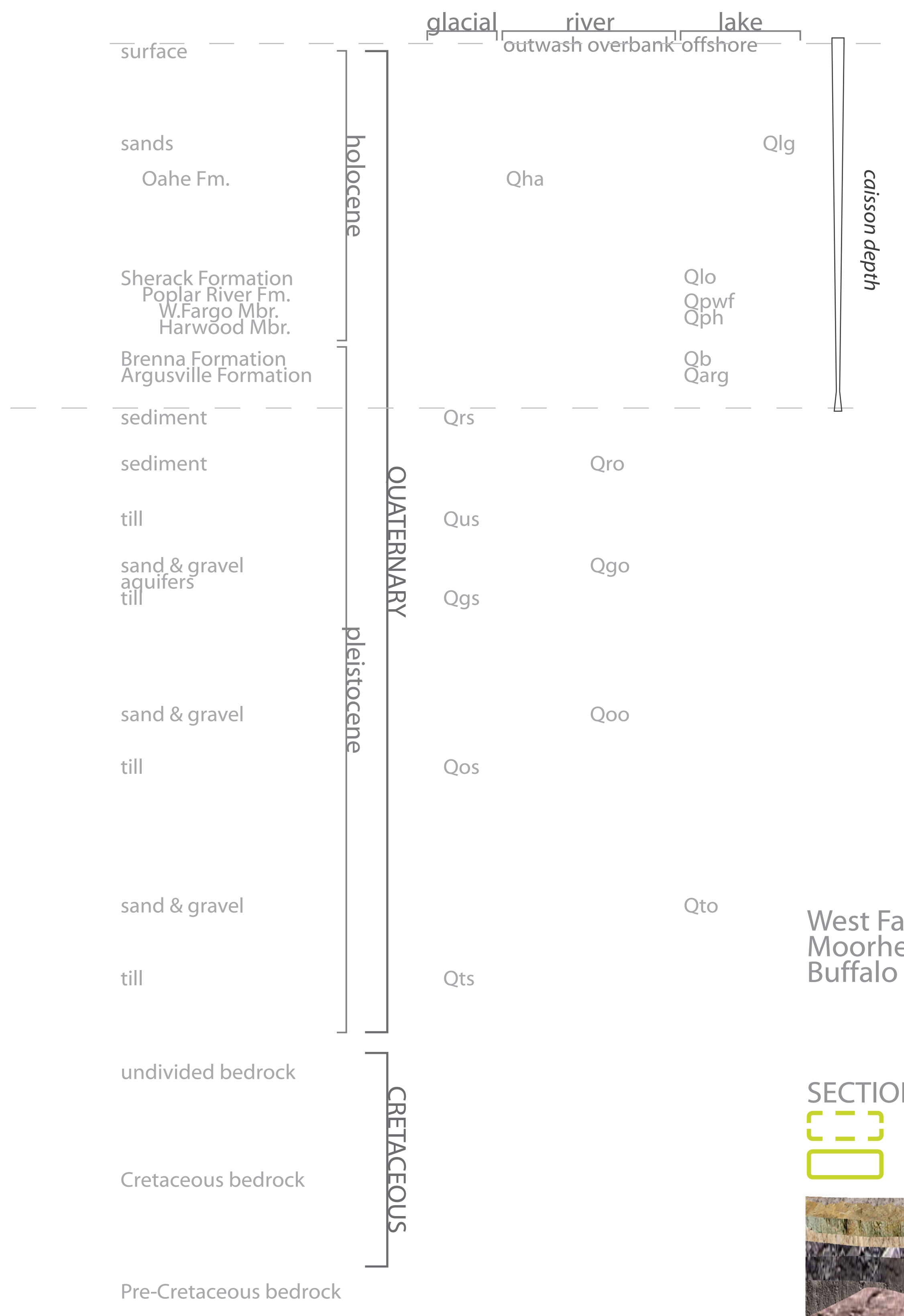
The stratigraphic relationships of offshore lacustrine Sherack and Brenna Formations cause engineering and environmental geologic problems in combination with hydraulic movement.

04 | RESEARCH SITE INVENTORY

//Glacial movement_glacial melt_soil depth & composition
/long-term drought water supply
/sustainable water resources use

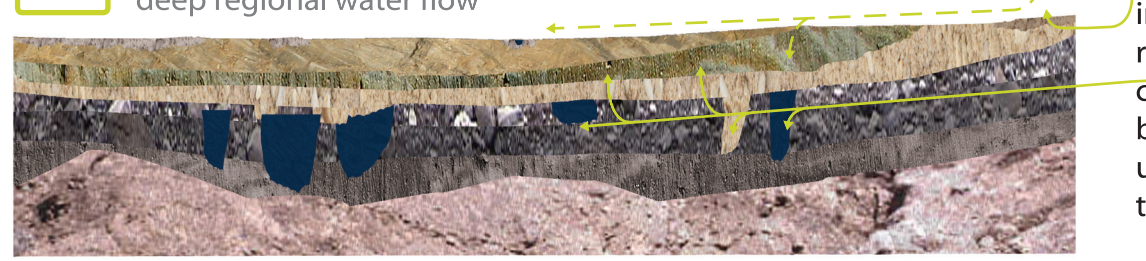
SURFICIAL GEOLOGY

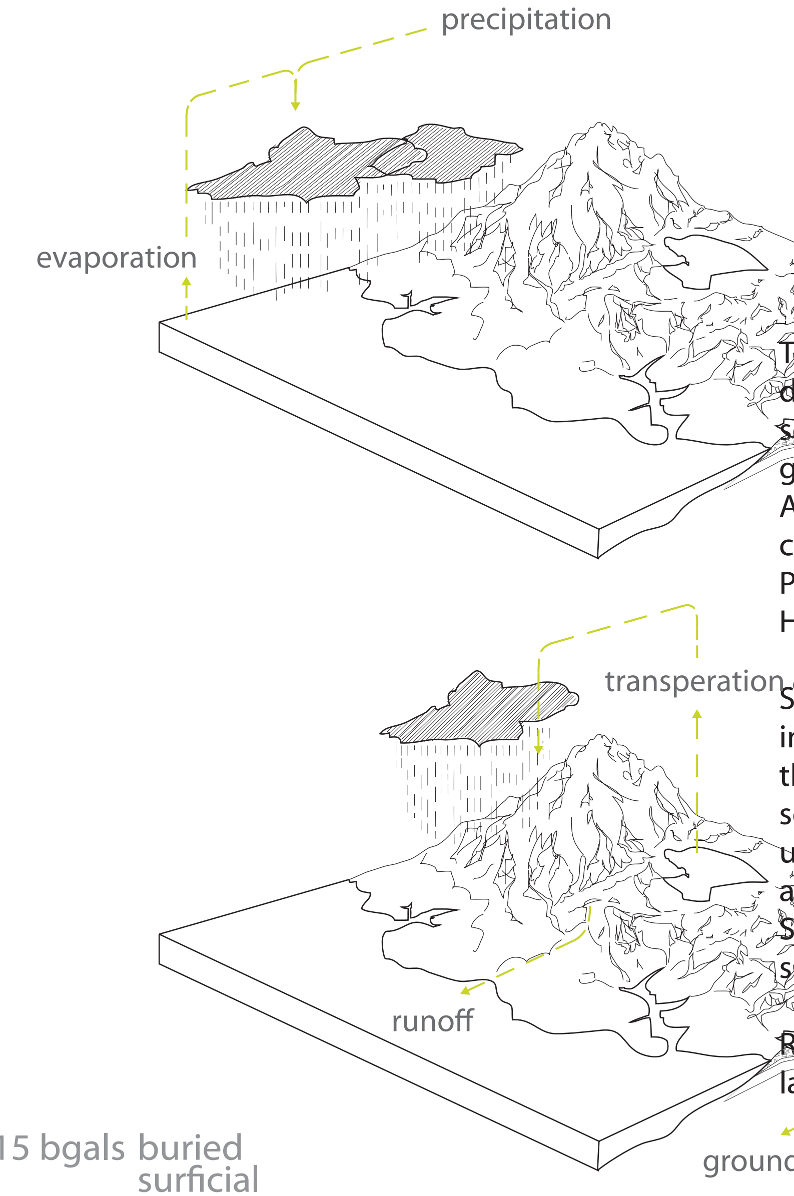




West Fargo Aquifer 415 bgals buried
Moorhead surficial
Buffalo Aquifer 250 bgals surficial

SECTION
near surface water flow
deep regional water flow





The base geologic unit was formed with the advance and retreat of deposited subglacial till. The lowest layer is composed of subglacial sediment (Qg) of clay matrix and diamicton (gravel >= 2 mm set in fine grains matrix) sediments. Glacial retreat and formation of Glacial Lake Agassiz deposited offshore sediments. From oldest to youngest, they consist of the Argusville Formation (Qarg), Brenna Formation (Qb), Poplar River Formation (Qp), consisting of the West Fargo (Qpwf) and Harwood Members (Qph), and the Sherack Formation (Qs).

Successive glacial retreat of the waters of Glacial Lake Agassiz resulted in the drainage formation of the Red River, which over time incised into the offshore sediments through meanders. Red River Valley overbank sediments (Qro) overlay the offshore deposits. Flooding has contributed to the fluvial sediments in overbank areas within the floodplain and adjacent tributaries. River Alluvium (Halr) consisting of reworked Sherack and Red River overbank sediments (Qro) also mantle the offshore deposits.

Recent anthropogenic materials consist of engineered fill (Hf) and landfills (Hlf).

CASE STUDY: Ogallala Aquifer
People began digging wells for drinking water and irrigation for centuries. With the Industrial Revolution, cheap energy and technology allowed people to pump groundwater on a massive scale. By the mid-1930s farmers decided to tap into the Ogallala (High Plains) Aquifer. By the 1970s the aquifer accounted for one-fifth of the irrigated area in the United States. It was being drawn at 10 times the rate it could recharge. This irrigation allowed farming in areas unsuitable for agriculture of this sort. Half of the accessible water in the aquifer was gone by 1993 (McNeill, 2000). While it took millennia to fill, the Ogallala's usefulness to humankind will have lasted less than a century, due to the avarice and ignorance of working against nature (McNeill, 2000).

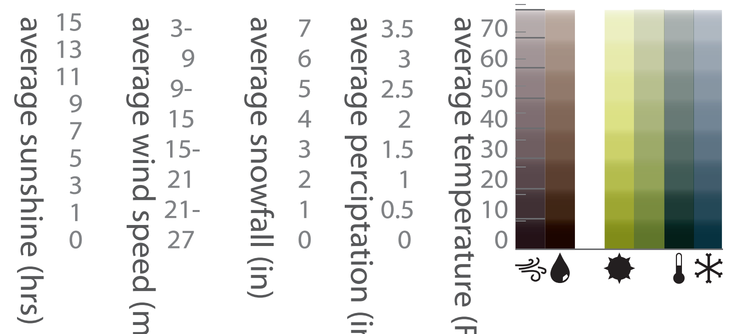
Climatology is the study of climate, scientifically defined as weather conditions averaged over a period of time.

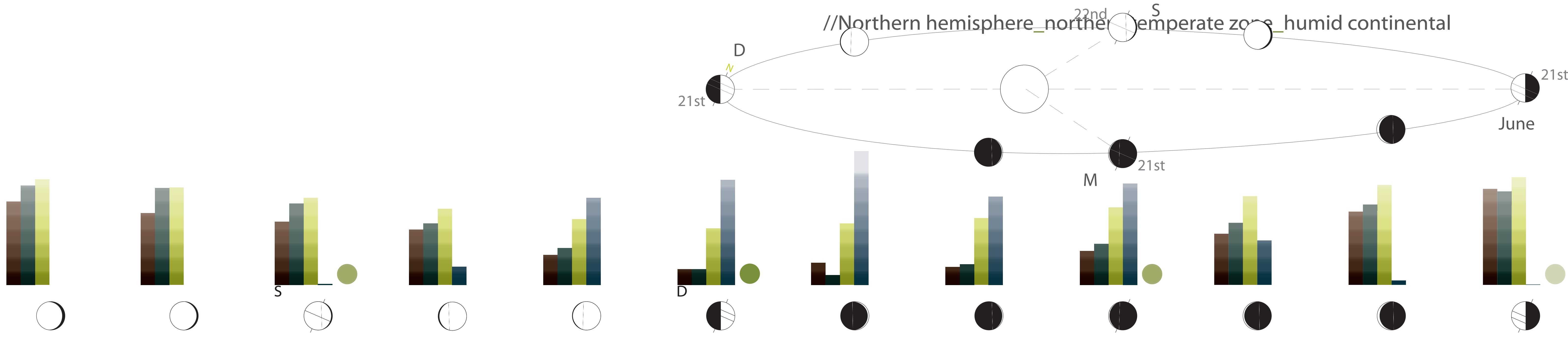
Seasonal data is a combination from Moorhead and Fargo, 1996-2001 Automated Surface Observing System (ASOS) Fargo Airport (Godon & Godon, 2002).

Average annual temperature: 41.5 °F
July is the warmest month with an average temperature of 70.6 °F
January is the coldest month with an average temperature of 6.8 °F

Average yearly precipitation: 21.19 inches
Wettest months are May through August, averaging 2.50 inches per month
Driest months are December through February, averaging 0.76 inches per month

Average yearly snowfall: 40.0 inches.
Snowfall runs from October through May, January being the snowiest month





| fall
Fall Season: September through mid-November
On average: 11 days 32 °F or colder, 2 days with a low of 0 °F or colder. The majority of colder days occur in November. First frost occurs by September 24, effectively ending the growing season.

Average Temperature: 43.5 °F
Average Precipitation: 5.21 in
Average Snowfall: 6.7 in
Average Cloudy days: 49 percent
Least amount of sunshine occurs around December 21, with about 8.5 hrs of sun.

Mean Wind Direction: south-southeast
Mean Wind Speed: 12mph
Daily Average Wind Speeds: 26 percent >= 20 mph
Peak Daily Wind Speeds: 27 percent >= 40 mph

| winter
Winter Season: middle to late November through March
On average: high 32 degrees by Nov 20, stays at or below freezing through March 9.
On average: 44 days zero or colder, 19 of occurring in January.

Average Temperature: 11.1 °F
Average Precipitation: 1.92 in
Average Snowfall: 22.6 in
Average Cloudy Days: 55 percent
Least amount of sunshine occurs around December 21, at 8.5 hrs of sun.

Mean Wind Direction: south
Mean Wind Speed: 12-13mph December through February
Daily Average Wind Speeds: 30 percent >= 20 mph
Peak Daily Wind Speeds: 25 percent >= 40 mph

| spring
Spring Season: April through May.
On average: one day above 90 °F, 5 days with thunderstorms. Growing season starts May 14, low temps stop dropping below 32 °F.

Average Temperature: 42.7 °F
Average Precipitation: 5.15 in
Average Snowfall: 10.7 in
Average Cloudy Days: 49 percent
Least amount of sunshine around December 21, with about 8.5 hrs sun.

Mean Wind Direction: north
Mean Wind Speed: 13mph
Daily Average Wind Speeds: 43 percent >= 20 mph
Peak Daily Wind Speeds: 30 percent >= 40 mph

| summer
Summer Season: June through August
On average: 12 days with a high temperature of 90 °F or warmer.

Average Temperature: 68.5 °F
Average Precipitation: 8.91 in
Average Clear Days: 29 percent
The longest day of the year is around June 21, with nearly 16 hrs of sun.

Mean Wind Direction: south-southeast
Mean Wind Speed: 11 mph
Daily Average Wind Speeds: >= 20 mph
Peak Daily Wind Speeds: 18 percent >= 40 mph

WIND STUDIES

The wind rose shows the frequency of winds blowing from particular directions. The length of each spoke around the circle is related to the frequency of time the wind blows from the particular direction. Each concentric circle represents a different frequency, emanating from zero at the center to increasing frequencies at the outer circles. Each spoke is broken down into frequency categories that show the percentage of time winds blow from the particular direction and duration of the speed at which it blows.

Wind is formed from the balancing of inequalities in air pressure due to unequal heating of the earth's surface. Solar radiation is the energy source for most wind. Wind is created by pressure gradient force, the Coriolis effect, and friction (Lutgens & Tarbuck, 2005). The pressure gradient is the magnitude and direction of which air moves from areas of higher pressure area to an area of lower pressure. The Coriolis Effect is the deflection of the Earth's rotation on the atmosphere. Friction acts to slow air movement and as a consequence alters wind direction. Pressure differences create wind and the greater the pressure differences the greater the wind speed. The pressure gradient is the driving force behind wind and it has both magnitude and direction. Difference of force is from higher pressure to lower areas of pressure.

Topographic effects or variations in surface composition in the immediate area also have an effect on local wind patterns.

The polar continental air mass of the region comes north from Canada, and retreats across the great lakes.

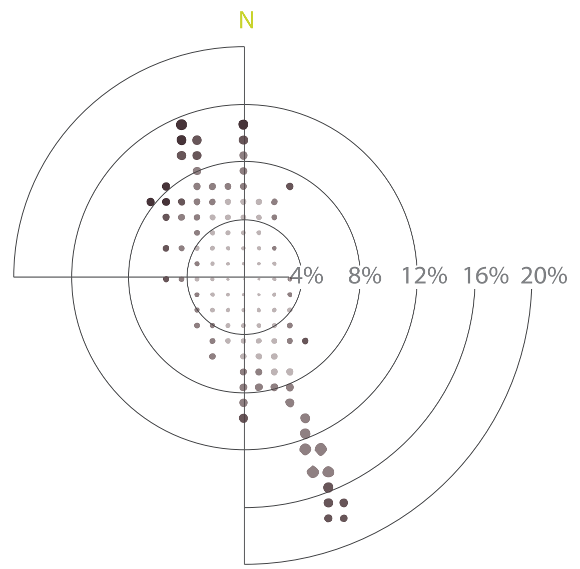
SUN & SHADOW STUDIES

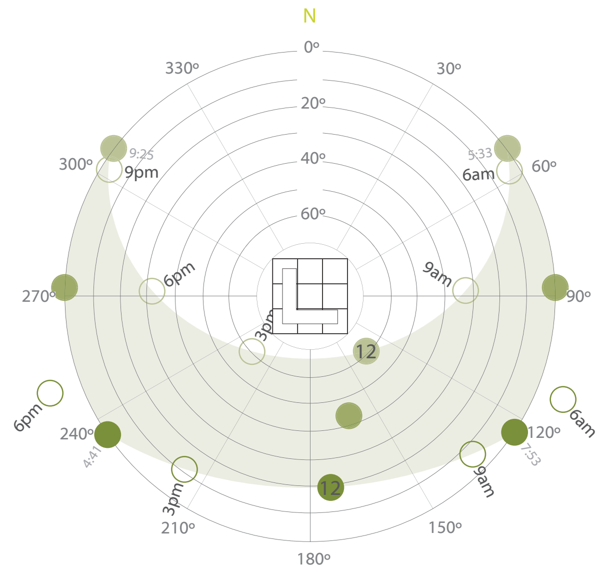
A solar path diagram is a visualization of the sun's path through the sky. The path is formed by plotting azimuth (left-right) and elevation (up-down) angles of the sun in a given day to a diagram. To find the position azimuth = 60, elevation = 30, imagine standing at the center of the diagram heading to the true north, turn 60 degrees to the right and raise your head 30 degrees from the horizon.

The major frequency of winds blow from the southeast at 9-21 mph. May through September summer winds prevail from the southeast. November through February harsh winter winds prevail from the northwest.

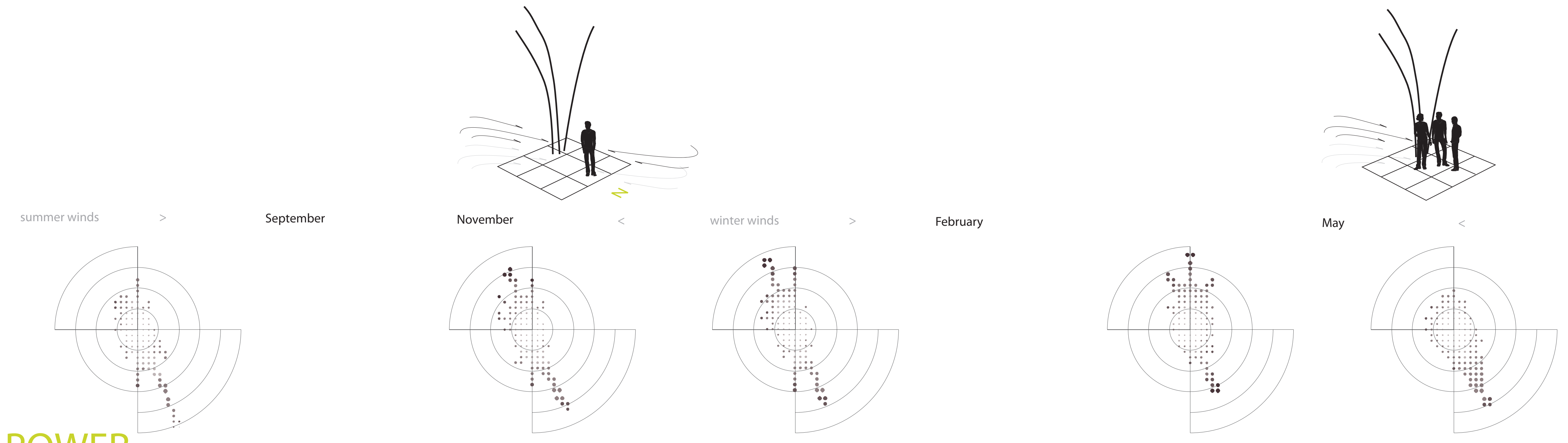
CASE STUDY | integrated

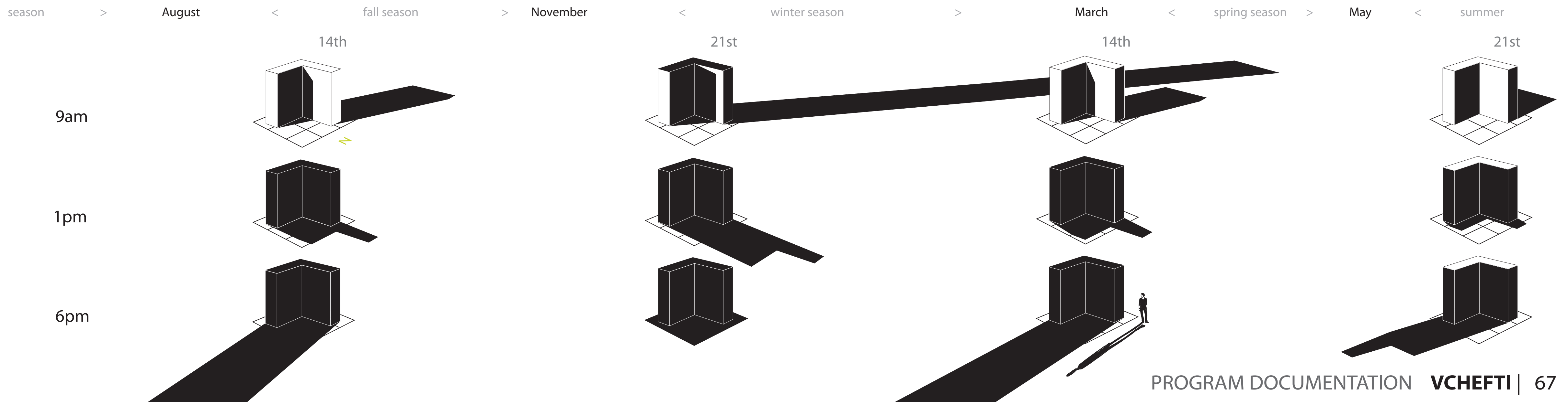
The City of Portland, Oregon recently signed a contract with Lucid Energy to develop a hydropower system within the city's water mains. The system is based on in-pipe turbines that capture energy from fast-moving water inside gravity-fed water pipelines. It produces clean, reliable, low-cost electricity. They also plan to identify innovative applications for the technology, such as providing power to eco-districts, car charging stations, purification systems and off-grid water agency tasks ("Lucid energy links," 2011). Conventional hydroelectric power generation is known to cause ecological and environmental problems, this design causes no more disturbance, as it is implemented with the water main itself.

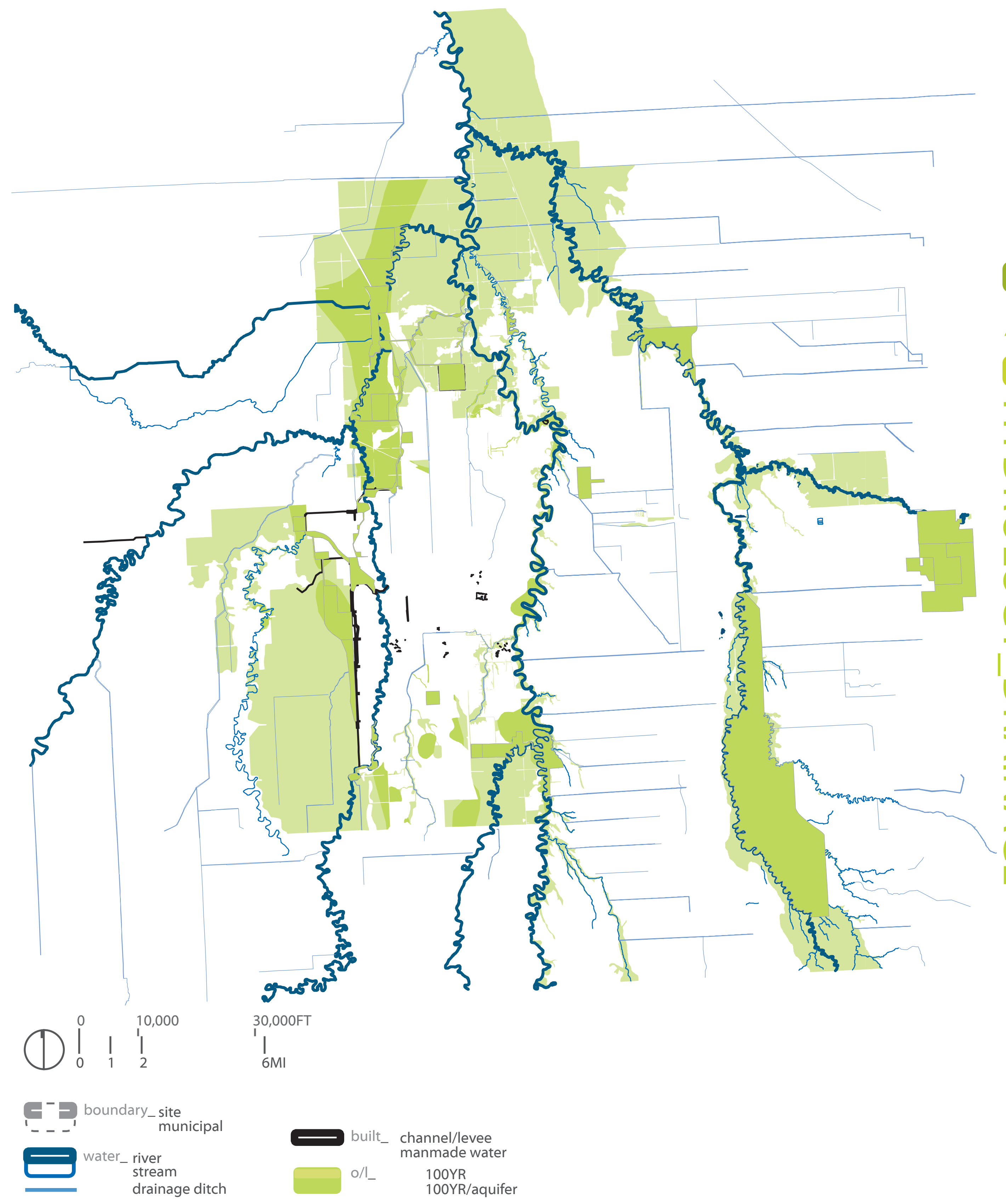




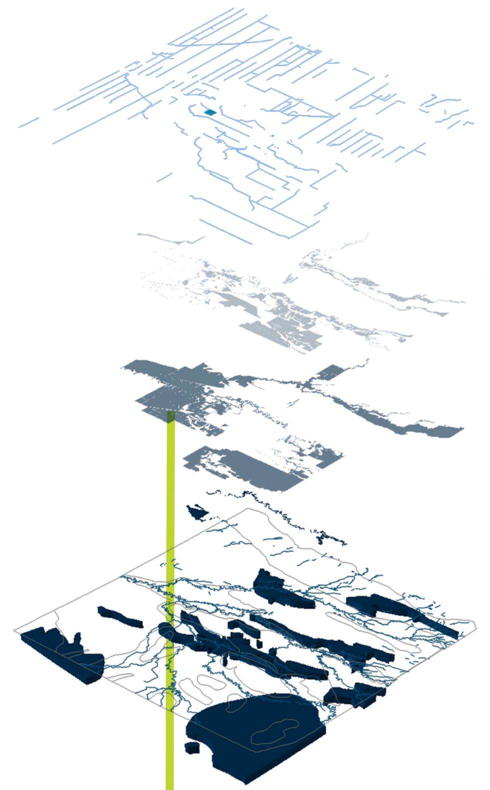
WIND POWER

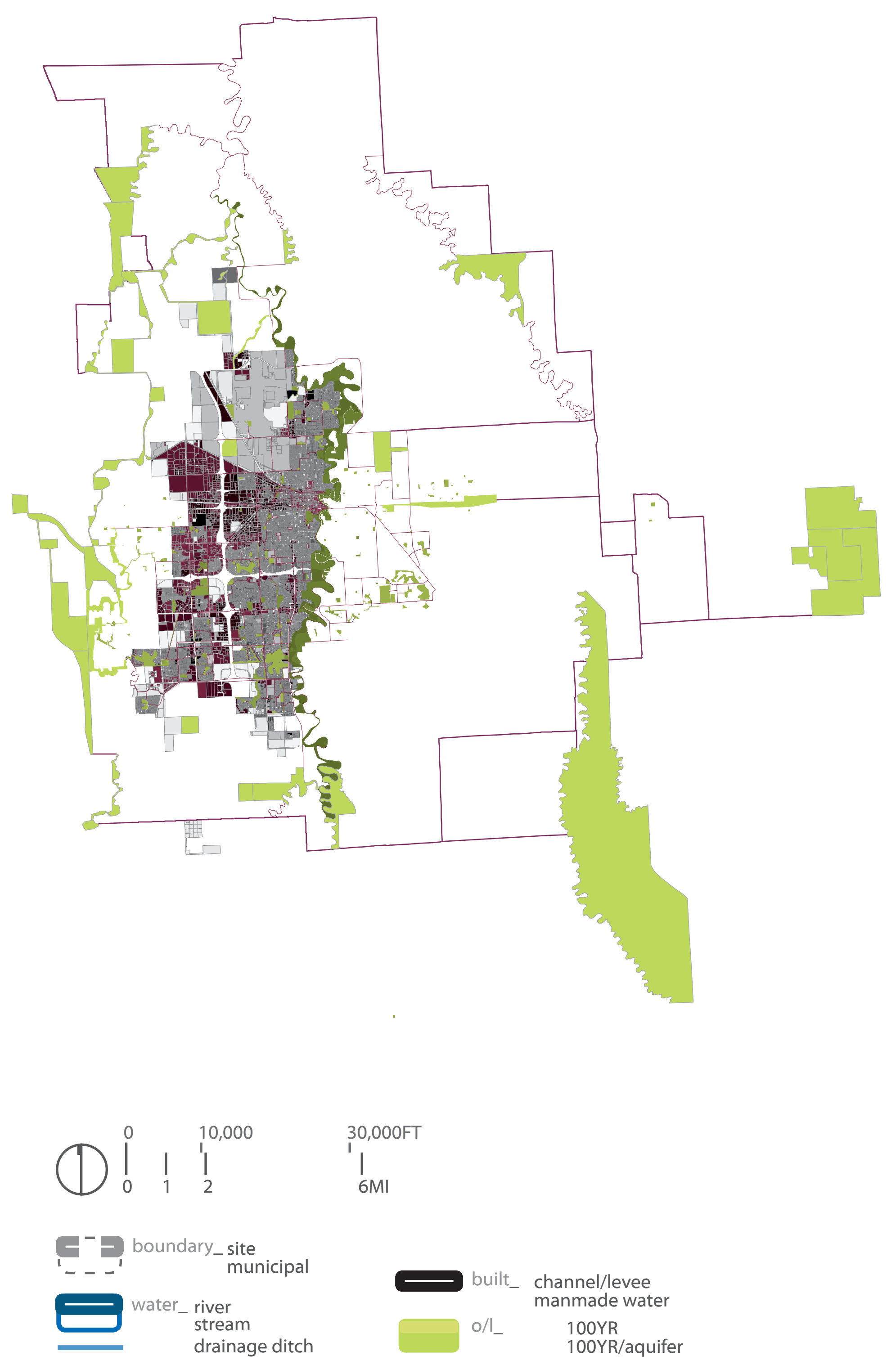




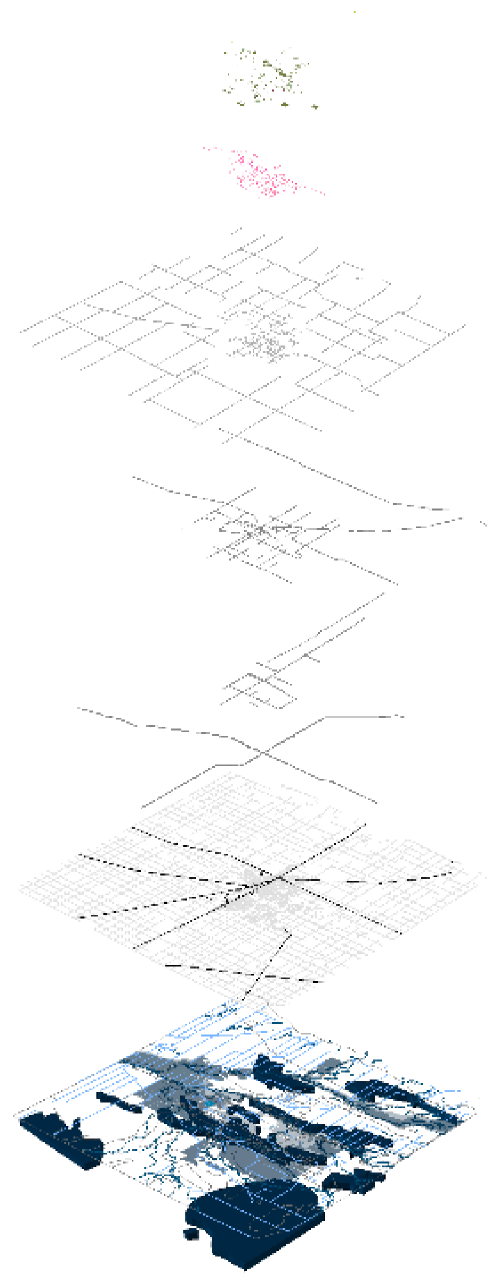


HYDROLOGY_DRAINAGE





LAND USE & ZONING



Adjustments for land use and zoning with the aim of maintaining property rights as much as possible, while maintaining the integrity of the new park system's function.

However, as discussed earlier, mass wasting on riverbanks required a zoning push back from the river.

This opened the opportunity to expand the Red River Park and Trail system, using prairie and riparian plantings to restabilize slopes. Where this is not practical, such as with the historic downtown, other suitable implementations are put in place.

SCHEMATIC PLAN

SCHEMATIC ANALYSIS

Ur	Su	Ru
grey material	↔	green material
grey fabric		green fabric
structure		ecology
educational (describing process)	→ mitigative ←	functional (programming process)
interpretive		ecological
Reniassance Zone aesthetic	↔	Great Plains Microsoft aesthetic

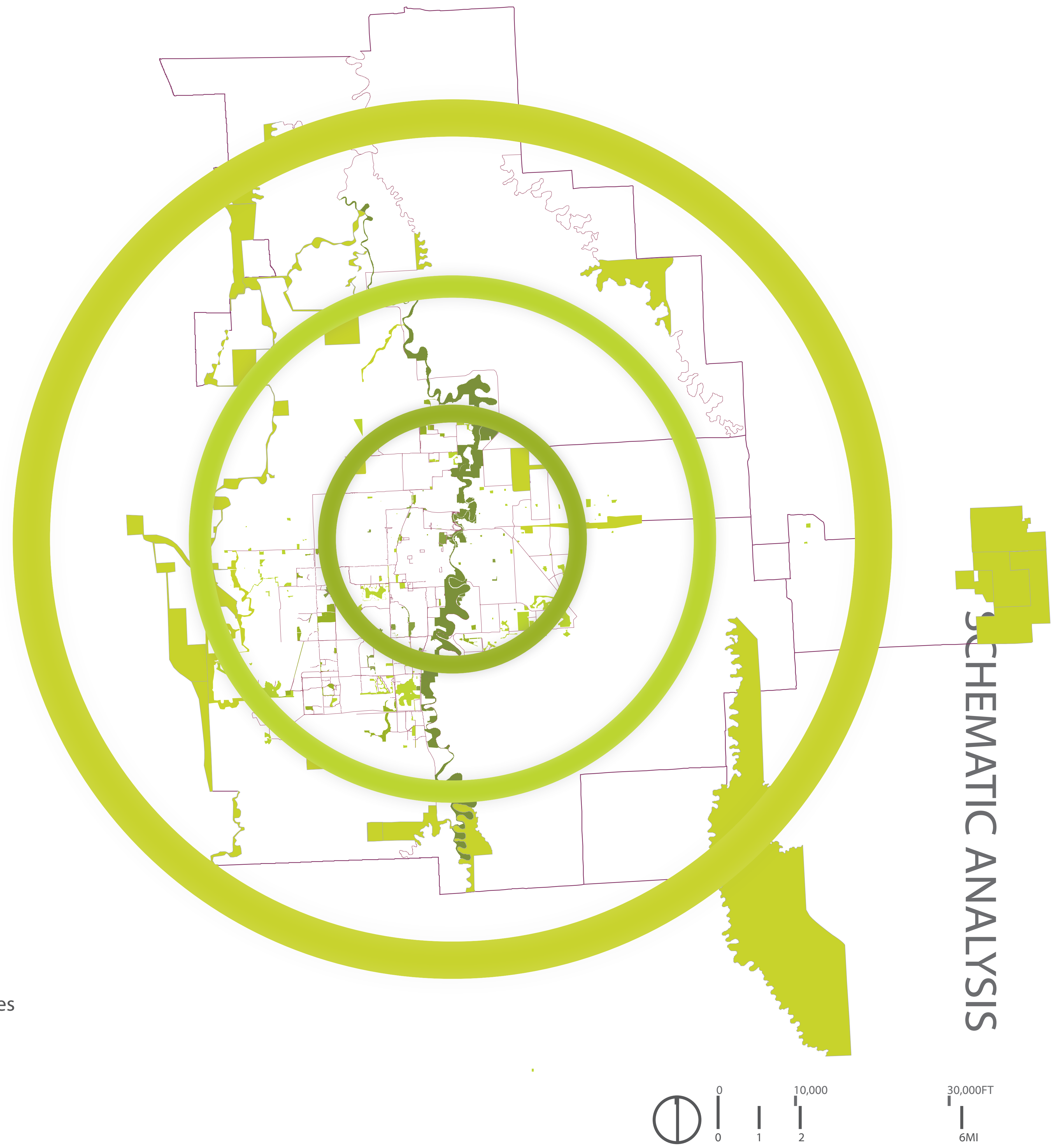
Ru Rural Park System
preventative_
highly functional tallgrass prairie wetland ecological parks
1. Wastewater Wetland Park Sub-System
2. West Aquifer Park Sub-System
3. Buffalo Aquifer Park Sub-System

1. Rural to Suburban transition parks

Su Suburban Park System
mitigative_
neighborhood park with integrated wetland functions
2. Neighborhood parks

3. Suburban to Urban systems

Ur Urban Park System
interpretive_
wet tallgrass prairie functions integrated into highly structured spaces
1. Urban parks
2. Urban river parks



H Master Context Map Defined

Red River Park System_high performance landscape system

NDSU Department of Landscape Architecture | THESIS | May 2012

Ru Rural Park System

preventative_highly functional tallgrass prairie wetland ecological parks

1. Wastewater Wetland Park Sub-System
Current wastewater ponds sited on a massive flood zone are replaced with constructed wet tallgrass prairie ponds. Treatment ponds are integrated in a series of wetland retention and detention ponds designed in hierarchical system that filters and remediates water as it flows through the ponds and eventually into nearby rivers and streams

2. West Aquifer Park Sub-System
On a massive flood zone and atop the West Fargo Aquifer, the Sheyanne Diversion Channel is be removed, replaced with the native wet tallgrass prairie ecosystem. In a report, the Bureau of Reclamation suggested a recharge method for buried aquifers of this type (where recharge sources are unknown), to drill wells. On their recommendation specialized wells are commissioned for design. These wells are then strategically placed near final ponding zones where filtration and remediation stages would assure quality water recharge of the aquifer.

3. Buffalo Aquifer Park Sub-System
Located East and partially atop of the Buffalo Aquifer, on a site of severe flooding, this location maximizes recharge of the aquifer. Vertical infiltration is allowed through sandy zones prior to reaching the clay lined portion of the Red River Basin. Locating the Park upslope to the East of this zone allows collection of surficial water flow. Thus, surficial water flows horizontally downslope into the wetland park where it is filtered and remediated by movement through the system, maximizing water quality as it reaches zones of infiltration.

All three parks feature interwoven trail systems [*detail:* Ru 2 & 3] and educational components, interpretive, figurative, and literal, potentially with Educational Research Centers located in the parks, sponsored civically, governmentally through University, or through private Environmental organizations. The parks also take advantage of strong prevailing winds in the region, featuring ecologically designed wind-powered electric generators, called 'windstalks'. Windstalks are coupled with below ground hydraulic backup storage device systems, that pump water to an upper storage chamber while wind power is active, then release water to a lower chamber when wind is still [Ru 4b]. The windstalks assimilate aesthetically complimenting the sway of prairie grasses in the wind.

Su Suburban Park System

mitigative_neighborhood park with integrated wetland functions

1. Bridging rural parks to Residential zoning, these suburban parks transition low-structured recreation tallgrass prairie wetland to high-structured recreational neighborhood parks. Here, wet tallgrass prairie is implemented aesthetically into the design of neighborhood parks as low-point water features or integrated bioswales acting for stormwater detention and retention, remediating and filtering pollutants from neighborhood drives and lawns prior to reaching larger water bodies. The trail system hierarchy continues from rural and urban parks, designed to weave and merge, meeting flood levels at grade, maintaining a consistent trailway is always open for route up to the 100yr flood [Su 2c].

2. Neighborhood parks integrate wet tallgrass prairie aesthetically as water features and/or bioswales for stormwater detention and retention, remediating and filtering pollutants from neighborhood drives and lawns prior to piping into larger water bodies.

3. Suburban to urban systems act in the prior, additionally integrating figurative educational components in the form of site furniture, public art, play structures and design form. For instance, a drinking fountain could integrate the design function of an aquifer, a play water feature could mimic the function of a check dam, or a playground structure could feature the deep root system of a prairie grass. All structures strictly adhere to selected material representation for complete congruency of the overall system, adding specific materials per neighborhood, by neighborhood associations to achieve identity. For instance a neighborhood may desire the inclusion of a Blue-Green Interference Coated Stainless Steel and complimentary Arborvitae hedges, or Yellow Fluorocarbon-coated Aluminium and Thornless Honey Locusts. These selections aid in the prevention of monoculture, both horticulturally and thematically.

Ur Urban Park System

interpretive_wet tallgrass prairie functions integrated into highly structured spaces

1. Urban parks highly focus on the integrated interpretive education that tells the story of the Red River Park System. The aim of these interpretive elements is to educate residents on the great utility and service this high-performance landscape system provides them. Locally commissioned public art is designed to figuratively iterate different functions of the system, the water cycle, the journey of water down slope, the function of a prairie plant, the recharge of an aquifer, and so on and so forth. Wet tallgrass prairie is still implemented, often more formalized and structured in the form of bioswales or lining sidewalk or plaza planting beds to complement the downtown aesthetic, while still performing their functional utility.

2. Urban river parks merge the above intention with riparian prairie functions of slope stabilization. Nearer the urban core, these parks implement a higher grade of hard engineering structure, such as that of suspension reinforced caisson anchored flood walls acting as a recreation riverwalk/trail, slope stabilizer, and flood protection for the urban core. As the outer park system, mitigative flood measurements in retention and detention, bioswales, and series of check and control dams regulating agricultural drainage flow, act to lower the flood level of the urban core, it becomes available for structured recreation that reaches down and touches the river.

Red River Fire Festival

Annual Community Celebration

Prairie grasses require burning every 3-5years. With a stratigized staggered approach, prairie burning festivals are held annually in celebration of the unique and beautiful Red River prairie landscape.

Burning different sectors of the park system every year, creates a civic bonding of the community in an entirely rare and identifying way. These festivals close down the streets of Downtown, creating a pedestrian mall, bringing in markets, music, food, drink, and folly, all in the theme of the 'Red'.

Every year, just when the buds of the Sugar Maple begin to open, this festival turns a once mournful spring that used to drown the city, into a celebratory jubilation of the underlaying ecosystems that serves the community with the utmost function and utility.

Ru Rural Park System

preventative_

highly functional tallgrass prairie wetland ecological parks

1. Wastewater Wetland Park Sub-System
2. West Aquifer Park Sub-System
3. Buffalo Aquifer Park Sub-System

Su Suburban Park System

mitigative_

neighborhood park with integrated wetland functions

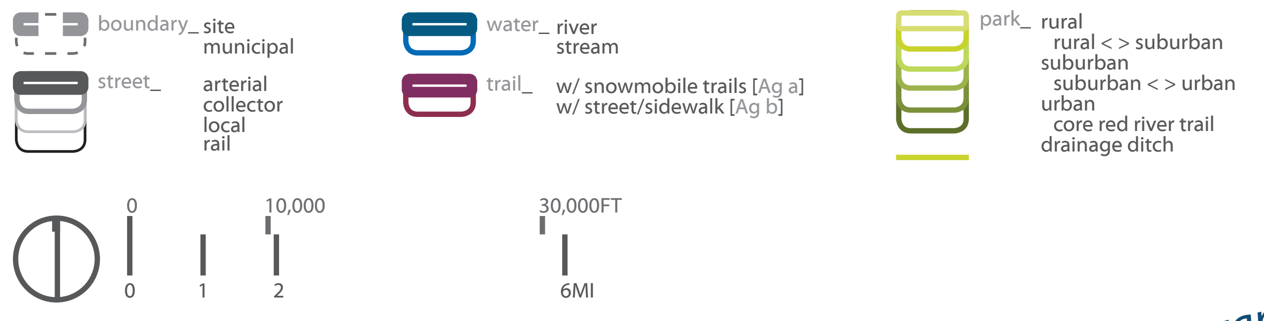
1. Rural to Suburban transition parks
2. Neighborhood parks
3. Suburban to Urban systems

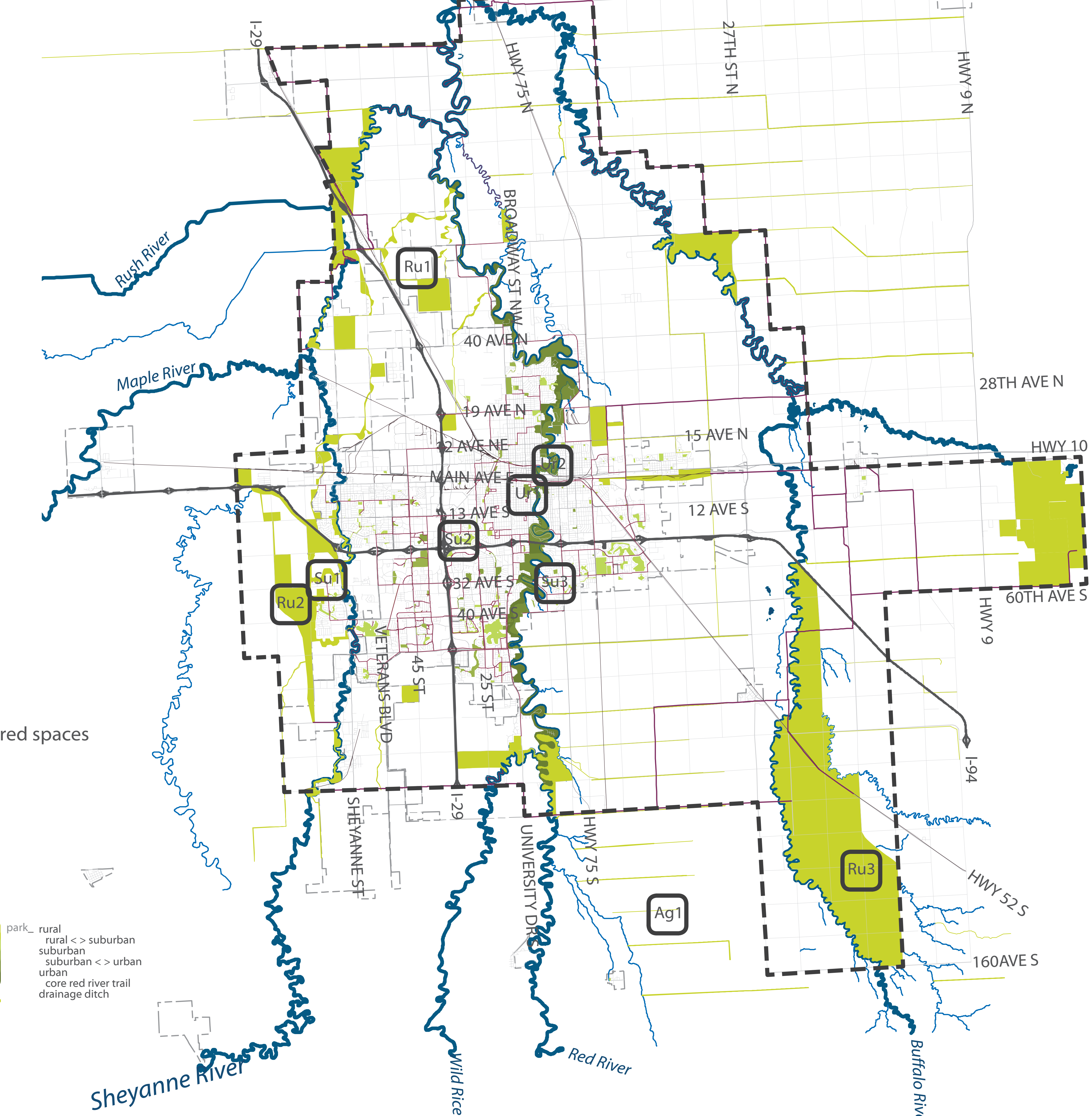
Ur Urban Park System

interpretive_

wet tallgrass prairie functions integrated into highly structured spaces

1. Urban parks
2. Urban river parks





theme/concept

design standards_define and distinguish place identity

NDSU Department of Landscape Architecture | THESIS | May 2012

downtown historic marker detail Fargo, ND

urban

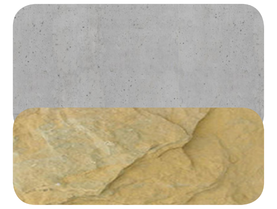
brick red/purple hues
maple varieties orange/red/purple fall hues

wood red/orange/yellow
red dogwood red/orange

corten purple/red/orange
big bluestem red/orange fall
purple late summer

rural

Great Plains Microsoft Fargo, ND

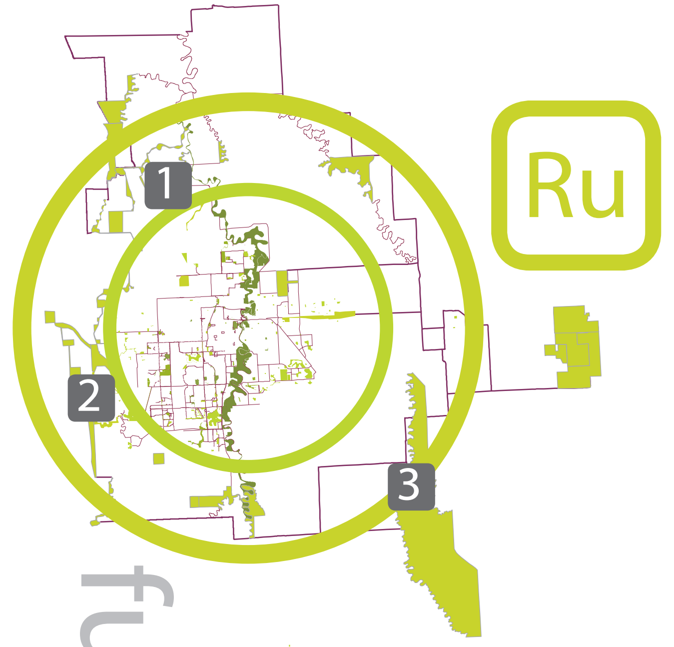


rebar reinforced scored concrete

yellow sandstone

mulch and rock groundcover prevents sunspots

The presumption of Fargo is altered when looking under the surface. Fargo has a unique segmented culture of agriculture/education/professional. Visually, I corollate brick revealed through worn concrete downtown. This coupled with the recent trend in downtown revitalization, expresses a tie between those layers and the dual act of preservation of history with forward-thinking integration.



Ru

Buffalo Aquifer Park

preventative_highly functional tallgrass prairie wetland ecological parks

functional

PROGRAM
walking/running
dog walking
hiking
biking
horseback riding
canoeing (water level dependent)
kayaking (water level dependent)

snowshoeing
cross country skiing
ice skating

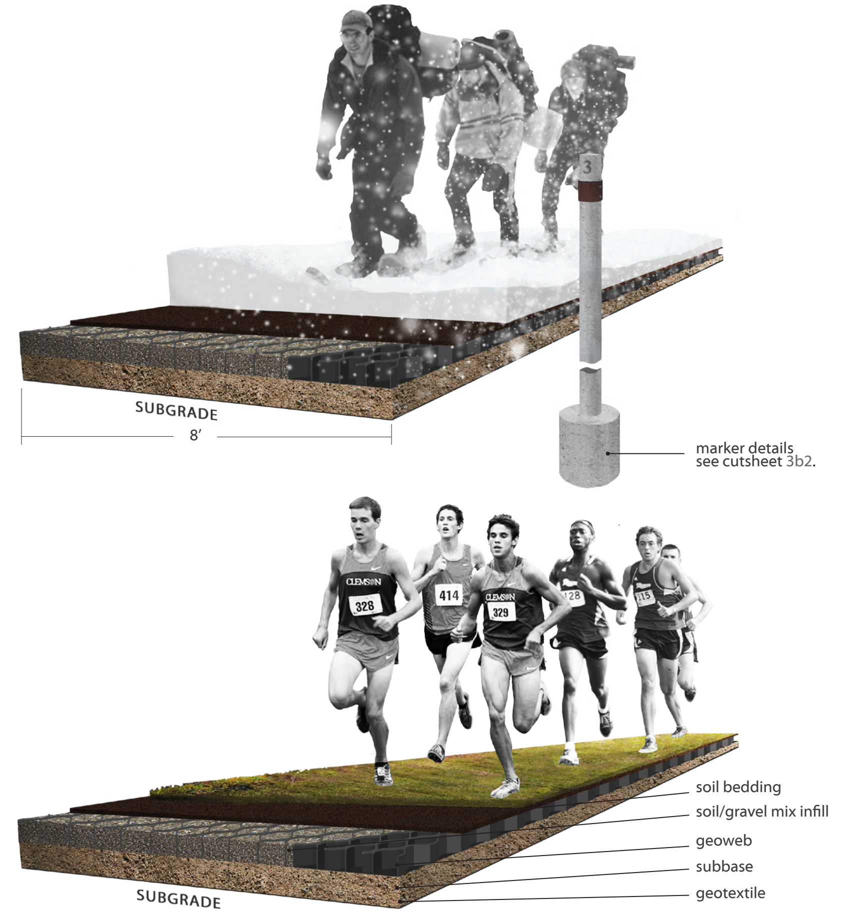
festivals (permitted)

hunting/fishing/ camping (permitted)

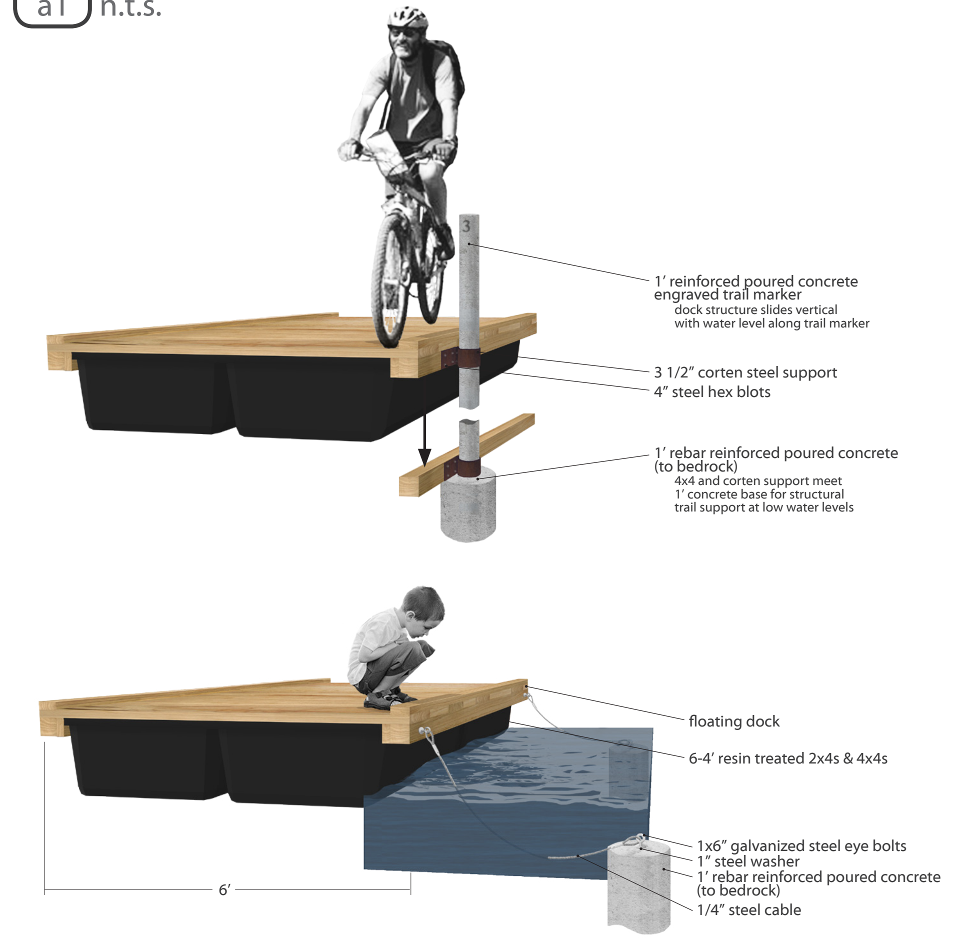
field trips
interpretive education
research

prescribed burning
adaptive management
CRP integration
natural resource use
flood control
aquifer recharge
sustainable energy generation

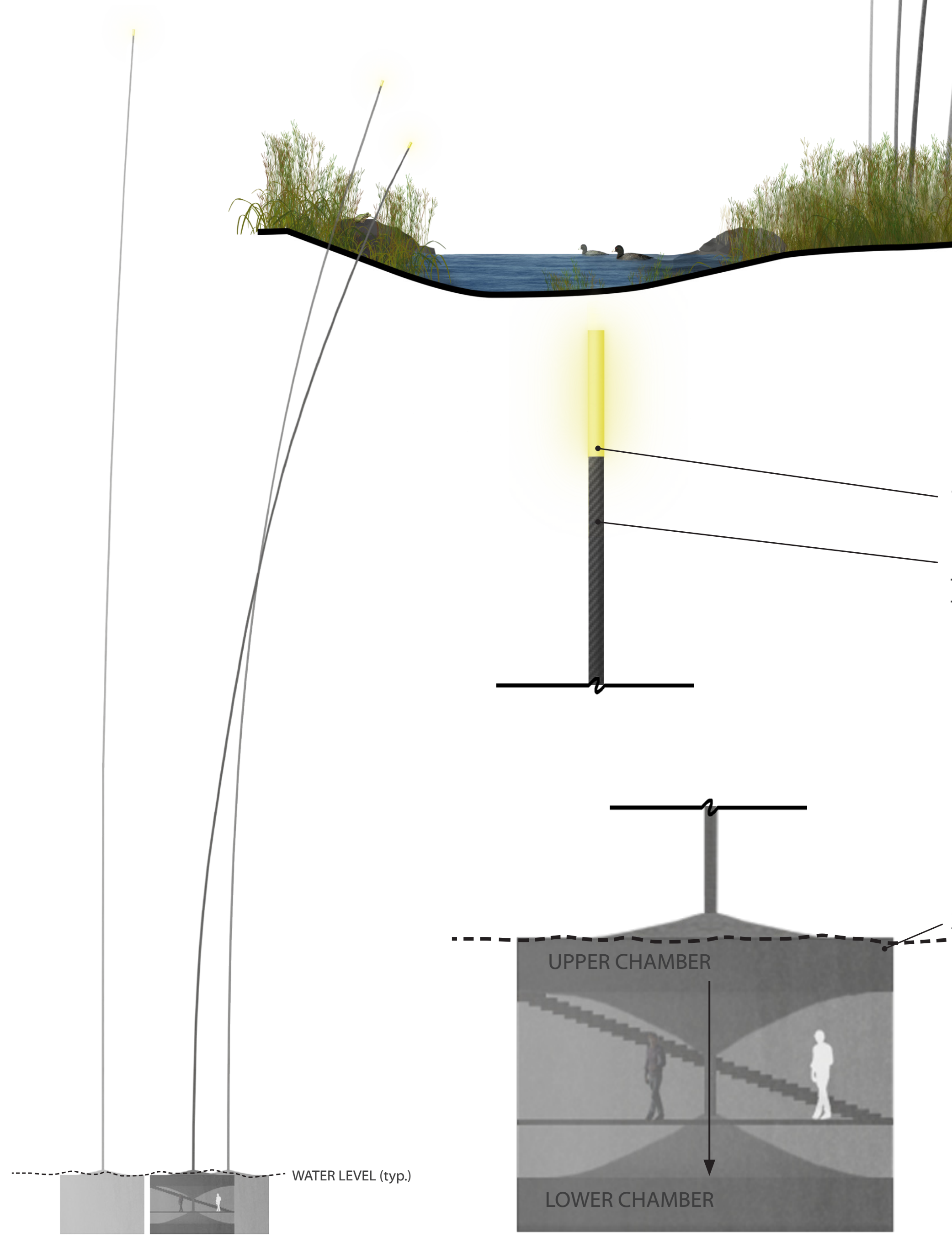
1 | a RURAL PARK ENTRY SIGNAGE (typ.)
n.t.s.



2 | a1 GEOWEB TRAIL STRUCTURE (typ.)
n.t.s.



3 | b1 FLOATING SUSPENSION BRIDGE (typ.)
n.t.s.



7" max LED lamp; positively correlated light intensity with wind speed

180'x1' diameter (25'x1/4' min) carbon fiber reinforced resin poles tapering toward the peak to 2" (1"min)

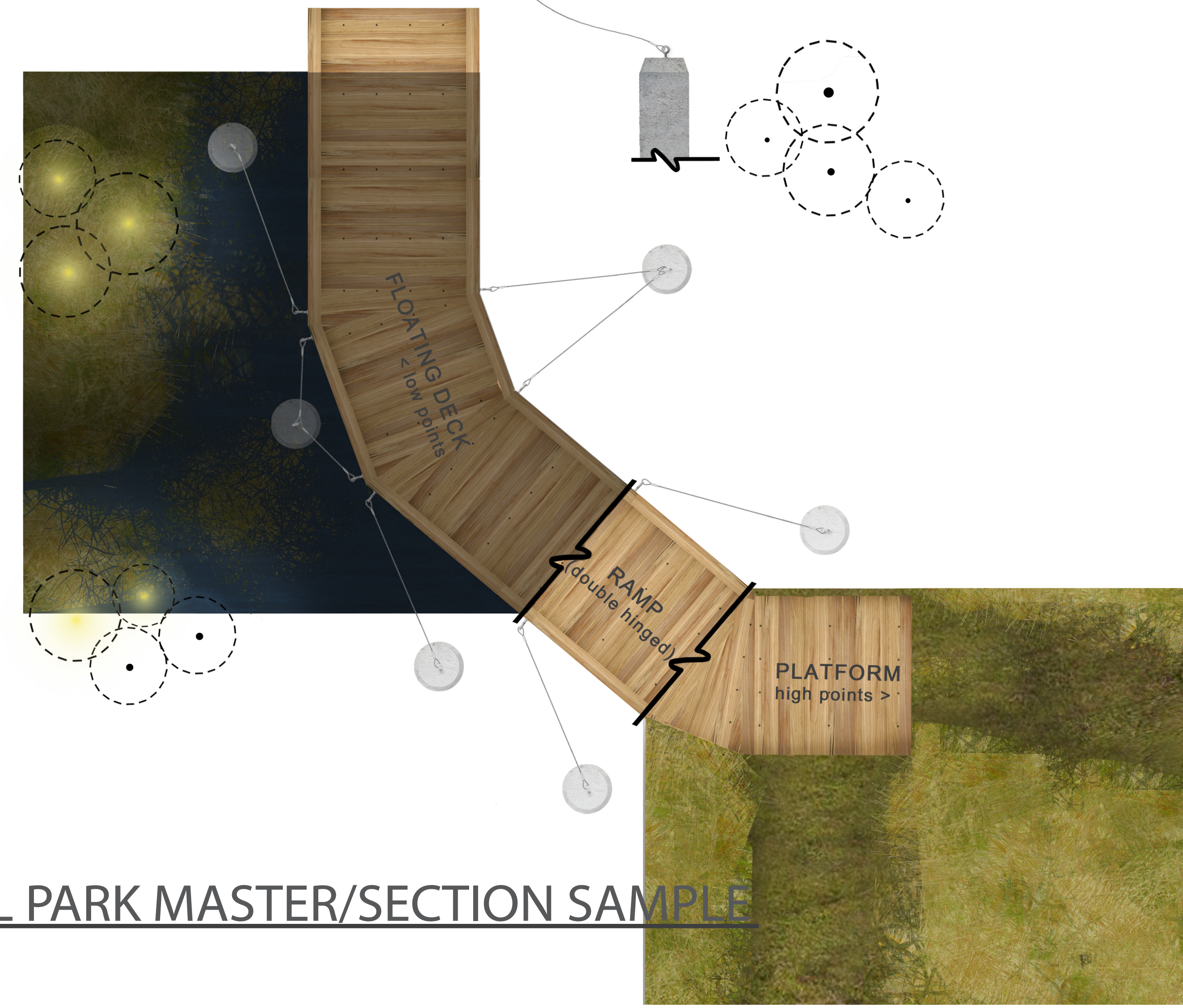
poles contain electrodes between piezo-electric ceramic discs. A cable connects every other electrode, another cable connecting the others. When the pole sways, the stack of piezoelectric disks is compressed, generating a current through the electrodes.

20' diameter max concrete chamber

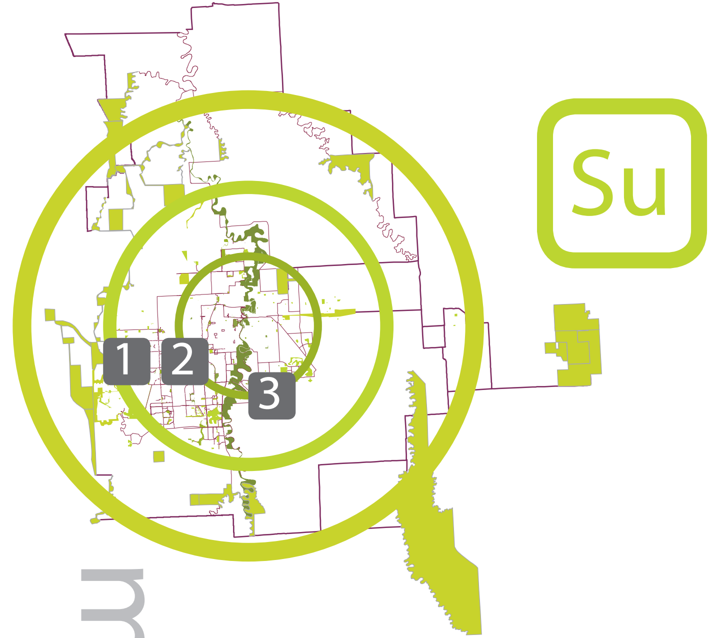
housing a torque generator converting the kinetic energy of poles into electrical energy with an array of current generating shock absorbers, using the forced movement of fluid through the cylinders.

part of the wind energy goes to power a set of pumps that move water from lower chamber to upper. This acts as a back up generator, allowing water from the upper chamber to flow down to the lower chamber, turning the pumps into generators.

4 | a1 WINDSTALK STRUCTURE CONCEPT (typ.)
n.t.s.



5 | a RURAL PARK MASTER/SECTION SAMPLE
n.t.s.



Su

Suburban Park System

mitigative_neighborhood park with integrated wetland functions

mitigative

PROGRAM
walking/running
biking

basketball/tennis/volleyball courts
soccer/football/baseball fields
frisbee golf course

*additional neighborhood
requested activities

children's play areas
art and sculpture

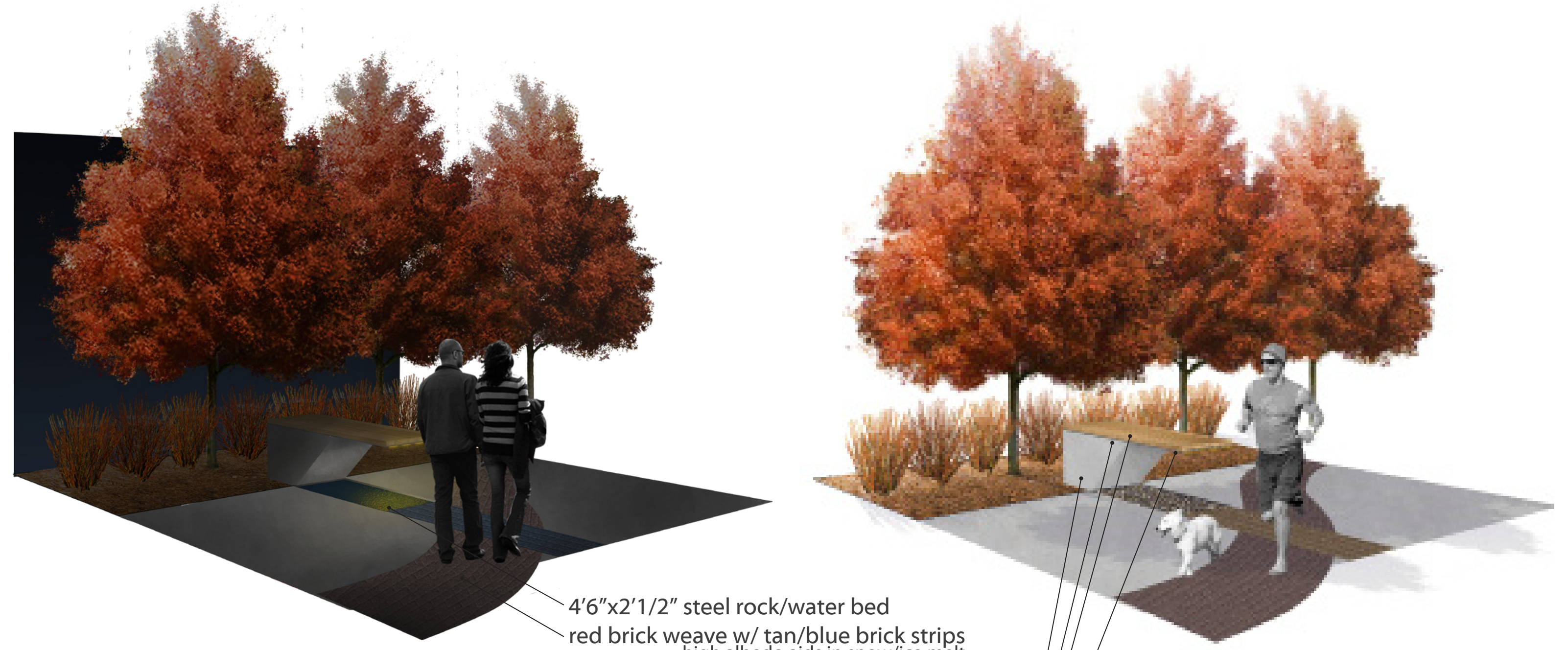
snowshoeing
cross country skiing
hockey rink

ice skating

festivals/concerts (permitted)
interpretive education

prescribed burning
adaptive management
stormwater retention/detention
sustainable energy generation

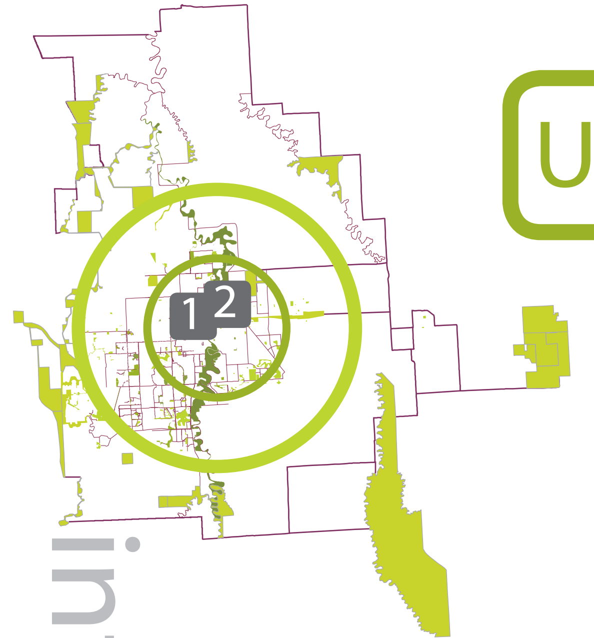
1 b SUBURBAN PARK ENTRY SIGNAGE (typ.)
n.t.s.



Memorial Plaza trail design

2 c CANTILEVER BENCH (typ.)
n.t.s.

5 b SUBURBAN TRAIL SYSTEM (typ.)
n.t.s.



Ur

interpretive

Red River Fire Festival

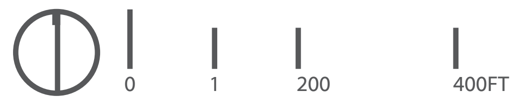
Annual Community Celebration

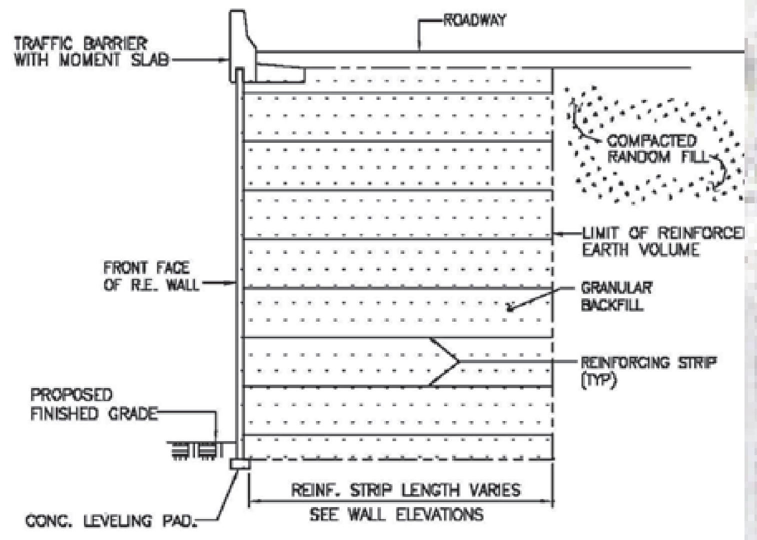
Prairie grasses require burning every 3-5years. With a stratigized staggered approach, prairie burning festivals are held annually in celebration of the unique and beautiful Red River prairie landscape.

Burning different sectors of the park system every year, creates a civic bonding of the community in an entirely rare and identifying way. These festivals close down the streets of Downtown, creating a pedestrian mall, bringing in markets, music, food, drink, and folly, all in the theme of the 'Red'.

Every year, just when the buds of the Sugar Maple begin to open, this festival turns a once mournful spring that used to drown the city, into a celebratory jubilation of the underlaying ecosystems that serves the community with the utmost function and utility.

1 / c URBAN PARK ENTRY SIGNAGE (typ.)
n.t.s.





[01]-[03]
Wellock, T. R. (2007) Preserving the Nation. Wheeling, IL: Harlan Davidson, Inc. [pg 20-25; pg 29; pg 1-425]
Newton, N. T. (1971). Design on the land. Cambridge,Massachusetts: Harvard University Press. [pp. 1-640]
Domek, Tom.(1998). Last call for tallgrass in North Dakota. North Dakota Outdoors 60(10):14-19. Retrieved from Jamestown, Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/plants/tallgrass/index.htm (Version 02OCT1998).
population data: US Census Bureau
map data: USGS

[04] // case studies
Jost, D. (2011, October). The soft solution: first san diego river improvement project. Landscape Architecture Magazine, 101(10), 170-179.
First san diego river improvement project. (2011). Retrieved from http://www.asla.org/2011awards/309.html
First san diego river improvement project. (2011). Retrieved from http://www.wyac.com/projects/first-san-diego-river-improvement-project
ADD

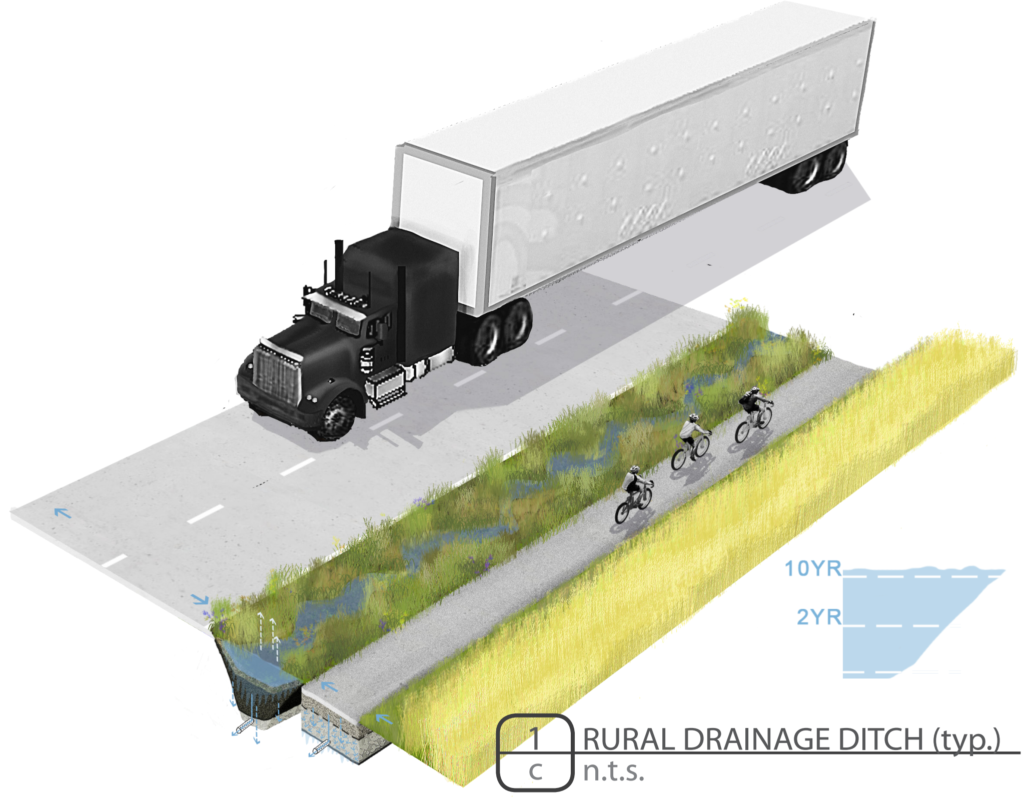
Windstalk. (2010, August 5). Retrieved from http://atelierdna.com/?p=144
Land art generator initiative: Windstalk. (2010). Retrieved from http://www.edesigndynamics.com/main/windstalk/
Vital. (2011, October 7). Windstalk concept provides bird-safe alternative. Retrieved from http://www.energyrebels.com/blog/2011/10/07/windstalk-concept-provides-bird-safe-alternative/
ADD

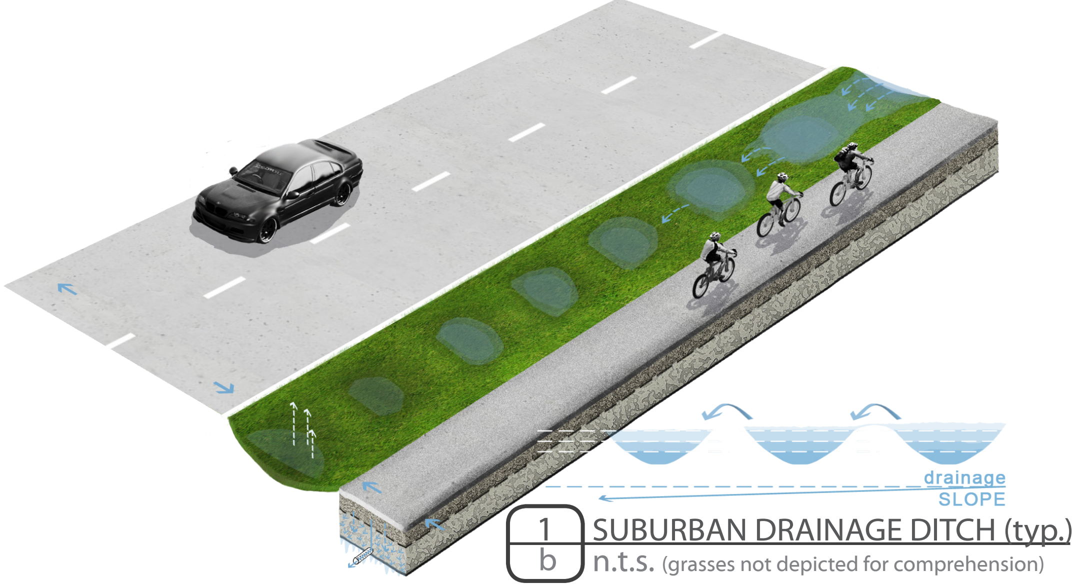
Quinnipiac university. (2010). Retrieved from http://windspireenergy.com/applications/schools/case-studies/quinnipiac-university/
University develops 'green' york hill campus. (2008, October 2). Retrieved from http://www.quinnipiac.edu/x2651.xml
First micro wind farm on a college campus to go online at quinnipiac university this fall. (2009, October 30). Retrieved from http://environmentalheadlines.com/ct/2009/10/30/first-micro-wind-farm-on-a-college-campus-to-go-online-at-quinnipiac-university-this-fall/
Preston. (Photographer). (2011). helix wind. [Web Graphic]. Retrieved from http://www.jetsongreen.com/2011/01/helix-vawt-integrated-wind-chicago.html/helix-wind-vawt-advantage

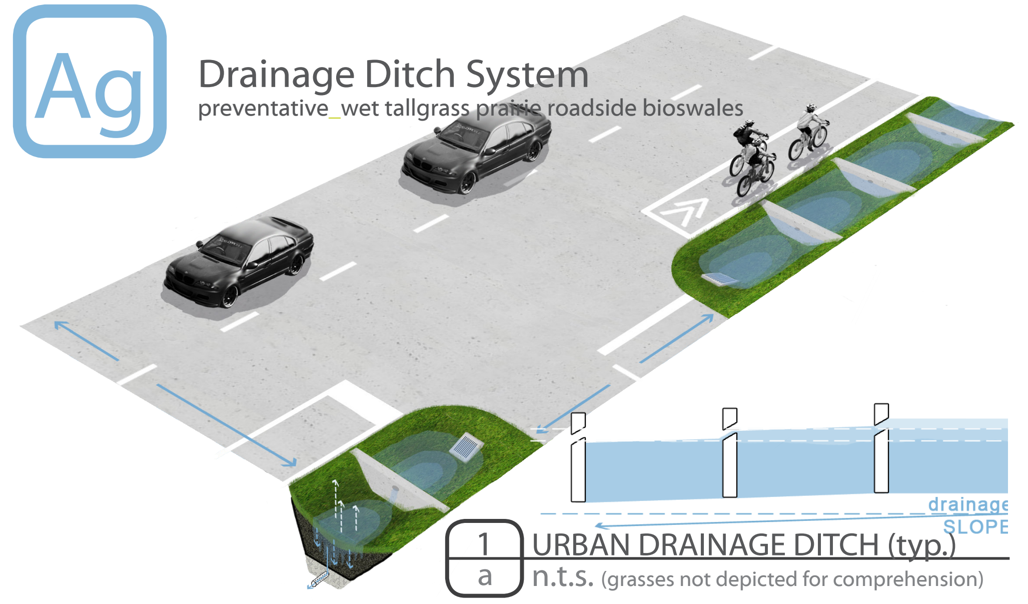
Landscapes of place, llc: Landscapes. (2011, December 03). Retrieved from http://www.landscapesofplace.com/id1.html
Making a wild place in milwaukee's urban menomonee valley. (2011). Retrieved from http://www.asla.org/2011awards/436.html
Aten, N. M. (Photographer). (2011). All photos. Retrieved from http://picasaweb.google.com/113786461365580167485
Aten, N. M. (Designer). (2011). Forest target plant communities. [Web Graphic]. Retrieved from http://www.asla.org/2011awards/436.html
Aten, N. M. (Designer). (2011). Prairie and Savanna Target Plant Communities. [Web Graphic]. Retrieved from http://www.asla.org/2011awards/436.html

[04] // historical context
Wellock, T. R. (2007) Preserving the Nation. Wheeling, IL: Harlan Davidson, Inc. [pg 20-25; pg 29; pg 1-425]
McNeill, J. R. (2000) Something New Under the Sun: An Environmental History of the Twentieth-Century World. New York, NY: W. W. Norton & Company, Inc.
Newton, N. T. (1971). Design on the land. Cambridge,Massachusetts: Harvard University Press. [pp. 1-640]
Smithsonian Institution. (Photographer). (1800). panel4. [Web Graphic]. Retrieved from http://www.wiley.com/WileyCDA/Section/id-303137.htmlEliot
Eliot, C. (1903). Charles eliot: Landscape architect. (pp. 132-132). Cambridge,Massachusetts: The Riverside Press.
Cleveland, H. W. S. (Designer). (1883). Map of minneapolis, minn. [Print Drawing]. Retrieved from http://minneapolisparkhistory.files.wordpress.com/2010/09/horace-clevelands-map.jpg
Howard, E. (Designer). (1902). No.5 diagram. [Print Drawing]. Retrieved from http://www.library.cornell.edu/Reps/DOCS/howard.htm
Howard, E. (Designer). (1902). Ward and Center. [Print Drawing]. Retrieved from http://www.library.cornell.edu/Reps/DOCS/howard.htm
Interview with nina-marie lister, affiliate asla . (2011). Retrieved from http://www.asla.org/ContentDetail.aspx?id=31738

Ward, F. A. (2006). Environmental and natural resource economics. (pp. 15, 79, 85-86). Upper Saddle River, New Jersey: Pearson Education, Inc.
Donlan, J., Mandel, J. & Wilcox, C. (2009, April 22). Why environmentalism needs high finance. SEEDmagazine, Retrieved from http://seedmagazine.com/content/article/why_environmentalism_needs_high_finance/







[04] // inventory: ecology
Smith, T., & Smith, R. (2006). Elements of ecology. (6 ed., pp. XX-XX). San Francisco, California: Pearson Education Inc.
Domek, T., (1998). Last call for tallgrass in North Dakota. North Dakota Outdoors 60(10):14-19. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/plants/tallgrass/index.htm (Version 02OCT1998).
Brooks, M. S. (2011, May 19). Lake agassiz plain ecoregion summary. Retrieved from http://landcovertrends.usgs.gov/gp/eco48Report.html
Samson, Fred B., Fritz L. Knopf, and Wayne R. Ostlie. (1998). Grasslands. Pages 437-472 in M. J. Mac, P. A. Opler, C. E. Puckett Haecker, and P. D. Doran, eds. Status and Trends of the Nation's Biological Resources, Vol. 2. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/habitat/grlands/index.htm (Version 21JAN2000).
U.S. Fish & Wildlife Service. (2008, August 08). Tallgrass prairie ecosystems. Retrieved from http://www.fws.gov/midwest/ecosystemconservation/tallgrass_prairie.html
Smith, D. D. (1992). Tallgrass prairie settlement: Prelude to demise of the tallgrass ecosystem. Proceedings of Twelfth North American Prairie Conference, Retrieved from http://www.tallgrassprairiecenter.org/pdf/Recapturing_A_Vanishing_Heritage.pdf
Tallgrass prairie ecosystem. (n.d.). Retrieved from http://www.landscope.org/explore/ecosystems/disappearing_landscapes/tallgrass_prairie/
Hays, M. USDA, Forest Service, (1994). South dakota prairies. Retrieved from website: http://www3.northern.edu/natsource/HABITATS/Sdprai1.htm
Ecoregions of north dakota and south dakota. (2006, August 03). Retrieved from http://www.npwrc.usgs.gov/resource/habitat/ndsdeco/48a.htm

RESEARCH | climatology
Godon, V., & Godon, N. National Weather Service Eastern North Dakota, Scientific Services Division. (2002). Fargo, north dakota climate
(Godon & Godon, 2002)

[04] // inventory:
Dramstad, W., Olson J., Forman R. (1996). Landscape Ecology Principles in Landscape Architecture and Land-Use Planning. Washington, DC: President and Fellows of Harvard College.
Forman, R. T. (1995) Land Mosaics: The Ecology of Landscapes and Regions. Cambridge, UK: Cambridge University Press.

Simonds, J. O., & Starke, B. W. (2006). Landscape Architecture: A Manual of Environmental Planning and Design. New York, NY: McGraw-Hil Companies, Inc.

Author, A. A. (YEAR). Title of work. Location: Publisher.

Author, A. A. (YEAR). Title of Chapter/Entry. In A. Editor (Ed.), Title of work (pp xxx-xxx). Location: Publisher.

Author, A. A. (YEAR). Title of Chapter/Entry. In Stradling, David (Ed.) Conservation in the Progressive Era (pp. xxx-xxx) Seattle, WA: University of Washington Press.

Author, A. A., & Author, B. B. (Date of publication). Title of article. Title of Online Periodical, volume number (issue number if available). Retrieved from http://www.someaddress.com/full/url/

McGeough, U. Newman, D., & Wrobel, J. (2004). Model for Sustainable Design. Retrived from

[04] // inventory:

ENVIRONMENTAL HEALTH | energy

Gunther, M. (2010, September). Investing in wind power is smart — but not how we're doing it. WIRED, 18(09), 31-32.
Lucid energy inks agreement with city of portland. (2011, October 18). Retrieved from http://www.prweb.com/releases/2011/10/prweb8886497.htm
Field, M. (Photographer). (2011). wind_0. [Web Photo]. Retrieved from http://www.unitedbyblue.com/blog/beauty-unexpected

ENVIRONMENTAL HEALTH | soils
Boggess, J. (2011, November). Phytoremediation in landscape architecture. Retrieved from http://www.aslaoregon.org/updates/articles/phytoremediation-in-landscape-architecture

Turenscape. (Photographer). (2010). park_2. [Web Graphic]. Retrieved from http://urbanhydrologics.com/2011/04/30/shanghai-houtan-park-wetland-cascade-system/
Turenscape. (Photographer). (2010). park_3. [Web Graphic]. Retrieved from http://urbanhydrologics.com/2011/04/30/shanghai-houtan-park-wetland-cascade-system/

ENVIRONMENTAL HEALTH | air
Bacongco, K. (Photographer). (2011). air pollution. [Web Graphic]. Retrieved from http://www.greenprophet.com/2011/01/israel-clean-air-act/

VANESSA CHRISTINE HEFTI

vc.hefti@gmail.com
970-692-9716

4910 15th Ave. S
Fargo, ND 58103

Quote | A Preface

…knowing what you want is half of the battle; the rest is mostly paperwork. I'm sure someone more renowned has said something along those lines...I'd like to sit down and have a cup of tea with that person one day.

On | regulation
What is left for creativity? Original thought? Insight? Isn't it more important that we do something purposeful and take our time doing it well, rather simply becoming quite proficient at jumping through hoops?

On | education
I regret that the most iconic lesson I've learned has been how the institution of 'education' is completely overrated. I've spent most of my time here in a rushed and hurried state, I could hardly enjoy sitting down and reading a book for the pure joy and interest in learning. So if that is institutional learning…I'm afraid we've gone terribly wrong.

On | the NDSU ALA program
Albert Einstein said, "The aim [of education] must be the training of independently acting and thinking individuals who, however, see in the service to the community their highest life problem." In colloquial expression, it's said that even if you lead a horse to water, you can't make it drink. In these terms, I'm still not quite sure whether I should be more disappointed in the rider or the horse.

I studied, in my research, the trend in ecological theory of looking rather not on the community, but the individual. Oddly, taken in another context, it brings to mind the objectivist theories of philosophical thinker and writer, Ayn Rand. It isn't the community, but the individuals who make up the community, and so Atlas Shrugged. I say this to note that I take no pride in the name NDSU, nor the contrary. I'm indifferent. However, I do take much pride in the individuals who have had a positive impact on me. To those people, I am very grateful.

On | the experience
This past semester, any time I needed a reminder of who I am, and why I do what I do, I listen to Steve Jobs' 2005 Stanford Commencement Speech. I listen as he talks about dropping out of college and trusting that everything would be okay. I listen to him explaining how taking a random calligraphy course changed the world of typeface as we know it. I listen to him talk about getting fired and getting cancer. I hear him say:

> "Your time is limited, so don't waste it living someone else's life. Don't be trapped by dogma — which is living with the results of other people's thinking. Don't let the noise of others' opinions drown out your own inner voice. And most important, have the courage to follow your heart and intuition. They somehow already know what you truly want to become. Everything else is secondary."

Then I listen to him talk about death and how it is the greatest motivator. Then I think about him dying this past year. I think about all he achieved in his life, for himself and for the world…

On | to the future
And it stands echoing in my head, "most important, have the courage to follow your heart and intuition." I do this work because it is what I am meant to do, and for no other reason. One day, we die and all of this ceases to matter, so why not love the lives we live. It matters that we do what we love…and maybe that's the point of being here. The Buddha is quoted as saying, "Your work is do discover your work and then with all your heart to give yourself to It."

On | this
I refuse to be patronized into quoting one short, pithy sentence of poetic incite on my thoughts of NDSU. These are my thoughts.