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WaterSmart Innovations 2015



Durkees Run Stormwater Park

A Green Infrastructure Case Study

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Team Leader-Integrated Planning



Williams Creek Consulting

- Williams Creek's mission is to preserve and improve natural water resources through engineering design and implementation of sustainable, practical, **financially responsible solutions.**
- Integrated Design Practice:
 - Land Use and Urban Planning
 - Sustainable Infrastructure Engineering
 - Landscape Architecture
 - Regulatory Compliance and Consultation
 - Water Footprinting (Water Use/Wastewater Treatment)





Project Community Background- Lafayette, IN

What happens when a community goes “ALL IN” with Green Infrastructure?

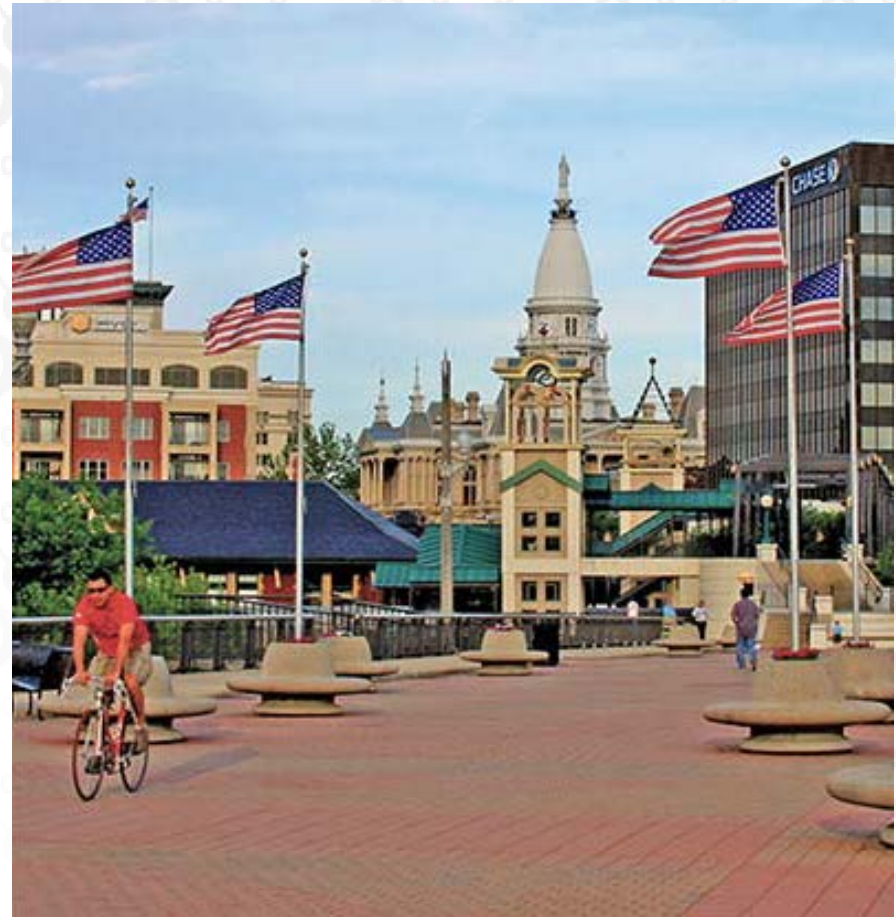




Project Community Background

Why Green Infrastructure?

- City of Lafayette is under a consent agreement for CSO abatement
- CSO system serves 3,800 acres with 12 CSO service areas
- Upgrading wastewater treatment facilities + implementing integrated grey and green infrastructure for LTCP
- **GI provides direct benefit of reduced peak flow and annual runoff volumes**
- **GI supports Lafayette's economic development, historic preservation and community enhancement efforts**





City of Lafayette Integrated Infrastructure Strategy

CIP Integration

- Right of Way
- Open Space
- Neighborhood revitalization



3rd Street & Alabama Street



Maple Point Dr. & Concord Road



North Street Reconstruction



Durkees Run Stormwater Park



Vinton Elementary Rain Garden



North Street Reconstruction

Streetscape Water Quality Elements and Permeable Pavers





North Street Reconstruction

Streetscape Water Quality Elements and Permeable Pavers





North Street Reconstruction

Streetscape Water Quality Elements and Permeable Pavers





Avoided Costs – By the Numbers

Project	Gallons removed	Annual treatment costs savings	Peak flow reduction	Capital investment treated
North Street	6.6 million (potential for 8 million)	\$44,000	30%	\$0.50/gallon
Durkees Run Stormwater Park	2.8 million	\$19,000	84%	\$0.57/gallon
Vinton Elementary School Rain Garden	2 million (designed for 8 million)	\$13,000	89%	\$0.08/gallon



Case Study

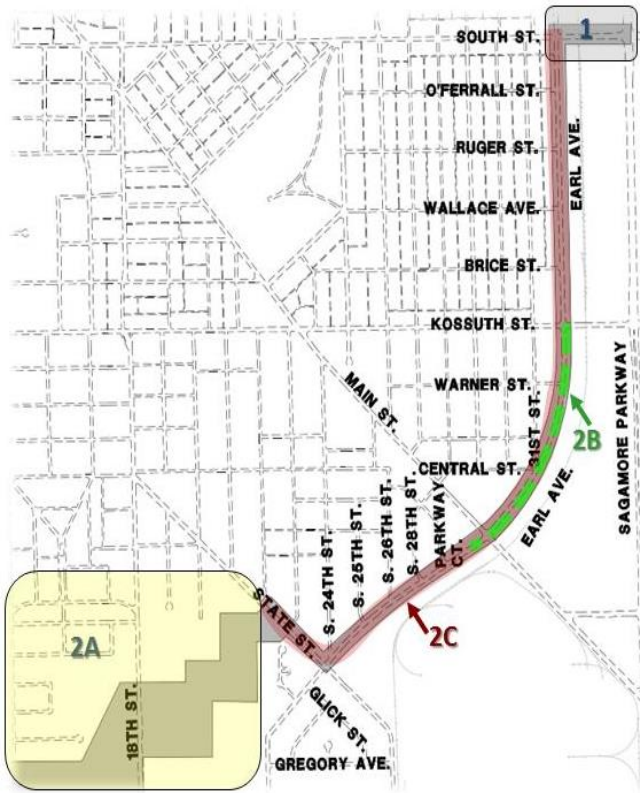
Durkees Run Stormwater Park



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Durkees Run Stormwater Park Phase 2A





Durkees Run Stormwater Park

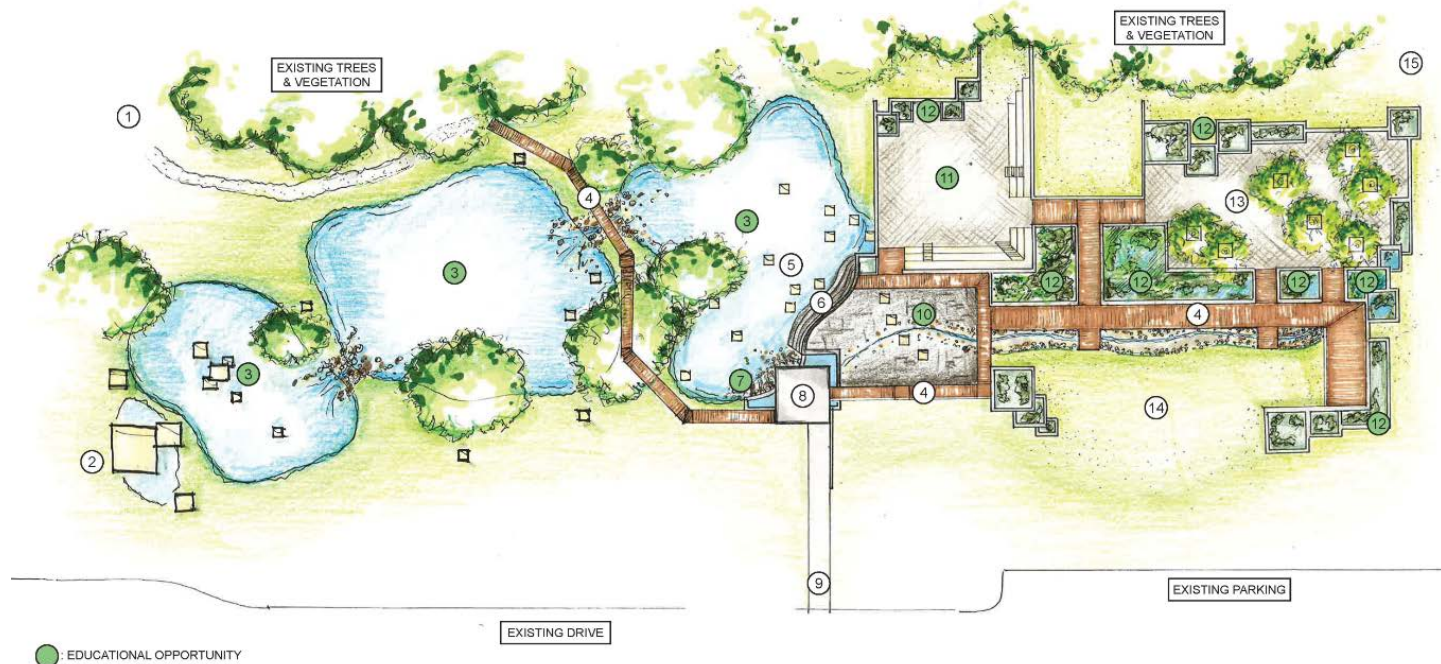
Pre-existing Conditions





Durkees Run Stormwater Park Concept Development

Multidisciplinary Approach



● EDUCATIONAL OPPORTUNITY

1. 18TH STREET PEDESTRIAN CONNECTION
2. STORMWATER OVERFLOW AS INTERPRETIVE FEATURE
3. CONSTRUCTED STORMWATER WETLANDS
4. BOARDWALK
5. LIMESTONE COLUMNS
6. CASCADE OVERFLOW
7. WATER PRESSURE OUTFLOW DEMONSTRATION
8. OVERLOOK AND STUDENT ACCESS

9. PEDESTRIAN CONNECTION TO JEFFERSON HIGH SCHOOL
10. TRANSITIONAL PLAZA WITH ARCHITECTURAL FLOOD STAGE MARKERS
11. OUTDOOR CLASSROOM
12. ECO-SYSTEM DEMONSTRATION PLANTERS
13. ECO-SYSTEM GATHERING AREA
14. LAWN
15. STORMWATER OUTFALL

DURKEE'S RUN STORMWATER PARK - CONCEPT PLAN





Durkees Run Stormwater Park Final Concept



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Guaranteed Energy Savings Project Delivery



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Durkees Run Stormwater Park



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Durkees Run Stormwater Park

High Performance Infrastructure



1. Overall Project Costs (Durkees Run Interceptor + Earl Avenue Reconstruction Project) = +\$33M and growing!
2. Durkees Run Stormwater Park = \$1.6M
3. Overall project diverts 100M gallons of stormwater annually over 1000 ac.
4. Durkees Run Stormwater Park reduces peak flow by 84% from contributing watershed.
5. Removes 2.8M gallons from combined sewer system annually
6. \$0.57 per gallon treated capital investment
7. 6,500 SF of permeable pavers
8. 35,000 SF of constructed wetlands
9. 18,821 native plugs, shrubs and grasses
10. 56 native trees
11. Net Annual Cost of Treatment Reduction = \$19K

Additional Benefits:

1. Interactive watershed and stormwater management educational features in outdoor classroom setting
2. Connects to overall Lafayette trails system providing
3. Passive and “active”/learning interaction
4. Positive capital return on investment
5. Enhance public health and safety
6. Fosters next generation of natural resource stewards



Durkees Run Stormwater Park Stakeholders

City Of Lafayette

- Mayor's Office
- Waste Water Department
- Engineering Department

Lafayette Jefferson High School

- Administration
- Athletic Department
- Science Department

Design Build Team

- Bowen
- Williams Creek
- B.F.&S.



Project Ecosystems



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Upland Ecosystem Project Elements





Outdoor Classroom





Mesic Ecosystem Project Elements





Wetland Ecosystem Project Elements



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Educational Components

Water Pressure Demonstration





Educational Components

Flood Stage Markers





Educational Component Outdoor Classroom



Project Signage

DURKEES RUN STORMWATER PARK

The Experience of Durkees Run Stormwater Park

What is Durkees Run and Where Does the Water Go?

Durkees Run is a tributary of the Wabash River; water that flows through Durkees Run works its way to the Wabash, then to the Ohio River, the Mississippi River, and eventually to the Gulf of Mexico.

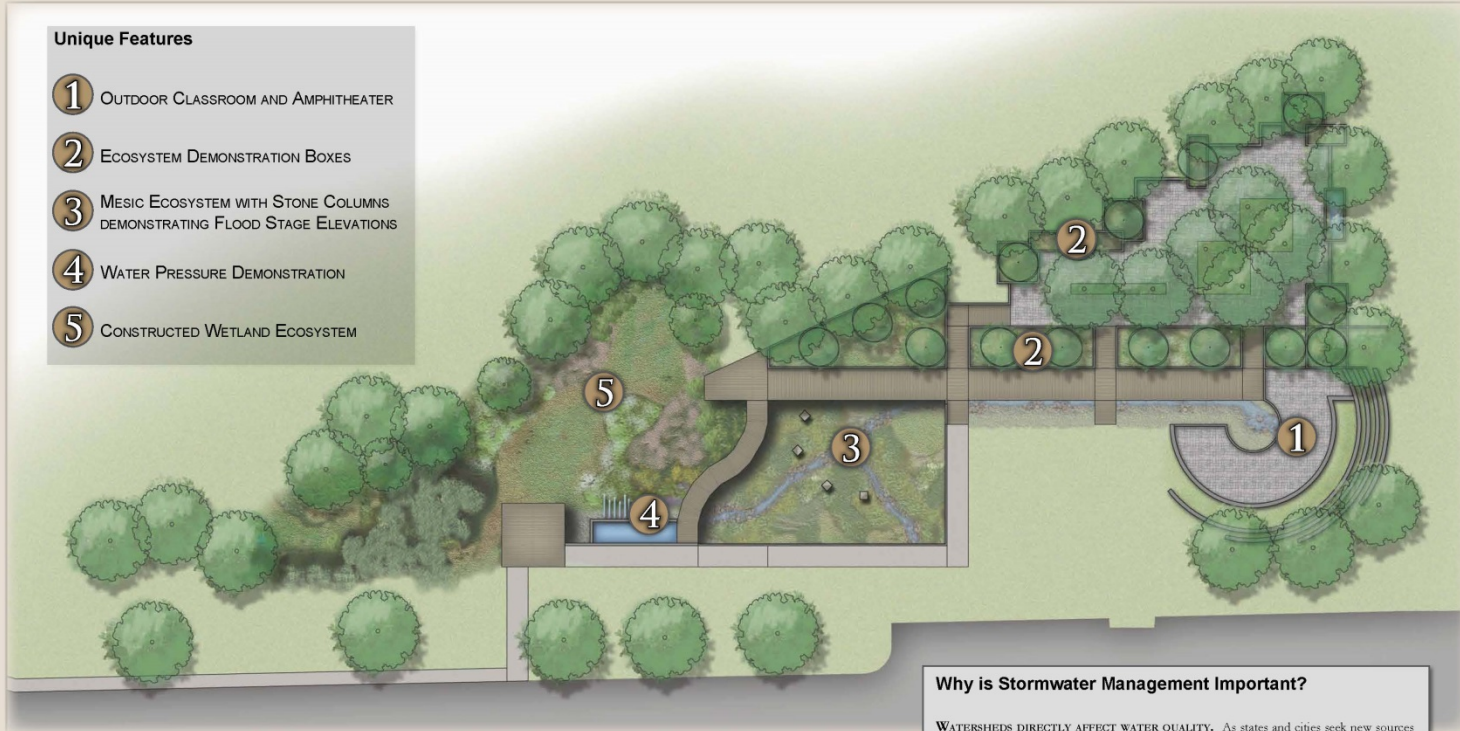


What is the Function of Durkees Run Stormwater Park

Durkees Run Stormwater Park treats, stores, and infiltrates stormwater from the surrounding area, providing benefits in the form of decreased stormwater flow, recharge of underground aquifers, educational opportunities, and added community recreational amenities.

Unique Features

- 1 OUTDOOR CLASSROOM AND AMPHITHEATER
- 2 ECOSYSTEM DEMONSTRATION BOXES
- 3 MESIC ECOSYSTEM WITH STONE COLUMNS DEMONSTRATING FLOOD STAGE ELEVATIONS
- 4 WATER PRESSURE DEMONSTRATION
- 5 CONSTRUCTED WETLAND ECOSYSTEM



Why is Stormwater Management Important?

WATERSHEDS DIRECTLY AFFECT WATER QUALITY. As states and cities seek new sources of uncontaminated drinking water, keeping watersheds healthy becomes increasingly vital to keeping water clean.

UNHEALTHY WATERSHEDS AFFECT WILDLIFE. Aquatic life quickly suffers the effects of water pollution; pollutants introduced into ecosystems alter wildlife habitat and food sources.

THREAT OF EROSION. Water flowing in streams collects soil and sediment which causes erosion. As water flow increases, stream banks may become unstable and eventually erode away. This can result in loss of wildlife habitat.

URBAN ENVIRONMENT AFFECTS STORMWATER. Development alters the natural environment which alters natural drainage paths. Rainwater that would have been absorbed naturally by soil, plants, etc. instead is sent directly into streams via impervious surfaces such as roadways, rooftops, and driveways.

Project Signage

DURKEES RUN STORMWATER PARK

The Power of Water within Durkees Run Stormwater Park

Water is Vital

Water is all around us. All forms of life need it. It comprises most of the human body. Water is in the food we eat and the beverages we drink. It covers about 70 percent of the Earth for a total of approximately 332.5 million cubic miles.

Water Flows

The flow of water refers to the amount of water coming from a source, in a certain period of time. Water flowing in ditches, streams, or rivers is runoff from the surrounding land. Runoff comes from either impervious surfaces, such as rooftops or parking lots, or through soils and groundwater. By decreasing the amount of impervious surfaces, water is allowed to infiltrate back into the soil, recharging aquifers, instead of flowing into streams.

Water is Powerful

When water moves soil and sediment it is called erosion. Soil erodes more quickly when the flow of water increases in speed and volume; reducing these factors can help reduce the rate of soil erosion. Durkees Run Stormwater Park forces a portion of the runoff to infiltrate into the ground while retaining the remaining water to be released slowly over time.

The Driving Forces of Water

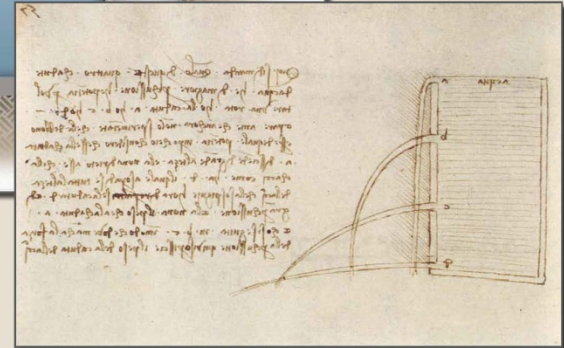
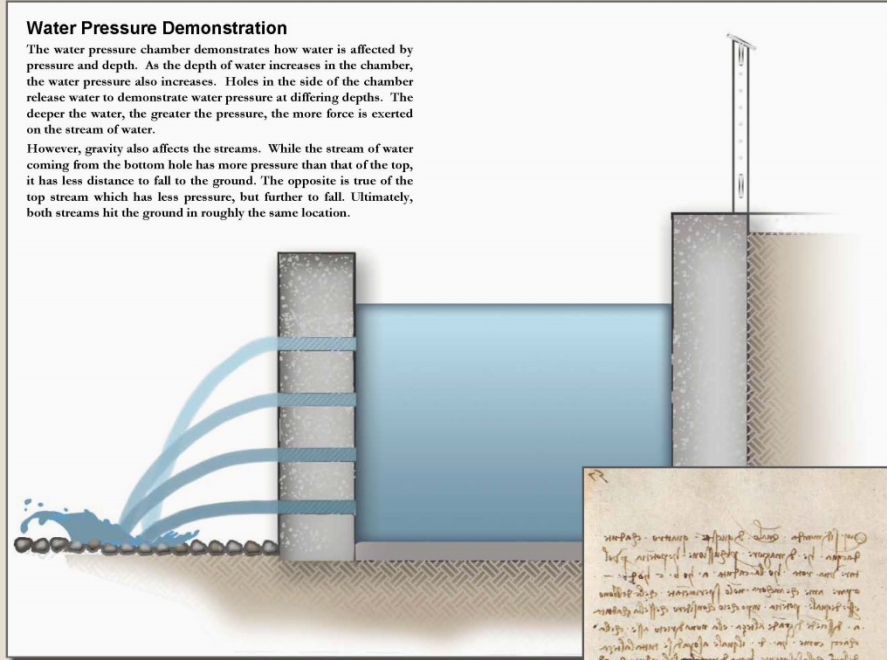
Water pressure is the result of a combination of air pressure and the weight of the water itself. As depth increases, pressure increases, due to the increased weight being applied. Pressure is measured in units of force divided by area, such as pounds per square inch (psi). A unit called an atmosphere (atm) is often used to calculate pressure. One atm is equal to the pressure of the atmosphere at sea level (14.7psi). Because water is more dense than air, for every 33 feet of depth, the water pressure increases by 1 atm.

1 FOOT	0.43 PSI
2 FEET	0.86 PSI
3 FEET	1.29 PSI
4 FEET	1.72 PSI
5 FEET	2.15 PSI
6 FEET	2.58 PSI

Water Pressure Demonstration

The water pressure chamber demonstrates how water is affected by pressure and depth. As the depth of water increases in the chamber, the water pressure also increases. Holes in the side of the chamber release water to demonstrate water pressure at differing depths. The deeper the water, the greater the pressure, the more force is exerted on the stream of water.

However, gravity also affects the streams. While the stream of water coming from the bottom hole has more pressure than that of the top, it has less distance to fall to the ground. The opposite is true of the top stream which has less pressure, but further to fall. Ultimately, both streams hit the ground in roughly the same location.

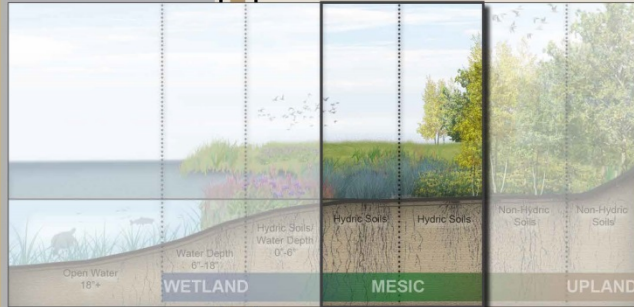


LEONARDO DAVINCI USED A DEVICE SIMILAR TO THAT OF THE STRUCTURE BEFORE YOU TO INVESTIGATE THE EFFICIENCY OF WATER AS IT FALLS. BY EXPERIMENTING WITH AND ANALYZING THE EFFECT OF FOUR STREAMS OF WATER FROM FOUR EQUAL OPENINGS MADE AT DIFFERING HEIGHTS IN A TANK FULL OF WATER, HE THEORIZED THAT THE POWER OF EACH OF THE STREAMS WAS BASED UPON THE COMBINED EFFECT OF THE WEIGHT OF THE WATER AND ITS PERCUSSION, OR THE PRESSURE BY WHICH IT IS EXPELLED. DAVINCI CONCLUDED THAT THE FOUR STREAMS "SHOULD BE OF EQUAL POWER," NOTING THAT "WHERE THE FORCE OF PERCUSSION IS LACKING, THE WEIGHT COMPENSATES."

Project Signage

DURKEES RUN STORMWATER PARK

Mesic Ecosystems within Durkees Run Stormwater Park



Mesic - Nature's Filter

Located adjacent to both wetland and upland ecosystems, mesic ecosystems aid in flood control, clean and filter stormwater runoff, and provide habitat for wildlife such as insects, birds, amphibians, reptiles, and small animals. A mesic ecosystem within a watershed is like the liver within the human body; it filters and cleans. The mesic ecosystem filters and cleans stormwater of chemicals and sediment. Mesic ecosystems are neither too wet nor too dry, but instead maintain a balanced level of soil moisture. Adaptable vegetation that can tolerate a wide range of conditions is the key identifying feature of a mesic ecosystem.

For a greater explanation and in depth study of Mesic Ecosystems, please refer to the United States Army Corps of Engineers Wetland Delineation Manual 1987 and the Mid-West Supplement, both found on the USACE website: <http://www.usace.army.mil/E3ome>.

Mesic Ecosystem Plants:

Trees

Amelanchier arborea – Serviceberry

Height: 15-25'
Spread: 15-25'
Bloom Time: April-May
Flower Color: White
Fall Color: Orange to Red
Notes: Flowers attract bees and butterflies. Edible red-purple berries in summer are enjoyed by fruit eating birds.

Betula nigra – River Birch

Height: 40-70'
Spread: 40-60'
Bloom Time: April-May
Flower Color: Green/Brown drooping catkins
Fall Color: Yellow
Notes: Reddish brown exfoliating bark. Excellent food source and shelter for caterpillars, butterflies, and many types of birds.

Cornus Canadensis – Eastern Redbud

Height: 20-30'
Spread: 25-35'
Bloom Time: April-May
Flower Color: Pink
Fall Color: Yellow
Notes: Small brown fruit pods and heart shaped leaves. Flowers along bare branches attract bees and butterflies while the seedpods provide food for many types of birds.

Grasses/Sedges

Carex molesta – Field Oval Sedge

Height: 12-24"
Spread: 12-18"
Bloom Time: May-July
Flower Color: Green
Fall Color: Green
Notes: Medium leaf texture. Foliage is enjoyed by caterpillars and butterflies, while birds eat the seedheads.

Schizanthus sarparyum – Little Bluestem

Height: 24-48"
Spread: 18-24"
Bloom Time: Aug-Oct
Flower Color: Purplish Bronze
Fall Color: Bronze Orange
Notes: Medium leaf texture with seeds eaten by birds.

Sporobolus heterolepis – Prairie Dropseed

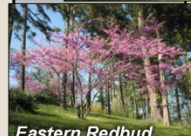
Height: 24-36"
Spread: 24-36"
Bloom Time: Aug-Oct
Flower Color: Pinkish Brown
Fall Color: Bronze Orange
Notes: Fine leaf texture and flowers are noted for their conical-like fragrance.



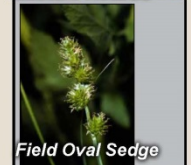
Serviceberry



River Birch



Eastern Redbud



Field Oval Sedge



Little Bluestem



Prairie Dropseed



Sky Blue Aster



Blue Wild Indigo



Purple Coneflower



Dense Blazing Star



Wild Quinine



Foxglove Beardtongue



Mountain Mint

Forbs

Aster acutus – Sky Blue Aster

Height: 18-36"
Spread: 18-24"
Bloom Time: Sept-Oct
Flower Color: Blue
Notes: Great food source for butterflies and birds.

Baptisia australis – Blue Wild Indigo

Height: 36-48"
Spread: 36-48"
Bloom Time: May-June
Flower Color: Blue
Notes: In the bean family and therefore adds nitrogen to the soil. Early Americans used the plant as a substitute for true indigo in making blue dyes and the seedpods as toy rattles.

Echinacea purpurea – Purple Coneflower

Height: 36-48"
Spread: 18-24"
Bloom Time: July-Aug
Flower Color: Pink
Notes: Flowers attract butterflies and hummingbirds while in bloom. Finches and other birds feed on the seeds in the fall.

Liatis spicata – Dense Blazing Star

Height: 24-48"
Spread: 12-18"
Bloom Time: July-Aug
Flower Color: Purple
Notes: Tall flower spikes attract butterflies and birds.

Parthenium integrifolium – Wild Quinine

Height: 24-36"
Spread: 12-24"
Bloom Time: June-Aug
Flower Color: White
Notes: Basal leaves are quite large up to a foot long and 4 inches wide and stay close to the ground. The flower heads are often described as looking like a small head of cauliflower.

Penstemon digitalis – Foxglove Beardtongue

Height: 24-36"
Spread: 18-24"
Bloom Time: May-June
Flower Color: White
Notes: Flowers attract butterflies and bumblebees and songbirds feed on seed in the fall and winter. Native Americans chewed the root and placed it in a cavity to relieve toothache pain.

Pycnanthemum virginianum – Mountain Mint

Height: 12-24"
Spread: 12-18"
Bloom Time: July-Aug
Flower Color: White
Notes: Foliage has strong mint fragrance. The fresh or dried leaves used to be brewed into a refreshing mint-like tea.



Connection to Regional Trail System

City of Lafayette Bike & Pedestrian Master Plan NORTH QUARTER

2015 Planned Routes (Under Review):

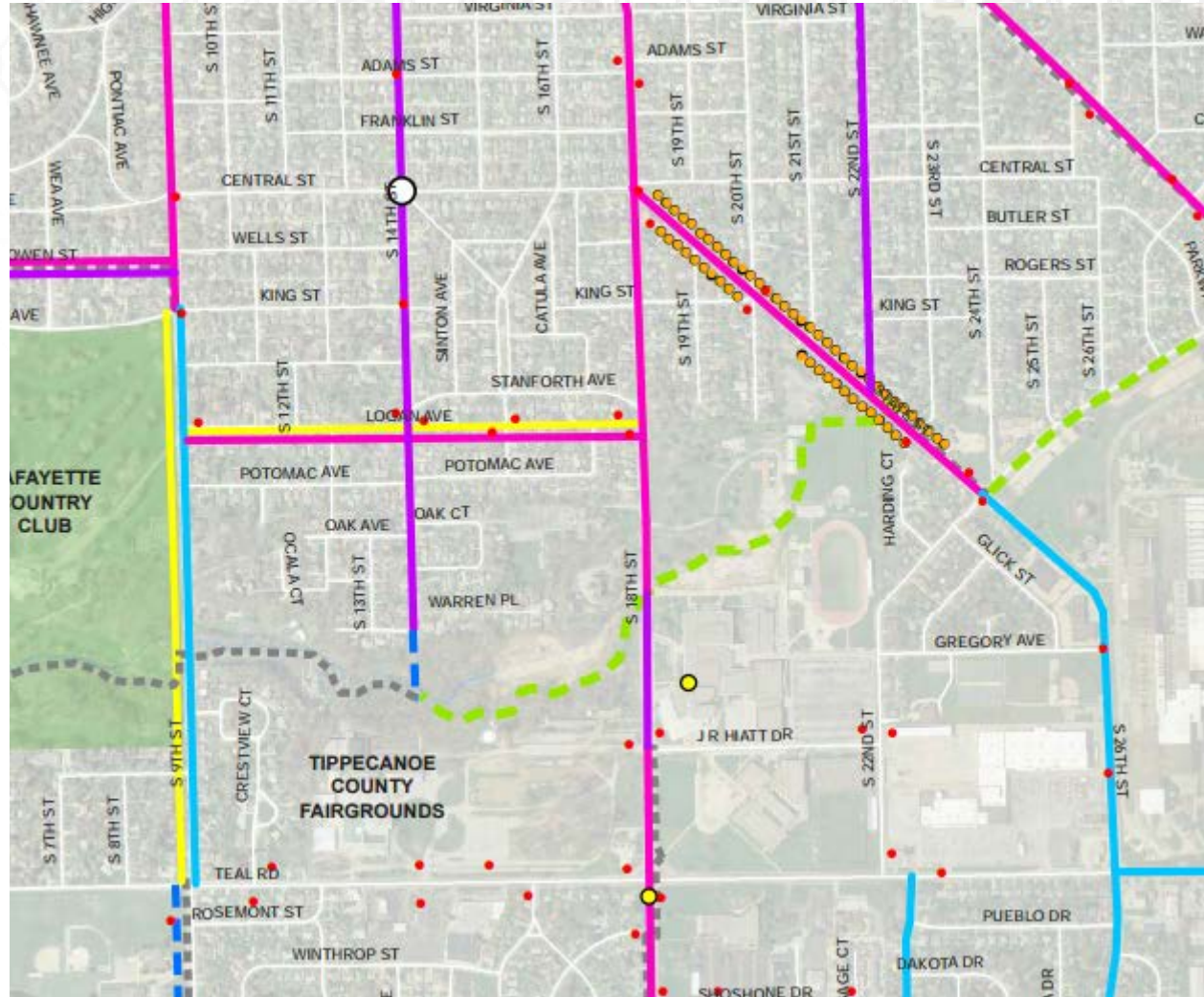
- SHARED-USE PATH
- BIKE LANE
- SHARED LANE w. MARKED PARKING
- SHARED LANE w. NO PARKING
- SIDEWALK
- INTERSECTION IMPROVEMENT

2012 Trail Master Plan Routes:

- SHARED-USE PATH
- ON-ROAD ROUTES

Existing Routes:

- SHARED-USE PATH
- BIKE LANE
- ROUTE UNDER DESIGN
- ROADWAY
- LAFAYETTE CITY LIMITS
- WATER BODIES
- PARK - RECREATION SPACE
- COMMERCIAL - RETAIL SPACE
- SCHOOLS
- BUS STOPS





Thank You!

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