TRWD Urban Watershed Modeling

Resilient Urban Infrastructure to Protect and Enhance Receiving Water Quality

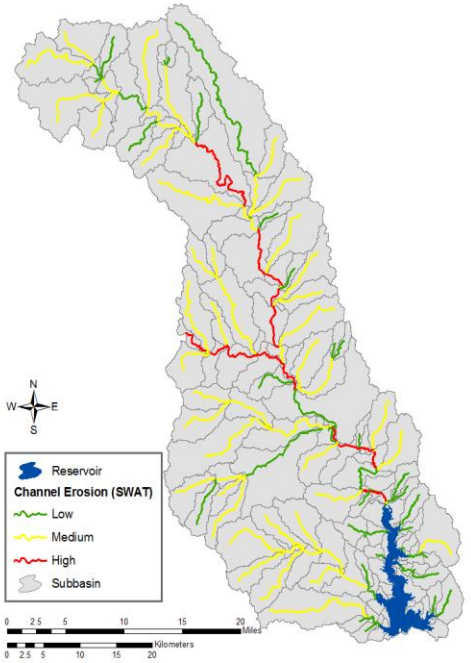
Trinity River Water Quality - Project Need

Watershed Planning

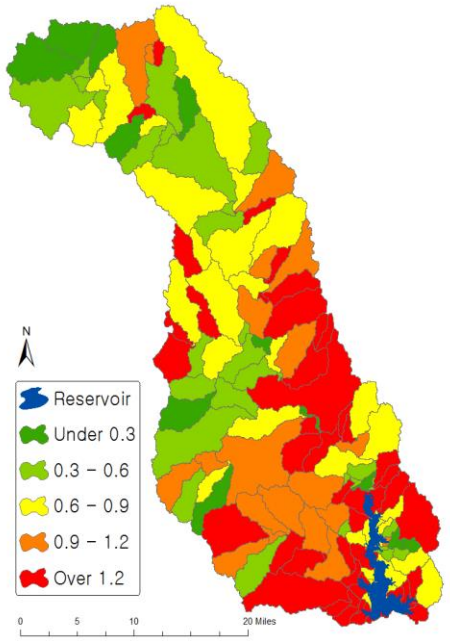
Eagle Mountain Lake

Nutrients & Sediment

- Point Source
- NPS/land use
- Channel erosion
- Internal loading



Channel erosion estimation

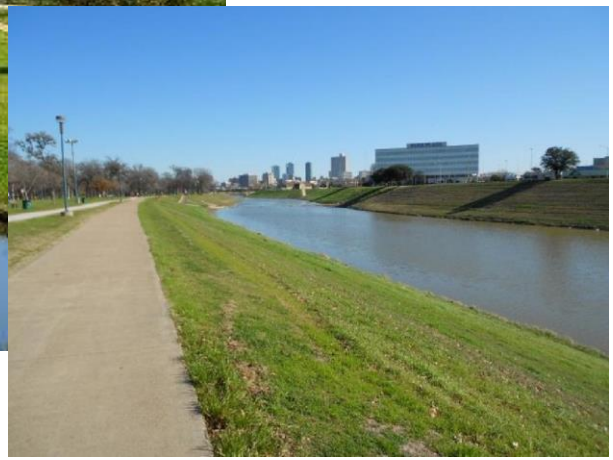


TP loading (kg/ha) by overland flow

2011 SWAT Technical Report

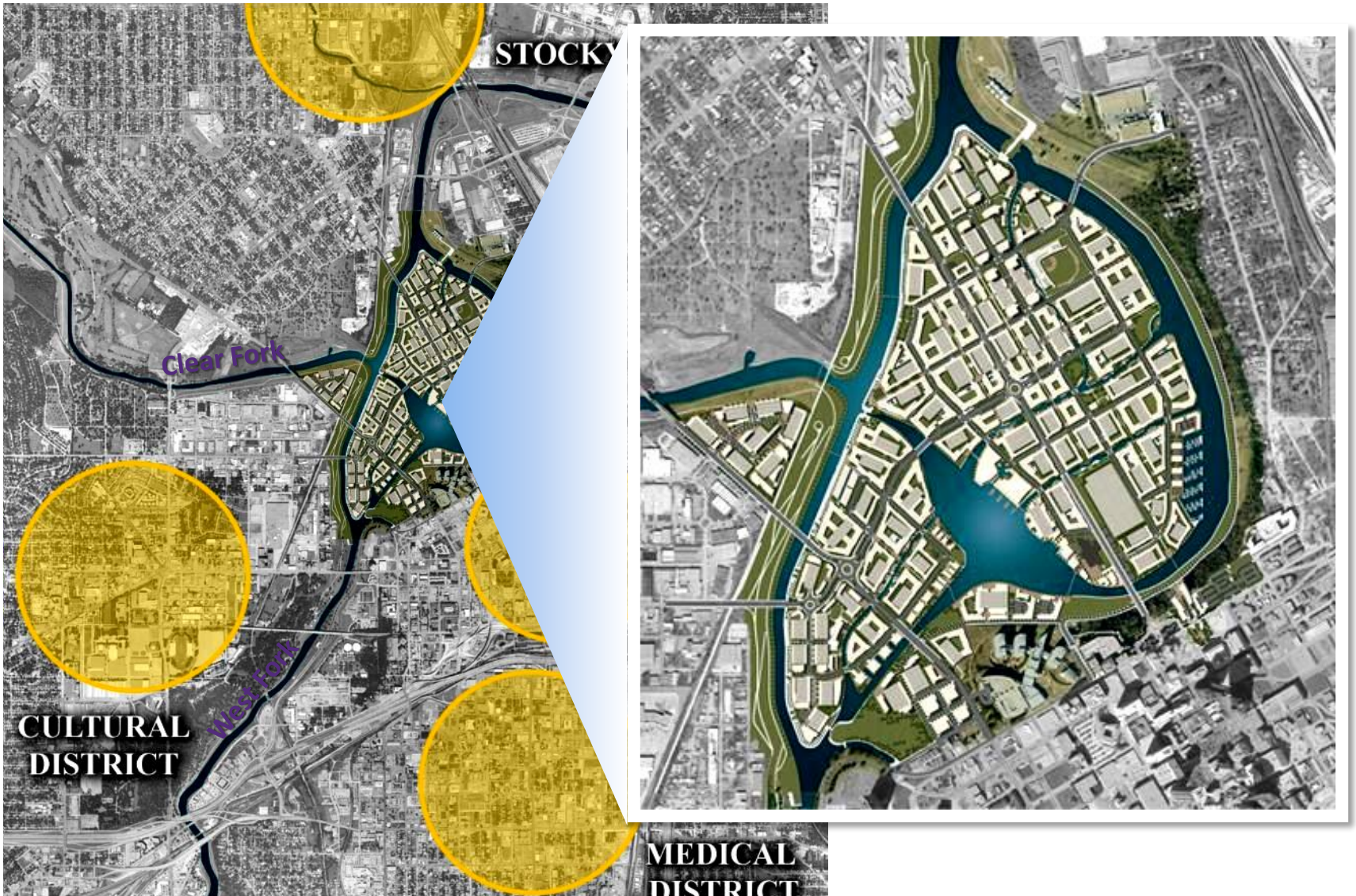
Trinity River Levee System developed in response to the catastrophic flooding

Fort Worth's Current Levee System



Fort Worth Central City Flooding

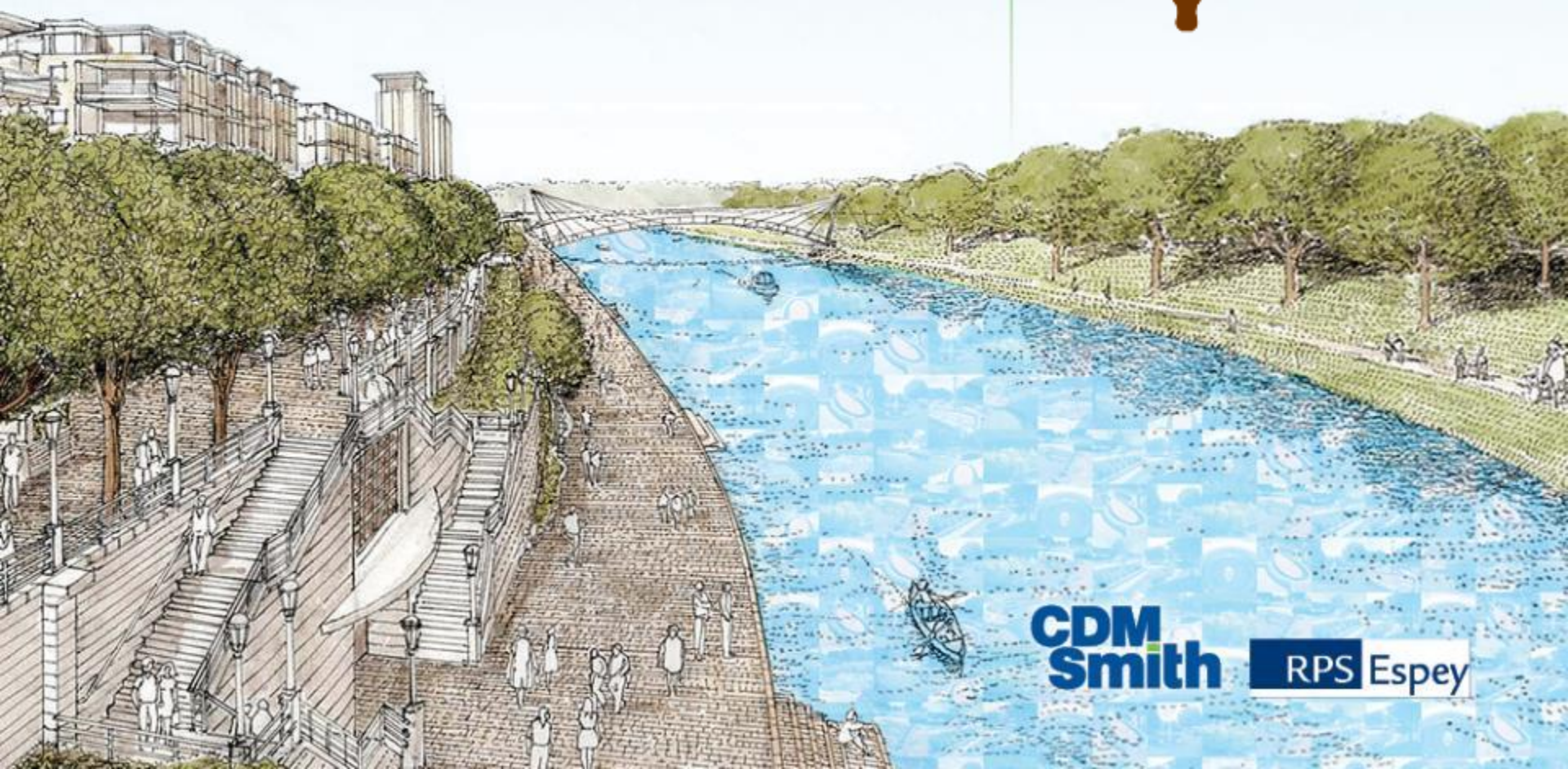
Panther Island/Central City
Additional flood protection



Trinity River Water Quality Planning

trwd Tarrant Regional Water District

FORT WORTH



CDM Smith

RPS Espey

Project Vision

*Water quality for the Trinity River in Fort Worth should be **managed** such that there is **public acceptance** that the water is **suitable** for swimming, fishing, recreating, and as a desirable **public destination** that is integral to the City/Region's image. Furthermore, the water quality of the Trinity River in Fort Worth is a highly **valuable regional resource that should be protected**.*

Water Quality Modeling Toolset

Watershed Model (SWMM)

EPA's Storm Water Management Model

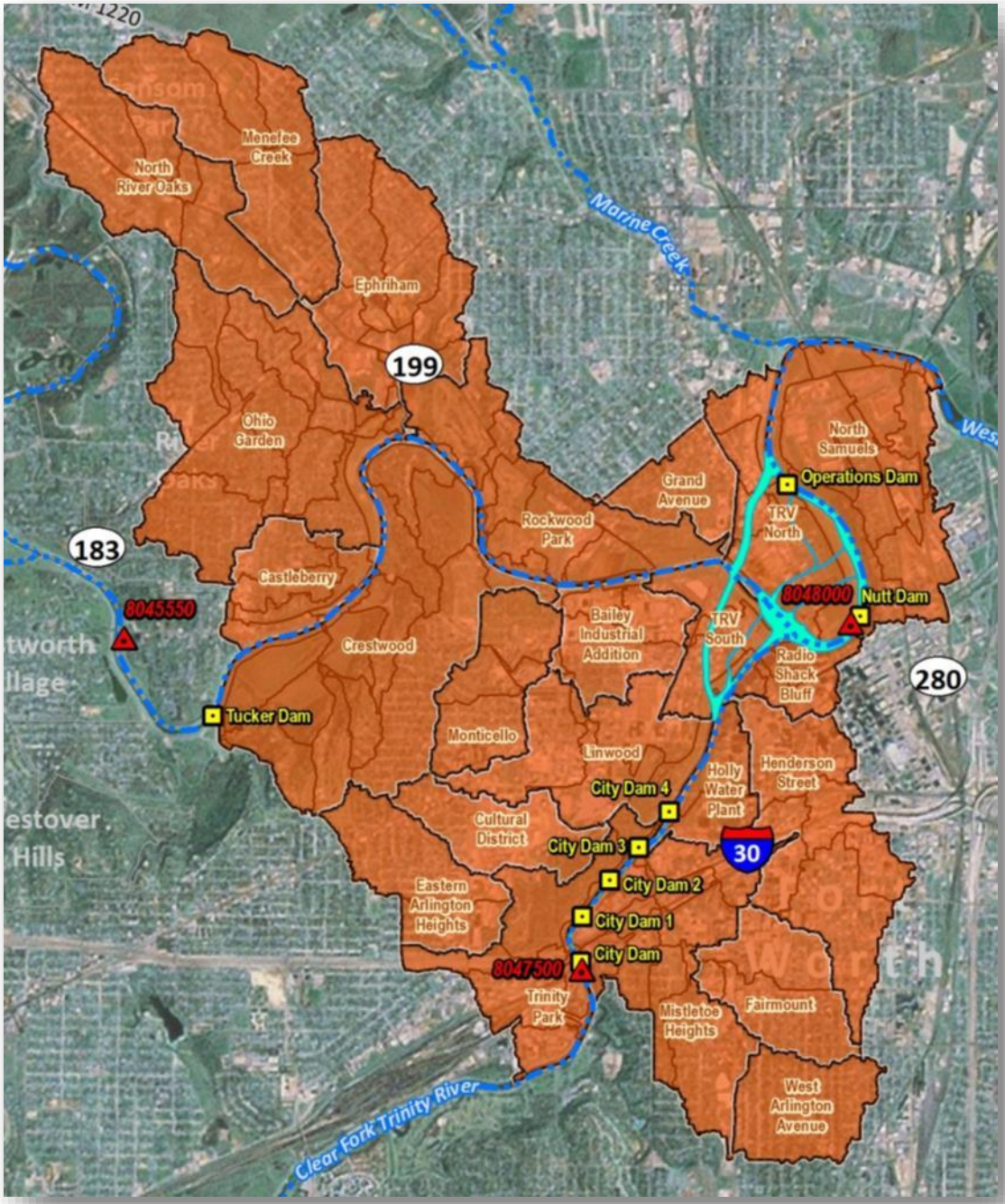
Planning, analysis and design related to stormwater runoff in urban areas

Dynamic hydrology-hydraulic WQ simulation model

Single event or continuous simulation of runoff quality and quantity

Sub catchment areas generating pollutant loads

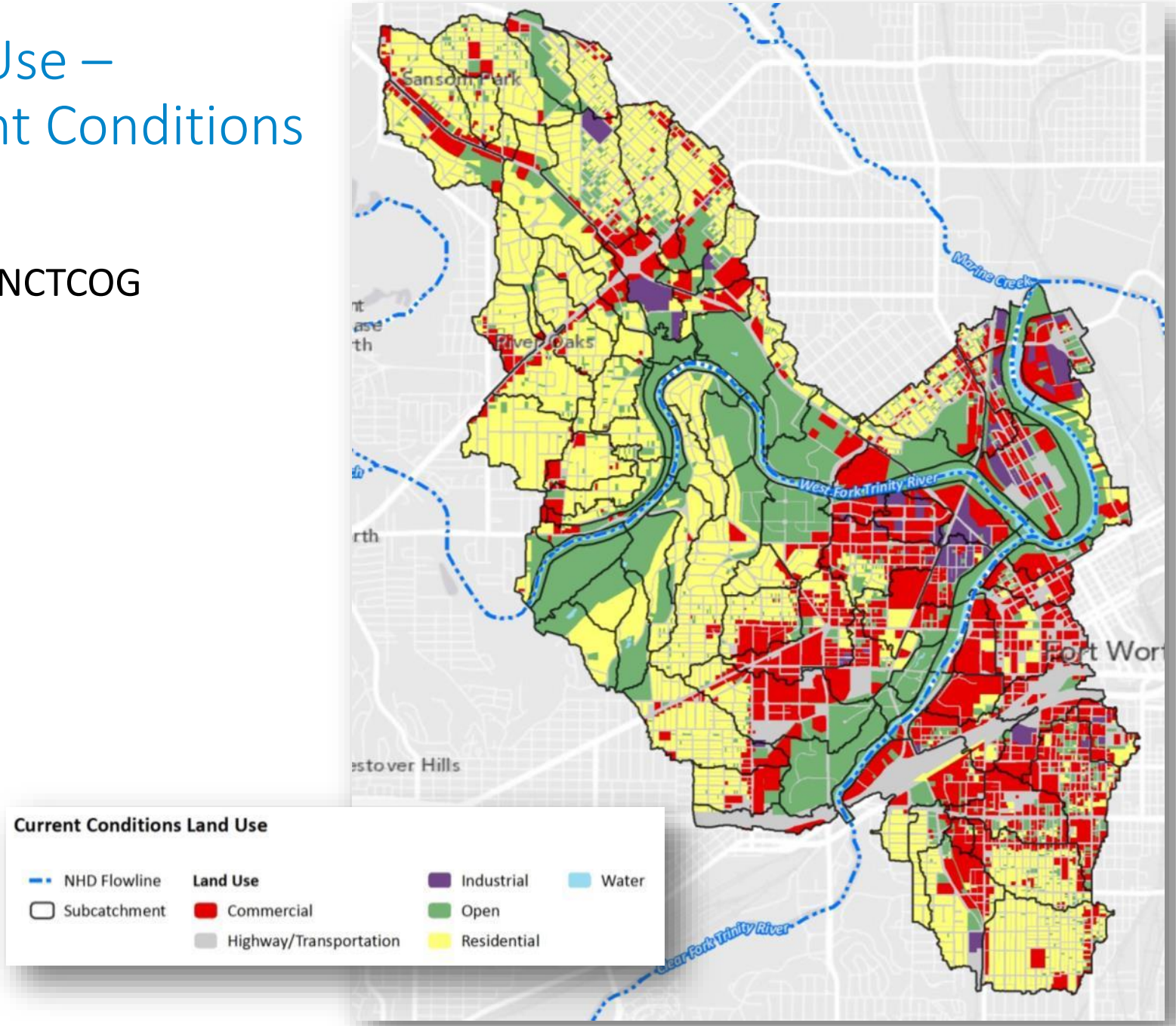
Phase One Study Area



Water quality parameters to be managed

Land Use – Current Conditions

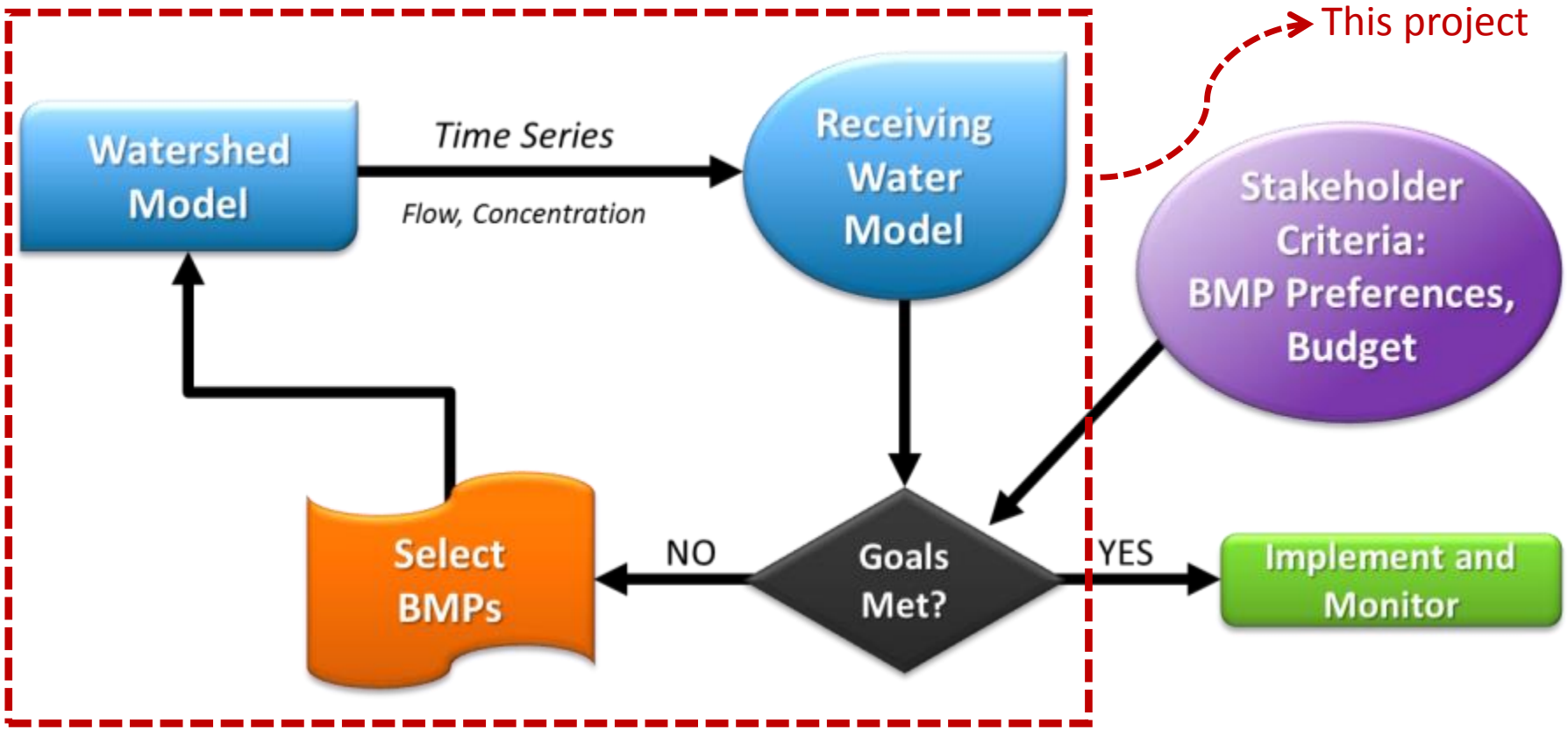
- 2010 NCTCOG



Data Sources for Development of Model

Data Type	Data Sources
Watersheds	City of Fort Worth (mapsheds), TRWD (sump watersheds)
Land Use	City of Fort Worth, North Texas Council of Governments, National Land Cover Data sets
Impervious cover	City of Fort Worth, National Land Cover Data Set
Water quality & floatables	TRWD (receiving water, stormwater, Trinity River, debris and floatables), City of Fort Worth (stormwater, debris and floatables)
Climate data	National Weather Service, City of Fort Worth
GIS data	City of Fort Worth (pipes, inlets, outfalls, parcels), Natural Resources Conservation Service (soils)
Other studies	Island Mass Grading study

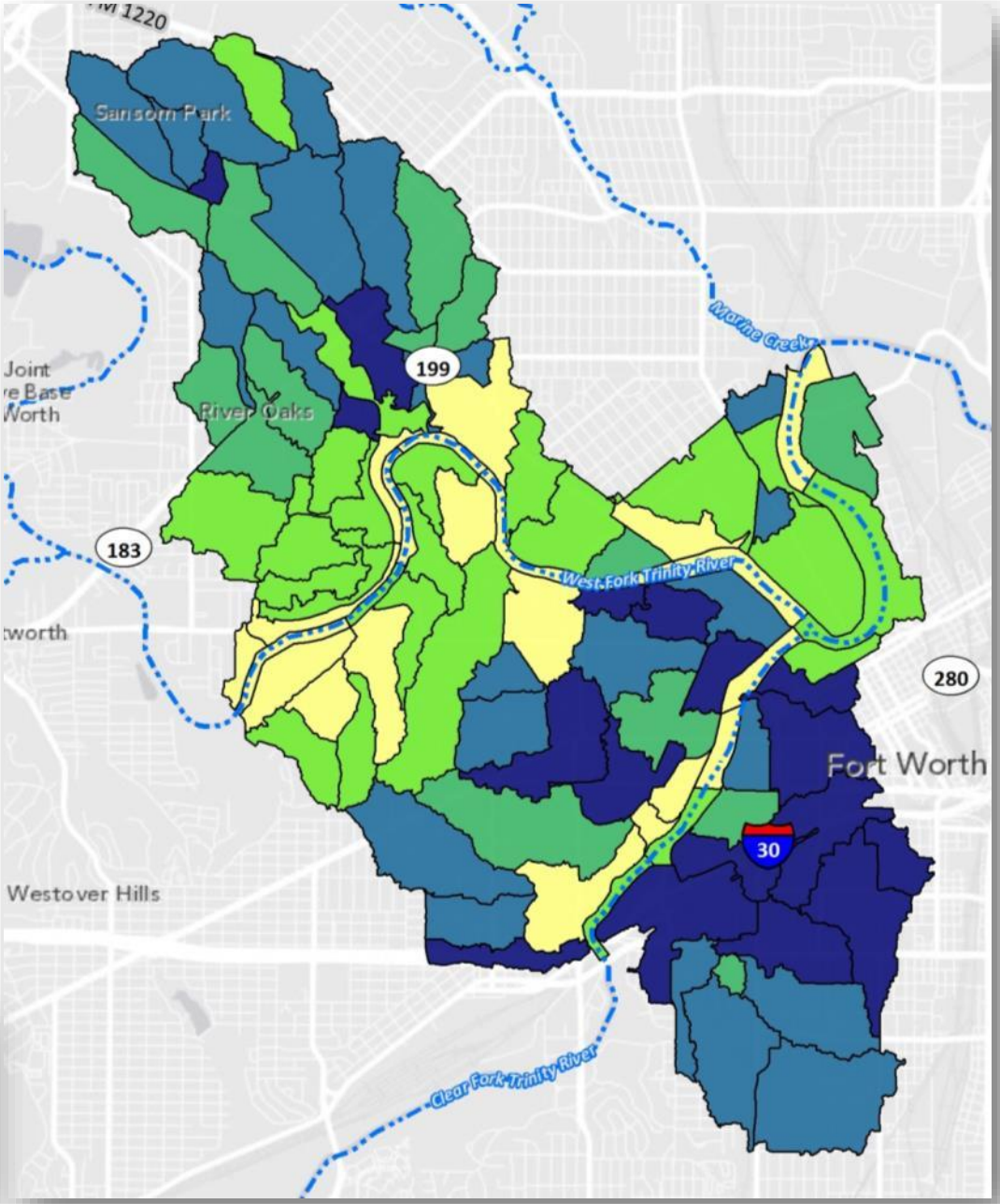
Watershed Management Process



Modeled Constituents

- Total suspended solids (TSS)
- Ammonia (NH3)
- Nitrate-nitrite (NO2+NO3)
- Total phosphorus
- Total organic carbon (TOC)
- Total dissolved solids (TDS)
- 5-day carbonaceous biochemical oxygen demand (BOD5)
- Bacteria (*Escherichia coli*)
- Floatables

TSS Loading – Current Conditions

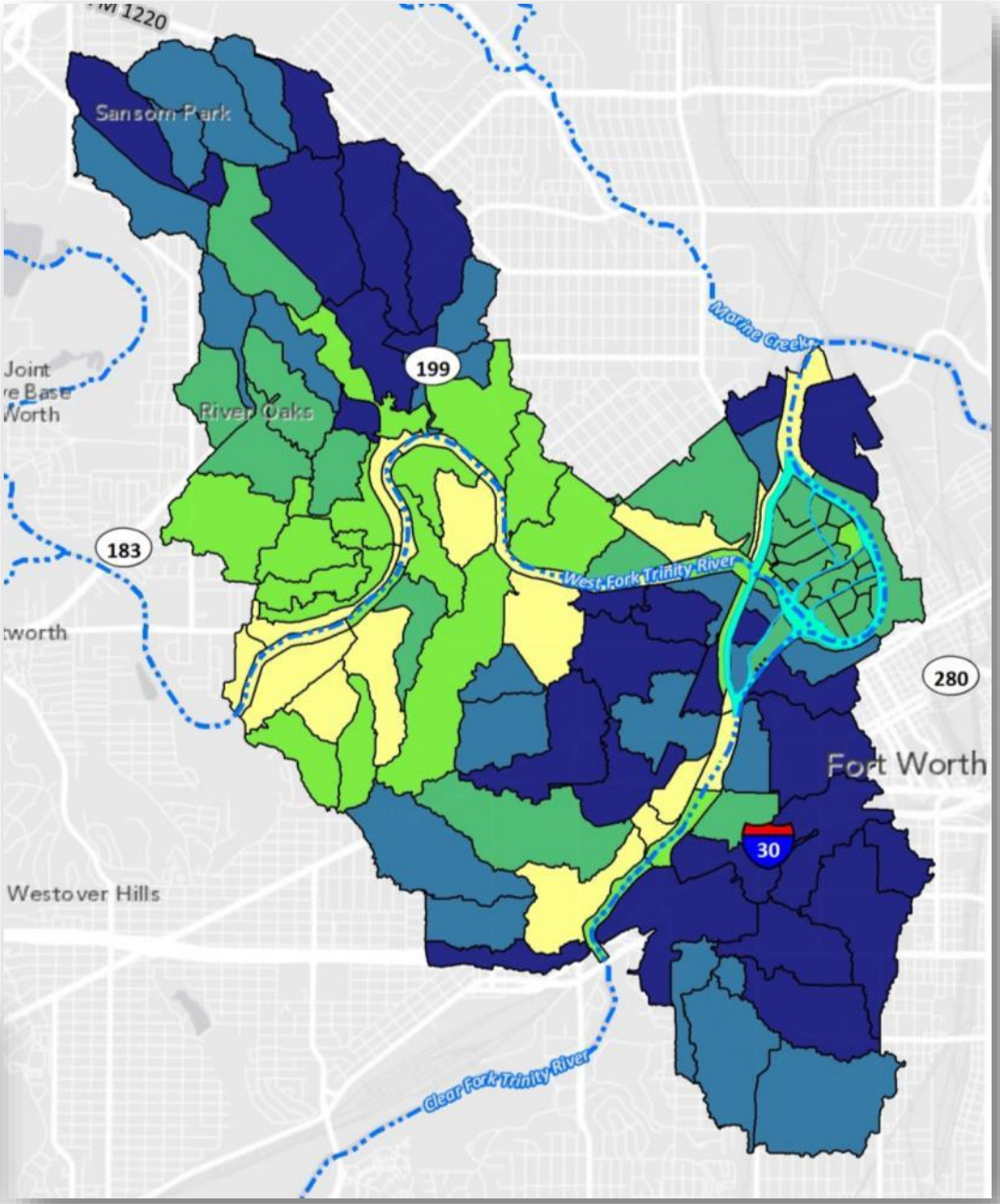


Model Water Quality Loading

TSS lbs/acre/year

- 2.9 - 69.1
- 69.1 - 142.5
- 142.6 - 201.8
- 201.9 - 240.6
- 240.7 - 361.2

TSS Loading – Future Conditions



Model Water Quality Loading

TSS lbs/acre/year

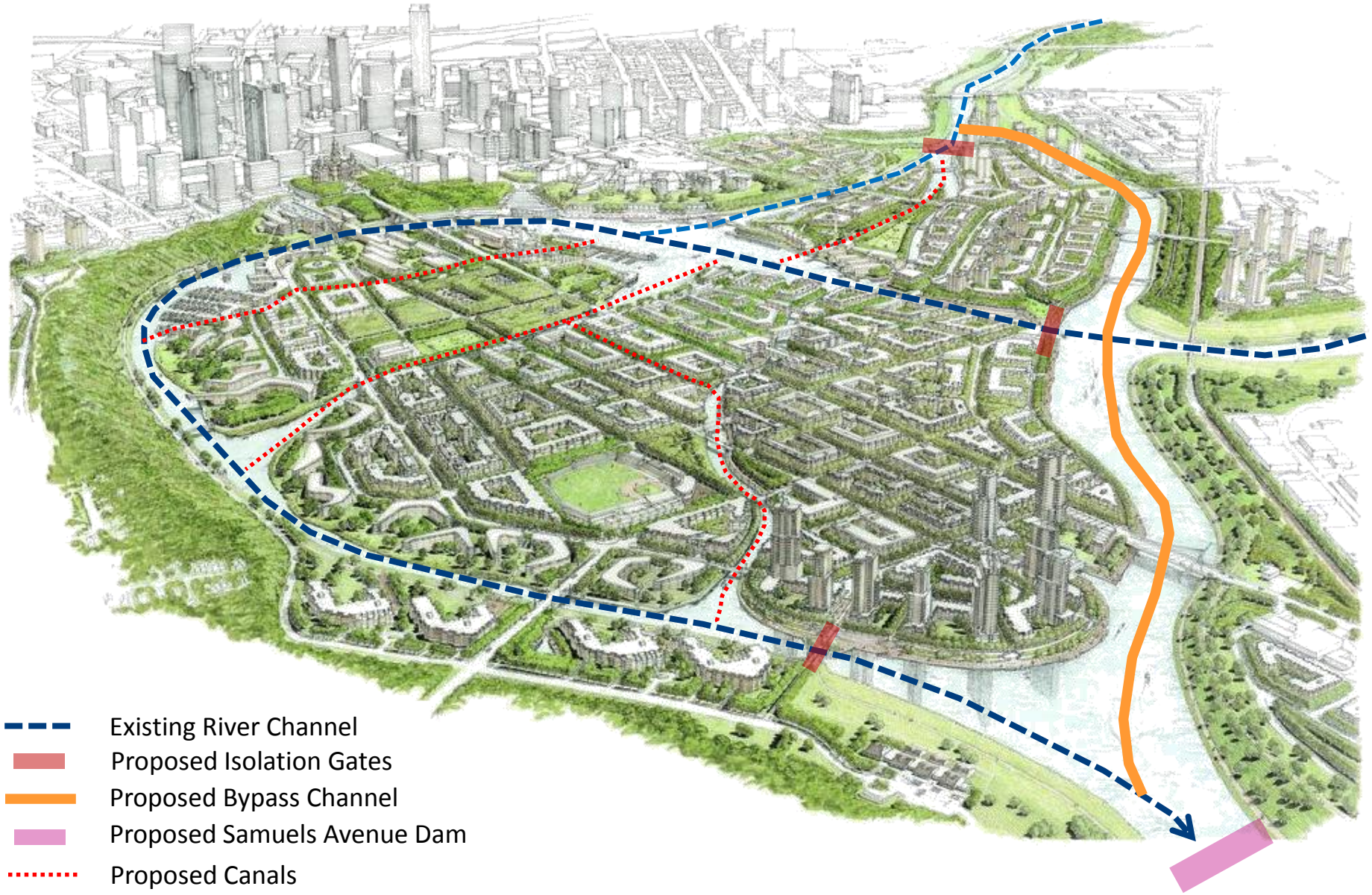
- 2.9 - 69.1
- 69.1 - 142.5
- 142.6 - 201.8
- 201.9 - 240.6
- 240.7 - 361.2

Receiving Water Model (CEQUALW2)

Two-Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model

Portland State University

CE-QUAL-W2 Model

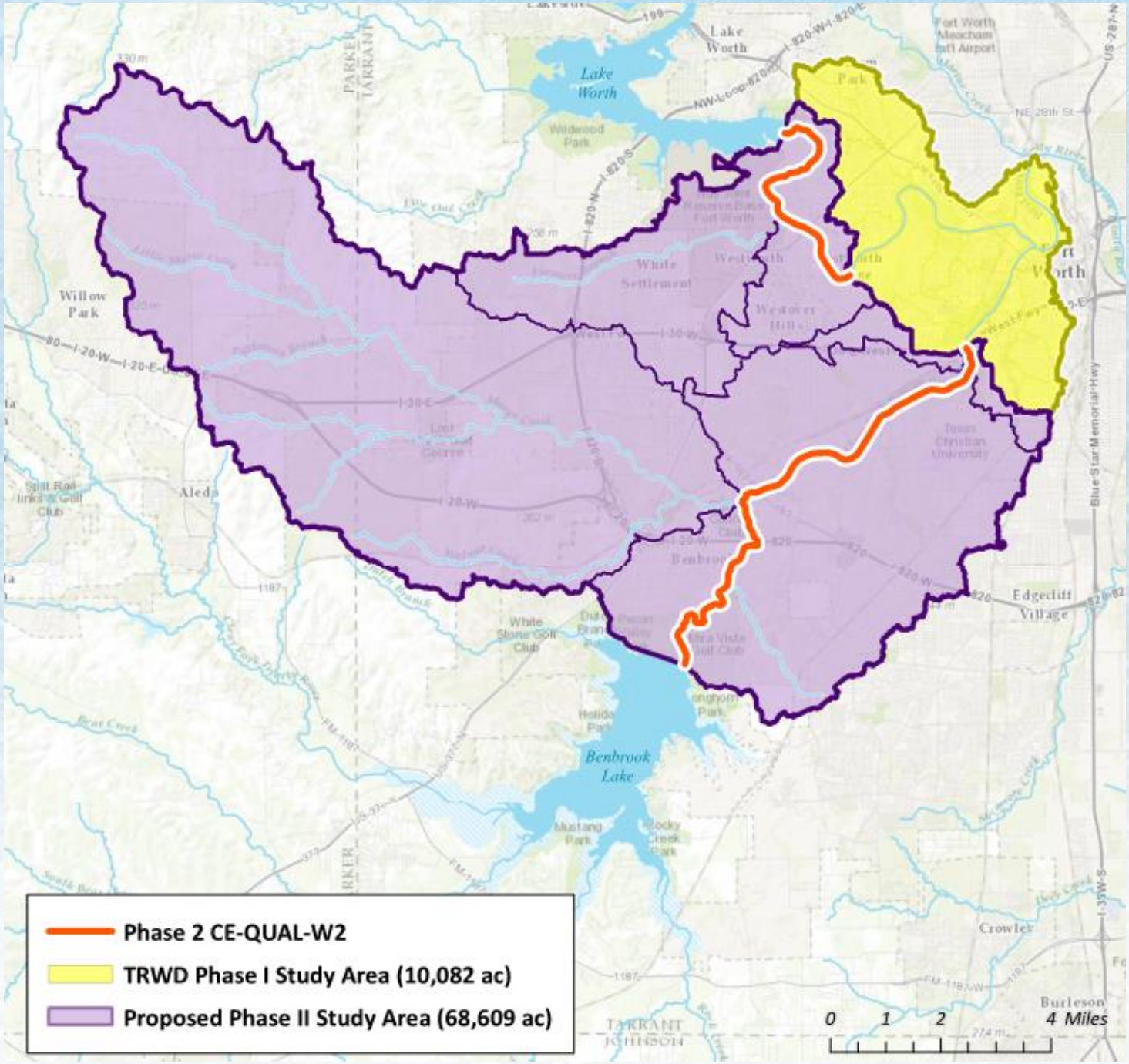


Phase 1 Accomplishments

- Refined receiving water quality model (CEQUALW2)
- Developed watershed models of core area using SWMM
- Linked models into a water quality management “toolset”
- Demonstrated contribution and impact of watersheds to the Trinity
  - Nutrients
  - Bacteria (E. Coli)
  - Sediment
  - Floatables

Phase 1 Accomplishments

- Identified potential storm water quality management practices (BMPs) to reduce pollutants going to river
- Demonstrated benefits of applying BMPs in watershed on Trinity River water quality
- Learned best practices from other cities and agencies with storm water quality management experience
- Collaborated with City of Fort Worth on the study


Phase 2 CE-QUAL-W2
TRWD Phase I Study Area (10,082 ac)
Proposed Phase II Study Area (68,609 ac)
0 1 2 4 Miles
Lake Worth
Willow Park
Aledo
White Settlement
Edgecliff Village
Benbrook Lake
Crowley
Burleson

Phase 2 Accomplishments

- Extended CEQUALW2 upstream to Benbrook and Lake Worth
- Expanded area covered by SWMM watershed models
- Developed appropriate sizing criteria for BMPs to result in the most cost-effective infrastructure
- Developed a short list of BMPs appropriate for Panther Island
- Refined Event Mean Concentrations (EMCs) of targeted pollutants
- Continued coordination with City of Fort Worth

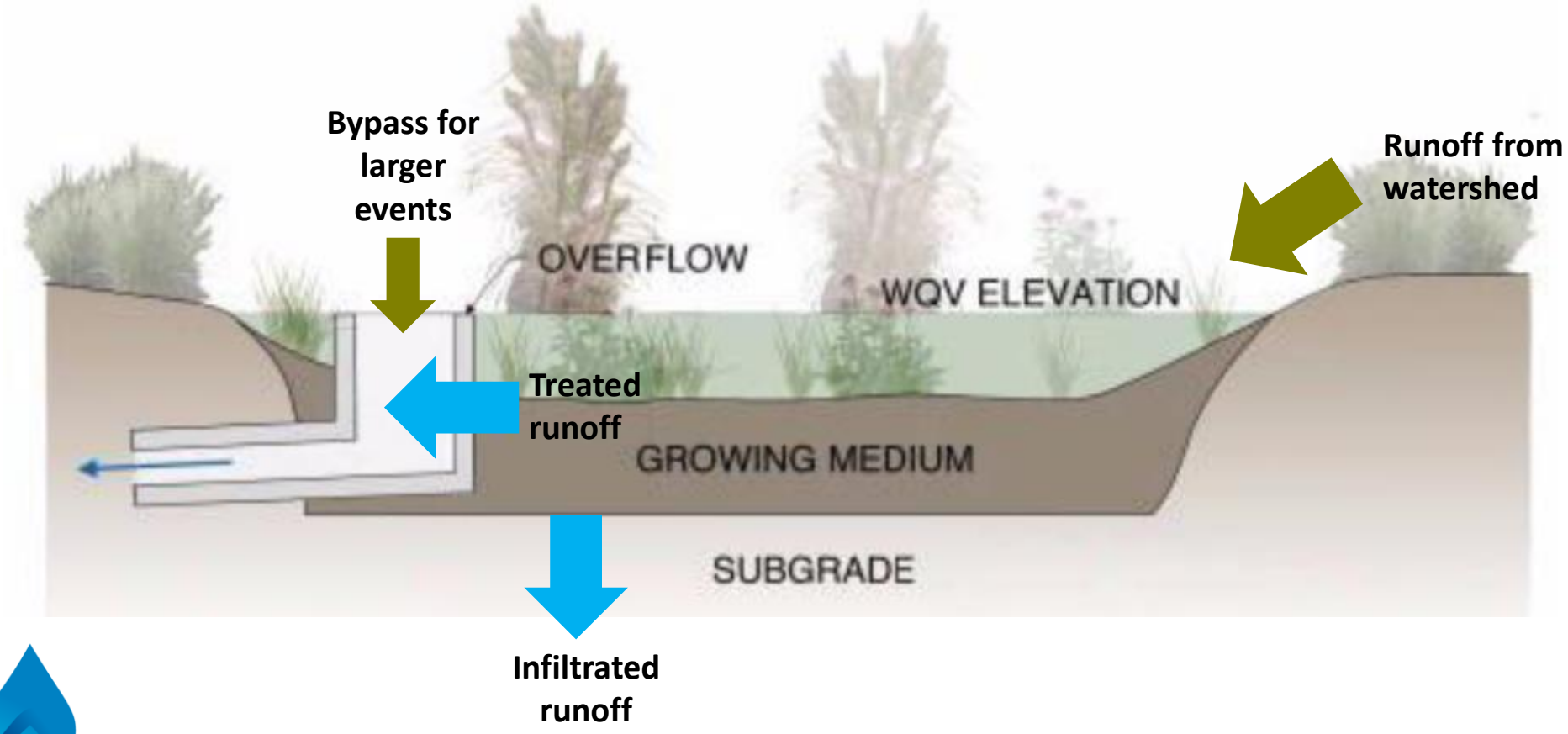
Phase 3 Goals

- Develop WQ Plan for a demonstration watershed
- Develop a BMP/Developers Guidance Document
- Modeling Toolset Documentation
- Coordinate with COFW on joint MS4 Program

Water Quality Capture Volume

- Goal – the volume of stormwater that can be cost-effectively "captured" for pollutant reduction through treatment practices
- Is dependent on:
  - Local climate
  - Local hydrology
  - Pollutants of concern
- Is the principle factor in sizing treatment practices and therefore the cost of associated infrastructure

WQv in perspective of infiltration type of treatment practices



How was WQv determined – iSWM?

- iSWM:
  - Based on Historical Rainfall
  - 85th percentile 24-hour rainfall depth (1.5 inches)
  - Assumes capture of the ENTIRE rainfall event
    - Does not consider that the basin will be emptying at the same time as it is filling
    - Does not consider hydrologic processes that would mitigate runoff (i.e., infiltration, etc)

BMP selection considerations

What BMPs make sense for Panther Island? Criteria could include…..

- Project characteristics and site factors
  - Mixed use / high density land use
  - Reduced land requirements
  - Blends into urban landscape
  - Elevated groundwater
- Pollutant removal capability
  - TSS, bacteria, nutrients, floatables
- Costs
- Maintenance Requirements and Responsibility

What BMPs make sense for City of Fort Worth? Criteria could include…

- Project characteristics and site factors
  - Address stormwater and water quality benefits
  - Landscape enhancement
  - Infiltration opportunities
- Pollutant removal capability
  - TSS, bacteria, nutrients, floatables
- Costs
- Maintenance Requirements and Responsibility

Panther Island Preliminary BMP Evaluation

BMP	Site Characteristics	Water Quality	Cost, O&M
Bioretention Areas / Rain Garden			
Planter Boxes			*
Stormwater Pond			
Multi-Purpose Detention Areas			
Modular Porous Paver			*
Sand Filters			
Enhanced Dry/wet Swale			
Dry Detention			
Porous Concrete			*
Alum Treatment			
Green Roof			
Filter Strip			
Grass Channel			
Gravity (Oil-Grit) Separator			
Stormwater Wetlands	*		
Downspout Drywell			
Soakage Trench			
Submerged Gravel Wetland			
Hydrodynamic Separator			

* Dependent on anticipated urban landscaping and other practices/needs

Most Preferred — Least Preferred

City of Fort Worth Preliminary BMP Evaluation

BMP	Site Characteristics	Water Quality	Cost, O&M
Bioretention Areas / Rain Garden			
Planter Boxes			*
Stormwater Pond			
Multi-Purpose Detention Areas			
Modular Porous Paver			*
Sand Filters			
Enhanced Dry/wet Swale			
Dry Detention			
Porous Concrete			*
Alum Treatment			
Green Roof			
Filter Strip			
Grass Channel			
Gravity (Oil-Grit) Separator			
Stormwater Wetlands			
Downspout Drywell			
Soakage Trench			
Submerged Gravel Wetland			
Hydrodynamic Separator			

Most Preferred — Least Preferred

BMPs for Further Consideration

- Rain Garden
- Bioretention
- Sand Filters
- Biofilter
- Pervious Pavement / Porous Concrete
- Dry Detention
- Wet swales
- Stormwater Wetlands
- Floatable separators (inserts)
- Hydrodynamic Separator
- Gravity (Oil-Grit) Separator

Rain Garden

Bioretention

Bioretention

Biorentention

Biofilter

Biofilter

Pervious Pavement

Dry Detention

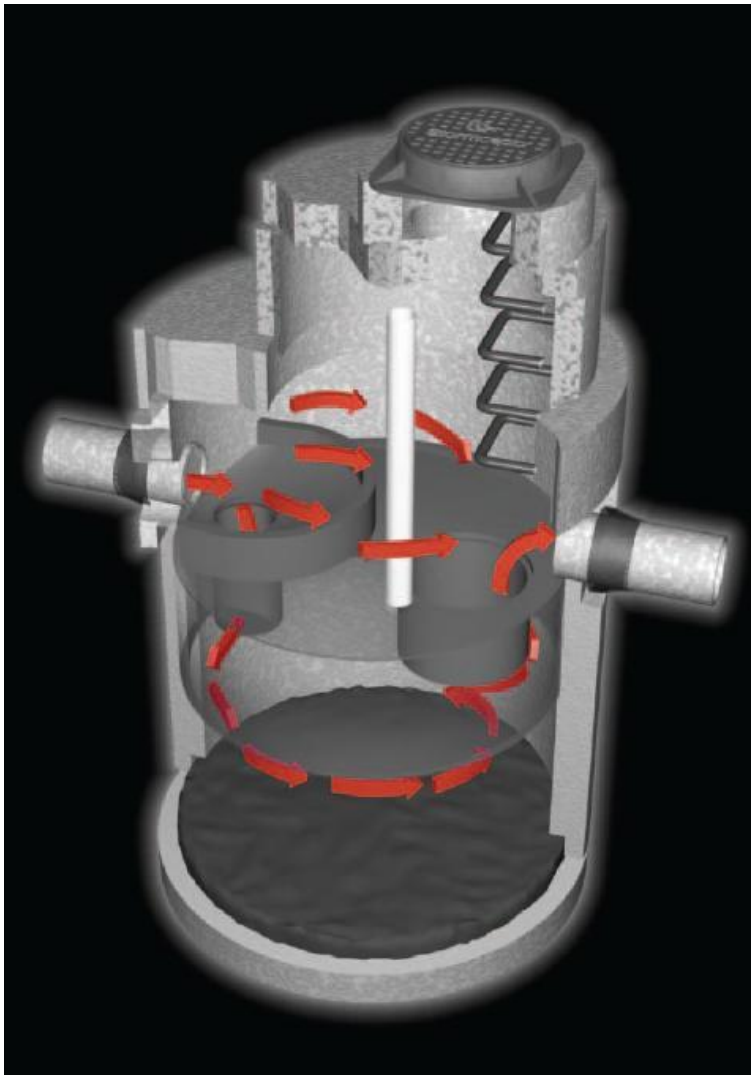
Sand Filter

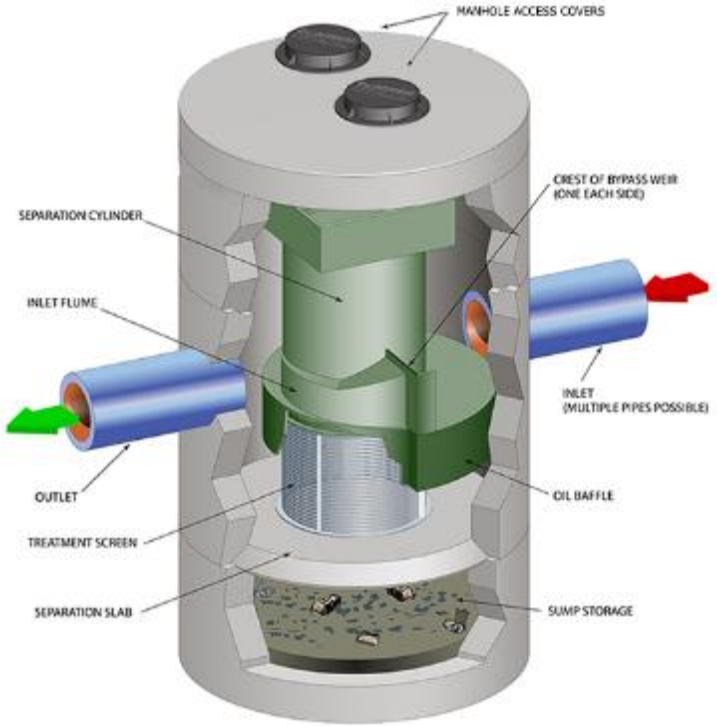
Stormwater Wetlands

Wet Swales

Wet Swales

Hydrodynamic, Oil/Water Separators





Stormwater Quality Practices Can Be Effective on Pollutants But Are Often Utilitarian

Sand Filters – Austin Texas