

Appendix D: Sulfate Listing Threshold Update

Sulfate (SO₄) loads to surface waters can be naturally occurring or originate from urban runoff, agricultural runoff, acid mine drainage, atmospheric deposition, and wastewater dischargers. When naturally occurring, they are often the result of the breakdown of leaves that fall into a stream or of water passing through rock or soil containing gypsum and other common minerals (MDE 2014). For the 2024 IR, MDE reevaluated all Maryland 8-digit watershed sulfate listings because of issues that were discovered with the previous BSID listing approach, specific to sulfate. The BSID compared the data distribution in streams with good and bad IBI, which led to the development of low sulfate threshold values. This threshold was not based on toxicological impact on aquatic life and did not consider covariance with other contaminants such as chlorides.

Therefore, based on an extensive literature review, and in consultation with EPA, MDE replaced the previous BSID threshold with an ultra-conservative screening threshold of 145 mg/L. The updated threshold is based on the results of Soucek and Dickinson’s 2015 study on the toxicity of sodium salts, including sodium sulfate, to the Mayfly *Neocloeon triangulifer*. See Table D- 2 for a summary of all endpoints considered during the literature review. For definitions on the effects of the endpoints, see EPA’s webpage on [Aquatic Life Benchmarks and Ecological Risk Assessments](#). Once the new threshold was selected, the historical data used to list the sulfate impairments was re-evaluating using the updated threshold. Table D- 1 below outlines the summary data for all sulfate impaired watersheds. Data in 22 of the 26 watersheds do not exceed the updated screening threshold. See Figure D- 1 for a map of the sample stations and impaired watersheds. These watersheds were delisted from Category 5 and moved to Category 2 in the 2024 IR, while the remaining 4 watersheds with threshold exceedances will remain in Category 5. As Figure D- 2 demonstrates, there are no active or abandoned mine lands in the delisted watersheds.

Table D- 1: Summary Data of Complete List of Impaired Watersheds.

Watershed	Data Collection Time Period	# of Samples	Min SO ₄ Conc	Max SO ₄ Conc	Mean SO ₄ Conc	# of Exceedances
Anacostia River ^{1,2}	1997-2012	37	8.77	115.74	20.78	0
Antietam Creek ^{1,2}	1995-2015	34	4.54	65.30	16.99	0

Watershed	Data Collection Time Period	# of Samples	Min SO4 Conc	Max SO4 Conc	Mean SO4 Conc	# of Exceedances
Back River ¹	1995-2016	29	7.38	53.53	27.09	0
Baltimore Harbor ^{1,2}	1995-2015	32	14.70	36.80	22.25	0
Bush River ¹	1996-2007	9	4.20	22.48	11.99	0
Cabin John Creek ¹	1997-2003	7	16.09	36.91	23.74	0
Conococheague Creek ^{1,2}	1995-2016	25	7.55	362.60	49.04	1
Deep Creek Lake ^{1,2,3,5}	1995-2014	65	2.78	55.21	14.94	0
Evitts Creek ^{1,2}	1996-2016	22	8.95	81.34	30.35	0
Georges Creek ^{1,2,3,4,5}	1996-2016	158	5.72	2483.71	285.85	60
Jones Falls ^{1,2}	1995-2016	30	1.51	78.58	15.57	0

Watershed	Data Collection Time Period	# of Samples	Min SO4 Conc	Max SO4 Conc	Mean SO4 Conc	# of Exceedances
Loch Raven Reservoir ^{1,2}	1996-2016	61	1.21	27.91	8.37	0
Lower Gunpowder Falls ^{1,2}	1996-2016	17	4.05	24.38	12.26	0
Lower Pocomoke River	1997-2016	19	9.29	90.24	43.4	0
Marsh Run ¹	1995-2014	8	25.68	36.17	30.32	0
Patapsco River L N Br ^{1,2}	1995-2015	42	4.99	45.82	25.64	0
Patuxent River Middle ^{1,2}	1997-2015	27	14.90	40.13	26.21	0
Patuxent River Upper ^{1,2}	1997-2011	19	11.84	48.81	22.08	0
Port Tobacco River ^{1,2}	1995-2015	16	8.21	38.86	18.04	0

Watershed	Data Collection Time Period	# of Samples	Min SO4 Conc	Max SO4 Conc	Mean SO4 Conc	# of Exceedances
Potomac River FR Cnty ¹	1996-2016	24	7.23	34.69	17.95	0
Potomac River MO Cnty ^{1,2}	1997-2016	34	4.18	50.76	16.14	0
Potomac River U N Branch ^{1,2,5}	1996-2016	75	5.69	361.36	87.72	6
Potomac River U tidal ^{1,2}	1997-2015	19	9.65	37.28	24.63	0
Potomac River WA Cnty ^{1,2}	1995-2014	26	7.69	66.63	18.62	0
West River ¹	1997-2016	8	12.62	36.62	25.77	0
Wills Creek ^{1,2,3,5}	1996-2016	102	9.51	899.30	199.54	49

Data Sources: ¹MBSS Data, ²MD Ion Study Data, ³Western MD pH TMDL Data, ⁴Marcellus Shale Natural Gas Baseline Data, ⁵MD DNR Monthly Core Trend Data

Table D- 2: Summary of Literature Review Endpoints

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_and_Dickson_2015	Neocloeon	triangulifer	Invert	chronic	145	EC20
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	145	NOEC
Elphick_etal_2011	Ceriodaphnia	dubia	Invert	chronic	150	NOEC
Elphick_etal_2011	Ceriodaphnia	dubia	Invert	chronic	150	LOEC
Soucek_and_Dickson_2016	Neocloeon	triangulifer	Invert	chronic	164	MATC
Soucek_and_Dickson_2017	Neocloeon	triangulifer	Invert	chronic	170	EC20
Kunz_etal_2013	Lampsilis	siliquoidea	Invert	chronic	172	NOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	176	EC25
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	205	NOEC
Wang_etal_2011	Pimephales	promelas	vert	chronic	215	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	245	EC10
Elphick_etal_2011	Ceriodaphnia	dubia	Invert	chronic	246	EC25
Soucek_and_Dickson_2015	Neocloeon	triangulifer	Invert	chronic	274	MATC
Simmons_2012	Pseudokirchneriella	subcapitata	plant	acute	288	EC10
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	297	EC10

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	298	EC50
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	300	LOEC
Elphick_etal_2011	Oncorhynchus	mykiss	vert	chronic	340	LOEC
Simmons_2012	Lemna	minor	plant	chronic	346	EC10
Elphick_etal_2011	Oncorhynchus	mykiss	vert	chronic	356	EC10
Elphick_etal_2011	Hyaella	Azteca	Invert	chronic	380	EC10
Elphick_etal_2011	Pimephales	promelas	vert	chronic	388	EC10
Kunz_etal_2013	Lampsilis	siliquoidea	Invert	chronic	393	NOEC
Soucek_2007	Hyaella	Azteca	Invert	acute	431	LC50
Wang_etal_2011	Pimephales	promelas	vert	chronic	436	LOEC
Elphick_etal_2011	Ceriodaphnia	dubia	Invert	chronic	465	EC50
Kunz_etal_2013	Lampsilis	siliquoidea	Invert	chronic	471	NOEC
Kunz_etal_2013	Centroptilum	triangulifer	Invert	chronic	483	NOEC
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	496	IC25
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	501	EC25
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	510	NOEC

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Hyaella	Azteca	Invert	acute	524	LC50
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	531	EC10
Simmons_2012	Pseudokirchneriella	subcapitata	plant	acute	548	EC10
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	560	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	560	NOEC
Elphick_etal_2011	Pimephales	promelas	vert	chronic	595	NOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	603	NOEC
Soucek_2007	Hyaella	Azteca	Invert	acute	607	LC50
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	625	IC25
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	654	NOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	654	NOEC
Wang_etal_2011	Ceriodaphnia	dubia	Invert	chronic	677	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	678	EC10
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	700	EC10
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	703	EC10
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	715	IC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	716	EC10
Soucek_etal_2018	Neocloeon	triangulifer	Invert	acute	728	LC50
Elphick_etal_2011	Oncorhynchus	mykiss	vert	chronic	734	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	752	EC25
Elphick_etal_2011	Pimephales	promelas	vert	chronic	760	NOEC
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	766	IC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	820	NOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	820	EC25
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	828	EC25
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	844	EC10
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	849	EC25
Wang_etal_2011	Lampsilis	abrupda	Invert	chronic	875	NOEC
Simmons_2012	Lemna	minor	plant	acute	922	EC10
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	941	EC10
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	950	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	960	LOEC

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	978	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	997	EC25
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1027	EC25
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	1029	EC50
Elphick_etal_2011	Hyaella	Azteca	Invert	chronic	1056	EC25
Simmons_2012	Pseudokirchneriella	subcapitata	plant	acute	1057	EC50
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	1060	IC25
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1075	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1100	LOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1100	LOEC
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1100	NOEC
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1112	EC25
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1116	EC50
Simmons_2012	Pseudokirchneriella	subcapitata	plant	acute	1153	EC50
Davies_and_Hall_2007	Daphnia	Magna	Invert	acute	1194	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1200	NOEC

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Hyalella	Azteca	Invert	acute	1210	LC50
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1214	EC50
Soucek_and_Dickson_2015	Neocloeon	triangulifer	Invert	acute	1227	LC50
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	1240	LOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	1240	LOEC
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1244	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1250	LOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	1250	LOEC
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1252	EC10
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	1252	IC50
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	1264	EC25
Davies_etal_2003	Daphnia	Magna	Invert	acute	1285	LC50
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1292	EC25
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1300	LOEC
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1300	NOEC
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1300	NOEC

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1323	EC10
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1328	EC50
Soucek_etal_2018	Neocloeon	triangulifer	Invert	acute	1338	LC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1342	EC10
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1342	EC10
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1345	EC10
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1348	EC25
Soucek_2007	Hyaella	Azteca	Invert	acute	1348	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1359	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1377	EC10
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1400	LOEC
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1430	EC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1433	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1438	LC50
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	1450	LOEC
Soucek_2007	Hyaella	Azteca	Invert	acute	1460	LC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Hyaella	Azteca	Invert	acute	1480	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1485	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1505	LC50
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1510	EC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1558	LC50
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1560	EC25
Davies_and_Hall_2007	Daphnia	Magna	Invert	acute	1563	LC50
Davies_etal_2003	Daphnia	Magna	Invert	acute	1571	LC50
Wang_etal_2011	Ceriodaphnia	dubia	Invert	chronic	1610	LOEC
Soucek_2007	Hyaella	Azteca	Invert	acute	1616	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1621	LC50
Simmons_2012	Lemna	minor	plant	chronic	1633	EC50
Elphick_etal_2011	Hyaella	Azteca	Invert	acute	1637	NOEC
Elphick_etal_2011	Hyaella	Azteca	Invert	chronic	1637	NOEC
Wang_etal_2011	Lampsilis	abrupda	Invert	chronic	1638	LOEC
Soucek_2007	Hyaella	Azteca	Invert	acute	1679	LC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Hyaella	Azteca	Invert	acute	1684	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1699	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1727	EC25
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	1755	EC50
Soucek_etal_2018	Neocloeon	triangulifer	Invert	acute	1758	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1763	EC25
Soucek_2007	Hyaella	Azteca	Invert	acute	1767	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1779	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1793	EC50
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1800	LOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1800	EC50
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1800	EC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1810	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1820	LC50
Soucek_etal_2018	Neocloeon	triangulifer	Invert	acute	1822	LC50
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1824	EC25

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1828	EC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1830	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1830	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	1847	LC50
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1853	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1869	EC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1879	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	1901	LC50
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1925	LOEC
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1925	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1950	EC25
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1950	LOEC
Davies_and_Hall_2007	Daphnia	Magna	Invert	acute	1985	LC50
Davies_etal_2003	Daphnia	Magna	Invert	acute	1993	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	2000	LOEC
Soucek_2007	Hyaella	Azteca	Invert	acute	2000	LC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Hyaella	Azteca	Invert	acute	2002	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	2002	LC50
Soucek_2007	Sphaericum	simile	Invert	acute	2029	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2030	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2052	LC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	acute	2056	LC50
Elphick_etal_2011	Hyaella	Azteca	Invert	acute	2069	EC10
Mount_etal_1997	Ceriodaphnia	dubia	Invert	acute	2083	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2095	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2100	LC50
Davies_and_Hall_2007	Hyaella	Azteca	Invert	acute	2101	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	2121	LC50
Wang_etal_2011	Lampsilis	abrupda	Invert	acute	2149	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2184	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2188	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2198	EC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	2200	EC50
Soucek_2007	Hyaella	Azteca	Invert	acute	2203	LC50
Soucek_2007	Sphaericum	simile	Invert	acute	2209	LC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	chronic	2216	LOEC
Davies_and_Hall_2007	Hyaella	Azteca	Invert	acute	2240	LC50
Wang_etal_2011	Ceriodaphnia	dubia	Invert	acute	2241	EC50
Elphick_etal_2011	Hyaella	Azteca	Invert	acute	2246	EC25
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2263	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2269	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2270	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2297	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2327	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2333	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2383	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2389	LC50
Simmons_2012	Lemna	minor	plant	acute	2402	EC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2404	EC50
Elphick_etal_2011	Hyaella	Azteca	Invert	acute	2412	LOEC
Elphick_etal_2011	Hyaella	Azteca	Invert	chronic	2412	LOEC
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2433	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2446	EC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	acute	2446	LC50
Elphick_etal_2011	Hyaella	Azteca	Invert	acute	2461	EC50
Elphick_etal_2011	Hyaella	Azteca	Invert	chronic	2461	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2472	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2481	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	2491	EC10
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2516	EC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	2518	EC50
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	2522	EC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	acute	2527	LC50
Soucek_2007	Sphaericum	simile	Invert	acute	2530	LC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2542	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2549	LC50
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	2575	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	2591	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2653	LC50
Soucek_2007	Sphaericum	simile	Invert	acute	2654	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	2700	LOEC
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2706	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	2724	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2724	EC50
Davies_and_Hall_2007	Hyalella	Azteca	Invert	acute	2725	LC50
Soucek_2007	Sphaericum	simile	Invert	acute	2732	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	2740	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	2742	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2757	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2761	EC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	2800	LOEC
Soucek_2007	Hyalella	Azteca	Invert	acute	2840	LC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	2850	LOEC
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2853	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	2955	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	2986	LC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	chronic	3000	LOEC
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3051	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	3055	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3059	EC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	acute	3065	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3073	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	3077	EC25
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3091	EC50
Mount_etal_1997	Daphnia	Magna	Invert	acute	3097	LC50
Davies_etal_2003	Daphnia	Magna	Invert	acute	3146	LC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Davies_and_Hall_2007	Daphnia	Magna	Invert	acute	3203	LC50
Wang_etal_2011	Chironomus	dilutus	Invert	chronic	3223	NOEC
Wang_etal_2011	Chironomus	dilutus	Invert	chronic	3223	LOEC
Soucek_2007	Sphaericum	simile	Invert	acute	3246	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3265	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3297	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3338	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3361	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3369	EC50
Soucek_2007	Hyaella	Azteca	Invert	acute	3400	LC50
Soucek_2007	Hyaella	Azteca	Invert	acute	3462	LC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	3463	EC25
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3506	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3716	EC50
Soucek_2007	Hyaella	Azteca	Invert	acute	3785	LC50

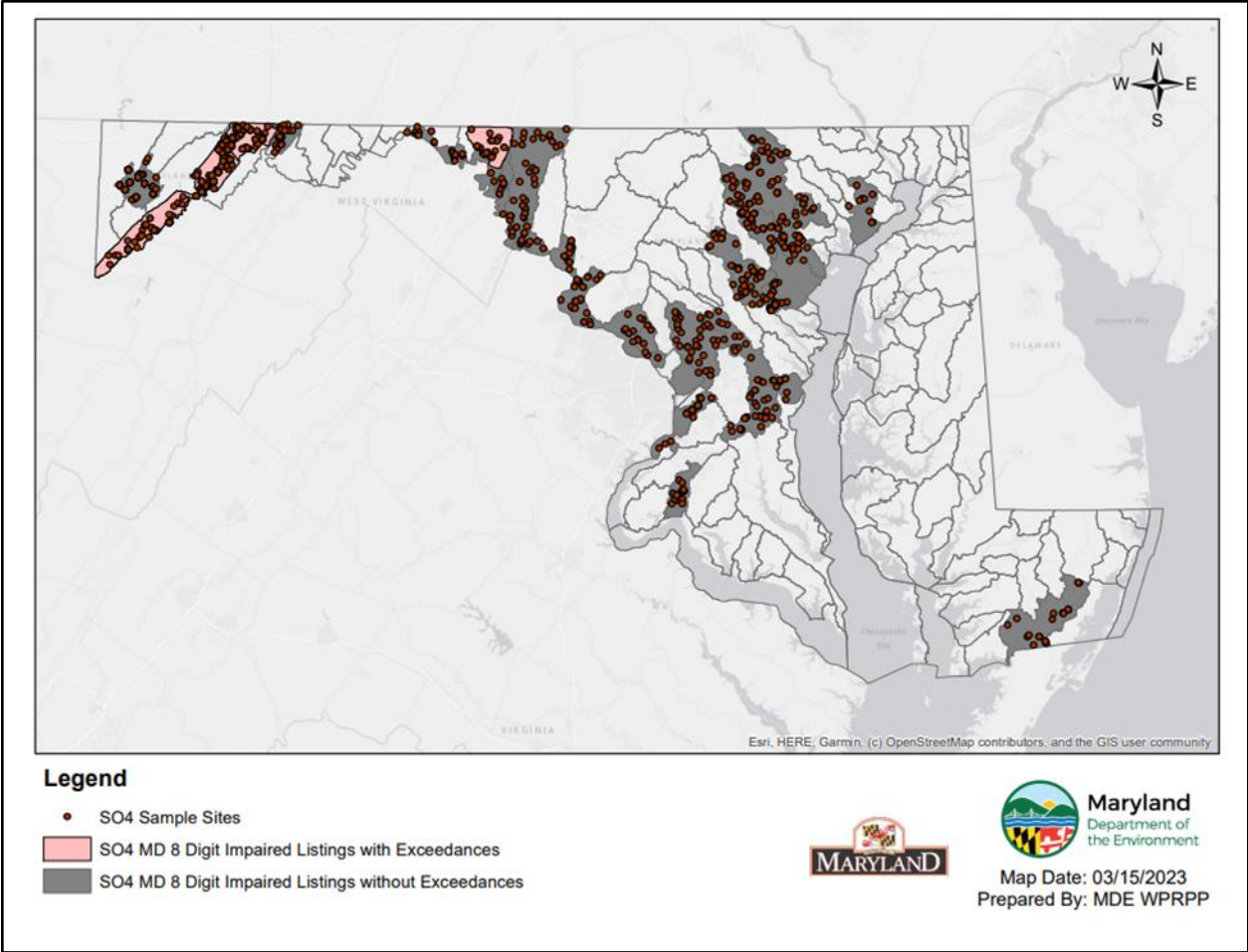


Figure D- 1: Map of Sample Stations in All Impaired Watersheds

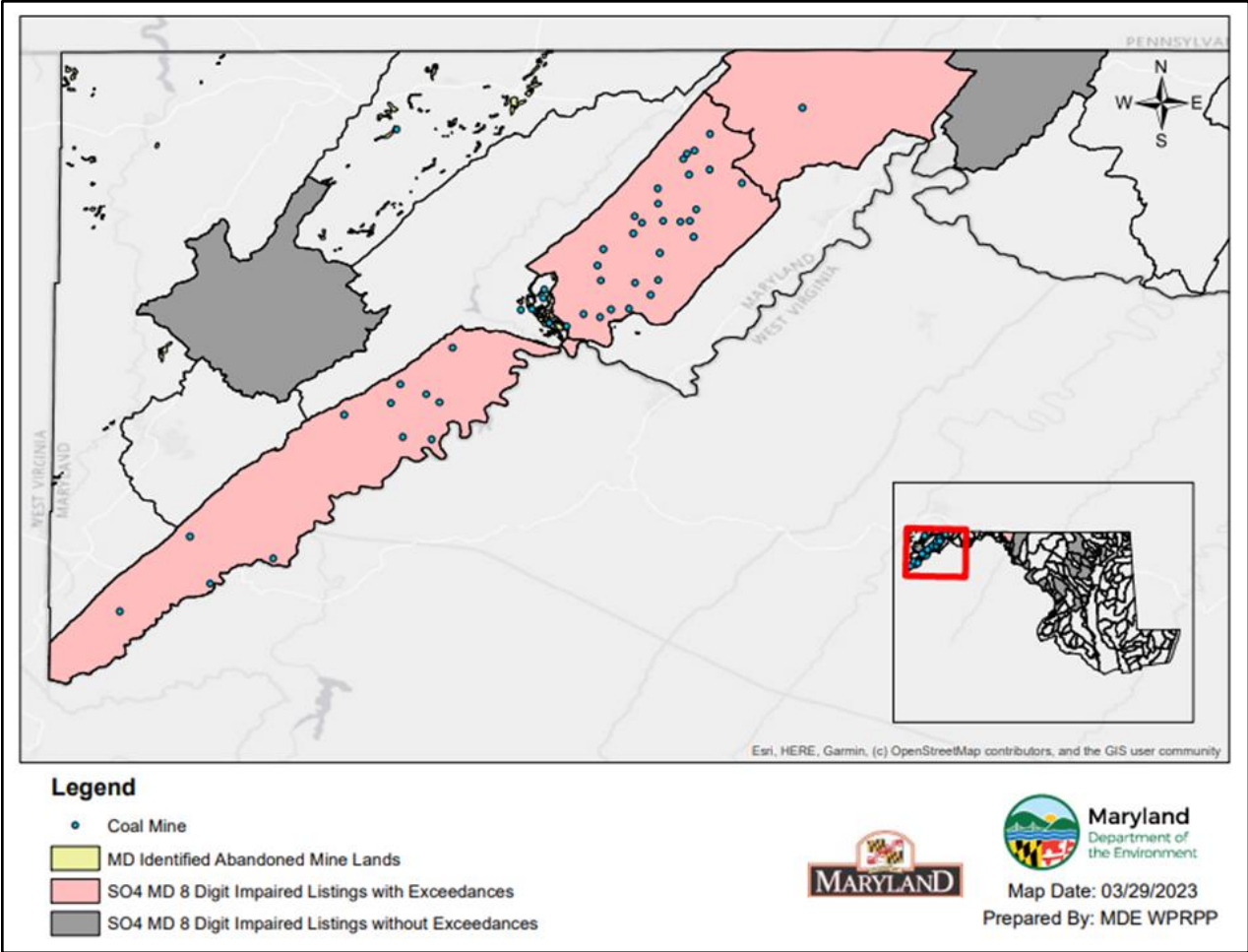


Figure D- 2: Map of Active and Abandoned Mines