This presentation premiered at WaterSmart Innovations

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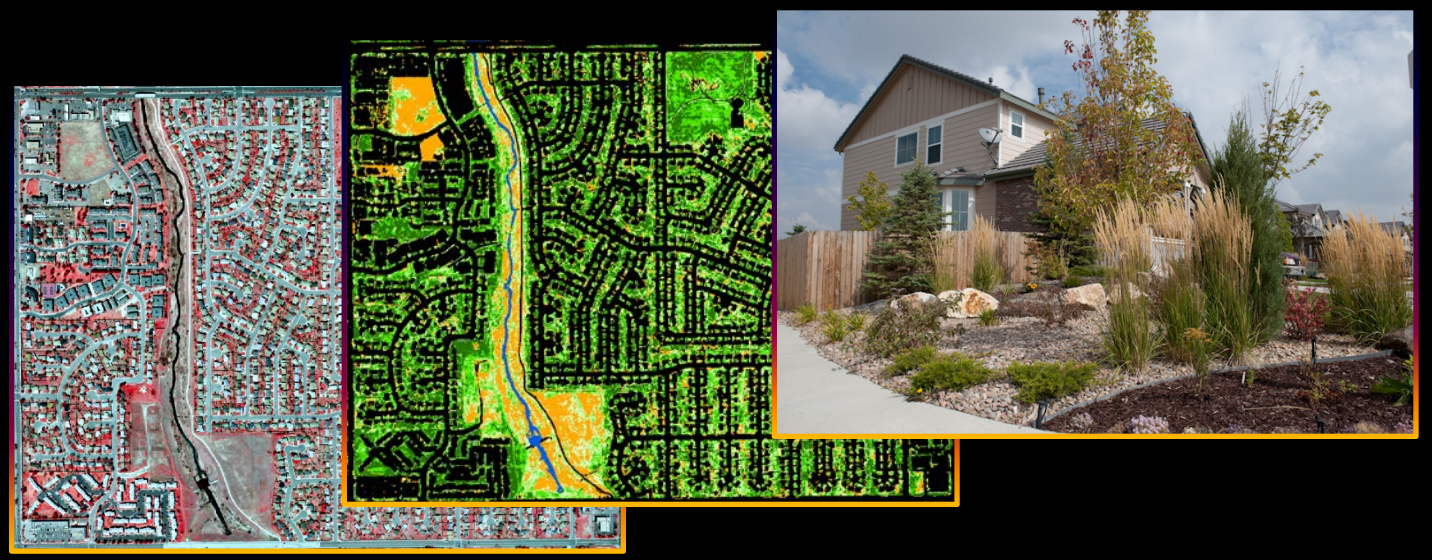
Geospatial Approach for an Innovative Water Conservation Program

watersmart INNOVATIONS 2012 Conference & Exposition

amec Environment & Infrastructure

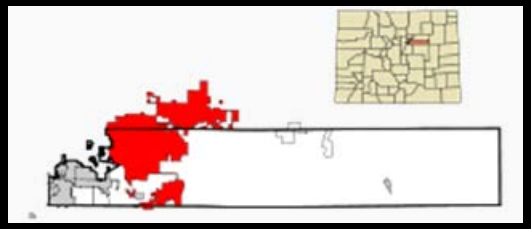
Aurora Water



Presentation Overview

Aurora Water Conservation's System Incentive Program (SIP) Project

- Current conservation program, drivers for change
- History/progression of SIP project
- Goals of the project
- AMEC's role – geospatial data development
- Applications
- Future Enhancements



Project Introduction → Workflow & Results → Hurdles & Enhancements → Data Applications

Conservation – Status Quo and Drivers for Change

Current state of Conservation:

- Little public understanding of appropriate water use or effective conservation measures
- Limited interaction with customers, generic outreach
- Most responsive customers already conservation-conscious
- Indoor audit program, no outdoor information
- Plethora of tools, rebates/incentives, specialized programs available to customers… under-utilized, little ROI
- REACTIVE program may not reach goals set in Water Conservation Plan monitored by the State of Colorado

Water Conservation Calculator

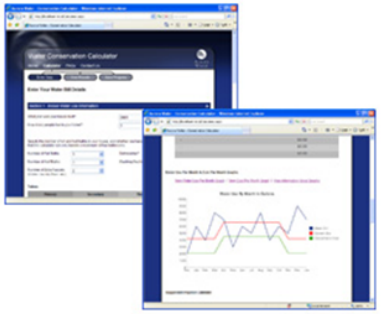
Home Calculator FAQs Contact Us

AURORA WATER

Welcome Aurora Water Customer,

Understanding where and how much water we use is the first step in beginning to conserve.

The Residential Water Use Calculator serves as an analysis of your current water use and conservation potential, providing you with a long term plan to meet your conservation goals. It is recommended that you review the calculator before using it to determine what data you need to collect. This will be the longest part of the process. The Calculator requires specific information about your property, including:



1. Construction Year
2. Number of family members
3. Indoor appliance usage data
   (Toilet, shower, faucet, washing machine & dishwasher)
4. Zone-by-zone irrigation system details

Once this information is entered, determine which retrofit actions you are interested in taking under the retrofit options pulldown menus. Based on your decisions, your 'Ranked Conservation Plan' will be produced. As you complete these steps, you will be able to view your changes graphically on the following spreadsheet as your water use approaches your conservation goals. Finally, the Water Use Calculator will produce an 'Irrigation Calendar' based on your plant material, environmental factors, and irrigation system information.

tion Calculator

Contact Us

AURORA WATER

Enter Data | View Results | Save Progress

Enter Your Water Use Information

- Section 1 - Indoor Water Use Information
- Section 2 - Outdoor Water Use Information
- Section 3 - Water Bill Information
- Section 4 - Indoor Retrofits and Behavior Changes
- Section 5 - Outdoor Retrofits and Behavior Changes

From Concept to Reality – SIP History

The path from reactive program toward proactive conservation:

- Growing trend toward water-budgeting
- Early 'irrigated-area' data born of the City's LIRF study
- Demonstrated need for outdoor water use information, city-wide
- 2007 Water Conservation Plan
- Pilot study – landcover and ROI-rebate analysis
- Grant proposal to the Colorado Water Conservation Board (CWCB)

	Cost	Water Savings/Year	ROI
Current Rebates	$984.42	14,220	8.54
ROI Rebates	$64.57	19,577	0.41

Table 4: Cost and Savings comparison between Aurora's current rebate programs and Aurora's proposed ROI based rebate programs. The ROI in the third column supports the idea that customers would benefit greatly from the new options.

Conservation Program Assumptions and Goals

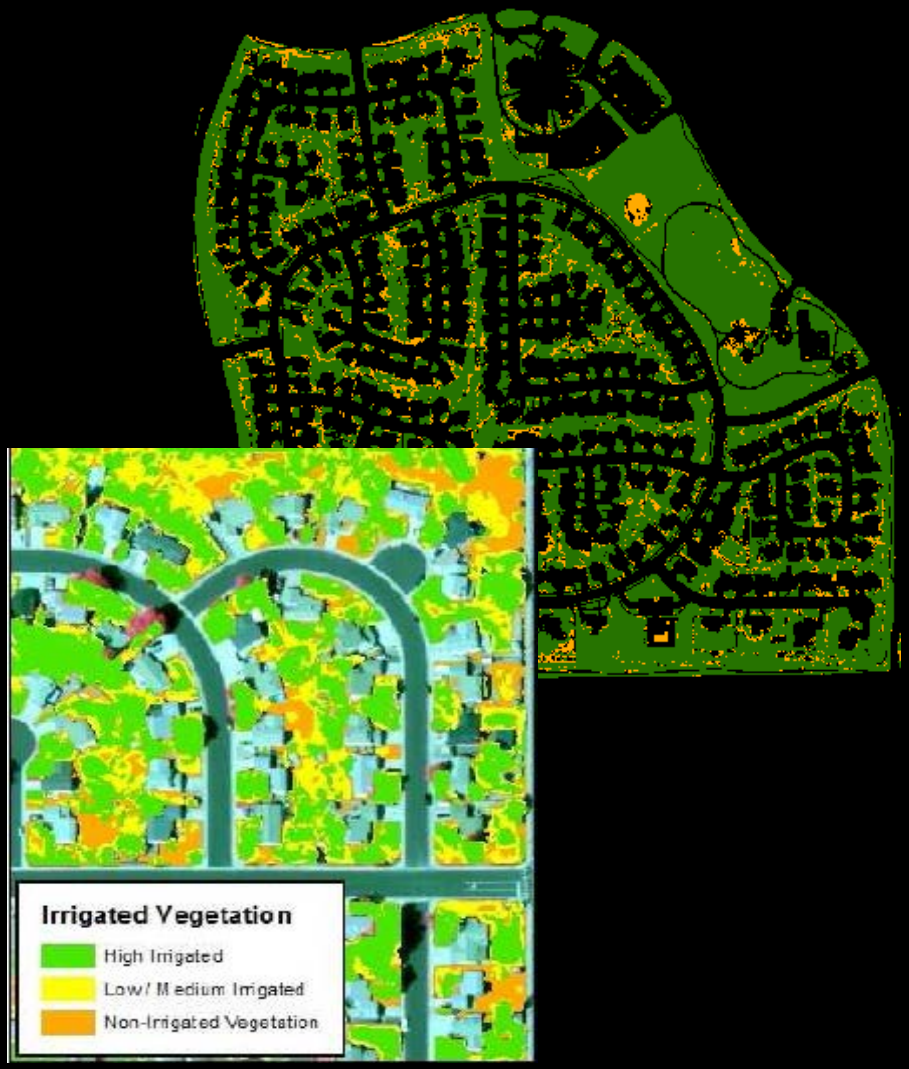
Conservation Observations and Assumptions:

- Targeted outreach is cheaper and more effective than generic efforts
- Active engagement and awareness will help change consumptive behaviors
- Holistic (system-wide) rebates/incentives will yield better results
- Water-budget information and potential $-savings from lower consumption listed on water bill will hit home with customers

Primary Project Goals:

- Develop a water-use map for visualization and planning
- Identify the biggest water-wasters and target outreach to those customers
- Empower customers to understand their water use and outdoor needs
- Improve rebate/incentive program efficiency and ROI

AMEC's Geospatial Role



- Landcover mapping
  - Vegetation
  - Impervious
  - Soil / Non-Veg
  - Water / Shadow
- Vegetation categorization
  - Level of stress / health
  - Insight into level of irrigation
- Database development
  - Parcel-based
  - Combination of water-budget factors and consumption information

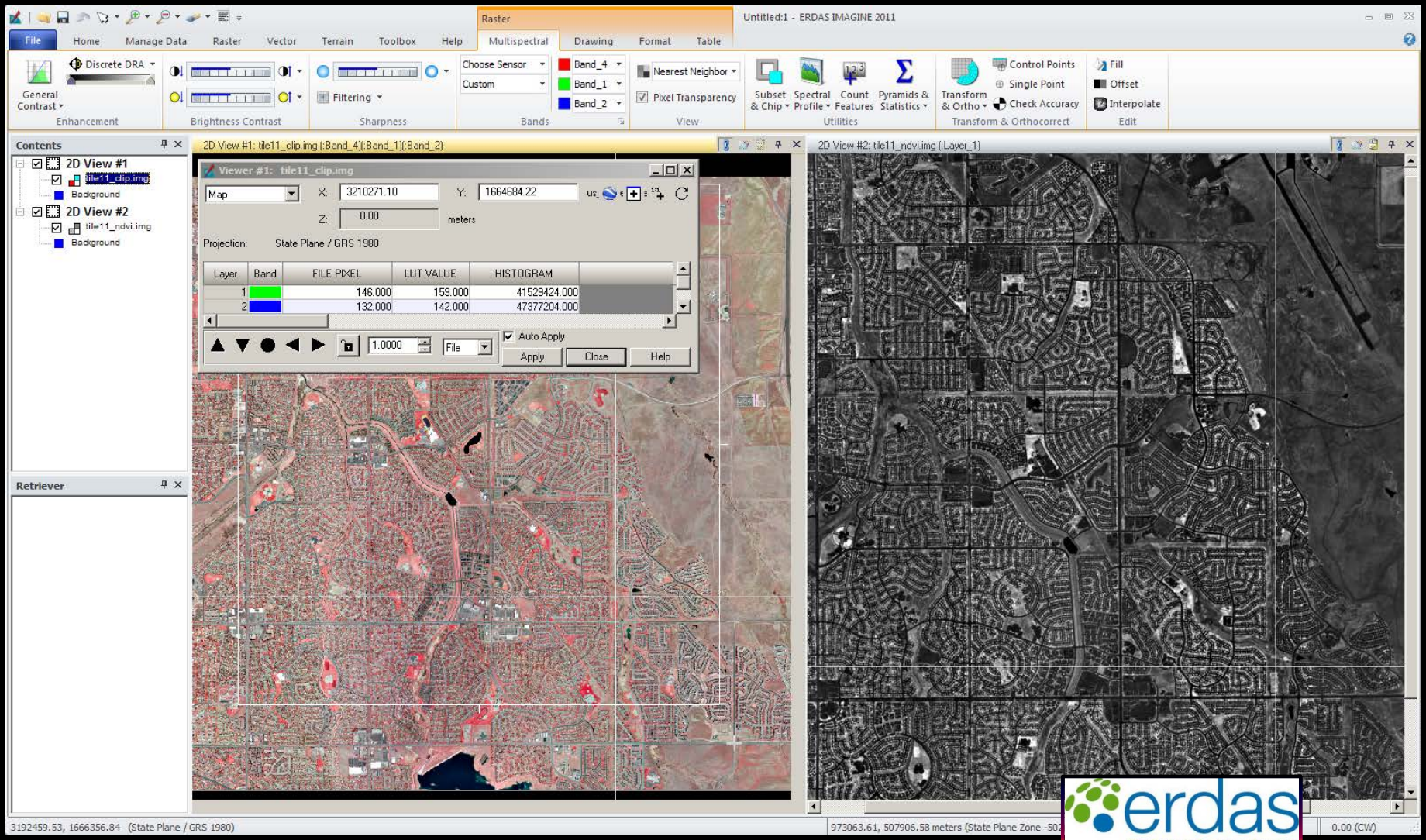
Denver Regional Aerial Photography Project

DRAPP Specifications:

- Denver metro coverage
- 2010 collection
  - Spring / leaf-off
- 6” resolution
- 4 Spectral Bands
  - Blue
  - Green
  - Red
  - NIR
- Compressed JPEG 2000 format

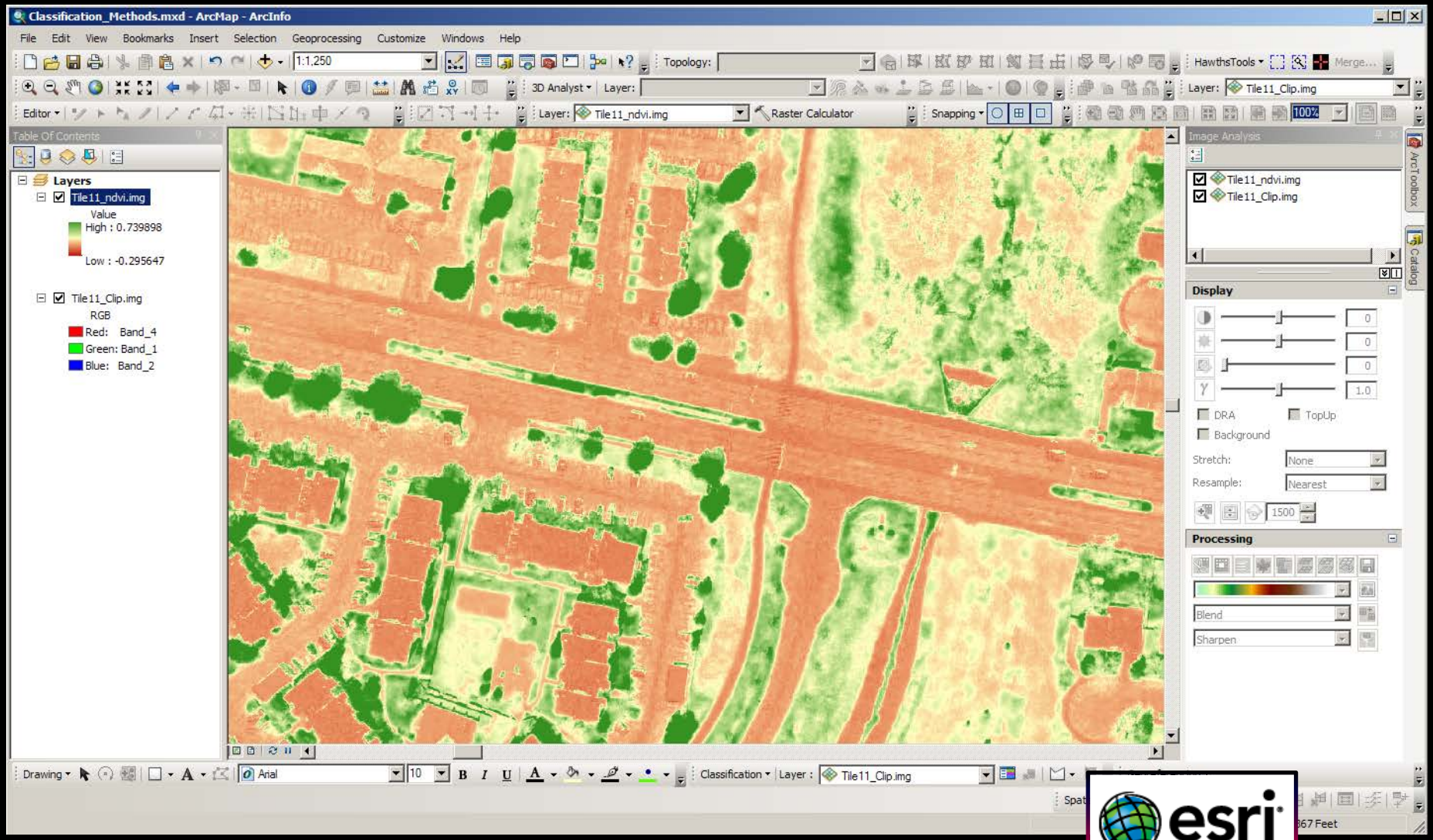
Workflow & Results

Image Processing Tools – ERDAS Imagine

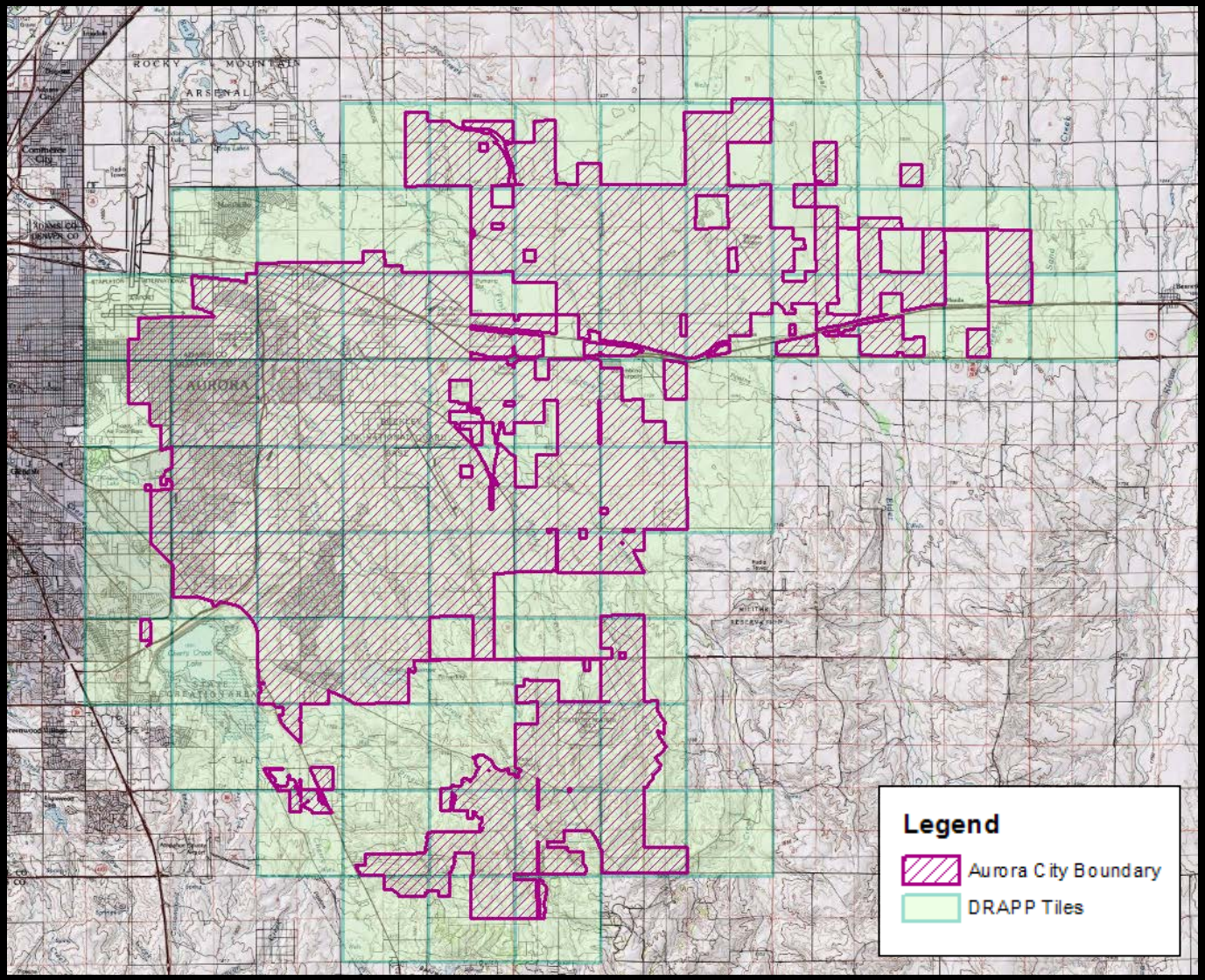


Workflow & Results

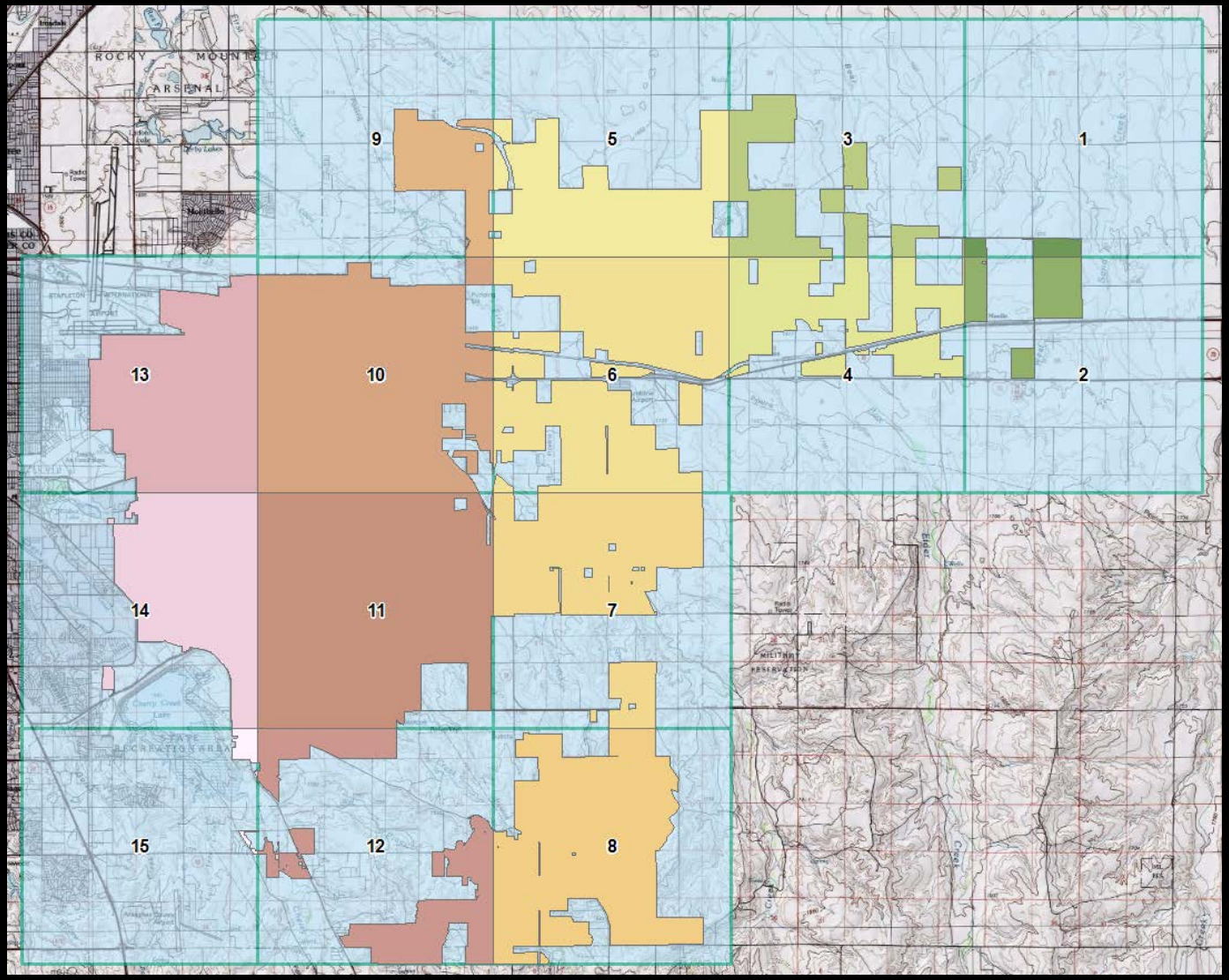
Image Processing Tools – ESRI ArcGIS



Project Area

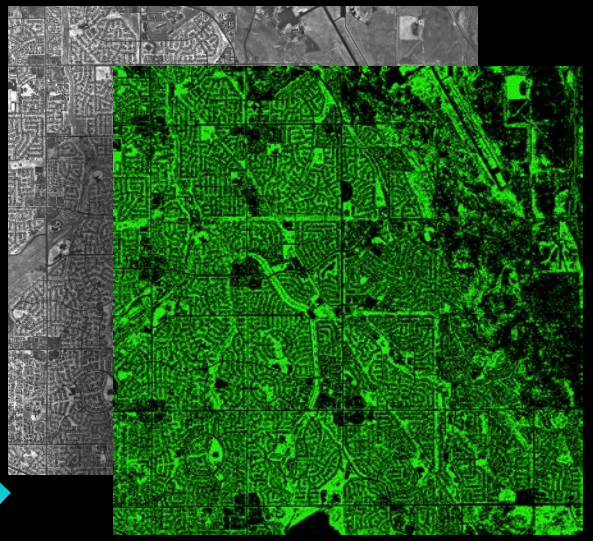


Imagery Prep – Tile Scheme



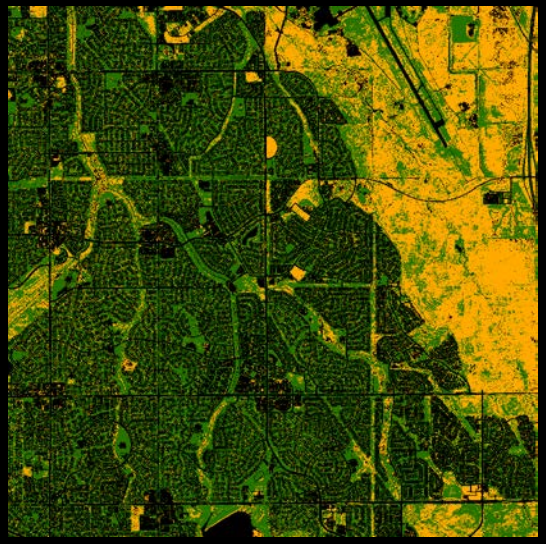
Mapping Process Overview

Clip Imagery to Tiles



Compute / Render NDVI

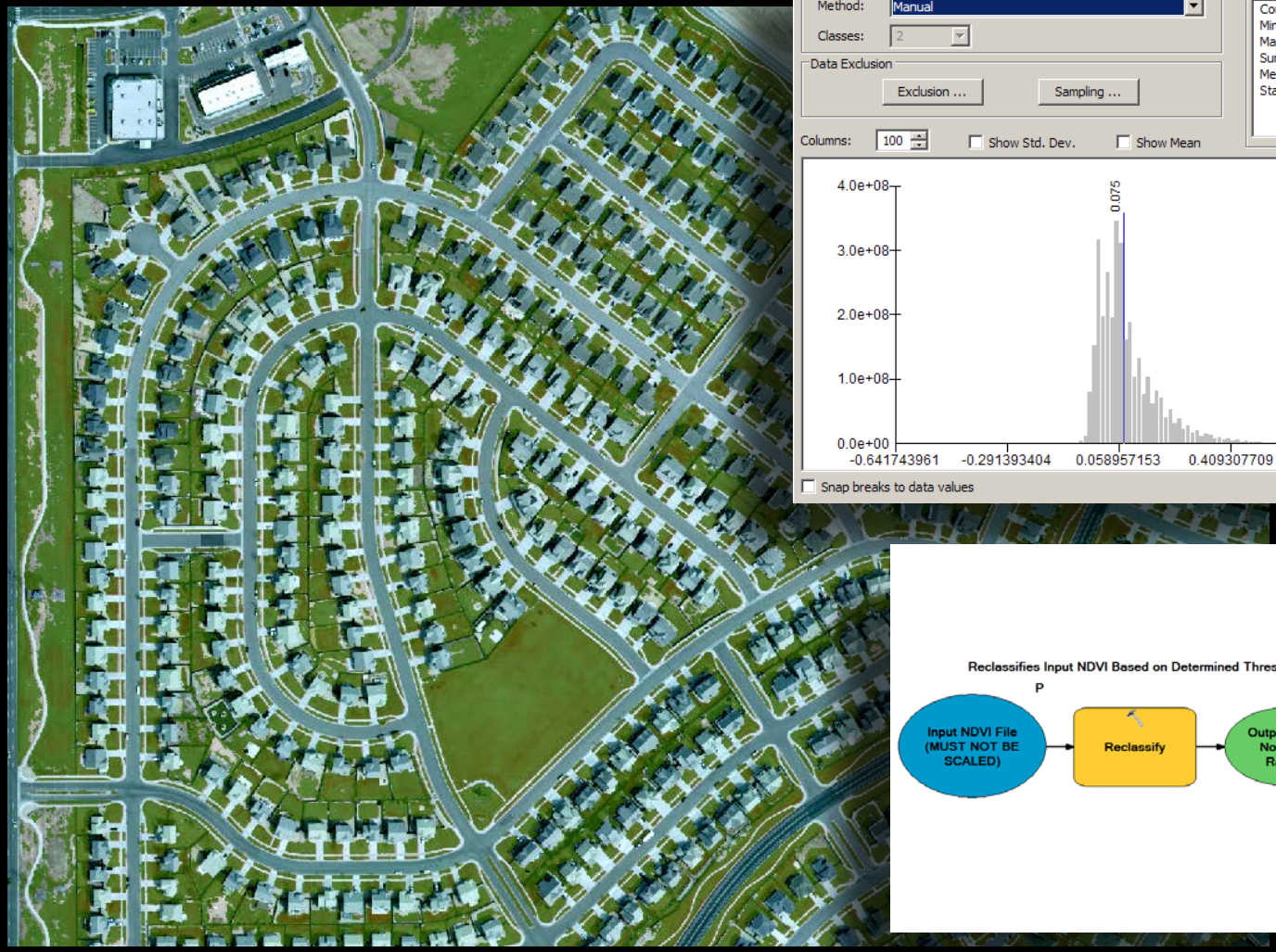
Base Classification

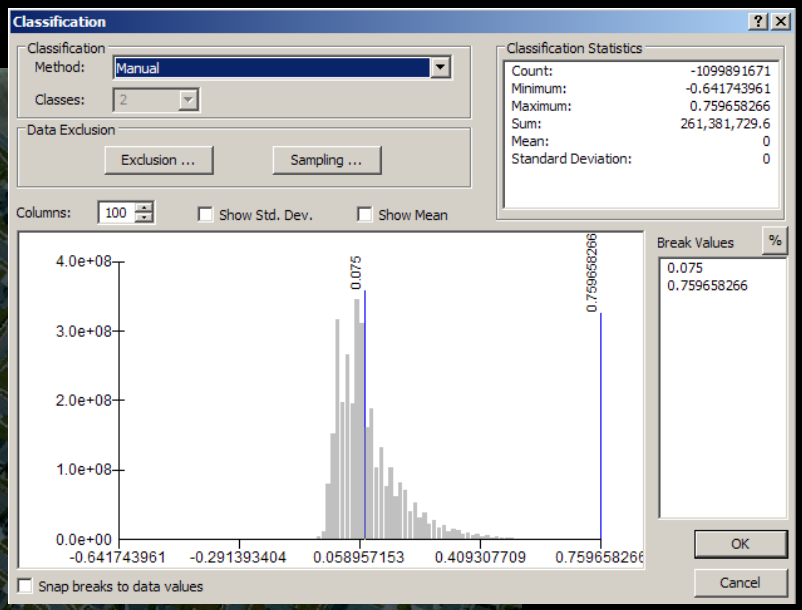


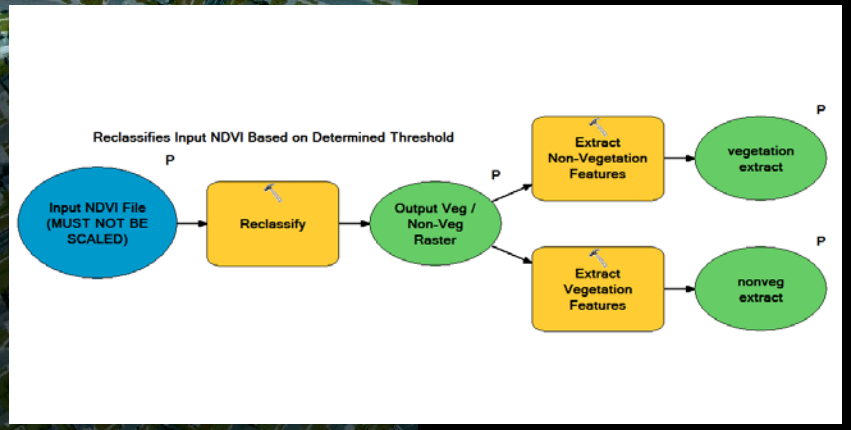
Vegetation Analysis

Mapping Process Overview

NDVI Threshold







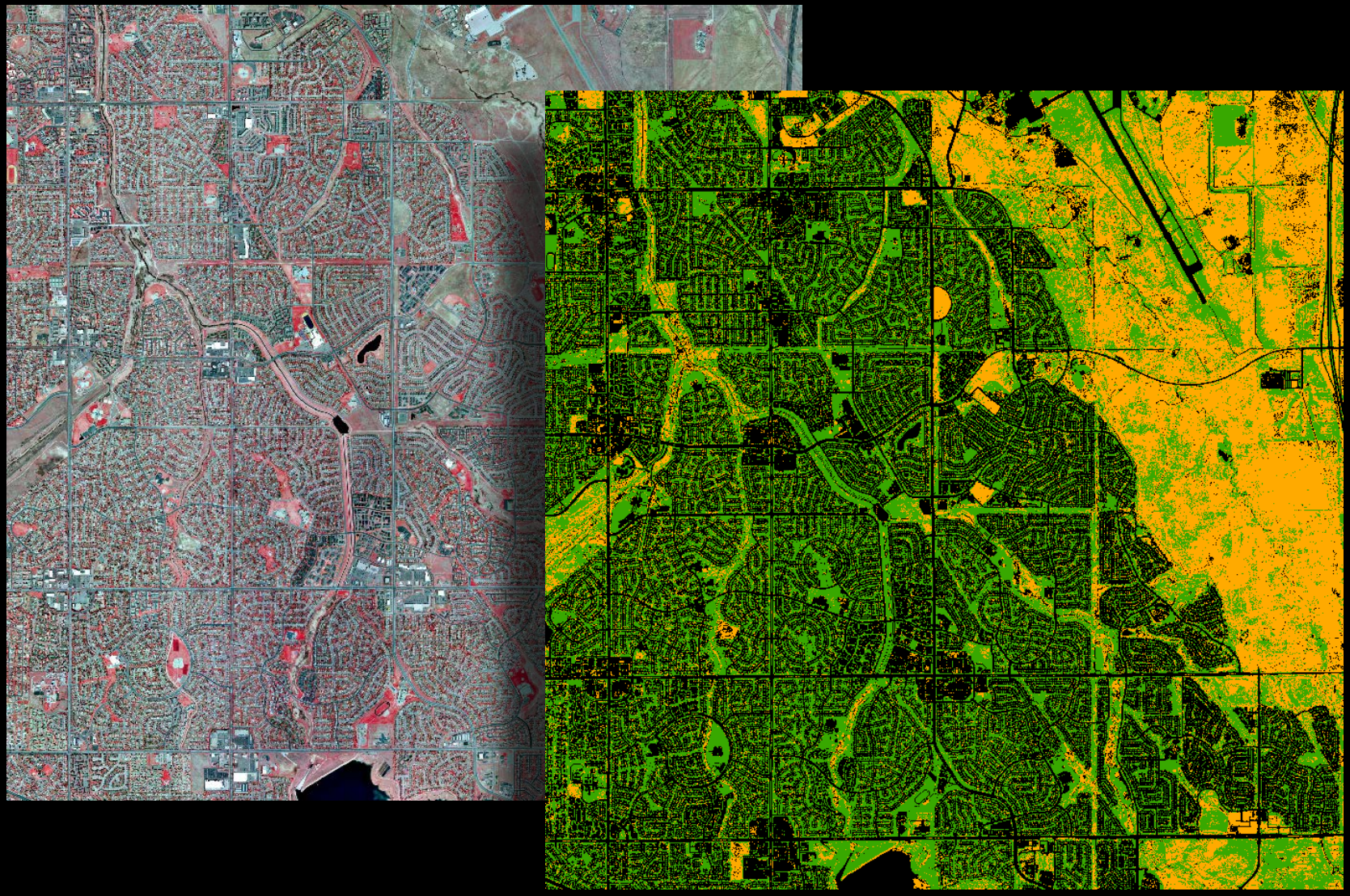
Mapping Process Overview

Training Samples

Mapping Process Overview

Post Processing

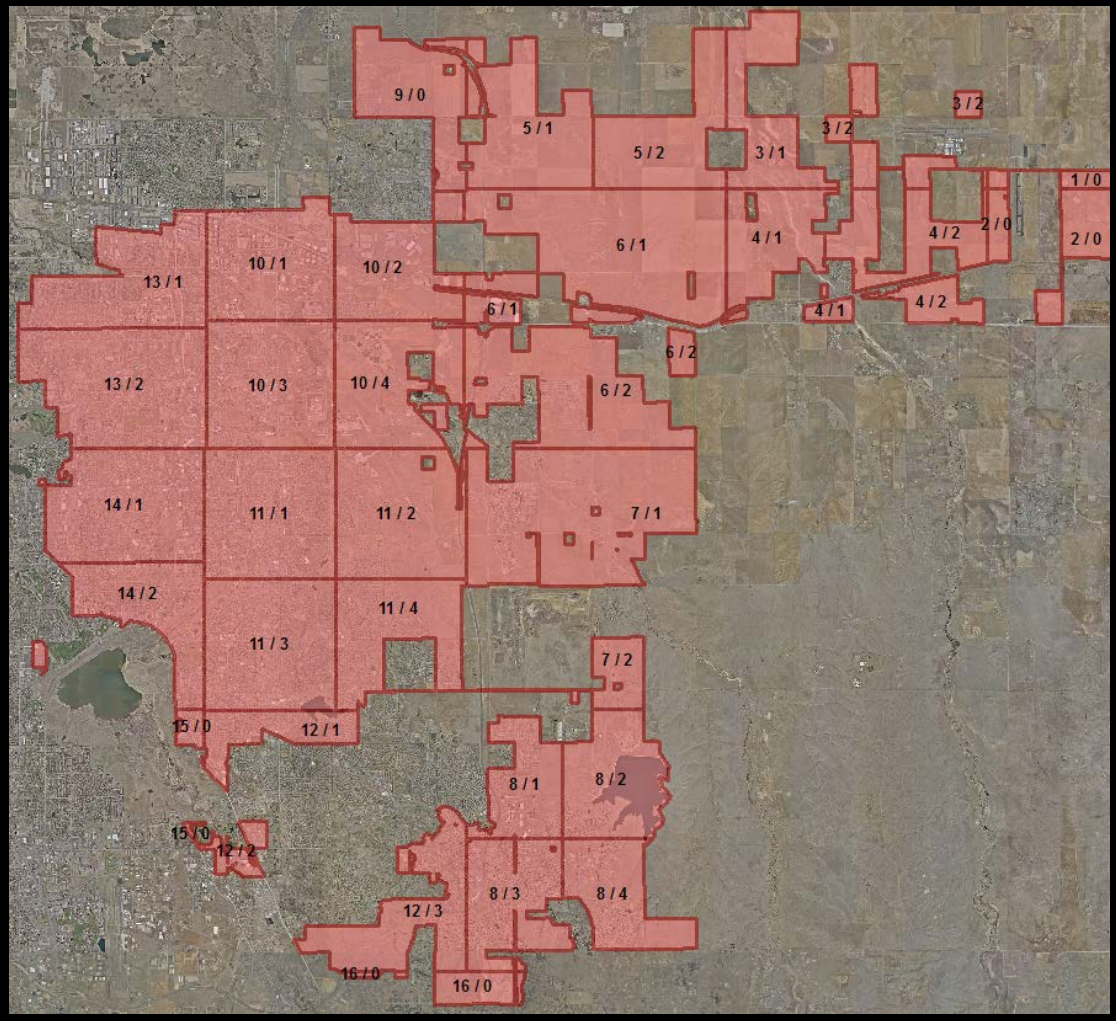
Mapping Process Overview



Mapping Process Overview

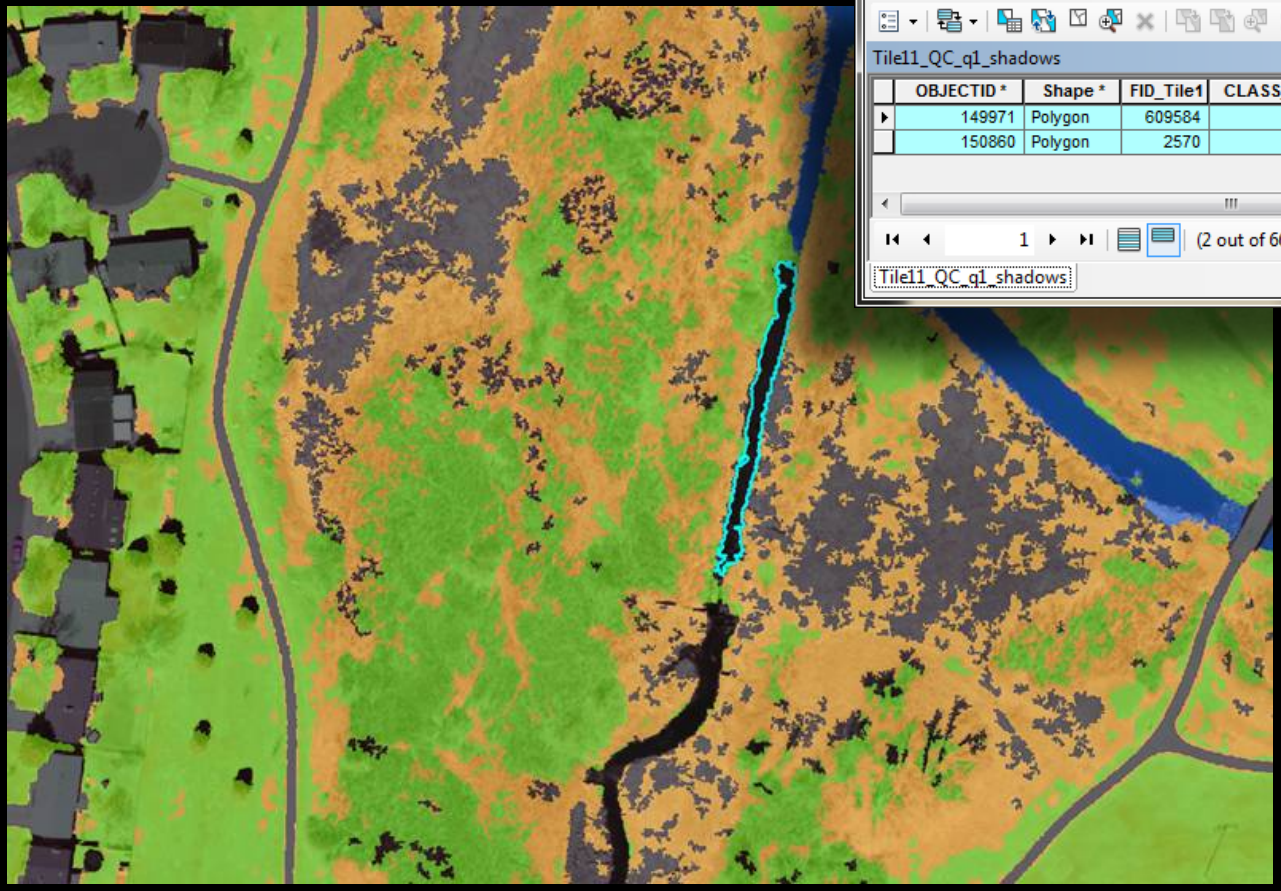
Mosaic and QC

- Stack Individual Classification Results
- Export Results to Vector Format
- Subset data to Quarter Sections
- Review / QC Results
  - Review Areas within City of Aurora Boundary only
  - Reassign Class Values to Clean data
  - Water / Shadow class developed and assembled during QC process



Mapping Process Overview

Water / Shadows



Table

Tile11_QC_q1_shadows

OBJECTID *	Shape *	FID_Tile1	CLASS_ID	Class	SHADOW	Shape_Length	Shape_Ar
149971	Polygon	609584	0	Impervious	0	14669.228654	62257.767
150860	Polygon	2570	0	Impervious	77	812.999032	2641.983

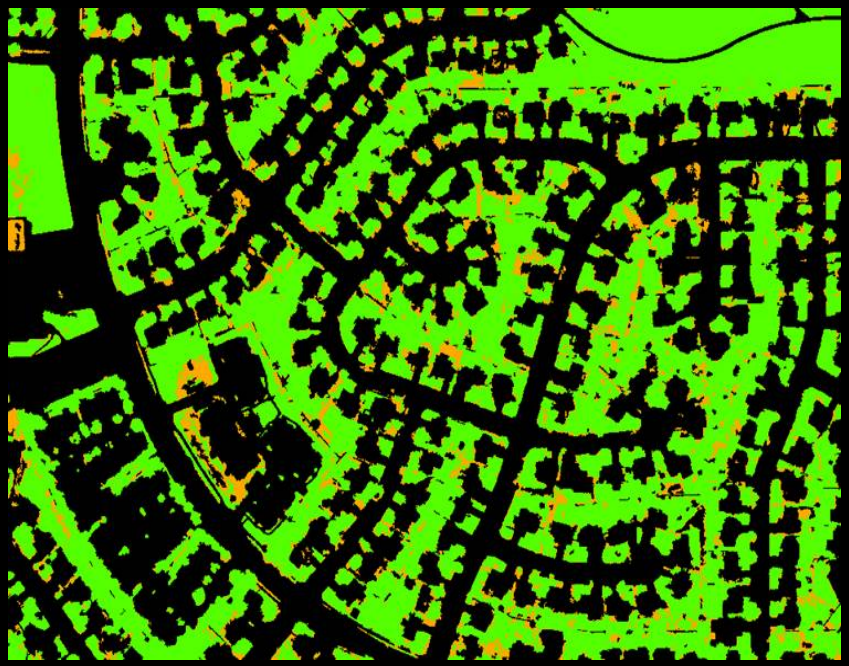
1 (2 out of 661604 Selected)

Tile11_QC_q1_shadows

Mapping Process Overview

QC Findings...

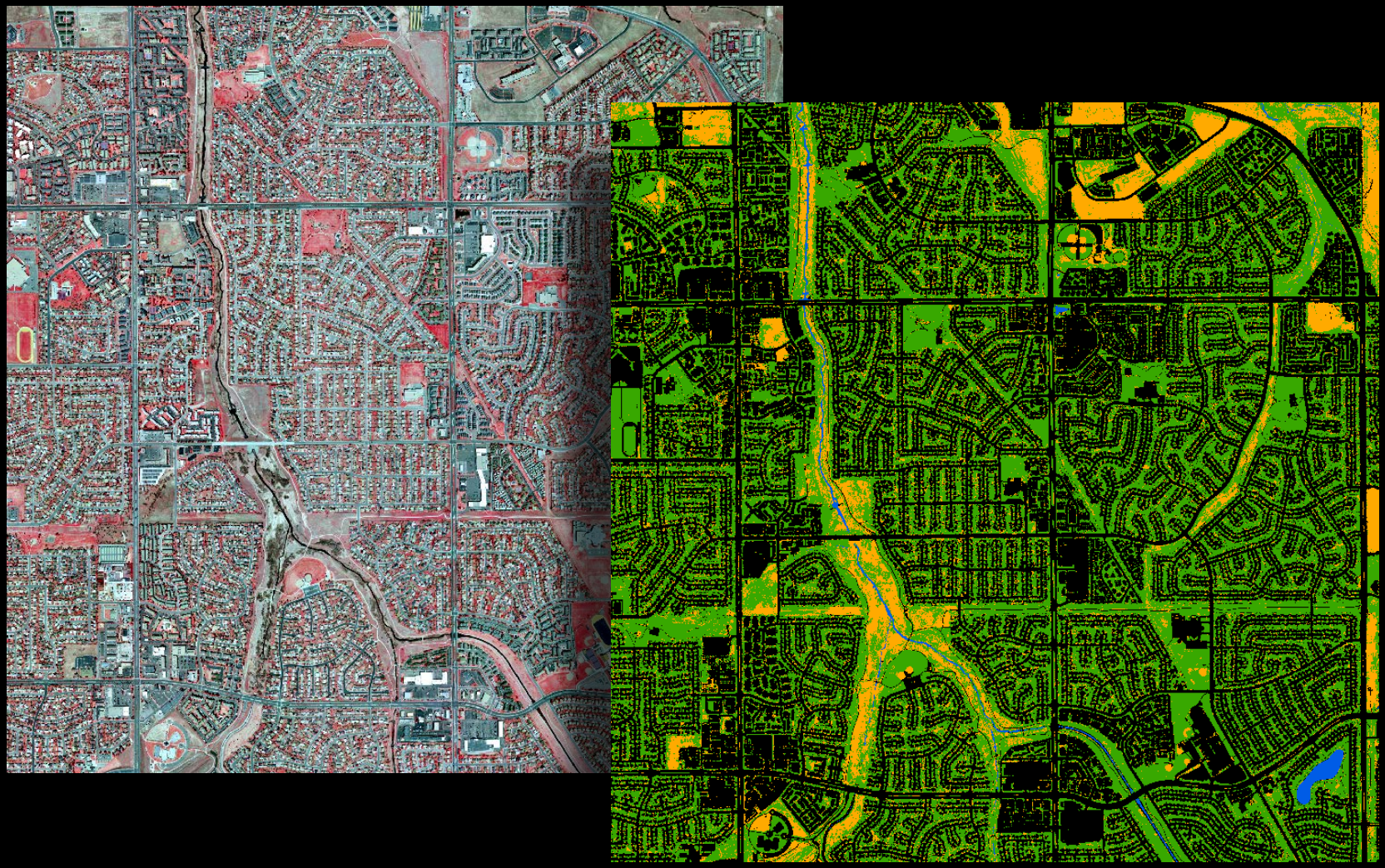
Fence Lines and Shadows



Faux Grass

Mapping Process Overview

Post QC Results

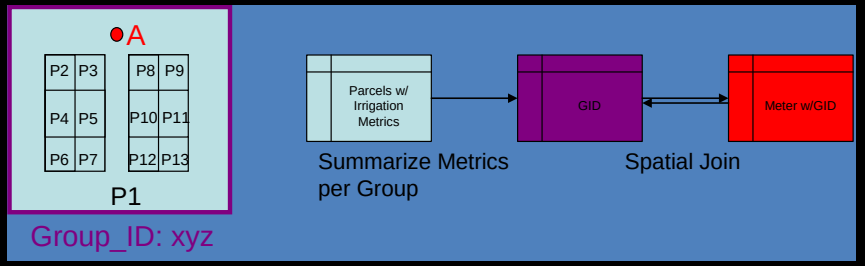


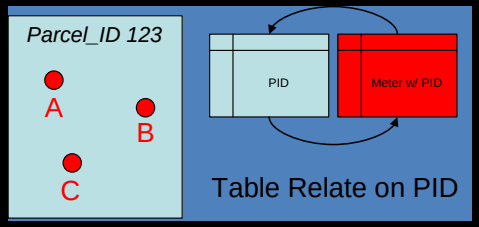
Mapping Process Overview

Vegetation Stress

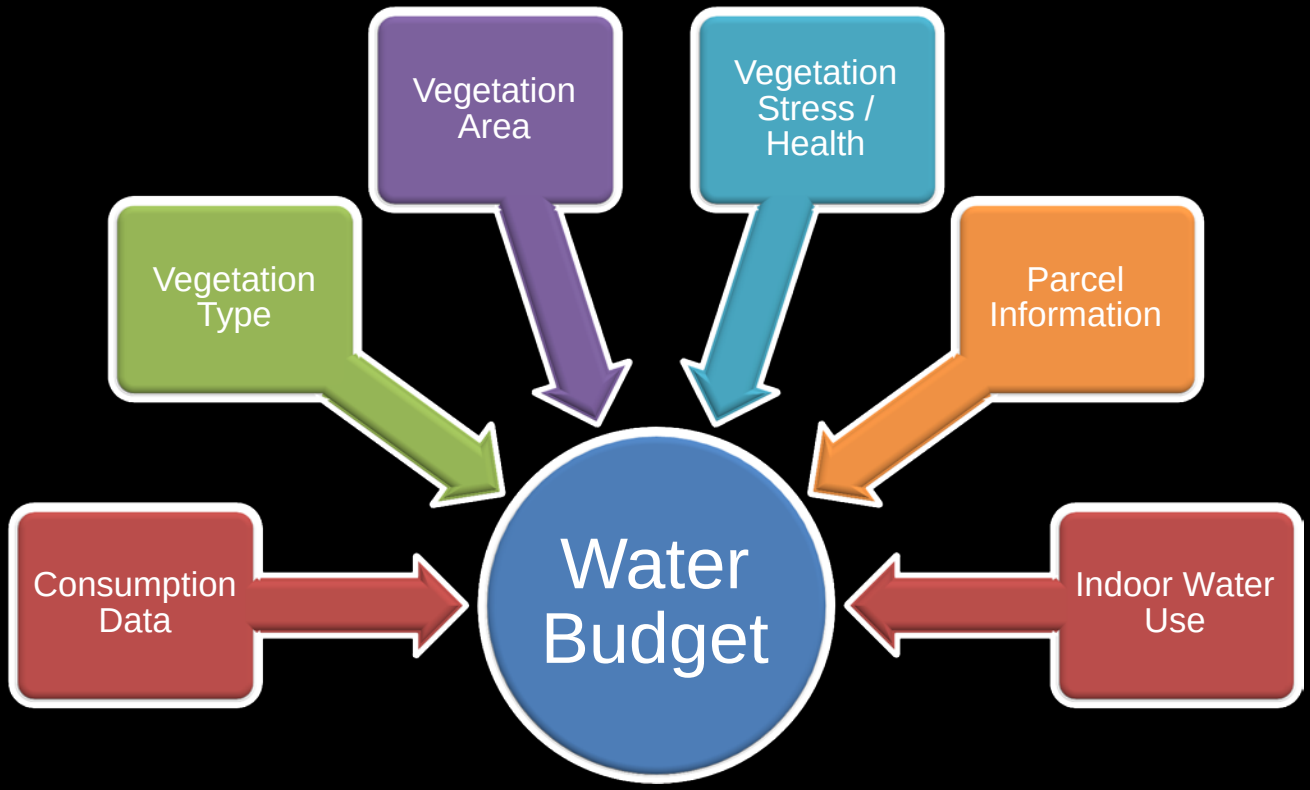
Water-Use Database Development

- Water Use Database
  - Landcover
  - Irrigated Area
  - Customer Data
  - Parcel Data
  - Meter (Consumption) Data
  - Master Calculator File
  - Geoprocessing Tools



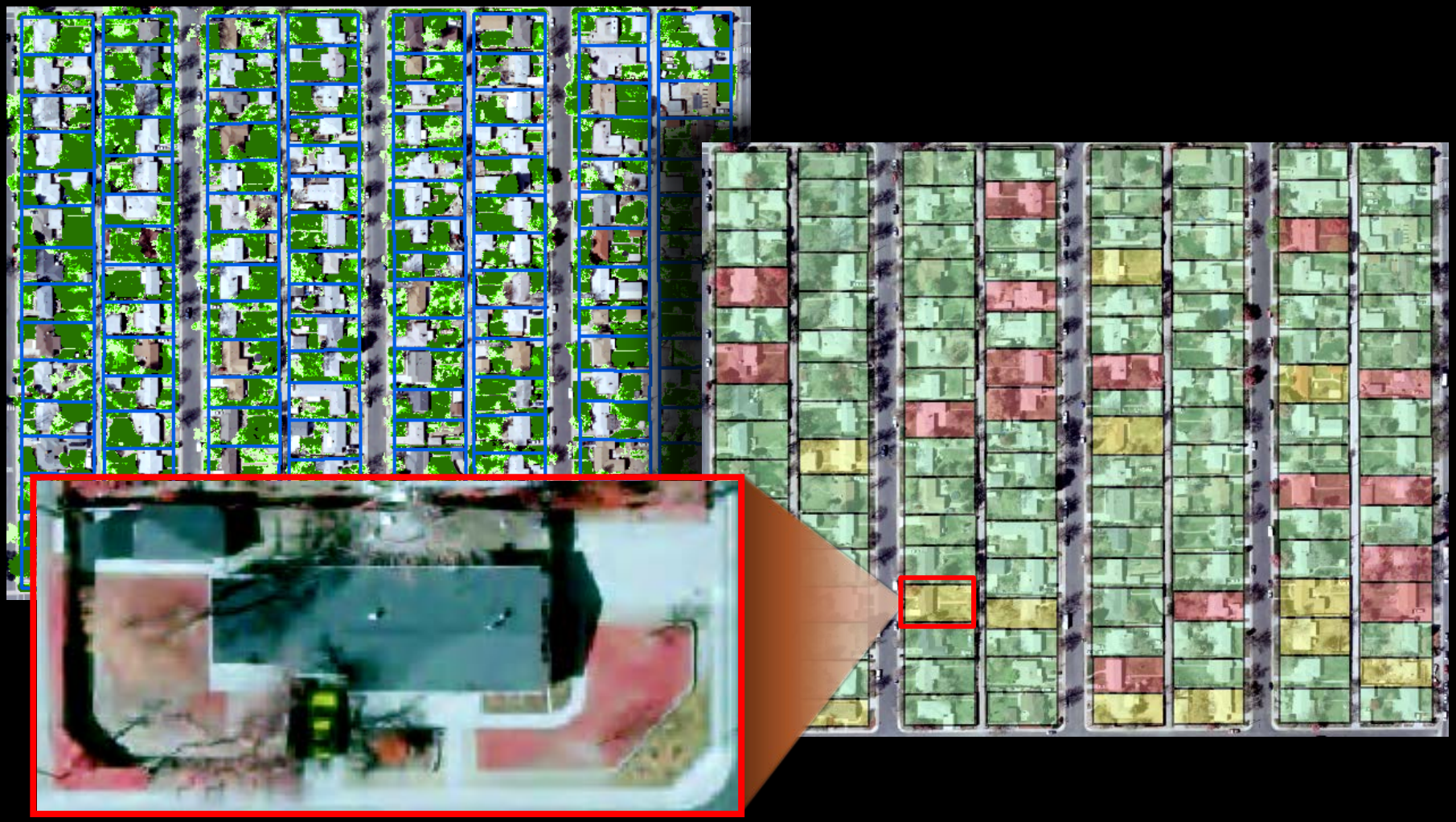


Water-Use Information At a Glance



Consumption compared to predicted water budget reveals where water is likely being wasted.

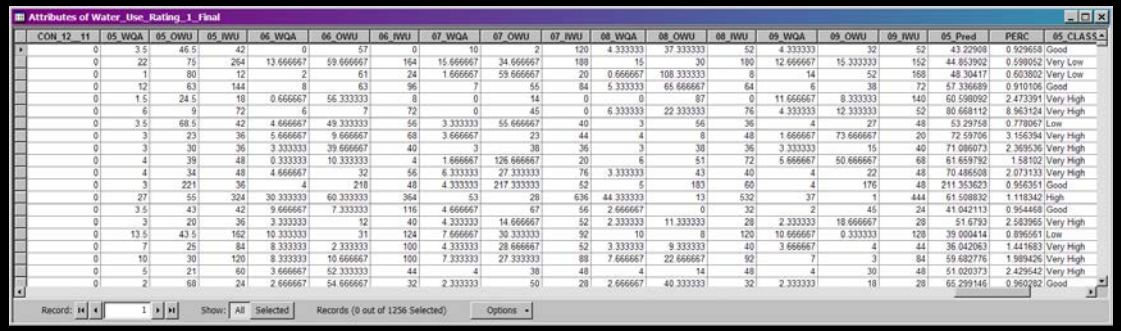
Water-Use Database Development



Water-Use Map and Targeted Outreach

Easy visualization of water-use trends

Editable water-use calculation environment


Attributes of Water_Use_Rating_1_Final

CON_12__11	05_WQA	05_OWU	05_IWU	06_WQA	06_OWU	06_IWU	07_WQA	07_OWU	07_IWU	08_WQA	08_OWU	08_IWU	09_WQA	09_OWU	09_IWU	05_Pred	PERC	05_CLASS
0	3.5	46.5	42	0	57	0	10	2	120	4.333333	37.333333	52	4.333333	32	52	43.22908	0.929658	Good
0	22	75	264	13.666667	59.666667	164	15.666667	34.666667	188	15	30	180	12.666667	15.333333	152	44.853902	0.599052	Very Low
0	1	80	12	2	61	24	1.666667	59.666667	20	0.666667	108.333333	8	14	52	168	48.30417	0.603802	Very Low
0	12	63	144	8	63	96	7	55	84	5.333333	65.666667	64	6	38	72	57.336689	0.910106	Good
0	1.5	24.5	18	0.666667	56.333333	8	0	14	0	0	87	0	11.666667	8.333333	140	60.598092	2.473391	Very High
0	6	9	72	6	7	72	0	45	0	6.333333	22.333333	76	4.333333	12.333333	52	80.668112	8.963124	Very High
0	3.5	68.5	42	4.666667	49.333333	56	3.333333	55.666667	40	3	56	36	4	27	48	53.29758	0.778067	Low
0	3	23	36	5.666667	9.666667	68	3.666667	23	44	4	8	48	1.666667	73.666667	20	72.59706	3.156394	Very High
0	3	30	36	3.333333	39.666667	40	3	38	36	3	38	36	3.333333	15	40	71.086073	2.369536	Very High
0	4	39	48	0.333333	10.333333	4	1.666667	126.666667	20	6	51	72	5.666667	50.666667	68	61.659792	1.58102	Very High
0	4	34	48	4.666667	32	56	6.333333	27.333333	76	3.333333	43	40	4	22	48	70.486508	2.073133	Very High
0	3	221	36	4	218	48	4.333333	217.333333	52	5	183	60	4	176	48	211.353623	0.956351	Good
0	27	55	324	30.333333	60.333333	364	53	28	636	44.333333	13	532	37	1	444	61.508832	1.118342	High
0	3.5	43	42	9.666667	7.333333	116	4.666667	67	56	2.666667	0	32	2	45	24	41.042113	0.954468	Good
0	3	20	36	3.333333	12	40	4.333333	14.666667	52	2.333333	11.333333	28	2.333333	18.666667	28	51.6793	2.583965	Very High
0	13.5	43.5	162	10.333333	31	124	7.666667	30.333333	92	10	8	120	10.666667	9.333333	128	39.000414	0.896561	Low
0	7	25	84	8.333333	2.333333	100	4.333333	28.666667	52	3.333333	9.333333	40	3.666667	4	44	36.042063	1.441683	Very High
0	10	30	120	8.333333	10.666667	100	7.333333	27.333333	88	7.666667	22.666667	92	7	3	84	59.682776	1.989426	Very High
0	5	21	60	3.666667	52.333333	44	4	38	48	4	14	48	4	30	48	51.020373	2.429542	Very High
0	2	68	24	2.666667	54.666667	32	2.333333	50	28	2.666667	40.333333	32	2.333333	18	28	65.299146	0.960282	Good

Record: 1 | Show: All Selected | Records (0 out of 1256 Selected) | Options

Limitations and Enhancements

Hurdles and Limitations:

- Enormous data
- Correlation between raw pixel values and lossy compression
- Radiometric error
- Tree canopy
- Multi-relationship meters and common-area property
- Leaf-off springtime imagery
- Missing or non-located meters, property/meter confusion
- Budget and timeframe

Potential Data Enhancements:

- Combine multi-temporal datasets to gain data in shadows, and more accurate estimations of natural moisture v. applied irrigation
- Tree-canopy, precipitation, solar exposure, wind exposure, temperature
- Complete meter location / assignment

What's Next…

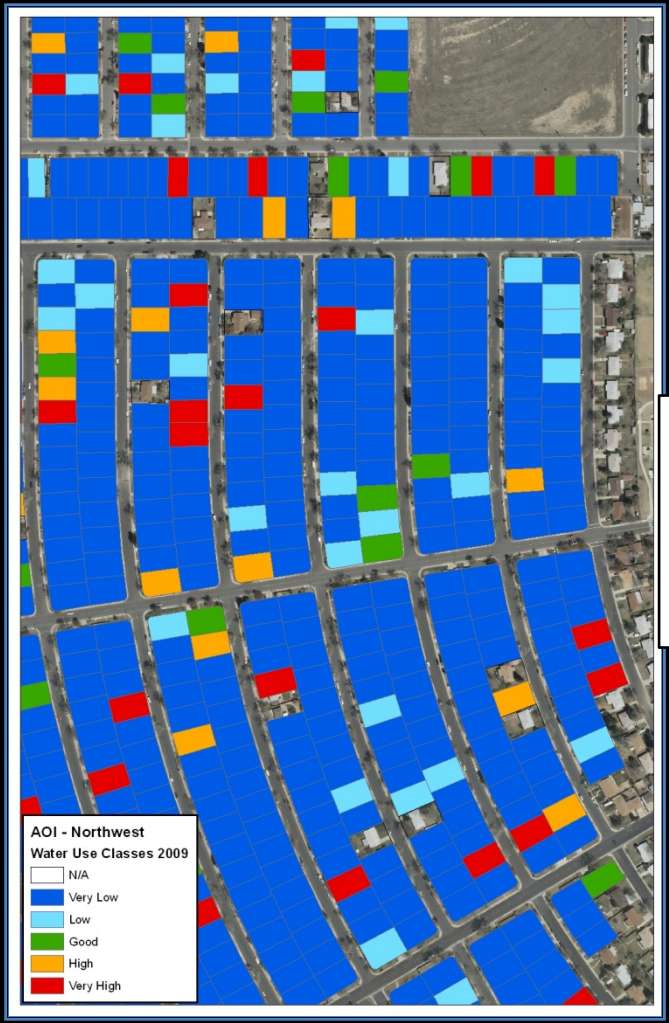
Immediate Applications:

- City will target the top 200 residential water-wasters for completion of grant-funded study
- Work with Water Billing department to add water-budget and conservation savings information directly to monthly water bill

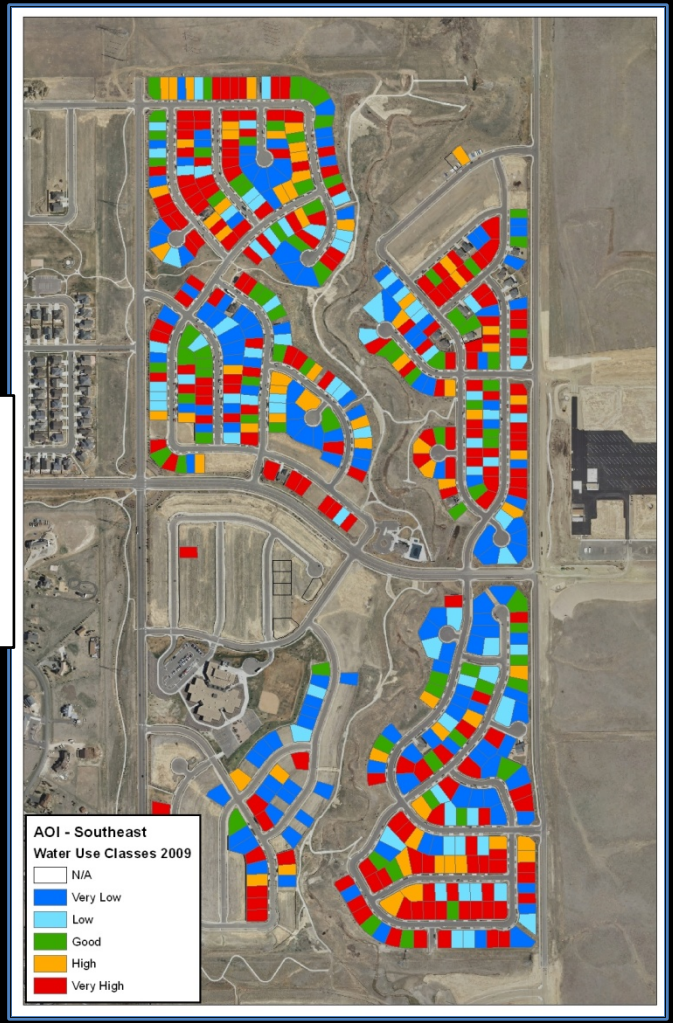
Future Refinements / Applications:

- Expand SIP to non-residential customers
- Web-based calculator enhancements
- Web-based interactive mapping tools for customers
- Water-budget based allocation and billing
- Share application and tools with other communities and water utilities

What's Next…



Categories:
Very Low Water Use: <70%
Low Water Use: 70% - 89%
Good Water Use: 90% - 110%
High Water Use: 111% - 130%
Very High Water Use: >130%



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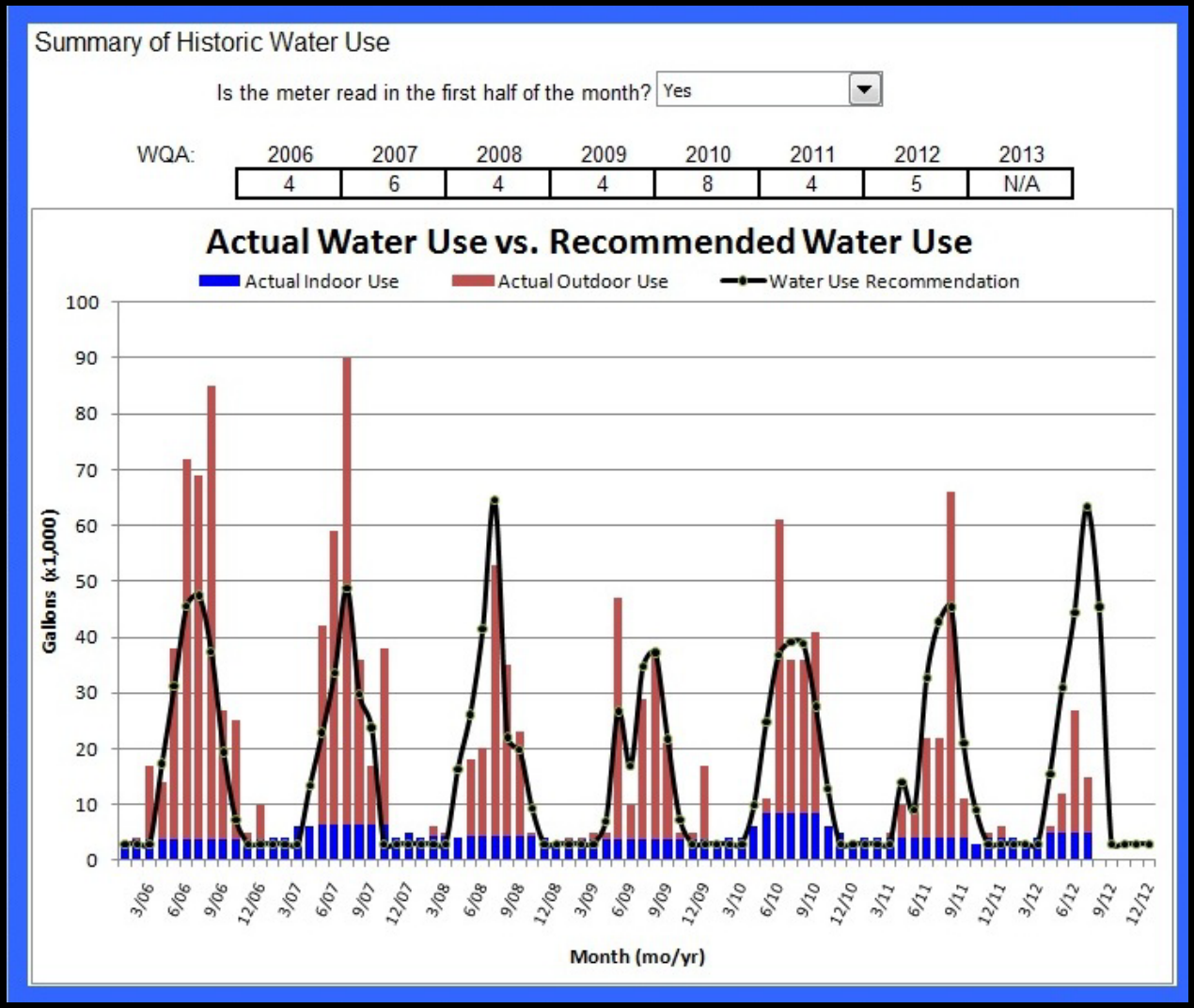
Data Applications

What's Next…



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Thank You!

www.amec.com

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