Sampling Summary

RIO PUERCO, ZUNI RIVER AND PUERCO RIVER WATERSHEDS WATER QUALITY SURVEY

Survey Conducted
March-November, 2011

Summary Prepared
February 2014

Monitoring, Assessment and Standards Section
Surface Water Quality Bureau
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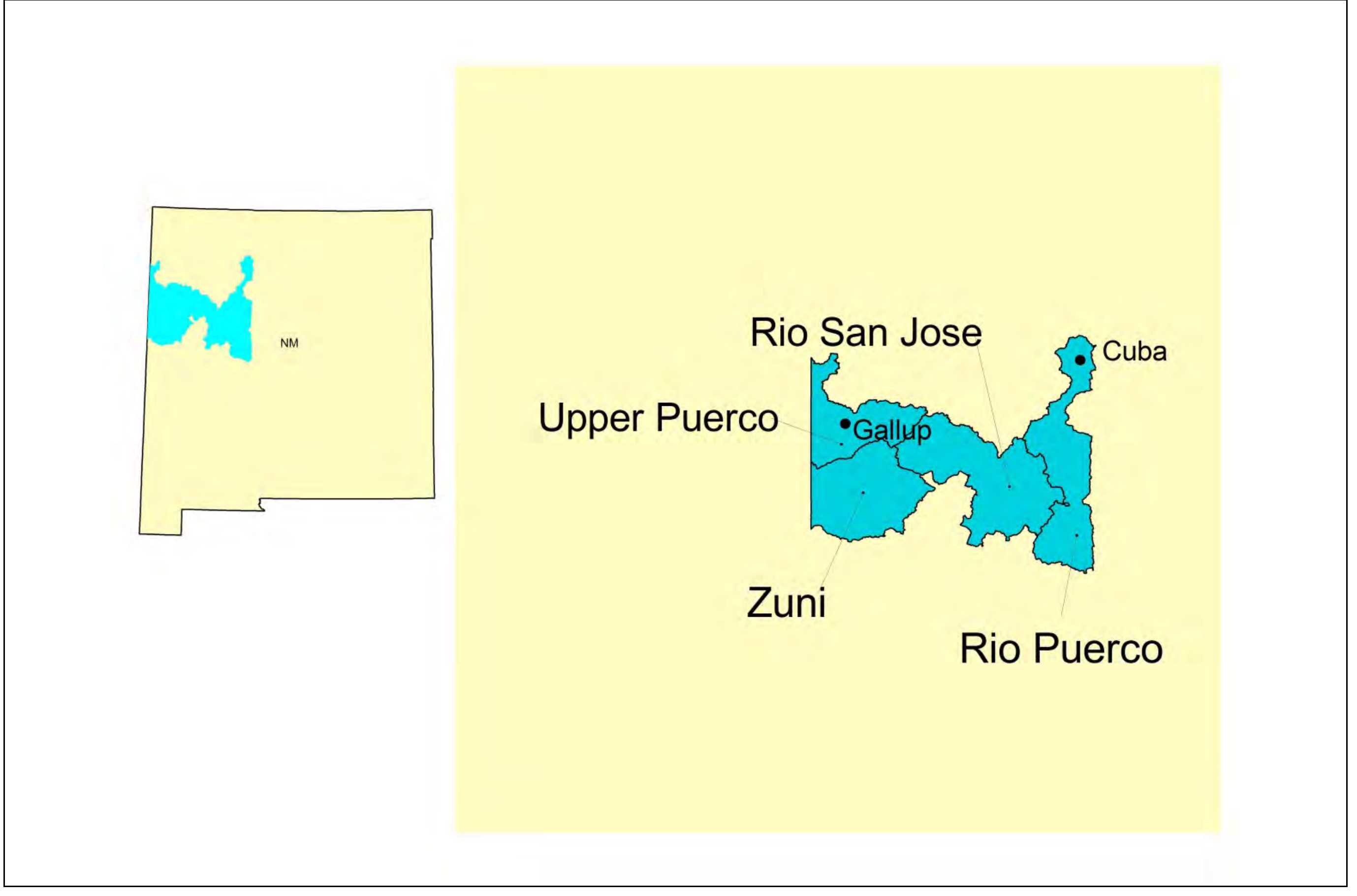
Abbreviations

AP	Assessment Protocol
AU	Assessment Unit
BMP	Best Management Practice
BNSF	Burlington Northern – Santa Fe
CWA	Clean Water Act
FR	Forest Road
FSP	Field Sampling Plan
HP	Hydrology Protocol
IR	State of New Mexico Clean Water Act §303(d)/305(b) Integrated Report
km	kilometer
m	meter
MASS	Monitoring, Assessment and Standards Section
NMED	New Mexico Environment Department
NMEDAS	New Mexico Environmental Data Analysis System
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
PSRS	Point Source Regulation Section
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SLD	Scientific Laboratory Division
SOP	Standard Operating Procedures
SVOC	Semi-Volatile Organic Compounds
SWQB	Surface Water Quality Bureau
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
THM	Total Heavy Metals
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UAA	Use Attainability Analysis
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
WQCC	Water Quality Control Commission
WPS	Watershed Protection Section
WQS	Water Quality Standard
WWTP	Wastewater Treatment Plant

INTRODUCTION

The Rio Puerco watershed is located along the east-southeast margin of the Colorado Plateau, along a transition zone with the Rio Grande Rift. The Zuni and Puerco River Watersheds are located in the southern portion of the Colorado plateau physiographic province in western New Mexico. Soft Mesozoic, upper Paleozoic, and lower Cenozoic sedimentary strata dominate the geologic setting of the area. Specific units include Permian through Tertiary age continental and marine sandstones, shales, mudstones, and carbonate rocks. These strata are generally flat lying, often faulted, and carved into broad valleys flanked by mesas and mountains. The mountainous areas along the margins of the northeast and west-central watershed are made up of intrusive igneous rocks (granitic plutonic rocks, gneiss, and schists). Younger Tertiary or Quaternary volcanic rocks intrude the sediments and occasionally cap high standing mesas. Tertiary and Quaternary valley fill, pediment gravels, talus, and alluvial deposits mantle the geologic section (Coleman et al., 1998).

Figure 1. Location of the Rio Puerco, Puerco River, and Zuni River watersheds in New Mexico.



Numerous geomorphic elements combine to form the watershed's present structural, fluvial, and topographic settings. Existing landforms are an indication of the large amounts of surface materials that have been removed from the region by wind and water. Elevations range from the 3,445 meter (m) peak of Mt. Taylor, terrain at 3,200 m in the Sierra Nacimiento - San Pedro Parks Wilderness headwaters area, and 2,780 m along the Continental Divide in the Zuni Mountains to 1,430 m at the Rio Puerco - Rio Grande confluence at Bernardo, NM (Coleman et al., 1998).
A high regional surface gradient and an excess of straight drainage channel segments combines with the region's climatic setting and vulnerable sedimentary lithologies to create the watershed's dramatic erosion (Gellis, 2000).

Average rainfall in the basin varies annually between 30.5 and 51 cm, delivered mostly by late summer monsoon thunderstorms that create violent flash flooding that sweeps out of well-vegetated highlands across sparsely vegetated slopes and valley surfaces, carrying away thin topsoil and weathered bedrock (Gellis, 2000).

The main stem of the Rio Puerco begins in a wetland in Omernik Ecoregion (Omernik and Griffiths, 2008) 21b (Crystalline Subalpine Forests) in the Nacimiento Mountains east of Cuba, NM, within the San Pedro Parks Wilderness area of the Santa Fe National Forest and descends through ecoregions 21c (Crystalline Mid-Elevation Forests), 22n (Near-Rockies Valleys and Mesas), 22i (San Juan-Chaco Table Lands), 22j (Semiarid Tablelands), and joins the Rio Grande in 22m (Albuquerque Basin).

Soil loss contributing to sediment loading is such an extreme problem throughout the watershed that the basin is one of the nation's most actively eroding watersheds. The Rio Puerco Basin has been documented to transport one of the highest known average annual sediment loads and is the major source of suspended sediment entering the Rio Grande above Elephant Butte Reservoir (Happ, 1948). The distribution of soils and vegetation is also influenced strongly by topography and geology. Satellite images show many parts of the basin are very responsive to seasonal variations in precipitation, whereas scattered riparian corridors in main stem and tributary drainages are increasingly stable and less prone to significant vegetation changes in response to variation in precipitation.

From the Santa Fe National Forest boundary downstream approximately 10 kilometers (km) to the Village of Cuba, domestic and wildlife grazing, road construction, and maintenance activities on private and public lands have impacted riparian vegetation and initiated discontinuous stream channel incision. In some local segments the stream bed is now 1.5 to 3 m below its original floodplain, whereas adjacent reaches remain relatively stable. At and below the Village of Cuba, flows from several tributaries coalesce and drop off the western face of the Sierra Nacimiento. This flow combines with effluent from the Cuba wastewater treatment plant (WWTP) to provide perennial flow in the Rio Puerco downstream toward the confluence with Arroyo Chijuilla (Coleman et al., 1998).

The foothills north and northeast of Cuba are composed of erodible sedimentary units (clay and mudstones), so while stream incision occurs in this drainage system very close to its headwaters area, the downstream reach’s sand-dominated setting and decreased gradient allows for more stable channel dimension, pattern, and profile. The least incised, best vegetated, and most stable segment occurs 1.6 to 4.8 km (1-3 miles) upstream of the Village of Cuba, below which deep incision and a broad meandering pattern becomes characteristic across the wide flat valleys to the distant confluence with the Rio Grande (Coleman et al., 1998).

The reach of the Rio Puerco downstream of Cuba flows through a complex mixture of private, State, and Federal lands in a wide, deeply incised, vertical-walled canyon with banks up to 10 m high. Erosional processes within this reach of the stream are extensive. Significant landscape erosion and channel incision are common throughout the majority of the Rio Puerco Watershed (Coleman et al., 1998).

The Rio San Jose main stem originates on Mt. Taylor in Omernik Ecoregions 23c (Montane Conifer Forests) and 23d (Arizona/New Mexico Subalpine Forests), quickly descending into 23e (Conifer Woodlands and Savannahs), arriving at the valley floor in 22j, and flowing into the Rio Puerco southwest of Albuquerque in 22m. Historically, Bluewater Creek was a major tributary of the Rio San Jose, beginning on the west flank of the Zuni Mountains in ecoregion 23c, dropping briefly into 23e, and emptying into the Rio San Jose in 22j, east of Grants, NM.

The sedimentary rocks in the area around Grants have long been a center for uranium mining, mainly in the Morrison Formation. The JJ No. 1/L-Bar Mine, 2.25 miles east/northeast of Moquino, produced uranium from 1976-1981. This mine was operated in conjunction with the L-Bar uranium mill and mine tailings facility. The mine was closed and reclaimed in 1986-1987 (Intera, Inc 2006). Cretaceous sandstones are capped by basalt east of the Zuni uplift into the Rio San Jose watershed (Chronic, 1987). Further downstream the Rio San Jose – Rio Puerco confluence occurs in an area of erodible Triassic redbeds, just east of a broad zone of faults that marks the west edge of the Rio Grande Rift. The wetland-type area near Laguna is the original lake that led to the Spanish name for that town (Chronic, 1987).

The Rio San Jose, with the exception of the uppermost headwaters, has become ephemeral or intermittent above Horace Springs, located 12 km southwest of Grants. The discharge from the springs creates a perennial reach that is confined almost exclusively to Acoma and Laguna Pueblo lands. In general, the degree of incision in the broad valley of the Rio San Jose is less than the Rio Puerco's main stem on the other side of the watershed.

The Zuni River is a tributary to the Little Colorado River, which it joins in eastern Arizona. The 5,478 km^2 Zuni watershed straddles the Arizona – New Mexico border with approximately 2,564 km^2 of that lying within the boundaries of Zuni Pueblo. Principal tributaries of the Zuni River are the Rio Pescado and Rio Nutria. Flow is ephemeral or intermittent in the Zuni River, Rio Pescado, Rio Nutria, and Rio Cebolla below the perennial headwaters in the Zuni Mountains.

The upper reaches of the Zuni watershed are located in Omerik Ecoregions 23e (Arizona/New Mexico Mountains) and 23c. The lower reaches are in 22j. Land ownership in the western watershed is predominately Zuni Pueblo, with small inholdings of private land. The eastern watershed is also owned mostly by the Zuni Pueblo with tracts of private and Forest Service land in the upper Rio Nutria and Tampico Draw watersheds.

The Puerco River, located near Gallup, is an ephemeral tributary of the Little Colorado. Flow, outside of storm events, is dominated by effluent from the Gallup WWTP and extends from the WWTP discharge roughly to the Arizona border under dry conditions. The effluent- dominated ephemeral reach is approximately 12 km long and lies in ecoregion 22j.

Personnel Roles and Responsibilities

This survey was primarily conducted by the Surface Water Quality Bureau (SWQB) Monitoring, Assessment and Standards Section (MASS), but staff from other sections within SWQB were involved with planning, carrying out the work and using the data. Individual roles and responsibilities are described in Table 1.

Objectives

This survey had several objectives because the data it generates must serve the needs of all sections within the SWQB. These objectives are outlined in Table 2.

Table 1. Personnel roles and responsibilities.

Name	Position / Role	Responsibilities
Doug Eib 505-827-0106 Don Carlson 505-827-0596	Monitoring Staff	• Planned survey • Collected and documented chemical, biological, and habitat samples • Provided chemical, biological, and habitat results for final report • Wrote survey report
Mike Matush 505-827-0505	Watershed Protection Section (WPS) Liaison	• • Provided information and data needs pertaining to nonpoint sources of pollution and best management practices (BMPs) located within the study area
Barbara Cooney 505-827-0212	Point Source Regulation Section (PSRS) Liaison	• Provided information and data needs pertaining to point source discharges located within the study area • Assisted with development of final survey report
Heidi Henderson 505-827-2901	Total Maximum Daily Load (TMDL) Liaison	• Provided information and data needs pertaining to TMDL development to be conducted in the study area • Assisted with development of final survey report; will develop TMDLs as needed

Schedule

This survey was made up of many components beginning with planning and ending with the generation of the State of New Mexico Clean Water Act (CWA) Section 303(d)/305(b) Integrated Report (IR). Total Maximum Daily Loads (TMDLs), if necessary, will be written in the Winter of 2014-2015. A tentative schedule (Table 3) shows that completion of the entire project took four years.

Table 2. Survey Objectives.

	Intended use of data	Question to be answered	Products / Outcomes	Decision Criteria
Primary Objective	Assess designated use attainment for the New Mexico Clean Water Act (CWA) §303(d)/305(b) *Integrated Report (IR)* and provide information to the public on the condition of surface water	Are sampled waterbodies meeting water quality standards (WQS) criteria?	Survey Report, IR	WQS as interpreted by the Assessment Protocols (APs)
Secondary Objectives	Develop load and waste load allocations for TMDLs	What is the maximum pollutant load a waterbody can receive and meet the requirements of the WQS?	TMDL loading calculations and National Pollutant Discharge Elimination System (NPDES) permit limits	WQS as interpreted by the APs
	Evaluate restoration and mitigation measures implemented to control NPS pollution	Have watershed restoration activities and mitigation measures improved water quality?	Project Summary Reports, Nonpoint Source (NPS) Annual Report, *IR (De-Listing)*	WQS as interpreted by the APs
	Develop or refine surface WQS	Are the existing uses appropriate for the waterbody?	Use Attainability Analyses (UAA), Amendments to WQS	Are data sufficient to support a petition to the Water Quality Control Commission (WQCC) to revise WQS?

As part of the survey planning process a public meeting was held to answer questions and solicit input for the survey. This meeting took place March 9, 2011 at the Cuba Senior Center in Cuba, NM.

Table 3. Project Schedule.

Activity	Win ’10-11	Spri ‘11	Sum ‘11	Fall ‘11	Win ‘11-‘12	Spr ‘12	Sum ‘12	Fall ‘12	Winter ‘12	Spr ’13	Sum ‘13	Fall ‘13	Win ’13-14	Win ‘15
Survey planning, site reconnaissance, public input period	=========►													
Data collection, sample submittal to SLD		==============►												
Data verification & validation, data assessment				==========================►										
Preparation of survey report, TMDL development								==►						

SAMPLING PLAN

The survey included chemical samples, which were collected monthly between March and October 2011, biological sampling, conducted within the index period (August 15 - November 15, 2011) to standardize life stages at the time of sampling, and habitat measurements that were taken during periods of base flow. Data were collected according to SWQB standard operating procedures (SOPs; NMED/SWQB 2007-2011) and the field sampling plan (FSP).

Chemical Sampling

Chemical sampling sites were allocated one per assessment unit (AU) and were usually positioned near the lower end of the AU, access permitting. Additional stations were located to document the condition of AUs below potential pollution sources. Stations from previous surveys were used whenever possible to evaluate trends. Water samples for chemical analyses were submitted to the New Mexico Scientific Laboratory Division (SLD). *E.coli* samples were processed in the SWQB laboratory or with mobile equipment. Water quality analytes and their sampling frequencies are outlined in Table 4 and the location of sampling stations is shown in Figures 2 and 3. In addition to the analytes listed, field measurements (temperature, specific conductance, dissolved oxygen concentration and percent saturation, pH, and turbidity) were taken during each sampling visit or during deployments of 3-21 days with a multi-parameter sonde. Secchi depth readings, as well as depth profiles, also obtained with a multi-parameter sonde, were recorded as part of reservoir sampling visits.

Table 4. Summary of completed/planned chemical samples. Station numbers refer to locations in Figures 2 and 3.

Station Number	Station Name	Assessment Unit (AU)	TSS/TDS[1]	Nutrients[2]	Dissolved Metals[3]	Total Metals[4]	*E. coli*	Radionuclides[5]	VOCs[6]	SVOCs[7]	Station Rationale
1	La Jara Creek above Irrigation Diversion	La Jara Creek (Perennial reaches above Arroyo San Jose)	7/8	7/8	7/8	7/8	6/8	1/2	0/0	1/0	only station in AU
2	Arroyo San Jose below Hwy 550	Arroyo San Jose (Rio Puerco to La Jara Creek)	0/0	3/3	3/3	3/3	3/3	2/2	0/0	0/0	only station in AU
3	Rito de los Pinos at USFS gate on FR 95	Rito de los Pinos (Arroyo San Jose to headwaters)	0/0	0/3	0/3	0/3	0/3	0/0	0/0	0/0	only station in AU
4	Rio Puerco (northern boundary Cuba to headwaters)	Rio Puerco at CR13 Bridge	2/8	5/8	5/8	5/8	4/8	1/0	0/0	0/0	only station in AU
5	Rio Puerco at Hwy 550 Bridge	Rio Puerco (Arroyo Chijuilla to northern boundary Cuba)	3/8	6/8	6/8	6/8	5/8	1/0	0/0	1/0	above WWTP, land use change
6	Rito Leche below Hwy 126	Rito Leche (Rio Puerco to Hwy 126)	0/0	4/3	4/3	4/3	4/3	0/0	0/0	0/0	only station in non-perennial reach
7	Nacimiento Creek at Eureka Road	Nacimiento Creek (Hwy 126 to San Gregorio Reservoir)	6/8	6/8	6/8	6/8	6/8	0/2	0/0	0/0	only station in AU
8	Nacimiento Creek below Hwy 126	Nacimiento Creek (Rio Puerco to Hwy 126)	1/0	2/3	2/3	2/3	2/3	0/0	0/0	0/0	only station in non-perennial reach
9	Cuba WWTP Outfall Channel	NPDES Discharge	3/4	4/4	2/3	2/3	4/4	0/0	0/0	0/0	NPDES permit

Station Number	Station Name	Assessment Unit (AU)	TSS/TDS[1]	Nutrients[2]	Dissolved Metals[3]	Total Metals[4]	*E. coli*	Radionuclides[5]	VOCs[6]	SVOCs[7]	Station Rationale
10	Rio Puerco below WWTP at Sanchez Property	Rio Puerco (non-pueblo Rio Grande to Arroyo Chijuilla)	4/8	5/8	6/8	6/8	4/8	1/2	0/0	1/2	below WWTP
11	Senorito Creek above Nacimiento Mine	Senorito Creek (Nacimiento Mine to headwaters)	3/8	6/8	6/8	6/8	6/8	0/2	0/0	0/0	only station in AU
12	Senorito Creek below Nacimiento Mine	Senorito Creek (San Pablo Canyon to Nacimiento Mine)	1/0	1/3	2/3	2/3	1/3	0/0	0/0	0/0	only station in AU
13	San Pablo Canyon at FR 533	San Pablo Canyon (perennial reach)	2/8	4/8	4/8	4/8	3/8	0/2	0/0	0/0	only station in AU
14	San Miguel Arroyo at FR 533	San Miguel Arroyo (perennial reach)	0/8	0/8	0/8	0/8	0/8	0/2	0/0	0/0	only station in perennial AU
15	San Miguel Arroyo at Hwy 44	San Miguel Arroyo (Rio Puerco to perennial reach)	0/0	0/3	0/3	0/3	0/3	0/0	0/0	0/0	only station in non-perennial reach
16	San Pablo Canyon above Rio Puerco	San Pablo Canyon (non-perennial reaches)	0/0	0/3	0/3	0/3	0/3	0/0	0/0	0/0	only station in non-perennial reach
17	Rio Puerco at Hwy 279 Bridge near San Luis	Rio Puerco (non-pueblo Rio Grande to Arroyo Chijuilla)	1/8	3/8	3/8	3/8	2/8	0/0	0/0	0/0	below Arroyo Chijuilla
18	Clear Creek above San Gregorio Reservoir	Clear Creek (san Gregorio Reservoir to headwaters)	2/2	2/2	1/2	1/2	2/2	0/0	0/0	0/0	only station in AU
19	San Gregorio Reservoir	San Gregorio Reservoir	2/3	2/2	2/2	2/3	2/2	1/1	1/0	1/0	only station in AU

Station Number	Station Name	Assessment Unit (AU)	TSS/TDS[1]	Nutrients[2]	Dissolved Metals[3]	Total Metals[4]	*E. coli*	Radionuclides[5]	VOCs[6]	SVOCs[7]	Station Rationale
20	Rio Puerco at I-25	Rio Puerco (non-pueblo Rio Grande to Arroyo Chijuilla)	0/5	0/3	0/3	0/3	0/3	0/2	0/0	0/0	compleme nt USGS sampling
21	Rito Moquino below confluence	Rio Moquino (Laguna Pueblo to Seboyettia Creek)	1/8	1/8	1/8	1/8	1/8	0/2	0/0	0/2	only station in AU
22	Rio Paguate above Laguna Pueblo	Rio Paguate (Laguna Pueblo boundary to headwaters)	0/8	0/8	0/8	0/8	0/8	0/2	0/0	0/0	only station in AU
23	Rio San Jose above Milan at Hwy 122	Unclassified Intermittent	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	monitoring requested by citizens group
24	Rio San Jose at Riverwalk Park	Rio San Jose (Horace Springs to BNSF RR in Grants)	0/0	3/0	2/0	2/0	3/0	0/0	0/0	1/0	ground-water discharge discovered
25	Rio San Jose at Hwy 117	Rio San Jose (Horace Springs to BNSF RR in Grants)	1/0	7/0	7/0	7/0	7/0	2/0	0/0	2/0	lowest station in AU
26	Bluewater Creek above Bluewater Reservoir	Bluewater Creek (Bluewater Reservoir to headwaters)	2/8	5/8	5/8	5/8	6/8	0/0	0/0	0/0	only station in AU
27	Bluewater Reservoir	Bluewater Reservoir	4/8	4/8	4/3	4/8	4/4	2/2	2/2	2/2	only station in AU
28	Bluewater Creek at Mouth of Bluewater Canyon	Bluewater Creek (non-tribal Rio San Jose to Bluewater Reservoir)	4/8	5/8	5/8	5/8	4/8	1/2	0/0	2/0	only station in AU
29	Puerco River below Gallup WWTP	Puerco River Puerco River (non-tribal AZ border to Gallup WWTP)	0/4	4/4	6/4	6/4	6/4	2/2	0/0	2/2	only station in AU

Station Number	Station Name	Assessment Unit (AU)	TSS/TDS[1]	Nutrients[2]	Dissolved Metals[3]	Total Metals[4]	*E. coli*	Radionuclides[5]	VOCs[6]	SVOCs[7]	Station Rationale
30	McGaffey Reservoir	McGaffey Reservoir	4/4	4/4	4/3	4/3	4/4	2/2	2/0	2/0	only station in AU
31	Tampico Draw above Rio Nutria	Tampico Draw (Rio Nutria to headwaters)	0/8	0/8	0/8	0/8	0/8	0/0	0/0	0/0	only station in AU
32	Rio Nutria above Tampico Draw	Rio Nutria (Tampico Draw to headwaters)	0/0	0/3	0/3	0/3	0/3	0/0	0/0	0/0	only station in AU
33	Rio Nutria below Tampico Draw	Rio Nutria (Zuni Pueblo boundary to Tampico Draw)	1/6	4/6	4/6	4/6	4/6	1/2	0/0	1/0	only station in AU
34	Cebolla Creek above Falls	Cebolla Creek (perennial reaches, Ramah Reservoir to headwaters)	0/8	0/8	0/8	0/8	0/8	0/2	0/0	0/0	only station in AU
35	Cebolla Creek at FR 157	Cebolla Creek (perennial reaches, Ramah Reservoir to headwaters)	0/5	0/5	0/3	0/3	0/5	0/0	0/0	0/0	above reservoir
36	Ramah Reservoir	Ramah Reservoir	4/8	4/8	4/3	4/3	4/8	2/2	2/2	2/2	only station in AU
37	Cebolla Creek below Ramah Reservoir	Cebolla Creek (Rio Pescado to headwaters)	0/6	0/6	0/3	0/3	0/6	0/2	0/0	0/0	below reservoir
38	Ramah WWTP effluent channel	Unclassified Perennial	0/4	4/4	3/4	3/4	3/4	0/0	0/0	0/0	monitor WWTP effluent

[1]Total Suspended Solids / Total Dissolve Solids. [2]Suite includes total Kjeldahl nitrogen (TKN), nitrate+nitrite, ammonia and total phosphorus. [3]Suite includes aluminum, antimony, arsenic, barium, boron, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, silicon, silver, tin, vanadium, zinc and hardness. [4] Aluminum, selenium and mercury only. [5]A radionuclide sample is initially analyzed for gross alpha and gross beta radiation and, depending on results of the gross alpha and gross beta screen, might also include uranium mass and radium 226 + 228. [6] Volatile Organic Compounds; see Appendix A for a list of analytes included in the suite. [7]Semi-Volatile Organic Compounds; see Appendix A for a list of analytes included in the suite.

Figure 2. Location of sampling stations in Eastern Rio Puerco Watershed.

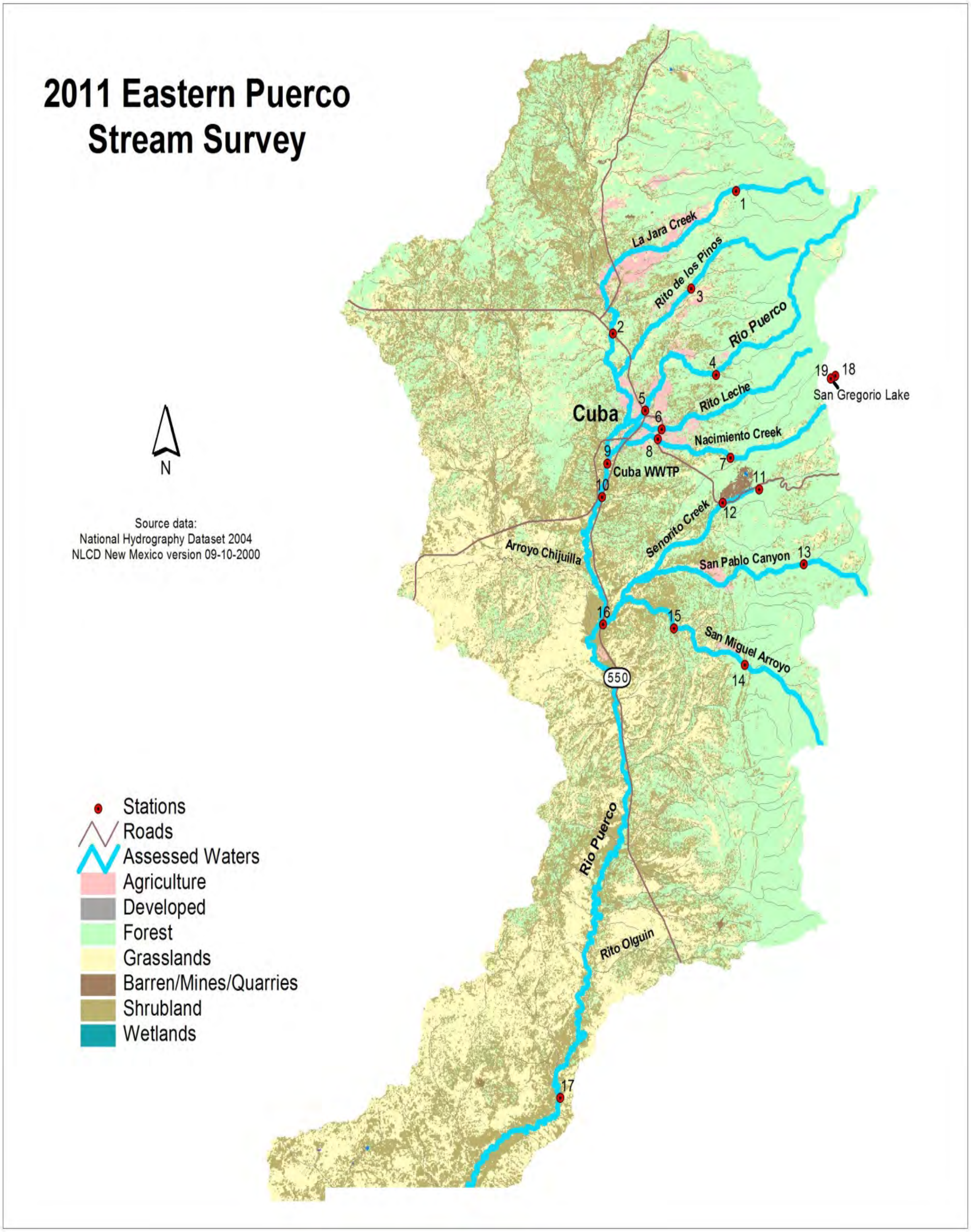
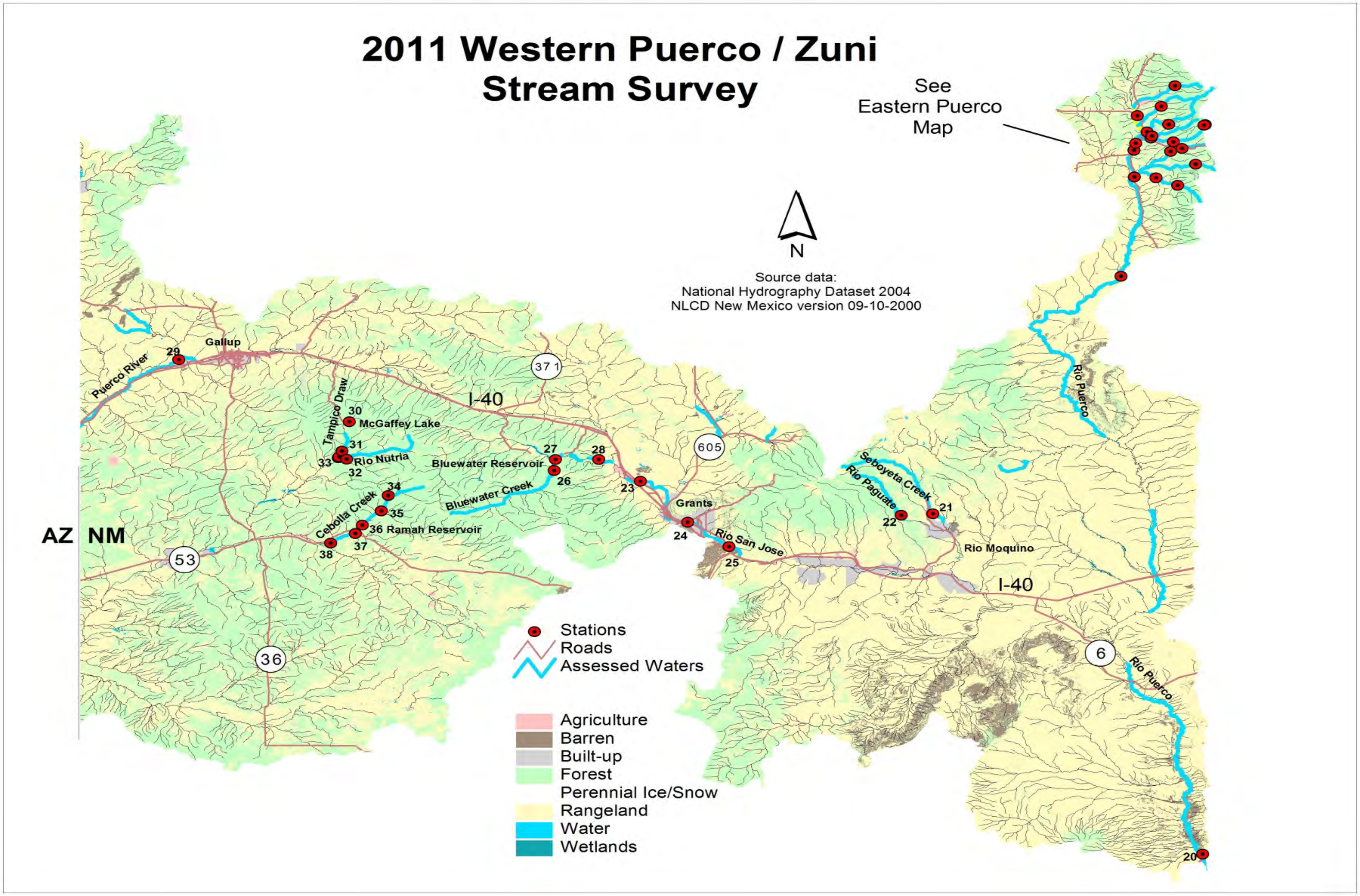


Figure 3. Location of sampling stations in Western Rio Puerco and Zuni River Watersheds.



Nutrientrient / Habitat Sampling

Biological indicators and habitat measurements give an overall indication of the integrity of the AU. Stations were selected for biological and habitat monitoring based on their current IR status and results of level 1 nutrient assessments. Resources and access issues did not allow for the collection of biological and habitat data in all AUs.

The SWQB collected fish, periphyton, and physical habitat data at select sites to assess waterbodies for potential impairment from sediment deposition and nutrient enrichment, and to obtain data to support water quality standards development. A summary of biological and habitat monitoring appears below (Table 6).

Table 6. Summary of completed/planned biological and physical sampling. Station numbers refer to locations in Figures 2 and 3.

Station Number	Station Name	Assessment Unit (AU)	Sedimentation[1] and Habitat[2]	Thermograph	Sonde[3]	L2 Nutrient Survey[4]	Macroinvertebrates	Fish	Chlorophyll a	Phytoplankton
1	La Jara Creek above irrigation diversion	La Jara Creek (Perennial reaches above Arroyo San Jose)	1/1	1/1	1/1	0/0	1/1	0/0	0/0	0/0
5	Rio Puerco at Hwy 550 Bridge	Rio Puerco (Arroyo Chijuilla to northern boundary Cuba)	1/1	1/1	1/1	1/1	0/0	0/0	0/0	0/0
7	Nacimiento Creek at Eureka Road	Nacimiento Creek (Hwy 126 to San Gregorio Reservoir)	1/1	1/1	1/1	0/0	1/1	0/0	0/0	0/0
10	Rio Puerco below WWTP at Sanchez Property	Rio Puerco (Arroyo Chijuilla to northern boundary Cuba)	1/1	1/1	1/1	1/1	0/1	0/1	0/0	0/0
11	Señorito Creek above Nacimiento Mine	Señorito Creek (Nacimiento Mine to headwaters)	1/1	1/1	2/2	0/0	1/1	0/0	0/0	0/0
13	San Pablo canyon at FR 533	San Pablo Canyon (Rio Puerco to headwaters)	1/1	1/1	1/1	0/0	0/1	0/0	0/0	0/0
14	San Miguel Arroyo at FR 533	San Miguel Arroyo (San Pablo Canyon to headwaters)	1/1	1/1	1/1	0/0	0/1	0/0	0/0	0/0
19	San Gregorio Reservoir	San Gregorio Reservoir	0/0	0/0	0/0	0/0	0/0	0/0	5/2	2/2

21	Rito Moquino below confluence	Rio Moquino (Laguna Pueblo to Seboyettia Creek)	0/1	0/1	2/1	0/1	0/1	0/0	0/0	0/0
22	Rio Paguate above Laguna Pueblo	Rio Paguate (Laguna Pueblo boundary to headwaters)	0/1	0/1	0/1	0/0	0/1	0/0	0/0	0/0
25	Rio San Jose at Hwy 117	Rio San Jose (Horace Springs to BNSF RR in Grants)	1/0	1/0	1/0	1/0	0/0	0/0	0/0	0/0
26	Bluewater Creek above Bluewater Lake	Bluewater Creek (Bluewater Reservoir to headwaters)	0/1	2/1	0/1	0/1	0/1	0/0	0/0	0/0
27	Bluewater Reservoir	Bluewater Reservoir	0/0	0/0	0/0	0/0	0/0	0/0	7/4	4/4
28	Bluewater Creek at mouth of Bluewater Canyon	Bluewater Creek (non-tribal Rio San Jose to Bluewater Reservoir)	0/1	2/1	1/1	0/0	0/0	0/0	0/0	0/0
29	Puerco River below Gallup WWTP	Puerco River (non-tribal AZ border to Gallup WWTP)	1/0	2/0	1/0	1/0	0/0	0/0	0/0	0/0
30	McGaffey Reservoir	McGaffey Reservoir	0/0	0/0	0/0	0/0	0/0	0/0	7/4	4/4
31	Tampico Draw above Rio Nutria	Tampico Draw (Rio Nutria to headwaters)	1/1	1/1	1/1	0/0	0/0	0/0	0/0	0/0
33	Rio Nutria below Tampico Draw	Rio Nutria (Zuni Pueblo boundary to Tampico Draw)	1/1	1/1	1/1	0/0	0/1	0/0	0/0	0/0
34	Cebolla Creek above Falls	Unclassified Cebolla Creek (Rio Pescado to headwaters)	0/1	0/1	0/1	0/1	0/1	0/1	0/0	0/0
36	Ramah Reservoir	Ramah Reservoir	0/0	0/0	0/0	0/0	0/0	0/0	7/4	2/4

[1]If sedimentation data (pebble counts) exceed the threshold value for percent fines at a site, more extensive habitat data were collected during a subsequent visit. [2]Habitat data collection was triggered by sedimentation data (pebble counts) that show excessive values of percent fines as determined by exceedences of threshold values established for mountain, plains and foothills regions. [3]Sondes are deployed to collect long-term turbidity data and as part of level 2 nutrient surveys. [4]Level 2 nutrient survey; nutrient screening is a two-step process: A preliminary visual assessment of periphyton, together with an assessment of early season total phosphorus and nitrogen concentrations (level 1 screening) was used to determine if a level 2 survey, consisting of periphyton collection, chlorophyll determinations, further water samples for nitrogen and phosphorus, and a sonde deployment to record diurnal variations in pH and dissolved oxygen concentrations, was warranted.

Deviations from the FSP were caused by five main factors:

1. Lack of water during some or all sampling visits to a given site resulted in collection of fewer samples than planned. This occurred at the following stations: 2, 3, 6, 8, 10, 12, 13, 14, 15, 16, 17, 20, 23, 31, 32, 34, 35, and 37.

2. The presence of water where it had not been found during earlier surveys, mischaracterized point-source discharges (stations 29 and 38), or the discovery of a discharge that created a new perennial reach (stations 24 and 25).

3. Staff were denied access to station 21 after a single visit due to conflicts between NMED and the Cebolleta Land Grant. Access was never obtained to station 22 because of changes in property ownership, locked gates and restrictions imposed by Laguna Pueblo. In addition, fire, or fire restrictions, prevented access to stations throughout the survey located on United States Forest Service land during portions of July and August, 2011.

4. Some stations had more samples collected than planned due to a surplus of analytical services made available by other sites going dry.

5. Discrepancies in planned versus completed chlorophyll a sampling on reservoirs resulted from cancelled sampling trips and a decision to double chlorophyll a samples to allow comparison of two methods of analysis.

   Although not included in the FSP for the survey, the SWQB hydrology protocol (HP) was conducted at stations 14, 26 and 34.

SUMMARY

Although a detailed FSP was prepared prior to beginning sampling, a large number of deviations occurred over the course of the survey. The causes of these deviations were primarily the result of a lack of precipitation and the absence of water in streams during the survey year. The HP should be conducted at sites that went dry during this survey to determine if the appropriate WQS are in place, and to aid in future survey design. Secondary causes of changes to the FSP were the discovery of water in locations where none had been anticipated, due to new discharges from groundwater pumping or WWTPs that had previously been thought to be applying their effluent to land, and lack of access to sampling stations for various reasons.

The data from this survey have been validated and verified according to SWQB standard operating procedures (SOPs; NMED/SWQB 2011) and are currently undergoing assessment to determine the impairment status of the sampled waters. The assessment conclusions will be incorporated into the 2014-2016 IR, which will be completed early in 2014. These conclusions will be used to generate an amendment to this report, detailing the results. In cases where impairments to water and habitat quality are found, data from this survey will also be used to calculate TMDLs, depending on the outcome of assessments and listing.

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APPENDIX A. Analytes included in Volatile (VOC) and Semi-volatile (SVOC) organic compound suites.

Semi-Volatile Organic Compounds	**Volatile Organic Compounds**
1,2,4-Trichlorobenzene	1,1,1,2-Tetrachloroethane
1,2-Dichlorobenzene	1,1,1-Trichloroethane
1,2-Dinitrobenzene	1,1,2,2-Tetrachloroethane
1,3-Dichlorobenzene	1,1,2-Trichloroethane
1,3-Dinitrobenzene	1,1-Dichloroethane
1,4-Dichlorobenzene	1,1-Dichloroethene
1,4-Dinitrobenzene	1,1-Dichloropropene
1-Methylnaphthalene	1,2,3-Trichlorobenzene
2,3,4,6-Tetrachlorophenol	1,2,3-Trichloropropane
2,3,5,6-Tetrachlorophenol	1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol	1,2,4-Trimethylbenzene
2,4,6-Trichlorophenol	1,2-Dibromo-3-chloropropane (DBCP)
2,4-Dichlorophenol	1,2-Dibromoethane (EDB)
2,4-Dimethylphenol	1,2-Dichlorobenzene
2,4-Dinitrophenol	1,2-Dichloroethane
2,4-Dinitrotoluene	1,2-Dichloropropane
2,6-Dinitrotoluene	1,3,5-Trimethylbenzene
2-Chloronaphthalene	1,3-Dichlorobenzene
2-Chlorophenol	1,3-Dichloropropane
2-Methylnaphthalene	1,4-Dichlorobenzene
2-Methylphenol	1,4-Dioxane
2-Nitroaniline	2,2-Dichloropropane
2-Nitrophenol	2-Butanone (MEK)
3,3'-Dichlorobenzidine	2-Chloroethyl vinyl ether
3-Methylphenol & 4-Methylphenol	2-Chlorotoluene
3-Nitroaniline	2-Hexanone
4,4'-DDD	4-Chlorotoluene
4,4'-DDE	4-Isopropyltoluene
4,4'-DDT	4-Methyl-2-pentanone
4,6-Dinitro-2-methylphenol	Acetone
4-Bromophenyl Phenyl Ether	Acetonitrile
4-Chloro-3-methylphenol	Acrolein
4-Chloroaniline	Acrylonitrile
4-Chlorophenyl Phenyl Ether	Allyl chloride
4-Nitroaniline	Benzene
4-Nitrophenol	Bromobenzene
Acenaphthene	Bromochloromethane
Acenaphthylene	Bromodichloromethane
Alachlor	Bromoform
Aldrin	Bromomethane
alpha-BHC	Carbon disulfide
Aniline	Carbon tetrachloride
Anthracene	Chlorobenzene
Atrazine	Chloroethane
Azobenzene	Chloroform

Semi-Volatile Organic Compounds	**Volatile Organic Compounds**
Benzidine	Chloromethane
Benzo(a)anthracene	Chloroprene
Benzo(a)pyrene	cis-1,2-Dichloroethene
Benzo(b)fluoranthene	cis-1,3-Dichloropropene
Benzo(g,h,i)perylene	cis-1,4-Dichloro-2-butene
Benzo(k)fluoranthene	Dibromochloromethane
Benzyl alcohol	Dibromomethane
beta-BHC	Dichlorodifluoromethane
bis(2-Chloroethoxy)methane	Ethyl methacrylate
bis(2-Chloroethyl)ether	Ethylbenzene
bis(2-Chloroisopropyl)ether	Hexachlorobutadiene
bis(2-Ethylhexyl)adipate	Iodomethane
bis(2-Ethylhexyl)phthalate	Isobutyl alcohol
Butyl Benzyl Phthalate	Isopropylbenzene
Carbazole	m- & p-Xylenes
Chrysene	Methyl methacrylate
cis-Chlordane	Methylacrylonitrile
Cyanazine	Methylene chloride (Dichloromethane)
delta-BHC	Naphthalene
Dibenz(a,h)anthracene	n-Butylbenzene
Dibenzofuran	Nitrobenzene
Dieldrin	o-Xylene
Diethylphthalate	Pentachloroethane
Dimethylphthalate	Propionitrile
Di-n-butyl Phthalate	Propylbenzene
Di-n-octyl phthalate	sec-Butylbenzene
Endosulfan I	Styrene
Endosulfan II	tert-Butyl methyl ether (MTBE)
Endosulfan sulfate	tert-Butylbenzene
Endrin	Tetrachloroethene
Endrin aldehyde	Tetrahydrofuran (THF)
Endrin ketone	Toluene
Fluoranthene	Total trihalomethanes
Fluorene	Total xylenes
gamma-BHC (lindane)	trans-1,2-Dichloroethene
Heptachlor	trans-1,3-Dichloropropene
Heptachlor epoxide	trans-1,4-Dichloro-2-butene
Hexachlorobenzene	Trichloroethene
Hexachlorobutadiene	Trichlorofluoromethane
Hexachlorocyclopentadiene	Vinyl acetate
Hexachloroethane	Vinyl chloride
Indeno(1,2,3-cd)pyrene	
Isophorone	
Methoxychlor	
Metolachlor	
Metribuzin	
Naphthalene	

Semi-Volatile Organic Compounds	Volatile Organic Compounds
Nitrobenzene	
N-nitrosodimethylamine	
N-nitroso-di-n-propylamine	
N-nitrosodiphenylamine	
Pentachlorophenol	
Phenanthrene	
Phenol	
Prometryne	
Pyrene	
Pyridine	
Simazine	
trans-Chlordane	