

Dataset Development:

My initial analyses have drawn data from both ECHO and VPDES. ECHO is an EPA run federal database that draws data from a variety of sources (both state and federal) to create a central repository for all compliance, permit, violation, enforcement, and penalty data across air, water, and hazardous waste fields. For this project, I have drawn data from its water facility REST services as well as its effluent charts REST services. Collectively, these sites allow users to download a list of facilities in the state and any corresponding effluent data they may be reporting. These services are linked in resources below. In Virginia, ECHO draws the majority of its data from state DEQ submissions. It inspects a few facilities separately, but it appears that the majority are submitted (90% and above, I think) by the DEQ.

VPDES is a program run by VADEQ and represents the Commonwealth's discharge monitoring program. Authorized by the EPA, VPDES is responsible for issuing and monitoring permits for all sites across the state discharging 'pollutants' into Virginia waters, as defined under the Clean Water Act. I have two primary avenues of accessing VPDES outfall information (collected by permiters and inspectors). First, VPDES offers a list of permitted, active outfalls (updated daily) on their website, listed below in resources. Although this shapefile contains more outfalls than those listed in ECHO, it fails to report any information other than location and overall facility name. The second VPDES dataset was developed in 2016 and was received via Robert Burgholzer of the VADEQ. Developed in 2016, this shapefile offers "design flow" values to indicate maximum permitted discharge from an outfall. However, the list of outfalls are out-of-date and only offer insight into about two thirds of active outfalls.

Dataset Descriptions:

**Note:* Before these particular datasets can be described, it is important to note that both VPDES and ECHO databases are updated frequently. Quantities below were developed 5 October 2017.

ECHO

Accessing the water REST services on ECHO shows that there are 1,947 facilities regulated by the Clean Water Act across the Commonwealth with attributes shown below. The effluent chart REST services offered by ECHO reveals that there are only 2,330 outfalls across 1,100 facilities that report any effluent or DMR data (although only 1,585 outfalls across 930 facilities report discharge). The effluent chart databases offers too many attributes to conveniently list here, but they can be seen in the data dictionary listed in resources below. The most important fields are Dmr_value_nmbr (discharge value), monitoring_period_end_date, parameter_code, limit_value_nmbr (VPDES limit), and standard_unit_desc (units associated with limit and discharge). It also lists an outfall ID that can be combined with the facility identifier below to create an outfall ID that can be related to other datasets.

Table 1. First half of water REST table from ECHO, showing facility information.

| OBJECTID * | SourceID * | EPASystem | RegistryID | Statute | CWPName * | CWPStreet | CWPCounty | CWPIndianCntryFlg |
|------------|------------|-----------|------------|---------|---------------------|----------------------------|-----------|-------------------|
| 1565 | VAU000001 | ICP | 1.1E+11 | CWA | LEBANON CHEMICAL | 5600 OLD OSBORNE TPK | Henrico | N |

Table 2. Second half of water REST table from ECHO, showing facility information.

| CWPPermitStatusDesc | FacPopDen | FacFederalAgencyCode | FacLat | FacLong | FacMapFlg | FacMapIcon | CWPComplianceTracking | Shape * |
|---------------------|-----------|----------------------|----------|----------|-----------|-----------------|-----------------------|---------|
| <Null> | 2485.87 | <Null> | 37.5095 | -77.4139 | Y | CWA-IC-MN-N.png | <Null> | Point |
| <Null> | <Null> | <Null> | 37.73535 | -79.3552 | Y | CWA-IC-MN-G.png | <Null> | Point |

VPDES

The daily updated shapefile given on the VPDES webpage offers a list of 9,254 outfalls. Each outfall is stored as a separate point object with the attributes shown below in the following table. The permit type column is useful in separating outfalls with effluent data and those without because the state only requires individual permits to report effluent data. There are two kinds of these permits: major and minor. Major permits are designated as those that contain “sewage with a design volume greater than 1.0 million gallons per day and industrial discharges requiring EPA review” whereas minor permits are those dealing with “commercial, small industrial and sewage of less than 1.0 million gallons per day”. A simple filter on the VAP_TYPE column reveals that there are 2,914 VPDES outfalls with this individual permits, containing 1,020 listed major permits and 1,894 minor permits. The permit number (VAP_PMT_NP) is the same identifier reported by ECHO.

Table 3. VPDES attribute information from shapefile updated daily.

| OBJECTID | OUTFALLNO * | VAP_PMT_NO | VAP_TYPE | VAP_TYPE_A LT_VERSION | FAC_NAME | VAP_MAJO R_MINOR | Shape * | OBJECTID * |
|----------|--------------|------------|----------|--------------------------|--|---------------------|---------|------------|
| 4 | VA0000248004 | VA0000248 | VPDES_IP | VPDES | US Army - Radford Army Ammunition Plant | M | Point | 1 |
| 5 | VA0000248005 | VA0000248 | VPDES_IP | VPDES | US Army - Radford Army Ammunition Plant | M | Point | 2 |

As stated before, the older VPDES dataset contains a list of outfalls with more useful attributes. This 2016 shapefile contains 3,248 valid outfalls (an additional 120 appear to have corrupted or illegible attributes). The attributes listed for each outfall can be seen in the tables below. Although I have not been able to figure out what many of the attributes represent, each outfall contains an outfall ID as well as a permit ID, which can be concatenated to create a common ID with the newer VPDES dataset. In addition, a maximum design flow can be seen in the VPP_DES_FL column. Creating the ID above and joining with the newer VPDES shapefile shows 2,350 outfalls with an average design flow of 48.33 (units unknown).

Table 4. First third of information from 2016 VPDES dataset containing DMR information.

| FID | Shape * | FAC_NAME | FAC_ID | POF_DATE_ I | POF_DMR_PR | POF_HARMO N | POF_HIGH_1 | POF_HIGH_3 |
|-----|---------|---------------------|--------|----------------|------------|----------------|------------|------------|
| 0 | Point | VCI Radford Foundry | 2E+11 | | | 1525 | 548 | 1109 |
| 1 | Point | VCI Radford Foundry | 2E+11 | | | 1525 | 548 | 1109 |

Table 5. Second third of information from 2016 VPDES dataset containing DMR information.

| POF_HIGH_7 | POF_LOW_1_ _ | POF_LOW_30 | POF_LOW_7_ _ | POF_OUTFAL | POF_PIPE_D | POF_SIF_C O | VPP_DES_F L | VPP_PERMIT |
|------------|-----------------|------------|-----------------|------------|------------|----------------|----------------|------------|
| 800 | 464 | 684 | 587 | 1 | 0.52 | 3321 | 0.52 | VA0000213 |
| 800 | 464 | 684 | 587 | 2 | | 3321 | 0.52 | VA0000213 |

Table 6. Final third of information from 2016 VPDES dataset containing DMR information.

| VPP_TOT_FL | VPP_WFC_FA | LATITUDE | LONGITUDE | TYPE |
|------------|------------|----------|-----------|------------------|
| 0.52 | 2E+11 | 37.12861 | -80.5908 | MINOR INDUSTRIAL |
| 0.52 | 2E+11 | 37.12833 | -80.59 | MINOR INDUSTRIAL |

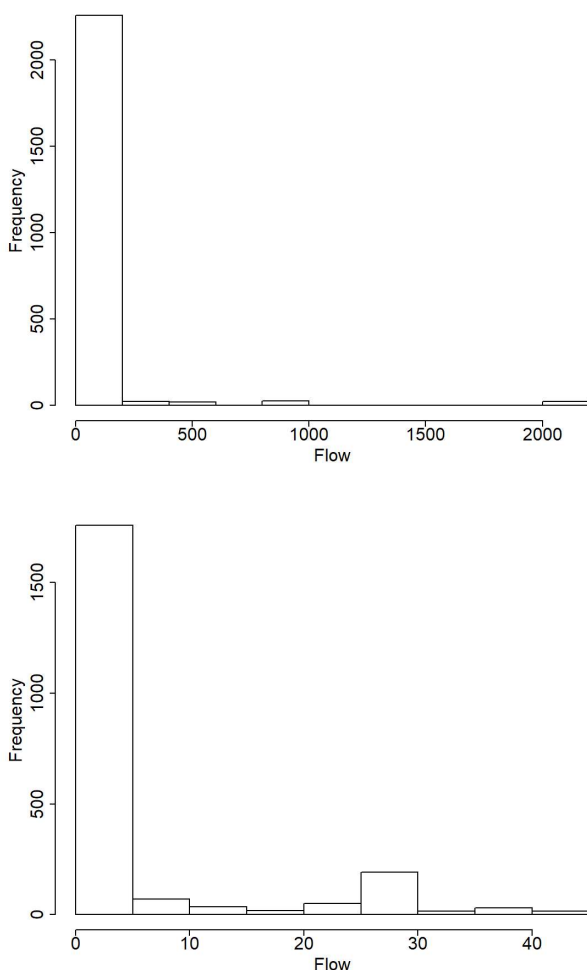


Figure 1. Histograms of the 2016 VPDES Design Flow Attributes

Dataset Limitations:

As can be noted above, there are several incongruencies between VPDES and NPDES data, with each dataset containing some outfalls that the other does not. So far, I have found several reasons for these discrepancies. First, VPDES appears to only maintain active outfalls while NPDES offers data for active and terminated permits. Second, state and federal regulations seem to state that the DEQ is only responsible for reporting both outfall and effluent information for major permits. This could contribute to a lack of information within ECHO pertaining to minor permits. Additionally, ECHO reports that “Virginia has just recently begun the data flow to ICIS-NPDES for the non-major individual permits; some of the permit, Discharge Monitor Report, and facility compliance status data displayed on ECHO may not be accurate. Data issues are in the process of being reviewed and will be corrected when identified.” Further, a review of the DEQ reporting system conducted by ECHO in 2017 (linked in resources below) indicated that the DEQ has not yet reported MS4 or mining operations to ECHO. The EPA reports that only 1% of Virginia facilities are missing from ECHO, but it seems likely that this does not account for individual outfalls. Per state regulations (see code 220 of chapter 35 of agency 25 under

title 9), there are a few instances where the DEQ may require a permit that NPDES otherwise would not. These outfalls may or may not be reported into ECHO.

Simple data joins using the unique outfall ID for each discharge points reveals a few trends in the overall completeness of each dataset. Of the 2,230 ECHO outfalls, only 1,768 have common IDs with corresponding outfalls in the VPDES database. Every one of these stations are marked as “effective” or “admin continued” individual permits. These matched outfalls consist of 563 major permits and 1,205 minor permits, revealing that ECHO may capture major facilities but may not report on their outfalls. The remaining 1,146 VPDES outfalls have no effluent data in ECHO. Further, of the 562 remaining ECHO outfalls, 216 are marked as “effective” or “admin continued” but do not appear in VPDES. These could be a result of facilities VA is not authorized to regulate (i.e. biosolid treatment) or errors in reporting between ECHO and VPDES.

Finally, not every outfall in ECHO reports the same discharge statistics. The majority provide a monthly average, but even then roughly 1,000 outfalls do not. About a quarter provide a daily maximum and roughly 500 give a monthly maximum. Below is a histogram of the reported monthly averages. These values are compared across HUC 8s with those in VPDES in the following two maps, displaying a number of different HUCs that experience different flows between VPDES and ECHO (though direct comparison should be viewed skeptically due to the lack of units associated with the VPDES data).

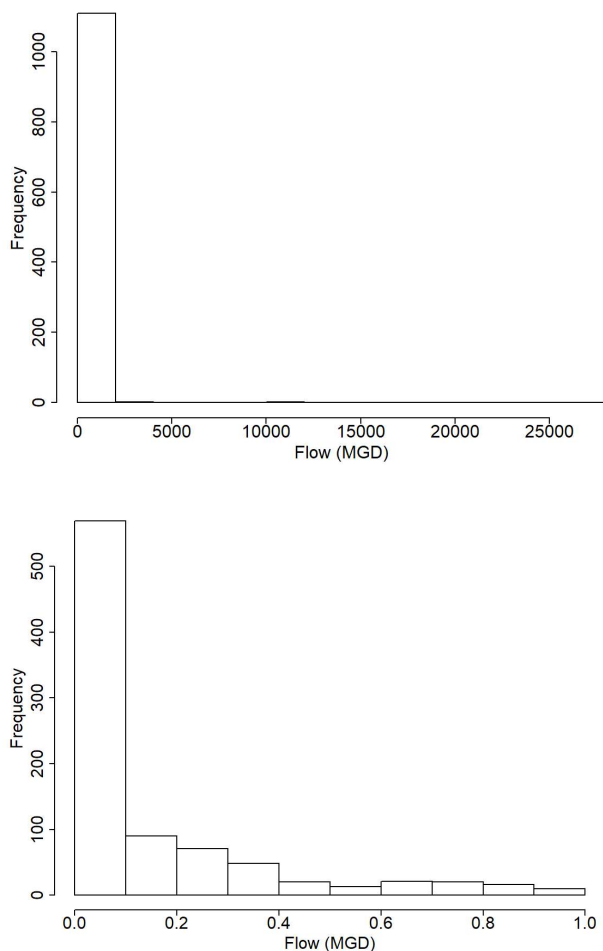


Figure 2. Histograms of Average monthly flow from ECHO outfalls.

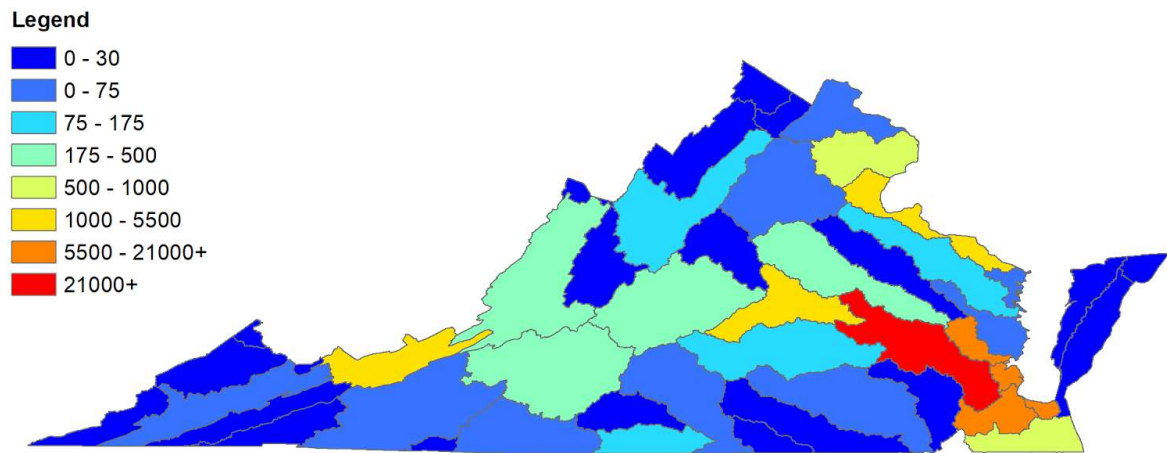


Figure 3. Map displaying the sum of all reported VPDES design flows in 2016 across HUC 8s.

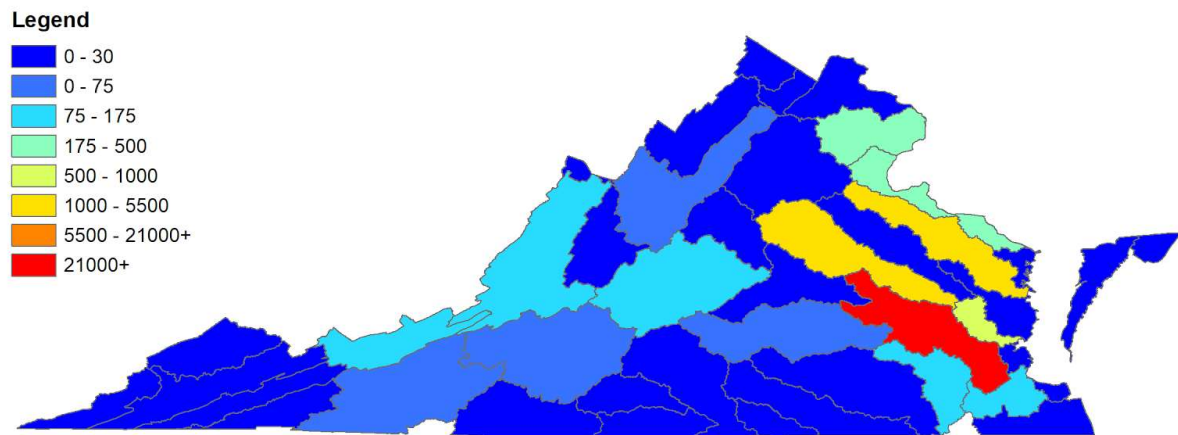


Figure 4. Map displaying the sum of all ECHO monthly averages (before 2016) across HUC 8s.

Table 7. Available Discharge Statistics from ECHO.

| Statistic | Count of Outfalls reporting |
|-----------|-----------------------------|
| 1 HR AVG | 2 |
| 30DA AVG | 2 |
| 30DA MAX | 2 |
| ALLWLOAD | 2 |
| ANNL AVG | 1 |
| ANNL TOT | 1 |
| AVERAGE | 103 |
| AVERAGE | 2 |
| DAILY AV | 27 |
| DAILY MN | 1 |
| DAILY MX | 754 |
| EVNT TOT | 13 |
| INST MAX | 1 |
| MAX BDL | 2 |
| MAXIMUM | 457 |
| MAXIMUM | 5 |
| MO AVG | 1264 |
| MO MAX | 141 |
| MX 7D GM | 8 |
| MX WK AV | 43 |
| NONSP MX | 1 |
| SINGSAMP | 2 |
| WKLY AVG | 26 |
| WKLY MAX | 2 |

Remaining Questions:

1. Why are there major outfalls not being listed in ECHO?
2. Does VPDES maintain DMR data elsewhere?
3. Is the VPDES-ECHO upload process monitored and enforced monthly?
4. ECHO mentions that there may be errors in VA State facility data. Are these a result of incomplete uploads so far?
5. Why does the 2016 dataset generate such different values than those in ECHO today?

Resources

Link to VPDES Daily Updated Shapefile:

<http://www.deq.virginia.gov/ConnectWithDEQ/VEGIS/VEGISDatasets.aspx>

Link to ECHO REST databases:

<https://echo.epa.gov/tools/web-services>

Link to ECHO Effluent Chart Variables and Definitions:

https://echo.epa.gov/help/reports/effluent-charts-help#data_dictionary

Link To EPA Review of Virginia CWA Compliance:

<https://www.epa.gov/compliance/virginia-state-review-framework>