Class 3:
BMP Design, Detention, Buffers & Floodplains

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CITY OF TOPEKA UTILITIES

Stormwater Design Handbook
Webinar Training Series

Survey questions from last class

Q. Will GI-BMPs be required to treat offsite flows that are coming onto the site?

A. No

- GI-BMPs are ***preferred where feasible,*** but are **not mandatory**
- Designers have flexibility to use any of the BMPs in the *Topeka Stormwater BMP Design Handbook*
- Water quality treatment of offsite flow is not required unless your BMP is intended to manage offsite water quality (e.g., a BMP serving multiple properties within a subdivision)

Source: GADNR, Gascoigne Park Rain Garden, Glynn Co. GA

Survey questions from last class

Q. Is there a "linked" list of the various resources being covered?

A. No. Generally, the City website and *www.marc.org*

Resource	Location
Topeka Municipal Code	https://topeka.municipal.codes/TMC
Stormwater BMP Design Handbook	https://www.topeka.org/utilities/stormwater-development-management/
Property Owners Guide to BMP Maint.	
Training slides and videos	
MARC Manual	https://www.marc.org/Environment/Water-Resources/Local-Government-Resources/Stormwater-Best-Management-Practices

Survey questions from last class

Q. One picture looked like permeable pavers were delineating parking stalls. Are permeable pavers a maintenance issue when used on a public street or are they better suited to slow speed/parking lot applications?

A. Pavers have a variety of applications depending on individual paver design (length, thickness, etc.)

Choose pavers based on application, expected loads, and maintenance needs vs owner capabilities, etc.

Reputable paver vendors (e.g., Belgard) will provide detailed information on paver selection and design

Note: Topeka does not allow private BMPs in the public ROW

Permeable Paver Crosswalks in Bloomington IN

Permeable Paver Parking Stalls in Auburn AL

Permeable Parking at METRA in Glen Ellyn IL

Permeable On-Street Parking in Portland OR

Permeable Paver Use
Enterprise Car Rental, Farragut TN

Toomer's Corner, Auburn AL
Pedestrian & On-street Permeable Pavers

Peoplestown Flood Mitigation
Downtown Atlanta GA

On-street Permeable Pavers

What is a Sustainable BMP?

A BMP that is **planned, designed, and constructed** in ways that maximize the potential **for successful long-term operation & maintenance**.

Chattanooga TN Transit Station Parking Lot.

Why design for BMP sustainability?

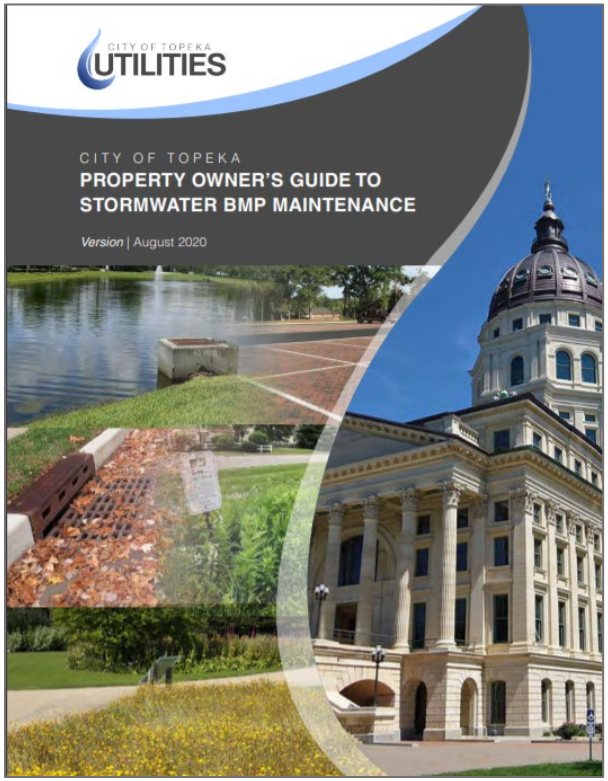
1. Municipal stormwater permit compliance

- Applies to new/redevelopments > 1 acre land disturbance
- Consider structural and non-structural strategies
- **Ensure the long-term BMP maintenance & operation**

EPA's original permit rules

Topeka's Requirements

- TMC Chapter 13.40 - property owners must **inspect and maintain** their BMPs
- BMP inspection (documented) by owner **every 2 years**
- BMP inspection by licensed PE or LA **every 6 years**
- Use the ***Topeka Property Owner's Guide to Stormwater BMP Maintenance***



Why design for BMP sustainability?

2. Public infrastructure management & costs

Well-maintained BMPs:

- won't overwhelm aging or undersized public drainage systems
- are key to extending the operational life of the public drainage system life

Recognizing BMP Maintenance Stakeholders

BMP Owners

- Private property owners who have BMPs on their land
  - Businesses, Industries, Etc. *that own the property*
  - Homeowner Associations *that have BMPs located in their common spaces*
  - Individual residents *that have an BMP on their lot (?)*

- Municipalities
- Developers *during property construction*

BMP Maintainers

- BMP Owners
- Tenants
- Facilities Managers
- Landscape companies
- Property management companies
- The kid from next door with the lawnmower

- Public Works/Utility crews
- Site construction contractors *during property construction*

BMP Owners & Maintainers – The Average Joe

- **The Average Joe doesn't know:**
  - what it is
  - where it is
  - what it does
  - how to inspect & maintain it

- **Complicating factors:**
  - Non-existent / defunct HOAs
  - Owner to User ratio often < 1
  - Unwilling or unable owners
  - It's already old and was never maintained
  - It never functioned properly in the first place

BMP Maintenance Grades

Non-Residential BMPs

- Awareness is moderate to high
- Understanding is low
- Proper maintenance is low
- Maintenance usually performed by third party
- Historically, local gov'ts have not enforced this

Overall Maintenance Grade

Residential BMPs

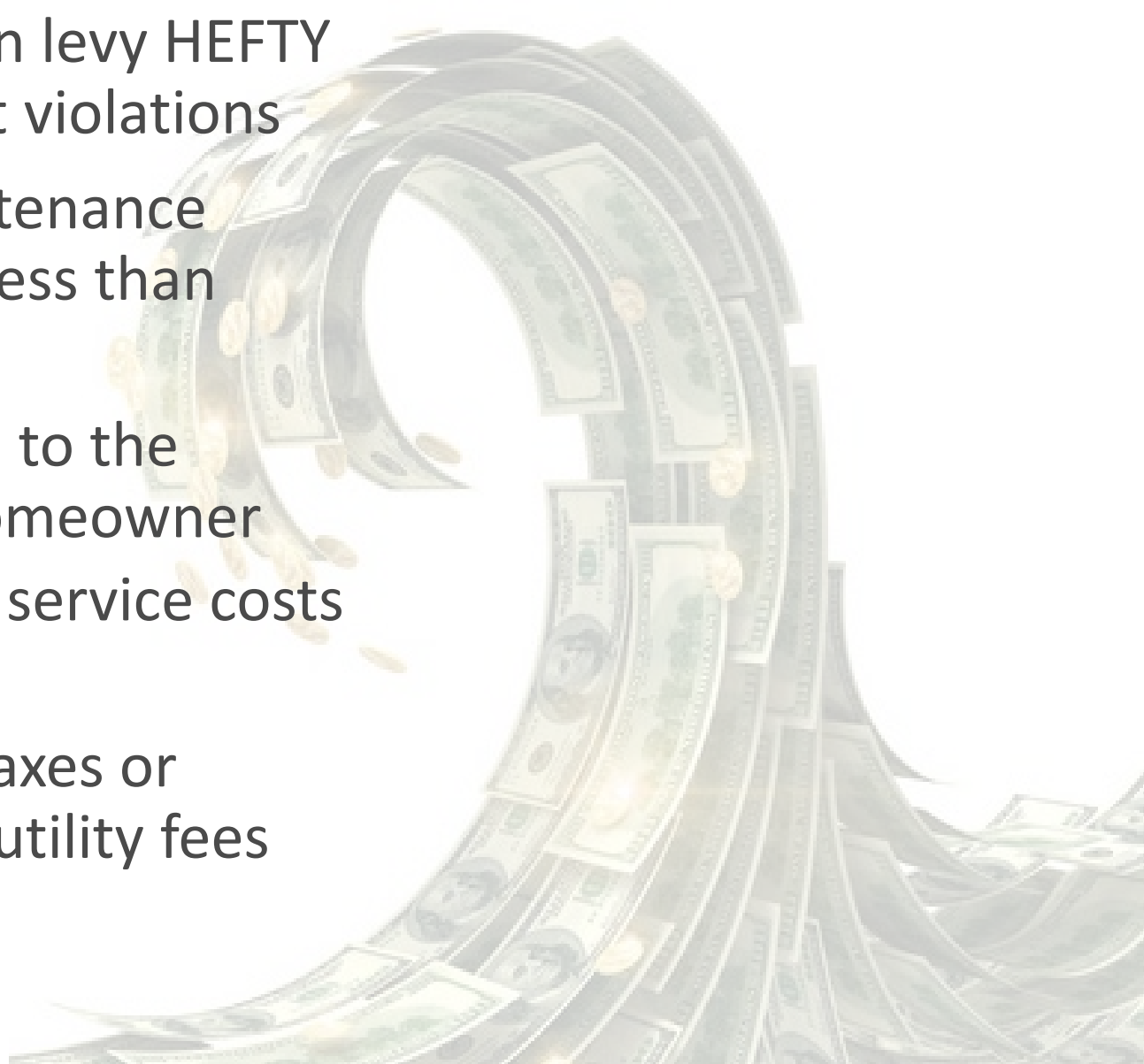
- Awareness is very low
- Understanding is non-existent
- Rarely, if ever, maintained
- Maintenance usually performed by third party
- Historically, local gov'ts haven't enforced AND its often politically unpalatable to do so

Overall Maintenance Grade

Current BMP Maintenance Reality

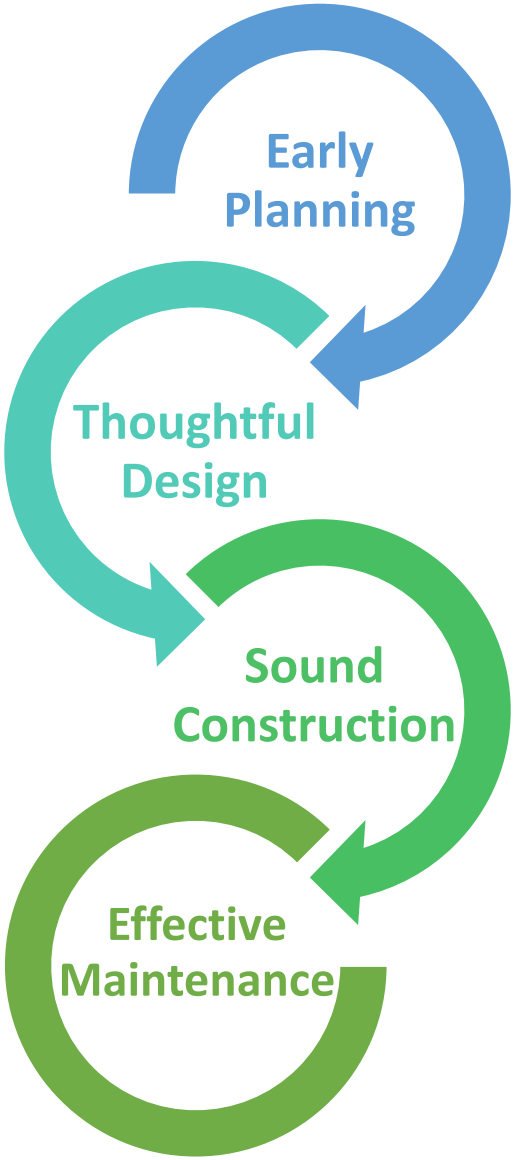
The Cost of Poor BMP Maintenance

- EPA & GEPD can levy HEFTY fines for permit violations
- Proactive maintenance **ALWAYS** costs less than repairs
- Increased costs to the consumer & homeowner
  - Product and service costs
  - HOA fees
  - Local gov't taxes or stormwater utility fees



How can DESIGNERS help?

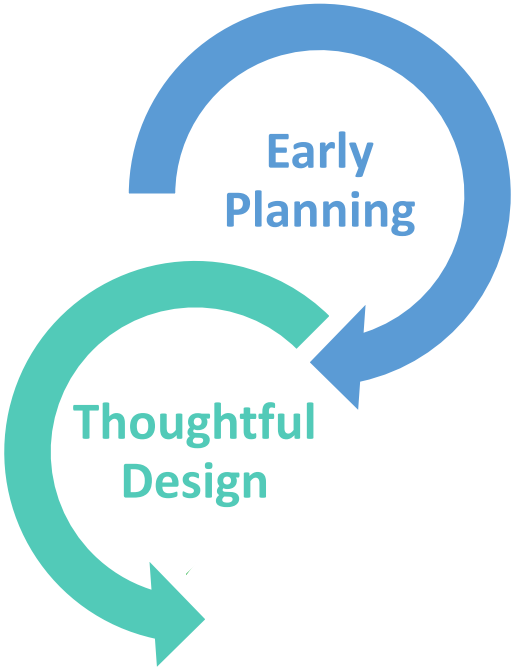
Plan, design, and construct BMPs to maximize its potential **for successful long-term operation & maintenance** by future property owners.



How can DESIGNERS help?

Maximize maintenance potential by your choices in:

- BMP Selection
- BMP Location
- BMP Protection



BMP Selection

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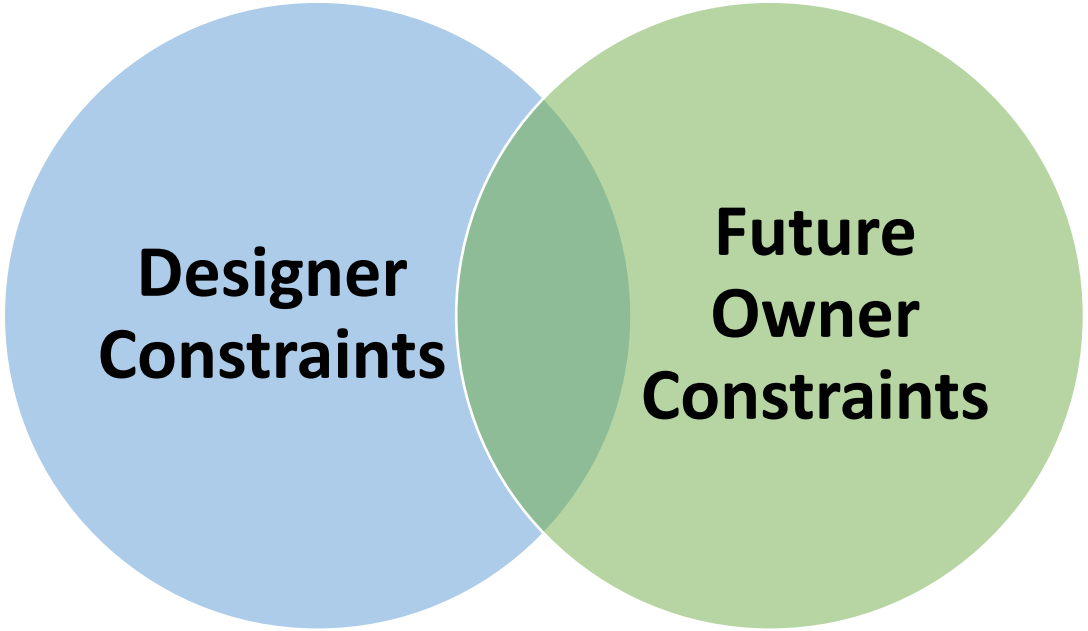
Designer Constraints

- ✓ Engineering criteria
- ✓ Construction feasibility
- ✓ Construction cost

Future Owner Constraints

- ✓ Long-term O&M costs
- ✓ Suitability for new land use
- ✓ Ease of maintenance



BMP Selection – Good Nonresidential BMP Choices

BMP Selection – Good Nonresidential BMP Choices

← Detention (natives)

Infiltration Trench →

Urban Bioretention ↓

↓ Extended Detention

Non-residential special applications – Cisterns & Green Roofs

Must have:

- An ongoing use for captured rainwater *(cistern only)*
- An owner who is able **and willing** to operate and maintain the BMP
- Best applied when the Owner or a Facility Manager will oversee BMP operation

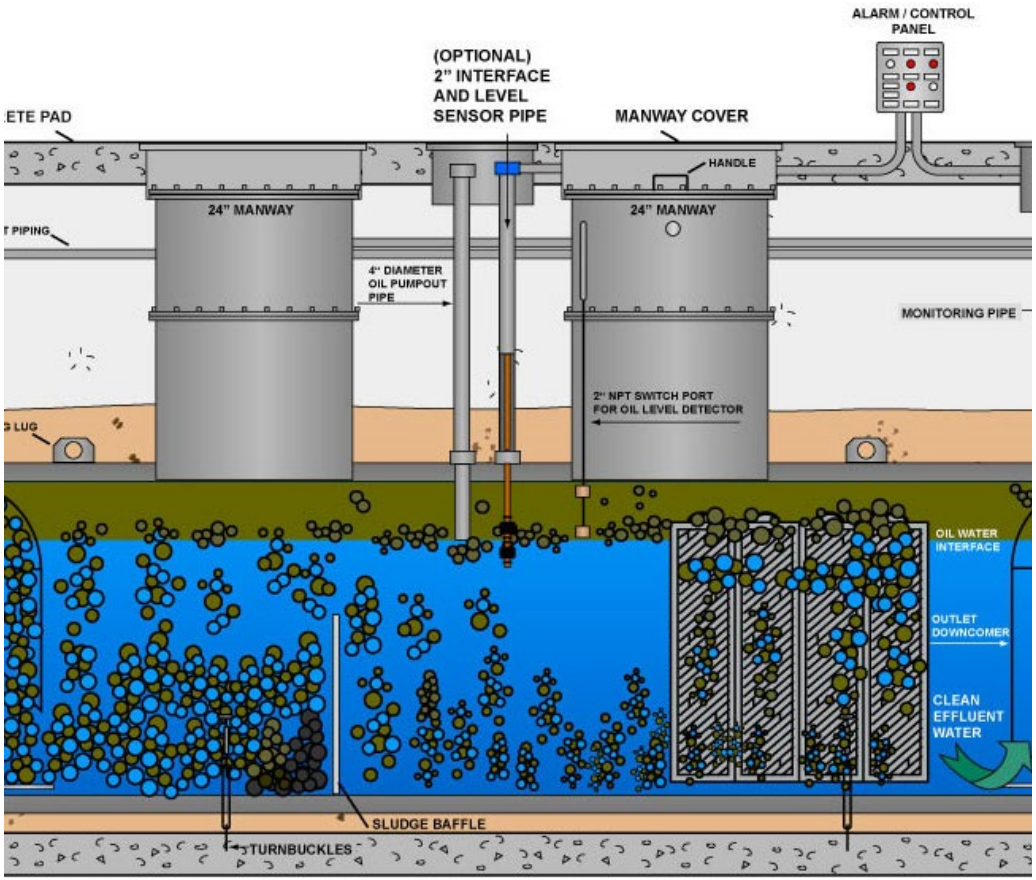
Non-residential special applications – Pervious Pavement/Pavers

- Becoming very popular with many styles and colors
- A lot of design versatility
- Be careful in hotspots
  - Auto repair
  - Kennels
  - Building materials stores
  - Brownfields
  - Floodplains

Non-residential special applications – Proprietary BMPs

- Effective for some pollutants, not so much for others – see memos on City website for LOS values
- Nice for small, highly impervious, special pollutant sites
- Easy for the developer – but can be difficult for the owner
- Many require **ALOT** of maintenance and unexpected costs
- Easily forgotten (out of sight, out of mind)
- Worries about long-term vendor support

Non-residential special applications – Other BMPs



ECOLOGIX HQB BELOW GROUND OIL/WATER SEPARATOR

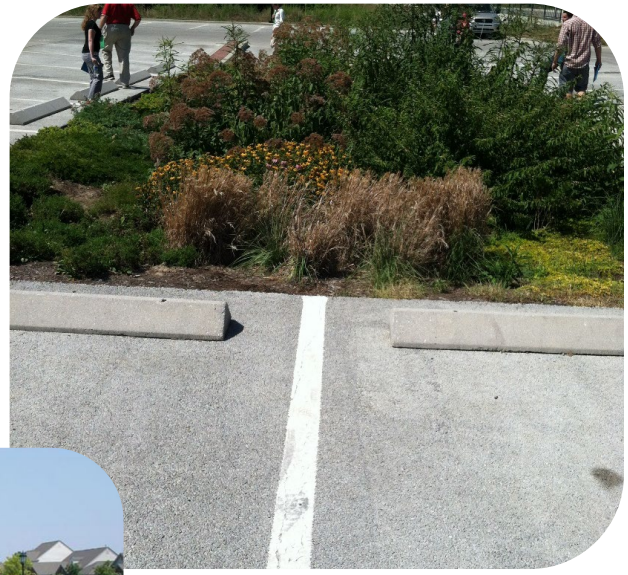
- Consider the land use draining to the BMP
- Which BMP is right?
  - Gas stations
  - Automotive repair shops
  - Plant nurseries
  - Fast food joints
  - Brownfield redevelopments
  - Floodplains
  - Sinkhole areas
- Ask City staff if you think your site might be a hotspot

BMP Selection – Good Residential BMP Choices

Know who the Owner will be

- **Strong HOA** – usually has amenities that require maintenance (pool, tennis courts, etc.). Good chance of maintenance.
- **Weak HOA** – no amenities, often just a common lot for a detention pond. Poor maintenance.
- **Homeowner(s)** – the poor souls who will buy the lots that have the detention pond. Poor maintenance.

BMP Choices for a strong HOA



Choose whatever a landscape maintenance company can handle

But, shy away from:

- **<u>Non-GI</u> proprietary BMPs**
- **Cisterns/Rain Barrels** *(Need frequent operational oversight that probably won't be onsite)*
- **Green roofs** *(Will someone really get up there?!)*
- **Lot-to-lot permeable pavements/pavers, rain gardens, etc.** *(unless strong covenants prevent BMP removal)*

BMP Choices for a weak HOA

Select BMPs that require little maintenance

Best choices:

- Dry ext. detention, dry channels, vegetated filters, etc.
  - Mowing
  - Erosion control
  - Outlet cleaning

Stay away from:

- Proprietary BMPs
- Cisterns
- Green roofs
- Any infiltration BMP

BMP Choices for a homeowner lots

Select BMPs that require little maintenance

Best choices:

- Dry ext. detention, dry channels, vegetated filters, etc.
  - Mowing, erosion control, outlet cleaning

Be careful:

- Infiltration BMPs that could easily be damaged or removed

Stay away from:

- Any BMP that requires a high level of, or complex, maintenance

BMP Location – The Old Way

Out of site. Out of mind

BMP Location – The New Way

- Front and center is better!
- Create a “showcase”?
- Integrate it into the property aesthetic and amenities
- Provide easy & unBMPeded access for inspection & maintenance

Source: City of Champaign IL

BMP Location – Good Examples

Source: City of Portland OR

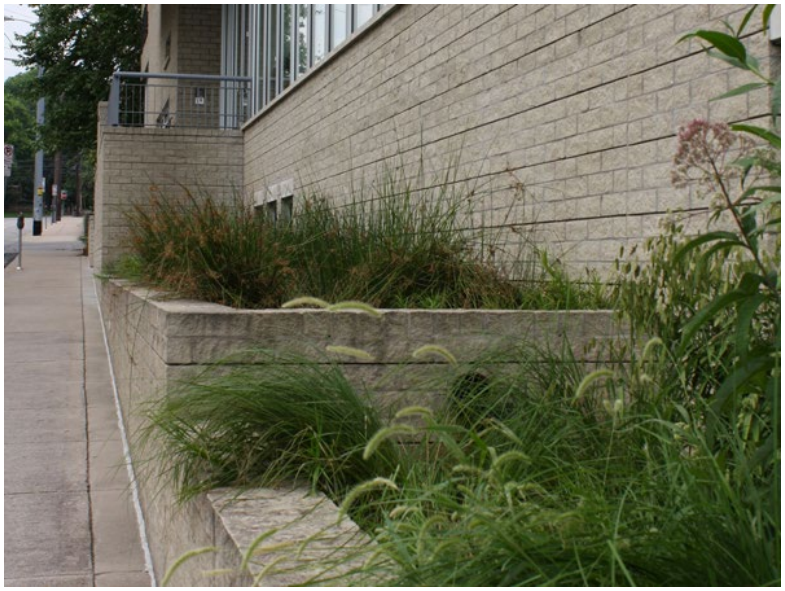
Source: City of Denver CO

BMP Location – Good Examples

Source for both: Chattahoochee Riverkeeper

BMP Location – Good Examples

Surface Sand Filter, Source: NC.gov



Downspout Disconnection, TN Assoc. of Realtors

Surface Sand Filter
Source:
Montgomery Co. MD

BMP Protection

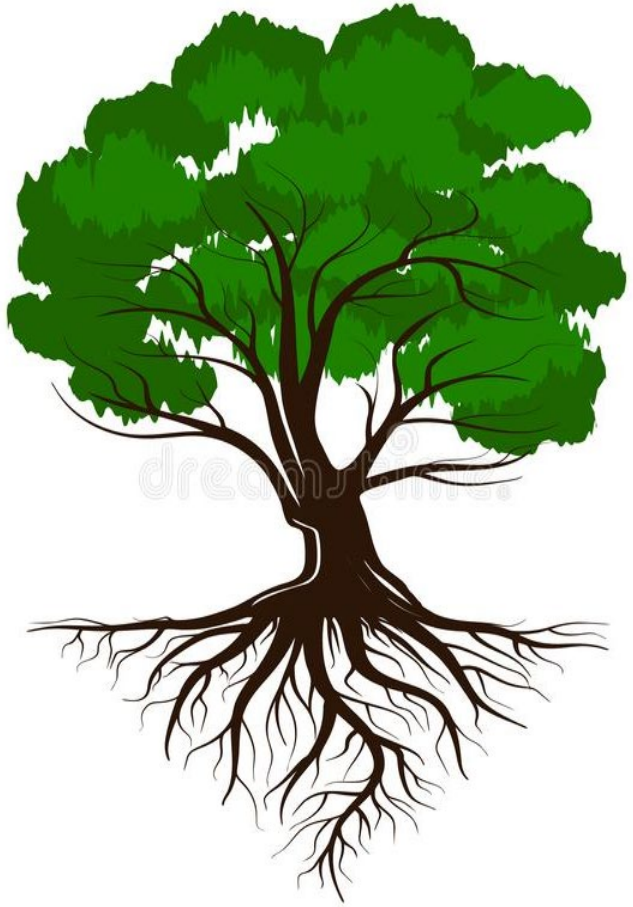
Goals:

- Prevent damage
- Limit encroachment
- Educate
  - Owner
  - Maintainer
  - Public
- Passive vs. Active

Remember Class 2's Key Lesson

Plants & soil are critical to the success of **stormwater LID techniques** and **GI-BMPs**

Protection from soil compaction and plant damage is paramount!



Passive BMP Protection – Educational Signs

NO Dumping, Grass Clippings or Landscape Debris

Passive Protection: Plants & Rocks

Passive Protection: Pathways

Passive Protection: Behavioral

Good for BMPs that are also amenities

- Walking trails
- Sidewalks
- Playgrounds
- Recreational fields

Signs are great for any residential application

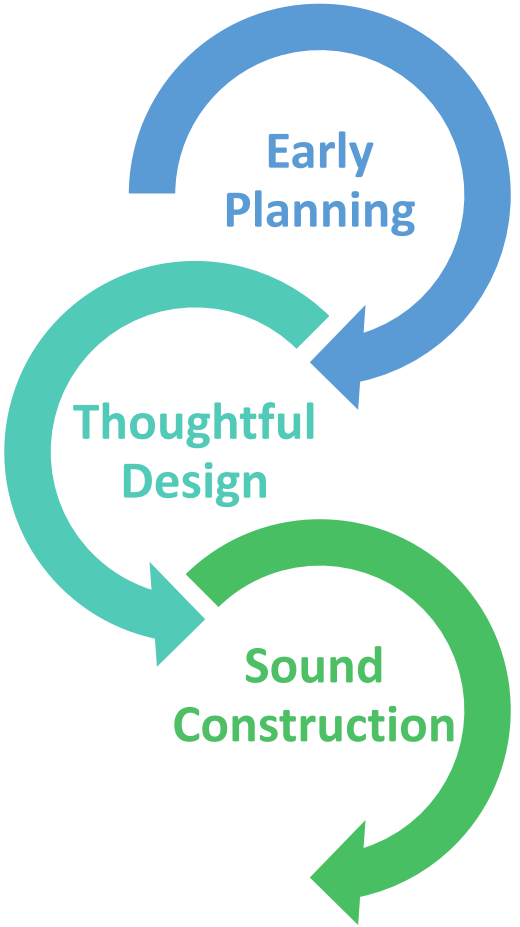
Waste stations are best for non-residential sites and residential sites with strong HOAs

Active BMP Protection: Fences & Curbs

Another way designers can help

Maximize maintenance potential by your choices in:

- BMP Selection
- BMP Location
- BMP Protection



Stay involved through construction. You sign the As-Built Plan. Make sure BMPs are:

- protected
- correctly installed/constructed
- clean, undamaged, and functional

Detention/Retention Requirements

Definitions

Detention BMPs: Designed to reduce the peak discharge and only detain runoff for some short period of time and **release** it **at a reduced peak discharge**

Retention BMPs: Designed to retain stormwater and allow it to evaporate and/or infiltrate **without release**.

Updated Performance Standards

- New HEC-RAS 2D modeling was performed for all Topeka drainage basins and streams in 2019 as part of a KDA grant

- The City was interested in using the models to test stream sensitivity to peak discharge and volume changes resulting from onsite controls

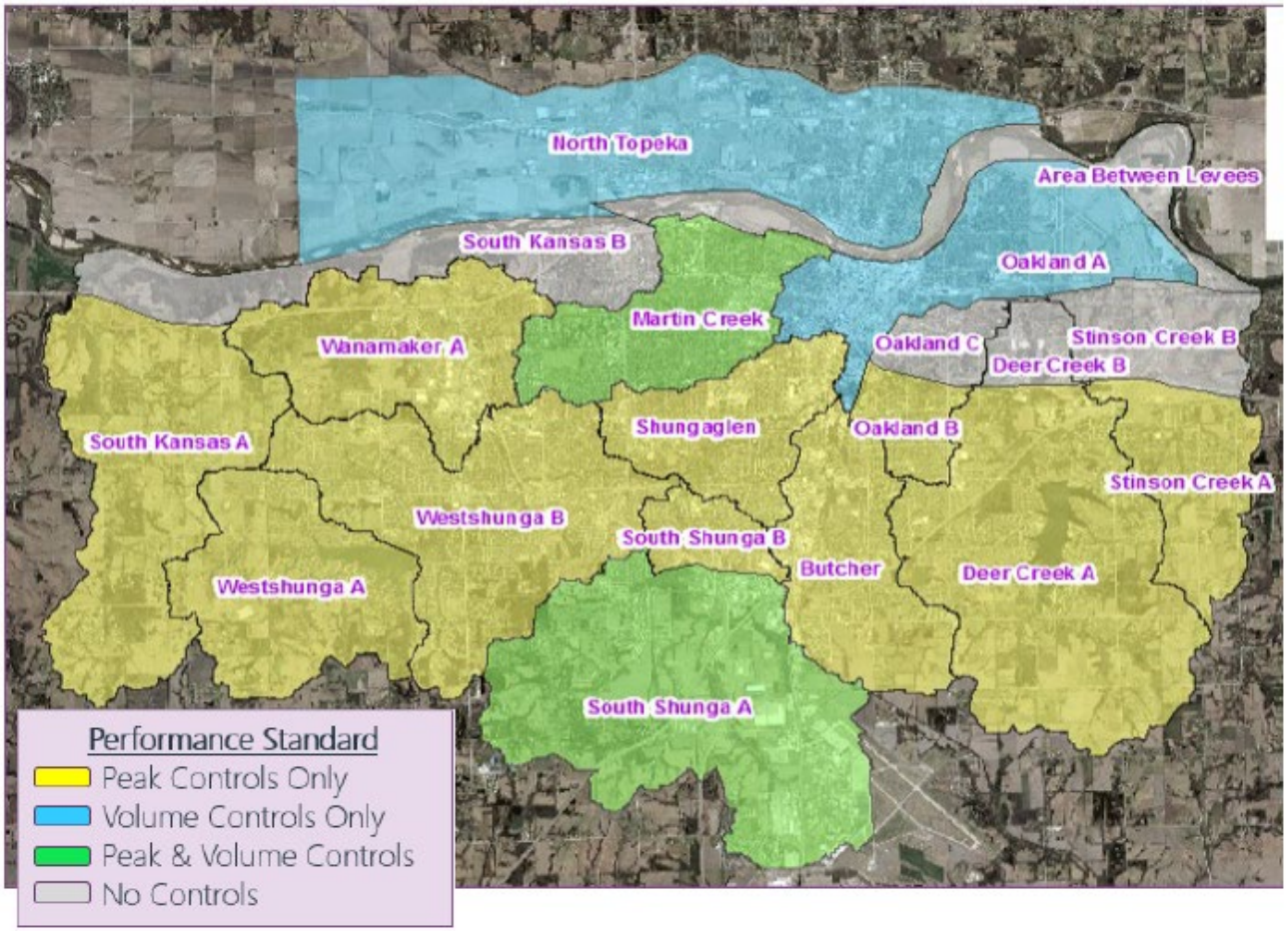
  - Model Results were used to develop the new Performance Standards Basin Map

Performance Standard Applicability

Chapter 4

Section 4.1

Topeka Stormwater BMP Design Handbook



A GIS file of these basins will be posted to the Utilities website and available for download

Performance Standard Applicability

Chapter 4

Section 4.2

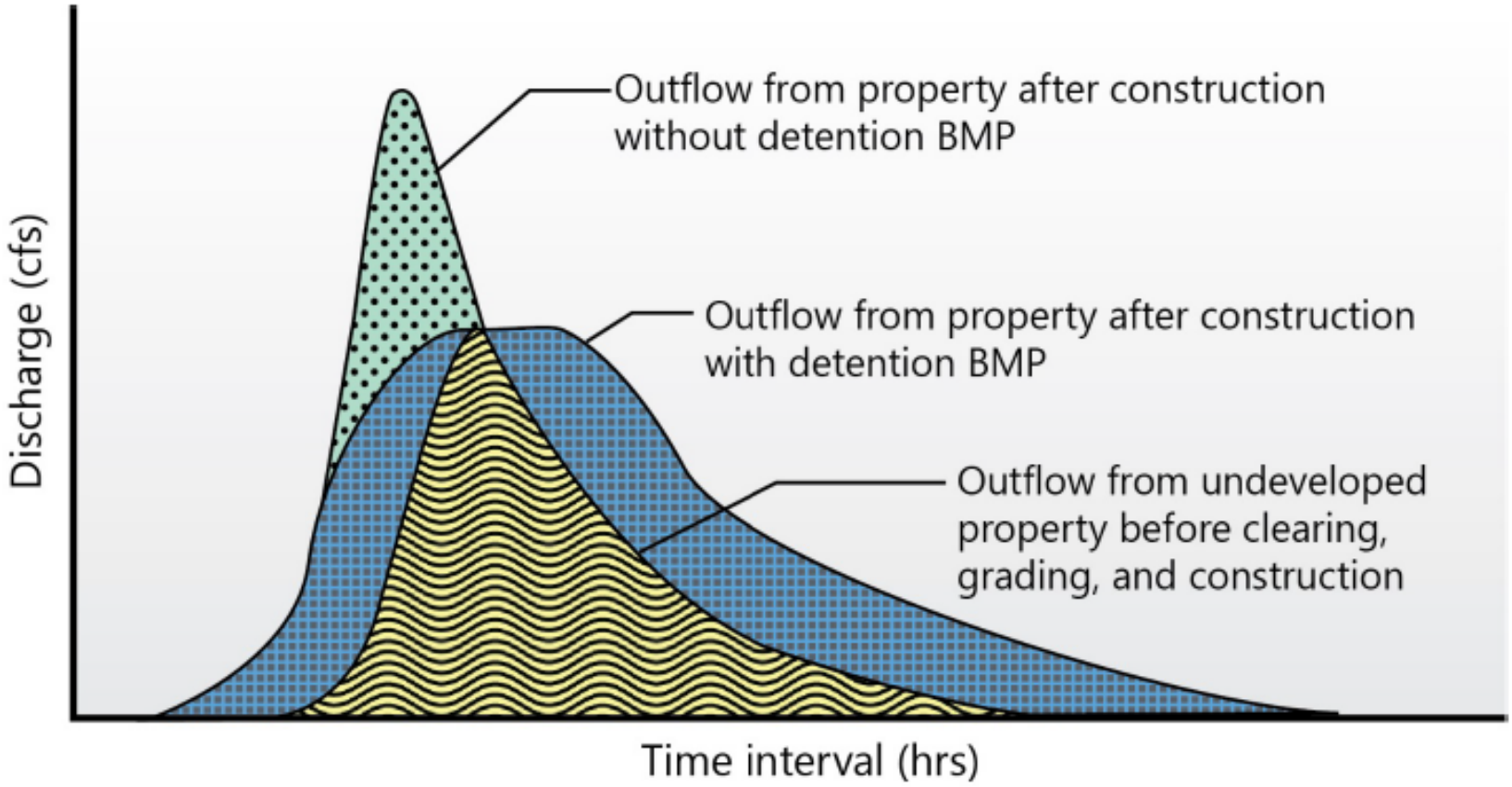
Topeka Stormwater BMP Design Handbook

Peak Flow Control Standard

- Post-developed peak discharge **shall not exceed** pre-developed peak discharge
  - Calculated for the 2-, 5-, 10-, 25-, 50- and 100-year return frequency, 24-hour duration storm events

- Compliance is typically achieved through detention or retention storage BMPs

Graph of Peak Flow Control



Performance Standard Applicability

Chapter 4

Section 4.2

Topeka Stormwater BMP Design Handbook

Volume Control Standard

- Post-developed volume of the 100-year return frequency, 24-hour duration storm event is retained or managed **entirely on-site**

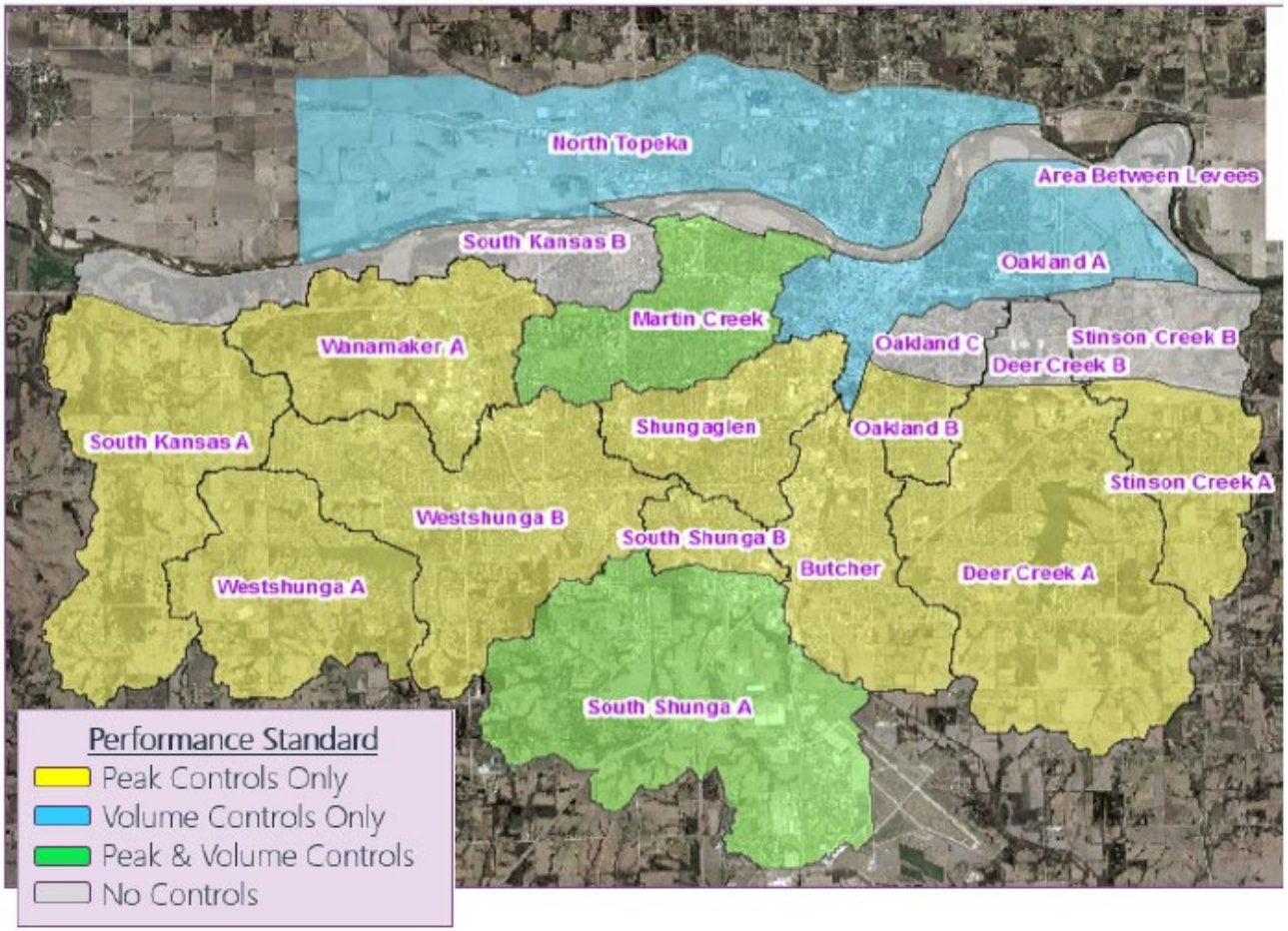
- Compliance achieved through retention and/or green infrastructure facilities

Performance Standard Applicability

Chapter 4

Section 4.1

Topeka Stormwater BMP Design Handbook



A GIS file of these basins will be posted to the Utilities website and available for download

Performance Standard Applicability

Chapter 4

Section 4.2

Topeka Stormwater BMP Design Handbook

Martin Creek and South Shunga A Basins

- These basins require peak flow and volume controls
- BMP design should strive towards achieving maximum retention of the post-developed volume of the 100-year return frequency, 24-hour duration storm event on-site.
- However, **alternative approaches** may be used such that post-developed volume discharge **does not exceed** pre-developed volume discharge for the design storm.
- Compliance achieved through retention and/or green infrastructure facilities

Performance Standard Applicability

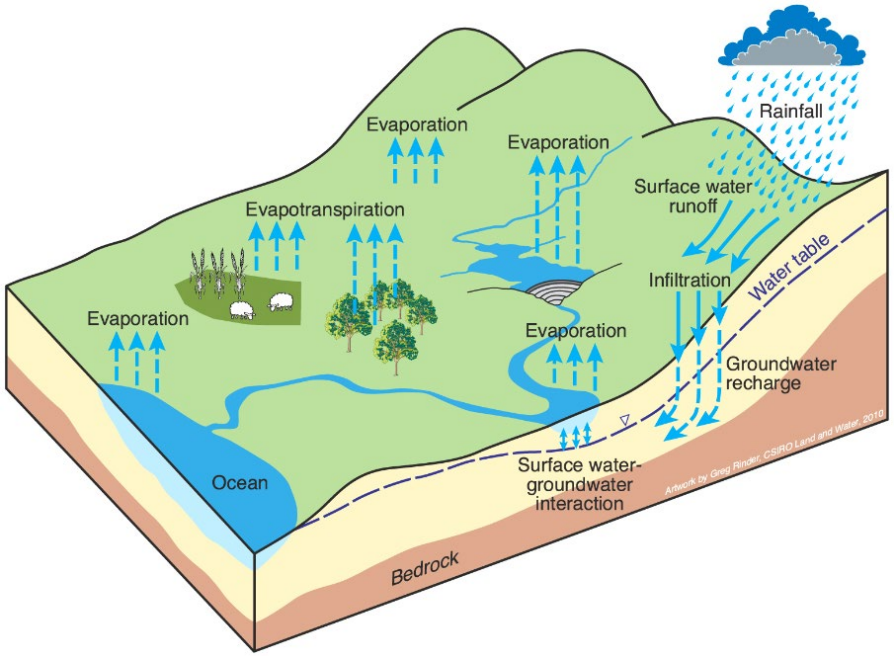
Chapter 4

Section 4.3.3

Topeka Stormwater BMP Design Handbook

Computational Methods

- Stormwater discharge should be calculated using the SCS Unit Hydrograph Method via a **rainfall-runoff modeling** approach
  - Rational method and regression formulas are not acceptable for designing detention/retention facilities



Performance Standard Applicability

Chapter 4

Section 4.3.3

Topeka Stormwater BMP Design Handbook

Rainfall

- **NOAA Atlas 14, Volume 8** rainfall data should be used for rainfall depths
- A **24-hour** duration rainfall depth, using **NRCS MSE4 nested** rainfall distribution should be used in developed storm hyetographs
  - The incremental rainfall depths have been developed for Topeka
  - The handbook describes an alternative approach

Table 4-3. Incremental Rainfall Hyetographs for Topeka, KS

Time (hrs)	*Incremental Rainfall Hyetographs for Topeka, KS*						
	2-year	*5-year*	*10-year*	*25-year*	*50-year*	*100-year*	*500-year*
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.100	0.001	0.002	0.002	0.002	0.003	0.003	0.004
0.200	0.001	0.002	0.002	0.003	0.003	0.003	0.004
0.300	0.002	0.002	0.002	0.003	0.003	0.003	0.004
0.400	0.002	0.002	0.002	0.003	0.003	0.004	0.005
0.500	0.002	0.002	0.002	0.003	0.003	0.004	0.005
0.600	0.002	0.002	0.003	0.003	0.003	0.004	0.005
0.700	0.002	0.002	0.003	0.003	0.004	0.004	0.005
0.800	0.002	0.002	0.003	0.003	0.004	0.004	0.006

Performance Standard Applicability

Chapter 4

Section 4.3.1

Topeka Stormwater BMP Design Handbook

Energy Dissipation

- To limit shear stresses on storage BMPs and receiving streams, energy dissipating devices should be installed at:
  - Primary outlets
  - Emergency spillways
  - Drain works
  - Conveyance system entrances into storage BMPs

Performance Standard Applicability

Chapter 4

Section 4.3.1

Topeka Stormwater BMP Design Handbook

Energy Dissipation

- Table 4-1 in the Handbook describes permissible shear stresses for lining material

Table 4-1. Permissible Shear Stresses for Lining Material *(Source: Table 5607-1, MARC/APWA BMP Manual)*

Lining Category	Lining Type	Permissible Shear Stress (lbs/ft^2)
General	Erosion Control Blankets	1.55 – 2.35
	Turf-Reinforced Matrix (TRMs):	- - -
	Unvegetated	3.0
	Vegetated	8.0
	Geosynthetic Materials	3.01
	Cellular Containment	8.1
	Woven Paper Net	0.15
	Jute Net	0.45
	Fiberglass Roving:	- - -
	Single	0.60
	Double	0.85
	Straw with Net	1.45
	Curled Wood Mat	1.55
	Synthetic Mat	2.00
Vegetative	Class A (see Table 4-2a)	3.70
	Class B (see Table 4-2a)	2.10
	Class C (see Table 4-2a)	1.00
	Class D (see Table 4-2a)	0.60
	Class E (see Table 4-2a)	0.35
Gravel Riprap	25 mm	0.33
	50 mm	0.67
Rock Riprap	150 mm	2.00
	300 mm	4.00
Bare Soil	Non-Cohesive	See Figure 4-3
	Cohesive	See Figure 4-4

Performance Standard Applicability

Chapter 4

Section 4.3.1

Topeka Stormwater BMP Design Handbook

Energy Dissipation

- Tables 4-2a and 4-2b in the Handbook describes usage policies for vegetated cover

Table 4-2a. Classification of Vegetal Covers as to Degree of Retardance *(Adapted from Table 5607-2, MARC/APWA BMP Manual)*

Retardance Class	Cover	Condition	Usage Policies and Other Notes
A	Weeping lovegrass	Excellent stand, tall (avg. 30")	Non-native species. Stormwater BMP credit is not available if used in a dry ED basin. See Section 3.4.2.
	Yellow bluestem	Excellent stand, tall (avg. 36")	
B	Kudzu	Very dense growth, uncut	Invasive species. Prohibited in stormwater BMPs in the City of Topeka.
	Bermuda grass	Good stand, tall (avg. 12")	Invasive species. Prohibited in stormwater BMPs in the City of Topeka.
	Native grass mix (little bluestem, big bluestem, blue grama, other long & short Midwest grasses	Good stand, unmowed	See Retardance Class B in Table 4-2b.
	Weeping lovegrass	Good stand, tall (avg. 24")	Non-native species. Stormwater BMP credit is not available if used in a dry ED basin. See Section 3.4.2.
	Lespedeza sericea	Good stand, not woody, tall (avg. 19")	Invasive species. Prohibited in stormwater BMPs in the City of Topeka.
	Alfalfa	Good stand, uncut (avg. 11")	Non-native species. Stormwater BMP credit is not available if used in a dry ED basin. See Section 3.4.2 Not appropriate for regular submergence/flooding or areas of high water table.
	Weeping Lovegrass	Good stand, unmowed (avg. 13")	Non-native species. Stormwater BMP credit is not available if used in a dry ED basin. See Section 3.4.2.
	Kudzu	Dense growth, uncut	Invasive species. Prohibited in stormwater BMPs in the City of Topeka.
	Blue grama	Good stand, uncut (avg.11")	Not appropriate for regular submergence/flooding or areas of high water table.
C	Crabgrass	Fair stand, uncut 10"-47"	Annual weed
	Bermuda grass	Good stand, mowed (avg. 6")	Invasive species. Prohibited in stormwater BMPs in the City of Topeka.
	Common lespedeza	Good stand, uncut (avg. 11")	Invasive species. Prohibited in stormwater BMPs in the City of Topeka.
	Grass/legume mix – summer (orchard grass, redtop, Italian ryegrass, common lespedeza)	Good stand, uncut (avg. 6"-8")	See Retardance Class C in Table 4-2b.
	Centipede grass	Very dense cover (avg. 6")	Grows in Southeastern U.S., Texas, and California
	Kentucky bluegrass	Good stand, headed (6"-12")	Perennial, cool-season, sod-forming, vigorous root development

Performance Standard Applicability

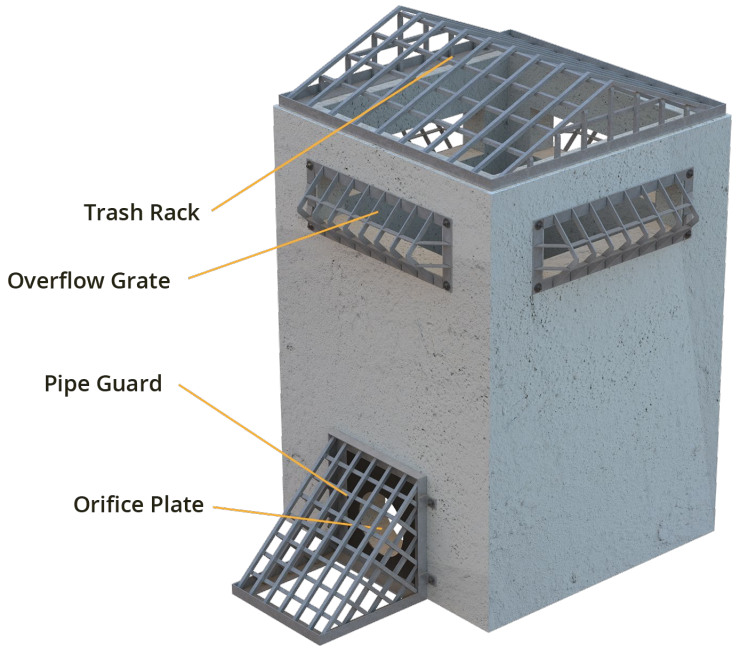
Chapter 4

Section 4.3.1

Topeka Stormwater BMP Design Handbook

Primary Outlet Design

- Should be designed to **prevent clogs**
  - Reverse-slope pipe draws water from below the permanent pool, being less likely to clog from floating debris
  - Trash racks, grates and stone filters also prevent clogs from floating debris



Performance Standard Applicability

Chapter 4

Section 4.3.1

Topeka Stormwater BMP Design Handbook

Emergency Spillway

- Can be combined with the primary outlet structure or be a separate structure
- Provides a flow path for the ultimate protection of the embankment and to control the location of overtopping
- Crest should be **at or above the 100-yr** (1% annual chance) **WSE**

Performance Standard Applicability

Chapter 4

Section 4.3.1

Topeka Stormwater BMP Design Handbook

Emergency Spillway

- Unless regulated by state or federal agencies, spillway should be designed to:
  - Pass the 100-yr flood event with 1 foot of freeboard, assuming zero flow through primary outlet
  - Pass spillway flows with one foot of depth at a velocity of:
    - 6 ft/s or less in vegetated spillways with clay soils
    - 4 ft/s or less in vegetated spillways with sandy soils
    - 12 ft/s or less in properly designed rip-rap spillways

Performance Standard Applicability

Chapter 4

Section 4.3.2

Topeka Stormwater BMP Design Handbook

Water Quality BMPs

- When a detention/retention structure also serves as a **water quality BMP**, design should fall in line with requirements specified in the **MARC Manual**
  - Sediment forebays/pretreatment
  - Appropriate side slopes
  - Vegetation requirements
  - Control of water quality volume

Stormwater Management Plan

- For each detention/retention facility, provide the following in the SWMP:
  - Drainage Area, impervious area, CN used in calculations
  - Inflow hydrograph information (tabular or graphical)
  - Stage-storage-outflow table
  - Routing information, including peak storage and outflow
  - Details (design, material, size, elevations etc) for all outlet structures

Stream Buffers

Importance of Stream Buffers

- **Water Quality:** mixture of native trees, plants, and grasses protect water quality by filtering out pollutants carried by stormwater runoff.

- **Bank Stabilization:** vegetation helps to hold the banks in place, particularly during high flows, controlling erosion and reducing sedimentation.

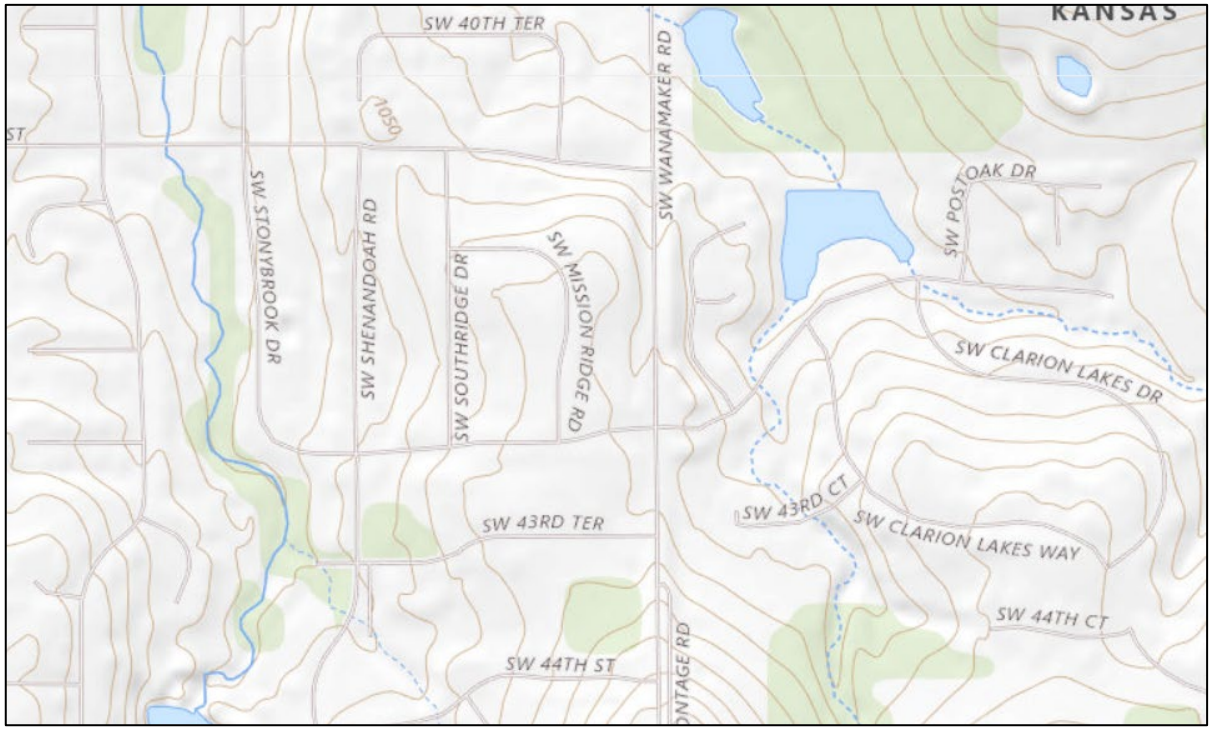
Importance of Stream Buffers

- **Wildlife Habitat:** native vegetation preserves wildlife habitat and food; tree canopy provides shade to keep water cool, increasing dissolved oxygen in the water.

- **Flood Protection:** stream setbacks help to protect the public from flooding

Stream Buffer Requirements

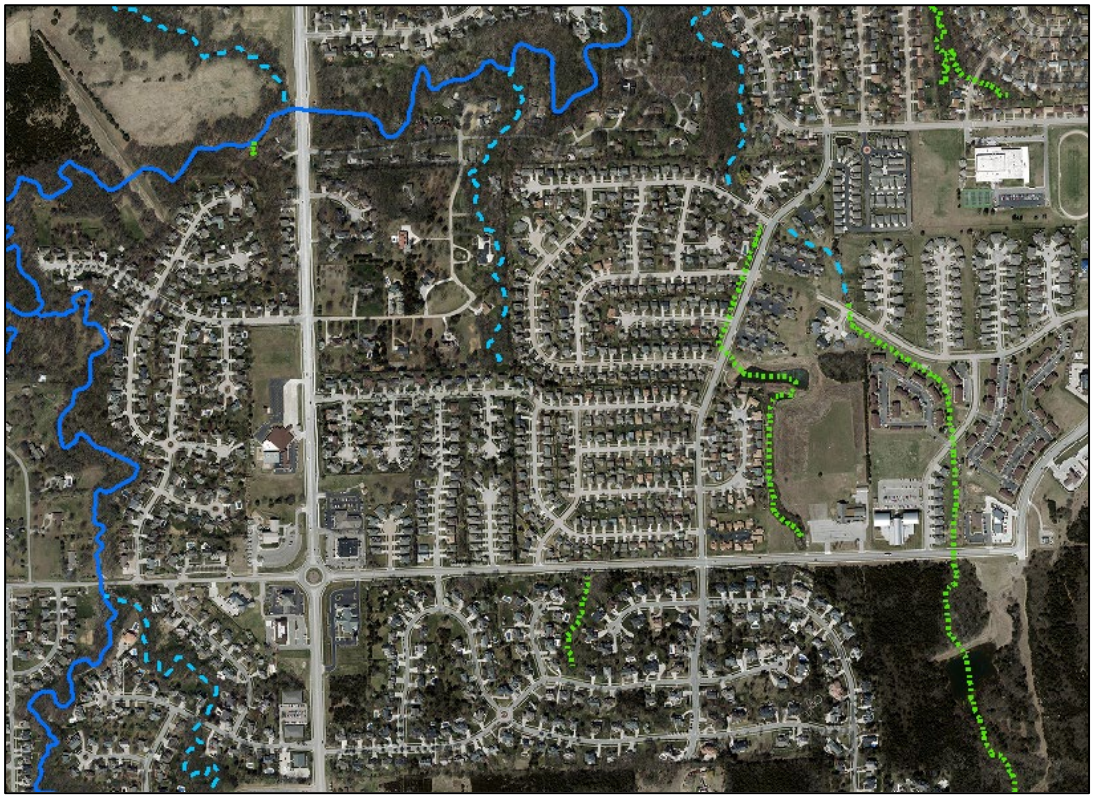
- **Type I Stream:**
  - Perennial Stream shown as solid blue lines on a USGS Map
- **Type II Stream:**
  - Intermittent Stream shown as a dashed blue line on a USGS Map



TMC Chapter 17.10

Stream Buffer Requirements

- **Type III Stream:**
  - Waterways or channels having a contributing drainage area of 40 acres or greater
  - A GIS file of these streams has been developed and will be posted to the Utilities website and available for download



TMC Chapter 17.10

Stream Buffer Requirements

TMC Chapter 17.10

Streamside Area

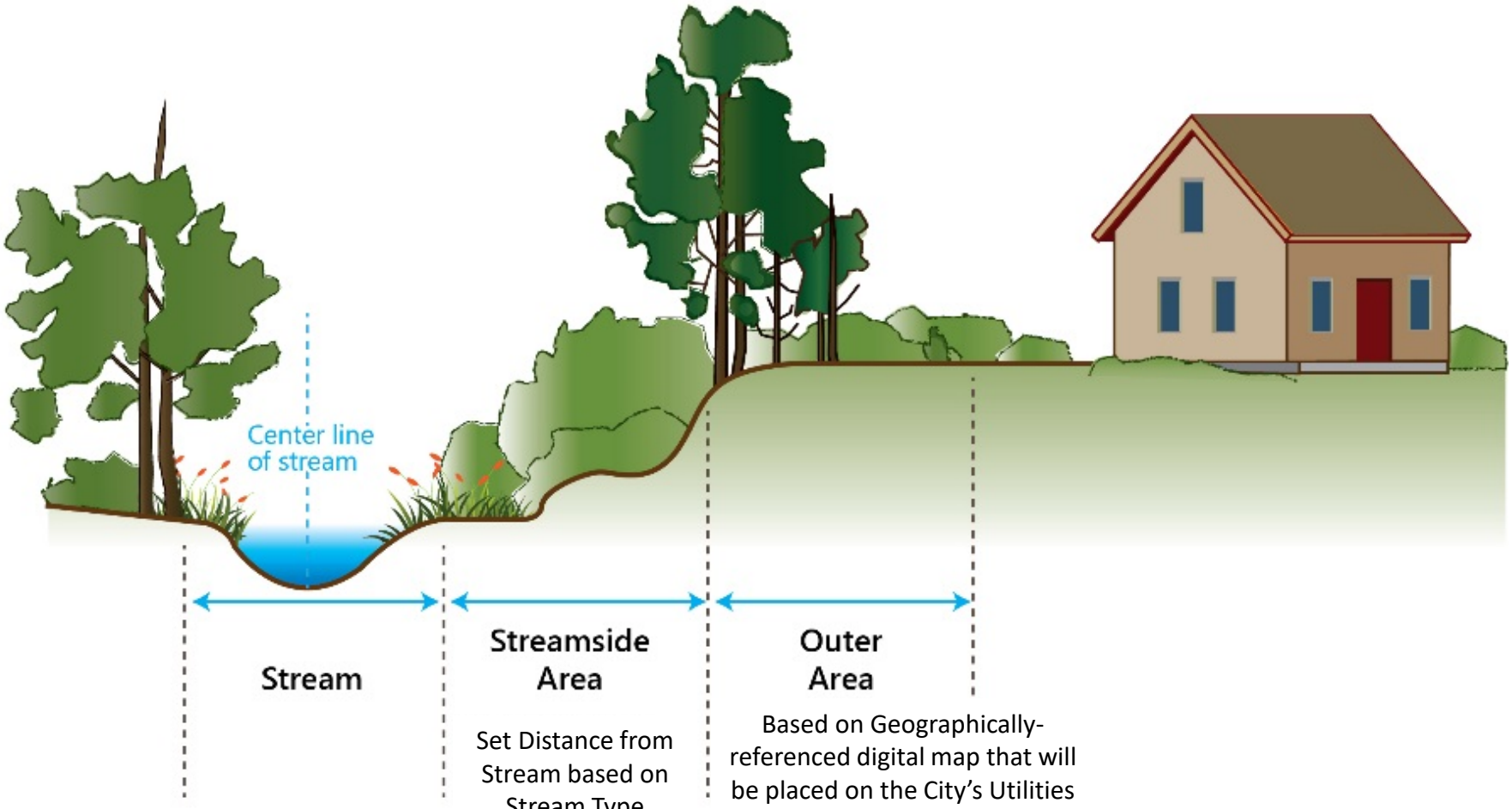
- **Function:**
  - Protects the physical and ecological integrity of the stream ecosystem
- **Allowable Uses:**
  - Streambank stabilization
  - Flood control
  - Utility corridors, unpaved foot paths, road crossings
- **Width:**
  - Type I Stream: 50 feet from edge of waterway (outer wet edge of channel during base flow or where vegetation begins)
  - Type II Stream: 25 feet from centerline of channel
  - Type III Stream: 15 feet from centerline of channel

Stream Buffer Requirements

TMC Chapter 17.10

Outer Area

- **Function:**
  - Protects key components of the stream
  - Filters runoff
  - Slows velocity of runoff
- **Allowable Uses:**
  - Biking/hiking paths
  - Flood control
  - Stormwater BMPs
  - Utility corridors
  - Residential yards, Landscaped areas
- **Width:**
  - Determined by GIS Stream Buffer Shapefiles developed for the City of Topeka, which will be posted to the Utilities website and available for download



Set Distance from Stream based on Stream Type

Based on Geographically-referenced digital map that will be placed on the City's Utilities Exploration Map

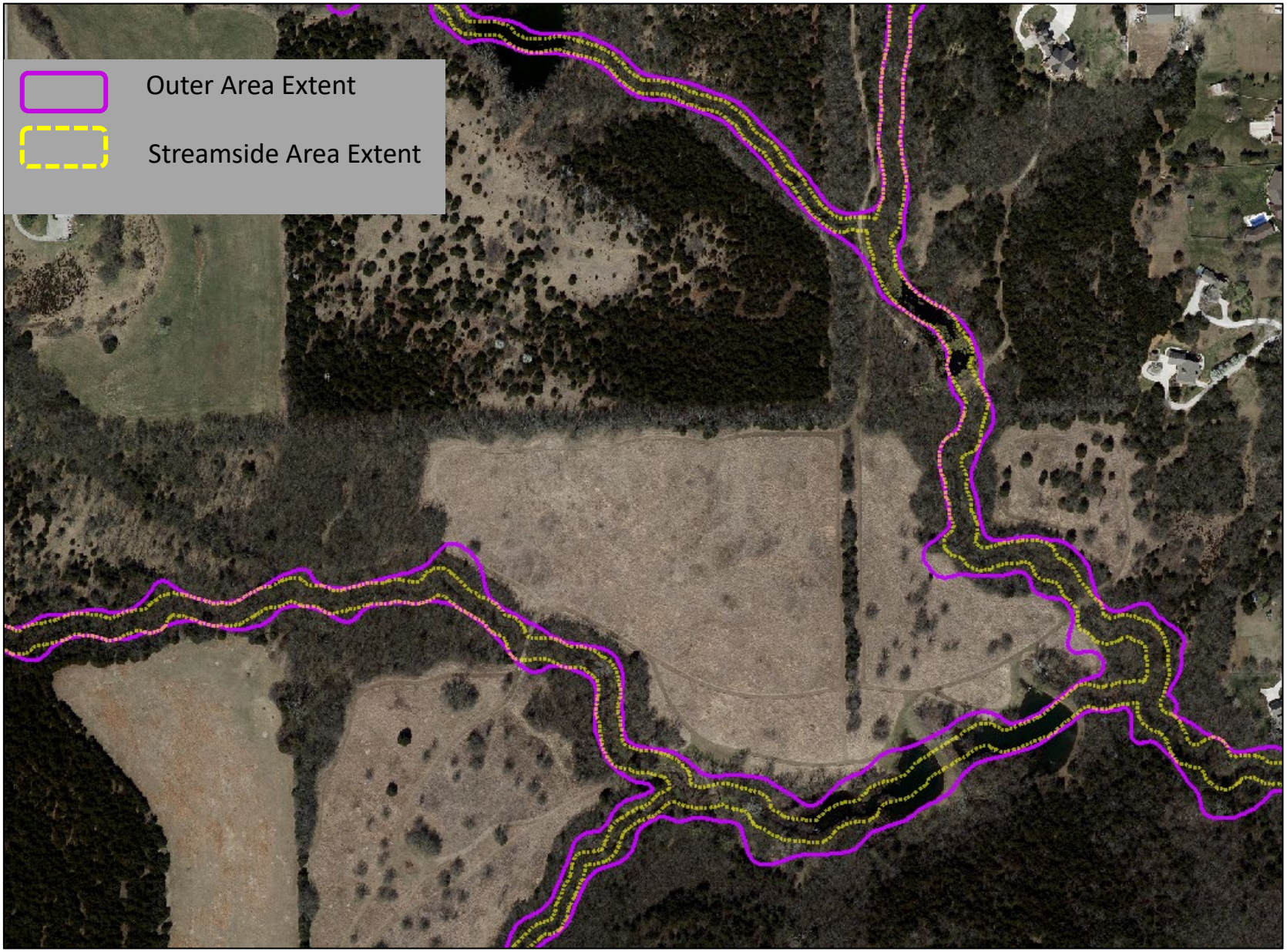
Background of GIS Stream Buffers

- New HEC-RAS 2D modeling was performed for all Topeka drainage basins and streams in 2019 as part of a KDA grant

- The City was interested in using the models to develop a science-based boundary for the Outer Stream Buffer based on the **prediction of streambank movement** and the **overall risk to the area**
  - This highlights areas where additional setbacks are needed to protect integrity of the stream
  - Proactive approach, preventing future property loss, and ultimately reducing corrective actions needed in the future

Background of GIS Stream Buffers

- The new buffers are based on direction of flow, flood depth, velocity, ground slope and curvature, soil erodibility, and shear stress.
- The science-based buffers were evaluated against known problem areas throughout the City for validation


Outer Area Extent
Streamside Area Extent

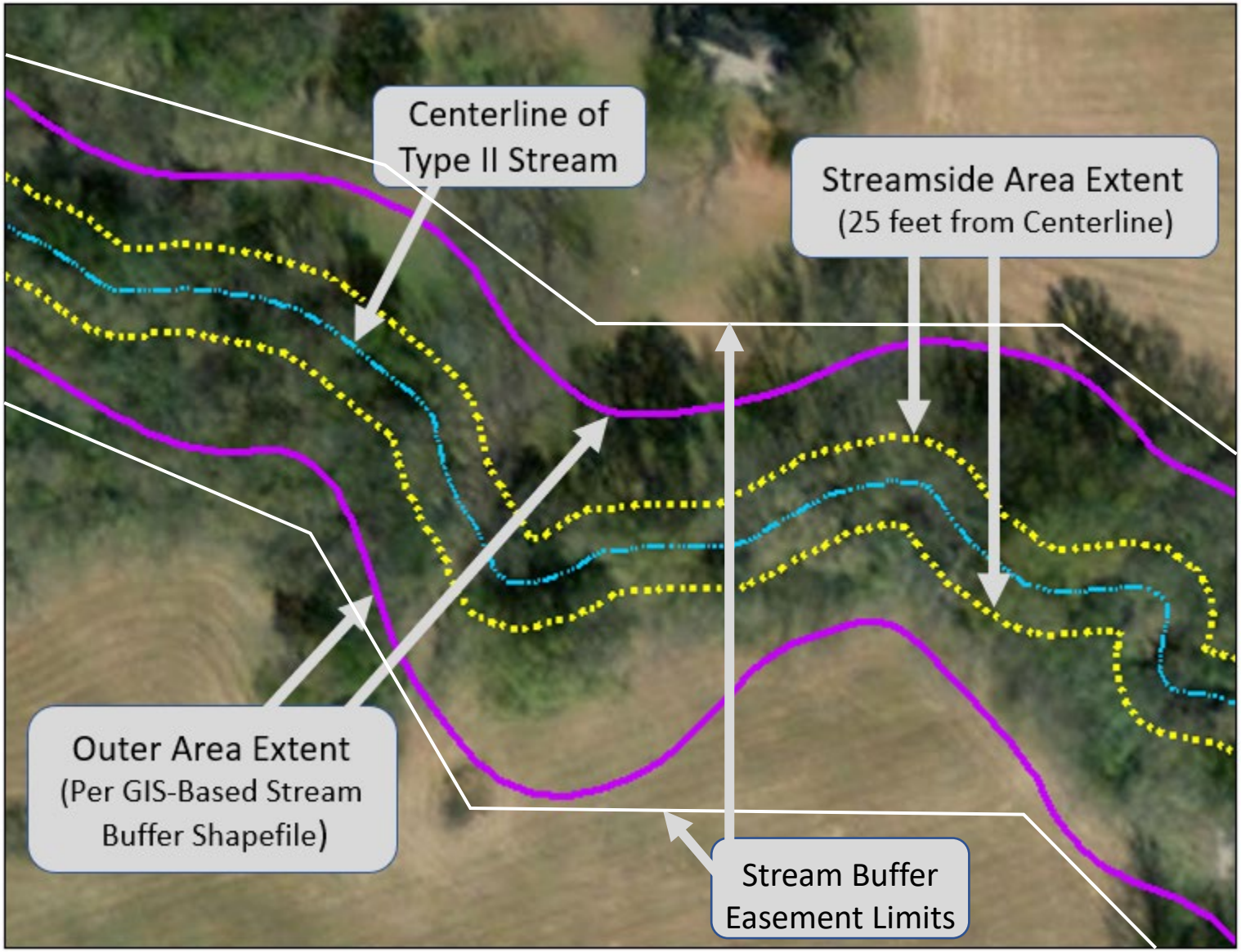
Stream Buffer Requirements

TMC Chapter 17.10

Stream Buffer Easement

- Provides for access to the buffer at reasonable times for periodic inspection by the City, or its contractor
- Requires property owner to ensure that the stream buffer is properly maintained
- Must cover the **full area** occupied by the **stream buffer extents**
- May be shown on recorded plat or granted by separate, recorded instrument https://www.topeka.org/engineering/easement-forms/

Mapping Stream Buffers



Stream Buffer Requirements

TMC Chapter 17.10

Outer Area Alternative

- **Width:**
  - As an alternative to using the GIS Based Stream Buffer Shapefile for the Outer Area extent, an analysis may be done using the procedure outlined in **Section 5605.5- Stream Assessment of the APWA 5600** to justify use of a different extent.
    - Rating of 12 or below when using the Channel Condition Scoring Matrix is considered acceptable.
    - Rating between 12 and 18 may be acceptable if engineering justification is provided to verify adequate protection of channel.

Stream Buffer Requirements

TMC Chapter 17.10

Additional Setback Requirements

- **Wetlands or critical areas:** extend buffer beyond these areas
- **Storage and use of hazardous substances:** 300 ft from stream
- **Above- or below-ground petroleum storage facilities:** 300 ft from stream
- **Drainfields from on-site sewage disposal and treatment system:** 200 ft from stream
- **Raised septic systems:** 500 ft from stream
- **Solids waste landfills or junkyards**: 600 ft from stream
- **Confined animal feeding operations:** 500 ft from stream

Stream Buffer Requirements

TMC Chapter 17.10

Prohibited Activities within Buffer

- Clearing of existing vegetation
- Grading, stripping, or other soil disturbing practices
- Filling or dumping
- Draining the buffer area by ditching, underdrains, or other systems
- Use, storage, or application of pesticides, except spot spraying of noxious weeds
- Housing, grazing, maintenance of livestock
- Storage or operation of motorized vehicles

Floodplains

Floodplain Management

- Mitigate future flood damage caused by development
  - Floodplains store excess water in times of flood, releasing it slowly and reducing property damage
- Promote public health and safety during large storm events
- Maintains the City of Topeka's eligibility for participation in the National Flood Insurance Program
  - Making flooding insurance available to local property owners

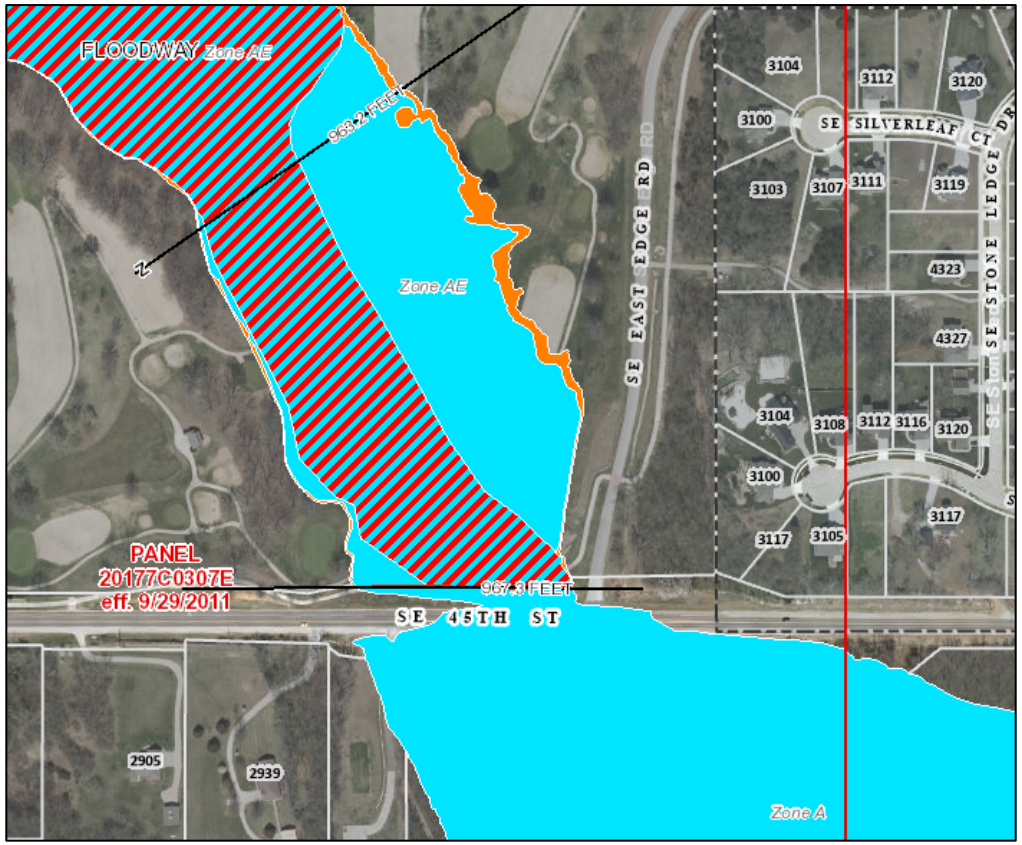
Floodplain Management Requirements

TMC Chapter 17.30

What is a Floodplain?

FEMA Special Flood Hazard Area:

- Zone A
- Zone AE/Floodway
- Zone AH

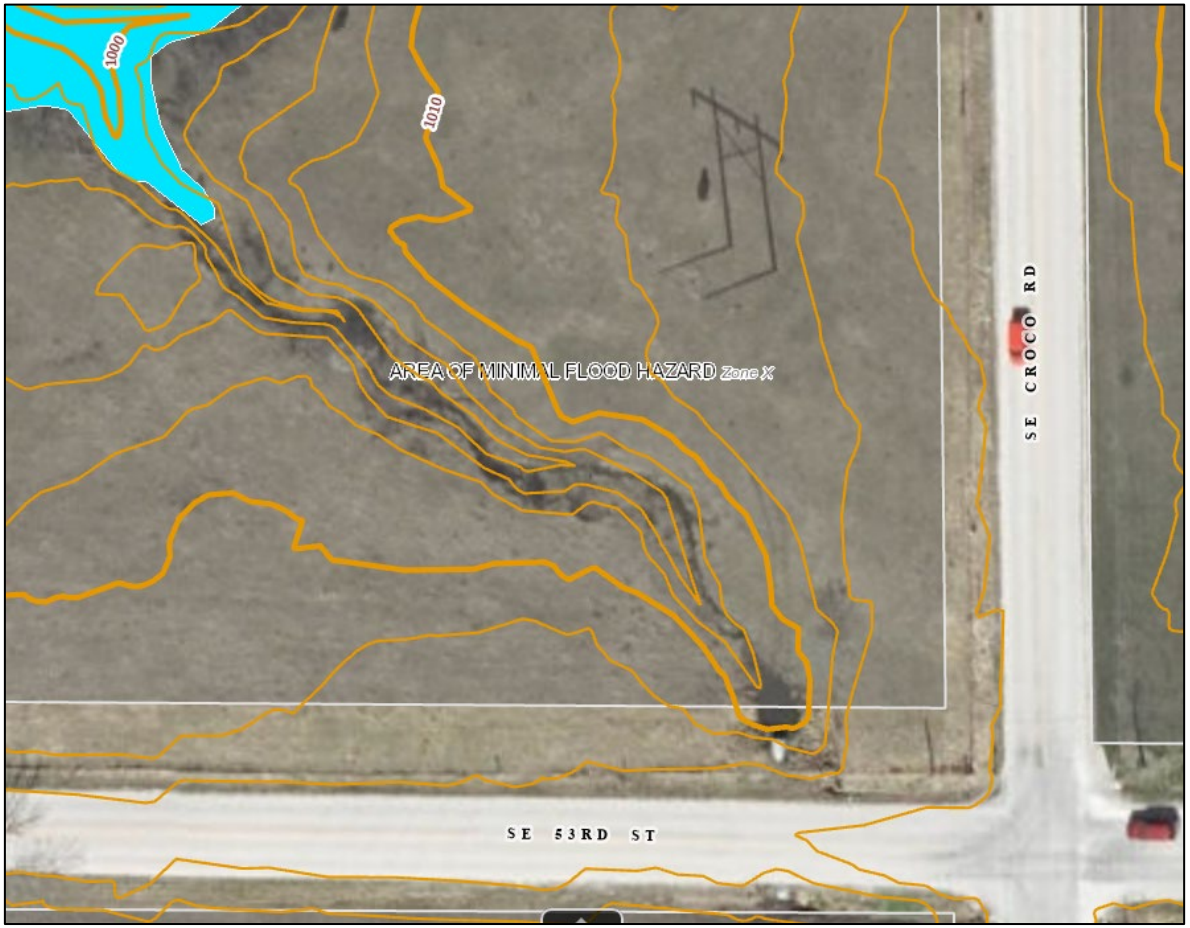


Floodplain Management Requirements

TMC Chapter 17.30

What is a Floodplain?

Channelized Drainage



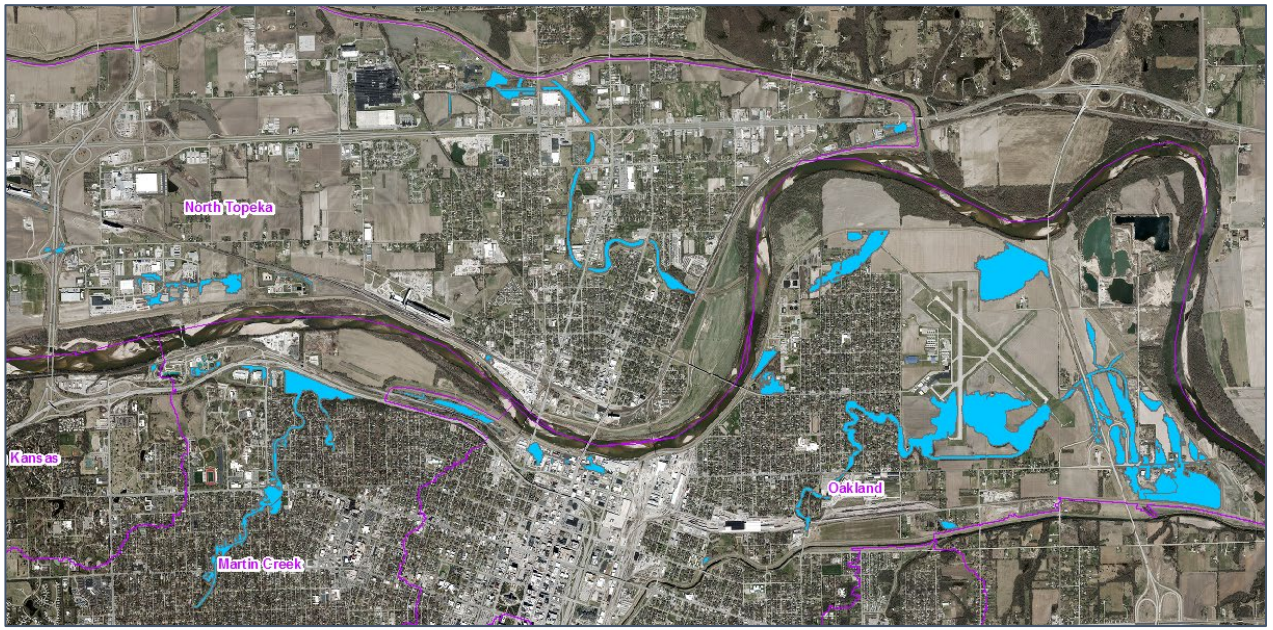
Floodplain Management Requirements

TMC Chapter 17.30

What is a Floodplain?

Designated Floodplain on City of Topeka work map:

- AH zones illustrated as interior drainage area floodplains (or levee ponding areas) as part of Topeka Levee Certification package
- Any other work map areas designated by the City of Topeka that can be considered best available data



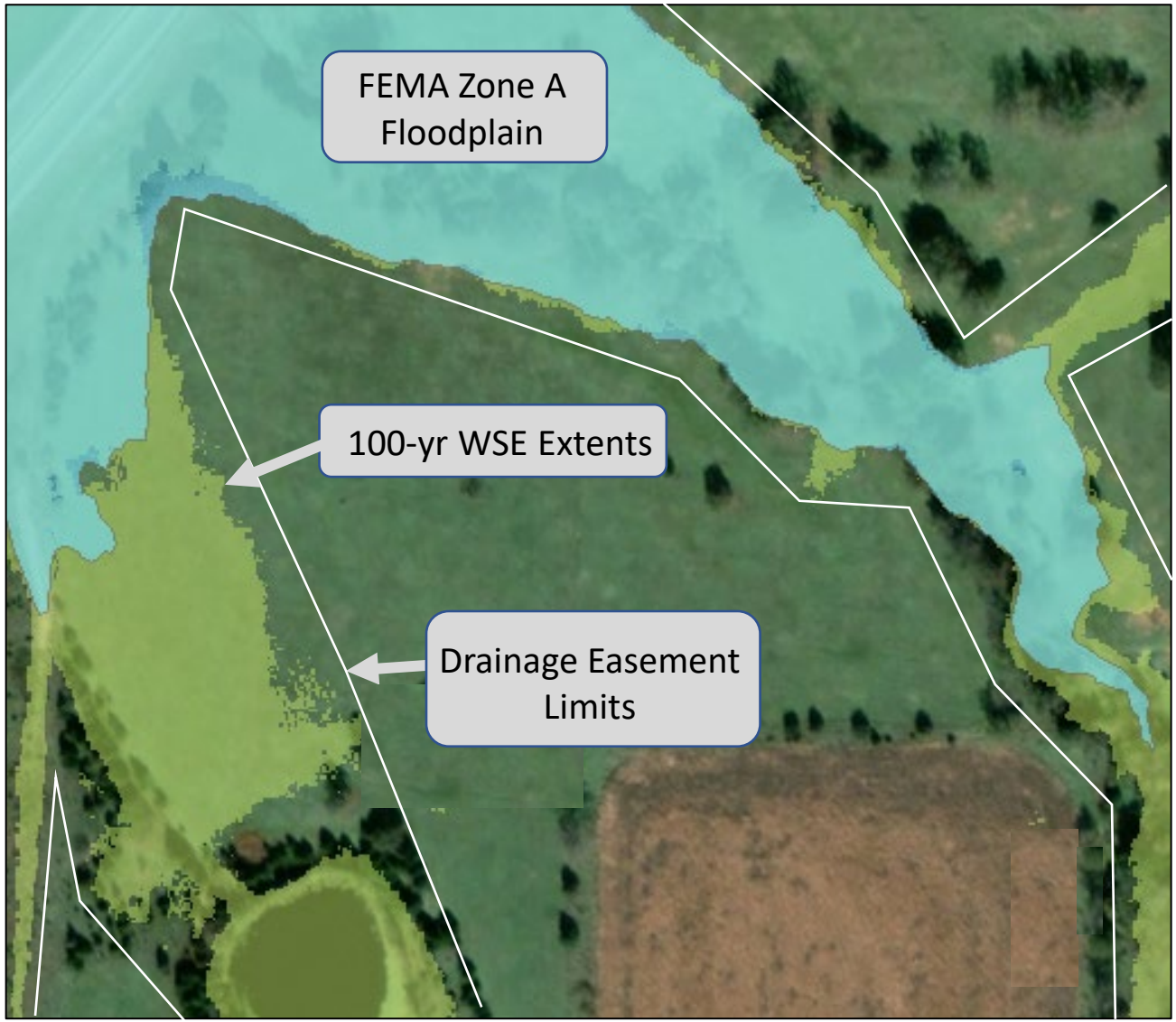
Floodplain Management Requirements

TMC Chapter 17.30

Drainage Easement

- Provides for access to the easement at reasonable times for periodic inspection by the City, or its contractor
- Requires property owner to ensure unobstructed flow of surface water.
- Must cover the **full area** occupied by the **100-year** (1% annual chance) **water surface elevation extents**
- May be shown on recorded plat or granted by separate, recorded instrument https://www.topeka.org/engineering/easement-forms/

Mapping Floodplains



Floodplain Management Requirements

TMC Chapter 17.30

Development in FEMA Zone A

- Requires City of Topeka Floodplain Development Permit

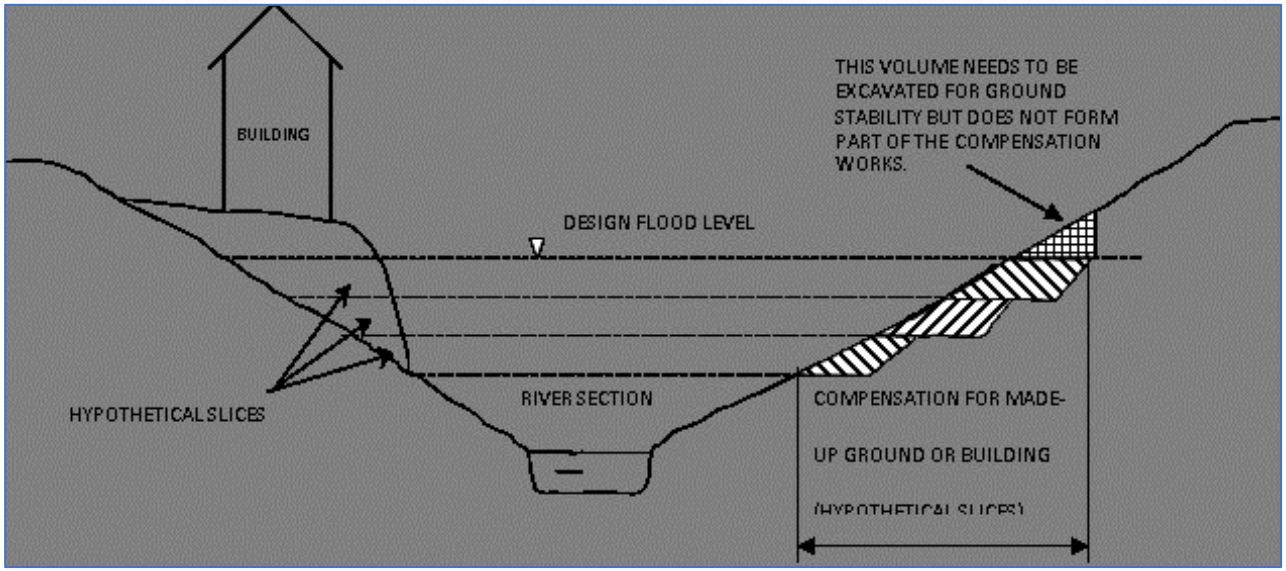
- If development exceeds 5,000 sq-ft of impervious surface or is part of larger common plan of development, an analysis shall be provided to verify:
  - The development will not cause more than a 1.0 ft rise in WSE
  - WSE will not exceed the lowest adjacent grade of the lowest impacted habitable structure
  - WSE will not exceed the current WSE at the location of a habitable structure currently impacted by the floodplain

Floodplain Management Requirements

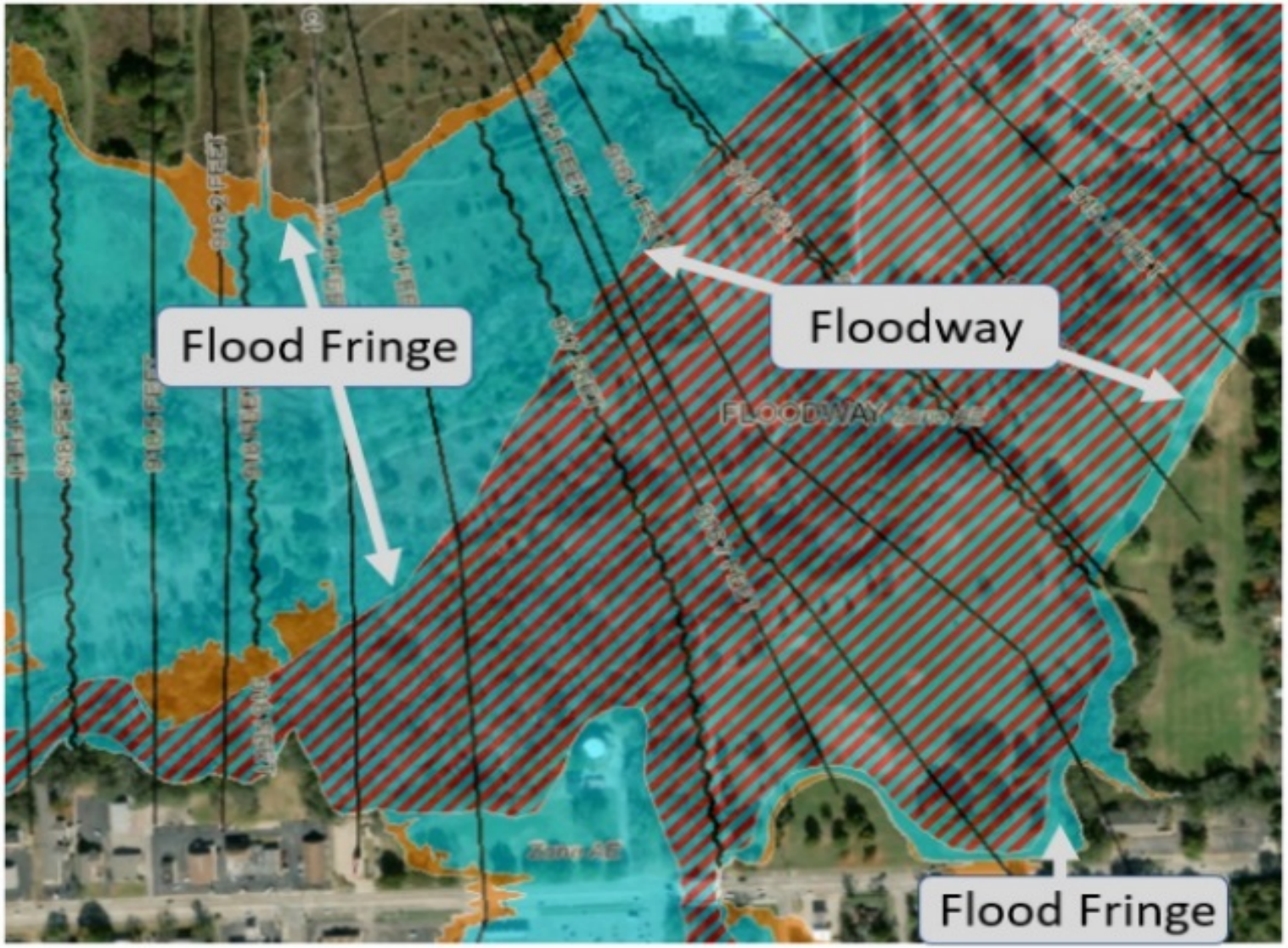
TMC Chapter 17.30

Development in FEMA Zone AH or levee ponding area

- Requires City of Topeka Floodplain Development Permit
- All fill in the Zone AH/ponding area needs to be offset by compensating cut to negate volume losses
  - Compensatory storage needs to be frequency/stage based



Floodway vs Flood Fringe



Floodplain Management Requirements

TMC Chapter 17.30

Development in FEMA Zone AE Flood Fringe

- Requires City of Topeka Floodplain Development Permit

- If development exceeds 5,000 sq-ft of impervious surface or is part of larger common plan of development, an analysis shall be provided to verify:
  - WSE will not exceed the lowest adjacent grade of the lowest impacted habitable structure
  - WSE will not exceed the current WSE at the location of a habitable structure currently impacted by the floodplain
  - Compensatory storage is recommended

Floodplain Management Requirements

TMC Chapter 17.30

Development in FEMA Zone AE Floodway

- Requires City of Topeka Floodplain Development Permit
- Requires KDA-DWR Permit and FEMA no-rise certification
  - Development needs to result in no increases in upstream or downstream flood elevations