2024 Annual Presumptive Stream Depletion Factor (PDF) Evaluation Report
Hydrologic Institutional (H-I) Model Area, Arkansas River Basin

August, 2024

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 in years 2016 through 2022 recommended a supplemental flood/furrow irrigation PDF of 36%. The 2023 PDF Evaluation used an additional methodology step that is not required but appeared to be appropriate that suggested that a supplemental flood/furrow irrigation PDF of 37.0% was more appropriate. The 2024 PDF Evaluation, using the same additional methodology step, suggests that a supplemental flood/furrow irrigation PDF of **37.0%** is appropriate and it is recommended that this value should be used by Division 2 for replacement plans in year 2025. 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

PDF Evaluation Year	Replacement Plan Year	PDF for Supplemental Flood/Furrow Irrigation
2011	2012	39.0%
2012	2013	38.1%
2013	2014	36.5%
2014	2015	36.0%
2015	2016	35.5%
2016-2022	2017-2023	36.0%
2023-2024	2024-2025	**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 H-I 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 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 gage records that establish flows for the model; effectively adding those deliveries to the native supplies that are available for ditches to divert. So similarly to 2023, for 2024 the model update file was reprocessed 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 2024 PDF evaluation suggests that a PDF of 37.0% may be appropriate for administration of replacement plans in year 2025.

2024 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	2004	-476	-570			
2	2005	-669	-766			
3	2006	-633	-745			
4	2007	-655	-731			
5	2008	-1824	-1964			
6	2009	-1658	-1778			
7	2010	-29	-123			
8	2011	176	74			
9	2012	2159	2077			
10	2013	1134	1067	2004-2013	-2475	-3459
11	2014	1098	1037	2005-2014	-901	-1852
12	2015	-250	-293	2006-2015	-482	-1379
13	2016	-3090	-3252	2007-2016	-2939	-3886
14	2017	-14217	-14545	2008-2017	-16501	-17700
15	2018	-1088	-1123	2009-2018	-15765	-16859
16	2019	494	432	2010-2019	-13613	-14649
17	2020	1124	1047	2011-2020	-12460	-13479
18	2021	1105	1036	2012-2021	-11531	-12517
19	2022	1515	1459	2013-2022	-12175	-13135
20	2023	297	248	2014-2023	-13012	-13954

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

2024 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	2004	172	118			
2	2005	-419	-462			
3	2006	-462	-512			
4	2007	-500	-560			
5	2008	-1032	-1084			
6	2009	-1823	-1884			
7	2010	-306	-352			
8	2011	0	-1010			
9	2012	2084	-993			
10	2013	1231	-378	2004-2013	-1055	-7117
11	2014	1196	-214	2005-2014	-31	-7449
12	2015	-164	-1111	2006-2015	224	-8098
13	2016	1168	540	2007-2016	1854	-7046
14	2017	-357	-1568	2008-2017	1997	-8054
15	2018	-4315	-5407	2009-2018	-1286	-12377
16	2019	1410	526	2010-2019	1947	-9967
17	2020	-485	-1713	2011-2020	1768	-11328
18	2021	1145	699	2012-2021	2913	-9619
19	2022	1478	1335	2013-2022	2307	-7291
20	2023	725	453	2014-2023	1801	-6460

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