Yakima River Basin Study Out-of-Stream Water Needs Subcommittee

Meeting 3

June 10, 2010

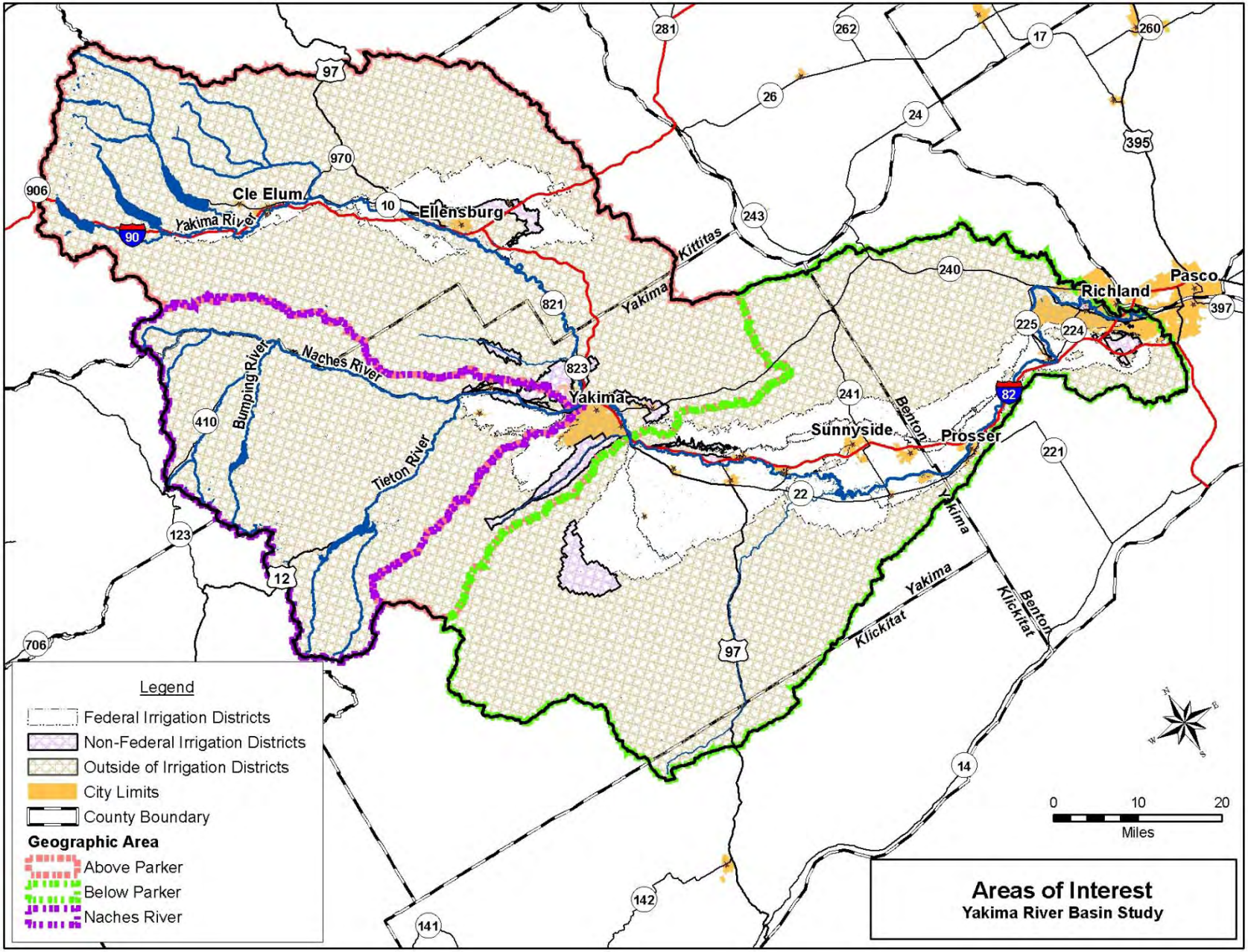
Disclaimer

- Results discussed today are working drafts for Committee discussion purposes
- Data and calculations are still being checked and results may change

Framework for the Assessment

1. Current Conditions
   - Agriculture – federal supply/ other supplies
   - Municipal Systems and Domestic wells
   - Other uses

2. Future Needs
   - Population growth
   - Conversion of farmland to urban use
   - New or additional conservation
   - Alternative crop mixes
   - Climate change effects


Legend
Federal Irrigation Districts
Non-Federal Irrigation Districts
Outside of Irrigation Districts
City Limits
County Boundary
Geographic Area
Above Parker
Below Parker
Naches River
Areas of Interest
Yakima River Basin Study
0
10
20
Miles
Cle Elum
Ellensburg
Yakima
Sunnyside
Prosser
Richland
Pasco
Yakima River
Kittitas
Bumping River
Naches River
Tieton River
Benton
Klickitat
281
262
17
260
97
26
24
395
906
970
10
243
90
240
821
225
224
397
823
241
82
410
221
22
123
12
706
14
142
141

YAKIMA PROJECT AGRICULTURAL NEEDS ANALYSIS

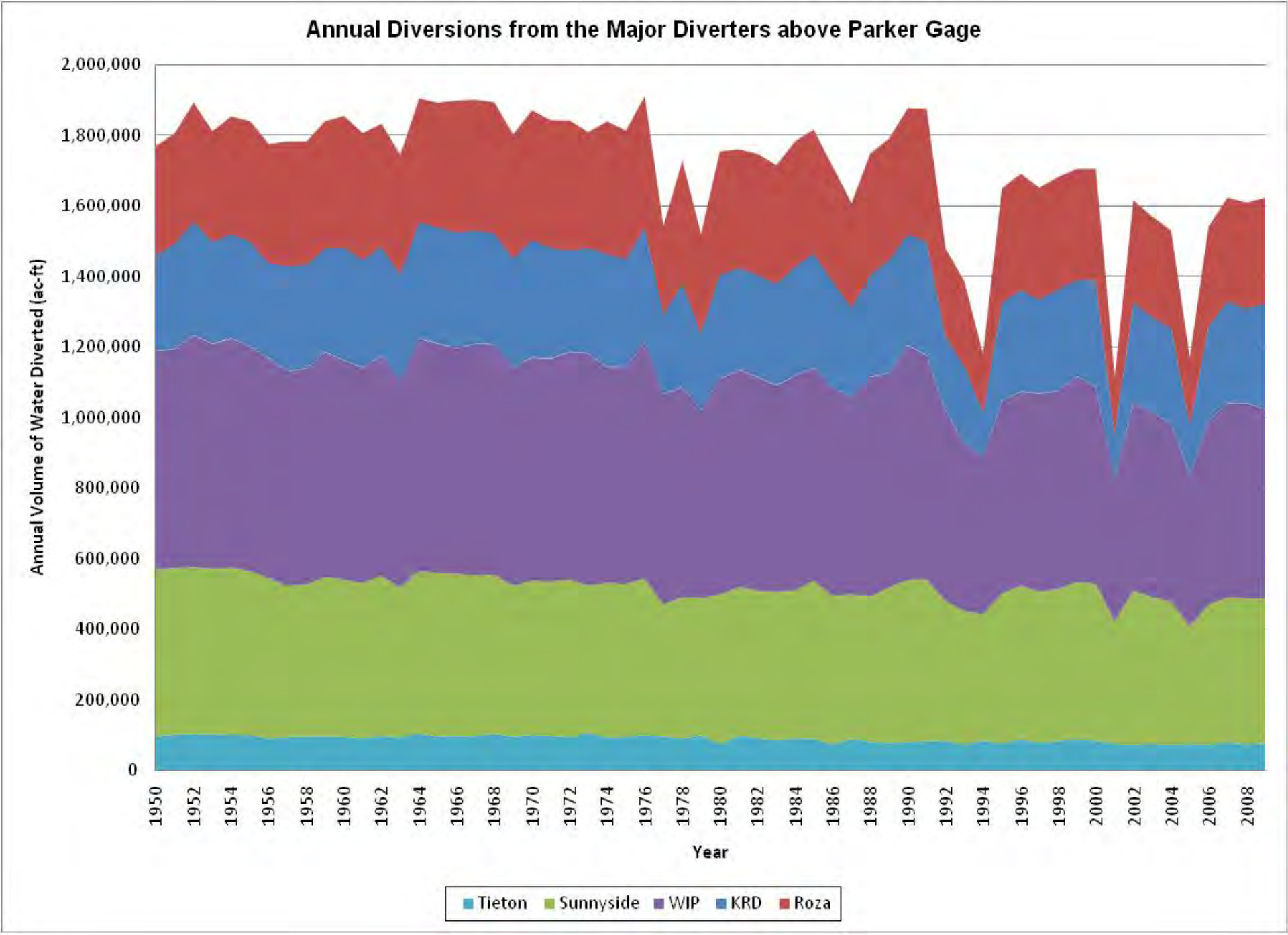
Outline

- Entitlements and Diversions
- Proratable District Shortfalls
- Irrigated Crop Analysis
- Return Flows

Summary of Annual Entitlements (April-October) Diverting Surface Water above Parker Gage (ac-ft)

Irrigation Entity	Proratable Entitlements	Non-Proratable Entitlements	Total Entitlements
Wapato Irrigation Project	350,000	305,613	655,613
Sunnyside Division	142,684	315,836	458,520
Roza Irrigation District	375,000	0	375,000
Kittitas Reclamation District	336,000	0	336,000
Yakima-Tieton Irrigation District	38,181	75,865	114,049
Naches Selah Irrigation District	4,486	49,658	54,144
Cascade Ditch	0	49,525	49,525
Ellensburg Town Ditch	0	47,758	47,758
Westside Irrigation Company	8,200	31,128	39,328
Selah Moxee Irrigation District	4,281	27,493	31,774
Congdon Ditch	4,305	23,720	28,025
Union Gap Irrigation District	4,606	20,697	25,303
South Naches Ditch	0	22,946	22,946
Gleed Ditch	0	22,819	22,819
Wapatox Ditch	0	20,230	20,230
Fruitvale Ditch	0	17,708	17,708
Old Union Ditch	0	17,675	17,675
Naches Cowiche Ditch	0	15,096	15,096
Woldale Ditch	0	12,973	12,973
Hubbard Ditch	0	11,165	11,165
City of Yakima Irrigation	1,500	8,805	10,305
Others	11,560	120,248	131,805
Total	**1,280,803**	**1,216,958**	**2,497,761**

Source: Reclamation (TS-YSS-21, January 2008)


Annual Diversions from the Major Diverters above Parker Gage
Annual Volume of Water Diverted (ac-ft)
2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Year
Tieton
Sunnyside
WIP
KRD
Roza

Diversions Below Parker

- Kennewick Division is present below Parker gage
  - Proratable water right holder, relies on return flow for water supply
  - Diverts approximately 99,300 acre-feet per year
  - Have not been prorated, however concern is with increasing water conservation return flow will decrease, affecting their water supply

Summary of Proratable Entitlements (April-October) Diverting Surface Water above Parker Gage

Irrigation Entity	Proratable Entitlements (ac-ft)	% of Total Proratable Entitlements	% of Total Proratable Entitlements Not Including Sunnyside and Tieton
Roza Irrigation District	375,000	29%	34%
Wapato Irrigation Project	350,000	27%	32%
Kittitas Reclamation District	336,000	26%	31%
Subtotal	***1,061,000***	***83%***	***96%***
Sunnyside Division	142,684	11%	
Yakima-Tieton Irrigation District	38,181	3%	
Subtotal	***1,241,865***	***97%***	
Others	38,938	3%	***4%***
Total	**1,280,803**	**100%**	**100%**

RID, WIP and KRD comprise 96% of the proratable entitlements that desire additional water during drought years.

Annual Water Use (acre-feet)

	KRD	Roza	WIP
Entitlements (April - October)	336,000	375,000	655,613
Peak Year Diversion (1990-2009)	322,588	377,679	665,298
Average Non-Drought Diversions (1990-2009)	285,478	312,849	559,092
Drought Year 2001 Diversions	122,780	166,690	404,645
Drought Year 2005 Diversions	144,662	192,573	428,080

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Provisional Results

Measures of Diversion Shortfalls
April-October (acre-feet)

	KRD	Roza	WIP
Shortfall between Drought Year 2001 and Average Non-Drought Diversions (1990-2009)	162,698	146,158	154,448
Shortfall between Drought Year 2001 and (100% of Non-Proratable Entitlements + 70% of Proratable Entitlements)	112,705	105,456	157,476
Shortfall between Drought Year 2005 and Average Non-Drought Diversions (1990-2009)	140,816	122,702	131,934
Shortfall between Drought Year 2005 and (100% of Non-Proratable Entitlements + 70% of Proratable Entitlements)	95,848	84,274	129,004

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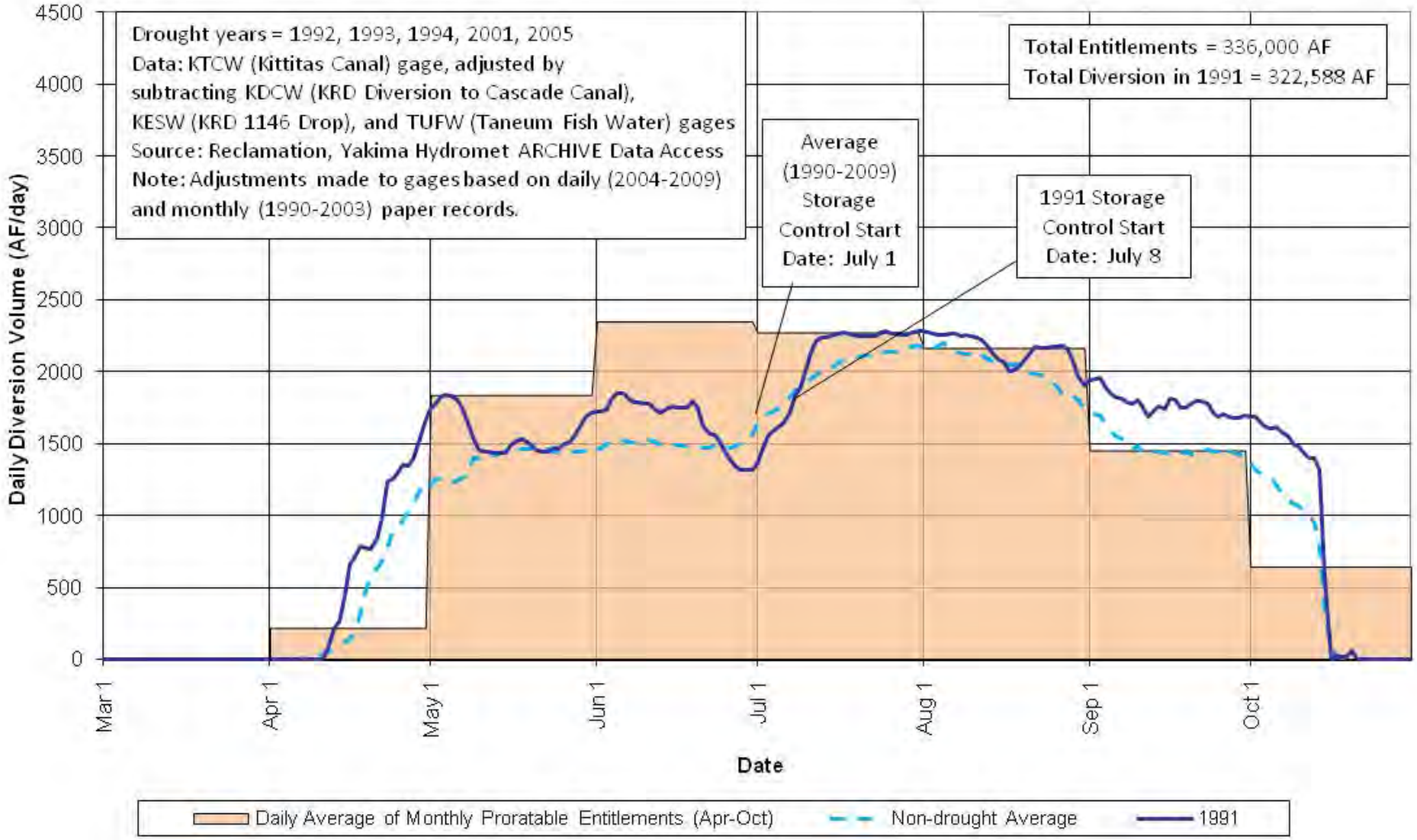
Provisional Results

KRD Diversion Comparison
Average Non-Drought Years (1990-2009) vs. Maximum Diversion Year 1991



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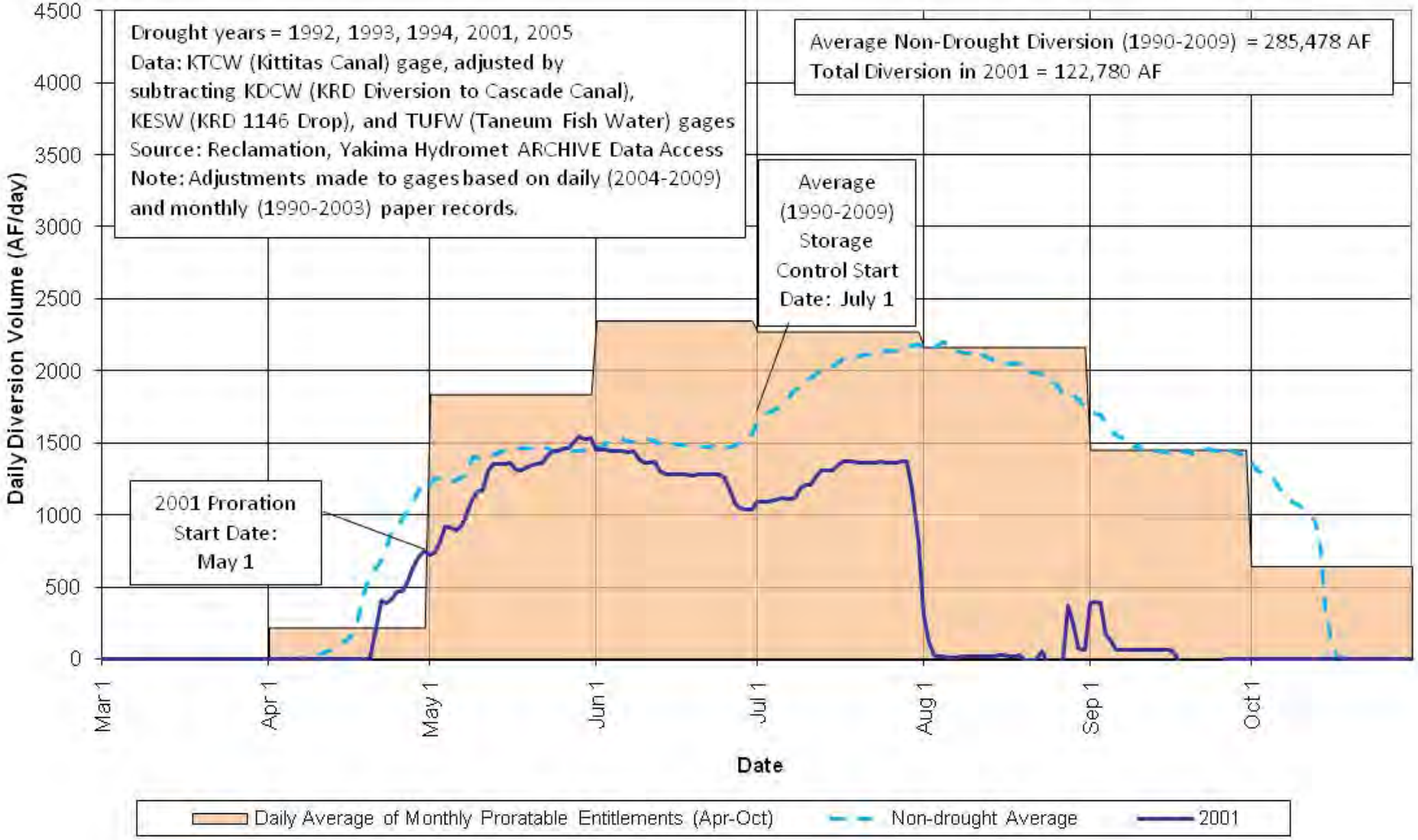
Provisional Results

KRD Diversion Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2001



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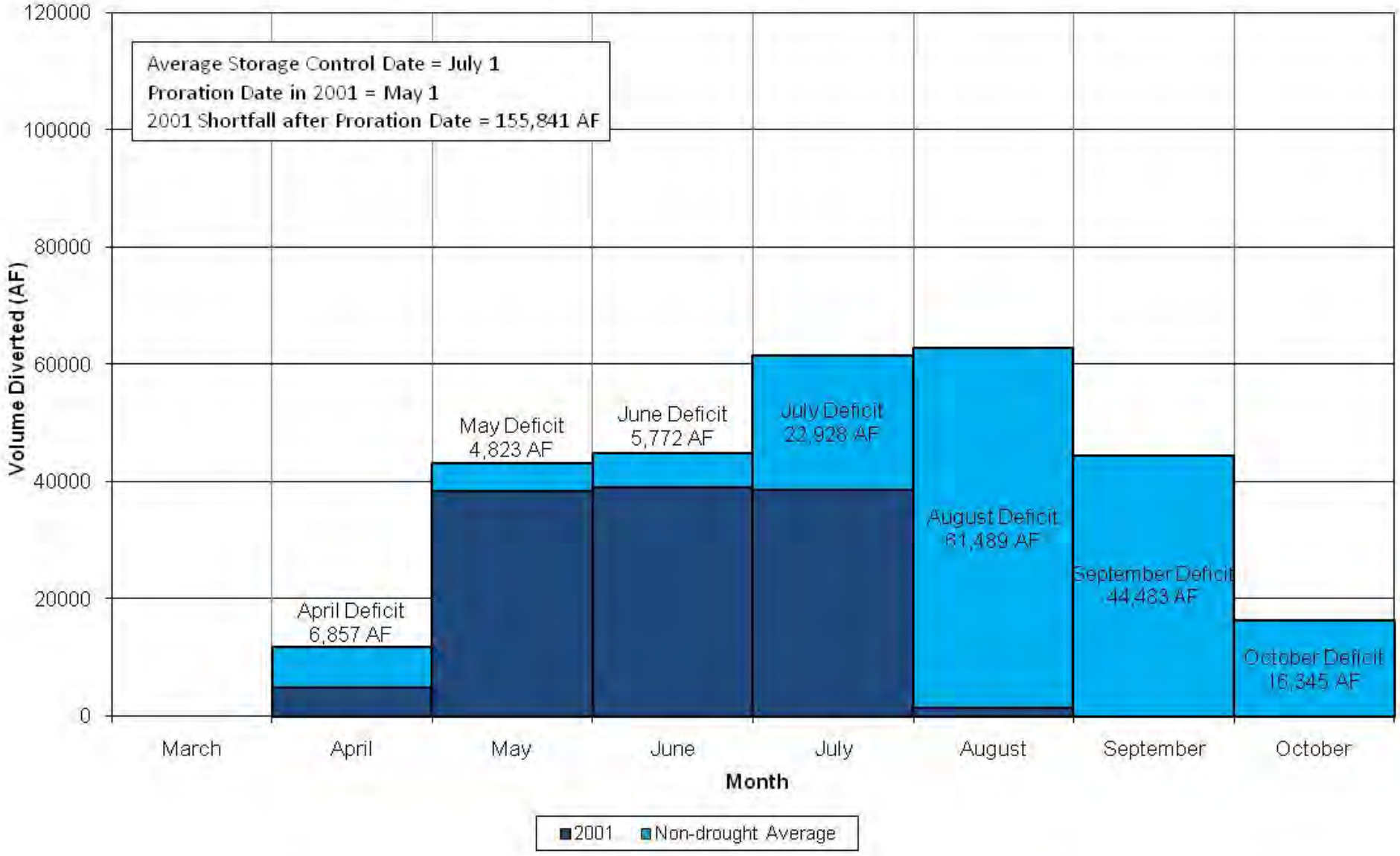
Provisional Results

KRD Monthly Diversion Deficit Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2001



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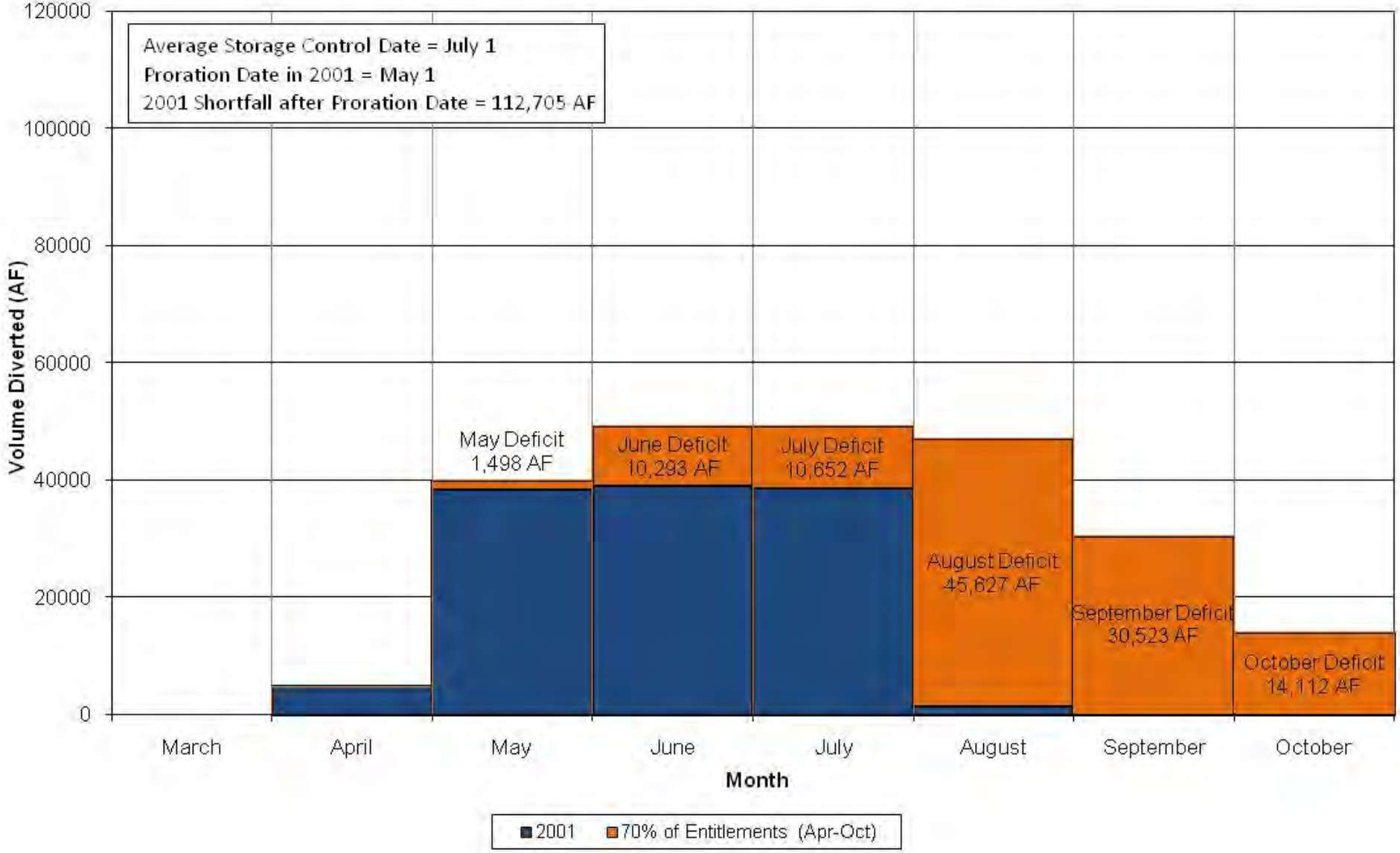
Provisional Results

KRD Monthly Diversion Deficit Comparison
70 Percent of Entitlements vs. Drought Year 2001



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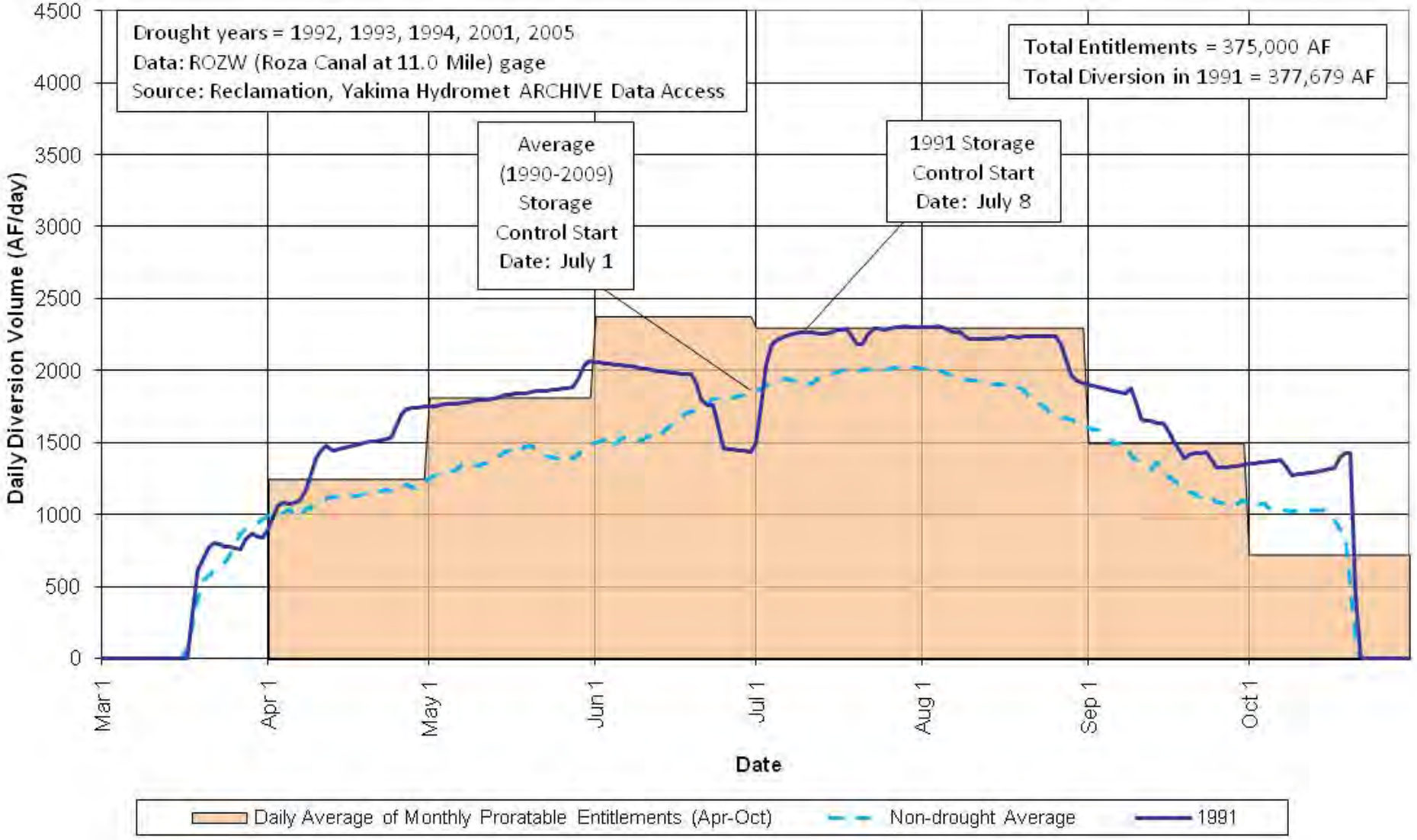
Provisional Results

Roza Irrigation District Diversion Comparison
Average Non-Drought Years (1990-2009) vs. Maximum Diversion Year 1991



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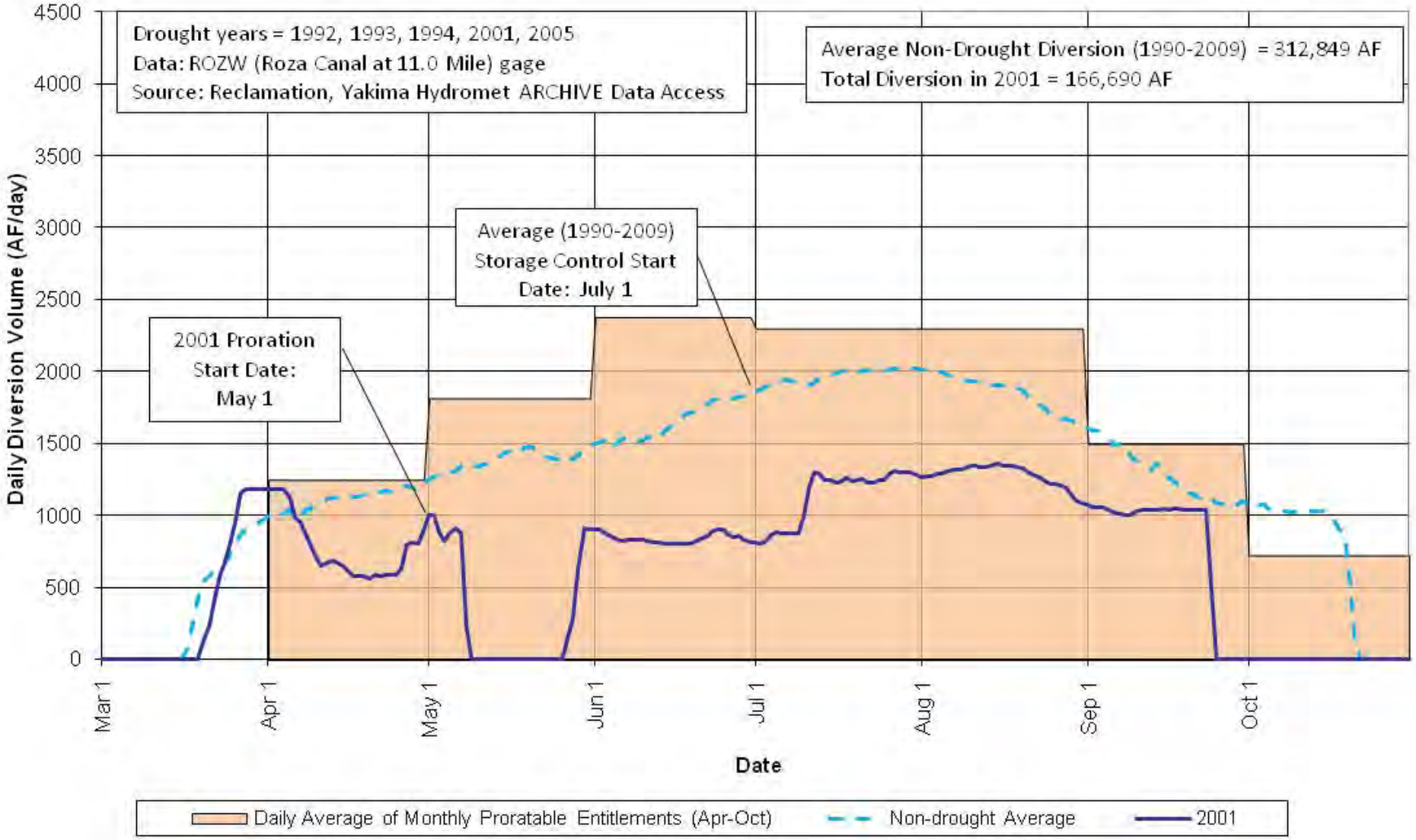
Provisional Results

Roza Irrigation District Diversion Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2001



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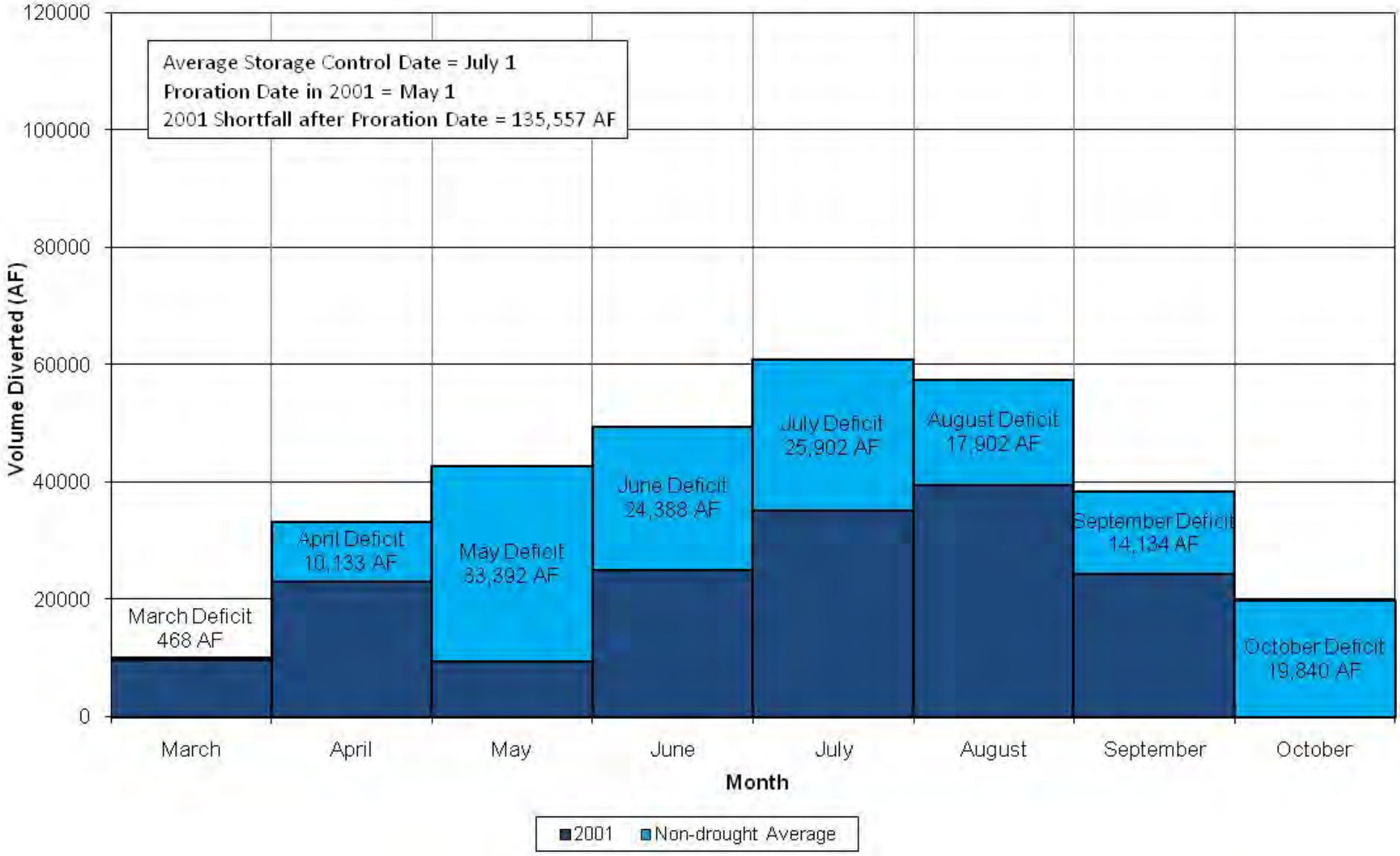
Provisional Results

Roza Irrigation District Monthly Diversion Deficit Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2001



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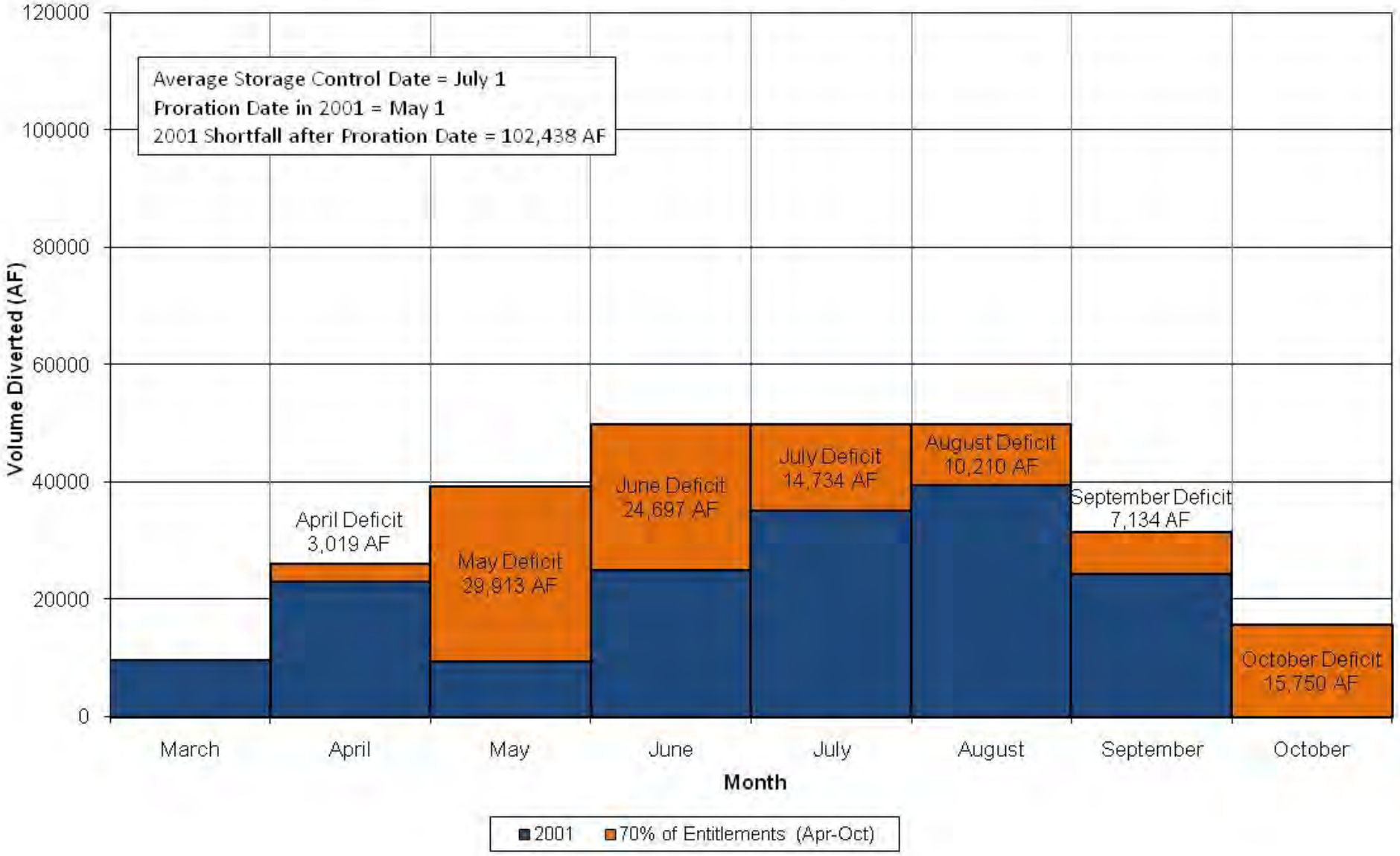
Provisional Results

Roza Irrigation District Monthly Diversion Deficit Comparison
70 Percent of Entitlements vs. Drought Year 2001



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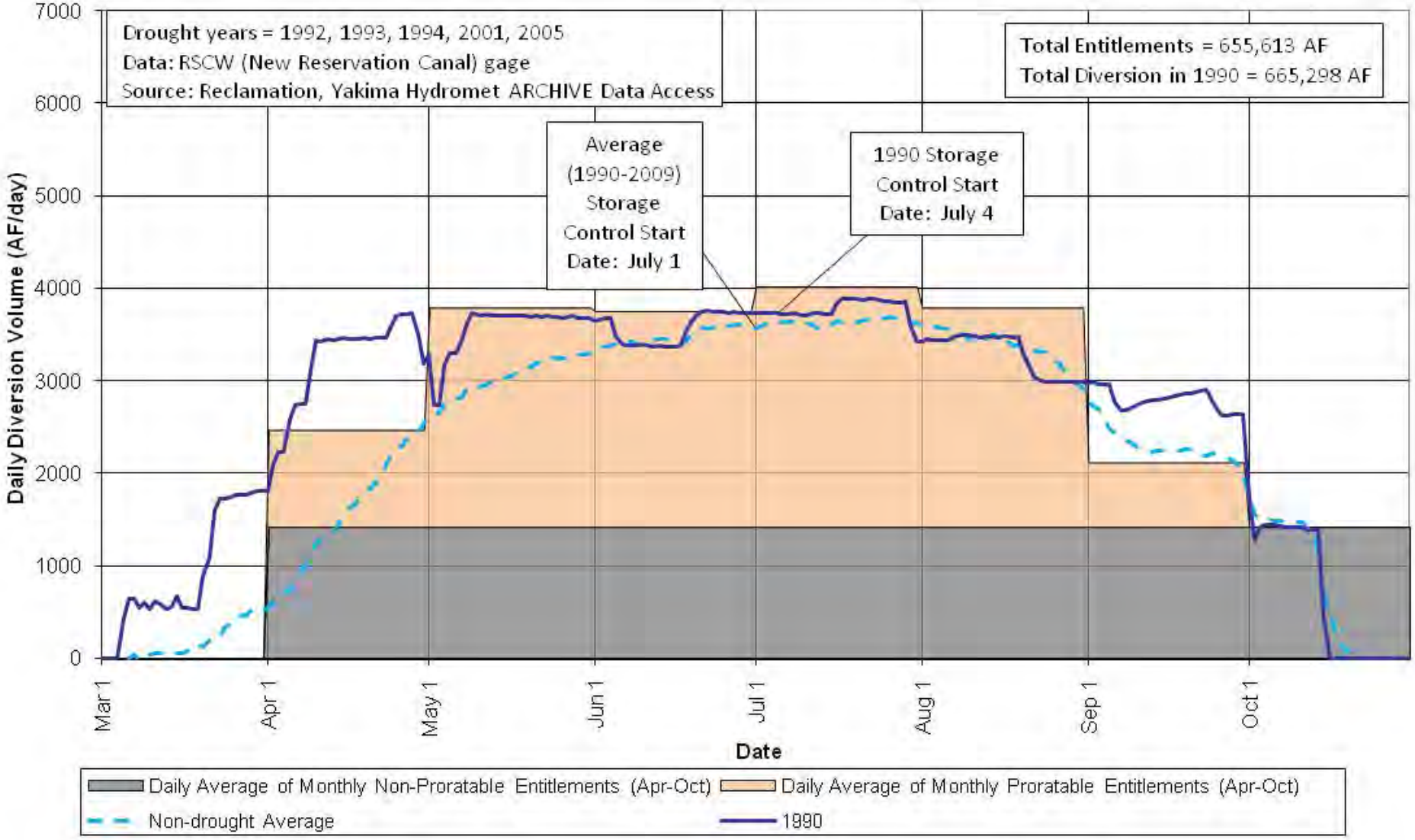
Provisional Results

WIP Diversion Comparison
Average Non-Drought Years (1990-2009) vs. Maximum Diversion Year 1990



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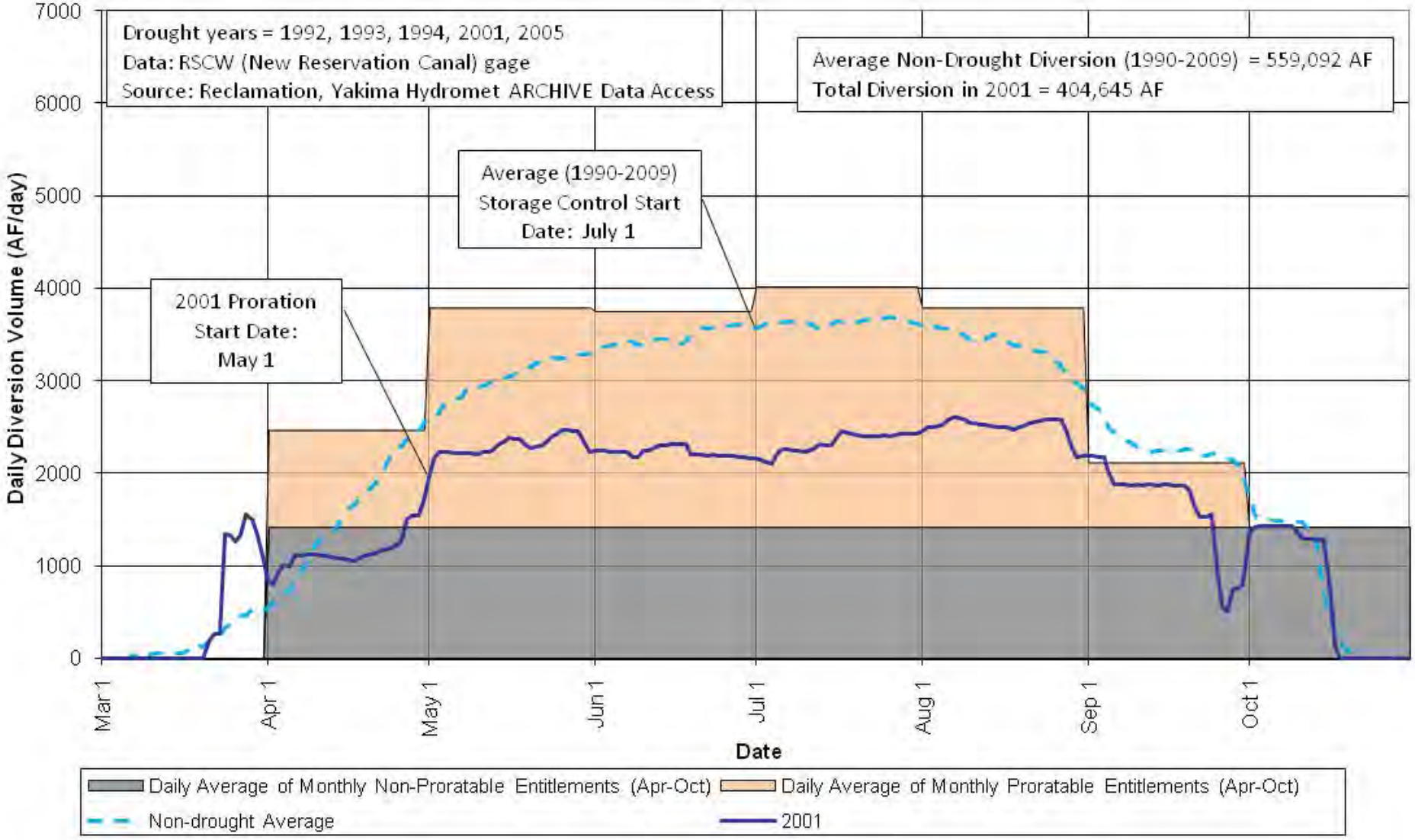
Provisional Results

WIP Diversion Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2001



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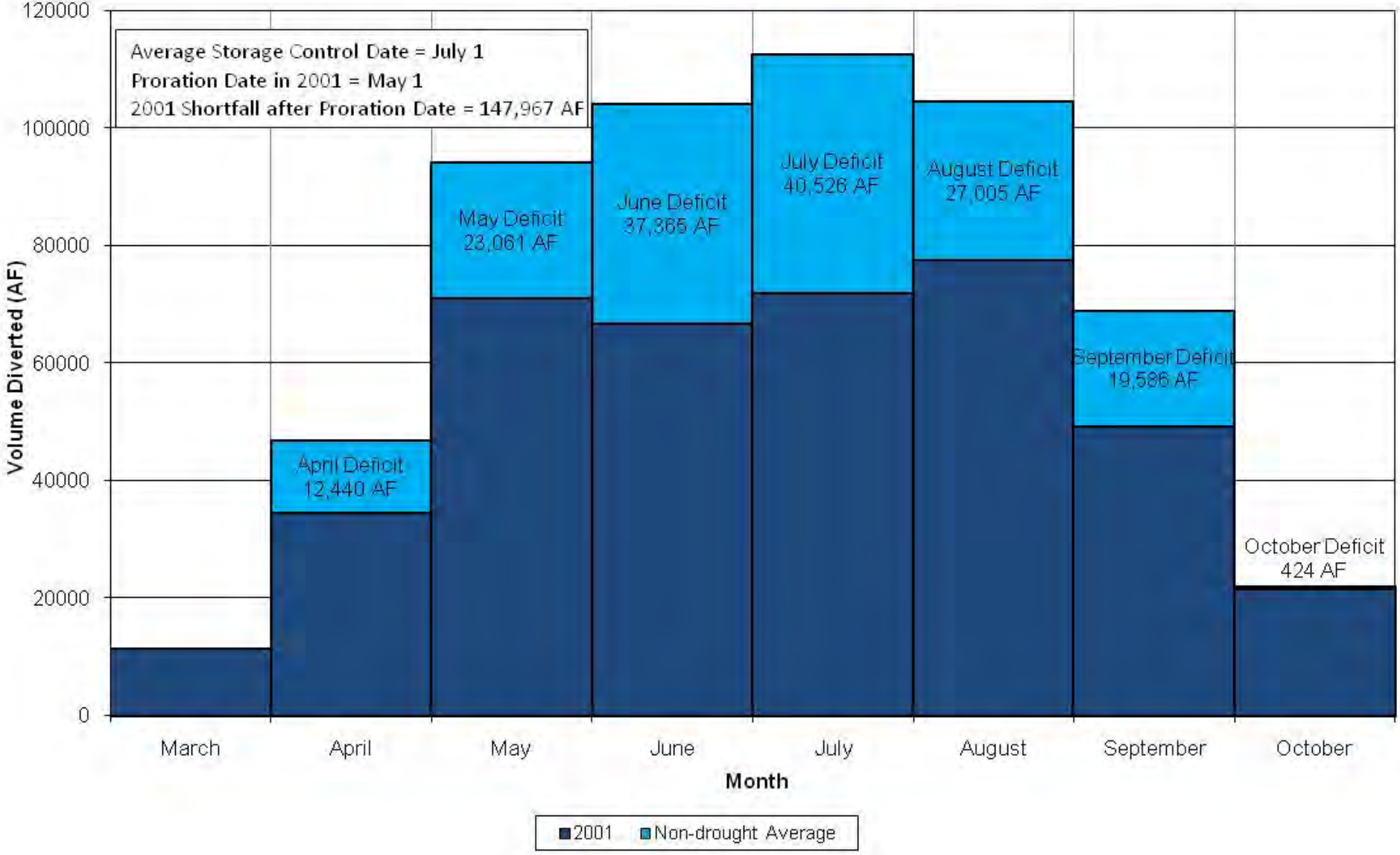
Provisional Results

WIP Monthly Diversion Deficit Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2001



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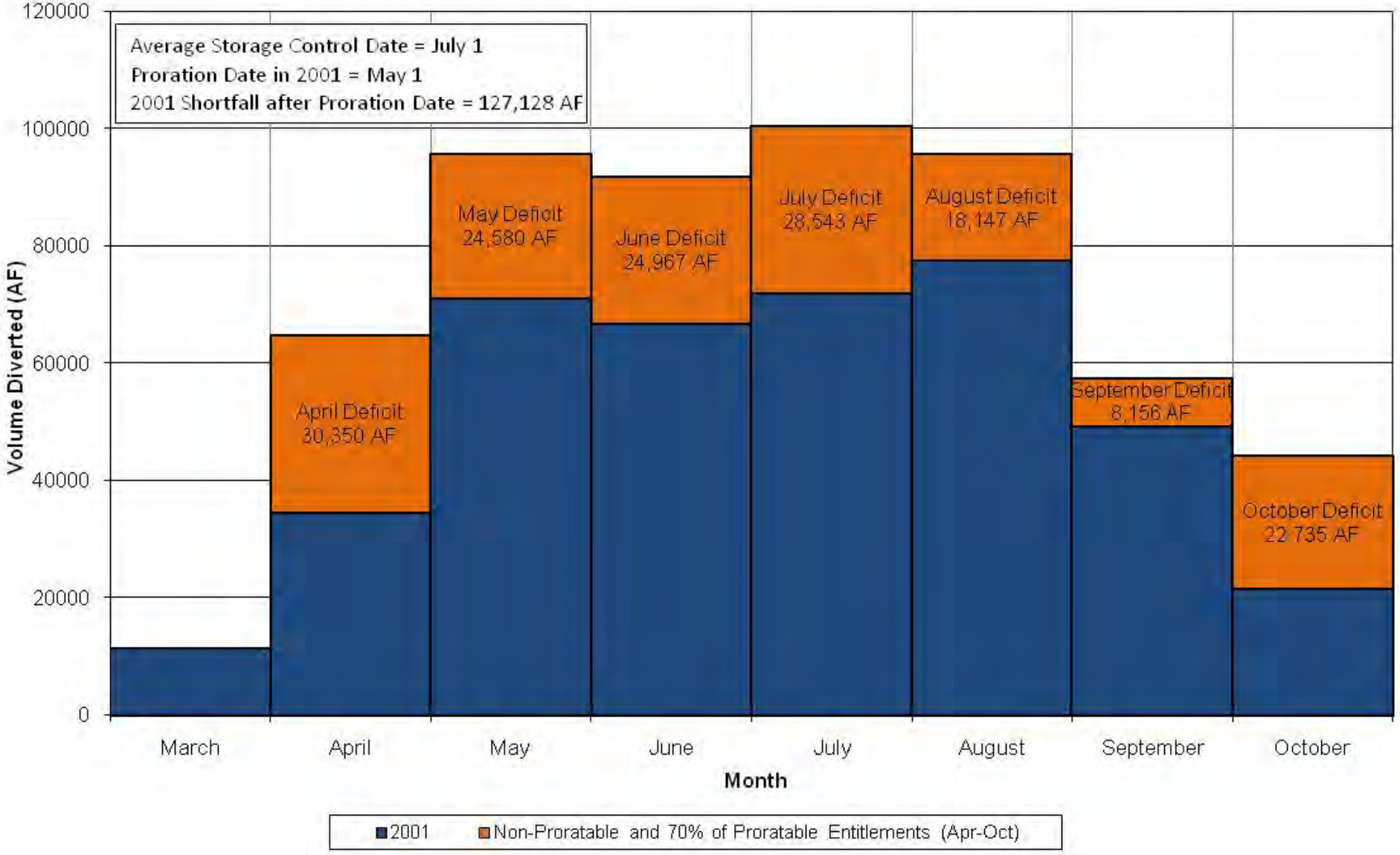
Provisional Results

WIP Monthly Diversion Deficit Comparison
Non-Proratable and 70 Percent of Proratable Entitlements vs. Drought Year 2001



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Provisional Results

Measures of Diversion Shortfalls Adjusted for Proration Date (acre-feet)

	KRD	Roza	WIP
Shortfall between Drought Year 2001 and Average Non-Drought Diversions (1990-2009) Measured after Proration Date of May 1, 2001	155,841	135,557	147,967
Shortfall between Drought Year 2001 and (100% of Non-Proratable Entitlements + 70% of Proratable Entitlements) Measured after Proration Date of May 1, 2001	112,705	102,438	127,128
Shortfall between Drought Year 2005 and Average Non-Drought Diversions (1990-2009) Measured after Proration Date of April 6, 2005	140,815	122,702	131,934
Shortfall between Drought Year 2005 and (100% of Non-Proratable Entitlements + 70% of Proratable Entitlements) Measured after Proration Date of April 6, 2005	95,848	83,155	125,063

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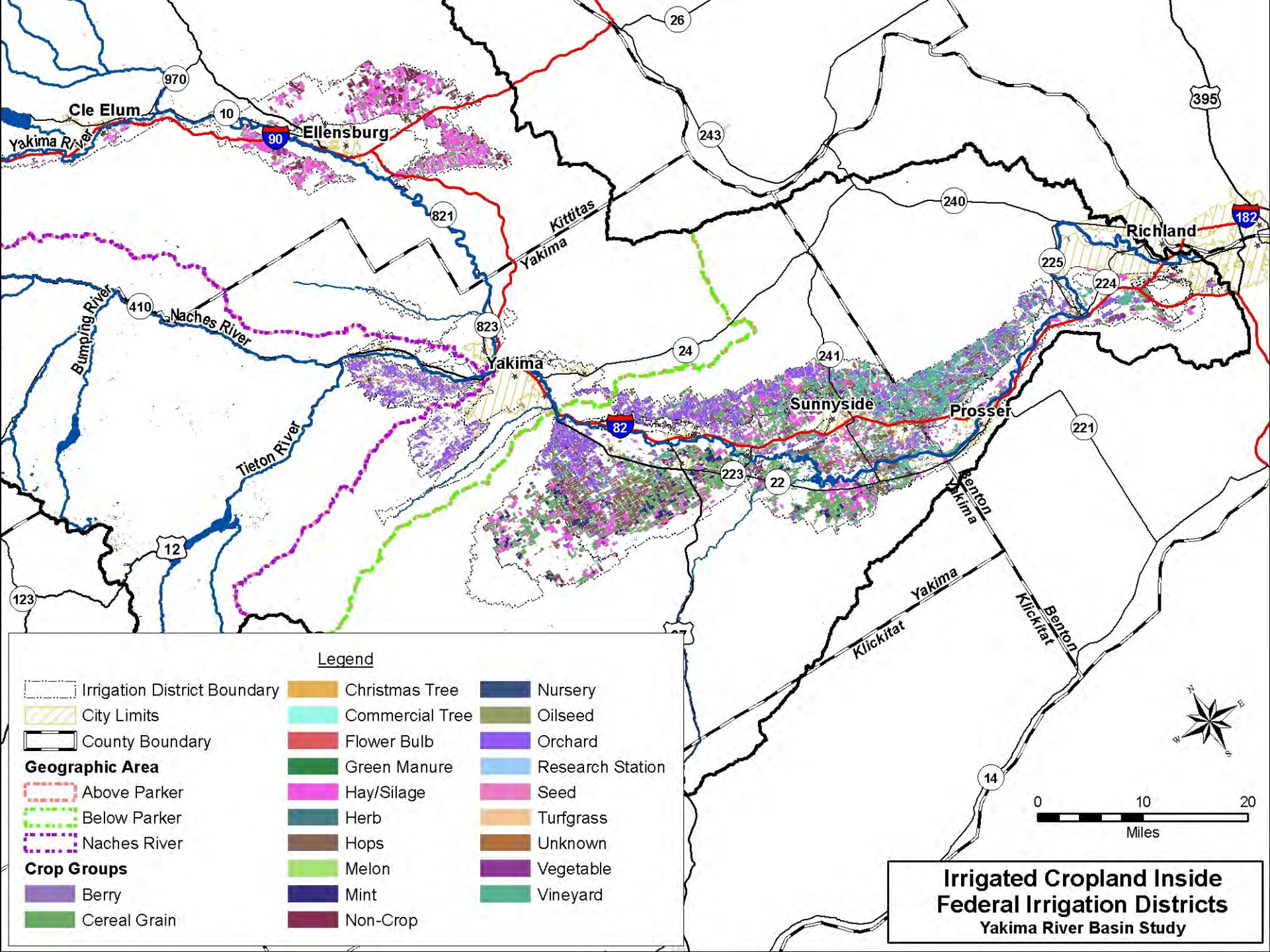
Provisional Results

Irrigated Farmland Analysis

- Crop Types and Acreage
- Crop Irrigation Requirement (CIR)
- Irrigation Types and Efficiencies


Cle Elum
Yakima River
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Irrigation District Boundary
City Limits
County Boundary
Geographic Area
Above Parker
Below Parker
Naches River
Crop Groups
Berry
Cereal Grain
Christmas Tree
Commercial Tree
Flower Bulb
Green Manure
Hay/Silage
Herb
Hops
Melon
Mint
Non-Crop
Nursery
Oilseed
Orchard
Research Station
Seed
Turfgrass
Unknown
Vegetable
Vineyard
0
10
20
Miles
Irrigated Cropland Inside
Federal Irrigation Districts
Yakima River Basin Study

Yakima Project Irrigated Crop Production (acres)

Crop	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Corn	14,937	13,941	21,095	18,444	13,995	10,958	8,859	14,124	12,244	13,134	13,489
Grain	52,176	48,846	43,839	35,996	32,726	27,095	26,740	27,951	31,370	19,449	27,417
Forage	136,797	139,242	135,851	146,014	134,833	135,010	134,617	136,769	140,931	139,268	139,390
Beans	7,731	1,225	2,436	2,975	2,413	2,308	2,385	3,226	3,046	2,949	3,834
Hops	28,928	27,024	23,150	21,000	20,324	23,539	23,791	23,237	26,924	28,472	29,500
Mint	15,874	14,106	16,854	18,959	15,258	13,880	15,342	16,492	19,144	19,474	18,664
Vegetables	28,267	27,521	28,587	27,655	27,296	33,045	30,041	27,185	29,818	30,108	24,158
Nursery	895	1,356	1,078	633	698	625	780	964	561	596	629
Seed crops	457	390	262	726	91	471	773	797	485	447	358
Fruits	82,071	91,566	94,080	90,570	95,000	102,231	103,281	100,017	101,146	99,580	102,226
Nuts				5	5	5	5	29	38	38	38
All Crops	**371,096**	**367,669**	**369,113**	**363,870**	**363,870**	**350,752**	**349,931**	**354,111**	**365,809**	**354,470**	**360,675**

Source: Reclamation, YRBWEP Draft Programmatic EIS (April 1998)

Yakima Project Crop Survey Data (acres)

Orchard	63,462
Hay/Silage	53,841
Cereal Grain	51,582
Vineyard	36,418
Hops	21,081
Non-Crop	12,857
Vegetable	10,220
Mint	8,858
Unknown	8,058
Nursery	963
Turfgrass	629
Seed	617
Research Station	470
Berry	442
Green Manure	253
Oilseed	244
Melon	98
Herb	51
Commercial Tree	49
Flower Bulb	31
Christmas Tree	7

- 80-90,000 acres not accounted for, some crop types and areas probably not picked up in survey.
- Further crop survey data required to fill in data holes

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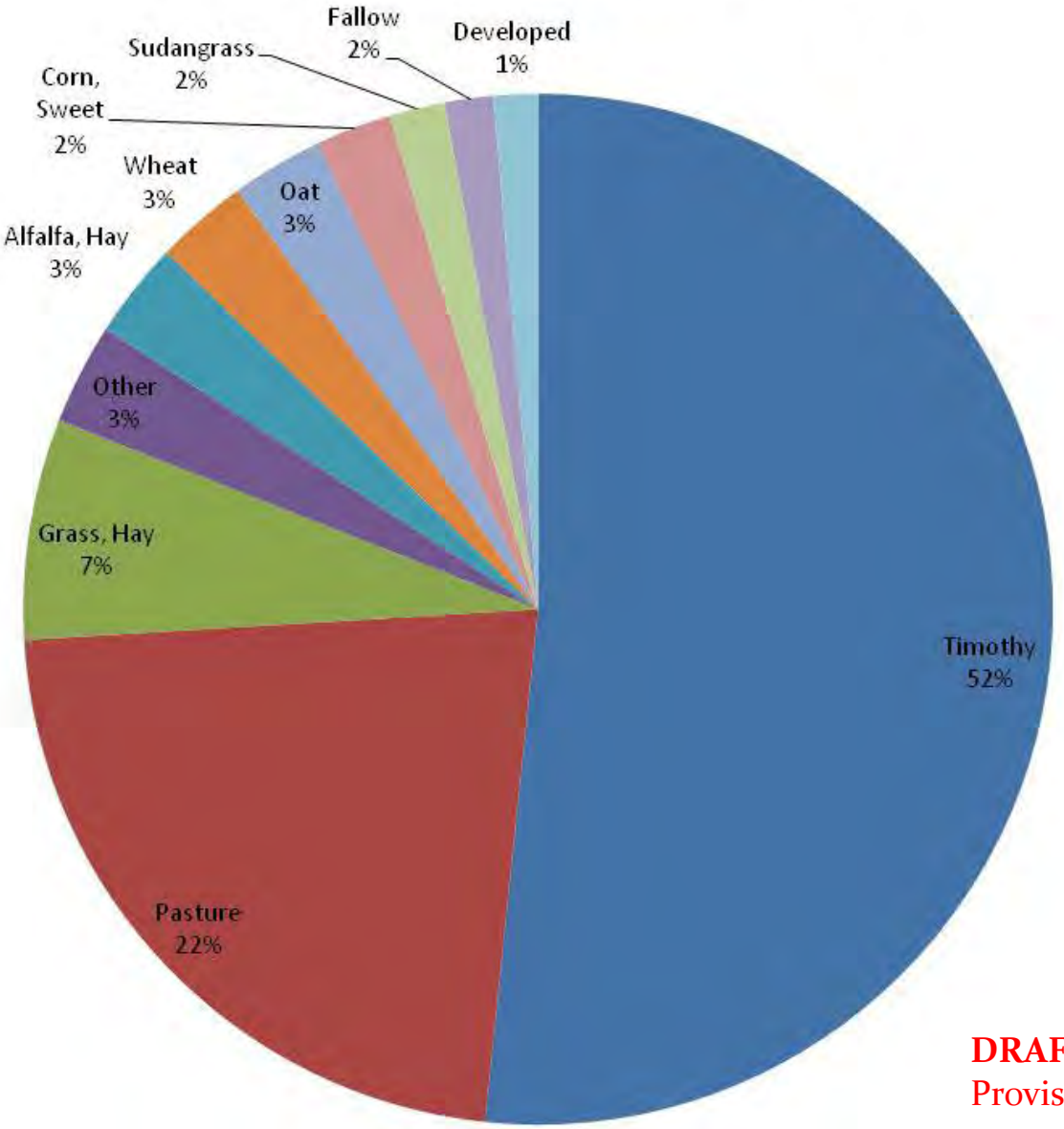
Provisional Results

Source: Washington State Department of Agriculture Survey Data (GIS Database)

Crop Irrigation Requirements (CIR) Methodology

- Sum crops from crop survey data for each district
- Determine irrigation requirement from representative Washington Irrigation Guide station for each crop
- Determine average CIR for entire district
- Multiply by irrigated acres to determine total CIR for each district

Estimated Crop Distribution for KRD



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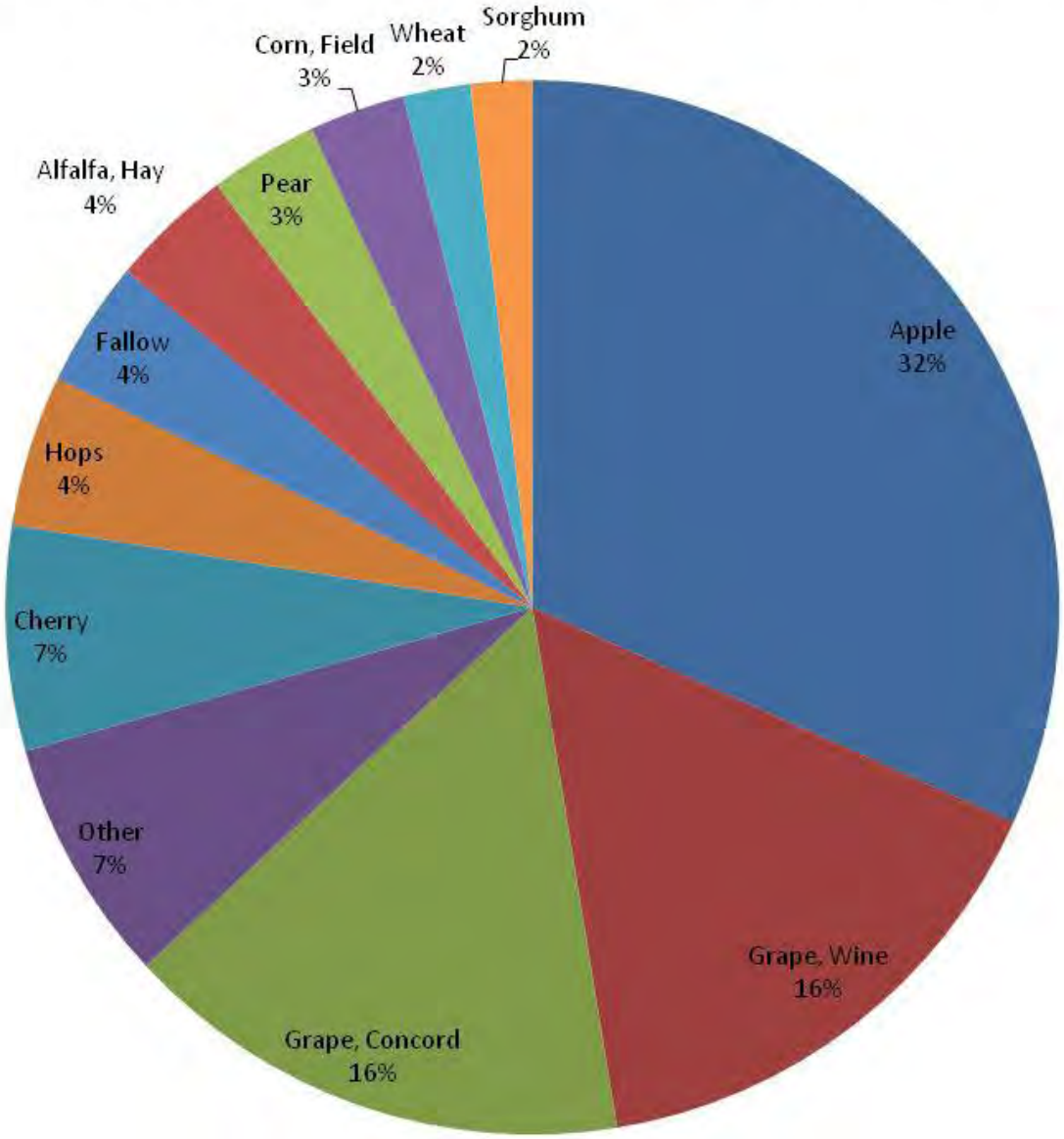
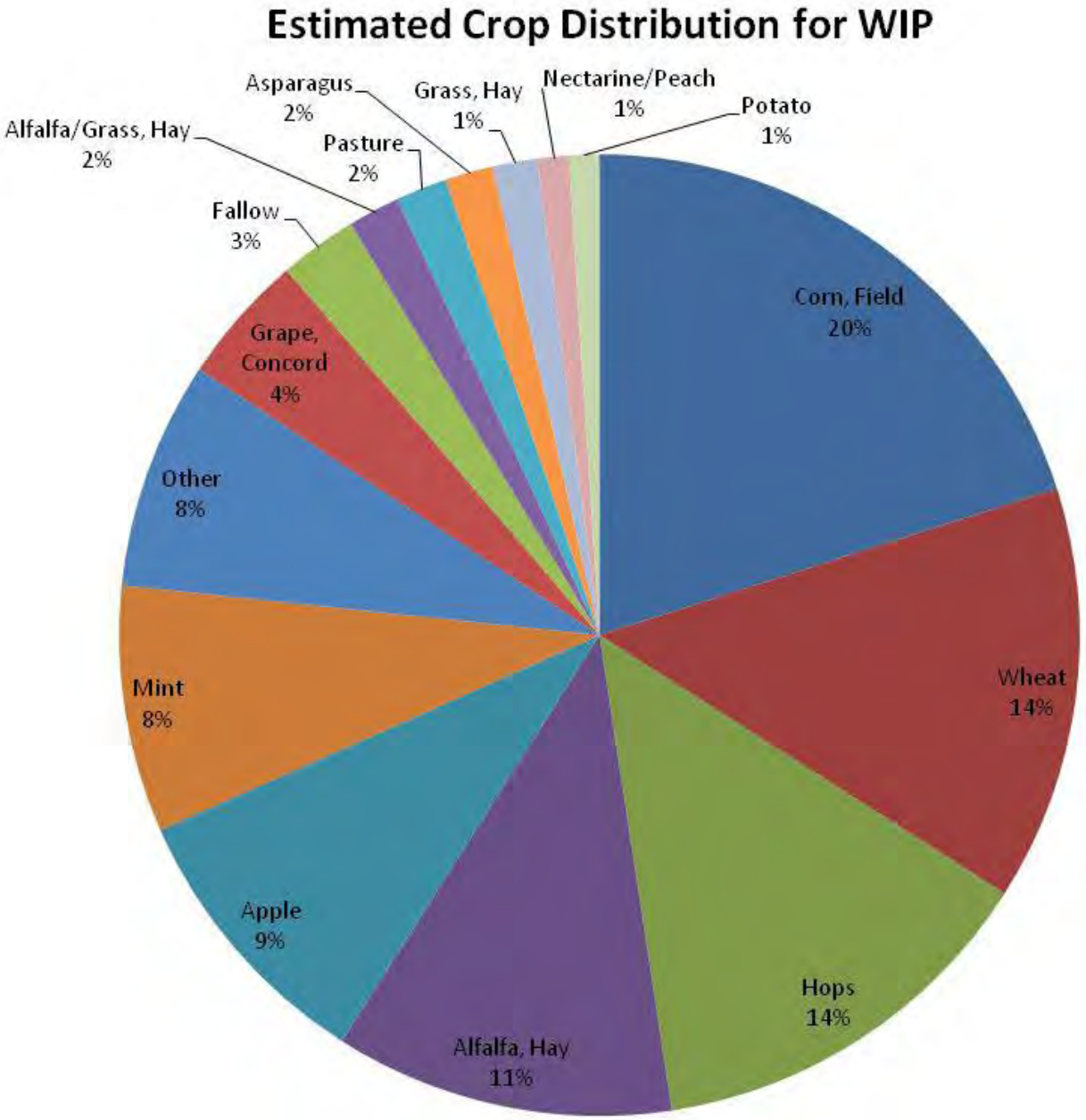
Provisional Results

Source: Washington State Department of Agriculture Survey Data (GIS Database)

Estimated Crop Distribution for Roza Irrigation District



Source: Washington State Department of Agriculture Survey Data (GIS Database)



Source: Washington State Department of Agriculture Survey Data (GIS Database)

Example Crop Irrigation Requirements
Sunnyside Station

Crop	Total CIR (ft)
Caneberry	3.58
Currant	3.58
Barley	2.05
Corn, Field	2.44
Oat	2.05
Rye	2.05
Triticale	2.05
Wheat	2.03
Green Manure	2.05
Alfalfa, Hay	3.09
Alfalfa/Grass, Hay	3.09
Clover, Hay	3.43
Grass, Hay	3.43
Hay/Silage, Unknown	3.43
Sorghum	2.09

Crop	Total CIR (ft)
Sudangrass	3.43
Timothy	3.43
Hops	2.56
Watermelon	1.26
Mint	3.00
Pasture	2.46
Wildlife Feed	2.44
Apple	3.70
Apricot	3.50
Cherry	3.74
Nectarine/Peach	3.48
Orchard, Unknown	3.70
Pear	3.42
Plum	3.42
Driving Range	3.26

Crop	Total CIR (ft)
Golf Course	3.26
Sod Farm	3.26
Asparagus	2.50
Bean, Dry	1.89
Bean, Green	1.55
Corn, Sweet	1.75
Cucumber	1.83
Market Crops	2.29
Onion	2.77
Potato	2.40
Pumpkin	1.49
Squash	1.49
Tomato	2.29
Vegetable, Unknown	2.29
Grape, Concord	2.28
Grape, Wine	2.28

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District Crop Irrigation Requirements (acre-feet)

	KRD	Roza	WIP
Station	Ellensburg	Sunnyside	Sunnyside
Average Crop Irrigation Requirement (ft)	2.51	2.97	2.69
Estimated Irrigated Area (ac)	55,500	71,700	96,700
Estimated Crop Irrigation Requirement (ac-ft)	140,000	214,000	260,000

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Provisional Results

Comparison between Crop Irrigation Requirements and Drought Year Diversions (acre-feet)

	KRD	Roza	WIP
Drought Year 2001 Diversions	122,780	166,690	404,645
Drought Year 2005 Diversions	144,662	192,573	428,080
Estimated Crop Irrigation Requirement	140,000	214,000	260,000

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Provisional Results

Yakima Project Irrigation Type by Crop

Irrigation Type	Orchard	Hay/Silage	Cereal Grain	Vineyard	Hops	Non-Crop	Vegetable	Mint	Unknown	Nursery	Turfgrass	Seed	Research Station	Berry	Green Manure	Oilseed	Melon	Herb	Commercial Tree	Flower Bulb	Christmas Tree	Grand Total
Rill	1,200	20,957	29,941	10,726	3,178	5,539	5,471	5,578	1,337	238		337		69	45			11		26		**84,653**
Sprinkler	58,972	3,989	864	13,615	62	1,109	307	274	2,574	456	629	6	148	41	52					5	7	**83,110**
Drip	2,422			11,917	17,697		1,704		152	241			286	332			98		6			**34,853**
Wheel Line	58	17,804	6,749		73	1,244	1,083	2,837	934	8		166	28		18	208						**31,211**
Center Pivot	125	9,467	12,969			906	1,579	115	927			107				36		40				**26,273**
None	503	1,275	680	114	33	973	56	6	1,171				8									**4,819**
Flood		25				2,967																**2,992**
Unknown	183	87	204	46	37	99	22	47	962	14					138				43			**1,882**
Big Gun		237	176			15																**428**
Hand										6												**6**
(blank)						5																**5**
Grand Total	**63,462**	**53,841**	**51,582**	**36,418**	**21,081**	**12,857**	**10,220**	**8,858**	**8,058**	**963**	**629**	**617**	**470**	**442**	**253**	**244**	**98**	**51**	**49**	**31**	**7**	**270,232**

Source: Washington State Department of Agriculture Survey Data (GIS Database)

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Provisional Results

Ecology Guidance for Irrigation Efficiencies

Table 1: Summary of Application Efficiency Ranges, Consumptive Use, and Return Flows[1]

Method		Application Efficiency, Ea (%)[2]		%Total Evaporated	% Total Use Consumed	Return Flow
		Range	Average, Ea_{avg}	%Evap	%CU, Average[3]	%RF, Average[4]
Surface:	Graded Furrow	50 – 80	65	5	70	30
	w/ tailwater reuse	60 – 90	75	5	80	20
	Level Furrow	65 – 95	80	5	85	15
	Graded Border	50 – 80	65	5	70	30
	Level Basins	80 – 95	85	5	90	10
	Flood	35 – 60	50	5	55	45
Sprinkler:	Periodic Move (Handline)	60 – 85	75	10	85	15
	Side Roll (Wheelline)	60 – 85	75	10	85	15
	Moving Big Gun	55 – 75	65	10	75	25
	Solid-Set—Overtree	55 – 80	70	15	85	15
	Solid Set--Undertree	60 – 85	75	10	85	15
	Pop-Up Impact	60 – 85	75	10	85	15
Center-Pivot	Impact heads w/end gun	75 – 90	80	15	95	5
	Spray heads w/o end gun	75 – 95	90	10	100	0
	LEPA[5] w/o end gun	80 – 98	92	5	97	3
Lateral-Move	Spray heads w/hose feed	75 – 95	90	10	100	0
	Spray heads w/canal feed	70 – 95	85	10	95	5
Microirrigation:	Trickle/Drip	70 – 95	88	5	93	7
	Subsurface Drip	75 – 95	90	0	90	10
	Microspray	70 – 95	85	10	95	5

1. Calculate the actual water use from water meter data, power meter, or run-time data. In the absence of such data, the TIR (total irrigation requirement) = CIR / Ea, where CIR is the crop irrigation requirement from the WIG (Appendix B) and Ea is the case-specific application efficiency above.
2. %Evap is the portion of the total irrigation requirement that is evaporated due to factors other than crop ET.
3. Select appropriate %CU based on type of irrigation system. If calculated Ea is greater or less than Ea_{avg}, then %CU = Ea + %Evap. CU = TIR x %CU.
4. Select appropriate %RF based on type of irrigation system. If calculated Ea is greater or less than Ea_{avg}, then %RF = 100 - %CU. RF = TIR x %RF
5. Low Energy Precision Application.

Projected Monthly Usable Return Flow (ac-ft) for TWSA Development

Month	Low Runoff Year	Average Runoff Year	High Runoff Year
April	42,000	42,000	42,000
May	58,000	64,000	70,000
June	64,000	66,000	66,000
July	76,000	78,000	82,000
August	71,000	73,000	75,000
September	39,000	52,000	65,000
October	16,000	21,000	26,000
Total	**366,000**	**396,000**	**426,000**

Note: Does not include drought years (1992, 1993, 1994, 2001, 2005)

Source: Reclamation, IOP (November, 2002)

Next Steps

- Complete Irrigation District Crop Data Analysis
  - Use data received from Districts
  - Analyze cropping patterns
- Agricultural Water Conservation
  - Estimate water conservation savings using list of previous projects
  - Review potential on-farm water conservation opportunities
- Complete Return Flow Analysis

MUNICIPAL AND DOMESTIC WATER USES

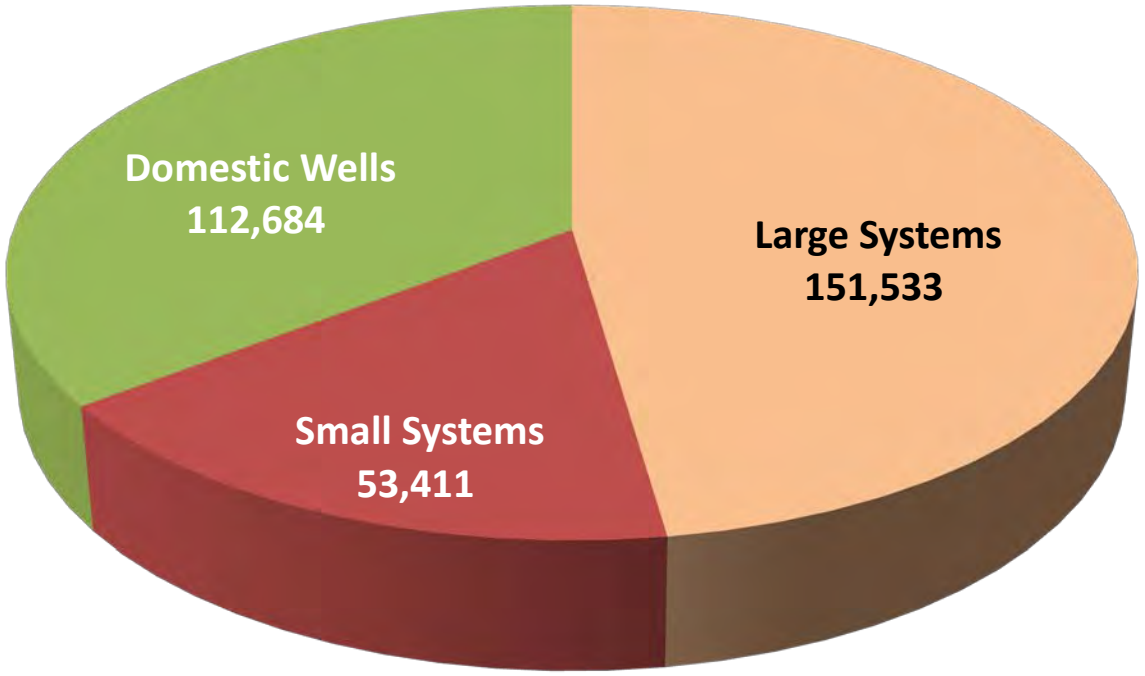
Approach for Municipal & Domestic Uses

1. Document current use for larger systems
2. Calculate gallons per capita per day from these data
3. Estimate population served by smaller systems & domestic wells
4. Multiply population by gpcd for current use by smaller systems & domestic wells
5. Account for return flows
6. Forecast future uses based on population growth
7. Adjust for factors like land conversion;

Steps Completed (Draft)

1. Document current use for larger systems
2. Calculate gallons per capita per day from these data
3. Gather population & growth estimates from Counties
4. Estimate population served by smaller systems & domestic wells
5. Multiply population by gpcd for current use by smaller systems & domestic wells
6. Account for return flows
7. Forecast future uses based on population

2010 Yakima Basin Population by Type of Water Service



Total Basin Population: 318,000

DRAFT
Provisional Results

2010 Population Served by All Categories (DRAFT)

County/Category	Pop. Served (2010)
Benton Co. (w/in Basin)	
Large Public Systems	5,110
Small Systems	8,436
Domestic Wells	4,592
Benton Co. Total	***18,138***
Kittitas Co.	
Large Public Systems	17,230
Small Systems	7,869
Domestic Wells	18,802
Kittitas Co. Total	***43,901***
Yakima Co.	
Large Public Systems	129,193
Small Systems	37,106
Domestic Wells	89,290
Yakima Co. Total	***255,589***
Total Basin Population	**317,628**

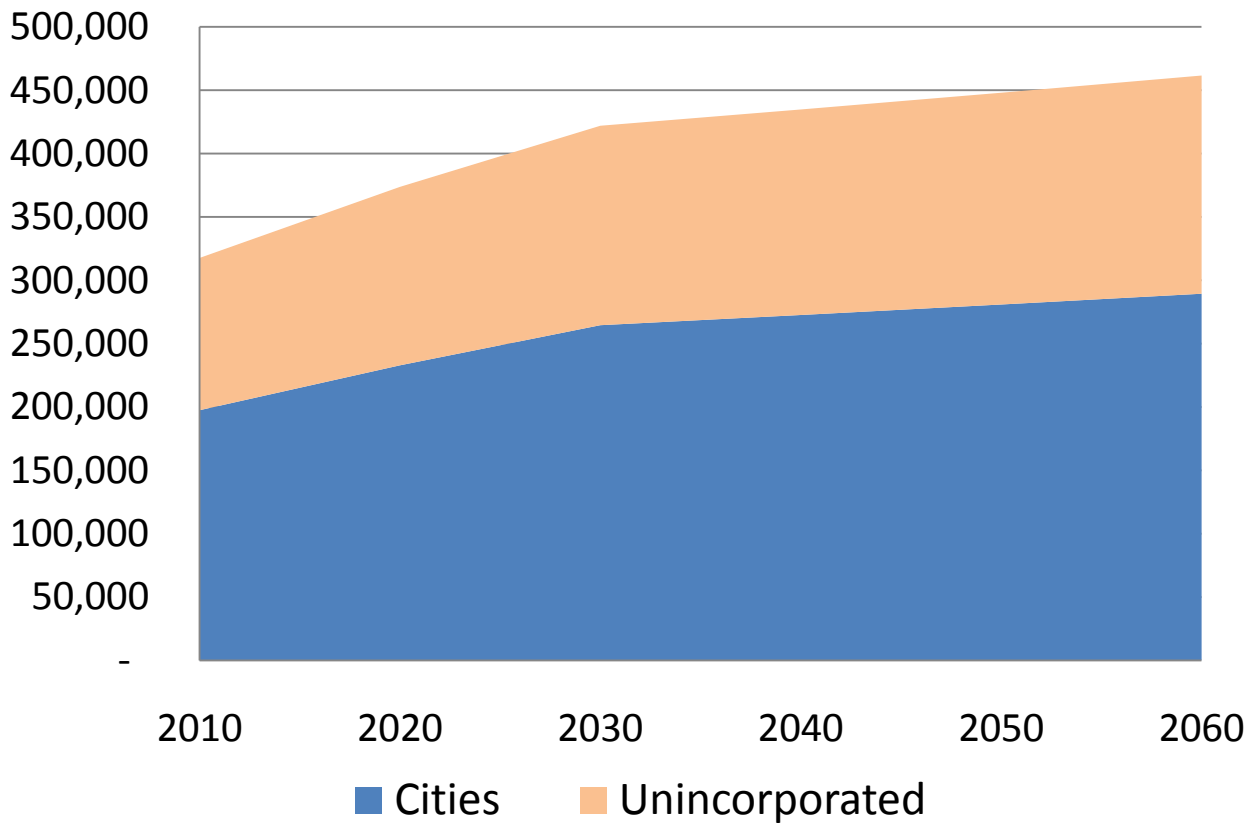
Population Forecasts

	2010	2030	2060
Yakima County	255,589	342,890	375,100
Kittitas County	43,901	55,510	60,730
Benton Co. (w/in Basin)	18,138	23,610	25,820
Total	**317,628**	**422,010**	**461,650**
Cities	197,436	264,560	289,400
Unincorporated	120,191	157,450	172,250
Total:	**317,628**	**422,010**	**461,650**

Based on County forecasts to 2025; then 1% annual growth to 2030; then 0.3% annual growth to 2060. (Does not address water availability as a constraint).

DRAFT
Provisional Results

Projected Population Growth



Growth to 2025 based on County projections; then 1% annual growth to 2030, then ½% annual growth to 2060.

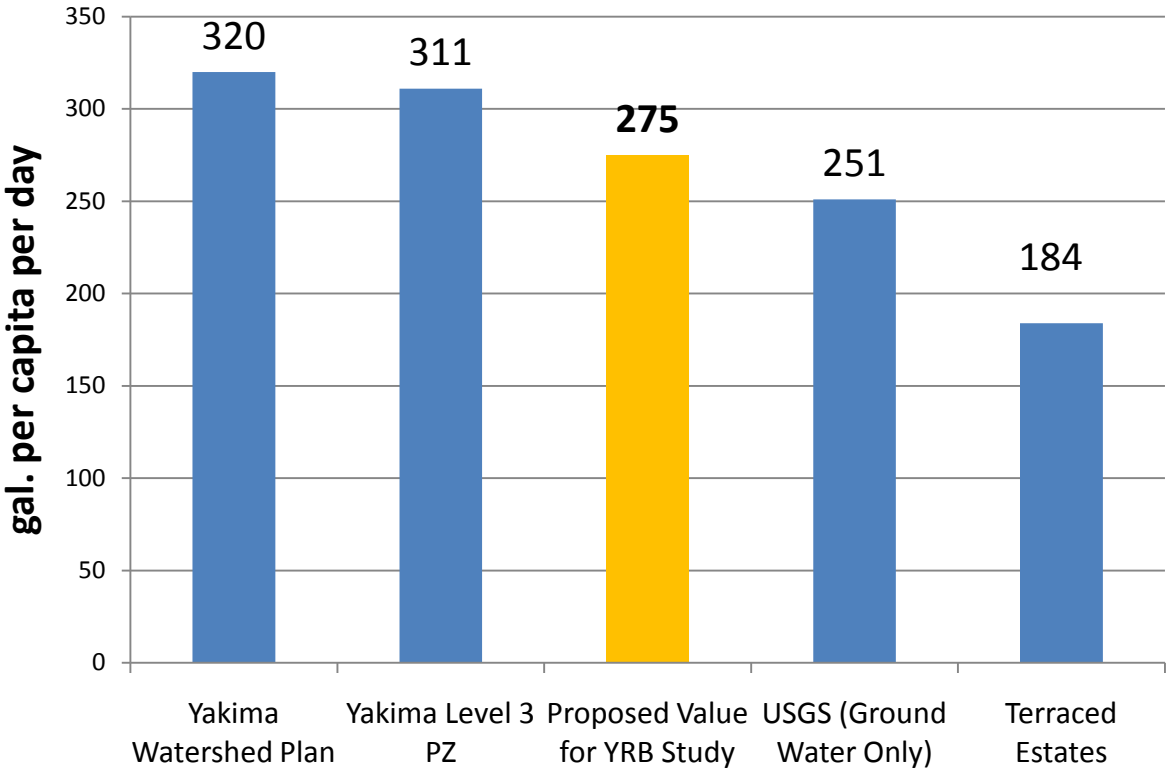
DRAFT
Provisional Results

Caveat on Population Growth

- Comparison with recent 20-year intervals:
- 1970 – 1990: **35%** increase
- 1980 – 2000: **19%** increase
- 1990 – 2010: **18%** increase
- 2010 – 2030: **33%** increase

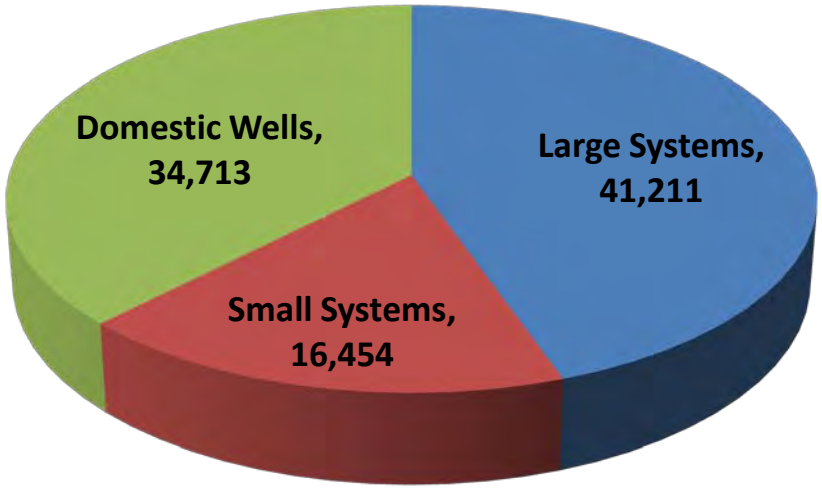
- Next step: follow up discussion with County planning departments

Estimates of Per Capita Use for Municipal/Domestic



DRAFT Provisional Results

Estimates of Current Municipal/Domestic Use (AFY -- 2010)



Total Estimated Use: 92,000 Acre-Feet

DRAFT
Provisional Results

Baseline 50-Year Change in Municipal/Domestic Use (considers pop. growth only) (DRAFT)

	2010	2060	Change
Large Systems	41,211	63,745	22,534
Small Systems	16,454	25,167	8,713
Domestic Wells	34,713	53,065	18,351
Total	92,378	141,976	**49,598**

Based on growth rates only. Per capita usage held constant.

Does not consider:

- Return flows through WTP's and septic systems.
- Future offsets from agricultural land conversion.
- Water availability as a constraint on growth.
- Future water conservation or climate change.

DRAFT
Provisional Results

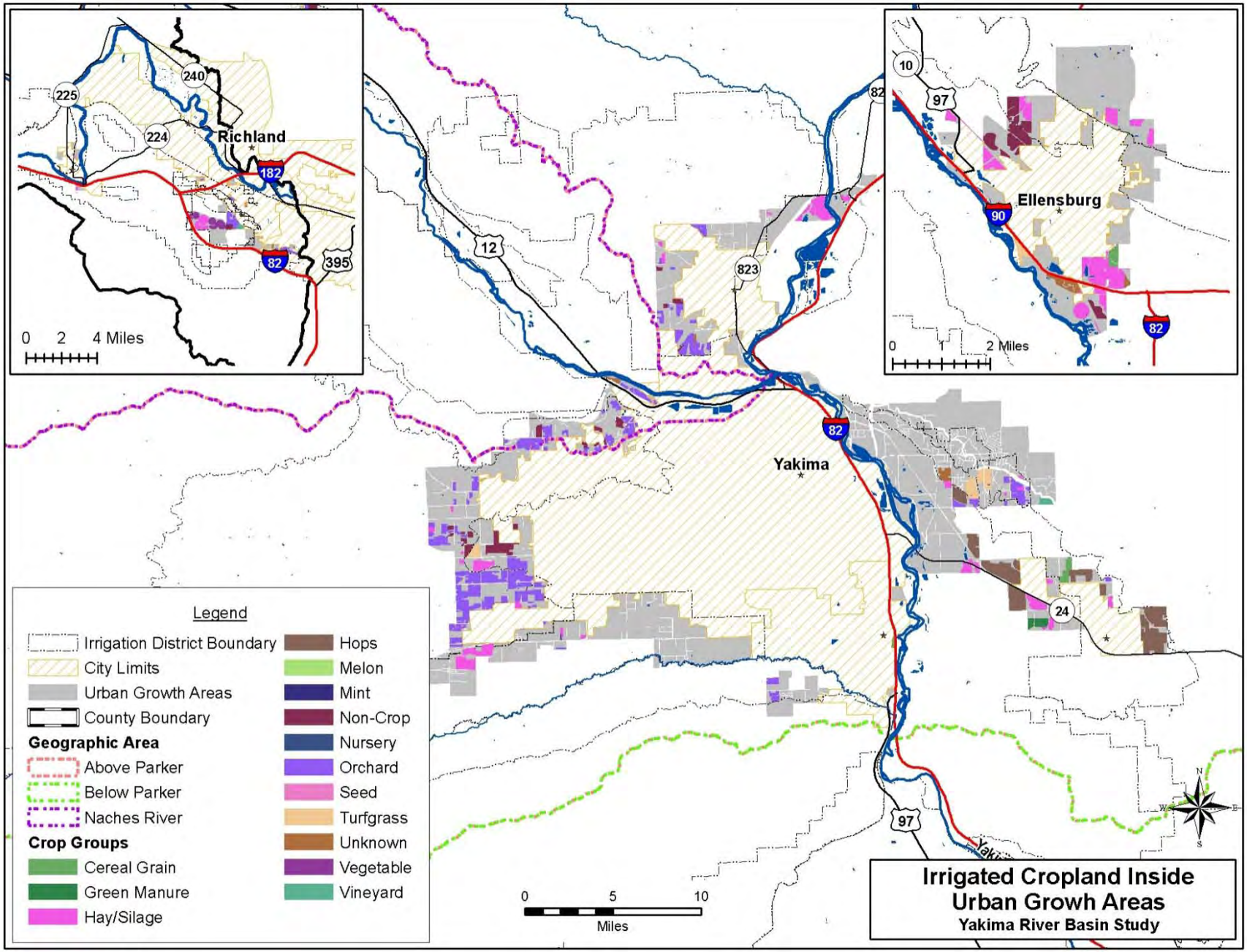
Next Steps for Municipal and Domestic Uses

- Current and Future Needs
  - Estimate Return Flows
- Future Needs Only
  - Calculate offsetting reduction from conversion of crop lands to urban uses
  - Estimate range of potential conservation savings
  - Estimate effects of climate change on outdoor uses.

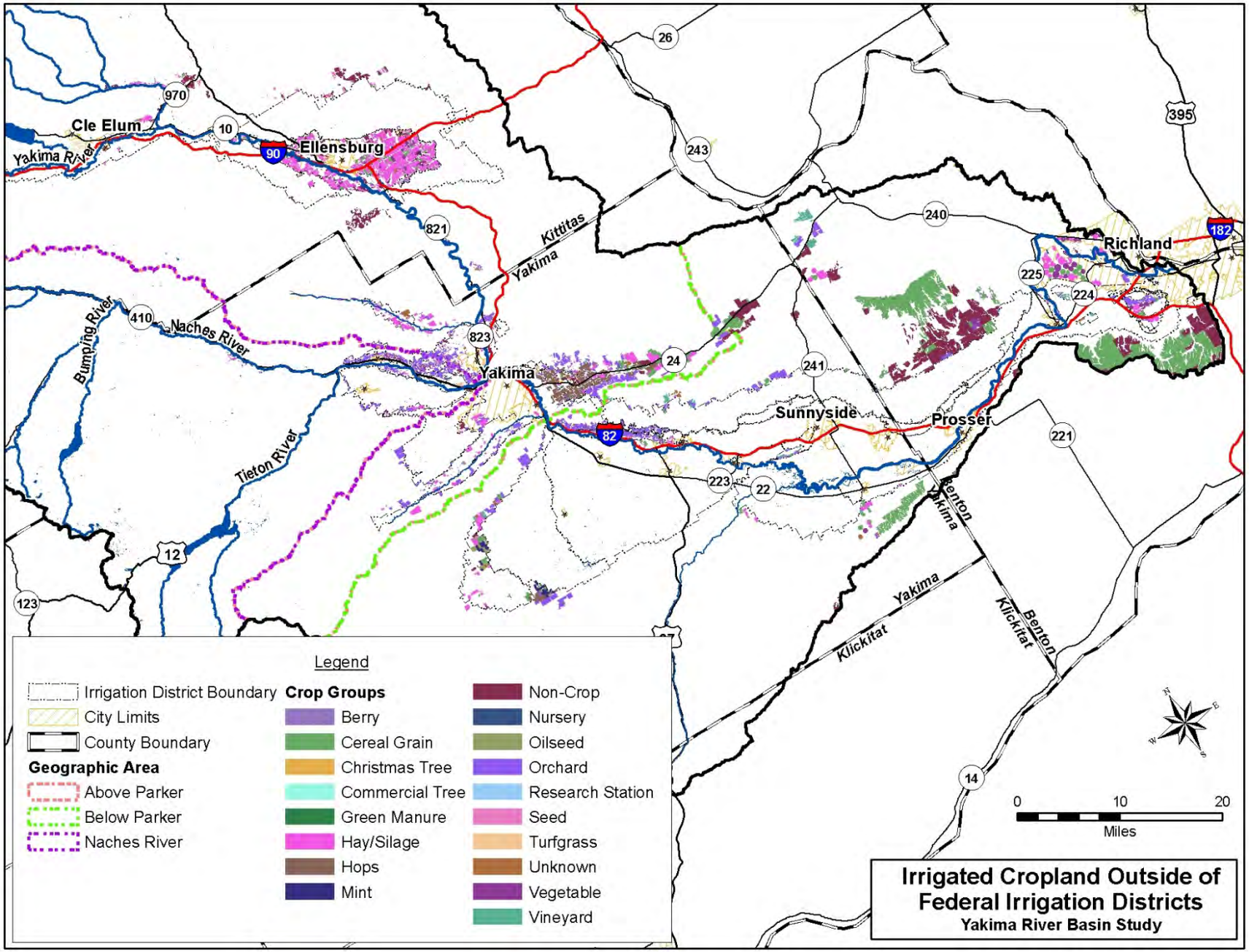
- Note: Final scope does not provide two elements discussed previously:
  - Econometric analysis
  - Uncertainty analysis

“Sideboards” for Municipal & Domestic Conservation

- **N0-Action Scenario**
  - Ongoing trends increase efficiency
  - Some reduction in system losses
  - Programs inconsistent across basin and don’t include domestic wells
- **Comprehensive Scenario**
  - Assumes more stringent plumbing code in future
  - Communities promote conservation extensively
  - Higher reduction in system losses
  - Programs are consistent across Basin and include


Richland
240
225
224
182
82
395
0 2 4 Miles
Ellensburg
10
97
90
82
0 1 2 Miles
12
823
82
Yakima
24
97
Legend
Irrigation District Boundary
City Limits
Urban Growth Areas
County Boundary
Geographic Area
Above Parker
Below Parker
Naches River
Crop Groups
Cereal Grain
Green Manure
Hay/Silage
Hops
Melon
Mint
Non-Crop
Nursery
Orchard
Seed
Turfgrass
Unknown
Vegetable
Vineyard
0 5 10
Miles
N
W
E
S
Irrigated Cropland Inside
Urban Growh Areas
Yakima River Basin Study

AGRICULTURE: NON-FEDERAL


Cle Elum
Yakima River
Ellensburg
Kittitas
Yakima
Bumping River
Naches River
Tieton River
Yakima
Sunnyside
Prosser
Richland
Benton
Yakima
Klickitat
Benton
Klickitat
970
10
90
26
243
395
821
240
182
225
224
410
823
24
241
82
221
223
22
12
123
14
Legend
Irrigation District Boundary
City Limits
County Boundary
Geographic Area
Above Parker
Below Parker
Naches River
Crop Groups
Berry
Cereal Grain
Christmas Tree
Commercial Tree
Green Manure
Hay/Silage
Hops
Mint
Non-Crop
Nursery
Oilseed
Orchard
Research Station
Seed
Turfgrass
Unknown
Vegetable
Vineyard
0
10
20
Miles
Irrigated Cropland Outside of Federal Irrigation Districts
Yakima River Basin Study

Progress on Non-Federal Category

- Acquired database of crop patterns
- Have done initial runs to estimate diversions
- Some holes in the data – working to resolve

OTHER USES

Other Uses

Use	AFY
Fish & Wildlife (GW)	9,000
Commercial/Industrial (GW)	7,000
Livestock (GW)	7,000
Non-Community Public Water Systems	3,000
Fish & Wildlife (SW)	TBD
Hydropower (SW)	TBD
Livestock (SW)	TBD

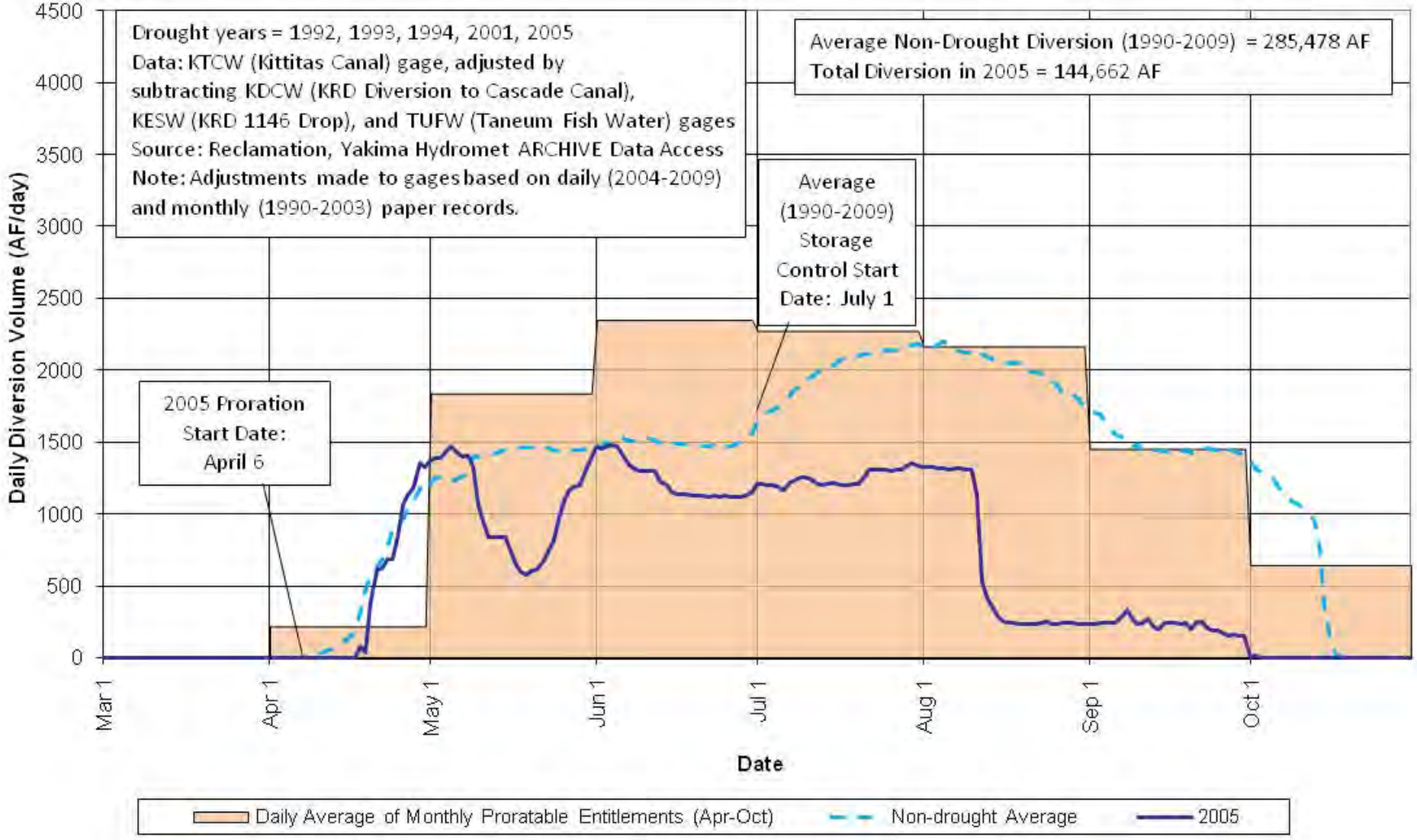
GW = ground water; SW = surface water

Ground water data from USGS (SIR 2006-5205 , April 2009).

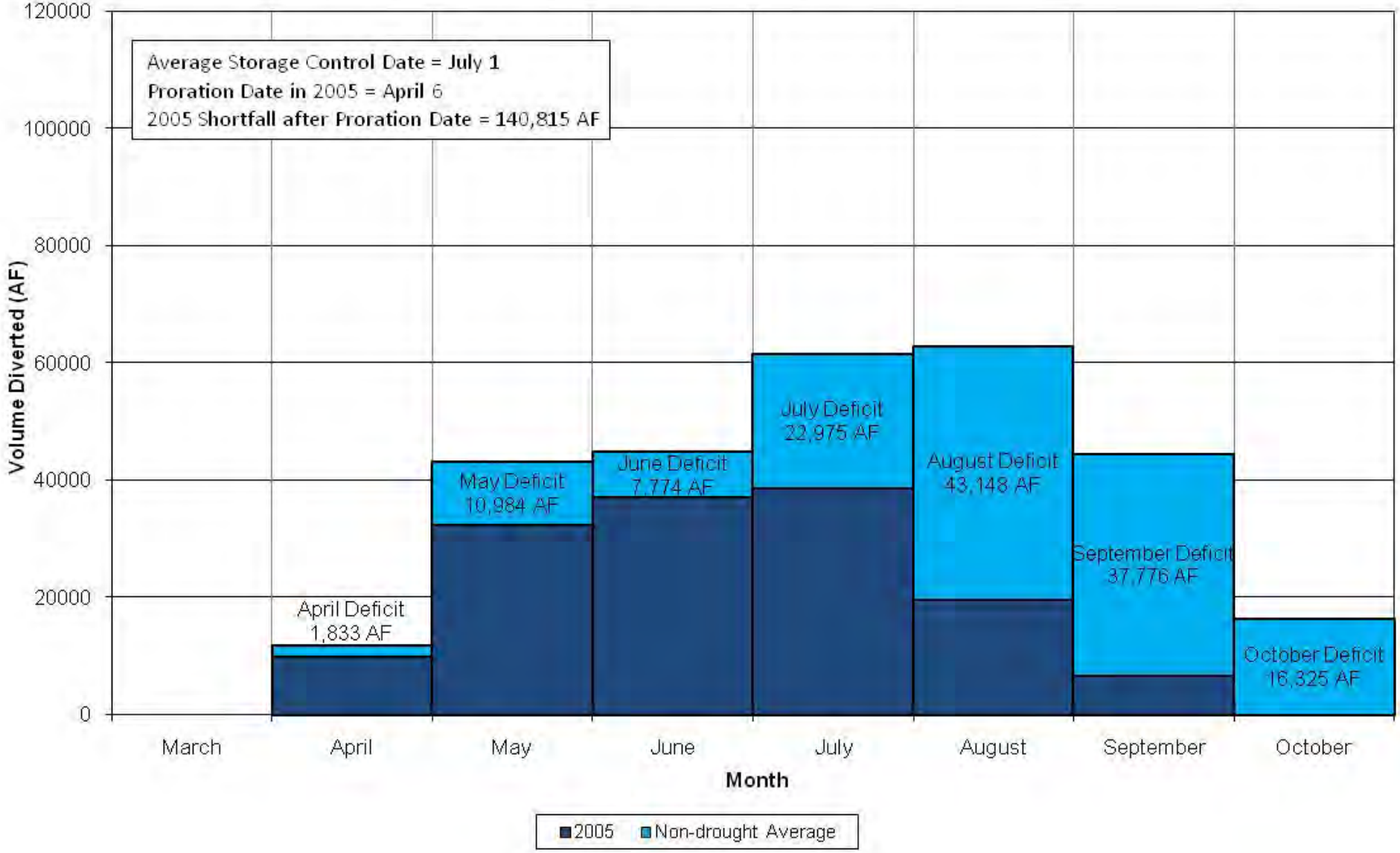
Questions/Discussion

ADDITIONAL SLIDES

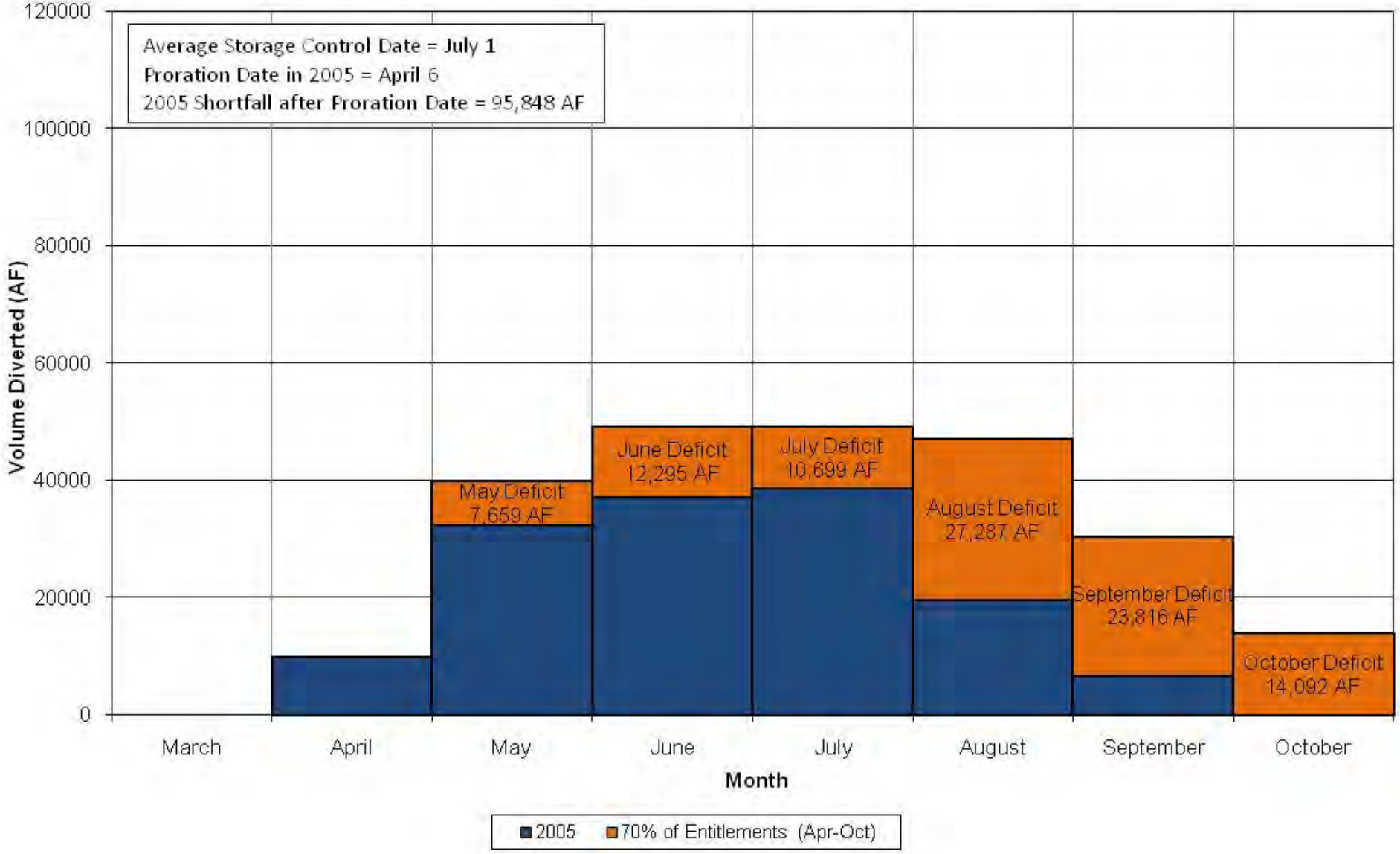
KRD Diversion Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2005



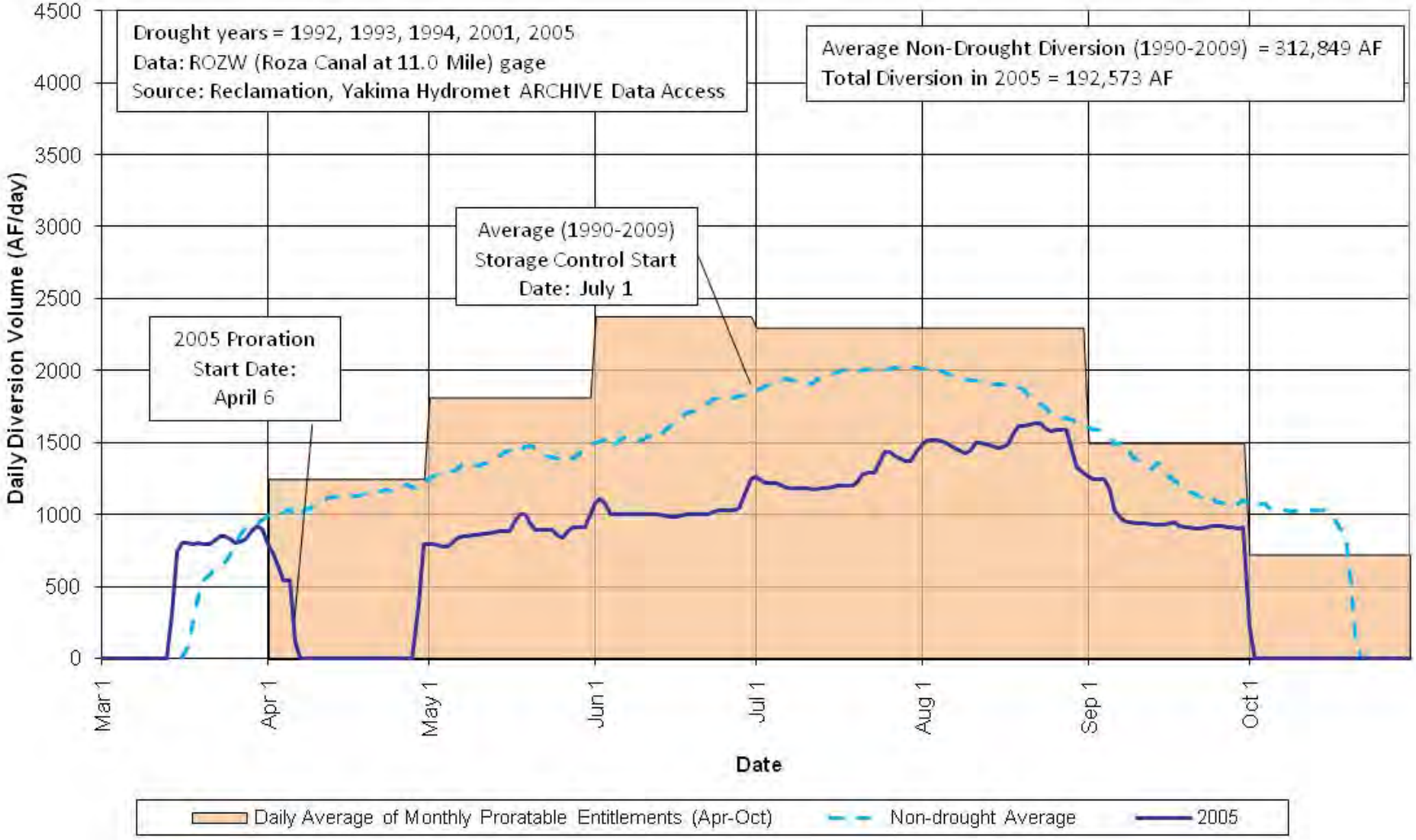
KRD Monthly Diversion Deficit Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2005



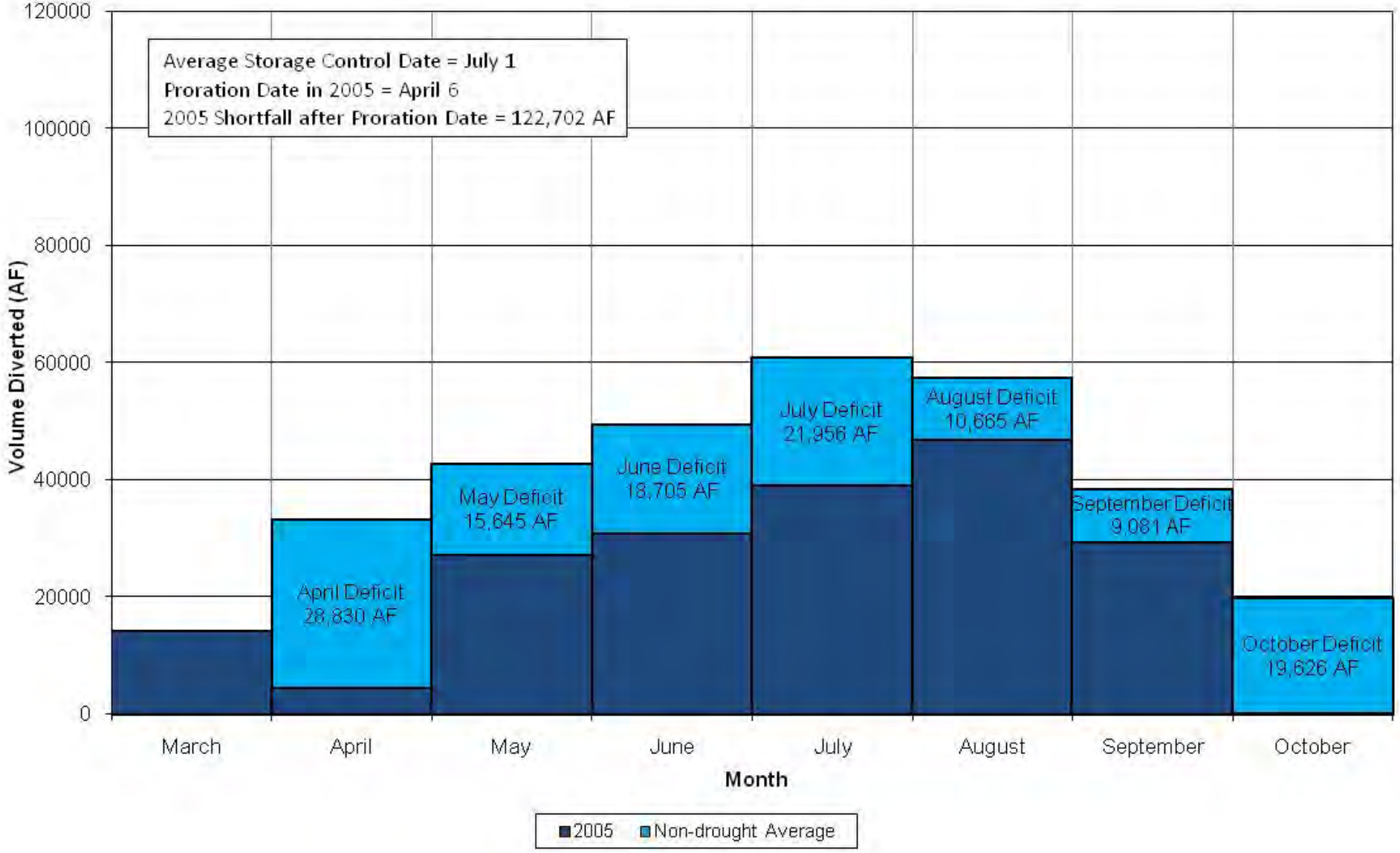
KRD Monthly Diversion Deficit Comparison
70 Percent of Entitlements vs. Drought Year 2005



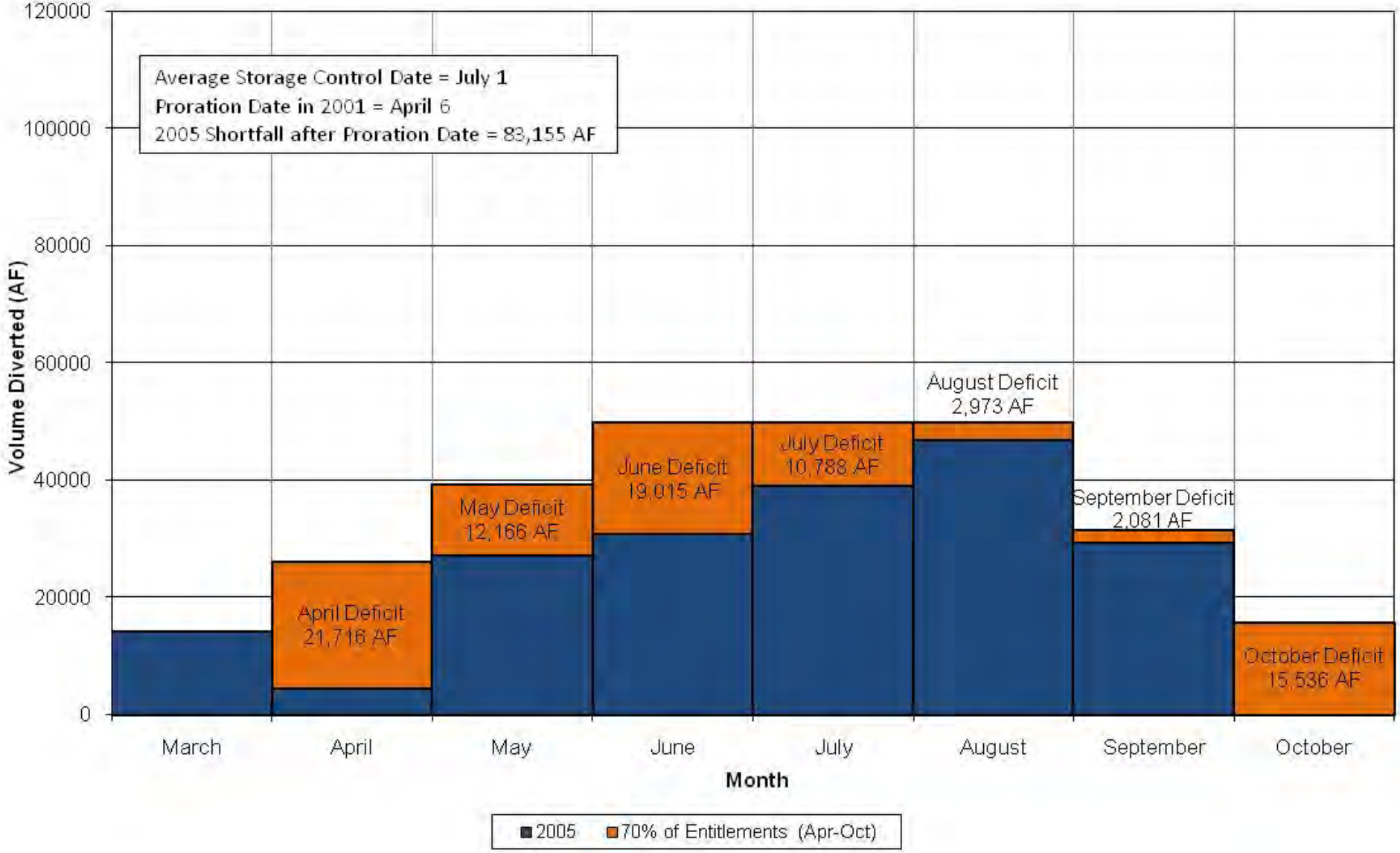
Roza Irrigation District Diversion Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2005



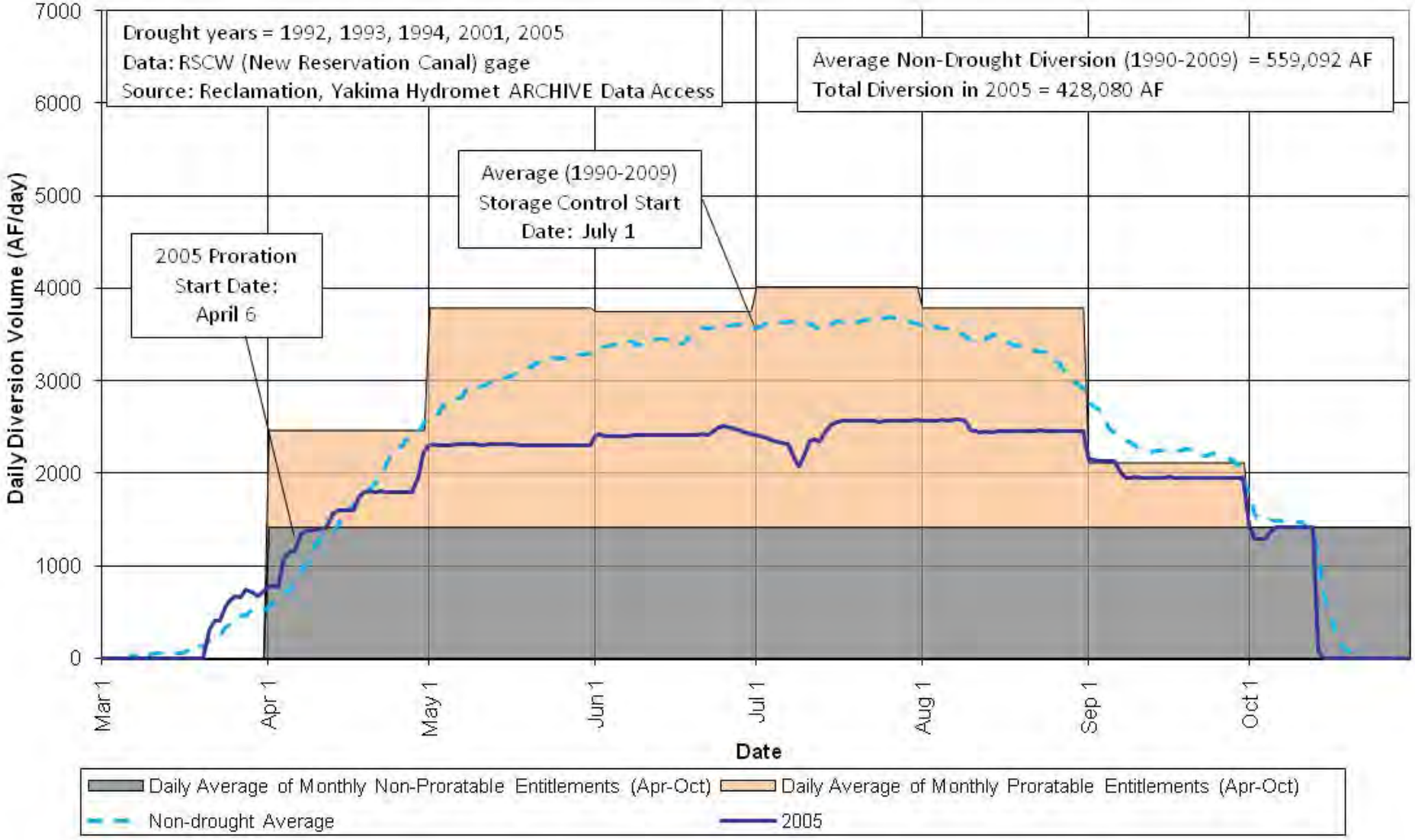
Roza Irrigation District Monthly Diversion Deficit Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2005

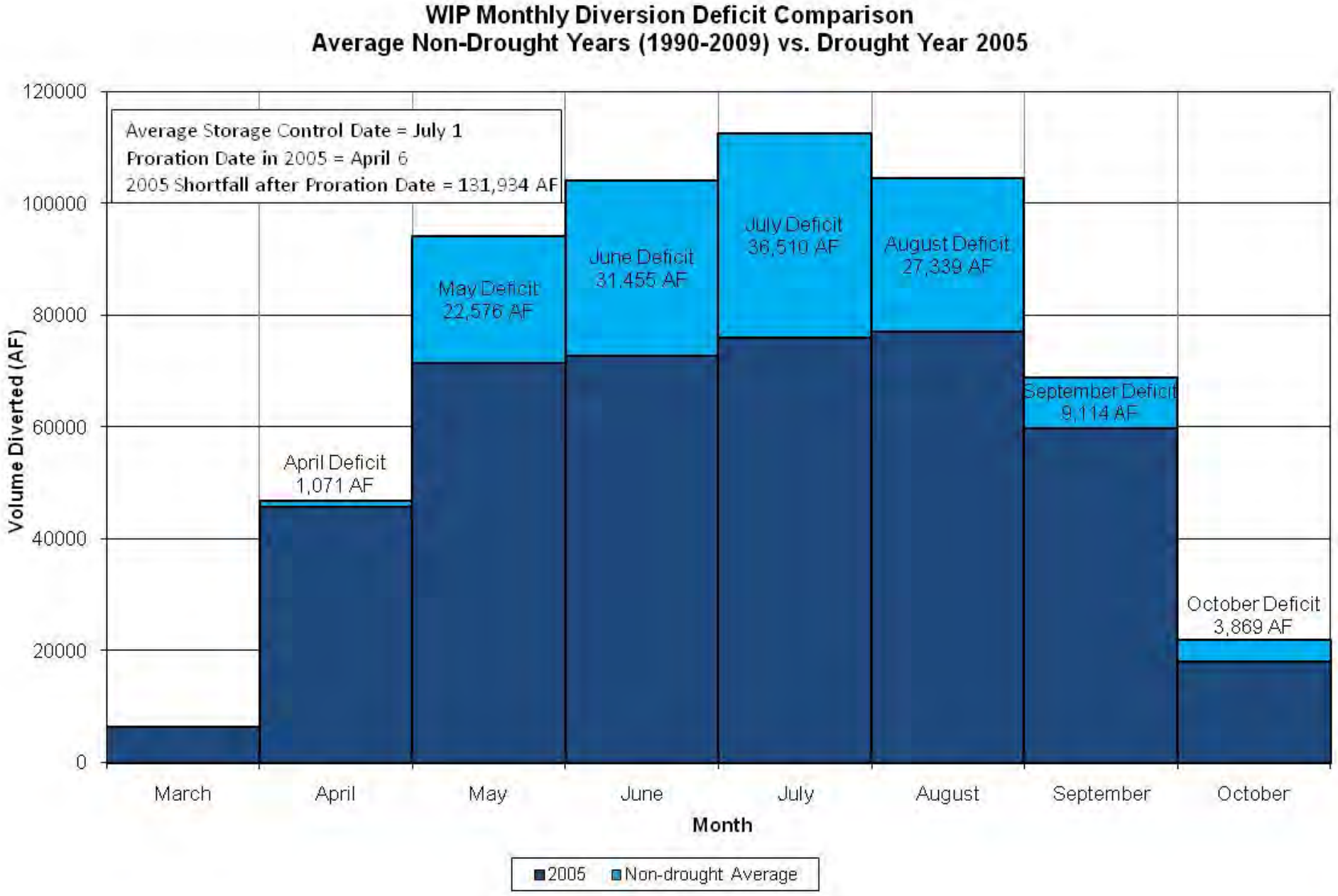


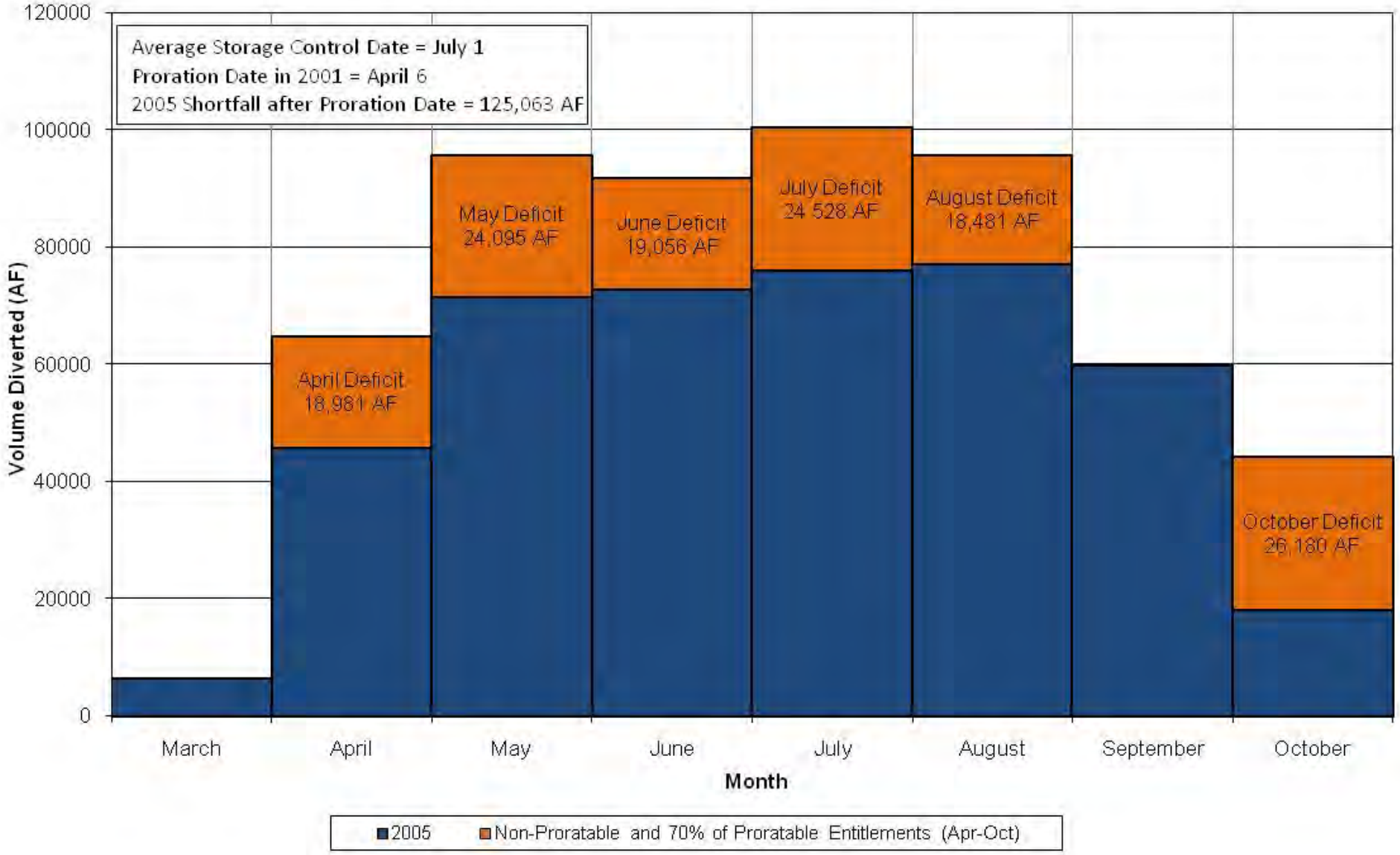
Roza Irrigation District Monthly Diversion Deficit Comparison
70 Percent of Entitlements vs. Drought Year 2005



WIP Diversion Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2005




WIP Monthly Diversion Deficit Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year 2005
Average Storage Control Date = July 1
Proration Date in 2005 = April 6
2005 Shortfall after Proration Date = 131,934 AF
April Deficit
1,071 AF
May Deficit
22,576 AF
June Deficit
31,455 AF
July Deficit
36,510 AF
August Deficit
27,339 AF
September Deficit
9,114 AF
October Deficit
3,869 AF
120000
100000
80000
60000
40000
20000
0
Volume Diverted (AF)
March
April
May
June
July
August
September
October
Month
2005
Non-drought Average


WIP Monthly Diversion Deficit Comparison
Non-Proratable and 70 Percent of Proratable Entitlements vs. Drought Year 2005
Average Storage Control Date = July 1
Proration Date in 2001 = April 6
2005 Shortfall after Proration Date = 125,063 AF
April Deficit 18,981 AF
May Deficit 24,095 AF
June Deficit 19,056 AF
July Deficit 24,528 AF
August Deficit 18,481 AF
October Deficit 26,180 AF
Volume Diverted (AF)
120000
100000
80000
60000
40000
20000
0
March
April
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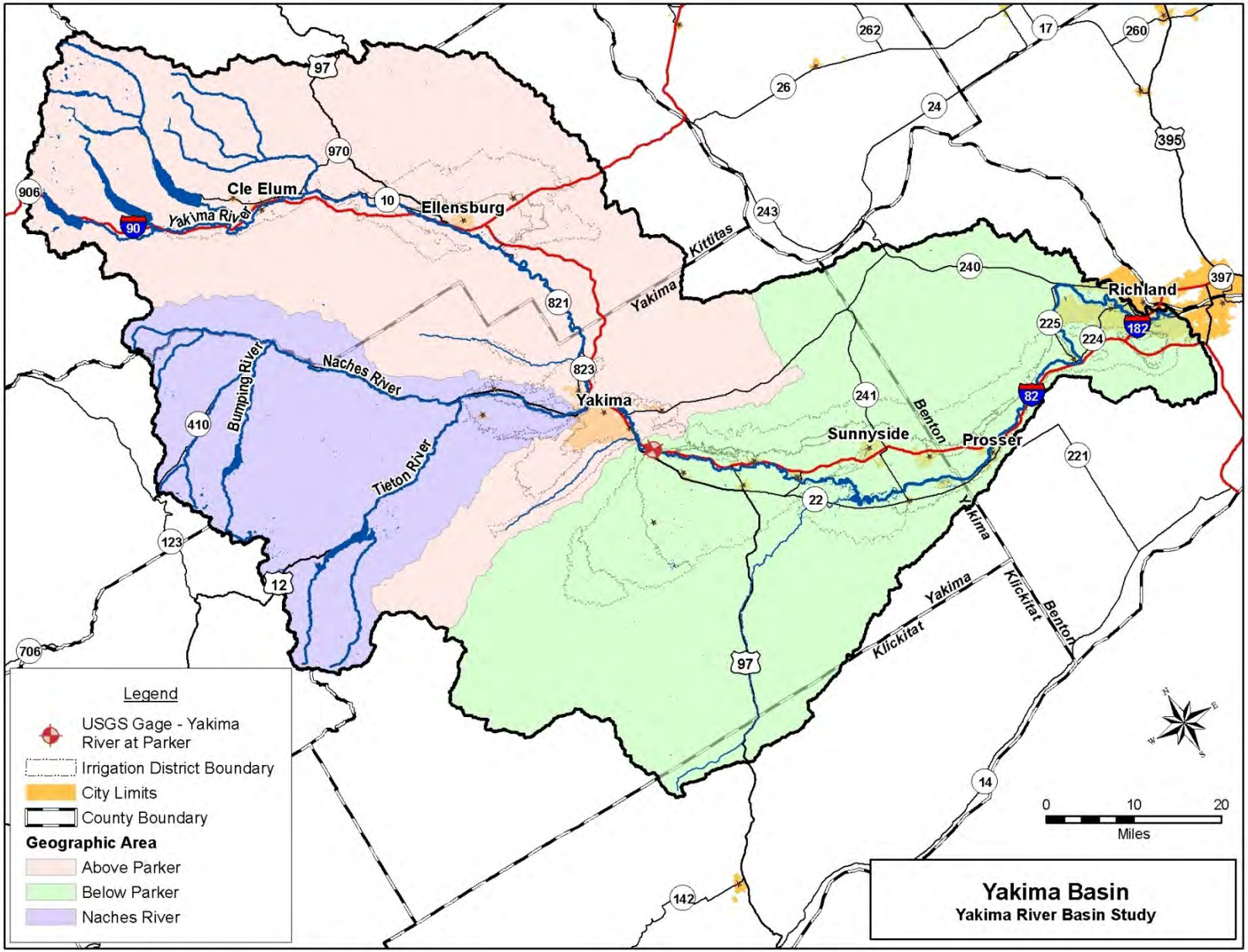
September
October
Month
2005
Non-Proratable and 70% of Proratable Entitlements (Apr-Oct)


Cle Elum
Ellensburg
Yakima River
Kittitas
Yakima
Naches River
Bumping River
Tieton River
Yakima
Richland
Sunnyside
Prosser
Benton
Yakima
Klickitat
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Legend
USGS Gage - Yakima River at Parker
Irrigation District Boundary
City Limits
County Boundary
Geographic Area
Above Parker
Below Parker
Naches River
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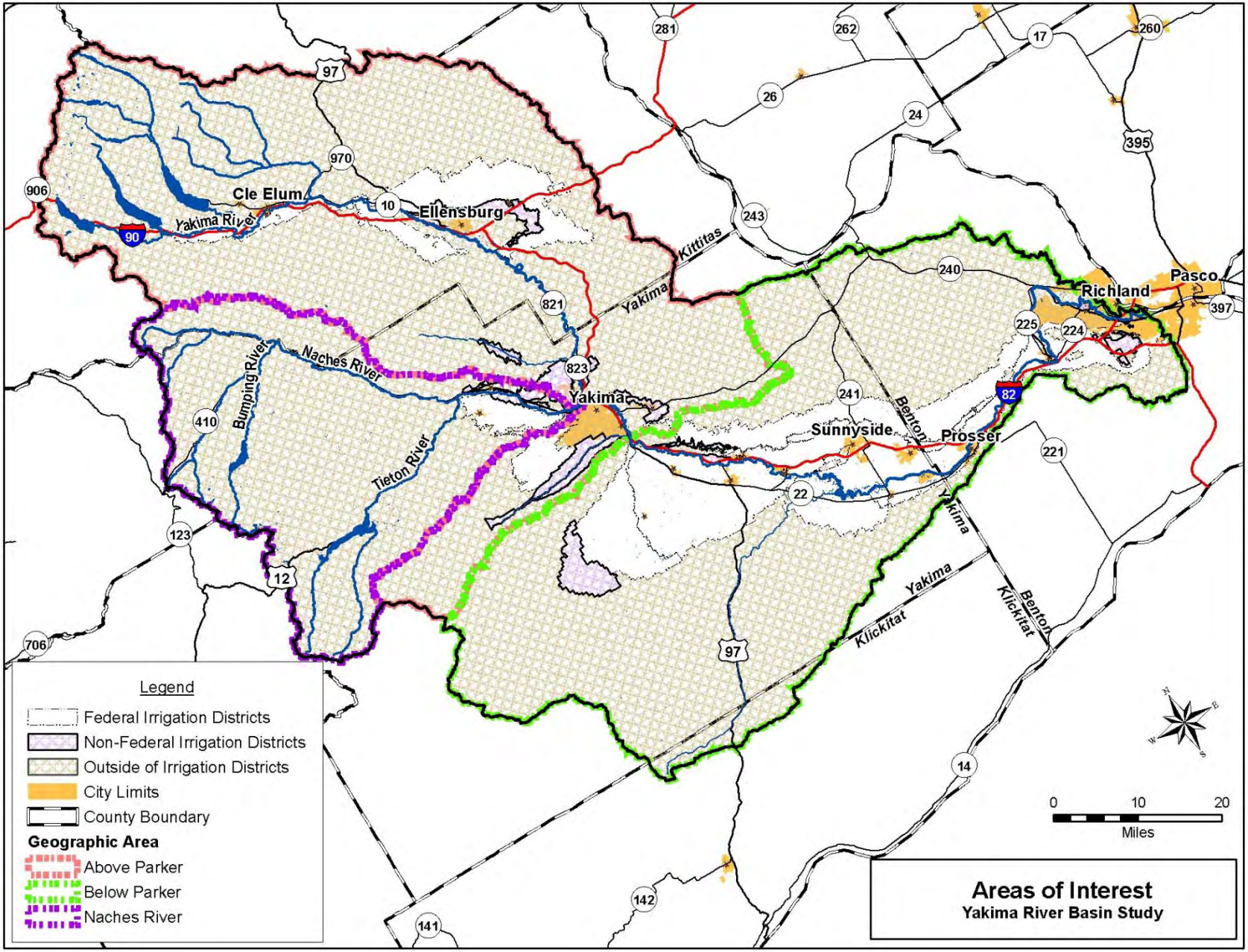
Miles
Yakima Basin
Yakima River Basin Study


Legend
Federal Irrigation Districts
Non-Federal Irrigation Districts
Outside of Irrigation Districts
City Limits
County Boundary
Geographic Area
Above Parker
Below Parker
Naches River
Areas of Interest
Yakima River Basin Study
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Ellensburg
Yakima
Sunnyside
Prosser
Richland
Pasco
Yakima River
Kittitas
Bumping River
Naches River
Tieton River
Benton
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