TECHNICAL MEMORANDUM 03

To: Peter Martins, P.E., Project Manager

From: David Carlson, Project Manager
Carmen Nale, P.E., Project Engineer

Date: August 27, 2012

RE: **Water Supply Needs**

1.0 INTRODUCTION

1.1 Overview

The purpose of this technical memorandum (TM) is to review and update the Joint Water Commission (JWC) water demand projections and to validate water supply needs for the Water Supply Evaluation Project. This Project includes the investigation of additional water supply options.

1.2 Purpose

The overall objective is to update the water demand projections and to validate water supply needs of the JWC. The scope of work for TM03 includes the following:

- Update Hillsboro Water Demand Projection.
- Update Tualatin Basin Water Supply Partner Demand Projections.
  - Calculate the average day demand, peak day demand, and peak season demand for TVWD, Hillsboro, Forest Grove, and Beaverton. State methodology and uncertainties provided by each entity.
  - Incorporate the storage water needs of Clean Water Service (CWS).
  - Aggregate water supply into consumptive and non-consumptive water needs for comparing drinking water with wastewater treatment needs.
  - Summarize in tabular and graphical forms the individual and aggregate water demands and summer storage needs.

1.3 Data Sources

The following is a list of the data provided by the JWC used for this TM:

- City of Forest Grove Water Demands from Forest Grove-Supply-Demand for JWC Alt. Analysis_20100427.xlsx.
- Clean Water Service Water Demands from Demand Summary 10-24-07 – FINAL.xls. This spreadsheet was updated in a Technical Advisory Committee (TAC) team meeting April 27, 2010, by shifting the transition year from 2015 to 2020 to match the TVWD switch from Portland supply to the JWC supply.

- Clean Water Services Draft Dam Raise Technical Memorandum dated November 26, 2010.
- TVWD Water Demands from TVWD Demand Update – Rev 1 – Sept 2010.xls. This spreadsheet was updated by Hillsboro in January 2011.
- City of Beaverton from JWC-COBdemand41210.pdf. This spreadsheet was updated by Hillsboro in January 2011.
- Existing water rights from JWC Existing Storage Volumes.xlsx.

1.4 Study Area

The study area includes the JWC and Clean Water Services (CWS).

The JWC is a collective water supply agency formed under an ORS 190 agreement between the Cities of Hillsboro, Forest Grove, Beaverton, and TVWD. The City of North Plains became a wholesale customer to the JWC in June 2005. The JWC treats water at its 75 million gallon per day (MGD) maximum capacity water treatment plant (WTP) and distributes it on a wholesale basis to the member agencies, which in turn deliver water to area customers. The existing service area is shown on Figure 3-1. Through its member agencies, the JWC provides potable water for a service population of roughly 252,000. The ownership of facilities among the group includes raw water impoundment in Barney Reservoir, raw water storage contracts with the Bureau of Reclamation in Scoggins Reservoir, a 75 million gallon per day (MGD) water treatment plant located along the Tualatin River, two 20 million gallon (MG) finished water reservoirs located atop Fern Hill, and three transmission lines that deliver finished water to the JWC members.

As the 2050 planning horizon nears, it is anticipated that continued growth may lead to the extension of urban zoning and each JWC partner's water service area into new urban growth areas as permitted under Oregon statues. These growth areas are shown as "potential urban reserves" on Figure 3-1. These areas correspond to the areas approved by the Metro Council in Resolution #11-4245.

There are several third party wholesale agreements, through the City of Hillsboro, which allow other agencies to receive JWC water. The City of Gaston, LA Water Co-Op, and a portion of the Upper System can be fed from either the JWC WTP or the City of Hillsboro's Cherry Grove Slow Sand WTP. Currently these customers are served primarily from the Cherry Grove WTP and receive supplemental flow from the JWC WTP through the Dilley PRV. Prior to August 2004, the City of Cornelius was fed from the Cherry Grove Slow Sand WTP; in 2004 their service was switched to the JWC WTP. Demands associated with these third party agencies are included in the demands for the City of Hillsboro.

CWS is a special service district for the wastewater, stormwater and water resources management for the urban areas of Washington County. It serves twelve member cities and owns and operates four wastewater treatment plants.

FACILITY KEY

20 Reservoir ID
20 Other Facility ID

NAME	KEY ID
Dilley Reservoir	1
Springville Reservoir	2
Thompson Reservoir	3
North Road Reservoir	4
Bonny Slope Reservoir	5
Bonny Slope Park Reservoirs	6
Cornell Reservoir	7
Teufel Reservoir	8
Somerset Reservoir	9
Sunset Reservoir	10
Rosander Reservoir	11
Inglewood Reservoir	12
Hyde Park Reservoir	13
Garden Home Reservoirs	14
Florence Ln. Reservoirs	15
Taylors Ferry Reservoirs	16
Schell Reservoir	17
Cooper Mt. Reservoir (TVWD)	18
Goyak Reservoir	19
189th Reservoir	20
Grabhorn Reservoir	21
Evergreen Reservoir	22
24th Ave. Reservoir	23
Fern Hill Reservoirs	24
Sexton Mt. Reservoir	25
Cooper Mt. Reservoir (Beaverton)	26
Booster Pump Station	27
Booster Pump Station	28
Hillsboro Pump Station	29
Forest Grove Pump Station	30
Teufel Pump Station	31
Sunset Pump Station	32
Inglewood Pumps	33
Viewmont #1 Pump Station	34
189th Ave. Pump Station	35
Goyak Pump Station	36
Cooper Mt. Pump Station	37
Florence Ln. Pump Station	38
Bethany Pump Station	39
Viewmont #2 Pump Station	40
Catlin Crest Pump Station	41
Bannister Pump Station	42
Evergreen Pump Station	43
JWC Treatment Plant	44
Forest Grove Treatment Plant	45
JWC Intake Pump Station	46

LEGEND

FACILITIES
- JWC Intake
- JWC Pump Station
- JWC-Member Pump Station
- JWC Reservoir
- JWC-Member Reservoir
- JWC Treatment Plant
- JWC-Member Treatment Plant
- Beaverton Turnout
- Forest Grove Turnout
- Hillsboro Turnout
- North Plains Turnout
- TVWD - Portland Water Bureau Turnout
- TVWD Turnout

PIPES
- JWC Transmission Main
- JWC-Member Distribution Main

BASEMAP
- Freeway
- Major Arterial
- Waterbody
- River
- Tualatin Valley Water District
- City of Hillsboro Service Area
- City of Beaverton Service Area
- Tigard Water Service Area
- Cities
- Incorporated Area
- County Boundary
- Urban Growth Boundary
- Potential Urban Reserves

N

Project No.: 161669
Sources: Joint Water Commission (JWC)
City of Hillsboro
Tualitin Valley Water District (TVWD)
Washington County
Metro Data Resource Center

1 0 1 2 Miles

1 inch = 2 miles

BLACK & VEATCH
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Joint Water Commission

FIGURE 3-1

JWC WATER SYSTEM MAP

2.0 DEMAND PROJECTIONS

Updated JWC water demand projections from Year 2010 through Year 2050 were projected by each JWC partner and provided by the JWC for use in this TM. With the exception of the City of Hillsboro, independent projections were not evaluated or generated by Black & Veatch as part of this TM. Conservation was factored into the Hillsboro demands by utilizing the more recent per acre water consumption use for each zone. The City has seen reductions of use on that basis due to the higher density and recent updates in water efficient plumbing standards. Climate change impacts on water supply were included in the projections by assuming 184-day release season over the term of the study and a reduction of Hillsboro's natural flow right availability by 25%. The reduction was based on a conservative estimate provided in a recent climate change study completed on the Tualatin River by the University of Washington's Climate Impacts Group, *The Impacts of Climate Change on the Tualatin Basin Water Supply*, (Palmer et al., 2005). The following types of demands are included in the updated demand projections for 2010 through 2050:

- Average day demands (ADD): ADD is the daily demand averaged over a one-year period. A summary of the ADD projections for 2010 through 2050 are shown in Table 3-1a (mgd) and Table 3-1b (cfs), and the corresponding Figure 3-2a (mgd) and Figure 3-2b (cfs).
- Peak day demands (PDD): PDD is the maximum daily demand over a one-year period. PDD can also be referred to as Maximum Day Demand (MDD). PDD projections are typically calculated as the product of the ADD and the PDD peaking factor. Peak day demand (PDD) is the maximum quantity of water used on any one day of the year. The peak day demand is used to size water supply and water treatment infrastructure to ensure that reservoirs can be refilled following a day of peak demand. A summary of the PDD projections for 2010 through 2050 are shown in Table 3-2a (mgd) and Table 3-2b (cfs), and the corresponding Figure 3-3a (mgd) and Figure 3-3b (cfs).
- Peak Season Demand (PSD): PSD is defined as the average peak season demand roughly during the summer months of July, August and September.
    - For this Project, the 184 day peak season demand (184 Day PSD) will be used to account for unknown impacts to future storage requirements caused by climate change, etc. The 184 Day PSD is defined as the average PSD during May 1st through Oct 31st. A summary of the average peak season demand projections for 2010 through 2050 are shown in Table 3-3 and the corresponding Figure 3-4a (mgd) and Figure 3-4b (mg and acre-ft).
    - For comparison, the 160 day peak season demand (160 Day PSD) was calculated since this corresponds to current storage requirements. The 160 Day PSD is defined as the average PSD during May 25th through Oct 31st. A summary of the average peak season demand projections for 2010 through 2050 are shown in Table 3-4 and the corresponding Figure 3-5a (mgd) and Figure 3-5b (mg and acre-ft).

All demands presented in this memorandum are for JWC water use only and do not include JWC partner demands met by other sources unless otherwise noted.

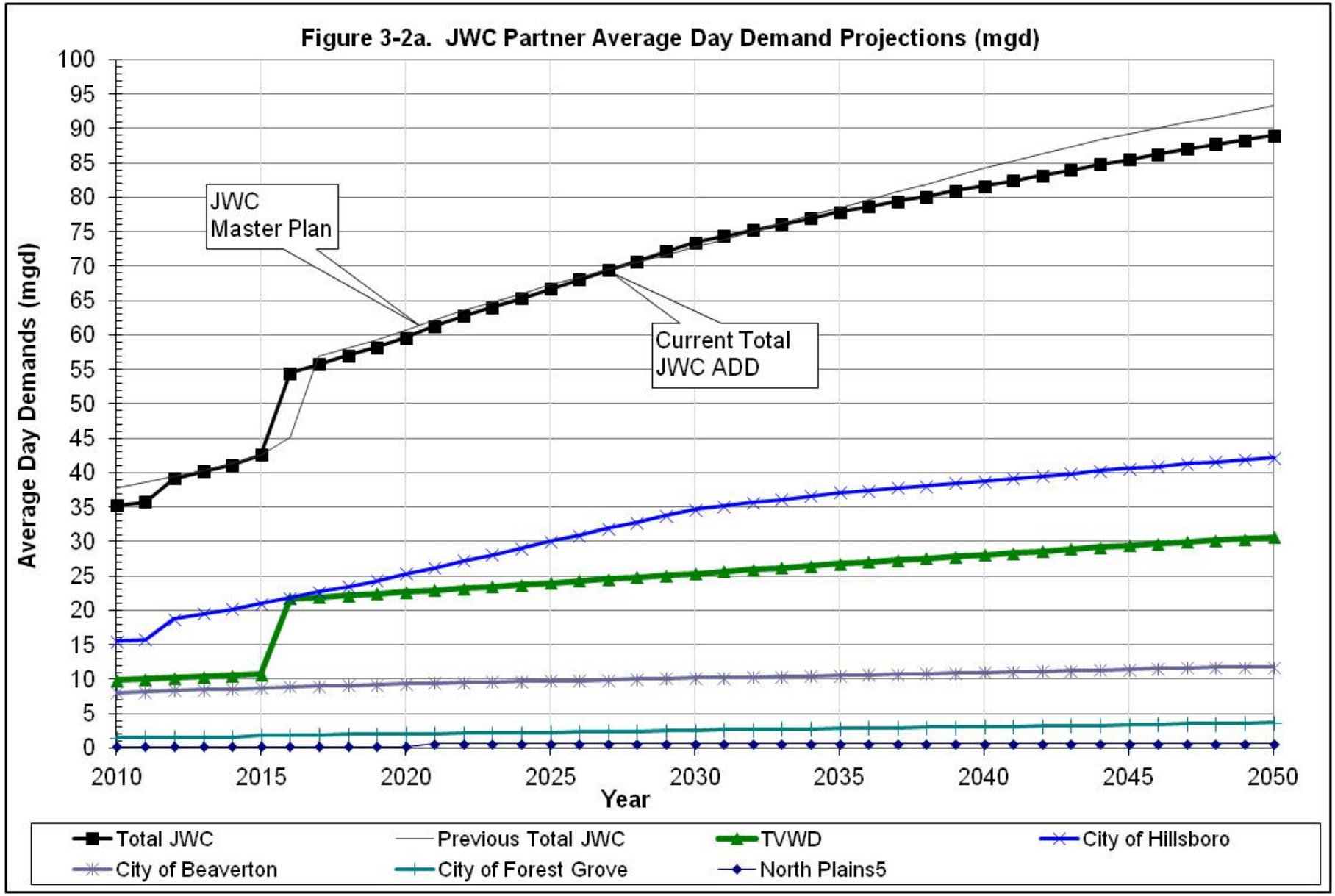
Figure 3-2a. JWC Partner Average Day Demand Projections (mgd)
Average Day Demands (mgd)
Year
JWC Master Plan
Current Total JWC ADD
Total JWC
Previous Total JWC
TVWD
City of Hillsboro
City of Beaverton
City of Forest Grove
North Plains5

Table 3.1a. JWC Partner Average Day Demand Projections (mgd)

Year	City of Beaverton[4]		City of Forest Grove[3]			City of Hillsboro[1]	TVWD[2]			North Plains[5]	Total JWC ADD	Previous Total JWC
	JWC	Total	Local Supply	JWC	Total		JWC	Portland	Total			
2010	8.1	8.1	1.7	1.5	3.2	15.5	9.9	13.2	23.1	0.2	**35.2**	37.8
2011	8.2	8.2	1.7	1.5	3.2	15.8	10.0	13.2	23.2	0.2	**35.8**	38.6
2012	8.4	8.4	1.7	1.6	3.3	18.8	10.2	13.2	23.4	0.2	**39.2**	39.5
2013	8.5	8.5	1.7	1.6	3.3	19.5	10.4	13.2	23.6	0.2	**40.2**	40.4
2014	8.6	8.6	1.7	1.6	3.3	20.2	10.6	13.2	23.8	0.2	**41.2**	41.3
2015	8.8	8.8	1.8	1.8	3.6	21.0	10.7	13.2	23.9	0.2	**42.6**	42.5
2016	8.9	8.9	1.8	1.9	3.7	21.8	21.7	2.5	24.2	0.2	**54.5**	45.1
2017	9.0	9.0	1.8	1.9	3.7	22.7	22.0	2.5	24.5	0.2	**55.8**	56.9
2018	9.1	9.1	1.9	2.0	3.9	23.5	22.2	2.6	24.8	0.2	**57.1**	58.1
2019	9.2	9.2	1.9	2.0	3.9	24.3	22.5	2.6	25.0	0.2	**58.2**	59.3
2020	9.3	9.3	1.9	2.1	4.0	25.3	22.7	2.6	25.3	0.2	**59.6**	60.6
2021	9.4	9.4	1.9	2.1	4.0	26.2	23.0	2.6	25.6	0.7	**61.4**	62.3
2022	9.5	9.5	1.9	2.1	4.1	27.2	23.2	2.7	25.9	0.7	**62.7**	63.5
2023	9.6	9.6	2.0	2.2	4.1	28.1	23.5	2.7	26.2	0.7	**64.0**	64.8
2024	9.7	9.7	2.0	2.2	4.2	29.0	23.7	2.7	26.5	0.7	**65.3**	66.1
2025	9.8	9.8	2.0	2.3	4.2	30.0	24.0	2.8	26.8	0.7	**66.7**	67.3
2026	9.8	9.8	2.0	2.4	4.4	30.9	24.3	2.8	27.1	0.7	**68.0**	68.5
2027	9.9	9.9	2.1	2.4	4.5	31.9	24.6	2.8	27.4	0.7	**69.5**	69.5
2028	10.0	10.0	2.1	2.5	4.5	32.8	24.8	2.9	27.7	0.7	**70.7**	70.5
2029	10.1	10.1	2.1	2.5	4.6	33.8	25.1	2.9	28.0	0.7	**72.2**	71.6
2030	10.2	10.2	2.1	2.5	4.6	34.7	25.4	2.9	28.3	0.7	**73.5**	72.8
2031	10.2	10.2	2.2	2.7	4.8	35.2	25.7	3.0	28.6	0.7	**74.4**	73.9
2032	10.3	10.3	2.2	2.7	4.9	35.7	25.9	3.0	28.9	0.7	**75.3**	75.1
2033	10.4	10.4	2.2	2.8	4.9	36.1	26.2	3.1	29.3	0.7	**76.1**	76.2
2034	10.5	10.5	2.2	2.8	5.0	36.6	26.5	3.1	29.6	0.7	**77.0**	77.4
2035	10.5	10.5	2.2	2.9	5.1	37.1	26.8	3.1	29.9	0.7	**77.9**	78.5
2036	10.6	10.6	2.3	2.9	5.2	37.4	27.0	3.2	30.2	0.7	**78.7**	79.7
2037	10.7	10.7	2.3	3.0	5.2	37.8	27.3	3.2	30.5	0.7	**79.5**	80.8
2038	10.8	10.8	2.3	3.0	5.3	38.1	27.6	3.2	30.8	0.7	**80.2**	81.9
2039	10.9	10.9	2.3	3.1	5.4	38.5	27.8	3.3	31.1	0.7	**81.0**	83.1
2040	11.0	11.0	2.3	3.1	5.5	38.8	28.1	3.3	31.4	0.7	**81.7**	84.2
2041	11.1	11.1	2.4	3.2	5.5	39.2	28.4	3.3	31.7	0.7	**82.5**	85.2
2042	11.2	11.2	2.4	3.2	5.6	39.5	28.6	3.4	32.0	0.7	**83.2**	86.3
2043	11.3	11.3	2.4	3.3	5.7	39.9	28.9	3.4	32.3	0.7	**84.0**	87.3
2044	11.4	11.4	2.4	3.3	5.8	40.3	29.2	3.4	32.6	0.7	**84.8**	88.3
2045	11.4	11.4	2.5	3.4	5.8	40.6	29.4	3.5	32.9	0.7	**85.5**	89.3
2046	11.5	11.5	2.5	3.5	5.9	40.9	29.7	3.5	33.2	0.7	**86.3**	90.1
2047	11.6	11.6	2.5	3.5	6.0	41.3	29.9	3.5	33.5	0.7	**87.0**	90.9
2048	11.7	11.7	2.5	3.6	6.1	41.6	30.2	3.6	33.7	0.7	**87.8**	91.7
2049	11.7	11.7	2.6	3.6	6.2	41.9	30.4	3.6	34.0	0.7	**88.4**	92.5
2050	11.8	11.8	2.6	3.7	6.3	42.2	30.7	3.6	34.3	0.7	**89.0**	93.3

Notes:

1. City of Hillsboro based on JWC supplies all water. City of Hillsboro demands include City of Cornelius and City of Hillsboro Upper System (2007 thru 2050). See Revised Peak Season Demand Calculations.xls, "Demand by Demand" tab for calculations.
2. TVWD information based on TVWD Demand Updates - Rev 1 - Sept 2010.xls.
3. Forest Grove information based on Forest Grove - Supply - Demand for JWC Alt. Analysis_20100427.xlsx.
4. City of Beaverton based on JWC-COBdemand41210.pdf. Assuming 115 gpcd, previous ASR information per City of Hillsboro Jan 2011.
5. Based on December 2005 Water System Master Plan (not updated 2010).

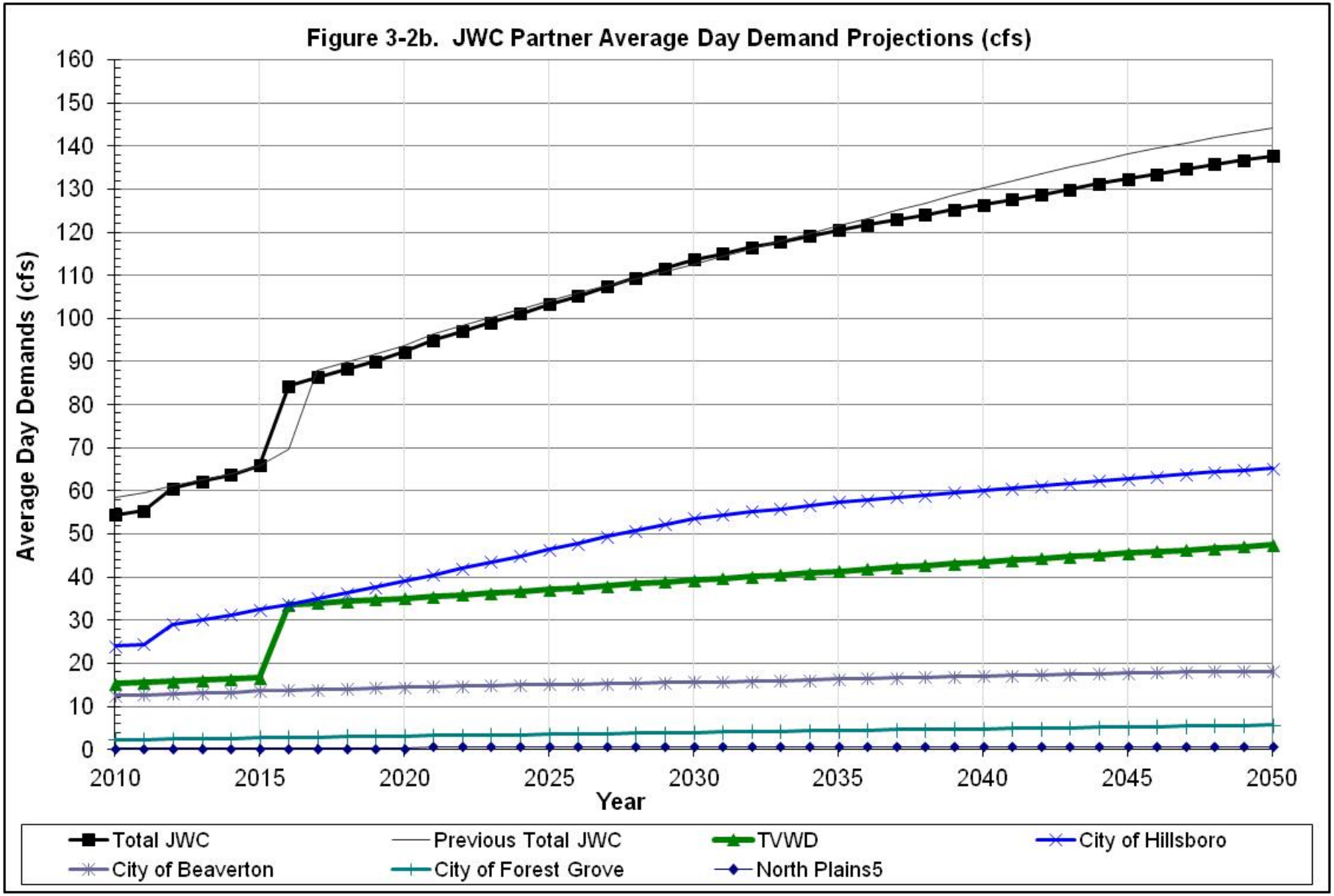
Figure 3-2b. JWC Partner Average Day Demand Projections (cfs)
Average Day Demands (cfs)
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
Total JWC
Previous Total JWC
TVWD
City of Hillsboro
City of Beaverton
City of Forest Grove
North Plains5

Table 3-1b. JWC Partner Average Day Demand Projections (cfs)

Year	City of Beaverton[4]		City of Forest Grove[3]			City of Hillsboro[1]	TVWD[2]			North Plains[5]	Total JWC ADD	Previous Total JWC
	JWC	Total	Local Supply	JWC	Total		JWC	Portland	Total			
2010	12.5	12.5	2.6	2.4	5.0	24.0	15.3	20.4	35.7	0.3	**54.5**	58.4
2011	12.7	12.7	2.6	2.4	5.0	24.4	15.5	20.4	36.0	0.3	**55.4**	59.7
2012	13.0	13.0	2.6	2.4	5.0	29.1	15.8	20.4	36.2	0.3	**60.6**	61.1
2013	13.1	13.1	2.6	2.4	5.1	30.2	16.1	20.4	36.5	0.3	**62.2**	62.5
2014	13.3	13.3	2.7	2.5	5.2	31.3	16.4	20.4	36.8	0.3	**63.7**	64.0
2015	13.6	13.6	2.8	2.8	5.6	32.5	16.6	20.4	37.1	0.3	**65.9**	65.8
2016	13.8	13.8	2.8	2.9	5.7	33.7	33.6	3.9	37.5	0.3	**84.3**	69.7
2017	13.9	13.9	2.8	2.9	5.8	35.1	34.0	3.9	37.9	0.3	**86.3**	88.0
2018	14.1	14.1	2.9	3.1	6.0	36.4	34.4	4.0	38.3	0.3	**88.3**	89.8
2019	14.3	14.3	2.9	3.1	6.1	37.6	34.7	4.0	38.8	0.3	**90.1**	91.7
2020	14.5	14.5	3.0	3.2	6.1	39.1	35.1	4.1	39.2	0.3	**92.3**	93.8
2021	14.6	14.6	3.0	3.2	6.2	40.5	35.5	4.1	39.6	1.0	**94.9**	96.4
2022	14.7	14.7	3.0	3.3	6.3	42.1	35.9	4.1	40.1	1.0	**97.1**	98.3
2023	14.9	14.9	3.0	3.4	6.4	43.5	36.3	4.2	40.5	1.0	**99.1**	100.3
2024	15.0	15.0	3.0	3.4	6.5	44.9	36.7	4.2	41.0	1.0	**101.1**	102.2
2025	15.2	15.2	3.1	3.5	6.5	46.4	37.2	4.3	41.4	1.0	**103.2**	104.2
2026	15.2	15.2	3.2	3.7	6.8	47.8	37.6	4.4	41.9	1.0	**105.3**	105.9
2027	15.3	15.3	3.2	3.7	6.9	49.4	38.0	4.4	42.4	1.0	**107.5**	107.5
2028	15.5	15.5	3.2	3.8	7.0	50.7	38.4	4.5	42.9	1.0	**109.5**	109.1
2029	15.6	15.6	3.2	3.9	7.1	52.3	38.8	4.5	43.3	1.0	**111.6**	110.7
2030	15.8	15.8	3.2	3.9	7.2	53.7	39.3	4.6	43.8	1.0	**113.7**	112.6
2031	15.8	15.8	3.3	4.1	7.5	54.5	39.7	4.6	44.3	1.0	**115.1**	114.4
2032	15.9	15.9	3.4	4.2	7.6	55.2	40.1	4.7	44.8	1.0	**116.5**	116.1
2033	16.0	16.0	3.4	4.3	7.6	55.9	40.6	4.7	45.3	1.0	**117.7**	117.9
2034	16.2	16.2	3.4	4.3	7.8	56.6	41.0	4.8	45.8	1.0	**119.1**	119.7
2035	16.3	16.3	3.5	4.4	7.9	57.4	41.4	4.8	46.2	1.0	**120.6**	121.5
2036	16.4	16.4	3.5	4.5	8.0	57.9	41.8	4.9	46.7	1.0	**121.7**	123.3
2037	16.6	16.6	3.5	4.6	8.1	58.5	42.2	4.9	47.2	1.0	**122.9**	125.0
2038	16.7	16.7	3.6	4.7	8.2	58.9	42.7	5.0	47.6	1.0	**124.0**	126.8
2039	16.9	16.9	3.6	4.8	8.3	59.6	43.1	5.0	48.1	1.0	**125.3**	128.6
2040	17.0	17.0	3.6	4.8	8.4	60.0	43.5	5.1	48.6	1.0	**126.4**	130.3
2041	17.1	17.1	3.7	4.9	8.5	60.7	43.9	5.1	49.0	1.0	**127.6**	131.9
2042	17.3	17.3	3.7	5.0	8.6	61.1	44.3	5.2	49.5	1.0	**128.7**	133.5
2043	17.4	17.4	3.7	5.1	8.8	61.7	44.7	5.2	50.0	1.0	**130.0**	135.0
2044	17.6	17.6	3.7	5.2	8.9	62.4	45.1	5.3	50.4	1.0	**131.2**	136.6
2045	17.7	17.7	3.8	5.2	9.0	62.8	45.5	5.4	50.9	1.0	**132.3**	138.2
2046	17.9	17.9	3.8	5.3	9.2	63.3	46.0	5.4	51.4	1.0	**133.5**	139.4
2047	18.0	18.0	3.9	5.4	9.3	63.9	46.3	5.5	51.8	1.0	**134.7**	140.6
2048	18.1	18.1	3.9	5.5	9.4	64.4	46.7	5.5	52.2	1.0	**135.8**	141.9
2049	18.1	18.1	3.9	5.6	9.6	64.8	47.1	5.5	52.6	1.0	**136.7**	143.1
2050	18.2	18.2	4.0	5.7	9.7	65.3	47.5	5.6	53.0	1.0	**137.7**	144.3

Notes:

1. City of Hillsboro based on JWC supplies all water. City of Hillsboro demands include City of Cornelius and City of Hillsboro Upper System (2007 thru 2050). See Revised Peak Season Demand Calculations.xls, "Demand by Demand" tab for calculations.
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4. City of Beaverton based on JWC-COBdemand41210.pdf. Assuming 115 gpcd, previous ASR information per City of Hillsboro Jan 2011.
5. Based on December 2005 Water System Master Plan (not updated 2010).

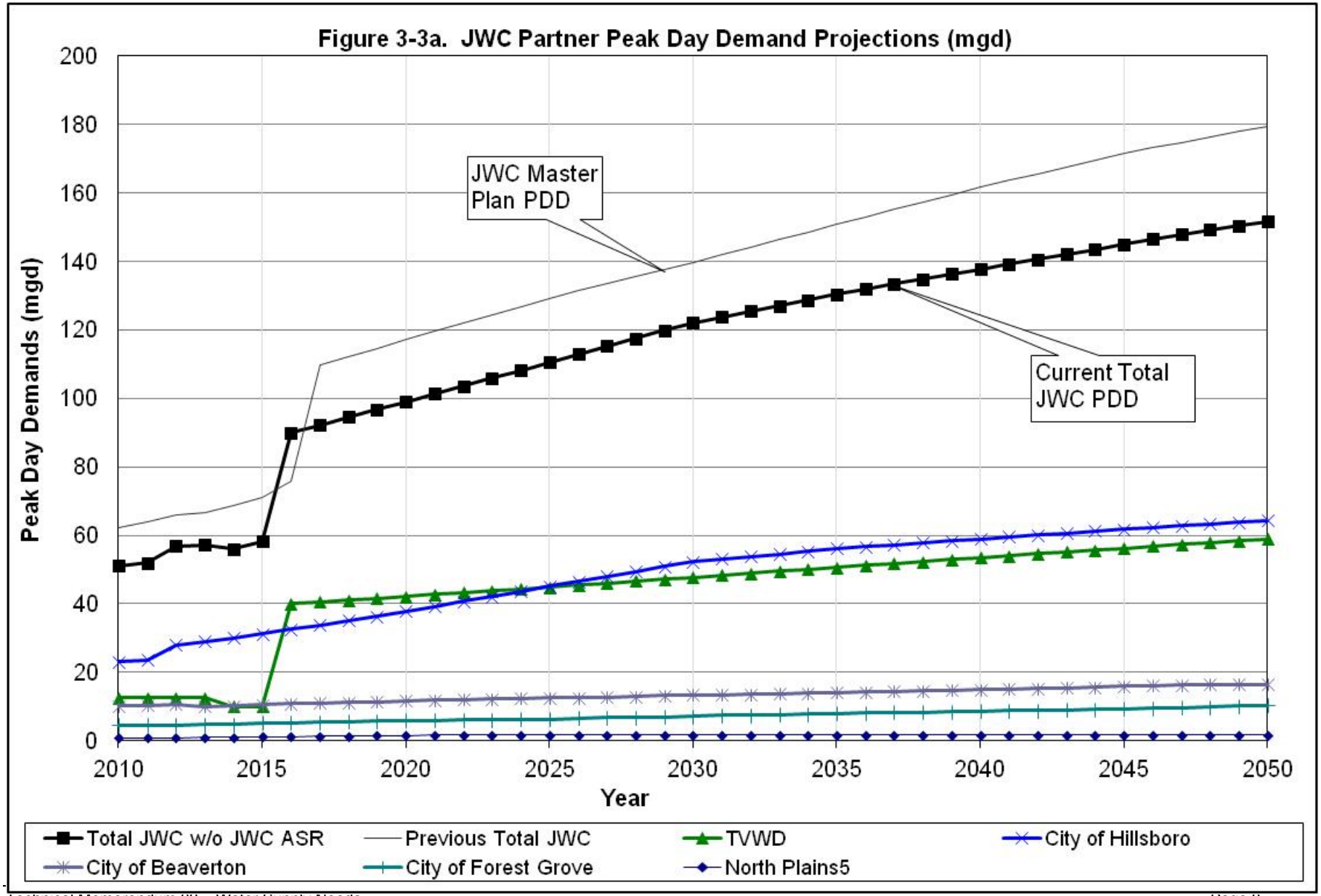


Figure 3-3a. JWC Partner Peak Day Demand Projections (mgd)
Peak Day Demands (mgd)
200
180
160
140
120
100
80
60
40
20
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
JWC Master Plan PDD
Current Total JWC PDD
Total JWC w/o JWC ASR
Previous Total JWC
TVWD
City of Hillsboro
City of Beaverton
City of Forest Grove
North Plains5

Table 3-2a. JWC Partner Peak Day Demand Projections (mgd)

	City of Beaverton[4]			City of Forest Grove[3]				TVWD[2]						
Year	JWC	ASR Maximum Rate	Total	Total	Local Supply	JWC	City of Hillsboro[1]	JWC	ASR	PWB Metzger	Total	North Plains[5]	Total JWC PDD	Previous Total JWC
2010	10.2	6.0	16.2	6.0	1.5	4.5	23.1	12.5	3.0		15.5	0.8	**51.1**	62.2
2011	10.4	6.0	16.4	6.1	1.5	4.6	23.6	12.5	3.0		15.5	0.8	**51.9**	63.9
2012	10.8	6.0	16.8	6.1	1.5	4.6	28.0	12.5	3.0		15.5	0.9	**56.8**	65.8
2013	10.0	7.0	17.0	6.2	1.5	4.7	29.0	12.5	3.0		15.5	1.0	**57.2**	66.7
2014	10.2	7.0	17.2	6.3	1.5	4.8	30.0	10.0	5.5		15.5	1.1	**56.0**	68.6
2015	10.6	7.0	17.6	6.7	1.5	5.2	31.3	10.0	5.5		15.5	1.2	**58.3**	71.0
2016	10.8	7.0	17.8	6.8	1.5	5.3	32.5	40.1	5.5	5.2	50.9	1.2	**90.1**	75.7
2017	11.0	7.0	18.0	6.9	1.5	5.4	33.8	40.6	5.5	5.3	51.4	1.3	**92.2**	109.7
2018	11.2	7.0	18.2	7.2	1.5	5.7	35.1	41.1	5.5	5.4	52.0	1.4	**94.6**	112.1
2019	11.5	7.0	18.5	7.3	1.5	5.8	36.4	41.7	5.5	5.4	52.6	1.5	**96.8**	114.5
2020	11.7	7.0	18.7	7.4	1.5	5.9	37.8	42.2	5.5	5.5	53.2	1.5	**99.1**	117.2
2021	11.9	7.0	18.9	7.5	1.5	6.0	39.2	42.7	5.5	5.6	53.8	1.6	**101.5**	119.6
2022	12.1	7.0	19.1	7.5	1.5	6.0	40.7	43.3	5.5	5.6	54.4	1.6	**103.7**	122.0
2023	12.2	7.0	19.2	7.6	1.5	6.1	42.1	43.8	5.5	5.7	55.0	1.6	**106.0**	124.4
2024	12.4	7.0	19.4	7.7	1.5	6.2	43.6	44.4	5.5	5.8	55.6	1.6	**108.2**	126.8
2025	12.6	7.0	19.6	7.9	1.5	6.4	45.0	44.9	5.5	5.8	56.3	1.6	**110.6**	129.3
2026	12.6	7.0	19.6	8.2	1.5	6.7	46.5	45.5	5.5	5.9	56.9	1.6	**112.9**	131.4
2027	12.8	7.0	19.8	8.3	1.5	6.8	47.9	46.1	5.5	6.0	57.5	1.6	**115.2**	133.5
2028	13.0	7.0	20.0	8.4	1.5	6.9	49.4	46.6	5.5	6.0	58.2	1.6	**117.5**	135.5
2029	13.2	7.0	20.2	8.5	1.5	7.0	50.9	47.2	5.5	6.1	58.8	1.6	**119.9**	137.5
2030	13.4	7.0	20.4	8.6	1.5	7.1	52.3	47.8	5.5	6.2	59.5	1.6	**122.2**	139.8
2031	13.4	7.0	20.4	8.9	1.5	7.4	53.1	48.4	5.5	6.3	60.1	1.6	**123.8**	142.0
2032	13.5	7.0	20.5	9.0	1.5	7.5	53.8	49.0	5.5	6.3	60.8	1.6	**125.5**	144.2
2033	13.7	7.0	20.7	9.2	1.5	7.7	54.6	49.5	5.5	6.4	61.4	1.6	**127.1**	146.4
2034	13.9	7.0	20.9	9.3	1.5	7.8	55.4	50.1	5.5	6.5	62.1	1.6	**128.8**	148.6
2035	14.1	7.0	21.1	9.4	1.5	7.9	56.2	50.7	5.5	6.6	62.8	1.6	**130.5**	150.8
2036	14.3	7.0	21.3	9.6	1.5	8.1	56.7	51.3	5.5	6.6	63.4	1.6	**132.0**	153.0
2037	14.4	7.0	21.4	9.8	1.5	8.3	57.3	51.8	5.5	6.7	64.0	1.6	**133.4**	155.2
2038	14.6	7.0	21.6	9.9	1.5	8.4	57.8	52.4	5.5	6.8	64.7	1.6	**134.9**	157.4
2039	14.8	7.0	21.8	10.1	1.5	8.6	58.4	53.0	5.5	6.8	65.3	1.6	**136.3**	159.6
2040	15.0	7.0	22.0	10.2	1.5	8.7	59.0	53.5	5.5	6.9	65.9	1.6	**137.8**	161.8
2041	15.2	7.0	22.2	10.3	1.5	8.8	59.5	54.1	5.5	7.0	66.5	1.6	**139.2**	163.7
2042	15.4	7.0	22.4	10.4	1.5	8.9	60.1	54.6	5.5	7.1	67.2	1.6	**140.6**	165.7
2043	15.5	7.0	22.5	10.6	1.5	9.1	60.7	55.2	5.5	7.1	67.8	1.6	**142.1**	167.7
2044	15.7	7.0	22.7	10.7	1.5	9.2	61.2	55.7	5.5	7.2	68.4	1.6	**143.6**	169.6
2045	15.9	7.0	22.9	10.9	1.5	9.4	61.8	56.3	5.5	7.3	69.1	1.6	**145.1**	171.6
2046	16.1	7.0	23.1	11.1	1.5	9.6	62.3	56.9	5.5	7.3	69.7	1.6	**146.6**	173.2
2047	16.3	7.0	23.3	11.3	1.5	9.8	62.8	57.4	5.5	7.4	70.3	1.6	**147.9**	174.8
2048	16.4	7.0	23.4	11.4	1.5	9.9	63.3	57.9	5.5	7.5	70.8	1.6	**149.3**	176.4
2049	16.5	7.0	23.5	11.6	1.5	10.1	63.8	58.4	5.5	7.5	71.4	1.6	**150.5**	177.9
2050	16.5	7.0	23.5	11.8	1.5	10.3	64.3	58.9	5.5	7.6	72.0	1.6	**151.7**	179.5

Notes:

1. City of Hillsboro based on JWC supplies all water. City of Hillsboro demands include City of Cornelius and City of Hillsboro Upper System (2007 thru 2050). See Revised Peak Season Demand Calculations.xls, "Demand by Demand" tab for calculations.

2. TVWD information based on TVWD Demand Updates - Rev 1 - Sept 2010.xls revised on Feb 2011 per City of Hillsboro Jan 2011. JWC demands do not include ASR demands. TVWD has native groundwater rights, but use them as an emergency back-up supply due to water quality concerns and are not considered part of their current system supply.

3. Forest Grove information based on Forest Grove - Supply - Demand for JWC Alt. Analysis_20100427.xlsx.

4. City of Beaverton based on JWC-COBdemand41210.pdf. Assuming 115 gpcd, JWC demands do not include ASR demands. ASR maximum rate, reliability factor and demands per City of Hillsboro Jan 2011.

5. Based on December 2005 Water System Master Plan (not updated 2010).

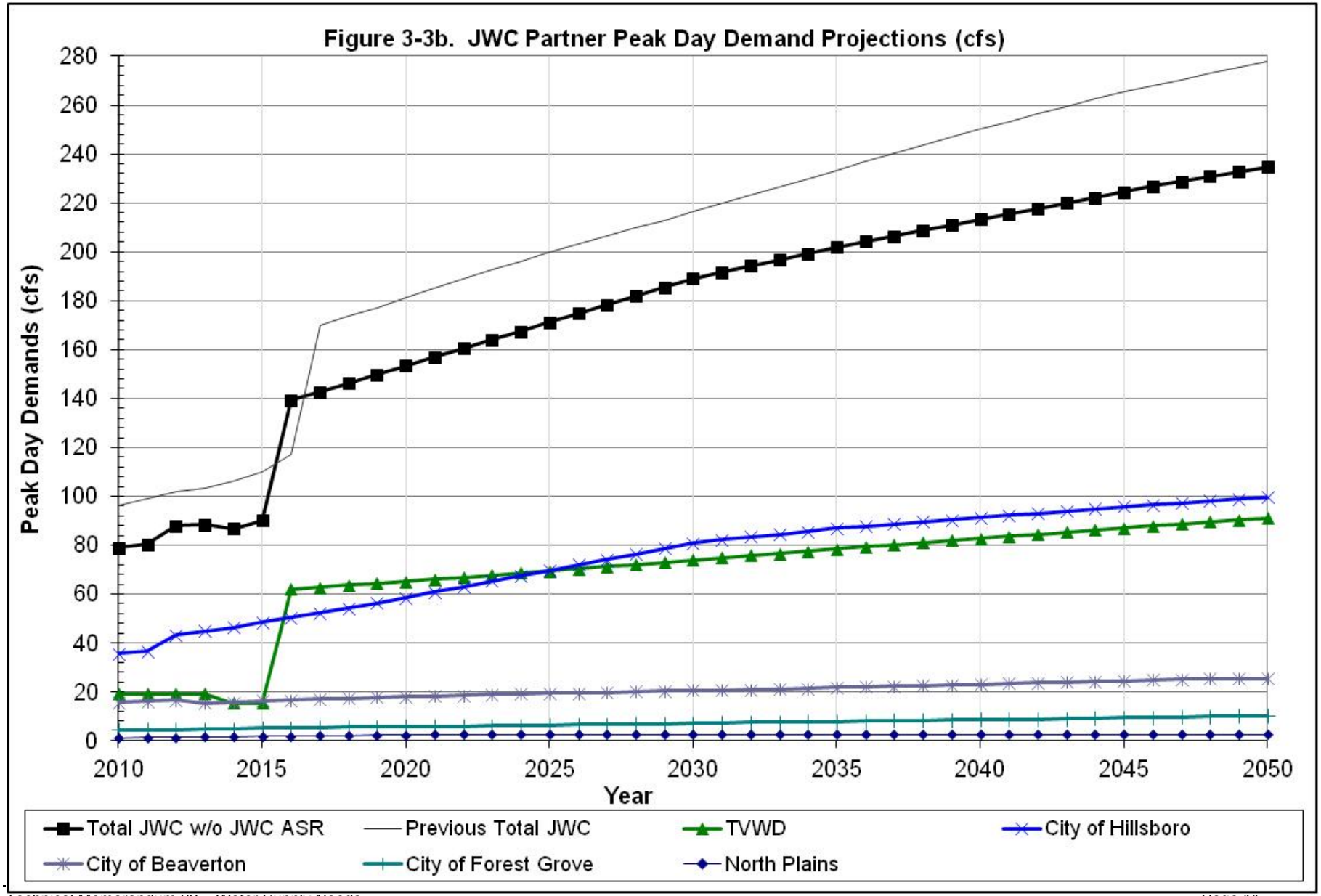


Figure 3-3b. JWC Partner Peak Day Demand Projections (cfs)
Peak Day Demands (cfs)
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
Total JWC w/o JWC ASR
Previous Total JWC
TVWD
City of Hillsboro
City of Beaverton
City of Forest Grove
North Plains

Table 3-2b. JWC Partner Peak Day Demand Projections (cfs)

Year	City of Beaverton[4]			City of Forest Grove[3]			City of Hillsboro[1]	TVWD[2]				North Plains[5]	Total JWC PDD
	JWC	ASR Maximum Rate	Total	Total	Local Supply	JWC		JWC	ASR	PWB Metzger	Total		
2010	15.8	9.3	25.1	9.3	2.3	7.0	35.8	19.3	4.6		24.0	1.2	**79.1**
2011	16.1	9.3	25.4	9.4	2.3	7.1	36.4	19.3	4.6		24.0	1.3	**80.3**
2012	16.6	9.3	25.9	9.5	2.3	7.2	43.3	19.3	4.6		24.0	1.4	**87.9**
2013	15.4	10.8	26.2	9.6	2.3	7.3	44.9	19.3	4.6		24.0	1.6	**88.5**
2014	15.7	10.8	26.6	9.7	2.3	7.4	46.4	15.5	8.5		24.0	1.7	**86.7**
2015	16.4	10.8	27.2	10.4	2.3	8.1	48.4	15.5	8.5		24.0	1.8	**90.1**
2016	16.7	10.8	27.5	10.6	2.3	8.2	50.4	62.1	8.5	8.1	78.7	1.9	**139.3**
2017	17.1	10.8	27.9	10.7	2.3	8.4	52.3	62.8	8.5	8.2	79.6	2.0	**142.6**
2018	17.4	10.8	28.2	11.1	2.3	8.8	54.3	63.7	8.5	8.3	80.5	2.1	**146.3**
2019	17.7	10.8	28.6	11.2	2.3	8.9	56.2	64.5	8.5	8.4	81.4	2.3	**149.6**
2020	18.1	10.8	28.9	11.4	2.3	9.1	58.5	65.3	8.5	8.5	82.3	2.4	**153.3**
2021	18.4	10.8	29.2	11.5	2.3	9.2	60.7	66.1	8.5	8.6	83.2	2.5	**156.9**
2022	18.6	10.8	29.5	11.7	2.3	9.3	63.0	66.9	8.5	8.7	84.2	2.5	**160.4**
2023	18.9	10.8	29.8	11.8	2.3	9.5	65.2	67.8	8.5	8.8	85.1	2.5	**163.9**
2024	19.2	10.8	30.0	12.0	2.3	9.6	67.4	68.6	8.5	8.9	86.1	2.5	**167.4**
2025	19.5	10.8	30.3	12.2	2.3	9.8	69.7	69.5	8.5	9.0	87.0	2.5	**171.0**
2026	19.5	10.8	30.4	12.6	2.3	10.3	71.9	70.4	8.5	9.1	88.0	2.5	**174.7**
2027	19.8	10.8	30.7	12.8	2.3	10.5	74.2	71.3	8.5	9.2	89.0	2.5	**178.2**
2028	20.1	10.8	30.9	13.0	2.3	10.6	76.4	72.2	8.5	9.4	90.0	2.5	**181.8**
2029	20.4	10.8	31.2	13.1	2.3	10.8	78.7	73.1	8.5	9.5	91.0	2.5	**185.4**
2030	20.7	10.8	31.5	13.3	2.3	11.0	80.9	74.0	8.5	9.6	92.0	2.5	**189.1**
2031	20.7	10.8	31.5	13.8	2.3	11.4	82.1	74.9	8.5	9.7	93.1	2.5	**191.6**
2032	20.9	10.8	31.8	14.0	2.3	11.6	83.3	75.7	8.5	9.8	94.1	2.5	**194.2**
2033	21.2	10.8	32.1	14.2	2.3	11.8	84.5	76.6	8.5	9.9	95.1	2.5	**196.7**
2034	21.5	10.8	32.3	14.4	2.3	12.0	85.7	77.5	8.5	10.0	96.1	2.5	**199.3**
2035	21.8	10.8	32.6	14.6	2.3	12.3	86.9	78.4	8.5	10.1	97.1	2.5	**201.9**
2036	22.1	10.8	32.9	14.9	2.3	12.5	87.8	79.4	8.5	10.3	98.1	2.5	**204.2**
2037	22.3	10.8	33.2	15.1	2.3	12.8	88.6	80.2	8.5	10.4	99.1	2.5	**206.4**
2038	22.6	10.8	33.5	15.3	2.3	13.0	89.5	81.1	8.5	10.5	100.0	2.5	**208.7**
2039	22.9	10.8	33.7	15.5	2.3	13.2	90.4	81.9	8.5	10.6	101.0	2.5	**210.9**
2040	23.2	10.8	34.0	15.8	2.3	13.5	91.2	82.8	8.5	10.7	102.0	2.5	**213.2**
2041	23.5	10.8	34.3	15.9	2.3	13.5	92.1	83.7	8.5	10.8	103.0	2.5	**215.3**
2042	23.8	10.8	34.6	16.1	2.3	13.8	93.0	84.5	8.5	10.9	103.9	2.5	**217.6**
2043	24.0	10.8	34.9	16.4	2.3	14.0	93.9	85.4	8.5	11.0	104.9	2.5	**219.8**
2044	24.3	10.8	35.1	16.6	2.3	14.3	94.8	86.2	8.5	11.1	105.9	2.5	**222.1**
2045	24.6	10.8	35.4	16.9	2.3	14.5	95.6	87.1	8.5	11.2	106.9	2.5	**224.4**
2046	24.9	10.8	35.7	17.1	2.3	14.8	96.4	88.0	8.5	11.3	107.9	2.5	**226.6**
2047	25.1	10.8	36.0	17.4	2.3	15.1	97.2	88.8	8.5	11.4	108.7	2.5	**228.7**
2048	25.4	10.8	36.3	17.7	2.3	15.4	98.0	89.6	8.5	11.5	109.6	2.5	**230.8**
2049	25.5	10.8	36.3	18.0	2.3	15.7	98.7	90.3	8.5	11.6	110.5	2.5	**232.7**
2050	25.5	10.8	36.4	18.3	2.3	16.0	99.5	91.1	8.5	11.7	111.4	2.5	**234.7**

Notes:

1. City of Hillsboro based on JWC supplies all water. City of Hillsboro demands include City of Cornelius and City of Hillsboro Upper System (2007 thru 2050). See Revised Peak Season Demand Calculations.xls, "Demand by Demand" tab for calculations.

2. TVWD information based on TVWD Demand Updates - Rev 1 - Sept 2010.xls revised on Feb 2011 per City of Hillsboro Jan 2011. JWC demands do not include ASR demands. TVWD has native groundwater rights, but use them as an emergency back-up supply due to water quality concerns and are not considered part of their current system supply.

3. Forest Grove information based on Forest Grove - Supply - Demand for JWC Alt. Analysis_20100427.xlsx.

4. City of Beaverton based on JWC-COBdemand41210.pdf. Assuming 115 gpcd, JWC demands do not include ASR demands. ASR maximum rate, reliability factor and demands per City of Hillsboro Jan 2011.

5. Based on December 2005 Water System Master Plan (not updated 2010).

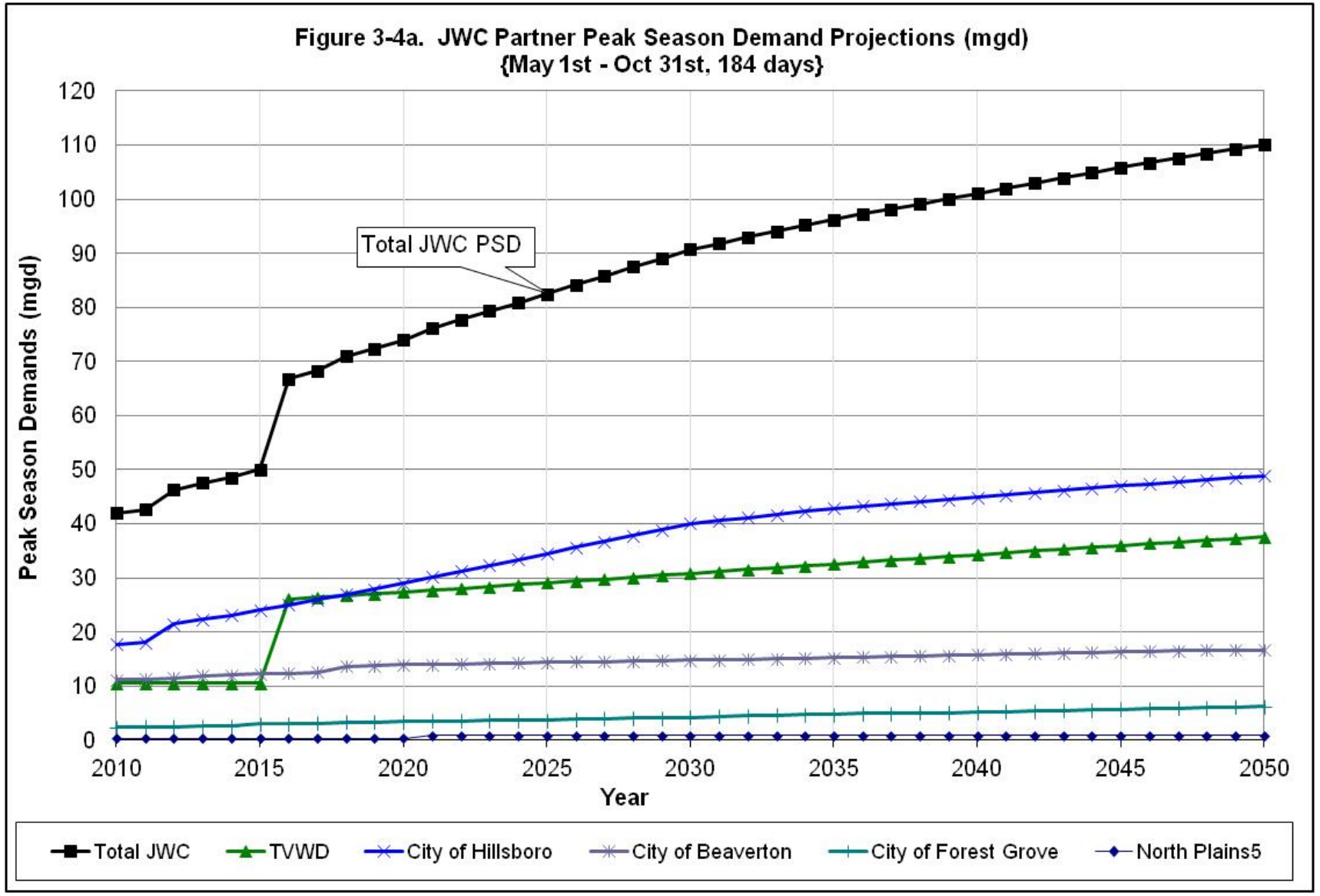


Figure 3-4a. JWC Partner Peak Season Demand Projections (mgd)
{May 1st - Oct 31st, 184 days}
Peak Season Demands (mgd)
120
110
100
90
80
70
60
50
40
30
20
10
0
Total JWC PSD
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
Total JWC
TVWD
City of Hillsboro
City of Beaverton
City of Forest Grove
North Plains5

Figure 3-4b. JWC Partner Peak Season Water Supply & Storage Needs (MG, Acre-Ft)
{May 1st - Oct 31st, 184 Days}

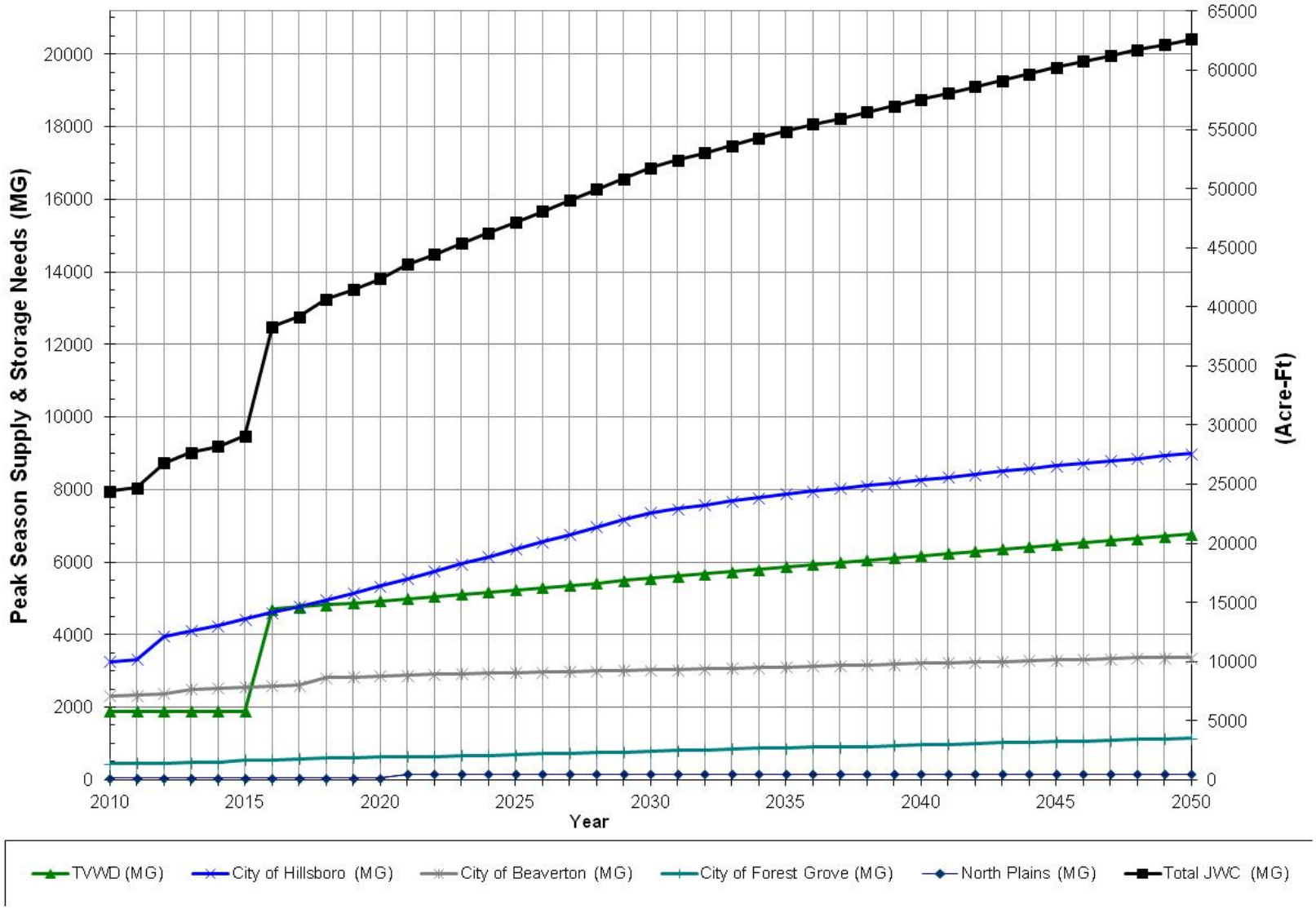


Table 3-3. JWC Partner Average Peak Season Demand Projections {May 1st - Oct 31st (184 days)}

	City of Beaverton[4]							City of Forest Grove[3]					City of Hillsboro[3]			TVWD[2]						North Plains[5]			Total JWC PSD		
Year	Max Total (mgd)	ASR Max Rate (mgd)	Reliability Factor	ASR Reduced Rate (mgd)	JWC (mgd)	JWC (MG)	JWC[6] (Acre-Ft)	Total (mgd)	Local Supply (mgd)	JWC[3] (mgd)	JWC[3] (MG)	JWC[3,6] (Acre-Ft)	JWC (mgd)	JWC (MG)	JWC[6] (Acre-Ft)	Total (Acre-Ft)	ASR (MG)	ASR (Acre-Ft)	JWC[2] (mgd)	JWC[2] (MG)	JWC[2,6] (Acre-Ft)	JWC (mgd)	JWC (MG)	JWC[6] (Acre-Ft)	(mgd)	(MG)	JWC[6] (Acre-Ft)
2010	15.2	6.0	67%	4.0	11.2	2313	7097	3.9	1.5	2.4	442	1355	17.7	3257	9996	6894	360	1105	10.5	1886	5789	0.3	50	154	**42.0**	**7948**	**24391**
2011	15.3	6.0	67%	4.0	11.3	2335	7165	4.0	1.5	2.5	460	1412	18.0	3320	10189	6894	360	1105	10.5	1886	5789	0.3	50	154	**42.6**	**8051**	**24708**
2012	15.5	6.0	67%	4.0	11.5	2371	7278	4.0	1.5	2.5	460	1412	21.5	3959	12149	6894	360	1105	10.5	1886	5789	0.3	50	154	**46.3**	**8727**	**26781**
2013	16.6	7.0	67%	4.7	11.9	2495	7658	4.1	1.5	2.6	478	1468	22.3	4103	12593	6894	360	1105	10.5	1886	5789	0.3	50	154	**47.6**	**9013**	**27661**
2014	16.7	7.0	67%	4.7	12.1	2517	7726	4.1	1.5	2.6	478	1468	23.1	4248	13037	7814	660	2025	10.5	1886	5789	0.3	50	154	**48.5**	**9180**	**28173**
2015	17.0	7.0	67%	4.7	12.3	2560	7855	4.5	1.5	3.0	552	1694	24.1	4426	13583	7814	660	2025	10.5	1886	5789	0.3	50	154	**50.1**	**9474**	**29075**
2016	17.1	7.0	67%	4.7	12.4	2582	7923	4.5	1.5	3.0	552	1694	25.0	4604	14130	16462	660	2025	26.1	4704	14436	0.3	50	154	**66.8**	**12492**	**38337**
2017	17.2	7.0	67%	4.7	12.5	2606	7997	4.6	1.5	3.1	570	1750	26.0	4782	14677	16633	660	2025	26.4	4760	14607	0.3	50	154	**68.3**	**12768**	**39185**
2018	18.4	7.0	67%	4.7	13.7	2814	8635	4.8	1.5	3.3	607	1863	27.0	4961	15225	16808	660	2025	26.8	4817	14783	0.3	50	154	**71.0**	**13249**	**40659**
2019	18.5	7.0	67%	4.7	13.8	2836	8702	4.8	1.5	3.3	607	1863	27.9	5139	15773	16984	660	2025	27.1	4874	14958	0.3	50	154	**72.4**	**13507**	**41451**
2020	18.6	7.0	67%	4.7	13.9	2860	8776	4.9	1.5	3.4	626	1920	29.0	5341	16391	17160	660	2025	27.4	4931	15134	0.3	50	154	**74.0**	**13808**	**42375**
2021	18.7	7.0	67%	4.7	14.0	2878	8832	5.0	1.5	3.5	644	1976	30.1	5543	17010	17340	660	2025	27.7	4990	15314	0.8	150	461	**76.2**	**14205**	**43594**
2022	18.8	7.0	67%	4.7	14.1	2898	8894	5.0	1.5	3.5	644	1976	31.2	5745	17629	17522	660	2025	28.1	5049	15496	0.8	150	461	**77.7**	**14487**	**44458**
2023	18.9	7.0	67%	4.7	14.2	2917	8951	5.1	1.5	3.6	662	2033	32.3	5947	18249	17708	660	2025	28.4	5110	15683	0.8	150	461	**79.3**	**14786**	**45377**
2024	19.0	7.0	67%	4.7	14.3	2935	9007	5.1	1.5	3.6	662	2033	33.4	6149	18870	17895	660	2025	28.7	5171	15869	0.8	150	461	**80.9**	**15068**	**46241**
2025	19.1	7.0	67%	4.7	14.4	2953	9064	5.2	1.5	3.7	681	2089	34.5	6351	19491	18081	660	2025	29.1	5232	16056	0.8	150	461	**82.5**	**15367**	**47161**
2026	19.1	7.0	67%	4.7	14.5	2959	9081	5.4	1.5	3.9	718	2202	35.6	6554	20112	18271	660	2025	29.4	5294	16246	0.8	150	461	**84.2**	**15674**	**48102**
2027	19.2	7.0	67%	4.7	14.6	2977	9137	5.5	1.5	4.0	736	2259	36.7	6756	20734	18463	660	2025	29.8	5356	16438	0.8	150	461	**85.8**	**15976**	**49029**
2028	19.3	7.0	67%	4.7	14.7	2996	9194	5.6	1.5	4.1	754	2315	37.8	6959	21357	18658	660	2025	30.1	5420	16633	0.8	150	461	**87.5**	**16279**	**49960**
2029	19.4	7.0	67%	4.7	14.8	3014	9250	5.6	1.5	4.1	754	2315	38.9	7162	21980	18854	660	2025	30.5	5484	16828	0.8	150	461	**89.1**	**16565**	**50835**
2030	19.6	7.0	67%	4.7	14.9	3034	9312	5.7	1.5	4.2	773	2372	40.0	7365	22603	19049	660	2025	30.8	5547	17024	0.8	150	461	**90.7**	**16870**	**51772**
2031	19.6	7.0	67%	4.7	14.9	3034	9312	5.9	1.5	4.4	810	2485	40.6	7469	22920	19244	660	2025	31.2	5611	17219	0.8	150	461	**91.8**	**17074**	**52397**
2032	19.7	7.0	67%	4.7	15.0	3053	9369	6.0	1.5	4.5	828	2541	41.2	7572	23238	19440	660	2025	31.5	5674	17414	0.8	150	461	**93.0**	**17278**	**53023**
2033	19.8	7.0	67%	4.7	15.1	3071	9425	6.1	1.5	4.6	846	2598	41.7	7676	23556	19635	660	2025	31.9	5738	17610	0.8	150	461	**94.1**	**17482**	**53650**
2034	19.9	7.0	67%	4.7	15.2	3091	9487	6.2	1.5	4.7	865	2654	42.3	7780	23875	19830	660	2025	32.2	5802	17805	0.8	150	461	**95.2**	**17688**	**54282**
2035	20.0	7.0	67%	4.7	15.3	3110	9544	6.2	1.5	4.7	865	2654	42.8	7884	24194	20026	660	2025	32.6	5865	18000	0.8	150	461	**96.2**	**17874**	**54853**
2036	20.1	7.0	67%	4.7	15.4	3128	9600	6.4	1.5	4.9	902	2767	43.3	7959	24427	20227	660	2025	32.9	5931	18201	0.8	150	461	**97.3**	**18071**	**55456**
2037	20.2	7.0	67%	4.7	15.5	3147	9657	6.4	1.5	4.9	902	2767	43.7	8035	24660	20409	660	2025	33.3	5990	18383	0.8	150	461	**98.1**	**18224**	**55928**
2038	20.3	7.0	67%	4.7	15.6	3167	9719	6.5	1.5	5.0	920	2823	44.1	8112	24894	20597	660	2025	33.6	6051	18571	0.8	150	461	**99.1**	**18400**	**56469**
2039	20.4	7.0	67%	4.7	15.7	3185	9775	6.6	1.5	5.1	938	2880	44.5	8188	25129	20785	660	2025	34.0	6113	18759	0.8	150	461	**100.1**	**18575**	**57004**
2040	20.5	7.0	67%	4.7	15.8	3204	9832	6.7	1.5	5.2	957	2936	44.9	8265	25364	20972	660	2025	34.3	6174	18947	0.8	150	461	**101.0**	**18750**	**57540**
2041	20.6	7.0	67%	4.7	15.9	3222	9888	6.8	1.5	5.3	975	2993	45.3	8342	25600	21160	660	2025	34.6	6235	19135	0.8	150	461	**102.0**	**18924**	**58077**
2042	20.7	7.0	67%	4.7	16.0	3242	9950	6.9	1.5	5.4	994	3049	45.8	8419	25836	21348	660	2025	35.0	6296	19323	0.8	150	461	**102.9**	**19101**	**58620**
2043	20.8	7.0	67%	4.7	16.1	3261	10007	7.0	1.5	5.5	1012	3106	46.2	8496	26074	21536	660	2025	35.3	6357	19510	0.8	150	461	**103.9**	**19277**	**59158**
2044	20.9	7.0	67%	4.7	16.2	3279	10063	7.1	1.5	5.6	1030	3162	46.6	8574	26312	21724	660	2025	35.7	6419	19698	0.8	150	461	**104.9**	**19452**	**59697**
2045	21.0	7.0	67%	4.7	16.3	3299	10125	7.2	1.5	5.7	1049	3219	47.0	8652	26551	21912	660	2025	36.0	6480	19886	0.8	150	461	**105.8**	**19630**	**60242**
2046	21.1	7.0	67%	4.7	16.4	3318	10182	7.3	1.5	5.8	1067	3275	47.4	8719	26758	22108	660	2025	36.4	6544	20082	0.8	150	461	**106.8**	**19798**	**60758**
2047	21.2	7.0	67%	4.7	16.5	3336	10238	7.4	1.5	5.9	1086	3332	47.8	8787	26965	22271	660	2025	36.7	6597	20246	0.8	150	461	**107.6**	**19956**	**61242**
2048	21.3	7.0	67%	4.7	16.6	3355	10295	7.5	1.5	6.0	1104	3388	48.1	8855	27174	22444	660	2025	37.0	6653	20418	0.8	150	461	**108.5**	**20117**	**61736**
2049	21.3	7.0	67%	4.7	16.6	3358	10306	7.6	1.5	6.1	1122	3445	48.5	8923	27383	22616	660	2025	37.3	6709	20590	0.8	150	461	**109.3**	**20263**	**62185**
2050	21.3	7.0	67%	4.7	16.7	3364	10323	7.7	1.5	6.2	1141	3501	48.9	8991	27593	22788	660	2025	37.6	6765	20762	0.8	150	461	**110.1**	**20411**	**62641**

Notes:

1. City of Hillsboro based on JWC supplies all water. City of Hillsboro demands include City of Cornelius and City of Hillsboro Upper System (2007 thru 2050). See Revised Peak Season Demand Calculations.xls, "Demand by Demand" tab for calculations. City of Hillsboro JWC storage demand equals JWC demand minus Hillsboro natural flow water rights.

2. TVWD information based on TVWD Demand Updates - Rev 1 - Sept 2010.xls revised on Feb 2011 per City of Hillsboro Jan 2011. JWC demands do not include ASR demands. JWC (MG) total based on 180 day PSD and 120 day ASR Reduced Rate. Total TVWD storage is the TVWD stated JWC storage less their ASR rate over 120-days so the total 1.5 billion gallon aquifer storage is not exceeded. TVWD has native groundwater rights, but use them as an emergency back-up supply due to water quality concerns and are not considered part of their current system supply.

3. Forest Grove information based on Forest Grove - Supply - Demand for JWC Alt. Analysis_20100427.xlsx.

4. City of Beaverton based on JWC-COBdemand41210.pdf. Assuming 115 gpcd, JWC demands do not include ASR demands. JWC (MG) total based on 184 day PSD and 120 day ASR Reduced Rate. ASR maximum rate, reliability factor and demands per City of Hillsboro Jan 2011. JWC demand equals Max Total - ASR Reduced Rate. Total PSD based on ASR information given for PDD and assumed the same for PSD.

5. North Plains demands based on December 2005 Water System Master Plan (not updated 2010). PSD based on City of Hillsboro WSA monthly factor per City of Hillsboro meeting 4/2010.

6. Historical stored water information based on "JWC Stored Water Historical Use 05-25-10.xlsx."

Figure 3-5a. JWC Partner Peak Season Demand Projections (mgd)
{May 25th - Oct 31st, 160 days}

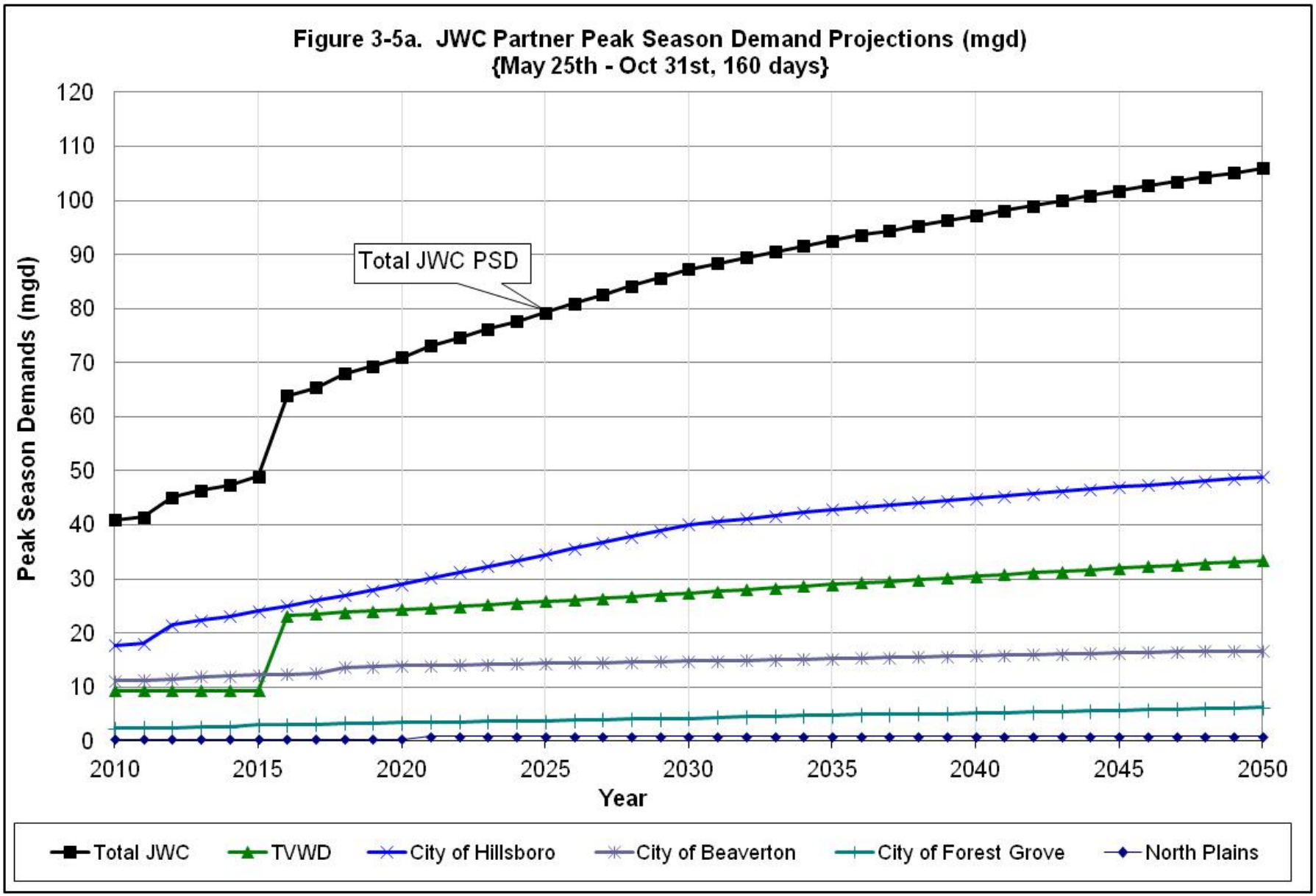


Figure 3-5b. JWC Partner Peak Season Water Supply & Storage Needs (MG, Acre-Ft)
{May 25th - Oct 31st, 160 Days}

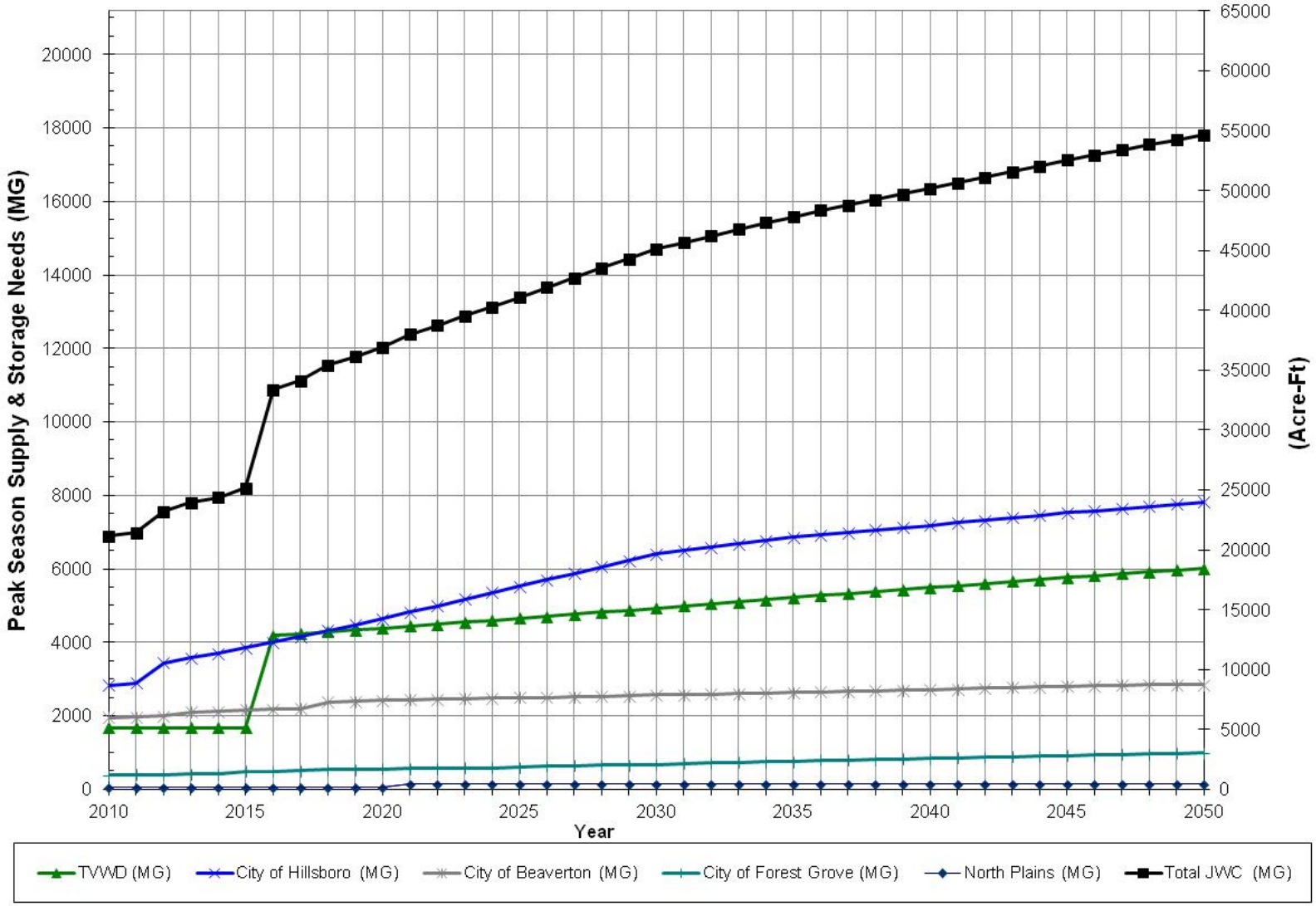


Table 3-4. JWC Partner Average Peak Season Demand Projections {May 25th - Oct 31st (160 days)}

	City of Beaverton[4]							City of Forest Grove[3]					City of Hillsboro[3]			TVWD[2]						North Plains[5]			Total JWC PSD		
Year	Max Total (mgd)	ASR Max Rate (mgd)	Reliability Factor	ASR Reduced Rate (mgd)	JWC (mgd)	JWC (MG)	JWC[6] (Acre-Ft)	Total (mgd)	Local Supply (mgd)	JWC[3] (mgd)	JWC[3] (MG)	JWC[3,6] (Acre-Ft)	JWC (mgd)	JWC (MG)	JWC[6] (Acre-Ft)	Total (Acre-Ft)	ASR (MG)	ASR (Acre-Ft)	JWC[2] (mgd)	JWC[2] (MG)	JWC[2,6] (Acre-Ft)	JWC (mgd)	JWC (MG)	JWC[6] (Acre-Ft)	(mgd)	(MG)	JWC[6] (Acre-Ft)
2010	15.2	6.0	67%	4.0	11.2	1948	5978	3.9	1.5	2.4	384	1178	17.7	2832	8692	6128	320	982	9.3	1677	5146	0.3	44	134	40.9	6885	21128
2011	15.3	6.0	67%	4.0	11.3	1967	6037	4.0	1.5	2.5	400	1228	18.0	2887	8860	6128	320	982	9.3	1677	5146	0.3	44	134	41.4	6975	21404
2012	15.5	6.0	67%	4.0	11.5	1999	6135	4.0	1.5	2.5	400	1228	21.5	3442	10564	6128	320	982	9.3	1677	5146	0.3	44	134	45.1	7562	23206
2013	16.6	7.0	67%	4.7	11.9	2096	6434	4.1	1.5	2.6	416	1277	22.3	3568	10950	6128	320	982	9.3	1677	5146	0.3	44	134	46.4	7801	23940
2014	16.7	7.0	67%	4.7	12.1	2116	6493	4.1	1.5	2.6	416	1277	23.1	3694	11336	6946	587	1800	9.3	1677	5146	0.3	44	134	47.3	7946	24385
2015	17.0	7.0	67%	4.7	12.3	2152	6605	4.5	1.5	3.0	480	1473	24.1	3849	11811	6946	587	1800	9.3	1677	5146	0.3	44	134	48.9	8201	25169
2016	17.1	7.0	67%	4.7	12.4	2172	6664	4.5	1.5	3.0	480	1473	25.0	4004	12287	14633	587	1800	23.2	4181	12832	0.3	44	134	63.9	10880	33390
2017	17.2	7.0	67%	4.7	12.5	2192	6728	4.6	1.5	3.1	496	1522	26.0	4159	12763	14785	587	1800	23.5	4231	12984	0.3	44	134	65.4	11122	34131
2018	18.4	7.0	67%	4.7	13.7	2373	7283	4.8	1.5	3.3	528	1620	27.0	4314	13239	14941	587	1800	23.8	4282	13140	0.3	44	134	68.0	11540	35416
2019	18.5	7.0	67%	4.7	13.8	2392	7342	4.8	1.5	3.3	528	1620	27.9	4469	13715	15097	587	1800	24.1	4333	13296	0.3	44	134	69.4	11766	36108
2020	18.6	7.0	67%	4.7	13.9	2413	7406	4.9	1.5	3.4	544	1669	29.0	4644	14253	15253	587	1800	24.4	4383	13452	0.3	44	134	71.0	12029	36915
2021	18.7	7.0	67%	4.7	14.0	2429	7455	5.0	1.5	3.5	560	1719	30.1	4820	14791	15413	587	1800	24.6	4436	13613	0.8	131	401	73.1	12375	37979
2022	18.8	7.0	67%	4.7	14.1	2447	7509	5.0	1.5	3.5	560	1719	31.2	4995	15330	15575	587	1800	24.9	4488	13774	0.8	131	401	74.6	12621	38733
2023	18.9	7.0	67%	4.7	14.2	2463	7558	5.1	1.5	3.6	576	1768	32.3	5171	15869	15741	587	1800	25.2	4542	13940	0.8	131	401	76.2	12883	39536
2024	19.0	7.0	67%	4.7	14.3	2479	7607	5.1	1.5	3.6	576	1768	33.4	5347	16409	15906	587	1800	25.5	4596	14106	0.8	131	401	77.7	13129	40291
2025	19.1	7.0	67%	4.7	14.4	2495	7656	5.2	1.5	3.7	592	1817	34.5	5523	16949	16072	587	1800	25.8	4650	14272	0.8	131	401	79.3	13391	41095
2026	19.1	7.0	67%	4.7	14.5	2500	7671	5.4	1.5	3.9	624	1915	35.6	5699	17489	16241	587	1800	26.1	4705	14441	0.8	131	401	80.9	13659	41917
2027	19.2	7.0	67%	4.7	14.6	2516	7720	5.5	1.5	4.0	640	1964	36.7	5875	18030	16412	587	1800	26.5	4761	14611	0.8	131	401	82.5	13922	42726
2028	19.3	7.0	67%	4.7	14.7	2532	7769	5.6	1.5	4.1	656	2013	37.8	6051	18571	16585	587	1800	26.8	4818	14785	0.8	131	401	84.2	14187	43540
2029	19.4	7.0	67%	4.7	14.8	2548	7818	5.6	1.5	4.1	656	2013	38.9	6228	19113	16759	587	1800	27.1	4874	14959	0.8	131	401	85.7	14436	44304
2030	19.6	7.0	67%	4.7	14.9	2565	7872	5.7	1.5	4.2	672	2062	40.0	6405	19655	16933	587	1800	27.4	4931	15132	0.8	131	401	87.3	14703	45123
2031	19.6	7.0	67%	4.7	14.9	2565	7872	5.9	1.5	4.4	704	2160	40.6	6494	19931	17106	587	1800	27.7	4987	15306	0.8	131	401	88.4	14882	45670
2032	19.7	7.0	67%	4.7	15.0	2581	7921	6.0	1.5	4.5	720	2210	41.2	6584	20207	17280	587	1800	28.0	5044	15479	0.8	131	401	89.5	15060	46218
2033	19.8	7.0	67%	4.7	15.1	2597	7971	6.1	1.5	4.6	736	2259	41.7	6675	20483	17453	587	1800	28.3	5101	15653	0.8	131	401	90.5	15239	46767
2034	19.9	7.0	67%	4.7	15.2	2615	8025	6.2	1.5	4.7	752	2308	42.3	6765	20761	17627	587	1800	28.7	5157	15827	0.8	131	401	91.6	15420	47321
2035	20.0	7.0	67%	4.7	15.3	2631	8074	6.2	1.5	4.7	752	2308	42.8	6855	21038	17801	587	1800	29.0	5214	16000	0.8	131	401	92.6	15583	47821
2036	20.1	7.0	67%	4.7	15.4	2647	8123	6.4	1.5	4.9	784	2406	43.3	6921	21241	17979	587	1800	29.3	5272	16179	0.8	131	401	93.6	15755	48349
2037	20.2	7.0	67%	4.7	15.5	2663	8172	6.4	1.5	4.9	784	2406	43.7	6987	21443	18141	587	1800	29.6	5325	16341	0.8	131	401	94.4	15890	48763
2038	20.3	7.0	67%	4.7	15.6	2680	8226	6.5	1.5	5.0	800	2455	44.1	7054	21647	18308	587	1800	29.9	5379	16508	0.8	131	401	95.4	16044	49237
2039	20.4	7.0	67%	4.7	15.7	2696	8275	6.6	1.5	5.1	816	2504	44.5	7120	21851	18475	587	1800	30.2	5433	16675	0.8	131	401	96.3	16197	49706
2040	20.5	7.0	67%	4.7	15.8	2712	8324	6.7	1.5	5.2	832	2553	44.9	7187	22056	18642	587	1800	30.5	5488	16842	0.8	131	401	97.2	16350	50176
2041	20.6	7.0	67%	4.7	15.9	2728	8373	6.8	1.5	5.3	848	2602	45.3	7254	22261	18809	587	1800	30.8	5542	17009	0.8	131	401	98.1	16503	50646
2042	20.7	7.0	67%	4.7	16.0	2746	8427	6.9	1.5	5.4	864	2652	45.8	7321	22466	18976	587	1800	31.1	5597	17176	0.8	131	401	99.1	16658	51122
2043	20.8	7.0	67%	4.7	16.1	2762	8476	7.0	1.5	5.5	880	2701	46.2	7388	22673	19143	587	1800	31.4	5651	17343	0.8	131	401	100.0	16812	51594
2044	20.9	7.0	67%	4.7	16.2	2778	8525	7.1	1.5	5.6	896	2750	46.6	7455	22880	19310	587	1800	31.7	5705	17510	0.8	131	401	100.9	16966	52066
2045	21.0	7.0	67%	4.7	16.3	2796	8579	7.2	1.5	5.7	912	2799	47.0	7523	23087	19477	587	1800	32.0	5760	17676	0.8	131	401	101.8	17121	52543
2046	21.1	7.0	67%	4.7	16.4	2812	8628	7.3	1.5	5.8	928	2848	47.4	7582	23267	19651	587	1800	32.3	5817	17851	0.8	131	401	102.7	17269	52996
2047	21.2	7.0	67%	4.7	16.5	2828	8678	7.4	1.5	5.9	944	2897	47.8	7641	23448	19797	587	1800	32.6	5864	17996	0.8	131	401	103.5	17407	53420
2048	21.3	7.0	67%	4.7	16.6	2844	8727	7.5	1.5	6.0	960	2946	48.1	7700	23629	19950	587	1800	32.9	5914	18149	0.8	131	401	104.4	17548	53853
2049	21.3	7.0	67%	4.7	16.6	2847	8737	7.6	1.5	6.1	976	2995	48.5	7759	23811	20103	587	1800	33.1	5964	18302	0.8	131	401	105.2	17676	54247
2050	21.3	7.0	67%	4.7	16.7	2852	8751	7.7	1.5	6.2	992	3044	48.9	7818	23994	20256	587	1800	33.4	6014	18455	0.8	131	401	105.9	17806	54646

Notes:

1. City of Hillsboro based on JWC supplies all water. City of Hillsboro demands include City of Cornelius and City of Hillsboro Upper System (2007 thru 2050). See Revised Peak Season Demand Calculations.xls, "Demand by Demand" tab for calculations. City of Hillsboro JWC storage demand equals JWC demand minus Hillsboro natural flow water rights.

2. TVWD information based on TVWD Demand Updates - Rev 1 - Sept 2010.xls revised on Feb 2011 per City of Hillsboro Jan 2011. JWC demands do not include ASR demands. JWC (MG) total based on 180 day PSD and 120 day ASR Reduced Rate. Total TVWD storage is the TVWD stated JWC storage less their ASR rate over 120-days so the total 1.5 billion gallon aquifer storage is not exceeded. TVWD has native groundwater rights, but use them as an emergency back-up supply due to water quality concerns and are not considered part of their current system supply.

3. Forest Grove information based on Forest Grove - Supply - Demand for JWC Alt. Analysis_20100427.xlsx.

4. City of Beaverton based on JWC-COBdemand41210.pdf. Assuming 115 gpcd, JWC demands do not include ASR demands. JWC (MG) total based on 184 day PSD and 120 day ASR Reduced Rate. ASR maximum rate, reliability factor and demands per City of Hillsboro Jan 2011. JWC demand equals Max Total - ASR Reduced Rate. Total PSD based on ASR information given for PDD and assumed the same for PSD.

5. North Plains demands based on December 2005 Water System Master Plan (not updated 2010). PSD based on City of Hillsboro WSA monthly factor per City of Hillsboro meeting 4/2010.

6. Historical stored water information based on "JWC Stored Water Historical Use 05-25-10.xlsx."

3.0 WATER STORAGE NEEDS

The water storage needs of the JWC and CWS were determined based on the difference of total water supply demands and the existing water rights.

3.1 Total Stored Water Demand

The total water storage needs are based on the gross total peak season demand (PSD) of consumptive (JWC) and non-consumptive (CWS) water use. The JWC total water storage needs are based on the 184 Day PSD. The CWS water requirements are based on a 120 day period since they do not follow the typical municipal and irrigation (M&I) consumption model. The CWS water requirements are based on total volume of water needed to discharge from the reservoirs during the peak season demand period for four major purposes:

1. Ensure minimum stream flows in the Tualatin River
2. Offset a portion of the thermal load discharged by the Rock Creek and Durham AWTFs,
3. Offset the impact of sediment oxygen demand in the river
4. Water quality enhancement.

The individual and total storage water demands are shown in Table 3-5 and Figure 3-6.

Figure 3-6. Total Water Supply & Storage Needs (Based on 184 Day PSD)
(Does not include conservation)

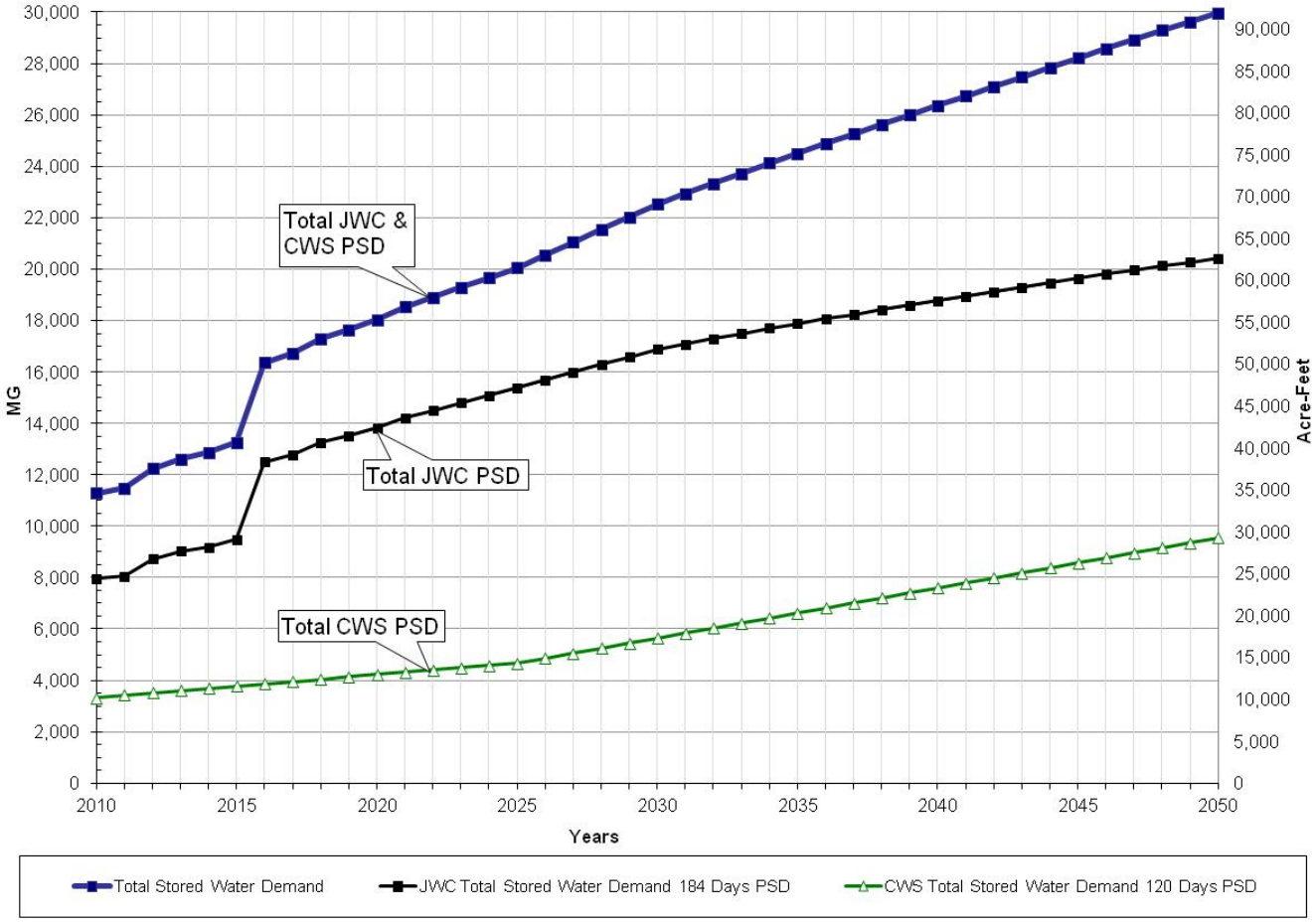


Table 3-5. Consumptive (JWC) and Non-Consumptive (CWS) Total Water Supply & Storage Needs

	Non-Consumptive (120 Days Peak Season Demand[1,2])			Consumptive (184 Days Peak Season Demand)			Total Stored Water Demand	
	Demand	Stored Demand		Demand	Stored Demand			
Year	(mgd)	(MG)	(Acre-Ft)	(mgd)	(MG)	(Acre-Ft)	(MG)	(Acre-Ft)
2010	27.7	3326	10207	42.0	7948	24391	**11274**	**34598**
2011	28.5	3416	10482	42.6	8051	24708	**11467**	**35190**
2012	29.2	3505	10757	46.3	8727	26781	**12232**	**37537**
2013	30.0	3595	11031	47.6	9013	27661	**12608**	**38693**
2014	30.7	3684	11306	48.5	9180	28173	**12864**	**39479**
2015	31.4	3774	11581	50.1	9474	29075	**13248**	**40656**
2016	32.2	3863	11856	66.8	12492	38337	**16355**	**50193**
2017	32.9	3953	12131	68.3	12768	39185	**16721**	**51316**
2018	33.7	4042	12405	71.0	13249	40659	**17291**	**53065**
2019	34.4	4132	12680	72.4	13507	41451	**17639**	**54131**
2020	35.2	4221	12955	74.0	13808	42375	**18029**	**55330**
2021	35.9	4311	13230	76.2	14205	43594	**18516**	**56824**
2022	36.7	4400	13505	77.7	14487	44458	**18887**	**57962**
2023	37.4	4490	13779	79.3	14786	45377	**19276**	**59157**
2024	38.2	4580	14054	80.9	15068	46241	**19647**	**60295**
2025	38.9	4669	14329	82.5	15367	47161	**20037**	**61490**
2026	40.5	4864	14927	84.2	15674	48102	**20538**	**63029**
2027	42.2	5059	15524	85.8	15976	49029	**21035**	**64554**
2028	43.8	5253	16122	87.5	16279	49960	**21533**	**66082**
2029	45.4	5448	16720	89.1	16565	50835	**22013**	**67555**
2030	47.0	5643	17318	90.7	16870	51772	**22513**	**69090**
2031	48.6	5838	17915	91.8	17074	52397	**22911**	**70313**
2032	50.3	6032	18513	93.0	17278	53023	**23310**	**71536**
2033	51.9	6227	19111	94.1	17482	53650	**23709**	**72760**
2034	53.5	6422	19708	95.2	17688	54282	**24110**	**73991**
2035	55.1	6617	20306	96.2	17874	54853	**24491**	**75160**
2036	56.8	6812	20904	97.3	18071	55456	**24882**	**76360**
2037	58.4	7006	21502	98.1	18224	55928	**25231**	**77430**
2038	60.0	7201	22099	99.1	18400	56469	**25601**	**78568**
2039	61.6	7396	22697	100.1	18575	57004	**25971**	**79701**
2040	63.3	7591	23295	101.0	18750	57540	**26340**	**80835**
2041	64.9	7785	23893	102.0	18924	58077	**26710**	**81969**
2042	66.5	7980	24490	102.9	19101	58620	**27082**	**83110**
2043	68.1	8175	25088	103.9	19277	59158	**27452**	**84246**
2044	69.7	8370	25686	104.9	19452	59697	**27822**	**85383**
2045	71.4	8564	26283	105.8	19630	60242	**28194**	**86525**
2046	73.0	8759	26881	106.8	19798	60758	**28557**	**87639**
2047	74.6	8954	27479	107.6	19956	61242	**28910**	**88721**
2048	76.2	9149	28077	108.5	20117	61736	**29265**	**89813**
2049	77.9	9344	28674	109.3	20263	62185	**29607**	**90859**
2050	79.5	9538	29272	110.1	20411	62641	**29950**	**91913**

Notes:
1. CWS total stored water demand needed discharged from reservoir during the 120 days PSD period to meet water quality at WWTP discharge points. The 120 day PSD period is not the assumed 184 day period, since demands don't follow the M&I consumption model.
2. CWS peak season was provided in the Demand Summary 10-24-07 - FINAL.xls.

3.2 Total Existing Water Rights

The existing water rights for JWC and CWS include stored water rights at Scoggins and Barney Reservoirs and natural flow. The individual and total existing water rights are shown in Table 3-6 and Figure 3-7.

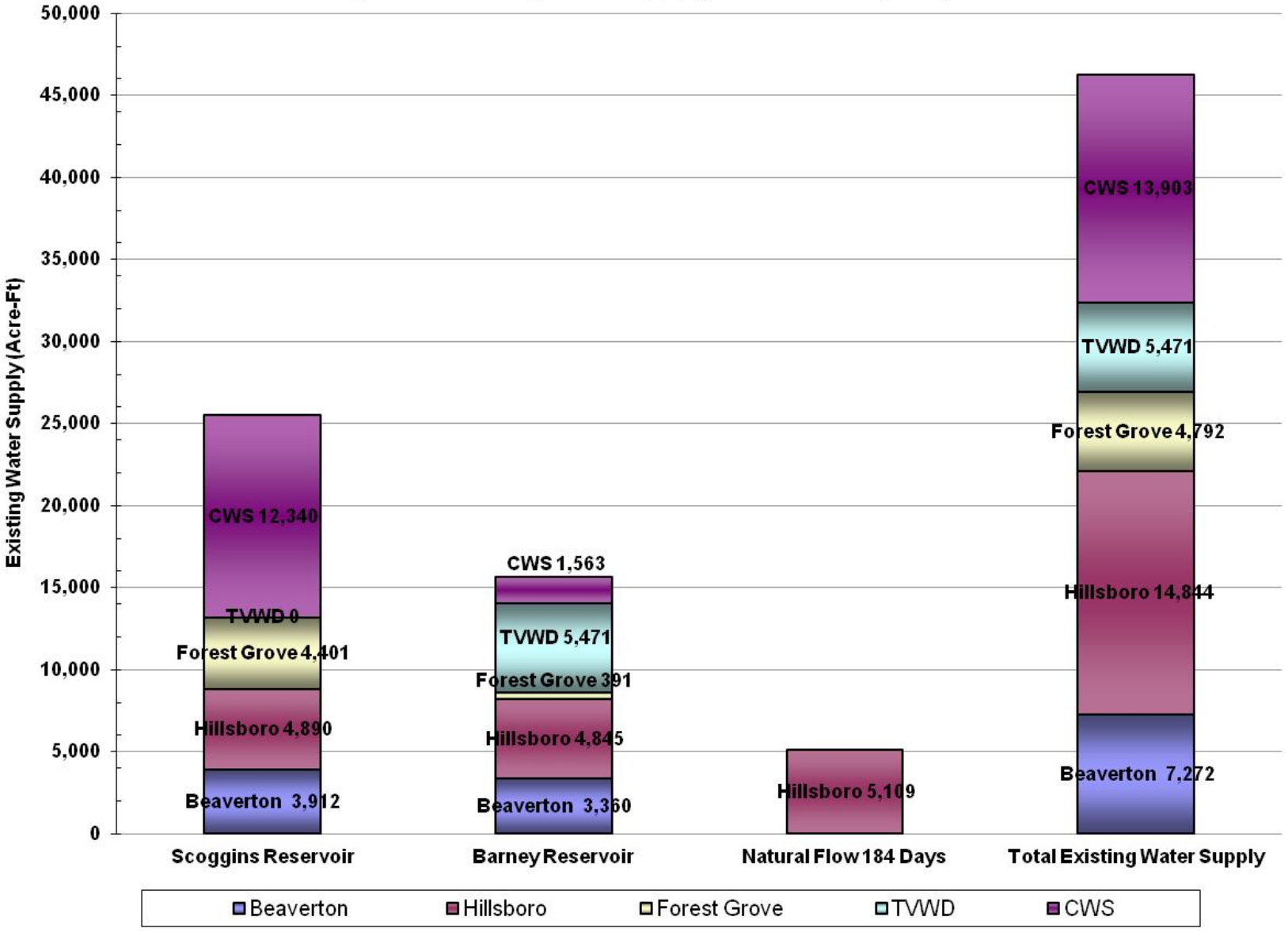
Table 3-6. Existing Water Supply

Agency	Scoggins Reservoir (ac-ft)	Barney Reservoir (ac-ft)	Natural Flow 184 Days (ac-ft)[2]	Total Existing Water Supply (ac-ft)[2]
Beaverton[4]	3,912	3,360		7,272
Hillsboro[3]	4,890	4,845	5109	14,844
Forest Grove[4]	4,401	391		4,792
TVWD	-	5,471		5,471
Total JWC Stored Water Supply (Scoggins and Barney Reservoir Only)				27,270
Total JWC Partner Water Supply				32,379
CWS	12,340	1,563		13,903
Total Existing Storage Water Supply (JWC & CWS)[1]	25,543	15,630	-	41,173
Total Existing Water Supply (JWC & CWS)	**25,543**	**15,630**	**5,109**	**46,282**

Note:
1. Total existing storage water supply equals JWC stored water supply + CWS storage supply.
2. Hillsboro natural flow water supply not accounted for as a reduction in demand but included in the total water supply.
3. Climate change was addressed only by Hillsboro's adjustment of its natural flow rights reliability from 100% in 2010 to 75% in 2050.
4. Reductions for fish flows, dead storage, and evaporation loss factors applied by the Washington County Water Master were applied to the storage allocations for Barney Reservoir.
5. Reductions for evaporation loss factors applied by the Washington County Water Master were applied to the storage allocations for Scoggins Reservoir.
6. Beaverton and TVWD local ASR water supply is accounted for in the reduction of their individual demands, not included in the total water supply.

Source: JWC Existing Storage Volume.xlsx

Figure 3-7. Existing Water Supply (Based on 184 Day PSD)



3.3 Total Future Needed Water Storage Rights

The total future supply and storage water needed was determined based on the difference between the total stored water demand and the existing water supply from year 2010 to year 2050. This is shown in Figure 3-8 and Table 3-7.

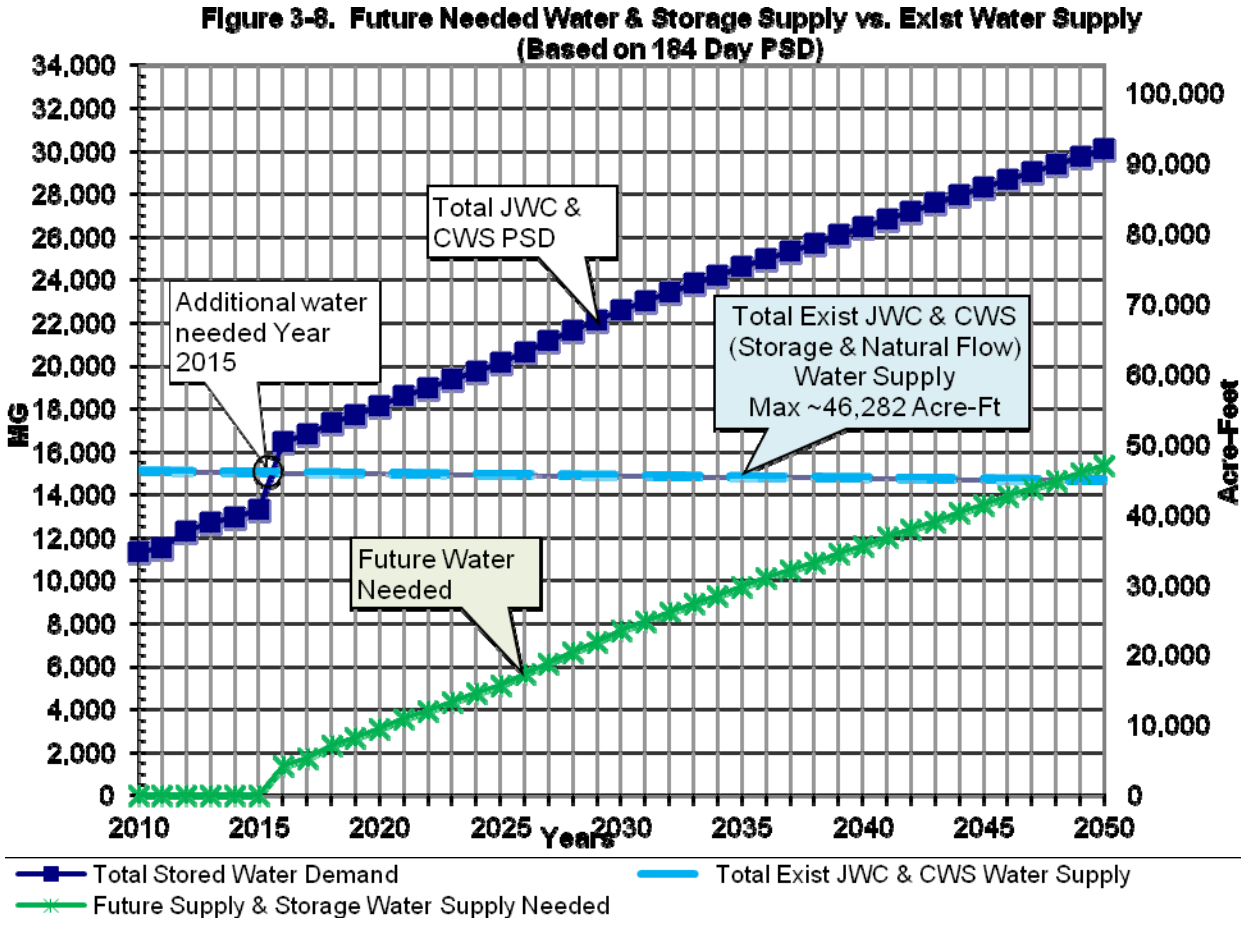


Table 3-7. Future Water Supply Needed

Year	Existing Stored Water Supply		Stored Water Demand		Future Stored Water Supply Needed	
	(MG)	(Acre-Ft)	(MG)	(Acre-Ft)	(MG)	(Acre-Ft)
2010	15081	46282	11274	34598	**0**	**0**
2011	15071	46250	11467	35190	**0**	**0**
2012	15060	46219	12232	37537	**0**	**0**
2013	15050	46187	12608	38693	**0**	**0**
2014	15040	46155	12864	39479	**0**	**0**
2015	15029	46123	13248	40656	**0**	**0**
2016	15019	46091	16355	50193	**1337**	**4102**
2017	15008	46059	16721	51316	**1713**	**5257**
2018	14998	46027	17291	53065	**2293**	**7038**
2019	14988	45995	17639	54131	**2651**	**8136**
2020	14977	45963	18029	55330	**3052**	**9367**
2021	14967	45931	18516	56824	**3549**	**10893**
2022	14956	45899	18887	57962	**3931**	**12063**
2023	14946	45867	19276	59157	**4330**	**13289**
2024	14935	45835	19647	60295	**4712**	**14460**
2025	14925	45803	20037	61490	**5112**	**15687**
2026	14915	45771	20538	63029	**5623**	**17258**
2027	14904	45740	21035	64554	**6131**	**18814**
2028	14894	45708	21533	66082	**6639**	**20374**
2029	14883	45676	22013	67555	**7129**	**21879**
2030	14873	45644	22513	69090	**7640**	**23446**
2031	14863	45612	22911	70313	**8049**	**24701**
2032	14852	45580	23310	71536	**8458**	**25956**
2033	14842	45548	23709	72760	**8867**	**27212**
2034	14831	45516	24110	73991	**9279**	**28475**
2035	14821	45484	24491	75160	**9670**	**29676**
2036	14811	45452	24882	76360	**10071**	**30908**
2037	14800	45420	25231	77430	**10430**	**32010**
2038	14790	45388	25601	78568	**10812**	**33180**
2039	14779	45356	25971	79701	**11191**	**34345**
2040	14769	45324	26340	80835	**11571**	**35511**
2041	14759	45292	26710	81969	**11951**	**36677**
2042	14748	45261	27082	83110	**12333**	**37850**
2043	14738	45229	27452	84246	**12714**	**39017**
2044	14727	45197	27822	85383	**13095**	**40186**
2045	14717	45165	28194	86525	**13477**	**41361**
2046	14707	45133	28557	87639	**13851**	**42507**
2047	14696	45101	28910	88721	**14214**	**43620**
2048	14686	45069	29265	89813	**14580**	**44744**
2049	14675	45037	29607	90859	**14931**	**45822**
2050	14665	45005	29950	91913	**15285**	**46908**

4.0 ASSUMPTIONS

Key assumptions associated with the demand projections are described below. Except where noted otherwise, the assumptions listed below are taken directly from the December 2007 Carollo Engineers Report titled *TBWSPP Water Supply Improvements Program Preliminary Engineering Phase 2* and updated demand projections from each JWC member.

4.1 City of Beaverton

The City of Beaverton currently uses the JWC as its only source of supply. However, the City also uses aquifer storage and recovery (ASR), which allows water to be stored during low-demand periods in the winter and then used to meet peak demands in the summer. The City also has the possibility of using up to 1.9 MGD of native groundwater rights only as an emergency back-up supply (due to water quality concerns) and are not considered part of their current system supply. This source was not included as a supply in the presented demand projections.

Key assumptions associated with the City of Beaverton demand projections include:

- Projections were based on the City's 2000 Water Master Plan that had been updated by City staff.
- ADD projections based on the number of customers multiplied by the average water usage of 115 gallons per capita per day (gpcd).
- Peaking factors were 1.135 for 184 day peak season, 1.18 for 160 day peak season demands, and 2.0 for peak day demand.
- Peak season demands begin in June 1st instead of May 1st.
- Beaverton's ASR supply was assumed to decrease Beaverton's demand on the JWC system.
- ASR supply was assumed 6 MGD starting in 2007, increasing to 7 MGD by 2013. For Peak Season Demand, ASR maximum flow rate was reduced by a reliability factor of 67%.

4.2 City of Forest Grove

The City of Forest Grove currently has two sources of supply: the JWC and their local Clear Creek source. The Clear Creek source is treated at the Forest Grove Water Treatment Plant (FGWTP), which has a capacity of 3.7 MGD. However, under maximum day conditions, production at the FGWTP is source limited to a capacity of 1.5 MGD. Key assumptions associated with the City of Forest Grove demand projections include:

- Demands were based on projections developed in the City's 2000 Water Master Plan that had been updated by City staff based on "Scenario B" (medium growth).
- The division of average day demands between the JWC and Clear Creek sources was based on the historical proportion coming from each source.

- Peaking factors were 1.23 for 184 day peak season, 1.13 for 160 day peak season demand, and an average 1.9 for maximum day include both the Clear Creek source and JWC source. (For the JWC source only, peaking factors are an average 1.6 for 184 day peak season, average 2.1 for 160 day peak season, and 2.8 for maximum day based on B&V review of projected demands.)

4.3 City of Hillsboro

The City of Hillsboro uses the JWC water as its sole source of supply for its primary service area, the City System, and wholesale customer, City of Cornelius. The City of Hillsboro uses both the Cherry Grove Water Treatment Plant and JWC as its sources of supply for its secondary service area, the Upper System. As part of the City of Hillsboro Capital Improvement Master Plan, Black & Veatch generated demand projections for the City of Hillsboro. The City System demands were calculated based on projected land use development and unit demands for each customer class in gallons per acre per day. The Upper System and wholesale customer demands were based on projected growth rates. Key assumptions associated with the City of Hillsboro demand projections include:

- Unit demands for each customer class were used to develop City System demand projections.
- Based on an analysis of historical maximum day demands, a design maximum day peaking factor for the City of Hillsboro of 1.46 for the City System current Water Service Area, 1.7 was used for the City System expansion areas, and 1.7 for both Cornelius and Upper System were used.
- Demand projections assume that the Cherry Grove WTP will be taken off line and the Upper System will be supplied by the JWC (per the City of Hillsboro).
- Hillsboro's natural flow rights were assumed to become less reliable over time. Reductions in reliability were applied on a straight line basis from 0% in 2010 to 25% in 2050.

4.4 Tualatin Valley Water District

TVWD currently uses two sources of supply: the JWC and water purchased from PWB. Key assumptions associated with the TVWD demand projections include:

- Updated demand projections were supplied by the TVWD in September 2010. The JWC Master Plan (March 2009, Black & Veatch) was based in part on TVWD's demand projections that had been prepared as part of TVWD's Water Master Plan Update (December 2007, Carollo Engineers). In March 2010, TVWD prepared an update to the District's water demand projections based on updated population estimates and actual water demands over the previous five years. These updated demands reflected significantly lower per-capita water consumption as well as reductions in seasonal and daily peaking factors based on actual water demands. In addition, near-term population forecasts were reduced slightly from the 2007 Master Plan to reflect lower growth rates resulting from the current economic recession.
- Annual average demands from Portland is 13.2 mgd based on existing wholesale agreement through year 2020. In year 2015, TVWD will reduce the amount of water

purchased from PWB and meet a majority of their demands through the JWC supply. After year 2016, Portland annual average is only for Metzger annual average demand and the remaining annual average demand is from JWC.

- The 160 day peak season demands were determined by multiplying the 184 day peak season demands by the ratio of 160 days/184 days.
- TVWD has native groundwater rights as an emergency back-up supplies due to water quality concerns and are not considered part of their current system supply. This source was not included as a supply in the presented demand projections.
- TVWD's ASR supply was assumed to decrease TVWD's demand on the JWC system.
- ASR is 4.6 mgd for peak day demand until year 2014 increasing to 8.5 mgd. Annual average demands for ASR is 0, assuming recharge approximately equals recovery.

4.5 City of North Plains

The City of North Plains currently uses the JWC as its source of supply. Key assumptions associated with the City of North Plains demand projections include:

- Demand projections are based on the City of North Plains December 2005 Water System Master Plan provided by the City of North Plains Public Works Director – Blake Boyles
- North Plains average day demand is expected to triple to 0.67 MGD by the year 2021, the year of forecasted saturation development.
- The maximum day demand is also expected to triple to 1.62 MGD by year 2021.
- Peak season demand based on City of Hillsboro City System monthly factors per City of Hillsboro April 2010 meeting.

4.6 Clean Water Services

Key assumptions associated with the Clean Water Services non-consumptive peak season storage demands are described in the Demand Summary 10-24-07 - FINAL.xls.

5.0 CLEAN WATER SERVICES ADDITIONAL SUPPLY

Except for participation in the TBWSP 40-foot dam raise, Clean Water Services (CWS) capacity requirements are not included with the proposed supply options for the JWC. CWS requires flow augmentation for the Tualatin River, but is planning on obtaining additional flow from within the basin by developing additional storage within Henry Hagg Lake. CWS has elected to not participate in obtaining additional supplies from outside the Tualatin Basin. CWS plans on meeting its future demands by participating in the TBWSP 40-foot dam raise, or with an alternative project that would only raise Scoggins Dam either 7.5 feet or 12.5 feet depending on placement of the dam.

If the TBWSP 40-foot dam raise is not constructed and one of the other water supply options is selected, then the alternative short dam raise project would be required. A cost allowance for the short dam raise is included in all of the options except the TBWSP Option. This allows for an equal comparison between the options that meets the needs of CWS.

6.0 WATER CONSERVATION

JWC prepared a Water Management Conservation Plan (WMCP) in accordance with Oregon State law (OAR 690-086-0150), which was approved by the Oregon Water Resources Department in September 2010. The WMCP describes regional conservation efforts, as well as each member agency's current conservation efforts and those planned for the future.

The Demand Analysis of this chapter recognizes impacts to the demands of the JWC members of conservation steps already taken, as reflected in current demands. The impact of conservation on future demands, to some extent, has been taken into account in the individual JWC members' demand projections. Please refer to the WMCP for details on future water conservation scenarios and potential impacts to the projected water demands presented.

7.0 CLIMATE CHANGE

Climate change poses a long-term risk to the assumptions of demand and supply in the Tualatin Basin. A PWB study showed a 4% to 5% increase in demands due to climate change. A recent study for Clean Water Services, *The Impacts of Climate Change on the Tualatin Basin Water Supply*, was performed by Dr. Richard Palmer, Erin Clancy, Nathan VanRheenen, and Matthew W. Wiley, and completed in 2004 (draft version)**.** Key findings of this study are summarized below.

- **Impacts on Temperature and Precipitation.** It was estimated that average monthly temperatures will increase by as much a 2° F by 2040 and as much as 4° F by 2080. The increase in temperatures will be the most dramatic during the winter and summer months. Although average annual precipitation will increase in future decades, this will be due to increased precipitation in the winter months. Summer months, particularly the late summer, will become drier. This will stress the ability of the Tualatin system to meet water temperature standards and maintain instream flows.
- **Impacts on Streamflow.** The changes in precipitation and temperature will significantly influence annual streamflow patterns. By 2040, the watershed's average annual runoff will be less than its historic average. In particular, summer streamflows will decrease by 10 to 20%. The increase in annual and winter precipitation will be overshadowed by increases in temperature. The increased temperature will increase evapotranspiration and result in much lower late-spring and summer flows. These changes will increase the Hagg Lake's drawdown period and decrease the reliability with which future demands can be met.
- **Impacts on System Yield.** During future decades, climate change will consistently and significantly impact on the yield of the water supply system. The yield of the current system is expected to erode by approximately 1.5% per decade during the next forty years. This is particularly important as system demands are expected to increase in the future, and will surpass the system yield.
- **Water Supply Expansion.** The referenced study considered the proposed expansion of the Hagg Lake storage as a means of mitigating climate change effects on water supply. The current planning for the water supply expansion of the TBWSP and the JWC incorporates this analysis.
- **Planning for Droughts.** As supply is impacted and demands increase, the likelihood of a multi-year drought that prevents full annual refill of the reservoirs will increase. Multi-year draw-downs will be common, and the impacts of extended droughts may be much more significant. System management must adjust to deal with these changes. The development of a drought management plan will be essential.

In summary, the key findings of this climate change study pose a long-term risk to the assumptions of demand and supply in the Tualatin Basin. The water demands presented in Section 2 of this Technical Memorandum were not explicitly adjusted based on these climate change findings due to significant uncertainties in the accuracy and timing of these conclusions. The available water supplies presented were adjusted based on assuming a184-day release season over the term of the study and a reduction of Hillsboro's natural flow right availability by 25%.

Regardless, there are significant uncertainties of how climate change may influence future population growth and/or changes in conservation ethics over time. It is suggested that JWC partners continue to track this important issue and regularly update water supply and demand forecasts in the future.

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