Calculations

Calculations to Baseline Water Quality and Determine Significance of Degradation (See 2020 Water Quality Management Plan / Continuous Planning Process Appendix A Sections 4 and 5).

Determine Critical Low Flow / Mixing Zones (See 20.6.4.11 NMAC (Applicability of Water Quality Standards):

Streams:

Human Health-Organism Only Criteria = Harmonic Mean (HM) or Modified (See 20.6.4.7 (H)(2) & 20.6.4.11(B)(1) NMAC)

All Other Narrative and Numeric Criteria = 4Q3 (See 20.6.4.7 (A)(1) & 20.6.4.11(B)(2) NMAC)

4Q3 Notes: Minimum average four consecutive day flow that occurs with a frequency of once in three years and may be determined on an annual, a seasonal or a monthly basis, as appropriate, after due consideration of site-specific conditions.

Lakes, Reservoirs, Playas:

See 20.6.4.11(E)(1) NMAC Mixing Zone Limitations / Criteria applicable "at point of discharge"

See 20.6.4.11(E)(1) NMAC Mixing Zone Limitations / Criteria applicable "at point of discharge"

Lake Notes: Antideg Procedures" omit Mixing Zone Limitations in 20.6.4.11 NMAC (Applicability of Water Quality Standards) and "Critical lake and reservoir water levels will be determined on a case-by-case basis."

Determine Reasonably Expected Concentration Effluent (Ce):

Reasonably Expected Pollutants: Determined by NPDES application, Safety Data Sheets, Manufacture's labels, intake or source waters, best professional judgement, or other sources

Ce Calculation Notes: See calculation notes for Cbwq

Determine Baseline Water Quality (BWQ):

Baseline Water Quality Concentration = Cbwq = Cs = Ca (concentration surface water quality above discharge)

Cbwq Calculation Notes: Minimum Detection Limit = MDL (See 2020 WQMP/CPP Appendix A Glossary and USEPA 40 CFR 136 Appendix B)

Minimum Level (ML) = Reported Level (RL) or Quantitation Level (See USEPA Sufficiently Sensitive Method Rule)

If pollutant "not detected" or "less than" MDL and MDL < or = Cwqs; then use Geometric Mean of MDL

If at least one data point detected (i.e., = or > MDL meaning estimated data may be used), then use MDL/2 for "less than"

If data not provided / not retested at MDL that is lower or < Cwqs, then Cbwq = MDL/2

If data not reported to MDL, then may substitute reported or quantitation minimum level (ML)

If higher ML or 1/2 ML (using same instructions for MDL) results in no or allowable degradation, then use of MDL or 1/2 MDL will also result in no or allowable degradation.

Evaluate Level of Degradation (Surface Water + Discharge):

Mass Balance Equation: $= (Qs \times Cs) + (Qd \times Cd) = (Qr \times Cr)$

Solve for Cd $= [(Qr \times Cr) - (Qs \times Cs)] / (Qd)$

Qr $= (Qs + Qd)$

Cd $= [((Qs + Qd) \times (Cr)) - (Qs \times Cs)] / (Qd)$

Where (Streams):

$=$ Flow x Concentration + Flow x Concentration = Flow x Concentration

Qs = critical low flow stream (4Q3 or HM)

Qd = flow discharge (cfs or MGD)

Qr = flow resulting in-stream or downstream of outfall (cfs or MGD)

Cs = concentration stream (mg/L)

Cd = concentration discharge (mg/L)

Cr = concentration resultant (in-stream) (mg/L)

Where (Lakes, Reservoirs, Playas - Antidegradation Procedure Only, Simplified Model):

$=$ Volume x Concentration + Volume x Concentration = Volume x Concentration

Qs = volume critical lake water level case by case (acre-feet or million gallons US)

Qd = discharge flow rate cfs or MGD or volume (acre-feet or million gallons US)

Qr = volume surface water resulting (assumes mixing) (acre-feet or million gallons US)

Cs = concentration surface water (mg/L)

Cd = concentration discharge (mg/L)

Cr = concentration resultant (assumes mixing) (mg/L)

"Antideg Procedures" omit an intake water credit when reasonably expected pollutants in the discharge are caused or contributed by source water which is also receiving surface water.

Concentration Water Quality Standard = Cwqs (limiting segment or use-specific numeric criteria (mg/L or as indicated))

Assimilative Capacity = AC = Cwqs-Cbwq (mg/L)

Notes: If AC negative (-), then water may not be high-quality. Tier 2 review not applicable and/or Tier 2 review not applicable at this time.

If AC negative (-), then evaluate need for additional testing or condition that Ce = Cwqs at point of discharge, outfall or end of pipe.

For example, may re-test to lower MDL (if available) if pollutant reasonably expected in discharge

Calculated Concentration Resultant ($Cr_{10\%}$) $= [(Cwqs - Cbwq) \times 0.1 + Cbwq]$

Calculated concentration discharge that uses 10% AC ($Cd_{10\%}$) $= \{[((Cwqs - Cbwq) \times 0.1 + Cbwq) \times (Qs + Qd)] - (Cs \times Qs)\} / [Qd]$

Cs $=$ Cbwq

Calculated concentration discharge that uses 10% AC ($Cd_{10\%}$) $= \{[((Cwqs - Cbwq) \times 0.1 + Cbwq) \times (Qs + Qd)] - (Cbwq \times Qs)\} / [Qd]$

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50% cumulative cap = Not applicable for only one (1) regulated discharge
= Only applicable for multiple regulated discharges to the same receiving water over time

Comparison (comprehensive Tier 2 antidegradation review includes an alternatives analysis and social and economic demonstration - See 2020 WQMP/CPP Appendix A Sections 6 & 7):

"no significant degradation" = If $Cd_{10\%} > Ce$, then antidegradation review process is complete and the permitting process may proceed

"comprehensive Tier 2 review required" = If $Cd_{10\%} <$ or = Ce or Ce > 50% cumulative cap, then "comprehensive Tier 2 review required"

Loading Calculations Notes: Calculated maximum loading capacity (with increased 10% assimilative capacity) would be flagged if further comprehensive review required.

References:

State of New Mexico Water Quality Management Plan / Continuing Planning Process Appendix A
Antidegradation Policy Implementation Procedure for Regulated Activities Revision October 23, 2020
https://www.env.nm.gov/surface-water-quality/wqs/

State of New Mexico Water Quality Standards (NMWQS) effective April 23, 2022 for state purposes
https://www.env.nm.gov/surface-water-quality/wqmp-cpp/

2022-2024 Integrated Report Clean Water Act 303(d)/305(b) Integrated Report EPA-Approved April 26, 2022
https://www.env.nm.gov/surface-water-quality/303d-305b/

Additional Information:

20.6.4.900(J)(1) Use-specific criteria (effective 04/23/22)
(2) Notes applicable to the table of numeric criteria in Paragraph (1) of this subsection.
(a) Where the letter "a" is indicated in a cell, the criterion is hardness-based and can be referenced in Subsection I of 20.6.4.900 NMAC.
(b) Where the letter "b" is indicated in a cell, the criterion can be referenced in Subsection C of 20.6.4.900 NMAC.
(c) Criteria are in µg/L unless otherwise indicated.
(d) Abbreviations are as follows: CAS - chemical abstracts service (see definition for "CAS number" in 20.6.4.7 NMAC);
 DWS - domestic water supply; Irr/Irr storage- irrigation and irrigation storage; LW - livestock watering;
WH - wildlife habitat; HH-OO - human health-organism only; C – criteria based on cancer-causing endpoint; P - persistent toxic pollutant.
(e) The criteria are based on analysis of an unfiltered sample unless otherwise indicated. The
acute and chronic aquatic life criteria for aluminum are based on analysis of total recoverable aluminum in a sample that is filtered to
minimize mineral phases as specified by the department.
(f) The criteria listed under human health-organism only (HH-OO) are intended to protect human
health when aquatic organisms are consumed from waters containing pollutants. These criteria do not protect the aquatic life itself;
rather, they protect the health of humans who ingest fish or other aquatic organisms.
(g) The dioxin criteria apply to the sum of the dioxin toxicity equivalents expressed as 2,3,7,8-TCDD dioxin.
(h) The criteria for polychlorinated biphenyls (PCBs) apply to the sum of all congeners, to the sum of all homologs or to the sum of all aroclors.
(i) The acute and chronic aquatic life criteria for dissolved aluminum only apply when the
concurrent pH is less than 6.5 or greater than 9.0 S.U. If the concurrent pH is between 6.5 and 9.0 S.U. then the hardness-dependent
total recoverable aluminum criteria in Paragraphs (1) and (2) of Subsection I of 20.6.4.900 NMAC apply.

Pollutant Approach:
Dinitrolphenols use 2,4-DNP as the surrogate (Source: https://www.oregon.gov/deq/FilterDocs/sToxicsdinitrolphenols.pdf)
BisChloromethyl (BCME) no recommended analytical methods (Source: https://www.oregon.gov/deq/FilterDocs/sToxicsBisChloromethylMemo.pdf)
Hexachlorocyclohexane (BHC) sum four major isomers alpha, beta, delta, and gamma (Source: https://www.oregon.gov/deq/FilterDocs/sToxicsbhcTechnical.pdf)
Nitrosamines use N-nitrosodiethylamine as surrogate (Source: EPA Method 607, https://www.oregon.gov/deq/FilterDocs/sToxicsnitrosamines.pdf)

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Permittee / Applicant: Bishop's Lodge Wasetewater Treatment Facility
Facility / Proposed Discharge: Wastewater Treatment Facility (WWTF)
NPDES Permit/Application Tracking #: NM0031233
Source Water: N/A
Receiving Water: Little Tesuque Creek (Rio Tesuque to headwaters), assessment unit ID NM-2118.A_34
Segment: Rio Grande Basin, Segment 20.6.4.121 NMAC
Designated Uses: domestic water supply, high quality coldwater aquatic life, irrigation, livestock watering, wildlife habitat and primary contact; and public water supply on Little Tesuque Creek
Existing Uses: Same as designated uses.
Segment Specific Numeric Criteria: Specific conductance 300 uS/cm or less; the monthly geometric mean of E. Coli bacteria 126 cfu/100 mL or less, single sample 235 cfu/100mL
Use Specific Numeric Criteria / Table: 20.6.4.900(J)(1) NMAC (Applicable to Existing, Designated or Attainable Uses unless otherwise specified in 20.6.4.97 through 20.6.4.899 NMAC)
Impairments: TMDL for aluminum, Fully supporting in 2024-2026 (draft) Integrated Report

$$Cd = [[((Cwqs - Cbwq) \times 0.1 + Cbwq) \times (Qd + Qs)] - [(Cbwq \times (Qs)]]/Qd$$

Cd = discharge concentration (mg/L)
Cwqs = water quality standard
Cbwq = baseline water quality
Qd = Discharge flow (cfs)
Qs = Stream flow (4Q3) (cfs)
Cs = concentration in-stream (at upstream water quality station, mg/L)
Cr = resultant concentration set equal to [(WQS-Cbwq) x 0.1 + Cbwq]

Solve for Cd (NMED solves for the discharge concentration that would use up 10% of the assimilative capacity):

	cubic feet per second (cfs)	million galls per day (MGD)	
Q_{d1} =	0.11 cfs	0.06 MGD	From NPDES application
Q_{d2} =	0.0 cfs	0.0 MGD	
Q_{d3} =	0.0 cfs	0.0 MGD	
Q_{d4} =	0.0 cfs	0.0 MGD	
Qd (effluent discharge) =	0.11 cfs	0.06 MGD	
Qs (4Q3) =	0.1 cfs	0.1 MGD	Calculated using StreamStats
Qd + Qs (total streamflow)=	0.21 cfs	0.16 MGD	
Qs (Harmonic Mean) =	0.263 cfs	0.17 MGD	Calculated using StreamStats
Qd + Qs (total streamflow, HM for HH-OO) =	0.37 cfs	0.20 MGD	
Cs (in-stream) =	Same as Cbwq, baseline water quality		
Cbwq =	Upstream of facility		

Cd_{10} (mg/L) = Effluent discharge concentration using 10% AC

The calculated discharge concentration (Cd) is compared with the proposed discharge concentration. If the proposed discharge is less than 10% of the assimilative capacity (calculated > proposed) and existing uses are maintained, the antidegradation review process is complete and the permitting process may proceed. If the proposed discharge consumes more than 10% of available assimilative capacity (calculated < proposed), a comprehensive Tier 2 review is required.

							Mixing Calculation		Loading Calculation						Antidegradation Analysis			
Pollutant	CAS	20.6.4 NMAC Water Quality Standard (Cwqs), ug/L	20.6.4 NMAC Water Quality Standard (Cwqs), mg/L	Baseline Concentration (Cbwq) In-Stream, mg/L	Assimilative Capacity (AC) (Cwqs-Cbwq), mg/L	Significant degradation (Cbwq+10% AC), mg/L	Calculated In-Stream Concentration (Cd) ((Cwqs-Cbwq) x 0.1 + Cbwq) x (Qd + Qs), mg/L	Cs*Qs	Calculated Effluent Concentration @ 10% of AC Daily Max (Cd₁₀), mg/L	Allowable Effluent Load @ 10% of AC Daily Max, lbs/day	Pollutant	Average (Geomean) Effluent Data, mg/L	Proposed discharge based on current effluent data, lbs/day	Proposed Discharge: if > Allowable Effluent Load @ 10% of AC Daily, then Further Degradation Analysis Required	Pollutants at MDL (Only for Further Degradation Analysis Needed, BL WWTF Effluent Data)	Flagging Pollutants Reported at MDL, all others No Additional Degradation Analysis	Additional analysis
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Aluminum, total *	7429-90-5	835.14	0.84	0.209325783	0.6258	0.27190748	0.044	0.0209	0.3762	0.1883	Aluminum, total *	0.120000	0.060048	No Additional Degradation Analysis	Not applicable	Not applicable	
Arsenic, dissolved	7440-38-2	9	0.009	0.445040222	-0.4360	0.401436199	0.064	0.0445	0.3288	0.1645	Arsenic, dissolved	0.001300	0.000651	No Additional Degradation Analysis	Not applicable	Not applicable	
Beryllium	7440-39-3	4	0.004	0.676744506	-0.6727	0.609470056	0.098	0.0677	0.4973	0.2489	Beryllium	0.001000	0.000500	No Additional Degradation Analysis	Below MDL	No Additional Degradation Analysis	
Boron, dissolved	7440-42-8	750	0.75	0.672120716	0.0779	0.679908644	0.109	0.0672	0.6929	0.3467	Boron, dissolved	0.096000	0.048038	No Additional Degradation Analysis	Not applicable	Not applicable	
Cadmium, dissolved *	7440-43-9	0.547253165	0.0005	0.113806592	-0.1133	0.102480658	0.016	0.0114	0.0836	0.0418	Cadmium, dissolved *	0.001000	0.000500	No Additional Degradation Analysis	Below MDL	No Additional Degradation Analysis	
Chromium III, dissolved *	16005-83-1	55.11496122	0.055	0.136839171	-0.0817	0.12866675	0.021	0.0137	0.1150	0.0576	Chromium III, dissolved *	0.003000	0.001501	No Additional Degradation Analysis	Below MDL	No Additional Degradation Analysis	
Cobalt, dissolved	7440-48-4	50	0.050	0.159862347	-0.1099	0.148876112	0.024	0.0160	0.1306	0.0653	Cobalt, dissolved	0.007000	0.003503	No Additional Degradation Analysis	Not applicable	Not applicable	
Copper, total *	7440-50-8	6.574950936	0.0066	0.01	-0.0034	0.009657495	0.002	0.0010	0.0091	0.0045	Copper, total *	0.032000	0.016013	Further Degradation Analysis Needed	Not applicable	Not applicable	Requires NPDES permit limit. Bishop's Lodge should design treatment scheme to lower copper concentration in effluent.
Lead		1.693914598	0.00169	0.001414	0.0003	0.001442184	0.000	0.0001	0.0015	0.0007	Lead, total *	0.000250	0.000125	No Additional Degradation Analysis	Below MDL	No Additional Degradation Analysis	
Mercury	7439-97-6	0.77	0.001	0.220488094	-0.2197	0.198516285	0.032	0.0220	0.1619	0.0810	Mercury	0.000200	0.000100	No Additional Degradation Analysis	Not applicable	Not applicable	
Molybdenum, dissolved	7439-98-7	1,000	1.000	0.2359	0.7641	0.312316059	0.050	0.0236	0.4397	0.2200	Molybdenum, dissolved	0.004000	0.002002	No Additional Degradation Analysis	Below MDL	No Additional Degradation Analysis	
Nickel, total *	7440-02-0	38.29865081	0.038	0.01	0.0283	0.012829865	0.002	0.0010	0.0175	0.0088	Nickel, total *	0.005000	0.002502	No Additional Degradation Analysis	Below MDL	No Additional Degradation Analysis	
Selenium, total recoverable	7782-49-2	5	0.005	0.000552195	0.0044	0.000996976	0.000	0.0001	0.0017	0.0009	Selenium, total recoverable	0.000500	0.000250	No Additional Degradation Analysis	Below MDL	No Additional Degradation Analysis	
Silver, total *	7440-22-4	1.7269	0.002	0.001	0.0007	0.00107269	0.000	0.0001	0.0012	0.0006	Silver, total *	0.002500	0.001251	Further Degradation Analysis Needed	Below MDL	No Additional Degradation Analysis	No. Further Analysis Required. The effluent was below the MDL and reported as non-detect. Instream data was reoported at the detection limit. The sensitivity of the instream water quality method is resulting in a flag for further analysis.
Vanadium, dissolved	7440-62-2	100	0.100	0.350937307	-0.2509	0.325843577	0.052	0.0351	0.2840	0.1421	Vanadium, dissolved	0.025000	0.012510	No Additional Degradation Analysis	Below MDL	No Additional Degradation Analysis	
Zinc, total *	7440-66-6	87	0.087	0.0050	0.0822	0.013222225	0.002	0.0005	0.0269	0.0135	Zinc, total *	0.070000	0.035028	Further Degradation Analysis Needed	Not applicable	Not applicable	Requires NPDES permit limit. Bishop's Lodge should design treatment scheme to lower copper concentration in effluent.
Adjusted gross alpha (pCi/L)		15	15.000	1	14.0000	2.4	0.384	0.1000	4.7333	2.3686	Adjusted gross alpha (pCi/L)	4.260000	2.131704	No Additional Degradation Analysis	Below MDL	No Additional Degradation Analysis	
Radium 226 + Radium 228 (pCi/L)		30	30	0.21	29.7900	3.189	0.510	0.0210	8.1540	4.0803	Radium 226 + Radium 228 (pCi/L)	2.303000	1.152421	No Additional Degradation Analysis	Not applicable	Not applicable	
Tritium (pCi/L)		20,000	20,000	214	19,786.0000	2192.6	350.816	21.4000	5490.2667	2,747.3294	Tritium (pCi/L)	-106.000000	-53.042400	No Additional Degradation Analysis	Not applicable	Not applicable	

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