Consumptive Water Use

Refining State Water Supply Estimates with Discharge and Withdrawal Data

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AMERICAN WATER RESOURCES ASSOCIATION

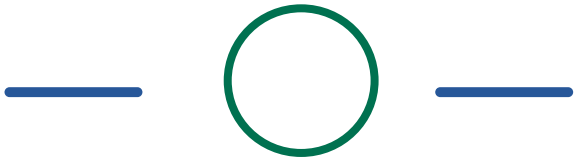
VIRGINIA TECH

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

USGS science for a changing world

Virginia Polytechnic Institute and State University[1]
Virginia Department of Environmental Quality[2]

Water-Use Data and Research Program



Water Availability & Use Science Program

Provide Assessment of the Water Resources of the U.S.

Water Use Data & Research Program

Support State Water Resource Agencies in Collecting and Reporting Water Use Data

Office of Water Supply

Collects and Analyzes State Water Use Data. Directs Water Supply Management and Planning

1999-2002

Record Low Mean Daily Flow Levels[2]

32%

Predicted Net Increase in Mean Daily Water Demand[1]

Data Gaps

In Ground and Surface Water Use across Certain Sectors[2]

Urgency for Improved Water Resource Modeling & Management

Effectiveness of Virginia's Water Resource Planning and Management

Unknown Consumption

Removal of Water Without Returning to a Water Resource System

Not Required in Reporting from Current State Regulations

Can be Used to Refine Water Supply and Aid DEQ to improve permitting and planning

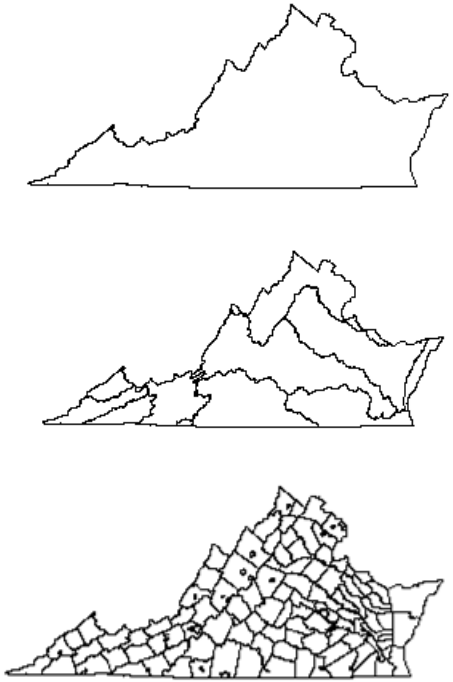
Objective

Withdrawals | Discharges

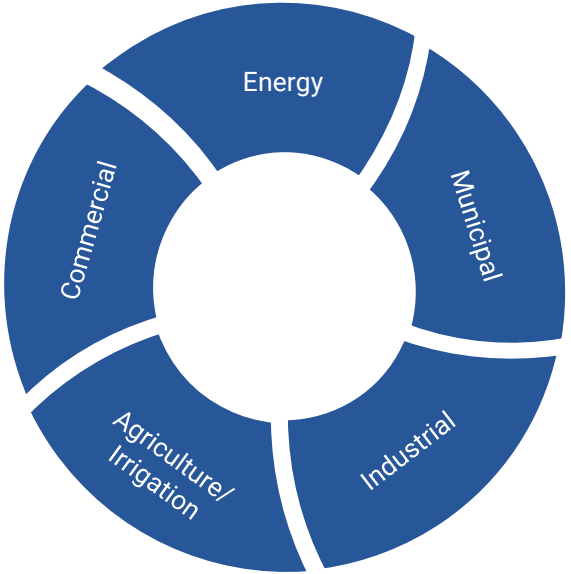
Consumptive Water Use

$$\frac{\sum_{i=1}^{n}(Withdrawals) - \sum_{i=1}^{n}(Discharges)}{\sum_{i=1}^{n}(Withdrawals)}$$

Spatial Scale



Water Sector



Data Sources

Withdrawals

Users under the Virginia Water Withdrawal Permitting Program

Withdrawals > 10,000 gal/day$_3$
Agricultural Withdrawals > 1 MGM$_3$

Virginia Water Use Data System (VWUDS)

Agency Source / Data Source / Reporting Requirements / Database

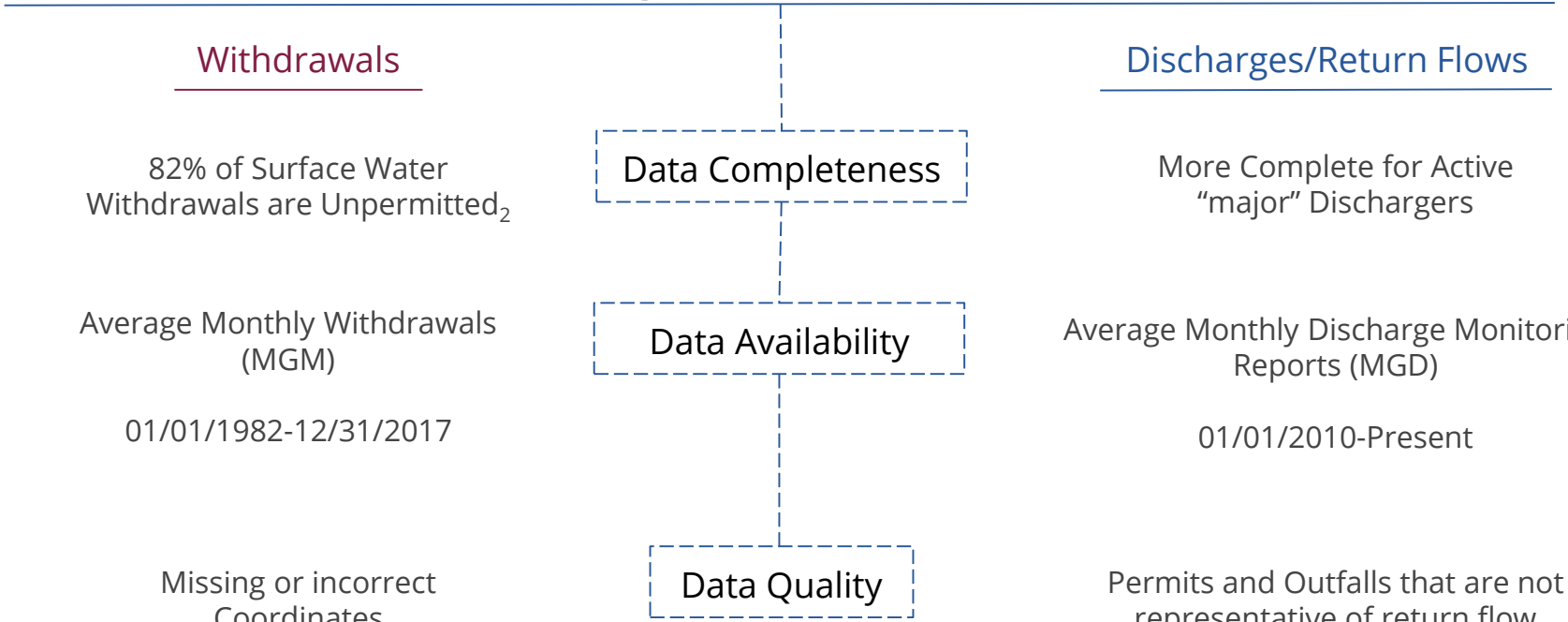
Discharges/Return Flows

Users under the Virginia Pollution Discharge Elimination System (VPDES) Program

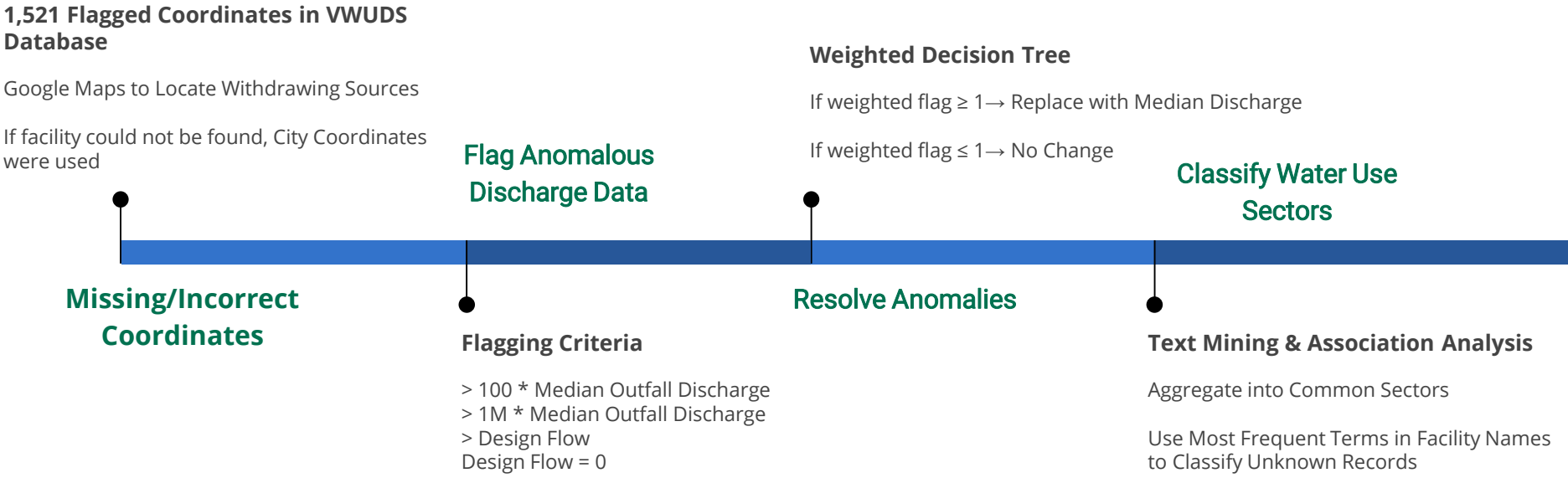
All Point source discharges to waters of U.S$_4$

ICIS-National Pollutant Discharge Elimination System (NPDES) Database

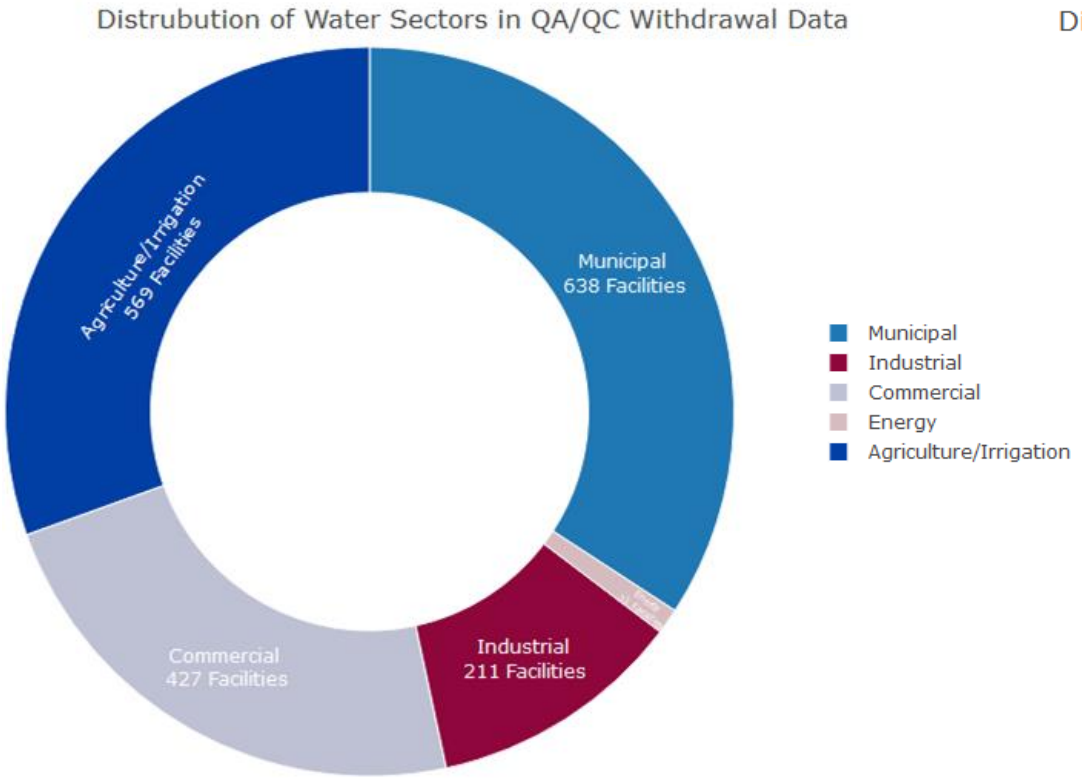
Data Sources: Challenges

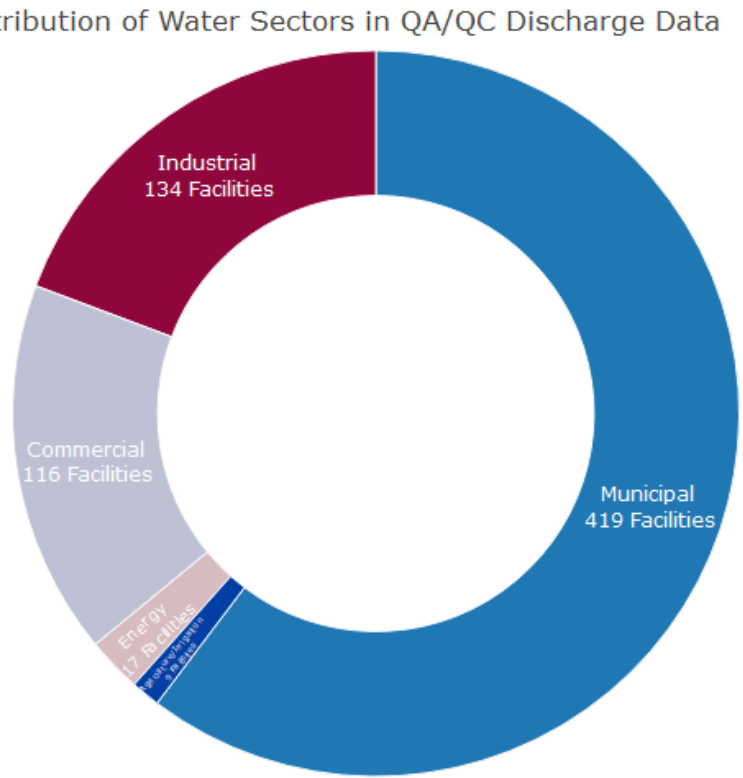


QA/QC


1,521 Flagged Coordinates in VWUDS Database
Google Maps to Locate Withdrawing Sources
If facility could not be found, City Coordinates were used
Missing/Incorrect Coordinates
Flag Anomalous Discharge Data
Flagging Criteria
> 100 * Median Outfall Discharge
> 1M * Median Outfall Discharge
> Design Flow
Design Flow = 0
Weighted Decision Tree
If weighted flag ≥ 1→ Replace with Median Discharge
If weighted flag ≤ 1→ No Change
Resolve Anomalies
Classify Water Use Sectors
Text Mining & Association Analysis
Aggregate into Common Sectors
Use Most Frequent Terms in Facility Names to Classify Unknown Records

Classification



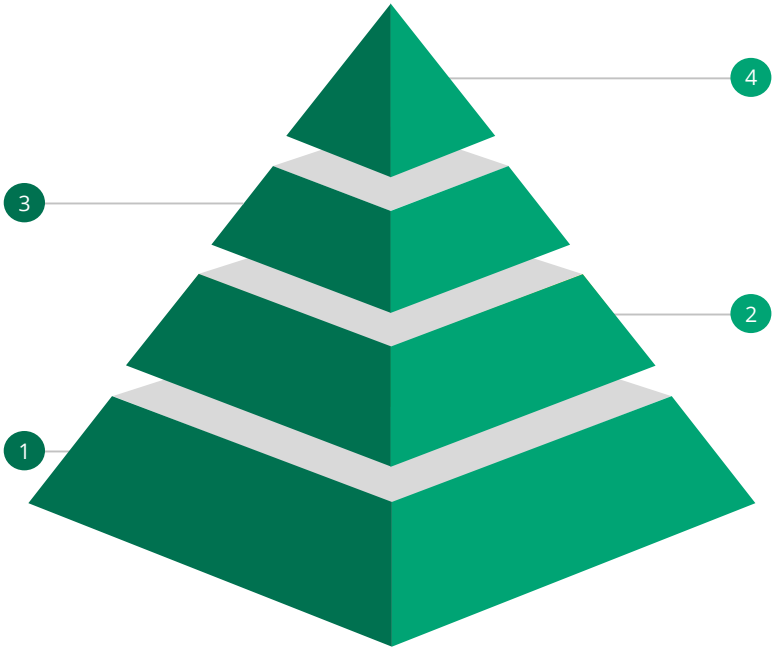


Facility Matching

Calculate String Distance Between Names

Weighted average number of insertions, deletions, and substitutions needed for names to match

Calculate Distance Between Facilities



Locate Best Match Based on Distance and String Distance

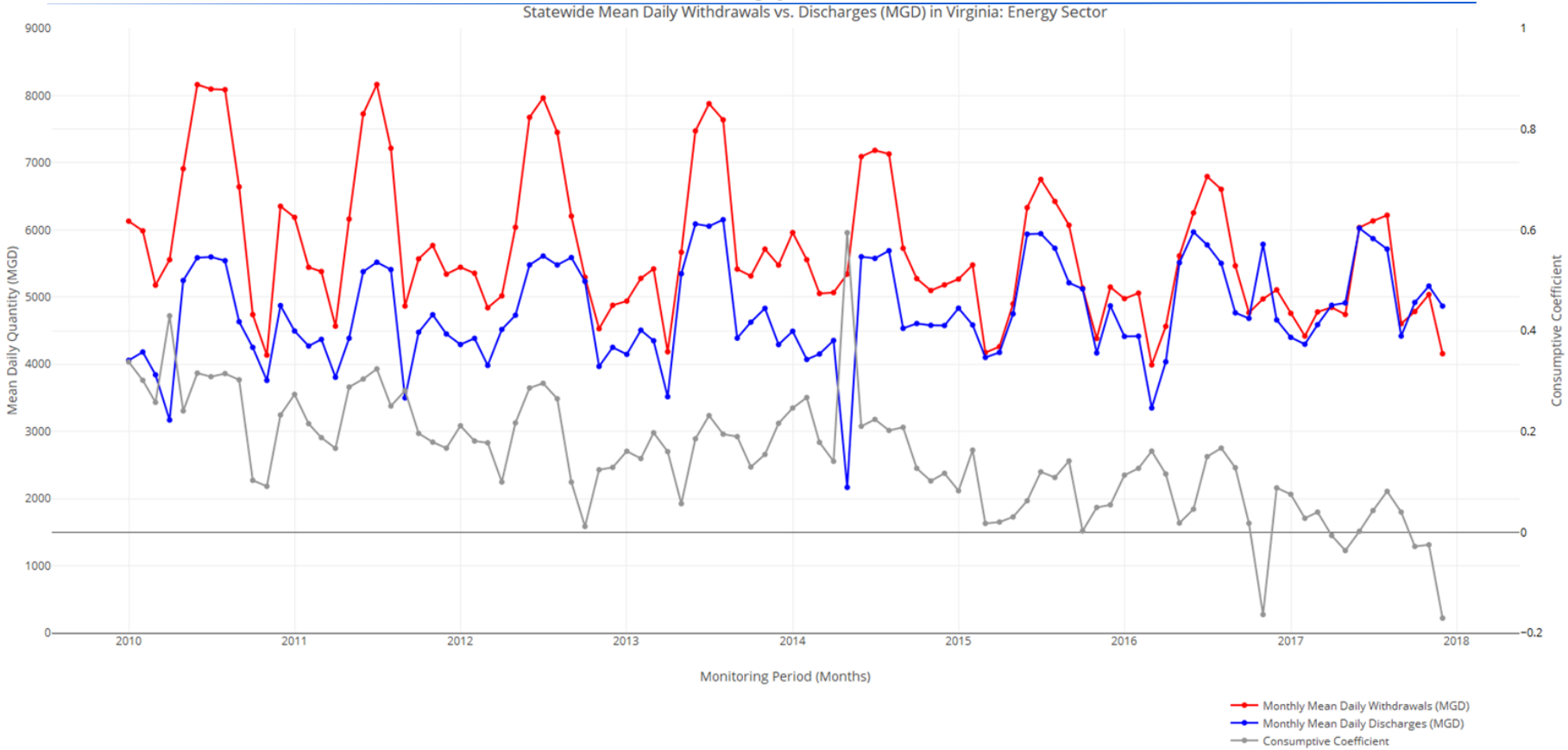
Apply Distance Threshold

Discharging Facility	Best Withdrawal Match	String Distance	Distance (km)
DOMINION - NORTH ANNA POWER STATION	NORTH ANNA NUCLEAR POWER PLANT	10	1.58
APCO - GLEN LYN	GLEN LYN POWER PLANT	5	0.96

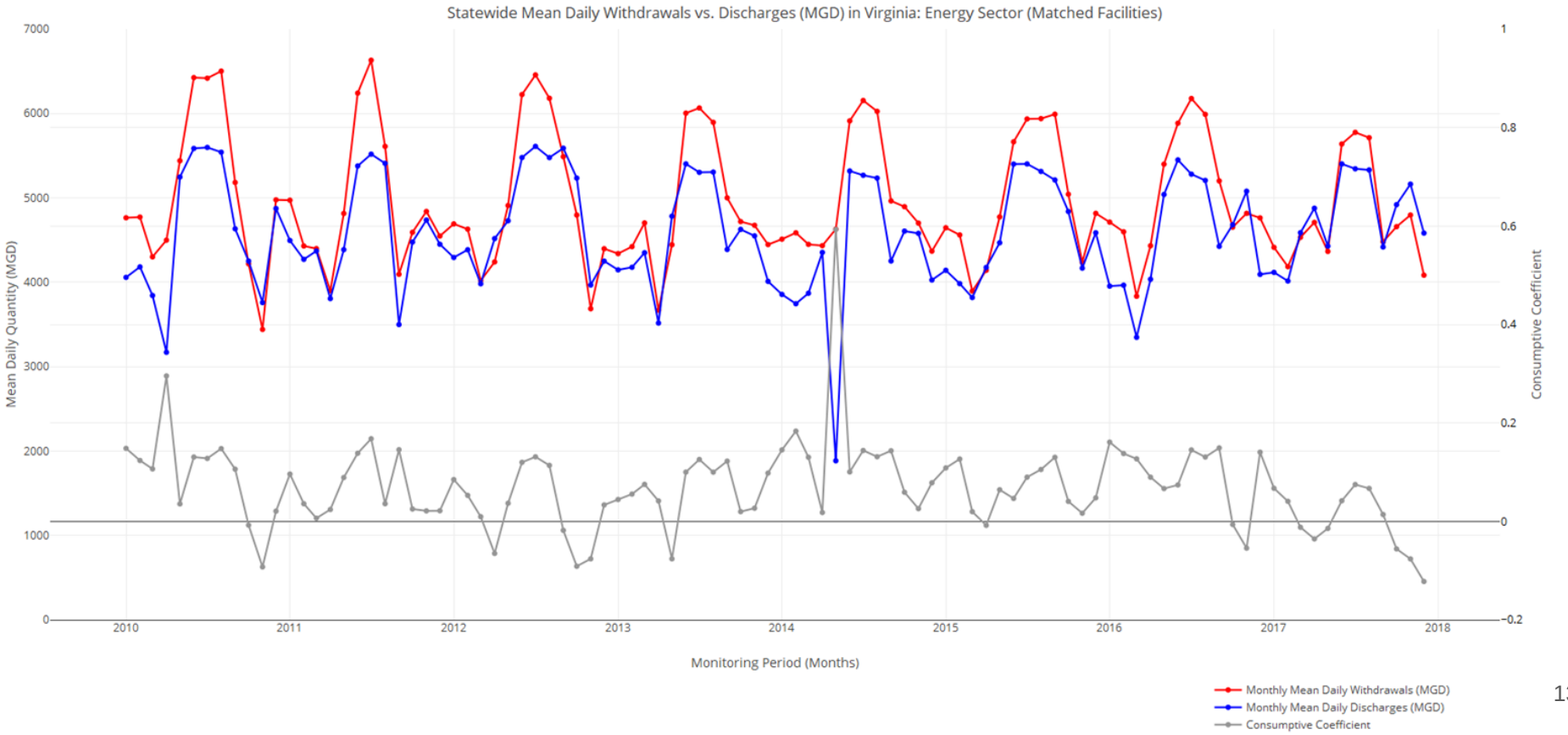
Consumption: Energy vs. Non-Energy

Surface and Groundwater Combined
Long Term Averages over 2010-2017

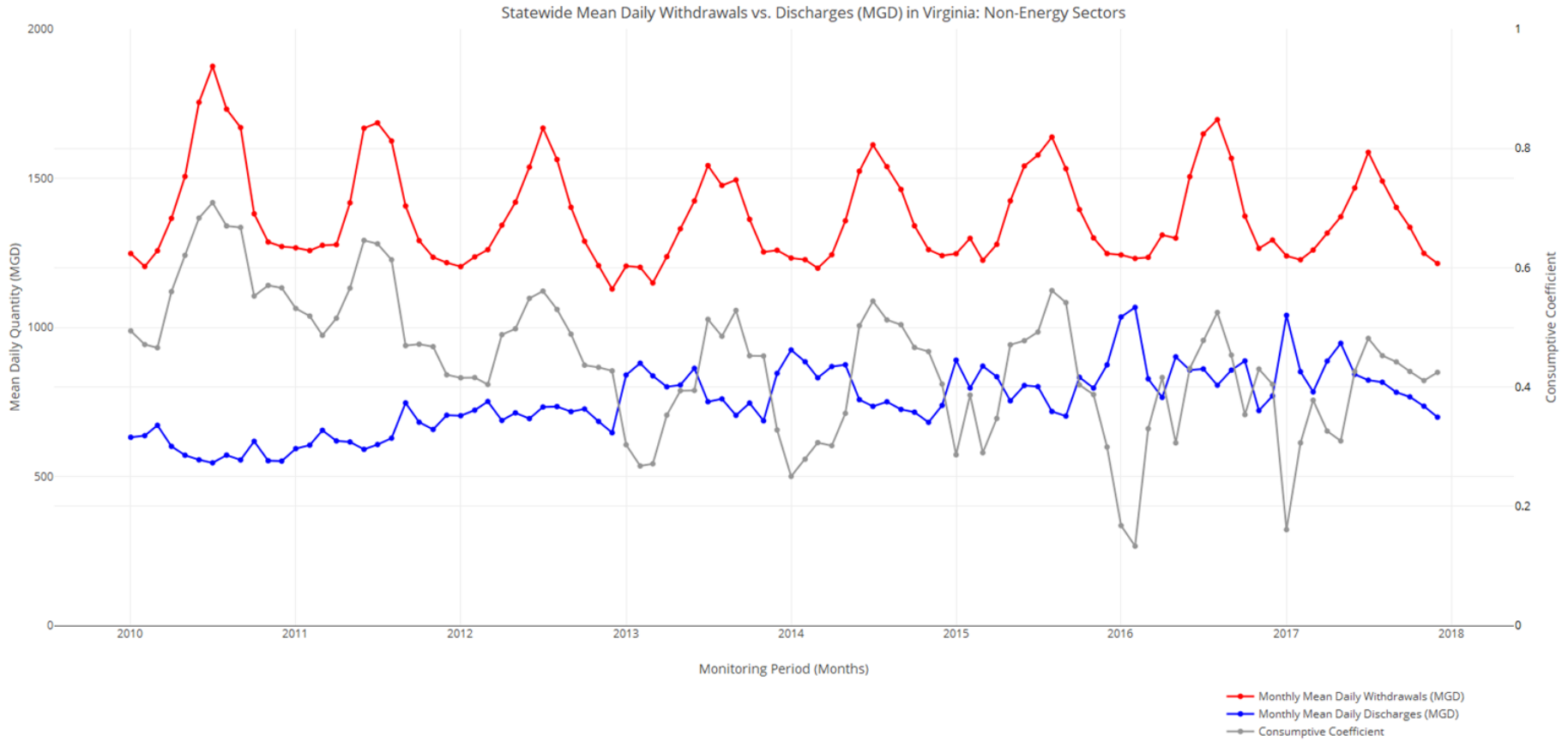
Statewide Water Use: Energy



Statewide Water Use: Energy

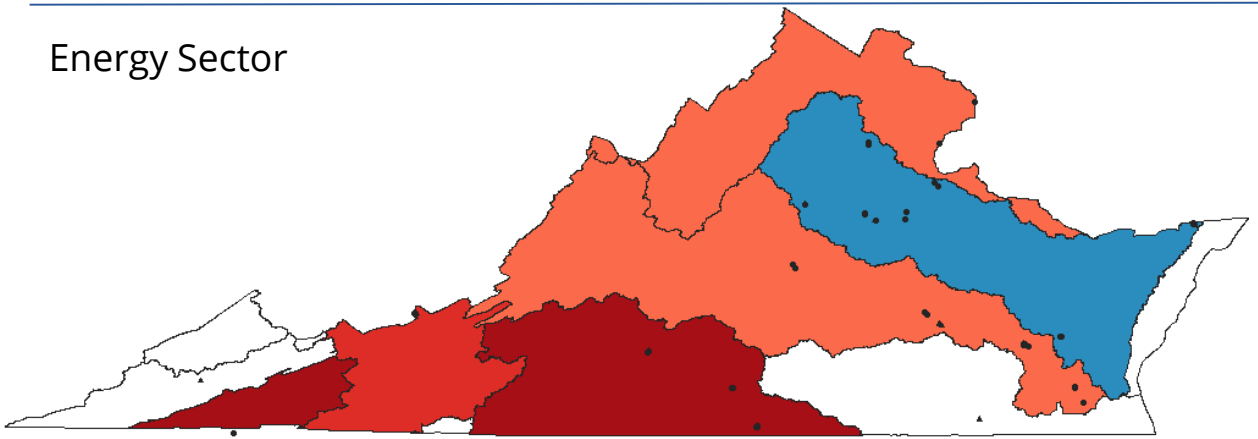


Statewide Water Use: Non-Energy

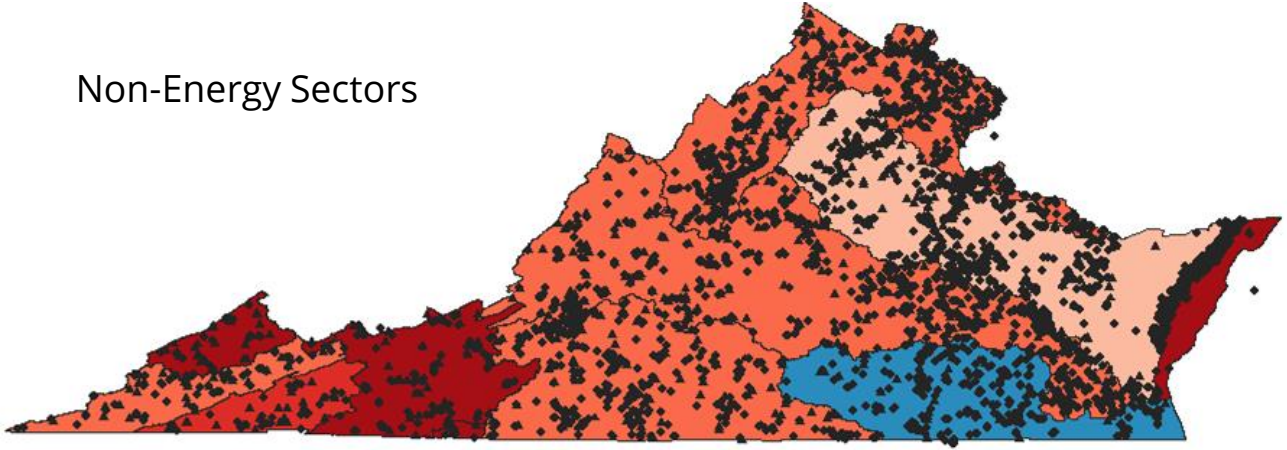


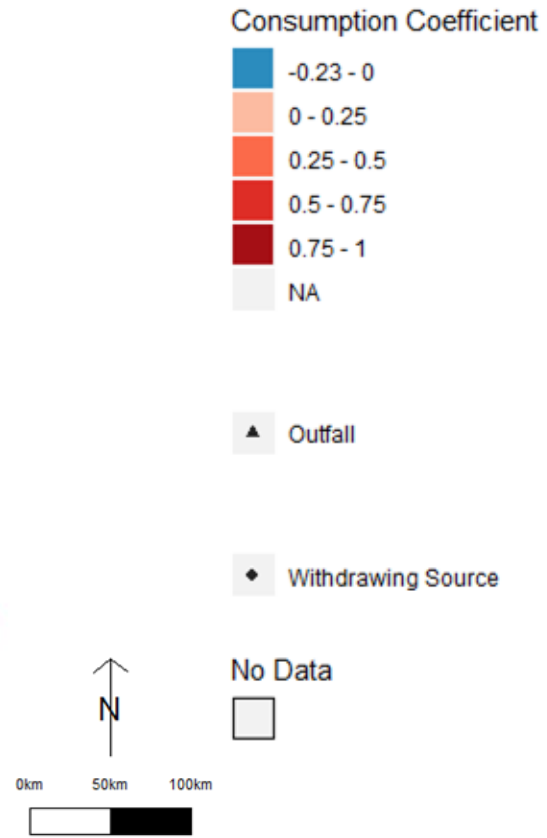
HUC 6 Watershed Energy vs. Non-Energy

Energy Sector



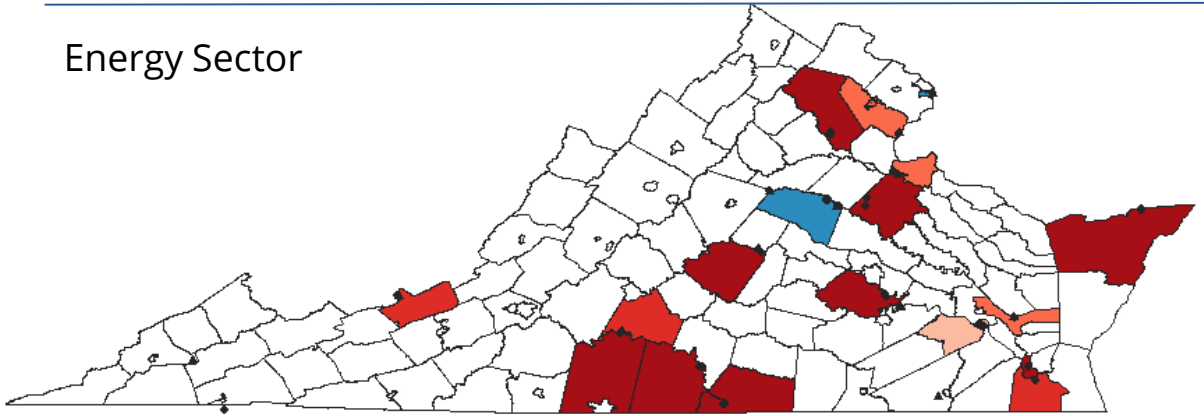
Non-Energy Sectors



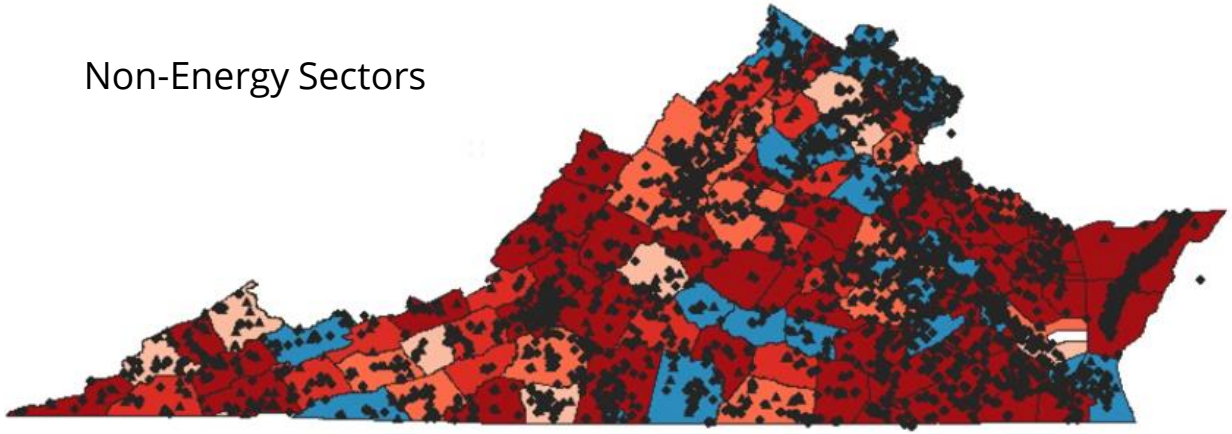


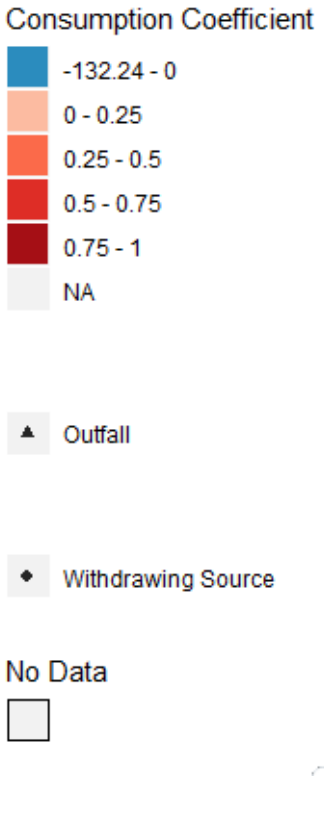
County Energy vs. Non-Energy

Energy Sector

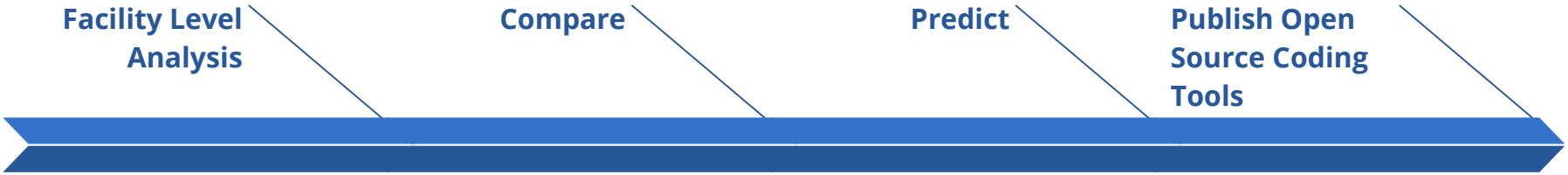


Non-Energy Sectors





Future Work



Compute Site Specific Consumption by Matching Discharging & Withdrawing Facilities

How Do These Estimates of Consumption Compare to Coefficients from Climatically Similar Areas?

Based on Current Policy and Past Data, What are the Predictions for Future Consumption Rates?

Make Data Retrieval, QA/QC, Analysis Tools Open for Other Entities to Use.

References

[1] Kitzhaber, J.A. and Wah, M. 2017. *Status of Virginia's Water Resources: A Report on Virginia's Water Resources Management Activities (2017)*. Available at: https://rga.lis.virginia.gov/Published/2017/RD343/PDF

[2] Audit, J.L. and Commission, R. 2017. Effectiveness of Virginia ' s Water Resource Planning and Management. 8, October 2016 (2017). Available at: http://jlarc.virginia.gov/pdfs/reports/Rpt486.pdf

[3] Hammond, A. 2007. Virginia Water Protection Permit Program (2007). Available at: https://www.deq.virginia.gov/Portals/0/DEQ/Water/OWS-WWPandC/VWP_WWRhandout_10102018.pdf?ver=2018-10-10-160533-350

[4] Davenport, M. D. (2014). VPDES Permit Manual. Virginia Department of Environmental Quality. Richmond. Retrieved from https://www.deq.virginia.gov/Portals/0/DEQ/Water/Guidance/142003.pdf

Questions?