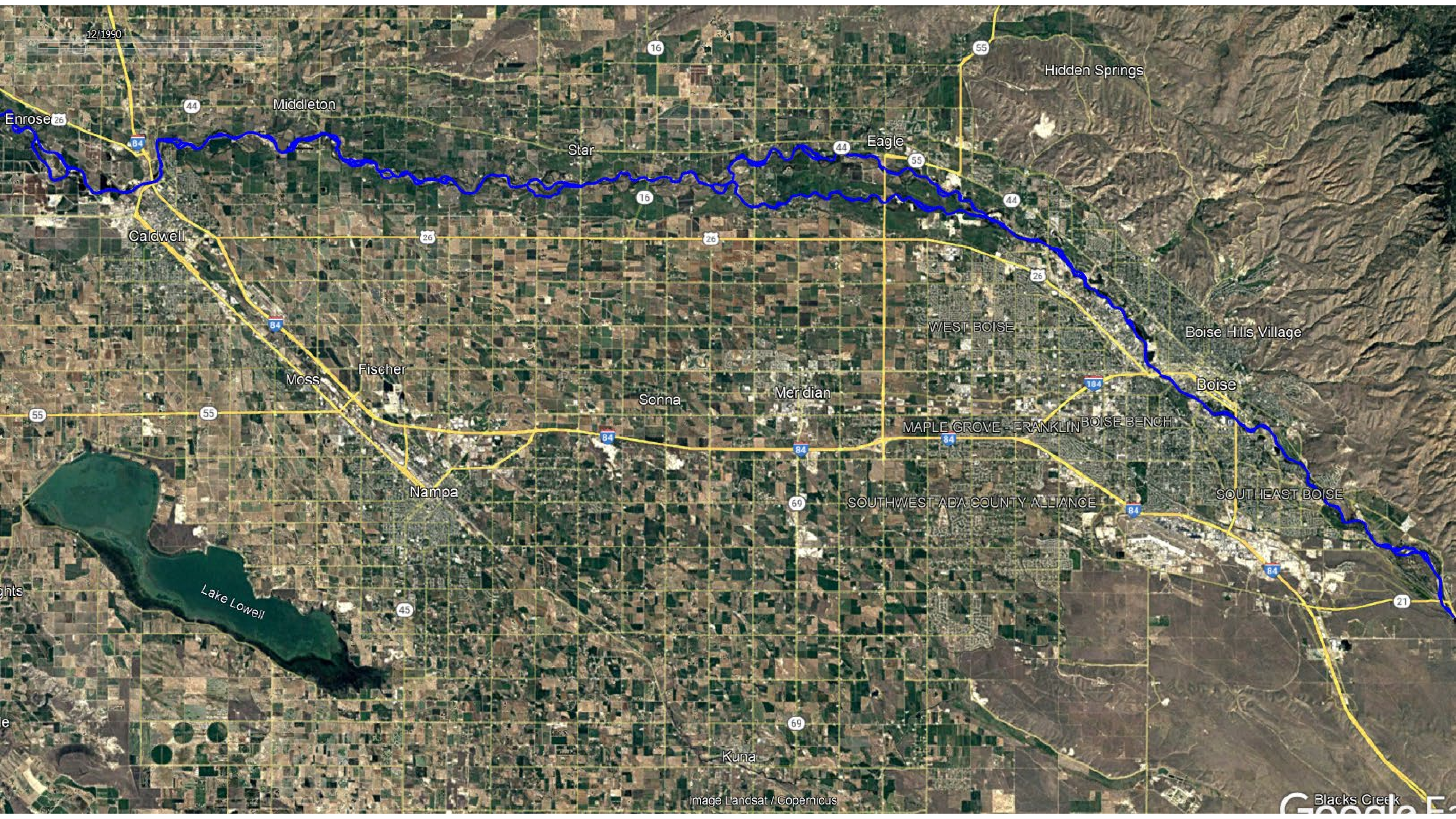
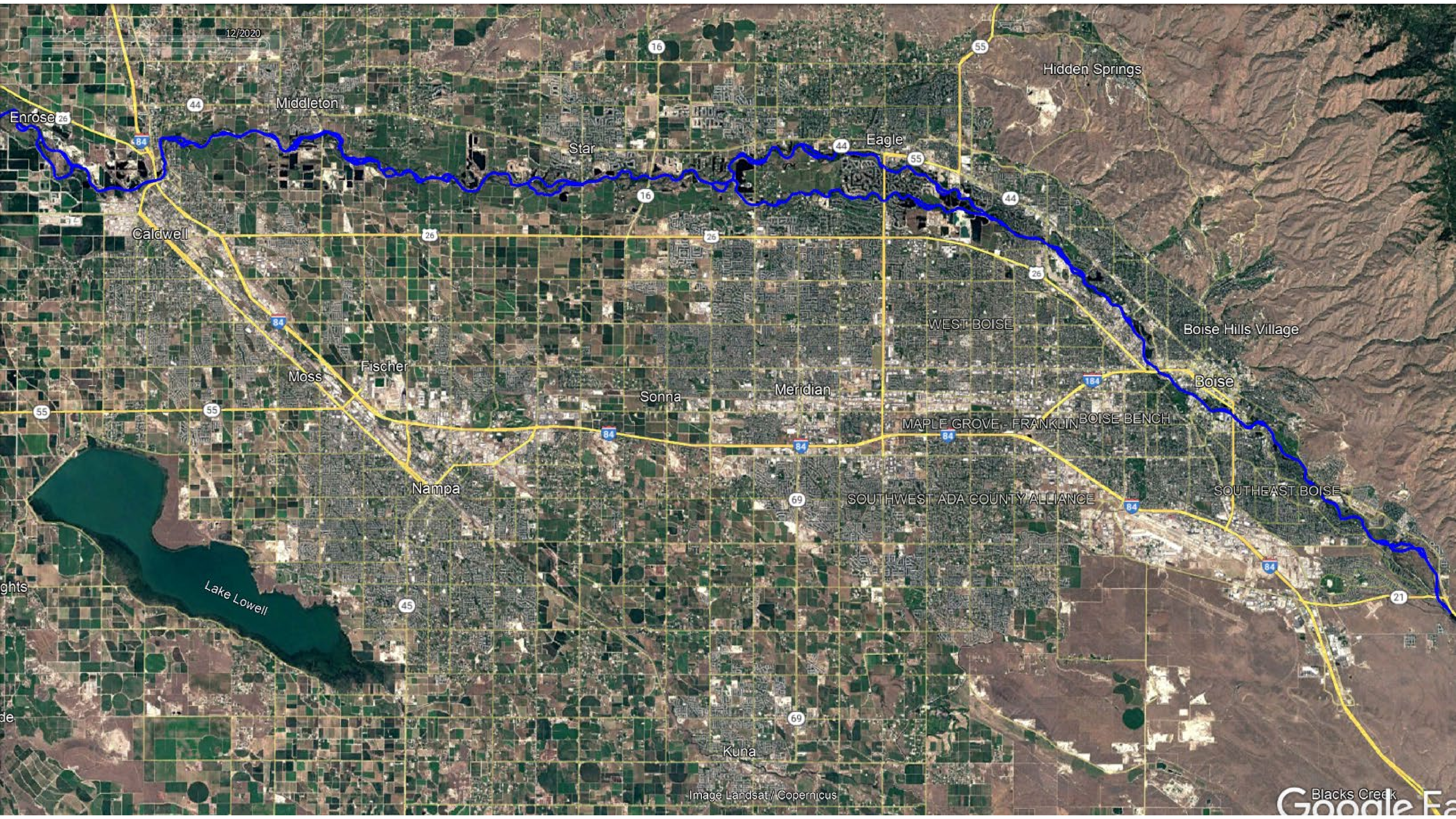
Treasure Valley Urbanization: Developing Tools to Assess & Manage Change



12/1990
Enrose
Middleton
Star
Eagle
Hidden Springs
Caldwell
WEST BOISE
Boise Hills Village
Boise
Fischer
Moss
Sonna
Meridian
MAPLE GROVE - FRANKLIN
BOISE BENCH
Nampa
SOUTHWEST ADA COUNTY ALLIANCE
SOUTHEAST BOISE
Lake Lowell
Kuna
Blacks Creek
Image Landsat / Copernicus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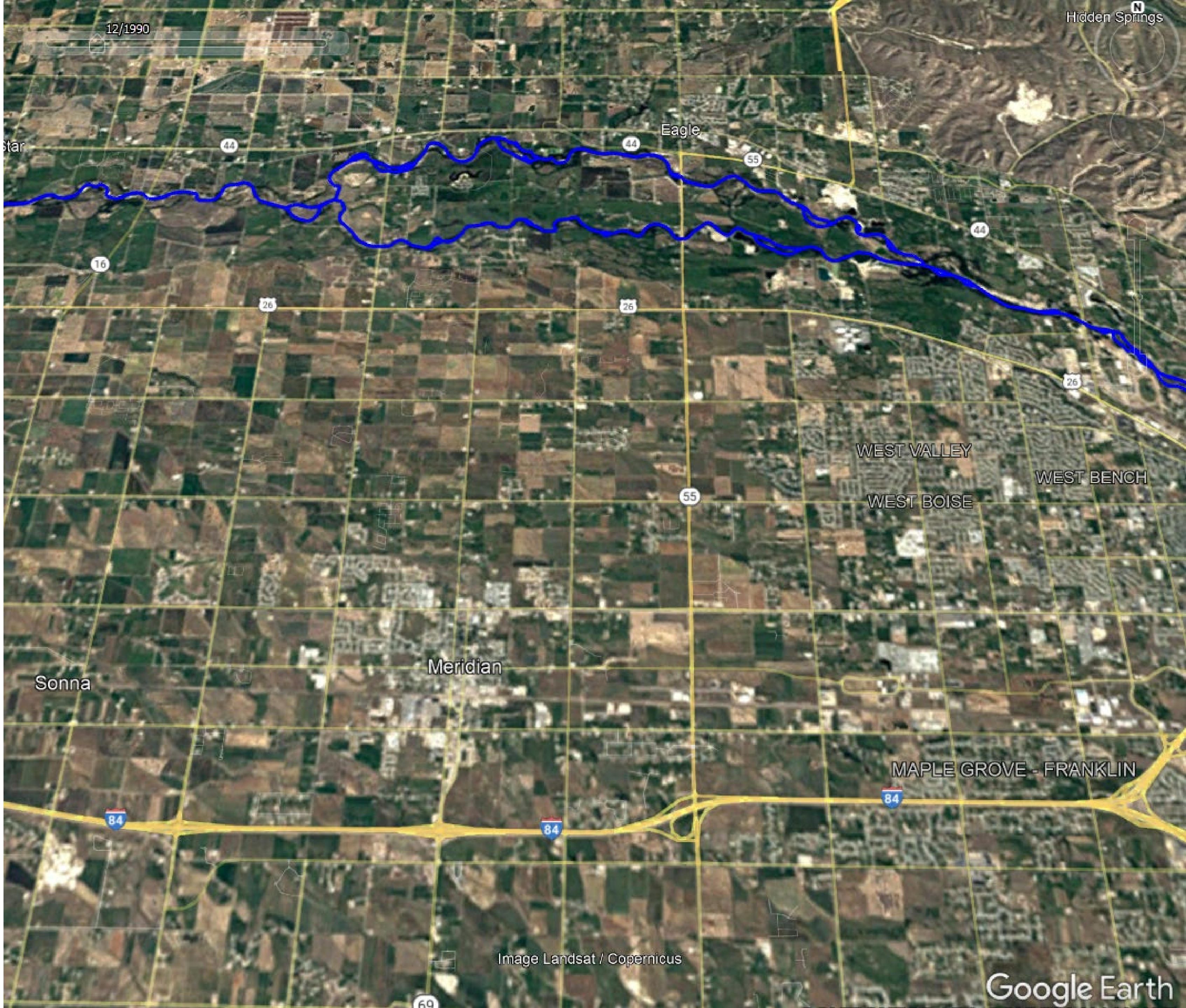
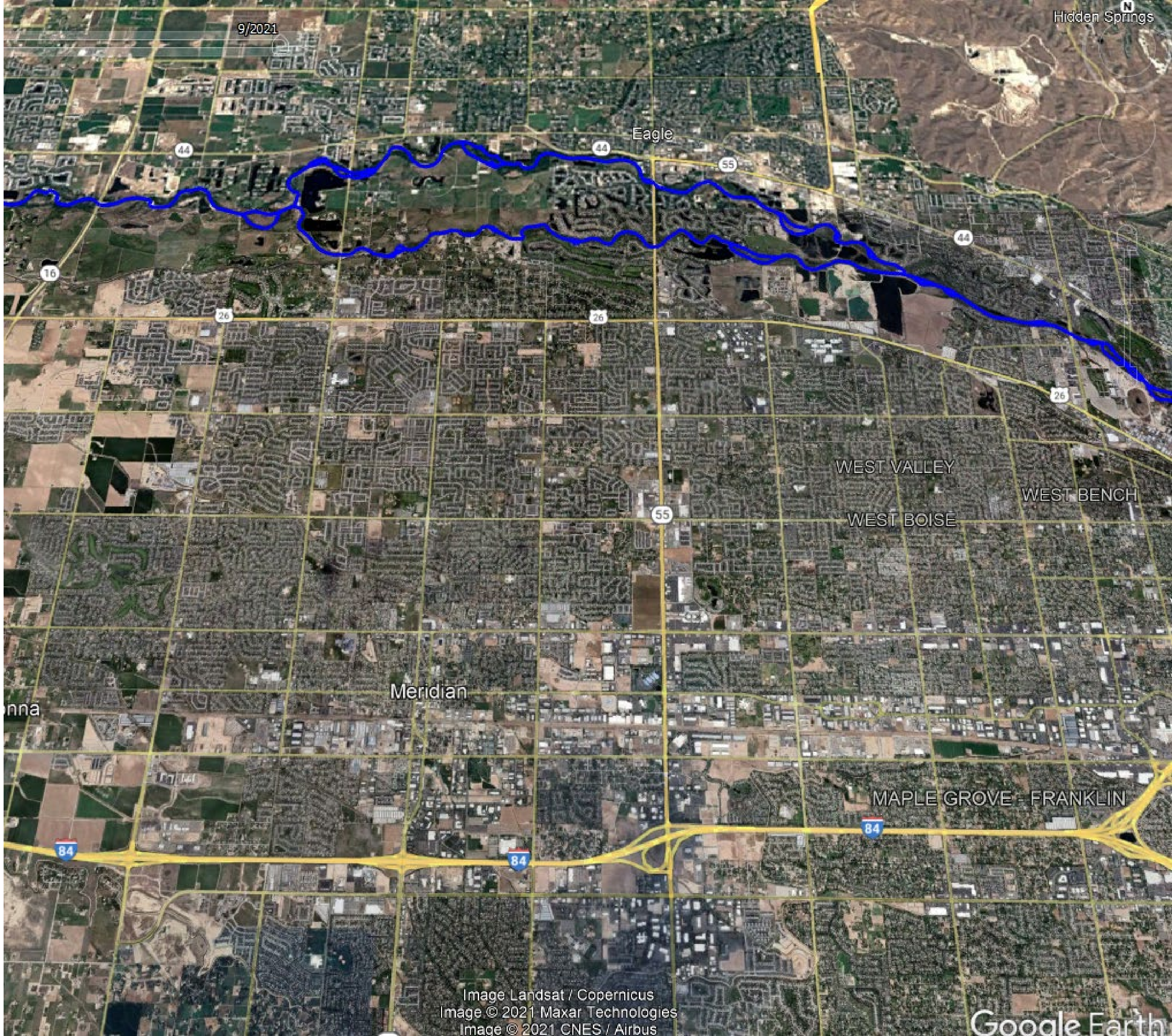
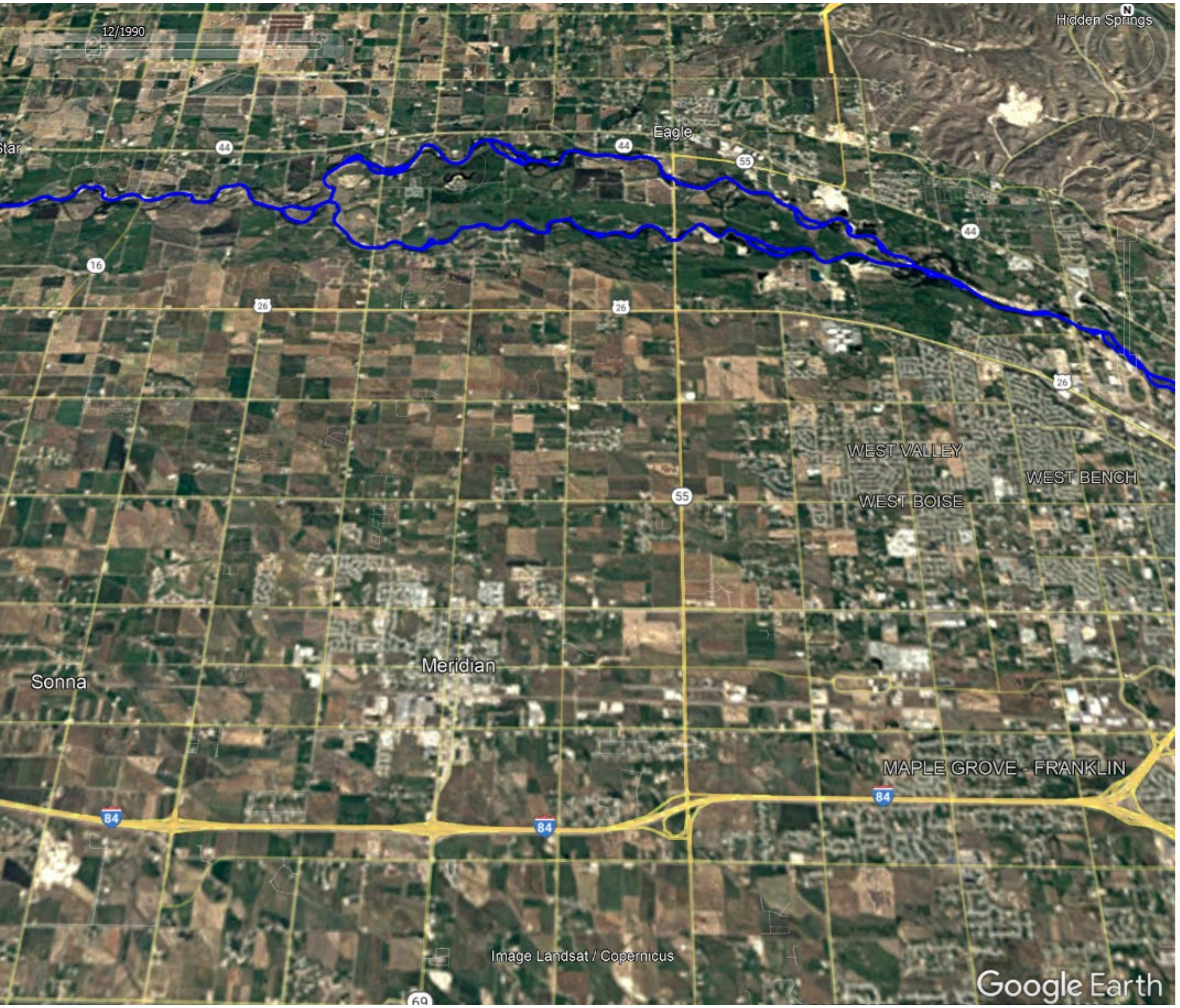
Ada County: 1990

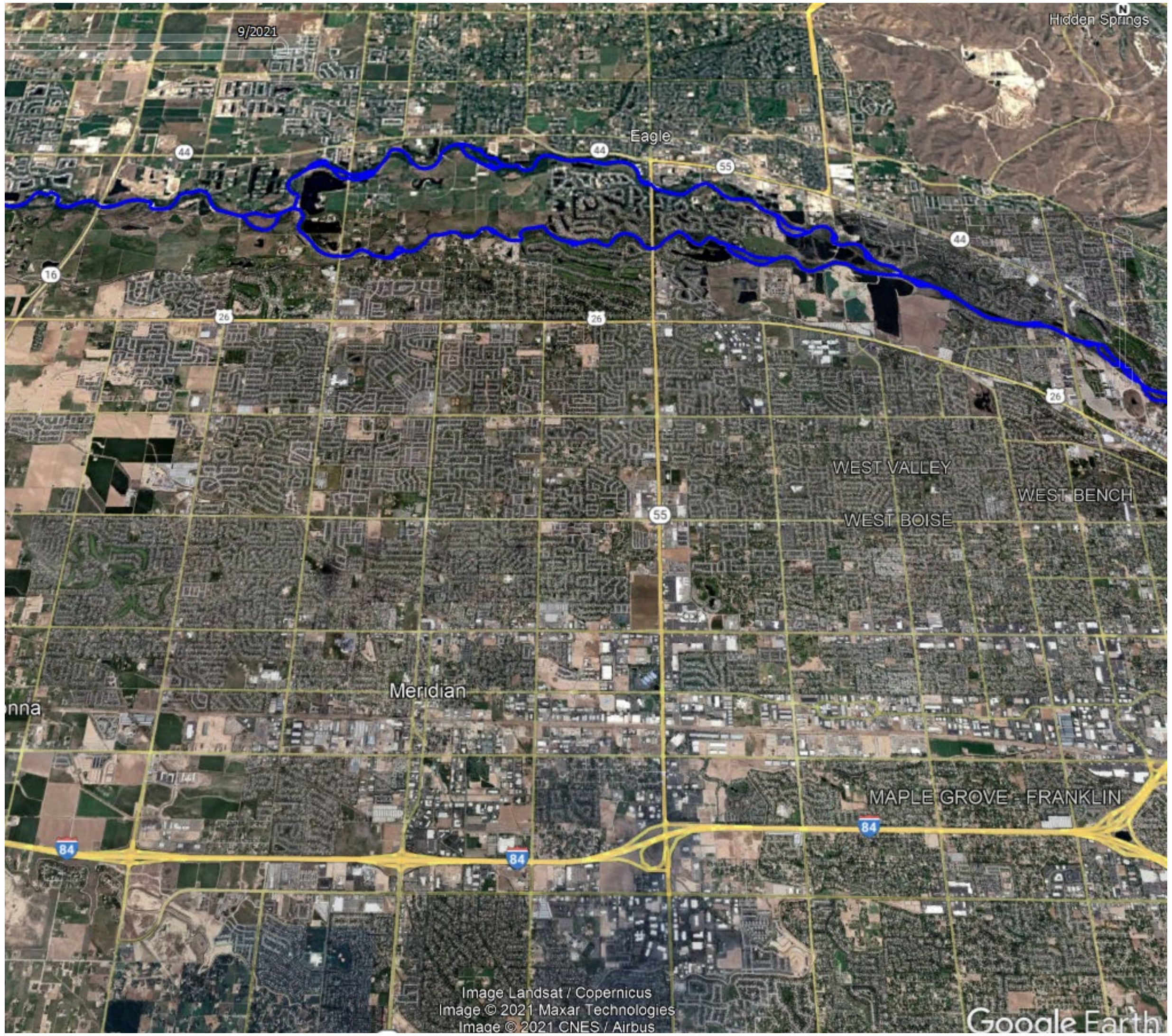


Ada County: 2021

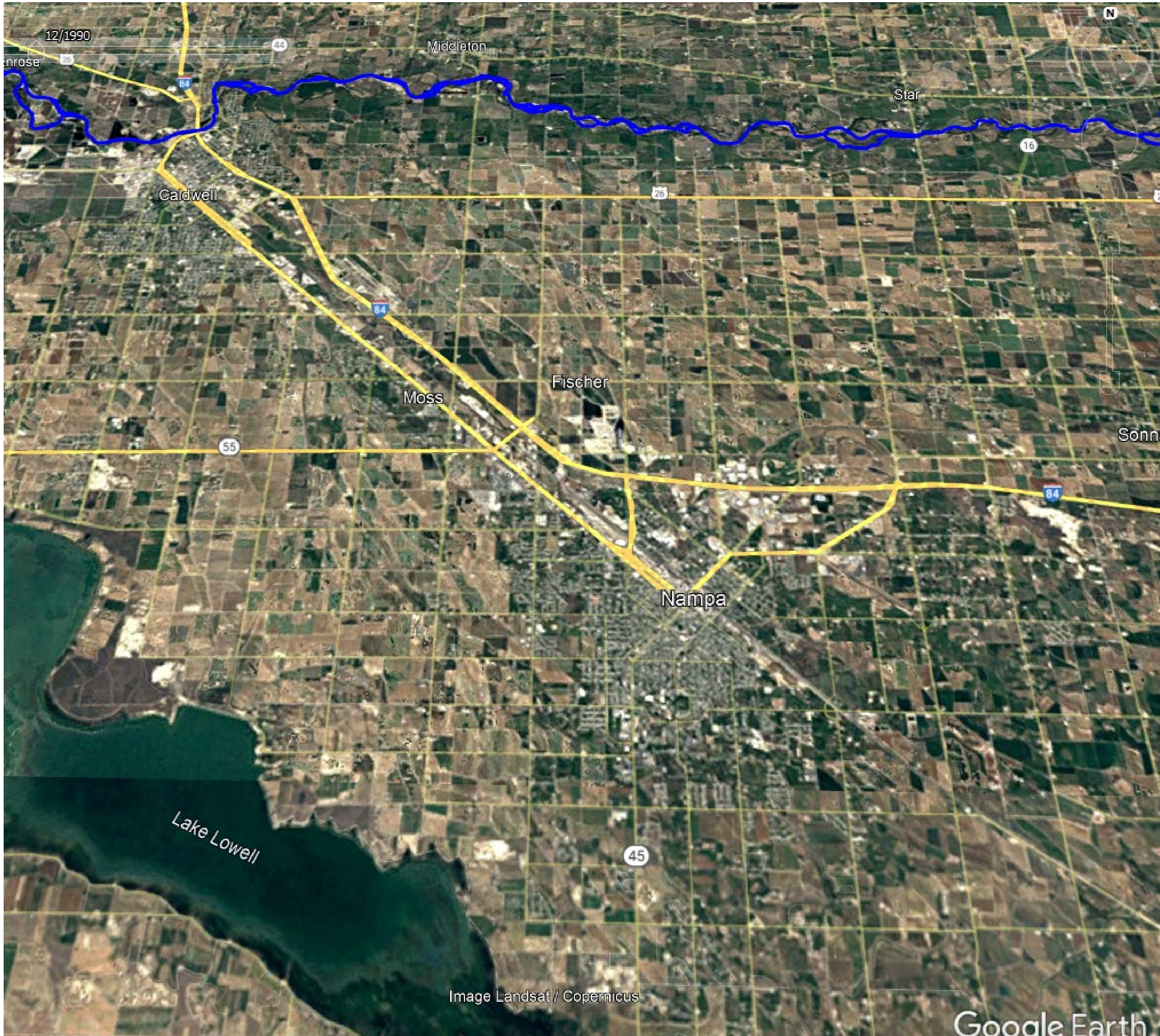


Ada County: 1990 - 2021

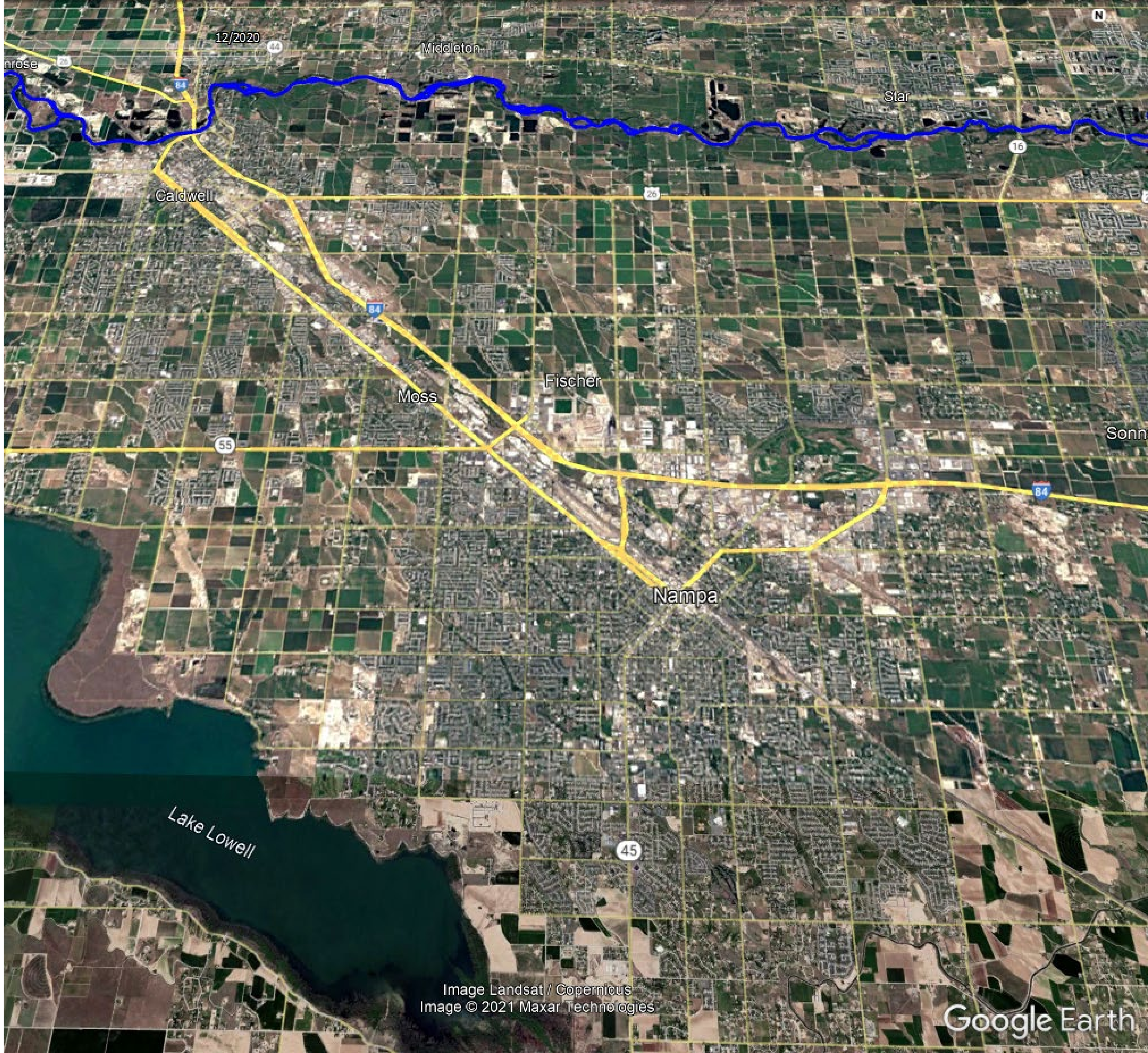




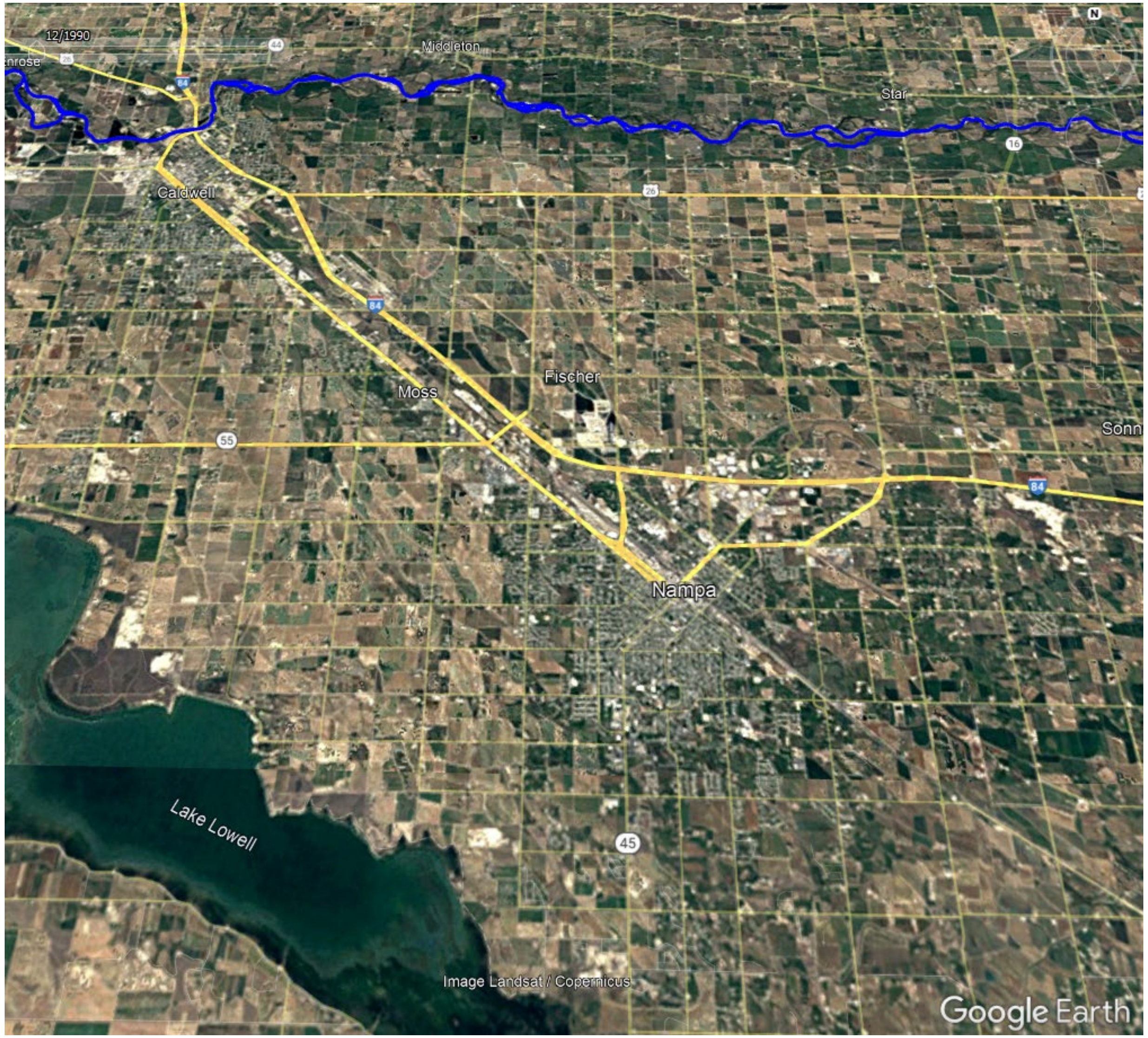
Canyon County: 1990

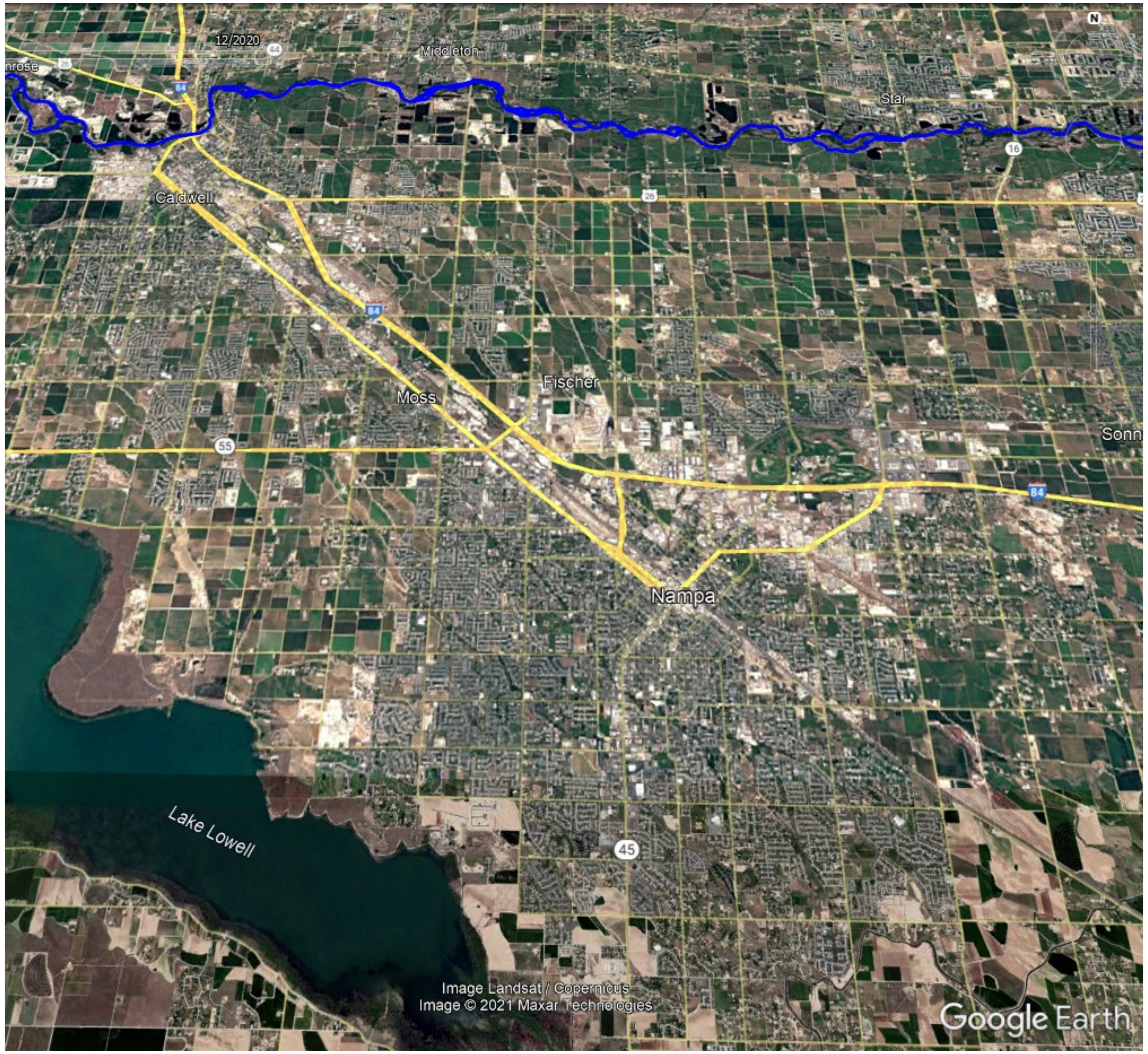


Canyon County: 2021

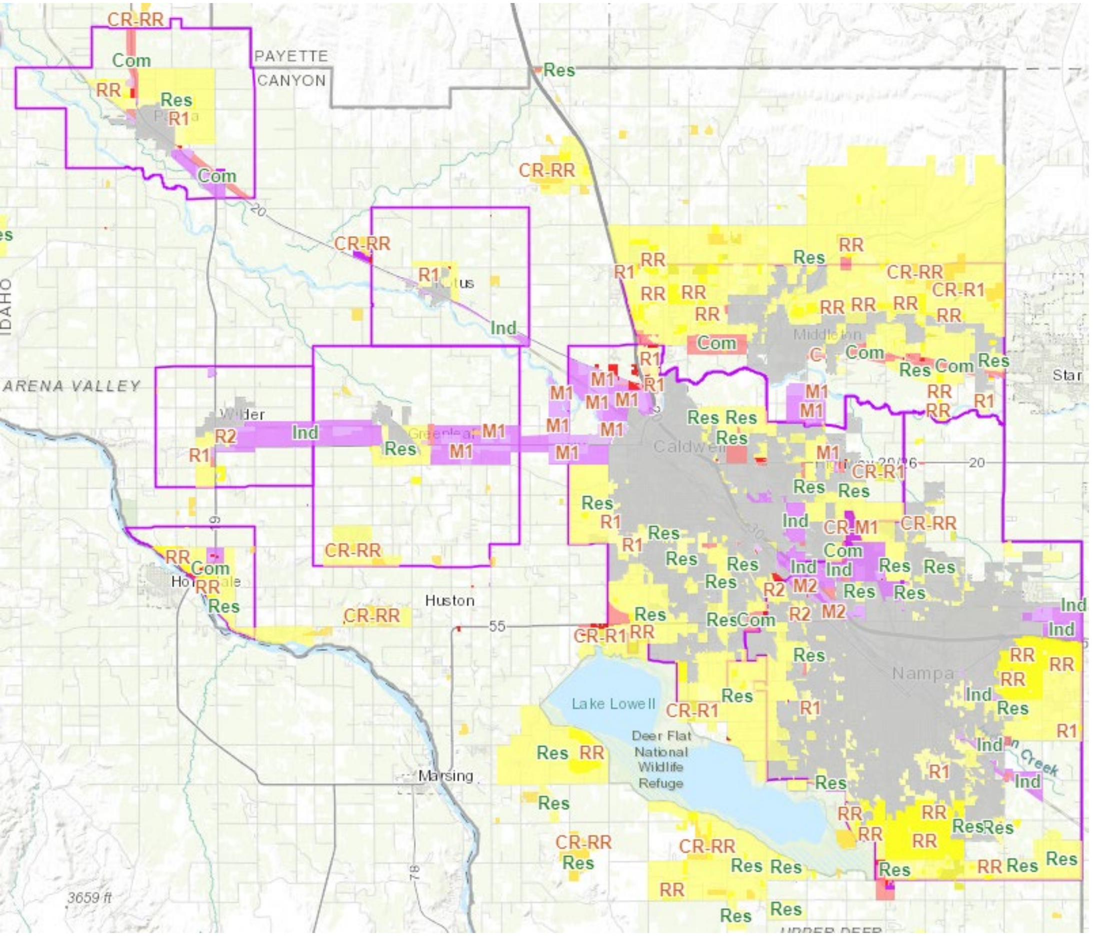


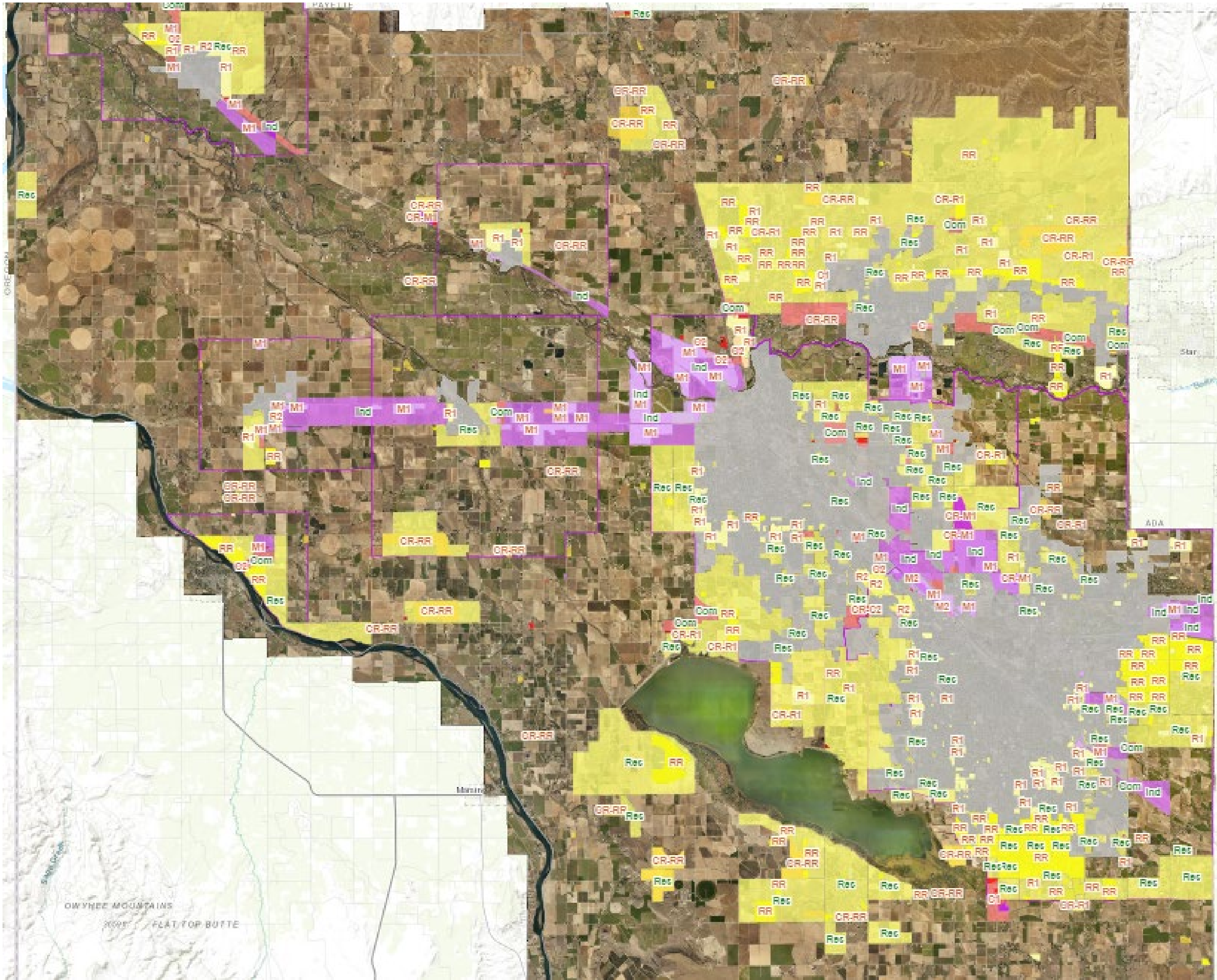
Canyon County: 1990 - 2021



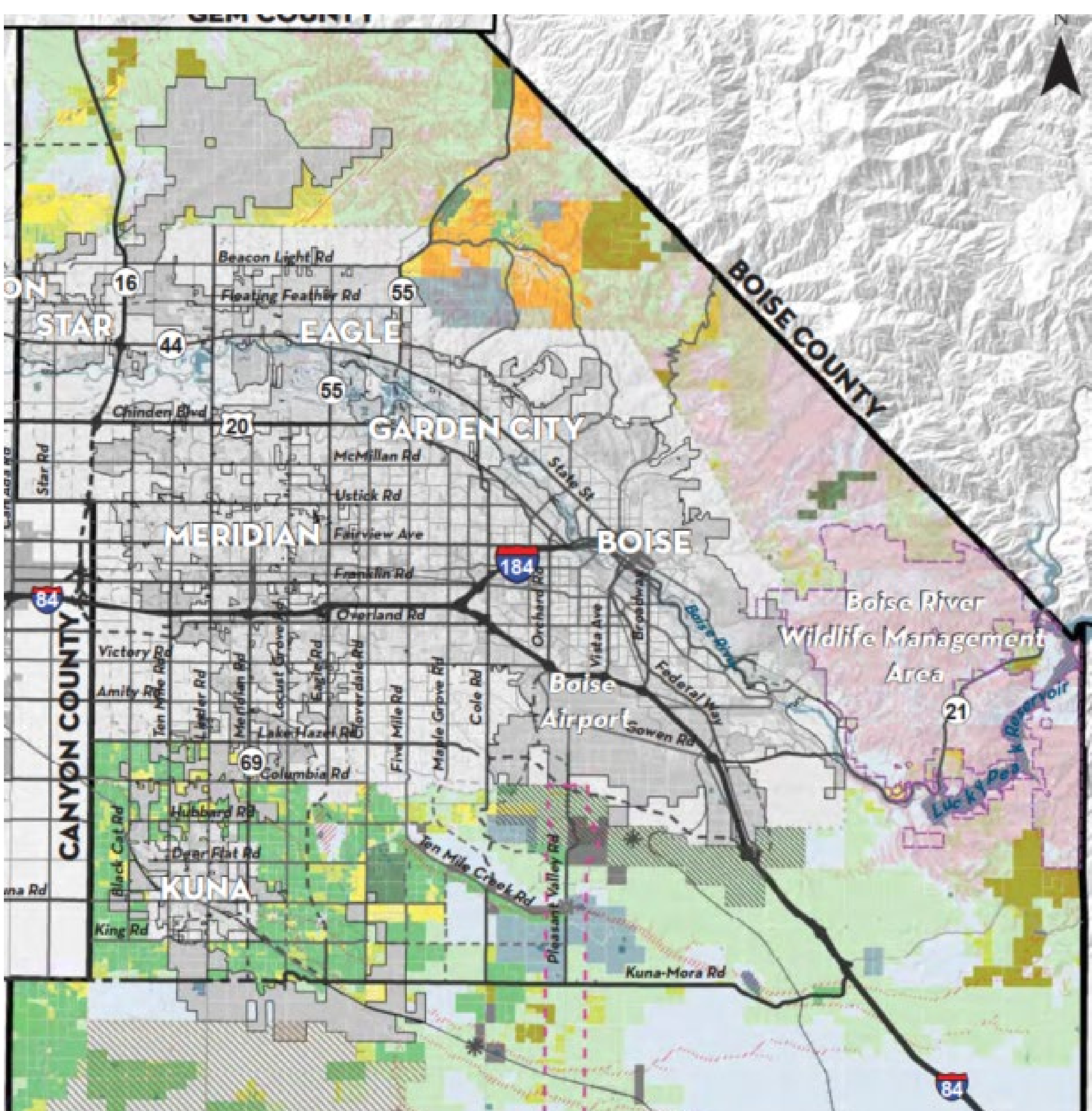


Forecasting Change:
Canyon County Land Use Plan



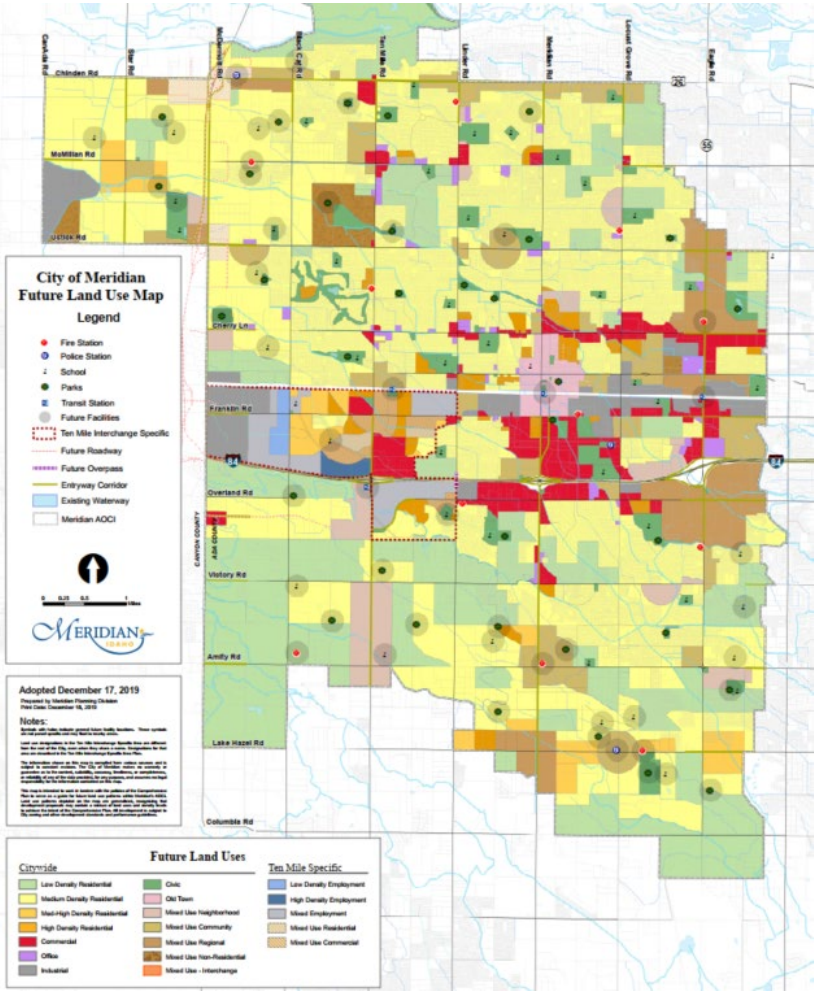


Forecasting Change: Ada County Land Use Plan

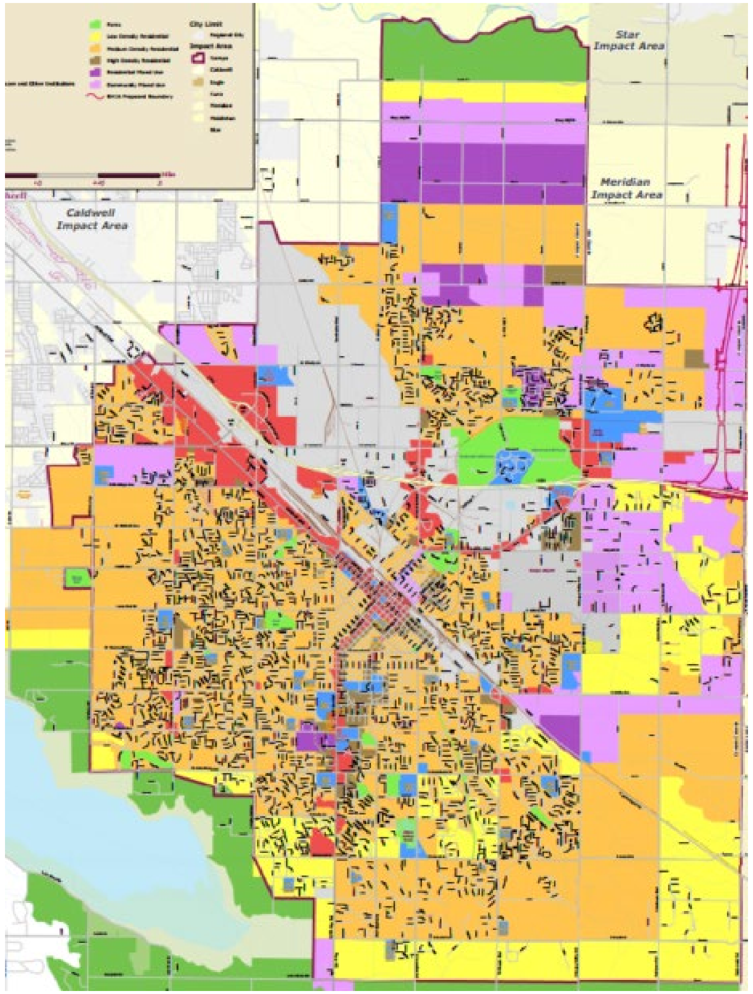


City Land Use Plans

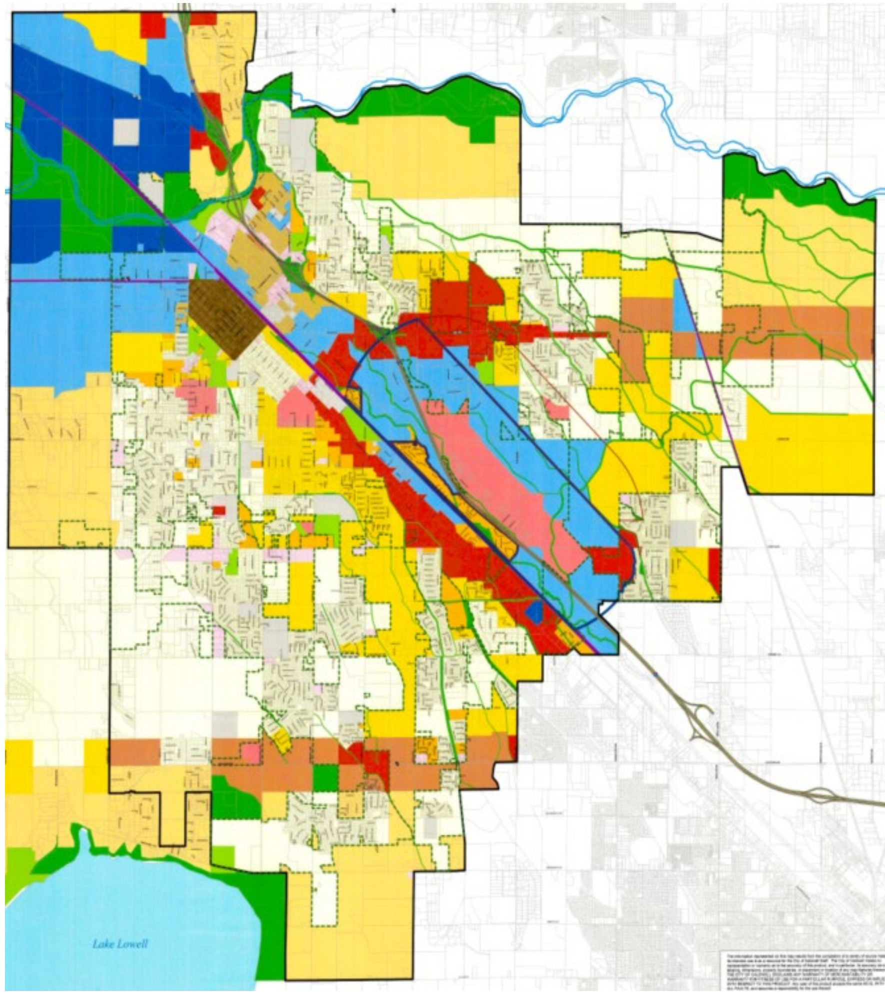
Meridian



Nampa

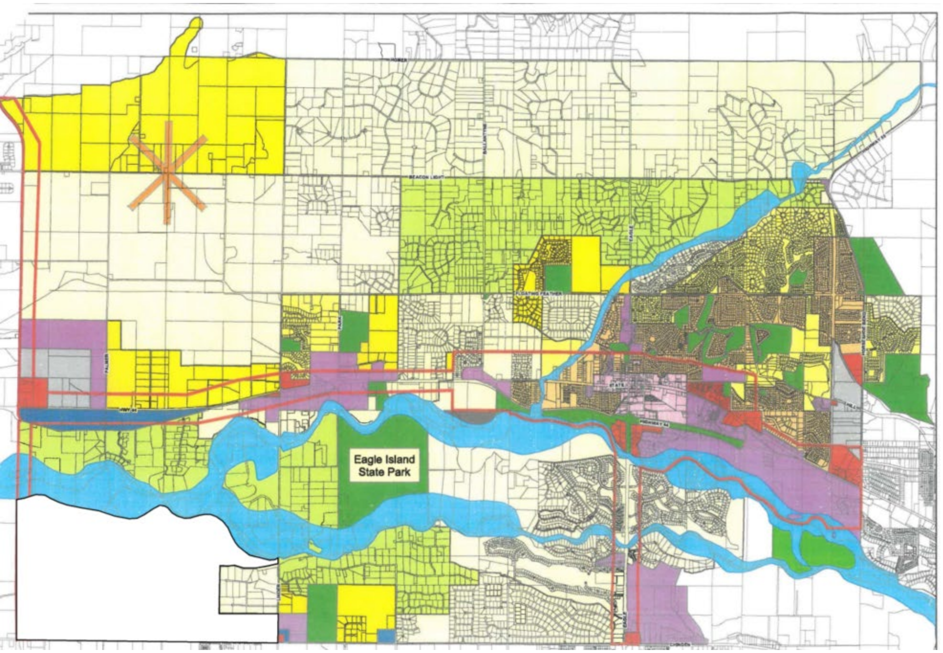


Caldwell

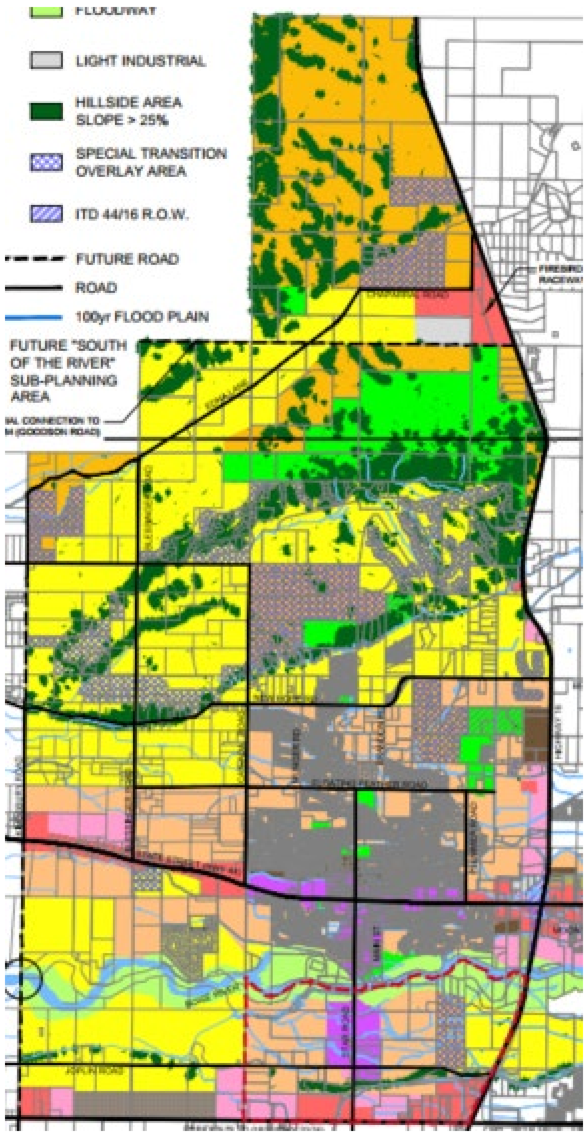


City Land Use Plans

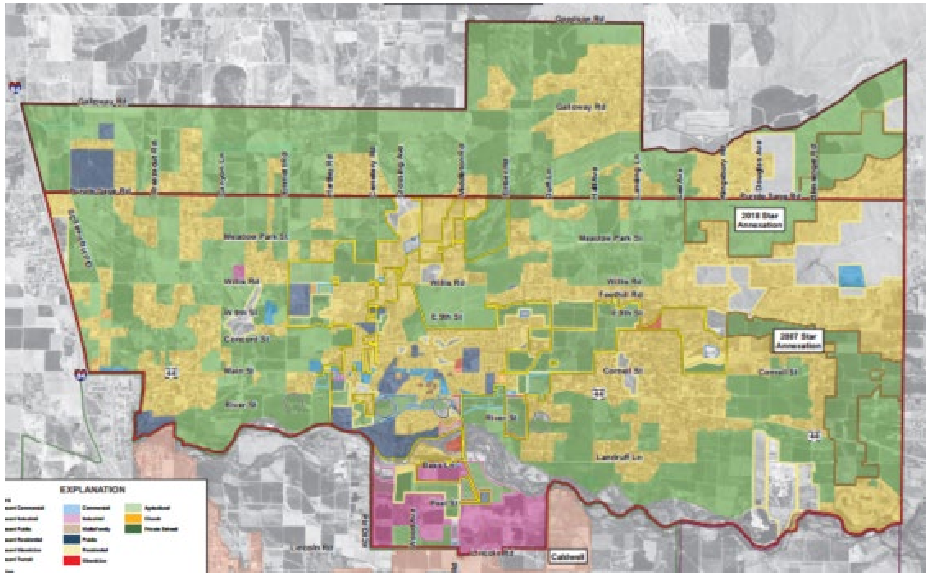
Eagle



Star

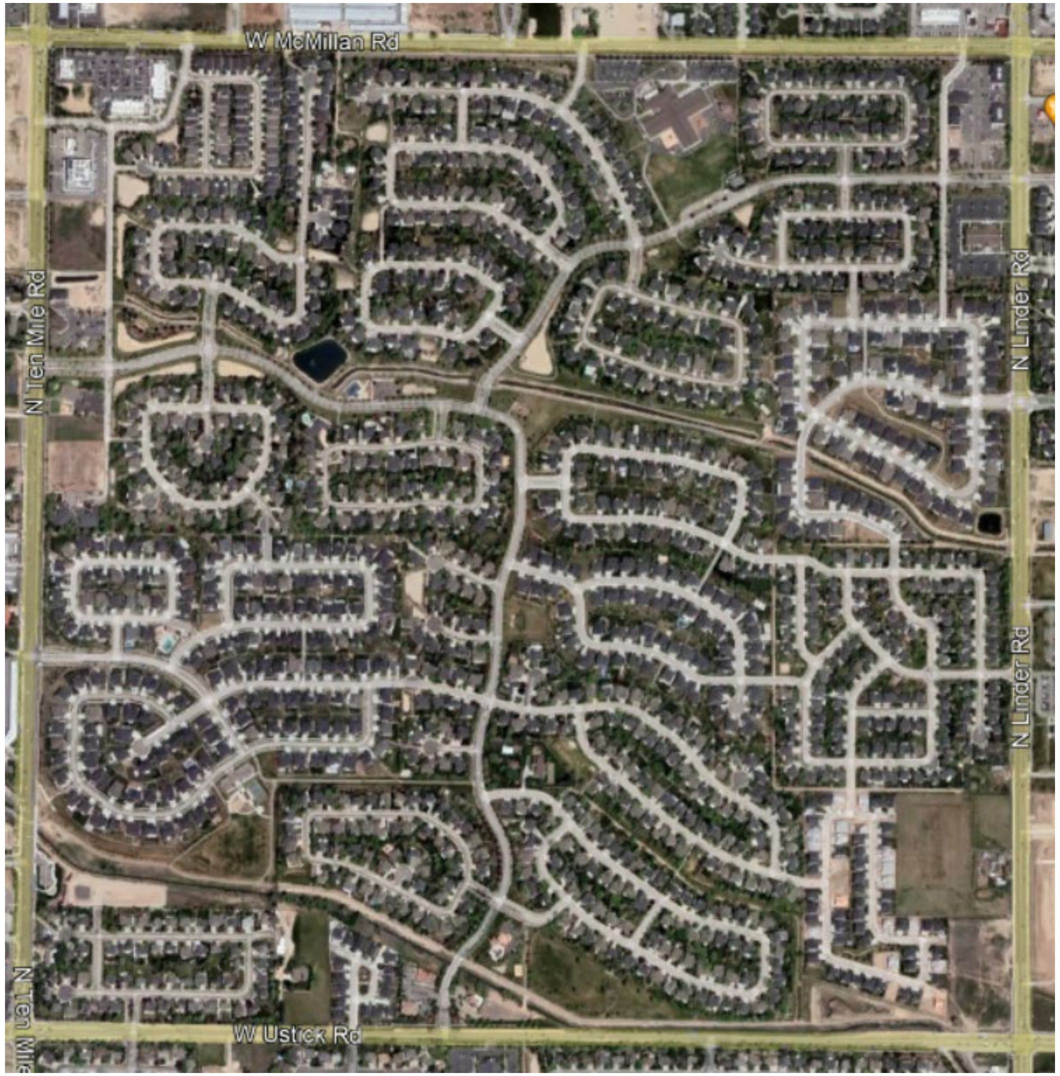


Middleton



Urbanization Effects

- Ditches & Easements
- User Management
- Water Demand Profile
- Hydrology & Water Supply
- Runoff & Water Quality
- Flood Risk

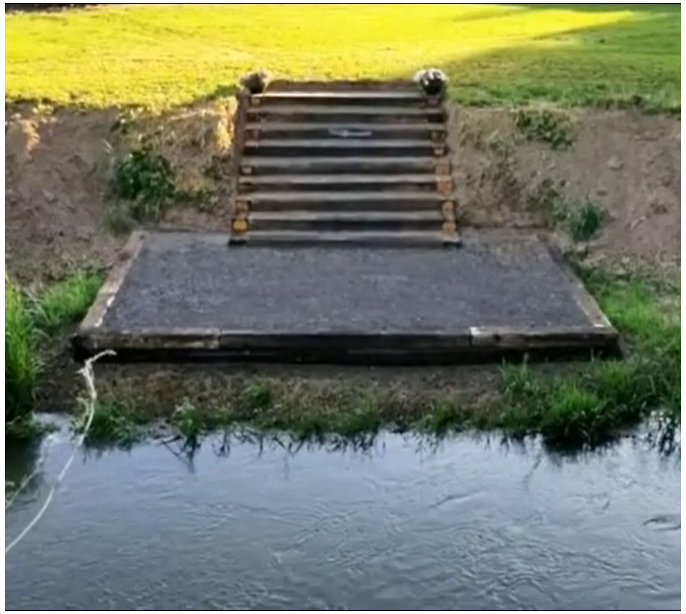


Urbanization Effects: Draft IWUA Resolution

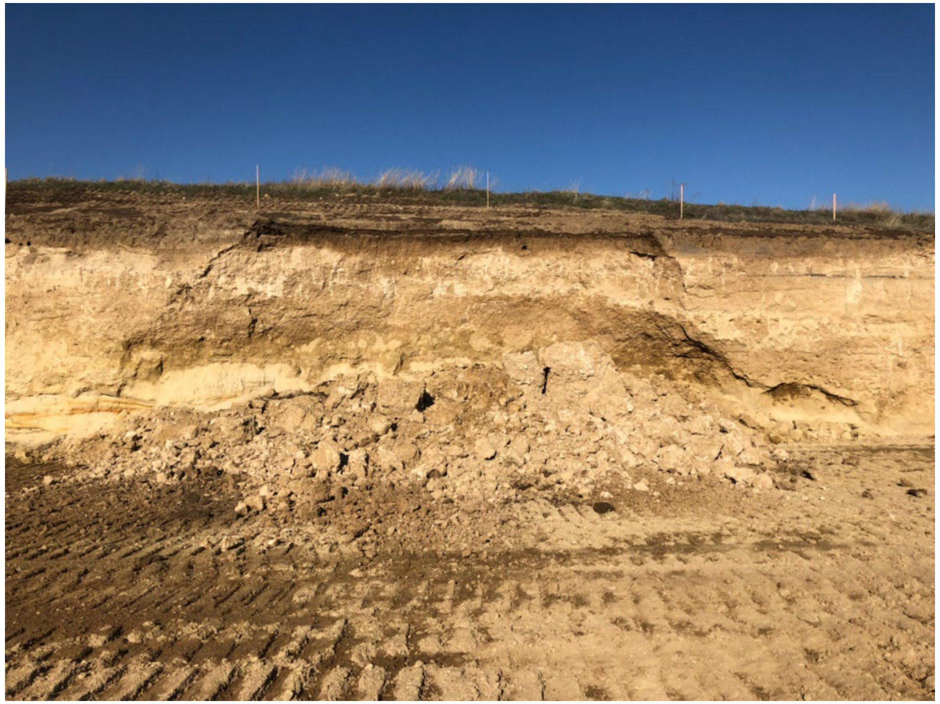
- **<u>Declaration</u>**: Understanding and managing the effects of urbanization on water infrastructure is a high priority for Idaho water users

- **<u>Effects/Issues</u>**:
  - Rapid Pace & large volume of widespread urbanization
  - Declining public awareness of Idaho's water infrastructure
  - Exponential increase in water users & smaller parcels
  - Infrastructure impacts:
    - Ditch relocation, piping & other modifications
    - Excavation
    - Encroachments
    - Adjoining construction and urban uses
    - Dumping waste and other debris
    - Unauthorized uses of water, ditches & easements (trespass)
  - Alteration of water use, delivery & demand profiles
  - Surface water, ground water & water quality effects of urban development

Infrastructure Effects: Encroachment & Dumping

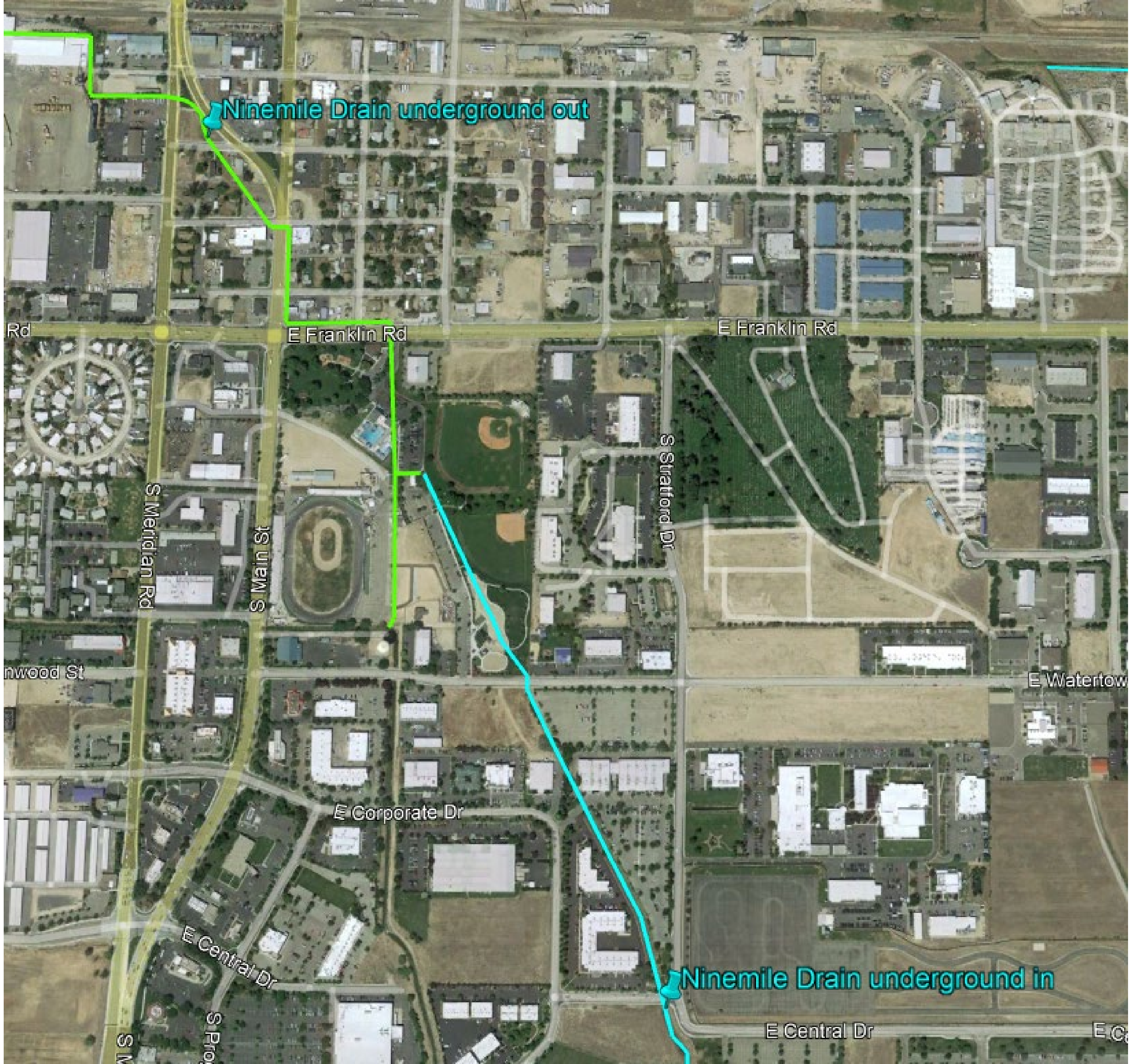


Infrastructure Effects: Excavation



Infrastructure Effects: Piping & Relocation

Infrastructure Effects: Ditch Location



Infrastructure Effects: Draft IWUA Resolution

- **Action**: increase awareness among the public, developers, legislative bodies and government agencies of:
  - the importance, location, operation and maintenance of water infrastructure
  - the impacts of urbanization on water infrastructure

- **Action**: work with the public, developers, legislative bodies, government agencies to:
  - prevent unauthorized use and interference with water infrastructure
  - mitigate the impacts of adjoining urban development

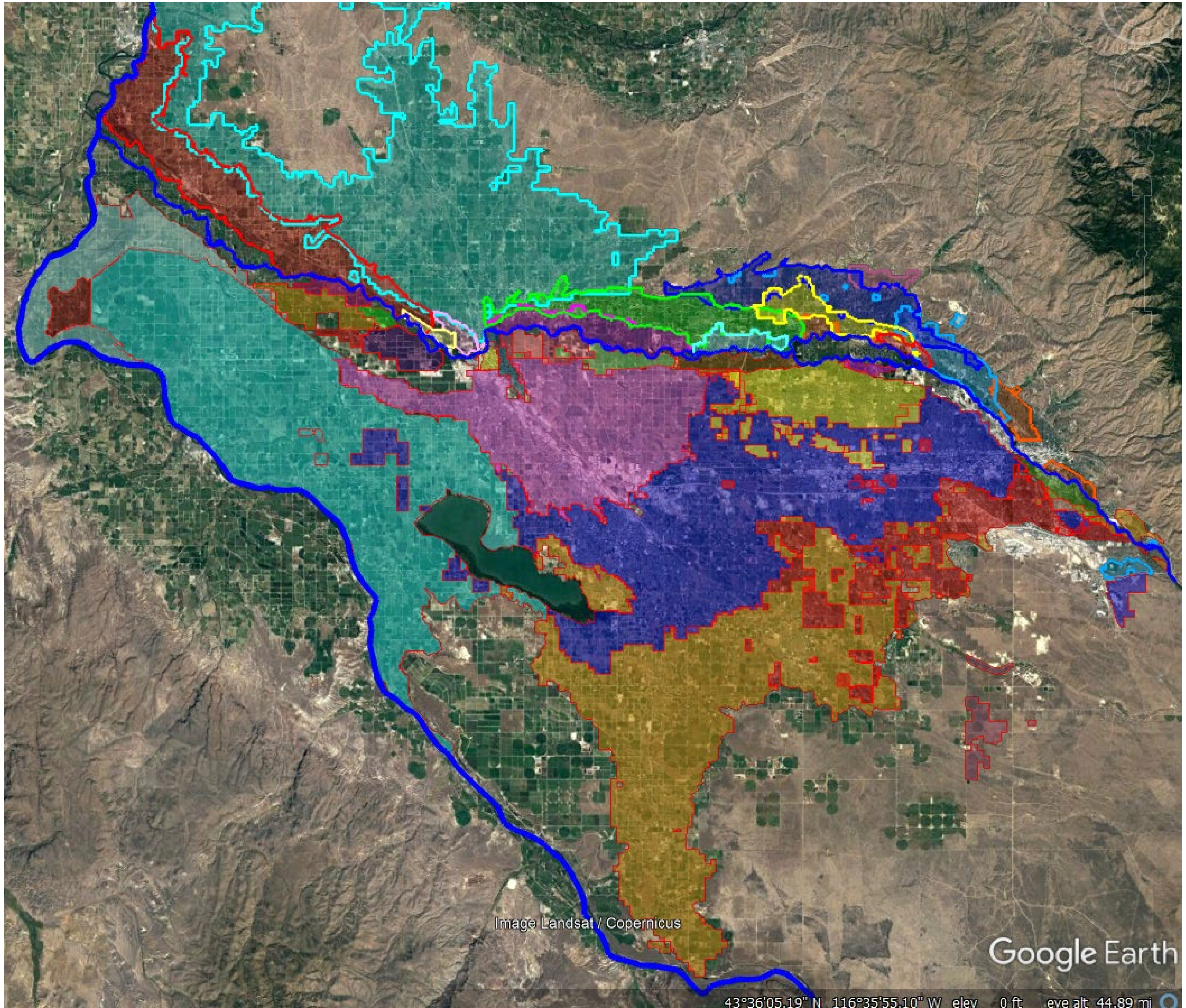
- **Action**: Seek funding assistance for geographic information system (GIS) technology and other tools to locate, track and map infrastructure and infrastructure changes

- **Action**: Promote and ensure:
  - Disclosure to land purchasers of irrigation and drainage benefits and assessment obligations, and
  - Timely notice to irrigation and drainage organizations of land ownership changes; and

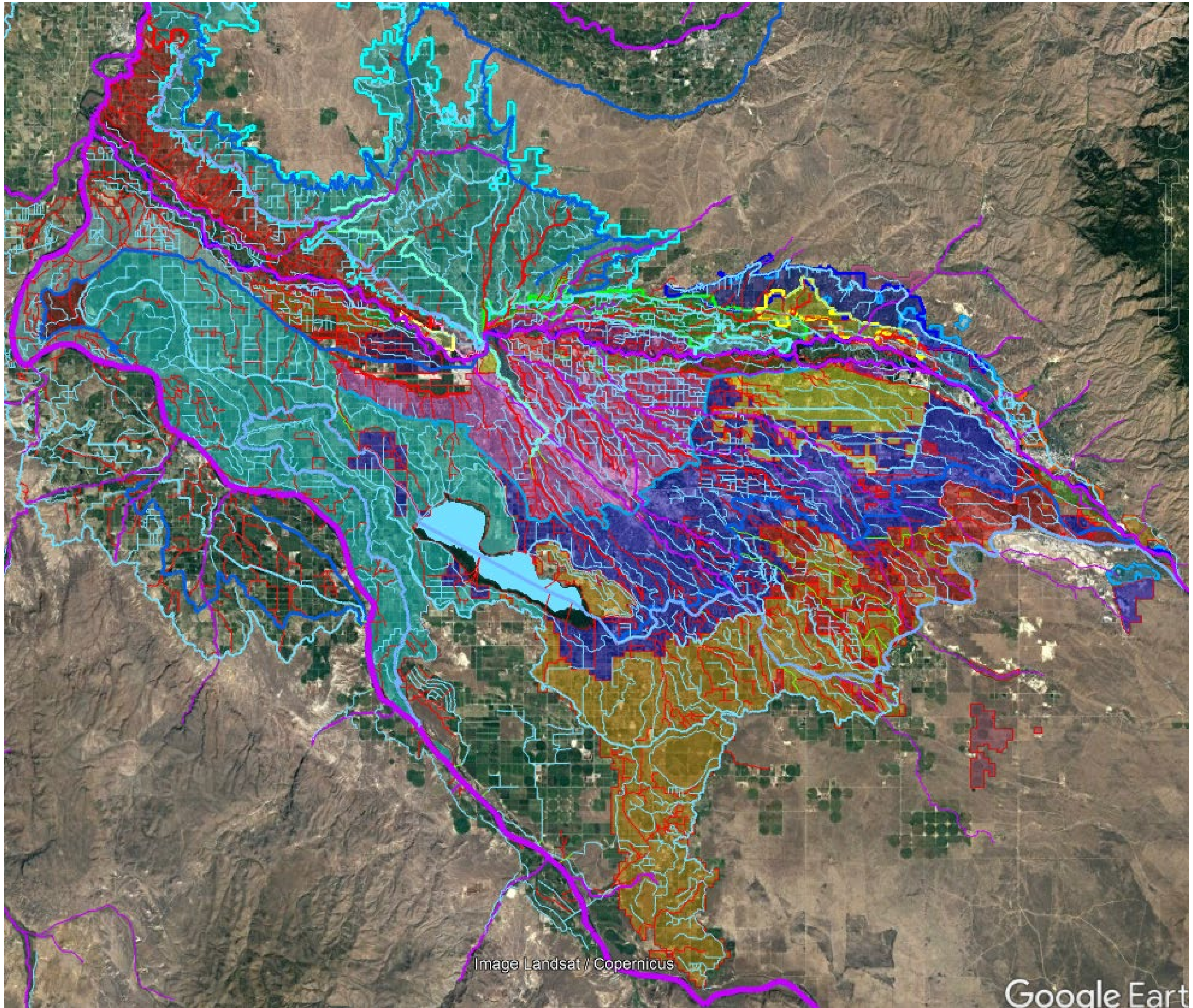
Hydrologic Effects: Draft IWUA Resolution

- **<u>Effects/Issues</u>**:
  - ❖ Piping and lining canals, laterals and drains:
    - reduces seepage loss
    - reduces ground water recharge
    - increases water supply in canal systems
  - ❖ Urban development alters drainage patterns
  - ❖ Conversion from flood irrigation to pressure irrigation eliminates or reduces:
    - field seepage that recharges aquifers and replenishes surface water sources
    - irrigation return flows that
      - replenish surface water sources
      - carry sediment and nutrient loads that can adversely impact water quality
  - ❖ Consequently, urban development reduces water available for recapture and reuse

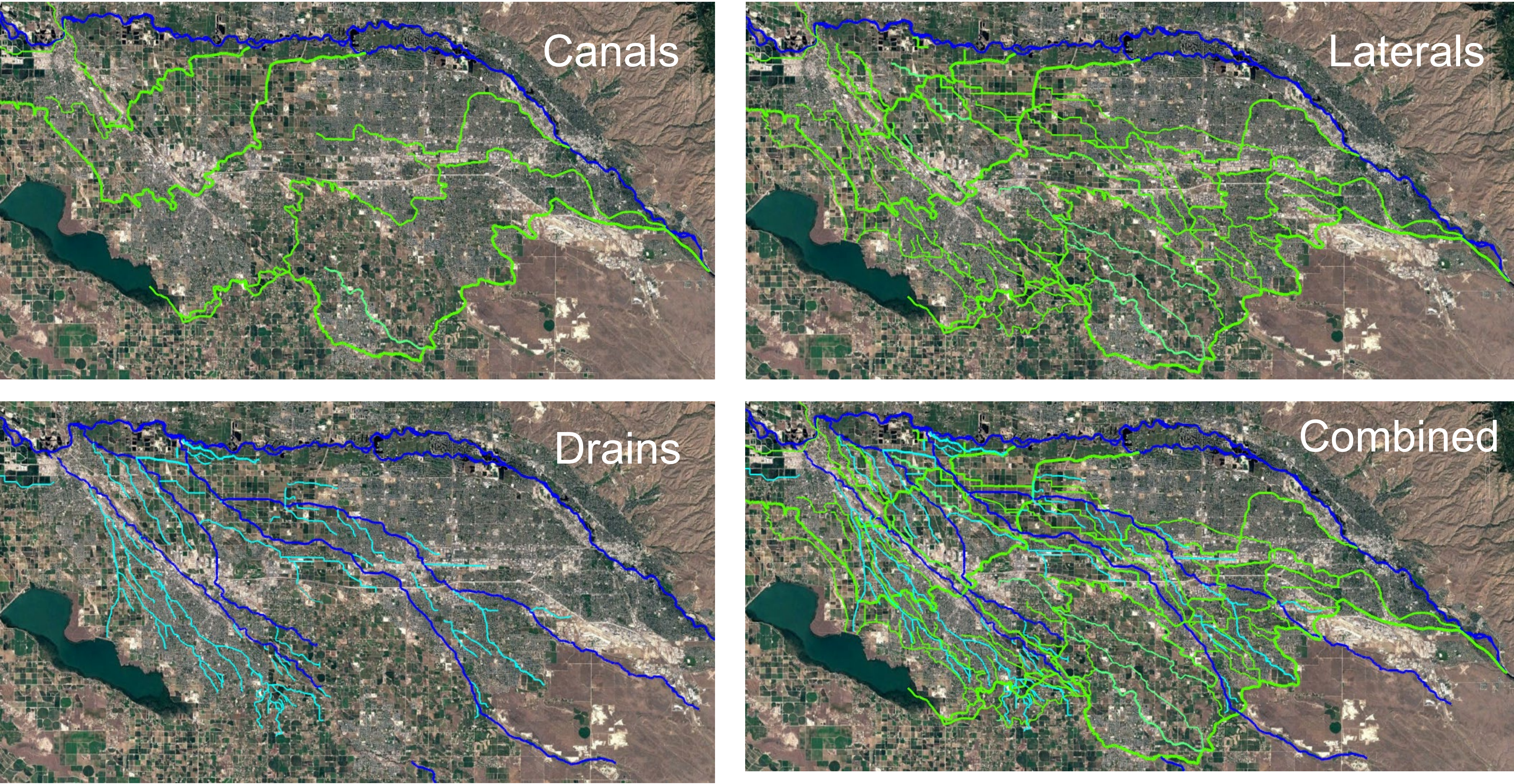
Treasure Valley Irrigation



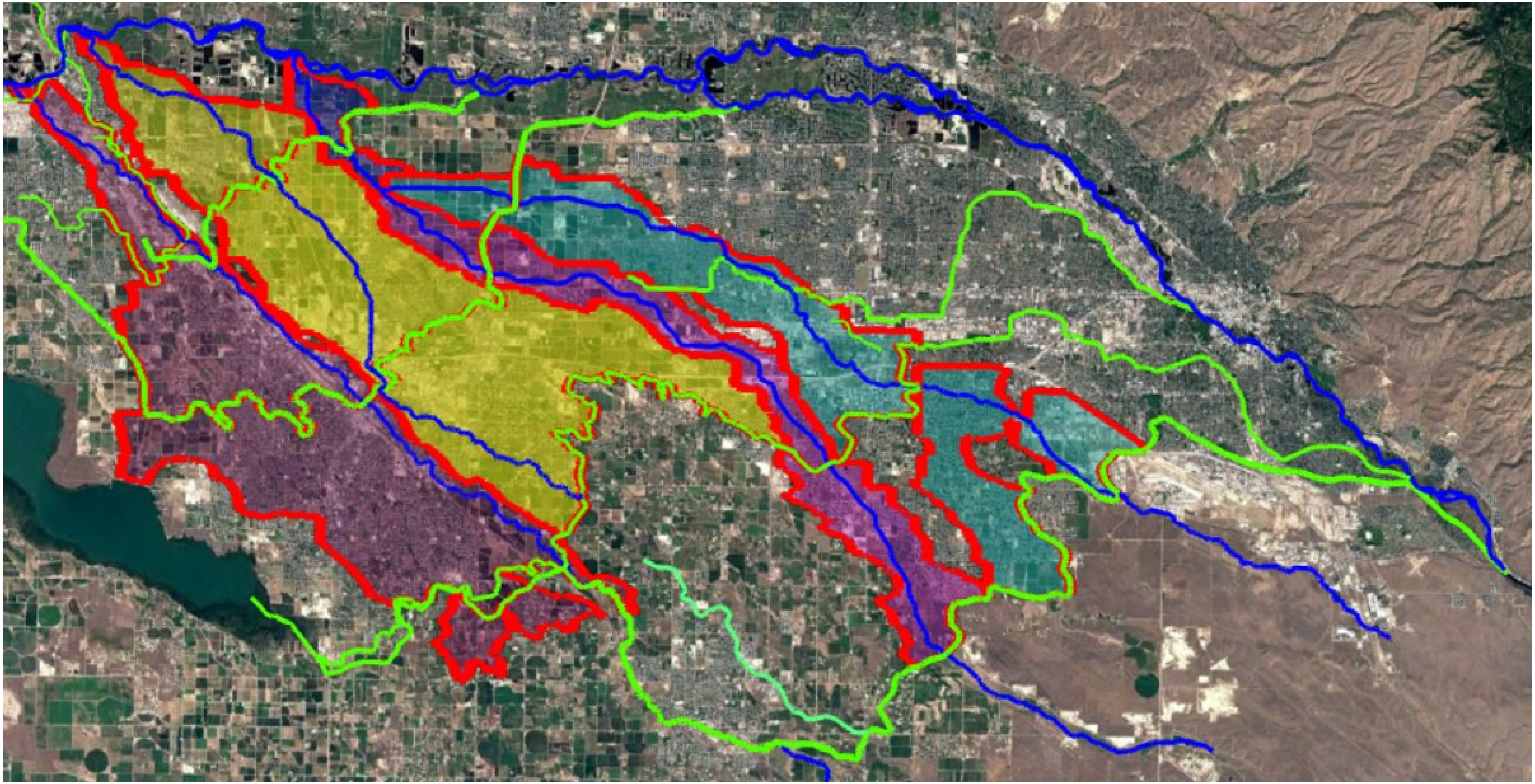
Treasure Valley Irrigation & Drainage



Urbanization Effects: Irrigation & Drainage Systems

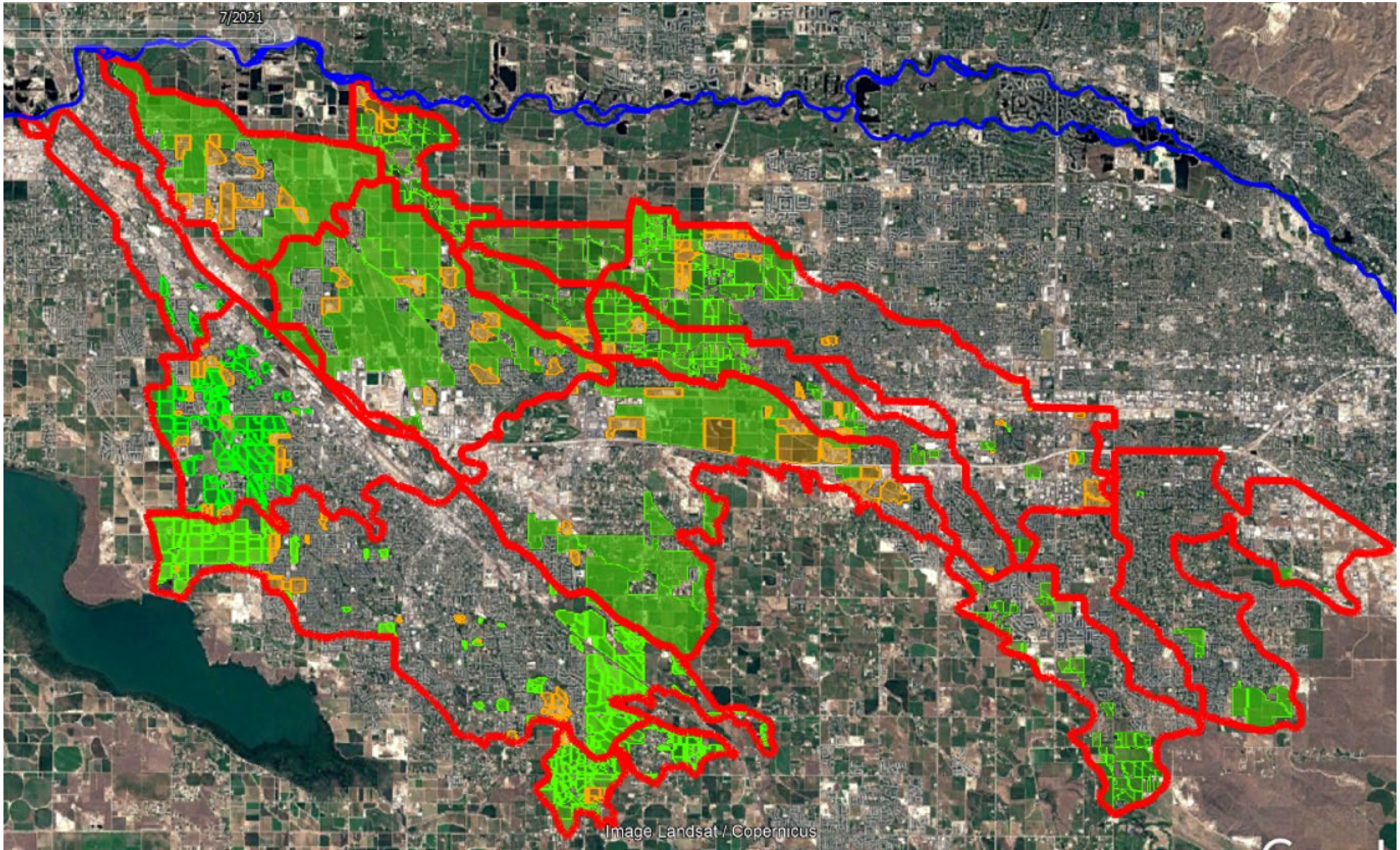


Accounting for Change: Subwatersheds (Fifteenmile, Mason, Indian)

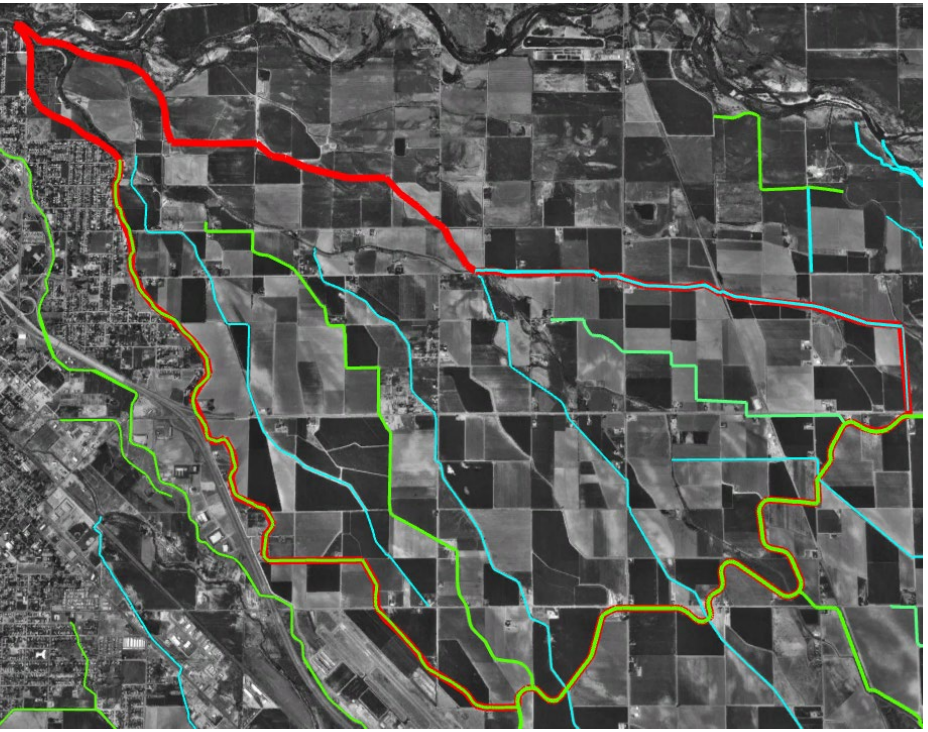


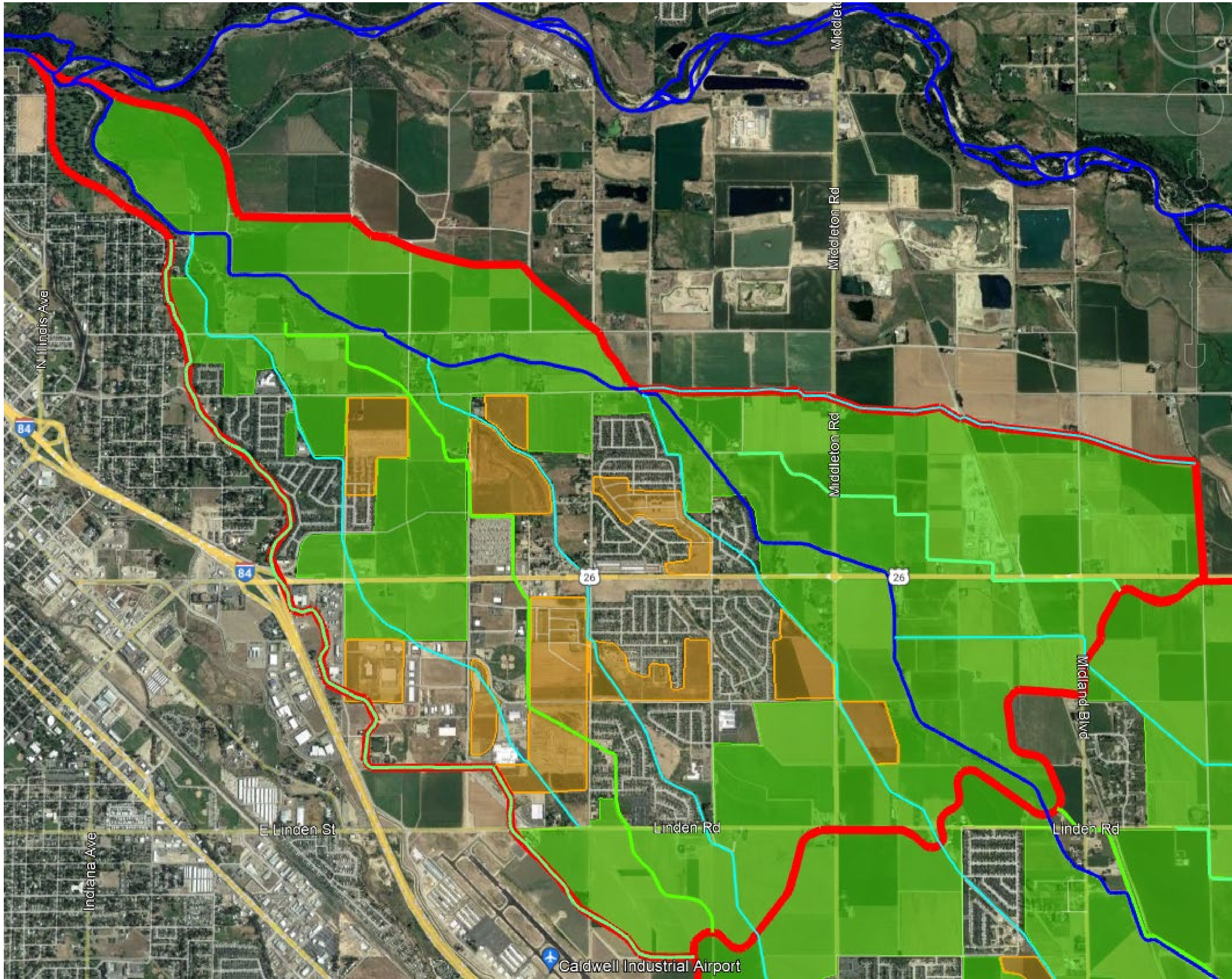
Accounting for Change: Ag. Delineation

2016-2020 conversions (orange) **2020 Ag. (green)**



Segment Ag. Land Use: converted 2016-20 (orange), ag. (green)





Accounting for Change: Ag. Delineation

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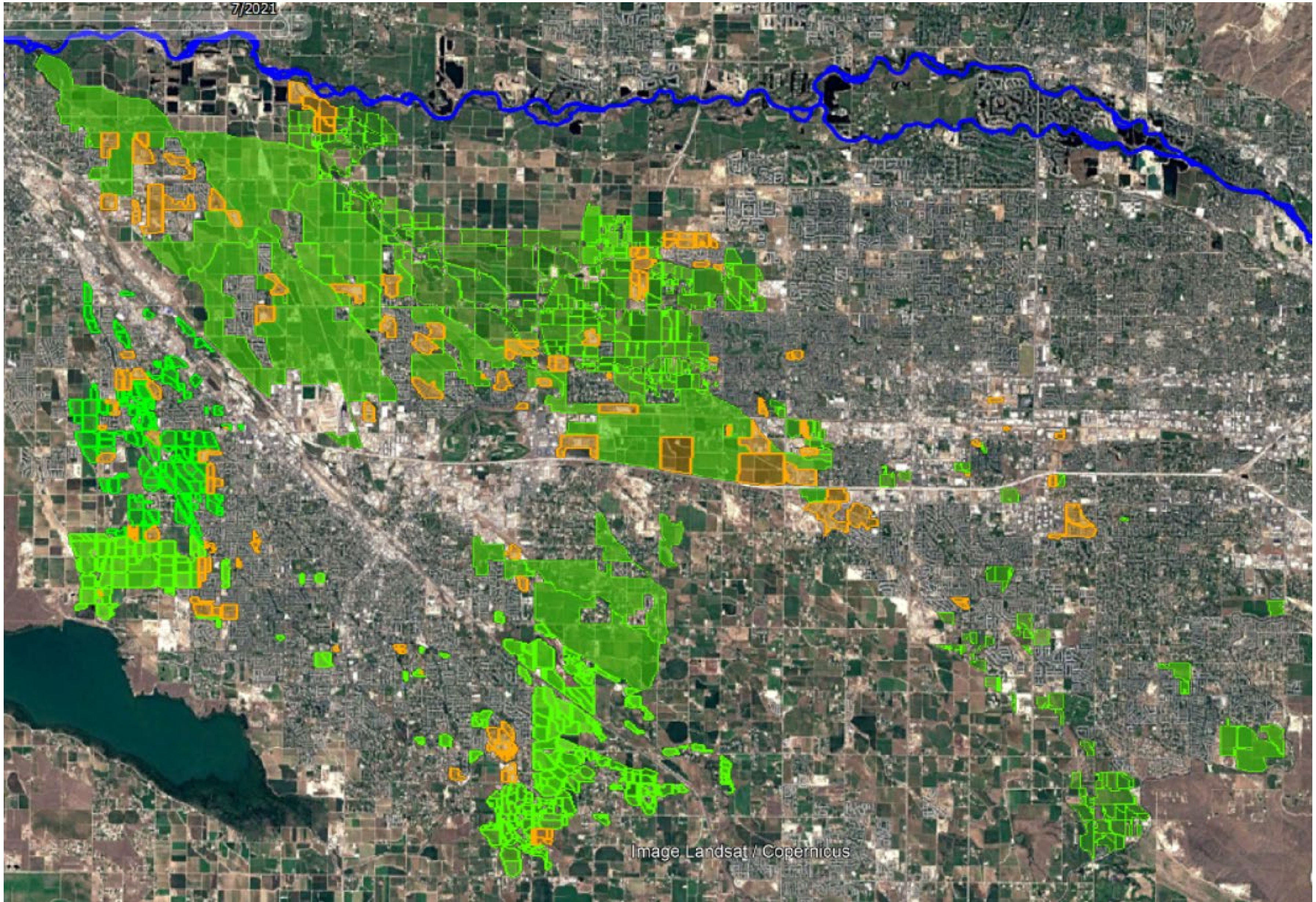
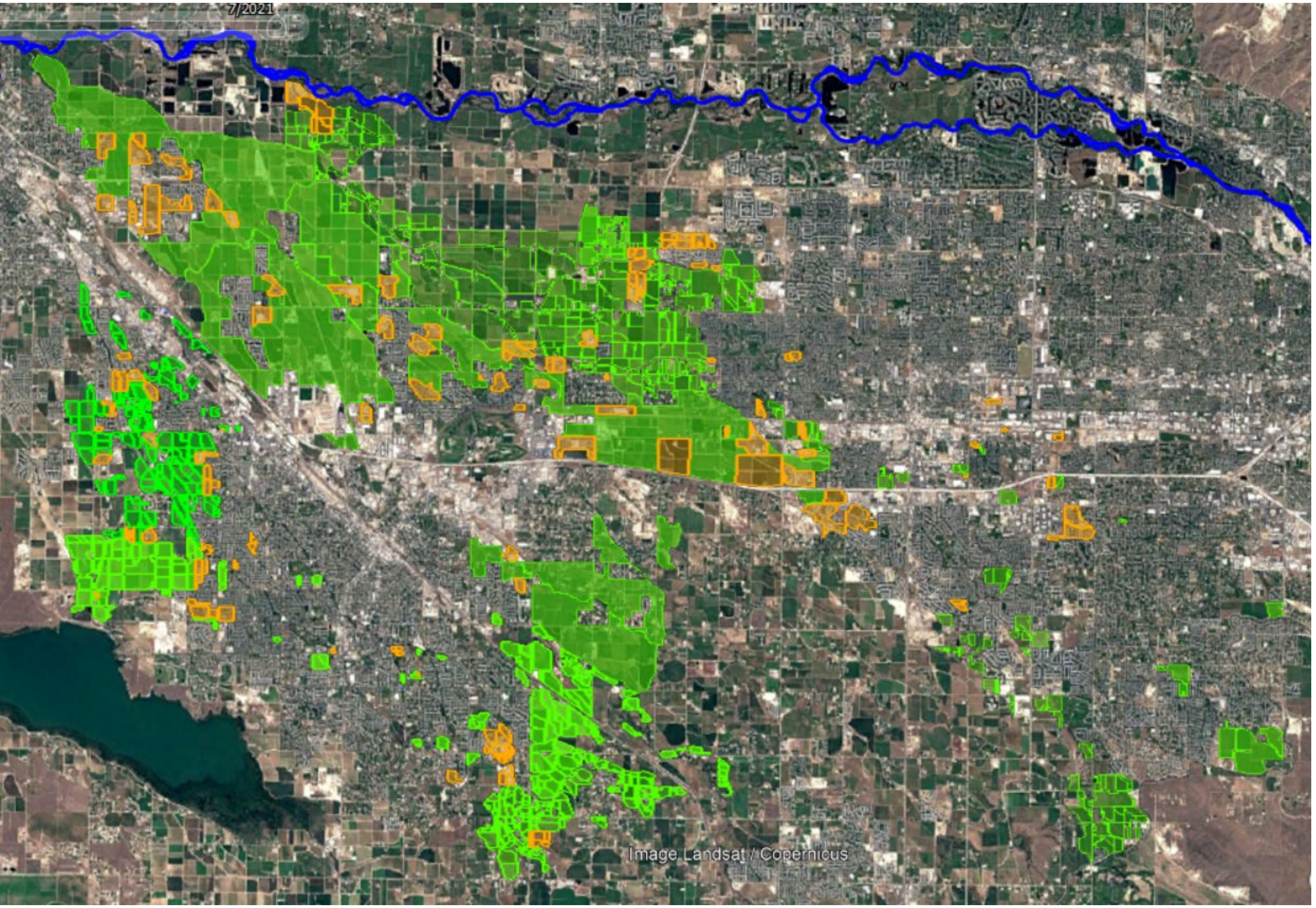


Accounting For Change: Ag. to Urban Conversions

		Total Acres	Total %	Annual %
Long-Term (2001-2016, Watershed):		46,859 acres	29%	2%
Recent (2016-2020):	Fifteen:	1,998 acres	16%	4%
	Mason:	1,351 acres	15%	3%
	Indian:	657 acres	12%	3%

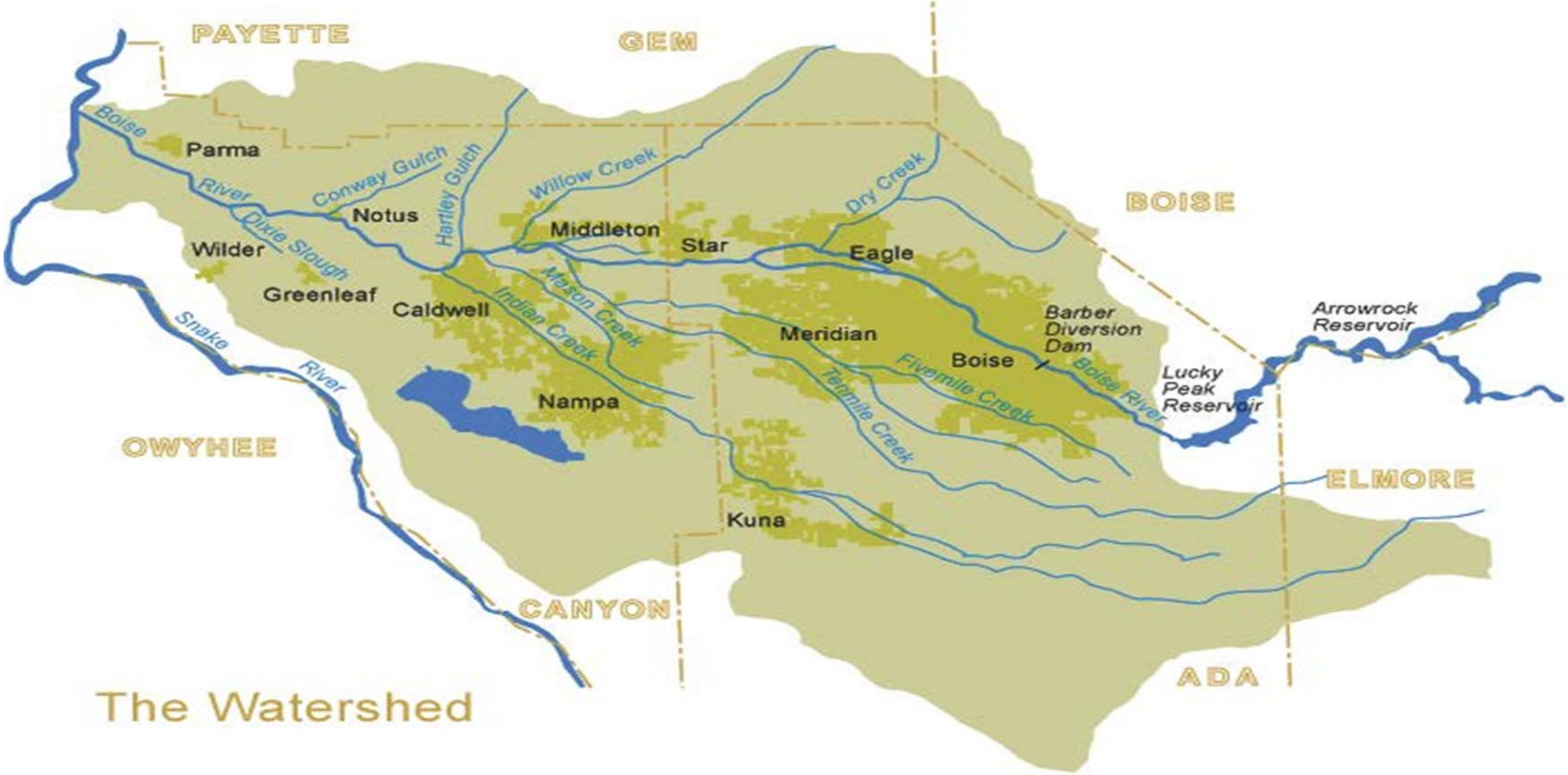


Water Supply & Water Quality Effects: Ag. Flood Irrigation Conversion to Urban Sprinkler

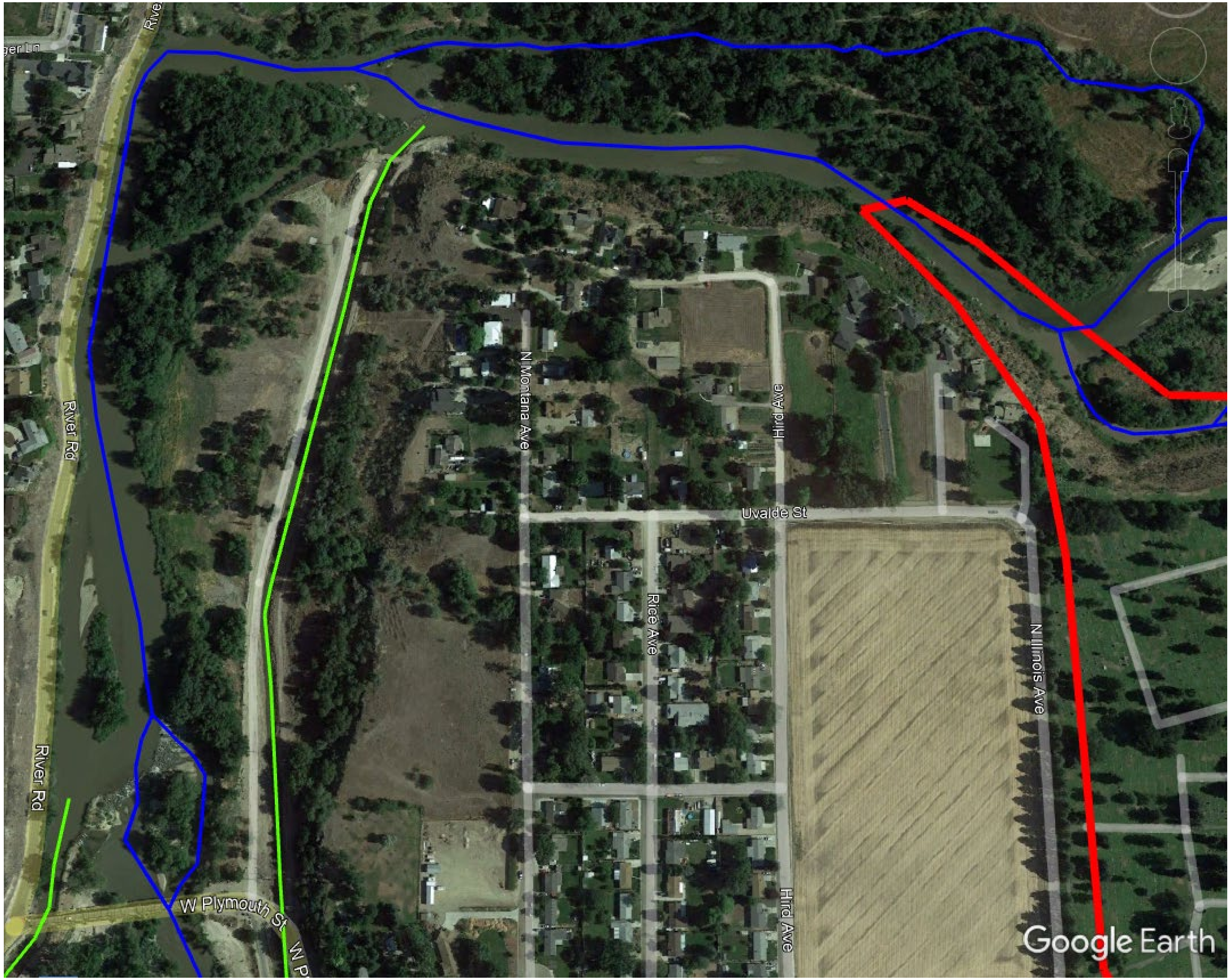
- eliminates or reduces field seepage that recharges aquifers and replenishes surface water sources
- eliminates or reduces irrigation return flows that:
  - replenish surface water & ground water sources
  - carry sediment and nutrient loads that can adversely impact water quality

Water Supply & Water Quality Effects: Conversion to Sprinkler

Treasure Valley Watershed: Surface Drainage



Water Supply Effects - Mason Cr. Discharge to Boise River



Water Quality Effects: Drain Sediment & phosphorus Loading to the Boise River

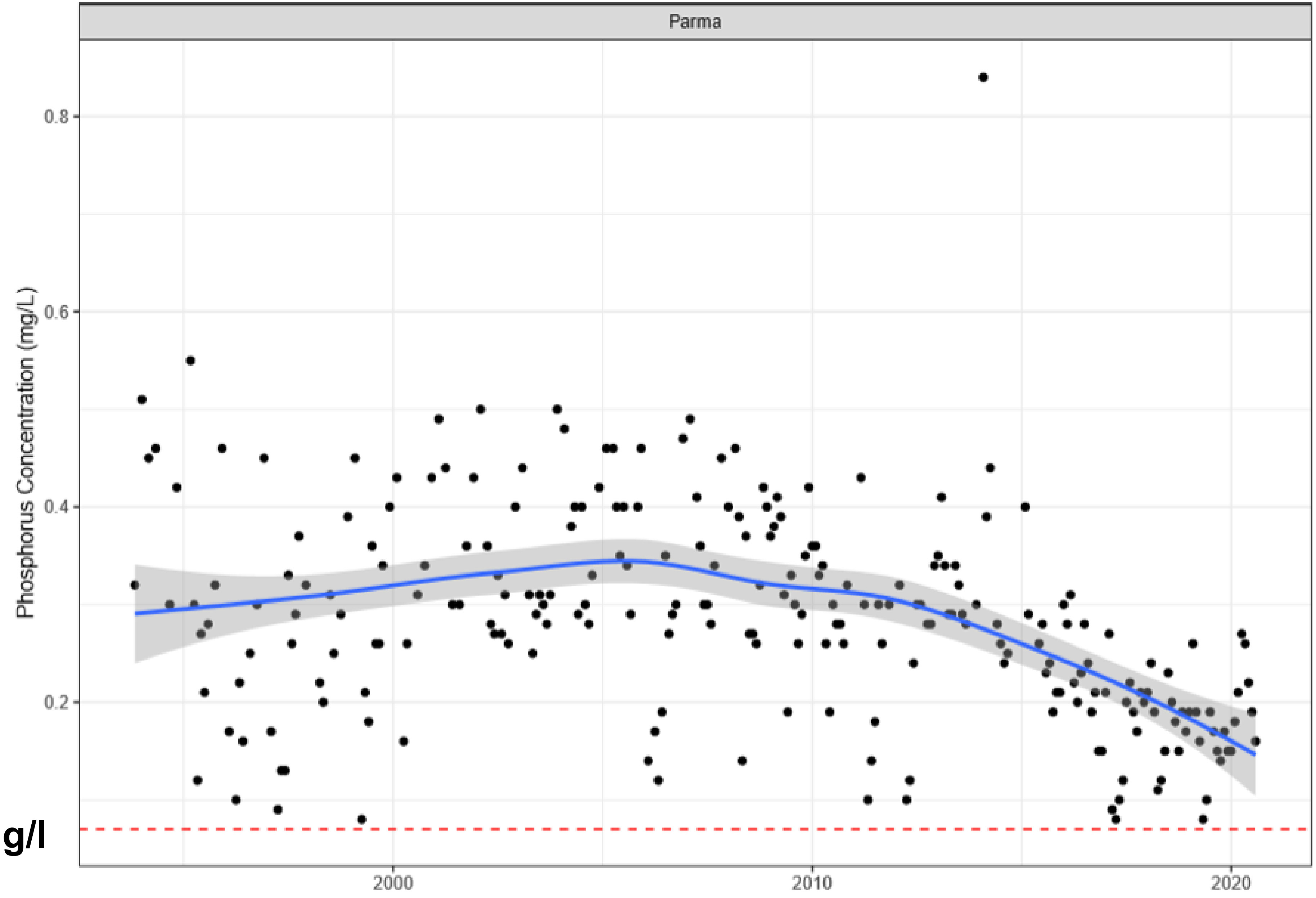
Fifteenmile Cr.

Mason Cr.

Indian Cr.

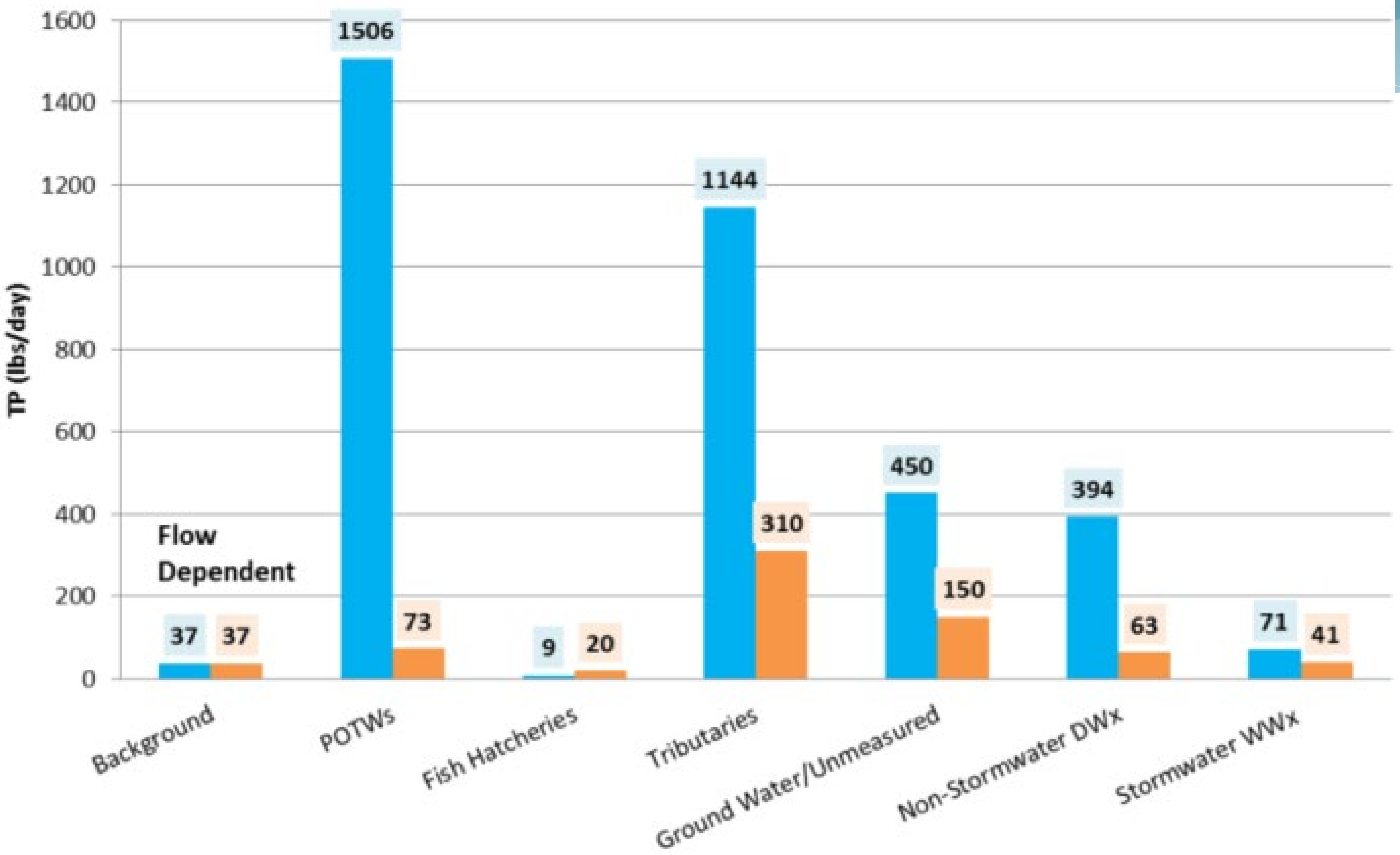
Boise River to Snake River

Boise River Phosphorus concentrations at Parma



TMDL Objective .07 mg/l →

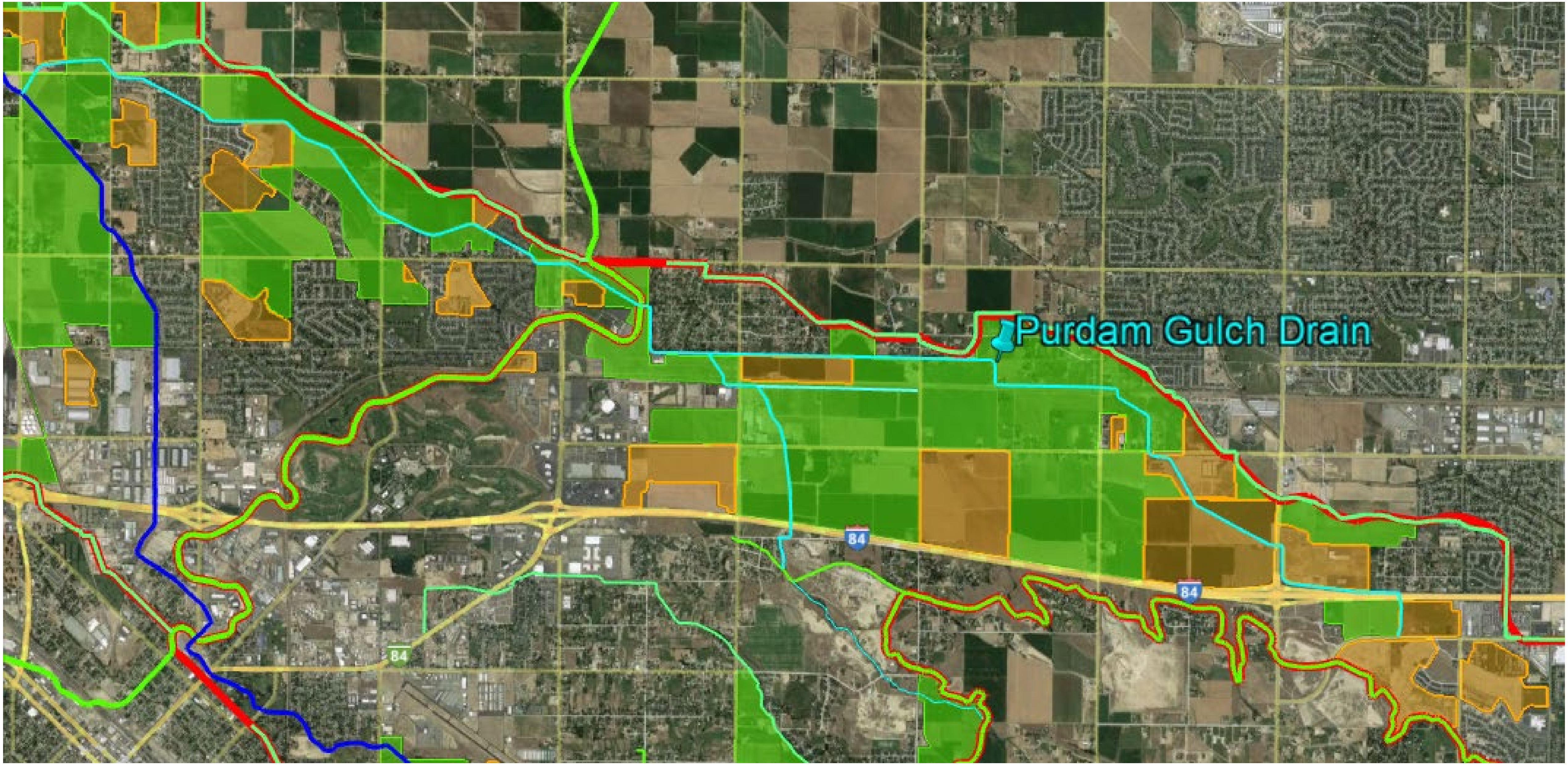
TMDL TP Load Reductions May 1 – Sept 30



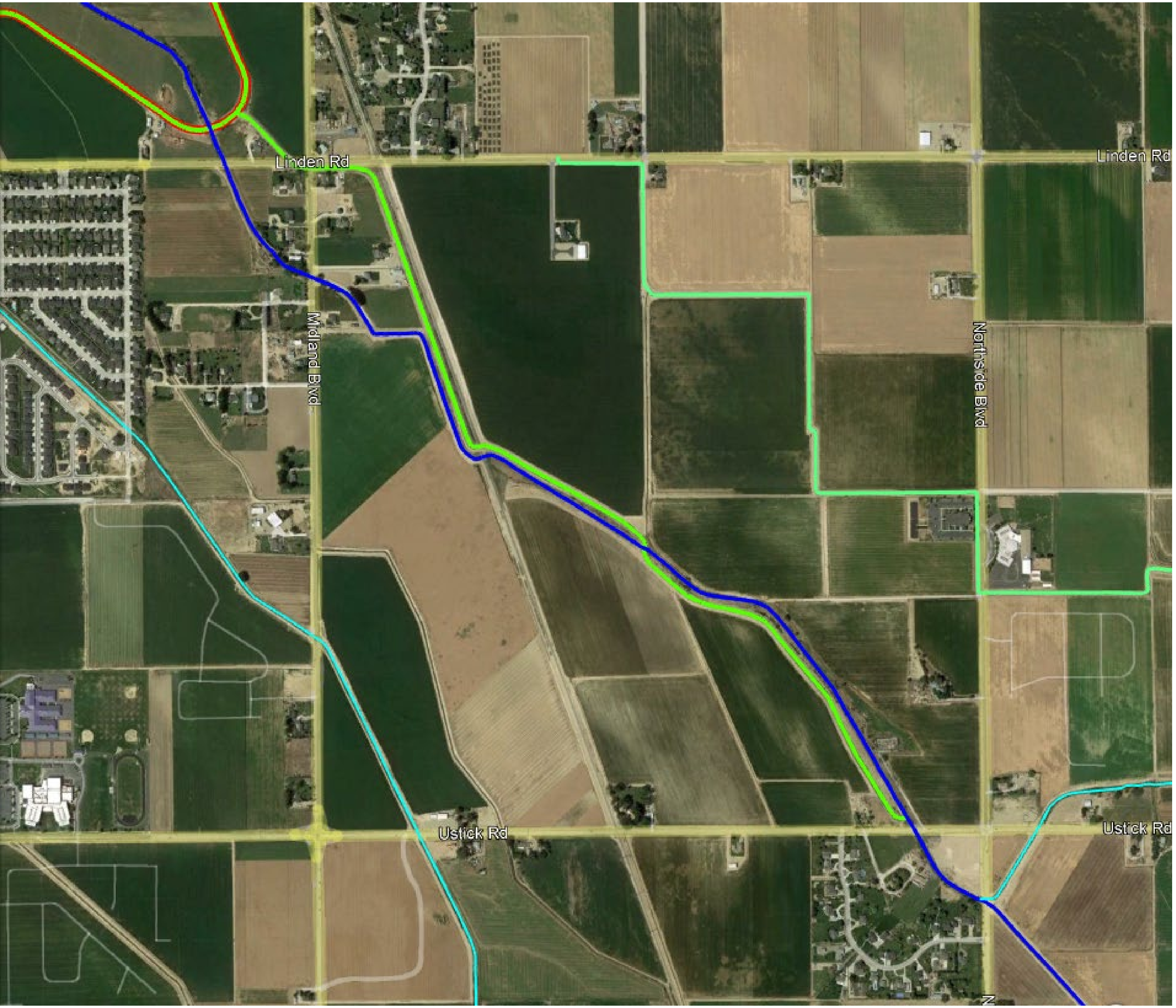
TMDL TP Load Reductions May 1 – Sept 30

Tributary	Boise River Receiving River Mile	Flow (cfs)	Current TP Conc. (mg/L)	Current TP Load (lb/day)	Target TP Conc. (mg/L)	Average TP Allocation[a] (lb/day as a monthly average)	Average TP Load Reduction (%)
Fifteenmile Creek	30.3	131.7	0.31	222.2	0.074	52.3	-76%
Mill Slough	27.2	104.9	0.21	118.2	0.071	40.1	-66%
Willow Creek	27.0	36.1	0.23	44.0	0.070	13.6	-69%
Mason Slough	25.6	13.0	0.22	15.4	0.070	4.9	-68%
Mason Creek	25.0	147.6	0.41	322.1	0.070	56.1	-83%
Hartley Gulch	24.4	39.2	0.27	57.4	0.070	14.8	-74%
Indian Creek	22.4	100.6	0.50	271.6	0.089	48.3	-82%

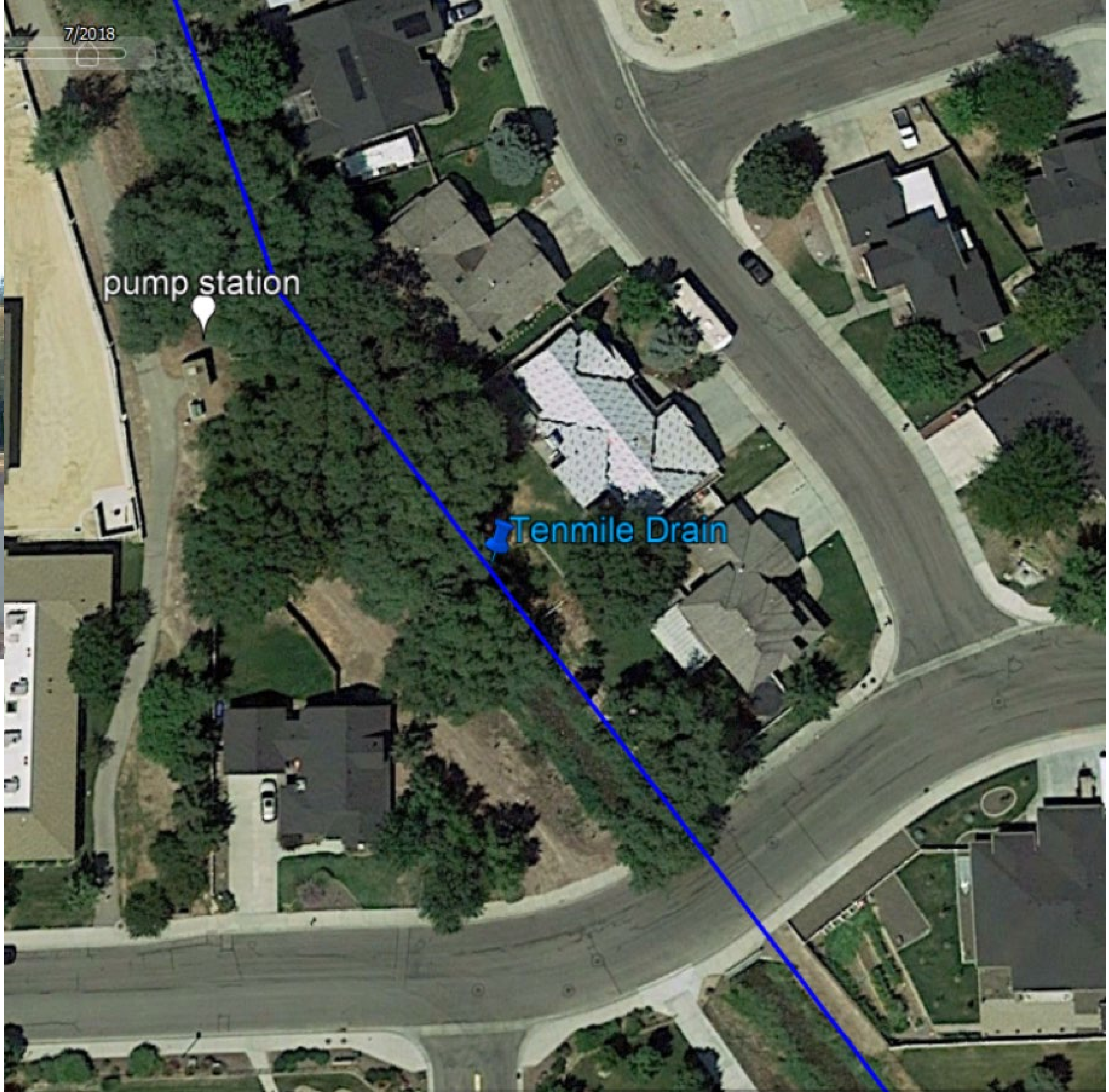
Purdam Gulch Loading & Reuse



Purdam Gulch Reuse & Loading



Ten Mile Drain Reuse



NMID:

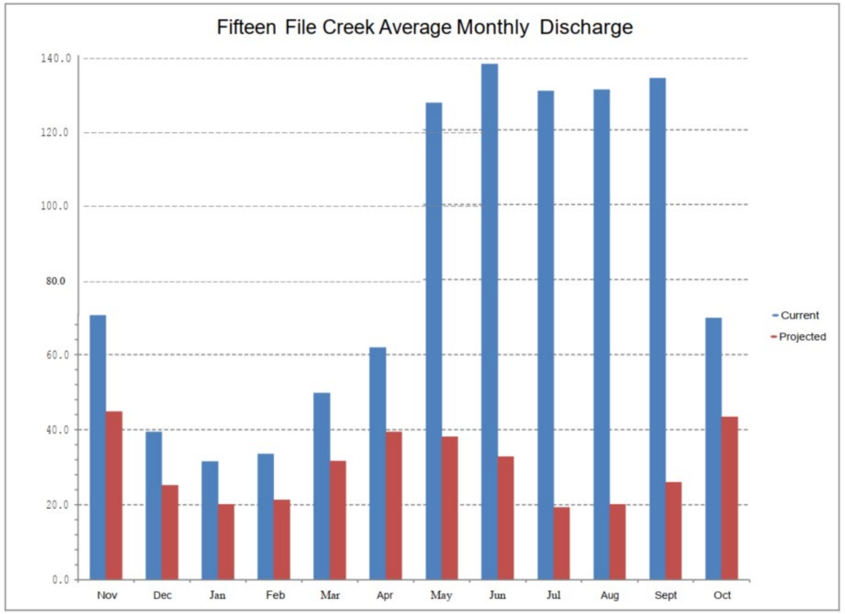
- 91 PUIS
- 300 pumps
- Approx. 1/3 in drains

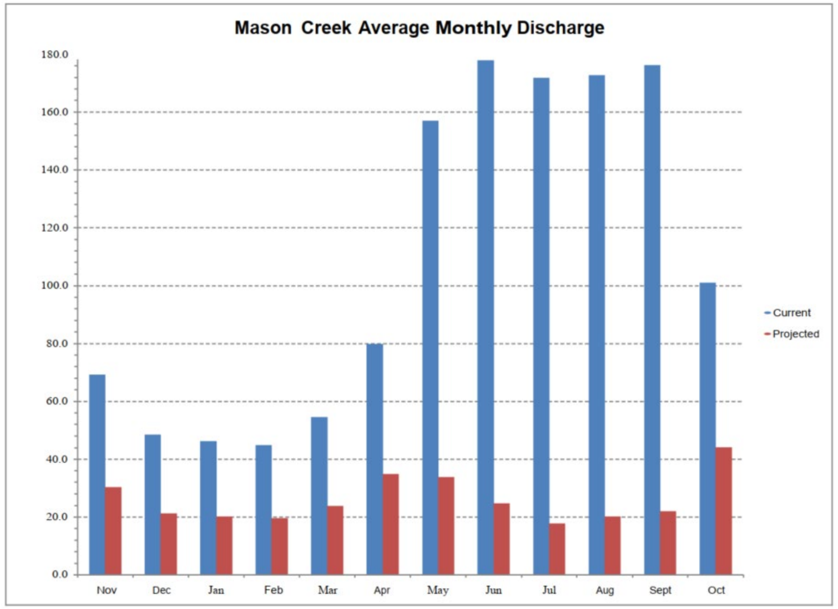
Estimates of Impacts on Lower Boise Valley Drain Discharge with Elimination of Gravity Irrigation (*Dave Shaw,* ERO Resources Corporation, 2014)

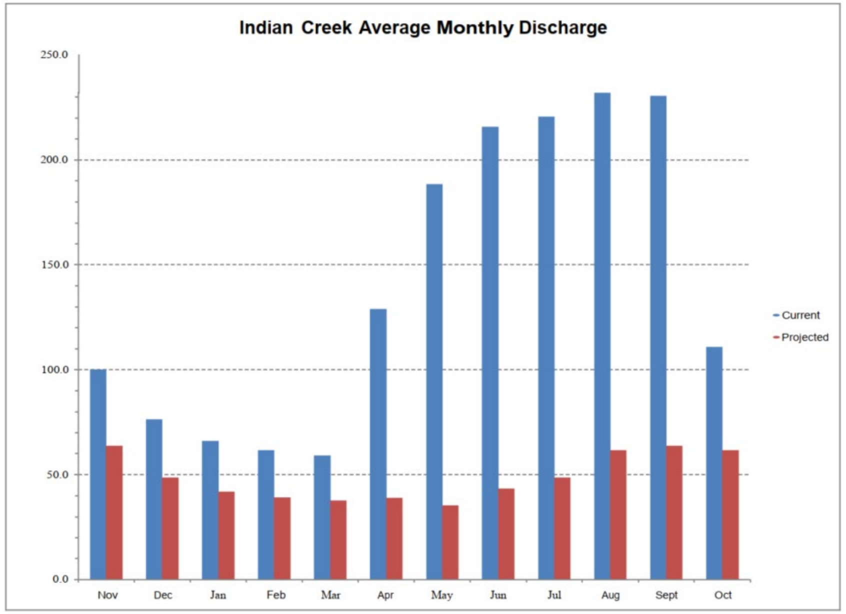
- Based on "A Distributed Parameter Water Budget Data Base for the Lower Boise Valley," (USBR, 2008)
- Estimates drain discharges after ***100% conversion of agricultural irrigation from gravity to sprinkler within 4 drainages***
    - ***Elimination of surface return flows and most on-farm infiltration from irrigation of agricultural lands***
- Reductions from less extensive conversion to sprinkler may be estimated proportionately from this analysis
- Need to update data & analysis

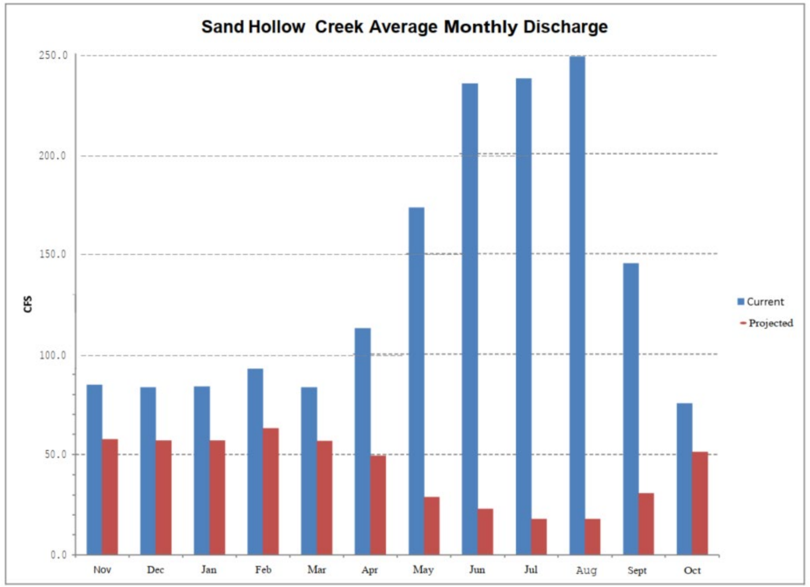
	Fifteen Mile Creek	Indian Creek	Mason Creek	Sand Hollow Creek
Current Surface Water (ac-ft)	27,128	46,770	35,500	54,959
Current Ground Water (ac-ft)	34,360	55,427	43,134	45,132
Current Total Discharge (ac-ft)	61,488	102,197	78,634	100,091
Projected Drain Discharge (ac-ft)	21,886	35,230	18,842	30,708
Percent Reduction	64%	66%	76%	69%

ESTIMATES OF IMPACTS ON LOWER BOISE VALLEY DRAIN DISCHARGE WITH ELIMINATION OF GRAVITY IRRIGATION (*Dave Shaw,* ERO Resources, 2014)









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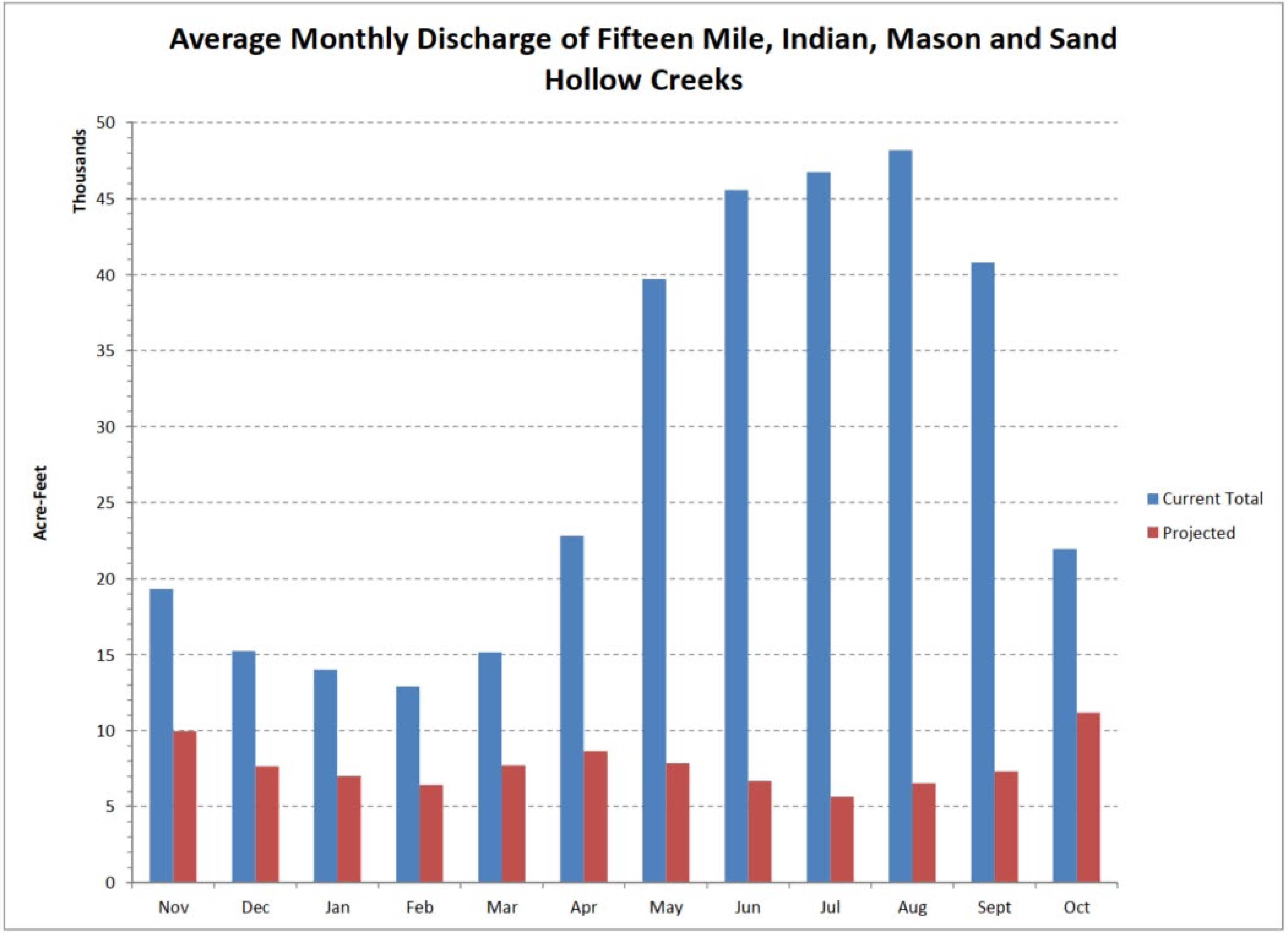
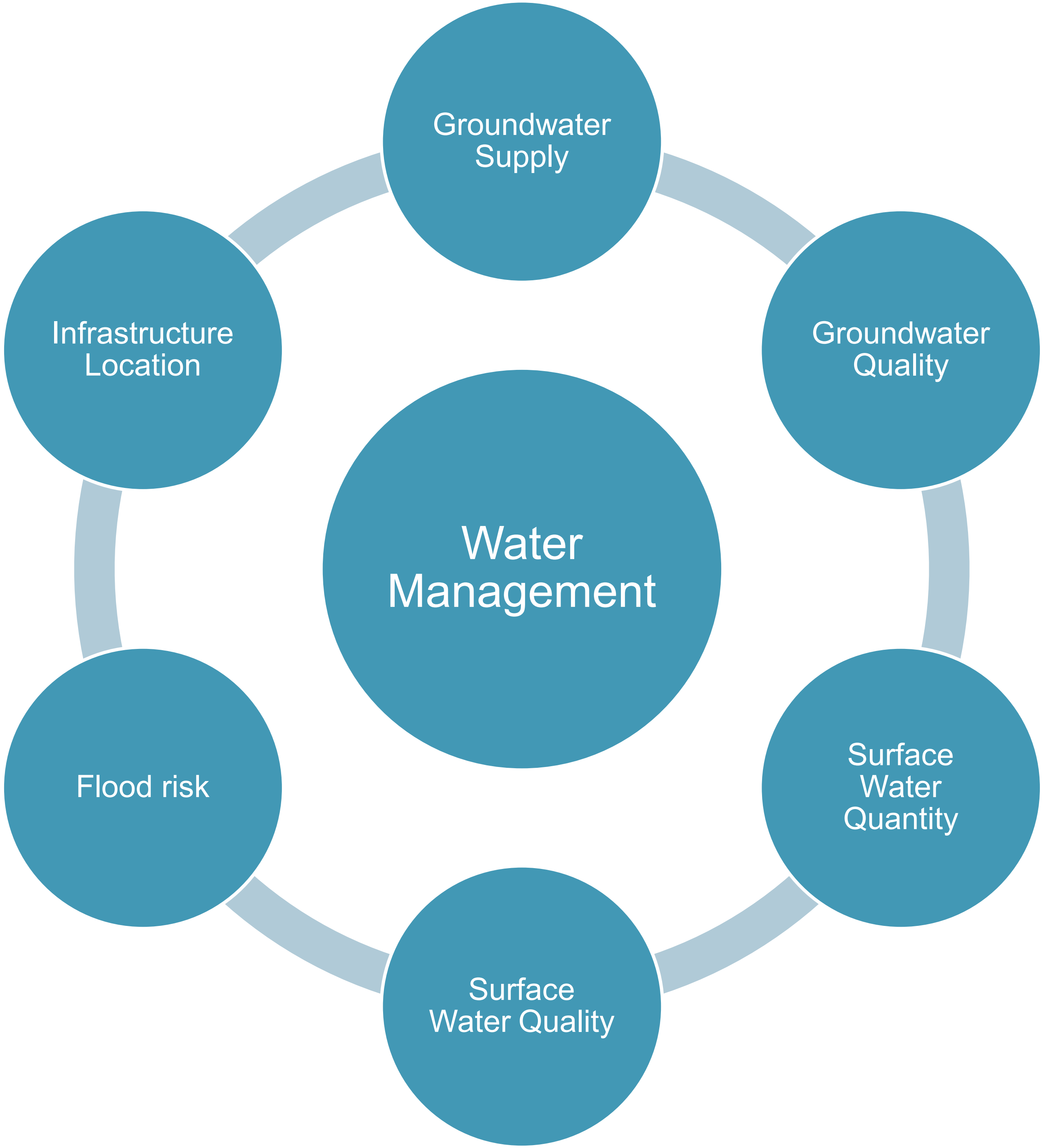


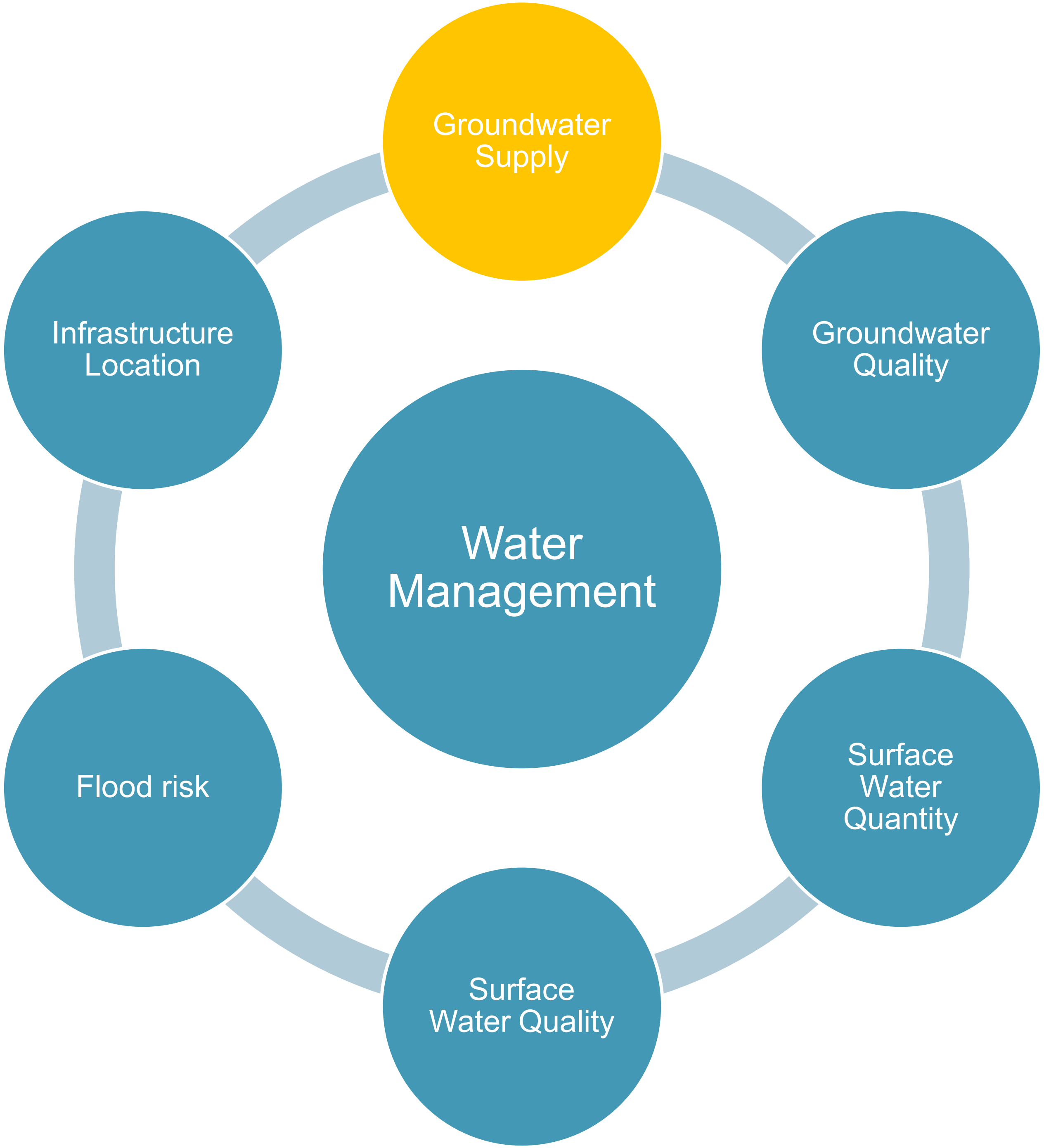
Water Supply & Water Quality Effects: Draft IWUA Resolution

- Seek funding assistance for technologies for monitoring, assessment and modeling to assess, plan for and manage the hydrologic impacts of land use changes on surface drainage, return flows, water reuse, ground water recharge and aquifer levels, water supplies and water quality

Potential Funding

- Potentially eligible for ARPA (CWSRF) funding to develop “an integrated water resource plan for the coordinated management and protection of surface water, ground water, and stormwater resources on a watershed or subwatershed basis to meet the objectives, goals, and policies of [the Clean Water Act].”


Groundwater Supply
Groundwater Quality
Surface Water Quantity
Surface Water Quality
Flood risk
Infrastructure Location
Water Management


Water Management
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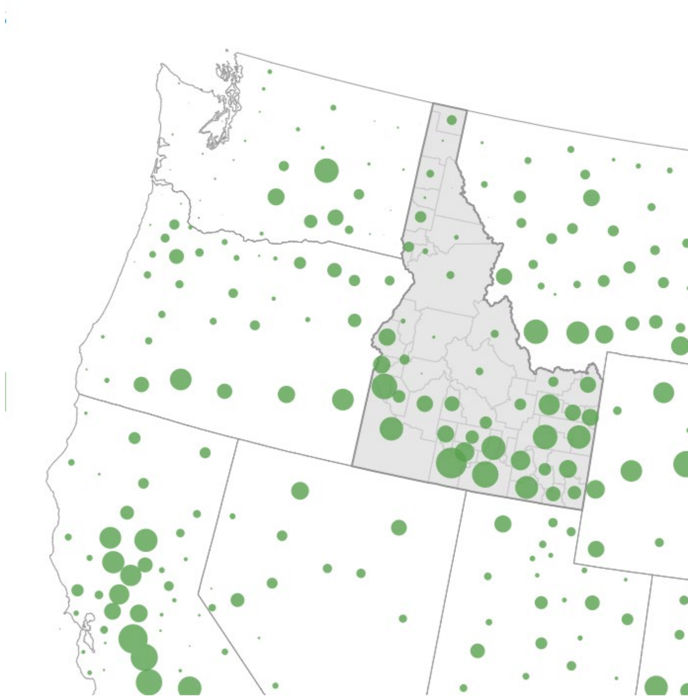
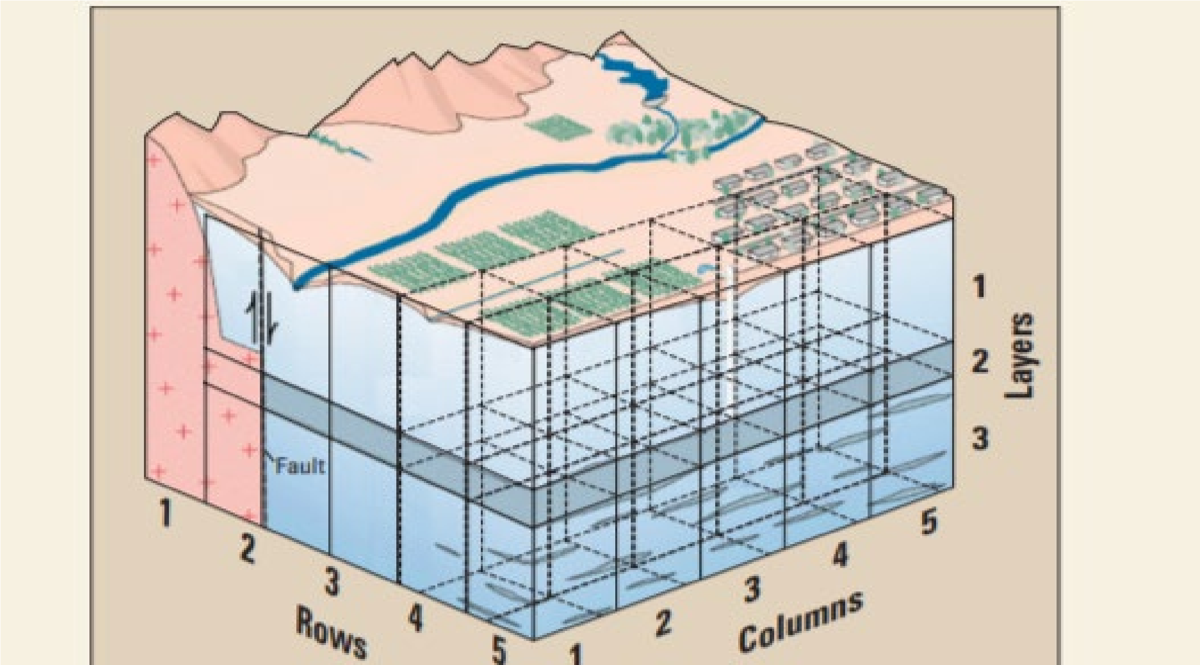
Infrastructure Location

Groundwater Supply

- Question: How are groundwater resources responding to changes in land use?
- Challenge: Quantify changes to recharge and demand from urbanization
- Tools:
  - Groundwater Monitoring
  - County Level Water Use Mapping
  - Groundwater Modeling





Bartolino and Vincent , 2017

USGS
science for a changing world

Monitoring

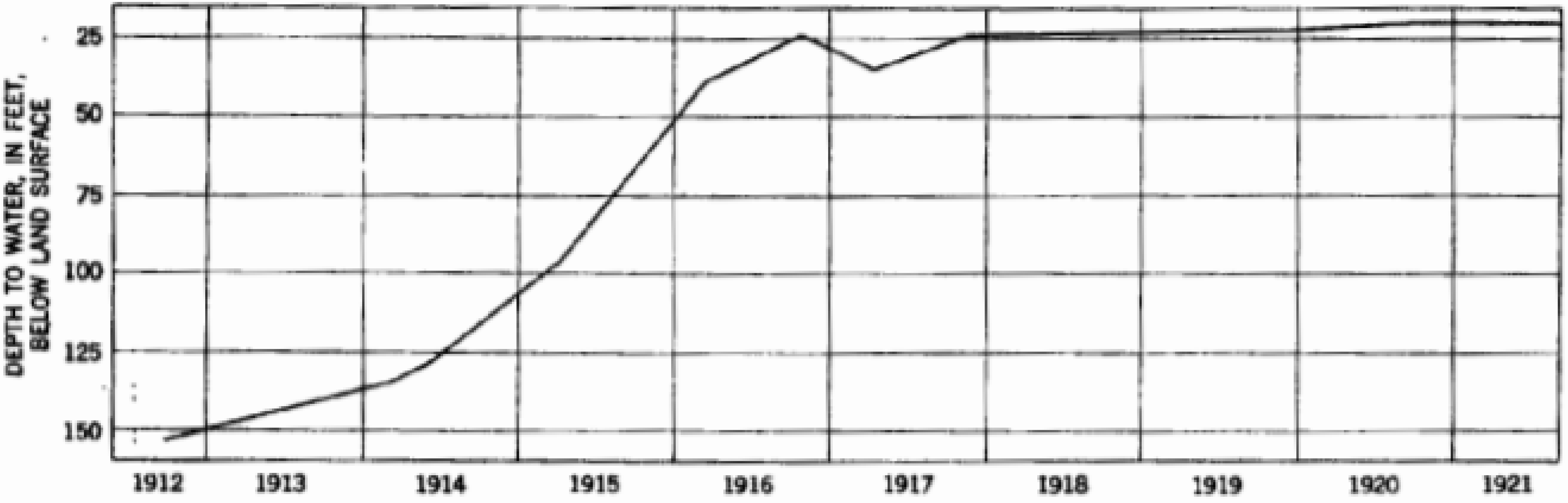
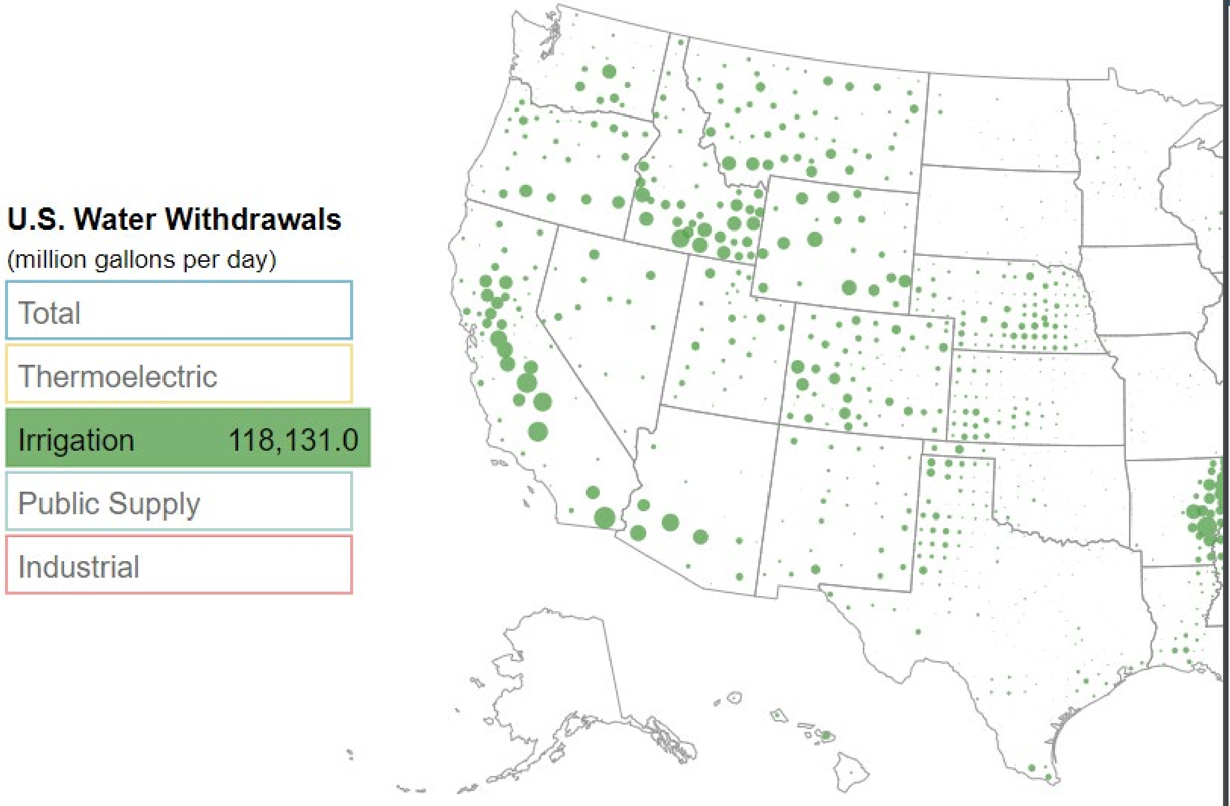


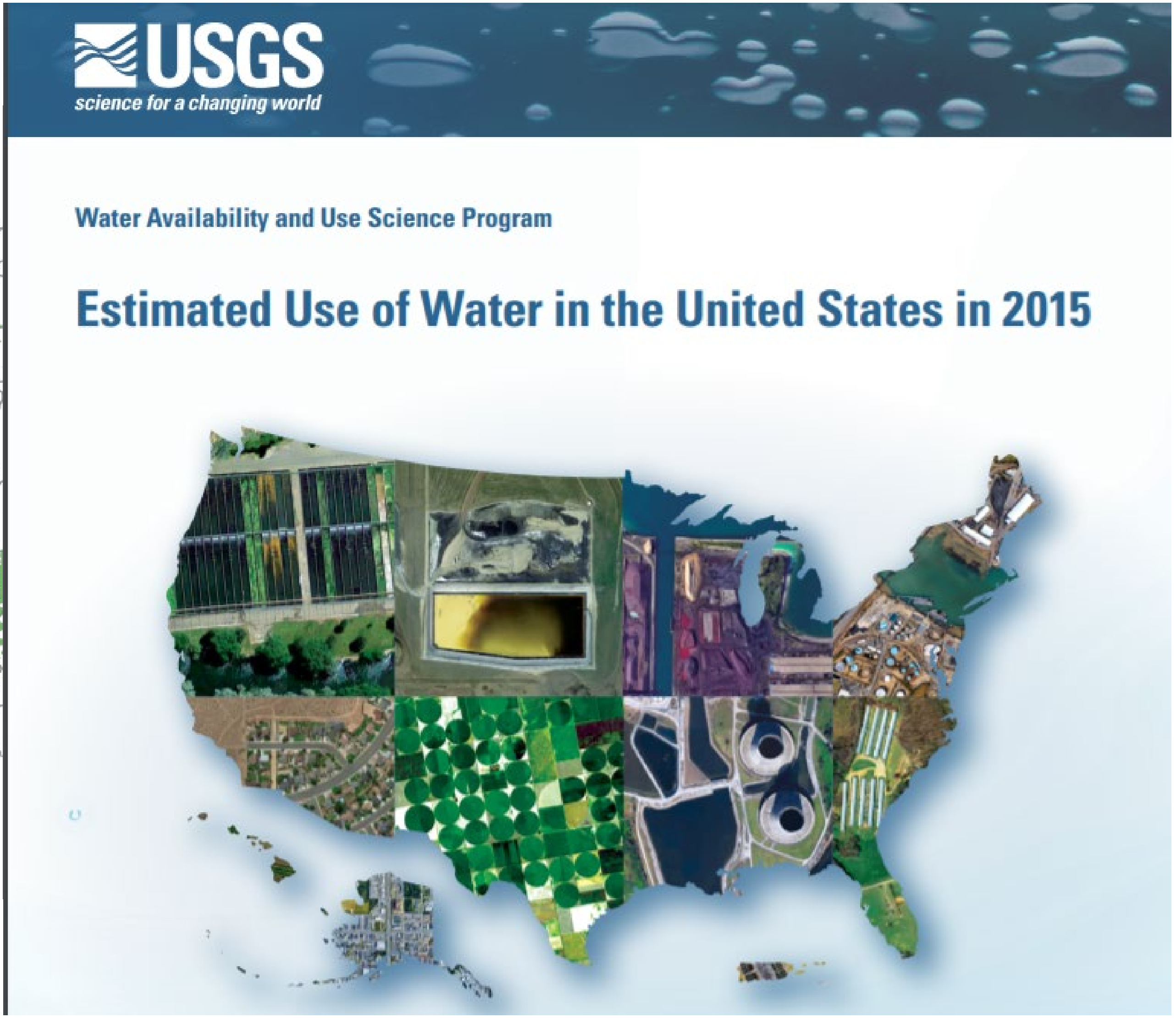
FIGURE 3.—Rise of the water level in well 4N–4W–34bc, 1912–21.

USGS, 1957

Water Use

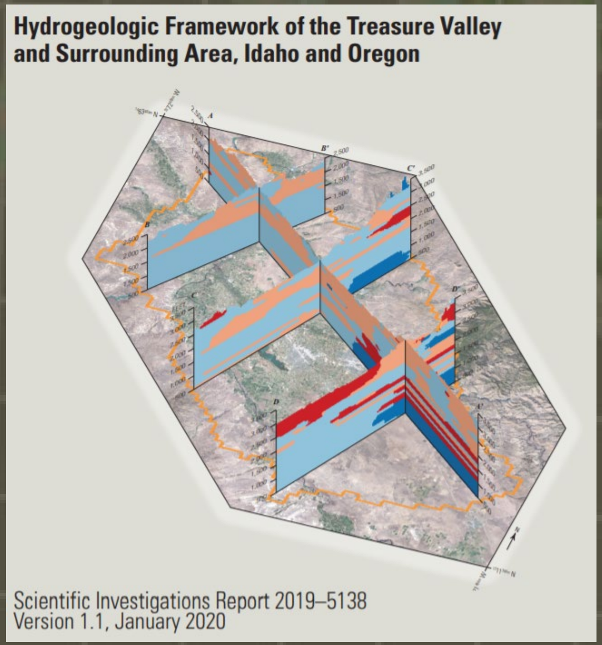


https://labs.waterdata.usgs.gov/visualizations/water-use-15

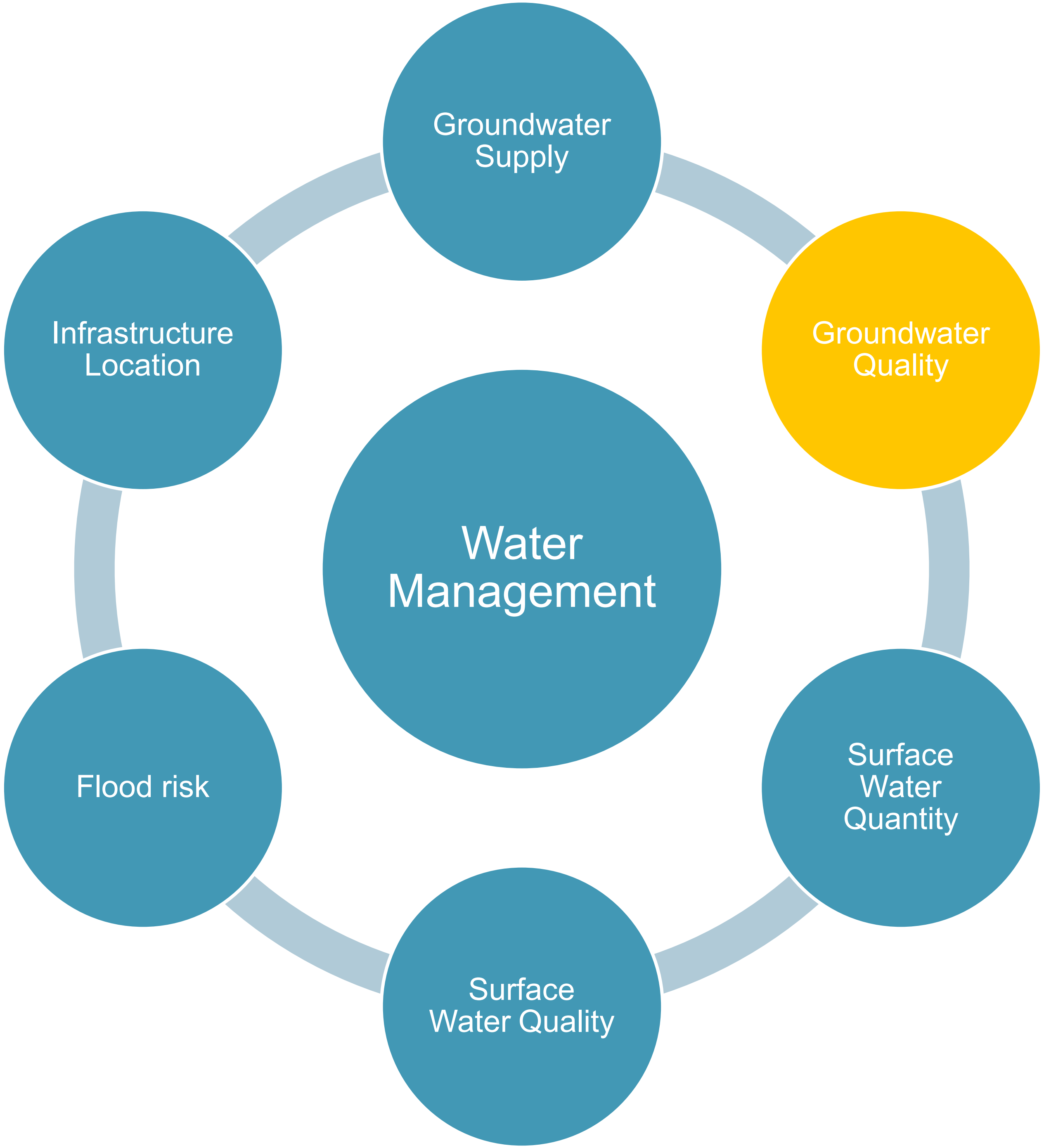


USGS
science for a changing world

Modeling



USGS science for a changing world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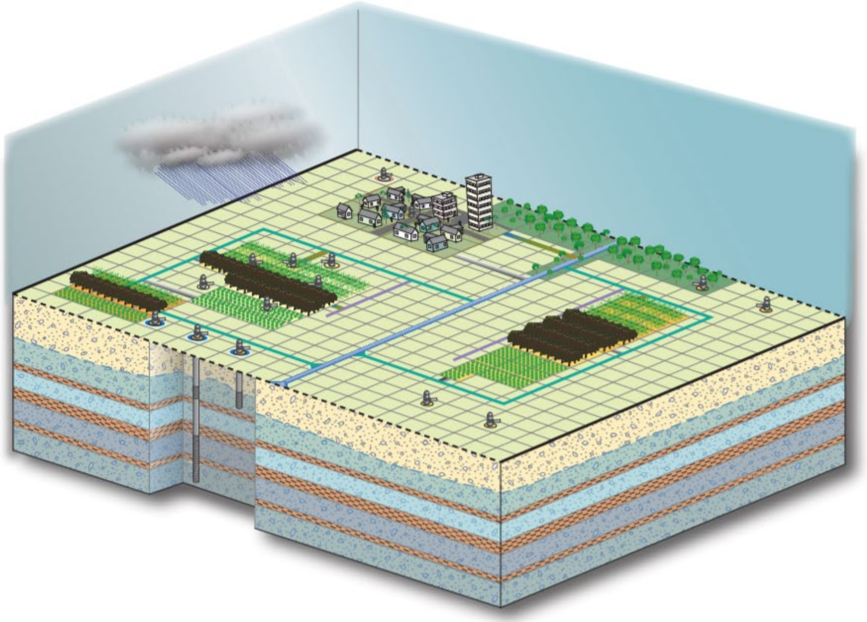
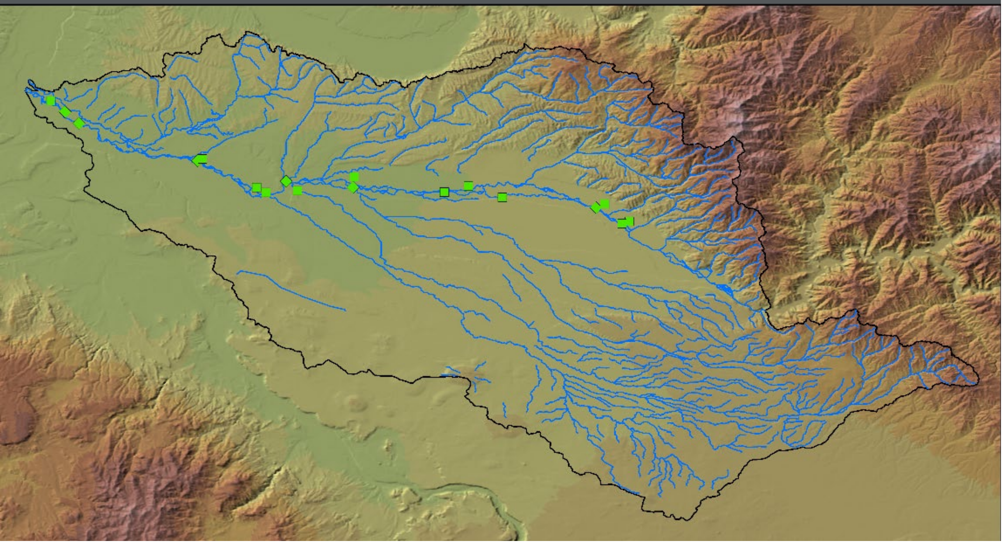
Infrastructure Location
Water Management



Groundwater Quality

- Question: How is groundwater quality affected by land use?
- Objective: Quantify changes to nutrient and contaminant loading from urbanization
- Tools:
  - Groundwater Monitoring
    - Contaminant identification
  - Groundwater Modeling
    - Residence times
    - Flow paths

USGS
science for a changing world



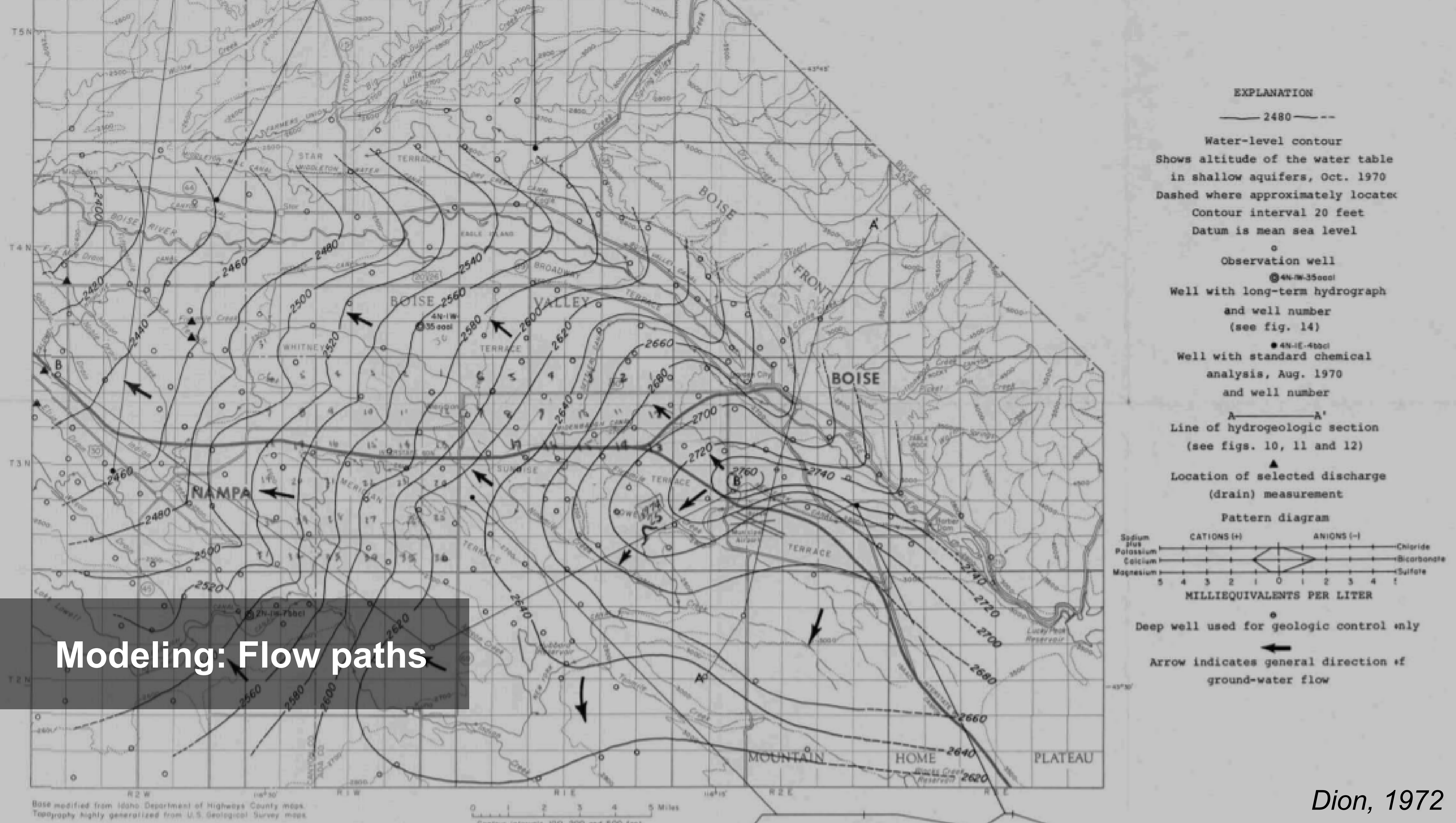
Groundwater Quality Monitoring

- Shallow and deep groundwater
- Previous studies show groundwater nutrients impact instream conditions

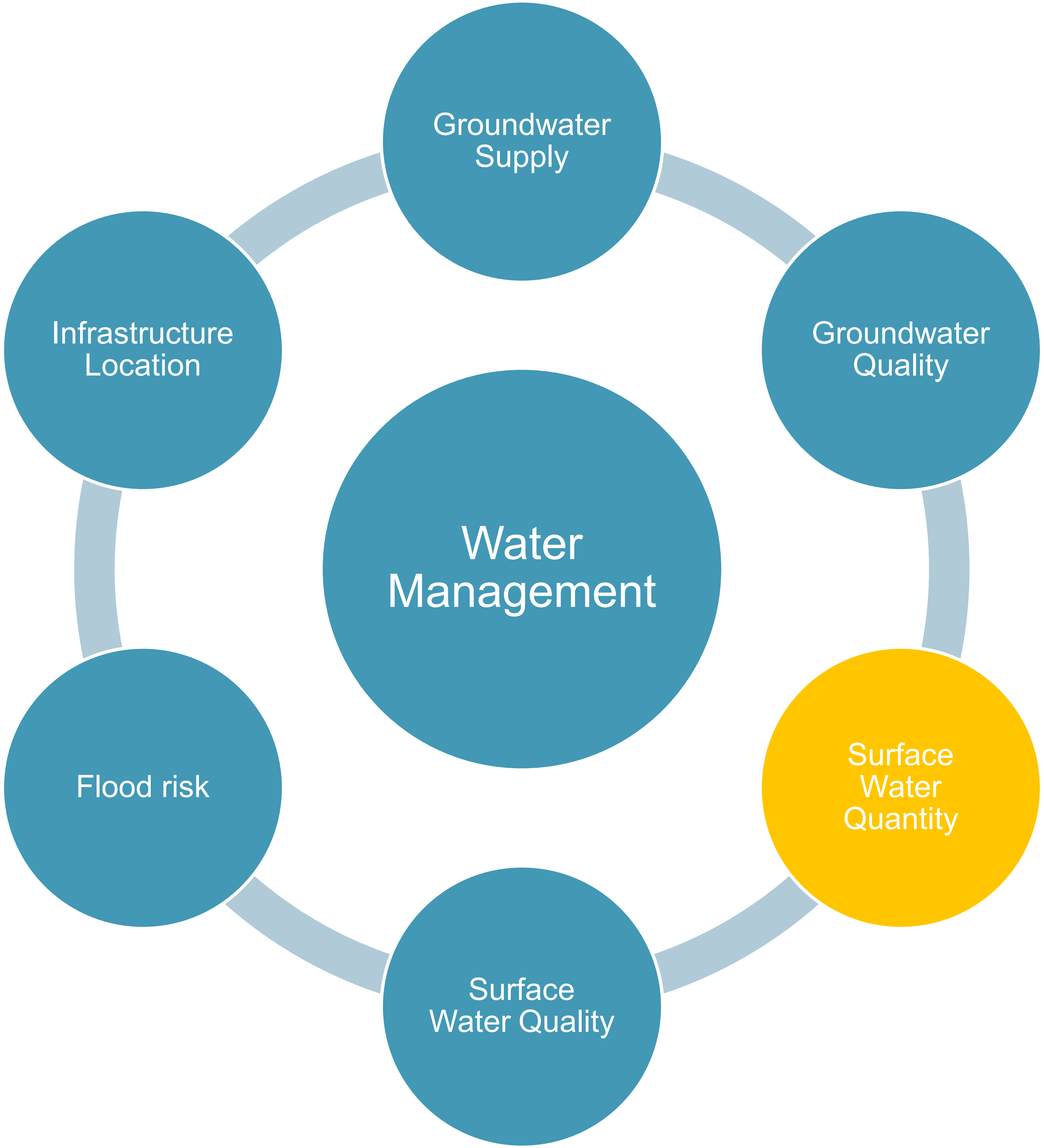
  Dion 1972, Neely and Crockett 1998, Fox et al 2002, MacCoy 2004, Etheridge 2013

- Enhanced groundwater quality monitoring
  - Update estimates of groundwater nutrients
  - Identify contaminants of concern
  - Provide up-to-date status for modeling

Modeling: Flow paths



Dion, 1972


Groundwater Supply
Groundwater Quality
Surface Water Quantity
Surface Water Quality
Flood risk
Infrastructure Location
Water Management

Surface Water Quantity

- Question: How will changes in surface and groundwater hydrology impact flows in drains and the Boise River?
- Challenge: Quantify changes in surface flow.
- Tools:
  - Monitoring of discharge in drains (TVGW model)
  - Modeling shallow groundwater flow to drains

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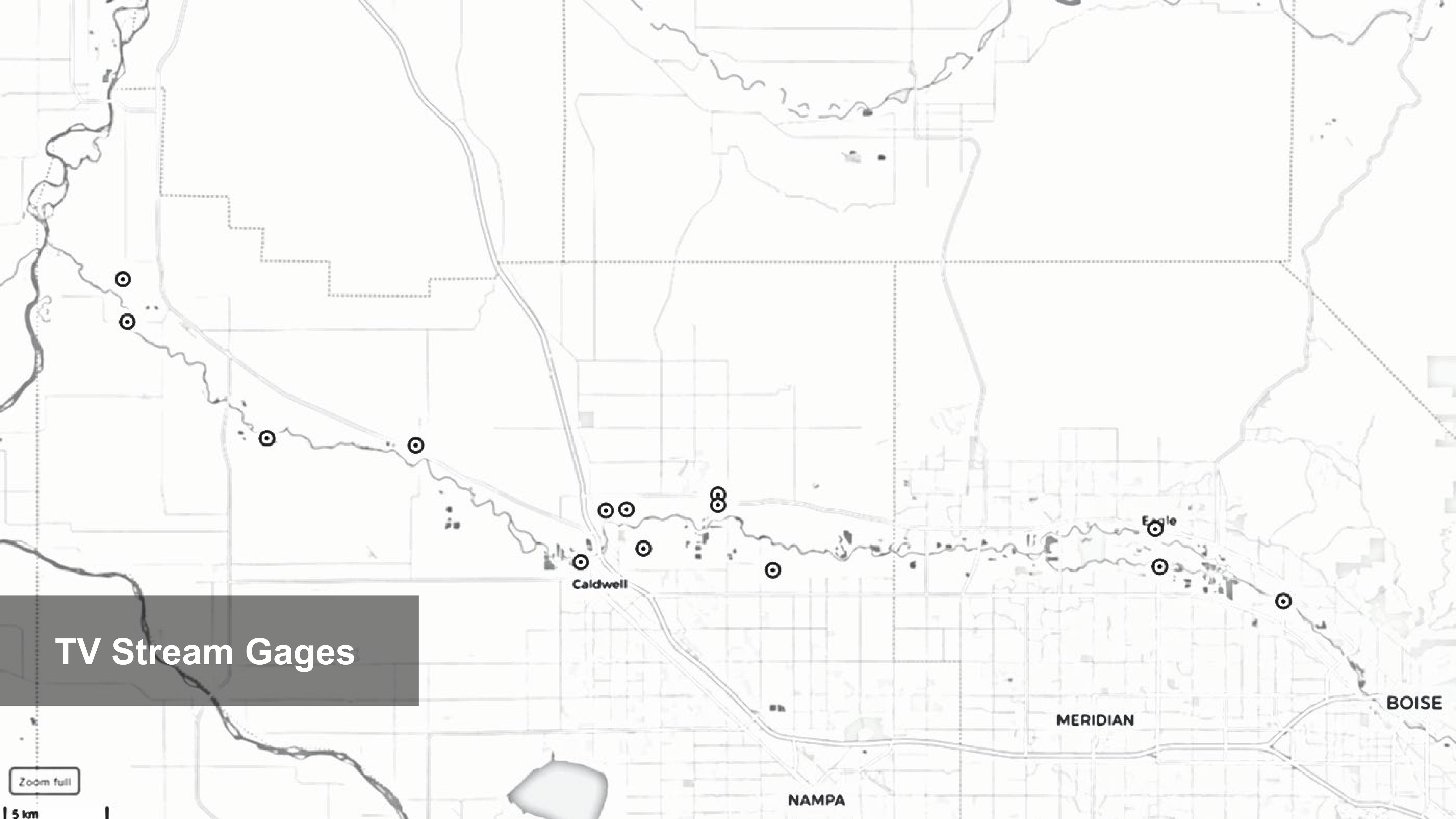
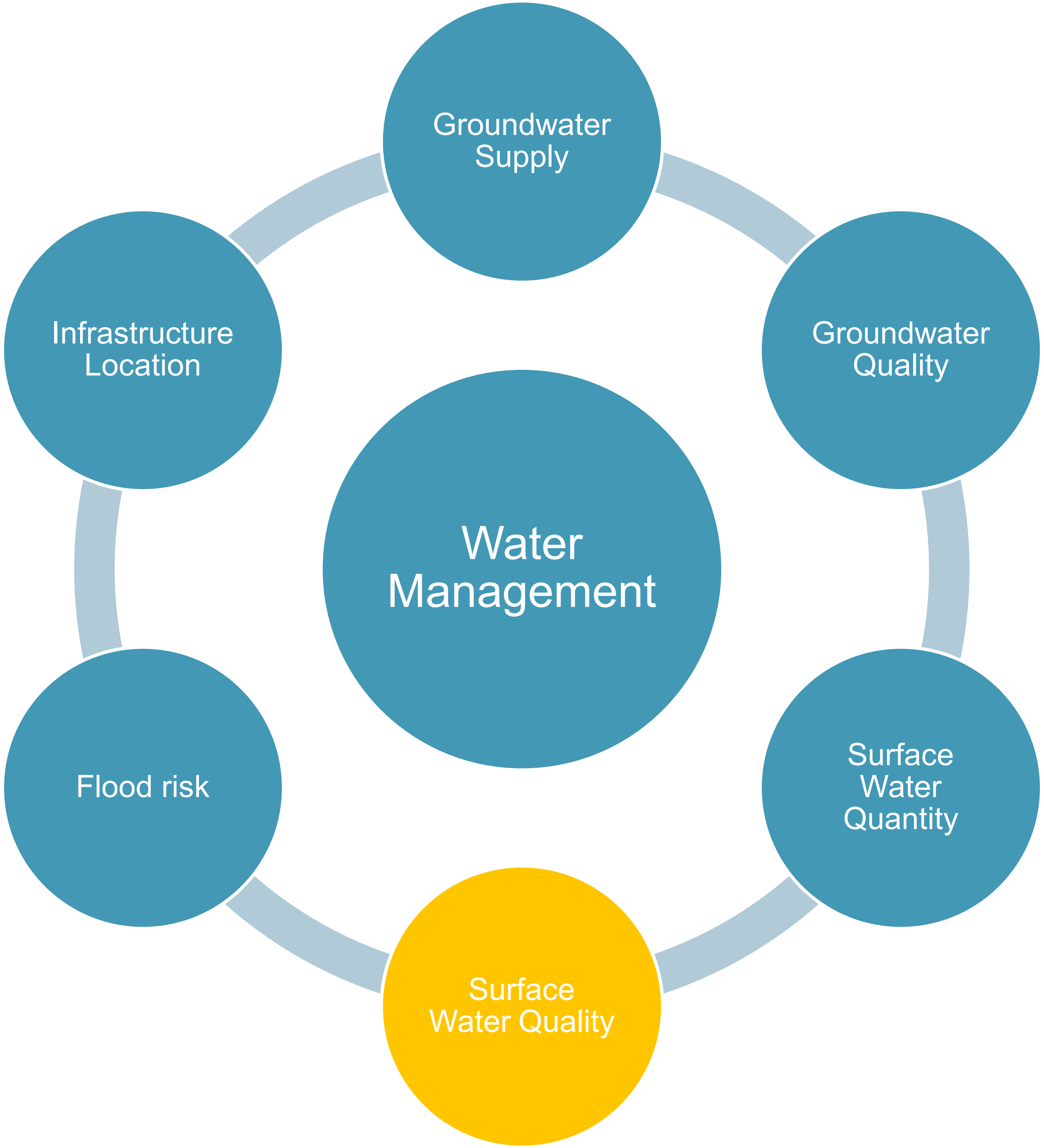
TV Stream Gages




Groundwater Supply
Groundwater Quality
Surface Water Quantity
Surface Water Quality
Flood risk
Infrastructure Location
Water Management

Surface Water Quality

- Question: What are the impacts of changing land use on surface water quality?
- Challenge: Identify contaminants, quantify loading, and transport.
- Tools:
  - Ongoing monitoring: nutrient, sediment, bacteria
  - Contaminant transport modeling (SWAT)
  - Flood District 10 2-d hydraulic modeling (Boise River Management Tool)

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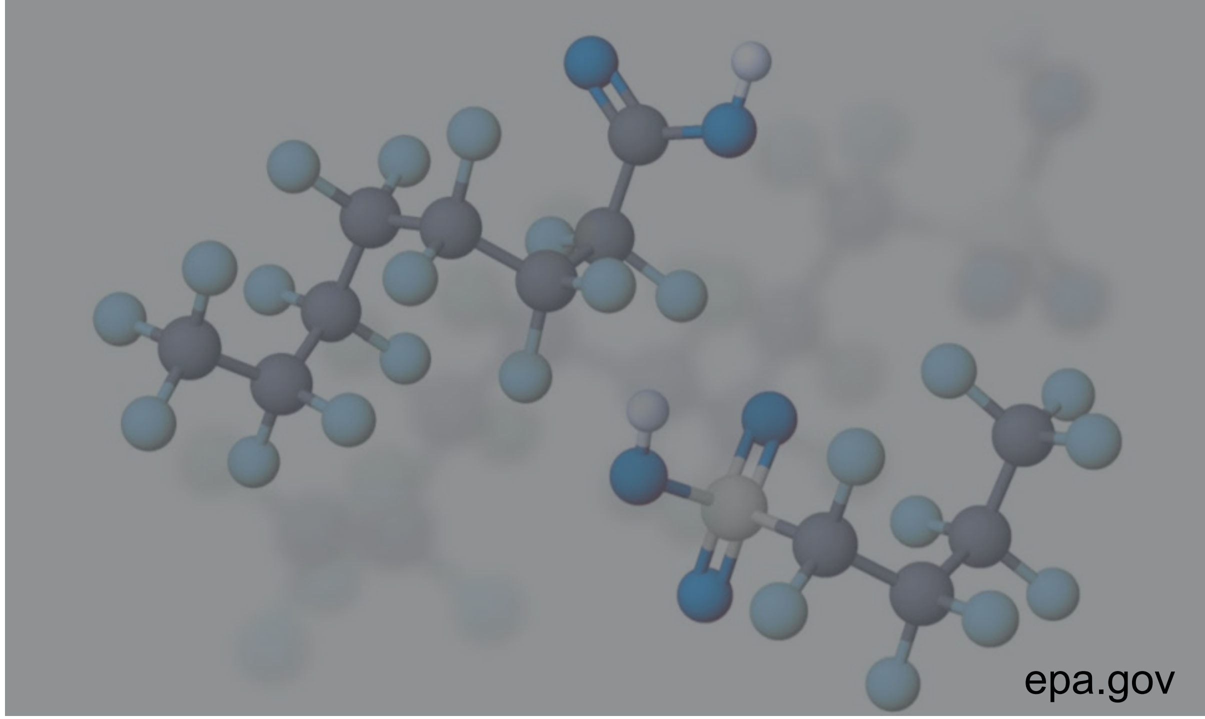
science for a changing world

Enhanced Surface Water Quality Monitoring

- Contaminants of emerging concern
  - PFAS
  - Personal Care Products
  - Pharmaceuticals
  - Hormones
- Synoptic monitoring of nutrients
- Trends analyses



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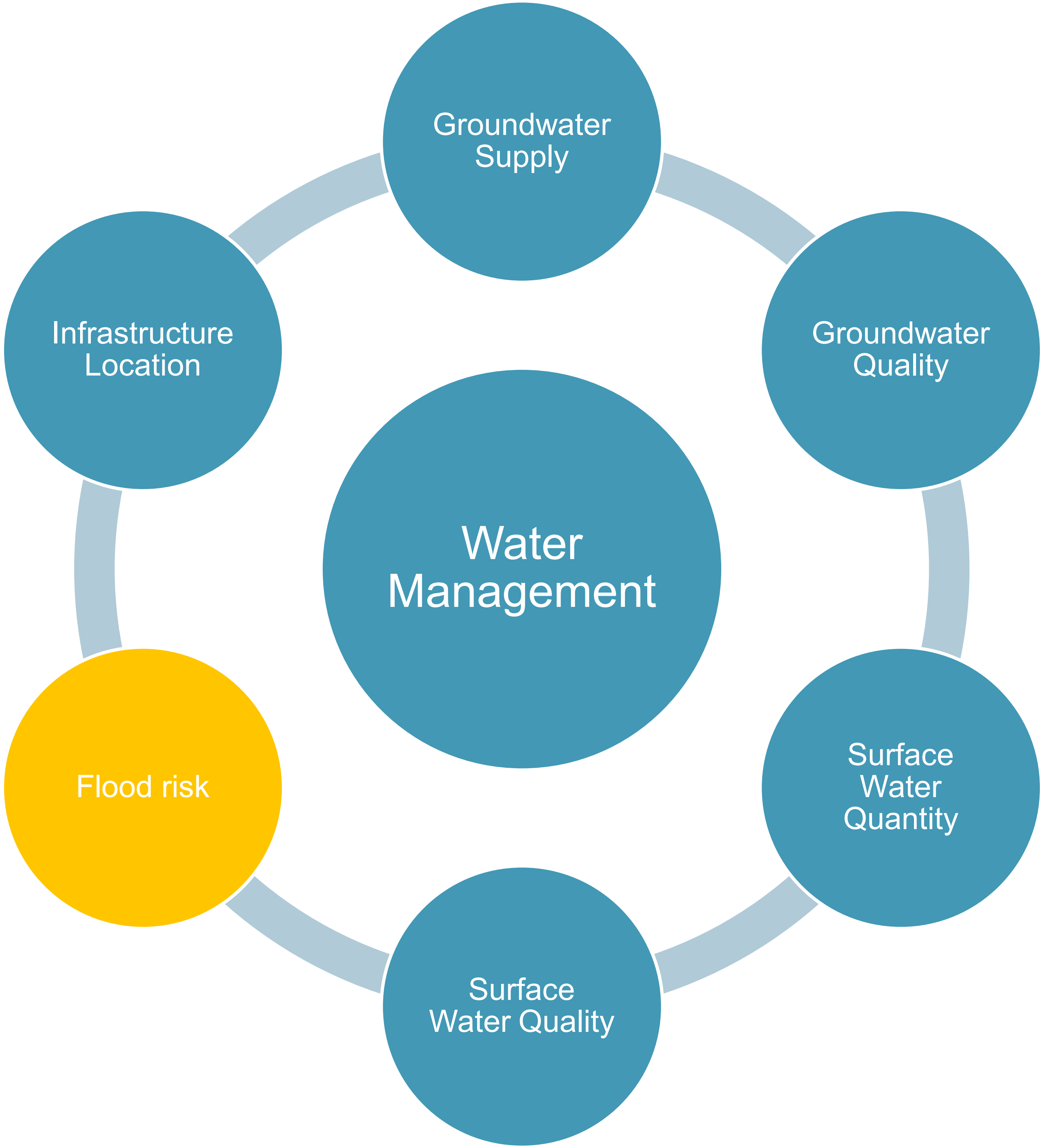
Groundwater Supply
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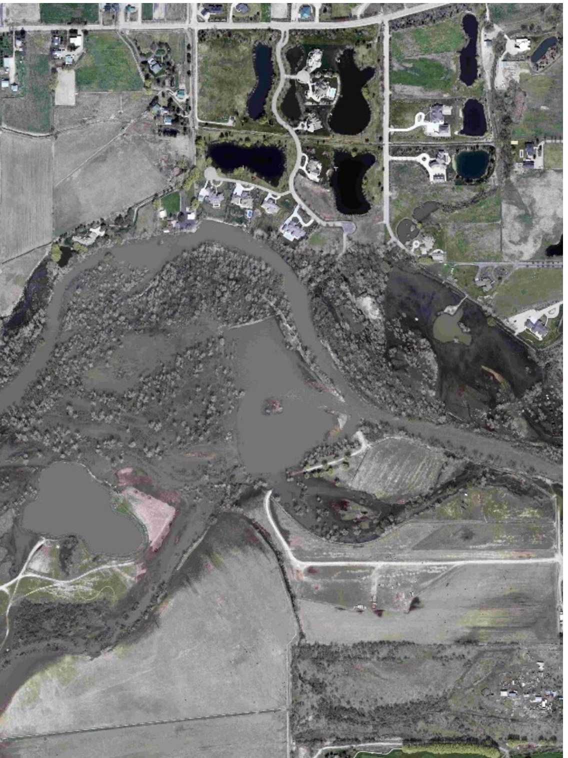
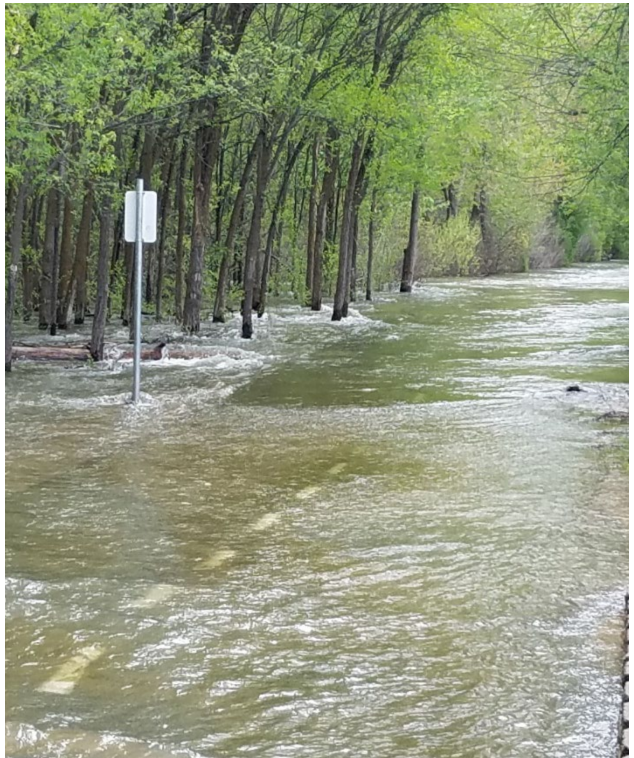
Water Management

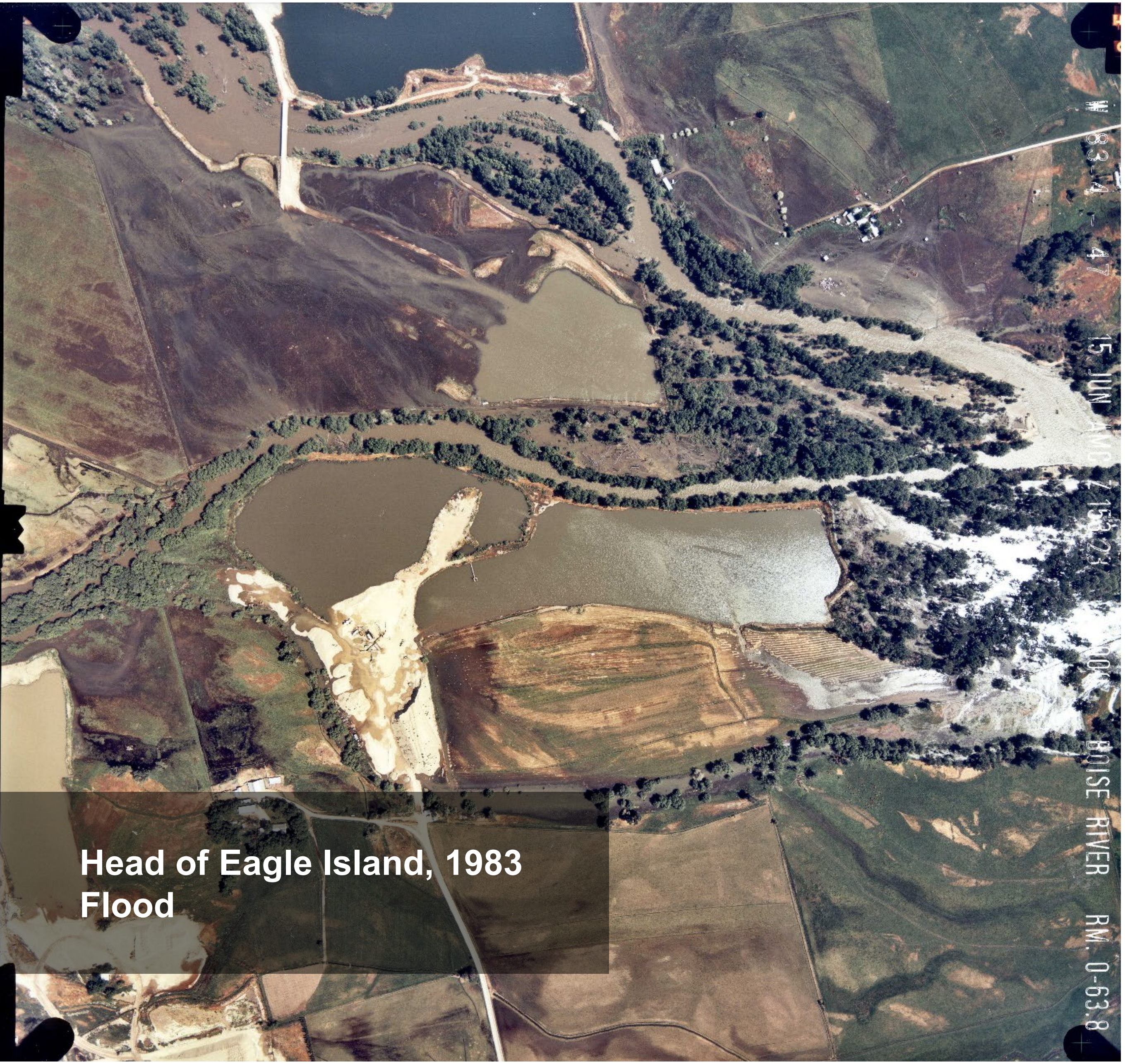
Flood Risk

- Development in the floodplain
- Greenbelt expansion
- Pit capture
- Dam Breach
- Evacuation Routes
- Impervious Area

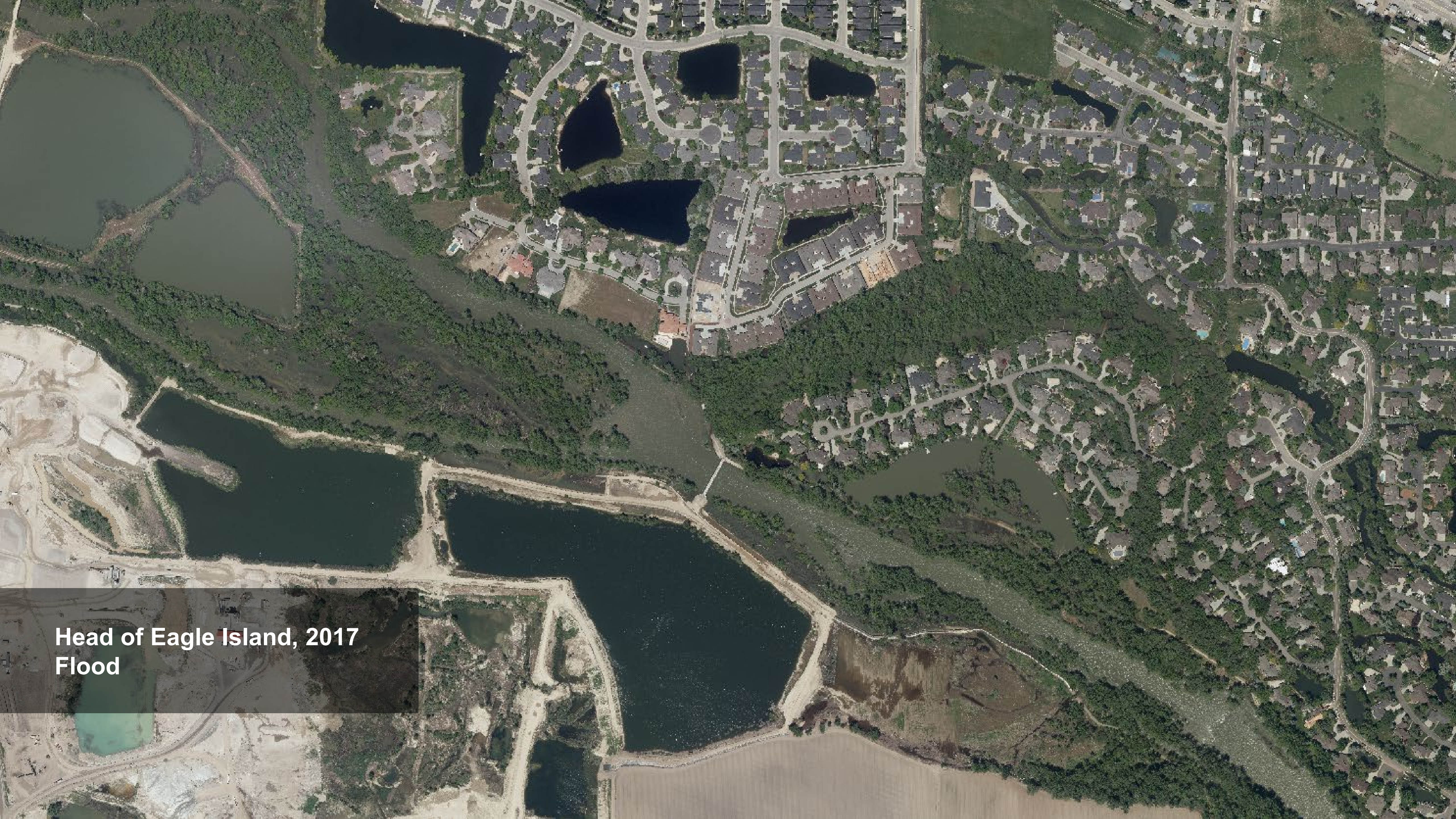

OF EAGLE





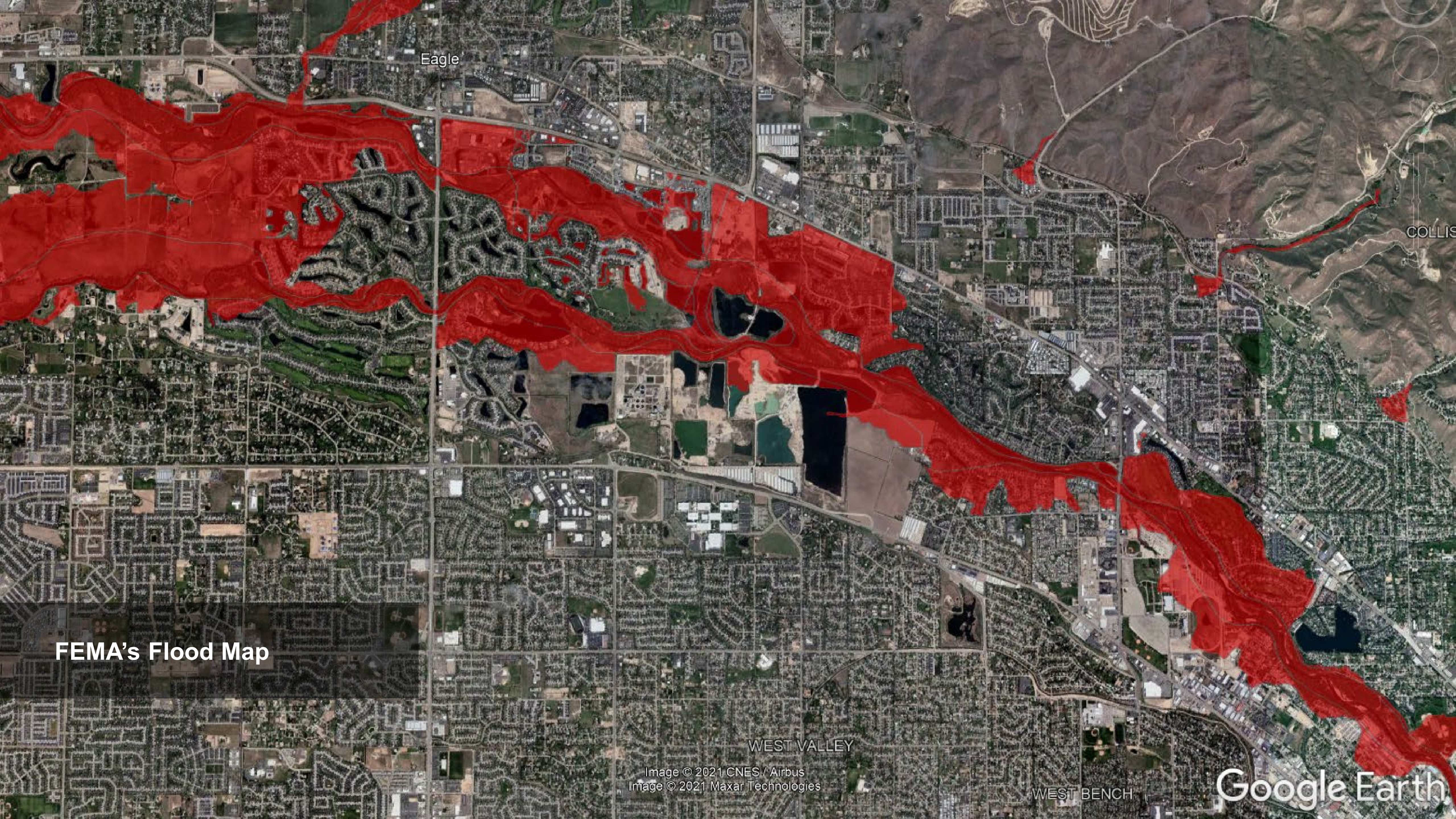


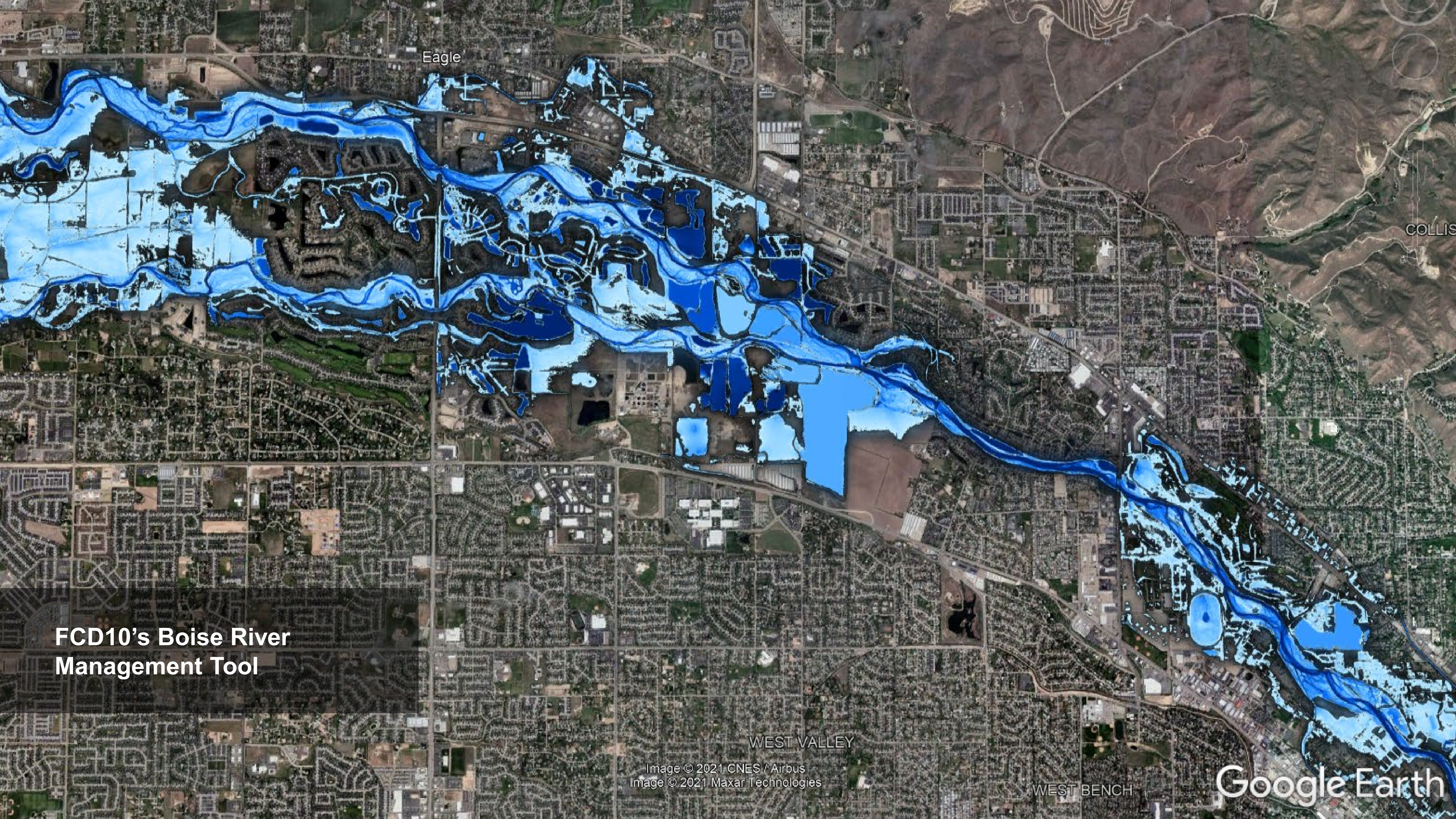
Head of Eagle Island, 1983 Flood

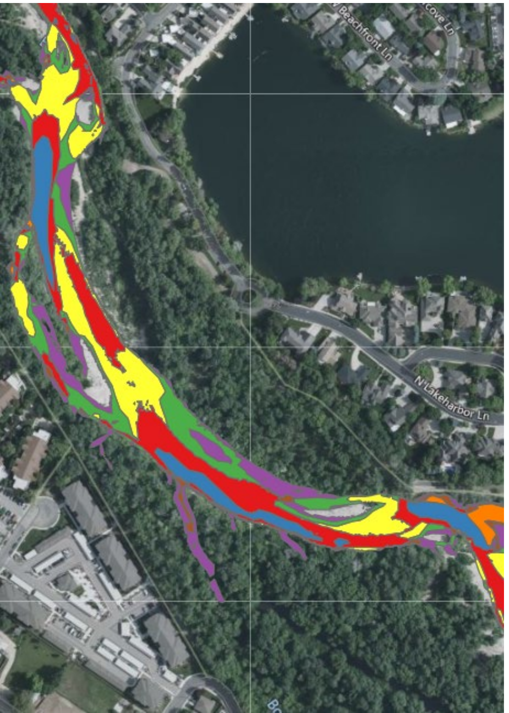

Head of Eagle Island, 2017 Flood

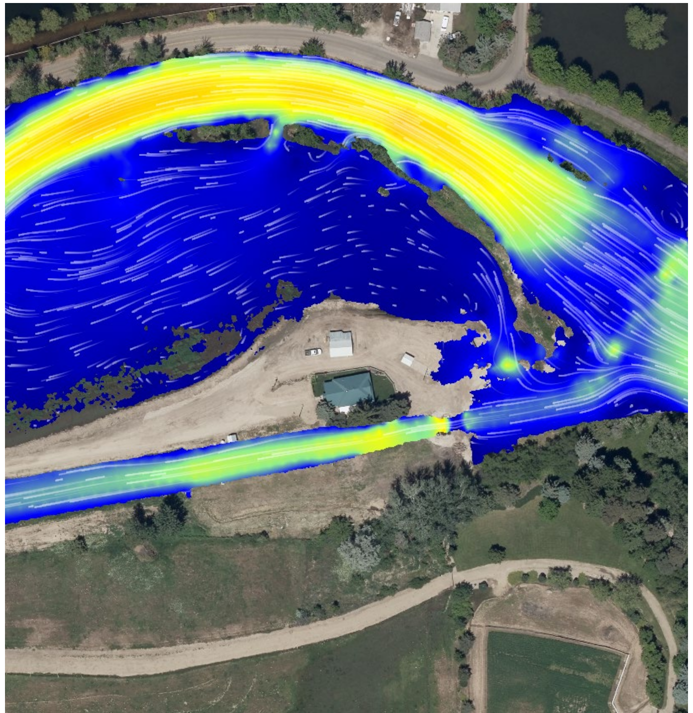

Eagle
COLLIS
East Eagle Island 1992
WEST VALLEY
Image Landsat / Copernicus
Image U.S. Geological Survey
WEST BENCH
Google Earth

East Eagle Island 2021


Eagle
COLLIS
FEMA's Flood Map
WEST VALLEY
Image © 2021 CNES / Airbus
Image © 2021 Maxar Technologies
WEST BENCH
Google Earth

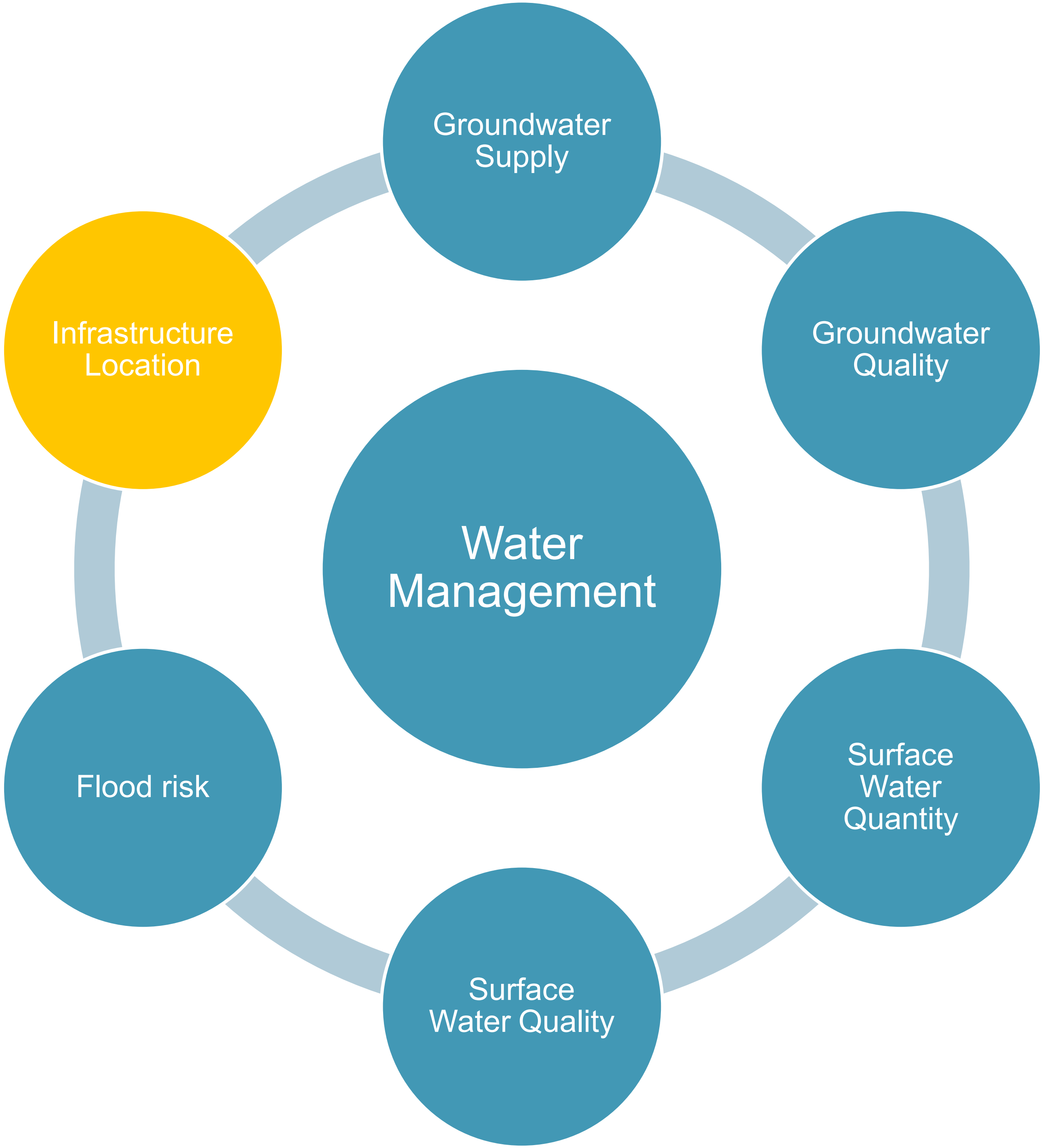

FCD10’s Boise River
Management Tool
Eagle
WEST VALLEY
WEST BENCH
Image © 2021 CNES / Airbus
Image © 2021 Maxar Technologies
Google Earth





BRMT – Improving Flood Management

- Boise River FCD10
  - Eagle Road North Channel
  - Canyon Reach
- USACE Dam Breach Modeling
- Ada Co./ City of Eagle- Eagle Island LOMR
- Pioneer Irrigation District- Phyllis Canal Diversion
- City of Boise- Esther Simplot Parks, Boise River System Assessments
- Barber Pool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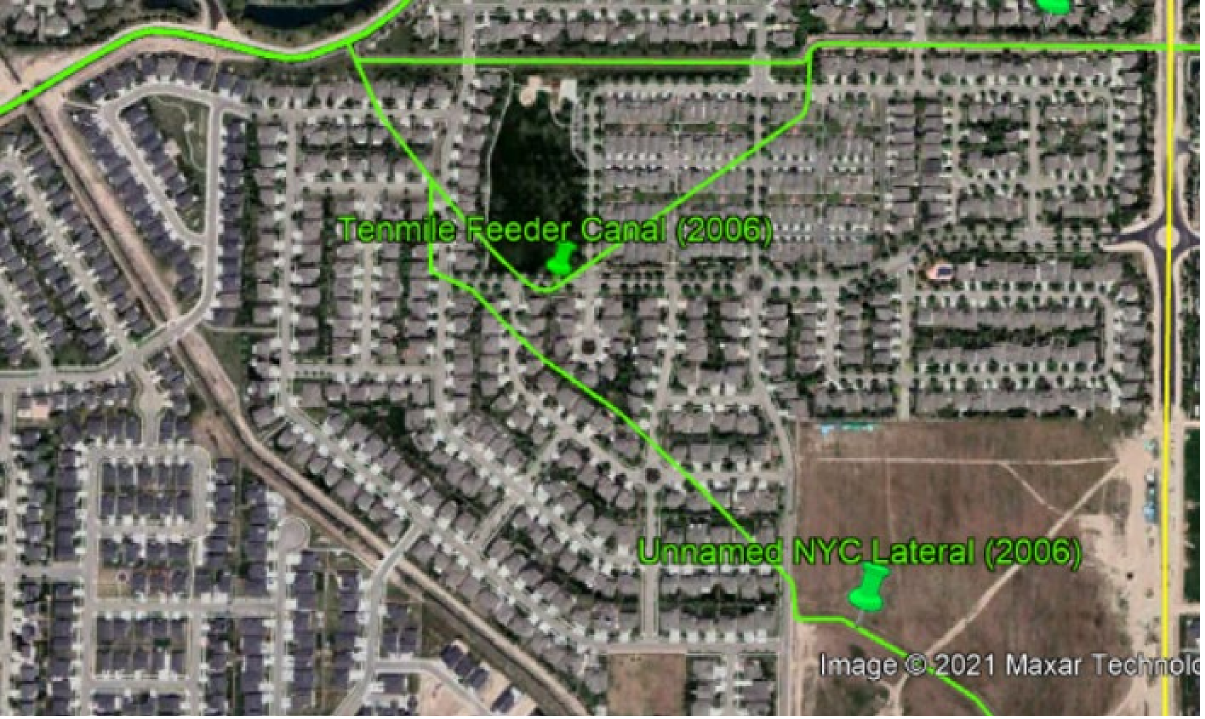
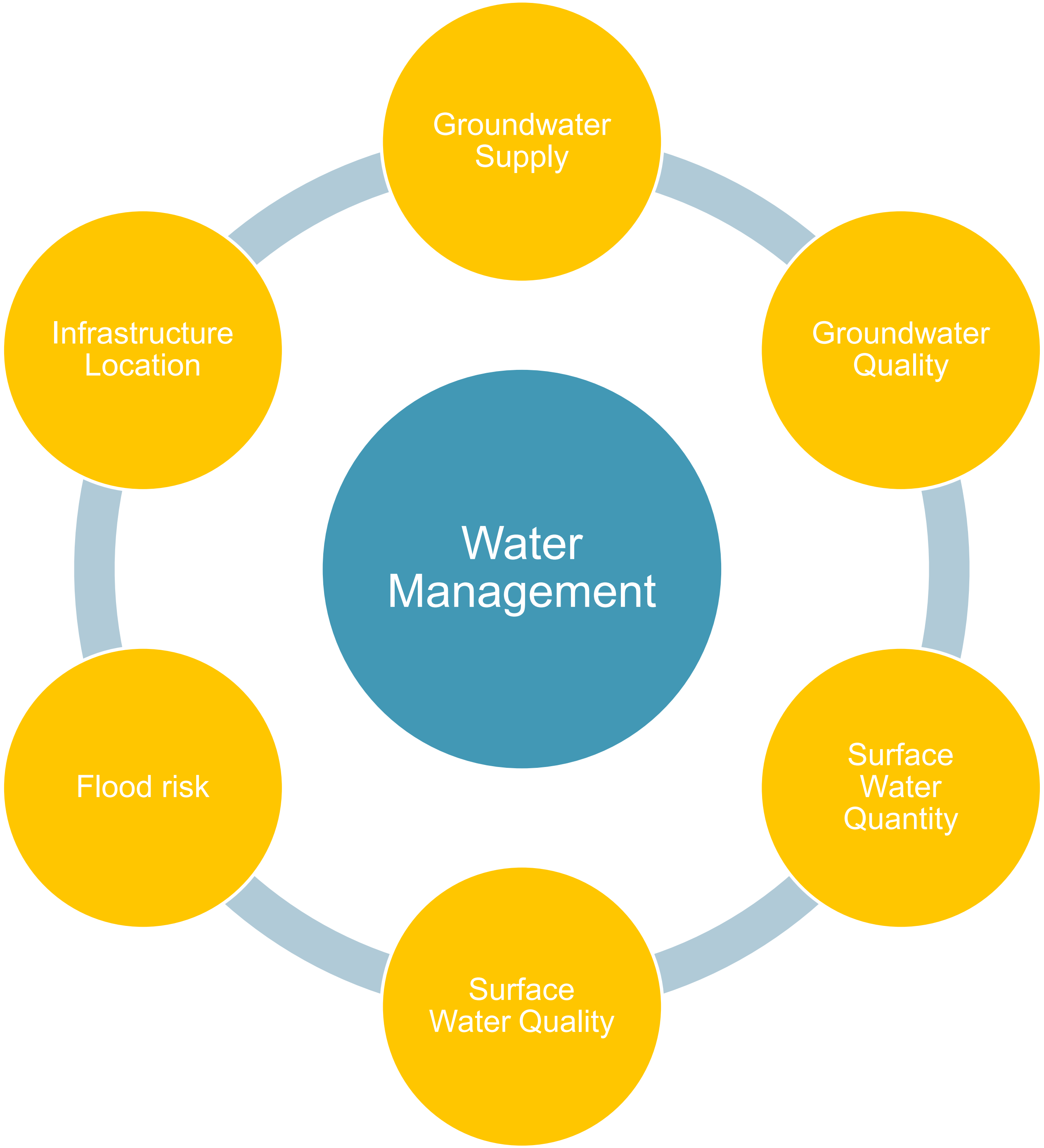


Infrastructure Location

- Man-made hydrologic system
- Historically open-channel, gravity drained
- Piped, buried, and pumped
- Hard to find, document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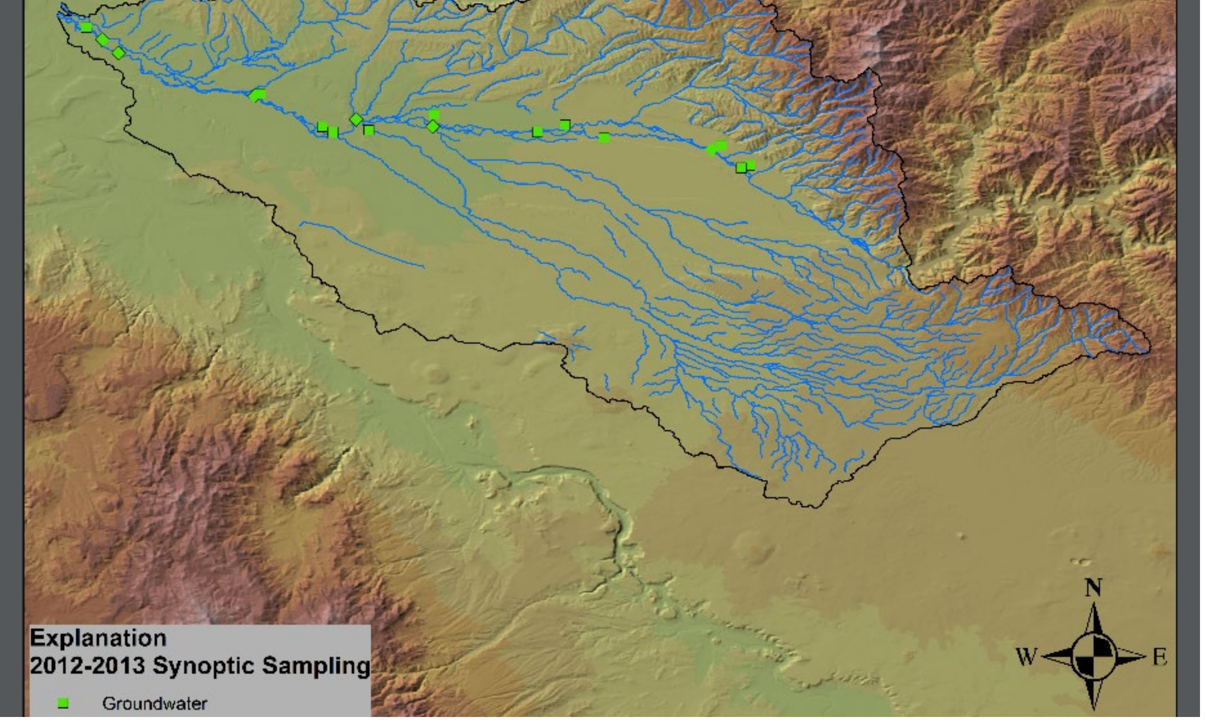


Develop Surface Water/ Ground Water Modeling Framework

Changes in land use and water demand impact flow and water quality in tributaries to the Lower Boise River

- Several ongoing projects are working at addressing individual facets of changes
  - Groundwater levels - IDWR's Groundwater Model
  - USGS proposed monitoring
  - IPC watershed modeling
  - LBWC Mapping for agricultural implementation
  - Boise River Management Tool
- Tool should leverage mapping and framework for evaluating water quality and quantity for the Treasure Valley

Management Framework

Inputs

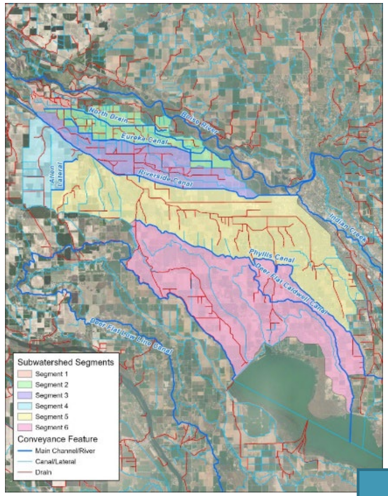
- Mapping
  - Facilities
  - Land Use
  - Diversions
  - Crop Data
- Operational Data

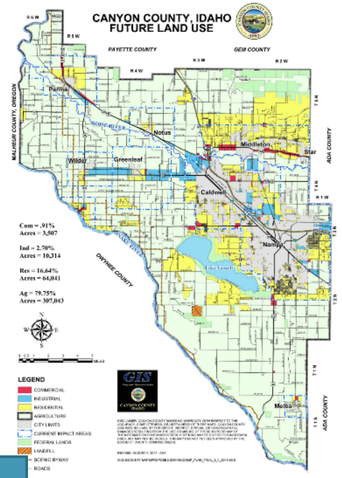
Modeling, Monitoring, and Analytics

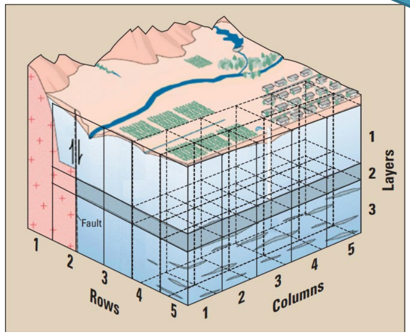
- Treasure Valley Groundwater Model
- USGS Enhanced Monitoring
- IPC SWAT Modeling
- Water District 63 Monitoring and Automation
- Boise River Management Tool

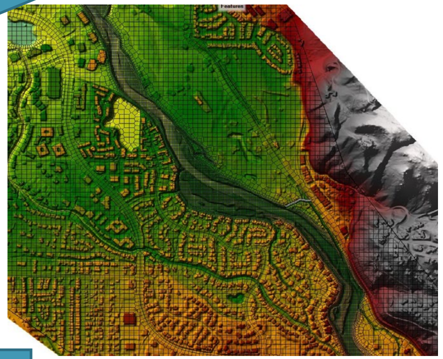
Management

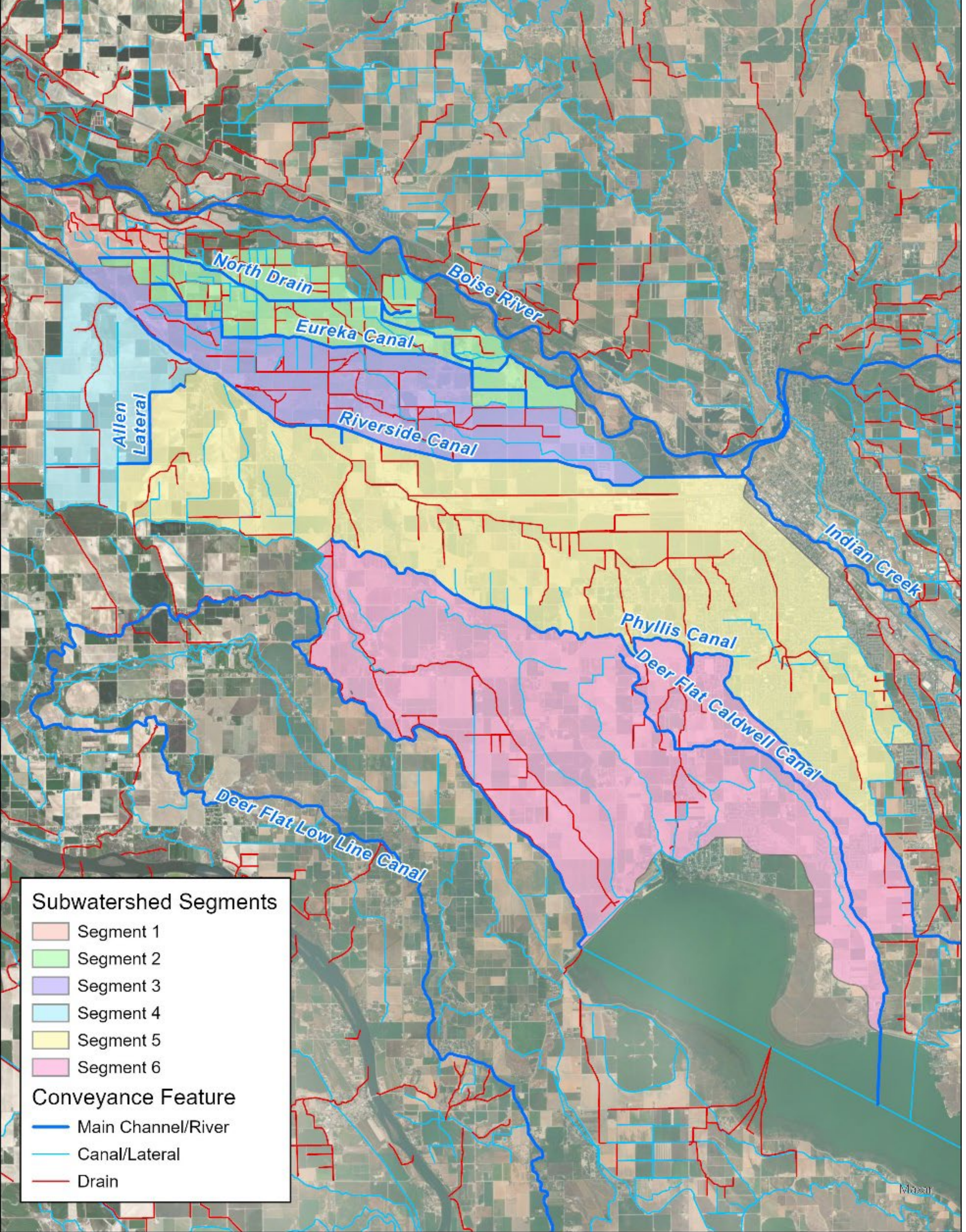
- Anticipate changes to water supply, delivery, water quality, and flooding for future conditions
- Invest in meeting future needs
- Identify projects that meet multiple needs











Starts with Mapping

- Up-to-date Land Use
  - Recharge- Groundwater levels
  - Runoff- surface water
  - Irrigation Demand
- Drainage Basins
  - Topography
  - Irrigation Facilities- canals, laterals, and drains
- Facility locations and conditions
  - Open or piped
  - Lined or unlined

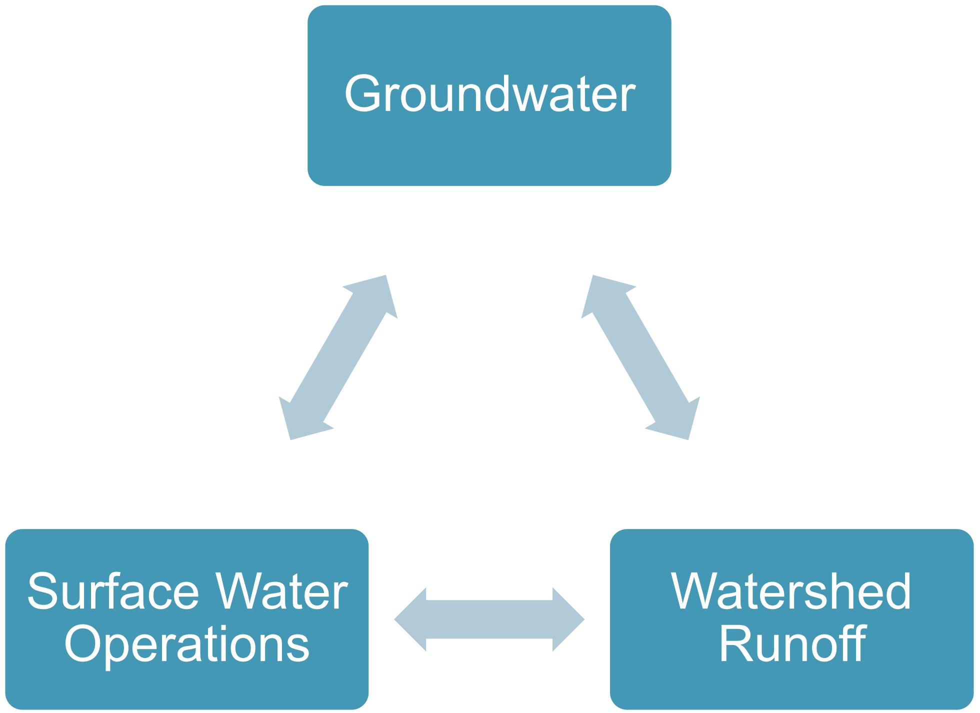


Operational Data

- Diversions
  - Irrigation Season
  - Non-irrigation season
- Pump-back
  - Locations
  - Magnitude

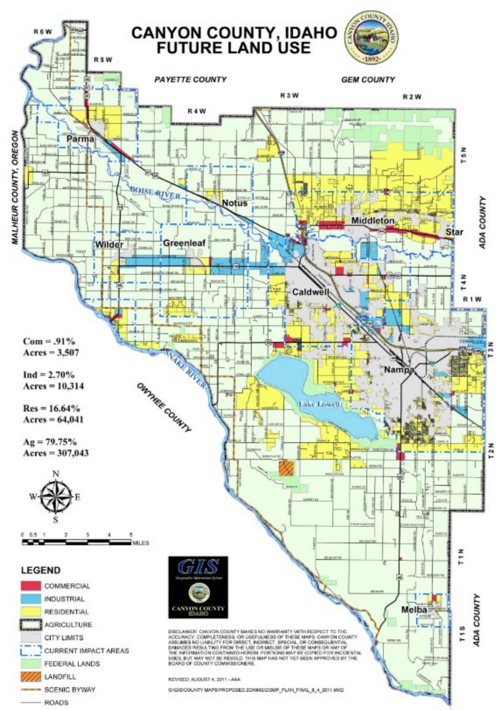
Integrating Modeling, Monitoring, and Analytics

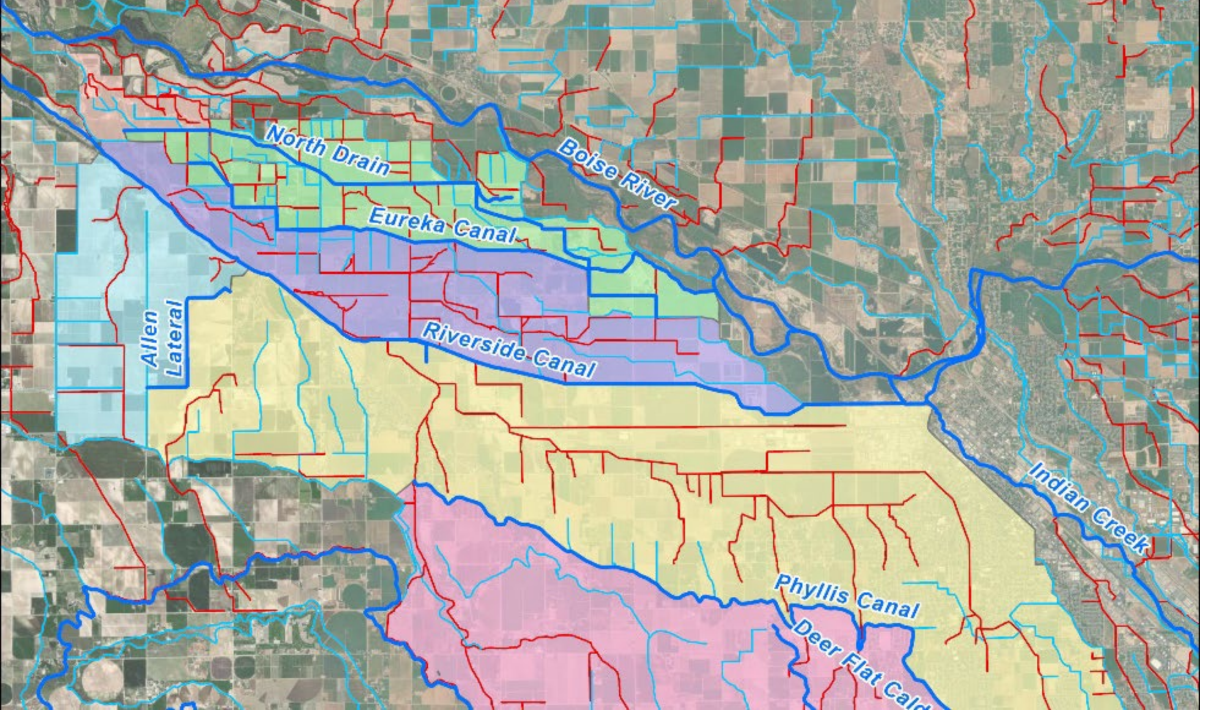
- Consistent inputs using current, accurate, authoritative mapping
  - Watershed Boundaries
  - Land Use, crop data
  - Facilities
- Activities should be intentionally coordinated
  - Groundwater Model -> reach gains, WQ modeling
  - Runoff Modeling, BRMT -> WQ modeling for Boise
  - USGS Monitoring-> IPC runoff modeling, LBWC TMDL Implementation



How will development impact my system?

- Estimate **flow in drains** used for water supply (Groundwater and return flow impacts)
- Evaluate **water quality projects** considering future land use (changes in return flow loading, groundwater contributions)
- **Do we need recharge?** How much Where? Quantity water supply and water quality benefits.






Integrated Response to Development

1. Maintain current, accurate watershed data
2. Continue and increase watershed monitoring effort to address challenges
3. Integrate mapping, monitoring, and modeling to continue to update current conditions and future projections
4. Invest in projects to meet future needs