Appendix A: Historic Nutrient Thresholds

The analysis conducted by SWQB to produce nutrient threshold values for streams was based on ecoregion and designated aquatic life use. For this analysis, TP, total Kjeldahl nitrogen (TKN), and nitrate plus nitrite (N+N) data from the National Nutrient Dataset (1990-1997) was combined with Archival STORET data from 1998 and 1999-2006 data from the SWQB in-house database. SWQB recognized site classes based on Level 3 ecoregions and cold, warm, and transitional temperature regimes as applied for designated Aquatic Life Uses. The threshold values (Table 3 in the main report) were derived from median values for all the data in each classification.

The query tool was used to acquire nutrient data from rivers and streams in the National Nutrient Dataset. There were 3230 total phosphorus, 3450 total Kjeldahl nitrogen, and 3250 nitrate plus nitrite stream data points generated with this query. The site information associated with the nutrient data such as the latitude and longitude, sample date, and water body name were include in the query. The query also contained a “Standard Value” which had one half of the “Reported Value” for those data points that were below the detection limit.

Data from 1998 was acquired from Archival STORET using the Advance Query Tool, and downloading all of the surface water data between 01-01-1998 and 12-30-1998 for parameter codes 00665 (Total Phosphorus), 00625 (Total Kjeldahl Nitrogen), and 00630 (Nitrate plus Nitrite). Unfortunately, the entire state could not be queried for specific dates and parameters so the data had to be downloaded by each county separately. Data for rivers, lakes, and reservoirs as well as playas was removed from this dataset. This query generated 483 total phosphorus, 489 total Kjeldahl nitrogen, and 662 nitrate plus nitrite data points. The “Standard Value” was calculated and these data were appended to the pre-1998 data.

Data from 1999 to 2006 were acquired from the SWQB in-house database. A query was run to compile total phosphorus, total Kjeldahl nitrogen, and nitrate plus nitrite data from streams as well as sample date and site location information. This query generated 3125 total phosphorus, 3216 total Kjeldahl nitrogen, and 3223 Nitrate plus Nitrite data points. The “Standard Value” was calculated and these data were appended to the pre-1999 data. All of the “Units” and “Standard Units” were converted to mg/L and designations for below the detection limit were standardized between the datasets from the different sources.

Once the dataset was compiled, the data were divided by waterbody type, removing all rivers, reservoirs, lakes, wastewater treatment effluent, and playas. For this project “rivers” were defined as systems that cannot be monitored effectively with methods developed for wadeable streams and generally have drainage areas greater than 2,300 square miles. The systems included in the "rivers" waterbody type are: 1) the San Juan River from below Navajo Reservoir to the Colorado border near Four Corners, 2) the Rio Grande in New Mexico, 3) the Pecos River from below Sumner Reservoir to the Texas border, 4) the Rio Chama from below El Vado Reservoir to the Rio Grande, 5) the Canadian River below the Cimarron River , 6) Rio Puerco below the confluence with the Rio San Jose, and 7) the Gila River below Mogollon. GIS was used to identify data from river sites as defined above.

Level III and IV Omernik ecoregions (Omernik 2006) as well as the designated aquatic life use were assigned to all stream sites using GIS coverages and the station’s latitude and longitude. New Mexico has 7 aquatic life uses: high quality coldwater, coldwater, marginal coldwater, warmwater, marginal warmwater, aquatic life, and limited aquatic life. Aquatic life and limited aquatic life sites were not used in this analysis as they generally represent waters with ephemeral or intermittent flow, naturally occurring rapid environmental changes, high turbidity, fluctuating temperatures, low dissolved oxygen content or unique chemical characteristics. Data from sites that had aquatic life designations of "aquatic life use" or "limited aquatic life use" were removed from the dataset. The 5 other aquatic life uses were divided into 3 groups:

1. Coldwater (CW) – those segments having only coldwater uses (high quality coldwater or coldwater)
2. Transitional (T)– waterbodies with marginal coldwater or both cold and warmwater uses
3. Warmwater (WW) - waterbodies having only warmwater uses (warmwater or marginal warmwater)

Because of the limited area and number of sites in the Madrean Archipelago (79), Western High Plains (25), and Colorado Plateau (20) ecoregions, these data where grouped with the most similar ecoregions; the Madrean Archipelago with the Chihahuan Desert and the Colorado Plateau with the Arizona New Mexico Plateau. The Western High Plains had no stream data as the only surface waters are playas, therefore this ecoregion was not included in the analysis.

The stream data were divided first by ecoregion then by aquatic life use. In ecoregion 26 on the Gallinas River below San Augustin, there was a period of 3 days when 4 to 15 samples were collected. For these data, daily averages were calculated. When there were less than 60 data points in the warmwater group, these data were combined with the transitional group to form the Trans/WW group. The 50th percentiles (medians) were calculated for each parameter and ecoregion/aquatic life use group using Excel. The total nitrogen value was then calculated by adding the percentile for total Kjeldahl nitrogen with the percentile for nitrate plus nitrite.

There was no difference in the TP threshold values for the coldwater and trans/ww groups in ecoregion 21. However, when examining the different level IV ecoregions there was a significant difference in the TP data from the volcanic and the other groups. This lead to the development of a separate threshold value for the ecoregion 21 volcanic group. The threshold value was calculating by determining the median of the data from ecoregions 21g and 21h as well as 21j in the Jemez Mountains. The Grassland Parks (21j) of the Jemez Mountains were included in this group as they are of volcanic origin and have the characteristic higher background TP.

Appendix B: Geospatial Analysis

Geospatial data were generated for stream sites in New Mexico. The sites were prioritized for analysis because the effort would be too high to delineate and analyze all sites with nutrient data. Prioritization was based on data completeness (having more than nutrient data alone), reference status (being considered as a possible reference site), and high nutrient values (to be certain we had representation from the stressed end of the disturbance gradient. We also identified identical site locations with different Station IDs. We prioritized 662 unique sites for analysis, including NMED, NRSA, and WSA sites (Table B-3). The geospatial data were used for the classification analyses and to screen sites for disturbance.

We used Geographic Information System software (ArcGIS 10.0) to spatially join the sampling sites with National Hydrography Dataset Plus Version 2 flowlines (NHDPlusV2) (http://www.horizon-systems.com/NHDPlus/NHDPlusV2_home.php). Then we used ArcHydro custom watershed delineation to delineate exact watersheds for all of the sites. Tetra Tech performed quality assurance and quality control procedures to screen for errors in the geospatial data. We were unable to check all of the stream data due to the large number of sites. We reviewed site delineations using desktop display in Google Earth; plotting drainage area vs. stream width and looking for outliers; and communicating with NMED staff to verify data that appeared questionable.

Land use statistics were used for disturbance screening. Table B-1 contains a list of the land use parameters that were generated for each site. The source of these data was the 2011 National Land Cover Database (NLCD) dataset (http://www.mrlc.gov/nlcd2011.php) (Jin et al. 2013).

Table B-1. Land use data that were generated for streams in New Mexico. Source: 2011 National Land Cover Database (NLCD) dataset.

Code	Description
	% Impervious cover
PNLCD_11	% Open Water
PNLCD_21	% Developed, Open Space
PNLCD_22	% Developed, Low Intensity
PNLCD_23	% Developed, Medium Intensity
PNLCD_24	% Developed, High Intensity
PNLCD_31	% Barren
PNLCD_41	% Deciduous Forest
PNLCD_42	% Evergreen Forest
PNLCD_43	% Mixed Forest
PNLCD_52	% Shrub/Scrub
PNLCD_71	% Grassland/Herbaceous
PNLCD_81	% Pasture/Hay
PNLCD_82	% Cultivated Crops
PNLCD_90	% Woody Wetlands
PNLCD_95	% Emergent Herbaceous Wetlands

Some of the land use categories were combined to generate land use indices. Examples include:
- % Agriculture = % Cultivated Crops (code 82) + % Pasture/Hay (code 81)
- % Urban = % Developed, Low Intensity (code 22) + % Developed, Medium Intensity (code 23) + % Developed, High Intensity (code 24)

Table B-2. Non-land use geospatial data generated by Tetra Tech.

Variable Code	Description and Source	Specific Measurement
SiteID	Site ID	Label
DrAreaMi2	Drainage Area Size	sq miles
Latitude	Latitude	
Longitude	Longitude	
Elev_m	Elevation from 30m DEM	meters
StrmOrdr	Stream Order NHDPlus V2 Data	modified Strahler
Slope_m_m	Stream Slope	m/m
Eco3Dom	Dominant Level 3 Ecoregion	Ecoregion code
GeolgDom	Dominant Geology "RockType1"	Rock type category
LndSlpMin%	Percent (Land) Slope (30-m resolution NED)	Min
LndSlpAvg%		Average
LndSlpMax%		Max
LndSlpSTD%		STD
PrecipMin30	PRISM climate data (1981-2010 "normals")	Monthly 30-year Average Precipitation (mm) - Minimum
PrecipAvg30		Monthly 30-year Average Precipitation (mm) - Average
PrecipMax30		Monthly 30-year Average Precipitation (mm) - Maximum
TempMin30		Monthly 30-year Average Minimum Temperature (deg C)
TempMax30		Monthly 30-year Average Maximum Temperature (deg C)
TempAvg30		Monthly 30-year (Calculated) Average Temperature (deg C)
RoadMiles	Roads (Census Streets, 2010)	Total Length of Roads (miles)
RoadDens		Road Density (length/area)
StrmMiles	Streams/Rivers (NHD Hi-Res)	Total Length of Streams (miles)
StrmDens		Stream Density (length/area)
RdXStrmCnt	Road/Stream Crossings	Total Count (#)
RdXStrmDens		Count/Area
DamsCnt	Dams and Diversions (NHDPlus V2)	Total Count (#)
DamsDens		Density (count/area)
DamDistMin		Distance to Drainage Outlet (Min)

Variable Code	Description and Source	Specific Measurement
DamDistAvg		Distance to Drainage Outlet (Avg)
DamDistMax		Distance to Drainage Outlet (Max)
NPDESCnt	NPDES Permits	Total Count (#)
NPDESDens		Density (count/area)
NPDdstMin		Distance to Drainage Outlet (Min)
NPDdstAvg		Distance to Drainage Outlet (Avg)
NPDdstMax		Distance to Drainage Outlet (Max)
SprFndCnt	Superfund Sites	Total Count (#)
SprFndDens		Density (count/area)
SFdistMin		Distance to Drainage Outlet (Min)
SFdistAvg		Distance to Drainage Outlet (Avg)
SFdistMax		Distance to Drainage Outlet (Max)
SFdst2strmMin		Distance to Closest NHDPLus HiRes Stream/River (Min)
SFdst2strmAvg		Distance to Closest NHDPLus HiRes Stream/River (Avg)
SFdst2strmMax		Distance to Closest NHDPLus HiRes Stream/River (Max)
MinesCnt	Mines (MRDS, Producers and Past Producers)	Total Count (#)
MinesDens		Density (count/area)
MineDstMin		Distance to Drainage Outlet (Min)
MineDstAvg		Distance to Drainage Outlet (Avg)
MineDstMax		Distance to Drainage Outlet (Max)
MnDst2strmMin		Distance to Closest NHDPLus HiRes Stream/River (Min)
MnDst2strmAvg		Distance to Closest NHDPLus HiRes Stream/River (Avg)
MnDst2strmMax		Distance to Closest NHDPLus HiRes Stream/River (Max)

Table B-3. Sites delineated and analyzed for geospatial attributes. Ordered by Site ID.

Site ID	Latitude	Longitude	Site Name
02Carriz002.7	36.8898	-103.0084	Carrizozo Creek near NM406 (DCR 12)
02DryCim003.2	36.9175	-103.0272	Dry Cimarron River at Wiggins Road (DCR 11)
02DryCim047.2	36.9931	-103.4086	Dry Cimarron R. at Jesus Mesa Rd (DCR 09) (ds gage)
02DryCim074.5	36.9367	-103.565	Dry Cimarron River abv Long Canyon (DCR 05)
02DryCim108.2	36.8728	-103.8808	Dry Cimarron R. at Folsom Falls abv Oak Crk
02DryCim122.7	36.8679	-103.9804	Dry Cimarron at Rainbow Ranch
02LongCa004.1	36.945	-103.5944	Long Canyon about 2 miles abv NM 456 (DCR 06)
02OakCre000.1	36.8999	-103.8588	Oak Creek abv Dry Cimarron River (DCR 03)
04Canadi352.7	36.3289	-104.4976	Canadian River abv Cimarron River at NM 56
04Canadi402.9	36.6521	-104.4883	Canadian River @ Tinaja - 04Canadi402.9
04Chicor010.9	36.77	-104.3958	Chicorica Creek below Una de Gato Creek
04Chicor034.4	36.9586	-104.3859	Chicorica Creek abv Lake Alice - 04Chicor034.4
04Dogget002.3	36.8708	-104.4258	Doggett Creek abv Raton WWTP
04RatonC007.8	36.8511	-104.4054	Raton Creek 5 miles abv Chicorica Cr
04RatonC010.9	36.8686	-104.4256	Raton Creek Below Raton Wwtf Discharge
04RatonC013.8	36.8879	-104.4439	Raton Creek Below Public Service Co.
04UnaGat000.1	36.7722	-104.395	Una De Gato Creek Upstream Of Chicorica Cr
04UnaGat020.9	36.8208	-104.2281	UNA DE GATO AT BRIDGE BELOW T O DAM
04Vermej080.2	36.859	-104.9501	Vermejo River at Juan Baca Canyon
04YorkCa000.1	36.8228	-104.9061	YORK CANYON CR. abv THE VERMEJO RIVER
05Cieneg006.3	36.4754	-105.2643	Cieneguilla Creek abv Eagle Nest Lake at USGS gage
05Cieneg016.5	36.4108	-105.2839	Cieneguilla Creek at County Road B-25
05Cieneg019.3	36.3844	-105.2836	Cieneguilla Creek at Angel Fire Road
05Cieneg021.9	36.3633	-105.2858	Cieneguilla Creek below Crooked Creek
05Cimarr013.4	36.3603	-104.5978	Cimarron River at USGS gauge in Springer
05Cimarr041.2	36.472	-104.8011	Cimarron River At CS Ranch HQ - 05Cimarr041.2
05Cimarr050.8	36.5197	-104.9783	Cimarron River abv Cimarron Village at USGS gage
05Cimarr077.2	36.538	-105.2233	Cimarron R. blw Eagle Nest Dam at Tolby Campgrnd
05Moreno003.7	36.5532	-105.2678	Moreno Creek on NM 64 at USGS gage
05MPonil000.1	36.6224	-105.04	Middle Ponil Creek abv South Ponil Creek
05MPonil016.2	36.7013	-105.1703	Middle Ponil Creek abv Greenwood Creek
05MPonil027.2	36.7764	-105.2136	Upper Middle Ponil Creek
05NPonil000.1	36.5881	-104.9656	North Ponil Creek abv South Ponil
05NPonil023.2	36.7482	-105.0715	North Ponil Cr abv Seally Cr - 05NPonil023.2

Site ID	Latitude	Longitude	Site Name
05NPonil027.5	36.7756	-105.0983	North Ponil Creek at FR 1950
05PonilC000.1	36.4714	-104.787	Ponil Creek abv Cimarron River - 05PonilC000.1
05PonilC002.2	36.4792	-104.7936	Ponil Creek at NM 58 - 05PonilC002.2
05PonilC014.9	36.5218	-104.8972	Ponil Creek abv NM 64 - 05PonilC014.9
05PonilC023.8	36.5733	-104.9464	Ponil Creek at USGS Gage
05Rayado001.8	36.3942	-104.7093	Rayado Creek abv Cimarron River
05Rayado033.8	36.3682	-104.9298	Rayado Creek on NM 21 - 05Rayado033.8
05Sixmil001.4	36.5183	-105.2745	Sixmile Creek abv US 64 near USGS gauge
05UteCre000.6	36.5608	-105.102	Ute Creek abv US 64 at Ute Park
06Canadi232.6	35.6559	-104.3762	Canadian River at NM 419 near Sanchez
06Canadi305.0	36.0669	-104.3722	Canadian River @ Mills Canyon - 06Canadi305.0
06Canadi348.3	36.2969	-104.4933	Canadian Riv.Near Taylor Springs Near USGS Gage
06OcateC025.1	36.2114	-104.6596	Ocate creek @ I-25 - 06OcateC025.1
07Coyote001.7	35.9039	-105.1528	Coyote Creek 1 Mile Abv Mora R. At Thal Ranch
07Maesta000.4	35.8532	-105.4594	Maestas Cr. abv Manuelitas Cr. - 07Maesta000.4
07Manuel020.9	35.855	-105.4556	Manuelitas Cr. abv Maestas Cr. - 07Manuel020.9
07MoraRi000.8	35.7321	-104.3914	Mora River 0.5 mile abv Canadian River
07MoraRi139.9	35.9408	-105.2497	MORA RIVER AT LA CUEVA USGS GAGE
07MoraRi146.6	35.9661	-105.3018	Mora River below Mora WWTP lagoons
07MoraRi147.1	35.9698	-105.3052	Mora River abv Mora WWTP lagoons
07MoraRi147.2	35.9692	-105.3061	Mora River abv Hatchery - 07MoraRi147.2
07MoraRi170.9	36.1161	-105.3753	MORA RIVER AT CHACON .6 MILES abv GAGE
07RioLaC006.2	35.9803	-105.4143	Rio de la Casa 4 miles abv Mora River
07RitoCe004.6	35.8736	-105.2508	Rito Cebolla abv hwy 518 - 07RitoCe004.6
07RSanJo000.5	35.8363	-105.4152	Rito San Jose abv Manuelitas Cr. - 07RSanJo000.5
07Sapell044.4	35.7703	-105.2519	Sapello R. at Hwy 518 - 07Sapell044.4
07Sapell069.8	35.8197	-105.4653	Sapello river 1/4 mi. inside Mosimann ranch gate
07WolfCr000.6	35.8123	-104.9231	Wolf Cr. abv Mora R. - 07WolfCr000.6
08Concha025.1	35.4028	-104.4431	Conchas River at USGS gage on NM 104
09Canadi001.2	35.3951	-103.0422	Canadian River abv NM/TX State Line
09Canadi062.4	35.3569	-103.4175	Canadian R 1 Mi Bl Ute Dam, at 54 nr USGS Gage
09Canadi144.5	35.3235	-103.981	Canadian River at NM 104 at milemarker 88
09Canadi204.1	35.4089	-104.1695	Canadian River immediately bl Conchas Dam
09Pajari001.0	35.3125	-103.7	PAJARITO CR abv THE CANADIAN RIVER
09Pajari020.0	35.2112	-103.743	Pajarito Creek at NM 104 - 09Pajari020.0

Site ID	Latitude	Longitude	Site Name
10UteCre104.3	35.9509	-103.6966	Ute Creek abv Highway 102 near Bueyeros
10UteCre150.7	36.2215	-103.8506	Ute Creek at Hwy 120 - 10UteCre150.7
16Corrum051.1	36.7026	-103.3049	Corrumpa Creek at Hwy 370 - 16Corrum051.1
16Seneca043.0	36.5884	-103.3156	Seneca Creek abv Clayton Lake - 16Seneca043.0
27CTGran000.7	36.8567	-106.1513	Canada Tio Grande abv Rio San Antonio
27RPinos002.6	36.9822	-106.0736	Rio de los Pinos at USGS gage - 27RPinos002.6
27RPinos007.3	36.9572	-106.0995	Rio de los Pinos near Ortiz - 27RPinos007.3
27RPinos011.3	36.9565	-106.1461	Rio de los Pinos abv NMDGF area at FS bridge
27RSanAn000.4	36.9936	-106.0383	Rio San Antonio at NM-CO border in Ortiz
27RSanAn025.3	36.8579	-106.1296	Rio San Antonio at FR 87 bridge - 27RSanAn025.3
28BigTes013.2	35.7784	-105.8	Big Tesuque Creek, abv Aspen Vista FR
28Bitter003.0	36.7194	-105.3797	Bitter Creek abv town of Red River - 28Bitter003.0
28Cabres005.4	36.7306	-105.5533	CABRESTO CREEK AT USGS GAGE 08266000
28Casias000.6	36.9135	-105.261	Casias Creek abv Costilla Reservoir - 28Casias000.6
28Chamis003.0	36.1709	-105.737	Chamisal Creek below Village of Chamisal
28Columb000.1	36.6806	-105.5147	Columbine Creek abv Red River
28Comanc000.1	36.8319	-105.3186	Comanche Creek abv Costilla Creek - 28Comanc000.1
28Comanc007.7	36.7792	-105.2753	Comanche below upper exclosure - 28Comanc007.7
28Cordov001.5	36.895	-105.4378	Cordova Creek abv Costilla Creek abv Hwy 196
28Cordov006.2	36.863	-105.4514	Cordova Creek 300m upstream from Day Lodge
28Embudo000.8	36.2108	-105.9131	Embudo Creek at Hwy 68 nr Dixon at USGS gage
28Embudo010.1	36.179	-105.8306	Embudo Creek abv Canoncito - 28Embudo010.1
28Embudo020.5	36.1969	-105.735	Embudo Creek blw Santa Barbara/Pueblo confluence
28LosAla021.5	35.8858	-106.3589	Upper Los Alamos Canyon abv reservoir
28NFkTes000.6	35.7694	-105.8086	N.Fork Of Tesuque Cr Abv Hyde Park (475) Rd
28Pionee000.7	36.7042	-105.4147	Pioneer Creek about 400 yards abv the Red R.
28Pojoaq005.0	35.8909	-106.0715	Pojoaque River at State Road 84D - 28Pojoaq005.0
28Pueblo013.4	36.1685	-105.6028	Rio Pueblo .8 miles abv Hwy 518/75 at USGS gage
28RChiqB000.1	36.1789	-105.703	Rio Chiquito near mouth - 28RChiqB000.1
28RChupa014.3	35.7843	-105.8785	Rio Chupadero @ FR 102 - 28RChupa014.3
28RChupa015.2	35.7856	-105.8694	Rio Chupadero abv summer homes
28RCosti005.7	36.9667	-105.5075	Costilla Creek abv Costilla at Hwy 196 bridge
28RCosti032.2	36.8319	-105.3194	Costilla Creek below Comanche Creek
28RCosti032.5	36.8322	-105.3184	Costilla Cr abv Comanche Cr - 28RCosti032.5
28RCosti052.2	36.8356	-105.3446	Rio Costilla at Valle Vidal Boundary

Site ID	Latitude	Longitude	Site Name
28RedRiv005.3	36.6824	-105.6557	Red River below Fish Hatchery near USGS
28RedRiv005.9	36.6853	-105.6514	Red River abv Fish Hatchery and diversion
28RedRiv014.0	36.7032	-105.5688	Red River @ USGS gage (Questa) - 28RedRiv014.0
28RedRiv024.4	36.6979	-105.4759	Red River @ Molycorp boundary - 28RedRiv024.4
28RedRiv027.8	36.7078	-105.4372	Red River abv Molycorp, below WWTP
28RedRiv031.1	36.705	-105.4042	Red River below Bitter Creek
28RedRiv035.5	36.6736	-105.3792	Red River at Zwergle - 28RedRiv035.5
28RFerna000.3	36.3947	-105.6185	Rio Fernando de Taos abv Rio Pueblo de Taos
28RFerna031.7	36.4181	-105.3427	Rio Fernando de Taos at Hwy 64 bridge
28RGRanc000.2	36.3878	-105.6314	Rio Grande del Rancho abv Rio Pueblo de Taos
28RGRanc013.1	36.2978	-105.5819	Rio Grande del Rancho @ gage near Talpa
28RGrand547.2	35.8747	-106.1417	Rio Grande at Otowi Bridge -- USGS 08313000
28RGrand550.8	35.9011	-106.1257	Rio Grande blw Rio Pojoaque - 28RGrand550.8
28RGrand650.8	36.3386	-105.7294	Rio Grande below Rio Pueblo de Taos
28RGrand725.5	36.9313	-105.7358	Rio Grande below Rio Costilla @ Ute
28RHondo000.1	36.5344	-105.708	Rio Hondo at Rio Grande confluence
28RHondo003.9	36.5353	-105.6667	Rio Hondo at HWY 3 Bridge
28RHondo012.1	36.5328	-105.5833	RIO HONDO AT VALDEZ BRIDGE
28RHondo014.8	36.5417	-105.5564	Rio Hondo 1.5 miles abv Valdez at USGS gage
28RHondo022.4	36.5883	-105.4918	RIO HONDO 2.4 MILES BLW STP
28RHondo026.7	36.5957	-105.459	RIO HONDO 300 YDS BLW STP - 28RHondo026.7
28RHondo026.9	36.5961	-105.454	Rio Hondo 50 feet abv WWTP - 28RHondo026.9
28RHondo027.3	36.596	-105.449	Rio Hondo abv Lake Fork at Taos Ski Valley Parking t
28RiOlla000.8	36.2762	-105.5764	Rito de la Olla at bridge on Hwy 518 - 28RiOlla000.8
28RLucer013.0	36.5083	-105.5302	Rio Lucero at USGS Gage on Taos Pueblo
28RMedio007.2	35.8206	-105.8903	Rio en Medio at USFS boundary - 28RMedio007.2
28RMedio013.3	35.8033	-105.8333	Rio en Medio at Aspen Ranch
28RMedio016.9	35.7934	-105.7994	Rio en Medio 200 m below ski area parking lot
28RMedio017.5	35.7915	-105.7936	Rio en Medio abv ski area
28RNambe005.1	35.8494	-105.8964	Rio Nambe abv Nambe Reservoir - 28RNambe005.1
28RPuebl000.3	36.1986	-105.7314	Rio Pueblo at HWY 75 abv Rio Santa Barbara
28RPuebl012.4	36.1715	-105.6123	Rio del Pueblo at 75/518 junction
28RPuebl019.0	36.1545	-105.551	Rio Pueblo below Flechado campground, abv Sipapu
28RPuebT000.1	36.3392	-105.7305	Rio Pueblo de Taos abv Rio Grande
28RPuebT008.1	36.3792	-105.6679	Rio Pueblo de Taos 20m below Taos effluent channel

Site ID	Latitude	Longitude	Site Name
28RPuebT008.3	36.3801	-105.6636	Rio Pueblo de Taos 20m below Taos effluent channel
28RPuebT013.2	36.3899	-105.6305	Rio Pueblo de Taos abv R. Gr. d Rancho, nr L. Cordovas
28RQuema003.1	36.0012	-105.9022	Rio Quemado near Chimayo - 28RQuema003.1
28RSanBa000.1	36.1972	-105.7342	Rio Santa Barbara at mouth - 28RSanBa000.1
28RSanBa002.0	36.1882	-105.7168	Rio Santa Barbara at Roybal Road - 28RSanBa002.0
28RSanBa013.2	36.1153	-105.6386	Rio Santa Barbara at Hodges Campground
28RSanBa017.9	36.0853	-105.6081	Rio Santa Barbara at Santa Barbara Campground
28SanCru004.2	35.9843	-106.0288	Santa Cruz River at town of Quarteles
28SanCru012.1	35.9996	-105.9505	Santa Cruz River abv County Rd 93 Bridge
28Tesuqu023.4	35.7389	-105.9056	Tesuque Creek at gage 08302500 near Santa Fe
29Abiqui001.8	36.2092	-106.3207	Abiquiu Creek at US 84 bridge - 29Abiqui001.8
29Abiqui002.3	36.1978	-106.3231	Abiquiu Creek
29Canjil006.2	36.3219	-106.494	Canjilon Creek abv Abiquiu Reservoir at US 84
29Canjil039.5	36.5066	-106.4028	Canjilon Creek abv Canjilon
29Canone001.7	36.222	-106.451	Canones Creek at hwy 96 - 29Canone001.7
29Canone002.4	36.8094	-106.5672	Cañones Creek abv HWY 84 (near Chama)
29Canone004.6	36.1992	-106.4508	Canones Creek @ FR 167 below Canones
29Cecili000.1	36.2006	-106.8	Cecilia Canyon Creek at FR 171 * 29Cecili000.1
29Chihua000.1	36.1328	-106.461	Chihuahuenos Creek abv Canones
29ClearC000.1	36.2027	-106.856	Clear Creek at FR 76 - 29ClearC000.1
29Coyote005.6	36.1319	-106.6172	Coyote Creek at FR 316 at Coyote Creek Campground
29Coyote017.5	36.0489	-106.6019	Coyote Creek at 0.5 mi abv FR 100 (near Coyote)
29ElRito035.9	36.44	-106.2728	El Rito (lower) on Oso Ranch
29ElRito050.2	36.5561	-106.29	El Rito (upper) near Canyon de Chacon
29LitTus003.4	36.7464	-106.1475	Little Tusas at FR 133
29NaborC000.1	36.9592	-106.6344	Nabor Creek 5 yards upstream of Rio Chamita
29PoleoC009.5	36.1242	-106.7122	Poleo Creek at FR 103 - 29PoleoC009.5
29Polvad008.8	36.1847	-106.4314	Polvadera Creek @ FR 27 (CR 95) - 29Polvad008.8
29RBrazo001.6	36.7469	-106.5664	RIO BRAZOS abv U.S. HIGHWAY 84 BRIDGE
29RBrazo010.1	36.7372	-106.4261	RIO BRAZOS I MILE abv CORKINS LODGE
29RChama079.5	36.3272	-106.6183	Rio Chama abv Abiquiu Reservoir at USGS gage
29RChama082.8	36.3424	-106.6516	Rio Chama 3 miles below Rio Gallina
29RChama143.8	36.6658	-106.6597	Rio Chama 2 Miles Downstream of La Puente Gage
29RChama147.1	36.7827	-106.5662	Chama River 4 km below Chama WWTP (G&F Area)
29RChama161.1	36.8784	-106.5829	Chama River at U.S. HWY 84 bridge below Chama

Site ID	Latitude	Longitude	Site Name
29RChama174.0	36.8442	-106.5786	Rio Chama Below Chama Town
29RChama183.4	36.9125	-106.5731	Rio Chama at NM 17
29RChami002.7	36.877	-106.587	Rio Chamita below Chama WWTP outfall
29RChami002.8	36.8803	-106.5873	Rio Chamita abv Chama WWTP outfall
29REncin009.7	36.1464	-106.5222	Rito Encino at FR 100Z - 29REncin009.7
29RGalli000.5	36.3706	-106.6847	Rio Gallina at confluence with Rio Chama
29RGalli005.5	36.4044	-106.7256	Rio Gallina abv Chama River and Skull Ranch
29RGalli045.1	36.1942	-106.8442	Rio Gallina at FR 76 - 29RGalli045.1
29RioOso001.9	36.1018	-106.165	Rio del Oso upstream from Canoncito
29RioOso004.7	36.0919	-106.1861	Rio del Oso abv Rio Chama - 29RioOso004.7
29RMedio002.7	36.5483	-106.4469	Rio del Medio abv FR 125 near Cebolla
29RNutri005.4	36.5659	-106.6751	Rio Nutrias abv Rio Chama - 29RNutri005.4
29RNutri028.4	36.5769	-106.5128	Rio Nutrias at US 84 - 29RNutri028.4
29ROjoCa005.1	36.1383	-106.1039	Rio Ojo Caliente 3.4 miles abv confl with Rio Chama
29RPuerc011.0	36.2047	-106.5825	Rio Puerco de Chama at CR 211 - 29RPuerc011.0
29RPuerc037.5	36.1002	-106.7269	Rio Puerco de Chama at FR 103 - 29RPuerc037.5
29RResum001.9	36.1081	-106.7478	Rito Resumidero below Resumidero Spring
29RResum002.5	36.1136	-106.7464	Rito Resumidero at FR 93 * 29RResum002.5
29RTierr026.1	36.6475	-106.4225	Rito Tierra Amarilla at Hwy 64 - 29RTierr026.1
29RTusas000.1	36.3836	-106.0361	Rio Tusas abv Rio Vallecitos * 29RTusas000.1
29RTusas000.2	36.3836	-106.0361	Rio Tusas @ FR 712 abv Madera - 29RTusas000.2
29RTusas028.5	36.5786	-106.0386	Rio Tusas abv Las Tablas
29RValle007.9	36.4367	-106.0633	Rio Vallecitos 3.9 miles abv La Madera @ bridge
29RValle037.8	36.6364	-106.2133	Rio Vallecito abv NF boundary at Vallecitos Ranch
29Willow000.1	36.732	-106.63	Willow Creek abv Heron Lake - 29Willow000.1
30Bulldo000.1	35.8572	-106.3342	Bulldog Gulch abv junction with Pajarito Canyon
30CanVal003.7	35.8508	-106.33	Canyon de Valle 2.6 miles abv Water Canyon
30CValle003.9	35.8501	-106.333	Canon de Valle DS end of perennial reach (E256)
30Galist030.9	35.4337	-106.1215	Galisteo Creek at Hwy 14 near Cerrillos
30Galist050.4	35.3953	-105.9434	Galisteo Creek in Galisteo - 30Galist050.4
30LHuert010.0	35.3259	-106.4216	Las Huertas Creek @ Tres Amigos Rd
30LHuert019.0	35.2561	-106.4068	Las Huertas Creek blw Caves - 30LHuert019.0
30Pajari012.6	35.8536	-106.2958	Pajarito Canyon below Twomile Canyon
30Pajari015.2	35.8572	-106.332	Pajarito Canyon downstream end of perennial reach
30Pajari016.1	35.8592	-106.3358	Pajarito Canyon below Starmer Gulch

Site ID	Latitude	Longitude	Site Name
30Pajari018.5	35.8694	-106.3575	Pajarito Creek 0.3 miles abv HWY 501
30RFrijo000.7	35.7572	-106.2584	Rito de los Frijoles 0.5 mile abv Rio Grande
30RGrand541.7	35.8359	-106.1607	Rio Grande at Buckman Road - 30RGrand541.7
30SanCri000.5	35.3855	-105.9447	San Cristobal Creek at Hwy 41 south of Galisteo
30Sandia009.0	35.8678	-106.2758	Sandia Canyon downstream end of perennial reach
30SanPed011.1	35.2333	-106.3012	San Pedro Creek @ Conservation Easement
30SantaF012.9	35.5473	-106.2292	SANTA FE RIVER abv Cochiti AT USGS GAGE
30SantaF015.3	35.5515	-106.2	Santa Fe River 0.5 mi upstream Lonestar Mine
30SantaF028.4	35.6028	-106.1213	Santa Fe River abv CRd 56 d/s of river preserve
30SantaF030.5	35.6184	-106.1118	Lower Santa Fe River Preserve
30SantaF057.4	35.6886	-105.8222	Santa Fe River abv McClure reservoirs
30SantaF061.2	35.7167	-105.8017	Santa Fe River at lower wilderness boundary
31Calave001.1	35.9319	-106.7091	Calaveras Creek Abv Rio Cebolla On Nm 126
31ClearC002.3	35.9959	-106.8255	CLEAR CREEK AT NM 126 - 31ClearC002.3
31ClearC009.2	36.041	-106.845	Clear Creek abv San Gregorio Lake - 31ClearC009.2
31EFkJem000.1	35.8276	-106.6436	East Fork Jemez abv confluence with San Antonio Crk
31EFkJem015.2	35.8147	-106.5258	East Fork Jemez River below Las Conchas day use
31EFkJem020.7	35.8486	-106.4898	East Fork Jemez below La Jara Creek
31EFkJem026.1	35.8716	-106.4438	East Fork Jemez abv Jaramillo Creek
31Jarami008.0	35.9044	-106.4862	Jaramillo abv Cerro Pinon at Rd B - 31Jarami008.0
31JemezR046.6	35.6539	-106.7369	Jemez River Near Canon, Below Municipal School
31JemezR048.7	35.6686	-106.7434	Jemez River below Rio Guadalupe - 31JemezR048.7
31JemezR049.2	35.67	-106.7435	Jemez River abv Rio Guadalupe - 31JemezR049.2
31JemezR058.6	35.7395	-106.7128	Jemez R. abv. Jemez Springs WWTP
31JemezR064.9	35.7921	-106.686	Jemez River abv Soda Dam - 31JemezR064.9
31RCebol000.1	35.8196	-106.788	Rio Cebolla abv the Rio de las Vacas
31RCebol011.4	35.8918	-106.7192	Rio Cebolla ~0.5 mile abv Fenton Lake
31RCebol017.9	35.9344	-106.6845	Rio Cebolla at campground abv 7 Springs hatchery
31Redond001.2	35.8727	-106.6215	Redondo Creek abv VCNP boundary
31RGuada000.1	35.6718	-106.7446	Rio Guadalupe abv Jemez River - 31RGuada000.1
31RIndio000.2	35.9649	-106.4868	Rito de los Indios abv San Antonio Creek
31RPalom000.1	35.9925	-106.7944	Rito de las Palomas at NM Hwy 126 - 31RPalom000.1
31RPNegr000.1	35.966	-106.787	Rito Penas Negras at NM Hwy 126 - 31RPNegr000.1
31RVacas000.1	35.8196	-106.7881	Rio de Las Vacas abv the Rio Cebolla
31RVacas011.1	35.9078	-106.8017	Rio de Las Vacas abv Girl Scout Camp

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31RVacas023.7	35.9974	-106.8072	Rio de Las Vacas at SR 126 - 31RVacas023.7
31RVacas026.5	36.0195	-106.8232	Rio de las Vacas abv FR 70 - 31RVacas026.5
31RValle012.2	35.6866	-106.6536	Vallecitos abv Ponderosa diversion
31RValle015.5	35.7038	-106.6284	Vallecito Creek at Paliza Campground
31SanAnt000.1	35.8286	-106.6437	San Antonio Creek abv East Fork Jemez R.
31SanAnt004.7	35.8642	-106.6375	San Antonio Creek below La Cueva - 31SanAnt004.7
31SanAnt008.4	35.8905	-106.6495	San Antonio Creek abv NM Hwy 126
31SanAnt025.7	35.9719	-106.5764	San Antonio Creek below warm springs
31Sulphu000.2	35.8761	-106.6315	Sulphur Creek abv Redondo Creek
31Vallec012.2	35.6866	-106.6536	Vallecitos abv Ponderosa diversion
32AboArr037.7	34.4357	-106.448	Abo Arroyo blw Hwy 60 - 32AboArr037.7
32RGrand258.0	33.6803	-106.9924	Rio Grande at USGS gage near San Marcial
32RGrand286.9	33.8757	-106.849	Rio Grande @ Bosque del Apache - 32RGrand286.9
32RGrand305.0	34.0272	-106.8654	NMW-05549-08
32RGrand326.4	34.2089	-106.8852	NMW05549-28
32RGrand346.1	34.3447	-106.8585	NMW-05549-12
32RGrand385.1	34.6493	-106.7375	NMW-05549-25
32RGrand392.1	34.7828	-106.729	NMW05549-29
32RGrand407.8	34.9064	-106.685	Rio Grande abv Isleta Diversion - 32RGrand407.8
32RGrand435.2	35.1206	-106.6915	Rio Grande @ Albuquerque Nature Center
32RGrand445.4	35.1969	-106.6415	Rio Grande abv Alameda Bridge - 32RGrand445.4
32Tijera021.0	35.0608	-106.4945	Tijeras Arroyo At Four Hills Brdg At Albq
32Tijera027.2	35.0667	-106.425	Tijeras Arroyo blw Deadmans Curve - 32Tijera027.2
33LaJara009.7	36.1277	-106.9043	La Jara Creek abv irrigation diversion - 33LaJara009.7
33NaciCr001.9	36.0025	-106.9076	Nacimiento Creek @ Eureka Rd.
33Nacimi003.4	36.0113	-106.9509	Nacimiento Creek at Hwy 126 - 33Nacimi003.4
33Nacimi008.0	36.0025	-106.9076	Nacimiento Creek at Eureka Rd. - 33Nacimi008.0
33RPuerc241.8	35.984	-106.9841	Rio Puerco blw WWTP at Sanchez Property
33RPuerc244.0	36.0024	-106.9809	Rio Puerco abv WWTP - 33RPuerc244.0
33RPuerc248.7	36.0245	-106.9583	Rio Puerco at Hwy 550 Bridge - 33RPuerc248.7
33RPuerc256.0	36.0413	-106.9162	Rio Puerco at CR13 Bridge - 33RPuerc256.0
33Senori008.8	35.9876	-106.8904	Senorito Creek abv Nacimiento Mine
36Bluewa003.5	35.2926	-108.027	Bluewater Creek at Mouth of Bluewater Canyon
36Bluewa016.7	35.2979	-108.1063	Bluewater Creek blw Dam - 36Bluewa016.7
36Bluewa018.9	35.2678	-108.1142	Bluewater Creek abv Bluewater Lake at USGS

Site ID	Latitude	Longitude	Site Name
36Bluewa023.2	35.2412	-108.1278	Bluewater Creek @ Forest Road 178
36RMoqui006.4	35.1709	-107.3759	Rito Moquino below Seboyetita Crk and Seboyeta Crk
38RSalad030.0	34.3391	-107.1233	Rio Salado 1 mile abv The Box - 38RSalad030.0
40Alamos058.5	33.5687	-107.5901	Alamosa Creek below USGS Gage 8360000
41LAnima029.3	33.0412	-107.5548	Las Animas Creek abv box - 41LAnima029.3
41LAnima038.3	33.0531	-107.6316	Las Animas Creek near Dunn - 41LAnima038.3
41Percha025.3	32.9179	-107.5289	Percha Creek at Percha Box - 41Percha025.3
41SPalom000.1	33.179	-107.5367	South Fork Palomas Creek abv North Fork
42RGrand001.1	31.9994	-106.6353	Rio Grande At Nm-225 Bridge Nr Anthony, Nm
42RGrand004.1	31.8028	-106.541	Rio Grande At Bridge Below Sunland Park
42RGrand030.8	31.9994	-106.635	Rio Grande At Nm-225 Bridge Nr Anthony, Nm
42RGrand038.7	32.2636	-106.8239	Rio Grande At Bridge Near La Mesilla
42RGrand044.2	32.31	-106.8261	Rio Grande At Picacho Ave In Las Cruces
42RGrand115.0	32.6544	-107.0758	Rio Grande Near Rincon At Nm
42RGrand160.3	32.8847	-107.292	Rio Grande Blw Caballo Dam,Nm
42RGrand171.9	32.8847	-107.292	Rio Grande Blw Caballo Dam,Nm
45Gallin021.5	32.8885	-107.8434	Gallinas Creek at Lower Gallinas Camground nr
45McKnig011.9	33.0149	-107.9407	McKnight Canyon Crk (EF of Mimbres) abv Mimbres.
45Mimbre062.7	32.587	-107.9211	Mimbres below Dwyer at Ranch del Rio
45Mimbre094.6	32.7908	-107.915	Mimbres R. at Hwy 90 bridge near San Lorenzo
45Mimbre104.8	32.8572	-107.9742	Mimbres River at Mimbres near USGS gage
45Mimbre112.2	32.9101	-108.0038	Mimbres River at upper Nature Conservency Property
45Mimbre127.4	33.0419	-107.9789	Mimbes River at Cooney Campgrnd (Forest Rd 150A)
45Mimbre127.8	33.0461	-107.9752	Mimbres River At Cooney Campground Crossing
45SanVic053.9	32.7621	-108.2698	San Vicente Arroyo at Ancheta Mill - 45SanVic053.9
45SanVic055.5	32.7726	-108.2752	San Vicente Arroyo at Big Ditch Park (@ 6th street)
48DogCan002.7	32.7495	-105.9124	Dog Canyon at Nature Trail - 48DogCan002.7
48FresCa001.0	32.9741	-105.9039	Fresnal Creek At Alamogordo Water Intake
48FresCa008.3	32.9547	-105.8751	Fresnal Creek abv Rio Salado - 48FresCa008.3
48KarrCa002.9	32.9289	-105.8167	Karr Canyon abv Raven Road - 48KarrCa002.9
48LaLuzC014.2	32.9847	-105.8297	La Luz Creek At County Road A-70 Crossing
48NogalC000.2	33.1581	-105.8645	NOGAL CREEK AT COUNTY ROAD B-17
48RTular030.0	33.145	-105.8972	Rio Tularosa At Usgs Gage - Old Hwy Crossing
48ThreeR022.8	33.4028	-105.8858	Three Rivers At Forest Service Campground
49Sacram014.6	32.7139	-105.7542	Sacramento River At Usgs Gage

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50AHerma000.1	35.5947	-105.224	Arroyo Hermanos - 50AHerma000.1
50Beaver000.1	35.7615	-105.4484	Beaver Cr. abv El Porvenir Cr. - 50Beaver000.1
50CowCre011.5	35.471	-105.5537	Cow Creek at North San Ysidro - 50CowCre011.5
50CowCre023.7	35.538	-105.581	Cow Creek blw confluence w Bull Creek at Forest Rd
50CowCre023.8	35.5382	-105.581	Cow Creek abv confluence with Bull Creek
50Dalton000.1	35.6586	-105.6907	Dalton Canyon Creek 20 M West Of Hwy 63 Brdg
50ElPorv000.1	35.69	-105.3758	El Porvenir Creek at HWY 65 abv the Gallinas
50ElPorv004.8	35.7108	-105.4156	El Porvenir Creek at Christian Camp, USGS 08380075
50ElPorv012.6	35.76	-105.449	El Porvenir Cr. blw Beaver and Hollinger creeks
50ElRito000.2	34.9256	-104.6831	El Rito Creek Downstream of the Santa Rosa WWTF
50ElRito000.3	34.9261	-104.6811	El Rito Creek Upstream Of Santa Rosa WWTF
50Gallin075.0	35.4647	-105.1572	Gallinas River at San Augustin - 50Gallin075.0
50Gallin101.8	35.565	-105.212	Gallinas River 0.25 mile below Las Vegas WWTF
50Gallin102.1	35.5667	-105.2108	Gallinas River abv Las Vegas WWTP
50Gallin104.9	35.5882	-105.2181	Gallinas R. abv Independence Ave. - 50Gallin104.9
50Gallin114.6	35.6542	-105.275	Gallinas R. at Montezuma, blw College lagoons
50Gallin119.7	35.6519	-105.3183	Gallinas River at Montezuma, USGS Gage 08380500
50Gallin131.8	35.6991	-105.4162	Gallinas R. at National Forest boundary.
50Gallin140.8	35.7166	-105.4874	Gallinas R. blw Burro Cr. - 50Gallin140.8
50Gallin141.9	35.724	-105.5084	Gallinas River at end of FR 263 abv Burro Creek
50Glorie001.8	35.5398	-105.6826	Glorieta Creek abv confluence with Pecos River
50Glorie012.6	35.5779	-105.7589	Glorieta Creek at Cur Trail - 50Glorie012.6
50Glorie013.5	35.5842	-105.765	Glorieta Creek blw Glorieta Conference Cntr WWTP
50Holing000.1	35.7608	-105.4495	Hollinger Cr. abv El Porvenir Cr. - 50Holing000.1
50HolyGh000.1	35.7412	-105.679	Holy Ghost Cr 300m Upstrm Hwy63 Br Over Pecos R
50PecosR512.6	34.73	-104.5245	Pecos River at Puerta de Luna bridge
50PecosR529.1	34.9248	-104.683	Pecos River Below Confluece With El Rito Crk
50PecosR529.2	34.9253	-104.6842	PECOS RIVER UPSTREAM OF EL RITO CREEK
50PecosR540.8	34.8267	-104.6254	Pecos R at Puerto de Luna - 50PecosR540.8
50PecosR601.2	35.0914	-104.7998	Pecos River at gage near Colonias - 50PecosR601.2
50PecosR670.2	35.2387	-105.1634	Pecos River Below Confluence with Tecolote Crk
50PecosR670.3	35.2378	-105.163	Pecos River abv Confluence with Tecolote Crk
50PecosR678.5	35.2366	-105.2537	Pecos River at Comanchero - 50PecosR678.5
50PecosR696.0	35.268	-105.3343	PECOS RIVER AT VILLANUEVA STATE PARK
50PecosR700.3	35.2666	-105.366	Pecos River at Los Schiffmillers - 50PecosR700.3

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50PecosR722.0	35.3972	-105.4703	PECOS RIVER AT SAN JOSE - 50PecosR722.0
50PecosR765.3	35.5352	-105.668	Pecos River at Pecos National Historical Park
50PecosR772.0	35.5828	-105.672	Pecos River at Adelo Property behind Catholic Church
50PecosR783.7	35.6063	-105.6771	Pecos River below Lisboa Springs fish hatchery
50PecosR784.1	35.6093	-105.677	Pecos River abv Lisboa Springs fish hatchery
50PecosR795.2	35.7448	-105.675	Pecos River below Terrero mine - 50PecosR795.2
50PecosR797.7	35.7629	-105.6701	Pecos River 400m abv Confluence W Willow Ck
50RioMor000.3	35.7772	-105.6575	Rio Mora At USGS GAGE abv Pecos campground
50Tecolo042.3	35.4575	-105.2776	TECOLOTE CREEK AT I-25 NEAR TECOLOTE
50Winsor000.2	35.8118	-105.6593	Winsor Creek at Pecos River - 50Winsor000.2
52PecosR305.0	33.5974	-104.3632	Pecos River at Bitter Lake NWR, North Unit
52PecosR430.0	34.3323	-104.1812	Pecos River at USGS gage blw Taiban Creek
52PecosR447.7	34.4444	-104.2342	Pecos R 100 Meters Below Ft Sumner Wwtp Disc
56PecosR169.0	32.841	-104.3239	Pecos River At U.S. 82 Bridge Near Artesia
56PecosR301.0	33.5722	-104.3695	Pecos R. at Bitter Lake Refuge At HWY 70/RR xing
57Carriz001.4	33.3203	-105.6675	CARRIZO CREEK abv GRINDSTONE CREEK
57NSprin000.6	33.4061	-104.492	North Spring River abv Rio Hondo
57NSprin002.0	33.4065	-104.5053	North Spring River at Loveless Park
57NSprin004.8	33.4001	-104.532	North Spring River 3 miles abv Rio Hondo
57RBonit027.7	33.5273	-105.4575	Rio Bonito at BLM Apple Orchard Site
57RBonit053.4	33.4479	-105.663	RIO BONITO AT ANGUS BRIDGE - 57RBonit053.4
57RBonit059.9	33.4529	-105.7277	Rio Bonito below Dam - 57RBonit059.9
57RBonit061.1	33.4558	-105.7511	Rio Bonito Abv Bonito Lk At Fr 107 Blw Bonito S.
57RHondo004.3	33.397	-104.4224	Rio Hondo at US 380 Bridge - 57RHondo004.3
57RHondo009.4	33.4119	-104.4591	Rio Hondo abv Hagerman Canal - 57RHondo009.4
57RHondo131.1	33.3817	-105.2703	RIO HONDO 100 YDS BELOW CONFLUENCE
57RRuido019.8	33.4103	-105.4449	Rio Ruidoso 7 Miles below Wwtp at Glencoe-Fr 443
57RRuido030.2	33.3663	-105.535	Rio Ruidoso blw WWTP, mile-marker 267.5, Hwy 70
57RRuido030.5	33.3626	-105.5393	Rio Ruidoso @ CR E002 - 57RRuido030.5
57RRuido031.5	33.3588	-105.5474	Rio Ruidoso abv Hwy 70 bridge - 57RRuido031.5
57RRuido045.3	33.325	-105.655	RIO RUIDOSO abv CARRIZO CREEK
57RRuido052.4	33.3363	-105.7229	Rio Ruidoso at Mescalero boundary at gauge
58RFelix002.1	33.1382	-104.3286	Rio Felix near Hagerman, NM - 58RFelix002.1
59AguaCh029.0	32.8017	-105.5456	Agua Chiquita between Weed and Sacramento
59RPenas108.4	32.8814	-105.1775	Rio Penasco At Nm Hwy 24 Bridge Near Dunken

Site ID	Latitude	Longitude	Site Name
59RPenas140.2	32.9217	-105.416	Rio Penasco on USFS (below Mayhill)
59RPenas170.4	32.8309	-105.7371	RIO PENASCO AT BLUFF SPRINGS
59RPenas176.0	32.8413	-105.7871	Rio Peñasco near FR 6563 - 59RPenas176.0
60BlackR005.7	32.2358	-104.0999	BLACK RIVER AT HIGBY HOLE - 60BlackR005.7
60BlackR019.8	32.2197	-104.2225	Black River @ Old Cavern Road Crossing
60BlackR023.7	32.2014	-104.2511	Black River at Black River Village - 60BlackR023.7
60BlackR052.0	32.0956	-104.4675	Black River abv Rattlesnake Spring - 60BlackR052.0
60BlackR055.4	32.0672	-104.4791	Black River @ headwater springs - 60BlackR055.4
60BlueSp002.0	32.1809	-104.2978	BLUE SPRING abv BOUNDS DIVERSION
60PecosR033.2	32.1891	-103.9784	Pecos River At Pierce Canyon Crossing, NM
60PecosR050.2	32.2409	-104.0474	Pecos River below Black River Harroun Crossing
60PecosR088.4	32.4006	-104.1712	Pecos River below Carlsbad WWTP near Otis
60Sittin000.1	32.2509	-104.6965	Sitting Bull Creek below recreation area
60Sittin000.3	32.2457	-104.6971	Sitting Bull Creek At The Base Of The Falls
60Sittin001.6	32.2385	-104.7026	Sitting Bull Creek Abv Sitting Bull Falls
62Delawa006.0	32.0231	-104.0547	Delaware River At Highway 285 Bridge
64Galleg000.4	36.6958	-108.1125	Gallegos Canyon at San Juan River - 64Galleg000.4
64Navajo022.1	36.9658	-106.9595	Navajo River upstream of Jicarilla Bnd
64Navajo023.3	36.9686	-107.0845	Navajo River DS from Barella Canyon and CO border
64PiedrAbvrNav	37.0486	-107.4118	Piedras River abv Navajo Lake - 64PiedrAbvrNav
64SanJua113.5	36.6941	-108.1034	San Juan River at McGee Park - 64SanJua113.5
64SanJua126.2	36.7	-107.9865	SAN JUAN RIVER AT BLOOMFIELD BRIDGE
64SanJua144.8	36.7246	-107.8129	SAN JUAN RIVER AT BRIDGE NEAR BLANCO
64SanJua162.8	36.8006	-107.6992	SAN JUAN RIVER BLW GAGE STATION
66Animas001.7	36.7198	-108.2063	ANIMAS R AT FARMINGTON - 66Animas001.7
66Animas018.0	36.7914	-108.0752	Animas River near Flora Vista - 66Animas018.0
66Animas027.8	36.8275	-107.9999	Animas R upstream of HWY 516 bridge in Aztec
66Animas043.0	36.9327	-107.894	Animas R upstream of HWY 550 bridge nr Cedar Hill
66Animas054.6	36.9812	-107.8719	ANIMAS RIVER @ COLORADO STATE LINE
66Animas055.8	36.9898	-107.8674	Animas River downstream of state line
66SanJua100.2	36.7217	-108.224	SAN JUAN RIVER AT BISTI BRIDGE - 66SanJua100.2
67LaPlat000.3	36.7375	-108.2497	LA PLATA R NR FARMINGTON - 67laplat000.3
67LaPlat024.8	36.9289	-108.1847	LA PLATA RIVER AT LA PLATA, NM
67LaPlat033.8	36.995	-108.1907	La Plata River At Nm-Colordo State Line

Site ID	Latitude	Longitude	Site Name
67SanJua082.6	36.7396	-108.4028	SAN JUAN RIVER NEAR KIRTLAND
67SanJua088.1	36.7208	-108.3276	San Juan River at Lions Park near Kirtland
75RNutri024.7	35.27	-108.5718	Rio Nutria @ Bridge to upper village - 75RNutri024.7
75RPesca012.8	35.1064	-108.5865	Rio Pescado @ Highway 53 bridge - 75RPesca012.8
75Tampic000.1	35.2981	-108.5337	Tampico Draw abv Rio Nutria - 75Tampic000.1
75ZuniRi040.5	35.0928	-108.7893	Zuni River below Black Rock Dam
77Beaver000.1	33.3359	-108.1027	Beaver Creek abv Taylor Creek - 77Beaver000.1
77BlackC000.1	33.1738	-108.1617	Black Canyon abv East Fork Gila River
77BlackC016.5	33.1836	-108.036	Black Cny Creek at Lower Black Cny Campground
77BlackC028.3	33.1648	-107.9474	Black Canyon Creek ~0.75 mi abv Aspen Canyon
77Bobcat000.8	33.2668	-108.1766	Bobcat Spring between Adobe spring and E. Fork Gila
77Bonner002.4	33.1811	-107.9598	Bonner trib to Black Canyon
77CubCre005.6	33.2931	-108.5544	Cub Creek 1mile abv Middle Fk Gila
77Diamon033.2	33.2809	-107.849	Main Diamond Creek at Trail 42 - 77Diamon033.2
77EFkGil000.2	33.177	-108.201	East Fork Gila abv West Fork - 77EFkGil000.2
77EFkGil010.0	33.1841	-108.1653	East Fork Gila River below Black Canyon
77EFkGil012.1	33.186	-108.1583	East Fork Gila River 1 mile abv Black Canyon
77EFkGil035.4	33.3017	-108.1233	East Fork Gila River below Taylor Creek
77Gilari088.0	33.0762	-108.4882	Gila River 300 meters abv Turkey Creek
77GilaRi092.0	33.0811	-108.4571	Gila River abv Turkey Creek
77Gilita000.2	33.4131	-108.4908	Gilita Creek abv Snow Canyon Creek - 77Gilita000.2
77IronCr000.1	33.3878	-108.4758	Iron Creek abv Middle Fork Gila - 77IronCr000.1
77IronCr009.7	33.3781	-108.5658	IRON CREEK @ FOREST TRAIL 151
77MFkGil000.1	33.2263	-108.2418	Middle Fork Gila abv West Fork - 77MFkGil000.1
77MFkGil028.3	33.3191	-108.3423	Middle Fork Gila River
77MFkGil055.0	33.4144	-108.614	Middle Fork Gila below Snow Lake
77Sapill018.0	33.0308	-108.1668	Sapillo Creek below Lake Roberts - 77Sapill018.0
77Taylor000.1	33.3358	-108.1006	Taylor Creek abv Beaver Creek - 77Taylor000.1
77Taylor004.2	33.3503	-108.0797	Taylor Creek below Wall Lake
77Turkey001.8	33.0892	-108.4861	Turkey Creek (at Wilderness Boundary Trail 155)
77WFkGil000.1	33.1806	-108.2061	West Fork Gila abv East Fork
77WFkGil010.0	33.2293	-108.266	West Fork Gila abv Cliff Dwelling Cyn
77WFkGil038.1	33.2826	-108.4674	West Fork Gila River abv White Creek
77Willow000.1	33.4081	-108.5747	Willow Creek abv Gilita Creek
78BearCr027.0	32.9219	-108.3923	Bear Creek blw Dorsey Springs - 78BearCr027.0

Site ID	Latitude	Longitude	Site Name
78BlueCr000.9	32.6627	-108.83	Blue Creek 0.5 mile abv Gila River - 78BlueCr000.9
78GilaR087.7	32.9693	-108.5873	Gila River @ NM Hwy 211 Bridge - 78GilaR087.7
78GilaRi026.1	32.6469	-108.8458	Gila River @ Red Rock
78GilaRi052.6	32.872	-108.5949	Gila River abv Mangas Creek, near Bill Evans Lake
78GilaRi069.2	32.833	-108.6116	Gila River below Mangas Creek - 78GilaRi069.2
78GilaRi074.8	33.043	-108.5283	Gila River abv Gila
78Mangas000.7	32.8616	-108.5861	Mangas Creek abv Gila River (Forest Road 809)
80Center000.1	33.8306	-108.8447	Centerfire Creek at Forest Road 210
80Center002.1	33.8375	-108.8556	Centerfire Creek abv San Francisco River
80MuleCr015.5	33.122	-108.9596	Mule Creek - 80MuleCr015.5
80Negrit000.1	33.6828	-108.7444	Negrito Creek abv Tularosa River
80SanFra028.6	33.2491	-108.879	San Francisco River below Glenwood at Hot Springs
80SanFra048.8	33.3691	-108.9107	San Francisco River at Alma Bridge - 80SanFra048.8
80SanFra105.7	33.6444	-108.7911	San Francisco River below Reserve - 80SanFra105.7
80SanFra109.6	33.7025	-108.7562	San Francisco River below Reserve WWTP
80SanFra109.7	33.7034	-108.7557	San Francisco River abv Reserve WWTP
80SanFra124.2	33.7869	-108.7702	San Francisco River at Upper Box - 80SanFra124.2
80SanFra154.1	33.8184	-108.992	San Francisco River abv Luna - 80SanFra154.1
80SNegri000.1	33.6069	-108.6311	South Negrito Creek - 80SNegri000.1
80TroutC002.1	33.8472	-108.9527	Trout Creek - Quality Area
80TroutC009.4	33.8813	-109	Trout Creek near FR 220 - 80Trout009.4
80Tularo001.3	33.6756	-108.7599	Tularosa River abv San Francisco River
80Tularo035.8	33.8315	-108.6238	Tularosa River abv Apache Creek - 80Tularo035.8
80Tularo050.8	33.8914	-108.515	Tularosa River abv Aragon at gage # 9442692
80Whitew000.5	33.3167	-108.8833	Whitewater Creek at Glenwood abv San Francisco R.
80WhiteW008.8	33.3729	-108.8414	Whitewater Creek abv campground
ANIMA_36817_108025	36.8172	-108.0247	ANIMAS RIVER
BEAR_32891_108233	32.8908	-108.2328	BEAR CREEK
BITTE_36705_105403	36.7047	-105.4025	BITTER CREEK
CLANT_31534_108875	31.5342	-108.875	CLANTON DRAW
DOUBL_31639_108754	31.6394	-108.7542	DOUBLE ADOBE CREEK
FW08AZ005	33.9123	-109.3565	North Fork East Fork Black River
FW08AZ006	33.7599	-109.434	Centerfire Creek
FW08AZ008	32.8711	-109.1983	Gila River
FW08AZ022	33.3099	-109.4966	Eagle Creek

Site ID	Latitude	Longitude	Site Name
FW08AZ075	33.1056	-109.3015	San Francisco River abv Clifton
FW08AZ107	32.7197	-109.0969	Gila River
FW08AZ134	32.8967	-109.8028	Gila River
FW08AZ139	33.0103	-109.3077	San Francisco River
FW08AZ155	33.0815	-109.4644	Eagle Creek
FW08AZ171	33.6845	-109.0832	Blue River
FW08CO001	37.3659	-108.5933	Hartman Draw
FW08CO020	38.0651	-102.3365	Wolf Creek
FW08CO028	37.6045	-103.606	Purgatoire River
FW08CO029	37.7141	-106.8382	Goose Creek
FW08CO033	37.1761	-105.7311	Rio Grande
FW08CO049	37.3591	-105.7664	Rio Grande
FW08CO060	37.8175	-103.3686	Purgatoire River
FW08CO072	37.3416	-103.9085	Purgatoire River
FW08CO073	37.0617	-105.9831	Rio San Antonio
FW08CO083	37.7228	-108.235	West Dolores River
FW08CO087	38.1856	-106.4897	East Past Creek
FW08CO125	37.5869	-104.8383	Cucharas River
FW08CO129	38.0673	-105.0848	Middle Creek
FW08CO136	37.4159	-102.5214	Bear Creek
FW08KS033	37.9748	-101.7879	Arkansas River
FW08NM001	35.9713	-106.6049	San Antonio Creek
FW08NM002	36.5978	-106.5008	Rio Nutrias
FW08NM003	36.4359	-105.2368	Saladon Creek
FW08NM005	35.7908	-104.6117	Mora River
FW08NM008	34.7508	-106.7434	Rio Grande
FW08NM010	32.9192	-105.3374	Penasco River
FW08NM012	36.1108	-105.7318	Rio De Las Trampas
FW08NM013	35.3771	-104.5055	Conchas River
FW08NM019	33.3008	-108.1255	East Fork Gila River
FW08NM022	36.7079	-108.2115	San Juan River
FW08NM023	34.0049	-104.3148	Pecos River
FW08NM024	35.1681	-106.6583	Rio Grande
FW08NM025	35.2432	-104.9107	Gallinas River
FW08NM026	32.1417	-106.6992	Rio Grande

Site ID	Latitude	Longitude	Site Name
FW08NM027	33.4146	-104.4566	Rio Hondo
FW08NM031	33.7577	-108.7627	San Francisco River
FW08NM034	34.4472	-106.8037	Rio Grande
FW08NM035	33.2025	-108.2088	West Fork Gila River
FW08NM038	36.6993	-107.9853	San Juan River
FW08NM039	34.4439	-104.2347	Pecos River
FW08NM042	32.5189	-104.3144	Pecos River
FW08NM043	32.9881	-108.5209	Gila River
FW08NM045	36.3594	-106.6758	Rio Chama
FW08NM047	33.1494	-107.2064	Rio Grande
FW08NM048	36.5482	-105.1302	Cimarron River
FW08NM061	36.7889	-106.2405	Unnamed
FW08NM064	36.7974	-104.8782	Vermejo River
FW08NM069	35.7715	-105.0072	Sapello River
FW08NM105	35.265	-105.3653	Pecos River
FW08OK031	36.6969	-101.6767	Beaver River
FW08RAZ9022	32.9563	-109.5314	Bonita Creek
FW08RNM9001	35.9512	-103.6974	Ute Creek
FW08RNM9002	36.2215	-103.8506	Ute Creek
FW08RNM9004	36.5887	-103.3149	Seneca Creek
FW08RNM9006	32.6491	-108.8468	Gila Reference
FW08RNM9030	36.1792	-105.8292	Embudo Creek
FW08RNM9049	32.7498	-105.9117	Dog Canyon
FW08RNM9060	36.9312	-105.7358	Rio Grande
FW08RNM9061	36.34	-105.7311	Rio Grande
FW08RNM9067	36.2164	-106.2481	Rio Chama
FW08RNM9075	33.5974	-104.3633	Pecos River
FW08RNM9076	34.3325	-104.1811	Pecos River
FW08RNM9081	35.3236	-103.9811	Canadian River
FW08RNM9082	36.0662	-104.3706	Canadian River
FW08RTX11553	33.3048	100.529	Croton Creek
FW08RUT9100	37.3885	-109.6885	Fish Creek
FW08RUT95790	37.9831	-109.5161	Indian Creek near Newspaper Rock
FW08RUT95820	37.9378	-109.6369	North Cottonwood Creek
FW08TX012	35.7621	-101.3198	Canadian River

Site ID	Latitude	Longitude	Site Name
FW08TX033	35.9691	-100.8192	Canadian River
FW08TX046	31.7705	-103.7793	Pecos River
FW08TX065	35.4507	-102.003	Canadian River
FW08UT014	37.2239	-109.8753	San Juan River
FW08UT023	38.3547	-104.7525	Colorado River
FW08UT030	37.2744	-109.4367	San Juan River
FW08UT046	37.1944	-109.7183	San Juan River
GILA_33179_108206	33.1794	-108.2061	Gila River
GILA_33222_108244	33.2222	-108.2442	Gila River
GILA_3324_108265	33.2397	-108.265	Gila River
GLORI_35565_105738	35.5651	-105.7377	Glorieta Creek
GLORI_35568_105722	35.5679	-105.7216	Glorieta Creek
GLORI_35571_105755	35.5714	-105.7549	Glorieta Creek
JEMEZ_35392_106537	35.3917	-106.537	Jemez River
LITTL_36301_105239	36.3006	-105.2392	Little Coyote Creek
LITTL_36302_105239	36.3017	-105.2389	Little Coyote Creek
LONG_36937_10358	36.9369	-103.58	Long Canyon Creek
LOSP_3699_107601	36.9897	-107.6011	Los Pinos River
MRG105.009035	35.7439	-106.7119	Jemez River Bel Jemez Springs Effluent Discharge
MRG106.007501	35.6963	-106.741	Rio Guadalupe Abv Confl With Jemez River
MRG106.010015	35.8761	-106.6314	Redondo Creek Near Sulphur Crk
NAVAJ_36949_107072	36.9489	-107.0721	Navajo River
NAVAJ_36967_107041	36.9666	-107.0407	Navajo River
OWW04440-0045	35.9584	-106.4867	San Antonio 2
OWW04440-0077	36.8688	-106.4545	Canones Creek
OWW04440-0205	36.4357	-105.237	Saladon Creek
OWW04440-0333	36.4926	-106.0073	Rio Tusas
OWW04440-0429	31.419	-103.3413	Pecos River
OWW04440-0557	35.971	-106.5999	San Antonio (2)
OWW04440-0717	36.148	-105.6725	Rio Santa Barbara
OWW04440-0845	36.5977	-106.4998	Rio Nutrias
OWW04440-1037	33.6084	-108.6356	Negritos Creek
OWW04440-1059	35.7675	-101.3163	Canadian River
OWW04440-1069	35.7182	-106.7213	Jemez Creek
OWW04440-1101	36.9551	-106.5418	Wolf Creek

Site ID	Latitude	Longitude	Site Name
OWW04440-NM01	36.1998	-103.8457	Ute Creek,Nm
OWW04440-NM03	33.4024	-105.8838	Three Rivers
OWW04440-NM07	33.0845	-108.4876	Turkey Creek
OWW04440-NM08	33.2806	-107.8484	Diamond Creek
PECOS_35708_105206	35.7075	-105.206	Pecos Arroyo
RIOC_35779_105711	35.7788	-105.7111	Rio Chupadero
RIOS_36103_105621	36.1033	-105.6206	Rio Santa Barbara
RIVER_36951_106145	36.9514	-106.145	River Los Pinos
SANTA_35582_10628	35.5822	-106.2803	Santa Fe River
SFR602.005030	33.6361	-108.7913	San Francisco River Below Reserve
TESUQ_35769_105725	35.7686	-105.725	Tesuque Creek
UPR211.001529	35.5658	-105.2117	Gallinas Riv Approx 400'below Stp Abv Arroyo
URG110.002050	35.6211	-106.1061	Santa Fe R 1.0 Mi Below 1st Bridge Below Wwtf
URG116.020005	36.8791	-106.587	Rio Chamita 25m Below Chama Outfall
URG116.020055	36.98	-106.6594	Rio Chamita Abv Confluence With Sexto Creek
UT111142	38.391	-109.217	Lasal Creek
WAZP04-RBON1	32.9568	-109.5313	Bonita Creek
WAZP04-RLCR1	34.0778	-109.4262	Little Colorado River
WAZP04-RMIN1	34.18	-109.6184	Mineral Creek
WAZP99-0512	32.8708	-109.1986	Gila River
WAZP99-0545	33.9122	-109.3558	Black River
WAZP99-0569	33.5922	-109.3219	Kp Creek
WAZP99-0599	32.8407	-109.5821	Gila River
WAZP99-0605	33.4603	-109.1819	Blue River
WAZP99-0615	33.6814	-109.445	Conklin Creek
WAZP99-0639	33.7501	-109.216	Campbell Blue Creek
WAZP99-0645	33.9486	-109.2024	Nutrioso Creek
WAZP99-0653	35.918	-109.3968	Nazlini Creek
WAZP99-0669	36.3549	-109.1131	Tsaile Creek
WAZP99-0681	33.2404	-109.1915	Blue River
WAZP99-0687	33.7596	-109.4336	Centerfire Creek
WAZP99-0701	35.8385	-109.1131	Bonito Creek
WAZP99-0722	33.5343	-109.293	Thompson Creek
WAZP99-0750	33.1385	-109.4935	Eagle Creek
WAZP99-0783	33.338	-109.0661	Lanphier Canyon

Site ID	Latitude	Longitude	Site Name
WAZP99-0828	33.8629	-109.3192	North Fork Black River
WAZP99-0840	33.851	-109.1508	San Francisco River
WAZP99-0876	36.2086	-109.1329	Wheatfields Creek
WAZP99-0888	33.6844	-109.3965	Fish Creek
WAZP99-0906	34.2842	-109.3521	Little Colorado River
WCOP01-0734	38.1608	-104.6781	Salt Creek
WCOP01-0765	38.1283	-102.1347	Wild Horse Creek
WCOP01-0777	37.4942	-103.6308	Chacuaco Creek
WCOP01-0812	37.4214	-103.8042	Purgatoire River
WCOP01-0819	37.7892	-103.8214	Timpas Creek
WCOP01-0833	38.0681	-104.9453	North St. Charles River
WCOP01-0836	38.1056	-103.3697	Horse Creek
WCOP03-R005	38.4364	-106.3722	Agate Creek
WCOP03-R007	37.6319	-107.8781	East Fork Hermosa Creek
WCOP03-R008	37.5208	-108.1106	Bear Creek
WCOP03-R009	37.4803	-107.0969	East Fork Piedra River
WCOP04-R003	37.5134	-103.0267	Two Butte Creek
WCOP04-R006	38.16	-108.4083	Naturita Creek
WCOP04-R007	37.3639	-108.9508	Yellow Jacket Creek
WCOP04-R009	37.8271	-103.773	Timpas Creek
WCOP99-0502	37.3294	-106.6897	Adams Fork Conejos River
WCOP99-0507	37.8747	-106.5686	Groundhog Creek
WCOP99-0508	37.6206	-107.0214	Red Mountain Creek
WCOP99-0513	38.07	-107.7403	Whitehouse Creek
WCOP99-0568	37.1342	-108.1642	La Plata River
WCOP99-0574	38.0211	-107.3905	Henson Creek
WCOP99-0591	37.9336	-108.0394	Fall Creek
WCOP99-0621	37.9736	-108.8267	Dolores River
WCOP99-0622	37.3703	-108.6011	Hartman Draw
WCOP99-0627	38.0664	-106.3811	Houselog Creek
WCOP99-0634	37.5961	-105.3989	Ute Creek
WCOP99-0646	37.2961	-108.3664	Mud Creek
WCOP99-0670	37.5231	-108.2336	Lost Canyon Creek
WHITE_35759_10567	35.7592	-105.6697	White Flow
WILLO_35747_105655	35.7467	-105.655	Willow Creek

Site ID	Latitude	Longitude	Site Name
WRIGH_35703_105485	35.7033	-105.4847	Wright Canyon

Appendix COutlier Analysis

We searched the database for nutrient and other values that were unusual, inexplicable, or associated with anomalous sampling conditions. Identification of outlier values was subjective; extremes were identified and then assessed individually. The approach we took was to look for outliers both within sites and across all data points. The outlier analysis addressed 10,064 nutrient records in the NMED database, including river sites.

Outlier TN and TP values (and associated NO_3NO_2 and TKN) were identified in two ways. First, the maximum value at each site was compared to the geometric mean value (which included the maximum). The difference between maximum and geometric mean divided by the geometric mean was used as a flag of possible high outlier values. When ratios were high (TN ratio >5 [72 cases], TP ratio > 10 [77 cases]), the maximum values were investigated as possible outliers to be removed. The second screen was on the maximum value alone. This screen helped to identify possible outliers in sites with single or few nutrient records. Values >5mg/L TN (47 cases) and >2mg/L TP (40 cases) were investigated as possible outliers to be removed.

All values in samples associated with high flow ratings or possible fire effects were also investigated. Flow and fire information was available as a comment associated with the sampling record. Flow was also recorded as a numeric rating in some cases. In sites with high flows (either relative to other recorded flows or rated as “4 – high flow”), the nutrient value was removed as a possible outlier. If no flow information was available, high turbidity was used as an indicator of recent flow disturbance. High nutrient values were identified as outliers if turbidity associated with the sample was high relative to other values at the same site. Sites with fires in the catchment were identified along with an estimate of the years the effects were probable. All nutrient values were reviewed for those sites and years and all high values (>5mg/L TN and >2mg/L TP) were removed as outliers. If no other supporting data were available (flow, turbidity, or fire effects), then high nutrient values were removed or retained depending on variability in other values at the site. If all other values were consistently low, the outlier was removed, and if there was high variability in other values at the site, the high value was retained. Through this process, 28 TN values and 24 TP values were removed from analyses (~0.25% of records).

Outliers for other variables (e.g. field and lab chemistry) were addressed ad hoc. Values outside the normal range were eliminated (e.g., dissolved oxygen > 20 mg/L). Unusually high values in a distribution were considered for removal. The level of scrutiny for non-nutrient variables was not as intense as it was for nutrients.

Outliers in the NRSA and WSA data sets were evaluated across sites, because within site replication was minimal. In the NRSA data, one record was considered for removal for both TN (6.6 mg/L) and TP (11.7 mg/L) based on high values, high TSS value (12,568 mg/L), and location (in the Texas plains). These values may be valid, but the record was removed for specific analyses (e.g., to simplify correlations with response variables). No outliers were removed from the WSA/EMAP data.

NMED conducted a review of high outlier values in reference sites. The threshold for review was lower in reference sites. High values did not automatically disqualify a site as reference. TN and TP average concentrations per reference site were plotted and outlier values were identified in the plots (Figure C-

1). All reference sites with average concentrations >0.15 mg/L TP or >0.80 mg/L TN were listed for review of data validity and appropriate reference designation (Tables C-1 and C-2). The table shows the numbers of samples included in the average, the median and maximum concentrations, and the standard deviation. These are presented to determine the persistence of high concentration values. For example, if median values are much lower than average values, then few high outliers that went into the average value are suspected of being unrepresentative.

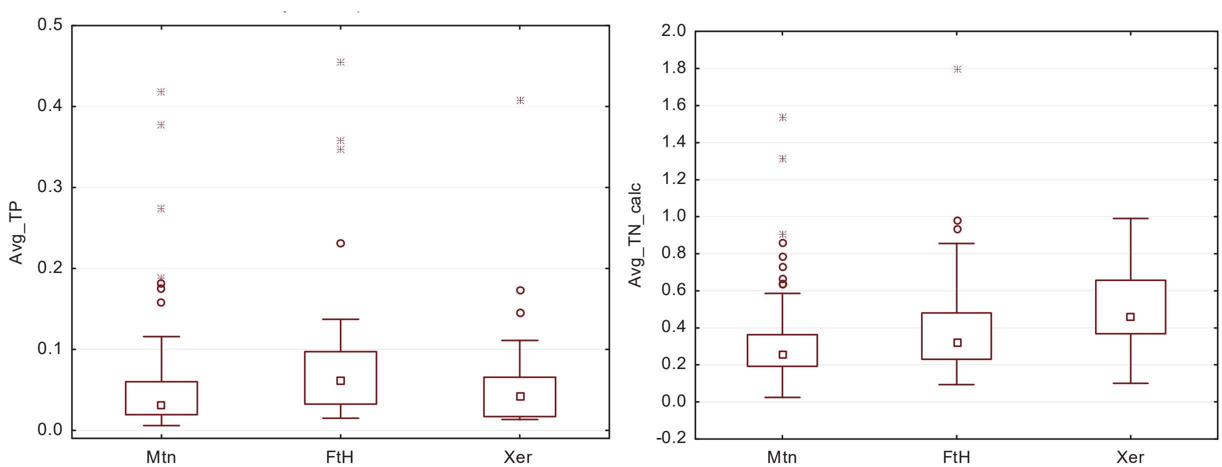

Figure C-1. Distributions of TP and TN concentrations (mg/L) in reference and near-reference sites by sediment site classes; Mountains (N = 98), Foothills (N = 54), and Xeric areas (N = 30).

Table C-1. TP outlier values at reference sites and statistics.

AltSiteID	MLOC_NAME	Years, # visits	Avg TP	TP Medn	Max TP	TP StdDev
40Alamos058.5	Alamosa Creek below USGS Gage	2004-2011, 10	0.454	0.0198	4.31	1.355
05NPonil023.2	North Ponil Cr abv Seally Cr	2006, 5	0.418	0.035	1.58	0.014
06OcateC025.1	Ocate creek @ I-25	2002, 3	0.408	0.058	1.15	0.643
RIOS_36103_105621	RIO SANTA BARBARA	1990, 3	0.377	0.015	1.1	0.626
80SanFra124.2	San Francisco River at Upper Box	2011, 9	0.359	0.1835	1.54	0.501
GILA_33222_108244	Gila River	1992-1996, 10	0.348	0.0325	1.8	0.569
LITTL_36302_105239	Little Coyote Creek	1991, 6	0.274	0.285	0.515	0.187
45Mimbre112.2	Mimbres River at Upper Nature Conservency Property	2002-2009, 17	0.231	0.1065	2.15	0.513
LITTL_36301_105239	Little Coyote Creek	1991, 6	0.189	0.1575	0.385	0.106
07Maesta000.4	Maestas Cr. abv Manuelitas Cr.	2002, 2	0.182	0.1815	0.307	0.177
WCOP99-0627	Houselog Creek	2002, 1	0.176			
WCOP01-0734	Salt Creek	2003, 1	0.174			
57RBonit061.1	Rio Bonito abv Bonito Lk At Fr 107 Blw Bonito S.	2003-2012, 11	0.157	0.073	1.16	0.334

Table C-2. TN outlier values at reference sites and statistics.

AltSiteID	MLOC_NAME	Years, # visits	Avg TN	TN Medn	Max TN	TN StdDev
48NogalC000.2	Nogal Creek at County Rd B-17	2012, 3	1.795	1.795	1.91	0.163
49Sacram014.6	Sacramento River at Gage	2012, 3	1.540	1.54	1.64	0.141
38RSalad030.0	Rio Salado 1 Mile abv the Box	2005-2008, 4	1.315	1.03	3.03	1.214
60BlueSp002.0	Blue Spring abv Bounds Diversion	2003-2007, 3	0.990	0.849	1.35	0.315
40Alamos058.5	Alamosa Creek Blw USGS Gage	2004-2011, 10	0.976	0.35	6.29	1.876
77Beaver000.1	Beaver Creek Above Taylor Crk	2011, 4	0.933	0.67	2.03	0.746
LITTL_36302_105239	Little Coyote Creek	1991, 6	0.907	0.868	1.41	0.423
80SanFra124.2	San Francisco River at Upper Box	2011, 9	0.856	0.5	3.01	1.002
57RRuido052.4	Rio Ruidoso at Mescalero Boundary at Gage	1993-2012, 19	0.854	0.666	2.86	0.710
16Corrum051.1	Corrumpa Creek at Hwy 370	2006, 1	0.840	0.84	0.84	0.000

Appendix D Estimated Values for Censored Data

Portions of the TN and TP data were reported as below detection limits, noted in the data set as "less than" a numeric value. The current default for these values has been substitution of ½ of a standardized less-than value for all samples with values below that standard or marked as below detection at a higher reported detection limit.

Some analyses rely on summary statistics of site nutrient conditions. Therefore, treatment of the censored data in summary statistics must be addressed before incorporating the site statistics into specific analyses, such as frequency distributions across sites. In addition, sites have varying numbers of samples, so the summary may be based on single or multiple values. TN is calculated from nitrate+ nitrite and TKN, both of which have their own detection limits.

One alternative for dealing with censored data is to continue to use the ½ detection substitution (HDS) in all cases. This is the simplest end of the spectrum of alternatives. Another alternative, elimination of all censored data, is not feasible as this would not account for low nutrient concentrations as an important reference condition. The Kaplan-Meier (KM) technique is a non-parametric method that relies only on the ranks of the data and makes no assumptions about the statistical distribution from which they originate. Regression on order methods (ROS) are techniques that calculate summary statistics with a regression equation on a probability plot. Maximum likelihood estimation (ML) techniques are methods that rely on knowing the underlying statistical distribution from which the data are derived. The most sophisticated approach is a multilevel model to estimate a grand mean using a Bayesian multilevel model. Given the small number of samples at each site, the KM non-parametric method and ROS are most appropriate of these alternatives. These techniques are described in the literature (Helsel 2010, Antweiler and Taylor 2008).

The Kaplan-Meier relies heavily on the detected values. The KM estimate returns a mean of 0 for single non-detect observations or sites with all observations as non-detects. If a site has one detected value and all others are non-detects, the detected value becomes the mean. So the KM estimated mean will be higher than the ½ substitution mean in all cases where there is at least one detected value.

The ROS method is also sensitive to the number of detections versus non-detects. It returns a mean of 0 for single non-detect observations or sites with >80% of observations as non-detects. When only one value is above detection, a warning is given to scrutinize results.

We ran an illustrative analysis in R software, calculating means using different methods for an example site with 5 values ranging from 2 to 10 (Table D-1). In the illustration, we only considered 3 methods: HDS, KM, and ROS. The table shows that for increasing numbers of non-detect values, only the HDS mean consistently decreases. Warnings are associated with ROS mean values derived from 1 or no detected values. The KM method also gave warnings when all values were non-detects. In the example, only the HDS method results in a consistently decreasing mean value as the number of non-detect values increases. This matches our expectations: If we can't see it most of the time, average concentrations are less than in sites where it is detected more often.

Table D-1. Illustrative data sets and mean values calculated with various methods for interpreting non-detects. FALSE = value is above detection levels. TRUE = value is below detection levels (ND).

Value	All Detected	ND: 2/5	ND: 3/5	ND: 4/5	All ND
10	FALSE	FALSE	FALSE	FALSE	TRUE
9	FALSE	FALSE	FALSE	TRUE	TRUE
4	FALSE	FALSE	TRUE	TRUE	TRUE
3	FALSE	TRUE	TRUE	TRUE	TRUE
2	FALSE	TRUE	TRUE	TRUE	TRUE
Method					
HDS	5.6	5.1	4.7	3.8	2.8
KM	5.6	6.2	9.2	10	0
ROS	5.6	5.3	8.0	10[a]	0[b]

a: ROS warning: Prediction from a rank-deficient fit may be misleading
b: ROS warning: Input > 80% censored -- Results are tenuous.

The applications we must consider are as follows:

1. Calculating TN from TKN and NO_3NO_2 for single sampling events
2. Calculating TN from TKN and NO_3NO_2 for site summaries
3. Using site summary data to calculate quantiles for site subsets
4. Using site summary data to calculate mean values for site subsets
5. Using site summary data to regress responses on sites
6. Using site summary data to calculate change-points

1. Calculating TN from TKN and NO_3NO_2 for single sampling events

There are no methods for estimating non-detect values for single observations. If we are going to combine the TKN and NO_3NO_2 values for a sampling event, we must use some value for the non-detected concentrations. The ½ detection level is a reasonable substitution as opposed to substituting the detection limit or 0. The ½ detection level assumes that the distribution of non-detected concentrations is neither all 0 nor all at the detection level. This issue is not relevant for TP, which is measured directly a single value.

2. Calculating TN from TKN and NO_3NO_2 for site summaries

If we forego sample-specific calculation of TN and instead target site-based calculations, we can use other mean estimation methods for TKN and NO_3NO_2 in each site, then add the mean values to get a site mean TN value. Alternatively, we could keep track of cases where both TKN and NO3NO2 are not detected and assign a ND value to TN for that sample. If one is ND and the other is detected, we would substitute the ½ detection for that sample only. This second alternative seems cumbersome and difficult to justify.

3. Using site summary data to calculate quantiles for site subsets

There will be relatively few sites for which all samples have values below detection. Therefore, we would need to consider a very low quantile before the non-detected values are part of the equation. Substitution values of 0, ½ detection, or detection level could be used for site summary non-detect values with no effect on the results if quantiles are 20th or greater. This is based on our observation that 17-21% of TKN samples had non-detect values and that after incorporating into site summaries, a smaller percentage of sites would have site non-detect values. Therefore, the decisions at the site summary level (#1 and #2) will have more impact than the decision on the substitution value for site non-detect values. Non-detect percentages for NO_3NO_2 and TP were higher and the critical quantiles should be investigated.

4. Using site summary data to calculate mean values for site subsets

We don't typically use mean values to summarize nutrient values in subsets of sites. We usually use non-parametric median and quantile values. These are not sensitive to the non-detects as long as the quantile examined is greater than the number of sites with non-detect values.

5. Using site summary data to regress responses on sites

Given the performance of site mean values in the example data analysis (Table D-1), it appears that the HDS method would give results that conform with our expectations for a site with varying numbers of non-detect values. By setting standard ½ detection values, we might risk creation of a non-normal distribution, but this is a relatively unimportant consideration. The site summary statistics outweigh the site group considerations.

6. Using site summary data to calculate change-points

As with regression, the distribution of non-detect values will be non-normal when using a standard substitution. This might affect the deviance calculations in the change-point analysis, showing very little variability at the lowest levels. However, the increased mean values and variability introduced by the KM and ROS methods might be misleading in other ways. Again, the decisions used to arrive at the site summary statistics will be more important than any manipulation or interpretation of summary statistics for site groups (as occurs in the change-point analysis).

TKN detection and reporting limits: a summary of TKN value distributions

NMED provided a file called Master TKN. This is not all of the TKN data, but is a large part of it. Master TKN was screened by limiting the 7090 records to those that were associated with valid sites for analysis. The resulting 4014 records were associated with 444 sites (including 145 ref and near_ref sites).

685 of 4014 values (17%) were flagged as "less than" or non-detects. The range of "less than" values was 0.04 – 0.25mg/L TKN. 216 "less than" values were below 0.05. 423 "less than" values were 0.10mg/L TKN. 46 "less than" values were between 0.10 and 0.26mg/L TKN. Because it was the mode of non-detect values, 0.10mg/L was considered as the standard non-detect value.

3062 of 4014 values (76%) had values <0.50mg/L TKN. This was the suggested MRL level.

1271 of 4014 records are from reference or near_ref sites. 270 reference or near_ref values (21%) were flagged as "less than". 241 of these values were ≤0.10. 1104 of 1271 records (87%) had values <0.50mg/L (suggested MRL level).

Conclusions

In prominent literature on dealing with censored data, Helsel (2010) suggests not to substitute for non-detects. However, this is not an option given the NMED data set with many non-detect values, especially in reference sites. In his review, Helsel concluded that the Maximum Likelihood Estimation (MLE, AKA Cohen's), Regression on Order Statistics (ROS), Kaplan–Meier (KM), and substitution methods each has a place. Antweiler and Taylor (2008) compared MLE, ROS, KM, and HDS methods in data sets with varying degrees of censored data. They recommended using KM or HDS when censored data was below 70%.

NMED also investigated this issue with an earlier data set. They decided that the ½ substitution or Kaplan-Meier methods were most appropriate (NMED – unpublished <Nut Crit Development Process final.doc>). The ½ substitution method was used because it gave results that were similar to the Kaplan-Meier method. A fairly large portion of the data were censored, i.e. below the detection limit (15-67% for TP, 10-86% for N+N, and 6-38% for TKN). Percentiles were calculated in two ways; using the substitution method (one half the detection limit) and using the nonparametric Kaplan-Meier method. In cases where the proportion of censored data was too high for Kaplan-Meier analysis (>50% non-detects), Regression on Order Statistics (ROS) were used. The results from the different analyses produced very similar results (Table D-2).

After discussions with NMED (6/26/2014), we decided to use the ½ substitution method for all analyses.

Table D-2. Comparison of the percentiles (mg/L), calculated using the substitution (substitut.) and Kaplan-Meier (KM) and ROS methods. Groups are defined by ecoregion number and method. The proportion of the data that was below the detection limit is shown in the % < DL columns.

	Total Phosphorus				Total Kjeldahl Nitrogen				Nitrate plus Nitrite			
Group	n	25th	50th	%< DL	n	25th	50th	%<DL	n	25th	50th	%<DL
21-substitut.	2160	0.015	0.020	41	2167	0.100	0.200	24	2217	0.025	0.050	60
21-KM			0.020			0.100	0.200			0.018	0.040	
22-substitut.	320	0.020	0.040	19	399	0.115	0.330	22	236	0.050	0.140	30
22-KM		0.020	0.040			0.130	0.330				0.140	
23- substitut.	855	0.020	0.020	49	864	0.110	0.200	19	829	0.025	0.050	57
23-KM		0.030	0.020			0.120	0.200			0.019	0.05	
24- substitut.	149	0.040	0.070	7	140	0.100	0.250	34	132	0.160	0.300	4
24-KM		0.040	0.070				0.270		129	0.160	0.300	
26- substitut.	502	0.010	0.020	42	494	0.158	0.325	18	415	0.050	0.090	36
26-KM	428		0.020	45		0.160	0.316		414	0.040	0.090	

Appendix E Seasonal Analysis

The NMED nutrient data were collected mostly in non-winter months (FigureE-1). The relative paucity of sample in the winter was a factor in deciding whether they would be included in the general analyses. If some bias was evident in the uncommon data, their removal would reduce bias in the remaining bulk of the data set. Also, during application of any nutrient criteria, any seasonal patterns of bias could be recognized and assessments in the non-winter months could be encouraged. At first glance, it appeared that there was some bias in the NMED winter nutrient values (N is high and P is low) (Figure E-2). The NRSA and WSA + EMAP samples were collected within a narrower index period (generally May to September), minimizing seasonal effects.

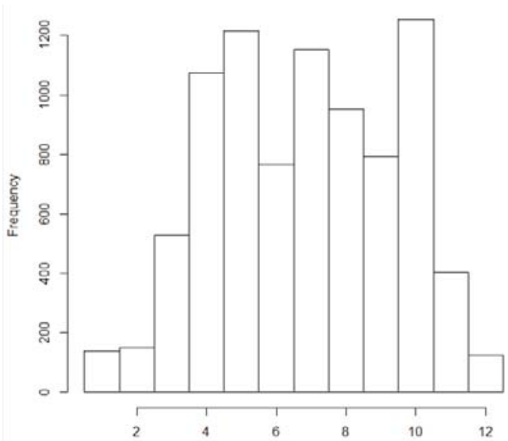

Figure E-1. Sampling frequency by month (NMED data).

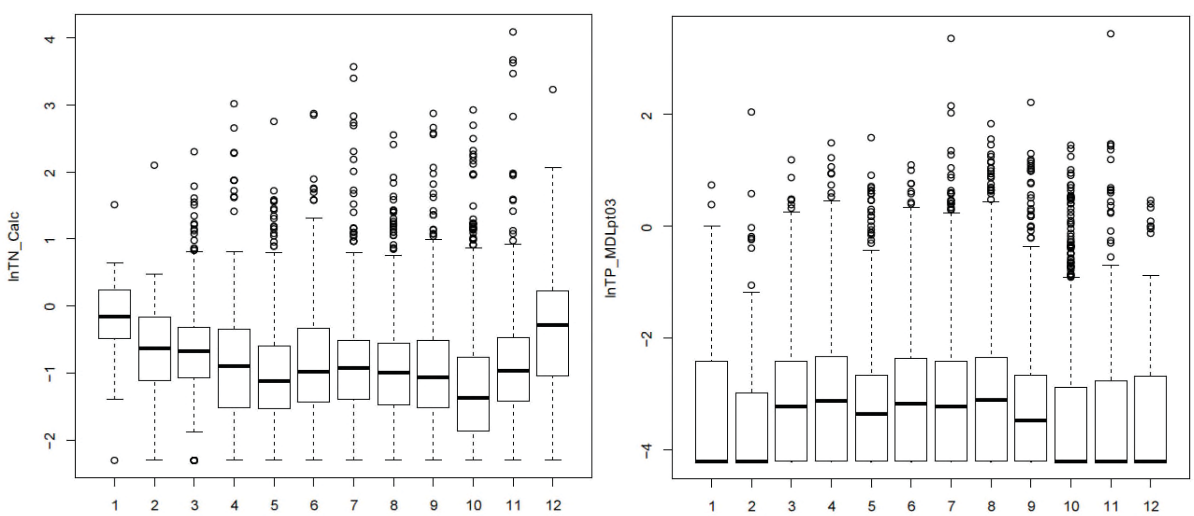

Figure E-2. TN (left) and TP (right) concentrations by month (NMED data).

We continued to explore the seasonality of TN and TP in indicator site classes (mountain, foothill, and xeric), in reference sites, and in selected sites that had several records over time. We limited this analysis to sites with multiple samples (only those with > 14 samples) because we were interested in seeing temporal patterns within sites, not just across sites. The analysis is exploratory and based on graphic interpretations. We do not expect that nutrient differences among months are significant and did not apply an ANOVA or other statistical tests.

Nitrogen

First, we show all sites (with >14 samples) and dates (by month over years) in the site classes with a Loess regression line superimposed. In each site class, there appears to be a drop in TN over the first 5 months (Figure E-3), perhaps coinciding with increasing temperatures, increasing denitrification as temperatures increase, and increased photosynthetic production that would absorb nutrients. In the mountains, a low point is reached in June and increases are seen in July and August. In the foothills and xeric classes, the peaks are also in July and August but the low point is in May. The peaks may be related to saturated uptake capacity in the streams and more free TN. There is a drop in the autumn before increases again in November or December. Xeric areas have low values in may and higher values in July.

When we limited the TN analysis to reference and near-reference sites, the same pattern was clear in the foothills (Figure E-4). In the mountains, there was still a trough in June and a peak in August, but the winter peak was not apparent (perhaps an artifact of fewer samples). The peak in April was as high as the one in August. In xeric areas, reference sites showed a peak in June and generally lower values in the fall. No winter peak was apparent. Given this comparison of reference and all sites (including non-reference), higher winter nutrients in all sites may indicate that the winter TN is either from unnatural sources or can be assimilated in natural areas.

We saw variety in TN concentration patterns for individual sites. In one series of graphs, TN concentrations in the Rio Hondo are displayed for particular years (Figure E-5). Rio Hondo site (28RHondo014.8) is in the mountains and is neither reference nor stressed (other). In 1991 and 1992 the troughs in TN concentration were in mid-summer, not as we saw in the composite of sites. The highest value was in the winter. In 2000, there were high values in May and August, but there were also low values during those months. In 2004, TN decreased over the year after peak values in February and March. In 2009, peak values were in March and August, which is similar to overall patterns. This kind of variation was seen in other sites also, suggesting that the general annual patterns are not rules that apply to all sites or to all years.

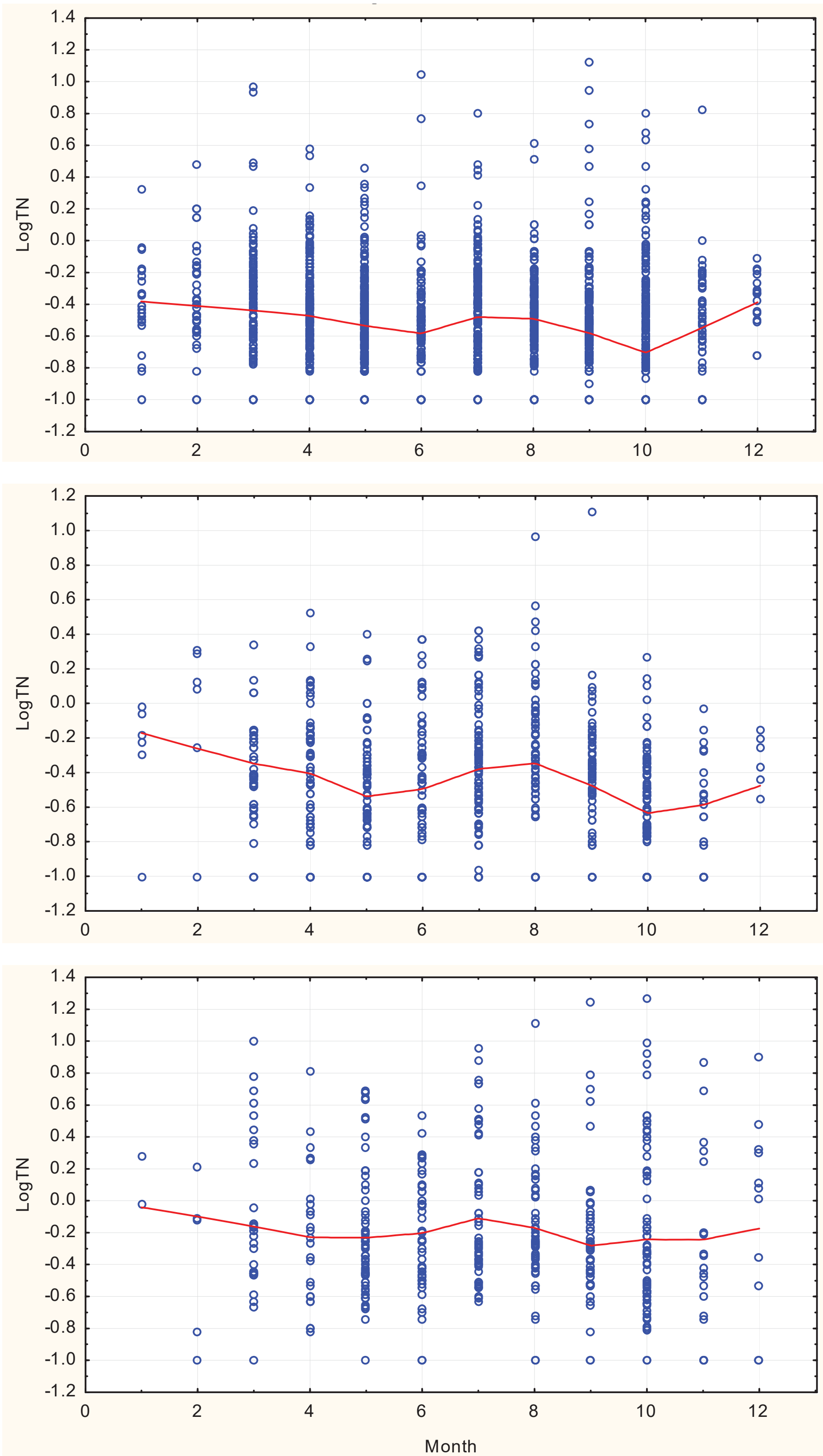

Figure E-3. TN concentration (log10 mg/L) by month in the mountain (top), foothill (middle), and xeric (bottom) site classes. The Loess regression line is shown as a red curve.

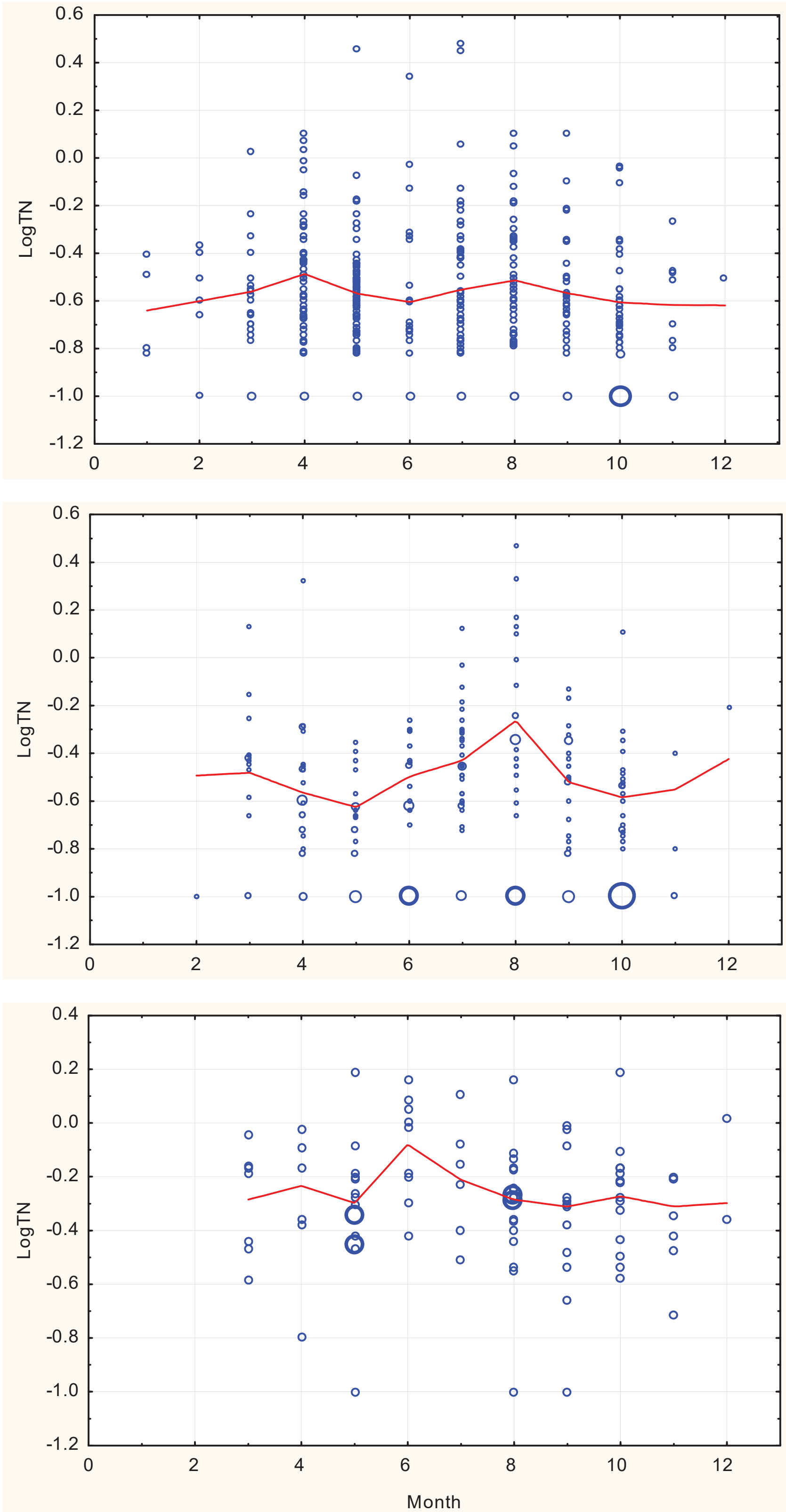

Figure E-4. Reference site TN concentration (log10 mg/L) by month in the mountain (top), foothill (middle), and xeric (bottom) site classes. Larger markers represent multiple samples.

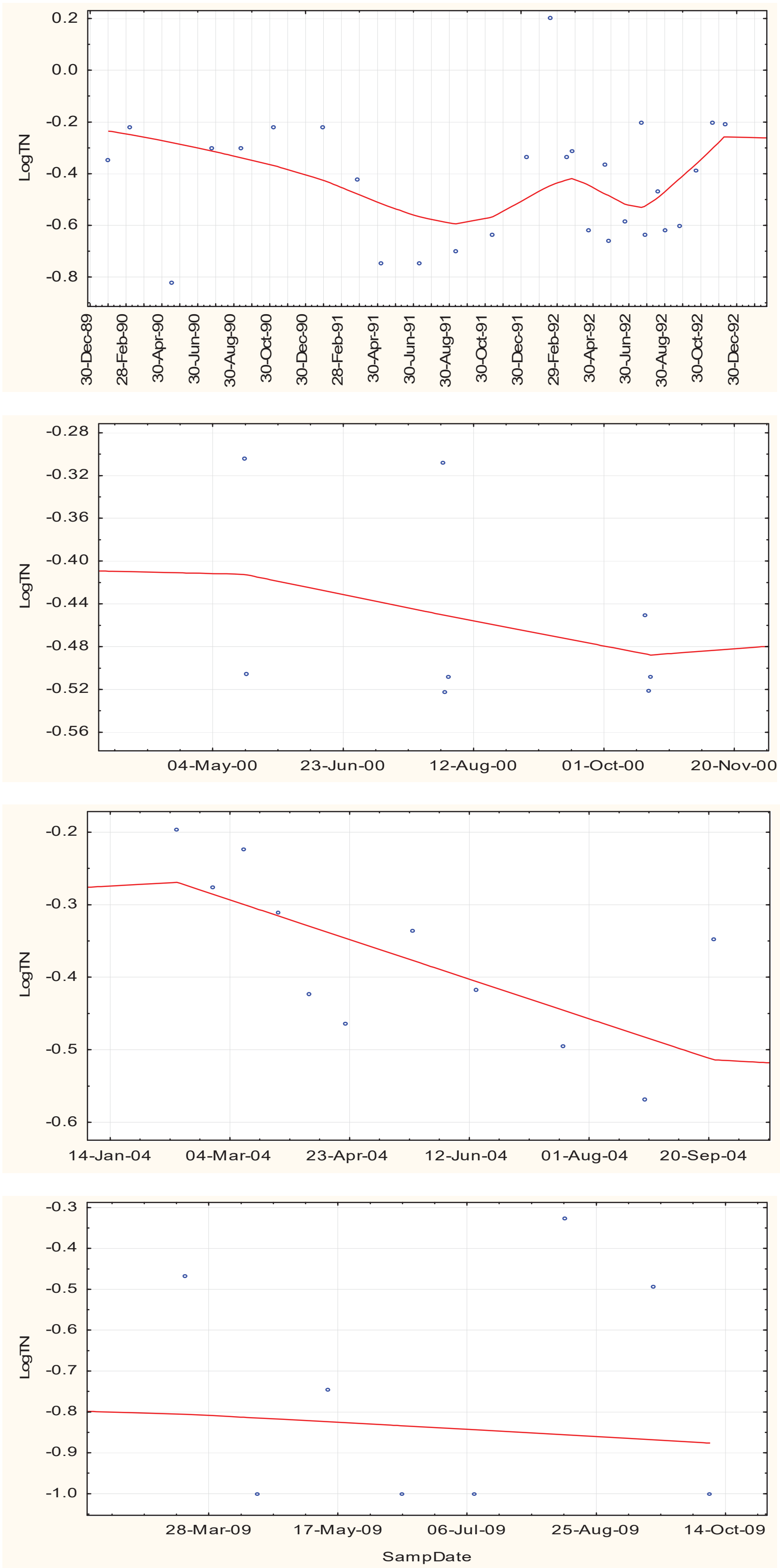

Figure E-5. TN concentrations over time in the Rio Hondo (28RHondo014.8) site.

Phosphorus

We show the same graphics for TP concentrations, all sites (with >14 samples) and dates (by month over years) in the site classes with a Loess regression line superimposed. The Loess regression line is subject to a large number of non-detect values (they appear as single points for each month along the bottom of the y-axis) (Figure E-6). The non-detects mask any true patterns, but we can see a slight peak in April in the mountains that coincides with a broader peak in the foothills. The foothills and xeric areas have peaks in July. TP in the winter drops off, though the few points in January in the xeric areas are higher. These patterns are also seen in the reference data set (Figure E-7).

We selected three sites to examine in more detail and again found variable patterns over time. The Rio Pueblo de Taos below the Taos effluent channel (28RPuebT008.1) is in the mountains and is neither reference nor stressed (other). From 1989 to 1995 there was a gradual decline in TP and then a slight increase in 1996 (Figure E-8, top). This pattern suggests that management actions were reducing TP sources over that period. In 2000, peak values were lowest in August (Figure E-8, middle). In 2009, TP was highest in July and October (Figure E-8, bottom).

In the Rio Ruidoso 7 miles below WWTP at Glencoe (57RRuido019.8), a stressed site in the foothills, we see relatively stable TP concentrations over years and variation within years that is not consistently related to seasons (Figure E-9). In the Tularosa River above the San Francisco River (80Tularo001.3), a near reference site in the foothills, we see variation over years that is much greater than the variation within years (Figure E-10).

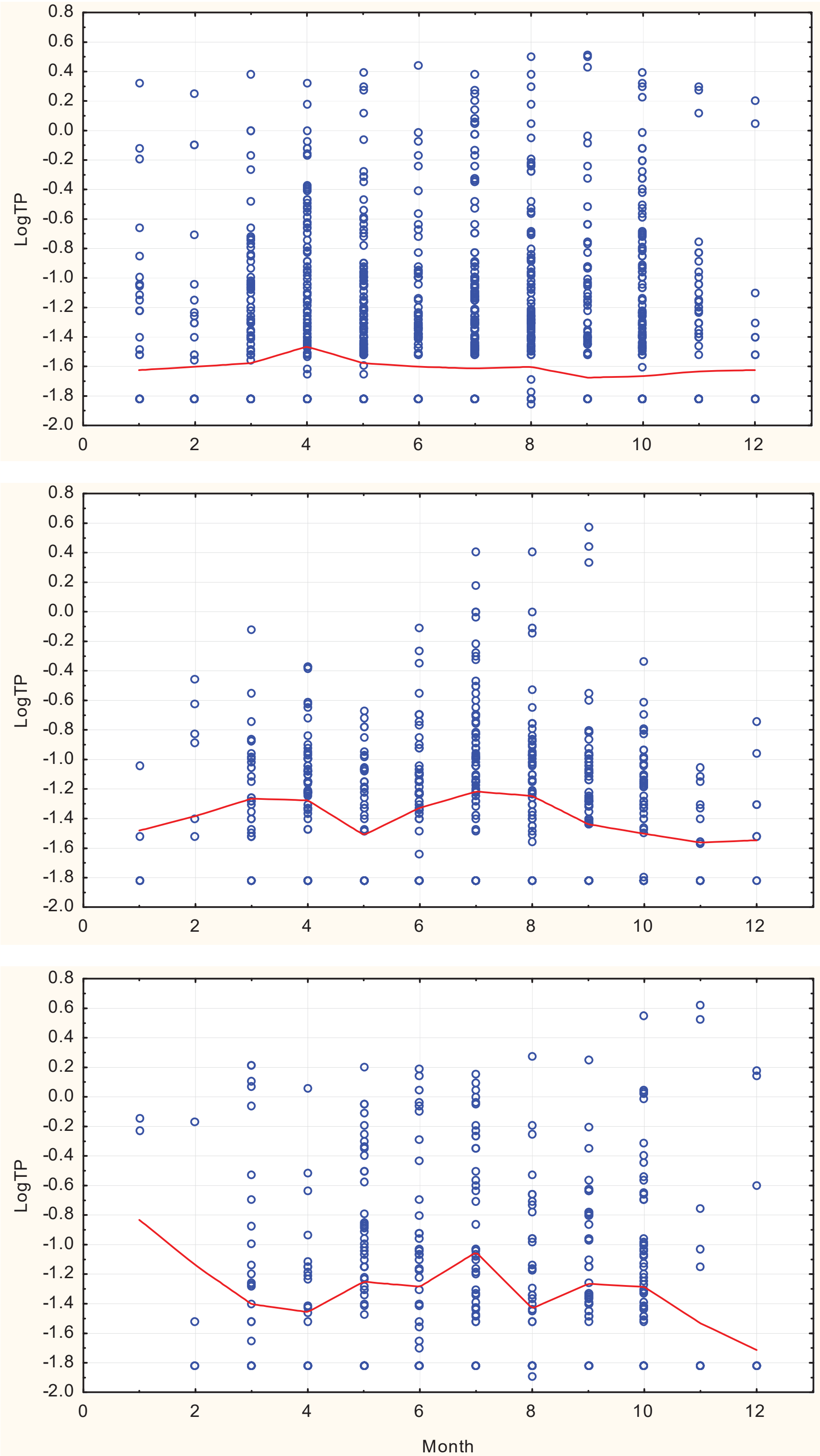

Figure E-6. TP concentration (log10 mg/L) by month in the mountain (top), foothill (middle), and xeric (bottom) site classes. The Loess regression line is shown as a red curve.

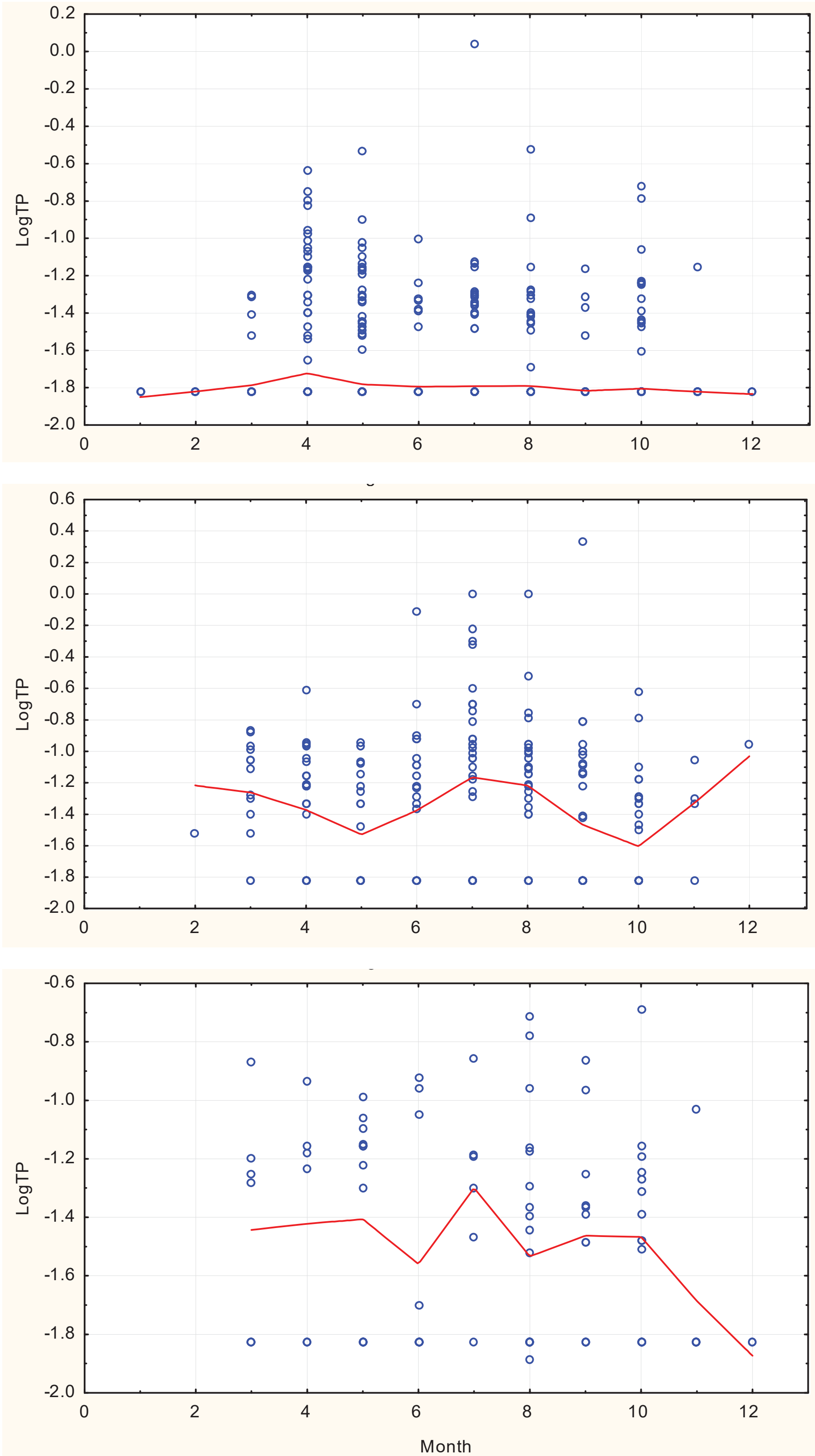

Figure E-7. Reference TP concentration (log10 mg/L) by month in the mountain (top), foothill (middle), and xeric (bottom) site classes.

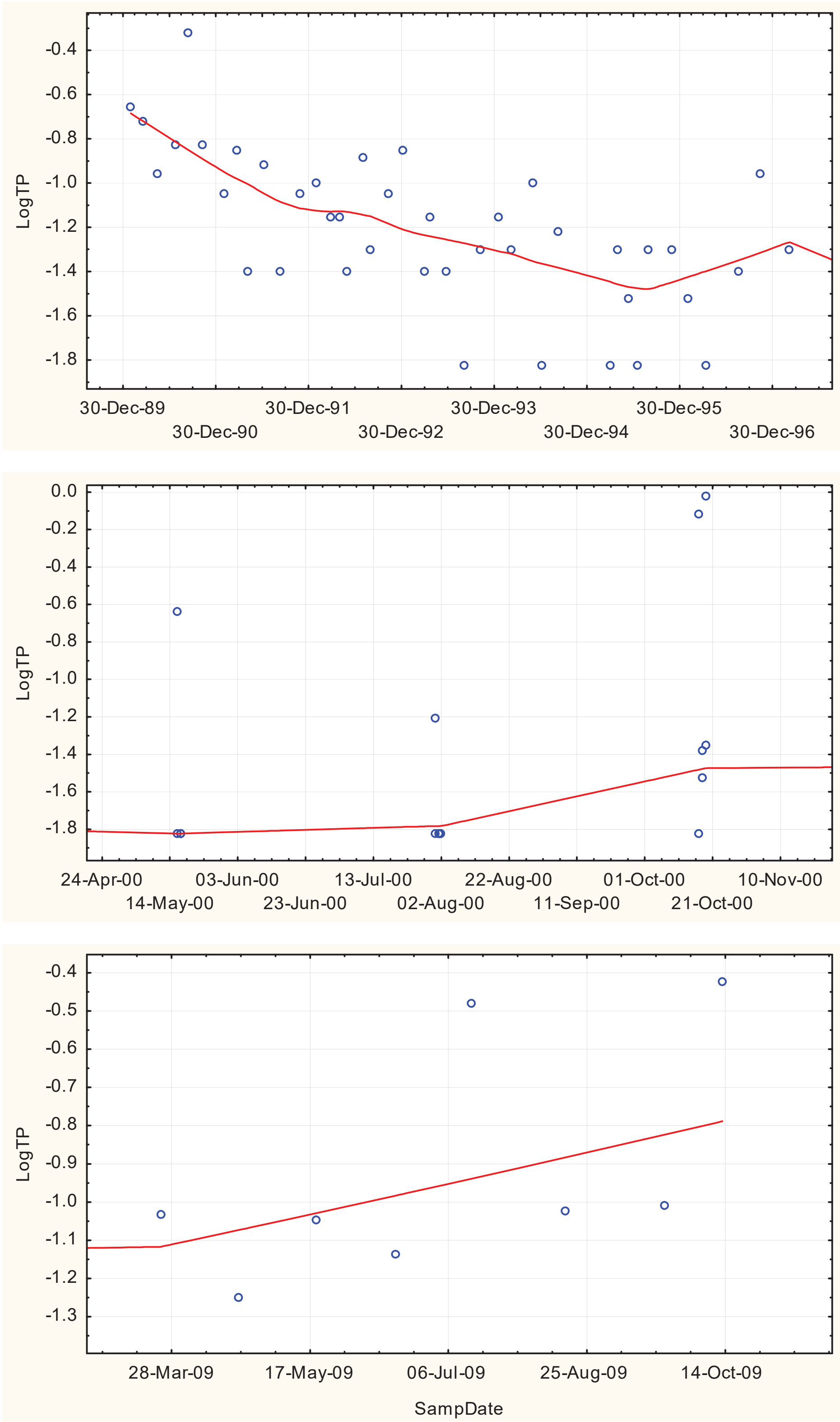

Figure E-8. TP concentrations over time in the Rio Pueblo de Taos (28RPuebT008.1) site.

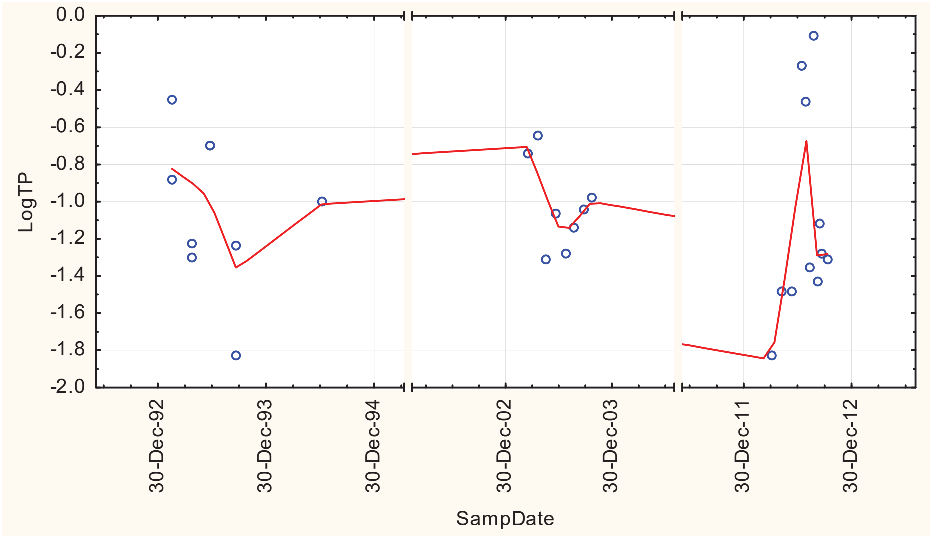

Figure E-9. TP concentrations over time in the Rio Ruidoso (57RRuido019.8) site.

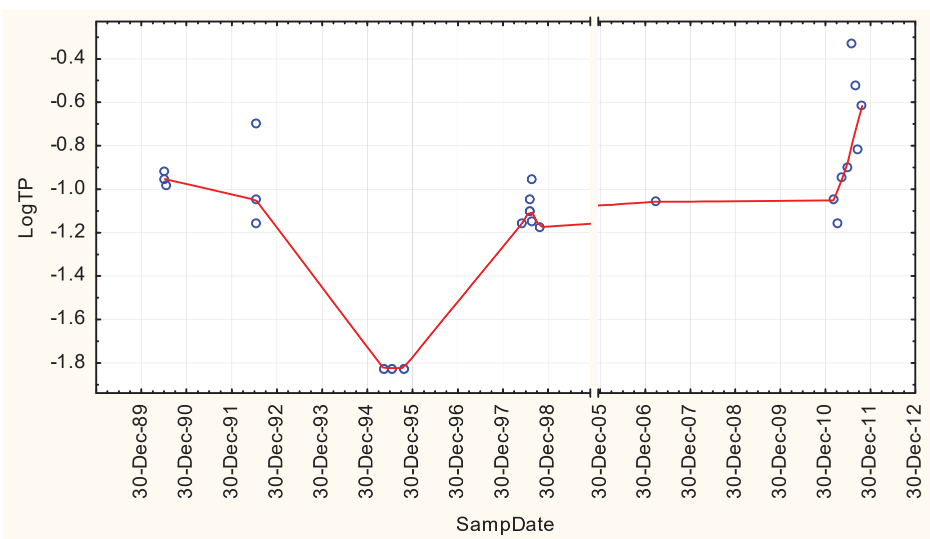

Figure E-10. TP concentrations over time in the Tularosa River (80Tularo001.3) site.

Conclusions on Nutrient Seasonality

The observations of TN and TP over time in site types and individual sites can influence our approaches in ongoing analyses. First, it is apparent that the winter samples are collected less frequently and do not show repeatable patterns. Winter samples may be associated with higher TN values in non-reference sites. This suggests that winter discharges should be monitored because there may be less assimilative capacity in streams in the winter. However, because the existing data set has so few winter samples, they are not representative of winter samples in all sites. Winter samples (December, January, and February) were excluded from general analyses, including site summaries of median values or other statistics. In stressor-response analysis, all of the matching response data are from non-winter months.

There appears to be a summer peak in TN around July and August. In comparison, TN concentrations in spring and fall are lower (and as we said, the winter may be higher, but not in reference sites). There may be a secondary peak in mountain reference sites in April, but this is not seen when non-reference sites are included and not in the other site classes. Therefore, the spring peak is suspicious. The peak in xeric reference sites may occur earlier in the season (June) compared to the foothill and mountain reference sites (August). We suggested possible associations of nutrients with temperature, productivity, and assimilative capacity, but did not analyze these relationships.

We did not conduct a comprehensive study of patterns in individual sites. Instead, we selected a few sites with higher numbers of samples collected over time and in various site classes and reference types. In those examples, the overall patterns exhibited in all sites are only supported in some sites and in some years. We also see some opposite patterns (low TN in the summers of 91 and 92 in the Rio Hondo) and some signs of management (gradual decrease in TP in the Rio Pueblo de Taos from 1989 – 1995). In reference sites, TP patterns were generally stable within years. Several reference sites were not selected as examples because the TP values were almost all non-detects (no patterns there).

The perceived TN and TP peaks in the data were not strong enough to warrant different nutrient expectations during the year. There may be times of the year when nutrient concentrations will be more predictable in relation to a criterion, but the seasonal effects appear to be variable or not supported in examples from individual sites. Therefore, we recommend using a statistical summary value for TN and TP concentrations within each site. This is also practical because the numbers of samples collected within sites varies considerably (1 to 75) and using individual sample values in a multi-site analysis would give undue weight to data-rich sites.

In reviewing these graphics, we can imagine the effects of averaging values within a site. In the examples, the average would probably be a sufficient estimate of overall site nutrient conditions. To reduce possible effects of high outliers, we use the median value within a site. Obviously sites with few samples will be represented by values near or above the mean value.

Seasonal effects on nutrient concentrations should be considered and analyzed in future analyses.

Appendix F Site Reference Designations

Table F-1. Site reference designations and count of samples. The total number of samples collected at each site between 1990 and 2012 (# Samps) were distributed among years (# Years) for TN and TP. Sites are ordered by collection agency and by short name.

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
NMED Sites						
29Abiqui001.8	Abiquiu Creek	Strs	11	2	11	2
29Abiqui002.3	Abiquiu Creek	NearRef	1	1	1	1
32AboArr037.7	Abo Arroyo	Other	3	1	3	1
59AguaCh029.0	Agua Chiquita	Strs	16	2	16	2
40Alamos058.5	Alamosa Creek	NearRef	9	3	9	3
66Animas001.7	Animas River	XStrs	35	6	31	5
66Animas018.0	Animas River	Strs	23	7	23	7
66Animas027.8	Animas River	Strs	22	5	22	5
66Animas043.0	Animas River	Strs	1	1	1	1
66Animas054.6	Animas River	Strs	10	2	10	2
66Animas055.8	Animas River	Strs	8	1	8	1
50AHerma000.1	Arroyo Hermanos	Strs	1	1	1	1
78BearCr027.0	Bear Creek	NearRef	9	2	9	2
BEAR_32891_108233	Bear Creek	Strs	1	1	1	1
50Beaver000.1	Beaver Creek	Ref	3	2	3	2
77Beaver000.1	Beaver Creek	NearRef	3	1	4	1
28BigTes013.2	Big Tesuque Creek	Other	6	1	6	1
28Bitter003.0	Bitter Creek	Other	4	1	4	1
BITTE_36705_105403	Bitter Creek	Other	2	1	2	1
77BlackC000.1	Black Canyon	Ref	1	1	1	1
77BlackC028.3	Black Canyon Creek	Ref	2	1	2	1
77BlackC016.5	Black Cny Creek	Ref	13	2	13	2
60BlackR005.7	Black River	Other	14	4	14	4
60BlackR019.8	Black River	Other	3	2	3	2
60BlackR023.7	Black River	Other	6	3	6	3
60BlackR052.0	Black River	NearRef	13	5	13	5
78BlueCr000.9	Blue Creek	Ref	4	4	4	4
60BlueSp002.0	Blue Spring	Ref	3	2	3	2
36Bluewa003.5	Bluewater Creek	NearRef	13	2	13	2
36Bluewa016.7	Bluewater Creek	Other	4	1	4	1
36Bluewa018.9	Bluewater Creek	Other	23	5	23	5
36Bluewa023.2	Bluewater Creek	NearRef	8	4	8	4
77Bobcat000.8	Bobcat Spring	NearRef	2	2	2	2

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
77Bonner002.4	Bonner Trib To Black Canyon	Other	1	1	1	1
30Bulldo000.1	Bulldog Gulch	Other	2	2	2	2
28Cabres005.4	Cabresto Creek	NearRef	7	3	8	3
31Calave001.1	Calaveras Creek	NearRef	18	2	15	2
27CTGran000.7	Canada Tio Grande	NearRef	4	1	4	1
04Canadi352.7	Canadian River	Other	9	1	9	1
04Canadi402.9	Canadian River	Other	9	2	9	2
06Canadi232.6	Canadian River	Other	10	3	10	3
06Canadi305.0	Canadian River	NearRef	3	3	3	3
06Canadi348.3	Canadian River	Other	3	2	3	2
09Canadi001.2	Canadian River	Other	7	1	7	1
09Canadi062.4	Canadian River	Other	3	2	3	2
09Canadi144.5	Canadian River	Other	8	2	8	2
09Canadi204.1	Canadian River	Other	2	1	2	1
29Canjil006.2	Canjilon Creek	Other	16	3	16	3
29Canjil039.5	Canjilon Creek	Other	2	1	2	1
30CValle003.9	Canon De Valle	Other	1	1	1	1
29Canone001.7	Canones Creek	Other	5	1	5	1
29Canone004.6	Canones Creek	Other	11	2	11	2
29Canone002.4	Cañones Creek	Other	6	2	4	2
57Carriz001.4	Carrizo Creek	XStrs	1	1	1	1
02Carriz002.7	Carrizozo Creek	NearRef	8	1	7	1
28Casias000.6	Casias Creek	Ref	8	1	8	1
29Cecili000.1	Cecilia Canyon Creek	Other	13	3	13	3
80Center000.1	Centerfire Creek	Other	3	1	3	1
80Center002.1	Centerfire Creek	Other	8	1	6	1
29RChama147.1	Chama River	Strs	2	1	2	1
29RChama161.1	Chama River	Other	3	1	3	1
28Chamis003.0	Chamisal Creek	XStrs	3	1	3	1
04Chicor010.9	Chicorica Creek	Other	9	2	9	2
04Chicor034.4	Chicorica Creek	Other	9	2	9	2
29Chihua000.1	Chihuahuenos Creek	Other	9	1	9	1
05Cieneg006.3	Cieneguilla Creek	Strs	18	4	18	4
05Cieneg016.5	Cieneguilla Creek	XStrs	5	1	5	1
05Cieneg019.3	Cieneguilla Creek	Strs	18	4	18	4
05Cieneg021.9	Cieneguilla Creek	XStrs	9	2	9	2
05Cimarr013.4	Cimarron River	Other	12	2	12	2
05Cimarr041.2	Cimarron River	Other	1	1	1	1
05Cimarr050.8	Cimarron River	Other	22	8	21	8
05Cimarr077.2	Cimarron River	Strs	18	4	17	4
29ClearC000.1	Clear Creek	Other	17	3	17	3

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
31ClearC002.3	Clear Creek	Other	16	2	16	2
31ClearC009.2	Clear Creek	Ref	2	1	2	1
28Columb000.1	Columbine Creek	Ref	3	1	3	1
28Comanc007.7	Comanche	Other	21	6	21	6
28Comanc000.1	Comanche Creek	Other	13	2	13	2
08Concha025.1	Conchas River	Other	3	1	3	1
28Cordov001.5	Cordova Creek	Other	13	3	13	3
28Cordov006.2	Cordova Creek	NearRef	12	2	12	2
16Corrum051.1	Corrumpa Creek	NearRef	1	1	1	1
28RCosti032.2	Costilla Creek	NearRef	8	1	8	1
28RCosti032.5	Costilla Creek	NearRef	13	2	13	2
50CowCre011.5	Cow Creek	Other	7	1	7	1
50CowCre023.7	Cow Creek	Other	9	2	9	2
50CowCre023.8	Cow Creek	Other	15	2	15	2
07Coyote001.7	Coyote Creek	Other	9	2	9	2
29Coyote005.6	Coyote Creek	Other	12	3	12	3
77CubCre005.6	Cub Creek	Ref	1	1	1	1
50Dalton000.1	Dalton Canyon Creek	NearRef	4	1	4	1
62Delawa006.0	Delaware River	Other	6	3	6	3
48DogCan002.7	Dog Canyon	Ref	13	3	13	3
04Dogget002.3	Doggett Creek	XStrs	5	4	4	3
DOUBL_31639_108754	Double Adobe Creek	NearRef	1	1	1	1
02DryCim122.7	Dry Cimarron	NearRef	7	1	7	1
02DryCim003.2	Dry Cimarron River	NearRef	18	3	18	3
02DryCim047.2	Dry Cimarron River	NearRef	12	3	12	3
02DryCim074.5	Dry Cimarron River	NearRef	15	2	15	2
02DryCim108.2	Dry Cimarron River	NearRef	20	5	20	5
77EFkGil000.2	East Fork Gila River	Ref	21	4	21	4
77EFkGil010.0	East Fork Gila River	Ref	1	1	1	1
77EFkGil012.1	East Fork Gila River	Other	2	1	2	1
77EFkGil035.4	East Fork Gila River	Other	10	2	10	2
31EFkJem000.1	East Fork Jemez	Other	16	2	16	2
31EFkJem020.7	East Fork Jemez	Other	17	2	17	2
31EFkJem026.1	East Fork Jemez	NearRef	3	2	3	2
31EFkJem015.2	East Fork Jemez River	NearRef	8	1	8	1
50ElPorv000.1	El Porvenir Creek	Ref	55	10	55	10
50ElPorv004.8	El Porvenir Creek	Ref	23	5	22	5
50ElPorv012.6	El Porvenir Creek	Ref	2	1	2	1
29ElRito035.9	El Rito	Other	1	1	1	1
29ElRito050.2	El Rito	Ref	1	1	1	1
50ElRito000.2	El Rito Creek	XStrs	15	4	15	4

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
50ElRito000.3	El Rito Creek	XStrs	10	3	10	3
28Embudo000.8	Embudo Creek	Strs	23	4	23	4
28Embudo010.1	Embudo Creek	Other	10	2	9	2
28Embudo020.5	Embudo Creek	Other	7	2	7	2
48FresCa001.0	Fresnal Creek	Other	1	1	1	1
48FresCa008.3	Fresnal Creek	Other	5	1	5	1
30Galist030.9	Galisteo Creek	Other	3	1	3	1
30Galist050.4	Galisteo Creek	Other	8	1	8	1
64Galleg000.4	Gallegos Canyon	Strs	1	1	1	1
45Gallin021.5	Gallinas Creek	Other	10	2	10	2
50Gallin075.0	Gallinas River	Strs	37	8	37	8
50Gallin101.8	Gallinas River	Strs	20	6	26	6
50Gallin102.1	Gallinas River	Other	27	6	28	7
50Gallin104.9	Gallinas River	Strs	1	1	1	1
50Gallin114.6	Gallinas River	Other	11	2	11	2
50Gallin119.7	Gallinas River	Other	56	10	56	10
50Gallin131.8	Gallinas River	NearRef	44	9	44	9
50Gallin140.8	Gallinas River	Ref	13	3	13	3
50Gallin141.9	Gallinas River	Ref	30	7	30	7
UPR211.001529	Gallinas River	Other	2	2	2	2
77Gilari088.0	Gila River	Ref	5	3	5	3
77GilaRi092.0	Gila River	Ref	1	1	1	1
78GilaR087.7	Gila River	NearRef	11	2	11	2
78GilaRi026.1	Gila River	Other	14	5	13	5
78GilaRi052.6	Gila River	Other	1	1	1	1
78GilaRi069.2	Gila River	Other	10	2	10	2
78GilaRi074.8	Gila River	NearRef	2	1	2	1
GILA_33179_108206	Gila River	NearRef	3	1	3	1
GILA_33222_108244	Gila River	NearRef	10	2	9	2
77Gilita000.2	Gilita Creek	Ref	4	1	4	1
50Glorie001.8	Glorieta Creek	Strs	16	5	16	5
50Glorie012.6	Glorieta Creek	Strs	8	4	8	4
50Glorie013.5	Glorieta Creek	Strs	3	1	3	1
GLORI_35565_105738	Glorieta Creek	Strs	1	1	1	1
GLORI_35568_105722	Glorieta Creek	Strs	6	3	6	3
GLORI_35571_105755	Glorieta Creek	Strs	1	1	1	1
50Holing000.1	Hollinger Creek	Ref	3	2	3	2
50HolyGh000.1	Holy Ghost Creek	Other	21	5	21	5
77IronCr000.1	Iron Creek	Ref	12	3	12	3
77IronCr009.7	Iron Creek	Ref	12	4	12	4
31Jarami008.0	Jaramillo	Other	17	2	17	2

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
31JemezR046.6	Jemez River	Strs	8	1	8	1
31JemezR048.7	Jemez River	Strs	8	1	8	1
31JemezR049.2	Jemez River	Strs	9	2	9	2
31JemezR058.6	Jemez River	Other	8	1	8	1
31JemezR064.9	Jemez River	Other	17	1	17	1
JEMEZ_35392_106537	Jemez River	XStrs	6	1	6	1
MRG105.009035	Jemez River	Strs	9	1	9	1
48KarrCa002.9	Karr Canyon	Other	12	2	12	2
33LaJara009.7	La Jara Creek	Ref	14	2	14	2
48LaLuzC014.2	La Luz Creek	Other	2	1	2	1
67LaPlat000.3	La Plata River	Other	14	3	15	3
67LaPlat024.8	La Plata River	Other	14	2	14	2
67LaPlat033.8	La Plata River	Other	16	2	16	2
41LAnima029.3	Las Animas Creek	Ref	9	6	9	6
41LAnima038.3	Las Animas Creek	Ref	1	1	1	1
30LHuert010.0	Las Huertas Creek	Other	8	1	8	1
30LHuert019.0	Las Huertas Creek	Other	5	1	5	1
LITTL_36301_105239	Little Coyote Creek	Ref	6	1	6	1
LITTL_36302_105239	Little Coyote Creek	Ref	6	1	6	1
29LitTus003.4	Little Tusas	Other	1	1	1	1
02LongCa004.1	Long Canyon	Other	15	2	15	2
LONG_36937_10358	Long Canyon Creek	Other	3	1	3	1
LOSP_3699_107601	Los Pinos River	Other	7	2	5	2
30SantaF030.5	Lower Santa Fe River	XStrs	7	3	7	3
07Maesta000.4	Maestas Creek	NearRef	2	1	1	1
77Diamon033.2	Main Diamond Creek	Ref	5	2	5	2
78Mangas000.7	Mangas Creek	Other	12	3	12	3
07Manuel020.9	Manuelitas Creek	NearRef	9	2	9	2
45McKnig011.9	Mcknight Canyon Creek	Ref	13	2	13	2
77MFkGil000.1	Middle Fork Gila River	Ref	20	4	20	4
77MFkGil028.3	Middle Fork Gila River	Ref	1	1	1	1
05MPonil000.1	Middle Ponil Creek	NearRef	13	2	13	2
05MPonil016.2	Middle Ponil Creek	Other	4	1	4	1
45Mimbre127.4	Mimbes River	Ref	16	3	16	3
45Mimbre062.7	Mimbres	Other	16	3	16	3
45Mimbre094.6	Mimbres River	Other	20	4	20	4
45Mimbre104.8	Mimbres River	Other	16	3	16	3
45Mimbre112.2	Mimbres River	Ref	16	3	15	3
45Mimbre127.8	Mimbres River	Ref	3	2	3	2
07MoraRi000.8	Mora River	Other	1	1	1	1
07MoraRi139.9	Mora River	Other	11	2	11	2

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
07MoraRi146.6	Mora River	Other	11	2	11	2
07MoraRi147.1	Mora River	Other	10	2	10	2
07MoraRi147.2	Mora River	Other	4	2	4	2
07MoraRi170.9	Mora River	Other	11	2	11	2
05Moreno003.7	Moreno Creek	Other	19	4	19	4
80MuleCr015.5	Mule Creek	Other	16	3	9	2
28NFkTes000.6	N.Fork Of Tesuque Creek	Other	22	4	23	4
29NaborC000.1	Nabor Creek	Other	5	2	4	2
33Nacimi003.4	Nacimiento Creek	Other	4	2	4	2
33Nacimi008.0	Nacimiento Creek	Strs	12	2	12	2
64Navajo022.1	Navajo River	Other	12	2	12	2
64Navajo023.3	Navajo River	Other	6	1	6	1
NAVAJ_36949_107072	Navajo River	Other	6	1	6	1
NAVAJ_36967_107041	Navajo River	Strs	6	1	6	1
80Negrit000.1	Negrito Creek	Ref	6	2	6	2
32RGrand305.0	Nmw-05549-08	Other	1	1	1	1
32RGrand346.1	Nmw-05549-12	Other	1	1	1	1
32RGrand385.1	Nmw-05549-25	Strs	1	1	1	1
32RGrand326.4	Nmw05549-28	Other	1	1	1	1
32RGrand392.1	Nmw05549-29	XStrs	1	1	1	1
48NogalC000.2	Nogal Creek	NearRef	3	1	3	1
05NPonil000.1	North Ponil Creek	Ref	13	3	12	3
05NPonil023.2	North Ponil Creek	Ref	3	1	3	1
05NPonil027.5	North Ponil Creek	Ref	4	1	4	1
57NSprin000.6	North Spring River	XStrs	1	1	1	1
57NSprin002.0	North Spring River	XStrs	1	1	1	1
57NSprin004.8	North Spring River	XStrs	2	2	2	2
02OakCre000.1	Oak Creek	Ref	15	2	15	2
06OcateC025.1	Ocate Creek	NearRef	3	1	2	1
30Pajari012.6	Pajarito Canyon	Other	2	2	3	3
30Pajari015.2	Pajarito Canyon	Other	1	1	1	1
30Pajari016.1	Pajarito Canyon	Other	2	2	2	2
09Pajari001.0	Pajarito Creek	Other	1	1	2	2
09Pajari020.0	Pajarito Creek	Other	9	2	9	2
30Pajari018.5	Pajarito Creek	Ref	1	1	1	1
50PecosR512.6	Pecos River	Other	35	9	35	9
50PecosR529.1	Pecos River	XStrs	8	1	8	1
50PecosR529.2	Pecos River	NearRef	10	3	10	3
50PecosR540.8	Pecos River	Other	6	1	6	1
50PecosR601.2	Pecos River	Other	5	2	5	2
50PecosR670.2	Pecos River	Other	9	1	9	1

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
50PecosR670.3	Pecos River	NearRef	6	4	6	4
50PecosR678.5	Pecos River	NearRef	1	1	1	1
50PecosR696.0	Pecos River	Other	18	2	10	2
50PecosR700.3	Pecos River	Other	4	1	4	1
50PecosR722.0	Pecos River	Other	30	3	19	3
50PecosR765.3	Pecos River	Other	8	1	8	1
50PecosR772.0	Pecos River	Other	7	1	7	1
50PecosR783.7	Pecos River	Other	6	1	6	1
50PecosR784.1	Pecos River	Other	8	1	8	1
50PecosR795.2	Pecos River	Other	35	5	26	5
50PecosR797.7	Pecos River	Ref	18	2	9	2
52PecosR305.0	Pecos River	Other	1	1	1	1
52PecosR430.0	Pecos River	Other	1	1	1	1
52PecosR447.7	Pecos River	Other	8	1	8	1
56PecosR169.0	Pecos River	Other	9	2	9	2
56PecosR301.0	Pecos River	Other	7	2	7	2
60PecosR033.2	Pecos River	Other	7	1	7	1
60PecosR050.2	Pecos River	Other	9	2	9	2
60PecosR088.4	Pecos River	Other	8	1	8	1
41Percha025.3	Percha Creek	Other	9	3	9	3
64PiedrAbvrNav	Piedras River	Other	1	1	1	1
28Pionee000.7	Pioneer Creek	Other	8	3	8	3
28Pojoaq005.0	Pojoaque River	Other	5	1	5	1
29PoleoC009.5	Poleo Creek	Ref	14	3	14	3
29Polvad008.8	Polvadera Creek	NearRef	15	4	15	4
05PonilC000.1	Ponil Creek	Other	9	2	8	2
05PonilC002.2	Ponil Creek	NearRef	6	2	5	2
05PonilC014.9	Ponil Creek	NearRef	9	2	9	2
05PonilC023.8	Ponil Creek	NearRef	4	1	4	1
04RatonC007.8	Raton Creek	Strs	8	2	8	2
04RatonC010.9	Raton Creek	XStrs	5	4	4	3
04RatonC013.8	Raton Creek	XStrs	1	1	1	1
05Rayado001.8	Rayado Creek	Other	9	1	9	1
05Rayado033.8	Rayado Creek	Ref	12	4	10	4
28RedRiv005.3	Red River	Strs	8	1	8	1
28RedRiv005.9	Red River	Other	8	1	8	1
28RedRiv014.0	Red River	Other	17	2	17	2
28RedRiv024.4	Red River	Other	17	2	16	2
28RedRiv027.8	Red River	Other	9	1	9	1
28RedRiv031.1	Red River	Other	9	1	9	1
28RedRiv035.5	Red River	NearRef	17	2	17	2

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
31Redond001.2	Redondo Creek	Other	19	4	19	4
MRG106.010015	Redondo Creek	Other	7	1	7	1
57RBonit027.7	Rio Bonito	NearRef	12	3	12	3
57RBonit053.4	Rio Bonito	Other	6	2	6	2
57RBonit059.9	Rio Bonito	Other	2	1	2	1
57RBonit061.1	Rio Bonito	Ref	10	2	10	2
29RBrazo001.6	Rio Brazos	Other	14	2	11	2
29RBrazo010.1	Rio Brazos	Ref	9	3	7	3
31RCebol000.1	Rio Cebolla	Other	9	1	9	1
31RCebol011.4	Rio Cebolla	Other	9	1	9	1
31RCebol017.9	Rio Cebolla	Ref	8	1	8	1
29RChama079.5	Rio Chama	Other	17	5	17	5
29RChama082.8	Rio Chama	Other	1	1	1	1
29RChama143.8	Rio Chama	Other	5	4	5	4
29RChama174.0	Rio Chama	Strs	15	2	14	2
29RChama183.4	Rio Chama	Ref	20	3	18	3
29RChami002.7	Rio Chamita	Strs	11	3	11	3
29RChami002.8	Rio Chamita	Other	12	4	10	4
URG116.020005	Rio Chamita	Strs	10	3	10	3
URG116.020055	Rio Chamita	Other	4	1	4	1
28RChiqB000.1	Rio Chiquito	Other	3	1	3	1
28RChupa014.3	Rio Chupadero	Other	13	5	13	5
28RChupa015.2	Rio Chupadero	Other	8	1	8	1
RIOC_35779_105711	Rio Chupadero	Ref	4	1	4	1
28RCosti052.2	Rio Costilla	NearRef	13	5	13	5
07RioLaC006.2	Rio De La Casa	Ref	8	1	8	1
31RVacas000.1	Rio De Las Vacas	Other	16	2	16	2
31RVacas011.1	Rio De Las Vacas	Other	7	1	7	1
31RVacas023.7	Rio De Las Vacas	Ref	15	2	15	2
31RVacas026.5	Rio De Las Vacas	Ref	4	1	4	1
27RPinos002.6	Rio De Los Pinos	Ref	18	3	18	3
27RPinos007.3	Rio De Los Pinos	Ref	5	5	5	5
27RPinos011.3	Rio De Los Pinos	Ref	8	1	8	1
29RMedio002.7	Rio Del Medio	Other	1	1	1	1
29RioOso001.9	Rio Del Oso	Other	8	1	8	1
29RioOso004.7	Rio Del Oso	Other	4	3	4	3
28RMedio007.2	Rio En Medio	NearRef	17	5	17	5
28RMedio013.3	Rio En Medio	XStrs	10	5	10	5
28RMedio016.9	Rio En Medio	Other	35	5	35	5
28RMedio017.5	Rio En Medio	Ref	17	5	17	5
58RFelix002.1	Rio Felix	Other	1	1	1	1

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
28RFerna000.3	Rio Fernando De Taos	Strs	4	1	4	1
28RFerna031.7	Rio Fernando De Taos	Other	21	5	21	5
29RGalli000.5	Rio Gallina	Other	3	2	3	2
29RGalli005.5	Rio Gallina	Other	1	1	1	1
29RGalli045.1	Rio Gallina	Ref	25	7	25	7
28RGrand547.2	Rio Grande	Other	1	1	1	1
28RGrand550.8	Rio Grande	XStrs	1	1	1	1
28RGrand650.8	Rio Grande	Other	7	1	7	1
28RGrand725.5	Rio Grande	Other	1	1	1	1
30RGrand541.7	Rio Grande	Other	2	1	2	1
32RGrand258.0	Rio Grande	Other	19	4	19	4
32RGrand286.9	Rio Grande	Other	6	2	6	2
32RGrand407.8	Rio Grande	Strs	9	2	9	2
32RGrand435.2	Rio Grande	XStrs	1	1	1	1
32RGrand445.4	Rio Grande	XStrs	17	4	17	4
42RGrand001.1	Rio Grande	Other	8	1	8	1
42RGrand004.1	Rio Grande	Strs	2	2	2	2
42RGrand038.7	Rio Grande	Other	9	2	9	2
42RGrand044.2	Rio Grande	Other	9	2	9	2
42RGrand115.0	Rio Grande	Other	10	3	10	3
42RGrand160.3	Rio Grande	Other	8	1	8	1
42RGrand171.9	Rio Grande	Other	5	2	5	2
28RGRanc000.2	Rio Grande Del Rancho	Other	16	2	16	2
28RGRanc013.1	Rio Grande Del Rancho	Ref	17	6	17	6
31RGuada000.1	Rio Guadalupe	Strs	9	2	9	2
MRG106.007501	Rio Guadalupe	Strs	7	1	7	1
28RHondo000.1	Rio Hondo	Other	25	3	24	3
28RHondo003.9	Rio Hondo	Other	9	1	9	1
28RHondo012.1	Rio Hondo	Other	18	2	18	2
28RHondo014.8	Rio Hondo	Other	65	10	65	10
28RHondo022.4	Rio Hondo	Other	25	3	25	3
28RHondo026.7	Rio Hondo	XStrs	8	1	8	1
28RHondo026.9	Rio Hondo	XStrs	36	7	36	7
28RHondo027.3	Rio Hondo	Other	36	4	36	4
57RHondo004.3	Rio Hondo	Other	8	1	8	1
57RHondo009.4	Rio Hondo	Other	1	1	1	1
57RHondo131.1	Rio Hondo	Other	28	4	28	4
28RLucer013.0	Rio Lucero	Ref	4	1	4	1
50RioMor000.3	Rio Mora	Ref	38	9	38	9
28RNambe005.1	Rio Nambe	Ref	6	2	6	2
75RNutri024.7	Rio Nutria	Other	4	1	4	1

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
29RNutri005.4	Rio Nutrias	Other	5	1	5	1
29RNutri028.4	Rio Nutrias	Other	5	2	5	2
29ROjoCa005.1	Rio Ojo	Other	8	1	8	1
59RPenas108.4	Rio Penasco	NearRef	16	3	16	3
59RPenas140.2	Rio Penasco	Other	12	2	12	2
59RPenas170.4	Rio Penasco	Other	7	3	7	3
59RPenas176.0	Rio Peñasco	NearRef	9	1	9	1
75RPesca012.8	Rio Pescado	Other	7	1	7	1
28Pueblo013.4	Rio Pueblo	Ref	4	1	4	1
28RPuebl000.3	Rio Pueblo	Other	18	4	17	4
28RPuebl019.0	Rio Pueblo	Ref	21	6	21	6
28RPuebT000.1	Rio Pueblo De Taos	Other	16	3	16	3
28RPuebT008.1	Rio Pueblo De Taos	Other	59	10	59	10
28RPuebT008.3	Rio Pueblo De Taos	Other	4	3	4	3
28RPuebT013.2	Rio Pueblo De Taos	Other	17	3	17	3
33RPuerc241.8	Rio Puerco	Other	14	3	14	3
33RPuerc244.0	Rio Puerco	Other	8	2	8	2
33RPuerc248.7	Rio Puerco	Other	14	3	14	3
33RPuerc256.0	Rio Puerco	NearRef	10	2	10	2
29RPuerc011.0	Rio Puerco De Chama	Other	17	3	17	3
29RPuerc037.5	Rio Puerco De Chama	Ref	15	4	15	4
28RQuema003.1	Rio Quemado	Other	7	2	7	2
57RRuido019.8	Rio Ruidoso	Strs	26	4	26	4
57RRuido030.2	Rio Ruidoso	Strs	12	3	12	3
57RRuido030.5	Rio Ruidoso	Strs	2	1	2	1
57RRuido031.5	Rio Ruidoso	Strs	32	6	31	6
57RRuido045.3	Rio Ruidoso	Other	11	1	11	1
57RRuido052.4	Rio Ruidoso	NearRef	19	5	19	5
38RSalad030.0	Rio Salado	Ref	3	2	3	2
27RSanAn000.4	Rio San Antonio	NearRef	9	2	9	2
27RSanAn025.3	Rio San Antonio	NearRef	9	2	9	2
28RSanBa000.1	Rio Santa Barbara	Other	14	2	14	2
28RSanBa002.0	Rio Santa Barbara	Other	4	2	4	2
28RSanBa013.2	Rio Santa Barbara	Ref	12	2	12	2
28RSanBa017.9	Rio Santa Barbara	Ref	12	5	12	5
RIOS_36103_105621	Rio Santa Barbara	Ref	3	1	2	1
48RTular030.0	Rio Tularosa	Other	34	8	34	8
29RTusas000.1	Rio Tusas	Other	30	4	30	4
29RTusas028.5	Rio Tusas	NearRef	1	1	1	1
29RValle037.8	Rio Vallecito	Other	4	3	4	3
29RValle007.9	Rio Vallecitos	Other	11	2	11	2

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
07RitoCe004.6	Rito Cebolla	Other	3	1	3	1
28RiOlla000.8	Rito De La Olla	Ref	8	1	8	1
31RPalom000.1	Rito De Las Palomas	Other	9	1	9	1
30RFrijo000.7	Rito De Los Frijoles	Other	1	1	1	1
31RIndio000.2	Rito De Los Indios	NearRef	17	2	17	2
29REncin009.7	Rito Encino	Other	12	3	12	3
36RMoqui006.4	Rito Moquino	Other	7	2	7	2
31RPNegr000.1	Rito Penas Negras	Other	8	1	8	1
29RResum001.9	Rito Resumidero	Ref	6	1	6	1
29RResum002.5	Rito Resumidero	Other	21	3	13	3
07RSanJo000.5	Rito San Jose	Strs	5	1	5	1
29RTierr026.1	Rito Tierra Amarilla	NearRef	2	2	5	2
RIVER_36951_106145	River Los Pinos	Ref	2	1	2	1
49Sacram014.6	Sacramento River	NearRef	3	1	2	1
31SanAnt000.1	San Antonio Creek	Other	9	1	9	1
31SanAnt004.7	San Antonio Creek	Other	8	1	8	1
31SanAnt008.4	San Antonio Creek	Ref	16	2	16	2
31SanAnt025.7	San Antonio Creek	NearRef	17	2	17	2
30SanCri000.5	San Cristobal Creek	Other	5	1	5	1
80SanFra028.6	San Francisco River	NearRef	21	5	21	5
80SanFra048.8	San Francisco River	NearRef	13	3	13	3
80SanFra105.7	San Francisco River	Strs	10	2	10	2
80SanFra109.6	San Francisco River	Other	6	1	6	1
80SanFra109.7	San Francisco River	Other	5	1	5	1
80SanFra124.2	San Francisco River	NearRef	6	1	4	1
80SanFra154.1	San Francisco River	Other	20	4	20	4
64SanJua113.5	San Juan River	XStrs	8	1	8	1
64SanJua126.2	San Juan River	Other	17	3	17	3
64SanJua144.8	San Juan River	Other	18	3	18	3
64SanJua162.8	San Juan River	Other	4	2	4	2
66SanJua100.2	San Juan River	Other	13	4	13	4
67SanJua082.6	San Juan River	Strs	17	2	17	2
67SanJua088.1	San Juan River	Other	9	2	9	2
30SanPed011.1	San Pedro Creek	Other	4	2	4	2
45SanVic053.9	San Vicente Arroyo	XStrs	15	2	15	2
45SanVic055.5	San Vicente Arroyo	XStrs	7	1	7	1
30Sandia009.0	Sandia Canyon	XStrs	1	1	1	1
28SanCru004.2	Santa Cruz River	Other	9	3	9	3
28SanCru012.1	Santa Cruz River	Other	1	1	1	1
30SantaF012.9	Santa Fe River	XStrs	53	8	51	7
30SantaF015.3	Santa Fe River	XStrs	8	1	7	1

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
30SantaF028.4	Santa Fe River	XStrs	7	2	7	2
30SantaF057.4	Santa Fe River	Ref	38	6	0	0
30SantaF061.2	Santa Fe River	Ref	41	7	41	7
SANTA_35582_10628	Santa Fe River	XStrs	7	1	7	1
URG110.002050	Santa Fe River	XStrs	0	0	1	1
07Sapell044.4	Sapello River	Other	9	1	9	1
07Sapell069.8	Sapello River	Ref	12	2	12	2
77Sapill018.0	Sapillo Creek	Other	4	1	4	1
16Seneca043.0	Seneca Creek	Ref	4	3	4	3
33Senori008.8	Senorito Creek	Strs	13	2	13	2
60Sittin000.1	Sitting Bull Creek	Other	5	3	5	3
60Sittin000.3	Sitting Bull Creek	Other	2	2	2	2
60Sittin001.6	Sitting Bull Creek	Other	1	1	1	1
05Sixmil001.4	Sixmile Creek	Other	22	4	17	4
41SPalom000.1	South Fork Palomas Creek	NearRef	3	1	3	1
80SNegri000.1	South Negrito Creek	NearRef	11	2	11	2
31Sulphu000.2	Sulphur Creek	Other	1	1	7	1
75Tampic000.1	Tampico Draw	Strs	4	1	4	1
77Taylor000.1	Taylor Creek	NearRef	4	1	4	1
77Taylor004.2	Taylor Creek	Other	10	2	10	2
50Tecolo042.3	Tecolote Creek	Other	15	2	15	2
28Tesuqu023.4	Tesuque Creek	Ref	12	2	12	2
TESUQ_35769_105725	Tesuque Creek	Ref	4	1	4	1
48ThreeR022.8	Three Rivers	Ref	13	2	13	2
32Tijera021.0	Tijeras Arroyo	XStrs	6	1	13	4
32Tijera027.2	Tijeras Arroyo	Strs	5	1	5	1
80TroutC002.1	Trout Creek	Other	1	1	5	2
80TroutC009.4	Trout Creek	Other	7	1	7	1
80Tularo001.3	Tularosa River	NearRef	28	6	28	6
80Tularo035.8	Tularosa River	Other	7	1	7	1
80Tularo050.8	Tularosa River	NearRef	4	2	4	2
77Turkey001.8	Turkey Creek	Ref	5	3	5	3
04UnaGat020.9	Una De Gato Creek	XStrs	9	2	9	2
04UnaGat000.1	Una De Gato Creek	Other	8	2	8	2
05MPonil027.2	Upper Middle Ponil Creek	Ref	4	1	4	1
05UteCre000.6	Ute Creek	Other	14	2	11	2
10UteCre104.3	Ute Creek	NearRef	9	3	9	3
10UteCre150.7	Ute Creek	NearRef	1	1	1	1
31RValle015.5	Vallecito Creek	Other	9	1	9	1
31RValle012.2	Vallecitos	Other	9	1	9	1
04Vermej080.2	Vermejo River	Other	8	1	8	1

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
77WFkGil000.1	West Fork Gila River	NearRef	6	1	6	1
77WFkGil010.0	West Fork Gila River	Ref	12	5	12	5
77WFkGil038.1	West Fork Gila River	Ref	1	1	1	1
WHITE_35759_10567	White Flow	Other	11	3	11	3
80Whitew000.5	Whitewater Creek	Other	22	4	23	4
80WhiteW008.8	Whitewater Creek	Ref	16	4	16	4
29Willow000.1	Willow Creek	Other	1	1	1	1
77Willow000.1	Willow Creek	Other	9	2	9	2
50Winsor000.2	Winsor Creek	NearRef	8	2	8	2
07WolfCr000.6	Wolf Creek	Other	4	1	4	1
WRIGH_35703_105485	Wright Canyon	Other	7	1	7	1
04YorkCa000.1	York Canyon Creek	Other	8	1	8	1
75ZuniRi040.5	Zuni River	Other	1	1	1	1
NRSA Sites						
FW08KS033	Arkansas River	Other	1	1	1	1
FW08CO136	Bear Creek	Other	1	1	1	1
FW08OK031	Beaver River	Other	1	1	1	1
FW08AZ171	Blue River	NearRef	1	1	1	1
FW08RAZ9022	Bonita Creek	Ref	1	1	1	1
FW08RNM9081	Canadian River	Other	1	1	1	1
FW08RNM9082	Canadian River	Other	1	1	1	1
FW08TX012	Canadian River	Strs	1	1	1	1
FW08TX033	Canadian River	XStrs	1	1	1	1
FW08TX065	Canadian River	Strs	1	1	1	1
FW08AZ006	Centerfire Creek	Other	1	1	1	1
FW08NM048	Cimarron River	Other	1	1	1	1
FW08UT023	Colorado River	Ref	1	1	1	1
FW08NM013	Conchas River	Other	1	1	1	1
FW08CO125	Cucharas River	XStrs	1	1	1	1
FW08RNM9049	Dog Canyon	Ref	1	1	1	1
FW08AZ022	Eagle Creek	Ref	1	1	1	1
FW08AZ155	Eagle Creek	Ref	1	1	1	1
FW08NM019	East Fork Gila River	NearRef	1	1	1	1
FW08CO087	East Past Creek	Other	1	1	1	1
FW08RNM9030	Embudo Creek	Other	1	1	1	1
FW08RUT9100	Fish Creek	Ref	1	1	1	1
FW08NM025	Gallinas River	Other	1	1	1	1
FW08RNM9006	Gila	Ref	1	1	1	1
FW08AZ008	Gila River	Other	1	1	1	1
FW08AZ107	Gila River	Other	1	1	1	1
FW08AZ134	Gila River	Other	1	1	1	1

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
FW08NM043	Gila River	Strs	1	1	1	1
FW08CO029	Goose Creek	Other	1	1	1	1
FW08CO001	Hartman Draw	Strs	1	1	1	1
FW08RUT95790	Indian Creek	Other	1	1	1	1
FW08CO129	Middle Creek	Other	1	1	1	1
FW08NM005	Mora River	Other	1	1	1	1
FW08RUT95820	North Cottonwood Creek	Other	1	1	1	1
FW08AZ005	North Fork East Fork Black River	Other	1	1	1	1
FW08NM023	Pecos River	Other	1	1	1	1
FW08NM039	Pecos River	Other	1	1	1	1
FW08NM042	Pecos River	Other	1	1	1	1
FW08NM105	Pecos River	Other	1	1	1	1
FW08RNM9075	Pecos River	Other	1	1	1	1
FW08RNM9076	Pecos River	Other	1	1	1	1
FW08TX046	Pecos River	Other	1	1	1	1
FW08NM010	Penasco River	Other	1	1	1	1
FW08CO028	Purgatoire River	Other	1	1	1	1
FW08CO060	Purgatoire River	Other	1	1	1	1
FW08CO072	Purgatoire River	Other	1	1	1	1
FW08NM045	Rio Chama	Other	1	1	1	1
FW08RNM9067	Rio Chama	Other	1	1	1	1
FW08NM012	Rio De Las Trampas	Other	1	1	1	1
FW08CO033	Rio Grande	Other	1	1	1	1
FW08CO049	Rio Grande	Other	1	1	1	1
FW08NM008	Rio Grande	Strs	1	1	1	1
FW08NM024	Rio Grande	Other	1	1	1	1
FW08NM026	Rio Grande	Other	1	1	1	1
FW08NM034	Rio Grande	Strs	1	1	1	1
FW08NM047	Rio Grande	Other	1	1	1	1
FW08RNM9060	Rio Grande	XStrs	1	1	1	1
FW08RNM9061	Rio Grande	Other	1	1	1	1
FW08NM027	Rio Hondo	Other	1	1	1	1
FW08NM002	Rio Nutrias	Other	1	1	1	1
FW08CO073	Rio San Antonio	Other	1	1	1	1
FW08NM003	Saladon Creek	Ref	1	1	1	1
FW08NM001	San Antonio Creek	NearRef	1	1	1	1
FW08AZ075	San Francisco River	Other	1	1	1	1
FW08AZ139	San Francisco River	Other	1	1	1	1
FW08NM031	San Francisco River	Other	1	1	1	1
FW08NM022	San Juan River	Other	1	1	1	1

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
FW08NM038	San Juan River	Other	1	1	1	1
FW08UT014	San Juan River	NearRef	1	1	1	1
FW08UT030	San Juan River	Strs	1	1	1	1
FW08UT046	San Juan River	Other	1	1	1	1
FW08NM069	Sapello River	Other	1	1	1	1
FW08RNM9004	Seneca Creek	Ref	1	1	1	1
FW08NM018	Unknown	Other	1	1	1	1
FW08NM061	Unnamed	Ref	1	1	1	1
FW08NM070	Unnamed	Other	1	1	1	1
FW08RNM9001	Ute Creek	Ref	1	1	1	1
FW08RNM9002	Ute Creek	Ref	1	1	1	1
FW08NM064	Vermejo River	Strs	1	1	1	1
FW08CO083	West Dolores River	NearRef	1	1	1	1
FW08NM035	West Fork Gila River	Ref	1	1	1	1
FW08CO020	Wolf Creek	Other	1	1	1	1
WSA data						
WCOP99-0502	Adams Fork Conejos River	Ref	1	1	1	1
WCOP03-R005	Agate Creek	Other	1	1	1	1
WCOP03-R008	Bear Creek	NearRef	1	1	1	1
WAZP99-0545	Black River	Other	1	1	1	1
WAZP99-0605	Blue River	Other	1	1	1	1
WAZP99-0681	Blue River	Other	1	1	1	1
WAZP04-RBON1	Bonita Creek	Ref	1	1	1	1
WAZP99-0701	Bonito Creek	Strs	1	1	1	1
WAZP99-0639	Campbell Blue Creek	NearRef	1	1	1	1
OWW04440-1059	Canadian River	Strs	1	1	1	1
OWW04440-0077	Canones Creek	Strs	1	1	1	1
WAZP99-0687	Centerfire Creek	Other	1	1	1	1
WCOP01-0777	Chacuaco Creek	Other	1	1	1	1
WAZP99-0615	Conklin Creek	NearRef	1	1	1	1
OWW04440-NM08	Diamond Creek	Ref	1	1	1	1
WCOP99-0621	Dolores River	Other	1	1	1	1
WAZP99-0750	Eagle Creek	Other	1	1	1	1
WCOP03-R007	East Fork Hermosa Creek	Other	1	1	1	1
WCOP03-R009	East Fork Piedra River	Other	1	1	1	1
WCOP99-0591	Fall Creek	Other	1	1	1	1
WAZP99-0888	Fish Creek	Other	1	1	1	1
WAZP99-0512	Gila River	Other	1	1	1	1
WAZP99-0599	Gila River	Other	1	1	1	1
WCOP99-0507	Groundhog Creek	NearRef	1	1	1	1
WCOP99-0622	Hartman Draw	Strs	1	1	1	1

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
WCOP99-0574	Henson Creek	Ref	1	1	1	1
WCOP01-0836	Horse Creek	Other	1	1	1	1
WCOP99-0627	Houselog Creek	NearRef	1	1	1	1
OWW04440-1069	Jemez Creek	Other	1	1	1	1
WAZP99-0569	Kp Creek	Other	1	1	1	1
WCOP99-0568	La Plata River	XStrs	1	1	1	1
WAZP99-0783	Lanphier Canyon	Ref	1	1	1	1
WAZP04-RLCR1	Little Colorado River	Other	1	1	1	1
WAZP99-0906	Little Colorado River	Other	1	1	1	1
WCOP99-0670	Lost Canyon Creek	Other	1	1	1	1
WCOP01-0817	Markham Arroyo	Strs	1	1	1	1
WAZP04-RMIN1	Mineral Creek	Ref	1	1	1	1
WCOP99-0646	Mud Creek	XStrs	1	1	1	1
WCOP04-R006	Naturita Creek	XStrs	1	1	1	1
WAZP99-0653	Nazlini Creek	Other	1	1	1	1
OWW04440-1037	Negritos Creek	Ref	1	1	1	1
WAZP99-0828	North Fork Black River	Strs	1	1	1	1
WCOP01-0833	North St. Charles River	XStrs	1	1	1	1
WAZP99-0645	Nutrioso Creek	Other	1	1	1	1
OWW04440-0429	Pecos River	Other	1	1	1	1
WCOP01-0812	Purgatoire River	Strs	1	1	1	1
WCOP99-0672	Purgatoire River	Other	1	1	1	1
WCOP99-0508	Red Mountain Creek	Other	1	1	1	1
OWW04440-0845	Rio Nutrias	Other	1	1	1	1
OWW04440-0717	Rio Santa Barbara	Other	1	1	1	1
OWW04440-0333	Rio Tusas	Other	1	1	1	1
OWW04440-0205	Saladon Creek	Ref	1	1	1	1
WCOP01-0734	Salt Creek	NearRef	1	1	1	1
OWW04440-0045	San Antonio	Other	1	1	1	1
OWW04440-0557	San Antonio	NearRef	1	1	1	1
WAZP99-0840	San Francisco River	Other	1	1	1	1
OWW04440-NM03	Three Rivers	Ref	1	1	1	1
WCOP01-0819	Timpas Creek	Other	1	1	1	1
WCOP04-R009	Timpas Creek	Other	1	1	1	1
WAZP99-0669	Tsaile Creek	Other	1	1	1	1
OWW04440-NM07	Turkey Creek	Ref	1	1	1	1
WCOP04-R003	Two Butte Creek	Other	1	1	1	1
OWW04440-NM01	Ute Creek	Ref	1	1	1	1
WCOP99-0634	Ute Creek	Ref	1	1	1	1
WAZP99-0876	Wheatfields Creek	Other	1	1	1	1
WCOP99-0513	Whitehouse Creek	Ref	1	1	1	1

SiteID	ShortName	RefStatus	# TN Samps	# TN Years	# TP Samps	# TP Years
WCOP01-0765	Wild Horse Creek	Other	1	1	1	1
OWW04440-1101	Wolf Creek	Other	1	1	1	1
WCOP99-0510	Wolf Creek	Other	1	1	1	1
WCOP04-R007	Yellow Jacket Creek	Strs	1	1	1	1

Appendix G Additional Classification Analyses

Preliminary Classification Exploration

Exploration started with box plots of site average TN and TP values by collection program and potential site classes. Among collection programs, it appeared that the values are similar at the center of the distributions, but that the NMED values had higher minimum values and upper extremes when compared to both NRSA and WSA samples (Figure G-1). The difference in minimum values is related to variable detection limits, which are not specified for the NMED and WSA data. The higher extremes in the NMED data might be due to targeting some effluent dominated streams. The NRSA and WSA sites were randomly selected or targeted for reference conditions and highly stressed sites might be less common in those data sets. The patterns seen among programs in all sites were similar (though with lower magnitudes) when plotting only 'Ref' and 'NearRef' distributions (not shown). In our analysis, 'Ref' and 'NearRef' sites (N = 179) were predominantly from the NMED data set (N = 152), in contrast to the NRSA (N = 15) and WSA (N = 12). Although the median TN values are somewhat higher in the NMED compared to NRSA or WSA, we pooled the data collection programs when considering basic nutrient statistics.

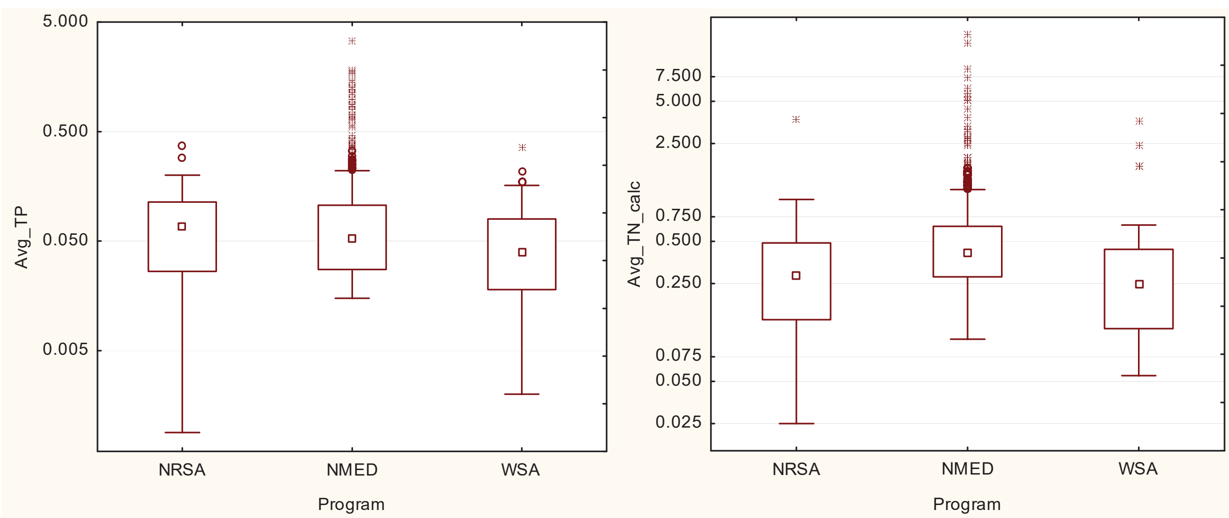

Figure G-1. Distributions of average TP and TN concentrations for all sites among sampling programs. In this and other box plots in this section, the symbols represent the median, quartiles, non-outlier ranges, and outliers.

Average TP and TN values by reference status were plotted, combining all collection programs (Figure G-2). These plots suggest that the nutrients are generally related to the reference designations, with lower concentrations in reference and near-reference sites in comparison to stressed and extremely-stressed sites. In several of the classification analyses, we looked at data from the reference and near-reference sites only so that influences of stressors would be minimized and nutrient relationships with natural conditions would be maximized.

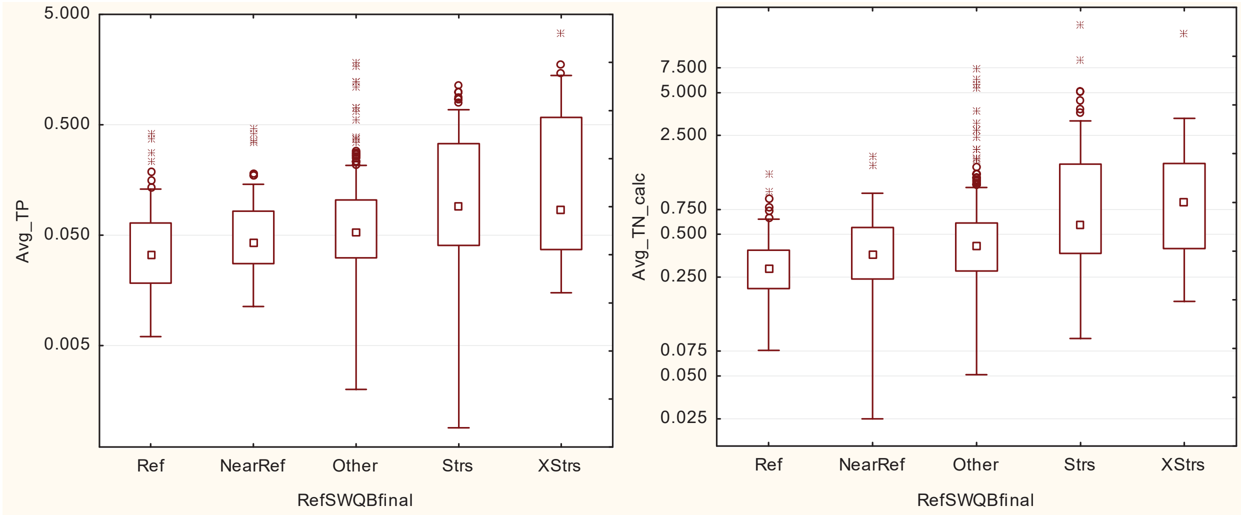

Figure G-2. Distributions of average TP and TN concentrations for all sites among disturbance categories.

Next, reference and near-reference nutrient concentrations were examined in classes of sites that are established and may be appropriate as final nutrient classes. These potential site classes include the sediment-specific site classes (Mountains, Foothills, and Xeric), nutrient categories (designated uses and ecoregions) (NMED 2011), and level 3 ecoregions (Griffith et al. 2006). These site classes simplify the landscape of New Mexico into categories of sites with similar ecological characteristics (ecoregions), including natural characteristics that might affect nutrients such as geology, terrain, vegetation, temperature, and precipitation patterns. The sediment site classes (Figure G-3) and the existing NMED nutrient classes were based on level 3 and 4 ecoregions of New Mexico. In general, the Mountain ecoregions are higher elevation, colder temperature, wetter, and have smaller drainages than the Xeric areas (Table G-1). Foothills are transitional. The Xeric areas have higher conductivity, even in reference sites, compared to the Mountains and Foothills.

Table G-1. Mean (standard deviation) of watershed characteristics by level 3 ecoregion.

Ecoregion Level 3	Sediment Class	Elevation (m)	Drainage Area (mi^2)	Land slope (%)	Avg. Ann. Precipitation (mm)	Avg. Air Temperature (C)
21 Southern Rockies (N=237)	Mtn-Fthl	2402 (301)	67 (97)	27 (9)	732 (145)	4.7 (1.5)
22 AZ/NM Plateau (N=58)	Mtn-Xer	1932 (229)	278 (333)	22 (10)	556 (148)	6.9 (2.1)
23 AZ/NM Mountains (N=125)	Fthl-Mtn	1938 (329)	242 (424)	26 (10)	607 (126)	9 (1.8)
79 Madrean Archipeligo (N=7)	Foothills	1297 (232)	1010 (1209)	24 (4)	511 (37)	12 (1.4)
26 Southwest Tablelands (N=82)	Xeric	1641 (268)	1062 (2197)	13 (7)	485 (74)	9.5 (1.8)
24 Chihuahuan Deserts (N=17)	Xeric	1186 (294)	323 (439)	15 (10)	414 (66)	14.4 (1.8)
20 Colorado Plateau (N=14)	Xeric	1814 (145)	429 (474)	23 (11)	580 (156)	6.8 (2)
25 High Plains (N=2)	Xeric	1174 (151)	145 (41)	2 (0)	418 (7)	11.7 (0.4)

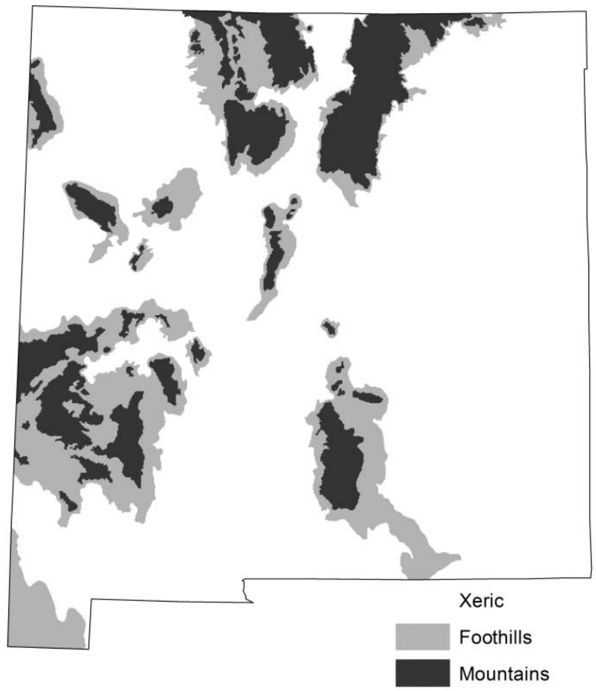

Figure G-3. Regional site classes defined for sediment analyses in New Mexico.

When we compared average TP and TN concentrations in reference and near reference sites among the existing sediment site classes, we found that concentrations were lowest in Mountain sites for both TP and TN (Figure G-4). Although differences are probably not significant, the highest median concentration of TP was in the Foothills and the highest for TN was in the Xeric areas.

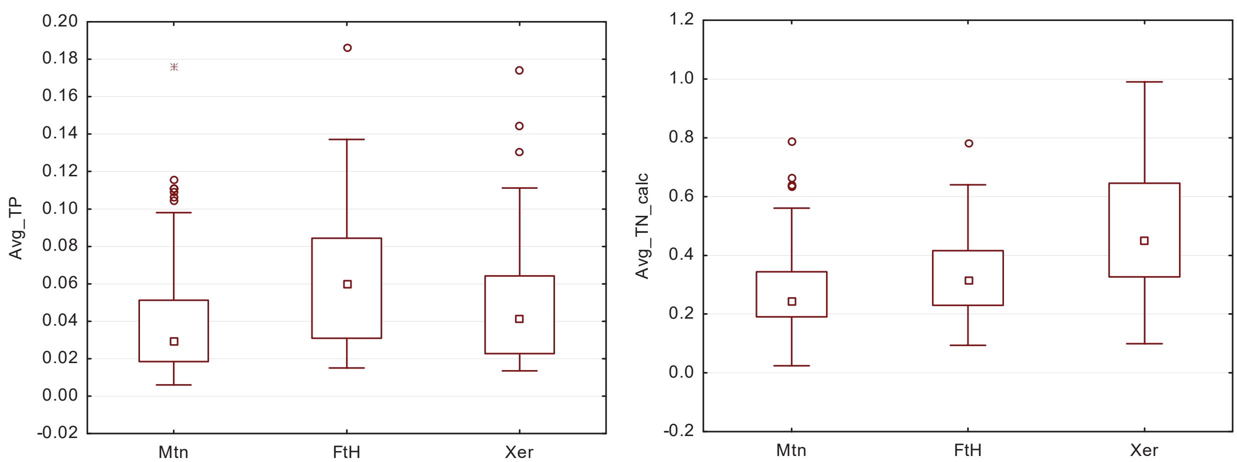

Figure G-4. Distributions of TP and TN concentrations (mg/L) in reference and near-reference sites by sediment site classes; Mountains (N = 88), Foothills (N = 53), and Xeric areas (N = 36).

Among ecoregions, TP and TN values differed somewhat (Figure G-5), though many of the ecoregions were represented by too few reference and near reference sites to justify classification. Among the regions with more than 5 sites, the Southern Rockies (Mountains and Foothills) had the lowest median TP values. The Southwestern Tablelands (Xeric) had the highest median TN values.

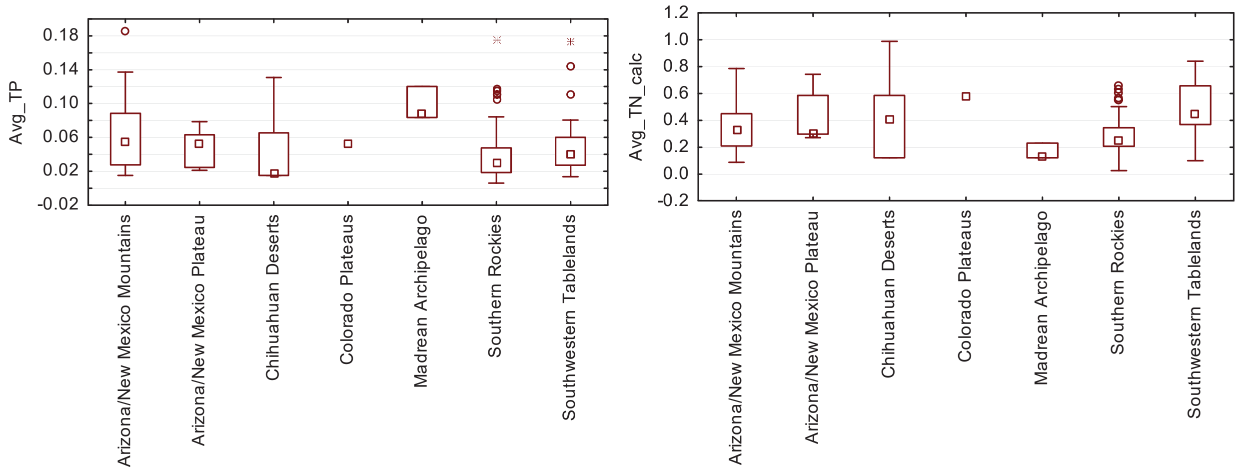

Figure G-5. Distributions of TP and TN concentrations (mg/L) in reference and near-reference sites by level 3 ecoregion. Sample sizes for ecoregions are 54, 5, 5, 1, 3, 84, and 25, in the order displayed.

When comparing reference nutrient concentrations among the established NMED nutrient regions, cold-water groups generally had lower TN concentrations (Figure G-6). For TP, patterns were not clearly associated with water temperature. The distributions of both TN and TP values difference among cold versus transitional and warm-water sites the Southern Rockies (21) and between transitional and warm-water site in the Southwestern Tablelands (26) (no reference or near-reference sites were sampled in the High Plains (25)).

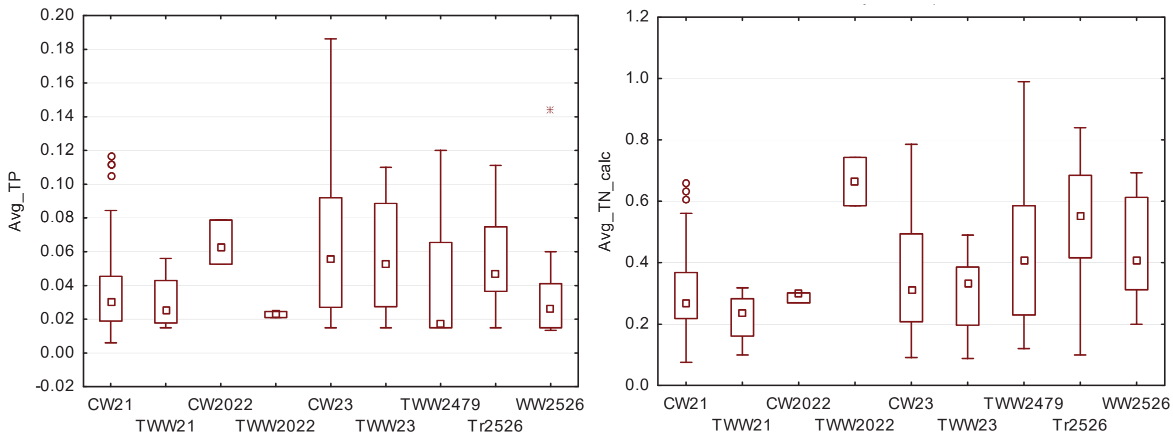

Figure G-6. Distributions of TP and TN concentrations (mg/L) in reference and near-reference sites by established NMED nutrient classes (cold, warm and transitional-water, and ecoregions number. Sample sizes for ecoregions are 74, 4, 3, 2, 39, 15, 5, 14 and 10, in the order displayed.

Hybrid Site Classes for TN and TP

If NMED was inclined to identify site classes that are identical for both nutrients, then we could find a hybrid threshold for land slope between the one used for TP (29%) and for TN (32%). Inspection of Figures 10 and 14 suggests that a compromise threshold of 30% would divide higher concentrations below the threshold and lower concentrations above the threshold for both nutrients.

The 15% land slope threshold that was recognized for TN may be applicable for TP also. Sites with flat landscapes have lower TP than sites with moderate land slopes, except for a few outliers (Figure 10). This was recognized in the CART analysis, though we had earlier dismissed it as possibly overfitting and did not want to define a class based on only a few eastern sites with a land slopes threshold < 12.4% as identified through CART. With a higher threshold (15% instead of 12.4%) and including western sites, the flat landscape site class has sufficient sample size and apparent distinctions in TP concentrations compared to sites with moderate slopes.

In the sites with moderate slopes, the western sites (west of longitude -108) have higher TP than eastern sites (Figure G-7). For TN, there is no distinction with longitude (-105) in the moderate land slope class. Regional distinctions in the site classes are evident when mapping all sites (Figure G-8).

These observations suggest a hybrid site classification that could work for both TN and TP (Table G-2). Distributions of TN and TP appear to be distinct in the hybrid classes, though some classes might be combined (Figure G-7). The two moderate classes have indistinct TN concentrations. The flat and steep classes have similar TP concentrations, but the justification for combining these classes is uncertain because of the large difference in landscape types. The non-parametric Kruskal-Wallis comparison among groups suggests that the hybrid scheme is not as strong as the nutrient specific schemes.

Table G-2. Potential hybrid site classes for TN and TP.

	Flat	Moderate West	Moderate East	Steep
Longitude	NA	< -108	> -108	NA
Land slope (%)	< 15	15 - 30	15 - 30	>= 30
Ref-NearRef N	31	57	32	57

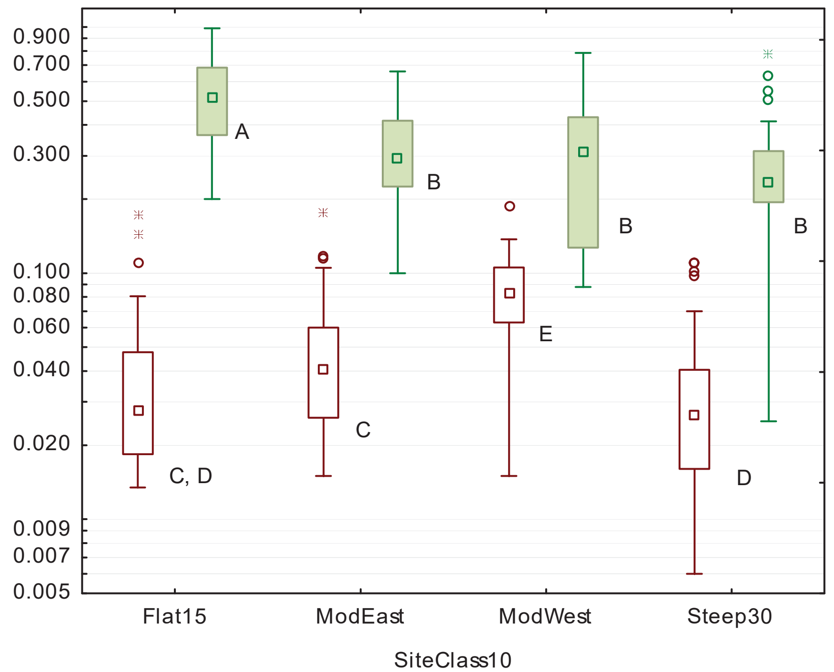

Figure G-7. TN (solid) and TP (open) concentrations in hybrid site classes. Distributions with different letter designations are significantly different (Kruskal-Wallis p<0.05).

Similarities among samples were examined by comparing differences in TN and TP concentrations among sites within (W) classes versus among sites between (B) classes, as demonstrated by Van Sickle and others (Van Sickle 1997, Van Sickle and Hughes 2000). TN and TP values were standardized by log transforming and then converting each to a proportional score of the observed range of reference and near-reference log-transformed values. Absolute differences between each sample pair were calculated for TN and TP separately. We also calculated a Bray-Curtis (BC) similarity index to compare combined TN and TP concentrations among samples. The samples were grouped according to the classification scheme to be tested. The average difference or BC value within groups (W), weighted by sample size, was compared to the average value between groups (B). Distinct classification was indicated by high similarity within groups compared to between groups, measured as the difference of W-B.

Van Sickle and Hughes (2000) found W-B values in the range of 0.03 – 0.05 for comparing biological metrics among ecoregions or basins in western Oregon streams. These are comparable to our values in Table G-3. When we divided the TN and TP reference and near-reference data into three equal-sized groups based on high, moderate, and low nutrient concentrations, the best W-B classification strengths were 0.14 and 0.23 for TN and TP. Therefore, the TN classification explains roughly 0.03/0.14 (21%) of the variability and the TP classification explains 0.05/0.13 (22%). We found that the site classes developed as a hybrid of the specific TN and TP classes were almost as effective at distinguishing TN as the TN-specific classes.

Table G-3. Classification strengths (W-B) of site classes

Nutrient	Comparison	Classification Scheme		
		TN specific	TP specific	TN/TP hybrid
TN	1 – absolute difference*	0.030	NA	0.029
TP	1 – absolute difference*	NA	0.047	0.049
TN/TP	Bray-Curtis similarity	0.029	0.028	0.031

* Subtracting the difference from 1 converts the difference to a similarity measure among samples.

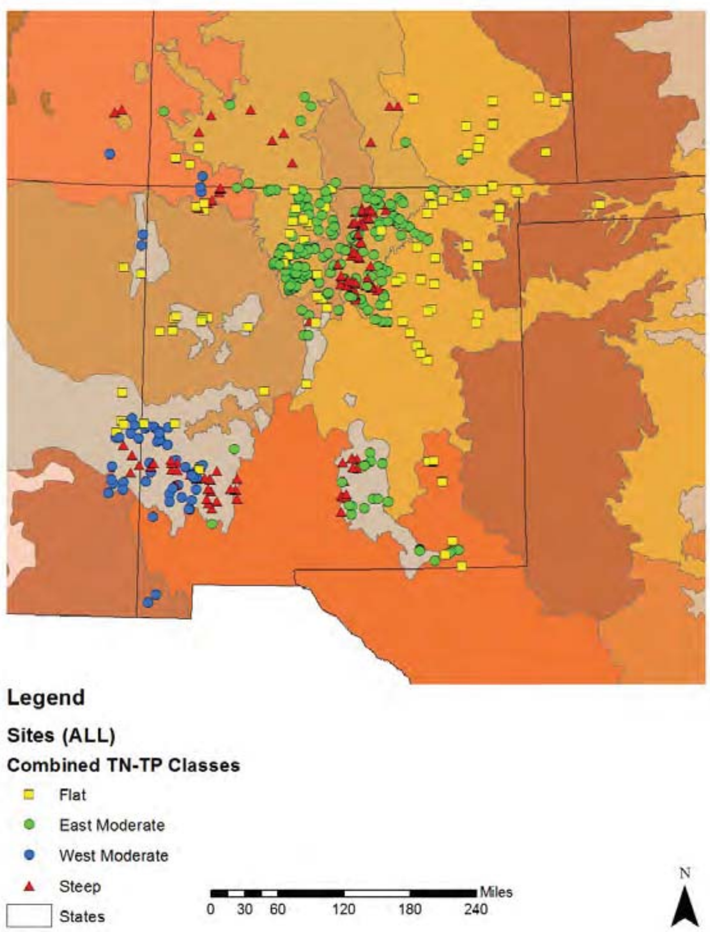

Figure G-8. All sites in the ecoregions of New Mexico, marked by the hybrid TN-TP site classes.

Residual Variations of TP and TN with Environmental Variables

Phosphorus

A correlation analysis of environmental variables was run with phosphorus within site classes to find those variables that still showed relationships with phosphorus after recognizing the site classes (Table G-4). The correlations show that longitude is still related to phosphorus in the WestFlat class (Figure G-9), latitude and turbidity are related in the EFltWStp class (Figure G-10), and latitude and temperature were related in the EastSteep class (Figure G-11).

Table G-4. Correlation coefficients for reference and near reference phosphorus concentrations and environmental variables within site classes.

	Marked correlations are significant at p <.05000								
Class	LndSlp Avg%	Lat	Long	Elev m	DrArea Mi2	Precip Avg30	Temp Avg30	Gm EC	Gm turbidity
WestFlat	0.23	-0.18	-0.42	-0.16	-0.06	0.26	0.04	-0.28	0.29
EFltWStp	0.06	0.42	0.06	0.06	0.07	-0.03	-0.14	-0.03	0.37
EastSteep	0.23	-0.45	-0.25	-0.29	-0.16	-0.29	0.44	-0.08	0.14

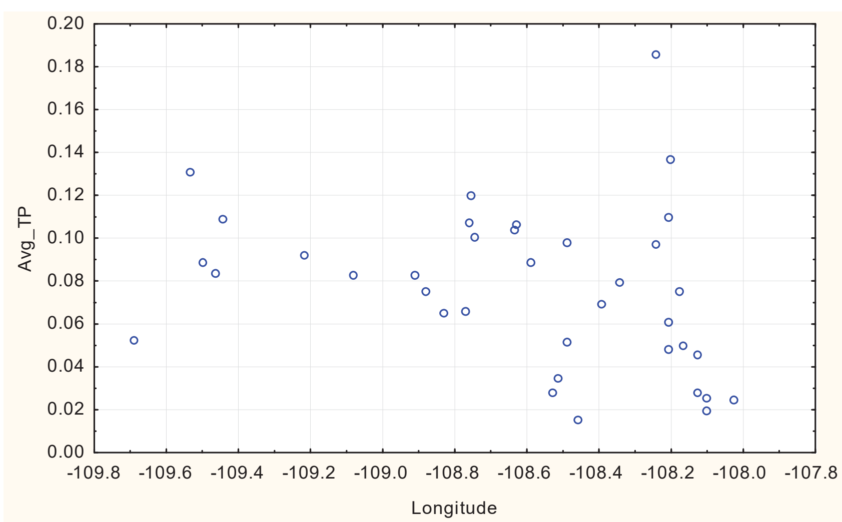

Figure G-9. This residual relationship in the WestFlat class between longitude and TP suggests that TP is generally lowest in the east (of the western site class). However, higher values are about as likely from east to west. The AZ border is at longitude -109.

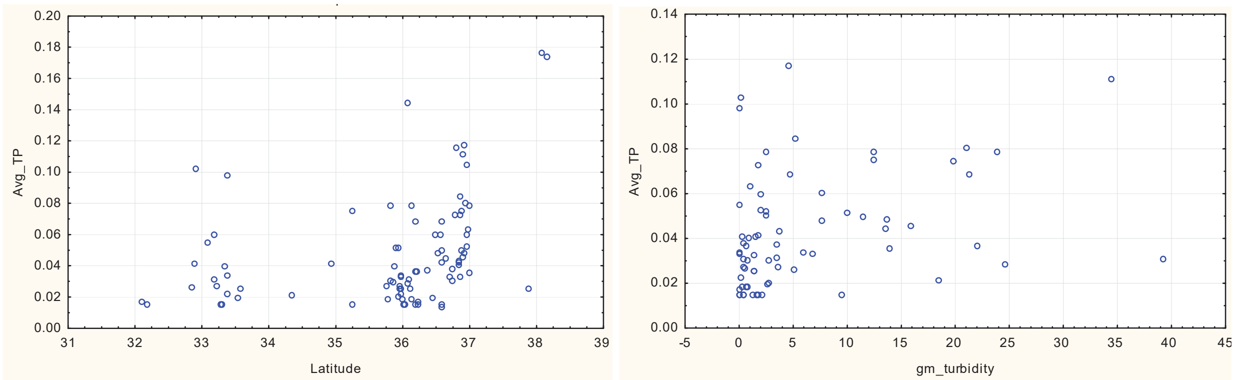

Figure G-10. These residual relationships in the EFltWStp class suggest that TP is generally highest in the north. The CO border is at latitude 37. The turbidity relationship is associated with numerous low-turbidity/low-TP sites. As turbidity increases above 5 ntu, there are fewer reference and near reference sites in general, and fewer with very low TP.

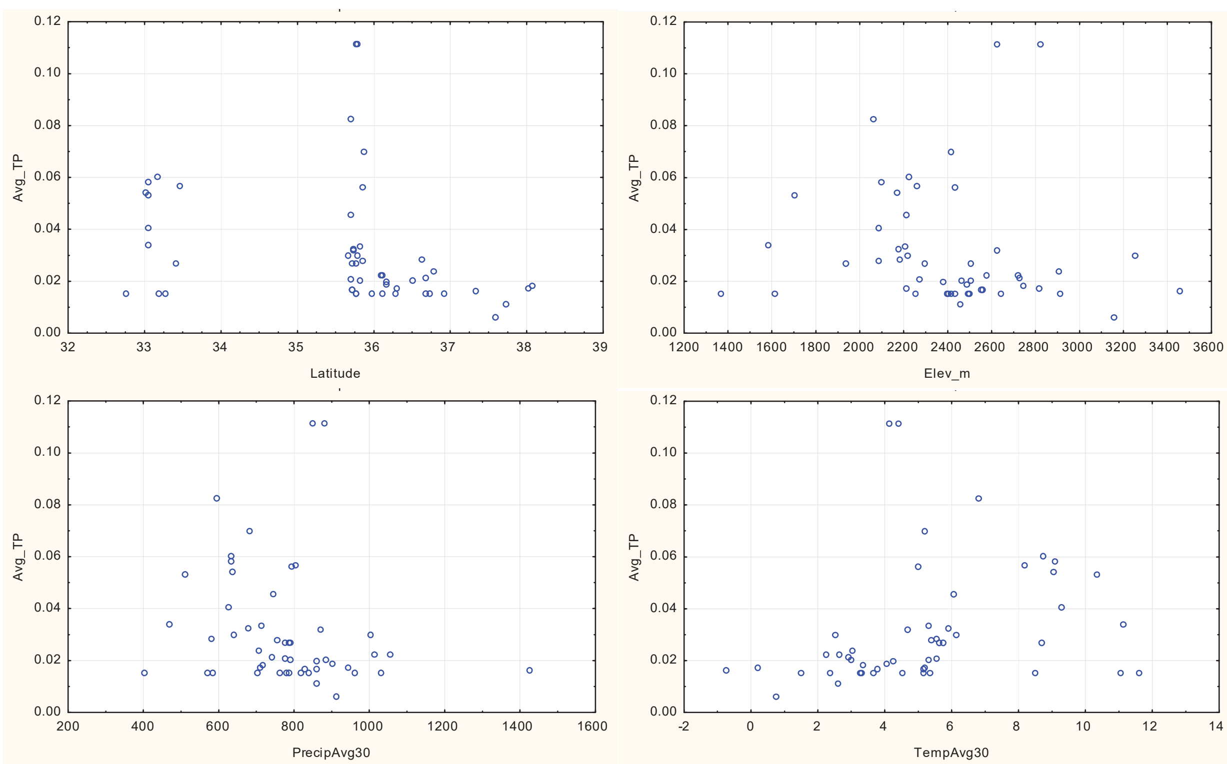

Figure G-11. These residual relationships in the EastSteep class suggest that TP is generally highest in the mid-latitudes. In this site class, there might be fewer exceedances north of latitude 36. Relationships with elevation, precipitation and temperature are variable and do not suggest biased nutrient expectations.

Nitrogen

We ran a correlation analysis of environmental variables with nitrogen within site classes to find those variables that still showed relationships with nitrogen after recognizing the site classes (Table G-5). The correlations show that elevation and conductivity are still related to nitrogen in the flat class (Figure G-12), conductivity is related in the moderate class (Figure G-13), and latitude and conductivity were related in the steep class (Figure G-14).

Table G-5. Correlation coefficients for reference and near reference nitrogen concentrations and environmental variables within site classes.

	Marked correlations are significant at $p < .05000$								
Class	LndSlp Avg%	Lat	Long	Elev m	DrArea Mi2	Precip Avg30	Temp Avg30	Gm EC	Gm turbidity
Flat	-0.17	-0.08	0.25	-0.53	0.31	-0.32	0.39	0.51	0.37
Moderate	-0.07	-0.03	0.20	-0.12	0.07	-0.25	0.18	0.40	0.29
Steep	0.18	-0.42	-0.02	-0.28	0.05	-0.34	0.40	0.10	-0.01

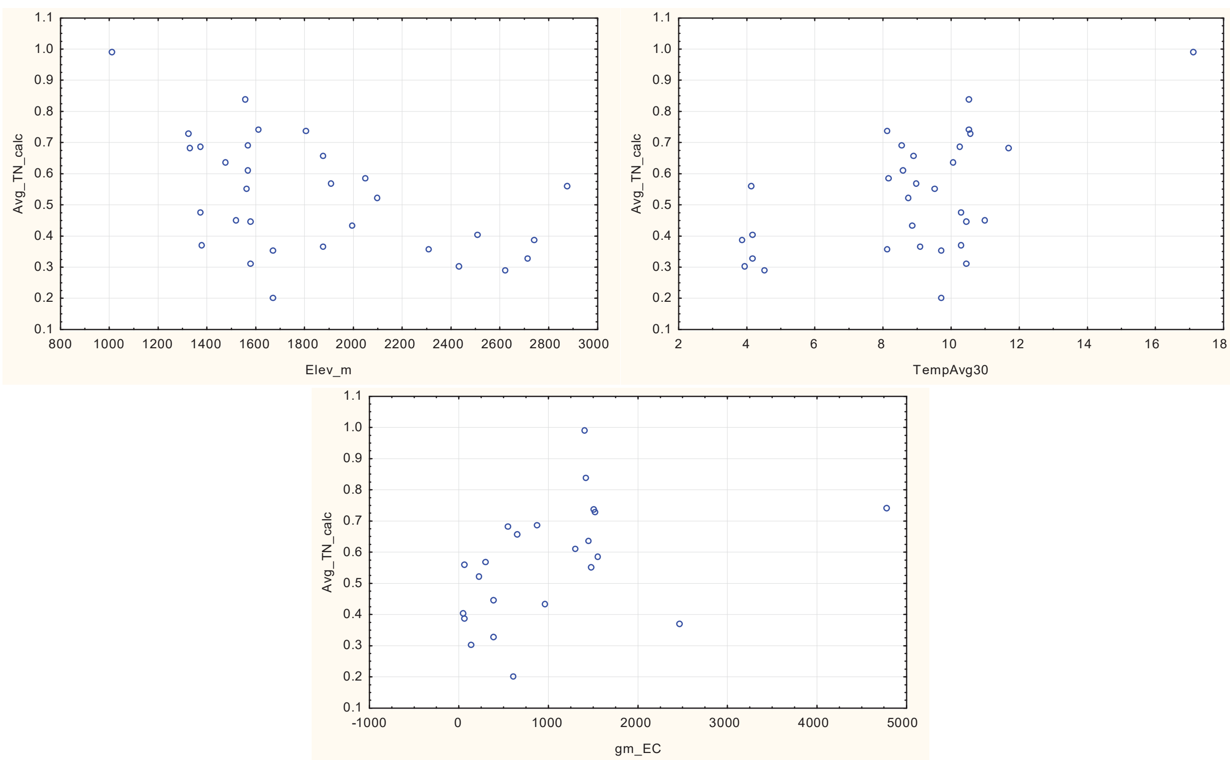

Figure G-12. In the Flat sites, there appear to be more high TN values in low elevation, high temperature, and high conductivity sites.

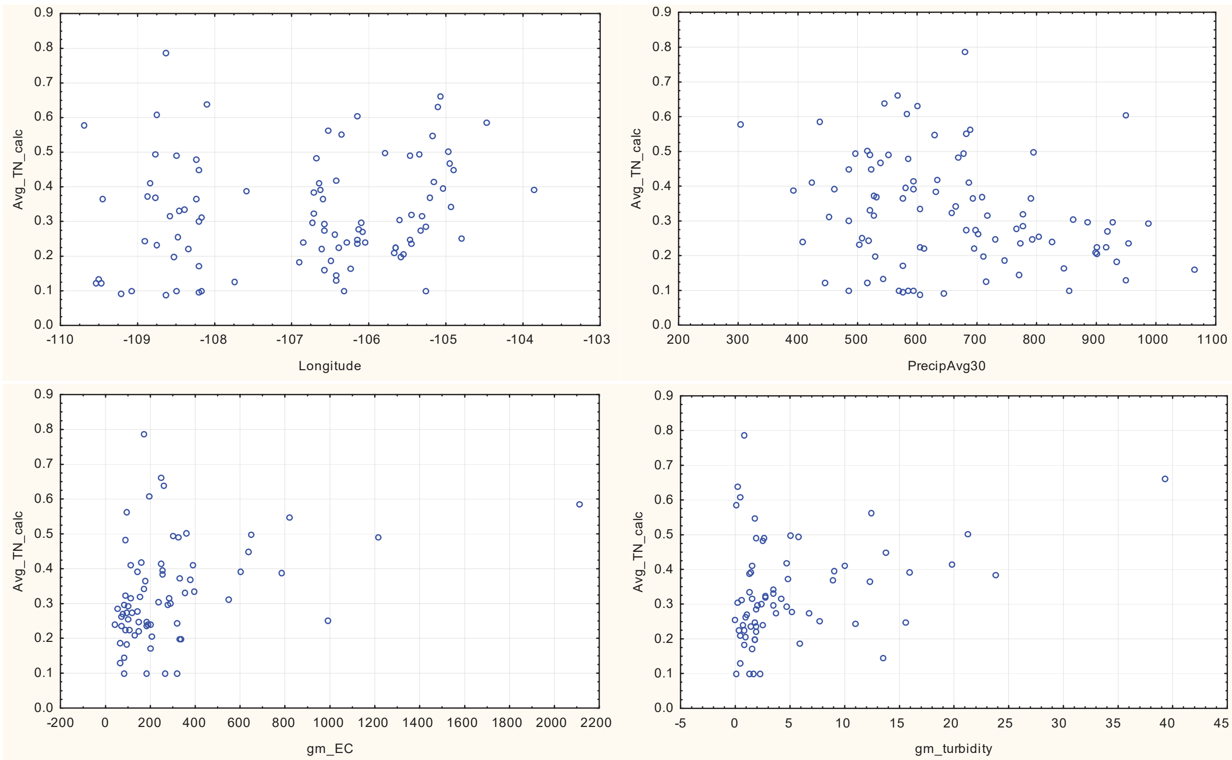

Figure G-13. In sites with moderate land slopes, longitude does not show a pattern consistent with the correlation coefficient. Higher precipitation is generally associated with lower TN. Sites with higher conductivity and turbidity do not have the lowest TN.

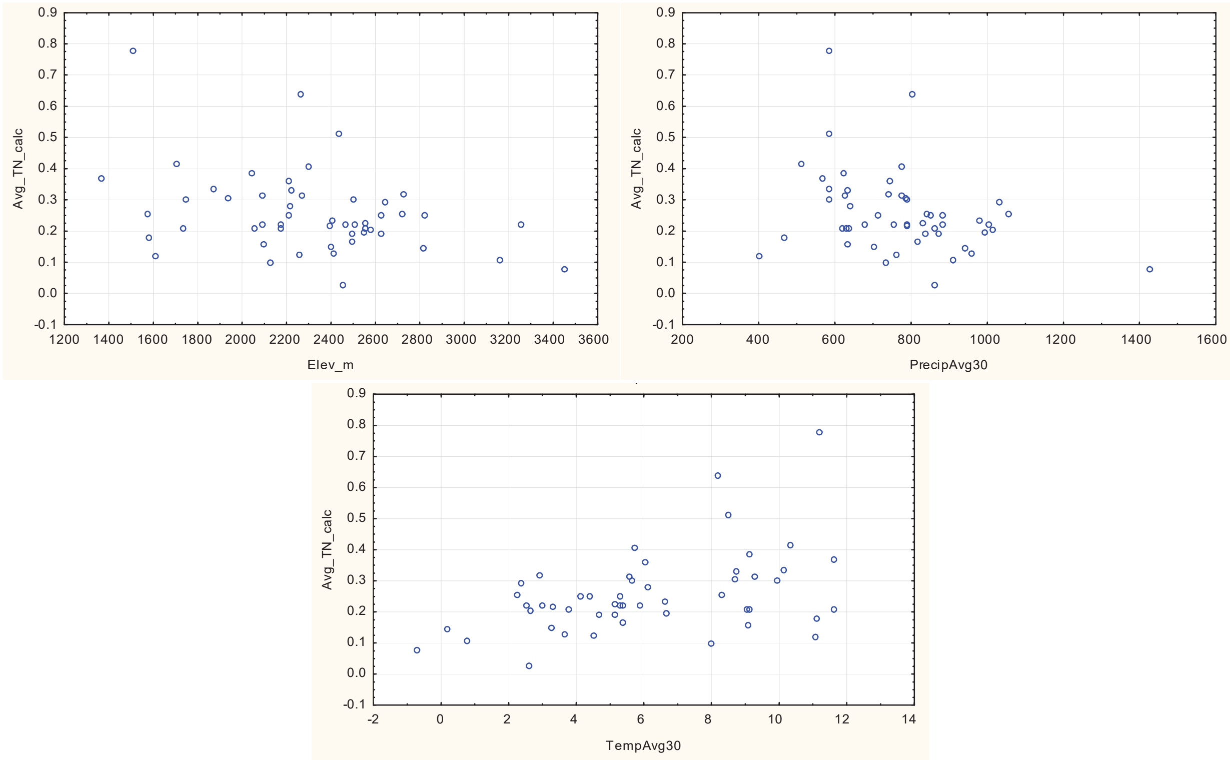

Figure G-14. In the steep site class, higher TN is in lower, drier, and warmer sites.

Appendix H Modifying factors of chlorophyll a

Multiple Regressions

A forward stepwise multiple regression analysis was conducted to predict benthic chl-a from nutrients, water quality and site characteristics. Separate analyses were run for NMED and NRSA data because there was lower benthic chl-a in NRSA sites, on average. The variables considered as possible predictors of benthic chl-a included drainage area, latitude, longitude, TP, TN, conductivity, turbidity, temperature, and pH.

In the NMED analysis limiting variables to a *p* to enter of 0.05, two variables entered the model to predict benthic chl-a, including conductivity and TP, in decreasing order of correlation strength. Chl-a increased with TP and conductivity. The model had an adjusted R^2 of 0.16.

In the NRSA model, only latitude entered the model (no nutrients entered). The model adjusted R^2 was 0.14. Benthic chl-a was negatively correlated with latitude (higher chl-a was found in the south of the study region).

Multiple regression analysis was conducted with limited numbers of variables to test assumptions regarding watershed size and turbidity affecting the relationships between nutrients and chl-a. In analyses to predict chl-a from TN, TP, turbidity, and catchment size, only TP entered for NMED data and no variables entered the models for NRSA data ($p>0.05$).

Random Forest

In a classification exercise using a random forest algorithm and NMED data for all regions, conductivity, elevation, drainage area, longitude, and pH were most important in the multiple iterations of the models to classify benthic chl-a. TP and TN were less important. Hydrological and canopy variables were not available for many sites in this analysis, those they might have modifying effects. The strong positive relationship between chl-a and conductivity and the relative absence of a chl-a relationship with TN or TP (Figure H-1) suggests that conductivity is a stronger influence on chl-a density than nutrients. A CART analysis with the most important variables resulted in conductivity in the first two splits, at values of 192 and 370 uS/cm.

In a similar analysis using the NRSA data, latitude was the most important variable in the random forest analysis, followed by TP and conductivity (Figure H-2). NRSA sites in the south had moderate TP concentrations, neither the lowest nor highest in the data set. The relationship between TP and benthic chl-a was unexpectedly negative.

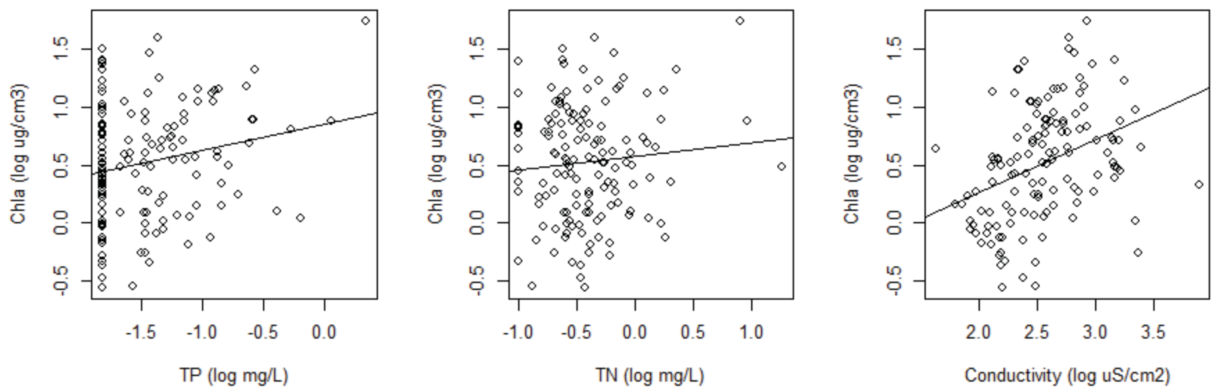

Figure H-1. Relationships between conductivity TP, TN, and conductivity and benthic chl-a density in the NMED data set. R^2 values for regressions with chl-achl-are 0.035 (p<0.05), 0.002 (p>0.1), and 0.126 (p<0.001), respectively.

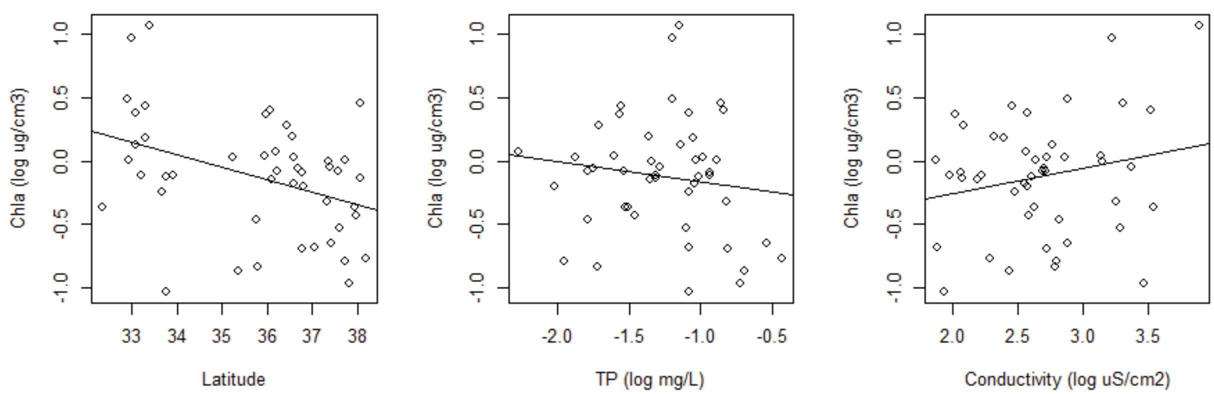

Figure H-2. Relationships between latitude, TP, conductivity (EC), and benthic chl-a density in the NRSA data set. R^2 values for regressions with chl-achl-are 0.131 (p<0.01), -0.002 (p>0.1), and 0.023 (p>0.1), respectively.

The relationship between benthic chl-a and conductivity is strong in the NMED data and recognizable in the NRSA data set (third most important variable in the random forest analysis). TN was higher with higher conductivity and was significantly correlated in the NMED data set (Spearman rho = 0.37, p<0.05). TP was not significantly correlated with conductivity.

The relationships between conductivity and landscape variables were further explored to determine possible sources of conductivity, such as land uses or catchment size. Both chl-a and conductivity were positively related to catchment size in the NMED data, though the regression coefficients were small (Figure H-3). With land use, conductivity was positively related to agricultural uses, though the uses never amount to any large percentages of the catchments (Figure H-4). Agricultural uses include crops, hay, and pasture. Percent forest cover has a stronger relationship to conductivity (Figure H-4). Because agriculture and urban uses are relatively small in the catchments, the dominant alternative to forest is scrubland. Small catchments were mostly forested ($R^2 = 0.15$, $p<0.001$). Conductivity was lowest in small forested catchments.

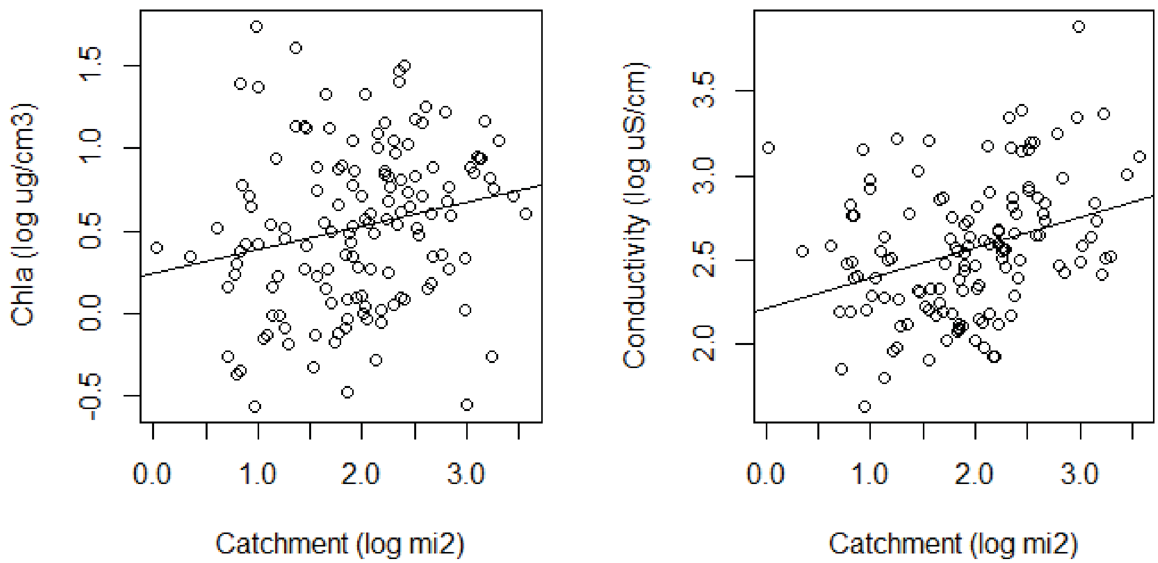

Figure H-3. Relationships between benthic chl-a density, conductivity (EC), and stream catchment area in the NMED data set. R^2 values for regressions with catchment area are 0.046 ($p<0.05$) and 0.110 ($p<0.001$), respectively.

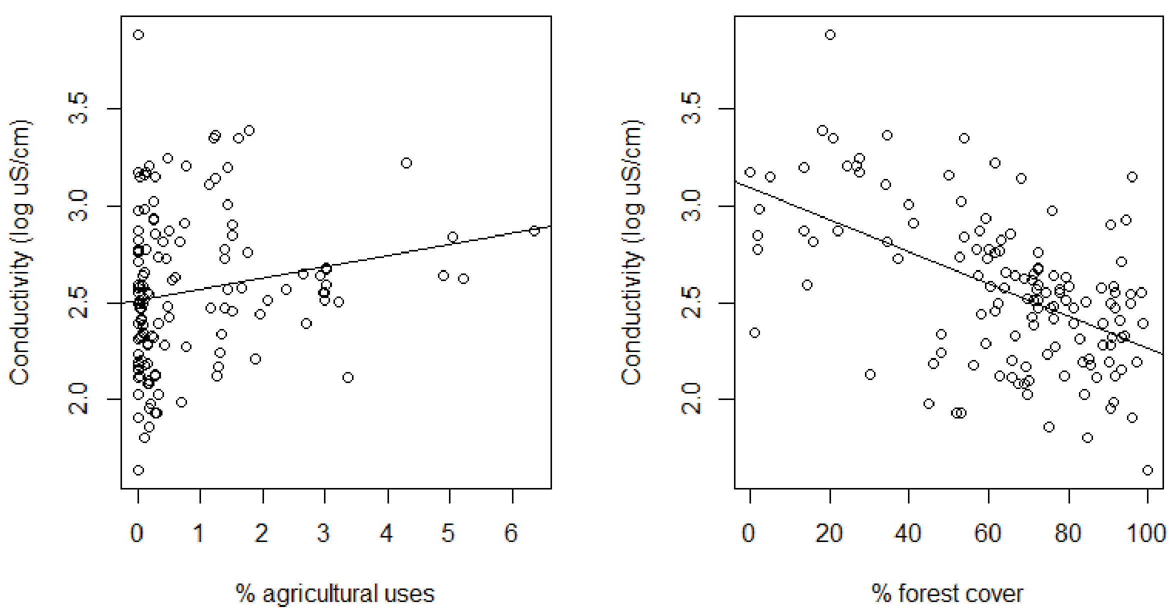

Figure H-4. Relationships between conductivity and agricultural land uses and percent forest cover in the NMED data set. R^2 values for regressions with conductivity are 0.034 ($p<0.05$) and 0.28 ($p<0.001$), respectively.

In a random forest analysis that included land use and cover, conductivity was the most important classification variable for chl-a (Table H-1). Elevation, % forest cover, catchment area, and longitude were more important than nutrients or land use activities. In turn, conductivity was most often classified by elevation, % forest cover, and longitude. This suggests that conductivity is an important determinant of chl-a and that conductivity is related to natural characteristics of the landscape.

Table H-1. Random forest importance assigned to variables in classifying NMED benthic chl-a and conductivity data.

Chl-a				Conductivity			
Variable	Import.	Variable	Import.	Variable	Import.	Variable	Import.
LogEC	6.7	LogTP	1.9	Elev_m	4.1	LogTN	1.1
Elev_m	2.9	Latitude	1.9	ForestIndx	3.5	Latitude	0.9
ForestIndx	2.5	UrbanIndex	1.6	Longitude	3.0	Crops82	0.8
LogDrArea	2.5	Crops82	1.6	LogChla	2.0	AgIndex	0.6
Longitude	2.4	AgIndex	1.6	LogDrArea	1.5	PasHay81	0.4
LogTN	2.2	PasHay81	1.5	UrbanIndex	1.1	LogTP	0.4

Factoring out conductivity to refine the relationship between chl-a and nutrients was attempted by categorizing the NMED data into bins of low, medium and high conductivity. Regressions between nutrients and chl-a were explored within those bins. A CART analysis identified 200 and 400 µS/cm as breakpoints between the low, medium, and high categories. Relationships between nutrients and chl-a were not strong within the conductivity bins (Table H-2). Only TP had a significant p value ($p<0.10$), though the regression coefficient indicated a weak relationship ($R^2 = 0.069$).

Table H-2. Regression coefficients (R^2) and p-values for regressions of TP, TN, and conductivity versus chl-a in bins of low, medium, and high electrical conductivity (EC). Measures were all log transformed before regression analysis.

	Low EC (N = 36)	Med EC (N = 43)	High EC (N = 54)
TN	R^2= 0.015, p= 0.48	R^2= 0.0008, p= 0.86	R^2= 0.0005, p= 0.87
TP	R^2= 0.027, p= 0.33	R^2= 0.069, p= 0.09	R^2= 0.03, p= 0.19
Conductivity	R^2= 0.016, p= 0.46	R^2= 0.0068, p= 0.60	R^2= 0.05, p= 0.10

The residual chl-a values were calculated from a regression against conductivity and nutrient relationships with those residuals were tested. In the NMED data, the regression equation for conductivity on chl-a was significant, but the coefficient was low ($R^2 = 0.126$, $p<0.001$). A constant (1.0) was added to the difference (predicted Chl_a – observed Chl_a) to keep the residual range positive. The resulting regressions with nutrients were negative with TP and flat with TN (Figure H-5). TN was correlated with conductivity, so that factoring out conductivity also factored out TN. TP did not have a significant relationship with conductivity, but after factoring out conductivity, the relationship was negative, which was unexpected.

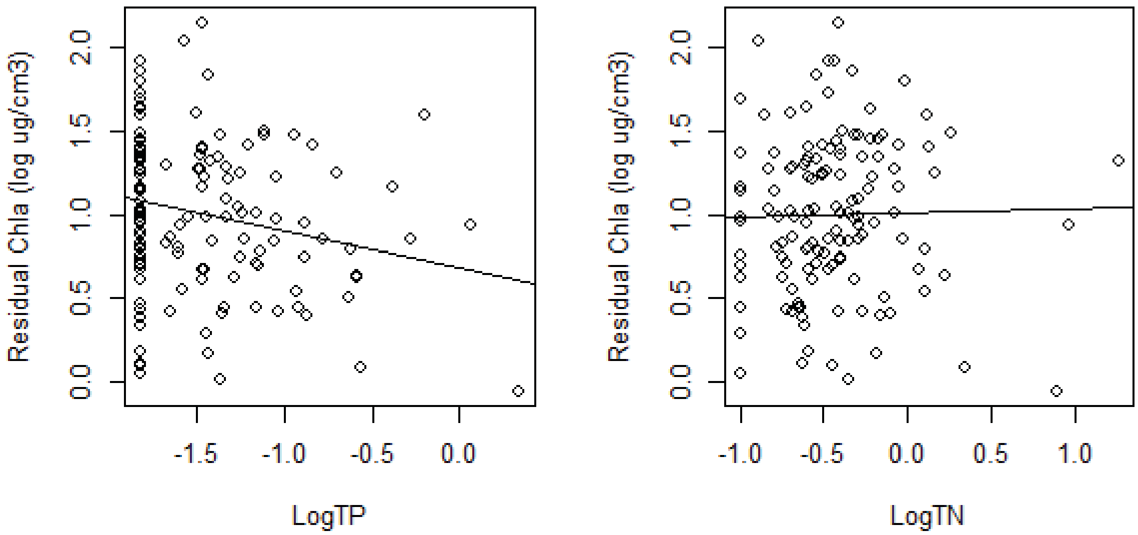

Figure H-5. Relationships between residuals of chl-a after accounting for conductivity and nutrients in the NMED data set. R^2 values for regressions are 0.046 ($p<0.05$) and 0.00 ($p>0.10$) for TP and TN, respectively.

Benthic chl-a variance in samples collected over several visits within the same sites was investigated. Using a mixed model, the among-site variance of log(chl-a) was 0.091 while the within-site variance was 0.146. Therefore, at most 38% of the variability in chl-a measurements can be explained with differences in site characteristics (e.g., nutrient concentrations). In Figure H-6, the mean chl-a for each site was plotted on the horizontal axis and for each mean value, the observed sampled values. So, the vertical spread of each set of points is the within-site variability, and the spread of values across the horizontal axis is the among-site variability.

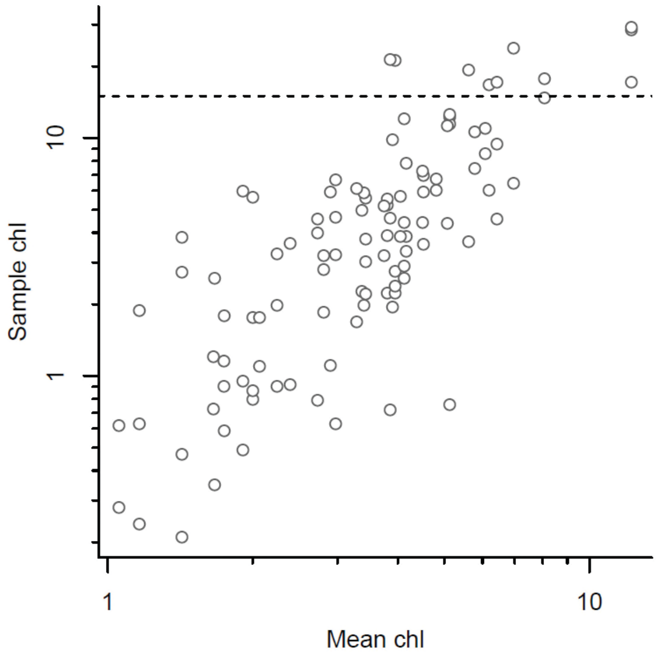

Figure H-6. Benthic chl-a (µg/cm^2) plotted as a mean of multiple samples within sites on the x-axis (Mean chl) and as individual samples on the y-axis (Sample chl). Dashed line is at 15 µg/cm^2.

Appendix I Diatom Metric Correlations

NMED and NRSA data were analyzed separately. For TN in the NMED data, 21 of the 68 diatom metrics were significantly ($p<0.05$) correlated (Table I-1). The correlations were strongest in the flat site class, where 27 metrics were significantly correlated. In the moderate and steep site classes, only 0 and 3 metrics, respectively, were significantly correlated to TN. In the flat site class, the percentage of tolerant organisms (category 1 in the metric names) increases with increasing TN and the percentage of sensitive organisms (category 2) decreases, as expected. This can be seen in the NAWQA TN 1 metric (Figure I-1). The moderate site class does not have any significant correlations, though the trends (signs of the correlation coefficient) appear to follow those seen in the significant metrics of the flat site class (Table I-1). The steep site class shows increasing percentages of non-nitrogen-fixing diatoms (pi_NF_20) with increasing TN (Table I-1). Percentages of diatoms in the order Fragilariales increase with increasing TN in the flat site class. In the steep site class, diatoms in the Surirellales and Tabellariales orders increase with increasing TN.

For TP in the NMED data, 36 of the 68 diatom metrics were significantly correlated ($p<0.05$) in all sites combined (Table I-1). Based on the number of significant correlations, diatoms appear to be more sensitive to TP than to TN. In the site classes, only the TP Flat site class had several correlated metrics (28) compared to fewer in the TP High Volcanic (9) and TP Steep (5) classes. In each of the classes, the TP sensitive diatoms had lower percentages with increasing TP, as shown for metrics pi_NAWQA_TP_2 (Figure I-2) and pi_Ptpv_TP_all_Lo.

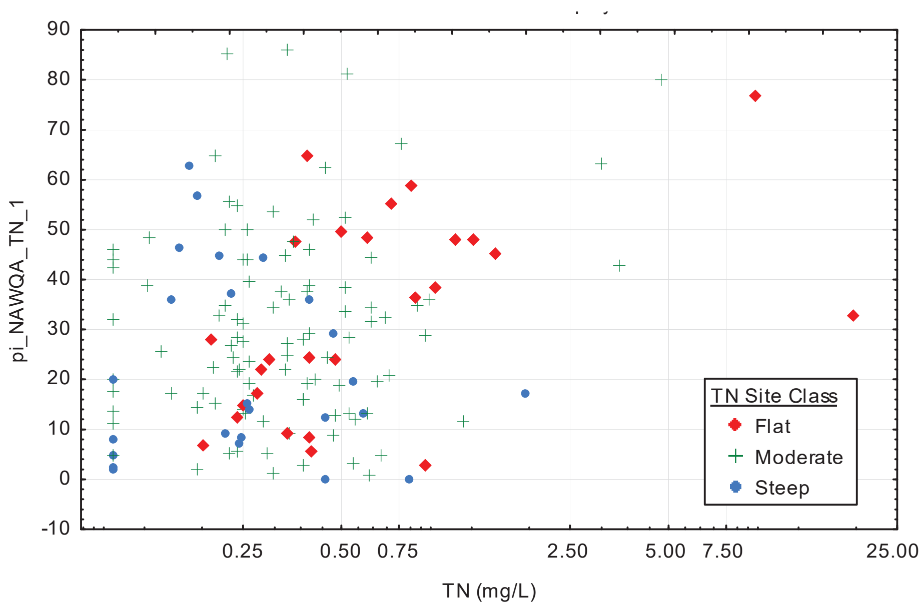

Figure I-1. Metric values (% NAWQA TN category 1 individuals) against TN concentrations, marked by site class.

Table I-1. Spearman rank correlation coefficients for TN and TP against diatom metrics in all NMED sites and by site class. Marked correlations are significant at p <.05.

Metric	TN All Grps	TN Flat	TN Moderate	TN Steep	TP All Grps	TP High Volcanic	TP Flat	TP Steep
N:	151	26	100	25	151	18	105	28
ni_total	0.10	0.47	-0.02	-0.03	0.20	0.23	0.19	0.21
nt_total	0.04	-0.13	0.06	0.10	0.06	-0.14	0.09	-0.32
pi_Ben_Ses_1	0.01	-0.04	-0.01	0.18	-0.04	-0.22	0.11	-0.25
pi_Ben_Ses_2	-0.01	0.03	-0.01	-0.19	0.00	0.12	-0.14	0.17
pi_Diat_CA_1	0.28	0.21	0.17	0.29	-0.06	-0.02	0.02	-0.37
pi_Diat_CA_2	-0.12	-0.13	0.00	-0.08	0.01	-0.27	0.11	0.04
pi_Motility_1	0.20	0.30	0.08	0.21	0.19	-0.16	0.22	-0.40
pi_Motility_2	-0.21	-0.30	-0.10	-0.21	-0.19	0.16	-0.22	0.41
pi_NAWQA_CL_1	0.17	0.40	-0.07	0.33	0.01	0.42	0.04	-0.07
pi_NAWQA_CL_2	-0.15	-0.42	-0.06	0.05	-0.27	-0.23	-0.17	-0.11
pi_NAWQA_Cond_1	0.24	0.25	0.11	0.14	0.05	0.00	0.01	-0.04
pi_NAWQA_Cond_2	-0.03	0.10	0.04	-0.07	-0.14	-0.38	-0.07	-0.14
pi_NAWQA_TN_1	0.15	0.51	0.07	-0.05	0.33	-0.24	0.43	-0.36
pi_NAWQA_TN_2	0.01	-0.43	0.13	0.12	-0.21	-0.35	-0.22	-0.01
pi_NAWQA_TP_1	0.18	0.51	0.11	-0.17	0.32	0.07	0.36	-0.39
pi_NAWQA_TP_2	0.04	-0.10	0.12	0.22	-0.23	-0.71	-0.17	-0.22
pi_NF_1	-0.12	-0.40	-0.02	-0.38	0.02	-0.21	0.01	-0.01
pi_NF_2	0.07	0.41	-0.09	0.45	-0.05	0.10	-0.01	-0.04
pi_Ptpv_TN_all_Hi	0.14	0.48	0.05	-0.02	0.38	0.03	0.42	-0.25
pi_Ptpv_TN_all_Lo	-0.03	-0.44	0.06	0.17	-0.20	-0.31	-0.19	-0.13
pi_Ptpv_TP_all_Hi	0.18	0.48	0.08	-0.12	0.32	0.22	0.31	-0.35
pi_Ptpv_TP_all_Lo	-0.01	-0.16	0.03	0.23	-0.24	-0.61	-0.18	-0.28
x_Ptpv_RP_all	0.10	0.34	0.02	-0.30	0.37	0.62	0.30	0.00
x_Ptpv_RN_all	0.10	0.53	-0.01	-0.11	0.31	0.17	0.33	-0.08
x_Kelly_WMS	0.17	0.47	0.12	-0.19	0.39	0.09	0.47	-0.15
x_Kelly_TDI	0.17	0.47	0.12	-0.19	0.39	0.09	0.47	-0.15
x_Shan_e	0.01	-0.14	-0.06	0.23	0.08	-0.13	0.06	-0.23
wa_Poll_Class	0.02	-0.23	0.17	0.16	-0.21	-0.43	-0.13	0.29
wa_Poll_Tol	0.10	-0.17	0.18	0.28	-0.16	-0.36	0.01	-0.26
wa_Salinity	0.21	0.34	0.09	0.01	0.16	0.04	0.22	-0.55
wa_Saprobic	0.03	0.26	-0.10	0.08	0.33	-0.06	0.31	0.24
wa_Org_N	0.13	0.50	0.03	-0.09	0.31	0.20	0.34	-0.18
wa_OxyTol	0.01	0.48	-0.14	-0.05	0.32	0.17	0.31	0.21
wa_pH	-0.09	-0.25	0.05	-0.09	-0.12	0.02	-0.07	-0.04
wa_Moisture	0.03	0.15	0.05	-0.16	0.08	-0.18	0.07	-0.30
pi_TPReqMA97_0	-0.14	-0.16	-0.13	0.06	0.06	0.18	0.10	-0.32
pi_TPSENSMA97_0	-0.06	0.18	-0.04	-0.17	0.26	0.06	0.34	-0.29

Metric	TN				TP			
	All Grps	Flat	Moderate	Steep	All Grps	High Volcanic	TP Flat	TP Steep
pi_TPReqMA97_1	0.08	0.36	0.06	-0.25	0.34	-0.35	0.41	-0.11
pi_TPSENSMA97_1	-0.04	0.00	-0.08	0.06	-0.01	0.40	-0.11	0.05
pi_Trophic_12	-0.08	-0.22	-0.06	-0.09	-0.15	-0.37	-0.24	-0.22
pi_Trophic_56	0.11	0.50	0.03	-0.12	0.27	0.11	0.36	-0.28
wa_AVGTSIC	0.12	0.55	0.09	-0.22	0.33	0.02	0.35	0.05
wa_FTSIC	0.09	0.41	0.07	-0.18	0.30	-0.09	0.35	-0.09
wa_FTSIC2	0.09	0.42	0.06	-0.19	0.31	-0.09	0.35	-0.10
wa_FTSIC3	-0.07	-0.26	-0.03	-0.02	0.02	0.27	-0.05	0.36
wa_MAIATSIC	0.12	0.55	0.09	-0.22	0.33	0.02	0.35	0.05
wa_NEWTSIC	0.07	0.58	0.02	-0.13	0.25	0.20	0.28	0.05
wa_OptCat_DisTotMMI	0.24	0.42	0.12	0.13	0.23	0.44	0.18	-0.11
wa_OptCat_L1DisTot	0.27	0.39	0.15	0.17	0.12	0.49	0.10	-0.27
wa_OptCat_L1Ptl	0.18	0.47	0.06	0.00	0.34	0.34	0.28	-0.08
wa_OptCat_LCond	0.21	0.35	0.07	0.07	0.09	0.52	0.08	-0.28
wa_OptCat_LNtl	0.26	0.41	0.14	0.21	0.17	0.45	0.13	-0.11
wa_OptCat_NutMMI	0.22	0.45	0.09	0.11	0.27	0.38	0.22	-0.09
wa_OptCat_PctFN	0.17	0.39	0.01	0.26	0.15	0.42	0.08	-0.08
wa_OptCat_pH	0.03	0.02	-0.08	0.09	-0.07	0.55	-0.05	-0.25
wa_OptCat_XEMBED	0.18	0.11	0.04	0.26	0.12	0.51	0.03	-0.29
pi_Achnanthales	0.05	-0.12	0.13	0.24	-0.16	-0.33	-0.09	-0.15
pi_Centrales	-0.11	0.08	-0.06	-0.27	0.10	-0.23	0.14	-0.11
pi_Cymbellales	-0.08	0.10	-0.10	-0.01	-0.05	-0.14	-0.06	0.16
pi_Eunotiales	0.01	-0.12	0.09	-0.28	0.00	-0.26	-0.06	
pi_Fragilariales	-0.24	-0.64	-0.16	0.09	-0.06	0.04	-0.08	0.06
pi_Naviculales	0.09	0.05	-0.01	0.12	0.04	0.27	0.00	-0.42
pi_Pennales	0.00	0.13	-0.01	-0.17	0.20	-0.19	0.29	-0.22
pi_Surirellales	0.22	0.24	0.15	0.52	0.11	0.30	0.22	-0.03
pi_Tabellariales	0.19	0.08	0.09	0.41	-0.13		-0.06	-0.25
pi_Thalassiosirales	0.06	0.01	0.02	-0.26	0.11	0.22	-0.06	0.29
wa_KY_PTI	-0.14	0.12	-0.06	-0.15	-0.19	-0.86	-0.05	0.16
wa_MT_Tol	-0.01	-0.25	0.13	0.13	-0.23	-0.54	-0.14	0.31

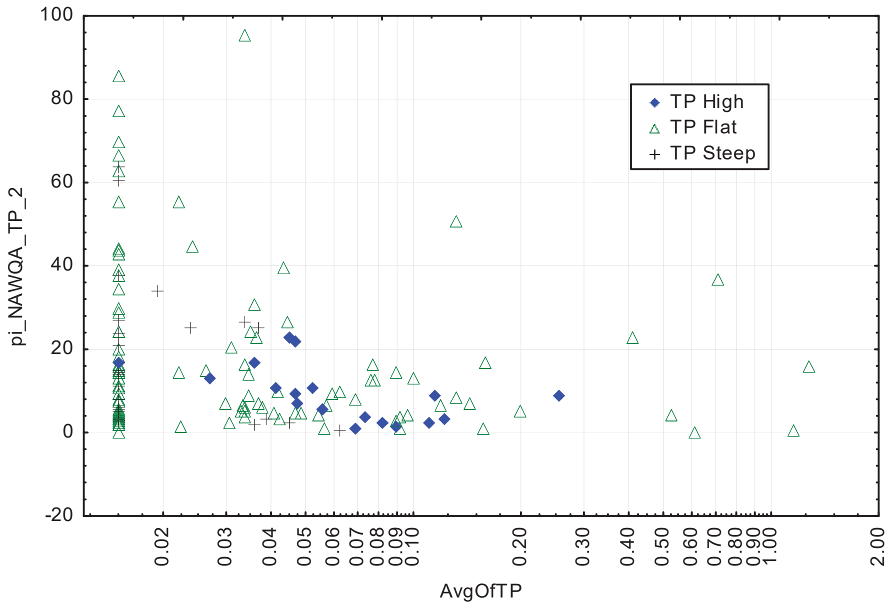

Figure I-2. Metric values (% NAWQA TP category 2 individuals) against TP concentrations, marked by site class.

A similar correlation analysis was conducted using the NRSA periphyton data with 48 valid samples. Almost all significant correlations were in the TN Flat site class for TN and in the TP Flat-Moderate class for TP (Table I-2). In general, correlations in the NRSA data set were stronger than those in the NMED data set. There were not enough TN Steep or TP Steep sites for meaningful correlation analysis. In plots with general disturbance metrics, patterns that are apparent in the whole data set are not necessarily obvious in the individual site classes (Figures I-3 and I-4). This might be due to ranges of nutrient concentrations that are broad over all sites and narrower in the individual site classes.

Table I-2. Spearman rank correlation coefficients for TN and TP against diatom metrics in all NRSA sites and by site class. Marked correlations are significant at $p < 0.05$.

Metric	TN All Grps	TN Flat	TN Moderate	TP All Grps	TP High Volcanic	TP Flat-Moderate
N:	48	22	21	47	13	27
ni_total	-0.21	-0.40		-0.12	0.08	-0.28
nt_total	0.08	-0.07	0.04	0.27	0.14	0.12
pi_Ben_Ses_1	-0.30	-0.47	-0.08	-0.33	0.01	-0.39
pi_Ben_Ses_2	0.46	0.45	0.40	0.36	0.33	0.38
pi_Diat_CA_1	0.48	0.73	0.08	0.15	-0.32	0.36
pi_Diat_CA_2	-0.27	-0.46	-0.10	0.14	-0.36	-0.08
pi_Motility_1	0.60	0.68	0.15	0.42	0.49	0.47
pi_Motility_2	-0.59	-0.69	-0.17	-0.44	-0.37	-0.52
pi_NAWQA_CL_1	0.38	0.55	-0.09	0.15	-0.36	0.33
pi_NAWQA_CL_2	-0.54	-0.70	0.03	-0.42	-0.42	-0.48
pi_NAWQA_Cond_1	0.56	0.75	-0.05	0.13	-0.33	0.37
pi_NAWQA_Cond_2	0.05	-0.19	0.41	0.03	-0.27	0.07
pi_NAWQA_TN_1	0.29	0.31	-0.02	0.42	0.60	0.35
pi_NAWQA_TN_2	-0.51	-0.65	-0.01	-0.33	-0.50	-0.40
pi_NAWQA_TP_1	0.47	0.53	0.00	0.30	0.40	0.26
pi_NAWQA_TP_2	-0.42	-0.50	0.28	-0.28	0.05	-0.24
pi_NF_1	-0.32	-0.25	-0.40	-0.06	-0.09	-0.42
pi_NF_2	0.34	0.14	0.44	0.06	0.18	0.29
pi_Ptpv_TN_all_Hi	0.26	0.30	-0.05	0.45	0.59	0.38
pi_Ptpv_TN_all_Lo	-0.53	-0.73	-0.04	-0.34	-0.41	-0.48
pi_Ptpv_TP_all_Hi	0.49	0.56	0.03	0.36	0.49	0.33
pi_Ptpv_TP_all_Lo	-0.42	-0.46	0.30	-0.28	0.03	-0.22
x_Ptpv_RP_all	0.51	0.60	-0.21	0.34	0.24	0.29
x_Ptpv_RN_all	0.49	0.65	0.03	0.43	0.38	0.47
x_Kelly_WMS	0.27	0.34	-0.30	0.27	0.40	0.17
x_Kelly_TDI	0.27	0.34	-0.30	0.27	0.40	0.17
x_Shan_2	0.09	-0.01	-0.16	0.30	0.21	0.15
wa_Poll_Class	-0.60	-0.46	-0.31	-0.47	-0.38	-0.54
wa_Poll_Tol	-0.34	-0.29	0.04	-0.36	-0.59	-0.27
wa_Salinity	0.55	0.75	0.13	0.36	0.19	0.44
wa_Saprobic	0.28	0.22	0.07	0.56	0.37	0.53
wa_Org_N	0.23	0.36	0.10	0.50	0.72	0.58
wa_OxyTol	0.35	0.35	0.08	0.48	0.27	0.47
wa_pH	-0.37	0.02	-0.24	-0.27	0.08	-0.38
wa_Moisture	0.03	0.03	0.32	0.06	0.25	0.36
pi_TPReqMA97_0	0.18	0.37	-0.07	0.32	0.24	0.26
pi_TPSENSMA97_0	0.05	-0.07	-0.10	0.38	0.58	0.20

Metric	TN All Grps	TN Flat	TN Moderate	TP All Grps	TP High Volcanic	TP Flat-Moderate
pi_TPReqMA97_1	0.07	0.00	-0.21	0.38	0.42	0.14
pi_TPSENSMA97_1	0.36	0.41	-0.10	0.17	0.36	0.12
pi_Trophic_12	0.14	-0.03	0.14	0.02	0.55	-0.08
pi_Trophic_56	0.13	0.37	-0.12	0.12	0.07	-0.04
wa_AVGTSIC	-0.12	-0.15	-0.33	-0.07	-0.10	-0.30
wa_FTSIC	-0.16	-0.35	-0.17	-0.14	0.15	-0.26
wa_FTSIC2	-0.17	-0.36	-0.17	-0.14	0.15	-0.24
wa_FTSIC3	-0.21	-0.48	-0.06	-0.04	0.37	-0.06
wa_MAIATSIC	-0.12	-0.15	-0.33	-0.07	-0.10	-0.30
wa_NEWTSIC	0.04	0.20	-0.48	-0.01	-0.35	-0.10
wa_OptCat_DisTotMMI	0.61	0.82	-0.05	0.35	0.30	0.43
wa_OptCat_L1DisTot	0.64	0.84	0.14	0.31	-0.14	0.48
wa_OptCat_L1Ptl	0.58	0.80	-0.17	0.40	0.51	0.41
wa_OptCat_LCond	0.63	0.80	0.09	0.15	-0.41	0.32
wa_OptCat_LNtl	0.65	0.82	0.08	0.32	0.14	0.47
wa_OptCat_NutMMI	0.60	0.78	-0.07	0.36	0.40	0.42
wa_OptCat_PctFN	0.73	0.81	0.33	0.33	0.20	0.46
wa_OptCat_pH	0.24	0.44	-0.07	-0.17	-0.53	-0.31
wa_OptCat_XEMBED	0.65	0.75	0.04	0.34	0.18	0.41

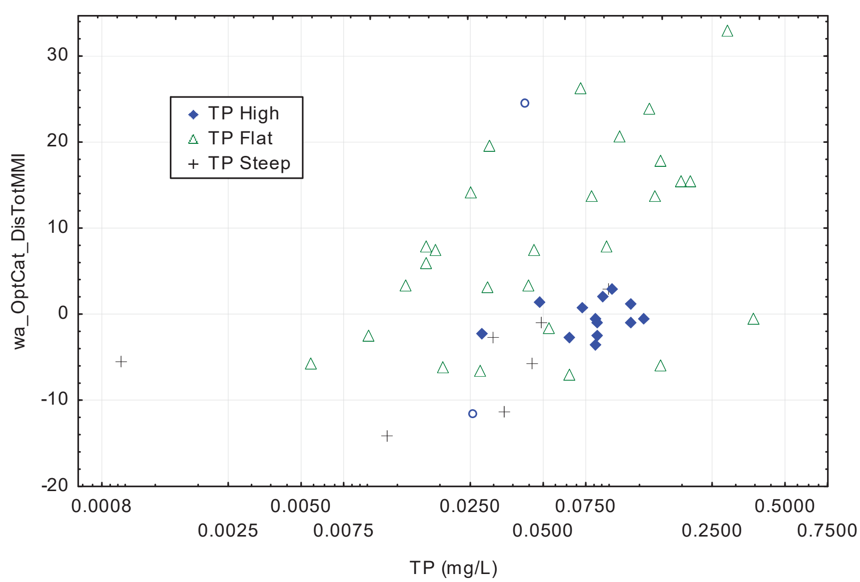

Figure I-3. Diatom metric values (weighted average total disturbance multimetric index) against TP concentrations, marked by site class; NRSA data.

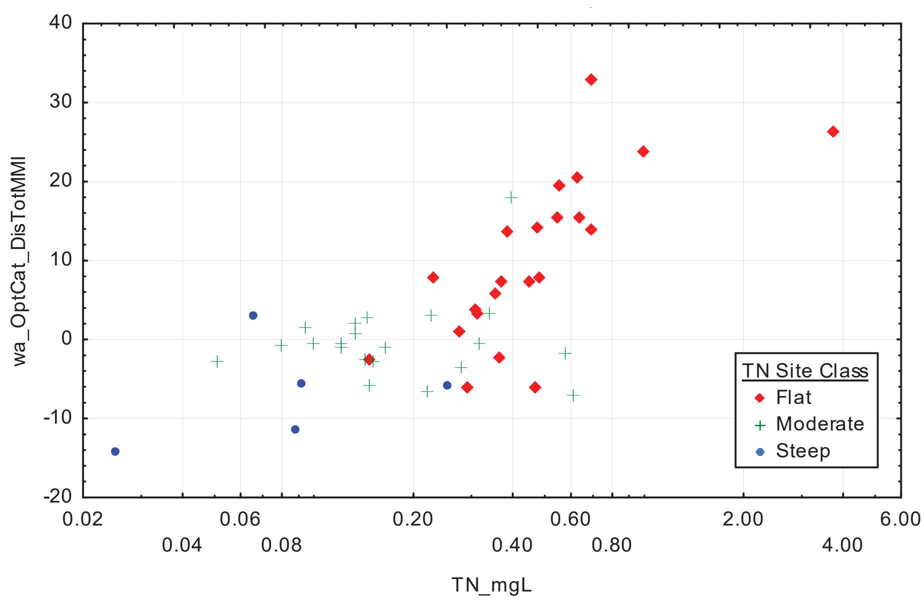

Figure I-4. Diatom metric values (weighted average total disturbance multimetric index) against TN concentrations, marked by site class; NRSA data.

To summarize the diatom data, another Spearman correlation analysis was conducted on the NMED and NRSA data combined, also combining the nutrient site classes. Significant correlations between diatoms, TN, TP, and chlorophyll were identified for 29 metrics (Table I-3). TP was significantly related to most of the metrics with significant correlations in more than one measure. The fewest significant correlations were with chlorophyll. Some of the chlorophyll correlations were opposite the nutrient correlations (e.g. nt_total, x_Shan_2, and wa_Saprobic). Not all sites had chlorophyll measurements, so the opposite responses might be related to the specific data subset. However, more diverse diatom taxa (nt_total, x_Shan_2) were observed with either low chlorophyll or high TP. This suggests that diatom communities associated with high chlorophyll might be composed mostly of a few dominant taxa. These might be taxa that can thrive among the soft algae that contribute to a higher chlorophyll concentration, but are not counted in the diatom metrics. In contrast, diatom communities in high TP sites had high diversity, suggesting that high TP favors several types of diatoms. TP and chlorophyll were negatively and non-significantly correlated (Spearman rho = -0.13, p>0.05).

Table I-3. Spearman correlation coefficients between diatom metrics and chlorophyll a, TN and TP in all stream sites. Marked correlations are significant at p <0.05.

	Chl_a	TN	TP	
Metric \ N	157	200	200	Metric description
nt_total	-0.25	-0.03	0.25	Number of diatom taxa
pi_Motility_1	0.01	0.27	0.27	% highly Motile
pi_NAWQA_CL_2	-0.07	-0.22	-0.34	% Chloride sensitive diatoms
pi_NAWQA_Cond_1	0.05	0.27	0.14	% conductivity tolerant diatoms
pi_NAWQA_Cond_2	-0.22	-0.04	-0.07	% conductivity sensitive diatoms
pi_NAWQA_TN_1	0.03	0.18	0.34	% TN tolerant diatoms
pi_NAWQA_TN_2	-0.16	-0.11	-0.24	% TN sensitive diatoms
pi_NAWQA_TP_1	-0.11	0.23	0.36	% TP tolerant diatoms
pi_NAWQA_TP_2	-0.19	-0.04	-0.28	% TP sensitive diatoms
pi_Ptpv_TN_all_Hi	0.07	0.17	0.38	% high TN all regions
pi_Ptpv_TN_all_Lo	-0.14	-0.16	-0.23	% low TN all regions
pi_Ptpv_TP_all_Hi	-0.07	0.23	0.37	% high TP all regions
pi_Ptpv_TP_all_Lo	-0.18	-0.08	-0.29	% low TP all regions
x_Ptpv_RP_all	0.09	0.17	0.40	Ratio of high TP to low TP (all regions)
x_Ptpv_RN_all	0.11	0.19	0.34	Ratio of high TN to low TN (all regions)
x_Kelly_TDI	0.11	0.19	0.38	Kelly's Index.
x_Shan_2	-0.21	-0.03	0.23	Shannon-Weiner Index
wa_Salinity	0.00	0.27	0.25	weighted average, Salinity
wa_Saprobic	-0.19	0.07	0.38	weighted average, Saprobic
wa_Org_N	-0.05	0.19	0.31	weighted average, organic N
wa_OptCat_DisTotMMI	0.12	0.29	0.31	weighted average, multi-metric index
wa_OptCat_L1DisTot	0.14	0.32	0.22	weighted average, disturbance index
wa_OptCat_L1Ptl	0.07	0.23	0.40	Western EMAP weighted average TP score
wa_OptCat_LCond	0.20	0.27	0.14	weighted average conductivity score
wa_OptCat_LNtl	0.15	0.31	0.26	Western EMAP weighted average TN score
wa_OptCat_NutMMI	0.11	0.27	0.34	Western EMAP multi-metric index of nutrients
wa_OptCat_PctFN	0.08	0.25	0.26	weighted average % fine score
wa_OptCat_XEMBED	0.13	0.23	0.25	weighted average embeddedness score
wa_OptCat_pH	0.28	0.06	-0.07	weighted average pH

The weighted average pH diatom metric was most strongly correlated with chlorophyll. Diatoms that are better suited to high pH were more common in sites with high benthic chlorophyll. The mechanism could be that sites with high chlorophyll are producing more oxygen, which increases pH and benefits the diatoms suited to higher pH. The mechanism is further supported by the relationship between chlorophyll and the saprobic metric, which indicates that taxa preferring high dissolved oxygen (low saprobic conditions) are in sites with high benthic chlorophyll. High TP is associated with sites with diatoms preferring low DO (high saprobic) conditions.

In addition, TP was positively correlated with diatom metrics that indicate other stressors, such as general disturbance, conductivity, and fine substrates (wa_OptCat_L1DisTot, wa_OptCat_LCond, wa_OptCat_PctFN, and wa_OptCat_XEMBED). If there are multiple covarying stressors in the sites with high nutrients, that might change the types of algal growth that occurs in the sites.

Most of the significant correlations with TP were also significant with TN, though in general, the correlations with TN were weaker. The only correlations that were somewhat stronger with TN were with conductivity (pi_NAWQA_Cond_1 and wa_OptCat_LCond). TN does not appear to have strong association with taxa diversity (nt_total and x_Shan_2) or the saprobic conditions (wa_Saprobic).

Based on the multiple correlation analyses, we selected responsive metrics to carry forward in analyses. These included wa_OptCat_DisTotMMI, wa_OptCat_L1DisTot, wa_OptCat_L1Ptl, wa_OptCat_LNtl, wa_OptCat_NutMMI pi_NAWQA_TN_1, pi_Ptpv_TP_all_Hi, and x_Shan_e.

In an investigation of possible confounding factors, the significance of the data source for predicting selected metrics was checked using multiple regressions with sample year, latitude, and longitude as predictors, in addition to nutrients. Sampling year was significant in regressions for some metrics (Figure I-5). In further investigations, we found that year was also related to latitude and longitude, with 2006 sites further north and east than in other years (Figure I-6). Year and location are apparently related to sampling design, which should not affect basic nutrient – diatom relationships. Data source (NMED or NRSA) was also significant in multiple regressions, cautioning against combining data sets in analysis.

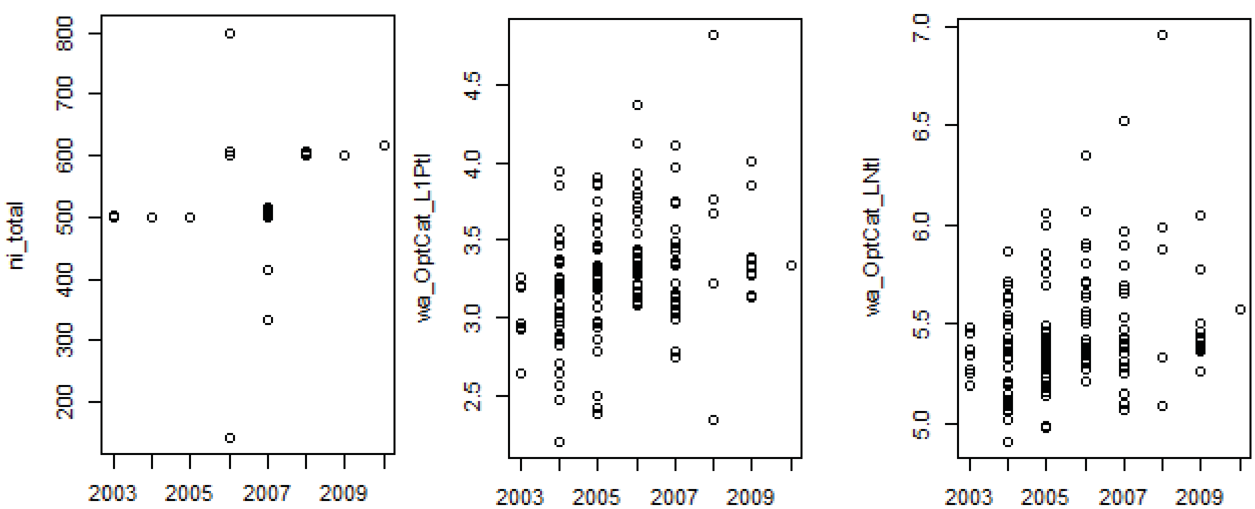

Figure I-5. Diatom metrics in NMED data over sampling years.

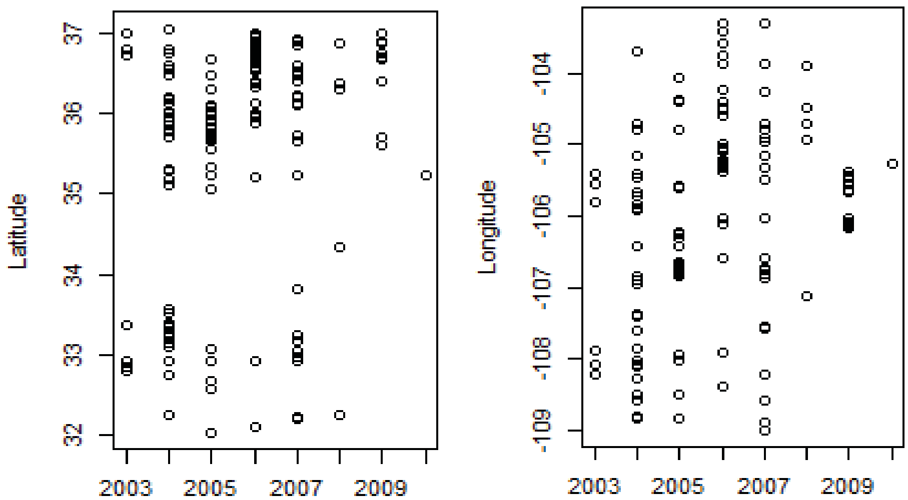

Figure I-6. Latitude and longitude in to relation to diatom sample years.

In multiple regression analyses, a single nutrient (either TN or TP) was first used in the equations. Then pH, conductivity, and turbidity were added in the models. Separate models for NMED and NRSA data sets were run. With a selection of general response metrics, TN was a good predictor of the weighted average metrics when regressed without other predictors (Table I-4). When other variables were allowed in the models, conductivity (EC) often became the dominant predictor, especially in the NMED data. TP regressions were also significant, though other variables entered in addition to TP when allowed.

Table I-4. Results of regression analyses on diatom metrics. The metrics were predicted using either TN or TP alone and then with either nutrient and turbidity, conductivity, and pH. Variables were not significant (ns) in the models or significant at p levels <0.001 (***), <0.01 (**), <0.05 (*), or <0.10 (.).

Data Source	NMED				NRSA			
Nutrient	TN		TP		TN		TP	
Predicted: nt_total								
log10(TN_Calc) or log10(AvgOfTP)	ns	ns	ns	ns	ns	ns	*	*
log10(AvgOfturbidity		ns		ns		ns		ns
log10(AvgOfEC)		ns		ns		ns		ns
AvgOfpH		ns		ns		ns		ns
Predicted: x_Shan_e								
log10(TN_Calc) or log10(AvgOfTP)	ns	ns	ns	ns	ns	ns	**	*
log10(AvgOfturbidity		ns		ns		ns		ns
log10(AvgOfEC)		ns		ns		ns		ns
AvgOfpH		*		*		ns		ns
Predicted: wa_OptCat_DisTotMMI								
log10(TN_Calc) or log10(AvgOfTP)	***	ns	**	***	***	ns	**	*
log10(AvgOfturbidity		ns		ns		.		.
log10(AvgOfEC)		***		***		.		***
AvgOfpH		ns		ns		ns		ns
Predicted: wa_OptCat_L1DisTot								
log10(TN_Calc) or log10(AvgOfTP)	***	ns	.	ns	***	ns	*	*
log10(AvgOfturbidity		ns		ns		*		.
log10(AvgOfEC)		***		***		*		***
AvgOfpH		ns		ns		ns		ns
Predicted: wa_OptCat_LNtl								
log10(TN_Calc) or log10(AvgOfTP)	***	ns	**	**	***	ns	*	*
log10(AvgOfturbidity		ns		ns		.		.
log10(AvgOfEC)		***		***		*		***
AvgOfpH		ns		ns		ns		ns
Predicted: wa_OptCat_L1Ptl								
log10(TN_Calc) or log10(AvgOfTP)	***	ns	***	***	***	ns	**	**
log10(AvgOfturbidity		ns		ns		.		ns
log10(AvgOfEC)		***		***		ns		*
AvgOfpH		.		.		ns		ns

Correlations among the water quality variables in the diatom data set were calculated to see if the predictors were correlated (Table I-5). TN and TP were correlated at a Spearman rho of 0.31. Both TP and TN were correlated strongly and positively with turbidity. TN was positively correlated with conductivity (Figure I-7). TP was not strongly correlated with conductivity, though both were significant in predictive models of diatom metrics. The correlations with nutrients and other water quality measures are not unexpected. These might help in interpreting stressor-response relationships and multiple stressor effects should be considered. However, given relatively strong correlations with the metrics and nutrients without the interacting predictors, adjustments for additional predictors might not increase our ability to identify nutrient criteria.

Table I-5. Spearman rank correlation coefficients for TN, TP, and possible modifying factors in diatom relationships.

		TP	TN	3	4	5	6	7	8	9	10
1	AvgOfTP										
2	TN_Calc	**0.31**									
3	Latitude	0.09	0.16								
4	Longitude	-0.08	**0.32**	**0.28**							
5	AvgOfChl_a	0.05	-0.05	-0.01	0.22						
6	AvgOfpH	0.03	-0.05	**0.38**	-0.02	0.02					
7	AvgOfEC	-0.10	**0.30**	-0.19	**0.37**	**0.46**	-0.05				
8	AvgOftemperature	**0.28**	0.16	-0.09	0.00	0.01	-0.01	0.05			
9	AvgOfDOsat	-0.02	0.03	0.18	-0.04	0.13	**0.32**	0.10	**0.26**		
10	AvgOfturbidity	**0.48**	**0.41**	0.17	0.17	0.15	0.02	0.15	**0.26**	0.07	
11	AvgOfSalinity	-0.06	**0.30**	**-0.27**	**0.41**	**0.45**	-0.13	**0.93**	0.05	0.03	0.11

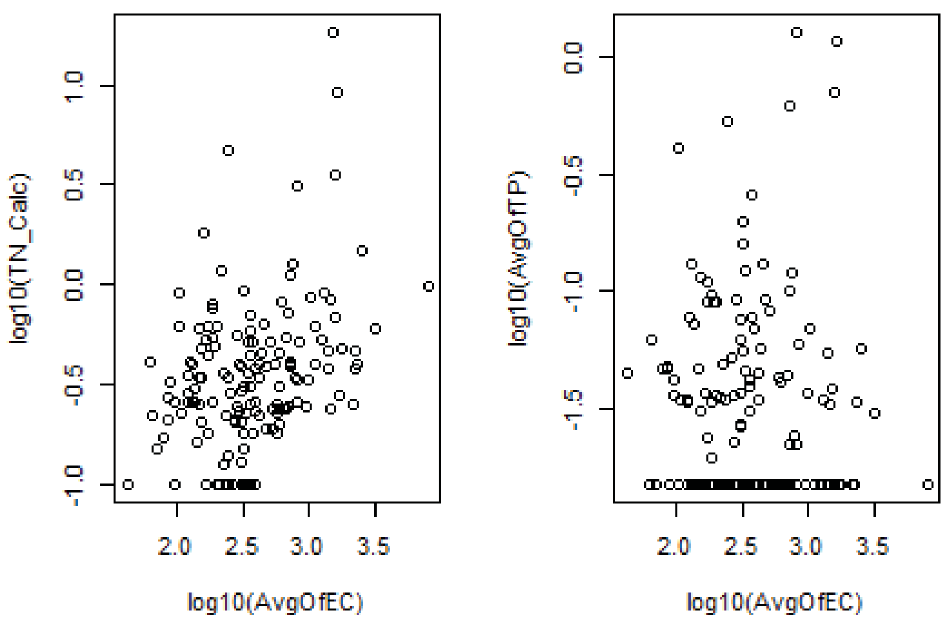

Figure I-7. Nutrient concentrations in relation to conductivity (NMED data).

We combined NMED and NRSA data in future analyses because the data sets were indiscernible in some plots of nutrients and metric values (Figure I-8). For this important metric, regression equations were similar for the two data sets and a regression line on the combined data set would give a comprehensive estimate for all data.

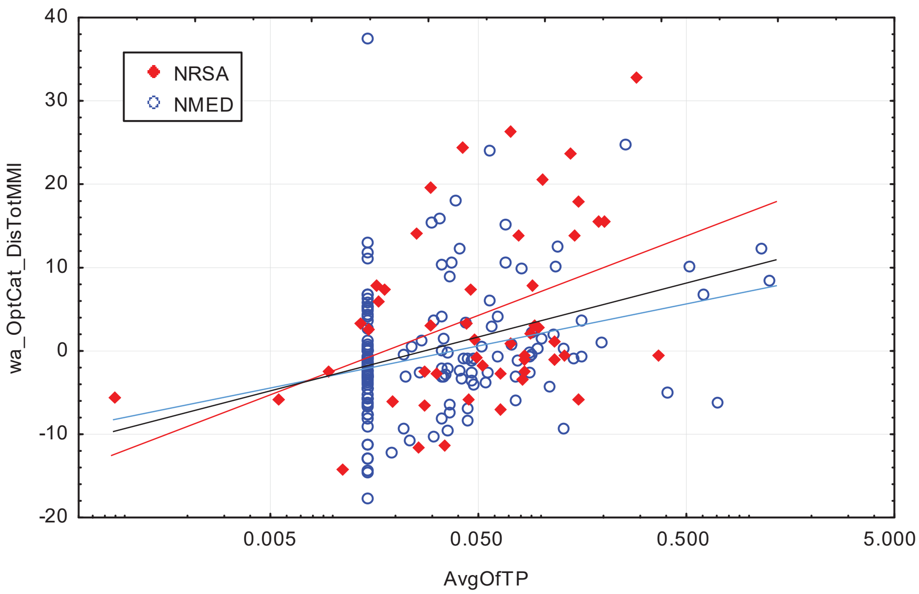

Figure I-8. Diatom metric in relation to TP showing the two data sources with regression lines of matching colors for the separate data sets and a black regression line for the combined data set.

Appendix J Benthic Macroinvertebrate Correlations

Table J-1. Spearman Correlation coefficients for benthic metrics and diel DO statistics in all sites and by TP site class.

	All Sites (N = 77)					High-Volcanic (N= 20)				Flat-Mod (N = 41)				Steep (N = 16)			
Statistic Metric	GPP	ER	DO min	Delta DO	Prod 4hr	GPP	DO min	Delta DO	Prod 4hr	GPP	DO min	Delta DO	Prod 4hr	GPP	DO min	Delta DO	Prod 4hr
TotalInd	0.04	0.00	-0.05	0.05	0.06	-0.09	0.24	-0.12	-0.14	0.03	-0.25	0.10	0.13	0.14	0.01	0.15	0.01
TotalTax	-0.03	-0.06	0.06	-0.01	0.03	-0.04	-0.01	-0.10	0.05	0.28	-0.10	0.15	0.20	0.28	-0.28	-0.17	0.14
InsectTax	-0.05	-0.09	0.09	-0.02	-0.01	0.21	-0.11	0.15	0.24	0.13	0.04	0.03	0.04	0.33	-0.16	-0.13	0.08
EPTTax	-0.07	-0.12	0.27	-0.16	-0.19	0.23	0.28	-0.31	-0.19	-0.16	0.30	-0.23	-0.27	0.08	-0.06	-0.19	-0.03
EphemTax	-0.08	0.00	0.30	-0.13	-0.14	-0.08	0.39	-0.47	-0.36	-0.01	0.16	-0.08	-0.13	0.26	0.16	-0.19	0.00
PlecoTax	-0.20	-0.20	0.24	-0.28	-0.38	0.28	0.41	-0.01	-0.04	-0.56	0.29	-0.39	-0.49	0.14	0.19	-0.30	-0.51
TrichTax	0.04	-0.11	0.08	-0.02	-0.03	0.25	-0.05	-0.12	-0.08	0.03	0.16	-0.17	-0.11	0.11	-0.26	0.10	0.21
DipTax	0.06	-0.14	-0.08	0.07	0.06	0.27	-0.08	0.40	0.40	0.24	-0.19	0.16	0.16	-0.02	-0.08	-0.42	-0.24
ChiroTax	0.13	-0.14	-0.10	0.13	0.14	0.28	-0.09	0.42	0.43	0.37	-0.28	0.29	0.32	0.05	0.00	-0.42	-0.27
ColeoTax	-0.14	0.01	0.16	-0.02	-0.02	-0.06	-0.14	-0.03	0.11	-0.16	0.22	-0.08	-0.13	-0.08	0.08	0.27	0.42
CrMolTax	0.06	0.08	-0.25	0.16	0.22	-0.67	-0.29	-0.32	-0.30	0.30	-0.23	0.24	0.32	-0.11	-0.41	0.41	0.46
OligoTax	0.15	-0.11	-0.04	-0.12	-0.03	-0.38	0.40	-0.52	-0.52	0.18	-0.19	-0.05	0.02	0.62	-0.03	-0.15	0.03
Shan_2	-0.02	-0.04	0.03	0.00	-0.02	-0.23	0.19	-0.33	-0.31	0.28	-0.06	0.14	0.12	-0.12	-0.48	-0.29	-0.02
Dom01Pct	0.14	-0.11	-0.17	0.08	0.14	0.42	-0.43	0.73	0.71	-0.08	-0.21	-0.02	0.02	0.59	0.35	0.23	0.11
D	0.07	0.00	-0.06	0.05	0.10	0.33	-0.29	0.55	0.54	-0.20	-0.03	-0.08	-0.05	0.38	0.44	0.31	0.10
Evenness	-0.01	-0.05	0.06	-0.02	-0.05	-0.22	0.18	-0.37	-0.35	0.20	0.00	0.09	0.07	-0.19	-0.39	-0.38	-0.12
D_Mg	0.04	-0.07	0.05	0.04	0.06	-0.05	0.06	-0.09	0.05	0.34	-0.08	0.19	0.23	0.28	-0.20	-0.24	0.07
EPTPct	-0.06	0.09	0.12	-0.01	-0.05	0.38	0.09	0.10	-0.01	-0.38	0.13	-0.26	-0.33	0.22	0.10	0.41	0.44
EphemPct	-0.08	0.12	0.14	-0.01	-0.04	-0.01	0.23	-0.01	-0.08	-0.18	0.23	-0.15	-0.23	-0.01	-0.26	0.15	0.29
PlecoPct	-0.24	-0.16	0.31	-0.32	-0.42	0.25	0.44	-0.05	-0.07	-0.63	0.32	-0.44	-0.53	0.17	0.32	-0.35	-0.62
TrichPct	0.18	-0.08	-0.14	0.09	0.12	0.74	-0.18	0.28	0.25	-0.18	-0.10	-0.24	-0.20	0.14	-0.10	0.73	0.68
NonInPct	0.18	-0.11	-0.18	0.10	0.16	-0.36	-0.10	-0.07	0.09	0.30	-0.15	0.11	0.17	-0.15	-0.70	-0.22	-0.03
AmphPct	0.07	0.32	0.11	0.18	0.21	0.09	0.39	0.14	0.17	0.12	0.06	0.24	0.21	-0.18	0.10	-0.01	0.10

Statistic	All Sites (N = 77)					High-Volcanic (N= 20)				Flat-Mod (N = 41)				Steep (N = 16)			
Metric	GPP	ER	DO min	Delta DO	Prod 4hr	GPP	DO min	Delta DO	Prod 4hr	GPP	DO min	Delta DO	Prod 4hr	GPP	DO min	Delta DO	Prod 4hr
BivalPct	-0.03	0.13	-0.03	0.02	0.04	-0.37	0.04	-0.23	-0.19	0.04	-0.03	0.08	0.07	-0.14	0.13	0.02	0.05
ChiroPct	0.10	-0.11	-0.10	0.11	0.06	-0.06	-0.25	0.40	0.29	0.34	-0.12	0.23	0.21	-0.06	-0.16	-0.47	-0.47
ColeoPct	-0.14	0.00	0.12	-0.09	-0.11	-0.32	-0.10	-0.52	-0.35	-0.08	0.22	-0.10	-0.14	-0.49	0.07	0.43	0.32
CrMolPct	-0.04	0.21	-0.20	0.20	0.24	-0.69	-0.09	-0.09	-0.07	0.24	-0.20	0.25	0.30	-0.28	-0.40	0.27	0.39
DipPct	0.06	0.01	-0.03	0.09	0.05	0.13	-0.03	0.35	0.29	0.17	0.04	0.24	0.20	0.15	-0.20	-0.44	-0.50
GastrPct	0.09	0.04	-0.30	0.26	0.30	-0.74	-0.42	-0.09	-0.07	0.35	-0.28	0.34	0.41	-0.24	-0.39	0.30	0.40
OdonPct	-0.04	0.14	0.00	-0.06	0.00	-0.38	0.23	-0.54	-0.50	0.03	-0.02	0.06	0.08	0.35	-0.62	0.06	0.31
OligoPct	0.03	-0.01	0.13	-0.15	-0.11	-0.18	0.67	-0.63	-0.47	0.11	-0.01	0.01	0.02	0.00	-0.29	-0.40	-0.33
HBI	0.16	0.06	-0.30	0.26	0.27	-0.11	-0.47	0.39	0.55	0.37	-0.33	0.43	0.41	0.16	-0.40	-0.32	-0.23
BeckBI	-0.22	-0.11	0.30	-0.30	-0.37	0.16	0.27	-0.21	-0.17	-0.39	0.34	-0.43	-0.49	0.01	-0.03	-0.09	-0.09
IntolPct	-0.08	-0.24	0.30	-0.25	-0.28	0.03	0.26	-0.12	-0.18	-0.25	0.37	-0.45	-0.44	0.11	0.37	0.27	0.11
TolerPct	0.20	0.00	-0.25	0.23	0.24	-0.08	-0.38	0.32	0.43	0.33	-0.20	0.33	0.31	-0.24	-0.24	-0.32	-0.09
IntolTax	-0.24	-0.09	0.29	-0.31	-0.37	0.13	0.27	-0.24	-0.15	-0.43	0.36	-0.46	-0.50	0.03	-0.09	0.02	0.02
TolerTax	0.01	0.07	-0.08	0.08	0.14	-0.27	-0.04	-0.04	0.08	0.34	-0.26	0.27	0.32	0.11	-0.34	-0.13	0.08
Baet2EphPct	-0.18	0.00	0.06	-0.22	-0.30	-0.04	0.20	-0.33	-0.56	-0.06	0.11	-0.13	-0.15	-0.59	-0.22	-0.42	-0.57
Hyd2EPTPct	0.00	0.16	0.03	0.09	0.00	0.40	-0.19	0.19	0.06	-0.27	0.09	-0.06	-0.13	0.21	0.04	0.19	0.04
Hyd2TriPct	-0.11	0.25	0.15	0.02	-0.07	0.13	0.05	0.11	0.00	-0.30	0.21	-0.09	-0.19	0.22	0.19	0.03	-0.17
CllctPct	-0.08	0.03	0.01	-0.06	-0.07	-0.13	0.19	0.04	0.13	-0.02	0.00	0.13	0.06	0.43	-0.15	-0.47	-0.45
FiltrPct	0.02	0.13	-0.04	0.05	-0.02	0.51	-0.08	0.19	0.02	-0.26	-0.05	-0.15	-0.22	-0.13	0.00	0.22	0.15
PredPct	0.06	-0.11	-0.15	0.10	0.11	-0.06	-0.22	0.18	0.15	0.05	0.02	0.05	0.05	0.13	-0.70	0.10	0.33
ScrapPct	0.05	-0.19	-0.01	-0.02	0.01	-0.38	0.18	-0.56	-0.49	0.05	-0.01	-0.14	-0.09	-0.28	0.05	0.58	0.55
ShredPct	-0.17	-0.19	0.34	-0.19	-0.23	-0.08	0.47	-0.15	-0.08	-0.03	0.27	-0.08	-0.13	-0.28	0.29	-0.53	-0.63
CllctTax	0.10	-0.14	-0.04	0.06	0.08	0.41	-0.19	0.42	0.47	0.23	-0.10	0.16	0.18	0.45	-0.26	-0.24	-0.07
FiltrTax	0.06	-0.01	0.01	0.09	0.08	-0.16	-0.01	-0.09	-0.03	0.34	-0.12	0.07	0.15	0.13	-0.16	0.19	0.03
PredTax	-0.06	-0.02	-0.01	0.09	0.10	-0.02	-0.24	0.33	0.34	0.01	0.11	0.11	0.06	0.21	-0.25	-0.11	0.20
ScrapTax	0.06	-0.04	0.01	0.06	0.08	-0.14	0.03	-0.37	-0.42	0.05	0.05	0.04	0.09	0.00	-0.14	0.44	0.56

	All Sites (N = 77)					High-Volcanic (N= 20)				Flat-Mod (N = 41)				Steep (N = 16)			
Statistic Metric	GPP	ER	DO min	Delta DO	Prod 4hr	GPP	DO min	Delta DO	Prod 4hr	GPP	DO min	Delta DO	Prod 4hr	GPP	DO min	Delta DO	Prod 4hr
ShredTax	-0.32	-0.02	0.39	-0.25	-0.28	-0.11	0.36	-0.11	-0.06	-0.17	0.32	-0.24	-0.27	-0.18	0.34	-0.38	-0.44
BrrwrPct	0.19	-0.09	-0.05	0.09	0.11	-0.29	0.17	-0.39	-0.33	0.30	-0.13	0.19	0.21	0.25	-0.17	0.04	0.01
ClmbrPct	0.23	-0.23	-0.26	0.12	0.14	0.10	-0.51	0.39	0.49	0.46	-0.22	0.20	0.28	-0.04	-0.30	-0.25	-0.32
ClngrPct	-0.17	0.14	0.14	-0.11	-0.15	0.37	-0.11	-0.07	-0.04	-0.41	0.14	-0.12	-0.19	-0.06	0.49	0.10	-0.04
SprwlPct	0.17	-0.14	-0.08	0.21	0.24	0.20	0.25	0.31	0.28	0.31	-0.14	0.37	0.33	0.33	-0.21	0.22	0.32
SwmmrPct	-0.29	0.04	0.26	-0.26	-0.32	0.21	0.31	0.13	0.10	-0.49	0.48	-0.47	-0.54	-0.26	-0.22	-0.18	-0.19
BrrwrTax	0.15	-0.14	-0.07	0.03	0.13	-0.32	-0.04	-0.06	0.12	0.43	-0.17	0.12	0.26	0.22	0.09	-0.14	-0.12
ClmbrTax	0.10	-0.17	-0.11	0.10	0.12	-0.10	-0.27	0.08	0.14	0.48	-0.13	0.28	0.38	0.16	-0.51	-0.05	0.10
ClngrTax	0.01	-0.04	0.03	0.03	0.02	0.17	-0.14	0.01	0.09	-0.04	0.08	-0.08	-0.10	0.17	-0.15	0.20	0.33
SprwlTax	-0.01	0.01	-0.01	0.08	0.05	0.13	0.21	0.21	0.15	0.14	-0.05	0.22	0.17	-0.16	-0.19	-0.37	-0.11
SwmmrTax	-0.11	-0.06	0.28	-0.12	-0.11	0.24	0.05	0.18	0.35	-0.21	0.39	-0.30	-0.32	0.22	0.32	-0.06	-0.11

Table J-2. Spearman rank correlation coefficients for TN, TP, and chlorophyll against macroinvertebrate metrics in all sites and by site class. Marked correlations are significant at p <.05.

	TN				TP				Benthic Chlorophyll				Sestonic
	All Sites	Flat	Moderate	Steep	All Sites	High Volc	Flat	Steep	All Sites	High Volc	TP Flat	TP Steep	All Sites
N	440	88	259	93	436	102	243	91	193	47	111	35	35
TotalTax	-0.25	-0.37	-0.22	0.06	-0.02	-0.20	-0.11	-0.04	0.12	0.16	0.14	0.16	-0.36
InsectTax	-0.23	-0.32	-0.20	0.10	-0.01	-0.11	-0.07	-0.03	0.08	0.05	0.17	0.16	-0.36
EPTTax	-0.40	-0.32	-0.39	-0.01	-0.12	-0.29	-0.15	-0.08	0.00	0.10	0.06	-0.14	-0.21
EphemTax	-0.29	-0.27	-0.28	0.01	-0.04	-0.15	-0.16	-0.03	-0.12	0.01	-0.09	-0.27	-0.41
PlecoTax	-0.30	-0.26	-0.25	0.00	-0.20	-0.07	-0.13	0.04	-0.18	-0.07	-0.10	-0.34	-0.22
TrichTax	-0.30	-0.24	-0.23	-0.01	-0.05	-0.29	-0.07	-0.11	0.18	0.12	0.24	0.16	-0.34
DipTax	0.02	-0.13	0.13	0.05	0.05	0.11	0.03	-0.04	0.15	0.17	0.22	0.15	
ChiroTax	0.07	-0.10	0.09	0.09	0.11	0.11	0.06	0.00	0.08	0.08	0.07	0.22	-0.10
ColeoTax	-0.16	-0.28	-0.13	0.00	-0.06	-0.08	-0.09	-0.19	0.10	0.26	0.01	0.27	
CrMolTax	0.11	-0.10	0.11	-0.08	-0.10	-0.20	-0.09	-0.04	-0.02	-0.28	-0.01	0.29	
OligoTax	0.07	0.10	0.04	0.10	0.11	0.03	0.08	0.31	-0.01	-0.01	-0.06	0.02	
Shan_2	-0.11	-0.22	-0.02	0.14	-0.11	-0.24	-0.12	0.02	0.37	0.42	0.38	0.38	-0.12
Dom01Pct	0.16	0.25	0.16	0.10	0.02	0.17	0.06	-0.02	-0.09	-0.23	-0.05	-0.15	-0.05
D	0.11	0.30	0.10	0.02	0.03	0.19	0.06	-0.05	-0.17	-0.20	-0.15	-0.36	
Evenness	-0.12	-0.27	-0.06	-0.12	-0.01	-0.16	-0.03	0.03	0.16	0.18	0.16	0.23	
D_Mg	-0.15	-0.19	-0.09	-0.07	0.02	-0.12	-0.01	-0.04	0.14	0.13	0.21	0.15	
EPTPct	-0.14	-0.22	-0.12	0.09	-0.02	0.06	-0.02	-0.02	0.09	0.01	0.09	0.25	-0.12
EphemPct	-0.05	-0.24	0.00	0.20	0.06	0.14	0.02	0.03	-0.06	-0.04	-0.09	0.01	-0.29
PlecoPct	-0.28	-0.28	-0.22	0.02	-0.17	-0.03	-0.14	0.11	-0.21	-0.12	-0.11	-0.59	-0.43
TrichPct	-0.15	-0.10	-0.07	-0.11	-0.11	-0.17	-0.08	-0.17	0.29	0.32	0.22	0.55	0.06
NonInPct	0.15	0.10	0.05	0.02	0.07	0.08	0.04	0.00	0.11	0.23	-0.02	0.26	-0.01
AmphPct	0.23	0.07	0.16	0.19	-0.03	0.27	-0.06	-0.03	0.20	0.19	0.18	0.11	

	TN				TP				Benthic Chlorophyll				Sestonic
	All Sites	Flat	Moderate	Steep	All Sites	High Volc	Flat	Steep	All Sites	High Volc	TP Flat	TP Steep	All Sites
BivalPct	0.09	-0.12	0.09	-0.02	-0.12	-0.13	-0.03	-0.18	0.01		-0.07	0.20	
ChiroPct	0.07	0.07	0.07	-0.09	0.10	0.24	0.07	0.04	-0.01	0.03	-0.03	-0.02	0.22
ColeoPct	-0.19	-0.22	-0.13	-0.20	-0.15	-0.40	-0.10	-0.22	0.05	-0.02	-0.06	0.43	
CorbPct	0.02	-0.07	0.10	-0.17	-0.04		0.00	-0.09	0.04		-0.02	0.18	
CrMolPct	0.16	0.01	0.07	-0.01	-0.08	-0.02	-0.10	-0.02	0.11	-0.04	0.04	0.33	
DipPct	0.11	0.11	0.16	0.04	0.03	0.08	-0.02	0.09	-0.13	0.07	-0.02	-0.58	
GastrPct	0.12	-0.09	0.09	-0.06	-0.08	-0.15	-0.16	0.06	0.04	-0.25	0.07	0.26	
IsoPct	-0.08		-0.10		0.03			0.16					
OdonPct	0.08	-0.27	0.10	-0.13	0.03	-0.25	-0.03	0.06	0.12	-0.23	0.23	0.16	
OligoPct	0.13	0.15	0.10	0.17	0.17	0.01	0.15	0.41	0.05	0.03	0.02	0.07	
HBI	0.30	0.32	0.28	0.07	0.11	0.02	0.03	0.14	-0.03	-0.05	0.00	-0.02	
BeckBI	-0.39	-0.32	-0.41	0.02	-0.15	-0.30	-0.10	-0.07	-0.18	-0.06	-0.18	-0.14	
IntolPct	-0.32	-0.31	-0.30	-0.04	-0.17	-0.14	-0.12	-0.07	-0.09	-0.01	-0.08	-0.14	-0.24
TolerPct	0.20	0.08	0.14	0.03	0.06	0.08	0.06	-0.05	0.08	0.26	-0.05	0.11	0.16
IntolTax	-0.36	-0.27	-0.38	-0.09	-0.09	-0.29	-0.10	-0.04	-0.34	-0.10	-0.12	-0.16	-0.41
TolerTax	0.10	-0.07	0.05	0.04	0.07	0.01	0.01	0.07	0.10	0.17	0.02	0.22	0.03
Baet2EphPct	0.14	-0.06	0.21	0.14	0.05	0.02	0.08	0.25	-0.15	-0.61	0.05	-0.21	
Hyd2EPTPct	-0.02	-0.03	0.01	-0.12	0.03	0.00	-0.02	0.10	0.08	-0.03	0.05	0.08	
Hyd2TriPct	0.05	0.03	0.06	0.02	0.11	0.18	0.04	0.16	-0.02	0.04	-0.02	-0.15	
CllctPct	0.20	0.13	0.16	0.23	0.17	0.29	0.14	0.17	-0.28	-0.24	-0.23	-0.48	-0.03
FiltrPct	0.00	-0.03	-0.03	-0.11	0.05	0.10	0.02	0.07	0.00	-0.14	-0.05	0.26	0.28
PredPct	-0.15	-0.33	-0.15	-0.26	-0.02	-0.06	-0.06	-0.10	-0.03	0.14	-0.11	0.10	-0.14
ScrapPct	-0.18	-0.03	-0.11	-0.17	-0.23	-0.30	-0.18	-0.23	0.16	0.09	0.14	0.35	-0.14
ShredPct	-0.23	-0.29	-0.24	-0.12	-0.08	0.17	-0.12	0.05	-0.08	0.26	-0.20	-0.05	-0.01
CllctTax	-0.03	-0.21	-0.08	0.08	0.06	0.18	0.00	-0.01	-0.08	-0.06	-0.14	0.08	-0.18
FiltrTax	-0.02	-0.04	-0.16	0.09	0.12	-0.06	0.07	0.15	0.04	-0.07	0.04	0.10	0.04
PredTax	-0.23	-0.44	-0.15	-0.25	-0.04	0.02	-0.08	-0.14	-0.11	-0.12	-0.09	-0.06	-0.25

	TN				TP				Benthic Chlorophyll				Sestonic
	All Sites	Flat	Moderate	Steep	All Sites	High Volc	Flat	Steep	All Sites	High Volc	TP Flat	TP Steep	All Sites
ScrapTax	-0.20	-0.23	-0.11	-0.03	-0.14	-0.26	-0.11	-0.22	0.17	-0.05	0.28	0.18	-0.25
ShredTax	-0.32	-0.30	-0.37	0.19	-0.07	-0.02	-0.14	0.16	-0.18	0.09	-0.25	-0.07	-0.17
BrrwrPct	0.12	0.20	0.01	-0.03	0.20	0.06	0.28	0.00	-0.14	-0.29	-0.12	-0.02	0.14
ClmbrPct	-0.02	-0.04	-0.03	-0.23	-0.02	-0.09	-0.05	0.13	-0.07	0.03	-0.14	0.01	0.17
ClngrPct	-0.19	-0.13	-0.10	-0.28	-0.07	-0.18	-0.04	0.04	-0.08	-0.29	0.04	-0.16	-0.22
SprwlPct	0.06	-0.27	0.06	0.09	0.03	0.27	-0.02	0.03	-0.02	0.15	-0.17	0.08	-0.14
SwmmrPct	0.04	-0.21	0.12	0.26	0.02	0.11	0.01	0.04	0.09	0.11	0.06	0.12	0.04
BrrwrTax	0.04	0.05	-0.04	0.07	0.12	0.01	0.14	0.09	-0.11	-0.10	-0.16	0.04	0.10
ClmbrTax	-0.01	-0.13	-0.03	-0.11	0.06	-0.20	0.02	0.11	-0.08	-0.14	-0.08	0.08	0.03
ClngrTax	-0.35	-0.40	-0.29	-0.14	-0.05	-0.22	-0.08	-0.13	0.04	0.07	0.10	0.02	-0.34
SprwlTax	0.00	-0.28	0.01	0.05	0.03	0.23	-0.06	0.03	-0.05	-0.10	-0.08	0.11	-0.32
SwmmrTax	-0.10	-0.40	-0.09	0.14	-0.03	0.07	-0.19	-0.08	0.03	0.05	0.02	0.07	-0.11
HSMMCI*	-0.25	-0.68	-0.32	0.19	-0.16		-0.10	-0.05			0.02	0.41	

NM_BenthicMetrics, MD pairwise deleted, Include condition: ValidSamp='Yes'.
* Correlations with the high small index were limited to high small sites only.

Variability introduced by sample collection method might result in some weaker correlation coefficients. Therefore, the Spearman correlation analysis was run within method-based subsets and within site classes. Canton Hess, Jacobi Hess, and Surber methods were grouped because they were all based on a delimited area of substrate in flowing water. Kicknet and Targeted Riffle samples were not combined, though they are conceptually similar techniques. Reachwide samples were also analyzed as a separate group. Sample sizes were too small for reliable analyses in some site classes (e.g., all but reachwide methods in the WestFlat class) (Table J-3). The correlations for the method and site class subsets were weaker than correlations for data sets with combined methods. Considerable overlap was apparent for samples with different methods in plots of nutrients and metrics (Figures J-1 and J-2). Therefore, the data were analyzed with all methods pooled.

Table J-3. Sample size for benthic macroinvertebrate analysis.

Site Class	Canton Hess	Jacobi Hess	Surber	Kicknet	Reachwide	Targeted Riffle	Unknown
EFltWStp	47	24	4	60	103	27	8
EastSteep	15	22	4	27	21	6	1
WestFlat	5	3	0	7	43	7	0
Flat	12	5	1	9	52	7	2
Moderate	41	26	2	61	93	27	6
Steep	14	18	5	24	24	6	1

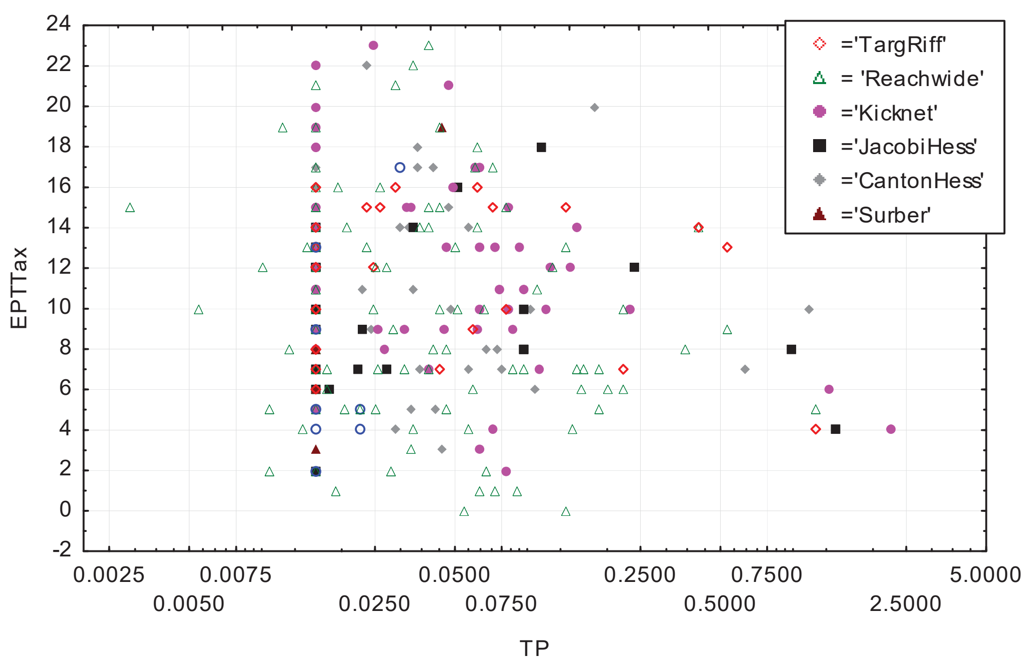

Figure J-1. Relationship between TP and EPT taxa in the EastFlat –WestSteep sites, showing macroinvertebrate sampling methods.

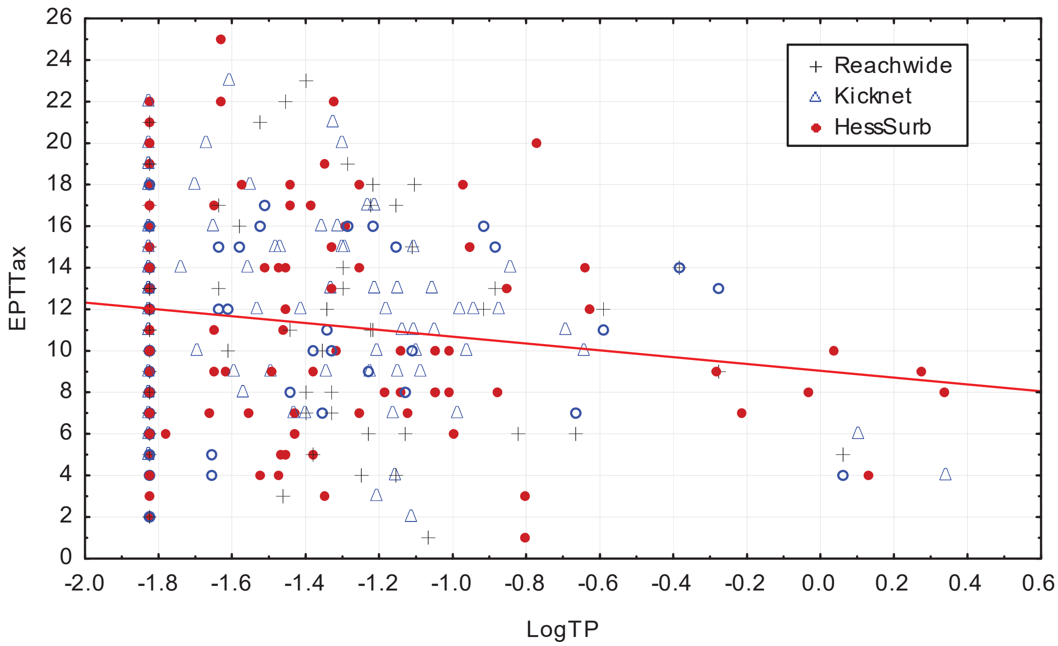

Figure J-2. Relationship between EPT richness and TP, showing collection methods (NMED data).

Table J-4. TP Spearman correlation coefficients for selected metrics within site classes and methods.

TPSiteClass	High-Volcanic				Flat-Moderate				Steep			
Method / Metric	REACHWIDE	CantJacoSurb	KICKNET	TargRiff	REACHWIDE	CantJacoSurb	KICKNET	TargRiff	REACHWIDE	CantJacoSurb	KICKNET	TargRiff
TotalTax	-0.25	0.06	-0.07	-0.40	-0.22	-0.19	0.08	0.28	-0.04	-0.08	0.00	0.51
InsectTax	-0.12	0.04	-0.03	-0.30	-0.05	-0.18	-0.01	0.24	0.07	-0.13	0.04	0.27
EPTTax	-0.35	-0.11	-0.52	-0.08	-0.16	-0.13	-0.31	0.05	-0.01	-0.14	-0.13	0.10
EphemTax	-0.22	0.19	-0.33	-0.25	-0.10	-0.22	-0.39	-0.05	0.06	-0.01	-0.29	0.07
PlecoTax	-0.02	-0.13	-0.20	0.25	-0.09	-0.05	-0.21	-0.22	0.15	0.07	-0.15	-0.22
TrichTax	-0.37	-0.29	-0.28	-0.23	-0.14	0.03	-0.21	0.26	-0.19	-0.22	0.17	0.16
ChiroTax	0.17	0.16	0.33	0.10	0.05	-0.24	0.30	0.50	0.04	-0.24	0.27	0.78
Shan_2	-0.45	-0.02	-0.08	-0.09	-0.16	-0.12	0.06	0.19	-0.14	-0.10	0.24	0.17
BeckBI	-0.18	-0.19	-0.61	-0.36	-0.12	-0.05	-0.28	0.03	-0.52	-0.13	-0.13	0.27
HBI	-0.22	0.15	0.27	0.10	0.05	-0.14	0.21	0.22	0.00	0.27	0.27	0.85
TolerPct	-0.15	0.49	0.09	0.14	0.03	-0.18	0.43	0.32	-0.41	0.18	0.18	0.10
IntolTax	-0.35	-0.21	-0.51	0.02	-0.08	-0.05	-0.24	-0.04	-0.04	-0.09	-0.10	-0.02
PlecoPct	-0.10	0.09	0.04	0.15	-0.01	0.11	-0.18	-0.15	-0.04	-0.04	-0.03	-0.78
TrichPct	-0.02	0.25	0.17	0.33	-0.05	0.03	0.24	-0.08	0.03	0.01	0.13	-0.78
NonInPct	0.00	0.10	-0.17	0.15	-0.10	0.00	-0.15	-0.32	0.26	0.12	-0.14	-0.10
ChiroPct	-0.19	-0.33	-0.29	0.10	-0.04	0.05	-0.46	0.13	-0.07	-0.37	0.07	-0.37
ColeoPct	0.19	0.19	-0.06	-0.09	-0.09	-0.09	0.34	0.15	-0.22	0.12	0.17	0.51
DipPct	0.26	0.18	0.42	0.15	0.11	-0.21	0.27	0.59	0.01	-0.11	0.22	0.03
GastrPct	-0.55	-0.08	-0.32	-0.84	-0.22	0.12	-0.18	-0.38	-0.60	-0.29	-0.05	-0.54
OdonPct	-0.11	-0.07	0.31	0.04	-0.09	-0.14	0.22	0.23	0.59	0.11	0.07	0.78
OligoPct	-0.45	-0.05	0.04	-0.41	-0.22	-0.23	-0.14	-0.07	-0.28	0.23	-0.06	0.50
CllctPct	-0.25	-0.05	-0.06	-0.38	-0.10	-0.14	0.28	-0.13	0.35	0.15	-0.08	0.22
FiltrPct	-0.11	0.25	-0.08	-0.29	0.02	0.12	0.29	0.44	0.44	0.54	0.41	0.90
ScrapPct	0.30	0.19	0.49	0.28	0.04	0.13	0.43	0.15	0.01	0.31	0.29	0.07
ShredPct	0.29	-0.17	-0.11	0.31	0.20	-0.01	-0.35	-0.15	0.18	-0.05	0.15	0.03
FiltrTax	-0.16	0.11	-0.27	0.28	-0.05	-0.21	0.26	-0.05	-0.21	-0.06	-0.21	-0.07
ScrapTax	-0.25	-0.07	-0.47	-0.47	-0.22	0.02	-0.50	-0.14	-0.08	-0.54	-0.05	-0.78
ShredTax	0.04	0.41	0.31	0.14	-0.02	-0.25	-0.17	-0.11	0.03	0.24	-0.37	0.78
BrrwrPct	0.19	0.24	0.35	-0.08	-0.11	-0.09	0.10	0.29	-0.10	-0.09	0.28	0.68
ClngrPct	0.04	-0.21	-0.16	0.09	0.09	-0.06	-0.07	0.24	0.34	-0.12	0.22	0.22
SwmmrPct	-0.14	0.16	0.18	0.01	-0.19	-0.10	0.03	0.22	-0.29	-0.02	-0.26	0.51
BrrwrTax	-0.30	0.00	-0.51	-0.30	-0.22	-0.05	-0.22	0.08	-0.34	-0.35	-0.14	-0.19
ClmbrTax	-0.15	0.13	0.35	-0.29	-0.21	-0.12	-0.19	-0.05	0.06	0.27	0.04	-0.07
ClngrTax	0.17	0.17	0.01	-0.42	0.21	0.25	0.46	0.75	-0.17	0.35	-0.17	0.37
SprwlTax	-0.36	-0.05	0.42	-0.41	-0.05	-0.28	0.00	0.17	-0.04	0.23	0.20	0.44
HSMMCI	-0.11	-0.20	-0.26	-0.04	-0.03	0.12	-0.25	-0.34	0.46	-0.19	-0.18	0.07

Table J-5. TN Spearman correlation coefficients for selected metrics within site classes and methods.

TNSiteClass	TN Flat				TN Moderate				TN Steep			
Method / Metric	REACHWIDE	CantJacoSurb	KICKNET	TargRiff	REACHWIDE	CantJacoSurb	KICKNET	TargRiff	REACHWIDE	CantJacoSurb	KICKNET	TargRiff
TotalTax	-0.46	-0.38	-0.32	0.07	-0.32	-0.22	0.05	-0.08	0.24	0.18	0.06	-0.93
InsectTax	-0.23	-0.60	-0.45	0.16	-0.28	-0.23	0.01	-0.15	0.18	0.15	0.17	-0.52
EPTTax	-0.38	-0.37	-0.24	-0.41	-0.30	-0.37	-0.40	-0.30	-0.17	0.08	0.18	-0.49
EphemTax	-0.34	-0.11	-0.41	0.00	-0.31	-0.16	-0.30	-0.34	0.02	0.16	0.05	-0.60
PlecoTax	-0.30	-0.22	-0.40	0.18	-0.08	-0.25	-0.39	-0.27	-0.42	0.24	0.12	-0.03
TrichTax	-0.31	-0.33	0.15	-0.65	-0.20	-0.34	-0.09	0.15	0.21	-0.19	0.21	-0.53
ChiroTax	-0.17	-0.23	-0.14	0.37	0.03	-0.02	0.31	0.00	0.31	0.06	0.25	0.31
Shan_2	-0.26	-0.09	-0.34	-0.50	0.04	-0.21	-0.03	0.13	0.31	0.02	0.25	-0.89
BeckBI	-0.55	-0.31	-0.30	-0.21	-0.36	-0.30	-0.53	-0.16	0.17	0.05	0.20	-0.43
HBI	0.56	0.22	-0.17	0.57	0.23	0.09	0.41	0.19	0.19	0.03	-0.02	-0.43
TolerPct	0.22	-0.07	-0.15	0.29	0.02	-0.04	0.32	0.39	-0.02	0.10	0.06	-0.49
IntolTax	-0.29	-0.29	-0.24	-0.18	-0.31	-0.29	-0.45	-0.15	-0.46	0.06	0.17	-0.46
EPTPct	-0.46	0.17	0.02	-0.71	-0.03	0.00	-0.21	-0.29	-0.12	0.17	0.22	0.14
EphemPct	-0.52	0.32	-0.10	-0.11	-0.03	0.15	0.04	-0.39	0.00	0.38	0.34	0.14
PlecoPct	-0.32	-0.24	-0.40	0.18	-0.08	-0.18	-0.33	-0.36	-0.17	0.23	-0.01	0.17
TrichPct	-0.17	-0.04	0.24	-0.75	-0.05	-0.12	-0.20	0.19	-0.17	-0.43	0.01	-0.26
NonInPct	0.04	0.37	0.20	-0.07	-0.08	-0.11	0.28	0.38	-0.10	0.18	0.11	-0.60
ChiroPct	0.21	-0.06	-0.38	0.29	-0.04	-0.11	0.34	0.14	-0.12	-0.10	0.17	-0.43
ColeoPct	-0.38	-0.13	0.30	-0.79	-0.14	0.12	-0.40	0.21	0.05	-0.18	-0.25	-0.43
DipPct	0.31	0.05	-0.58	0.89	0.18	-0.06	0.27	-0.10	-0.03	0.09	0.00	0.03
CllctPct	0.05	0.19	0.23	0.71	0.09	0.29	0.26	-0.08	0.04	0.43	0.24	0.14
FiltrPct	0.04	-0.17	-0.09	-0.79	0.00	0.01	-0.13	0.15	-0.12	-0.24	0.08	-0.60
PredPct	-0.34	-0.28	-0.35	-0.43	-0.25	-0.10	0.08	0.05	-0.51	0.03	-0.06	-0.31
ScrapPct	-0.07	0.04	0.08	-0.64	-0.10	-0.05	-0.35	0.12	-0.13	-0.33	-0.10	-0.03
ShredPct	-0.23	-0.29	-0.76	-0.50	-0.16	-0.27	-0.27	-0.19	-0.10	0.07	-0.30	0.14
CllctTax	-0.31	-0.23	-0.52	0.49	-0.28	0.08	0.16	-0.04	0.02	0.10	0.23	0.32
FiltrTax	-0.08	-0.18	0.27	-0.30	-0.07	-0.29	-0.02	-0.01	0.11	-0.12	0.46	-0.17
PredTax	-0.55	-0.34	-0.40	-0.32	-0.28	-0.17	0.16	0.22	-0.48	0.16	-0.25	-0.52
ScrapTax	-0.26	-0.07	-0.01	-0.68	-0.09	-0.26	-0.12	0.32	-0.14	-0.06	0.06	-0.44
ShredTax	-0.39	-0.47	-0.37	-0.32	-0.35	-0.23	-0.42	-0.41	0.33	0.33	-0.03	0.33
BrrwrPct	0.33	0.20	-0.03	0.96	0.00	0.03	0.09	0.28	-0.20	0.09	0.02	0.60
ClngrPct	-0.25	-0.10	-0.23	-0.29	-0.14	0.01	-0.29	-0.09	-0.45	-0.32	-0.18	0.20
SprwlPct	-0.28	-0.28	-0.28	0.18	0.03	0.11	0.21	0.07	0.17	0.48	-0.07	0.60
BrrwrTax	0.17	0.11	-0.38	0.86	-0.01	0.03	-0.01	0.12	0.09	0.18	0.00	0.00
ClngrTax	-0.56	-0.31	-0.22	-0.74	-0.35	-0.25	-0.16	-0.04	-0.19	-0.15	0.15	-0.64
SprwlTax	-0.44	-0.27	-0.19	0.31	-0.22	0.01	0.35	0.03	-0.09	0.25	0.06	0.03
SwmmrTax	-0.36	-0.41	-0.53	-0.81	-0.13	-0.11	0.01	-0.15	0.35	0.12	-0.20	0.88

Table J-6. Benthic chlorophyll Spearman correlation coefficients for selected macroinvertebrate metrics within site classes and methods.

TPSiteClass	High-Volcanic				Flat-Moderate				Steep			
Method / Metric	REACHWIDE	CantJacoSurb	KICKNET	TargRiff	REACHWIDE	CantJacoSurb	KICKNET	TargRiff	REACHWIDE	CantJacoSurb	KICKNET	TargRiff
TotalTax	0.22	0.43	-0.10	0.18	0.27	0.34	0.34	0.08	0.22	0.03	0.05	0.50
InsectTax	0.29	0.49	-0.12	0.07	0.13	0.26	0.33	0.01	0.80	0.25	0.10	0.50
EPTTax	0.41	0.71	-0.70	0.52	0.06	0.11	0.03	-0.04	-0.08	-0.24	-0.12	0.50
ChiroTax	-0.18	0.36	0.47	0.16	0.07	0.42	0.47	-0.11	0.21	0.50	0.18	-0.50
Shan_2	0.48	0.31	0.12	0.50	0.51	0.22	0.55	0.04	0.13	0.02	-0.13	1.00
IntolTax	-0.01	0.35	-0.59	0.71	-0.13	-0.14	0.28	-0.19	-0.12	-0.36	-0.41	0.00
PlecoPct	-0.20	0.26	-0.03	-0.11	-0.01	-0.32	0.12	-0.33	-0.78	-0.44	-0.33	-1.00
TrichPct	0.66	0.50	-0.54	0.71	0.09	0.32	0.09	0.31	0.38	0.59	0.38	1.00
OdonPct	0.04	-0.29	-0.27	-0.22	0.45	-0.04	-0.17	0.51	0.40	-0.02	-0.14	0.87
FiltrPct	-0.02	0.14	-0.77	0.64	-0.33	0.19	0.17	0.01	0.03	0.54	0.38	-0.50
PredPct	0.46	-0.05	-0.18	0.29	-0.05	-0.15	0.53	0.00	0.38	-0.10	-0.07	1.00
ShredPct	0.34	-0.05	0.80	0.21	-0.50	0.17	0.15	-0.20	0.03	-0.23	0.48	-0.50
ScrapTax	-0.12	0.14	-0.50	0.33	0.33	0.34	0.09	0.30	0.13	0.18	-0.60	1.00
ClmbrTax	-0.04	-0.59	0.27	-0.62	-0.10	0.28	0.10	-0.10	0.63	-0.30	0.14	0.50
SwmmrTax	0.30	-0.32	-0.27	0.35	0.29	-0.19	-0.10	-0.18	0.03	0.13	0.82	
HSMMCI			-0.30		-0.94	0.60		-0.71		1.00		

Table J-7. Summary/interpretation of benthic macroinvertebrate responses to nutrients and chlorophyll – all site classes combined, by macroinvertebrate sample collection method.

	TP				TN				Chlorophyll				DO			
	RW	KN	TR	HS	RW	KN	TR	HS	RW	KN	TR	HS	Pr	GPP	Rp	min
TotalTax	-	+	+	-	—	+	-	—	+	+	+	+	+	-	+	+
EPTTax	-	—	+	-	—	—	—	—	+	-	+	+	-	-	+++	+++
EphemTax	-	-	+	-	—	—	—	-	-	-	-	+	-	-	+++	+++
PlecoTax	—	—	-	-	—	—	-	—	-	+	-	—	—	-	+++	+++
TrichTax	-	-	+	-	—	-	-	—	+	-	+++	+	-	+	+	+
Shan_2	—	+	+	-	—	+	-	—	+++	+	+	+	-	-	+	+
EPTPct	+	-	-	+	—	-	-	+	-	-	+	+	-	-	+	+
EphemPct	+	+	-	+	—	+	-	+	-	+	+	+	-	-	+	+
PlecoPct	-	—	-	-	—	—	-	-	-	+	---	-	—	—	+++	+++
TrichPct	-	—	+	-	—	-	+	-	+	-	+++	+++	+	+	-	-
NonInPct	-	+++	+	-	+	+++	+	+	+++	+	+++	-	+	+	-	-
IntolTax	-	—	-	-	—	—	-	—	—	-	+	-	—	—	+++	+++
TolerPct	-	+++	+	+	+++	+++	+	+	+++	+	+++	+	+++	+	—	—
CllctPct	+	+++	+	+++	+	+++	+	+++	-	+	-	-	-	-	+	+
ScrapPct	—	—	-	-	—	—	+	-	+	-	+	+	+	+	+	-
ShredPct	+	—	+	-	-	—	—	—	—	+++	-	+	—	-	+	+
ShredTax	-	-	+	-	—	—	—	—	-	+	-	-	—	—	+++	+++
BrrwrPct	+	+++	+++	+++	+++	+	+	+	-	-	+	-	+	+	-	-
ClngrPct	+	—	-	-	—	—	-	-	—	-	+	+	-	-	+	+

Appendix K Regression Interpolation

Table K-1. Regression equations for interpolating candidate TP thresholds from diatom metrics. The x and y axes are log10 nutrient concentrations and diatom metrics, respectively.

LogTP	TPClass	TP High-Volcanic	TP Flat-Moderate	TP Steep
wa_OptCat_DisTotMMI				
y = 10.0781 + 6.416*x;	Metric ref75th	1.220	5.113	0.111
r = 0.3097, p = 0.00001; r2 = 0.0959	Interp TP	0.042	0.168	0.028
wa_OptCat_L1DisTot				
y = 1.315 + 0.2154*x;	Metric ref75th	0.967	1.219	0.979
r = 0.2423, p = 0.0006; r2 = 0.0587	Interp TP	0.024	0.358	0.027
wa_OptCat_L1Ptl				
y = 3.8471 + 0.3727*x;	Metric ref75th	3.412	3.535	3.275
r = 0.3817, p = 0.00000; r2 = 0.1457	Interp TP	0.068	0.145	0.029
wa_OptCat_LNtl				
y = 5.815 + 0.219*x;	Metric ref75th	5.470	5.675	5.465
r = 0.2767, p = 0.00008; r2 = 0.0766	Interp TP	0.057	0.311	0.054
wa_OptCat_NutMMI				
y = 11.3888 + 7.1011*x;	Metric ref75th	1.970	6.320	0.072
r = 0.3368, p = 0.00000; r2 = 0.1134	Interp TP	0.047	0.193	0.025
pi_NAWQA_TN_1				
y = 51.8677 + 16.0564*x;	Metric ref75th	46.400	37.600	19.717
r = 0.3622, p = 0.00000; r2 = 0.1312	Interp TP	0.457	0.129	0.010
pi_Ptpv_TP_all_Hi				
y = 44.4493 + 17.4269*x;	Metric ref75th	25.600	30.200	10.636
r = 0.4082, p = 0.00000; r2 = 0.1666	Interp TP	0.083	0.152	0.011
x_Shan_e				
y = 3.0411 + 0.2395*x;	Metric ref75th	3.273	3.247	2.581
r = 0.1623, p = 0.0227; r2 = 0.0264	Interp TP	9.272	7.272	0.012
	Max TP in site class	0.22	1.82	0.12

Table J-2. Regression equations for interpolating candidate TN Thresholds from diatom metrics. The x and y axes are log10 nutrient concentrations and diatom metrics, respectively.

LogTN	TNClass	Flat	Moderate	Steep
wa_OptCat_DisTotMMI				
y = 4.797 + 8.0487*x;	Metric ref75th	12.965	1.202	-1.058
r = 0.3495, p = 0.00000; r2 = 0.1222	Interp TN	10.348	0.358	0.187
wa_OptCat_L1DisTot				
y = 1.1728 + 0.3427*x;	Metric ref75th	1.605	0.993	0.925
r = 0.3470, p = 0.00000; r2 = 0.1204	Interp TN	18.260	0.299	0.189
wa_OptCat_L1Ptl				
y = 3.4775 + 0.3385*x;	Metric ref75th	3.773	3.353	3.298
r = 0.3107, p = 0.00001; r2 = 0.0965	Interp TN	7.449	0.430	0.294
wa_OptCat_LNtl				
y = 5.6551 + 0.3166*x;	Metric ref75th	5.978	5.503	5.416
r = 0.3599, p = 0.00000; r2 = 0.1295	Interp TN	10.487	0.330	0.176
wa_OptCat_NutMMI				
y = 5.1327 + 8.0596*x;	Metric ref75th	12.923	1.171	0.006
r = 0.3436, p = 0.00000; r2 = 0.1181	Interp TN	9.260	0.322	0.231
pi_NAWQA_TN_1				
y = 34.9485 + 12.9021*x;	Metric ref75th	36.333	43.200	44.311
r = 0.2595, p = 0.0002; r2 = 0.0673	Interp TN	1.280	4.361	5.317
pi_Ptpv_TP_all_Hi				
y = 28.5578 + 18.5995*x;	Metric ref75th	45.333	17.333	25.600
r = 0.3917, p = 0.00000; r2 = 0.1534	Interp TN	7.979	0.249	0.693
x_Shan_e				
y = 2.6258 - 0.1407*x;	Metric ref25th	2.576	2.454	1.893
r = -0.0850, p = 0.2312; r2 = 0.0072	Interp TN	2.264	16.633	>100,000
	Max TN in site class	3.44	2.63	0.75

Table K-3. Regression equations for interpolating candidate TP Thresholds from macroinvertebrate metrics. The x and y axes are log10 nutrient concentrations and macroinvertebrate metrics, respectively.

	TPClass	TP High-Volcanic	TP Flat-Moderate	TP Steep
EPTTax y = 8.0624 - 2.0045*x;	Metric ref25th	10	7	10
r = -0.1784, p = 0.0002; r2 = 0.0318	Interp TP	0.11	3.39	0.11
EphemTax y = 3.9984 - 0.427*x; r = -0.0874, p = 0.0727;	Metric ref25th	4	3	4
r = -0.0874, p = 0.0727; r2 = 0.0076	Interp TP	1.00	211.63	1.00
PlecoTax y = 0.2028 - 0.9833*x;	Metric ref25th	0	0	1
r = -0.2123, p = 0.00001; r2 = 0.0451	Interp TP	1.61	1.61	0.15
IntolTax y = 3.8737 - 2.3646*x;	Metric ref25th	4	2	5
r = -0.2008, p = 0.00003; r2 = 0.0403	Interp TP	0.88	6.22	0.33
TolerPct y = 19.4567 + 3.3253*x;	Metric ref75th	17.3	21.1	13.6
r = 0.0868, p = 0.0746; r2 = 0.0075	Interp TP	0.22	3.11	0.02
EPTPct y = 43.7178 - 3.043*x;	Metric ref25th	29.2	39.1	26.4
r = -0.0547, p = 0.2639; r2 = 0.0030	Interp TP	59102.65	31.91	491758.14
PlecoPct y = 0.5496 - 2.2279*x;	Metric ref25th	0	0.0	0.8
r = -0.1344, p = 0.0056; r2 = 0.0181	Interp TP	1.74	1.74	0.80
NonInPct y = 13.8075 + 2.3764*x;	Metric ref75th	14.2	12.5	7.8
r = 0.0743, p = 0.1273; r2 = 0.0055	Interp TP	1.46	0.28	0.00
ShredTax y = 2.8879 - 0.5069*x;	Metric ref25th	2	2	3
r = -0.1069, p = 0.0279; r2 = 0.0114	Interp TP	56.47	56.47	0.60
ClngrPct y = 37.9857 - 5.6993*x;	Metric ref25th	31.6	34.0	39.7
r = -0.1200, p = 0.0136; r2 = 0.0144	Interp TP	13.22	5.01	0.50
	Max TP in site class	0.22	1.82	0.12

Table K-4. Regression equations for interpolating candidate TN Thresholds from macroinvertebrate metrics. The x and y axes are log10 nutrient concentrations and macroinvertebrate metrics, respectively.

	TN Class	Flat	Moderate	Steep
EPTTax				
y = 8.0307 - 5.3365*x	Metric ref25th	5	12	10
r = -0.389, p < 0.001, r2 = 0.151	Interp TN	3.70	0.18	0.43
EphemTax				
LogTN:EphemTax: y = 3.6345 - 1.7854*x;	Metric ref25th	3	4	4
r = -0.3001, p < 0.001, r2 = 0.0901	Interp TN	2.266	0.624	0.624
PlecoTax				
LogTN:PlecoTax: y = 0.7837 - 1.529*x;	Metric ref25th	0	0	0
r = -0.2720, p < 0.001, r2 = 0.0740	Interp TN	3.257	3.257	3.257
IntolTax				
LogTN:IntolTax: y = 4.648 - 4.8895*x;	Metric ref25th	2	6	5
r = -0.3418, p < 0.001, r2 = 0.1169	Interp TN	3.479	0.529	0.847
TolerPct				
LogTN:TolerPct: y = 21.6082 + 12.5247*x;	Metric ref75th	55.40984	14.8	15.5
r = 0.2647, p < 0.001, r2 = 0.0701	Interp TN	500.804	0.288	0.326
EPTPct				
LogTN:EPTPct: y = 40.9242 - 12.5266*x;	Metric ref25th	8.333333	51.9	24.2
r = -0.1832, p < 0.001, r2 = 0.0336	Interp TN	398.742	0.134	21.470
PlecoPct				
LogTN:PlecoPct: y = 1.3505 - 4.4002*x;	Metric ref25th	0	0.0	0
r = -0.2187, p < 0.001, r2 = 0.0478	Interp TN	0.493	0.493	0.493
NonInPct				
LogTN:NonInPct: y = 15.779 + 9.3338*x;	Metric ref75th	29.33	9.5	11.77346
r = 0.2289,p < 0.001, r2 = 0.0524	Interp TN	28.334	0.213	0.372
ShredTax				
LogTN:ShredTax: y = 2.6543 - 1.8224*x;	Metric ref25th	2	2	3
r = -0.3164, p < 0.001, r2 = 0.1001	Interp TN	2.276	2.276	0.642
ClngrPct				
LogTN:ClngrPct: y = 38.5364 - 13.685*x;	Metric ref25th	10.67	39.3	33.22508
r = -0.2341, p < 0.001, r2 = 0.0548	Interp TN	108.591	0.876	2.445
	Max TN in site class	3.44	2.63	0.75

Table K-5. Regression equations for interpolating candidate DO Thresholds from nutrient reference 90th quantiles.

	TP Class	High-Vol	TP Flat	TP Steep
DeltaDO by TN (Log-Log)				
y = -0.54 + 0.3119*x	TN ref 90th	0.69	0.42	0.30
r = 0.2300; p = 0.0090; r2 = 0.0529	Interpolated Delta DO	16.39	3.34	1.13
DeltaDO by TP (Log-Log)				
y = -1.5055 + 0.4782*x	TP ref 90th	0.105	0.061	0.030
r = 0.3254; p = 0.0002; r2 = 0.1059	Interpolated Delta DO	12.63	4.06	0.92
Prod4hr by TN (Log-Log)				
y = -0.2919 + 0.2568*x	TN ref 90th	0.69	0.42	0.30
r = 0.2427; p = 0.0062; r2 = 0.0589	Interpolated Prod4hr	3.23	0.47	0.13
Prod4hr by TP (Log-Log)				
y = -1.1191 + 0.3764*x	TP ref 90th	0.105	0.061	0.030
r = 0.3309; p = 0.0002; r2 = 0.1095	Interpolated Prod4hr	2.36	0.56	0.08

Appendix L Change-point graphs and evaluations

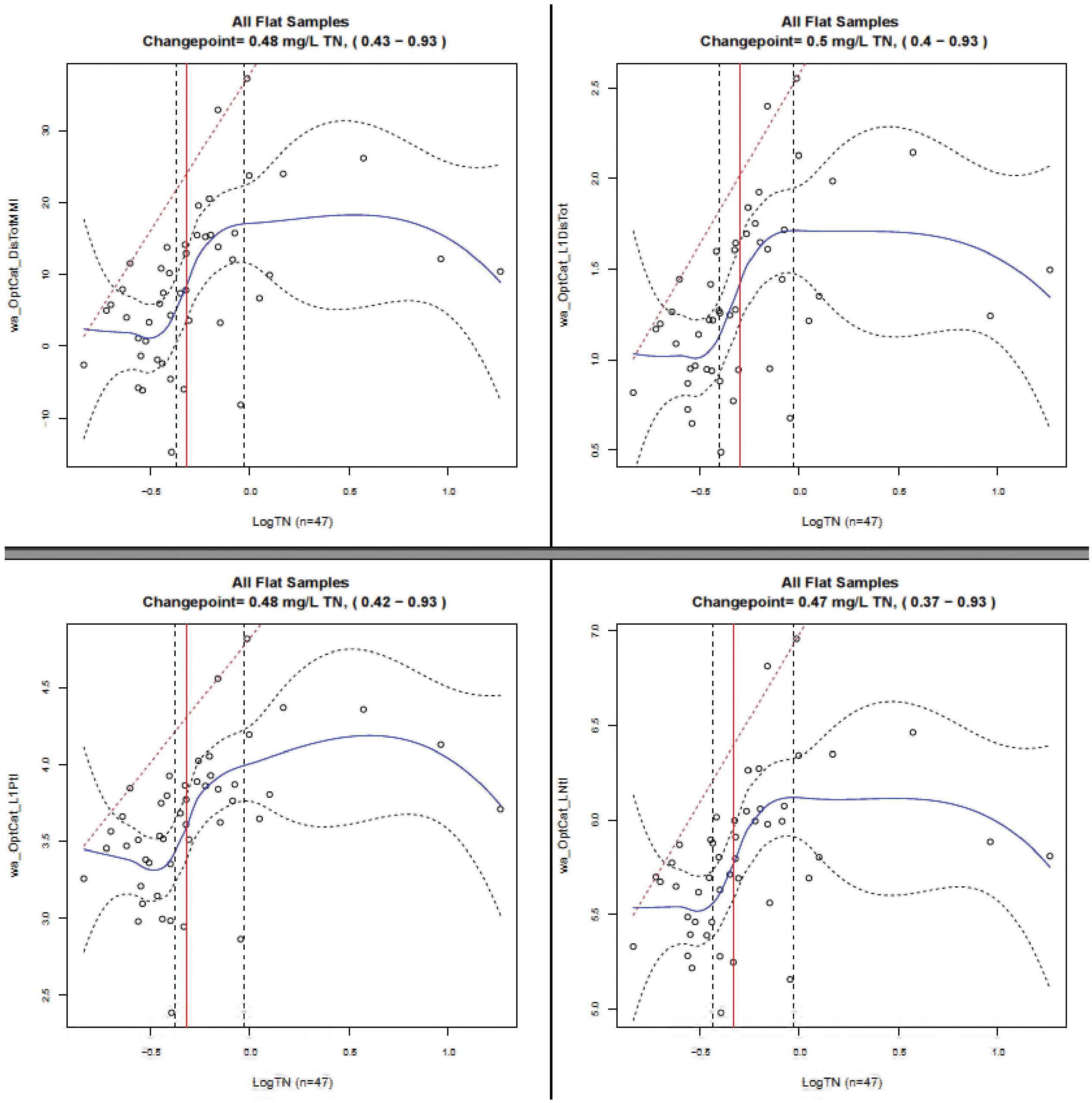

Figure L-1. Change-point graphs for **TN** and **diatom** metrics in the **Flat** site class.

Table L-1. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_DisTotMMI	0.48	Good	Narrrow	Midslope	Retain
wa_OptCat_L1DisTot	0.5	Good	Narrrow	Midslope	Retain
wa_OptCat_L1Ptl	0.48	Good	Narrrow	Midslope	Retain
wa_OptCat_LNtl	0.47	Good	Narrrow	Midslope	Retain

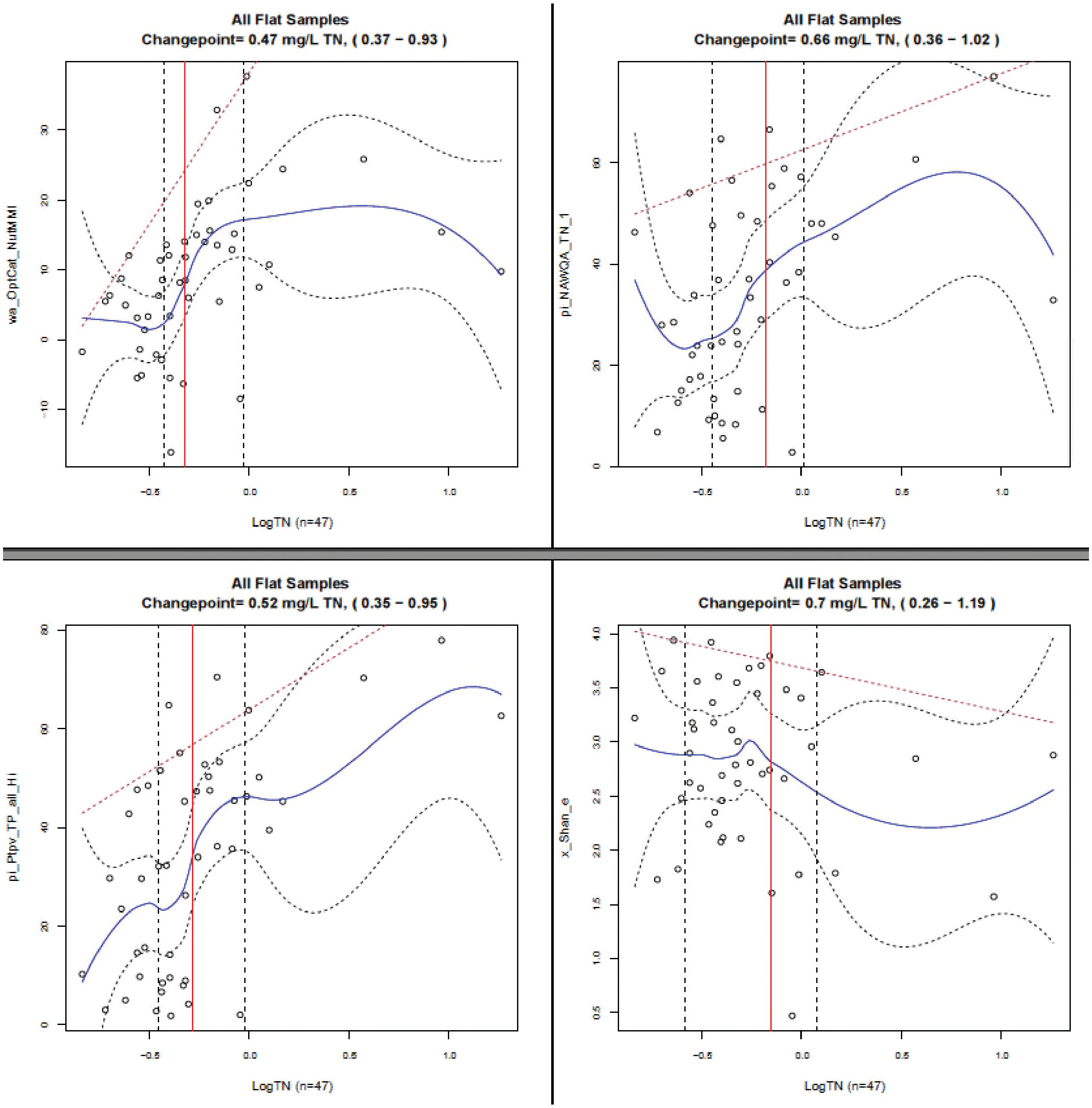

Figure L-2. Change-point graphs for **TN** and **diatom** metrics in the **Flat** site class.

Table L-2. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_NutMMI	0.47	Good	Narrrow	Midslope	Retain
pi_NAWQA_TN_1	0.66	Good	Narrrow	Midslope	Retain
pi_Ptpv_TP_all_Hi	0.52	Good	Narrrow	Midslope	Retain
x_Shan_e	0.7	Fair	Moderate	Midslope	Retain

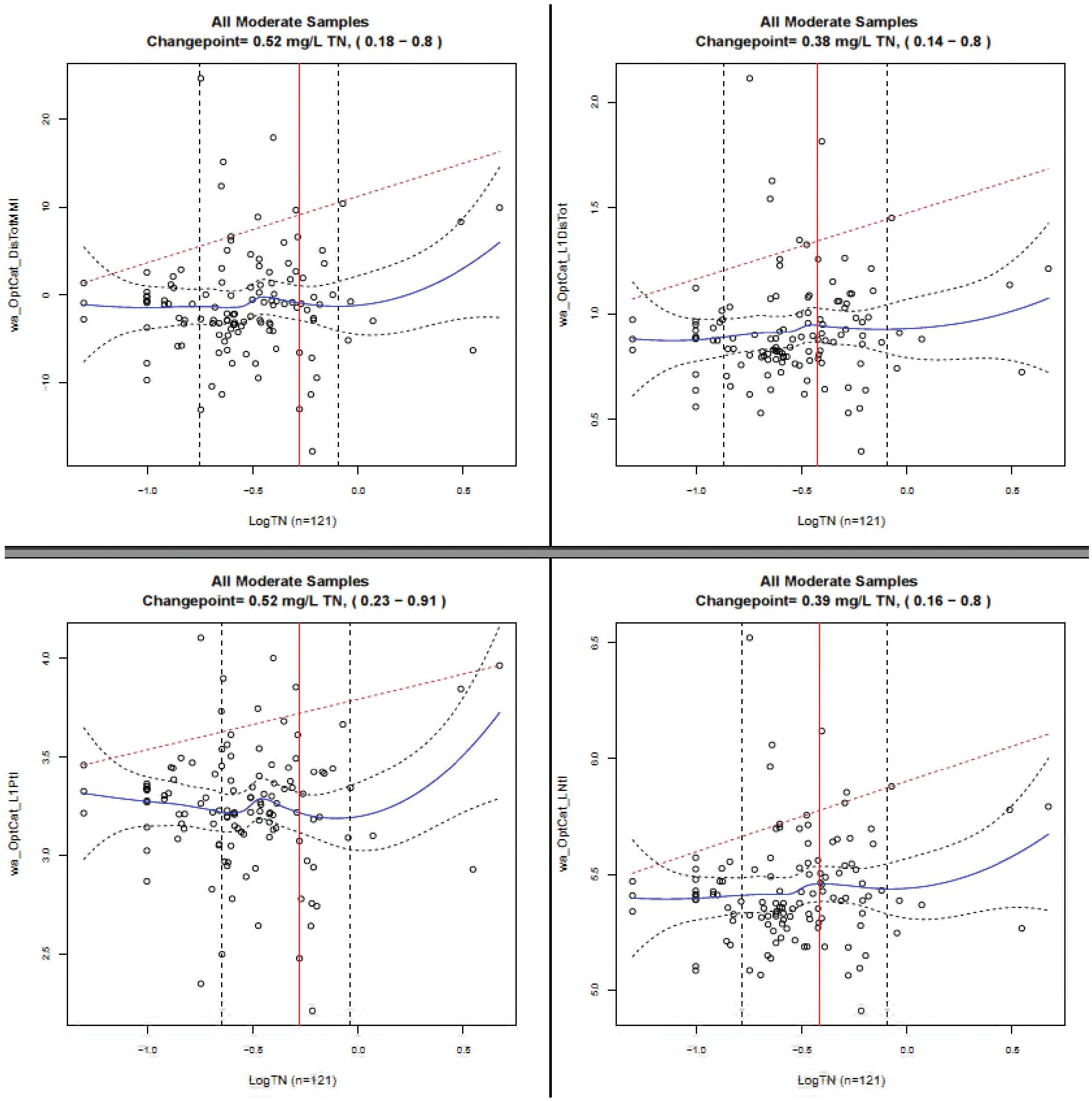

Figure L-3. Change-point graphs for **TN** and **diatom** metrics in the **Moderate** class.

Table L-3. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_DisTotMMI	0.52	Good	Moderate	Poor	Remove
wa_OptCat_L1DisTot	0.38	Good	Moderate	Fair	Retain
wa_OptCat_L1Ptl	0.52	Good	Moderate	Poor	Remove
wa_OptCat_LNtl	0.39	Good	Moderate	Fair	Retain

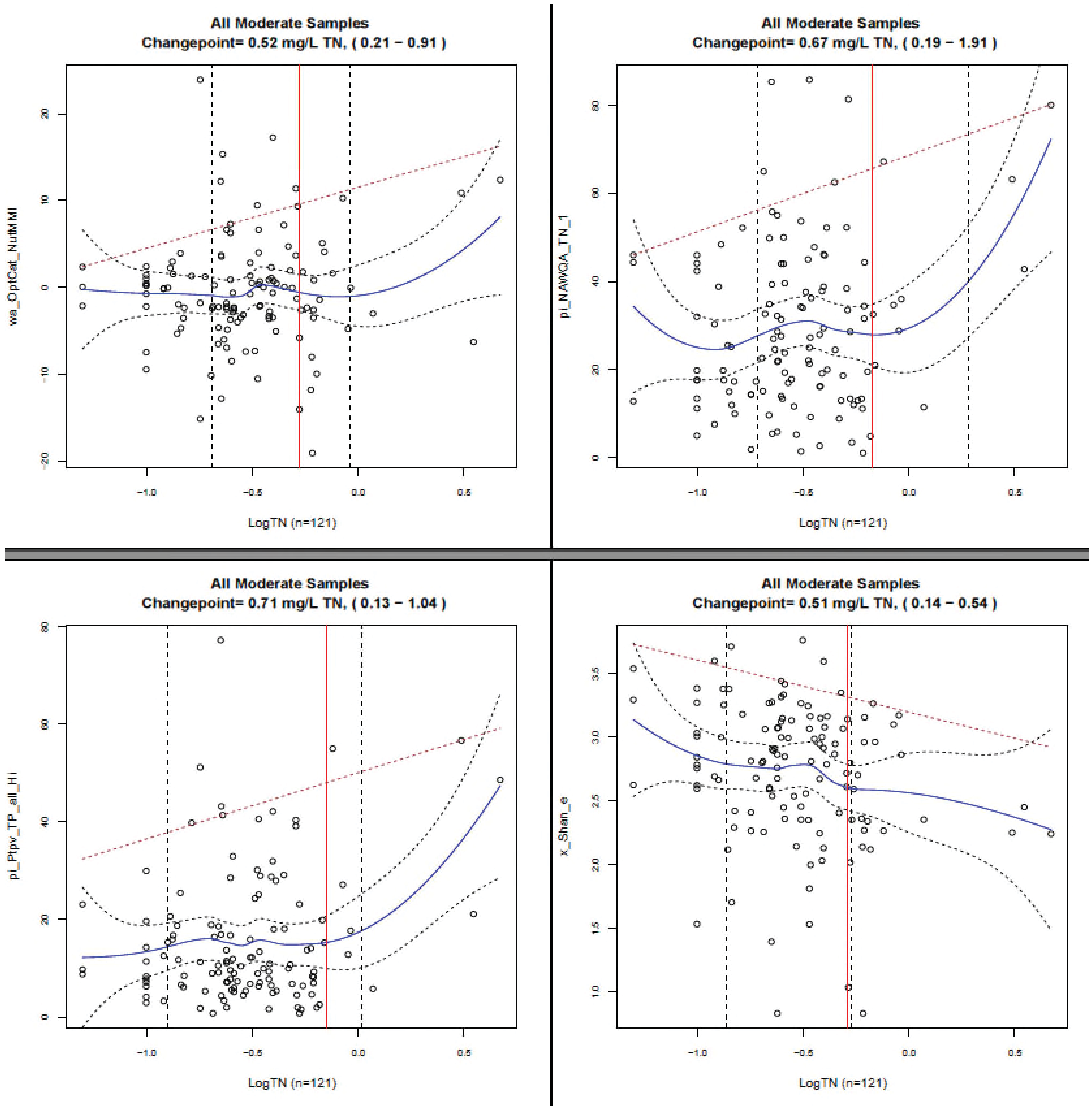

Figure L-4. Change-point graphs for **TN** and **diatom** metrics in the **Moderate** class.

Table L-4. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_NutMMI	0.52	Good	Moderate	Poor	Remove
pi_NAWQA_TN_1	0.67	Good	Wide	Poor	Remove
pi_Ptpv_TP_all_Hi	0.71	Good	Wide	Fair	Retain
x_Shan_e	0.51	Good	Moderate	Fair	Retain

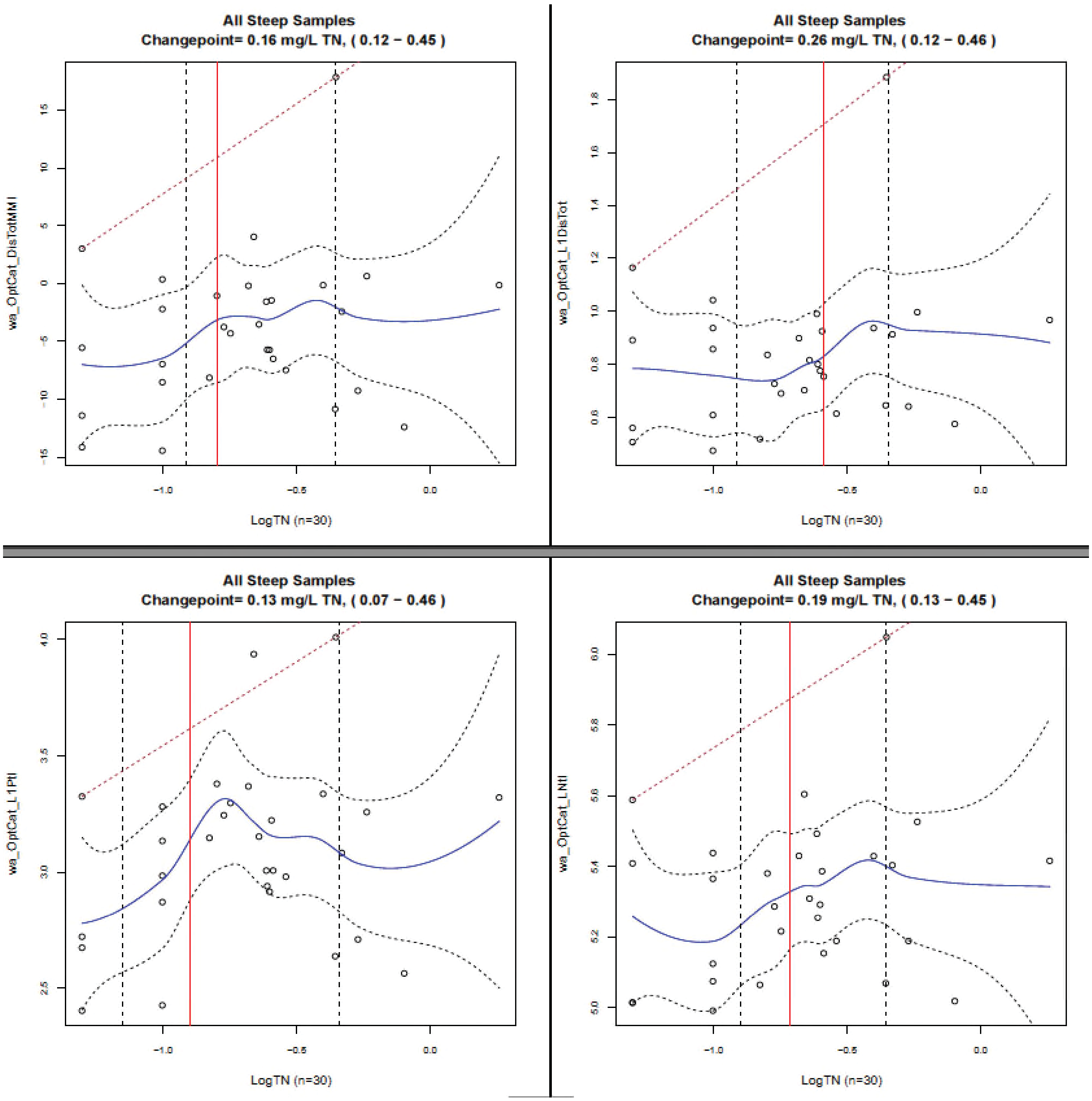

Figure L-5. Change-point graphs for **TN** and **diatom** metrics in the **Steep** class.

Table L-5. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_DisTotMMI	0.16	Good	Moderate	Topofslope	Retain
wa_OptCat_L1DisTot	0.26	Good	Moderate	Midslope	Retain
wa_OptCat_L1Ptl	0.13	Good	Wide	Midslope	Retain
wa_OptCat_LNtl	0.19	Good	Moderate	Midslope	Retain

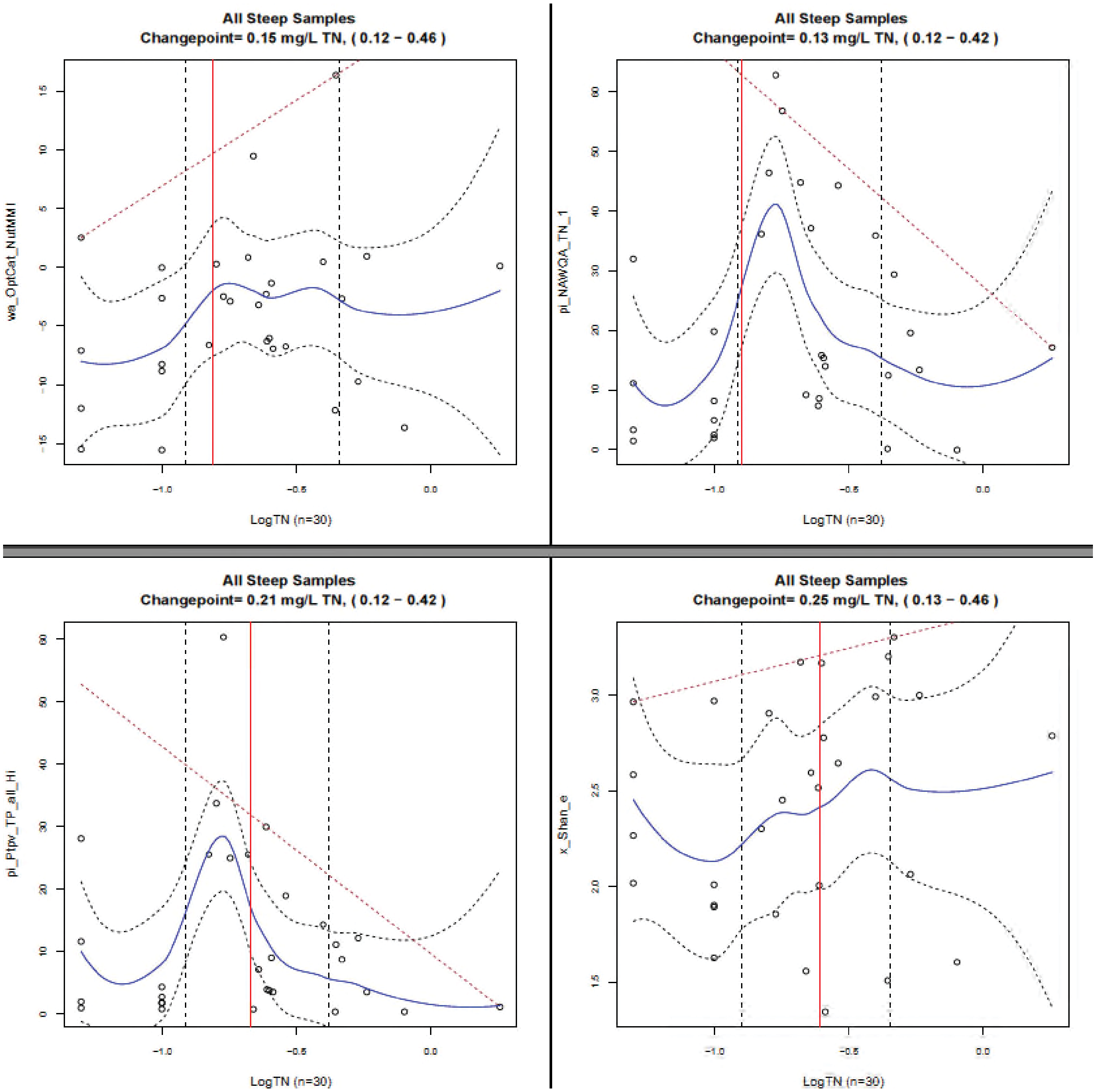

Figure L-6. Change-point graphs for **TN** and **diatom** metrics in the **Steep** class.

Table L-6. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_NutMMI	0.15	Good	Moderate	Topofslope	Retain
pi_NAWQA_TN_1	0.13	Decreaser	Moderate	Midslope	Remove
pi_Ptpv_TP_all_Hi	0.21	Decreaser	Moderate	Midslope	Remove
x_Shan_e	0.25	Increaser	Moderate	Midslope	Retain

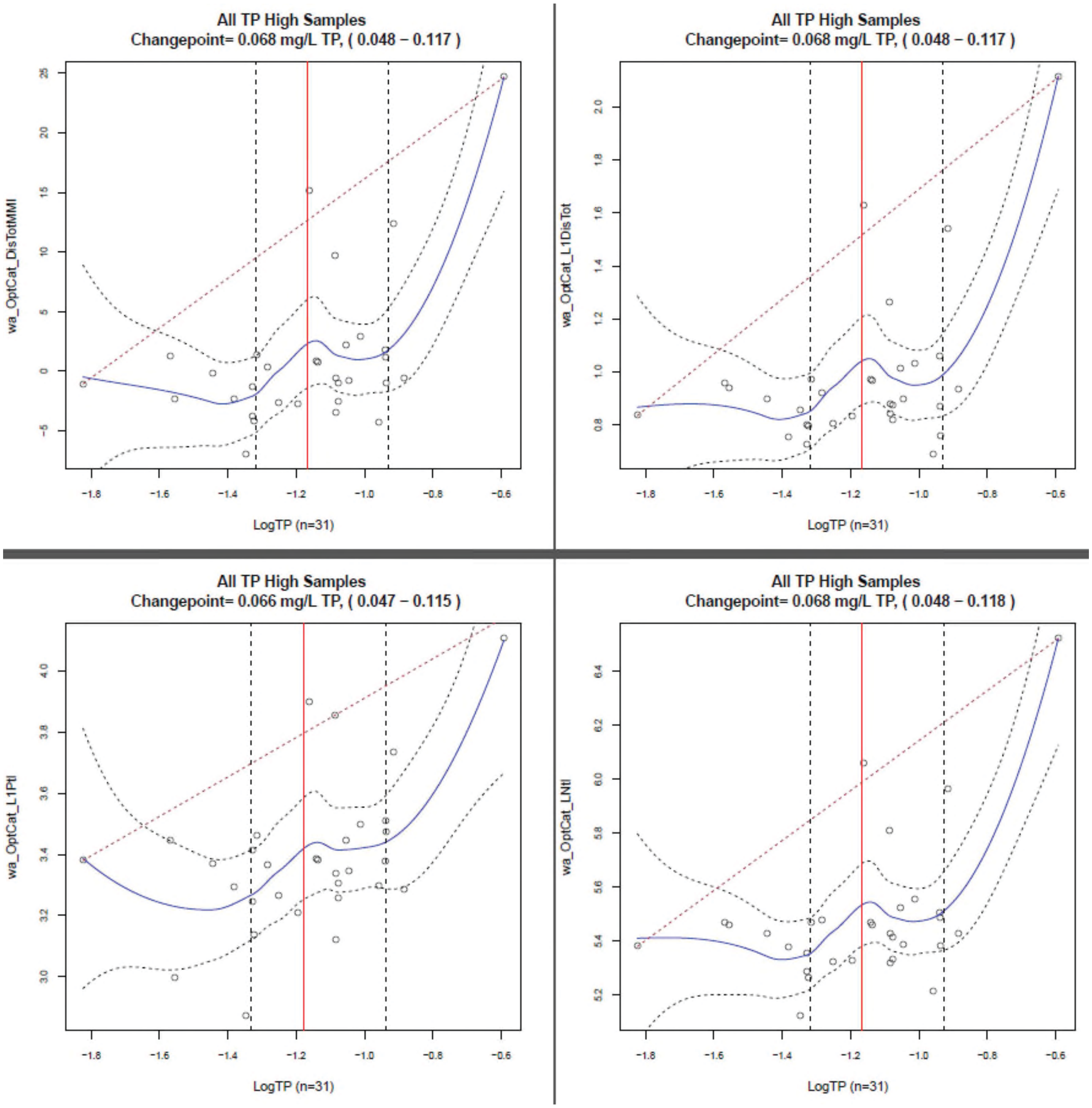

Figure L-7. Change-point graphs for **TP** and **diatom** metrics in the **TP High-Volcanic** class.

Table L-7. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_DisTotMMI	0.068	Good	Moderate	Topofslope	Retain
wa_OptCat_L1DisTot	0.068	Good	Moderate	Topofslope	Retain
wa_OptCat_L1Ptl	0.066	Good	Moderate	Topofslope	Retain
wa_OptCat_LNtl	0.068	Good	Moderate	Topofslope	Retain

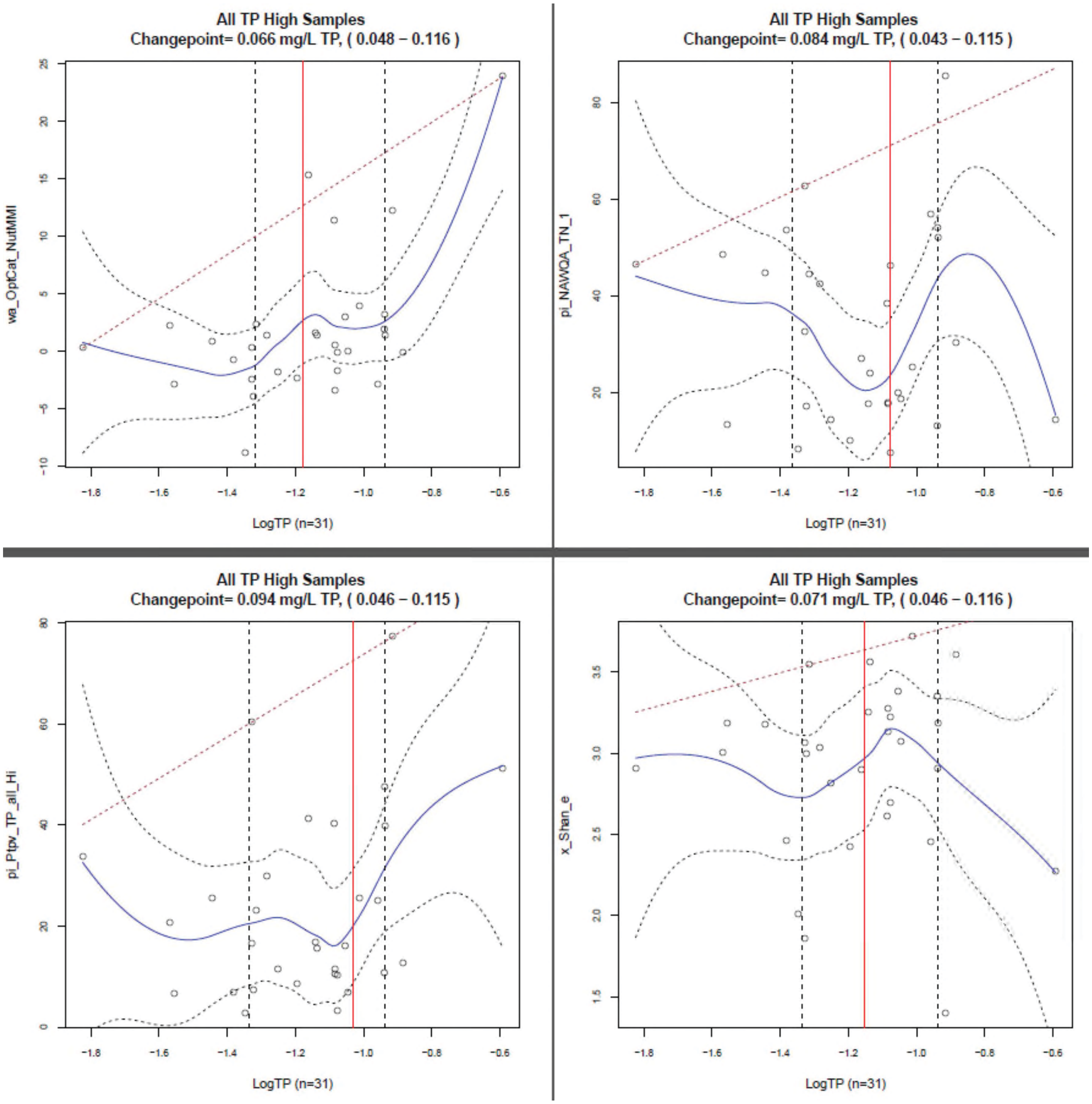

Figure L-8. Change-point graphs for **TP** and **diatom** metrics in the **WestFlat** class.

Table L-8. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_NutMMI	0.066	Good	Moderate	Topofslope	Retain
pi_NAWQA_TN_1	0.084	Good	Moderate	Inconsistent	Remove
pi_Ptpv_TP_all_Hi	0.094	Good	Moderate	Midslope	Retain
x_Shan_e	0.071	Good	Moderate	Midslope	Retain

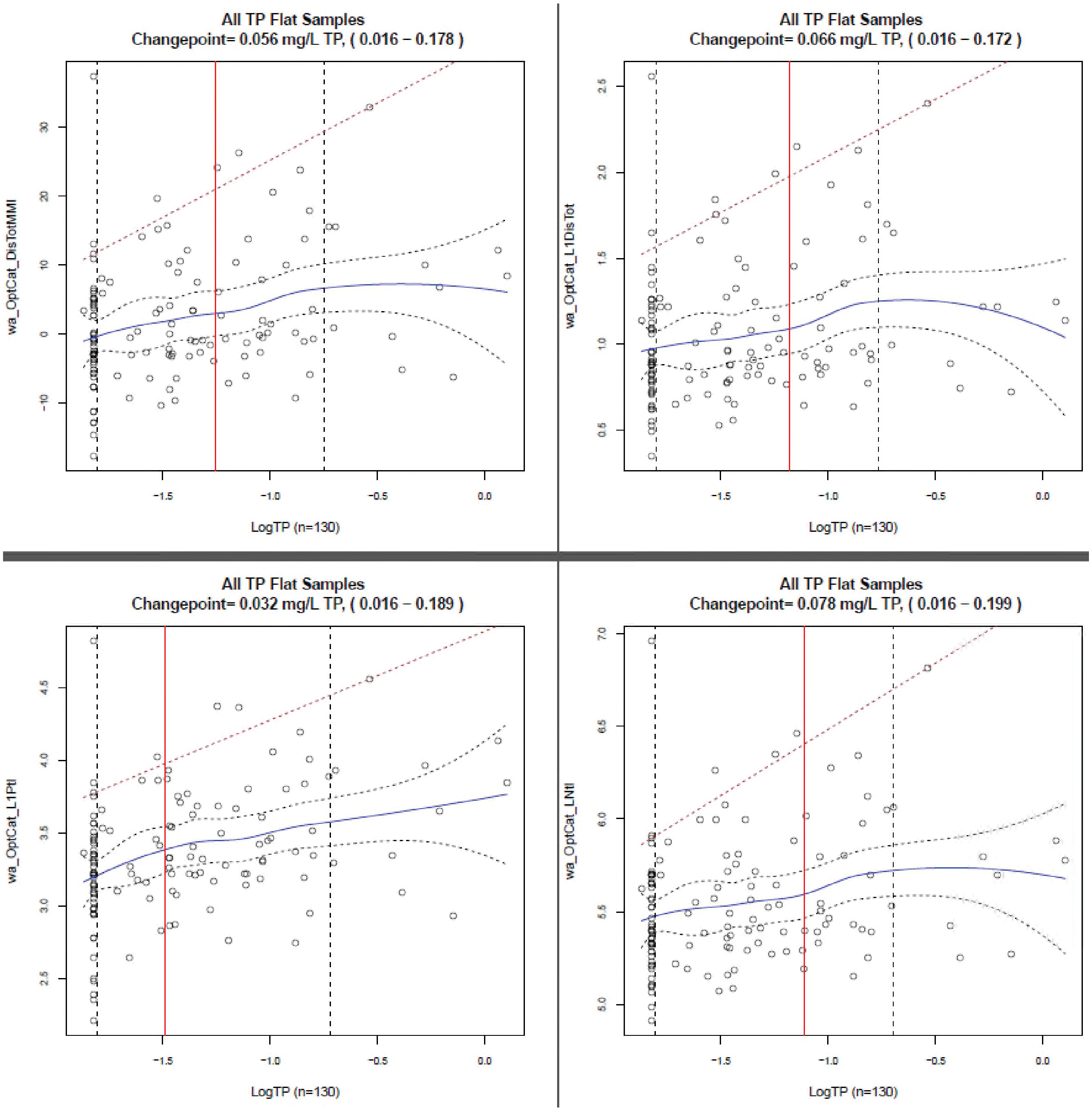

Figure L-9. Change-point graphs for **TP** and **diatom** metrics in the **TP Flat-Moderate** class.

Table L-9. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_DisTotMMI	0.056	Good	Wide	Midslope	Retain
wa_OptCat_L1DisTot	0.066	Good	Wide	Midslope	Retain
wa_OptCat_L1Ptl	0.032	Good	Wide	Midslope	Retain
wa_OptCat_LNtl	0.078	Good	Wide	Midslope	Retain

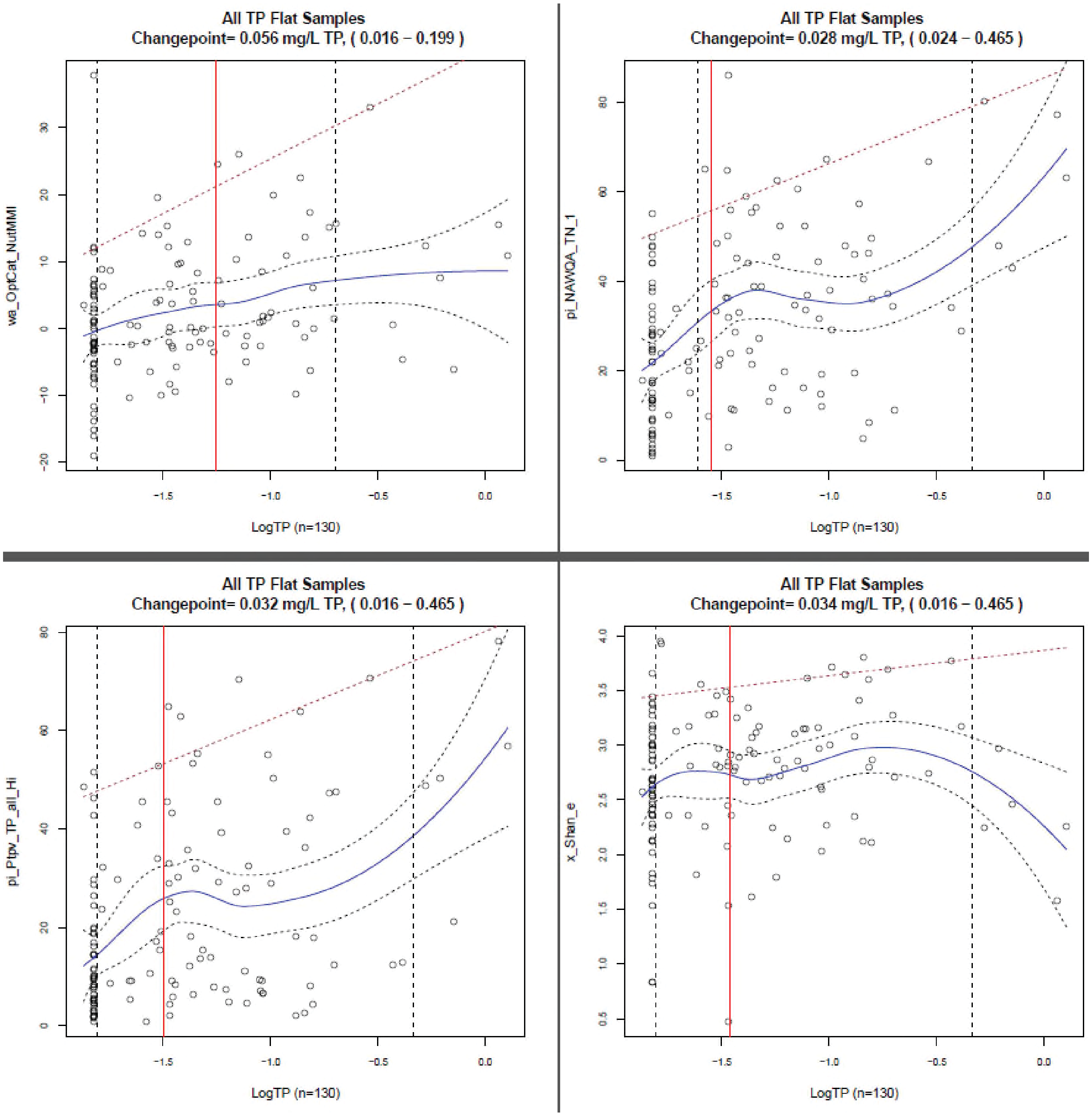

Figure L-10. Change-point graphs for **TP** and **diatom** metrics in the **TP Flat** class.

Table L-10. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_NutMMI	0.056	Good	Wide	Midslope	Retain
pi_NAWQA_TN_1	0.028	Good	Wide	Midslope	Retain
pi_Ptpv_TP_all_Hi	0.032	Good	Wide	Midslope	Retain
x_Shan_e	0.034	Good	Wide	Inconsistent	Remove

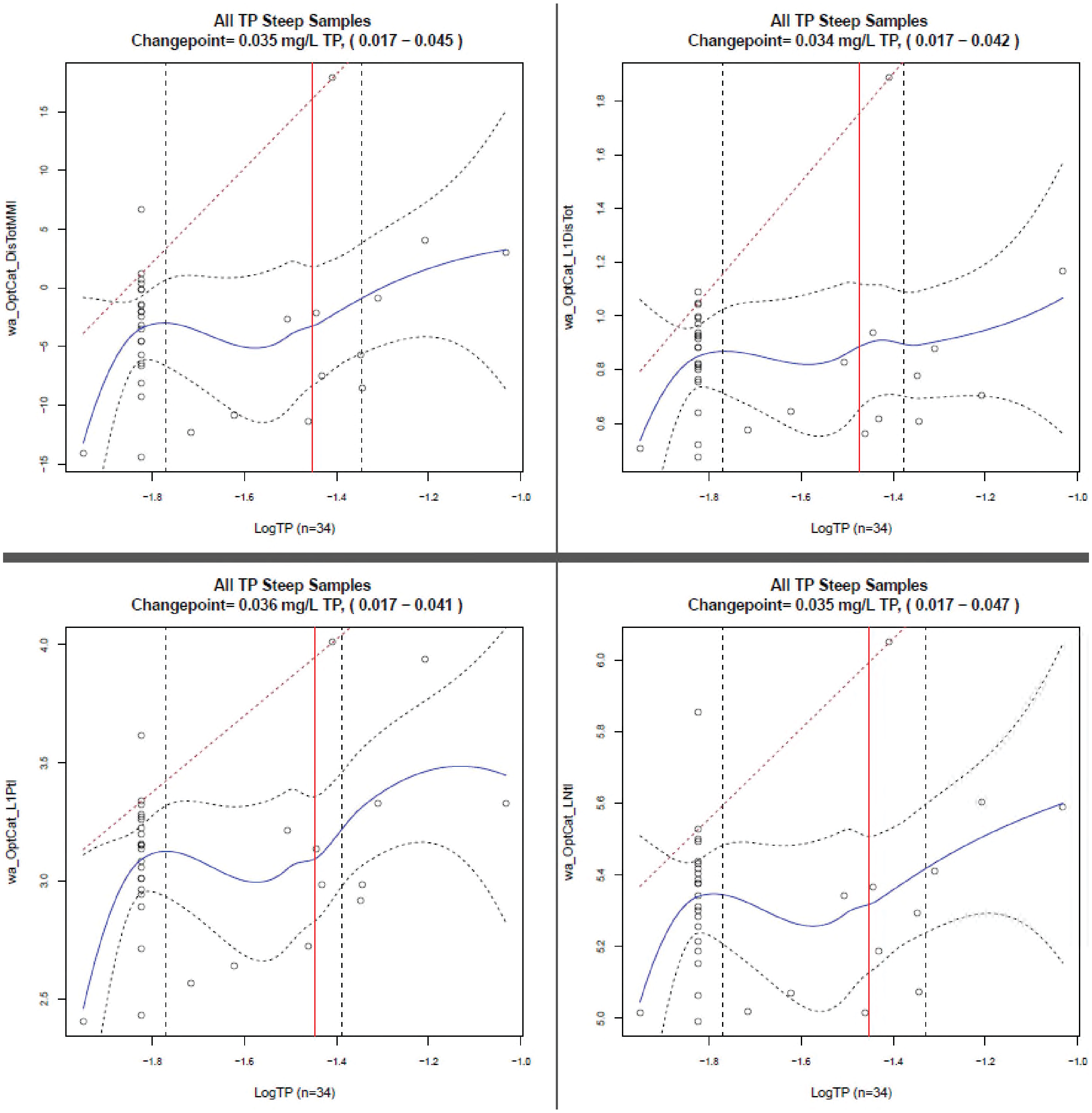

Figure L-11. Change-point graphs for **TP** and **diatom** metrics in the **TP Steep** class.

Table L-11. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_DisTotMMI	0.035	Good	Moderate	Midslope	Retain
wa_OptCat_L1DisTot	0.034	Good	Moderate	Midslope	Retain
wa_OptCat_L1Ptl	0.036	Good	Moderate	Midslope	Retain
wa_OptCat_LNtl	0.035	Good	Moderate	Midslope	Retain

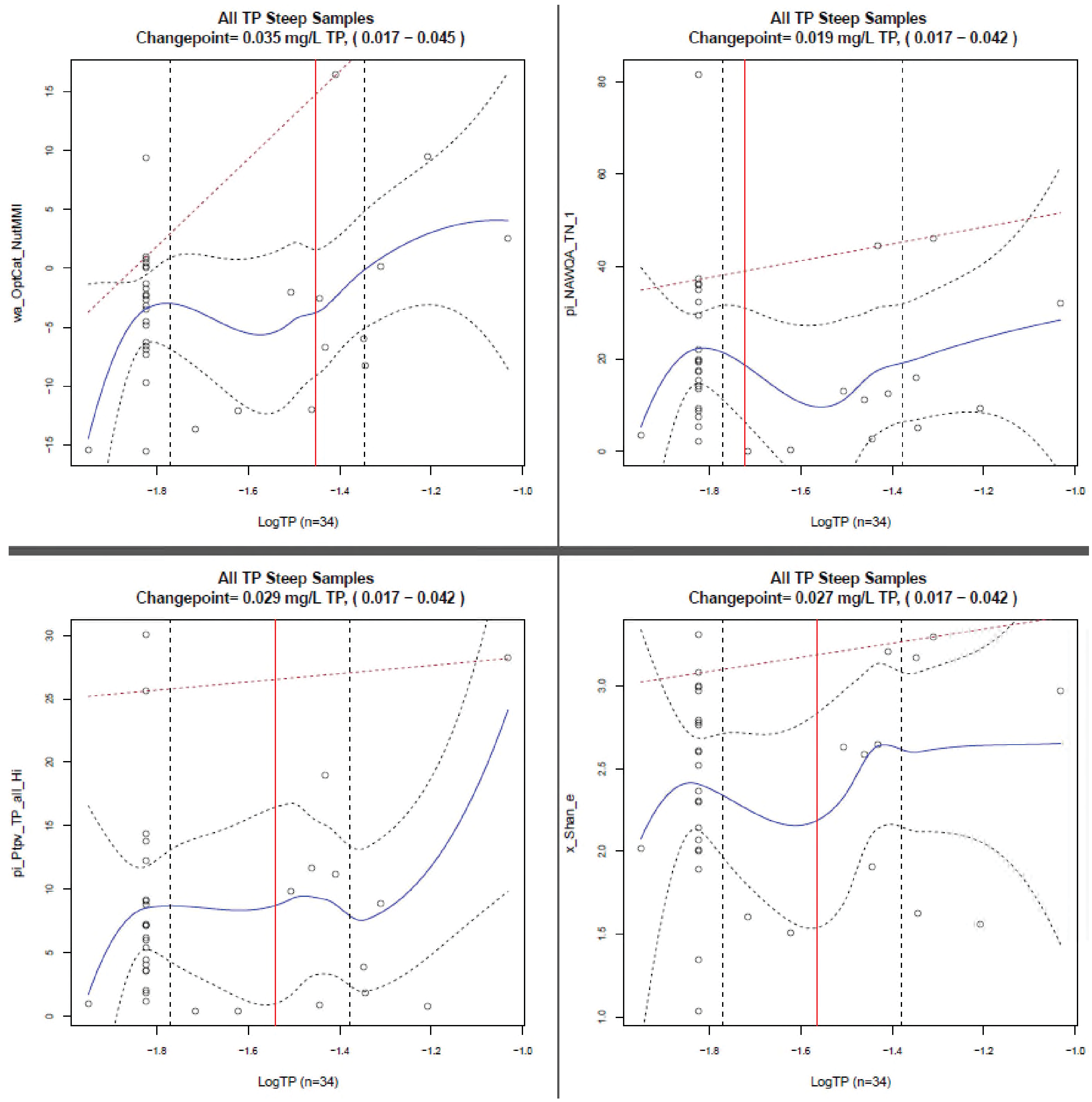

Figure L-12. Change-point graphs for **TP** and **diatom** metrics in the **TP Steep** class.

Table L-12. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
wa_OptCat_NutMMI	0.035	Good	Moderate	Midslope	Retain
pi_NAWQA_TN_1	0.019	Good	Moderate	Inconsistent	Remove
pi_Ptpv_TP_all_Hi	0.029	Good	Moderate	Flat	Remove
x_Shan_e	0.027	Good	Moderate	Inconsistent	Remove

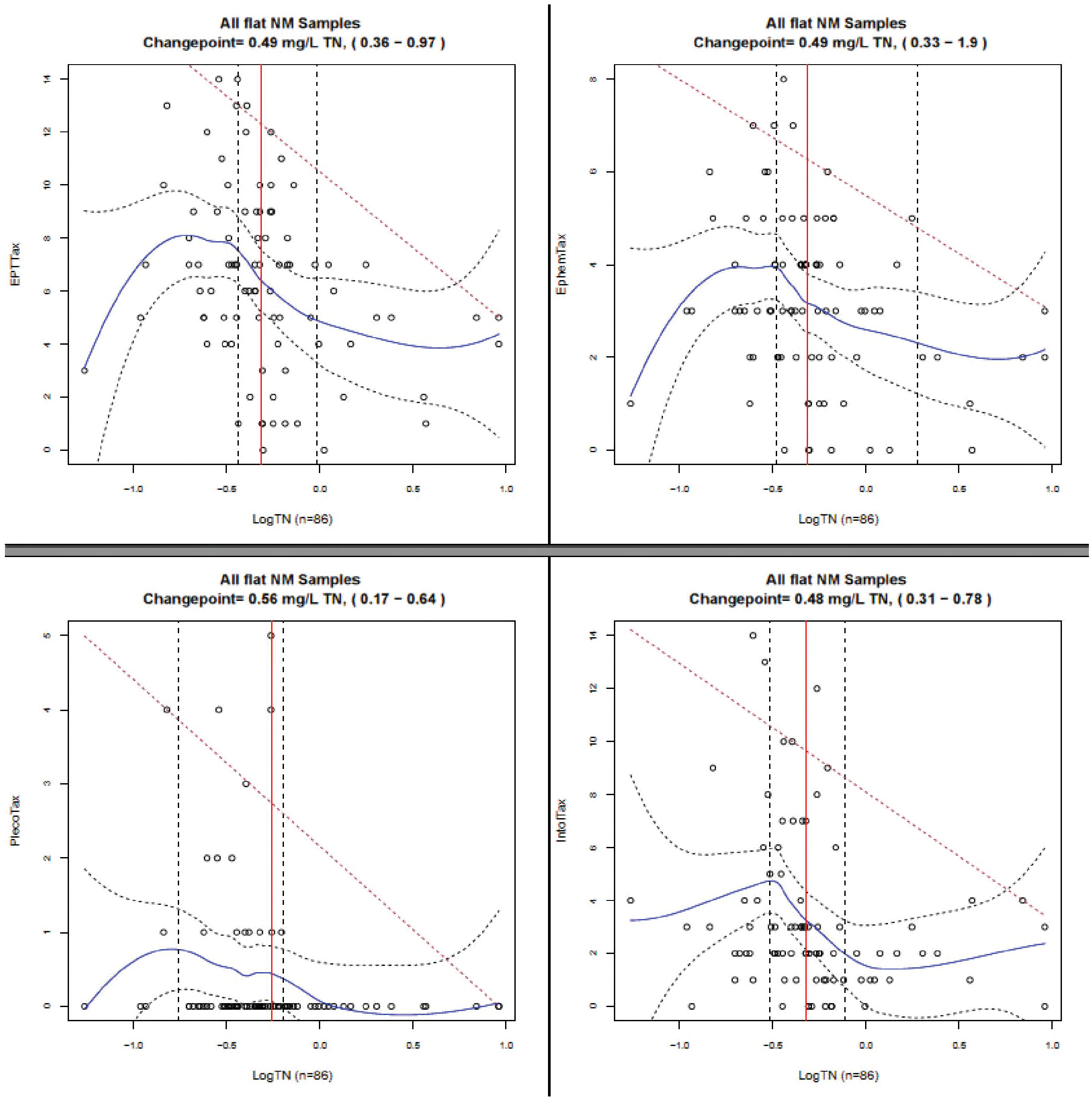

Figure L-13. Change-points graphs for **TN** and **macroinvertebrates** in the **TN Flat** class.

Table L-13. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
EPTTax	0.49	good	narrow	midslope	Retain
EphemTax	0.49	good	moderate	midslope	Retain
PlecoTax	0.56	good	moderate	midslope	Retain
IntolTax	0.48	good	narrow	midslope	Retain

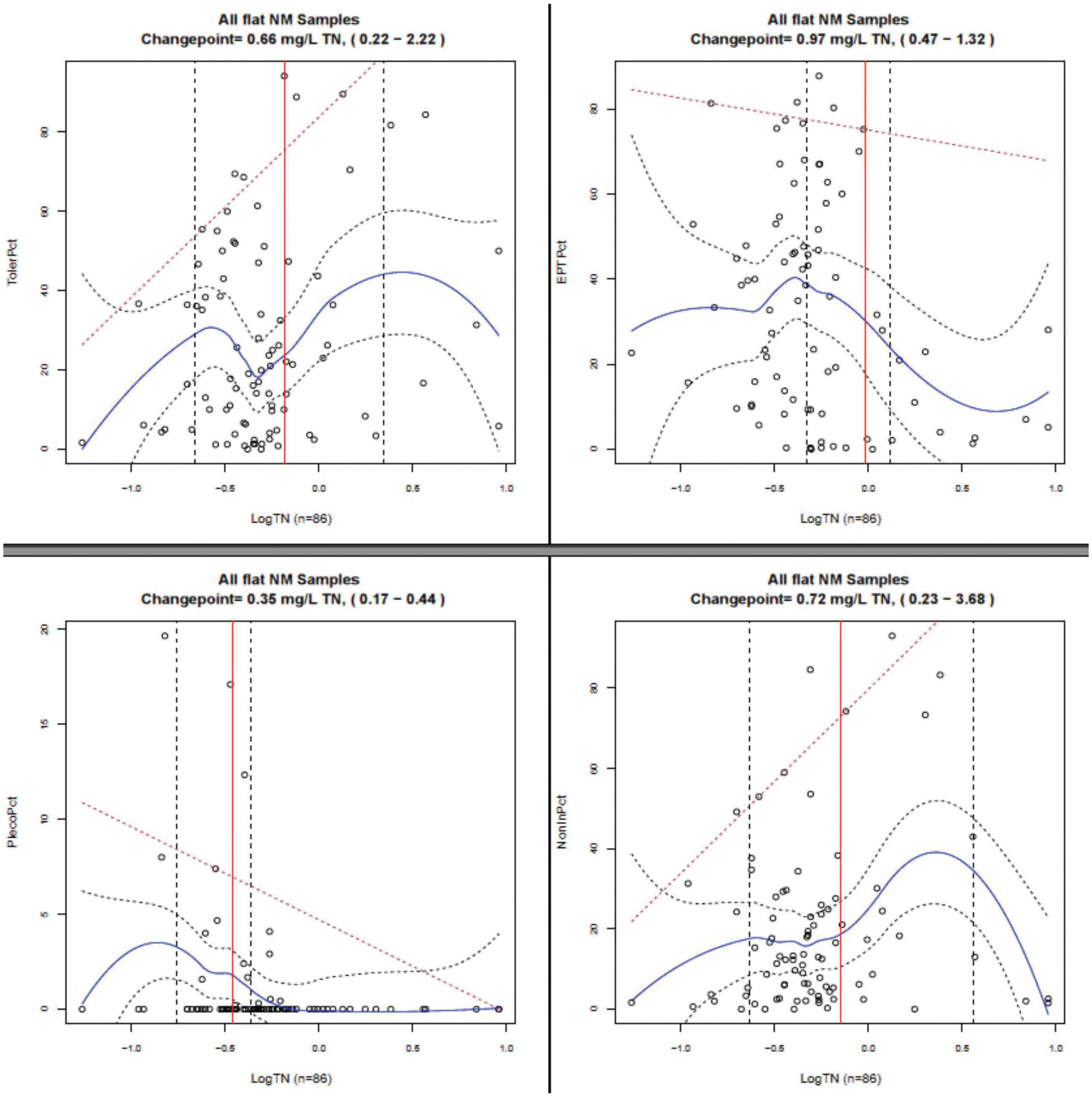

Figure L-14. Change-points graphs for **TN** and **macroinvertebrates** in the **TN Flat** class.

Table L-14. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
TolerPct	0.66	good	wide	midslope	Retain
EPTPct	0.97	good	narrow	midslope	Retain
PlecoPct	0.35	good	narrow	midslope	Retain
NonInPct	0.72	good	wide	earlyslope	Retain

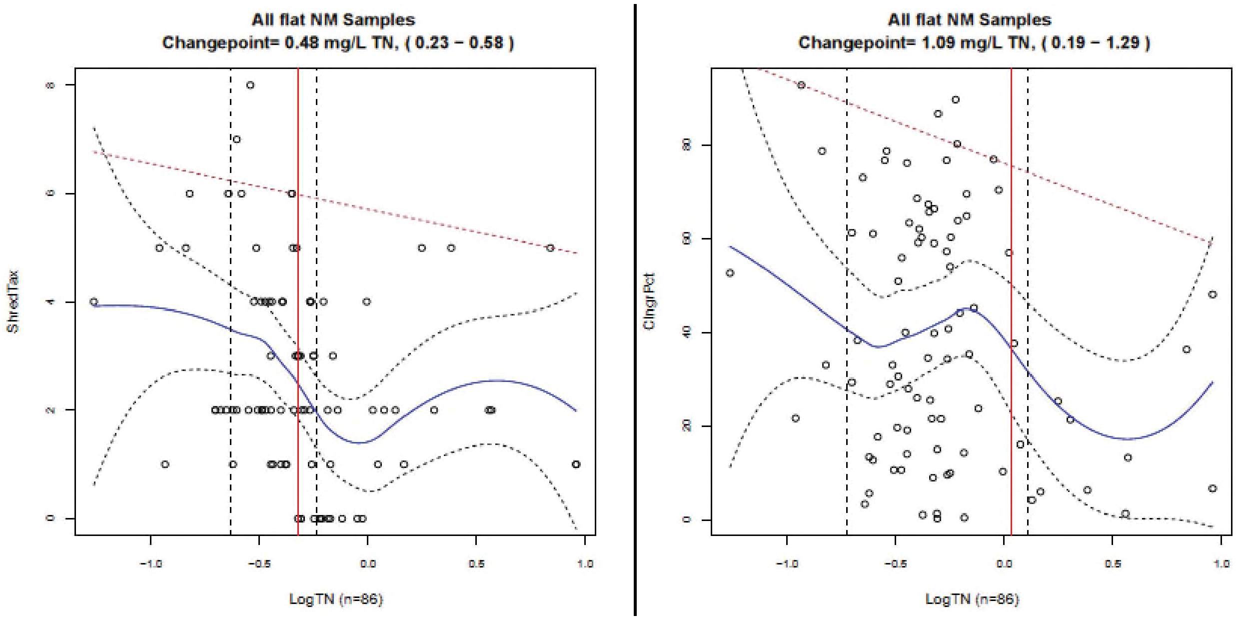

Figure L-15. Change-points graphs for **TN** and **macroinvertebrates** in the **TN Flat** class.

Table L-15. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
ShredTax	0.48	good	narrow	midslope	Retain
ClngrPct	1.09	good	moderate	midslope	Retain

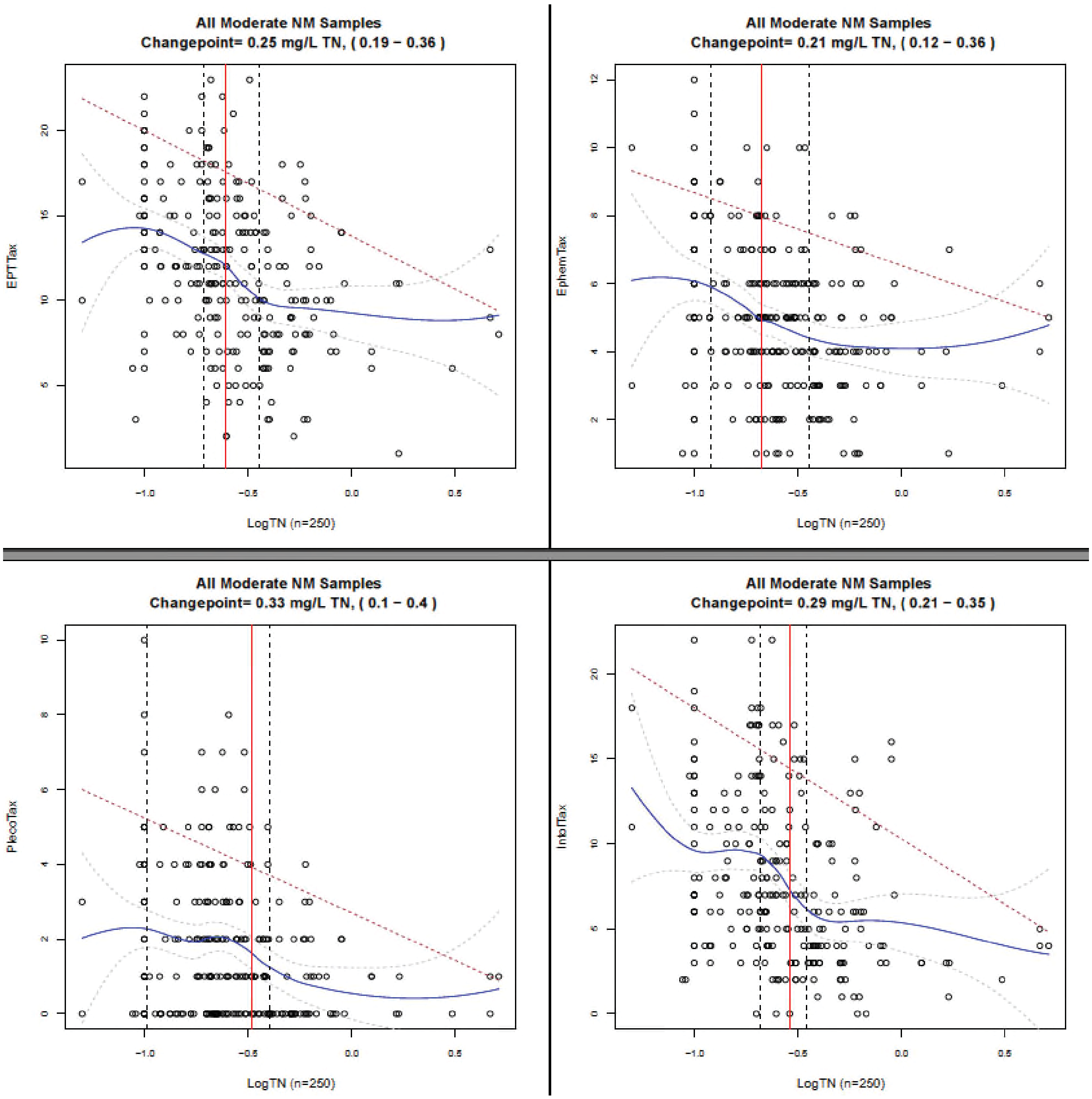

Figure L-16. Change-points for **TN** and **macroinvertebrates** in the **TN Moderate** class.

Table L-16. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
EPTTax	0.25	good	narrow	midslope	Retain
EphemTax	0.21	good	moderate	midslope	Retain
PlecoTax	0.33	good	moderate	midslope	Retain
IntolTax	0.29	good	narrow	midslope	Retain

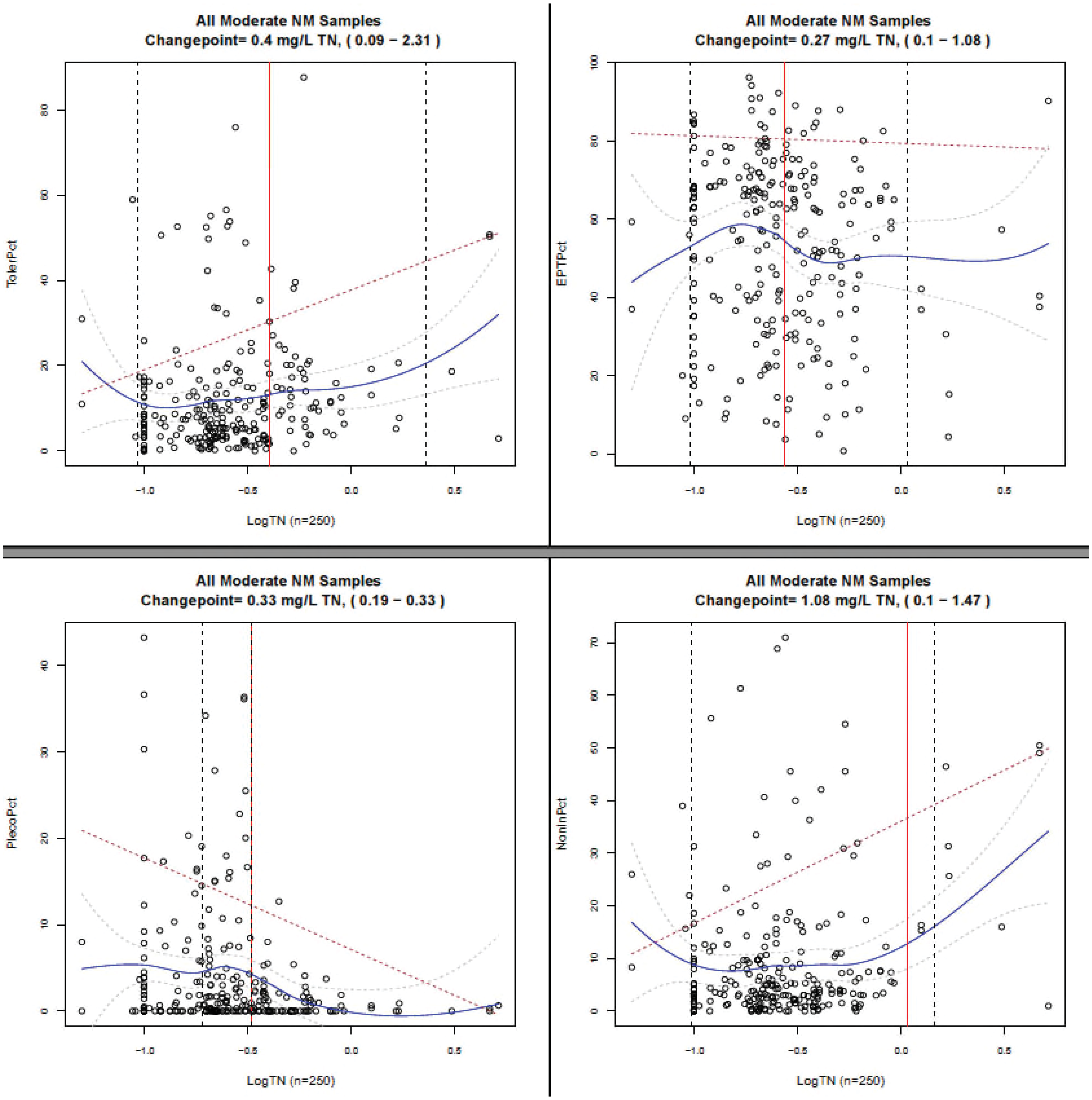

Figure L-17. Change-points for **TN** and **macroinvertebrates** in the **TN Moderate** class.

Table L-17. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
TolerPct	0.4	good	wide	longslope	Retain
EPTPct	0.27	flat	wide	midslope	Remove
PlecoPct	0.33	good	narrow	earlyslope	Retain
NonInPct	1.08	good	wide	midslope	Retain

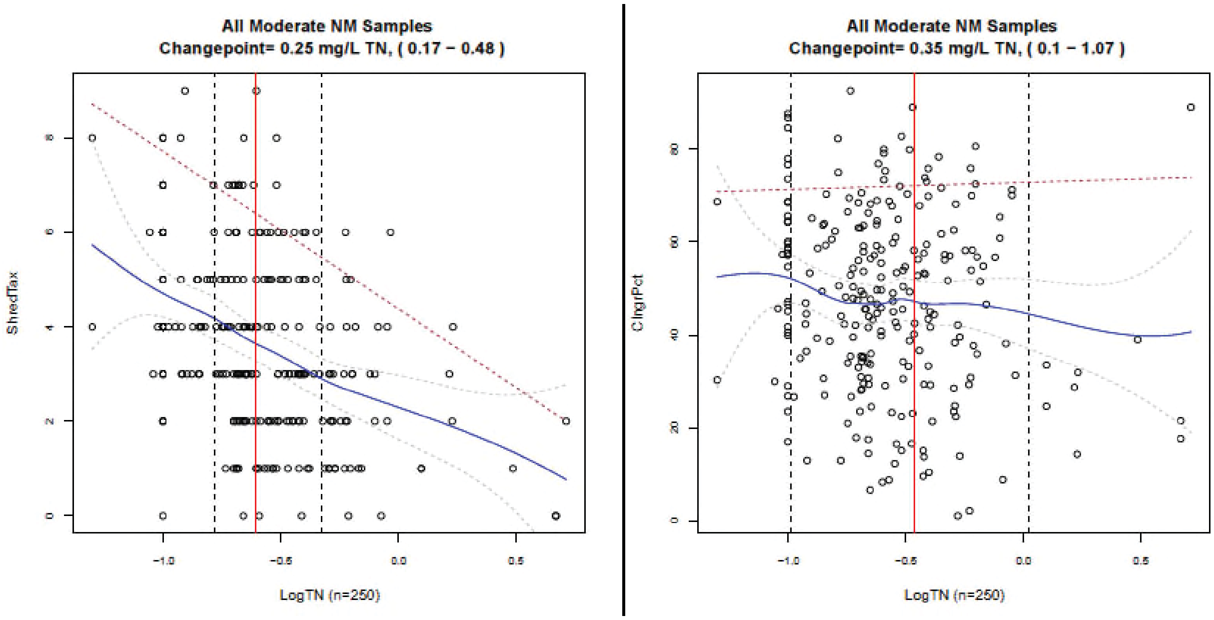

Figure L-18. Change-points for **TN** and **macroinvertebrates** in the **Moderate** class.

Table L-18. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
ShredTax	0.25	good	moderate	longslope	Retain
ClngrPct	0.35	flat	wide	flat	Remove

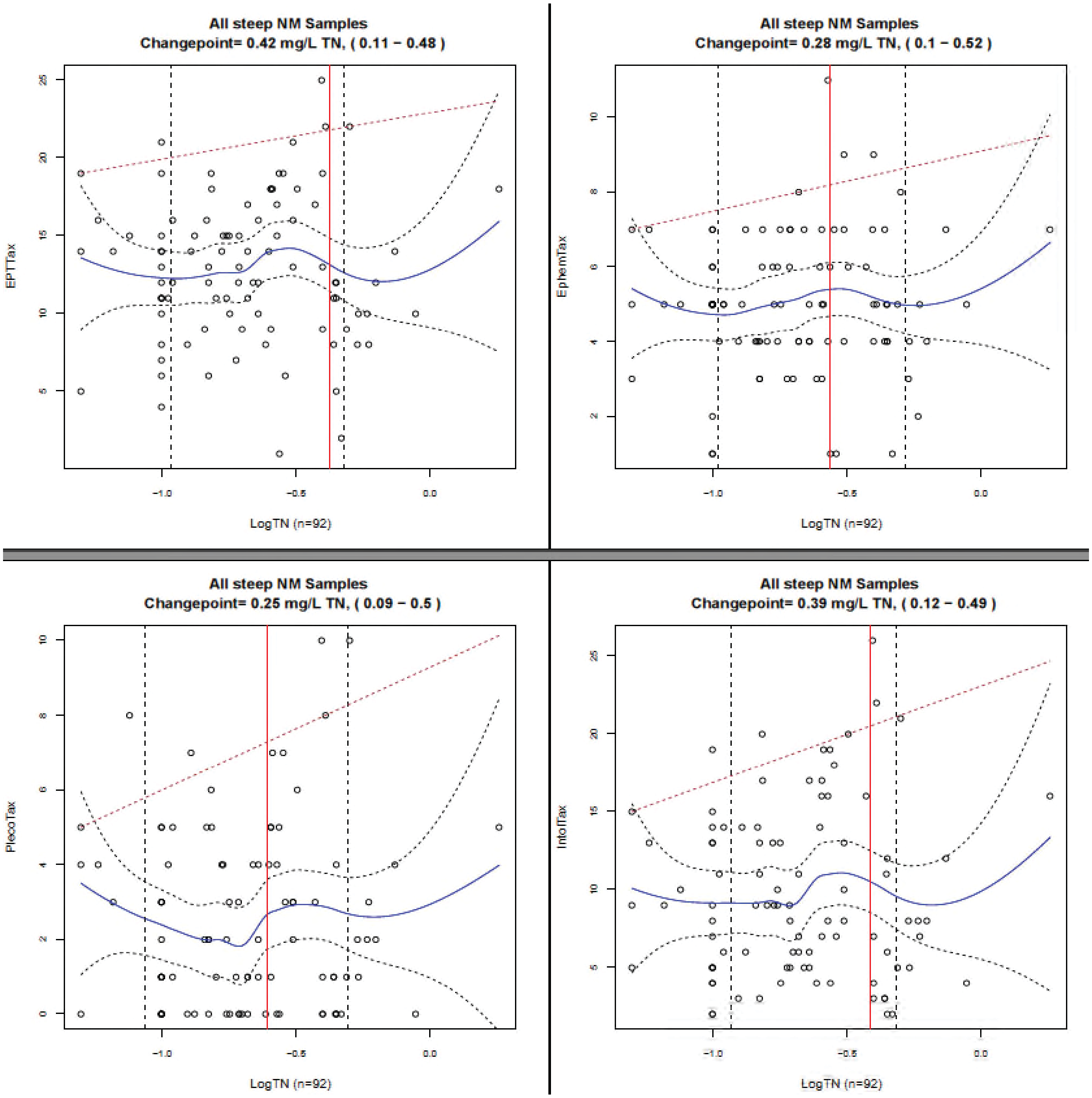

Figure L-19. Change-point graphs for **TN** and **macroinvertebrates** in the **TN Steep** class.

Table L-19. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
EPTTax	0.42	wrong trend	wide	inconsistent	Remove
EphemTax	0.28	wrong trend	wide	peak	Remove
PlecoTax	0.25	wrong trend	wide	wrong trend	Remove
IntolTax	0.39	wrong trend	wide	inconsistent	Remove

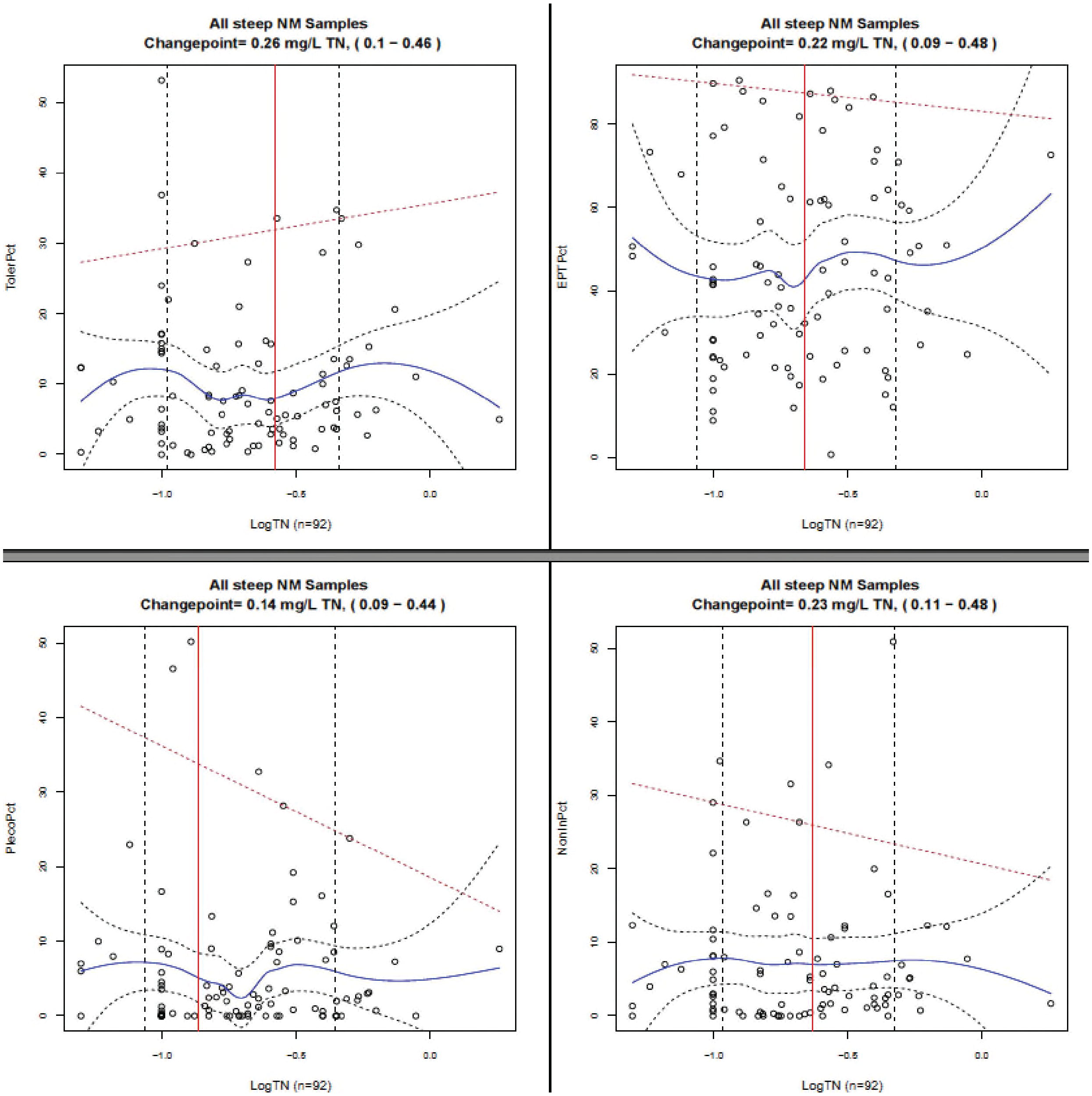

Figure L-20. Change-point graphs for **TN** and **macroinvertebrates** in the **TN Steep** class.

Table L-20. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
TolerPct	0.26	good	wide	inconsistent	Remove
EPTPct	0.22	shallow	wide	inconsistent	Remove
PlecoPct	0.14	good	wide	midslope	Remove
NonInPct	0.23	wrong trend	wide	flat	Remove

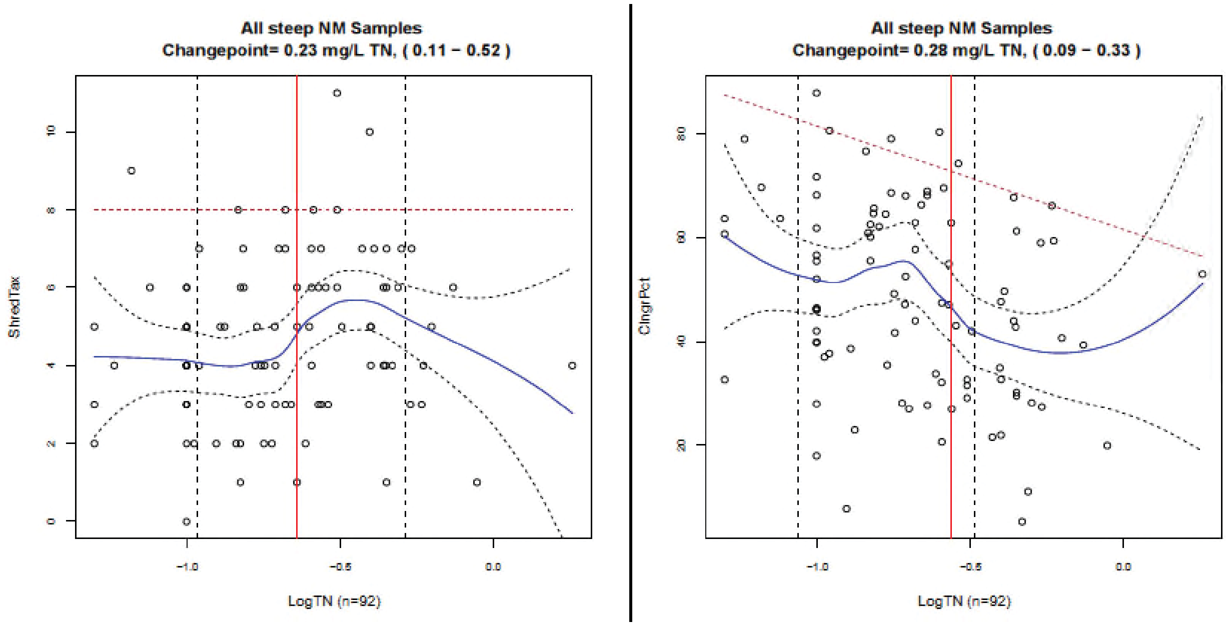

Figure L-21. Change-point graphs for **TN** and **macroinvertebrates** in the **TN Steep** class.

Table L-21. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
ShredTax	0.23	flat	wide	wrong trend	Remove
ClngrPct	0.28	good	moderate	midslope	Retain

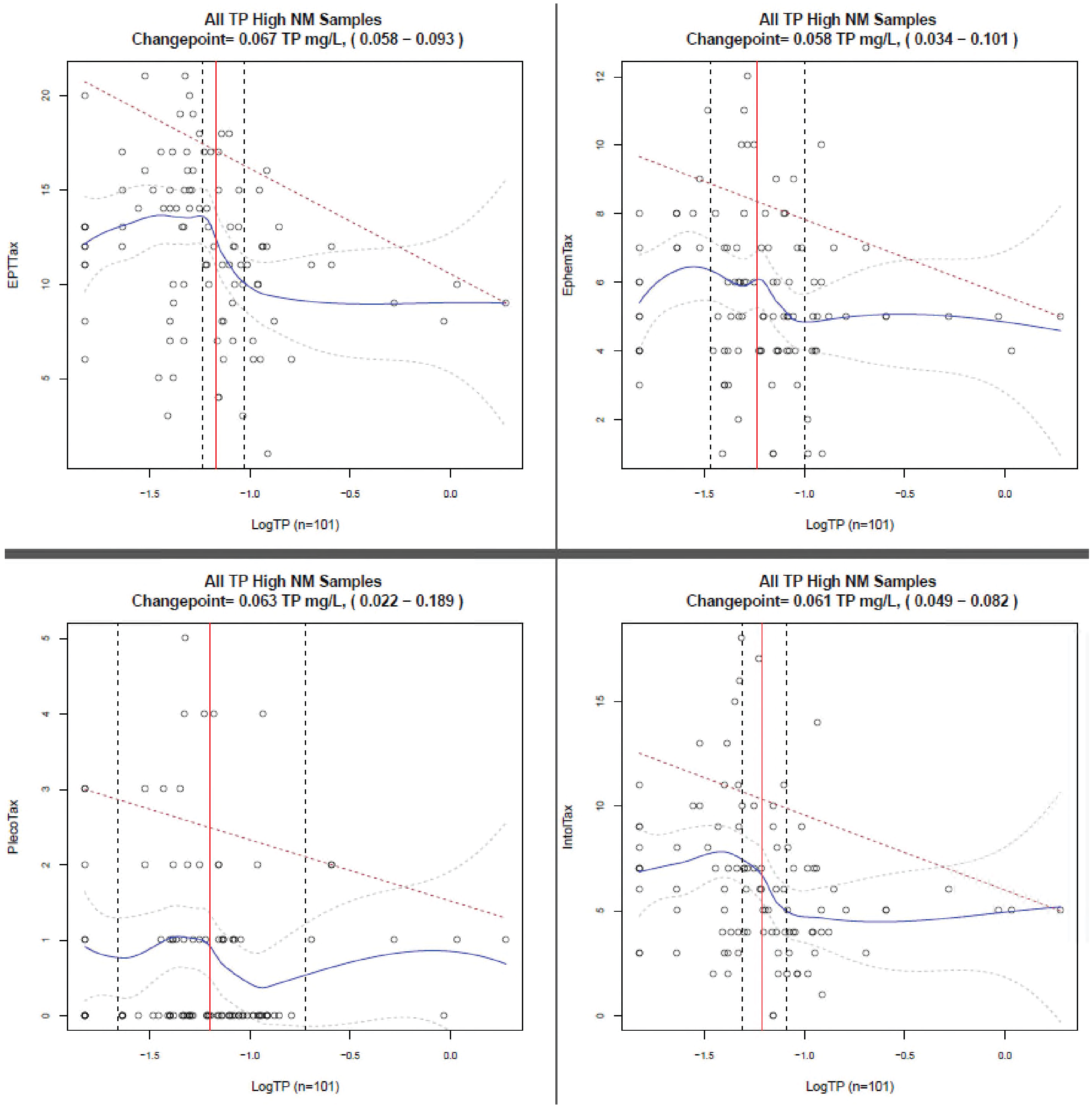

Figure L-22. Change-points for **TP** and **macroinvertebrates** in the **TP High-Volcanic** class.

Table L-22. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
EPTTax	0.067	good	narrow	midslope	Retain
EphemTax	0.058	good	narrow	top of slope	Retain
PlecoTax	0.063	good	broad	top of slope	Retain
IntolTax	0.061	good	narrow	midslope	Retain

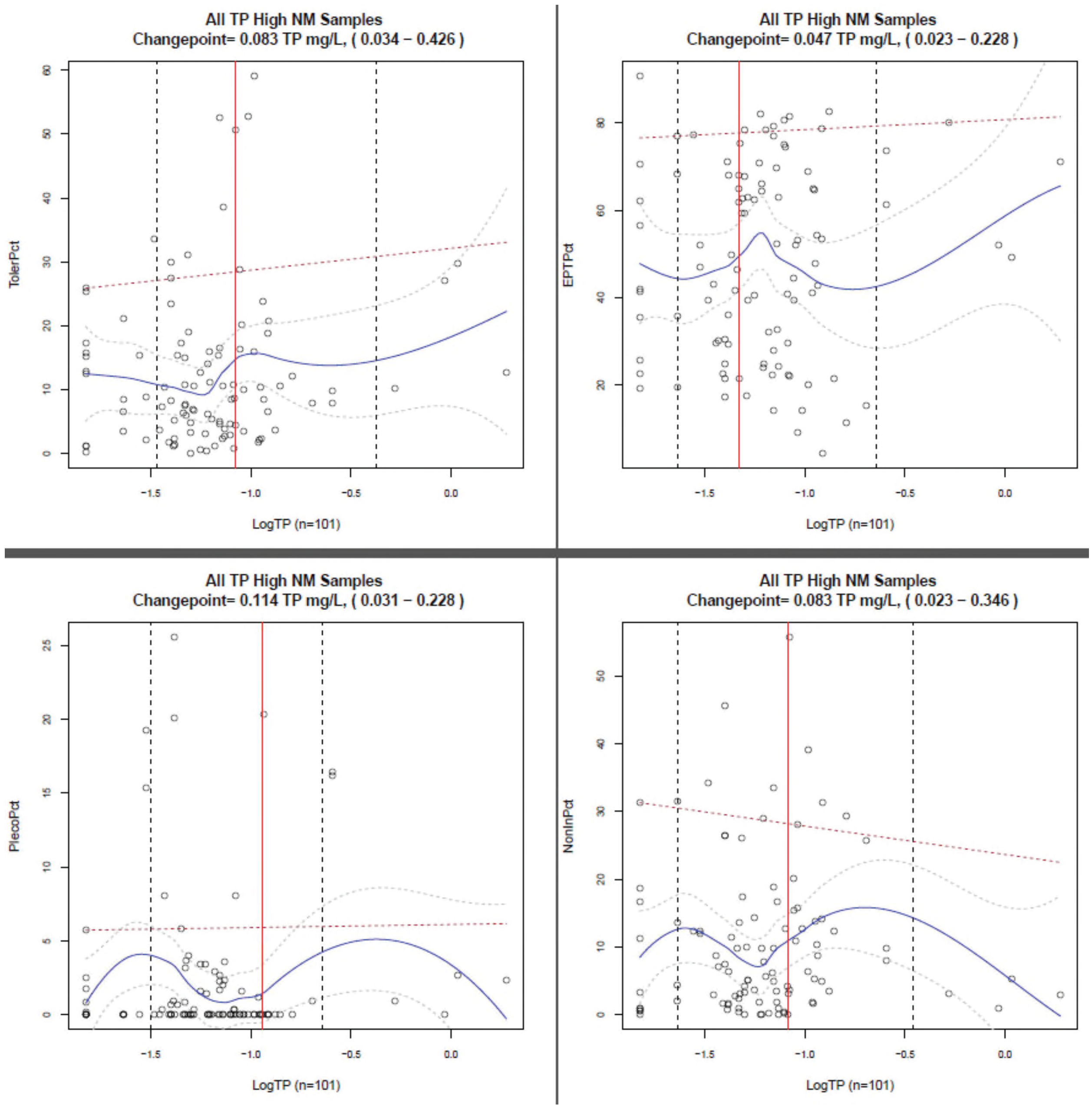

Figure L-23. Change-points for **TP** and **macroinvertebrates** in the **TP High-Volcanic** class.

Table L-23. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
TolerPct	0.083	good	moderate	midslope	Retain
EPTPct	0.047	shallow	broad	midslope	Retain
PlecoPct	0.114	flat	moderate	inconsistent	Remove
NonInPct	0.083	good	broad	inconsistent	Remove

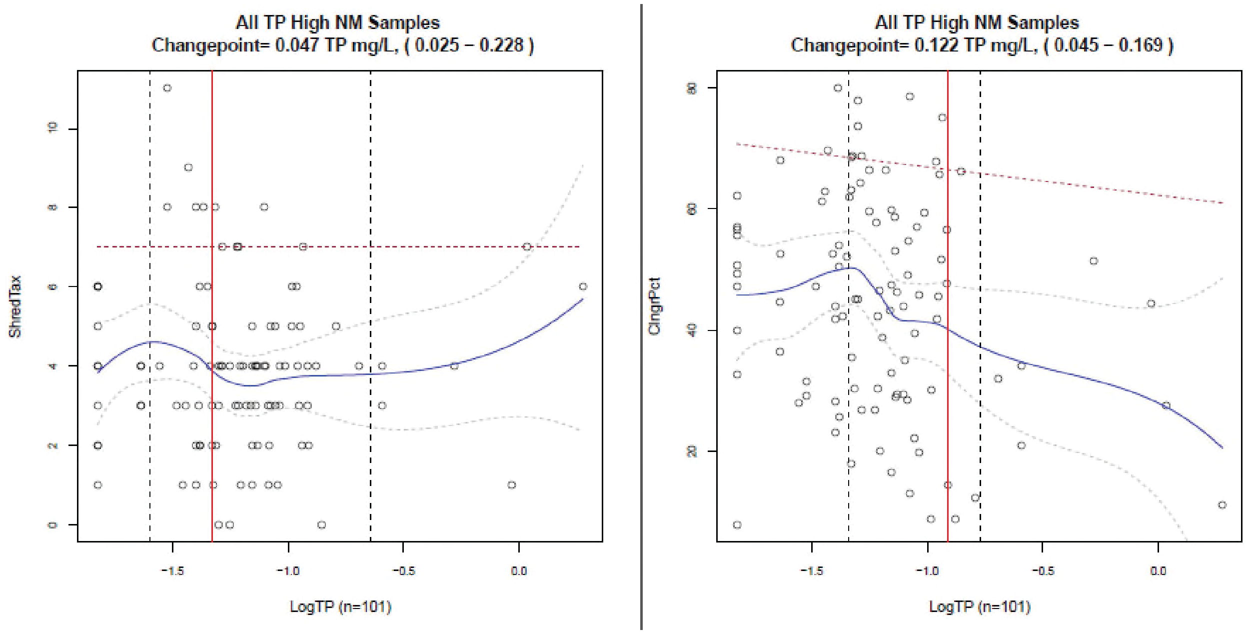

Figure L-24. Change-points for **TP** and **macroinvertebrates** in the **TP High-Volcanic** class.

Table L-24. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
ShredTax	0.047	flat	broad	midslope	Remove
ClngrPct	0.122	good	moderate	midslope	Retain

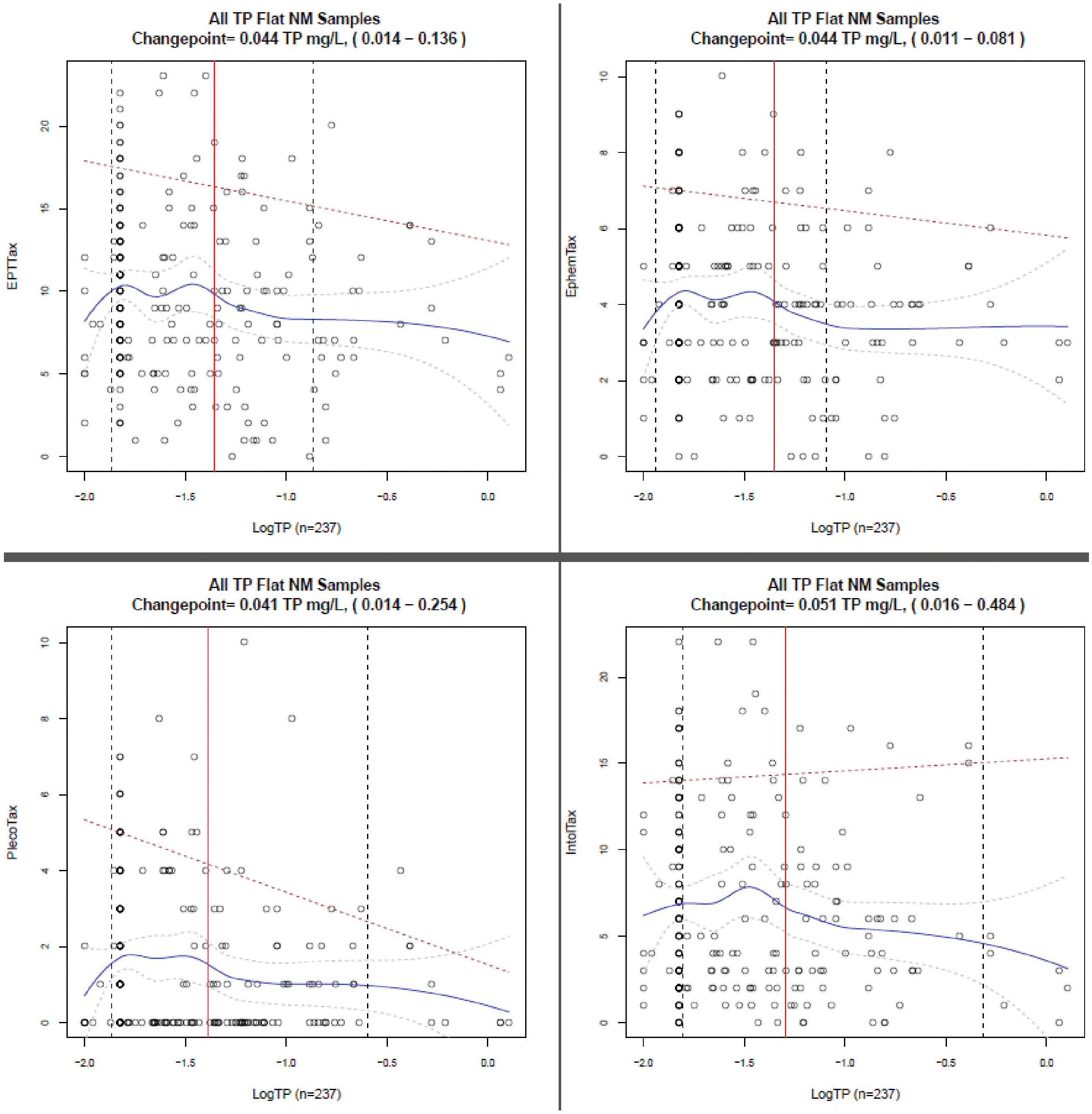

Figure L-25. Change-points for **TP** and **macroinvertebrates** in the **TP Flat-Moderate** class.

Table L-25. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
EPTTax	0.044	good	broad	midslope	Retain
EphemTax	0.044	good	broad	midslope	Retain
PlecoTax	0.041	good	narrow	midslope	Retain
IntolTax	0.051	good	broad	inconsistent	Remove

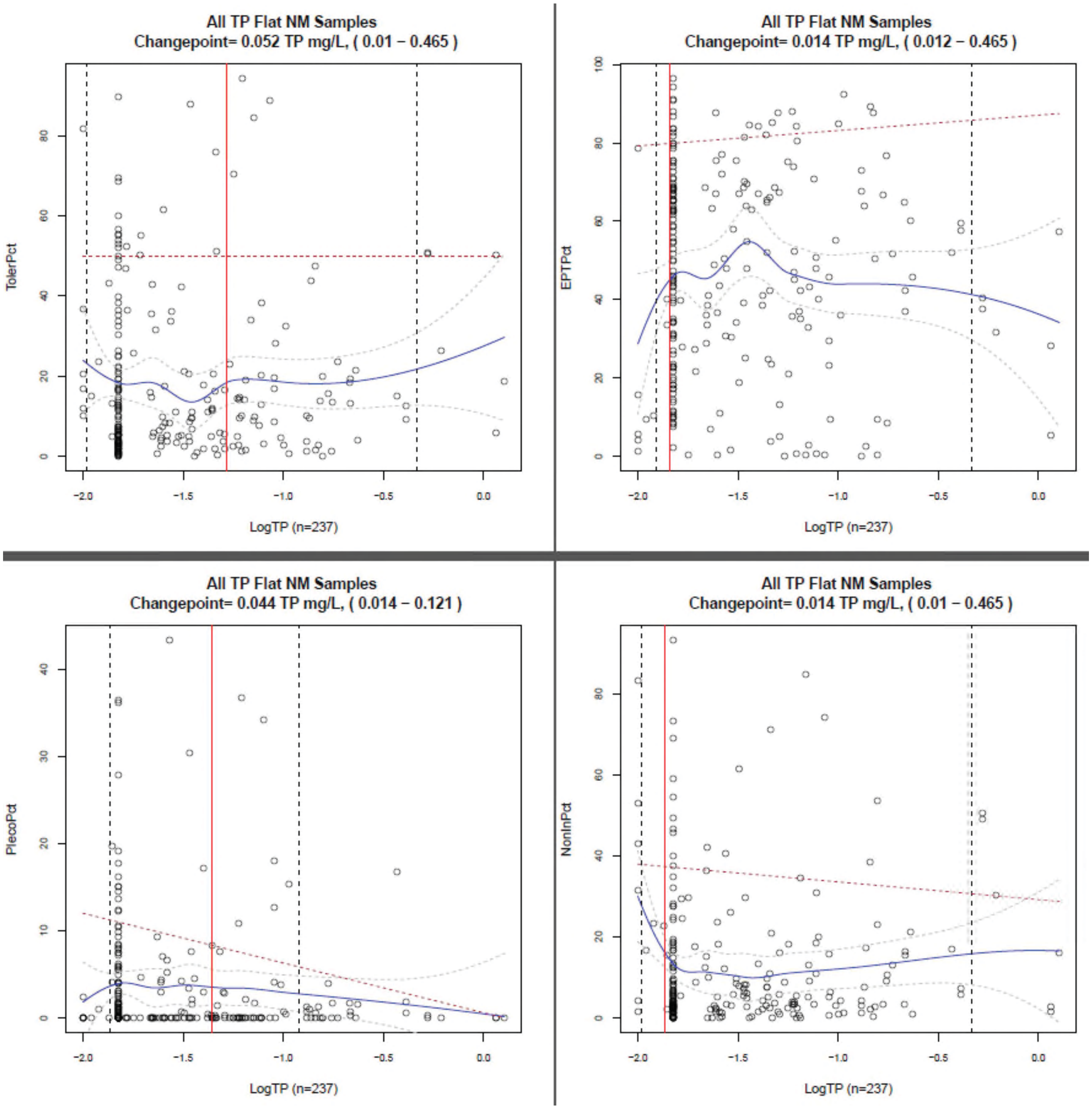

Figure L-26. Change-points for **TP** and **macroinvertebrates** in the **TP Flat-Moderate** class.

Table L-26. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
TolerPct	0.052	flat	broad	midslope	Remove
EPTPct	0.014	wrong trend	broad	midslope	Remove
PlecoPct	0.044	good	moderate	shallow	Retain
NonInPct	0.014	wrong trend	moderate	midslope	Remove

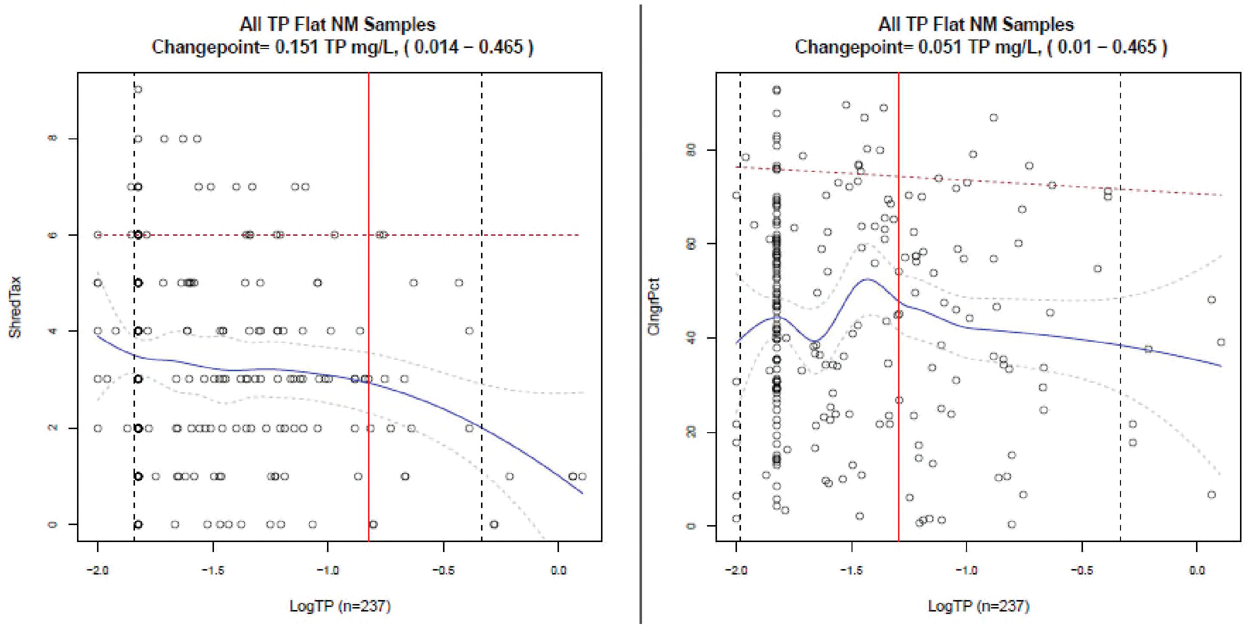

Figure L-27. Change-points for **TP** and **macroinvertebrates** in the **TP Flat-Moderate** class.

Table L-27. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
ShredTax	0.151	flat	broad	midslope	Remove
ClngrPct	0.051	good	broad	midslope	Retain

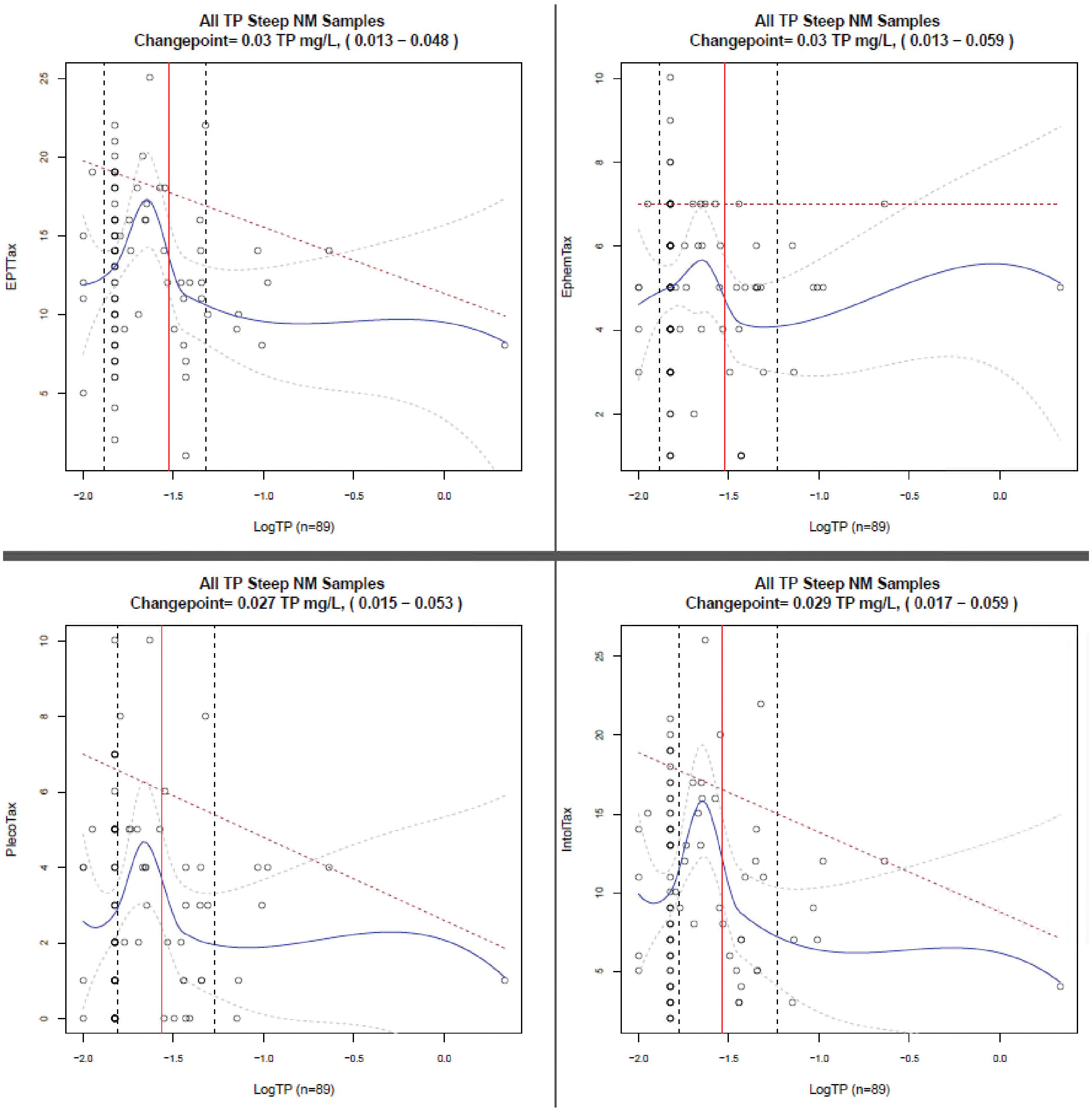

Figure L-28. Change-points for **TP** and **macroinvertebrates** in the **TP Steep** class.

Table L-28. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
EPTTax	0.030	good	moderate	midslope	Retain
EphemTax	0.030	flat	narrow	peak	Remove
PlecoTax	0.027	good	narrow	midslope	Retain
IntolTax	0.029	good	narrow	midslope	Retain

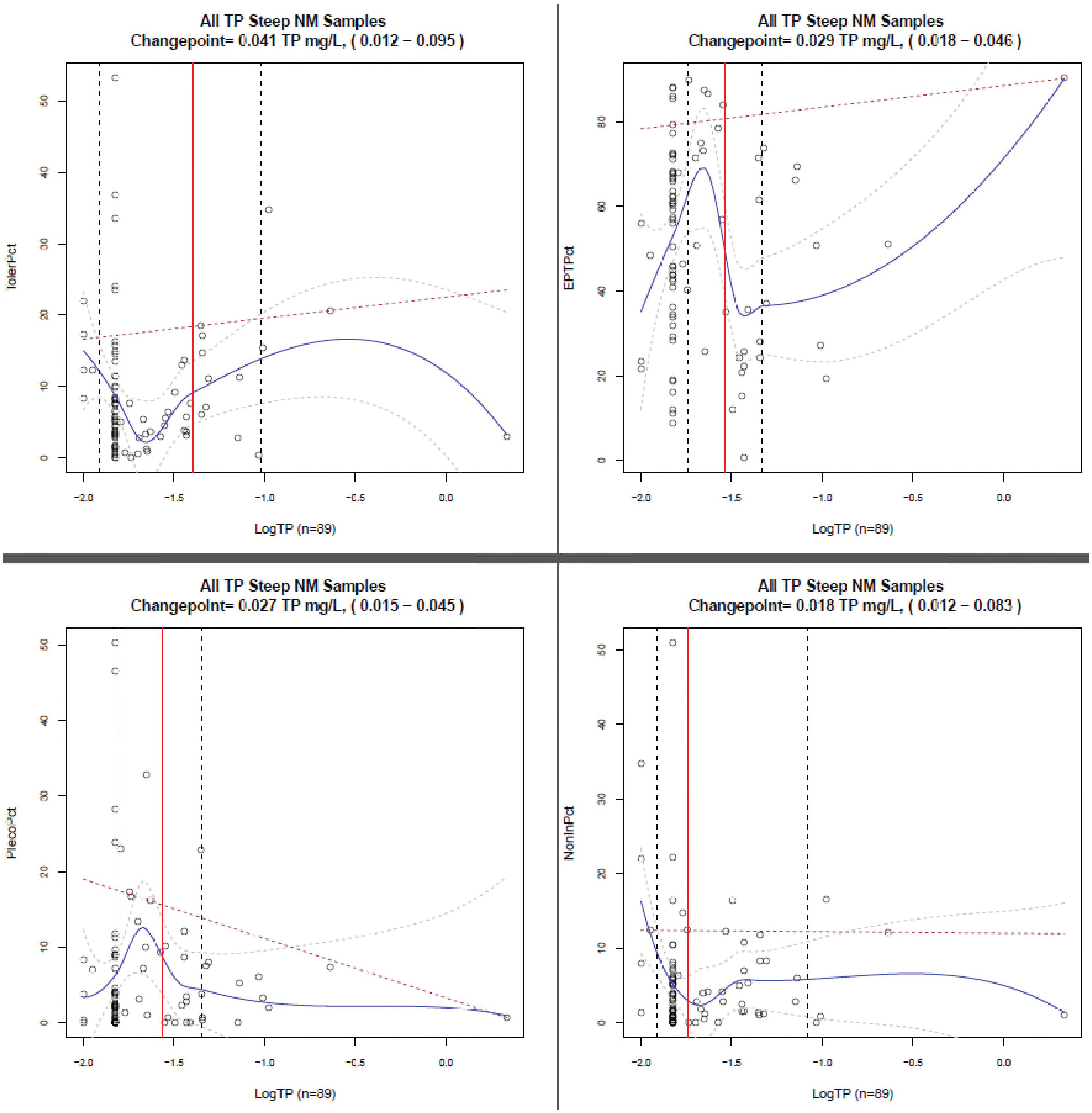

Figure L-29. Change-points for **TP** and **macroinvertebrates** in the **TP Steep** class.

Table L-29. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
TolerPct	0.041	good	moderate	midslope	Retain
EPTPct	0.029	good	narrow	inconsistent	Remove
PlecoPct	0.027	good	narrow	midslope	Retain
NonInPct	0.018	flat	moderate	trough	Remove

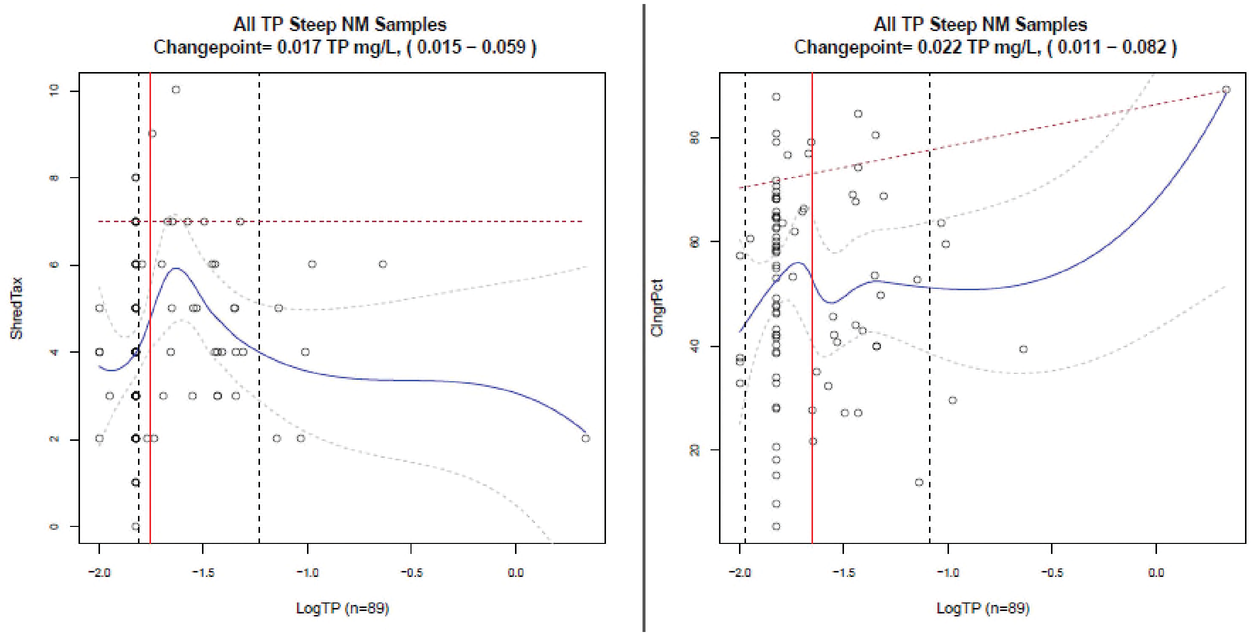

Figure L-30. Change-points for **TP** and **macroinvertebrates** in the **TP Steep** class.

Table L-30. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
ShredTax	0.017	flat	broad	peak	Remove
ClngrPct	0.022	Outlier driven	moderate	midslope	Remove

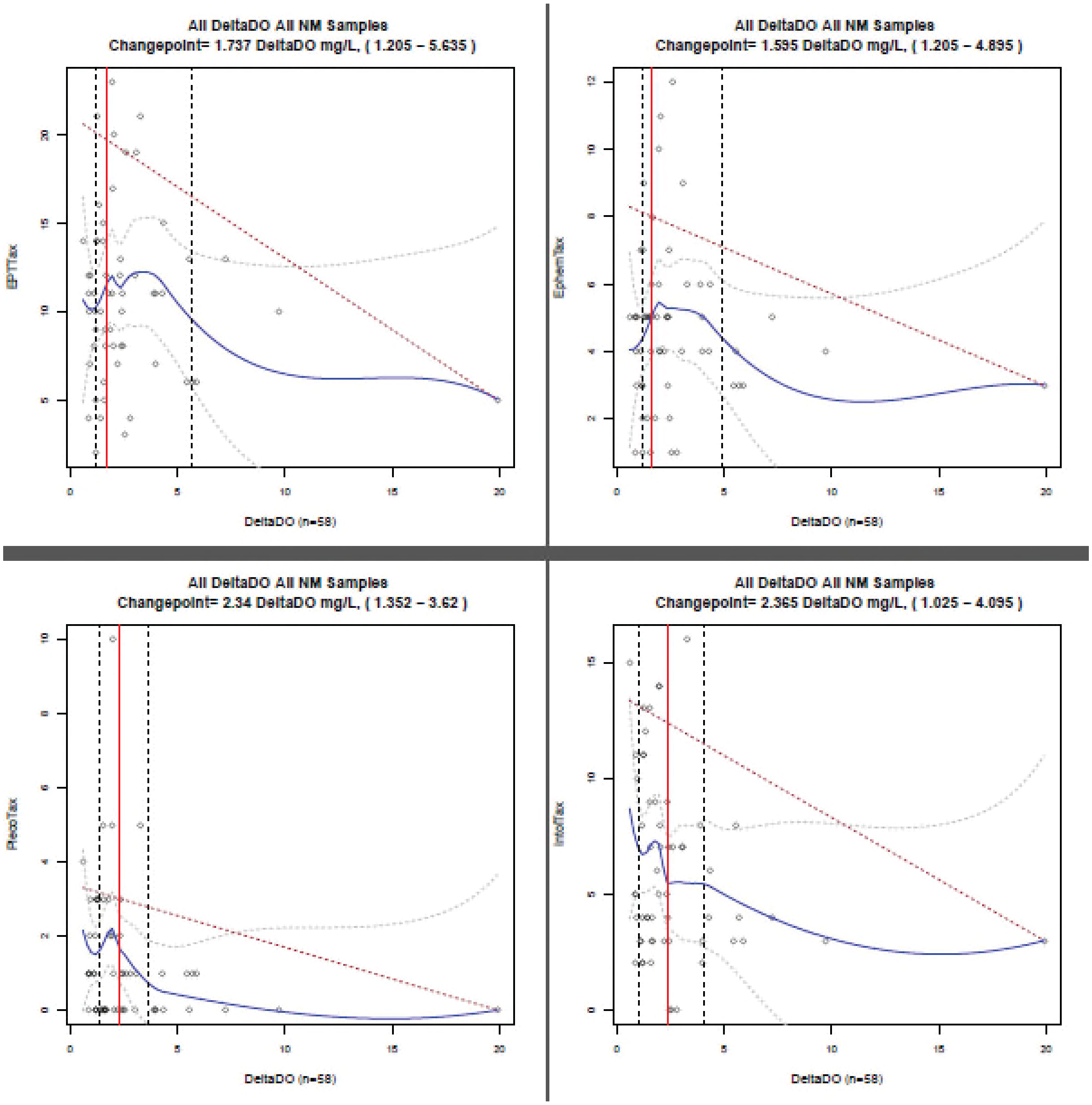

Figure L-31. Change-points for **Delta DO** and **macroinvertebrates** in all sites.

Table L-31. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
EPTTax	1.74	Opposite Loess	moderate	Peak	no
EphemTax	1.60	Opposite Loess	moderate	Peak	no
PlecoTax	2.34	OK	moderate	Midslope	Yes
IntolTax	2.37	OK	moderate	Toe of Slope	Yes

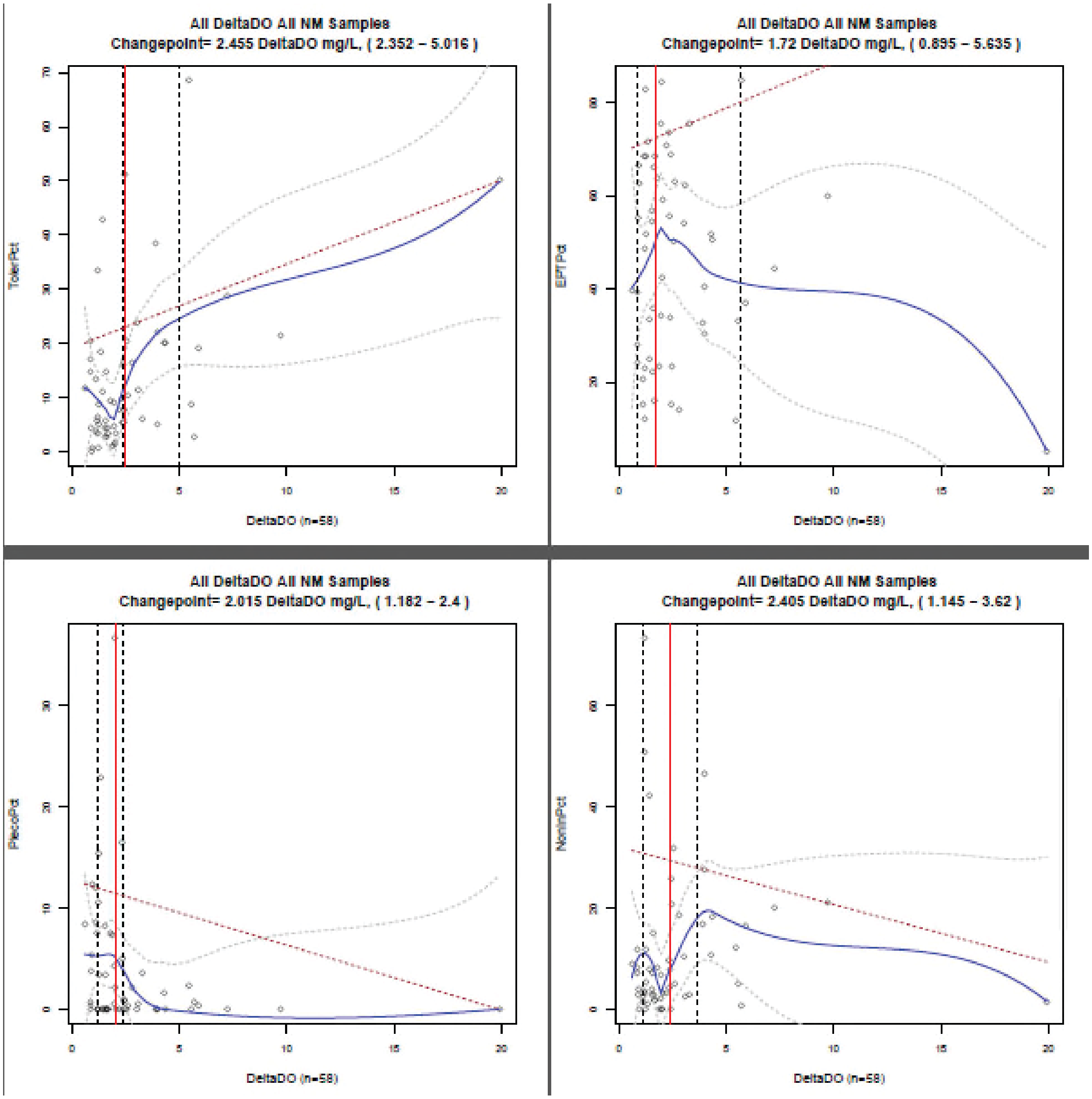

Figure L-32. Change-points for **Delta DO** and **macroinvertebrates** in all sites.

Table L-32. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
TolerPct	2.46	OK	moderate	Midslope	Yes
EPTPct	1.72	Wrong trend	moderate	Peak	no
PlecoPct	2.02	OK	narrow	Peak	Yes
NonInPct	2.41	wrong trend	moderate	Midslope	no

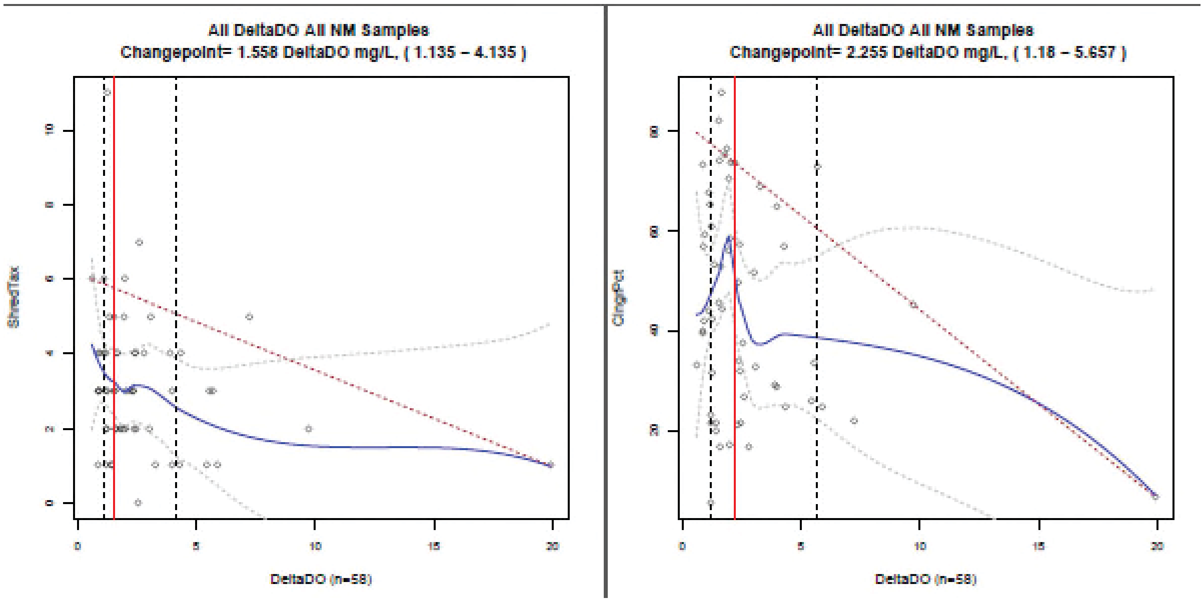

Figure L-33. Change-points for **Delta DO** and **macroinvertebrates** in all sites.

Table L-33. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
ShredTax	1.56	OK	moderate	Midslope	Yes
ClngrPct	2.26	OK	moderate	Midslope	Yes

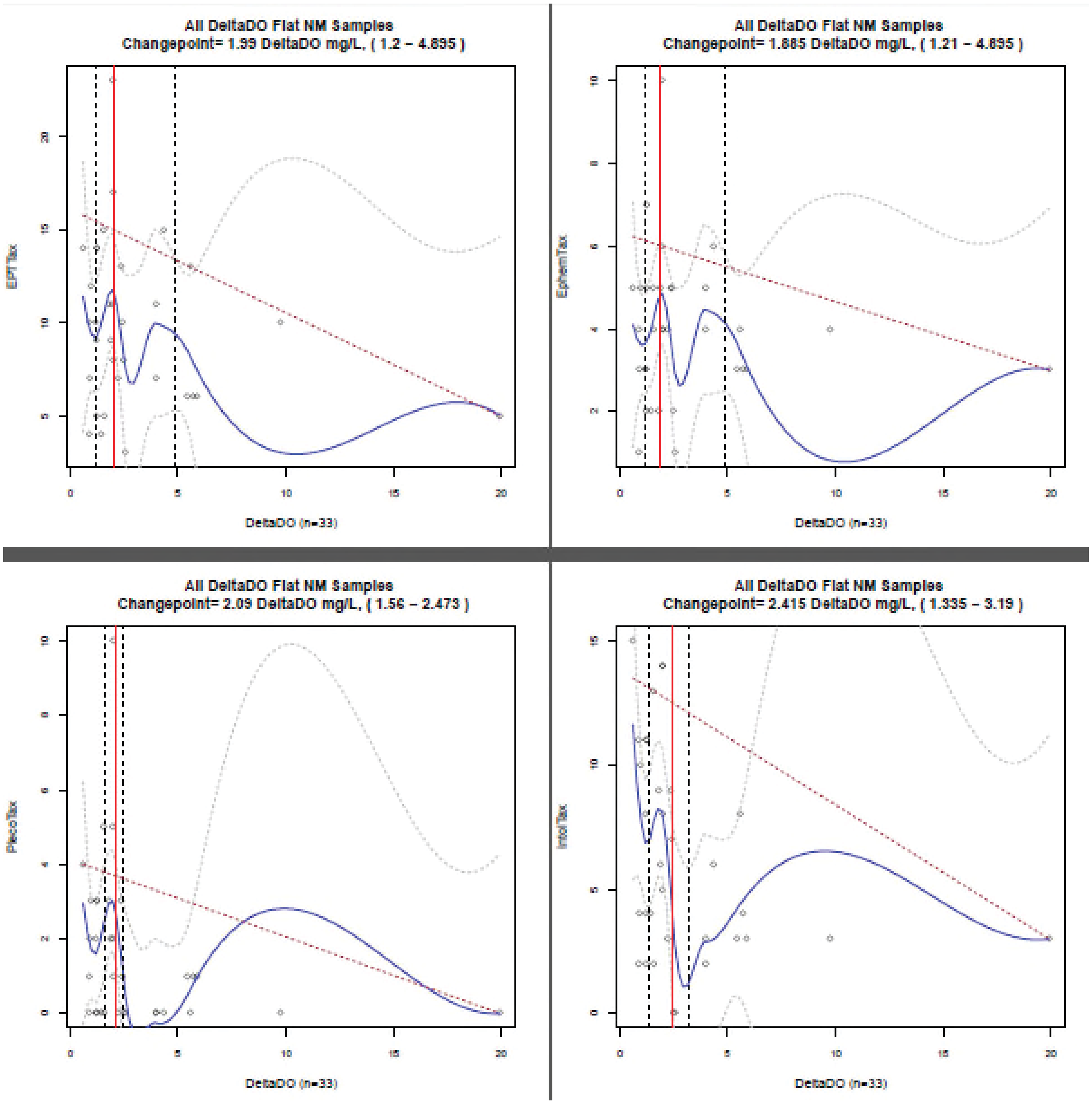

Figure L-34. Change-points for **Delta DO** and **macroinvertebrates** in the **TP Flat-Moderate** class.

Table L-34. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
EPTTax	1.99	OK	moderate	Peak	Yes
EphemTax	1.88	OK	moderate	Peak	Yes
PlecoTax	2.09	OK	narrow	Peak	Yes
IntolTax	2.42	OK	narrow	Midslope	Yes

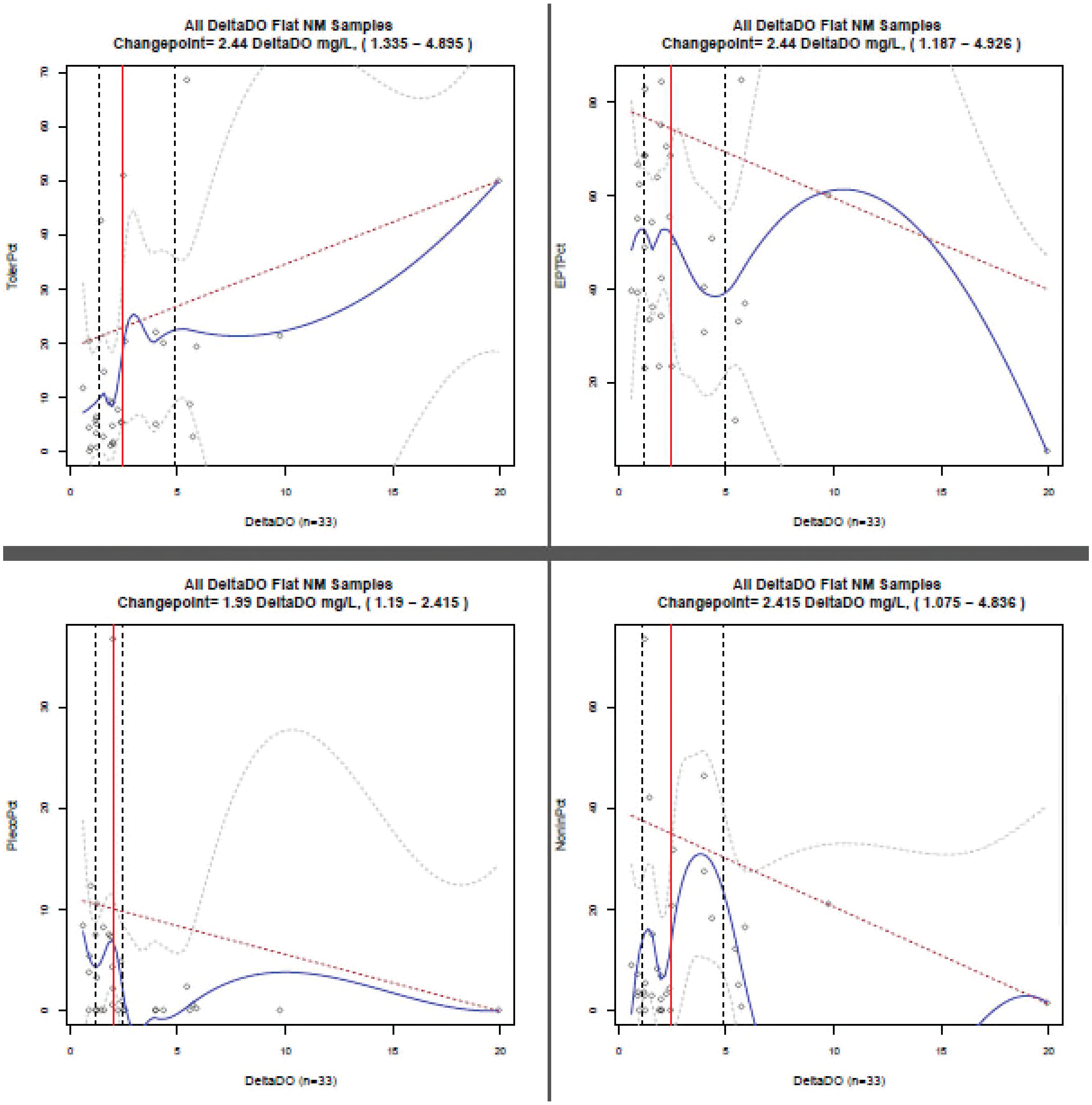

Figure L-35. Change-points for **Delta DO** and **macroinvertebrates** in the **TP Flat-Moderate** class.

Table L-35. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
TolerPct	2.44	OK	moderate	Midslope	Yes
EPTPct	2.44	OK	moderate	Peak	Yes
PlecoPct	1.99	OK	narrow	Peak	Yes
NonInPct	2.42	wrong trend	moderate	Peak	no

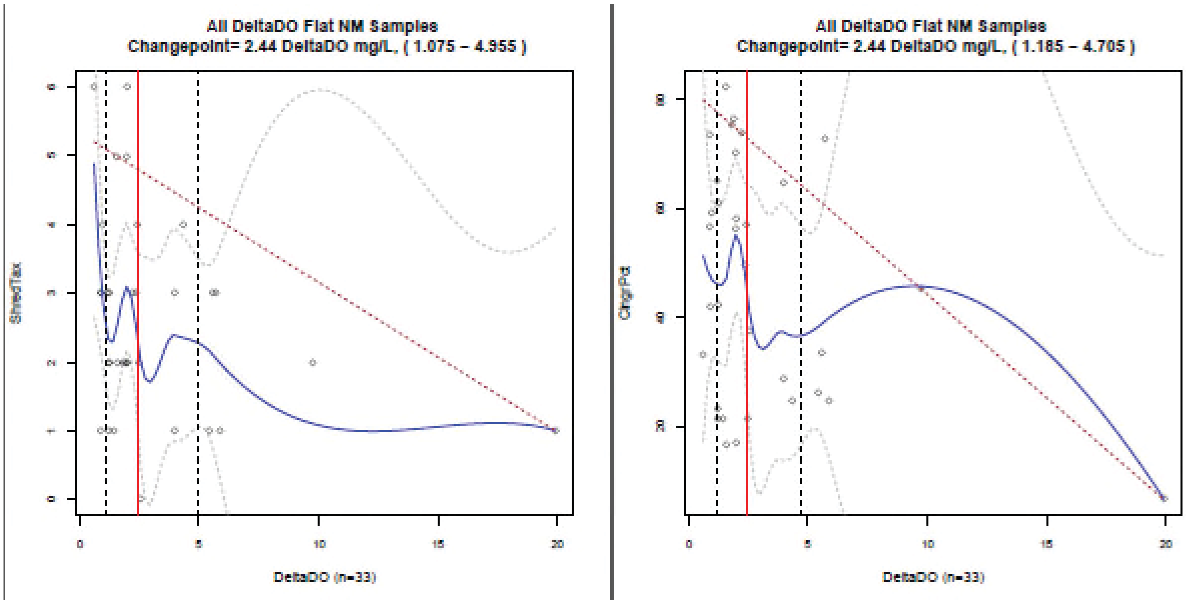

Figure L-36. Change-points for **Delta DO** and **macroinvertebrates** in the **TP Flat-Moderate** class.

Table L-36. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
ShredTax	2.44	OK	moderate	Midslope	Yes
ClngrPct	2.44	OK	moderate	Midslope	Yes

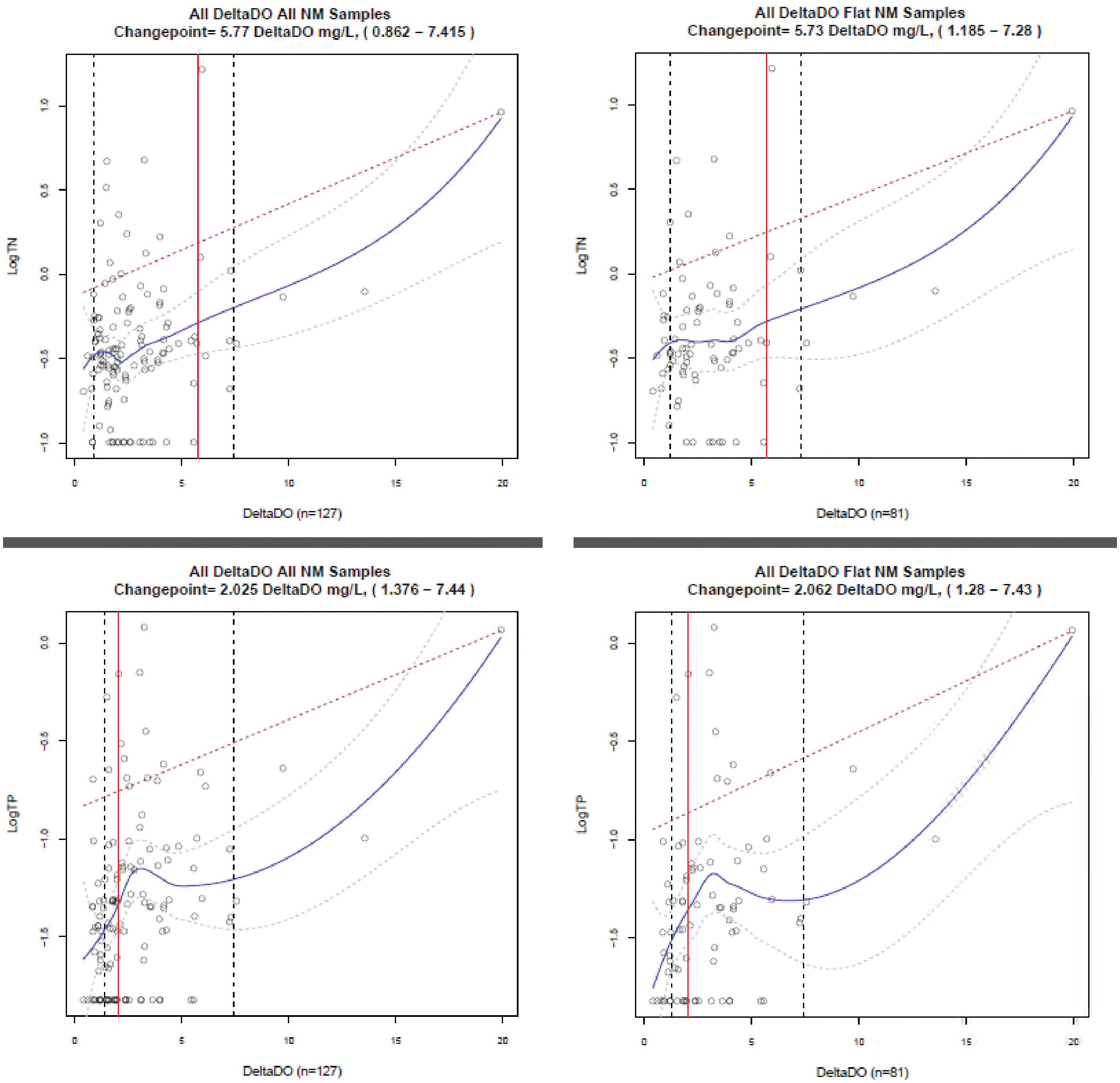

Figure L-37. Change-points for **Delta DO** and **nutrients** in all sites (left) and in the **TP Flat-Moderate** class (right).

Table L-37. Change-point evaluation.

Nutrient/subset	CP	QR95	CP_CI	Loess	Retain
TN/All	5.77	OK	Broad	Midslope	Yes
TP/All	2.025	OK	Broad	Midslope	Yes
TN/Flat	5.73	OK	Broad	Midslope	Yes
TP/Flat	2.062	OK	Broad	Midslope	Yes

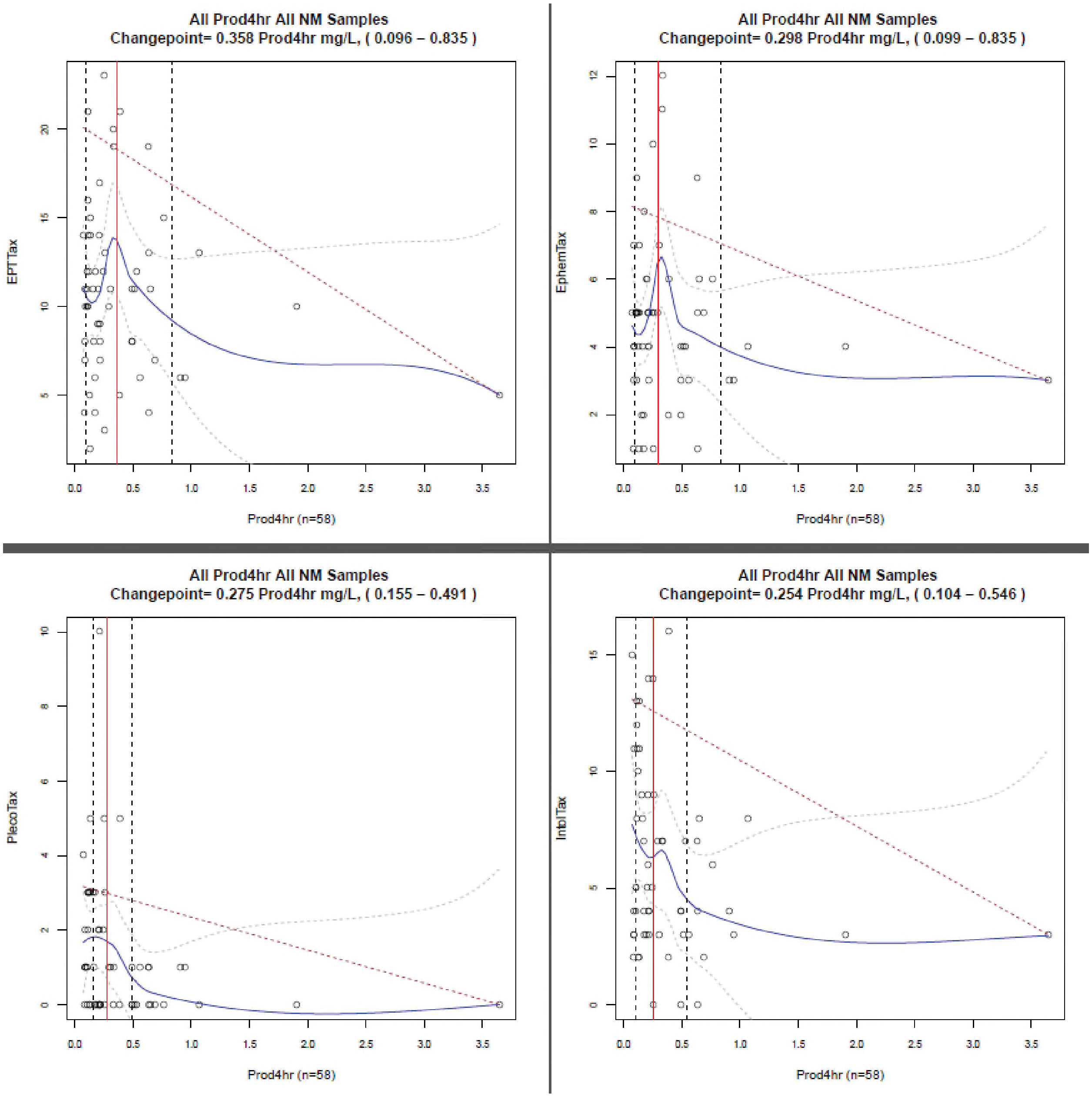

Figure L-38. Change-points for **Pmax4hr** and **macroinvertebrates** in all sites.

Table L-38. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
EPTTax	0.358	OK	moderate	Peak	Yes
EphemTax	0.298	OK	moderate	Peak	Yes
PlecoTax	0.275	OK	narrow	Peak	Yes
IntolTax	0.254	OK	moderate	Midslope	Yes

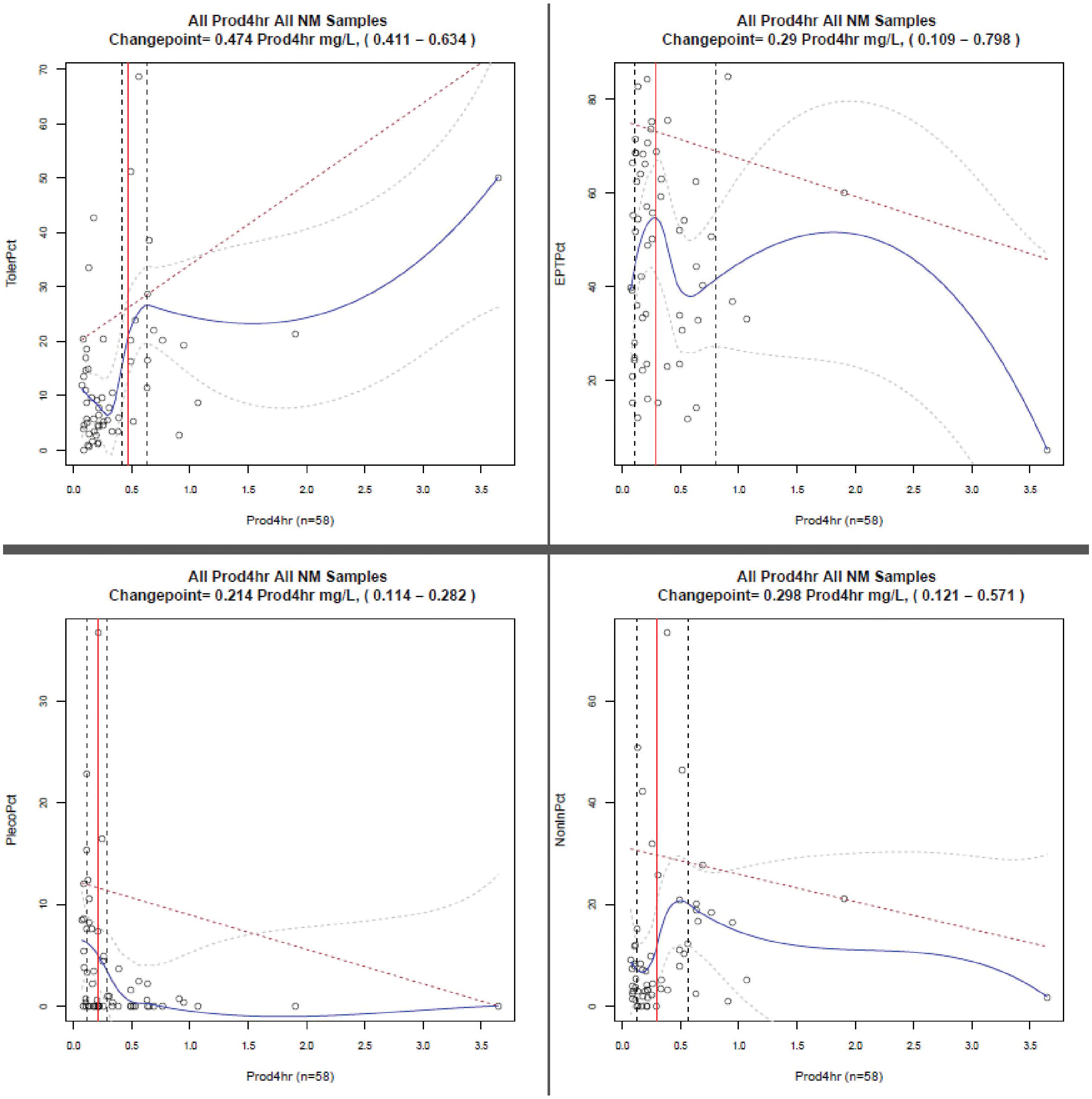

Figure L-39. Change-points for **Pmax4hr** and **macroinvertebrates** in all sites.

Table L-39. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
TolerPct	0.474	OK	narrow	Midslope	Yes
EPTPct	0.29	OK	moderate	Peak	Yes
PlecoPct	0.214	OK	narrow	Midslope	Yes
NonInPct	0.298	wrong trend	moderate	Midslope	no

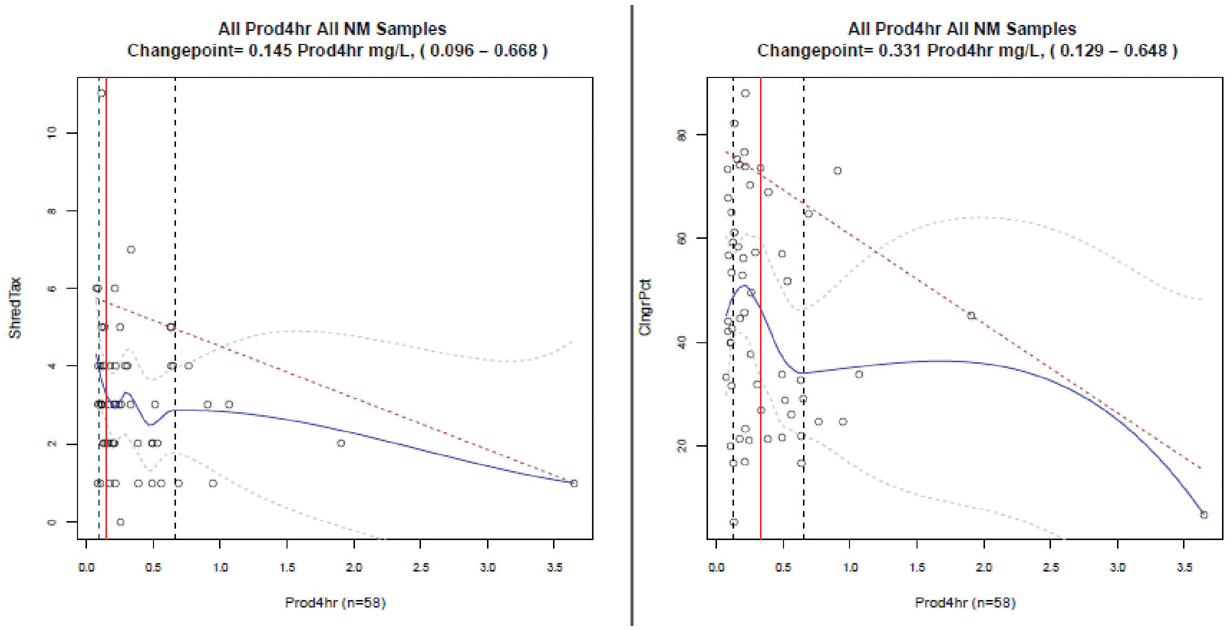

Figure L-40. Change-points for **Pmax4hr** and **macroinvertebrates** in all sites.

Table L-40. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
ShredTax	0.145	OK	moderate	Midslope	Yes
ClngrPct	0.331	OK	moderate	Midslope	Yes

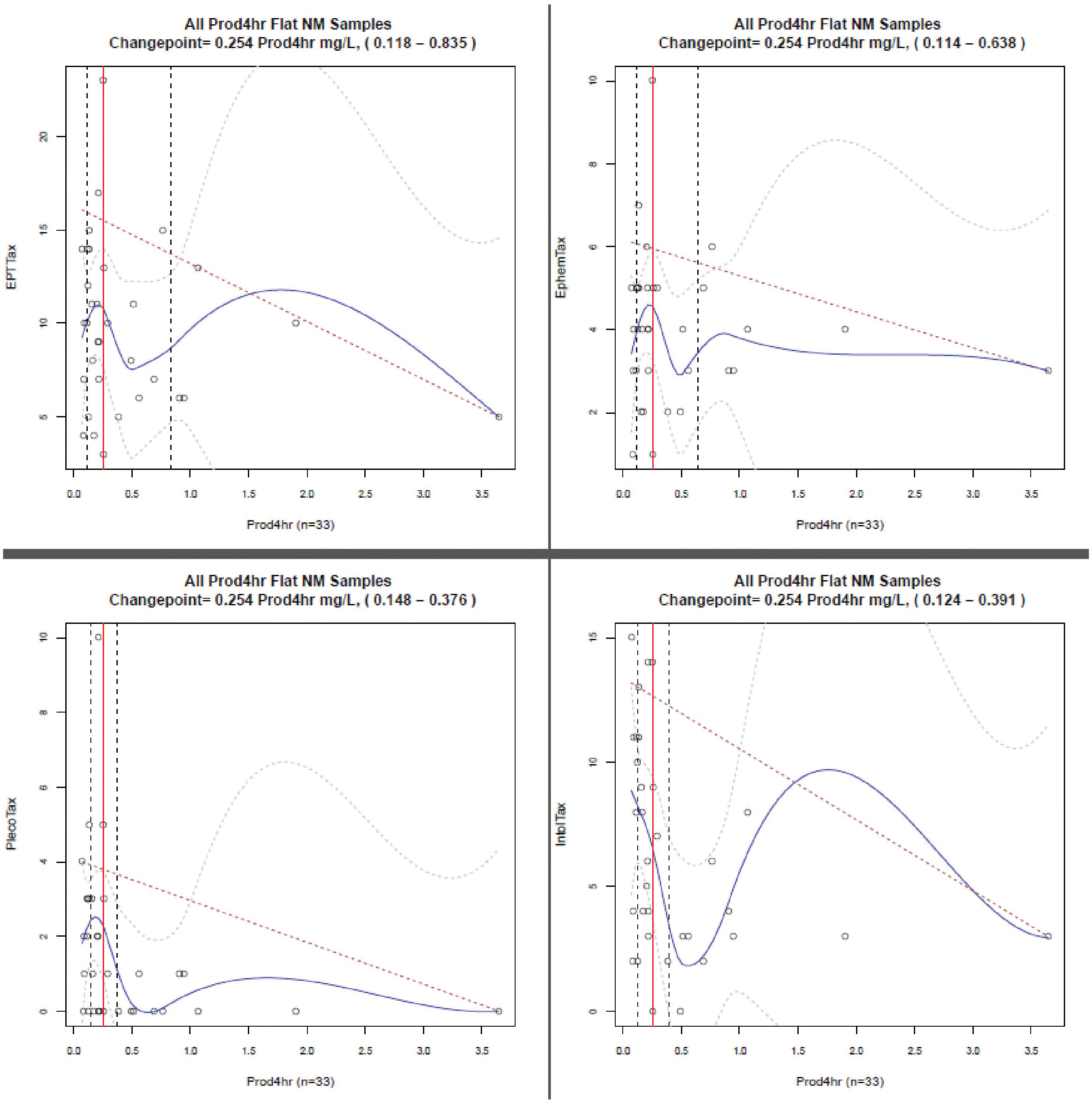

Figure L-41. Change-points for **Pmax4hr** and **macroinvertebrates** in the **TP Flat-Moderate** class.

Table L-41. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
EPTTax	0.254	OK	moderate	Peak	Yes
EphemTax	0.254	OK	moderate	Peak	Yes
PlecoTax	0.254	OK	narrow	Peak	Yes
IntolTax	0.254	OK	narrow	Midslope	Yes

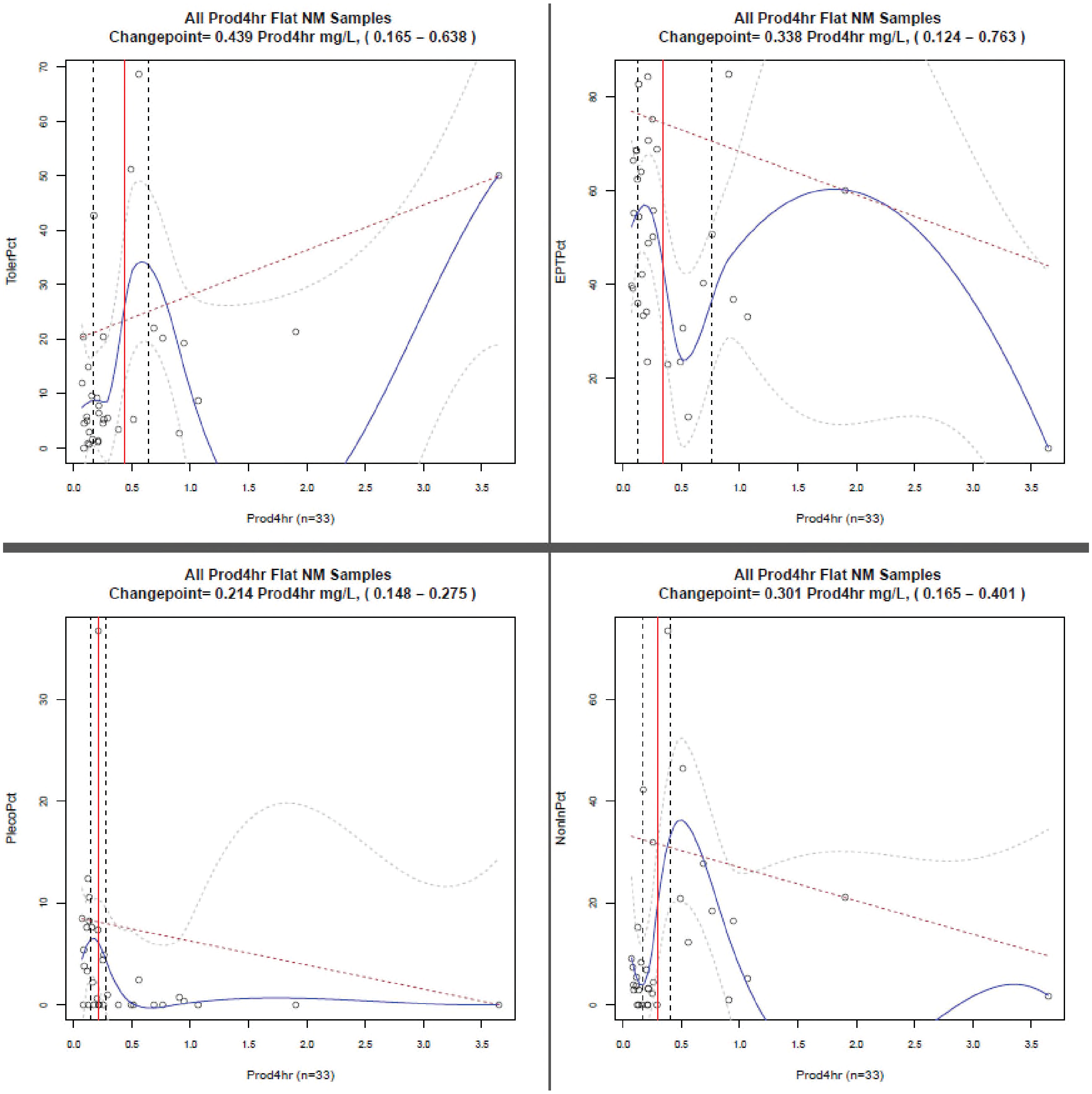

Figure L-42. Change-points for **Pmax4hr** and **macroinvertebrates** in the **TP Flat-Moderate** class.

Table L-42. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
TolerPct	0.439	OK	moderate	Midslope	Yes
EPTPct	0.338	OK	moderate	Midslope	Yes
PlecoPct	0.214	OK	narrow	Peak	Yes
NonInPct	0.301	wrong trend	narrow	Midslope	no

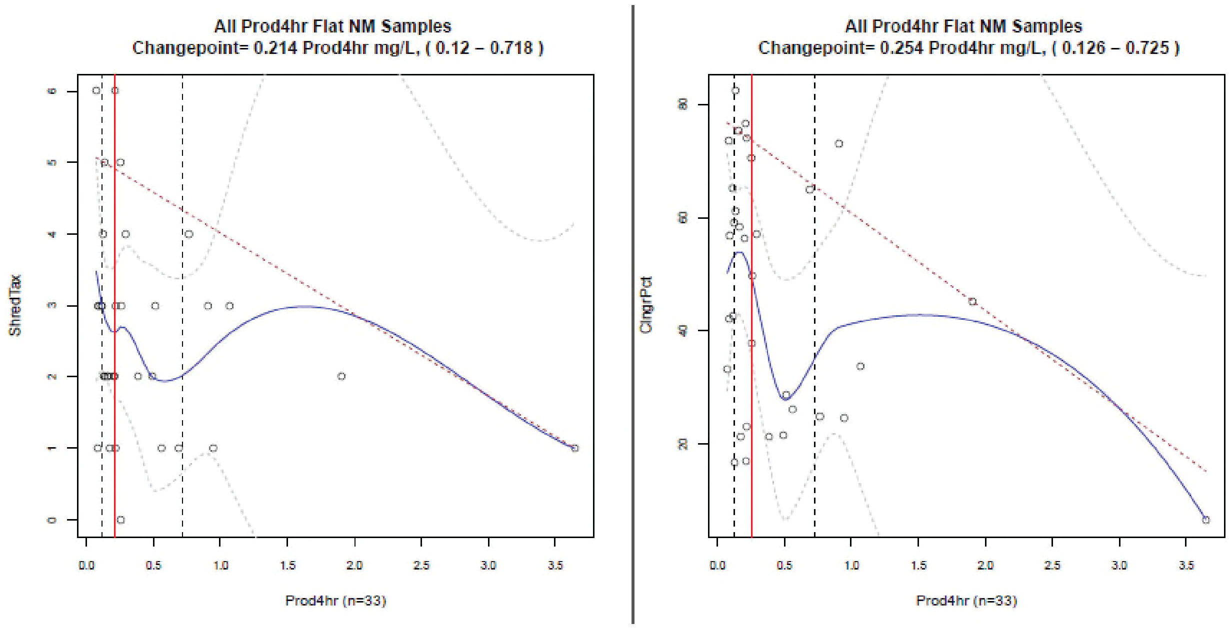

Figure L-43. Change-points for **Pmax4hr** and **macroinvertebrates** in the **TP Flat-Moderate** class.

Table L-43. Change-point evaluation.

Metric	CP	QR95	CP_CI	Loess	Retain
ShredTax	0.214	OK	moderate	Midslope	Yes
ClngrPct	0.254	OK	moderate	Peak	Yes

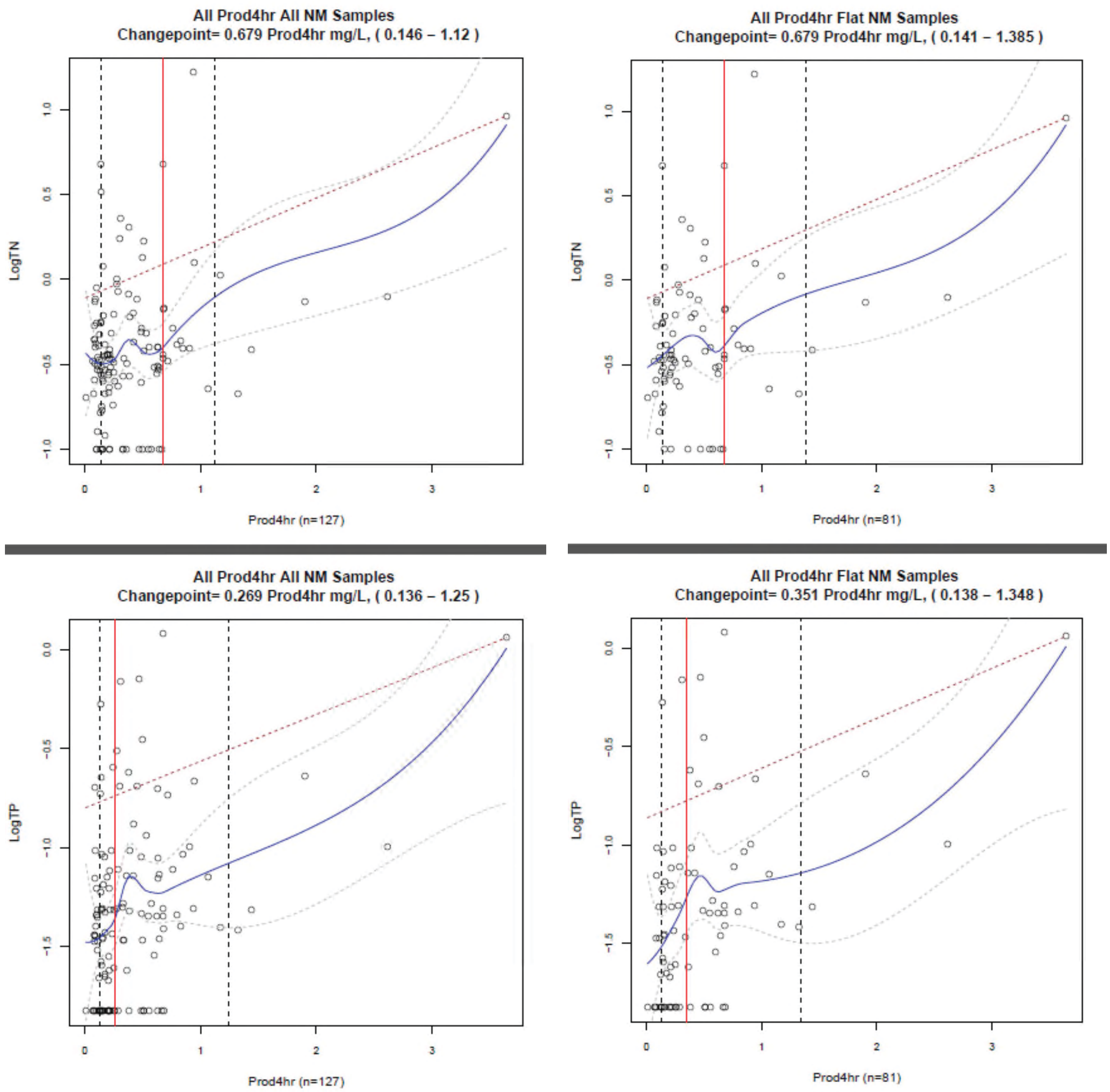

Figure L-44. Change-points for **Pmax4hr** and **nutrients** in all sites (left) and in the **TP Flat-Moderate** class (right).

Table L-44. Change-point evaluation.

Nutrient/subset	CP	QR95	CP_CI	Loess	Retain
TN/All	0.679	OK	Broad	Midslope	Yes
TP/All	0.269	OK	Broad	Midslope	Yes
TN/Flat	0.679	OK	Broad	Midslope	Yes
TP/Flat	0.351	OK	Broad	Midslope	Yes