



2023 Annual Presumptive Stream Depletion Factor (PDF) Evaluation Report Hydrologic Institutional (H-I) Model Area, Arkansas River Basin

August, 2023

Introduction and Summary

Presumptive depletion factors, or PDFs, are used by the Colorado Division of Water Resources Division 2 in the administration of water replacement plans in the Arkansas River Basin to relate amounts of groundwater pumping from a well to amounts of stream depletions. Colorado's 1996 Use Rules define groundwater-only PDFs for flood and sprinkler irrigation. However, Amended Appendix A.4 of the Kansas v. Colorado decree directs the state of Colorado to conduct an annual evaluation of the PDF for supplemental flood/furrow irrigation following the annual update of the Hydrologic Institutional Model (H-I Model).

The PDF evaluations for the last six years have recommended a supplemental flood/furrow irrigation PDF of 36%. The 2023 Annual PDF Evaluation, using an additional methodology step that is not required but appears to be appropriate, suggests that a supplemental flood/furrow irrigation PDF of **37.0%** is more appropriate and that this value or higher should be used by Division 2 for replacement plans in year 2024. PDFs for supplemental flood/furrow irrigation for recent water replacement plan years are shown in the following table.

Presumptive Depletion Factors for Water Replacement Plan Years

Replacement Plan Year	PDF for Supplemental Flood/Furrow Irrigation
2012	39.0%
2013	38.1%
2014	36.5%
2015	36.0%
2016	35.5%
2017-2023	36.0%
2024	37.0%

Note: Other PDFs are 50% for sole-source flood/furrow, 75% for sprinkler, and 100% for drip irrigation



Methods and Results

Amended Appendix A.4 provides a methodology framework for the annual PDF evaluations, but the methodology is updated and more fully described in a report titled “Annual Presumptive Stream Depletion Factor (PDF) Evaluation Methodology for the Hydrologic Institutional Model Area, Arkansas River Basin, Colorado” (PDF Evaluation Methodology, 2015 revised 2020). The methodology incorporates updates to the H-I Model; primarily those acknowledging higher groundwater irrigation application efficiencies from sprinkler and drip systems. The GWAM model is used to determine idealized replacements given PDF values which are provided to a modified version of the HI model with a revised update file. Annual depletions and accretions to usable stateline flow are then estimated from historic (with actual pumping and ideal replacements represented) and compact (without pumping or replacements) runs of the modified HI model.

For the current year, the process described in the PDF Evaluation Methodology Document indicates that a supplemental PDFs of 35.0% produces no cumulative shortfall to usable stateline flows over any 10-year period as shown in the following table. As such, a 35.0% PDF would be acceptable under Amended Appendix A.4 using current methodologies.

However, the State of Colorado believes that the current methodology may over-estimate the range of the water supply available in the Arkansas River. In the current PDF methodology, transmountain deliveries are removed from user supplies, but these deliveries are not removed from the Pueblo or the Fountain Creek gage records; effectively adding those deliveries to the native supplies that are available for ditches to divert. To address this, Colorado reprocessed the model update file to remove TM delivery and transit loss amounts in model datasets 14 and 15 from monthly “node1” tributary inflows and daily flows at Pueblo in the model update file (TM deliveries from Fountain Creek were removed from node 1 but not daily Pueblo flows, while native portions of Twin Lake deliveries were not removed). Annual and ten-year sums of accretions and depletions for PDF values given the modified methodology are also shown in a following table and suggest that a supplemental flood/furrow PDF of 37.0% may be appropriate.

Therefore, even though a supplemental flood/furrow PDF of 35.0% would be acceptable under the methods defined in Amended Appendix A.4 and the current PDF Evaluation Methodology Document, the 2023 PDF evaluation suggests that a PDF of 37.0% may be appropriate for administration of replacement plans in year 2024. Amended Appendix A.4 item 5.b also states that the Colorado State and Division Engineers can implement PDF values that are higher than those indicated by the evaluation particularly if there is a risk of a shortfall in the 10-year compact accounting.

2023 PDF Evaluation Results – using Current Methodologies

Year of Review Period	Calendar Year	Annual Usable Stateline Depletions (+)/ Accretions (-) (acre-feet)		10-Year Period	10-year Sum of Usable Stateline Depletions (+) / Accretions (-) (acre-feet)	
		SF.PDF: 35.0%	SF.PDF: 36.0%		SF.PDF: 35.0%	SF.PDF: 36.0%
1	2003	1159	1053			
2	2004	-249	-335			
3	2005	-457	-590			
4	2006	-556	-654			
5	2007	-616	-689			
6	2008	-1812	-1943			
7	2009	-1669	-1785			
8	2010	-43	-134			
9	2011	166	68			
10	2012	2159	2078	2003-2012	-1918	-2931
11	2013	1134	1068	2004-2013	-1943	-2916
12	2014	1099	1038	2005-2014	-595	-1543
13	2015	-249	-292	2006-2015	-387	-1245
14	2016	-3089	-3250	2007-2016	-2920	-3841
15	2017	-14216	-14543	2008-2017	-16520	-17695
16	2018	-1087	-1121	2009-2018	-15795	-16873
17	2019	495	433	2010-2019	-13631	-14655
18	2020	1125	1049	2011-2020	-12463	-13472
19	2021	1105	1037	2012-2021	-11524	-12503
20	2022	1528	1466	2013-2022	-12155	-13115

*Note: indicated PDF is for supplemental flood/furrow irrigation
PDF of 50% sole-source flood/furrow, 75% for sprinkler, and 100% for drip irrigation used
PDFs of 35.0% and 36.0% do not indicate any shortfall and therefore are both sufficient*

2023 PDF Evaluation Results – using Modified Methodology

Year of Review Period	Calendar Year	Annual Usable Stateline Depletions (+)/ Accretions (-) (acre-feet)		10-Year Period	10-year Sum of Usable Stateline Depletions (+) / Accretions (-) (acre-feet)	
		SF.PDF: 36.5%	SF.PDF: 37.0%		SF.PDF: 36.5%	SF.PDF: 37.0%
1	2003	1601	1555			
2	2004	379	320			
3	2005	-268	-315			
4	2006	-382	-437			
5	2007	-459	-501			
6	2008	-1014	-1073			
7	2009	-1820	-1888			
8	2010	-315	-367			
9	2011	-7	-1019			
10	2012	2065	-992	2003-2012	-220	-4717
11	2013	1230	-379	2004-2013	-591	-6651
12	2014	1197	-214	2005-2014	227	-7185
13	2015	-163	-1110	2006-2015	332	-7980
14	2016	1169	540	2007-2016	1883	-7003
15	2017	-356	-1567	2008-2017	1986	-8069
16	2018	-4313	-5406	2009-2018	-1313	-12402
17	2019	1411	526	2010-2019	1918	-9988
18	2020	-484	-1712	2011-2020	1749	-11333
19	2021	1145	699	2012-2021	2901	-9615
20	2022	1638	1408	2013-2022	2474	-7215

*Note: indicated PDF is for supplemental flood/furrow irrigation
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a PDFs of 37.0% does not indicate any shortfall and therefore is sufficient*