ur su ru

high performance landscape systems
// An Integrated Solution

NORTH DAKOTA STATE UNIVERSITY
Department of Landscape Architecture
MAY 2012 | dominic fischer

vc.hefti
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?
<table>
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<tr>
<th>Year/City</th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
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<tr>
<td>Fargo</td>
<td>74,111</td>
<td>12,287</td>
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<td>West Fargo</td>
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<td>Moorhead</td>
<td>38,065</td>
<td>2,653</td>
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Total acreage~73076

Total acreage~17339

Total acreage~90415
“No snowflake in an avalanche ever feels responsible.”

Stanisław Jerzy Lec, poet & aphorist
FLOODING

memorial bridge
fargo/moorhead border

http://farm4.staticflickr.com/3594/3395342393_49bbbf5c46_o.jpg
“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
DOWNTOWN

HIGHER EDUCATION

ndsu, msum, concordia
INTELLECTUAL INDUSTRY

http://microsoft.areavoices.com/2011/06/04/little-gem-on-the-prairie-inside-the-microsoft-campus/

great plains microsoft, sanford health
ECOSYSTEM

tallgrass prairie, wind, river

from this... to this
“...there was a unity in this complication. ...one single question with many parts... The one great central problem...the [wise] use of the earth for the good of man.”

- Gifford Pinchot,
  Head of US Forest Service

“...a judicious expenditure for such objects is always a wise and safe investment.”

-Horace Cleveland,
on the Minneapolis/St. Paul park system

Horace Cleveland// Minneapolis & St. Paul_1872
“The subject of public improvements in the form of parkways is sure in its first inception to meet with opposition.”

“In the ten years succeeding...Central Park the increased valuation of taxable property in the...surrounding it was no less than $54,000,000, affording a surplus...sufficient...to pay the entire cost of the park in less times than was required for its construction.”

“...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...when the city has a population of a million...They will have wealth enough...but all their wealth cannot purchase a lost opportunity”

...evident that St. Paul and Minneapolis ...will become virtually one city...they should unite in the designing...the area which now separates them, by which they are to be mutually benefitted” (Newton, 2006).

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anthropocene

holoscene

gr. ‘holos’ - ‘cenos’ - ‘scene’

holos = ‘whole/entire’
cenos = ‘new/recent’
scene = ‘view/picture/where something occurs/milieu’

zones

mosaic

pixels

gradient
“Knowing is not enough; we must apply. Willing is not enough; we must do.”

Johann Wolfgang von Goethe,
German Playwright, Poet, Novelist and Dramatist
About a third of the endangered species in the United States make their homes in wetlands.

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

75-80% of the prairies biomass, or plant material, is underground.

Beneath the surface lies the main stems or rhizomes, running horizontally.

Here, they remain protected from drying, grazing, trampling, fire, and frost.

Tough fibrous roots descend from these rhizomes deep into the ground. Some plants have been reported to go 10 to 15 feet deep (nps.gov, complex prairie ecosystem).

Repeated Burn cycles create dark mineral and nutrient rich top soil.

Restored prairies can reclaim many of their native qualities in as little as 10 years.

TALLGRASS PRAIRIE ECOSYSTEM

- deep roots
- water infiltration
- water/sediment filtration
- recharging groundwater stores
- slope stabilization
- erosion prevention
- keeps silt from clogging streams

OPERANT DISTURBANCE REGIMES

- drought
- fire > 4-5yr fire regime
- grazing

WET-MESIC

- 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

WET

- 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
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<th>yellow-rumped warbler</th>
<th>Dendroica coronata</th>
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SURFICIAL GEOLOGY

- Glacial movement
- Glacial melt
- Soil depth & composition
- Long-term drought water supply
- Sustainable water resources use

Pre-Cretaceous bedrock

Cretaceous bedrock

Brenna Formation

Sherack Formation

Sediment
- Sand & gravel
- Till

Argusville Formation

Surface

Glacial

River

Lake

Caisson depth

BURIED SURFICIAL GEOLOGY
West Fargo Aquifer System

Moorhead Aquifer

Buffalo Aquifer

SECTION

Near surface water flow

Deep regional water flow

Precipitation

Evaporation

Transpiration & evaporation

Runoff

Groundwater & infiltration

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

- **Manitoba**: 600,000 → 300,000 ha. Decline: 99.9%
- **Minnesota**: 7,300,000 → 30,000-60,000 ha. Decline: 99.2-99.6%
- **North Dakota**: 130,000 → 120,000 ha. Decline: 99.9%

PRAIRIE/FLOOD CORRELATION OVER TIME

1800: One of the biggest wetland areas in the world was from Manitoba/Dakotas to Ontario/Ohio
- settlement → prairie grasses removed → fields ploughed → limited waterholding/slowing vegetative cover → drainage ditches → impervious surfaces → encouraged drainage → upstream development

1870: American farmers drained 17 million hectares of wetland, United States drained half

1970: TALLGRASS PRAIRIE ECOSYSTEM

FLOOD STAGES
- 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

DATASTREAM

<table>
<thead>
<tr>
<th>Location</th>
<th>Past area (ha.)</th>
<th>Current area (ha.)</th>
<th>Decline (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manitoba</td>
<td>600,000</td>
<td>300</td>
<td>99.9</td>
</tr>
<tr>
<td>Minnesota</td>
<td>7,300,000</td>
<td>30,000-60,000</td>
<td>99.2-99.6</td>
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<td>North Dakota</td>
<td>130,000</td>
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average monthly water use

- **Total**: ~2383 → 366.4 millions of gal.

ANNUAL PEAK STREAMFLOW

1900-2010

- 1800: One of the biggest wetland areas in the world was from Manitoba/Dakotas to Ontario/Ohio
- 1870: American farmers drained 17 million hectares of wetland, United States drained half

FARGO


~366.4 millions of gal.

Bureau of Reclamation’s solutions range:

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

DATASTREAM

- working landscape
- floating ponding protected
- floodwall levee [constructed]
- levee [earthen]
- levee [sandbag]
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

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

- Development increases weight and induces runoff, weakening soils.
- Septic installation adds weight, increasing runoff, and weakening soils.
- Native vegetation removal reduces slope stability.
- Deep-rooted plant removal reduces infiltration and increases rate of runoff.
- Soil saturates with no plants, taking water.
- Ground water builds, further slumping and foundation shifts.
- Riverbank begins to slump, leading to more slumping and foundation cracks.
- House removed due to increased runoff.
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.

“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

The United State pays around $20 billion per year in Agricultural subsidies.

Wind and flood erosion in the area removes the nutrient rich black topsoil formed by the prairie fire regime, requiring increasing dependence on fertilizers, in turn polluting waterways.

Decaying prairie plants assimilated nutrients and returned them to the ground, creating rich, dark soils
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

Suburban Park System
mitigative
neighborhood park with integrated wetland functions
2. Neighborhood parks
3. Suburban to Urban systems

Urban Park System
interpretive
wet tallgrass prairie functions integrated into highly structured spaces
1. Urban parks
2. Urban river parks
grey material  grey fabric  structure  educational (describing process)  interpretive  Reniassance Zone aesthetic

mitigative

green material  green fabric  ecology  functional (programming process)  ecological  Great Plains Microsoft aesthetic
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Buffalo Aquifer Park
preventative, highly functional tallgrass prairie wetland ecological parks

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
FLOATING SUSPENSION BRIDGE (typ.)

1' rebar reinforced poured concrete (to bedrock)
3 1/2" corten steel support
4" steel hex bolts
1' rebar reinforced poured concrete
engraved trail marker
dock structure slides vertical
with water level along trail marker

4x4 and corten support meet
1' concrete base for structural
trail support at low water levels
dock structure slides vertical
with water level along trail marker

6' resin treated 2x4s & 4x4s
floating dock
6-4' galvanized steel eye bolts
1" steel washer
1' rebar reinforced poured concrete
(to bedrock)
1/4" steel cable
1' reinforced poured concrete
engraved trail marker

Ru
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 piezoelectric 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.
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

SUBURBAN PARK ENTRY SIGNAGE (typ.)

n.t.s.
Suburban Park System
mitigative neighborhood park with integrated wetland functions

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

mitigative

geoweb groomed trail (ru3a)

planting
preserved riparian old growth
reconstructed river edge

planting
preserved riparian old growth
reconstructed wet tallgrass prairie

55

SYR FLOOD LEVEL

5

n.t.s.

SUBURBAN TRAIL SYSTEM (typ.)

123

mitigative

planting
red maple
red osier dogwood
mulch bed

patterned brick (4b)

cast concrete
2x4 treated wood
stainless steel support
LED underlighting
rock underbed

carbon fiber windstalls (4a)

cantilever bench (4c)

engraved mile marker
feeder reinforced concrete
rock bed

permeable asphalt trail

100

rock bed

planting

preserved riparian old growth
reconstructed wet tallgrass prairie

5

b

SUBURBAN TRAIL SYSTEM (typ.)

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

- 4'6"x2'1/2" steel rock/water bed
- Red brick weave w/ tan/blue brick strips
- High albedo aids in snow/ice melt
- Rebar reinforced cast concrete
- 1/4" steel supporting plate
- 6' treated 2x4's
- LED strip underlighting

Memorial Plaza trail design
Urban Park System

interpretive

wet tallgrass prairie functions integrated into highly structured spaces

1. Urban parks
2. Urban river parks
Red River Fire Festival
Annual Community Celebration

Prairie grasses require burning every 3-5 years. 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.
Rural Park System

preventive
highly functional tallgrass prairie wetland ecological parks

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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?

“Success on any major scale requires you to accept responsibility . . . . In the final analysis, the one quality that all successful people have is the ability to take on responsibility.”

Michael Korda
Editor-in-Chief, Simon & Schuster

“Being responsible sometimes means pissing people off.”

General Colin Powell