Connecting The Mapped Risk to The Actual Risk to What's at Risk

David Skuodas, PE, Project Manager

Urban Drainage & Flood Control District

Denver, Colorado

2017 ASFPM National Conference

May 3rd, 2017

EXPO 2017
10th
CENTRE: AG HALL
KANSAS

An

URBAN DRAINAGE & FLOOD CONTROL DISTRICT

Production

About a year ago in a State not too far away….

STORMWATER WARS

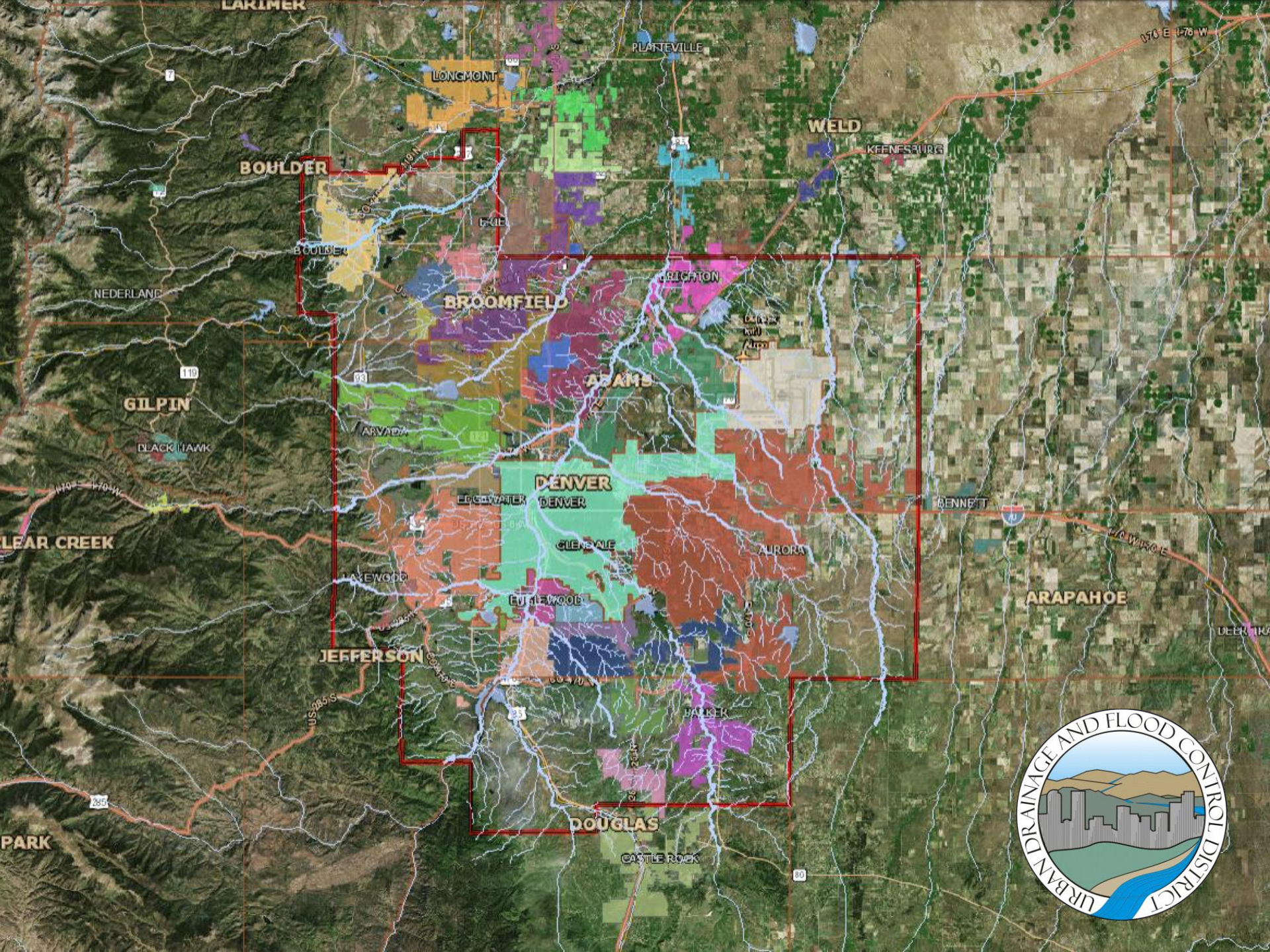
Episode IV

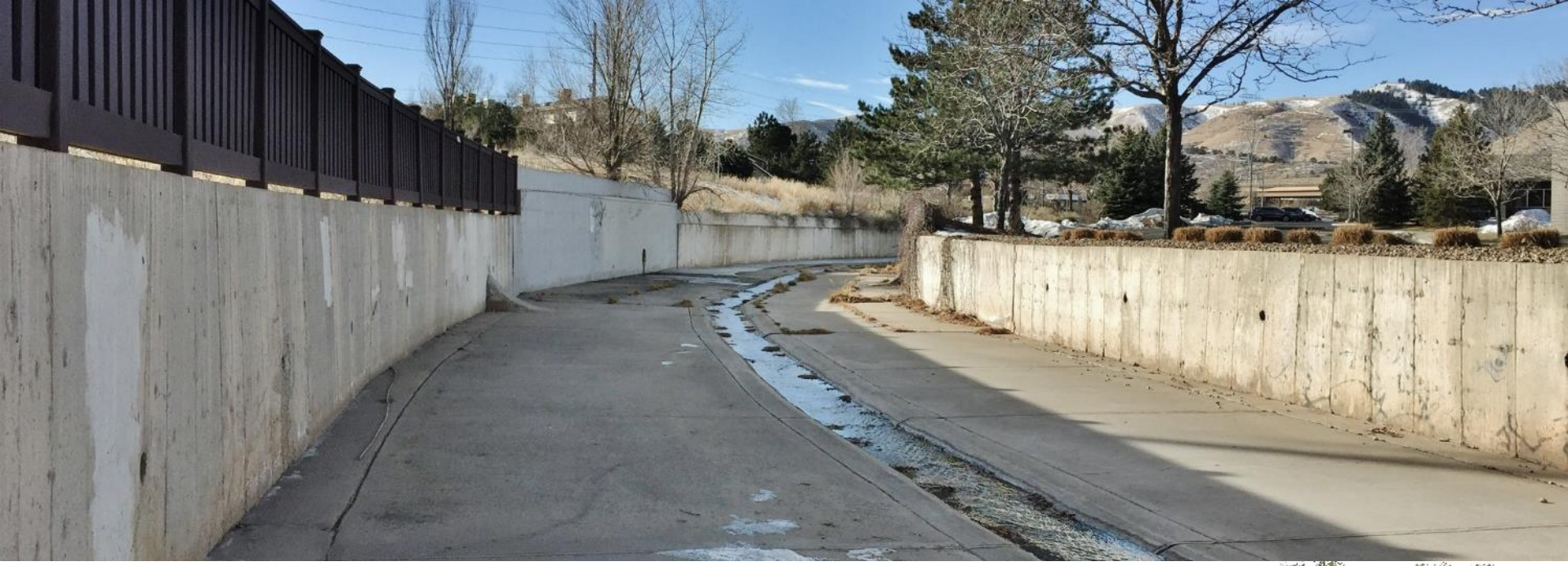
A NEW HOPE

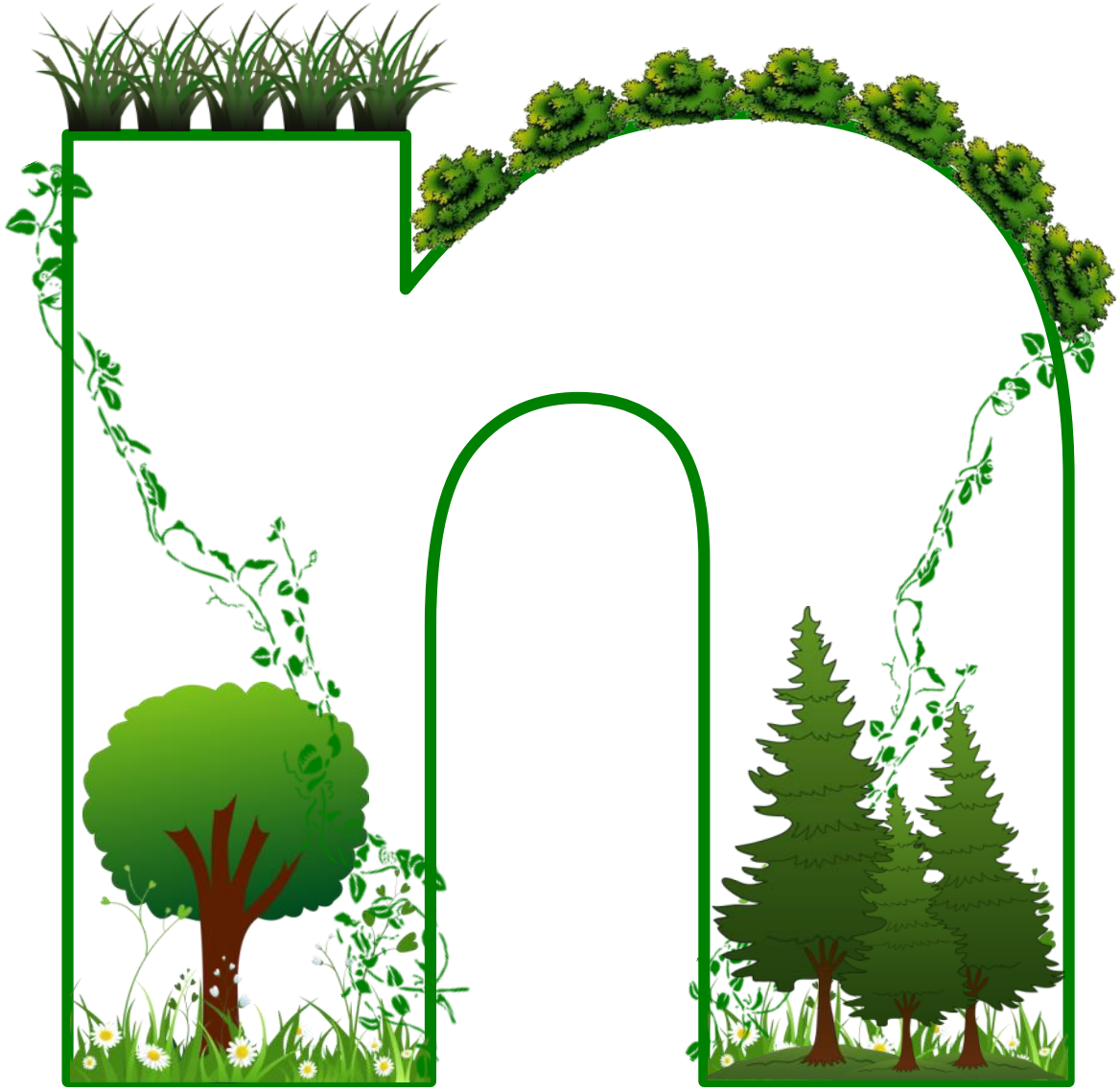
It is a period of climate extremes. Major weather systems, striking without warning, have struck fear in the hearts of citizens across the galaxy.

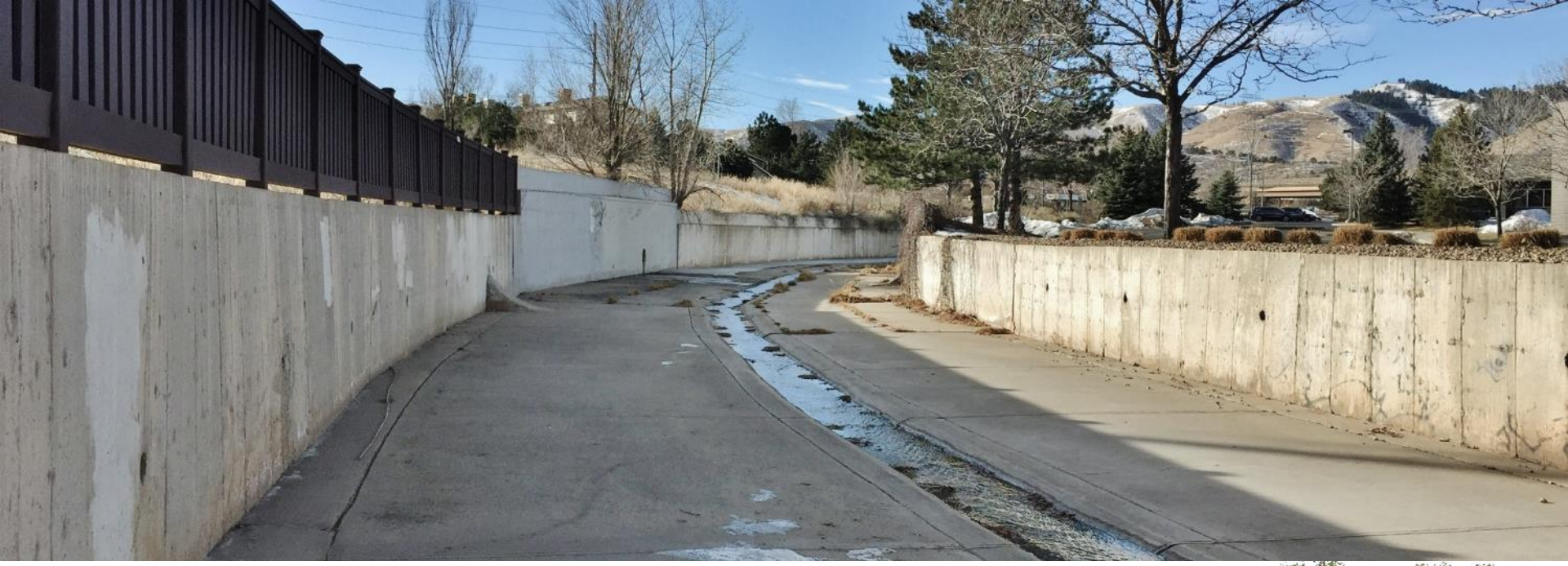
Floodplain managers, in a vain attempt to tame the very forces of nature, are secretly devising a strategy to manage flood risk where it's needed most and where it will matter most.

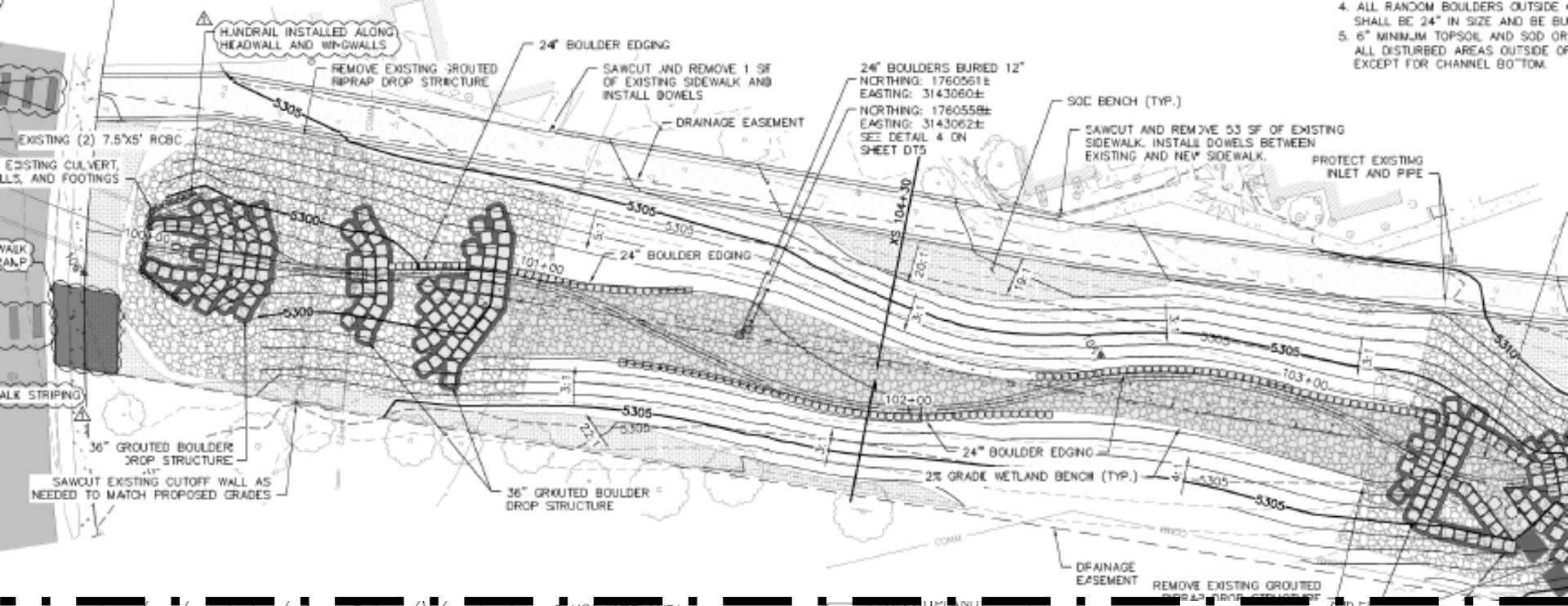
Pursued by the Empire's sinister agents, an engineer from the Urban Drainage and Flood Control District in Denver has been dispatched to the ASFPM Conference to share their secret strategy…

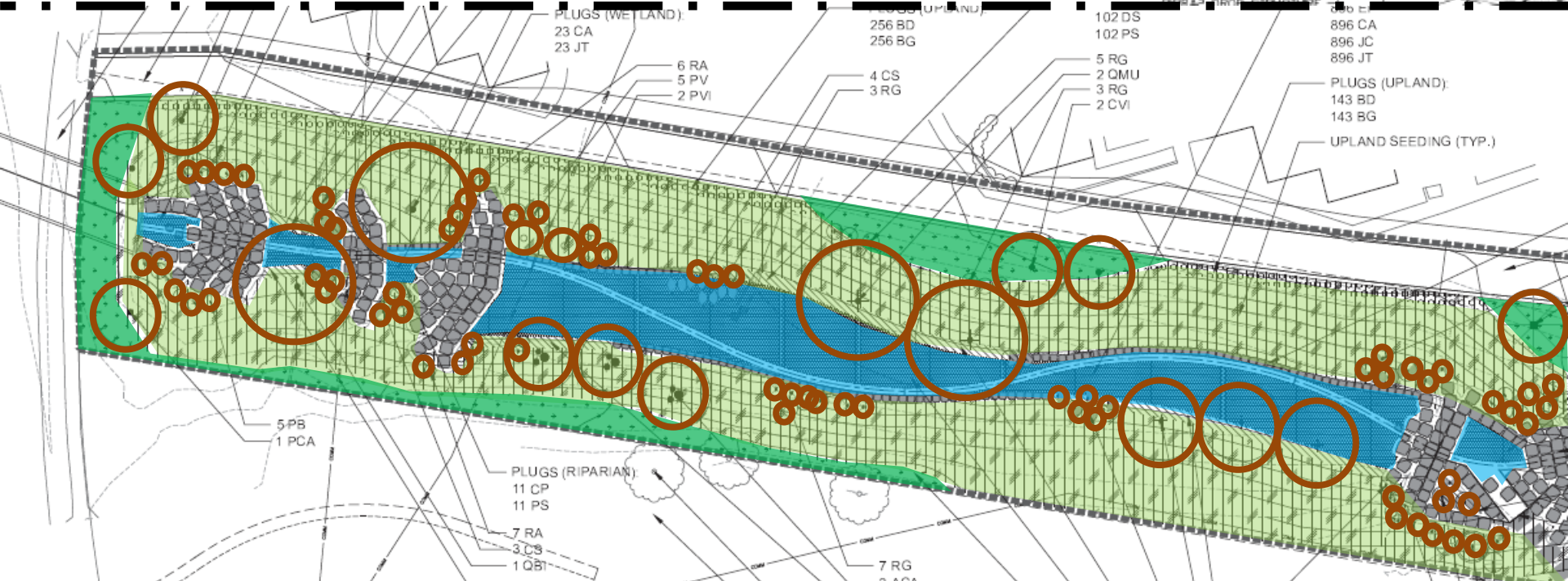

LARIMER
LONGMONT
PLATTEVILLE
WELD
KEENESBURG
BOULDER
BOULDER
NEDERLAND
BROOMFIELD
BRIGHTON
ADAMS
GILPIN
ARVADA
BLACK HAWK
DENVER
EDGEWATER
DENVER
BENNETT
CLEAR CREEK
GLENDALE
AURORA
LAKEWOOD
ENGLEWOOD
ARAPAHOE
JEFFERSON
PARKER
DOUGLAS
CASTLE ROCK
PARK
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT








HANDRAIL INSTALLED ALONG HEADWALL AND WINGWALLS
REMOVE EXISTING GROUTED RIPRAP DROP STRUCTURE
24" BOULDER EDGING
SAWCUT AND REMOVE 1 SF OF EXISTING SIDEWALK AND INSTALL DOWELS
DRAINAGE EASEMENT
24" BOULDERS BURIED 12"
NORTHING: 1760561±
EASTING: 3143060±
NORTHING: 1760558±
EASTING: 3143062±
SEE DETAIL 4 ON SHEET DT5
SOD BENCH (TYP.)
SAWCUT AND REMOVE 53 SF OF EXISTING SIDEWALK. INSTALL DOWELS BETWEEN EXISTING AND NEW SIDEWALK.
PROTECT EXISTING INLET AND PIPE
EXISTING (2) 7.5'X5' RCBC
EXISTING CULVERT, LLS, AND FOOTINGS
WALK RAMP
ALK STRIPING
36" GROUTED BOULDER DROP STRUCTURE
SAWCUT EXISTING CUTOFF WALL AS NEEDED TO MATCH PROPOSED GRADES
36" GROUTED BOULDER DROP STRUCTURE
24" BOULDER EDGING
2% GRADE WETLAND BENCH (TYP.)
DRAINAGE EASEMENT
REMOVE EXISTING GROUTED
XS 104+30
100+00
101+00
102+00
103+00
5300
5305
5310
4. ALL RANDOM BOULDERS OUTSIDE
SHALL BE 24" IN SIZE AND BE BU
5. 6" MINIMUM TOPSOIL AND SOD OR
ALL DISTURBED AREAS OUTSIDE OF
EXCEPT FOR CHANNEL BOTTOM.

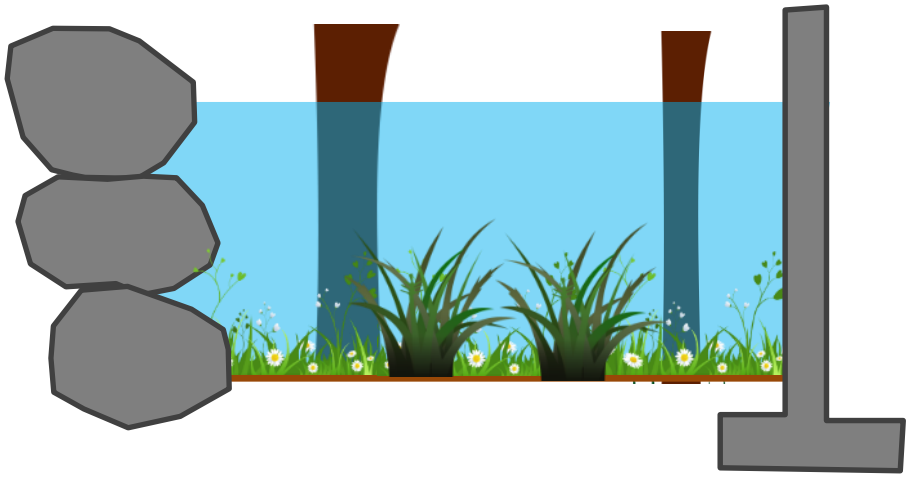

PLUGS (WETLAND):
23 CA
23 JT
6 RA
5 PV
2 PVI
PLUGS (UPLAND):
256 BD
256 BG
4 CS
3 RG
102 DS
102 PS
5 RG
2 QMU
3 RG
2 CVI
896 CA
896 JC
896 JT
PLUGS (UPLAND):
143 BD
143 BG
UPLAND SEEDING (TYP.)
5 PB
1 PCA
PLUGS (RIPARIAN):
11 CP
11 PS
7 RA
3 CS
1 QB1
7 RG

Discrepancies with "n" Values – in the Field and in Designs

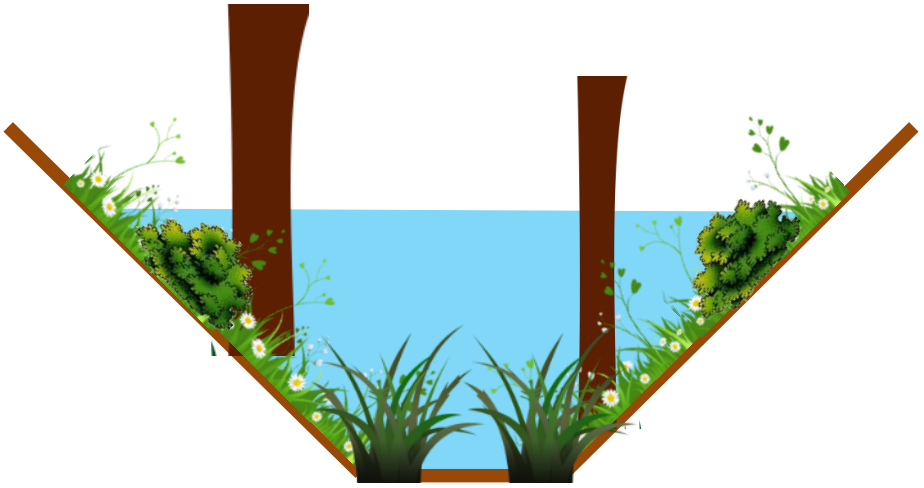
Case Studies of Mapped Risk vs. Actual Risk

GIS Tools to Help Us Prioritize Maintenance $$$

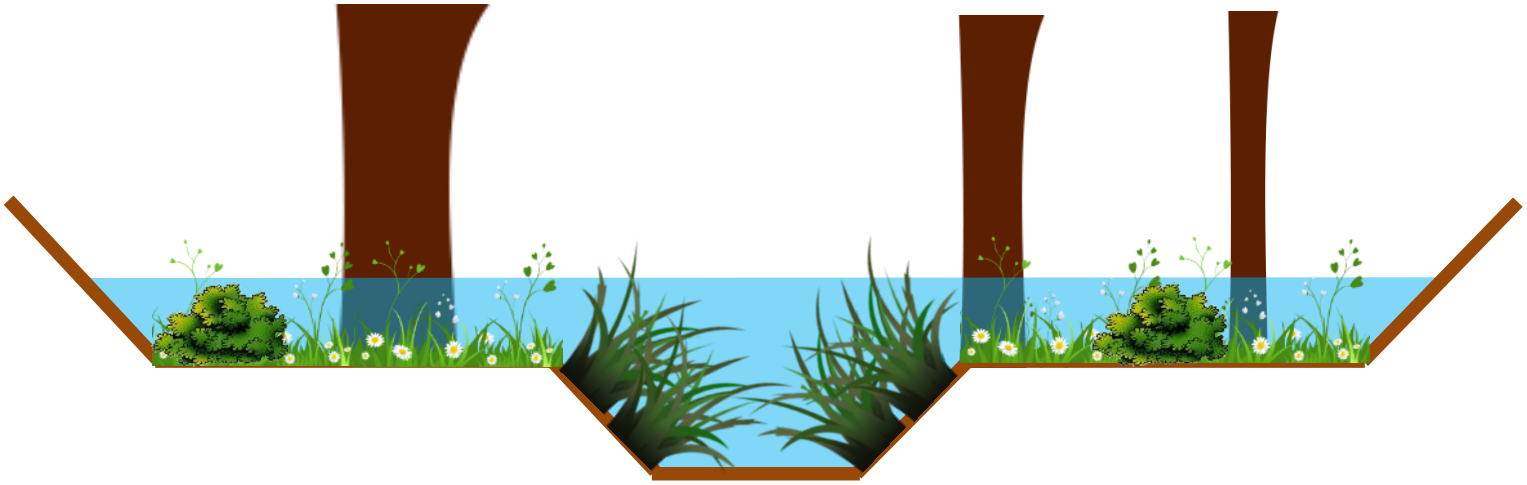
Where to Spend Maintenance $?



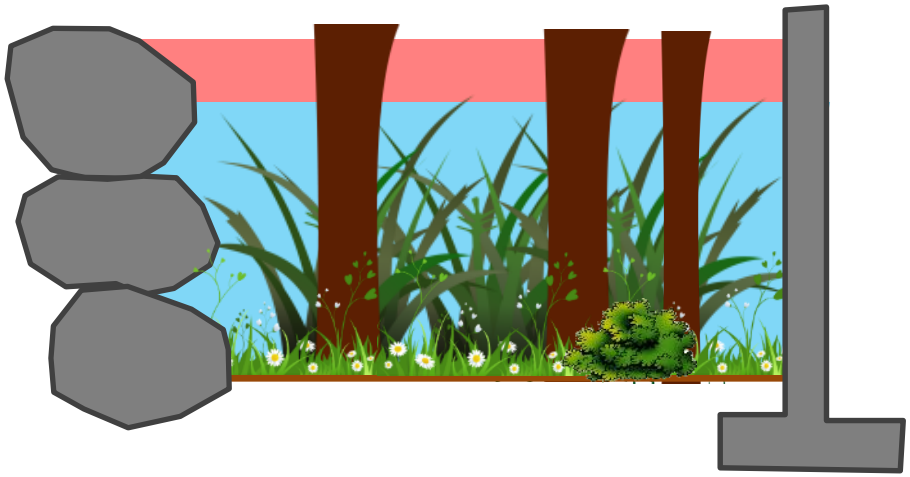
Walled Section



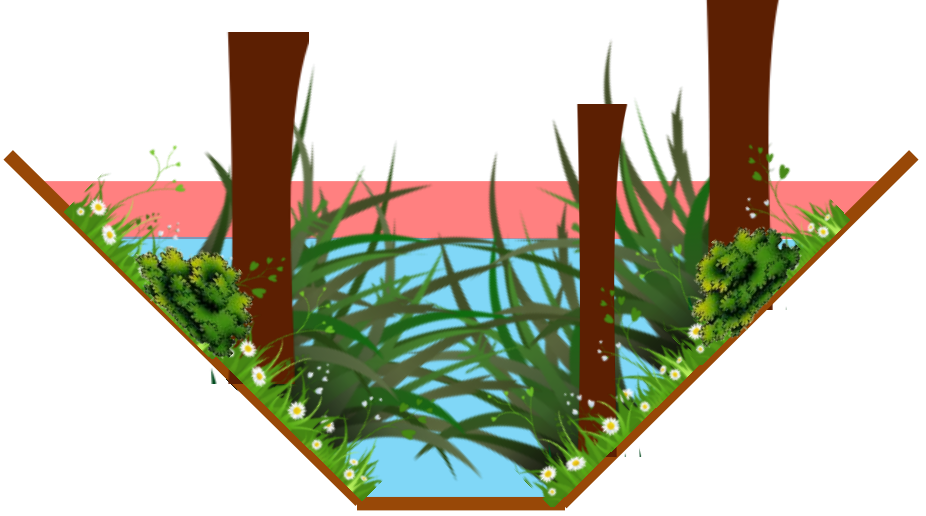
Trapezoidal Section



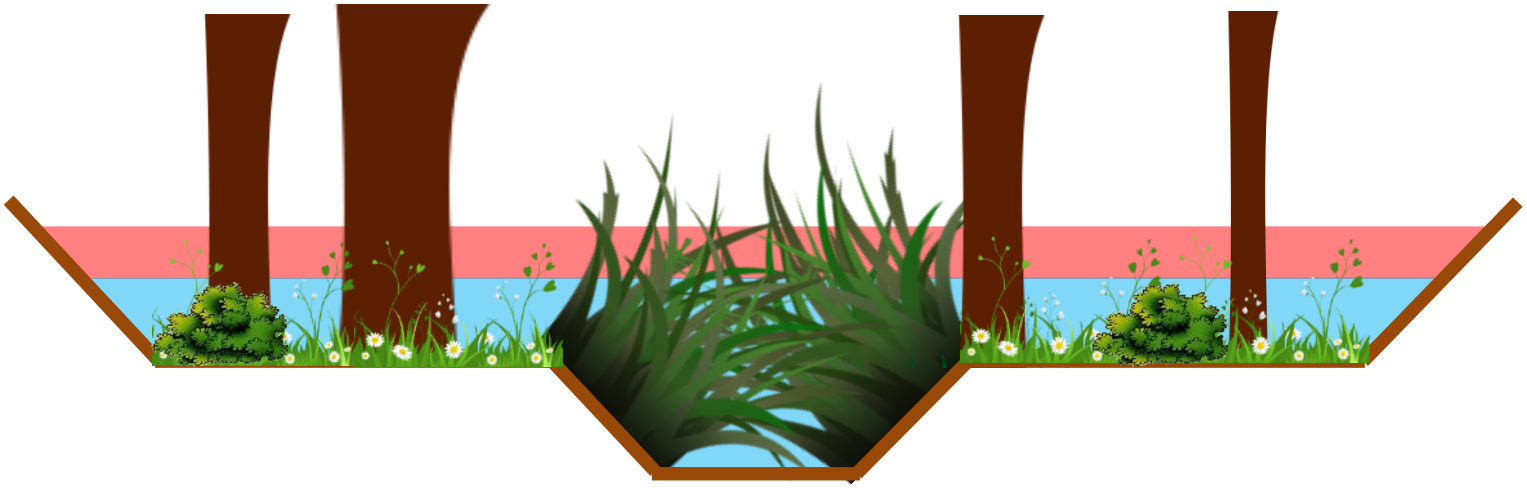
Open Floodplain



Walled Section



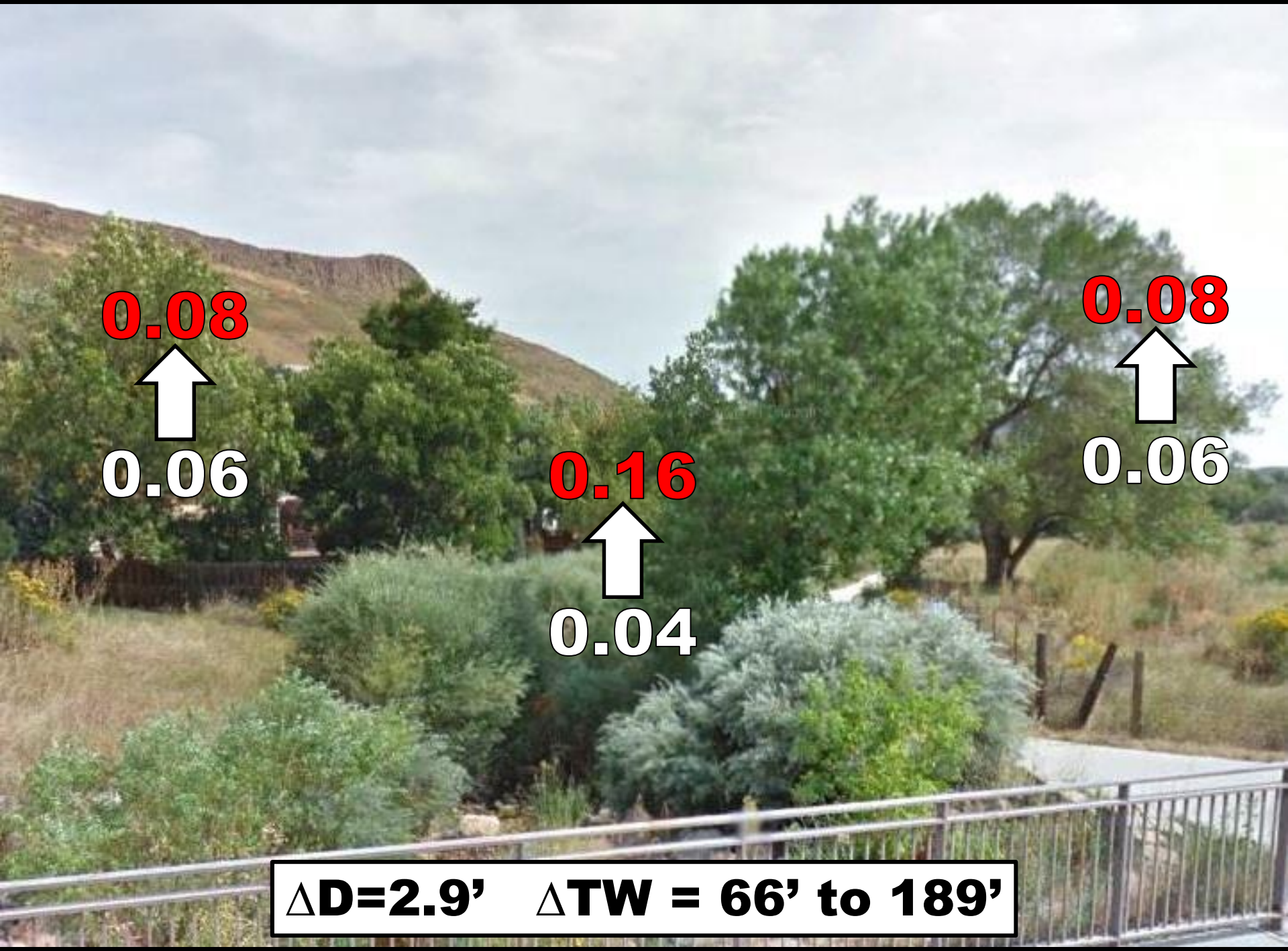
Trapezoidal Section



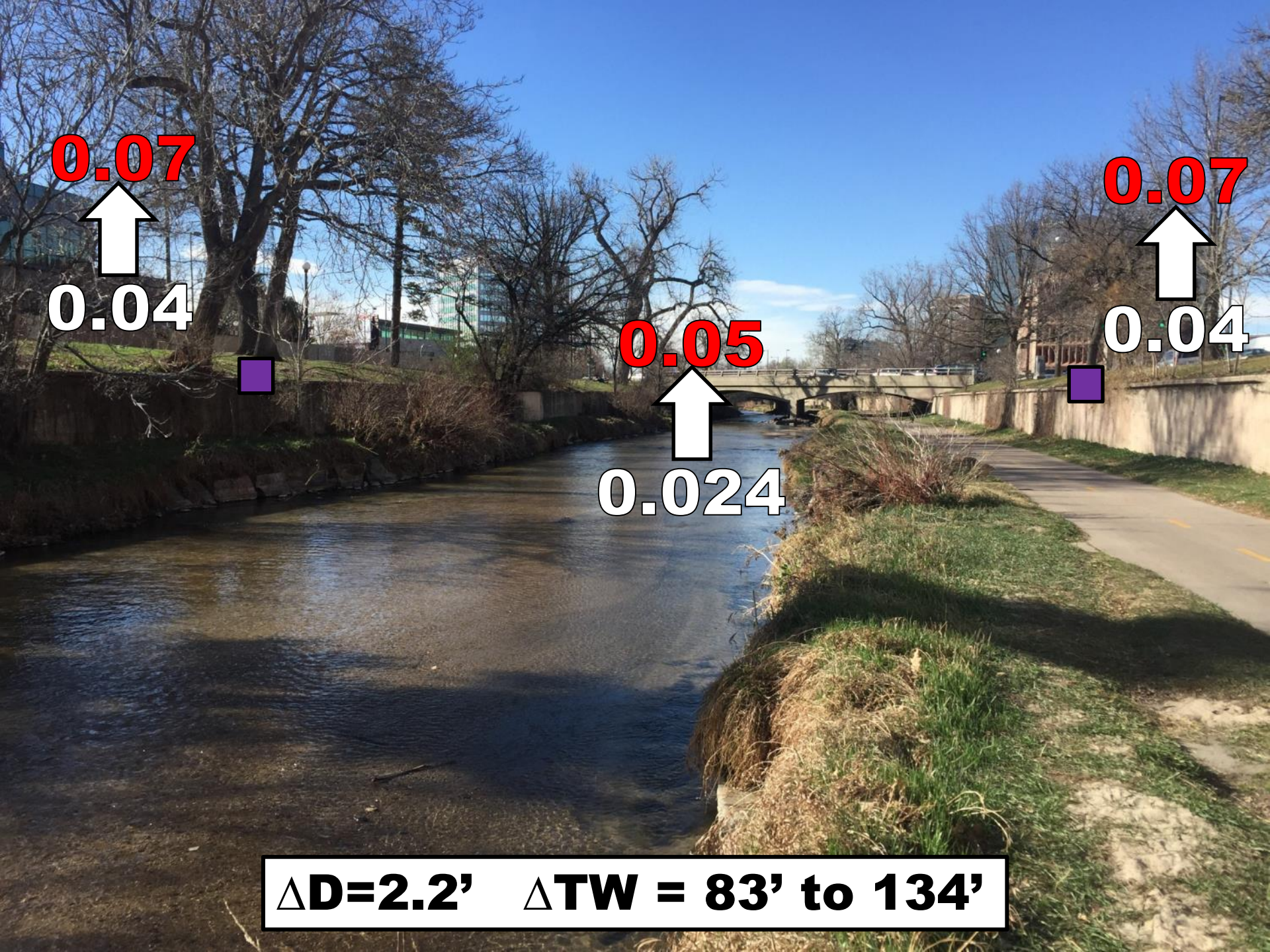
Open Floodplain

Tucker Gulch DS of Ford Street

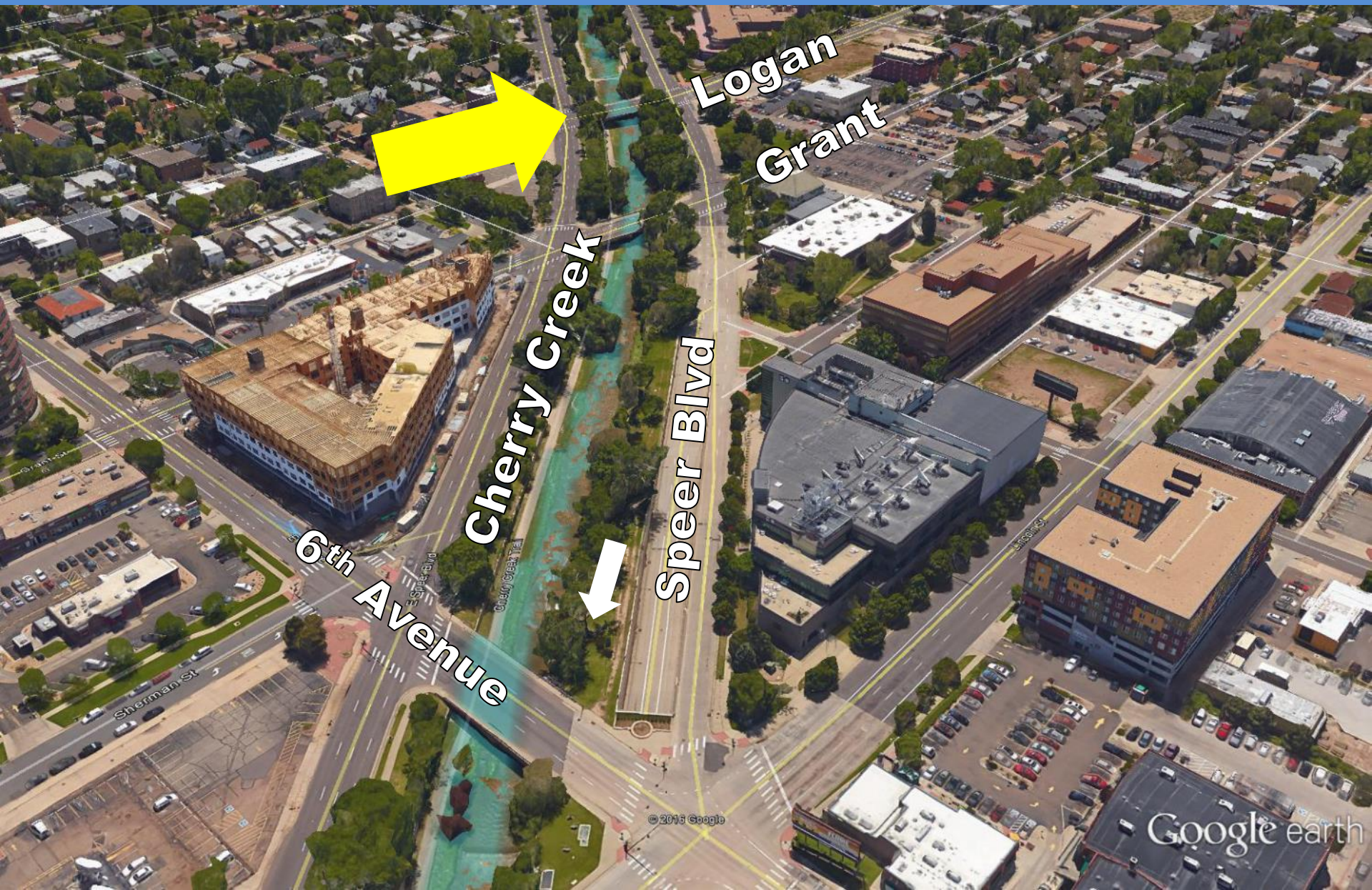
0.06
0.06
0.04

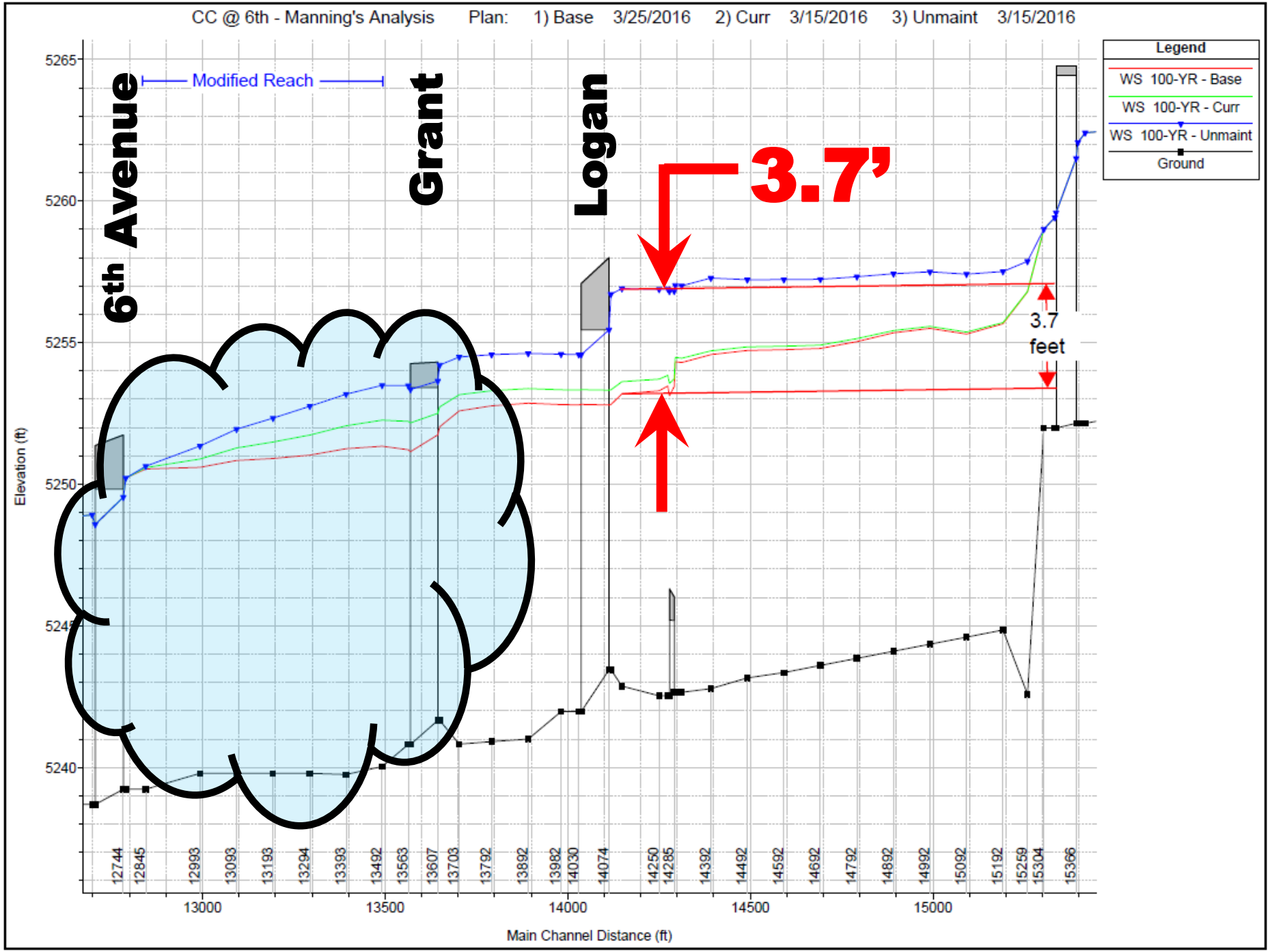

0.08
0.06
0.16
0.04
0.08
0.06
ΔD=2.9’ ΔTW = 66’ to 189’

Cherry Creek US of 6th Ave

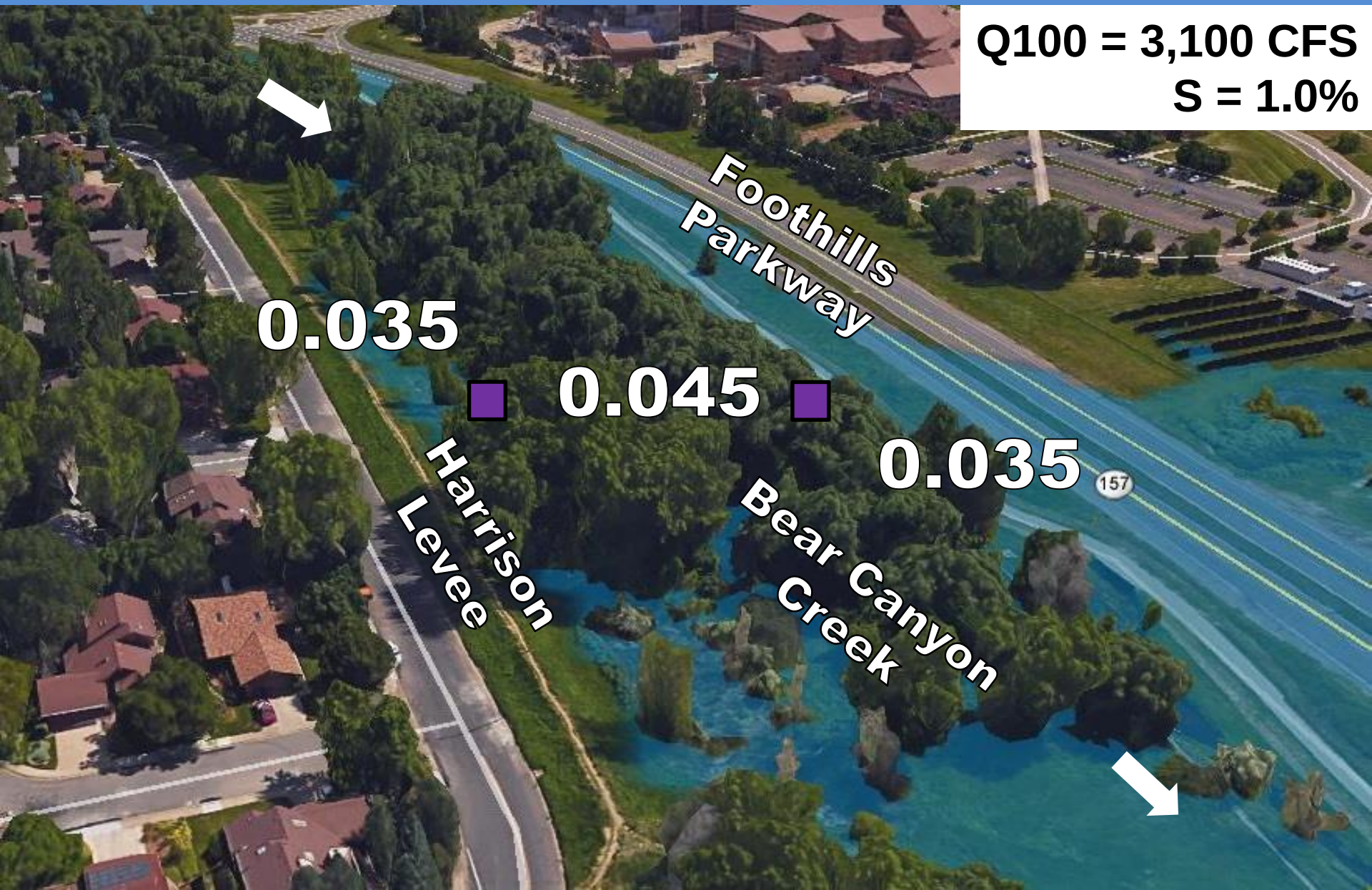

0.07
0.04
0.05
0.024
0.07
0.04
ΔD=2.2’ ΔTW = 83’ to 134’

Cherry Creek US of 6th Ave



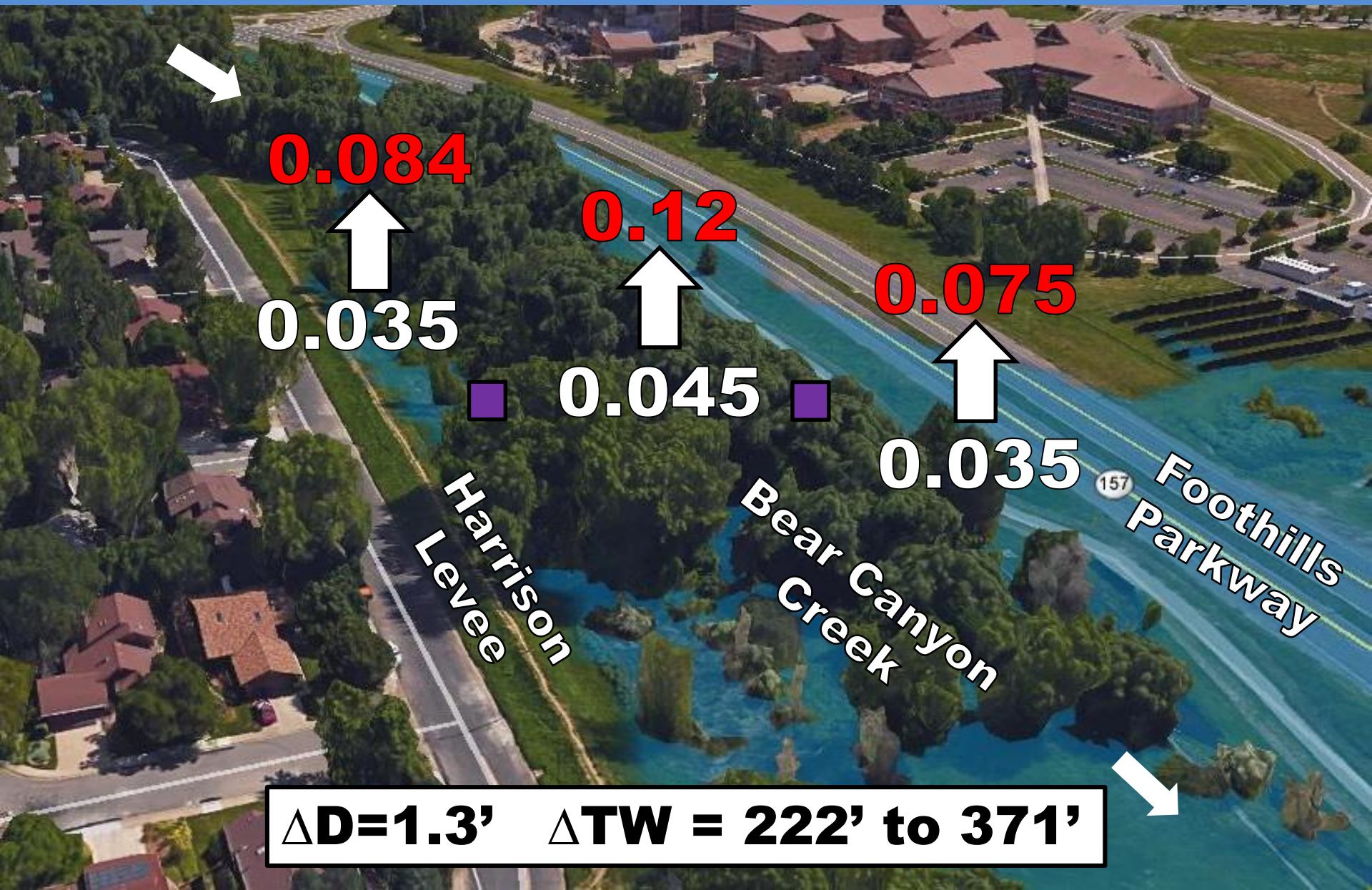

CC @ 6th - Manning's Analysis
Plan: 1) Base 3/25/2016 2) Curr 3/15/2016 3) Unmaint 3/15/2016
Legend
WS 100-YR - Base
WS 100-YR - Curr
WS 100-YR - Unmaint
Ground
Modified Reach
6th Avenue
Grant
Logan
3.7'
3.7 feet
Elevation (ft)
Main Channel Distance (ft)
5265
5260
5255
5250
5240
13000
13500
14000
14500
15000
12744
12845
12993
13093
13193
13294
13393
13492
13563
13607
13703
13792
13892
13982
14030
14074
14250
14285
14392
14492
14592
14692
14792
14892
14992
15092
15192
15259
15304
15366

Bear Canyon Ck DS of Foothills



0.12
0.045

Bear Canyon Ck DS of Foothills



0.045

Case Study Conclusions

- **Vegetation Can Dramatically Increase Flood Depth and Width, but Context Matters**
- **Confined Channel Sections ~ More Risky**
- **Flatter Channel Sections ~ More Risky**
- **Freeboard Matters!**

Account for Realistic Vegetation in Design
~and/or~
Plan to Manage the Vegetation

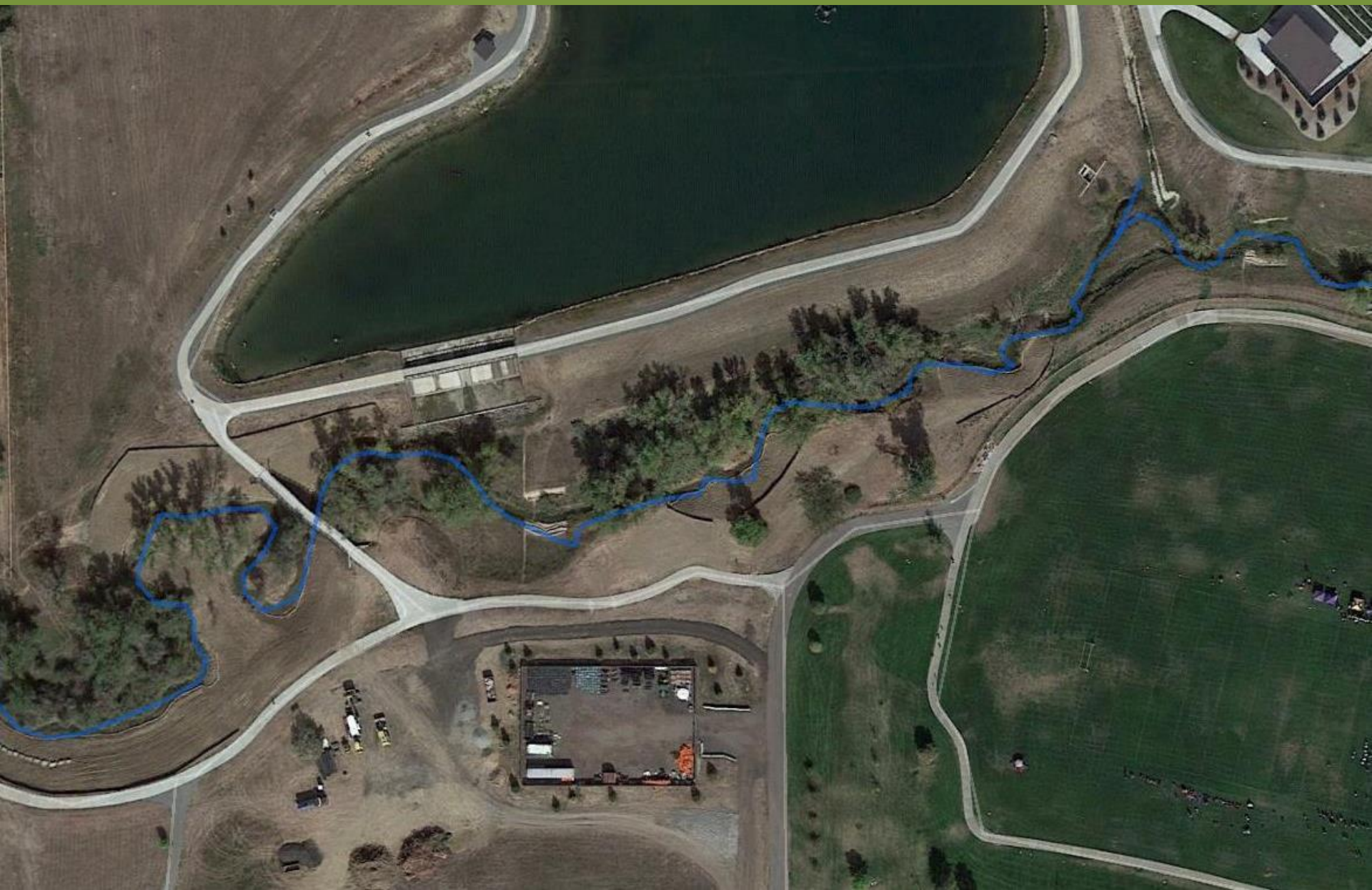
GIS Applications

- **Document “n” Values**
- **Understand Hydraulic Sensitivity to Changes in Vegetation**
- **Assess Field Conditions – How do They Compare to Model Assumptions?**
- **Identify Stream Reaches with the Highest Flood Risk**

GIS Applications

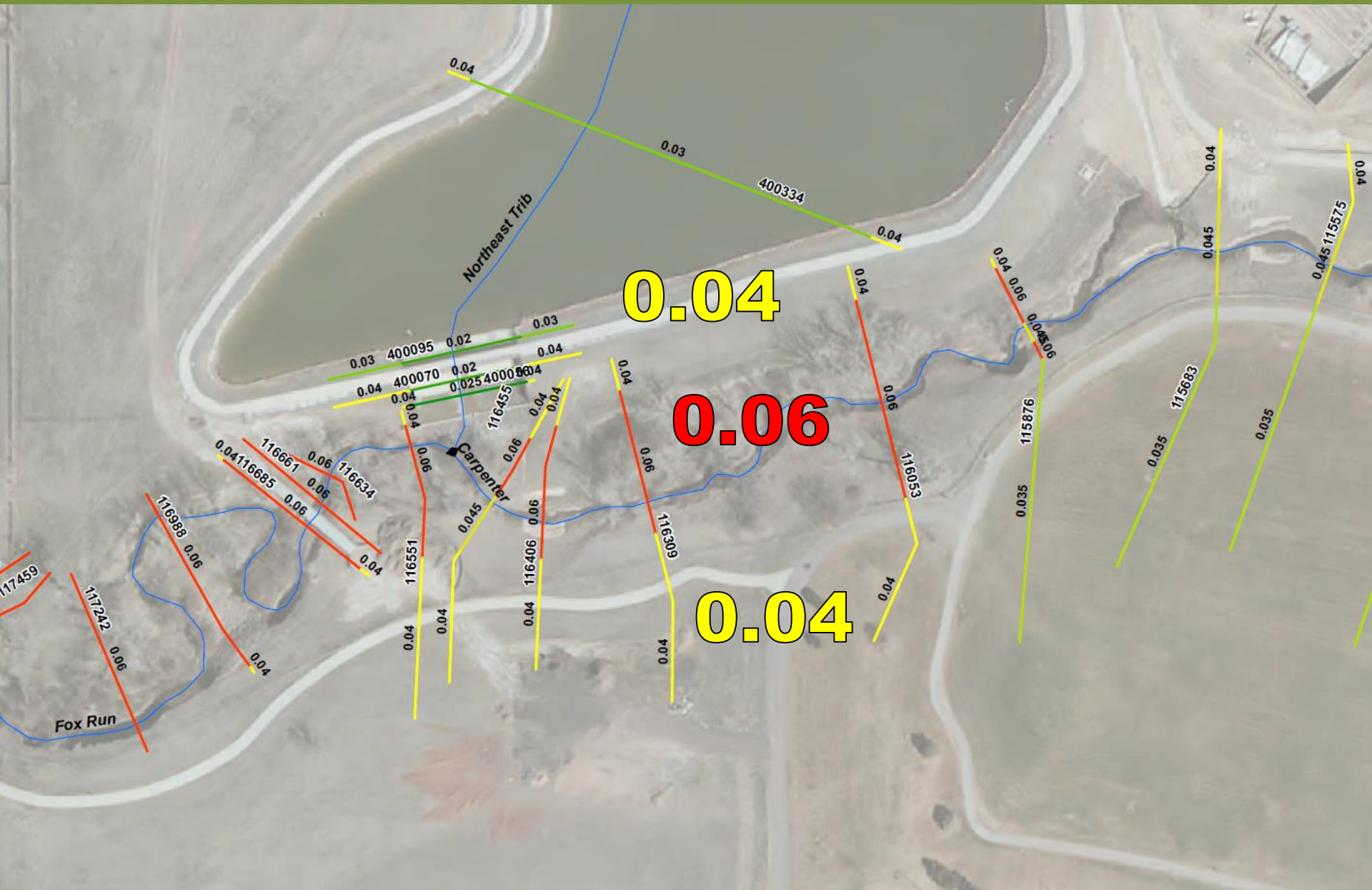
David Delagarza (the brains)
David.Delagarza@respec.com
RESPEC Consulting

Documenting “n” Values

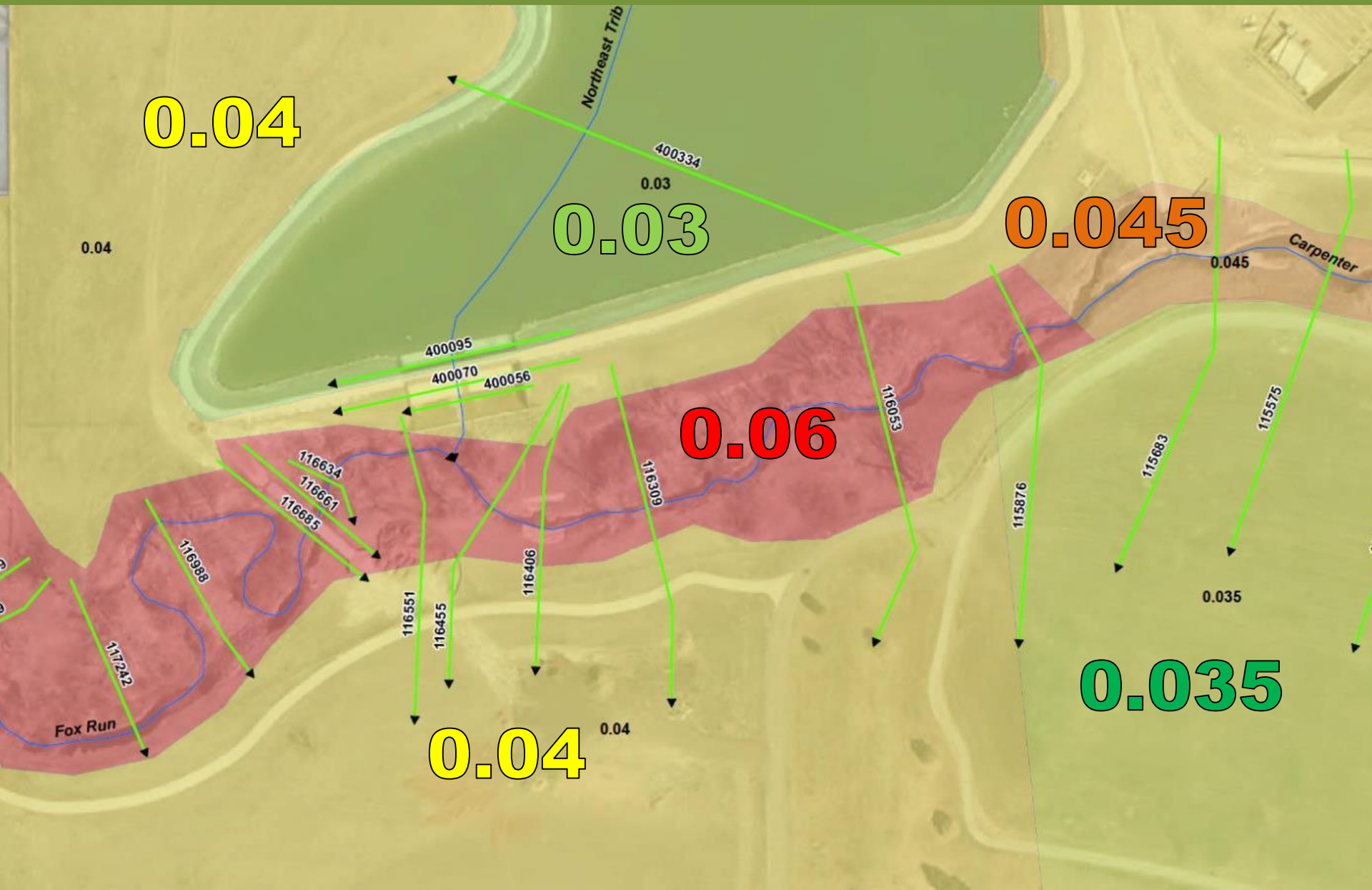


Documenting “n” Values

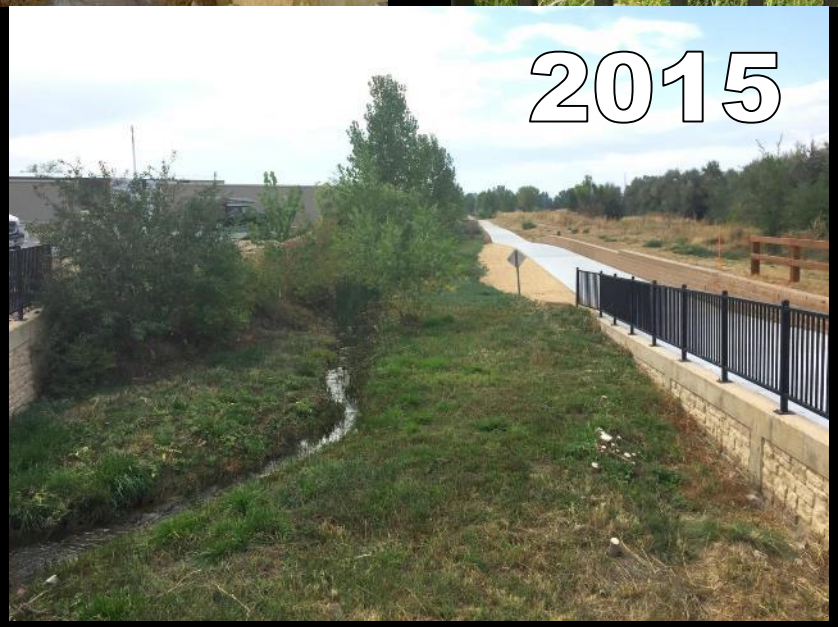
Documenting “n” Values



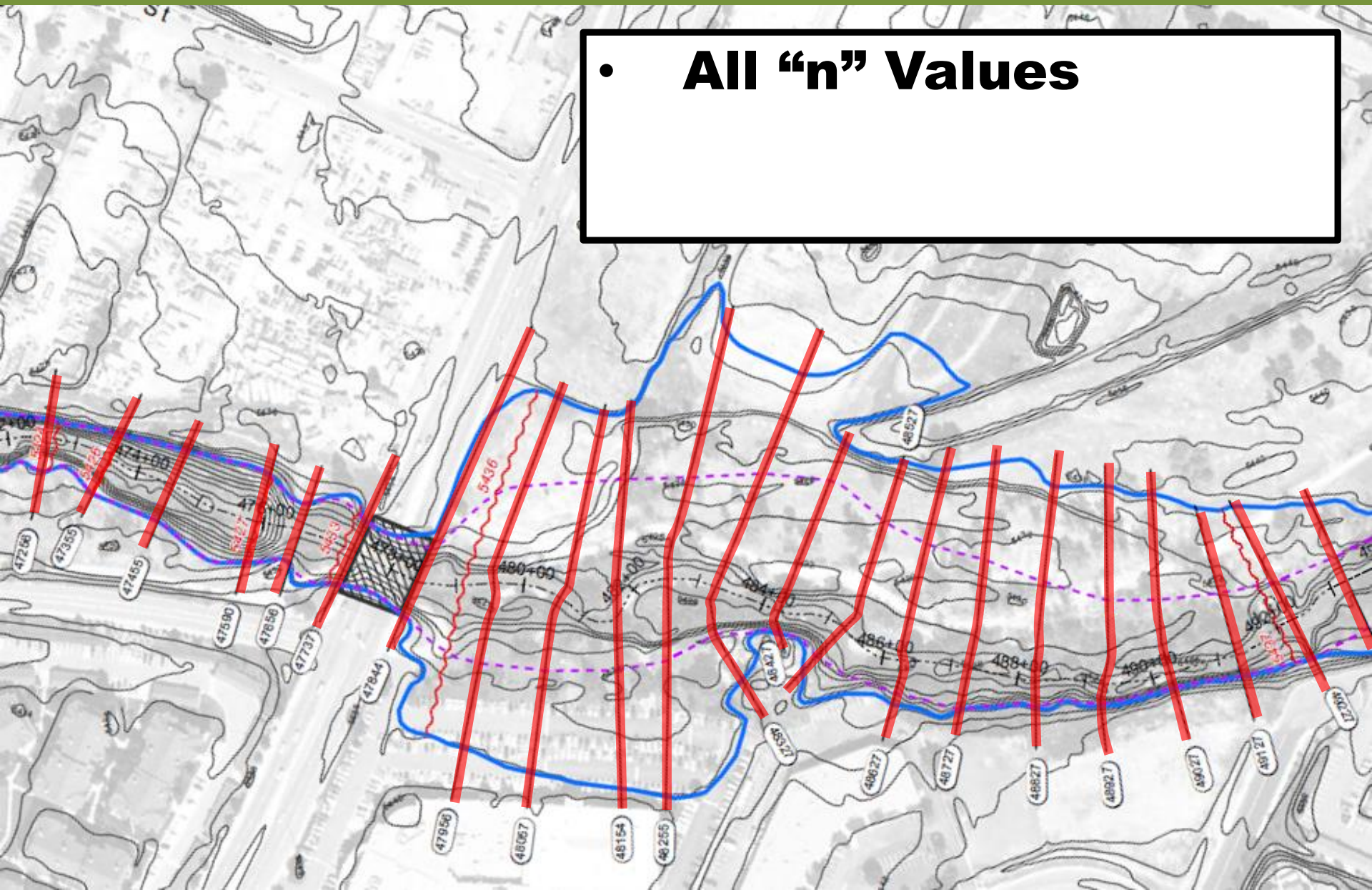
Documenting “n” Values



Vegetative Photo Points

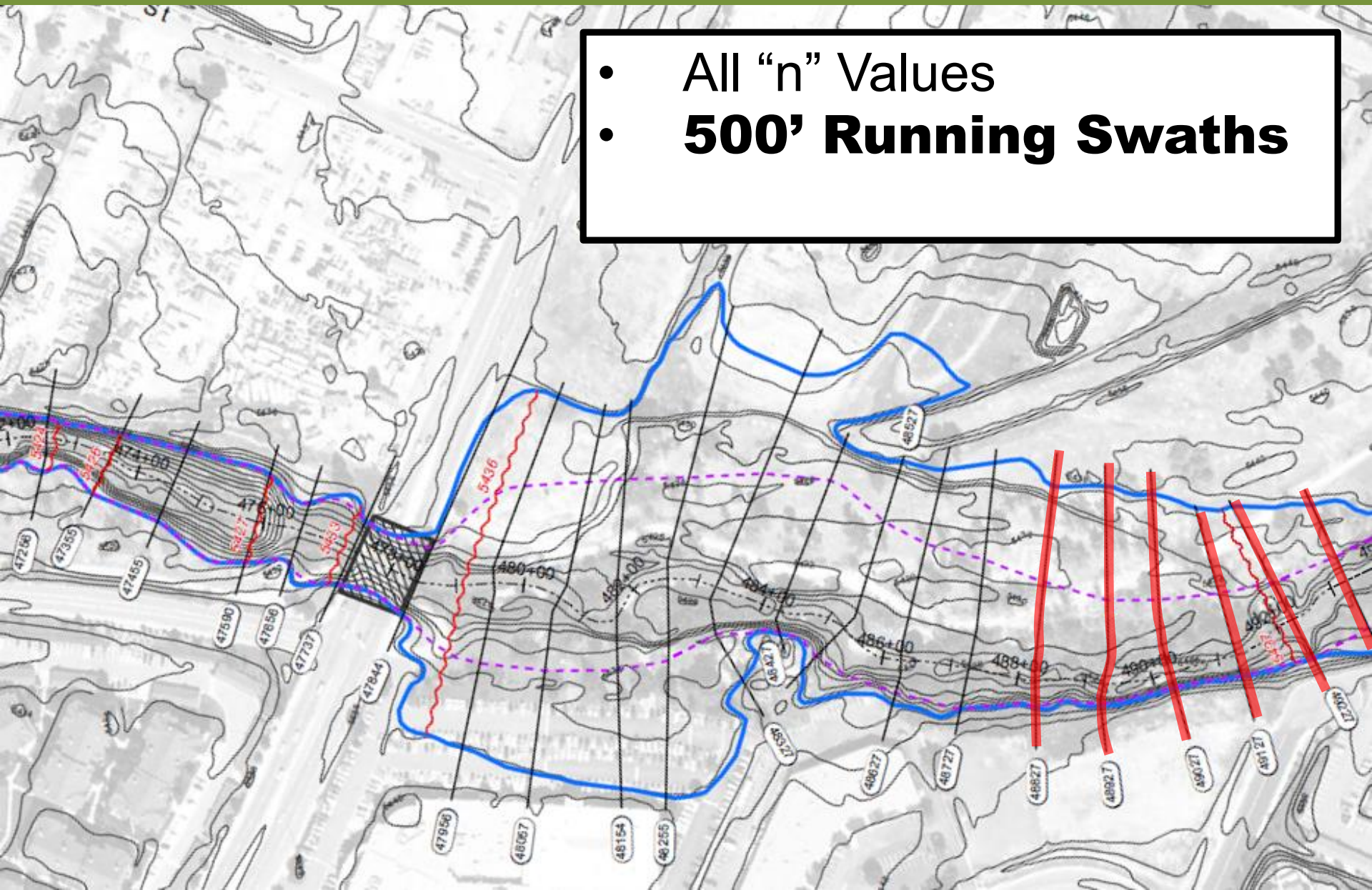


“n” Sensitivity - Scenarios

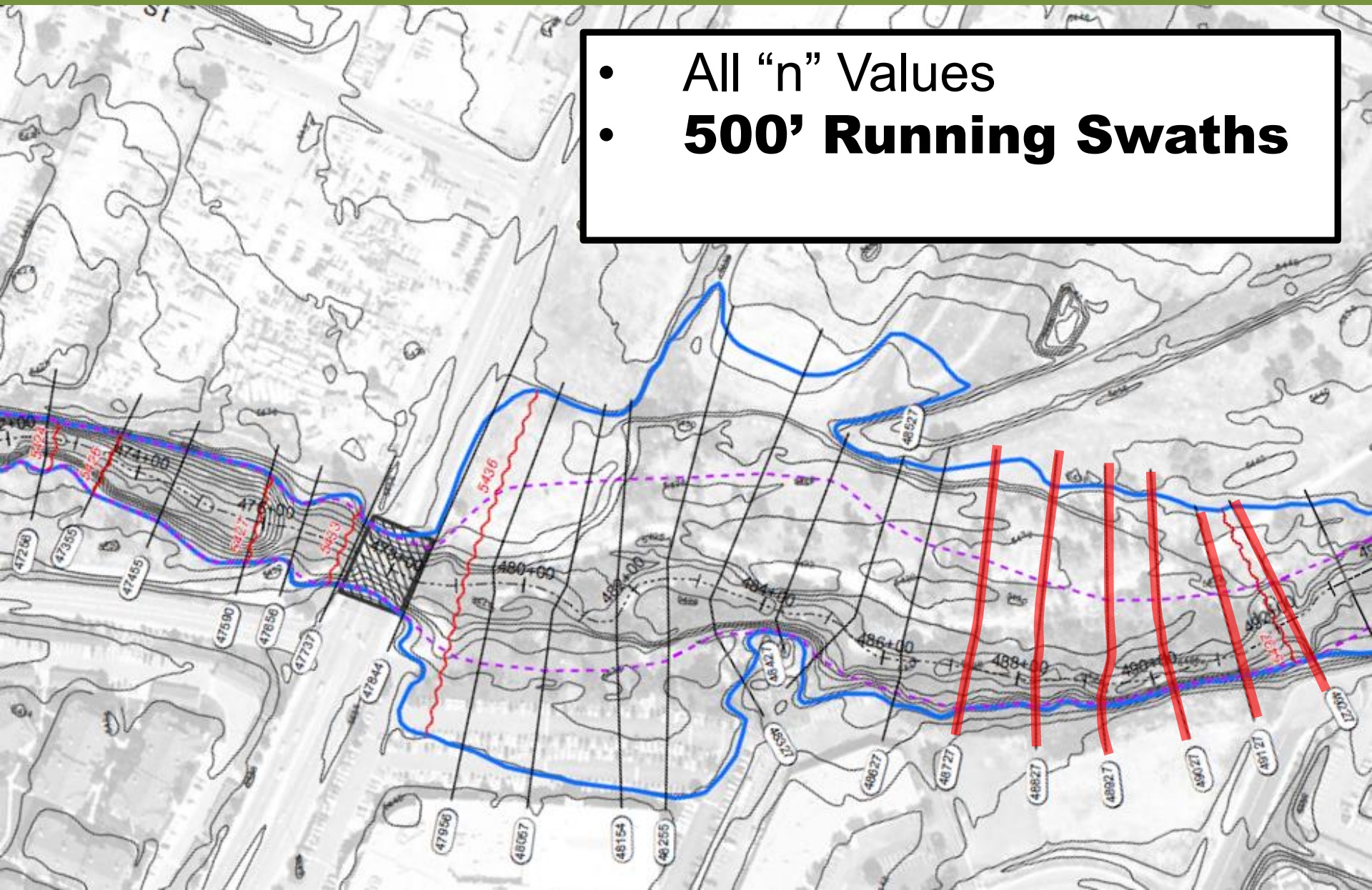


- **All “n” Values**

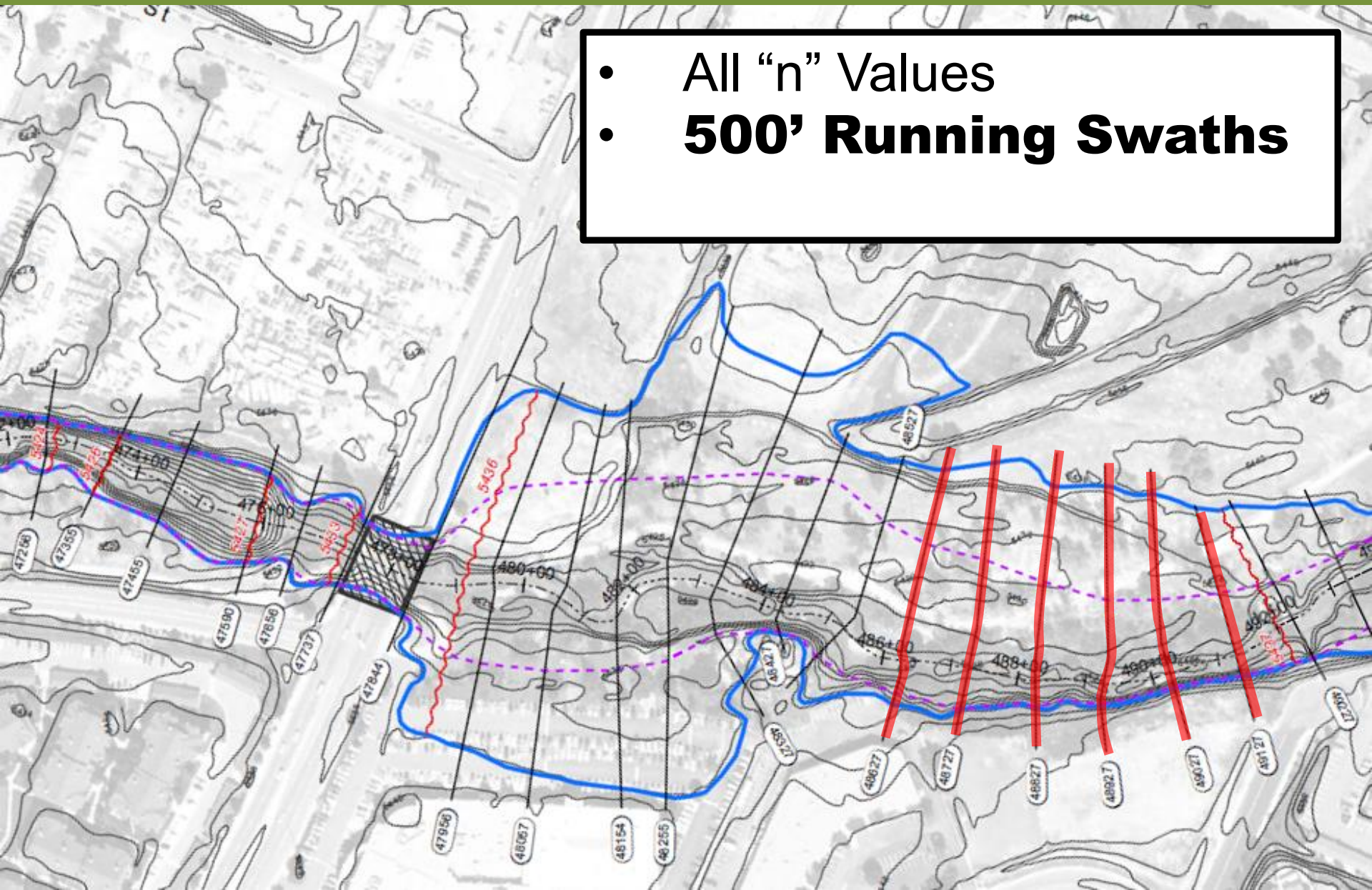
“n” Sensitivity - Scenarios



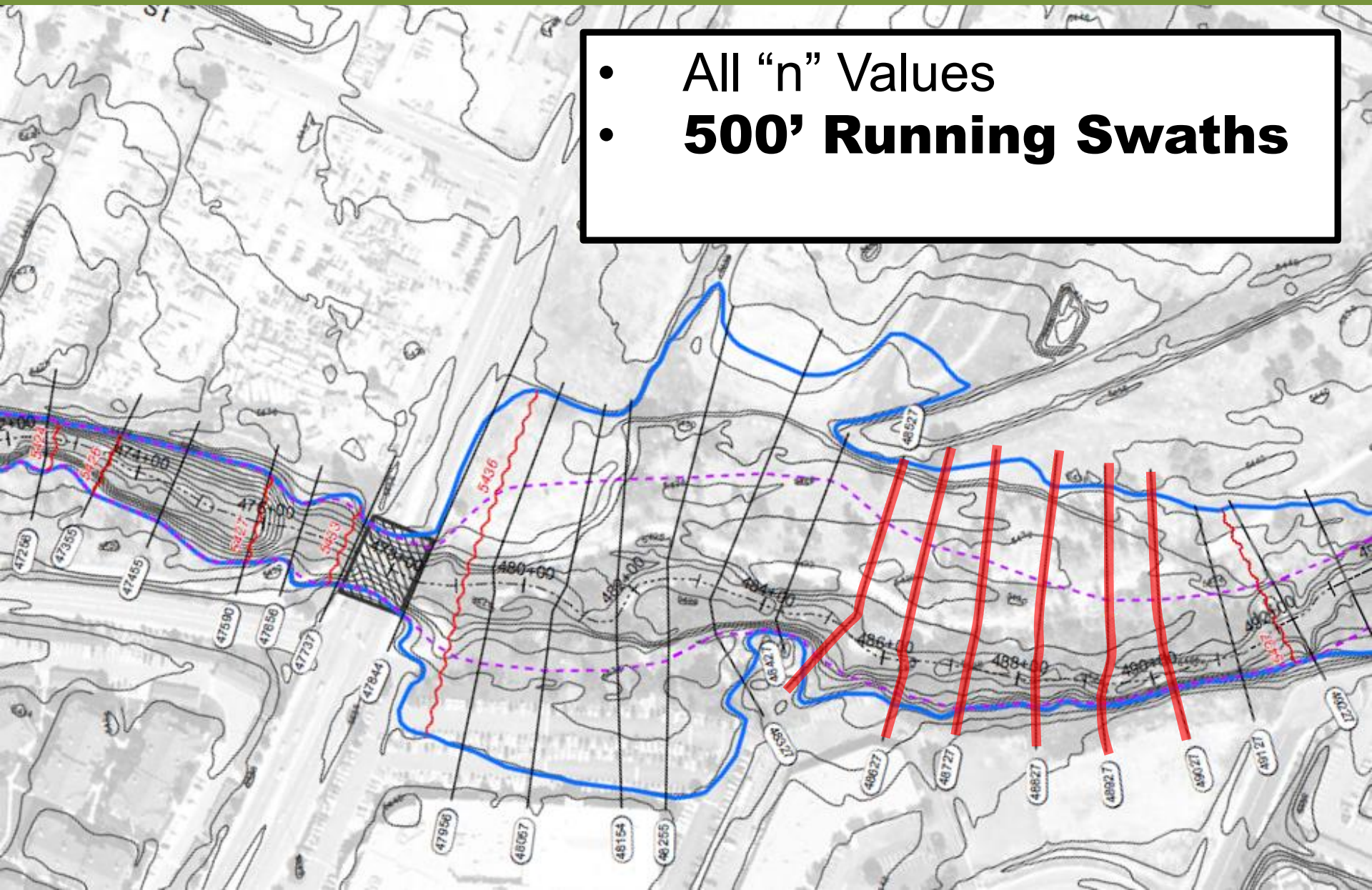
“n” Sensitivity - Scenarios



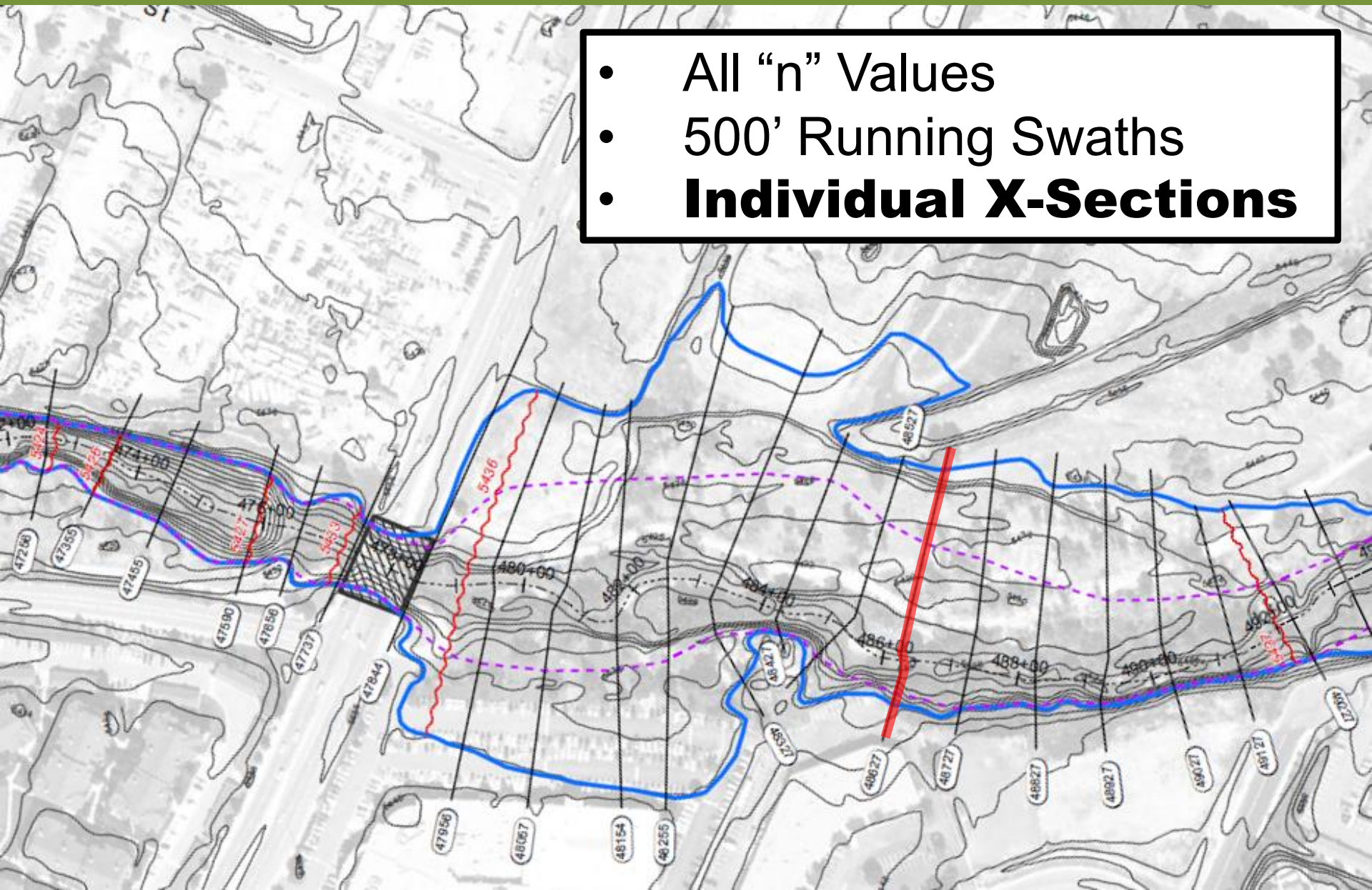
“n” Sensitivity - Scenarios



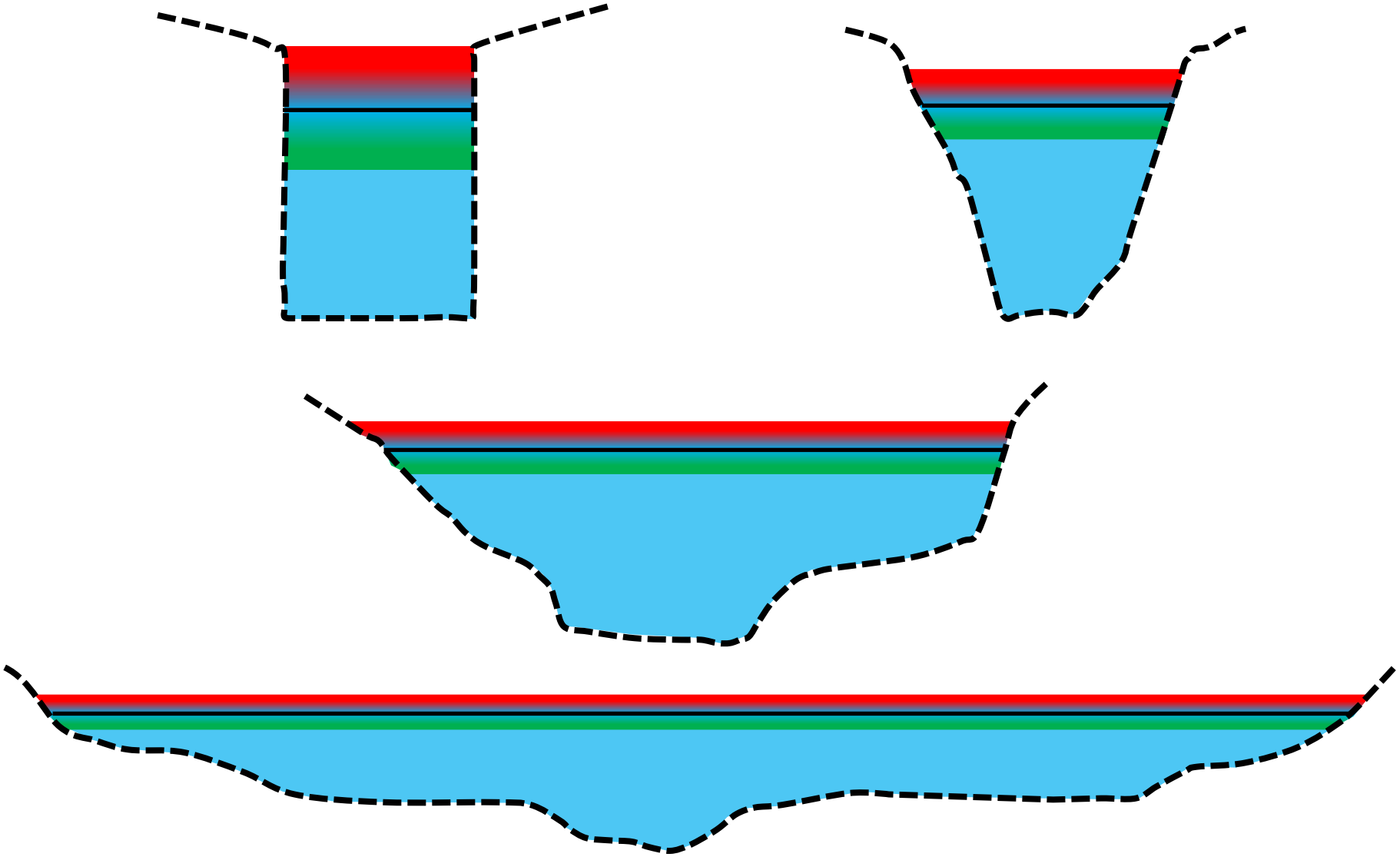
“n” Sensitivity - Scenarios



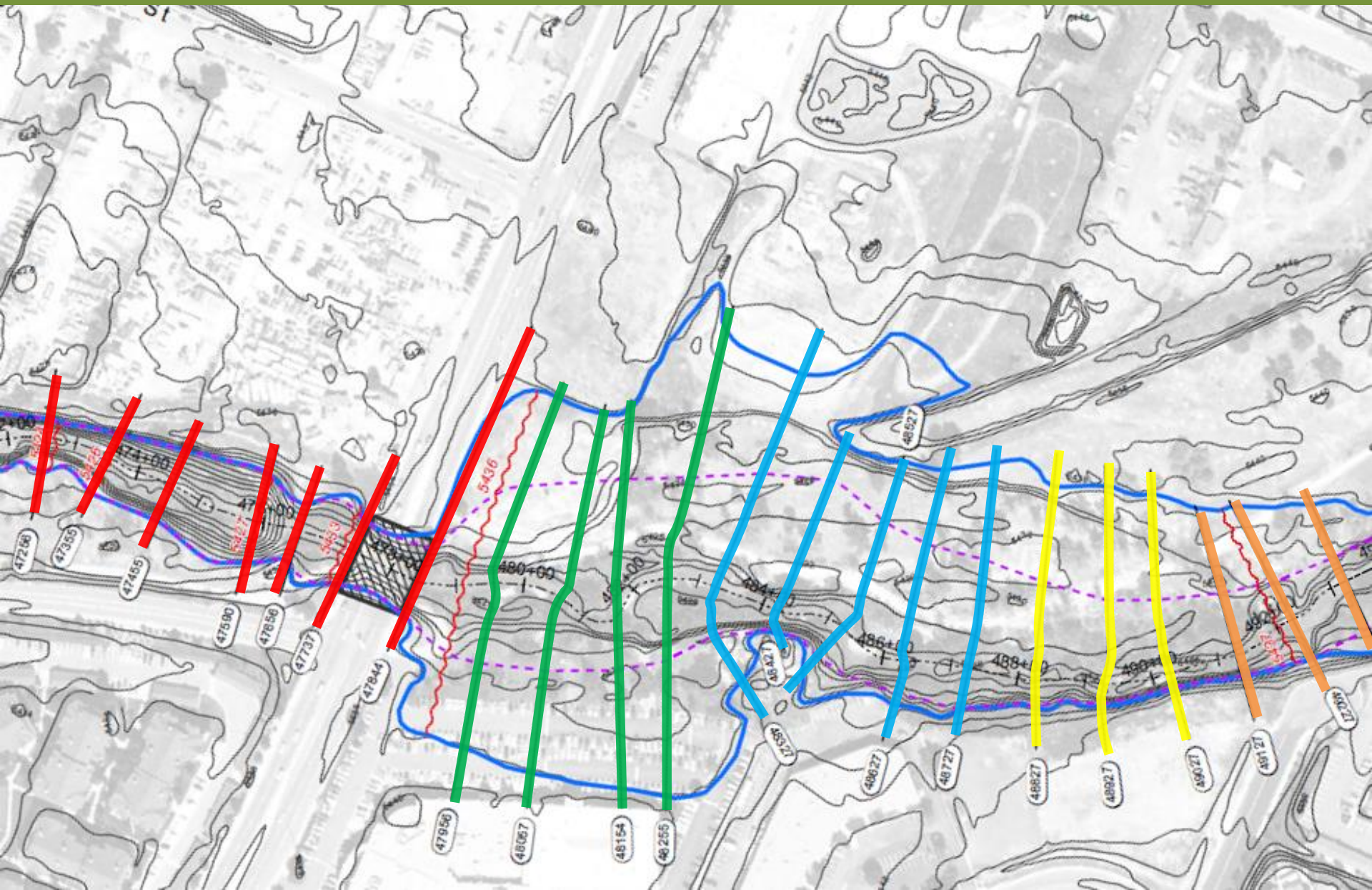
“n” Sensitivity - Scenarios



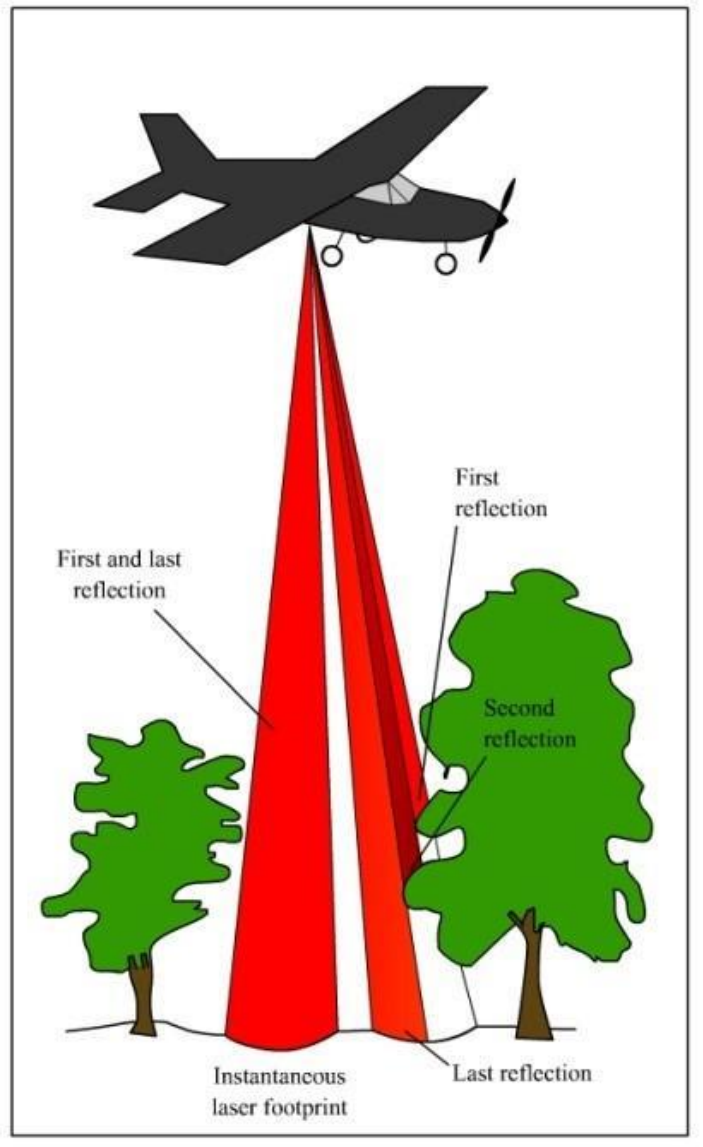
“n” Sensitivity

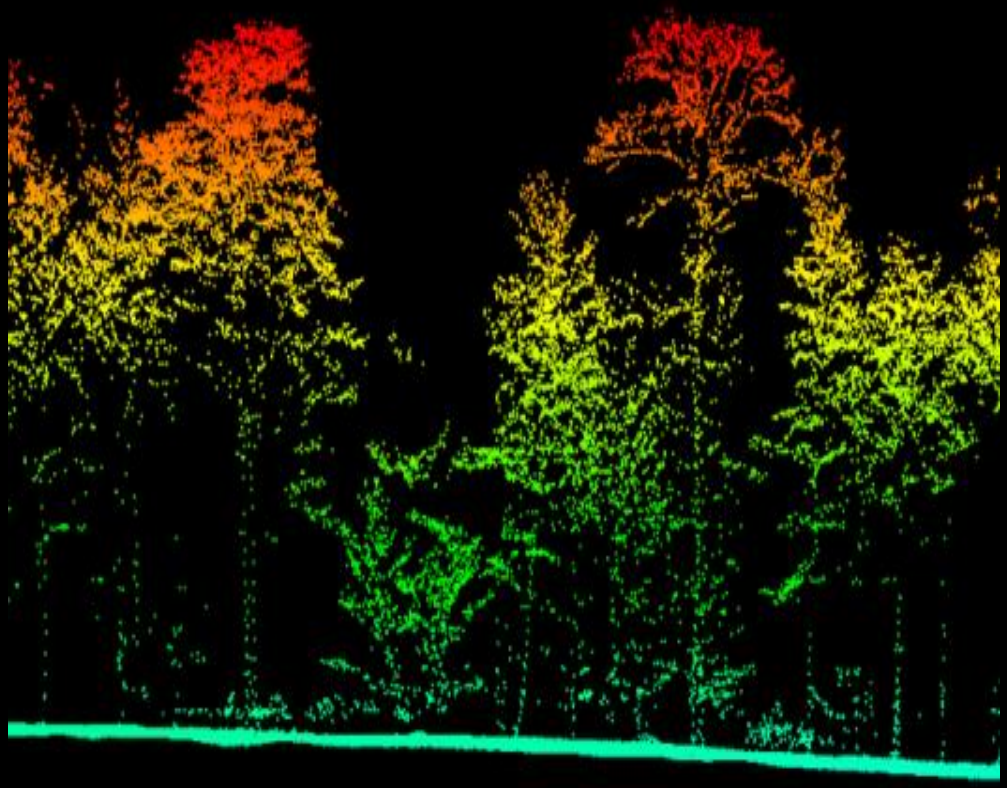


“n” Sensitivity - Output

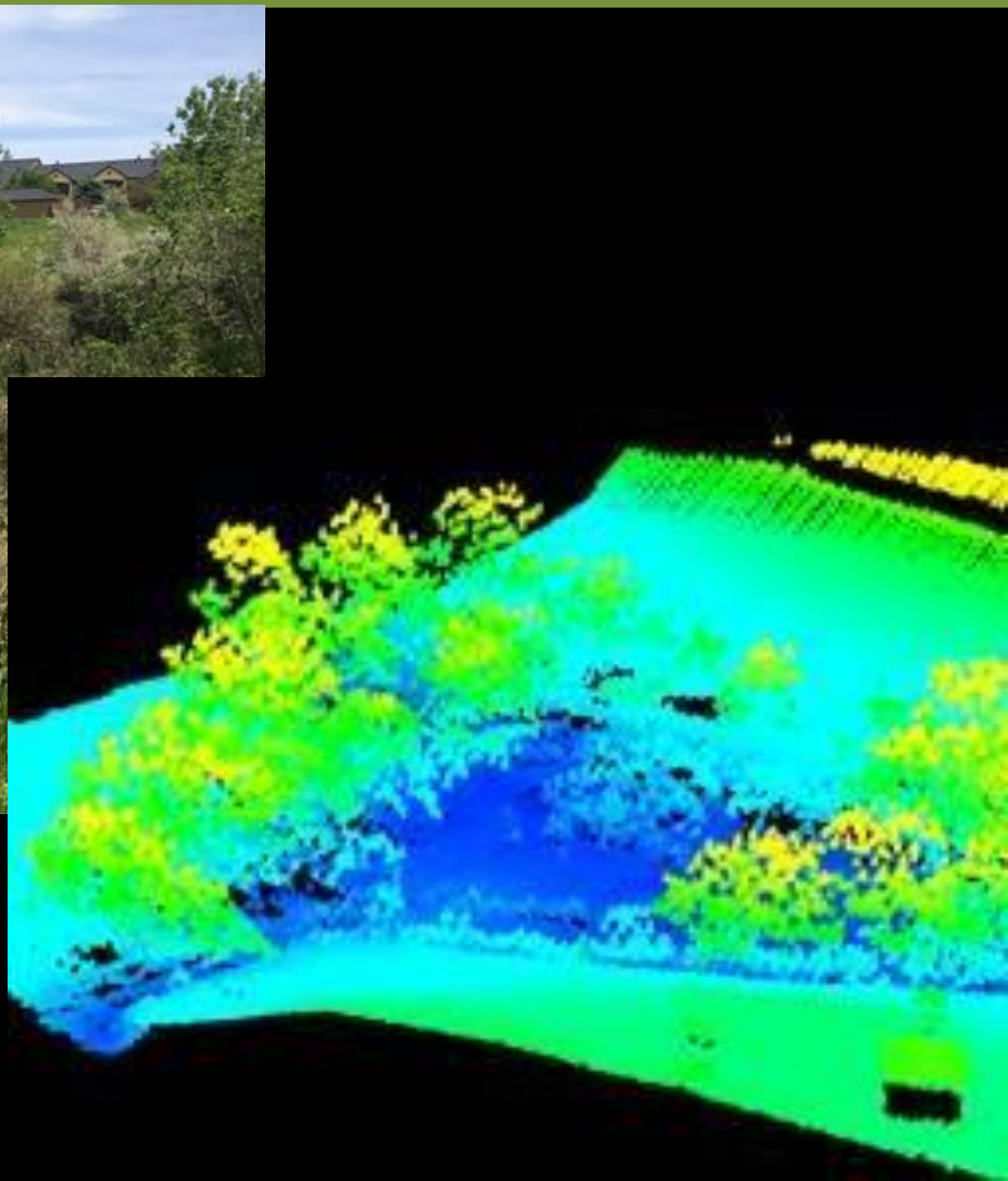


Field Conditions - LIDAR

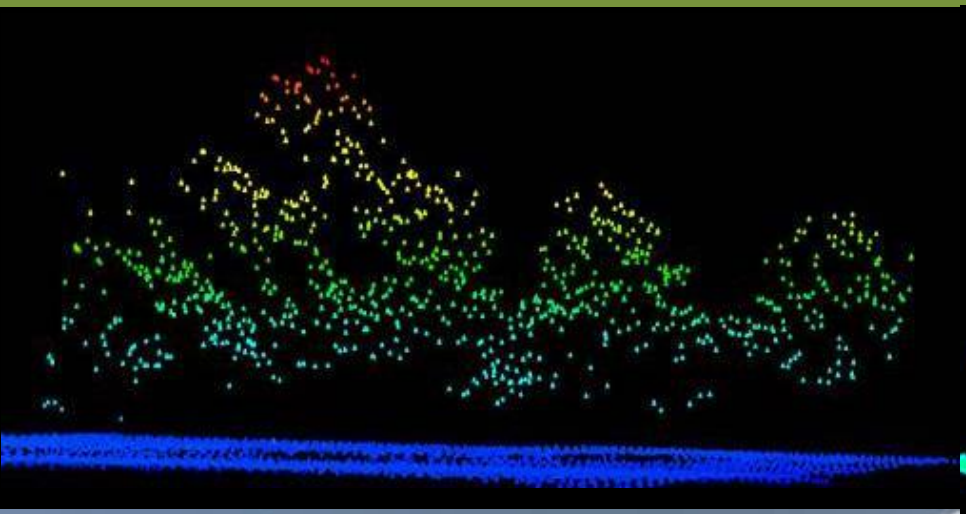


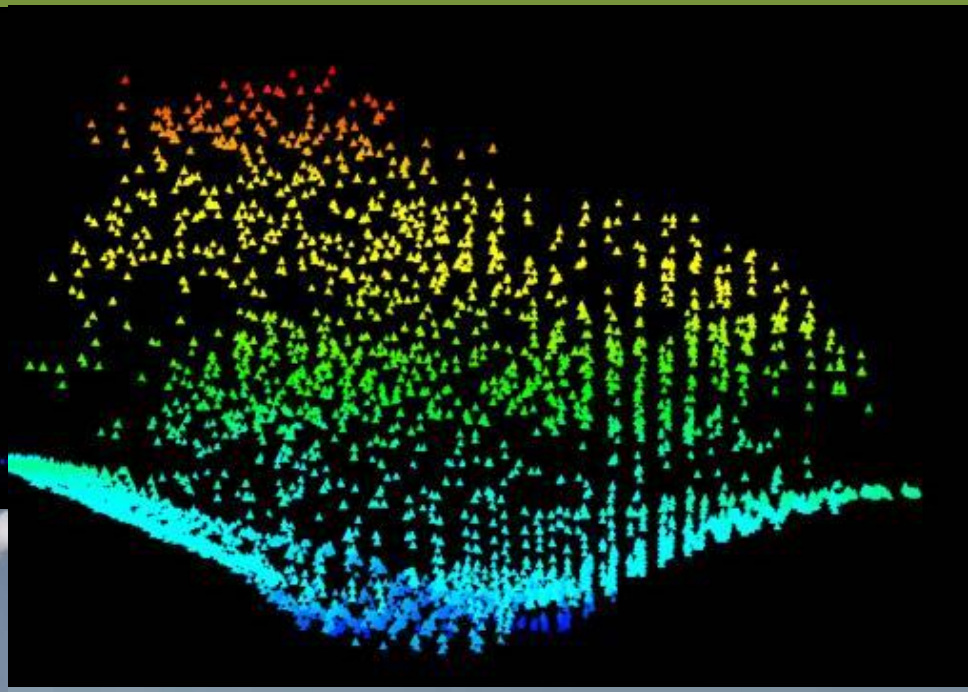


Field Conditions - LIDAR



Field Conditions - LIDAR

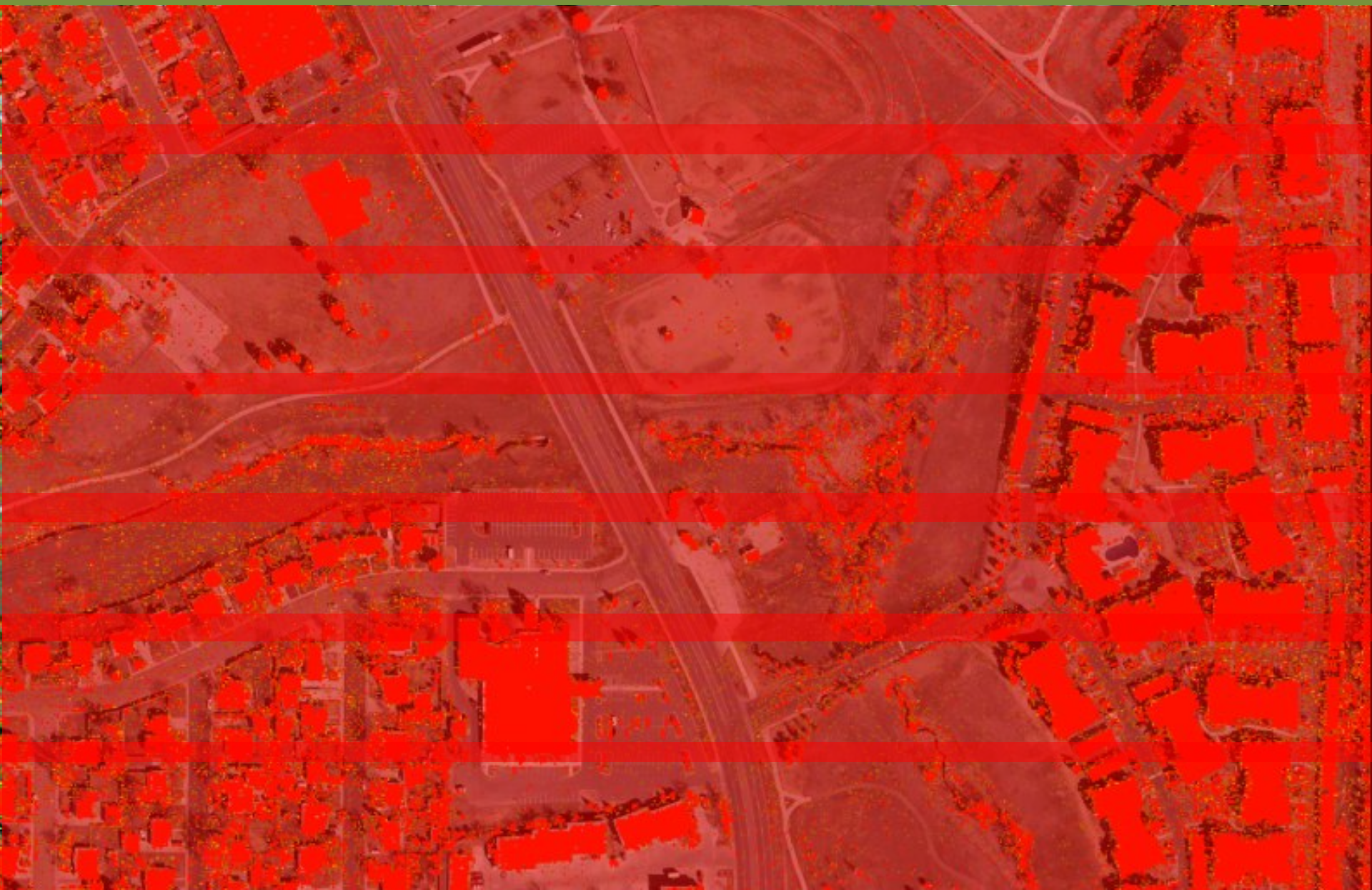




Field Conditions - LIDAR

Field Conditions - LIDAR

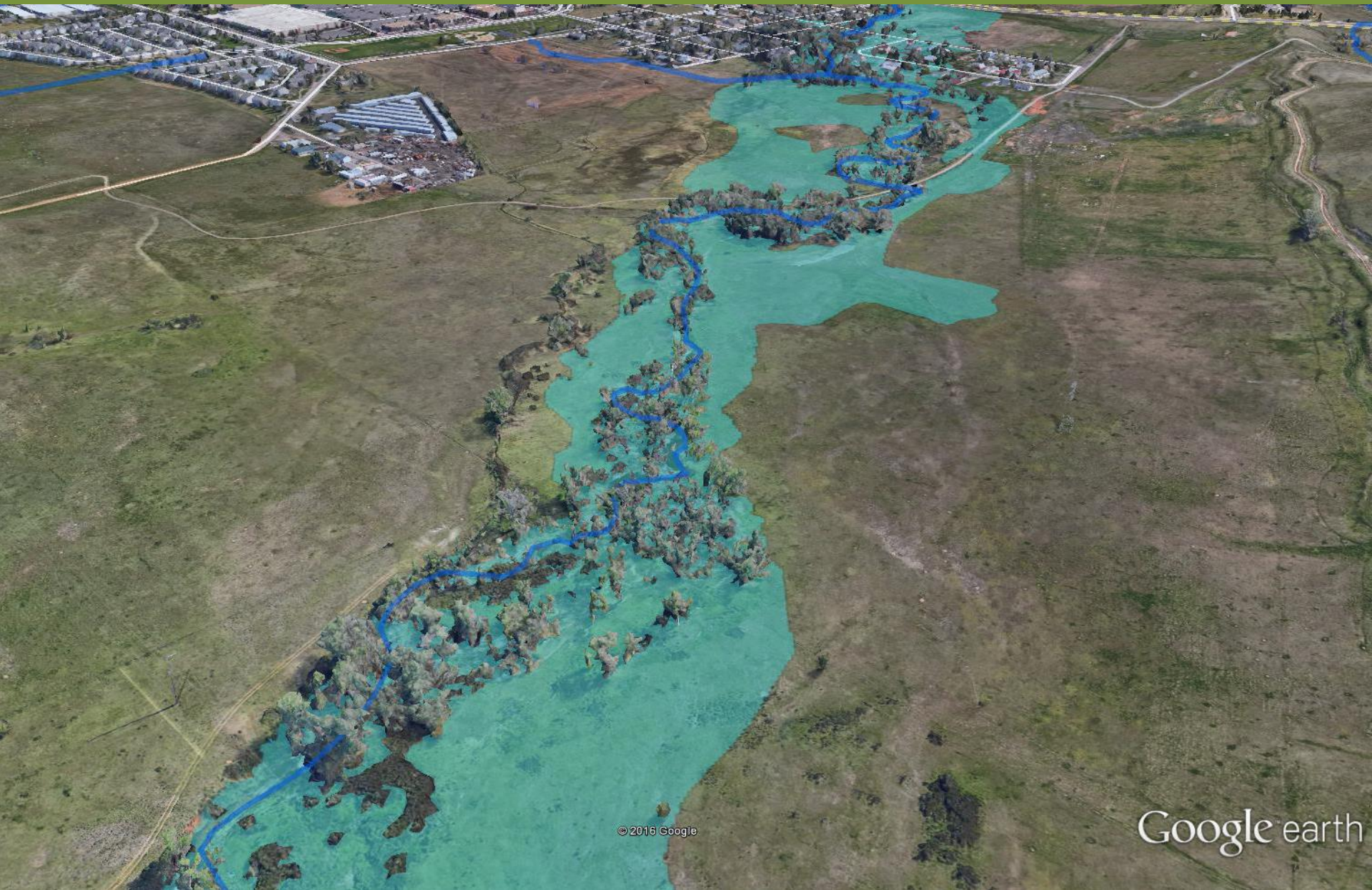
Field Conditions - LIDAR



Field Conditions - LIDAR

Field Conditions - Infrared

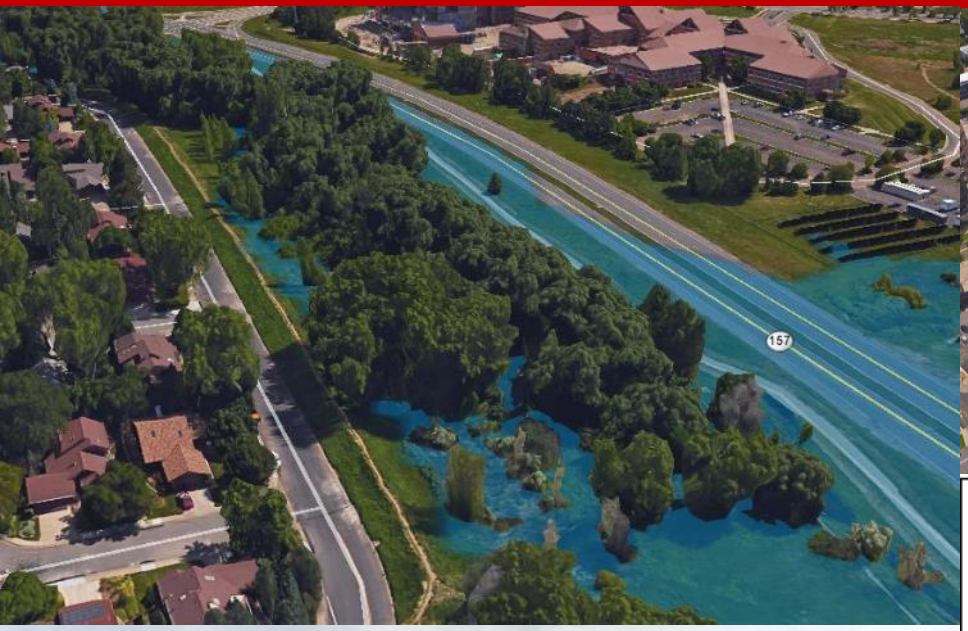
What's at Risk?

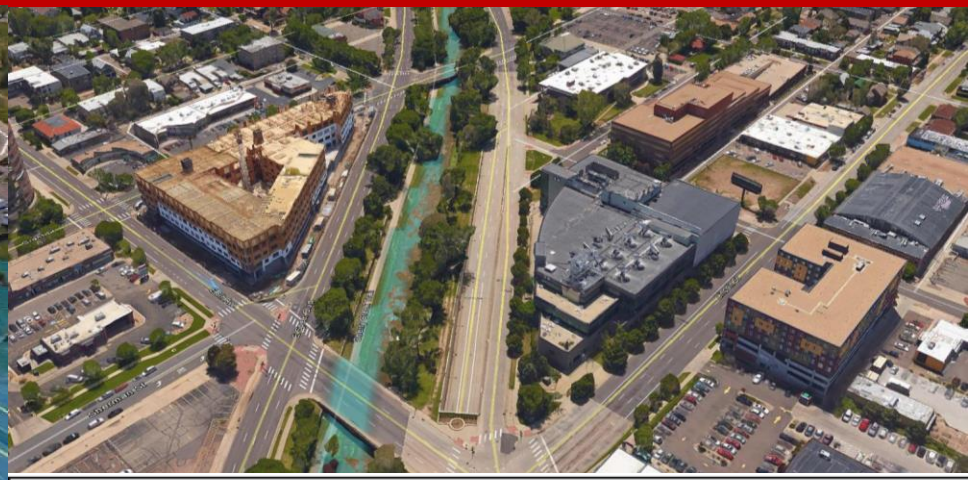


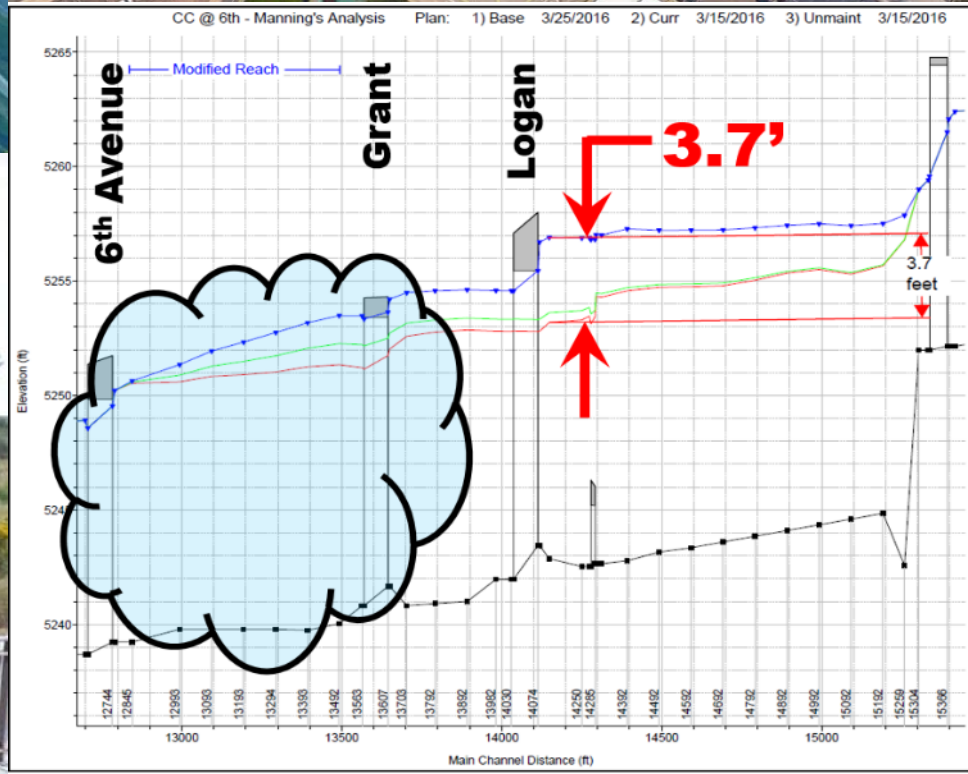
What's at Risk?

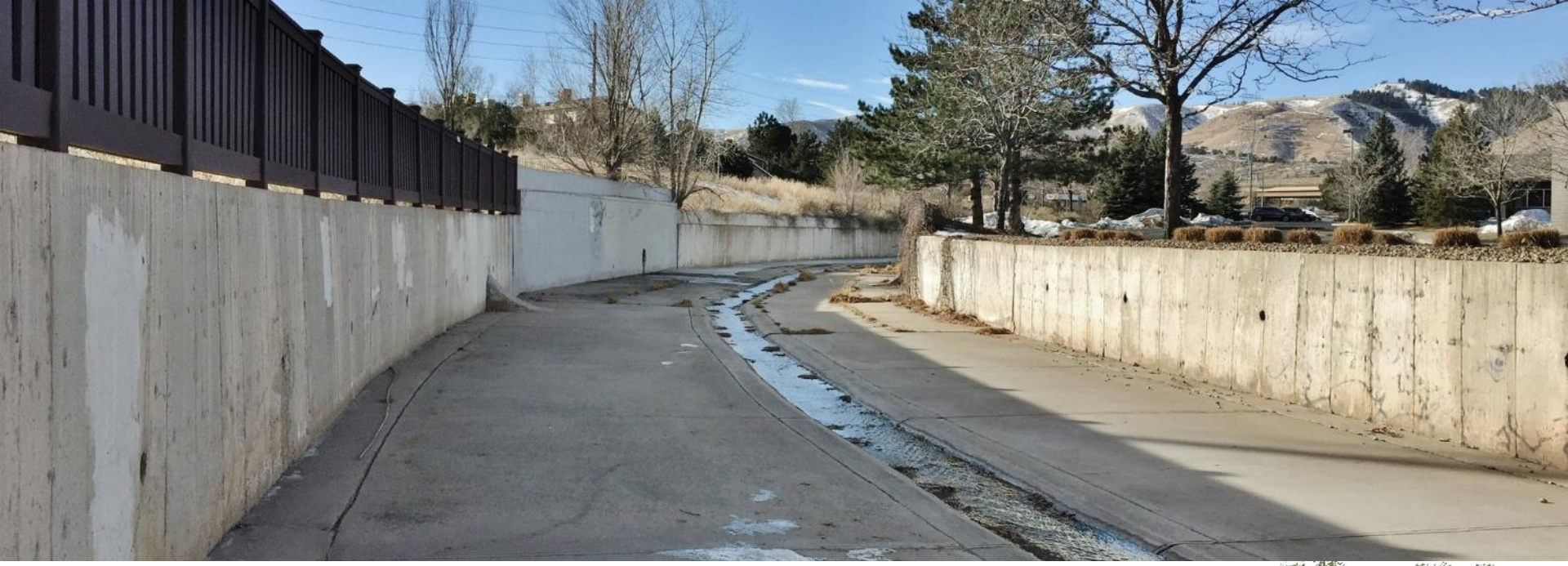
What's at Risk?

What's at Risk?

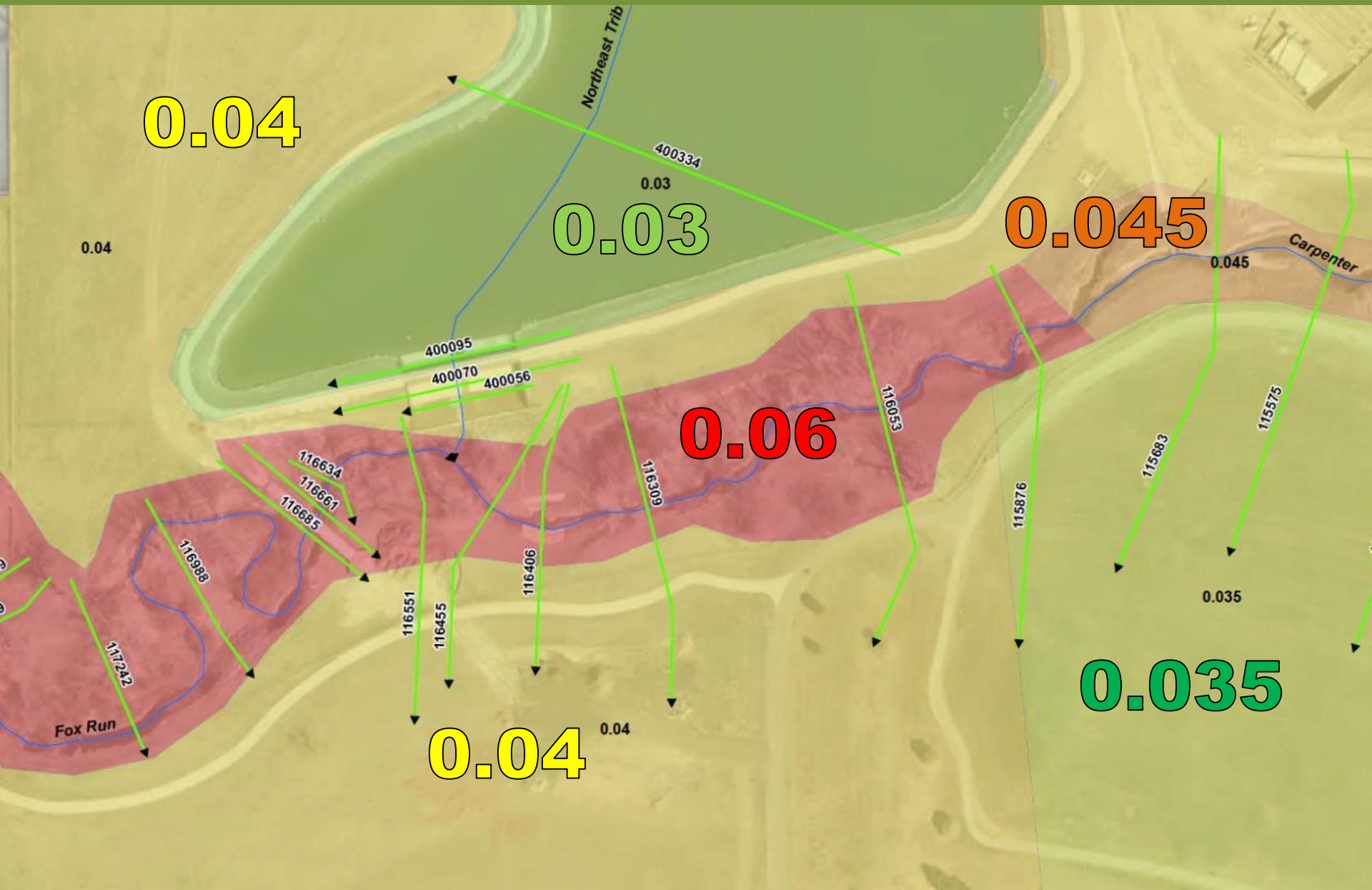




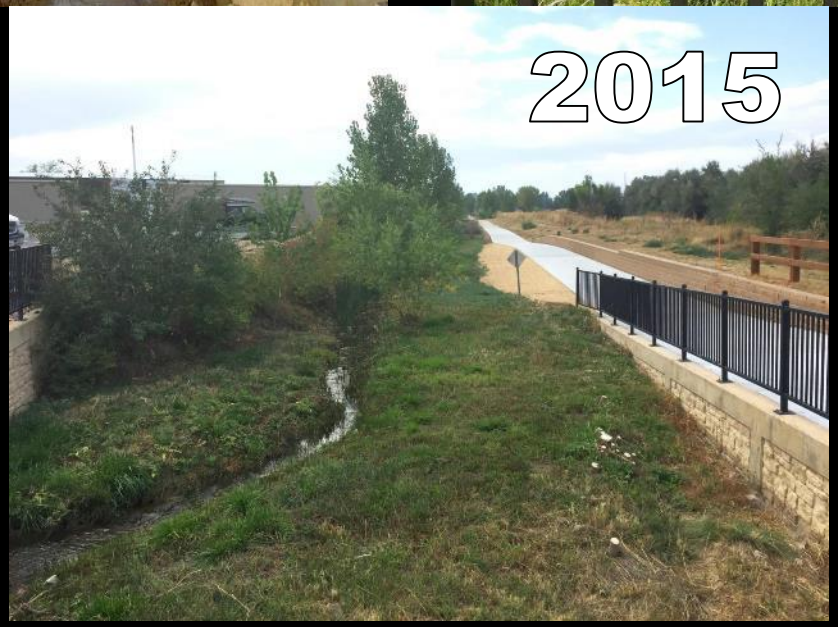




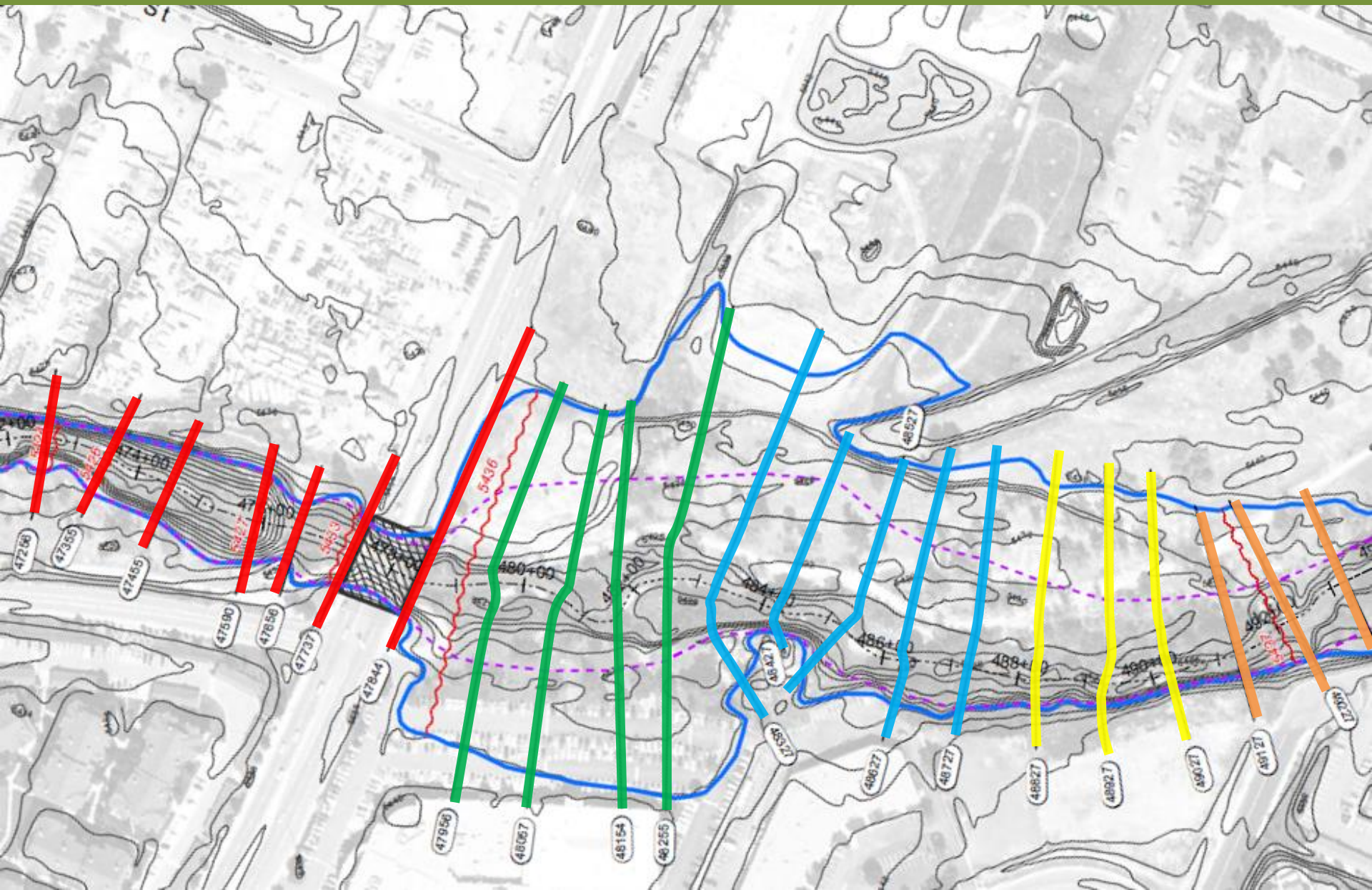
Documenting “n” Values



Vegetative Photo Points



“n” Sensitivity



Field Conditions

What's at Risk?

Where to Spend Maintenance $?

For More Information

David Delagarza
david.delagarza@respec.com
RESPEC Consulting

Dave Skuodas
dskuodas@udfcd.org
Urban Drainage &
Flood Control District

Episode V Coming Soon
to a Theater Near You