Appendix A. Compilation of Model Input Data

This appendix contains brief descriptions of how the data sets representing nutrient sources and land-to-water-delivery variables were compiled and how these data sets differed from those used in the RF1 SPARROW models. Detailed descriptions of the methods used to compile these data sets are contained in the data archives for each one.

Nutrient Sources

Natural Nutrient Sources

The nutrient source terms representing west-side and east-side forestland in the total nitrogen (TN) and total phosphorus (TP) models and scrubland and grassland in the TP model were used as surrogates for natural sources of nitrogen and phosphorus because direct estimates of these natural nutrient sources were not available for the Pacific Northwest (PNW). These natural nutrient sources result from complex biological and abiotic processes. In the TN model the natural source of nitrogen was fixation of atmospheric nitrogen in forests and in the TP model the natural source of phosphorus was the weathering of geologic material. These nutrient source terms were derived from the 2001 National Land Cover Data Base (NLCD) (Homer and others, 2004) (Michael Wieczorek, U.S. Geological Survey, written commun., June 11, 2011). The total areas of forestland (NLCD categories 41, 42, and 43), scrubland (NLCD category 52), and grassland (NLCD category 71) were summarized for each incremental NHD catchment.

Point Sources

The nutrient source terms representing point sources included 785 facilities having a National Pollutant Discharge Elimination System (NPDES) permit. The discharge of TN and TP for 2002 from sewage treatment and food processing facilities were estimated using measured flow at plant outflows and either onsite measurements of TN and TP or a regional average for a specific industrial classification. The discharge of TN and TP were not estimated for facilities without adequate flow data. The discharges of TN and TP from fish farms and hatcheries for 2002 were estimated by using a mass balance of annual fish production and feed usage and an estimate of nitrogen and phosphorus content for fish and feed (Hal Michael, Washington Department of Fish and Wildlife, oral commun., December 2009). The discharge of TN and TP were not estimated for hatcheries and other aquaculture facilities without adequate production and feed data. The total amount of TN and TP discharged during 2002 from all point sources was estimated for each incremental NHD catchment (see GIS data #14 and #22). The data set of point sources used in the NHD SPARROW model included more facilities than the one used in the RF1 SPARROW model (785 versus 391) (Maupin and Ivahnenko, 2011) and the additional facilities were mostly non-major sewage treatment plants, fish farms and hatcheries, and food processing operations.

Developed Land

The nutrient source term representing developed land was used as surrogate for various nutrient sources originating from residential, commercial, and industrial land. The use of this source was intended to capture non-point sources of nutrients, including fertilizer, animal waste, and failing sewer systems from these settings. However, the atmospheric deposition of nitrogen or nutrients discharged from permitted point sources were not intended to be represented by this source. Developed land was equal to the summed areas of NLCD categories 21, 22, 23, and 24, minus areas representing roads. Areas representing roads were removed for three reasons: (1) forested catchments with extensive logging road networks would incorrectly exhibit a strong developed land signal, (2) an accurate representation of residential land use was needed to estimate the distribution of non-sewered population and non-farm fertilizer (see section Farm Fertilizer and Non-Farm Fertilizer), and (3) the lack of nutrient use along most roadways. The total area of developed land was summarized for each incremental NHD catchment (GIS data #6 and #19). This approach was different from the approach used for the RF1 SPARROW models, which included NLCD categories 22, 23, and 24, but did not explicitly eliminate roads.

Non-Sewered Population

The nutrient source term representing non-sewered population (the number of people not served by a municipal wastewater-treatment plant) was used as a surrogate for nitrogen leaching from septic tanks. The extent of non-sewered population was computed by (1) overlaying census blocks polygons from the 2000 United States census on a grid of developed land (see section Developed Land); (2) distributing the population of each census block equally to each developed land grid cell within that census block; and (3) removing any of the grid cells that were within an area served by municipal sewers during 2002 (GIS data #15). The total non-sewered population was summarized for each incremental NHD catchment (GIS data #11 and #24). This approach was different from the one used in the RF1 SPARROW models, which used 1990 census tract data to estimate the population served by septic tanks (U.S. Geological Survey, 2011a).

Atmospheric Nitrogen Deposition

The nutrient source term representing atmospheric nitrogen deposition was based on the results from the U.S. Environmental Protection Agency Community Multiscale Air Quality (CMAQ) model (R.L. Dennis, U.S. Environmental Protection Agency, written commun., June 2011). The CMAQ model provided spatially refined atmospheric deposition data, which reflected orographic barriers and nitrogen-islands, such as cities and farmland, and included estimates of wet and dry oxidized nitrogen deposition as well as wet and dry reduced nitrogen deposition. The CMAQ atmospheric nitrogen data were summarized for each incremental NHD catchment (GIS data #1 and #16). This data set was different from the atmospheric nitrogen deposition data set used in the RF1 SPARROW TN model (Wieczorek and Lamotte, 2013), which was obtained from the National Atmospheric Deposition Program (NADP), because it represented total nitrogen deposition for 2002 (wet, dry, oxidized, and reduced), whereas the NADP data only represented wet deposition.

Farm Fertilizer and Non-Farm Fertilizer

The nutrient source terms representing farm and non-farm fertilizer were based on county-level estimates of nitrogen and phosphorus from fertilizer use on farmland and non-farm land. The county-level estimates of 2002 farm and non-farm fertilizer use were compiled by the USGS based on statewide fertilizer sales and county-level expenditures (Gronberg and Spahr, 2012). The county-level USGS data for Idaho, Oregon, and Washington, however, were scaled to reflect differences between the statewide sales data compiled by the USGS and data compiled by those states. The statewide sales data were obtained from the Idaho State Department of Agriculture (Richard Killebrew, written commun., March 2011), the online archives of the Oregon State Library (Oregon Department of Agriculture, 2011), and the Washington State Department of Agriculture (Lizette Beckman, written commun., March 2011). The county-level estimates of nitrogen and phosphorus from farm fertilizer were disaggregated equally to NLCD farmland in each county (NLCD categories 81 and 82) and the county-level estimates of nitrogen and phosphorus from non-farm fertilizer use were disaggregated equally to the developed land (see section Developed Land) in each county. The total amount of nitrogen and phosphorus from farm and non-farm fertilizer applied during 2002 was summarized for each incremental NHD catchment (GIS data #2–5 and #18). This approach was different from the approach used for the RF1 SPARROW models (Wieczorek and Lamotte, 2013), which did not account for differences between USGS and state estimates of sales data.

Livestock Manure

The nutrient source terms representing confined cattle and grazing livestock manure were based on the animal populations at registered dairies and feedlots, county-level livestock populations, and animal-specific nutrient generation factors (nitrogen and phosphorus generated per animal per year).

Confined Cattle Manure

The nutrient source term representing confined cattle manure was estimated by multiplying the number of cattle at each dairy or feedlot by the nitrogen and phosphorus generation factors for dairy cows and feedlot cattle, respectively. The location and population of each dairy and feedlot for 2002 were determined from permitting and inspection records obtained from the Idaho, Oregon, and Washington Departments of Agriculture (J.P. Bilderback, written commun., December 2009; Melissa Boschee, written commun., December 2009; and Virginia Prest, written commun., December 2009; respectively). The nitrogen and phosphorus generation factors were obtained from the USGS (D.K. Mueller, written commun., June 2010). All manure generated by a dairy or feedlot was assumed to be applied within the incremental NHD catchment containing that dairy or feedlot. This assumption was based on the facts that (1) most confined operations grow some or most of their own feed on nearby farmland and (2) manure is a low-cost alternative to commercial fertilizer for those crops if it is not trucked long distances (Araji and others, 2001, Sanford and others, 2009). The authors recognize that the assumption of applying all manure locally may over-represent manure applications in some areas because manure at some facilities is not applied locally, may be composted, or is used for energy production. The data needed to quantify these practices, however, does not exist on a regional basis and these practices are likely applied to a small fraction of the total manure generated in the PNW. The total amount of nitrogen and phosphorus generated at dairies and feedlots during 2002 was summarized for each incremental NHD catchment (GIS data #13 and #21). The approach used to develop the nutrient source term representing manure from confined cattle for the NHD SPARROW models differed from the approach used for the RF1 SPARROW models (Wieczorek and Lamotte, 2013). The data set for the RF1 model was based on livestock confinement factors for each county that were obtained from survey data from the 1980s (Kellog and others, 2000) rather than 2002 estimates of cattle populations at individual dairies and feedlots.

Grazing Livestock Manure

The nutrient source term representing grazing livestock manure included manure generated by rangeland cattle and the manure generated by all other non-cattle, non-poultry livestock. Each of these nutrient sources were compiled at the county level and disaggregated to the land based on assumed land use patterns. The manure generated by poultry operations was not included in this nutrient source term because poultry manure typically was not applied to farmland in the county where it was produced. Rather, poultry manure was most often sold statewide and regionally as fertilizer for farm and for nonfarm use (Julie Walker, Washington State Department of Agriculture, oral commun., January 2010), and could not be traced to a particular place of application.

The county-level estimates of nitrogen and phosphorus from rangeland cattle manure was estimated by subtracting the amount of nitrogen and phosphorus generated by dairy and feedlot cattle in each county from the total amount generated by all cattle. The county-level estimates of total of nitrogen and phosphorus generated by all cattle in each county were obtained from the USGS (D.K. Mueller, written commun., June 2010) and were based on 2002 animal counts compiled by the U.S. Department of Agriculture and annual nitrogen and phosphorus generation factors. The county-level estimates of nitrogen and phosphorus from non-cattle grazing livestock manure, which was generally a small percentage of the total grazing livestock manure, were also obtained from the USGS and based on 2002 animal counts compiled by the U.S. Department of Agriculture and annual nitrogen and phosphorus generation factors.

The county-level estimates of nitrogen and phosphorus from rangeland cattle manure were disaggregated equally to the potential grazing land in each county. A raster data set of potential rangeland was compiled using NLCD categories 41 (deciduous forest), 42 (evergreen forest), 43 (mixed forest), 52 (shrub/scrub), 71 (grassland/herbaceous), and 81 (pasture/hay). Potential rangeland was removed if it did not meet criteria for maximum slope, maximum canopy cover, minimum distance to perennial surface water or wells (David Ganskopp, U.S. Department of Agriculture, Agricultural Research Service, oral commun., January 2010), or if the land was managed by the Bureau of Land Management but was not part of a grazing allotment in 2002. The total amount of nitrogen and phosphorus from rangeland cattle manure during 2002 was summarized for each incremental NHD catchment (GIS data #9, #10, and #20). The county-level estimates (2002) of nitrogen and phosphorus from non-cattle grazing livestock manure were disaggregated equally to grassland and pasture in each county (NLCD categories 70 and 81, respectively). The total amount of nitrogen and phosphorus from non-cattle grazing livestock manure during 2002 was summarized for each incremental NHD catchment (GIS data #7, #8, and #20).

The approach used to develop the nutrient source term representing manure from grazing livestock for the NHD SPARROW models differed from the method used for the RF1 SPARROW models (Wieczorek and Lamotte, 2013) primarily in the way that the manure was disaggregated to the land. In the RF1 models, the land that received grazing livestock manure included cultivated crops even though very little of that land is used for livestock grazing in the PNW (U.S. Department of Agriculture, 2009). Additionally, the landscape types that received grazing livestock manure in the RF1 models omitted much of the rangeland throughout the PNW by not including shrub/scrubland and forestland.

Nitrogen Leaching from Red Alder Trees

The nutrient source term representing the leaching of nitrogen from read alder trees (*Alnus rubra*) was based on a data set showing the distribution of this plant species throughout western Oregon and Washington. The same data set was used for the RF1 SPARROW models (U.S. Geological Survey, 2011b). The total basal area of red alder trees circa 2002 was summarized for each incremental NHD catchment (GIS data #23).

Springs and Power Returns

A substantial proportion of the flow in some streams in the PNW is due to groundwater discharged from large spring complexes and a substantial proportion of the flow in some streams is due to the return of water that is diverted upstream for power generation. Because springs and power returns represent a routing of water that cannot be modeled within the SPARROW framework they were modeled as nutrient point sources. The nutrients in springs and power returns originate from some or all of the other natural and anthropogenic nutrient sources included in the models, but reach waterways in a concentrated manner similar to point sources. There were sufficient discharge and water-quality data to estimate mean annual TN and TP loads for three of the largest spring complexes—Opal Springs on the Crooked River in Oregon, Thousand Springs on the Snake River near Hagerman, Idaho, and Griffith and Waikiki Springs on the Little Spokane River in Washington. The nutrient loads from power returns were estimated in one of two ways. One approach was to use the fraction of streamflow received from an upstream reach (see section Surface-Water Drainage Network) at the point of diversion to estimate the percentage of load that was delivered to the receiving reach (an assumption was made that no nutrients were lost between the two reaches) and apply this percentage to the mean annual load estimated for a calibration station on or near the diversion reach. The other approach was used when no calibration station was on or near the diversion

reach. In this case, measurements of discharge and nutrient concentrations for the diversion at the point where it entered a receiving reach were used to estimate mean annual TN and TP loads. The total amount of TN and TP discharged during 2002 from the three spring complexes and the power returns was estimated for each incremental NHD catchment. This nutrient source was not included in the RF1 SPARROW models.

Land-to-Water Delivery

Solar Radiation

A data set of mean annual solar radiation was obtained for the PNW that represented the period between 1991 and 2005 (National Renewable Energy Laboratory, 2011). The average mean annual solar radiation for each incremental NHD catchment was estimated (GIS data #12 and #25).

Arid Land Irrigated Agriculture

Arid land irrigated agriculture was defined as all agricultural land east of the Cascade Range to which irrigation water was applied. The extent of arid land irrigated agriculture was determined by (1) identifying areas of pasture/hay and cultivated crops (NLCD categories 81 and 82, respectively) that were east of the crest of the Cascade Range and (2) removing areas representing non-irrigated wheat from the areas identified in (1). Land containing non-irrigated wheat was identified based on professional understanding of major agricultural cropping patterns in the PNW, research done for this study, and evaluating the NLCD and aerial photography for obvious signs of irrigation such as center pivot circles or irrigation ditches. The percentage of each NHD incremental catchment containing arid land irrigation was estimated (GIS data #17). This data set was a refinement of the one used in the RF1 SPARROW models (Wise and Johnson, 2011).

Metadata Links to GIS Data

GIS Rasters

1. *Total atmospheric deposition of oxidized and reduced nitrogen in the United States Pacific Northwest for 2002*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of wet and dry deposition of oxidized and reduced nitrogen in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_AtmosphericDeposition_td_tn

2. *Application of fertilizer nitrogen to farm land in the United States Pacific Northwest for 2002*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of fertilizer nitrogen that was applied to farm land in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_FertilizerDistribution_Farm_fert_n

3. *Application of fertilizer phosphorus to farm land in the United States Pacific Northwest for 2002*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of fertilizer phosphorus that was applied to farm land in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_FertilizerDistribution_Farm_fert_p

4. *Application of fertilizer nitrogen to nonfarm land in the United States Pacific Northwest for 2002*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of fertilizer nitrogen that was applied to nonfarm land in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_FertilizerDistribution_Nonfarm_nfert_n

5. *Application of fertilizer phosphorus to nonfarm land in the United States Pacific Northwest for 2002*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of fertilizer phosphorus that was applied to nonfarm land in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_FertilizerDistribution_Nonfarm_nfert_p

6. *Nonroad developed land in the United States Pacific Northwest for 2001*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the extent of non-road developed land in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) in 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_LandUseDistribution_dev_nonroad

7. *Application of nitrogen generated by non-cattle livestock to pasture land in the United States Pacific Northwest for 2002*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of nitrogen generated by pastured, non-cattle livestock that was applied to pasture land in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_LivestockWasteDistribution_Pasture_past_n

8. *Application of phosphorus generated by non-cattle livestock to pasture land in the United States Pacific Northwest for 2002*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of phosphorus generated by pastured, non-cattle livestock that was applied to pasture land in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_LivestockWasteDistribution_Pasture_past_p

9. *Application of nitrogen generated by grazing cattle to range land in the United States Pacific Northwest for 2002*

Pischel, E.M.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of nitrogen generated by grazing cattle that was applied to range land in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_LivestockWasteDistribution_Rangeland_range_n

10. *Application of phosphorus generated by grazing cattle to range land in the United States Pacific Northwest for 2002*

Pischel, E.M.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of phosphorus generated by grazing cattle that was applied to range land in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_LivestockWasteDistribution_Rangeland_range_p

11. *Nonsewered population in the United States Pacific Northwest for 2002*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent populations that did not have access to municipal sewer service in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) in 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_SewageTreatment_NonSewered_nonsewered

12. *Mean annual solar radiation in the United States Pacific Northwest (1991–2005)*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent mean annual solar radiation in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) for the period between 1991 and 2005.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_SolarRadiation_ghi_100

GIS Shapefiles

13. *Nutrient generation at dairies and feedlots in the United States Pacific Northwest for 2002*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of nitrogen and phosphorus generated by cattle at dairies and feedlots in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_PointSources_ConfinedCattle_CAFOs

14. *Point source nutrient discharges to surface water in the United States Pacific Northwest for 2002*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of total nitrogen and total phosphorus discharged to surface waters in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002 from individual permitted wastewater facilities.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_PointSources_NHD

15. *Areas with access to municipal sewer service in the United States Pacific Northwest for 2002*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent areas that had access to municipal sewer service in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) in 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_SewageTreatment_Sewered_SeweredAreas

Summary Tables

16. *Atmospheric deposition of nitrogen in the United States Pacific Northwest for 2002 summarized for NHDPlus v2 catchments*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of atmospheric nitrogen deposition in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002 within each incremental watershed delineated in the NHDPlus v2 dataset.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_AtmosphericDeposition_summary

17. *Arid land irrigation in the United States Pacific Northwest for 2001 summarized for NHDPlus v2 catchments*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the area of arid land irrigation in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2001 within each incremental watershed delineated in the NHDPlus v2 dataset.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_EastsideIrrigation_summary

18. *Fertilizer nutrients applied to farm and nonfarm land in the United States Pacific Northwest for 2002 summarized for NHDPlus v2 catchments*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of fertilizer nitrogen and phosphorus that was applied to farm and nonfarm land in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002 within each incremental watershed delineated in the NHDPlus v2 dataset.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_FertilizerDistribution_summary

19. *Nonroad developed land in the United States Pacific Northwest for 2001 summarized for NHDPlus v2 catchments*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the area of non-road developed land within each incremental watershed delineated in the NHDPlus v2 dataset in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) in 2001.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_LandUseDistribution_DevelopedNonRoad_summary

20. *Nutrients generated by livestock applied to farm land, pasture land, and range land in the United States Pacific Northwest for 2002 summarized for NHDPlus v2 catchments*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of nitrogen and phosphorus that was generated by livestock and applied to land in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002 within each incremental watershed delineated in the NHDPlus v2 dataset.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_LivestockWasteDistribution_summary

21. *Nutrient generation at dairies and feedlots in the United States Pacific Northwest for 2002 summarized for NHDPlus v2 catchments*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of nitrogen and phosphorus generated by cattle at dairies and feedlots in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002 within each incremental watershed delineated in the NHDPlus v2 dataset.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_PointSources_ConfinedCattle_CAFO_summary

22. *Point source nutrient discharges to surface water in the United States Pacific Northwest for 2002 summarized for NHDPlus v2 catchments*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the amount of total nitrogen and total phosphorus discharged to surface waters in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) during 2002 from all permitted wastewater facilities located within each incremental watershed delineated in the NHDPlus v2 dataset.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_PointSources_NHD_summary

23. *Red alder trees distribution in the United States Pacific Northwest for 2002 summarized for NHDPlus v2 catchments*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the basal area of red alder trees within each incremental watershed delineated in the NHDPlus v2 dataset in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) in 2001.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_RedAlder_summary

24. *Nonsewered population in the United States Pacific Northwest for 2002 summarized for NHDPlus v2 catchments*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent the population within each incremental watershed delineated in the NHDPlus v2 dataset in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) that did not have access to municipal sewer service in 2002.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_SewageTreatment_NonSewered_summary

25. *Mean annual solar radiation in the United States Pacific Northwest (1991–2005) summarized for NHDPlus v2 catchments*

Wise, D.R.
This spatial data set was created by the U.S. Geological Survey (USGS) to represent mean annual solar radiation in the Pacific Northwest region of the United States (Hydro Region 17; MRB7) for the period between 1991 and 2005 within each incremental watershed delineated in the NNHDPlus v2 dataset.
http://water.usgs.gov/lookup/getspatial?sir2013-5103_PNW_SPARROW_SolarRadiation_summary

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