2.0 Data Summary

This chapter outlines the types and sources of data developed by ADEQ in support of the Queen Creek TMDL modeling (**Table 2-1**). Detailed summaries of dissolved copper and total lead instream observations are also presented along with the spatial distribution of the hardness instream concentrations. ADEQ's sampling and analysis plan for the Queen Creek TMDL project was specifically designed with the purpose to develop and implement a dynamic watershed model. ADEQ installed automated instrumentation to generate sufficient data for populating model input. ADEQ has also collected numerous grab samples across the watershed to characterize water quality from various sources, landuse types and bedrock lithologies. All these data sources were analyzed and used in the initial model setup, parameterization, and calibration of the Queen Creek TMDL model (Arizona DEQ, 2010).

Table 2-1: Summary of Data

Data Types	Sources
Topography	USGS - 7.5' Quadrangle and 30 m DEM (Digital Elevation Model)
Waterbodies	USGS - NHD (National Hydrography Dataset)
Soils	USEPA BASINS – SATSGO
Vegetation	USEPA BASINS
Land use	USEPA BASINS
Surficial Geology	1988 Arizona Geologic Survey
Meteorologic (15-minute data) Air Temperature, Relative Humidity, Wind Speed, and Solar Radiation)	ADEQ – Pinto/Mineral Creek Weather Station
Precipitation (15-minute data)	ADEQ – Two Electronic Recording Rain Gages (Omya Mine/Pump Spring and at Boyce Thompson Arboretum).
Stream Discharge (15-minute data)	ADEQ – Eight Electronic Stream Stage Recorders On Queen Creek and Tributaries
In-stream water Quality Data	ADEQ – Automatic and Manual Collection in Queen Creek and Tributaries
Point Source (NPDES) Discharge and Pollutant Concentrations (15-minute data)	ADEQ - Facility Discharge Monitoring Reports (DMR) data for Resolution Copper Co (previously BHP and Magma) and Town of Superior WWTP
Hard Rock Data and Non-Point Source Pollutant Concentrations (geology, abandon/inactive mines, etc.)	ADEQ – Hard Rock and Surface Water Samples from Select Sub-watersheds
Design/Synthetic Storms Precipitation Frequency	NOAA Atlas 14
Channel Geometry	USEPA BASINS, ADEQ Surveys and USGS Topographic Maps

2.1. Water Quality Data

ADEQ collected water quality samples using automatic samplers deployed at numerous locations in the watershed. These automated samplers collected samples through several storm events and were supplemented with manually collected samples throughout the data collection period. Field data collection began in the fall of 2003 until late February 2008. Numerous samples were taken during the winter of 2007-2008 where several runoff-producing precipitation events were recorded. In fact, a total of 22.2 inches of rainfall was recorded from late November 2007 to late February 2008 at the headwaters

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(Omya) rain gage. Water quality data were also collected at numerous other sites across the watershed and were used to assign pollutant concentrations for sub-watersheds and other individual sources.
In 2010, ADEQ initiated an additional monitoring program and collected water quality and lithologic data in the Queen Creek watershed. The intent was to fill a few spatial water quality data gaps identified during the initial modeling phase. This additional data will allow a fine-tuning of the watershed model spatial representation and distribution of dissolved copper and total lead loadings. The following sections present a summary of the dissolved copper, total lead, hardness, and hard rock data.

2.1.1 Dissolved Copper Instream Data

Figure 2-1 presents the average observed dissolved copper concentrations for each segment with water quality station(s) in the Queen Creek watershed. **Table 2-2** presents similar results in a tabular format. These summaries clearly indicate that all the sub-basins in the Queen Creek watershed have been covered through an extensive collection of water quality measurements totaling 700 data points. **Figure 2-1** indicates that the highest observed concentrations were observed in the Oak Flat sub-basin (segments 22, 23, and 24), the Apex Wash sub-basin (segment 50), and the RCC Superior Wash (segment 90).

2.1.2 Hardness Instream Data

Since the dissolved copper criteria are hardness-dependent, knowledge of the hardness (mg/L as CaCO3) instream levels are important for assessing compliance with water quality standards. **Figure 2-2** depicts the spatial distribution of observed hardness instream concentrations and reveals that the lowest hardness levels were recorded in the Oak Flat sub-basin.

2.1.3 Total Lead Instream Data

Figure 2-3 presents the average observed total copper concentrations for each segment with water quality station(s) in the Queen Creek watershed. **Table 2-3** presents similar results in a tabular format. These summaries clearly indicate that all the sub-basins in the Queen Creek watershed have been covered through an extensive collection of water quality measurements totaling 700 data points. **Figure 2-3** and **Table 2-3** indicates that the highest observed total lead concentrations were observed in the Reymert Wash sub-basin (segment 28) where the average total concentration was recorded at 1.63 mg/L. Even though just two observations were made at this segment, the excessively high instream copper concentration is confirmed and consistent with the hard rock data collected in Reymert Wash (**Section 2.1.4**)

2.1.4 Hard Rock Data

In 2010 ADEQ collected additional copper and lead samples at specific locations in the Queen Creek watershed. This sampling focused on specific locations in the watershed such as waste piles in abandoned mines, mineralized rocks, and single lithology areas. Dissolved copper and lead data as well as soil data copper and lead (hard rock) were collected at these locations. The soil copper and lead data are depicted in **Figures 2-4** and **2-5**, respectively. The highest soil copper concentration of 14,000 mg/kg was recorded at segment 16 (Potts Canyon). The highest soil lead concentration was recorded a segment 55 (Reymert Wash) at a concentration of 40,000 m/kg exceeding by one order of magnitude all the other soil lead data in the watershed.

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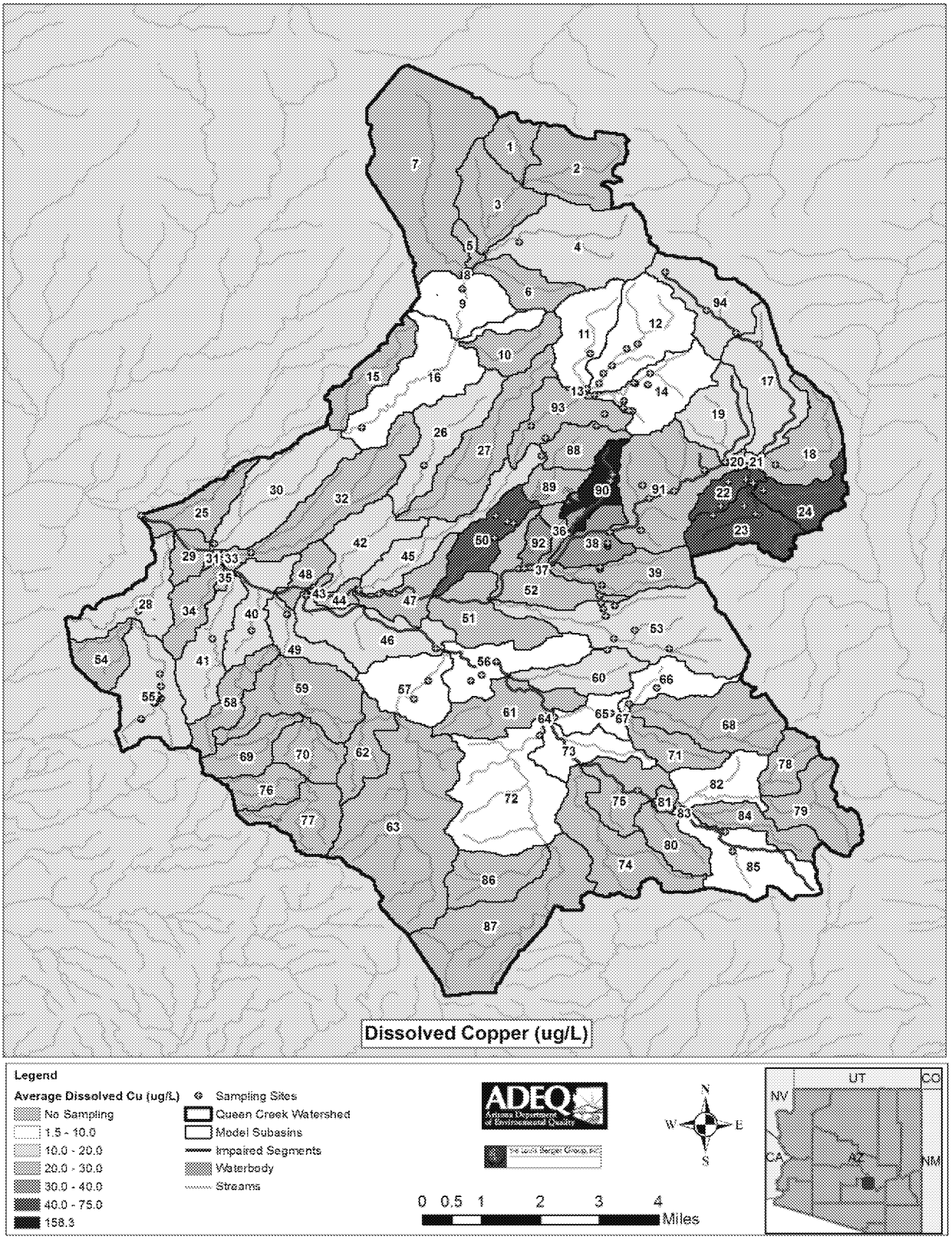

Figure 2-1: Average Dissolved Copper Concentrations by Segment in the Queen Creek Watershed

Table 2-2: Summary of Dissolved Copper Instream Observations by Sub-Basin and Subwatershed								
Subbasin	Model-Segment	# of Stations	# of Samples	Min	Max	Mean	STD	Data Range
				µg/L				
Potts Canyon	4	1	1	12.1	12.1	12.1	NA	1/19/2010
	9	1	4	3.3	9.8	7.2	2.9	9/3/2009 - 1/19/2010
	16	2	5	5.1	11.9	9.2	2.8	12/8/2009, 1/22/2010, 1/27/2010
	25	1	12	8.1	44.0	21.6	12.1	8/10/2005 - 2/5/2008
	30	1	48	2.5	49.0	11.4	6.6	8/10/2005 - 2/4/2008, 12/8/2009
Happy Camp Canyon	26	1	1	18.6	18.6	18.6	NA	1/20/2010
	32	1	1	24.8	24.8	24.8	NA	1/21/2010
	42	1	1	18.1	18.1	18.1	NA	12/8/2009
Silver King Wash	11	2	4	4.7	10.0	6.9	2.2	1/28/2008, 2/22/2010, 7/29/2010
	12	5	13	3.5	8.9	6.1	1.8	12/7/2007 - 1/28/2008, 1/27/2010 - 2/22/2010
	14	9	9	3.2	16.0	8.8	4.7	1/28/2008, 2/22/2010
	45	2	29	6.7	62.0	14.0	10.9	3/12/2006 -1/28/2008, 1/22/2010
	93	4	9	6.4	101.	24.6	30.6	8/16/2007 - 1/28/2008, 2/22/2010
Apex Wash	50	4	32	21.9	1000	74.1	171.3	12/7/2010, 12/7/2009 - 1/22/2010
	88	2	2	9.3	36.9	23.1	19.5	2/22/2010
RCC Superior Wash	90	2	2	9.5	307.	158.3	210.4	3/7/2010
	92	1	81	11.0	92.0	31.9	14.3	7/31/2006 - 3/4/2008
Queen Creek	17	2	52	1.0	70.0	15.6	11.6	4/10/2005 - 3/4/2008
	18	1	3	24.2	32.1	27.6	4.1	1/22/2010, 2/7/2010, 2/22/2010
	19	1	6	14.0	25.0	19.2	4.1	8/7/2007 - 1/6/2008
	20	1	2	11.0	49.0	30.0	26.9	4/19/2005, 8/10/2005
	21	1	4	4.5	34.0	18.1	13.8	7/23/2007 - 1/27/2008
	38	4	24	6.2	131.	34.8	31.6	12/29/2004 - 3/4/2008, 1/21/2010, 2/7/2010
	39	3	5	11.3	35.3	22.2	9.4	1/21/2010
	47	2	13	10.0	51.0	26.5	13.5	11/14/2002 - 5/19/2003, 4/13/2005 - 1/28/2008
	52	2	5	17.0	30.0	22.3	5.9	4/10/2005 - 8/30/2005, 1/21/2010
	53	7	15	6.0	24.4	12.9	6.7	8/21/2009 - 2/7/2010
	91	5	16	1.5	121.	24.2	31.2	5/22/2003- 4/19/2005, 8/17/2007-1/8/2008, 1/21/2010
	94	3	87	0.7	55.0	12.3	12.3	4/10/2003 - 3/4/2008
Oak Flat	22	6	81	10.3	65.0	44.0	12.2	7/31/2006 - 3/4/2008, 12/7/2009 - 3/8/2010
	23	4	13	26.7	80.0	53.7	17.9	12/8/2007 - 2/4/2008, 12/7/2009 - 1/22/2010
	24	1	1	41.0	41.0	41.0	N/A	12/11/2007
Arnett Creek	46	2	57	5.0	25.0	10.6	3.8	12/19/2001 - 8/26/2002, 3/23/2007 - 1/29/2008
	56	3	3	8.5	10.5	9.2	1.1	2/8/2009, 1/21/2010
	57	2	4	4.5	12.8	8.5	3.5	2/8/2009 - 1/27/2010
	60	2	2	12.1	15.3	13.7	2.3	1/21/2010
	65	2	3	5.3	13.0	8.2	4.2	12/7/2007, 1/7/2008, 1/21/2010
	66	2	3	2.1	13.4	8.4	5.8	1/21/2010
	72	1	4	6.9	14.2	9.8	3.1	12/8/2009 - 1/21/2010
	73	1	1	9.7	9.7	9.7	NA	1/21/2010
	75	1	2	1.5	1.5	1.5	NA	5/26/2004, 8/3/2004
	82	1	2	7.2	8.9	8.1	1.2	1/7/2008, 1/28/2008
	83	1	1	9.3	9.3	9.3	NA	1/28/2008
	85	2	2	6.0	8.7	7.4	1.9	1/7/2008, 1/28/2008
Alamo Canyon	40	1	2	14.1	15.3	14.7	0.8	1/21/2010 - 1/22/2010
	41	1	1	12.2	12.2	12.2	NA	1/22/2010
	49	1	3	7.5	13.4	11.1	3.2	1/21/2010 - 1/22/2010, 3/7/2010
Reymert Wash	28	1	2	9.2	17.3	13.3	5.7	1/21/2010 - 1/22/2010
	55	9	27	4.5	23.6	11.2	3.9	2/8/2009 - 1/22/2010

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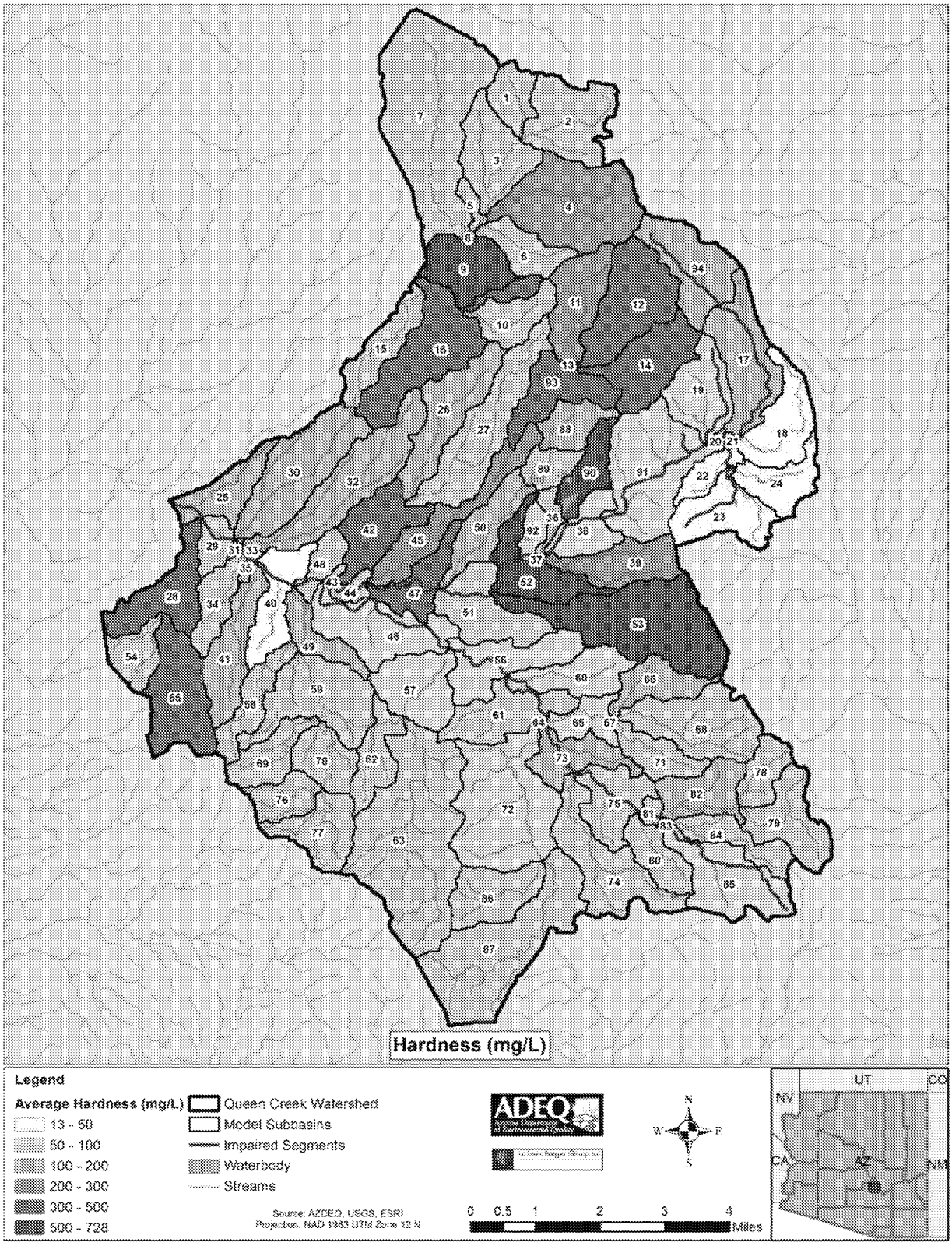

Figure 2-2: Average Dissolved Hardness Concentrations by Segment in the Queen Creek Watershed

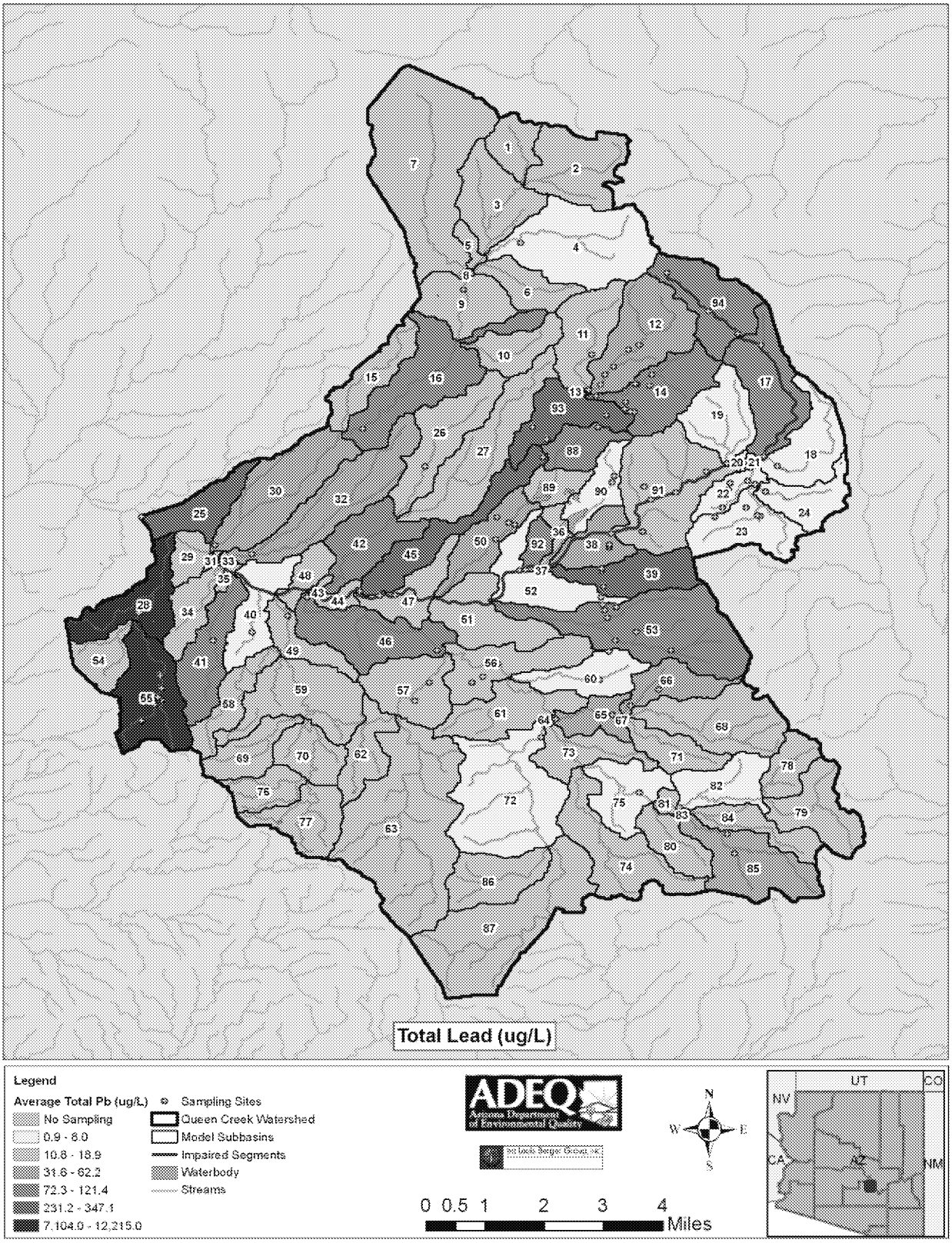

Figure 2-3: Average Total Lead Concentrations by Segment in the Queen Creek Watershed

Table 2-3: Summary of Total Lead Instream Observations by Sub-Basin and Segment								
Sub-Basin	Sub-watershed	# of Stations	# of Samples	Min	Max	Mean	STD	Data Range
				µg/L				
Potts Canyon	4	1	1	0.9	0.9	0.9	NA	1/19/2010
	9	1	4	0.2	40.2	18.9	21.7	9/3/2009 - 1/19/2010
	16	2	5	0.3	135.0	76.2	60.5	12/8/2009, 1/22/2010, 1/27/2010
	25	1	12	2.5	1200.0	288.2	424.2	8/10/2005 - 2/5/2008
	30	1	49	2.5	300.0	62.2	70.2	8/10/2005 - 2/4/2008, 12/8/2009
Happy Camp Canyon	26	1	1	14.5	14.5	14.5	NA	1/20/2010
	32	1	1	32.4	32.4	32.4	NA	1/21/2010
	42	1	1	96.3	96.3	96.3	NA	12/8/2009
Silver King Wash	11	2	4	0.2	44.0	18.5	19.0	1/28/2008, 2/22/2010, 7/29/2010
	12	5	13	0.2	240.0	31.6	70.1	12/7/2007 - 1/28/2008, 1/27/2010 - 2/22/2010
	14	9	9	0.2	436.0	97.2	176.6	1/28/2008, 2/22/2010
	45	2	29	2.5	840.0	231.2	222.6	3/12/2006 -1/28/2008, 1/22/2010
	93	4	9	2.1	1000.0	347.1	345.7	8/16/2007 - 1/28/2008, 2/22/2010
Apex Wash	50	4	31	6.1	212.0	49.4	48.8	12/7/2010, 12/7/2009 - 1/22/2010
	88	2	2	2.5	224.0	113.3	156.6	2/22/2010
RCC Superior Wash	90	2	2	0.2	2.9	1.5	1.9	3/7/2010
	92	1	90	2.0	810.0	121.4	164.2	7/31/2006 - 3/4/2008
Queen Creek	17	2	52	2.3	960.0	72.5	169.8	4/10/2005 - 3/4/2008
	18	1	3	1.1	6.1	4.0	2.6	1/22/2010, 2/7/2010, 2/22/2010
	19	1	6	2.5	12.0	4.6	3.8	8/7/2007 - 1/6/2008
	20	1	2	1.0	2.5	1.8	1.1	4/19/2005, 8/10/2005
	21	1	4	2.5	2.5	2.5	NA	7/23/2007 - 1/27/2008
	38	4	23	0.7	460.0	46.0	108.0	12/29/2004 - 3/4/2008, 1/21/2010, 2/7/2010
	39	3	5	3.7	877.0	240.6	365.7	1/21/2010
	47	2	14	2.5	82.0	11.9	21.1	11/14/2002 - 5/19/2003, 4/13/2005 - 1/28/2008
	52	2	5	1.0	12.9	4.7	4.8	4/10/2005 - 8/30/2005, 1/21/2010
	53	7	14	1.1	397.0	79.3	105.5	8/21/2009 - 2/7/2010
	91	5	16	0.5	126.0	14.1	32.0	5/22/2003 - 4/19/2005, 8/17/2007 - 1/8/2008, 1/21/2010
	94	3	86	1.0	810.0	83.7	160.2	4/10/2003 - 3/4/2008
Oak Flat	22	6	73	1.0	62.0	8.0	12.6	7/31/2006 - 3/4/2008, 12/7/2009 - 3/8/2010
	23	4	13	0.5	6.8	2.2	1.6	12/8/2007 - 2/4/2008, 12/7/2009 - 1/22/2010
	24	1	1	2.5	2.5	2.5	NA	12/11/2007
Arnett Creek	46	2	54	2.5	350.0	72.3	78.1	12/19/2001 - 8/26/2002, 3/23/2007 - 1/29/2008
	56	3	3	1.4	28.8	10.8	15.6	2/8/2009, 1/21/2010
	57	2	4	0.4	45.2	12.3	22.0	2/8/2009 - 1/27/2010
	60	2	2	2.6	5.0	3.8	1.7	1/21/2010
	65	2	3	10.7	85.0	36.9	41.7	12/7/2007, 1/7/2008, 1/21/2010
	66	2	3	3.0	92.4	37.7	47.9	1/21/2010
	72	1	4	0.5	2.7	1.6	0.9	12/8/2009 - 1/21/2010
	73	1	1	16.5	16.5	16.5	NA	1/21/2010
	75	1	2	1.5	1.5	1.5	*0.0*	5/26/2004, 8/3/2004
	82	1	2	2.5	11.0	6.8	6.0	1/7/2008, 1/28/2008
	83	1	1	13.0	13.0	13.0	NA	1/28/2008
	85	2	2	32.0	70.0	51.0	26.9	1/7/2008, 1/28/2008
Alamo Canyon	40	1	2	3.2	6.6	4.9	2.4	1/21/2010 - 1/22/2010
	41	1	1	95.5	95.5	95.5	NA	1/22/2010
	49	1	3	0.2	29.9	10.9	16.5	1/21/2010 - 1/22/2010, 3/7/2010
Reymert Wash	28	1	2	1630.	22,800	12,215	14,969	1/21/2010 - 1/22/2010
	55	9	27	0.7	35500.0	7104.4	9746.2	2/8/2009 - 1/22/2010

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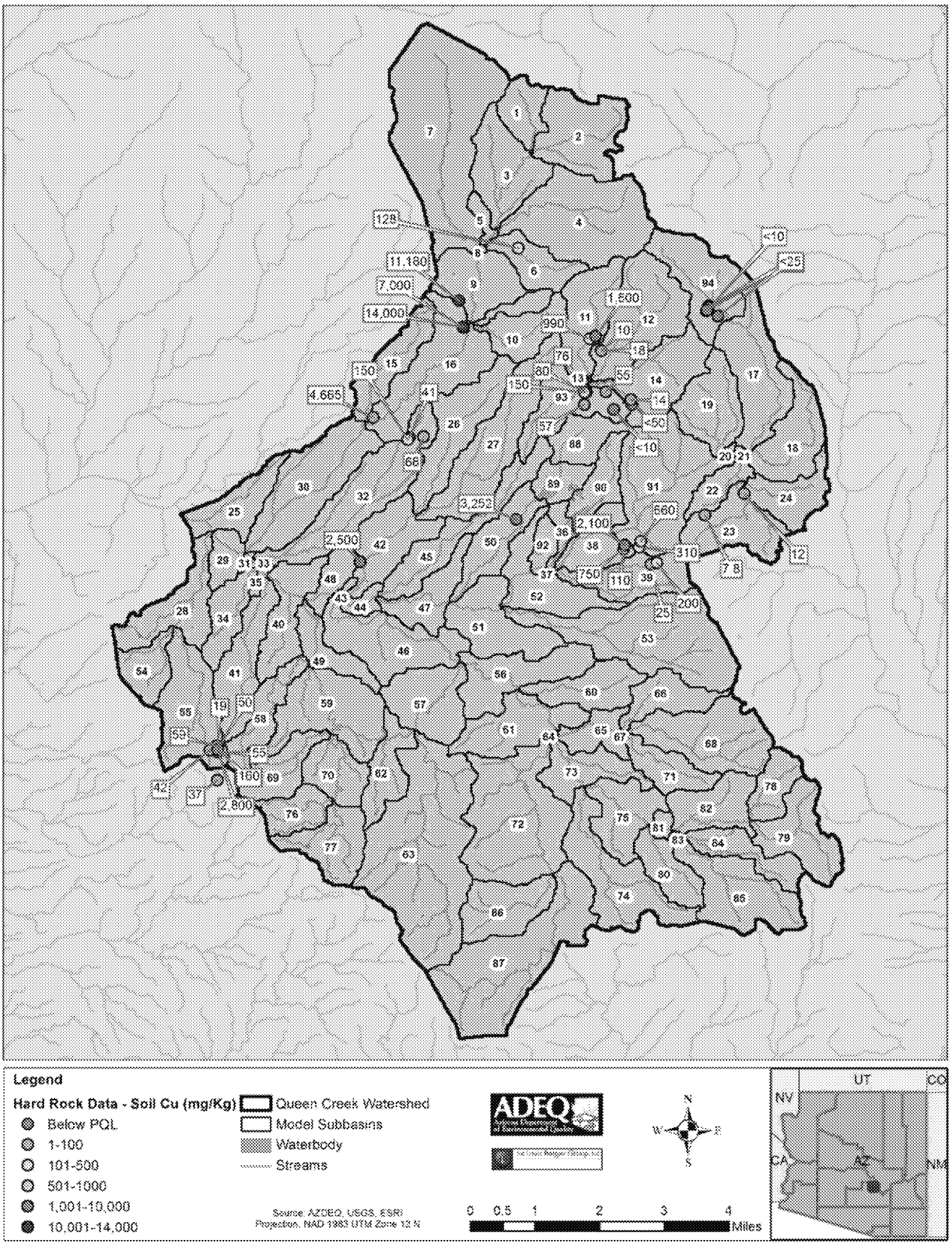

Figure 2-4: Soil Copper Data in the Queen Creek Watershed

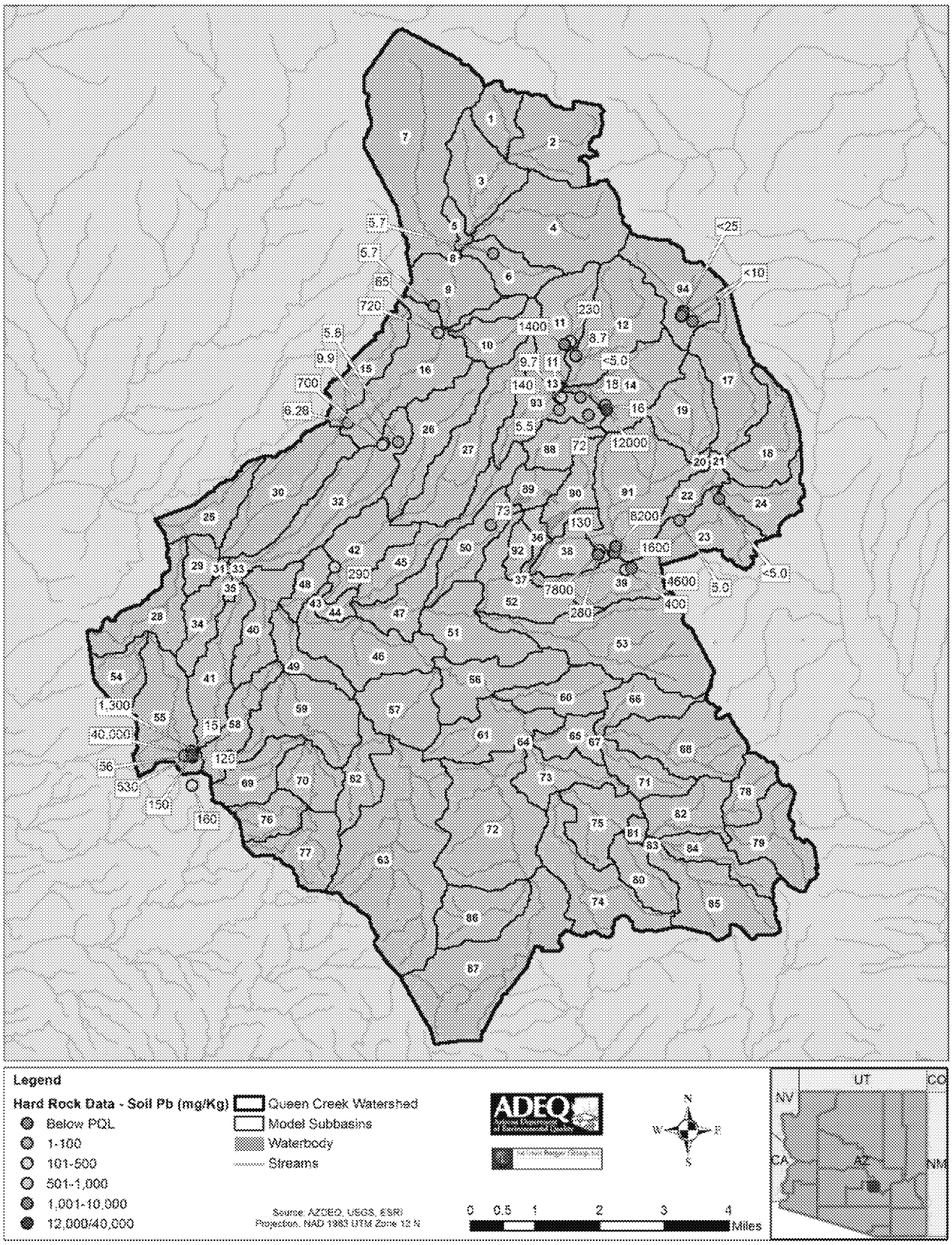

Figure 2-5: Soil Lead Data in the Queen Creek Watershed

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