Memorandum

To: Steam Electric ELG Rulemaking Record – EPA-HQ-OW-2009-0819
From: U.S. EPA
Date: March 11, 2026
Re: Environmental Assessment Memorandum for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category - Unmanaged Combustion Residual Leachate

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1 Introduction

The EPA is proposing revisions to the effluent limitations and guidelines (ELG) applicable to unmanaged combustion residual leachate (CRL) discharges from steam electric plants. This memorandum presents an assessment of the environmental impacts of these discharges and discusses changes expected under the options the EPA considered for this proposed rule. The memo complements information provided in environmental assessments conducted for the 2015, 2020, and 2024 rules that discuss the impacts of pollutants present in steam electric plant discharges (U.S. Environmental Protection Agency, 2015a, 2020, 2024a).

The regulations at 40 CFR 423.11(r) define CRL as "leachate from landfills or surface impoundments containing combustion residuals. Leachate is composed of liquid, including any suspended or dissolved constituents in the liquid, that has percolated through waste or other materials emplaced in a landfill, or that passes through the surface impoundment's containment structure (*e.g.*, bottom, dikes, berms).

Combustion residual leachate includes seepage and/or leakage from a combustion residual landfill or impoundment unit. Combustion residual leachate includes wastewater from landfills and surface impoundments located on non-adjoining property when under the operational control of the permitted facility. Combustion residual leachate does not include wastewater generated by a 10-year, 24-hour or longer duration storm event when meeting the certification requirements in § 423.19(o)."

This proposed rule applies more specifically to discharges of unmanaged CRL from an unlined impoundment or landfill. Unmanaged CRL is leachate that is not captured from a leachate collection system and instead percolates out of the landfill or impoundment unit and into the subsurface. The EPA defines two types of unmanaged CRL discharges in §423.11(ff): "The term unmanaged combustion residual leachate means combustion residual leachate which either: (1) is determined by the permitting authority to be the functional equivalent of a direct discharge to Waters of the United States (WOTUS) through groundwater; or (2) has leached from a waste management unit into the subsurface and mixed with groundwater prior to being captured and pumped to the surface for discharge directly to WOTUS."

The baseline for this action is the 2024 rule which set numerical limits based on chemical precipitation for the treatment of unmanaged CRL before discharge. The 2025 rule (91 FR 4016), which later extended compliance deadlines for certain wastestreams along with other amendments, did not affect the 2024 ELGs for unmanaged CRL.

The options considered for this proposed rule include:

- Option 1: keeping numerical limits based on chemical precipitation for pump and treat discharges only (type 2 above) and setting limits for discharges that are functionally equivalent to a direct discharge (type 1 above) subject to best professional judgment (BPJ).
- Option 2: setting numerical limits based on chemical precipitation for all unmanaged CRL (*i.e.*, maintaining the limits set in the 2024 rule baseline)
- Option 3: specifying zero discharge for all unmanaged CRL.

The environmental assessment identifies waterbodies and associated resources affected by unmanaged CRL discharges that indicate potential pathways of human exposure to unmanaged CRL pollutants (*e.g.,* drinking water sources and fishable waters). The direction of environmental impacts depends on changes between the options and the baseline. For Option 1, the overall direction of environmental effects is *uncertain*. For plants with discharges determined to be the functional equivalent to a direct discharge, permit writers may elect, based on BPJ, not to set limits, to set limits based on chemical precipitation, to specify zero discharge, or another approach. In its analysis, the EPA effectively attributed no loading reductions to BPJ-based limits. For Option 2, the EPA estimates *no changes* relative to the baseline. For Option 3, the EPA estimates *reductions* in pollutant loadings relative to those achieved with chemical precipitation. See Table 3-1 for a summary of the options for the proposed rulemaking.

2 Pollutants of Concern

Ash ponds vary in size, but average more than 50 acres and 20 feet deep, while landfills average over 120 acres with typical depths up to 40 feet. Both ash ponds and landfills contain many layers of combustion residuals, reflecting their use over the decades. For example, as different coal types were used, the layers depict the ash composition. They are not a well-mixed, homogenous source of contaminants.

Table 2-1 summarizes the pollutants of concern in CRL and provides estimated concentrations in untreated CRL (adapted from Table 20 in the 2024 rule Technical Development Document [TDD]; U.S. Environmental Protection Agency, 2024d). These values are based on sampling data for untreated landfill and/or impoundment leachate for active landfills and impoundments at a subset of plants that responded to the 2009 Steam Electric Survey, as well as grab samples the EPA collected in 2021 of untreated landfill leachate.[1] The data show that untreated CRL contains high concentrations of chloride, sulfate, total dissolved solids (TDS), total suspended solids (TSS), calcium, sodium, and magnesium. See the 2015 TDD for details (U.S. Environmental Protection Agency, 2015b). Leachate pollutants may undergo transformation when mixed with groundwater and transported in aquifers. Because of the heterogeneity of coal ash within each pond and by facility, and due to varying data sampling protocols and surveying timeframes, these values represent an estimate of baseline conditions but are not representative of national average concentrations.

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[1] The concentrations are expressed as total element or component mass per unit volume and do not differentiate between chemical forms of pollutants.

Table 2-1: Untreated CRL Concentration Estimate.[2]

Pollutant	Untreated CRL Concentration (ug/L)
Total dissolved solids (TDS)	3,570,000
Sulfate	1,630,000
Chlorides	566,000
Calcium	490,000
Sodium	328,000
Magnesium	99,800
Total suspended solids (TSS)	33,900
Iron	23,000
Boron	22,000
Aluminum	3,190
Manganese	2,840
Copper	1,700
Vanadium	1,570
Molybdenum	1,480
Barium	148
Zinc	133
Selenium	93.8
Cobalt	63.4
Arsenic	32.2
Mercury	9.44
Chromium	8.17
Antimony	3.82
Thallium	1.55
Nickel	0.94

Source: U.S. EPA Analysis, 2026

The EPA assessed the changes in pollutant loading under the options. To represent the average pollutant concentrations for unmanaged CRL, the EPA used average pollutant concentrations for CRL calculated from data compiled from the 2015 ELG and 2024 ELG. However, CRL is subject to settling and leaching processes in impoundments and landfills. In addition, when pollutants enter the groundwater system, they go through diffusion, advection, dilution, and adsorption processes that may transform pollutants and/or change pollutant concentrations before pollutants enter the surface water system.

As a result, due to the lack of pollutant concentration data available for each analyte in unmanaged CRL, as well as the highly variable impact of ambient groundwater water quality and groundwater fate and transport processes on pollutant concentrations in unmanaged CRL, the EPA estimated loadings of TSS and TDS only. The EPA did not make assumptions about ambient TSS and TDS concentrations in groundwater when calculating the pollutant loadings. The selection of TSS and TDS ensures that the sum of these two metrics does not double count other pollutants that potentially may be present in unmanaged CRL, which the EPA is unable to numerically quantify due to lack of available data. As such, the environmental effects of TDS and TSS discharges are the primary focus of discussion in Sections 2.1 and 2.2.

2.1 TDS and Salinity

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[2] As discussed in the 2024 rule Environmental Assessment (EA) (U.S. EPA, 2024a), the EPA analyzed additional CRL data that included bromide concentrations in CRL at five plants; however, more than half of the samples were nondetect values. Therefore, the EPA did not estimate bromide loadings in CRL. See the memorandum titled “2024 Final Rule - Combustion Residual Leachate Analytical Data Evaluation” (U.S. EPA, 2024b).

TDS represents the concentration of combined dissolved organic and inorganic matter, whereas salinity represents the total concentration of dissolved inorganic salts. Common inorganic salts found in TDS include cations (positively charged ions), such as calcium, magnesium, potassium, and sodium, and anions (negatively charged ions), such as carbonates, nitrates, bicarbonates, chlorides, and sulfates. TDS concentrations in steam electric power plant wastestreams include contributions from dissolved metals and halogens (*e.g.*, chlorides, bromides, and iodides). As described in EAs for prior steam electric ELG rulemakings (*e.g.*, Section 2.1.1 of the 2020 EA, Section 2.1.3 of the 2024 EA), the adverse impacts of TDS and salinity pollutants on aquatic organisms include increases in invasive species, lower rates of organic matter processing, changes in biogeochemical cycles, decreased riparian vegetation, and altered composition of primary producers (*i.e.*, plants, bacteria, and algae) (Cañedo-Argüelles et al., 2013).

Increases in aquatic salinity may cause shifts in biotic communities, limit biodiversity, exclude less-tolerant species, and result in acute or chronic effects at specific life stages (Weber-Scannell & Duffy, 2007). Several studies summarized by Scannell and Jacobs (2001) have indicated that TDS concentrations higher than 700,000 ug/L can result in reduced growth, decreased survival rates, and altered behavior in macroinvertebrate communities (*e.g.*, Hamilton et al., 1975; Hoke et al., 1992; Khangarot, 1991; Mount et al., 1997; Tietge & Hockett, 1997).

Elevated levels of TDS in source water can also negatively impact downstream drinking water treatment and distribution by accelerating corrosion of transport pipes and producing organoleptic effects (*e.g.*, undesirable taste and smell). The EPA has not set a primary maximum contaminant level (MCL) for TDS but has set a secondary MCL for TDS as a nuisance parameter at 500,000 ug/L. Above this level, drinking water can demonstrate excessive hardness, deposits, color, staining, and a salty taste (U.S. Environmental Protection Agency, 2023).

Individual halides, such as bromide, chloride, and iodide, in source water can contribute to the formation of disinfection by-products (DBPs), which can impact human health (Cornwell et al., 2018; Corsi et al., 2010; Eastern Research Group, 2019; Good & VanBriesen, 2016, 2017; McTigue et al., 2014; Ruhl et al., 2012; States et al., 2013). The EPA did not estimate average halide levels in CRL, but some untreated CRL samples showed bromide to be present (U.S. Environmental Protection Agency, 2024c). Toxicology and epidemiology studies have documented evidence of genotoxic (including mutagenic), cytotoxic, and carcinogenic properties of DBPs, including brominated DBPs (National Toxicology Program, 2018; Richardson et al., 2007; U.S. Environmental Protection Agency, 2016). Studies have documented evidence of a linkage between DBP exposure and bladder cancer and, to a lesser degree, colon and rectal cancer, other cancers, and reproductive and developmental effects (Cantor et al., 2010; Cornwell et al., 2018; Regli et al., 2015; Richardson et al., 2007; U.S. Environmental Protection Agency, 2016; Villanueva et al., 2004; Chisholm et al., 2008; Villanueva et al., 2007; Villanueva et al., 2015).

Unmanaged CRL discharges have the potential to increase TDS levels in the receiving waters. However, other anthropogenic sources of TDS are widespread in the environment, making it more likely that receiving waters for the discharges of the evaluated wastestreams already carry augmented TDS loads. These other sources include mining activities, use of road salt for de-icing, and discharge of sewage and industrial wastewater (Cañedo-Argüelles et al., 2013; Corsi et al., 2010).

2.2 TSS

Total suspended solids impact aquatic life through a variety of mechanisms (Kjelland et al., 2015). Effects of exposure to high levels of suspended solids vary by species and life history strategies. Changes in TSS can change the behaviors and movement of aquatic life as well as lead to sublethal levels of stress.

Foraging efficiency can also be altered, further increasing physiological stress. Such stresses can impact reproduction and have community-level impacts as reproductive impacts accumulate. Changes in organisms that fulfill important ecosystem functions, such as key food sources, top predators, or habitat modifiers could lead to indirect impacts on other species as well. Specifically, elevated TSS can interfere with the life cycle of aquatic organisms at multiple trophic levels by increasing turbidity and thereby reducing light penetration in water and altering aquatic habitats. A reduction in light penetration can lead to a decrease in primary production, driven by photosynthetic microorganisms and aquatic plants, reducing the food supply for secondary producers that consume them (Chapman et al., 2017).

Additionally, increased suspended sediment can reduce the suitability of spawning habitat by smothering spawning sites (Kjelland et al., 2015) thereby hindering the development of fish eggs, larvae, and juveniles (Wood & Armitage, 1997). For adult fish, an abundance of suspended solids can trap heat and harm species adapted to lower temperatures (U.S. EPA, 2012). Salmonoid fish are particularly susceptible to lifecycle disruption from TSS, as a reduction in food from the lower trophic levels can harm their most sensitive life stages (Chapman et al., 2017).

Solids and suspended solids may also harbor pathogenic organisms and certain toxins can sorb to fine particulates in TSS (Mittal, 2004; U.S. EPA, 2012). Additionally, research has found positive correlations between increased turbidity in treated drinking water and gastrointestinal illness in some settings and across some turbidity ranges (Mann et al., 2007). If unmanaged CRL discharges interfere with water treatment and result in increased turbidity in treated water discharges, there may be adverse health effects.

Changes in sediment loads could affect dredging activities in reservoirs and navigational waterways. Reservoirs serve many functions, including storage of drinking and irrigation water supplies, flood control, hydropower supply, and recreation. Streams can carry sediment into reservoirs, where it can settle and cause buildup of sediment layers over time, reducing reservoir capacity (Graf et al., 2010) and the useful life of reservoirs unless measures such as dredging are taken to reclaim capacity (Hargrove et al., 2010; Miranda, 2017). Navigable channels are prone to reduced functionality due to sediment build-up, which can reduce the navigable depth and width of the waterway (Clark et al., 1985; Ribaudo & Johansson, 2006). For many navigable waters, periodic dredging is necessary to remove sediment and keep them passable. The EPA expects that changes in suspended solids discharges under the options could affect reservoir and navigational waterway maintenance by changing the frequency or volume of dredging activity.

2.3 Metals and Toxic Bioaccumulative Pollutants

Studies commonly cite metals and toxic bioaccumulative pollutants (*e.g.*, arsenic, mercury, and selenium) as the primary cause of ecological damage following exposure to steam electric power plant wastewater (U.S. EPA, 2015a). Metals and toxic bioaccumulative pollutants in steam electric power plant wastewater are present in both soluble (*i.e.*, dissolved) and particulate (*i.e.*, suspended) form. Environmental conditions influence the tendency of a dissolved pollutant to remain in solution or precipitate out of solution, sorb to either organic or inorganic suspended matter in the water column, or sorb to the mixture of materials found in sediments, such as clays and humic matter (U.S. EPA, 2007). Pollutants that precipitate out of solution can become concentrated in the sediments of a waterbody. Aquatic organisms bioaccumulate pollutants by consuming pollutant-enriched sediments and suspended particles, filtering ambient water containing dissolved pollutants, or both. In the case of unmanaged CRL that has undergone settling and leaching processes in impoundments and landfills and then transport through groundwater, the EPA expects metals and toxic bioaccumulative pollutants to be present primarily in dissolved form.

See the 2015 EA and Appendix A of the 2020 EA for a description of the adverse impacts of metals and toxic bioaccumulative pollutants on human health, wildlife, and aquatic organisms (U.S. EPA, 2015a, 2020).

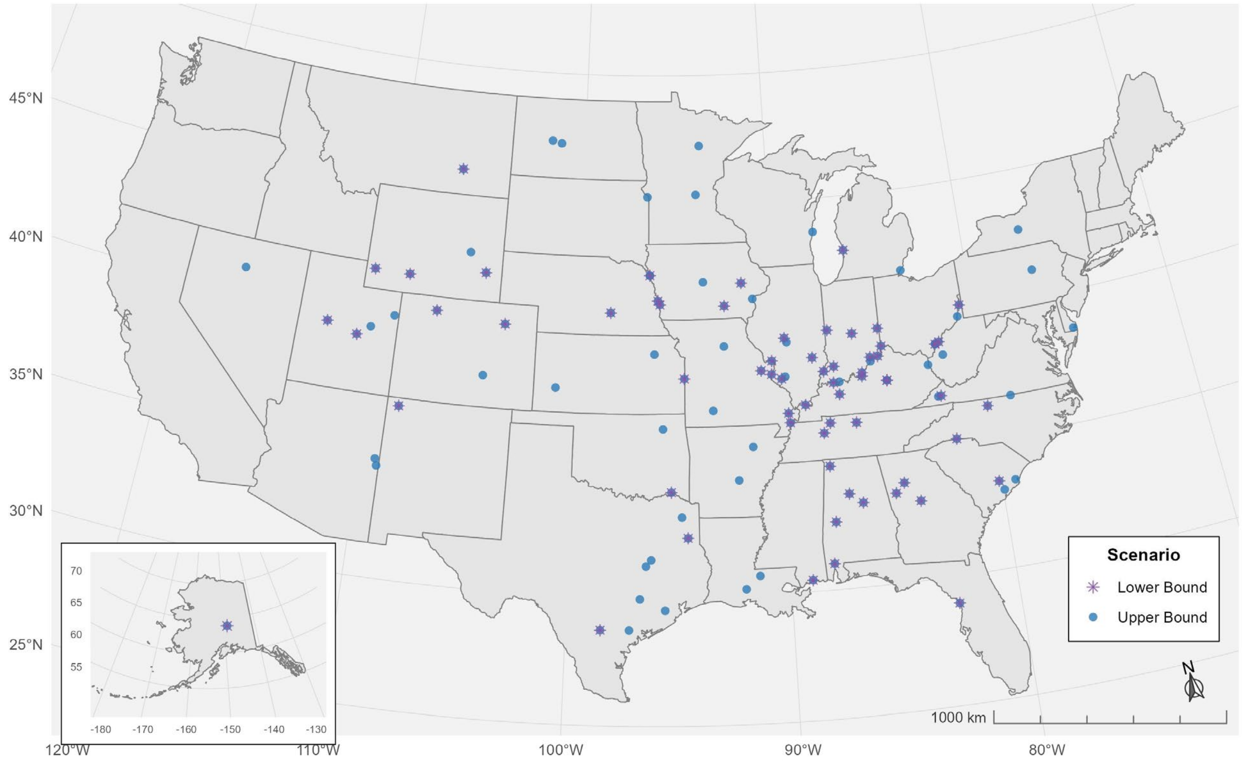
The EPA did not quantify baseline loadings of metal and toxic bioaccumulative pollutants or changes under the options, but expects similar directional changes under the three options as for TDS and TSS.

3 Impacts of Unmanaged CRL Discharges

The EPA evaluated the environmental effects of unmanaged CRL discharges from steam electric power plants subject to the ELGs. However, there is uncertainty about which plants may be required to meet effluent limits for unmanaged CRL as it will depend on case-by-case findings by future permitting authorities. To account for this uncertainty, the EPA developed lower and upper bound scenarios based on different sets of assumptions regarding which plants may implement different treatment technologies. The scenarios consider three main factors indicative of the potential for an unmanaged CRL discharge to be present, namely: the presence of landfills or surface impoundments that are not clean closed or composite lined, with a total estimated groundwater pumping rate greater than 0.5 gallons per minute (gpm), and undergoing corrective action for groundwater exceedances based on the site’s most recent groundwater monitoring reported in the CCR database.

The EPA determined that between 63 and 111 power plants may be discharging unmanaged CRL based on whether the plants’ waste management units are unlined, not clean-closed, or undergoing corrective action. The EPA does not expect that all these landfills and surface impoundments are discharging unmanaged CRL; permitting authorities would ultimately determine whether or not unmanaged CRL is discharged on a site-specific case-by-case basis. Figure 3-1 shows the distribution of the steam electric plants that may be discharging unmanaged CRL.

Figure 3-1: Distribution of Steam Electric Plants that may be Discharging Unmanaged CRL[3]



For the lower bound scenario, the EPA considered a population of 63 plants with CCR landfills or surface impoundments units without a composite liner that additionally report undergoing corrective action for groundwater exceedances based on the site's most recent groundwater monitoring reported in the CCR database. For the upper bound scenario, the EPA considered a population of 111 plants with landfills or surface impoundments that are not clean closed or composite lined, but did not limit the population to that where the waste management units have reported corrective action. The EPA identified seven plants, included in the populations for both scenarios, where pumping and treatment of groundwater was selected as the corrective remedy (Figure 3-2). The EPA sees this as indication that these plants currently generate a CRL discharge that "has leached from a waste management unit into the subsurface and mixed with groundwater prior to being captured and pumped to the surface for discharge directly to WOTUS."

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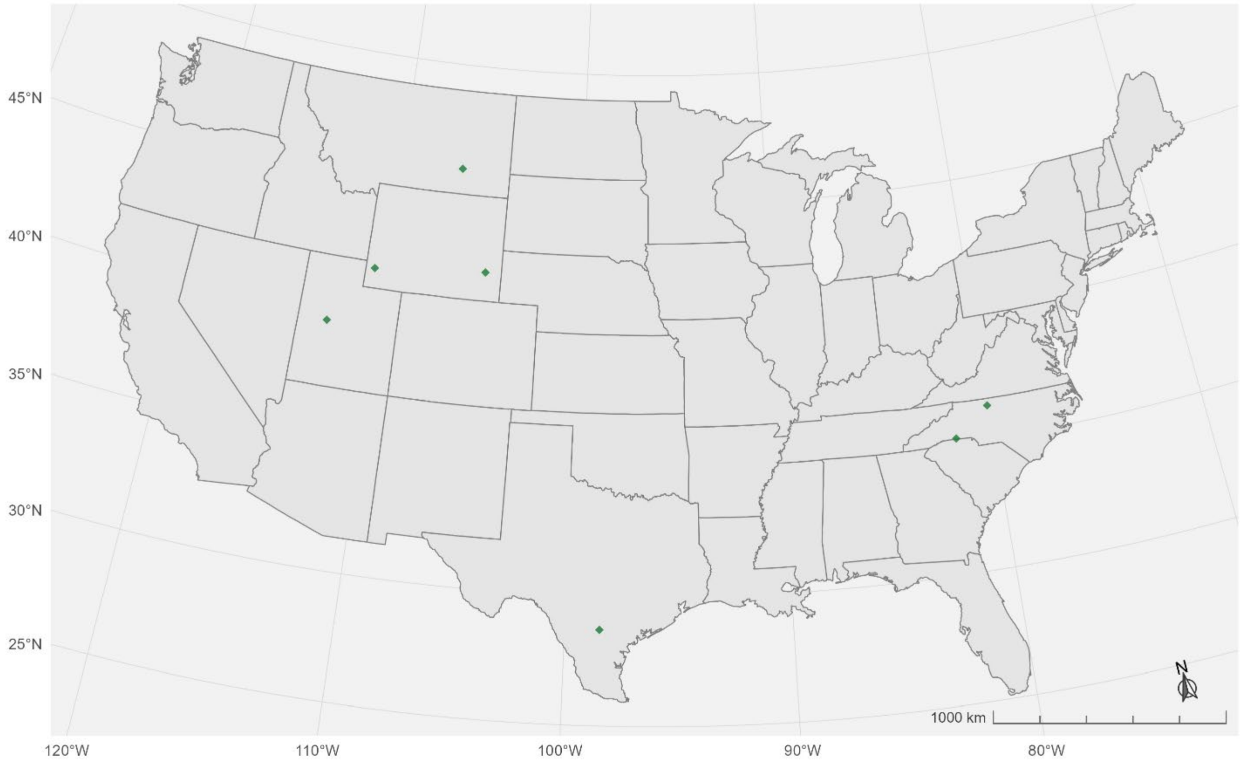
[3] The plants associated with the lower bound scenario are also included in the upper bound scenario (*i.e.*, the upper bound symbol indicates the 48 additional plants in the upper bound scenario).

Figure 3-2: Distribution of the Seven Steam Electric Plants where Pumping and Treatment of Groundwater was Selected as the Corrective Remedy



a. Type 1 = unmanaged CRL that the permitting authority determines is the functional equivalent of a direct discharge to WOTUS through groundwater; Type 2 = unmanaged CRL that has leached from a waste management unit into the subsurface and mixed with groundwater prior to being captured and pumped to the surface for discharge directly to WOTUS

b. BPJ = best professional judgment; CP = chemical precipitation; ZLD = zero liquid discharge

Source: U.S. EPA Analysis, 2026.

Table 3-1 summarizes the technology basis assigned to the plants under each cost scenario and option.

Table 3-1 Summary of Plant Universe and Technology Basis by Scenario, Option, and Discharger Type

Option	Discharge Type[a]	Lower Bound Scenario (63 Plants)	Lower Bound Scenario (63 Plants)	Upper Bound Scenario (111 Plants)	Upper Bound Scenario (111 Plants)
		Number of Plants	Technology Basis[b]	Number of Plants	Technology Basis[b]
1	Type 1	56	BPJ	104	BPJ
	Type 2	7	CP	7	CP
2	Type 1	56	CP	104	CP
	Type 2	7	CP	7	CP
3	Type 1	56	ZLD	104	ZLD
	Type 2	7	ZLD	7	ZLD

3.1 Unmanaged CRL Discharges Pollutant Loading Reductions

As discussed above, the EPA estimated loadings of TSS and TDS under the baseline and options. Table 3-2 summarizes the estimated pollutant loads under each of the three options and the lower and upper bound scenarios, and the incremental pollutant loads relative to the baseline. The incremental values are obtained by subtracting the baseline loadings (represented by Option 2) from the loadings resulting from each option and the corresponding lower or upper bound scenario. Negative incremental loadings (for Option 3) represent reductions in pollutant loads in unmanaged CRL discharges, whereas positive incremental loadings (for Option 1) denote increases. The environmental effects of these changes will depend on the receiving waters and resources downstream from the discharges. See the Engineering Memorandum for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category - Unmanaged Combustion Residual Leachate (Engineering memo) for details on how the loadings changes for each scenario were calculated (U.S. EPA, 2026b).

The loadings estimated under Option 1 reflect the proposed limits for the seven plants that the EPA identified as discharging unmanaged CRL that is mixed with groundwater before being captured and pumped to the surface before discharge directly to a WOTUS. The analysis does not account for additional pollutant loading reductions under Option 1 that may result from treatment required to meet limits established based on BPJ at plants with discharges of unmanaged CRL that the permitting authority determines to be the functional equivalent of a direct discharge to WOTUS. This is consistent with the economic analysis where the EPA did not attribute the costs or benefits of BPJ-required treatment to the proposed rule (see U.S. EPA, 2026a for details).

Table 3-2: Summary of Estimated Pollutant Loadings (TSS + TDS) under Options and Incremental Loadings Relative to the Baseline (Pounds per Year)

Option	Loadings	Loadings	Incremental Loadings	Incremental Loadings
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
1	597,000,000	1,220,000,000	12,900,000	29,800,000
2	584,000,000	1,190,000,000	0	0
3	0	0	-584,000,000	-1,190,000,000

Source: U.S. EPA Analysis, 2026.

3.2 Proximity Analyses

The EPA evaluated the environmental and human health impacts of the proposed limits for unmanaged CRL discharges by looking at the overlap between potentially impacted receiving waters and sensitive environments. Because of data limitations, the EPA did not explicitly model the downstream fate and transport of the pollutants or the effects of the considered options on these environments (*e.g.*, the degree of improvements to those waters).

To evaluate the sensitive environments potentially affected by the considered options, the EPA first identified the potential receiving waters for unmanaged CRL discharges.[4] The EPA represented potential receiving waters using National Hydrography Dataset (NHD) Plus Version 2 stream segments. Using the same dataset, the EPA also identified stream segments five miles[5] along the flowpath downstream from immediate receiving waters for the analysis of overlap with some sensitive environments. Table 3-3

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[4] There were 28 plants with an identified receiving water COMID from the 2024 rule. There were an additional 84 plants for which the EPA identified the receiving water based on proximity to the plant location. Of the 84 plants, one plant located outside of the conterminous US was not included in the proximity analyses due to gaps in the data representing the sensitive environments.

[5] Due to the varying lengths of stream segments in the NHD dataset, some downstream paths are shorter than five miles and some are longer than five miles. The EPA used best professional judgment in assigning a distance of five miles for the downstream flowpath.

summarizes the plants affected under each scenario and option and the associated identified immediate receiving waters. For Option 1, similar to the loading estimates discussed in the previous section, the analyses only consider the seven plants that the EPA identified as discharging unmanaged CRL that is mixed with groundwater before being captured and pumped to the surface before discharge directly to a WOTUS. The analyses do not account for the remaining plants that would be subject to limitations based on BPJ if they have discharges of unmanaged CRL that the permitting authority determine to be the functional equivalent of a direct discharge to WOTUS.

Table 3-3: Summary of Plant Universe and Associated Receiving Waters by Scenario, Option, and Discharger Type Used for the Proximity Analyses

Option	Discharge Type[a]	Lower Bound Scenario (63 Plants)[b]	Lower Bound Scenario (63 Plants)[b]	Upper Bound Scenario (110 Plants)[b]	Upper Bound Scenario (110 Plants)[b]
		Number of Plants	Number of Receiving Waters[c]	Number of Plants	Number of Unique Receiving Waters[c,d]
1	Type 2	7	7	7	7
2	Type 1	55	59	103	106
2	Type 2	7	7	7	7
3	Type 1	55	59	103	106
3	Type 2	7	7	7	7

[a] Type 1 = CRL discharge that the permitting authority determines to be the functional equivalent of a direct discharge to WOTUS through groundwater; Type 2 = CRL discharge that has leached from a waste management unit into the subsurface and mixed with groundwater prior to being captured and pumped to the surface for discharge directly to WOTUS

[b] One plant (EIA Plant ID 6288) located outside of the conterminous US was not included in the proximity analyses due to gaps in the data representing the sensitive environments.

[c] Three Type 1 plants included in both scenarios discharge to more than one immediate receiving water.

[d] Two Type 1 plants included in the upper bound scenario discharge to the same immediate receiving water.

Source: U.S. EPA Analysis, 2026.

The EPA then used this geospatial dataset representing affected stream segments to identify the number of surface waters that may receive unmanaged CRL discharges and are located near the following sensitive environments:

Immediate receiving waters for which states, territories, and authorized tribes have identified, pursuant to section 303(d) of the Clean Water Act (CWA), as no longer meeting the fish consumption designated use due to pollutant concentrations above water quality standards.

Immediate receiving waters and a five-mile downstream path that intersects with drinking water resources, including intakes, public wells, and sole-source aquifers.

Immediate receiving waters that intersect with the current range and habitat of threatened and endangered (T&E) species.

Table 3-4 summarizes the data sources used for analyses in the following sections.

Table 3-4: Data Sources for Evaluating the Potential Effects on Sensitive Environments

Analysis	Data Name	Summary	Data Source (Data Vintage)
Fishable Waters	Assessment, Total Maximum Daily Load Tracking and Implementation System (ATTAINS) Database	Information on the attainment of designated uses for waters assessed through the 303(d) and 305(b) process.	EPA (2026)
Drinking Water Impacts	National Public Water System Location and Attribute Dataset	Locations of surface water intakes and public wells	EPA (2023)
Drinking Water Impacts	Sole-Source Aquifers	Boundaries for aquifers that supply at least 50 percent of drinking water consumed in the area overlying the aquifer	EPA (2025)
Endangered Species Habitat and Protected Areas	Environmental Conservation Online System (ECOS) Threatened & Endangered Species Active Critical Habitat	Critical habitat locations for threatened and endangered species.	USFWS (2025)
Endangered Species Habitat and Protected Areas	NOAA Threatened and Endangered Species Critical Habitat	Critical habitat locations for threatened and endangered species.	NOAA (2025)
Endangered Species Habitat and Protected Areas	ECOS Threatened and Endangered Species Current Range	Current range locations for threatened and endangered species.	USFWS (2015)

Source: U.S. EPA Analysis, 2026

For each of the proximity analyses, the EPA identified the number of plants and/or waters that receive or would be affected by unmanaged CRL discharges treated to the limits applicable under the baseline and considered options. In other words, the analysis indicates the number of waters or environments that may see improvements under each option.[6] Differences in the number of reaches or sensitive environments between the baseline and the options indicates the direction of potential environmental changes.

3.2.1 Impacts to Fishable Waters

The EPA performed a proximity analysis to identify immediate receiving waters for which states, territories, and authorized tribes have identified, pursuant to section 303(d) of the CWA, as no longer meeting the fish consumption designated use due to pollutant concentrations above water quality standards. The EPA used the ATTAINS database to identify receiving waters that have a fish consumption designated use, but do not support this use.

Table 3-5 summarizes the number and percentage of receiving waters identified as not supporting a fish consumption designated use. Overall, the EPA estimated that about 10 percent of the immediate receiving waters analyzed under the baseline and Options 2 and 3 are unable to support their fish consumption designated use. Five of these receiving waters (associated with five different plants) were unable to support the fish consumption designated use because of exceedances of water quality criteria associated with mercury, a pollutant commonly found in unmanaged CRL discharges. Under Option 3, the pollutant loading reductions could help with attainment of the fish consumption designated use for these reaches, especially as it impacts reductions in mercury concentrations. However, it is uncertain whether these pollutant loading reductions would ultimately change the attainment status of the reaches given other contributors to mercury

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[6] As discussed at the beginning of this section, the analysis does not account for additional pollutant loading reductions under Option 1 that may result from treatment required to meet limits established based on BPJ at plants with discharges of unmanaged CRL that the permitting authority determines to be the functional equivalent of a direct discharge to WOTUS.

levels. The impact of the other considered options on fish consumption use attainment is uncertain. Changes in unmanaged CRL discharges from the considered options could affect existing issues of criteria attainment as well as cause future issues with criteria attainment.

Table 3-5: Number and Percentage of Immediate Receiving Waters Identified as Not Supporting a Fish Consumption Designated Use Under Each Evaluated Scenario

Scenario	Option	Number of Receiving Waters (Difference Relative to Baseline)	Percentage of Receiving Waters
Lower Bound	Baseline	6	9%
	1	0 (-6)	0%
	2	6 (0)	9%
	3	6 (0)	9%
Upper Bound	Baseline	9	8%
	1	0 (-9)	0%
	2	9 (0)	8%
	3	9 (0)	8%

Source: U.S. EPA Analysis, 2026

3.2.2 Impacts to Surface Water and Groundwater Drinking Water Sources

The EPA performed a proximity analysis to identify plants whose discharges (including a five-mile downstream path[7]) of unmanaged CRL under the baseline and/or one or more considered options intersect with the following drinking water resources:

- Drinking water intakes: drinking water sources that collect surface water through a public water system. Intakes are protected under the Safe Drinking Water Act (SDWA) of 1974 and its 1986 and 1996 amendments, which require delegated states and tribes to perform routine testing to ensure that they meet state drinking water standards.
- Public Wells: drinking water sources that collect groundwater through a public water system. Public wells are protected under the SDWA, which requires states, territories, and authorized tribes to perform routine testing to ensure that they meet state drinking water standards.
- Sole-Source Aquifers: drinking water sources that supply at least 50 percent of drinking water consumed in the area overlying the aquifer. These areas may have no reasonably available drinking water source(s) if the aquifer were to become contaminated.

Table 3-6 summarizes the number of plants and associated receiving waters or five-mile downstream path that intersect with intake(s), public well(s), and/or sole-source aquifer(s). The EPA found that the receiving waters and downstream flowpath for the full universe of plants intersects with three sole-source aquifers: the Chicot Aquifer System SSA, Southern Hills Regional Aquifer System SSA, and Greater Miami Buried Aquifer & OKI Extension (Southern Portion) SSA.

Steam electric power plants may pose a threat to public and private sources of drinking water. Although many of the pollutants expected to be present in unmanaged CRL discharge (*e.g.*, metals, selenium) would likely be reduced to safe levels during drinking water treatment, these pollutants could potentially impact the effectiveness or costs of treatment. Additionally, halides, such as bromide and iodide, are not typically removed during drinking water treatment and can contribute to disinfection by-product formation when drinking water plants use chlorination or ozonation to disinfect source water.

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[7] The EPA used best professional judgment in assigning a distance of five miles for the downstream flowpath.

Table 3-6: Number of Plants and Associated Receiving and Downstream Waters that Intersect with a Drinking Water Resource

Type of Drinking Water Resource	Scenario	Option	Number of Plants (Difference Relative to Baseline)	Number of Receiving and Downstream Waters (Difference Relative to Baseline)
Surface water intakes	Lower Bound	Baseline	4	9
		1	0 (-4)	0 (-9)
		2	4 (0)	9 (0)
		3	4 (0)	9 (0)
Surface water intakes	Upper Bound	Baseline	8	14
		1	0 (-8)	0 (-14)
		2	8 (0)	14 (0)
		3	8 (0)	14 (0)
Public wells	Lower Bound	Baseline	1	1
		1	0 (-1)	0 (-1)
		2	1 (0)	1 (0)
		3	1 (0)	1 (0)
Public wells	Upper Bound	Baseline	1	1
		1	0 (-1)	0 (-1)
		2	1 (0)	1 (0)
		3	1 (0)	1 (0)
Sole-source aquifers	Lower Bound	Baseline	1	3
		1	0 (-1)	0 (-3)
		2	1 (0)	3 (0)
		3	1 (0)	3 (0)
Sole-source aquifers	Upper Bound	Baseline	3	13
		1	0 (-3)	0 (-13)
		2	3 (0)	13 (0)
		3	3 (0)	13 (0)

Source: U.S. EPA Analysis, 2026

3.2.3 Impacts to Endangered Species Habitat and Protected Areas

For threatened and endangered species (T&E species), even minor changes to reproductive rates and mortality may represent a substantial portion of annual population growth. Water pollution can also affect T&E species indirectly by damaging food webs and decreasing ecosystem function and stability. The considered options have the potential to affect the survivability of some T&E species living in these habitats. Due to the variation in life history and function of T&E species, changes in pollutant exposure are difficult to translate to recovery success. However, improvements in water quality through reduced pollutant discharges have the potential to assist in recovery efforts by mitigating the impacts of pollutants on T&E species.

To assess the potential impacts of the considered options on T&E species, the EPA first compiled data on all habitat ranges available for all species currently listed under the Endangered Species Act (ESA) (ESA, 16 U.S.C. 1531-1544). Due to limitations on the available data and models necessary to quantitatively estimate population changes from the options, the EPA identified and quantified the T&E species whose habitat, and therefore wellbeing, may be impacted by the options. To do so, the EPA obtained the geographical distribution of T&E species ranges from Environmental Conservation Online System Threatened & Endangered Species Active Critical Habitat Report.[8] This database includes only species protected under the ESA. Additional species may be considered threatened or endangered by scientific organizations, but are not protected by the ESA (*e.g.,* the American Fisheries Society). Furthermore, the

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[8] https://ecos.fws.gov/ecp/report/table/critical-habitat.html

database only includes animal species and does not include plants. The EPA constructed a screening database using the spatial data on species habitat ranges and receiving waters for unmanaged CRL discharges and identified a total of 122 T&E species with potentially impacted ranges.

The EPA then classified these species according to their potential vulnerability to water pollution based on a review of the species' life history data and food sources. For this analysis, species were classified as follows:

- Higher vulnerability – species living in aquatic habitats for several life history stages and/or species that obtain a majority of their food from aquatic sources.
- Moderate vulnerability – species living in aquatic habitats for one life history stage and/or species that obtain some of their food from aquatic sources.
- Lower vulnerability – species whose habitats overlap bodies of water, but whose life history traits and food sources are terrestrial.

Other ecological mechanisms, additional threats to T&E species, and population parameters of the species themselves are not factored into the evaluation of species vulnerability.

Of the 122 total species included in this analysis, around half (60) have a higher vulnerability to water quality impacts. Bivalves (40) and fishes (10) accounted for over 80 percent of higher vulnerability species potentially affected by the considered options and were preeminent taxa at risk from degraded habitat quality due to their fully aquatic nature and their decreased ability to emigrate to less disturbed habitat relative to other taxa, such as birds or terrestrial mammals.

The high vulnerability species are most likely to be affected by water quality changes associated with the considered options as they live in aquatic habitats for several life stages or obtain a majority of their food from aquatic sources. For this reason, the EPA focused on these species for a more detailed presentation. Table 3-7 provides a summary of the number of receiving waters that intersect with the current range of higher-vulnerability species. The Agency notes that while the more detailed presentation focuses on the subset of high-vulnerability species, water pollution may also be a factor in the decline and recovery of species with moderate or lower vulnerability.

Table 3-7: Number and Percentage of Immediate Receiving Waters Intersecting with Higher Vulnerability T&E Species Critical Habitat and Current Range Under Each Evaluated Scenario

Scenario	Option	Number of Receiving Waters (Difference Relative to Baseline)	Percentage of Receiving Waters
Lower Bound	Baseline	37	56%
	1	3 (-34)	43%
	2	37 (0)	56%
	3	37 (0)	56%
Upper Bound	Baseline	58	51%
	1	3 (-55)	43%
	2	58 (0)	51%
	3	58 (0)	51%

Source: U.S. EPA Analysis, 2026

3.2.4 Limitations and Uncertainty

The methodologies and data used in the proximity analyses involve limitations and uncertainties. Table 3-8 summarizes the limitations and uncertainties and indicates the direction of the potential bias.

Table 3-8: Limitations and Uncertainties of the Proximity Analyses

Uncertainty/Limitation	Analysis Effect	Notes
Plants with unmanaged CRL discharges subject to the ELGs	Uncertain	The EPA cannot prospectively determine how many or which instances of CRL discharged through groundwater would ultimately be found to require CWA permits. To be a covered discharge, there must be a discharge (or functionally equivalent discharge) of pollutants from a point source into WOTUS. The EPA used bounding scenarios to identify the steam electric plants that may be subject to the ELGs. The bounding scenarios consider factors indicative of the potential for an unmanaged CRL discharge to be present. Based on these factors, the EPA determined that between 63 and 111 power plants may be discharging unmanaged CRL, but permitting authorities would ultimately determine whether unmanaged CRL is discharged on a site-specific case-by-case basis. The number of steam electric plants with unmanaged CRL discharges may ultimately be less than estimated in this analysis.
Controls permitting authorities will determine as appropriate for certain unmanaged CRL discharges under Option 1 based on site-specific conditions	Uncertain	The EPA attributed no loading reductions for limits based on BPJ, implicitly assuming that BPJ would require no treatment of unmanaged CRL before discharge. This is one end of the range of possibilities. Instead, permit writers may consider site-specific factors to set limits similar to those achievable with chemical precipitation or even require zero liquid discharge for unmanaged CRL.
Receiving waters for unmanaged CRL discharges assumed to be those most proximal to the plant location	Uncertain	In some cases, the associated impoundment or landfill for the plant that is the source of the unmanaged CRL discharge could be located away from the plant and affect different receiving waters.
Definition of T&E species vulnerability	Uncertain	Threatened and endangered species vulnerability was based on aquatic life stages or aquatic food utilization. Other ecological mechanisms, additional threats to T&E species, and population parameters of these species themselves are not factored into the evaluation of species vulnerability.
Change in T&E species populations in response to the considered options	Uncertain	Data and models necessary to quantitatively estimate population changes are unavailable. Therefore, the EPA used the methodology described in Section 3.2.3 as a screening-level analysis to estimate whether the options could contribute to a change in the habitat and recovery of T&E species populations.
Only those T&E species listed as threatened or endangered under the ESA are included in the analysis	Underestimate	The databases used to conduct this analysis include only species protected under the ESA. Additional species may be considered threatened or endangered by scientific organizations, but are not protected by the ESA (*e.g.,* the American Fisheries Society).
Lack of reliable designated critical habitat spatial data for some species.	Underestimate	All species listed as threatened or endangered through the ESA are required to have critical habitat defined where determinations can be made, based on criteria set forth by USFWS and NMFS. However, not all species have reliable data and as such may not be detected in critical habitat analysis. This is offset through the use of both current range and critical habitat datasets in the evaluation of potentially affected sensitive environments.

Source: U.S. EPA Analysis, 2026

4 References

Cañedo-Argüelles, M., Kefford, B. J., Piscart, C., Prat, N., Schäfer, R. B., & Schulz, C.-J. (2013). Salinisation of rivers: An urgent ecological issue. *Environmental Pollution*, *173*, 157-167. https://doi.org/https://doi.org/10.1016/j.envpol.2012.10.011

Cantor, K. P., Villanueva, C. M., Silverman, D. T., Figueroa, J. D., Real, F. X., Garcia-Closas, M., Malats, N., Chanock, S., Yeager, M., & Tardon, A. (2010). Polymorphisms in GSTT1, GSTZ1, and

CYP2E1, disinfection by-products, and risk of bladder cancer in Spain. *Environmental Health Perspectives*, *118*(11), 1545-1550.

Chapman, P. M., Hayward, A., & Faithful, J. (2017). Total Suspended Solids Effects on Freshwater Lake Biota Other than Fish. *Bulletin of Environmental Contamination and Toxicology*, *99*(4), 423-427. https://doi.org/10.1007/s00128-017-2154-y

Chisholm, K., Cook, A., Bower, C., & Weinstein, P. (2008). Risk of birth defects in Australian communities with high levels of brominated disinfection by-products. *Environmental Health Perspectives*, *116*(9), 1267-1273.

Clark, E. H., Haverkamp, J. A., & Chapman, W. (1985). *Eroding soils. The off-farm impacts*. Conservation Foundation.

Cornwell, D. A., Sidhu, B. K., Brown, R., & McTigue, N. E. (2018). Modeling bromide river transport and bromide impacts on disinfection byproducts. *Journal-American Water Works Association*, *110*(11), E1-E23.

Corsi, S. R., Graczyk, D. J., Geis, S. W., Booth, N. L., & Richards, K. D. (2010). A Fresh Look at Road Salt: Aquatic Toxicity and Water-Quality Impacts on Local, Regional, and National Scales. *Environmental Science & Technology*, *44*(19), 7376-7382. https://doi.org/10.1021/es101333u Eastern Research Group. (2019). *Final Notes from Site Visit to Harris Treatment Plant*.

Good, K. D., & VanBriesen, J. M. (2016). Current and potential future bromide loads from coal-fired power plants in the Allegheny River basin and their effects on downstream concentrations. *Environmental Science & Technology*, *50*(17), 9078-9088.

Good, K. D., & VanBriesen, J. M. (2017). Power plant bromide discharges and downstream drinking water systems in Pennsylvania. *Environmental Science & Technology*, *51*(20), 11829-11838.

Graf, W. L., Wohl, E., Sinha, T., & Sabo, J. L. (2010). Sedimentation and sustainability of western American reservoirs. *Water Resources Research*, *46*(12).

Hamilton, R. W., Butter, J. K., & Brunette, R. G. (1975). Lethal levels of sodium chloride and potassium chloride for an oligochaete, chironomid, and a caddisfly of Lake Michigan. *Environmental Entomology*, *4*, 1003-1006.

Hargrove, W. L., Johnson, D., Snethen, D., & Middendorf, J. (2010). From dust bowl to mud bowl: sedimentation, conservation measures, and the future of reservoirs. *Journal of Soil and Water Conservation*, *65*(1), 14A-17A. https://doi.org/10.2489/jswc.65.1.14A

Hoke, R. A., Gala, W. R., Drake, J. B., Geisy, J. P., & Fleger, S. (1992). Bicarbonate as a potential confounding factor in cladoceran toxicity assessments of pore water from contaminated sediments. *Canadian Journal of Fisheries and Aquatic Sciences*, *49*, 1633-1640.

Khangarot, B. S. (1991). Toxicity of metals to a tubificid worm, *Tubifex tubifex* (Muller). *Bulletin of Environmental Contamination and Toxicology*, *46*, 906-912.

Kjelland, M. E., Woodley, C. M., Swannack, T. M., & Smith, D. L. (2015). A review of the potential effects of suspended sediment on fishes: potential dredging-related physiological, behavioral, and transgenerational implications. *Environment Systems and Decisions*, *35*(3), 334-350. https://doi.org/10.1007/s10669-015-9557-2

Mann, A. G., Tam, C. C., Higgins, C. D., & Rodrigues, L. C. (2007). The association between drinking water turbidity and gastrointestinal illness: a systematic review. *BMC Public Health*, *7*(1), 256. https://doi.org/10.1186/1471-2458-7-256

McTigue, N. E., Cornwell, D. A., Graf, K., & Brown, R. (2014). Occurrence and consequences of increased bromide in drinking water sources. *Journal-American Water Works Association*, *106*(11), E492-E508. https://doi.org/http://dx.doi.org/10.5942/jawwa.2014.106.0141

Miranda, L. E. (2017). Section 3: Sedimentation. In *Reservoir fish habitat management* (pp. 35-60). Lightning Press.

Mittal, G. S. (2004). Characterization of the Effluent Wastewater from Abattoirs for Land Application. *Food Reviews International*, *20*(3), 229-256. https://doi.org/10.1081/FRI-200029422

Mount, D. R., Gulley, D. D., Hockett, J. R., Garrison, T. D., & Evans, J. M. (1997). Statistical models to predict the toxicity of major ions to *Ceriodaphnia dubia, Daphnia magna* and *Pimephales promelas* (fathead minnows). *Environmental Toxicology and Chemistry*, *16*(10), 2009-2019.

National Toxicology Program. (2018). *Report on Carcinogens: Monograph on Haloacetic Acids Found as Water Disinfection By-Products*. Research Triangle Park, NC.

Regli, S., Chen, J., Messner, M., Elovitz, M. S., Letkiewicz, F. J., Pegram, R. A., Pepping, T. J., Richardson, S. D., & Wright, J. M. (2015). Estimating potential increased bladder cancer risk due to increased bromide concentrations in sources of disinfected drinking waters. *Environmental Science & Technology*, *49*(22), 13094-13102.

Ribaudo, M., & Johansson, R. (2006). Chapter 2.2 Water Quality: Impacts of Agriculture. In K. W. a. N. Gollehon (Ed.), *Agricultural Resources and Environmental Indicators, 2006 Edition*.

Richardson, S. D., Plewa, M. J., Wagner, E. D., Schoeny, R., & DeMarini, D. M. (2007). Occurrence, genotoxicity, and carcinogenicity of regulated and emerging disinfection by-products in drinking water: a review and roadmap for research. *Mutation Research/Reviews in Mutation Research*, *636*(1-3), 178-242.

Ruhl, L., Vengosh, A., Dwyer, G. S., Hsu-Kim, H., Schwartz, G., Romanski, A., & Smith, S. D. (2012). The impact of coal combustion residue effluent on water resources: a North Carolina example. *Environmental Science & Technology*, *46*(21), 12226-12233.

Scannell, P. W., & Jacobs, L. L. (2001). *Effects of Total Dissolved Solids on Aquatic Organisms: A Literature Review*. (Technical Report No. 01-06). Alaska Department of Fish and Game, Division of Habitat and Restoration

States, S., Cyprych, G., Stoner, M., Wydra, F., Kuchta, J., Monnell, J., & Casson, L. (2013). Marcellus Shale drilling and brominated THMs in Pittsburgh, Pa., drinking water. *Journal AWWA*, *105*(8), E432-E448. https://doi.org/10.5942/jawwa.2013.105.0093

Tietge, J. E., & Hockett, J. R. (1997). Major ion toxicity of six produced waters to three freshwater species: Application of ion toxicity models and TIE procedures. *Environmental Toxicology and Chemistry*, *16*(10), 2002-2008.

U.S Environmental Protection Agency. (2007). *Framework for Metals Risk Assessment*. (EPA 120/R-07/001). Washington, DC

U.S. Environmental Protection Agency. (2012). *5.8 Total Solids*. https://archive.epa.gov/water/archive/web/html/vms58.html

U.S. Environmental Protection Agency. (2015a). *Environmental Assessment for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*. (EPA 821-R-15-006).

U.S. Environmental Protection Agency. (2015b). *Technical Development Document for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*. (EPA-821-R-15-007).

U.S. Environmental Protection Agency. (2016). *Six-Year Review 3 Technical Support Document for Disinfectants/Disinfection Byproducts Rules*. (EPA-810-R-16-012). Retrieved from https://www.epa.gov/sites/production/files/2016-12/documents/810r16012.pdf

U.S. Environmental Protection Agency. (2020). *Supplemental Environmental Assessment for Revisions to the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*.

U.S. Environmental Protection Agency. (2023). *Secondary Drinking Water Standards: Guidance for Nuisance Chemicals*. https://www.epa.gov/sdwa/secondary-drinking-water-standards-guidance-nuisance-chemicals

U.S. Environmental Protection Agency. (2024a). *Environmental Assessment for Supplemental Effluent Guidelines and Standards for the Steam Electric Power Generating Point Source Category*. (821-R-24-005).

U.S. Environmental Protection Agency. (2024b). *Memorandum: 2024 Final Rule - Combustion Residual Leachate Analytical Data Evaluation – DCN SE11715*.

U.S. Environmental Protection Agency. (2024c). *Memorandum: Evaluation of Unmanaged CRL (DCN SE11501)*.

U.S. Environmental Protection Agency. (2024d). *Technical Development Document for Supplemental Revisions to the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*. (821-R-24-004).

U.S. Environmental Protection Agency. (2026a). *Economic Analysis Memorandum for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category - Unmanaged Combustion Residual Leachate (DCN SE12127)*.

U.S. Environmental Protection Agency. (2026b). *Engineering Memorandum for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category - Unmanaged Combustion Residual Leachate (DCN SE12105)*.

Villanueva, C. M., Cantor, K. P., Cordier, S., Jaakkola, J. J. K., King, W. D., Lynch, C. F., Porru, S., & Kogevinas, M. (2004). Disinfection byproducts and bladder cancer: a pooled analysis.

Epidemiology, 357-367.

Villanueva, C. M., Cantor, K. P., Grimalt, J. O., Malats, N., Silverman, D., Tardon, A., Garcia-Closas, R., Serra, C., Carrato, A., Castaño-Vinyals, G., Marcos, R., Rothman, N., Real, F. X., Dosemeci, M., &

Kogevinas, M. (2007). Bladder cancer and exposure to water disinfection byproducts through ingestion, bathing, showering, and swimming in pools. *American Journal of Epidemiology*, *165*(2), 148-156.

Villanueva, C. M., Cordier, S., Font-Ribera, L., Salas, L. A., & Levallois, P. (2015). Overview of disinfection by-products and associated health effects. *Current Environmental Health Reports*, *2*(1), 107-115.

Weber-Scannell, P. K., & Duffy, L. K. (2007). Effects of Total Dissolved Solids on Aquatic Organisms: A Review of Literature and Recommendation for Salmonid Species. *American Journal of Environmental Sciences*, *3*(1). https://doi.org/10.3844/ajessp.2007.1.6

Wood, P. J., & Armitage, P. D. (1997). Biological Effects of Fine Sediment in the Lotic Environment.

Environ Manage, *21*(2), 203-217. https://doi.org/10.1007/s002679900019