

# Greening Your Infrastructure

It's Not as Difficult  
as You Think

**2024 CML ANNUAL CONFERENCE**



Recognizing that  
**building  
resilient &  
sustainable  
communities is  
the greatest  
challenge to  
public works** in  
the twenty-first  
century

# Today's Agenda

- ▶ What role does climate change play in public works
  - ▶ Colorado Trends
- ▶ Mile High Flood District's Approach to Design
- ▶ Creating the Knowledge Ecosystem
- ▶ What are you doing and why?
  - ▶ What actions are highest on your community's list?
  - ▶ What other communities are you partnering with?
  - ▶ Challenges

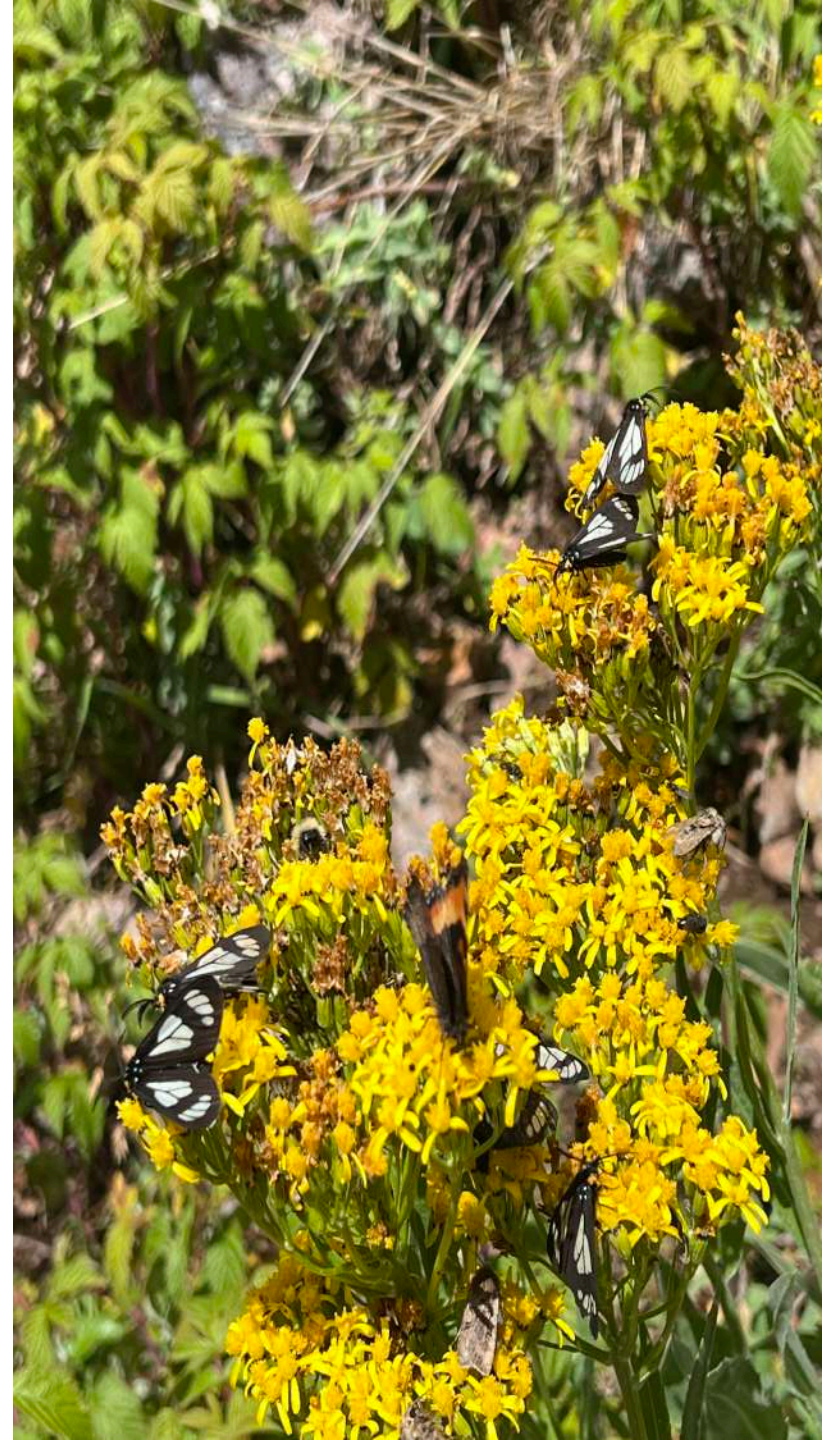
**Keith Reester, Reester & Associates**

**Dave Skuodas, Mile High Flood District**

**CML Public Works Section**

**American Public Works Association – Colorado**

**June 2024**



# Colorado Trends

## ▶ Water

### ▶ Too little

▶ Drier

▶ Water Conservation

▶ Native Plant Life

### ▶ Too much

▶ 2013

▶ Glenwood Canyon

▶ Bigger

▶ Wildfire scars, Dry Soil,  
& Rain

▶ Flood disaster in areas  
with no Flood Insurance

## ▶ Energy

▶ Resiliency

▶ Collaboration

▶ Asset Management

▶ Storm Changes

▶ Destructivity



# The Mile High Flood District's Approach to Urban Waterway Design

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**Dave Skuodas**

DCM Director

Mile High Flood District









20



PUSH

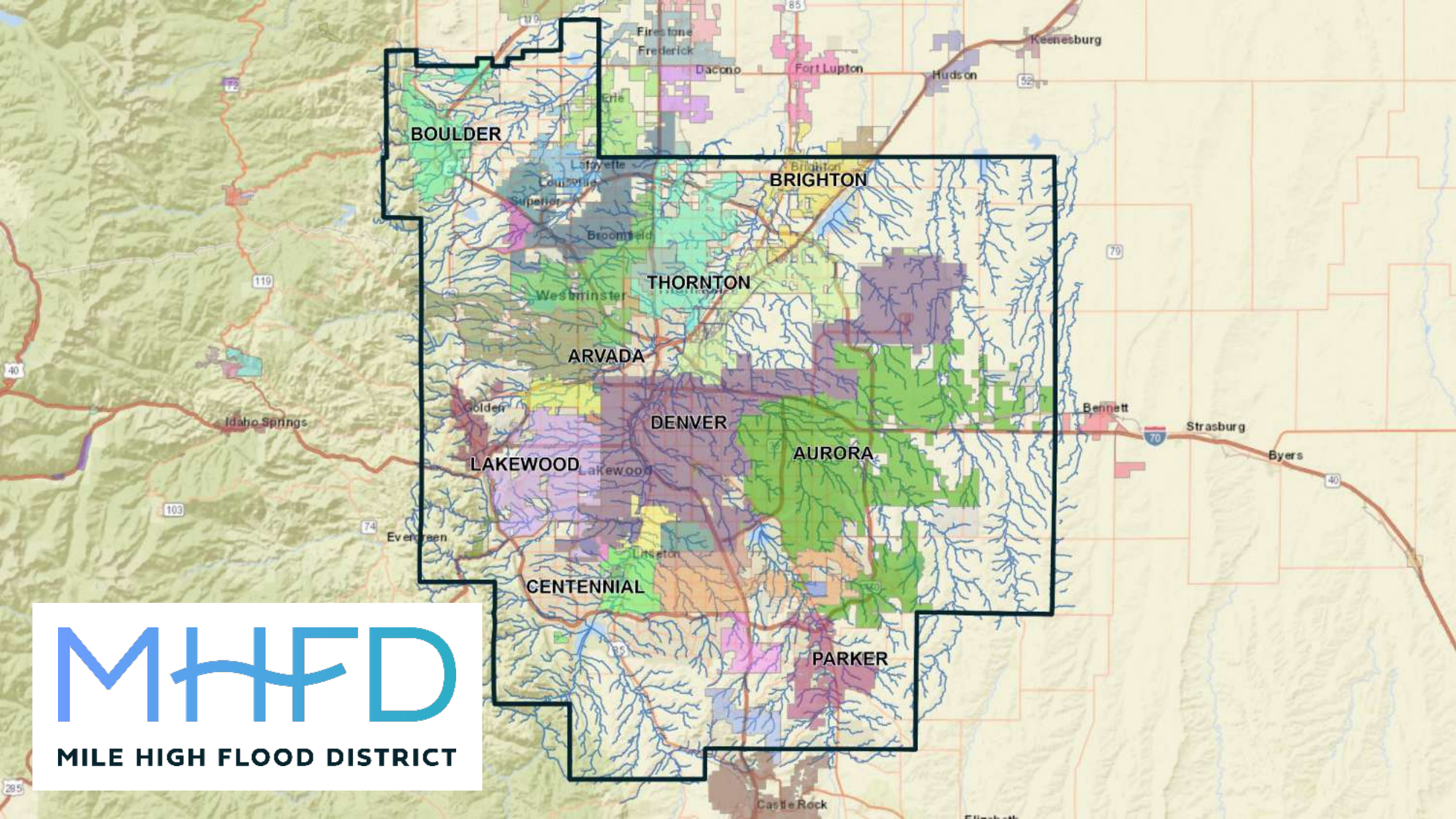
← Broadway



9th St  
Balsam Ave







**BOULDER**

**BRIGHTON**

**THORNTON**

**ARVADA**

**DENVER**

**AURORA**

**LAKWOOD**

**CENTENNIAL**

**PARKER**

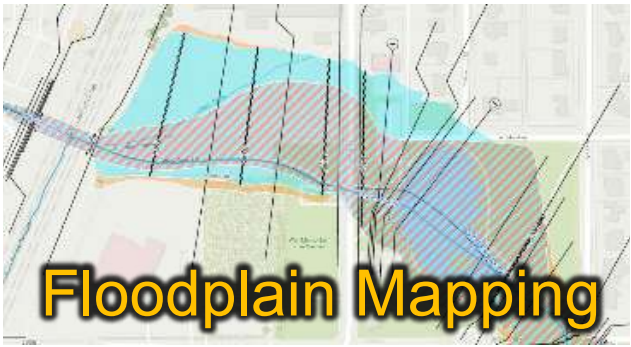
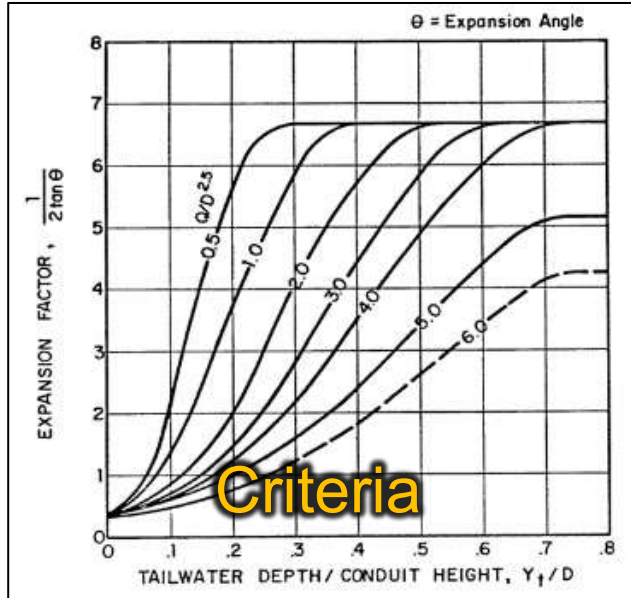




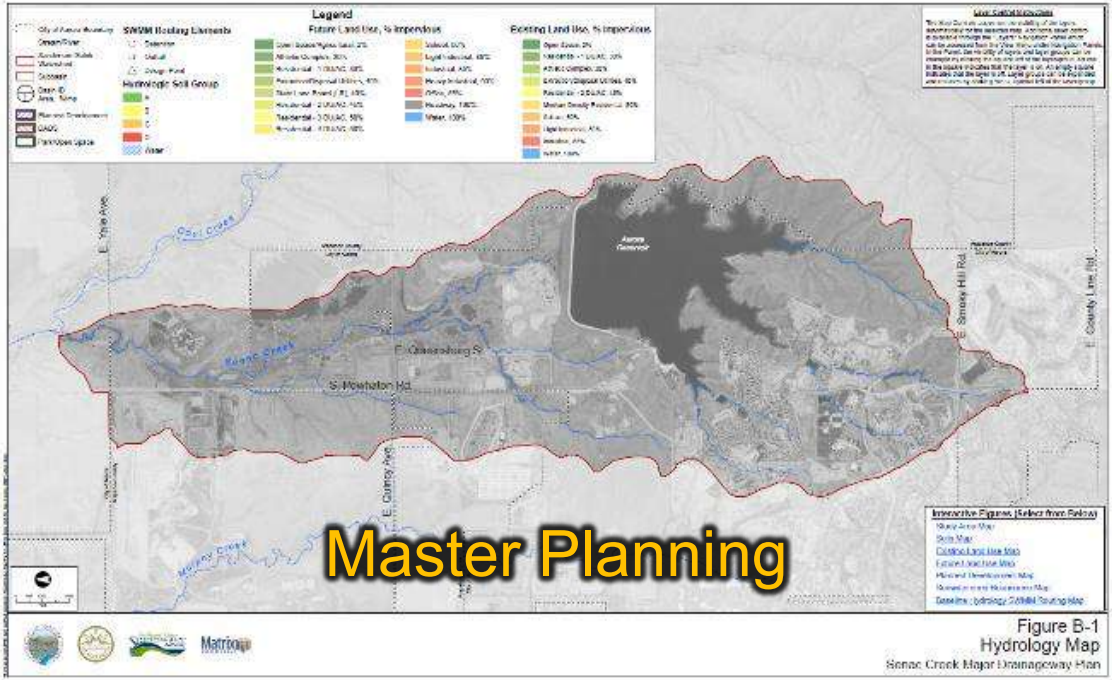
**Flood Warning**



**Development**



**Floodplain Mapping**



**Capital Construction**



**Maintenance**



QRSTUVWXYZ

ABC

MUCHOOL  
RULES!



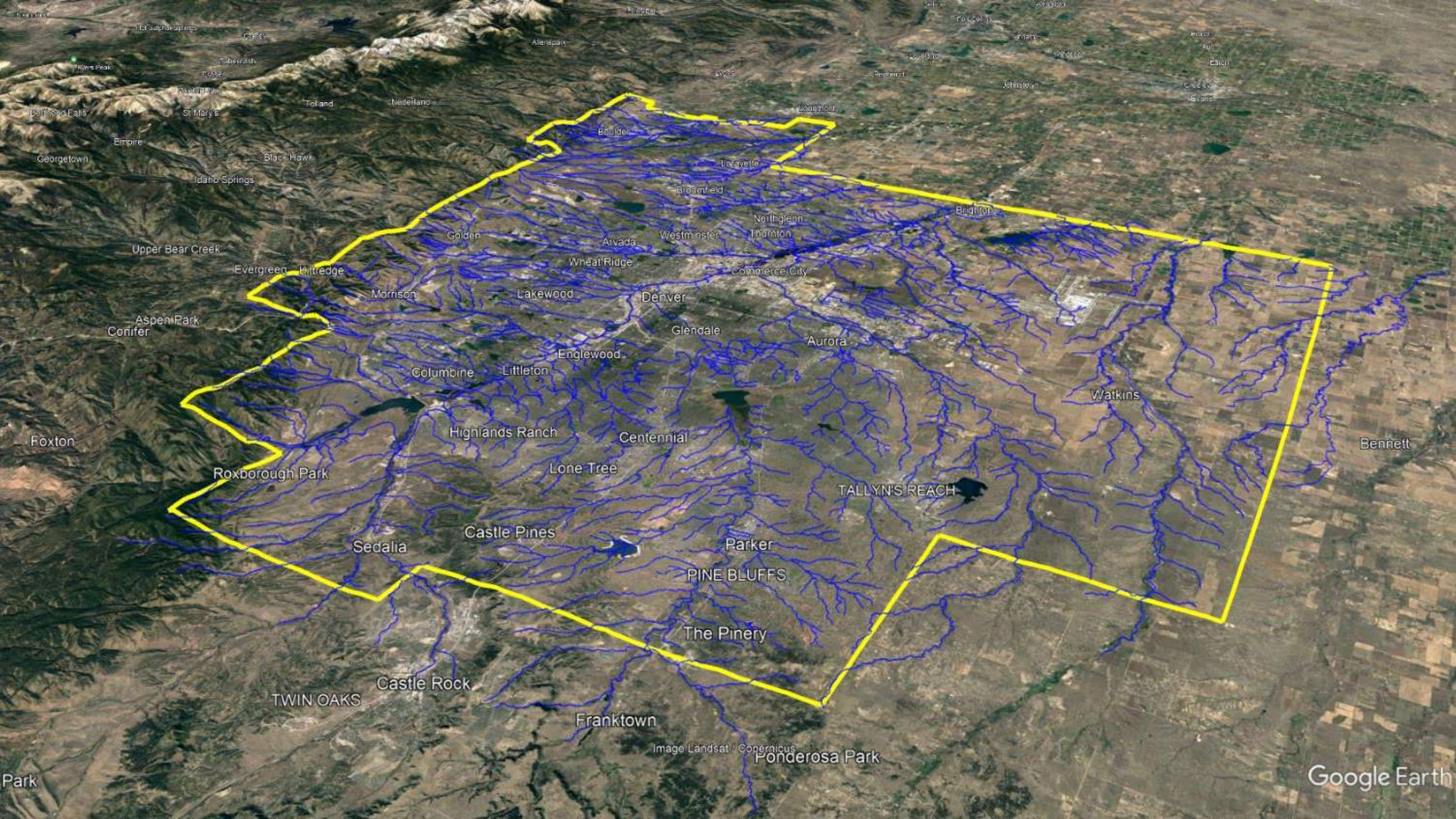












TWIN OAKS

TALLYN'S REACH

PINE BLUFFS



***Urban Stream  
Design History***

Closed Conduit



W 16th Ave

Closed Conduit



W 16th Ave

# Westerly Creek at Montview Mitigation Project



# Confined Channel with Concrete Lining



# Concrete Low Flow Channels



# Confined Channel with Large Drop Structures





**Failed Concrete Lining**



**Failed Drop Structure**



**Failed Drop Structure**





**Failed Drop Structure**

**Sand Creek at Quebec**

© 2018 Google

Google Earth

**Failed Drop Structure**



**Sand Creek at Quebec**

**Failed Drop Structure**



**Sand Creek at Quebec**

**Failed Drop Structure**



**Sand Creek at Quebec**



1986 Project



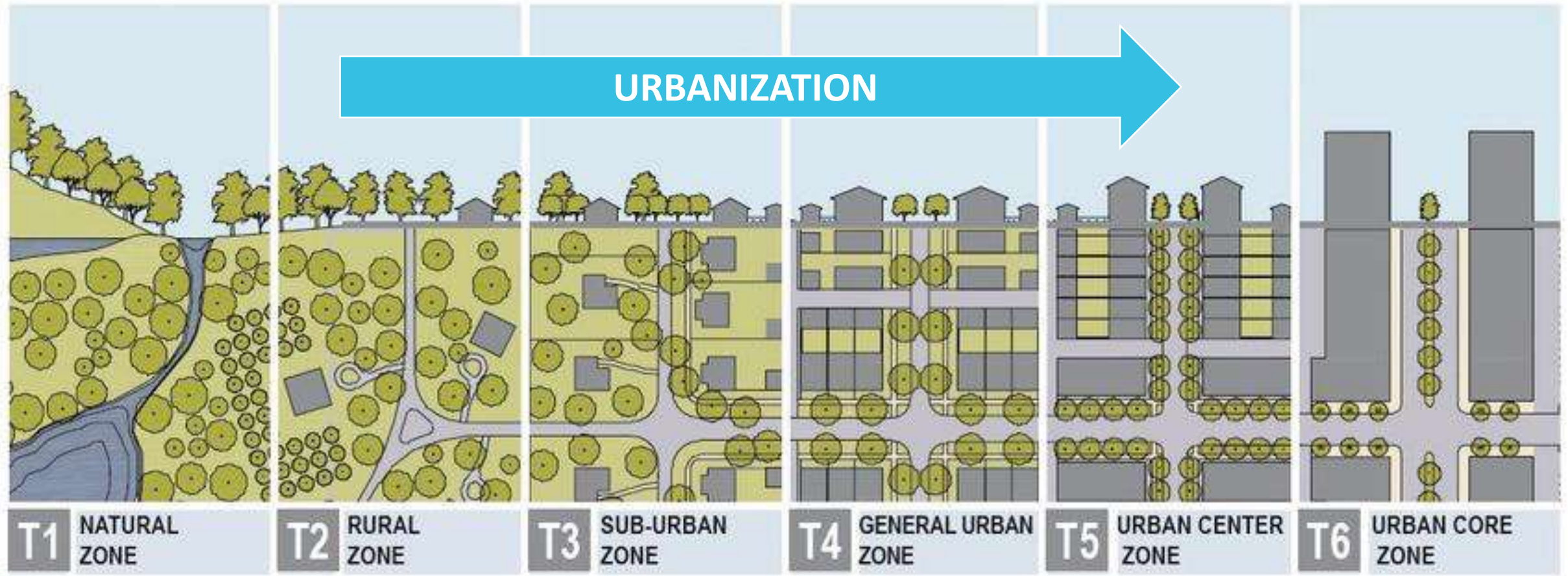
2017 Project







*The gradual increase in the proportion of people living in an area...*

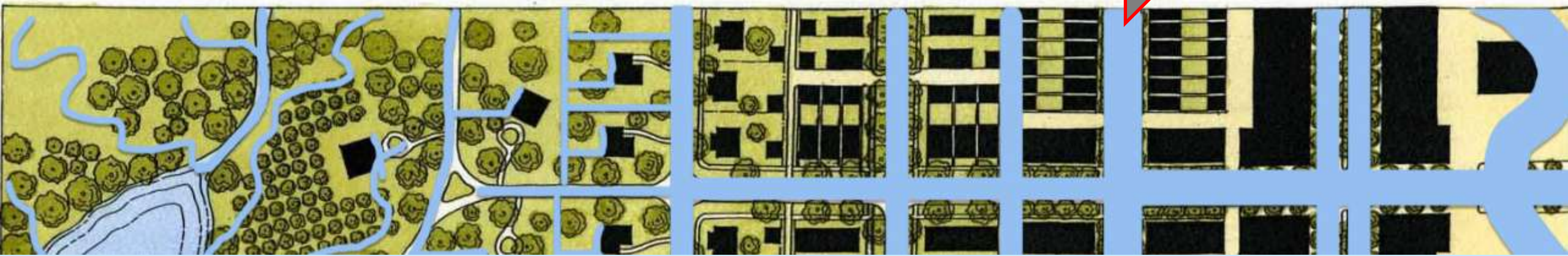


The transect. Duany PlaterZyberk & Company

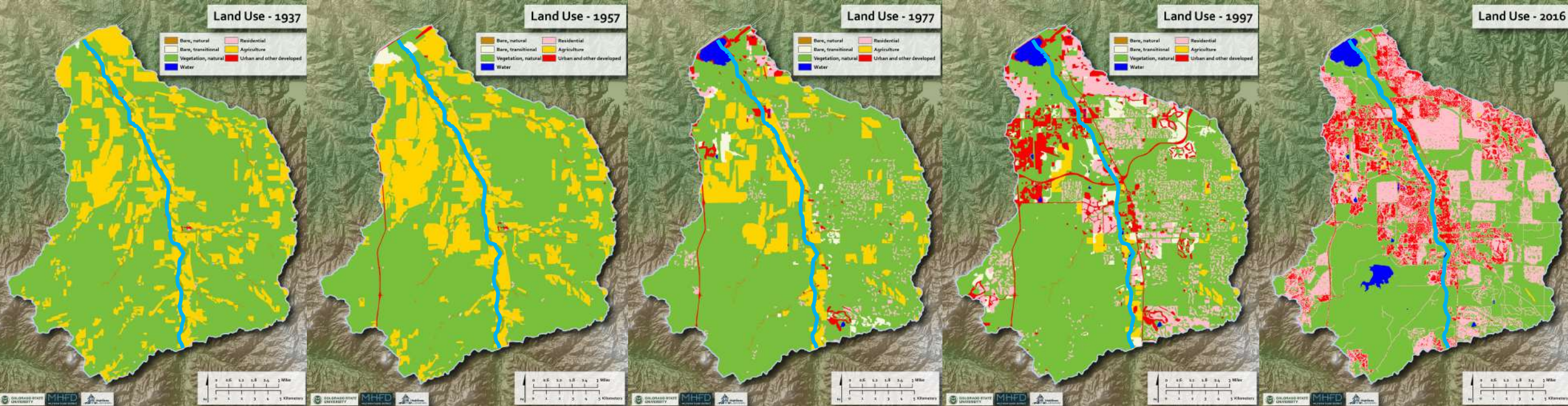
*we usually adapt our stream systems to our context ...  
(and rarely the other way around)*



**STREAM SYSTEM ADAPTATION**



# Land Use Changes



**1937**

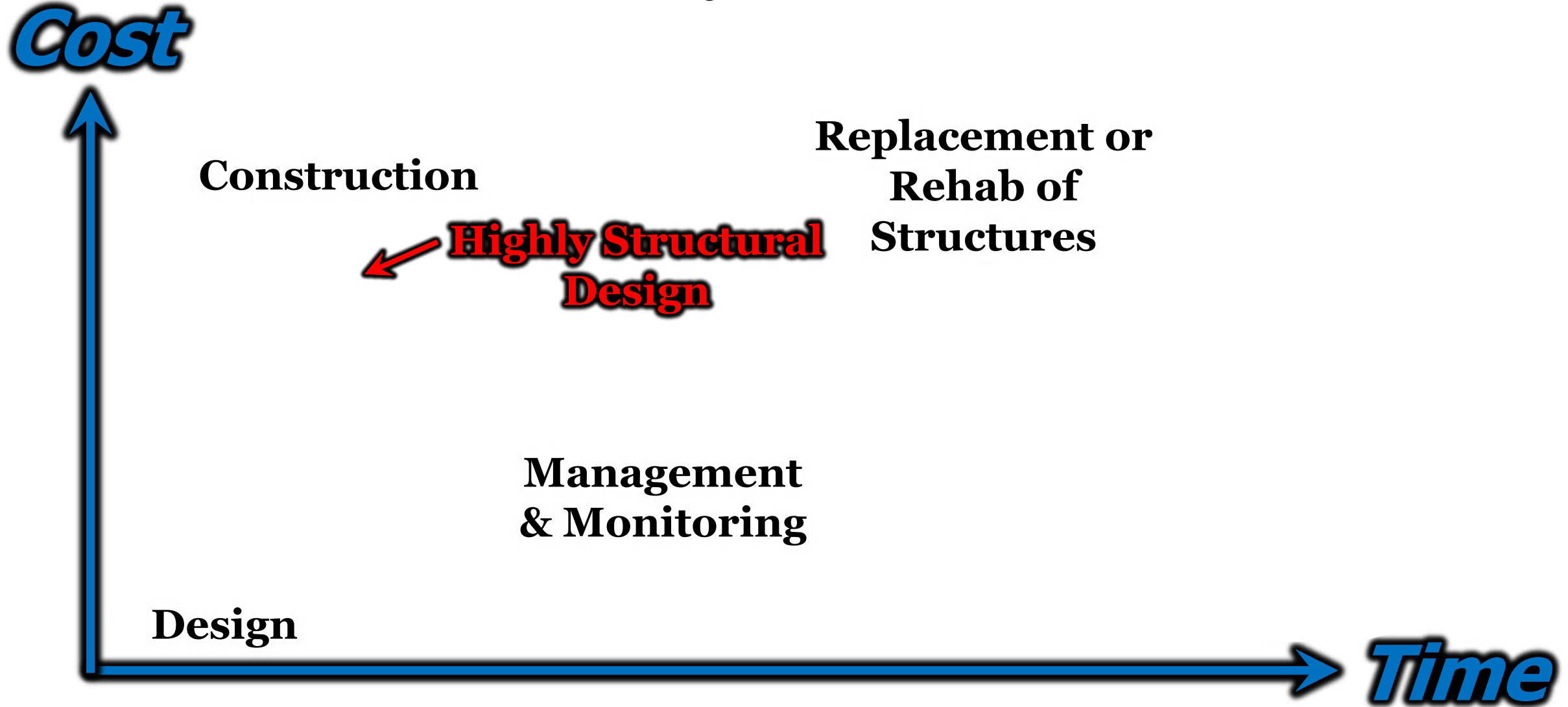
**1957**

**1977**

**1997**

**2016**

# Life Cycle Cost





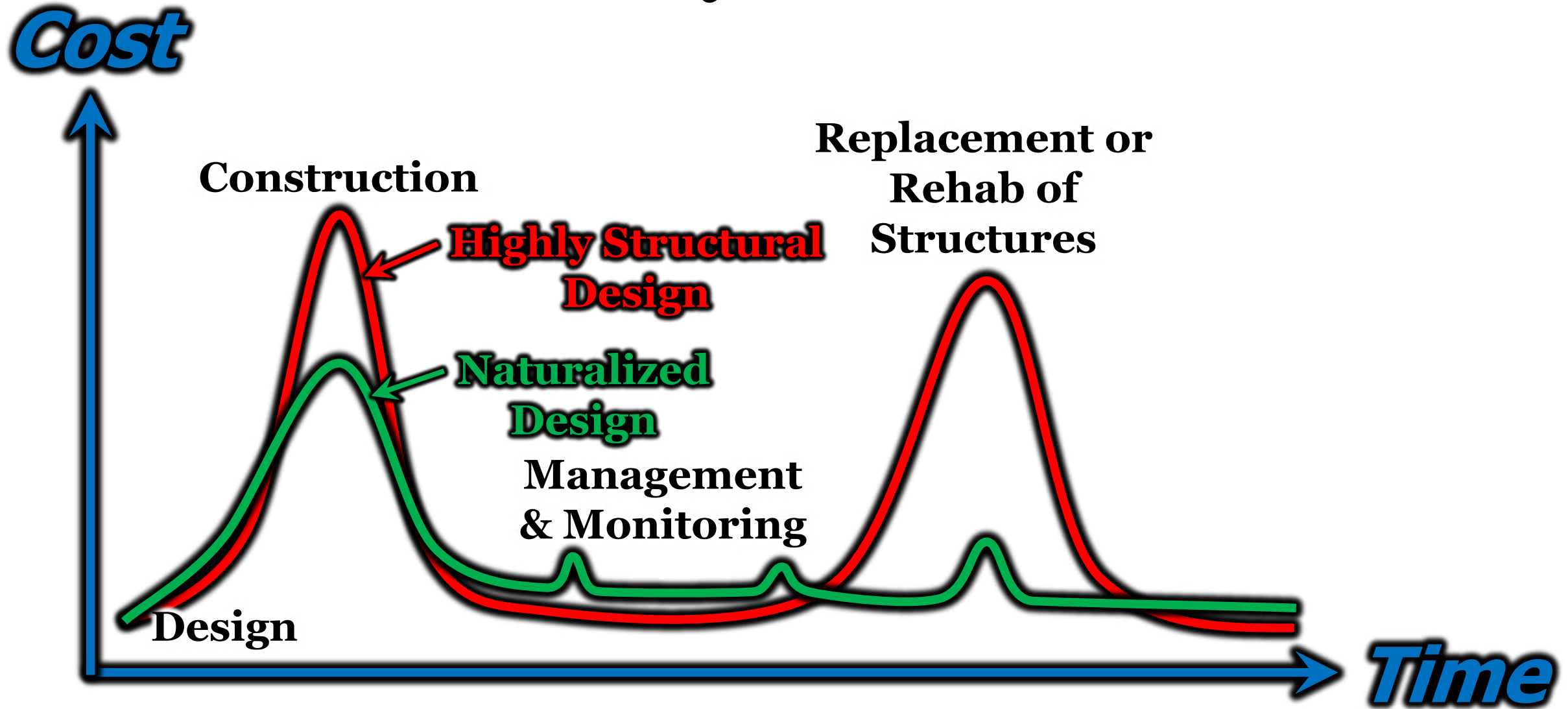






Lady Creek Trail

# Life Cycle Cost







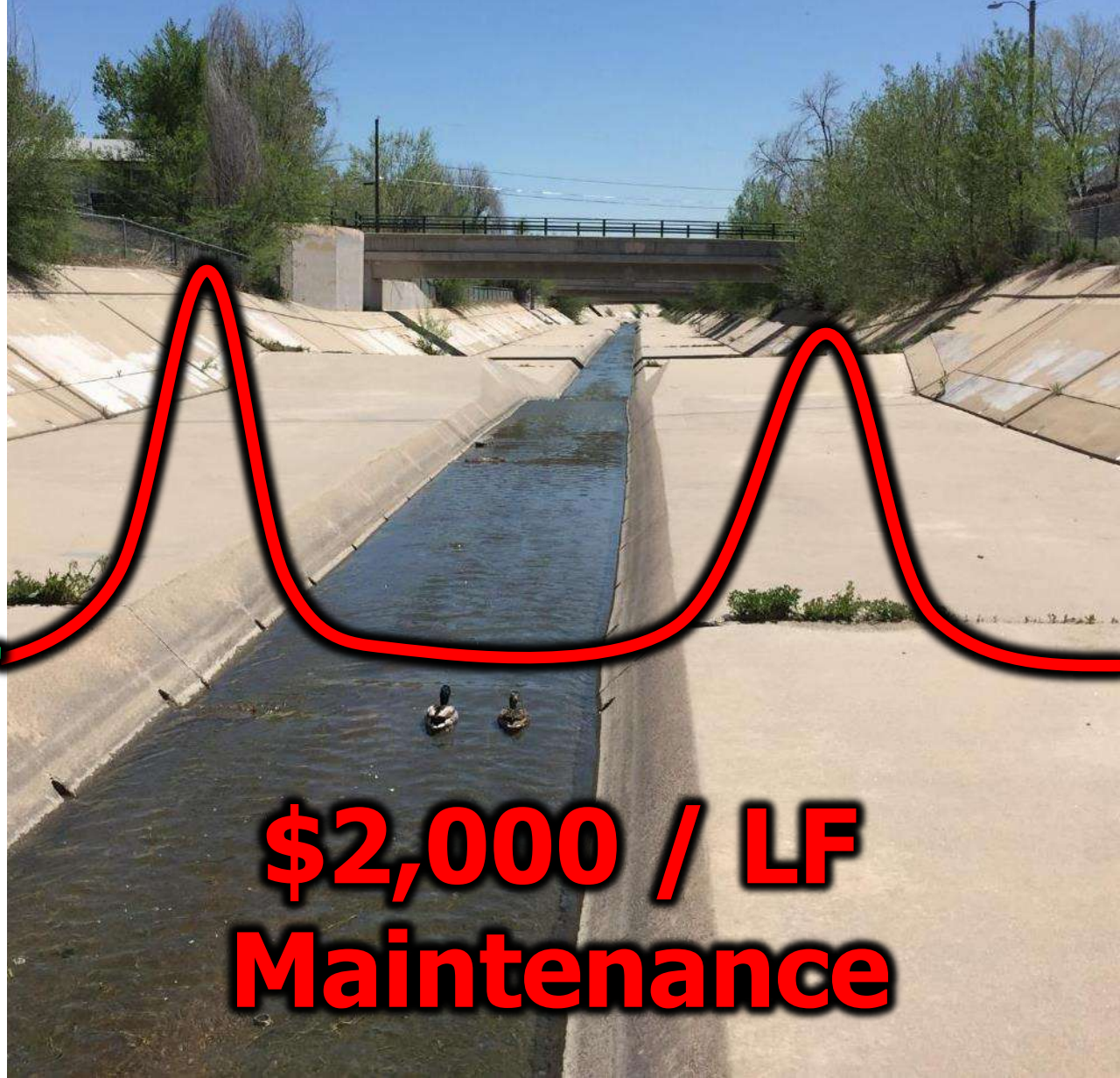


*\*Photo courtesy of Valerian*

# Little Dry Creek (AdCo)



**\$2 / LF**  
**Maintenance**



**\$2,000 / LF**  
**Maintenance**

# High Maintenance Vegetation



# High Maintenance Vegetation

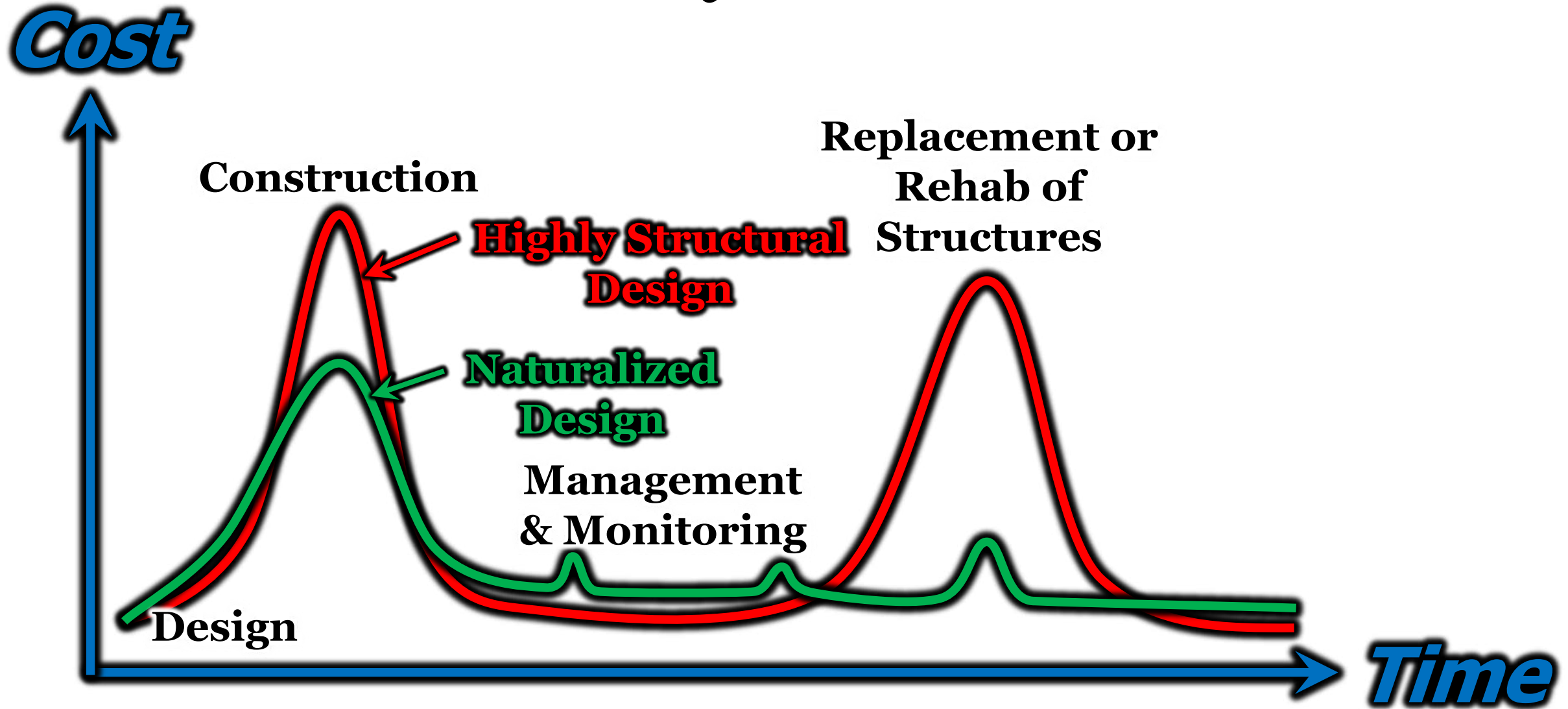




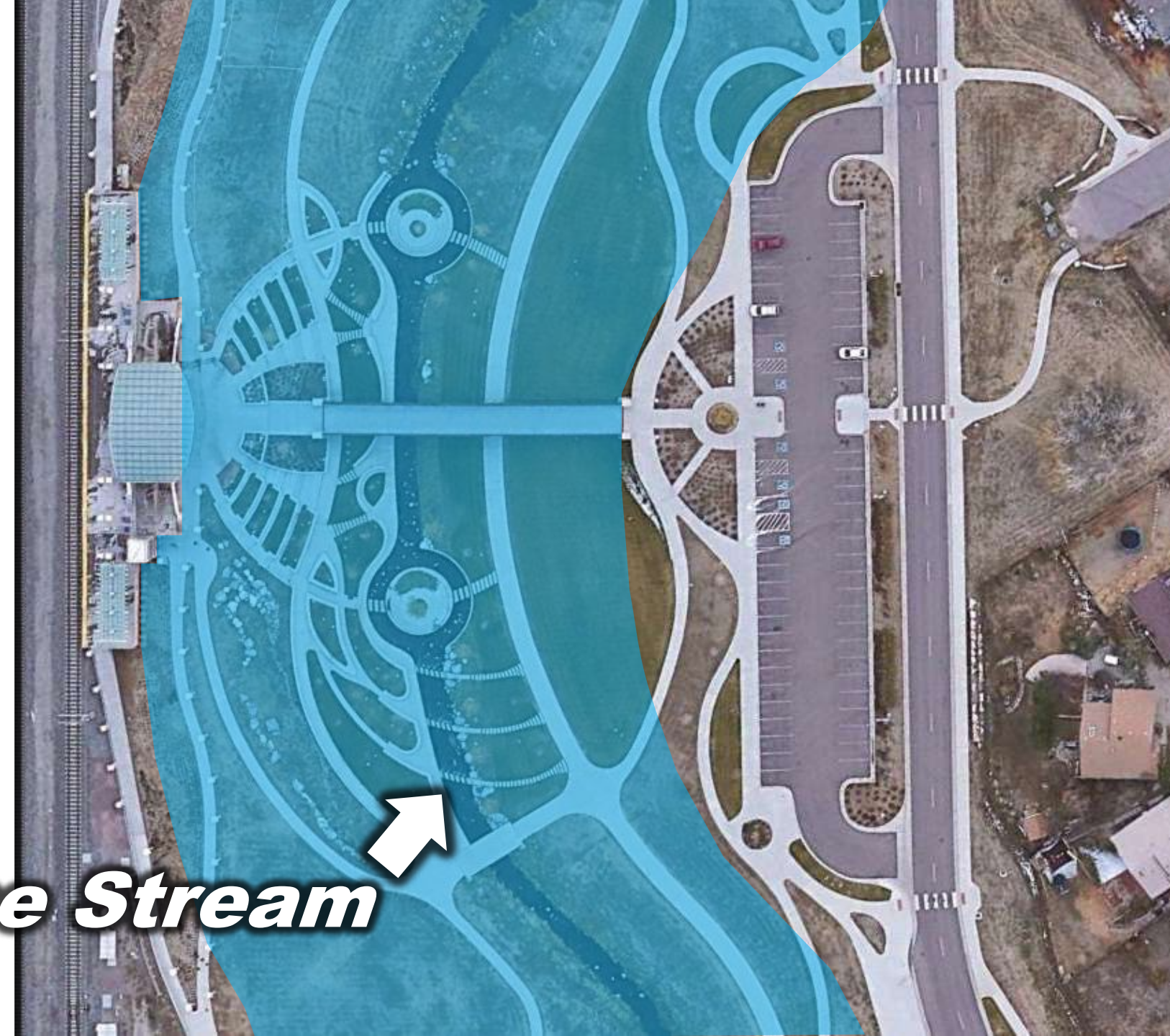
# High Maintenance Vegetation



# Life Cycle Cost







***Same Stream***

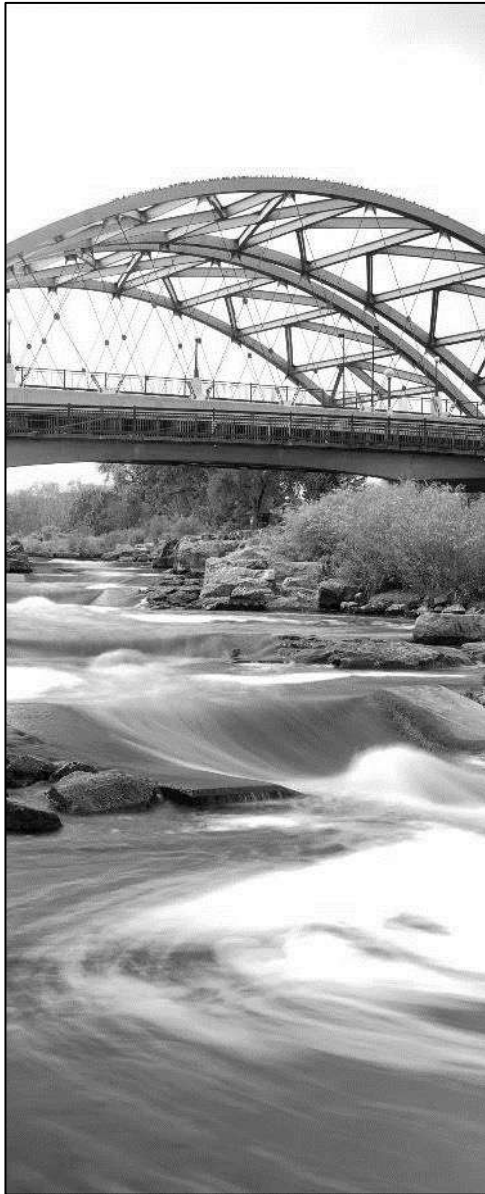


# *Creating Value*

# Hydrology



# Hydraulics



# Geo-morphology



# Vegetation



# Community Values

























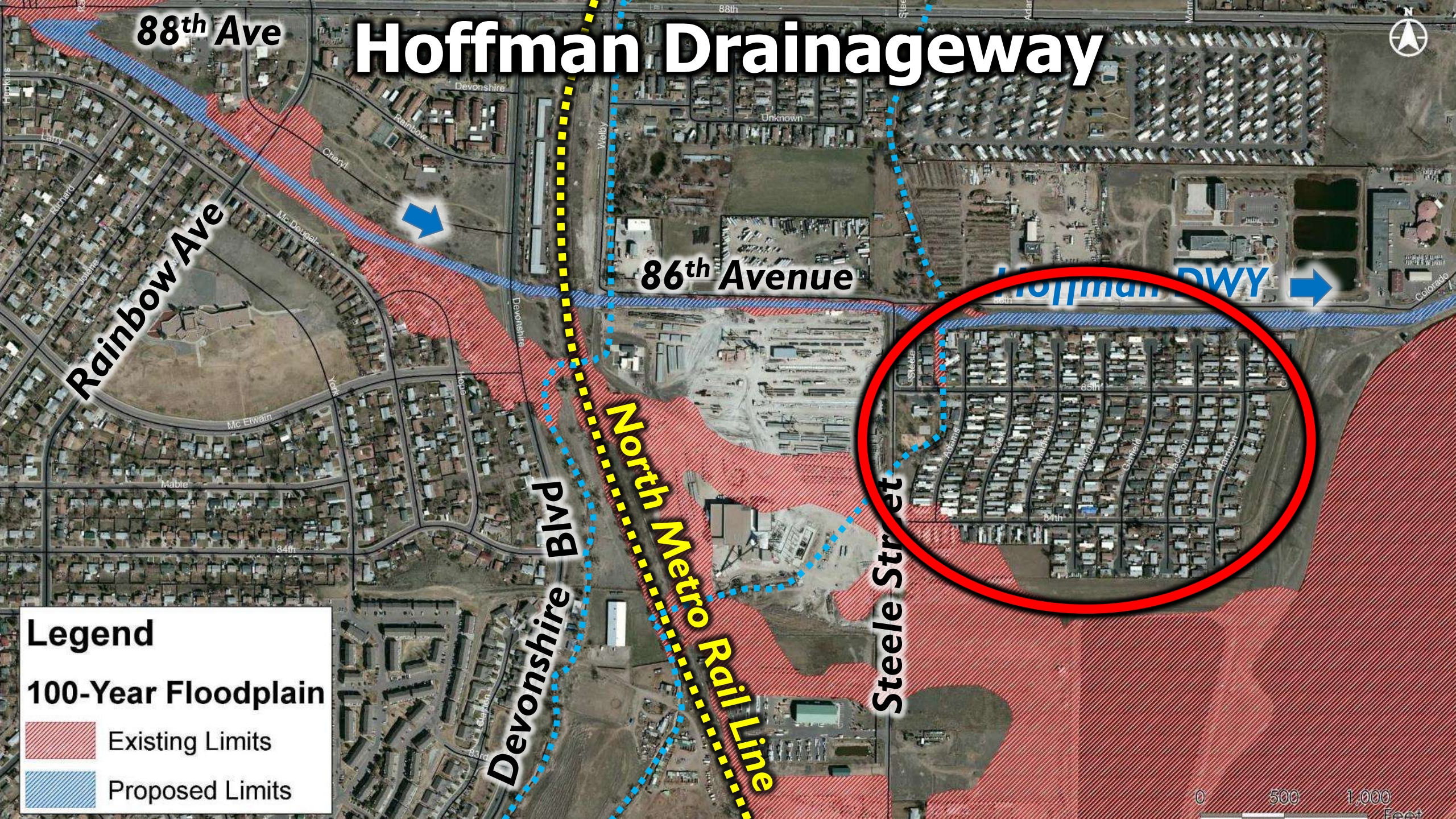




A scenic river flows through a lush landscape with vibrant autumn foliage. A stone bridge spans the river, and several people are visible on the banks. The text is overlaid in a bold, blue, italicized font with a black outline.

***How do we know we're building  
the best projects we could,  
in all the ways we should,  
to improve quality of life?***

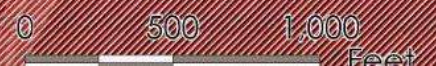
# Hoffman Drainageway



**Legend**

**100-Year Floodplain**

- Existing Limits
- Proposed Limits



# Hoffman Drainageway

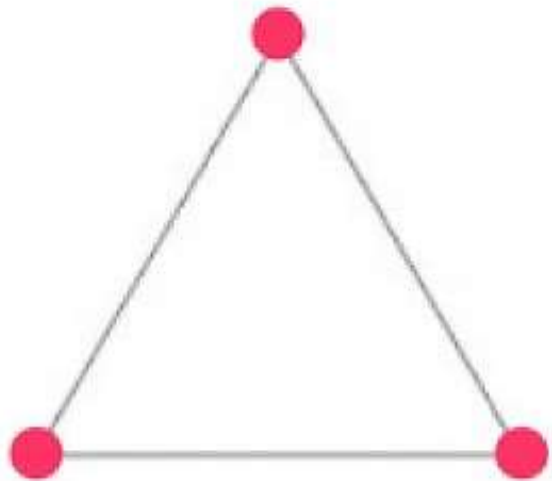


# Hoffman Drainageway

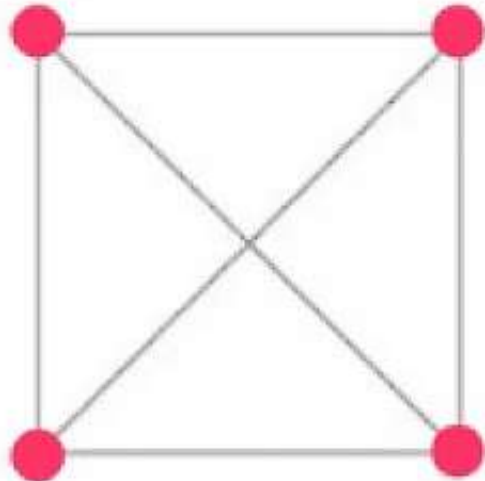


# Hoffman Drainageway

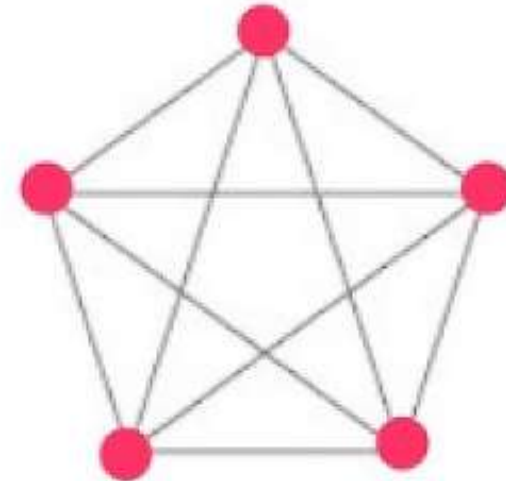




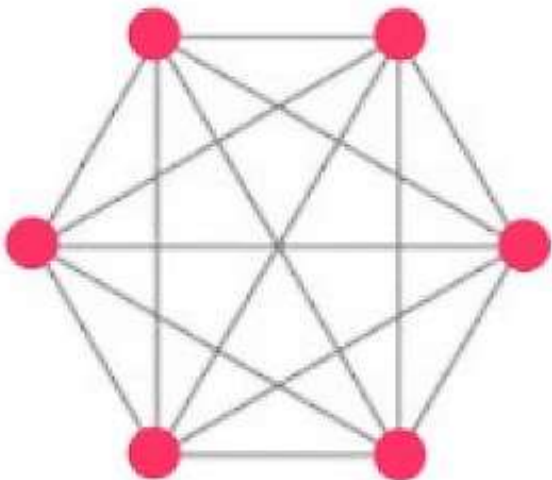
**3 people, 3 lines**



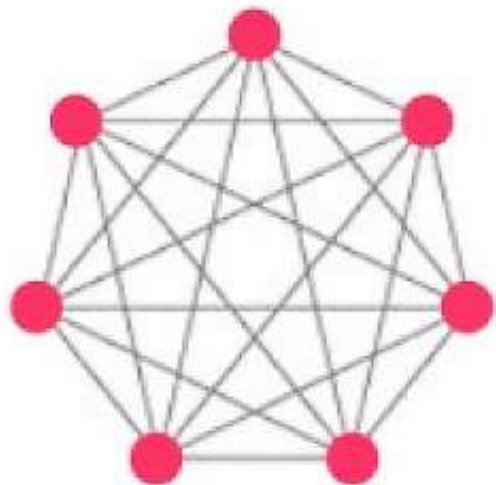
**4 people, 6 lines**



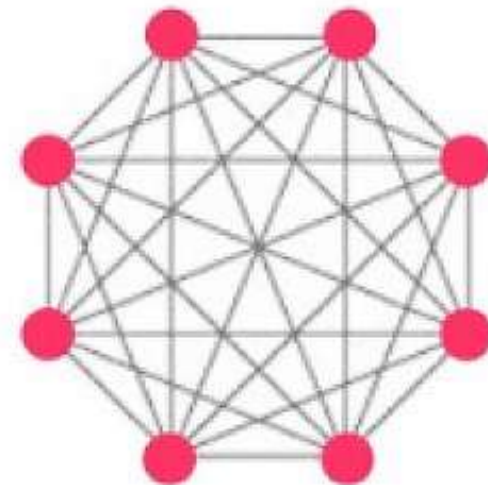
**5 people, 10 lines**



**6 people, 15 lines**



**7 people, 21 lines**



**8 people, 28 lines**

# Cost vs Value



\$10



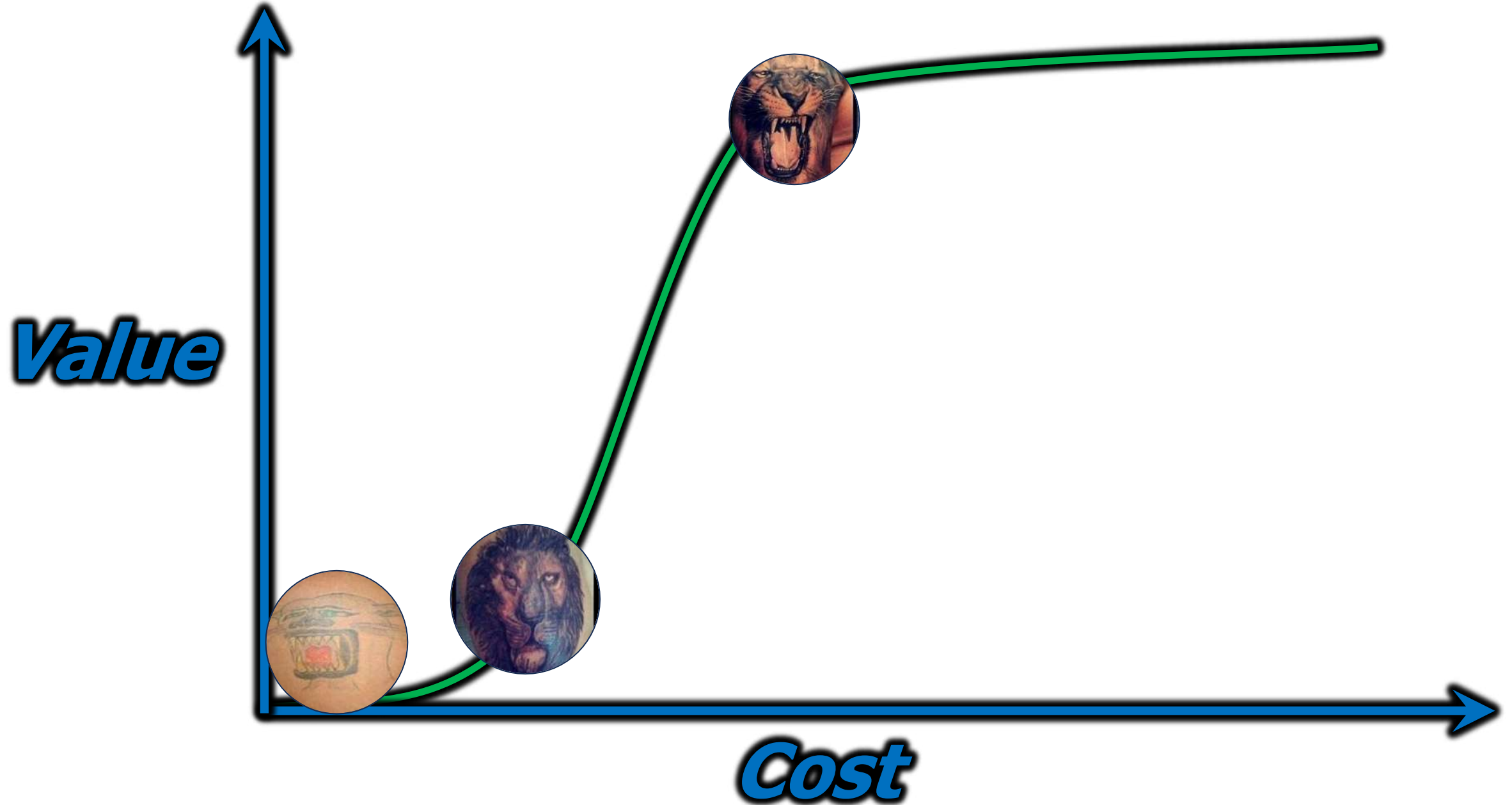
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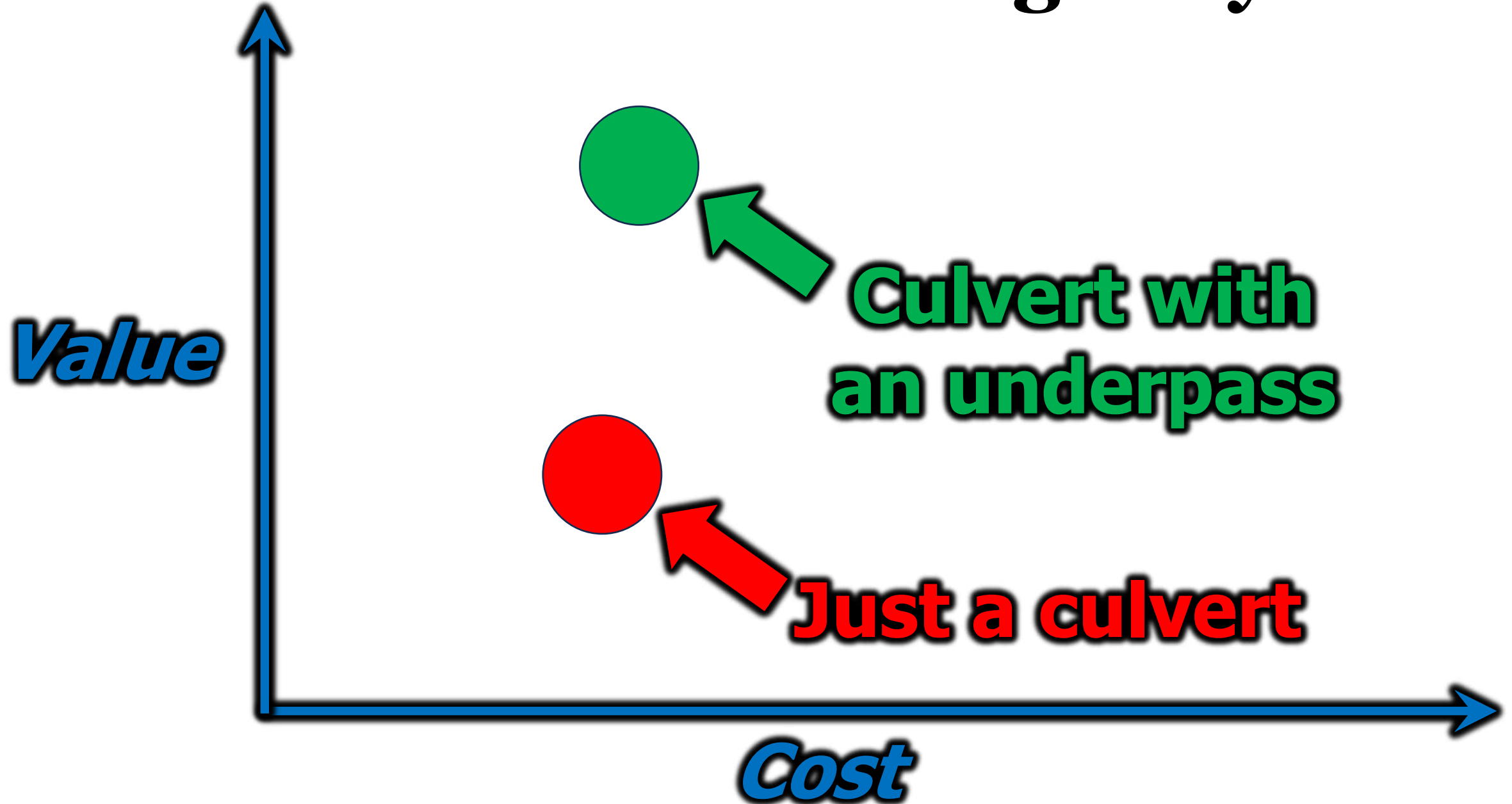
\$650



# Value vs Cost



# Hoffman Drainageway

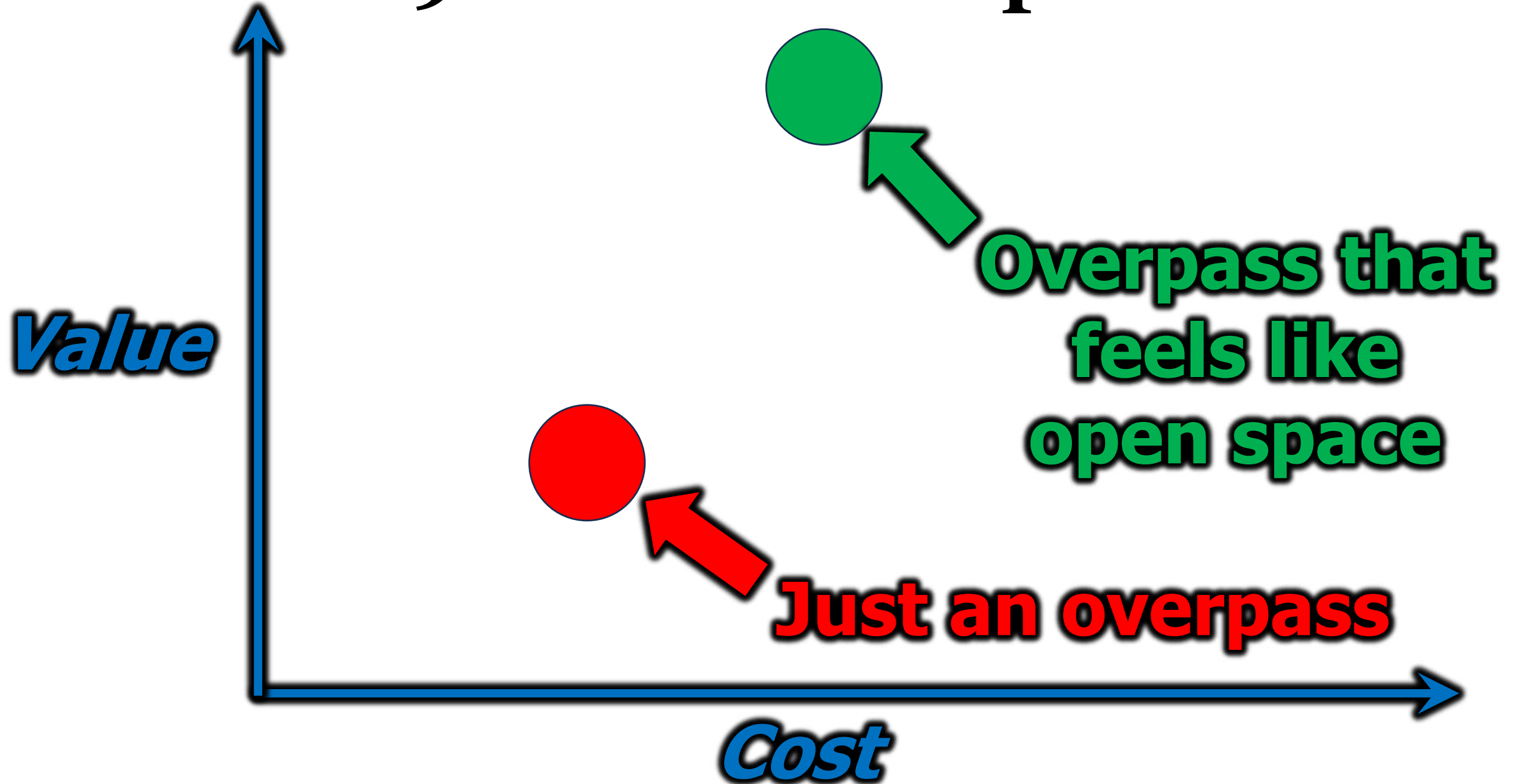


# 19<sup>th</sup> Street Overpass



**Added Bridge Length**

# 19<sup>th</sup> Street Overpass



# Sanderson Gulch Failing Drop Structure



# Sanderson Gulch Failing Drop Structure

Arkansas Ave

**Drop Structure**



Florida Ave

# Sanderson Gulch at Arkansas

**6'-6" Height**

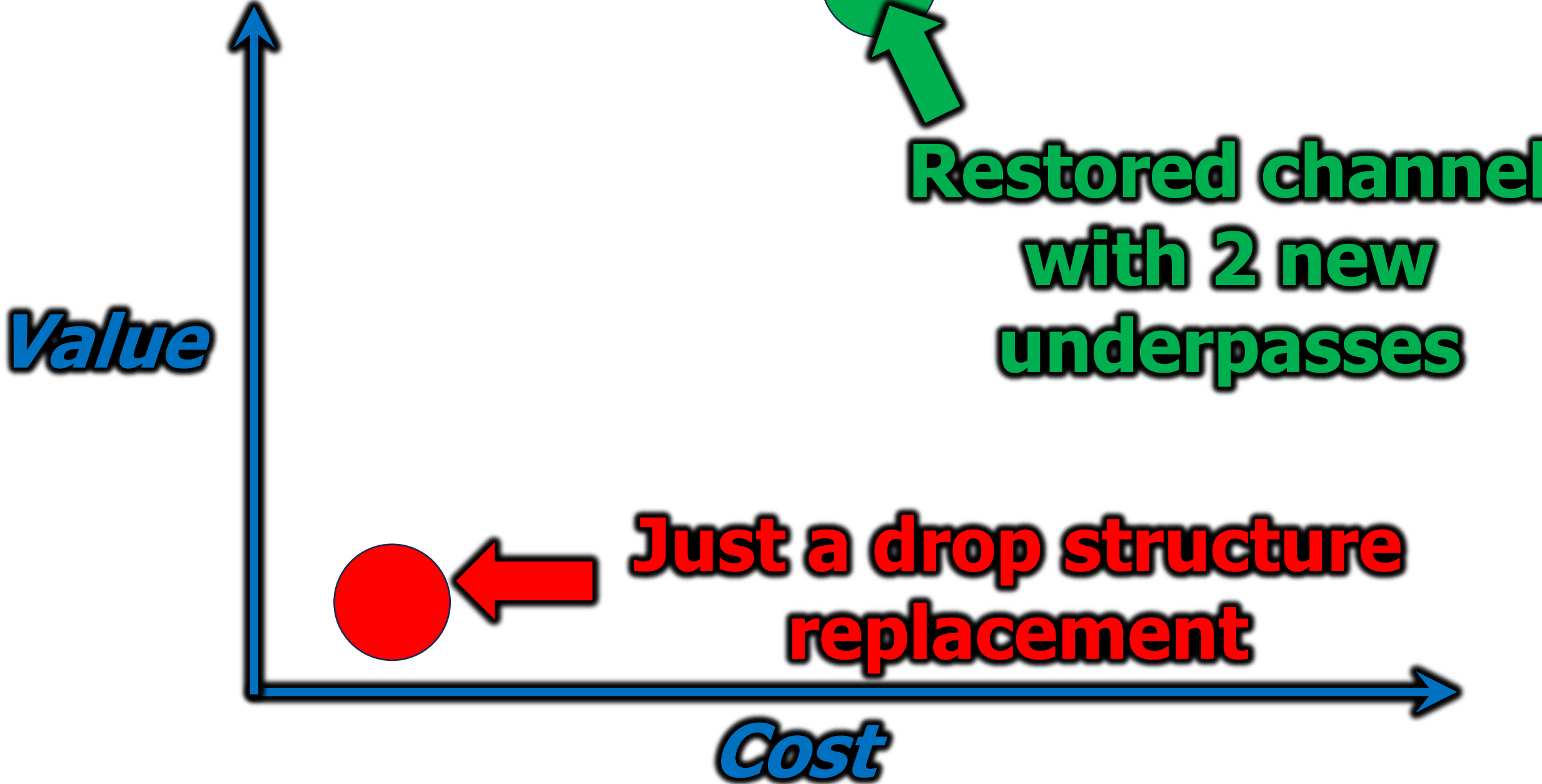
*\*Video courtesy of City & County of Denver*

# Sanderson Gulch at Florida





# Sanderson Gulch Florida to Arkansas



# Westerly Creek at Stanley Marketplace



**Landfill**

**Proposed WQ Basin**

# Westerly Creek at Stanley Marketplace



*\*Rendering courtesy of Stream Landscape Architecture*

# Westerly Creek at Stanley Marketplace



*\*Rendering courtesy of Stream Landscape Architecture*

# Westerly Creek at Stanley Marketplace



*\*Rendering courtesy of Stream Landscape Architecture*

# Westerly Creek at Stanley Marketplace



# North Outfall Retrofit Storm Drain



# North Outfall Trash Vault



*\*Photo courtesy of ICON Engineering*



# Canyon Creek at I-70 Fish Passage




*\*Photo by Olivia Emmer*

# Canyon Creek at I-70 Fish Passage



*\*Photo by Olivia Emmer*

# Canyon Creek at I-70 Fish Passage



*\*Photo courtesy of Wright Water Engineers*

# Hydrology

**Runoff  
Production**

**Flow Regime**

# Hydraulics

**Flood Hazards**

**Flow  
Conveyance**

**Floodplain  
Connectivity**

# Geo- morphology

**Sediment  
Regime**

**Stability**

**Morphology**

# Vegetation

**Flood  
Conveyance**

**Dynamic  
Stability**

**Resiliency**

**Adaptability**

# Community Values

**Access to  
Nature**

**Vitality**

**Economics**

**Stewardship**

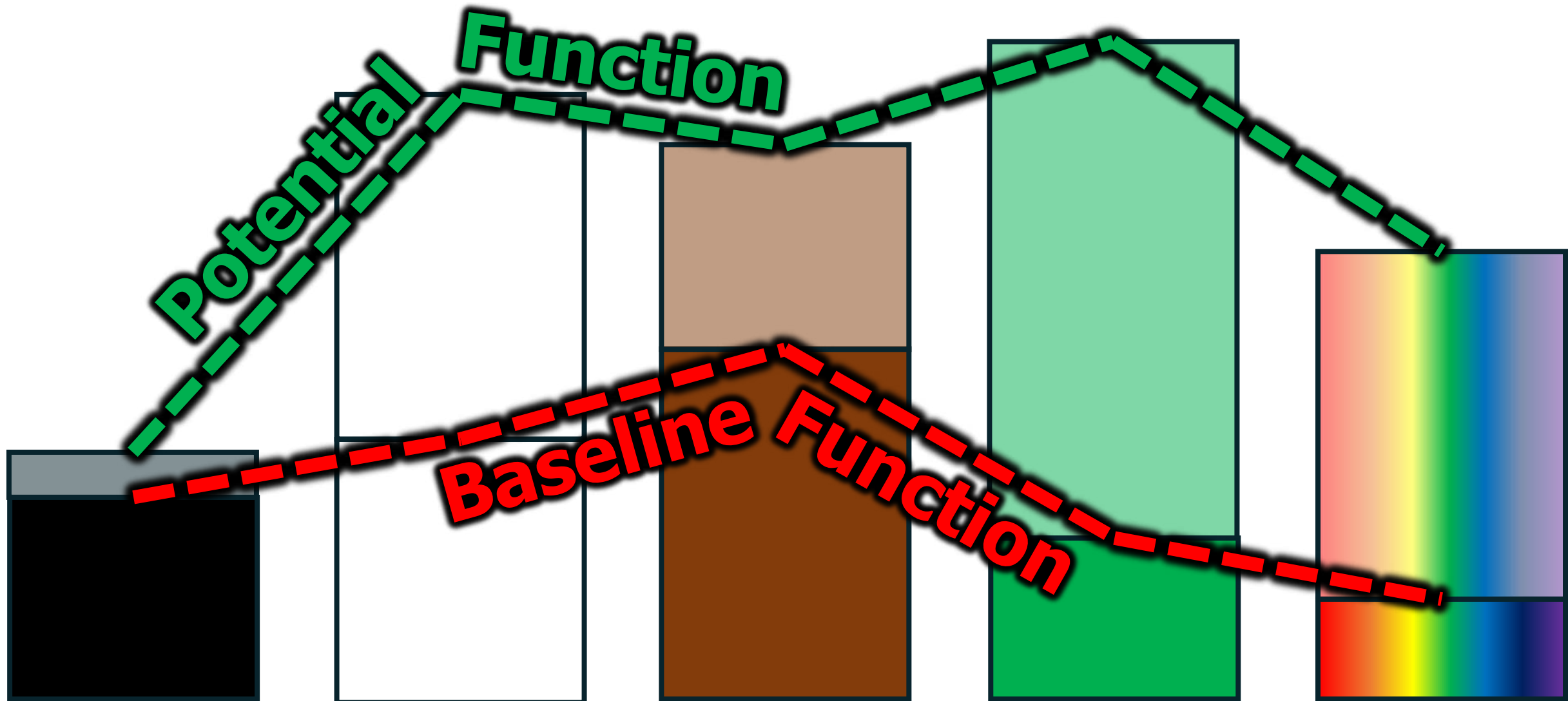
**Hydrology**

**Hydraulics**

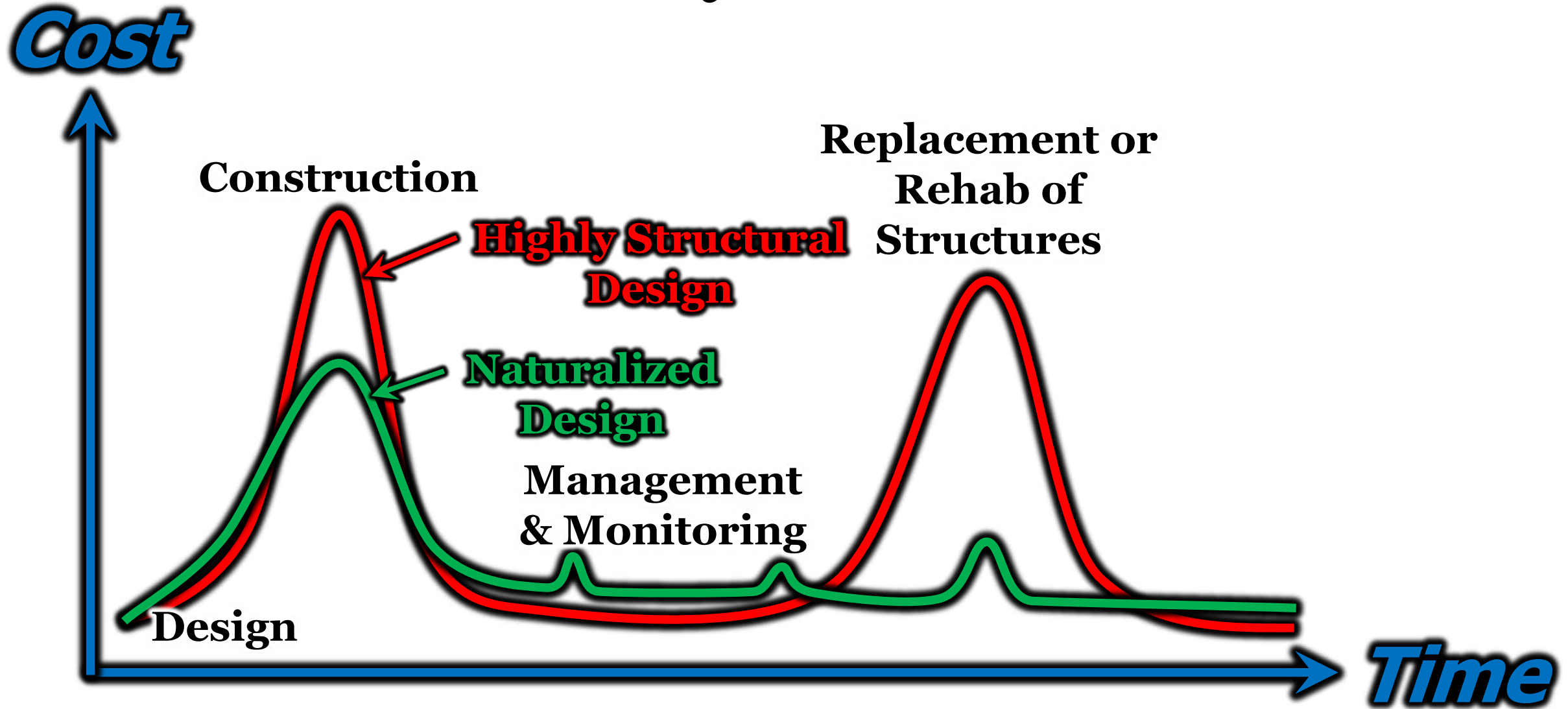
**Geo-  
morphology**

**Vegetation**

**Community  
Values**



# Life Cycle Cost



# Cost vs Value



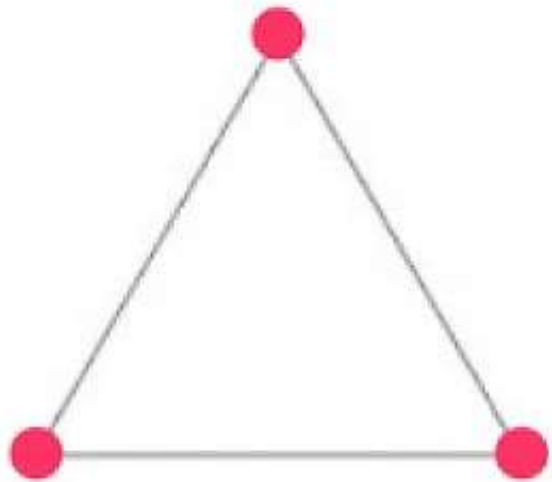
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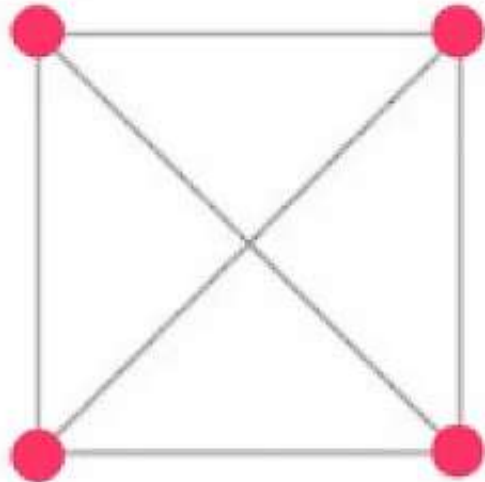
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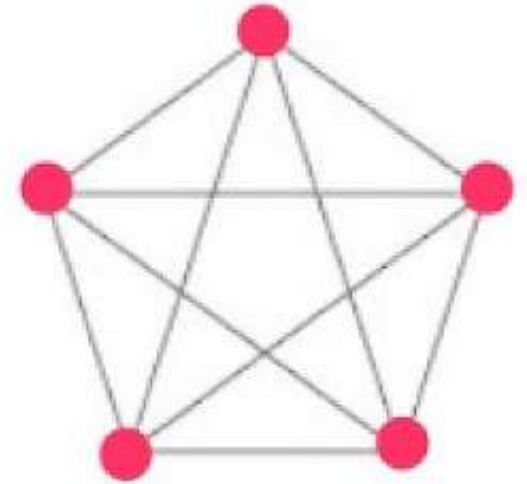
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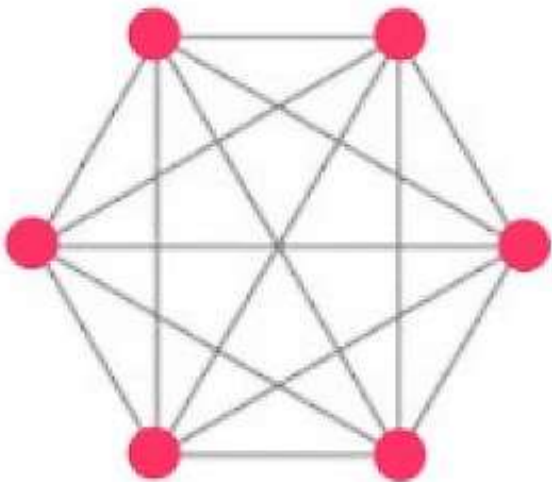
**3 people, 3 lines**



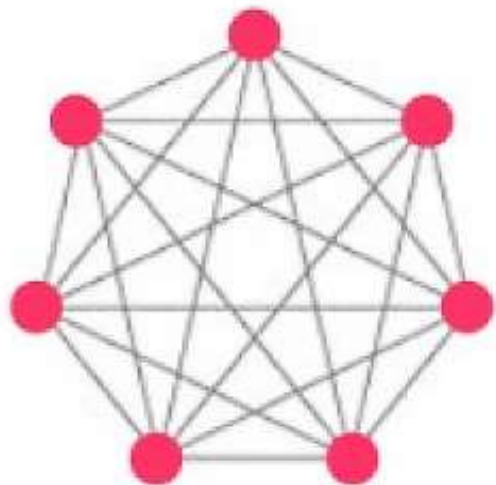
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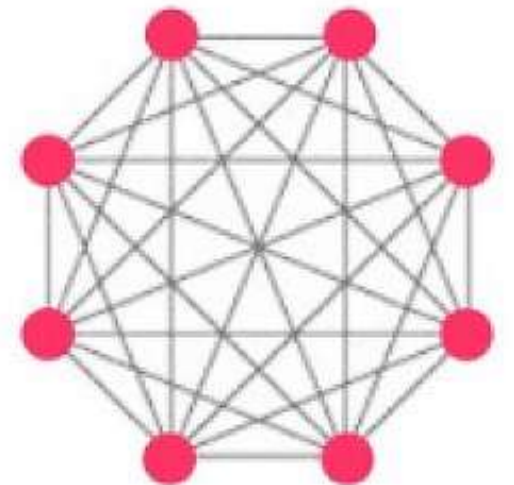
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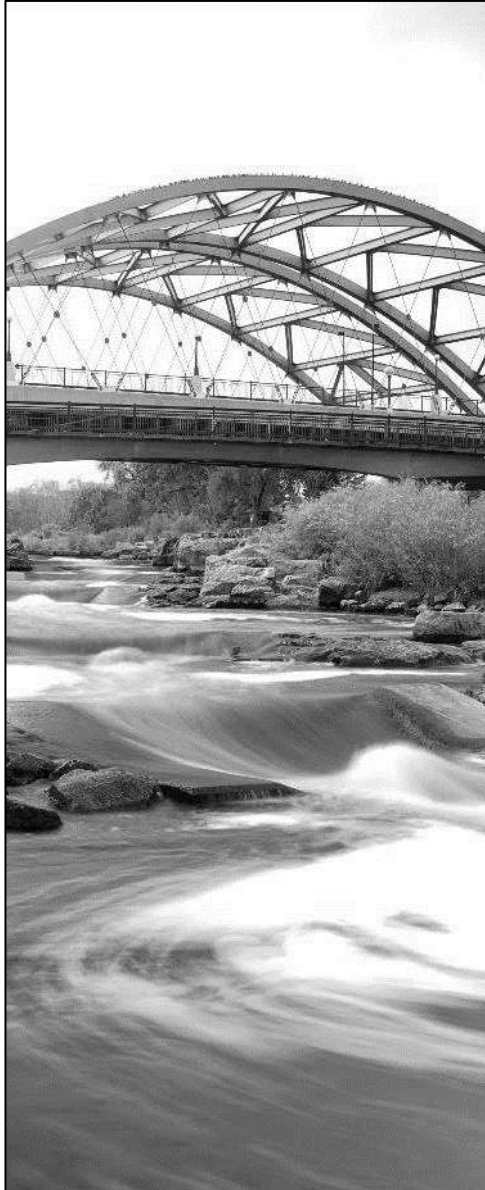
**8 people, 28 lines**



# Hydrology



# Hydraulics



# Geo-morphology



# Vegetation



# Community Values



# Creating the Knowledge Ecosystem

- ✓ Culture of innovation
- ✓ Diversity & equity of
  - ✓ Thought
  - ✓ Participation
- ✓ Patience
- ✓ Collaboration
- ✓ Willingness to fail
- ✓ Partnerships

# What Role Should Government Play

## Lead

- City takes the primary role in making this happen in the community

## Partner

- City co-leads through resources and funding this strategic goal

## Facilitate

- City serves as a facilitator to bring together key stakeholders but does not fund the project/program efforts

## Support

- City supports the efforts in this area but does not fund them

## Observe

- City plays the role of only observer in this goal area

# What's Your Story

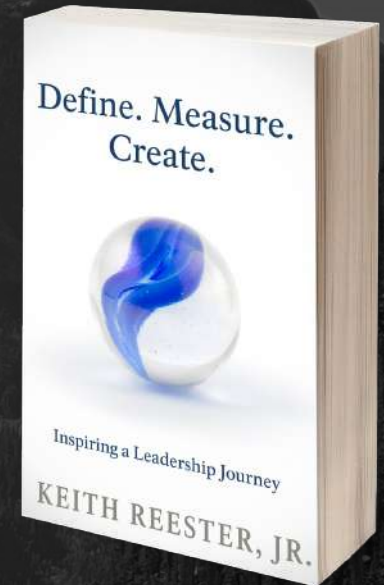
- ▶ What are you doing?
  - ▶ What actions are highest on your community's list?
  - ▶ What other communities are you partnering with?
- ▶ Challenges



# Final Thoughts

## Ten Touchstones for '24

- Spend more time with your family
- Take better care of yourself physically
- Spend less time at your desk
- Listen to what your people are saying
- Find something positive in each person – each day
- Take better care of yourself mentally
- Develop a strategic plan for developing your people
- Read 3 Books – business, fictional, spiritual
- Find a friend
- Take this out on the 10<sup>th</sup> of the month



## The Effective Client

Why Being a Good Client is Smart Business in the Architecture, Engineering, and Construction Industries

David Skuodas

