Final Report Implementing Green Infrastructure Elements for Enhanced Water Quality in the Beaver Lake Watershed Project #17-1000 FY 2017 CWA Section 319(h)



Green Infrastructure - Parking Lot Project, Hickory Creek Boat Launch, Lowell, AR

#### **Executive Summary**

The Beaver Watershed Alliance project, titled "Implementing Green Infrastructure Elements for Enhanced Water Quality in the Beaver Lake Watershed," aimed to implement recommendations from the Beaver Lake Watershed Protection Strategy to reduce nonpoint sources including sediment and nutrient loads going into Beaver Lake, through the implementation of three demonstration green infrastructure projects. Key program activities included Best Management Practice (BMP) Implementation, Demonstration and Planning. The project location was within the Beaver Reservoir watershed (HUC 11110001), where segments of waterways are impaired (Arkansas Department of Energy and Environment). Components of this project addressed the Arkansas Nonpoint Source Management (NPS) program's Section 3 and Section 8 from the 2011-2016 NPS management plan.

The Beaver Watershed Alliance (Alliance) works collaboratively with communities in the watershed to proactively protect a drinking water supply for 500,000 people in Northwest Arkansas. The Alliance mission is to proactively protect, enhance and sustain Beaver Lake and the integrity of its watershed, and works to evaluate and inform the greatest possible benefits of conservation efforts and investments. Conservation, restoration and enhancement of natural areas in the watershed can be realized by installing green infrastructure and demonstrating a broad approach to treating urban nonpoint source runoff in urban areas.

The Beaver Lake watershed is located in the Ozark Highlands of northwest Arkansas in Benton, Carroll, Madison, and Washington counties. The watershed is 1,192 square miles and includes 17 incorporated municipalities. Historically, the watershed has been characterized by forest and pastureland use with little development; however, over the last two decades nearly one quarter

of the watershed land use has changed with significant increases in residential, commercial, and industrial development that have replaced forest and pastureland. The Beaver Reservoir is one of ten priority watersheds in the Arkansas NPS Management Program. Several stream segments within the watershed are listed on the Arkansas Department of Energy and Environment's 2018 303 (d) list. The Beaver Lake watershed is also a designated nutrient surplus area by Arkansas Dept of Agriculture – Natural Resources Division. Reducing nonpoint source sediment and nutrient inputs associated with land use change by incorporating green infrastructure projects into the Beaver Lake watershed can improve water quality.

Population density increases within a watershed lead to increased runoff volume from the urbanized areas (Paul and Meyer, 2001). As with most urban areas, impervious surfaces dominate the landscape increasing the potential for nutrients, sediment, metals, hydrocarbons, pesticides and litter to flow rapidly and untreated into storm drains and directly to creeks and streams. Within this watershed project area those "pollutants" flow downstream into Beaver Lake. Green infrastructure can be used as a BMP to address hydrologic modification resulting from rapid land use change by reducing runoff volume and improving the retention of nutrients and sediment.

In addition, training workshops, field days and education programs were conducted, and water quality improvements were achieved through institutionalizing green infrastructure as a water quality Best Management Practice (BMP) for voluntary implementation by individuals and organizations within the project area. Project partners included US EPA, Arkansas Department of Agriculture – Natural Resources Division, Beaver Water District, City of Fayetteville, Army Corps of Engineers, City of Huntsville, and multiple program partners that made this project possible.

The timeframe for implementation was October 1, 2017 through September 30, 2021. Project costs included \$499,783 in federal funding, with \$377,029 in matching nonfederal funding, for a total of \$876,812. Additional match was secured throughout the program timeframe.

#### **Project Chronology**

#### **Introduction**

This project had two goals. One, demonstrate Green Infrastructure, including low impact development practices, and encourage thoughtful growth/development in an effort to minimize hydrologic modification. Two, institutionalize and promote green infrastructure as a common water quality Best Management Practice (BMP) for voluntary implementation by individuals and organizations.

Goals were accomplished by installing three green infrastructure parking lots at Hickory Creek Boat Launch, Lowell, AR, Mitchusson Park, Huntsville, AR and Mount Kessler Regional Park, Fayetteville, AR. Parking lots featured pervious paving, native plants and educational signage. The Alliance, in partnership with cities, agencies, design firms and other nonprofit groups, hosted a total of 82 educational field days, training sessions, events, and outreach meetings throughout the course of the project timeframe, reaching over 2,932 stakeholders.

#### Project Steering Committee

The Alliance obtained participation of local stakeholders to serve on a project steering committee. Regular meetings were held to map out the project milestones and discuss project needs. Steering committee members also participated in actively helping to select sites for Green Infrastructure project implementation.

Name	Title	Organization
Mike Kopek	Real Estate Agent	Weichert Griffin
Ray Avery	Engineer	BWD
Brad Hufhines	Environmental Manager	BWD
Allison Jumper	Project Designer	Ecological Design Group
Anthony Kendrick	Green Infrastructure Specialist	Construction EcoServices
Sean Harper	Beaver Lake Operations Project Manager	USACOE
Mike Richards	Deputy Operations Project Manager	USACOE
Ted Jack	Park Planning Super	City Fay Parks and Rec
Alan Pugh	MS4/Staff Engineer	City of Fayetteville
Jim Maclean	Planning Commission/Master Gardener	Huntsville Planning Cmte
Max Poye	Mayor Goshen	City of Goshen
Carole Jones	Consultant/P.E.	Greenland
Chris Kauffman	Civil Engineer	Nabholz
Trish Ouei	Stormwater Agent	UAEX Benton County
Amy Wilson	Communications Director	BWD

#### Best management Practices Implemented

The Alliance solicited bids from area design firms to help achieve the design aspect of this project. Crafton Tull & Associates, Inc., a design and engineering firm based in Rogers, AR, was selected to design and aid in construction administration of the three green infrastructure parking lots. Design work included topographical surveys, environmental assessments, site and geotechnical investigations, feasibility studies, development plans, conceptual, preliminary and final designs, drainage reports, and educational signage design. Construction administration aided the Alliance in bidding and negotiations with contractors, progress meetings and inspections.

Site selection included outreach by the Alliance to potential partners through meetings, site visits and site assessments. Locations selected were based on high public visibility, proximity or location to impaired waterway, and willingness of landowner to maintain project for at least five years.

Hickory Creek Boat Launch, Lowell, AR



Hickory Creek Boat Launch is a highly-used public access point to Beaver Lake. Boaters, fishers, recreators, and visitors to the Army Corps of Engineers' campground frequent the parking lot area to access the Lake. The Alliance worked with the US Army Corps of Engineers to develop a plan to incorporate green infrastructure/Low Impact Development features into this parking lot to solve flooding/pooling issues, reduce runoff from boat pullout areas, and help protect the water quality of Beaver Lake. The entire parking lot area is 27,420 square feet. 7,000 square feet of interlock pervious pavers were mechanically installed, along with a 1,500 square feet native plant bioswale. Plants used in the design were both seed and plug varieties of grasses, forbes and shrubs, including purple coneflower, soft rushes, spicebush, cardinal flower, and wood oats. Educational signage is located near the bioswale where patrons of the boat launch can easily access education on Beaver Lake, its watershed and the features at Hickory Creek Boat Launch. This project was completed in Spring of 2021, installed by Steep Creek, LLC.





Pervious pavers installation (top) Bioswale planting (left)

Hickory Creek Boat Launch

Educational signage near newly planted bioswale (right)

Hickory Creek Boat Launch



#### Mitchusson Park, Huntsville, AR



Mitchusson Park (Before Construction)

Mitchusson Park is a highly-visible location in Huntsville, AR, and located within the War Eagle subwatershed area. Mitchusson is a popular community park with soccer fields, baseball fields and walking trails for the surrounding communities. The Alliance worked with the City of Huntsville Planning Commission to develop plans to improve a gravel parking lot and hillside with LID features. The parking lot drainage area had steep topography, and erosion has been a reoccurring issue for the City for many years. The green infrastructure parking lot helped to address sheet runoff and reduce erosion, helped to reduce mowing and maintenance on the hillside of

the lot, reduce maintenance on a gravel lot and increase education to patrons of the park. The total green infrastructure area is 3,400 square feet, with 1,400 square feet of interlock pervious pavers that were mechanically installed. The hillside was constructed to slow down rain runoff and seeded with native plant seed mix. Educational signage is located at the corner of the pervious parking lot for visitors to easily access education on Beaver Lake, its watershed and LID features within the parking lot area. This project was completed in Spring of 2021, installed by Steep Creek, LLC.





Pervious pavers installation and educational signage

Mitchusson Park, Huntsville, AR



Kessler Mountain Regional Park in southwest Fayetteville comprises some 620 acres on and around historic Kessler Mountain. The Park serves as a regional sports park, with numerous soccer and baseball fields, a nearly 400-acre nature preserve, and as a popular area for mountain-bikers and hikers, with more than ten miles of natural-surface trails. This Park is also located in the West Fork watershed, with segments of the West Fork-White River listed as

impaired on the Arkansas Department of Energy and Environment 303d list. The Alliance worked with the City of Fayetteville Engineering Dept and the Parks and Recreation Dept to develop plans for the green infrastructure parking lot. The project area is 46,850 square feet, with 32,750 square feet of impervious area draining to interlock pervious pavers. Flush curbs, native plantings and contoured landscapes collect water runoff and allow it to drain into the ground slowly, before entering nearby waterways. Educational signage is located near the pervious pavers to highlight LID features of the parking lot. This project was completed in Summer of 2021, installed by Crossland Construction, in partnership with Garver Engineering.



#### **Challenges**

Missed opportunities during this grant timeframe included the time needed for educational programs to construction and engineering groups. Northwest Arkansas is experiencing tremendous growth and development, challenging the education opportunities to reach busy professionals and the construction industry. Overcoming these challenges was addressed by reaching out to Alliance partners, which included training during already scheduled events, and seeking guidance from the Project Steering Committee from leaders in those industries for input on best methods to cater to their needs for education. Contractors and developers were a priority target audience for education and technical services, and due to the busy landscape in Northwest Arkansas, it was a slow, challenging process.

Additional challenges included not having the opportunity to conduct in-person trainings and field days due to current circumstances with the COVID-19 pandemic. Online trainings were effective, however, not as effective as in-person events.

Costs to construct Low Impact Development features in the region was also a challenge. The first round of bids for Hickory Creek came in at 400% of the budget, delaying contractor selection until a qualified contractor would be agreeable to the budget. Mitchusson Park was constructed on time, within budget, however Kessler Mountain Regional Park was also delayed due to a good problem, the fact that the parking lot project scope grew in size but delayed the installation time due to the additional design work and surveys needed.

Overall, we see these (garnering construction and developer industry professionals time and cost-efficient contractors on board) as continuing challenges in the region. We have seen an uptick in qualified contractors that are using new methods to install pervious pavers more efficiently, utilizing mechanical installation equipment to cut labor costs down. Low Impact Development features are being used in large, public facility/new developments, including the Walmart Global Campus, the J.B. and Johnelle Hunt Family Ozark Highlands Nature Center and downtown Rogers, a positive sign that Green Infrastructure/LID is catching on, is beneficial, and is seen as doable for Northwest Arkansas. We (Alliance) have also initiated a program for local producers to grow local genotype native plants to reduce transportation costs and increase local stock for conservation and restoration projects. We are also inspired to see cities working together to address maintenance of pervious paver systems, by sharing equipment or resources. There are also opportunities to collaborate with regional partners more to reach industry stakeholders.

#### Measures of Success

Green Infrastructure/LID project features help to reduce rain runoff and store rainwater for slow release to recharge groundwater supplies. Rain runoff can also prevent sedimentation and nutrients entering local waterways. Crafton Tull helped to quantify reductions based on designs. Hickory Creek Boat Launch site provides 795 cubic feet of stormwater storage under the permeable pavers. Features capture the first 1/4 inch of rainfall runoff from the parking lot, which then drains through a grate and underdrain to a bio-retention basin before it's discharged into Beaver Lake. Mitchusson Park works to provide 532 cubic feet of storage under the permeable pavers and captures the first 3/8 inch of rainfall runoff from the driveway. Kessler

Mountain Regional Park provides 1,330 cubic feet of stormwater storage under the permeable pavers and captures the first 3/4 inch of rainfall runoff from the new parking lot (this is 3x the volume of a traditional sediment forebay required by the Fayetteville Drainage Manual). The parking lot design also includes a 1,091 cubic foot bio-retention cell that collects stormwater runoff from the existing parking lot and treats the first 1.25 inches of rainfall runoff off the existing parking lot.

The Alliance developed fact sheets for each of the three projects to highlight these water quality improvement benefits.

#### **Lessons Learned**

As the Northwest Arkansas region grows, tools are needed for rural and unincorporated areas of the watershed to help with managing rainwater runoff as they grow and develop. The three GI/LID parking lot demonstration projects will provide a learning lab for city, county and agency staff to learn how to implement green infrastructure, evaluate and overcome cost barriers, calculate cost benefits for reduced maintenance on systems to manage stormwater, and provide education to the general public about native plants, LID features and the benefits provided.

There is still a great need for scientific and technical investigation in this watershed, particularly in identifying priority urban stormwater issues and challenges, and assessing relative loadings of other potential sources of urban pollution, such as fertilizers, pesticides, septic tank leakage, etc. We anticipate updates to the Beaver Lake Watershed Protection Strategy and other regional initiatives to reveal opportunities for prioritization, and also see areas of improvement where the Alliance can work more closely with the Soil and Water Districts, University of Arkansas, cities and other stakeholders to address urban NPS.

#### **Technical Transfer**

Education and technical assistance remain critical components to advance implementation of green infrastructure and low impact development in our communities. We are thankful for the opportunities to increase living classrooms in the Beaver Lake watershed to continue to educate and physically, as well as scientifically, show how the features can benefit communities and water guality. US EPA is a leading source for materials, guides and resources for Green Infrastructure, which the Alliance continues to share, as well as develop in-house materials for local use. We encourage others that are looking to install best management practices to learn successes and failures of previous projects. Case studies and historical data can be key to understanding what features work best in a potential location, based on geographical data, climate data, and current developments. Placement of features is also key in the success. Pervious pavers are not suitable in steep slope locations, nor suitable in areas that receive fines (small aggregates and sediments) that may clog the pavers and reduce its ability to soak in rainfall. Using multiple features, also known as a treatment train approach, to treat rain runoff is the ultimate combination. Pervious pavers collecting parking lot runoff, that drain to a bioretention with native plants and perhaps a secondary bioretention area or planted green space can be a strategic way to capture, collect, store and slowly release urban runoff. Features do not have to take up a lot of space as well, they can make up for storage on a horizontal plane by deepening the capacity area to vertical storage, depending on soil types. Residents can also learn from these projects as they are scalable. Driveways, patios and sidewalks can

use pervious materials, and rain gardens, bioswales and native plant filter strips can be scaled down to a homeowner lot.

The Alliance, in partnership with cities, agencies, design firms and other nonprofit groups, hosted a total of 82 events, including educational field days, training sessions, events, and outreach meetings on how to design and install LID and incorporate Green Infrastructure in their communities, reaching 2,932 stakeholders throughout the course of the project timeframe. The project aimed to reach two categories of stakeholders, including cities, designers, developers and contractors, with the second target audience being residential homeowners. Collectively, these two groups can both have a positive impact on water quality by implementing practices on their properties.

Five fact sheets, a vendor lists for LID contractors, multiple presentations and flyer templates were developed as part of the project. Alliance also worked with Crafton Tull to design educational signage at each of project locations to continue to educate on the pervious pavers, native plants, watershed facts and incorporated elements of the GI/LID parking lot.



PEREMULALS Plants that return year after year. Also known as Hert ials or Forbes

common vame	Botannean Manne	son moisture	negut	BIOOM TIME	Bioom color	Sun Requirements/Toterates	Auracis
Arkansas Blue Star	Amsonia hubrichtii	Medium	4'	April-May	Blue	Full sun to part shade, deer	¥
Aster - Bushy	Aster dumosus	Medium	1.2	Aug-Oct	Purple	Full sun, Drought, Clay Soil	×
Aster - Heath	Symphyotrichum ericoides	Dry to medium	1.3	Aug-Oct	White	Full sun, Drought, Erosion, Clay Soil, Dry Soil, Rocky Soil	×
Aster - New England	Aster novae-angliae	Medium	3-6"	Aug-Oct	Purple	Pall sun, Clay Soil	¥
Black-eyed Susan	Rudbeckia hirta	Medium	2-3'	June-Sep	Yellow	Pull sun, Deer, Drought, Clay Soil	¥ A
Blue Sage	Salvia azurea	Dry to medium	3-4'	July-Oct	Blue	Full sun, Deer, Drought, Dry Soil, Rocky Soil	¥
Blue Vervain	Verbena hastata	Medium to wet	3-6'	Jul-Sep	Blue	Full sun, Wet Soil	¥
Elue-eyed Grass	Sisyrinchium angustifolium	Medium	2'	May-June	Blue	Pall pan, Groundcover	
Boneset	Eupatorium perfoliatum	Medium to Wet	4-6	Jul-Sep	White-Pink	Full sun to part shade, Deer, Clay Soil, Wet Soil	¥
Brown-eyed Susan	Rudbeckia triloba	Medium	3'	July-Oct	Yellow	Full run, Deer, Drought, Clay Soil	¥
Butterfly milkweed	Asclepias tuberosa	Dry to medium	1.5-3'	Jul-Aug	Orange	Full sun, Deer, Drought, Erosion, Dry Soil, Rocky Soil	¥
Catmint	Nepeta racemosa 'Walker's Low'	Dry to medium	2-3	April-Sept	Purple	Pull sun to part shade, Deer, Drought, Rocky Soil	
Common Blue-eyed Grass	Sisyrinchium albidum	Medium	6*-1'	May-Jun	Blue	Full sun, Groundcover	
Coral Bells/Alumroot	Heuchera americana	Medium	1.2	June-Aug	Yellow-Red	Full sun to part shade, Drought	
Culvers Root	Veronicastrum virginicum	Medium to wet	3-4'	May-August	White/Purple	Full sun, Wet Soil	¥
Dwarf Crested Iris	Iris cristata	Medium	8*	April	Purple	Full sun to part shade, Deer, Drought, Groundcover	
Foxplove Beardtongue	Penstemon digitalis	Dry to medium	2.3	April - June	White	Fall run, Deer, Drought, Clay Soil, Dry Soil	¥.A
Garden Phlox	Phlox paniculata	Medium	4'	Jul-Sep	Pink	Full sun to part shade, Deer, Clay Soll, Black Walnut	¥ A
Hymop	Agastache rupestris	Dry to medium	1.2	July - Sept	Orange-Pink	Full run to part shade, Deer, Drought	¥
Iris - Copper	Iris fulva	Medium to wet	2-3	May-June	Gopper	Full sun to part shade. Deer, Clay Soil, Wet Soil	XA
Ironweed	Vernonia arkansana	Medium to wet	4-6	Aug-Oct	Pink-Purple	Full run, Deer, Wet Soil	
Joe Pye weed	Eupatorium fistulosum	Medium to Wet	To6	July-Sept	Pink-Purple	Full sun to part shade, Deer, Wet Soil	¥
Joe Pye weed 'Little Joe'	Eutrochium dubium 'Little Joe'	Medium to Wet	3-4'	July-Sept	Pink-Purple	Full sun to part shade, Deer, Wet Soil	¥
Lizards Tail	Saururus cermuns	Wet	1.2	June-Sept	White	Full sun to part shade, Heavy Shade, Wet Soil	
Mist Flower, Wild Ageratum	Conoclinium coelestinum	Medium	2-3	July-October	Blue/Purple	Full sun to part shade	¥
Obedient Plant	Physostegia virginiana	Medium	4'	June-Sept	Pink	Full run, Deer, Clay Soil	A
Prairie Blazing Star	Liatris pycnostachya	Dry to medium	2-5'	July-Oct	Purple	Full sun, Drought, Clay Soil, Dry Soil	A
Purple Coneflower	Echinacea purpurea	Dry to medium	4'	June-Aug	Purple	Full sun to part shade, Deer, Drought, Clay Soll, Rocky Soll	¥.A
Purple Poppy Mallow	Callirhoe involucrata	Dry to medium	6*-1'	May-June	Purple	Full sun, Drought, Dry Soil, Shallow-Rocky Soil	
Purple Milkweed	Asclepias purpurascens	Dry to medium	2-3'	May-July	Purple	Pull sun	¥
Rattlesnake Master	Eryngium yuccifolium	Dry to medium	4'	June-Sep	Green-White	Pall sun, Drought, Erosion, Clay Soil, Rocky Soil	
Robin's Plantain	Erigeron pulchellus	Dry to medium	1'	May-Jun	Purple-Yellow	Pull sun, Groundcover	×
Rose Mallow	Hibiscus laevis	Medium to wet	5'	Aug-Sep	Pink	Pull sun, Deer, Wet Soil	¥
Rough Goldenrod	Solidago rugosa 'Fireworks'	Medium to wet	2-3	Sept-Oct	Yellow	Pull run, Deer, Clay Soil, Wet Soil	×
Royal Catchfly	Silene regia	Dry to medium	4'	Jul-Aug	Red	Full sun to part shade, Drought, Rocky Soil	×.
Spiderwort	Tradescantia virginica	Medium	1.3	Apr-Jul	Purplish blue	Part shade to full shade, Clay Soil, Black Walnut	
Stiff Goldenrod	Solidago rigida	Medium	3-5"	Aug-Sept	Yellow	Pall sun, Deer, Clay Soil	×
Stonecrop	Hylotelephium 'Herbstfreude'	Dry to medium	1.2	Sept-Oct	Purple	Full sun to part shade, Drought, Rocky Soil	¥
Swamp Milloweed	Asclepias incarnata	Medium to wet	4-5"	Jul-Sep	White Pink	Pall ran, Deer, Clay Soil, Wet Soil	¥
Threadleaf Coreopsis	Coreopsis verticillata	Dry to medium	1.2	June-Sept	Yellow	Pull sun, Deer, Drought, Rocky Soil	¥
Turtlehead	Chelone glabra	Medium to wet	2-3'	Aug-Oct	Cream	Part shade, Erosion, Wet Soil	×
White False Indigo	Baptisia alba	Dry to medium	2-4'	April-May	Gream	Pull sun to part shade, Drought, Erosion, Dry Soil	¥
White Sage	Artemisia ludoviciana	Dry to medium	2-3'	Aug-Sept	White/Gray	Full sun, Rabbit, Deer, Drought, Erosion, Dry Soil	
Wild Bergamot/Beebalm	Monarda fistulosa	Dry to medium	2-4'	Jul-Sep	Purple	Fall sun to part shade, Deor, Drought, Clay Soil, Rucky Soil, Black Walnut	¥.A
Wild Columbine	Aquilegia canadensis	Medium to dry	2.3	Feb - July	Red & yellow	Pull sun to part shade, Rabbit, Deer, Drought, Dry Soil	,
Wild Ginger	Asarum canadense	Medium to wet	6"-1'	April-May	Purple	Part shade to full shade, Groundcover, Deer, Heavy Shade, Eresion, Wet Sol	
Wild Strawberry	Pragaria virginiana	Medium	6*	April-May	White	Full san to part shade, Deer, Drought, Erosion, Groundcover	A
Wild Sweet William	Phlox divaricata	Medium	1'	Apr-May	Blue	Part shade to full shade, Deer, Drought, Clay Soil	W.A
FeYVV-S Nonflowering vascular plants that possess true roots: stems, and complex leaves and that reproduce by spores.							
sum nountais rema	r wysochum acrosticnoides	uny to meatum	- 2			ram searce or normalized, Kalobi, Dent, Umingel, Heavy Salah, Streken, Rocky Seil	

Elackhaw	Viburnum prunifolium	Dry to medium	12-15'	May-Jun
Battonbush	Cephalanthus occidentalis	Medium to wet	5-12'	Jun-Aug
Deciduous Holly	llex decidua	Medium	7-15'	May
False Indigo	Baptisia australis	Dry to medium	34'	May-June
Fragrant Sumac	Rhus aromatica	Dry to medium	2-6'	April
Fringe Tree	Chionanthus virginicus	Medium	12-20'	May-June
Inkberry	Illex glabra	Medium to wet	4-5'	Evergreen
New Jersey Tea	Ceanothus americanus	Dry to medium	3-4'	May-July
Northern Spicebush	Lindera benzoin	Medium	6-12'	March
Ozark Witch Hazel	Hamamelis virginiana	Medium	15-20'	Oct-Decembe
Prairie Ninebark	Physocarpus opulifolius	Medium	8'	May-June
Red Osier Dogwood	Cornus stolonifera	Medium to wet	6-9'	May-June
River Birch Tree	Betula nigra	Medium to wet	50'	Apr-May
Rough-leaf Dogwood	Cornus drummondii	Medium to wet	6-15'	May-June
Smooth Sumac	Rhus glabra	Dry to medium	9-15'	June
Sweet Pepperbush	Clethra alnifolia	Medium to wet	3-8'	July-Aug
Sweetspire	Itea virginica 'Henry's Garnet'	Medium to wet	3-4'	May-June
Winterberry Holly	llex verticillata	Medium to wet	4-10'	June-July
¥	Des meniteria	Madium to wat	10.201	Evergreen

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Fact sheet example (above) Natural Infrastructure Design - Ozark Native Plants, 2018





Fact sheets were developed for each project site, featuring details on water quality benefits and improvements for each location. (left)

Educational signage at LID Parking Lot, Kessler Mountain Regional Park, Fayetteville, AR.

#### GYASSES Herbaceous plant with a grass-like morphology, also known as gram

Common Name	Botanical Name	Planting Zone	Height	Bloom Time	Bloom Color	Sun Requirements/Tolerates	Attracts
Beak-grain	Diarrhena obovata	Medium to wet	2-3"	June-Oct	Green/yellow	Part shade to full shade, Black Walnut	
Common Bur Sedge	Carex grayi	Medium to wet	3'	May-Oct	Green	Full sun to part shade, Deer, Erosion, Wet Soil	
Common Fox Sedge	Carex vulpinoidea	Wet	3'	May-July	Green	Full sun to part shade	
Common Rush	Juncus effusus	Medium to wet	3'	June-Aug	Yellow-green	Full sun, Erosion, Wet Soil	
Common Tussock Sedge	Carex stricta	Medium to wet	3,	May-June	<b>Reddish Brown</b>	Full sun to part shade, everyreen, erosion	
Eastern Gama Grass	Tripsacum dactyloides	Medium	4-8'	May-Sept	Purple/Orange	Full sun to part shade, Elack Walnut	
Indian Grass	Sorghastrum nutans	Dry to medium	3-5"	Sept-Feb	Light brown	Full sun, Drought, Erosion, Rocky Soil, Black Walnut	A
Little Bluestem	Schizachyrium scoparium	Dry to medium	3'	Aug-Feb	Bronze	Full sun, Deer, Drought, Erosion, Rocky Soil, Black Walnut	
Prairie Dropseed	Sporobolus heterolepis	Dry to medium	2-3"	Aug-Oct	Pink/brown	Full sun, Deer, Drought, Erosion, Rocky Soil, Black Walnut	A
Purple Muhly	Muhlenbergia capillaris	Dry to medium	2-3'	Sept-Nov	Pink	Fall sun to part shade, Drought, Black Walnut	
River-Oats	Chasmanthium latifolium	Medium to wet	2-5'	Aug-Sept	Green	Full sun to part shade, Elack Walnut	
Side-oats Grama	Bouteloua curtipendula	Dry to medium	2'	July-Aug	Purple bronze	Full sun, Drought, Erosion, Rocky Soil, Black Walnut	
Southeastern Wild Ryc	Elymus canadensis	Dry to medium	2-5'	July-Sept	Green	Full sun, Drought, Erosion, Dry Soil, Black Walnut	
Switchgrass	Panicum virgatum	Medium to wet	3-6'	July-Feb	Pink tinged	Full sun to part shade, Drought, Erosion, Elack Walnut	A
Virginia Wild Rye	Elymus virginicus	Medium	2-4	June-Oct	Green	Full sun to part shade	¥

#### Shrubs & Small Trees Woody plants with single or multiple ste

Height Bloom Tim 25 Apr-May

#### Educational outreach efforts included:

Number of Programs	Program	Participants
6	Field Days; Included on-site events at each project location and video productions	42
30	Training Sessions; Included Rain Ready Workshops for Homeowners, Native Plant Walks, Invasive Species Removal events, Construction Workshops with partners, and LID Series online webinars (3)	553
9	General Events/Outreach and Education; including Beaver Lake Annual Symposium, Alliance Speaker Series	600
37	Outreach Meetings; presentations to clubs, civic groups, schools, churches, businesses, cities	1,737

#### YouTube Channel Recordings:

LID Online Series (1 of 3) Mission Impossible - Keeping Permeable Pavement Permeable <u>https://youtu.be/hC4cR5\_43KI</u>

LID Online Series (2 of 3) Multi-Functional Stormwater Design with Vegetated Systems and Native Plants that Work <u>https://youtu.be/A6dXHVOfovY</u>

LID Online Series (3 of 3) Where Have All the Ditches Gone? The Value of Bioswales as Stormwater Detention Features <u>https://youtu.be/QAWo3Pd--Qs</u>

Mitchusson Park Drone Footage and Facebook video share provided by Steep Creek, LLC. <u>https://fb.watch/4Rs4hKy1Sq/</u>

LID Video Tour at Hickory Creek Parking Lot https://fb.watch/4Rs4hKy1Sq/



Rain Ready program flyer for residents (left)

# LOW IMPACT DEVELOPMENT



# **ONLINE SERIES**

May 13 Wednesday 10:00 am - 11:30 am (CST)

FREE ONLINE TRAINING COURSE [ZOOM WEBINAR]

The Low Impact Development Online Series is a free virtual training series geared towards providing you with current topics and knowledge to implement and manage LID features.

The Beaver Watershed Alliance mission is to proactively protect, enhance and sustain water quality in Beaver Lake and the integrity of its watershed.

#### **TOPIC:**

## Multi-Functional Stormwater Design with Vegetated Systems and Native Plants that Work

Vegetated systems used for stormwater management are an important tool in Low Impact Development. This presentation will review how these systems are designed, built and installed; with a focus on designing with maintenance in mind. This presentation will also cover how to select the optimal native plant species selection for your next LID project.

This free presentation is available for contractors, home builders, developers, landscapers/landscape maintenance crews, Government public works crews, property owners, municipal and county personnel, professionals with licensure, and is open to the general public.

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### **REGISTER FOR WEBINAR**

https://us02web.zoom.us/webinar/register/WN\_1CYMJm34T769Wl--HFiwYg



The Alliance online LID Series, a three-part series, was a big success, reaching hundreds of practitioners, cities, and interested stakeholders. (Example flyer above)

As Green Infrastructure/Low Impact Development concepts grow in the Northwest Arkansas region, the Alliance looks to be a trusted source of information for cities, communities, residents, and developers looking to implement these technologies. The Alliance has a strong library of resources for technology transfer as a result of this project.

#### **EPA Feedback Loop**

Innovative funding and financing mechanisms are in place throughout the US. In Arkansas, we have the Clean Water State Revolving Loan Fund and Drinking Water Revolving Loan Fund, both programs show high potential but low to none participation for funding GI/LID. It would be helpful to reevaluate these programs and look at how these frameworks may be better utilized to incentivize and or assist communities on a larger scale, rather than smaller projects funded every year. To get ahead of the "water curve" in terms of costs, cities need financial support to dedicate to LID and green infrastructure now, before it is too late. Once our communities reach a certain imperviousness level, the effects are nearly irreversible to watershed health. Communities need support to implement GI/LID. There is also opportunity for workforce development in Arkansas. If EPA could support workforce development education to increase the number of trained professionals and qualified contractors to install and maintain LID features, we could advance water quality improvements on a much larger scale.

#### **Conclusion/Outcomes**

Overall, the project, Implementing Green Infrastructure Elements for Enhanced Water Quality in the Beaver Lake Watershed, Project #17-1000, was a great success.

Several partner agencies and organizations contributed time and resources to this project, and the success of this project can be attributed to their efforts, as well as the emphasis on voluntary action for cities, landowners and stakeholders – an approach which can serve as a model for future efforts by Beaver Watershed Alliance and programs by other organizations and agencies.

The need for both large and small- scale LID contractors has increased significantly in the NWA region. The demand is directly related to increased education and outreach efforts by the Alliance and partner organizations. The Alliance is developing a network of vendors and contractors that can fulfill projects in this sector.

Pervious pavers are increasingly becoming a more utilized product in place of concrete in parking areas and other applications. Cities have expressed interest in management tools to continue to maintain and install additional pervious paver materials. With the help of outside expertise, the Alliance has helped to facilitate education on the available maintenance tools for paver management.

Cities are also updating their ordinances and policies for water quality. City of Goshen implemented an ordinance to have all new construction include native plantings and LID to reduce nonpoint source runoff. City of Fayetteville is looking to revise an ordinance in Chapter 168 to include no adverse impact in the floodplain clause, which would be the first in the state. Additionally, the City of Fayetteville is continuing to develop the stormwater fee program to advance water quality programming to increase detention in residential areas, as well as provide funding for stream restoration and GI/LID projects.

The investments in the Beaver Lake watershed area to install GI/LID has already produced numerous benefits. Long-term, these projects have helped this region better understand the costs, materials, designs and maintenance that is feasible for Northwest Arkansas. The goal is to institutionalize LID and Green Infrastructure into our communities to avoid adverse effects of population growth. We are thankful that we have had the opportunity to develop sound science and case studies for communities to grow thoughtfully, with water quality in mind. It is clear that there are barriers and challenges that still exist, however, with continued efforts to make GI/LID a norm, we believe we can overcome those barriers.

We want to thank the US EPA and the Arkansas Department of Agriculture – Natural Resources Division for their support, funding, technical assistance and guidance to advance water quality improvement in Arkansas, and for the Beaver Lake watershed.