

Flood Documentation

David Skuodas, PE, Project Manager











A SEPTEMBER TO REMEMBER

***THE 2013 COLORADO FLOOD WITHIN THE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT***



By Urban Drainage and Flood Control District and Wright Water Engineers, Inc.

UDFCD Flood Photo Guidelines



Purpose: To document stream conditions and other flow paths during and following major flow events.

This information will be used:

- As historical record
- To record the extent of the flooding footprint, damages that may have occurred, condition of the ground and other infrastructure once water recedes, changes in channel geometry (morphology)
- Identify problem areas
- Validate the results of existing and future flood mapping studies

What to Document:

- High Water (active)
- High Water Marks/Debris Lines (along banks, trees, fences, etc.)
- Flood related damage to roads, structures, utilities, etc.
- Debris and Sedimentation
- Bank Erosion
- Headcuts
- Overtopping of roads, trails, spillways, etc.
- Levees
- Bridges and Culverts
- Drop Structures
- Street inlets for regional storm drains (during active flow and post event)
- Detention Basins (outlet works, forebays, spillways, etc.)
- Water Quality Features (during active flow and post event)
- Headgates, diversions, ditch crossings, etc.

How to Document It:

- Use people, objects, or other features to show a sense of scale
- Land marks (signs, structures, buildings, addresses) help confirm photo location
- Use same vantage point as a pre-flood photo if you have one
- Photos during and after the flood (safety first)
- **NO DUPLICATES** of same vantage point
- Only send us your best photos (don't give us ALL of your photos)



Mid-Flood



Post-Flood

Photos will be stored in GIS, so only georeferenced photos will be accepted by UDFCD (i.e. taken by a GPS enabled camera or a smartphone with the location turned on).

Good Example Photos



HIGH WATER



POST FLOOD STREAM CONDITIONS



FLOOD DAMAGE



HYDRAULIC STRUCTURES



Z by Author

Staff Only







High Water



High Water

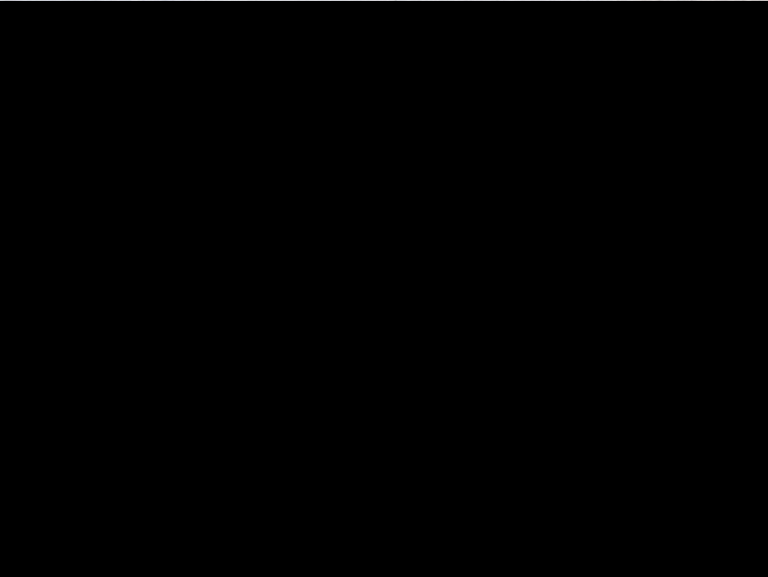


High Water





Flood Damage



Flood Damage



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High Water Marks



Post Flood Stream Conditions

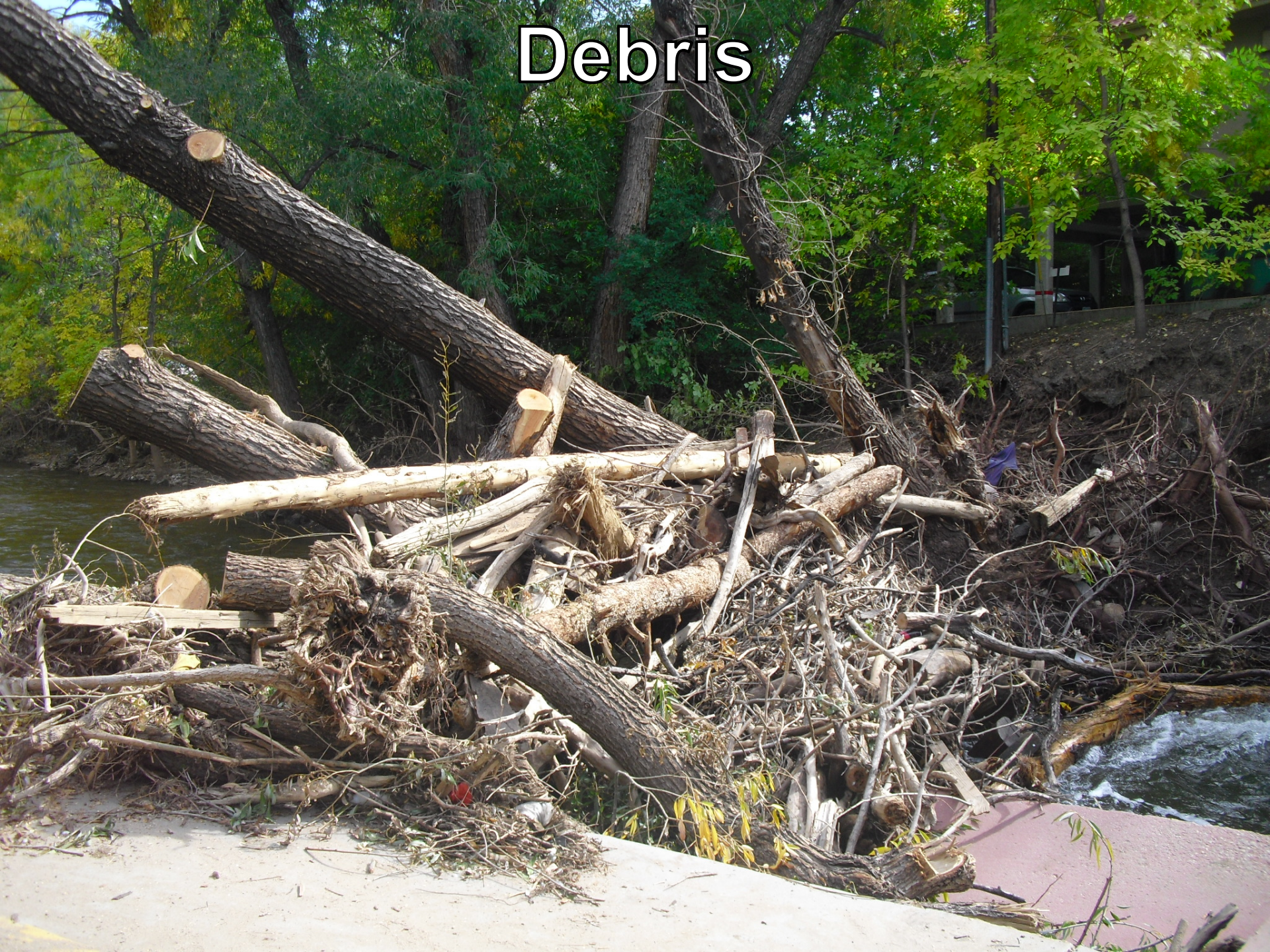




Sediment Deposition



Debris



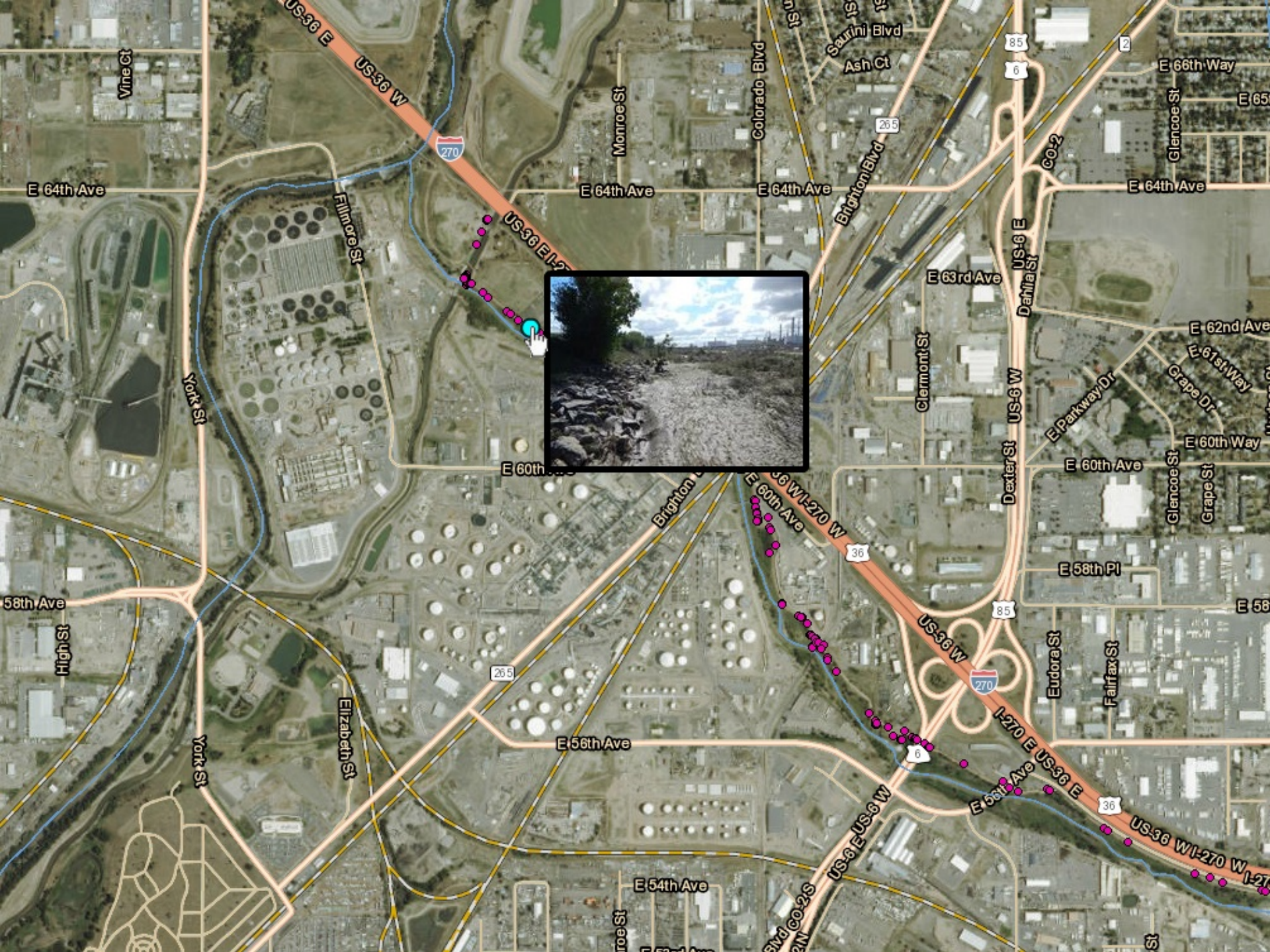
Debris





Hydraulic Structures





Flood Videos



Flood Videos



UDFCD Flood Photo Guidelines



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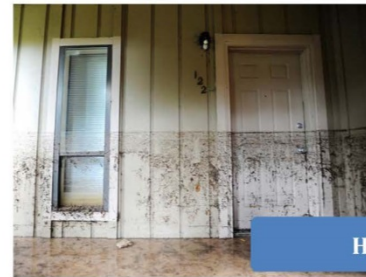
Mid-Flood



Post-Flood

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Good Example Photos



HIGH WATER



POST FLOOD STREAM CONDITIONS



FLOOD DAMAGE



HYDRAULIC STRUCTURES





NEXT STEPS...

High Water Mark Survey Performance Spec

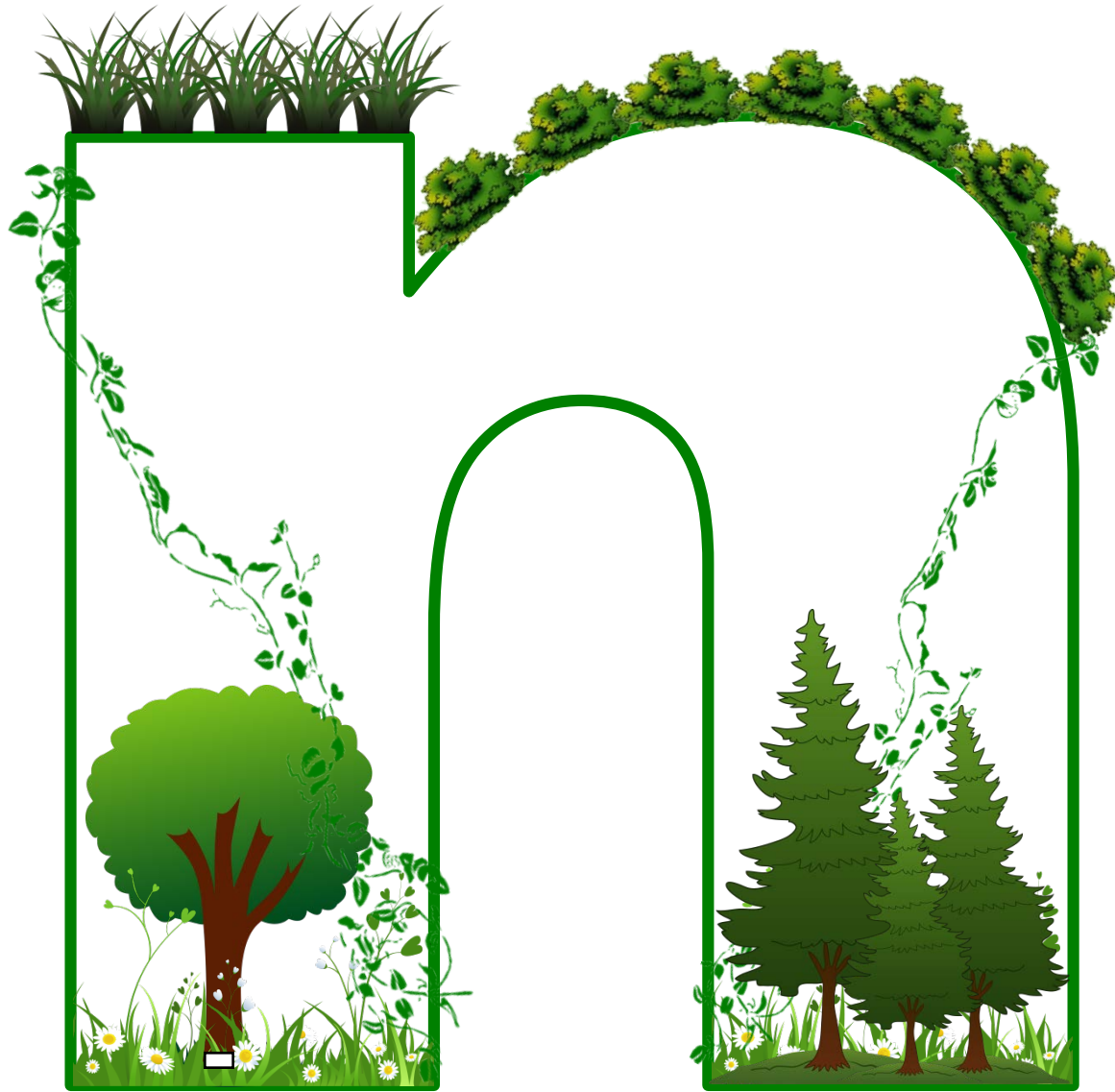


**When you Say “Rough”, We
Want to Know “How Rough?”**

**Connecting Vegetation
Management to the Mapped
Flood Risk**

David Skuodas, PE, Project Manager





Mapped
Flood Risk

Vegetation
Management









Mark Hunter

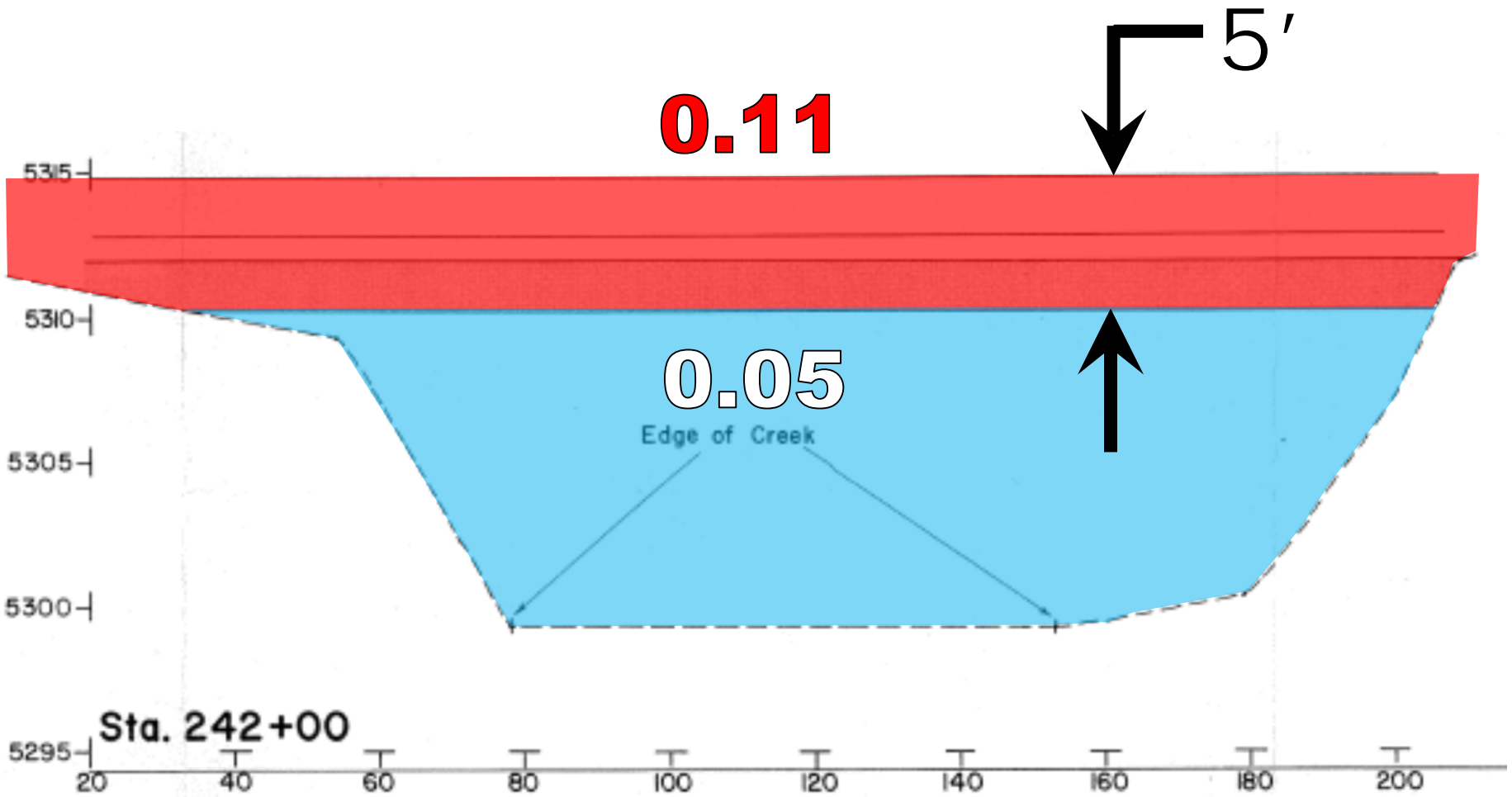
CRITERIA FOR SELECTIVE CLEARING CHERRY CREEK

Urban Drainage and Flood Control District
Maintenance Program

October 1982

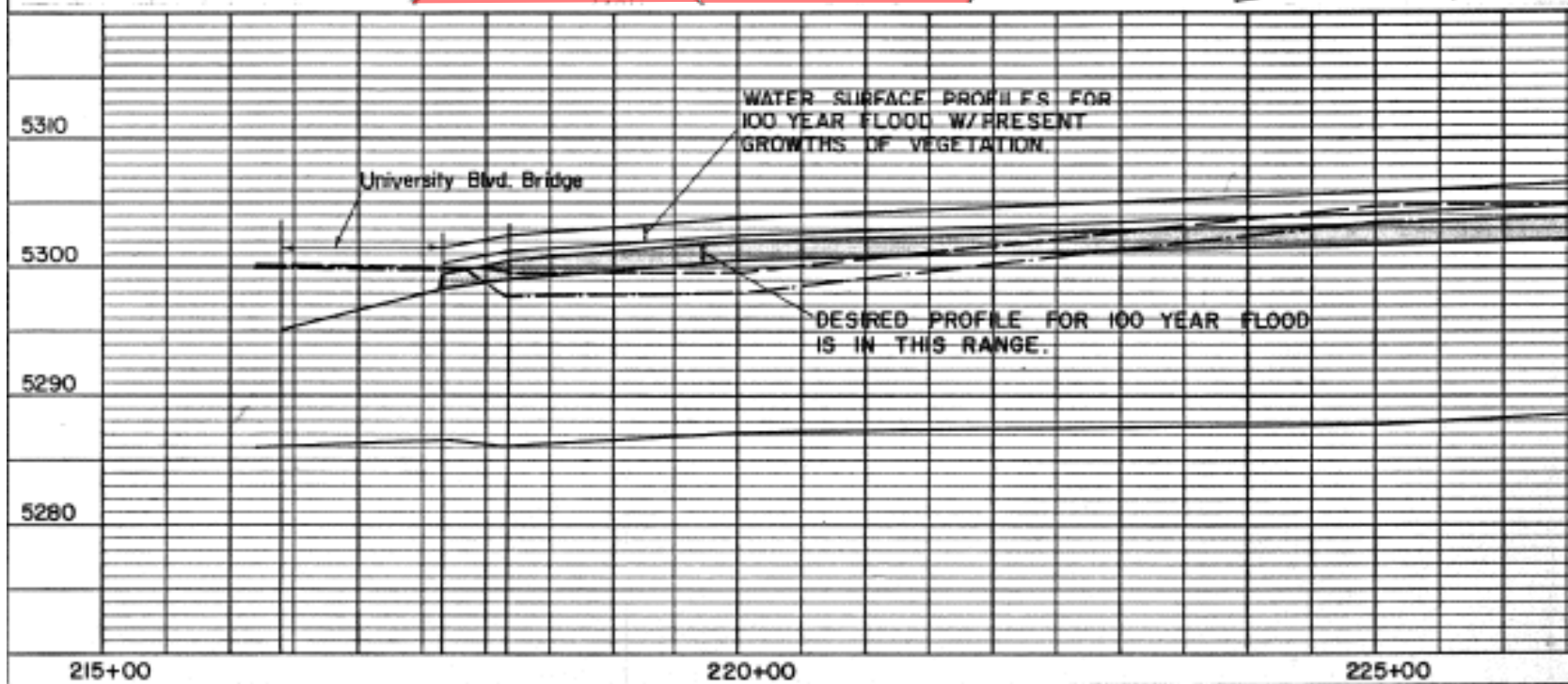
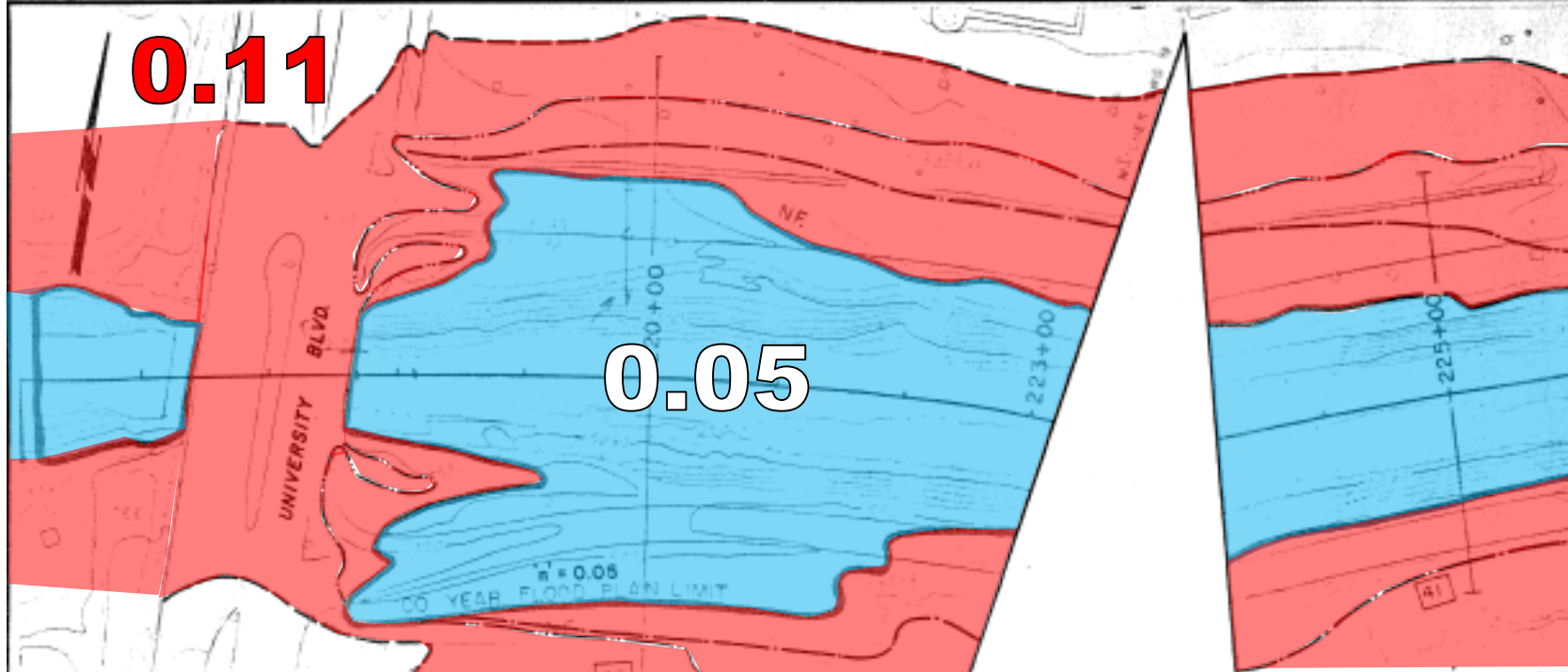
PROJECT CONSULTANTS

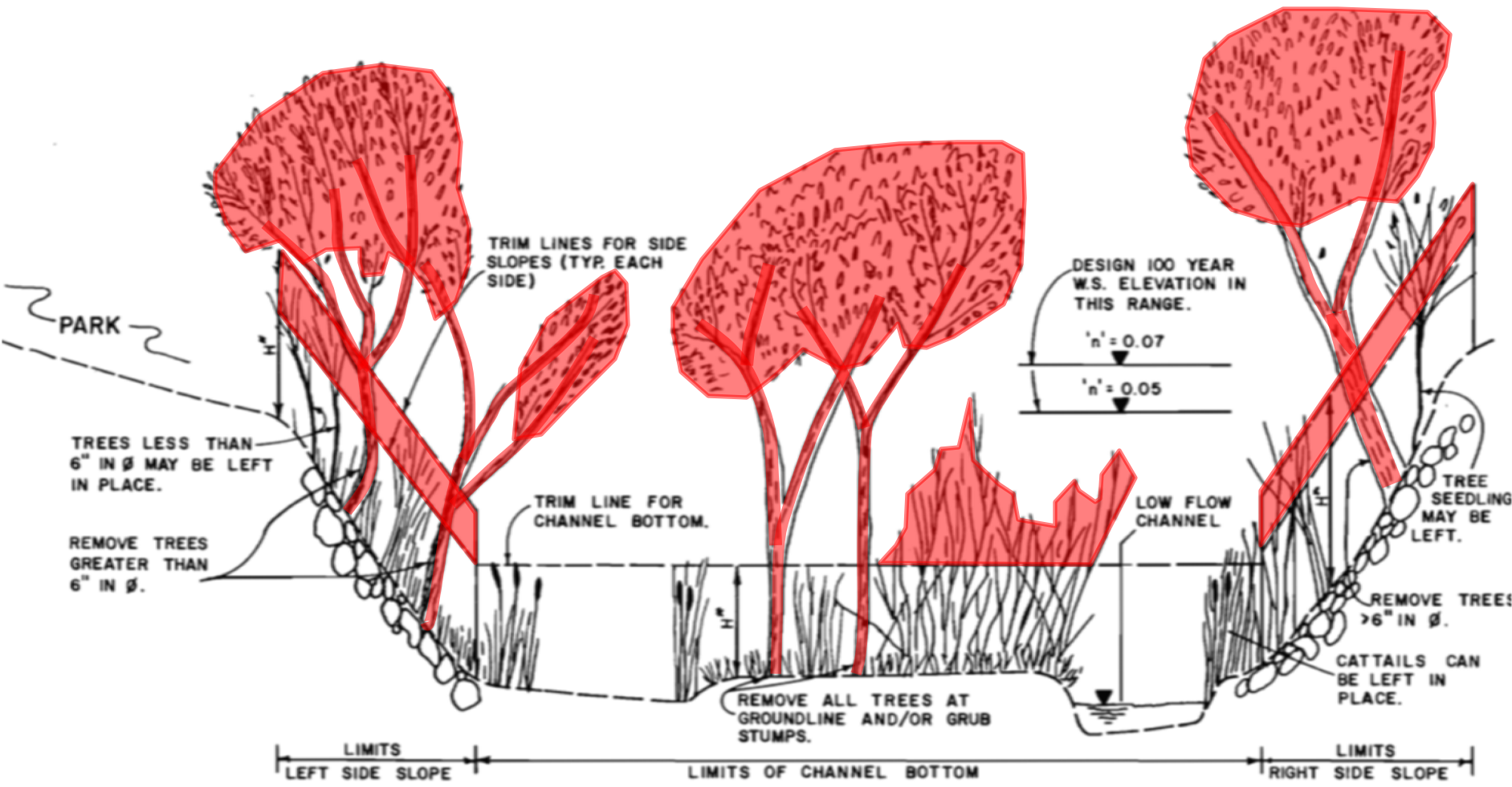
Engineering/Planning/Management



0.11

0.05





$H^* = 4'$ FOR BIENNIAL CLEARING TO
MAX. 6' FOR ANNUAL CLEARING -
CHANNEL BOTTOM SHOULD BE GRUBBED & RESEEDED
IF FREQUENCY OF CLEARING IS TO BE LESS.

DIAGRAM OF CHERRY CREEK CLEARING

Scale: (H) 1" = 20' ; (V) 1" = 5'

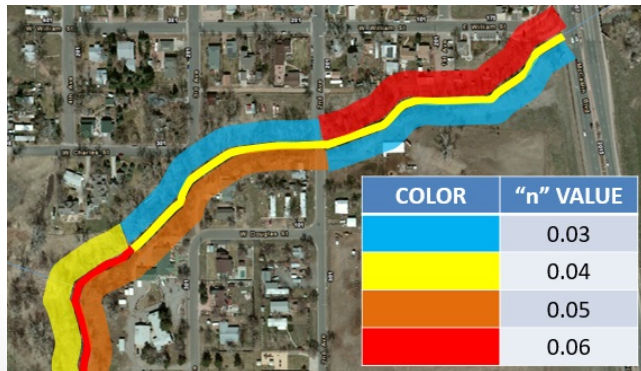


Manning's n Values		
LOB	Channel	ROB
0.035	0.03	0.035

Modeling Roughness



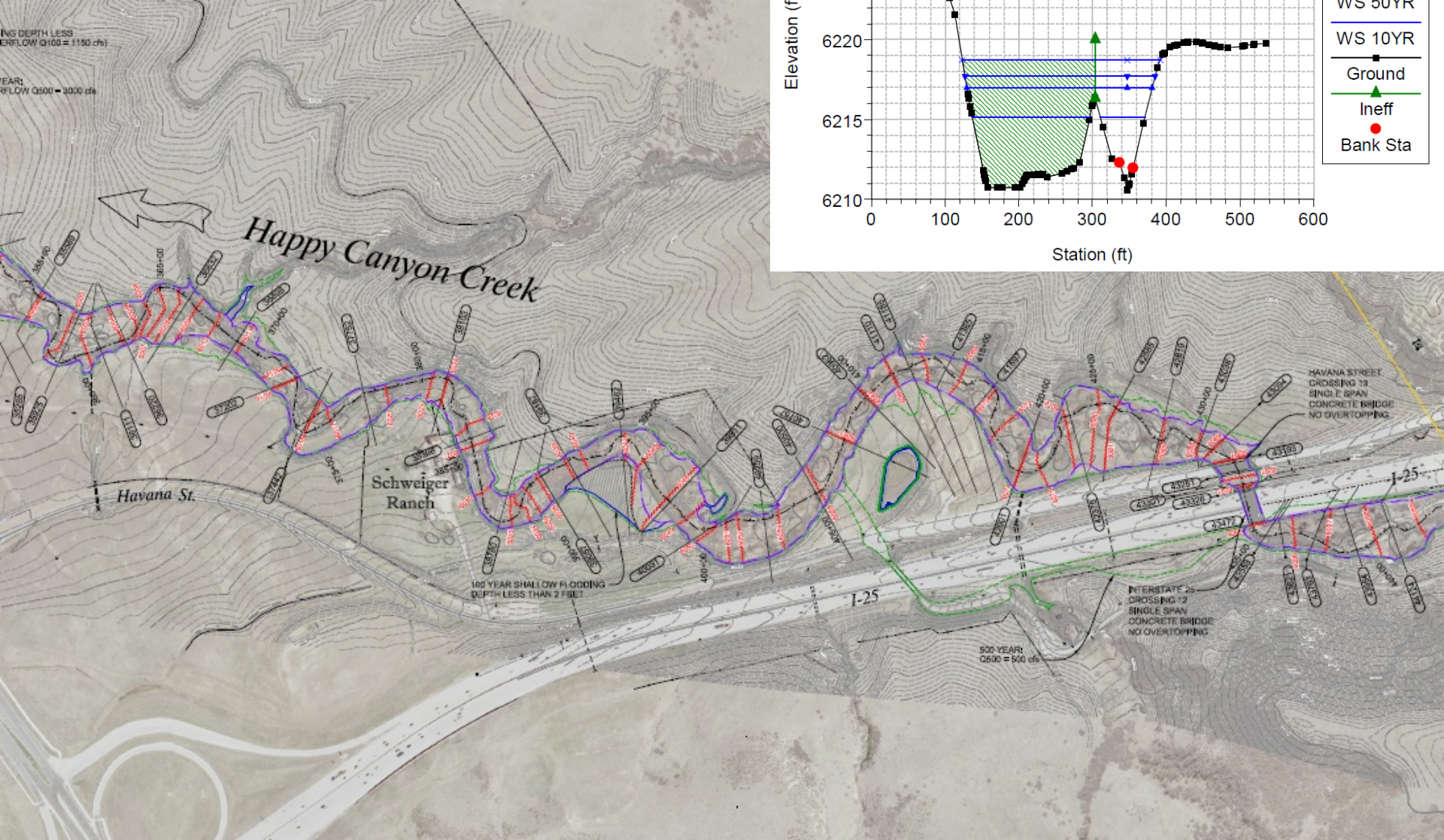
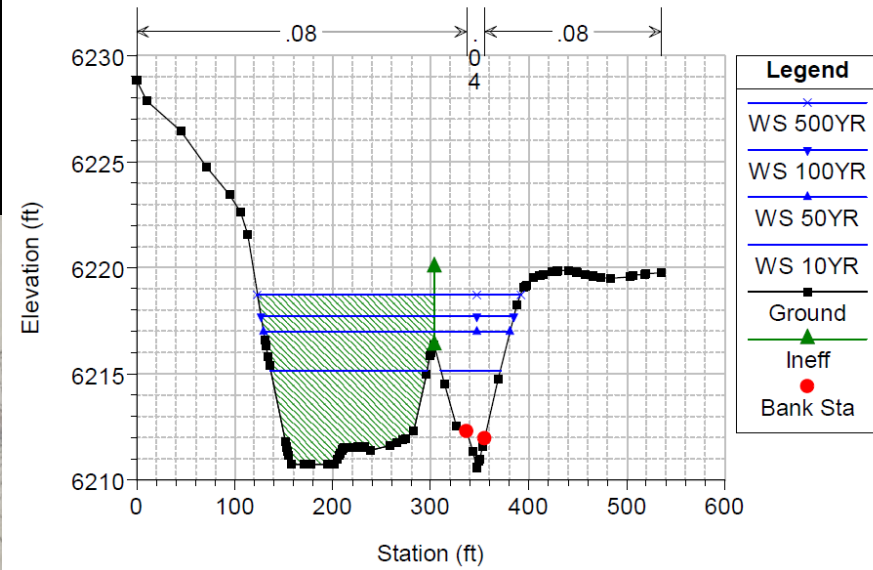
Case Studies



Documenting & Using Roughness Values

Geom: Happy Canyon FHAD Draft Flow: HCC FHAD FUTURE

River = HCC Reach = Mainstem_1 RS = 52947 Stock Pond in LOB (modeled as IEFA)





Map Controls (Select from Below):

- Study Area Map
- Soil Survey Map
- Existing Land Use Map
- Future Land Use Map
- Subwatershed Boundaries Map
- Baseline Hydrology SWMM Routing Map

The Map Controls set the visibility of the layers automatically for the selected map. Additional layer control is available through the "Layers" Navigation Panel which can be accessed from the View Menu under Navigation Panels. In the Panel, the visibility of layers and layer groups can be changed by clicking the square left of the layer/group. An eye in the square indicated that the layer is on. An empty square indicates that the layer is off. Layer groups can be expanded and reduced by clicking the +/- symbol left of the layer/group.

Map Legend

	Watershed Boundary		Design Point		2		50
	Major Basin Boundary		SWMM Subwatershed		5		60
	Sub-basin Boundary		Conveyance Element		10		70
	Jurisdiction Boundary		Detention Facility		15		75
	Existing Regional Detention		Outfall		20		80
	Reach Delimiter	Soil Type			25		85
	Subwatershed Label		A		30		90
			B		35		95
			C/D		40		100

No.	DATE	REVISIONS	APPR.

MULLER ENGINEERING CO., INC.
 CONSULTING ENGINEERS
 778 SOUTH WASHINGTON ST. SUITE 4-100
 LAKEWOOD, COLORADO 80226 (303) 958-4959

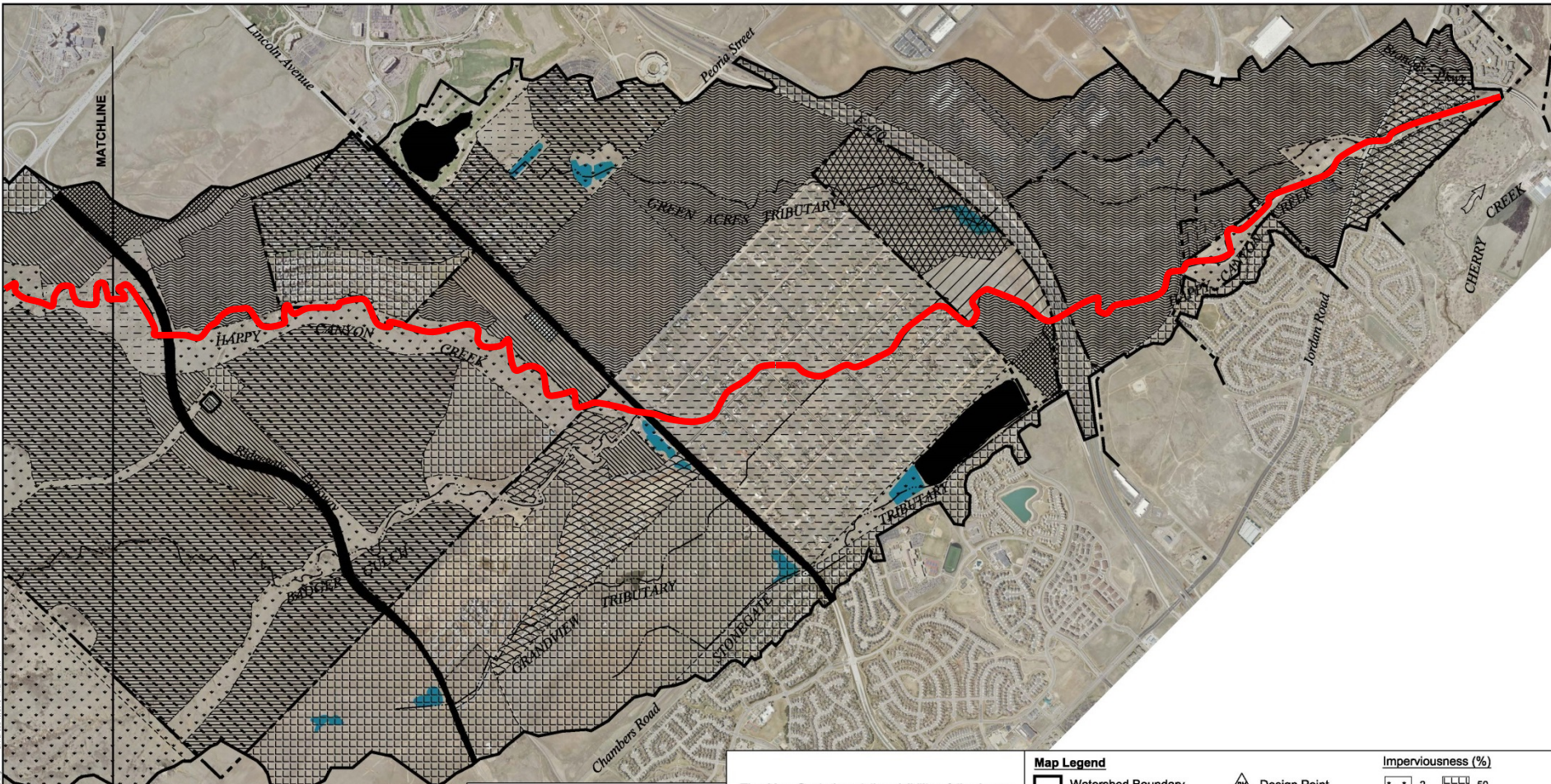
CLIENT: MDC
 DESIGNER: JHK
 CHECKER: JTW

**HAPPY CANYON CREEK
 MAJOR DRAINAGEWAY PLAN**

INTERACTIVE HYDROLOGY MAP
 STUDY AREA

DATE: JULY 2013
 FIGURE NO: B-2

DATE: JUL 23, 2013 TIME: 10:48 AM



Map Controls (Select from Below):

- Study Area Map
- Soil Survey Map
- Existing Land Use Map
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	Reach Delimiter	Soil Type					
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			B				

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MULLER ENGINEERING CO., INC.
 CONSULTING ENGINEERS
 775 SOUTH WALDEN ROAD, SUITE 4-100
 LAKEWOOD, COLORADO 80226
 (303) 958-4959

CLIENT: MDC
 CONTRACTOR: SHK
 DESIGNER: JTW

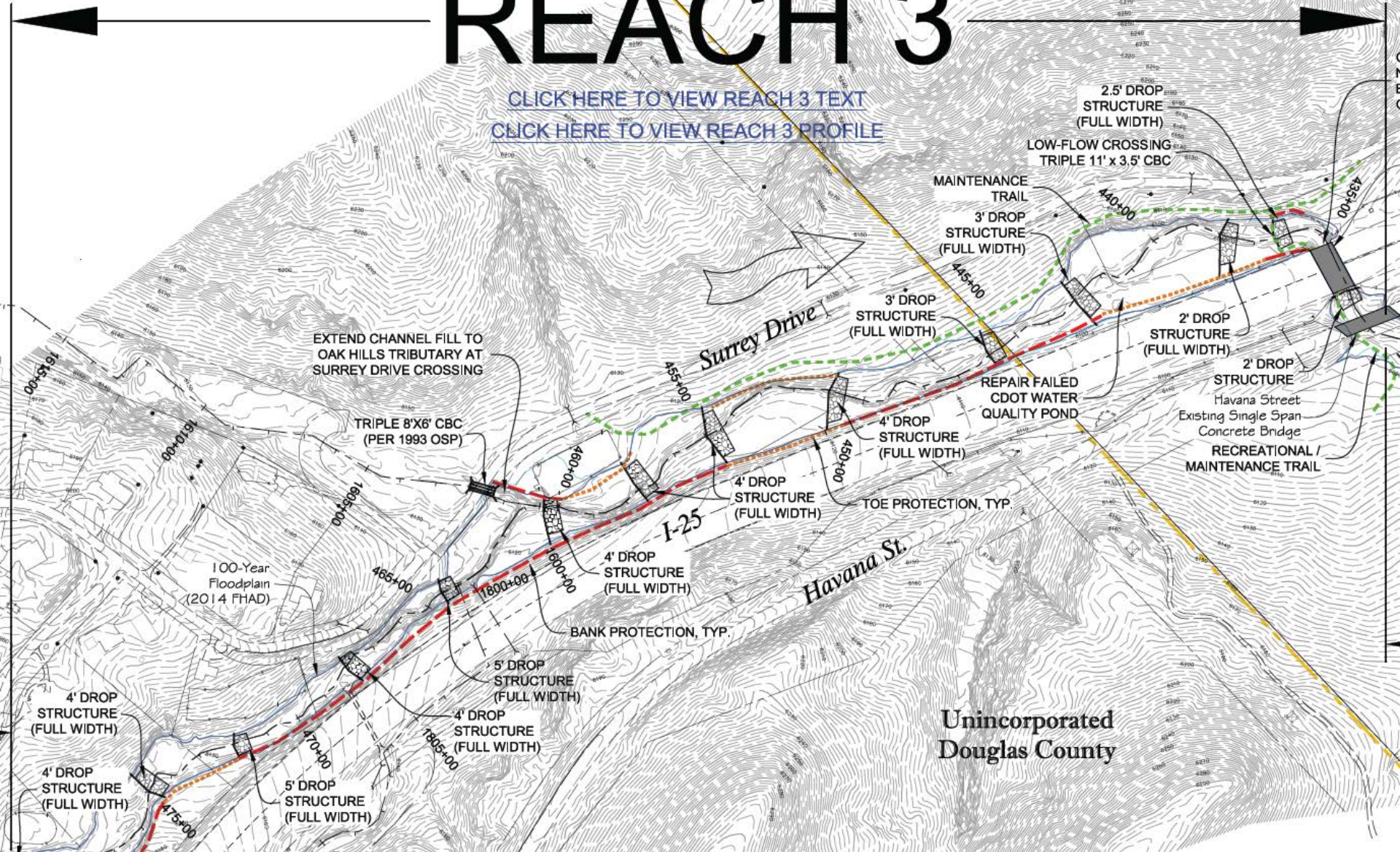
**HAPPY CANYON CREEK
 MAJOR DRAINAGEWAY PLAN**

**INTERACTIVE HYDROLOGY MAP
 FUTURE LAND USE**

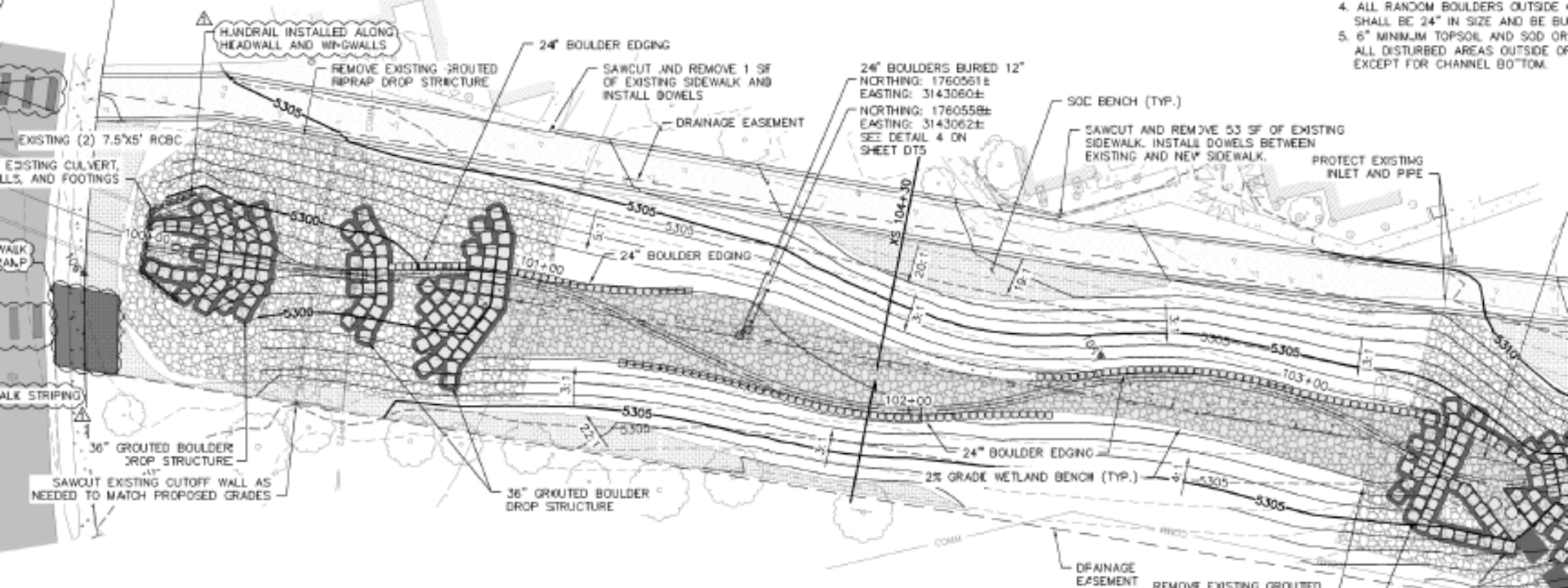
DATE: JULY 2013
 FIGURE NO: B-2

REACH 3

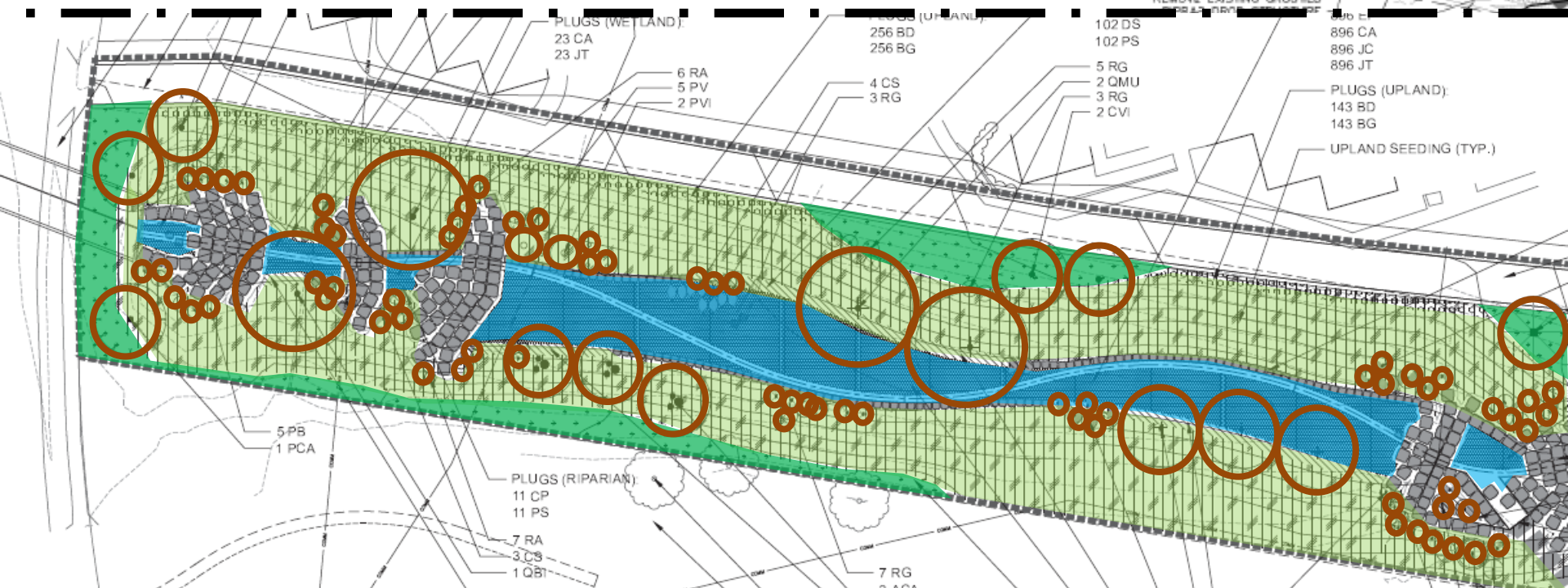
[CLICK HERE TO VIEW REACH 3 TEXT](#)
[CLICK HERE TO VIEW REACH 3 PROFILE](#)



Unincorporated
Douglas County



4. ALL RANDOM BOULDERS OUTSIDE CHANNEL SHALL BE 24" IN SIZE AND BE BURIED 12" UNDER THE SURFACE.
5. 6" MINIMUM TOPSOIL AND SOD OR MULCH SHALL BE APPLIED TO ALL DISTURBED AREAS OUTSIDE OF CHANNEL BOTTOM EXCEPT FOR CHANNEL BOTTOM.



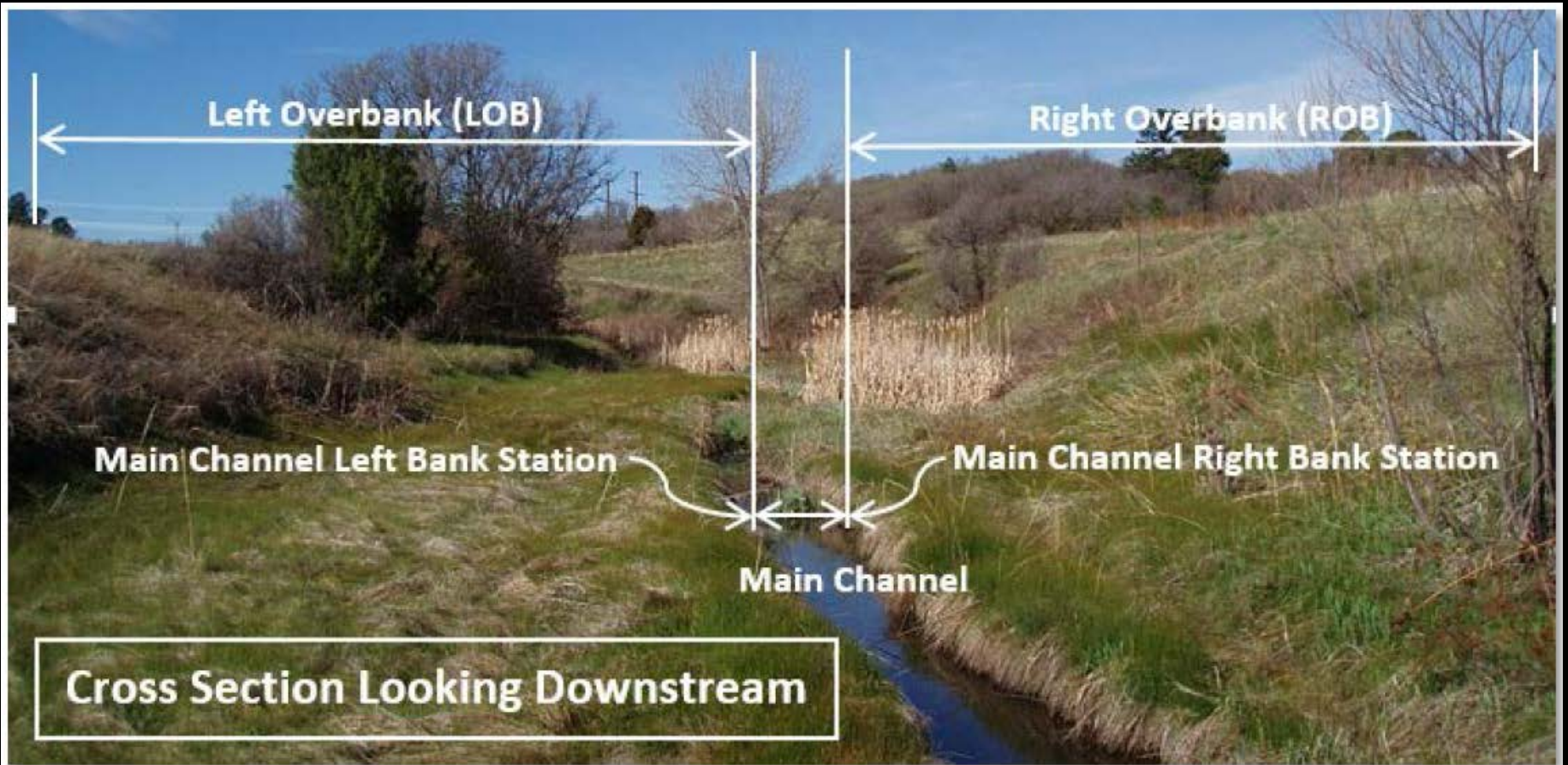
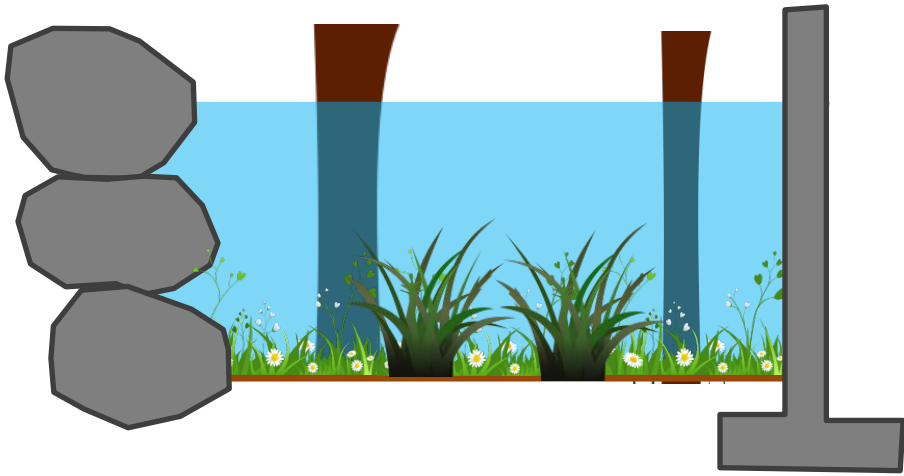


Figure 8-27. HEC-RAS cross section definitions

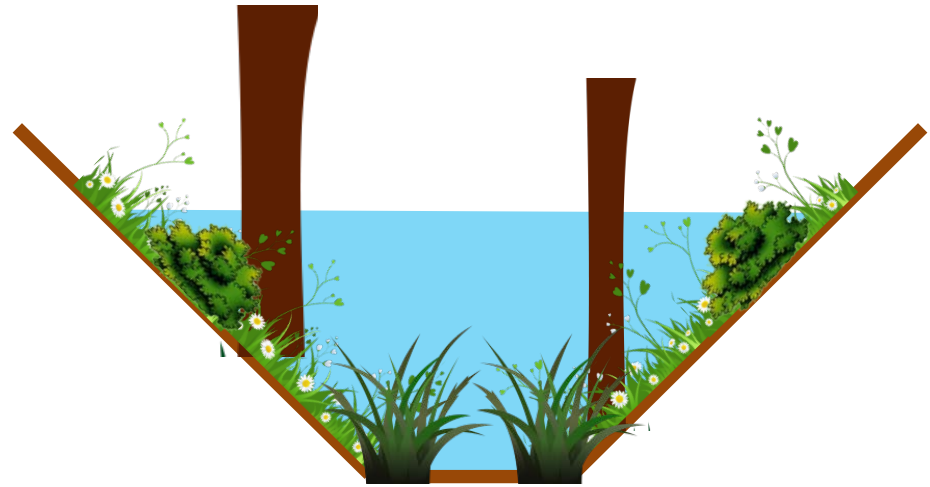
Table 8-5. Recommended roughness values

Location and Cover	When Assessing Velocity, Froude No., Shear Stress	When Assessing Water Surface Elevation and Water Depth
<u>Main Channel (bankfull channel)</u>		
Sand or clay bed	0.03	0.04
Gravel or cobble bed	0.035	0.07
<u>Vegetated Overbanks</u>		
Turfgrass sod	0.03	0.04
Native grasses	0.032	0.05
Herbaceous wetlands (few or no willows)	0.06	0.12
Willow stands, woody shrubs	0.07	0.16

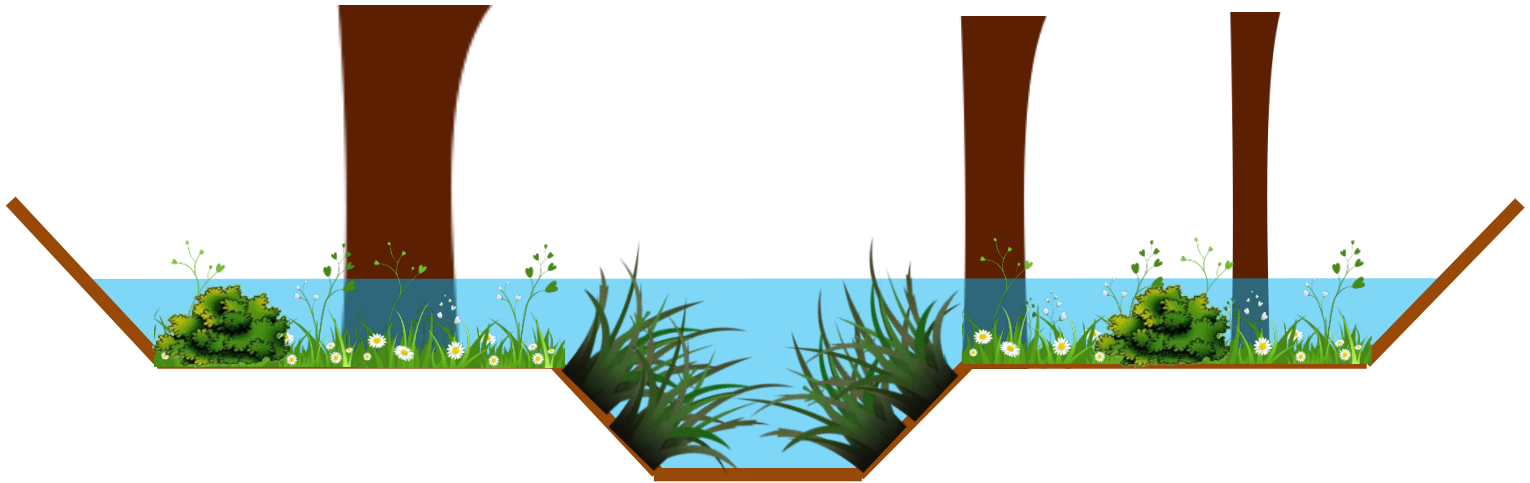
(Source: Chow 1959, USDA 1954, Barnes 1967, Arcement and Schneider 1989, Jarrett 1985)



Walled Section



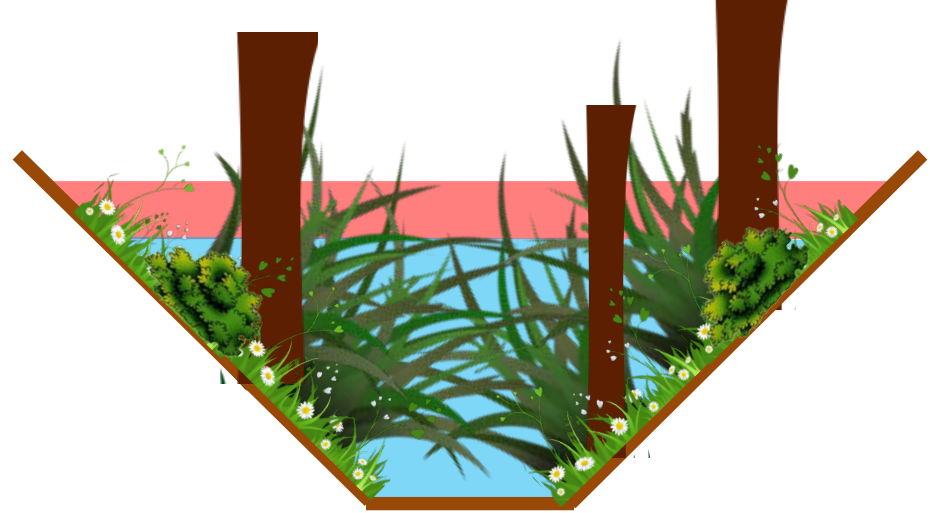
Trapezoidal Section



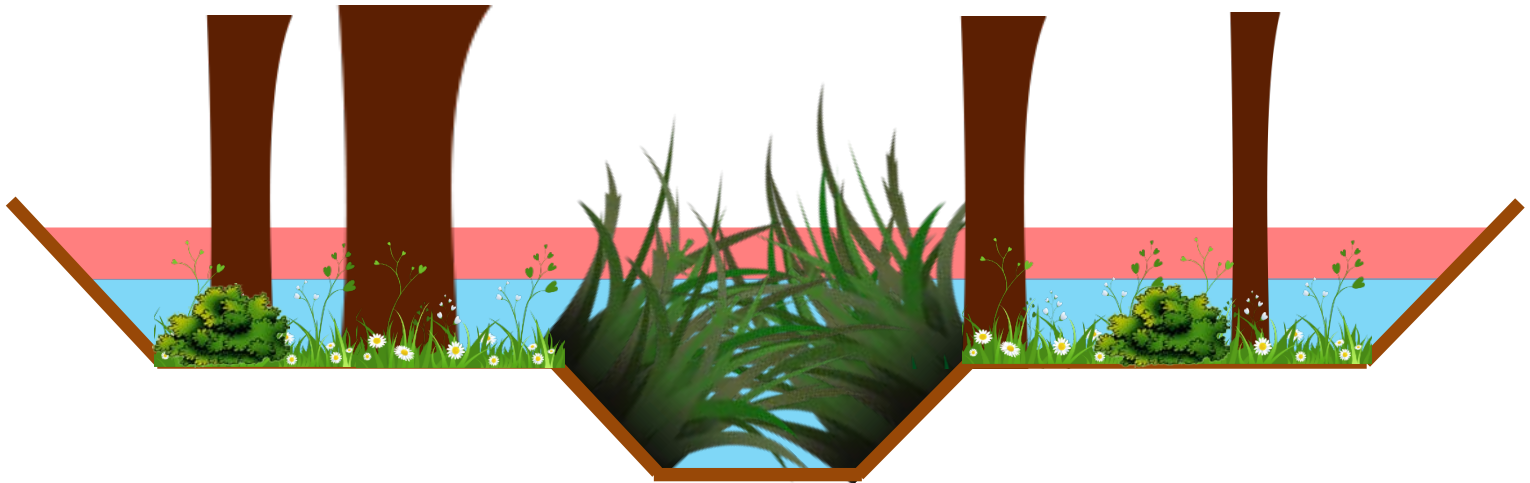
Open Floodplain



Walled Section



Trapezoidal Section



Open Floodplain



Tucker Gulch DS of Ford Street

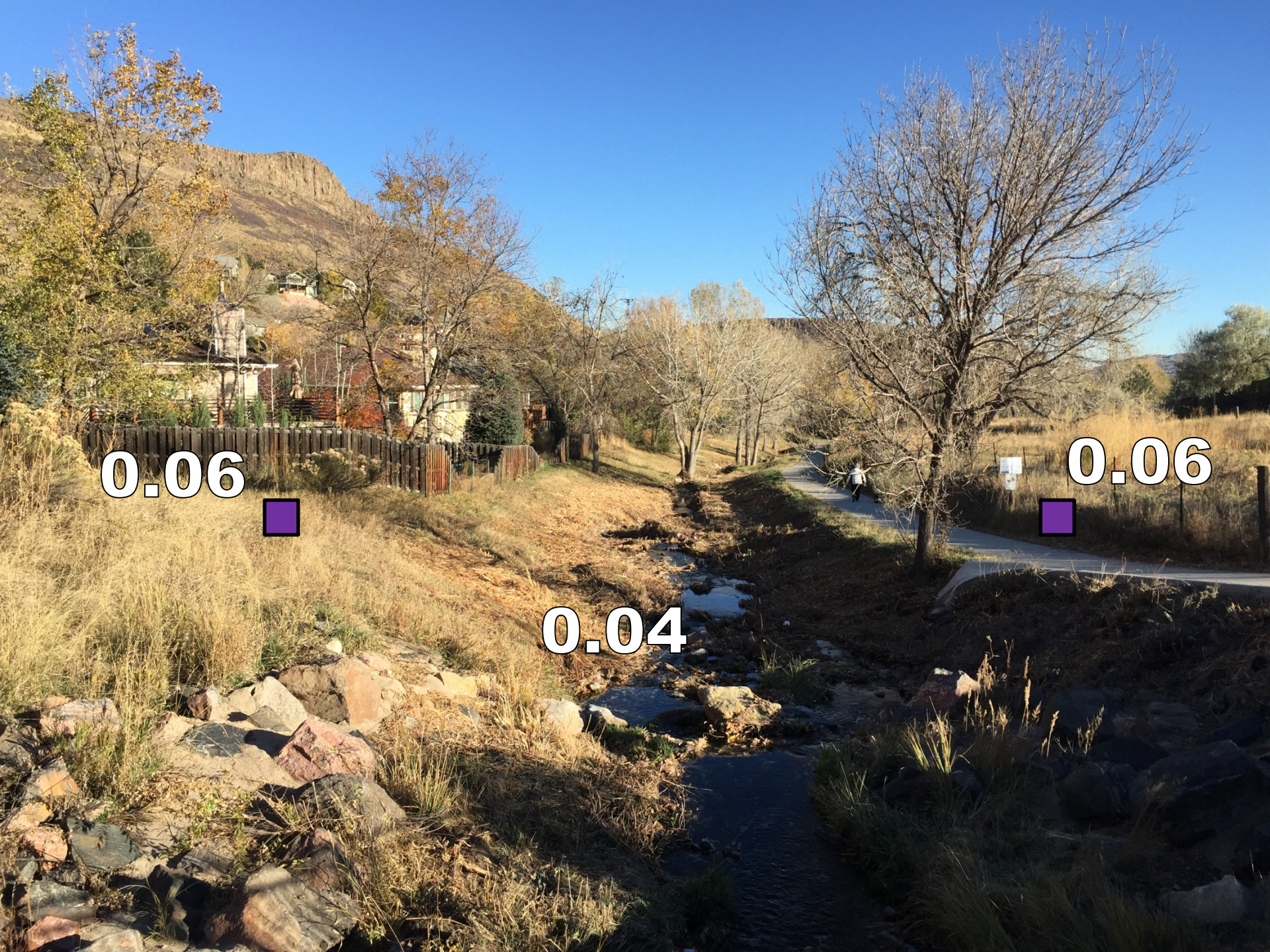


0.06



0.04

0.06



0.08



0.06

0.16

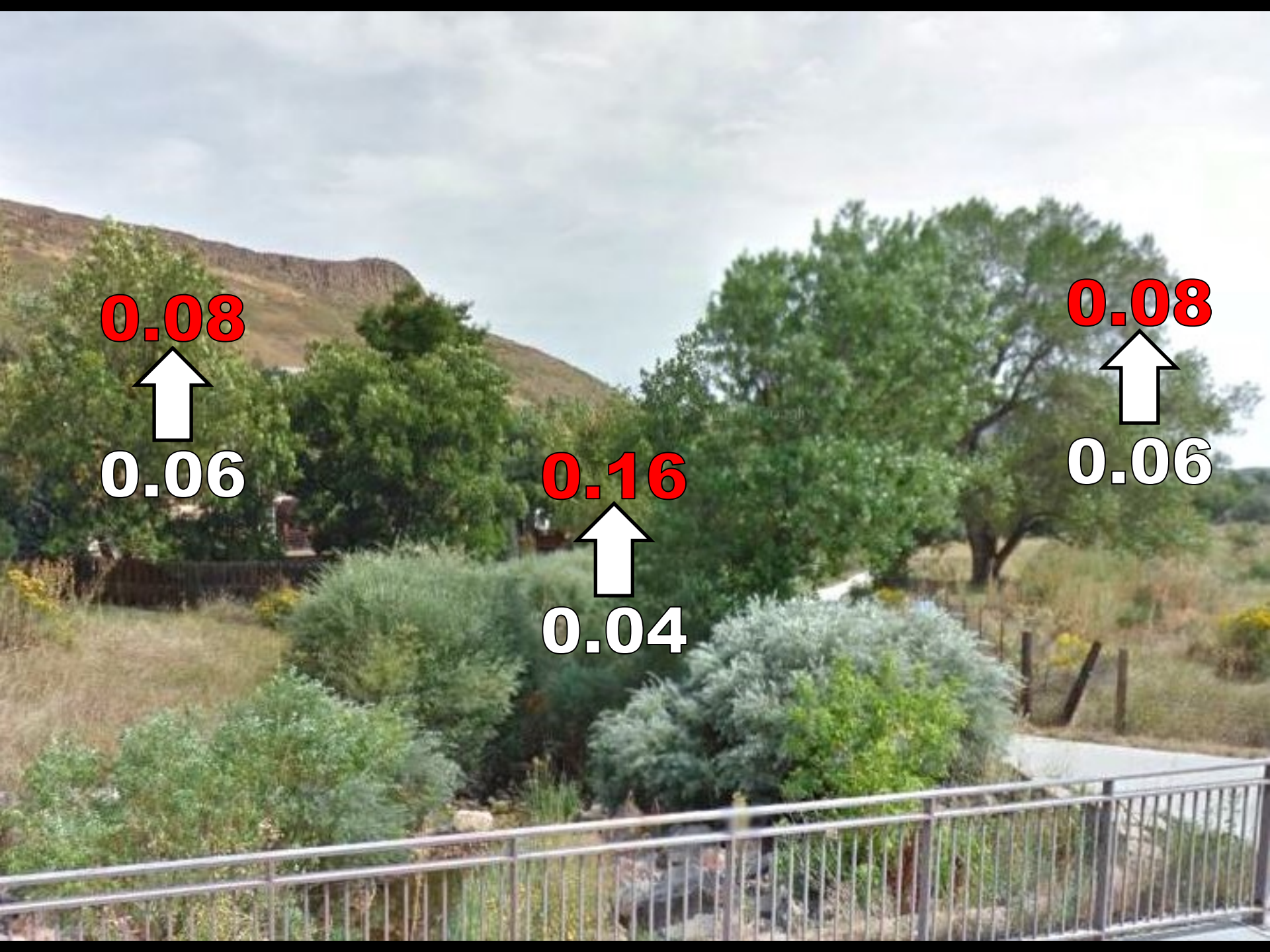


0.04

0.08



0.06



Reach CC10 US of County Line Rd





0.04

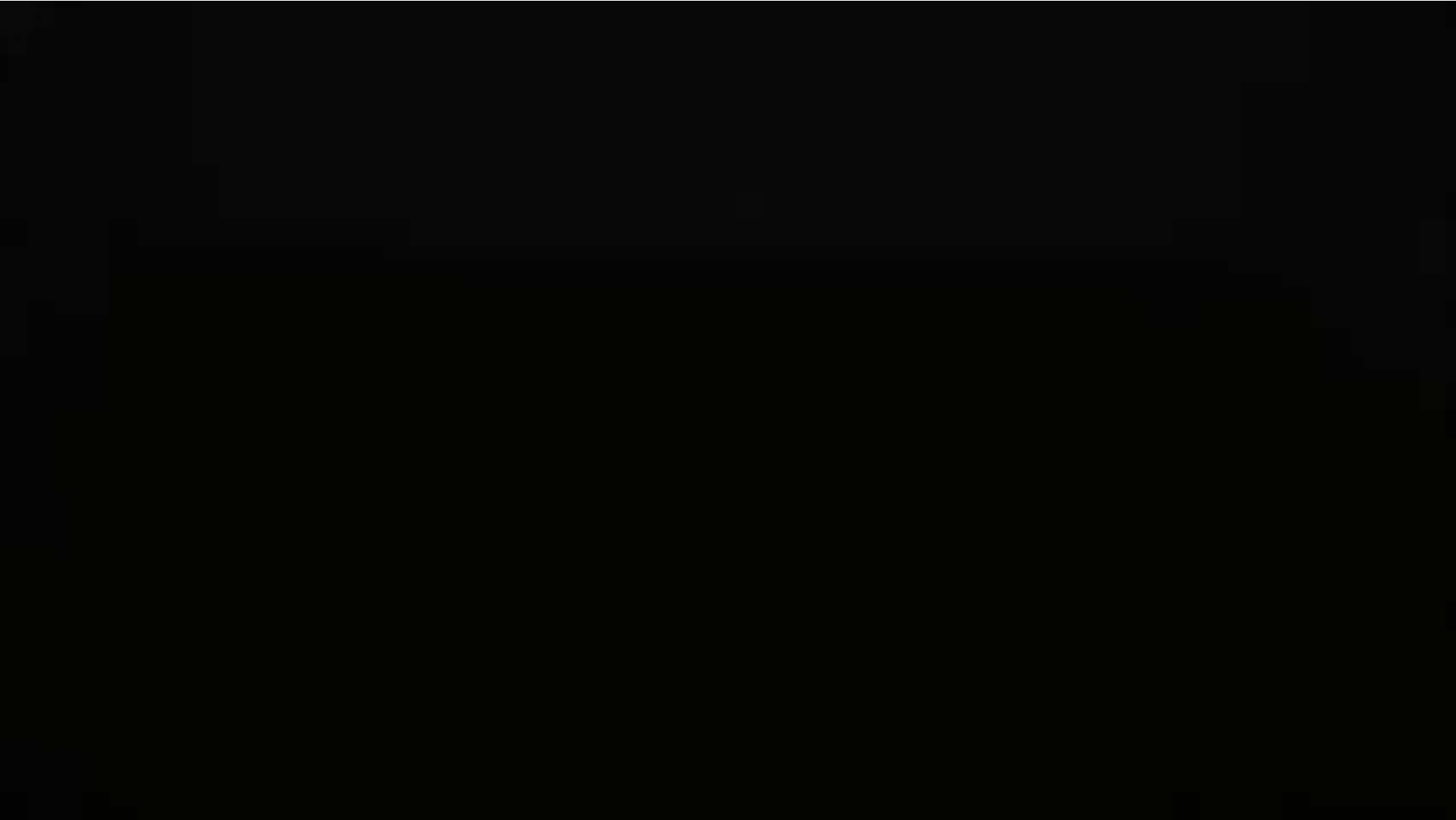


0.04

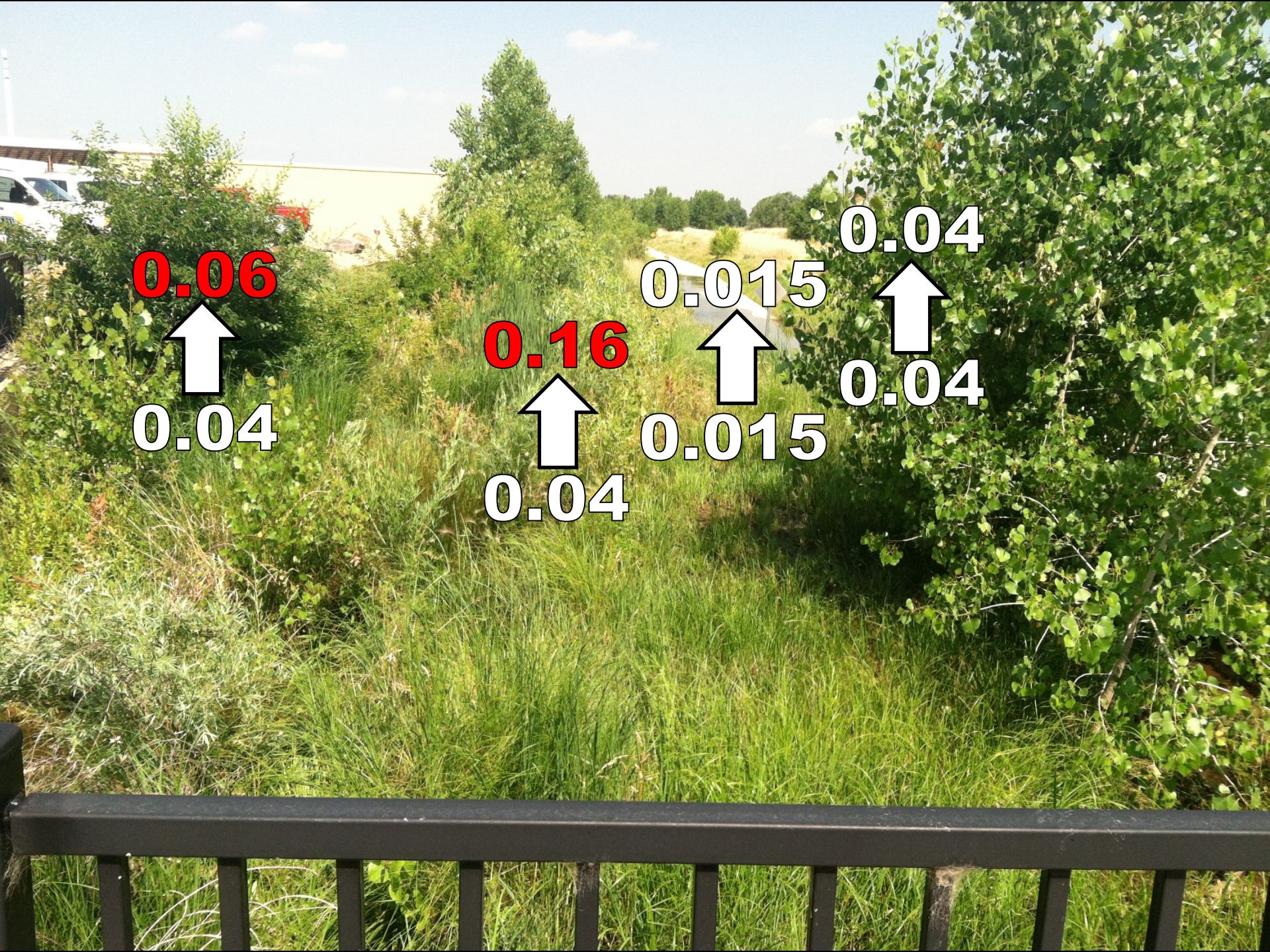
0.015



0.04







0.06



0.04

0.16



0.04

0.015



0.015

0.04



0.04



0.04

0.04

0.015

0.04

Lena Gulch DS of Ulysses St







0.035

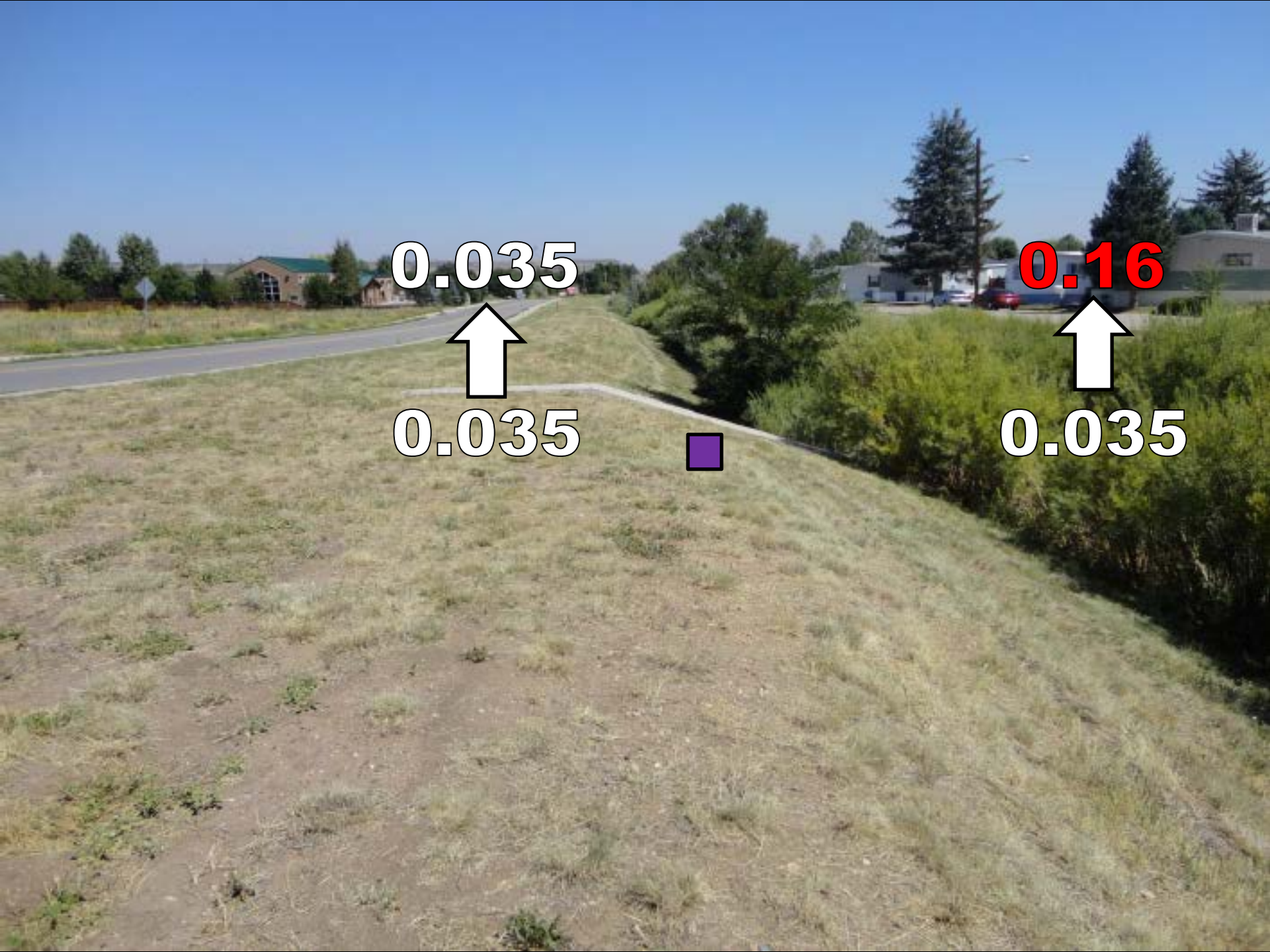


0.035



0.035





0.035



0.035



0.16



0.035



0.16



0.035





0.035



0.035



0.035



Elmer's Twomile US of Valmont



Elmer's Twomile
Canyon Creek



Valmont Rd

36

28th St

© 2016 Google

Google earth

0.047



0.039



0.16



0.042

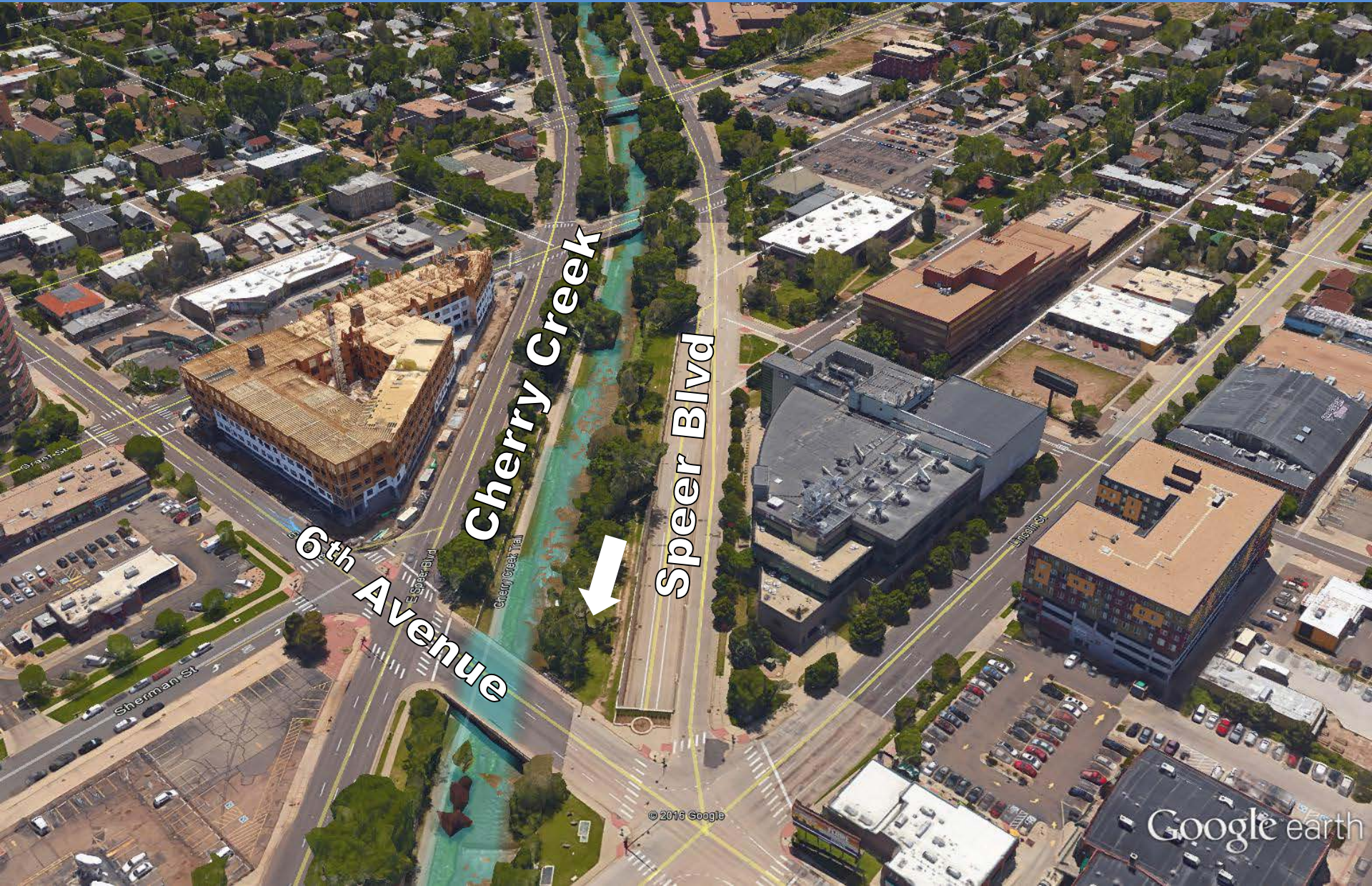
0.035



0.035



Cherry Creek US of 6th Ave



0.07



0.04



0.05



0.024

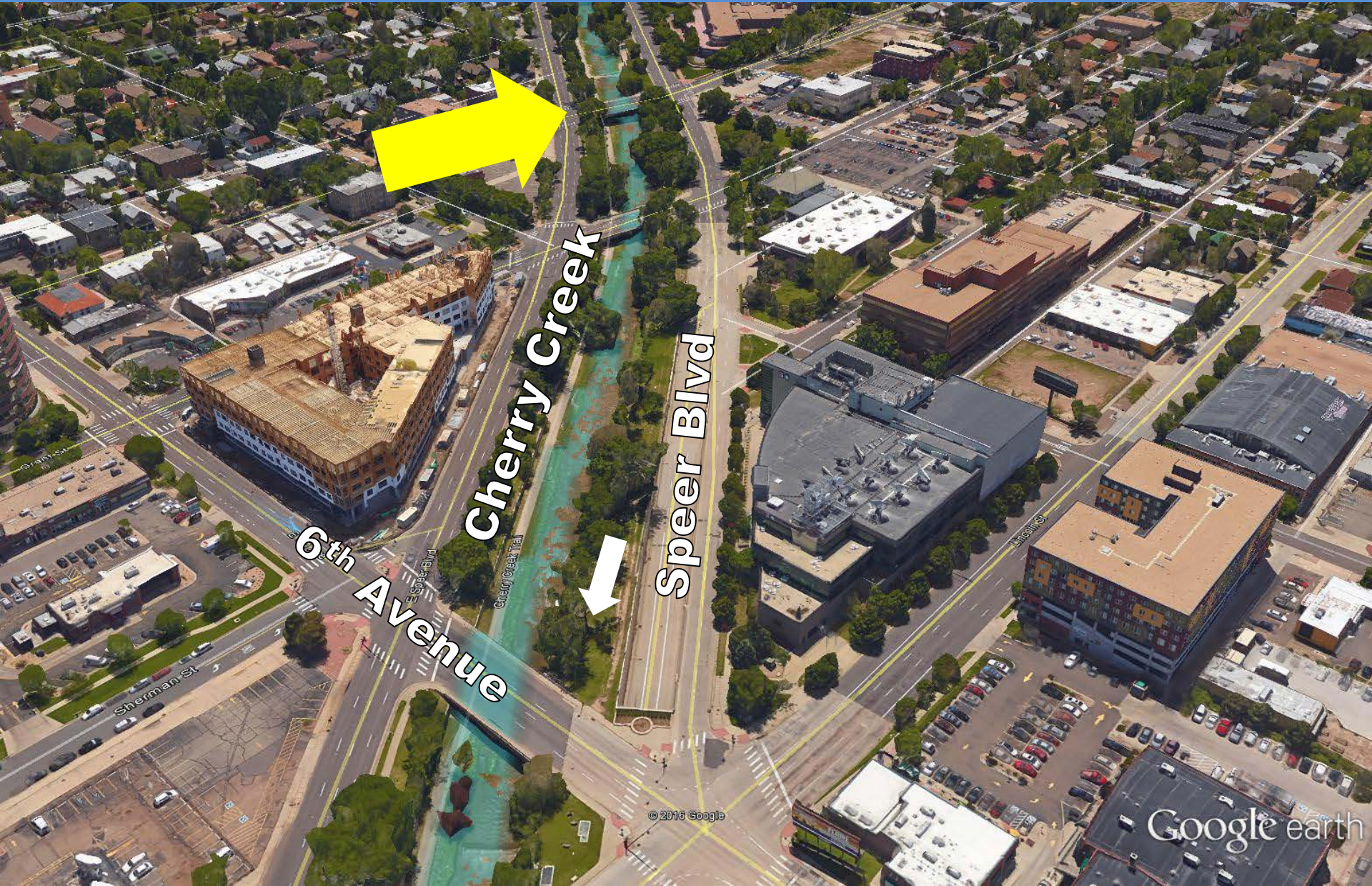
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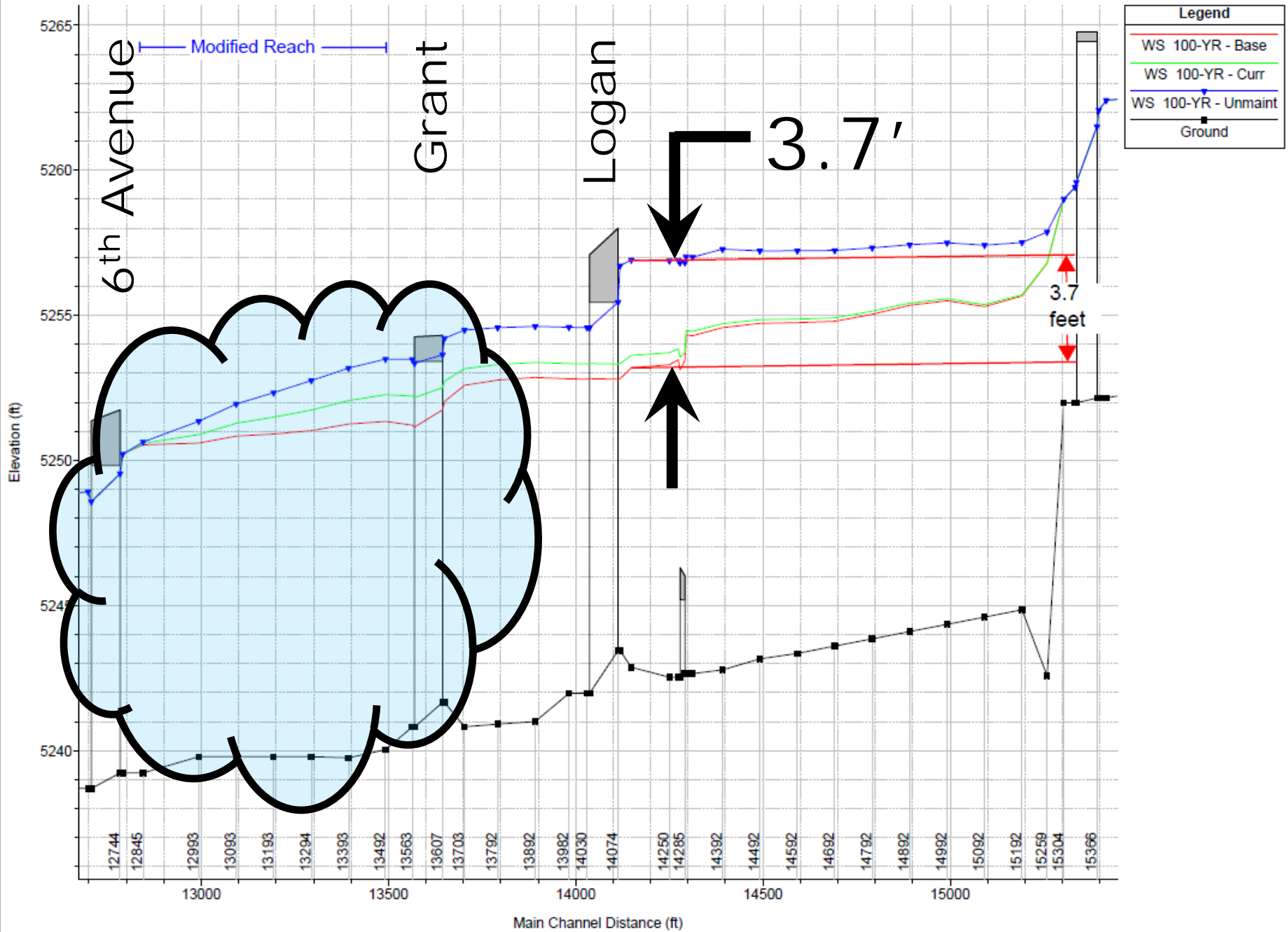


0.04



Cherry Creek US of 6th Ave





Wonderland Creek DS of Kalmia



Highway 36

Kalmia Avenue

Diagonal Highway

Wonderland Creek

119

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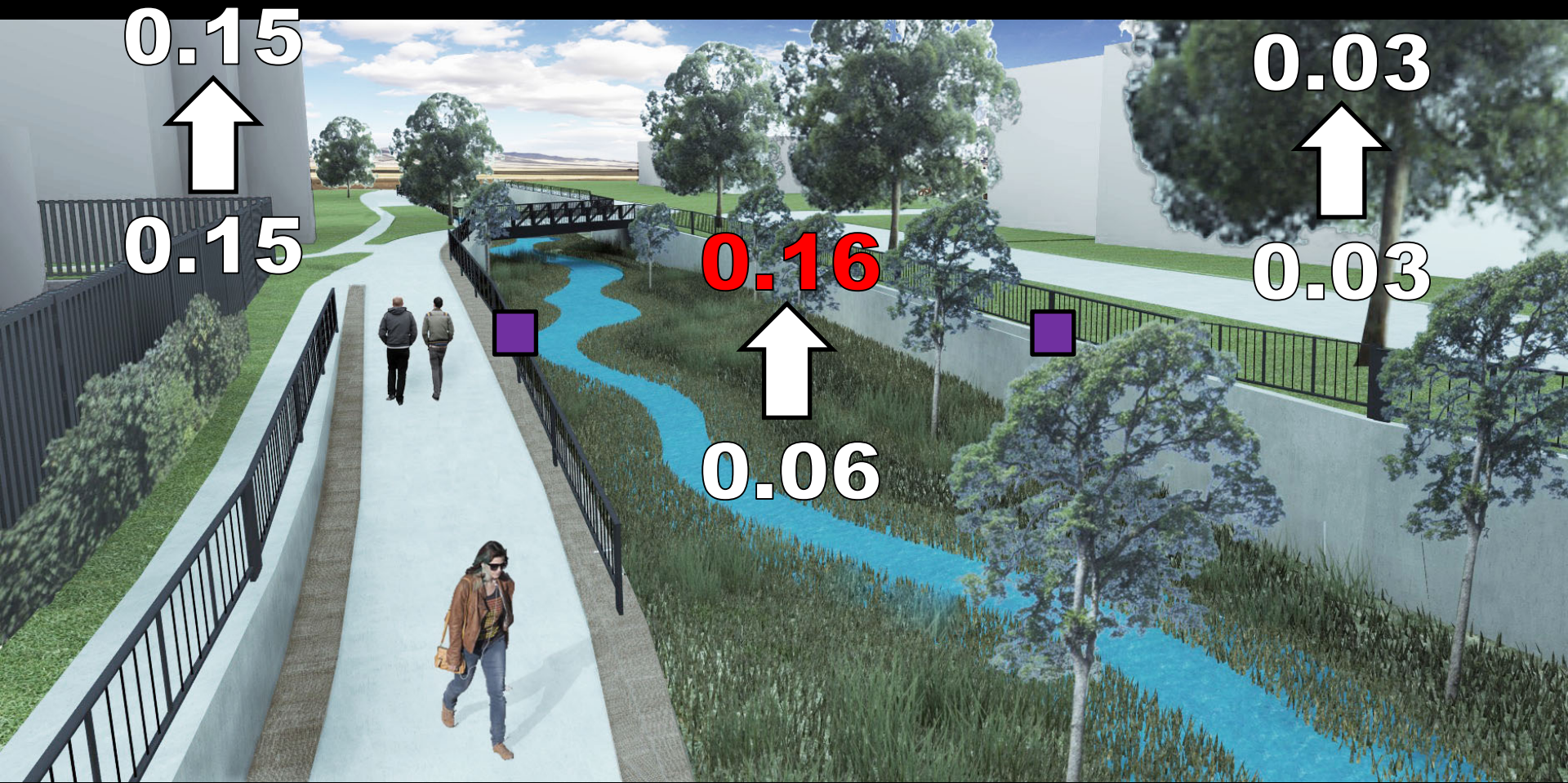
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Goog

ROAD
CLOSED

Wonderland
Creek
Greenway
Trail





0.15



0.15

0.16



0.06

0.03



0.03

Mark Hunter

CRITERIA FOR SELECTIVE CLEARING CHERRY CREEK

Urban Drainage and Flood Control District
Maintenance Program

October 1982

PROJECT CONSULTANTS

Engineering/Planning/Management

Cherry Creek US of University Blvd



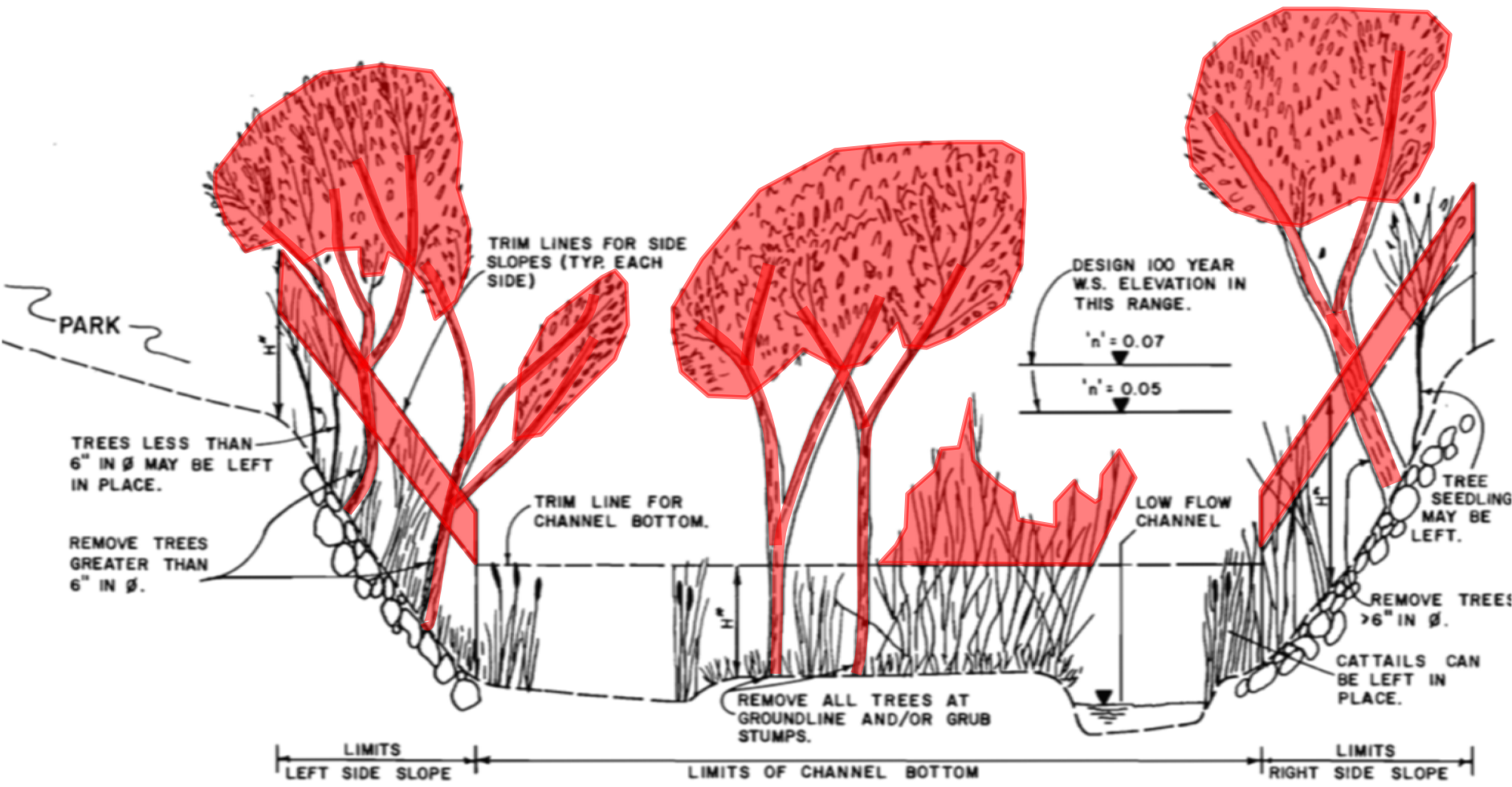
Cherry Creek

University Blvd

Cherry Creek Trail

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Google earth



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DIAGRAM OF CHERRY CREEK CLEARING

Scale: (H) 1" = 20' ; (V) 1" = 5'

0.07



0.035



0.07



Cherry Creek Trail

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Google earth

0.10



0.07



0.05

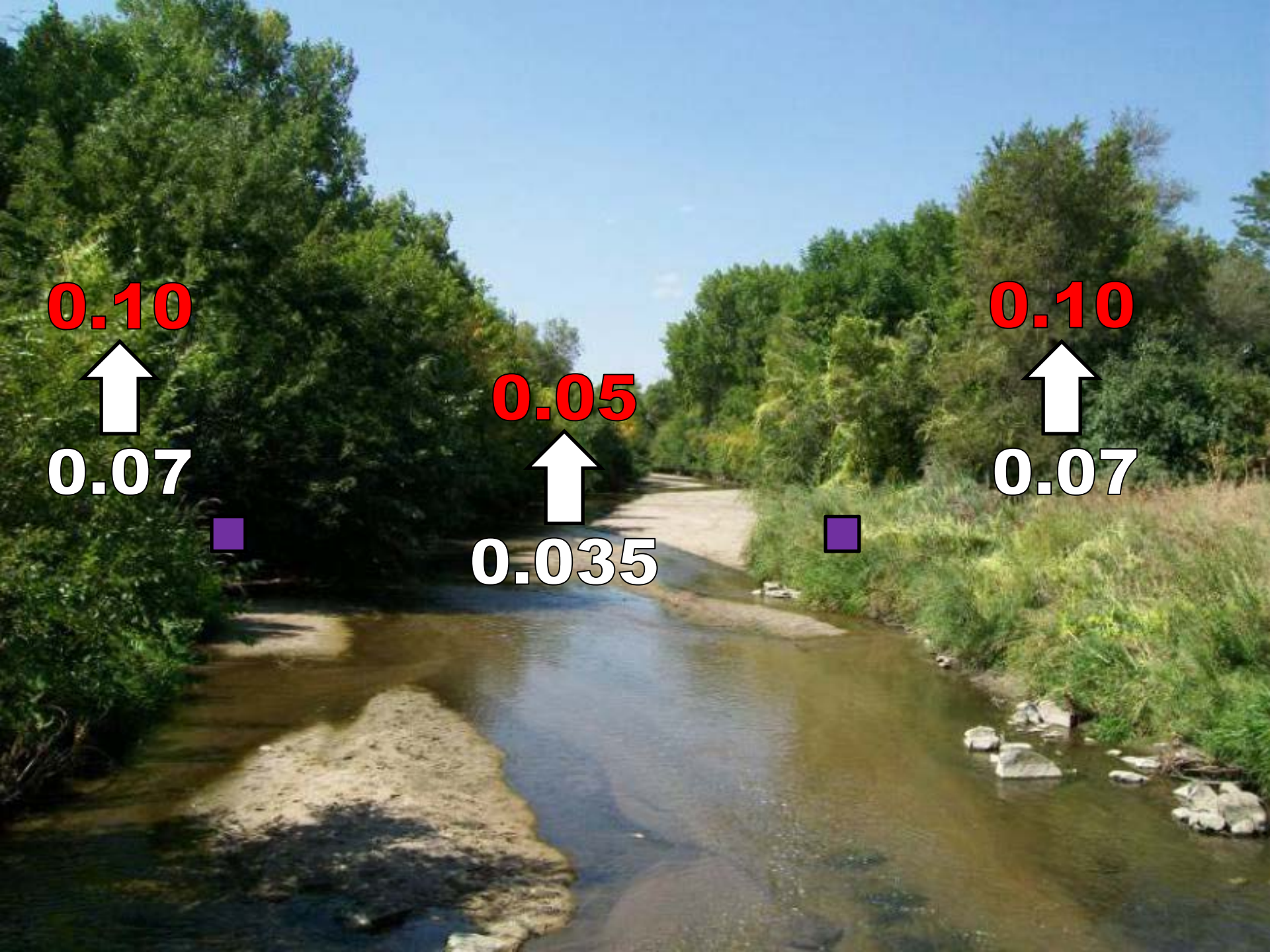


0.035

0.10



0.07



Cherry Creek DS of Broncos Pkwy



Cherry
Creek

Broncos Parkway

0.08



0.06



0.057



0.049

0.05



0.045



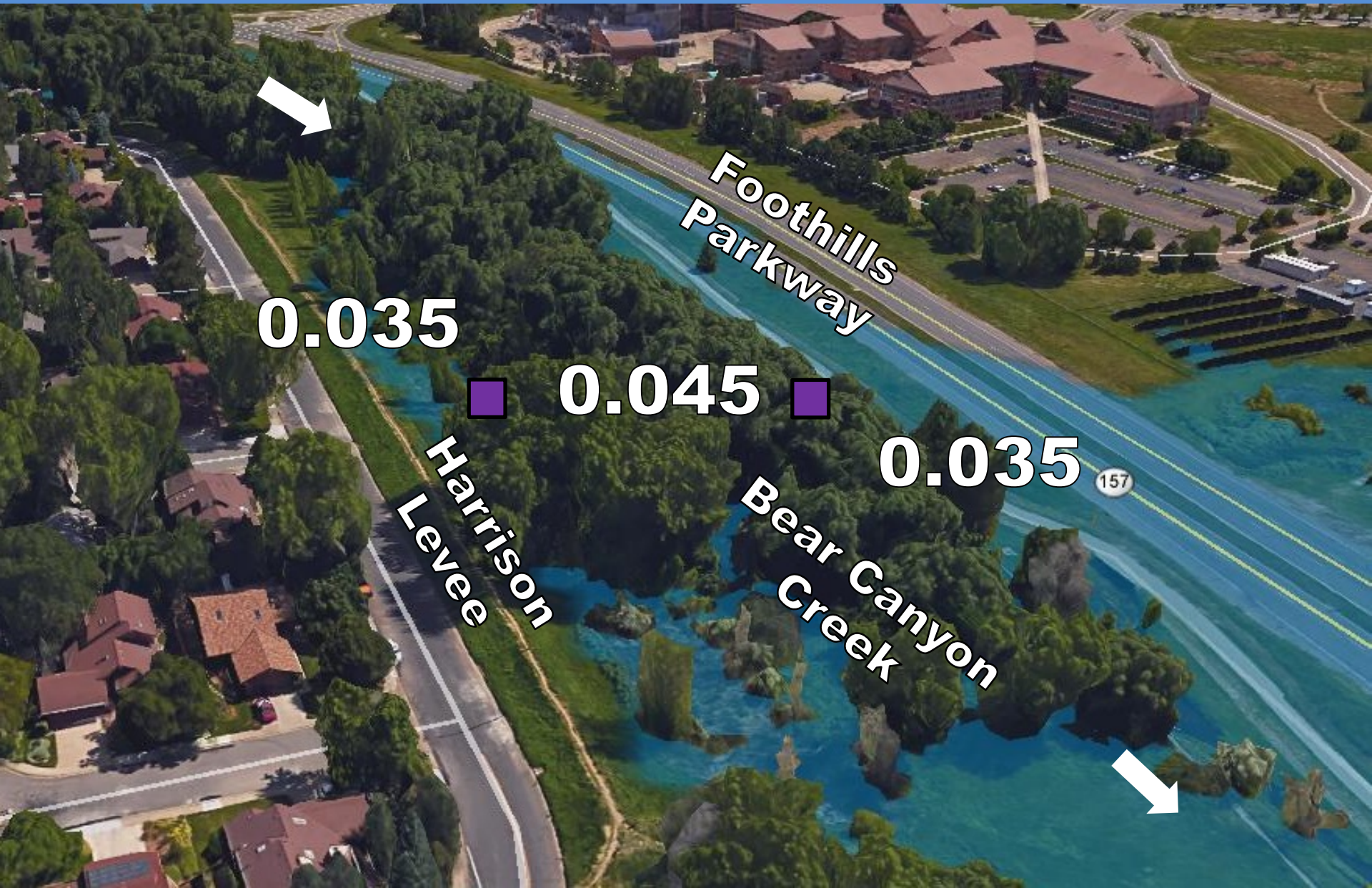
Cherry Creek DS of Broncos Pkwy



Cherry
Creek

Broncos Parkway

Bear Canyon Ck DS of Foothills



0.035

0.045

0.035

Foothills
Parkway

Harrison
Levee

Bear Canyon
Creek

157





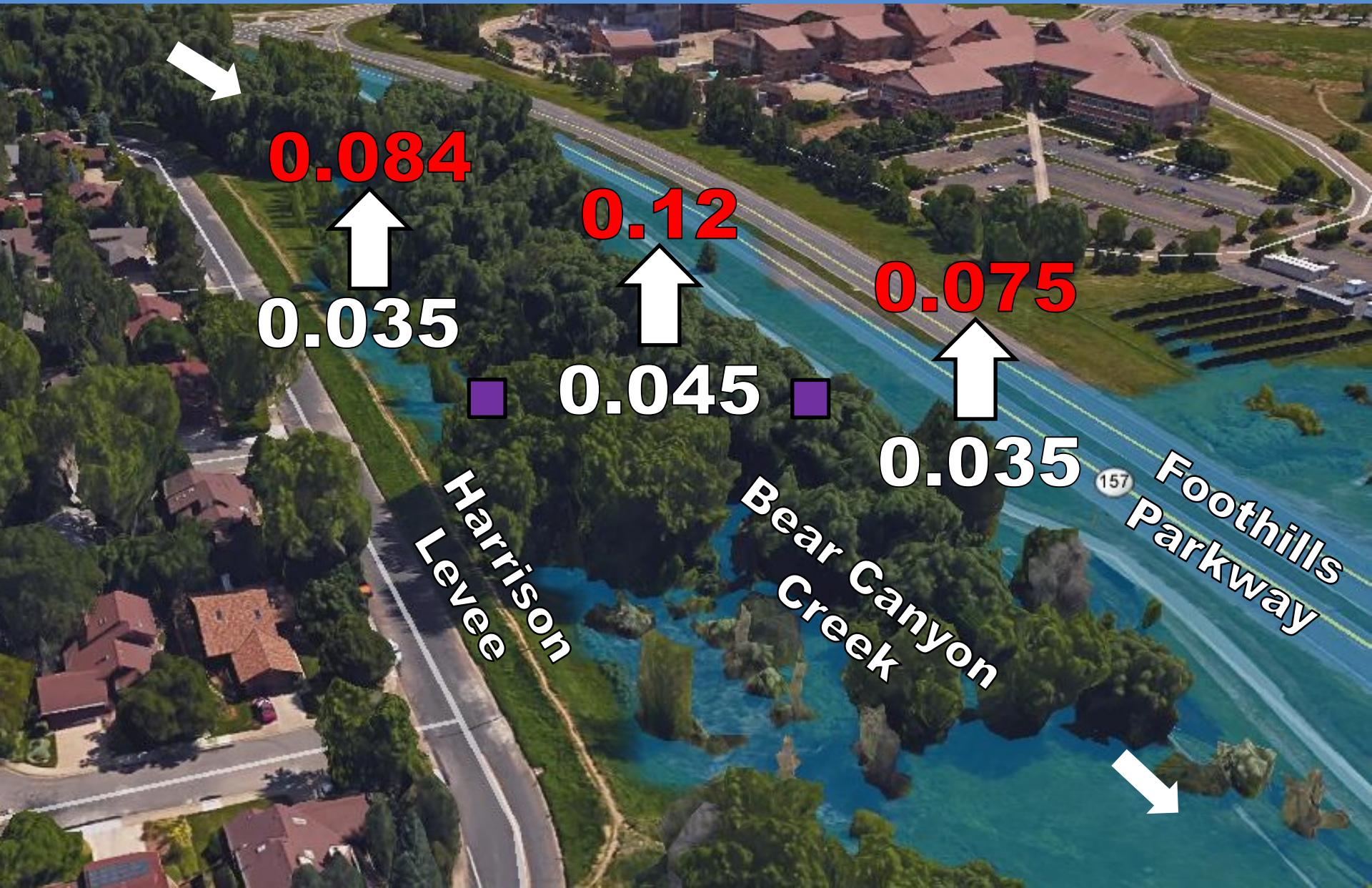


0.12



0.045

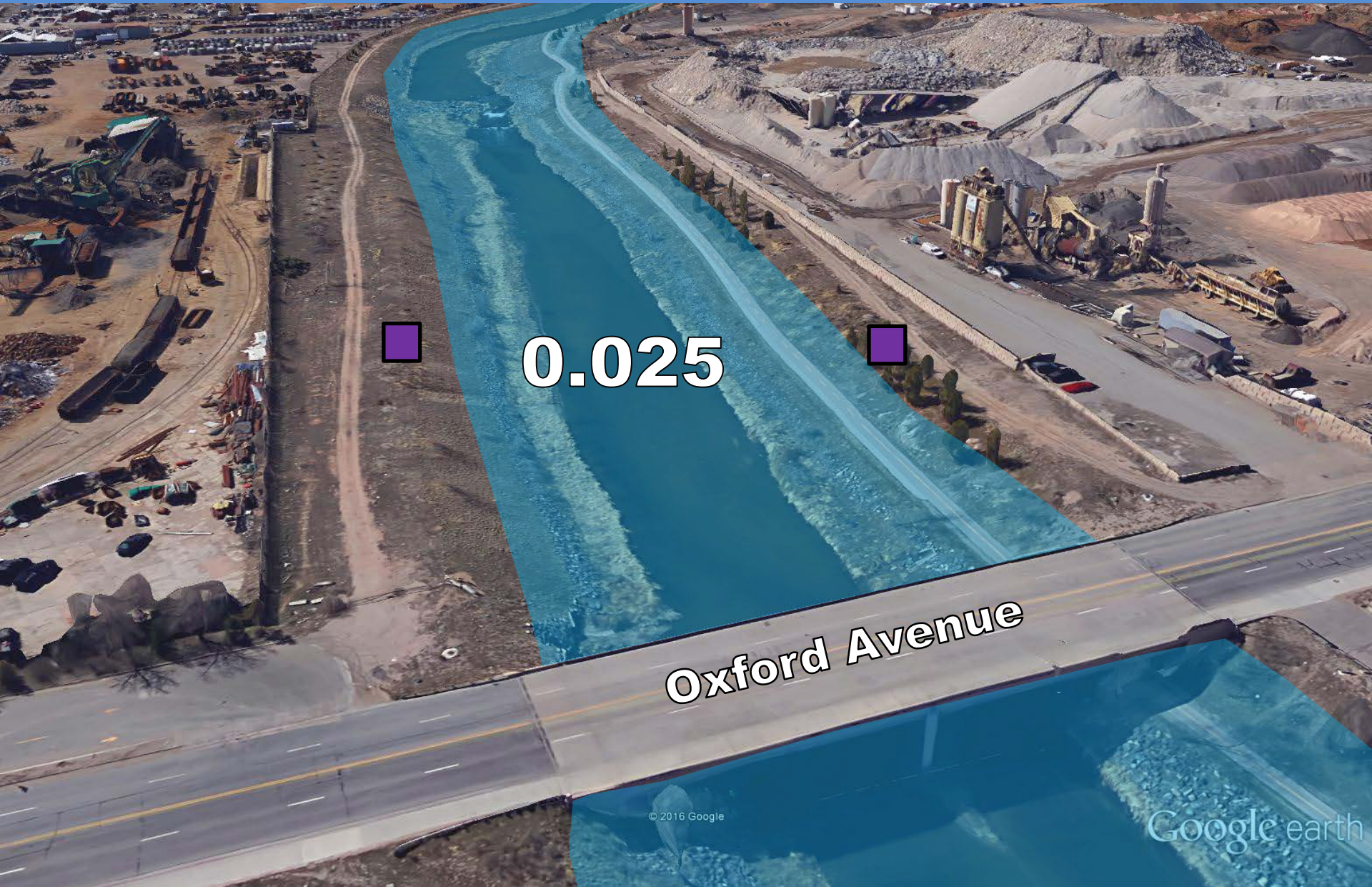
Bear Canyon Ck DS of Foothills







South Platte River Corps Channel



0.025



Oxford Avenue



0.025

6/3/2009

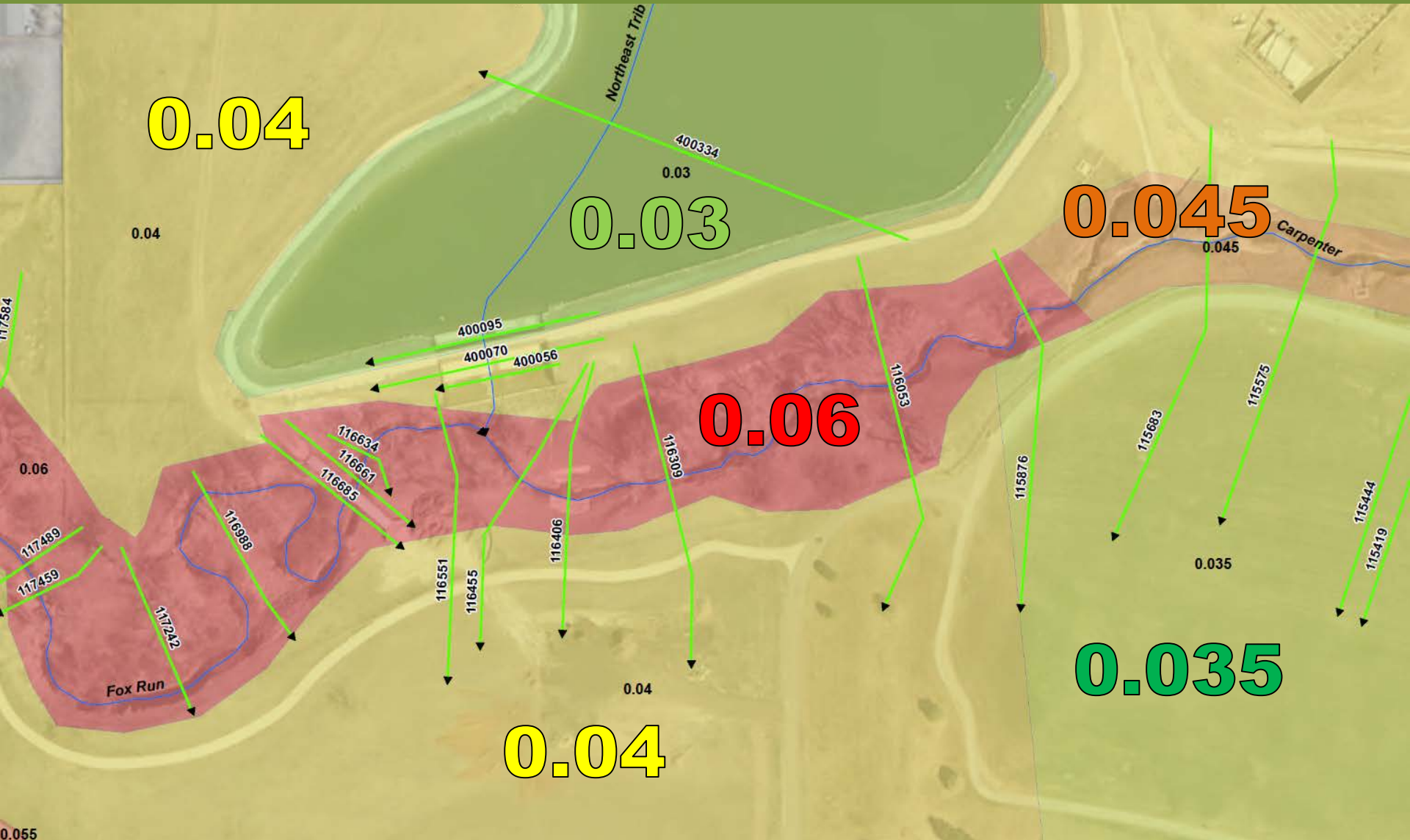
Documenting “n” Values



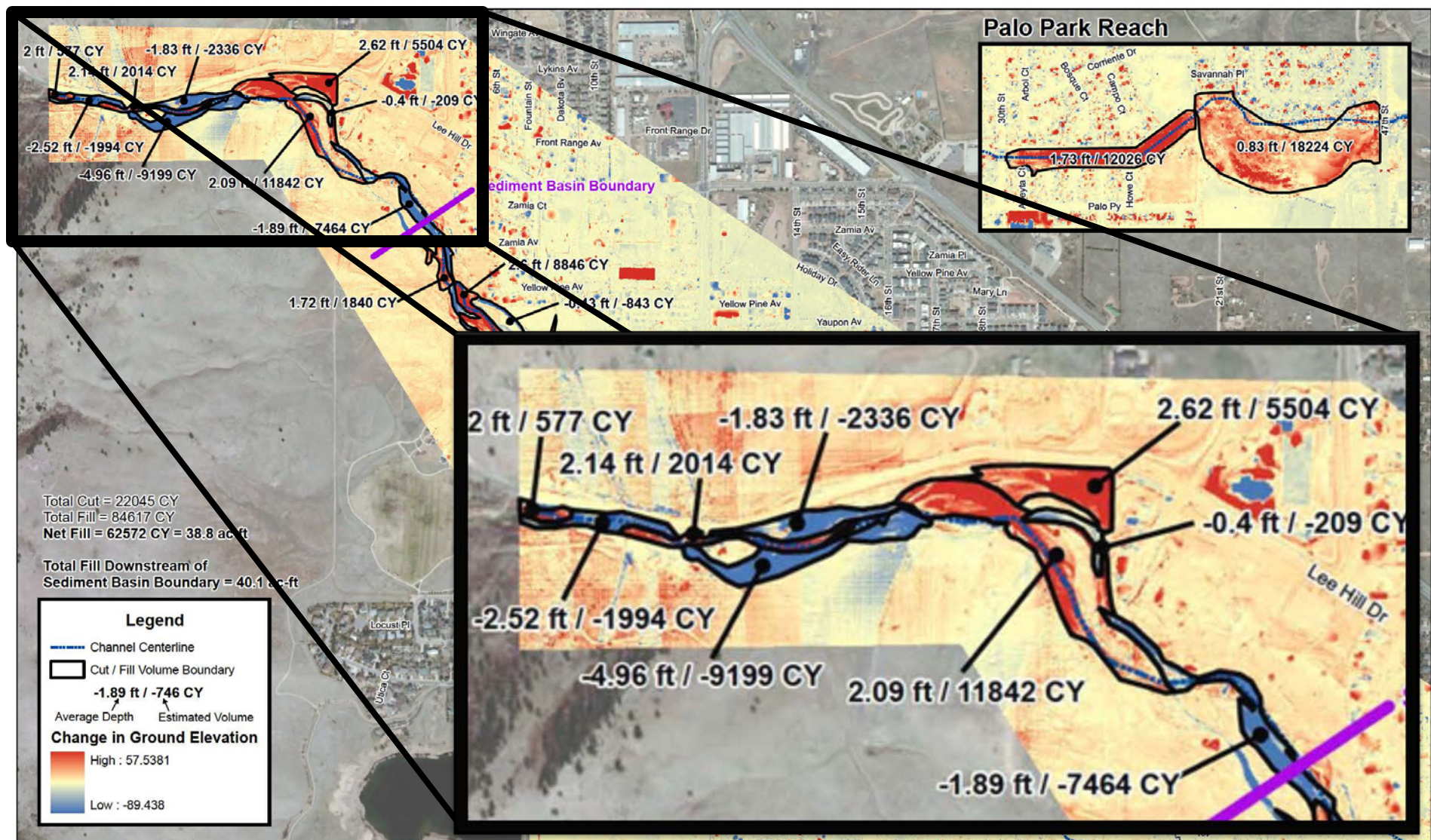
Documenting “n” Values



Documenting "n" Values



Documenting Sediment Deposition



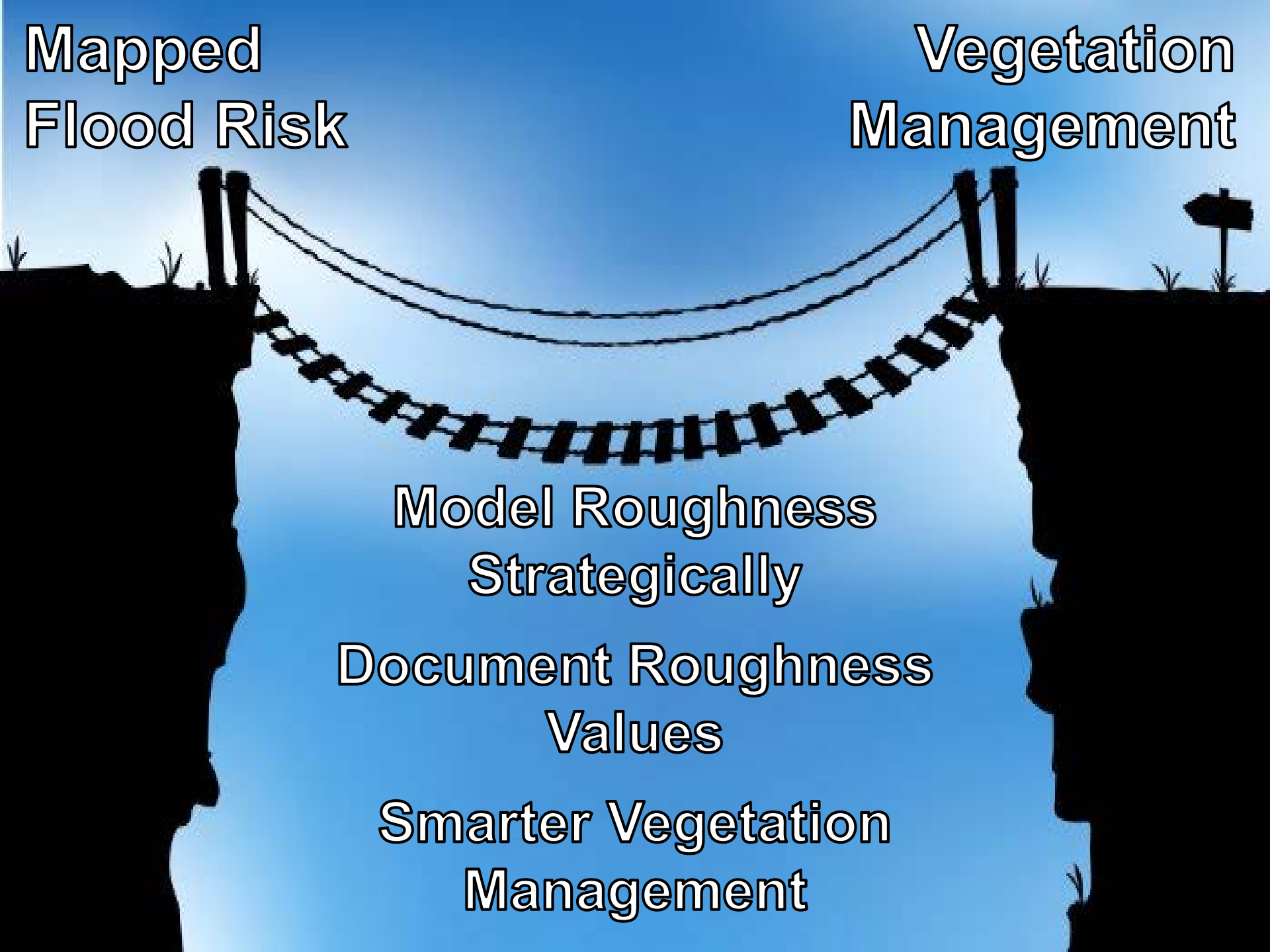
**Mapped
Flood Risk**

**Vegetation
Management**



**Mapped
Flood Risk**

**Vegetation
Management**

A silhouette of a suspension bridge spanning a chasm, with text centered below it.

**Model Roughness
Strategically**

**Document Roughness
Values**

**Smarter Vegetation
Management**

**When you Say “Rough”, We
Want to Know “How Rough?”**

**Connecting Vegetation
Management to the Mapped
Flood Risk**

David Skuodas, PE, Project Manager













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ENGINEER SAYS: "NO COMMENT"



Lorem Ipsum In libris
graecis appetere mea. At
vim odio lorem omnes, pri id
iuvaret partiendo. Vivendo
menandri et sed. Lorem
volumus blandit cu has. Sit
cu alia porro fuisset.

Ea pro natum invidunt
repudiandae, his et facilis
vituperatoribus. Mei eu
ubique altera senserit,
consul eripuit accusata has
ne.

In libris graecis appetere
mea. At vim odio lorem
omnes, pri id iuvaret
partiendo. Vivendo menandri
et sed.

In libris graecis appetere
mea. At vim odio lorem
omnes, pri id iuvaret
partiendo. Vivendo menandri
et sed. Lorem volumus
blandit cu has. Sit cu alia
porro fuisset.

Ea pro natum invidunt
repudiandae, his et facilis
vituperatoribus. Mei eu
ubique altera senserit,
consul eripuit accusata has
ne.

Ea pro natum invidunt
repudiandae, his et facilis
vituperatoribus.



A man in a black jacket and tan pants is climbing a concrete structure, possibly a baffle chute, with large yellow text overlaid. The text reads:

***DON'T GET THROWN
IN A
BAFFLE CHUTE DROP***