Preparation of the 2005 Point Sources National Emissions Inventory

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ABSTRACT

Every three years, the U.S. Environmental Protection Agency (EPA) prepares the National Emissions Inventory (NEI), an air quality emissions inventory dataset that serves numerous stakeholders, including federal, regional, state, local, and tribal agencies. Uses of the NEI data include: evaluating emission trends; preparing inputs for air quality modeling; and evaluating the need for additional control technology standards. The NEI consists of stationary, mobile, and biogenic emission sources. Stationary sources can be classified as point or nonpoint area sources, whereas mobile sources are categorized as onroad or nonroad sources. At present, the NEI houses criteria and hazardous air pollutants.

The purpose of this paper is to describe the compilation of the point sources portion of the 2005 NEI. A number of data sources, augmentation techniques, and quality assurance checks were used to prepare the point sources inventory. Over 70 datasets from federal, state, local, tribal, and regional air agencies were the primary basis for the national inventory. Emissions, locational coordinates, and stack parameter data from EPA's Risk and Technology Review Program are also considered a primary data source, as these high quality data have been peer-reviewed by numerous state agencies, industry, and trade associations. Additionally, EPA datasets from the Emission Inventory and Analysis Group, the Sector Policies and Programs Division, the Toxic Release Inventory, and version 3 of the 2002 NEI are blended and merged with the above primary data sources for source category and geographic completeness. Finally, emissions data from offshore oil and gas platforms operating in the Gulf of Mexico were included from the Minerals Management Services.

INTRODUCTION

The Clean Air Act (CAA), as amended in 1990, requires the U.S. Environmental Protection Agency (EPA) to identify the sources of, quantify the emissions of, and assess the public health and environmental impacts of, criteria air pollutants and hazardous air pollutants (HAPs).[1] EPA houses these data in its National Emissions Inventory (NEI), which covers stationary (point and nonpoint area) and mobile (onroad and nonroad) source emissions. Point source data are maintained at the process-level, while nonpoint area, onroad, and nonroad emissions are at the county-level. The NEI is a tool that can be used to conduct the analyses required by the 1990 CAA, such as for State Implementation Plans (SIPs), compliance demonstrations, emissions trading, modeling activities, as well as store and share data being generated through various EPA programs, including the National-scale Air Toxics Assessment (NATA).[2] From a geographic standpoint, the NEI covers the entire United States, the District of Columbia, Puerto Rico, and The Virgin Islands. For the 2005 baseyear, oil and natural gas platform emissions from the Gulf of Mexico Outer Continental Shelf (OCS) are also included. Previous NEI cycles include 1990, 1996, 1999, and 2002.

Criteria air pollutant (CAP) emissions for the NEI are collected under the Consolidated Emissions Reporting Rule (CERR).[3] Under the CERR, EPA requires states to report sulfur dioxide (SO_2), volatile organic compounds (VOC), nitrogen oxides (NO_x), carbon monoxide (CO), lead (Pb), particulate matter-10 (PM_{10}), particulate matter-2.5 ($PM_{2.5}$) and ammonia (NH_3). The CERR specifies two sets of reporting thresholds for criteria pollutants. Type A (large sources) must report annually, while Type B sources must report every three years. The actual thresholds differ by pollutant and depend upon whether the source is in a nonattainment area or not. For the 2005 NEI, EPA collected information on both Type A and Type B sources.

For HAPs, major sources are defined in the CAA as stationary sources that:

- Have the potential to emit 10 tons per year (tpy) or more of one HAP; or
- Have the potential to emit 25 tpy or more of any combination of HAPs.

Smaller point source facilities with annual emissions below these thresholds can be defined as nonpoint area sources and inventoried as such. While states are more likely to report major sources as point sources and smaller sources as nonpoint sources, there are no reporting thresholds for the NEI, and EPA encourages states to submit small sources to the point inventory. In particular, some source categories which are composed of smaller facilities may emit pollutants which have a high toxicity weighting, and states may give these categories high priority in data collection efforts.

METHODOLOGY

The goal in developing the point source NEI was to obtain facility-specific data such as facility name, location, stack information, emissions, and process descriptions. It was hoped that the data would be sufficient to support modeling and risk assessment needs. The starting point for obtaining this facility-specific data was, therefore, state and local air pollution control agencies and tribes, who are most likely to have this type of detailed inventory data, as well as EPA regulatory databases. The following approach was used by EIAG to prepare the 2005 NEI for point sources:

1) Prepared estimates for Electric Generating Utilities (EGUs) and airports;
2) Requested data from:
    a. EPA's Risk and Technology Review (RTR) Program
    b. EPA's Sector Policies and Programs Division (SPPD)
    c. State, local, and tribal air agencies
    d. Minerals Management Services (MMS) for offshore platforms in the Gulf of Mexico OCS
    e. Regional Planning Organizations (RPOs) for special inventories
3) Retrieved and prepared estimates from the 2005 Toxic Release Inventory;
4) Performed quality assurance (QA) checks on the submitted data;
5) Assigned/verified NEI Unique IDs to submitted data;
6) Added Version 3 of the 2002 NEI to supplement missing facilities;
7) Removed facilities that were identified as closed prior to 2005;
8) Blended and merged all the data sources;
9) Applied a hierarchy on the data sources to "select" preferred data;
10) Removed duplicate and/or overlapping data records from different sources;
11) Prepared draft NEI Output Format (NOF) data file;
12) Assigned Maximum Achievable Control Technology (MACT) codes based on SPPD facility lists and a default protocol;
13) Checked and corrected stack parameter data;
14) Checked and corrected locational coordinate data; and
15) Finalized NOF data file

Data Sources

The following data sources were used to compile the 2005 NEI for point sources:

- Emission Inventory and Analysis Group (EIAG) Data: EPA used emissions and heat input data from the Department of Energy's (DOE) Energy Information Agency (EIA) and EPA's Clean Air Markets Division (CAMD) Emission Tracking System/Continuous Emissions Monitoring (ETS/CEM) data for electric generating utilities (EGUs).[5] Emissions for SO_2 and NO_x were available for 2005; all other pollutants were scaled from their 2002 emissions to baseyear 2005 using the ratio of the heat inputs for 2005 and 2002. Additionally, EIAG prepared point source estimates for airports. CAP and HAP estimates were provided for these source categories.

- Risk and Technology Review (RTR) Data: The RTR project is an effort to conduct residual risk assessment and technology review under CAA section 112(f) and 112(d)(6), respectively.[4] Section 112(f)(2) requires EPA to conduct risk assessments on the source categories subject to MACT standards and to determine if additional standards are necessary to reduce the residual risk. Section 112(d)(6) requires EPA to review and revise MACT standards taking into account developments in practices, processes, and control technologies. Where there are advances in controls, EPA will consider costs, potential emissions reductions, and health and environmental risk in determining what further controls are necessary. The RTR program has prepared emission estimates for over 50 MACT sources categories, and they are presented in Table 1. For nearly all of these categories, only HAP data were provided. The exceptions were for the Pulp and Paper and Portland Cement Manufacturing source categories, which are enabling multi-pollutant strategies.

- Sector Policies and Programs Division (SPPD) Data: For certain MACT source categories, EPA routinely calculates periodic emission inventories. For the 2005 NEI, emission inventories were available for: large municipal waste combustors; small municipal waste combustors; and hazardous waste combustors.[6,7,8,9] SPPD also provided a number of MACT- and area-source facility lists that were applied to the final inventory. CAP and HAP estimates were provided for these source categories.

- Tribal, Local, and State Agency Data: Table 2 presents the 70 tribal, local, and state air agencies which provided point source data; this total was comprised of 4 tribal air agencies, 19 local air agencies, and 47 state air agencies. All of the above agencies provided CAP data, while 52 of the 70 provided HAP data.

- Gulf of Mexico's Oil and Gas Platform Data: The Minerals Management Service (MMS) developed a baseyear 2005 emission inventory for nearly 1,600 oil and natural gas platforms operating in the Gulf of Mexico OCS.[13] This inventory consists of CAPs only.

- Regional Planning Organization (RPO) Agency Data: Table 3 presents tribal data that was compiled by the Western Regional Air Partnership (WRAP) for their 2002 emissions inventory.[10] These 5 tribes were not in the 2002 NEI, and the pollutant coverage consists of CAPs only.

- Toxic Release Inventory (TRI) Data: The TRI database is required as part of Title III of the Superfund Amendments and Reauthorization Act (SARA).[11] TRI data have been compiled on a facility-specific basis, as opposed to the process-level. Facilities that are required to report into TRI are only those that meet certain reporting criteria (thus not accounting for smaller sources

that may fall within an industry group). Emission calculation methods cannot be confirmed from this group of sources. Only HAP estimates were provided from this inventory.

- Version 3 of the 2002 NEI Data: Where facilities were deemed missing from the compilation of the above data sources, version 3 of the 2002 NEI were retrieved and supplemented for the 2005 effort.[12] CAP and HAP estimates were provided for these source categories.

Initial QA Procedure

Each of the above data sources were either submitted or converted into the NIF structure. Several established QA routines were developed for the 2002 NEI using the NIF structure as the basis. Such checks include identifying: records that violate referential integrity; widows and/orphan records; and records that use incorrect codes. A summary report of errors was generated for each data submittal.

Following the initial QA of each submitted data file, the NIF structure records were converted into a flattened table format by joining the NIF tables. The flattened table contains all of the NIF fields, plus additional fields that were needed during the QA process; these tables are then compiled into the Master Database. Additionally, the flattened view allowed the combination of site, process, and pollutant information to be reviewed easier.

Blending and Merging (aka Data Selection)

Because the NEI is composed of databases submitted from multiple sources, there can be overlapping estimates from one or more of these sources. The NEI blend-merge or data selection process attempts to eliminate duplicates. It is important to note, however, that no estimate is actually deleted from EPA's Master Database inventory. Estimates deemed as duplicative are simply "unselected" and thus do not appear in any output or summary files. This method allows EPA to track competing estimates, and refine its merging or data selection routine over time using different rules of selection.

Prior to any blend-merging, EPA first matched the facilities from the multiple data sources and assign common IDs to facilities found in one or more dataset. Facilities found in both the HAP and CAP inventories should share the same NEI Unique Facility ID. It is important to note that data providers sometimes use different Site IDs for their CAP and HAP inventories. In the NEI, these different Site IDs are retained; the common NEI Unique Facility ID indicates that sites are at the same facility. When state, local and tribal data submittals were received in Fall 2007, EPA compared facilities from these submittals to the 2002 NEI. When there was a name or local identifier match between the new data set and the crosswalk, EPA verified that other information such as state, county, address, zip code, TRI ID (or other type of ID), and latitude/longitude coordinates were identical. If so, both of the sites received the corresponding NEI Unique Facility ID. Facilities not found in the crosswalk were assigned a new NEI Unique Facility ID. After NEI Unique Facility IDs were assigned, data selection took place.

The blending and merging had two primary purposes: 1) identifying common facilities; units; and/or processes for overlap analysis; and 2) standardizing non-primary key fields. For example, two different data sources may have provided information on the same facility, even though the Facility ID may different. Each data source may have provided slightly different street addresses, such as "123 Main Street" vs. "123 Main St." Where these differences occurred, the street addresses were standardized to be the same.

Each data record was assigned a hierarchy code based on the data source. The hierarchy is as followed:

1) EPA RTR data
2) EPA EIAG data
3) EPA SPPD data
4) Tribal air agency data
5) Local air agency data
6) State air agency data
7) RPO air agency data
8) 2005 TRI data
9) 2002 NEI data
10) 2005 Gulf of Mexico OCS data

Additionally, each data record was assigned a Record ID consisting of the following data fields:

- Tribal_Code
- State_County_FIPS
- NEI_Unique_Facility_ID/State_Facility_ID
- Pollutant_Group_ID/Pollutant_Code
- Emission_Unit_ID
- Process_ID
- Emission_Release_Point_ID
- Start_Date/End_Date

Three types of passes were done to identify duplicate records. In all cases, the RTR data set was retained over all the other data sets. The overlap analysis passes were:

1) Data records that had the same Record ID were identified. Data records were then selected or deselected based on the above hierarchy.
2) The second pass consisted of grouping NEI_Unique_Facility_IDs and Pollutant_Code to identify potential record overlaps. After careful examination of the results, data records were then selected or deselected based on the above hierarchy.
3) The third pass consisted of grouping NEI_Unique_Facility_IDs and Pollutant_Group_ID to identify additional potential record overlaps. After careful examination of the results, data records were then selected or deselected based on the above hierarchy.

Final QA Procedure

After the "selected" records were identified in the Master Database, the data were then converted to the NOF, and additional checks were performed. They include:

- Verification of referential integrity;
- Stack Parameter QA;
- Latitude/Longitude Coordinates QA;
- Assignment of MACT/Area Source Program codes based on SPPD facility lists;
- Assignment of MACT Code Defaults;
- Miscellaneous fixes, such as:
    - emission changes due to lead NAAQS;
    - control device changes due to EPA CoST work;
    - miscellaneous state/local agency comments
    - additional closed facilities
    - populating null SCCs

PRELIMINARY RESULTS

Stack Parameter QA

Figure 1 presents the results of the Stack Parameter QA. Nearly 38% of the submitted emission release point (ERP) records retained their original stack parameters without modification. If at least one parameter was changed due to falling outside the acceptable range, then those ERP records are identified and account for an additional 32%. The remainder of submitted ERP records (30%) either did not include stack parameters, or all parameters were out of range.

Latitude/Longitude QA

Figure 2 presents the results of the Latitude/Longitude QA. Over 82% of the submitted ERPs were identified as valid. Another 2% were data coordinates submitted through the RTR process, while another 2% were the result of site averages. Finally, 2% of the latitude and longitude coordinates were geocoded using the street address. The remaining 12% of the ERP latitude and longitude coordinates had to be defaulted using zipcode- and county-centroid information.

2005 and 2002 Comparisons

Table 4 presents a comparison of selected parameters between Version 3 of the 2002 point sources NEI and the 2005 point sources NEI. The number of annual emission records was comparable between the two inventories. The 2005 point sources NEI contained more unique facilities, additional tribal areas, additional counties, and the inclusion of the Gulf of Mexico OCS oil and gas platforms.

Data Considerations

Although improvements and additional data have been incorporated in the 2005 point sources NEI, there are a few data considerations that will need to be addressed during the revisions stage. They include:

- No PM Augmentation: Unlike the 2002 NEI, PM augmentation was not performed for the 2005 NEI. Thus, the number of PM records, especially $PM_{2.5}$ are likely under-reported;
- No Boiler Augmentation: Similar to the PM Augmentation, no boiler augmentation was performed for the 2005 NEI. Thus, boiler emission records are likely under-reported;
- Missing States: Five states and 1 U.S. territory did not submit 2005 inventories;
- Missing Counties: Similarly, point sources from 100 U.S. counties are not represented. It's possible that these counties may not actually contain significant point sources, and are represented in the Nonpoint Area Sources portion of the NEI;
- Missing Pollutants: While CAPs were submitted for all submitted state, local, and tribal agency data sets, 18 data sets did not include HAP data;
- Unidentified Closed Facilities/Units: Although a number of closed facilities and units were not included in the 2005 NEI, this does not likely account for all the closed facilities and units that occurred prior to 2005.
- Use of Defaults: Although the majority of the data in the 2005 NEI consists of actual data, significant portions of the inventory data were the result of defaults.

CONCLUSIONS

The 2005 point sources NEI was compiled using numerous data sources from EPA, regional, state, local, and tribal air agencies, and MMS. A number of QA procedures were implemented to verify and correct submitted data, and to identify duplicate and overlapping data records from different data sources. Initial results indicated good comparability between the 2002 and 2005 point sources NEI.

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KEYWORDS

National Emissions Inventory (NEI)
Point Sources
Hazardous Air Pollutants
Criteria Air Pollutants

Table 1. RTR Phases and Groups for Source Category Review

Phase I	
Coke Ovens	Gasoline Distribution
Dry Cleaning	Ethylene Oxide Sterilizers
Industrial Cooling Towers	Magnetic Tape
Hazardous Organic NESHAP (HON)	Halogenated Solvents
Phase II	
Group 1	
Polymers/Resins I-Polysulfide Rubber	Polymers/Resins II-Epoxy Resins
Polymers/Resins I-Ethylene-Propylene Rubber	Polymers/Resins II-Non-nylon Polyamides
Polymers/Resins I-Butyl Rubber	GMACT- Hydrogen Fluoride
Polymers/Resins I-Neoprene	GMACT- Acetal Resins
Group 2	
Aerospace	Polymers/Resins IV-Polystyrene
Marine Vessel Loading	Polymers/Resins IV-Methyl Methacrylate-Butadiene-Styrene
Mineral Wool	Polymers/Resins IV-Methyl Methacrylate-Acrylonitrile-Butadiene-Styrene Resins
Natural Gas Transmission	Polymers/Resins IV-Nitrile Resins
Oil & Natural Gas	Polymers/Resins IV-Polyethylene Terephthalate
Petroleum Refineries	Polymers/Resins IV-Acrylonitrile-Butadiene-Styrene
Polymers/Resins I-Hypalon Production	Polymers/Resins IV-V-Styrene-Acrylonitrile
Polymers/Resins I-Epichlorohydrine Elastomers	Pharmaceuticals
Polymers/Resins I-Polybutadiene Rubber	Printing and Publishing
Polymers/Resins I-Styrene-Butadiene Rubber/Latex	Primary Aluminum
Polymers/Resins I-Nitrile Butadiene Production	Ship Building
Group 3	
Acrylic and Modacrylic Fibers	Primary Lead Smelting
Chrome Electroplating (3 subcategories)	POTWs
Ferroalloys Production	Pulp and Paper Production
Flexible Polyurethane Foam	Secondary Aluminum Production
Offsite Waste and Recovery	Secondary Lead Smelting
Phosphoric Acid/Phosphoric Fertilizer Production	Steel Pickling-HCl Process
Polycarbonates Production	Wood Furniture
Polyether Polyols Production	Wool Fiberglass
Portland Cement Manufacturing	

Table 2. State, Local, and Tribal Agency Submittals

State	Submitting Agency	Type	CAP	HAP
Alabama	Alabama Department of Environmental Management	State	X	X
Alabama	Alabama: Jefferson County Health Board	Local	X	X
Alaska	Alaska Department of Environmental Conservation	State	X	
Arizona	Arizona Department of Environmental Quality	State	X	X
Arizona	Arizona: Maricopa County Environmental Services Department	Local	X	
Arizona	Arizona: Navajo Nation, Arizona, New Mexico & Utah	Tribal	X	
Arkansas	Arkansas Department of Environmental Quality	State	X	X
California	California Air Resources Board	State	X	X
Delaware	Delaware Department of Natural Resources	State	X	X
Dist. Of Columbia	District of Columbia Department of Health	State	X	
Florida	Florida Department of Environmental Protection	State	X	X
Georgia	Georgia Department of Natural Resources	State	X	
Hawaii	Hawaii Department of Health, Clean Air Branch	State	X	
Idaho	Idaho Department of Environmental Quality	State	X	X
Illinois	Illinois Environmental Protection Agency	State	X	X
Indiana	Indiana Department of Environmental Management	State	X	X
Iowa	Iowa Department of Natural Resources	State	X	X
Kansas	Kansas Department of Health and Environment	State	X	X
Kansas	Kansas: Sac & Fox Nation of Missouri in Kansas and Nebraska	Tribal	X	
Kentucky	Kentucky Division of Air Quality	State	X	X
Kentucky	Air Pollution Control of Jefferson County	Local	X	X
Louisiana	Louisiana Department of Environmental Quality	State	X	X
Maine	Maine Department of Environmental Protection	State	X	X
Maryland	Maryland Department of Environment	State	X	X
Massachusetts	Massachusetts Department of Environmental Protection	State	X	X
Michigan	Michigan Department of Environmental Quality	State	X	X
Minnesota	Minnesota Pollution Control Agency	State	X	X
Mississippi	Mississippi Department of Environmental Quality	State	X	X
Missouri	Missouri Department of Natural Resources	State	X	X
Montana	Montana Department of Environmental Quality	State	X	
Montana	Montana: Assiniboine and Sioux Tribes of the Fort Peck Indian Reservation	Tribal	X	X
Nebraska	Nebraska Department of Environmental Quality	State	X	X
Nebraska	Nebraska: Winnebago Tribe	Tribal	X	X
Nebraska	Lincoln-Lancaster County Health Department	Local	X	X
Nebraska	City of Omaha Public Works Department	Local	X	X
Nevada	Nevada Bureau of Air Quality	State	X	
Nevada	Clark County Department of Air Quality and Management	Local	X	
Nevada	Washoe County Air Quality Management Division	Local	X	
New Hampshire	New Hampshire Department of Environmental Services	State	X	X
New Jersey	New Jersey Department of Environmental Protection	State	X	
New Mexico	City of Albuquerque	Local	X	X
New York	New York Department of Environmental Conservation	State	X	X
North Carolina	North Carolina Division of Air Quality	State	X	X
North Carolina	Western North Carolina Regional Air Quality Agency – Buncombe County	Local	X	X
North Carolina	Forsyth County Environmental Affairs Department	Local	X	X
North Carolina	Mecklenburg County Air Quality	Local	X	X
Ohio	Ohio Environmental Protection Agency	State	X	X
Oklahoma	Oklahoma Department of Environmental Quality	State	X	X

Table 2. State, Local, and Tribal Agency Submittals (Cont.)

State	Submitting Agency	Type	CAP	HAP
Oregon	Oregon Department of Environmental Quality	State	X	
Oregon	Lane Regional Air Pollution Authority	Local	X	
Pennsylvania	Pennsylvania Department of Environmental Protection	State	X	X
Pennsylvania	Allegheny County Health Department	Local	X	X
Pennsylvania	City of Philadelphia	Local	X	X
Puerto Rico	Puerto Rico Environmental Quality Board	Territory	X	
Rhode Island	Rhode Island Department of Environmental Management	State	X	
South Carolina	South Carolina Department of Health and Environmental Control	State	X	X
South Dakota	South Dakota Department of Environment and Natural Resources	State	X	
Tennessee	Tennessee Department of Environment and Conservation	State	X	X
Tennessee	Chattanooga Hamilton County Air Pollution Control Bureau	Local	X	X
Tennessee	Memphis and Shelby County Health Department	Local	X	X
Tennessee	Metro Public Health Dept. Nashville/Davidson County	Local	X	X
Texas	Texas Commission on Environmental Quality	State	X	X
Utah	Utah Division Of Air Quality	State	X	X
Vermont	Vermont Department of Environmental Quality	State	X	
Virginia	Virginia Department of Environmental Quality	State	X	X
Washington	Washington State Department of Ecology	State	X	X
Washington	Olympic Region Clean Air Agency	Local	X	X
Washington	Puget Sound Clean Air Agency	Local	X	X
West Virginia	West Virginia Division of Air Quality	State	X	X
Wisconsin	Wisconsin Department of Natural Resources	State	X	X
		TOTALS	70	52

Table 3. WRAP Supplemental Tribal Data

Tribal Area
Confederated Tribes of the Colville Reservation, Washington
Puyallup Tribe of the Puyallup Reservation, Washington
Confederated Tribes and Bands of the Yakama Nation, Washington
Arapahoe Tribe of the Wind River Reservation, Wyoming
Tohono O'Odham Nation of Arizona

Table 4. Data Comparison of Selected Parameters

Parameter	2005 NEI	2002 NEI
Annual emission records	3.4 million	3.5 million
# Unique Facilities	98,255	85,144
# Tribal Areas	23	15
# U.S. Counties	3,111	3,027
# Gulf of Mexico OCS Areas	1,079	0

Figure 1. Stack Parameter QA Results

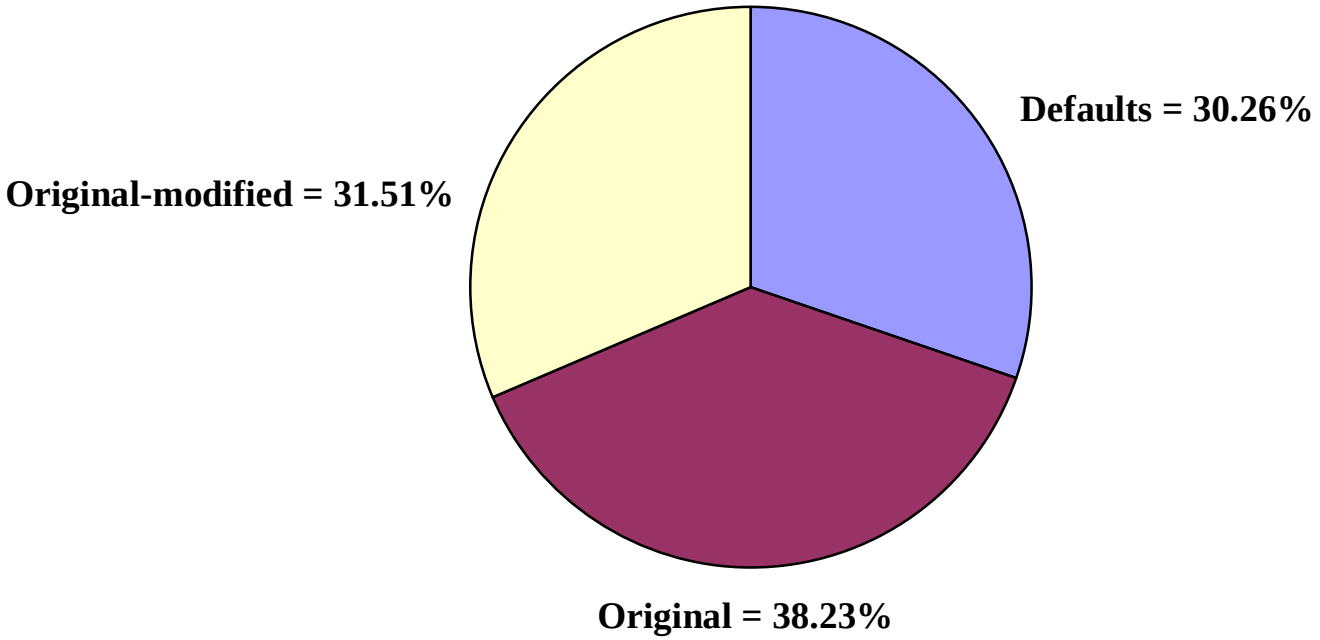

Figure 2. Latitude/Longitude QA Results

A	RTR Fixes
B	County-Centroid
C	Site Average
D	Zipcode-centroid
E	Address match