CITY OF MOORE MS4 AND LAKE THUNDERBIRD TMDL COMPLIANCE PLAN

November 2015 - Final

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ACRONYMS / GLOSSARY

ACOG - Association of Central Oklahoma Governments

BMP – Best Management Practice(s)

CP - Lake Thunderbird Compliance Plan, document that sets the way the City of Moore will meet the regulatory requirements.

DEQ – Oklahoma Department of Environmental Quality

LID- Low Impact Development , comprehensive strategy for maintaining predevelopment runoff characteristics by integrating site design, natural hydrology, and smaller controls to capture and treat runoff at the source.

EPA – Environmental Protection Agency

Impervious Surface-surfaces that prevent stormwater from infiltrating to below the ground, includes rooftops, pavement, and gravel.

MS4 – Municipal Separate Storm Sewer System

OPDES – Oklahoma Pollutant Discharge Elimination System

Nutrients – Total phosphorus and total nitrogen

TMDL – Total Maximum Daily Load, the maximum amount of a pollutant a water body can receive and still meet water quality standards.

TN – Total Nitrogen

TP – Total Phosphorus

TSS – Total Suspended Solids

CBOD - Carbonaceous Oxygen Demand

Watershed – an area of land that drains down slope to the lowest point, discharging to a river, river system or other body of water.

WL - Load Allocation

WLA – Waste Load Allocations

EXECUTIVE SUMMARY

The City of Moore (City) Municipal Separate Storm Sewer System (MS4) and Lake Thunderbird Total Maximum Daily Load (TMDL) Compliance Plan (CP) is required by Section 303(d) of the federal Clean Water Act (CWA) and U.S. Environmental Protection Agency (EPA) Water Quality Planning and Management Regulations (40 Code of Federal Regulations [CFR] Part 130); which requires development of "total maximum daily loads" (TMDLs) for waterbodies not meeting designated uses where technology-based controls are in place. TMDLs establish the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions to implement water quality-based controls to reduce pollution from point and nonpoint sources and restore and maintain water quality (EPA, 1991a).

Lake Thunderbird is on Oklahoma's 2012 303(d) list for impaired beneficial uses of public/private water supply and warm water aquatic community life. Causes of impairment have been identified in the Final Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs, approved by the EPA on November 13, 2013, as low oxygen levels, high levels of chlorophyll-*a*, and high turbidity (DEQ, 2010a). Lake Thunderbird is designated by the Oklahoma Water Quality Standards (OWRB 2011) as a Sensitive Water Supply (SWS) since the Lake serves as the primary public water supply source for the cities of Norman, Midwest City and Del City. There are three municipalities within the Lake Thunderbird watershed: the City of Moore, the City of Norman and Oklahoma City.

The CP is a plan for achieving the 35% waste load (WL) reduction of total suspended solids (TSS), total nitrogen (TN), total phosphorous (TP), and carbonaceous biological oxygen demand (CBOD) established in the TMDL. The "waste load" (WL) reduction activities are also included as minimum control measures in the City of Moore Oklahoma Pollutant Discharge Elimination System (OPDES) Phase II Small MS4 permit required Storm Water Management Plan.

The CP presents the strategies to meet the WL reductions and TMDL goals as specified in the TMDL and current MS4 permit. Specifically, the CP will provide the basis for the City to:

1. Provide Best Management Practices (BMPs) to achieve an equivalent of 35% WL reductions of its contributing watershed which stormwater runoff is managed to the maximum extent practicable (MEP).
2. Meet TMDL Waste load Allocations (WLAs) approved by the Oklahoma Department of Environmental Quality (DEQ) and EPA.
3. Educate and involve residents, businesses, and stakeholder groups in achieving measurable water quality improvements.
4. Establish a reporting framework that will be used for annual reporting as required in the City's OPDES MS4 Permit.
5. Identify necessary maintenance, adaptive management, staffing, and financial strategies to implement the CP.

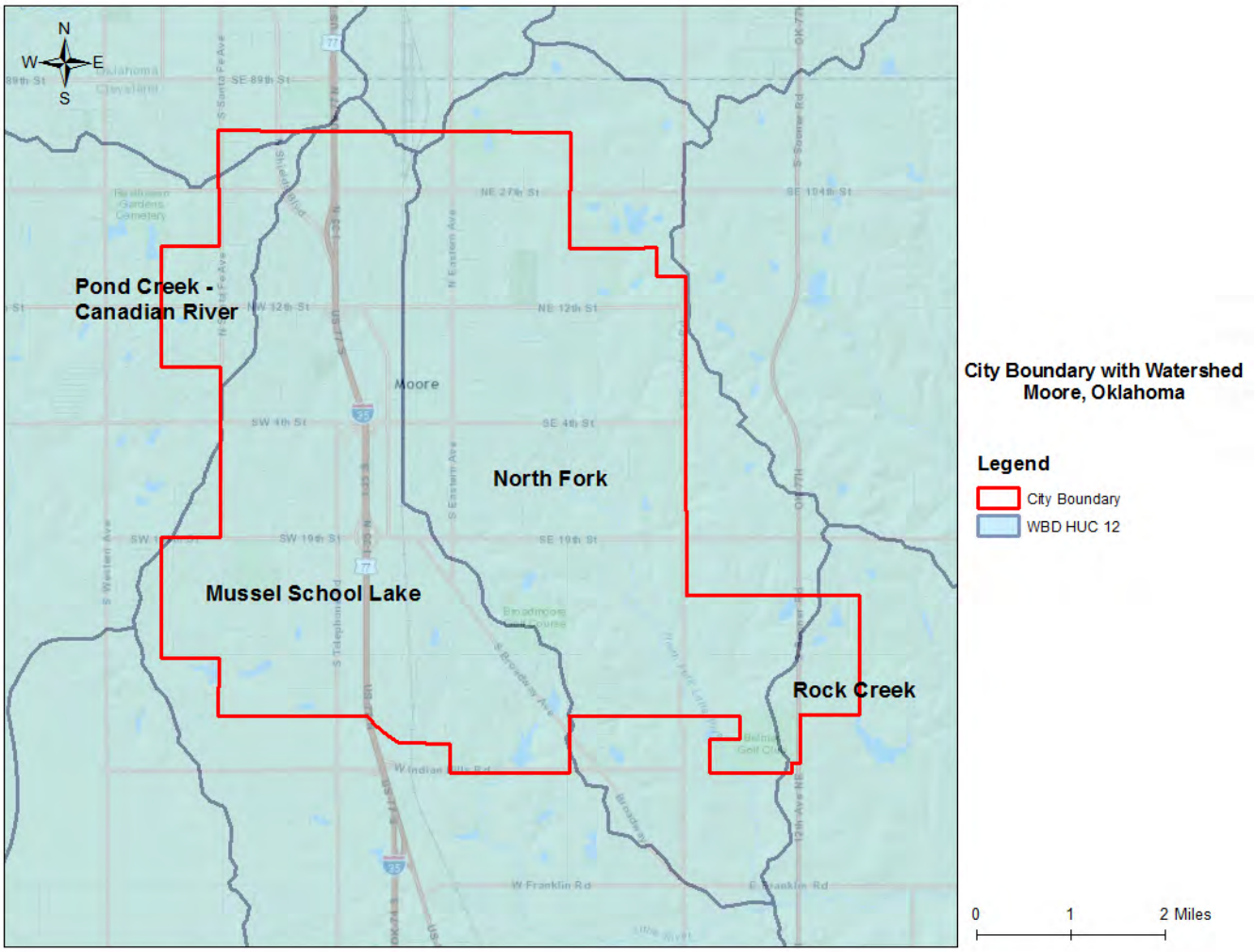
City of Moore: Existing Conditions and Challenges

The City's MS4 permit coverage area includes the land within the legal City boundary, see Figure 1 below, discharging to and associated with runoff to Little River and its tributaries. For the purposes of the WL reduction and TMDL compliance conditions of the MS4 permit, the CP will concentrate on the area within the City limits, which includes the following watersheds, as defined by the Department of Natural Resources:

1. Little River
2. North Fork of the Little River

Although neither of the above watersheds are listed as impaired, they contribute flow to Lake Thunderbird and are assigned a TMDL associated with nutrients and sediment. The City is part of the Lake Thunderbird watershed, and therefore subject to the TMDL for nutrients and sediments. The Lake Thunderbird TMDL available guidance documents were focused on the pollutant loadings based on construction, industrial, and MS4 permittee contributions and their correlation of BMPs to quantified reductions of nutrients and sediment. Illicit discharge detection and elimination (IDDE) programs will be used to reduce the loadings of the other potential contributors.

<u>Figure 1:</u> Legal City Boundary



Meeting the TMDL Goals

To meet the 35% reduction goal, the City will utilize a diverse and comprehensive approach for meeting the TMDL requirements as needed. This includes:

- Implementing stormwater management <u>projects,</u> including traditional Best Management Practice(s) (BMP), Low Impact Development Design (LID) practices where applicable, and Educational BMP;
- Employing a variety of <u>programs</u> to improve water quality, including mechanical street sweeping, construction site inspections, and IDDE; and
- Fostering <u>partnerships</u> to encourage private development of stormwater management practices.

Finally, the City believes that by implementing stormwater management projects, employing a variety of programs, and fostering partnerships, we will be on track to meet the TMDL goals. Implementing these practices will provide a reduction of 35% of our current WL to meet the TMDL requirement of 205.1 Kg/day of TN, 44.5 Kg/day of TP, 781.3 Kg/day of CBOD, and 16,236.0 Kg/day of TSS by the end of the third MS4 permit period. Education and enforcement programs focused on illicit discharges, in

concert with water and sanitary sewer infrastructure improvements, will also result a reduction of nutrients. A monitoring program focused on illicit discharges will address the TMDL for TSS and nutrients from construction and industrial permittees.

Public Outreach

In order for the CP to be successful, it will need an informed public and engaged partners to review and provide advice on the Plan as well as identify needs and issues that will need to be addressed. The City recognizes and is committed to the role that public outreach and stewardship will play if improved water quality conditions are going to be achieved. This will require engaging diverse set of stakeholders who can serve as the leaders and champions for clean water in their communities, including greater participation from business groups, schools, and neighborhood associations. Additionally, this approach requires working collaboratively with other City agencies to look for better and more efficient ways to communicate messages, cross-train, and create synergies that result in greater engagement, greater awareness, and sustained changes in behavior.

Maintenance

Having a successful TMDL program does not stop with the implementation of BMPs; in order to improve maintenance of current facilities, as well as meet the stormwater management practices that will be implemented to meet the Small MS4 Permit and TMDL requirements, the City will focus on BMP maintenance and implementation. The City has designated personnel, as identified in the City of Moore SWMP that will maintain all city-owned BMP, regardless of the agency that installed or is responsible for the BMP.

1 INTRODUCTION

On October 18, 2015, The Oklahoma Department of Environmental Quality (DEQ) reissued an Oklahoma Pollutant Discharge Elimination System (OPDES) Small Municipal Separate Storm Sewer (MS4) General Permit, which takes effect November 1, 2015. The City initially submitted a Notice of Intent (NOI) on March 8, 2005 for permit coverage under OKR04 and is currently updating its Stormwater Management Program (SWMP) as required by the newly reissued permit. This permit lasts for 5 years and covers stormwater discharges from the MS4 owned or operated by the City.

In order to reduce potentially contaminated stormwater runoff and improve water quality, the City's MS4 permit requires that the City develop a compliance plan (CP) by November 13, 2015 to reduce by 35% its contribution of Total Nitrogen, Total Phosphorus, Carbonaceous Biological Oxygen Demand (CBOD), and total suspended solids (TSS) as required in the Lake Thunderbird TMDL. Thirty-five percent restoration represents a significant commitment by the City to reduce potential pollutants through educational activities, construction inspection, identification, review, and possible implementation of low impact development (LID) standards, and good housekeeping procedures and implementation.

The MS4 Permit requires that the City manage, implement, and enforce a stormwater management program in accordance with the Clean Water Act (CWA) and corresponding stormwater OPDES regulations, 40 CFR Part 122, to meet the following requirements:

1. Effectively prohibit pollutants in stormwater discharges or other unauthorized discharges into the MS4 as necessary to comply with DEQ's receiving water quality standards;
2. Attain applicable waste load allocations (WLA) for each established or approved TMDL for each receiving water body, consistent with Title 33 of the U.S. Code (USC) §1342(p)(3)(B)(iii); 40 CFR §122.44(k)(2); and
3. Comply with all other provisions and requirements contained in the MS4 permit, and in plans and schedules developed in fulfillment of the MS4 permit such as the Lake Thunderbird TMDL.

One condition of the City's MS4 Permit is to make progress toward implementation of TMDL load reduction allocations in the City watersheds.

Understanding the physical, economic, social, hydrologic, and organizational conditions of the City provides necessary guidance to craft a CP that best achieves the established restoration goals. The CP is divided into 6 Sections and an Appendix:

1. Background – this section establishes the CP strategy, identifying the existing conditions, current initiatives, and other information that form the basis of decision making.
2. Projects, Programs, and Partnerships – this section includes a brief description of the strategy for implementing the CP, including public outreach and maintenance.

3. Milestones – this section summarizes year-by-year goals to track progress within the permit periods. Progress of the milestones will be included in Annual MS4 Reports submitted to the DEQ.
4. Adaptive Management –this section includes the plan for evaluating and adjusting the CP.
5. Financial Strategy – this section identifies the funding sources and strategies for financing, implementing, and maintaining the projects and programs identified in the CP.
6. Resources – this section includes a list of resources, publications, and website referenced.
7. Appendix B – this appendix includes a detailed chart for tracking proposed best management practice(s) (BMP). Status summaries of the charts will be developed and updated during the new 2015 OKR04 Small Phase II MS4 General Permit cycle (referred to as the first Permit term relating to implementation of this CP) and included in the Annual MS4 Reports submitted to DEQ.

2 BACKGROUND

2.1 Existing Conditions

2.1.1 Geography

The City is located just south of Oklahoma City and north of Norman, in central Oklahoma. The City has a total area of 22.2 square miles of which 21.8 square miles is land and 0.35 square miles or 1.52%, is water.

The City lies in the Cross Timbers region of the Southern Plains. The soil types associated with this area, according to the Natural Resources Conservation Service, are designated:

- Phy (approximately 45% of the City)- HENNESSEY FORMATION (Permian) Shale and siltstone, poorly exposed, mostly moderate reddish brown (10R4/6), moderate red (5R4/6), to moderate reddish orange (10R6/6) with conspicuous light greenish gray (5GY8/1) iron-reduction spots. The lower 20 - 30 ft is predominantly a blocky-weathering, silty shale and clayshale that exhibits good paleosol development; locally with lenticular beds of sandstone and siltstone-pebble conglomerate and fine- to very fine grained sandstone. Shale typically unstratified and highly fractured; rarely with small-scale slickensides that are evidence of paleosol development. Above the lower part, thinbedded to laminated, stratified to well stratified siltstones and very fine grained sandstones are more common. Siltstone moderately to well stratified. Sandstone locally cross-stratified on large and small scale, uncommonly trough-cross-stratified and/or ripple marked. Trace fossils and shale rip-up clasts very rare. Sandstone rarely forms channelform deposits. Shale outcrops locally weather to blocky, very fractured, or “hackly” appearance; form bare, rounded outcrops and/or “badlands”-type topography. In other places, shale weathers to muddy soil with abundant small calcareous nodules. Calcite veinlets uncommon. Interbedded siltstone and shale weather to bench-and-slope topography. Siltstone and sandstone exhibit platy to flaggy weathering. Siltstone and sandstone beds with small-scale cross-stratification and ripples. Moderately indurated, occur as resistant beds capping tops of hills and ridges. Overall, unit is expressed as highly weathered, muddy soil. Thickness: 0 - 220 ft, top not exposed.
- Qcs (approximately 25% of the City) - COVER SAND (Pleistocene) Very fine grained to coarse-grained silt and clay, moderately to poorly sorted. Consists mainly of rounded to subrounded quartz grains, with abundant silt and clay-size material. Forms extensive nearly flat topographic surfaces as much as 50 ft above modern alluvial valleys. Probably represents eolian reworking of older Pleistocene-aged terrace deposits. Thickness: from a thin veneer to as much as 10 ft, averages closer to 3 ft.
- Qglo (approximately 20% of the City) - REMNANTS OF OLDER TERRACE DEPOSITS (Pleistocene) Clay, silt, sand, and gravel adjacent to flood plain of Little River. Sand commonly is medium- to coarse-grained and very light colored; gravel locally consists of concentrations of distally derived pebbles and cobbles, mostly well rounded and sub-discoidal quartz and metaquartzites. Base of unit is about 30 ft to 60 ft above the modern flood plain and ranges in elevation from

1130 ft to 1190 ft above sea level. The top of the unit is as much as 70 ft above the modern flood plain and is as high as 1230 ft above sea level. The majority of these deposits occur along the north side of Little River. Thickness: 0 to 35 ft, averages about 10 ft.

- Qal (approximately 10% of the City) - ALLUVIUM (Holocene) Clay, silt, sand, and gravel in channels and on flood plains of modern streams. Includes terrace deposits of similar composition located directly above and adjacent to modern channels and flood plains. Thickness: 0 to about 30 ft.

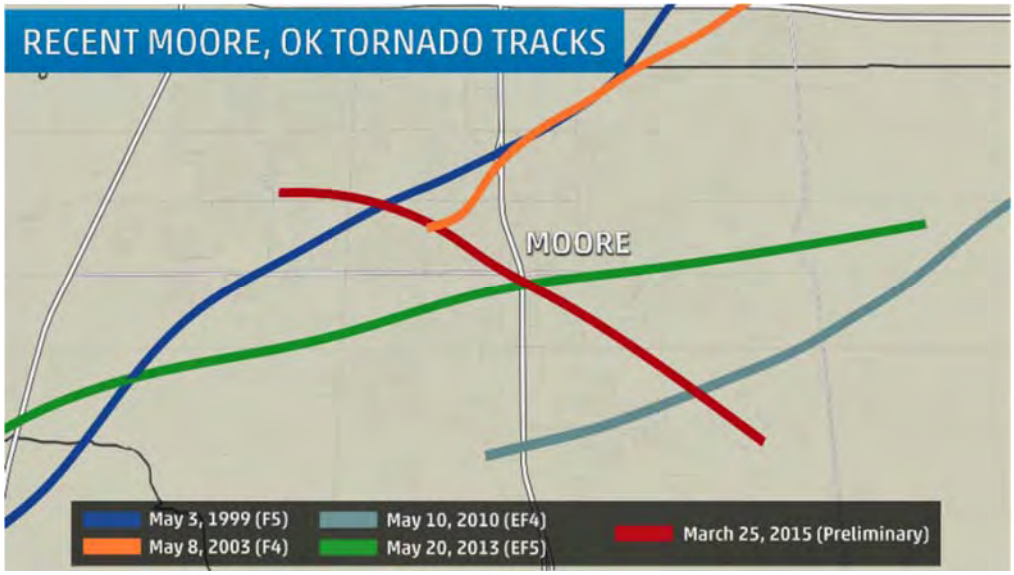
As indicated by the soil types listed above the City is located on soil that is naturally predisposed to excessive soil runoff during storm events. This predisposition to natural erosion places a greater burden on the City to control the amount of total suspended solids from entering Little River and other un-named tributaries discharging to Lake Thunderbird.

2.1.2 History

The City of Moore has seen ten tornadoes between 1998 and 2015, three of them big enough to claim lives and cause catastrophic damage. The City was damaged by significant tornadoes on October 4, 1998; May 3, 1999; May 8, 2003; May 10, 2010; and May 20, 2013, with weaker tornadoes striking at other times, notably May 31, 2013 and March 25, 2015. The most significant tornadoes to hit the City occurred in 1999 and 2013. The tracks of the tornadoes can be seen in Figure 2 below,

After the May 31, 2013 tornado the City saw two schools, a school administration building, a regional hospital, 90-businesses and over 2,400-housing units damaged or destroyed. The figure is important as it relates to disaster recovery in the City related to rebuilding significant structures. This disaster rebuilding may, in part, relate to abnormally higher instances of TSS contribution.

Figure 2: Tornado Tracks



The City is currently working with consultants to prepare the Comprehensive Storm Water Management and Drainage Plan with the goal to develop a comprehensive, integrated storm water plan for the City, The plan will evaluate existing and potential drainage and flooding problems within the City and recommend capital improvement projects and/or programmatic measures to correct or avoid such problems. The projects will include streambank stabilization to reduce the potential for erosion within the City.

2.1.3 Potential Sources of TSS, Nutrients, and CBOD

An investigation to determine potential sources of TSS, nutrients and CBOD deposition was conducted within the City. Each area of the city was inspected by on-ground investigation and utilization of existing GIS data. An inventory of outfalls from existing GIS records was utilized to determine contributing areas within each of the established watersheds within the City.

The City consists of three Wards, each with its own characteristics, see Figures 3,4,5, and 6 below.

- Ward 1 is a mix of light commercial, minor industrial, single and multi-family residential and maintains the largest amount of open space and agricultural activities. Ward 1 discharges mainly to the North Fork of the Little River.
- Ward 2 is a mix of light commercial along IH-35, minor industrial, single and multi-family residential. Ward 2 discharges to both the North Fork of the Little River in the east and Little River to the west.
- Ward 3 is a mix of commercial, some minor industrial and single and multi-family residential. Ward three also has constructed water amenities that contain waterfowl populations.

Figure 3: City Wards

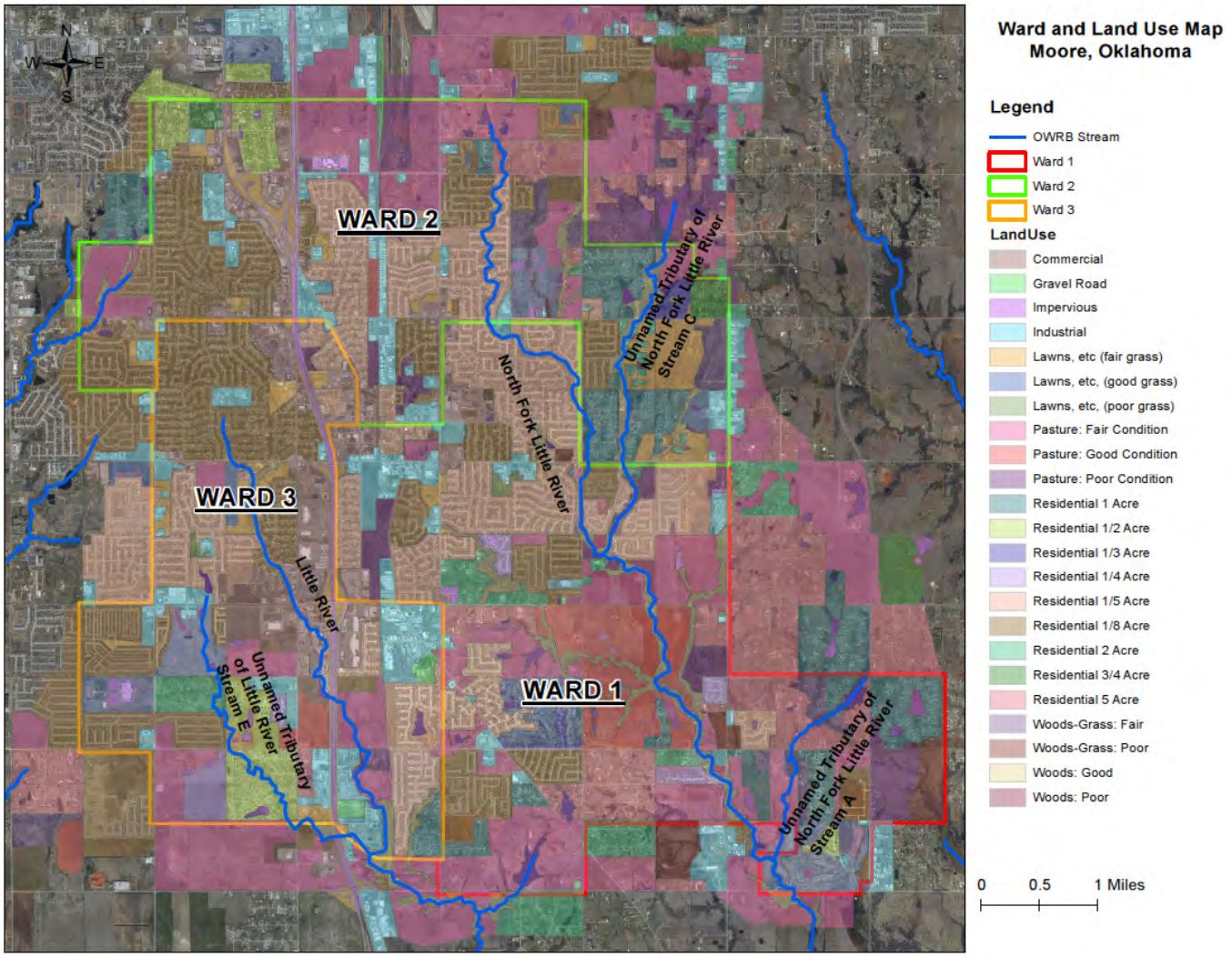


Figure 4: Ward 1

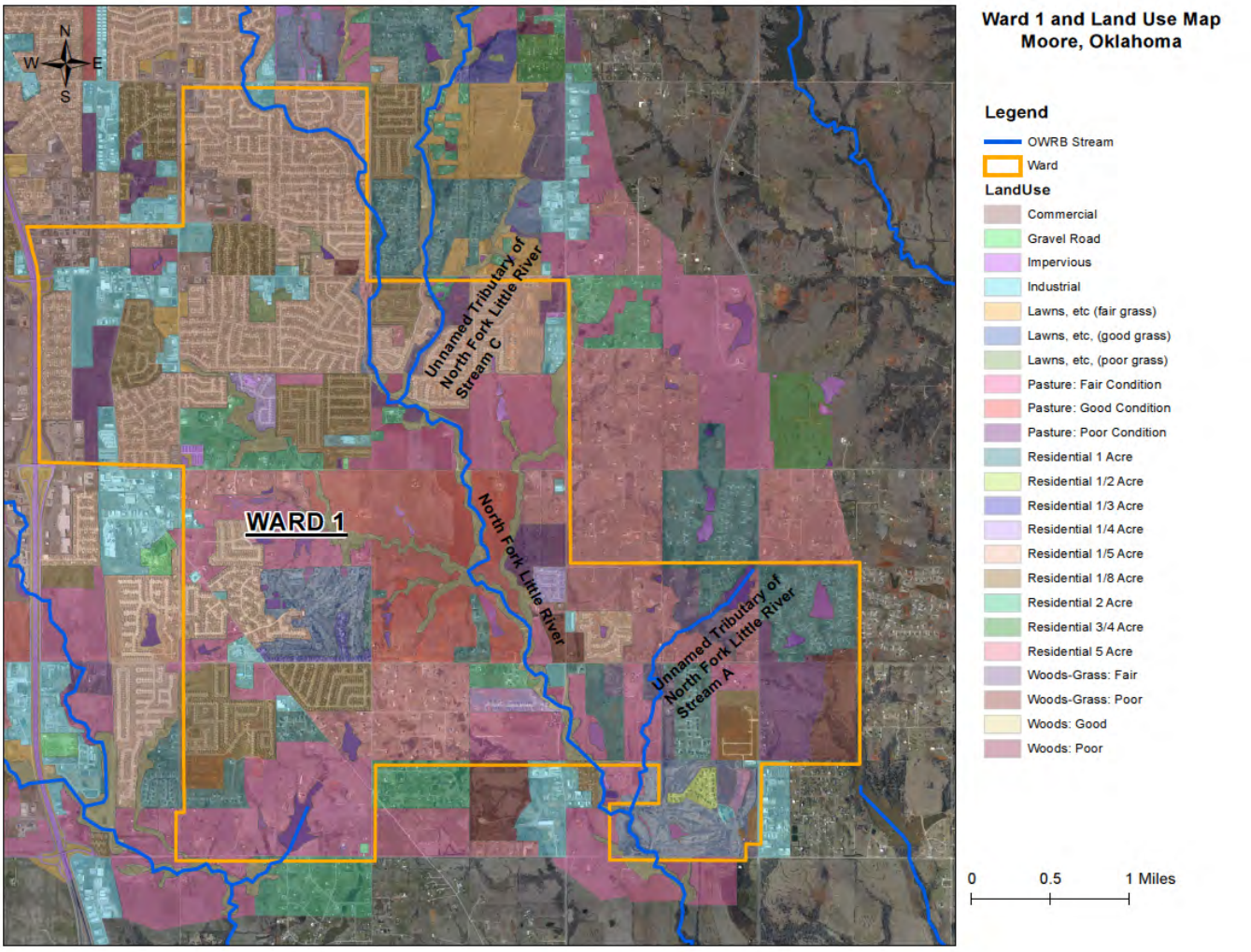


Figure 5: Ward 2

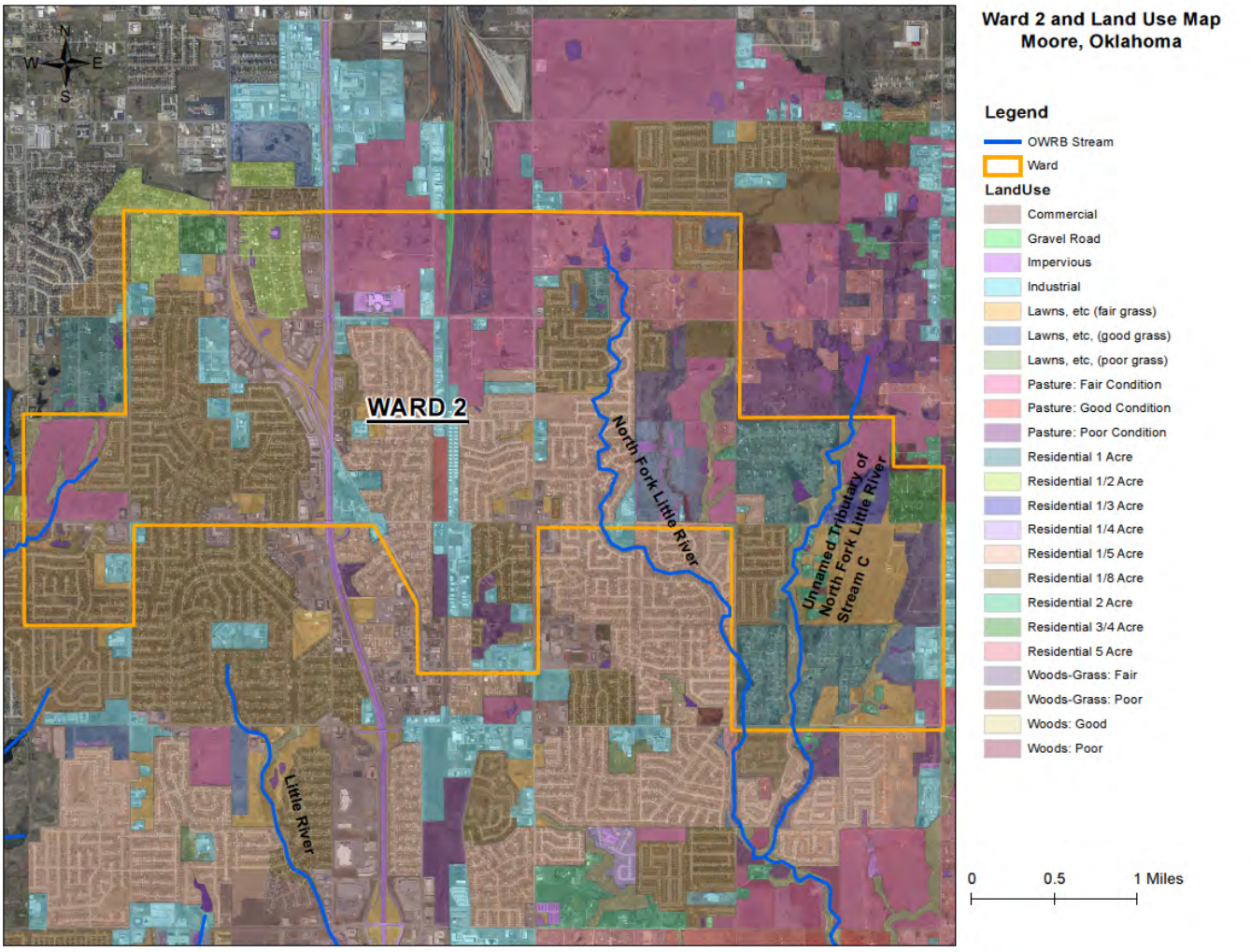
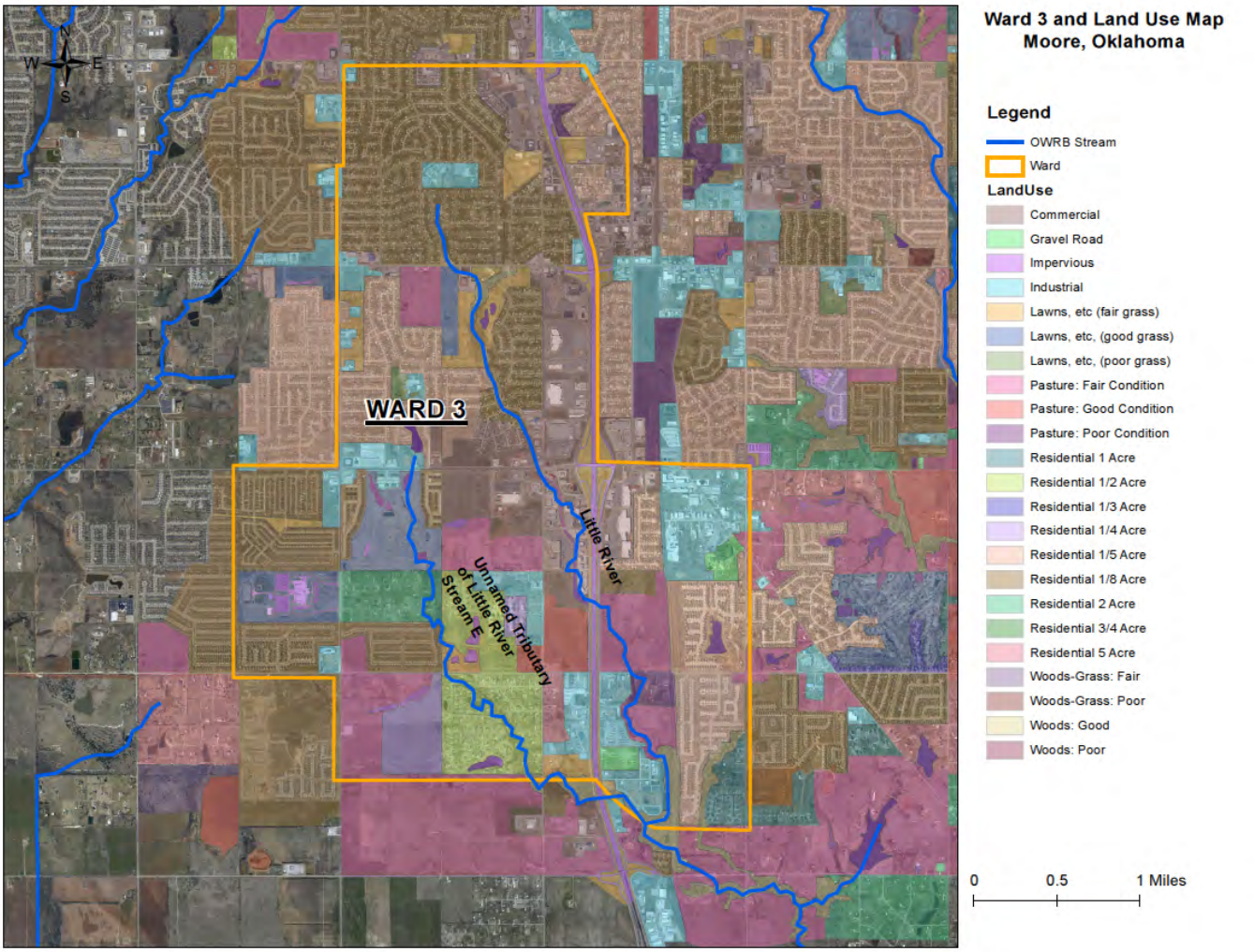


Figure 6: Ward 3



After inspecting the three wards for potential pollutant sources, it has been determined that following sources, in order suspected contribution, have the greatest potential to contribute. A detailed evaluation of sources will be performed during the first permit term.

1. Construction sites: construction within the City will continue as the City grows at its current rate, but as indicated above; the City has seen increased construction activities due to tornado destruction. Construction activities can contribute TSS, which in the case of the Lake Thunderbird TMDL is used as a surrogate that has the potential to carry nutrients along with the potential TSS discharges.
2. Pet, Waterfowl, and Livestock Waste: Pet waste continues to be a significant source of potential nutrients that can enter the Lake Thunderbird watershed, along with livestock mainly located in Ward 2. Waterfowl, located within Ward 3 at the constructed water amenities, can contribute significant levels of nutrients as the population grows and becomes domesticated. Waterfowl problems in urban and suburban areas are primarily caused by giant Canada geese, which are probably the most adaptable of all waterfowl. If left undisturbed, these geese can readily establish nesting territories on constructed water amenities, in residential yards, golf courses, condominium complexes, city parks, or on agricultural areas. Waterfowl can soon turn from visual amenity to pest, however. A pair of geese can, in 5 to 7 years, easily become 50 to 100 birds that can then foul constructed water amenities and surrounding greenbelts and damage landscaping, gardens, and golf courses.
3. Fertilizer Application: Fertilizer application in the spring can potentially contribute to nutrient loadings within the City.
4. Natural Soil Runoff: As stated above in Section 2.1.1, the City lies on very sandy soil that very easily and naturally erodes through storm event runoff. Natural soil runoff includes streambank stabilization within the channels and streams of the City. Currently the City is conducting a study of potential streambank stabilization opportunities through hydro-geomorphology improvements. This may be the most difficult potential contribution to reduce, but can be minimized through the use of low impact development (LID) and streambank stabilization techniques.
5. Sanitary Sewer Overflows: Sanitary sewer overflows can potentially contribute to the nutrient loading within the Lake Thunderbird watershed.

2.1.4 Stormwater Infrastructure and Streams

The City has about 18.8 miles of streams, and consist of the Little River and North Fork of Little River and their unnamed tributaries. However, the open network of the City MS4 (natural ditches, improved ditches, natural channels, improved channels, and constructed open conveyances is approximately 183 linear miles and are all part of the City's MS4. The storm drain system includes:

- 23 miles of storm drain pipes
- 900 storm drain inlets

- 5,432 manholes
- 43 outfalls
- 4 outfalls 36 inches or greater

2.1.5 Land Usage

DEMOGRAPHIC ANALYSIS

The City's population grew from 41,699 in 2000 to 55,081 in 2010, over 32%, a faster pace than Cleveland County, the Oklahoma City Metropolitan Statistical Area (MSA), and the State of Oklahoma. According to the Oklahoma Department of Commerce, the population of Cleveland County is projected to grow an additional 14.5% in the next ten years from 262,862 in 2012 to 303,105 in 2022.

- Households grew at an even faster rate than population, increasing almost 36% from 2000 to 2010. Non-family households make up 26.7% of the households in Moore, and nearly 80% are one-person households. The City's highly regarded school system has been largely credited for the attraction of family households to Moore.

HOUSING ANALYSIS

Based on data obtained from the Cleveland County real property tax assessment database, the City contains a total of 21,199 residential dwelling units comprising single family detached, mobile homes, duplexes, and garden apartments.

- In 2012, the City housing inventory comprised 69% owner occupied homes, compared to 59% of owner occupied homes in the State of Oklahoma and 66% in the nation. The renter occupied inventory in the City was 26% in the same year, compared to 29% in the state and 34% in the nation. The percentage of rental occupied homes rose from 22% in 2000 to 26% in 2012, following a national trend. Based on an inventory of 1,899 apartments and 853 duplexes/triplexes of which 90%, or 768, are probably rentals, the balance of approximately 2,845 renter occupied dwellings comprise single family detached units.
- Based on the preceding analysis, rental housing can be broken out as follows:
    - Total rental occupied units: 5,512
    - Purpose built rental units: 2,667
        - Apartments: 1,899
        - Duplexes: 768
        - Estimated single family rentals: 2,845
- Since 2012, 702 apartment units, 110-duplexes, and 337 single family homes have been constructed. An examination of proposed development in the City (as of Nov. 1 2015) shows a

diverse mix of residential use types in the planning stages, including 80 duplex units, approximately 400 single-family homes, and 264 apartment units.

- Most of the remaining developable land in the City falls into the Rural Residential and Urban Residential/Low Density zoning designations, with only small amounts of acreage that could be developed to Medium Density or High Density Residential. In total, vacant and underutilized land could support a range of 2,123 to 16,478 residential units at full build out, with a midpoint of 9,300 units. The minimum build out of 2,123 units is estimated at approximately 4- 7 years, the maximum build out of 16,478 units is estimated at 34-55 years, and the midpoint of 9,300 units is estimated at 19-31 years.
- The May 2013 F5 tornado, nearly a mile wide, directly impacted almost 10% of the City's entire housing stock by either damaging or completely destructing housing units. Of a total of 1,776 single family homes impacted, 696 were damaged and 1,080 were destroyed. Approximately 247 apartment units were destroyed in the event. Approximately 700 single family residential building permits have been issued for rebuilds and 450 have been issued for remodels.

HOUSING BUILDOUT ESTIMATES

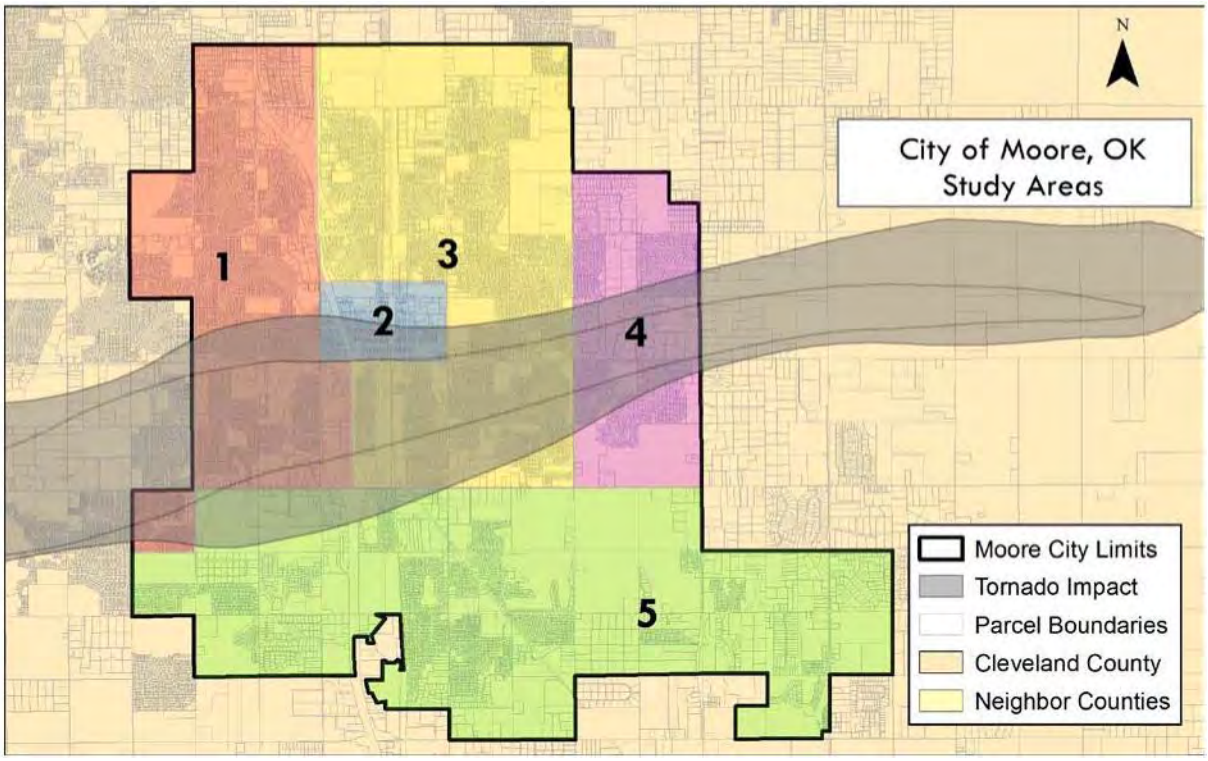
The City's future residential development is constrained by its relatively limited land area of 22 square miles, in stark contrast to the 621 square miles of Oklahoma City and 190 square miles of Norman. Given the finite and limited amount of land remaining for residential development the potential for construction impacts is limited. Most of the remaining developable land in the City falls into the Rural Residential and Urban Residential/Low Density land use designations, with only small amounts of acreage that could be developed to Medium Density of High Density Residential. The 1,082 acres slated for Rural Residential development could support a maximum of 811 residential units, assuming full build out at one unit per 0.75 acres. The 2,402 acres of Urban Residential/Low Density land could support in the range of 811 to 14,413 units at full build out, based on densities of one unit per 0.75 acres to six units per acre. Medium Density land is estimated to equal approximately 39 acres, allows 6 to 14 units per acre, and could support a range of 231 to 578 units. High Density land is estimated to equal approximately 45 acres, allows 6 to 14 units per acre as well, and could support a range of 270 to 675 units. In total, vacant and underutilized land could support a range of 2,123 to 16,478 residential units at full build out, with a midpoint of 9,300 units.

TORNADO IMPACT AREA

This section places specific focus on the housing directly impacted by the May 2013 F5 tornado and the necessity to rebuild at higher than normal rate which may have had an arbitrary effect on potential pollutants such as suspended solids that may have discharged during the development of the Lake Thunderbird TMDL. This potential effect may have contributed to higher than normal discharges of suspended solids and requires that a baseline pollutant study be performed to assure that proper levels are considered to determine what is an elevated level of potential pollutant discharge. The path of the tornado is shown in Figure 7 below. The May 2013 tornado directly impacted almost 10% of Moore's

entire housing stock either by damage or total destruction. Of a total of 1,776 single family homes impacted, 696 were damaged and 1,080 were destroyed.

Figure 7: May 2013 F5 Tornado Path



Source: City of Moore; RKG Associates 2013

2.2 MS4 Permit Coverage

On December 8, 1999, EPA published final regulations that address urban stormwater runoff from cities under 100,000 population and counties that lie within the Urbanized Area as defined by the latest US Bureau of Census designation. These "Phase II" cities and counties must develop a comprehensive Stormwater Management Program that addresses six "Minimum Control Measures" (MCMs). These are:

1. Public Education and Outreach
2. Public Participation and Involvement
3. Illicit Discharge Detection and Elimination
4. Construction Site Stormwater Runoff Control
5. Post Construction Management in New Development and Re-Development
6. Pollution Prevention and Good Housekeeping

The Oklahoma Department of Environmental Quality (DEQ) presently has primary jurisdiction over permitting and enforcement of the Phase II Stormwater Program for Oklahoma. The DEQ has developed

a General Permit (OKR04) for “Phase II Municipal Separate Storm Sewer System Discharges for Small Cities Within the State of Oklahoma” that was re-issued on October 1, 2015. The Phase II regulations require that the regulated community submit a Notice of Intent (NOI) to apply for coverage under the Oklahoma Stormwater General Permit (OKR04) along with a Stormwater Management Program document (SWMP) that specifies, for each MCM, what activities will be performed (Best Management Practices – BMP), along with schedules and measurable goals for each BMP.

The City is updating its existing SWMP document which provides descriptions of all activities that will be conducted on behalf of the City to meet its obligations under the DEQ General Permit for Phase II Municipal Separate Storm Sewer System (MS4) Discharges for Small Cities Within the State of Oklahoma (OKR04). The existing SWMP was submitted on May 8, 2005 along with the Notice of Intent (NOI) that together constitute the application for coverage under the OKR04 general permit; the new NOI and SWMP is due to DEQ by February 1, 2016. All six Minimum Control Measures (MCMs) were addressed in previous SWMP. In addition, the City of Moore will include the requirements of the Lake Thunderbird TMDL into the new SWMP in which the city will have continuous coverage for all MS4 activities. Each MCM has a number of BMP that constitute the core activities pertaining to each MCM. The SWMP Appendices will summarize the BMP and provide Measurable Goals for each BMP, along with descriptions, implementation schedules and estimated annual costs. Every reasonable effort has been, and will be, made to comply with all requirements in the State’s OKR04 general permit for small MS4.

2.2.1 Watersheds

The City has two 8-digit watersheds as designated by the USGS:

1. Little River - 11090203
2. Lower Canadian-Walnut - 11090202

Only the Little River Watershed contributes flow to Lake Thunderbird. The drainage area and features can be found in the Final *"Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs"* Attached as Appendix A.

2.3 Local Government

Implementing the CP and maintaining compliance with the City's MS4 permit requires a collaborative effort among city departments, local non-profit activities such as recycling centers, community partners, and the private sector. This collaboration will focus on the planning, design, construction, implementation, and maintenance of projects and programs.

Community Development

The mission of the Community Development Department is to plan and guide the orderly growth and development of the City, to enforce compliance with applicable legislation in order to meet the quality of life, health, and safety needs of the community, and to deliver to its customers courteous,

efficient, and competent services. The Community Development Department is made of the following separate but related divisions:

- Building Inspections and Permits - The Inspections staff provides inspections and review of residential, commercial and industrial building permits. They provide construction applications within the City and issue MS4 SWMP BMP information requirements such as required DEQ construction permits, City building code standards, and any necessary low impact development requirements adopted.
- Code Enforcement - The Code Enforcement Division works to reduce neighborhood nuisances and residential deterioration within the city. Typical violations include overgrown grass and weeds, parking in the yard, junked vehicles, trash and debris.
- Planning - Planning is an essential service provided by the City to promote the health, safety, and welfare of its residents. The following are the main functions of the planning division:
    - Building ordinances
    - Floodplain administration
    - Geographic Information Systems (GIS)
    - Comprehensive Plan Development
    - Subdivision Development
    - Traffic Impacts
    - Zoning
- Environmental Services - The City's Environmental Services Division is dedicated to improving the environment by offering safe ways to dispose of hazardous waste, convenient options for recycling, and educating the public on the effects of wrongful disposal of liquids into our city sewer system. These values are important in promoting a healthy environment for all residents and visitors alike. The Environmental Services Divison operates the following functions:
    - Household Hazardous Waste Collection
    - Recycling
    - Stormwater Management

Parks and Recreation

The City Parks and Recreation Department works to provide quality recreational opportunities for all citizens of Moore. The Department strives to provide environmentally safe and beneficial areas for recreational purposes, and to coordinate efforts to maximize the use of existing parks utilizing approved methods for maintenance, such as fertilizer application, and use.

Public Utilities

The City of Moore has 230 miles of water line, 34 active water wells, 5 water towers, one ground storage pump station, 2,000 fire hydrants, and two new water booster stations. The Public Utilities Department is made of the following divisions:

- Water
- Sewer and Waste Treatment
- Trash Collection

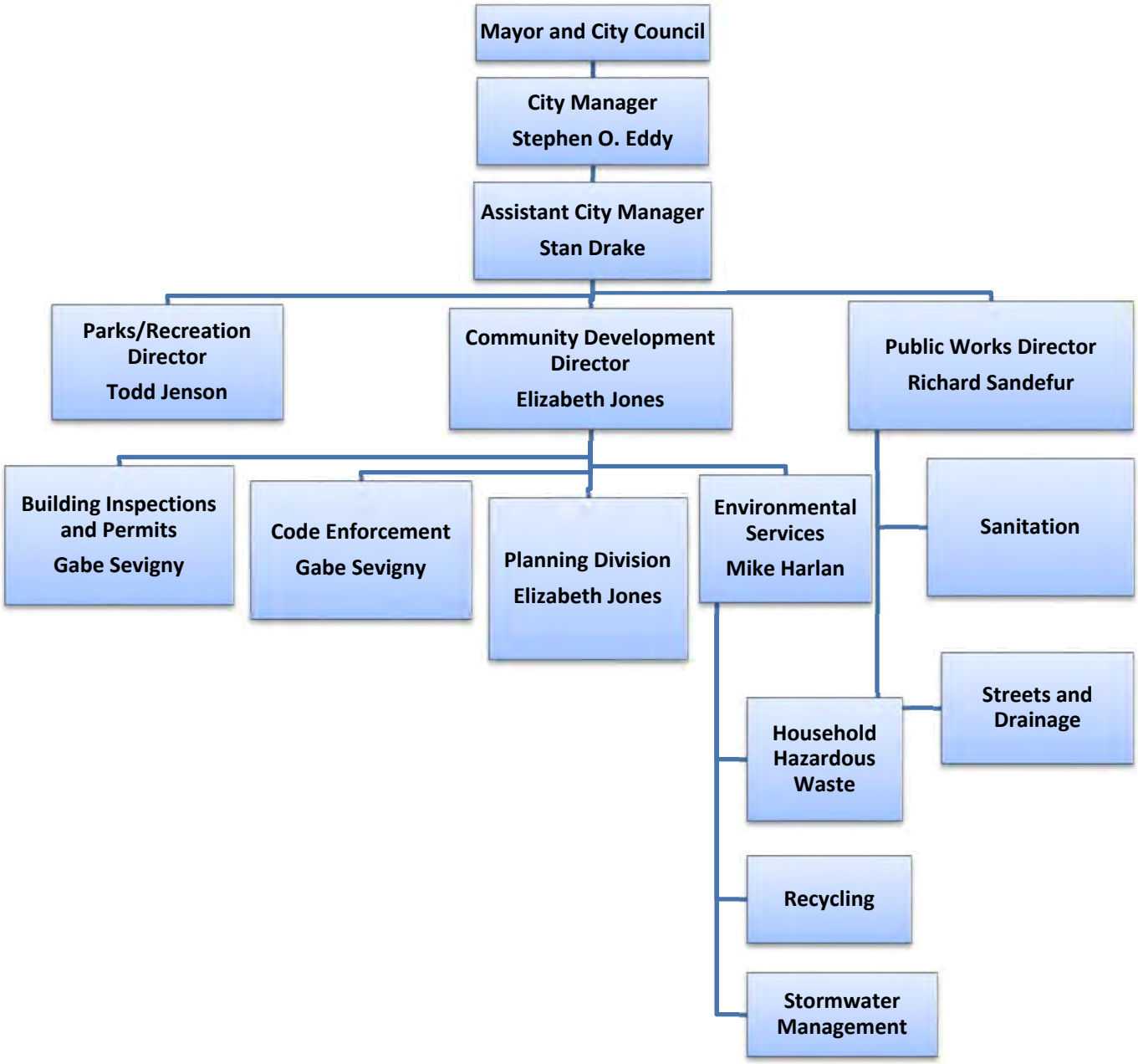
Public Works

The City of Moore Public Works Department has 48 employees who manage:

- Residential Sanitation
- Animal Welfare
- Streets Maintenance
- Fleet Maintenance
- Facilities Maintenance

An organizational chart of the City's departments is presented below in Figure 8.

Figure 8: Organization Chart



Responsibilities and duties of personnel and departments are as follows:

City Manager

- Development of design standards and specifications for stormwater management and erosion and sediment control, as used in the City's capital projects
- Compliance with NPDES General Construction permit of all MS4 capital projects

Community Development Director

- Final approval of proposed policy, financial planning, rate structure and budget recommendations related to this CP to be submitted to the Assistant City Manager, then to the City Manager before presentation to the Mayor and / or City Council for adoption
- Final approval of proposed CP and other MS4 deliverables to be submitted to Environmental Services for review and agreement
- Oversight of outreach and education materials for the City Stormwater Management Program
- Coordination of City and other utility capital improvement projects to reduce land (soil) disturbance

Stormwater Management Division

- Point of contact for the MS4 permit
- CP development and annual reporting for the MS4 permit
- Partnership coordination for grant funding, community engagement, education content
- Stormwater management and erosion and sediment control program for development (plans reviews and inspections)
- Response and investigation for erosion and sediment control and polluted surface waters response
- Surface water quality monitoring - sampling and analysis
- Illicit discharge detection and elimination (IDDE) program

GIS/ IT

- Maintenance of GIS information related to the public storm drain system.
- Maintenance of GIS information related to planned and completed Stormwater management facilities

Public Works Director

- Immediate response to repair and replace infrastructure as it relates to flooding, sewer overflows, and water main breaks

Streets and Roads Division

- Mechanical street sweeping
- Inlet cleaning
- Stream debris removal and disposal

Parks and Recreation

- Fertilizer storage, application, and disposal

2.4 Regional Stormwater Program

The City participates in a regional stormwater program sponsored by the Association of Central Oklahoma Governments (ACOG), a sub-state planning agency in Oklahoma City, Oklahoma. Stakeholders in the ACOG Regional Stormwater Program consists of the voluntary association of Phase II cities and counties that collectively fund specific SWMP activities that are suitable for regional approaches. The ACOG regional activities include public education and participation.

2.5 TMDL

2.5.1 Lake Thunderbird TMDL for Nutrient, Turbidity, and Dissolved Oxygen

Lake Thunderbird is a 6,070-acre reservoir located 13 miles east of downtown Norman in Cleveland County, Oklahoma. The Lake is located within a 256 square mile drainage area of the upper Little River watershed (HUC, 11090203). The Lake, owned by the U.S. Bureau of Reclamation, was constructed to provide flood control, municipal water supply, recreation and wildlife habitat. The Lake serves as the primary public water supply for the cities of Norman, Midwest City, and Del City with water usage governed by the Central Oklahoma Master Conservancy District (COMCD). Lake Thunderbird is on Oklahoma's 2010 303(d) list for impaired beneficial uses of public/private water supply and warm water aquatic community (WWAC).

The purpose of the TMDL is to establish waste load allocations (WLA) and load allocations (LA) determined to be necessary for reducing turbidity and chlorophyll-*a* levels and maintaining sufficient oxygen levels in the Lake to attain water quality targets to restore impaired beneficial uses and protect public health. TMDLs determine the pollutant loading that a waterbody, such as Lake Thunderbird, can assimilate without exceeding applicable water quality standards. TMDLs also establish the pollutant load allocation necessary to meet the water quality standards established for a waterbody based on the relationship between pollutant sources and water quality conditions in the waterbody. A TMDL consists of a waste load allocation (WLA), load allocation (LA), and a margin of safety (MOS). The WLA is the fraction of the total pollutant load apportioned to point sources, and includes stormwater discharges regulated under the National Pollutant Discharge Elimination System (NPDES) as point sources. Additional information can be found in the Final *"Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs"* Appendix A.

2.5.2 TMDL Identification and Water Quality Targets

Designated uses of Lake Thunderbird are flood control, municipal water supply, recreation, and fish and wildlife propagation. Lake Thunderbird is designated as a Category 5a lake on the Oklahoma 303(d) list with a Priority 1 ranking. Category 5 defines a waterbody where, since the water quality standard is not attained, the waterbody is impaired or threatened for one or more designated uses by a pollutant(s), and the water body requires a TMDL. DEQ has determined that Lake Thunderbird, designated as a Sensitive Water Supply (SWS) lake, is not supporting its designated uses for (a) Fish & Wildlife Propagation (FWP) for a Warm Water Aquatic Community because of excessive levels of turbidity and low dissolved oxygen; and (b) Public Water Supply because of excessive chlorophyll-*a* levels. High levels of both turbidity and chlorophyll-*a* can have deleterious effects on the raw water quality, such as taste and odor complaints and treatment costs of drinking water. The water quality targets established for Lake Thunderbird, based on statistics of the most recent 10 years of record, are defined as the long-term average in-lake surface concentration of 10 µg/L for chlorophyll-*a* and the 90th percentile of the in-lake surface concentration of 25 NTU for turbidity.

2.5.3 Watershed and Lake Modeling

A model framework was developed to establish the cause-effect linkage between pollutant loading from the watershed (the HSPF model) and water quality conditions in the lake (the EFDC model). Flow and pollutant loading from the watershed to the Lake was simulated for a one year period from April 2008 to April 2009 with the public domain HSPF watershed model. Watershed model results were used to estimate the relative contributions of point and nonpoint sources of pollutant loading. The three cities of Moore, Norman and Oklahoma City accounted for the dominant share of total pollutant loading from the watershed. The EFDC model was developed to simulate water quality conditions in Lake Thunderbird for sediments, nutrients, organic matter, dissolved oxygen and chlorophyll-*a*.

The linked watershed (HSPF) and lake (EFDC) model framework was used to calculate average annual suspended solids, CBOD, nitrogen and phosphorus loads (kg/yr) that, if achieved, should meet the water quality targets established for turbidity, chlorophyll-*a*, and dissolved oxygen. For reporting purposes, the final TMDLs, according to EPA guidelines, are expressed as daily loads (kg/day). The waste load allocation (WLA) for the TMDL for Lake Thunderbird is assigned to regulated NPDES point source discharges under three MS4 stormwater permits for Moore, Norman and Oklahoma City. The WLA, split among the three MS4 permits, includes pollutant discharges regulated under NPDES stormwater permits for Construction Sites and Multi-Sector General Permit (MSGP) for various industrial facilities located within the MS4 areas of the watershed. The load allocation (LA) for the TMDL is assigned to the small land area of the watershed not included in the land area for the three MS4 permits and is set at the existing loading during the calibration period.

2.5.4 TMDL, Waste Load Allocation, Load Allocation and Margin of Safety

The calibrated lake model (EFDC) was used to evaluate the water quality response to reductions in watershed loading of sediment and nutrients. Load reduction scenario model runs were performed to determine if water quality targets for turbidity and chlorophyll could be attained with watershed-based load reductions based on 35% removal of loading for sediment and nutrients. The long-term model results indicated that compliance with water quality criteria for turbidity, dissolved oxygen and chlorophyll could be achieved within a reasonable time frame. The calibrated model results thus supported the development of TMDLs for sediments, CBOD, TN and TP to achieve compliance with water quality standards for turbidity, chlorophyll and dissolved oxygen.

The load allocation (LA) is computed as the difference from the total maximum daily load (TMDL) and the total WLA load. The TMDL load is split between three WLAs for the three MS4 cities, the LA for the unincorporated area of the watershed and the implicit MOS as shown in Table 1 below.

Table 1: Load Allocations

Water Quality Constituent	TMDL	LA	WLA				MOS
			Total	Moore	Norman	OKC	
	(Kg/day)	(Kg/day)	(Kg/day)	(Kg/day)	(Kg/day)	(Kg/day)	(Kg/day)
Total Nitrogen (TN)	807.7	21.3	786.4	205.1	319.4	261.8	Implicit
Total Phosphorus (TP)	158.4	4.4	154.0	44.5	60.1	49.4	Implicit
CBOD	2,480.8	57.4	2,423.4	781.3	955.6	686.5	Implicit
Suspended solids (TSS)	76,950.8	2,068.7	74,882.1	16,236.0	31,596.1	27,049.9	Implicit

Additional information regarding MOS can be found in the Final *"Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs"* Appendix A.

2.6 Comprehensive Storm Water Management and Drainage Plan

The City is working with consultants to prepare the Comprehensive Storm Water Management and Drainage Plan with the goal to develop a comprehensive, integrated storm water plan for the City. The plan will evaluate existing and potential drainage and flooding problems within the City and recommend capital improvement projects and/or programmatic measures to correct or avoid such problems.

2.7 Other Regulatory Factors

2.7.1 Oklahoma Pollutant Discharge Elimination System (OPDES) Permits

As authorized by the Clean Water Act, the OPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Industrial,

municipal, and other facilities must obtain permits if their discharges go directly to surface waters. The OPDES permit program is administered by DEQ. In addition to the MS4 Permit, three NPDES permits regulate activities in the City:

- OPDES Stormwater Discharges from Construction Activities Permit OKR10

  Stormwater discharges from construction activities (such as clearing, grading, excavating, and stockpiling) that disturb one or more acres, or smaller sites that are part of a larger common plan of development or sale, are regulated under the OPDES stormwater program. Prior to discharging stormwater, construction operators must obtain coverage under an NPDES permit. The General Construction Permit, with its increased regulations, will result in less sediment entering the City's waters. However, the burden of pollutant contribution from these permitted sites has been assigned to the City, and as such the City must now assume the responsibility of reducing the impacts from the permitted sources.

- OPDES Multi-Sector General Permit for Industrial Activities Permit OKR05

  DEQ authorizes the discharge of stormwater associated with industrial activities to waters of the state under the OPDES General Permit Number OKR05. The permit contains provisions that require industrial facilities in 26 different industrial sectors to, among other things, implement control measures and develop site-specific stormwater pollution prevention plans (SWPPP) to comply with OPDES requirements. Again, the burden of pollutant contribution from these permitted sites has been assigned to the City, and as such the City must now assume the responsibility of reducing the impacts from the permitted sources.

- Wastewater Treatment Plant Discharge Permits

  The operations of the City Wastewater Treatment Plant is permitted by DEQ. The permit contains general operating restrictions as well as limitations on the contents of the plants' effluent. Compliance with these numeric effluent limits is determined by regular sampling and reporting to the DEQ. There is no discharge from the treatment plant into the Lake Thunderbird watershed. Sanitary sewer overflows within the City are responded to immediately and reported to DEQ as they occur.

2.7.2 Planning, Zoning, and Development Standards

The City Planning, Zoning and Development Standards (Standards) are the regulations and process by which the City will ensure the design and construction of buildings for public and private development. Updated in 2009, the Standards are based on the National Municipal Code (MuniCode) program, which has been adapted and customized to fit the development conditions, local market and sustainability goals of the City and surrounding environment. Meeting the Standards requires addressing a range of sustainable practices, including stormwater management.

3 CP DEVELOPMENT

As established in Section 3 of the Final *"Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs"* Appendix A, urban stormwater related discharges are the main sources of controllable pollutants to Lake Thunderbird. The three main municipalities in the watershed are therefore required to undertake certain pollutant reduction measures within the terms of their MS4 permits under the OPDES system. These measures are designed to achieve progress toward meeting the reduction goals established in the TMDL. These stormwater BMP based requirements are as follows:

1. Perform an evaluation to identify potential significant sources of TSS, nutrients and organic matter entering the MS4.
    a. Such an evaluation should include an enhanced plan for illicit discharge screening and remediation.
        i. Following the evaluation and using guidelines outlined below, each permittee shall develop (or modify an existing program as necessary) and implement a program to reduce the discharge of TSS, nutrients and organic matters in municipal stormwater contributed by all significant sources identified in the evaluation.

    This evaluation is described in Section 2.1.3 of this CP.

2. An MS4 should demonstrate, in the TMDL Compliance Plan, that it understands the TMDL requirements and that it has a strategy for meeting the WLAs. The City's understanding of the TMDL requirements is presented in Section 2.5 of this CP.
    a. There are several ways for an MS4 to meet a TMDL waste load allocation (WLA) using BMPs and other approaches, including but not limited to:
        i. Retrofitting developed areas and other suitable sites with structural stormwater BMPs (e.g. infiltration BMPs in built out areas).
        ii. Implementing BMPs that prevent additional stormwater TSS, nutrients and organic matter pollution associated with new development and re-development; (e.g. promoting Low Impact Development and green infrastructure, installing infiltration BMPs in areas converting from one land use to another).
        iii. Implementing non-structural BMPs designed for source control (e.g. fertilizer application restrictions or soil nutrient testing requirements, and riparian buffer protection requirements) by considering ordinances or other regulatory mechanisms to require TSS, nutrients and organic matter pollution control, as well as enforcement procedures for noncompliance.
        iv. Implementing non-structural BMPs designed to treat existing loads (e.g. more frequent street sweeping).
        v. Developing and implementing water quality trading: water quality trading among the MS4 permittees may be considered as a tool to achieve the overall WLA of the

TMDLs. As the authorization and enforcement agency of Oklahoma's MS4 permits, the DEQ reserves the authority for the final approval of any trades or trading programs that may be considered in the Lake Thunderbird watershed.

3. Implementing enhanced or more frequent construction site stormwater compliance inspections and considering adopting ordinance that allows "stop work" orders and other enhanced enforcement for construction permit violators.

4. Determining a schedule for achieving the WLA: This schedule can be general in nature, discussing groups of activities to be implemented within permit cycles or based on funding cycles. Specific activities need not be included in this section of the TMDL Compliance Plan. For example:

   "MS4 X" will achieve necessary pollutant reductions within four permit cycles. During the first permit cycle, "MS4 X" will evaluate its existing stormwater program in relation to the TMDL compliance plan, determine if the program requires modification, outline a process for develop the TMDL compliance plan, and implement BMP if opportunities arise. In the second permit cycle, "MS4 X" will modify its stormwater program as necessary, implement non-structural BMP, develop a system to evaluate the effectiveness of these BMPs and implement structural BMP if opportunities arise. In the third permit cycle, "MS4 X" will evaluate the effectiveness of non-structural BMP, determine if structural BMPs (through retrofits) are needed, identify where and which structural BMP will achieve the needed pollutant load reductions, and implement structural BMP if opportunities arise. In the fourth permit cycle, "MS4 X" will implement structural BMP as needed.

5. Implementing and Tracking BMPs

   BMP Summary Sheets should be prepared for both structural and non-structural BMP. For BMP for which pollutant reductions can be calculated or modeled, BMP sheets should include any information used to make the calculations, BMP efficiencies, and maintenance information for the BMP (e.g. to ensure the efficiency used in the calculation is valid into the future or determine if it needs to be adjusted). Include references to support the calculations or modeling.

   BMP Sheets can be prepared for ordinances, resources, or other tools needed for implementation of BMP. Load reductions may be difficult to quantify with these BMP, but these tools may be needed to implement BMP that reduce loading.

6. Educational programs directed at reducing TSS, nutrients and organic matter pollution. Implement a public education program to reduce the discharge of TSS, nutrients and organic matter in municipal stormwater contributed (if applicable) by construction activities, recreational and agricultural activities, etc.

3.1 MS4 Public Meetings

Two Public meetings were held for the Lake Thunderbird TMDL. The first was held on May 24, 2012 and the second on July 23, 2013. These meetings were an opportunity to help educate people about the TMDL modeling and the requirement for development and implementation of the CP, Monitoring Plan (MP, and update of the Phase II Small MS4 SWMP.

The Public Notices can be viewed on http://www.deq.state.ok.us/wqdnew/tmdl/thunderbird/index.html, which also contains presentations, reports, and comments.

3.2 Technical Advisory Committee (TAC) Meetings

Three TAC meetings were conducted during the development of the TMDL. These meeting occurred as follows:

1. September 22, 2011
2. January 17, 2012
3. April 24, 2012

The purpose of the TAC was to inform Stakeholders of technical issues, provide advice on technical issues, and to act as a bridge between DEQ and Stakeholders.

Meeting agendas, presentations, and attendee lists can be viewed on http://www.deq.state.ok.us/wqdnew/tmdl/thunderbird/index.html

4 PROCEDURES TO ACHIEVE WASTE LOAD ALLOWCATION (WLA), BEST MANAGEMENT PRACTICES (BMP)

Given the mainly urban nature of the City of Moore, a diverse and comprehensive approach for meeting the 35% WL reduction and TMDL requirements is needed. This will include:

- Evaluating the need to restore streams (hydro-geomorphology);
- Evaluating, establishing through ordinance, and Installing "low impact development" (LID) stormwater management practices like stormwater retention in public right-of-ways, parking lots, and vacant lots, as well as construction LID practices;
- Evaluating the need to retrofit and/or install ponds or wetlands;
- Evaluating the need to disperse waterfowl populations in water amenities (wildlife management);
- Inspecting and eliminating illicit discharges into the storm sewer system;
- Reducing trash and litter with street sweeping and inlet cleaning;
- Updating ordinances as necessary, such as:
    - Stream Setbacks;
    - Fertilizer application;
    - LID Standards for new and post construction activities;
- Educating the public about what they can do to reduce polluted runoff, including:
    - Pet waste;
    - Livestock waste;
    - Fertilizer application
    - Septic System Discharge

To best achieve the identified WL reduction of 35%, the City intends to implement a strategy that allows for the best identification, placement, and implementation of BMP. The City currently implements stormwater BMP that reduces the contribution of pollutants to Lake Thunderbird, but the City still needs a better understanding of the background contributions from its streams and watersheds. We have divided our approach into three categories:

1. **Watershed Background Assessment** - As indicated in the Final *"Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs" Section 2.2*, the background concentrations of pollutant levels was determined from a special study conducted by Oklahoma Water Resources Board (OWRB); the Oklahoma Conservation Commission (OCC) conducted a special monitoring program for the Lake and its tributaries from April 2008 through April 2009. The City intends to conduct an ambient background concentration study during the first Small MS4 permit term (five years) to better understand the pollutant concentrations that may discharge

from the City. The City believes that this level of analysis will provide the necessary background levels to model pollutant reduction of the established TMDL constituents more effectively. This Background Assessment is presented in the Monitoring Plan attached in Appendix C.

2. **Project BMP** – Capital projects like stormwater retention, bio-swales, and LID standards will be evaluated during the first Small MS4 permit term to develop standards and establish reasonable costs and identify funding mechanisms, resulting in definable asset that can be implemented. The City will be the lead for the evaluation and implementation of these projects and will work in collaboration with DEQ to target available funding and technical assistance to support implementation of pollution controls and management measures. Project BMP to be assessed and selected are presented in Appendix D.
3. **Program BMP** – City support services and operations, including street cleaning, IDDE inspections, and public outreach and education. Program BMP to be assessed and selected are presented in Appendix D.
4. **Partnerships** – Watershed practices that are established as required by regulation or through voluntary implementation by private and non-profit entities such as ACOG.

The following is a description of the strategies and goals for each of the above categories. It should be noted that, while the 35% reduction goal is established, the following strategies are based on reducing the WL to meet the TMDL goals. Identifying more projects than is needed will accommodate changes due to projects and programs being determined not feasible, too expensive, or delayed. It also accommodates assumptions made for changes in allowable WL reductions that are being made for any stream restoration, LID practices, wildlife management IDDE, erosion and sediment control, and public education.

4.1 Baseline Monitoring

The primary goal of the monitoring program is to obtain baseline data on receiving streams in the City for use in determining long-term water quality trends. Baseline monitoring utilized in the determination of the Lake Thunderbird TMDL consisted of monitoring data from one monitoring location from Little River at its crossing of 17th Street in the City. The monitoring consisted of water samples collected for a one year period from April 2008 to April 2009. Though a baseline was reported in the final Lake Thunderbird TMDL a true ambient baseline contribution from the City cannot be determined from one sample location within a one year period. Establishing baseline data requires a multi-year (typically a minimum of five (5) years, *EPA841-R-97-006, May 1997*) monitoring program that provides for variations in drought, above annual average rainfall, and natural disasters such as tornadoes. The baseline utilized in the development of the Lake Thunderbird TMDL should be augmented with additional data to establish actual trends. The City seeks to continue documenting water quality improvements resulting from BMP effectiveness as they have over the past several years encompassing the previous Small MS4 permit term. The City intends to perform baseline monitoring in order to provide: 1) more coordinated and comprehensive baseline water

quality sampling; 2) more sound and reliable ambient baseline data collection; 3) to ensure greater cost effectiveness for proposed BMP; and 4) to establish a truer assessment of the City's impact on stream and watershed water quality.

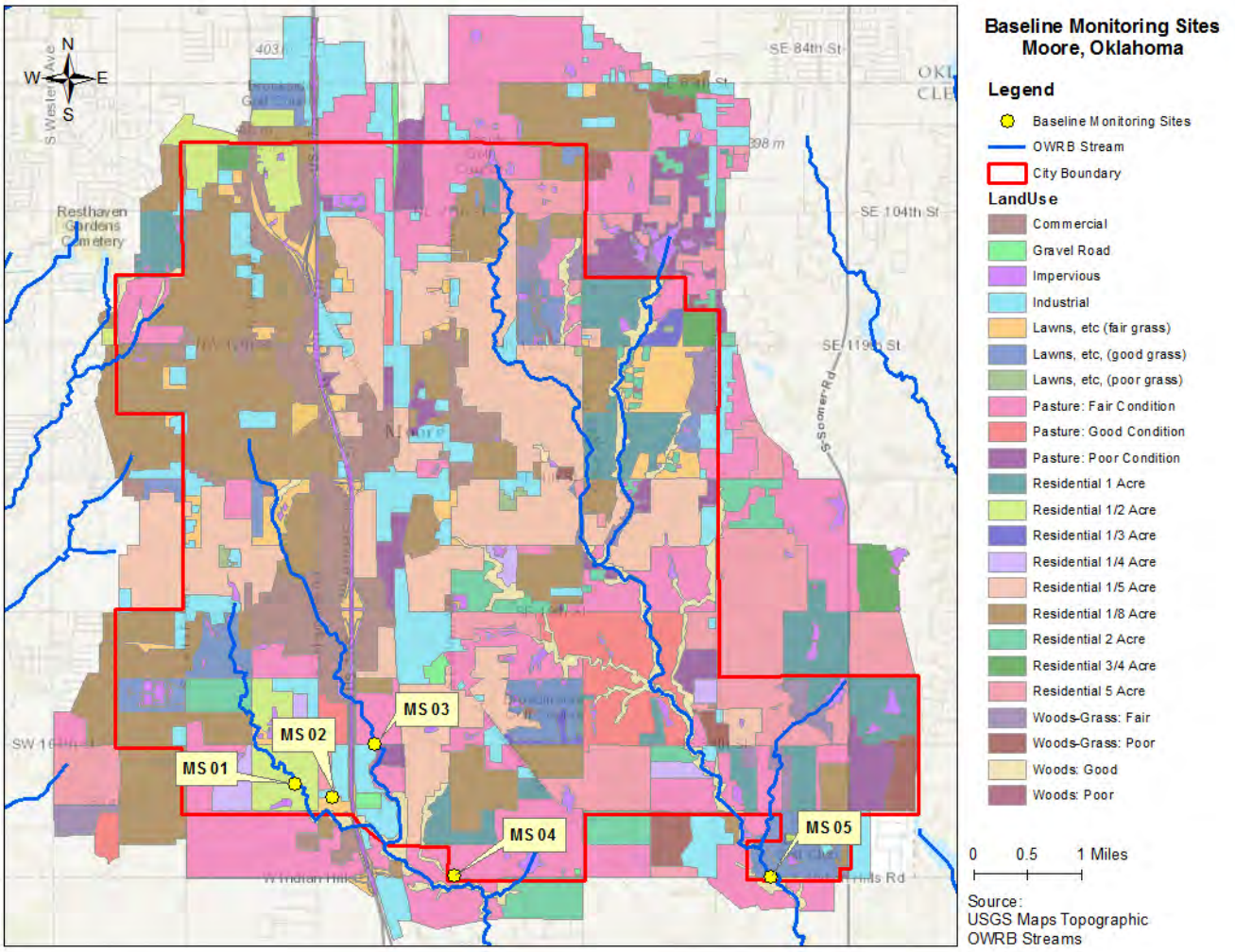
The City has created a Monitoring Plan (MP), see Appendix C, that will effectively monitor each stream at its point of discharge from its jurisdictional area, as well as in-stream locations based on land use, by the end of the permit term. This extent of jurisdictional coverage will allow a reasonable assessment of the City's contribution to the Lake Thunderbird watershed while striving to achieve a balance among the various goals of obtaining valid ambient baseline data, meeting permit compliance, and addressing what is practicable for the City. This plan proposes in-stream baseline watershed monitoring, but seeks to obtain greater statistical robustness of ambient data by sampling quarterly at each monitoring location a minimum of five years to coincide with the City Small MS4 permit which began November 1, 2015. Again, the primary goal of the baseline monitoring during this permit term will be to continue the assessment of the City's impact on receiving stream water quality and to document any improvement resulting from BMP implementation. The data collected during this permit term will build upon the set of TMDL data from each site for a more meaningful trend analysis. The City will identify a capable tracking program and/or develop a database for tracking specific BMP, both project and program; the selected tracking program will have the capability of storing montioring data and will be used for projection analysis and level of current conditions.

A map indicating the monitoring locations is shown in Figure 9 below. Specific locations of sampling sites will be evaluated prior to each sampling year and may be modified to accommodate better access, laminar flow deficiencies, and safety, and will be updated in its Small MS4 Annual report.

Monitoring and sampling metrics and procedures are presented in the City of Moore Lake Thunderbird TMDL Monitoring Plan.

Data that is collected by others, such as Central Oklahoma Master Conservancy District (COMCD) monitoring data obtained in Lake Thunderbird and any additional monitoring data made available from the City of Oklahoma City and the City of Norman will be compared to ambient data collected in the City of Moore to verify pollutant reductions. Additional data may include studies and monitoring performed by the Oklahoma Conservation Commission (OCC).

Figure 9: Baseline Monitoring Locations



4.2 Project BMP

Project BMP consist of three types: Traditional BMP, LID Practices, and Alternative BMP. It is projected that these projects will help reduce the WL by 35%. Types of BMP to be considered can be found in Appendix D, and when implemented will reduce potential pollutant loads by 35% over the three permit terms established in this plan.

Identifying and Prioritizing Project BMP Locations

Project BMP locations are a combination of specific locations (streams, commercial and residential developments, parks, streets, and stormwater infrastructure) and targeted Wards, and will be selected during the first Small MS4 permit cycle using data collected in the attached Monitoring Plan. Additional data may be utilized from other completed TMDL plans such as:

- BMP identified in other DEQ TMDL Reports and Assessments, including the Cobb Creek Watershed and Neosho River Basin.
- Other plans and studies, including the Greater Trinity River Implementation Plan.
- City of Moore Comprehensive Plan (Moore Vision 20/20) project budget assessment for FY2015 – FY2020.

4.2.1 Traditional BMP

For the purposes of the CP, Traditional BMP, also known as structural BMP, are typically practices that treat drainage areas of 5 acres or more, such as stormwater ponds, wetlands, detention basins, and infiltration swales. Unfortunately, the City has very few stormwater management ponds, and limited space to install new ponds or large practices. However, there may be some that were developed prior to 2010 that will be evaluated as candidates for retrofitting. These include the stormwater containment at the Little River shopping area located between S. Telephone Rd. and IH 35 south of SW 19th St.

Opportunities for installing new ponds, wetlands, and large bio-retention facilities are typically in parks or major right-of-ways and will be evaluated and identified during the first Small MS4 permit cycle.

4.2.2 LID Practices

LID practices are small stormwater facilities that treat 5 acres or less, including bio-retention, bio-swales, permeable paving, and rain barrels. Given the small size of these practices, they fit well into the City's urban environment of streets, parking lots, small parks, and school grounds. Unfortunately, they can be expensive to install, limited by existing conduits, utilities, and soil conditions, and conflict with right-of-way needs like on-street parking or community acceptance. LID practices will be evaluated and identified during the first Small MS4 permit cycle using a community planning process led by the Community Development Department. Potential projects will be developed for each of the three Wards and will be assigned a prioritization level if applicable and appropriate. The locations in the Wards will be selected based on a combination of the following criteria:

1. Adjacent to and/or upland from stream restoration projects
2. Adjacent to and/or upland from flood prone areas
3. Adjacent to City storm drain projects or other City initiatives (street sweeping, recycling stations, etc)
4. Other identified stormwater projects, partnerships, and initiatives (new and renovated schools, park master plans, new communities, etc)
5. CIP project locations by other agencies. In particular, The City will coordinate with the Department of Transportation as they develop streetscape and highway plans.

Figure 10: Bioretention cell for street/yard drainage, Los Angeles, CA.
Source: Bill DePoto

4.2.3 Alternative BMP

Alternative BMP, include stream restoration, pervious surface placement and greening.

The City's streams are moderately degraded, with eroding banks and shifting bottoms due to the nature of the soil within the City. Stream restoration may be an opportunity to reduce erosion and sedimentation, increase natural channel flow, and improve the health of the stream and adjacent riparian areas . Stream restoration projects will be evaluated and identified during the first Small MS4 permit cycle. A prioritization matrix will be developed as needed and appropriate.

As noted in the Section 2.1.5 of the CP, many of the City's neighborhoods have been destroyed by tornadoes. While this destruction of properties is catastrophic to the families that inhabited them, they may offer an opportunity as locations for pervious surface placement, small stormwater management practices, and tree planting; although, the available funding available through Disaster Recovery may not allow such practices. Types of BMP to be considered can be found in Appendix D.

4.3 Program BMP

Programs are operations and services that reduce pollutants in stormwater runoff. It is projected that implementation of the BMP will reduce the level of potential pollutants. The following are BMP that the City is currently implementing or will be undertaking:

4.3.1 Street Sweeping

The City currently maintains one street sweeper and sweeps central areas of the City and many of the main commuter routes and corridors on a daily schedule. Other streets in neighborhoods and commercial areas of the City are swept on an as-needed/as-requested basis. The City collects on average six (6) 40 yard dumpsters of street sweeping debris monthly and disposes of it in a contracted landfill.

The City will evaluate the need for additional scheduled cleaning and the need for additional mechanical sweeper purchase during the first permit term of the Small MS4 permit, where the mechanical sweepers can be the most effective. If it determined to be appropriate and successful, the City will look to expand the street sweeping programs.

With increased public education and outreach, the City expects the amount of trash and debris collected by the mechanical street sweeping program to decrease over the course of the permit. A peak amount collected will be established and attributed to the mechanical street sweeping program. Any decrease will be monitored and attributed to the education and outreach programs.

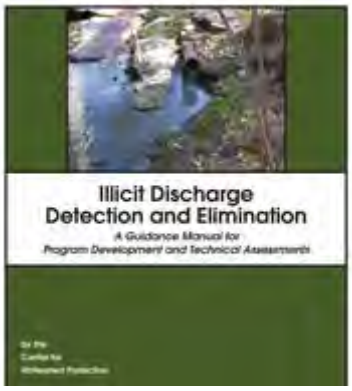
4.3.2 Catch Basins and Inlet Cleaning

The City currently performs catch basin and inlet cleaning on as as-needed basis. The City will evaluate the need for additional scheduled cleaning and the possible need for catch basin/inlet filter placement during the first permit term of the Small MS4 permit, where the filters can be the most cost effective. If it is determined to be appropriate and successful, the City will look to expand the catch basin/inlet filter programs.

4.3.3 Illicit Discharge Detection and Elimination (IDDE) Program

The City's Stormwater Management Office under the Environmental Services Department is responsible for monitoring the quality of the streams and MS4 in the City. Source tracking inspections for chronic sources consist of a visual inspections performed by City crews, and may include one or more field test kits for parameters that monitor the most likely type of stormwater pollution that is indicated (e.g. chlorine residual, pH, dissolved oxygen, conductivity, etc.). The visual inspection will describe and/or quantify the extent of pollution (e.g. floatables, excess algae growth, dead or stressed stream vegetation and organisms, color of water, odors, sediments, etc).

When episodic incidental pollution is reported to the City (e.g. motor oil dumped into a storm drains), the City's stormwater staff will record the date, location, information source, and description of the event. If necessary, a public works crewman will be sent to investigate and determine if the site should be cleaned (e.g. removal of yard waste, containment of oil, etc.). After inspection and/or cleanup, the City keeps a record of all actions taken regarding the incident. Any data collected is included in the City's Annual Report and used to evaluate program effectiveness.



4.3.4 Erosion and Sediment Control Practices

In 2007, the City adopted a new ordinance for erosion and sediment control (Moore City Code, Chapter 15 Article C). The ordinance updates the City's erosion and sediment control law, provides clear guidance to developers and property owners, and provides additional authority to enforce violations. The City also provides continued education and training to developers, contractors and homeowners regarding erosion and sediment control through its Stormwater SAVVY online program. Finally, the City has implemented Service Request system that allows citizens to report any erosion problems, whether construction sites, street work, or from properties by phone and email. Through implementation of ordinances, standards, and inspections the City will be able to quantify benefits related to TMDL pollutant reduction. Metrics for quantified benefits will be developed as baseline pollutant concentrations are established.

4.3.5 Public Education and Enforcement

The City recognizes that meeting the MS4 and TMDL requirements cannot be done solely by government – residents, organizations, schools, and businesses each play a role. In order to facilitate and expand public education and enforcement of stormwater BMP, the City will develop and provide educational material and training in support of the Small Phase II MS4 permit, this CP, and the City's stormwater management efforts, and assist in the promotion and dissemination of this information. When identifying BMP for public education and outreach for trash and litter reduction, pet and agricultural waste, and illegal dumping, the City will provide additional focus and training in target areas where baseline monitoring information indicates higher than expected levels of pollutants. Encouraging the reduction of stormwater runoff from private properties will target those activities "upland" of stream ambient monitoring locations.

4.4 Proposed Methods for WL Reductions

The eligible BMP approved by the City may be limited and can be very expensive in its applicability to urban environments. In order to offset some of the significant costs of the City's TMDL Phase II MS4 and CP Strategy, the City will conduct studies within the first Small MS4 permit term to quantify the nutrient and sediment removal efficiencies of new, nontraditional BMPs, which may include but are not limited to:

- Debris collection systems
- Additional street sweeping
- Public education
- Eroded slope stabilization
- Infrastructure replacement (inflow/infiltration)
- Sanitary sewer overflow (SSO) program
- Pet waste management programs

- Wildlife management programs
- Ordinance updates
- Fertilizer application standards
- Increased IDDE program

4.5 Partnerships

Partnerships are BMP that are installed by the public, private and non-profit sectors, whether as a requirement for development, projects by environmental non-profits, or participation in local sub-state organizations such as ACOG. It is projected that these BMP will reduce the WL to the watershed.

4.5.1 Development Requirements

No person shall conduct, allow or permit land disturbing activity, whether temporary or permanent, on any premises within The City of Moore until a land disturbing permit has been issued allowing such activity pursuant to the provisions of the Stormwater Ordinance. Land disturbance activities are required to meet stormwater management regulations – including City departments, public and private institutions, and developers. Acceptable stormwater management projects include bio-retention, swales, pervious pavement where applicable and appropriate, and impervious surface removal if appropriate.

4.6 Suitability of BMP

Although the City may be considered small in area compared to other MS4 jurisdictions, the variability of the land use conditions, population/development density, and age/size/density of infrastructure have determined the practicality of the implementation of BMP for the Lake Thunderbird watershed. Table 6 illustrates the distribution of where BMP will be targeted.

Table 2: Suitability of BMP

Little River	North Fork of Little River
Develop LID Standards and Implement	Develop LID Standards and Implement
Streambank Stabilization Assessment	Streambank Stabilization Assessment
Street Sweeping	Street Sweeping
Catch Basins and Inlet Cleaning	Catch Basins and Inlet Cleaning
IDDE	IDDE
Erosion and Sediment Control Practices	Erosion and Sediment Control Practices
Public Education and Enforcement	Public Education and Enforcement
Pet and Livestock Waste Management	Pet and Livestock Waste Management
Wildlife Management	Wildlife Management
Fertilizer application standards	Fertilizer application standards
Partnerships	Partnerships
Development Standards	Development Standards

4.7 Prioritization and Benefits

Not all of the BMP identified in Appendix D will be implemented. The City has identified more BMP than what is needed to meet the current TMDL and MS4 permit conditions. As part of the adaptive management process, BMP will be selected after they are prioritized based on several factors, including:

- Equitable distribution of implementation across City watersheds, neighborhoods, and demographics and potential to address environmental conditions;
- Cost effectiveness of practice compared to load reduction capability;
- Collaboration opportunity with other environmental initiatives within the City
- Social and economic benefits to areas surrounding BMP location;
- Public outreach and stewardship opportunities to modify behaviors (increase secondary activity-based BMPs for pollution prevention) and decrease maintenance needs;
- Stream restoration, beyond simple reductions of identified pollutants.

Additionally, while new neighborhoods may be targeted for the location of LID practices, other neighborhoods may be considered during the course of the first Small MS4 Permit period. These adjustments will be made as part of the Adaptive Management process.

Table 3: Benefits of LID, Alternative, and Program BMP

HIGH BENEFIT SOME BENEFIT NO BENEFIT	Pollutant Reduction	Community Engagement	Job Creation	Habitat Restoration	Reduced Flooding	Neighborhood Enhancement	Recreation / Open Space	Public-Private Partnership / Funding Diversity
Stream Restoration								
Tree Planting								
Using vacant land for stormwater management								
Removing impervious surfaces where practicable								
Bio-retention - public space								
Bio-retention - private								
Erosion and Sediment Control								
Permeable Paving								
Street Sweeping								
Inlet Cleaning								
Illicit Discharge Detection and Elimination								
Public Education								
Fertilizer application standards								
Erosion and sediment control enforcement								
Pet and Livestock Waste Management								
Wildlife Management								

4.8 Public Outreach

In order for the MS4 CP to be successful, it will need an informed public and engaged partners to review and provide advice on the Plan as well as identify needs and issues that will need to be addressed. The City recognizes and is committed to the role that public outreach and stewardship will play if improved water quality conditions are going to be achieved. This will require engaging a broader and more diverse set of stakeholders who can serve as leaders and champions for clean water in their neighborhoods, including greater participation from minority and faith-based groups, business groups, schools, and neighborhood associations. Additionally, this approach requires working collaboratively with other City departments to look for better and more efficient ways to communicate messages,

cross-train, and create teamwork that results in greater engagement, greater awareness, and sustained changes in behavior.

In order to facilitate and lead public outreach and education for the MS4 CP, the City identified the Community Development Department as the lead department for stormwater quality management. The responsibilities of the Community Development Department are:

- Provide community planning and outreach to neighborhoods where stormwater BMP are to be located;
- Coordinate with other City departments, non-profits, and community partners on the planning and implementation of stormwater BMP;
- Serve as the City's "point person" with other City initiatives, such as contracting with Trifecta Communications to produce informational videos for the community and City Hall. Videos such as "Inside Moore" can be seen monthly on television, and involve the people, places and events that make up Moore, Oklahoma. Each month programs covering topics from local government and economic development to unique people and local events appear;
- Coordinate and staff the Environmental Services Division;
- Coordinate and host regular outreach meetings with stakeholder groups;
- Serve on partner-led committees and work groups, including the Moore Vision 20/20 Plan and Comprehensive Stormwater Management and Drainage Plan;
- Develop educational and training material in support of the MS4 CP and the Department's stormwater management efforts, and assist in the promotion and dissemination of this information;
- Provide outreach and tracking for the stormwater BMP implementation;
- Collect and track information on stormwater management projects by industrial and construction General permit holders; and
- Coordinate grant development and administration for Federal, State, and private foundation funding, as well as administer any City grant programs.

The Community Development Department will work closely with other departments within the City, including Public Works and Parks and Recreation.

As outlined above, public outreach will consist of a variety of methods, some led by the City and others as a partner with other agencies, and other identifiable and practicable non-profit led efforts.

4.8.1 Leadership and Engagement

The following efforts will be led by the Community Development Department:

Technical Work Group - The City will be forming a work group in 2016. The purpose of this work group is to share information, resolve issues, and foster collaboration concerning the implementation of stormwater management projects. Members of the work group will be from City Departments who are actively working on putting stormwater projects in the ground, and/or implementing specified BMP. While this group is independent of the SWAC, it will report to the Committee at least once a year.

Annual Public Progress Meeting - Beginning in FY2016, the City will hold a public meeting to present progress on the MS4 CP. The presentation will be a summary of our Annual Report, as well as a look at projects, programs, and partnerships for the coming year.

4.8.2 Partnering and Collaborating

In addition to leading outreach efforts, the City will continue to serve on partner-led initiatives and work groups, including:

Association of Central Oklahoma Governments - ACOG's Water Resources Division helps local governments to maximize the use of ground and surface water resources. This includes planning, management, protection and research of potable water supplies.

4.8.3 Community / School Outreach and Education

The City Maintains the website http://www.cityofmoore.com/stormwatersavvy Stormwater Management and addresses and provides an overview of the City's stormwater program and initiatives – including compliance with the City's current Small Phase II MS4 Stormwater Permit. The web site includes updates on capital projects, events, public meetings, information on how to reduce stormwater pollution, and customer support. MS4 public meetings, plans, and annual reports are also presented. Information posted on the web site is also posted on City's Facebook page and Twitter account.

In addition to web and social media, the City's Community Development Department regularly provides presentations at community and civic meetings, including information on stormwater methods that residents can undertake to reduce stormwater runoff. Increased attention may be given for outreach to minority communities, faith-based organizations, and businesses – not the typical water quality groups – as well as to young adults (ages 25-34) who tend to be more environmentally active. This will be accomplished by:

1. Providing regular outreach to community associations, merchant groups, and faith-based organizations; and
2. Attending non-traditional events like the Moore Pride Red Ribbon Parade and other City Council and special meetings and events.

The Community Development Department will also assist the City's Community Partners with educational programs and outreach to public schools, including information on trash reduction, recycling, pet waste, and storm drains, with the connection between these efforts and the health of the Lake Thunderbird watershed. In order to support these outreach efforts, the Environmental Services Division will implement the following:

1. Create a "one-stop shop" for resources and information on reducing stormwater pollutants on the City website.
2. Implement a stormwater planning and outreach team in the Community Development Department.
3. Create a consistent set of informational sheets, messages, and signage for reducing stormwater pollutants. Given the number of BMP that may be installed across the City, the Community Development Department will focus on helping people understand:
    a. How the BMP is reducing and cleaning stormwater;
    b. Other community and environmental benefits;
    c. How the BMP is being paid. In addition signage can recognize any funding partners as well as who to contact if there are any problems;
    d. Create a pet waste campaign. Pet waste contributes to increased bacteria levels in stormwater runoff. The campaign will include community outreach and developing signage and educational information.

4.9 Maintenance

Having a successful CP does not stop with the installation and implementation of the BMP. Maintaining public stormwater BMP is critical to their ability to function as designed. This was one of the top considerations during the development of the CP.

While EPA guidance focuses on the function of BMP, a majority of these practices will be very visible to public, so they need to look good as well. Thus, maintenance can be classified as aesthetic and functional.

- Aesthetic maintenance focuses on how the stormwater facility looks, making sure that it is litter and trash free and that the plants are healthy and attractive. This includes routine maintenance like removing litter and debris, weeding, and mulching. Aesthetic maintenance provides opportunities for collaboration with residents, businesses, and civic groups.
- Functional maintenance makes sure that the facility is properly removing pollutants and filtering stormwater. This includes sediment removal, soil and medium replacement, and inspecting and repairing structural integrity. Functional maintenance requires a broader skill set; it is more than mowing or landscaping.

4.9.1 Current Maintenance Practices

Multiple departments have installed, and are responsible for, stormwater BMP, including the Community Development, Public Utilities, Public Works, and Parks and Recreation. The responsibility for maintaining the BMP rests with each Department. Some departments have their own crews who maintain the BMP, while other departments use outside contractors to provide these services.

In meetings with city departments, the following was identified:

- Need for an accurate list of facilities and corresponding responsible departments;
- Need for maintenance standards; and
- Need for specific training on stormwater BMP maintenance for City staff, contractors, community groups, and partners.

The current system can be more effective and efficient. In order to improve maintenance of current BMP, as well as meet the growing number of stormwater BMP that may be utilized to meet our MS4 and TMDL requirements, the City will establish a Stormwater BMP Maintenance Team that will maintain all city-owned BMP, regardless of the department that installed or is responsible for the facility.

With each set of BMP, more crews may need to be hired for preventative maintenance. To determine the number of maintenance staff needed, the City will determine in the first MS4 permit term number and size of crew that can maintain large BMP and/or small BMP, and the watershed size served per year.

Depending on the length of time needed to establish the Stormwater BMP Maintenance Team, the consolidated maintenance might be contracted.

The goal is to have a Stormwater BMP Maintenance Plan approved by 2020.

4.9.2 Stewardship

As identified in Appendices B - D, the City's BMP may be installed at parks and schools, in the public right-of-way, and on vacant lots – highly visible locations that are in communities and neighborhoods. While the City recognizes that the responsibility of these stormwater facilities lies with the city, they also offer opportunities for community partnership and stewardship for aesthetic maintenance.

The City will work to identify and potentially partner with organizations to promote existing BMP, like Stormwater SAVVY as well as identify education and training needs to help communities adopt maintenance practices. To further support community stewardship, the creation of BMP education and training curriculums may be studied.

The Environmental Services Division may offer community members free or subsidized materials useful to the mitigation of polluted urban runoff, including, but not limited to: mulch, plants, soil media, leaf bags, rain barrels, etc. The Community Development Department will also offer design

assistance and advice for LID and other stormwater remediation measures after establishing and adopting standards.

Additionally, the City will explore developing a program that will give community groups incentives to become stewards of BMP in their neighborhood. This will be modeled on successful Adopt-A-Stream and Adopt-A-Highway programs. Target groups will include corporate partners, local businesses, churches, neighborhood associations, and concerned individuals that are willing to commit to maintain and monitor one or more BMP.

5 MILESTONE SCHEDULE

To promote continual progress, the City has established the following milestone increments to meet the TMDL WL requirements. There are two categories of milestones:

1. Program enhancement are actions needed to increase resources and improve the implementation processes to accelerate meeting the WL.
2. Implementation actions are on-the-ground activities that will result in nutrient and sediment load reductions.

The City submits this CP Milestones to DEQ describing how it plans to reduce pollution from sources within its watershed.

The City's milestones are programmatic (staffing, policies and guidelines, program enhancement, etc.) and projects (stream restorations, LID, etc).

Table 4: Milestones Schedule

Permit Term	Description
	Program Milestones
2015-2020	Complete the City of Moore Comprehensive Storm Water Management and Drainage Plan
	Identify education needs and cost for, and begin program issuance: o Pet waste; o Livestock waste; o Fertilizer application o Septic System Discharge
	Perform Ambient Background Assessment monitoring program
	Establish and implement Lake Thunderbird specific IDDE protocols and procedures and begin increased performance as appropriate
	Evaluate the need to restore streams (hydro-geomorphology) and establish design standards and requirements
	Evaluate and establish need to update ordinance "low impact development" (LID) stormwater management practices, and develop standards as appropriate
	Identify need for increased staff • Establish staff qualification criteria • Develop budget requirements for additional staff
	Evaluate the need to disperse waterfowl populations in water amenities (wildlife management) and develop standard procedures as necessary

Permit Term	Description
	Program Milestones
2015-2020	Evaluate the need to retrofit and/or install ponds or wetlands and begin development of design standards as appropriate.
	Identify the need for increased preventative inlet cleaning in targeted neighborhoods of the City. The effort will be in collaboration with inlet screen installation and expanded street sweeping operations. • Develop costs for performance • Identify funding sources
	Establish and perform increased Construction site inspection schedules in coordination with DEQ
	Develop the protocols for the Technical Work Group. • Identify members of the Technical Work Group • Establish goals • Conduct development meetings with identified City departments
	Identify members and form the Technical Work Group • Establish protocols for participation as necessary • Identify members as appropriate • Approve members • Conduct meetings
	Perform cost to benefit analysis of TMDL program to date

Permit Term	Description
	Program Milestones
2020-2025	Develop Ambient Background Assessment Monitoring Program Report and submit to DEQ for review and consideration
	Develop feasibility studies for private participation incentive programs
	Complete feasibility study for the use of recycled materials in BMP construction as a sustainable alternative to material disposal.
	Assess performance of BMP implementation based on monitoring data collected in the City as well as monitoring data from sampling and analysis on Lake
	Increase staff as appropriate by hiring or contracting for utility maintenance
	Begin installing LID practices as appropriate
	Begin installation of Retrofit projects as appropriate
	Begin restoration of streams (hydro-geomorphology) as appropriate
	Adopt new ordinance for: • LID • Erosion and sediment control • Pet waste • Wildlife management • Vehicle washing
	Create a consistent set of informational sheets, messages, and signage for reducing stormwater pollutants.
	Establish capital projects like stormwater retention, bio-swales, and LID standards evaluated and identified during the first Small MS4 permit term along with reasonable costs and the identification of funding mechanisms that result in definable assets that can be implemented as appropriate
	Increase staff by hiring or contracting as appropriate
	Complete an analysis of city-owned facilities for possible stormwater retrofits
	Create an MOU with Moore Beautiful to incorporate trees and landscaping into stormwater BMP projects
	Perform cost to benefit analysis of TMDL program to date

Fiscal Year	Description
	Project Milestones
2020-2030	Develop new monitoring program as appropriate
	Reassess BMP Practices
	Update Ordinance as necessary
	Perform cost to benefit analysis of TMDL program to date
	Continue BMP implementation as appropriate
	Update the Final Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs

5.1 Tracking Mechanisms

The City will track all BMP (both planned, implemented, and/or constructed) using an acceptable database and GIS tracking tool. The tracked data will coincide with MS4 permit OKR04 reporting requirements. A majority of BMP implementation will be reported through the permitting process for construction activities.

The Program and BMP milestones will also be updated as per the TMDL CP and Phase II MS4 permit requirements.

5.2 Staffing

Under this CP, the pace of implementation is required to increase. Meeting the MS4 and TMDL requirements may require an increase in the design and construction of stormwater capital projects, inspection of facilities, water quality testing and analysis, community outreach, and maintenance. This again may require increased staffing and/or contractual services. New employees may include engineers, scientists, inspectors, technicians, community planners, and maintenance staff (Table 5).

The most significant increases will be for inspections (in order to increase the number of construction and industrial site inspections, as well as installed BMP), BMP implementation (providing dedicated project management and in-house design and engineering), and education and outreach (build community capacity by targeting new partner groups that provide the necessary leadership, oversight, and sustained effort to change behaviors and foster stewardship).

Table 5: Anticipated Staffing Related to the CP

Program	Current	Future Increase
Plan Review & Inspections	1	TBD
Water Quality Monitoring & IDDE	1	TBD
Project Implementation (Engineering & Construction)	1	TBD
Education & Outreach	1	TBD
Stormwater BMP Maintenance	0	TBD
Inlet Cleaning	1	TBD
MS4 Monitoring and Sample Collection	1	TBD
TBD - To be determined		

6 ADAPTIVE MANAGEMENT

Sound CP implementation strategies require ongoing assessment and effective adaptation to respond to changing conditions, new technologies, and lessons learned. This will be the basis of the plan that will be used when WLA are not met and the projected funding is inadequate.

Adaptive management requires monitoring of a variety of measures that can be used to determine whether progress is being made towards meeting the MS4 and TMDL water quality objectives. Ultimately, it is the in-stream water quality and the loading limits with respect to the TMDL that determine the success of implementation; however, there are many interim measures that can also be correlated to success, which are worth pursuing.

If a TMDL is established for any waterbody into which a MS4 (City) discharges prior to the date that the MS4 submits a NOI, and if that TMDL includes a wasteload allocation (WLA) or load allocation (LA) for a parameter likely to be discharged by the City, the City's discharges must meet any limitations, conditions, or other requirements of this CP associated with that WLA, LA and/or TMDL within any timeframes established in the TMDL. Monitoring and reporting of the discharges may also be required as appropriate to ensure compliance with the TMDL. The City must adopt any WLAs assigned to its discharges specified in the TMDL as measurable goals in the SWMP. If the TMDL relies on a BMP-based approach, effective implementation of additional TMDL related BMP will be sufficient to implement applicable WLAs. This BMP-based approach is consistent with EPA memoranda dated November 22, 20121 (EPA 2002) and November 26, 20142 (EPA 2014). If the TMDL or watershed plan specifies additional requirements, the MS4 must also meet these additional requirements.

For many TMDL CP strategies, it may be difficult to formulate individual effectiveness in terms of pollutant load reductions, but collectively, the monitoring and tracking that occurs should provide adequate insight into the overall effectiveness of the CP strategy. In addition to the monitoring and assessment, the City will be reporting results on an annual basis as part of their OPDES MS4 Permit annual report. The MS4 Permit requires annual reporting of the following:

- The status of the City's compliance with permit conditions, an assessment of the appropriateness of the identified best management practices, progress towards achieving the statutory goal of reducing the discharge of pollutants to the Maximum Extent Practicable (MEP), and progress toward achieving the measurable goals for each of the MCMs;
- Results of information collected and analyzed, if any, during the reporting period, including monitoring data used to assess the success of the SWMP at reducing the discharge of pollutants to the MEP;
- A summary of the stormwater activities the City plans to undertake during the next reporting cycle (including an implementation schedule);

- Proposed changes to the SWMP, including changes to any BMP or any identified measurable goals that apply to the SWMP elements;
- Description and schedule for implementation of any additional BMP or monitoring that may be necessary to reduce/eliminate the discharges of the pollutant of concern into impaired waters on the 303(d) list;
- Description and schedule for implementation of any additional BMP or monitoring that may be necessary to ensure compliance with any applicable TMDL or watershed plan in lieu of a TMDL;
- Notice that you are relying on another government entity to satisfy some of your permit obligations (if applicable) and a copy of the written agreement with that entity.

The City will build upon annual reporting that has historically occurred to meet permit requirements and will supplement this reporting with tracking table summaries that quantify implementation activities for the range of strategies pursued during that year so that the following can be incorporated and evaluated:

- Adherence to the TMDL CP and project schedule
- Meeting milestones
- New technology and innovative practices
- Changes to any stormwater laws, rules and regulations
- Resource availability
- Monitoring results

If sufficient progress is not demonstrated in this evaluation, you will be required to submit an updated compliance plan and implementation schedule within 6 months. Noncompliance may subject the permittee to enforcement action.

As described in the Public Outreach section, the Stormwater Advisory Committee will review the MS4 Permit Annual Report and the adaptive management plan on an annual basis. Any changes to the CP as a result of adaptive management will be shared through the Stormwater Advisory Committee members and on http://www.cityofmoore.com/stormwatersavvy.

7 FINANCIAL STRATEGY

7.1 Stormwater Utility

The estimated cost for capital projects will be developed during the first MS4 permit cycle. In order to fund identified projects and the operations to comply with this CP and the MS4 permit, the City will assess and may propose Stormwater Utility Fee assignment. It provides:

- A more equitable system: contributors to stormwater runoff share based on a metric directly connected with the service provided.
- A stable level of funding: ensures that stormwater management receives adequate support, independent of the City's tax rate and General Fund.
- A dedicated fund: revenues are used solely for stormwater management purposes.

The Stormwater Fee provides a sustainable, dedicated revenue source for maintaining, operating, and improving the City's stormwater management system, with the ultimate goal of reducing flooding and erosion, and keeping our waterways cleaner.

7.2 Water Quality Trading

The City will evaluate the benefit of any water quality trading program during the implementation of this CP. At this time no water quality trading considered as a tool to achieve the overall WLA of the TMDL.

8 REFERENCES

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APPENDIX A

"Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs"

Appendix A is hereby included by reference. The Report may be obtained at,
http://www.deq.state.ok.us/WQDnew/tmdl/thunderbird/LakeThunderbirdFinalTMDL_ReportNov2013.pdf

APPENDIX B

Summary of BMP

The City will assess and determine within the first Small MS4 Permit term, appropriate and cost effective BMP to mitigate and reduce the level of potential pollutants contributing to the Lake Thunderbird TMDL.

The Appendices attached in Appendix B will be used to report and track BMP identification, implementation, design, construction, and associated cost.

APPENDIX B: Summary of Projects

CP Project ID	BMP Type	Watershed	Location	Estimated Pollutant (lbs/yr) Removal			Estimated Capital Cost	Schedule to Implement	Schedule to Design	Start Construction FY
				TN	TP	TSS				
Baseline Monitoring										
Subtotal Baseline Monitoring:										

APPENDIX B: Summary of Projects

BMP Type	Watershed	Location	Estimated Pollutant (lbs/yr) Removal			Estimated Capital Cost	Schedule to Implement	Schedule to Design	Start Construction FY
			TN	TP	TSS				
Project BMP									
Traditional BMP									
LID Practices									
Alternative BMP									
Subtotal Project BMP:									

APPENDIX B: Summary of Projects

BMP Type	Watershed	Location	Estimated Pollutant (lbs/yr) Removal			Estimated Capital Cost	Schedule to Implement	Schedule to Design	Start Construction FY
			TN	TP	TSS				
Program BMP									
Street Sweeping									
Catch Basin and Inlet Cleaning									
Illicit Discharge Detection and Elimination (IDDE) Program									
Erosion and Sediment Control Practices									
Public Education and Enforcement									
Subtotal Program BMP:									

APPENDIX C

Monitoring Plan

APPENDIX D

BMP for Evaluation and Selection

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CITY OF MOORE MS4 AND LAKE THUNDERBIRD TMDL MONITORING PLAN

November 2015 - Final

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1.0 Introduction

Lake Thunderbird is on Oklahoma's 2012 303(d) list for impaired beneficial uses of public/private water supply and warm water aquatic community life. Causes of impairment have been identified in the Oklahoma Department of Environmental Quality (DEQ) Final Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs, approved by the EPA on November 13, 2013, as low oxygen levels, high levels of chlorophyll-*a*, and high turbidity (DEQ, 2010a). Lake Thunderbird is designated by the Oklahoma Water Quality Standards (OWRB 2011) as a Sensitive Water Supply (SWS) since the Lake serves as the primary public water supply source for the cities of Norman, Midwest City and Del City. There are three municipalities within the Lake Thunderbird watershed: the City of Moore, the City of Norman and Oklahoma City.

Stormwater discharges are highly variable both in terms of flow and pollutant concentration, and the relationships between discharges and water quality can be complex. For municipal stormwater discharges in particular, the current use of system-wide permits and a variety of jurisdiction-wide BMPs, including educational and programmatic BMPs, does not easily lend itself to the existing methodologies for deriving numeric water quality-based effluent limitations. These methodologies were designed primarily for process wastewater discharges which occur at predictable rates with predictable pollutant loadings under low flow conditions in receiving waters.

The United States Environmental Protection Agency (EPA) has recognized these problems and developed permitting guidance for stormwater permits. [See "Interim Permitting Approach for Water Quality-Based Effluent Limitations in Stormwater Permits" (EPA-833-D-96-00, Date published: 09/01/1996)] Due to the nature of stormwater discharges, and the typical lack of information on which to base numeric water quality-based effluent limitations (expressed as concentration and mass), EPA recommends an interim permitting approach for NPDES stormwater permits which is based on BMPs. "The interim permitting approach uses best management practices (BMPs) in first-round stormwater permits, and expanded or better-tailored BMPs in subsequent permits, where necessary, to provide for the attainment of water quality standards." (*ibid.*)

A monitoring component is also included in the recommended BMP approach. "Each stormwater permit should include a coordinated and cost-effective monitoring program to gather necessary information to determine the extent to which the permit provides for attainment of applicable water quality standards and to determine the appropriate conditions or limitations for subsequent permits." (*ibid.*)

The goals of the monitoring program is to; 1) establish the effectiveness of the selected BMPs and, 2) demonstrate progress toward achieving the waste load allocations (WLA) and load allocations (LA) reduction goals of the TMDL and eventually attaining water quality standards in

Lake Thunderbird. The monitoring results should also be used to refine TSS, nutrient and organic matter controls in the future. With three permitted MS4 entities in the watershed, it is likely that a cooperative monitoring program would be more cost effective than three individual programs. Individual permittees are not required to participate in a coordinated program and are free to develop their own program if desired. Specific requirements for an effective monitoring and tracking program are as follows:

A. Within 24 months of EPA approval of this TMDL, each permittee shall prepare and submit to the DEQ either a TMDL monitoring plan or a commitment to participate in a coordinated regional monitoring program. Unless disapproved by the Director within 60 days of submission, the plan shall be approved and then implemented by the permittee. The plan or program shall include:

    a. Evaluation of any existing stormwater monitoring program in relation to TMDL reduction goals.

    b. A detailed description of the goals, monitoring, and sampling and analytical methods.

    c. A map that identifies discharge points, stormwater drainage areas contributing to discharge points, and within each such drainage area, mapping the conveyance system.

    d. A list and map of the selected TMDL monitoring sites, which may include sites on receiving water bodies.

    e. Consideration of methods for evaluating pollutant loading in stormwater discharges from construction and industrial sites, such as monitoring requirements for site operators or small drainage monitoring for multiple construction sites.

    f. The frequency of sample collection to occur at each station or site: at a minimum, sample collection shall include at least one representative sample of a stormwater discharge from at least 50% of the major discharge points discharging directly to surface waters of the state within the portion of the TMDL watershed in the MS4 area. A major discharge point is a pipe or open conveyance measuring 36 inches or more at its widest cross section.

    g. The parameters to be measured, as appropriate for and relevant to the TMDL: at a minimum, the sample shall be analyzed for total phosphorus (TP), total nitrogen (TN), total suspended solids(TSS), and CBOD20.

    h. A Quality Assurance Project Plan that complies with EPA requirements [EPA Requirements for QA Project Plans (QA/R-5)].

B. The monitoring program shall be fully implemented within three years of EPA approval of this TMDL.

C. With the obtained monitoring and tracking data, periodically evaluate the effectiveness of individual BMPs if possible and the effectiveness of the overall TMDL compliance plan to ensure progress toward attainment of the waste load allocations. If progress cannot be shown, the MS4 permittee must revise its TMDL compliance plan to further its load reduction efforts.

2.0 Lake Thunderbird TMDL Monitoring Plan Requirement

This Monitoring Plan (MP) addresses the obligation of the City of Moore (City) to submit to the DEQ and implement the MP to establish the effectiveness of the selected BMP and demonstrate progress toward achieving the reduction goals of the TMDL and eventually attaining water quality standards in Lake Thunderbird. The monitoring results will also be used to refine TSS, nutrient and organic matter controls in the future.

This MP addresses the requirements and goals to implement a TMDL monitoring program providing the data necessary to review and update the Lake Thunderbird TMDL including:

1. A City watershed-wide MP to determine baseline ambient levels of interim and/or final Total nitrogen, Total phosphorus, TSS, and CBOD20 used in WLAs and LAs.
2. A City watershed-wide MP to determine compliance with the Lake Thunderbird TMDL, including meeting the established WLAs and LAs.

3.0 City of Moore TMDL Monitoring Plan

The MP described herein is consistent with the Final Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs, approved by the EPA on November 13, 2013, requirements and considers monitoring recommendations presented by the EPA and DEQ to track compliance with the TMDL's and associated load allocations, as well as, measuring compliance to numeric water quality targets defined as WLA and LA. However, due to budgetary and staffing considerations, as well as, significant gaps in information required to understand in-stream and watershed processes this MP considers a phased approach. This approach will enable the City to focus resources on the most prominent data gaps and limitations to the TMDL calculation, while maintaining the prescribed minimum level of compliance monitoring.

The MP is proposed to be conducted in two general phases. Phase 1 of this program focuses on data issues regarding ambient baseline concentration processes and the "linkage analysis" relating external pollutant loading to in-lake response and the associated predicted TMDL concentrations compared to numeric water quality targets. This key point, ambient and/or baseline concentrations in the TMDL calculation is not well understood and has a direct influence on the assessment of the required external load reductions to Lake Thunderbird. Additionally, in consideration of wet-weather events during this phase of TMDL MP implementation, the City will be prepared to perform wet-weather watershed monitoring. Phase 1 monitoring is not a requirement of the TMDL, and though it is suggested as a BMP in the City of Moore Compliance Plan (CP) as well as this MP, it will be performed only as deemed necessary and appropriate by the City. If Phase 1 monitoring is not financially feasible or practicable for the City, it may be discontinued at the City's discretion.

Phase 2 will be performed concurrently with Phase I, and focuses on intensive study in the watershed. Specifically, sample collection will include the collection of at least one representative sample annually of a stormwater discharge from at least 50% of the major discharge points discharging directly to surface waters of the state within the portion of the TMDL watershed of the City. A major discharge point is a pipe or open conveyance measuring 36 inches or more at its widest cross-section.

The duration of Phase 1 monitoring is anticipated to be approximately 5-10 years depending on the completion of in-stream studies and the amount of data collected under Phase 1 and establishment of data trends. Since the implementation schedule of the Lake Thunderbird TMDL allows a multi-year approach, it is envisioned that the results of Phase 1 monitoring will be used for the possible review and revision of the TMDL. The process of conducting the more intensive in-stream monitoring program while proceeding with the Phase 1 intensive watershed monitoring program is reflective of the adaptive management approach in addressing the Lake Thunderbird TMDL.

3.1 Phase 1: Watershed Baseline Assessment

Phase 1 monitoring extends the previous TMDL data collection effort for trend analysis, and also focuses on collecting key information to address identified data gaps. Phase 1 monitoring sites within the Lake Thunderbird watershed are consistent with those performed during the development of the Lake Thunderbird TMDL. Sampling methods at the stream monitoring sites will be consistent with existing Quality Assurance Project Plans (QAPPs); a QAPP has been developed, but may be modified after selection of a private contractor to perform the actual monitoring. Frequency of sampling is to be performed quarterly, with sampling occurring from January through December. Baseline sampling will be pre-scheduled to occur on specific dates within the each quarter. However, during the Spring (March - May) and Winter (November-February) quarters, the sampling events will be based on wet-weather events. A wet weather event is generally defined as storm events that are greater than 0.1 inch and at least 72 hours from the previously measurable storm event. The City however intends to utilize a 168 hour timeframe as the cutoff for the antecedent dry period because at 168 hours, a pollutant build-up time of one week has occurred, thus providing a more robust statistical representation. If wet-weather events cannot be collected due to lack of rainfall, safety, or inability to collect, samples will be collected as ambient samples on the last day of the quarter.

Monitoring is scheduled to begin November 2016. This will provide the City adequate time to select a contractor to perform monitoring, provide baseline data collection, purchase the necessary monitoring and sampling equipment, and select a laboratory with DEQ accreditation.

Monitoring sites for the baseline assessment are presented in Figure 3-1. Sub-watershed contributions are presented in Figure 3-2. Individual monitoring site locations are presented in Figures 3-3 through 3-7 respectively. Consistent with TMDL recommendations and the EPA Urban Stormwater BMP Performance Monitoring, 2009, sampling for Phase 1 includes multiple samples (5 samples for general water quality and TMDL constituents) for two storms per year and two ambient scheduled samples.

Table 3-1 includes a summary of the watershed monitoring sites. Sections 3.1.1 and 3.1.2 provide additional discussion of the monitoring components, including the specific parameters to be measured, and summarizes the investment required for implementation of each of the components of the monitoring plan.

Figure 3-1. TMDL Baseline Monitoring Sites for Phase 1 Watershed Monitoring

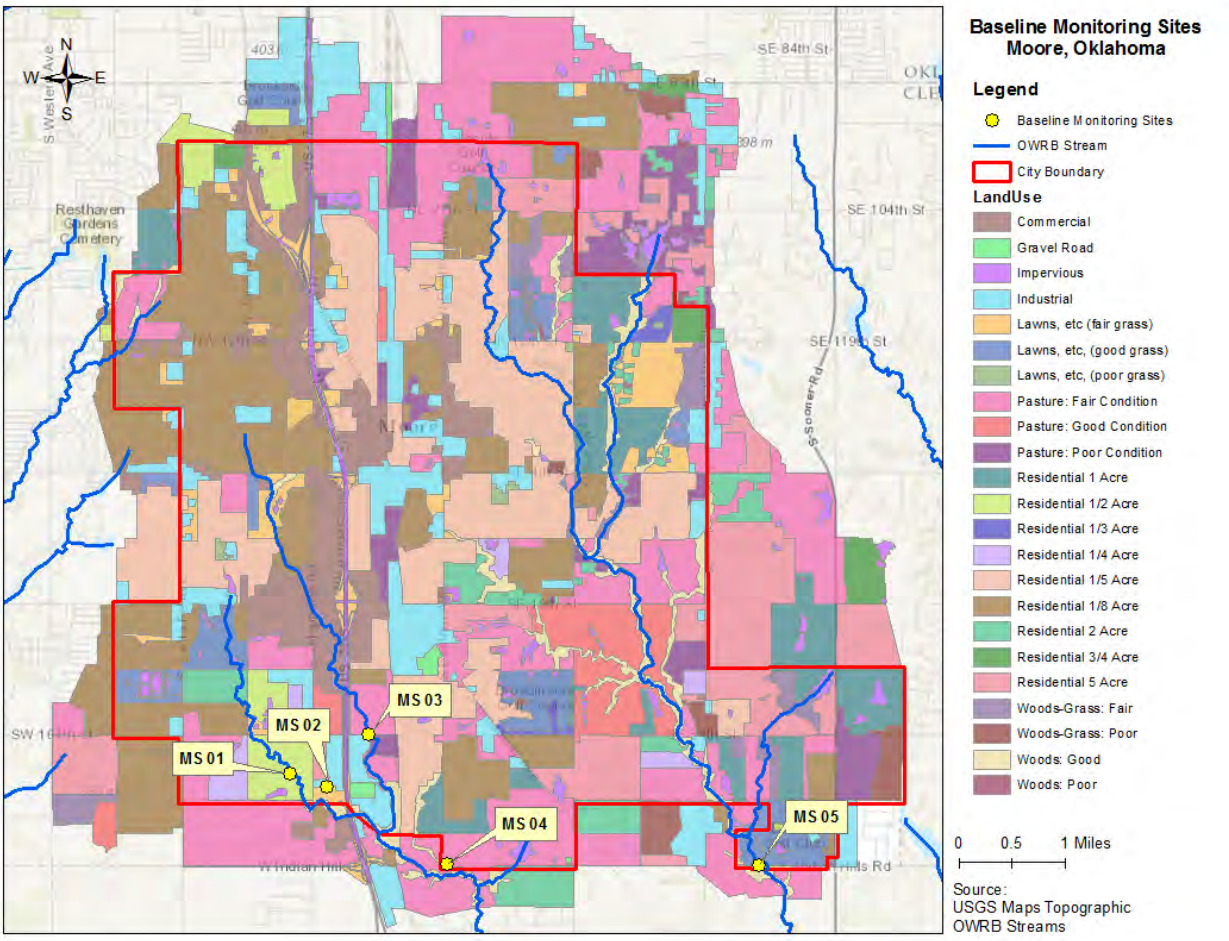


Figure 3-2 TMDL Sub-watershed Contributions

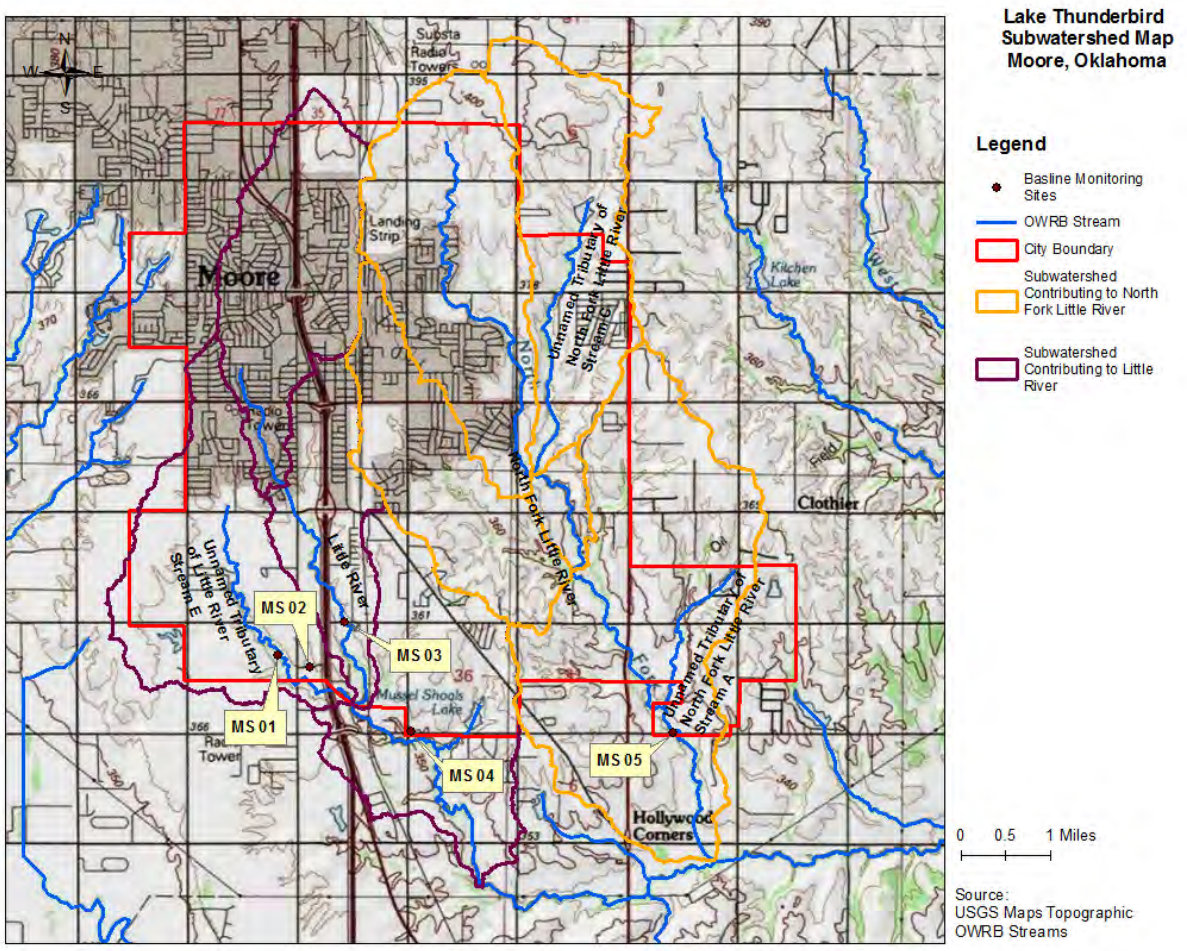


Figure 3-3 Baseline Monitoring Site 01

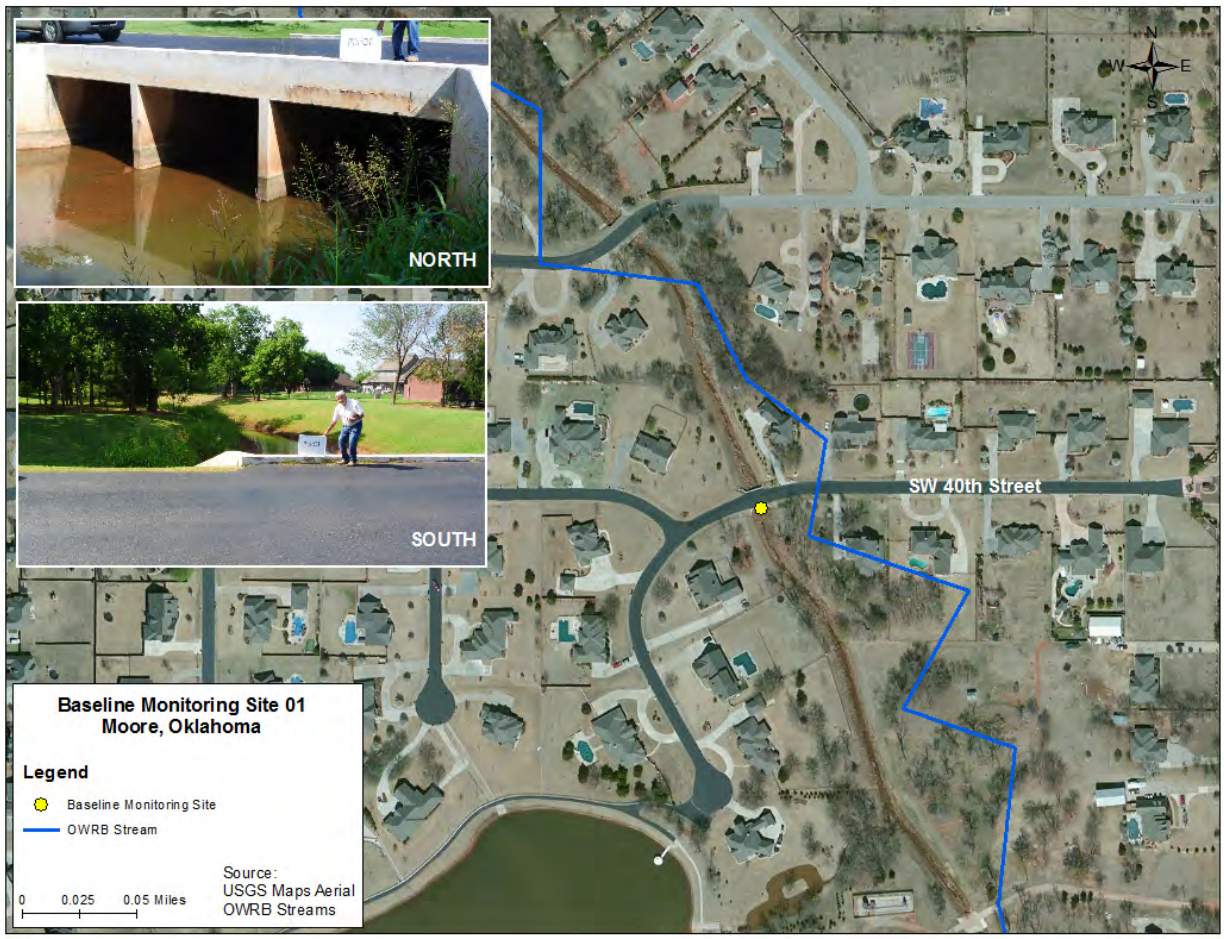


Figure 3-4 Baseline Monitoring Site 02

Figure 3-5 Baseline Monitoring Site 03

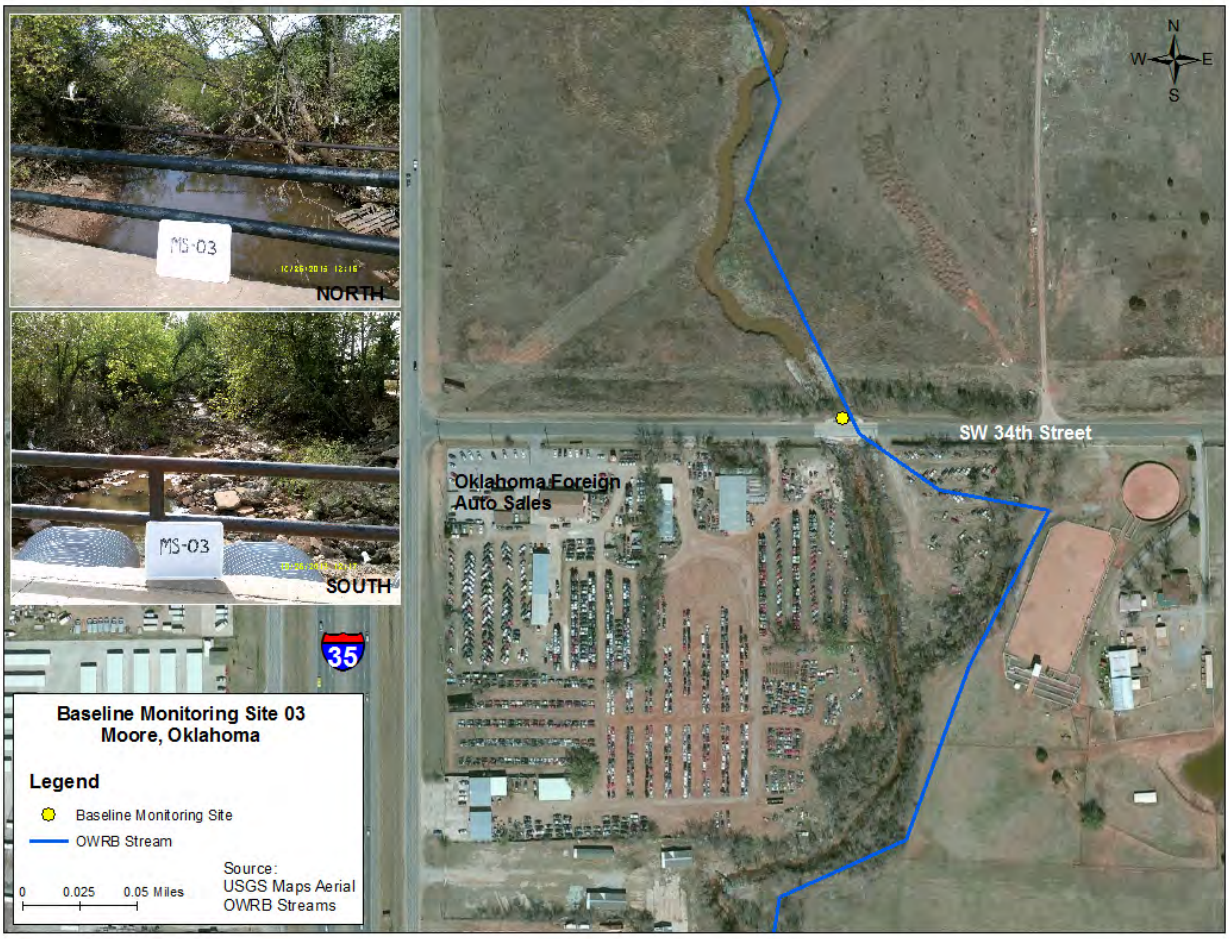


Figure 3-6 Baseline Monitoring Site 04

Figure 3-7 Baseline Monitoring Site 05

Table 3-1. Summary of Phase 1

DESCRIPTION	MONITORING SITE NUMBER	Frequency	DATA COLLECTED
Residential	01	Quarterly	Temp, pH, DO, Conductivity, TDS, Turbidity, ORP, Total N, Total P, TSS, CBOD20
Park/Greenspace, Commercial	02	Quarterly	Temp, pH, DO, Conductivity, TDS, Turbidity, ORP, Total N, Total P, TSS, CBOD20
Commercial	03	Quarterly	Temp, pH, DO, Conductivity, TDS, Turbidity, ORP, Total N, Total P, TSS, CBOD20
Residential, Undeveloped	04	Quarterly	Temp, pH, DO, Conductivity, TDS, Turbidity, ORP, Total N, Total P, TSS, CBOD20
Agricultural and Residential	05	Quarterly	Temp, pH, DO, Conductivity, TDS, Turbidity, ORP, Total N, Total P, TSS, CBOD20

3.1.1 Phase 1: Laboratory Analyses

Separate laboratory analyses are required for watershed samples. The following sections discuss parameters to be measured for each sample and the total cost of laboratory analyses. All laboratory analyses will be performed according to 40 CFR 136 or its approved standard methods.

3.1.2: Watershed Samples

For all samples collected from the watershed TMDL monitoring sites, Both Phase 1 and Phase 2, the following parameters are recommended for laboratory analyses:

- Water temperature
- pH
- Dissolved oxygen
- Specific conductance
- Total Dissolved Solids
- Turbidity
- Total nitrogen
- Total Phosphorous
- Total suspended solids (TSS)
- Carbonaceous Biological Oxygen Demand (20 day)

3.1.3 Phase 1Flow Measurement

Stream flow, or discharge, is the volume of water that moves over a designated point over a fixed period of time. It will be measured as cubic feet per second (ft^3/sec).

The flow of a stream is directly related to the amount of water moving off the watershed into the stream channel. It is affected by weather, increasing during rainstorms and decreasing during dry periods.

Flow is a function of water volume and velocity. Stream velocity, which increases as the volume of the water in the stream increases, determines the kinds of organisms that can live in the stream (some need fast-flowing areas; others need quiet pools). It also affects the amount of silt and sediment carried by the stream. Sediment introduced to quiet, slow-flowing streams will settle quickly to the stream bottom. Fast moving streams will keep sediment suspended longer in the water column. Lastly, fast-moving streams generally have higher levels of dissolved oxygen than slow streams because they are better aerated.

This section describes the method for estimating flow in a specific area or reach of the streams monitored in the Lake Thunderbird watershed. It is adapted from techniques used by several monitoring programs and uses a float (an object such as an orange, ping-pong ball, etc.) to measure stream velocity. Calculating flow involves solving an equation that examines the relationship among several variables including stream cross-sectional area, stream length, and water velocity. Flow will be measured by solving the following equation:

Flow = ALC / T

Where:

- A = Average cross-sectional area of the stream (stream width multiplied by average water depth).
- L = Length of the stream reach measured (usually 20 ft.)
- C = A coefficient or correction factor (0.8 for rocky-bottom streams or 0.9 for muddy-bottom streams). This allows you to correct for the fact that water at the surface travels faster than near the stream bottom due to resistance from gravel, cobble, etc. Multiplying the surface velocity by a correction coefficient decreases the value and gives a better measure of the stream's overall velocity.

T = Time, in seconds, for the float to travel the length of L

Procedures for measuring flow at Phase 1 monitoring locations is presented in the attached Quality Assurance Project Plan (QAPP).

Flow

Flow is required at all routine stream monitoring sites. Flow values will be reported in cubic feet per second (ft3 /s).

Considerations when Measuring Flow

When measuring flow two things will be kept in mind.

1. Flow will be measures first in order to delay collection of chemical and biological water samples with limited holding times.
2. If flow is measured first, care will be taken to not to deploy a multi-probe instrument or to collect water samples in the area disturbed during flow measurement.

Exceptions to Flow-Reporting Requirements

There are two exceptions to the flow-reporting requirements:

1. ***No flow and pools.*** If there is no flow at a stream site, and accessible, isolated pools remain in the stream bed, collect and report the required field data and laboratory samples from the pools and report instantaneous flow. Under these conditions, report flow (ft3 /s) as zero.
2. ***Dry.*** If the stream bed holds no water, no sampling is required. Report that the stream was —dry in the. No value is reported for flow since there is no water.

3.1.4. Wet Weather Monitoring Event

The City will be prepared to monitor wet weather events at monitoring sites during the spring and fall quarters. Data collected during this event will provide information required to verify hydrologic and pollutant transport processes established within the watershed model for the Lake Thunderbird watershed.

3.1.5 Monitoring of Dry-weather Runoff Flows and Water Quality

In order to develop the best understanding of the influences of dry-weather runoff on stream water quality, it is necessary to quantify the dry-weather inputs from surrounding land uses and major tributaries; this was how each of the monitoring sites were selected. These will be analyzed for the constituents identified in Table 3.1. Also, any flow will be measured at the time of sample collection.

Monitoring of the dry weather flows will help identify major inputs of nutrients, organics, and sediments to the watershed during the warmer growing season. Further, a more complete description of contributions to the watershed during the dry season will complement monitoring data from wet-weather monitoring. Together, these data will allow the most complete understanding of influences on the watershed to be addressed. This knowledge will then facilitate the most efficient use of limited resources in mitigation of these impacts through best management practices (BMP) and use of other available technologies.

3.1.6 Study to Evaluate Benefits from Watershed BMP

Based on data collected from baseline watershed monitoring outlined above, analyses will be performed to evaluate benefits observed from implemented BMP. Established BMP are identified in the City of Moore Lake Thunderbird Compliance Plan.

3.1.7 Study to Re-evaluate Site-specific Nutrient Targets

For the Lake Thunderbird TMDL development, watershed-specific numeric targets were established based on reference conditions when beneficial uses of the lake were not met. Continued study of these conditions can further refine the cause-and-effect relationship between nutrient levels and impairments to beneficial uses, including assessment of nuisance algae levels and dissolved oxygen variability that can be influenced by nutrient levels and biological activity.

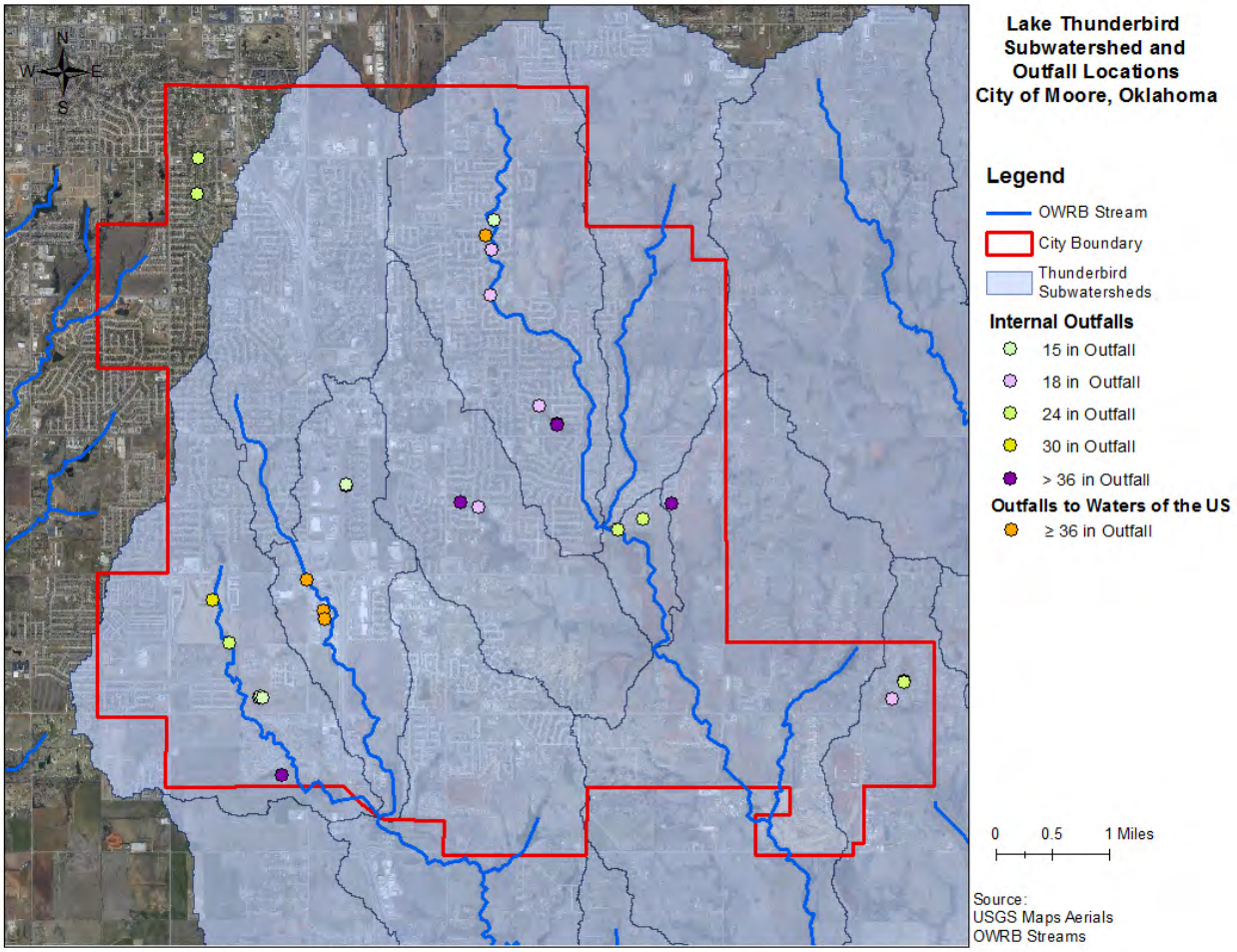
Analysis of previous and current monitoring data can provide sufficient data for assessment. In addition, development of dynamic models that provide full simulation of eutrophic processes can assist in understanding cause-and-effect relationships. However, if model results are to assist in analysis, associated model development is assumed to be performed in separate studies after data is collected.

3.2 Phase 2: Outfall Monitoring

This data collection strategy, outlined in Appendix E of the Final Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs, requires the collection of at least one representative sample of a stormwater discharge from at least 50% of the major discharge points discharging directly to surface waters of the state within the portion of the TMDL watershed in the MS4 area. A major discharge point is a pipe or open conveyance measuring 36 inches or more at its widest cross section.

There are four outfalls that meet the criteria established in Appendix E of the Final Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs. These outfalls are as follows presented in Figure 3-8 along with the current location of identified outfalls, both internal (does not discharge directly to Waters of the U.S. and those 36 inches or greater that discharge to Waters of the U.S.

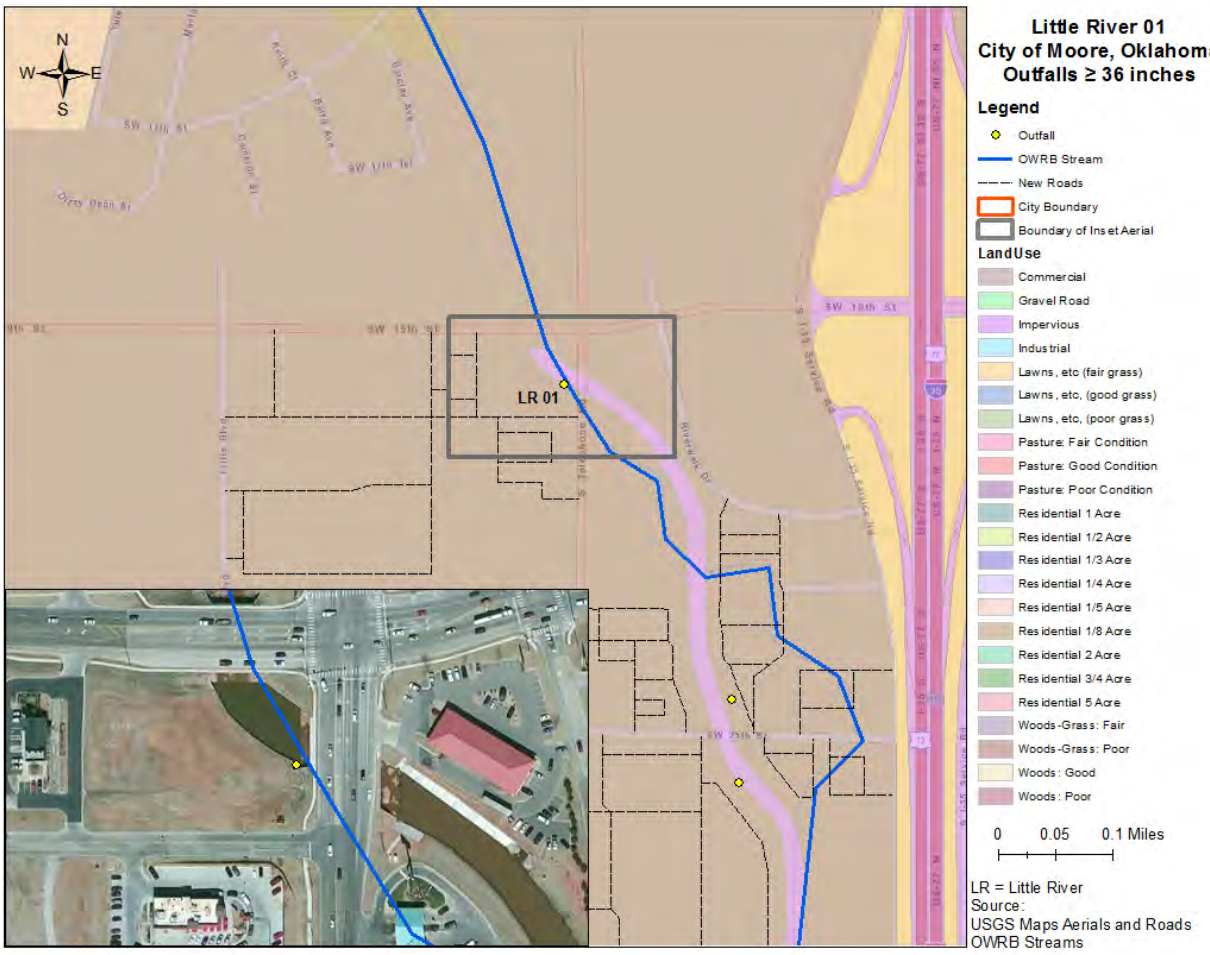
Figure 3-8


N
W
E
S
Lake Thunderbird Subwatershed and Outfall Locations City of Moore, Oklahoma
Legend
OWRB Stream
City Boundary
Thunderbird Subwatersheds
Internal Outfalls
15 in Outfall
18 in Outfall
24 in Outfall
30 in Outfall
> 36 in Outfall
Outfalls to Waters of the US
≥ 36 in Outfall
0 0.5 1 Miles
Source:
USGS Maps Aerials
OWRB Streams

Individual outfall monitoring locations are presented in Figures 3-9 through Figure 3-12.

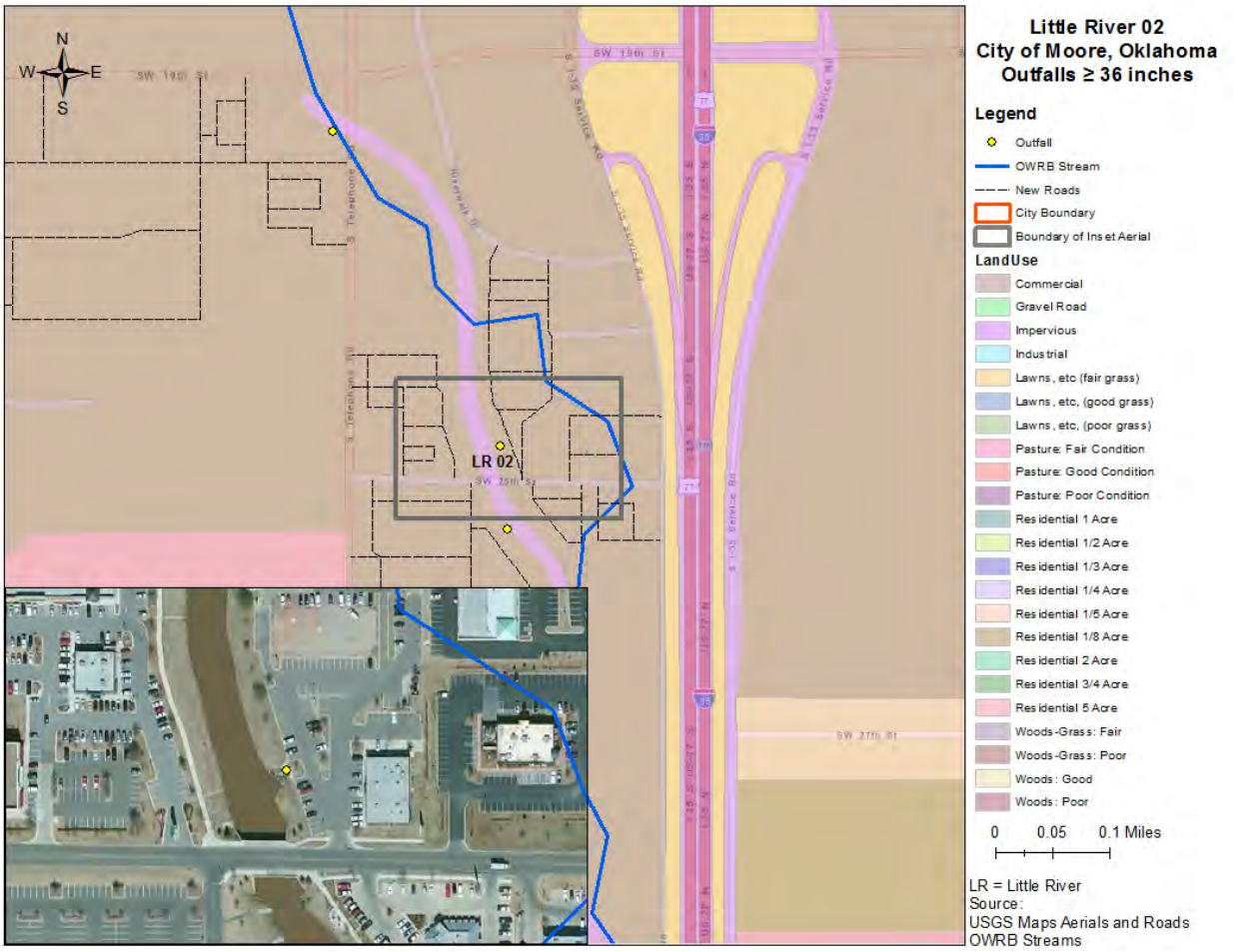
Little River Outfall 01 (LR01) - is a 55 inch reinforced concrete box that collects runoff from a commercial development area. The outfall location is presented in Figure 3-9 below.

Figure 3-9 LR01



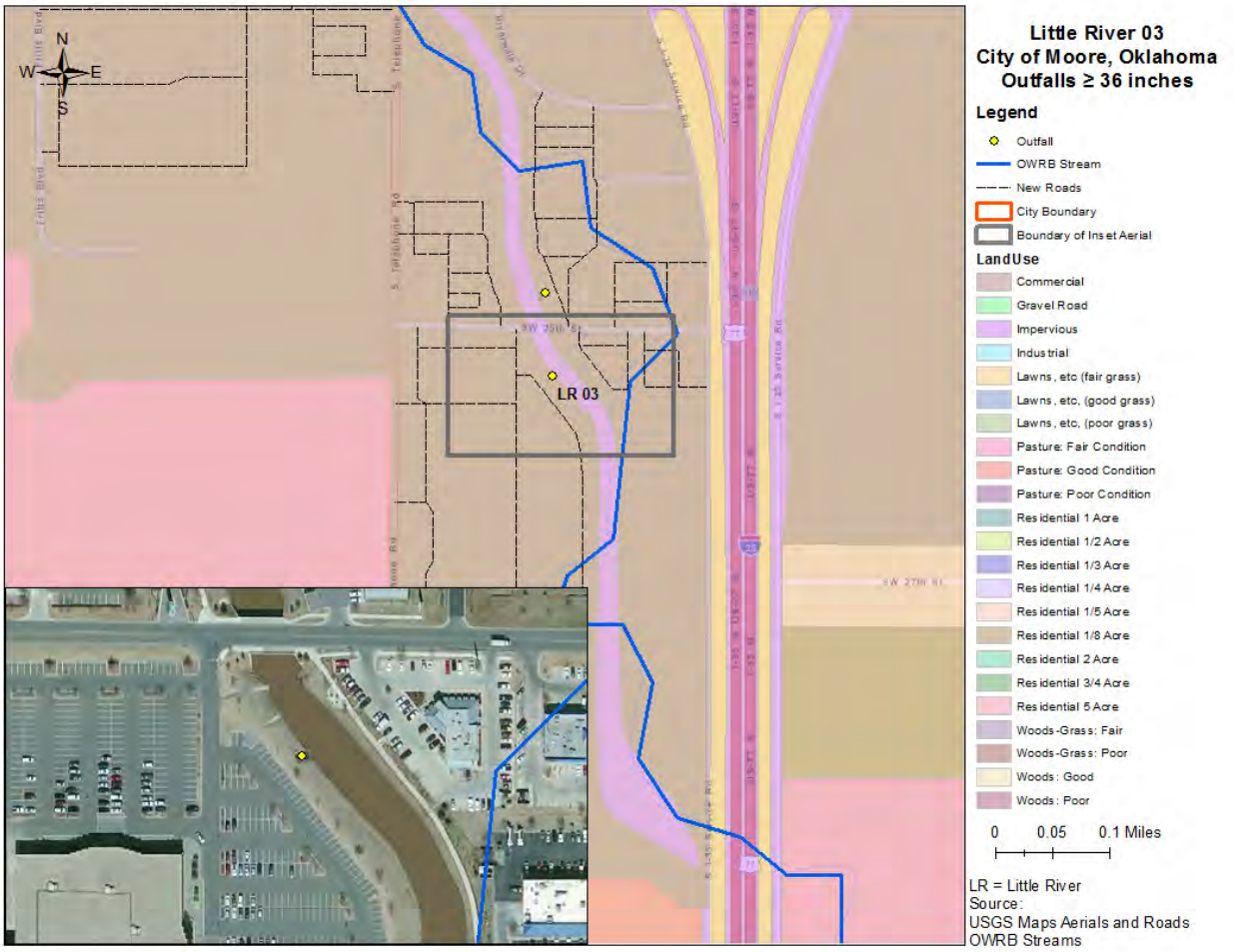
Little River Outfall 02 (LR02) - is a 96 inch reinforced concrete box that collects runoff from a commercial development area. The outfall location I presented in Figure 3-10 below.

Figure 3-10 LR02



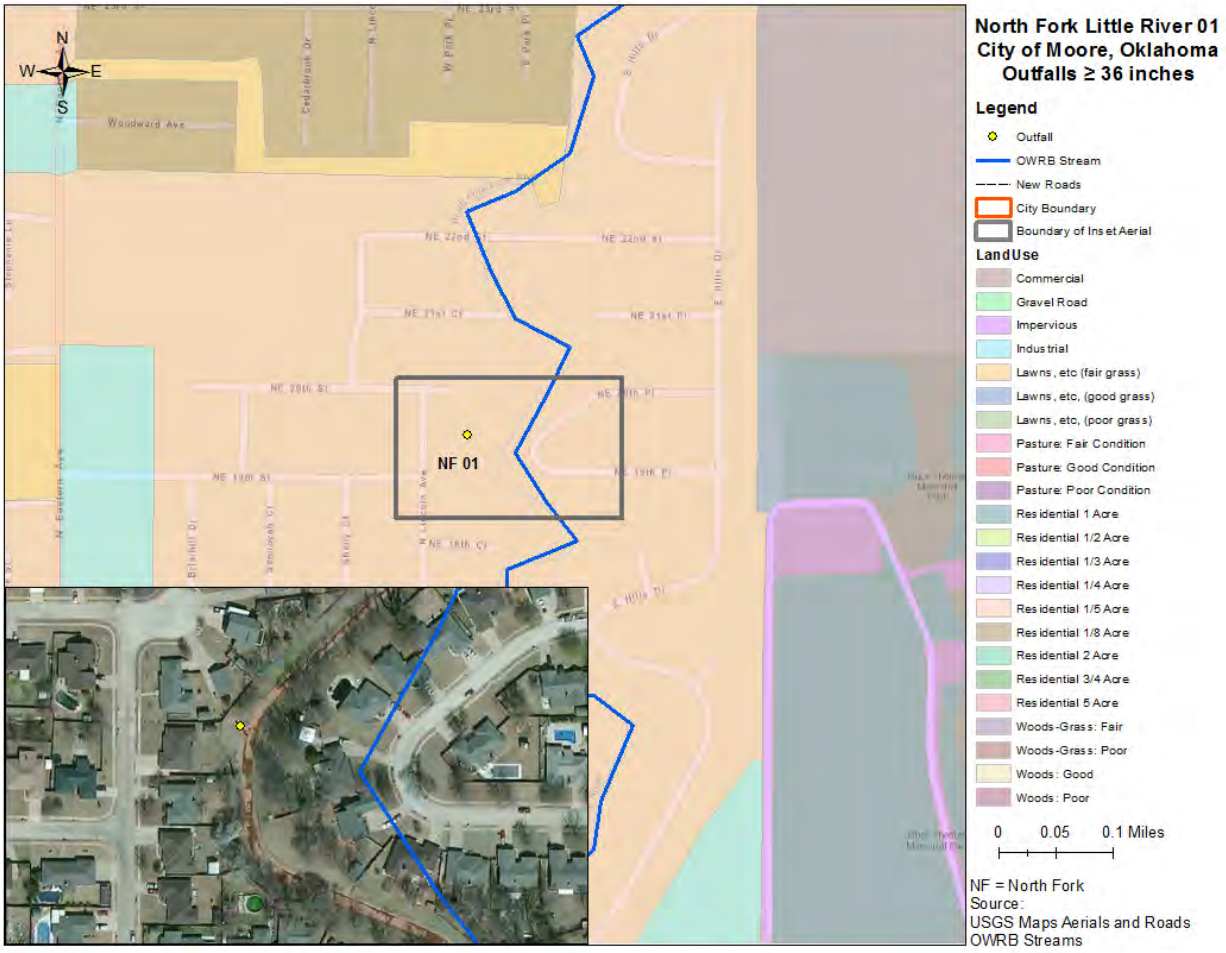
Little River Outfall 03 (LR03) - is a 36 inch reinforced concrete pipe that collects runoff from a commercial development area. The outfall location I presented in Figure 3-11 below.

Figure 3-11 LR03



North Fork Little River Outfall 01 (NF01) - is a 72 inch corrugated metal pipe (CMP) that collects runoff from a commercial development area. The outfall location I presented in Figure 3-12 below.

Figure 3-12 NF01



Phase 2 monitoring will be performed semi-annually on 50 percent of the identified outfalls. Sampling methods at the outfall monitoring sites will be consistent with existing Quality Assurance Performance Plans (QAPPs); a QAPP has been developed, but may be modified after selection of a private contractor to perform the actual monitoring. Frequency of sampling is to be performed semi-annually, with sampling occurring from January through December. Outfall sampling will be pre-scheduled to occur on specific dates within the semi-annual period. The sampling events will be based on wet-weather events. A wet weather event is generally defined as storm events that are greater than 0.1 inch and at least 72 hours from the previously measurable storm event. If wet-weather events cannot be collected due to lack of rainfall, safety, or inability to collect, samples will be collected during the next rotational semi-annual period.

Table 3-2 includes a summary of the outfall monitoring sites. Sections 3.2.1 and 3.2.3 provide additional discussion of the monitoring components, including the specific parameters to be

measured, and summarizes the investment required for implementation of each of the components of the monitoring plan.

Table 3.2 Summary of Phase 2

DESCRIPTION	MONITORING SITE NUMBER	Frequency	DATA COLLECTED
Commercial	LR01	Annually	Temp, pH, DO, Conductivity, TDS, Turbidity, Total N, Total P, TSS, CBOD20
Commercial	LR02	Annually	Temp, pH, DO, Conductivity, TDS, Turbidity, Total N, Total P, TSS, CBOD20
Commercial	LR03	Annually	Temp, pH, DO, Conductivity, TDS, Turbidity, Total N, Total P, TSS, CBOD20
Residential	NF01	Annually	Temp, pH, DO, Conductivity, TDS, Turbidity, Total N, Total P, TSS, CBOD20

Phase 2 monitoring will be performed to address potential data gaps not answered through typical watershed monitoring, as well as establishing potential WLA and LA pollutant contribution from subwatersheds, particular land uses, agricultural management practices, and to determine the efficiencies of BMP.

3.2.1 Laboratory Analyses

Laboratory analyses is required for Phase 1 and Phase 2 samples, methods are presented in the attached QAPP.

For all samples collected from the Phase 1 and Phase 2 TMDL monitoring sites, the following parameters will be submitted for laboratory analyses:

- Total nitrogen
- Total Phosphorous
- Total suspended solids (TSS)
- Carbonaceous biological oxygen demand (20 day) (CBOD)

3.2.2 Phase 2 Outfall Flow Measurement

Flow monitoring of outfalls identified in Table 3.2 will be performed using cost effective water current meters. The water current meter offers two unique methods for determining average water velocity: 1) For small stream flows and pipes, the current velocity meter may be moved smoothly and uniformly throughout the stream flow profile until a steady average reading is displayed. This steady reading is the true average velocity for the stream flow. 2) For larger streams, the current velocity meter may be used to measure a vertical profile of water velocity at several points across a stream channel. The stream flow measurement for the profile is the sum of the average velocity of each subsection of stream flow times its cross-sectional area.

3.2.3 Field Analyses

Field analyses is required for Phase 1 and Phase 2 samples, methods are presented in the attached QAPP.

For all samples collected from the Phase 1 and Phase 2 TMDL monitoring sites, the following parameters will be analyzed in the field:

- Water temperature
- pH
- Dissolved oxygen
- Specific conductance
- Total Dissolved Solids
- Turbidity

Field analysis of identified parameters will be performed using a Horiba® U-50 Series multi-parameter water quality meter that is equipped to measure and log data for the parameters identified simultaneously with one single probe. The U-50 meter is equipped with a 10 meter cable that will allow direct deployment to the streams and outfalls monitored. If no flow conditions exist the U-50 meter comes with a sample container to collect and observe direct measurement of each of the parameters selected.

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Appendix A - QAPP