Forecast Results for Individual WRIAs

WRIA 29a & 29b Wind & White Salmon 56
WRIA 30 Klickitat 60
WRIA 31 Rock-Glade 64
WRIA 32 Walla Walla 68
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WRIA 34 Palouse 76
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WRIA 37, 38 & 39 Lower Yakima, Naches & Upper Yakima 88
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Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." Results for WRIAs 29a and 29b are presented together due to limitations in the Department of Ecology GIS database. The tributary surface water supply forecast for Wind-White Salmon is characterized mostly by increases from late fall through mid-spring, with smaller decreases in the late spring and summer.

Irrigation is the dominant source of demand in WRIA 29, although it is smaller than irrigation demands in many other WRIAs of eastern Washington. Assuming no change in irrigated acreage, these demands are projected to increase in most spring and summer months (April through August), with little impact from the consideration of alternate future economic scenarios. Municipal demands are very small in comparison. They are projected to grow 120% by 2030, though the total municipal demand will still be quite small in comparison to other watersheds.

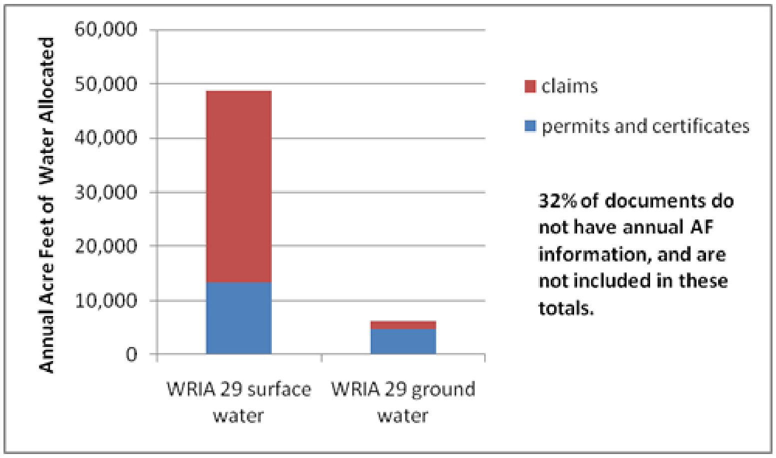
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply is forecasted to be sufficient to meet combined municipal and surface water irrigation demands on a watershed scale. Additional water supply is available in this watershed from the Columbia River, though separate analysis indicates that only about 5% of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

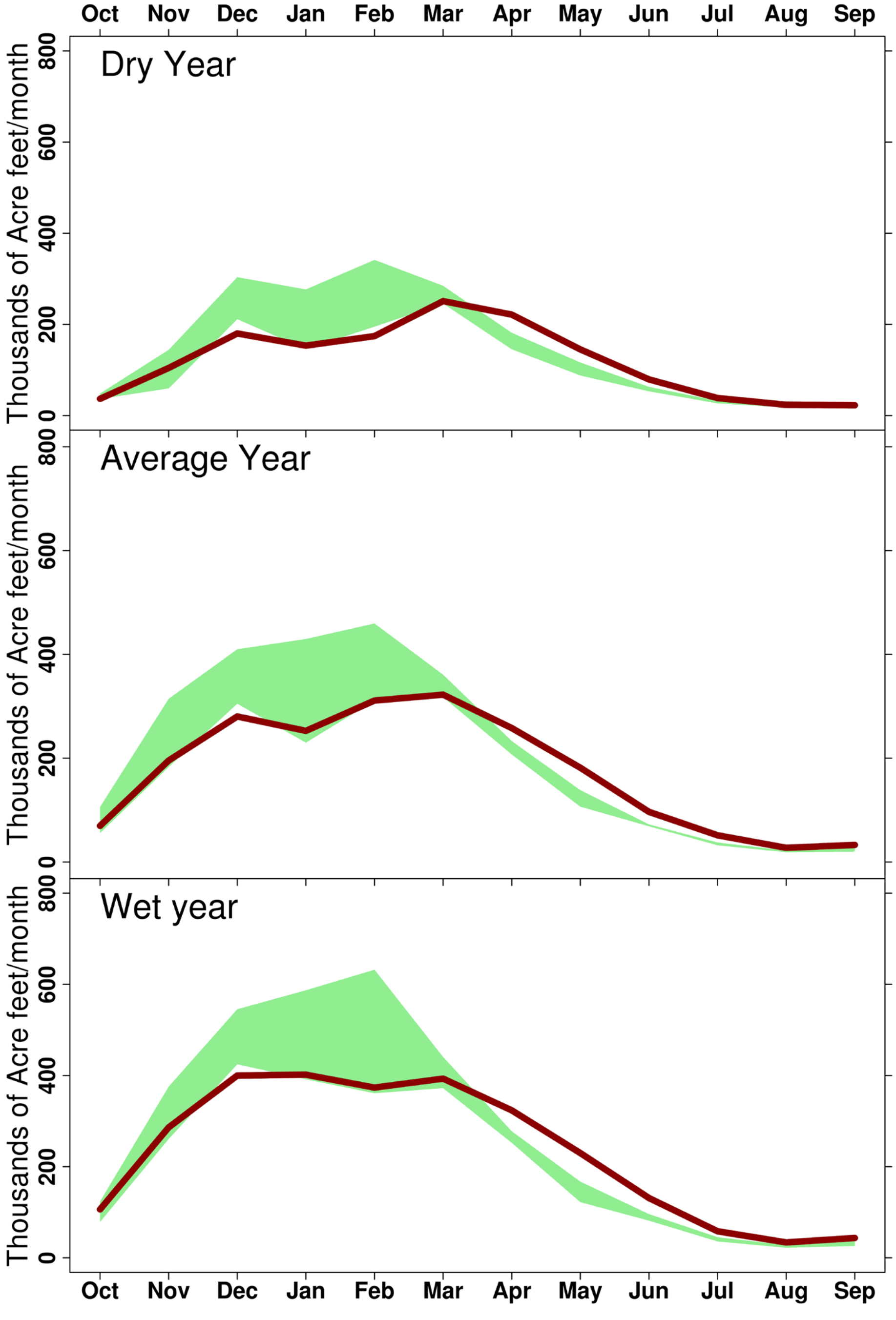
Fish listed under the Endangered Species Act that spawn or rear in tributary waters of this watershed include Lower Columbia River Bull Trout, Lower Columbia River Chinook, Lower Columbia River Steelhead, Middle Columbia Steelhead, and Upper Columbia River Summer and Fall Run Chinook.

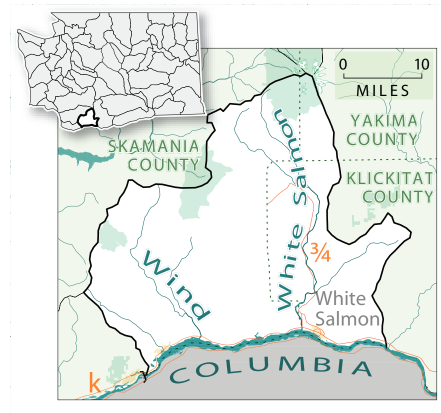
Management Context	
Adjudicated Areas	NO
Watershed Planning	WRIA 29a: Phase 4 (Implementation) WRIA 29b: NO (planning terminated)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Lower Columbia River Bull Trout Lower Columbia River Chinook Lower Columbia River Steelhead Middle Columbia Steelhead Upper Columbia River Summer and Fall Run Chinook [Columbia mainstem migratory corridor]
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.

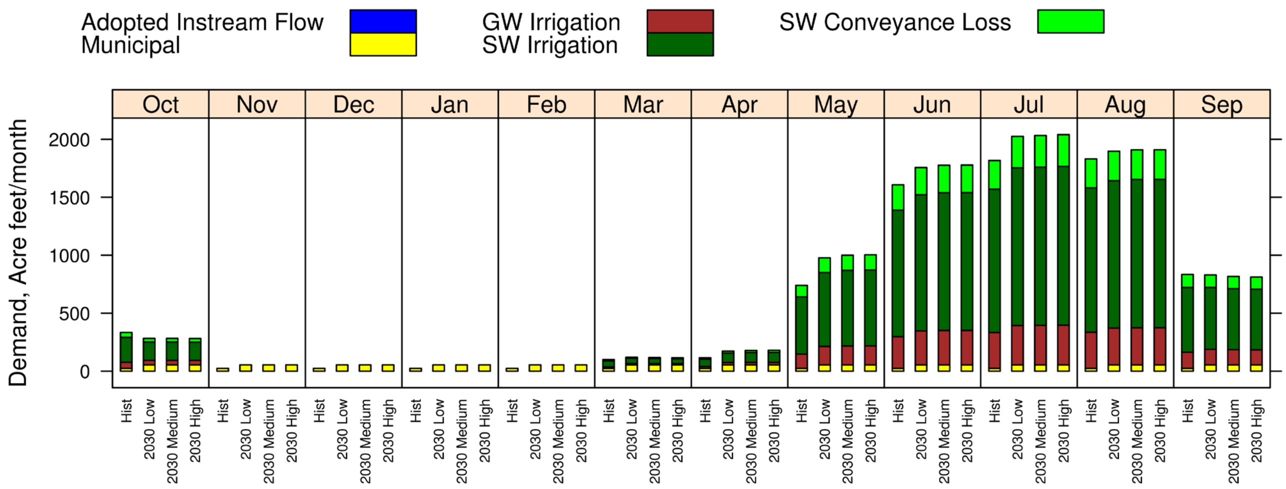




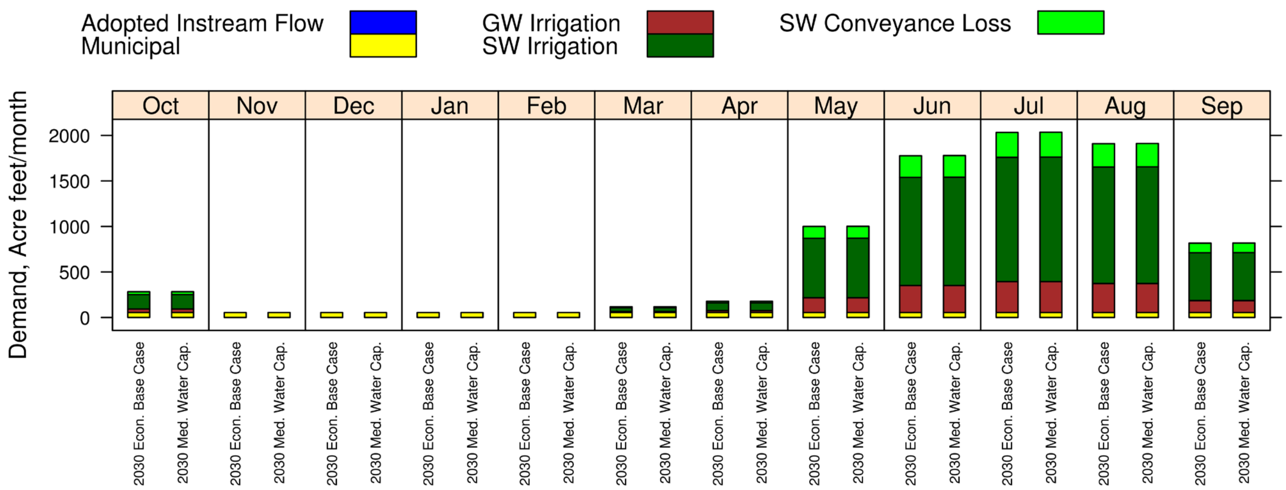
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

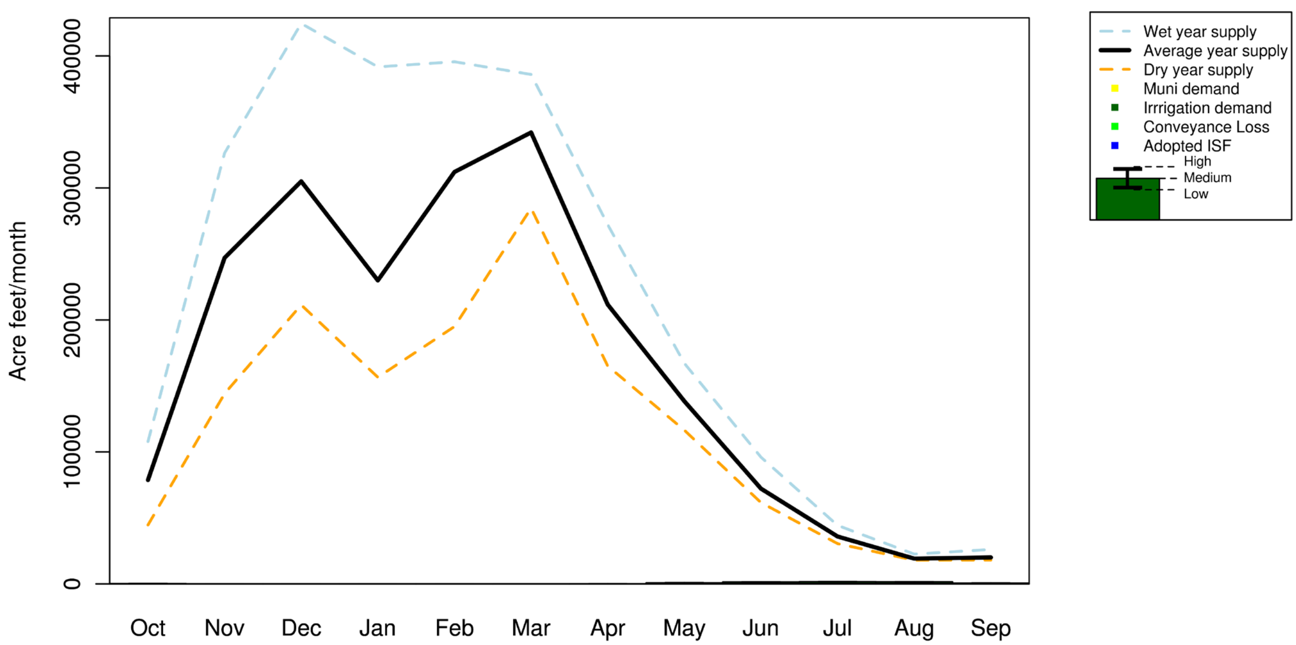
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Klickitat is characterized mostly by substantial increases in the late fall, winter and early spring and decreases in late spring through early fall.

Irrigation is the dominant source of demand in WRIA 30, with municipal demands that are much smaller. Assuming no change in irrigated acreage, irrigation demand is forecasted to increase somewhat for most months of the irrigation season in the future, with small variations in impact when alternate future economic scenarios are considered. Municipal demands are expected to grow 20% by 2030.

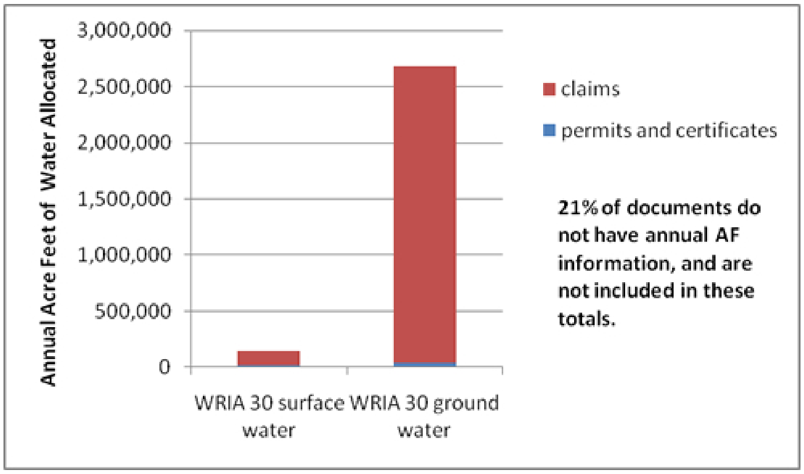
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply is projected to be sufficient to meet combined municipal and surface water irrigation demands on a watershed scale. Additional water supply is available in this watershed from the Columbia River, though separate analysis indicates that only about 5% of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

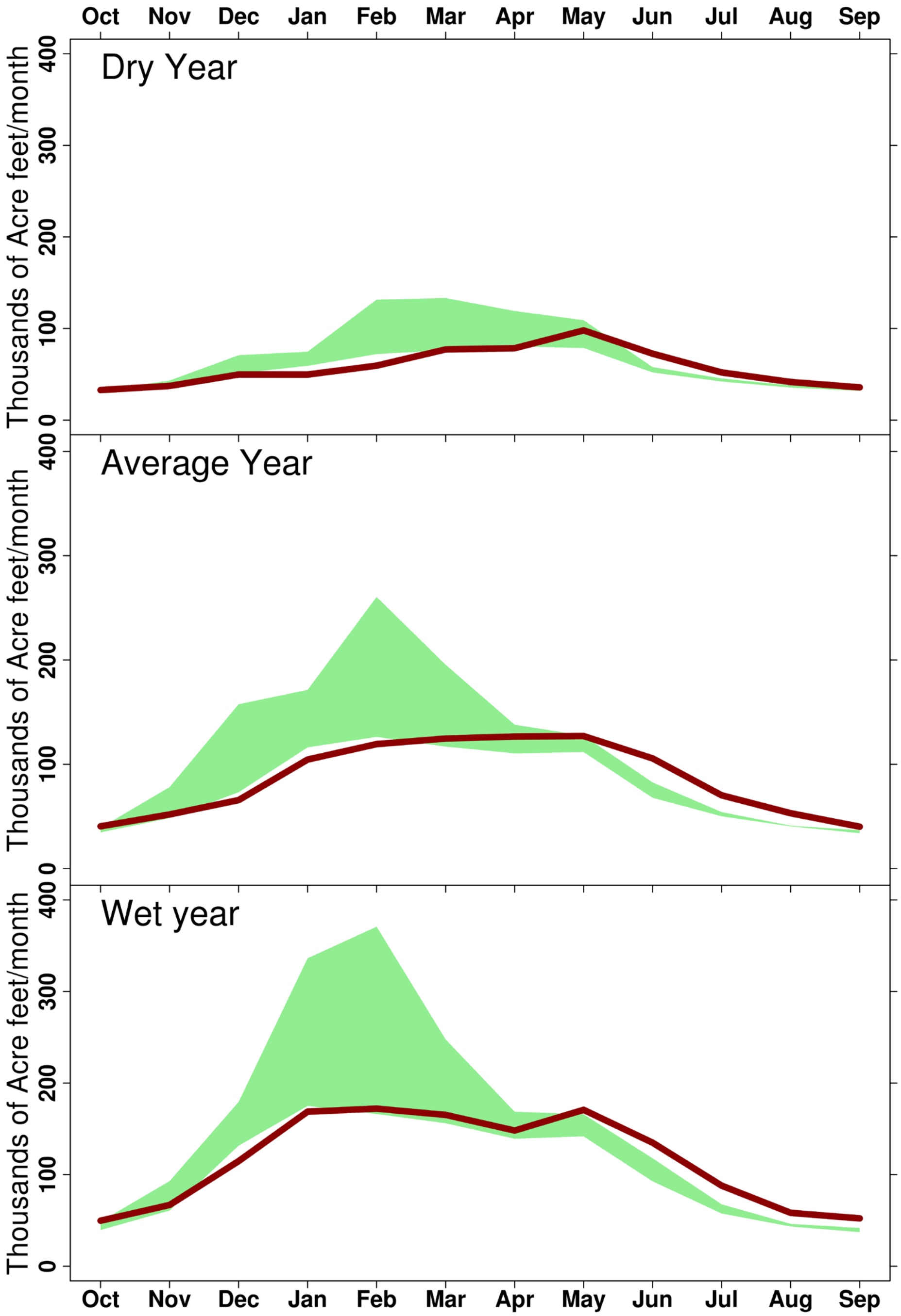
Fish listed under the Endangered Species Act that spawn or rear in tributary waters of this watershed include Lower Columbia River Bull Trout and Middle Columbia Steelhead.

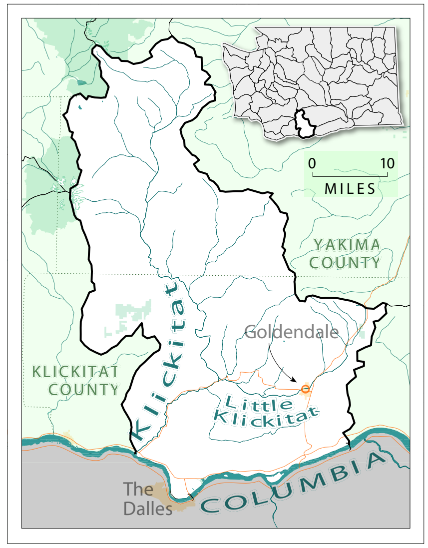
Management Context	
Adjudicated Areas	Bird-Frazier Creeks Bacon Creek Little Klickitat River Mill Creek Blockhouse Creek
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Lower Columbia River Bull Trout Middle Columbia Steelhead [Columbia mainstem migratory corridor]
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



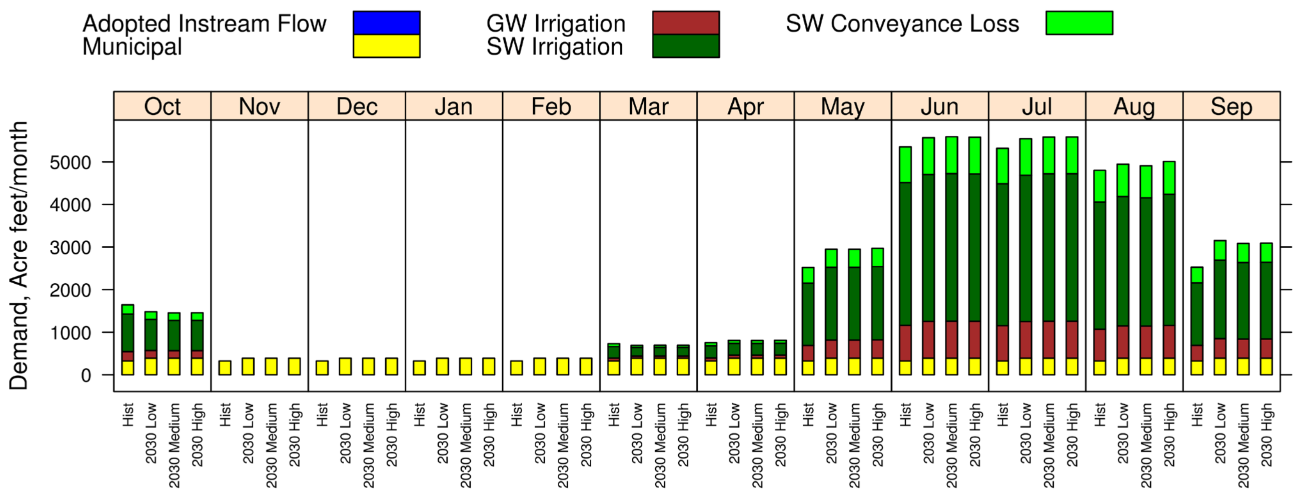
To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.



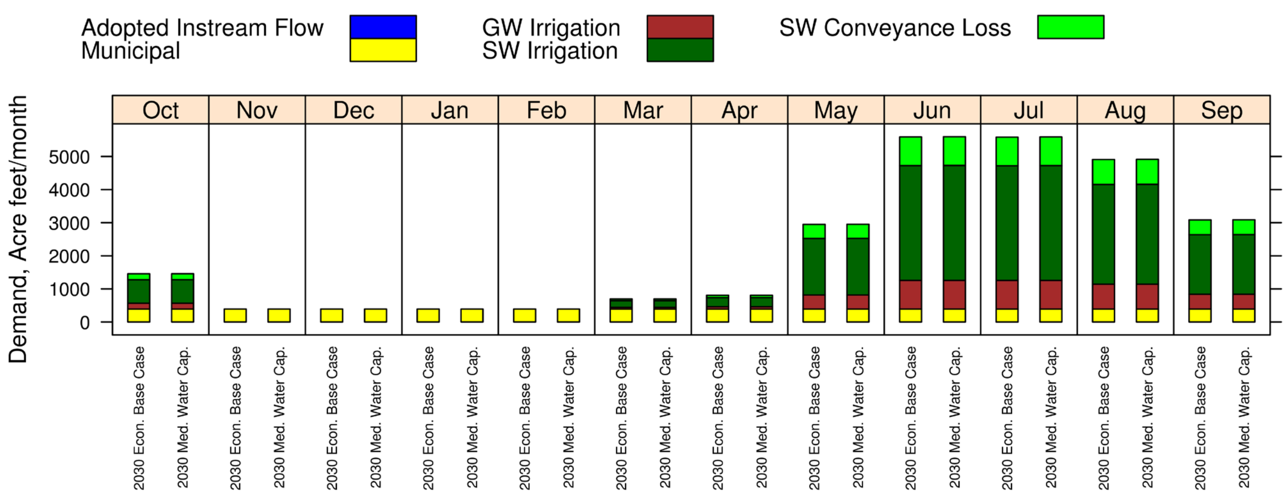


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

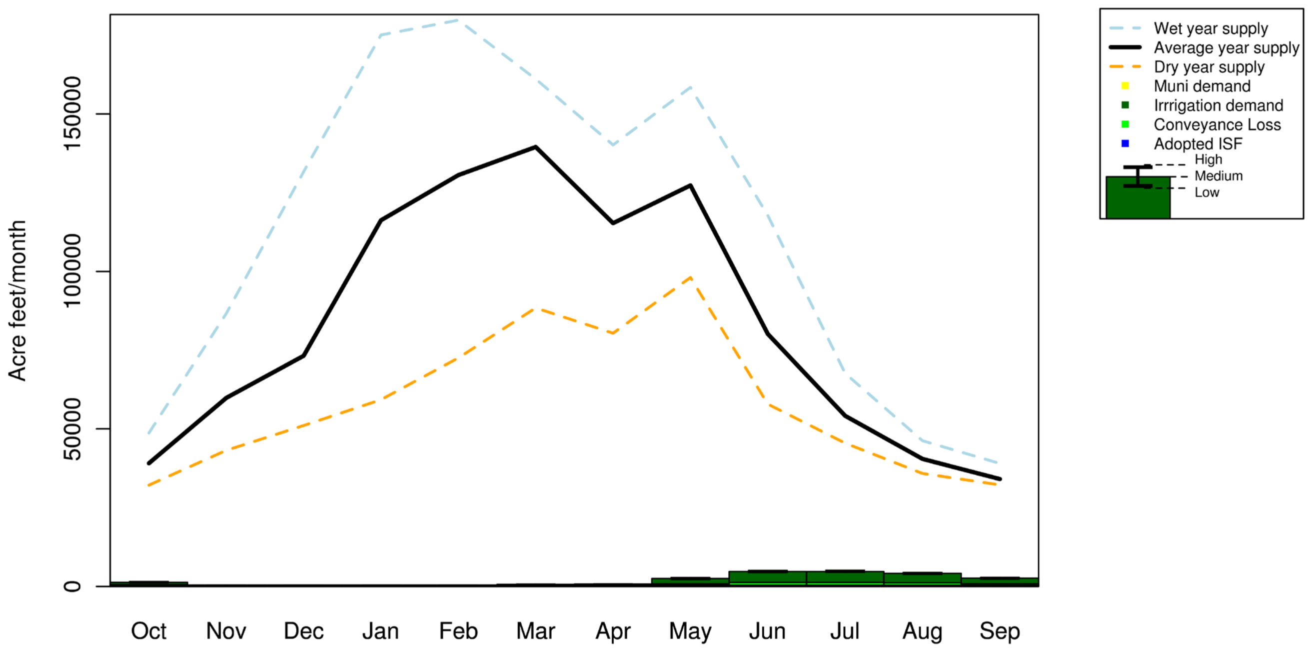
*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

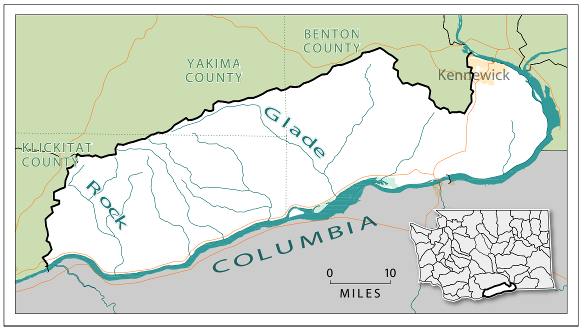
Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Rock Glade is characterized mostly by slight increases during the winter.

Irrigation is the primary source of demand in WRIA 31, with much smaller municipal demands. Assuming no change in irrigated acreage, irrigation demand is projected to increase slightly during future summer months (June through August) but decrease in other months, with little impact on results from the consideration of alternate future economic scenarios. Municipal demands are expected to grow 11% by 2030, a smaller increase than in many other eastern Washington WRIAs.

If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

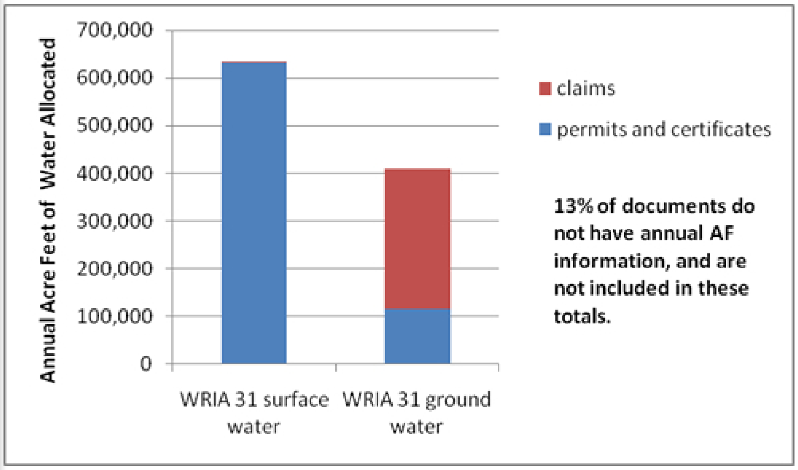
In 2030, combined municipal and surface water irrigation demands are projected to outstrip unregulated tributary supply on a watershed scale during most years for May through September. Much of this demand is met from mainstem supplies, and separate analysis indicates that almost a quarter of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

Fish listed under the Endangered Species Act that spawn or rear in tributary waters of this watershed include Middle Columbia Steelhead and Upper Columbia River Summer and Fall Run Chinook.



Management Context	
Adjudicated Areas	NO
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Middle Columbia Steelhead Upper Columbia River Summer and Fall Run Chinook [Columbia mainstem migratory corridor]
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



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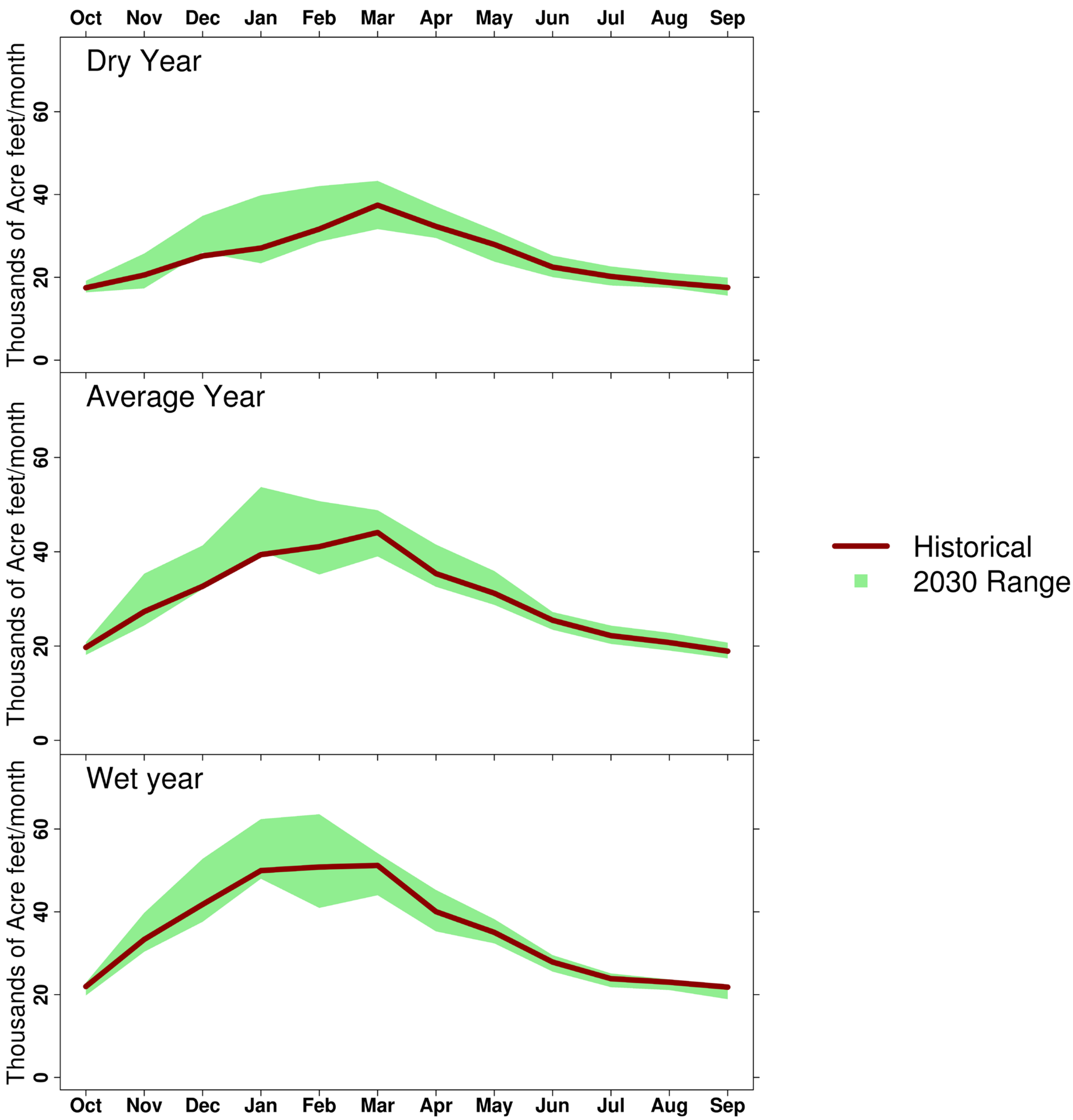
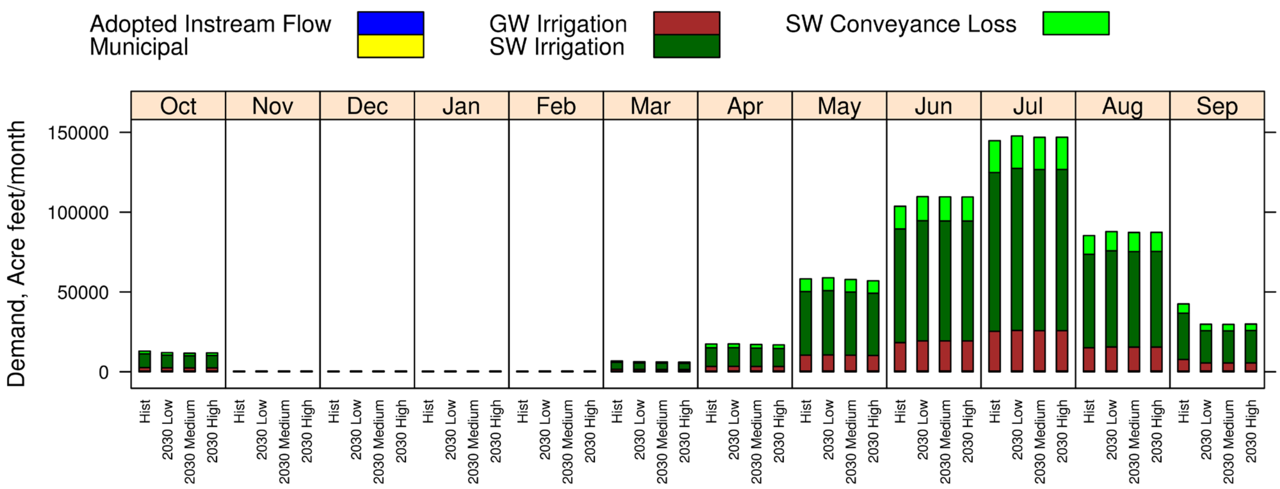


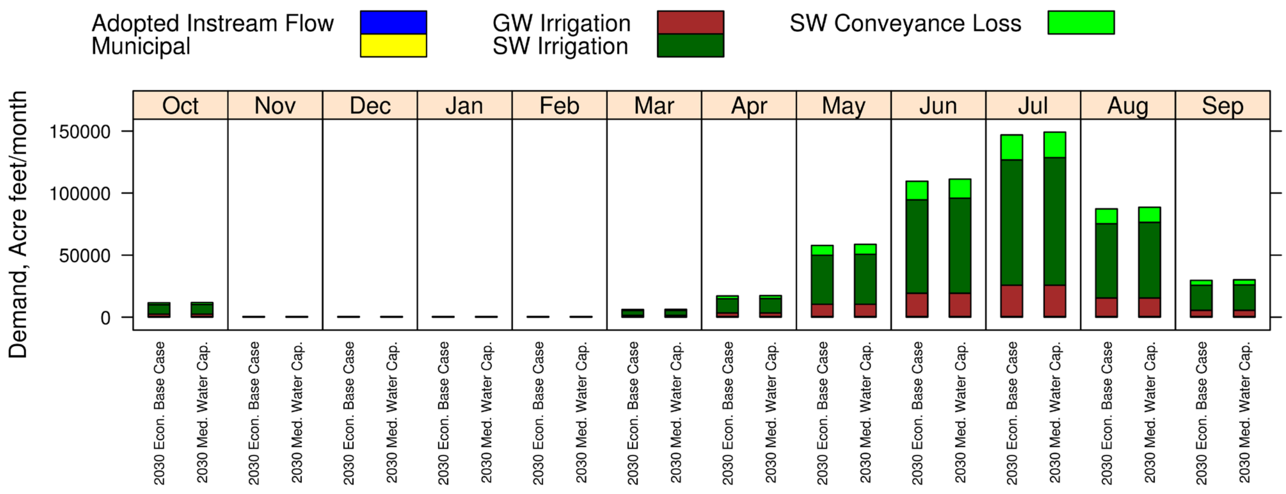
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

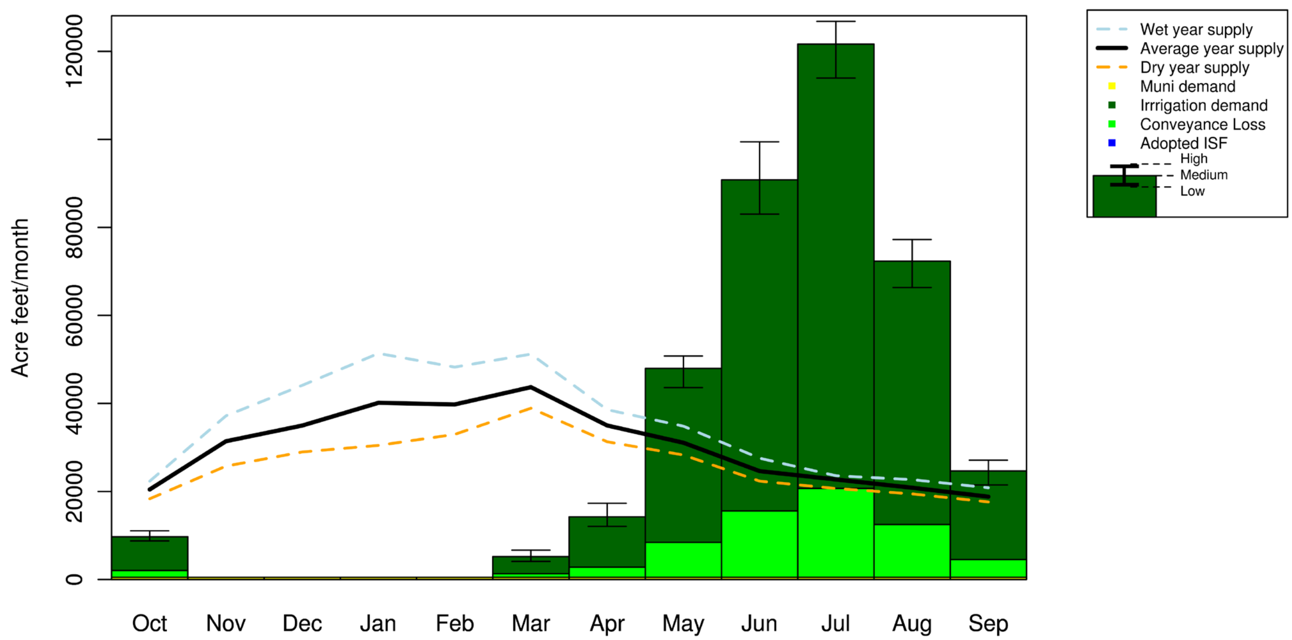
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Walla Walla is characterized mostly by significant increases from late fall through early spring and slight decreases in late spring and early summer.

Primary demands are irrigation and instream flow requirements, with much smaller municipal demands. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase in in some months in the future (June, August, and October) and decrease slightly in other months, with small variations depending on the future economic scenarios considered. Municipal demands are projected to grow 21% by 2030. Because there are no adopted instream flows in Walla Walla at the mouth of the watershed, instream flows are shown as the highest quantified flow at any point for a given month, as specified in Chapter 173-532 WAC. For December through May, flows are shown at Walla Walla River at Detour road. For other months, when the Walla Walla River is closed to new uses, flows from other control points are shown.

If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is not anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will only increase demand in WRIAs where water is provided for new irrigated land.

In 2030, at the watershed scale, combined municipal and surface water irrigation demands and adopted instream flows are projected to outstrip unregulated tributary supply generated within the Washington portion of the watershed during average and dry years in June, and in most years for July through October. Upstream portions of the watershed outside of Washington provide additional supplies, but may also have additional demands. Modeling indicated that at the WRIA level there was insufficient water to serve all demands in every year between 1977 and 2006. The resulting unmet demand ranged from 19,589 to 64,692 ac-ft per year depending on yearly flow conditions, with an average of 44,257 ac-ft per year. Simulation of future insufficient water occurred in all the years for the middle climate scenario. The resulting unmet demand per year ranged from 19,679 to 69,149 with an average of 44,601 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Although not shown here, unmet demands due to a failure to meet adopted instream flows are shown in the technical report. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

Steelhead in the Walla Walla basin are part of the ESA-Threatened Middle Columbia steelhead population, while bull trout here are part of an ESA-Threatened Touchet/Walla Walla Oregon Recovery Unit. Summer Steelhead are primarily spawning in April-May, while spring Chinook spawn in the late summer and fall.

Management Context	
Adjudicated Areas	Touchet River Dry Creek Walla Walla River Stone Creek Doan Creek
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	YES (Chapter 173-532 WAC)
Fish Listed Under the Endangered Species Act[1]	Middle Columbia Steelhead, Snake River Basin Steelhead, Touchet/Walla Walla (Oregon Recovery Unit) Bull Trout [Columbia mainstem migratory corridor]
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

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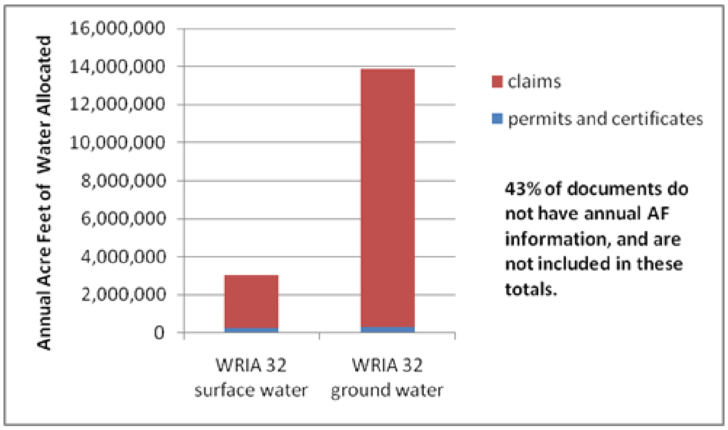

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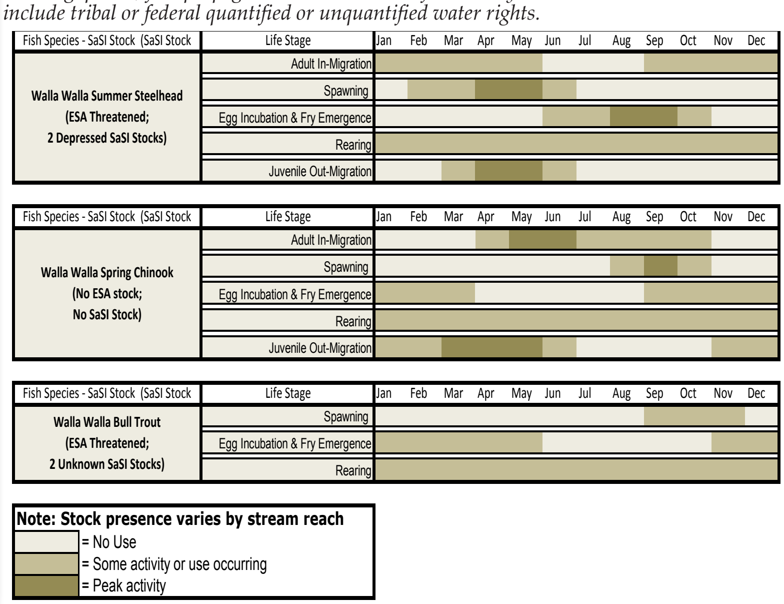
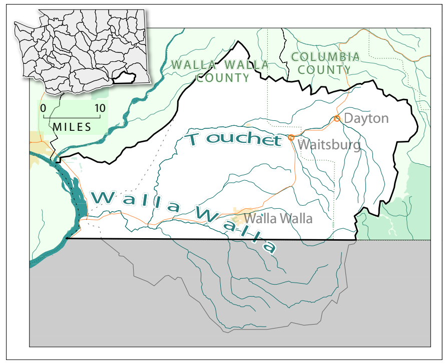
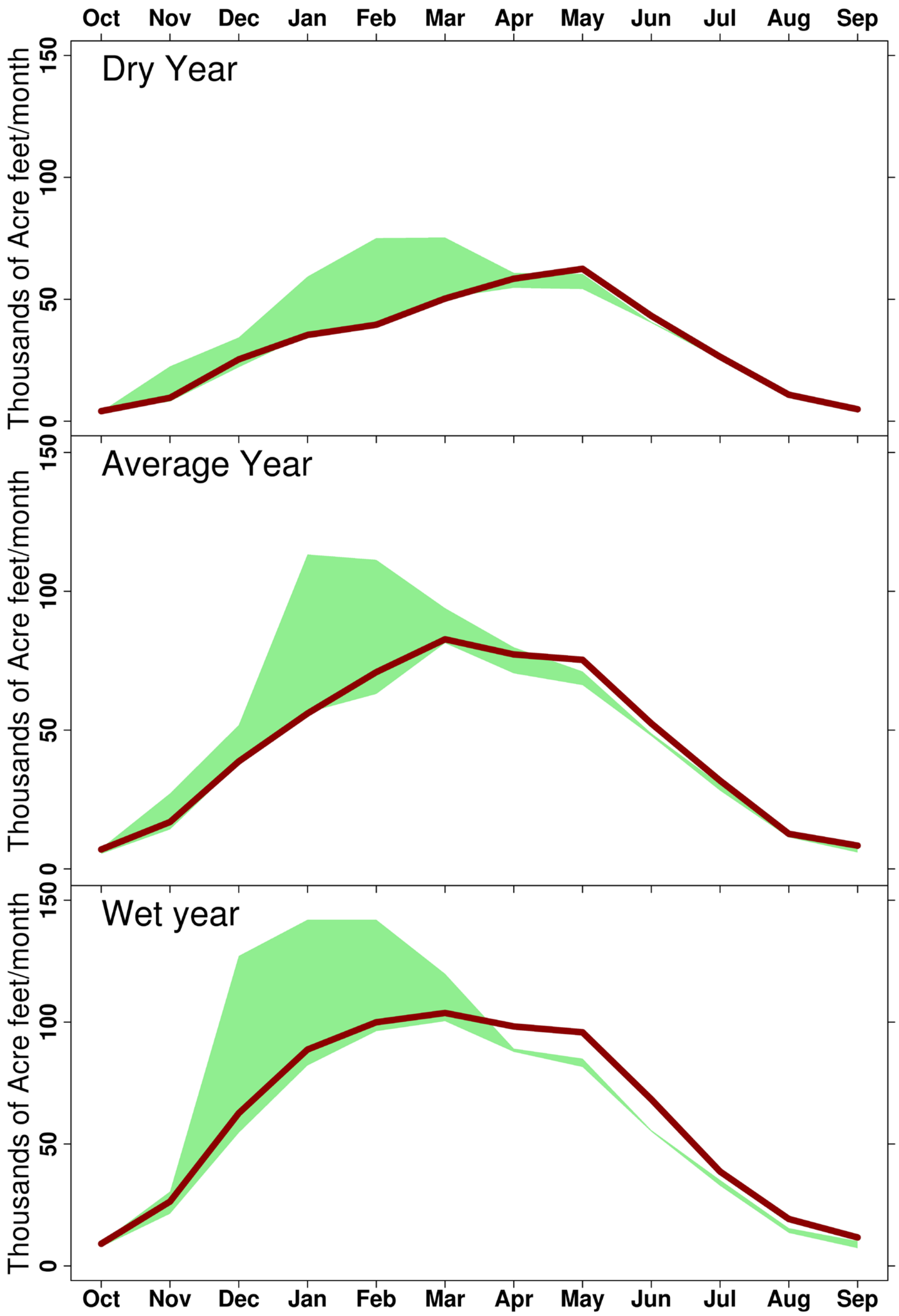


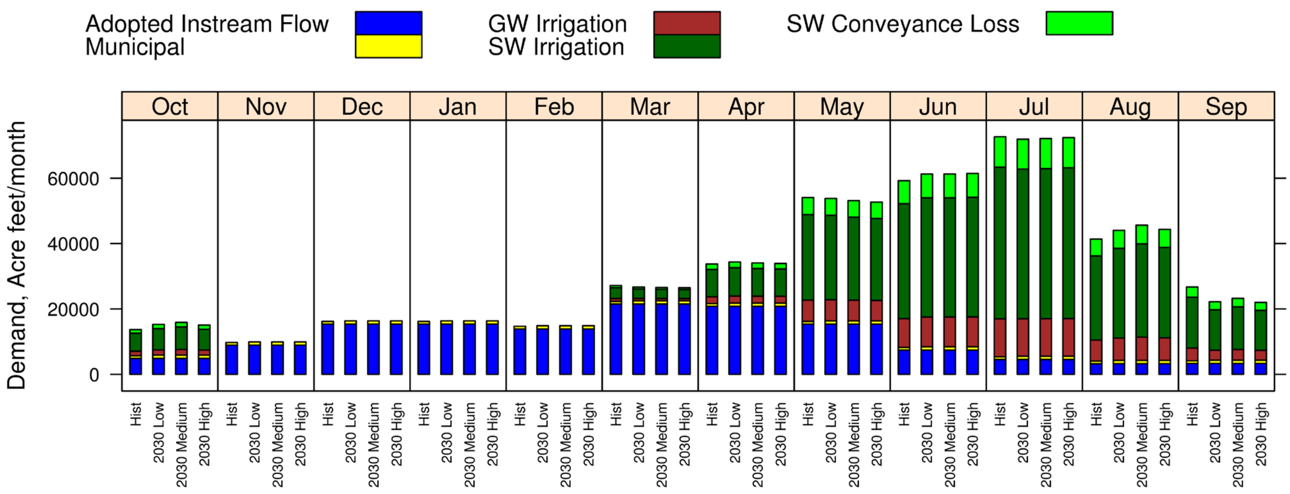
Fish use of WRIA waters (provided by the Washington Department of Fish and Wildlife)



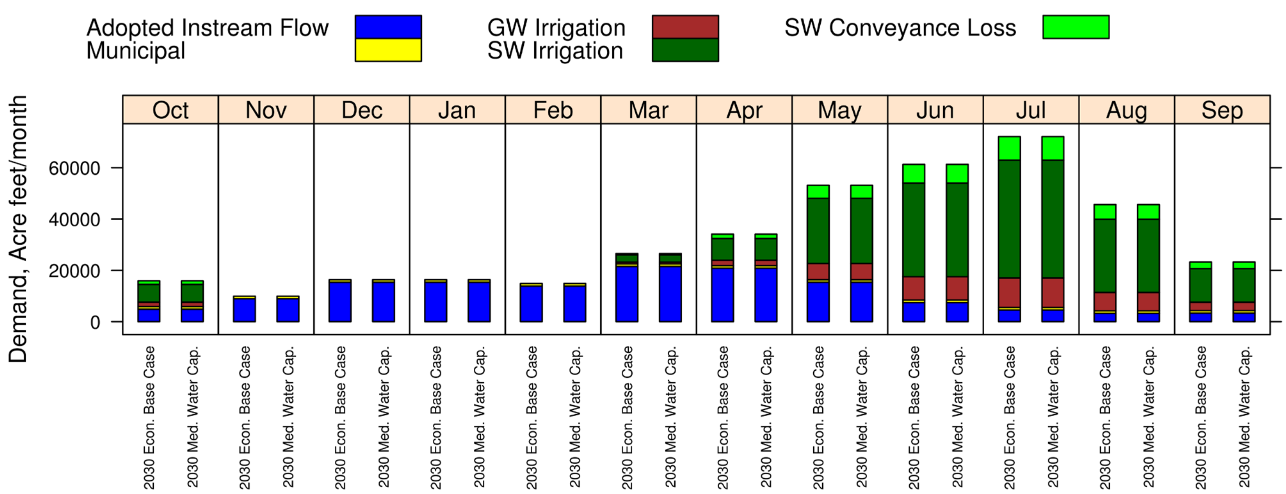


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

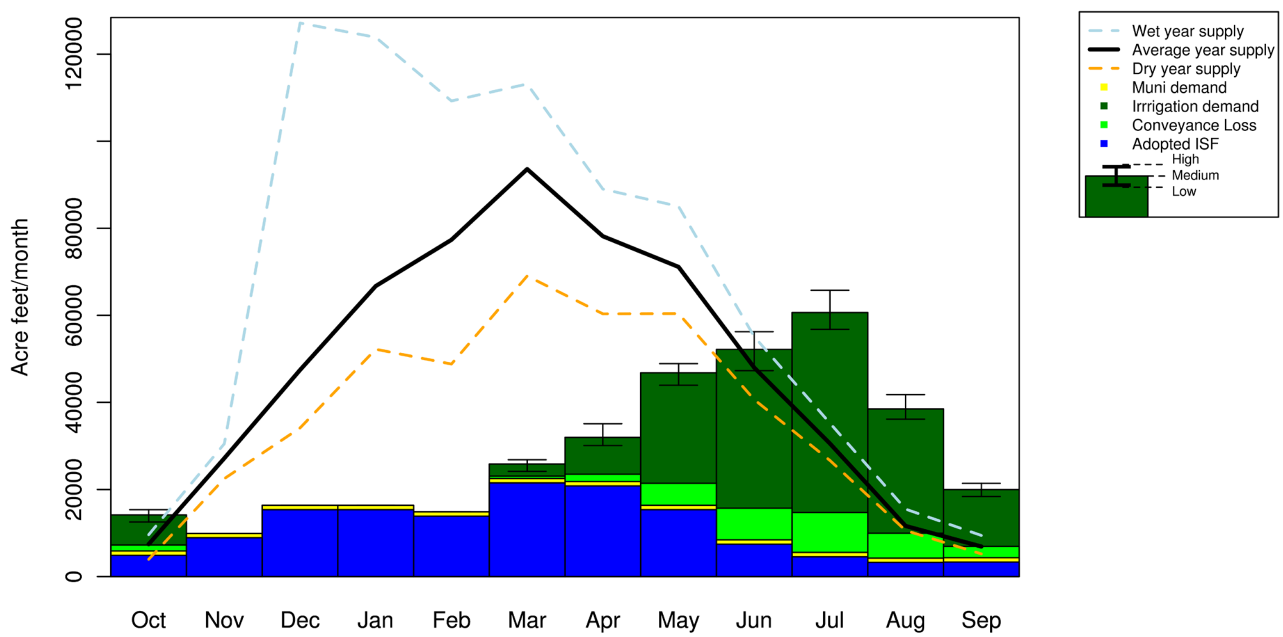
Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Lower Snake is characterized mostly by small increases in some years from late fall through mid-spring.

As in many other WRIAs in eastern Washington, irrigation demands dominate, and municipal demands are much smaller.

Assuming no change in irrigated acreage, irrigation demands are projected to increase somewhat in most months of future irrigation seasons, with some variation in the magnitude of the increase depending on the economic scenario being considered. Municipal demands are expected to grow 16% by 2030.

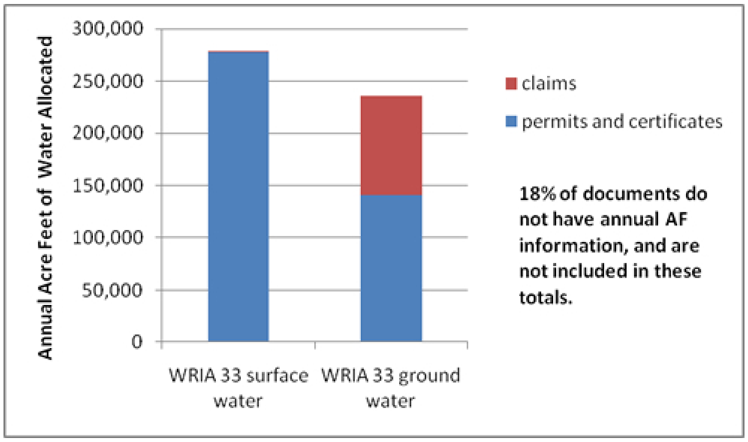
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is not anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will only increase demand in WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply would be insufficient to meet combined municipal and surface water irrigation demands at the watershed scale on its own during most years for May through October, and in some years in April. Additional water supply is available to some areas from the Columbia Basin Project. Other areas receive Snake River water supplies. Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

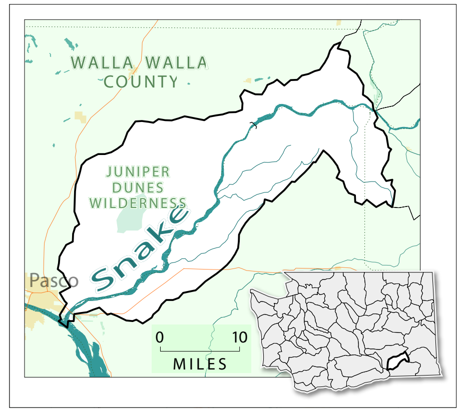
Fish listed under the Endangered Species Act that spawn or rear in tributary waters of this watershed include Snake River Basin Steelhead, Snake River Fall Run Chinook, and Snake River Spring and Summer Run Chinook.

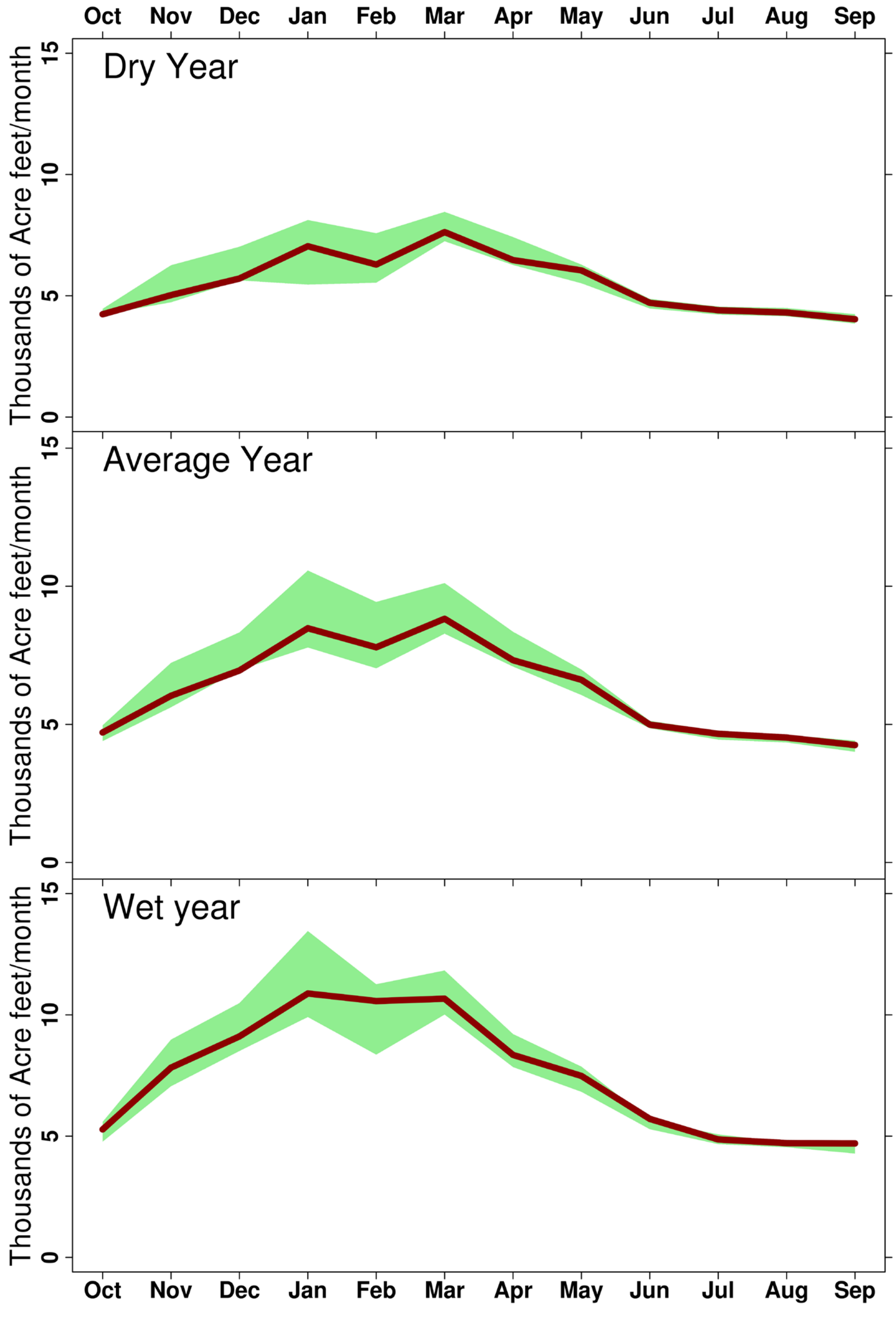
Management Context	
Adjudicated Areas	NO
Watershed Planning	NO
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Snake River Basin Steelhead Snake River Fall Run Chinook Snake River Spring and Summer Run Chinook [Snake mainstem migratory corridor for Snake River sockeye]
Groundwater Management Area	YES (Franklin Co. portions are part of Columbia Basin GWMA)
Groundwater Studies	No WRIA level studies found (but see WSU's technical report for references on Columbia Basin Groundwater Management Area and Columbia Plateau Regional Aquifer System)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



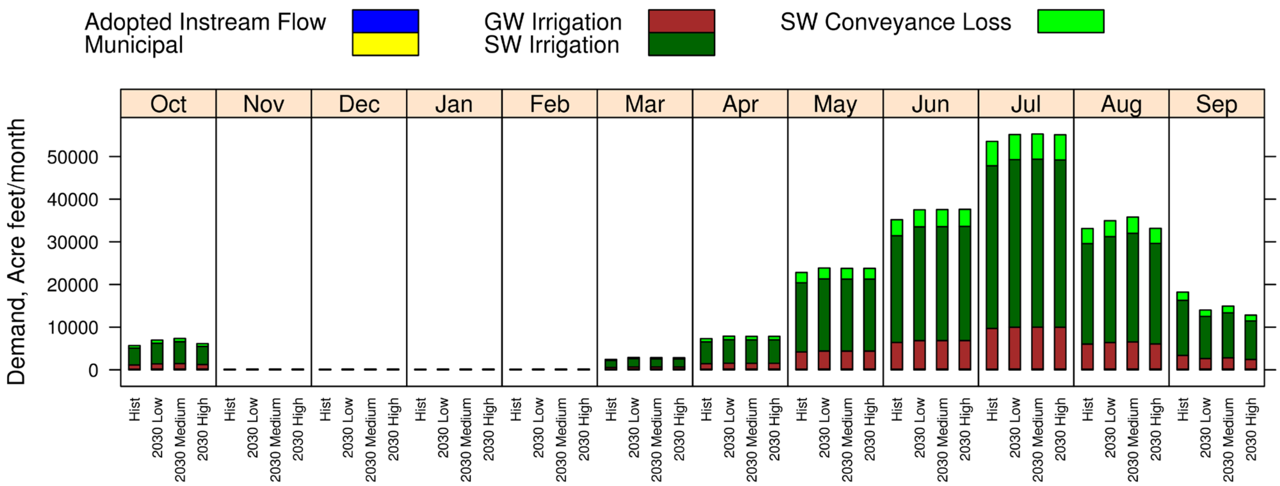
To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.



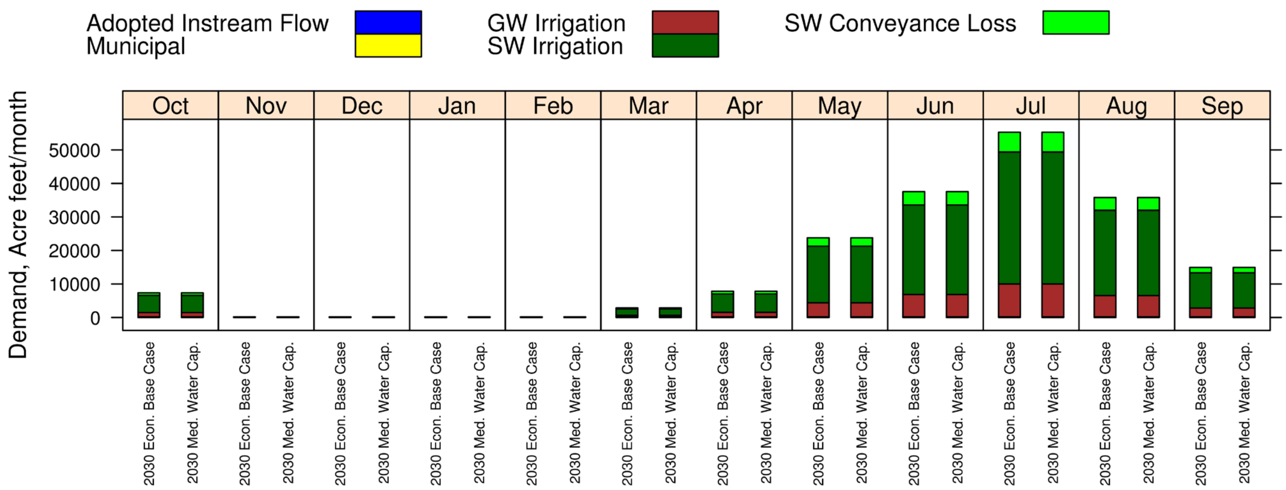


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

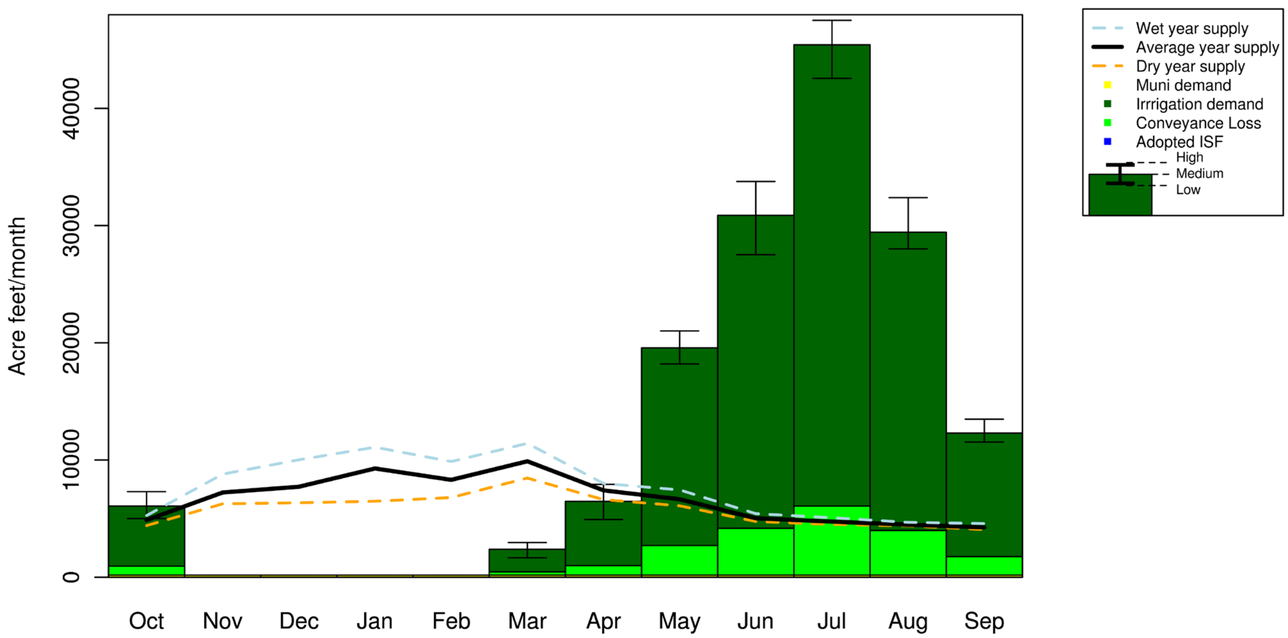
*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Palouse is characterized mostly by substantial increases in the winter.

Irrigation is the primary demand in WRIA 34, though municipal demands are also sizeable. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase in most months of the irrigation season, with little impact on results from the consideration of alternate future economic scenarios. Because of declining groundwater in the Odessa area, some irrigation demand is forecasted to shift by 2030 from groundwater to surface water. Municipal demands are projected to increase 5% by 2030, a smaller increase than in most other watersheds in eastern Washington.

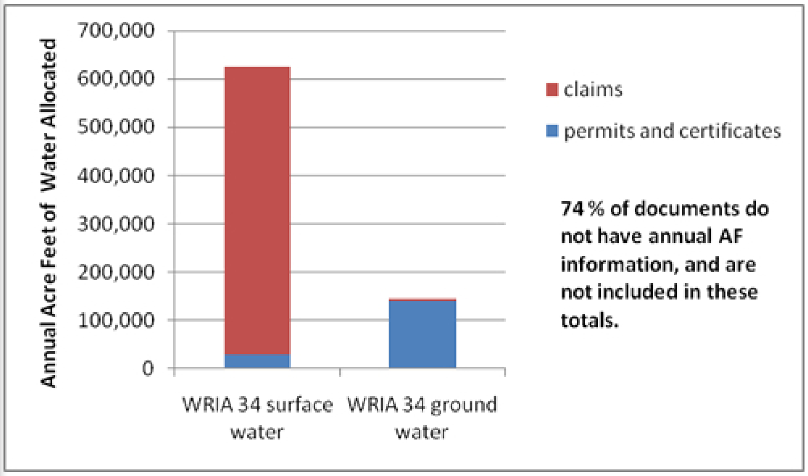
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, combined municipal and surface water irrigation demands at the watershed scale are projected to outstrip unregulated tributary supply generated within the Washington portion of the watershed during some years in July and October, and during most years for August and September. Upstream portions of the watershed outside of Washington provide some additional supplies, but may also have additional demands. Modeling did not show curtailment of interruptible water rights holders between 1977 and 2005. Simulation of future curtailment occurred in 100% of years for the middle climate scenario, resulting from acreage currently receiving groundwater in the Odessa area. This area was assumed to have unmet surface water demand in 2030 under the baseline scenario, ranging from 5,503 to 6,675 with an average of 6,121 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

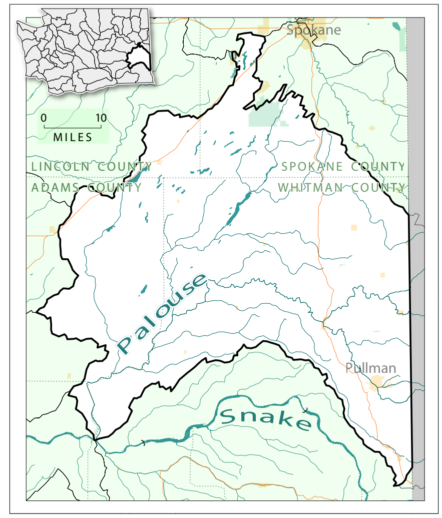
No fish listed under the Endangered Species Act spawn or rear in tributary waters of the Palouse watershed, but the Snake River in this area is the migratory corridor for a number of fish listed under the Endangered Species Act.

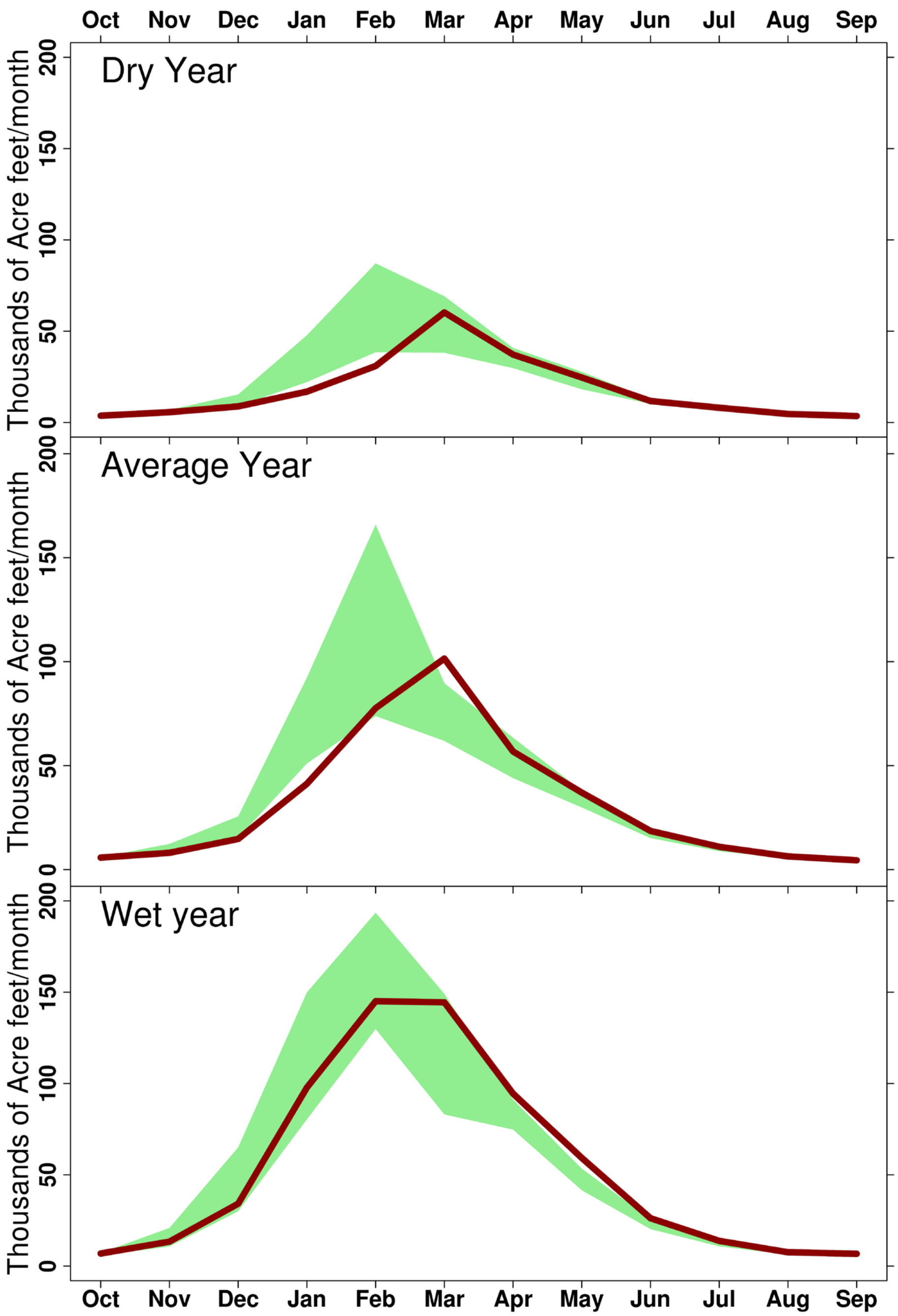
Management Context	
Adjudicated Areas	Cow Creek & Sprague Lake
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	[Snake mainstem migratory corridor for Snake River Basin Steelhead, Snake River Fall Run Chinook, Snake River Spring and Summer Run Chinook and Snake River sockeye]
Groundwater Management Area	YES (Lincoln and Adams Co. portions are part of Columbia Basin GWMA, and a portion of this is in Odessa Subarea)
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.

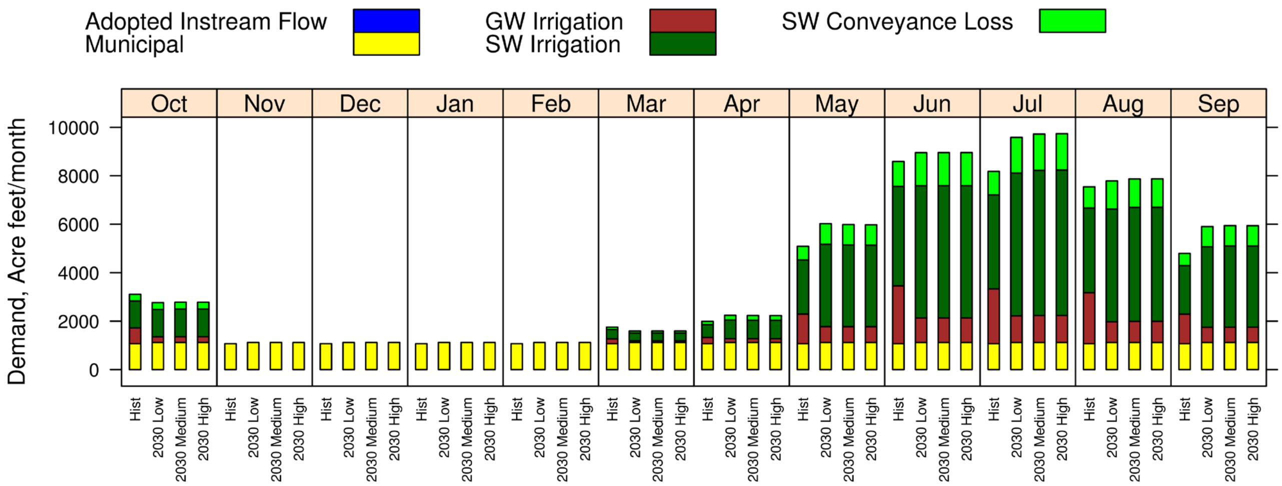




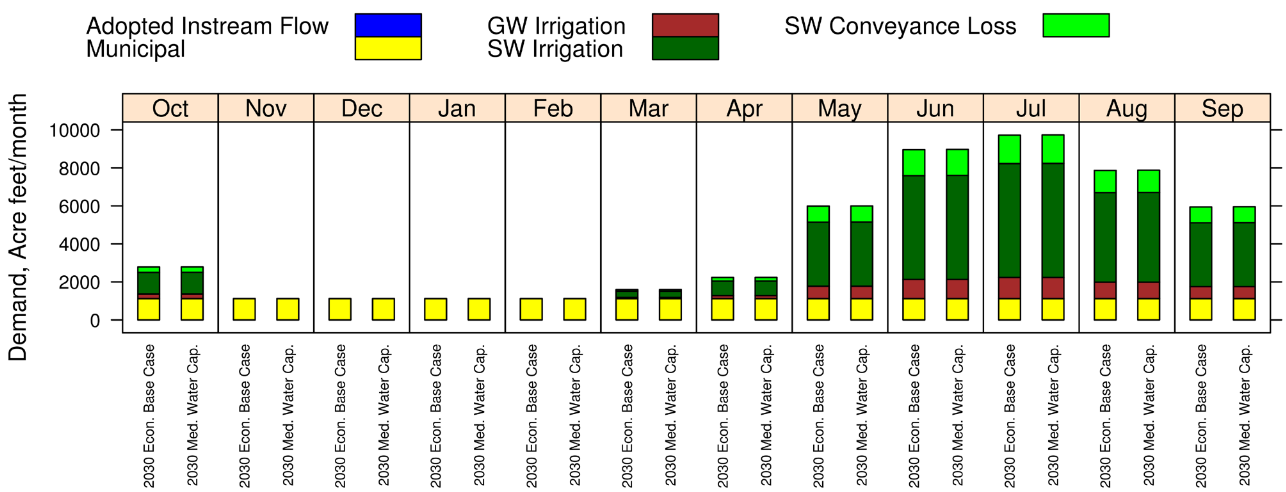
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

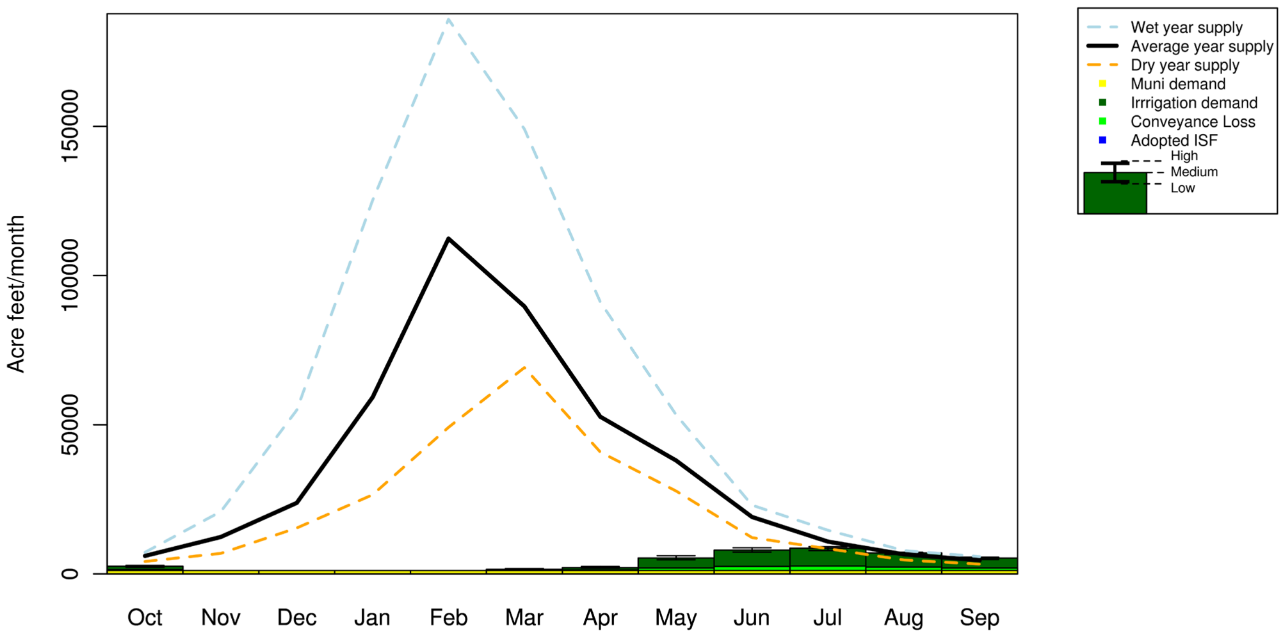
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Middle Snake is characterized mostly by increases from late fall through early spring.

Overall demands are relatively modest compared to other watersheds in eastern Washington, with municipal demands that are generally larger than irrigation demands. Assuming no change in irrigated acreage, irrigation demand is expected to increase slightly in many months but decrease in others in the future, with little impact on results from the consideration of alternate future economic scenarios. Municipal demands are projected to increase 13% by 2030.

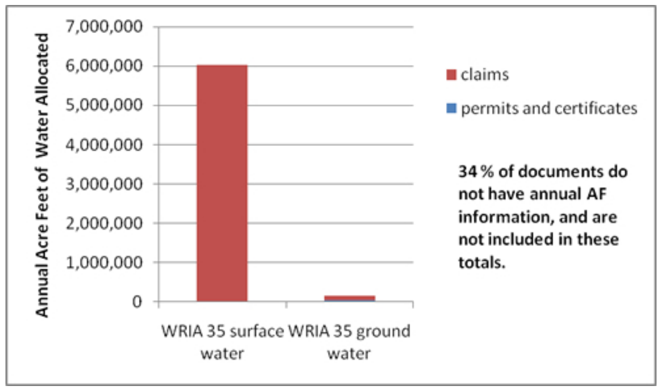
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is not anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will only increase demand in WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply within the Washington portion of the watershed is forecasted to be sufficient to meet combined municipal and surface water irrigation demands and adopted instream flows at the watershed scale, and additional water supply is available in this watershed from the Snake River. Upstream portions of the watershed outside of Washington provide additional supplies, but may also have additional demands. Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

All wild salmon, steelhead, and bull trout stocks using the Middle Snake basin are listed as Threatened under the ESA, with the exception that sockeye are ESA-Endangered. Peak spawning of one species or another occurs from September through June. Anadromous juveniles are primarily out-migrating from March through June.

Management Context	
Adjudicated Areas	Deadman Creek Wawawai Creek Meadow Gulch Creek Alpowa Creek
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Snake River Basin Steelhead Snake River Bull Trout Snake River Fall Run Chinook Snake River Spring and Summer Run Chinook [Snake mainstem migratory corridor for Snake River sockeye]
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



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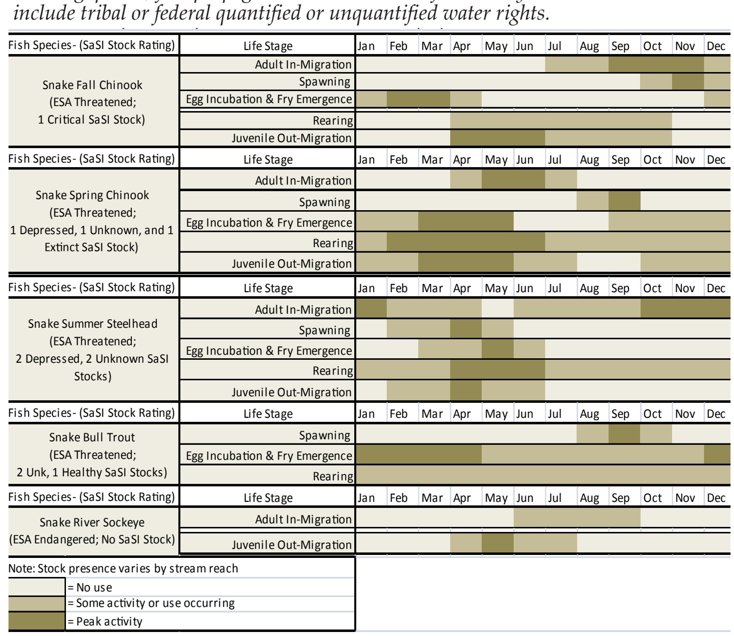
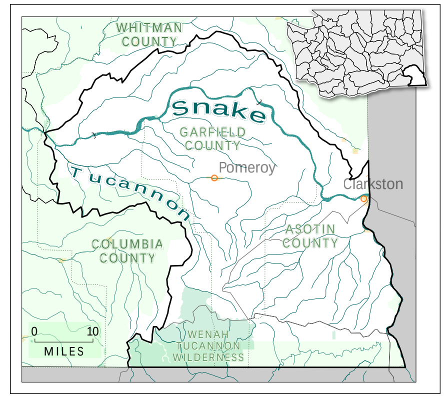
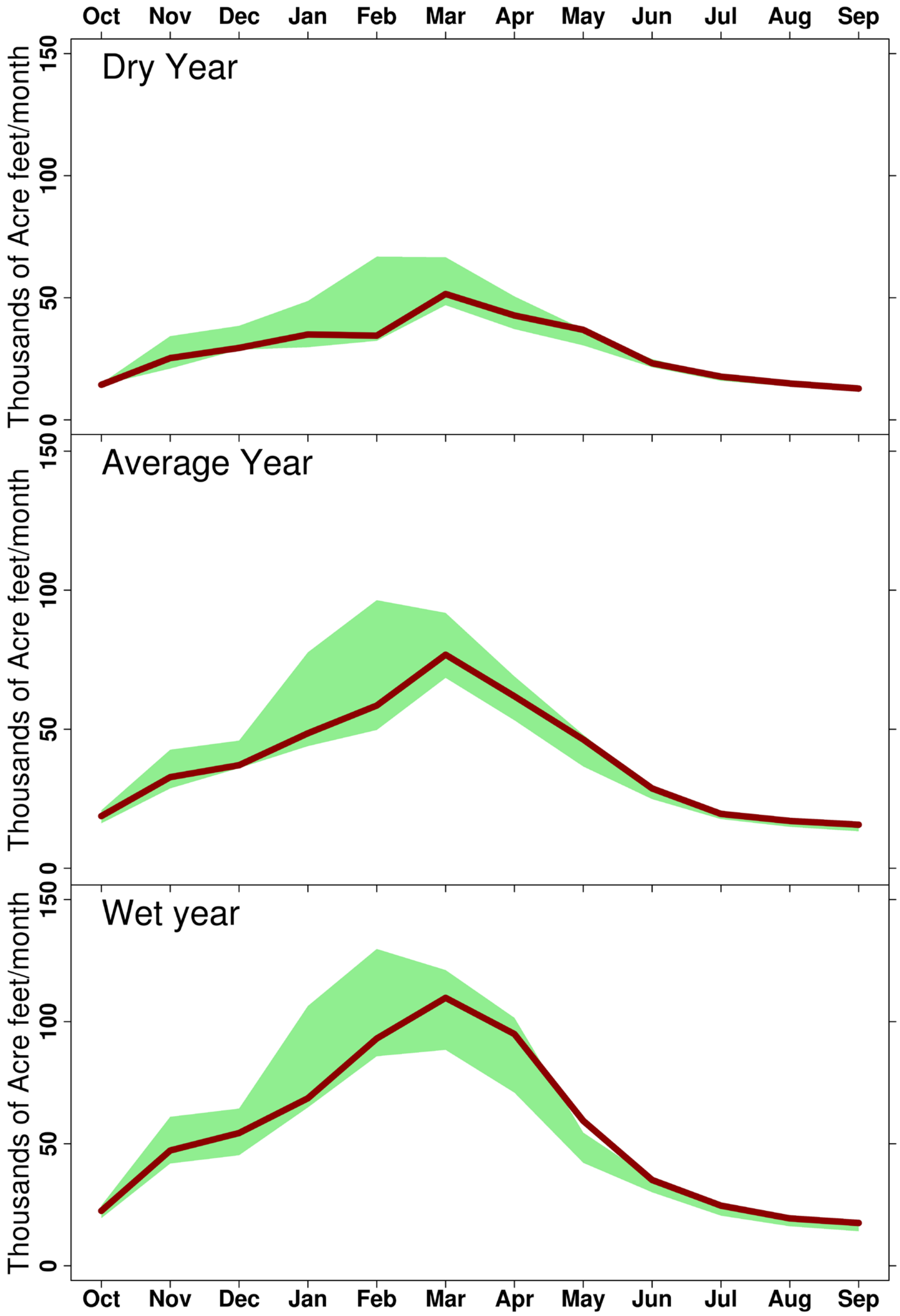
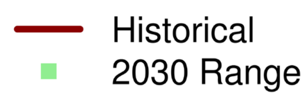


Fish use of WRIA waters (provided by the Washington Department of Fish and Wildlife)

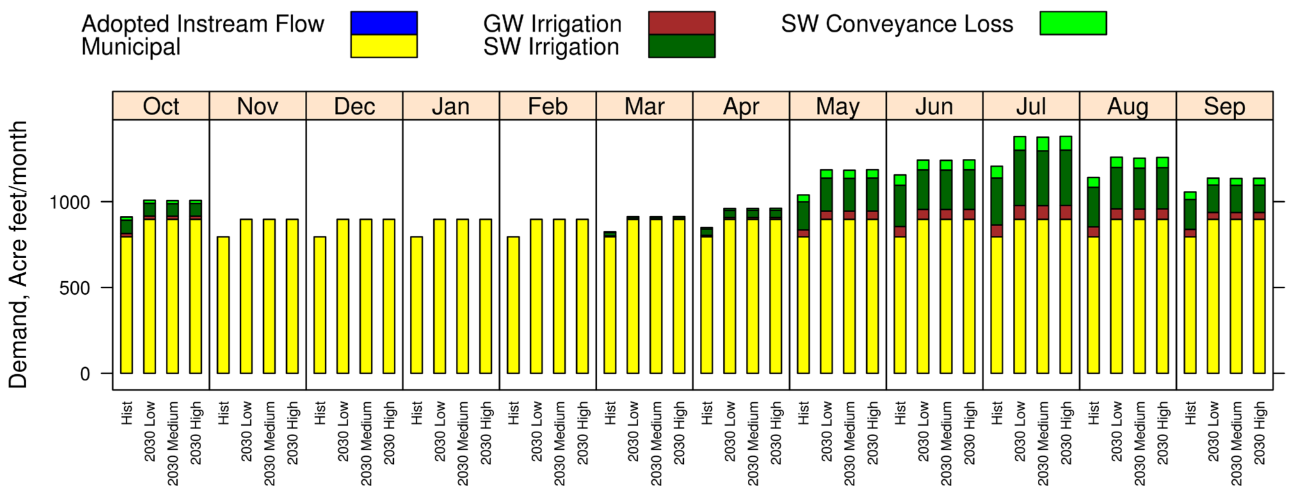




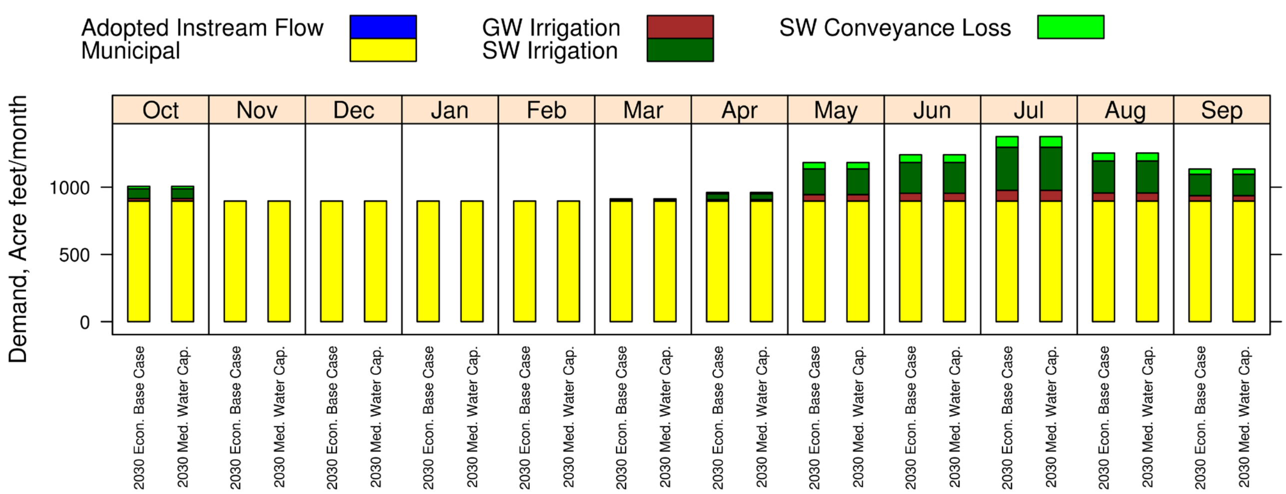


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

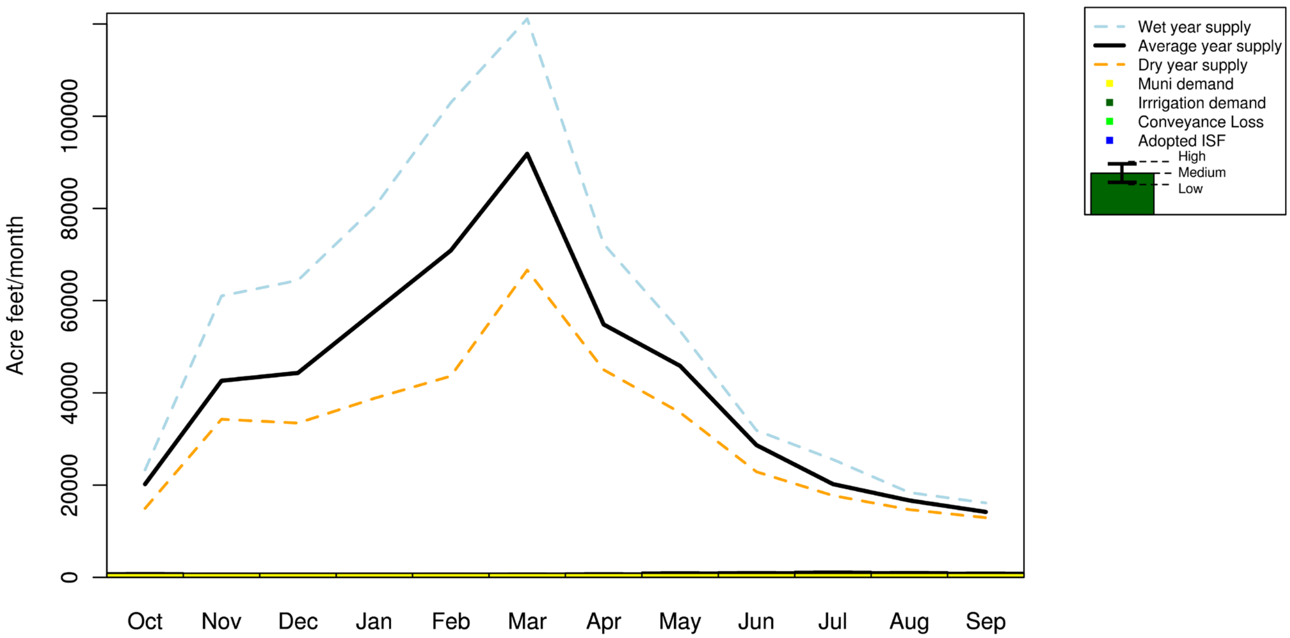
Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

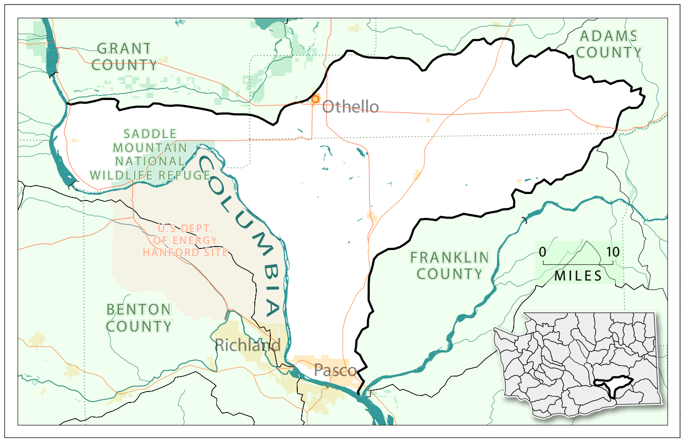
Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Esquatzel Coulee shows little change, with possible slight increases from mid-fall through mid-spring.

Irrigation is the most significant source of demand in WRIA 36. Municipal demands are quite small in comparison, though larger than those of many other eastern Washington WRIAs. Assuming no change in irrigated acreage, irrigation demand is expected to increase in many future months, but decrease in others. The magnitude of the increase in future demand varies by a small amount when alternate future economic scenarios are considered. Because of declining groundwater in the Odessa area, some irrigation demand is forecasted to shift by 2030 from groundwater to surface water. Municipal demands are projected to grow 62% by 2030, though this may be impacted by forecasted growth associated with the Quad Cities

If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

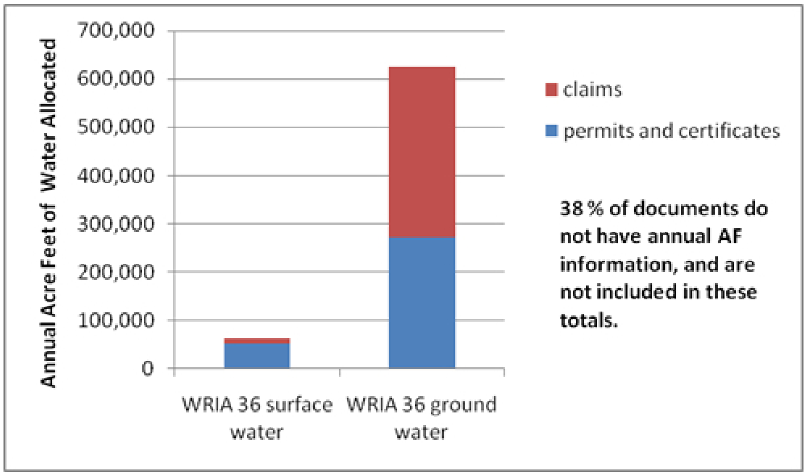
In 2030, unregulated tributary supply would be insufficient on its own to meet combined municipal and surface water irrigation demands at the watershed scale during the irrigation season for most years, but a significant portion of demand in this WRIA is met by water supply from the Columbia River, including from the Columbia Basin Project. A separate analysis indicates that roughly one sixth of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling did not show curtailment of interruptible water rights holders between 1977 and 2005. Simulation of future curtailment occurred in 100% of years for the middle climate scenario, resulting from acreage currently receiving groundwater in the Odessa area. This area was assumed to have unmet surface water demand in 2030 under the baseline scenario, ranging from 60,581 to 70,687 with an average of 66,047 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

No fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed, but the Columbia River mainstem in this area is a migratory corridor for ESA-listed fish.

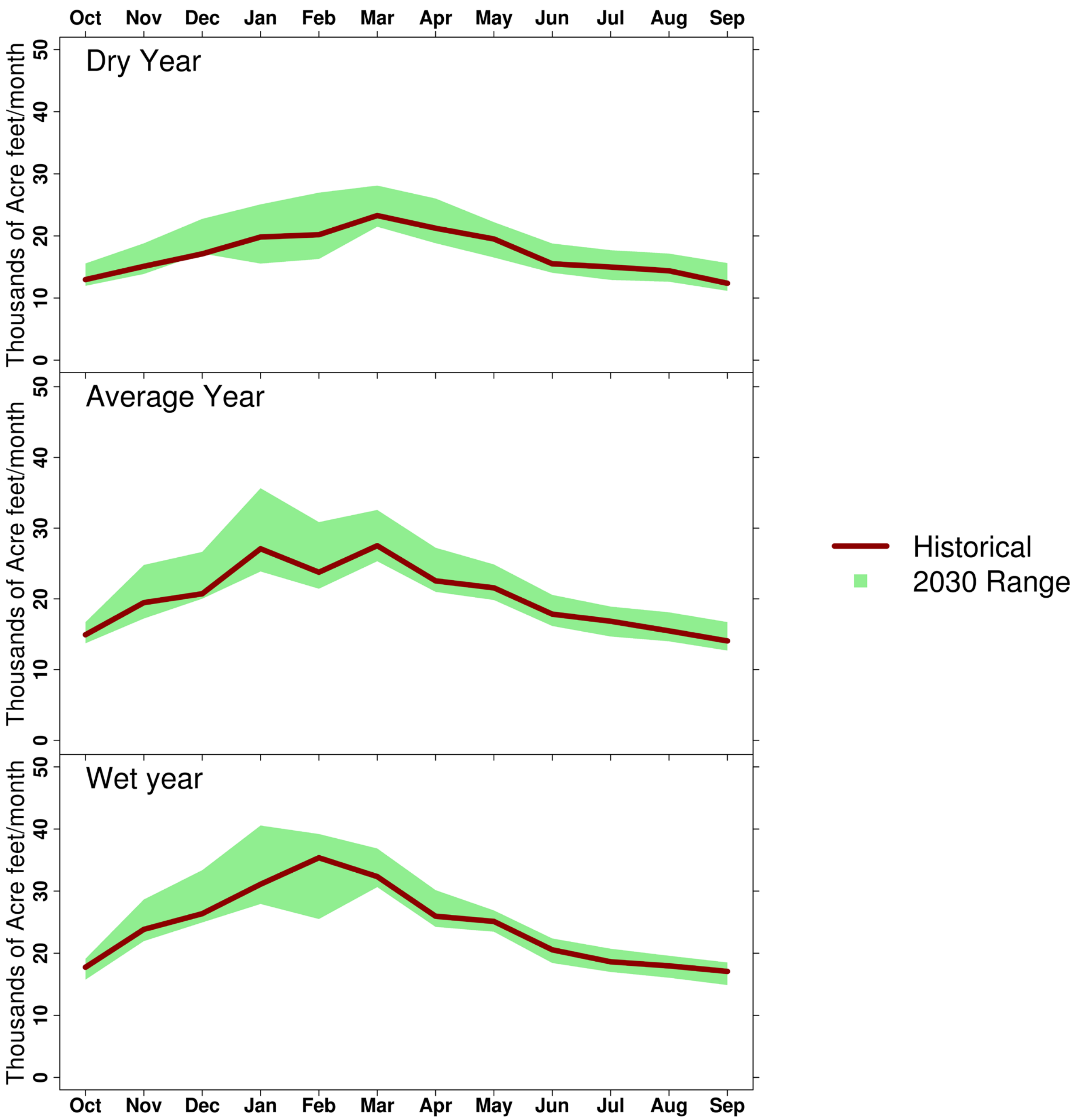


Management Context	
Adjudicated Areas	NO
Watershed Planning	NO
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	[Columbia mainstem migratory corridor]
Groundwater Management Area	YES (Columbia Basin GWMA and Odessa Subarea)
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



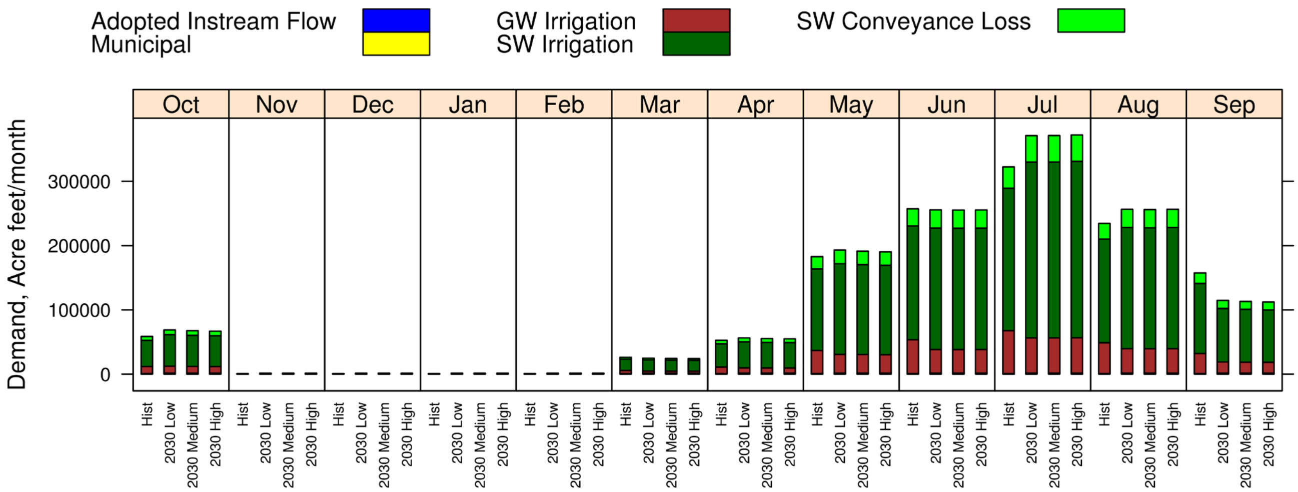
To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.



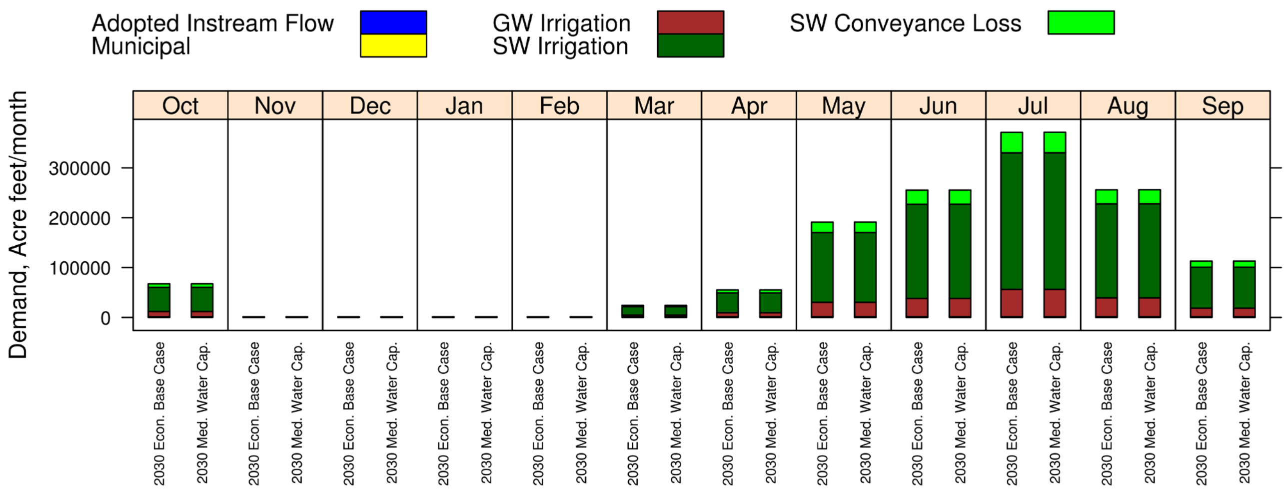
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

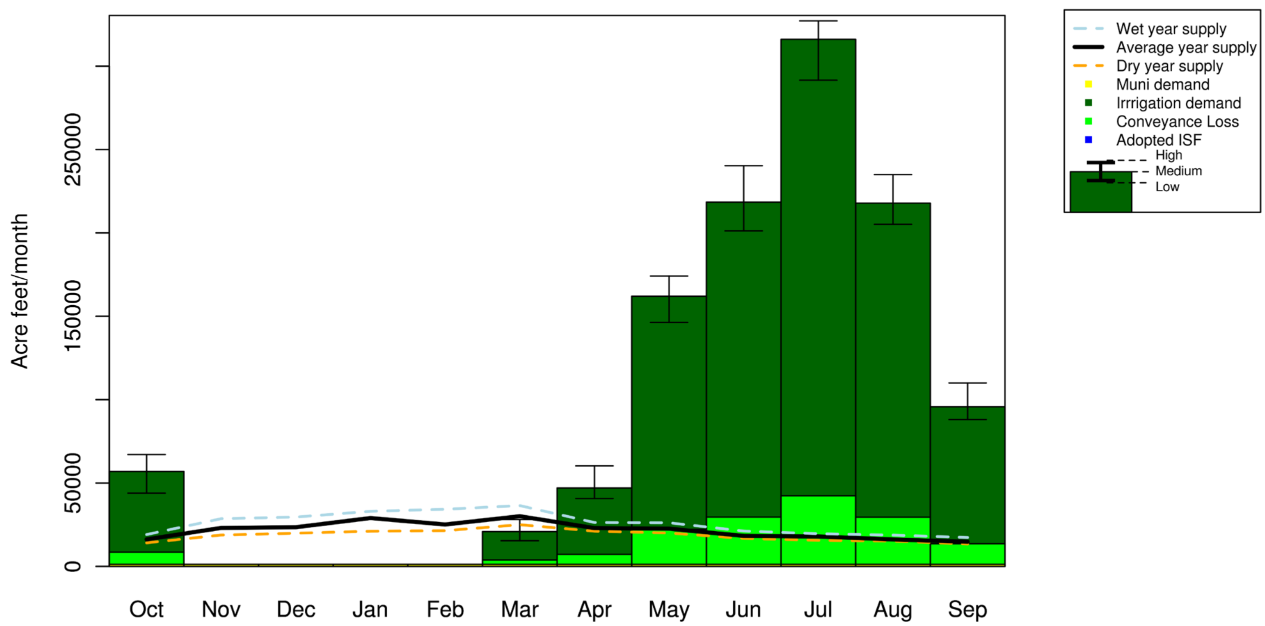
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The regulated tributary surface water supply forecast for the Yakima is characterized by increases from late fall through early spring. Decreases are notable in the late spring and early summer under all flow conditions, continuing through the summer into mid-fall under average and wet flow conditions.

Irrigation is the primary source of demand in these WRIAs. Federal flow targets, shown for Yakima River at Parker for both the historical and the future case, are also important. While small in comparison with irrigation demands, municipal demands are significantly larger than most other WRIAs of eastern Washington. Assuming no change in irrigated acreage, irrigation demand is forecasted to increase in most months in the future, with small variations in the magnitude of this future increase when alternate future economic scenarios are considered. Municipal demand is projected to grow by 23% by 2030.

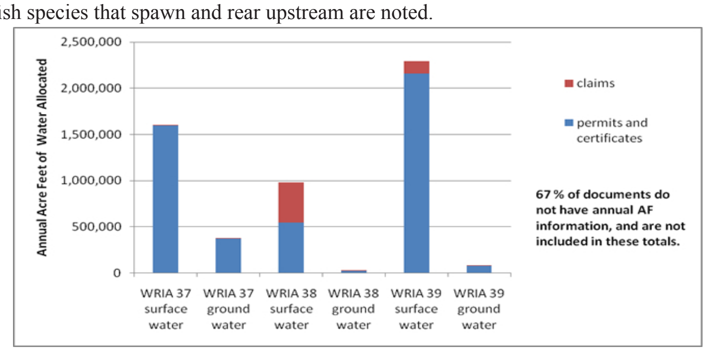
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, combined municipal and surface water irrigation demands and federal instream flow targets are projected to outstrip regulated tributary supply at the watershed scale during most years for June through October. Modeling of curtailment of pro-ratable irrigation water rights indicated that it occurred in 45% of years between 1977 and 2005. The resulting unmet demand ranged from 7200 to 278,600 ac-ft per year depending on yearly flow conditions, with an average of 108,000 ac-ft per year. Simulation of future curtailment suggested that it will occur in 90% of years for the middle climate scenario. The resulting unmet demand ranged from 14,300 to 434,000 with an average of 154,000 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Although not shown here, unmet demands due to a failure to meet federal flow targets are shown in the technical report. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

Yakima summer steelhead stocks are part of the ESA-Threatened Mid-Columbia steelhead listing unit. Juveniles are rearing year-round and outmigrating primarily in April and May. Coho and sockeye are being re-introduced to the Yakima system. Bull trout in the Yakima basin are part of the Middle Columbia bull trout listing unit.

Management Context	
Adjudicated Areas	YES (basin-wide adjudication in process)
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Middle Columbia River Bull Trout Middle Columbia Steelhead [WRIA 37 is also Columbia mainstem migratory corridor]
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



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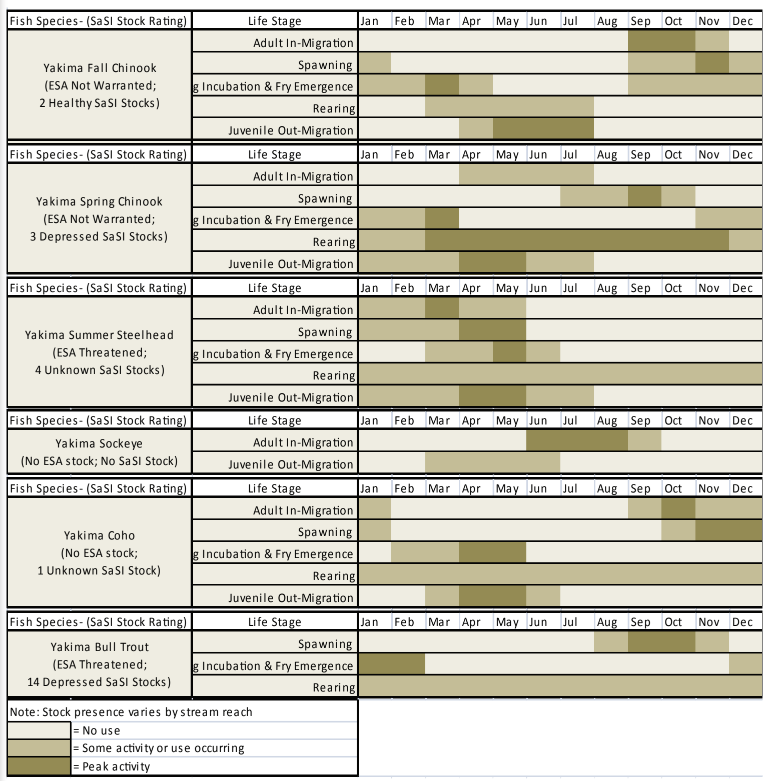
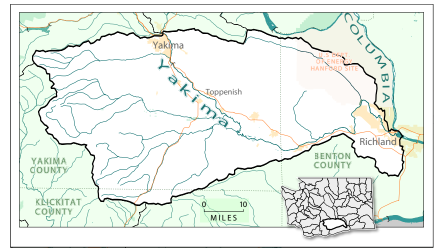
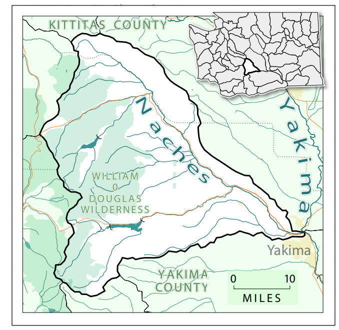
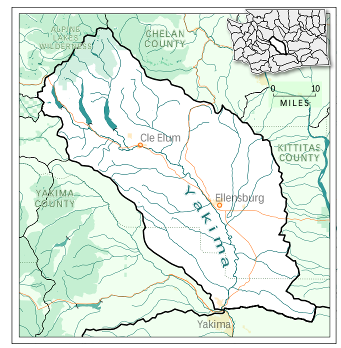
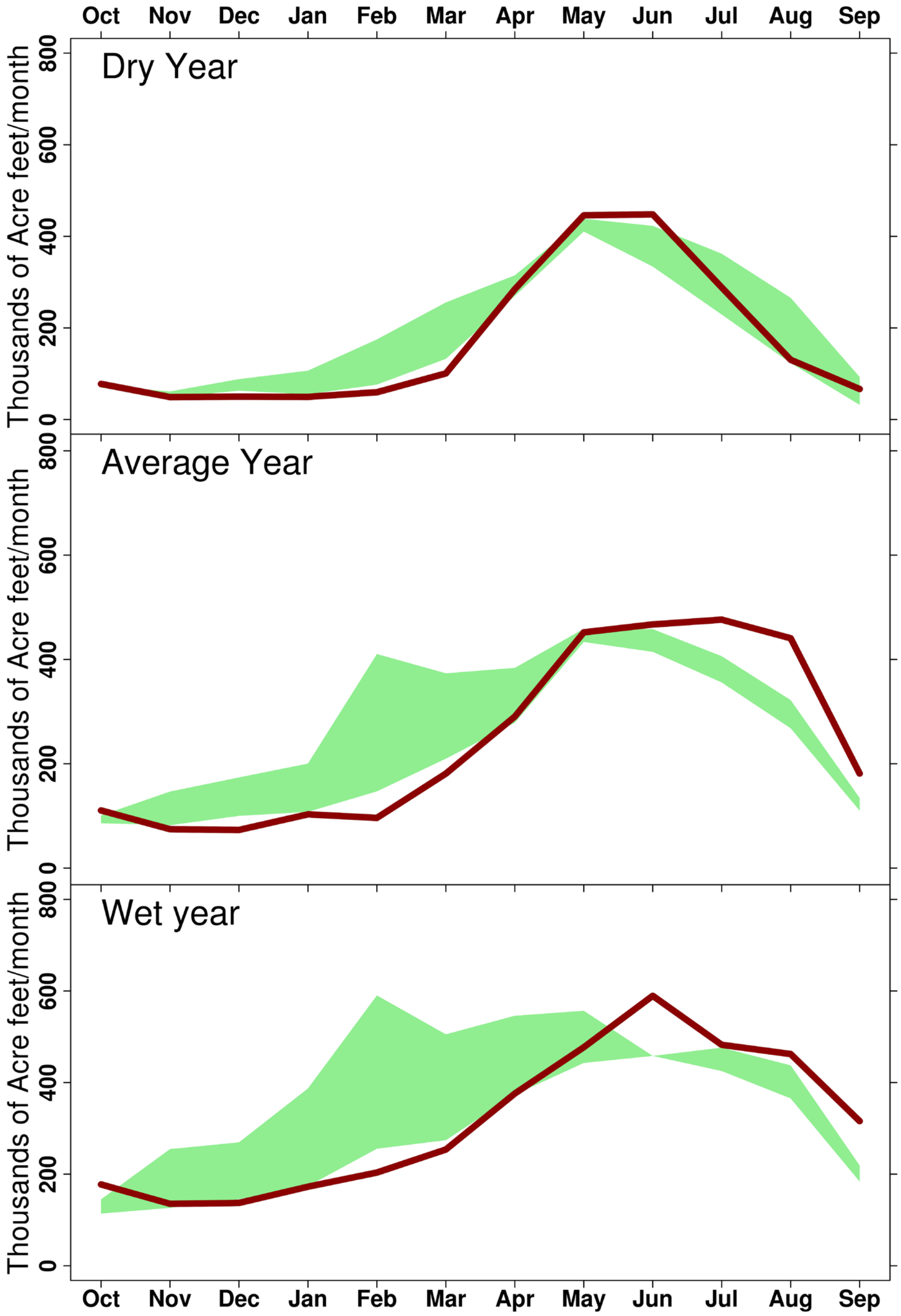


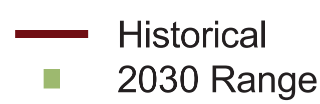
Fish Use of WRIA Waters (provided by the Washington Department of Fish and Wildlife)











Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

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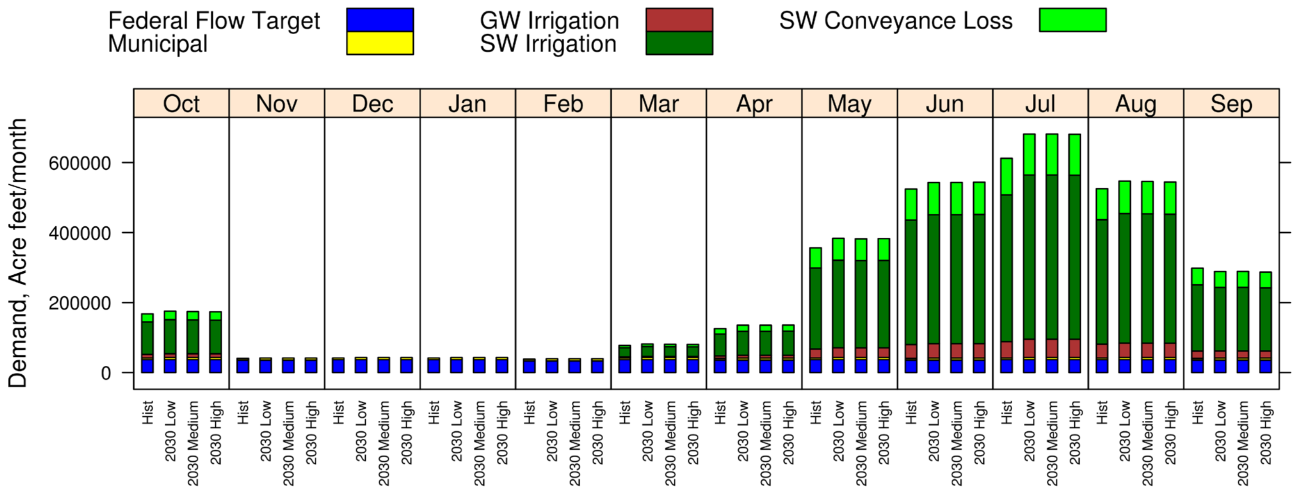
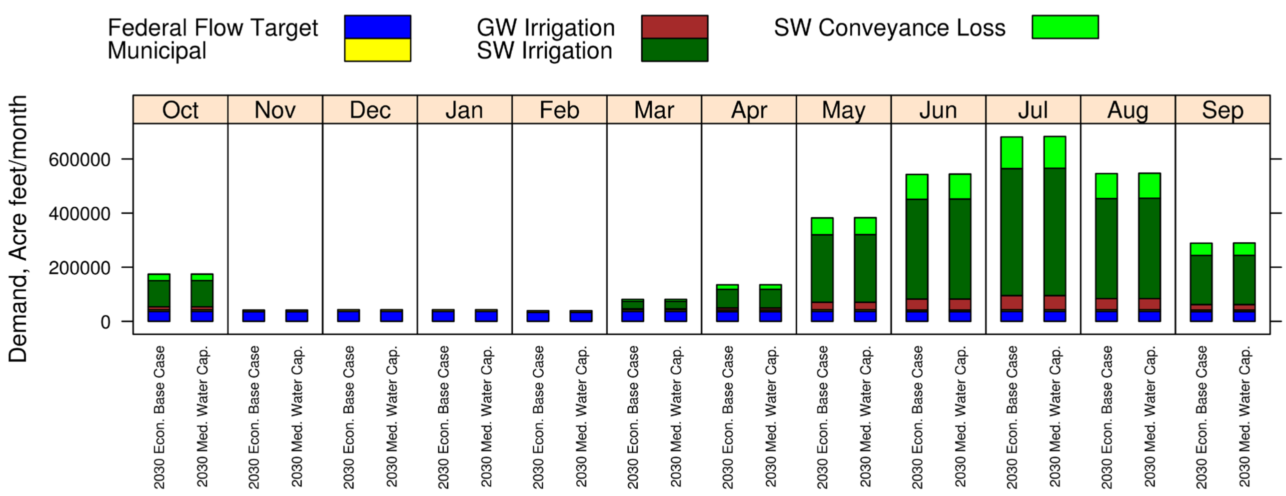
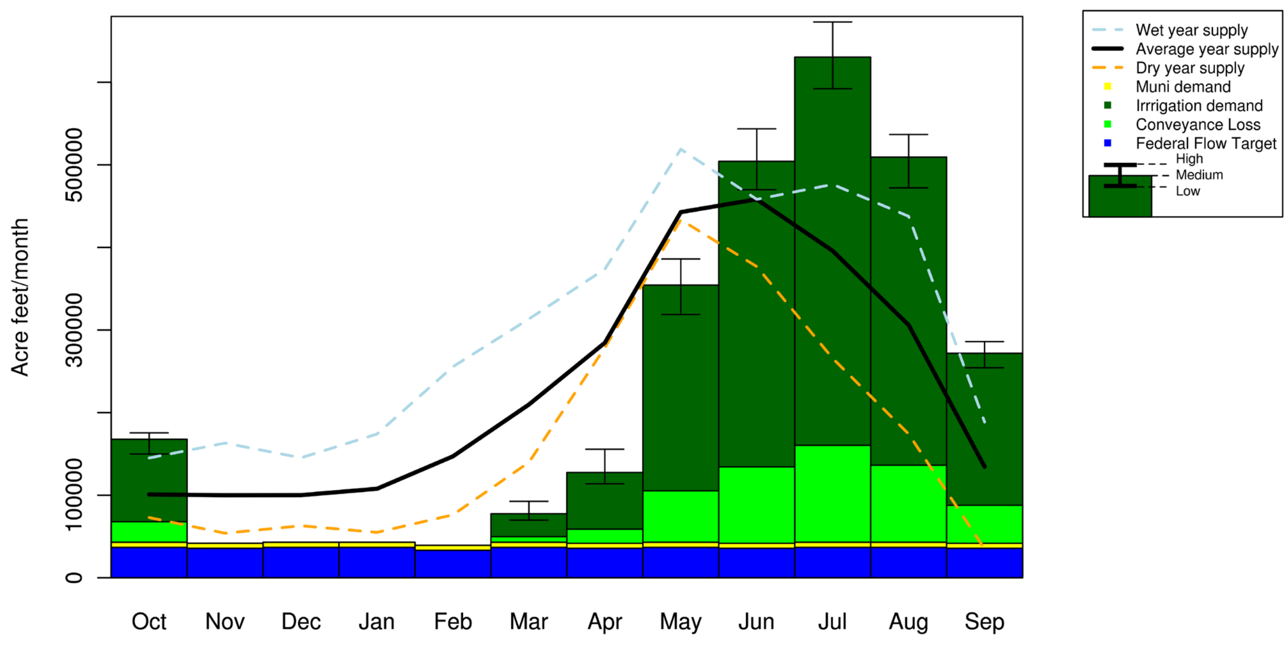
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Alkali-Squilchuck and Stemilt Squilchuck is characterized by small increases from late fall through winter.

Primary demands in WRIAs 40 and 40a are irrigation and municipal. Assuming no change in irrigated acreage, irrigation demand is forecasted to increase in some months and decrease in other months in the future, though the specific economic scenario being considered has more of an impact here than in other watersheds of eastern Washington. Municipal demands are expected to increase roughly 5%, a smaller increase than in many other WRIAs of eastern Washington. DOD lands contribute very little water demand or supply.

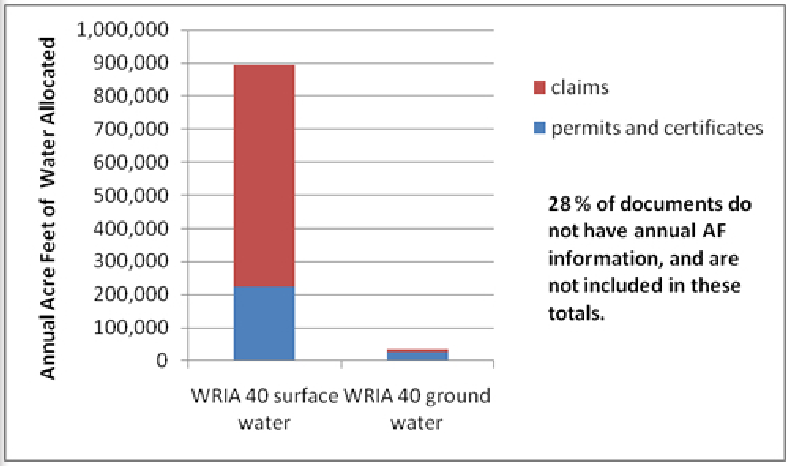
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply is projected to be sufficient to meet combined municipal and surface water irrigation demands at the watershed scale on its own in most months, except July under dry or average conditions. Additional water supply is available in some areas from the Columbia River, and a separate analysis indicates that most agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

No fish listed under the Endangered Species Act spawn or rear in tributary waters of WRIAs 40 and 40a, but the Columbia River mainstem in this area is a migratory corridor for ESA-listed fish.

Management Context	
Adjudicated Areas	Stemilt Creek Squillchuck Creek Cummings Canyon Creek
Watershed Planning	WRIA 40a: Phase 4 (Implementation) WRIA 40: NO
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	[Columbia mainstem migratory corridor]
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



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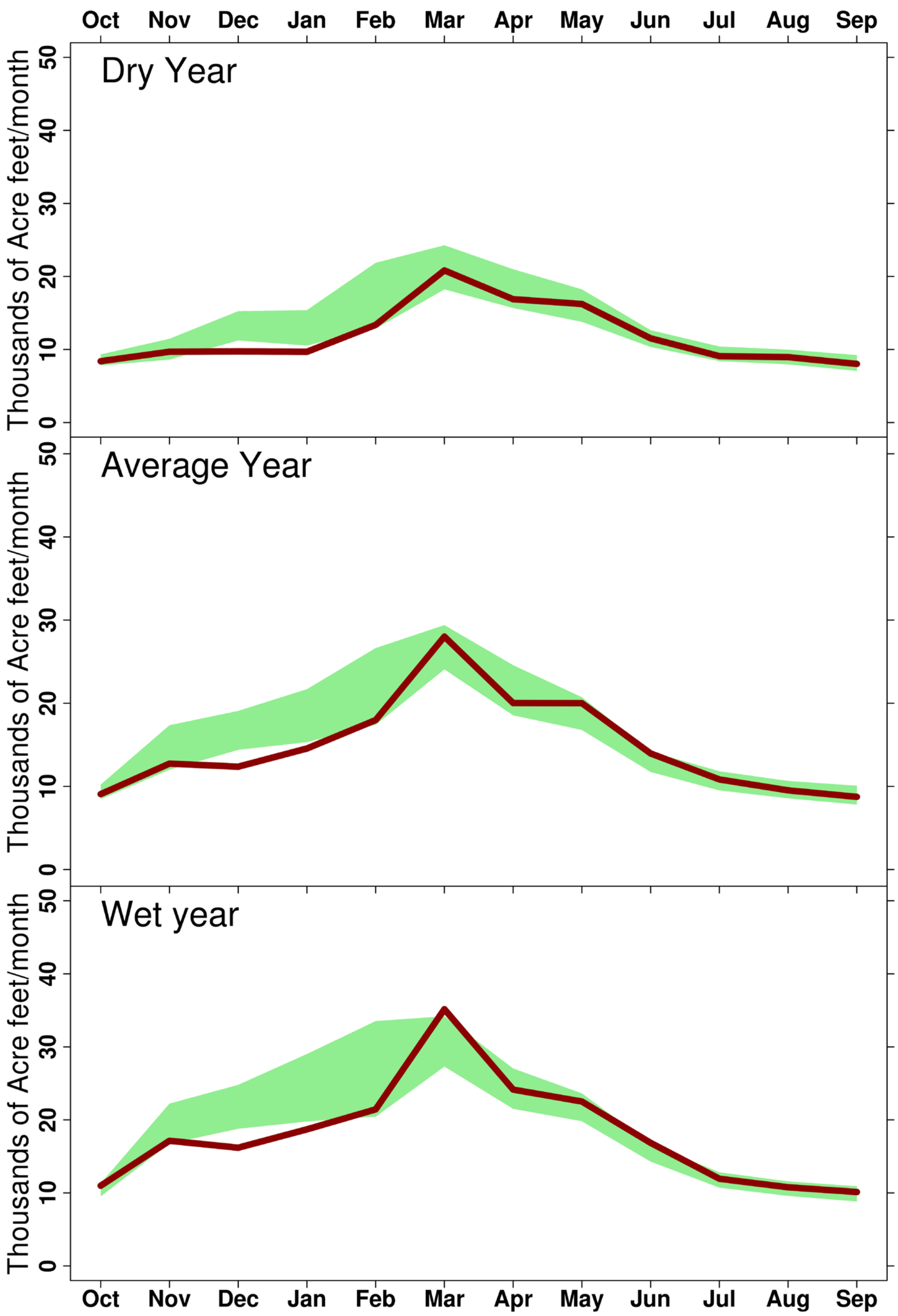

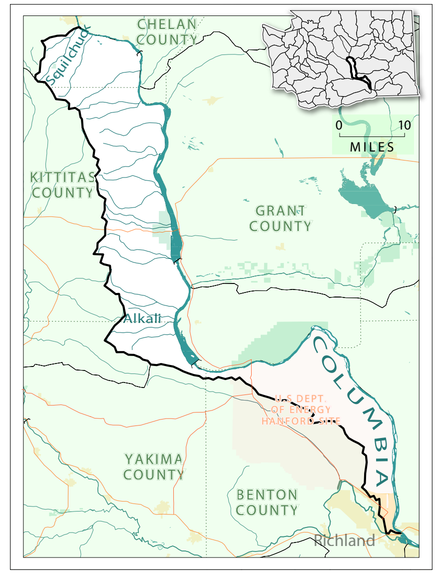

Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

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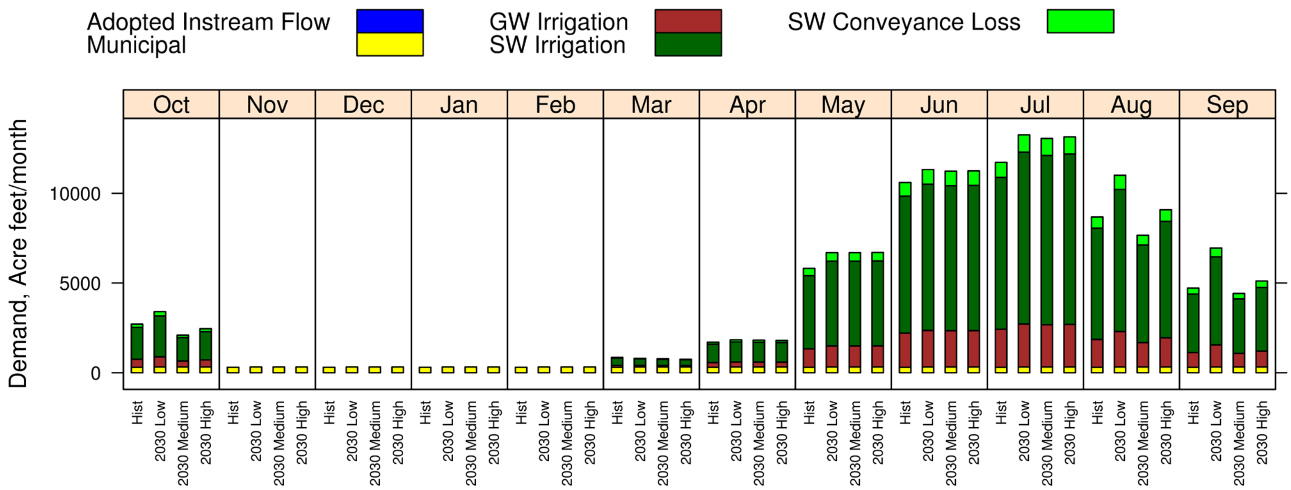
Demand



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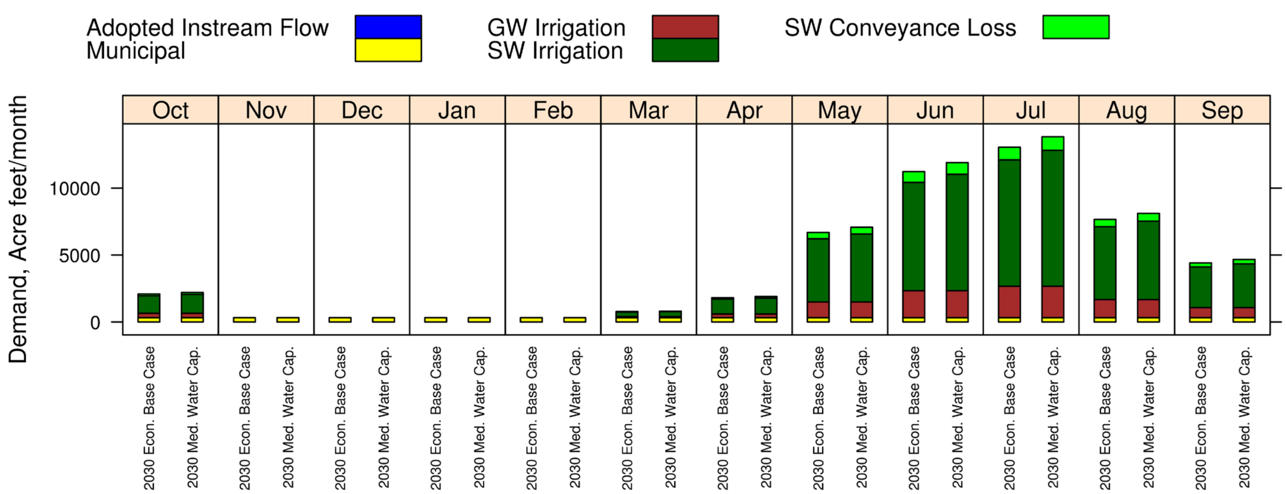
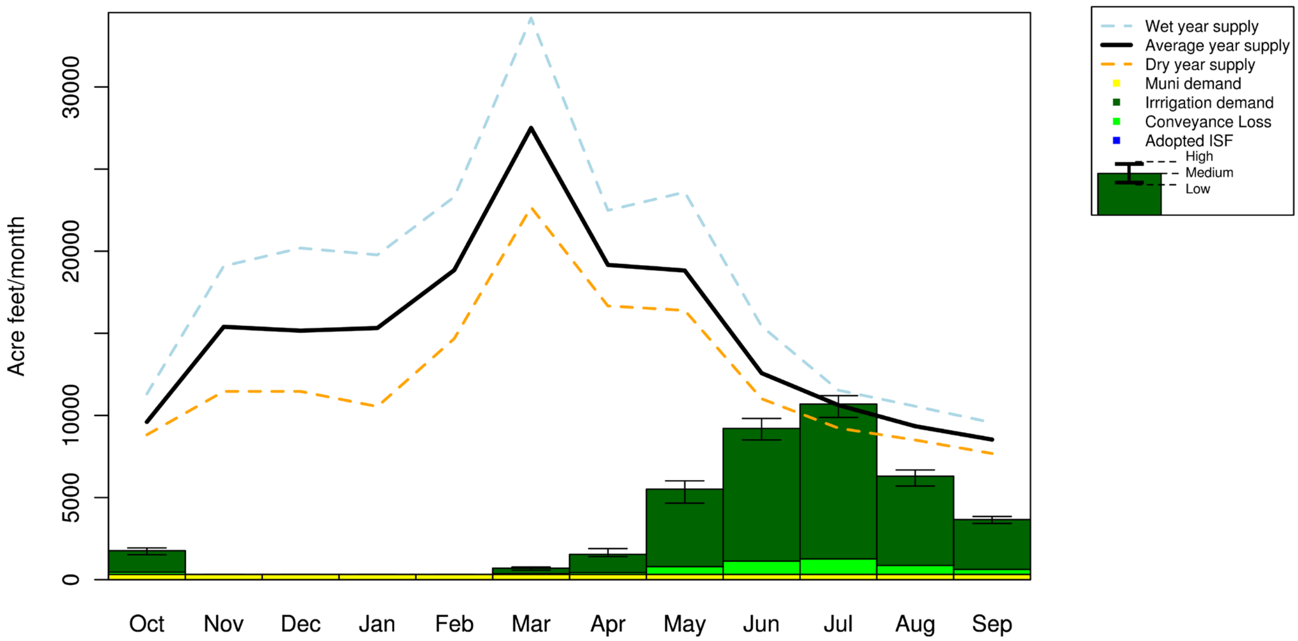


2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

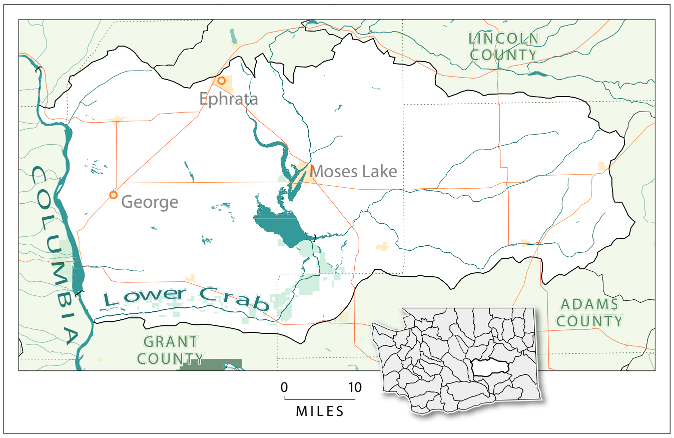
Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Lower Crab is characterized mostly by relatively little change in water supply, with a possible small increase in late fall and winter.

Irrigation is the primary source of demand in WRIA 41, with much smaller municipal demands. Assuming no change in irrigated acreage, irrigation demand is projected to increase in some months in the future, and decrease in others, with only slight variation when alternate future economic scenarios are considered. Because of declining groundwater in the Odessa area, some irrigation demand is forecasted to shift by 2030 from groundwater to surface water. Municipal demands are projected to grow by 29% by 2030.

If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supplies would be insufficient on their own to meet combined municipal and surface water irrigation demands at the watershed scale year-round for most years. However, additional water supply is available in many areas from the Columbia River, including from the Columbia Basin Project. A separate analysis indicates that about 5% of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling did not show curtailment of interruptible water rights holders between 1977 and 2005. Simulation of future curtailment occurred in 100% of years for the middle climate scenario, resulting from acreage currently receiving groundwater in the Odessa area. This area was assumed to have unmet surface water demand by 2030 under the baseline scenario. The resulting unmet demand per year ranged from 85,433 to 99,542 with an average of 92,038 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

No fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.



Management Context	
Adjudicated Areas	Crab Creek & Moses Lake
Watershed Planning	NO
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	No ESA-listed fish spawn or rear in WRIA waters
Groundwater Management Area	YES (Columbia Basin GWMA, Odessa Subarea, and Quincy Subarea)
Groundwater Studies	YES (references listed in WSU's technical report)

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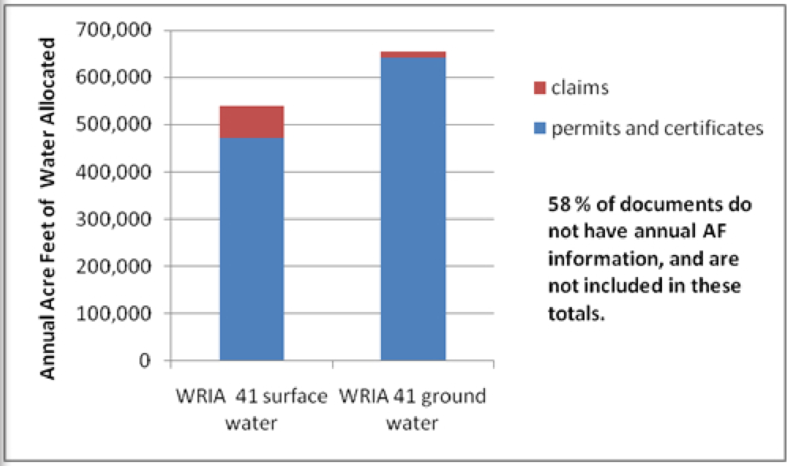

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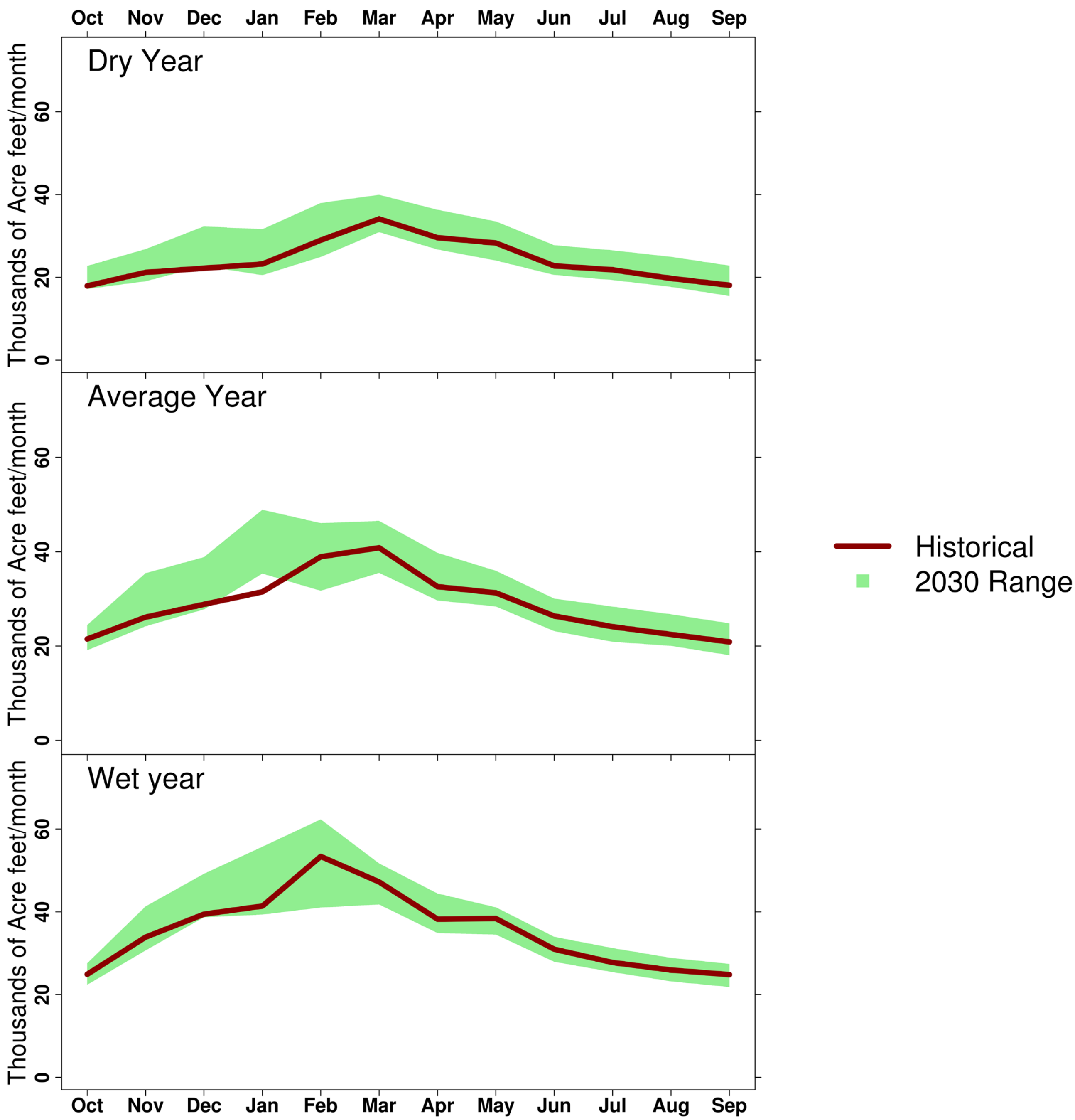

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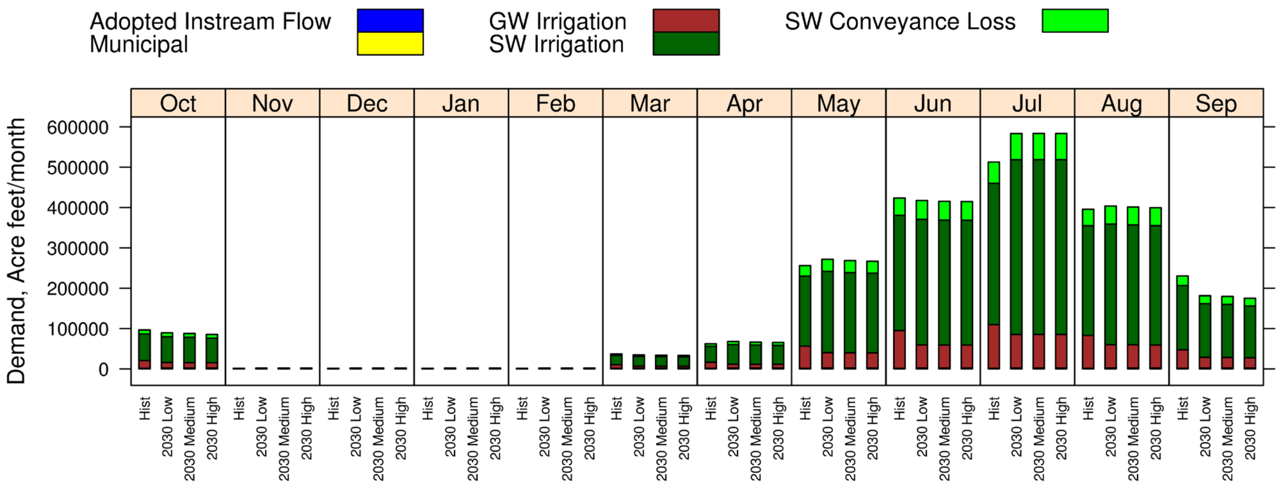
Demand



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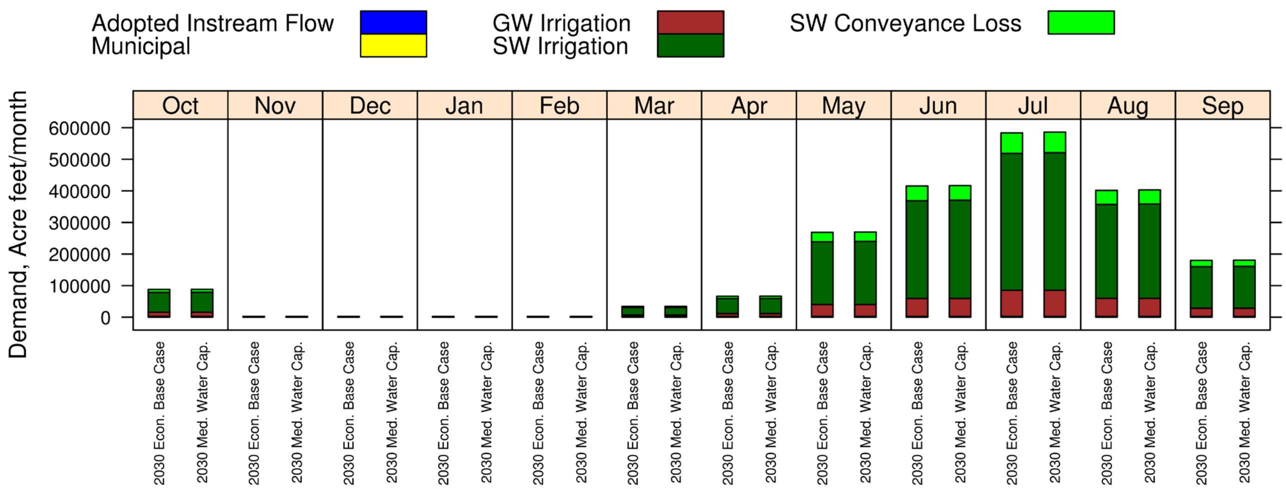

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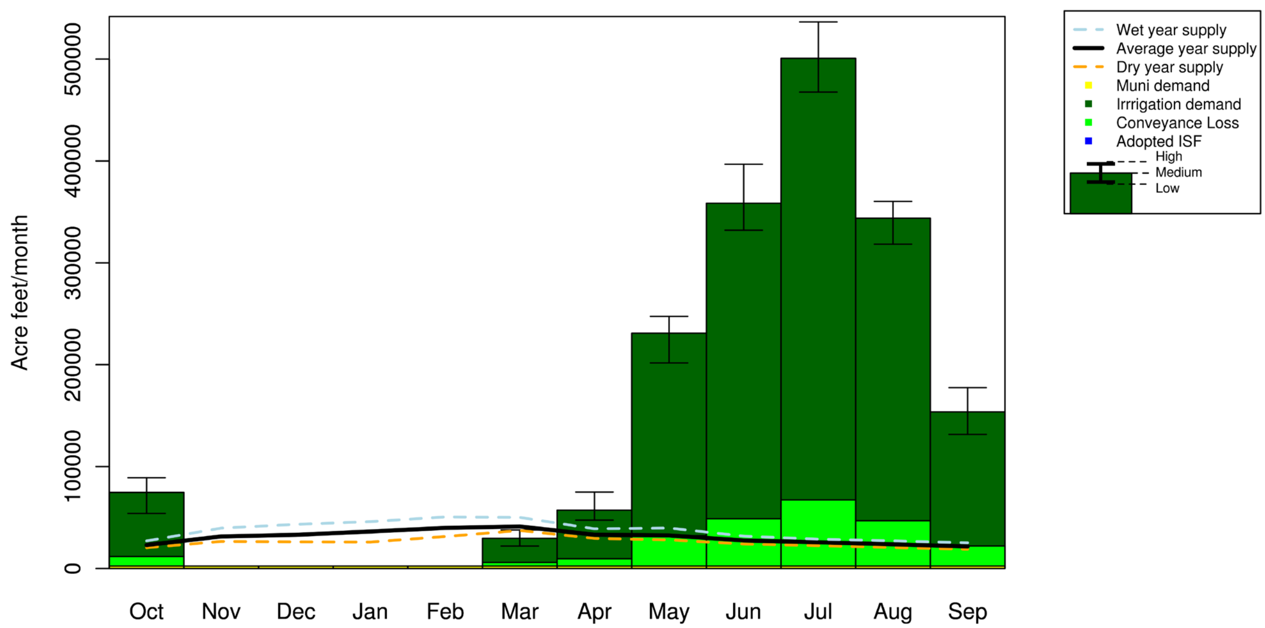


Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Grand Coulee is characterized mostly by slight increases from late fall through early winter.

As in many other WRIAs of eastern Washington, municipal demands are much smaller than irrigation demands. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase in some months in the future and decrease in others, with little variation in future demand when alternate future economic scenarios are considered. Because of declining groundwater in the Odessa area, some irrigation demand is forecasted to shift by 2030 from groundwater to surface water. Municipal demand is projected to shrink by 5% by 2030.

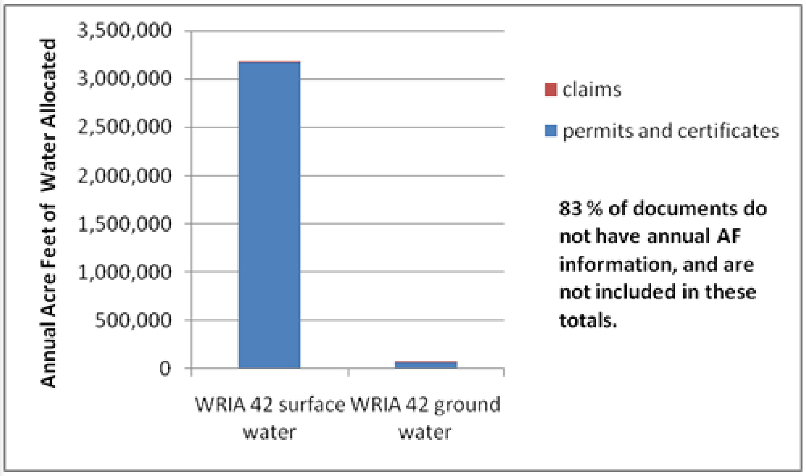
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, combined municipal and surface water irrigation demands are forecasted to outstrip unregulated tributary supply at the watershed scale from May through September in almost all years. However, additional water supply is available to some areas from the Columbia Basin Project. Modeling did not show curtailment of interruptible water rights holders between 1977 and 2005. Simulation of future curtailment occurred in 100% of years for the middle climate scenario, resulting from acreage currently receiving groundwater in the Odessa area. This area was assumed to have unmet surface water demand by 2030 under the baseline scenario. The resulting unmet demand per year ranged from 3,393 to 4,219 with an average of 3,896 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

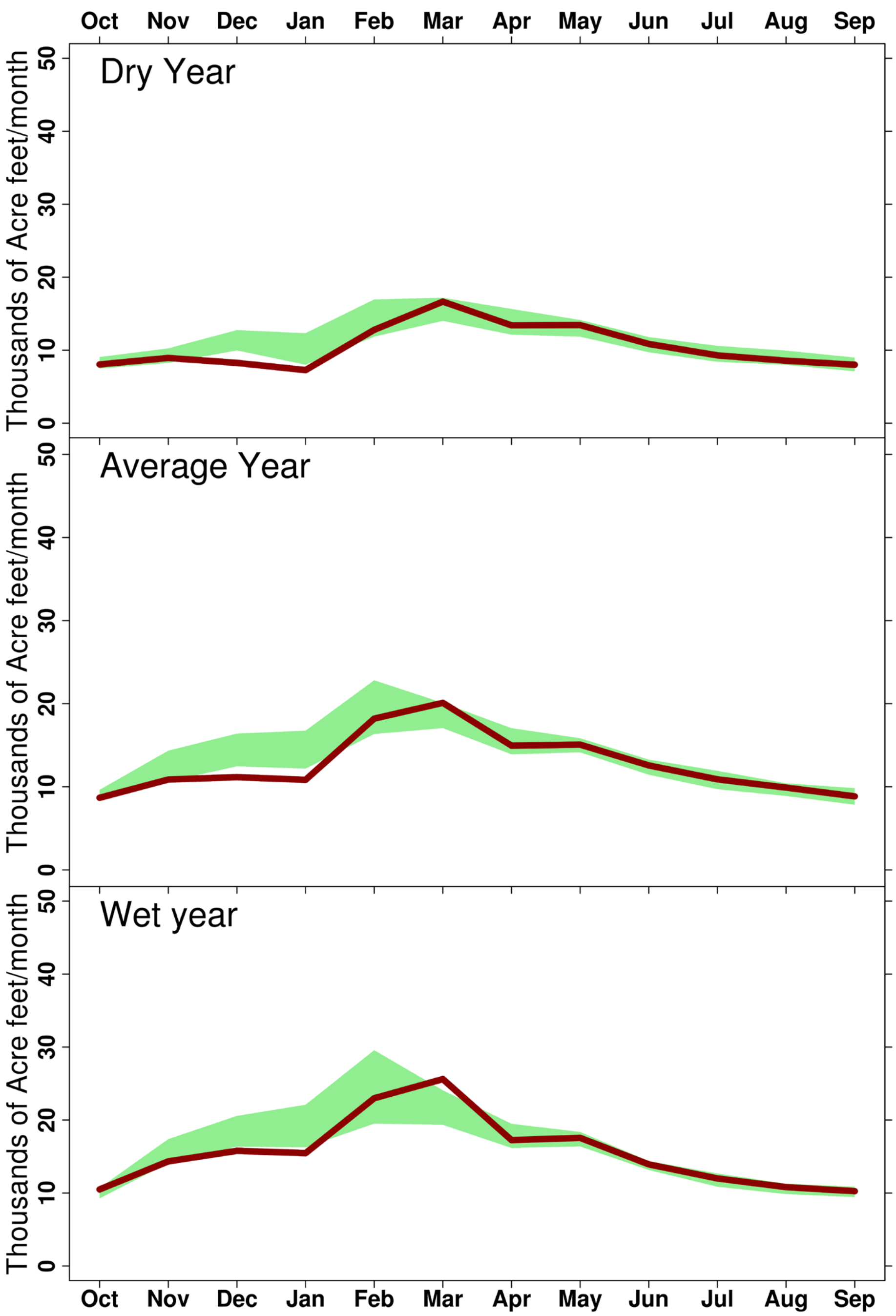
No fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.

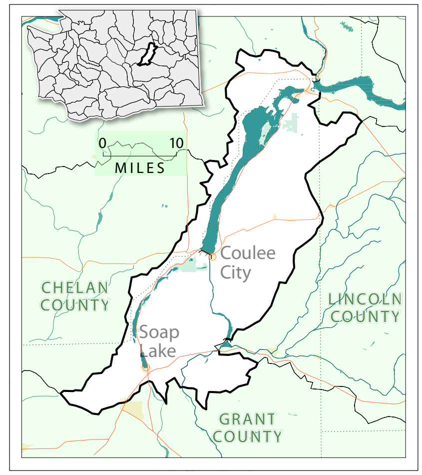
Management Context	
Adjudicated Areas	NO
Watershed Planning	NO
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	No ESA-listed fish spawn or rear in WRIA waters
Groundwater Management Area	YES (Columbia Basin GWMA, Quincy Subarea and small portion of Odessa Subarea)
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.

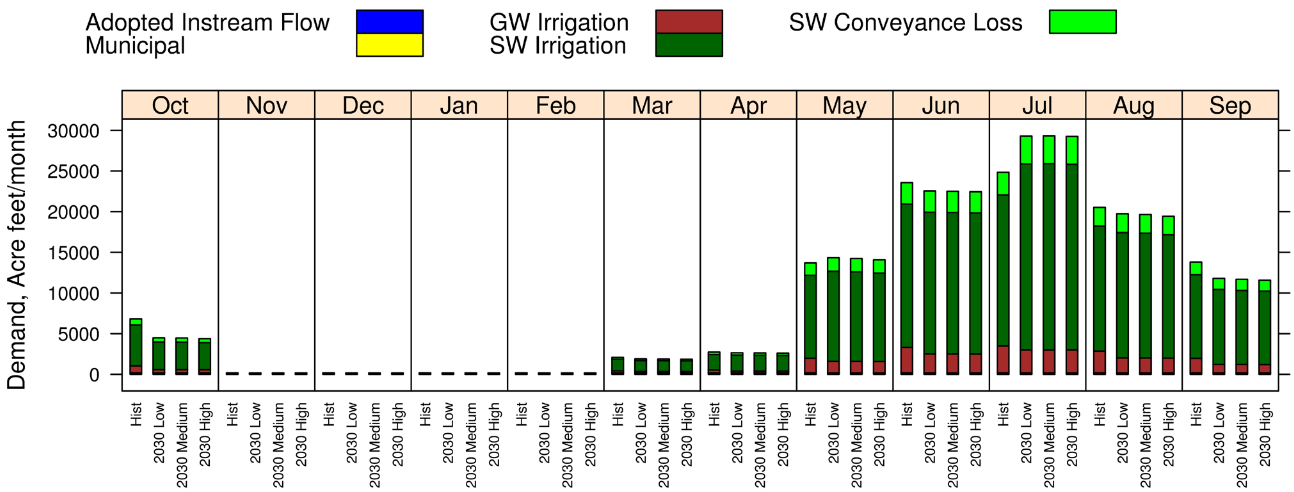




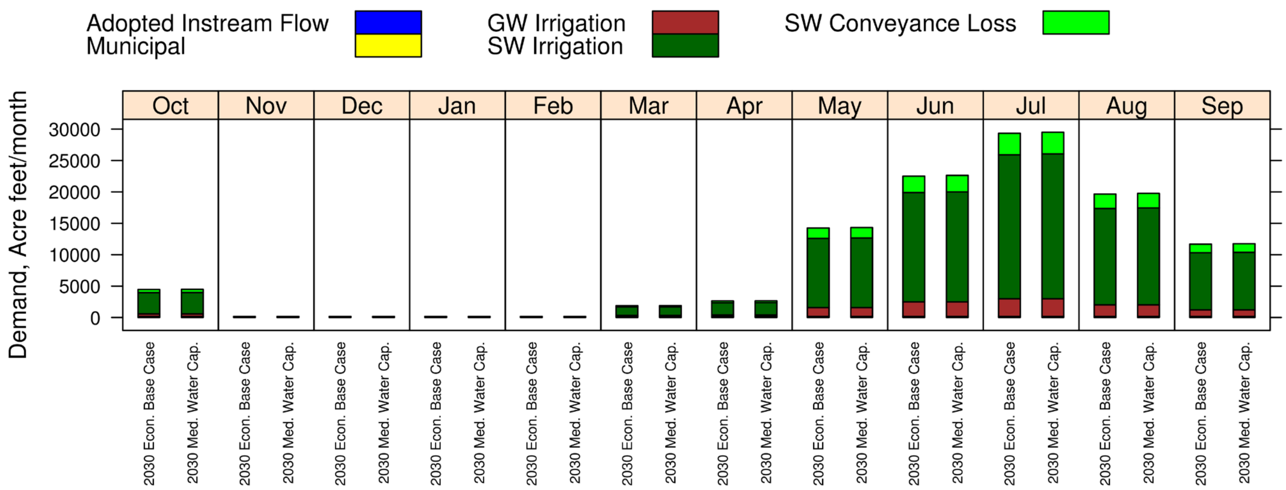
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

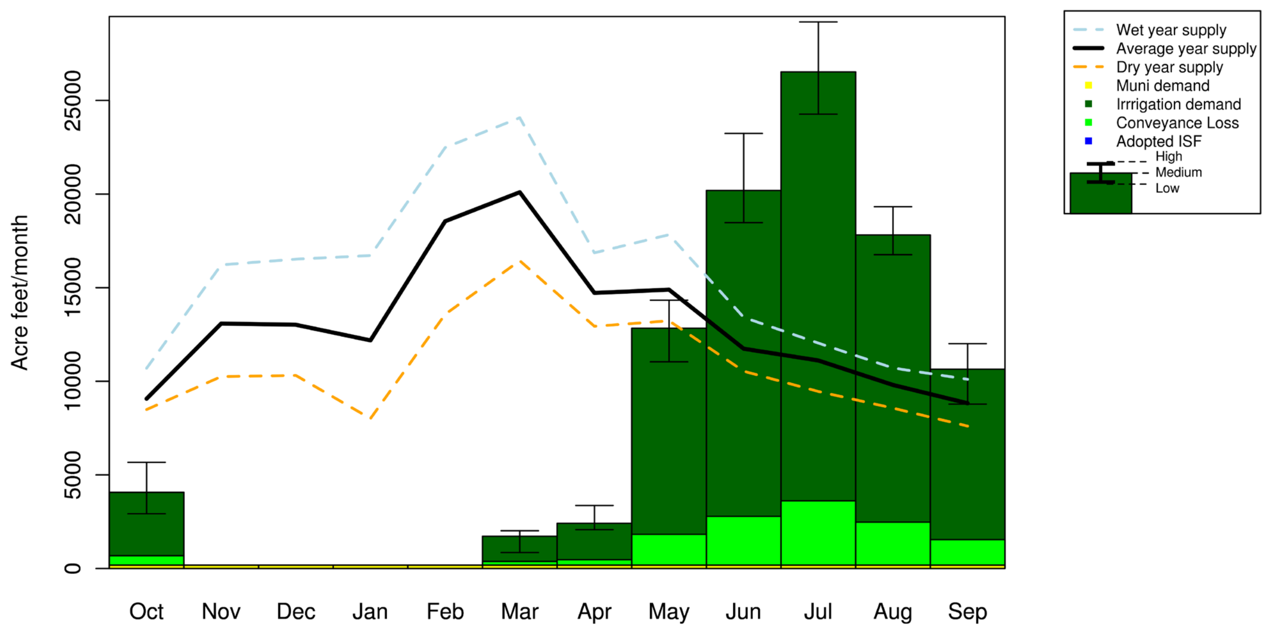
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

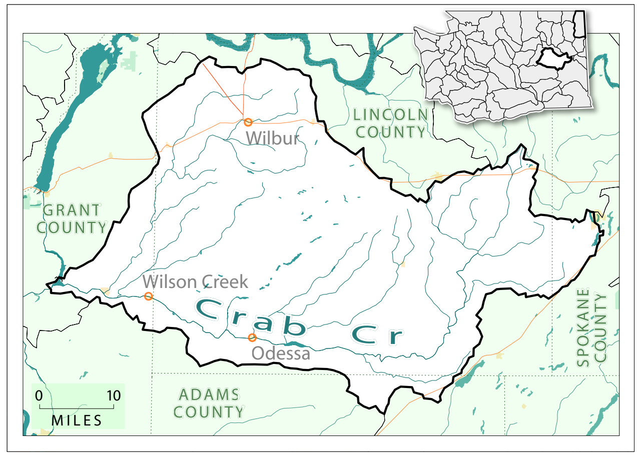
Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Upper Crab-Wilson is characterized mostly by a sharp increase in supply in the late winter.

As in many other WRIAs of eastern Washington, municipal demands are much smaller than irrigation demands. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase substantially in all months except October in the future, with slight variations in the magnitude of this increase depending on the alternate future economic scenario being considered. Because of declining groundwater in the Odessa area, irrigation demand is forecasted to shift by 2030 from predominantly groundwater to nearly all surface water. Municipal demands are projected to grow by 2%, a smaller increase than in many other watersheds of eastern Washington.

If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

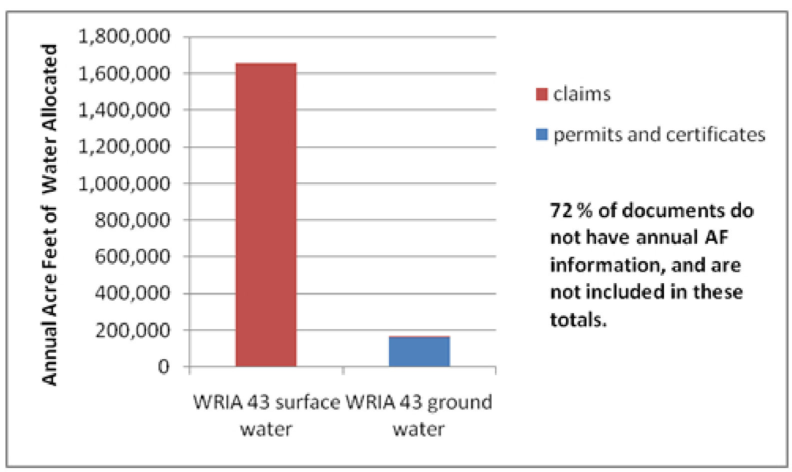
In 2030, unregulated tributary supply will be insufficient on its own to meet combined municipal and surface water irrigation demands at the watershed scale across the irrigation season. Modeling did not show curtailment of interruptible water rights holders between 1977 and 2005. Simulation of future curtailment occurred in 100% of years for the middle climate scenario, resulting from acreage currently receiving groundwater in the Odessa area. This area was assumed to have unmet surface water demand by 2030 under the baseline scenario. The resulting unmet demand per year ranged from 68,045 to 79,348 with an average of 73,405 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

No fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.



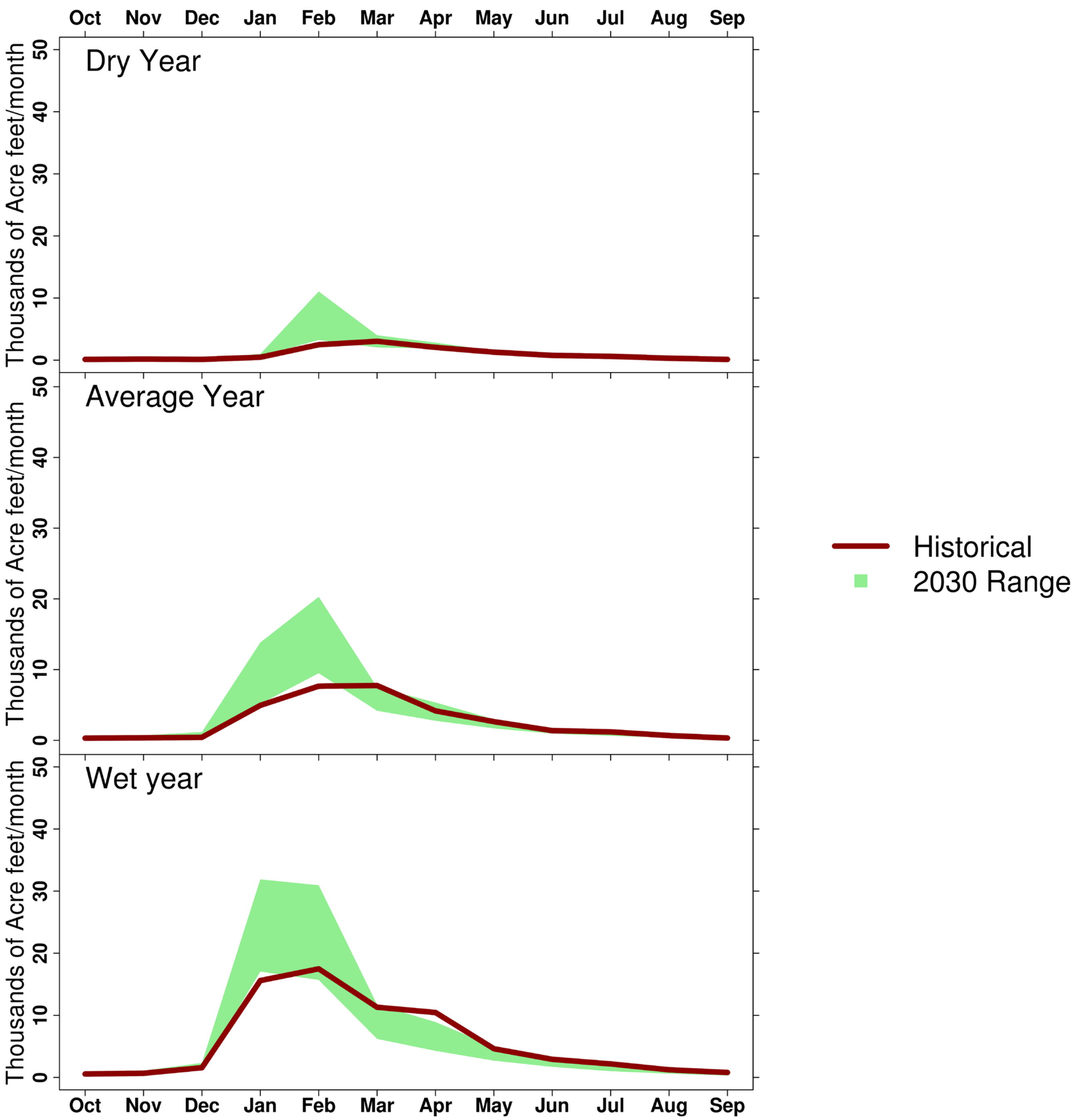
Management Context	
Adjudicated Areas	Crab Creek, Odessa Crab Creek, South Fork
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	No ESA-listed fish spawn or rear in WRIA waters
Groundwater Management Area	YES (Grant and Lincoln County portions are part of Columbia Basin GWMA, and Odessa Subarea)
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.

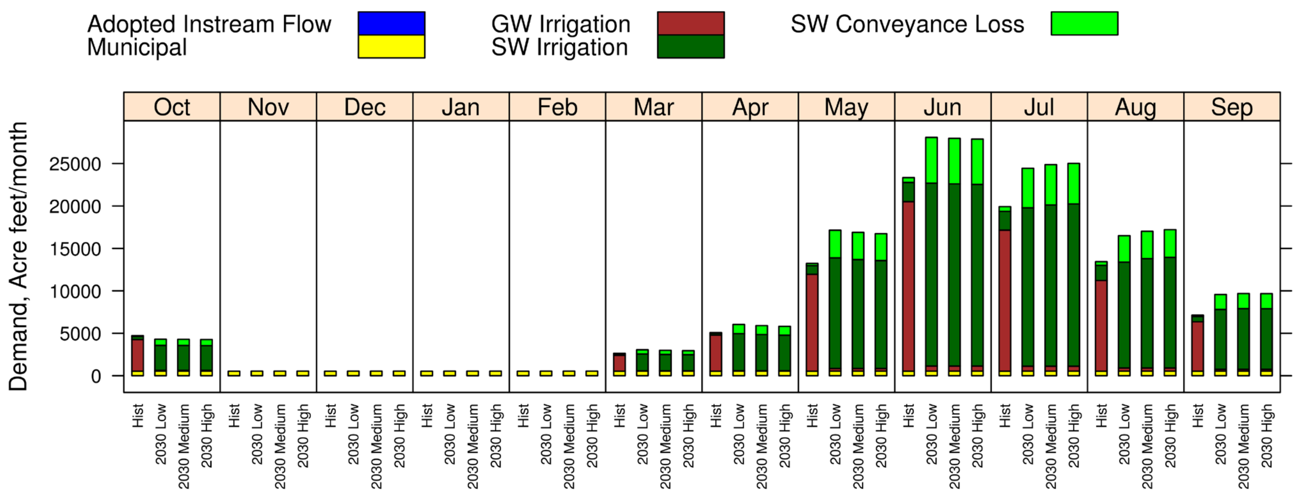
Supply



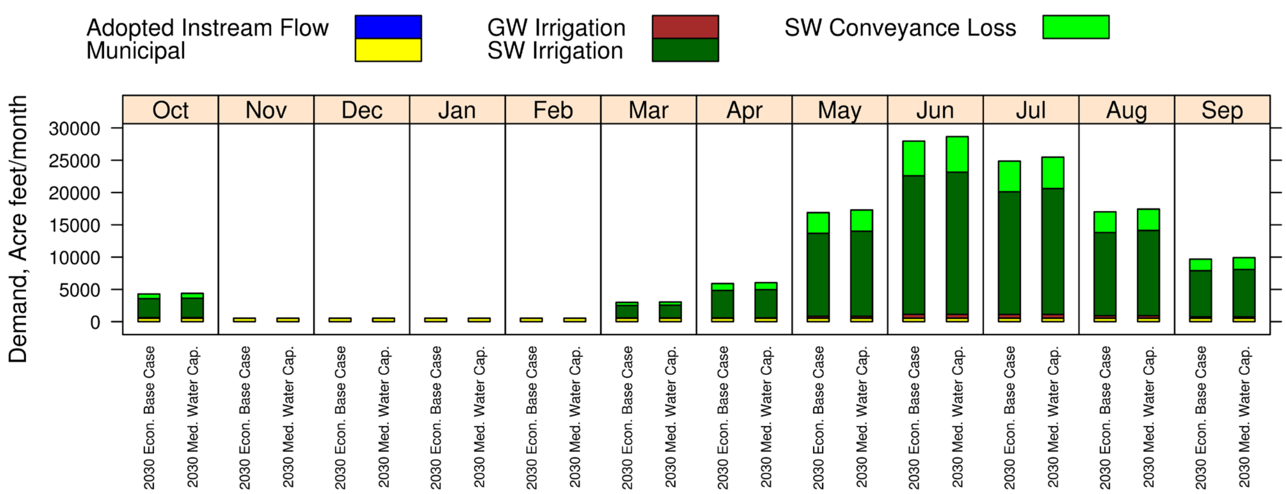
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

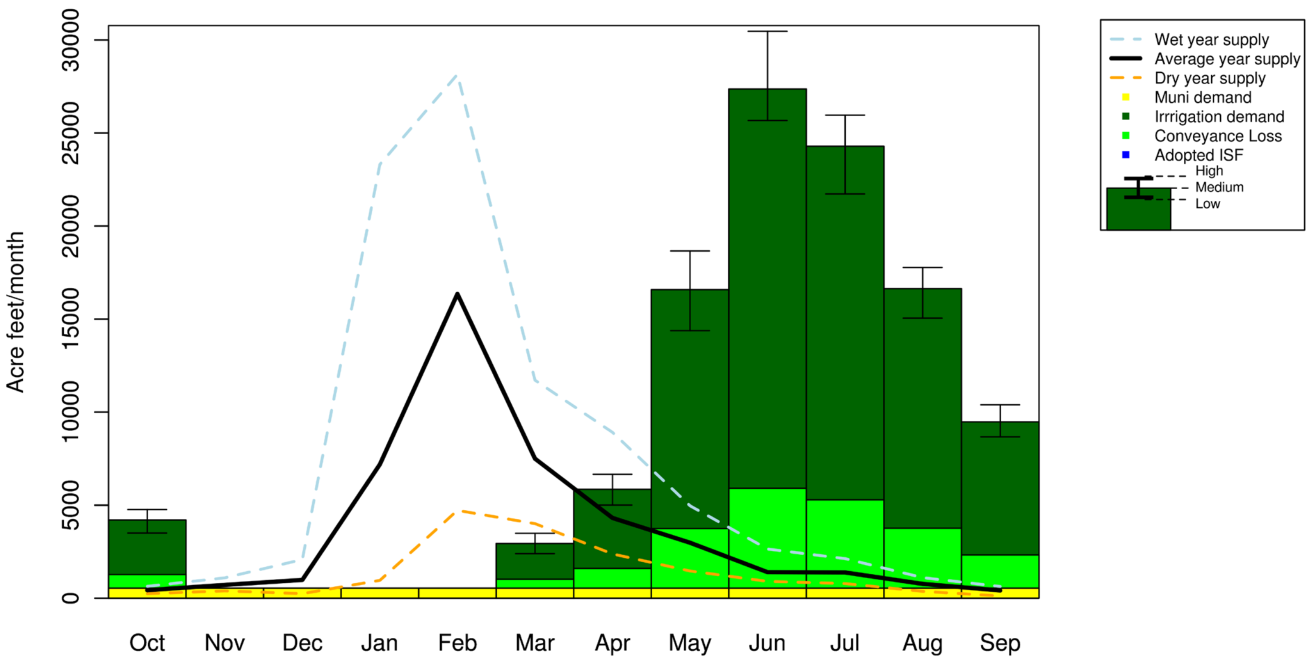
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Moses Coulee and Foster is characterized mostly by increases from late fall through winter and decreases in early spring.

As in many other watersheds of eastern Washington, municipal demands in these WRIAs are much smaller than irrigation demands. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase for future years from April through October, with small variations in the magnitude of change when alternate future economic scenarios are considered. Municipal demands are forecasted to grow by roughly 23% by 2030.

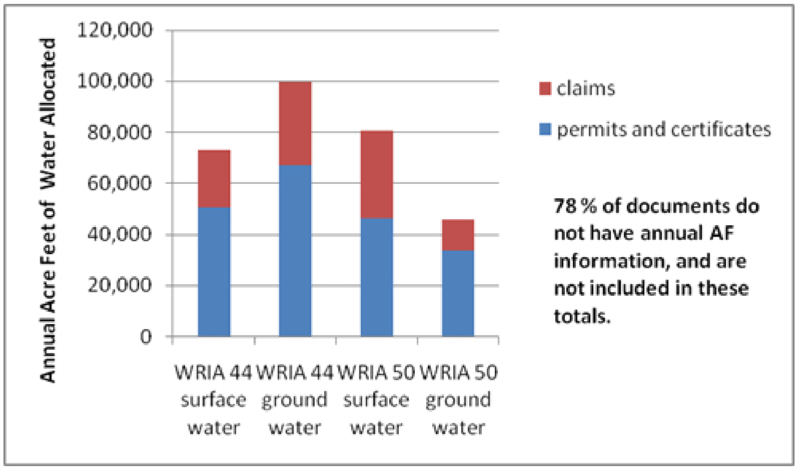
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply would be sufficient to meet combined municipal and surface water irrigation demands at the watershed scale on its own. Additional water supplies from the Columbia River are important to meeting demands in these WRIAs, and a separate analysis indicates that the majority of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

Fish listed under the Endangered Species Act that spawn or rear in tributary waters of WRIA 50 include the Upper Columbia River Spring Run Chinook and the Upper Columbia Steelhead. No fish listed under the Endangered Species Act spawn or rear in tributary waters of WRIA 44, but the Columbia River mainstem in this area is a migratory corridor for ESA-listed fish.

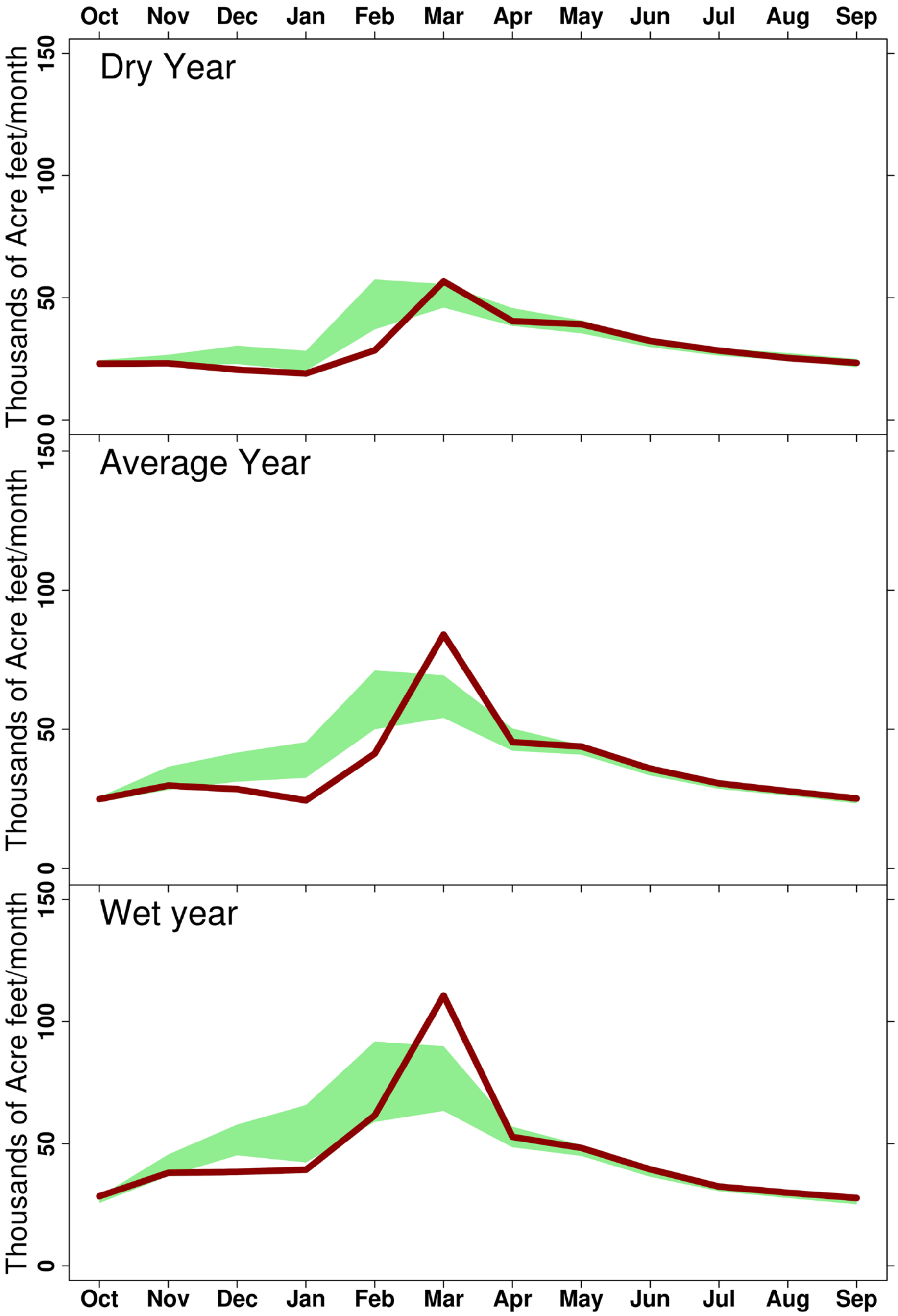
Management Context	
Adjudicated Areas	NO
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	WRIA 44: No ESA-listed fish spawn or rear in WRIA waters WRIA 50: Upper Columbia River Spring Run Chinook Upper Columbia Steelhead [Columbia mainstem migratory corridor]
Groundwater Management Area	NO
Groundwater Studies	No WRIA level studies found (but see WSU's technical report for references on Columbia Plateau Regional Aquifer System)

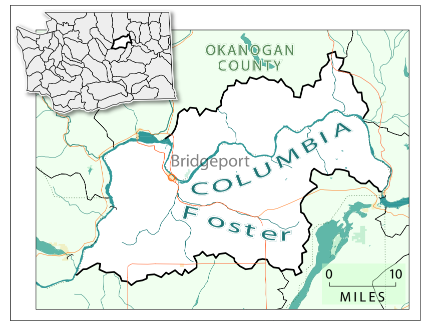
[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.

Supply

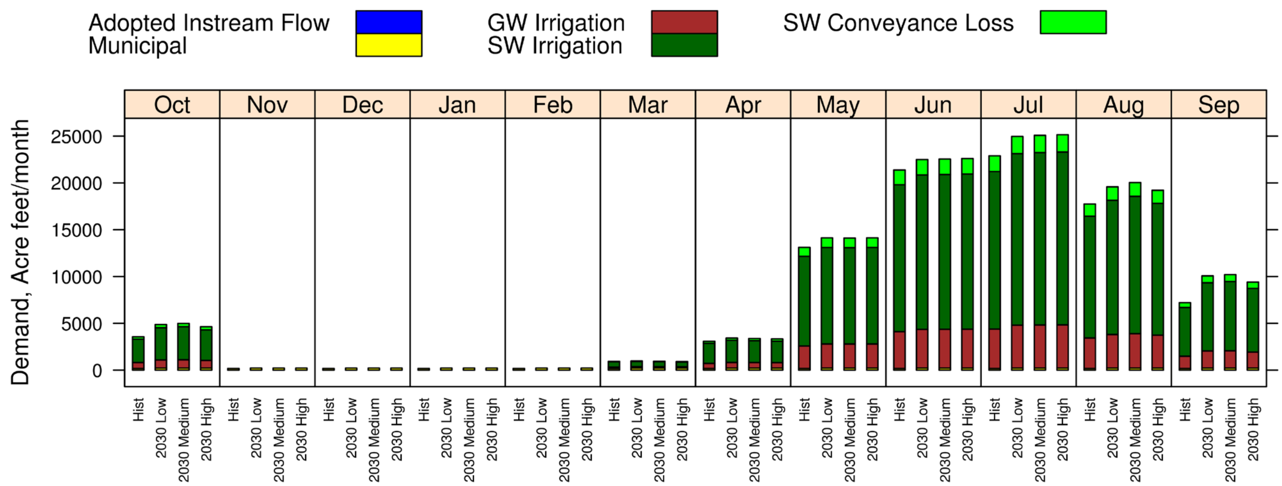




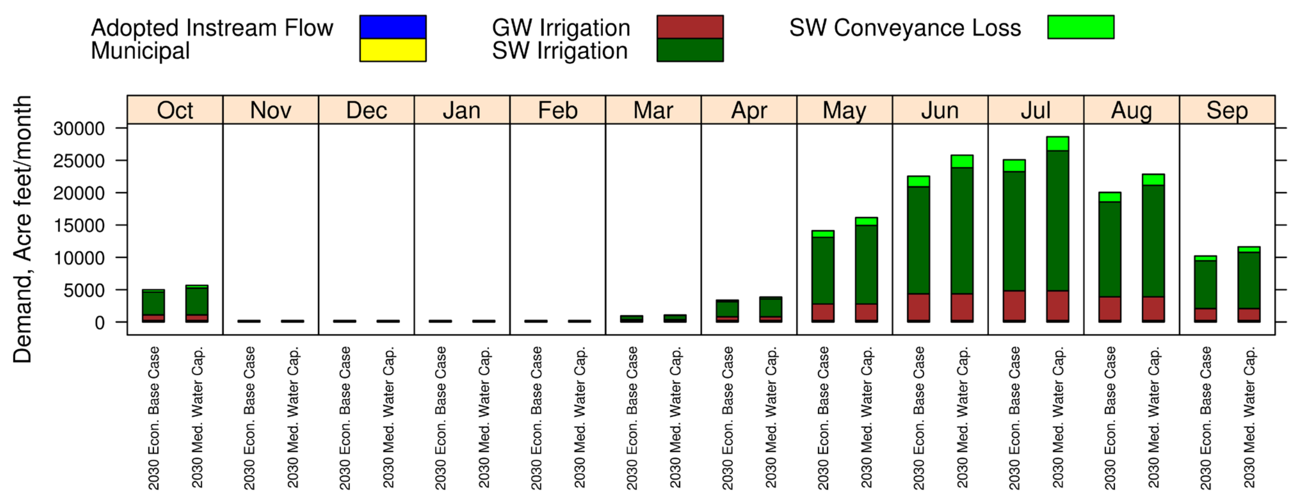
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

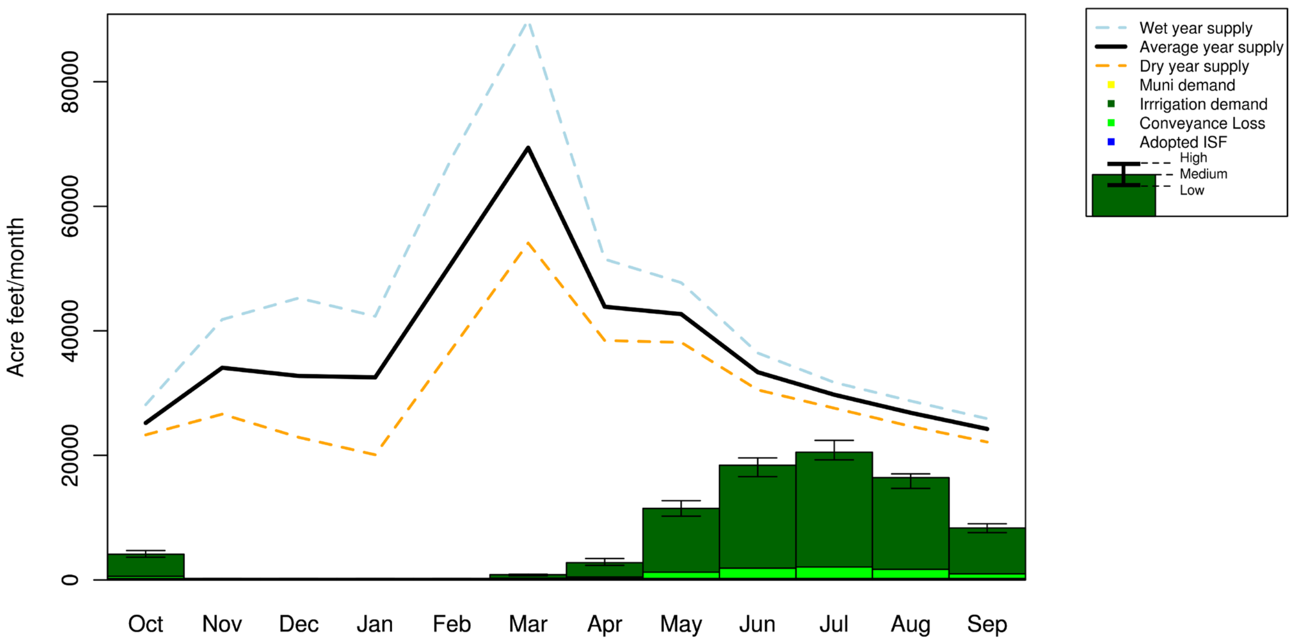
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Wenatchee is characterized mostly by substantial increases from fall through early spring and decreases in late spring through early fall.

Instream flow requirements are the largest water demand in WRIA 45, which has smaller irrigation demands and even smaller municipal demands in comparison. Instream flows based on watershed planning are shown for Wenatchee River at Peshastin, as specified in Chapter 173-545 WAC. Assuming no change in irrigated acreage, irrigation demand is projected to increase in many months in the future but decrease in others, with little difference when alternate future economic scenarios were considered. Municipal demands are forecasted to increase by 30% by 2030.

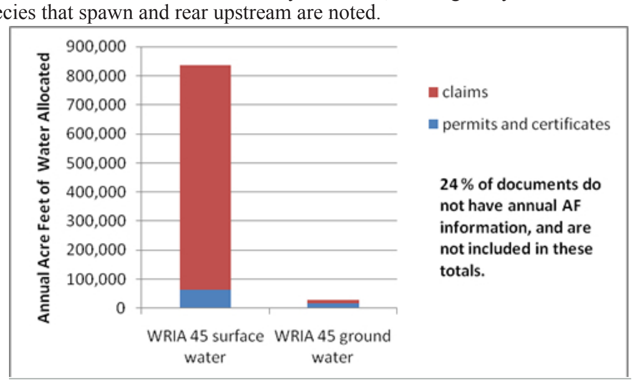
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, combined municipal and surface water irrigation demands and adopted instream flows are projected to outstrip unregulated tributary supply at the watershed scale in many years from July through March, and for almost all years from August through November. Additional water supplies from the Columbia River are available to meet demands in some areas of the WRIA, though a separate analysis indicates that less than 10% of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling of curtailment of interruptible irrigation water rights indicated that it occurred in 90% of years between 1977 and 2006. The resulting unmet demand ranged from 79 to 6,879 ac-ft per year depending on yearly flow conditions, with an average of 1,891 ac-ft per year. Simulation of future curtailment occurred in all the years for the middle climate scenario. The resulting unmet demand per year ranged from 97 to 8,908 with an average of 4,424 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Although not shown here, unmet demands due to a failure to meet adopted instream flows are shown in the technical report. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

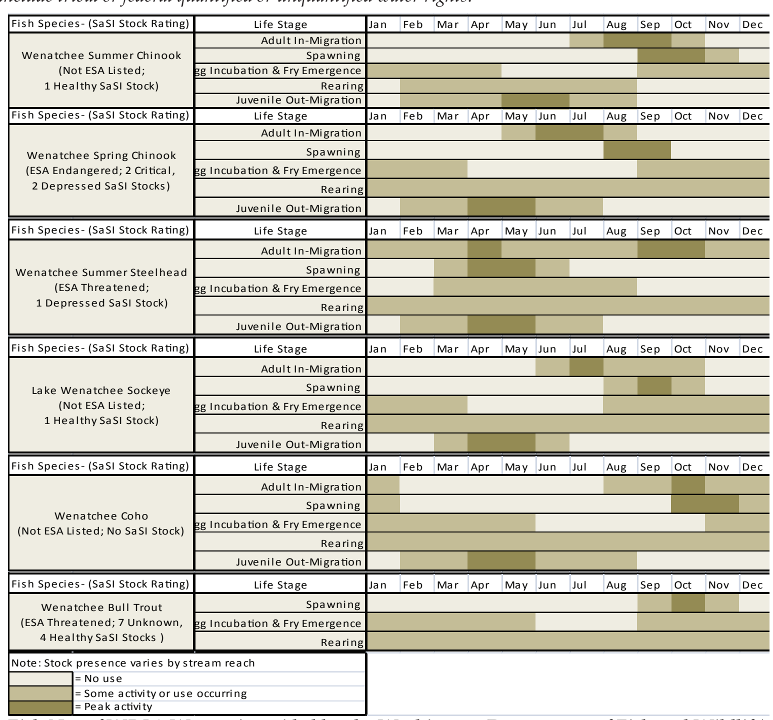
The Wenatchee River is home to bull trout, sockeye, coho, steelhead, spring Chinook and summer Chinook. There are four distinct stocks of ESA-Endangered Upper Columbia spring Chinook in the Wenatchee. Spawning generally occurs in August and September, and most juveniles migrate out of the system the following April-May. Bull trout in the Wenatchee are part of the ESA-listed Upper Columbia Bull Trout population.

Management Context	
Adjudicated Areas	Chumstick Creek Icicle Creek Nahahum Canyon
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	YES (Chapter 173-545 WAC) (interruptible users curtailed annually)
Fish Listed Under the Endangered Species Act[1]	Lake Wenatchee Sockeye Upper Columbia River Bull Trout Upper Columbia River Spring Run Chinook Upper Columbia Steelhead [Columbia mainstem migratory corridor]
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

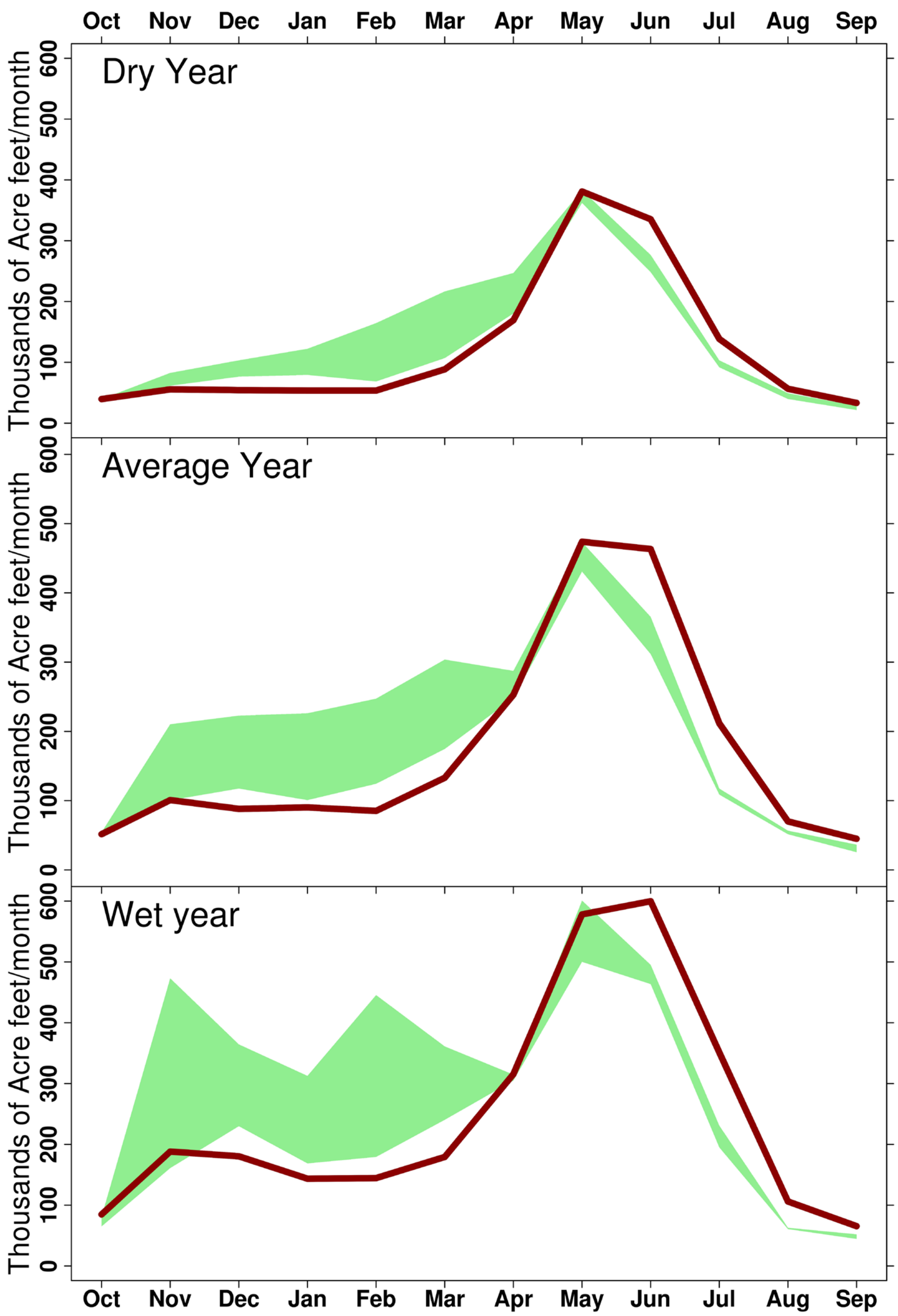
[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.

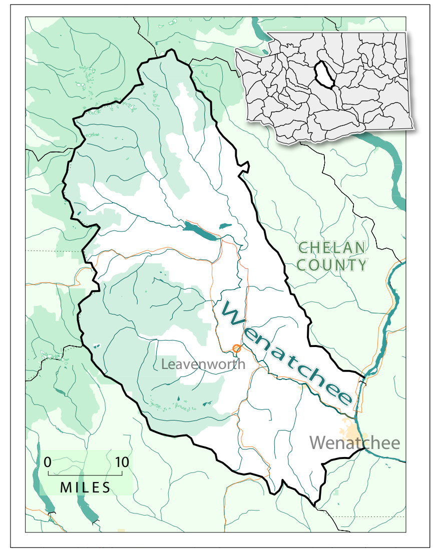


To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.



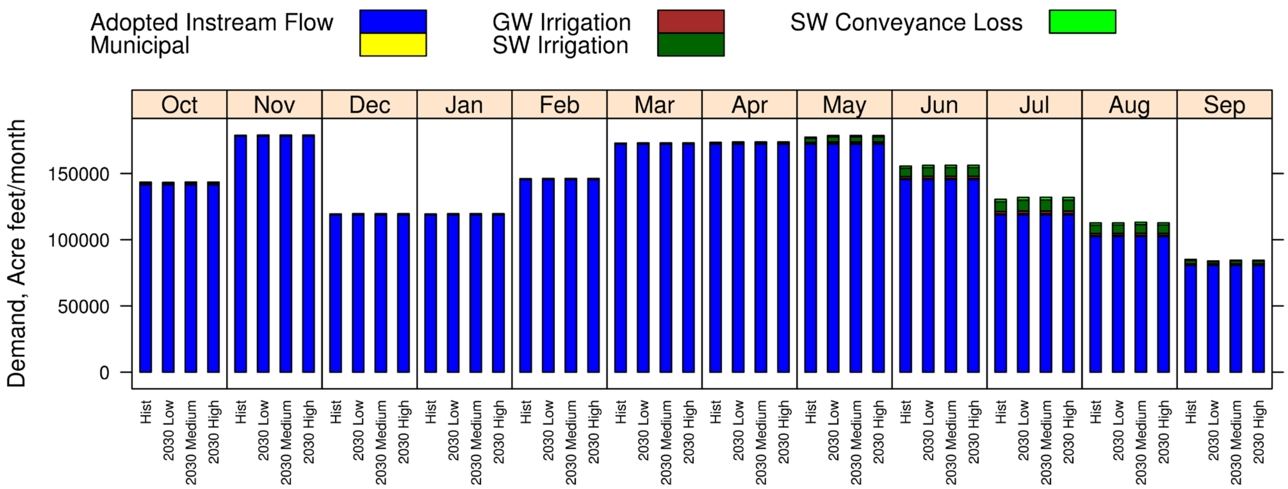
Fish Use of WRIA Waters (provided by the Washington Department of Fish and Wildlife)



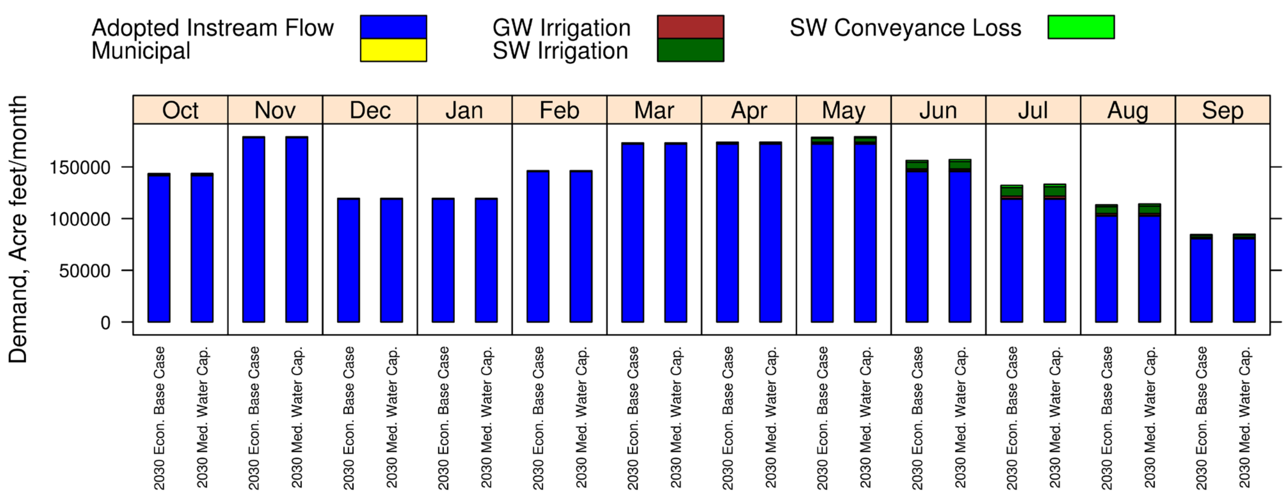


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

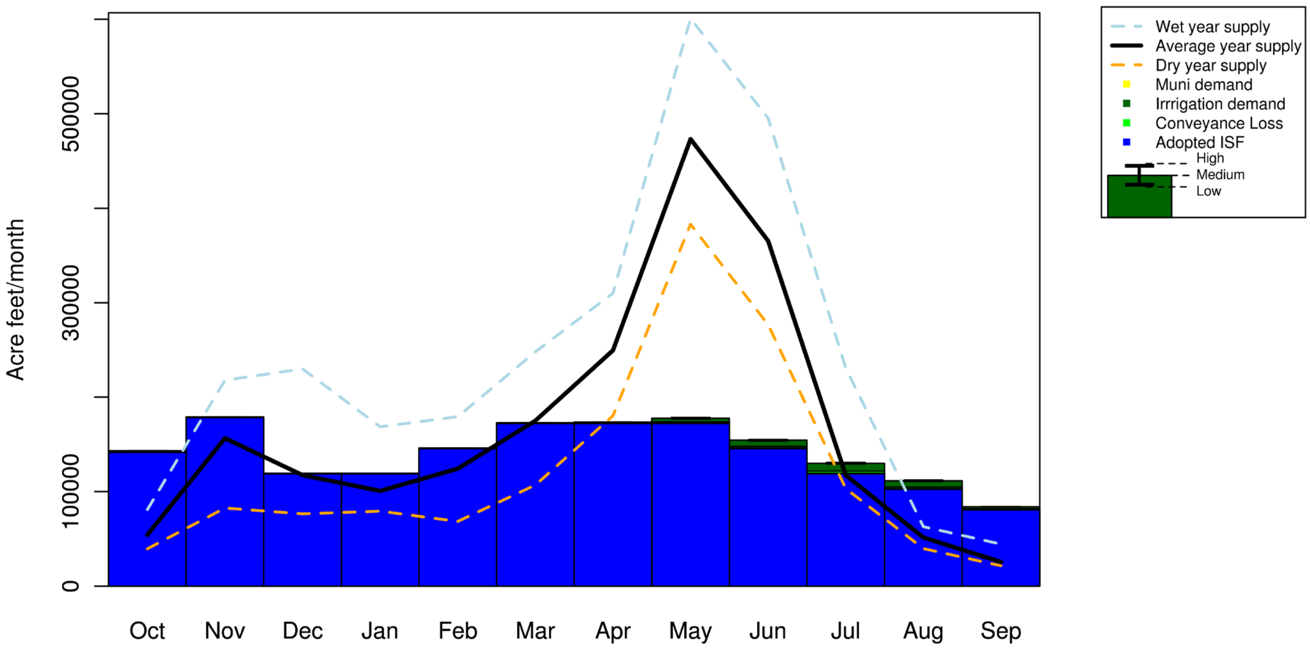
*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Entiat is characterized mostly by increases from late fall through spring and decreases during the late spring and summer.

Instream flow requirements are the largest demand in WRIA 46, with much smaller irrigation and municipal demands. Because the instream flows specified in Chapter 173-546 WAC are sometimes higher for the upper Entiat River near Ardenvior than for the lower Entiat near river mile 1.4, instream requirements are shown as the higher of these two instream flow requirements for each month, for both the historical and future period. Assuming no change in irrigated acreage, irrigation demand is projected to increase somewhat in future summers under all economic scenarios considered, and decrease for most future falls. Meanwhile, municipal demands are forecasted to increase by 19% by 2030.

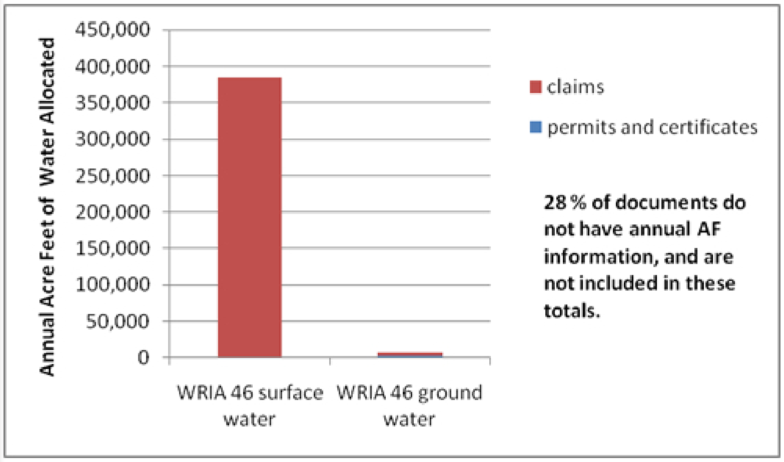
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply is forecasted to be insufficient to meet combined municipal and surface water irrigation demands and adopted instream flows at the watershed scale in most years from July through September. Additional water supplies from the Columbia River could meet demands in some localized areas of the WRIA, though a separate analysis indicates that very little agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Although not shown here, unmet demands due to a failure to meet adopted instream flows are shown in the technical report. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

Fish listed under the Endangered Species Act that spawn or rear in tributary waters of this watershed include the Upper Columbia River Bull Trout, the Upper Columbia River Spring Run Chinook, and the Upper Columbia Steelhead.

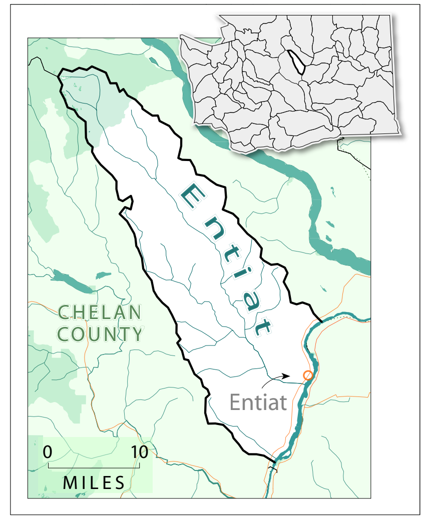
Management Context	
Adjudicated Areas	Roaring Creek
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	YES (Chapter 173-546 WAC)
Fish Listed Under the Endangered Species Act[1]	Upper Columbia River Bull Trout Upper Columbia River Spring Run Chinook Upper Columbia Steelhead [Columbia mainstem migratory corridor]
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

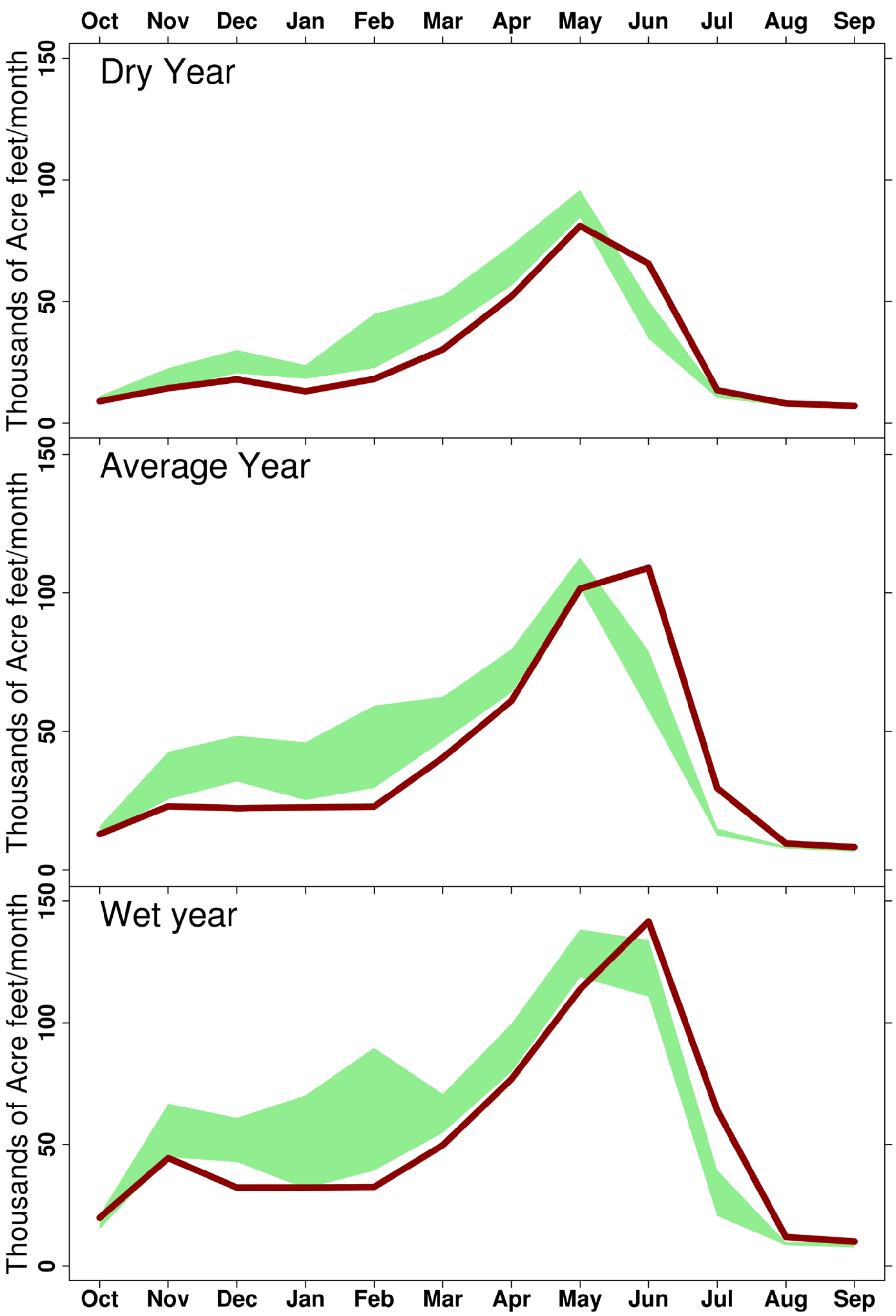
[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.

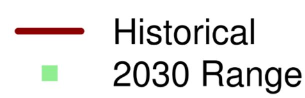


To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.

Supply



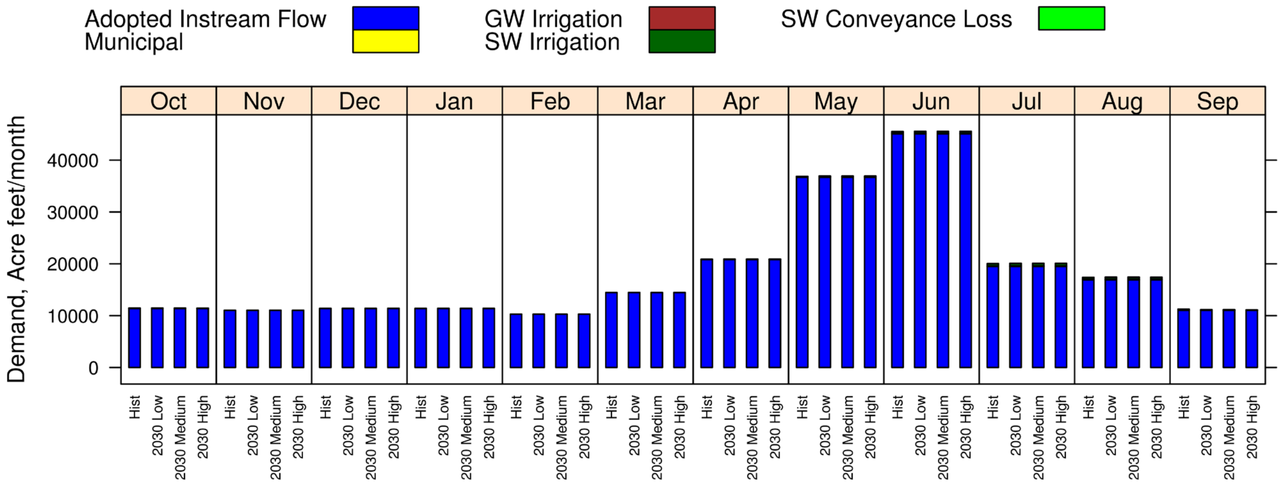




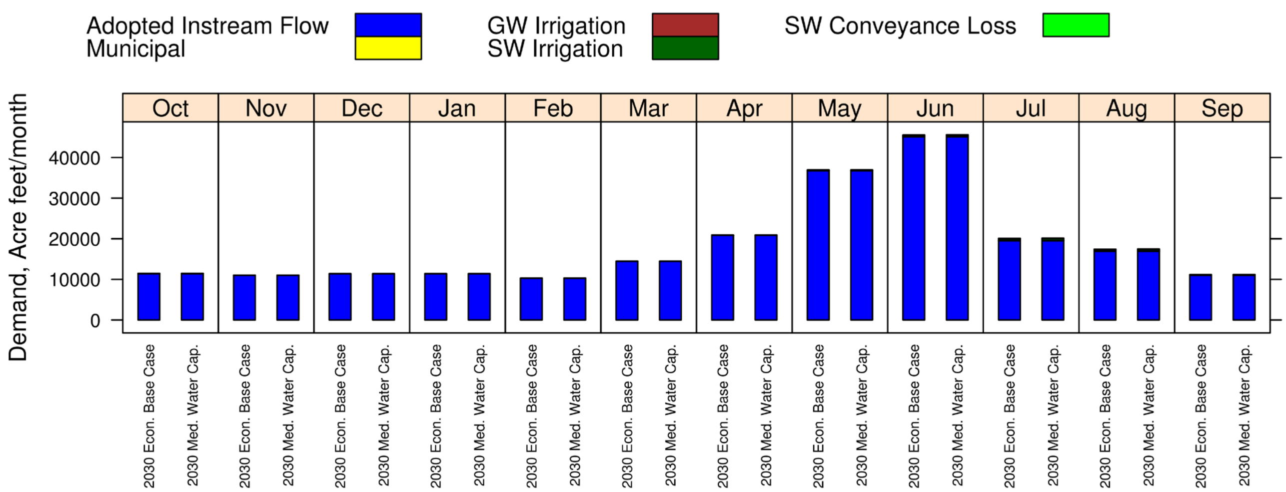
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

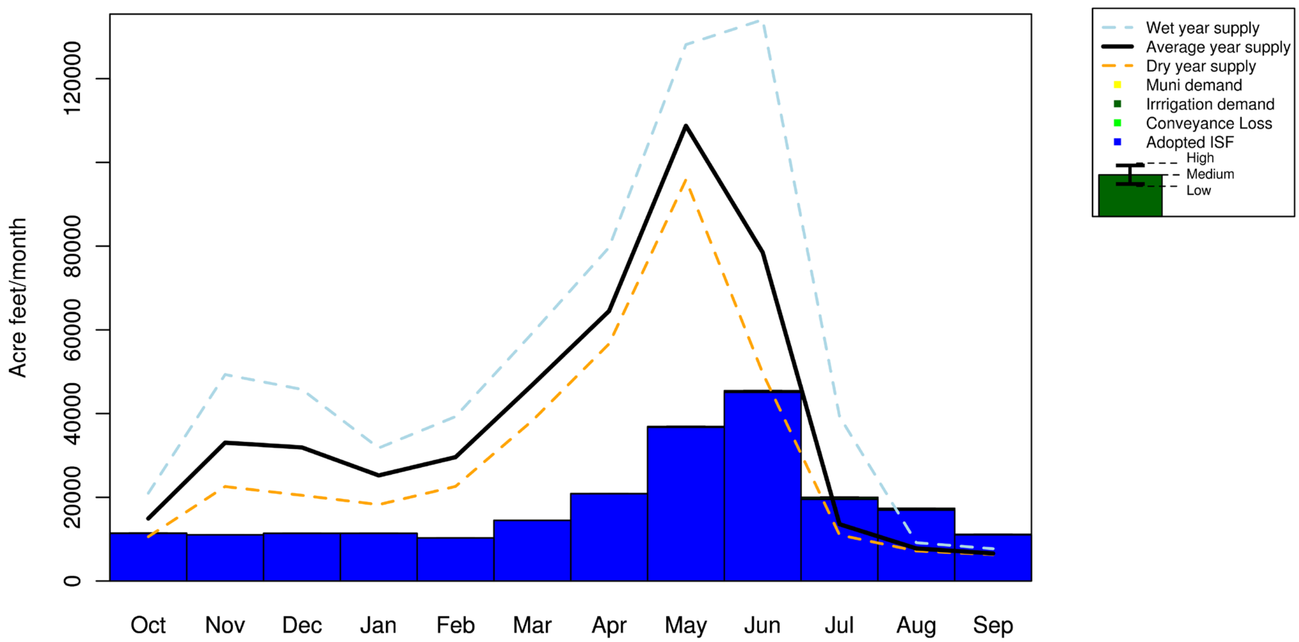
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Chelan

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Chelan is characterized mostly by increases from late fall through mid-spring and decreases in summer and early fall.

Irrigation is the primary demand in Chelan, with much smaller municipal demands. Assuming no change in irrigated acreage, irrigation demand is forecasted to increase most future months but decrease in others, with some variation in impacts in other months when alternate future economic scenarios were considered. Municipal demand projected to grow by roughly 32% by 2030.

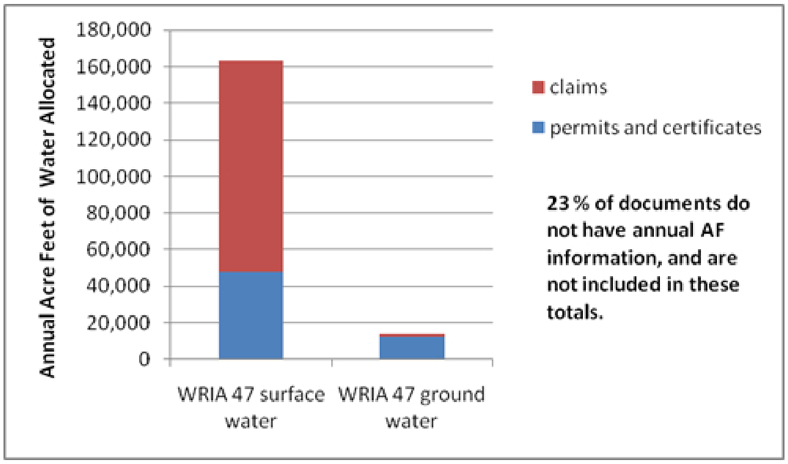
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply is projected to be sufficient to meet combined municipal and surface water irrigation demands at the watershed scale. Additional water supplies from the Columbia River are available in some areas of the WRIA, and a separate analysis indicates that roughly a third of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

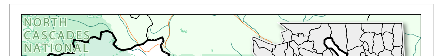
No fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed, but the Columbia River mainstem in this area is a migratory corridor for ESA-listed fish.

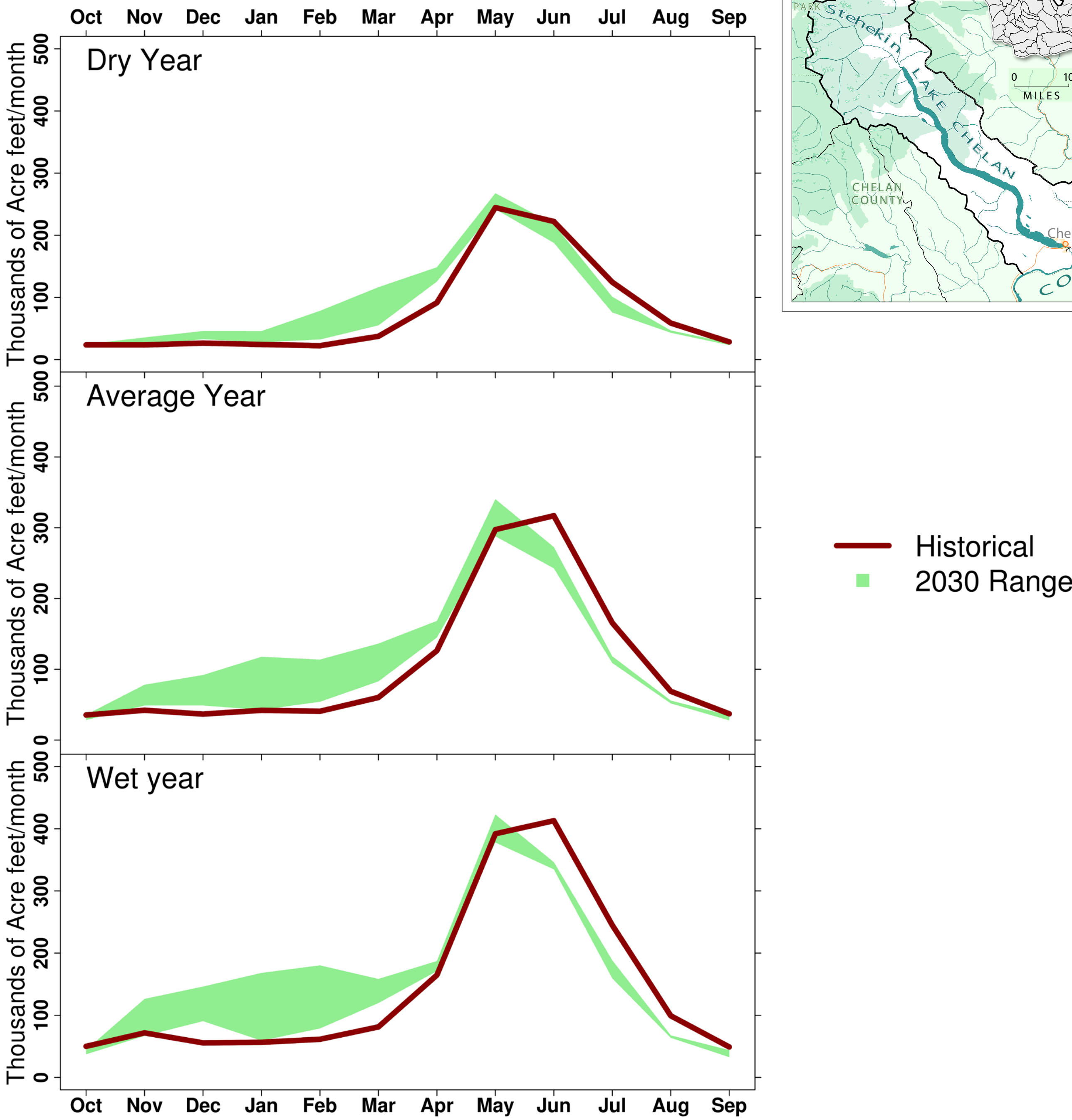
Management Context	
Adjudicated Areas	Antoine Creek Joe Creek Safety Harbor Creek Johnson Creek
Watershed Planning	Phase 2 (Assessment)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	[Columbia mainstem migratory corridor]
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



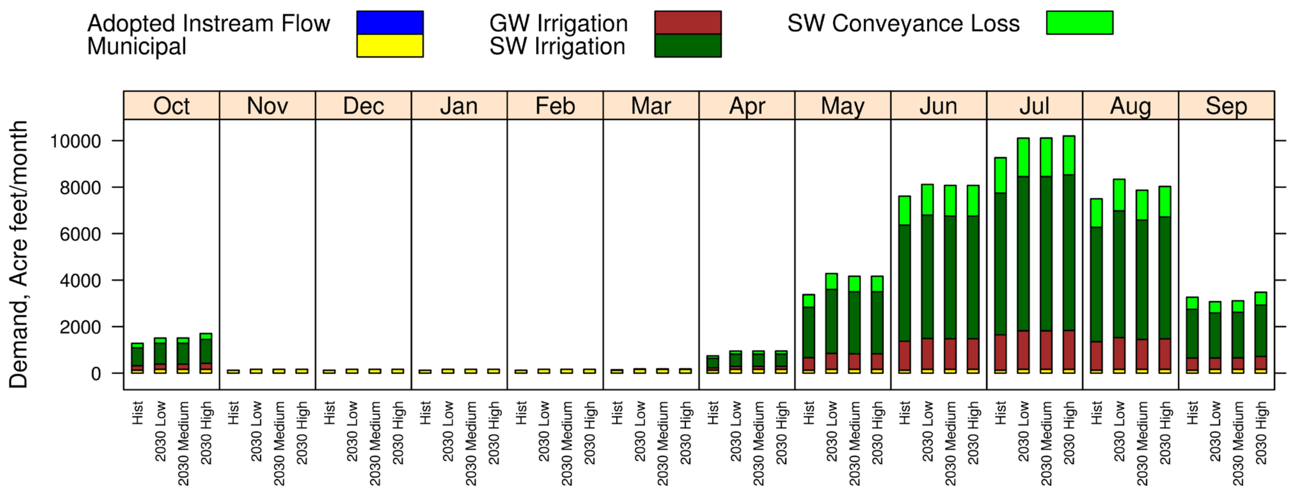
To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.



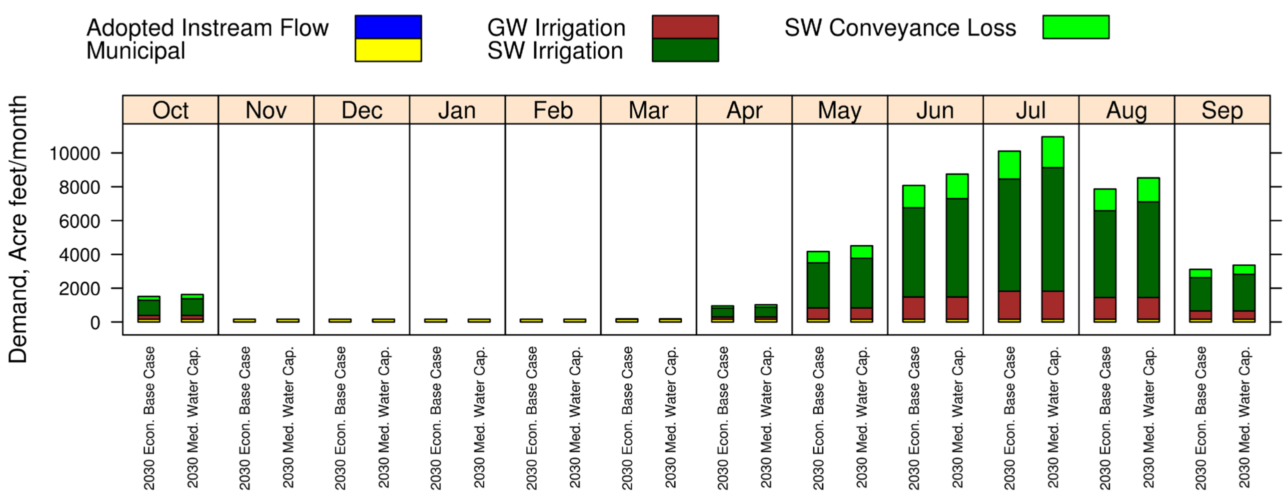


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

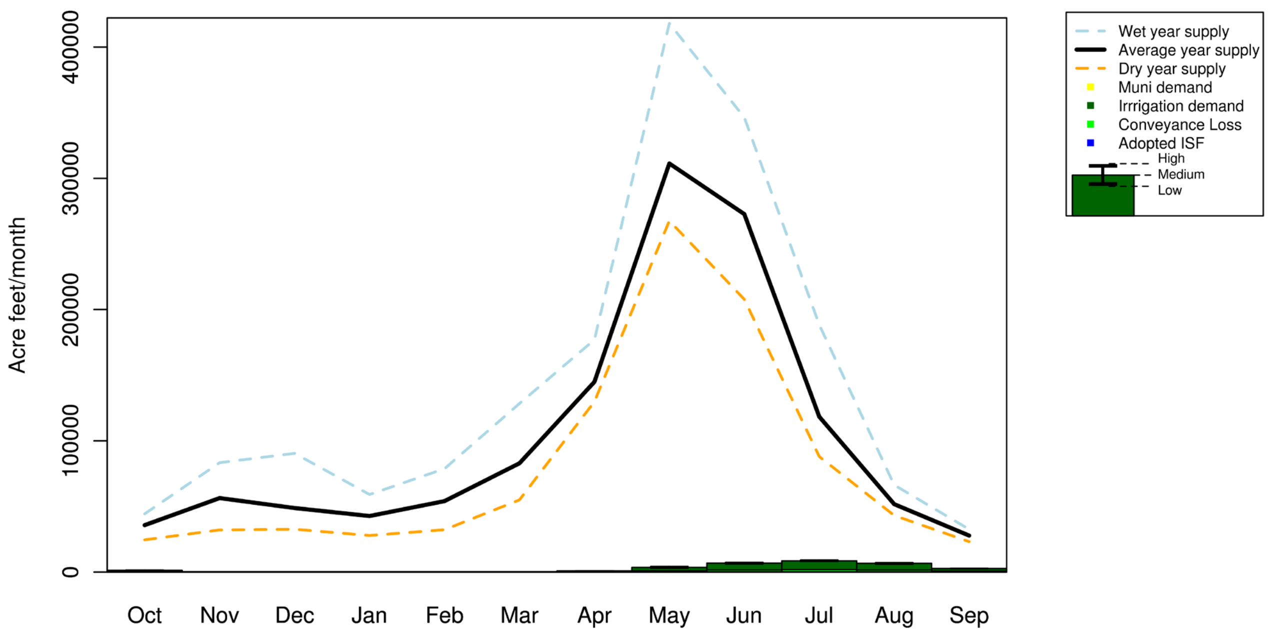
Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Methow is characterized mostly by increases in the late winter through late spring and slight decreases in late spring and summer.

WRIA 48 has much larger instream flow requirements than irrigation demands, and even smaller municipal demands. Because the instream flows specified in Chapter 173-548 WAC are sometimes higher for the middle Methow River near Twisp than for the lower Methow River near Pateros, instream requirements are shown as the higher of these two instream flow requirements for each month, for both the historical and future period. Assuming no change in irrigated acreage, irrigation demand is projected to increase in future summers under all economic scenarios that were considered, with small variations in impact when alternate economic scenarios are considered. Municipal demands are forecasted to grow by 20% by 2030.

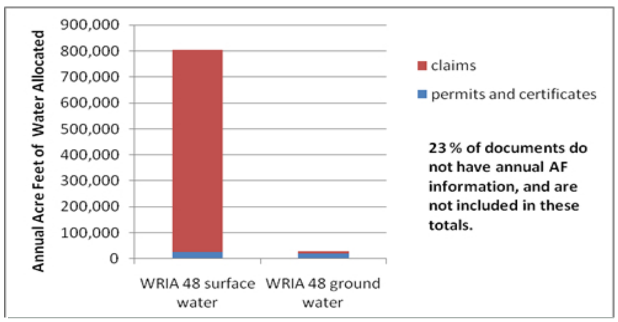
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, at the watershed scale, combined municipal and surface water irrigation demands and adopted instream flows are projected to outstrip unregulated tributary supply generated within the Washington portion of the watershed during many years from July through November, and in some years from December through February. Upstream portions of the watershed outside of Washington provide additional supplies, but may also have additional demands. Additional water supplies from the Columbia River are available to meet demands in some areas of the WRIA, and a separate analysis indicates that a bit more than a third of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling of curtailment of interruptible irrigation water rights indicated that it occurred in 80% of years between 1977 and 2006. The resulting unmet demand ranged from 14 to 2,217 ac-ft per year depending on yearly flow conditions, with an average of 622 ac-ft per year. Simulation of future curtailment occurred in 93% of years for the middle climate scenario. The resulting unmet demand per year ranged from 12 to 2,594 with an average of 1,465 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Although not shown here, unmet demands due to a failure to meet adopted instream flows are shown in the technical report. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

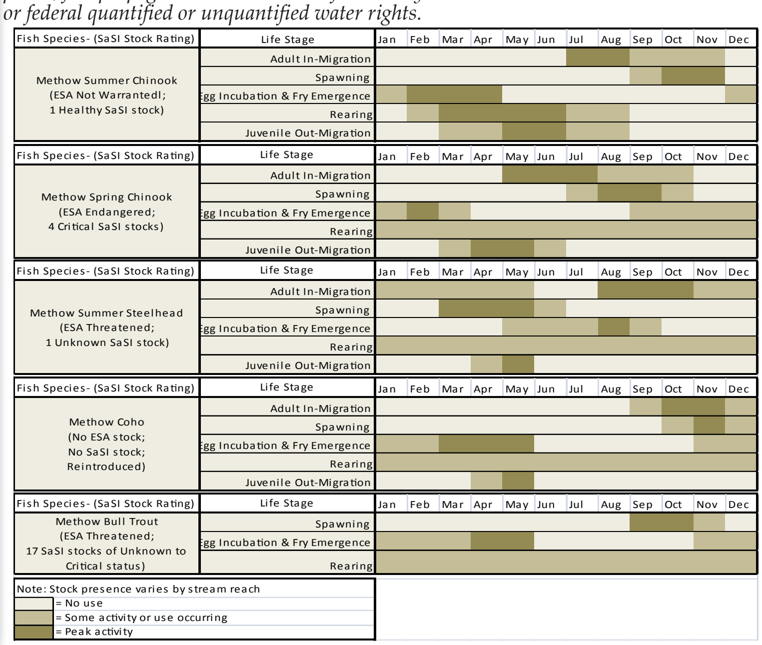
Methow spring Chinook are a key component of the ESA-Endangered Upper Columbia Spring Chinook run. Adults spawn from late July through October, and most juveniles outmigrate in April-May. Juvenile salmon rearing occurs year-round. Bull trout in the Methow are part of the ESA-Threatened Upper Columbia Bull Trout listing unit.

Management Context	
Adjudicated Areas	Beaver Creek Bear Creek & Davis Lake Libby Creek Gold Creek McFarland Creek Black Canyon Creek Wolf Creek Thompson Creek (incomplete)
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	YES (Chapter 173-548 WAC) (interruptible users curtailed annually)
Fish Listed Under the Endangered Species Act[1]	Upper Columbia River Bull Trout Upper Columbia River Spring Run Chinook Upper Columbia Steelhead [Columbia mainstem migratory corridor]
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

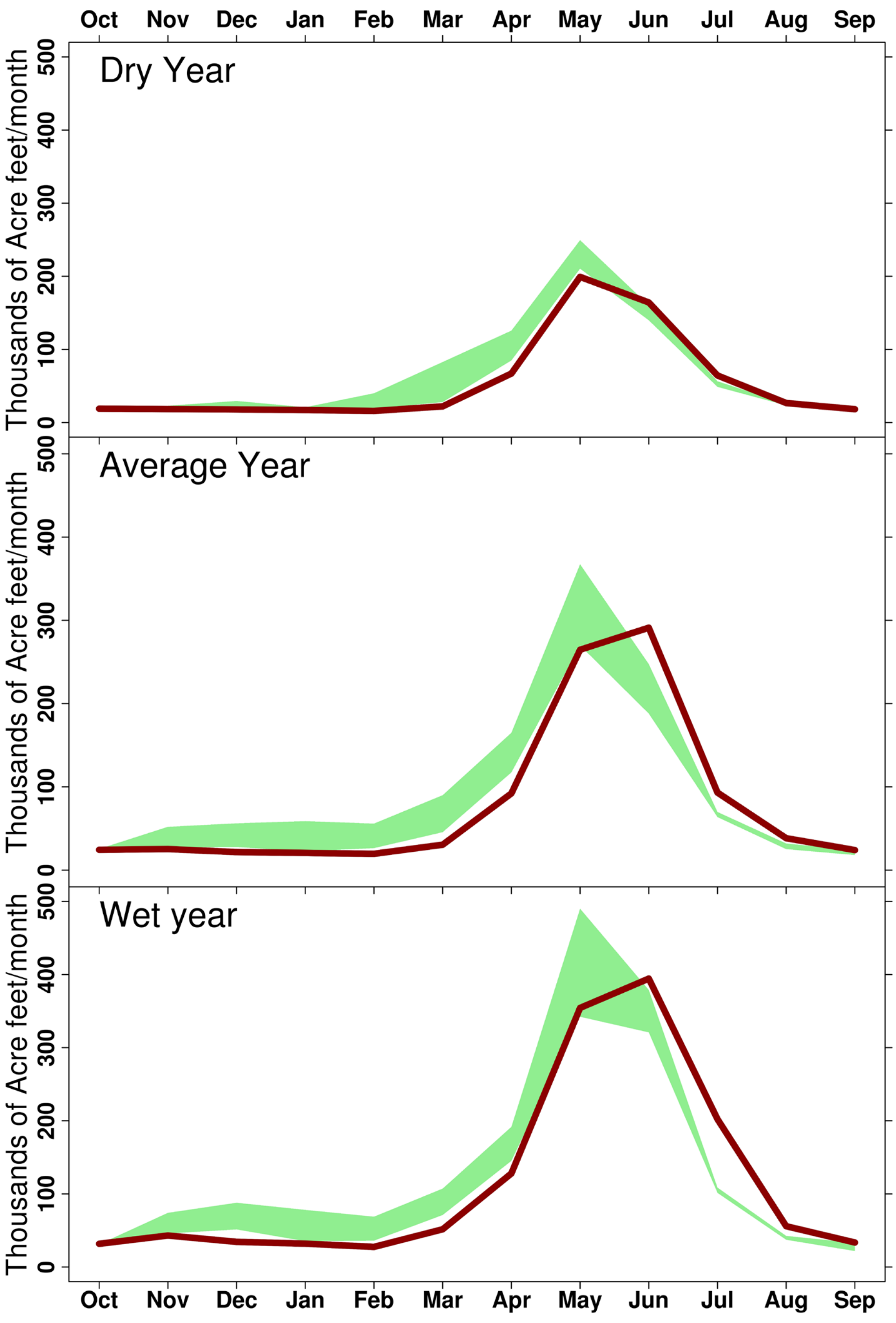
[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.

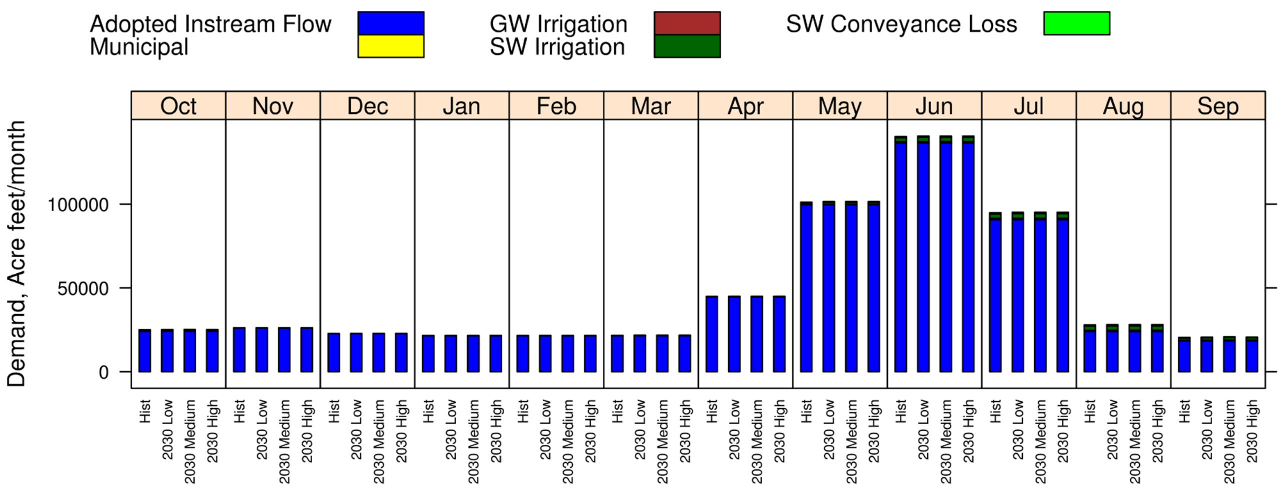


Fish use of WRIA waters (provided by the Washington Department of Fish and Wildlife)

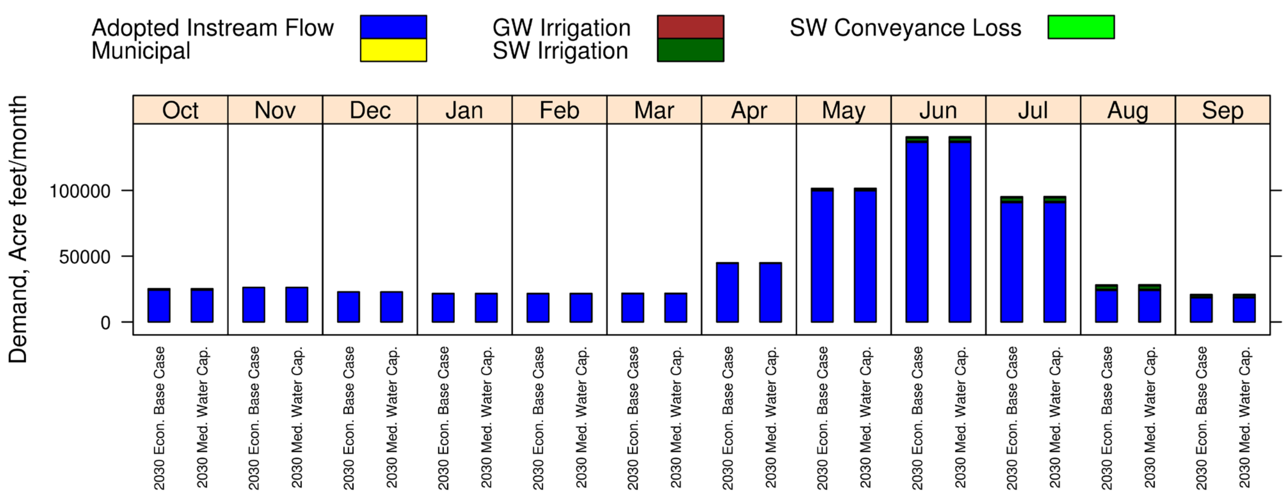


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

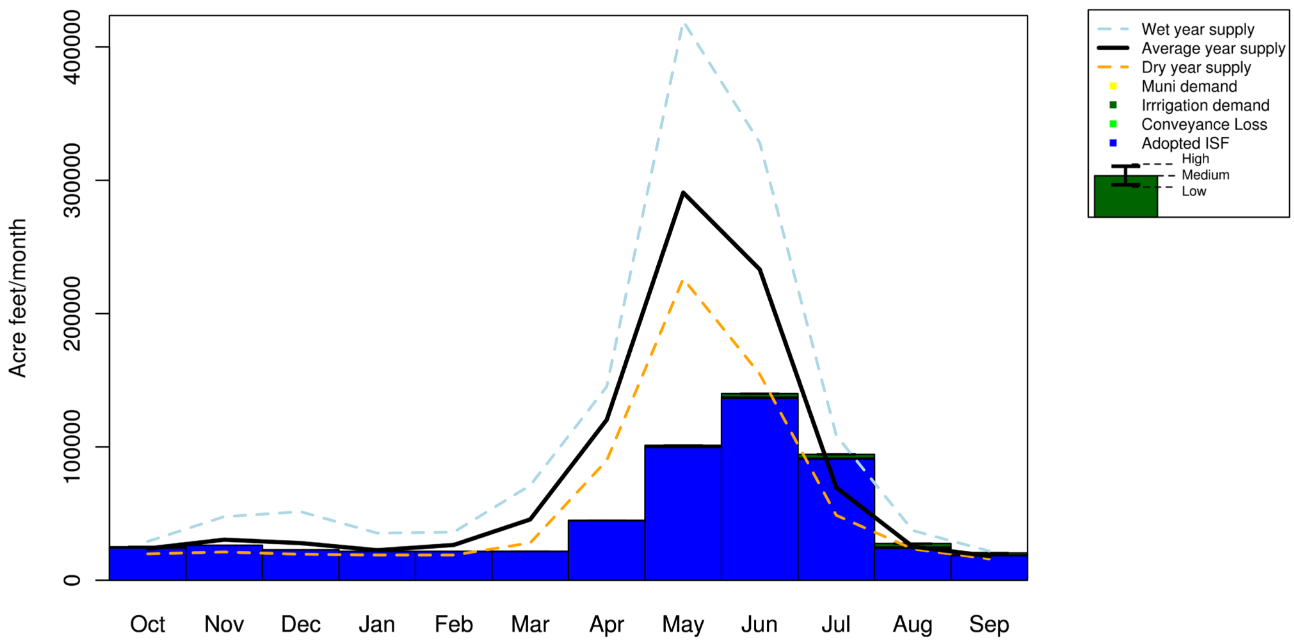
*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Okanogan is characterized mostly by increases from mid-fall through winter and decreases under most flow conditions from late spring through early fall.

The largest demands in WRIA 49 are from instream demands, though irrigation demands are also important. Municipal demands are much smaller. Because the instream flows specified in Chapter 173-549 WAC are higher for some time periods for the middle Okanogan River near Tonaskett than for lower Okanogan River at Malott, instream requirements are shown as the higher of these two instream flow requirements for each month, for both the historical and future period. Assuming no change in irrigated acreage, irrigation demand is projected to increase in most months but decrease in others under all future economic scenarios that were considered. Municipal demands are forecasted to grow by 22% by 2030.

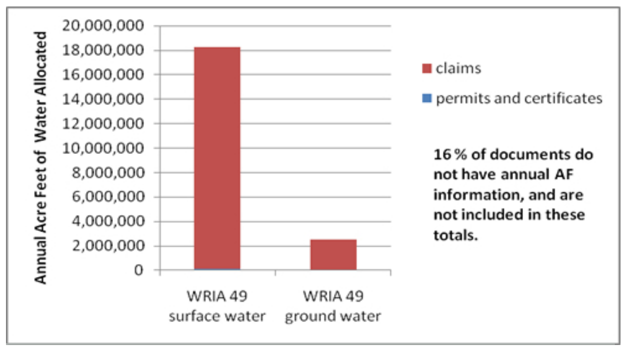
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, at the watershed scale, combined municipal and surface water irrigation demands and adopted instream flows are projected to outstrip unregulated tributary supply generated within the Washington portion of the watershed during most years for May through February. Upstream portions of the watershed outside of Washington provide additional supplies, but may also have additional demands. Additional water supplies from the Columbia River are available to meet demands in a few areas of the WRIA, and a separate analysis indicates that roughly one sixth of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling of curtailment of interruptible irrigation water rights indicated that it occurred in every year between 1977 and 2006. The resulting unmet demand ranged from 144 to 11,388 ac-ft per year depending on yearly flow conditions, with an average of 4,426 ac-ft per year. Simulation of future curtailment occurred in 97% of years for the middle climate scenario. The resulting unmet demand per year ranged from 263 to 21,292 with an average of 10,464 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Although not shown here, unmet demands due to a failure to meet adopted instream flows are shown in the technical report. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

The Okanogan summer steelhead stock is a component of the ESA-Threatened Upper Columbia steelhead listing unit. These fish spawn from March through June, juveniles overwinter, and juvenile outmigration generally occurs in April and May. Okanogan sockeye are returning to, rearing in, and migrating from lakes along the U.S. Canada border and in British Columbia.

Management Context	
Adjudicated Areas	Similkameen River Sinlahekin Creek Whitestone Lake Bonaparte Creek & Lake Lower Antoine Creek Johnson Creek Duck Lake Groundwater Subarea Chiliwist Creek Salmon Creek, Lr & WF & tributaries Omak Creek (incomplete)
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	YES (Chapter 173-549 WAC) (interruptible users curtailed annually)
Fish Listed Under the Endangered Species Act[1]	Okanogan River Sockeye Upper Columbia Steelhead [Columbia mainstem migratory corridor]
Groundwater Management Area	YES (Duck Lake subarea)
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



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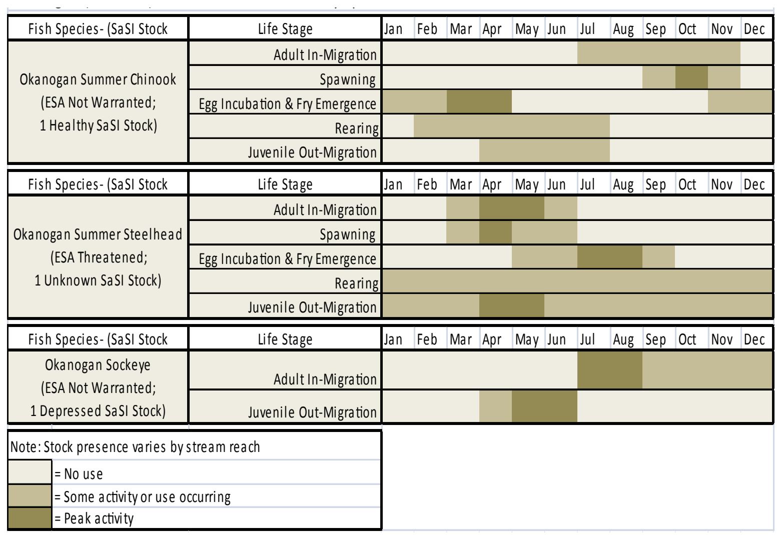
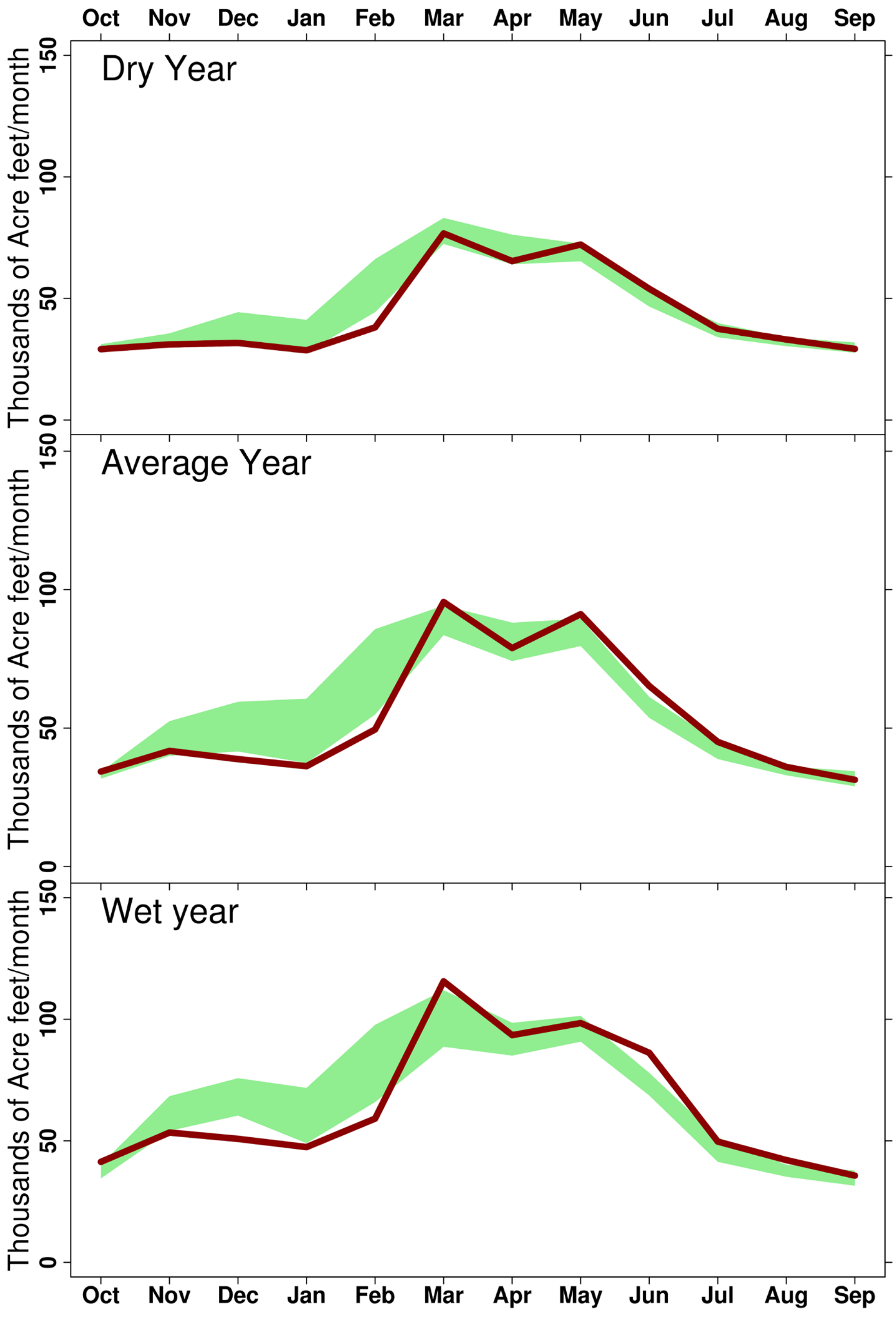
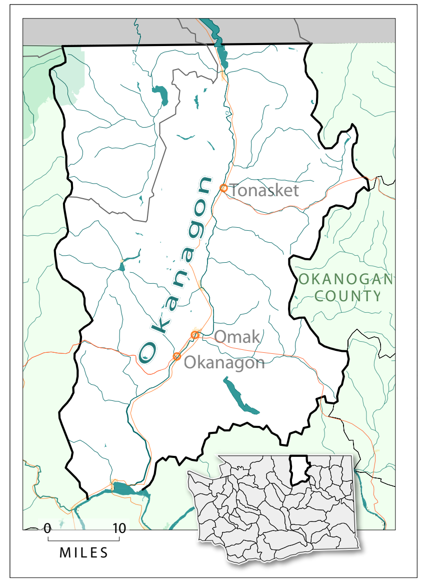


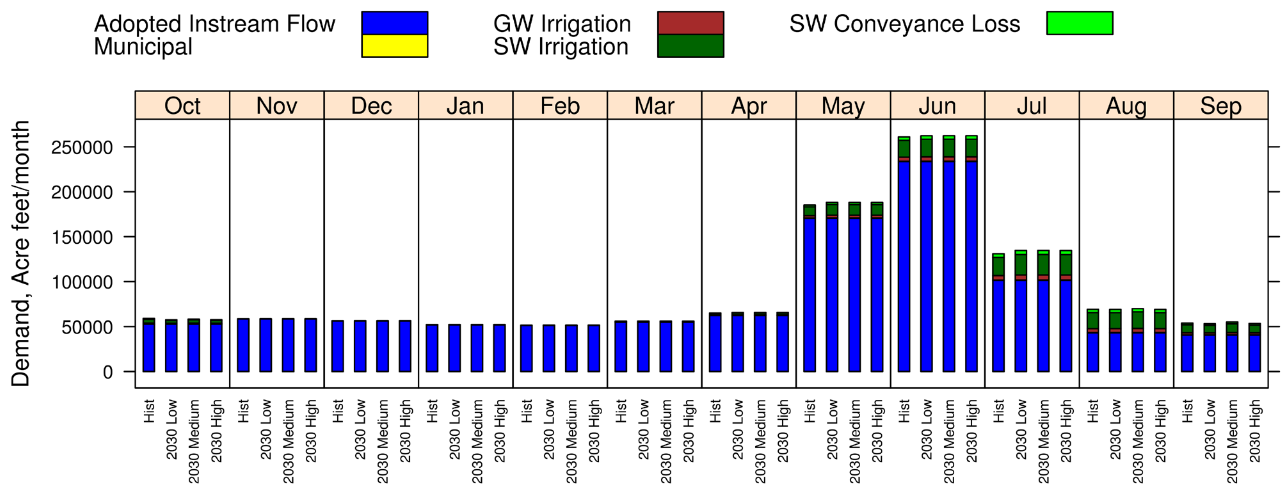
Fish use of WRIA waters (provided by the Washington Department of Fish and Wildlife)



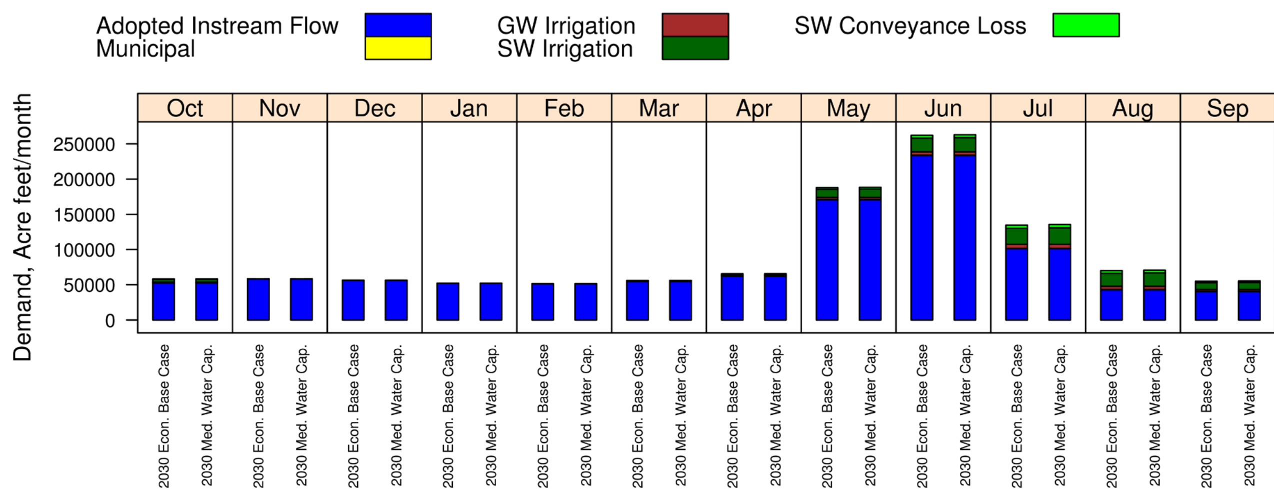


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

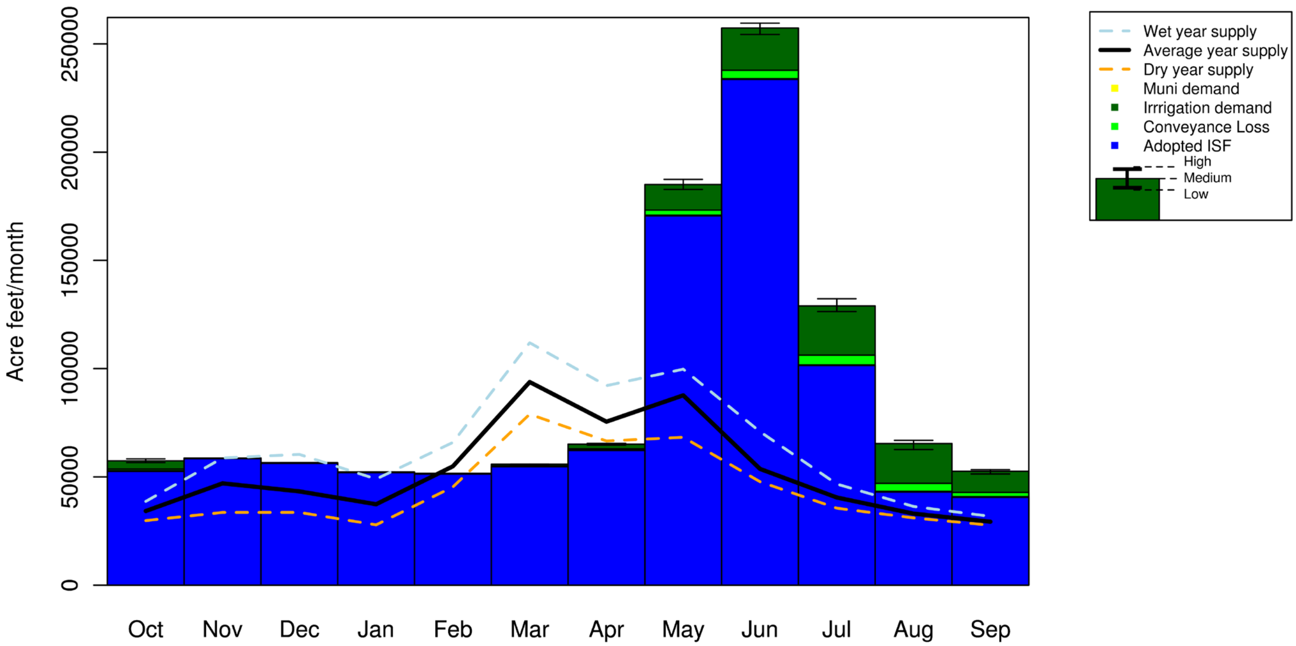
*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The supply forecast for Nespelem is characterized mostly by very slight increases from mid-fall through winter.

Municipal/domestic demands are quite small in this watershed compared to other watersheds in eastern Washington, and there were no modeled irrigation demands in either the historical or the future period. Municipal demands are forecasted to grow 13% by 2030, a smaller increase than in many other watersheds of eastern Washington.

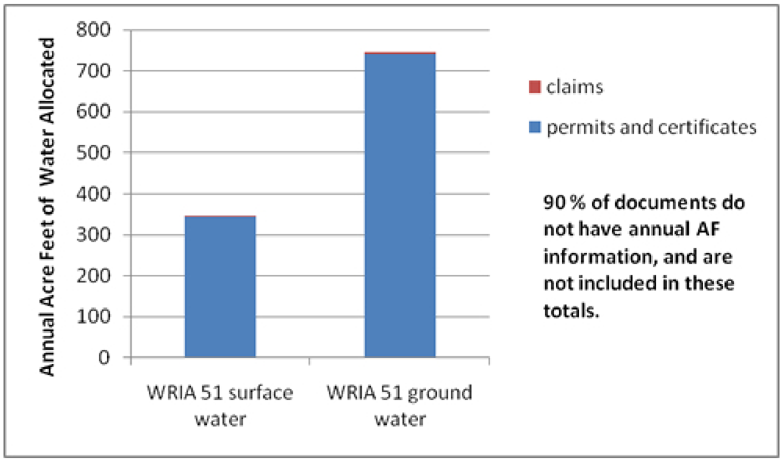
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is not anticipated to create any agricultural irrigation water demand in this WRIA. Additional capacity will only increase demand in WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply is projected to be sufficient to meet combined municipal and surface water irrigation demands at the watershed scale. Additional water supplies may be available from the Columbia River in a localized area of the watershed. Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

It is not known whether bull trout spawn or rear in the tributary waters of Nespelem, and no other fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.

Management Context	
Adjudicated Areas	NO
Watershed Planning	NO
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Bull Trout spawning and rearing unknown
Groundwater Management Area	NO
Groundwater Studies	None found

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



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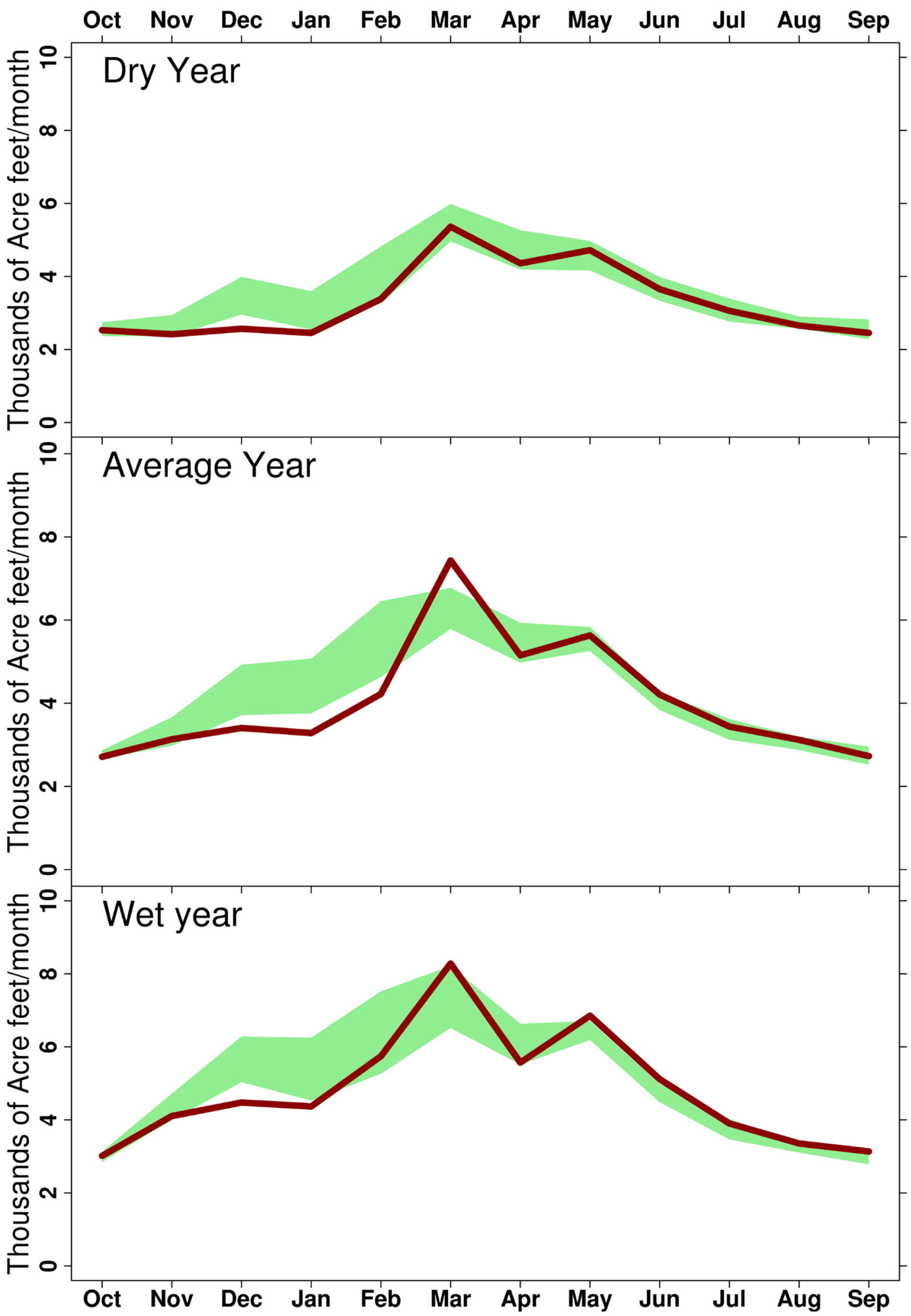
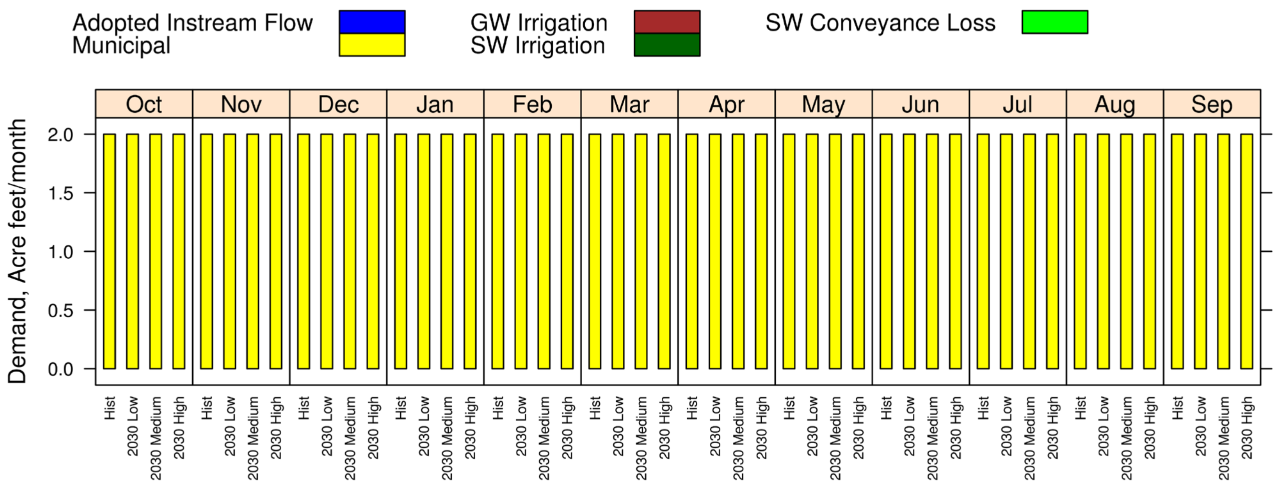


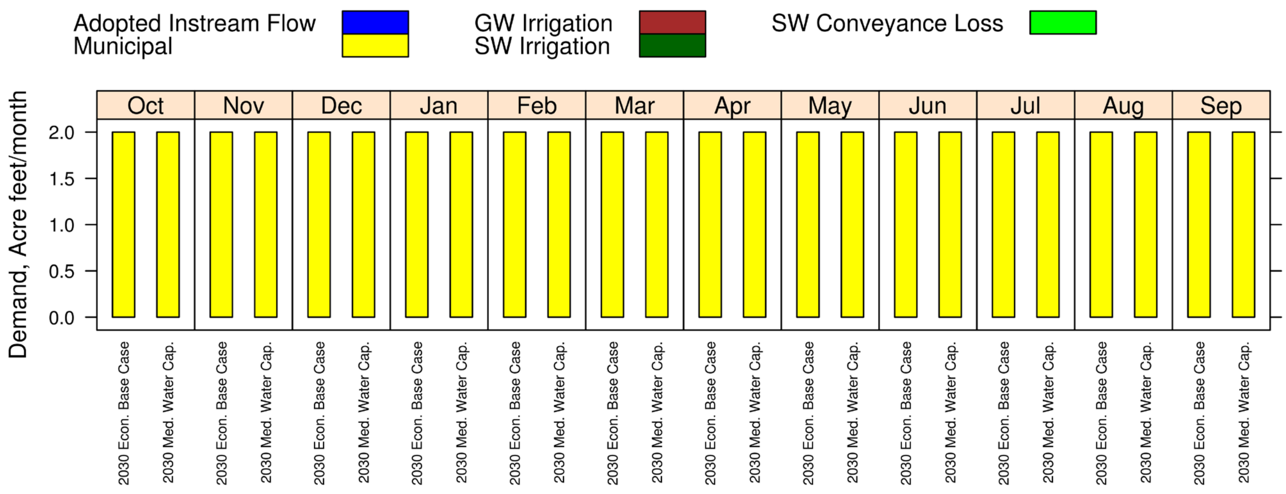
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

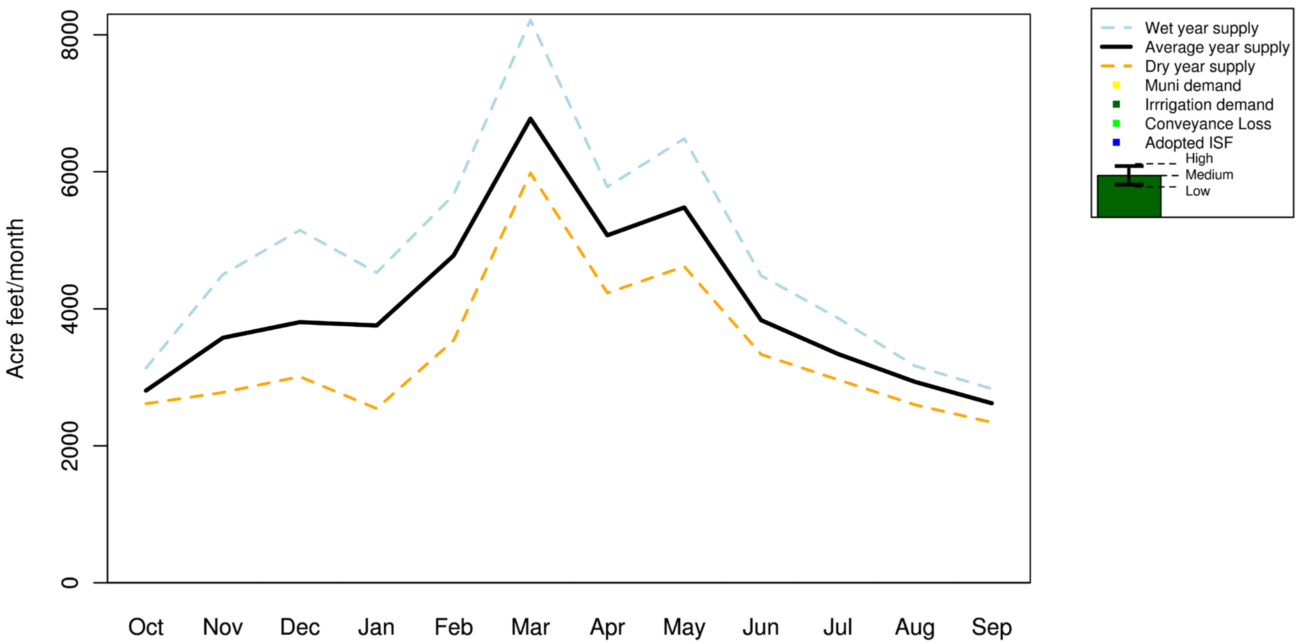
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Sanpoil is characterized mostly by increases from mid-fall through winter and slight decreases in average and wet years in late spring through early fall.

Both irrigation and municipal/domestic demands are quite small in this watershed. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase in some months and decrease in others, with little change in impacts when alternate future economic scenarios are considered. Municipal demands are forecasted to grow 25% by 2030.

If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply is projected to be sufficient to meet combined municipal and surface water irrigation demands at the watershed scale. Additional water supplies may be available from the Columbia River in a localized area of the watershed. Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

It is not known whether bull trout spawn or rear in the tributary waters of Sanpoil, and no other fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.

Management Context	
Adjudicated Areas	NO
Watershed Planning	NO
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Bull Trout spawning and rearing unknown
Groundwater Management Area	NO
Groundwater Studies	None found

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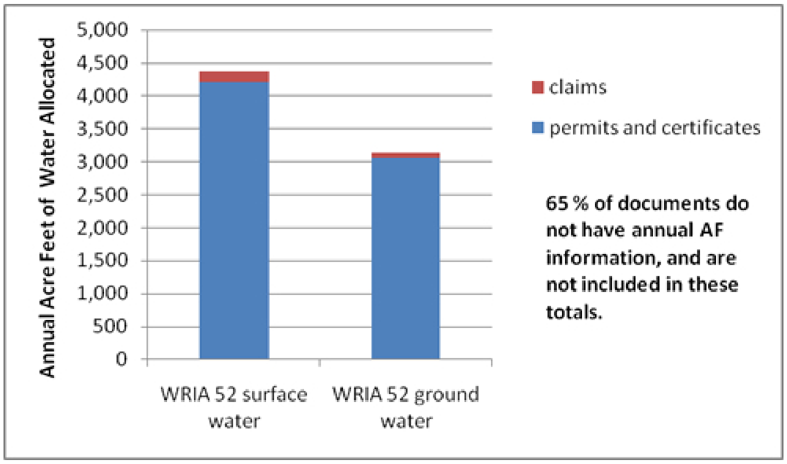

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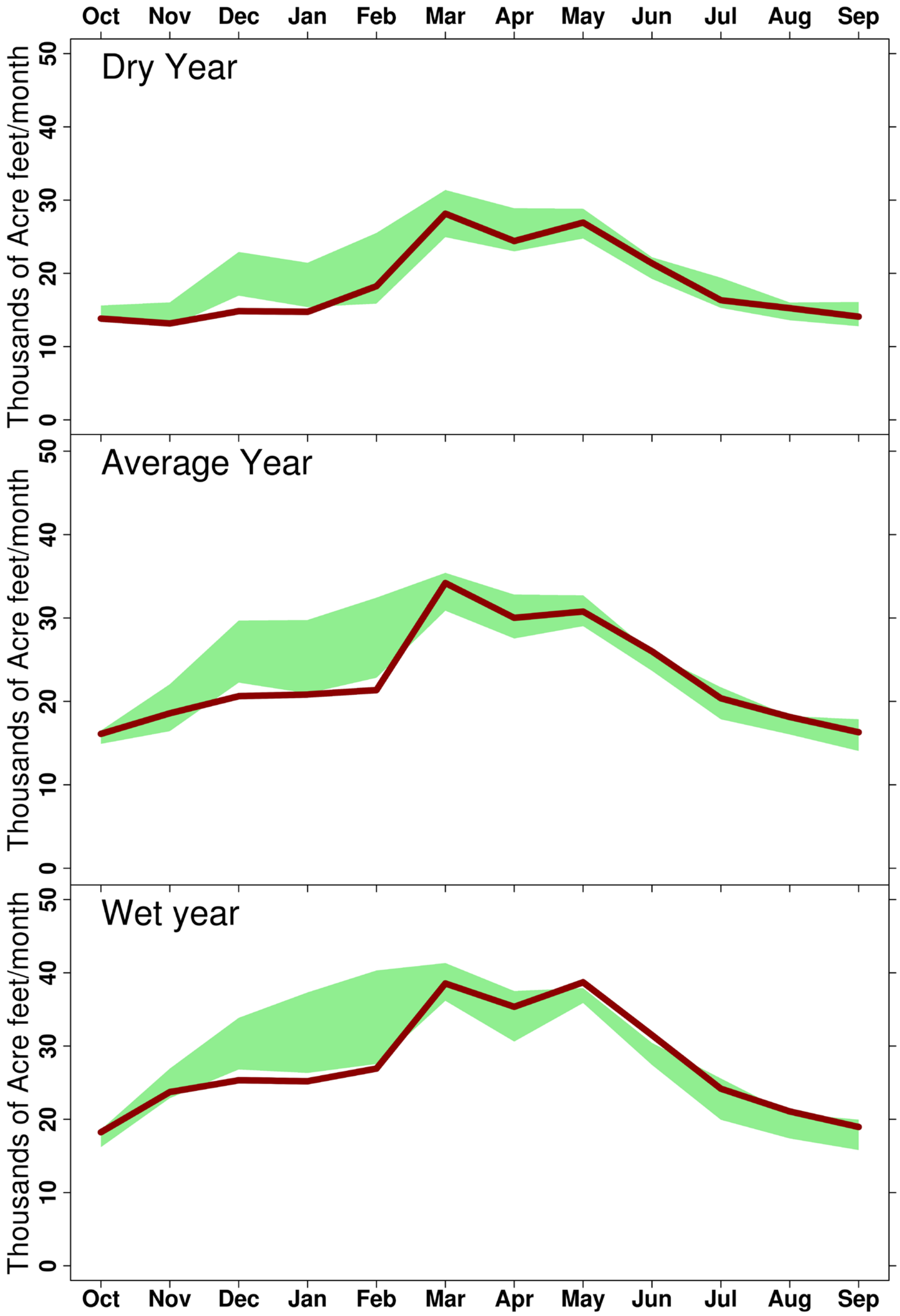
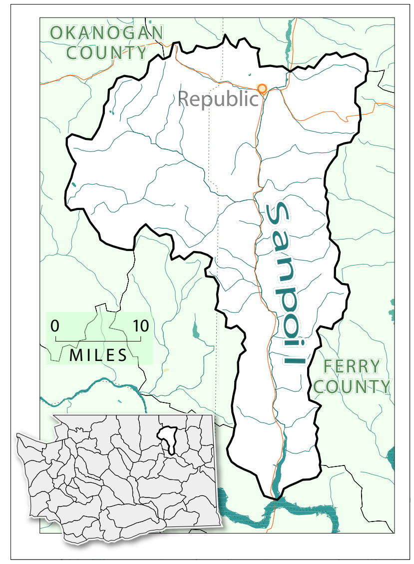
Supply





Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

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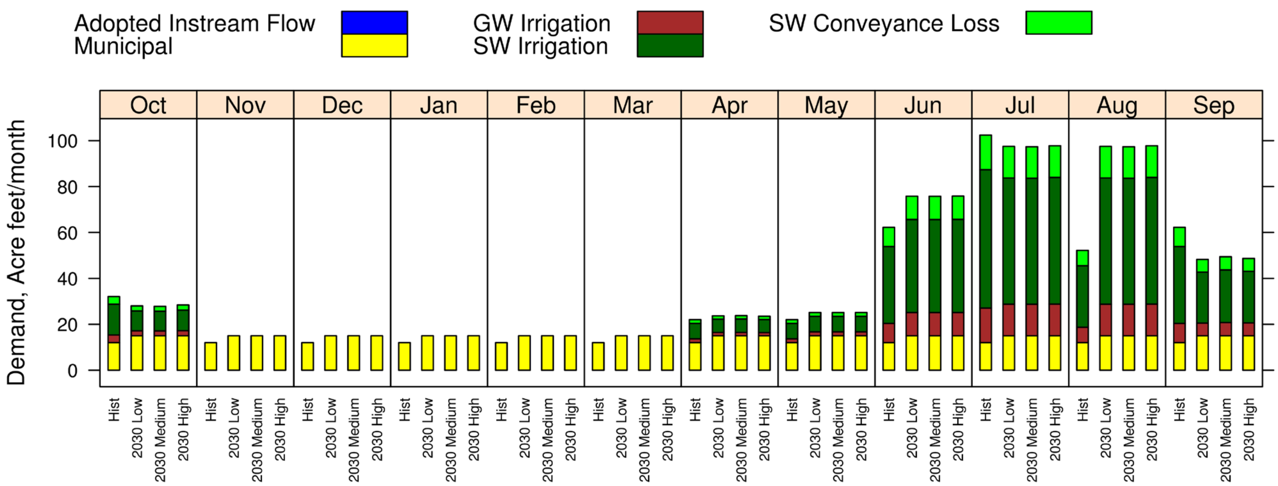

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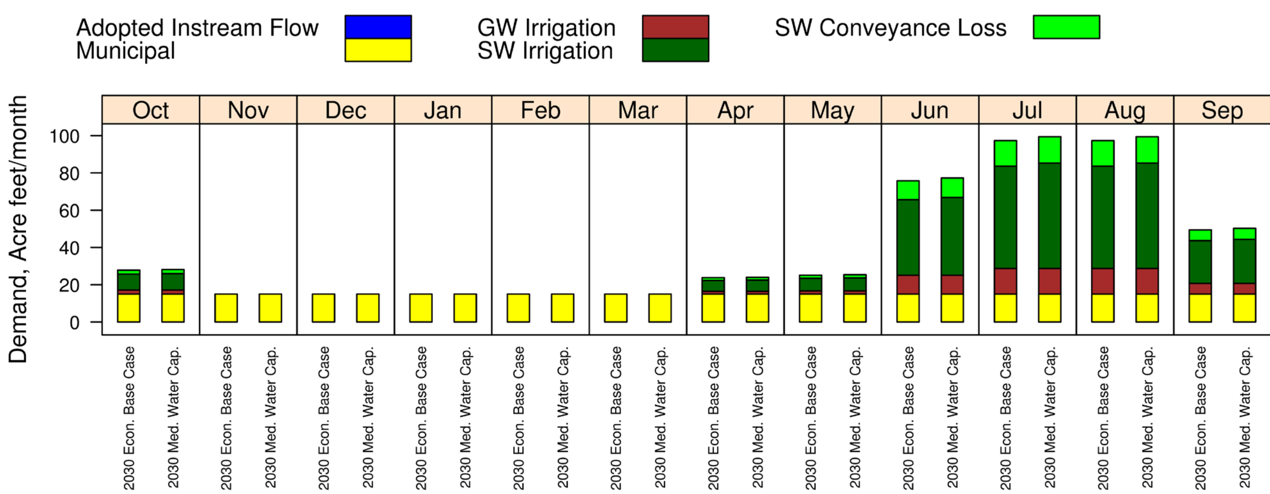
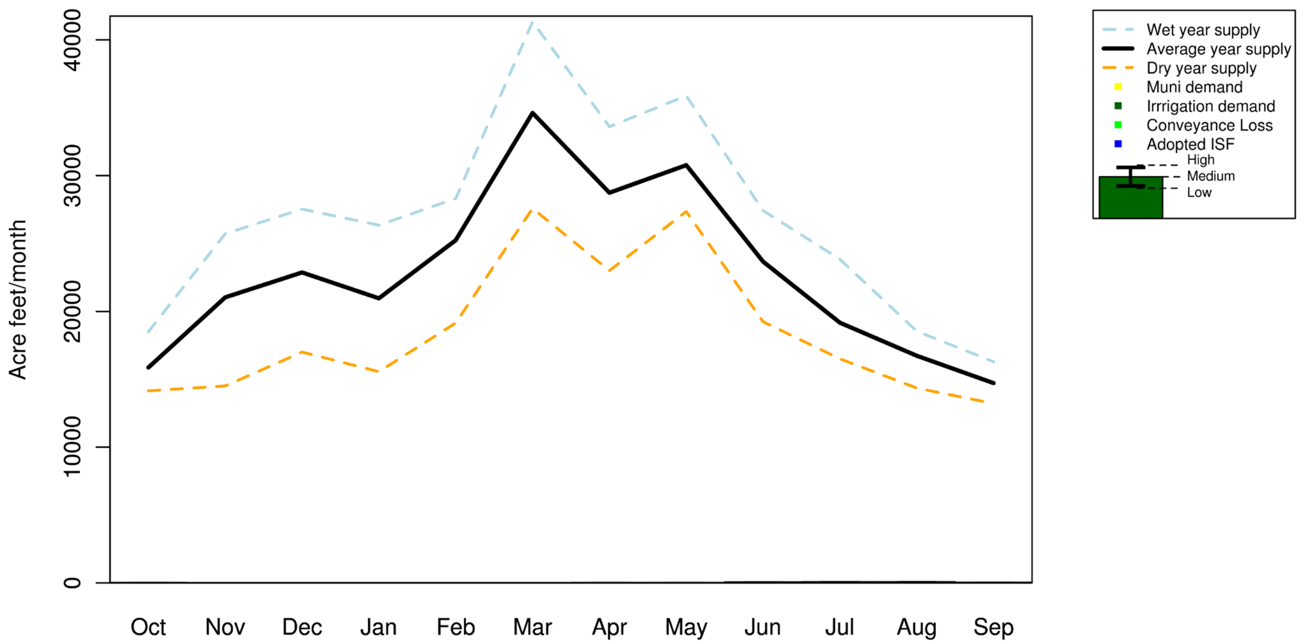


2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



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Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Lower Lake Roosevelt is characterized mostly by small increases from late fall through winter.

Irrigation is the primary source of demand, though overall demands are modest in comparison to other watersheds within eastern Washington. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase for some months by 2030, with modest differences in the magnitude of changes when alternate future economic scenarios are considered. Municipal demands are forecasted to grow by 24% by 2030.

If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply would be sufficient on its own to meet combined municipal and surface water irrigation demands at the watershed scale. Additional water supplies from the Columbia River are available to meet demands in some areas of the WRIA, and a separate analysis indicates that more than half of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

The Northeast Washington Bull Trout, listed under the Endangered Species Act, spawn or rears in tributary waters of this watershed.

Management Context	
Adjudicated Areas	Hawkes Creek (incomplete)
Watershed Planning	Phase 2 (Assessment)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Northeast Washington Bull Trout
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

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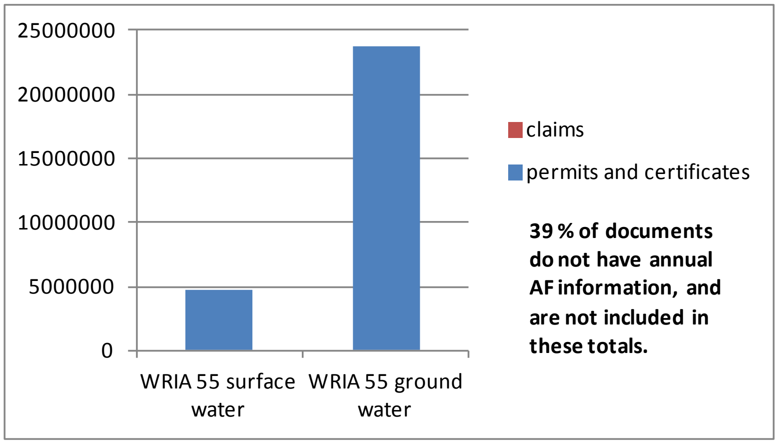

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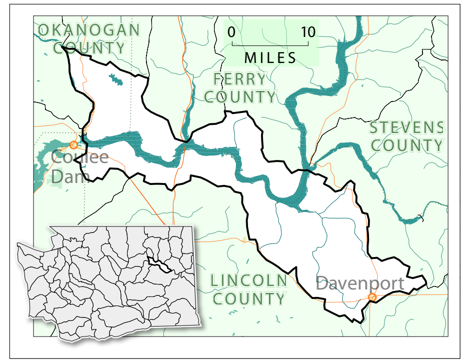
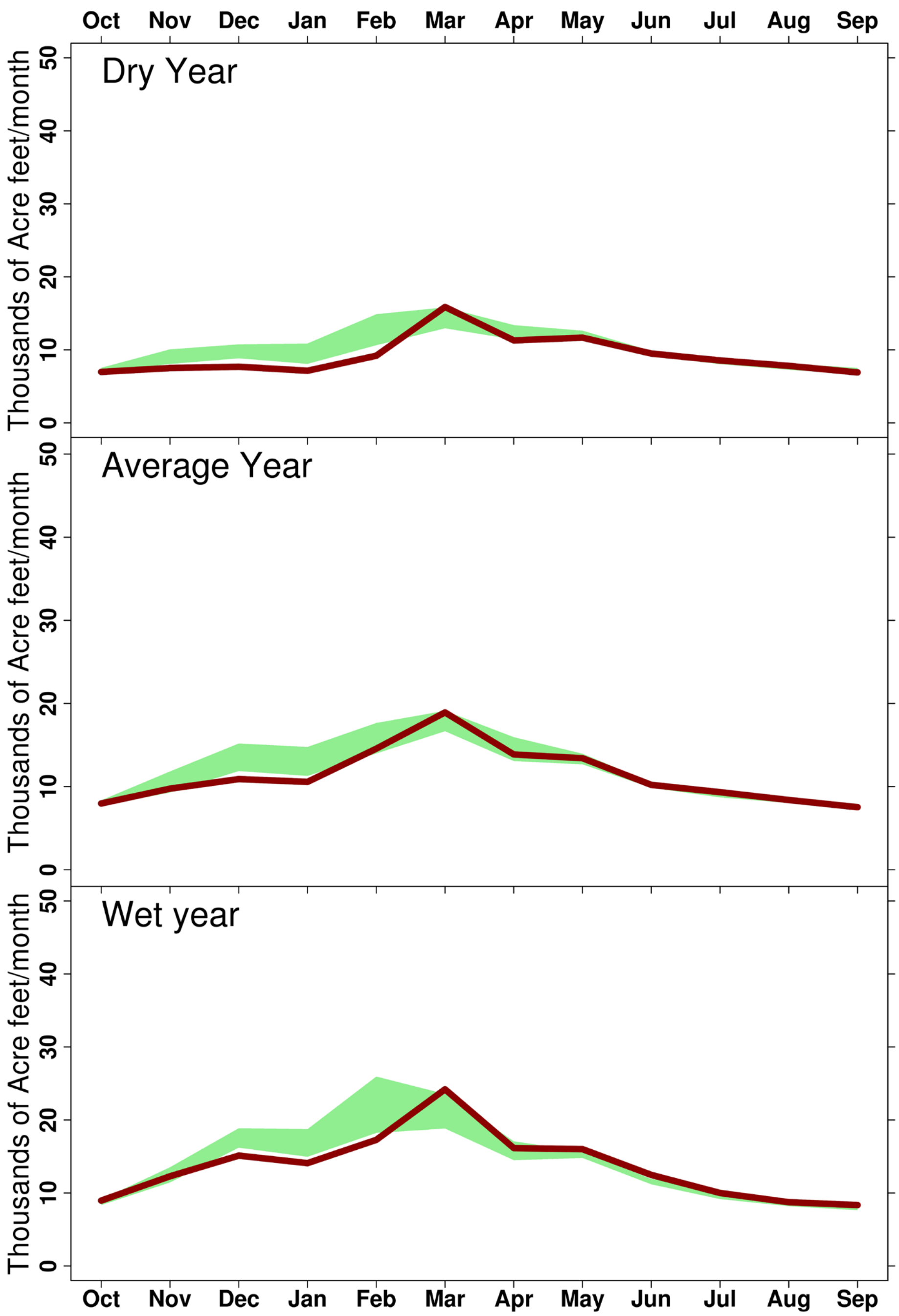
Supply





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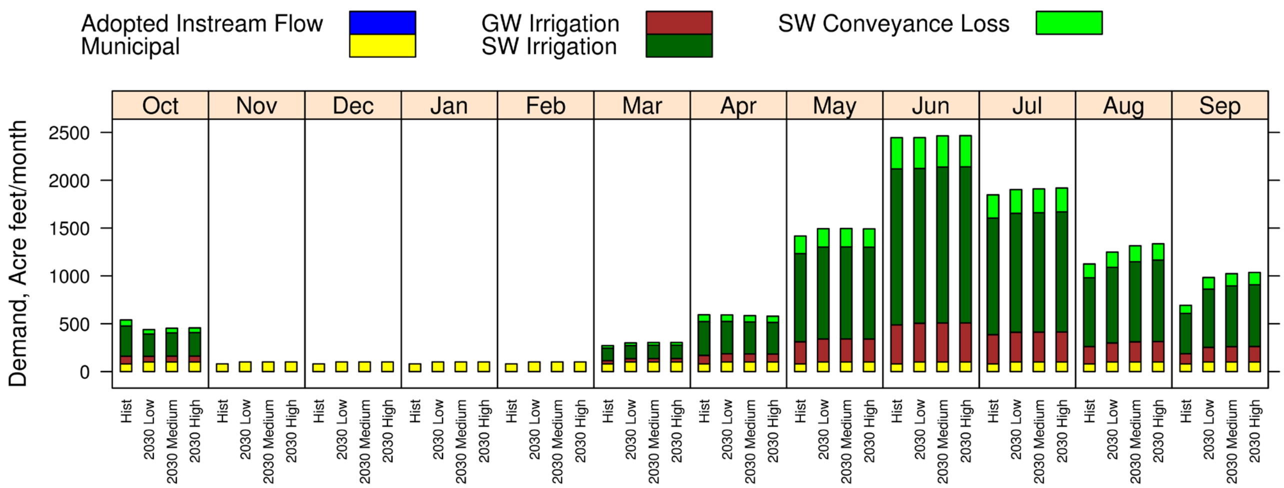
Demand



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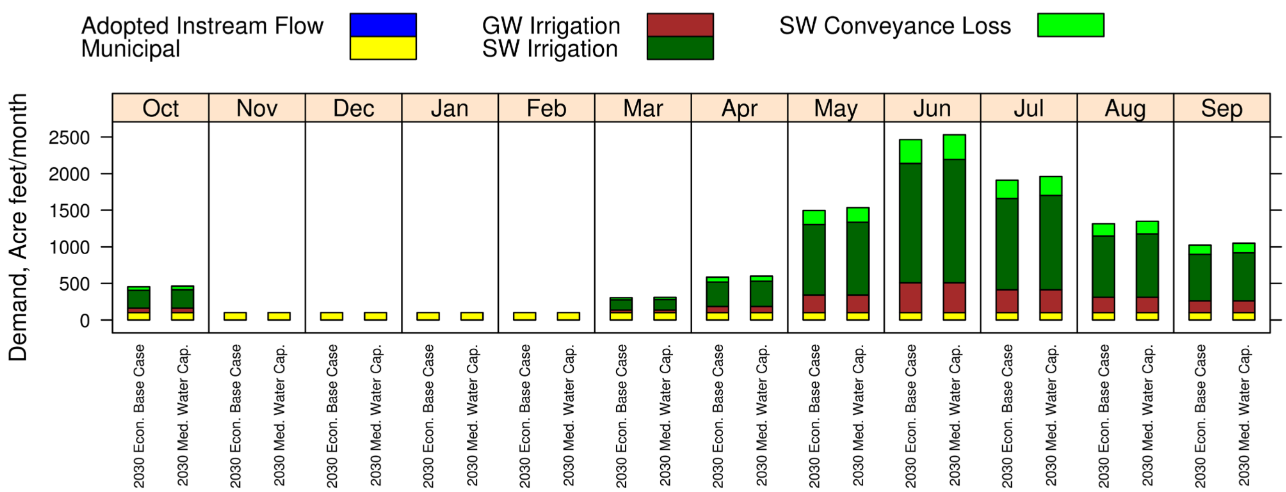

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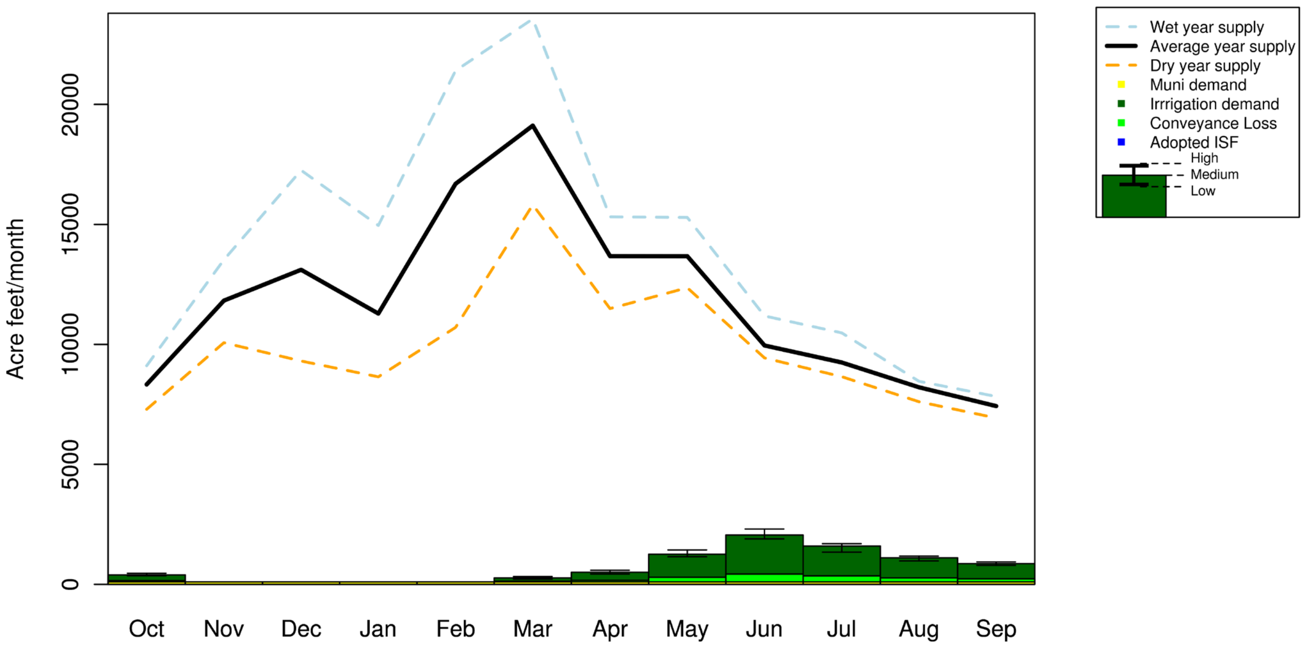

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Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Lower Spokane is characterized mostly by increases from late fall through early spring.

Irrigation demands are larger than municipal demands in this watershed, though they are relatively modest overall. Assuming no change in irrigated acreage, irrigation demand is projected to increase in many months in the future, but decrease in others. The magnitude of change is similar across all future economic scenarios. Municipal demand is forecasted to increase by 32% by 2030.

If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply is projected to be sufficient to meet combined municipal and surface water irrigation demands at the watershed scale. Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

It is not known whether bull trout spawn or rear in the tributary waters of the Lower Spokane, and no other fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.

Management Context	
Adjudicated Areas	Chamokane Creek (incomplete)
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Bull Trout spawning and rearing unknown
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

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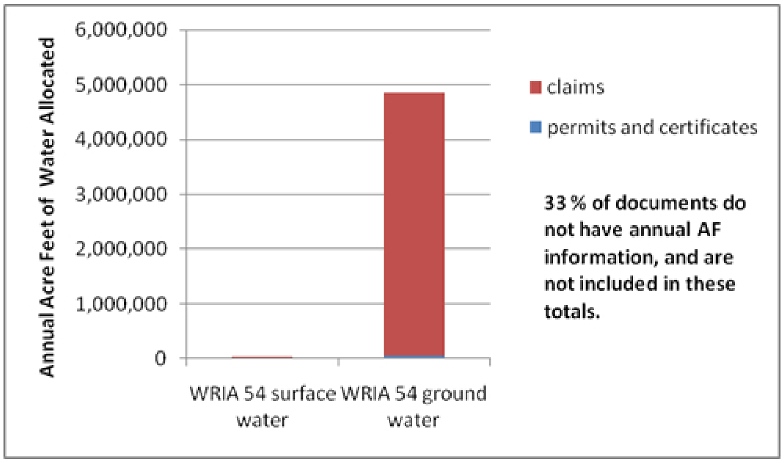

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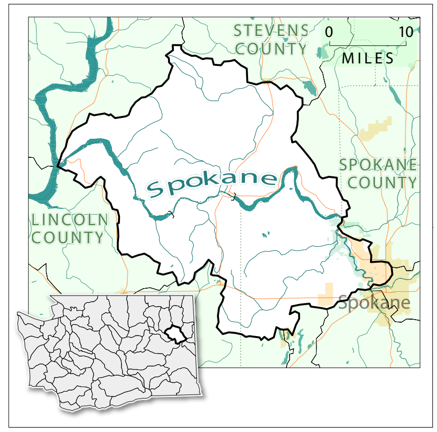
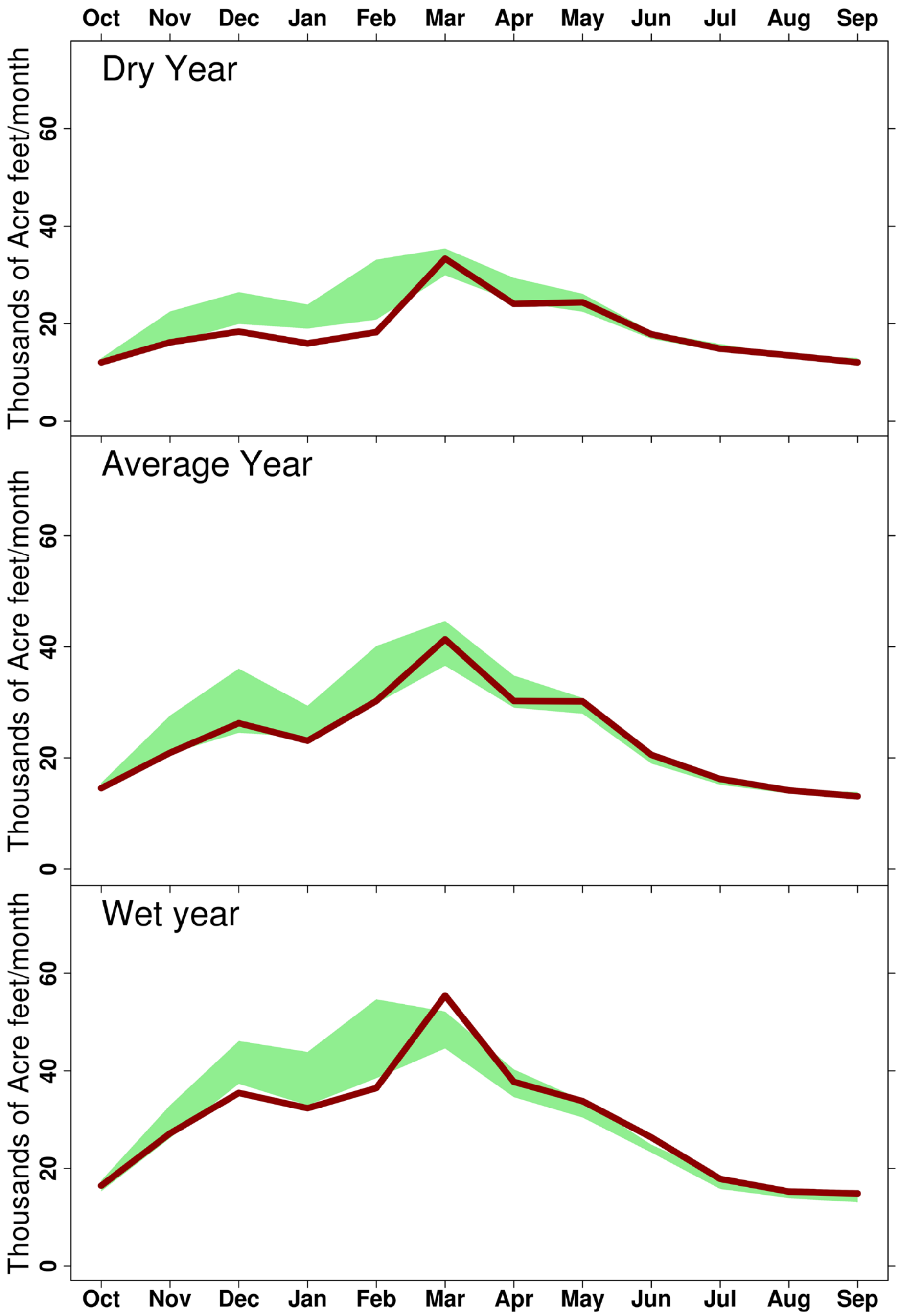
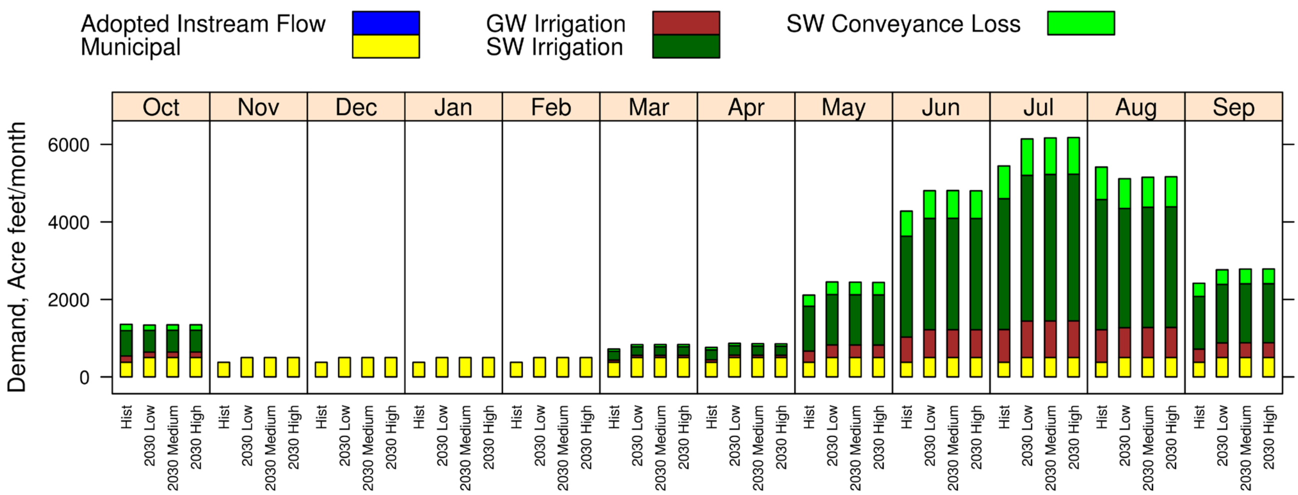


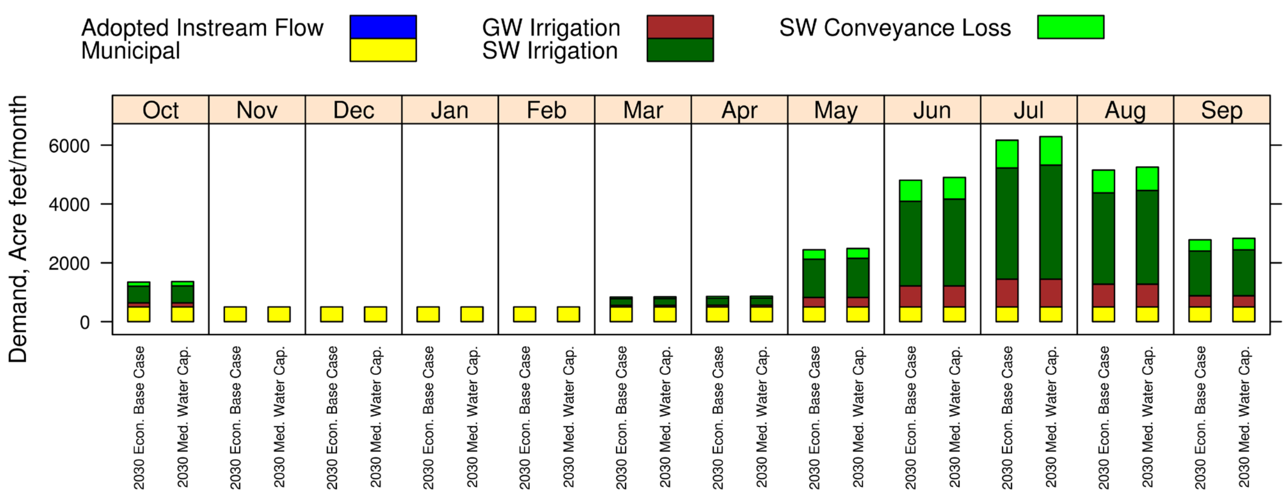


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

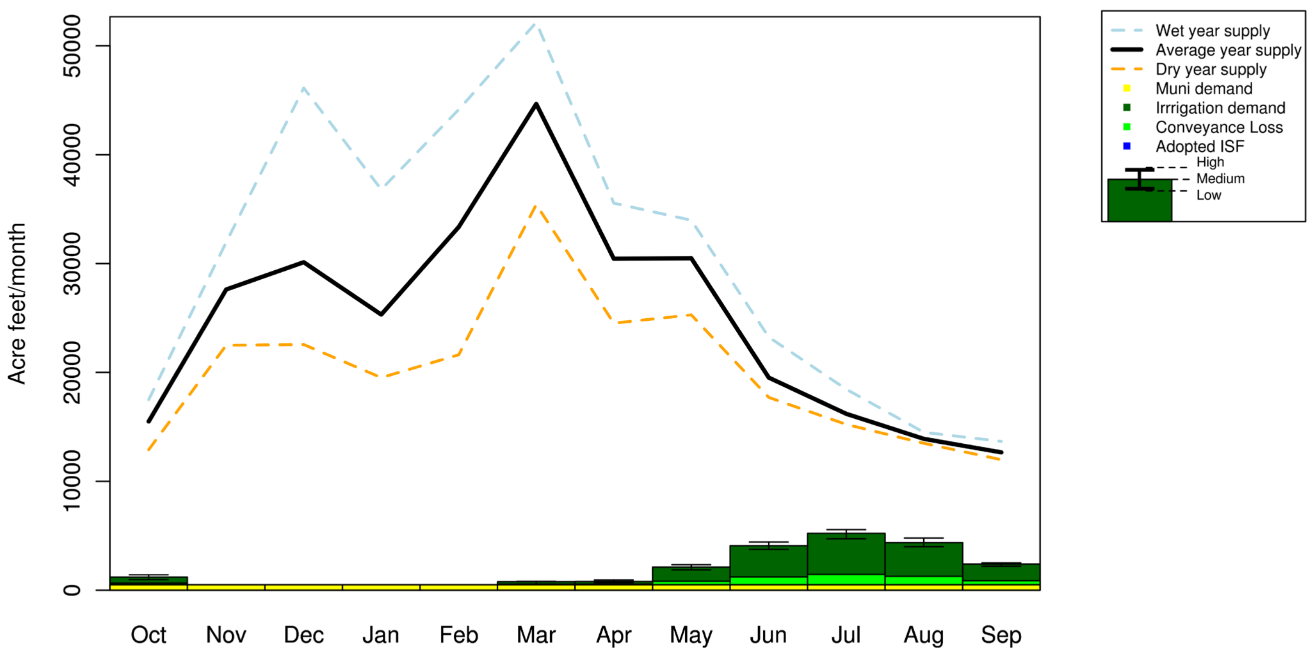
Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Little Spokane is characterized mostly by increases from the fall through early spring, and smaller decreases in summer and early fall under average and wet flow conditions.

Instream flow requirements are the largest water demands in Little Spokane. Municipal demands are larger than in many other watersheds of eastern Washington, exceeding irrigation demand. Adopted instream flows are shown by the instream flow requirements for the Little Spokane confluence, as specified in Chapter 173-555 WAC, for both the historical and future period. Municipal demand is projected to increase by 13% by 2030. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase modestly in many months in the future, with impacts that varied only slightly in magnitude between the alternate future economic scenarios considered.

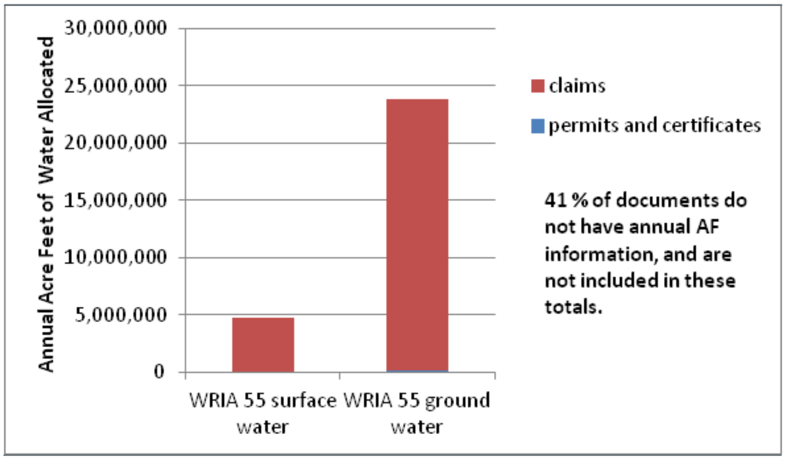
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, at the watershed scale, combined municipal and surface water irrigation demands and adopted instream flows are projected to outstrip unregulated tributary supply generated within the Washington portion of the watersheds during most years for May through February and year-round under low flow conditions. Modeling of curtailment of interruptible irrigation water rights indicated that it occurred in every year between 1977 and 2005. The resulting unmet demand ranged from 1,130 to 3,541 ac-ft per year depending on yearly flow conditions, with an average of 2,503 ac-ft per year. Simulation of future curtailment occurred in all the years for the middle climate scenario. The resulting unmet demand per year ranged from 1,512 to 3,870 with an average of 1,512 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Although not shown here, unmet demands due to a failure to meet adopted instream flows are shown in the technical report. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

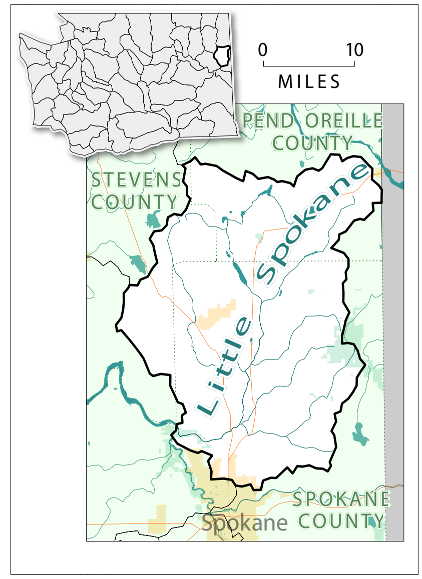
It is not known whether bull trout spawn or rear in the tributary waters of these watersheds, and no other fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.

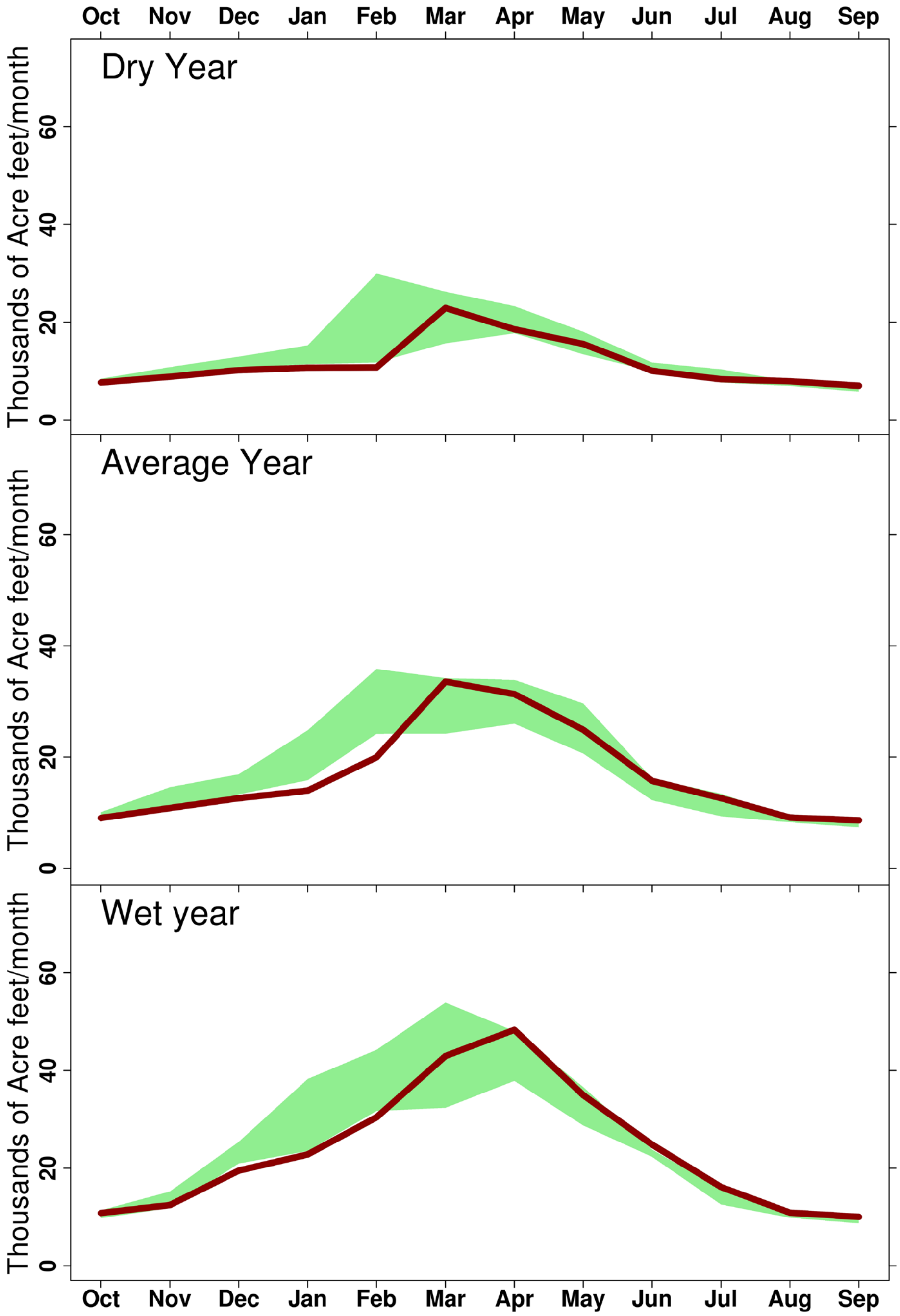
Management Context	
Adjudicated Areas	Deadman Creek Bigelow Gulch Creek
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	YES (Chapter 173-555 WAC)
Fish Listed Under the Endangered Species Act[1]	Bull Trout spawning and rearing unknown
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.

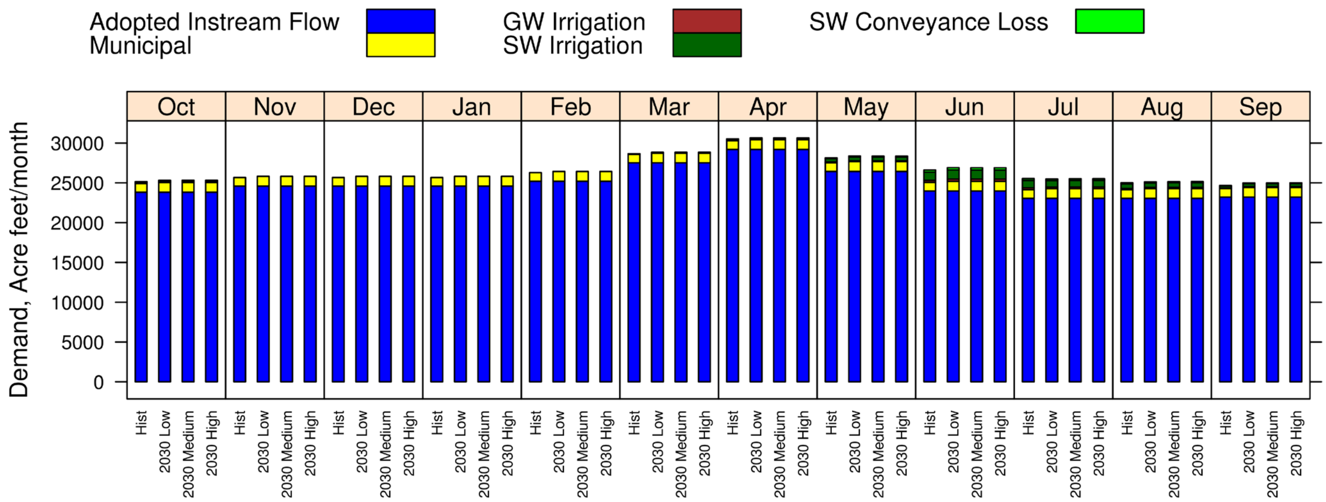




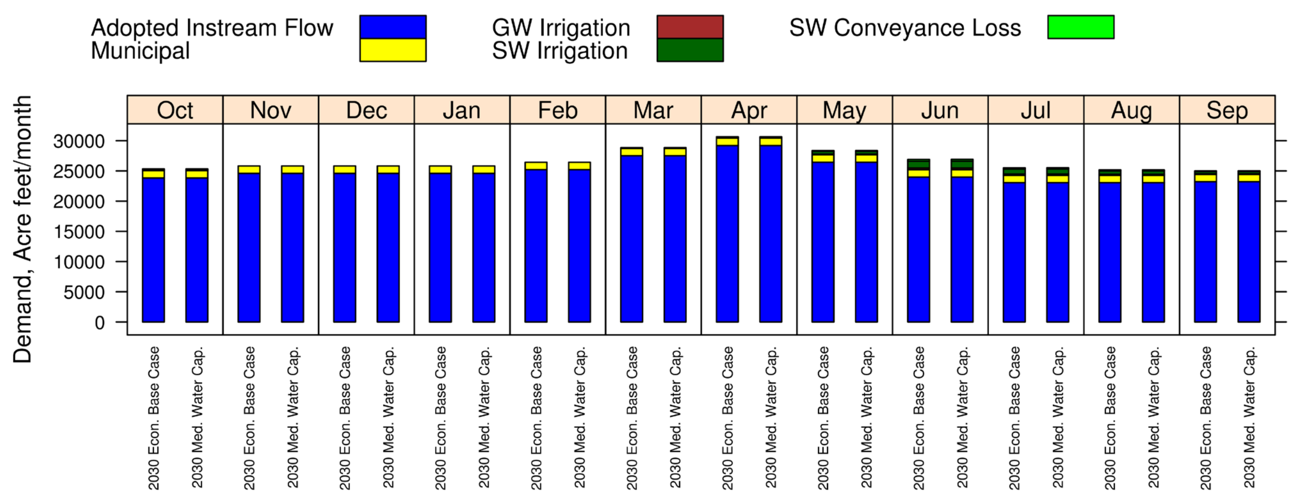
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

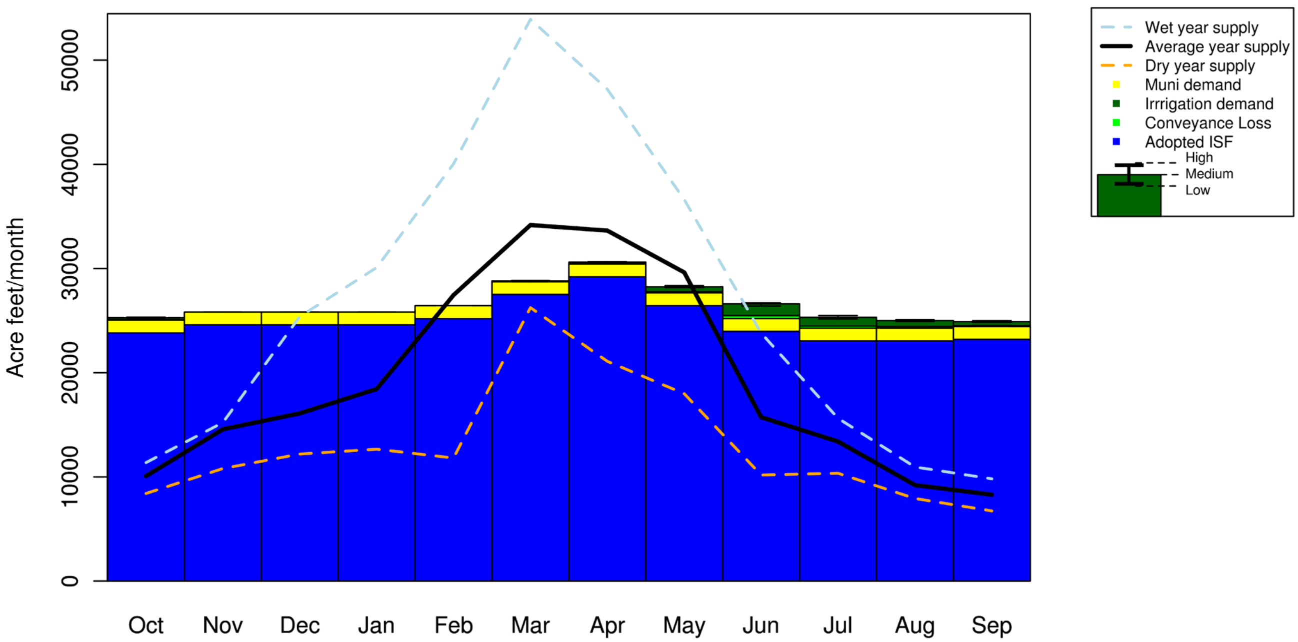
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Hangman is characterized mostly by substantial increases in late fall and winter.

Unlike many other watersheds in eastern Washington, municipal demands are larger than irrigation demands in Hangman watershed. Municipal demand is forecasted to grow 9% by 2030. Assuming no change in irrigated acreage, irrigation demand is forecasted to increase in most months (May through July and September), with little difference in the magnitude of impacts from the consideration of alternate future economic scenarios.

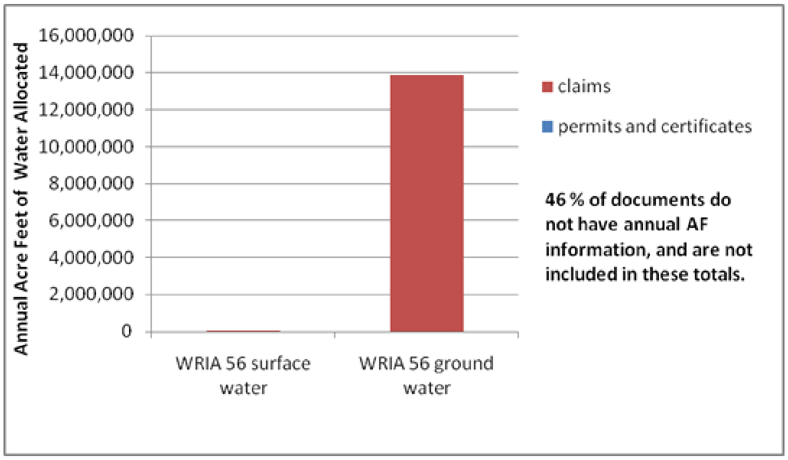
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is not anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will only increase demand in WRIAs where water is provided for new irrigated land.

In 2030, at the watershed scale, combined municipal and surface water irrigation demand is projected to outstrip unregulated tributary supply generated within the Washington portion of the watershed during most years for August and September, as well as July and October under some flow conditions. Upstream portions of WRIA 56 outside of Washington provide additional supplies, but may also have additional demands. Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

No fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.

Management Context	
Adjudicated Areas	Crystal Springs
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	No ESA-listed fish spawn or rear in WRIA waters
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



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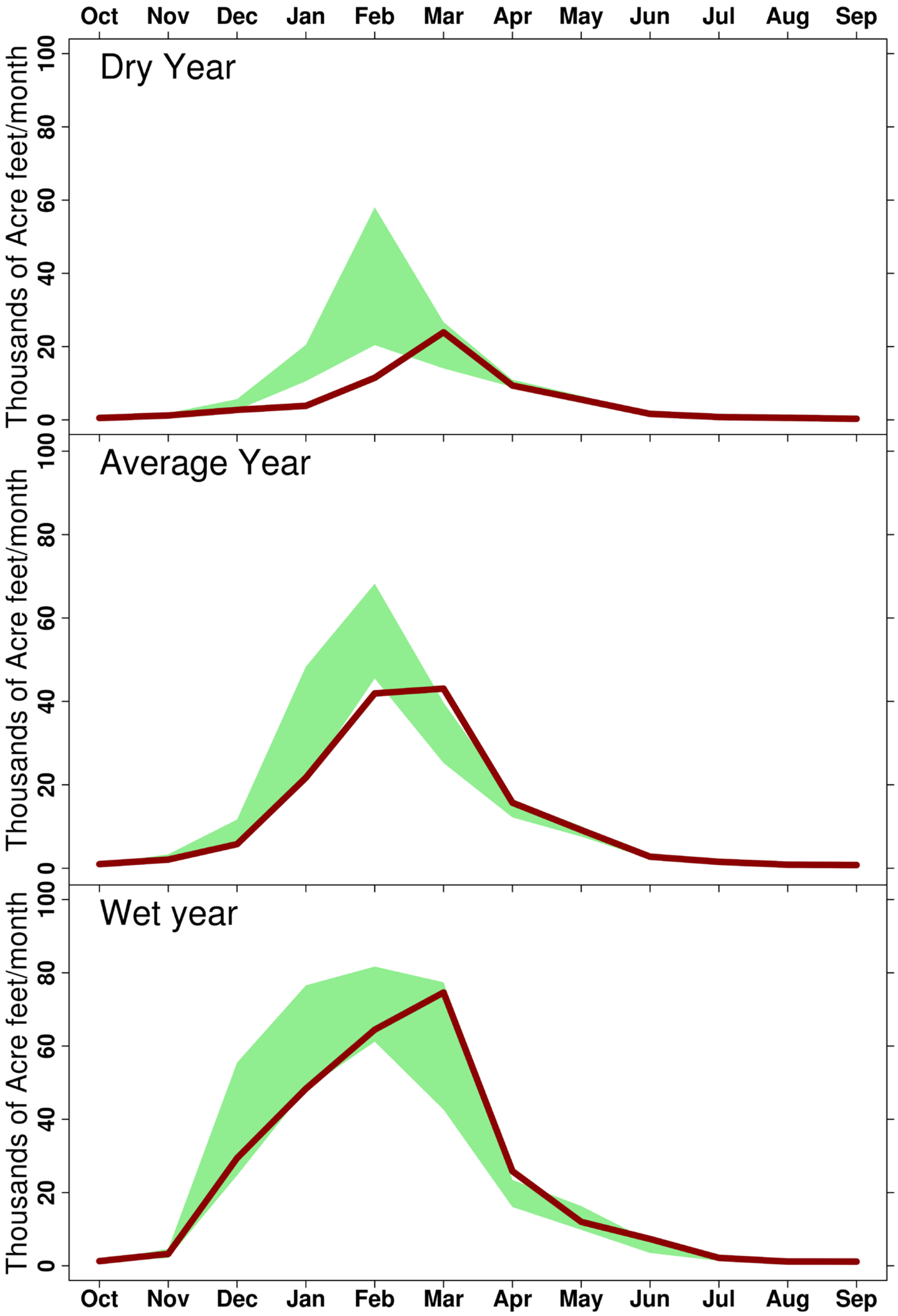
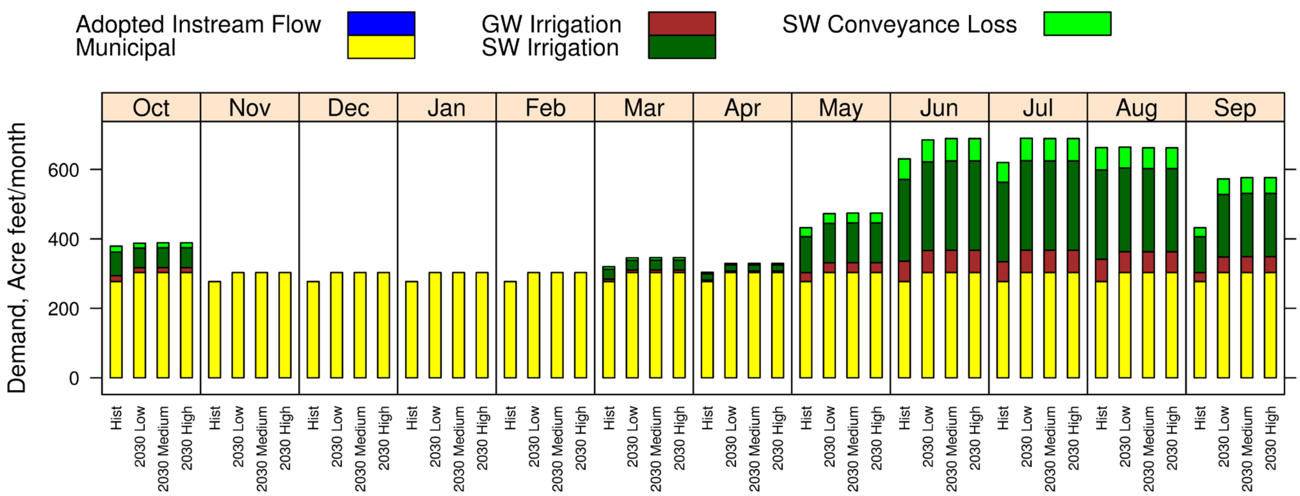


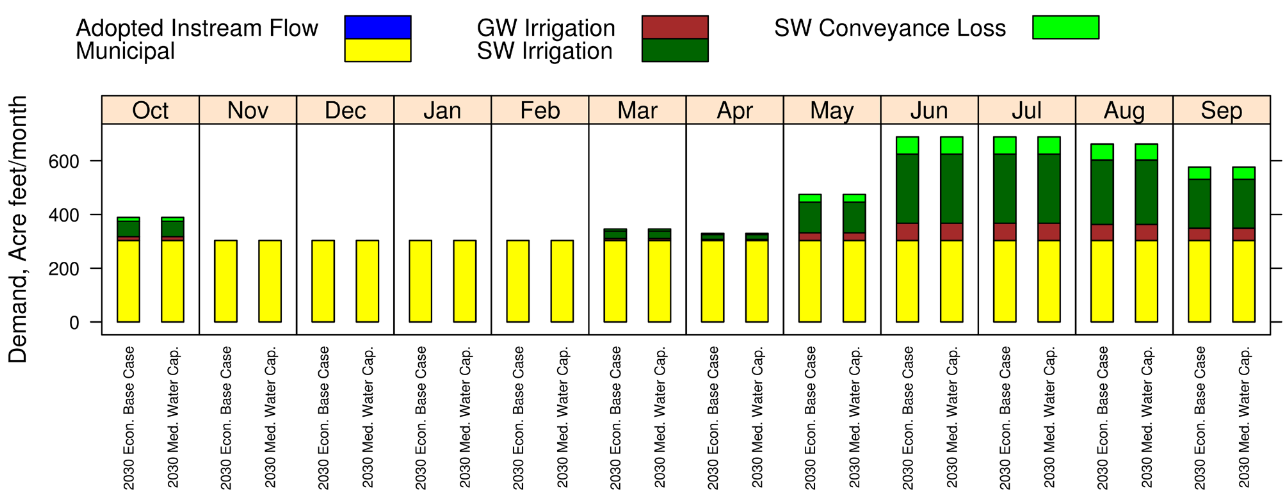
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

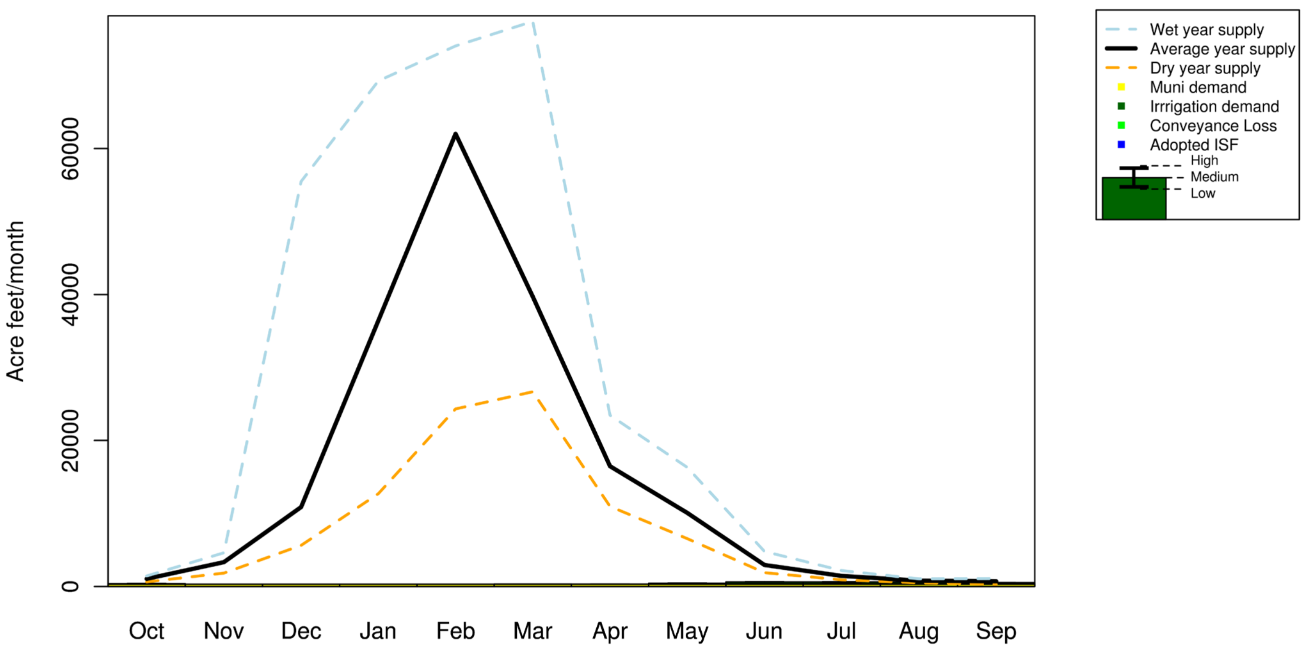
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Middle Spokane is characterized mostly by increases from late fall through early spring, and smaller decreases in summer and early fall.

Municipal demands are the largest source of water demand in this watershed, and are also larger than in any other WRIA of eastern Washington. Municipal demand is projected to increase by 34% by 2030. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase slightly in the fall, with little impact on the magnitude of change when alternate future economic scenarios were considered.

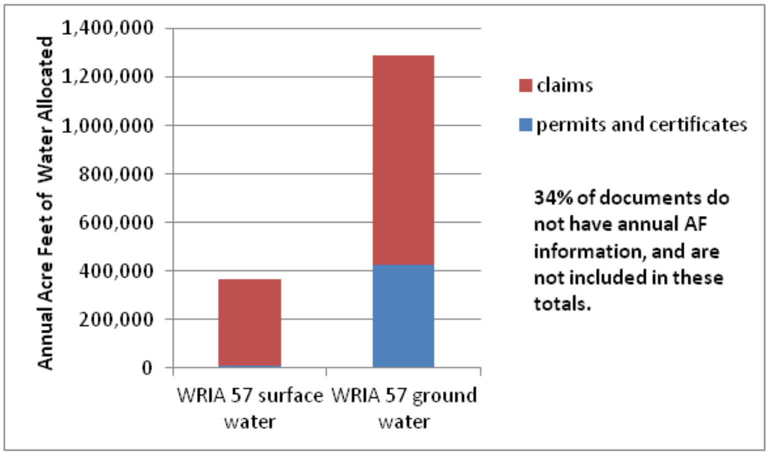
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is not anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will only increase demand in WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply generated within the Washington portion of the watershed is forecasted to be sufficient to meet combined municipal and surface water irrigation demand at the watershed scale. Upstream portions of WRIA 57 outside of Washington provide additional supplies, but may also have additional demands. Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

It is not known whether bull trout spawn or rear in the tributary waters of these watersheds, and no other fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.

Management Context	
Adjudicated Areas	NONE
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Bull Trout spawning and rearing unknown
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



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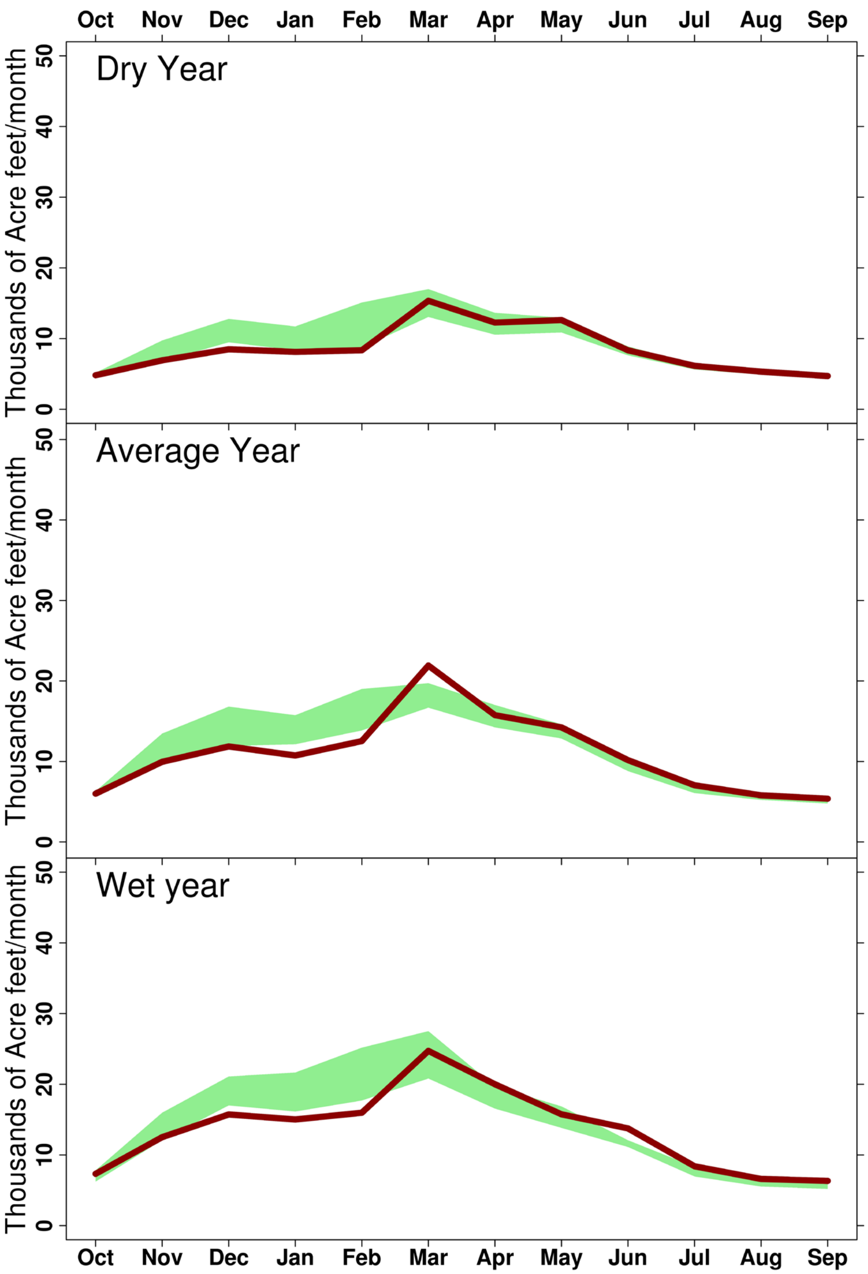
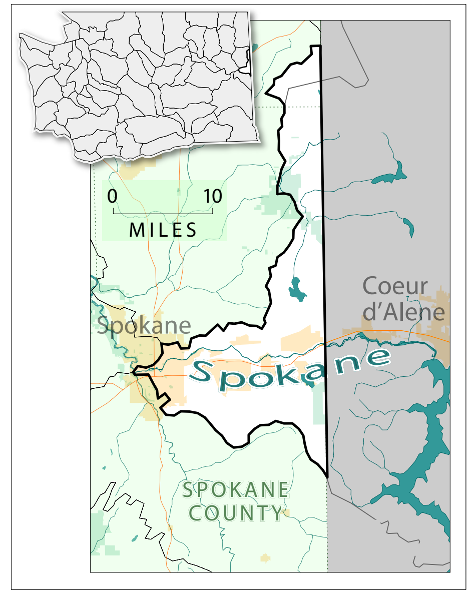
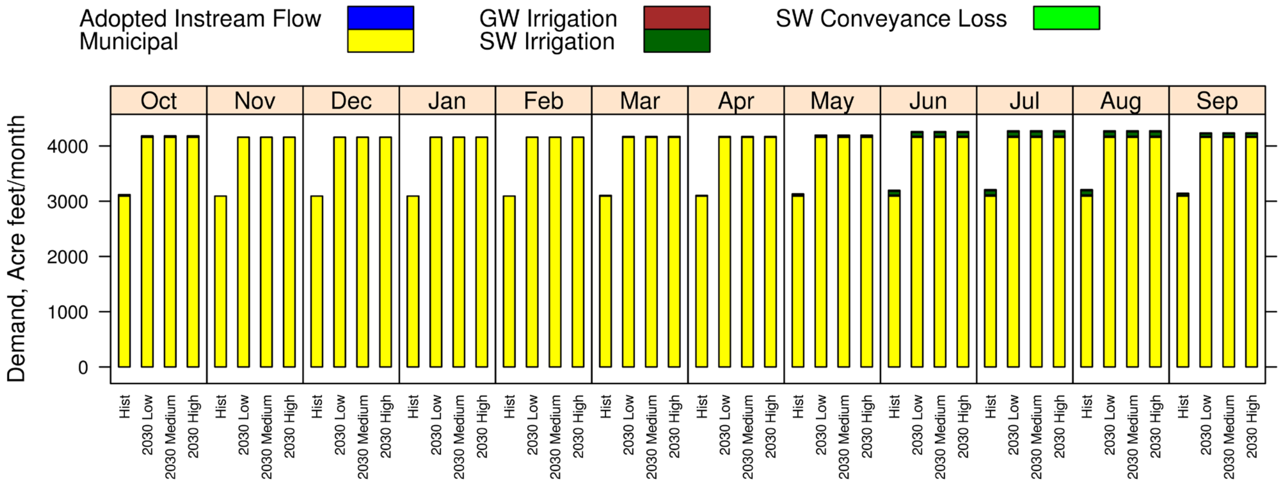
Supply



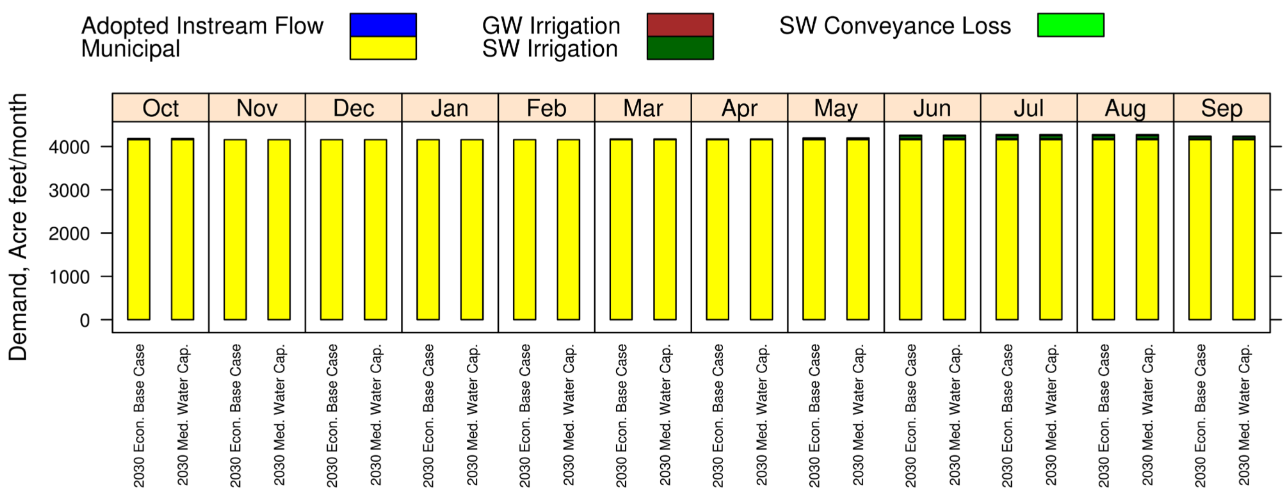


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

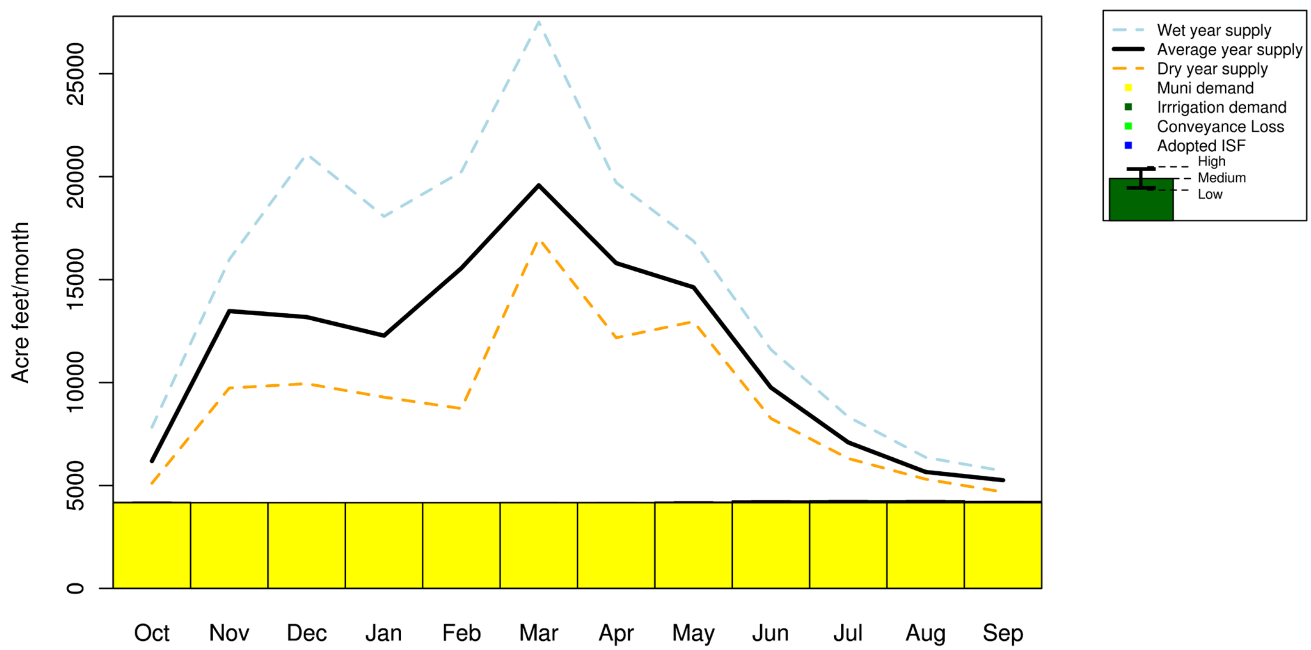
Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Middle Lake Roosevelt is characterized mostly by increases from late fall through winter, and smaller decreases in the spring and summer under average and wet flow conditions.

Irrigation is a larger source of demand than municipal demand, though both demands are modest in comparison to other watersheds within eastern Washington. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase somewhat in most months of the summer and fall by 2030, with little impact on the magnitude of change from consideration of alternate future economic scenarios. Municipal demand is forecasted to grow by 55% by 2030, though the total municipal demand will still be fairly small.

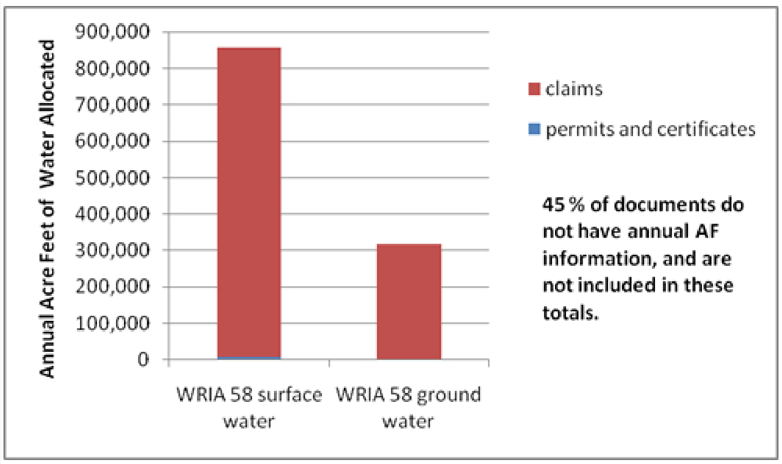
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply would be sufficient to meet combined municipal and surface water irrigation demand on its own at the watershed scale, though additional water supplies from the Columbia River are important in this watershed. A separate analysis indicates that roughly 85% of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

It is not known whether bull trout spawn or rear in the tributary waters of these watersheds, and no other fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.

Management Context	
Adjudicated Areas	Quillisascut Creek Cheweka Creek Jennings Creek Magee Creek Stranger Creek Harvey Creek Alder Creek O-Ra-Pak-En Creek Corus Creek Hunter Creek (incomplete)
Watershed Planning	NO
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Bull Trout spawning and rearing unknown
Groundwater Management Area	NO
Groundwater Studies	None found

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



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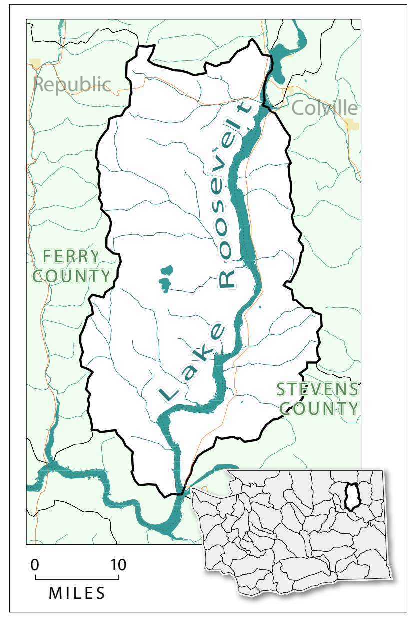
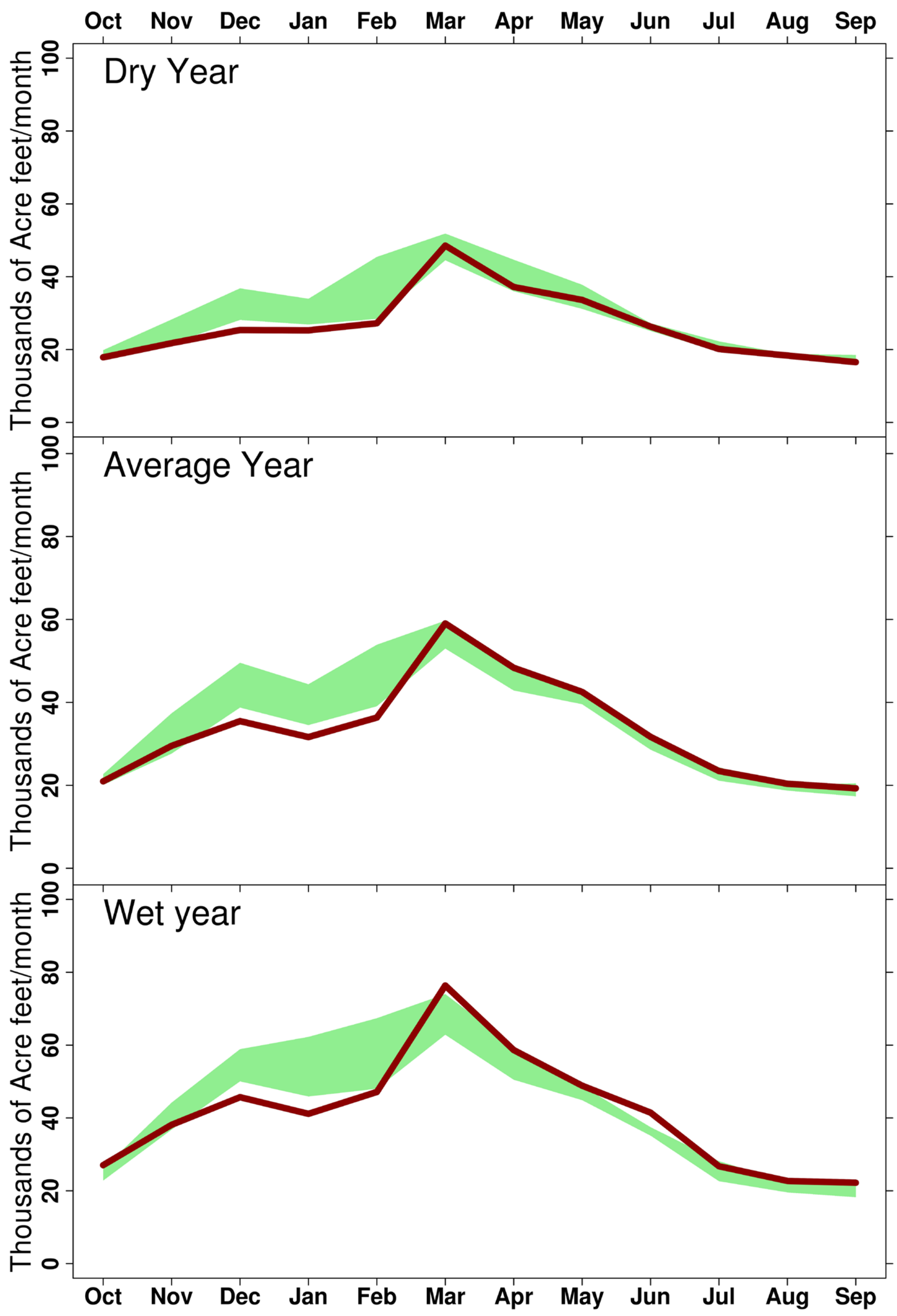
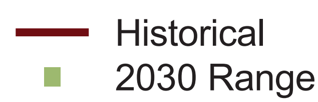
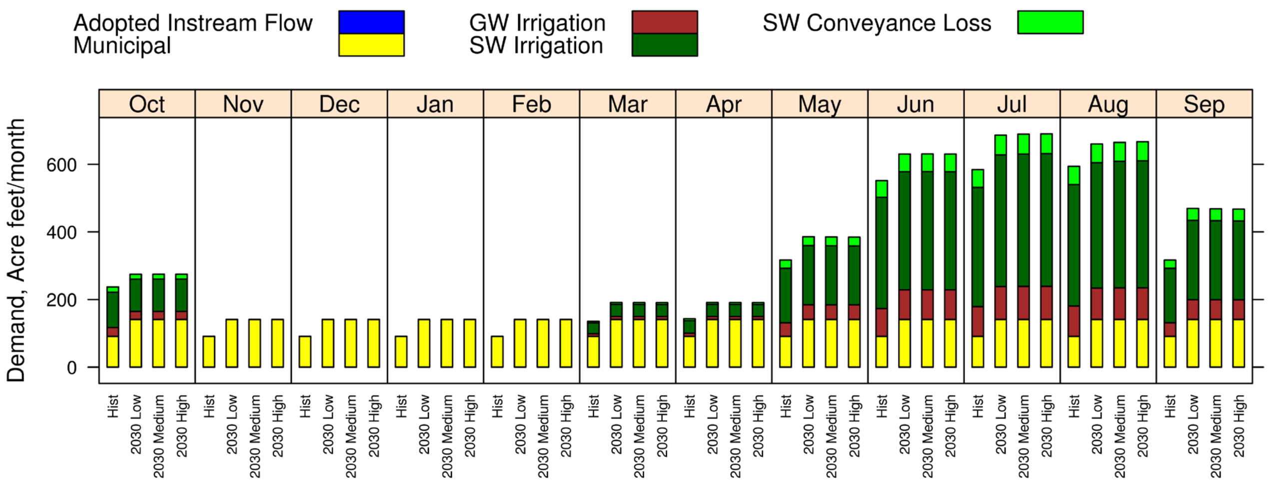




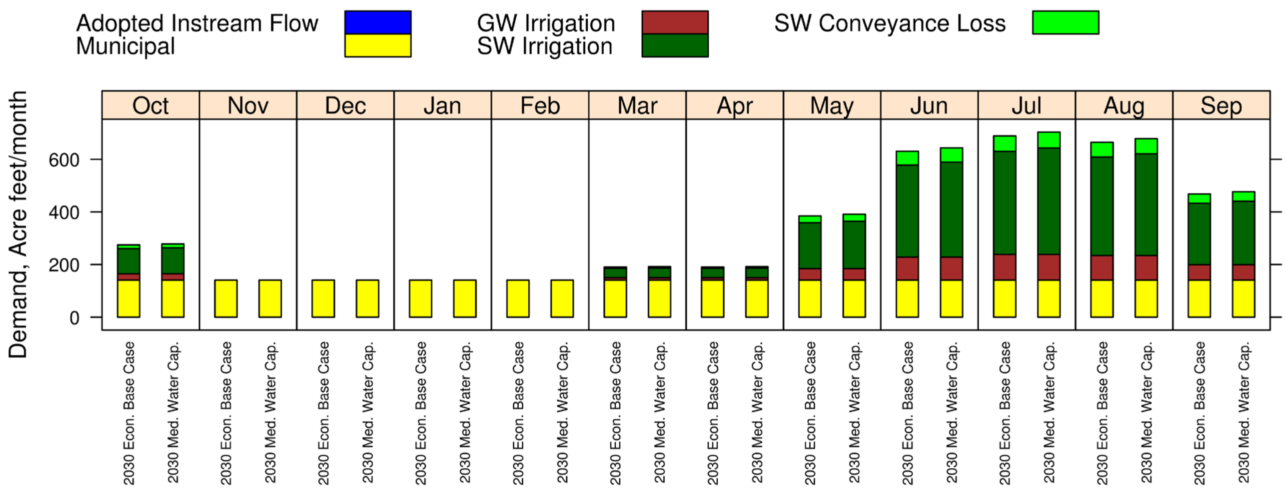


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

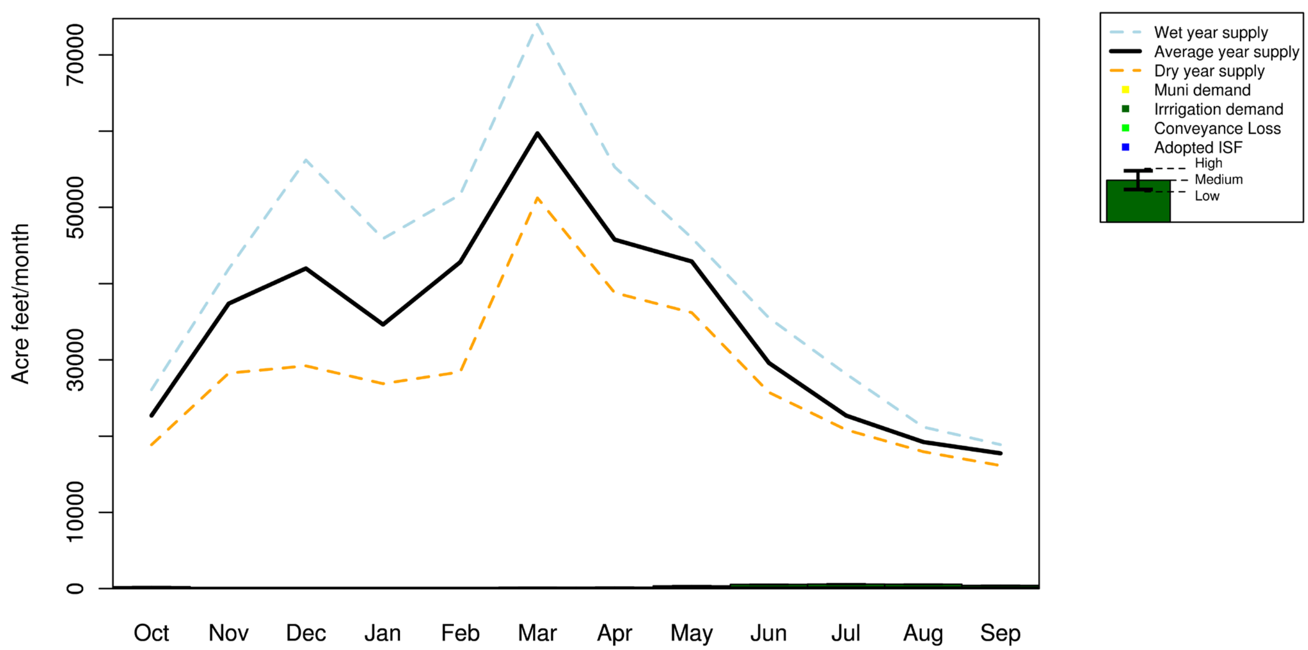
*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Colville is characterized mostly by substantial increases from late fall through mid spring, and small decreases in May and June, extending through the summer and early fall under average and wet conditions.

The primary demands are instream flow requirements and irrigation, with municipal demands that are fairly small. Adopted instream flows are shown by the instream flow requirements for the lower Colville River at river mile 5, as specified in Chapter 173-559 WAC, for both the historical and future period. Assuming no change in irrigated acreage, irrigation demand is projected to increase in most months in the future, with little difference in the magnitude of change between the various future economic scenarios considered. Municipal demands are forecasted to grow by roughly 56% by 2030, though the resulting demand will still be modest in comparison to other WRIAs of eastern Washington.

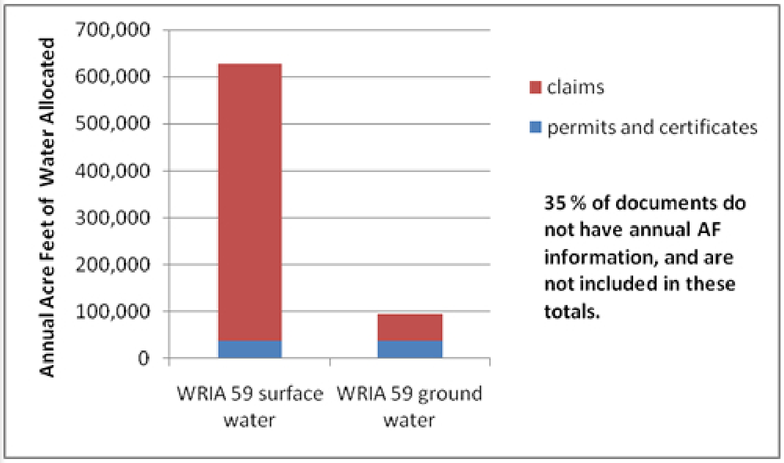
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, combined municipal and surface water irrigation demands and adopted instream flows are projected to outstrip unregulated tributary supply at the watershed scale during most years for August and September, and in some years for June, July, and October. Additional water supplies may be available from the Columbia River in a localized area of the watershed. Modeling of curtailment of interruptible irrigation water rights indicated that it occurred in 80% of years between 1977 and 2006. The resulting unmet demand ranged from 233 to 11,187 ac-ft per year depending on yearly flow conditions, with an average of 3,490 ac-ft per year. Simulation of future curtailment occurred in 93% of years for the 2030s middle climate scenario. The resulting unmet demand per year ranged from 738 to 12,829 with an average of 4,807 ac-ft per year. Due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Although not shown here, unmet demands due to a failure to meet adopted instream flows are shown in the technical report. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

It is not known whether bull trout spawn or rear in the tributary waters of these watersheds, and no other fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.

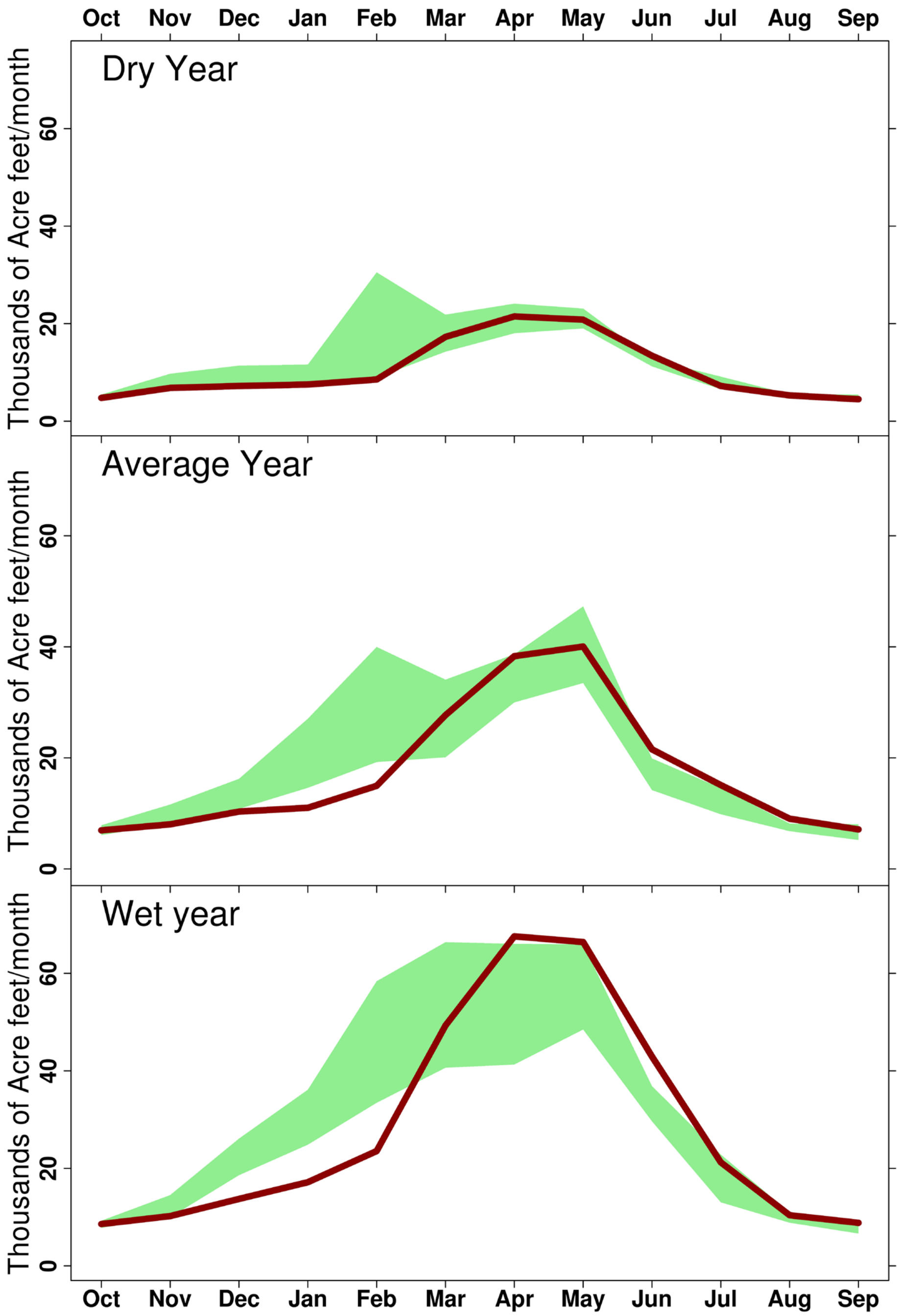
Management Context	
Adjudicated Areas	Narcisse Creek Chewela Creek Thomason Creek Sherwood Creek Grouse Creek & Jumpoff Joe Bull Dog Creek Deer Creek Hoffman Creek Clugston Creek (incomplete)
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	YES (Chapter 173-559 WAC) (In most years, interruptible users not curtailed)
Fish Listed Under the Endangered Species Act[1]	Bull Trout spawning and rearing unknown
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

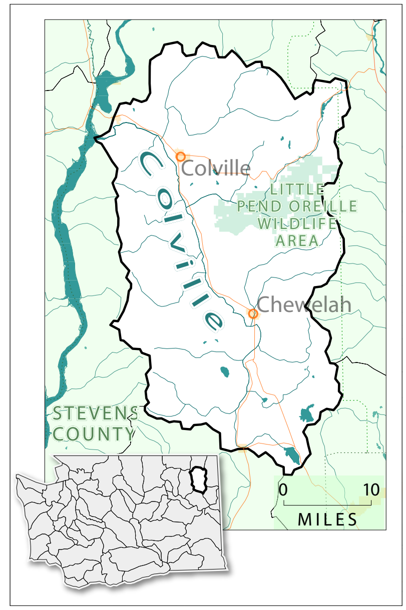
[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.

Supply

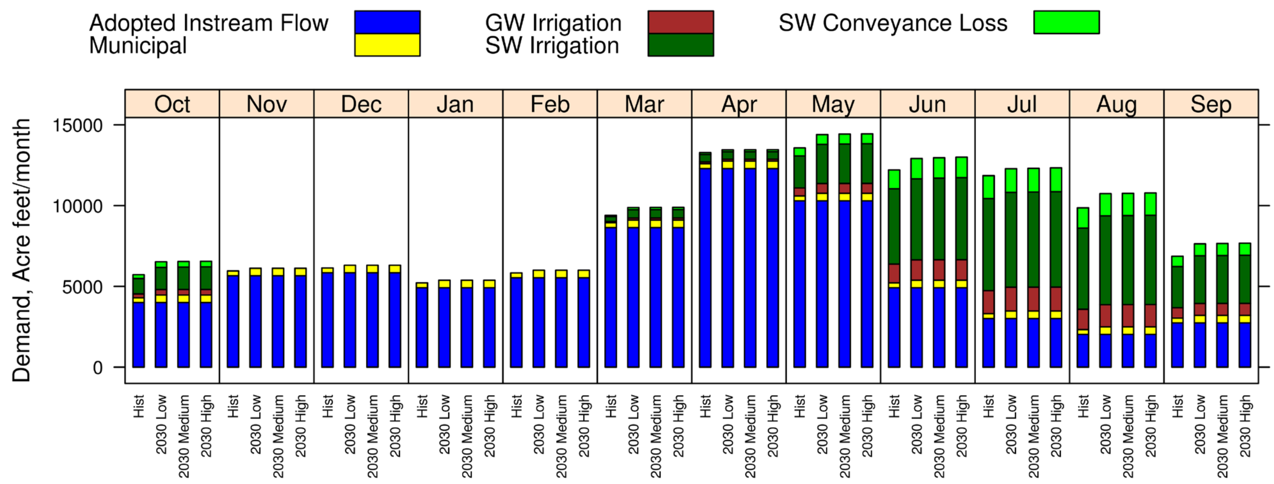




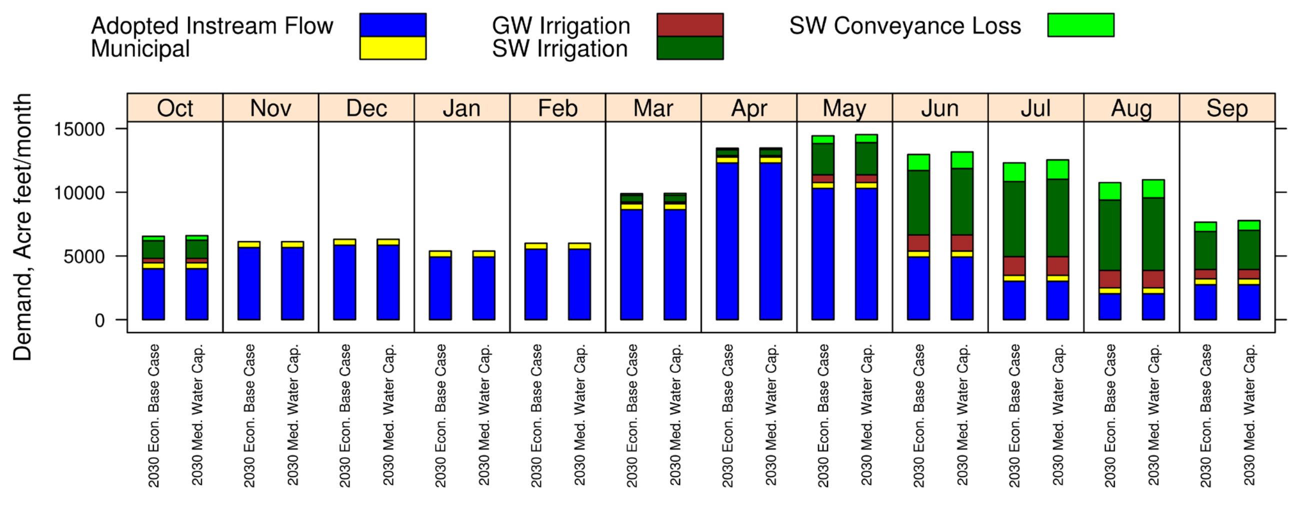
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

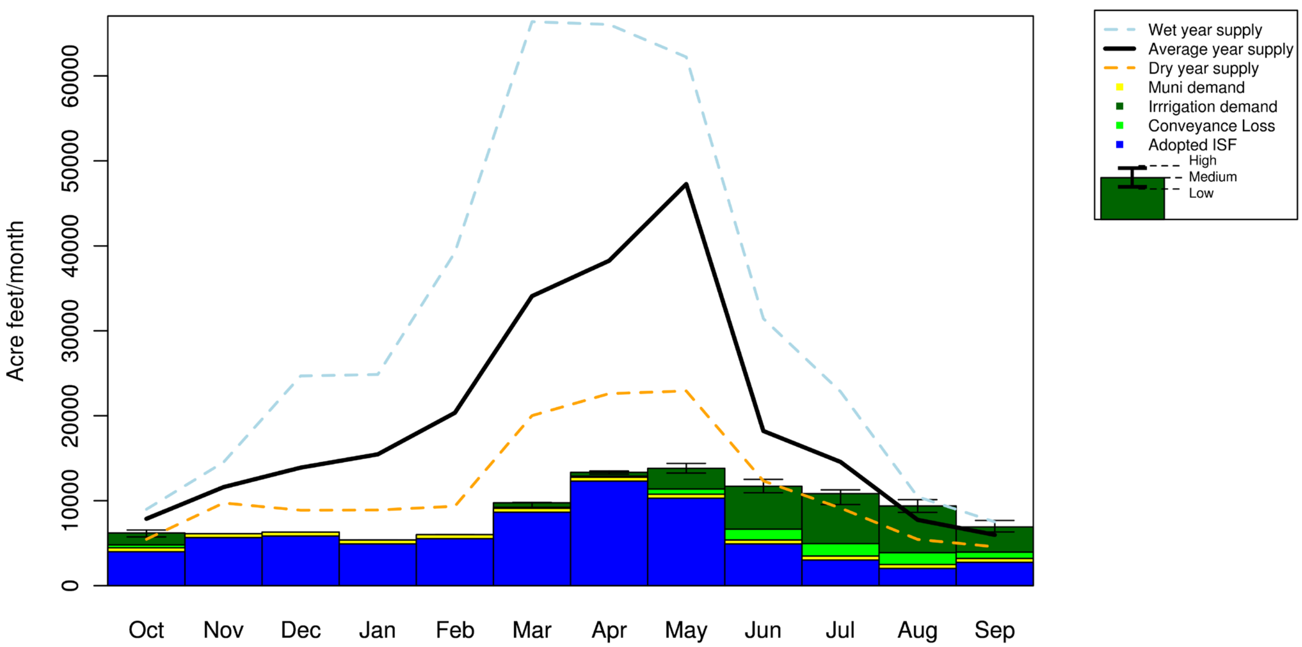
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

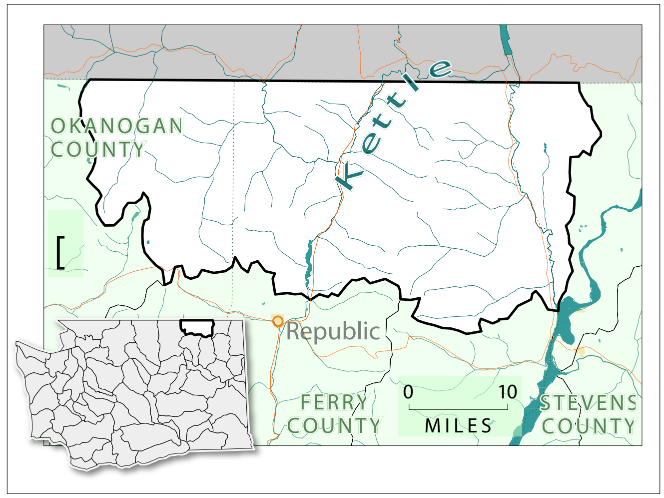
Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Kettle is characterized mostly by increases from late fall through winter and decreases under average and wet flow conditions from spring through early fall.

Both irrigation and municipal/domestic demands are quite small in WRIA 60. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase in many months in the future, but decrease in other months. The magnitude of change is similar under all future economic scenarios that were considered. Municipal demand is forecasted to grow roughly 39% by 2030, though total municipal demand will still be modest.

If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

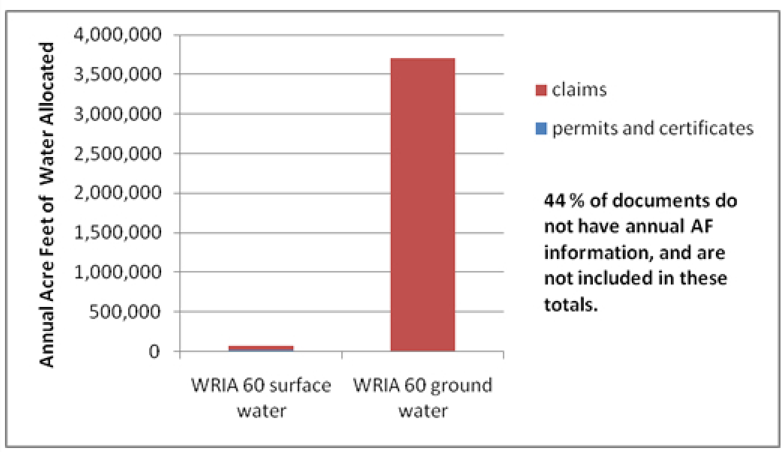
In 2030, unregulated tributary supply generated within the Washington portion of the watershed would be sufficient to meet combined municipal and surface water irrigation demand at the watershed scale. Additional water supplies may be available from the Columbia River in a localized area of the watershed. Upstream portions of the watershed outside of Washington provide additional supplies, but may also have additional demands. Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

It is not known whether bull trout spawn or rear in the tributary waters of these watersheds, and no other fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.

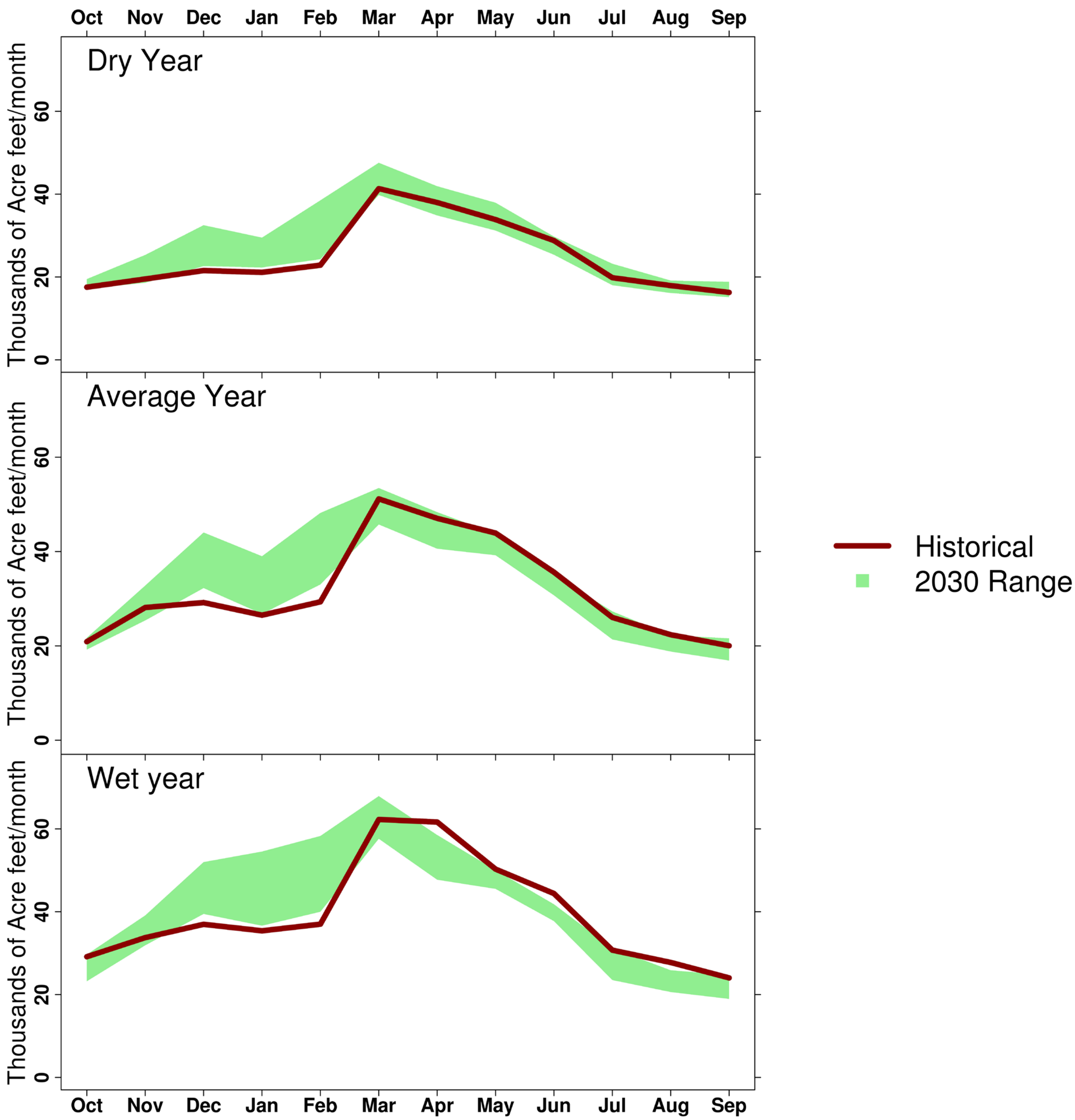


Management Context	
Adjudicated Areas	Myers Creek Twin Creeks
Watershed Planning	NO (planning terminated at the end of phase 2)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Bull Trout spawning and rearing unknown
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.

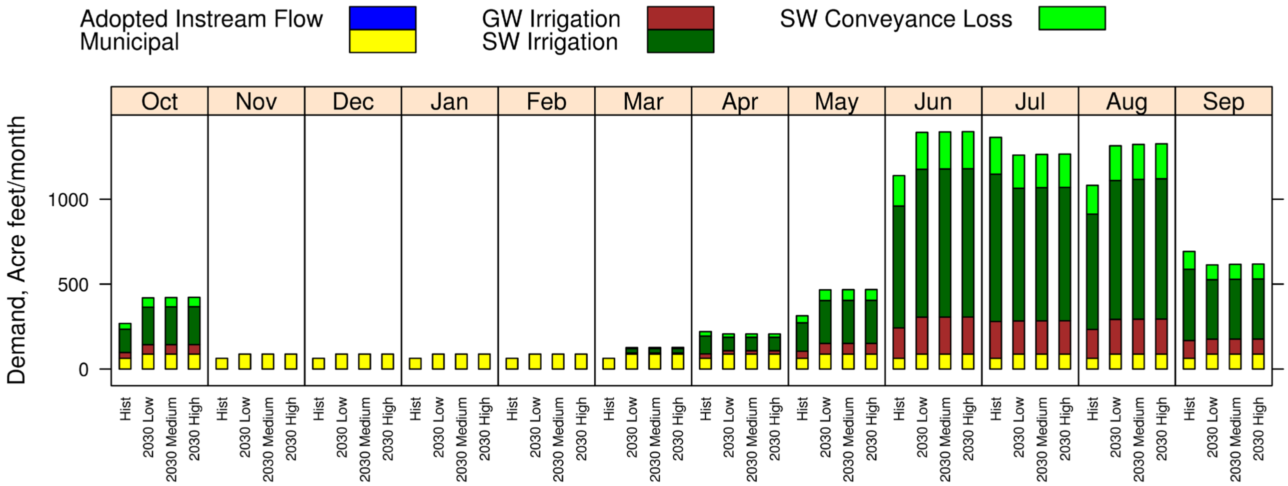


To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.

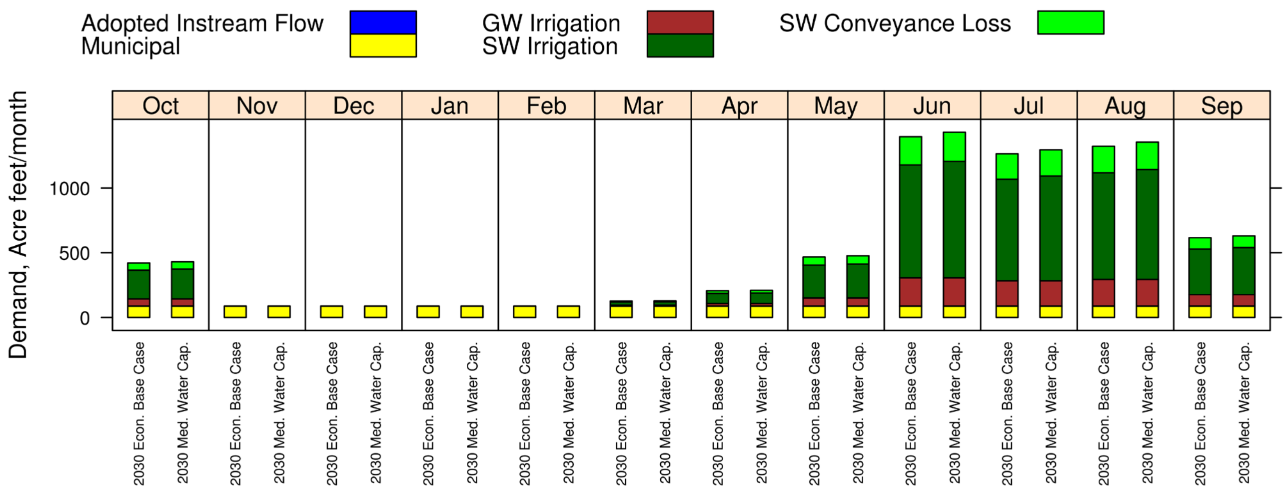


Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

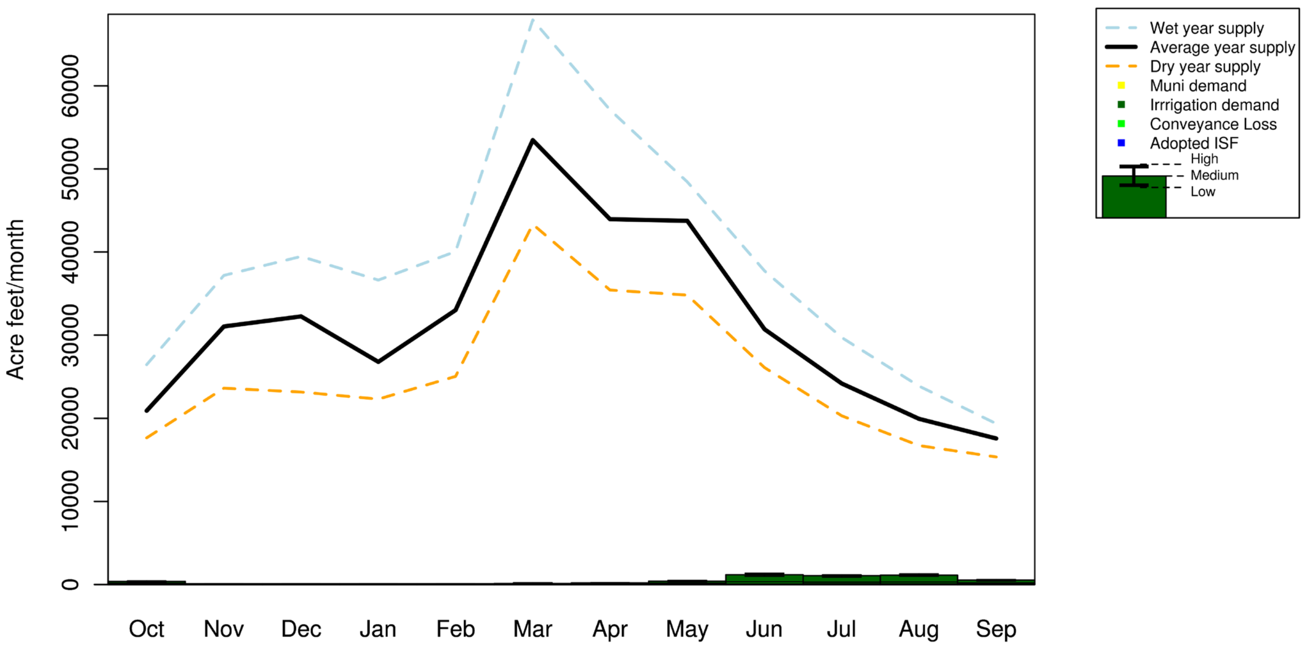
*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Management Context

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Upper Lake Roosevelt is characterized mostly by increases from late fall through winter and decreases in most years from spring through early fall.

Both municipal/domestic and irrigation demands are fairly small in WRIA 61. Municipal demand is forecasted to grow roughly 61% by 2030, though total municipal demand will still be modest. Assuming no change in irrigated acreage, irrigation demands are forecasted to increase in some months in the future and decrease in others, with an overall increase. There is little impact on the magnitude of these results from the consideration of alternate future economic scenarios.

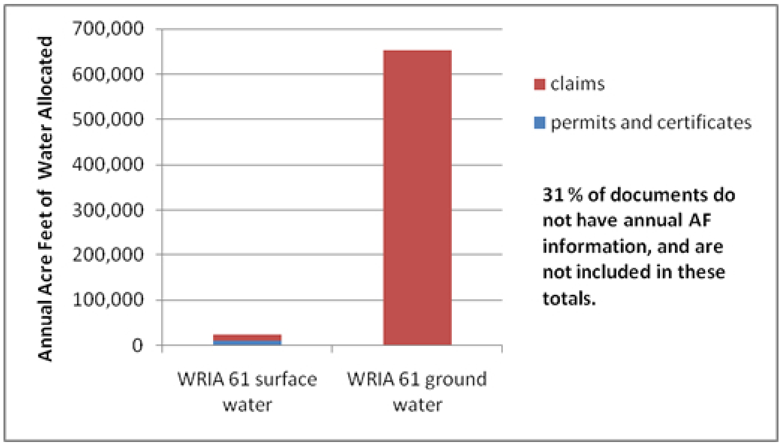
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is anticipated to increase agricultural irrigation water demand in this WRIA compared to 2030 irrigation water demand under the economic base case (a scenario of no additional capacity). Additional capacity will increase demand in all WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply generated within the Washington portion of the watershed would be sufficient to meet combined municipal and surface water irrigation demand at the watershed scale. Additional water supplies from the Columbia River are important to meeting demands in some areas of the watershed and analysis indicates that almost half of agricultural demand is within a mile of the Columbia River (results shown in "Washington's Columbia River Mainstem: Tier III Results"). Upstream portions of the watershed outside of Washington provide additional supplies, but may also have additional demands. Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

It is not known whether bull trout spawn or rear in the tributary waters of these watersheds, and no other fish listed under the Endangered Species Act spawn or rear in tributary waters of this watershed.

Management Context	
Adjudicated Areas	Pingston Creek
Watershed Planning	NO
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Bull Trout spawning and rearing unknown
Groundwater Management Area	NO
Groundwater Studies	None found

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



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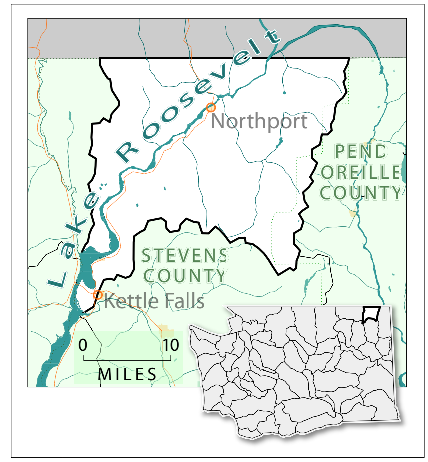
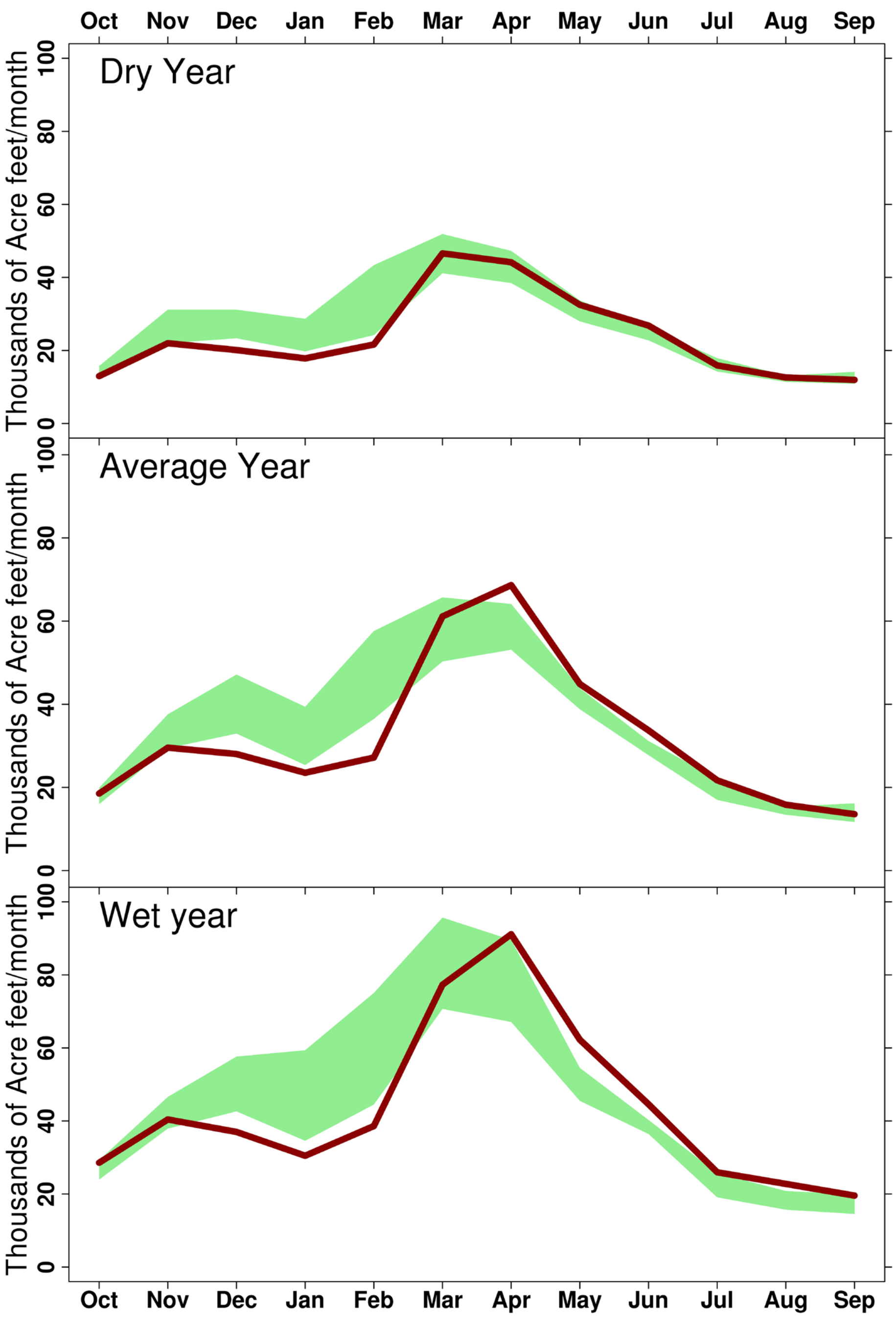
Supply

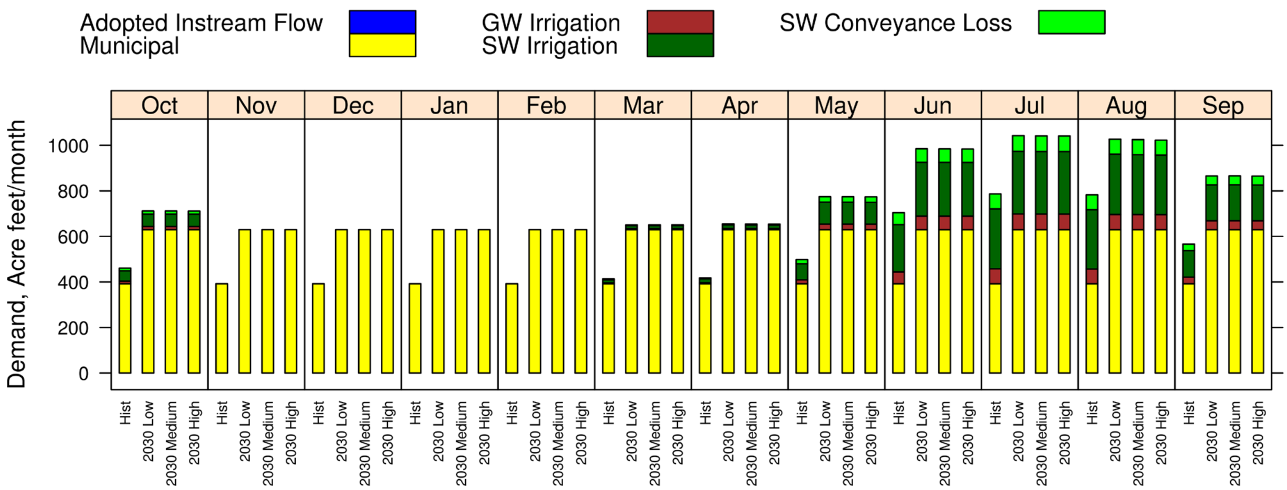




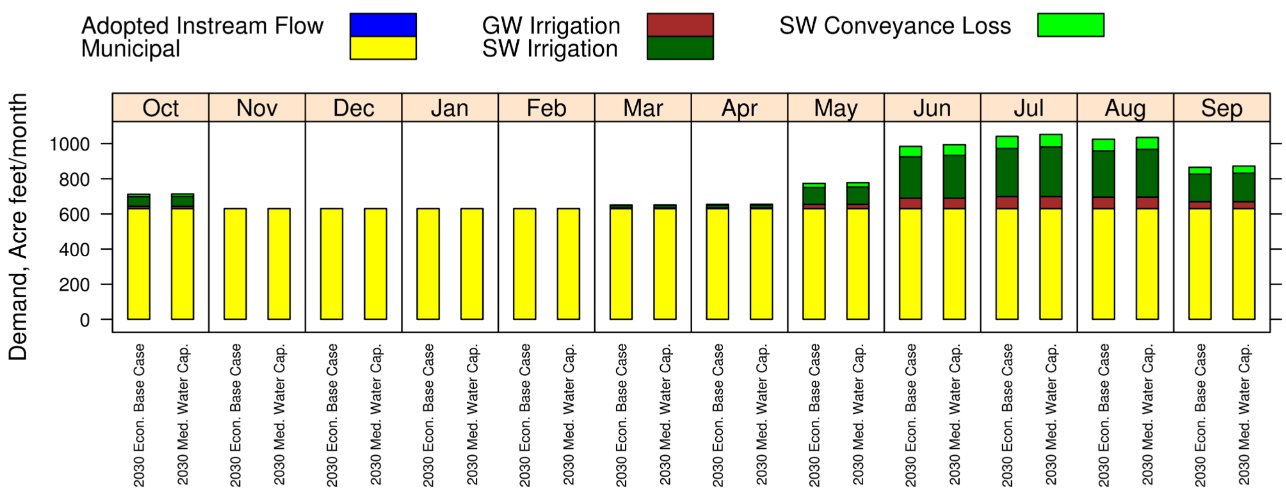
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

Surface water supplies include ***only*** *supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

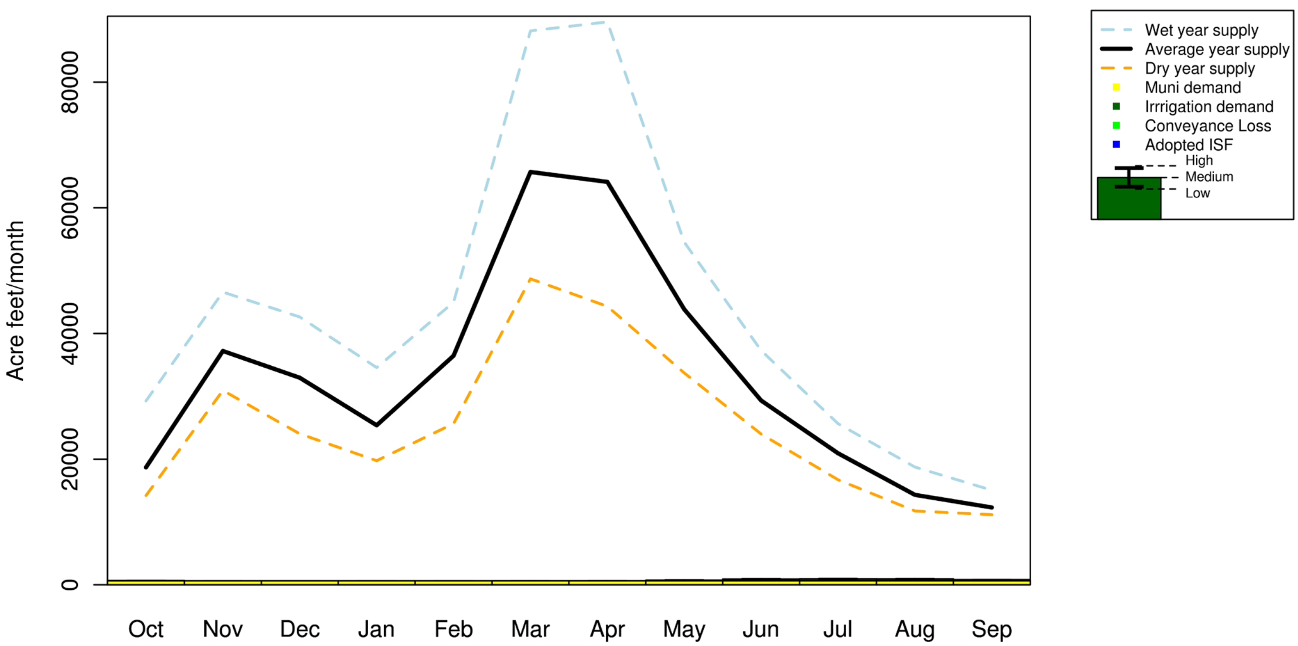
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

Supplies and demands are defined as described in the text box "Definitions of Water Supply and Water Demand Used in the 2011 Forecast." The tributary surface water supply forecast for Pend Oreille is characterized mostly by increases from late fall through early spring and decreases in most years from spring through early fall.

Municipal demand is the primary source of demand in WRIA 62, though relatively modest in comparison to watersheds with larger population centers. Forecasting did not identify irrigation demands. Municipal demand is forecasted to grow 36% by 2030.

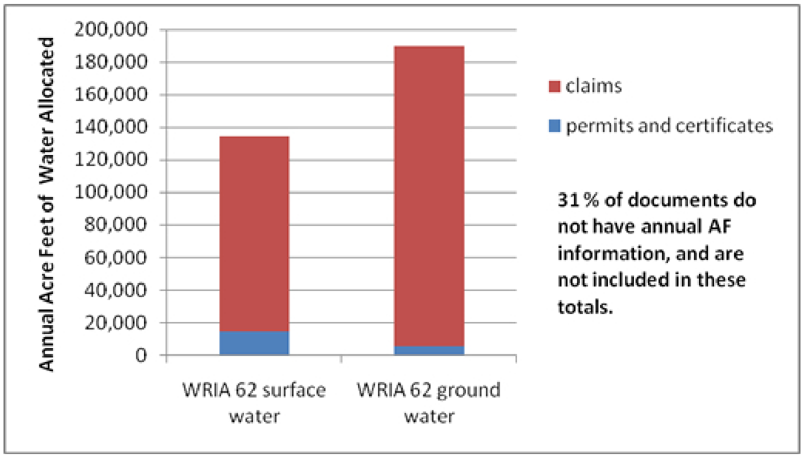
If provided, additional water capacity as specified by the proposed projects in the Office of Columbia River "medium" scenario is not anticipated to create any agricultural irrigation water demand in this WRIA. Additional capacity will only increase demand in WRIAs where water is provided for new irrigated land.

In 2030, unregulated tributary supply generated within the Washington portion of the watershed would be sufficient to meet combined municipal and surface water irrigation demand at the watershed scale. Upstream portions of the watershed outside of Washington provide additional supplies, but may also have additional demands. Modeling results suggested no unmet demand for this WRIA resulting from curtailment of interruptible water rights holders in the historical or future period. However, due to data and resource constraints, the modeling of unmet demand did not consider curtailment of one water user in favor of another more senior water right holder. Water shortages outside the scope of this analysis may also exist in localized areas, and over time periods within months.

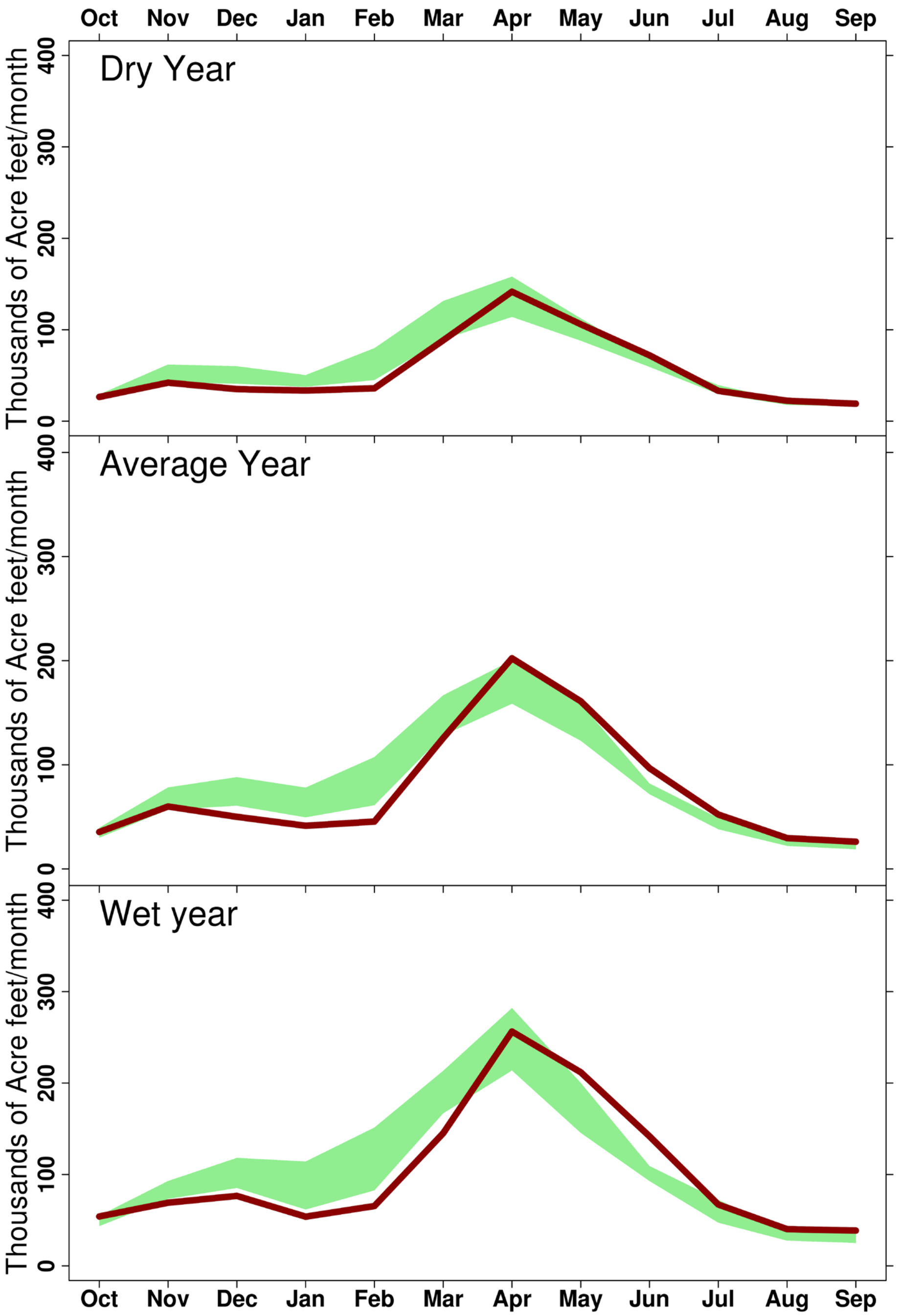
Bull trout, listed under the Endangered Species Act, spawn or rear in tributary waters of this watershed.

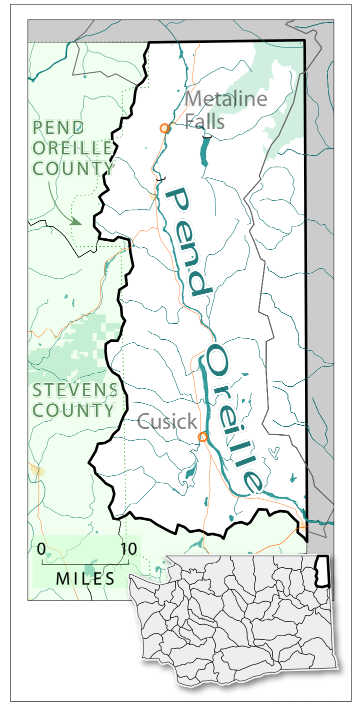
Management Context	
Adjudicated Areas	Renshaw Creek Little Calispell Creek Marshall Lake & Creek
Watershed Planning	Phase 4 (Implementation)
Adopted Instream Flow Rules	NO
Fish Listed Under the Endangered Species Act[1]	Bull Trout
Groundwater Management Area	NO
Groundwater Studies	YES (references listed in WSU's technical report)

[1]All species that spawn or rear in WRIA waters are identified. Species that migrate through WRIA waters are not individually identified, but migratory corridors for listed fish species that spawn and rear upstream are noted.



To give an indication of the amount of uncertainty related to water claims, permits, and certificate data, total annual quantities of water identified under state level water claims, permits, and certificates in Ecology's Water Rights Tracking System (WRTS) are provided, as well as information on the percentage of documents without information. Water documents that could be identified as exclusively non-consumptive uses (e.g. power, fish propagation) were removed from analysis. WRTS data does not include tribal or federal quantified or unquantified water rights.

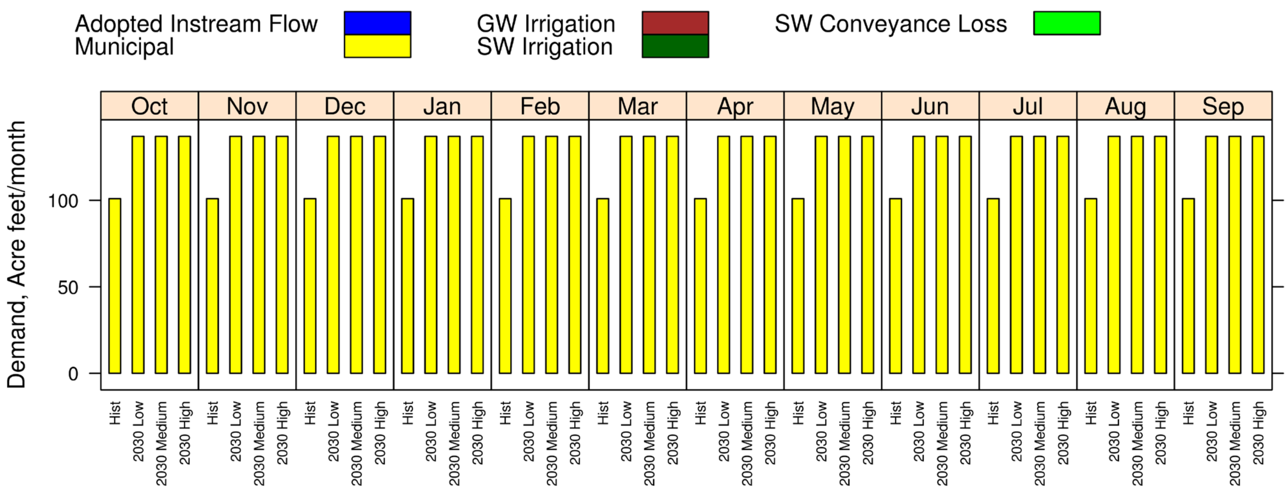




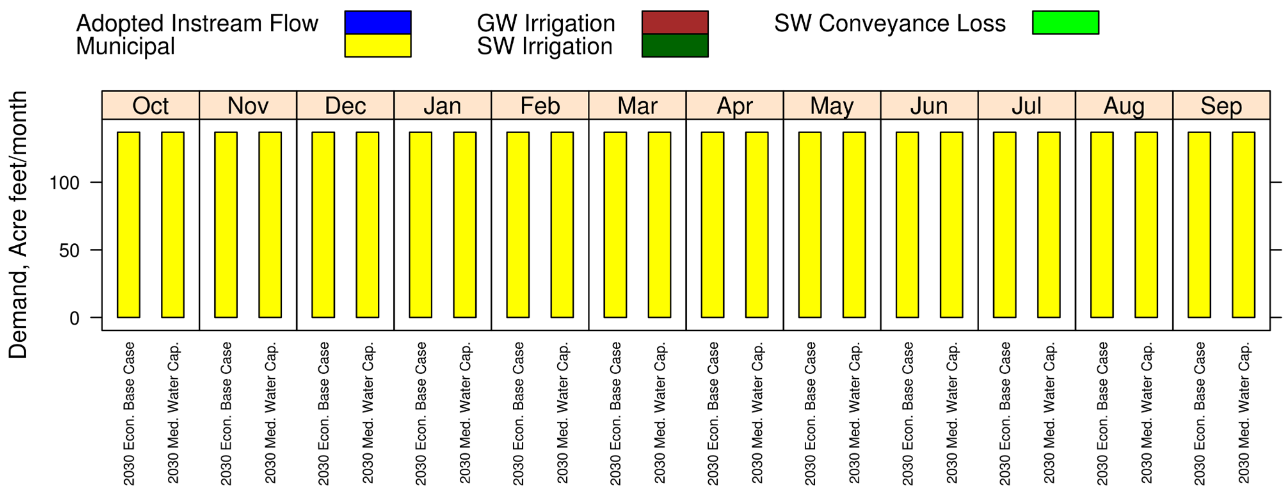
Modeled historical (1977-2006) and 2030 surface water supply generated within the WRIA for dry (20th percentile, top), average (middle), and wet (80th percentile, bottom) flow conditions. The spread of 2030 flow conditions is due to the range of climate change scenarios considered. Supply includes current major reservoir operations for Yakima (WRIAs 37, 38, and 39); otherwise it is the unregulated supply, without consideration for reservoirs. Supplies are reported prior to accounting for demands, and thus should not be compared to observed flows

*Surface water supplies include **only** supplies generated on tributaries within the Washington portion of the watershed. They do not include water supplies that enter the WRIA from upstream portions of the watershed, nor do they include water supplies from the Snake River or Columbia River mainstem. These water supplies are characterized in Figure 13 and "Washington's Columbia River Mainstem: Tier III results."*

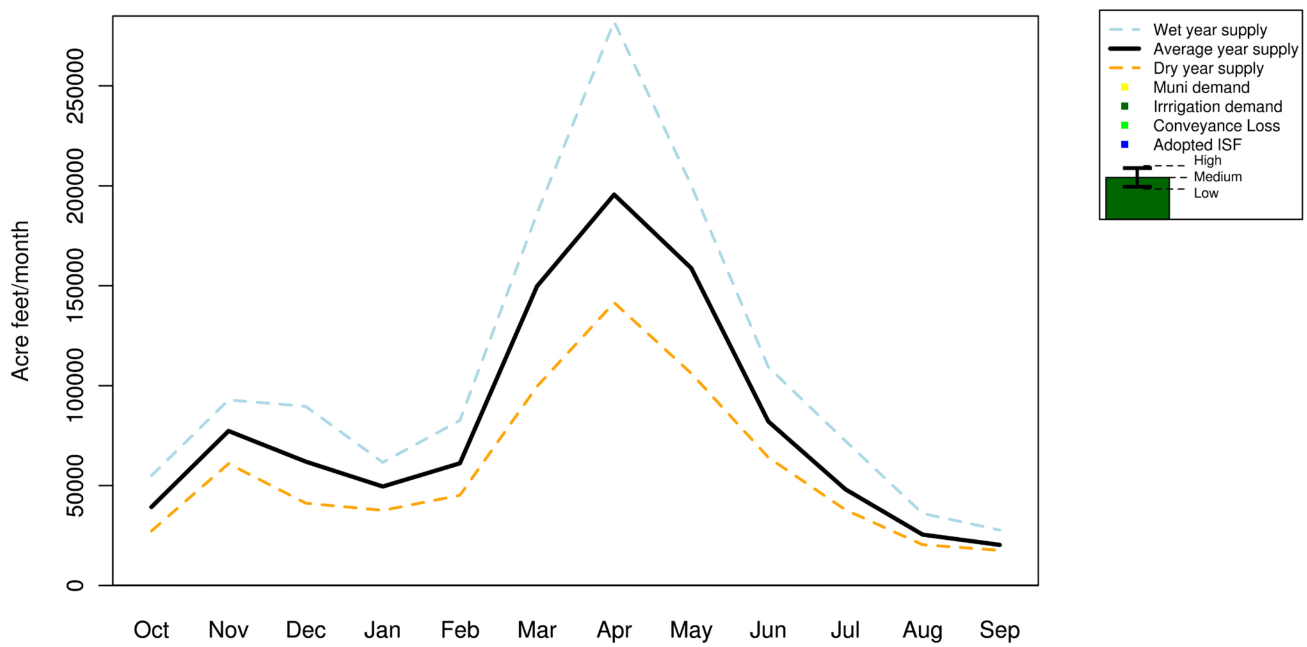
Demand



Modeled historical (1977-2006) and 2030 irrigation water, municipal, and instream flow demands under average flow conditions, and under the middle climate change scenario considered. Forecast 2030 water demands are shown for three economic scenarios: low, medium, and high growth in the domestic economy and international trade. Ground water (GW, brown) and surface water (SW, dark green) irrigation demands are shown at the "top of crop" and include water that will actually be used by plants, as well as on-field losses based on irrigation type. Conveyance losses (light green) are estimated separately. Consumptive municipal demands (yellow) include self-supplied domestic use, but exclude self-supplied industrial use. Instream flows (blue) for both the historical and 2030 forecast are shown using adopted state instream flows or federal flow targets. When more than one instream flow exists at the sub-watershed level for a given month, the largest value (generally also the most downstream) was used to express instream flows at the WRIA level.



2030 forecast water demands under the 2030 forecast economic base case (medium economic scenario, no additional water capacity, same as "2030 Medium" in the graph above), and under the 2030 medium water capacity scenario (with the addition of 200,000 ac-ft per year of proposed additional capacity). The medium water capacity scenario examined a specific set of water capacity projects across eastern Washington, and assumed that new surface water supplies would be used for two purposes: as replacement water for acreage in Odessa currently irrigated with groundwater, and to grow crops on land that is not currently irrigated. Irrigation water demand is shown under average flow conditions and for the middle climate change scenario considered. It includes ground water and surface water demands, as well as conveyance losses, as above.



Comparison of surface water supply, surface water irrigation demands, and municipal demand for 2030, using the baseline economic scenario, and the middle value of the range of climate change scenarios considered. Wet (80th percentile), average, and dry (20th percentile) flow conditions are shown for supply. The 80th, 50th, and 20th percentile conditions are also shown for irrigation demand using error bars. Demands and supplies are defined as above. Water curtailment is not considered.

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Photos by Dana Pride unless otherwise noted