ON BEYOND Q

A project of South Dakota State School of Design – Landscape Architecture Program

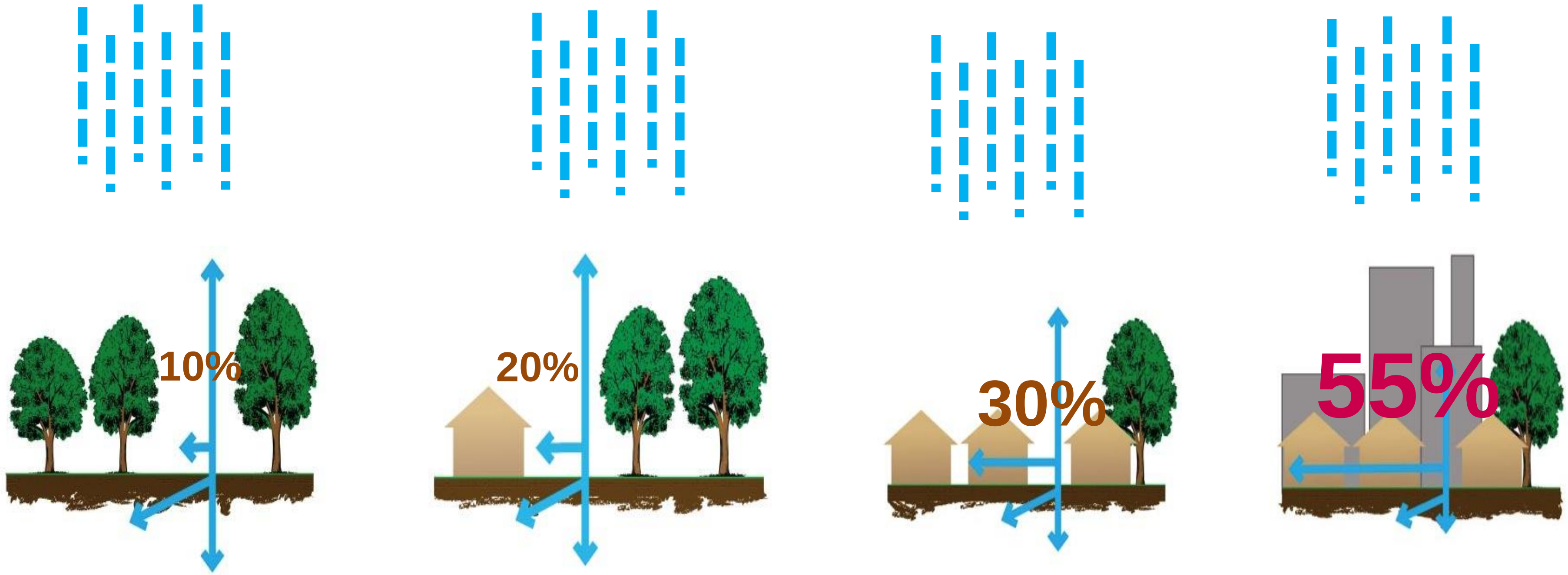
Presented in partnership with SDSU Extension

Sponsored by California Landscape Architectural Student Scholarship Fund and East Dakota Water Development District

Introduction

Stormwater management in the 21st Century

The Impact of Development on Stormwater Runoff



More development → *More impervious surfaces* → *More stormwater runoff*

USEPA Phase II Stormwater Management

To meet the intent of the SD DENR "General Permit for Storm Water Discharges from Small MS4s," management strategies need to:

- Reduce peak flows

…and….

- Reduce runoff volume
- Reduce pollution discharged to local waterways

Green Stormwater Infrastructure

…an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly.

Green stormwater infrastructure projects:

- capture stormwater runoff from impervious areas,
- manage stormwater runoff as near to the source as possible
- include a series of practices that filter, absorb, and reuse stormwater runoff
- restore the natural water cycle

Low Impact Development Design Principles

- Manage runoff volumes from smaller, more frequent storm events using on-site practices
- Keep runoff out of pipes as much as possible – use landscape strategies first
- Runoff volume from first inch (1”) of rainfall should not leave site
- Disconnect all impervious areas from directly discharging runoff into the storm sewer system

On-site GSI Stormwater Management Techniques

Bioretention

Permeable Pavement

On-site GSI Stormwater Management Techniques

Rain Harvesting

Green Roof

ON BEYOND Q

Research Project

Assessment & Mapping

- Soil Infiltration Testing and Analysis
- GIS mapping
  - Soils
  - Land use
  - Infrastructure
  - Drainage basins
  - Impervious areas
- Hydrologic calculations

Soil Sampling

- 16 locations
- Infiltration Testing
- Low Infiltration (4 sites)

  0.49 in/hr – 0.94 in/hr

- Mid-range Infiltration (8 sites)

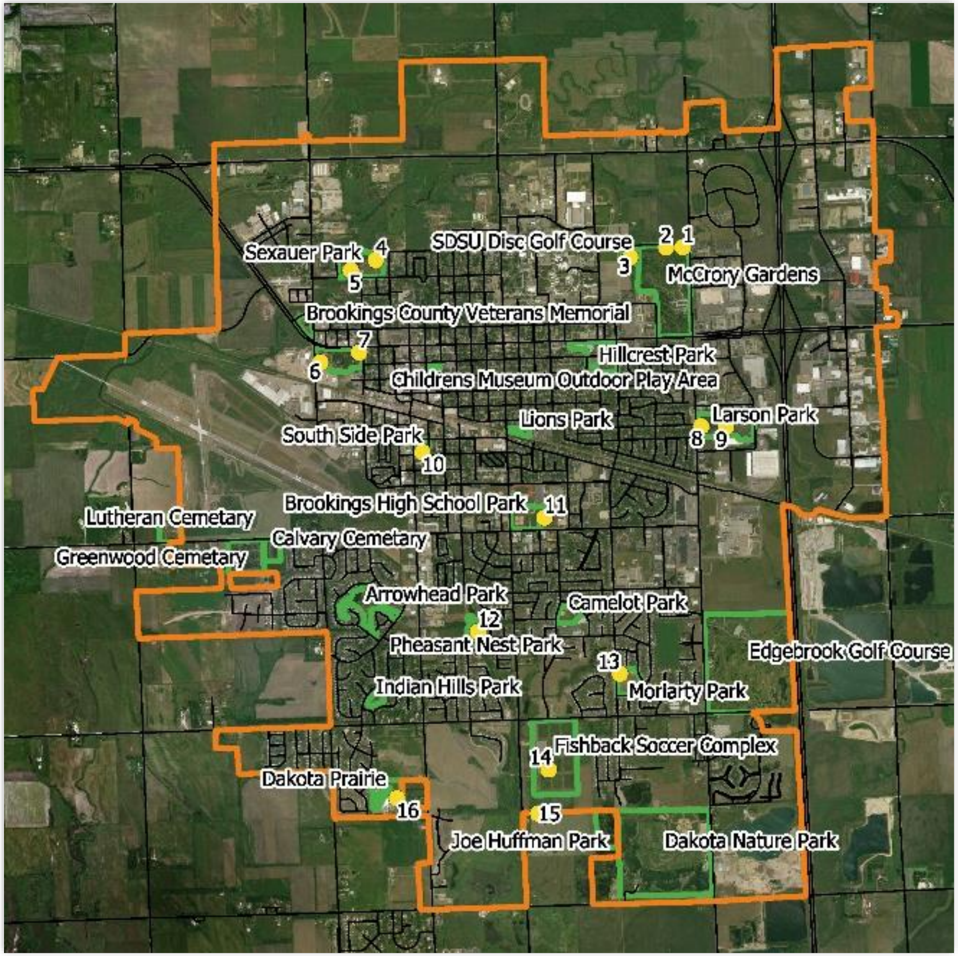
  1.22 in/hr – 2.72 in/hr

- High Infiltration (4 sites)

  3.24 in/hr – 5.61 in/hr

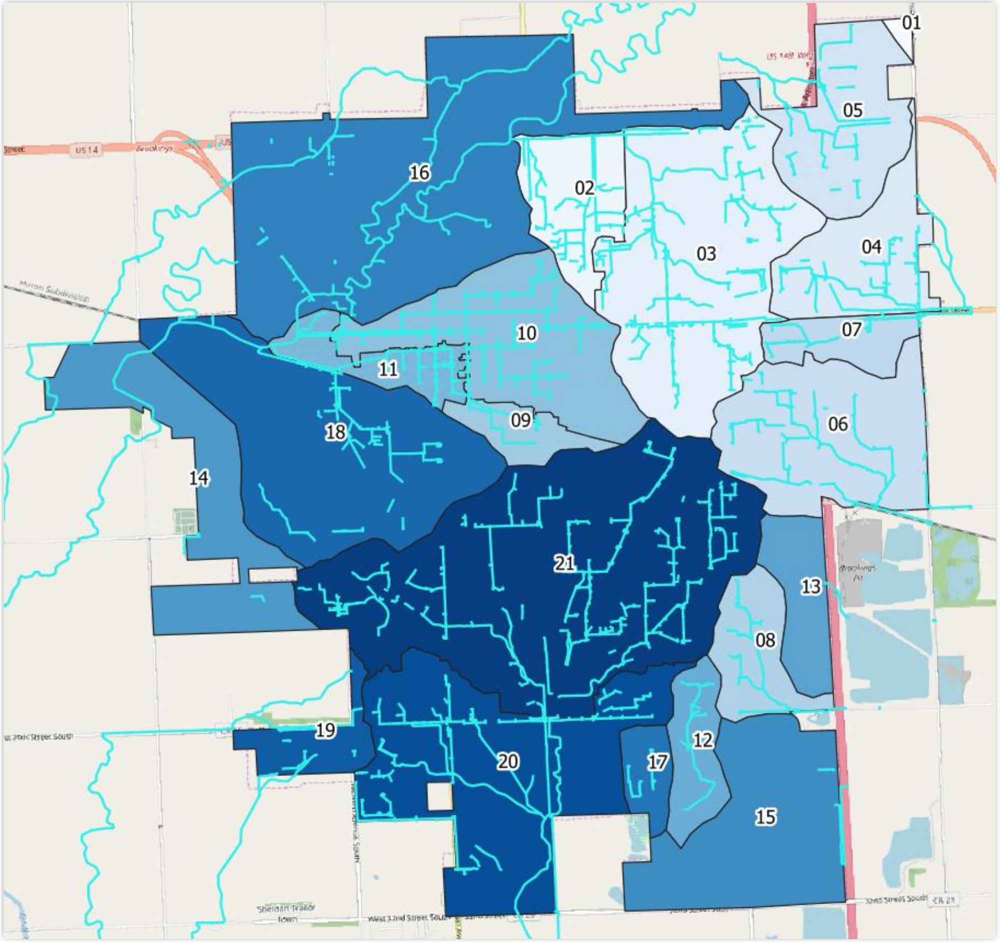
- Soil analysis for physical properties

  % sand, silt, and clay

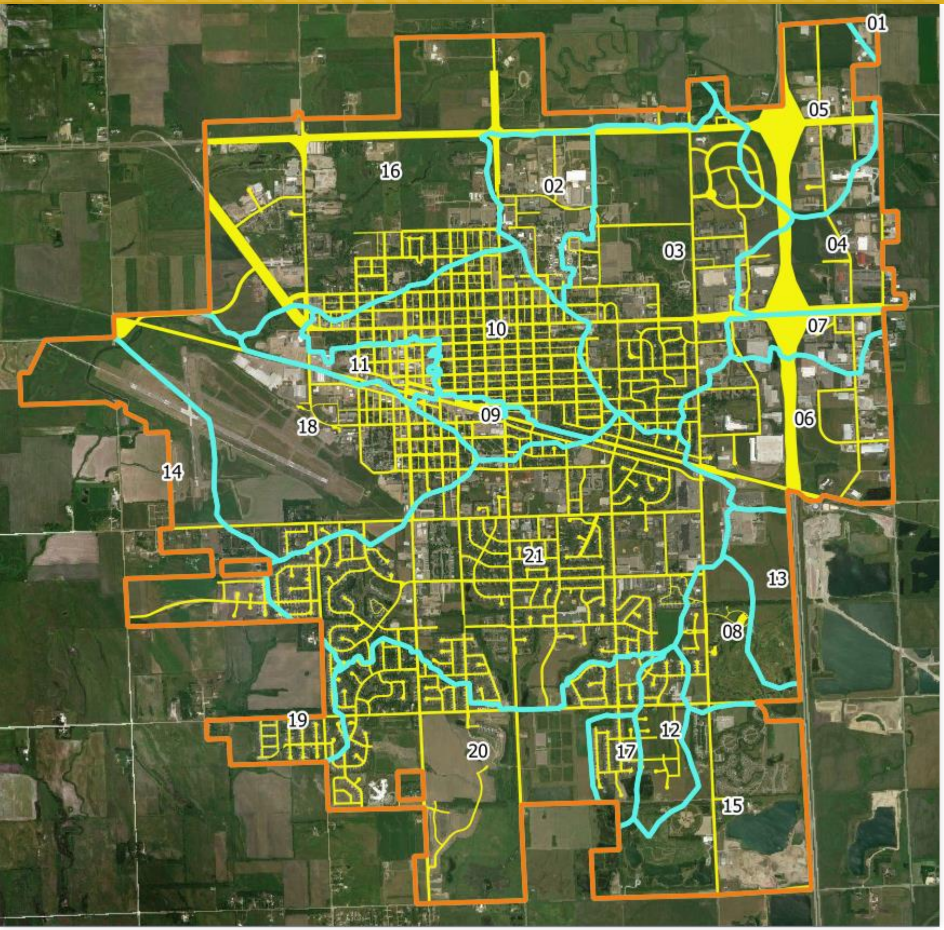


Analysis

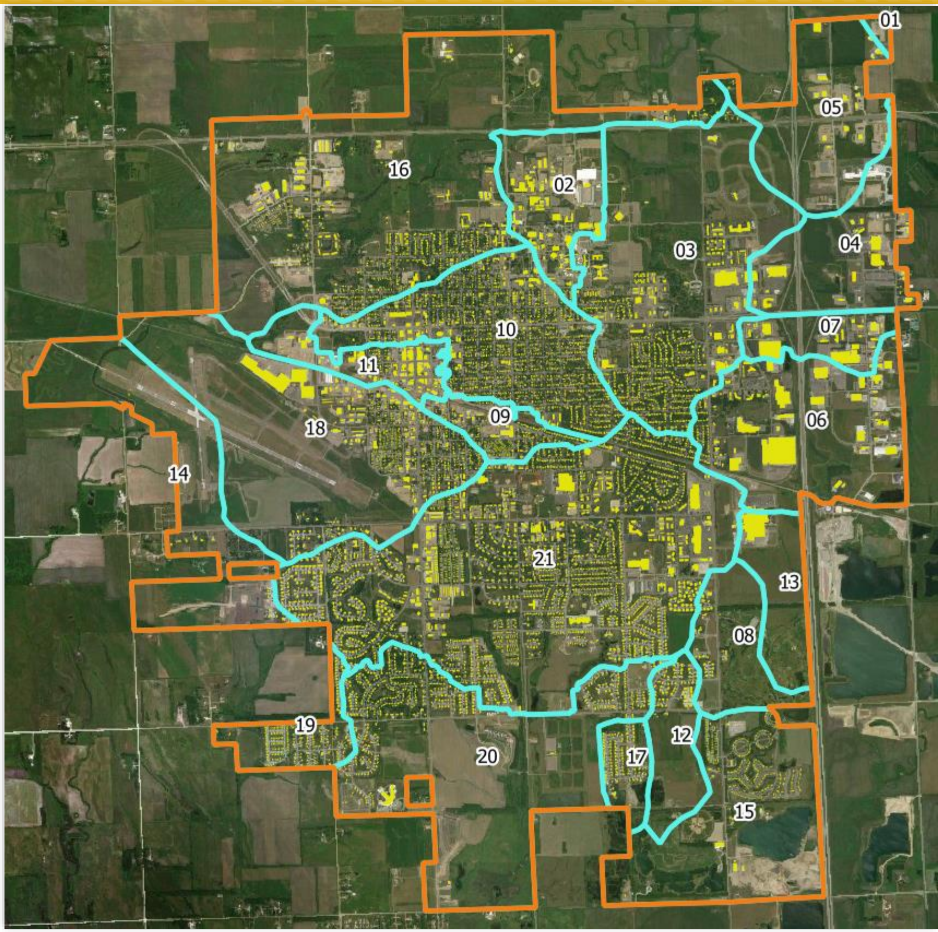
- Soils
- Precipitation Patterns
- Impervious Cover Calculations
- Drainage Summary



Impervious Cover



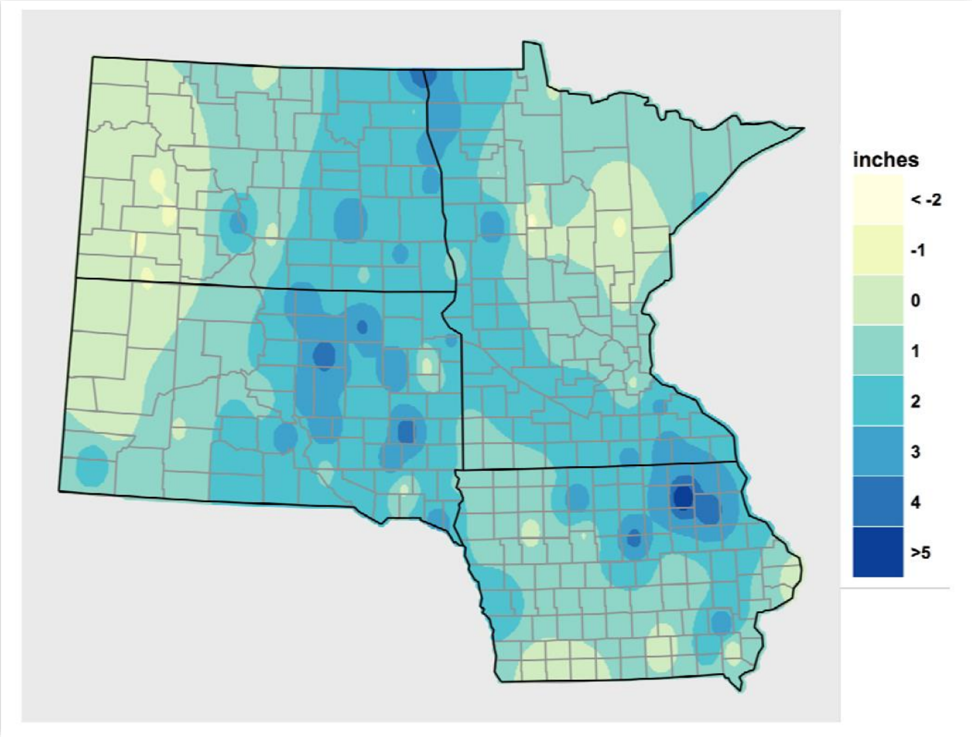
Right-of-Way



Roof Area

Changes in Precipitation Patterns

- Average annual precipitation has increased from 2 to over 5 inches (Hay & Todey, 2011)
- Since 1990, South Dakota has averaged 14% more 1-inch rain events (NOAA)
- Winter precipitation is projected to increase by 10%–20% (NOAA)

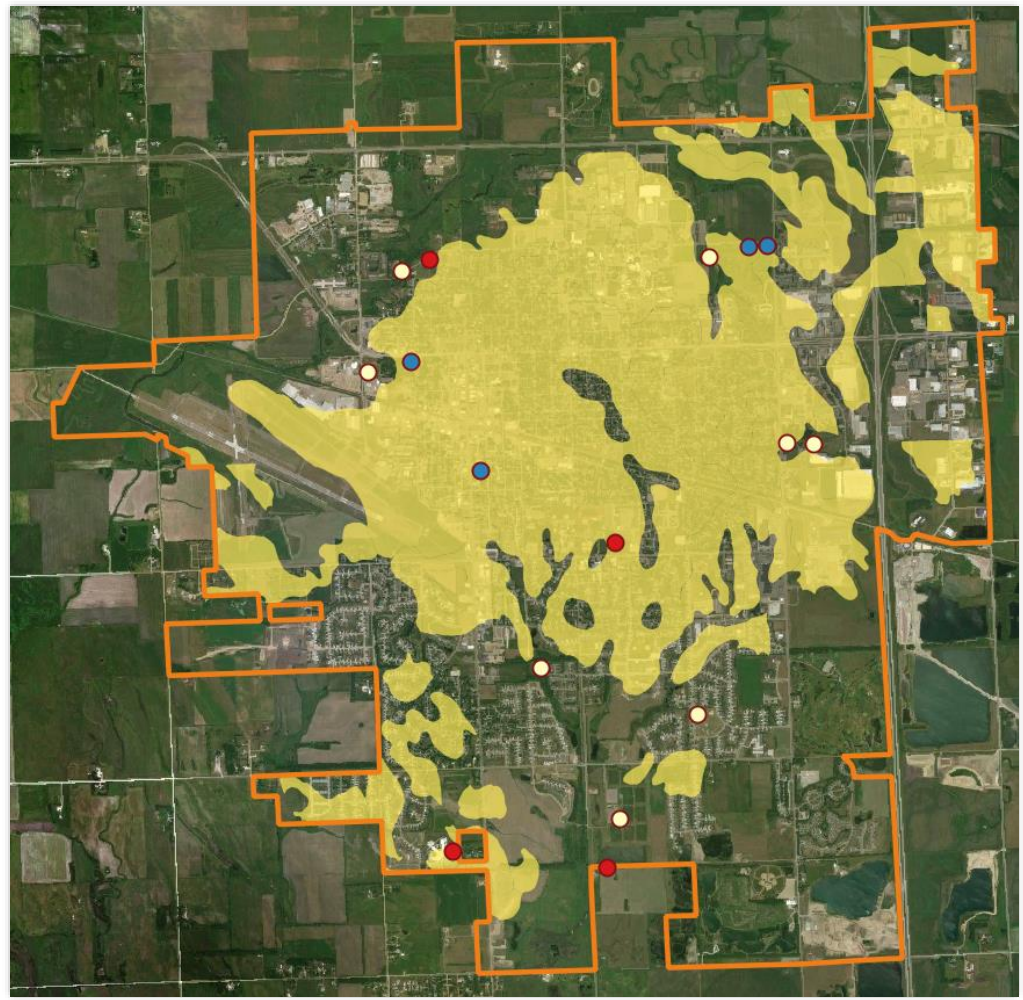


Hay & Todey, 2011: Change in mean annual precipitation, in inches, for the period of 1991-2009 as compared to 1961-1990

Soils

Best available soils for GSI practices:

- >80 in. to water table
- > 1in/hr permeability rating
- A, B, C HSG rating



Soil Infiltration
- < 1"
- 2 - 3"
- > 3"

Impervious Cover Calculations

Basin ID	Area_Acres	Soil HSG	R.O.W. Acres	% R.O.W.	Rooftop S.F.	Rooftop Acres	% Rooftop	R.O.W.+ROOF	High Point	Low Point	Length	Slope
01	11.92	B	0	0%	251	0.01	0%	0%	1664.8	1653.6	900	1.24%
02	217.77	C	27.04	12%	1039680	23.87	11%	23%	1660.5	1610	5056	1.00%
03	793.74	C	135.56	17%	2355170	54.07	7%	24%	1690.7	1617.4	9252	0.79%
04	277.41	C	60.26	22%	641367	14.72	5%	27%	1672.8	1621.7	5842	0.87%
05	329.23	C	80.96	25%	299826	6.88	2%	27%	1666.9	1630	3217	1.15%
06	481.26	C	75.27	16%	2156120	49.50	10%	26%	1692.1	1615.1	6007	1.28%
07	118.76	C	38.96	33%	843482	19.36	16%	49%	1675.3	1625.4	4235	1.18%
08	176.65	C	19.67	11%	146568	3.36	2%	13%	1660	1607.2	4227	1.25%
09	96.74	C	32.36	33%	534493	12.27	13%	46%	1674.8	1627.3	4166	1.14%
10	475.96	C	151.35	32%	2692980	61.82	13%	45%	1684.9	1605.4	8864	0.90%
11	134.65	C	39.24	29%	834679	19.16	14%	43%	1634.8	1600	4761	0.73%
12	139.53	C	18.1	13%	237582	5.45	4%	17%	1650	1597.4	4042	1.30%
13	152.98	C	0	0%	446314	10.25	7%	7%	1668.4	1608.6	4922	1.21%
14	419.03	B	17.81	4%	81259	1.87	0%	5%	1673.7	1591.3	4232	1.95%
15	483.32	B	16.93	4%	368465	8.46	2%	5%	1635.6	1596.8	4272	0.91%
16	1181.12	B	145.62	12%	1693990	38.89	3%	16%	1635.8	1599.8	14422	0.25%
17	75.92	C	11.83	16%	274387	6.30	8%	24%	1623.6	1596.8	2236	1.20%
18	771.89	C	88.12	11%	1941790	44.58	6%	17%	1647.8	1599.5	8191	0.59%
19	111.98	B	22.51	20%	457550	10.50	9%	29%	1671.8	1595.1	4833	1.59%
20	773.81	C	90.08	12%	1276400	29.30	4%	15%	1664.7	1595	8232	0.85%
21	1382.27	C	238.08	17%	7219710	165.74	12%	29%	1689.5	1605.3	8479	0.99%

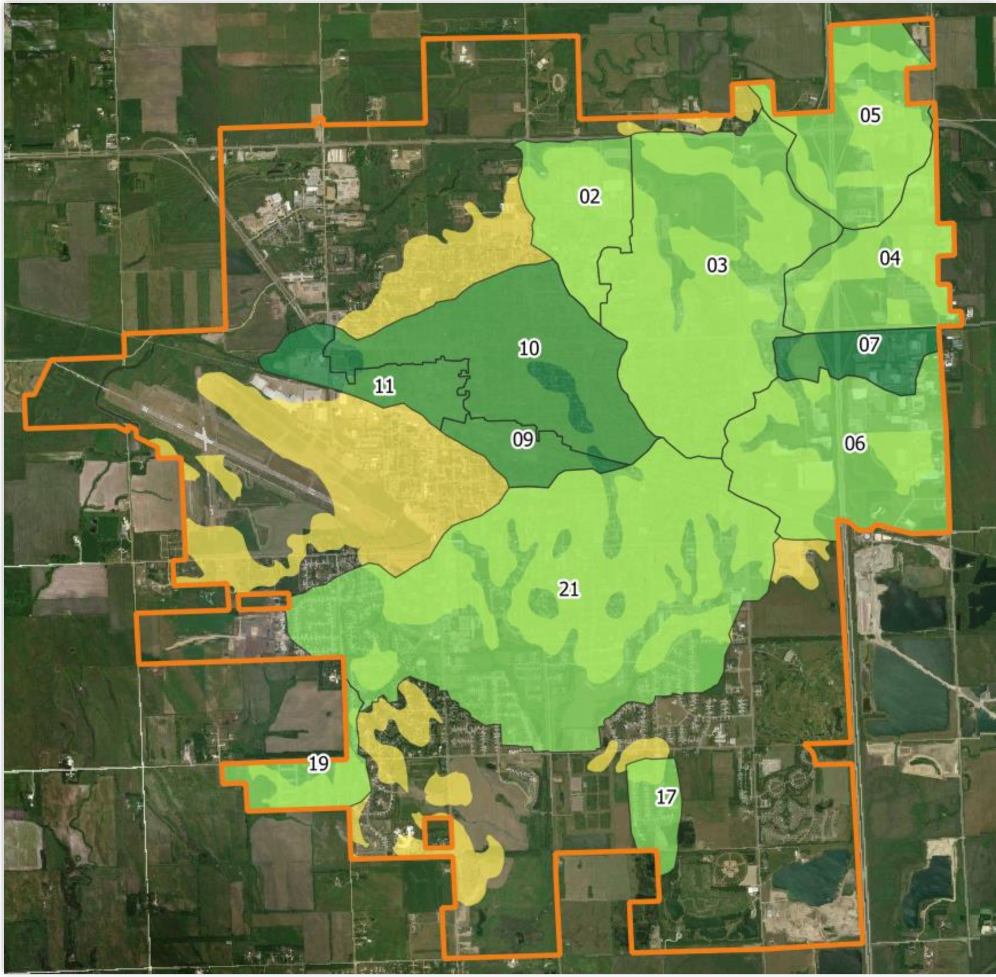
Priority GSI Basins

First priority areas:

> 40% directly connected impervious cover

Second priority areas:

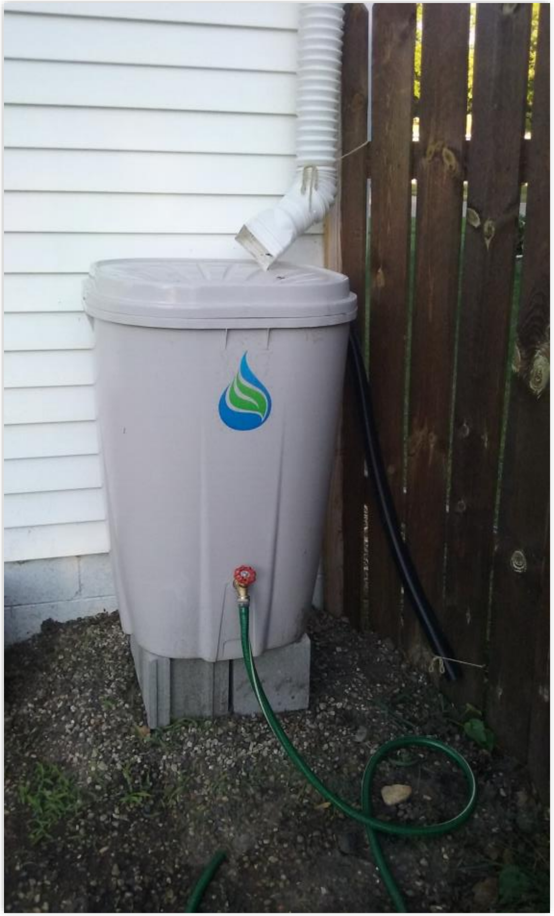
> 20% directly connected impervious cover



Preliminary Findings

- GSI is feasible in select areas with suitable soils
- Capacity for significant stormwater *infiltration* is limited
- Underdrain systems connected to stormwater infrastructure are needed to minimize failure due to increased precipitation in off-growing seasons
- Opportunity for GSI to disconnect impervious cover from existing sewer system is significant
- Lack of steep slopes support GSI installations
- Shallow systems (<24" depth) focused on detention and plant uptake most practical

Ongoing Research & Community Outreach



Ongoing Research & Community Outreach

Ongoing Research & Community Outreach

Opportunities for Brookings

- Utilize activities conducted through the On Beyond Q project to enhance Public Education, Outreach, and Participation under MS4 permit
- Enhance on-site stormwater management requirements for new development and redevelopment projects
- Expand public education, outreach, and participation

Next Steps for Research and Development

- Refine GSI analysis to identify feasible projects on priority sites in Brookings
- Collaborate with the City of Brookings to design GSI demonstration projects on city-owned properties / integrate into new capital improvement projects
- Establish monitoring program to evaluate effectiveness of GSI practices in Brookings
- Recommend standards updates to allow developers to implement GSI