Dry Branch Watershed Management Plan
City of Wentzville, Missouri

Water Resources Solutions

City of Flint Hill, Missouri

St. Charles County

Missouri Department of Natural Resources

"The Environmental Protection Agency Region 7, through the Missouri Department of Natural Resources (Subgrant G11-NPS-07), has provided partial funding for this project under Section 319 of the Clean Water Act"

February 2013

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The Dry Branch Watershed Management Plan was completed by Water Resources Solutions with assistance from Shockey Consulting, the City of Wentzville, St. Charles County, the City of Flint Hill, and the Dry Branch Watershed Planning Team.

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1.0 BACKGROUND

The City of Wentzville, Missouri has been awarded a grant for the Dry Branch Watershed: Clear Stormwater & Green Parks project from the Missouri Department of Natural Resources (MDNR) and the United States Environmental Protection Agency, under the provisions of Section 319(h) of the Clean Water Act. The project began in April of 2011 and runs through April 2015. The schedule of key activities associated with the grant includes:

Table 1: Grant Schedule

Year	Activities
1	• Establish a Watershed Planning Team • Develop a Dry Branch Watershed Management Plan • Install a biofilter at the Law Enforcement Center detention basin • Monitor water quality to measure pollution reduction (years 1-4)
2	• Design green infrastructure at Heartland Park • Design green infrastructure at three retrofit sites • Stream Naming Contest
3	• Retrofit two commercial and one residential site to reduce pollutants • Install wetlands, biofilter zones, pervious pavement, interpretive trail and boardwalk at Heartland Park (years 3-4)
4	• Public tour of Heartland Park • Stormwater Retrofit Project Field Day • Water quality monitoring data analysis

The objectives of the Clear Stormwater & Green Parks project include:

- To assess and improve water quality in the Dry Branch Watershed and to make stormwater cleaner and clearer.
- To beautify parks, subdivisions, municipal and other private property while saving money on maintenance.
- To show the community better alternatives to fescue, concrete and pipes.
- To develop a nine-element watershed management plan (WMP) that identifies nonpoint source pollutants, sources, and prioritizes solutions in year one and two of the project.
- To evoke change by increasing community awareness of water quality issues through service learning projects, web-based education, public tours, groundbreaking ceremonies, and water quality-based contests.

2.0 INTRODUCTION

Under the grant, the City is developing a Watershed Management Plan for the Dry Branch Watershed in concert with St. Charles County and the City of Flint Hill. The Watershed Management Plan follows EPA's Handbook for Developing Watershed Plans to Restore and

Protect Our Waters and includes the Nine Minimum Elements of Watershed Plans. These nine elements include:

- Identification of cause of impairment and pollutant sources
- An estimate of load reductions from management measures
- Description of the nonpoint source management measures
- An estimate of the amount of technical and financial assistance
- An information and education component
- Schedule for implementing the nonpoint source management measures
- Description of interim measurable milestones
- Set of criteria to be used to determine if loading reductions are being achieved
- Monitoring component to evaluate the effectiveness of the implemented measures

The project team was led by the City of Wentzville. The City retained the consultant team of Water Resources Solutions, LLC (WRS), in association with Shockey Consulting Services, (SCS) to develop the Watershed Management Plan. A Dry Branch Watershed Planning Team, comprised of residents, grant partners, representatives from the business community and local boards and committees, and technical advisors from natural resources agencies, was also formed to discuss the goals and objectives of the watershed plan in maintaining stream and watershed health. The Planning Team identified watershed issues and opportunities, assisted in the development of the potential project prioritization criteria, and provided feedback throughout the progression of the Management Plan. The specific activities completed by the consultant team are:

- Identify sources of nonpoint source pollution sources within the Dry Branch Watershed.
- Identify, describe and quantify potential nonpoint source pollution mitigation measures.
- Develop a set of evaluation criteria to judge the effectiveness of the installed mitigation measures.
- Inform and educate stakeholders and residents within the Watershed.

The purpose of the Watershed Plan is to characterize the condition, develop plan and policy within the watershed regarding water quality, and develop future water quality projects within the watershed. The use of this management plan won't stop at the end of the Clear Stormwater & Green Parks project. This watershed management plan can be used by various entities (private citizens, organizations, private entities, and governmental entities) who have a vested interest in their community, and it will help them understand the issues, the location and extent of the issues, and what they can do to help educate others to maintain or improve the health of the community.

2.1 Watershed Characteristics

A watershed is an area of land where all of the water drains off into the same stream, lake or other waterbody. McCoy Creek Watershed (12-digit HUC 071100080408) contains McCoy Creek, Dry Branch, Spring Creek, and Enon Branch. A summary and classification of each of these streams are described below:

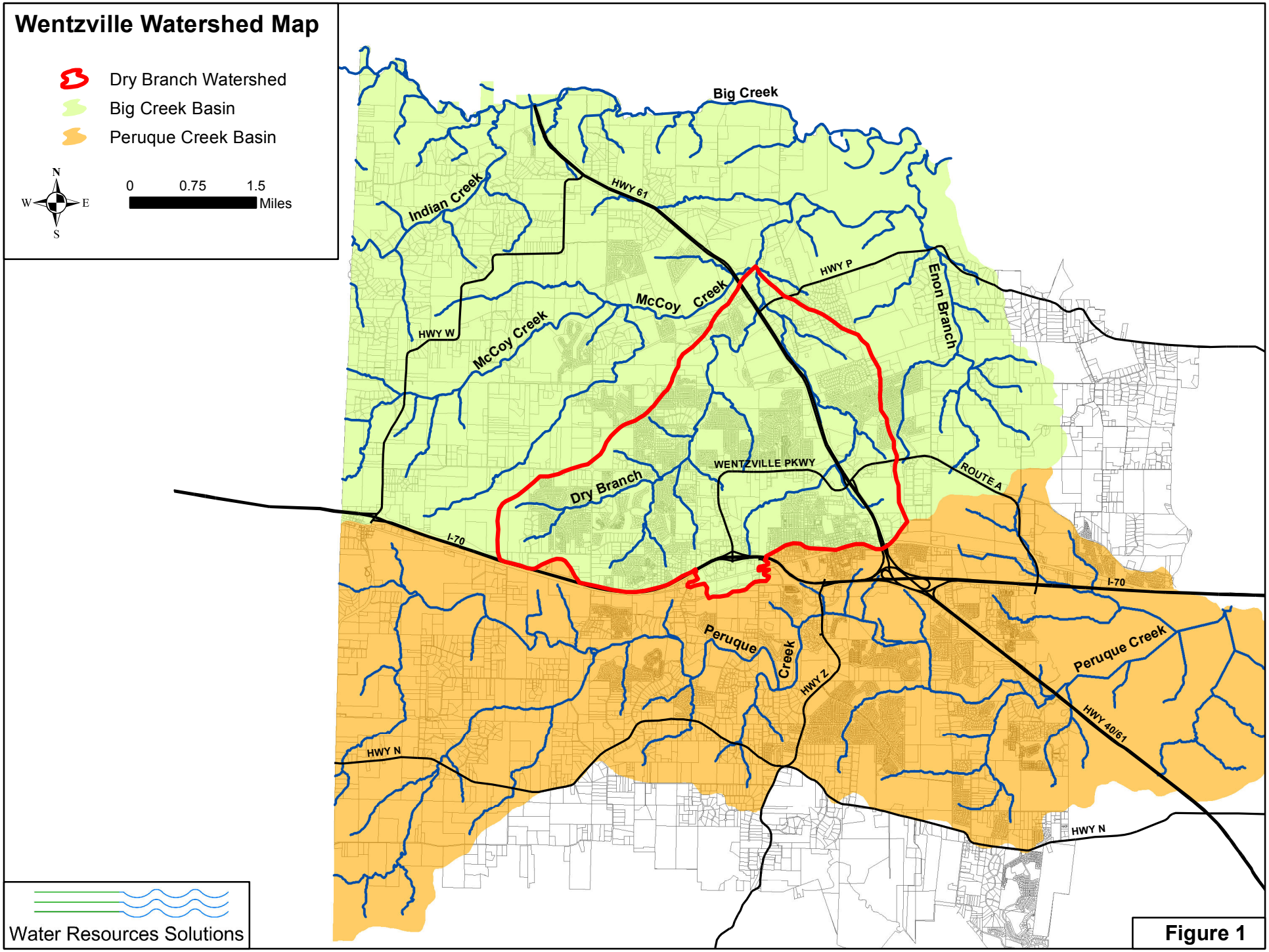
- McCoy Creek: the classification for McCoy Creek is designated as a stream that maintains permanent flow even during drought periods from mouth 1.9 miles upstream, then classified as class C (Stream that may cease flow in dry periods but maintain permanent pools which support aquatic life) for 4.5 miles upstream of this point.
- Dry Branch: unclassified tributary to McCoy Creek (proposed for classification).
- Spring Creek: unclassified tributary to McCoy Creek (proposed for classification).
- Enon Branch: unclassified tributary to McCoy Creek.

Dry Branch and Spring Creek are visible at the 1/100K resolution, and it should be noted that they will be proposed for classification at the end of the current triennial review.

This watershed management plan will focus specifically on the Dry Branch watershed. The Dry Branch Watershed is located in northwestern St. Charles County, Missouri. It covers approximately 6,800 acres from the headwaters just south of Interstate 70 to the confluence with McCoy Creek located northeast of Highway 61 and Highway P. Figure 1 Wentzville Watershed Map shows the location of the Dry Branch Watershed in reference to McCoy Creek. Streams in the Basin are characterized by narrow bottoms, rock and gravel bottom strata, high gradient, and are surrounded by high relief outside of the flood plains. There are approximately 20.2 miles of stream within the watershed, including 2.8 miles of gaining streams where the channel bottom is lower than the groundwater table and 17.4 miles of permanent or intermittent flow. Water moves from the ground into the stream channel, gaining water flow from the subsurface.

2.1.1 Demographic and Population

The Dry Branch Watershed drains a portion of the Cities of Flint Hill and Wentzville, as well as unincorporated areas of St. Charles County. Population data from the 2010 census show the City of Wentzville population 29,070 (censusview.com), a 321% increase from the 2000 census, when the population was 6,896. St. Charles County population also increased from 2000, when the population was 283,883, to 360,485 (censusview.com) in 2010. This is a 27% increase. The City of Flint Hill population in 2010 was 525 (censusview.com), which is a 38% increase from the 2000 census, when the population was 379. Population trends show an increase of 16% from 2010 to 2020 in St. Charles County. Population projections performed by the City of Wentzville estimate the population with the City to increase of 47%. City of Flint Hill population projections were not available.



GIS data was provided by the City of Wentzville and was the most current available as of June 2012.

2.1.2 Climate and Hydrology

Climate for the region is considered temperate, with an average temperature of 55 degrees Fahrenheit and an average annual precipitation of 39 inches (National Oceanic and Atmospheric Administration). As shown in Figure 2 below, monthly average rainfall is highest in May and June at 4.7 and 4.5 inches. High average rainfall totals also occur in the months of April and September with 4.0 and 4.2 inches. The lowest average rainfall totals occur in December, January and February with between 1.8 and 2.0 inches. The average monthly temperatures range between 30 degrees in January to 78 degrees in July.

The Dry Branch Watershed is in the Interior River Lowland EPA Level III/IV Ecoregion, characterized as river hills of the Mississippi River. Paleozoic sedimentary rock is typical, with mostly clay loam till soils and some loamy alluvium soil in low lying floodplains. The elevation of the water shed is roughly 500 to 650 feet. Land slopes range from 0-15% or more. The geomorphic features of this area include terraced valleys, forested valley slopes, and dissected glacial till plains. The watershed has a diverse assemblage of land use including about 55% in residential/commercial/industrial developments and 30% agricultural with an even distribution of pasture/hay and cultivated crops, and the area has approximately 15% tree coverage which is predominantly deciduous oak and oak/hickory forest. Over the past several decades one of the primary reasons the ecoregion has changed is due to urbanization. Residential developments and agricultural areas are interspersed throughout the area. The drained alluvial soils are farmed for feed grains and soybeans, whereas the valley uplands are commonly used for pasture/hay, woodlots, mixed farming and livestock. There are no Concentrated Animal Feeding Operations (CAFOs) or Animal Feeding Operations currently permitted by MDNR.

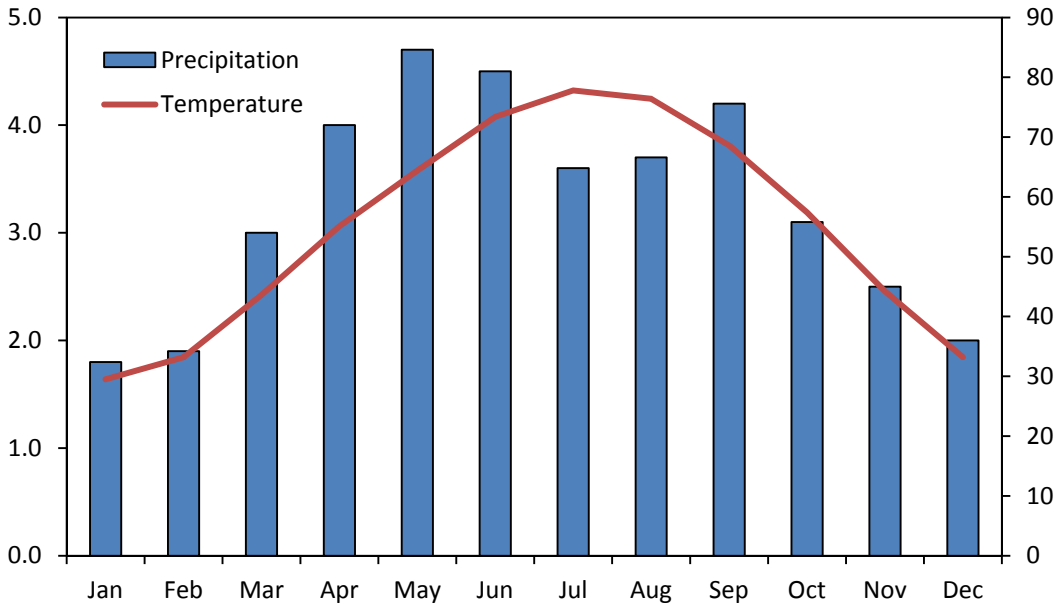


Figure 2: Monthly Average Precipitation and Temperature for Columbia, MO (1900-2012).

3.0 POLLUTANT SOURCE IDENTIFICATION (ELEMENT 1)

To identify and characterize the sources of nonpoint pollution in the Dry Branch Watershed, a watershed assessment was completed to identify potential high pollution regions based on the existing land use, soils, and the City's Commercial/Industrial Hot Spot Inventory data. In the summer of 2009, the Storm Water Pollution Hotspot Inventory & Source Control Plan was completed by the City of Wentzville as part of their Stormwater Management Program. The Storm Water Pollution Hotspot Inventory was completed to identify current practices, spill risks, and storm water problems associated with the businesses. All commercial and industrial parcels within the City of Wentzville were assessed to determine their "hotspot" potential, or potential to produce higher levels of storm water pollutants, and/or present a higher potential risk for spills leaks or illicit discharges. A total of 469 parcels developed and used for industrial and commercial business were assessed and categorized as "not a hotspot", "potential hotspot", "confirmed hotspot", and "severe hotspot".

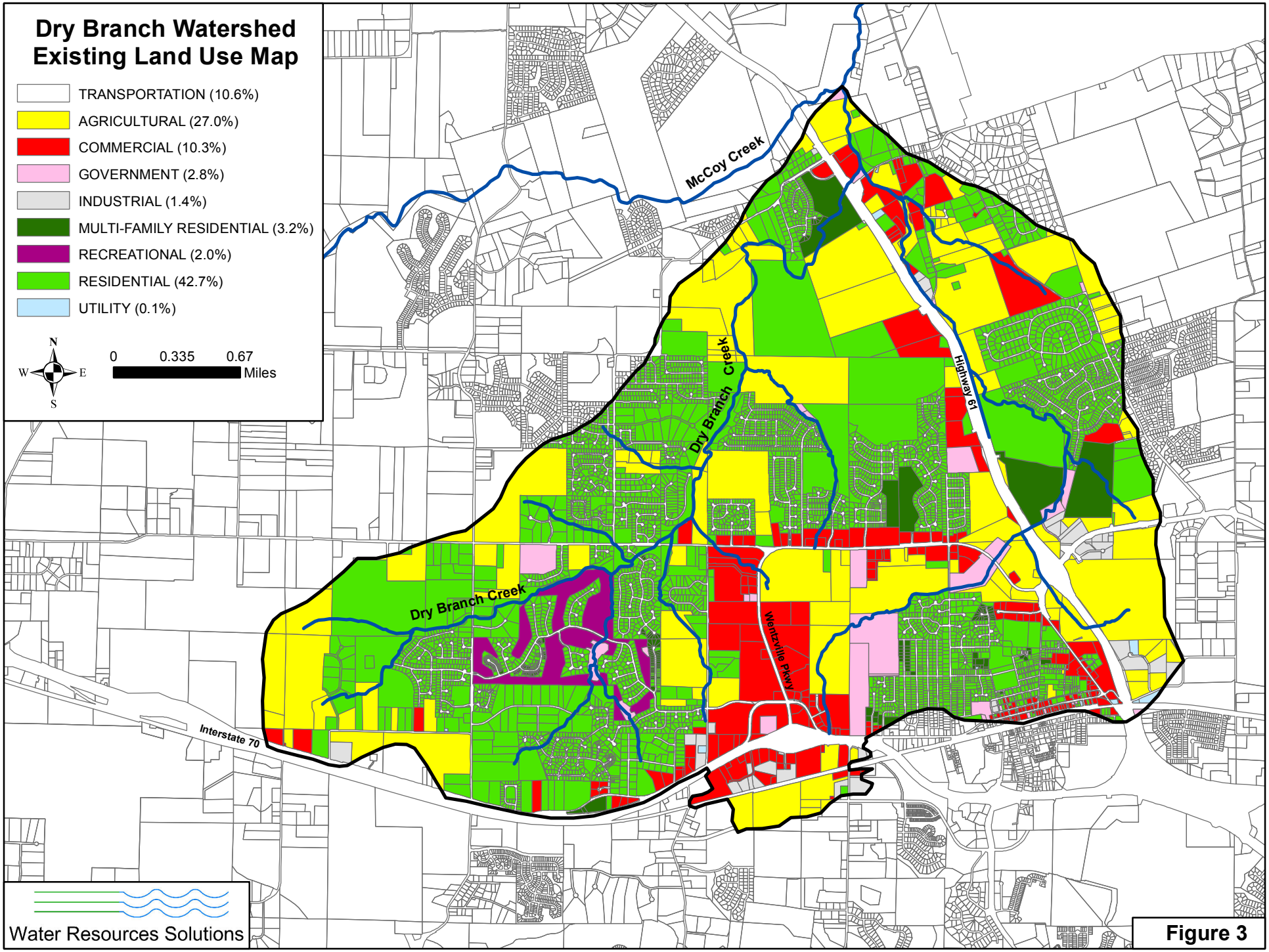
A stream asset inventory was completed to characterize the stability of the stream within the watershed and their potential for contributing sediment loading to the system. A water quality model was then developed for the watershed to establish a water quality/pollutant loading baseline for the watershed.

3.1 Watershed Assessment

The area for each existing land use within the Dry Branch watershed was determined by intersecting the St. Charles County land parcels and existing land uses obtained from the City of Wentzville with the Dry Branch watershed boundary. Table 2 below shows the break out of the existing land uses by acreage and by percentage of the watershed, and Figure 3 Dry Branch Watershed Existing Land Uses Map illustrates the existing land uses. As displayed in the table below, nearly three quarters of the existing Dry Branch Watershed is classified as residential and agricultural.

Table 2: Land Use Summary

	Existing Land Use	
Land Use	**Area (acres)**	**Percent of Area**
Urban	4,982.91	73.0%
Commercial	704.56	14.1%
Government	188.45	3.8%
Industrial	94.97	1.9%
Multi-Family Residential	219.55	4.4%
Recreational	133.56	2.7%
Residential	2,912.26	58.4%
Utility	8.69	0.2%
Transportation	720.89	14.5%
Agriculture	1,839.63	27.0%
Total	**6,822.54**	



GIS data was provided by the City of Wentzville and was the most current available as of June 2012.

3.1.1 Land Use Descriptions

There are nine land use classifications listed in the previous table. This section describes each land use type and where it is currently located in the watershed.

3.1.1.1 Agriculture

This land use classification refers to farming and ranching activities. At 27% of the land area, agriculture land use is the second largest existing land use and is located throughout of the Dry Branch watershed. Common practices include row crops and smaller scale ranching operations. Specific data is tracked by the Soil & Water Conservation District and the Natural Resource Conservation Service at the county level, but is not available just for the watershed area. Figure 4 below illustrates this land use in the watershed.

Figure 4: Agriculture land use. Wheat field near State Highway N.

Agricultural activities that cause nonpoint source pollution includes poorly located or managed feeding operations, overgrazing, plowing too often or at the wrong time, improper or excessive application of pesticides, irrigation water and fertilizer. Typical pollutants from agriculture land use include fertilizers, pesticides, chemicals, sediment, bacteria and nutrients.

Best management practices (BMP) that could be used on agriculture land include stream buffers, vegetated swales, farming practices that maintain soil cover and manage nutrient loading. Here is a link to the Soil and Water Programs cost share program: http://dnr.mo.gov/pubs/pub2348.pdf.

3.1.1.2 Commercial

This land use classification refers to commercial property, such as retail stores and other businesses. Commercial land use is the third highest existing land use category. A majority of the commercial land use is located along Wentzville Parkway and Highway 61. Figure 5 is one of the commercial properties along Wentzville Parkway.

Figure 5: Commercial land use. Grocery and retail stores along Wentzville Parkway.

Typical pollutants associated with commercial land areas include oil, grease, petroleum (from leaking vehicles), metals (from exhaust and brakes), sediments, and windblown trash. BMPs that can be used on commercial properties include bioretention basins, flood control basins, filter strips, and sand filters.

3.1.1.3 Government/Institutional

Government land use classification in Dry Branch watershed is represented by state and city owned property and facilities (such as City Hall, Police, Public Works, Parks, etc), school district facilities, and fire and ambulance stations. Similar to commercial properties, typical pollutants associated with government/institutional land areas include oil, grease, and nutrients. BMPs that can be used to improve the water quality of the runoff include bioretention basins, filter strips, and sand filters.

3.1.1.4 Industrial

The Industrial land use classification in this watershed is primarily assigned to land occupied by the industrial work facilities. The difference between industrial and commercial properties is based mainly on use. Commercial properties are used for selling of goods and services, while industrial areas are used primarily for production. These are located east of Highway 61 along

County Road A in the southeast corner of the watershed. Figure 6 below shows an industrial property within the watershed. Like commercial properties, typical pollutants include oil, grease, windblown trash, petroleum (from leaking vehicles), metals (from exhaust and brakes), sediments, and nutrients from fertilizers. Typical BMPs that can be used on industrial properties include bioretention basins, filter strips, and sand filters.

Figure 6: Industrial land use building off County Road A, east of Highway 61.

3.1.1.5 Muli-Family Residential

The Multi-Family Residential land use classification is assigned to property that includes apartment complexes and duplexes. This land use is the highest percentage of the smaller land use classifications at 3.6%. The majority of this land resides east of Highway 61, with another just north of Wentzville Parkway. Pollutants typically associated with multi-family residential land areas include nutrients from fertilizers, sediment, yard waste, pet waste, oil, grease, and nutrients. BMPs that can be used to treat these pollutants are bioretention basins, filter strips, and sand filters.

3.1.1.6 Recreational

The Recreation land use classification in the Dry Branch watershed is assigned entirely to the Bear Creek Golf Course. It is located in the southwest portion of the watershed and is surrounded by residential properties. Figure 7 below is a photo from the Bear Creek Golf Course. Typical pollutants associated with golf courses and park areas are predominantly nutrients due to fertilizers and pesticides. BMPs that can be used include filter strips, stream buffers, and fertilizer/pesticide and water conservation management plans.

Figure 7: Recreational land use. Bear Creek Golf Course.

3.1.1.7 Residential

The Residential land use is the predominant land use in Dry Branch Watershed. It is characterized by single-family residential lots in the watershed. These land uses are scattered throughout the watershed with large concentrations north and west of the Wentzville Parkway. There are also residential subdivisions located east of Highway 61. Figure 8 below illustrates a typical residential land use in the watershed. Similarly to the multi-family residential land use, typically pollutants include nutrients from fertilizers, sediment, yard waste, and pet waste. BMPs used to treat these pollutants include bioretention basins, open channel swales, low impact development methods, flood control basins, stream buffers, rain gardens, and rain barrels.

Figure 8: Residential land use. Stone Ridge Canyon Subdivision.

3.1.1.8 Utility

The Utility land use is assigned to the different utility companies, including railroads within the watershed. These land uses are scattered throughout the watershed and a majority of them are owned by Union Electric Company.

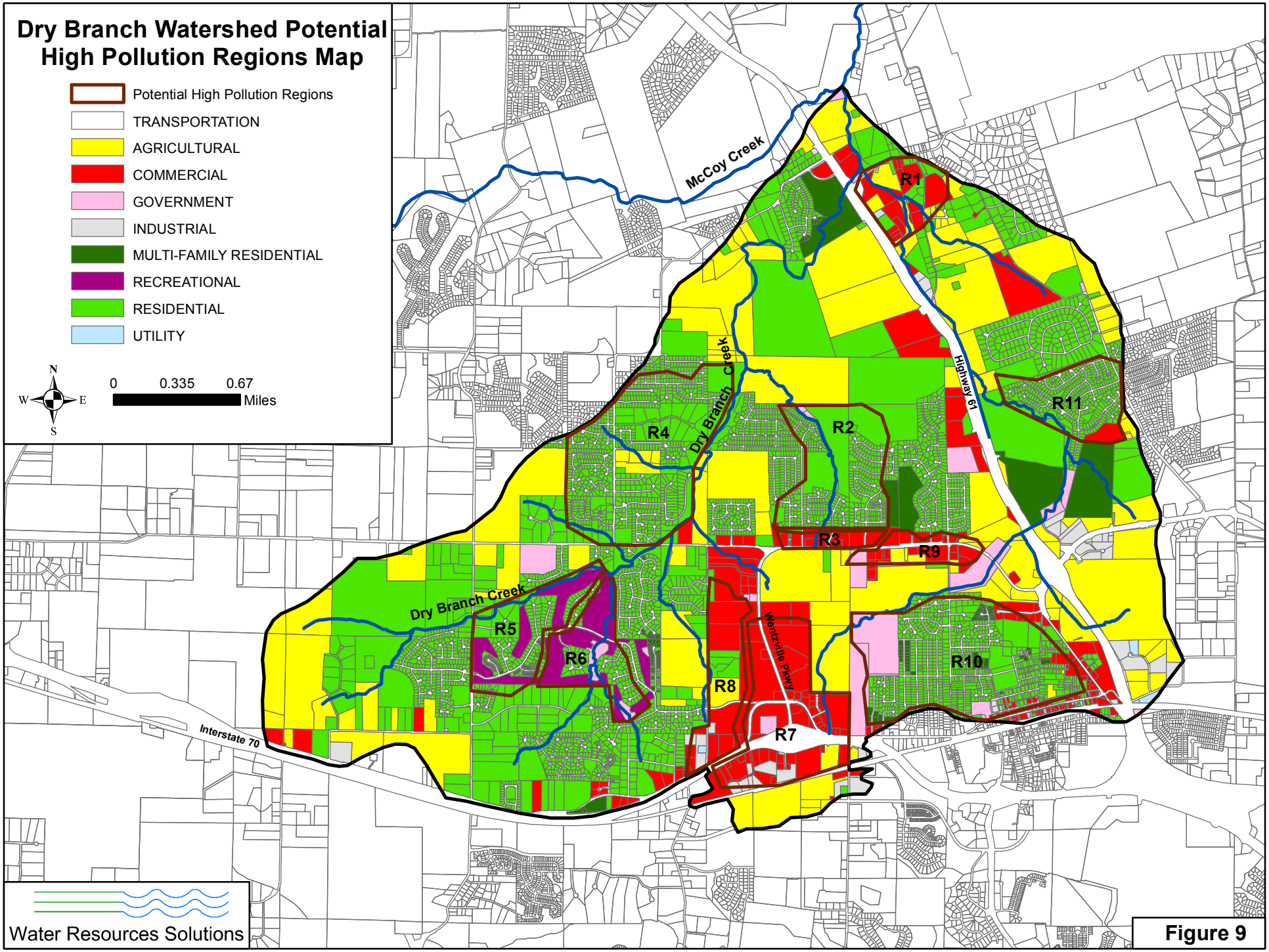
3.1.2 Potential High Pollution Regions

Potential high pollution regions were identified according to their pollutant loading potential to the watershed based on existing land use, topography, connectivity to the stream network, soils, availability to BMP's, and the City's Commercial/Industrial Hot Spot Inventory data. Figure 9 Potential High Pollution Regions Map shows the location of the regions. These regions were used as one of the potential NPS pollution mitigation measure site identification criteria. This is discussed in the Potential NPS Pollution Mitigation Measure Site Identification section of this management plan.

Residential, commercial and industrial, and agricultural areas makeup a majority of the land uses within the watershed and these are prone to producing nonpoint source pollution. Typical sources of residential pollution include pesticides, nutrients, and sediment. Typical sources of agricultural pollution include animal waste, pesticides, fertilizers, and sediment. Typical sources of commercial and industrial pollution include oils and greases, cleaners, solvents, and sediment. Future water quality monitoring data will help confirm and quantify the watershed's existing impairments. When identifying the potential high pollution regions, not only did they include these land use areas, but also the connectivity to a stream. The potential high pollution regions were in close proximity to a stream networks. The soil type within potential high pollution regions included those with a low infiltration rate, and thus a high runoff potential.

The high runoff potential contributes to higher nonpoint source pollution. The potential high pollution regions included those of residential, commercial, industrial, agricultural, and recreational areas that were in close proximity to streams, and had soil types that had high runoff potential.

Regions R1, R3, R7, R8 and R9 consist mainly of commercial and industrial areas. Regions R2, R4, R10, and R11 are residential areas, while Regions R5 and R6 include recreational areas.


Dry Branch Watershed Potential High Pollution Regions Map
Potential High Pollution Regions
TRANSPORTATION
AGRICULTURAL
COMMERCIAL
GOVERNMENT
INDUSTRIAL
MULTI-FAMILY RESIDENTIAL
RECREATIONAL
RESIDENTIAL
UTILITY
N
W
E
S
0
0.335
0.67
Miles
McCoy Creek
Dry Branch Creek
Dry Branch Creek
Highway 61
Wentzville Pkwy
Interstate 70
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
Water Resources Solutions
Figure 9

3.2 Stream Asset Inventory

A stream assessment using a refined version of the protocol developed by Johnson, Gleason & Hey with the Federal Highway Administration was completed. The stream asset inventory characterized the stability of the streams and their potential for contributing sediment loading to the system. The data also provided a criterion for ranking potential NPS pollution mitigation measures. The following section outlines the process and results of this assessment.

3.2.1 Data Collection

The stream data for the Dry Branch Watershed was collected by Matt Harper, P.E., Water Resources Solutions, LLC, on March 29, 2012. The field data was collected using a Trimble GeoHX GPS data collector. The data was collected using the NAD 1983 (US Feet) State Plane Missouri East FIPS 2401 coordinate system. Other data was determined using the aerial photography and GIS information provided to Water Resources Solutions by the City of Wentzville. The other data included sinuosity and radius of curvature. The rapid stream assessment included identifying key locations within the watershed that were known or predicted to be of concern based on existing land use and stream accessibility (as depicted in Figure 10). Detailed stream asset inventories were performed at 14 key locations. Figure 10 below is a photo taken during the stream asset inventory.

Figure 10: Photo taken during stream asset inventory on Reach 3 behind Dierbergs.

The data collected in the field and from the GIS information was based on the data required to complete the Channel Condition Scoring Matrix (Table 5605-2) in the Kansas City Metropolitan Chapter of the American Public Works Association Section 5600 design guidance document for

Storm Drainage Systems & Facilities. The Channel Condition Scoring Matrix provides a quantitative evaluation system for stream reaches to provide an unbiased assessment and comparison of stream reaches.

The Channel Condition Scoring Matrix is based on the scoring or assessment of 15 Channel Stability Indicators. A score of "Good" receives 1 point, "Fair" receives 2 points, and "Poor" receives 3 points. The Stability Indicators from the Channel Condition Scoring Matrix are listed in Table 3 below.

Table 3: Stability Indicator List

Stability Indicators	Weighting Factor
Bank soil texture and coherence	0.6
Average bank slope angle	0.6
Average bank height	0.8
Vegetative bank protection	0.8
Bank cutting	0.4
Mass wasting	0.8
Bar development	0.6
Debris jam potential	0.2
Obstructions, flow deflectors (walls, bluffs) and sediment traps	0.2
Channel bed material consolidation and armoring	0.8
Sinuosity	0.8
Ratio of radius of curvature to channel width	0.8
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	0.8
Percentage of channel constriction	0.8
Sediment movement	0.8

3.2.2 Channel Condition Rating and Ranking

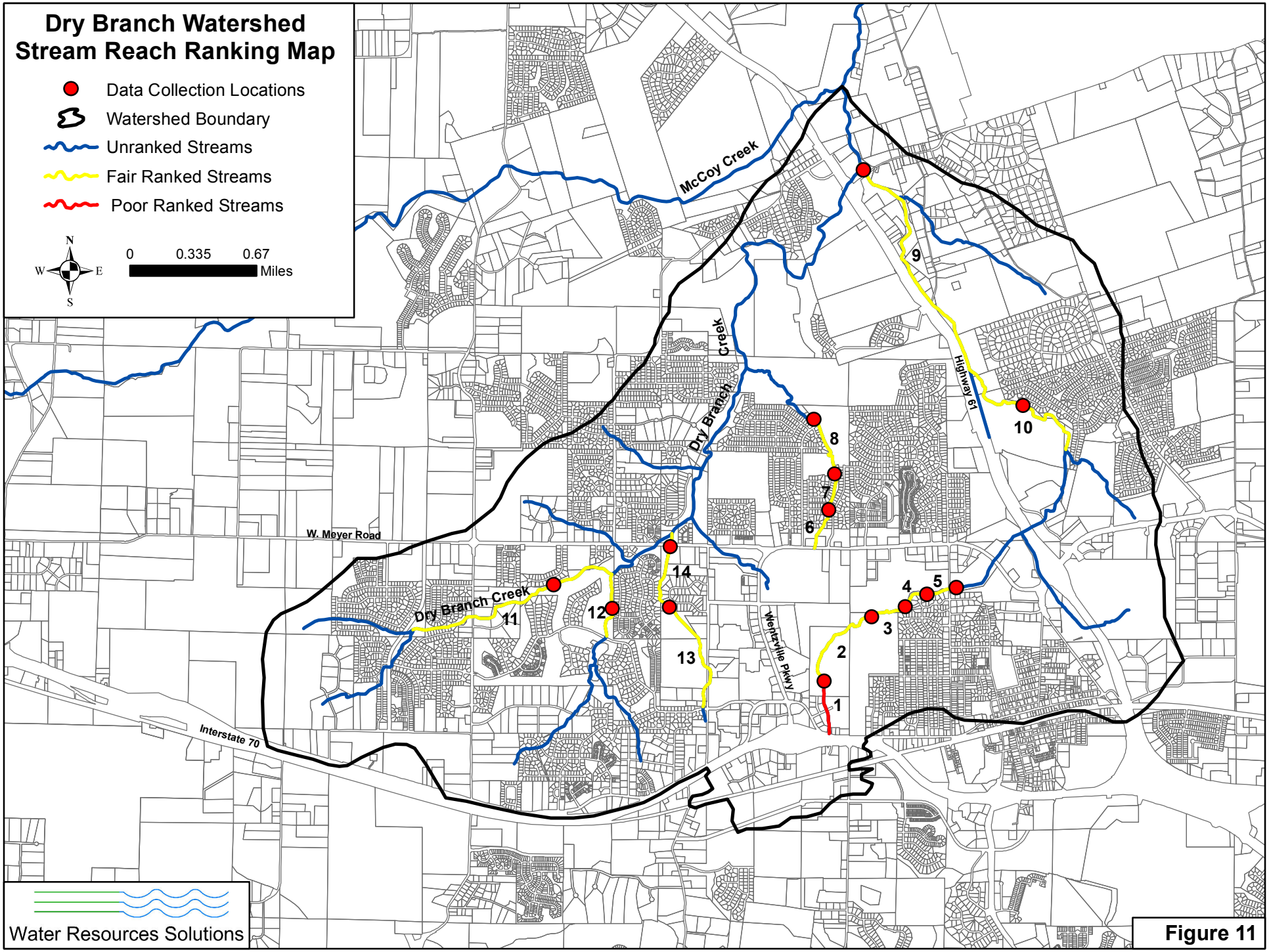
Each of the Stability Indicator scores described in the previous section was multiplied by a Weighting Factor that produces a numeric Rating for each Indicator. The Weighting Factor is a decimal ranging from 0.2 to 0.8 that establishes the relative importance of the Indicators to stream stability. The Weighting Factors for the matrix add to a total of 9.8.

The Stability Indictor Ratings are then added together to produce a Total Ranking. As a result, the upper limit of Total Ranking for a stream reach to be ranked "Good" would be 9.8 (1 x9.8). The upper limit for a stream reach to be ranked "Fair" is 19.6 (2 x 9.8). Similarly, the upper limit of the Total Ranking for a stream reach to be ranked "Poor" is 29.4 (3 x 9.8). Table 4 shows the total rating and ranking of each stream reach assessed. As the table shows, no assessed stream reaches were assigned a "Good" ranking. This was to be expected because the assessed reaches were those within the identified potential high pollution regions. Figure 11 Dry Branch

Watershed Stream Reach Ranking Map illustrates the location and ranking for each stream reach. Although no assessed stream reach received a "Good" total ranking, they did receive a "Good" rating in some of the stability indicator rating categories. The Stream Asset Inventory Reports, including the Channel Condition Scoring Matrix, for each of the assessed reaches are found in Appendix A.

3.2.3 Stream Asset Inventory Results

The results of the previous section indicate that channel instability issues exist within the stream reaches that were assessed. While the detail of this assessment does not allow a detailed recommendation for stream improvements, some general recommendations can be made. In general, the stream rating reflected lack of sinuosity, steep bank slopes, high debris jam potential, and lack of vegetative protection. A more detailed study needs to be completed before the placing of grade controls and bank stability measures along the stream. Channel stability measures to be considered include incorporating meanders, creating or increasing stream buffers, grade stabilizing the channel bed, and restoring the stream banks.



GIS data was provided by the City of Wentzville and was the most current available as of June 2012.

Table 4: Stream Reach Rating and Ranking

Stream Reach	Bank Soil	Bank Slope Angle	Bank Height	Vegetative Bank Protection	Bank Cutting	Mass Wasting	Bar Development	Debris Jam Potential	Obstructions	Channel Bed Material	Sinuosity	Rc/Wc	Pool-riffle/Wc	% of Channel Constriction	Sediment Movement	TOTAL RATING	TOTAL RANKING
1	G	P	G	F	P	F	P	F	F	G	P	P	G	G	P	19.8	Poor
2	G	G	G	F	F	G	F	F	G	G	F	P	G	G	G	14.2	Fair
3	G	F	F	G	F	G	F	F	G	G	P	P	G	G	G	15.6	Fair
4	G	G	G	P	G	G	G	G	G	G	F	P	G	G	G	13.8	Fair
5	G	F	F	G	G	F	G	G	G	G	P	P	G	G	G	15.2	Fair
6	G	F	F	F	F	G	G	F	G	G	P	P	G	G	F	16.6	Fair
7	G	F	F	F	F	F	G	P	F	F	P	P	G	G	F	18.6	Fair
8	G	F	F	F	F	F	F	F	G	G	F	P	G	G	G	16.4	Fair
9	G	P	F	F	F	F	G	F	G	G	F	P	G	G	F	17.2	Fair
10	F	P	F	F	P	P	F	F	G	F	G	F	G	G	P	19.6	Fair
11	G	F	F	P	P	F	F	F	G	G	P	P	G	G	G	18.4	Fair
12	G	P	F	F	P	P	F	F	G	G	P	P	G	G	G	19.0	Fair
13	G	F	G	F	P	F	F	P	G	F	F	P	G	G	G	17.0	Fair
14	G	F	G	P	G	G	G	F	G	F	G	P	G	G	G	14.6	Fair

G = good, F = fair, P = poor

3.3 Water Quality Model

A water quality model for the existing conditions in the watershed was developed to establish a water quality/pollutant loading baseline for the watershed. The water quality model will be used to estimate the percent pollutant load reduction for each of the selected potential NPS pollution mitigation measures, which will then be used as one of the criterion for ranking potential NPS pollution mitigation measures. The modeling done for this management plan does not use specific inputs for pollutant loading, but as data becomes available through water quality testing, the water quality model can be revised and updated. The following section outlines the process and results of the water quality model development.

3.3.1 Water Quality Model Development

The water quality model was developed for the existing conditions using the Spreadsheet Tool for the Estimation of Pollutant Load (STEPL) Version 4.1 model. This model was used to establish a water quality/pollutant loading baseline for the City and other stateholders within the watershed to use as the BMPs are implemented and to compare with the water quality monitoring component of the 319 Grant.

The model was also used to estimate the percent pollutant load reduction for each of the selected potential NPS mitigation measures. The selected potential NPS pollution mitigation measures are discussed in the Potential NPS Pollution Mitigation Measures Selection section of

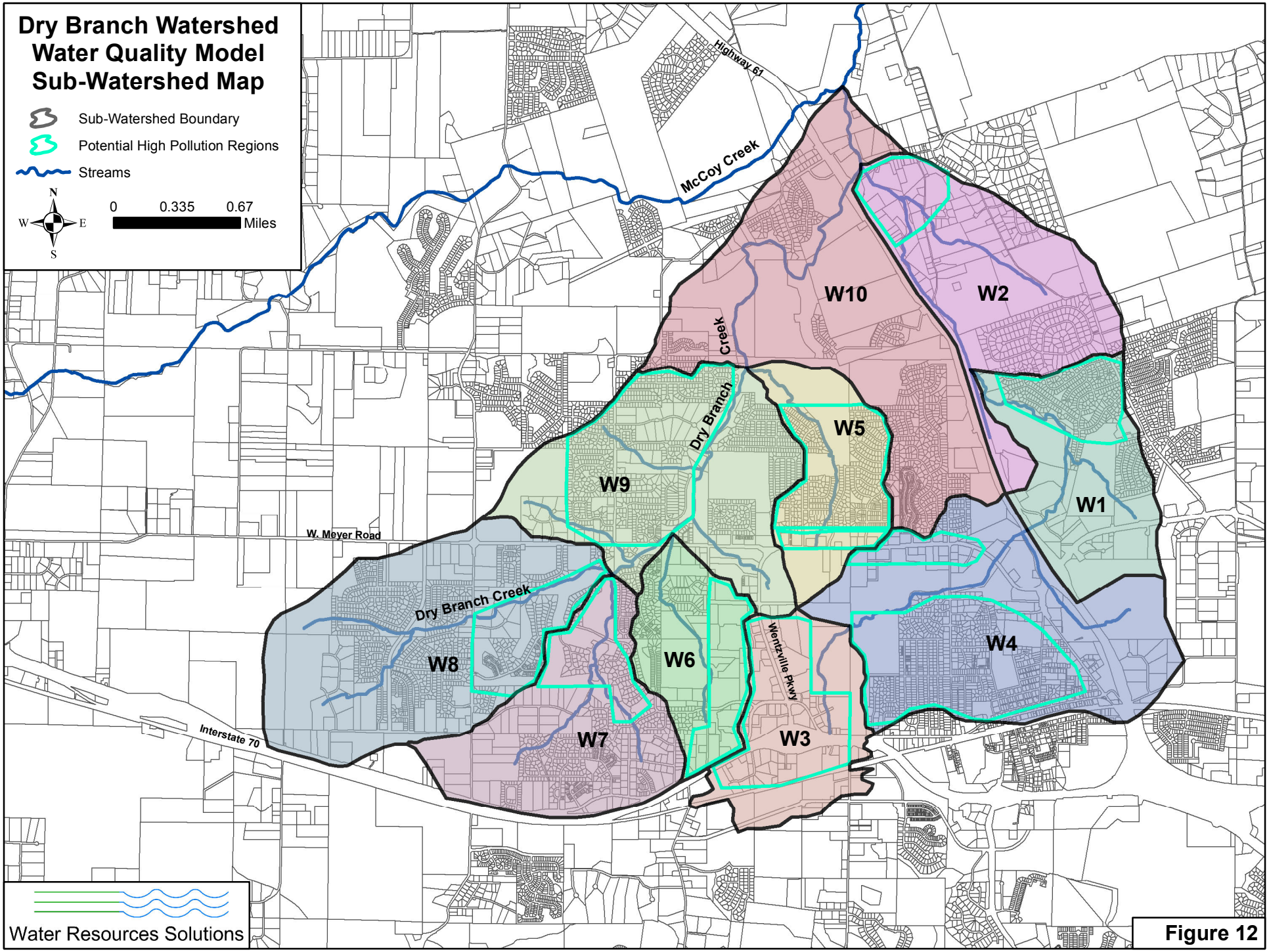
this management plan. Each of the potential mitigation measures were entered into the model.

The Dry Branch Watershed was divided into 10 sub-watersheds that were entered into water quality model. Figure 12 Dry Branch Watershed Water Quality Model Sub-Watershed Map shows the 10 sub-watersheds used in the water quality model. The sub-watersheds correspond to potential high pollution regions, stream confluences and potential BMP sites. The existing land use data and soil hydrologic group for each sub-watershed was entered into the water quality model. The watershed consists of hydrologic groups B, C, and D. Figure 13 Dry Branch Watershed Hydrologic Soil Group Map illustrates the locations of the hydrologic soil groups throughout the watershed. Table 5 below shows the breakdown of the existing land use for each sub-watershed.

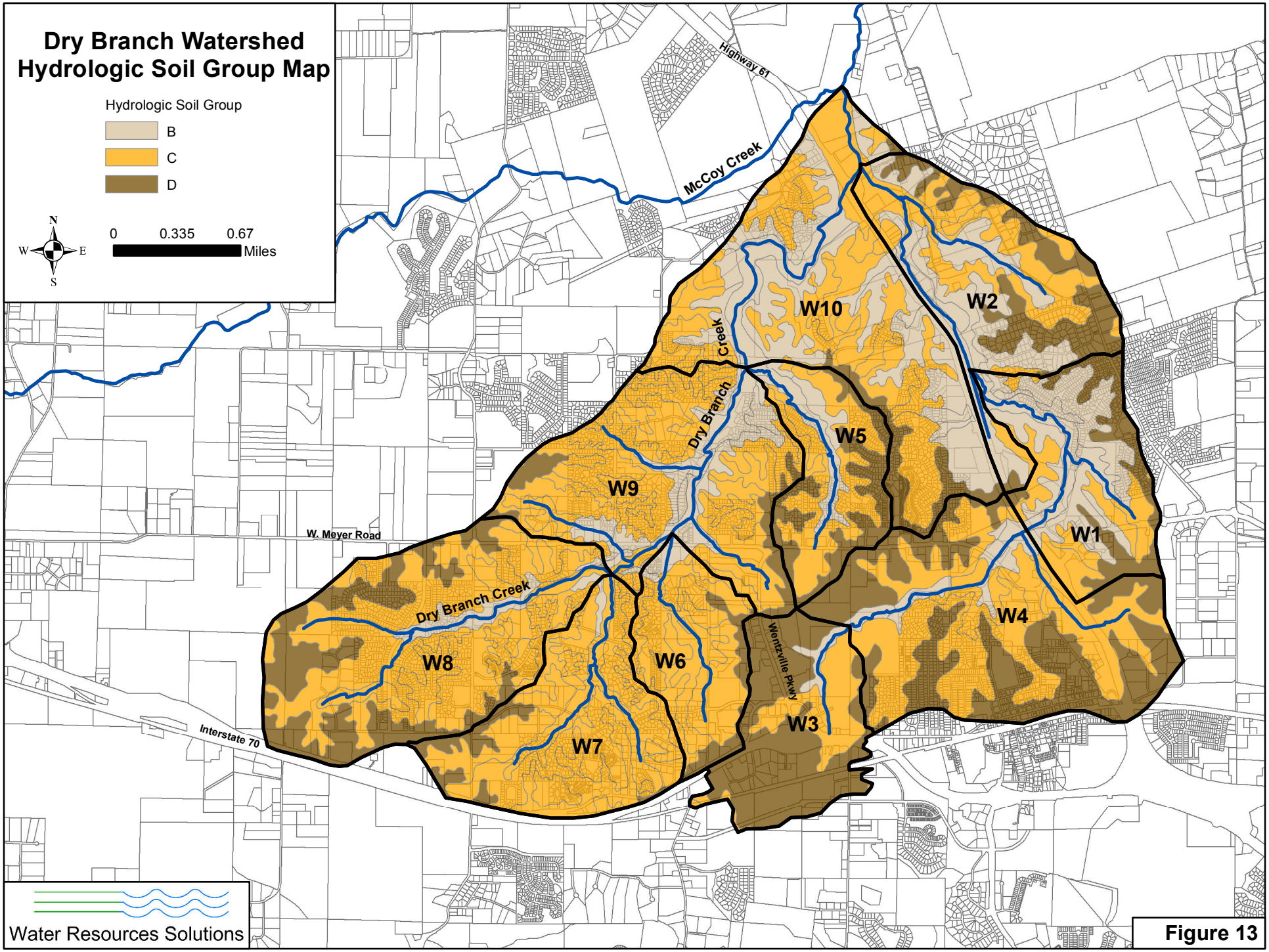
Table 5: Sub-Watershed Existing Land Use

Land Use	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10
Urban (ac)	389.3	432.3	319.4	678.8	269.9	265.9	578.1	684.3	637.9	726.9
Commercial	2.6%	21.2%	61.7%	16.3%	12.3%	32.8%	3.6%	2.4%	8.8%	11.1%
Industrial	7.0%	1.1%	8.5%	2.8%	0.0%	3.3%	0.0%	1.1%	0.0%	0.1%
Institutional	3.0%	0.9%	8.2%	15.0%	0.9%	1.2%	2.0%	2.7%	0.2%	2.3%
Transportation	14.3%	15.4%	21.2%	22.0%	12.8%	10.5%	12.1%	9.0%	14.3%	12.2
Multi-Family Res.	22.2%	3.3%	0.0%	3.1%	1.4%	2.9%	1.1%	0.4%	0.05%	10.6%
Single Family Res.	50.9%	58.1%	0.4%	40.8%	72.6%	46.4%	68.4%	76.8%	76.6%	63.7%
Rec./Open Space	0.0%	0.0%	0.0%	0.0%	0.0%	2.9%	12.8%	7.6%	0.01%	0.0%
Agri/Pasture (ac)	110.6	229.9	127.3	312.6	100.2	81.4	36.0	292.8	194.5	354.3
TOTAL AREA (ac)	499.9	662.2	446.7	991.4	370.1	347.3	614.1	977.1	832.4	1081.2

Precipitation data is calculated using the annual precipitation, number of days with measurable precipitation, and correction factors for each watershed. The precipitation data is determined by selecting the county (St. Charles County) and the nearest weather station (Lambert St. Louis Airport). Once the land use area, precipitation data, and soil hydrological group for each watershed have been entered, the STEPL model calculates the average annual runoff for each type of land use. Pollutant concentration in runoff for each land use is also entered and used for calculating urban pollutant load and load reduction. For our model, default pollutant concentration values were used since no water quality testing or monitoring has been completed (See Table 6). Once water quality monitoring is complete, the pollutant concentrations will be reevaluated and revised, if necessary, per the water quality monitoring results.



GIS data was provided by the City of Wentzville and was the most current available as of June 2012.



GIS data was provided by the City of Wentzville and was the most current available as of June 2012.

Table 6: Pollutant Concentration in Runoff (mg/L)

	Commercial	Industrial	Government/ Institutional	Transportation	Multi-Family Residential	Single-Family Residential	Urban-Cultivated	Vacant Developed	Open Space
Total Nitrogen (TN)	2.0	2.5	1.8	3.0	2.2	2.2	1.9	1.5	1.5
Total Phosphorous (TP)	0.2	0.4	0.3	0.5	0.4	0.4	0.3	0.15	0.15
5-Day Biological Oxygen Demand (BOD)	9.3	9.0	7.8	9.3	10	10	4.0	4.0	4.0
Total Sediment (TSS)	75	120	67	150	100	100	150	70	70

3.3.2 Water Quality Model Results

The results from the model included expected pollutant loadings from sub-basins within the watershed. Actual pollutant loadings will be determined once the water quality testing is completed. This data will be assessed and summarized. This information will be added to this watershed management plan in Appendix G. The default pollutants in STEPL were modeled. These pollutants included:

- Total Nitrogen (TN)
- Total Phosphorous (TP)
- 5-day Biological Oxygen Demand (BOD)
- Total Sediment

Total Nitrogen (TN) is a measure of all forms of nitrogen (Nitrate and Ammonia) in a water sample. Nitrogen is abundant naturally in the environment, but it is also found in fertilizers and sewage. Too much nitrogen in the water can lead to excessive aquatic plant and algae growth and can be harmful to aquatic life.

Total Phosphorous (TP) is a measure of phosphates, which are classified as orthophosphates, polyphosphates, and organic phosphates. Phosphates come from a variety of sources including agricultural fertilizers, domestic wastewater, detergents, industrial process wastes and geological formations. High levels of phosphorous in water promote excessive algae growth.

5-day Biological Oxygen Demand (BOD) is a measure of the oxygen consumed by bacteria as they consume the organic material in the water. Sources of organic material in the water include decomposing plants, leaf or crop litter, animal waste, sewage and fertilizers. High levels of BOD indicate that the oxygen in the water is taken up by bacteria and is less available to other life forms. Low levels of BOD indicate higher water quality.

Total Sediment is the measure of all forms of sediment suspended in water. High levels of turbidity limit penetration of sunlight into the water column, thus disrupting the aquatic ecosystem by hurting the habitat, including rooted aquatic plants and potential fish spawning beds.

Table 7 below shows the baseline results from the Dry Branch Watershed water quality model. These baseline results will be revised if necessary once the water quality monitoring is complete and the pollutant load concentrations are determined. The precipitation data combined with the land use and soil hydrological group were used to calculate the average annual runoff. The default pollutant concentration in runoff for each land used to calculate the urban pollutant load for each land use and sub-watershed. The Total Nitrogen baseline values ranged from 6.6 lb/ac-yr in sub-watershed W7 to 12.1 lb/ac-yr in sub-watershed W3. The Total Phosphorous baseline values ranged from 1.1 to 1.5 lb/ac-yr with the lowest found in sub-watershed W7 and the highest found in sub-watersheds W3 and W4. The BOD baseline values ranged from 25.0 lb/ac-yr in sub-watersheds W1 and W7 to 43.3 lb/ac-yr in sub-watershed W3. The Total Sediment baseline values ranged from 0.19 ton/ac-yr in sub-watershed W7 to 0.43 ton/ac-yr in sub-watershed W3.

Table 7: Water Quality Model Baseline Results

Sub-Watershed		Total Nitrogen	Total Phosphorous	BOD	Total Sediment	Dominant Land Use
W1	Annual Load	3,605.4 lb/yr	582.5 lb/yr	12,506.5 lb/yr	158.1 ton/yr	Single Family Res.
	Unit Area Load	7.2 lb/ac-yr	1.2 lb/ac-yr	25.0 lb/ac-yr	0.32 ton/ac-yr	
W2	Annual Load	5,232.5 lb/yr	779.2 lb/yr	17,397.7 lb/yr	273.2 ton/yr	Single Family Res.
	Unit Area Load	7.9 lb/ac-yr	1.2 lb/ac-yr	26.3 lb/ac-yr	0.41 ton/ac-yr	
W3	Annual Load	5,397.7 lb/yr	690.6 lb/yr	19,342.5 lb/yr	190.0 ton/yr	Commercial
	Unit Area Load	12.1 lb/ac-yr	1.5 lb/ac-yr	43.3 lb/ac-yr	0.43 ton/ac-yr	
W4	Annual Load	9,937.7 lb/yr	1,458.8 lb/yr	33,729.5 lb/yr	417.2 ton/yr	Agriculture/ Pasture
	Unit Area Load	10.0 lb/ac-yr	1.5 lb/ac-yr	34.0 lb/ac-yr	0.42 ton/ac-yr	
W5	Annual Load	3,164.0 lb/yr	472.8 lb/yr	11,137.1 lb/yr	133.5 ton/yr	Single Family Res.
	Unit Area Load	8.5 lb/ac-yr	1.3 lb/ac-yr	30.1 lb/ac-yr	0.36 ton/ac-yr	
W6	Annual Load	3,060.0 lb/yr	427.3 lb/yr	11,214.4 lb/yr	117.6 ton/yr	Single Family Res.
	Unit Area Load	8.8 lb/ac-yr	1.2 lb/ac-yr	32.3 lb/ac-yr	0.34 ton/ac-yr	
W7	Annual Load	4,045.8 lb/yr	658.8 lb/yr	15,364.5 lb/yr	115.9 ton/yr	Single Family Res.
	Unit Area Load	6.6 lb/ac-yr	1.1 lb/ac-yr	25.0 lb/ac-yr	0.19 ton/ac-yr	
W8	Annual Load	7,878.5 lb/yr	1,185.1 lb/yr	26,888.2 lb/yr	360.1 ton/yr	Single Family Res.
	Unit Area Load	8.1 lb/ac-yr	1.2 lb/ac-yr	27.5 lb/ac-yr	0.37 ton/ac-yr	
W9	Annual Load	6,926.4 lb/yr	1,060.1 lb/yr	24,566.0 lb/yr	278.3 ton/yr	Single Family Res.
	Unit Area Load	8.3 lb/ac-yr	1.3 lb/ac-yr	29.5 lb/ac-yr	0.33 ton/ac-yr	
W10	Annual Load	9,747.1 lb/yr	1,443.6 lb/yr	33,626.1 lb/yr	439.0 ton/yr	Single Family Res.
	Unit Area Load	9.0 lb/ac-yr	1.3 lb/ac-yr	31.1 lb/ac-yr	0.41 ton/ac-yr	
Total Watershed	Annual Load	58,997.1 lb/yr	8758.9 lb/yr	205,772.4 lb/yr	2482.9 ton/yr	Residential
	Unit Area Load	8.6 lb/ac-yr	1.3 lb/ac-yr	30.2 lb/ac-yr	0.36 ton/ac-yr	

More extensive water quality monitoring data will be conducted over the next two years, as outlined in the Dry Branch Watershed QAPP, and based upon this data; the water quality baseline conditions will be revised/updated. The complete QAPP is available at the City of Wentzville. The main body of the QAPP is available on the City of Wentzville website at http://www.wentzvillemo.org/Stormwater%20PDF/pdf/319%20Grant/QAPP%20Final%20-%20Front%20for%20Web.pdf. Data collected from the QAPP will be added to the Management Plan in Appendix G.

The potential NPS pollution mitigation measures were evaluated to estimate the percent load reduction. The percent load reduction will be used in the water quality component of the potential NPS pollution mitigation measure prioritization criteria that is discussed in the Prioritization of Potential NPS Pollution Mitigation Measures section of this management plan. Table 6 below shows the percent load reduction by selected potential NPS pollution mitigation measure.

3.3.3 Water Quality and Environmental Goals

The ultimate water quality and environmental goals of the Dry Branch Watershed Management Plan include:

- Meet state water quality standards
- Reduce pollutants of concern
- Prevent illegal discharges/spills
- Improve the condition of poor/fair rated streams
- Conserve natural areas

Per the Code of State Regulations, Division 20, Chapter 7 Water Quality (10 CSR 20.7), the streams within the Dry Branch watershed are unclassified. To be classified, the streams, lakes, and rivers must have identified beneficial uses and have some water year round and listed in Tables G and H in 10 CSR 20-7. Dry Branch is a tributary to McCoy Creek, a classified stream, and a lower portion of Dry Branch is backwatered and considered a mixing zone. Per 10 CSR 20.7, these mixing zone areas within the Dry Branch watershed must meet the acute toxicity criteria identified in 10 CSR 20.7 Table A and B (See Appendix H). In addition, all waters of the state shall meet the following water quality standards:

A. Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits or prevent full maintenance of beneficial uses.
B. Waters shall be free from oil, scum and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses.

C. Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor or prevent full maintenance of beneficial uses
D. Waters shall be free from substances or conditions in sufficient amount to result in toxicity to human, animal or aquatic life.
E. There shall be no significant human health hazard from incidental contact with the water.
F. There shall be no acute toxicity to livestock or wildlife watering.
G. Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community.
H. Waters shall be free from used tires, car bodies, appliances, demolition debris, used vehicles or equipment and solid waste as defined in Missouri's Solid Waste Law, section 260.200, RSMo, except as the use of such materials is specifically permitted pursuant to section 260.200-260.247.
I. Waters in mixing zones and unclassified water which support aquatic life on an intermittent basis shall be subject to the following requirements:
    1. The acute toxicity criteria of Tables A and B (See Appendix H) and the requirements of subsection (4)(B); and
    2. The following whole effluent toxicity conditions must be satisfied:
        A. Single dilution method. The percent effluent at the edge of the zone of initial dilution will be computed and toxicity tests performed at this percent effluent. These tests must show statistically-insignificant mortality on the most sensitive of at least two (2) representative, diverse species; and
        B. Multiple dilution method. An LC_{50} will be derived from a series of test dilutions. The computed percent effluent at the edge of the zone of initial dilution must be less than three-tenths (0.3) of the LC_{50} for the most sensitive of at least two (2) representative diverse species.

Table 8: Potential Mitigation Measure Percent Load Reduction

Potential Mitigation Measure	Percent Reduction				
	Total Nitrogen	Total Phosphorous	BOD	Total Sediment	Average % Reduction
Filtering – Bioretention	63%	80%	n/a	n/a	72%
Open Channel – Dry Swale	10%	25%	30%	65%	33%
Stormwater Wetland	20%	44%	63%	78%	52%
Stormwater Ponds	35%	45%	n/a	60%	47%
Infiltration Practices	60%	65%	n/a	75%	67%
Filter Strips	40%	45%	51%	73%	52%

Table 8 above shows the percent load reduction by pollutant for each potential mitigation measure identified in Section 4.0 Nonpoint Source Pollution Mitigation Measures. There aren't any numerical criteria and/or impairment, and water quality information has not yet been collected to determine the extent of the water quality conditions. Over the next year, water quality monitoring will be conducted throughout the Dry Branch watershed as part of the 319 grant for the Dry Branch Watershed Clear Stormwater & Green Parks project to identify the pollutants of concern. The monitoring plan identified in the MDNR approved Dry Branch Watershed QAPP includes at least five, and possibly seven if funding is available, synoptic monitoring locations throughout the watershed. One grab sample will be collected on six events, including both base flow conditions and stormwater runoff events, at each site to provide a baseline assessment of the current water quality. The pollutant load concentrations in water quality model should be updated as needed based on the water quality monitoring results. This could change the total loads and percent load reductions.

4.0 NONPOINT SOURCE (NPS) POLLUTION MITIGATION MEASURES (ELEMENTS 2, 3, 4, 6 & 7)

The integration of nonpoint source (NPS) pollution mitigation measures into the Dry Branch Watershed can substantially benefit water quality, habitat, and provide opportunities for public education regarding water resources. This section will identify and quantify the potential NPS pollution mitigation measures for the Dry Branch Watershed. This section includes following:

- Potential NPS pollution mitigation measures
- Potential NPS pollution mitigation measures site identification
- Potential NPS source pollution mitigation measures selection
- Opinions of probable construction and implementation costs
- Prioritization of potential NPS pollution mitigation measures
- Implementation Plan

4.1 Potential NPS Pollution Mitigation Measures

Best management practices (BMP) are an emerging technology serving to decentralize some aspects of stormwater management while improving water quality and enhancing habitat. BMP solutions are a key component to watershed management because they can benefit water quality and potentially mitigate flooding damage. These practices include both structural and non-structural solutions, maintenance procedures, and other management practices. This section describes both the non-structural and structural potential nonpoint source pollution mitigation measures.

The City of Wentzville requires stormwater detention and water quality facilities on all new development and redevelopment projects that disturb greater than or equal to one acre or

increase runoff by 1 cfs or greater for the 15-yr, 20-minute storm event. St. Charles County and the City of Flint Hill currently only have requirements for stormwater detention. Stormwater detention is required on developments that are less than acre lot sizes or an increase in runoff by 2 cfs or greater for the 15-yr, 20-minute storm event.

4.1.1 Structural BMP Solutions

Structural BMP solutions for the Dry Branch Watershed were selected using consideration from the City of Wentzville, Engineering Design Criteria (June 2009). There are six general categories for stormwater quality control. They include the following conceptual practices.

4.1.1.1 Stormwater Ponds

Stormwater Ponds include practices that have a combination of permanent pool, extended detention or shallow wetlands. They facilitate settling as runoff collects in the pool as well as pollutant uptake through biological and chemical activity. These practices include micropool extended detention ponds, wet ponds, wet extended detention ponds, multiple pond systems, and pocket ponds. This BMP option can be effective in enhancing water quality, flood and erosion protection, and wildlife and aquatic habitats. It can also integrate community education, recreation and aesthetic benefits. Figure 14 below is an example of a stormwater pond.

Figure 14: Stormwater pond.

4.1.1.2 Stormwater Wetlands

Stormwater Wetlands include practices that have significant shallow wetland areas to treat urban stormwater but may also incorporate small permanent pools and/or extended detention ponds. Like Stormwater Ponds, they facilitate settling as runoff collects in the wetland as well as pollutant uptake through biological and chemical activity. Stormwater Wetlands differ from

Stormwater Ponds primarily in having a greater average depth. These practices include shallow wetlands, extended detention shallow wetlands, pond/wetland systems, and pocket wetlands. Figure 15 below is an example of a stormwater wetland.

Figure 15: Stormwater wetland.

4.1.1.3 Infiltration Practices

Infiltration Practices include many options at different scales using the same theory: runoff is filtered and infiltrated through the natural chemical, biological, and physical properties of plants, microbes, and soils. They capture and temporarily store the runoff, while allowing infiltration into the soil. These practices include infiltration trenches and basins.

4.1.1.4 Filtering Practices

Filtering Practices capture and temporarily store runoff. The runoff is then passed through a filter bed of sand, organic matter, soil or other media. The filtered runoff may be collected in an underdrain system and discharged to the storm sewer system or directly to receiving waters. Filtering practices include surface sand filters, underground sand filters, perimeter sand filters, organic sand filters, pocket sand filters, and bioretention cells. Bioretention cells are typically installed to infiltrate and treat surface water runoff from parking lots and roadways. Pollutants are removed by natural processes including absorption, filtration, volatilization, ion exchange and decomposition. Figure 16 is an example of a filtering practice.

Figure 16: Bioretention cell inlet.

4.1.1.5 Open Channel Practices

Open Channel Practices include both wet and dry swales. Open swales are broad, shallow, natural or constructed channels with a dense stand of native vegetation. A wetland can be incorporated (wet swale), but success is dependent on soil conditions. The vegetation promotes infiltration, plant transpiration and enhances water quality as many particulate contaminants settle. These are a viable alternative to lined channels or typical curb-gutter systems where there is limited flow. Figure 17 below is an example of an Open Channel.

Figure 17: Open channel (dec.ny.gov).

4.1.1.6 Filter Strips, Rain Gardens and Small Scale Solutions

Filter strips are grassed areas often placed adjacent to an impervious surface such as a driveway, parking lot, sidewalk or roadway. These areas are used to treat shallow sheet flows and can be linked to another BMP such as a shallow ponding area where the water quality volume can be detained. A rain garden is a small depression planted with native wetland and prairie vegetation where sheet flow runoff collects and infiltrates. These gardens, usually placed in residential areas, act as small scale bioretention solutions and utilize the same natural processes to improve water quality. Figure 18 is an example of a rain garden.

Figure 18: Rain garden (hoklife.com).

4.1.1.7 Other Structural Practices

Rain barrels are above ground water storage units that collect and store rainwater from building roofs that would otherwise be lost to runoff and diverted to storm drains and streams. The gutter and downspouts from the roof are connected directly to the rain barrels. The rain water collected in the barrels can be used between rain events, or emptied at a slower rate by using a valve at the bottom of the barrel. This will reduce runoff and increase infiltration. More information on rain barrels can be found on the EPA website at http://www.epa.gov/region3/p2/what-is-rainbarrel.pdf. More information on structural BMP solutions can be found in the Missouri Guide to Green Infrastructure, which can be found on the MDNR website at http://www.dnr.mo.gov/env/wpp/stormwater/mo-gi-guide.htm.

4.1.2 Non-structural BMP Solutions

Non-structural BMP solutions prevent pollution through education, management, and planning procedures. They serve to limit the amount of pollutants available and typically lessen the need for more costly structural solutions. As part of their Engineering Design Criteria, the City of Wentzville has adopted the Stormwater Credits for Innovative Site Planning, from the Maryland Stormwater Design Manual, Chapter 5.0 for their non-structural practices. These practices can be utilized within the Dry Branch Watershed on both existing and future developments and are described below.

4.1.2.1 Natural Area Conservation

Natural area conservation is the practice of protecting natural areas within development sites. By doing this, the pre-development hydrologic and water quality characteristics in these areas are maintained. Examples of natural conservation area include forest, wetlands, and streams and associated buffers. Conservation easements will facilitate the protection of these areas.

4.1.2.2 Disconnection of Rooftop Runoff

Disconnection of rooftop runoff is the practice of disconnecting rooftop runoff and directing it to a pervious area. The runoff will either infiltrate into the soil or filter over it. Examples of this practice include site grading to promote overland flow or connecting the rooftop drains to bioretention areas.

4.1.2.3 Disconnection of Non-Rooftop Runoff

Disconnection of non-rooftop runoff is the practice of disconnecting impervious surface runoff by directing it to pervious areas. The runoff will either infiltrate into the soil or filter over it. As with the Disconnection of Rooftop Runoff practices, examples of this practice include site grading to promote overland flow or providing bioretention areas.

4.1.2.4 Sheet Flow to Buffers

Sheet flow to buffers is the practice of treating stormwater runoff by using a natural buffer to a stream or forested area. Effective treatment is achieved when pervious and impervious area runoff is discharged to a grass or forested stream buffer through overland flow.

4.1.2.5 Open Channel Use

Open channel use is the practice of using open grass channels in lieu of typical curb and gutter to reduce the volume of runoff and pollutants during smaller, more frequent storm events. This creates more green space while also naturally treating the runoff in the channels.

4.1.2.6 Environmentally Sensitive Development

Environmentally sensitive development is the practice of applying environmental site design techniques to low density or residential developments. The environmental techniques include grass lined channels in lieu of curb and gutters, disconnecting rooftop runoff, and protecting natural conservation areas with permanent easements.

4.1.2.7 Other Management Practices

Ordinances and practices associated with land use and comprehensive site planning will be integral to the non structural options for the Dry Branch watershed. Erosion and sediment control programs are important to the preservation of soil and its capacity for infiltration. Sample erosion and sediment control model ordinances can be found on the EPA website. Ordinances typically include during construction and post construction phase erosion and sediment control guidelines, inspection requirements and checklists, and effective best management practices.

Stream buffers or riparian areas create the natural corridor vegetation of a channel and generally consist of herbaceous and woody vegetation. Natural watercourses and adjacent riparian buffers absorb runoff, help filter pollutants, and provide food and shade for aquatic life. These stream systems can be interrupted by road crossings, development encroachments, extended culverts, channelization or other “improvements.” Stream interruptions and

modifications are an important factor as they can alter channel erosion, pollutant buffering capacity, and habitat suitability. Jurisdictions can use design standards or ordinances to prevent or minimized the effects such modifications have on water quality. Incorporating setback areas and/or design considerations for bridges and culverts can help preserve the physical, biological, and chemical integrity of the watercourse. Stream buffer and riparian corridor minimum standards are outlined in the City of Wentzville's Protection of Natural Watercourse Ordinance. It requires any proposed developments to maintain or plant a riparian corridor for a natural watercourse impacted by the development. The width of the riparian corridor (25/50/100 feet) within the Dry Branch Watershed is based on those identified on the City of Wentzville's Natural Watercourse and Riparian Buffer Protection Map. St. Charles County minimum standards require a vegetated buffer along natural watercourse depicted on the most current USGS 7.5 Minute Series Maps. The minimum width along the main branch of Dardenne Creek, the Peruque Creek, the Femme Osage Creek, the Big Creek, and the McCoy Creek is 50 feet. For all other natural watercourses, a 25-foot minimum vegetated buffer is required. The City of Flint Hill follows St. Charles County requirements for vegetated buffers. Riparian corridors could be improved to meet the requirements of the City's Ordinance.

Resource agencies or municipalities could help property owners develop Nutrient Management Plans for yards that will reduce the nitrogen and phosphorus pollutants. This could be an educational program designed to raise awareness about the role urban stormwater runoff plays in the water quality of nearby streams, creeks, rivers, and lakes. St. Charles County Soil & Water Conservation District could provide technical assistance to communities in regards to water quality BMPs and management. Cost share programs are available or can be developed specifically for residents that are interested in participating in projects that improve the water quality of stormwater runoff. Projects could include nutrient management plans, rain barrels, improving riparian buffers, and stream bank protection measures.

4.1.2.8 Stream Restoration

As opportunities arise, stream stabilization and restoration projects can improve the water quality within the Dry Branch watershed. The stream asset inventory procedure described in the Stream Asset Inventory section of this report, Channel Condition Scoring Matrix, can be used to identify potential stream stabilization and restoration projects. Stream reaches receiving a "Fair" or "Poor" ranking could be candidates for stabilization and/or restoration projects. Refer to Section 4.4.3 for technical and financial assistance available.

Stabilization decreases the stream's impact on an urban environment, securing vegetation that benefits habitat and water quality, and protecting the stream from higher events while maintaining the structure of the channel forming flow. Stream designs could include incorporating meanders, creating or increasing stream buffers, grade stabilizing the channel bed, and restoring or stabilizing the stream banks.

Before any sort of stream restoration measures are undertaken, it is imperative that the hydrology of the watershed be understood. As the watershed develops, the runoff from the watershed will increase. If stream stability measures are constructed without understanding the increased hydraulic forces associated with the increased runoff, there is a good probability that the measures will fail.

The Hydrologic Engineering Center's River Analysis System (HEC-RAS) model can be used to obtain detailed stream hydraulic information that is essential to evaluate the stability of stream improvements at a variety of flow conditions. Where high velocities contribute to erosion, low velocities allow possible sediment accumulations in the stream bed. Permissible velocity and shear stresses should be determined to reduce the erosive potential of flowing water. Chen and Cotton (1988) demonstrate that the shear stress method is preferable as it evaluates the expected channel shear stress to permissible shear stress of the lining material. Shear stresses should be evaluated for the channel bottom, banks as well as channel bends. Providing pools and riffles with appropriate spacing can reduce shear stresses and decrease the need for resistive materials. Basic hydraulic and sediment transport principles as well as geotechnical classification of soil and rock characteristics and vegetation recommendation should be incorporated into the final design.

4.2 Potential NPS Pollution Mitigation Measures Site Identification

A methodology that uses GIS data and analysis was developed to determine optimal locations for potential nonpoint source pollution mitigation measures throughout the Dry Branch Watershed. The factors taken into account in the potential site identification include drainage patterns, existing landuse, property ownership (private vs. public), soil type, connectivity to streams, and previous stormwater facility inspection results. The applied methodology accounts for these characteristics and links a site specific BMP to each location. Table 9 below shows the data that provided the basis for analysis in the GIS processing methodology.

Table 9: Potential NPS Mitigation Measures Site Identification GIS Data

Layer	Source	Description
Streams	City of Wentzville	Stream centerlines within watershed
Existing Land Use, Property Boundaries	St. Charles County	
Soils	NRCS	U.S. General Soil Map developed by National Cooperative Soil Survey (St. Charles County, MO)
Contours	City of Wentzville	Contours (2' interval)
Watershed Boundary	City of Wentzville	Dry Branch Watershed boundary
Potential High Pollution Regions	Water Resources Solutions	Created by Water Resources Solutions base on existing land use
Stormwater Facilities	City of Wentzville	Existing stormwater

		detention/retention facilities
Aerial Photo	City of Wentzville	MrSID format

4.3 Potential NPS Pollution Mitigation Measures Selection

Potential NPS pollution mitigation measures can have an impact on the health and integrity of a watershed. The identification methodology that was applied to the Dry Branch watershed generated a total of 60 locations (see Appendix B), including 34 commercial properties, 23 residential properties, and 3 public properties where mitigation measures could potentially be installed based on specific site conditions and mitigation measure characteristics. The structural BMPs are broken down into three categories, filtering practices, stormwater ponds and wetlands, and open channel practices.

The Dry Branch watershed is primarily residential with commercial properties concentrated along Wentzville Parkway and Highway 61. In both residential and commercial areas, structural BMP recommendations include filter strips and bioretention areas with native vegetation that enhance habitat and promote stormwater infiltration of water on-site. Many of the potential residential area BMPs include retrofitting an existing dry basin into a bioretention area. Many of the commercial property BMPs include using the existing open space/landscaping areas as bioretention facilities. Other potential mitigation measures within residential areas include stormwater wetlands. The locations of each of the potential mitigation measures are illustrated on the Potential NPS Pollution Mitigation Measures Maps found in Appendix B.

At the time of publication, 27% of land use in the watershed is agricultural. Data was requested, but was not available, from NRCS and SWCD on specifics regarding active farming practices in the watershed (i.e. acreage in row crops, number of cattle/hogs, acres in state/federal programs, etc.) This data was available countywide, but could not be segregated for the watershed. As St. Charles has many big river floodplains and some larger-scale animal farms, county-wide data is not representative of the Dry Branch watershed. According to local knowledge, there are no concentrated animal feeding operations in the watershed. Many agricultural lands are inactive and, over time, are being converted for development. Due to lack of data and this general conversion, the suggested management practices listed in this plan focus more on existing and future developments. If more data is available on agricultural practices in the future, the plan can be updated to include an assessment and recommendation for agricultural management practices to improve water quality. In general, agricultural activities that cause NPS pollution include poorly located or managed animal feeding operations, overgrazing, plowing too often or at the wrong time, and improper, excessive or poorly timed applications of pesticides, irrigation water and fertilizer. EPA's National Management Measures to Control Nonpoint Sources Pollution provides guidance to help

farmers reduce nonpoint source pollution. Examples of agricultural management practices include conservation tillage, crop nutrient management, pest management, conservation buffers, irrigation water management, grazing management, animal feeding operations management, and erosion and sediment control.

One of the large recreation land use areas within the Dry Branch Watershed is the Bear Creek Golf Course. Golf courses can have a large impact on the water quality due to the amounts of fertilizers and pesticides used to maintain the golf course. Through water quality management, strategies can be developed to improve the water quality leaving golf course. The United States Golf Association (USGA) is a source for information regarding water quality and water conservation management practices. The USGA, in cooperation with Audubon International, has developed the Audubon Sanctuary Program that promotes ecologically sound land management and the conservation of natural resources. Audubon International provides golf courses with one-on-one assistance in developing an appropriate environmental plan that includes wildlife and habitat management, outreach and education, chemical use reduction and safety, water conservation, and water quality management.

4.4 Opinions of Probable Construction and Implementation Costs

This section includes the methodology for developing a cost estimate, including capital costs, life cycle costs, and maintenance costs, for each of the potential nonpoint source mitigation measures. Possible sources of funding were also investigated and included in this section.

4.4.1 Capital Cost

A capital cost was developed for each of the potential nonpoint source mitigation measures. The capital cost is the sum of the estimated construction cost and estimated planning/engineering cost. The 60 potential mitigation measures can be divided into five different types of projects:

- Filtering bioretention practice – commercial property – detention retrofit
- Filtering bioretention practice – residential property – detention retrofit
- Filtering bioretention practice – commercial property – new bioretention
- Open channel dry swale practice – residential/commercial property – new swale
- Stormwater wetland – residential property – detention/retention retrofit

A base construction cost estimate was developed for each of the five types of projects using 2012 unit costs. The estimated cost for each of the potential mitigation measures was then calculated using the appropriate base cost estimate and adjusted by the drainage area to the potential mitigation measure. The planning/engineering cost for each potential mitigation measure was estimated at 15% of the construction cost. Once capital costs were developed for each potential mitigation measure, the projects were grouped by cost ranges resulting in 6 projects greater than $80,000, 2 projects between $60,000 and $80,000, 38 projects between

$40,000 and $60,000, and 14 projects between $20,000 and $40,000. The different types of potential projects are described below.

4.4.1.1 Filtering Bioretention Practice

Filtering biorentention practices, both new facilities and detention pond retrofits, include grading, an engineered soil filtering material depth of three feet, an underdrain, possible drainage basins and/or modifications to the existing outfall structure, and native plantings. The required bioretention area was based on the water quality volume as calculated in the City of Wentzville Engineering Design Criteria.

4.4.1.2 Open Channel Dry Swale Practice

Open channel dry swale practices, similar to the filtering bioretention practices, include grading, an engineered soil filtering material depth of three feet, an underdrain, and native plantings.

4.4.1.3 Stormwater Wetland

Stormwater wetland practices include grading, possible modifications to the existing outfall structure, wetland mulch or topsoil, and native plantings. The required wetland treatment area was based on the water quality volume as calculated in the City of Wentzville Engineering Design Criteria.

Although the site identification and selection methodology did not identify locations for each BMP included in this management plan, Table 10 below shows cost estimate for other BMPs.

Table 10: Cost Estimates for Other Nonpoint Pollution BMPs

BMP	Engineering/Planning /Construction Cost	Description
Infiltration Practices	$5/CF of storage	Includes grading, revegetation, and very little infrastructure.
Filter Strips	$1.50/SF of sod	Includes soil preparation and installation of sod.
Rain Barrels	$250/barrel	Includes rain barrel and accessories for a small residential rain barrel used for small scale irrigation and gardening.
Stream Restoration	$300/LF	Includes bank reshaping and restoration with native vegetation.

4.4.2 Life Cycle Cost and Maintenance Cost

Life cycle cost assessment provides a baseline to approximate relative costs. The life cycle costs represent the total expenditure over the lifetime of each mitigation measure. This type of analysis allows different mitigation measures to be compared and can help determine when minimizing initial cost could possibly lead to greater overall costs. The life cycle cost method

identifies future costs and associates present day values using standard accounting techniques. In order to simply the mode for consideration of projects throughout the watershed, the following assumptions were made:

- A rate of 3% was used to convert present value costs and annual maintenance cost to future costs.
- A design life of 50 years.
- A medium level of maintenance.
- Land acquisition costs are not accounted.

Routine maintenance activities for the potential mitigation measures were taken from the EPA Stormwater Menu for BMPs fact sheet. Routine maintenance includes inspection, reporting, information management and vegetation management with trash and minor debris removal. Table 11 below shows the typical maintenance activities and estimated costs.

Table 11: Potential NPS Mitigation Measure Maintenance Activities

Mitigation Measure	Activity	Schedule	Estimated Yearly Cost
Filtering – Bioretention	• Remulch void areas • Treat diseased trees and shrubs • Mow turf areas	As needed	$5,000 - $6,000
	• Water plants daily for 2 weeks	At project completion	
	• Inspect soil and repair eroded areas • Remove litter and debris	Monthly	
	• Remove and replace dead and diseased vegetation	Twice per year	
	• Add mulch • Replace tree stakes and wires	Once per year	
Stormwater Wetland	• Inspect for invasive vegetation and remove where possible	Twice per year	$2,500 - $3,500
	• Inspect for damage to the embankment and repair • Note signs of hydrocarbon build-up and address • Monitor sediment accumulation	Once per year	
	• Clean and remove debris from inlet and outlet structures • Mow side slopes	4 times per year	
	• Supplement wetland plants if significant portions have not established • Harvest wetland plants that have been “choked out” by sediment	Once per year as needed	

	build-up		
Filtering – Bioretention	• Water plants daily for 2 weeks	At project completion	$5,000 - $6,000
	• Inspect soil and repair eroded areas • Remove litter and debris	Monthly	
	• Remove and replace dead and diseased vegetation	Twice per year	
	• Add mulch • Replace tree stakes and wires	Once per year	

4.4.3 Technical and Financial Assistance

Technical and financial assistance is available to municipalities, homeowners and any organization interested in implementing potential water quality BMPs to their property. Financial assistance can be provided in the form of cost-sharing programs, grants, and financial incentives. Information on these opportunities is provided below.

As part of the Dry Branch Watershed Clear Stormwater & Green Parks project from the Department of Natural Resources and the US EPA, the City of Wentzville has funding for three nonpoint source pollution, one residential property retrofit and two commercial property retrofits. This funding source could apply to any of the retrofit project identified in Appendix B.

Both economic and environmental benefits will be achieved by demonstrating and educating local citizens and businesses throughout the watershed. By implementing the three demonstration projects and promoting other low cost practices, such as rain gardens, rain barrels, swales, and native plantings, along with an extensive education outreach plan, low cost and esthetically pleasing management practices can be easily implemented across the watershed. The City of Wentzville has also established ordinances for new construction and riparian corridor/stream buffer set-backs to reduce the impact to the stream and stormwater conveyance systems.

One of the goals of the Dry Branch Watershed Management Plan is to encourage a proactive approach to obtain citizen/business buy-in and encourage them to implement small scale practices across the watershed. In doing so, this will improve awareness, watershed health, and environmental conditions. Implementing and promoting low cost practices could keep future city stormwater utilities costs down and prevent costly repairs or retrofits that have to be addressed after the fact.

The Missouri Department of Natural Resources (MDNR) provides technical and financial assistance for building watershed protection capacity in watersheds targeted by Missouri's Nonpoint Source Management Plan and other water quality initiatives. Due to funding limitations, financial assistance through MDNR is ever changing. For the most current

information regarding technical and financial assistance, check their website at www.dnr.mo.gov or contact them at 573-751-7428. This potential funding source could apply to nonpoint source pollution management measures such as bioretention and filtering practices, rain gardens, and other watershed management plans.

The Clean Water State Revolving Fund (CWSRF), through the EPA and MDNR, is source of funding for water quality projects for wastewater treatment, nonpoint source pollution control, and watershed and estuary management. The program offers loans with low interest rates and flexible terms to a wide range of barrowers including municipalities, communities, farmers, homeowners, small businesses, and nonprofit organizations. Contact the MDNR at 573-751-1192 for more information.

The Green Project Reserve, or GPR, requires all Clean Water State Revolving Fund (CWSRF) programs to direct a portion of their capitalization grant toward projects that address green infrastructure, water efficiency, energy efficiency, or other environmentally innovative activities. Innovative environmental activities are those that demonstrate new and/or innovative approaches to managing water resources to prevent or remove water pollution in an economically and environmentally sustainable way, such as: decentralized wastewater treatment solutions, projects that facilitate adaptation of clean water facilities to climate change, and projects that identify and quantify the benefits of using integrated water resources management approaches, among others. For more information on the Green Project Reserve, contact Missouri Department of Natural Resources at 573-751-1192.

Environmental Education Grants Program, through the EPA provides financial assistance supporting environmental education projects that increase the public awareness about environmental issues and increase people's ability to make informed decisions that impact environmental quality. For more information contact EPA's Office of Environmental Education at 913-551-7003.

EPA's Five Star Restoration Grant Program that provides funding to brings students, conservation corps, other youth groups, citizen groups, corporations, landowners and government agencies together to provide environmental education and training through projects that restore wetlands and streams. The program provides challenge grants, technical support and opportunities for information exchange to enable community-based restoration projects. Funding levels range from $10,000 to $40,000, with $20,000 as the average amount awarded per project. More information can be found by contacting the USEPA Wetlands Division at 202-566-1225.

The St. Charles County Soil and Water Conservation District (district) provides technical and financial assistance to agricultural landowners in St. Charles County. They provide various cost-

share programs to help reduce NPS water quality issues relating to sediment, nutrients, pesticides, and bacteria. The district is funded by a one-tenth-of-one-percent parks and soil and water sales tax that provides funds for administrative expenses and cost-share incentives to landowners. Qualifying landowners may be reimbursed up to 75% of the state average costs for installing conservation practices on their land to control soil erosion and protect water quality. To qualify as an agricultural landowner a person must own at least 10 acres of land, produce $1000/year from an agricultural commodity and have a farm number with the Farm Service Agency. Popular practices are waterways, terraces and grazing systems. Other practices available for stream protection are Riparian Forest Buffer and Streambank Protection. For more information, the district can be contacted at 636-922-2833, ext 3 or you can go the district's website at www.swcd.mo.gov/stcharles.

The Missouri Department of Conservation provides technical and financial assistance for practices that incorporate wildlife habitat, stormwater infiltration, or native landscaping. One opportunity is St. Louis Community Stewardship Grant Program. This program supports urban wildlife habitat improvement, encourages organizational partnerships for land stewardship and engages urban residents in community conservation through volunteering. Program funding is available to non-profit organizations, parks departments and other land-management entities and volunteer groups within the St. Louis metropolitan area. Eligible areas include St. Louis City, St. Louis County, St. Charles County and Jefferson County, and incorporated areas (in municipalities or townships) of Franklin, Lincoln and Warren Counties. Projects eligible for funding include (but aren't limited to) stream restoration, prairie or native warm-season grass reconstruction, or exotic species control and replanting. Grant requests should not exceed $10,000, and preference will be given to projects that involve cost-share or in-kind contributions. Contact Missouri Department of Conservation at 314-301-1500 for more information.

The Missouri Department Conservation also offers financial assistance through a cost share program for landowners. It provides a $3,000 max per landowner per year with a 50% match required. For more information on other potential funding opportunities, technical assistance and resources contact the Missouri Department of Conservation at 314-301-1500.

The Environmental Quality Incentives Program (EQIP), through the United State Department of Agriculture/Natural Resources Conservation Service, is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland.

For Urban Projects, eligible entities could apply for various grants such as Section 319 NPS grants to implement best management practices such as rain gardens, swales, bioretention systems, permeable surfaces, rain barrels, etc. to slow, reduce and capture runoff. This will help reduce in-stream impacts and improve water quality and quantity.

4.5 Prioritization of Potential NPS Pollution Mitigation Measures

The 60 potential NPS pollution mitigation measures identified in the previous sections were prioritized based on water quality improvement potential, visibility, existing outfall stream condition, treatment drainage area, and capital cost. This section describes the prioritization methodology and used to prioritize the mitigation measures found in Appendix B.

The prioritization methodology included assigning a score value to each of the prioritization categories, then totaling them to get the total rating score. For the water quality improvement potential criteria, the numerical value is determined based on the percent load reduction for the potential NPS pollution mitigation measure. The treatment drainage areas were divided into five categories: less than 3 acres, between 4 and 7 acres, between 8 and 11 acres, between 12 and 15 acres, and greater than 15 acres. The larger the drainage area, the more points that particular mitigation measure received. The water quality improvement potential is represented by the percent load reduction for that particular mitigation measure. The product of these two values results in the water quality benefit score. The visibility score is based on the road classification that the potential mitigation measure property is located. The more visible or high traffic road received a higher score than a less traveled road. The existing stream condition score is determined based on the stream ranking from the stream asset inventory, as described earlier in this watershed plan. A "Poor" stream ranking received a higher score than a "Good" stream ranking. As described in the Capital Cost section of this watershed management plan, the capital costs were divided into five categories: less than $20,000, $20,000 to $40,000, $40,000 to $60,000, $60,000 to $80,000, and greater than $80,000. Those mitigation measures in the lower cost range received higher points than the mitigation measures in the higher cost range. Table 12 below shows the scoring and procedure for prioritizing the potential mitigation measures.

Table 12: Potential NPS Mitigation Measure Prioritization Criteria

Criteria	Definition	Numerical Values Assigned
Water Quality Improvement Potential	Average % load reduction in pollutants	0% to 100%
Drainage Area	Area draining to the mitigation measure (rounding to nearest whole number)	1=3 acres or less 2=4 to 7 acres 3=8 to 11 acres 4=12 to 15 acres 5=greater than 15 acres
Water Quality Benefit	Product of the Average % load	Percentage x DA Score

	reduction in pollutants and Drainage Area Score	
Visibility	Type of road adjacent to mitigation measure	1=local road 3=minor road 5=major road
Proximity to Stream	Location of outfall to stream	1=multiple segments away 3=one segment away 5=direct oufall
Existing Stream Condition	Condition according to stream asset inventory	1=Good 3=Fair 5=Poor
Capital Cost	Construction Cost plus Engineering Cost	1=greater than $80,000 2=$60,000 to $80,000 3=$40,000 to $60,000 4=$20,000 to $40,000 5=less than $20,000
TOTAL	**Sum of each of the Prioritization Criteria Scores**	**WQ Benefit, Visibility, Prox. To Stream, Existing Stream Condition, Capital Cost**

The prioritization methodology above will also be used to rank future projects not identified in this watershed management plan. This prioritization ranking tool is just one of the components that a municipality or agency will use to look at projects, but it is not necessarily the final determining factor. The tool does give the decision makers a quick reference to score potential projects, but it has its limitations. Other factors that may also impact the selection of a project that are not included in the tool are probably of success, partner willingness, long term maintenance cost, capitalizing on other watershed projects, sustainability, and quality of life or value added to the community. A sample prioritization ranking form is found in Appendix C.

4.6 Implementation Plan

The implementation of best management practices within the Dry Branch watershed may substantially benefit water quality, habitat, and provide opportunities for public education regarding water quality issues. Both structural and non-structural solutions can benefit water quality. Non-structural BMPs, hinging on education and management, can have substantial impact on the Dry Branch watershed as redevelopment opportunities emerge.

One avenue for implementing water quality best management practices includes requirements on new construction and redevelopment. The City of Wentzville stormwater detention and water quality facilities on all new development and redevelopment projects that disturb greater than or equal to 1 acre and those projects that have a differential runoff of 1 cfs or greater for the 15-yr, 20-minute storm event. The City also uses a series of non-structural BMP credits as incentive to incorporate non-structural BMPs in a development's stormwater management

plan. By incorporating non-structural BMPs practices, the water quality volume is reduced, thus the side of the water quality feature is reduced.

The Dry Branch Watershed Management Plan provides the guidelines to improvement water quality, but the actual implementation of BMPs will be left up to the City of Wentzville, other municipalities in the watershed, and their residents to decide on best options for land usage and grant/cost-share opportunities. At this time, two commercial and one residential project will be funded as part of the 319 grant for the Dry Branch Watershed Clear Stormwater & Green Parks project. Based on water quality benefit, visibility, proximity to stream, existing stream condition, and capital cost, the identified potential mitigation measures are listed from highest to lowest ranking priority for commercial, residential and public properties (See Appendix B). As funding becomes available, this prioritization table can be a starting point to begin the selection process. Also, if potential projects not identified in this management plan are brought to the attention of a municipality, the prioritization ranking form (See Appendix C) can be used to score the project.

As discussed in Section 3.3.3, the ultimate goals of the Dry Branch Watershed Management Plan to improve and maintain water quality are to:

- Meet state water quality standards
- Reduce pollutants of concern
- Prevent illegal discharges/spills
- Improve the condition of poor/fair rated streams
- Conserve natural areas

With the implementation of the potential nonpoint source mitigation measures dependent upon funding and property owner participation, the short-term goals identified in Table 10 below are crucial to the success of the management plan. The mid-term and long-term goals are also shown in Table 13. Using these goals/milestones, the ultimate goals of the Management Plan can be reached.

Table 13: Dry Branch Watershed Management Plan Implementation Goals

Timeframe	Goals/Milestones
Short-term (5 years)	• Complete 3 retrofit projects funded by the 319 grant for the Dry Branch Watershed Clear Stormwater & Green Parks project. • Use these projects as demonstration projects to promote water quality improvement BMPs. • Complete synoptic watershed monitoring to identify pollutants of concern. • Validate/revise water quality model based on monitoring data, as necessary.

	• Complete synoptic watershed monitoring to identify pollutants of concern. • Validate/revise water quality model based on monitoring data, as necessary. • Hold public meetings, information sessions and workshops to education the citizens to on the different ways to improve water quality. • Promote and encourage residents to implement small scale water quality features, such as rain barrels, rain gardens, etc., to improve water quality. • Complete water quality testing to establish a baseline for the existing water quality within the watershed, as identified in the Dry Branch Watershed QUAP. • Develop water quality ordinances within municipalities that do not have one established. • Enforce existing conservation and water quality ordinances. • Revise plan with planning team input as needed.
Mid-term (15 years)	• Continue to implement potential NPS pollution mitigation measures. • Continue monitoring to evaluate the effectiveness of the installed water quality BMPs and stream water quality. • Improve the score of at least one stream reach each year by improving the score of one of the stream stability indicators from the Channel Condition Scoring Matrix. • Revisit/revise ordinances to conserve natural areas. • Seek funding for water quality improvement projects.
Long-term (25 years)	• Continue to implement potential NPS pollution mitigation measures. • Continue monitoring to evaluate the effectiveness of the installed water quality BMPs and stream water quality. • Secure funding for water quality improvement projects.

Quantifiable mid-term and long-term milestones are funding dependent, thus it is tough to plan too far into the future. This being said, as future funding becomes available, the mid-term and long-term milestones can be researched and/or investigated.

5.0 EVALUATION OF NONPOINT SOURCE POLLUTION MEASURES (ELEMENTS 8 & 9)

In coordination with stream restoration projects and NPS pollution mitigation measures, a water quality monitoring plan is an integral component to the guide future planning and to address critical areas within the watershed. This section discusses the evaluation criteria to judge the effectiveness of the installed mitigation measures as well as a water quality monitoring program.

5.1 Evaluation Criteria

It has not yet been determined if there is Total Maximum Daily Load (TMDL) for this watershed. Since the waterbody is not classified as impaired by the Department, a TMDL has yet or is currently not scheduled to be developed. As part of the 319 grant for the Dry Branch Watershed Clear Stormwater & Green Parks project, a Quality Assurance Project Plan (QAPP) for the Dry Branch Watershed has been developed and approved by MDNR. A copy of the QAPP is available from the City of Wentzville Engineering Department. As part of the water quality testing, water quality and flow data will be collected from selected monitoring locations in the Dry Branch Watershed for a period of two years to establish a baseline for existing water quality within the watershed.

The initial evaluation criteria will be to see lower pollutant load numbers at the sampling locations. Other criteria include BMPs meeting expected load reductions, streams meeting state water quality standards, and tracking stream macroinvertebrite data. As the Dry Branch Watershed Management Plan is implemented, and more water quality data is available, the evaluation criteria can be modified and refined. Qualitative criteria could include tracking the numbers of attendance and involvement in watershed activities.

5.2 Water Quality Monitoring Program

The water quality monitoring program should be headed by the municipalities that the NPS pollution mitigation measures are implemented. The purpose of a monitoring plan is to identify overall water quality in the Dry Branch Watershed and document changes due to the implementation of NPS pollution mitigation measures.

The monitoring plan identified in the MDNR approved Dry Branch Watershed QAPP includes at least five, and possibly seven if funding is available, synoptic monitoring locations throughout the watershed. One grab sample will be collected on six events, including both base flow conditions and stormwater runoff events, at each site to provide a baseline assessment of the current water quality. The selected locations will also lend themselves to future monitoring efforts to quantify the impacts of the mitigation measures on the entire watershed. The Water Quality Monitoring Locations Map is located in Appendix G.

Local monitoring of implemented NPS pollution mitigation measures should also be performed to quantify the effectiveness of the individual mitigation measure. Based on the type of mitigation measure, the monitoring could include paired inlet/outlet monitoring, pre- and post construction monitoring, or bracketed stream segment (upstream and downstream) monitoring. The Dry Branch Watershed QAPP includes sampling at the retrofit project sites to be funded by the 319 grant for the Dry Branch Watershed Clear Stormwater & Green Parks project. The samples will be collected on seven events, including both base flow conditions and

stormwater runoff events. The water quality parameters to be analyzed include but are not limited to:

- Total Nitrogen
- Total Phosphorus
- Chloride
- pH
- Specific Conductance
- Water Temperature
- Turbidity
- DO
- BOD
- Metals and Hardness
- Oil & Grease
- Total Suspended Solids

The monitoring procedures outlined in the Dry Branch Watershed QAPP are scheduled for two years and is funded through the 319 grant for the Dry Branch Watershed Clear Stormwater & Green Parks project. Although the QAPP provides a water quality monitoring plan for only two years, annual monitoring should be continued. The QAPP provides guidelines for a monitoring plan, but each municipality or organization can develop their own monitoring plan. The complete QAPP is available at the City of Wentzville. The main body of the QAPP is available on the City of Wentzville website at http://www.wentzvillemo.org/Stormwater%20PDF/pdf/319%20Grant/QAPP%20Final%20-%20Front%20for%20Web.pdf.

Other monitoring methods include low cost biological monitoring that can be utilized to track overall stream health and document gross water quality changes. This biological monitoring can be performed at low costs by stream teams. Photo point monitoring can also be used to document physical changes within the watershed, along with tracking various land management activities. The stream team data could be collected into the future to obtain gross changes in the water quality and watershed health.

The management plan will be reviewed and revised every five years. At that time adjustments will be made to incorporate new ideas and process as directed by the watershed planning team.

6.0 INFORMATION AND EDUCATION (ELEMENT 5)

Throughout each stage of the study, active citizen and stakeholder participation was a key component to the development of the Dry Branch Watershed Management Plan. The activities allowed the project team to exchange information and educate the citizens and stakeholders within the Dry Branch Watershed. This section explains the information and education components used during the watershed management planning process.

6.1 Stakeholder Outreach Plan

The project team created a Stakeholder Outreach Plan to guide the information and education component of the watershed management plan. The Stakeholder Outreach Plan outlined the

objectives for each engagement, key input needed, and the target audience. A copy of the Stakeholder Outreach Plan is provided in Appendix D.

6.2 Watershed Planning Team

An important part of the watershed management plan was the participation, input and considerations provided by the Dry Branch Watershed Planning Team (DBWPT). Individuals were sent invitations to participate on the Planning Team. DBWPT members include volunteers that represent the interests of the watershed residents, farmers, land owners developers, business owners, and stakeholders. Table 14 below shows the members of the DBWPT.

Table 14: Dry Branch Watershed Planning Team

Name	Organization
Sara Blandino	City of Wentzville Resident
Terry Brennan	Timberland High School
Jim Burris	City of Wentzville Stormwater Advisory Committee
Frankie Coleman	St. Charles Soil & Water Conservation District
Mary Jo Dessieux	City of Wentzville Director of Parks
Theresa Dunlap	St. Charles County Soil & Water Conservation District
Kim Eckelkamp	Wentzville Middle School
Rob Ferguson	City of Wentzville Resident
Doug Forbeck	City of Wentzville Community Development Director
Rich Gnecco	St. Charles County Government Community Development
Terry Kraus	City of Wentzville Resident
Cheryl Kross	City of Wentzville, Board of Aldermen
Susan Maag	SLM Consulting
Tony Matthews	Wentzville Chamber of Commerce
Peggy Meyer	City of Wentzville Resident
Paul Morris	Missouri Department of Natural Resources
Jannette Nolen	City of Wentzville Stormwater Advisory Committee
Jon Parmentier	Wentzville Chamber of Commerce
Charlie Perkins	St. Charles County Soil & Water Conservation District
Jennifer Porcelli	Missouri Department of Conservation
Darren Ridenhour	THF Realty, Inc.
Trish Rielly	Missouri Department of Natural Resources
Tom Rothermich, P.E.	City of Flint Hill City Engineer
Charlene Waggoner	Greenway Network
Greg Younger	Friends of Wentzville Parks

Figure 19: Planning Team Meeting.

The project team held a total of three Planning Team meetings from May 2012 to September 2012. The first meeting was held on May 30, 2012, and the second meeting was held on July 17, 2012, and the third meeting was held on September 18, 2012. The purpose of the first meeting was to identify the stakeholders concerns and opportunities in the watershed and to begin the discussion of criteria for prioritizing projects. At the second meeting, the prioritization criteria were finalized and findings regarding pollutants were reported. Pollution mitigation strategies were also discussed. At the third meeting, the draft watershed management plan was presented and discussed. Figure 19 above shows Matt Harper presenting the prioritization criteria to the Planning Team during one of the Planning Team Meetings. A copy of meeting notes, meeting materials, and attendance records are provided in Appendix E.

6.3 Education and Public Involvement

Public education on water quality issues is a key to the implementation of a successful watershed management plan. Public awareness of the causes of nonpoint source pollution as well as the possible mitigation measures to reduce the pollution will assist in the public involvement. Education and public involvement opportunities could include:

- Conduct workshops for area professionals, contractors, and landowners to educate them on the design and uses of water quality BMPs.
- Hold public meetings to educate the community about water quality issues within the watershed.
- Identify key locations to implement demonstration projects that can be a source of ongoing education for the local community.

- Hold field days, stream clean-up days, and bus tours of completed water quality improvement projects to promote the use of water quality BMPs.
- Use local media, such as newsletters, websites, flyers, etc., to explain BMPs and their benefits.

Both the government and residential stakeholders from the Dry Branch Planning Team should be involve in the water quality awareness public meetings, workshops and events to help promote and provide information.

As part of the 319 Grant, the City of Wentzville developed a marketing plan for 2012-2015. The goal of the marketing plan is to increase Dry Branch Watershed residents, developers, and business owner's awareness of NPS pollutants and water quality issues. Another goal is to evoke change in residential, developers and business owner's habits to positively change water quality and reduce NPS pollutants within the watershed. To reach these goals, the market plan suggests using printed publication, such as Note Worthy, Vision Newsletter, and Fun Times, to update the residents on green infrastructure projects and water quality issues. Local newspapers and radio will also be used to educate the public and promote the use of water quality BMPs. The marketing plan also includes the use of events as an avenue to provide valuable information to target audiences. These events include a stream naming contest, Wabash Days, GM Earth Day, Home Owners Association Symposium, and Make a Difference Day. Although this marketing plan is limited to 2 years, activities outlined in the plan should continue well into the future. A copy of the marketing plan can be found in Appendix F.

Programs, such as "Grow Native", can be used to assist in public education. "Grow Native" is a joint endeavor of the Missouri Department of Conservation and the Missouri Department of Agriculture that aims to increase conservation awareness of native plants and their effective use. As identified in the Technical and Financial Assistance Section of this watershed management plan, programs like the Environmental Education Grants Program and the Five Star Restoration Grant Program through the EPA provide financial and technical assistance supporting environmental education projects that increase the public awareness about environmental issues and increase people's ability to make informed decisions that impact environmental quality.

7.0 CONCLUSION

The Dry Branch Watershed Management Plan provides the methodology, results and guidance for cities, residents, and organizations within the Dry Branch Watershed to apply towards improving the quality of their stormwater runoff.

60 potential mitigation measure sites, including 34 commercial properties, 23 residential properties, and 3 public properties, were identified within the Dry Branch watershed. The

selected mitigation measures for the identified sites included bioretention areas, open channel dry swales, and stormwater wetlands. Although no agricultural land use sites were identified during the site identification methodology, there are opportunities for agricultural mitigation measures with approximately a quarter of the watershed consisting of agricultural land.

The stream asset inventory produced a scored system to determine the existing condition of the streams within the identified potential high pollution regions. The existing stream condition was one of the prioritization criteria used in ranking the potential mitigation measures. In general, the stream rating reflected lack of sinuosity, steep bank slopes, high debris jam potential, and lack of vegetative protection. The stream asset inventory scoring procedure can be used in the future to rate other streams within the watershed to determine restoration potential and guide future planning.

A prioritization procedure was developed as part of this watershed management plan to rate the potential mitigation measures by assigning a rating score. The prioritization procedure uses criteria that include the load reduction percentage, the drainage area, visibility, proximity to stream, existing stream condition, and capital cost. This prioritization ranking tool can also be used to rank future projects not identified in this watershed management plan.

Engaging the community in stormwater management should include educational and demonstration projects that can be taken to the residential level, such as rain barrels and rain gardens planted with native vegetation to increase infiltration capacity.

The opportunities within the Dry Branch watershed center on retrofitting existing stormwater infrastructure with a water quality component to improve the water quality of the stormwater runoff. This Management Plan is a living document that provides guidelines for improving water quality within the watershed. It is recommended that the plan be updated every five years after evaluating the performance of the constructed NPS pollution mitigation measures. Regrouping the stakeholders/Planning Team would provide additional input on the success of the Dry Branch Management Plan.

8.0 REFERENCES

City of Wentzville, 2009. Engineering Design Criteria, Chapter 6, Design Requirements for Storm Drainage Facilities.

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Rules of Department of Natural Resources, May 31, 2012. *Division 20 – Clean Water Commission, Chapter 7 – Water Quality*

Census Viewer, http://censusviewer.com.

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APPENDIX A: STREAM ASSET INVENTORY REPORTS

(See Figure 10 – Stream Reach Ranking Map for reach locations)

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Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	1

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	3	0.6	1.8
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	1	0.8	0.8
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	2	0.8	1.6
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	3	0.4	1.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	2	0.8	1.6
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	3	0.6	1.8
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	2	0.2	0.4
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	2	0.2	0.4

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Channel bed material consolidation and armoring	Massive competent to thinly bed limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated. Small % of particles < 4mm	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate % of particles < 4mm	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high % of material < 4mm	1	0.8	0.8
Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	3	0.8	2.4
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	3	0.8	2.4
Total						**19.8**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	2

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	1	0.6	0.6
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	1	0.8	0.8
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	2	0.8	1.6
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	2	0.4	0.8

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	1	0.8	0.8
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	2	0.6	1.2
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	1	0.2	0.4
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	1	0.2	0.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Channel bed material consolidation and armoring	Massive competent to thinly bed limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated. Small % of particles < 4mm	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate % of particles < 4mm	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high % of material < 4mm	1	0.8	0.8
Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	2	0.8	1.6
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	1	0.8	0.8
Total						**14.2**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	3

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	2	0.6	1.2
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	2	0.8	1.6
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	1	0.8	0.8
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	2	0.4	0.8

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	1	0.8	0.8
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	2	0.6	1.2
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	2	0.2	0.4
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	1	0.2	0.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Channel bed material consolidation and armoring	Massive competent to thinly bed limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated. Small % of particles < 4mm	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate % of particles < 4mm	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high % of material < 4mm		0.8	0.8
Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1		0.8	2.4
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7		0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence		0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%		0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment		0.8	0.8
Total						**15.6**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	4

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	1	0.6	0.6
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	1	0.8	0.8
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	3	0.8	2.4
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	1	0.4	0.4

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
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Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	1	0.6	0.6
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	1	0.2	0.2
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	1	0.2	0.2

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(adapted from Johnson, et al. 1999)

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Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	2	0.8	1.6
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	1	0.8	0.8
Total						**13.8**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	5

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
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Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	2	0.8	1.6
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	1	0.8	0.8
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	1	0.4	0.4

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(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
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Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	1	0.2	0.2
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Table 5605-2
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(adapted from Johnson, et al. 1999)

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Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	3	0.8	2.4
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	1	0.8	0.8
Total						**15.2**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	6

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	2	0.6	1.2
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	2	0.8	1.6
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	2	0.8	1.6
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	2	0.4	0.8

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	1	0.8	0.8
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	1	0.6	0.6
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	2	0.2	0.4
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	1	0.2	0.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Channel bed material consolidation and armoring	Massive competent to thinly bed limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated. Small % of particles < 4mm	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate % of particles < 4mm	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high % of material < 4mm	1	0.8	0.8
Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	3	0.8	2.4
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	2	0.8	1.6
Total						**16.6**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	7

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	2	0.6	1.2
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	2	0.8	1.6
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	2	0.8	1.6
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	2	0.4	0.8

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	2	0.8	1.6
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	1	0.6	0.6
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	3	0.2	0.6
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	2	0.2	0.4

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Channel bed material consolidation and armoring	Massive competent to thinly bed limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated. Small % of particles < 4mm	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate % of particles < 4mm	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high % of material < 4mm	2	0.8	1.6
Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	3	0.8	2.4
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	1	0.8	0.8
Total						**18.6**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	8

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	2	0.6	1.2
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	2	0.8	1.6
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	2	0.8	1.6
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	2	0.4	0.8

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	2	0.8	1.6
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	2	0.6	1.2
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	2	0.2	0.4
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	1	0.2	0.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Channel bed material consolidation and armoring	Massive competent to thinly bed limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated. Small % of particles < 4mm	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate % of particles < 4mm	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high % of material < 4mm	1	0.8	0.8
Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	2	0.8	1.6
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	1	0.8	0.8
Total						**16.4**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	9

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	2	0.6	1.8
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	2	0.8	1.6
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	2	0.8	1.6
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	2	0.4	0.8

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	2	0.8	1.6
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	1	0.6	0.6
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	2	0.2	0.4
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	1	0.2	0.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Channel bed material consolidation and armoring	Massive competent to thinly bed limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated. Small % of particles < 4mm	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate % of particles < 4mm	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high % of material < 4mm	1	0.8	0.8
Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	2	0.8	1.6
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	1	0.8	0.8
Total						**17.2**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	10

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	2	0.6	1.2
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	3	0.6	1.8
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	2	0.8	1.6
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	2	0.8	1.6
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	3	0.4	1.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	3	0.8	2.4
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	2	0.6	1.2
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	2	0.2	0.4
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	1	0.2	0.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
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Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	1	0.8	0.8
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	2	0.8	1.6
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	1	0.8	0.8
Total						**19.6**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	11

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	2	0.6	1.2
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	2	0.8	1.6
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	3	0.8	2.4
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	3	0.4	1.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	2	0.8	1.6
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	2	0.6	1.2
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	2	0.2	0.4
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	1	0.2	0.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Channel bed material consolidation and armoring	Massive competent to thinly bed limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated. Small % of particles < 4mm	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate % of particles < 4mm	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high % of material < 4mm	1	0.8	0.8
Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	3	0.8	2.4
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	1	0.8	0.8
Total						**18.4**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	12

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	3	0.6	1.8
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	2	0.8	1.6
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	2	0.8	1.6
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	3	0.4	1.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	3	0.8	2.4
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	2	0.6	1.2
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	2	0.2	0.4
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	1	0.2	0.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Channel bed material consolidation and armoring	Massive competent to thinly bed limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated. Small % of particles < 4mm	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate % of particles < 4mm	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high % of material < 4mm	1	0.8	0.8
Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	3	0.8	2.4
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	1	0.8	0.8
Total						**19.0**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	13

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	2	0.6	1.2
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	1	0.8	0.8
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	2	0.8	1.6
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	3	0.4	1.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	2	0.8	1.6
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	2	0.6	1.2
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	3	0.2	0.6
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	1	0.2	0.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Channel bed material consolidation and armoring	Massive competent to thinly bed limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated. Small % of particles < 4mm	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate % of particles < 4mm	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high % of material < 4mm	2	0.8	1.6
Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	2	0.8	1.6
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	1	0.8	0.8
Total						**17.0**

Project:	Dry Branch Watershed Management Plan
Stream Name and Location	Dry Branch Creek Trib, St. Charles County, Missouri
Evaluated By	Matt Harper, P.E.
Firm	Water Resources Solutions, LLC
Date	March 29, 2012
Reach Number	14

Photo 1

Photo 2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bedded limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP), (SW), (GC), (GM), (GP), (GW)	1	0.6	0.6
Average bank slope angle	Slopes ≤2:1 on one or occasionally both banks	Slopes up to1.7:1 (60˚) common on one or both banks	Bank slopes over 60˚on one or both banks	2	0.6	1.2
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet	1	0.8	0.8
Vegetative bank protection	Wide to medium band of woody vegetation with 70-90% plant density and cover. Majority are hardwood, deciduous trees with well developed understory layer, minimal root exposure	Narrow bank of woody vegetation, poor species diversity, 50-70% plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank	3	0.8	2.4
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 foot	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-rootmat overhangs common. Bank failures frequent	1	0.4	0.4

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating S*W = (R)
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping evident	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.	1	0.8	0.8
Bar development	Narrow relative to stream width at low flow, wellconsolidated, vegetated and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar	Bar widths wide relative to stream width with freshly deposited sand to small cobbles with sparse vegetation	Bar widths greater than ½ the stream width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation	1	0.6	0.6
Debris jam potential	Slight – small amounts of debris in channel. Small jams could form	Moderate – noticeable debris of all sizes present	Significant – moderate to heavy accumulations of debris apparent	2	0.2	0.4
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions	Frequent and unstable causing continual shift of sediment and flow	1	0.2	0.2

Table 5605-2
CHANNEL CONDITION SCORING MATRIX
(adapted from Johnson, et al. 1999)

Stability Indicator	**Good (1)**	**Fair (2)**	**Poor (3)**	**Score (S)**	**Weight (W)**	**Rating S*W = (R)**
Channel bed material consolidation and armoring	Massive competent to thinly bed limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated. Small % of particles < 4mm	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate % of particles < 4mm	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high % of material < 4mm	2	0.8	1.6
Sinuosity	1.2 ≤Sinuosity ≤1.4	1.1<Sinuosity <1.2	Sinuosity <1.1	1	0.8	0.8
Ratio of radius of curvature to channel width	3 ≤Rc/Wb ≤5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7	3	0.8	2.4
Ratio of pool-riffle spacing to channel width at elevation of 2-year flow	4 ≤Length/Wb < 8	3 ≤Length/Wb < 4, 8 < Length/Wb ≤9	3 > Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence	1	0.8	0.8
Percentage of channel constriction	< 25%	26-50%	> 50%	1	0.8	0.8
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment	1	0.8	0.8
Total						**14.6**

APPENDIX B: POTENTIAL NPS POLLUTION MITIGATION MEASURES TABLE AND MAPS

Potential NPS Pollution Mitigation Table
Dry Branch Watershed NPS Pollution Mitigation Measures Map North Watershed
Dry Branch Watershed NPS Pollution Mitigation Measures Map West Watershed
Dry Branch Watershed NPS Pollution Mitigation Measures Map East Watershed

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Potential Non-Point Source Pollution Mitigation Measures

Potential Non-Point Source Pollution Mitigation Measures - Private Commercial

Sub-Watershed	BMP No.	BMP Type	BMP Description	BMP Drainage Area (ac)	Parcel ID	Owner	Subdivision Name	Street Address	Total Rating Score
W3	W3-007	Filtering - Bioretention	Detention Retrofit	7.08	4-0013-8601-00-1A	MCW-RD WENTZVILLE COMMONS LLC	SCHNUCKS WENTZ RESUB LOT 1	1950 WENTZVILLE PKWY	17
W3	W3-008	Filtering - Bioretention	New Bioretention	12.25	4-0013-8601-00-1B	HD DEVELOPMENT OF MARYLAND INC	SCHNUCKS WENTZ RESUB LOT 1	1920 WENTZVILLE PKWY	17
W3	W3-009	Filtering - Bioretention	New Bioretention	13.98	4-0013-A322-00-8	DIERBERGS WENTZVILLE LLC	DIERBERGS WENTZ CROSSING BDRY ADJ LO	1800 WM DIERBERG DR	17
W3	W3-001	Filtering - Bioretention	Detention Retrofit	2.11	4-0013-8769-00-3E	OASIS KWIK WASH LLC	COLEMAN SUB RE-RESUB LOT 3D OF LOT 3	3E JIFFY ST	17
W3	W3-002	Filtering - Bioretention	New Bioretention	0.63	4-0013-A500-00-3H	MIDAS REALTY CORPORATION	COLEMAN SUB #1 3RD RESUB LOT 3	2 JIFFY ST	17
W3	W3-003	Filtering - Bioretention	New Bioretention	1.62	4-0013-9508-00-1	SALT LICK ROAD LLC	PEARCE BUS PK	1109 W PEARCE BLVD	17
W3	W3-004	Filtering - Bioretention	New Bioretention	1.85	4-0013-8529-00-3A	ACC PROPERTIES LLC	COLEMAN SUB RESUB LOT 3	1123 W PEARCE BLVD	17
W3	W3-005	Filtering - Bioretention	New Bioretention	1.37	4-0013-8601-00-1G	DDL PARTNERSHIP LP	SCHNUCKS WENTZ RESUB LOT 1	1986 WENTZVILLE PKWY	17
W5	W5-006	Filtering - Bioretention	New Bioretention	1.30	4-0010-S014-00-24.3	T G L PROPERTIES LLC	N/A	1409 WENTZVILLE PKWY	17
W6	W6-003	Filtering - Bioretention	Detention Retrofit	11.73	4-0013-A246-00-5	THF WENTZVILLE THREE DEVELOPMENT~LLC	WENTZ CROSSROADS MARKET PLACE N #2	WENTZVILLE PKWY	15
W2	W2-001	Filtering - Bioretention	New Bioretention	1.12	2-0143-9524-00-1	K & R REAL ESTATE LLC	PEANICK PARC	1906 HWY 61	15
W2	W2-002	Filtering - Bioretention	New Bioretention	0.63	2-0143-9524-00-2	BOGART & MCALEXANDER PROPERTIES LLC	PEANICK PARC	1904 HWY 61	15
W2	W2-003	Filtering - Bioretention	New Bioretention	0.57	2-0143-9524-00-3	LETA LAND CO LLC	PEANICK PARC	1902 HWY 61	15
W3	W3-006	Filtering - Bioretention	New Bioretention	1.49	4-0013-8601-00-1F	BREIHAN FAMILY TRUST	SCHNUCKS WENTZ RESUB LOT 1	1992 WENTZVILLE PKWY	15
W6	W6-001	Filtering - Bioretention	Detention Retrofit	7.85	4-0013-A011-00-A	THF WENTZVILLE TWO DEVELOPMENT LLC	WENTZVILLE SOUTH #2	W PEARCE BLVD	14
W6	W6-002	Filtering - Bioretention	Detention Retrofit	7.49	4-0013-9820-00-6	THF WENTZVILLE DEVELOPMENT LLC	WENTZ CROSSROADS MARKETPLACE #2	1905 WENTZVILLE PKWY	13
W4	W4-001	Filtering - Bioretention	New Bioretention	1.78	4-0010-8761-00-3	KRISHNA RADHA LLC	STONE RIDGE CANYON COMMERCIAL #1	1215 WENTZVILLE PKWY	13
W4	W4-002	Filtering - Bioretention	New Bioretention	1.84	4-0010-8761-00-2	T G L PROPERTIES LLC	STONE RIDGE CANYON COMMERCIAL #1	1155 WENTZVILLE PKWY	13
W4	W4-003	Filtering - Bioretention	New Bioretention	1.35	4-0010-8761-00-1	BANK OF OLD MONROE	STONE RIDGE CANYON COMMERCIAL #1	1093 WENTZVILLE PKWY	13
W4	W4-004	Filtering - Bioretention	New Bioretention	1.12	4-0013-9455-00-1	SCHROEDER CREEK LLC	SCHROEDER COMMERCIAL PK #1	1000 SCHROEDER CREEK BLVD	13
W4	W4-005	Filtering - Bioretention	New Bioretention	1.73	4-0013-A383-00-1	1ST FINANCIAL FEDERAL CREDIT UNION	SCHROEDER COMMERCIAL PARK #1 RESUB	1232 WENTZVILLE PKWY	13
W4	W4-006	Filtering - Bioretention with filter strip	New Bioretention	1.12	4-0013-S024-00-6.22	CURATORS OF THE UNIVERSITY OF~MISSOURI	N/A	1092 WENTZVILLE PKWY	13
W4	W4-007	Filtering - Bioretention with filter strip	New Bioretention	0.39	4-0013-S024-00-6.21	PHILLIPS JOHN D and PHILLIPS VIRGINIA A	N/A	1078 WENTZVILLE PKWY	13
W4	W4-008	Filtering - Bioretention	New Bioretention	0.65	4-0013-A454-00-1	WALGREEN CO	1053 MEYER RD SUB	1022 WENTZVILLE PKWY	13
W4	W4-009	Filtering - Bioretention	New Bioretention	1.63	4-0013-A446-00-1	DEVELOPMENTAL LEARNING CENTER INC	MEYER RID DED & ESMT	1060 MEYER RD	13
W4	W4-012	Filtering - Bioretention	New Bioretention	1.61	4-0013-9957-00-1	PBSP HOLDINGS LLC	BORNHOP CIRCLE	970 WENTZVILLE PKWY	13
W5	W5-004	Filtering - Bioretention	New Bioretention	1.15	4-0010-9906-00-5	PEARCE PARTNERS LLC	HERITAGE POINTE COMMONS	1235 WENTZVILLE PKWY	13
W5	W5-008	Filtering - Bioretention	New Bioretention	0.76	4-0010-9906-00-6	WEST HERITAGE COMMONS LLC	HERITAGE POINTE COMMONS	1251 WENTZVILLE PKWY	13
W5	W5-009	Filtering - Bioretention	New Bioretention	0.98	4-0010-8411-00-1	KENZLEE PROPERTIES LLC	WILLIAMSBURG ON THE PKY COMMERCIAL P	1513 WENTZVILLE PKWY	13
W7	W7-002	Filtering - Bioretention	New Bioretention	0.85	4-0014-S022-00-2.16	BEAR CREEK GOLF LLC	N/A	159 BEAR CREEK DR	13
W4	W4-010	Filtering - Bioretention	New Bioretention	0.60	4-0013-S024-00-2.016.2	CROSSROADS PROFESSIONAL BUILDING LLC	N/A	1040 MEYER RD	11
W4	W4-011	Filtering - Bioretention	New Bioretention	0.74	4-0013-9957-00-5	KAYLOR REAL PROPERTIES LLC	BORNHOP CIRCLE	1020 MEYER RD	11
W5	W5-005	Filtering - Bioretention	New Bioretention	2.06	4-0010-A642-00-3	WEST HERITAGE COMMONS LLC	TWIN OAKS AT HERITAGE POINTE BDRY ADJ	1229 WENTZVILLE PKWY	11
W5	W5-007	Filtering - Bioretention	New Bioretention	0.76	4-0010-9964-00-2B	HERITAGE INVESTMENT GROUP LLC	HERITAGE POINTE COMMONS RESUB LOT 2	989 HERITAGE PKWY	11

Potential Non-Point Source Pollution Mitigation Measures - Public

Sub-Watershed	BMP No.	BMP Recommendation	BMP Description	BMP Drainage Area (ac)	Parcel ID	Owner	Subdivision Name	Street Address	Total Rating Score
W4	W4-015	Open Channel - Dry Swale	New Swale	19.72	4-0013-S024-00-25.8	WENTZVILLE REORGANIZED SCHOOL DISTRICT #4	N/A	1 CAMPUS DR	15
W4	W4-013	Filtering - Bioretention	New Bioretention	2.58	4-0013-S024-00-3	WENTZVILLE CITY OF	N/A	968 MEYER RD	14
W7	W7-001	Open Channel - Dry Swale	New Swale	14.57	4-0014-S022-00-2.12	CITY OF WENTZVILLE	N/A	BEAR CREEK DR	13

Potential Non-Point Source Pollution Mitigation Measures - Private Residential

Sub-Watershed	BMP No.	BMP Recommendation	BMP Description	BMP Drainage Area (ac)	Parcel ID	Owner	Subdivision Name	Street Address	Total Rating Score
W9	W9-005	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	13.84	4-0010-9409-00-A	VICTORIA'S RIDGE HOMEOWNERS ASSOCIATION	VICTORIAS RIDGE	HIGHLAND MEADOWS PL	16
W10	W10-002	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	16.00	4-0010-A448-00-B	STONE RIDGE CANYON OWNERS ASSOCIATION INC	STONE RIDGE CANYON #6	APPALACHIAN DR	16
W4	W4-014	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	18.04	4-0013-A723-00-65	ADDINGTON FRANKLIN J and ADDINGTON SANDRA J	SPRING MEADOWS #2 & #3 BDRY ADJ LOTS 4	555 SPRING MEADOW XING	16
W9	W9-010	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	13.12	4-0010-9392-00-A	HIGHLAND FOREST HOMEOWNERS~ASSOCIATION	HIGHLAND FOREST	HIGHLAND MEADOWS CT	15
W9	W9-007	Filtering - Bioretention	Detention Retrofit	11.87	4-0010-9495-00-A	PROVIDENCE ON PEINE HOMEOWNERS ASSOCIATION	PROVIDENCE ON PEINE #2	PROVIDENCE ESTATE DR	15
W7	W7-003	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	10.33	4-0017-9103-00-B	HUNTSDALE HOMEOWNERS ASSOCIATION	HUNTSDALE #1	HUNTSDALE DR	15
W10	W10-001	Filtering - Bioretention	Detention Retrofit	8.86	4-0010-A236-00-A	STONE RIDGE CANYON HOMEOWNERS ASSOCIATION	STONE RIDGE CANYON #5	LOST CANYON BLVD	14
W8	W8-001	Filtering - Bioretention	Detention Retrofit	1.90	4-0014-8251-00-A	BEAR CREEK HOLLOW TRUSTEES	BEAR CREEK HOLLOW	BEAR TRACKS DR	14
W9	W9-001	Filtering - Bioretention	Detention Retrofit	0.34	4-0010-9409-00-12	PEECHER STEVEN and PEECHER BUFFY	VICTORIAS RIDGE	441 HIGHLAND MEADOWS PL	14
W9	W9-002	Filtering - Bioretention	Detention Retrofit	0.49	4-0010-9409-00-10	HIRTZ JASON ROBERT	VICTORIAS RIDGE	437 HIGHLAND MEADOWS PL	14
W9	W9-003	Filtering - Bioretention	Detention Retrofit	0.34	4-0010-9409-00-8	RALSTON RICHARD W. and RALSTON MARSHA E.	VICTORIAS RIDGE	433 HIGHLAND MEADOWS PL	14
W9	W9-004	Filtering - Bioretention	Detention Retrofit	1.74	4-0010-9409-00-3	NOTHEIS MELINDA A	VICTORIAS RIDGE	423 HIGHLAND MEADOWS PL	14
W2	W2-004	Open Channel - Dry Swale	New Swale	3.89	2-0095-A133-00-9	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	104 ALLEN RIDGE DR	14
W9	W9-006	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	20.59	4-0009-8408-00-A	PEINE RIDGE HOMEOWNERS ASSOCIATION	PEINE RIDGE #1	W MEDALIST DR	14
W5	W5-002	Filtering - Bioretention	Detention Retrofit	6.92	4-0010-8306-00-A	GREAT OAKS ESTATES TRUSTEES	GREAT OAKS	ASHFORD OAKS CT	13
W9	W9-009	Filtering - Bioretention	Detention Retrofit	6.67	4-0010-9332-00-D	AUTUMN TRLS COMMUNITY ASSOCIATION	AUTUMN TRAIL	AUTUMN TRL	13
W5	W5-001	Filtering - Bioretention	Detention Retrofit	4.95	4-0010-8561-00-D	GREAT OAKS ESTATES TRUSTEES	GREAT OAKS #3	GREAT OAKS MEADOW DR	13
W8	W8-002	Filtering - Bioretention	Detention Retrofit	2.91	4-0014-8251-00-B	BEAR CREEK HOLLOW TRUSTEES	BEAR CREEK HOLLOW	BEAR TRACKS CT	13
W1	W1-001	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	32.37	2-0046-7477-00-A	PEARCE FARMS ESTATES HOMEOWNERS ASSOCIATION	PEARCE FARM EST #2	GLENSHEE DR	12
W9	W9-008	Filtering - Bioretention	Detention Retrofit	4.57	4-0009-8743-00-A	WILLOWS ON PEINE ESTATES HOMEOWNERS ASSOCIATION	WILLOWS ON PEINE ESTS	STEWART SPRINGS DR	11
W1	W1-002	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	12.50	2-0045-7891-00-A	WHITE FENCE ESTATES PLAT 5 TRUSTEES	WHITE FENCE #5	WHITE FENCE DR	11
W5	W5-003	Filtering - Bioretention	Detention Retrofit	12.62	4-0010-8045-00-C	MEADOWS AT WILLIAMSBURG HOMEOWNERS ASSOCIATION	MEADOWS AT WILLIAMSBURG #1	OLD JAMESTOWN CT	11
W9	W9-011	Filtering - Bioretention	Detention Retrofit	8.08	4-0009-9614-00-A	LK PROPERTIES II LLLP	SHERWOOD OAKS	SHERWOOD OAKS DR	10
W2	W2-004	Open Channel - Dry Swale	The BMP Description for these properties is calculated with Parcel ID 2-0095-A133-00-9	3.89	2-0095-A133-00-8	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	106 ALLEN RIDGE DR	The Total Rating Score for these properties is calculated with Parcel ID 2-0095-A133-00-9
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-10	BEHLMANN JEFFREY E and BEHLMANN MARYLEE	ALLEN RIDGE	102 ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-A	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-7	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	108 ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-3	VEHIGE LEROY and VEHIGE LAVERNE	ALLEN RIDGE	105 ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-6	HUTH DANIEL and HUTH STACI A	ALLEN RIDGE	2 ALLEN RIDGE CT	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-1	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	101 ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-2	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	103 ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-4	SCHIPPER JEFFERY C and SCHIPPER LORA C	ALLEN RIDGE	3 ALLEN RIDGE CT	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-5	HACKENWERTH DONALD and HACKENWERTH SALLY L	ALLEN RIDGE	4 ALLEN RIDGE CT	

Dry Branch Watershed Potential NPS Pollution Mitigation Measures Map North Watershed

- Filtering - Bioretention
- Filtering - Bioretention with filter strip
- Open Channel - Dry Swale
- Stormwater Wetland - Ext Det Shallow Wetland

N W E S

0 0.125 0.25 Miles

McCoy Creek

Highway 61

Dry Branch Creek

W10

W2

W1

W5

W9

W2-001

W2-002

W2-003

W2-004

Allen Ridge

W10-002

Stone Ridge Canyon

W10-001

W1-001

White Fence

W1-002

W5-001

Great Oaks

W5-002

W5-003

W5-007

W5-005

Meadows at Williamsburg

Willows on Peine Estates

Providence on Peine

W9-008

W9-007

Peine Ridge

W9-006

Autumn Trail

W9-009

W9-001

W9-002

W9-003

W9-004

W9-005

Victoria's Ridge

Sherwood Oaks

Highland Forest

W9-010

W9-011

Water Resources Solutions

Figure B-1

Dry Branch Watershed Potential NPS Pollution Mitigation Measures Map West Watershed

- Filtering - Bioretention
- Filtering - Bioretention with filter strip
- Open Channel - Dry Swale
- Stormwater Wetland - Ext Det Shallow Wetland

N W E S

0 0.125 0.25 Miles

West Meyer Road

Dry Branch Creek

Bear Creek

Interstate 70

Peine Ridge

Autumn Trail

Meadows at Williamsburg

Victoria's Ridge

Sherwood Oaks

Highland Forest

Huntsdale

Wentzville Pkwy

W9-006
W9-009
W9-001
W9-002
W9-003
W9-004
W9-005
W9-010
W9-011
W5-001
W5-003
W5-009
W9

W7-002
W8-002
W8-001
W8
W6-003
W6-002
W6
W3-009
W3-008
W3-007
W3-006
W6-001
W3

W7-001
W7-003
W7

Water Resources Solutions

Figure B-2

Dry Branch Watershed Potential NPS Pollution Mitigation Measures Map East Watershed

- Filtering - Bioretention
- Filtering - Bioretention with filter strip
- Open Channel - Dry Swale
- Stormwater Wetland - Ext Det Shallow Wetland

N W E S

0 0.125 0.25 Miles

W10-002
Stone Ridge Canyon
W10-001
W1-001
White Fence
W1-002
W5
W5-002
W1
Highway A
W9-004
W9-010
W5-009
W5-006
W5-007
W5-005
W5-008
W5-004
W4-001
W4-003
W4-002
W4-008
W4-009
W4-012
W4-010
W4-004
W4-005
W4-006
W4-007
W4-011
W4-013
W4-014
Spring Meadows
Meyer Road
W4
W4-015
Highway 61
W6-003
W3-009
W6-002
W3-008
W6
Wentzville Pkwy
W3-007
W3-005
W3-006
W3-001
W3-002
W6-001
W3-004
W3-003
W3
Interstate 70

Water Resources Solutions

Figure B-3

APPENDIX C: SAMPLE PRIORITIZATION FORM

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City of Wentzville
Public Works Deparment
200 Fourth Street
Wentzville, MO 63385

NPS Pollution BMP Prioritization Form

Project location:

Description of water qualiity problem:

Water Quality Concern Investigated by:

Project Ranking by:

Date entered into stormwater project list:

Prioritization Criteria	Score
Water Quality Improvement Potential (Average % load reduction) (0% to 100%)	
Drainage Area Treated by BMP (1=3 ac or less, 2=4 to 7 ac, 3=8 to 11 ac, 4 = 12 to 15 ac, 5 = greater than 15 ac)	
Water Quality Benefit (Product of WQ Improvement Potential and DA Score)	
Visibility (type of road adjacent to BMP) (1=local road, 3=minor road, 5=major road)	
Proximity to Stream (Location of outfall to stream) (1=multiple segments, 3=one segment away, 5=direct outfall)	
Existing Stream Condition (according to stream asset inventory) (1=Good, 3=Fair, 5=Poor)	
Capital Cost (Construction Cost plus Engineering Cost) (1=greater than $80K, 2=$60K to $80K, 3=$40K to $60K, 4=$20K to $40K, 5=less than $20K)	
Total Score*:	

*Total Score is the sum of WQ Benefit, Visibility, Proximity to Stream, Existing Stream Condition, and Capital Cost Scores

Stormwater Project Number:

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APPENDIX D: STAKEHOLDER OUTREACH PLAN

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Dry Branch Watershed Management Plan
Public Engagement Planning

Stakeholders to Consider

- Business owners
- Developers - could be HBA or another professional organization
- Residents – could be neighborhood association representatives or trustees from a subdivision group
- Significant nonpoint source pollution sources
- Middle/High School Students
- Other 319 grant partners – St. Charles County Soil and Water Conservation District (SWCD), Greenway Network, Inc., Friends of Wentzville Parks
- City staff who will manage projects – Parks, PW?

Key Input Desired and Technical Information Required

	Topics	Technical Information Required
Meeting #1 (May 2012)	• Opportunities and concerns • Goals • Prioritization Criteria	Baseline Data, 319 Grant
Meeting #2 (July 2012)	• Confirm Goals • Finalize Prioritization Criteria • Pollution Mitigation Strategies	Pollutant Source Data
Meeting #3 (August 2012)	Review draft report	Draft Watershed Management Plan

Key Messages

Consistent messages will be used to educate and inform stakeholders through the process. Messages to consider:

- Addressing nonpoint source pollution will be most successful with collaboration and cooperation from the entire community.
- Development of the Dry Branch Creek Watershed Management Plan is an important element of the City of Wentzville's ongoing commitment to meet state and federal laws and help improve water quality.
- The planning process will be inclusive and will provide decision makers with important input regarding identification of problems and solutions for the Dry Branch Creek watershed.

- The large amount of untreated water entering the storm sewer system — and eventually our streams and lakes — has lasting health, safety, environmental and economic impacts on our watersheds and communities.
- Protecting the health of our watersheds preserves and enhances the quality of life for Wentzville residents and our neighbors.

APPENDIX E: PLANNING TEAM MEETING MATERIALS

Planning Team Meeting #1
Planning Team Meeting #2
Planning Team Meeting #3

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PLANNING TEAM MEETING #1

Dry Branch Planning Team
Meeting #1

May 30, 2012
Progress Park Banquet Center
2:30 -4:30 p.m.

Meeting Objectives:

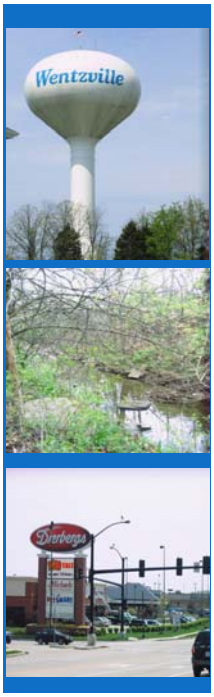
- Provide information on Dry Branch Watershed
- Draft stakeholder goals for the watershed plan
- Identify watershed issues and opportunities
- Define criteria for selecting projects

Agenda

2:30	Welcome and Introductions	Zachary Wolff, City of Wentzville Beth Quindry, Shockey Consulting
2:45	Dry Branch Watershed Plan: Background	Zachary Wolff Matt Harper, Water Resource Solutions
3:00	Goals Exercise	All
3:30	Issues and Opportunities Discussion	All
4:00	Prioritization Criteria Discussion	All
4:30	Wrap Up and Adjourn	

DRY BRANCH WATERSHED MANAGEMENT PLAN

PLANNING TEAM MEETING #1



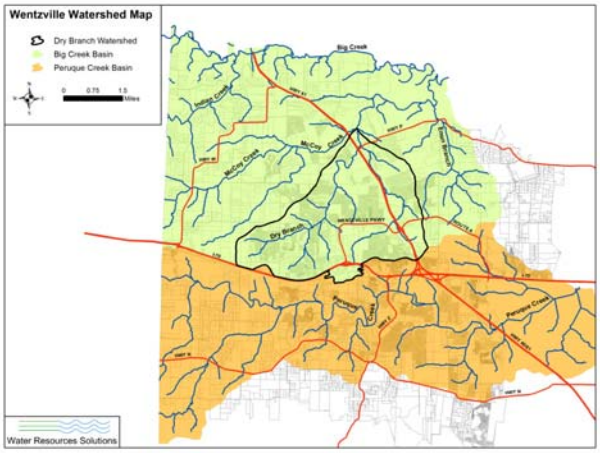
WENTZVILLE AREA WATERSHEDS

A watershed is an area of land where all of the water drains off into the same stream, lake or other waterbody. A watershed, or drainage basin, can cross city, county and state lines.

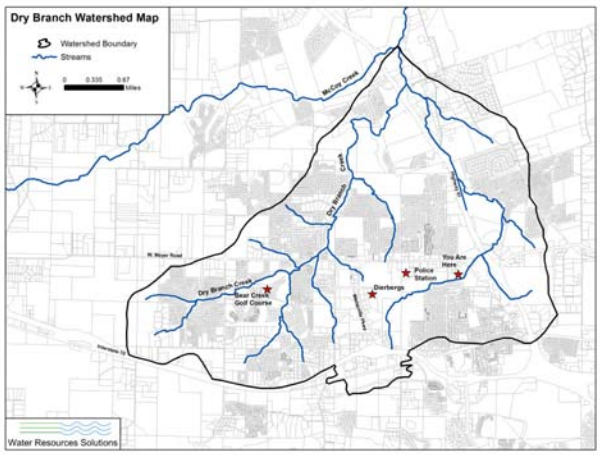
The Wentzville area has two major watersheds:

- Big Creek Basin – McCoy Creek, Enon Branch, Dry Branch Creek and Indian Creek
- Peruque Creek Basin

WENTZVILLE WATERSHEDS



DRY BRANCH WATERSHED



319 GRANT BACKGROUND

Grant Objectives

- ✓**Assess** and **improve** water quality.
- ✓**Beautify** Wentzville while saving money on maintenance.
- ✓**Show** the community better alternatives to fescue, concrete and pipes.
- ✓**Develop** a Watershed Management Plan that identifies nonpoint source pollutants, sources and prioritizes solutions
- ✓**Evoke change** by increasing community awareness of water quality issues.

319 GRANT
CLEAR STORMWATER AND GREEN PARKS

Key Grant Activities	Timeframe
Watershed Management Plan	2012
Existing Detention Basin Retrofit at Law Enforcement Center	2012
Stormwater Retrofit Projects at (2) commercial properties (TBD)	2013
Stormwater Retrofit Project in (1) Residential Subdivision (TBD)	2013
Heartland Park, green infrastructure	2013-2014

Educate community about water quality throughout

LAW ENFORCEMENT CENTER

PROJECT COMPLETE!

Before **Stormwater Retrofit**

After **Stormwater Retrofit**

HEARTLAND PARK

Heartland Park (behind Dierbergs), construction planned for 2014

Green Infrastructure to include -
Pervious pavement • athletic field biofilters • native meadow • parking lot bioswales

GREEN SOLUTIONS TO MANAGING STORMWATER

WATERSHED MANAGEMENT PLAN
(ORANGE = COMPLETE/UNDERWAY)

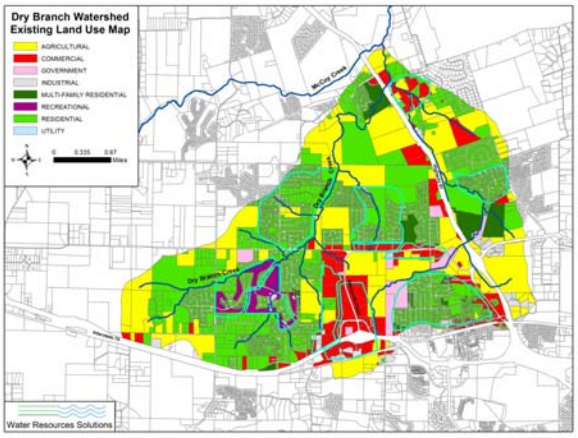
1. Identify causes of impairment and pollutant sources
2. Estimate load reductions from management measures
3. Describe non-point source management measures
4. Estimate amount of technical and financial assistance needed
5. Inform and educate
6. Schedule for implementing nonpoint source management measures
7. Describe interim measurable milestones
8. Determine criteria for evaluating pollution reduction
9. Monitor the effectiveness of the implemented measures

TECHNICAL WORK TO DATE
WATERSHED PLAN ELEMENT #1: IDENTIFYING POLLUTANTS

- Watershed Assessment
- Stream Asset Inventory
- Water Quality Model

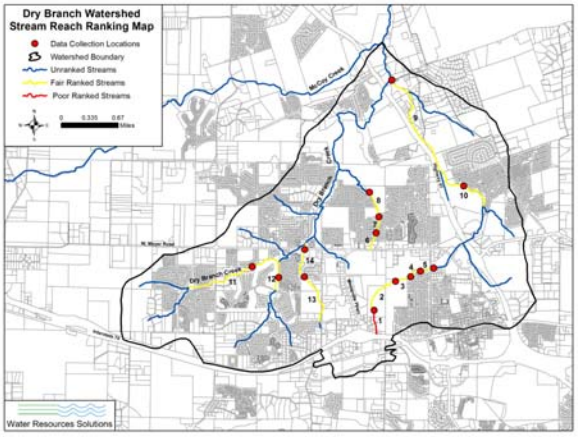
TECHNICAL WORK TO DATE
WATERSHED ASSESSMENT

- Identify potential high pollution regions.
- Approximately 6,800 acres.
- Existing Land Use
  - 42.7% Residential
  - 27.0% Agriculture
  - 10.3% Commercial



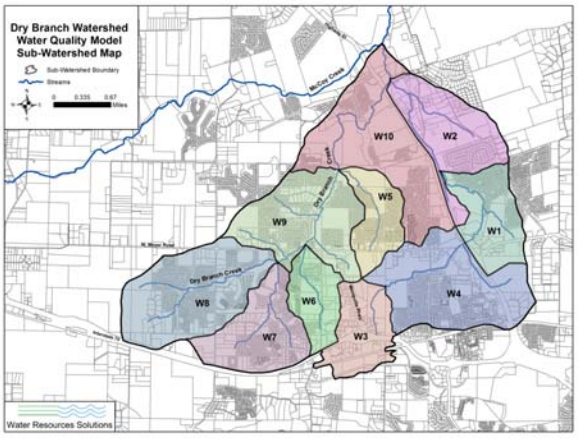
TECHNICAL WORK TO DATE
STREAM ASSET INVENTORY

- Characterize the stability of the streams.
- Potential for contributing sediment loading to the system
- March 29, 2012 using Trimble GPS data collector.
- Refined version of the protocol developed by Johnson, Gleason & Hey with FHWA.



TECHNICAL WORK TO DATE
WATER QUALITY MODEL

- Establish a water quality/pollutant loading baseline.
- Spreadsheet Tool for the Estimation of Pollutant Load (STEPL)
- Pollutants modeled
  - Total Nitrogen (TN)
  - Total Phosphorus (TP)
  - 5-day Biological Oxygen Demand (BOD)
  - Total Sediment



WE NEED YOUR HELP!

MAKING DECISIONS:

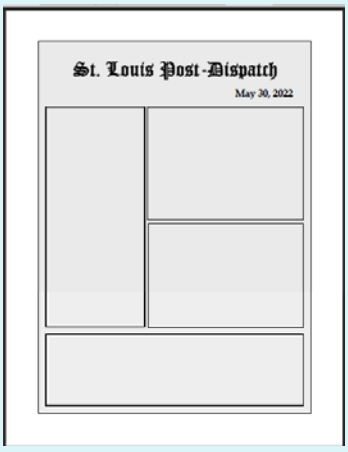
- Identify issues and concerns
- Develop criteria for selecting projects
- Prioritize proposed projects

MAXIMIZING PUBLIC OUTREACH:

- Share information with the stakeholders you represent.
- Ask them for input.
- Be a community spokesperson.

WRITE THE HEADLINE!

- Imagine the future!
- What does success look like?



NONPOINT POLLUTION SOURCES

Nonpoint source (NPS) pollution comes from many diffuse sources.

As rain and snow washes over roofs, streets, driveways, sidewalks, parking lots, and land surfaces, it can pick up a variety of pollutants, such as oil, pesticides, metals, chemicals, and soil. This polluted stormwater drains into the storm system that eventually discharges into our rivers and streams.

NONPOINT POLLUTION SOURCES

Question 4: Which of the items below are non-point source water pollutants? Red answers are correct.

Algae
Industrial plant discharges
Litter/trash
Mud
Pet waste
Pharmaceuticals
Salt
Wastewater plant discharges

PREPARING TO DISCUSS ISSUES

5. Please indicate whether each of the following is "not a problem," a "minor problem" or a "major problem" in Dry Branch Watershed.

	Not a problem	Minor problem	Major problem	Not Sure	Response Count
Water pollution from wastewater treatment plants	21.4% (3)	21.4% (3)	0.0% (0)	**57.1% (8)**	14
Water pollution from industrial/manufacturing discharges	21.4% (3)	14.3% (2)	7.1% (1)	**57.1% (8)**	14
Water pollution from storm water running off streets, parking lots, lawns, etc.	0.0% (0)	30.8% (4)	**38.5% (5)**	30.8% (4)	13
Water pollution from sewage overflows or septic tanks	0.0% (0)	**50.0% (7)**	14.3% (2)	35.7% (5)	14
Water pollution from farming and agriculture	0.0% (0)	21.4% (3)	35.7% (5)	**42.9% (6)**	14
Water pollution from pharmaceutical contamination	21.4% (3)	14.3% (2)	7.1% (1)	**57.1% (8)**	14
				answered question	14

PREPARING TO DISCUSS ISSUES

7. Please indicate whether each of the following is "not a pollution problem," a "minor pollution problem" or "a major pollution problem" in Dry Branch Watershed.

	Not a pollution problem	Minor pollution problem	Major pollution problem	Not sure	Response Count
Pet waste	0.0% (0)	**57.1% (8)**	7.1% (1)	35.7% (5)	14
Grass clippings	0.0% (0)	**42.9% (6)**	28.6% (4)	28.6% (4)	14
Lawn/garden products (fertilizers/pesticides)	0.0% (0)	28.6% (4)	**42.9% (6)**	28.6% (4)	14
Automotive fluids	0.0% (0)	**42.9% (6)**	14.3% (2)	**42.9% (6)**	14
Litter/trash	0.0% (0)	**42.9% (6)**	21.4% (3)	35.7% (5)	14
Household hazardous waste	0.0% (0)	42.9% (6)	7.1% (1)	**50.0% (7)**	14
				answered question	14

HOW DO WE DECIDE WHICH PROJECTS TO RECOMMEND?

Establish criteria to rank the projects.

PROJECT EVALUATION CRITERIA

15. Of the criteria listed above, please indicate up to four (4) you consider most important.

	Response Percent	Response Count
Cost	64.3%	9
Visibility	78.6%	11
Public v. private	28.6%	4
Water quality benefit	**92.9%**	**13**
Existing stream condition	71.4%	10
Capitalizing on other opportunities	42.9%	6
Other (please specify)		2
answered question		**14**

City of Wentzville, Missouri
Dry Branch Watershed Management Plan
Planning Team Meeting
May 30, 2012

Progress Park Center
968 Meyer Road, Wentzville, MO 63385

MEETING OUTCOMES

- Issues and opportunities for the watershed plan were identified.
- The Planning Team approved draft project selection criteria. The draft list includes several items added during the meeting (see page 5).
- Next meeting will be Tuesday, July 17, 2012 from 2:30-4:30p at Progress Park Center.

ATTENDANCE

Planning Team members in attendance:

Jim Burris, Stormwater Advisory Committee
Frankie Coleman, St. Charles Soil & Water Conservation District
Mary Jo Dessieux, City of Wentzville Parks and Recreation
Doug Forbeck, City of Wentzville Community Development
Rich Gnecco, St. Charles County Community Development
Terry Kraus, Resident
Cheryl Kross, City of Wentzville Board of Aldermen
Susan Maag, SLM Consulting
Tony Matthews, Wentzville Chamber of Commerce
Peggy Meyer, Resident/former member, Wentzville Board of Aldermen
Paul Morris, Department of Natural Resources
Jannette Nolen, Wentzville Stormwater Advisory Committee
Charlie Perkins, *for Theresa Dunlap,* St. Charles Soil & Water Conservation District
Darren Ridenhour, THF Realty
Trish Rielly, Department of Natural Resources
Tom Rothermich, P.E., City Engineer, City of Flint Hill
Charlene Waggoner, Greenway Network
Greg Younger, Friends of Wentzville Parks

Project Team members in attendance, including consultants and city staff:

Matt Harper, Water Resources Solutions
Amanda Kerns, City of Wentzville Public Works Intern
Jamie Paige, City of Wentzville Public Works
Beth Quindry, Shockey Consulting
Zachary Wolff, P.E., City of Wentzville Public Works

1. WELCOME AND INTRODUCTIONS

Zachary Wolff, City of Wentzville welcomed everyone and introduced himself and the project team. Planning Team members were then asked to introduce themselves.

In their introductions, members were asked to tell the group their interest in the planning process and what they hoped it would achieve. Answers included:

- Education/information
- Better stormwater management that is both aesthetically pleasing and effective
- Improved water quality
- Improved development practices

2. DRY BRANCH WATERSHED: BACKGROUND INFORMATION

Zachary Wolff and Matt Harper presented information on Dry Branch Watershed, the 319 Grant and the technical work done to date as part of the watershed management plan. Presentation slides are attached.

Beth Quindry reviewed the role of the Planning Team. She provided a definition for nonpoint source pollution to clear up some confusion indicated by survey results. Nonpoint source (NPS) pollution comes from many diffuse sources. As rain and snow washes over roofs, streets, driveways, sidewalks, parking lots, and land surfaces, it can pick up a variety of pollutants, such as oil, pesticides, metals, chemicals, and soil. This polluted stormwater drains into the storm system that eventually discharges into our rivers and streams.

Sources of nonpoint source pollution include litter/trash, mud, pet waste, pharmaceuticals and salt. Sources such as industrial plant discharges and wastewater plant discharges are point sources, where pollutants enter rivers and streams through a single point, like a pipe coming from a wastewater treatment plant. The 319 grant addresses nonpoint source pollution only.

3. GOAL EXERCISE

Each table was asked to come up with a headline that would indicate success for the Dry Branch Watershed 10 years in the future. Responses are listed below.

Table 1

- Wentzville's Ahead of the Curve
- Wentzville's Forward Thinking Saves Millions

Table 2

- Land Values Remain High in Dry Branch Watershed
- Wentzville Turns Stormwater into Community Asset
- 10 Years Later, Look at Wentzville Now
- A Decade of Education Spurs Improved Water Quality
- THF Realty Leads to Improved Water Quality This Decade

Table 3

- City of Wentzville has won Governor's Award for Clean Water
- Management plan led to x% cleaner water, greater biodiversity including native plants on private and public lands and increased use of trails and parks. Wentzville is a great place to live and a great example of watershed management.

Table 4

- The Dry Branch Watershed has 90% less Pollution from Stormwater

Beth Quindry told the group to keep in mind that the 319 grant area goes beyond the City of Wentzville. The City of Flint Hill and some properties in St. Charles County are also included.

4. ISSUES AND OPPORTUNITIES DISCUSSION

Results of the pre-meeting survey were discussed. Jamie Paige reported there is still much to learn about sources of pollution in the Wentzville area. Known problems include water pollution from stormwater runoff and from farming and agriculture. Water quality testing to be completed as part of the 319 Grant will provide additional information.

Working in small groups, the Planning Team identified issues and opportunities in the watershed. In some cases, an issue was paired with an opportunity or solution. In the summary chart that follows, the forward arrow symbol () is used to identify the relationship.

Issues	Opportunities
▪ Cost to construct and maintain	▪ Proactive planning
▪ Effective education regarding best practices by property owners such as using pervious pavement instead of asphalt	▪ Multi-use BMPs, i.e. trail system are a win-win
▪ Finding centrally located information on best practices	▪ Reframe the discussion among developers and taxpayers – pay a little bit now or a lot later
▪ Impact of developable ground 	▪ Smart development: bioswales, rain gardens, aesthetics/proactive approach
▪ Long-term compliance	▪ Detention basin retrofit
▪ Multiple audiences to convince and gain support from	▪ Holistic watershed approach
▪ Retrofits of existing structures	▪ Standards on stormwater as an incentive to put in a BMP, i.e. reduce overall costs
▪ Uniform standards 	▪ Clear design standards
▪ Siltation/degradation 	▪ BMPS, development and permanent structures
	▪ Corridor restoration
	▪ Education
▪ Chemical Application 	▪ Buffers
	▪ Education
	▪ Regulations
	▪ Native plantings (public and private)
▪ Loss of biodiversity 	▪ Riparian restoration, enhancement and increase

5. PRIORITIZATION CRITERIA DISCUSSION

The group discussed the six suggested prioritization criteria offered in the pre-meeting survey.

Cost: the funds needed to install and maintain the project

Visibility: level of visibility to the public. Some projects are in areas where a lot of people see them, others are not; if projects are more visible, they can raise awareness about the project and its purpose.

Public v. private benefit: who should benefit from a project? A rain garden in your neighbor's yard benefits that property while a wet pond in the neighborhood may benefit many.

Water quality benefit: the improvement a certain project will have on water quality or stream health based on a water quality model and technical ranking developed by the technical team.

Existing stream condition: an indicator of the health of the stream segment. Some project areas are in good condition and may need work to preserve them, whereas others are in poor condition and need work to improve them.

Capitalizing on other opportunities: the ability to incorporate water quality practices into existing projects or scheduled work such as infrastructure repairs, replacement or expansion.

Beth Quindry asked the group whether any should be eliminated. Through group discussion, it was agreed that these six criteria should all be considered. In addition, the following should be added:

- Sustainability
- Accessibility to site (possibly factored into visibility criteria)
- Quality of life – defined as the extent to which a project enhances the community. This criterion includes the aesthetics of a project as well as how it improves the lives of residents by solving existing problems like erosion and flooding.

Other comments:

- Cost of maintenance must be factored into total cost.
- Safety should be considered as projects are implemented.
- While Wentzville's 319 grant includes public funds for stormwater retrofit projects, private participation needs to be encouraged.
- Water quality criterion should include water quantity as well as water quality.

Ms. Quindry asked whether the group felt any of the criteria needed to be weighted more heavily. The consensus was that all should be considered equally.

6. WRAP UP AND ADJOURN

The next meeting of the Planning Team was planned for **Tuesday, July 17th from 2:30 to 4:30 at the Progress Park Center**. Ms. Quindry thanked the planning team members for their time. The meeting adjourned at 4:25 p.m.

St. Louis Post-Dispatch

May 30, 2022

Water Resources Solutions

219 Mockingbird Lane · Waterloo, IL · 62298 · (314) 458-7852 Phone · (913) 962-2245Fax · Info@WRS-rc.com

May 10, 2012

Dear Planning Team Member:

Again, thank you for agreeing to serve on the Planning Team for the City of Wentzville's Dry Branch Watershed Management Plan.

Our first meeting, on May 30th, is an important one. The project team of Water Resources Solutions, Shockey Consulting, and the City of Wentzville will provide information on Dry Branch Watershed. Through exercises and facilitated group discussion, the Planning Team will discuss issues, opportunities, and goals for the watershed plan. We'll also begin discussion of prioritizing potential watershed improvement projects.

In order to make the meeting as productive as possible, your review of materials beforehand is greatly appreciated. In addition, we ask that you please complete the pre-meeting questionnaire by Monday, May 21. It will take approximately ten minutes to complete. The questionnaire is available on-line at http://www.surveymonkey.com/s/DryBranchSurvey. If you prefer, you may complete the included paper copy and mail it to the address found on the final page.

The project team is looking forward to working with you. If you have any questions about the upcoming meeting or the Dry Branch Watershed Management Plan, please contact any of the following personnel:

- Mr. Zachary S. Wolff, PE at the City of Wentzville (636) 639-2050
- Mr. Matt Harper, PE at Water Resources Solutions (314) 458-7152
- Ms. Beth Quindry at Shockey Consulting (314) 497-3126

Sincerely,

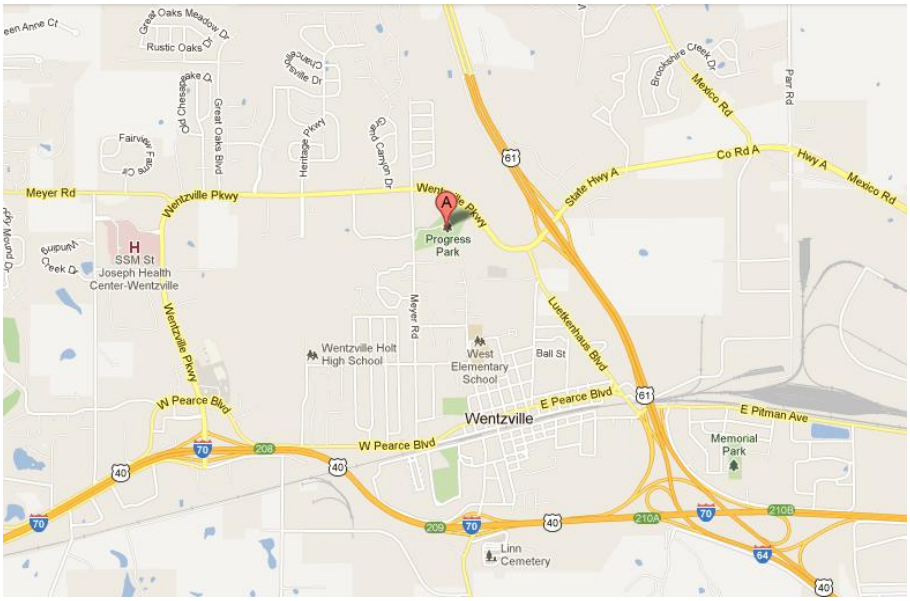
Matt Harper, Civil Engineer

Dry Branch Watershed
Planning Team Meeting #1
May 30, 2012
2:30-4:30p

Progress Park Banquet Center
968 Meyer Road
Wentzville, MO 63385

From eastbound 70:
Exit 208, Wentzville Parkway
Turn left onto Wentzville Parkway
Turn right onto Meyer Road
Progress Park is on the left at the first stop sign

From westbound 70:
Exit 210B, merge onto U.S. 61 North (toward Hannibal)
Take the Wentzville Parkway exit
Turn left onto County Road A/Wentzville Parkway
Turn left onto Meyer Road
Progress Park is on the left at the first stop sign



At Progress Park:
From Meyer Road, you will enter the park facing the Progress Park sign and a ballfield. Turn left and follow the road to the parking lot in front of Progress Park Banquet Center.

Dry Branch Planning Team
Meeting #1

May 30, 2012
Progress Park Banquet Center
2:30 -4:30 p.m.

Meeting Objectives:

- Provide information on Dry Branch Watershed
- Draft stakeholder goals for the watershed plan
- Identify watershed issues and opportunities
- Define criteria for selecting projects

Agenda

2:30	Welcome and Introductions	Zachary Wolff, City of Wentzville Beth Quindry, Shockey Consulting
2:45	Dry Branch Watershed Plan: Background	Zachary Wolff Matt Harper, Water Resource Solutions
3:00	Goals Exercise	All
3:30	Issues and Opportunities Discussion	All
4:00	Prioritization Criteria Discussion	All
4:30	Wrap Up and Adjourn	

Dry Branch Watershed Planning Team Questionnaire

SurveyMonkey

1. Which of the following BEST describes the location where you live?

		Response Percent	Response Count
I live near a watershed.		0.0%	0
I live in a watershed.		**78.6%**	**11**
I don't live in a watershed.		7.1%	1
Don't know/I'm not familiar with the term watershed.		14.3%	2
		answered question	**14**
		skipped question	**0**

2. What stakeholder group(s) do you represent (SELECT ALL THAT APPLY)?

		Response Percent	Response Count
Resident (Wentzville/Flint Hill area)		**46.2%**	**6**
Business Owner		0.0%	0
Subdivision Trustee		0.0%	0
Educator		7.7%	1
Student		7.7%	1
Grant Partner		0.0%	0
Government Agency		30.8%	4
Non-Profit Organization		23.1%	3
Develop/Builder		7.7%	1
None		7.7%	1
		Other (please specify)	1
		answered question	**13**
		skipped question	**1**

3. How aware do you feel of local water quality issues?

	Response Percent	Response Count
I am very familiar.	7.1%	1
I know some things.	**64.3%**	**9**
I know very little.	14.3%	2
I am unfamiliar.	14.3%	2
Not sure.	0.0%	0
answered question		**14**
skipped question		**0**

4. In general, which of the items below are non-point source water pollutants (SELECT ALL THAT APPLY)?

	Response Percent	Response Count
Algae	30.8%	4
Industrial plant discharges	30.8%	4
Litter/trash	76.9%	10
Mud	69.2%	9
Pet waste	**84.6%**	**11**
Pharmaceuticals	38.5%	5
Salt	61.5%	8
Wastewater plant discharges	23.1%	3
answered question		**13**
skipped question		**1**

5. Please indicate whether each of the following is “not a problem,” a “minor problem” or a “major problem” in Dry Branch Watershed.

	Not a problem	Minor problem	Major problem	Not Sure	Response Count
Water pollution from wastewater treatment plants	21.4% (3)	21.4% (3)	0.0% (0)	**57.1% (8)**	14
Water pollution from industrial/manufacturing discharges	21.4% (3)	14.3% (2)	7.1% (1)	**57.1% (8)**	14
Water pollution from storm water running off streets, parking lots, lawns, etc.	0.0% (0)	30.8% (4)	**38.5% (5)**	30.8% (4)	13
Water pollution from sewage overflows or septic tanks	0.0% (0)	**50.0% (7)**	14.3% (2)	35.7% (5)	14
Water pollution from farming and agriculture	0.0% (0)	21.4% (3)	35.7% (5)	**42.9% (6)**	14
Water pollution from pharmaceutical contamination	21.4% (3)	14.3% (2)	7.1% (1)	**57.1% (8)**	14
				answered question	**14**
				skipped question	**0**

6. If you can think of any other known water quality issues or areas of concern within Dry Branch Watershed, please share your comments.

	Response Count
	6
answered question	**6**
skipped question	**8**

7. Please indicate whether each of the following is “not a pollution problem,” a “minor pollution problem” or “a major pollution problem” in Dry Branch Watershed.

	Not a pollution problem	Minor pollution problem	Major pollution problem	Not sure	Response Count
Pet waste	0.0% (0)	**57.1% (8)**	7.1% (1)	35.7% (5)	14
Grass clippings	0.0% (0)	**42.9% (6)**	28.6% (4)	28.6% (4)	14
Lawn/garden products (fertilizers/pesticides)	0.0% (0)	28.6% (4)	**42.9% (6)**	28.6% (4)	14
Automotive fluids	0.0% (0)	**42.9% (6)**	14.3% (2)	**42.9% (6)**	14
Litter/trash	0.0% (0)	**42.9% (6)**	21.4% (3)	35.7% (5)	14
Household hazardous waste	0.0% (0)	42.9% (6)	7.1% (1)	**50.0% (7)**	14
				answered question	**14**
				skipped question	**0**

8. On a scale from 1 (Poor) to 5 (Excellent), how would you rate this practice shown in terms of its value/usefulness for the following?

	Poor	Fair	Neutral	Good	Excellent	Unsure	Response Count
Appearance	15.4% (2)	23.1% (3)	0.0% (0)	23.1% (3)	**38.5% (5)**	0.0% (0)	13
Effect on Property Value	21.4% (3)	21.4% (3)	0.0% (0)	**28.6% (4)**	7.1% (1)	21.4% (3)	14
Benefit to Water Quality	0.0% (0)	14.3% (2)	7.1% (1)	21.4% (3)	**42.9% (6)**	14.3% (2)	14
Potential for Generating Complaints	0.0% (0)	7.1% (1)	14.3% (2)	**42.9% (6)**	7.1% (1)	28.6% (4)	14
Suitability for Near my Home	21.4% (3)	**28.6% (4)**	14.3% (2)	0.0% (0)	21.4% (3)	14.3% (2)	14
					answered question		**14**
					skipped question		**0**

9. On a scale from 1 (Poor) to 5 (Excellent), how would you rate this practice shown in terms of its value/usefulness for the following?

	Poor	Fair	Neutral	Good	Excellent	Unsure	Response Count
Appearance	0.0% (0)	0.0% (0)	0.0% (0)	**64.3% (9)**	35.7% (5)	0.0% (0)	14
Effect on Property Value	7.1% (1)	7.1% (1)	0.0% (0)	**50.0% (7)**	21.4% (3)	14.3% (2)	14
Benefit to Water Quality	0.0% (0)	7.1% (1)	0.0% (0)	**42.9% (6)**	35.7% (5)	14.3% (2)	14
Potential for Generating Complaints	21.4% (3)	28.6% (4)	**35.7% (5)**	0.0% (0)	7.1% (1)	7.1% (1)	14
Suitability for Near my Home	0.0% (0)	0.0% (0)	14.3% (2)	**50.0% (7)**	28.6% (4)	7.1% (1)	14
						answered question	**14**
						skipped question	**0**

10. On a scale from 1 (Poor) to 5 (Excellent), how would you rate this practice shown in terms of its value/usefulness for the following?

	Poor	Fair	Neutral	Good	Excellent	Unsure	Response Count
Appearance	**42.9% (6)**	14.3% (2)	7.1% (1)	35.7% (5)	0.0% (0)	0.0% (0)	14
Effect on Property Value	**42.9% (6)**	21.4% (3)	21.4% (3)	7.1% (1)	0.0% (0)	7.1% (1)	14
Benefit to Water Quality	**42.9% (6)**	14.3% (2)	7.1% (1)	21.4% (3)	0.0% (0)	14.3% (2)	14
Potential for Generating Complaints	14.3% (2)	**28.6% (4)**	**28.6% (4)**	14.3% (2)	7.1% (1)	7.1% (1)	14
Suitability for Near my Home	**35.7% (5)**	0.0% (0)	**35.7% (5)**	14.3% (2)	0.0% (0)	14.3% (2)	14
						answered question	**14**
						skipped question	**0**

11. On a scale from 1 (Poor) to 5 (Excellent), how would you rate this practice shown in terms of its value/usefulness for the following?

	Poor	Fair	Neutral	Good	Excellent	Unsure	Response Count
Appearance	21.4% (3)	28.6% (4)	14.3% (2)	**35.7% (5)**	0.0% (0)	0.0% (0)	14
Effect on Property Value	7.1% (1)	35.7% (5)	**42.9% (6)**	7.1% (1)	0.0% (0)	7.1% (1)	14
Benefit to Water Quality	23.1% (3)	**30.8% (4)**	23.1% (3)	15.4% (2)	0.0% (0)	7.7% (1)	13
Potential for Generating Complaints	28.6% (4)	**35.7% (5)**	14.3% (2)	7.1% (1)	7.1% (1)	7.1% (1)	14
Suitability for Near my Home	21.4% (3)	**28.6% (4)**	**28.6% (4)**	14.3% (2)	0.0% (0)	7.1% (1)	14
						answered question	**14**
						skipped question	**0**

12. On a scale from 1 (Poor) to 5 (Excellent), how would you rate this practice shown in terms of its value/usefulness for the following?

	Poor	Fair	Neutral	Good	Excellent	Unsure	Response Count
Appearance	0.0% (0)	7.1% (1)	14.3% (2)	7.1% (1)	**71.4% (10)**	0.0% (0)	14
Effect on Property Value	0.0% (0)	14.3% (2)	0.0% (0)	**42.9% (6)**	35.7% (5)	7.1% (1)	14
Benefit to Water Quality	0.0% (0)	0.0% (0)	7.1% (1)	28.6% (4)	**50.0% (7)**	14.3% (2)	14
Potential for Generating Complaints	21.4% (3)	7.1% (1)	**28.6% (4)**	7.1% (1)	7.1% (1)	**28.6% (4)**	14
Suitability for Near my Home	0.0% (0)	7.1% (1)	14.3% (2)	**42.9% (6)**	28.6% (4)	7.1% (1)	14
						answered question	**14**
						skipped question	**0**

13. On a scale from 1 (Poor) to 5 (Excellent), how would you rate this practice shown in terms of its value/usefulness for the following?

	Poor	Fair	Neutral	Good	Excellent	Unsure	Response Count
Appearance	7.1% (1)	**42.9% (6)**	7.1% (1)	28.6% (4)	14.3% (2)	0.0% (0)	14
Effect on Property Value	7.1% (1)	**35.7% (5)**	21.4% (3)	14.3% (2)	14.3% (2)	7.1% (1)	14
Benefit to Water Quality	21.4% (3)	**42.9% (6)**	0.0% (0)	14.3% (2)	7.1% (1)	14.3% (2)	14
Potential for Generating Complaints	14.3% (2)	**28.6% (4)**	21.4% (3)	0.0% (0)	14.3% (2)	21.4% (3)	14
Suitability for Near my Home	7.1% (1)	14.3% (2)	**35.7% (5)**	28.6% (4)	7.1% (1)	7.1% (1)	14
						answered question	**14**
						skipped question	**0**

14. Are there any other factors that should be considered when rating these practices?

	Response Count
	2
answered question	**2**
skipped question	**12**

15. Of the criteria listed above, please indicate up to four (4) you consider most important.

	Response Percent	Response Count
Cost	64.3%	9
Visibility	78.6%	11
Public v. private	28.6%	4
Water quality benefit	**92.9%**	**13**
Existing stream condition	71.4%	10
Capitalizing on other opportunities	42.9%	6
Other (please specify)		2
answered question		**14**
skipped question		**0**

Page 2, Q2. What stakeholder group(s) do you represent (SELECT ALL THAT APPLY)?		
1	marketing intern	May 18, 2012 2:34 PM

Page 3, Q6. If you can think of any other known water quality issues or areas of concern within Dry Branch Watershed, please share your comments.		
1	Land in various stages of development is a major factor in siltation. Only a few sites have an adequate riparian buffer.	May 18, 2012 4:26 PM
2	Runoff from sites in construction areas; waste water coming off of impervious areas; chemicals from lawns, golf courses, streets.	May 18, 2012 2:04 PM
3	Water Pollution from active construction sites	May 17, 2012 5:22 PM
4	Partilulate form subdivisions under development or in financial difficulty	May 11, 2012 9:38 PM
5	trash such as plastic cup and cigarette butts, and plastics	May 10, 2012 6:30 PM
6	erosion/sedimentation/water velocity	May 10, 2012 4:51 PM

Page 9, Q14. Are there any other factors that should be considered when rating these practices?		
1	potential for backing up sewers in the future (tree roots)	May 20, 2012 8:32 PM
2	Effort & Cost of long-term Maintenance & Problems that result from lack of maintenance.	May 17, 2012 5:28 PM

Page 10, Q15. Of the criteria listed above, please indicate up to four (4) you consider most important.		
1	Long-term maintenance costs & effort	May 17, 2012 5:31 PM
2	Quality of life and value added to the community	May 11, 2012 9:46 PM

PLANNING TEAM MEETING #2

Dry Branch Planning Team
Meeting #2

July 17, 2012
Progress Park Banquet Center
2:30 - 4:30 p.m.

Meeting Objectives:

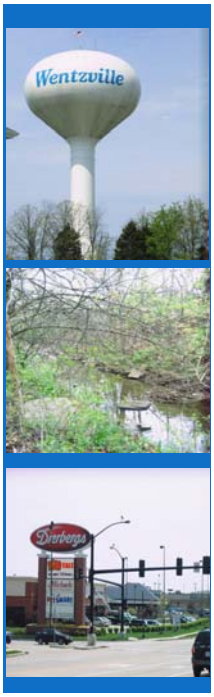
- Review of Meeting 1 outcomes: stakeholder issues and opportunities, criteria for selecting projects
- Provide information on types of pollution mitigation measures
- Provide information on draft project rankings
- Discussion of draft project rankings

Agenda

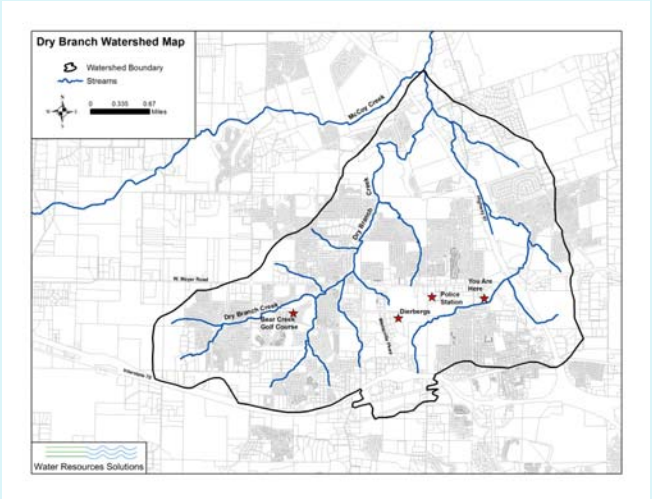
2:30	Welcome	Jamie Paige, City of Wentzville
2:35	Meeting 1 Recap	Beth Quindry, Shockey Consulting
2:45	Update on Technical Work & Draft Project Rankings	Matt Harper, Water Resource Solutions
3:15	Project Ranking Discussion	All
4:15	Wrap-Up and Adjourn	

DRY BRANCH WATERSHED MANAGEMENT PLAN

PLANNING TEAM MEETING #2



DRY BRANCH WATERSHED



319 GRANT BACKGROUND

Grant Objectives

- ✓**Assess** and **improve** water quality.
- ✓**Beautify** Wentzville while saving money on maintenance.
- ✓**Show** the community better alternatives to fescue, concrete and pipes.
- ✓**Develop** a Watershed Management Plan that identifies nonpoint source pollutants, sources and prioritizes solutions
- ✓**Evoke change** by increasing community awareness of water quality issues.

319 GRANT
CLEAR STORMWATER AND GREEN PARKS

Key Grant Activities	Timeframe
Watershed Management Plan	2012
Existing Detention Basin Retrofit at Law Enforcement Center	2012
Stormwater Retrofit Projects at (2) commercial properties (TBD)	2013
Stormwater Retrofit Project in (1) Residential Subdivision (TBD)	2013
Heartland Park, green infrastructure	2013-2014

Educate community about water quality throughout

NONPOINT POLLUTION DEFINED

Nonpoint source (NPS) pollution comes from many diffuse sources.

As rain and snow washes over roofs, streets, driveways, sidewalks, parking lots, and land surfaces, it can pick up a variety of pollutants, such as oil, pesticides, metals, chemicals, and soil. This polluted stormwater drains into the storm system that eventually discharges into our rivers and streams.

NONPOINT POLLUTION SOURCES

Question 4: Which of the items below are non-point source water pollutants? Red answers are correct.

Algae

Industrial plant discharges

Litter/trash

Mud

Pet waste

Pharmaceuticals

Salt

Wastewater plant discharges

MEETING 1 OUTCOMES: ISSUES

PREPARING FOR IMPLEMENTATION
- Multiple audiences need to buy in
- Cost to construct and maintain

IMPLEMENTATION ISSUES
- Impact of developable ground
- Long-term compliance
- Retrofits of existing structures
- Uniform standards

BEYOND CITY FUNDED PROJECTS: PROMOTING BEST PRACTICES
- Finding centrally located information on best practices
- Effective education regarding best practices by property owners

PROBLEMS TO SOLVE
- Siltation/degradation
- Loss of biodiversity
- Chemical application

MEETING 1 OUTCOMES: OPPORTUNITIES

PREPARING FOR IMPLEMENTATION
- Proactive planning
- Holistic watershed approach
- Reframe discussion among developers/taxpayers

IMPLEMENTATION STRATEGIES
- Multi-use BMPs
- Clear design standards
- Use standards as an incentive to put in a BMP (reduce overall cost)
- Smart development
- Regulations

BEYOND CITY FUNDED PROJECTS: PROMOTING BEST PRACTICES
- Education

PROBLEMS SOLVED: IMPLEMENTATION TOOLS
- Native plantings
- BMPs: during development and permanent
- Corridor restoration/riparian restoration/buffers
- Detention basin

MEETING 1 OUTCOMES: PRIORITIZATION CRITERIA

- Cost
- Visibility
- Public v. private
- Water quality benefit
- Existing stream conditions
- Capitalizing on other opportunities
- Quality of life (aesthetics)
- Impact on developable land

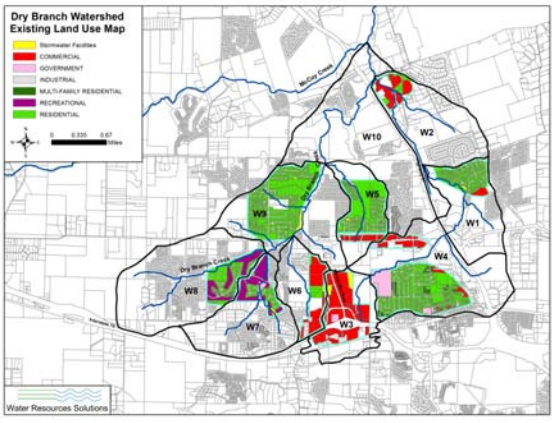
WATERSHED MANAGEMENT PLAN
(ORANGE = COMPLETE/UNDERWAY)

1. Identify causes of impairment and pollutant sources
2. Estimate load reductions from management measures
3. Describe non-point source management measures
4. Estimate amount of technical and financial assistance needed
5. Inform and educate
6. Schedule for implementing nonpoint source management measures
7. Describe interim measurable milestones
8. Determine criteria for evaluating pollution reduction
9. Monitor the effectiveness of the implemented measures

TECHNICAL WORK TO DATE
WATERSHED PLAN ELEMENT #3: NON-POINT SOURCE MITIGATION MEASURES

- Site Identification
  - GIS based method
    - Existing land use
    - Potential High Pollution Regions
    - Streams
    - Contours
    - Stormwater facilities
    - Aerial photo

TECHNICAL WORK TO DATE
WATERSHED PLAN ELEMENT #3: NON-POINT SOURCE MITIGATION MEASURES



TECHNICAL WORK TO DATE

WATERSHED PLAN ELEMENT #3: NON-POINT SOURCE MITIGATION MEASURES

- Potential Non-Point Source Mitigation Measure Selection
  - City of Wentzville Engineering Design Criteria
  - Structural BMPs
    - Filtering Practices (bioretention areas)
    - Stormwater Ponds and Wetlands
    - Open Channel Practices
  - Non-structural BMPs
    - Natural area conservation
    - Disconnection of rooftop runoff
    - Environmentally sensitive development
    - Stream Buffers

POLLUTION MITIGATION MEASURES

(also called green infrastructure and BMPs)

FILTERING PRACTICES: LARGE SCALE SOLUTIONS

FILTERING PRACTICES: SMALL SCALE SOLUTIONS

STORMWATER PONDS AND STORMWATER WETLANDS

OPEN CHANNEL PRACTICES

TECHNICAL WORK TO DATE

WATERSHED PLAN ELEMENT #4: ESTIMATE AMOUNT OF FINANCIAL AND TECHNICAL ASSISTANCE NEEDED

What are we estimating?

- The cost of 60 identified projects: 34 commercial, 23 residential, 3 public

How is the estimate calculated?

- **Capital Cost Estimate = Construction Cost** (based on drainage area) **+ Engineering Cost** (15% of construction cost)

How is cost factored into the rankings?

- >$60,000, 1 points
- $40,000-$60,000, 2 points
- $20,000-$40,000, 3 points

TECHNICAL WORK TO DATE

WATERSHED PLAN ELEMENT #2: ESTIMATE LOAD REDUCTIONS FROM MANAGEMENT MEASURES

- Used STEPL model to estimate the load reductions for each recommended BMP.

- % Load Reduction
  - Filtering – Bioretention = 72% average
  - Open Channel – Dry Swale = 33% average
  - Stormwater Wetland = 52% average

TECHNICAL WORK TO DATE

WATERSHED PLAN ELEMENT #3: NON-POINT SOURCE MITIGATION MEASURES

- Prioritization Criteria Used in Rankings
  - Water quality benefit
  - Existing condition
  - Visibility
  - Proximity to stream
  - Cost
- Other Criteria to be Considered in Final Decisions
  - Public vs. Private
  - Capitalizing existing watershed projects
  - Quality of life (aesthetics)
  - Impact on developable land

CRITERIA	DEFINITION	NUMERICAL VALUES ASSIGNED
Water Quality Improvement Potential	Average % load reduction in pollutants	1=low 2=medium 3=high
Visibility	Type of road adjacent to mitigation measure	1=local; 2=minor; 3=major
Proximity to Stream	Location of outfall to stream	1=multiple segments away 2=one segment away 3=direct outfall
Stream Condition	Condition according to stream asset inventory	1=Good; 2=Fair; 3=Poor
Sub-TOTAL		Scores of 4-12
Drainage Area	Multiplier to adjust for size of area draining to the mitigation measure	1=5 acres or less 2=5-10 acres 3=greater than 10 acres
Sub-TOTAL		Scores from 4-36
Capital Cost	Construction + engineering	1=more than $60,000; 2=$40,000-$60,000; 3=$20,000-40,000
TOTAL		Scores from 5 to 39

SAMPLE PROJECT RANKING: HIGH SCORE

Criteria	Numerical Values Assigned	
Water Quality Improvement Potential	1=low 2=medium 3=high	3
Visibility	1=local; 2=minor road; 3=major road	3
Proximity to Stream	1=multiple segments away 2=one segment away 3=direct	3
Stream Condition	1=Good; 2=Fair; 3=Poor	2
Sub-TOTAL	*Scores of 4-12*	11
Drainage Area Multiplier	1=5 acres or less 2=5-10 acres 3=greater than 10 acres	3
Sub-TOTAL	*Scores from 4-36*	33
Capital Cost	1=more than $60,000; 2=$40,000-$60,000; 3=$20,000-40,000	1
TOTAL	***Scores from 5 to 39***	**34**

SAMPLE PROJECT RANKING: LOW SCORE

Criteria	Numerical Values Assigned	
Water Quality Improvement Potential	1=low 2=medium 3=high	2
Visibility	1=local; 2=minor road; 3=major road	1
Proximity to Stream	1=multiple segments away 2=one segment away 3=direct	1
Stream Condition	1=Good; 2=Fair; 3=Poor	2
Sub-TOTAL	*Scores of 4-12*	6
Drainage Area Multiplier	1=5 acres or less 2=5-10 acres 3=greater than 10 acres	3
Sub-TOTAL	*Scores from 4-36*	18
Capital Cost	1=more than $60,000; 2=$40,000-$60,000; 3=$20,000-40,000	3
TOTAL	***Scores from 5 to 39***	**21**

FINAL COMMENTS & NEXT STEPS

- Final project selection
- Feedback needed from Planning Team members
- Next meeting: Tuesday, August 28 or Tuesday, September 18

  Final watershed management plan elements
  - Schedule for implementing nonpoint source management measures
  - Describe interim measurable milestones
  - Determine criteria for evaluating pollution reduction
  - Monitor the effectiveness of the implemented measures

City of Wentzville, Missouri
Dry Branch Watershed Management Plan
Planning Team Meeting
July 17, 2012

Progress Park Center
968 Meyer Road, Wentzville, MO 63385

MEETING OUTCOMES

- The Planning Team verified the list of issues and opportunities identified in the first meeting; no additions or modifications were made.
- A modification to the draft ranking methodology will be evaluated to more heavily weight a project's potential improvement to water quality. Matt will redo the rankings and make a suggestion for the Planning Team's consideration. For thorough explanation of the discussion, see page 5.
- The watershed management plan will include a section on design considerations to emphasize the importance of aesthetics in final project design.
- Next meeting will be Tuesday, September 18, 2012 from 2:30-4:30 p.m. at Progress Park Center.

ATTENDANCE

Planning Team members in attendance:

Frances Coleman, St. Charles Soil & Water Conservation District
Theresa Dunlap, St. Charles Soil & Water Conservation District
Rich Gnecco, St. Charles County Community Development
Cheryl Kross, City of Wentzville Board of Aldermen
Susan Maag, SLM Consulting
Peggy Meyer, Resident/former member, Wentzville Board of Aldermen
Paul Morris, Missouri Department of Natural Resources
Jannette Nolen, Wentzville Stormwater Advisory Committee
Jennifer Porcelli, Missouri Department of Conservation
Darren Ridenhour, THF Realty, Inc.
Charlene Waggoner, Greenway Network

Project Team members in attendance, including consultants and city staff:

Matt Harper, Water Resources Solutions
Amanda Kerns, City of Wentzville Public Works Intern
Jamie Paige, City of Wentzville Public Works
Beth Quindry, Shockey Consulting

1. WELCOME AND INTRODUCTIONS

Jamie Paige, City of Wentzville welcomed everyone and discussed the purpose of the meeting. She asked the Planning Team to keep these things in mind:

- The Watershed Management Plan is not just for the City of Wentzville. Any city, the county, a community organization or neighborhood association can implement a project, and after the plan is approved, become eligible to submit grant proposals for Section 319 Grant funding. .
- Cities, St. Charles County, and community organization staff and neighborhood associations will be guided by the project ranking methodology you have developed and incorporate new projects as they come along.
- The plan will not specify individual projects to be funded through the grant, but rather priorities and recommendations for how to choose projects that improve water quality. For the City of Wentzville's current 319 grant, there is funding for three retrofit projects-one on residential property and two on commercial property.
- Final project selection is dependent upon the cooperation of private landowners.

2. MEETING 1 RECAP

Beth reviewed the geography of the Dry Branch Watershed, the major activities and objectives of the 319 grant and the definition of nonpoint pollution. Beth also reviewed the issues and opportunities identified in the first meeting.

3. UPDATE ON TECHNICAL WORK AND DRAFT PROJECT RANKINGS

Matt provided an update on technical tasks to date. The result of this work is a list of 60 potential mitigation projects to manage stormwater runoff and improve water quality. The summary of the discussion is divided into two categories: selecting potential mitigation measures (projects) and ranking potential mitigation measures.

<u>SELECTING POTENTIAL MITIGATION MEASURES (PROJECTS)</u>

As Matt explained, mitigation measures, also referred to as best management practices (or BMPs), are the ***structural measures*** - things like stormwater ponds, open channel practices and filtering practices such as rain gardens.

In addition to these structural measures, the Watershed Management Plan will also include **non-structural BMPs**. These are not constructed projects but policies and practices that also serve to manage stormwater and improve water quality in the watershed such as conservation of natural areas, stream buffers and disconnection of rooftop runoff. More information on these non-structural BMPs will be shared with the Planning Team at the final meeting in September.

In order to determine the best potential structural measures (projects), technical work evaluated the location, the type and the cost of projects, meeting specific guidance from the EPA on how to develop a watershed management plan. Specific tasks included:

- Estimating load reductions from management measures (EPA's Watershed Management Plan Element #2)
    - Using STEPL water quality model to estimate load reductions for each recommended BMP
- Describing non-point source mitigation measures (EPA's Watershed Management Plan Element #3)
    - Site selection: where are BMPs needed? Factors considered are existing land use, potential high pollution regions, streams and contours, and existing stormwater facilities.
    - Mitigation measure selection: what type of BMP would work best for each of these sites?
- Estimating the amount of technical and financial assistance needed to implement management measures (EPA's Watershed Management Plan Element #4)
    - Cost = construction + engineering
        - Typical construction costs were developed for each BMP type. Adjustments were made for drainage area.
        - An additional cost of 15% was added for engineering design (which is the industry standard).

<u>RANKING POTENTIAL PROJECTS</u>

With 60 projects identified using the considerations listed above, the next step was to rank them according to the criteria developed by the Planning Team.

Criteria used in rankings:

- Water quality benefit
- Existing condition
- Visibility
- Proximity to stream
- Cost

Several criteria identified by the Planning Team will be considered as final decisions are made but were not included in the ranking for the reasons listed below:

- Public v. private. *Reason: considered as part of the visibility criteria.*
- Capitalizing on existing watershed projects. *Reason: cannot be determined at this time but will be considered as new capital improvement projects and repair projects are identified*.
- Quality of life (aesthetics). *Reason: Difficult to assign an objective numerical value – what is beautiful to one person may not be beautiful to another.*
- Impact on developable land. *Reason: Subject to final design of the mitigation measure; to be considered on a project by project basis with the goal of protecting the economic viability of developable land.*

60 projects were ranked according to the criteria identified by the Planning Team in its first meeting. The proposed methodology for ranking is summarized in the table below.

CRITERIA	DEFINITION	NUMERICAL VALUES ASSIGNED
Water Quality Improvement Potential	Average % load reduction in pollutants	1=low 2=medium 3=high
Visibility	Type of road adjacent to mitigation measure	1=local; 2=minor; 3=major
Proximity to Stream	Location of outfall to stream	1=multiple segments away 2=one segment away 3=direct outfall
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Sub-TOTAL		Scores from 4-36
Capital Cost	Construction + engineering	1=more than $60,000; 2=$40,000-$60,000; 3=$20,000-40,000
TOTAL		**Scores from 5 to 39**

4. PROJECT RANKING DISCUSSION

During the discussion, two issues came up: 1) the importance of considering aesthetics and 2) whether drainage area was the right multiplier to use in the ranking formula.

Aesthetics. Susan Maag made the comment that aesthetics are critical to the success of a project. Discussion followed. The project team's concern was that it was difficult to evaluate aesthetics objectively. Susan noted there was research that suggests certain parameters to be

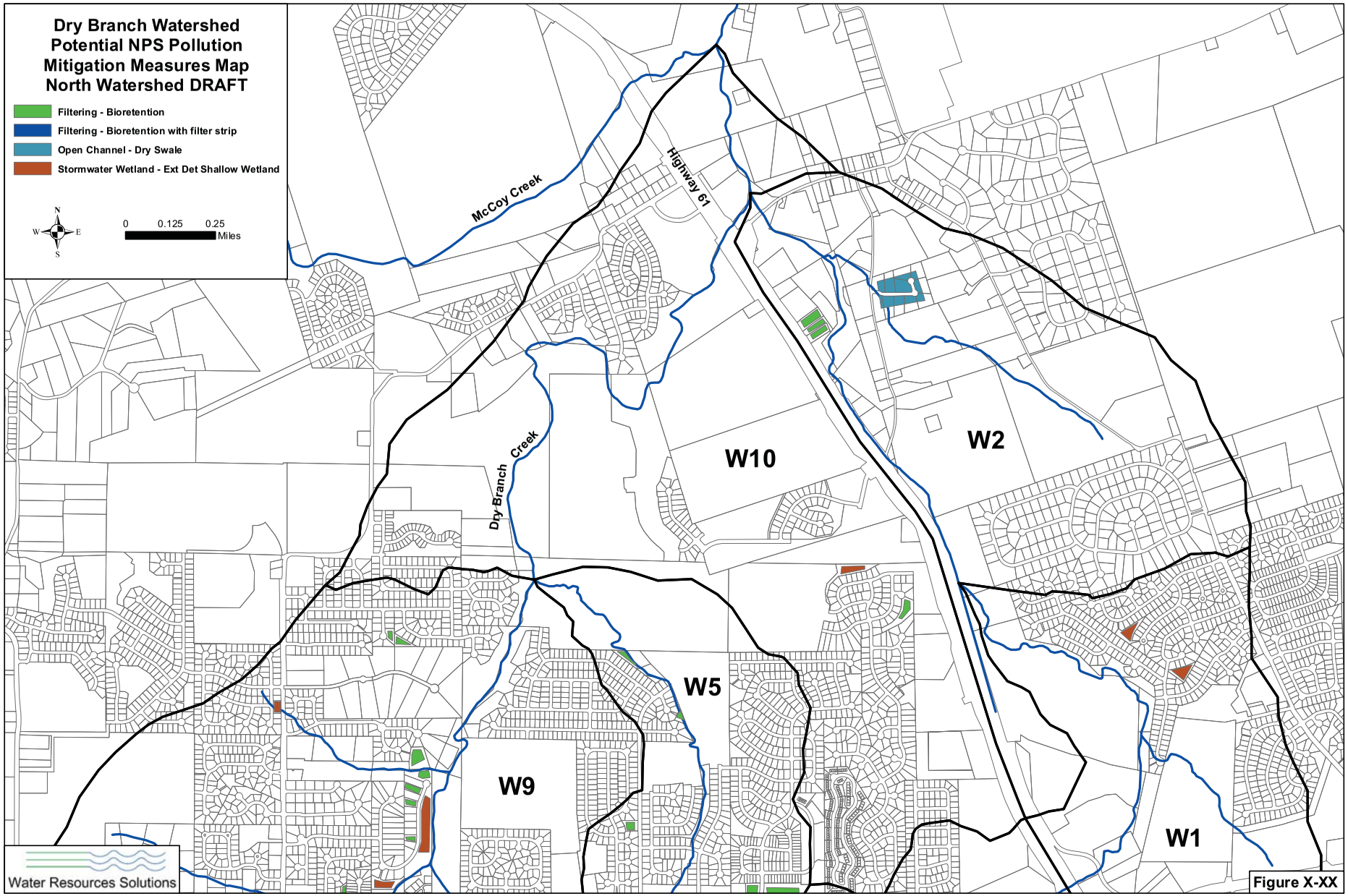
universally acceptable – things like height and simplicity of plant material, architectural features such as fencing, and presence of a mow-line. She agreed to provide reference information to the project team. Jamie Paige said the watershed management plan could include a section on design considerations to capture this research and the importance of aesthetics.

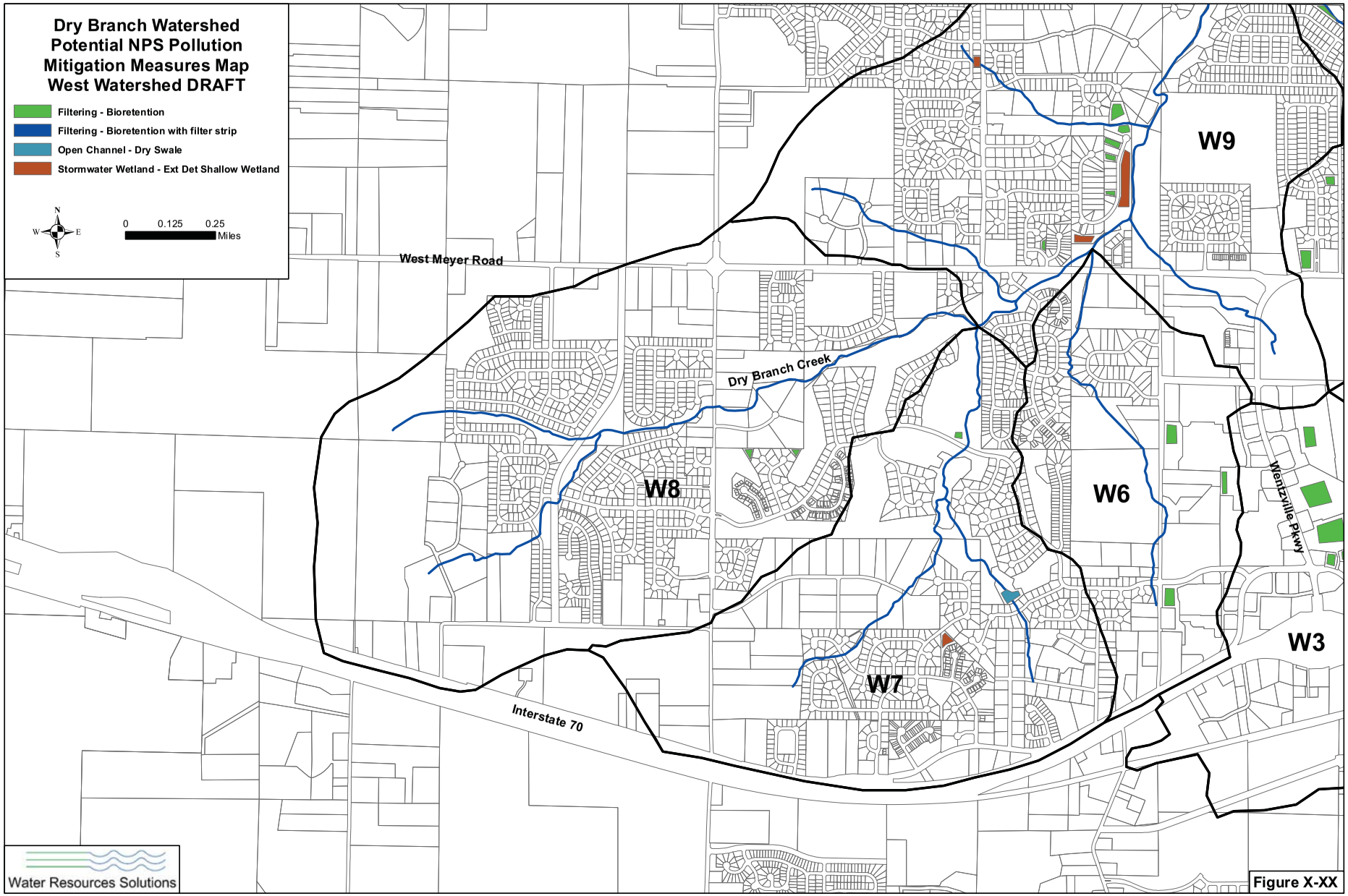
Water quality benefit v. drainage area as a multiplier in the rankings. As proposed, the formula for ranking projects uses drainage area as a multiplier. The result is that projects with a larger drainage area are given more emphasis in the rankings than those draining a smaller area. Rich Gnecco questioned this logic saying just because a project drains a larger area doesn't mean it has a greater impact on water quality. He raised the question of whether water quality shouldn't be used as the multiplier instead – giving more emphasis to projects with greater water quality improvement. After some discussion the group agreed. Matt will recalculate the rankings switching the scoring for drainage area and water quality to see if there is enough change in rankings to warrant this modification.

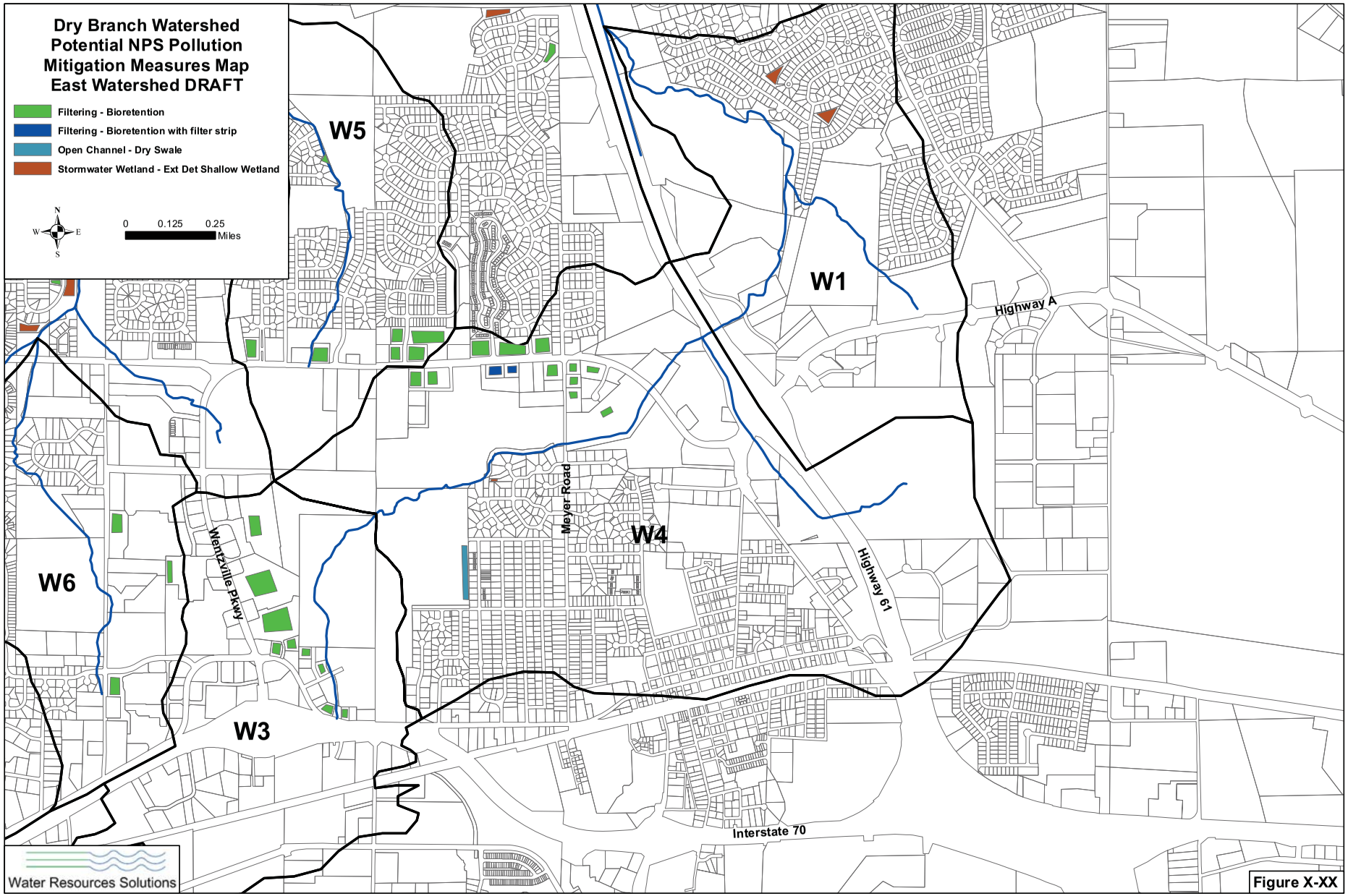
5. WRAP UP AND ADJOURN

Beth told the group that meeting notes would follow along with a list of ranked projects for the Planning Team's review. The project team needs feedback regarding the willingness of individual property owners to implement projects.

The next meeting of the Planning Team was planned for **Tuesday, September 18th from 2:30 to 4:30 at the Progress Park Center**. Ms. Quindry thanked the planning team members for their time. The meeting adjourned at 4:15 p.m.


Dry Branch Watershed
Potential NPS Pollution
Mitigation Measures Map
North Watershed DRAFT
Filtering - Bioretention
Filtering - Bioretention with filter strip
Open Channel - Dry Swale
Stormwater Wetland - Ext Det Shallow Wetland
N
W
E
S
0
0.125
0.25
Miles
McCoy Creek
Highway 61
Dry Branch Creek
W10
W2
W5
W9
W1
Water Resources Solutions
Figure X-XX


Dry Branch Watershed
Potential NPS Pollution
Mitigation Measures Map
West Watershed DRAFT
Filtering - Bioretention
Filtering - Bioretention with filter strip
Open Channel - Dry Swale
Stormwater Wetland - Ext Det Shallow Wetland
N
W
E
S
0
0.125
0.25
Miles
West Meyer Road
Dry Branch Creek
W8
W9
W6
W7
W3
Wentzville Pkwy
Interstate 70
Water Resources Solutions
Figure X-XX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N
W
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0
0.125
0.25
Miles
W5
W1
W6
W4
W3
Highway A
Meyer Road
Wentzville Pkwy
Highway 61
Interstate 70
Water Resources Solutions
Figure X-XX

Potential Non-Point Source Pollution Mitigation Measures - Private Commercial

Sub-Watershed	BMP No.	BMP Type	BMP Description	BMP Drainage Area (ac)	Parcel ID	Owner	Subdivision Name	Street Address	Total Rating Score
W3	W3-007	Filtering - Bioretention	Detention Retrofit	7.08	4-0013-8601-00-1A	MCW-RD WENTZVILLE COMMONS LLC	SCHNUCKS WENTZ RESUB LOT 1	1950 WENTZVILLE PKWY	17
W3	W3-008	Filtering - Bioretention	New Bioretention	12.25	4-0013-8601-00-1B	HD DEVELOPMENT OF MARYLAND INC	SCHNUCKS WENTZ RESUB LOT 1	1920 WENTZVILLE PKWY	17
W3	W3-009	Filtering - Bioretention	New Bioretention	13.98	4-0013-A322-00-8	DIERBERGS WENTZVILLE LLC	DIERBERGS WENTZ CROSSING BDRY ADJ LC	1800 WM DIERBERG DR	17
W3	W3-001	Filtering - Bioretention	Detention Retrofit	2.11	4-0013-8769-00-3E	OASIS KWIK WASH LLC	COLEMAN SUB RE-RESUB LOT 3D OF LOT 3	3E JIFFY ST	17
W3	W3-002	Filtering - Bioretention	New Bioretention	0.63	4-0013-A500-00-3H	MIDAS REALTY CORPORATION	COLEMAN SUB #1 3RD RESUB LOT 3	2 JIFFY ST	17
W3	W3-003	Filtering - Bioretention	New Bioretention	1.62	4-0013-9508-00-1	SALT LICK ROAD LLC	PEARCE BUS PK	1109 W PEARCE BLVD	17
W3	W3-004	Filtering - Bioretention	New Bioretention	1.85	4-0013-8529-00-3A	ACC PROPERTIES LLC	COLEMAN SUB RESUB LOT 3	1123 W PEARCE BLVD	17
W3	W3-005	Filtering - Bioretention	New Bioretention	1.37	4-0013-8601-00-1G	DDL PARTNERSHIP LP	SCHNUCKS WENTZ RESUB LOT 1	1986 WENTZVILLE PKWY	17
W5	W5-006	Filtering - Bioretention	New Bioretention	1.30	4-0010-S014-00-24.3	T G L PROPERTIES LLC	N/A	1409 WENTZVILLE PKWY	17
W6	W6-003	Filtering - Bioretention	Detention Retrofit	11.73	4-0013-A246-00-5	THF WENTZVILLE THREE DEVELOPMENT~LLC	WENTZ CROSSROADS MARKET PLACE N #2	WENTZVILLE PKWY	15
W2	W2-001	Filtering - Bioretention	New Bioretention	1.12	2-0143-9524-00-1	K & R REAL ESTATE LLC	PEANICK PARC	1906 HWY 61	15
W2	W2-002	Filtering - Bioretention	New Bioretention	0.63	2-0143-9524-00-2	BOGART & MCALEXANDER PROPERTIES LLC	PEANICK PARC	1904 HWY 61	15
W2	W2-003	Filtering - Bioretention	New Bioretention	0.57	2-0143-9524-00-3	LETA LAND CO LLC	PEANICK PARC	1902 HWY 61	15
W3	W3-006	Filtering - Bioretention	New Bioretention	1.49	4-0013-8601-00-1F	BREIHAN FAMILY TRUST	SCHNUCKS WENTZ RESUB LOT 1	1992 WENTZVILLE PKWY	15
W6	W6-001	Filtering - Bioretention	Detention Retrofit	7.85	4-0013-A011-00-A	THF WENTZVILLE TWO DEVELOPMENT LLC	WENTZVILLE SOUTH #2	W PEARCE BLVD	14
W6	W6-002	Filtering - Bioretention	Detention Retrofit	7.49	4-0013-9820-00-6	THF WENTZVILLE DEVELOPMENT LLC	WENTZ CROSSROADS MARKETPLACE #2	1905 WENTZVILLE PKWY	13
W4	W4-001	Filtering - Bioretention	New Bioretention	1.78	4-0010-8761-00-3	KRISHNA RADHA LLC	STONE RIDGE CANYON COMMERCIAL #1	1215 WENTZVILLE PKWY	13
W4	W4-002	Filtering - Bioretention	New Bioretention	1.84	4-0010-8761-00-2	T G L PROPERTIES LLC	STONE RIDGE CANYON COMMERCIAL #1	1155 WENTZVILLE PKWY	13
W4	W4-003	Filtering - Bioretention	New Bioretention	1.35	4-0010-8761-00-1	BANK OF OLD MONROE	STONE RIDGE CANYON COMMERCIAL #1	1093 WENTZVILLE PKWY	13
W4	W4-004	Filtering - Bioretention	New Bioretention	1.12	4-0013-9455-00-1	SCHROEDER CREEK LLC	SCHROEDER COMMERCIAL PK #1	1000 SCHROEDER CREEK BLVD	13
W4	W4-005	Filtering - Bioretention	New Bioretention	1.73	4-0013-A383-00-1	1ST FINANCIAL FEDERAL CREDIT UNION	SCHROEDER COMMERCIAL PARK #1 RESUB	1232 WENTZVILLE PKWY	13
W4	W4-006	Filtering - Bioretention with filter strip	New Bioretention	1.12	4-0013-S024-00-6.22	CURATORS OF THE UNIVERSITY OF~MISSOURI	N/A	1092 WENTZVILLE PKWY	13
W4	W4-007	Filtering - Bioretention with filter strip	New Bioretention	0.39	4-0013-S024-00-6.21	PHILLIPS JOHN D and PHILLIPS VIRGINIA A	N/A	1078 WENTZVILLE PKWY	13
W4	W4-008	Filtering - Bioretention	New Bioretention	0.65	4-0013-A454-00-1	WALGREEN CO	1053 MEYER RD SUB	1022 WENTZVILLE PKWY	13
W4	W4-009	Filtering - Bioretention	New Bioretention	1.63	4-0013-A446-00-1	DEVELOPMENTAL LEARNING CENTER INC	MEYER RID DED & ESMT	1060 MEYER RD	13
W4	W4-012	Filtering - Bioretention	New Bioretention	1.61	4-0013-9957-00-1	PBSP HOLDINGS LLC	BORNHOP CIRCLE	970 WENTZVILLE PKWY	13
W5	W5-004	Filtering - Bioretention	New Bioretention	1.15	4-0010-9906-00-5	PEARCE PARTNERS LLC	HERITAGE POINTE COMMONS	1235 WENTZVILLE PKWY	13
W5	W5-008	Filtering - Bioretention	New Bioretention	0.76	4-0010-9906-00-6	WEST HERITAGE COMMONS LLC	HERITAGE POINTE COMMONS	1251 WENTZVILLE PKWY	13
W5	W5-009	Filtering - Bioretention	New Bioretention	0.98	4-0010-8411-00-1	KENZLEE PROPERTIES LLC	WILLIAMSBURG ON THE PKY COMMERCIAL P	1513 WENTZVILLE PKWY	13
W7	W7-002	Filtering - Bioretention	New Bioretention	0.85	4-0014-S022-00-2.16	BEAR CREEK GOLF LLC	N/A	159 BEAR CREEK DR	13
W4	W4-010	Filtering - Bioretention	New Bioretention	0.60	4-0013-S024-00-2.016.2	CROSSROADS PROFESSIONAL BUILDING LLC	N/A	1040 MEYER RD	11
W4	W4-011	Filtering - Bioretention	New Bioretention	0.74	4-0013-9957-00-3	KAYLOR REAL PROPERTIES LLC	BORNHOP CIRCLE	1020 MEYER RD	11
W5	W5-005	Filtering - Bioretention	New Bioretention	2.06	4-0010-A642-00-3	WEST HERITAGE COMMONS LLC	TWIN OAKS AT HERITAGE POINTE BDRY ADJ	1229 WENTZVILLE PKWY	11
W5	W5-007	Filtering - Bioretention	New Bioretention	0.76	4-0010-9964-00-2B	HERITAGE INVESTMENT GROUP LLC	HERITAGE POINTE COMMONS RESUB LOT 2	989 HERITAGE PKWY	11

Potential Non-Point Source Pollution Mitigation Measures - Public

Sub-Watershed	BMP No.	BMP Recommendation	BMP Description	BMP Drainage Area (ac)	Parcel ID	Owner	Subdivision Name	Street Address	Total Rating Score
W4	W4-015	Open Channel - Dry Swale	New Swale	19.72	4-0013-S024-00-25.8	WENTZVILLE REORGANIZED SCHOOL DISTRICT #4	N/A	1 CAMPUS DR	15
W4	W4-013	Filtering - Bioretention	New Bioretention	2.58	4-0013-S024-00-3	WENTZVILLE CITY OF	N/A	968 MEYER RD	14
W7	W7-001	Open Channel - Dry Swale	New Swale	14.57	4-0014-S022-00-2.12	CITY OF WENTZVILLE	N/A	BEAR CREEK DR	13

Potential Non-Point Source Pollution Mitigation Measures - Private Residential

Sub-Watershed	BMP No.	BMP Recommendation	BMP Description	BMP Drainage Area (ac)	Parcel ID	Owner	Subdivision Name	Street Address	Total Rating Score
W9	W9-005	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	13.84	4-0010-9409-00-A	VICTORIA'S RIDGE HOMEOWNERS ASSOCIATION	VICTORIAS RIDGE	HIGHLAND MEADOWS PL	16
W10	W10-002	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	16.00	4-0010-A448-00-B	STONE RIDGE CANYON OWNERS ASSOCIATION INC	STONE RIDGE CANYON #6	APPALACHIAN DR	16
W4	W4-014	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	18.04	4-0013-A723-00-65	ADDINGTON FRANKLIN J and ADDINGTON SANDRA J	SPRING MEADOWS #2 & #3 BDRY ADJ LOTS 4	555 SPRING MEADOW XING	16
W9	W9-010	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	13.12	4-0010-9392-00-A	HIGHLAND FOREST HOMEOWNERS~ASSOCIATION	HIGHLAND FOREST	HIGHLAND MEADOWS CT	15
W9	W9-007	Filtering - Bioretention	Detention Retrofit	11.87	4-0010-9425-00-A	PROVIDENCE ON PEINE HOMEOWNERS ASSOCIATION	PROVIDENCE ON PEINE #2	PROVIDENCE ESTATE DR	15
W7	W7-003	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	10.33	4-0077-9103-00-B	HUNTSDALE HOMEOWNERS ASSOCIATION	HUNTSDALE #1	HUNTSDALE DR	15
W10	W10-001	Filtering - Bioretention	Detention Retrofit	8.96	4-0010-A236-00-A	STONE RIDGE CANYON HOMEOWNERS ASSOCIATION	STONE RIDGE CANYON #5	LOST CANYON BLVD	14
W8	W8-001	Filtering - Bioretention	Detention Retrofit	1.90	4-0014-8251-00-A	BEAR CREEK HOLLOW TRUSTEES	BEAR CREEK HOLLOW	BEAR TRACKS DR	14
W9	W9-001	Filtering - Bioretention	Detention Retrofit	0.34	4-0010-9409-00-12	PEECHER STEVEN and PEECHER BUFFY	VICTORIAS RIDGE	441 HIGHLAND MEADOWS PL	14
W9	W9-002	Filtering - Bioretention	Detention Retrofit	0.49	4-0010-9409-00-10	HIRTZ JASON ROBERT	VICTORIAS RIDGE	437 HIGHLAND MEADOWS PL	14
W9	W9-003	Filtering - Bioretention	Detention Retrofit	0.34	4-0010-9409-00-8	RALSTON RICHARD W. and RALSTON MARSHA E.	VICTORIAS RIDGE	433 HIGHLAND MEADOWS PL	14
W9	W9-004	Filtering - Bioretention	Detention Retrofit	1.74	4-0010-9409-00-3	NOTHEIS MELINDA A	VICTORIAS RIDGE	423 HIGHLAND MEADOWS PL	14
W2	W2-004	Open Channel - Dry Swale	New Swale	3.89	2-0095-A133-00-9	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	104 ALLEN RIDGE DR	14
W9	W9-006	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	20.59	4-0009-8408-00-A	PEINE RIDGE HOMEOWNERS ASSOCIATION	PEINE RIDGE #1	W MEDALIST DR	14
W5	W5-002	Filtering - Bioretention	Detention Retrofit	5.92	4-0010-8306-00-A	GREAT OAKS ESTATES TRUSTEES	GREAT OAKS	ASHFORD OAKS CT	13
W9	W9-009	Filtering - Bioretention	Detention Retrofit	6.67	4-0010-9332-00-D	AUTUMN TRLS COMMUNITY ASSOCIATION	AUTUMN TRAIL	AUTUMN TRL	13
W5	W5-001	Filtering - Bioretention	Detention Retrofit	4.95	4-0010-8561-00-D	GREAT OAKS ESTATES TRUSTEES	GREAT OAKS #3	GREAT OAKS MEADOW DR	13
W8	W8-002	Filtering - Bioretention	Detention Retrofit	2.91	4-0014-8251-00-B	BEAR CREEK HOLLOW TRUSTEES	BEAR CREEK HOLLOW	BEAR TRACKS CT	13
W1	W1-001	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	32.37	2-0046-7477-00-A	PEARCE FARMS ESTATES HOMEOWNERS ASSOCIATION	PEARCE FARM EST #2	GLENSHEE DR	12
W9	W9-008	Filtering - Bioretention	Detention Retrofit	4.57	4-0009-8743-00-A	WILLOWS ON PEINE ESTATES HOMEOWNERS ASSOCIATION	WILLOWS ON PEINE ESTS	STEWART SPRINGS DR	11
W1	W1-002	Stormwater Wetland - Ext Det Shallow Wetland	Det/Ret Retrofit	12.50	2-0045-7891-00-A	WHITE FENCE ESTATES PLAT 5 TRUSTEES	WHITE FENCE #5	WHITE FENCE DR	11
W5	W5-003	Filtering - Bioretention	Detention Retrofit	12.62	4-0010-8045-00-C	MEADOWS AT WILLIAMSBURG HOMEOWNERS ASSOCIATION	MEADOWS AT WILLIAMSBURG #1	OLD JAMESTOWN CT	11
W9	W9-011	Filtering - Bioretention	Detention Retrofit	8.08	4-0009-9614-00-A	LK PROPERTIES II LLLP	SHERWOOD OAKS	SHERWOOD OAKS DR	10
W2	W2-004	Open Channel - Dry Swale	The BMP Description for these properties is calculated with Parcel ID 2-0095-A133-00-9	3.89	2-0095-A133-00-8	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	106 ALLEN RIDGE DR	The Total Rating Score for these properties is calculated with Parcel ID 2-0095-A133-00-9
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-10	BEHLMANN JEFFREY E and BEHLMANN MARYLEE	ALLEN RIDGE	102 ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-A	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-7	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	108 ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-3	VEHIGE LEROY and VEHIGE LAVERNE	ALLEN RIDGE	105 ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-6	HUTH DANIEL and HUTH STACI A	ALLEN RIDGE	2 ALLEN RIDGE CT	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-1	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	101 ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-2	L AND L VEHIGE AND ASSOCIATES INC	ALLEN RIDGE	103 ALLEN RIDGE DR	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-4	SCHIPPER JEFFERY C and SCHIPPER LORA C	ALLEN RIDGE	3 ALLEN RIDGE CT	
W2	W2-004	Open Channel - Dry Swale		3.89	2-0095-A133-00-5	HACKENWERTH DONALD and HACKENWERTH SALLY L	ALLEN RIDGE	4 ALLEN RIDGE CT	

Water Resources Solutions

8800 Linden Drive · Prairie Village, KS · 66207 · (913) 302-1030 Phone · (913) 962-2245Fax · Info@WaterResourcesSolns.com

TECHNICAL MEMO

Project: Dry Branch Watershed Management Plan
Designer: Matt Harper, P.E.
Date: 7-25-12
Subject: Potential NPS Pollution Mitigation Measure Prioritization Method

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Background: A prioritization method and ranking criteria for potential NPS pollution mitigation measures was developed as part of the Dry Branch Watershed Management Plan. The criteria included drainage area, water quality benefit, existing stream condition, visibility, proximity to stream, and cost. The ranking methodology assigned a score to each one of the categories and used the drainage area score as the multiplier to get the Total Ranking Score. The result of this methodology is that projects with a larger drainage area are given more emphasis in the ranking than those with a smaller drainage area.

At the Planning Team Meeting #2 on July 17, 2012, the prioritization procedure and ranking criteria was explained to the Planning Team. A couple of the members of the Planning Team questioned the use of the drainage area score as the multiplier, stating that just because a project drains a larger area, doesn't mean it necessarily has a greater impact on water quality. The question was raised whether water quality shouldn't be used as the multiplier instead – giving more emphasis to projects with greater water quality improvement.

Objective: Evaluate the impact on the rankings of using the water quality benefit score as the multiplier instead of the drainage area score.

Procedure and Results: The prioritization spreadsheet was revised by using the water quality benefit score as the multiplier instead of the drainage area score. This revision resulted in some change to the potential mitigation measure rankings, but decreased the range of the Total Ranking Scores. During the meeting on July 17th, Planning Team members had expressed the importance of variance in the scores to differentiate project benefits so further revision was needed.

After discussions with Jamie Paige and Zach Wolff with the City of Wentzville, two changes were made. First, scoring was made more sensitive for three of the criteria including drainage area, cost and water quality pollution reduction in order to increase the range of Total Ranking Scores. Second, a water quality benefit measure was developed to incorporate both water quality improvement potential and drainage area. Water quality benefit is now defined as the product of the water quality reduction percentage times the drainage area score; it is given equal weight as the other primary criteria: visibility, proximity to stream existing stream condition and cost. This methodology allows drainage area to amplify water quality benefit without having such an impact on the Total Ranking Score.

The table below shows the revised prioritization methodology.

Criteria	Definition	Numerical Values Assigned
Water Quality Improvement Potential	Average % load reduction in pollutants	0% to 100%
Drainage Area (DA)	Area draining to the mitigation measure (rounding to nearest whole number)	1=3 acres or less 2=4 to 7 acres 3=8 to 11 acres 4=12 to 15 acres 5=greater than 15 acres
Water Quality Benefit	Product of the Average % load reduction in pollutants and Drainage Area Score	Percentage x DA Score
Visibility	Type of road adjacent to mitigation measure	1=local road 3=minor road 5=major road
Proximity to Stream	Location of outfall to stream	1=multiple segments away 3=one segment away 5=direct oufall
Existing Stream Condition	Condition according to stream asset inventory	1=Good 3=Fair 5=Poor
Capital Cost	Construction Cost plus Engineering Cost	1=greater than $80,000 2=$60,000 to $80,000 3=$40,000 to $60,000 4=$20,000 to $40,000 5=less than $20,000
TOTAL	**Sum of each of the Prioritization Criteria Scores**	**WQ Benefit, Visibility, Prox. To Stream, Existing Stream Condition, Capital Cost**

Recommendation: It is the Project Team's recommendation that the Planning Team utilize this revised methodology for project rankings in the final Watershed Management Plan. As was discussed in the last planning team meeting, the prioritization spreadsheet is just one tool that helps anyone who uses the management plan look at potential projects, but it is not the only determining factor. Other factors that may go into choosing projects include probability of success, partner willingness, long term maintenance costs/requirements, capitalizing on other watershed projects, etc.

PLANNING TEAM MEETING #3

Dry Branch Planning Team
Meeting #3

September 18, 2012
Progress Park Banquet Center
2:30 - 4:00 p.m.

Meeting Objectives:

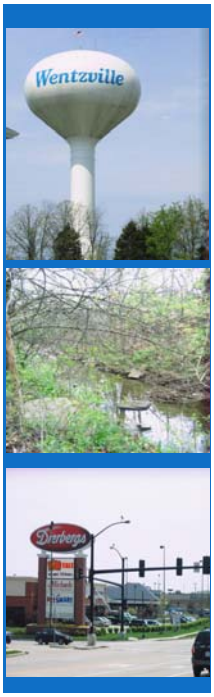
- Meeting 2 follow-up: review of final prioritization ranking
- Provide information on remaining watershed plan components including schedule of implementation and measuring progress
- Discussion of planning team member support to encourage implementation of the Dry Branch Watershed Management Plan

Agenda

2:30	Welcome	Zachary Wolff, City of Wentzville
2:35	Meeting 2 Follow-Up: Final Prioritization Methodology	Matt Harper, Water Resource Solutions
2:45	Watershed Management Plan Update	Matt Harper
3:15	Implementation Discussion	Beth Quindry, Shockey Consulting
3:45	Wrap-Up and Adjourn	Zachary Wolff

DRY BRANCH WATERSHED MANAGEMENT PLAN

PLANNING TEAM MEETING #3



319 GRANT BACKGROUND

Grant Objectives

- ✓**Assess** and **improve** water quality.
- ✓**Beautify** Wentzville while saving money on maintenance.
- ✓**Show** the community better alternatives to fescue, concrete and pipes.
- ✓**Develop** a Watershed Management Plan that identifies nonpoint source pollutants, sources and prioritizes solutions
- ✓**Evoke change** by increasing community awareness of water quality issues.

REVISED PRIORITIZATION CRITERIA

Criteria	Definition	Numerical Values Assigned
Water Quality Improvement Potential	Average % load reduction in pollutants	0% to 100%
Drainage Area (DA)	Area draining to the mitigation measure (rounding to nearest whole number)	1=3 acres or less 2=4 to 7 acres 3=8 to 11 acres 4=12 to 15 acres 5=greater than 15 acres
Water Quality Benefit	Product of the Average % load reduction in pollutants and Drainage Area Score	Percentage x DA Score
Visibility	Type of road adjacent to mitigation measure	1=local road 3=minor road 5=major road
Proximity to Stream	Location of outfall to stream	1=multiple segments away 3=one segment away 5=direct oufall
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TOTAL	**Sum of each of the Prioritization Criteria Scores**	**WQ Benefit, Visibility, Prox. To Stream, Existing Stream Condition, Capital Cost**

WATERSHED MANAGEMENT PLAN
(ORANGE = COMPLETE/UNDERWAY)

1. Identify causes of impairment and pollutant sources
2. Estimate load reductions from management measures
3. Describe non-point source management measures
4. Estimate amount of technical and financial assistance needed
5. Inform and educate
6. Schedule for implementing nonpoint source management measures
7. Describe interim measurable milestones
8. Determine criteria for evaluating pollution reduction
9. Monitor the effectiveness of the implemented measures

IMPLEMENTATION PLAN
WATERSHED MANAGEMENT PLAN, ELEMENTS 6 & 7

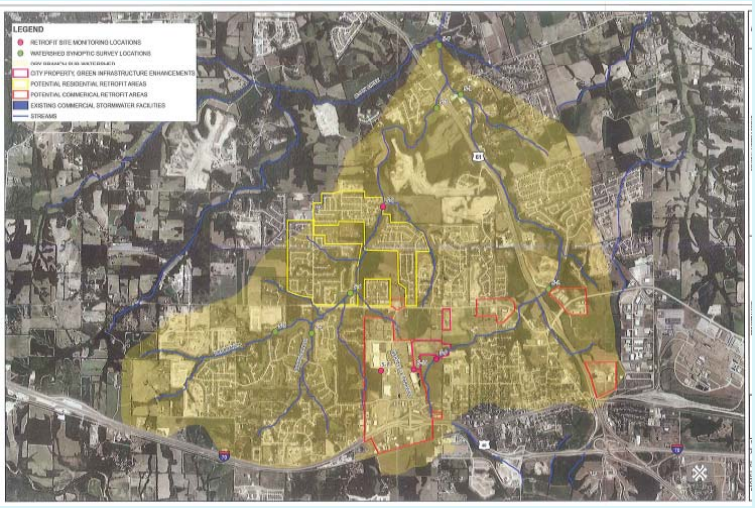
ULTIMATE GOALS
- Reduce pollutants of concern.
- Prevent illegal discharges/spills.
- Improve the condition of poor/fair streams.
- Conserve natural areas.

SHORT TERM GOALS (FIRST 5 YEARS)
MIDTERM AND LONG TERM GOALS

IMPLEMENTATION PLAN
WATERSHED MANAGEMENT PLAN, ELEMENTS 6 & 7

SHORT TERM GOALS (FIRST 5 YEARS)
- Complete 3 retrofit projects.
- Complete synoptic watershed monitoring.
- Validate/revise water quality model based on monitoring data.
- Hold public meetings, information sessions and workshops.
- Promote and encourage residents to implement water quality features.
- Complete water quality testing to establish baseline for existing water quality within the watershed.
- Enforce existing conservation ordinances to conserve natural areas.
- Revise plan with Planning Team input as needed.

WATER QUALITY MONITORING LOCATIONS



MARKETING PLAN

Strategies/Goals

To increase awareness and evoke change among residents, developers and business owners in Dry Branch watershed

Tactics

- Showcase retrofit projects
- Promote awareness at local events
- Utilize existing platforms to share information
- PSAs

IMPLEMENTATION PLAN
WATERSHED MANAGEMENT PLAN, ELEMENTS 6 & 7

MIDTERM AND LONGTERM GOALS

- Continue to implement potential NPS pollution mitigation measures.
- Continue water quality monitoring to evaluate the effectiveness of the installed water quality BMPs.
- Improve the score of at least one stream reach each year.
- Seek funding for water quality improvement projects (midterm).
- Revisit/revise ordinances to conserve natural areas.
- Secure funding for water quality improvement projects. (long term).

FINANCIAL ASSISTANCE

- Currently funded through 319 Grant
  - 1 residential retrofit
  - 2 commercial retrofits
- Other potential funding opportunities
  - Funding opportunities exist for structural BMPs as well as education and outreach
    - Clean Water State Revolving Fund (EPA and MDNR) – low interest loans
    - Five Star Restoration Grant Program (EPA) - grant
    - St. Charles Soil and Water Conservation District – cost share program
- Eligible recipients include not only municipalities but farmers, small businesses, homeowners and nonprofits

EVALUATION CRITERIA
WATERSHED MANAGEMENT PLAN ELEMENT 8

- Initial criteria will be to see lower pollutant load numbers.
- BMPs meeting the expected load reductions percentages.
- Streams are meeting State water quality standards.
- Revise once water quality monitoring is complete.

WATER QUALITY MONITORING
WATERSHED MANAGEMENT PLAN ELEMENT 9

- Headed by the municipalities that the NPS pollution mitigation measures are implemented.
- Continue the monitoring plan identified in the Dry Branch Watershed QAPP.
- Local Monitoring
  - Paired inlet/outlet
  - Pre- and Post Construction
  - Bracket Stream Segment
- Low cost biological monitoring (stream teams).
- Photo point monitoring.

WATERSHED MANAGEMENT PLAN IMPLEMENTATION

- Draft plan submitted to MDNR and comments received. Final plan to be submitted [end of September].
- Present to City of Wentzville Board of Aldermen, [Fall 2012]
- Once finalized, to be used as guidance document for improving water quality in Dry Branch Watershed
  - Identification of 319 grant funded projects

PROMOTING IMPLEMENTATION

- Stay informed
- Educate others
- Model best practices
- Suggestions

City of Wentzville, Missouri
Dry Branch Watershed Management Plan
Planning Team Meeting
September 18, 2012

Progress Park Center
968 Meyer Road, Wentzville, MO 63385

MEETING OUTCOMES

- The planning team reviewed the revised prioritization ranking methodology.
- The planning team received information on remaining watershed plan components including short, medium and long-term goals.
- The planning team received information on how their organizations could support implementation with public education and outreach.

ATTENDANCE

Planning Team members in attendance:

Jim Burris, Wentzville Stormwater Advisory Committee/Greenway Network
Frances Coleman, St. Charles Soil & Water Conservation District
Doug Forbek, City of Wentzville
Rich Gnecco, St. Charles County Community Development
Peggy Meyer, Resident/former member, Wentzville Board of Aldermen
Paul Morris, Missouri Department of Natural Resources
Jannette Nolen, Wentzville Stormwater Advisory Committee/Greenway Network
Terry Kraus, Resident
Trish Reilly, Missouri Department of Natural Resources

Project Team members in attendance, including consultants and city staff:

Matt Harper, Water Resources Solutions
Douglas Lee, City of Wentzville Public Works
Jamie Paige, City of Wentzville Public Works
Beth Quindry, Shockey Consulting
Zachary Wolff, P.E., City of Wentzville Public Works

1. WELCOME AND INTRODUCTIONS

Beth Quindry welcomed planning team members and thanked them for agreeing to meet outdoors for the final meeting. Highlights of the agenda were described. Beth mentioned that copies of the draft Dry Branch Watershed Management Plan were available on each of the tables. The 319 grant objectives were reviewed.

- ✓ **Assess** and **improve** water quality.
- ✓ **Beautify** Wentzville while saving money on maintenance.

- ✓ **Show** the community better alternatives to fescue, concrete and pipes.
- ✓ **Develop** a Watershed Management Plan that identifies nonpoint source pollutants, sources and prioritizes solutions
- ✓ **Evoke change** by increasing community awareness of water quality issues.

2. REVIEW OF FINAL PRIORITIZATION METHODOLOGY

Matt Harper reviewed the final prioritization methodology. Draft methodology had been proposed at the planning team's July meeting and there was some discussion about the weight given to drainage area relative to other criteria.

Changes were made as a result of the discussion and a technical memo was distributed to the planning team in July to describe the revisions. The table on the next page explains the revised methodology in detail. Changes can be summarized as follows:

- Water quality benefit to emphasize the importance of water quality improvement (more than drainage area).
- More sensitive scoring (more categories) for drainage area and cost to allow the variation in final scores
- Water quality improvement potential a percentage rather than in categories, also to allow more variation in final scores

Criteria	Definition	Numerical Values Assigned
Water Quality Improvement Potential	Average % load reduction in pollutants	0% to 100%
Drainage Area (DA)	Area draining to the mitigation measure (rounding to nearest whole number)	1=3 acres or less 2=4 to 7 acres 3=8 to 11 acres 4=12 to 15 acres 5=greater than 15 acres
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Capital Cost	Construction Cost plus Engineering Cost	1=greater than $80,000 2=$60,000 to $80,000 3=$40,000 to $60,000 4=$20,000 to $40,000 5=less than $20,000
TOTAL	**Sum of each of the Prioritization Criteria Scores**	**WQ Benefit, Visibility, Prox. To Stream, Existing Stream Condition, Capital Cost**

3. WATERSHED PLAN UPDATE

Matt Harper discussed a couple of the required watershed elements completed since the last meeting: a) determining criteria for evaluating pollution reduction; b) monitoring the effectiveness of the implemented measures and c) summary of financial assistance for watershed projects.

a) Initial evaluation criteria will be to see lower pollutant load numbers. BMPs will be monitored to make sure they are meeting the expected load reduction percentages as outlined in watershed management plan and streams will be monitored to make sure they are meeting State water quality standards.

   Evaluation criteria will be adjusted as water quality monitoring data becomes available.

b) Matt explained that water quality monitoring would be headed by the municipalities where the NPS pollution mitigation measures are implemented and would continue the monitoring plan identified in the Dry Branch Watershed QAPP. Local monitoring would be done in several ways:

   - Paired inlet/outlet
   - Pre- and Post-Construction
   - Bracket Stream Segment
   - Low cost biological monitoring (stream teams).

c) Matt highlighted some of the funding options available for projects in the watershed. More detail is available in the watershed management plan.
   - Currently funded through 319 Grant
     - 1 residential retrofit
     - 2 commercial retrofits
   - Other potential funding opportunities
     - Funding opportunities exist for BMPs as well as education and outreach
     - Clean Water State Revolving Fund (EPA and MDNR) – low interest loans
     - Five Star Restoration Grant Program (EPA) - grant
     - St. Charles Soil and Water Conservation District – cost share program
   - Eligible recipients include not only municipalities but farmers, small businesses, homeowners and nonprofits

4. IMPLEMENTATION DISCUSSION

Matt Harper reviewed goals of the watershed management plan. The ultimate goals of the Dry Branch Watershed Management Plan are:

- Reduce pollutants of concern.
- Prevent illegal discharges/spills.
- Improve the condition of poor/fair streams.
- Conserve natural areas.

SHORT TERM GOALS (FIRST 5 YEARS)

- Complete 3 retrofit projects.
- Complete synoptic watershed monitoring.
- Validate/revise water quality model based on monitoring data.
- Hold public meetings, information sessions and workshops.
- Promote and encourage residents to implement water quality features.
- Complete water quality testing to establish baseline for existing water quality within the watershed.
- Enforce existing conservation ordinances to conserve natural areas.
- Revise plan with Planning Team input as needed.

Jamie Paige explained that a marketing plan has been developed to organize work around the short terms goals related to public education and outreach. The goal of the marketing plan is to increase awareness and evoke change among residents, developers and business owners in Dry Branch Watershed.

Many of the activities in the marketing plan will be of interest to planning team members and could use their support:

- Showcase retrofit projects
- Promote awareness at local events
- Utilize existing platforms to share information

MIDTERM AND LONGTERM GOALS

- Continue to implement potential NPS pollution mitigation measures.
- Continue water quality monitoring to evaluate the effectiveness of the installed water quality BMPs.
- Improve the score of at least one stream reach each year.
- Seek funding for water quality improvement projects (midterm).
- Revisit/revise ordinances to conserve natural areas.
- Secure funding for water quality improvement projects (long term).

5. WRAP UP AND ADJOURN

Zach Wolff, P.E. thanked the planning team members and project team for their work in putting the watershed management plan together. He also encouraged planning team members to stay tuned as the plan moves into implementation. A presentation will take place later this fall to present the watershed plan to Wentzville's Board of Aldermen. Planning team members will be notified of the Board meeting.

The final watershed management plan will be submitted to the Missouri Department of Natural Resources by the end of September and will be available on the City of Wentzville's website at http://www.wentzvillemo.org/319.aspx .

APPENDIX F: THE DRY BRANCH WATERSHED: CLEAR STORMWATER & GREEN PARKS PROJECT MARKETING PLAN 2012-2015

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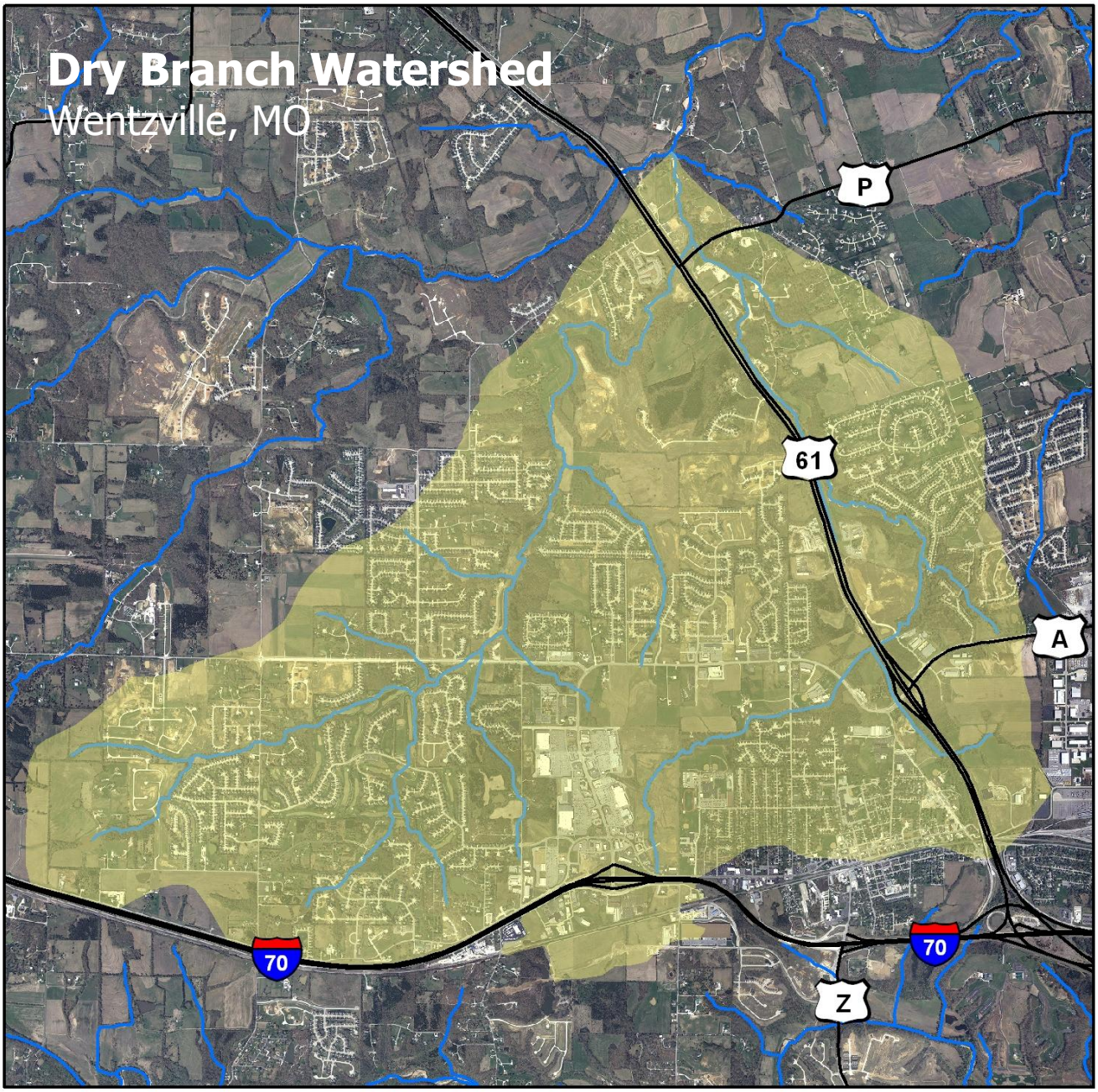
The Dry Branch Watershed: Clear Stormwater & Green Parks Project

Marketing Plan 2012-2015



Completed: Summer 2012

Overview

The Dry Branch Watershed: Clear Stormwater and Green Parks Project is a project partially funded by US EPA Region 7 through the Missouri Department of Natural Resources under Section 319 of the Clean Water Act. The project will assess the watershed and develop a management plan that identifies nonpoint source (NPS) pollutants, sources, and prioritizes solutions and implements practices within the watershed.

The Dry Branch Watershed: Clear Stormwater and Green Parks Project assessed the watershed and developed a nine element watershed management plan that identifies nonpoint source (NPS) pollutants, sources, and prioritized solutions within the first two years of the project. The first year of the project integrated a green infrastructure and NPS pollution education components at the City of Wentzville's Law Enforcement Center (LEC). By year four of the project there will be a green infrastructure developed at one City park. Year three of the project is planned to make stormwater cleaner and clearer by quantifying and reducing priority pollutants (i.e., trash, oil, sediment, etc) by 50% from two commercial sites and one residential subdivision by applying stormwater retrofits. The project as a whole intends to evoke change by increasing community awareness of water quality issues. By hosting a ground breaking ceremony, a stream naming contest, public tours of water quality features, developing a web-based tour, and designing and implementing service learning projects, awareness of water qualities will be increased. The project also plans to increase water quality through park enhancements on the 28-acre tract the City is developing as well as retrofits to storm water infrastructure on five other properties. The best management practices (BMP) planned are wetland forbays, bio-filter zones, permeable pavement, native riparian lake buffers, and a wetland and boardwalk with educational signage at Heartland Park. The improvements will all be used to educate the public on NPS pollutant issues and water quality.

The Dry Branch Watershed: Clear Stormwater and Green Parks Project Marketing Plan

Overview

The Dry Branch Watershed: Clear Stormwater and Green Parks Project Marketing Plan will inform and educate the public on nonpoint source pollution and help evoke a positive change from the target audience through a two year plan. The Dry Branch Watershed is in St. Charles County and encompasses 6,800 acres of incorporated and unincorporated areas of the City of Wentzville. The project encompasses the tributaries of the Dry Branch watershed, a sub-watershed of McCoy Creek and Cuivre River. The project includes large-scale commercial/industrial corridors along Wentzville Parkway, I-70, and Highway 61; many recent and older residential developments; as well as interspersed agricultural areas. The marketing plan will encompass watershed residents, business owners, and developers as its target audience. Information passed through this audience will inspire a pro-active change to keep streams clean and help

decrease nonpoint source (NPS) pollutants. The information presented to the target audience will be through a various marketing mix. Through various marketing outlets the audience will first understand the impact NPS pollution has on their water quality. Secondly, the target audience will take a proactive approach and evoke a change within their household, business, development and community to help make a positive impact on water quality. The evaluation process incorporates two assessment processes which will determine the success of both the project and marketing plan.

Strengths, Weaknesses, Opportunities, and Threats Analysis

The purpose of SWOT analysis is to be aware of all the outcomes, both negative and positive. Knowledge of potential outcomes of the marketing plan will help for the City to plan accordingly.

Strengths

The strengths of this marketing plan are outreach, directness and the specific calendar matrix. This plan is focused on how to reach out to the target audience. The spotlight of the marketing plan is the various outreach/media mix that is used. The mix will be very successful in reaching the target audience in the time allotted to reach each goal. The goals will also be accomplished because of directness. The directness is shown in the handouts and information outlets used that the City of Wentzville wants a positive change in water quality and reduction of NPS pollutants. There is also an established stormwater management program within the City. This established program helps the marketing plan instead of limiting it. The marketing mix developed for this marketing plan suggests to the City of Wentzville specific dates, events and developments to be aware of and how to let the target audience know what is happening, leading to a successful marketing plan.

Weaknesses

The weakness of the marketing plan is time constraints. To persuade the target audience to change their behavior. Wanting a significant change from the target audience within two years, is tough but not impossible. Time restraints may be the weakness of this plan, but if the City of Wentzville follows the suggested marketing matrix, there could be observable changes within the allotted two years.

Opportunities

The opportunities that are available to this marketing plan are availability to learn and a "green" alternative to lifestyle. With social media's popularity rising everyday it is an opportunity for the marketing plan to inform the audience through the social media outlet. Social media allows for information to be passed to the target audience at a fast pace and has the ability to be shared and impact people outside of the target audience. Another opportunity is the "green" aspect of the plan. Going "green" is a huge issue right now and residents, business/industry owners and developers are gaining an edge to others by incorporating a "green" lifestyle. By informing the

audience of the impact NPS pollutants and water quality has on their lifestyle and how making "green" changes can be beneficial for long term.

Threats
The only threat that is evident is if the target audience does not respond to the outreach this marketing plan suggests. For this threat not to happen it is essential that the City of Wentzville is enthusiastic and well informed to provide information to the target audience. Suggestions are that not only is that not just the stormwater coordinator is well informed about the projects and educating the public. The enthusiasm should be emanating from the whole city on the vastness of the project itself.

Goals and Objectives

Through the Dry Branch Watershed: Clear Stormwater and Green Parks Project, water quality issues will be assessed and prioritized and the City of Wentzville will move forward on implementing solutions. As solutions for water quality are being carried out, the marketing plan has two key goals to accomplish through the two year marketing plan. The first goal will be to educate the public, once the public becomes more aware the goal will be evoking a change from the target audience.

The overall goals for the marketing plan are as follows:

1. To increase Dry Branch Watershed residents, developers, and business owners awareness of NPS pollutants and water quality issues.

2. Through effective education help evoke change in residential, developers, and business owner's habits to positively change water quality and reduce NPS pollutants within the watershed.

The following objectives will help achieve successful goals:

1. City and local media will be contacted periodically with information regarding the projects progress and events the project will be displayed.

2. Informational materials will be produced and used as necessary to reach the target audience.

3. Provide information/resources to evoke change residentially and within the community.

Target Audience

As of the 2010 census the City of Wentzville has 20,070 residents. The Dry Branch Watershed encompasses roughly 65% of residents for a total of 13,455 persons.

The target audience of the Dry Branch Watershed: Clear Stormwater and Green Parks Marketing Plan consist of three distinct groups:

Existing business/industry owners
The marketing plan will teach them the benefits of treating stormwater as well as making their property more aesthetically pleasing. By incorporating education and display to their business or industry they will have a "green" edge to include into their own marketing plan which could help their overall business or industry in a positive manner.

Developers
Educating developers on how to treat stormwater and reduce NPS pollutants. And how native plants can be aesthetically pleasing (marketable) and will in the long run have low maintenance cost. As developers take this initiative it will become more common among developers. By incorporating education and display to their business or industry they will have a "green" edge to include into their own marketing plan which could help their overall business or industry in a positive manner.

Residents
Educating residents on stormwater runoff and their affects on it; and the benefits of native plants will help to inspire residents to take a native plants initiative in their landscaping. Residents will also become aware of the issue of litter in the watershed and how it is affecting the water quality. Residents will gain knowledge on the damages that litter makes and how to take a pro-active approach to limiting this burden.

The target audience is specific. However, reaching out further to neighboring communities or any citizens through the target audience outreach is not negative to the project or marketing plan.

Budget

In 2011, the Department of Natural Resources awarded to the City of Wentzville a grant of $748,015 through a section 319 Nonpoint Source Pollution Implementation Grant with the City matching $ 500,000 to support their four year project. Grant and city funds provided a working budget for years two through four (2-4) of the marketing plan.

This budget is subject to various usages from beginning stages to ending stages as needed to present a successful marketing plan.

Project Journaling (video, photos)	$1400/ 4 years (grant)
Stakeholders Meetings	$500 (grant)
Stream Naming Contest	$750
Law Enforcement Center Basin Sign	$3200
Business Outreach	$400
Outreach (programs and materials)	$750

Successful Outreach

The Stormwater Management Plan for the City of Wentzville uses specific outreach to educate the public on water quality. This outreach includes a stormwater webpage, brochures, fact sheets, school education programs, news articles, periodicals in city of Wentzville publications and volunteer groups. The measures that are taken to educate the public have been successful. Surveys that are given out yearly provide sufficient information to suggest that the public is getting the proper education about water resources. The survey that the city of Wentzville produced was mailed to 7,103 persons, with 60% of the recipients being over the age of 50; female and male distribution was even. 514 surveys were received back and the data collected from the received surveys showed that public awareness of water resource issues has increased as a result of outreach programming.

The results of the survey showed improve and awareness from effective outreach strategies.

Survey Response	***Year 1***	***Year 3***
I have a role in pollution prevention.	77%	82%
Respondent correctly defined "watershed"	61%	66%
Respondent knew they lived in a watershed.	23%	34%
Storm drains lead to creeks and lakes.	51%	66%

The successful outreach strategies used to educate the public from the Stormwater Management Plan will be similar to that of the Dry Branch Watershed: Clear Stormwater and Green Parks Project marketing plan. Knowledge of outreach that is successful will be the basis of the marketing plan and used to educate the public and evoke change.

Outreach

Awareness, education and evoking change outreach is the focus the marketing plan will present for the next two years of outreach of the Dry Branch Watershed: Clear Stormwater and Green Parks Project. The opportunities to reach the target audience

are numerous. However, to reach the focus this marketing plan suggests outreach with updates on the projects in progress within Wentzville by creating personalized using:

- city publications (including official website),
- local publications,
- local radio,
- and social media;
- attend and take part in events and symposiums held in/by the City of Wentzville;
- provide volunteering outlets for the changes developing from the target audience.

Any event that has interaction with the target audience should be documented by either photography or video. The documentation can provide content for any necessary scrapbooking or timeline of the Dry Branch Watershed: Clear Stormwater and Green Park Project.

Mass media as its name suggests is aimed at a large target market. Large population areas or even the entire country will be reached if mass media is a strong point to the marketing plan. Local media on the other hand is more personal and resonates with local and regional population areas. Specialty media is specific to an audience and relays a specific message. The Dry Branch Watershed: Clear Stormwater and Green Parks Project Marketing Plan will be using local and specialty media to reach the target audience. This method of using local and specialty media will allow the target audience to understand the importance of the changes that will be happening within their community.

Printed Publications

Printed publications will be specifically designed for the City of Wentzville and the Dry Branch Watershed: Clear Stormwater and Green Parks Project's goals in mind. Creation of printed publications for a specific area and cause allows the target audience to become acquainted with the issues as well as considering how the issues are affecting them. These publications will be available at most if not all of the events/symposiums that the City of Wentzville participates in through years 2012-April 2015 as well as on the City of Wentzville's official website to reach out to all that have an interest in the issues. Some of the issues that will be addressed from the created publications are nonpoint source (NPS) pollution, general Dry Branch Watershed information, impacts on watershed residents, and how to keep clean streams.

Because these issues are not foreign there are multiple publications that have been created that address the same issues the City of Wentzville is educating the target audience on. Some of the publications that available for public use are on the Environmental Protection Agenys (EPA) website and are presented in PDF format to print off as necessary. The publications that will be used but not limited to are *After the Storm Brochure, Make Your Home the Solution to Stormwater Pollution Brochure,*

Kids Stormwater Stickers, and Bookmark: "10 Things That You Can Do to Prevent Polluted Runoff".

City of Wentzville Publications

City of Wentzville publications are a great media to make use of in the marketing plan. There are a total of three City publications that the marketing plan will use as well as the City of Wentzville's official website. The benefits of using City publications are cost efficiency and the publications are currently circulating a majority of the marketing plan's target audience. The publications do not sync regarding release dates. This benefits the marketing plan as well as the target audience. The ability to present as much information as possible presents more awareness with a goal of evoking change in the community.

The publications do not take away from the Dry Branch: Clear Stormwater and Green Parks Project marketing plan budget since there is no cost to submit information, print distribute. The publications provide information solely about Wentzville. With Wentzville-specific issues surrounding the target audience, they have a better chance of change their habits since they can relate to the issues directly surrounding water quality and NPS pollutants.

- **Note Worthy**

Note Worthy is one of three publications that the City of Wentzville produces. Note Worthy is a monthly publication that is mailed with utility bills. Articles are requested approximately three weeks before the month they will be distributed. It is also available on the City of Wentzville's website in PDF format. The unique quality that Note Worthy creates is short informational paragraphs. The audience that Note Worthy reaches is larger than the target audience of the marketing plan. With the publication added to utility bills, information needs to stay short yet applicable to the target audience.

Throughout the duration of the Dry Branch Project Marketing Plan, Note Worthy will be provided with informative paragraphs and photos as needed no less than three entries per year from 2013 to 2015. The Dry Branch Project is scheduled to be complete by April 2015.

- **Vision Newsletter**

The Vision newsletter is another publication produced by the City of Wentzville. The Vision Newsletter is a periodical publication that is released bi-monthly. The Vision Newsletter reaches an audience of 29,000 households within the incorporated of the City.

The Vision Newsletter will be provided with information no less than twice a year from 2013-2015. With the Vision Newsletter being bi-monthly the due dates to get information to the Vision Newsletter must be early. Articles are requested approximately two months prior to publication.

- **Fun Times**

The third publication that the City of Wentzville produces is Fun Times and it is exclusively published for the parks and recreation department. This publication is released three times and is a brochure describing all activities and programs available through the parks and recreation department. It is mailed to all residents of Wentzville and is available online in PDF format for all interested persons.

Fun Times brochure is another great city publication to use. The Fun Times Brochure will be contacted with information yearly for information to be published in one of the three brochure releases yearly. Updates of construction and green infrastructure projects specifically from that project, park updates will be in Fun Times.

- **City of Wentzville's Official Website**

The official website is accessible to everyone and is routinely maintained by City staff. This website is used for multiple reasons including resident services, things to do, business services, employment opportunities and reporting concerns. Once users go to the homepage, they are exposed to more than just the reason they came to the website. The website is one of the main sources for information that people rely on and the marketing plan will use this outlet to its best advantage by updating and providing information about all that the Dry Branch Watershed: Clear Stormwater and Green Parks Project.

Media Outreach

Using the media to reach out to the target audience and beyond can greatly enhance the reach ability of the marketing plan. The media is a useful source in so many ways. Media is a means of communication that will transmit information to a wide range of an audience concurrently. The mass media outlets that will be used for this marketing plan are newspapers, radio and internet. Reaching out to the target audience and gaining awareness of NPS pollutants and water quality will spark interest and create the need for change. This outlet is also free. Local newspapers, newsletters, radio stations, social media and websites that the City of Wentzville will be utilizing are open and willing to publish and cover information that will benefit the masses of their audiences and the marketing plan's target audience. By delivering messages and information periodically through these outlets, the target audience will come to value the presented information. The information presented will be written and targeted so that NPS pollution and water quality become attractive to the audience and effective enough to create a need for more coverage through media outlets thus increasing awareness and evoking change. The media outlets that are planned to be used for the Dry Branch Watershed: Clear Stormwater and Green Parks Project Marketing Plan are newspapers and radio stations that are local.

- **Newspapers**

Newspapers have always been known to provide an outlet for awareness and education to be delivered to the public. Access to newspapers is usually easy and does not require anything special to view. Newspapers can also be read at someone's convenience without the typical news broadcast that is viewed at specific times. The following newspapers will be contacted with press releases regarding beneficial outlooks on the Dry Branch Watershed: Clear Stormwater and Green Parks Project updates and future endeavors.

  - **Suburban Journals**- The Suburban Journals are distributed throughout the St. Louis metropolitan area every Wednesday to an estimated 70,000 subscribers and households, unincorporated Wentzville and Flint Hill areas. The Suburban Journals are recognized for covering local news, government, education, chamber of commerce, and area associations. Wentzville will have great visibility by providing information to the Suburban Journals when the opportunity arises.
  - **Newstime**- A biweekly publication, Newstime produces news for the Lake St. Louis and Wentzville area. Newstime is available in print and online for viewing. Newstime is a trusted publication having served in the community for 29 years. Providing information to this publication will certainly be seen by the target audience suggested plus more in the St. Charles County area.
  - **Community News** (St. Charles County) - This weekly publication is circulated throughout St. Charles County plus areas of Lincoln County. Community News is available by home thrown, newsstands and online. The countywide coverage will help reach the target audience successfully.

- **Radio-** The benefits to using radio as a means to educate and inform is a high reach to the target audience, reach ability and a no-cost incentive. The no cost incentive is to provide Public Service Announcements (PSA). PSA's are no cost; the information can be produced by the city and/or submitted to local radio stations. Radio time is mobile. Being heard at the right time will be beneficial to reaching the marketing plan goals. By targeting local radio stations the message will be appealing to the target audience by making the significance relevant to the listener. The following radio stations are local to the area and will be heard by the target audience
  - **KFAV/KWRE-** The radio stations are apart of Kasper Broadcasting Company out of and stream out of Warrenton, Missouri. The station's coverage area includes St. Charles County. KFAV is broadcast on an FM frequency and KWRE is an AM frequency. Having stations broadcasting to AM and FM frequencies increases reach ability to the target audience.
  - **100.7 Westplex-** Broadcasting out of Moscow Mills, Missouri 100.7 Westplex is an FM frequency station. The station serves Lincoln, Warren, St. Charles, and Pike County areas, known as the Westplex. With such a large coverage area 100.7 will easily reach the target audience as well as many more.

- **Internet-** Using the internet as a media outreach approach can have many opportunities to reach the target audience and successfully achieve the goals of the Dry Branch Watershed: Clear Stormwater and Green Parks Project Marketing Plan. The internet is used daily nationwide to check news, updates, research and to network. Internet use is so wide that reaching the target audience successfully will require specific placement of information. That information will be placed on definite websites and two forms of social media will be used. The websites that will have continuous updates are the official website of Wentzville, Wentzville's Chamber of Commerce website and Patch.com.

  Social media is online media that allows for readers/viewers/listeners to participate in the content unlike traditional media that delivers a message but only allows for one way content contribution. Social media allows for the media audience to talk, participate in, share and network all online in common areas of interest. The variety of social media sites can be classified into two categories: social sharing like YouTube and social networking like Facebook and Twitter. Social media is very popular with the target audience of the marketing plan. The ability to share ideas, photos, likes and dislikes is what is making social media popular. This is a new ability that has never happened with media in the past; the chance to be apart of the media and engage others in the process.
    - **Wentzville's Chamber of Commerce website-** This website provides information to the members of the Chamber of Commerce. The information that is presented to the members is meant to help them increase their business, update them on city reports and provide networking outlets. Submitting information to the Chamber of Commerce will benefit the members of the organization. These members are apart of the target audience since they are business/industry owners.
    - **Patch.com-** this website is dedicated to what is happening in the community. The website is maintained by media professionals and is community specific. The most common information provided on this website is news, events, photos and videos. Patch welcomes discussions and perspectives on community issues and they are open personal postings of announcements, photos and reviews.
    - **Facebook-** Social networking at its core. It was created in 2004 and by 2012 it has over 900 million profiles. This social media site is able to connect old acquaintances, join interest groups or keep up to date on issues. Updating the city of Wentztville's Facebook page with Project updates and pictures will give the audience a connected feeling to the project. They will be able to provide input about the project. Wentzville currently has 1,017 likes on Facebook at this time.

- **Twitter-** This real-time information network allows for single persons, groups and organizations to connect to the latest news, ideas and opinions and provide their own ideas. Posting information for followers to read is referred to as Tweets. Tweets are 140 characters similar to a text message. Videos, photos and web links can all be added to Tweets to provide more information about the subject. This outlet is very useful for the marketing plan because it will reach out to the target audience and that audience can re-Tweet the information. Twitter allows for awareness leading to change to happen through information past through Twitter Wentzville has 377 followers at this time.

  Example Tweet: The City of Wentzville has broken ground on Heartland Park! #319Grant #StormwaterManagement

  Using hashtags to categorizing Tweets by keyword:
  - People use the hashtag symbol **#** before a relevant keyword or phrase (no spaces) in their Tweet to categorize those Tweets and help them show more easily in Twitter Search.
  - Clicking on a hashtagged word in any message shows you all other Tweets marked with that keyword..
  - Hashtags can occur anywhere in the Tweet – at the beginning, middle, or end.
  - Hashtagged words that become very popular are often Trending Topics.

  (Information received from: https://support.twitter.com/articles/49309-what-are-hashtags-symbols#)

Events and Contests

Taking part or hosting events and contests makes audiences aware of the goals and intended outcomes to the target audience. Showing the audience that they are important by attending city events or creating contests will make the audience more eager to learn about the plans goals and implementing them into their own lives. At any event, always be prepared with hands on examples related to the Dry Branch Watershed: Clear Stormwater and Green Parks Project; provide promotional items that will be a visual reminder to evoke change within them (i.e. pencils, cups, temporary tattoos, kids coloring workbooks); be ready to answer any questions that may arise about the project and how the audience can take part.

Throughout Wentzville there numerous events that the City can make appearances at to make their goals known.

- **Stream Naming Contest, summer 2012**
  The stream naming contest was a component of the grant awarded to the City of Wentzville. This contest was aimed at our target audience. The goal of the contest was to educate the target audience on stream water quality. The

contest opened on June 16, 2012 and ended July 23, 2012. Local media as well as all Wentzville publications were contacted at the beginning of the contest in addition to local radio stations, official websites, Twitter, and Facebook.

There is a separate marketing plan for the stream naming contest.

- **Wabash Days**
  Wabash Days celebrate Wentzville's history and the railroad heritage. The event is held in downtown Wentzville on West Allen, Linn and Main Streets. There is live music, demonstrations and fun for families. The City of Wentzville will have a booth in this event to showcase the advances in project goals as well as showing residents the issues surrounding NPS pollution, water quality and how to make a change.

  The event will reach our largest group within the target audience, residents. Wabash Days are a great resource to use because the target audience will be in abundance.

- **GM Earth Day**
  This event is held in the spring every year at the General Motors assembly, in 2013 third annual, in Wentzville, Missouri. The event helps the workers and their families gain exposure to issues surrounding the earth and its current state. Providing information at this event will reach more of the target audience.

- **Home Owners Association Symposium**
  This symposium is held to inform home owners about the issues that surround them and provides solutions. The information provided at this event could expose the issues of NPS pollution in a larger scale because quite a few of the containments are a result of pets, urban runoff, fertilizers, and oil/grease from cars. Informing this group will help reach the target audience as well as meeting the goals established.

- **Make a Difference Day, 2012-2014**
  This is a national day of helping others, by being neighborly. The event is held on the fourth Saturday of October each year. The day helps beautify the community by picking up litter near the neighborhood or school.

  Volunteer activities may include trash pick up, storm drain marking or nature landscaping project. By utilizing this day we can reach out to our target audience by word of mouth. With Make a Difference Day word of mouth is the only real option to spread awareness, while developing a positive change with community members. Realistically, giving handouts to volunteers who are picking up trash is not useful. Informing the volunteers of the impact trash

makes on water quality in their community will, by word of mouth, reach our other more difficult community members that are a part of the target audience.

Subjects to touch on before and after activities:

- Nonpoint Source Pollution
- Watershed Water Quality
- The impacts made during Make a Difference Day that will help water quality in the future
- Take what you learn today and spread the awareness to fellow community members

Implementation

To successfully reach the goals set by the marketing plan there will be a two stage process. The first stage will complete goal one of the marketing plan; to increase Dry Branch Watershed residents, developers, and business owner's awareness of NPS pollutants and water quality issues. The process to complete goal one will be to expose the target audience to NPS pollution and water quality issues surrounding the watershed. Providing information to the target audience through hosting events/contests, updating information pertaining to the Dry Branch Watershed: Clear Stormwater and Green Parks Project projects, producing target audience related PSAs, and submitting information to city and local publications will effectively increase awarenesss, thus meeting goal one.

The implementation of the marketing plan began in summer 2012 by hosting a contest. The stream naming contest challenges people in the community to find suitable names for fifteen tributaries within the Dry Branch Watershed. The stream naming contest is a component of the Dry Branch Watershed: Clear Stormwater and Green Parks project. The contest is meant to help evoke change in the community by increasing awareness of water quality. All information pertaining to the stream naming contest can be found from its own marketing plan entitled WATERMARK WENTZVILLE MISSOURI. The overview of how to engage and provide information for the audience is a marketing mix. An in-house flyer was produced and displayed at every city building in Wentzville. Press releases were distributed regarding the contest and its purpose to all local and city publications, radio stations, city of Wentzville's website as well as social media (Facebook and Twitter). This mix of outreach engaged more than just the target audience. Informing more people about NPS pollution and water quality is not negative to the marketing plan because it is beneficial to people who wish to learn more. Once official names have been approved winners will be recognized.

During the remainder of the 2012 year, the City of Wentzville should be represented at events that they host or are invited to. There will also be an article pulished in the stream team *Channels* newsletter in September about how to officially name an unnamed tributary. The stream naming contest publications provided an adequate amount of information to local newspapers, radio stations, and city publications. The

social media aspect of the contest helped Facebook and Twitter followers stay up to date with deadlines and lead them to further information. It is part of a Section 319 Nonpoint Source Implementation Grant partially funded by US EPA Region 7 through the Missouri Department of Natural Resources under the Clean Water Act.

- **In first stage (2013) of the marketing plan the city of Wentzville will educate the target audience on NPS pollution and water quality. The best results will come by informing the target audience on how NPS pollution and water quality will affect them.**

- **The second stage (2014- April 2015) of the marketing plan will be to evoke change from the target audience. The target audience has seen how NPS pollution and water quality can affect them, now is the time to introduce the ideas of how to change the habits that are having a negative affects on their lives.**

Providing both educational information and how to change habits can be useful through attending events, writing and submitting press releases/articles, updating the website, and stay connected through social media. It is recommended that the city of Wentzville attend events they host and are invited to. Any events help connect with the target audience. At these events it will help people remember what was presented to them if you give them something to take with them. The booth should have the stormwater exhibit board, handouts, and if the location allows it demonstrations. **ALWAYS TAKE PICTURES.** For any milestone that is notable (see attached marketing matrix), be sure to take photos and write up a press release/article and submit it to newspapers, city publications, website, and write up a 140 character overview to be seen on Facebook and Twitter.

For both stages of the marketing plan submit PSAs. PSAs are an easy way to inform the target audience and ask them to help make a positive change in their community and themselves. There will be four PSAs for the two stages of the PSAs need to be release at the beginning of the year because people feel the need to make a change or learn something with a new year. PSAs are free for the city of Wentzville; submit them to local radio stations to receive the best results.

Evaluation

The evaluation process that will take place for the marketing plan is a survey and visual observation. The survey is already being given out to the public in year four of the Dry Branch Watershed: Clear Stormwater and Green Parks Project. The survey will gauge the public's awareness of nonpoint source pollution and water quality. Visual observation as a process of evaluation is a great way to see if the target audience evoked change within their lives. There is no significant percent change that we can observe because this is the first type of marketing plan for the city of Wentzville.

Dry Branch Watershed: Clear Stormwater and Green Parks Project Outreach Matrix

Goal: To increase Dry Branch Watershed residents, developers, and business owners awareness of NPS pollutants and water quality issues.

Objective: City and local media will be contacted periodically with information regarding the projects progress and events the project will be displayed.

Significant Event/Topic	DATE	Preferred Outreach	Recommendations/ Comments	Status
Stream Naming Contest	2012-2013	Local Newspapers Local Radio Social Media Email Distribution Official Wentzville website Chamber website *Note Worthy* *Vision*	Stream Naming Contest began June16 and ended July 23, 2012. Once nominations are submitted and approved from the city recognition needs to be a priority.	In progress **To Do:** • **Submit nominated Stream Names to USGS.** • **Recognize winners**
Stream Naming Article	August 2012	*Channels* (Missouri Stream Team Newsletter)	Article submitted August 8, 2012 to Missouri DNR for publication in the September-October 2012 issue of Channels.	In Progress
Dry Branch Watershed Planning Team Meetings	May 30, 2012 July 17, 2012 September 18, 2012	Local Newspapers Official Wentzville website	The press release needs to be as close to the date of the meeting as possible to make it relevant.	In Progress **To Do:** • **Write final press release regarding decisions made at the September 18, 2012 meeting.**
Stream Naming Contest Update	July 13, 2012	Local Newspapers Local Radio Social Media		Complete
Public Viewing of LEC retrofit	July 13, 2012	*Note Worthy* Official Wentzville website		Complete
Overview of the 319 Grant	July 24,2012	*Vision*	August-September Issue	Complete
Wabash Days	August 2012 2013	Wentzville Website Social Media	Having a booth and talking to the audience has great benefit and does not require a press release. Be prepared!	
Heartland Park construction bid awarded Stormwater facility	September 2012	Local Newspapers Wentzville's Website *Note Worthy* *Vision*	Press release including picture of construction site. Press release needs to include information regarding NPS pollution,	

retrofit bid awarded.		Social Media	and how the park/retrofit is beneficial to the community.	
Make a Difference Day	October 2012 2013	Wentzville Website Social Media *Note Worthy* *Vision*	A short summary of the benefit this day makes and take pictures.	
Heartland Park Construction begins	December 2012	Local Newspapers *Vision* *Note Worthy* Wentzville's Website	Highlight the benefits of the elements going in to the park that benefit the target audience.	
Home Owners Association Workshop	December 2012 2013	Wentzville Website Social Media	Short summary of the workshop with pictures to post.	
GM Earth Day	Spring 2013	Local Newspapers *Vision* *Note Worthy* Wentzville Website Social Media Chamber of Commerce website	Press Release informing the audience on the benefits of GM Earth Day and the effects of NPS pollutants. Pictures.	
Heartland Park update	Summer 2013	Local Newspapers *Note Worthy* *Vision* Wentzville Website Social Media	Updates since December ground breaking. Include benefits for the target audience as well as water quality.	
Heartland Park completion	December 2013	Local Newspapers *Note Worthy* *Vision* *Fun Times* Wentzville Website Social Media	Full Article on the process, construction, elements and benefits to the community and NPS pollution and water quality. Lots of pictures.	
Objective: Informational materials will be produced and used as necessary to reach the target audience.				
Stormwater PSA	January 2013	Radio Stations	A prewritten PSA about stormwater and where it goes.	
NPS PSA	June 2013	Radio Stations	Definition of NPS pollution.	
Preventing NPS pollution PSA	January 2014	Radio Stations	Reducing NPS pollution at home	
Stormwater efficient Home PSA	June 2014	Radio Stations	Using stormwater at home.	
Goal: Through effective education help evoke change in residential, developers, and business owner's habits to positively change water quality and limit NPS pollutants within the watershed.				
Objective: Provide information/resources to evoke change residentially and within the community.				
GM Earth Day	Spring 2014	Local Newspapers *Vision* *Note Worthy* Wentzville Website	Press Release informing the audience on the benefits of GM Earth Day and the effects of NPS	

		Social Media Chamber of Commerce website	pollutants and what the audience can do to limit pollution for better water quality. Pictures	
Stormwater Facility retrofit field day	May 2014	Local Newspapers *Vision* *Note Worthy* Wentzville Website Social Media		
Wabash Days	August 2014	Wentzville Website Social Media	Having a booth and talking to the audience has great benefit and does not require a press release. Inform audience on NPS pollution prevention at home.	
Make a Difference Day	October 2014	Wentzville Website Social Media	A short summary of the benefit this day makes and pictures.	
Complete Park Construction	December 2014	Local Newspapers *Note Worthy* *Vision* *Fun Times* Wentzville Website Social Media	Full article on the process, construction, elements and benefits to the community and NPS pollution and water quality. Lots of pictures.	
Public Tour of Park	March 2014	Local Newspapers *Note Worthy* *Vision* Wentzville Website Social Media		

APPENDIX G: WATER QUALITY MONITORING DATA

- Water quality monitoring data will be included once it has been completed.
- Water Quality Monitoring QAPP Sample Location Map.

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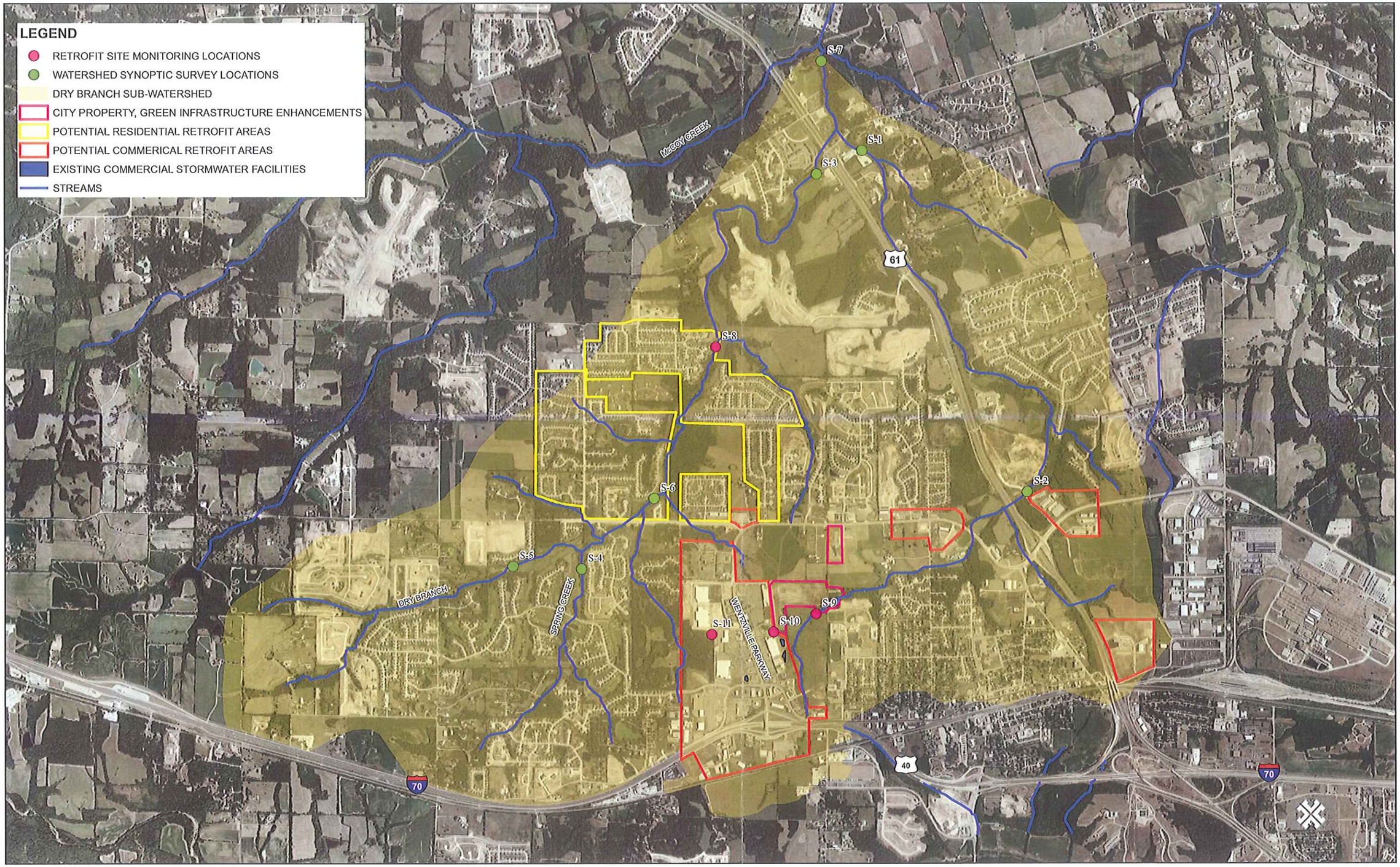

GENERAL NOTES/LEGEND

DIMENSIONS AND LOCATIONS ARE APPROXIMATE; ACTUAL MAY VARY.
DRAWING SHALL NOT BE USED OUTSIDE THE CONTEXT OF THE REPORT FOR WHICH IT WAS GENERATED.

PROJECT NAME
WATER QUALITY MONITORING SERVICES
WENTZVILLE, MISSOURI

WATER QUALITY MONITORING LOCATIONS

N
W E
S

SCALE	1" = 2,500'
JOB NUMBER	2011-0785.21
DATE	05/2012
DRAWN BY	LAP
CHECKED BY	TLC
FIGURE	1

APPENDIX H: 10 CSR 20-7 TABLE A AND TABLE B

- Table A – Criteria for Designated Uses.
- Table B – Acute Toxicity Criteria.

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Table A—Criteria for Designated Uses

WBC = Whole Body Contact Recreation
SCR = Secondary Contact Recreation
AQL = Protection of Aquatic Life
DWS = Drinking Water Supply
LWW = Livestock and Wildlife Watering
GRW = Groundwater

Pollutant (µg/L)	AQL
Chlorine (total residual)	
cold-water	2
warm-water chronic—	10
acute—	19
Cyanide (amenable to chlorination)	
chronic—	5
acute—	22
Hydrogen sulfide (un-ionized)	2

Pollutant (mg/L)	AQL	DWS	LWW	GRW
Chloride chronic—	(+)	250		
acute—	(+)			
Sulfate	(+)	250		
Fluoride		4	4	4
Nitrate-N		10		10
Dissolved oxygen (minimum)*				
warm-water and cool-water fisheries	5			
cold-water fisheries	6			
Oil and grease	10			

+ See Non-Metals (Hardness Dependent).
* Site-Specific Criteria have been promulgated for waters listed in Table K.

Pollutant (/100 mL)	WBC-A	WBC-B	SCR
E. coli Bacteria**	126	206	1134

**Geometric mean during the recreational season in waters designated for recreation or at any time in losing streams. The recreational season is from April 1 to October 31.

Pollutant	AQL	
Temperature (maximum)	°F	°C
warm-water	90	32 2/9
cool-water	84	28 8/9
cold-water	68	20
Temperature (maximum change)		
warm-water	5	2 7/9
cool-water	5	2 7/9
cold-water	2	1 6/9

Pollutant (percent saturation)	AQL
Total Dissolved Gases	110%

AQL = Protection of Aquatic Life
HHF = Human Health Protection-Fish Consumption
DWS = Drinking Water Supply
IRR = Irrigation
LWW = Livestock Wildlife Watering
GRW = Groundwater

Pollutant (µg/L)	AQL	HHF	DWS	IRR	LWW	GRW
Metals (refer to text in 10 CSR 20-7.031(4)(B)2.) (Not Hardness Dependant)						
Aluminum (acute)	750					
Antimony		4,300	6			6
Arsenic	20		50	100		50
Barium			2,000			2,000
Beryllium	5		4	100		4
Boron				2,000		2,000
Cadmium	*		5			5
Chromium III	*		100	100		100
Chromium VI						
chronic	10					
acute	15					
Cobalt					1,000	1,000
Copper	*		1,300		500	1,300
Iron	1,000					300
Lead	*		15			15
Manganese						50
Mercury			2			2
chronic	0.5					
acute	2.4					
Nickel	*		100			100
Selenium	5		50			50
Silver	*		50			50
Thallium		6.3	2			2
Zinc	*		5,000			5,000

*See Metals (Hardness Dependent)

AQL = Protection of Aquatic Life

Pollutant (μg/L)	AQL	
Metals (Hardness Dependent)		
Cadmium (μg/L)	Acute:	e(1.0166*ln(Hardness) − 3.062490) * (1.136672 − (ln(Hardness)*0.041838))
	Chronic:	e(0.7409*ln(Hardness) − 4.719948) * (1.101672 − (ln(Hardness)*0.041838))
Chromium III (μg/L)	Acute:	e(0.8190*ln(Hardness) + 3.725666) * 0.316
	Chronic:	e(0.8190*ln(Hardness) + 0.684960) * 0.860
Copper (μg/L)	Acute:	e(0.9422*ln(Hardness) − 1.700300) * 0.960
	Chronic:	e(0.8545*ln(Hardness) − 1.702) * 0.960
Lead (μg/L)	Acute:	e(1.273*ln(Hardness) − 1.460448) * (1.46203 − (ln(Hardness)*0.145712))
	Chronic:	e(1.273*ln(Hardness) − 4.704797) * (1.46203 − (ln(Hardness)*0.145712))
Nickel (μg/L)	Acute:	e(0.8460*ln(Hardness) + 2.255647) * 0.998
	Chronic:	e(0.8460*ln(Hardness) + 0.058978) * 0.997
Silver (μg/L)	Acute:	e(1.72*ln(Hardness) − 6.588144) * 0.850
Zinc (μg/L)	Acute:	e(0.8473*ln(Hardness) + 0.884) * 0.98
	Chronic:	e(0.8473*ln(Hardness) + 0.884) * 0.98

	Hardness								
	50–74	**75–99**	**100–124**	**125–149**	**150–174**	**175–199**	**200–224**	**225–249**	**250+**
Cadmium									
Acute:	2.4	3.6	4.8	5.9	7.1	8.2	9.4	10.5	11.6
Chronic:	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5
Chromium III									
Acute:	323	450	570	684	794	901	1,005	1,107	1,207
Chronic:	42	59	74	89	103	117	131	144	157
Copper									
Acute:	7	10	13	17	20	23	26	29	32
Chronic:	5	7	9	11	13	14	16	18	20
Lead									
Acute:	30	47	65	82	100	118	136	154	172
Chronic:	1	2	3	3	4	5	5	6	7
Nickel									
Acute:	261	367	469	566	660	752	842	930	1,017
Chronic:	29	41	52	63	73	84	94	103	113
Silver									
Acute:	1.0	2.0	3.2	4.7	6.5	8.4	10.6	13.0	15.6
Zinc									
Acute:	65	92	117	142	165	188	211	233	255
Chronic:	65	92	117	142	165	188	211	233	255

AQL = Protection of Aquatic Life

Pollutant (mg/L)	AQL	
Non-Metals (Hardness Dependent)		
Chloride (mg/L)	Acute:	$287.8 * (\text{Hardness})^{0.205797} * (\text{Sulfate})^{-0.07452}$
	Chronic:	$177.87 * (\text{Hardness})^{0.205797} * (\text{Sulfate})^{-0.07452}$

Sulfate (mg/L)	Chloride, Cl- (mg/L)		
Hardness, H (mg/L)	Cl- < 5	5 ≤ Cl- < 25	25 ≤ Cl- ≤ 500
H < 100	500	500	500
100 ≤ H ≤ 500	500	S1	S2
H > 500	500	2,000	2,000

S1 = [-57.478 + 5.79 (hardness) + 54.163 (chloride)] * 0.65
S2 = [1276.7 + 5.508 (hardness) − 1.457 (chloride)] * 0.65

AQL = Protection of Aquatic Life
HHF = Human Health Protection-Fish Consumption
DWS = Drinking Water Supply
GRW = Groundwater

Pollutant (µg/L)	AQL	HHF	DWS	GRW
Organics				
Acrolein		780	320	320
Bis-2-chloroisopropyl ether		4,360	1,400	1,400
2, chlorophenol		400	.1	.1
2,4-dichlorophenol	7	790	93	93
2,4-dinitrophenol		14,000	70	70
2,4-dimethylphenol		2,300	540	540
2,4,5-trichlorophenol		9,800	2,600	2,600
2,4,6-trichlorophenol		6.5	2	2
2-methyl-4,6-dinitrophenol		765	13	13
Ethylbenzene	320		700	700
Hexachlorocyclopentadiene	.5		50	50
Isophorone		2,600	36	36
Nitrobenzene		1,900	17	17
Phenol			100	300
chronic—	2,560			
acute—	10,200			
Dichloropropene		1,700	87	87
Para(1,4)-dichlorobenzene		2,600	75	75
Other Dichlorobenzenes		2,600	600	600
1,2,4-trichlorobenzene		940	70	70
1,2,4,5-tetrachlorobenzene		2.9	2.3	2.3
pentachlorobenzene		4.1	3.5	3.5
1,1,1-trichloroethane			200	200
1,1,2-trichloroethane		42	5	5
2,4-dinitrotoluene		9	.11	.04
1,2-diphenylhydrazine		.54	.04	.04
di (2-ethylhexyl) adipate			400	400
n-nitrosodiphenylamine		16	5	5
n-nitrosopyrrolidene		91.9		
2-chloronaphthalene	4,300			
n-nitrosodi-n-propylamine		1.4		

Pollutant (µg/L)	AQL	DWS	GRW
Pesticides			
Demeton	.1		
Endosulfan			
chronic—	.056		
acute—	0.11		
Guthion	.01		
Malathion	.1		
Parathion	.04		
2,4-D		70	70
2,4,5-TP		50	50
Chlorpyrifos	.04		
Alachlor		2	2
Atrazine		3	3
Carbofuran		40	40
Dalapon		200	200
Dibromochloropropane		.2	.2
Dinoseb		7	7
Diquat		20	20
Endothall		100	100
Ethylene dibromide		.05	.05
Oxamyl (vydate)		200	200
Picloram		500	500
Simazine		4	4
Glyphosate		700	700

AQL = Protection of Aquatic Life
HHF = Human Health Protection-Fish Consumption
DWS = Drinking Water Supply
GRW = Groundwater

Pollutant (μg/L)	AQL	HHF	DWS	GRW
Bioaccumulative, Anthropogenic Toxics (+)				
PCBs		.000045		.000045
4-4' dichlorodiphenyldichloroethane (DDT)		0.00059	0.00059	0.00059
4-4' dichlorodiphenyldichloroethylene (DDE)		0.00059	0.00059	0.00059
4-4' dichlorodiphenyldichloroethane (DDD)		0.00084	0.00083	0.00083
Endrin		.0023	2	2
Endrin aldehyde		.0023	.75	.75
Aldrin		.000079	.00013	.00013
Dieldrin		.000076	.00014	.00014
Heptachlor	.0038	.0002	0.4	0.4
Heptachlor epoxide		.00011	0.2	0.2
Methoxychlor	.03		40	40
Mirex	.001			
Toxaphene		.000073	3	3
Lindane (gamma-BHC)		.062	.2	.2
Alpha,beta,delta-BHC		.0074	.0022	.0022
Chlordane		.00048	2	2
Benzidine		.00053	.00012	.00012
2,3,7,8-tetrachlorodibenzo-p-dioxin (ng/L)* (TCDD or dioxin)		.000014	0.000013	0.000013
Pentachlorophenol**	3.2–pH 6.5 5.3–pH 7.0 8.7–pH 7.5 14.0–pH 8.0 23.0–pH 8.5	8	1	1

+Many of these values are below current detection limits; analyses will be determined by the 17th edition of *Standard Methods* or the most current methods approved by the Environmental Protection Agency.

*Units for dioxin are nanograms/liter (ng/L); 1 μg/L = 1,000 ng/L.

**Toxic impurities may be present in technical-grade pentachlorophenol; monitoring and discharge control will assure that impurities are below toxic concentrations.

HHF = Human Health Protection-Fish Consumption
DWS = Drinking Water Supply
GRW = Groundwater

Pollutant (μg/L)	HHF	DWS	GRW
Anthropogenic Carcinogens(+)			
Acrylonitrile	.65	.058	.058
Hexachlorobenzene	.00074	1	1
Bis (2-chloroethyl) ether	1.4	.03	.03
Bis (chloromethyl) ether	0.00078	.00013	.00013
Hexachloroethane	8.7	1.9	1.9
3,3'-dichlorobenzidine	0.08	.04	.04
Hexachlorobutadiene	50	.45	.45
n-nitrosodimethylamine	8	.0007	.0007

(+) Some of these values are below current detection limits; analyses will be determined by the 17th edition of *Standard Methods* or the most current methods approved by the Environmental Protection Agency.

Pollutant (μg/L)	HHF	DWS	GRW
Volatile Organics			
Chlorobenzene	21,000	100	100
Carbon Tetrachloride	5	5	5
Trihalomethanes		80	80
Bromoform	360	4.3	4.3
Chlorodibromomethane	34	0.41	0.41
Dichlorobromomethane	46	0.56	0.56
Chloroform	470	5.7	5.7
Methyl Bromide	4,000	48	48
Methyl Chloride	470	5	5
Methylene Chloride	1,600	4.7	4.7
Dichlorodifluoromethane	570,000		
Trichlorofluoromethane	860,000		
1,2-dichloroethane	99	5	5
1,1,2,2-tetrachloroethane	11	.17	.17
1,1-dichloroethylene	3.2	7	7
1,2-trans-dichloroethylene	140,000	100	100
1,2-cis-dichloroethylene		70	70
Trichloroethylene	80	5	5
Tetrachloroethylene	8.85	0.8	0.8
Benzene	71	5	5
Toluene	200,000	1,000	1,000
Xylenes (total)		10,000	10,000
Vinyl chloride	525	2	2
Styrene		100	100
1,2-dichloropropane	39	0.52	0.52

Pollutant (Fibers/L)	DWS	GRW
Asbestos	7,000,000	

HHF = Human Health Protection-Fish Consumption
DWS = Drinking Water Supply
GRW = Groundwater

Pollutant (µg/L)	HHF	DWS	GRW
Polynuclear Aromatic Hydrocarbons			
Anthracene	110,000	9,600	9,600
Fluoranthene	370	300	300
Fluorene	14,000	1,300	1,300
Pyrene	11,000	960	960
Benzo(a)pyrene	.049	0.2	0.2
other polynuclear aromatic hydrocarbons*	.049	.0044	.0044
Acenaphthene	2,700	1,200	1,200

*This concentration is allowed for each of the following PAHs: benzo(a)anthracene, 3,4-benzofluoranthene, chrysene, dibenzo-(a,h)anthracene, indeno(1,2,3-cd)pyrene and benezo(k)fluoranthene. Higher values may be allowed if natural background concentrations exceed these values.

Pollutant (µg/L)	HHF	DWS	GRW
Phthalate Esters			
Bis(2-ethylhexyl) phthalate	5.9	6	6
Butylbenzyl phthalate	5,200	3,000	3,000
Diethyl phthalate	120,000	23,000	23,000
Dimethyl phthalate	2,900,000	313,000	313,000
Di-n-butyl phthalate	12,000	2,700	2,700

Health Advisory Levels

Pollutant (µg/L)	DWS	GRW
Ametryn	60	60
Baygon	3	3
Bentazon	20	20
Bis-2-chloroisopropyl ether	300	300
Bromacil	90	90
Bromochloromethane	90	90
Bromomethane	10	10
Butylate	350	350
Carbaryl	700	700
Carboxin	700	700
Chloramben	100	100
o-chlorotoluene	100	100
p-chlorotoluene	100	100
Chlorpyrifos	20	20
DCPA (dacthal)	4,000	4,000
Diazinon	0.6	0.6
Dicamba	200	200
Diisopropyl methylphosphonate	600	600
Dimethyl methylphosphonate	100	100
1,3-dinitrobenzene	1	1
Diphenamid	200	200
Diphenylamine	200	200
Disulfoton	0.3	0.3
1,4-dithiane	80	80
Diuron	10	10

Table B1. Acute Criteria for Total Ammonia Nitrogen (mg N/L)

pH	Cold-Water Fisheries (1)	Cool & Warm-Water Fisheries (2)
6.5	32.6	48.8
6.6	31.3	46.8
6.7	29.8	44.6
6.8	28.1	42.0
6.9	26.2	39.1
7.0	24.1	36.1
7.1	22.0	32.8
7.2	19.7	29.5
7.3	17.5	26.2
7.4	15.4	23.0
7.5	13.3	19.9
7.6	11.4	17.0
7.7	9.6	14.4
7.8	8.1	12.1
7.9	6.7	10.1
8.0	5.6	8.4
8.1	4.6	6.9
8.2	3.8	5.7
8.3	3.1	4.7
8.4	2.5	3.8
8.5	2.1	3.2
8.6	1.7	2.6
8.7	1.4	2.2
8.8	1.2	1.8
8.9	1.0	1.5
9.0	0.8	1.3

Table B2. Chronic Criteria for Total Ammonia Nitrogen (mg N/L): Early Life Stage absent[(3)(4)]

	Temperature (°C)																
pH	0-7	8	9	10	11	12	13	14	15	16	18	20	22	24	26	28	30
6.5	10.8	10.1	9.5	8.9	8.3	7.8	7.3	6.8	6.4	6.0	5.3	4.6	4.1	3.6	3.1	2.8	2.4
6.6	10.7	9.9	9.3	8.7	8.2	7.7	7.2	6.7	6.3	5.9	5.2	4.6	4.0	3.5	3.1	2.7	2.4
6.7	10.5	9.8	9.2	8.6	8.0	7.5	7.1	6.6	6.2	5.8	5.1	4.5	3.9	3.5	3.0	2.7	2.3
6.8	10.2	9.5	8.9	8.4	7.9	7.4	6.9	6.5	6.1	5.7	5.0	4.4	3.8	3.4	3.0	2.6	2.3
6.9	9.9	9.3	8.7	8.1	7.6	7.2	6.7	6.3	5.9	5.5	4.8	4.3	3.7	3.3	2.9	2.5	2.2
7.0	9.6	9.0	8.4	7.9	7.4	6.9	6.5	6.1	5.7	5.3	4.7	4.1	3.6	3.2	2.8	2.4	2.1
7.1	9.2	8.6	8.0	7.5	7.1	6.6	6.2	5.8	5.4	5.1	4.5	3.9	3.5	3.0	2.7	2.3	2.0
7.2	8.7	8.2	7.6	7.2	6.7	6.3	5.9	5.5	5.2	4.9	4.3	3.7	3.3	2.9	2.5	2.2	1.9
7.3	8.2	7.7	7.2	6.7	6.3	5.9	5.6	5.2	4.9	4.6	4.0	3.5	3.1	2.7	2.4	2.1	1.8
7.4	7.6	7.2	6.7	6.3	5.9	5.5	5.2	4.8	4.5	4.3	3.7	3.3	2.9	2.5	2.2	1.9	1.7
7.5	7.0	6.6	6.2	5.8	5.4	5.1	4.8	4.5	4.2	3.9	3.4	3.0	2.6	2.3	2.0	1.8	1.6
7.6	6.4	6.0	5.6	5.3	5.0	4.6	4.3	4.1	3.8	3.6	3.1	2.7	2.4	2.1	1.9	1.6	1.4
7.7	5.8	5.4	5.1	4.7	4.0	4.2	3.9	3.7	3.4	3.2	2.8	2.5	2.2	1.9	1.7	1.5	1.3
7.8	5.1	4.8	4.5	4.2	4.4	3.7	3.5	3.2	3.0	2.8	2.5	2.2	1.9	1.7	1.5	1.3	1.1
7.9	4.5	4.2	3.9	3.7	3.5	3.2	3.1	2.8	2.7	2.5	2.2	1.9	1.7	1.5	1.3	1.1	1.0
8.0	3.9	3.7	3.4	3.2	3.0	2.8	2.6	2.5	2.3	2.2	1.9	1.7	1.5	1.3	1.1	1.0	0.8
8.1	3.4	3.1	2.9	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.6	1.4	1.2	1.1	1.0	0.8	0.7
8.2	2.9	2.7	2.5	2.4	2.2	2.1	1.9	1.8	1.7	1.6	1.4	1.2	1.1	0.9	0.8	0.7	0.6
8.3	2.4	2.3	2.1	2.0	1.9	1.7	1.6	1.5	1.4	1.3	1.2	1.0	0.9	0.8	0.7	0.6	0.5
8.4	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.7	0.7	0.6	0.5	0.4
8.5	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4
8.6	1.4	1.4	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3
8.7	1.2	1.1	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.2
8.8	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2
8.9	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2
9.0	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.1

Table B3. Chronic Criteria for Total Ammonia Nitrogen (mg N/L): Early Life Stages present (5)

	Temperature (°C)									
pH	0	14	16	18	20	22	24	26	28	30
6.5	6.6	6.6	6.0	5.3	4.6	4.1	3.6	3.1	2.8	2.4
6.6	6.5	6.5	5.9	5.2	4.6	4.0	3.5	3.1	2.7	2.4
6.7	6.4	6.4	5.8	5.1	4.5	3.9	3.5	3.0	2.7	2.3
6.8	6.2	6.2	5.7	5.0	4.4	3.8	3.4	3.0	2.6	2.3
6.9	6.1	6.1	5.5	4.8	4.3	3.7	3.3	2.9	2.5	2.2
7.0	5.9	5.9	5.3	4.7	4.1	3.6	3.2	2.8	2.4	2.1
7.1	5.6	5.6	5.1	4.5	3.9	3.5	3.0	2.7	2.3	2.0
7.2	5.3	5.3	4.9	4.3	3.7	3.3	2.9	2.5	2.2	1.9
7.3	5.0	5.0	4.6	4.0	3.5	3.1	2.7	2.4	2.1	1.8
7.4	4.7	4.7	4.3	3.7	3.3	2.9	2.5	2.2	1.9	1.7
7.5	4.3	4.3	3.9	3.4	3.0	2.6	2.3	2.0	1.8	1.6
7.6	3.9	3.9	3.6	3.1	2.7	2.4	2.1	1.9	1.6	1.4
7.7	3.5	3.5	3.2	2.8	2.5	2.2	1.9	1.7	1.5	1.3
7.8	3.1	3.1	2.8	2.5	2.2	1.9	1.7	1.5	1.3	1.1
7.9	2.8	2.8	2.5	2.2	1.9	1.7	1.5	1.3	1.1	1.0
8.0	2.4	2.4	2.2	1.9	1.7	1.5	1.3	1.1	1.0	0.8
8.1	2.1	2.1	1.9	1.6	1.4	1.2	1.1	1.0	0.8	0.7
8.2	1.7	1.7	1.6	1.4	1.2	1.1	0.9	0.8	0.7	0.6
8.3	1.5	1.5	1.3	1.2	1.0	0.9	0.8	0.7	0.6	0.5
8.4	1.2	1.2	1.1	1.0	0.9	0.7	0.7	0.6	0.5	0.4
8.5	1.0	1.0	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4
8.6	0.9	0.9	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3
8.7	0.7	0.7	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.2
8.8	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2
8.9	0.5	0.5	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2
9.0	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.1

(1) *Salmonids present:* $CMC = [0.275 / (1+10^{7.204-pH})] + [39.0 / (1+10^{pH-7.204})]$

(2) *Salmonids absent:* $CMC = [0.411 / (1+10^{7.204-pH})] + [58.4 / (1+10^{pH-7.204})]$

(3) Without sufficient and reliable data, it is assumed that Early Life Stages are present and must be protected at all times of the year.

(4) Early Life Stages absent

$$CCC = [0.0577 / (1+10^{7.688-pH})]+[2.487 / (1+10^{pH-7.688})] * 1.45 * 10^{0.028 * (25-MAX(T, 7))}$$

(5) Early Life Stages present

$$CCC = [0.0577 / (1+10^{7.688-pH})]+[2.487 / (1+10^{pH-7.688})] * MIN(2.85, 1.45 * 10^{0.028 * (25-T)})$$

DWS = Drinking Water Supply
GRW = Groundwater

Health Advisory Levels (continued)

Pollutant (µg/L)	DWS	GRW
Fenamiphos	2	2
Fluometron	90	90
Fluorotrichloromethane	2,000	2,000
Fonofos	10	10
Hexazinone	200	200
Malathion	200	200
Maleic hydrazide	4,000	4,000
MCPA	10	10
Methyl parathion	2	2
Metolachlor	70	70
Metribuzin	100	100
Naphthalene	20	20
Nitroguanidine	700	700
p-nitrophenol	60	60
Paraquat	30	30
Pronamide	50	50
Propachlor	90	90
Propazine	10	10
Propham	100	100
2,4,5-T	70	70
Tebuthiuron	500	500
Terbacil	90	90
Terbufos	0.9	0.9
1,1,1,2-Tetrachloroethane	70	70
1,2,3-trichloropropane	40	40
Trifluralin	5	5
Trinitroglycerol	5	5
Trinitrotoluene	2	2