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Substance Abuse and Mental Health Services Administration

2022 National Survey on Drug Use and Health (NSDUH) Methodological Resource Book

Section 2: Sample Design Report

Substance Abuse and Mental Health Services Administration
Center for Behavioral Health Statistics and Quality
Rockville, Maryland

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2022 National Survey on Drug Use and Health (NSDUH) Methodological Resource Book, Section 2: Sample Design Report

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1. Introduction

1.1 Purpose

The goal of this report is to document the sample design for the 2022 National Survey on Drug Use and Health (NSDUH). The 2022 NSDUH sample experiences will be further documented in the *2022 National Survey on Drug Use and Health (NSDUH) Methodological Resource Book, Section 14: Sample Experience Report* (Center for Behavioral Health Statistics and Quality, forthcoming a).

The report is organized into seven chapters and includes a list of cited references, a list of contributors, and several appendices. The remainder of Chapter 1 describes the target population, provides a general overview of the 2022 NSDUH sample design, and summarizes the impact of the coronavirus disease 2019 (COVID-19) pandemic on the 2022 NSDUH. Chapter 2 summarizes the 2014 through 2022 coordinated design, while Chapter 3 discusses the first three stages of selection in greater detail. Chapter 4 describes a hybrid field enumeration and address-based sampling (ABS) frame that was employed in 2022. Chapter 5 describes the fourth and fifth stages of selection. Chapter 6 describes sample weighting and variance estimation procedures for the 2022 NSDUH. Finally, Chapter 7 describes the sample design for an Incentives Field Test that was embedded in the NSDUH sample for Quarter 4 of 2022.

1.2 Target Population

The respondent universe for the 2022 NSDUH was the civilian, noninstitutionalized population aged 12 years or older residing within the 50 states and the District of Columbia. Consistent with NSDUH's designs since 1991, the 2022 NSDUH universe included residents of housing units (e.g., single-family houses, townhomes, condominiums, apartments, mobile homes, rented rooms), noninstitutional group quarters[1] (e.g., shelters, rooming houses, dormitories, group homes), and civilians residing on military bases. Coverage before the 1991 survey was limited to residents of the coterminous 48 states (i.e., excluding residents of Alaska and Hawaii), and it excluded residents of group quarters and all persons (including civilians) living on military bases. Persons excluded from the 2022 universe included those with no fixed household address (e.g., homeless and/or transient persons not in shelters), the active military population, and residents of institutional group quarters, such as jails and hospitals.

1.3 Overview

A coordinated sample design was developed for the 2014 through 2017 NSDUHs. A large reserve sample of area clusters was selected at the time the 2014 through 2017 NSDUH sample was selected. This reserve sample was used to field the 2018 through 2022 NSDUHs. Thus, the 2018 through 2022 NSDUH designs simply continue the coordinated design. The

[1] NSDUH defines group quarters as dwelling units in which 10 or more unrelated persons reside. The following dwelling units are considered group quarters regardless of the number or relationship of occupants: college dormitories, sorority houses, and fraternity houses; quarters for live-in staff members of institutions; and missions and shelters. Other noninstitutional group quarters include boarding or rooming houses, communes, convents and monasteries, halfway houses, migratory workers' camps, and nonmilitary barracks. Institutional group quarters, which are ineligible for NSDUH, include correctional facilities, nursing homes, and hospitals.

coordinated sample design is state based, with an independent, multistage area probability sample within each state and the District of Columbia.

For the 2022 NSDUH, a hybrid field enumeration and ABS approach was used to construct dwelling unit (DU) frames within sampled areas (see Chapter 4). Census block groups (CBGs) selected at the second stage of selection were evaluated using a set of ABS coverage criteria. If the CBG met all coverage criteria, the ABS frame was used for the CBG. If the CBG failed one or more coverage criteria, a smaller area (one or more census blocks) was selected, and field enumeration was used to construct the DU frame. The "segment" is the geographic area for which the DU frame is constructed even though ABS segments are second-stage sampling units and field enumeration segments are third-stage sampling units. For the remainder of this report, "segment" refers to both ABS segments and field enumeration segments if no distinction is made.

Once the DU frames were constructed, a sample of DUs was selected within each segment. Then, within sample DUs, 0, 1, or 2 persons were selected for the NSDUH interview using a pair sampling strategy developed by Chromy and Penne (2002).

Similar to NSDUHs dating back to 1999, the 2014 through 2022 surveys provide sufficient sample sizes to support state and national estimates. Furthermore, NSDUH was redesigned in 2014 to a more cost-efficient sample allocation, which increased the sample size in the largest states while maintaining adequate sample sizes in smaller states to support reliable state estimates based on small area estimation methodology. Reliable direct state estimates are also possible (in any state) by pooling multiple years of data.

For the 2022 NSDUH, the target national sample size of 67,507 was distributed across five age groups as follows: 25 percent for youths aged 12 to 17, 25 percent for young adults aged 18 to 25, 15 percent for adults aged 26 to 34, 20 percent for adults aged 35 to 49, and 15 percent for adults aged 50 or older. This large sample size would allow the Substance Abuse and Mental Health Services Administration (SAMHSA) to report precise estimates for demographic subgroups at the national level without needing to oversample specially targeted demographics.

1.4 Impact of COVID-19 on Sample Design and Data Collection

In 2022, the COVID-19 pandemic continued to have a negative impact on field data collection and response rates. Throughout the year, NSDUH project management at RTI International[2] worked closely with SAMHSA and RTI's Infectious Disease Response Team to determine how and where it was safe to collect data in person. In addition, web data collection continued to be used to minimize the COVID-19 pandemic's impact on respondent sample size.

At the beginning of each calendar quarter, sample dwelling units (SDUs) were mailed an invitation to participate via web. Several days later, field interviewers (FIs) began following up with pending SDUs for in-person data collection. At the beginning of 2022, FIs were able to collect data only in areas deemed safe for in-person data collection. As of February 2, 2022, FIs were able to collect data in all areas but were required to follow more stringent safety protocols

[2] RTI International is a trade name of Research Triangle Institute. RTI and the RTI logo are U.S. registered trademarks of Research Triangle Institute.

in areas where Centers for Disease Control and Prevention COVID-19 metrics were high. Throughout each quarter, respondents had the option of participating via web as long as they had not already participated in person.

Although FIs were able to collect data in most areas, field response rates were much lower than they were before the COVID-19 pandemic. Further, web data collection was expected to result in a much lower overall response rate than that for in-person data collection. For these reasons, a very large sample of DUs was selected each quarter. Because the NSDUH area segments were not designed to support as large of a sample as was required, a supplemental sample was selected from available DUs in area segments from a prior NSDUH sample in Quarter 3. Section 5.8 describes the Quarter 3 sample supplement in greater detail.

As a result of multimode data collection and large DU samples, the achieved sample for the 2022 NSDUH was 71,369 persons, with 41,121 interviews completed in person and 30,248 interviews completed via web.

Additional detail on the impact of the COVID-19 pandemic on each stage of the 2022 NSDUH sample design is provided in the chapters that follow.

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2. Coordinated Sample Design for the 2014-2022 NSDUHs

2.1 Multiyear Design

A coordinated sample design was developed for the 2014 through 2017 National Surveys on Drug Use and Health (NSDUHs) and has been extended to the 2018 through 2022 NSDUHs. The 2014 through 2022 coordinated design facilitates 50 percent overlap in sampled areas within each successive 2-year period from 2014 through 2022. This designed sample overlap may slightly increase the precision of estimates of year-to-year trends when there is a small positive correlation in successive survey years due to an overlapped segment being somewhat homogeneous. The 50 percent overlap of segments significantly reduces segment field enumeration or listing costs because dwelling unit (DU) frames need to be constructed for only the new panel of segments each survey year. For the 2022 survey, an address-based sampling (ABS) frame was used for a portion of the segments, which further reduced listing costs.

The 2014 through 2022 design provides for estimates by state in all 50 states plus the District of Columbia. States may therefore be viewed as the first level of stratification and as a reporting variable. As shown in Table 2.1, each annual survey was designed to yield the following target interviews:

- 4,560 completed interviews in California;
- 3,300 completed interviews each in Florida, New York, and Texas;
- 2,400 completed interviews each in Illinois, Michigan, Ohio, and Pennsylvania;
- 1,500 completed interviews each in Georgia, New Jersey, North Carolina, and Virginia;
- 967 completed interviews in Hawaii; and
- 960 completed interviews in each of the remaining 37 states and the District of Columbia.

To accommodate state and local policymakers' need for substate estimates in Kauai County, Hawaii, the sample was designed to yield a minimum of 200 completed interviews in this county over a 3-year period. This allows for Kauai County to be included as a separate entity in the production of substate estimates that are produced biennially and typically based on 3 years of data. To achieve this goal while maintaining precision at the state level, Kauai County is being treated separately from the remainder of Hawaii for sample allocation and sample size management purposes. The annual sample in Hawaii consists of 67 completed interviews in Kauai County and 900 completed interviews in the remainder of the state, for a total of 967 completed interviews each year.

Table 2.1 Annual National Sample of Area Segments and Respondents

Design Parameters	CA	FL, NY, and TX	IL, MI, OH, and PA	GA, NC, NJ, and VA	HI	Remaining 37 States and DC	Total
Total Sample							
SSRs	36	90	96	60	12	456	750
Segments	288	720	768	480	96	3,648	6,000
Respondents	4,560	9,900	9,600	6,000	967	36,480	67,507
Total per State							
SSRs	36	30	24	15	12	12	N/A
Segments	288	240	192	120	96	96	N/A
Respondents	4,560	3,300	2,400	1,500	967	960	N/A
Total per SSR							
Segments per Quarter	2	2	2	2	2	2	N/A
Segments over Four Quarters	8	8	8	8	8	8	N/A
Respondents per Segment	15.833	13.750	12.500	12.500	10.073	10.000	N/A

CA = California; DC = District of Columbia; FL = Florida; GA = Georgia; HI = Hawaii; IL = Illinois; MI = Michigan; N/A = not applicable; NC = North Carolina; NJ = New Jersey; NY = New York; OH = Ohio; PA = Pennsylvania; SSR = state sampling region; TX = Texas; VA = Virginia.

2.2 Stratification and First-, Second-, and Third-Stage Sample Selections

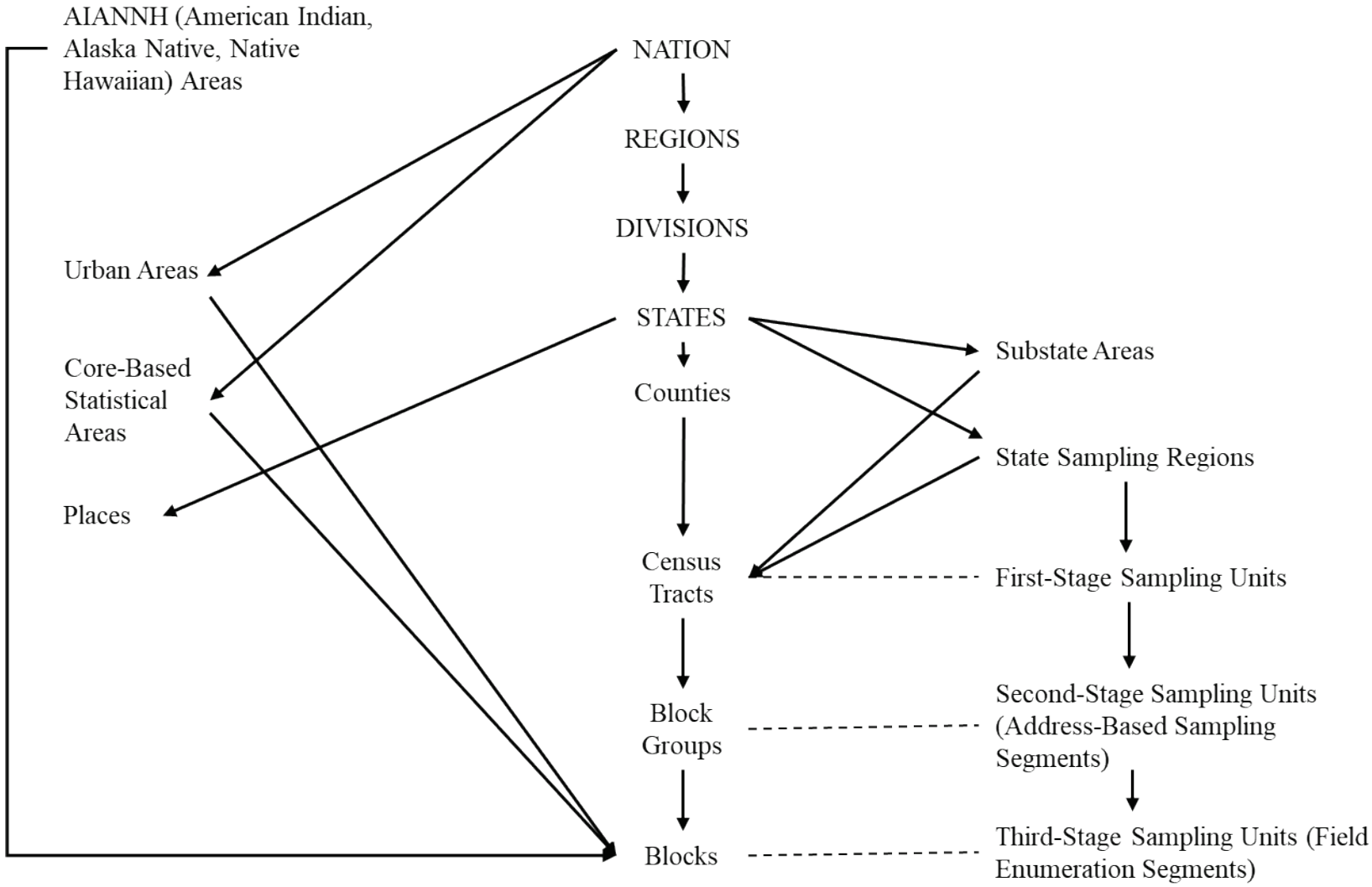
Exhibit 1 displays the relationship between census and NSDUH geographic entities. First, state sampling regions (SSRs) were formed by combining census tracts within each state. Each state was geographically partitioned into roughly equal-sized regions according to a composite size measure (i.e., population weighted by state and age group sampling rates). In other words, regions were formed such that each area within a state yielded, in expectation, roughly the same number of interviews during each data collection period. This partitioning divided the United States into 750 SSRs. Maps for these regions can be found in Appendix A.

Similar to the 2005 through 2013 NSDUHs, the first stage of selection for the 2014 through 2022 NSDUHs was census tracts.[3] This stage was included to contain sample segments within a single census tract to the extent possible. Segments that cross census tract boundaries make merging to external data sources difficult.

The first stage of selection began with the construction of an area sample frame that contained one record for each census tract in the United States. If necessary, census tracts were

[3] A census tract is a small, relatively permanent statistical subdivision of a county or equivalent entity that contains between 1,200 and 8,000 persons, with an optimum size of 4,000 persons (U.S. Census Bureau, 2001).

Exhibit 1 Hierarchy of Census and NSDUH Geographic Entities



aggregated within SSRs until each first-stage sampling unit met the minimum size requirement. In California, Florida, Georgia, Illinois, Michigan, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Texas, and Virginia, this minimum size requirement was 250 DUs[4] in urban areas and 200 DUs in rural areas.[5] In the remaining states and the District of Columbia, the minimum requirement was 150 DUs in urban areas and 100 DUs in rural areas.

Before selecting census tracts,[6] additional implicit stratification was achieved by sorting the first-stage sampling units by a CBSA/SES[7] (core-based statistical area/socioeconomic status) indicator[8] and by the percentage of the population that is non-Hispanic and White.[9] From this well-ordered sample frame, 48 census tracts per SSR were systematically selected with probabilities proportionate to a composite size measure and with minimum replacement (Chromy, 1979).

For the second stage of selection, adjacent census block groups were aggregated within selected census tracts as necessary to meet the minimum DU requirements (150 or 250 DUs in urban areas and 100 or 200 DUs in rural areas according to state). After the resulting second-stage sampling units were formed, they were sorted in the order they were formed (i.e., geographically), and one census block group[10] was selected per sampled census tract with probability proportionate to a composite size measure and with minimum replacement (Chromy, 1979). The selection of census block groups at the second stage of selection facilitated transitioning to a hybrid field enumeration and ABS frame for the 2022 NSDUH (see Chapter 4). Relative to field enumeration (see Section 4.3.2), the use of ABS frames reduces costs, improves timeliness, and improves accuracy in areas with controlled access. Because of the reduced costs of ABS frame construction, the smallest selected geographical areas can be larger than they are with field enumeration, and using census block groups instead of smaller segments reduces the clustering effect on the estimates, improving precision. For these reasons, census block groups selected at the second stage of selection serve as ABS segments for the 2022 NSDUH.

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[4] DU counts were obtained from the 2010 census data supplemented with revised population counts from Claritas, which is a market research firm headquartered in Cincinnati, Ohio (see https://www.claritas.com/).

[5] The basis for the differing minimum DU requirement in urban and rural areas is that it is more difficult to meet the requirement in rural areas, 100 DUs are sufficient to support one field test and two main study in-person samples in the smaller sample states, and 200 DUs are sufficient to support three in-person samples in the larger sample states.

[6] For the remainder of the discussion, first-stage sampling units are referred to as "census tracts" even though each first-stage sampling unit contains one or more census tracts.

[7] CBSAs include metropolitan and micropolitan statistical areas as defined by the Office of Management and Budget (2009).

[8] Four categories are defined as (1) CBSA/low SES, (2) CBSA/high SES, (3) non-CBSA/low SES, and (4) non-CBSA/high SES. To define SES, census tract-level median rents and property values obtained from the 2006-2010 American Community Survey data were given a rank (1,…,5) based on state and CBSA quintiles. The rent and value ranks then were averaged, weighted by the percentages of renter- and owner-occupied DUs, respectively. If the resulting score fell in the lower 25th percentile by state and CBSA, the area was considered "low SES"; otherwise, it was considered "high SES."

[9] Although the large sample size eliminates the need for the oversampling of specially targeted demographic subgroups as was required prior to the 1999 National Household Survey on Drug Abuse, sorting by a CBSA/SES indicator and by the percentage of the population that is non-Hispanic and White ensures dispersion of the sample with respect to SES and race/ethnicity. Implicit stratification also has the potential to lower sampling error by selecting neighboring and possibly similar segments at a lower probability than if the selection were done completely at random.

[10] For the remainder of the discussion, second-stage sampling units are referred to as "census block groups" even though each second-stage sampling unit contains one or more census block groups.

Because census block groups often greatly exceed the minimum DU requirement, one smaller geographic region was selected within each sampled census block group for field enumeration. For this third stage of sampling, each selected census block group was partitioned into compact clusters[11] of DUs by aggregating adjacent census blocks.[12] These geographic clusters of blocks are referred to as "segments" for the 2014 through 2021 NSDUHs and as "field enumeration segments" for the 2022 NSDUH. Similar to census tracts and census block groups, field enumeration segments were formed to contain a minimum of 150 or 250 DUs in urban areas and 100 or 200 DUs in rural areas according to state. This minimum DU requirement will support the overlapping sample design and any special supplemental samples or field tests the Substance Abuse and Mental Health Services Administration may wish to conduct.

Prior to selection, the field enumeration segments were sorted in the order they were formed (i.e., geographically), and one field enumeration segment was selected within each sampled census block group using Chromy's method of sequential random sampling (with probability proportionate to size and minimum replacement) (Chromy, 1979).

All 48 selected segments, both ABS and field enumeration segments, then were randomly assigned to a survey year and quarter of data collection as described in Section 3.4. Each NSDUH year, an equal probability subsample of eight segments is typically used. These eight segments are randomly assigned to quarters and to two panels within each quarter. For 2022, the first panel segments (panel I) were used for the 2021 and 2022 surveys, constituting the overlap sample. The second panel segments (panel J) were used for the 2022 survey and are being used again for the 2023 survey. In addition, some panel H segments were used to supplement the Quarter 3 sample, as described in Section 5.8.

2.3 Sample Dwelling Units and Persons

After sample segments for the 2022 NSDUH were selected, DU frames for the fourth stage of selection were constructed (see Chapter 4). A DU in NSDUH refers to either a housing unit or a group quarters listing unit, such as a dormitory room or a shelter bed.

The primary objective of the fourth stage of sample selection (DUs) was to select the minimum number of DUs needed in each segment to meet the targeted sample sizes for all age groups. Thus, DU sample sizes for the segment were determined using the age group with the largest sampling rate, which is referred to as the "driving" age group. Using 2010 census data adjusted to more recent data from Claritas, state- and age-specific sampling rates were computed. These rates then were adjusted by the segment's probability of selection;[13] the subsegmenting

[11] Although the entire cluster is compact, the final sample of DUs represents a noncompact cluster. Noncompact clusters (selection from a list) differ from compact clusters in that not all units within the cluster are included in the sample. Although compact cluster designs are less costly and more stable, a noncompact cluster design was used because it provides for greater heterogeneity of dwellings within the sample. Also, social interaction (contagion) among neighboring dwellings is sometimes introduced with compact clusters (Kish, 1965).

[12] A census block is a small statistical area bounded by visible features (streets, roads, streams, railroad tracks, etc.) and nonvisible boundaries (e.g., city, town, and county limits). A block group is a cluster of census blocks within the same census tract and generally contains between 300 and 6,000 persons (U.S. Census Bureau, 2001).

[13] The segment's probability of selection includes the probability of selecting the census tract, census block group, and segment for field enumeration segments. It includes the census tract and census block group probabilities of selection for ABS segments.

adjustment,[14] if any; the probability of selecting a person in the age group (equal to the maximum, or 0.99, for the driving age group); and an adjustment for the "maximum of two" rule.[15] In addition to these factors, historical data from the 2019 and 2020 NSDUHs were used to compute predicted screening and interviewing response rate adjustments.[16] The final adjusted sampling rate then was multiplied by the actual number of DUs found in the field during counting and listing activities (field enumeration segments) or on the ABS frame (ABS segments). The product represents the segment's DU sample size.

Some constraints were put on the DU sample sizes. For example, to ensure adequate samples for supplemental studies, the DU sample size could not exceed half of the actual DU count in panel J segments. Similarly, if five unused DUs remained in a segment, a minimum of five DUs per segment was required for cost efficiency.

Using a random start point and interval-based (systematic) selection, the DUs were selected from the segment frame (see Section 5.6). After DU selections were made, each selected DU was contacted to obtain a roster of all persons residing in the DU. Prior to Quarter 4 of 2020, a field interviewer (FI) visited each selected DU to obtain this roster information. Beginning in Quarter 4 of 2020 and continuing through 2022, an eligible member of the selected DU provided roster information by web or in person (i.e., multimode data collection). Using the roster information, 0, 1, or 2 persons were selected for the survey. Sampling rates were preset by age group and state. Roster information was entered directly into the web or in-person electronic screening instrument, which automatically implemented this fifth stage of selection based on the state and age group sampling parameters.

Individuals selected in a given year are not expected to be selected in subsequent years unless they move and their new residence is also selected. No mechanism is currently in place for identifying duplicate persons across years within a sample design (e.g., 2014 to 2022) or across quarters within a year, but this number should be small because DUs are not sampled more than once within a design.

One advantage of using an electronic screening instrument in NSDUH is the ability to impose a more complicated person-level selection algorithm on the fifth stage of the NSDUH design. Similar to the 1999 through 2013 designs, one feature included in the 2014 through 2022 NSDUHs was that any pair of survey-eligible persons within a DU had some chance of being selected (i.e., all survey-eligible pairs of persons had some nonzero chance of being selected). This design feature was of interest to NSDUH researchers because, for example, it allows analysts to examine how the drug use propensity of one individual in a family relates to the drug use propensity of another family member residing in the same DU (e.g., the relationship of drug use

[14] Segments found to be very large in the field are partitioned into *subsegments*. Then one subsegment is chosen at random with probability proportional to size. In some cases, a second-level subsegmenting was required if the census totals used in the initial subsegmenting were off and the selected subsegment was still too large for listing. The subsegmenting adjustment accounts for reducing the size of the segment.

[15] Brewer's Selection Algorithm never allows for greater than two persons per household to be chosen. Thus, sampling rates are adjusted to satisfy this constraint.

[16] Screening and interviewing response rates were computed using the American Association for Public Opinion Research (AAPOR) formulas for Response Rate 1 (RR1) and Response Rate 2 (RR2), respectively. For more information, see pp. 61 and 62 of the 9th edition of *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys* (AAPOR, 2016).

between a parent and his or her child). This pair sampling algorithm is based on the Chromy and Penne (2002) adaptation of the Brewer (1963, 1975) method for selecting samples of size two. Chromy and Penne (2002) also introduced a pair sampling parameter λ that governs the number of pairs selected. Appendix B describes the simulation analyses that were conducted to select the pair sampling parameter for the 2014 through 2022 NSDUHs.

As in previous years, during the screening interview, the FI asked the screening respondent about other units within the sampled DU or on the property (e.g., a garage apartment).[17] When found on the premises of a sampled DU, any new or missed dwelling was selected into the 2022 NSDUH. To minimize bias associated with large numbers of missed DUs, FIs were instructed to call their supervisors if they noticed large differences between the segment's list of DUs and what they encountered in the field. Then special "bust" procedures were implemented, as described in Section 5.7.

2.4 Impact of COVID-19 on the Coordinated Sample Design

Because area samples were selected simultaneously for the 2014 through 2022 NSDUHs, COVID-19 had no impact on stratification or the first two stages of selection in the coordinated sample design. At the third stage of selection, some field enumeration segments selected for an earlier NSDUH were used to supplement the 2022 NSDUH sample, as described in Section 5.8. The impact on the selection of DUs and persons is discussed in Section 5.9.

[17] To avoid respondent confusion, the missed DU question is skipped for web respondents and residents of larger multiunit structures (three or more units). The missed DU question is also skipped for residents of group quarters and residents of housing units associated with group quarters (e.g., a "house mother" apartment in a sorority house).

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3. Selection of First-, Second-, and Third-Stage Sampling Units for the 2014-2022 Coordinated Sample

As was mentioned previously, the first three stages of sample were selected simultaneously for each of the 2014 through 2022 National Surveys on Drug Use and Health (NSDUHs). Starting with a census block-level frame, first-, second-, and third-stage sampling units (census tracts, census block groups, and field enumeration segments, respectively) were formed by aggregating the block-level data to the appropriate level. A sufficient number of segments then were selected within state sampling regions (SSRs) to support the 2014 through 2017 main studies and a number of large field tests. A number of "reserve" segments also were selected to carry the sample through the next decennial census, if desired. This reserve sample was used to support the 2018 through 2022 NSDUHs.

3.1 Formation of and Objectives for Using the Composite Size Measures

The composite size measure procedure is used to obtain self-weighting[18] samples for multiple domains in multistage designs. The NSDUH sample design has employed the composite size measure methodology since 1988. The goal was to specify size measures for sample areas (segments) and dwelling units (DUs) that would achieve the following objectives:

- Yield the targeted domain respondent sample sizes in expectation (E_s) over repeated samples; that is, if m_{ds} is the domain d sample size achieved by sample s, then
$$E_s(m_{ds}) = m_d \text{ for } d = 1,...,D. \quad (1)$$
- Constrain the maximum number of selections per DU at a specified value; specifically, the total number of within-DU selections was limited across all age groups to a maximum of 2.
- Minimize the number of sample DUs that must be screened to achieve the targeted domain sample sizes.
- Eliminate all variation in the sample inclusion probabilities within a domain, except for the variation in the within-DU/within-domain probabilities of selection. The inverse probabilities of selection for each sample segment were used to determine the number of sample DUs to select from within each segment. As a consequence, all DUs within a specific stratum were selected with approximately the same probability and, therefore, approximately equalized DU sampling weights. This feature minimizes the variance inflation resulting from unnecessary variation in sampling weights.
- Equalize the expected number of sample persons per cluster to balance the interviewing workload and to facilitate the assignment of field interviewers to regions and segments. This feature also minimizes adverse effects on precision resulting from extreme cluster size variations.
- Simplify the size measure data requirements so that census data (block-level counts) are adequate to implement the method.

[18] Self-weighting implies equal weights within domains defined by state and age group.

Using the 2010 census data supplemented with revised population projections, a composite size measure was computed for each census block defined within the United States. The composite size measure began by defining $f_h(d)$, the proportion of age group domain d (d = 1,...,5 for 12 to 17, 18 to 25, 26 to 34, 35 to 49, and 50 years or older) in state h in the final respondent sample.

Let $C_{hijk}(d)$ be the population count from domain d in census block k of segment j of SSR i within each state h. The composite measure of size (*MOS*) for block k was defined as

$$MOS_{hijk} = \sum_{d=1}^{5} f_h(d) C_{hijk}(d). \quad (2)$$

The composite *MOS* for segment j was calculated as

$$MOS_{hij+} = \sum_{d=1}^{5} f_h(d) \sum_{k=1}^{N_{hij}} C_{hijk}(d), \quad (3)$$

where N_{hij} equals the number of blocks within segment j of SSR i and state h.

3.2 Stratification

Because the NSDUH design provides for estimates by state in all 50 states plus the District of Columbia, states may be viewed as the first level of stratification. The objective of the next level of stratification was to distribute the number of interviews, in expectation, equally among SSRs. Within each state, census tracts were joined to form mutually exclusive and exhaustive SSRs of approximately equal sizes according to a scaled composite MOS.[19] Using desktop computer mapping software,[20] a technician selected whole or partial counties (census tracts) and assigned them to an SSR. This process was repeated until each aggregate area had a scaled composite size measure of roughly 100. When forming the regions, the technician also considered geographical boundaries, such as mountain ranges and rivers, to the extent possible. Therefore, the resulting regions facilitated ease of access and distributed the workload evenly among regions within a state.

A total of 750 SSRs were formed for the coordinated 2014 through 2022 design: 36 SSRs in California; 30 SSRs each in Florida, New York, and Texas; 24 SSRs each in Illinois, Michigan, Ohio, and Pennsylvania; 15 SSRs each in Georgia, New Jersey, North Carolina, and Virginia; and 12 SSRs in each of the remaining 38 states and the District of Columbia. To facilitate sample allocation and sample size management in Kauai County, Hawaii, this county was assigned to 1 SSR, and the remainder of Hawaii was divided into 11 approximately equal-sized SSRs.

[19] Prior to forming the SSRs, composite size measures were scaled so that the aggregate composite size measure was roughly 100 per region. The scaling factor was equal to 100 divided by the expected sample size per SSR in the state (i.e., the state targeted sample size divided by the number of SSRs). For example, in California, the scaling factor was equal to 100/(4,560/36) = 0.789. This scaling made it easier for the technician when forming the regions but served no other purpose. Without scaling, the composite size measures would sum to the expected sample size per region, which varies by state.

[20] RTI developed this software for the purpose of forming NSDUH SSRs.

3.3 First-, Second-, and Third-Stage Sample Selection

Once the SSRs were formed, the first-stage sampling units were created by aggregating adjacent census tracts within regions until the resulting first-stage sampling units met the minimum DU requirement. In California, Florida, Georgia, Illinois, Michigan, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Texas, and Virginia, this minimum size requirement was 250 DUs in urban areas and 200 DUs in rural areas. In the remaining states and the District of Columbia, the minimum requirement was 150 DUs in urban areas and 100 DUs in rural areas. Once the first-stage sampling units were formed, a probability proportional to composite size sample was selected with minimum replacement within each SSR. The sampling frame was stratified implicitly by sorting the first-stage sampling units by a core-based statistical area/ socioeconomic status indicator and by the percentage of the population that is non-Hispanic and White. Table 3.1 summarizes the census tract sampling frame by state. In this table, a "census tract" is defined as one or more census tracts because some collapsing was done to meet the minimum DU size criteria.

For the second stage of selection, adjacent census block groups were collapsed within selected census tracts until the resulting second-stage sampling units met the minimum DU requirement. Second-stage units or "block groups" were required to have the same minimum number of DUs as the census tracts from which they were selected (150 or 250 in urban areas and 100 or 200 in rural areas, according to state). The resulting block groups were then sorted in the order in which they were formed, and one block group was selected per selected census tract with probability proportional to a composite size measure.

To form field enumeration segments within sampled census block groups, adjacent census blocks were collapsed until the total number of DUs within the aggregated area was at least 150 or 250 in urban areas and 100 or 200 in rural areas, according to state. In order to obtain geographic ordering of the blocks within block groups, block centers or centroids were serpentine-sorted by latitude and longitude (i.e., the blocks were sorted in an alternating ascending and descending pattern so that any two consecutive blocks on the sorted frame within a block group were geographically adjacent).[21] If a portion of a block fell between two other blocks but its centroid did not, the block was not combined with the other two blocks, and the resulting segment contained multiple pieces. However, the majority of segments consisted of contiguous blocks.

[21] The latitude and longitude for each census block were obtained from the Census 2010 Summary File 1, which is available at https://www2.census.gov/census_2010/04-Summary_File_1/.

Table 3.1 Number of Census Tracts, Block Groups, and Segments on Sampling Frame; by State

State	State Abbreviation	State FIPS Code	Number of Census Tracts on Sampling Frame	Number of Block Groups on Sampling Frame (in Selected Census Tracts)	Number of Segments on Sampling Frame (in Selected Block Groups)	Total Number of Census Tracts/ Block Groups/ Segments Selected	Number Selected for 2014-2022 Sample
Total United States			72,006	96,898	99,137	36,000	30,000
Northeast							
Connecticut	CT	09	824	1,837	1,646	576	480
Maine	ME	23	351	1,037	1,960	576	480
Massachusetts	MA	25	1,458	2,100	1,690	576	480
New Hampshire	NH	33	292	907	1,883	576	480
New Jersey	NJ	34	1,988	2,417	1,321	720	600
New York	NY	36	4,798	4,956	2,260	1,440	1,200
Pennsylvania	PA	42	3,184	3,849	2,202	1,152	960
Rhode Island	RI	44	240	796	1,486	576	480
Vermont	VT	50	183	515	1,363	576	480
Midwest							
Illinois	IL	17	3,107	3,706	2,311	1,152	960
Indiana	IN	18	1,503	1,968	2,114	576	480
Iowa	IA	19	823	1,781	1,830	576	480
Kansas	KS	20	758	1,728	1,840	576	480
Michigan	MI	26	2,736	3,476	2,078	1,152	960
Minnesota	MN	27	1,332	1,891	1,996	576	480
Missouri	MO	29	1,386	2,014	2,035	576	480
Nebraska	NE	31	529	1,471	1,602	576	480
North Dakota	ND	38	205	569	1,452	576	480
Ohio	OH	39	2,931	3,729	2,253	1,152	960
South Dakota	SD	46	221	644	1,555	576	480
Wisconsin	WI	55	1,390	1,975	1,925	576	480
South							
Alabama	AL	01	1,174	1,801	2,224	576	480
Arkansas	AR	05	683	1,708	2,146	576	480
Delaware	DE	10	214	546	1,480	576	480
District of Columbia	DC	11	178	448	1,057	576	480
Florida	FL	12	4,148	4,009	3,984	1,440	1,200
Georgia	GA	13	1,949	2,142	1,820	720	600
Kentucky	KY	21	1,104	1,875	1,876	576	480
Louisiana	LA	22	1,121	1,869	1,912	576	480
Maryland	MD	24	1,384	1,713	1,662	576	480
Mississippi	MS	28	654	1,727	2,199	576	480
North Carolina	NC	37	2,158	2,171	1,739	720	600
Oklahoma	OK	40	1,036	1,781	1,961	576	480
South Carolina	SC	45	1,082	1,711	2,270	576	480
Tennessee	TN	47	1,475	1,708	2,310	576	480
Texas	TX	48	5,191	4,493	3,426	1,440	1,200
Virginia	VA	51	1,864	2,174	1,412	720	600
West Virginia	WV	54	484	1,485	1,801	576	480

See notes at end of table.

(continued)

Table 3.1 Number of Census Tracts, Block Groups, and Segments on Sampling Frame; by State (continued)

State	State Abbreviation	State FIPS Code	Number of Census Tracts on Sampling Frame	Number of Block Groups on Sampling Frame (in Selected Census Tracts)	Number of Segments on Sampling Frame (in Selected Block Groups)	Total Number of Census Tracts/ Block Groups/ Segments Selected	Number Selected for 2014-2022 Sample
West							
Alaska	AK	02	165	516	1,212	576	480
Arizona	AZ	04	1,508	1,721	1,951	576	480
California	CA	06	7,935	5,155	3,570	1,728	1,440
Colorado	CO	08	1,234	1,760	2,166	576	480
Hawaii	HI	15	309	789	1,380	576	480
Idaho	ID	16	296	939	2,166	576	480
Montana	MT	30	268	814	1,765	576	480
Nevada	NV	32	678	1,448	1,718	576	480
New Mexico	NM	35	497	1,301	2,000	576	480
Oregon	OR	41	825	1,816	2,063	576	480
Utah	UT	49	582	1,448	1,944	576	480
Washington	WA	53	1,440	2,055	1,816	576	480
Wyoming	WY	56	131	409	1,305	576	480

FIPS = federal information processing standards.

To control the geographic distribution of the sample, segments were sorted in the order they were formed, and one field enumeration segment was selected per sampled census block group using the probability proportional to size sequential sampling method. As Table 3.1 indicates, 48 census tracts/census block groups/segments per SSR were chosen for a total of 36,000 segments. Although only 20 segments per SSR were needed to support the 2014 through 2017 NSDUHs, an additional 28 segments were selected to serve as replacements when segment DUs are depleted, to support any supplemental studies embedded within NSDUH, and to extend the sample to the next decennial census, if desired. As noted previously, these 28 segments constitute the "reserve" sample and were used to support the 2018 through 2022 NSDUHs.

3.4 Survey Year and Quarter Assignment

The 48 sampled segments per SSR were randomly assigned to survey years by drawing equal probability subsamples of 4 segments. Prior to selecting the second subsample, the first subsample segments were removed from the pool of eligible segments. The second subsample then was selected from the remaining segments. This process was repeated 11 times until the 48 sampled segments were assigned to 12 subsamples of 4 segments each—5 subsamples to field the 2014 through 2017 surveys and 7 "reserve" subsamples. The first five reserve subsamples were used to field the 2018 through 2022 surveys.

The first subsample of segments was assigned to the 2014 NSDUH and constituted the panel of segments to be used for 2014 only. The second subsample of segments was assigned to the 2014 NSDUH and was used again in the 2015 survey, the third subsample was assigned to the

2015 and 2016 surveys, and so on. Within each subsample, segments were assigned to survey Quarters 1 through 4 in the order they were selected.

Using the survey year and quarter assignments, a segment identification number (SEGID) then was assigned. Table 3.2 describes the relationship between SEGIDs and quarter assignment. The last two digits in the SEGID are called the "segment suffix," with the next-to-last digit being the panel identifier and the last digit being the original quarter assignment. A small number of segments are switched with another segment in the same SSR and panel due to difficult conditions during the winter months. In general, Quarter 1 segments are switched with Quarter 2 segments, and Quarter 4 segments are switched with Quarter 3 segments. The 2022 main survey corresponds to segment suffixes I1 through I4 and J1 through J4.

3.5 Impact of COVID-19 on Selection of First-, Second-, and Third-Stage Sampling Units

COVID-19 had no impact on stratification or the first three stages of selection for the 2014 through 2022 coordinated sample. The area samples were selected simultaneously in advance of the 2014 to 2022 NSDUHs.

Table 3.2 Segment Identification Number Suffixes and Quarter Assignment

Segment Suffix	2014 NSDUH	2015 NSDUH	2016 NSDUH	2017 NSDUH	2018 NSDUH	2019 NSDUH	2020 NSDUH	2021 NSDUH	2022 NSDUH	Variance PSU
A1	x (Q1)									1
A2	x (Q2)									1
A3	x (Q3)									1
A4	x (Q4)									1
B1	x (Q1)	x (Q1)								2
B2	x (Q2)	x (Q2)								2
B3	x (Q3)	x (Q3)								2
B4	x (Q4)	x (Q4)								2
C1		x (Q1)	x (Q1)							1
C2		x (Q2)	x (Q2)							1
C3		x (Q3)	x (Q3)							1
C4		x (Q4)	x (Q4)							1
D1			x (Q1)	x (Q1)						2
D2			x (Q2)	x (Q2)						2
D3			x (Q3)	x (Q3)						2
D4			x (Q4)	x (Q4)						2
E1				x (Q1)	x (Q1)					1
E2				x (Q2)	x (Q2)					1
E3				x (Q3)	x (Q3)					1
E4				x (Q4)	x (Q4)					1
F1					x (Q1)	x (Q1)				2
F2					x (Q2)	x (Q2)				2
F3					x (Q3)	x (Q3)				2
F4					x (Q4)	x (Q4)				2
G1						x (Q1)	x (Q1)			1
G2						x (Q2)	x (Q2)			1
G3						x (Q3)	x (Q3)			1
G4						x (Q4)	x (Q4)			1

See notes at end of table.

(continued)

Table 3.2 Segment Identification Number Suffixes and Quarter Assignment (continued)

Segment Suffix	2014 NSDUH	2015 NSDUH	2016 NSDUH	2017 NSDUH	2018 NSDUH	2019 NSDUH	2020 NSDUH	2021 NSDUH	2022 NSDUH	Variance PSU
H1							x (Q1)	x (Q1)		2
H2							x (Q2)	x (Q2)		2
H3							x (Q3)	x (Q3)		2
H4							x (Q4)	x (Q4)		2
I1								x (Q1)	x (Q1)	1
I2								x (Q2)	x (Q2)	1
I3								x (Q3)	x (Q3)	1
I4								x (Q4)	x (Q4)	1
J1									x (Q1)	2
J2									x (Q2)	2
J3									x (Q3)	2
J4									x (Q4)	2

PSU = primary sampling unit.

Note: The segment suffix is defined as the last two digits of the segment identification number (SEGID).

4. 2022 NSDUH Hybrid Field Enumeration and Address-Based Sampling Frame

4.1 Overview

Address-based sampling (ABS) refers to the sampling of residential addresses from lists purchased from a licensed vendor.[22] The vendor lists are based on the U.S. Postal Service's Computerized Delivery Sequence (CDS) and NoStat files. The CDS file includes addresses currently receiving mail.[23] The NoStat file contains addresses that do not receive mail delivery (e.g., new construction) and is often used to supplement the CDS. Both files are updated monthly. Relative to field enumeration, ABS could greatly reduce costs, improve timeliness, and improve frame accuracy in areas with controlled access.

ABS has some limitations. In-person surveys require addresses that can be located on the ground.[24] Thus, rural areas with high concentrations of Post Office Box™ addresses and noncity-style addresses[25] are undercovered[26] (Dohrmann et al., 2006, 2007). Some addresses, particularly those in smaller geographic areas, may geocode into the wrong area segment and therefore be incorrectly included or excluded in a segment. Group quarters and American Indian or Alaska Native areas also are known to be undercovered (Dohrmann et al., 2006; Dohrmann & Sigman, 2013; McMichael, 2015).

To maximize coverage and minimize costs, many studies use a hybrid approach that uses ABS and field enumeration, depending on the expected coverage of the ABS frame for particular areas.[27] In a two-tiered hybrid approach, a net coverage estimate is used to assign sampled areas to two coverage tiers. In general, the net coverage estimate is defined as the frame count (i.e., count of ABS addresses that geocode into the sampled area) divided by an external benchmark dwelling unit (DU) estimate (e.g., census count). Areas with a net coverage estimate below a predetermined threshold are field enumerated, whereas areas with a net coverage estimate that meets or exceeds the threshold use ABS.

An ABS research report was prepared to summarize ABS research to date and identify any continued areas of concern about the use of ABS frames on the National Survey on Drug Use and Health (NSDUH) (Substance Abuse and Mental Health Services Administration [SAMHSA],

[22] RTI purchases its address lists from Compact Information Systems, a marketing list service provider based in Redmond, Washington.

[23] In addition to the address, the CDS includes variables that can be used by sampling statisticians when constructing the dwelling unit frames. Some examples of these variables include address type (single family, multi-family, P.O. Box), address source (residential, business), drop point indicator and count (defined in Section 4.2), mail delivery type (contract delivery service route, city, rural route, P.O. Box, general delivery), vacant or seasonal indicator, and mail carrier route and walking sequence.

[24] Although data were initially collected via the web, all pending dwelling units were transferred to a field interviewer for in-person data collection. Thus, locatable addresses were required for 2022 NSDUH multimode data collection.

[25] City-style addresses are those with a street number and name, city name, state abbreviation or name, and ZIP Code. Noncity-style addresses include PO Boxes, rural route boxes, and highway contract boxes.

[26] Coverage is the extent to which the frame includes the eligible survey population. At the dwelling unit stage, a frame with complete coverage includes all eligible dwelling units in the sample segment.

[27] Other studies that have employed a hybrid ABS design include the National Health Interview Survey, the Residential Energy Consumption Survey, and the Tobacco Consumer Studies Panel.

2019). The findings were then used to inform research questions for an ABS field test. Based on the ABS research report and preliminary results from the ABS field test, SAMHSA approved the implementation of a hybrid field enumeration and ABS frame for the 2022 NSDUH. The approach allowed SAMHSA to deploy ABS on a smaller scale, without significant risk, while realizing some of the cost and timeliness benefits.

4.2 Hybrid Field Enumeration and Address-Based Sampling Approach

Compared with geocoding at the census block level, geocoding accuracy improves significantly at the census block group (CBG) level in rural and urban areas (Shook-Sa et al., 2010). Thus, in the hybrid field enumeration and ABS approach for the 2022 NSDUH, CBGs served as geographic clusters in areas with sufficient mailing address coverage. Net coverage estimates were computed for all CBGs that were selected at the second stage of selection and assigned to the 2022 NSDUH (see Section 3.4). Those CBGs that met the ABS coverage criteria then served as ABS segments.[28] CBGs that did not meet the ABS coverage criteria required field enumeration. For cost efficiency, the smaller geographic area selected at the third stage of selection (i.e., field enumeration segments described in Section 3.3) was field enumerated.

The net coverage estimate that was used to stratify CBGs was computed using the CDS + No-Stat throwback[29] count in the numerator because these are the addresses that constituted the ABS frames for NSDUH. Average total housing unit counts from the 2015-2019 American Community Surveys (ACSs) served as the denominator. Using total housing units instead of occupied housing units in the denominator provided a conservative estimate of ABS coverage. Group quarters unit counts were not included in the denominator. However, a separate criterion was used to assign CBGs with group quarters to field enumeration as described below.

The choice of coverage threshold used to stratify CBGs into those that use the ABS frame and those that are field enumerated involves a trade-off between cost and accuracy. Higher thresholds have less cost savings but better accuracy; lower thresholds result in higher cost savings at the expense of accuracy. For the 2022 NSDUH, a relatively high coverage threshold of 95 percent was used to stratify CBGs. As noted previously, using a higher threshold allowed SAMHSA to roll out ABS on a smaller scale for the 2022 NSDUH.[30]

In addition to having high expected ABS coverage, CBGs were required to meet a separate criterion for group quarters and drop points (defined in the next paragraph) to use the ABS frame (Table 4.1). Because group quarters were expected to be undercovered on the ABS frame and contacting group quarters administrators at the listing stage improves the likelihood of gaining access for screening and interviewing, it is preferable that CBGs containing group quarters be

[28] Because smaller geographic areas were not sampled within ABS segments, the third-stage probability of selection was set to 1 for these segments.

[29] *Active* No-Stat addresses include rural throwbacks and internal drops. Rural throwbacks are locatable addresses for residents on rural postal routes who specify that their mail be delivered to the post office rather than to their home address. Internal drops are locatable addresses (i.e., include unit type and identifying number) for units with identical street addresses on the CDS (Shook-Sa et al., 2013).

[30] The potential cost savings for the 2022 NSDUH approach was smaller than a less-conservative larger scale deployment of ABS.

assigned to field enumeration. For the 2022 NSDUH, any CBG with a nonzero adult (aged 18 or older) group quarter population according to the 2015-2019 ACS estimate was assigned to field enumeration.

Drop points on the ABS frame present additional challenges for sample implementation because of their one-to-many relationship to DUs. A drop point is a mail receptacle shared by multiple housing units (drop units). Although some drop points are large (e.g., gated communities and high-rise apartment buildings), the majority are two-unit drop points (e.g., a duplex with one mailing address) (Amaya, 2017). The ABS frame indicates the number of units at a drop point but does not include unit identifiers (e.g., apartment numbers). For the 2022 NSDUH, two drop point criteria were applied. First, if a CBG had at least one drop point with three or more units, it was assigned to field enumeration. This step eliminated the need to subsample units if more than five drop units were found at a selected drop point (and added as missed DUs). Second, if 25 percent or more of the addresses in a CBG were drop points (even if all of them were two-unit drop points), the CBG was assigned to field enumeration. This step eliminated the need to subsample missed DUs if more than 10 drop units were added as missed DUs within the segment.

Table 4.1 Summary of the Hybrid ABS Approach; 2022

Hybrid ABS Design Component	2022 NSDUH Approach
Coverage Threshold	If the CBG net coverage estimate was less than *95 percent*, a smaller segment was selected for field enumeration. Otherwise, the CBG was the segment and used the ABS frame.
Group Quarters	CBGs with any adult (aged 18 or older) group quarter population according to the 2015-2019 American Community Surveys were assigned to field enumeration.
Drop Points	1. If a CBG had at least one drop point with three or more units, it was assigned to field enumeration. 2. If 25 percent or more of the addresses in a CBG were drop points, the CBG was assigned to field enumeration.

ABS = address-based sampling; CBG = census block group.

Based on the hybrid field enumeration and ABS approach for the 2022 NSDUH, a total of 973 (32.43 percent) of the 3,000 segments that made up the new panel of segments for the 2022 NSDUH used the ABS frame and 2,027 (67.57 percent) were field enumerated beginning in June 2021.[31] The next sections describe the frame construction process for ABS and field enumeration segments.

4.3 Dwelling Unit Frame Construction

4.3.1 Address-Based Sampling Segments

For ABS segments, the DU frame consisted of locatable CDS + No-Stat throwback addresses that geocoded into the CBG. For all four quarters, ABS segment frames were constructed using the July 2021 version of the CDS.

Some ABS CBGs contained a large number of DUs (greater than 999). All NSDUH systems were built around a 10-digit DU identification number (DUID) with the last three digits

[31] The other half of the segments were field enumerated prior to the 2021 NSDUH.

being the DU line number. Rather than change the length of the DUID for the 2022 NSDUH, CBGs assigned to ABS and with more than 999 DUs were subsampled using standard subsegmenting procedures (see Appendix C). In summary, each large ABS CBG was divided into smaller areas or zones containing an approximately equal number of DUs and no more than 999 DUs. Then, one zone was randomly selected for the 2022 NSDUH sample with probability proportional to the number of DUs in the zone. As shown in Table 4.2, a total of 275 ABS segments were subsampled. The sample weights for these segments will be adjusted accordingly.

Table 4.2 ABS Segment and Dwelling Unit Summary

State	Total ABS Segments	Total Subsegmented ABS Segments	ABS Addresses
Total Population	973	275	574,813
Alabama	13	7	8,223
Alaska	4	0	2,894
Arizona	15	4	9,228
Arkansas	17	7	10,085
California	42	11	24,769
Colorado	26	12	16,239
Connecticut	13	2	7,461
Delaware	18	7	10,201
District of Columbia	11	3	6,970
Florida	49	25	34,170
Georgia	25	15	16,210
Hawaii	8	2	4,817
Idaho	16	7	8,542
Illinois	31	8	17,671
Indiana	13	4	7,574
Iowa	23	5	11,935
Kansas	17	3	9,412
Kentucky	21	4	13,073
Louisiana	16	4	8,869
Maine	4	2	2,225
Maryland	17	4	9,427
Massachusetts	13	3	6,597
Michigan	31	4	17,332
Minnesota	14	3	7,933
Mississippi	16	9	8,855
Missouri	18	4	10,028
Montana	12	1	6,767
Nebraska	17	2	7,864
Nevada	25	5	16,132
New Hampshire	20	7	12,990
New Jersey	25	5	13,847
New Mexico	15	5	7,947
New York	21	3	11,674
North Carolina	14	6	9,335
North Dakota	12	4	7,037
Ohio	40	8	21,237
Oklahoma	20	3	11,098
Oregon	11	4	6,299
Pennsylvania	29	5	15,820
Rhode Island	9	1	5,310

(continued)

Table 4.2 ABS Segment and Dwelling Unit Summary (continued)

State	Total ABS Segments	Total Subsegmented ABS Segments	ABS Addresses
South Carolina	18	10	11,576
South Dakota	16	7	8,342
Tennessee	20	8	12,965
Texas	50	15	31,936
Utah	21	4	12,262
Vermont	4	1	2,485
Virginia	23	3	14,833
Washington	20	4	14,015
West Virginia	16	0	8,803
Wisconsin	13	2	7,312
Wyoming	11	3	6,187

ABS = address-based sampling.

4.3.2 Field Enumeration Segments

The process by which the DU frame was constructed for field enumeration segments is also referred to as "counting and listing." In summary, a certified lister visits the selected area and lists a detailed and accurate address (or description, if no address is available) for each DU within the segment boundaries. The lister is given a series of maps on which to mark the locations of these DUs. Map pages are created so that the lister can easily navigate the segment and has sufficient space to denote the location of each DU. The number of map pages depends on the size and composition of the segment. In general, a sparsely populated rural segment has more map pages than a densely populated urban segment. Thus, segments in states like Maryland and Nevada have fewer map pages on average, whereas segments in states like North Dakota and Pennsylvania are much larger on average. The number of map pages per state and the average number of map pages per segment are summarized in Table 4.3. The list of DUs constructed during counting and listing is entered into a database and serves as the frame from which the fourth-stage sample is drawn.

In some situations, the number of DUs within the segment boundaries was much larger than the specified maximum. To obtain a reasonable number of DUs for the frame, the lister first counted the DUs in such an area. The sampling staff then partitioned the segment into smaller pieces or subsegments and randomly selected one to be listed. Beginning in 2008, some large segments were partitioned into subsegments using census information prior to being sent to the field. Sampling staff then randomly selected one subsegment to send to the field for listing. In a few of these cases, additional subsegmenting was required for one of the following reasons: (1) the area experienced high growth, and the census counts used in the initial subsegment were outdated; or (2) not enough information was available during the first subsegment, and the initial subsegment was still too large to list. Thus, an additional level of subsegmenting was implemented to make listing feasible. The number of field-enumerated segments subsegmented in the 2022 NSDUH sample is summarized in Table 4.4. For more information on the subsegmenting procedures, see Appendix C.

Table 4.3 Number of Map Pages; by State and FE Segment

State	Total FE Segments	Cumulative Number of Map Pages per State	Average Number of Map Pages per FE Segment
Total Population	5,764	35,482	6.2
Alabama	95	642	6.8
Alaska	104	558	5.4
Arizona	92	529	5.8
Arkansas	91	603	6.6
California	282	1,573	5.6
Colorado	82	435	5.3
Connecticut	95	390	4.1
Delaware	88	446	5.1
District of Columbia	96	323	3.4
Florida	221	1,392	6.3
Georgia	110	790	7.2
Hawaii	100	405	4.1
Idaho	92	588	6.4
Illinois	185	1,273	6.9
Indiana	95	583	6.1
Iowa	85	603	7.1
Kansas	91	685	7.5
Kentucky	87	439	5.0
Louisiana	92	527	5.7
Maine	103	561	5.4
Maryland	91	402	4.4
Massachusetts	95	435	4.6
Michigan	185	1,342	7.3
Minnesota	94	537	5.7
Mississippi	92	635	6.9
Missouri	90	554	6.2
Montana	96	732	7.6
Nebraska	91	739	8.1
Nevada	83	410	4.9
New Hampshire	87	491	5.6
New Jersey	110	697	6.3
New Mexico	93	531	5.7
New York	248	1,405	5.7
North Carolina	120	735	6.1
North Dakota	95	787	8.3
Ohio	176	1,373	7.8
Oklahoma	88	615	7.0
Oregon	96	464	4.8
Pennsylvania	187	1,636	8.7
Rhode Island	98	466	4.8
South Carolina	90	505	5.6
South Dakota	91	620	6.8
Tennessee	88	490	5.6
Texas	220	1,495	6.8

(continued)

Table 4.3 Number of Map Pages; by State and FE Segment (continued)

State	Total FE Segments	Cumulative Number of Map Pages per State	Average Number of Map Pages per FE Segment
Utah	87	430	4.9
Vermont	104	604	5.8
Virginia	111	692	6.2
Washington	88	385	4.4
West Virginia	92	597	6.5
Wisconsin	95	575	6.1
Wyoming	97	758	7.8

FE = field enumeration.

Table 4.4 FE Segment and Dwelling Unit Summary

State	Total FE Segments	Total Subsegmented FE Segments	Second-Level Subsegmented FE Segments	Listed Dwelling Units
Total Population	5,764	1,321	43	1,476,550
Alabama	95	4	0	23,034
Alaska	104	14	0	24,121
Arizona	92	15	1	22,011
Arkansas	91	4	0	20,819
California	282	138	1	81,005
Colorado	82	5	2	20,424
Connecticut	95	12	0	22,834
Delaware	88	10	0	21,410
District of Columbia	96	14	2	26,344
Florida	221	111	5	66,670
Georgia	110	54	0	30,191
Hawaii	100	14	3	25,373
Idaho	92	11	0	20,772
Illinois	185	76	0	53,582
Indiana	95	5	1	22,554
Iowa	85	6	0	19,177
Kansas	91	5	0	20,279
Kentucky	87	3	0	21,284
Louisiana	92	2	0	22,269
Maine	103	10	0	24,889
Maryland	91	8	0	23,080
Massachusetts	95	11	0	23,309
Michigan	185	86	2	52,815
Minnesota	94	4	0	20,525
Mississippi	92	6	0	21,531
Missouri	90	5	0	22,116
Montana	96	5	1	21,519
Nebraska	91	12	0	20,442
Nevada	83	14	1	22,272
New Hampshire	87	5	1	19,871
New Jersey	110	47	0	32,559
New Mexico	93	5	0	20,078

(continued)

Table 4.4 FE Segment and Dwelling Unit Summary (continued)

State	Total FE Segments	Total Subsegmented FE Segments	Second-Level Subsegmented FE Segments	Listed Dwelling Units
New York	248	127	3	73,295
North Carolina	120	46	3	36,284
North Dakota	95	12	1	21,299
Ohio	176	79	1	52,779
Oklahoma	88	5	2	21,972
Oregon	96	6	1	20,914
Pennsylvania	187	87	1	52,193
Rhode Island	98	6	0	22,714
South Carolina	90	9	2	22,223
South Dakota	91	11	1	19,451
Tennessee	88	9	0	19,615
Texas	220	112	8	65,194
Utah	87	6	0	20,355
Vermont	104	9	0	23,854
Virginia	111	48	0	34,919
Washington	88	7	0	21,016
West Virginia	92	3	0	19,897
Wisconsin	95	3	0	20,267
Wyoming	97	15	0	19,150

FE = field enumeration.

During counting and listing, the lister moves about the segment in a prescribed fashion called the "continuous path of travel." Beginning from a starting point noted on the map,[32] the lister attempts to move in a clockwise fashion, makes each possible right turn, makes U-turns at segment boundaries, and does not break street sections. Within apartment buildings and group quarters, the lister attempts to apply the same rules; that is, the lister moves in a clockwise fashion and enumerates building floors from bottom to top. Following these defined rules and always looking for DUs on the right-hand side of the street (or hall), the lister minimizes the chance of not listing a DU within the segment. Also, using a defined path of travel makes it easier for the field interviewer assigned to the segment to locate the sampled DUs. A detailed description of the counting and listing procedures is provided in the *2022 National Survey on Drug Use and Health: Counting and Listing General Manual* (RTI International, 2021).

[32] Sampling staff review each map and determine the most logical starting point. They choose an intersection of two boundaries of the segment that seems most appropriate considering the segment's composition.

5. Selection of Dwelling Units and Persons for the 2022 NSDUH

In this chapter, the computational details of the procedural steps used to determine both person and dwelling unit (DU) sample sizes are discussed. The within-DU age group-specific selection probabilities for the design of the 2022 National Survey on Drug Use and Health (NSDUH) also are addressed. This optimization procedure was designed specifically to address the Substance Abuse and Mental Health Services Administration's (SAMHSA's) design requirements while simultaneously minimizing the cost of data collection. Costs were minimized by determining the fewest number of interviews and selected DUs necessary to achieve the various design requirements. In summary, this three-step optimization procedure proceeded as follows:

1. In the first step, the optimal number of interviews (i.e., responding persons) by domains of interest needed to achieve acceptable precision for several outcome measures was determined. Using the results of several optimization models and other related analyses conducted in advance of the 2014 through 2022 NSDUHs, SAMHSA specified the 255 respondent sample sizes, m_{ha}, for each state h (51) and age group a (5). This step is described in further detail in Section 5.2.
2. Using the m_{ha} from Step 1, the next step was to determine the optimal (i.e., minimum) number of selected DUs (D_{hj}) (i.e., fourth-stage sample) that were necessary. This step was achieved by applying parameter constraints (e.g., probabilities of selection and expected response rates) at the segment level j or the stage at which DUs would be selected, which was done on a quarterly basis using approximately 25 percent of the m_{ha} values. This step is described in further detail in Section 5.3.
3. The final step in this procedure entailed determining age group-specific probabilities of selection (S_{hja}) for each segment given the m_{ha} and D_{hj} from Steps 1 and 2. This was achieved using a modification of Brewer's Method of Selection (Cochran, 1977, pp. 261-263). The modification was designed to select 0, 1, or 2 persons from each DU.[33] The details of this final step are provided in Section 5.4. After calculating the required DUs and the selection probabilities, sample size constraints were applied to ensure adequate samples for supplemental studies. Limits on the total number of expected interviews per segment also were applied. This process became iterative to reallocate the reduction in sample size to other segments not affected by such constraints. Details of this step in the optimization procedure are given in Section 5.5.

5.1 Notation

h = State indicator for 50 states plus the District of Columbia.

a = Age group a = 1,...,5 and represents the following groups: 12 to 17, 18 to 25, 26 to 34, 35 to 49, and 50 or older.

[33] Direct application of Brewer's method would require a fixed sample size.

j = Individual segment indicator (total of 6,737; 1,500 per quarter plus 737 supplemental segments [see Section 5.8]).

m_{ha} = Number of completed interviews (person respondents) desired in each state h and age group a. Computation of m_{ha} is discussed in Section 5.2. For quarterly computation of selected DU sample size, approximately 25 percent of the yearly estimate is used.

y_{ha} = Estimated number of persons in the population in state h and age group a. The 2022 population is estimated using the 2010 census data adjusted to the 2013 Claritas population projections in the compound interest formula, $y = Ae^{Bx}$, where

y = population at time x,
A = initial population,
e = base of the system of natural logarithms,
B = growth rate per unit of time, and
x = period of time over which growth occurs.

First, B is computed as $[ln(y/A)]/x$, where y = the population in 2013, A = the population in 2010, and $x = 3$.[34] Then the 2022 population (y^*_{ha}) is computed using the original formula and this time allowing x to be 12. Finally, the 2022 population is adjusted by the ratio of estimated eligible listed DUs to the Claritas DU counts (U_{hj}). This adjustment factor considers the probability of a DU being eligible (ε_h), which is determined via historical data. So, $y_{ha} = \left\{\left[\varepsilon_h * L_{hj} * \left(\frac{1}{I_{hj}}\right) / U_{hj}\right]\right\} * y^*_{ha}$, where ε_h, L_{hj}, and I_{hj} are defined further below. This adjustment is computed at the census block level and then aggregated to the state level.

f_{ha} = m_{ha} / y_{ha}. State-specific age group sampling fraction.

F_h = $Max[f_{ha} / (\phi_h * \lambda_{ha} * \delta_{ha})$, a = 1-5].

P_{hj} = Segment selection probability (includes the census tract and census block group selection probabilities). DU sample sizes are computed on a quarterly basis, and segments are selected on a yearly basis. Because each quarter contains only a fourth of the selected segments, these probabilities are adjusted by a factor of 1/4 so that weights will add to the yearly totals.

I_{hj} = Subsegmenting adjustment. For field enumeration segments too large to count and to list efficiently in both time and cost, field listing personnel may request that a portion of the segment be randomly sampled. First, they perform a quick count (best guess: $L_1^*{}_{hj}$) of the entire segment. The sampling staff then subdivides the segment into roughly equal-sized

[34] A comparison of B to annual growth rates computed using weighted population estimates from the 2011 through 2014 NSDUHs found that this approach may slightly underestimate the annual growth rate.

subdivisions or subsegments (using a best guess estimate of the number of DUs in each subsegment based on counts obtained from the field lister: $G^{*}_{1\,hj}$) and selects one for regular counting and listing. Some large field enumeration segments were subsegmented based on census information prior to being sent to the field for listing. In some of these segments, the selected subsegment was still too large for listing, and a second round of subsegmenting was required. The second-level subsegmenting was performed in a similar fashion as the first-level subsegmenting, in that the first-level subsegment was counted (best guess: $L_2^{*}{}_{hj}$) and subdivided into roughly equal-sized subdivisions or subsegments (best guess: G^{*}_{2hj}). Then one subsegment was selected for regular counting and listing by sampling staff. As noted in Section 4.3.1, large ABS segments were also subsegmented. For the subsegment to represent the entire field enumeration or ABS segment, the weights were adjusted up to reflect the unused portion of the segment:

= ($G^{*}_{1\,hj} / L^{*}_{1\,hj}$), if one round of subsegmenting was done;

= ($G^{*}_{1\,hj} / L^{*}_{1\,hj}$)*($G^{*}_{2\,hj} / L^{*}_{2\,hj}$), if two rounds of subsegmenting were required; and

= 1, if no subsegmenting was done.

D_{hj} = Minimum number of DUs to select for screening in segment *j* to meet the targeted sample sizes for all age groups.

L_{hj} = Final segment count of DUs available for screening.

S_{hja} = State- and segment-specific probability of selecting a person in age group *a*. One implemented design constraint was that no single age group selection probability could exceed 1. The maximum allowable probability was then set to 0.99.

ε_h = State-specific DU eligibility rate. This rate was derived from 2019 NSDUH Quarters 2 through 4 and 2020 NSDUH Quarter 1 data by taking the average eligibility rate within each state.

ϕ_h = State-specific screening response rates. These rates were calculated using data from Quarters 2 through 4 of the 2019 NSDUH and Quarter 1 of the 2020 NSDUH and averaging screening response within each state. The state-level response rates were then adjusted so that the overall expected response rate would be 12.16 percent, the expected multimode response rate based on experience from Quarter 3 of 2021.

λ_{ha} = State- and age group-specific interview response rate. Using data from Quarters 2 through 4 of the 2019 NSDUH and Quarter 1 of the 2020 NSDUH, the additive effects of state and age group on interview response were determined by taking the average interview response rate within each state. These rates were then adjusted so that the overall expected response rate would be 12.16 percent.

γ_{ha} = Expected number of persons within an age group per DU. This number was calculated using data from Quarters 2 through 4 of the 2019 NSDUH and Quarter 1 of the 2020

NSDUH by dividing the weighted total number of rostered persons in an age group by the weighted total number of complete screened DUs by state.

δ_{ha} = State- and age group-specific maximum-of-two rule adjustment. The survey design restricts the number of interviews per DU to a total of two. This is achieved through a modified Brewer's Method of Selection, which results in a loss of potential interviews in DUs where selection probabilities sum greater than 2. The adjustment is designed to inflate the number of required DUs to compensate for this loss. Using data from all four quarters of the 2019 NSDUH, the adjustment was computed by taking the average maximum-of-two rule adjustment within each state.

5.2 Determining Person Sample Sizes, by State and Age Group

The first step in the design of the fifth stage of selection was to determine the number of respondents needed in each of the 255 domains to minimize the costs associated with data collection, while ensuring adequate precision for key outcomes of interest. In preparation for the 2014 NSDUH sample redesign, several optimization models and other related analyses were conducted (RTI International, 2012a). SAMHSA used the results from these analyses to inform the 2014 through 2022 design. Compared with the sample allocation in prior years, the 2014 through 2022 design allows for a more cost-efficient sample allocation to the largest states, while maintaining a sufficient sample size in each of the smaller states to support small area estimation at the state and substate levels. Furthermore, the 2014 through 2022 design increases the 26 or older sample size to more accurately estimate drug use and related mental health measures among this age group.

The requirement of 67,507 completed interviews for the 2022 NSDUH was derived from the following objectives:

- minimum sample sizes of 4,560 completed interviews in California; 3,300 completed interviews each in Florida, New York, and Texas; 2,400 completed interviews each in Illinois, Michigan, Ohio, and Pennsylvania; 1,500 completed interviews each in Georgia, New Jersey, North Carolina, and Virginia; 967 completed interviews in Hawaii; and 960 completed interviews in each of the remaining 37 states and the District of Columbia; and
- allocation to age groups as follows: 25 percent for youths aged 12 to 17, 25 percent for young adults aged 18 to 25, 15 percent for adults aged 26 to 34, 20 percent for adults aged 35 to 49, and 15 percent for adults aged 50 or older.

Table 5.1 displays the projected sample distribution by state and age group.

Table 5.1 Sample Sizes and Projected Respondents; by State and Age Group, 2022

State	State Sampling Regions (SSRs)	Total Segments	Total Selected Dwelling Units	Total Selected Persons	Age Groups for Total Projected Respondents					
					12-17	18-25	26-34	35-49	50+	Total
Total Population	750	6,000	300,671	114,687	16,877	16,877	10,126	13,501	10,126	67,507
Northeast										
Connecticut	12	96	4,276	1,631	240	240	144	192	144	960
Maine	12	96	4,276	1,631	240	240	144	192	144	960
Massachusetts	12	96	4,276	1,631	240	240	144	192	144	960
New Hampshire	12	96	4,276	1,631	240	240	144	192	144	960
New Jersey	15	120	6,681	2,548	375	375	225	300	225	1,500
New York	30	240	14,698	5,606	825	825	495	660	495	3,300
Pennsylvania	24	192	10,689	4,077	600	600	360	480	360	2,400
Rhode Island	12	96	4,276	1,631	240	240	144	192	144	960
Vermont	12	96	4,276	1,631	240	240	144	192	144	960
Midwest										
Illinois	24	192	10,689	4,077	600	600	360	480	360	2,400
Indiana	12	96	4,276	1,631	240	240	144	192	144	960
Iowa	12	96	4,276	1,631	240	240	144	192	144	960
Kansas	12	96	4,276	1,631	240	240	144	192	144	960
Michigan	24	192	10,689	4,077	600	600	360	480	360	2,400
Minnesota	12	96	4,276	1,631	240	240	144	192	144	960
Missouri	12	96	4,276	1,631	240	240	144	192	144	960
Nebraska	12	96	4,276	1,631	240	240	144	192	144	960
North Dakota	12	96	4,276	1,631	240	240	144	192	144	960
Ohio	24	192	10,689	4,077	600	600	360	480	360	2,400
South Dakota	12	96	4,276	1,631	240	240	144	192	144	960
Wisconsin	12	96	4,276	1,631	240	240	144	192	144	960
South										
Alabama	12	96	4,276	1,631	240	240	144	192	144	960
Arkansas	12	96	4,276	1,631	240	240	144	192	144	960
Delaware	12	96	4,276	1,631	240	240	144	192	144	960
District of Columbia	12	96	4,276	1,631	240	240	144	192	144	960
Florida	30	240	14,698	5,606	825	825	495	660	495	3,300
Georgia	15	120	6,681	2,548	375	375	225	300	225	1,500
Kentucky	12	96	4,276	1,631	240	240	144	192	144	960
Louisiana	12	96	4,276	1,631	240	240	144	192	144	960
Maryland	12	96	4,276	1,631	240	240	144	192	144	960
Mississippi	12	96	4,276	1,631	240	240	144	192	144	960
North Carolina	15	120	6,681	2,548	375	375	225	300	225	1,500
Oklahoma	12	96	4,276	1,631	240	240	144	192	144	960
South Carolina	12	96	4,276	1,631	240	240	144	192	144	960
Tennessee	12	96	4,276	1,631	240	240	144	192	144	960
Texas	30	240	14,698	5,606	825	825	495	660	495	3,300
Virginia	15	120	6,681	2,548	375	375	225	300	225	1,500
West Virginia	12	96	4,276	1,631	240	240	144	192	144	960

(continued)

Table 5.1 Sample Sizes and Projected Respondents; by State and Age Group, 2022 (continued)

State	State Sampling Regions (SSRs)	Total Segments	Total Selected Dwelling Units	Total Selected Persons	Age Groups for Total Projected Respondents					
					12-17	18-25	26-34	35-49	50+	Total
West										
Alaska	12	96	4,276	1,631	240	240	144	192	144	960
Arizona	12	96	4,276	1,631	240	240	144	192	144	960
California	36	288	20,310	7,747	1,140	1,140	684	912	684	4,560
Colorado	12	96	4,276	1,631	240	240	144	192	144	960
Hawaii	12	96	4,307	1,643	242	242	145	193	145	967
Idaho	12	96	4,276	1,631	240	240	144	192	144	960
Montana	12	96	4,276	1,631	240	240	144	192	144	960
Nevada	12	96	4,276	1,631	240	240	144	192	144	960
New Mexico	12	96	4,276	1,631	240	240	144	192	144	960
Oregon	12	96	4,276	1,631	240	240	144	192	144	960
Utah	12	96	4,276	1,631	240	240	144	192	144	960
Washington	12	96	4,276	1,631	240	240	144	192	144	960
Wyoming	12	96	4,276	1,631	240	240	144	192	144	960

Using the state and age group sample requirements and 2019 NSDUH data, estimates and relative standard errors for 11 outcome measures and several domains of interest were modeled and are presented in Table 5.2 (Center for Behavioral Health Statistics and Quality [CBHSQ], 2021). Specifically, the 11 key NSDUH outcome measures are as follows:

1. *Past month alcohol use (ALCMON)*. Had at least one drink in the past 30 days.
2. *Past month binge alcohol use (BNGDRKMON)*. Drinking five or more drinks on the same occasion (i.e., at the same time or within a couple hours of each other) on at least 1 day in the past 30 days.
3. *Past month marijuana use (MRJMON)*.
4. *Past month cigarette use (CIGMON)*.
5. *Past month misuse of pain relievers (PNRNMMON = 1).*
6. *Past year alcohol use disorder (ABODALC).* Dependence or abuse of alcohol during the past 12 months.
7. *Past year illicit drug use disorder (UDPYILL).* Dependence or abuse of illicit drugs during the past 12 months.
8. *Past year substance use disorder (UDPYILAL).* Dependence or abuse of illicit drugs or alcohol during the past 12 months.
9. *Past year specialty substance use treatment (TXYRSPILAL).* Received treatment in the past year for an illicit drug or alcohol problem at a specialty facility. A specialty facility is a hospital (inpatient) or rehabilitation center (inpatient or outpatient).
10. *Past year serious mental illness (SMIYR_U).* Serious mental illness based on the predicted probability of serious mental illness and based on both distress and impairment.
11. *Past year major depressive episode (AMDEYR).*

Table 5.2 Relative Standard Errors and Sample Sizes for Key Outcome Measures; by Demographic Domain

Data File Variable Name	Measure	Domain	2019 Prevalence	Projected RSE (2022)	Expected Sample Size (2022)
ALCMON	Past Month Alcohol Use	12+	0.5077	0.0072	67,507
ALCMON	Past Month Alcohol Use	12-20	0.1851	0.0276	23,456
ALCMON	Past Month Alcohol Use	50+	0.4919	0.0127	10,126
ALCMON	Past Month Alcohol Use	API, 12+	0.3781	0.0415	4,017
ALCMON	Past Month Alcohol Use	AIAN, 12+	0.3210	0.0847	756
ALCMON	Past Month Alcohol Use	Pregnant, 12-44	0.0956	0.2105	696
BNGDRKMON	Past Month Binge Alcohol Use	18-25	0.3427	0.0145	16,877
BNGDRKMON	Past Month Binge Alcohol Use	12+	0.2392	0.0116	67,507
MRJMON	Past Month Marijuana Use	12+	0.1148	0.0172	67,507
MRJMON	Past Month Marijuana Use	12-17	0.0738	0.0372	16,877
MRJMON	Past Month Marijuana Use	18-25	0.2297	0.0193	16,877
MRJMON	Past Month Marijuana Use	50+	0.0647	0.0468	10,126
MRJMON	Past Month Marijuana Use	API, 12+	0.0482	0.0994	4,017
MRJMON	Past Month Marijuana Use	AIAN, 12+	0.1202	0.1367	756
MRJMON	Past Month Marijuana Use	Pregnant, 12-44	0.0542	0.2943	696
CIGMON	Past Month Cigarette Use	12-17	0.0230	0.0702	16,877
CIGMON	Past Month Cigarette Use	12+	0.1667	0.0163	67,507
PNRNMMON	Past Month Pain Reliever Misuse	18-25	0.0124	0.0897	16,877
PNRNMMON	Past Month Pain Reliever Misuse	12+	0.0102	0.0580	67,507
ABODALC	Past Year Alcohol Use Disorder	12+	0.0527	0.0250	67,507
UDPYILL	Past Year Illicit Drug Use Disorder	12+	0.0302	0.0293	67,507
UDPYILAL	Past Year Substance Use Disorder	50+	0.0411	0.0588	10,126
TXYRSPILAL	Past Year Specialty Substance Use Treatment	12+	0.0096	0.0628	67,507
SMIYR_U	Past Year SMI	18+	0.0524	0.0258	50,630
AMDEYR	Past Year MDE	18+	0.0783	0.0209	50,630

AIAN = American Indian or Alaska Native (NEWRACE2 = 3); API = Asian or Other Pacific Islander (NEWRACE2 = 4 or 5); MDE = major depressive episode; Pregnant, 12-44 (PREG2 = 1); RSE = relative standard error; SMI = serious mental illness.

Note: Projected RSEs were determined using 2022 state and age sample allocations in a variance component model. All model components were updated using 2019 NSDUH data.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2019.

SAMHSA based the selection of the above outcome measures on an assessment of how the data are used and what estimates are important for policymakers. Domains such as pregnant women, American Indian or Alaska Native, and aged 50 or older were chosen based on the importance of generally maintaining precision of estimates in those subgroups compared with the 2005 through 2013 design. Among the 50 states and the District of Columbia, a required total sample size of 67,507 respondents was necessary to meet all sample size requirements while ensuring sufficient precision for key outcome measures. The large overall sample makes it possible to get adequate precision for Hispanic and non-Hispanic Black or African American populations without any targeted oversampling of these populations. Consistent with previous surveys, the 2022 NSDUH was designed to oversample the younger age groups as shown in Table 5.1. Because of the shorter calendar length of Quarters 1 and 4 (due to field interviewer [FI] training and the holidays, respectively), a decision was made to allocate the quarterly state by age group sample sizes (25 percent of the annual sample) to the four quarters in ratios of 96, 104, 102, and 98 percent, respectively. Only minor increases in unequal weighting resulted from not distributing the sample equally across quarters.

5.3 Fourth-Stage Sample Determination for Each Segment

Once the desired respondent sample size for each state and age group (m_{ha}) was established, the next step was to determine the minimal number of DUs to select for each segment to meet the targeted sample sizes. At the planning stage, in-person data collection was assumed, and it was estimated that roughly 300,671 DUs would need to be selected to obtain a sample of 67,507 responding persons distributed by state and age group as shown in Table 5.1 (CBHSQ, 2021).[35] The actual fourth-stage sample size determination was performed on a quarterly basis to take advantage of both segment differences and, if necessary, make adjustments to design parameters (e.g., expected response rates from multimode data collection). Procedures described below were developed originally for initial implementation in Quarter 1 of the survey, and the description is specific to Quarter 1. Any modifications or corrections were made in subsequent quarters and are explained in detail in Section 5.8.

The NSDUH optimization formula is as follows:

$$f_{ha} = P_{hj} * I_{hj} * (\frac{D_{hj}}{L_{hj}}) * S_{hja} * \phi_h * \lambda_{ha} * \delta_{ha}. \quad (4)$$

At this point in the procedure, only two components in the formula are unknown: D_{hj} and S_{hja}. Selection probabilities are segment and age group specific, and to maximize the number of selected persons within a DU, the age group with the largest adjusted sampling fraction, formulated as $\left[f_{ha} / \left(\phi_h * \lambda_{ha} * \delta_{ha} \right) \right] = F_h$ and known as the driving age group (see Section 2.3), is set to the largest allowable selection probability (S_{hja}) of 0.99. D_{hj} then is computed as

$$D_{hj} = \frac{f_{ha}}{(P_{hj} * I_{hj} * S_{hja} * \phi_h * \lambda_{ha} * \delta_{ha})} * L_{hj}. \quad (5)$$

5.4 Determining Fifth-Stage Sample (Person) Selection Probabilities for Each Segment

$$S_{hja} = \frac{f_{ha}}{P_{hj} * I_{hj} * (\frac{D_{hj}}{L_{hj}}) * \phi_h * \lambda_{ha} * \delta_{ha}}. \quad (6)$$

Having solved for D_{hj}, the selection probabilities for the remaining age groups were solved. If L_{hj} equals 0, D_{hj} and S_{hja} are set to 0.

[35] The sample was simulated using 2019 NSDUH data and the expected state and age group sample distribution in Table 5.1. After accounting for eligibility, nonresponse, and the fifth-stage sample selection procedures, the results suggested that roughly 300,671 sample DUs would yield 114,687 selected persons and a sample of 67,507 responding persons.

5.5 Dwelling Unit Sample Size Constraints

A major area of interest for the survey is to ensure an adequate sample of eligible DUs remains within each segment. This sample surplus is needed to support the overlapping sample design and to allow SAMHSA to implement supplemental studies if desired.

In addition, concern was noted about limiting the number of interviews in a segment. These concerns prompted adjustments to the D_{hj} sample size:

1. Number of selected DUs for screening in panel J segments: < ½ L_{hj}. Adjustments were made by adjusting the D_{hj} counts to equal ½ L_{hj} when the number of selected DUs exceeded this limit.
2. Number of selected DUs: > 5. For cost purposes, if at least five DUs remain in the segment, the minimum number of selected DUs was set to five.
3. Expected number of interviews: < 40.

This expected number of interviews (m^*_{hja}) was computed as follows:

$$m^*_{hja} = D^*_{hj} * \varepsilon_h * \phi_h * \gamma_{ha} * S_{hja} * \lambda_{ha} * \delta_{ha}, \quad (7)$$

where D^*_{hj} has been adjusted for constraint 1. This value is the total number of interviews expected within each segment. The calculation of the first adjustment, the screening adjustment, is

$$5 / D^*_{hj}. \quad (8)$$

Similarly, the interview adjustment is computed as

$$40 / m^*_{hja}. \quad (9)$$

This second adjustment is applied to D_{hj} under the assumption of an equal number of screened DUs for each completed interview.

Both constraints 1 and 3 reduce the fourth-stage sample, which could in turn reduce the expected fifth-stage sample size. Therefore, the reduction in the fourth-stage sample is reallocated back to the segments by applying a marginal adjustment to the fifth-stage sample size (m_{ha}) at the state and age group level. As a result, segments not subject to these constraints could be affected. This adjustment to reallocate the DU sample is iterative until the expected person sample sizes approach the targets.

5.6 Dwelling Unit Selection and Release Partitioning

After derivation of the required DU sample size within each state and segment (D_{hj}), the sample was selected from the frame of DUs for each segment (L_{hj}) (see Section 4.3). In address-based sampling (ABS) segments, the frame was sorted by street name and number. In field

enumeration segments, the frame was ordered in the same manner as described in Section 4.3.2. In these segments, the listing order was used to approximate geographic location because a standard address is not available for all listed DUs. From the ordered ABS and field enumeration frames, selection was completed using systematic sampling with a random start value. Systematic sampling creates a heterogeneous sample of DUs by dispersing the sample throughout the segment. In addition, it minimizes social contagion from neighboring selected DUs that could have an impact on response rates and prevalence estimates.

Because a census block group can contain more than one sampled field enumeration segment, the potential existed for an ABS segment in the 2022 NSDUH to contain a field enumeration segment that was carried over from the prior year's sample (i.e., a panel I field enumeration segment). To avoid having a DU sampled more than once for the 2022 NSDUH, sample DU addresses were compared, and duplicates were removed after the quarterly samples were drawn.

To compensate for quarterly variations in response rates and yields, a sample partitioning procedure was implemented in all quarters. The entire sample (D_{hj}) still would be selected, but only certain percentages of the total would be released. An initial percentage would be released in all segments at the beginning of the quarter. Based on interquarter work projections, additional percentages could be released 1 month into the quarter as needed. Each partitioning of the sample is a valid sample and helps manage the sample sizes by state without jeopardizing the validity of the study. Incidentally, a reserve sample of 20 percent also was selected, over and above the required quarterly sample (see Section 5.2), to allow for supplemental releases based on state experiences within each quarter. In Quarter 1, the D_{hj} sample was allocated out to states in the following release percentages:

Release 1: 33 percent of entire sample (40/120, main sample + 20 percent reserve);
Release 2: 33 percent of entire sample (40/120, main sample + 20 percent reserve);
Release 3: 17 percent of entire sample (20/120, main sample + 20 percent reserve);
Release 4: 8 percent of entire sample (10/120, main sample + 20 percent reserve);
Release 5: 4 percent of entire sample (5/120, main sample + 20 percent reserve); and
Release 6: 4 percent of entire sample (5/120, main sample + 20 percent reserve).

As described in Section 6.1, a weight adjustment is applied to all DUs within a segment to account for the partial release of sample. The DU release adjustment (weight component #8) is equal to the inverse of the percentage of the sample released to data collection. For example, if only DUs in releases 1 and 2 were invited to participate, the DU release adjustment would equal 120/80 or 1.5. If releases 1, 2, and 3 were invited to participate, the adjustment would equal 120/100 or 1.2 because 40/120 + 40/120 + 20/120 = 100/120. A summary of the quarterly sample sizes and percentages released as well as the impact of the coronavirus disease 2019 (COVID-19) pandemic on sample releases will be provided in the *2022 National Survey on Drug Use and Health (NSDUH) Methodological Resource Book, Section 14: Sample Experience Report* (CBHSQ, forthcoming a).

5.7 Procedures for Adding Dwelling Units in the Field

To ensure that most DUs had a chance of selection and to minimize bias associated with incomplete frames, a check for missed DUs was implemented at each sampled DU that was screened in person.[36] During the screening interview, the FI asked the screening respondent about other units on the property of the sampled DU (e.g., a garage apartment). When found on the property of a sampled DU, the unlisted units became part of the sample (added DUs) and were considered "linked" to that DU. If the number of added DUs linked to any particular sample DU did not exceed 5, and if the number of added DUs for the entire segment was less than or equal to 10, the FI was instructed to consider these DUs as part of his or her assignment. If either of these limits was exceeded, special subsampling procedures were implemented, as described in Appendix D.

In addition to checking for missed DUs at each sampled DU, FIs were instructed to call their supervisors if they noticed large differences between the segment listing and what they encountered in the field. If the FI identified 150 or more missed DUs in a segment or 50 or more missed DUs following any DU, special "bust" procedures were implemented to minimize bias associated with large numbers of missed DUs. The bust procedures involve selecting a subsample of the missed DUs and adding them to the FI's assignment. They are described in more detail in Appendix D. The total number of added DUs identified during the screening interview or added through the bust procedures will be summarized in the 2022 Sample Experience Report (CBHSQ, forthcoming a).

5.8 Quarter-by-Quarter Deviations

The descriptions earlier refer to Quarter 1 methods and procedures, and this section describes corrections or modifications to the sampling procedures in subsequent samples. In what follows, "Design" on the left side of the page refers to departures from the Quarter 1 sample design, including modifications to quarterly sample targets and sample size calculations. "DU Selection" refers to the partitioning of the DU samples (as described in Section 5.6). Decisions were made on a quarter-by-quarter basis, and the modifications may or may not conform to usual NSDUH practice.

[36] The check for missed DUs was not implemented for DUs screened via web.

Quarter 2 Sample

Design:

For the Quarter 2 initial sample, an additional 20 percent reserve was added to the 104 percent quarterly sample to allow for supplemental releases where needed, as usual.

Data from Quarters 2 through 4 of 2019 and Quarter 1 of 2020 were used to compute state-specific yield and response rates. The screening and interview response rates were then adjusted so that the overall response rate would be 12.3 percent, the expected multimode response rate based on experience from Quarter 4 of 2021.

DU Selection:

The Quarter 2 D_{hj} sample was partitioned into the following release percentages:

Release 1: 33 percent of entire sample (main sample + 20 percent reserve);
Release 2: 33 percent of entire sample (main sample + 20 percent reserve);
Release 3: 17 percent of entire sample (main sample + 20 percent reserve);
Release 4: 8 percent of entire sample (main sample + 20 percent reserve);
Release 5: 4 percent of entire sample (main sample + 20 percent reserve); and
Release 6: 4 percent of entire sample (main sample + 20 percent reserve).

Quarter 3 Sample + Supplement

Design:

Using the completed cases from Quarter 1 and the projected interviews from Quarter 2, each state's midyear shortfall/excess was computed. The 102 percent sample from Quarter 3 then was adjusted by this amount, and an additional 20 percent sample was included.

Data from Quarters 2 through 4 of the 2019 NSDUH and Quarter 1 of the 2020 NSDUH were used to compute state-specific average yields, DU eligibility, screening response, and interview response rates. As done for Quarter 2, the screening and interview response rates were adjusted to an overall response rate of 12.3 percent (the multimode response rate from Quarter 4 of 2021).

To safeguard against the negative impact of the COVID-19 pandemic on data collection and response rates, the decision was made to select a Quarter 3 sample supplement. All remaining DUs (i.e., those not previously selected) in the Quarter 3 panel I segments (i.e., those retiring from use after 2022), all remaining DUs up to half of the listed DUs in the Quarter 3 panel J segments (i.e., those segments that will be used for a second time in the 2023 sample), and all remaining DUs in the Quarter 1 panel H segments (i.e., those retired from use after 2021) were selected. As a result, 737 segments were added to the Quarter 3 sample (13 panel H segments had no remaining DUs). In the panel H segments, person probabilities of selection were computed using the formula in Section 5.4. The Quarter 3 sample weights will be adjusted to reflect the selection of the additional sample.

DU Selection:

The combined (initial + supplement) Quarter 3 D_{hj} sample was partitioned into the following release percentages:

Release 1: 33 percent of entire sample (main sample + 20 percent reserve + supplemental sample);
Release 2: 33 percent of entire sample (main sample + 20 percent reserve + supplemental sample);
Release 3: 17 percent of entire sample (main sample + 20 percent reserve + supplemental sample);
Release 4: 8 percent of entire sample (main sample + 20 percent reserve + supplemental sample);
Release 5: 4 percent of entire sample (main sample + 20 percent reserve + supplemental sample); and
Release 6: 4 percent of entire sample (main sample + 20 percent reserve + supplemental sample).

Quarter 4 Sample

Design:

Using the completed cases from Quarters 1 and 2 and the projected interviews from Quarter 3, each state's shortfall/excess was computed. The 98 percent sample from Quarter 4 then was adjusted by this amount, and an additional 20 percent sample was included.

Data from Quarters 2 through 4 of the 2019 NSDUH and Quarter 1 of the 2020 NSDUH were used to compute state-specific average yields, DU eligibility, screening response, and interview response rates. Screening and interview response rates were adjusted to an overall response rate of 12.3 percent (the expected multimode response rate based on experience from Quarter 4 of 2021).

DU Selection: The Quarter 4 D_{hj} sample was partitioned into the following release percentages:

Release 1: 33 percent of entire sample (main sample + 20 percent reserve);
Release 2: 33 percent of entire sample (main sample + 20 percent reserve);
Release 3: 17 percent of entire sample (main sample + 20 percent reserve);
Release 4: 8 percent of entire sample (main sample + 20 percent reserve);
Release 5: 4 percent of entire sample (main sample + 20 percent reserve); and
Release 6: 4 percent of entire sample (main sample + 20 percent reserve).

5.9 Impact of COVID-19 on Dwelling Unit and Person Samples

As mentioned throughout this chapter, COVID-19 greatly affected the 2022 NSDUH DU and person samples. The ongoing COVID-19 pandemic affected the way the initial samples were selected and required a supplemental sample in Quarter 3 to minimize the impact of COVID-19 on national estimates.

In all four quarters, historical state-level response rates were adjusted so that the overall expected response rate would be approximately 12 percent (the expected multimode response rate), and these adjusted rates were used in the DU sample calculations. Using these assumptions, a large sample of DUs was required to meet the annual target through multimode data collection. Because the NSDUH segments were not designed to support as large a DU sample as was required, the "maximum" number of DUs was selected in most segments. In addition, as described in Section 5.8, a Quarter 3 sample supplement was selected from retired, retiring, and 2023 overlap segments to increase the final respondent sample size.

6. Sample Weighting and Variance Estimation

6.1 Sample Weighting Procedures

At the conclusion of data collection, design weights are constructed reflecting the various stages of sampling. This section describes the computation of design weights for the 2022 National Survey on Drug Use and Health (NSDUH). Full details of the sample weighting procedures, including procedures for computing final person-level weights, will be described in the *2022 National Survey on Drug Use and Health (NSDUH) Methodological Resource Book, Section 11: Person-Level Sampling Weight Calibration* report (Center for Behavioral Health Statistics and Quality [CBHSQ], forthcoming b). Details on how pair weights are computed will be described in the *2022 National Survey on Drug Use and Health (NSDUH) Methodological Resource Book, Section 12: Questionnaire Dwelling Unit-Level and Person Pair-Level Sampling Weight Calibration* report (CBHSQ, forthcoming c).

6.1.1 Design Weights

The calculation of the design weights are based on the stratified, five-stage design of the study. Specifically, the person-level design weights are the product of the five stagewise sampling weights, each equal to the inverse of the selection probability for that stage. In review, the stages are as follows:

Stage 1: Selection of census tract.

Stage 2: Selection of census block group.

Stage 3: Selection of field enumeration segment (equal to 1 for address-based sampling segments). Two possible adjustments exist for both field enumeration and ABS segments:

(1) quarter segment weight: adjusts for the number of quarterly samples being examined (equal to 1 if all four quarters are included); and

(2) subsegmenting adjustment: adjusts for within-segment subsampling (includes up to two levels of subsegmenting).

Stage 4: Selection of dwelling unit (DU). Two possible adjustments exist with this stage of selection:

(1) added DU: results from subsampling missed DUs; and

(2) release adjustment.

Stage 5: Selection of person within a DU.

The final analysis weight used in estimation will be computed as the product of 16 weight components: 5 design weight components, 4 design weight adjustments, and 7 model-based weight adjustments. The model-based weight adjustments will be described in the 2022 Person-Level Sampling Weight Calibration report (CBHSQ, forthcoming b). Exhibit 2 displays all of the individual weight components.

Exhibit 2 Sample Weight Components

Dwelling Unit-Level Design Weight Components
#1. Inverse Probability of Selecting Census Tract
#2. Inverse Probability of Selecting Census Block Group
#3. Inverse Probability of Selecting Segment
#4. Quarter Segment Weight Adjustment
#5. Subsegmentation Inflation Adjustment
#6. Inverse Probability of Selecting Dwelling Unit
#7. Inverse Probability of Added/Subsampled Dwelling Unit
#8. Dwelling Unit Release Adjustment
#9. Dwelling Unit Nonresponse Adjustment
#10. Dwelling Unit Poststratification Adjustment
#11. Dwelling Unit Extreme Weight Adjustment
Person-Level Design Weight Components
#12. Inverse Probability of Selecting a Person within a Dwelling Unit
#13. Selected Person Poststratification to Roster Adjustment
#14. Person-Level Nonresponse Adjustment
#15. Person-Level Poststratification Adjustment
#16. Person-Level Extreme Weight Adjustment

6.1.2 Quality Control Measures in Design-Based Weighting Procedures

Quality control (QC) measures are applied to every component of the DU-level and person-level design weights. In addition to the QC measures outlined as follows, SAS® (SAS Institute Inc., 2017) programs are examined for errors, warnings, and variable uninitialization in the log by a sampling team member and reviewed by a different sampling team member. The following QC measures are employed to ensure the accuracy of design-based weight calculations:

- For subsegmented segments, check that the subsegmenting adjustment factor is greater than 1 (i.e., the count for the entire segment is greater than the count for the subsegment). This check is also performed for segments that are subsegmented twice.
- Compare the DU eligibility indicator with the completed screener indicator. Make sure all screener-complete DUs are eligible.
- Compare the final screening code with the DU eligibility and completed screener indicators to ensure these variables are defined correctly.
- Check the subsampling rate for added DUs that are subsampled. Review the frequency distribution of the DU subsampling rates to check values and ensure the correct number of DUs are adjusted.
- Check that the minimum and maximum values of the DU release weight factor are within the expected range and that there are no missing values.
- Check the household-level weight to ensure there are no missing values and the sum is close to the expected value.
- Compare the person-level indicators for eligible, selected, and complete. Make sure all completed cases are selected and all selected cases are eligible.
- Compare the final interview code with the person-level eligibility indicator to make sure this variable is defined correctly.
- Make sure the probability of selection is nonmissing for all selected persons.
- Check the maximum-of-two selected persons adjustment to make sure the maximum value is 2.
- Check the person-level weight to ensure there are no missing values and the sum is close to the expected value.

6.2 Creation of Variance Strata and Variance Primary Sampling Units for Person-Level Estimates

The nature of the stratified, clustered sample design requires the design structure to be taken into consideration when computing variances of survey estimates. Variance strata and variance primary sampling units (PSUs)[37] were created to capture explicit stratification and to identify clustering (see Appendix E). For the 2014 through 2022 NSDUHs, variance strata were defined at the state sampling region (SSR) and quarter level (each SSR appears in a different stratum every quarter). Because census tracts, block groups, and field enumeration segments are nested within variance PSUs, the variance contributions of all three sampling stages are covered by the variance estimation variables. Also, because one field enumeration segment is selected per

[37] Variance PSUs were previously called variance replicates.

sampled census tract and block group, the selection of census tracts and block groups at the first and second stages of selection may reduce variance by minimizing the chance of selecting adjacent and possibly similar segments within the same census tract or block group.

To define the variance strata for each quarter of the 2014 through 2022 NSDUHs, the 750 SSRs were first placed in random order (states were randomly sorted, and SSRs were randomly sorted within states). This list, numbered 1 to 750, defined the Quarter 1 variance strata (VESTRQ1) for the 2014 through 2022 NSDUHs. For Quarter 2, the variance strata, VESTRQ2, were defined as VESTRQ1 + 150 (or VESTRQ1 + 150 − 750 if VESTRQ1 is ≥ 601).[38] Similarly, VESTRQ3 = VESTRQ2 + 150 (− 750 if VESTRQ2 ≥ 601), and VESTRQ4 = VESTRQ3 + 150 (− 750 if VESTRQ3 ≥ 601). As an example, an SSR that was assigned to variance stratum 451 in Quarter 1 was assigned to variance stratum 601 (= 451 + 150) in Quarter 2, variance stratum 1 (= 601 + 150 − 750) in Quarter 3, and variance stratum 151 (= 1 + 150) in Quarter 4. Finally, to make the values unique from previous years, 40,000 was added to the quarterly variance strata to create the final variance strata (e.g., VESTR = VESTRQ1 + 40,000). The resulting 750 variance strata values are the same for the 2014 through 2022 NSDUHs but have different values from variance strata defined for previous years because the 2014 through 2022 sample was selected independently from previous samples.

The 2014 through 2022 method of defining variance estimation strata had the effect of assigning SSRs to strata in a pseudo-random fashion while ensuring that each stratum consists of four SSRs from four different states. By combining SSRs across states to form strata, the risk of disclosure is reduced because an intruder cannot assume that respondents in the same variance stratum reside in the same state.

Similar to the 2005 through 2013 definition of variance strata, the 2014 through 2022 definition also has the effect of increasing the number of (nominal) degrees of freedom (*df*) for state-level estimates while preserving the number of *df* for national estimates (750).[39] Each of the smallest sample states is in 48 different variance strata (12 SSRs × 4 quarters); therefore, 48 *df* are available for state estimates in these states (each variance stratum contains two variance PSUs, as described in the next paragraph). At the other extreme, the largest sample state, California, is in 144 variance strata (36 SSRs × 4 quarters) and therefore has 144 *df* for estimation. As demonstrated in Appendix E, the 2014 through 2022 definition of variance strata achieves variance estimators with the same expected values as those formed by grouping segments across quarters within regions (i.e., the 1999 through 2004 definition of variance strata).

Two variance PSUs per year were defined within each variance stratum. Each variance PSU consists of four segments, one for each quarter of data collection. The first variance PSU consists of those segments that are "phasing out" or will not be used in the next survey year. The second variance PSU consists of those segments that are "phasing in" or will be fielded again the

[38] The interval of 150 between quarterly variance estimation strata for SSRs was arbitrarily chosen. Any number larger than the maximum number of SSRs in a state (36) could have been used to ensure that the resulting variance strata contain SSRs from four different states.

[39] This *df* is a measure of the precision of the variance estimate. The conventional (or "nominal") *df* measure for a variance estimate under a complex sample is the number of variance PSUs minus the number of variance strata. Ideally, the variance of the variance estimator is 2/*df* (the qualifier "nominal" is sometimes used because this ideal may not be realized).

following year, thus constituting the 50 percent overlap in area segments between survey years. To take into account the overlap with previous samples, supplemental segments will retain their original variance stratum and PSU assignment.

Table 3.2 (shown earlier) describes the assignment of segments to variance PSUs that are designed to account for any positive covariance among consecutive year change estimates. As shown in the table, the variance PSU values alternate between 1 and 2 for each panel of the 2014 through 2022 design. As a result, when combining data from multiple years, the pooling of the samples within variance PSUs provides increased precision of estimates.

In addition to variance strata and variance PSUs, a sample weight is computed for each final respondent as described in Section 6.1. The use of sample weights in analyses of NSDUH data is necessary to properly represent the target population and to account for disproportionate sampling by age group. All weighted statistical analyses for which variance estimates are needed should use the variance stratum and variance PSU variables to identify nesting. Variance estimates can be computed using a clustered data analysis software package such as SUDAAN® (RTI International, 2012b).[40] The SUDAAN software package computes variance estimates for nonlinear statistics using such procedures as a first-order Taylor series approximation of the deviations of estimates from their expected values. The approximation is unbiased for sufficiently large samples. SUDAAN also recognizes positive covariance among estimates involving data from 2 or more years.[41] Using data from the 2007 and 2008 NSDUHs and examining multiple measures, the average relative change in the standard error after accounting for covariance was about 1 percent.

6.3 Creation of Variance Strata and Variance Primary Sampling Units for Pair Analyses

Alternate versions of the variance strata and variance PSUs are created for use in analyses involving responding pairs (i.e., two unit respondents in the same household). In most years, these alternate versions are simply copies of the person-level variance strata and variance PSUs described in Section 6.2. Very rarely, however, alternate versions must be made because not all variance strata have at least one responding pair in both variance PSUs. In this scenario, variance strata with only one variance PSU represented by responding pairs were collapsed with a neighboring variance stratum.

The algorithm for selecting the neighboring variance stratum is as follows:

- Identify the person-level variance stratum that precedes the problematic one and the person-level variance stratum that follows the problematic one. The numbering is described in Section 6.2.

[40] See the *2020 National Survey on Drug Use and Health (NSDUH) Methodological Resource Book, Section 13: Statistical Inference Report* for additional examples of software that may be used (CBHSQ, 2022).

[41] Using the variance estimation strata and PSUs, SUDAAN recognizes positive covariance among estimates from consecutive years. For nonconsecutive years, strata are treated as collapsing with zero covariance.

- If one of the neighboring strata is in a different state, then collapse the problematic one with the neighboring stratum in the same state. Otherwise, choose between the two neighbors randomly.

6.4 Other Sampling-Related Variables

Because area segments consist of one or more census blocks, a number of demographic and geographic variables are available for sampled areas. The demographic data include the following: population counts by age, race, and ethnicity; estimated civilian, noninstitutionalized population aged 12 or older; DU counts; estimated group quarters units; and group quarters population by type of group quarters.[42] For these variables, the block-level data were aggregated to form segment-level estimates.

The U.S. Census Bureau also makes available several geographic variables that can be associated with the 2014 through 2022 NSDUH sample segments. These are state, county and county name, place name, census division and region, land area, CBSA/SES indicator (as defined in Section 2.2), county-level population density, and a rural or urban indicator.[43] Each census block is assigned a rural or urban status based on population density or proximity to a census-designated urbanized area or urban cluster. In the NSDUH sample, if one or more of the blocks within a segment is urban, the segment is defined as urban. If 100 percent of the blocks are rural, the segment is defined as rural. Defining rural or urban status in this way provides an aggregate variable that is needed for assigning minimum size requirements (see Section 3.3). However, the definition slightly overestimates the urban population.

Similar to the 2005 through 2013 NSDUH samples, the 2014 through 2022 samples were designed to facilitate matching to external data at the census tract level. Beginning in 2014 and continuing through 2022, the specific census block associated with each NSDUH respondent's DU was assigned. In ABS segments, census block was assigned based on geocoded location of the DU. In field enumeration segments, counting and listing occurs at the segment level rather than the block level (see Section 4.3.2); thus, only the group of blocks in which a NSDUH respondent resides is known. Using desktop computer mapping software, census block information was recorded by manually comparing electronic segment maps to field listings as is described in Appendix F. As a result, block-level data can be associated with NSDUH respondents, improving the accuracy of geographic variables used for data analyses. The block-level geographic variables include place name; rural or urban indicator; and American Indian, Alaska Native, and Native Hawaiian area codes and names.

At the end of Quarter 4, preliminary census block assignments were prepared so that block-level covariates could be defined and used in item imputation models. To accommodate the 12-month imputation schedule, all respondent DUs as of December 1, 2022, were identified. Next, the specific census block associated with each respondent DU in field enumeration segments was manually assigned using the procedures described in Appendix F. Addresses for all pending DUs in field enumeration segments were geocoded. Finally, the census block associated with each

[42] Data were obtained or derived from the Census 2010 Summary File 1 (see footnote 21) and adjusted using revised population counts from Claritas.

[43] All variables were obtained or derived from the Census 2010 Summary File 1 (see footnote 21).

respondent DU in ABS segments was assigned based on the geocoded location of the address. Block-level covariates were defined using the manually assigned or geocoded census block. If geocoding did not result in a valid census block (e.g., the address was geocoded outside the segment boundary, or the DU address was a description), the segment-level covariate was used.

6.5 Impact of COVID-19 on Sample Weighting and Variance Estimation

The COVID-19 pandemic had no impact on the creation of design weights, variance strata, variance PSUs, or other sampling-related variables. The impact on the final analysis weights will be described in the 2022 Person-Level Sampling Weight Calibration report (CBHSQ, forthcoming b).

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7. Incentives Field Test Sample Design

7.1 Overview

National Survey on Drug Use and Health (NSDUH) respondents are currently given a $30 incentive when they are selected for the main interview and complete the survey via the web or in person. The goal of the 2022 NSDUH Incentives Field Test was to evaluate whether adding a screening incentive and/or increasing the amount of the interview incentive increases the likelihood of participation in the household screening and subsequent interview(s). The Incentives Field Test evaluated two potential changes to the NSDUH incentive protocol—adding a $5 prepaid screening incentive and offering a higher $50 interview incentive.

The Incentives Field Test was conducted during Quarter 4 of the 2022 NSDUH and was embedded within the Quarter 4 main study sample. Thus, the target population for the field test is the U.S. civilian, noninstitutionalized population aged 12 or older.

7.2 Design of the Incentives Field Test

To test a $5 prepaid screening incentive and an increased interview incentive of $50, each Quarter 4 sample dwelling unit (SDU) was randomly assigned to one of the four experimental conditions shown in Table 7.1.

Table 7.1 Four Experimental Conditions for the Incentives Field Test

Experimental Condition	Incentive Amounts
1	$0 screening + $30 interview
2	$5 screening + $30 interview
3	$0 screening + $50 interview
4	$5 screening + $50 interview

Power analyses were conducted to determine minimum sample sizes needed to detect an increase in screening response rate (SRR) of 0.05 (5 percent) from adding a $5 prepaid screening incentive and an increase in interview response rate (IRR) of 0.05 (5 percent) from increasing the interview incentive from $30 to $50. The sample sizes were determined for these differences to be statistically significant at the alpha = 0.05 level with 80 percent power. Power analyses were conducted separately for the weighted SRR and for the weighted IRR. Equal sample sizes per experimental condition, including the control group, were assumed in determining the minimum sample sizes.

The weighted SRR power analysis indicated that a minimum sample size of approximately 6,250 SDUs for each screening incentive amount is needed for detecting a significant difference in SRRs of 0.05.

The weighted IRR power analysis was based on the expected number of persons aged 12 or older selected for an interview, among all completed screenings. The results of this analysis indicated that a minimum of approximately 4,200 sample persons for each interview incentive amount is needed for detecting a significant difference in IRRs of 0.05. Accounting for eligibility

and SRR, it was initially determined that approximately 12,500 SDUs per incentive amount would be needed to yield this number of selected persons. Because the IRR test required more SDUs than the SRR test, the IRR test ultimately determined the sample sizes required for each treatment condition.

7.3 Assignment of Sample Dwelling Units to Experimental Conditions

The sample sizes for the experimental conditions were determined assuming equal sizes for the three new conditions shown in Table 7.1 (a $5 prepaid screening incentive with a $30 interview incentive, no screening incentive with a $50 interview incentive, or a $5 prepaid screening incentive with a $50 interview incentive). Thus, an equal number of SDUs (6,250) was randomly assigned to each of the three treatment conditions. The remaining Quarter 4 sample was assigned to the control condition of no screening incentive and a $30 interview incentive (i.e., the current incentive protocol). By assigning only as many Quarter 4, 2022, SDUs as needed to each of the three new incentive protocols, the design was intended to minimize the potential for significant impacts of the new incentive protocols on key survey estimates (such as those for substance use and mental health).

Table 7.2 shows the final number of Quarter 4, 2022, SDUs assigned to each experimental condition. Note that one SDU assigned to the control group and one SDU assigned to the group receiving a $5 prepaid screening incentive with a $30 interview incentive were offered the wrong interview incentive treatment. Therefore, these two SDUs have been excluded from the Incentives Field Test analyses.

Table 7.2 Sample Dwelling Units for the Four Experimental Conditions for the Field Test Experiment

Incentive Amount	$0 Screening Incentive	$5 Screening Incentive	Interview Incentive Marginal Totals
$30 Interview Incentive	196,927	6,249	203,176
$50 Interview Incentive	6,250	6,250	12,500
Screening Incentive Marginal Totals	203,177	12,499	215,676

7.4 Incentives Field Test Sample Results

The experimental sample sizes for selected interview respondents are shown in Table 7.3. Note that the 12,500 SDUs assigned to the group receiving the $50 interview incentive yielded fewer than the expected 4,200 selected interview respondents. In investigating the reason for selecting fewer interview respondents than expected, a small computational error was found in the weighted IRR power analysis calculations. However, because of the additional sample in the control condition and by using regular design weights in the IRR calculations, the sample in the treatment condition for the interview incentive does not need to be so large to detect a 0.05 increase in IRR with a significance level of 0.05 and 80 percent power. When 7.34 percent of the 35,213 selected persons in Quarter 4 are offered the $50 incentive, as was the case in the field test, only 2,073 persons need to be offered the $50 incentive. That is, the conservative assumption of equal sample sizes per experimental condition more than compensated for the error in the initial power analysis calculations. The computational error did not affect the calculation for SDUs and

completed screenings for SRRs. For more information on the Incentives Field Test sample results, see the *2022 National Survey on Drug Use and Health (NSDUH): Respondent Incentives Field Test Summary Report* (Center for Behavioral Health Statistics and Quality, forthcoming d).

Table 7.3 Selected Interview Respondents for the Four Experimental Conditions for the Field Test Experiment

Incentive Amount	$0 Screening Incentive	$5 Screening Incentive	Interview Incentive Marginal Totals
$30 Interview Incentive	31,369	1,258	32,627
$50 Interview Incentive	1,190	1,396	2,586
Screening Incentive Marginal Totals	32,559	2,654	35,213

7.5 Incentives Field Test Weighting and Variance Estimation

The data from Quarter 4 of 2022 will be weighted following main study weighting procedures. Outcome rates relevant to the Incentives Field Test (SRR, IRR, and overall response rate) will be calculated with design-based weights applied. Four analysis weights will be developed for analyzing the field test data across the four experimental conditions.

Four separate dwelling unit nonresponse adjustment models corresponding to the four experimental conditions will be fit. Similarly, four separate person-level nonresponse adjustment models and four person-level poststratification adjustment models will be fit. The control totals for the poststratification will be the 2022 population totals in the United States available from the U.S. Census Bureau in February 2023. The sum of each analysis weight will match the target U.S. population estimates.

In addition to analysis weights, field test-specific variance estimation strata and replicates were created to account for the design when computing variances of estimates. To create the Incentives Field Test variance strata, groups of 10 adjacent NSDUH variance strata were collapsed. Thus, a total of 75 Incentives Field Test variance strata were formed. The variance replicates were retained from the main study.

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List of Contributors

This National Survey on Drug Use and Health methodological report was prepared by the Substance Abuse and Mental Health Services Administration (SAMHSA), Center for Behavioral Health Statistics and Quality, and RTI International. Work by RTI was performed under Contract No. HHSS283201700002C. Marlon Daniel served as the government project officer and as the contracting officer representative, and David Hunter served as the RTI project director.

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Also at RTI, Margaret Johnson copyedited the report, and Teresa Mink coordinated its web production.

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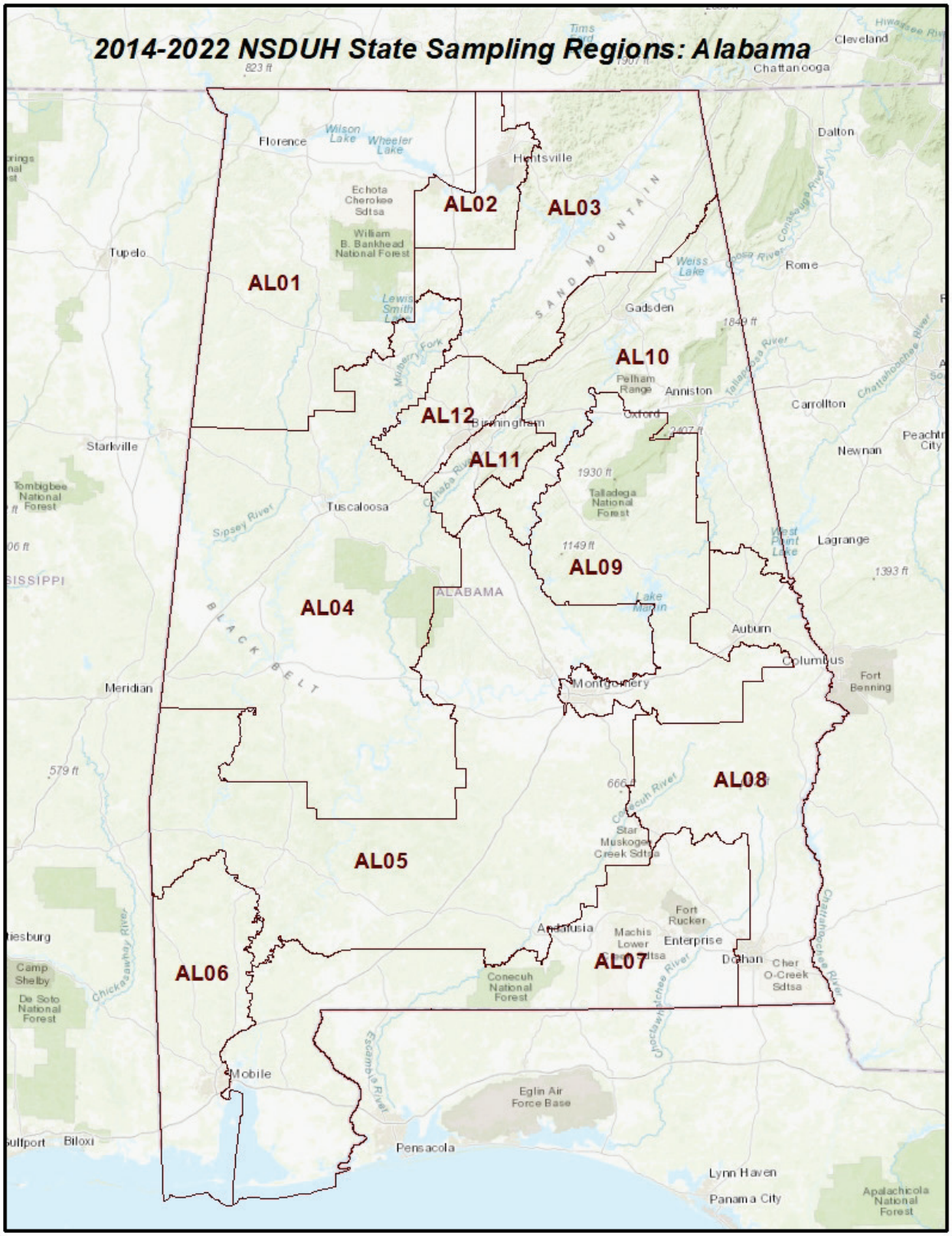
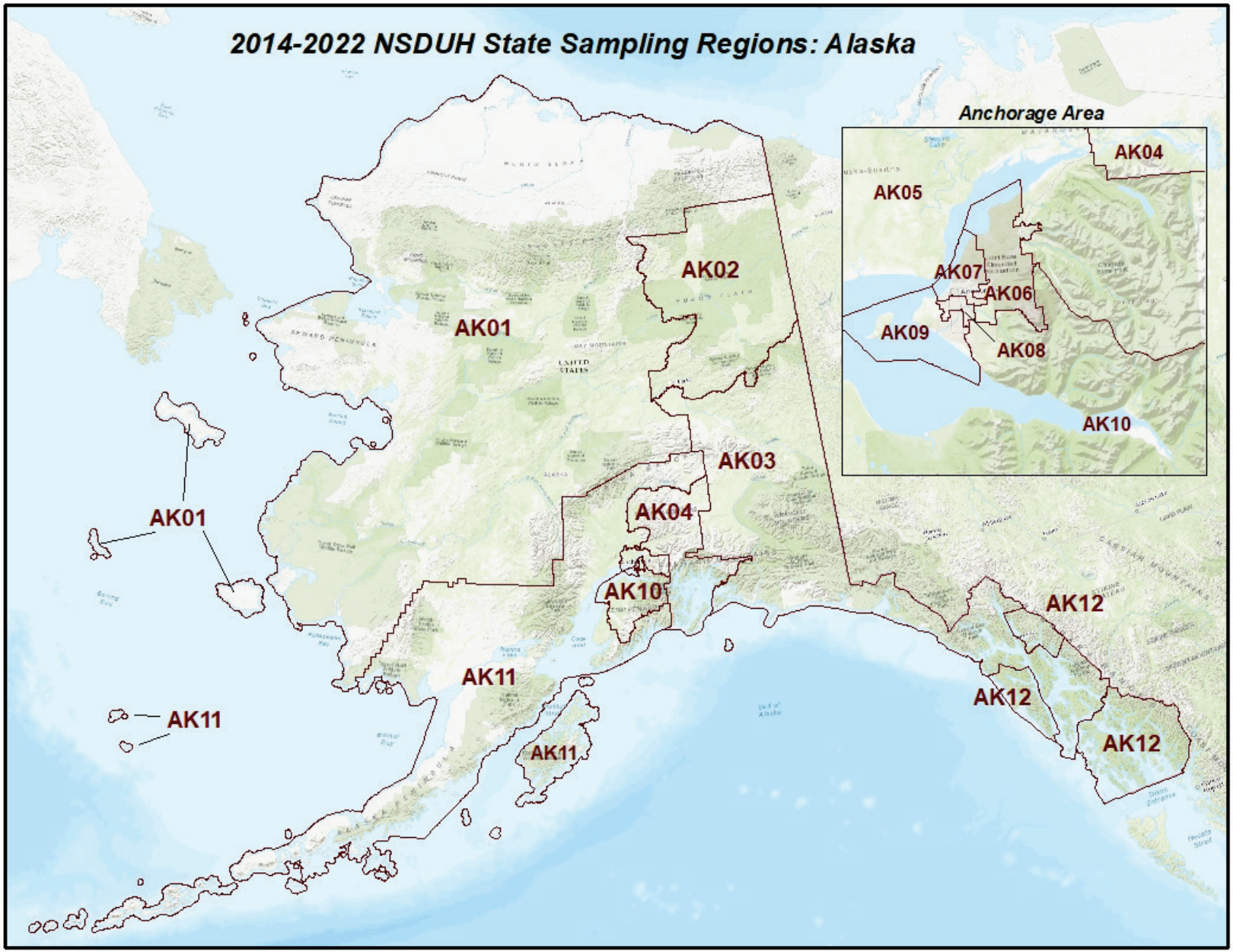
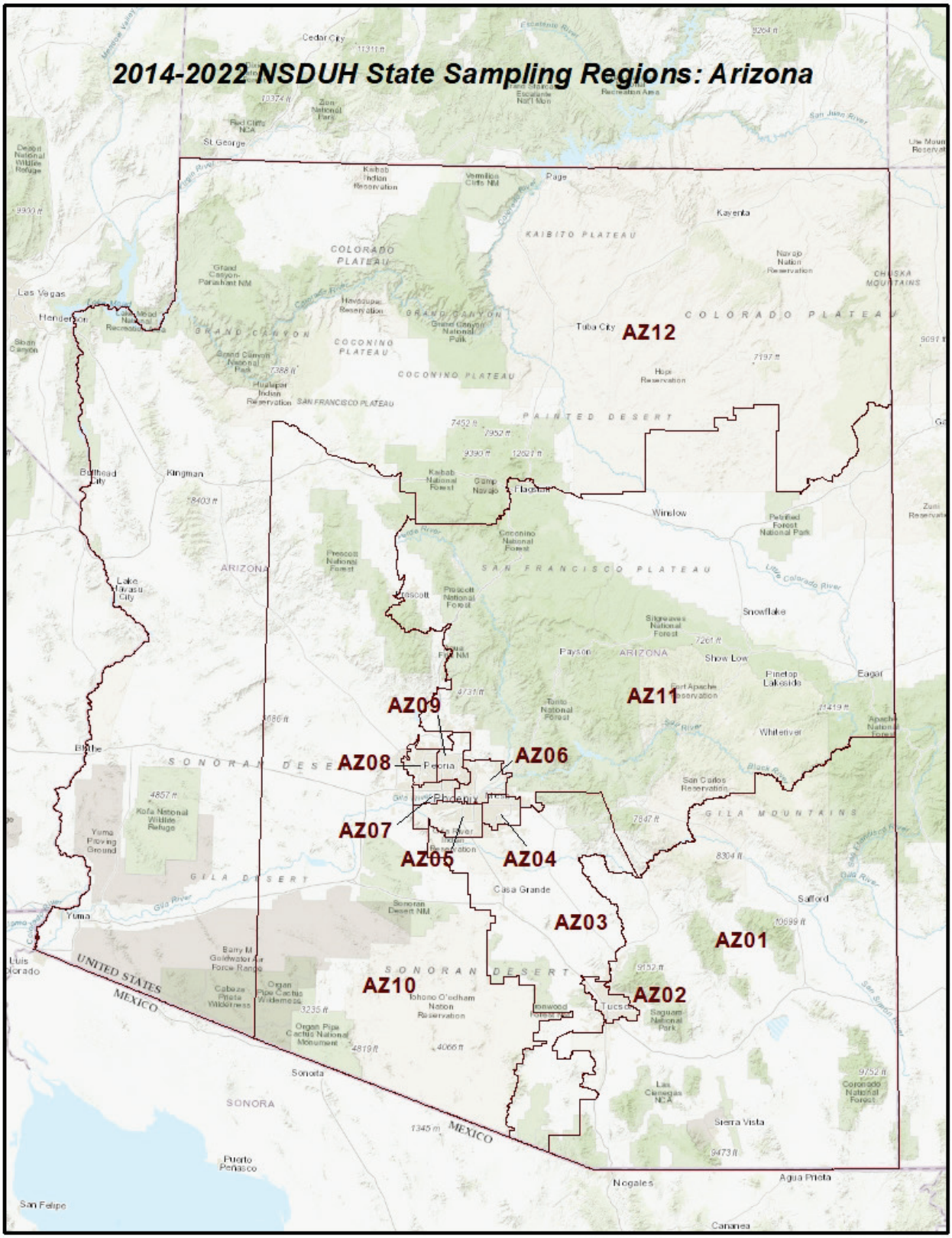
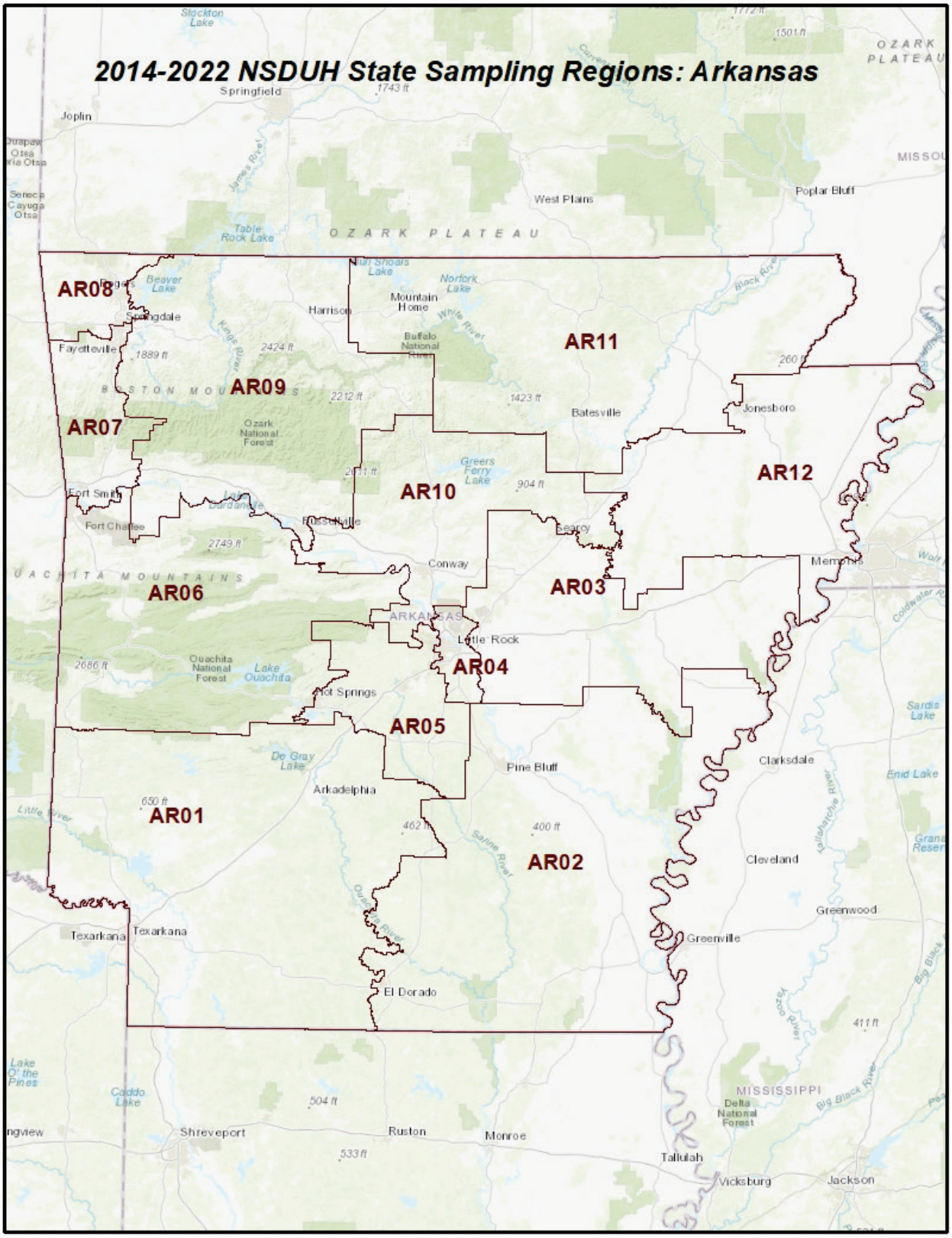
Appendix A:
2014 through 2022 NSDUH State Sampling Regions


2014-2022 NSDUH State Sampling Regions: Alabama
AL01
AL02
AL03
AL04
AL05
AL06
AL07
AL08
AL09
AL10
AL11
AL12
Florence
Wilson Lake
Wheeler Lake
Huntsville
Echota Cherokee Sdtsa
William B. Bankhead National Forest
Tupelo
Starkville
Meridian
Tombigbee National Forest
Tuscaloosa
Sipsey River
Lewis Smith Lake
Mulberry Fork
Cahaba River
Birmingham
Pelham Range
Anniston
Oxford
Talladega National Forest
Gadsden
Weiss Lake
Coosa River
Rome
Dalton
Cleveland
Chattanooga
Tallapoosa River
Carrollton
Newnan
Lagrange
West Point Lake
Auburn
Columbus
Fort Benning
Montgomery
Lake Martin
ALABAMA
BLACK BELT
SAND MOUNTAIN
Conecuh River
Star Muskogee Creek Sdtsa
Andalusia
Fort Rucker
Machis Lower Creek Sdtsa
Enterprise
Dothan
Cher O-Creek Sdtsa
Conecuh National Forest
Camp Shelby
De Soto National Forest
Chickasawhay River
Mobile
Escambia River
Eglin Air Force Base
Pensacola
Biloxi
Lynn Haven
Panama City
Apalachicola National Forest
Choctawhatchee River
Chattahoochee River
823 ft
1849 ft
2407 ft
1930 ft
1149 ft
1393 ft
579 ft


2014-2022 NSDUH State Sampling Regions: Alaska
Anchorage Area
AK01
AK02
AK03
AK04
AK05
AK06
AK07
AK08
AK09
AK10
AK11
AK12


2014-2022 NSDUH State Sampling Regions: Arizona
AZ12
AZ09
AZ11
AZ08
AZ06
AZ07
AZ05
AZ04
AZ03
AZ01
AZ10
AZ02
ARIZONA
COLORADO PLATEAU
SONORAN DESERT
GILA DESERT
GILA MOUNTAINS
PAINTED DESERT
SAN FRANCISCO PLATEAU
KAIBITO PLATEAU
COCONINO PLATEAU
GRAND CANYON
UNITED STATES
MEXICO
SONORA
Cedar City
St George
Page
Kayenta
Las Vegas
Henderson
Tuba City
Hopi Reservation
Kingman
Bullhead City
Lake Havasu City
Flagstaff
Winslow
Snowflake
Show Low
Payson
Prescott
Peoria
Phoenix
Yuma
Casa Grande
Safford
Tucson
Sierra Vista
Nogales
Agua Prieta
Puerto Peñasco
San Felipe


2014-2022 NSDUH State Sampling Regions: Arkansas
AR01
AR02
AR03
AR04
AR05
AR06
AR07
AR08
AR09
AR10
AR11
AR12
OZARK PLATEAU
OUACHITA MOUNTAINS
ARKANSAS
MISSISSIPPI
Springfield
Joplin
Poplar Bluff
West Plains
Harrison
Mountain Home
Batesville
Jonesboro
Fayetteville
Springdale
Fort Smith
Fort Chaffee
Russellville
Conway
Little Rock
Memphis
Hot Springs
Pine Bluff
Arkadelphia
Clarksdale
Cleveland
Greenwood
Greenville
Texarkana
El Dorado
Shreveport
Ruston
Monroe
Tallulah
Vicksburg
Jackson
Buffalo National River
Ozark National Forest
Ouachita National Forest
Lake Ouachita
Greers Ferry Lake
Beaver Lake
Norfork Lake
Table Rock Lake
Bull Shoals Lake
De Gray Lake
Caddo Lake
Lake O' the Pines
Delta National Forest
Sardis Lake
Enid Lake
James River
White River
Black River
Little River
Saline River
Ouachita River
Tallahatchie River
Yazoo River
Big Black River
Coldwater River
1743 ft
1501 ft
1889 ft
2424 ft
2212 ft
1423 ft
2749 ft
2686 ft
904 ft
650 ft
462 ft
400 ft
504 ft
533 ft
411 ft


2014-2022 NSDUH State Sampling Regions: California
Los Angeles Area
San Francisco Area
CA01
CA02
CA03
CA04
CA05
CA06
CA07
CA08
CA09
CA10
CA11
CA12
CA13
CA14
CA15
CA16
CA17
CA18
CA19
CA20
CA21
CA22
CA23
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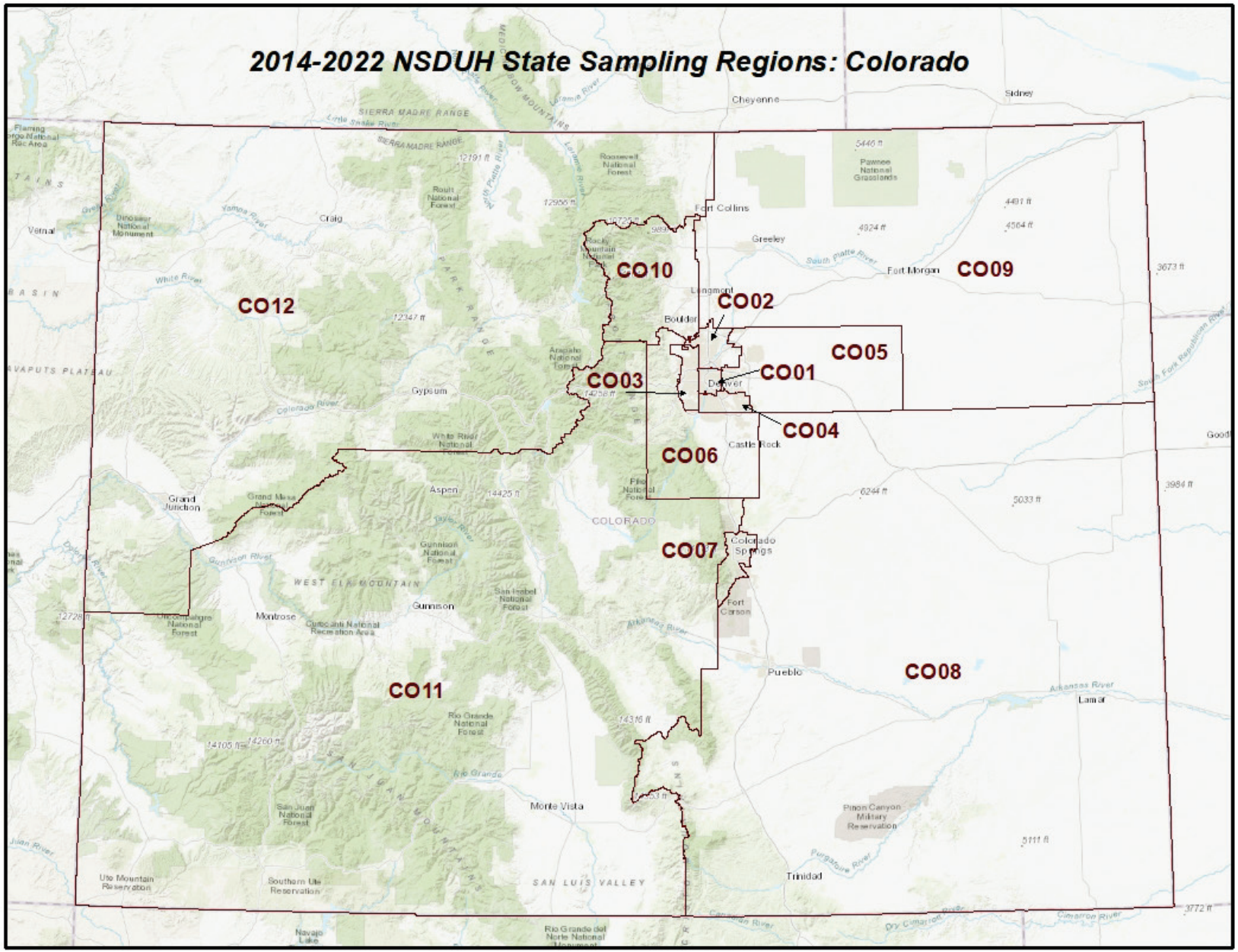
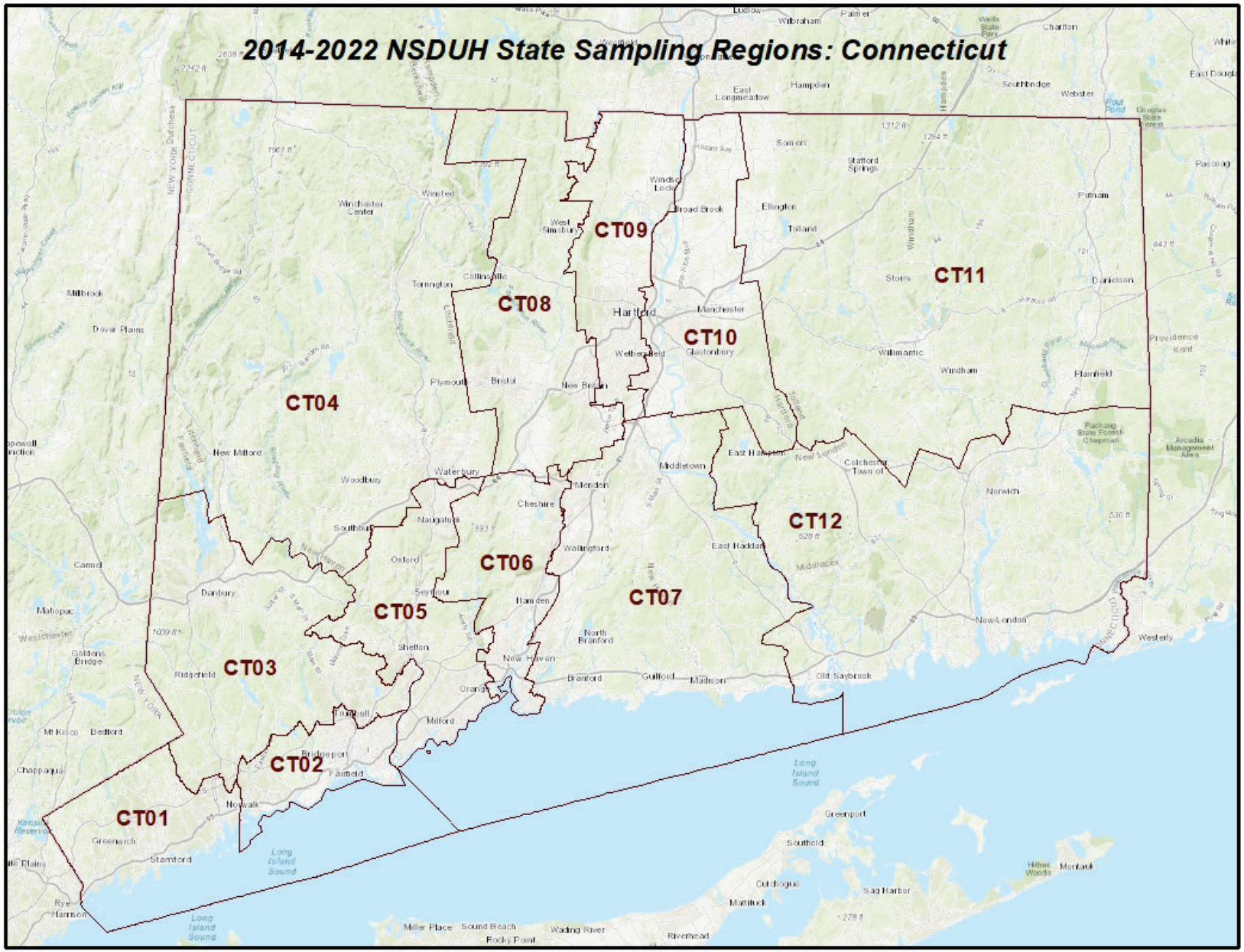
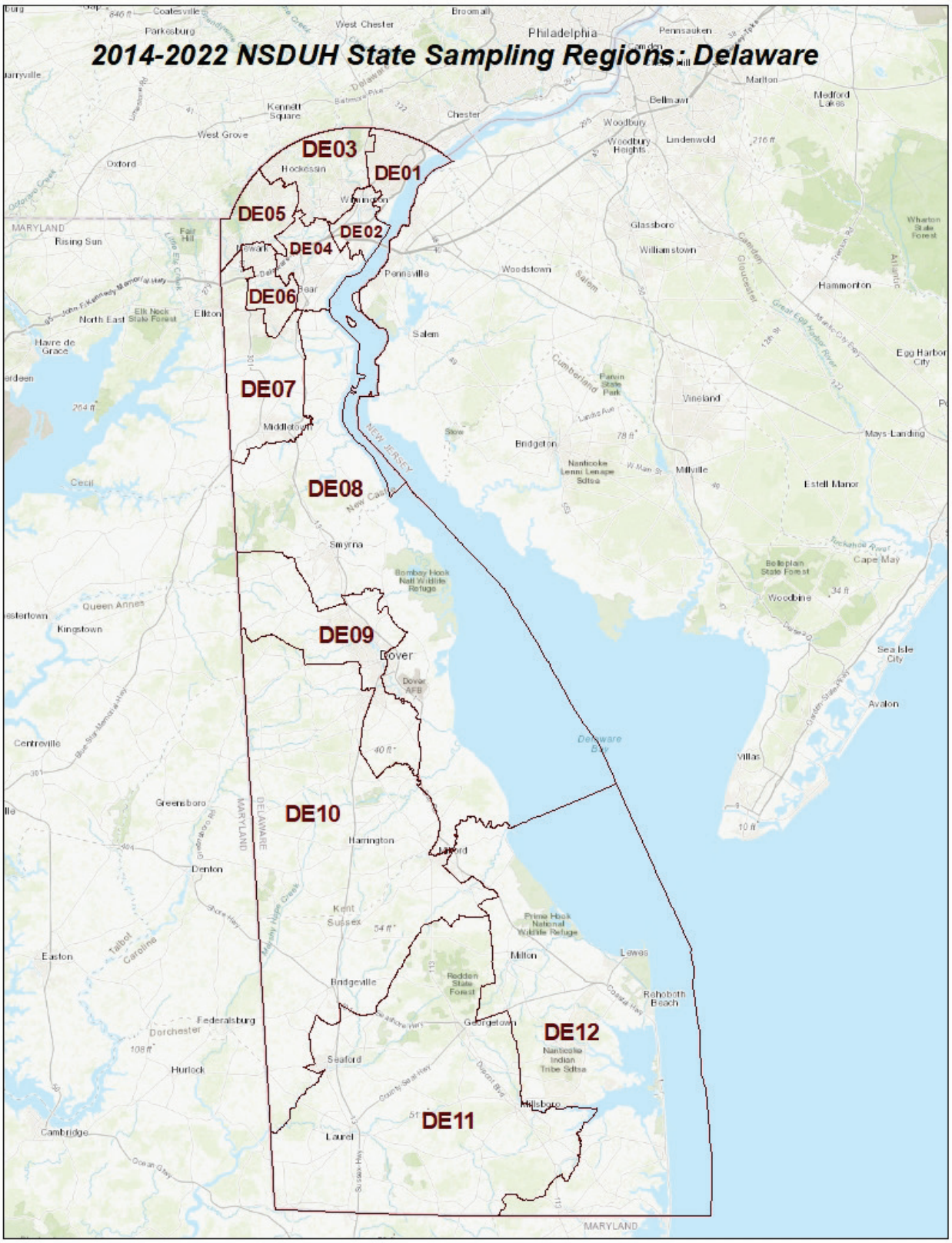
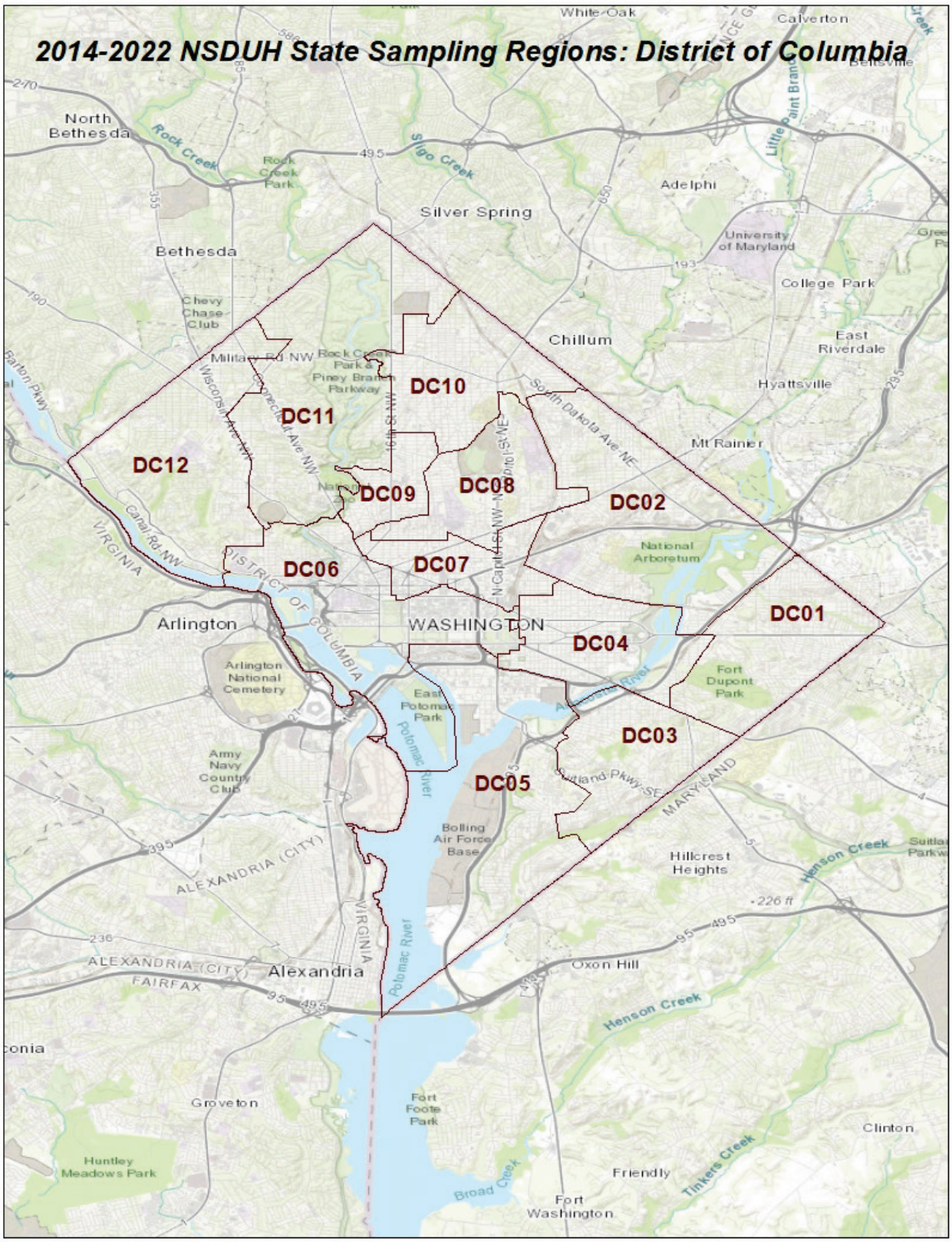
CA28
CA29
CA30
CA31
CA32
CA33
CA34
CA35
CA36

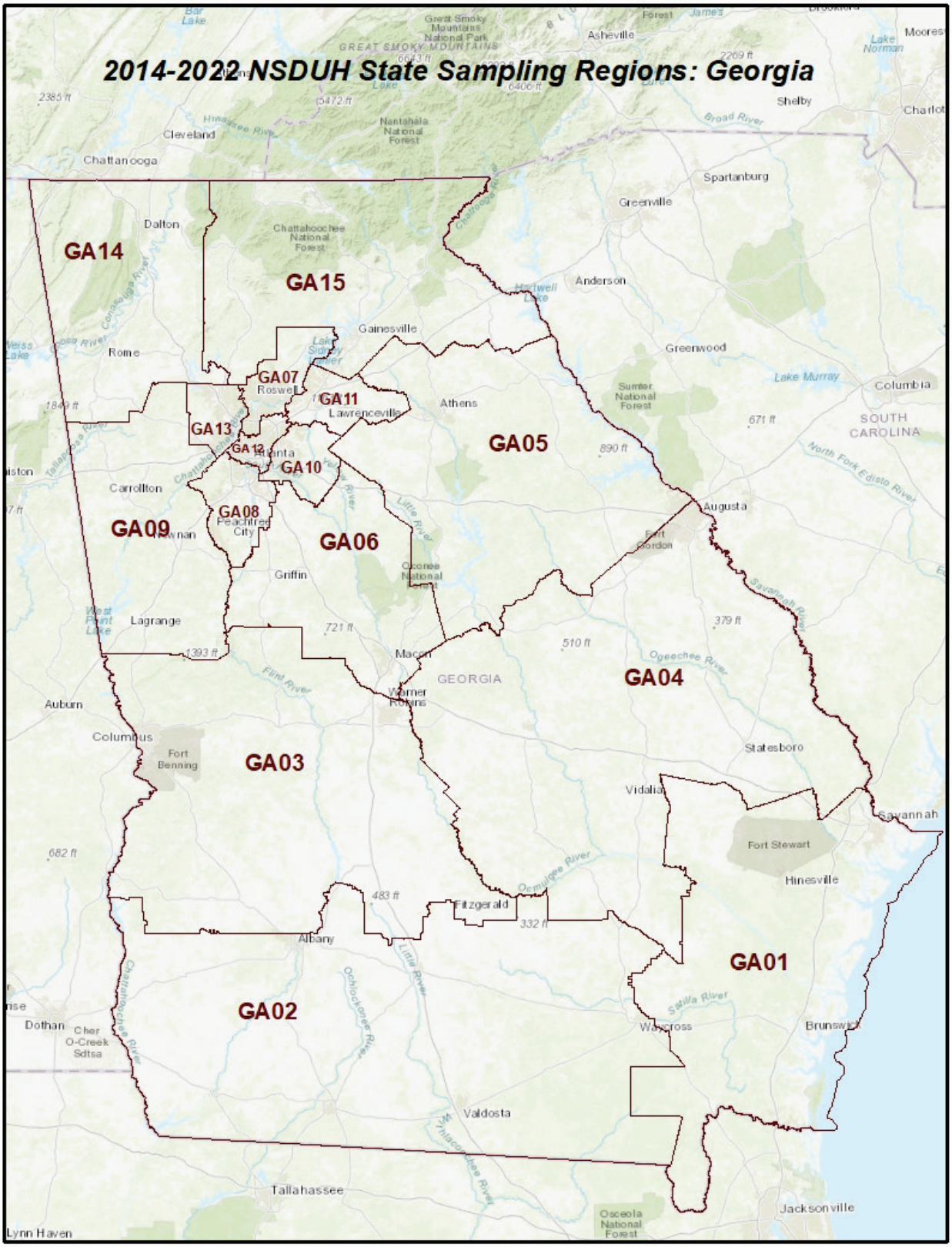

2014-2022 NSDUH State Sampling Regions: Colorado
CO01
CO02
CO03
CO04
CO05
CO06
CO07
CO08
CO09
CO10
CO11
CO12
Cheyenne
Sidney
Fort Collins
Greeley
Fort Morgan
Longmont
Boulder
Denver
Castle Rock
Colorado Springs
Fort Carson
Pueblo
Trimidad
Lamar
Aspen
Gypsum
Craig
Vernal
Grand Junction
Montrose
Gunnison
Monte Vista
COLORADO
SAN LUIS VALLEY
SIERRA MADRE RANGE
PARK RANGE
WEST ELK MOUNTAIN
SAN JUAN MOUNTAINS
UNCOMPAHGRE PLATEAU
Rio Grande
Arkansas River
Colorado River
White River
Yampa River
South Platte River
Gunnison River
Roosevelt National Forest
Routt National Forest
White River National Forest
Arapaho National Forest
Pike National Forest
San Isabel National Forest
Gunnison National Forest
Grand Mesa National Forest
Rio Grande National Forest
San Juan National Forest
Uncompahgre National Forest
Rocky Mountain National Park
Pawnee National Grasslands
Dinosaur National Monument
Curecanti National Recreation Area
Ute Mountain Reservation
Southern Ute Reservation
Navajo Lake
Rio Grande del Norte National Monument
Pinon Canyon Military Reservation
Fort Carson

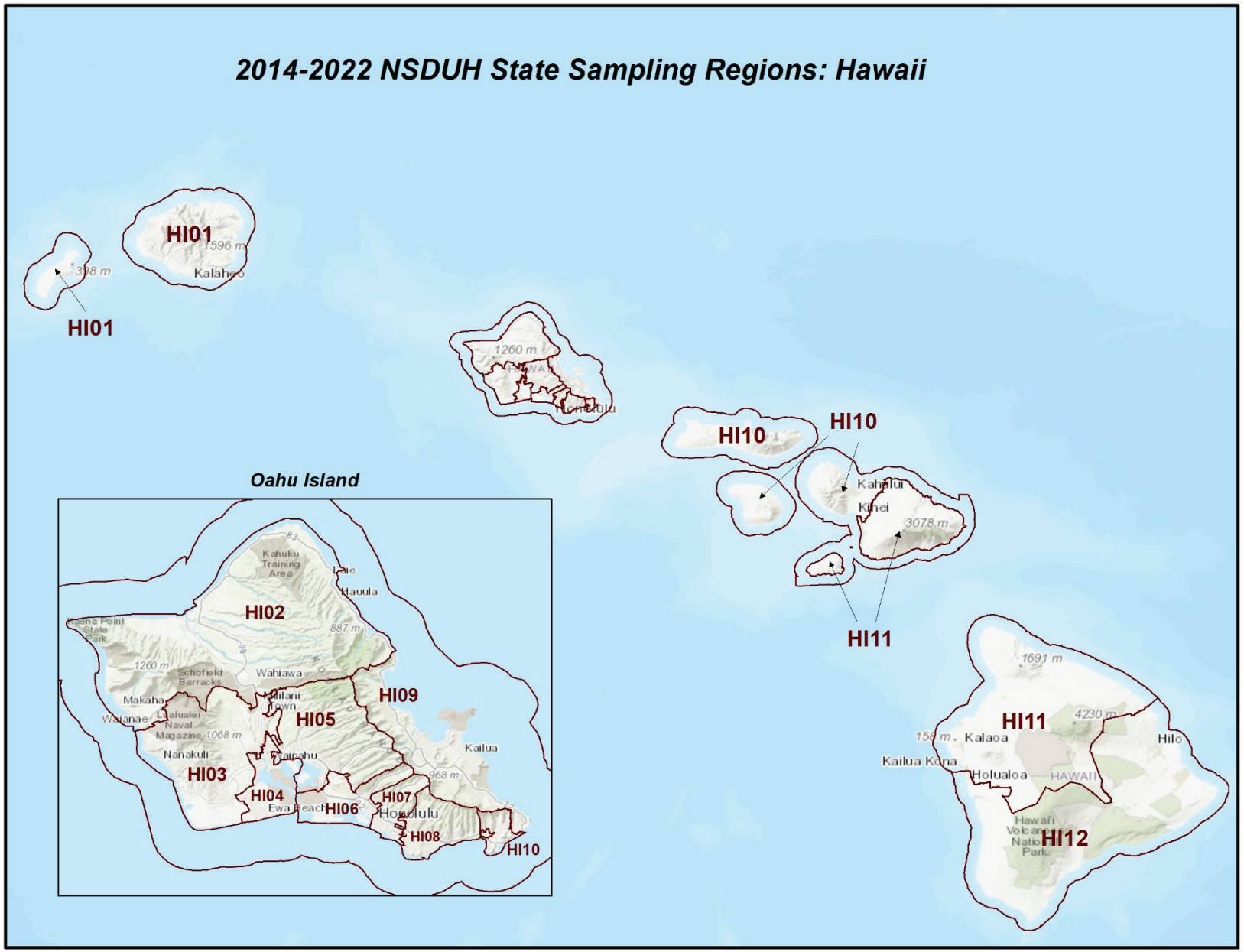

2014-2022 NSDUH State Sampling Regions: Connecticut
CT01
CT02
CT03
CT04
CT05
CT06
CT07
CT08
CT09
CT10
CT11
CT12
Long Island Sound

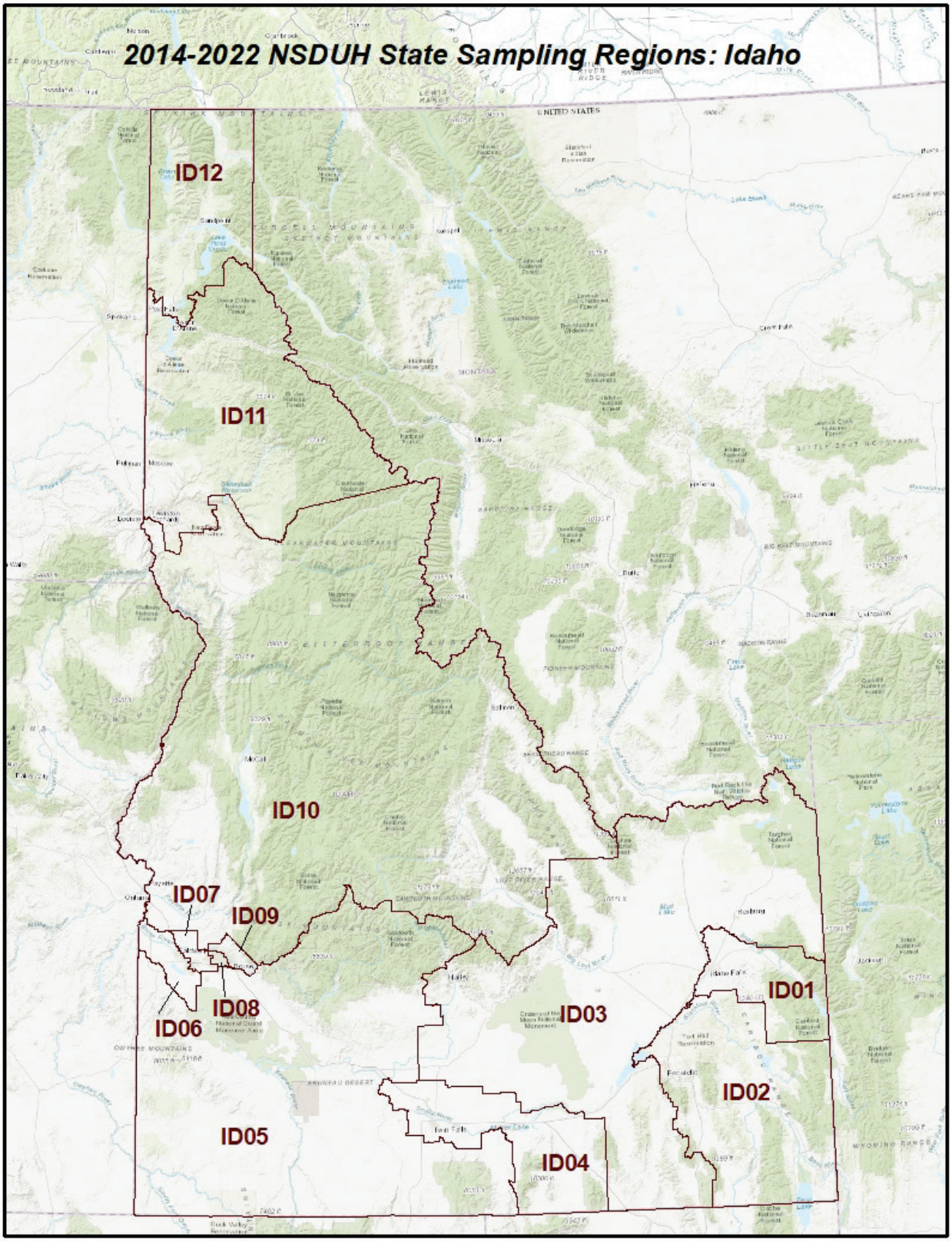

2014-2022 NSDUH State Sampling Regions: Delaware
DE01
DE02
DE03
DE04
DE05
DE06
DE07
DE08
DE09
DE10
DE11
DE12
Philadelphia
Wilmington
Dover
Salisbury
Georgetown
Lewes
Rehoboth Beach
Milford
Seaford
Laurel
Delmar
Bridgeville
Millsboro
Milton
Harrington
Smyrna
Middletown
Newark
Elkton
Chesapeake City
Cape May
Ocean City
Atlantic City
Vineland
Millville
Bridgeton
Salem
Pennsville
Woodstown
Glassboro
Williamstown
Hammonton
Mays Landing
Estell Manor
Egg Harbor City
Avalon
Sea Isle City
Woodbine
Villas
Cape May
Kennett Square
West Chester
Coatesville
Parkesburg
Oxford
West Grove
Hockessin
Bellmawr
Woodbury
Woodbury Heights
Lindenwold
Medford Lakes
Marlton
Pennsauken
Camden
Broomall
MARYLAND
NEW JERSEY
DELAWARE
Rising Sun
Elkton
North East State Forest
Elk Neck State Forest
Havre de Grace
Cecil
Queen Annes
Kent
Sussex
Centreville
Kingstown
Queenstown
Easton
Talbot
Caroline
Denton
Greensboro
Federalsburg
Dorchester
Hurlock
Cambridge
Bombay Hook Natl Wildlife Refuge
Prime Hook National Wildlife Refuge
Redden State Forest
Nanticoke Indian Tribe Sdtsa
Nanticoke Lenni Lenape Sdtsa
Belleplain State Forest
Parvin State Park
Delaware Bay
Atlantic
Wharton State Forest
Great Egg Harbor River
Cumberland
Salem
Gloucester
Camden
Trenton Rd
Blue Star Memorial Hwy
John F Kennedy Memorial Hwy
Ocean Gtwy
Shore Hwy
Coastal Hwy
Dupont Blvd
County Seat Hwy
Susan Hwy
Delaware Memorial Bridge
Dover AFB

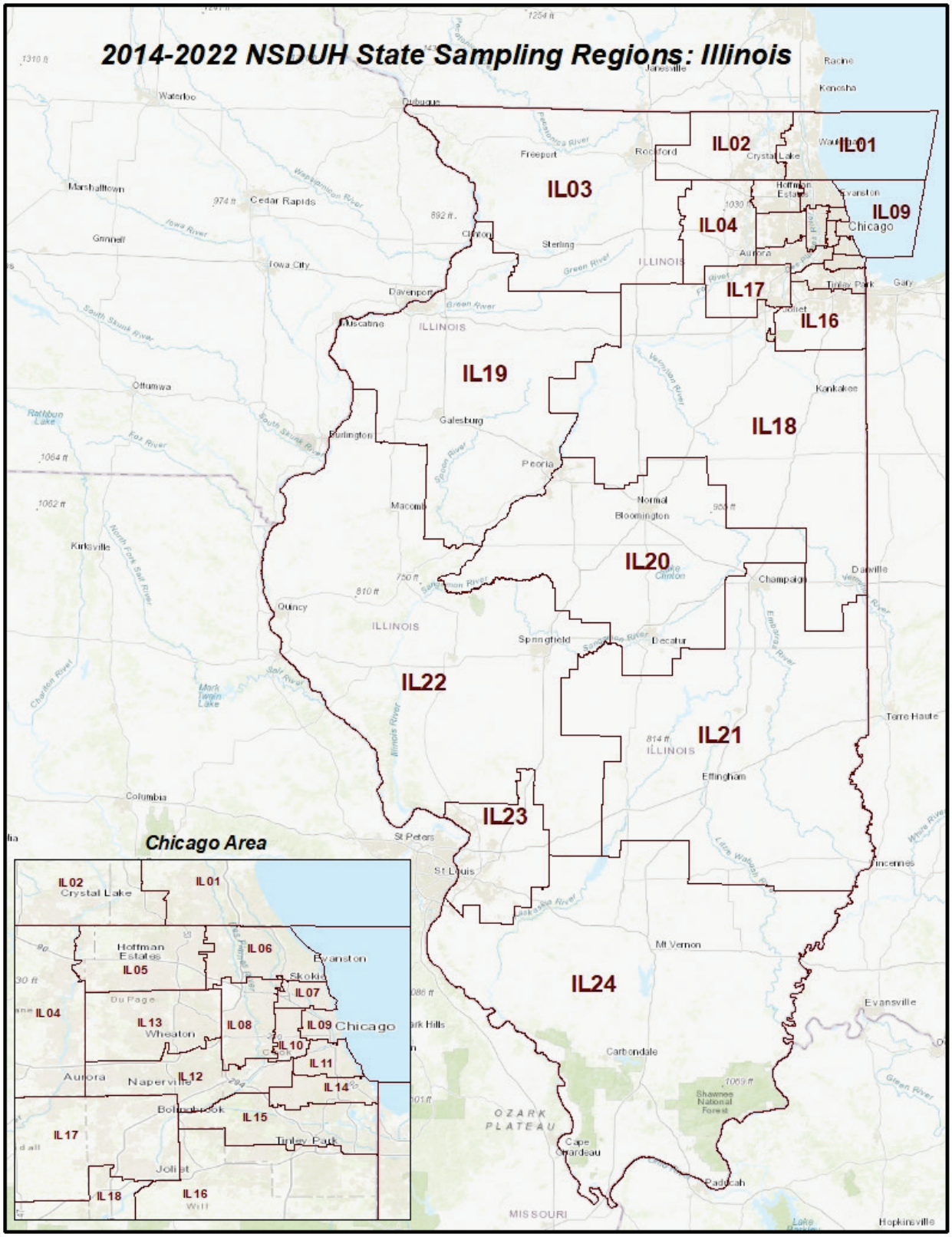

2014-2022 NSDUH State Sampling Regions: District of Columbia
DC01
DC02
DC03
DC04
DC05
DC06
DC07
DC08
DC09
DC10
DC11
DC12
WASHINGTON
Arlington
Alexandria
Silver Spring
Bethesda
North Bethesda
Chillum
Adelphi
College Park
East Riverdale
Hyattsville
Mt Rainier
Hillcrest Heights
Oxon Hill
Fort Washington
Friendly
Clinton
Groveton
Rock Creek
Sligo Creek
Henson Creek
Tinkers Creek
Broad Creek
Potomac River
Anacostia River
DISTRICT OF COLUMBIA
VIRGINIA
MARYLAND
ALEXANDRIA (CITY)
FAIRFAX
Rock Creek Park
Fort Dupont Park
East Potomac Park
Fort Foote Park
Huntley Meadows Park
Arlington National Cemetery
Army Navy Country Club
Bolling Air Force Base
National Arboretum
University of Maryland
Chevy Chase Club
Rock Creek Park & Piney Branch Parkway
Wisconsin Ave NW
Connecticut Ave NW
16th St NW
North Capitol St NW – NE
South Dakota Ave NE
Canal Rd NW
Suitland Pkwy
Little Paint Branch
White Oak
Calverton
Beltsville

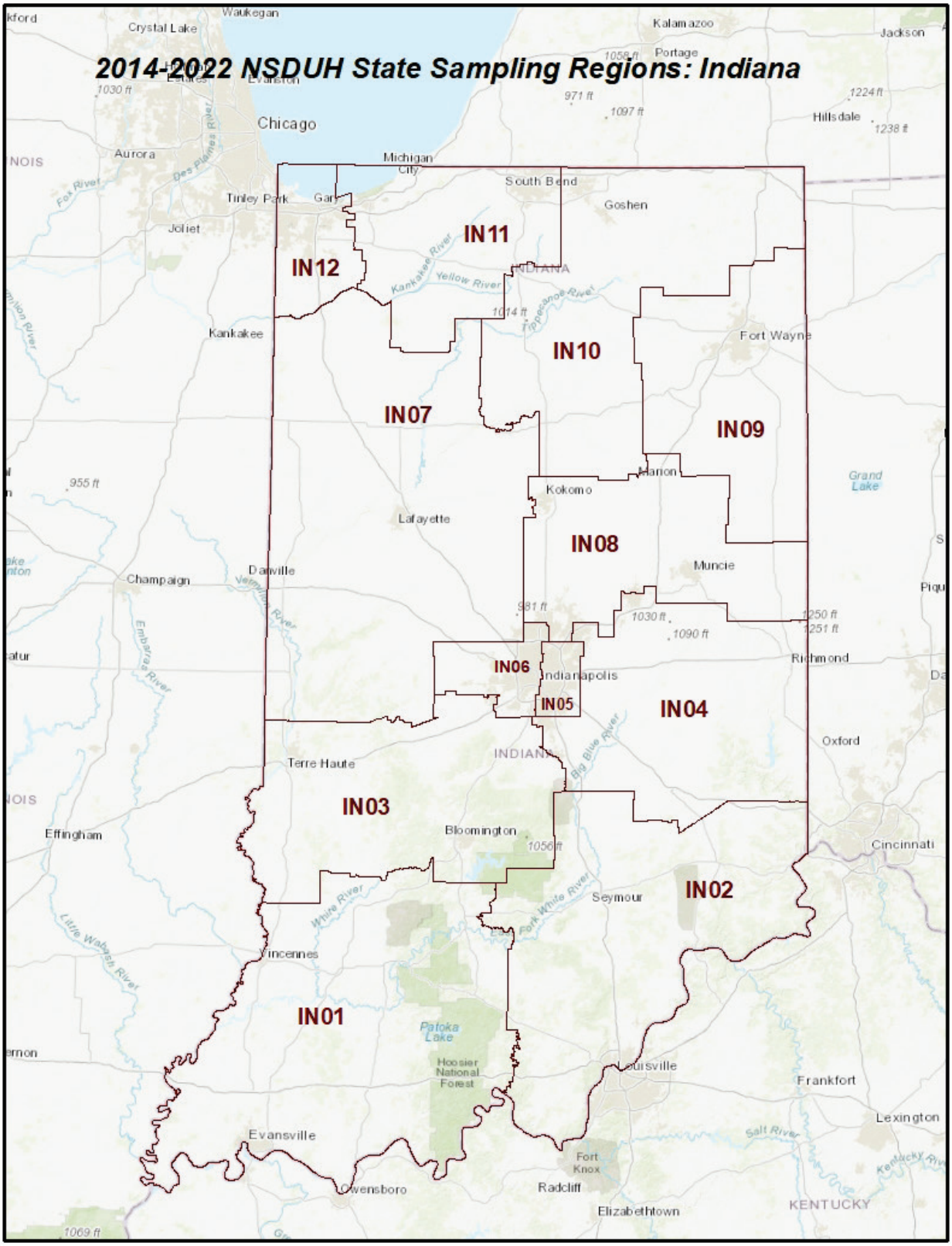

2014-2022 NSDUH State Sampling Regions: Florida
ALABAMA
GEORGIA
Macon
Warner Robins
Columbus
Montgomery
Albany
Dothan
Valdosta
Tallahassee
Pensacola
Eglin Air Force Base
Apalachicola National Forest
Suwannee
Gainesville
Palm Coast
Jacksonville
North Charleston
Charleston
Savannah
Stewart
FL01
FL02
FL03
FL04
FL05
FL06
FL07
FL08
FL09
FL10
FL11
FL12
FL15
FL16
FL17
FL18
FL19
FL20
FL21
FL22
FL23
FL27
FL28
FL30
Tampa Area
Clearwater
Tampa
Lakeland
Petersburg
Sarasota
365 ft
Miami Area
Lake Okeechobee
West Palm Beach
Boca Raton
Coral Springs
Pompano Beach
Pembroke Pines
Hollywood
Miami
Homestead
Biscayne National Park
Everglades National Park
Orlando Area
Daytona Beach
Port Orange
Ocala National Forest
Orlando
Titusville
Melbourne
Palm Bay
Port St Lucie
Cape Coral
Big Cypress National Preserve
Gulf of Mexico
Straits of Florida
Havana

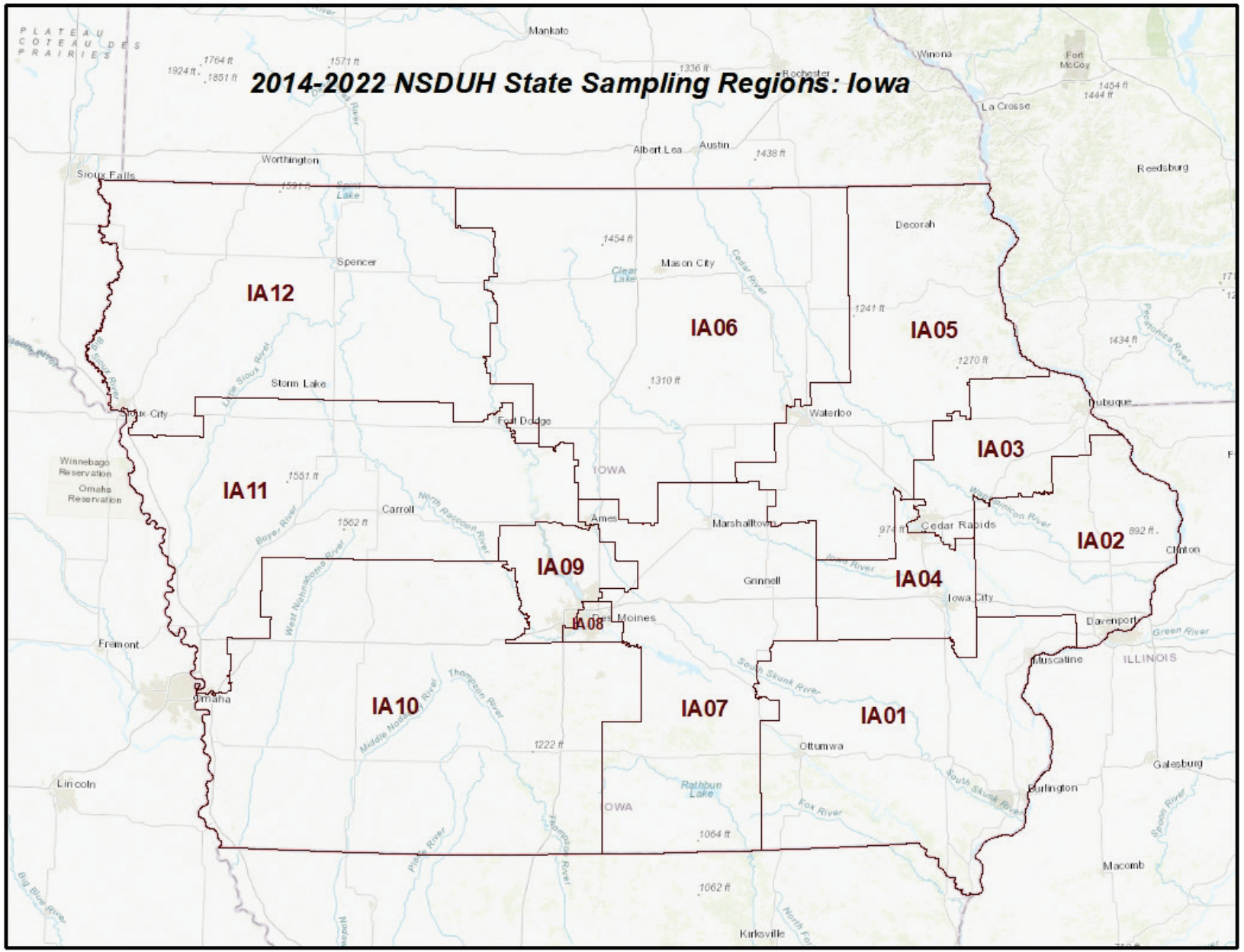

2014-2022 NSDUH State Sampling Regions: Georgia
GA14
GA15
GA07
GA11
GA13
GA12
GA10
GA05
GA08
GA09
GA06
GA04
GA03
GA01
GA02
GEORGIA
Chattanooga
Cleveland
Dalton
Rome
Gainesville
Roswell
Lawrenceville
Athens
Atlanta
Carrollton
Peachtree City
Griffin
Lagrange
Macon
Warner Robins
Auburn
Columbus
Fort Benning
Albany
Fitzgerald
Dothan
Valdosta
Tallahassee
Lynn Haven
Greenville
Spartanburg
Anderson
Greenwood
Augusta
Fort Gordon
Statesboro
Vidalia
Savannah
Fort Stewart
Hinesville
Waycross
Brunswick
Jacksonville
Asheville
Shelby
Columbia
SOUTH CAROLINA
Great Smoky Mountains National Park
Nantahala National Forest
Chattahoochee National Forest
Sumter National Forest
Oconee National Forest
Osceola National Forest

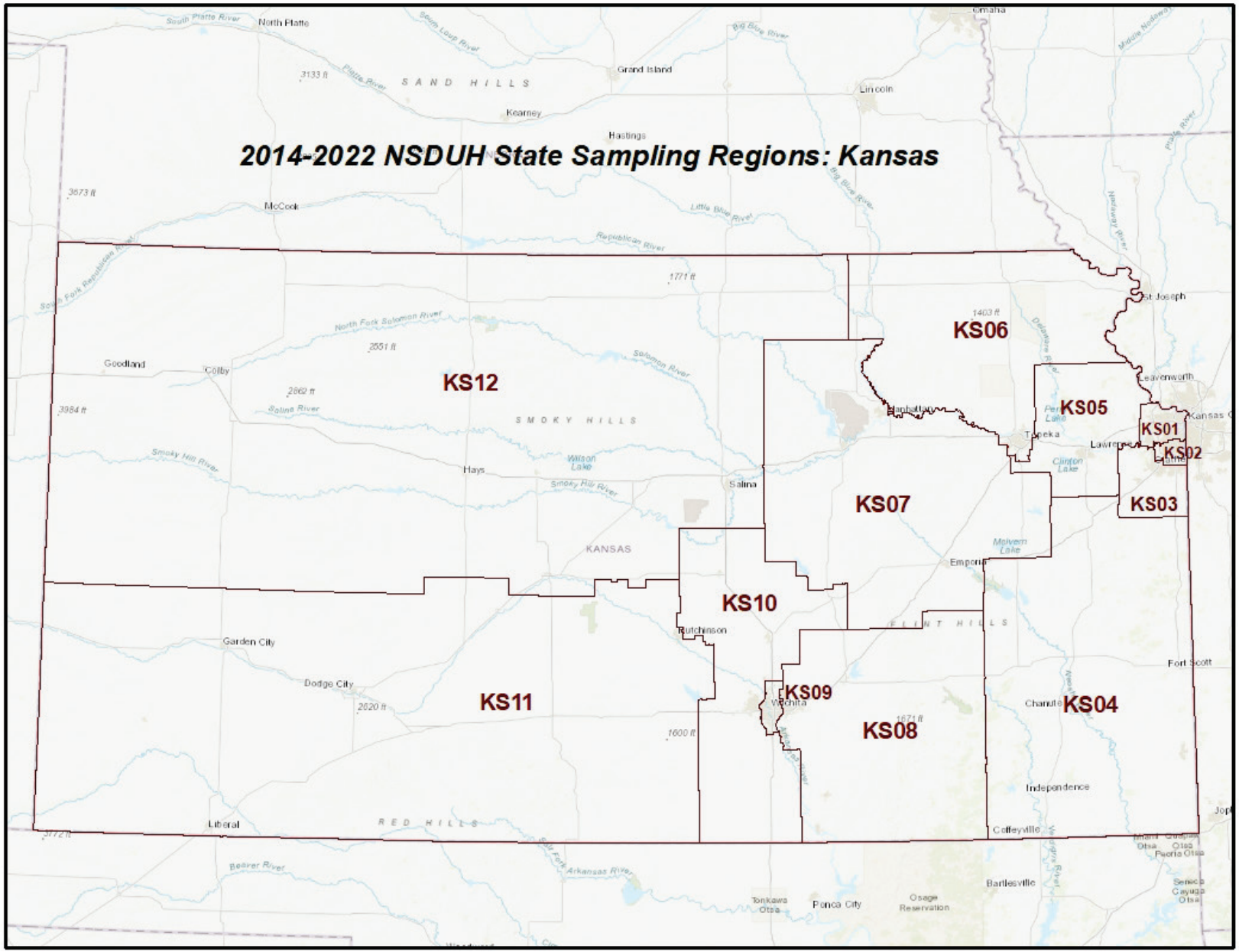

2014-2022 NSDUH State Sampling Regions: Hawaii
HI01
1596 m
Kalaheo
398 m
HI01
1260 m
HI10
HI10
Kahului
Kihei
3078 m
HI11
Oahu Island
Kahuku Training Area
Laie
Hauula
HI02
887 m
Kaena Point State Park
1260 m
Schofield Barracks
Wahiawa
Makaha
Waianae
Lualualei Naval Magazine
1068 m
Mililani Town
HI09
HI05
Nanakuli
Waipahu
Kailua
HI03
968 m
HI04
Ewa Beach
HI06
HI07
Honolulu
HI08
HI10
1691 m
HI11
4230 m
Kalaoa
Hilo
Kailua Kona
Holualoa
HAWAII
Hawai'i Volcanoes National Park
HI12

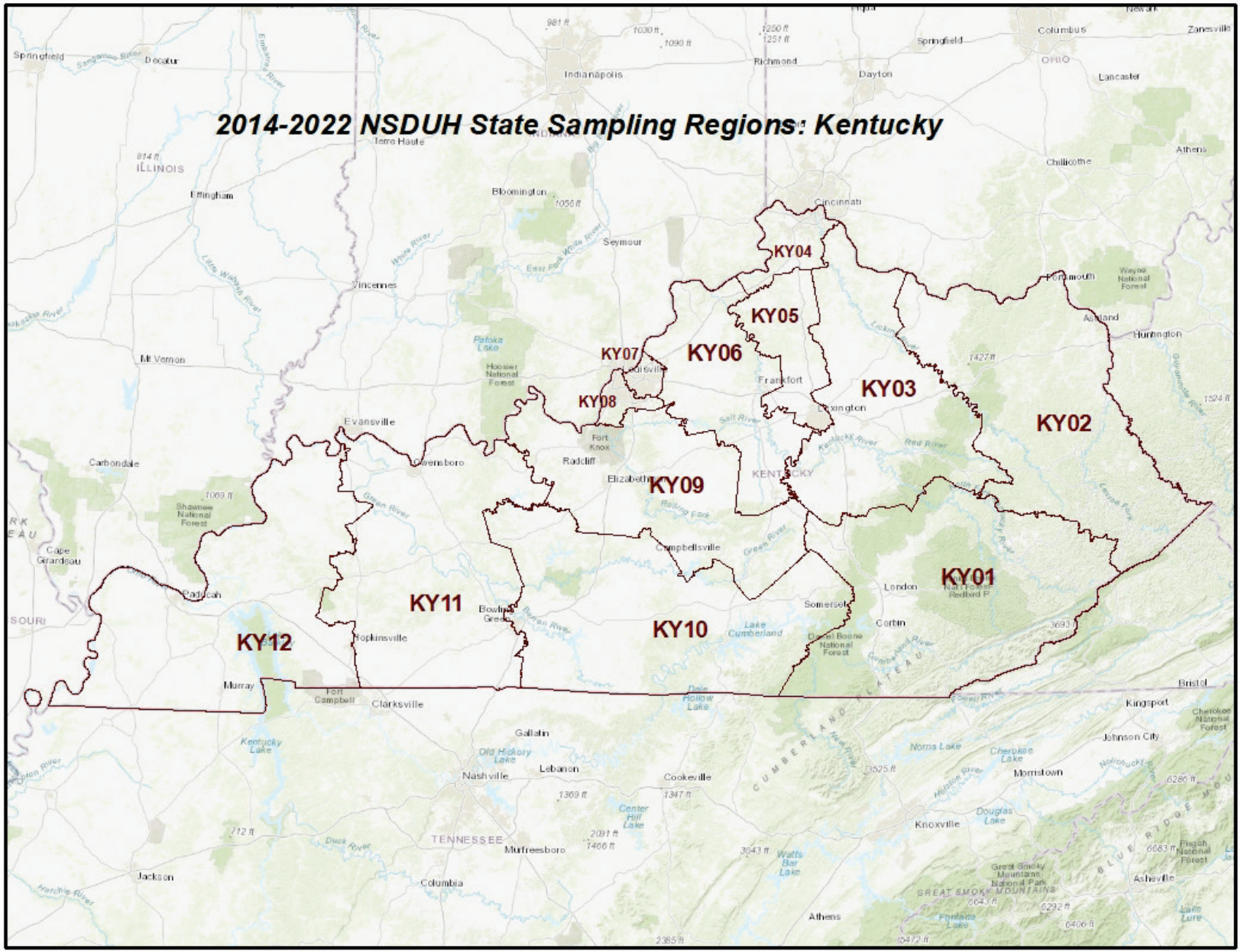

2014-2022 NSDUH State Sampling Regions: Idaho
ID12
ID11
ID10
ID07
ID09
ID06
ID08
ID03
ID01
ID02
ID05
ID04

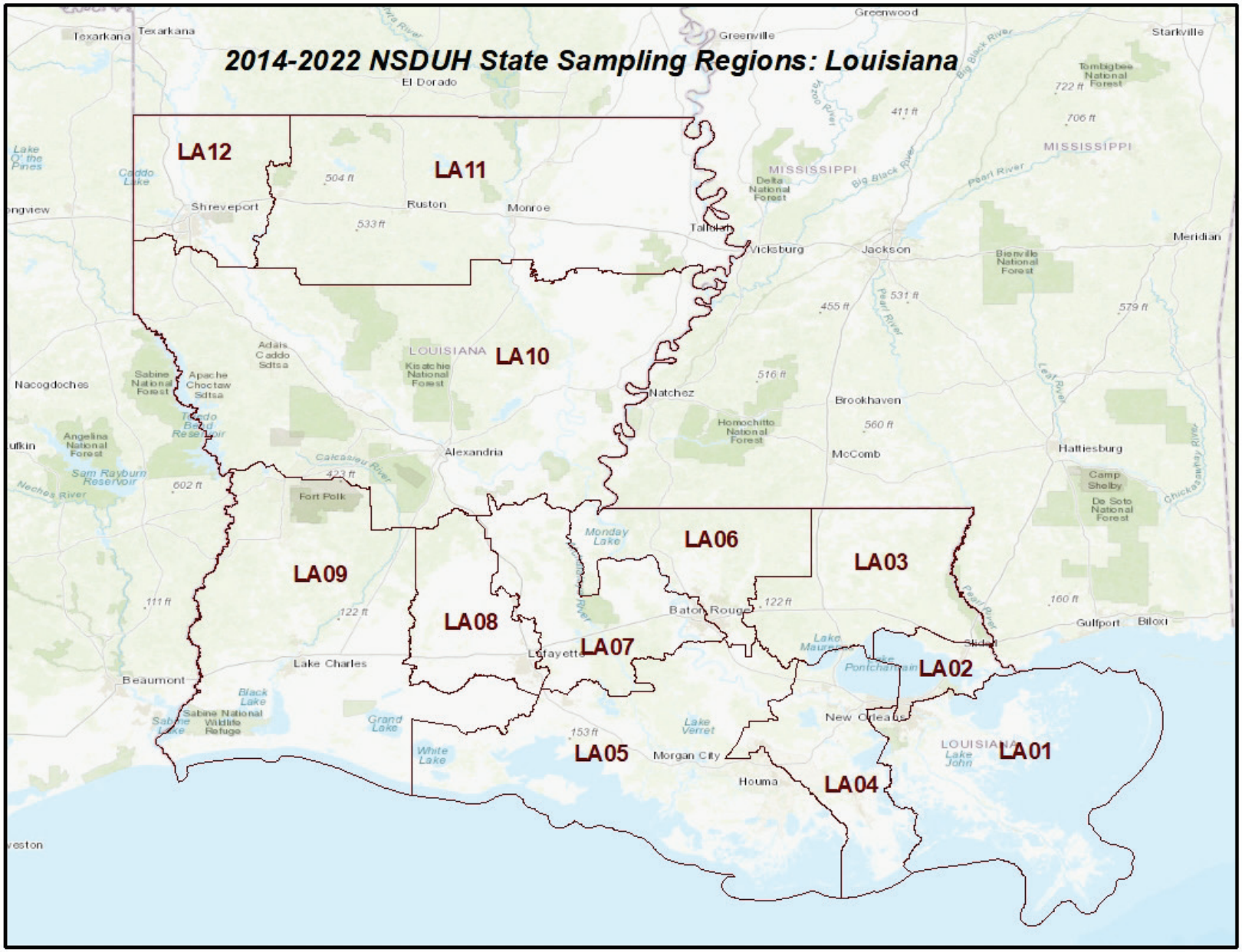

2014-2022 NSDUH State Sampling Regions: Illinois
IL01
IL02
IL03
IL04
IL09
IL16
IL17
IL18
IL19
IL20
IL21
IL22
IL23
IL24
Chicago Area
IL01
IL02
IL04
IL05
IL06
IL07
IL08
IL09
IL10
IL11
IL12
IL13
IL14
IL15
IL16
IL17
IL18
Crystal Lake
Hoffman Estates
Evanston
Skokie
DuPage
Wheaton
Chicago
Aurora
Naperville
Bolingbrook
Tinley Park
Joliet
Will
Waterloo
Dubuque
Freeport
Rockford
Crystal Lake
Janesville
Racine
Kenosha
Marshalltown
Cedar Rapids
Grinnell
Iowa City
Clinton
Sterling
Aurora
Davenport
Muscatine
Ottumwa
Galesburg
Burlington
Peoria
Macomb
Normal
Bloomington
Kankakee
Champaign
Danville
Kirksville
Quincy
Springfield
Decatur
Terre Haute
Effingham
Columbia
St Peters
St Louis
Mt Vernon
Evansville
Carbondale
Shawnee National Forest
OZARK PLATEAU
Cape Girardeau
Paducah
MISSOURI
Hopkinsville
ILLINOIS


2014-2022 NSDUH State Sampling Regions: Indiana
IN01
IN02
IN03
IN04
IN05
IN06
IN07
IN08
IN09
IN10
IN11
IN12
Chicago
Waukegan
Crystal Lake
Kalamazoo
Jackson
Portage
Hillsdale
Aurora
Michigan City
South Bend
Goshen
Tinley Park
Gary
Joliet
Kankakee
Fort Wayne
Kokomo
Marion
Lafayette
Muncie
Champaign
Danville
Richmond
Indianapolis
Terre Haute
Oxford
Bloomington
Cincinnati
Seymour
Effingham
Vincennes
Evansville
Hoosier National Forest
Louisville
Frankfort
Lexington
Fort Knox
Radcliff
Elizabethtown
Owensboro
KENTUCKY
INDIANA
Grand Lake
Patoka Lake
Yellow River
Kankakee River
Fox River
Des Plaines River
Vermilion River
Embarras River
Big Blue River
White River
Salt River

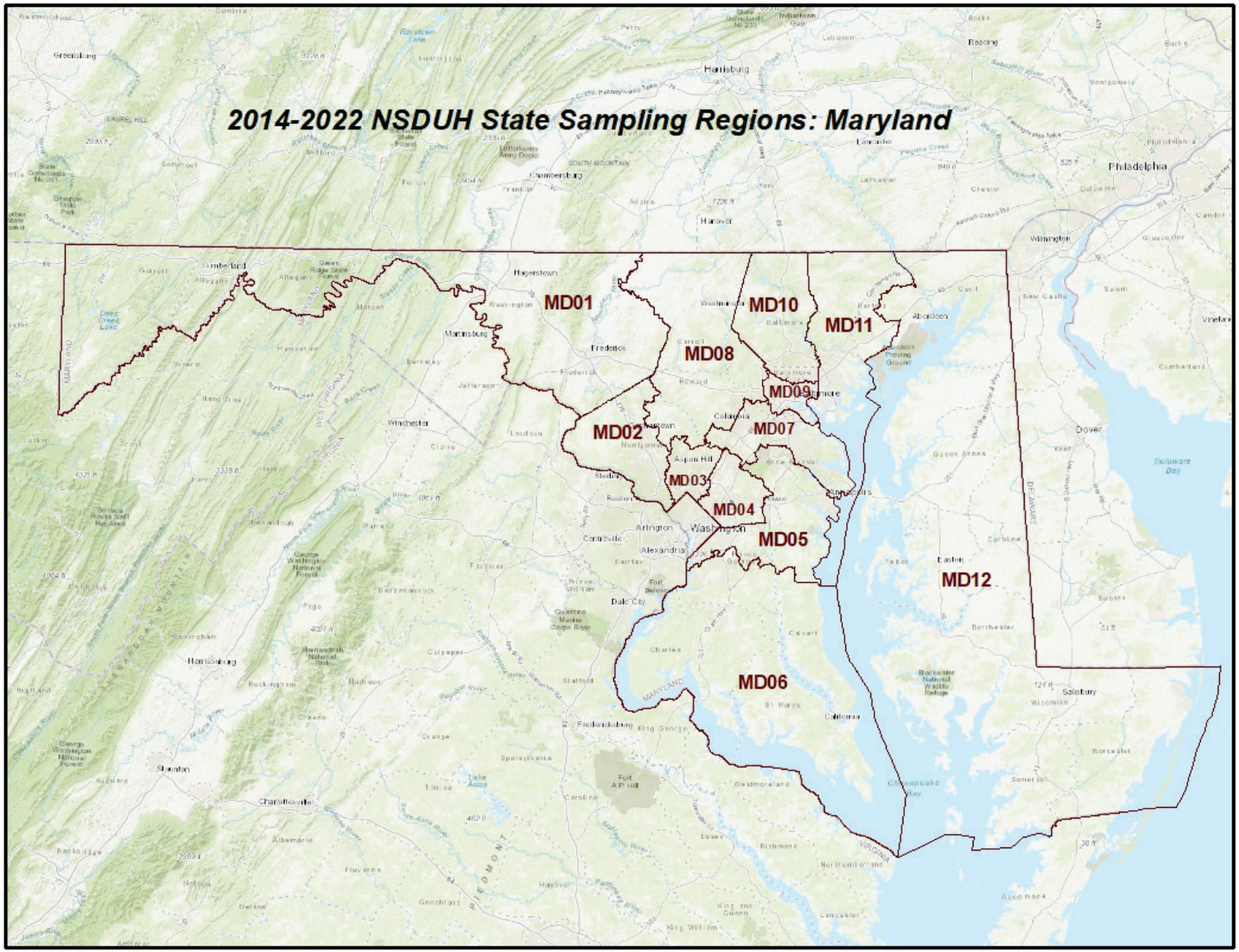

2014-2022 NSDUH State Sampling Regions: Iowa
IA12
IA06
IA05
IA11
IA03
IA09
IA02
IA04
IA08
IA10
IA07
IA01
Mankato
Winona
La Crosse
Rochester
Albert Lea
Austin
Worthington
Sioux Falls
Reedsburg
Decorah
Spencer
Mason City
Storm Lake
Sioux City
Fort Dodge
Waterloo
Dubuque
Winnebago Reservation
Omaha Reservation
IOWA
Carroll
Ames
Marshalltown
Cedar Rapids
Clinton
Grinnell
Iowa City
Des Moines
Davenport
Fremont
Omaha
Muscatine
ILLINOIS
Ottumwa
Galesburg
Burlington
Lincoln
Macomb
Kirksville

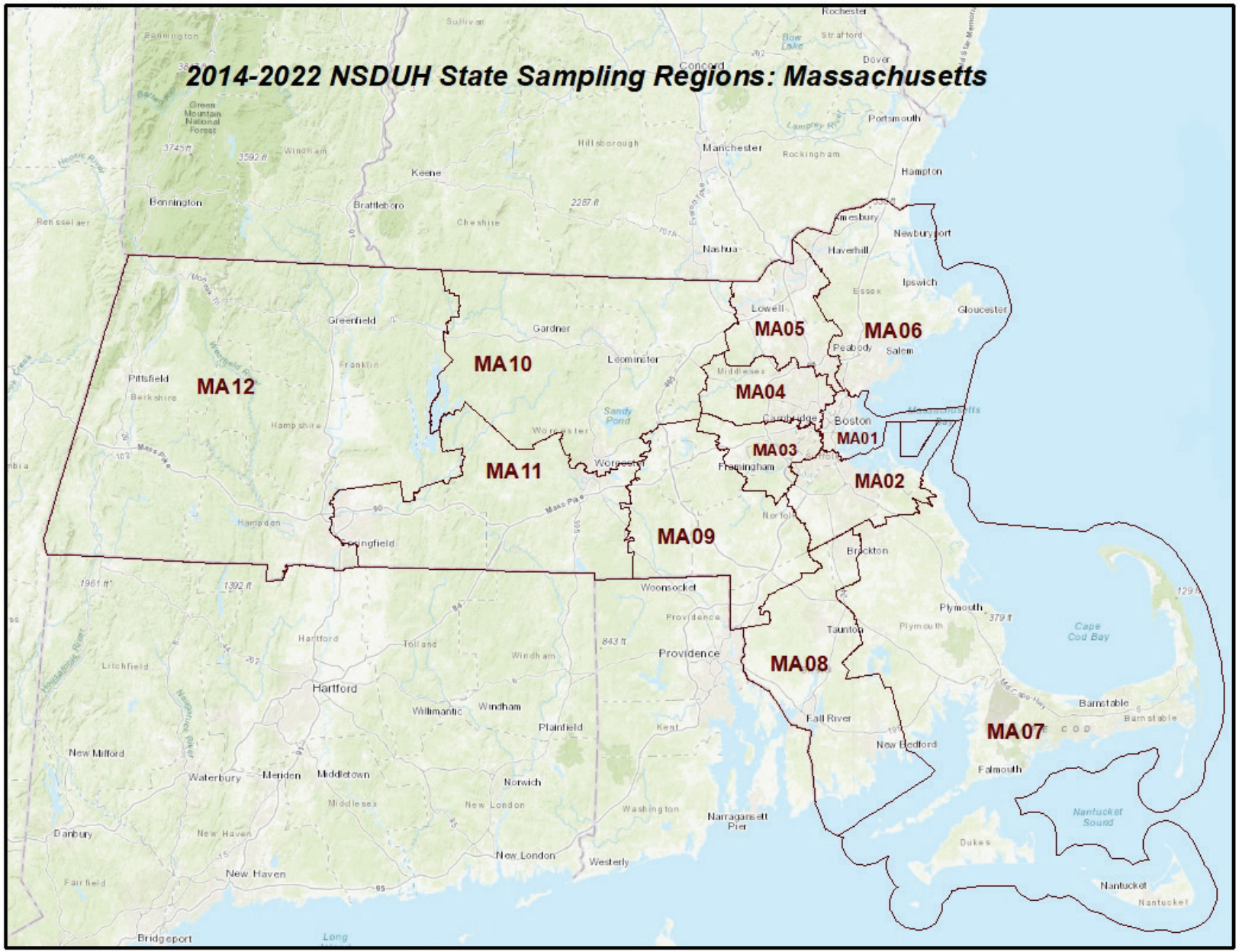

2014-2022 NSDUH State Sampling Regions: Kansas
KS01
KS02
KS03
KS04
KS05
KS06
KS07
KS08
KS09
KS10
KS11
KS12
North Platte
Grand Island
Lincoln
Omaha
Kearney
Hastings
McCook
Goodland
Colby
Hays
Salina
Manhattan
Topeka
Lawrence
Leavenworth
St Joseph
Emporia
Hutchinson
Garden City
Dodge City
Liberal
Wichita
Chanute
Fort Scott
Independence
Coffeyville
Bartlesville
Ponca City
SAND HILLS
SMOKY HILLS
FLINT HILLS
RED HILLS
KANSAS

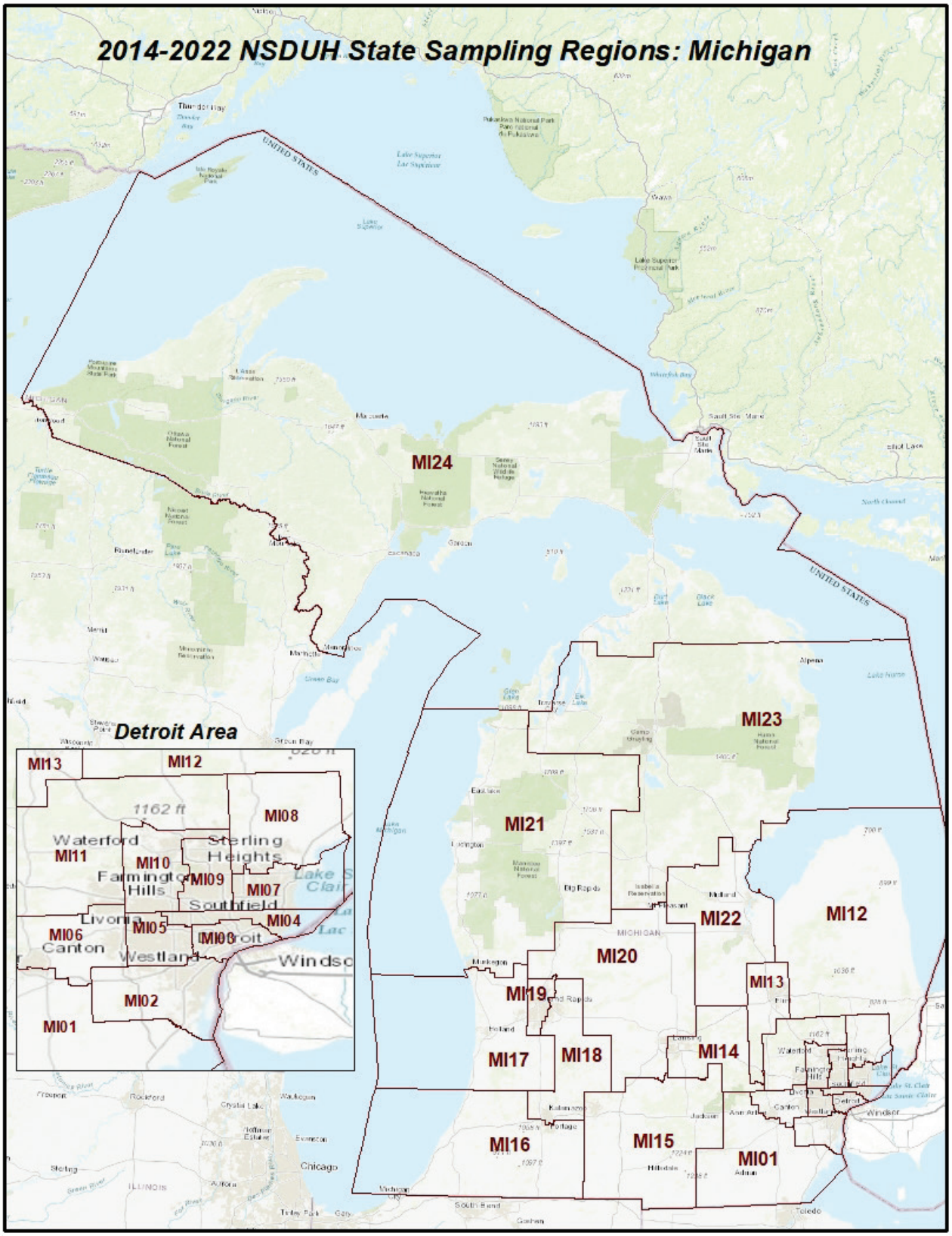

2014-2022 NSDUH State Sampling Regions: Kentucky
KY01
KY02
KY03
KY04
KY05
KY06
KY07
KY08
KY09
KY10
KY11
KY12
Springfield
Decatur
Indianapolis
Richmond
Dayton
Columbus
Zanesville
Lancaster
Chillicothe
Athens
Cincinnati
Terre Haute
ILLINOIS
Effingham
Bloomington
Seymour
Vincennes
Mt Vernon
Evansville
Owensboro
Carbondale
Cape Girardeau
Paducah
Hopkinsville
Murray
Fort Campbell
Clarksville
Radcliff
Fort Knox
Elizabethtown
Campbellsville
Frankfort
Lexington
Somerset
London
Corbin
Portsmouth
Ashland
Huntington
Bristol
Kingsport
Johnson City
Morristown
Knoxville
Asheville
Gallatin
Nashville
Lebanon
Cookeville
Murfreesboro
TENNESSEE
Columbia
Jackson
Athens
Kentucky Lake
Lake Cumberland
Center Hill Lake
Watts Bar Lake
Norris Lake
Douglas Lake
Fontana Lake
Great Smoky Mountains National Park
GREAT SMOKY MOUNTAINS
Daniel Boone National Forest
Hoosier National Forest
Shawnee National Forest
Wayne National Forest
Pine Mountain
Redbird P
CUMBERLAND PLATEAU
BLUE RIDGE MOUNTAINS
OHIO
KENTUCKY
SOURI

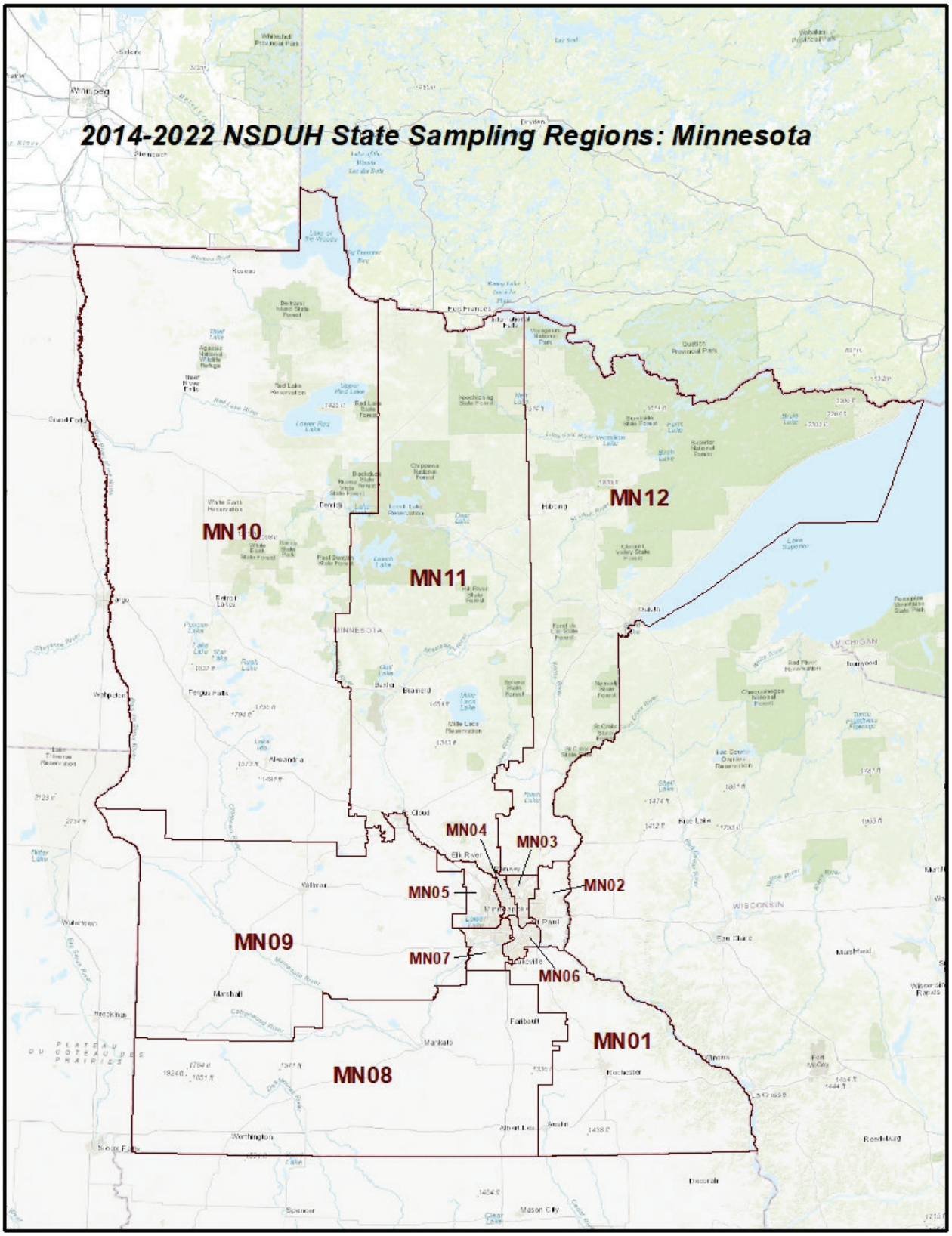

2014-2022 NSDUH State Sampling Regions: Louisiana
LA12
LA11
LA10
LA09
LA08
LA07
LA06
LA05
LA04
LA03
LA02
LA01
Texarkana
Shreveport
Ruston
Monroe
Vicksburg
Jackson
Natchez
Brookhaven
McComb
Alexandria
Fort Polk
Lake Charles
Beaumont
Lafayette
Baton Rouge
Morgan City
Houma
New Orleans
Hattiesburg
Gulfport
Biloxi
Meridian
Greenville
Greenwood
Starkville
El Dorado
Tallulah
Nacogdoches
MISSISSIPPI
LOUISIANA

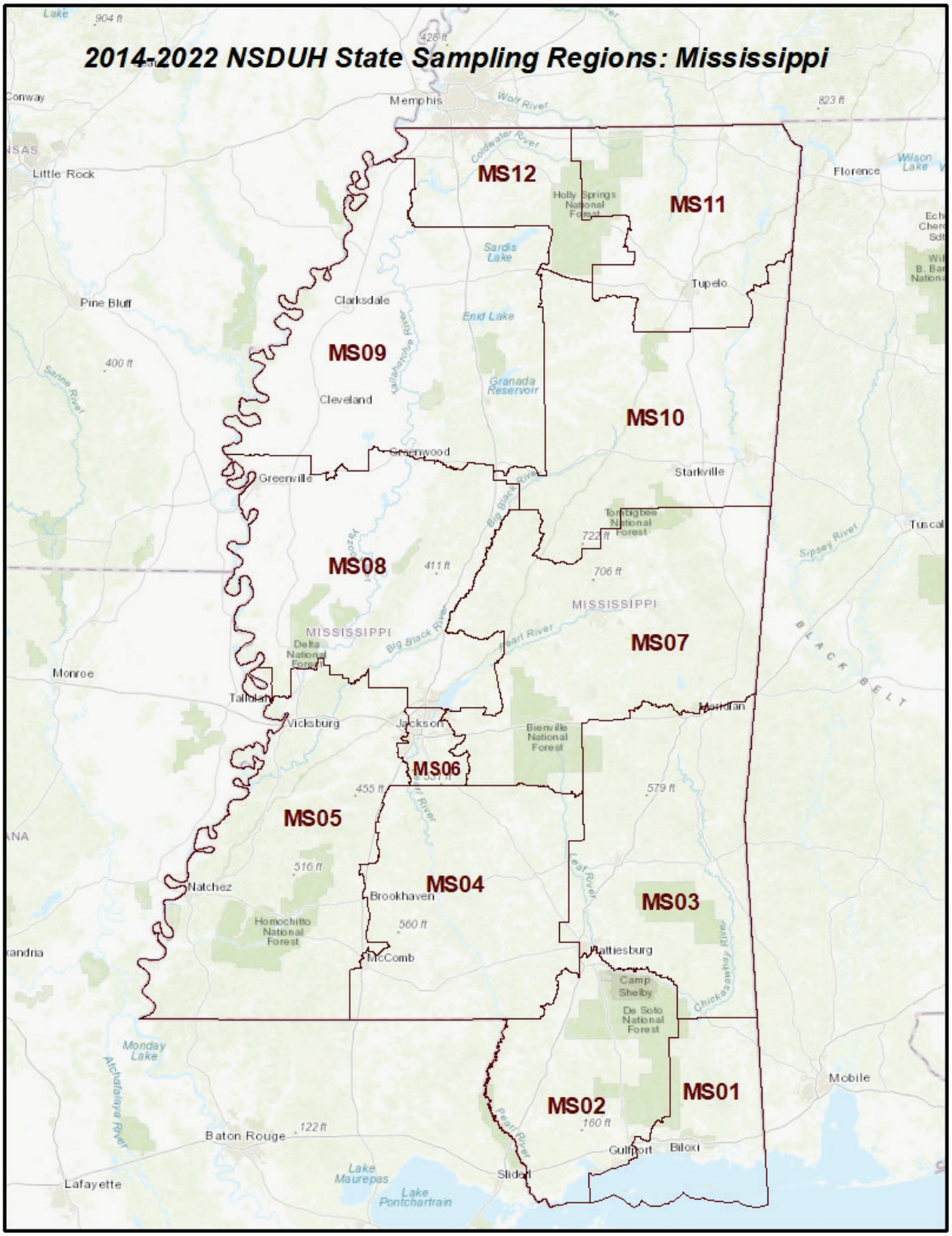

2014-2022 NSDUH State Sampling Regions: Maine
ME12
ME11
ME09
ME10
ME07
ME03
ME08
ME06
ME05
ME02
ME04
ME01
Québec
Lévis
Edmundston
Caribou
Thetford Mines
Saint-Georges
Baxter State Park
Millinocket
Lincoln
Bangor
Berlin
Augusta
Lewiston
Auburn
Brunswick
Portland
Sanford
Rochester
Dover
Concord
Manchester
Portsmouth
Conway
MAINE
NEW HAMPSHIRE
WHITE MOUNTAINS
BOUNDARY MOUNTAINS
BLUE MOUNTAINS
Moosehead Lake
Long Pond
Sebec Lake
Flagstaff Lake
Eagle Lake
Big Lake
Connecticut River
Androscoggin River
Saco River
Sebago Lake
Piscataquis River
Rivière-du-Loup
Rivière Henry
Fredericton
NEW BR
NOUVEAU-
Golfe du Maine

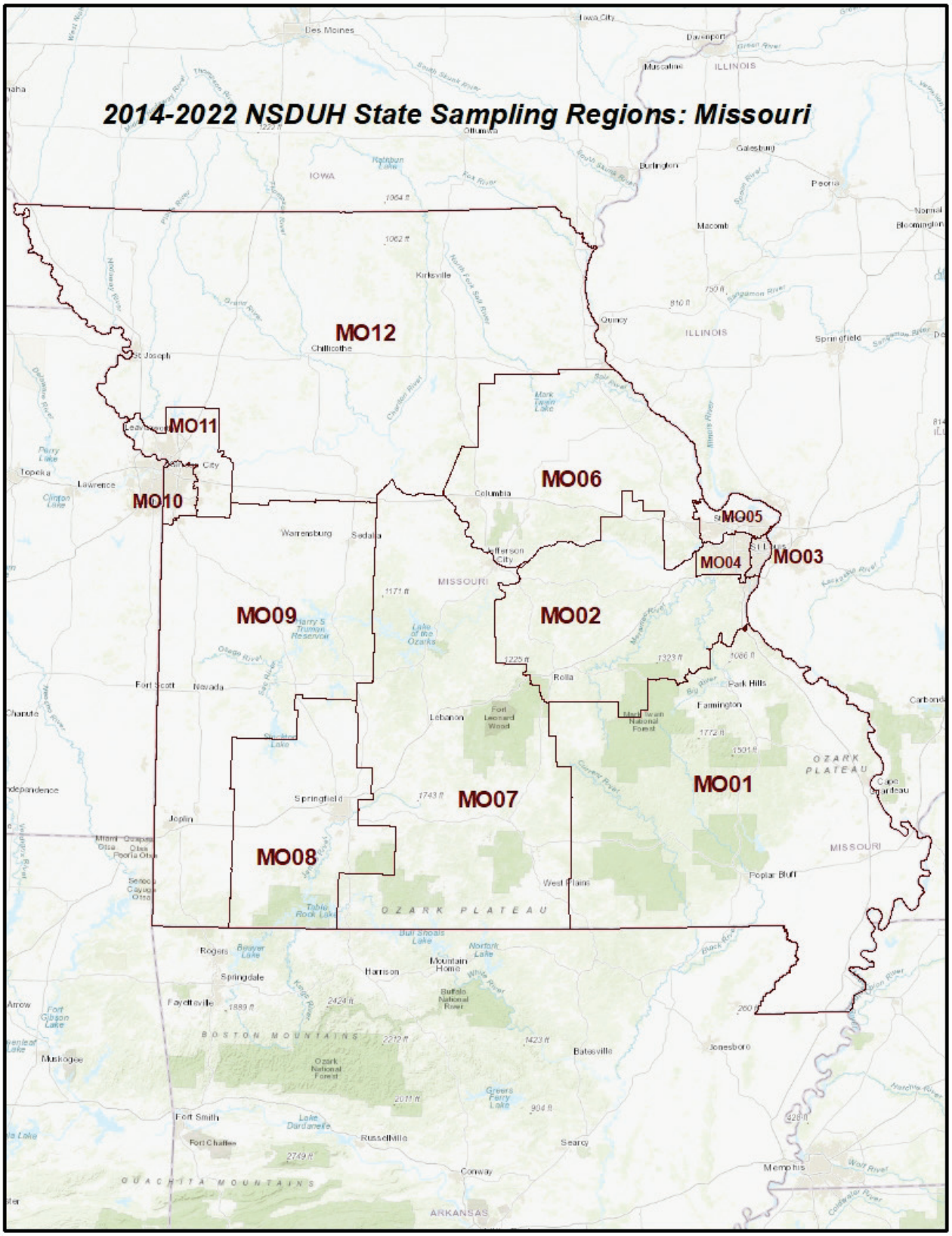

2014-2022 NSDUH State Sampling Regions: Maryland
MD01
MD02
MD03
MD04
MD05
MD06
MD07
MD08
MD09
MD10
MD11
MD12

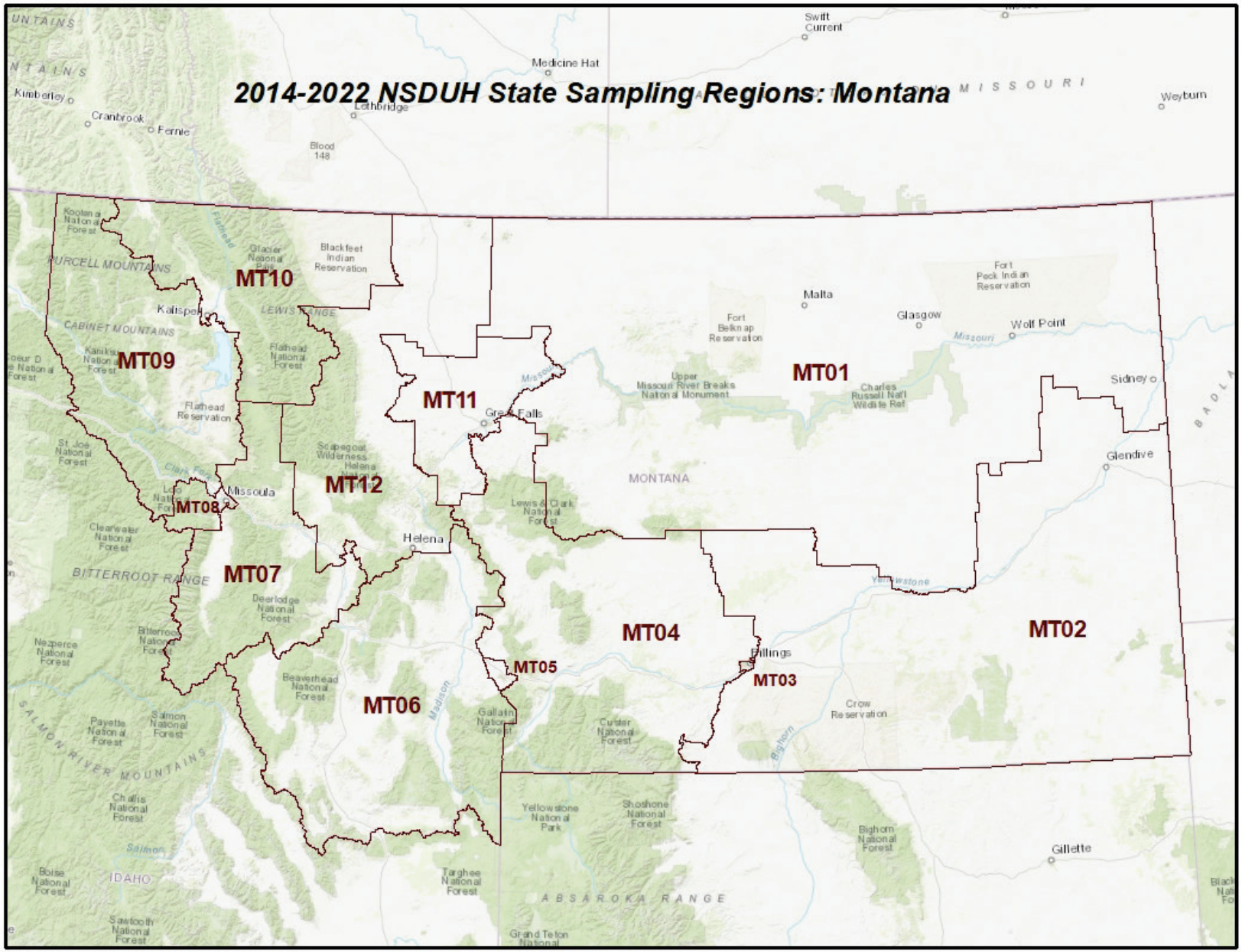

2014-2022 NSDUH State Sampling Regions: Massachusetts
MA01
MA02
MA03
MA04
MA05
MA06
MA07
MA08
MA09
MA10
MA11
MA12

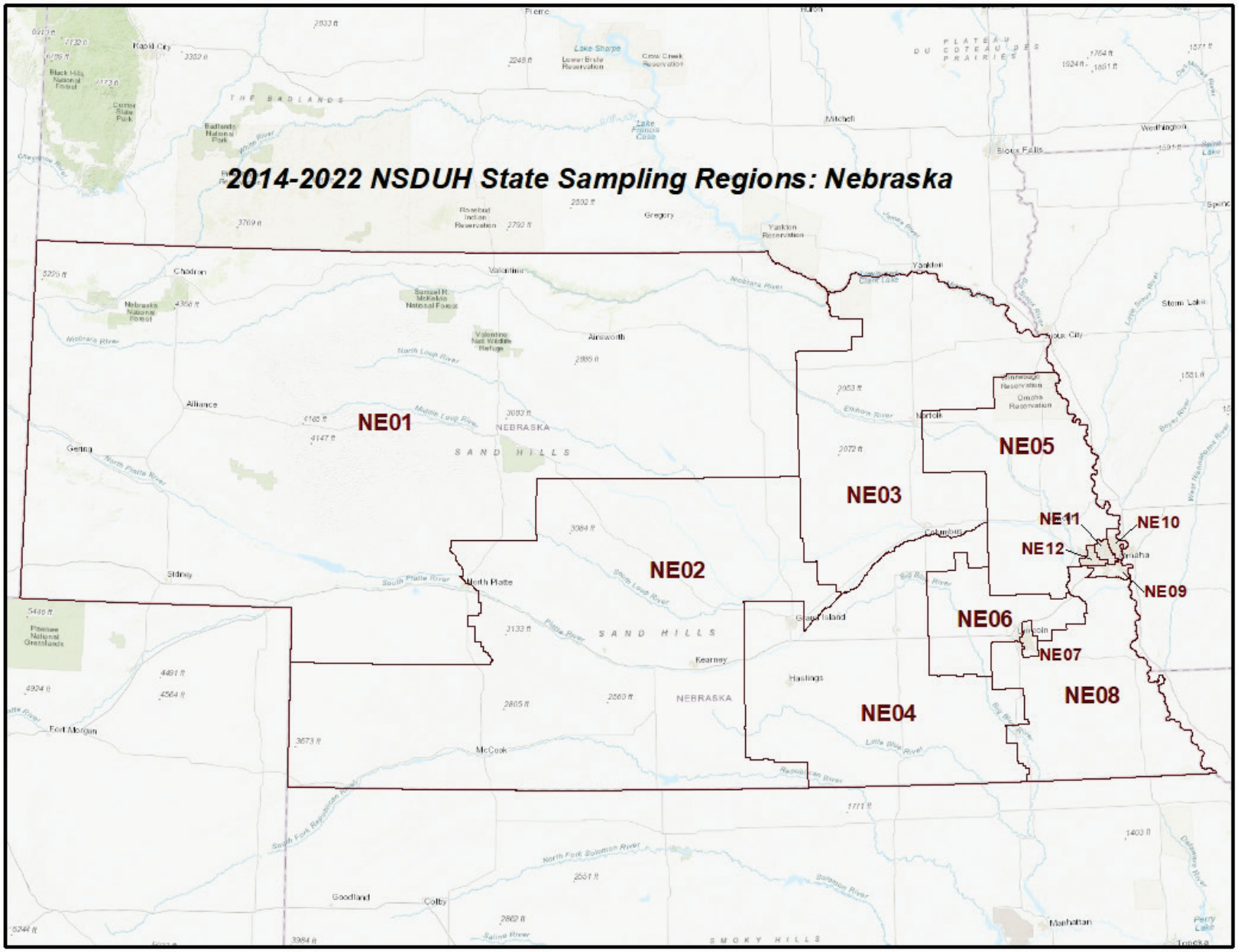

2014-2022 NSDUH State Sampling Regions: Michigan
MI24
MI23
MI21
MI22
MI12
MI20
MI13
MI19
MI14
MI17
MI18
MI16
MI15
MI01
Detroit Area
MI13
MI12
MI08
MI11
MI10
MI09
MI07
MI04
MI05
MI06
MI03
MI02
MI01
Waterford
Sterling Heights
Farmington Hills
Southfield
Livonia
Canton
Westland
Detroit
1162 ft
UNITED STATES
MICHIGAN
Chicago
ILLINOIS

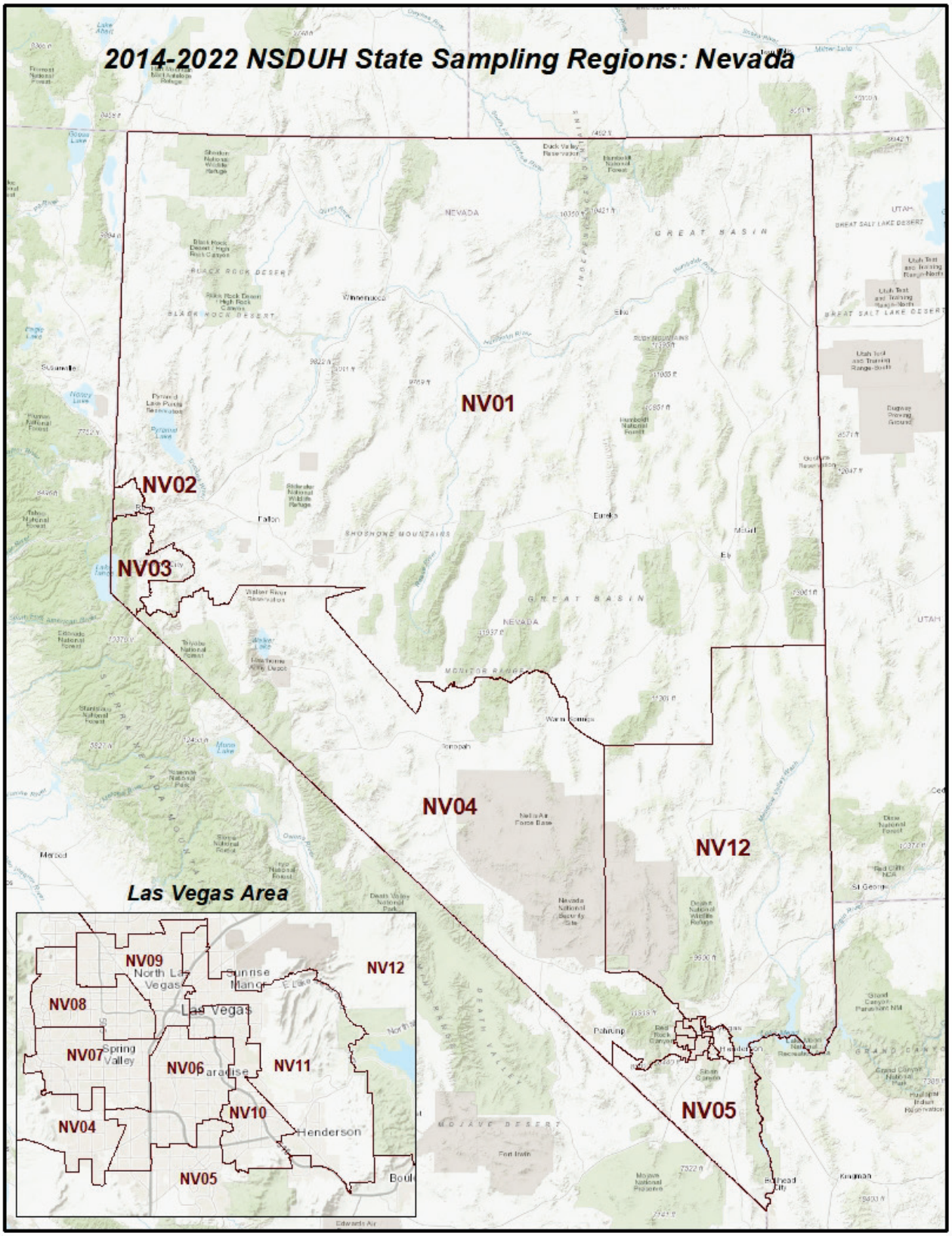

2014-2022 NSDUH State Sampling Regions: Minnesota
MN01
MN02
MN03
MN04
MN05
MN06
MN07
MN08
MN09
MN10
MN11
MN12


2014-2022 NSDUH State Sampling Regions: Mississippi
MS12
MS11
MS09
MS10
MS08
MS07
MS06
MS05
MS04
MS03
MS02
MS01
Memphis
Little Rock
Pine Bluff
Clarksdale
Tupelo
Cleveland
Greenwood
Greenville
Starkville
Monroe
Vicksburg
Jackson
Meridian
Natchez
Brookhaven
Hattiesburg
McComb
Baton Rouge
Lafayette
Gulfport
Biloxi
Mobile
Florence
Tuscaloo
MISSISSIPPI
Holly Springs National Forest
Tombigbee National Forest
Delta National Forest
Bienville National Forest
Homochitto National Forest
De Soto National Forest
Camp Shelby
Sardis Lake
Enid Lake
Granada Reservoir
Wolf River
Coldwater River
Big Black River
Pearl River
Yalobusha River
Tallahatchie River
Sunflower River
Leaf River
Chickasawhay River
Pascagoula River
Sipsey River
Wilson Lake
Monday Lake
Lake Maurepas
Lake Pontchartrain
Atchafalaya River
Saline River
BLACK BELT
904 ft
428 ft
823 ft
400 ft
722 ft
706 ft
411 ft
455 ft
579 ft
516 ft
560 ft
122 ft
160 ft

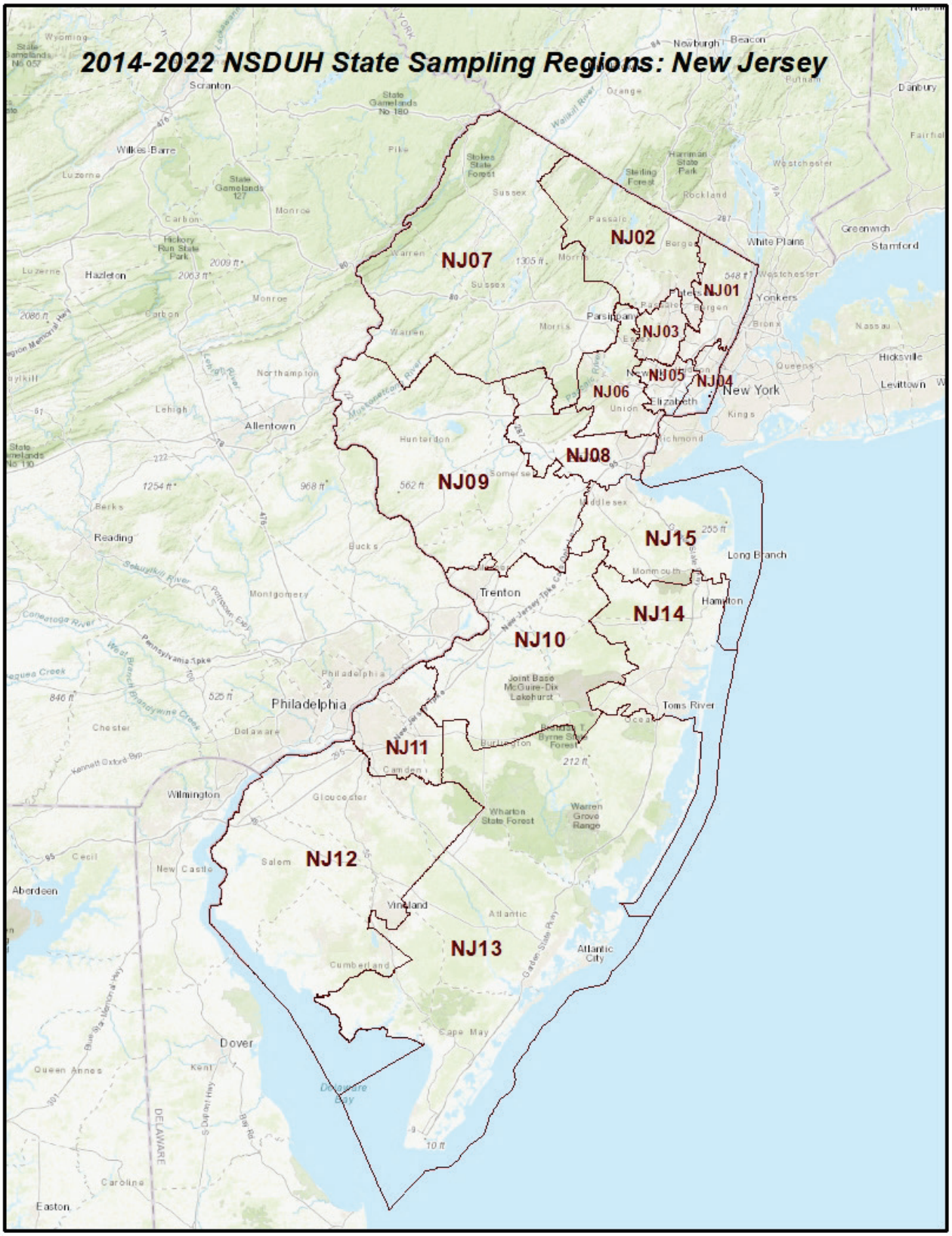

2014-2022 NSDUH State Sampling Regions: Missouri
MO12
MO11
MO10
MO06
MO05
MO04
MO03
MO09
MO02
MO07
MO01
MO08
Des Moines
Iowa City
Davenport
Muscatine
ILLINOIS
IOWA
Burlington
Galesburg
Peoria
Macomb
Bloomington
Kirksville
Quincy
Springfield
Chillicothe
St Joseph
Topeka
Lawrence
City
Columbia
Warrensburg
Sedalia
Jefferson City
MISSOURI
Harry S Truman Reservoir
Lake of the Ozarks
Rolla
Park Hills
Farmington
Fort Scott
Nevada
Lebanon
Fort Leonard Wood
Mark Twain National Forest
OZARK PLATEAU
Cape Girardeau
Springfield
Joplin
Poplar Bluff
West Plains
Table Rock Lake
Bull Shoals Lake
Rogers
Springdale
Harrison
Mountain Home
Fayetteville
Buffalo National River
BOSTON MOUNTAINS
Batesville
Jonesboro
Ozark National Forest
Muskogee
Fort Smith
Fort Chaffee
Russellville
Searcy
Conway
Memphis
OUACHITA MOUNTAINS
ARKANSAS

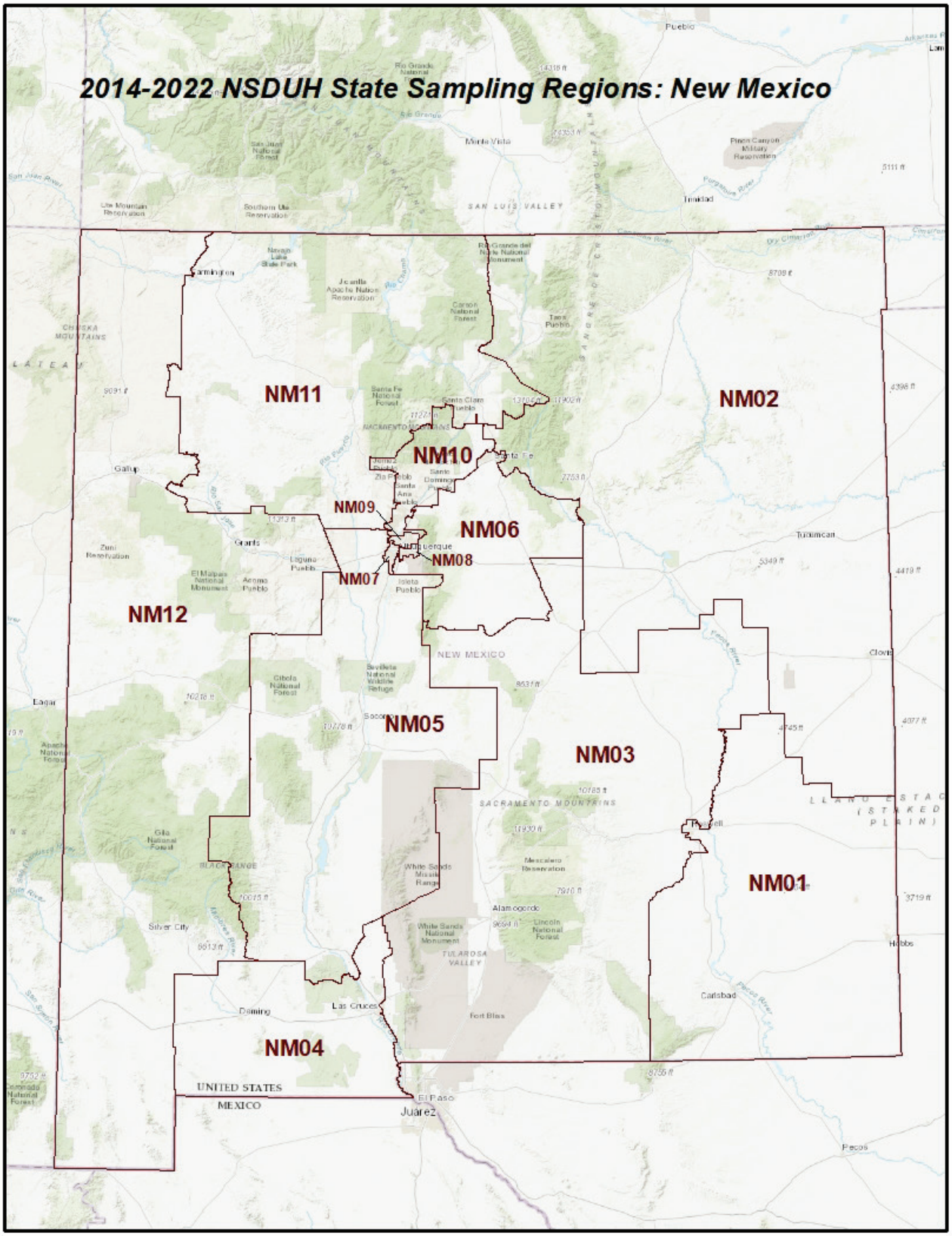

2014-2022 NSDUH State Sampling Regions: Montana
MT01
MT02
MT03
MT04
MT05
MT06
MT07
MT08
MT09
MT10
MT11
MT12
MONTANA
Swift Current
Medicine Hat
Lethbridge
Kimberley
Cranbrook
Fernie
Blood 148
Weyburn
Kootenai National Forest
Glacier National Park
Blackfeet Indian Reservation
PURCELL MOUNTAINS
Kalispell
CABINET MOUNTAINS
Flathead National Forest
Flathead Reservation
Malta
Fort Peck Indian Reservation
Glasgow
Wolf Point
Fort Belknap Reservation
Missouri
Upper Missouri River Breaks National Monument
Charles Russell Nat'l Wildlife Ref
Sidney
Glendive
Great Falls
Scapegoat Wilderness
St Joe National Forest
Missouri
Lolo National Forest
Missouri
Clearwater National Forest
Lewis & Clark National Forest
Helena
BITTERROOT RANGE
Deerlodge National Forest
Bitterroot National Forest
Nezperce National Forest
Beaverhead National Forest
Madison
Gallatin National Forest
Custer National Forest
Yellowstone
Billings
Crow Reservation
Bighorn
Payette National Forest
Salmon National Forest
SALMON RIVER MOUNTAINS
Challis National Forest
Salmon
Yellowstone National Park
Shoshone National Forest
Bighorn National Forest
Gillette
Boise National Forest
IDAHO
Targhee National Forest
ABSAROKA RANGE
Sawtooth National Forest
Grand Teton National

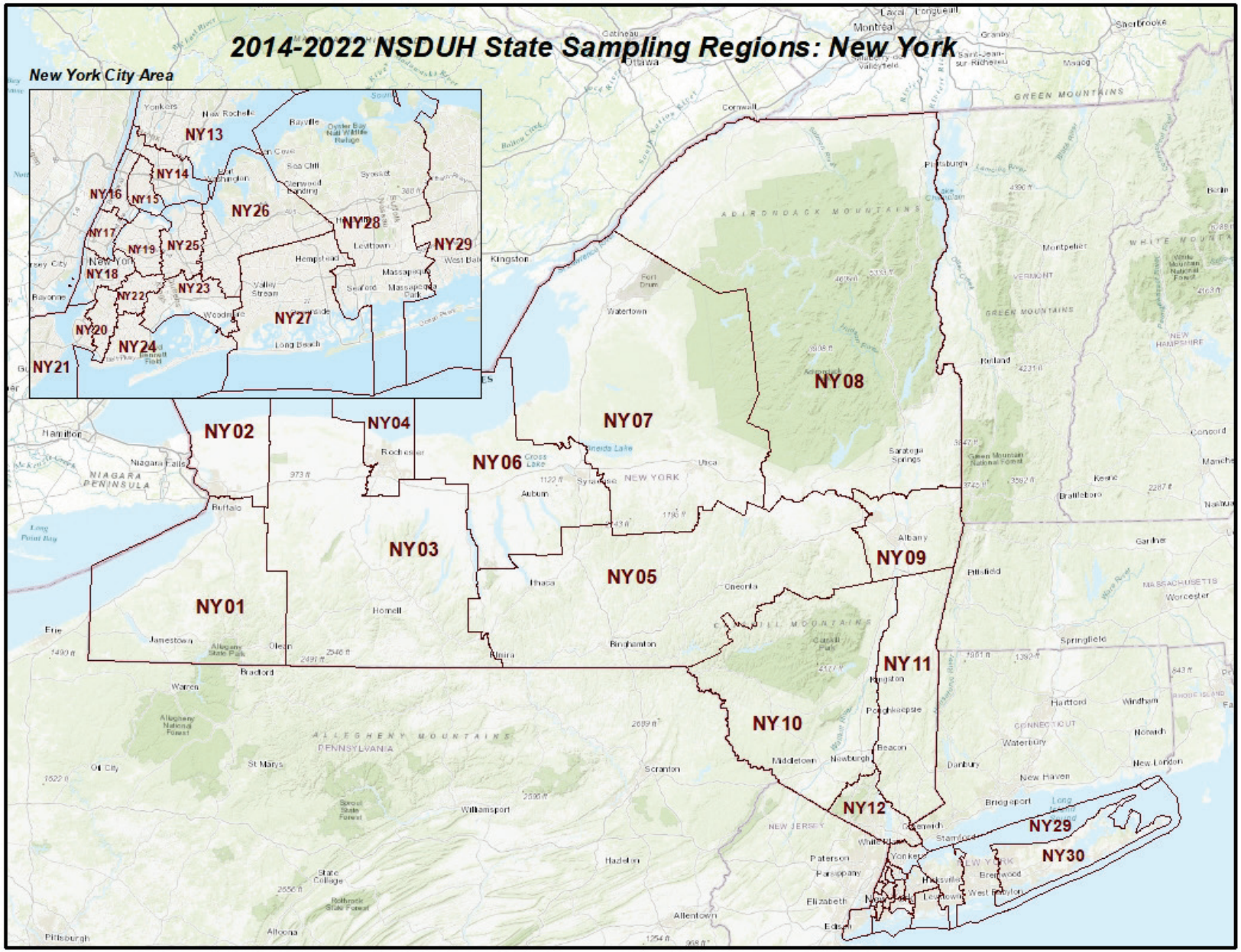

2014-2022 NSDUH State Sampling Regions: Nebraska
NE01
NE02
NE03
NE04
NE05
NE06
NE07
NE08
NE09
NE10
NE11
NE12
NEBRASKA
SAND HILLS
SMOKY HILLS
THE BADLANDS
Rapid City
Pierre
Mitchell
Sioux Falls
Yankton
Gregory
Chadron
Alliance
Gering
Sidney
North Platte
Kearney
Hastings
Grand Island
Columbus
Norfolk
Omaha
Lincoln
Fort Morgan
McCook
Goodland
Colby
Manhattan
Sioux City
Storm Lake
Valentine
Ainsworth


2014-2022 NSDUH State Sampling Regions: Nevada
NV01
NV02
NV03
NV04
NV05
NV12
Las Vegas Area
NV09
NV12
NV08
NV07
NV06
NV11
NV10
NV04
NV05
Las Vegas
Henderson
Spring Valley
North Las Vegas
Sunrise Manor
Paradise
NEVADA
GREAT BASIN
UTAH
MOJAVE DESERT
DEATH VALLEY


2014-2022 NSDUH State Sampling Regions: New Hampshire
NH01
NH02
NH03
NH04
NH05
NH06
NH07
NH08
NH09
NH10
NH11
NH12
Montpelier
Berlin
Lebanon
Laconia
Concord
Claremont
Keene
Nashua
Manchester
Rochester
Dover
Portsmouth
Hampton
Newburyport
Haverhill
Lowell
Sanford
Portland
Auburn
Lewiston
Conway
Rutland
Bennington
Brattleboro
Greenfield
Ipswich
Gloucester
GREEN MOUNTAINS
WHITE MOUNTAINS
BLUE MOUNTAINS


2014-2022 NSDUH State Sampling Regions: New Jersey
NJ01
NJ02
NJ03
NJ04
NJ05
NJ06
NJ07
NJ08
NJ09
NJ10
NJ11
NJ12
NJ13
NJ14
NJ15
Philadelphia
Trenton
New York
Allentown
Reading
Wilmington
Atlantic City
Dover
Easton
Scranton
Wilkes-Barre
Hazleton
Newburgh
Beacon
Danbury
Stamford
Long Branch
Toms River
Hamilton
Aberdeen


2014-2022 NSDUH State Sampling Regions: New Mexico
NM11
NM02
NM10
NM09
NM06
NM08
NM07
NM12
NM05
NM03
NM01
NM04
NEW MEXICO
SAN LUIS VALLEY
SACRAMENTO MOUNTAINS
TULAROSA VALLEY
UNITED STATES
MEXICO
Albuquerque
Las Cruces
El Paso
Juárez
Santa Fe
Roswell
Hobbs
Carlsbad
Clovis
Farmington
Gallup
Grants
Silver City
Deming
Alamogordo
Pecos
Tucumcari


2014-2022 NSDUH State Sampling Regions: New York
New York City Area
NY01
NY02
NY03
NY04
NY05
NY06
NY07
NY08
NY09
NY10
NY11
NY12
NY13
NY14
NY15
NY16
NY17
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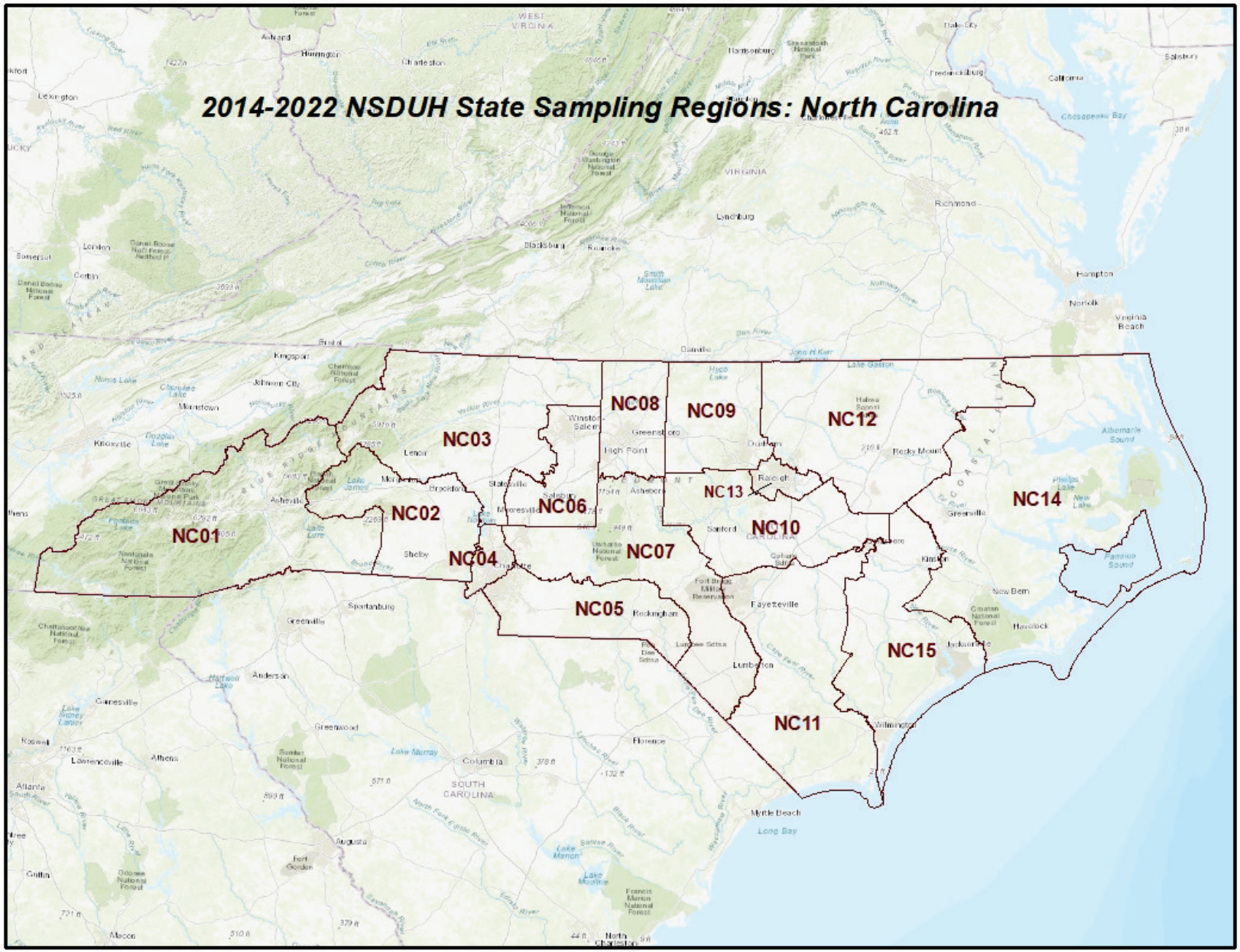
NY24
NY25
NY26
NY27
NY28
NY29
NY30


2014-2022 NSDUH State Sampling Regions: North Carolina
NC01
NC02
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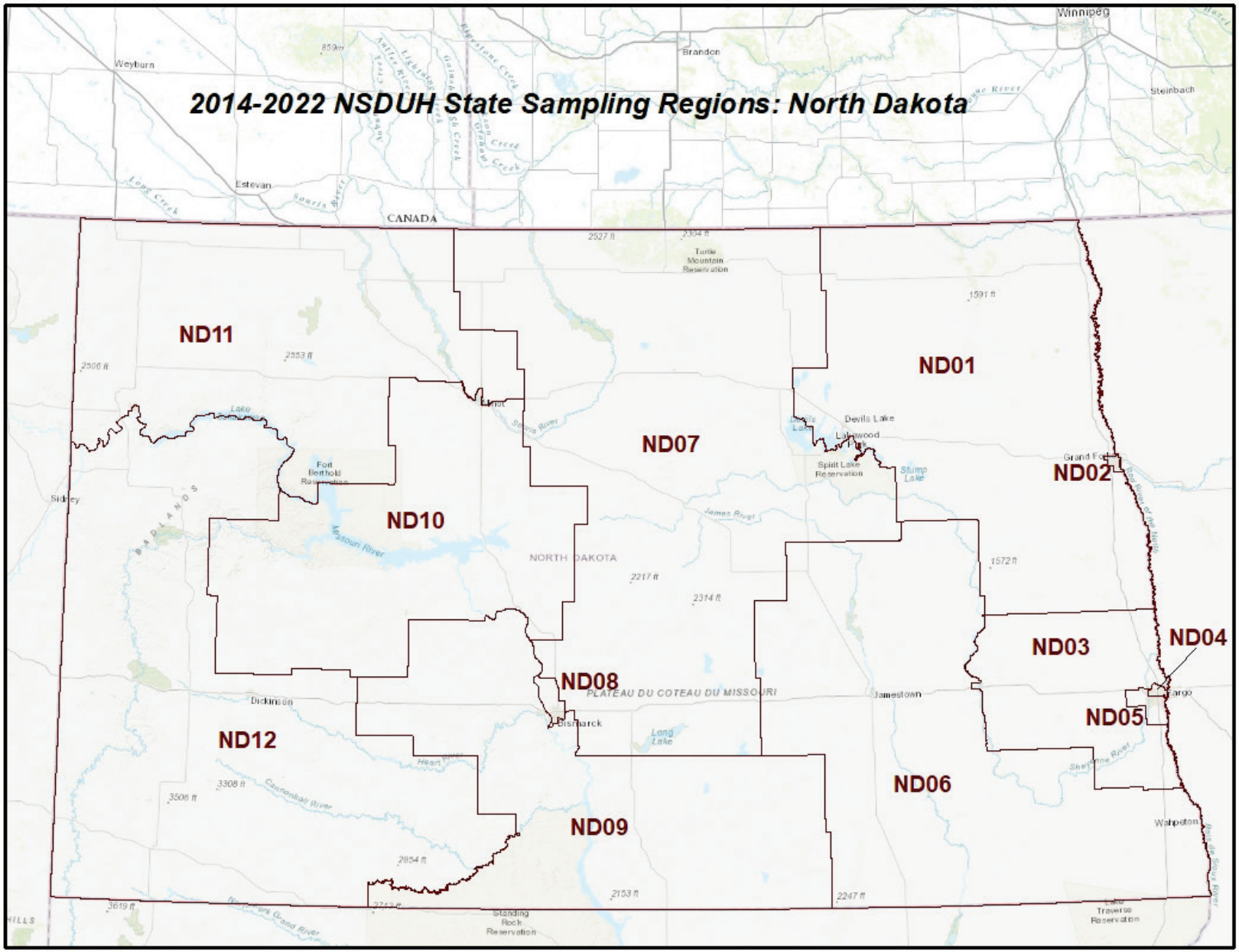
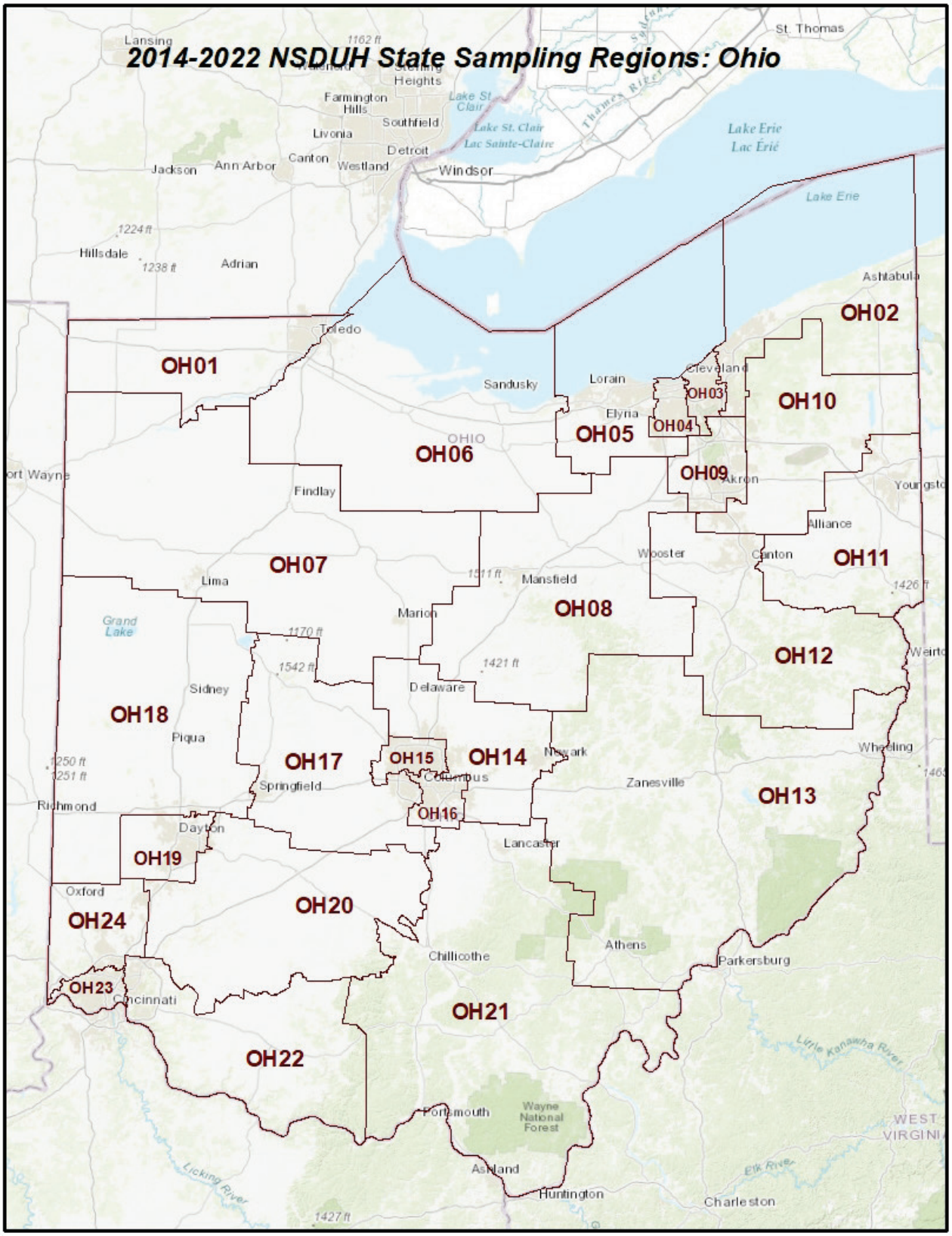
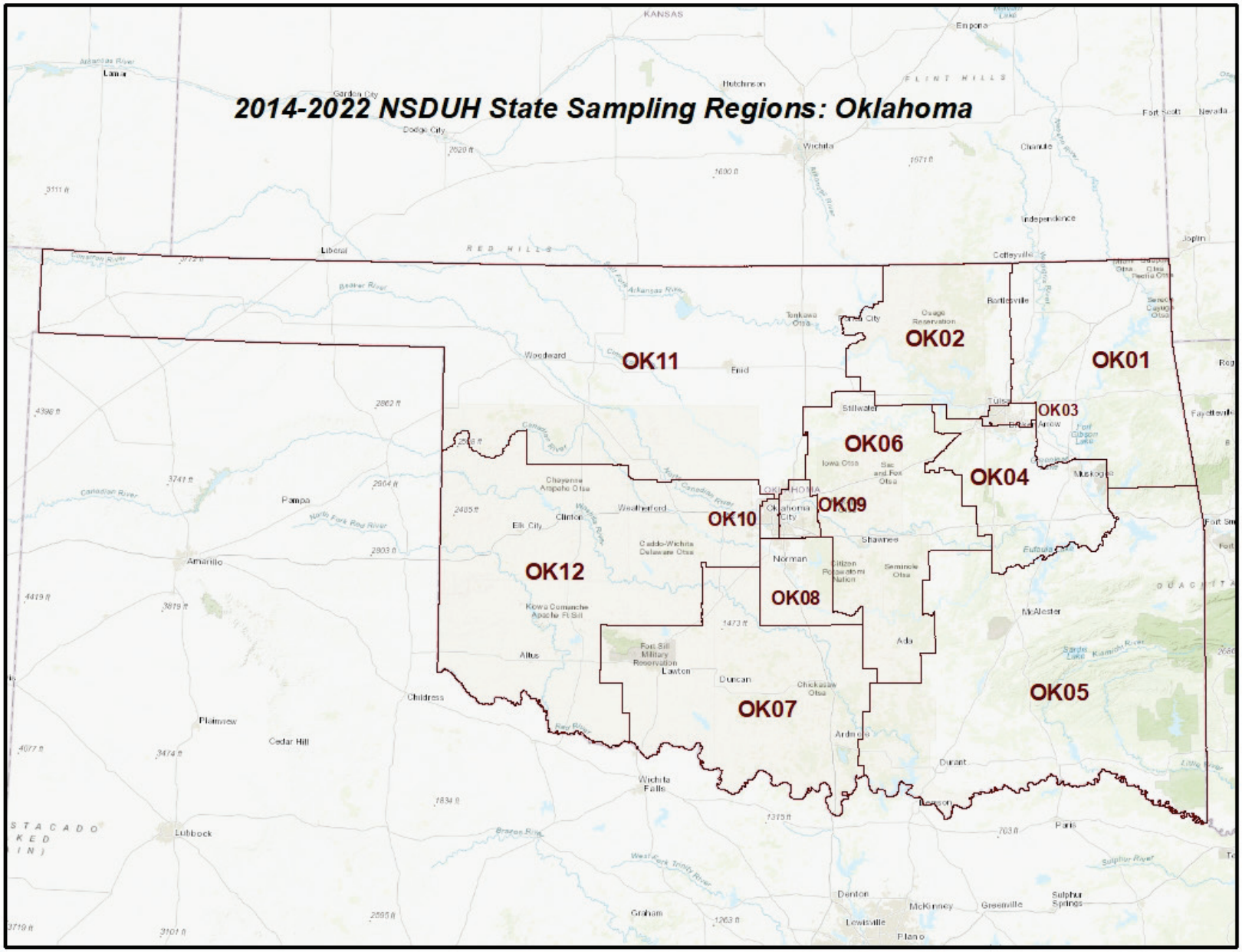
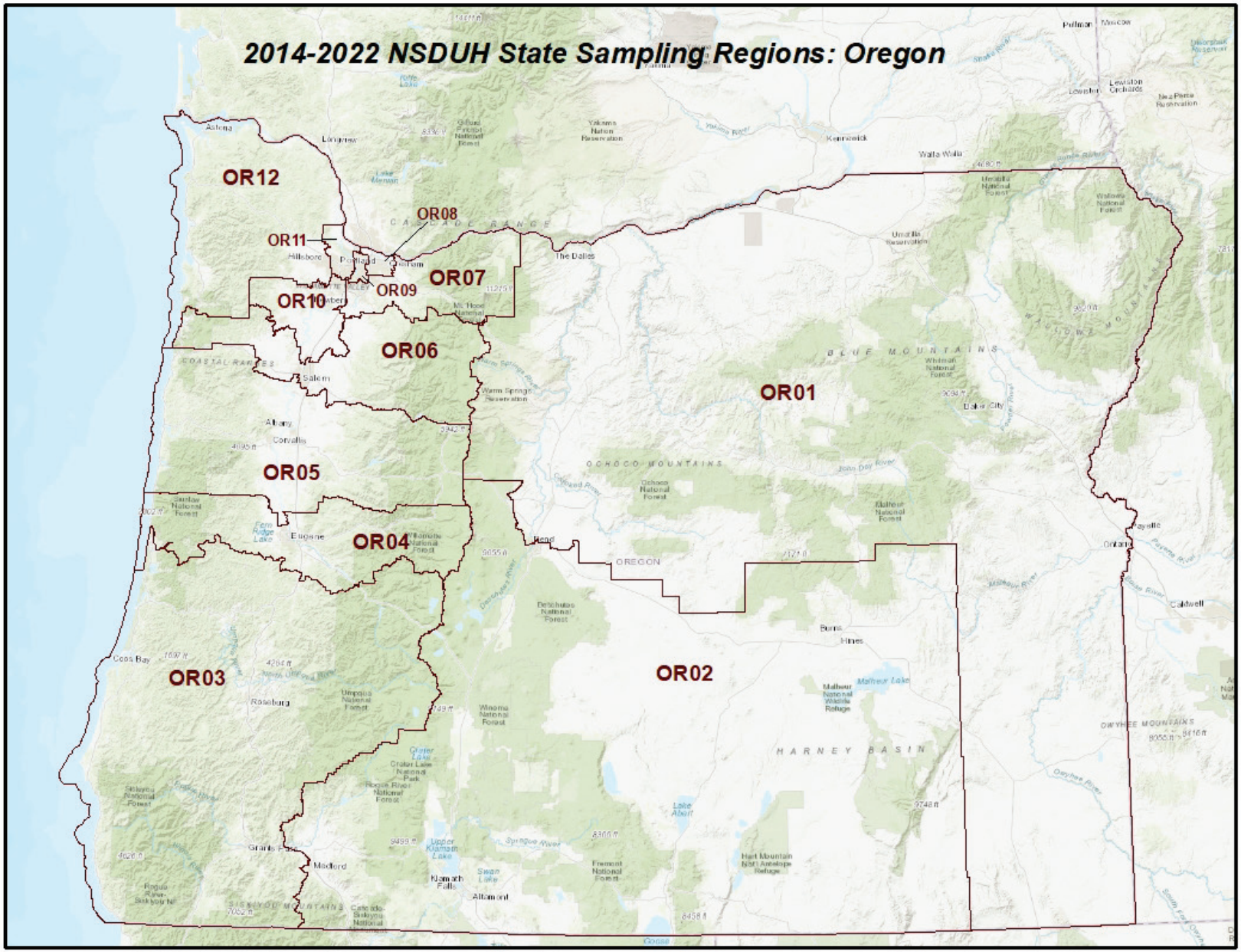
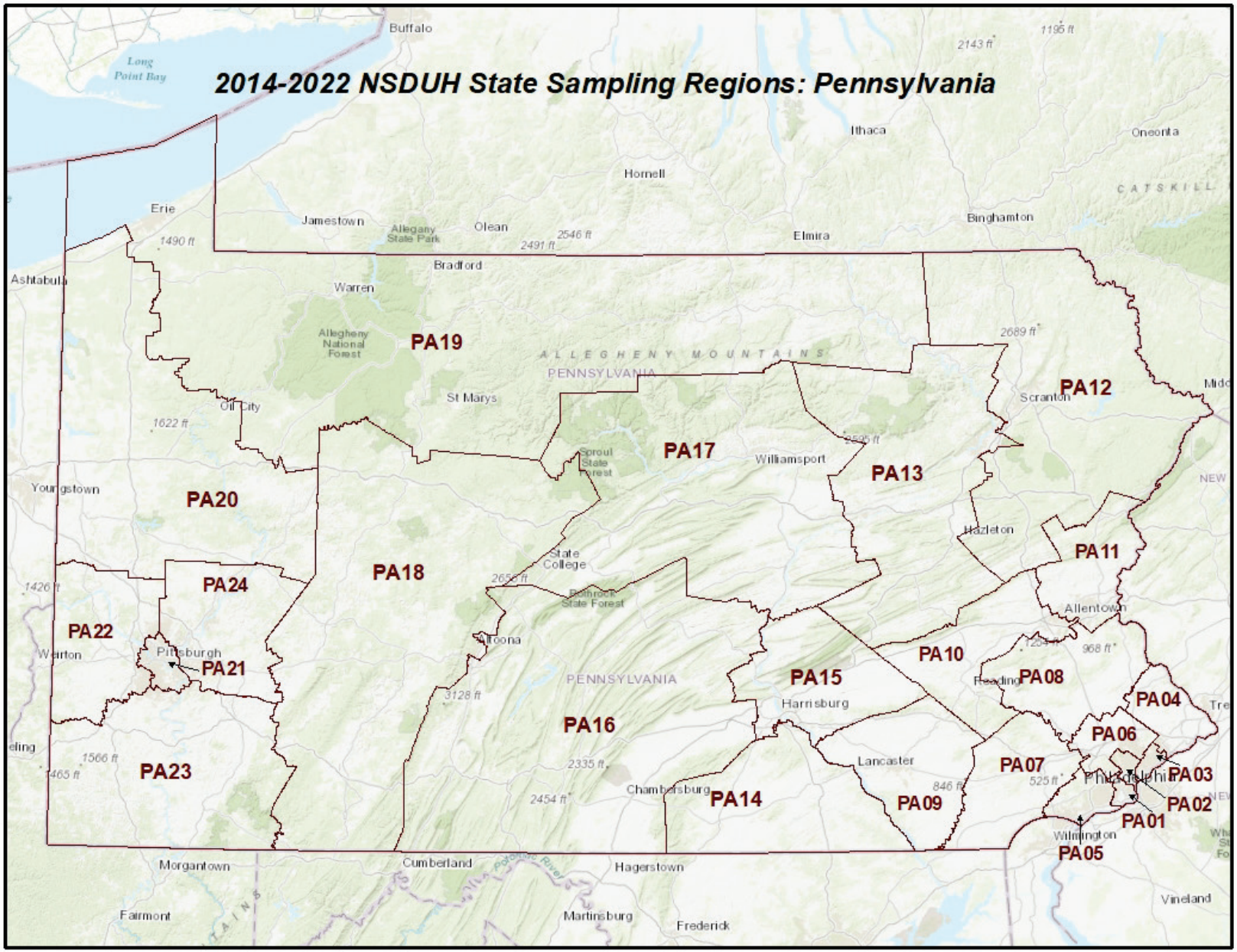
NC04
NC05
NC06
NC07
NC08
NC09
NC10
NC11
NC12
NC13
NC14
NC15


2014-2022 NSDUH State Sampling Regions: North Dakota
ND11
ND01
ND07
ND02
ND10
ND03
ND04
ND08
ND05
ND12
ND06
ND09
CANADA
NORTH DAKOTA
PLATEAU DU COTEAU DU MISSOURI
Winnipeg
Brandon
Weyburn
Estevan
Steinbach
Turtle Mountain Reservation
Devils Lake
Spirit Lake Reservation
Fort Berthold Reservation
Sidney
Dickinson
Bismarck
Jamestown
Fargo
Wahpeton
Standing Rock Reservation
Lake Traverse Reservation


2014-2022 NSDUH State Sampling Regions: Ohio
OH01
OH02
OH03
OH04
OH05
OH06
OH07
OH08
OH09
OH10
OH11
OH12
OH13
OH14
OH15
OH16
OH17
OH18
OH19
OH20
OH21
OH22
OH23
OH24
Lansing
Farmington Hills
Southfield
Livonia
Detroit
Canton
Westland
Ann Arbor
Jackson
Windsor
St. Thomas
Lake Erie
Lake St. Clair
Hillsdale
Adrian
Toledo
Sandusky
Lorain
Cleveland
Elyria
Akron
Findlay
Lima
Mansfield
Marion
Grand Lake
Wooster
Canton
Alliance
Sidney
Delaware
Piqua
Springfield
Columbus
Newark
Zanesville
Wheeling
Richmond
Dayton
Lancaster
Oxford
Chillicothe
Athens
Parkersburg
Cincinnati
Portsmouth
Wayne National Forest
Ashland
Huntington
Charleston
Licking River
Elk River
Kanawha River
OHIO
WEST VIRGINIA


2014-2022 NSDUH State Sampling Regions: Oklahoma
OK01
OK02
OK03
OK04
OK05
OK06
OK07
OK08
OK09
OK10
OK11
OK12
KANSAS
Liberal
Woodward
Enid
Stillwater
Tulsa
Bartlesville
Coffeyville
Independence
Joplin
Fayetteville
Muskogee
Fort Smith
Wichita
Dodge City
Garden City
Hutchinson
Emporia
Fort Scott
Nevada
Chanute
Pampa
Amarillo
Clinton
Elk City
Weatherford
Oklahoma City
Shawnee
Norman
McAlester
Ada
Durant
Paris
Altus
Lawton
Duncan
Childress
Plainview
Cedar Hill
Lubbock
Wichita Falls
Denton
McKinney
Greenville
Sulphur Springs
Lewisville
Plano
Graham


2014-2022 NSDUH State Sampling Regions: Oregon
OR12
OR08
OR11
OR07
OR09
OR10
OR06
OR01
OR05
OR04
OR03
OR02
CASCADE RANGE
COASTAL RANGE
BLUE MOUNTAINS
OCHOCO MOUNTAINS
HARNEY BASIN
OWYHEE MOUNTAINS
SISKIYOU MOUNTAINS
OREGON
Portland
Salem
Eugene
Albany
Corvallis
Bend
The Dalles
Pendleton
Walla Walla
Lewiston
Moscow
Pullman
Ontario
Caldwell
Burns
Hines
Klamath Falls
Medford
Roseburg
Coos Bay
Grants Pass
Lakeview
Baker City


2014-2022 NSDUH State Sampling Regions: Pennsylvania
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PA02
PA03
PA04
PA05
PA06
PA07
PA08
PA09
PA10
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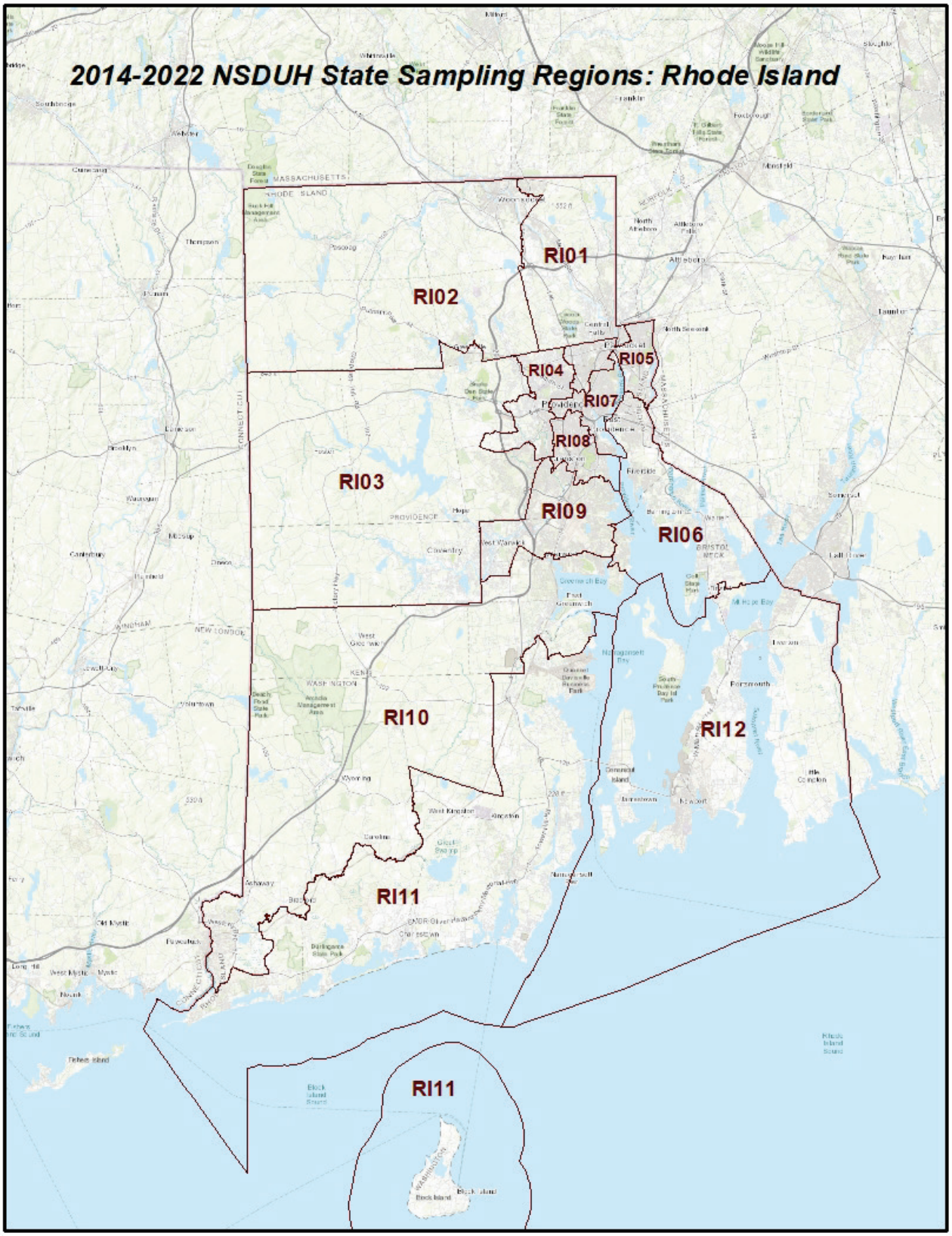
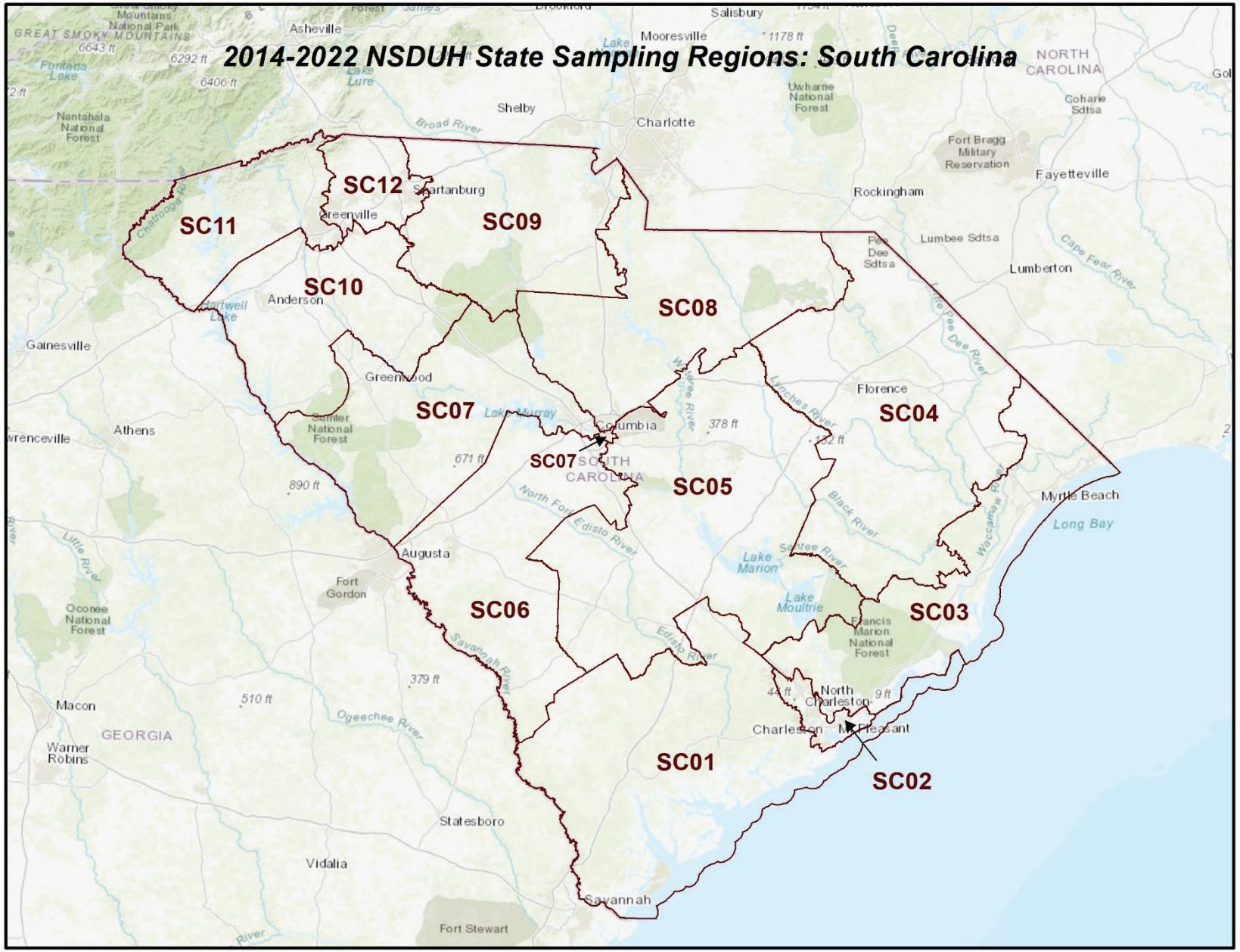
PA12
PA13
PA14
PA15
PA16
PA17
PA18
PA19
PA20
PA21
PA22
PA23
PA24
Buffalo
Erie
Jamestown
Allegany State Park
Olean
Bradford
Warren
Ithaca
Hornell
Elmira
Binghamton
Oneonta
Scranton
Williamsport
Harrisburg
Lancaster
Reading
Allentown
Hazleton
Wilmington
Philadelphia
Pittsburgh
Altoona
State College
Chambersburg
Cumberland
Hagerstown
Martinsburg
Frederick
Morgantown
Fairmont
Youngstown
Oil City
St Marys
Allegheny National Forest
Sproul State Forest
Bellefonte
Weirton
Vineland
ALLEGHENY MOUNTAINS
PENNSYLVANIA
CATSKILL
Long Point Bay


2014-2022 NSDUH State Sampling Regions: Rhode Island
RI01
RI02
RI03
RI04
RI05
RI06
RI07
RI08
RI09
RI10
RI11
RI12
RI11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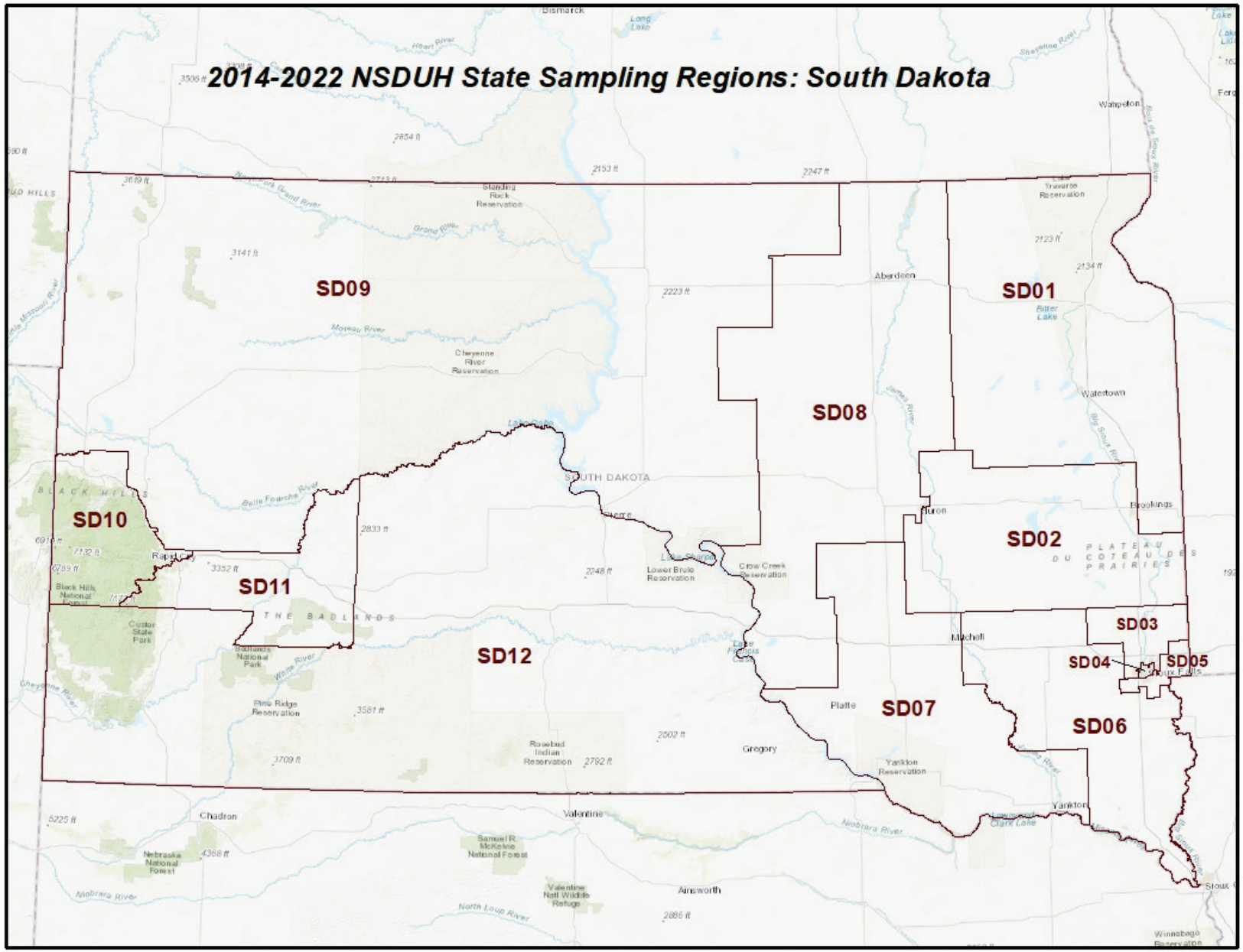
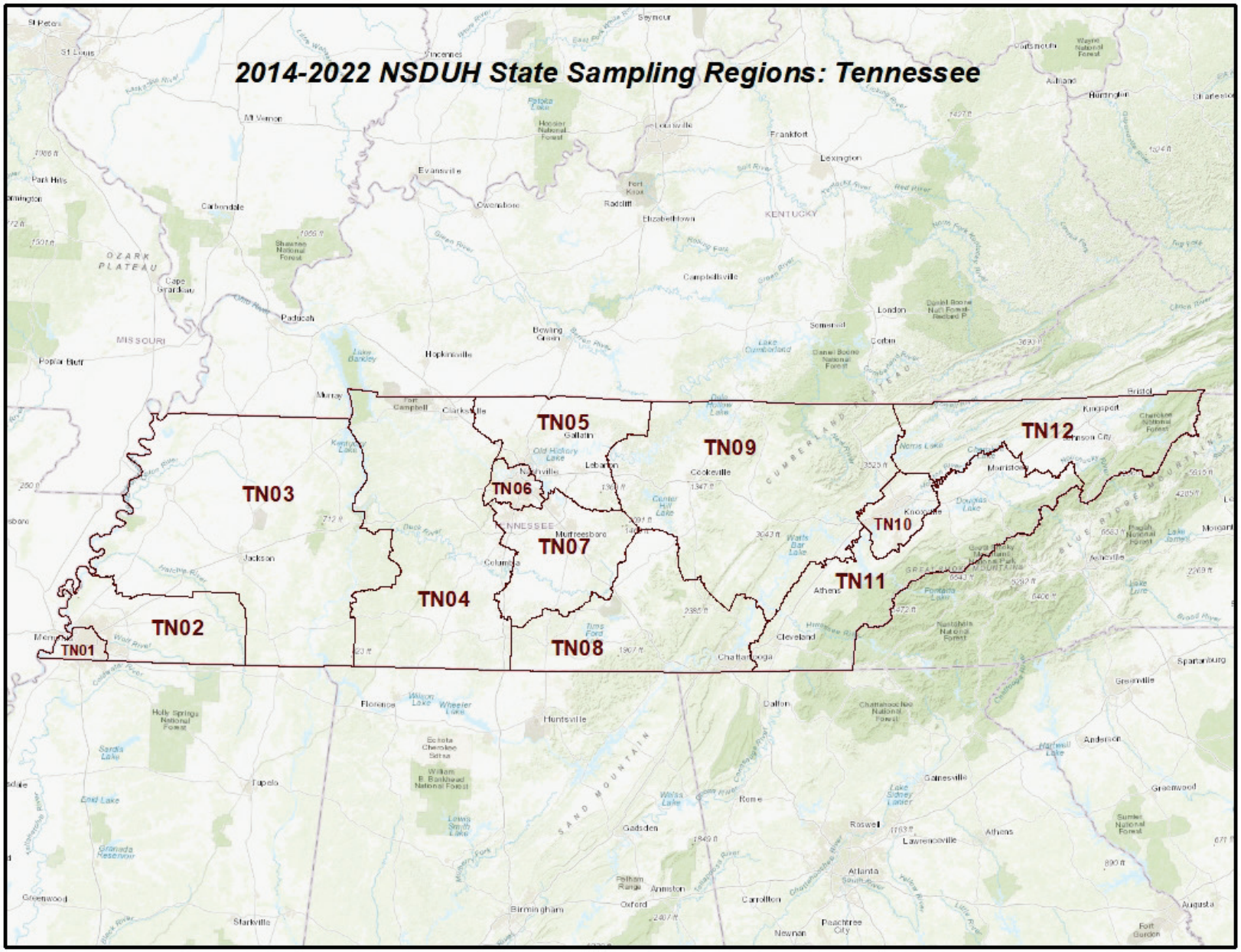
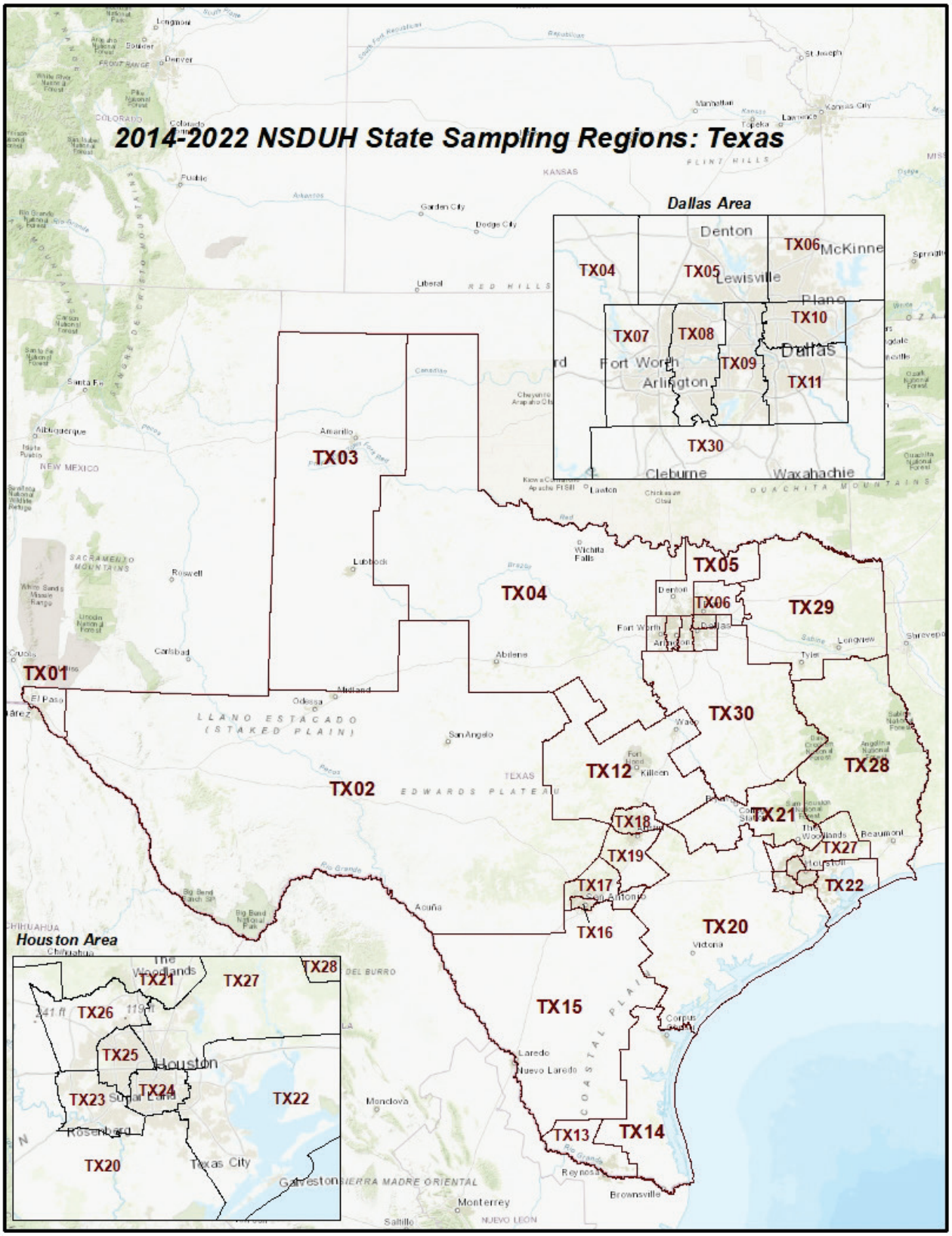
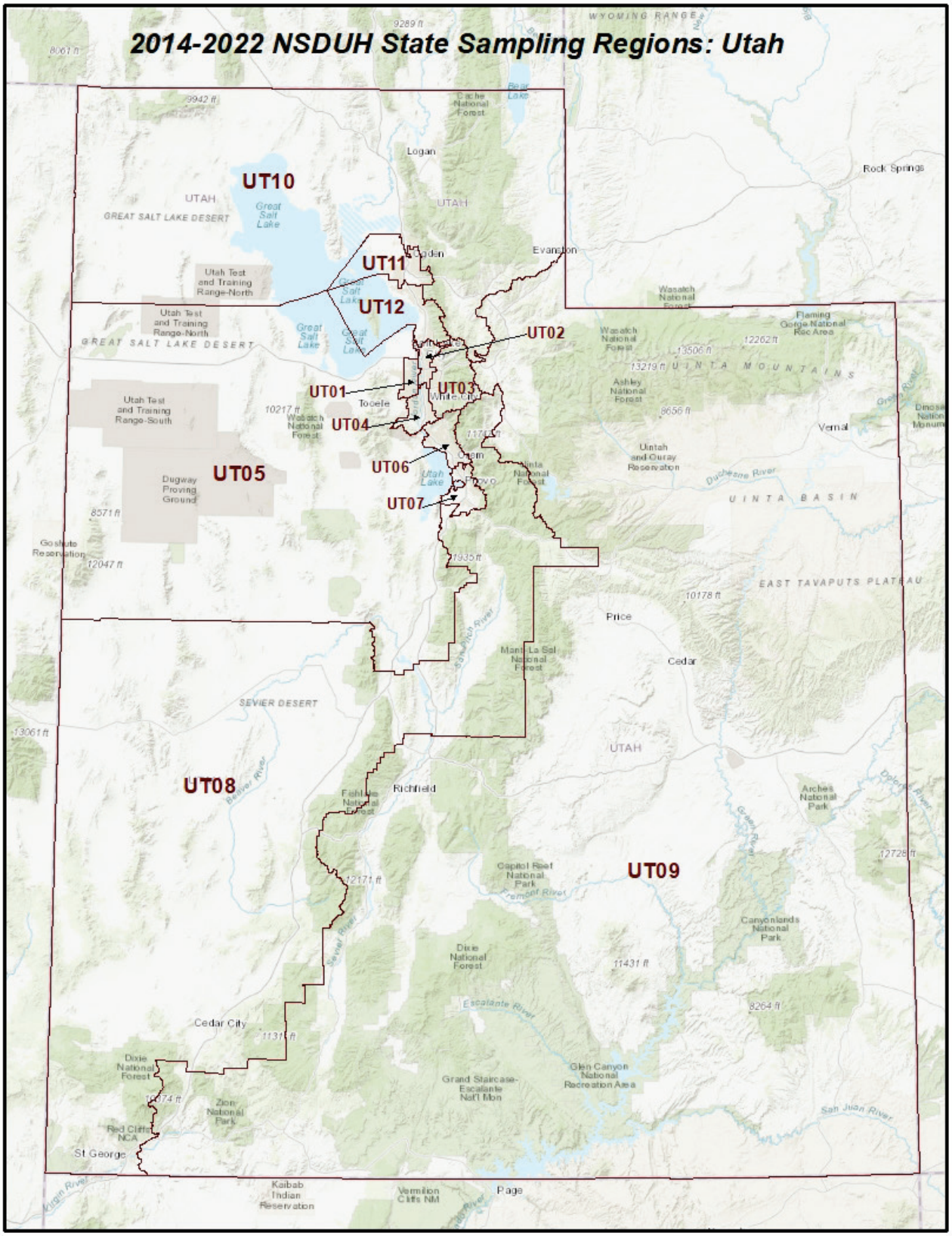
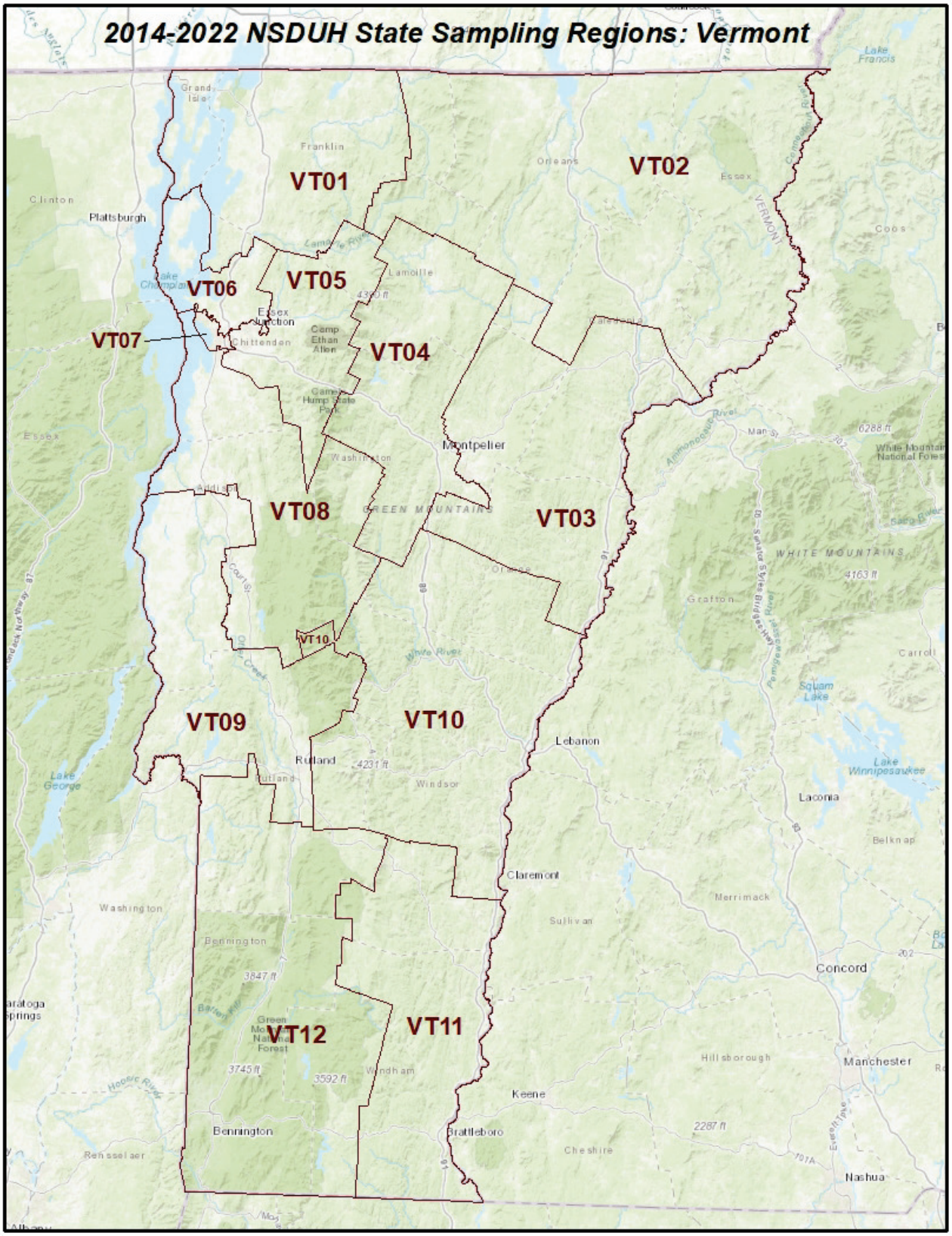
SC01
SC02
SC03
SC04
SC05
SC06
SC07
SC08
SC09
SC10
SC11
SC12
SC07
Asheville
Salisbury
Mooresville
Charlotte
Shelby
Spartanburg
Greenville
Anderson
Rockingham
Fayetteville
Lumberton
Florence
Columbia
Greenwood
Augusta
Fort Gordon
Myrtle Beach
Long Bay
North Charleston
Charleston
Mt Pleasant
Statesboro
Vidalia
Savannah
Fort Stewart
Macon
Warner Robins
GEORGIA
NORTH CAROLINA
SOUTH CAROLINA
Gainesville
Athens
Lake Murray
Lake Marion
Lake Moultrie
Francis Marion National Forest
Sumter National Forest
Oconee National Forest
Nantahala National Forest
Uwharrie National Forest
Fort Bragg Military Reservation
Pee Dee Sdtsa
Lumbee Sdtsa
Coharie Sdtsa
Broad River
Cape Fear River
Little Pee Dee River
Lynches River
Black River
Waccamaw River
Santee River
Edisto River
North Fork Edisto River
Savannah River
Ogeechee River
Little River
Hartwell Lake
Lake Lure
Fontana Lake
GREAT SMOKY MOUNTAINS
6643 ft
6292 ft
6406 ft
1178 ft
671 ft
890 ft
510 ft
379 ft
378 ft

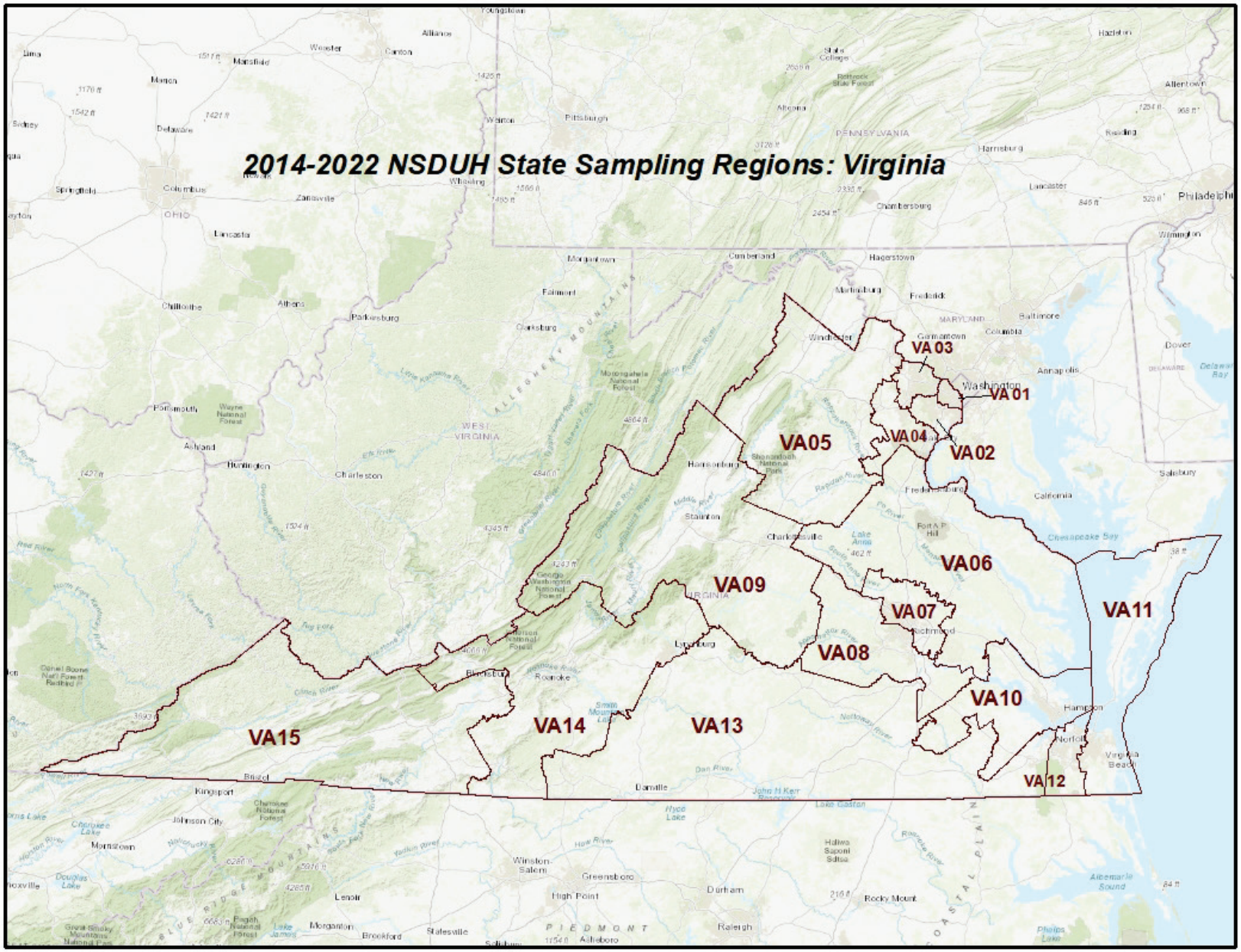

2014-2022 NSDUH State Sampling Regions: South Dakota
SD09
SD01
SD08
SD10
SD02
SD11
SD03
SD12
SD04
SD05
SD07
SD06
Bismarck
Aberdeen
Watertown
Huron
Brookings
Mitchell
Platte
Gregory
Yankton
Chadron
Valentine
Ainsworth
Rapid City
Standing Rock Reservation
Cheyenne River Reservation
Lower Brule Reservation
Crow Creek Reservation
Pine Ridge Reservation
Rosebud Indian Reservation
Yankton Reservation
Sioux Falls
SOUTH DAKOTA
BLACK HILLS
THE BADLANDS
PLATEAU DU COTEAU DES PRAIRIES

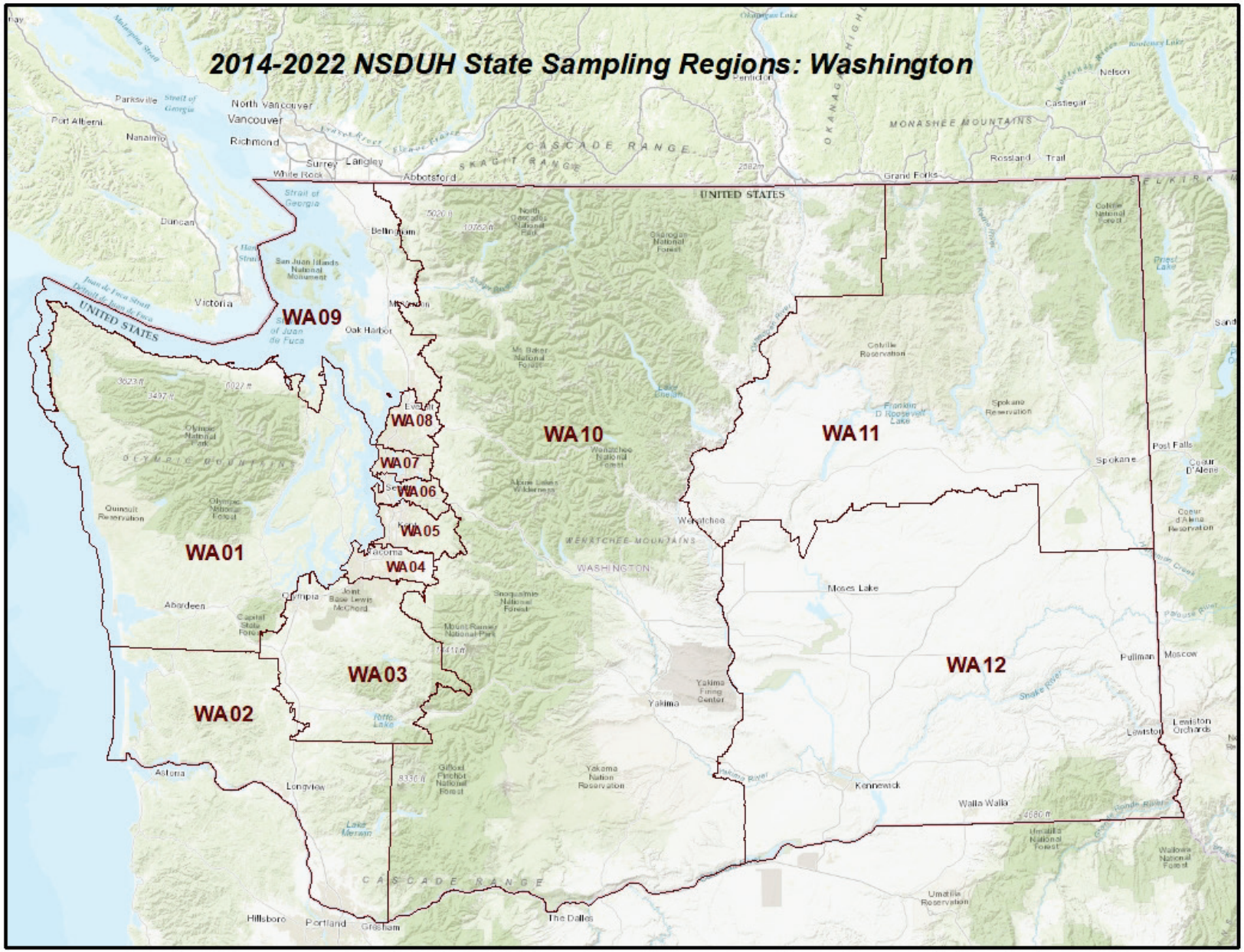

2014-2022 NSDUH State Sampling Regions: Tennessee
TN01
TN02
TN03
TN04
TN05
TN06
TN07
TN08
TN09
TN10
TN11
TN12
KENTUCKY
MISSOURI
TENNESSEE
OZARK PLATEAU
CUMBERLAND PLATEAU
BLUE RIDGE MOUNTAINS
SAND MOUNTAIN
Nashville
Memphis
Knoxville
Chattanooga
Clarksville
Murfreesboro
Jackson
Columbia
Cookeville
Athens
Cleveland
Huntsville
Birmingham
Atlanta

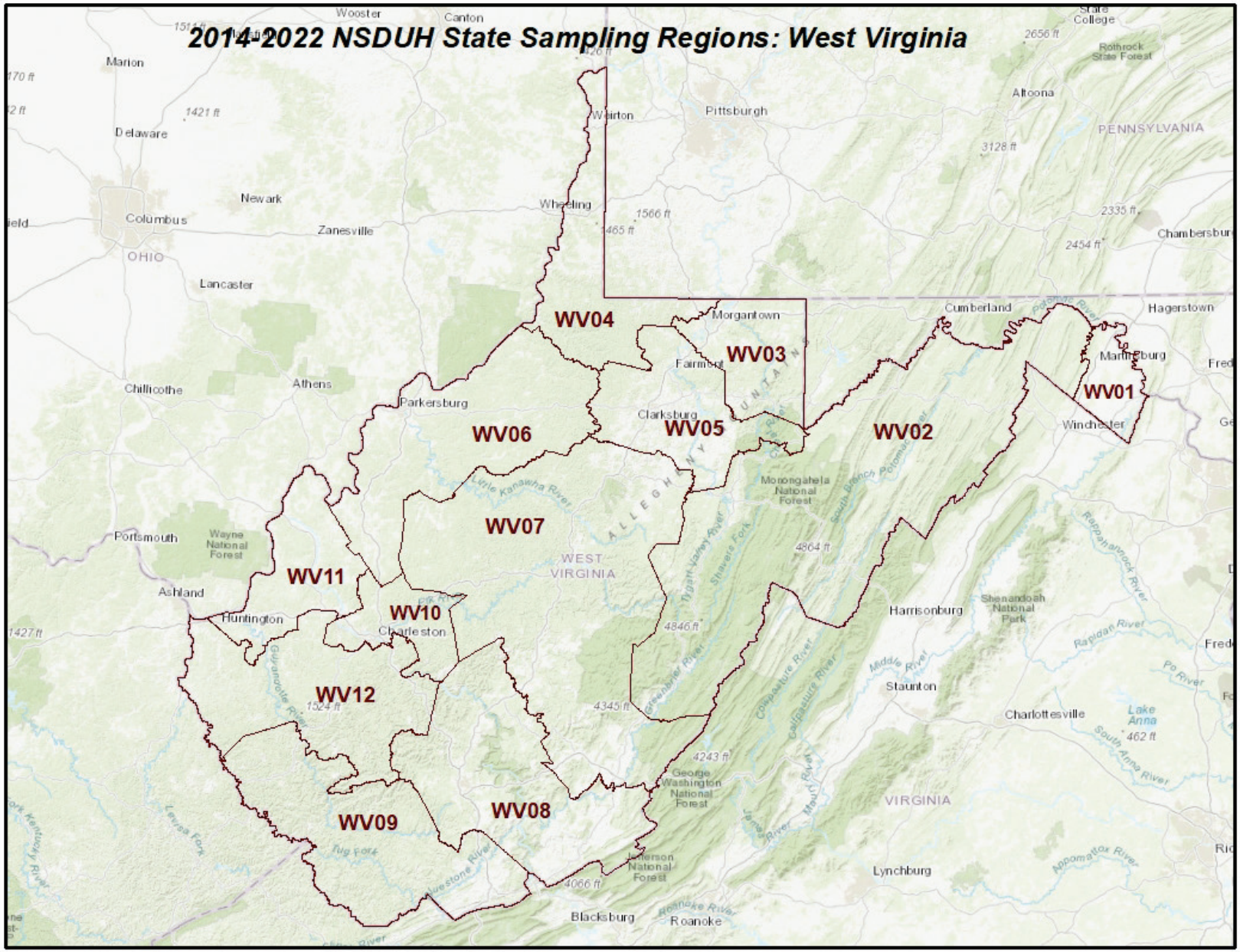

2014-2022 NSDUH State Sampling Regions: Texas
Dallas Area
Denton
McKinne
Lewisville
Plano
Dallas
Fort Worth
Arlington
Cleburne
Waxahachie
TX04
TX05
TX06
TX07
TX08
TX09
TX10
TX11
TX30
TX03
TX01
TX02
TX29
TX28
TX12
TX18
TX21
TX19
TX27
TX17
TX22
TX16
TX20
TX15
TX13
TX14
Houston Area
The Woodlands
Houston
Sugar Land
Rosenberg
Texas City
Galveston
Laredo
Nuevo Laredo
Monclova
Reynosa
Brownsville
Monterrey
Saltillo
Corpus Christi
Victoria
Beaumont
Lubbock
Amarillo
Odessa
Midland
Abilene
San Angelo
Wichita Falls
Lawton
Roswell
Carlsbad
El Paso
Ciudad Juárez
Acuña
Piedras Negras
Santa Fe
Albuquerque
NEW MEXICO
COLORADO
KANSAS
TEXAS
CHIHUAHUA
LLANO ESTACADO (STAKED PLAIN)
EDWARDS PLATEAU
COASTAL PLAIN
SIERRA MADRE ORIENTAL
NUEVO LEON
DEL BURRO
SACRAMENTO MOUNTAINS
OUACHITA MOUNTAINS
FRONT RANGE
RED HILLS
FLINT HILLS

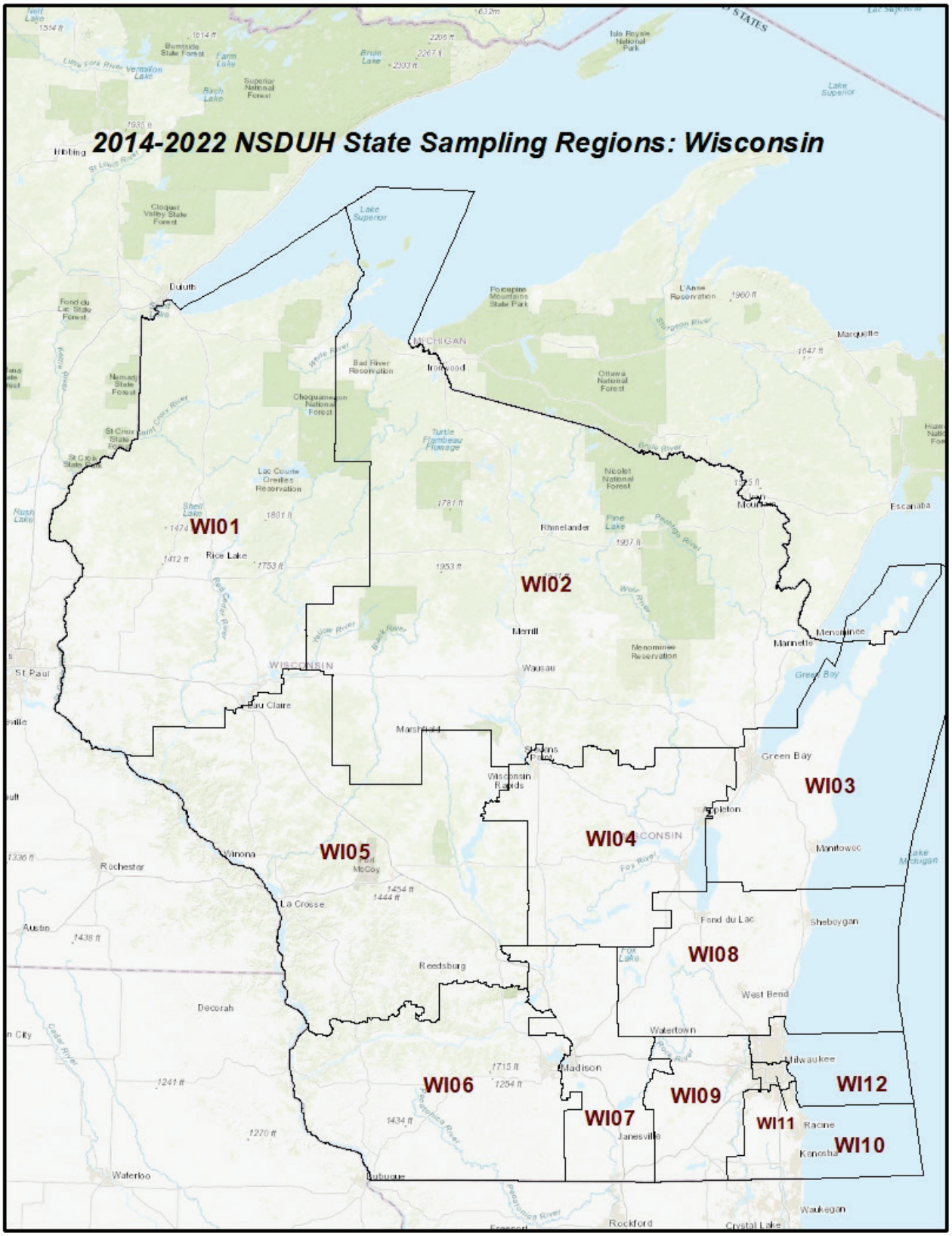

2014-2022 NSDUH State Sampling Regions: Utah
UT10
UT11
UT12
UT02
UT01
UT03
UT04
UT06
UT07
UT05
UT08
UT09
UTAH
GREAT SALT LAKE DESERT
Great Salt Lake
Logan
Ogden
Evanston
Rock Springs
Tooele
Provo
Vernal
Price
Cedar
Richfield
Cedar City
St George
Page
Utah Test and Training Range-North
Utah Test and Training Range-South
Dugway Proving Ground
Goshute Reservation
Wasatch National Forest
Ashley National Forest
Uinta National Forest
Manti-La Sal National Forest
Fishlake National Forest
Dixie National Forest
Capitol Reef National Park
Arches National Park
Canyonlands National Park
Zion National Park
Red Cliffs NCA
Kaibab Indian Reservation
Vermilion Cliffs NM
Glen Canyon National Recreation Area
Grand Staircase-Escalante Natl Mon
Uintah and Ouray Reservation
Flaming Gorge National Rec Area
Dinosaur National Monument
UINTA MOUNTAINS
UINTA BASIN
EAST TAVAPUTS PLATEAU
SEVIER DESERT
WYOMING RANGE
Bear Lake
Cache National Forest
Sevier River
Escalante River
Fremont River
Green River
Duchesne River
San Juan River
Virgin River
Colorado River
9289 ft
8061 ft
3942 ft
10217 ft
13061 ft
12047 ft
8571 ft
11935 ft
10178 ft
12171 ft
11431 ft
8264 ft
12728 ft
13506 ft
13219 ft
12262 ft
8656 ft

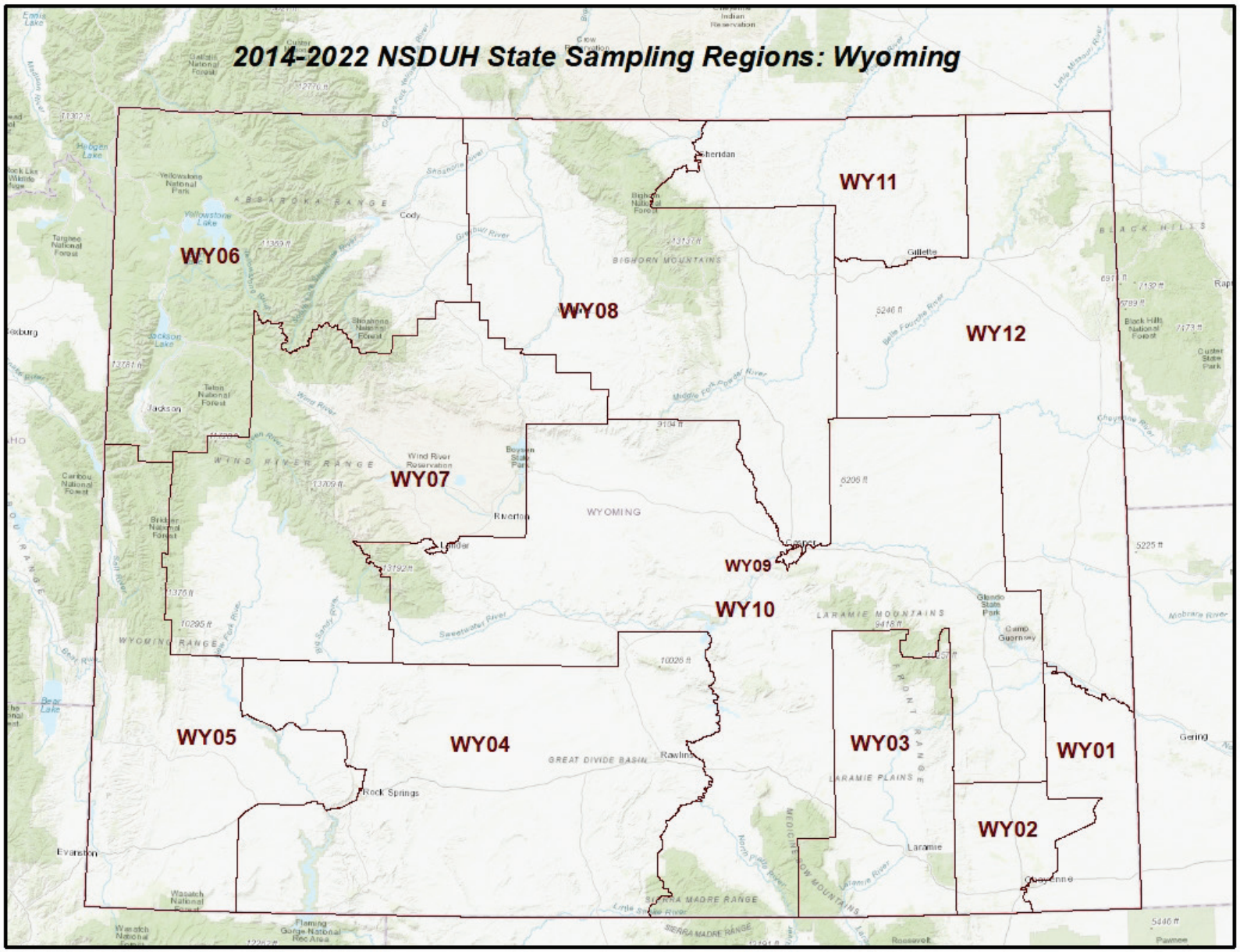

2014-2022 NSDUH State Sampling Regions: Vermont
VT01
VT02
VT03
VT04
VT05
VT06
VT07
VT08
VT09
VT10
VT11
VT12
Franklin
Orleans
Essex
Clinton
Plattsburgh
Coos
Lamoille
Essex Junction
Chittenden
Camp Ethan Allen
Montpelier
Washington
Orange
Windsor
Rutland
Windham
Bennington
Grafton
Carroll
Lebanon
Laconia
Belknap
Claremont
Merrimack
Sullivan
Concord
Hillsborough
Manchester
Keene
Cheshire
Nashua
Brattleboro
Lake Champlain
Lake George
Lake Francis
Lake Winnipesaukee
Squam Lake
GREEN MOUNTAINS
WHITE MOUNTAINS
VERMONT
Connecticut River
Ammonoosuc River
Pemigewasset River
White River
Battenkill River
Hoosic River
Green Mountain National Forest
White Mountain National Forest
4163 ft
6288 ft
4231 ft
3847 ft
3745 ft
3592 ft
2287 ft


2014-2022 NSDUH State Sampling Regions: Virginia
VA 03
VA 01
VA04
VA05
VA02
VA06
VA09
VA07
VA11
VA08
VA10
VA14
VA13
VA15
VA12


2014-2022 NSDUH State Sampling Regions: Washington
WA01
WA02
WA03
WA04
WA05
WA06
WA07
WA08
WA09
WA10
WA11
WA12
UNITED STATES
Vancouver
Victoria
Seattle
Spokane
Yakima
Portland
Moses Lake
Wenatchee
Pullman
Moscow
Lewiston
Kennewick
Walla Walla
Aberdeen
Longview
Olympia
Bellingham
Everett
Tacoma
The Dalles
CASCADE RANGE
OLYMPIC MOUNTAINS
WENATCHEE MOUNTAINS
MONASHEE MOUNTAINS
WASHINGTON


2014-2022 NSDUH State Sampling Regions: West Virginia
WV01
WV02
WV03
WV04
WV05
WV06
WV07
WV08
WV09
WV10
WV11
WV12
Wooster
Canton
Marion
Delaware
Newark
Columbus
Zanesville
OHIO
Lancaster
Chillicothe
Athens
Portsmouth
Ashland
Huntington
Wayne National Forest
Weirton
Pittsburgh
Wheeling
Morgantown
Parkersburg
Clarksburg
Farmington
WEST VIRGINIA
Charleston
Monongahela National Forest
George Washington National Forest
Jefferson National Forest
Blacksburg
Roanoke
Lynchburg
VIRGINIA
Harrisonburg
Shenandoah National Park
Staunton
Charlottesville
Lake Anna
Winchester
Martinsburg
Hagerstown
Cumberland
Altoona
State College
Rothrock State Forest
PENNSYLVANIA
Chambersburg
Greenbrier River
Shavers Fork
Tygart Valley River
Little Kanawha River
Elk River
Gauley River
Meadow River
James River
Middle River
Calfpasture River
Rapidan River
Rappahannock River
Potomac River
South Branch Potomac
South Anna River
Appomattox River
Roanoke River
Tug Fork
Levisa Fork
Big Sandy River
Kentucky River
Bluestone River
4864 ft
4846 ft
4345 ft
4243 ft
4066 ft
3128 ft
2656 ft
2454 ft
2335 ft
1566 ft
1465 ft
1524 ft
1427 ft
1421 ft
462 ft


2014-2022 NSDUH State Sampling Regions: Wisconsin
WI01
WI02
WI03
WI04
WI05
WI06
WI07
WI08
WI09
WI10
WI11
WI12
Duluth
Rice Lake
Rhinelander
Merrill
Wausau
Eau Claire
Marshfield
Green Bay
Appleton
Manitowoc
Sheboygan
Fond du Lac
West Bend
Watertown
Milwaukee
Racine
Kenosha
Waukegan
Rockford
Crystal Lake
Janesville
Madison
Reedsburg
La Crosse
Winona
Rochester
Austin
Decorah
Waterloo
Dubuque
Escanaba
Marquette
Menominee
Manitowoc
Lake Superior
Lake Michigan
MICHIGAN
WISCONSIN


2014-2022 NSDUH State Sampling Regions: Wyoming
WY11
WY06
WY08
WY12
WY07
WY09
WY10
WY05
WY04
WY03
WY01
WY02
WYOMING
Sheridan
Cody
Gillette
Jackson
Riverton
Lander
Rawlins
Rock Springs
Evanston
Laramie
Cheyenne
BIGHORN MOUNTAINS
WIND RIVER RANGE
WYOMING RANGE
GREAT DIVIDE BASIN
LARAMIE MOUNTAINS
LARAMIE PLAINS
SIERRA MADRE RANGE
ABSAROKA RANGE
BLACK HILLS

Appendix B:
2022 NSDUH Pair Sampling and Selection of the Pair Sampling Parameter

The pair sampling algorithm in the National Survey on Drug Use and Health (NSDUH) is based on the Chromy and Penne (2002) adaptation of the Brewer (1963, 1975) method for selecting samples of size two as a means of selecting samples of 0, 1, or 2 persons within a selected dwelling unit (DU) containing at least one eligible person. Chromy and Penne (2002) also introduced a pair sampling parameter λ that governs the number of pairs selected.

Define the target selection probability for person *i* in DU *h* as P_{hi}.[44] Then, to ensure that all pairs have a positive probability of selection, all person probabilities have to be strictly less than 1; and arbitrarily, the maximum P_{hi} is set to 0.99. In Brewer's (unadapted) method of sampling pairs, the sum of first-order inclusion probabilities is always equal to $n = 2$. However, because the NSDUH design calls for a selection of 0, 1, or 2 persons per DU, it is unlikely that the sum of person probabilities within a DU, $S_h = \Sigma_i P_{hi}$, equals 2. Adaptations were then applied to the sampling algorithm for the following types of DUs: DUs with S_h greater than or equal to 2 and DUs where S_h was less than 2.

B.1 Case I: Dwelling Units with $S_h \geq 2$

If $S_h \geq 2$, a multiplicative scaling factor, $F_h = 2/S_h$, was applied to all of the target selection probabilities so that they were scaled down to sum to exactly 2. Now, Brewer's method sets the pairwise selection probabilities at

$$P_{h(ij)} = \left[\frac{P_{h(i)}P_{h(j)}}{K}\right]\left[\frac{1}{1-P_{h(i)}} + \frac{1}{1-P_{h(j)}}\right]$$

by setting *K* at

$$K = 2 + \sum \frac{P_{h(i)}}{1-P_{h(i)}},$$

where

i = *i*-th person in household *h* (whose selection probability depends on his or her age category: 1, 2, 3, 4, or 5) and

j = *j*-th person in household *h* (whose selection probability depends on his or her age category: 1, 2, 3, 4, or 5; j not equal to i).

[44] The notation in Appendix B is consistent with Chromy and Penne (2002) but is not consistent with the notation in the remainder of the report.

Age category 1 corresponds to youths aged 12 to 17, 2 to adults aged 18 to 25, 3 to adults aged 26 to 34, 4 to adults aged 35 to 49, and 5 to adults aged 50 or older.

The sum of the pairwise selection probabilities taken over all unique pairs will be guaranteed to be exactly 1:

$$\sum_i \sum_{j>i} P_{h(ij)} = 1 .$$

It also guarantees that the sum of the pairwise selection probabilities for an individual is equal to the individual's selection probability

$$\sum_{j \neq i} P_{h(ij)} = P_{h(i)}$$

for all values of *i*.

Note that the above scheme always selects a pair of two eligible persons.

B.2 Case II: Dwelling Units with $S_h < 2$

If $S_h < 2$, the problem was remedied by creating three dummy persons and distributing the remaining size measure $(2 - S_h)$ to them equally (i.e., the inclusion of dummy persons in the selection could result in the selection of 0 or 1 actual person). Operationally, this initially required the application of the following multiplicative scaling factor to the person probabilities:

$$F_h = \min\left\{\frac{2}{S_h}, \frac{0.99}{\max\left(P_{hi}\right)}\right\}.$$

However, a further modification was applied to this scaling factor that allowed some flexibility in the actual number of pairs selected. This modification was governed by the pair sampling parameter λ. Define

$$T(\lambda) = S_h + \lambda(2 - S_h); 0 \leq \lambda \leq 1.$$

Then the modified multiplicative scaling factor was expressed as

$$F_h^* = \min\left\{\frac{T\left(\lambda\right)}{S_h}, \frac{0.99}{\max\left(P_{hi}\right)}\right\}.$$

Denote S' as the sum of the selection probability after scale adjustment by F_h^*. If S' is exactly 2, then dummy persons are not needed. If S' is less than 2, then three dummy persons are added to the DU.

Now, for Brewer's method, set the pairwise selection probabilities as

$$P'_{h(ij)} = \left[\frac{P'_{h(i)}P'_{h(j)}}{K'}\right]\left[\frac{1}{1-P'_{h(i)}} + \frac{1}{1-P'_{h(j)}}\right]$$

by setting K' at

$$K' = 2 + \sum_i \frac{P'_{h(i)}}{1-P'_{h(i)}},$$

where

$P'_{h(i)}$ and $P'_{h(j)}$ = selection probabilities adjusted by the scaling factor F_h^*,

i = i-th person in the household (whose selection probability depends on his or her age category: 0, 1, 2, 3, 4, or 5), and

j = j-th person in the household (whose selection probability depends on his or her age category: 0, 1, 2, 3, 4, or 5; j not equal to i).

Age category 0 corresponds to dummy persons, and categories 1 to 5 are defined as in Case I.

Note that the following equation is now available: $\sum_{j \neq i} P'_{h(ij)} = P'_{h(i)}$. To maintain the original person selection probabilities despite the scale adjustment by F_h^*, Brewer's method is modified as follows. First, draw a random number, R, from a uniform (0,1) distribution. If $R \leq 1/F_h^*$, then select a pair using Brewer's method based on the adjusted pairwise selection probability. However, if $R > 1/F_h^*$, then no one is selected from the household. In this way, the probability for selecting a pair (i,j) in household h becomes $P^*_{h(ij)} = P'_{h(ij)} / F_h^*$, which, in turn, gives the original person selection probabilities, $P_{h(i)}$. Unlike Case I, where a pair of eligible persons was always selected, this adjusted selection scheme allows for 0, 1, or 2 persons to be selected from a DU.

B.3 Selection of λ

Simulation analyses resulted in the selection of λ = 0.50 for the 2002 through 2013 NSDUH sample designs. However, changes to the sample design in 2014 with respect to age group and state necessitated further simulation analyses to identify the value of λ best suited for the 2014 through 2022 design. Simulation analyses based on the 2012 screening data, modified to reflect the required 2014 through 2022 age group sample proportions (but not modified to reflect the new state proportions), were conducted, and λ = 0.25 was selected (Center for Behavioral Health Statistics and Quality, 2016).

Table B.1 displays the expected pair selection counts (scaled to sum to 67,507) and corresponding pair response rates for $\lambda = 0.25$ based on 2019 screening data.

Table B.1 Expected Pair Selection Counts and Response Rates for $\lambda = 0.25$

Age Group Pair	Selected Pairs	Pair Response Rate, %
12+, 12+	30,100	57.4
12-17, 12-17	3,363	69.6
12-17, 18-25	2,718	61.4
12-17, 26+	8,630	61.9
18-25, 18-25	4,543	53.9
18-25, 26+	5,294	51.8
26+, 26+	5,553	49.5

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2019.

Appendix C:
2022 NSDUH Procedures for Subsegmenting

C.1 Introduction

Subsegmenting is a statistical process used in the National Survey on Drug Use and Health (NSDUH) to reduce the size of the sampled area, which reduces the time and cost spent in the field for counting and listing. The precise and accurate application of subsegmenting procedures is most feasible when boundaries of subsegments can be formed using actual surface features, such as streets, rivers, and railroads. When such features cannot be used, listing the entire area segment is considered.

Subsegmenting was also used for address-based sampling (ABS) segments with more than 999 dwelling units. Because subsegmenting is a sampling function, it must be carried out with the same high degree of scientific precision exercised in the other stages of sample development.

C.2 Determining Subsegmenting In House

Prior to sending segments to the field for listing, field enumeration segments that are candidates for in-house subsegmenting are identified based on the number of census blocks, square miles, and dwelling units (DUs).[45] For the 2022 NSDUH, the two criteria for identifying candidate segments were as follows:

- number of census blocks > 1, square miles ≥ 75, and DU count ≥ 200; or
- number of census blocks > 1 and DU count ≥ 400.

Candidate segments then were evaluated to determine whether they could be subsegmented without input from the field. If feasible, the subsegmenting was performed in house prior to sending the segment to the field for listing. This step expedites the process and saves time and field expenses for very large segments.

For ABS segments, address counts were pulled from the ABS frame, and those segments with at least one block and more than 999 dwelling units were subsegmented. The subsampling of ABS segments was necessary because of limitations on line number length in the 10-digit DU identification number (DUID) (see Section 4.3.1).

C.3 Determining Subsegmenting while in the Field

If a certified lister is counting a segment and determines that the DU count is greater than 400, the segment is too large and must be subsegmented. The lister then mails the segment materials back to the sampling support office. When the segment is in house, standard subsegmenting procedures are followed using the street segment counts obtained by the lister.

[45] DU counts were obtained from 2010 census data supplemented with revised population counts from Claritas.

In the field, some of the segments originally subsegmented in house (as described in Section C.2) may still be too large to list. Additional subsegmenting is required for one of the following reasons: (1) the area experienced high growth, and the census counts used in the initial subsegment were outdated; or (2) not enough information was available during the first subsegment, and the initial subsegment was still too large to list. In the latter case, the initial subsegment was done to make the counting more manageable, but a second subsegment had to be done to make listing feasible. The initial subsegment then is counted by the lister and sent back to the sampling support office where standard subsegmenting procedures are applied.

C.4 Standard Subsegmenting Procedures

Once it is determined that subsegmenting is required, the following procedures are used for field enumeration segments:

Step 1: On the basis of the count, the segment is divided into areas (list units) containing no fewer than 100 DUs. If available, actual surface features are used to form new boundaries between divisions. An attempt to maintain balance between divisions is made (the largest list unit should not contain more than 1.5 times the number of DUs contained in the smallest unit).

Step 2: After properly dividing the segment into list units, the units are lettered consecutively with capital letters (A, B, C, ...).

Step 3: Using a subsegmenting worksheet, one of the list units is randomly selected to be listed. On the worksheet, the number of DUs in each list unit is recorded and accumulated. A random number generated for each segment is multiplied by the total accumulated DUs. The product then is rounded up, and the list unit whose cumulative DUs are greater than or equal to the product is selected for listing.

After the segment materials have been returned to the field, only the selected unit is listed.

For ABS segments, Step 1 was automated using a program that combines contiguous census blocks to form approximately equal-sized "zones." The number of zones depends on the size of the ABS segment and the requirement that no zone exceed 999 dwelling units. Then, one zone was selected with probability proportional to size (dwelling units).

For both field enumeration and ABS segments, all counts used in the subsegmenting process are retained so that weights can be adjusted to reflect the entire area segment.

Appendix D:
2022 NSDUH Procedures for Adding Missed Dwelling Units

D.1 Introduction

In-person data collection for the 2022 National Survey on Drug Use and Health (NSDUH) required field interviewers (FIs) to visit sample segments and conduct screenings and interviews in dwelling units (DUs) that were selected from an ordered list. The list of DUs, which includes housing units (HUs) and group quarters (GQs), was constructed by the counting and listing staff during summer and fall 2021 or from the most current address-based sampling frame. Because the DU frames were constructed a short time before the 2022 screening and interviewing activities began, no major discrepancies were expected. However, factors such as new construction, demolition, and inaccurate listing may be present in some cases. More commonly, DUs may have been "hidden" and therefore overlooked by the counter and lister.

For the majority of DUs to be given a chance of being selected, the 2022 NSDUH had in place a procedure for checking for and adding missed DUs on the premises of sampled DUs.[46] During the screening interview, FIs asked the screening respondent about other units on the property of the selected DU. If the number of added DUs linked to any particular DU did not exceed 5 or if the number for the entire segment was less than or equal to 10, the FI was instructed to consider these DUs as part of his or her assignment. However, if either of these limits was exceeded, the FI contacted the sampling support office for subsampling to be considered.

Unlike the 2005 through 2013 NSDUHs but similar to the 2014 through 2021 NSDUHs, the half-open interval (HOI) rule was not implemented in the 2022 NSDUH. This procedure requires FIs to look between each selected DU and the next listed DU to identify any unlisted units. Prior research suggested that only 0.2 percent of the total DUs on the NSDUH frame were added through the HOI rule (Iannacchione et al., 2012). Eliminating the HOI rule in 2014 decreased the burden on FIs and simplified FI training and the screening process. This decrease in burden outweighed the small amount of coverage afforded by the HOI rule.

To minimize bias associated with large numbers of missed DUs (e.g., from new construction or a missed subdivision), FIs were instructed to contact their supervisors if they noticed large discrepancies between the segment listing and what they encountered in the field. If the FI encountered 150 or more total unlisted units or 50 or more missed DUs following any one DU, the situation qualified as a "bust" and special sampling procedures were employed (see Section D.6).

This appendix outlines the 2022 NSDUH procedures for adding missed DUs. For this appendix, procedures for adding missed DUs are classified into three categories: adding HUs, adding GQ units, and reconciling busts. Table D.1 compares the 2014 through 2022 procedures with those used for the 2013 NSDUH.

[46] The check for missed DUs was not implemented for DUs screened via web.

Table D.1 Comparison of 2013 with 2014 through 2022 NSDUH Procedures for Adding Missed Dwelling Units

Missed DU Scenario	2013 Procedure	2014 to 2022 Procedure
Regular housing units (e.g., houses, townhouses, duplexes, trailers)	During the screening interview, the respondent was asked the following question: "Are there any other living quarters within this structure or on this property, such as a separate apartment with a separate entrance?" If the response was "yes," the FI recorded the address of the possible missed unit and added the unit to the sample if it was not on the original handwritten list of DUs. In addition, the FI checked the interval between the SDU and the next listed DU for these types of DUs. Missed DUs found using the HOI rule were added to the sample.	The FI continued to ask the screening respondent about other DUs on the property of the SDU. Missed DUs identified during the screening interview were added to the sample. The HOI rule was not implemented to pick up these types of DUs in the interval between an SDU and the next listed DU.
Units in apartment and condo buildings	Missed DUs in an apartment building were picked up via the HOI rule; that is, each missed unit was linked to the preceding DU in the path of travel.	Missed DUs in apartment buildings were not added unless the situation qualified as a "bust" or in the unusual situation that there was a "unit within a unit" (e.g., maid or nanny quarters within a large apartment or flat).
Missed apartment buildings	Missed apartment buildings were picked up via the HOI rule.	Missed apartment buildings were not added unless the situation qualified as a bust.
Missed DUs in GQ structures (e.g., dormitories, shelters, boarding houses)	Missed GQ units were sampled at the same rate as the original listing.	Missed GQ units continued to be sampled at the same rate as the original listing.
Missed GQ structures	GQ structures were added via the HOI rule.	GQ structures were not added unless the situation qualified as a bust.
Major discrepancies (new subdivision, missed floor or wing in an apartment building, etc.)	FIs were instructed to call their supervisors if they noticed large omissions or changes to the area. These situations were handled using bust procedures; that is, a subsample of the missed DUs was added if there were 50 or more missed DUs following any one DU or 150 or more total missed DUs in the segment.	FIs were instructed to call their supervisors if they noticed major discrepancies between the segment listing and ground truth. Bust procedures were implemented if the situation qualified as a bust.

DU = dwelling unit; FI = field interviewer; GQ = group quarters; HOI = half-open interval; SDU = sample dwelling unit.

Note: A "bust" is any segment listing with a major discrepancy (defined by 150 or more total unlisted units or 50 or more added DUs linked to any one DU) or that is completely unrepresentative of what is actually found.

D.2 Subsampling of Dwelling Units

Prior to the 1999 survey, if the number of added DUs exceeded the defined limits, the added DUs were subsampled at the same rate as the original selection for the segment. To maintain the unequal weighting effect and to control costs associated with adding DUs, an updated subsampling procedure was implemented and continued through the 2022 survey:

Number of Added DUs	Sampling Rate
0	No action
1 to 10	Automatic (all DUs added to the sample)
11 to 25	½
26 to 40	⅓
41 to 50	¼
50 or more	⅕

D.3 Procedure for Adding Housing Units

This section refers to HUs that were obtained through the missed DU procedures. This method of dealing with added HUs is preferable to all others because it is probability based and maintains the integrity of the sample. When possible, this methodology was used to resolve added DU problems.

1. Once the limit of 5 (or 10) rule was exceeded, the FI was instructed to stop screening and interviewing activities on added HUs and contact the sampling support office. The FI was then instructed to do a quick check of the segment for major discrepancies in the segment listing. At this time, the FI completed a paper list of added HUs for the entire segment.
2. Once the final list of added HUs was received by the sampling support office, the following was done:
   (a) Sampling examined the added HUs and determined whether they were linked to a sample DU.
   (b) If the number of added HUs linked to any *one* sample DU exceeded 50, these units were treated as a bust (see Section D.6).
   (c) If the number of added HUs linked to any *one* nonsampled DU exceeded 50, these units also were treated using the procedure for busts (see Section D.6).
   (d) Sampling staff calculated the total number of added DUs by adding the number of sampling units obtained through the bust procedure to the number of added DUs obtained through the screening interview (i.e., on the premises of selected DUs).
   (e) If the total number of added DUs exceeded 10, a subsampling rate was determined using the criteria above.
3. The computing division added the DUs to the system and subsampled if necessary:
   (a) Data entry of the added DUs was done. Entries were made for all units that collectively qualified as a bust and units obtained through the missed DU procedures—not for all missed DUs found in the segment. The link number then

was entered and a line number was assigned.[47] For DUs obtained through the bust procedure, the sampling link number (SLN) also was recorded. Finally, it was necessary to check that none of the DUs had already been entered in the handheld computer so that DUs did not appear in the system twice.

(b) DUs were selected from the added DUs at the rate defined earlier. The subsampling rate was recorded in a data field.

(c) Probabilities of selection were brought over as appropriate for the segment.

(d) A random number was added for the screening selection algorithm.

4. Selected DUs were added to the FI's assignment during the next transmission.
5. A sample weight was assigned to each added DU. If the total number of added DUs was fewer than or equal to 10, each added DU was assigned the weight of the original selected DUs in the segment. If subsampling was required, the selected DU weight was adjusted by the inverse of the subsampling rate for each added DU.

D.4 Procedure for Adding Group Quarters Structures

If an entire GQ structure was not listed (or was erroneously listed as an HU), the GQ structure was not added to the sample. The exception to this rule was if the number of GQ units in the missed GQ structure exceeded 50. In this case, the bust procedure was applied (see Section D.6).

D.5 Procedure for Adding Group Quarters Units

In the case of discrepant GQ listings, two approaches were taken depending on whether the actual number of GQ units was less than or greater than the number of GQ units listed in advance.

D.5.1 Number of Actual Group Quarters Units Less Than Number of Advance Group Quarters Units

In the case that extra GQ units were listed, the units at the end of the list were assigned an ineligible code, such as "Listing Error." All other units remained eligible.

D.5.2 Number of Actual Group Quarters Units Greater Than Number of Advance Group Quarters Units

If more GQ units were in the structure than were previously listed, a complete list was made, and the units were consecutively numbered. Assume, for example, that 11 units were listed and 45 were actually found. Also, assume that units 1, 5, and 10 were selected for screening and interviewing (indicated in bold).

[47] During the listing process, each DU is written on a separate line on the listing form and assigned a corresponding line number (i.e., the number of lines equals the number of DUs). In ABS segments, DUs are assigned a sequential line number. In both field enumeration and ABS segments, added DUs are assigned the next available line number.

Original list:	**1**
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11

The additional units then were numbered consecutively, and an SLN corresponding to each of the originally listed units was assigned. Next, the added GQ units with SLNs corresponding to the original selected units were added to the sample:

Unit Number	SLN
12	**1**
13	2
14	3
15	4
16	**5**
17	6
18	7
19	8
20	9
21	**10**
22	11
23	**1**
24	2
25	3
26	4
27	**5**
28	6
29	7
30	8
31	9
32	**10**
33	11
34	**1**
35	2
36	3
37	4
38	**5**
39	6
40	7
41	8

42	9
43	**10**
44	11
45	**1**

D.6 "Busts"

A bust is any segment listing with a major discrepancy (defined by 150 or more total unlisted units or 50 or more added DUs linked to any one DU) or that is completely unrepresentative of what is actually found. In the case of a fictitious listing, a lister was identified to list the segment again as quickly as possible. Otherwise, the following approach was employed.

First, if any DUs disappeared since the time of the listing, all selected "disappears" were assigned an "ineligible" final screening code. Then any new DUs were listed consecutively, assigned an SLN, and added to the sample if the SLN corresponded to the line number of an originally selected DU. Note that if the DU was coded as ineligible in the first step, the new DUs having its line number as the SLN still were added. This procedure is identical to the procedure for adding extra GQ units; however, the list can contain any combination of HUs and GQ units in this case. Again, if the number of DUs added was greater than 10, then resampling occurred from all nonfinalized DUs as described in Section D.3.

D.7 Quality Control

To ensure quality, the sampling support office employed several quality control checks:

- Sampling staff ensured the correct information was keyed by data entry.
- Checks within the computing division were performed.
- Sampling staff checked the number of selected DUs and the person probabilities of selection assigned to each DU selected in the subsampling routine.

Appendix E:
Expected Value of the Collapsed Stratum Estimator as Applied to the NSDUH "with Replacement" Variance Estimator

The 2014 through 2022 National Survey on Drug Use and Health (NSDUH) design uses 750 state sampling regions (SSRs) as geographically defined sampling strata within states. In addition, the annual sample of eight area segments in each SSR is randomly assigned to four quarters (two segments per quarter). After 2014, one half of the segments (one per quarter in each SSR) will be replaced each year with a fresh subset of a combined 10-year sample design.

With this structure, maximum stratification at the first stage is recognized by defining strata as the combination of SSR and quarter yielding 3,000 (750 SSRs × 4 quarters) first-stage strata with two design primary sampling units (PSUs, or area segments in each stratum). This approach provides 3,000 degrees of freedom (*df*) for variance estimation for national estimates and 48 to 144 *df* for state estimates, depending on the state. The problem with applying this approach is that many segments can be anticipated to have no observations because of the combined effects of ineligibility, low sampling yields at the person level, and nonresponse at the dwelling unit or person levels. This problem was resolved in the 1999 to 2004 design by collapsing design strata (and design PSUs) across quarters to form variance strata (and variance PSUs). A similar approach for the 2014 to 2022 design would yield 750 national variance strata and 12 to 36 variance strata per state. Under the NSDUH design, 1 degree of freedom for variance estimation is associated with each variance stratum.

For the 2005 through 2013 design, an alternate stratum-collapsing strategy was defined that had the combined effect of maintaining adequate *df* for national estimates while obtaining higher *df* for state-level estimates. This stratum-collapsing strategy is being used for the 2014 through 2022 NSDUHs and provides 750 *df* for national estimates and 48 to 144 *df* for state-level estimates. This discussion is intended to show that any arbitrary grouping of sampling strata can be used to achieve variance estimators with the same expected values. This result suggests that instead of forming variance strata across quarters within SSRs, it is equally feasible to form variance strata across SSRs. In addition, if the SSRs that were combined to form a variance stratum come from different states, they provide some additional disclosure protection because an intruder can no longer assume that all respondents in a variance stratum come from the same state.

Consider a total defined in terms of the sample design structure as

$$T_Y = \sum_{h=1}^{3{,}000} \sum_{i=1}^{N_h} \sum_{j=1}^{N_{hi}} Y_{hij},$$

where Y_{hij} is a numeric characteristic of the *j*-th person in the *i*-th area segment of the *h*-th stratum, N_{hi} is the number of NSDUH-eligible persons in the *i*-th area segment of the *h*-th

stratum, and N_h is the number of area segments defined within the *h*-th stratum.[48] The NSDUH annual sample design calls for selecting two area segments from each of the 3,000 strata and a variable number of persons, n_{hi}, per area segment. The total sample of persons is targeted at 67,507 for the 2014 through 2022 samples or an average of 11.25 responding persons per segment.

An estimate of the population total can then be written in terms of the observed sample as

$$\hat{T}_Y = \sum_{h=1}^{3,000} \sum_{i=1}^{2} \sum_{j=1}^{n_{hi}} w_{hij} y_{hij},$$

where y_{hij} is the observed numeric characteristic of the *j*-th sample person in the *i*-th sample area segment of the *h*-th stratum, w_{hij} is the analytic weight of this person, and n_{hi} is the number of sampled and responding NSDUH-eligible persons in the *i*-th area segment of the *h*-th stratum.

Because the NSDUH first-stage sampling rate is low, the "with replacement" variance estimation option provides a nearly unbiased variance estimate for NSDUH estimates.[49] Following the notation in the SUDAAN manual (RTI International, 2012b), the variance estimate based on the 3,000 strata can be written as

$$v(\hat{T}_Y) = \sum_{h=1}^{3,000} \sum_{i=1}^{2} 2(z_{hi} - \bar{z}_h)^2,$$

where $z_{hi} = \sum_{j=1}^{n_{hi}} w_{hij} y_{hij}$, and $\bar{z}_h = \frac{\sum_{i=1}^{2} z_{hi}}{2}$.

Suppose someone wishes to collapse the 3,000 strata into *K* (< 3,000) strata, each containing H_k of the original strata, and such that $\sum_{k=1}^{K} H_k = 3,000$. In addition, the variance PSUs within these strata consist of the combined PSU 1 segments and combined PSU 2 segments from the contributing original strata. Then the variance of a total can be estimated on the collapsed strata as

$$v'(\hat{T}_Y) = \sum_{k=1}^{K} \sum_{i=1}^{2} 2(z'_{ki} - \bar{z}'_k)^2,$$

[48] The notation in this appendix is not consistent with the notation in the remainder of the report.

[49] The assumption of "with replacement" sampling produces estimates of variance that are slightly biased on the high side because they do not take account of variance reduction due to finite population sampling at the first stage of the design.

where $z'_{ki} = \sum_{h \in k}^{H_k} z_{hi}$, and $\bar{z}'_k = \frac{\sum_{i=1}^{2} z'_{ki}}{2} = \frac{\sum_{i=1}^{2} \sum_{h \in k}^{H_k} z_{hi}}{2} = \sum_{h \in k}^{H_k} \bar{z}_h$. Notice that $z'_{ki} - \bar{z}'_k = \sum_{h \in k}^{H_k} (z_{hi} - \bar{z}_h)$.

To show the equivalence of collapsed stratum variance estimate to the full stratum variance, the collapsed stratum variance can be re-expressed as

$$v'(\hat{T}_Y) = \sum_{k=1}^{K} \sum_{i=1}^{2} 2\{\sum_{h \in k}^{H_k} (z_{hi} - \bar{z}_h)\}^2 = \sum_{k=1}^{K} \sum_{i=1}^{2} 2 \sum_{h \in k}^{H_k} (z_{hi} - \bar{z}_h)^2 + \sum_{k=1}^{K} \sum_{i=1}^{2} 2 \sum_{h \neq h' \in k}^{H_k} (z_{hi} - \bar{z}_h)(z_{h'i} - \bar{z}_{h'}) .$$

The first term can be shown to have the same value as $v\left(\hat{T}_Y\right)$ by rearranging the summation as

$$\sum_{k=1}^{K} \sum_{i=1}^{2} 2 \sum_{h \in k}^{H_k} (z_{hi} - \bar{z}_h)^2 = \sum_{k=1}^{K} \sum_{h \in k}^{H_k} \sum_{i=1}^{2} 2(z_{hi} - \bar{z}_h)^2 = \sum_{h=1}^{3{,}000} \sum_{i=1}^{2} 2(z_{hi} - \bar{z}_h)^2 .$$

The second term has an expected value of zero because sample selection is done independently in each of the original strata. Because this second term is zero only in expectation, the exact values of the two variance estimates are not likely to be identical. Although the expectation of the second term is zero, it has a positive variance. As a result, there is a loss in statistical efficiency from using the collapsed method. That is to say, the relative variance of the collapsed variance estimator is higher than that of the uncollapsed variance estimator. This is reflected in its smaller *df*.

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Appendix F:
2022 NSDUH Census Block Assignment Procedures

F.1 Introduction

A coordinated sample design was developed for the 2014 through 2022 National Surveys on Drug Use and Health (NSDUHs). The multiyear design consists of a deeply stratified, multistage area probability design. The first stages of selection involve selecting census tracts within state sampling regions and census block groups (CBGs) within selected census tracts. For the 2022 NSDUH, CBGs were evaluated for address-based sampling (ABS) coverage. Those CBGs that met ABS coverage criteria served as ABS segments. In those CBGs that did not meet criteria, a smaller segment was selected for field enumeration.

Field enumeration segments consist of one or more adjacent census blocks and are defined using 2010 census geography. After the segments are selected, specially trained field listers visit the areas and enumerate all eligible dwelling units (DUs) within each field enumeration segment's boundaries. This process, called "counting and listing," creates the sample frame for the fourth stage of selection (DUs).

A requirement of the 2014 through 2022 surveys is to associate each NSDUH respondent's DU to a specific census block. Respondents in ABS segments are assigned to a census block based on their DU's geocoded location. Because the counting and listing of field enumeration segments for NSDUH occurs at the segment level rather than at the census block level, only the group of blocks in which these NSDUH respondents reside is known. Using desktop computer mapping software, census block information is recorded by manually comparing field listings with electronic segment maps that were created using the U.S. Census Bureau's Topologically Integrated Geographic Encoding and Referencing (TIGER) data. As a result, block-level data can be associated with all NSDUH respondents, improving the accuracy of geographic variables used for data analyses.

This appendix describes the procedures used to assign each NSDUH respondent in field enumeration segments to a census block (Section F.2). Section F.3 describes the quality control (QC) procedures used to ensure the accuracy of the census block assignments. The census block assignments and their corresponding QC procedures are completed on a quarterly basis.

F.2 Step-by-Step Procedures

1. **Create respondent DU file.** Approximately 2 weeks following the completion of each survey quarter, a respondent DU file is created from the preliminary person-level weight file. Because the completed case rule has not been implemented when the respondent DU file is created, some of these DUs may not be included on the final data file. First, to reduce the number of DU assignments required, segments consisting of only one block are flagged, and all respondents in the segment are assigned to the census block. Next, duplicates are eliminated such that multiple respondents at the same DU only require one assignment. This last step includes eliminating duplicate group quarters (GQ) units within the same GQ structure such

that only one census block assignment is required. For example, a college dormitory with X rooms within the same building will have X-1 duplicate GQ units.

2. **Append address to each respondent DU.** Addresses are appended to the respondent DU file created in Step 1, and the file is uploaded to the system.
3. **Open census block assignment application.** The census block assignment application is included as a feature of the web-Setting and Zooming (web-SAZ) utility that was developed by RTI for NSDUH map production. Setting and zooming is the process of assigning each census block in a segment to a map page and zooming congested areas to allow sufficient space for marking DU locations on the resulting block listing maps. For census block assignments, the user follows the same steps that are used to open web-SAZ for map setting and zooming.
4. **Navigate to segment maps.** After specifying the state and quarter within the appropriate survey year's tracking system, the user selects a segment and selects "Start" to open the segment maps.
5. **Select a DU for assignment.** In web-SAZ, the user selects the "Locate DU" button in the toolbar, identified by the house icon (see the top left side of Exhibit 3, which appears after this appendix's text discussion). The user then selects a DU from the DU dropdown box at the bottom of the page. DUs needing assignment are in red font, and those with assignments already made are in black font. Once selected, the DU's address appears in the "DU Address" box next to the DU dropdown box.
6. **Locate DU on original field listing map.** The user opens the hard-copy segment maps that were listed in the field and locates the DU on the map. As shown in Exhibit 4, the DU locations are marked on the hard-copy map, but the census block boundaries are not visible. The user verifies that the address at the line number in the segment listing matches the address in the "DU Address" field. If the addresses do not match (e.g., if the address was edited during screening and interviewing and not updated in the hard-copy listing), further investigation is required to ensure that the DU on the hard-copy map and in web-SAZ are the same.

   If the DU was added to the sample during screening and interviewing (i.e., it was located on the property or premises of a sample DU or was added using special "bust" procedures, as described in Section D.6 of Appendix D), the DU location may not be specified on the map. In this case, further investigation is required to identify the sample DU to which the added DU is linked. The added DU is then placed at the same location as the sample DU. A bust situation involves a large number of missed DUs (e.g., a new or missed road or subdivision). Thus, DUs added through the special bust procedures are almost always drawn on the map.
7. **Specify map page of the DU.** The user selects the DU's map page from the "Zoom to Page for DU work" dropdown box (see Exhibit 3). The map page containing the DU's location is displayed.
8. **Click on map at DU location.** The user clicks the point on the electronic map where the DU has been spotted by the lister. An "X" will appear on the map with the associated DU number above and the census block number below the "X." Although only the federal information processing standards (FIPS) code for the block is displayed for readability, the system captures the state, county, tract, and block group codes to uniquely identify the census block.

As shown in Exhibit 5, the census block boundaries are displayed with a thick gray line, which allows the user to see the census block boundaries even when a road or stream is placed over them. The FIPS code for the block is shown with a dark blue label. Three blocks make up the example in the exhibit, although all DUs are located within the same census block. The red square around the area displays the map page boundaries.

The census block number is automatically assigned based on the DU location inside the census block map layer. Thus, the system will allow users to associate DUs only with blocks that are part of the segment. If a user clicks on an area outside the segment, an error is displayed, and the user is asked to try again.

9. **Repeat Steps 5 through 8 for each respondent DU in the segment.** Once the census block assignments have been made for all respondent DUs in the segment, a pop-up will appear saying, "All DUs have been assigned to blocks for [current segment]." The same message appears at the bottom of the page as shown in Exhibit 6. The user then clicks the "complete" button in the toolbar, which is identified by the checkmark icon. The user is not able to mark a segment as complete until the census blocks for all respondent DUs in the segment have been assigned.
10. **Repeat Steps 4 through 9 for all field enumeration segments.**
11. **Output census block data to a file.** The file containing the census block assignments for all respondent DUs is processed, quality checked, and output to a file that can be easily appended to the master data file. The variables appended to the data file include tract (TRACT10), block group (BLKGRP10), and census block (BLOCK10).[50]

F.3 Quality Control Procedures

Throughout the process, QC procedures are implemented to ensure the accurate assignment of respondents to census blocks. Some quality checks are built into the application, while others are completed during the postprocessing of the data.

F.3.1 Built-In Quality Control Checks

- The user does not enter any census block numbers. Census blocks are automatically assigned based on the DU location inside the census block map layer. This ensures there are no data entry errors and only census blocks contained in the segment are assigned.
- The user is not able to specify a DU location outside of the segment boundaries.
- The user cannot mark a segment as complete until the census blocks for all respondent DUs in the segment have been assigned.

F.3.2 Postprocessing Quality Control Checks

- Confirm that all respondent DUs are assigned to a census block.

[50] State and county are already known for each segment and are delivered to the master data file separately.

- For each DU, confirm that the assigned census block is part of the segment associated with the DU.
- Confirm that all final respondents have a census block assignment by merging to the master data file.

Exhibit 3 Census Block Assignment Application with No Dwelling Units Assigned

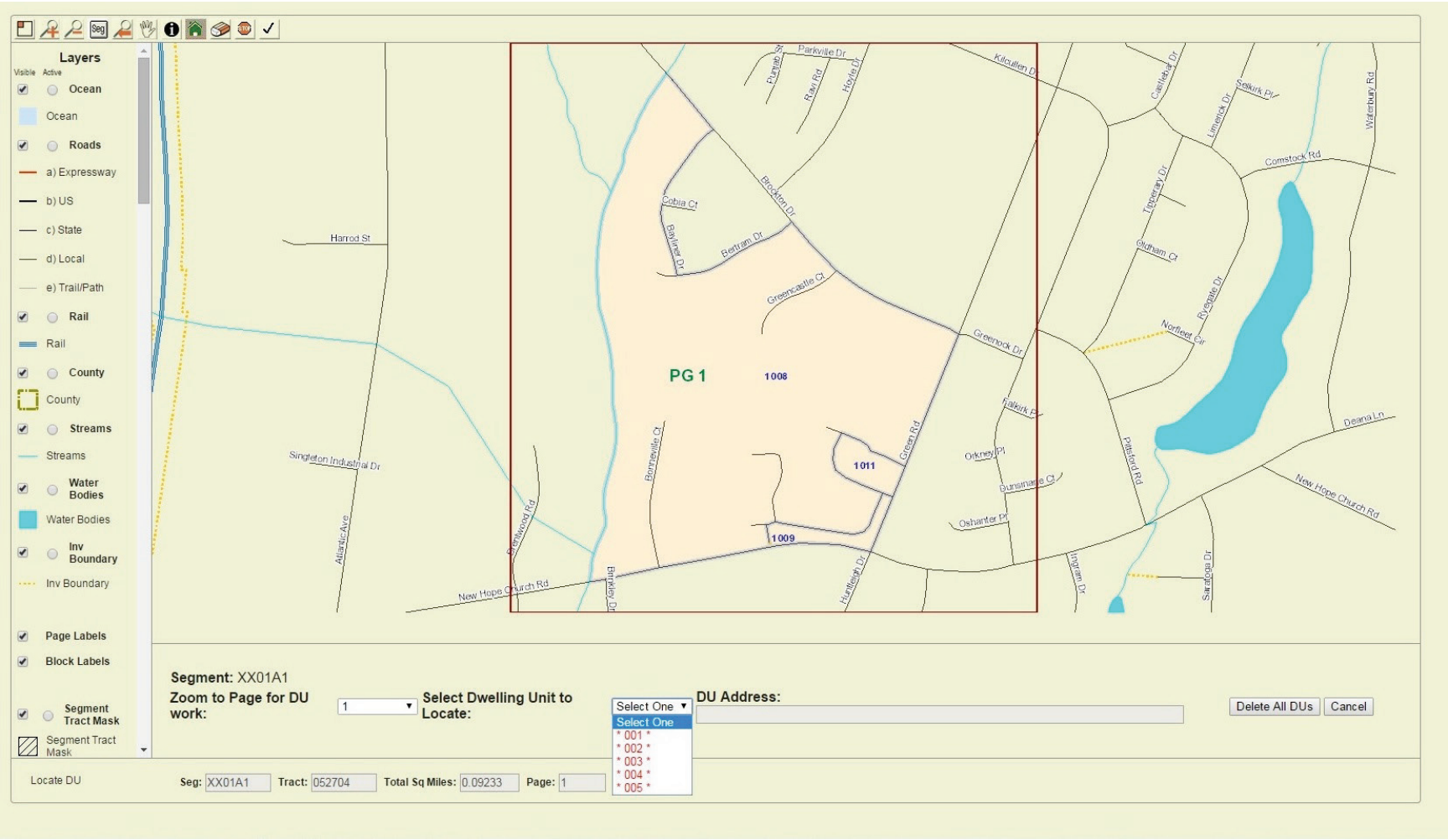


Exhibit 4 Field Listing Map

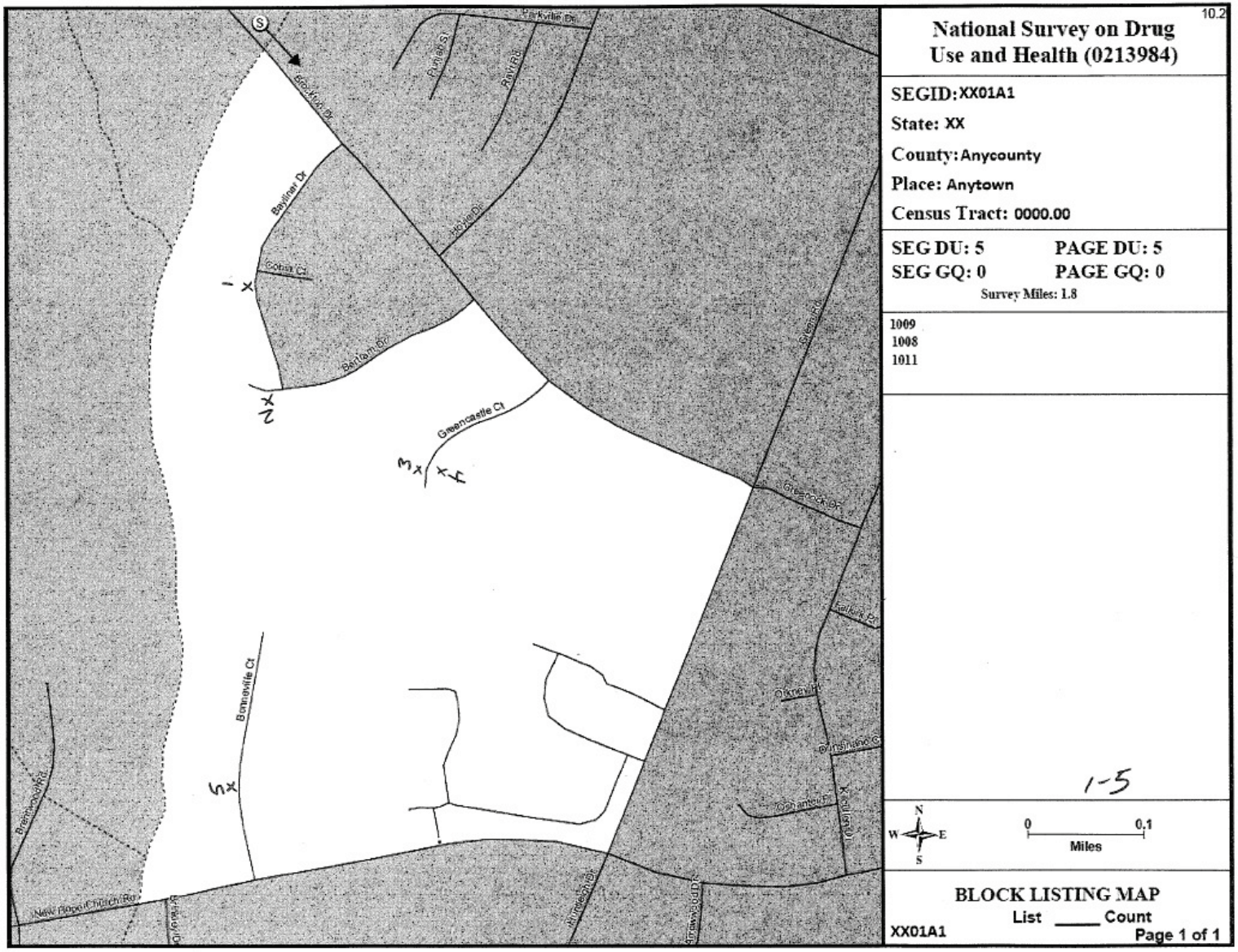


Exhibit 5 Census Block Assignment Application with Some Dwelling Units Assigned

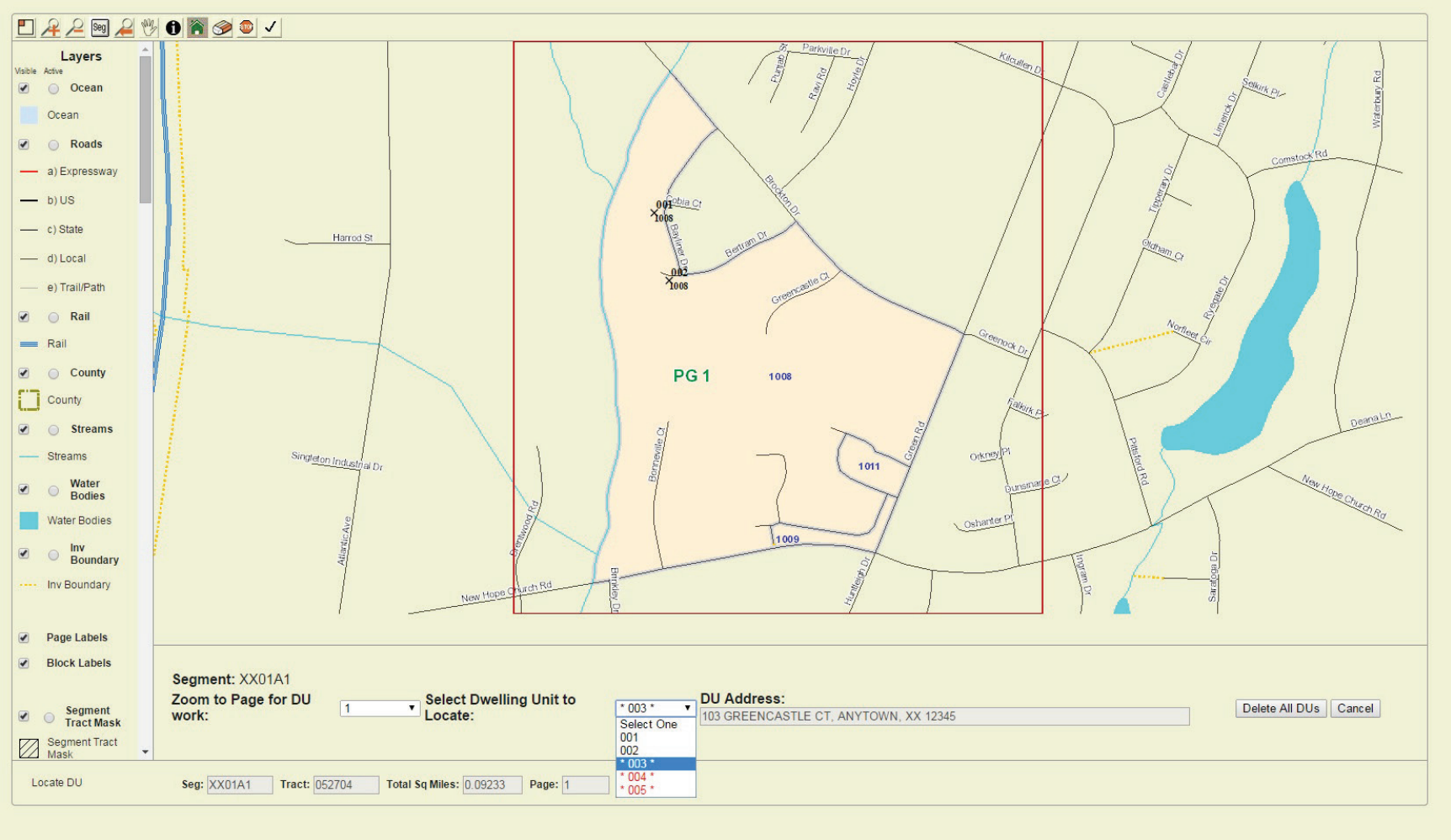
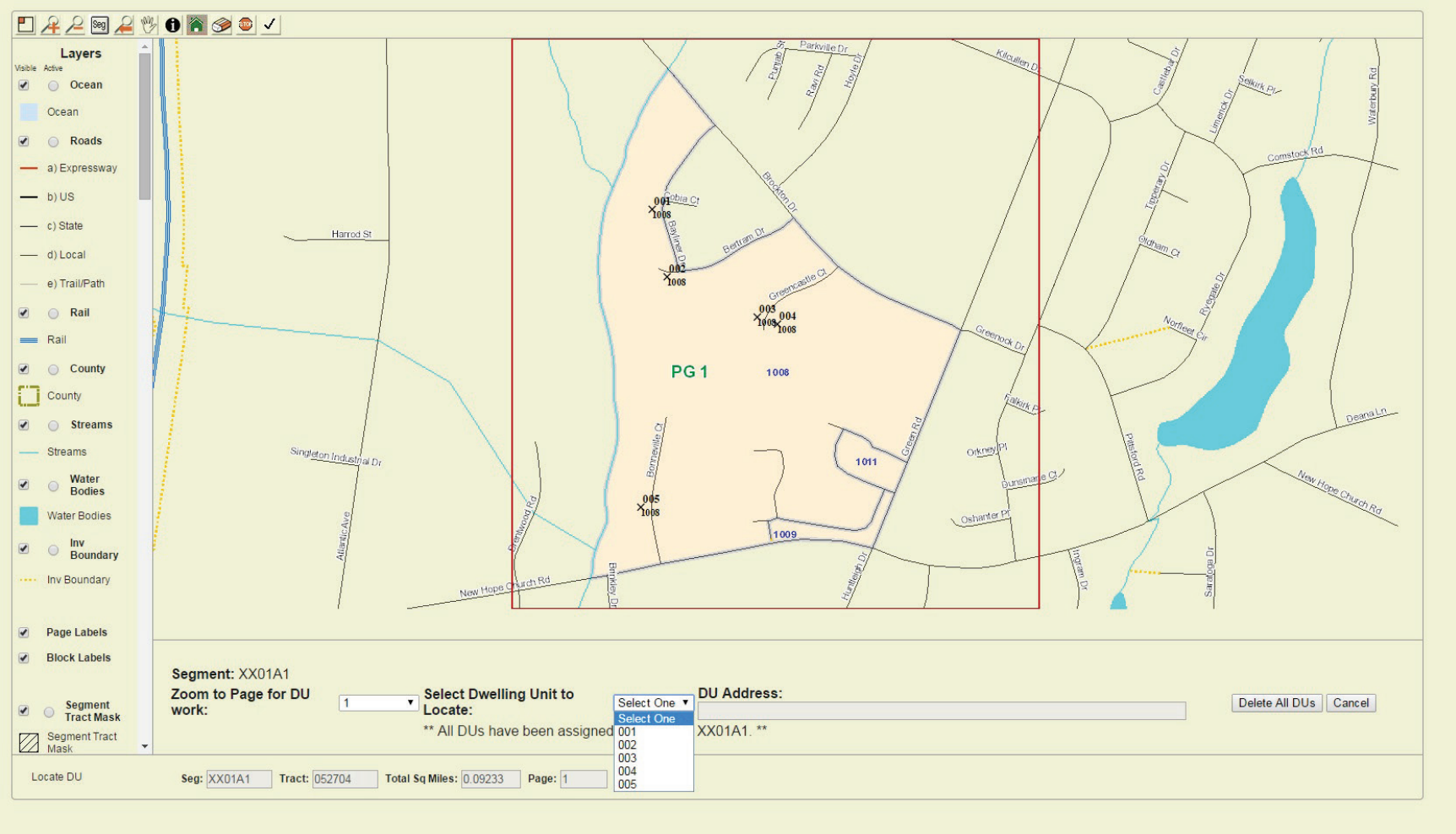


Exhibit 6 Census Block Assignment Application with All Dwelling Units Assigned



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