Appendix 11

Technical Report: Response to Recommended New Condition: Use of New Colgate Power Tunnel Intake (HDR Engineering, Inc. and Stephen Grinnell, P.E.)

Response to Recommended New Condition: Use of New Colgate Power Tunnel Intake

Yuba River Development Project
FERC Project No. 2246

Prepared by HDR Engineering, Inc. & Stephen Grinnell, P.E.

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RESPONSE TO RECOMMENDED NEW CONDITION: USE OF NEW COLGATE POWER TUNNEL INTAKE

The Yuba County Water Agency (YCWA), licensee for the Yuba River Development Project (YRDP), Federal Energy Regulatory Commission (FERC) Project No. 2246 ("Project"), has prepared this technical report in response to the comments, recommendations, and preliminary terms and conditions filed by the California Department of Fish and Wildlife (CDFW) and the United States Fish and Wildlife Service (FWS). CDFW and FWS each made recommendations for a new license condition that would require YCWA to operate the New Colgate Power Tunnel upper intake during the months of March, April and May and to consult with the Ecological Group during the annual meeting in April to "*determine which New Colgate Power Tunnel Intake will be utilized during each of the months in the remainder of the water year*." This is a new recommended condition that does not have a corresponding condition in YCWA's Final License Application that was filed with the FERC on April 21, 2014, as amended on June 5, 2017.

The FERC should not include the new recommended CDFW and FWS condition in the new license for numerous reasons, which are described in this report.

At the request of YCWA, HDR Engineering, Inc. (HDR) and Stephen Grinnell, P.E. have prepared this technical report.

1. YCWA Proposed Condition

YCWA has not proposed any condition in its Amended Final License Application (AFLA) that would require YCWA to operate the New Colgate Power Tunnel upper intake during the months of March, April and May or that would require YCWA to consult with the Ecological Group during the annual meeting in April to "*determine which New Colgate Power Tunnel Intake will be utilized during each of the months in the remainder of the water year*."

1.1 CDFW and FWS Recommended New Condition: Use of the New Colgate Power Tunnel Intake

CDFW and FWS each made recommendations for a new license condition that would require YCWA to operate the New Colgate Power Tunnel upper intake during the months of March, April and May and would require YCWA to consult with the Ecological Group during the annual meeting in April to *"determine which New Colgate Power Tunnel Intake will be utilized during each of the months in the remainder of the water year."* This is a new recommended condition that does not have a corresponding condition in YCWA's AFLA. The following is CDFW's recommended condition:

CDFW's recommended condition <u>2.7 - Use of Upper New Colgate Power Tunnel Intake - Licensee shall, beginning in the first full calendar year after license issuance, operate the upper intake at the</u>

temperature control structure on the New Colgate Power Tunnel Intake during the months of March, April, and May. Licensee shall consult with the Ecological Group defined in Recommended Condition 1.1 of this Enclosure A during the annual meeting in April, to determine which New Colgate Power Tunnel Intake will be utilized during each of the months in the remainder of the water year. A description of which intake was used throughout the WY shall be included in the annual water temperature monitoring report. Use of the upper intake on the New Colgate Power Tunnel Intake has not occurred since 1995, and therefore it is anticipated that Licensee may have to inspect the equipment for safety and functionality. Licensee shall make any necessary safety inspections and equipment improvements to facilitate use of the upper intake within three years of license issuance. Status updates regarding safety inspections and equipment improvements and a timeline for use of the upper intake shall be provided to the Ecological Group at the annual meeting.

FWS recommended condition 13 is almost identical to CDFW's recommended condition with the exception that FWS includes the following additional item - (E) The Licensee shall include discussion of this element during the annual Ecological Group meeting. Licensee shall consult with the Ecological Group to seek a consensus decision about how to manage available intakes to provide the best foreseeable temperature regime in the lower Yuba River throughout the rest of the water year.

1.1.1 CDFW and FWS Rationale and Biological Objectives

The CDFW Rationale Report (pg. 121) states that the objective of its recommended condition 2.7 is to "*To optimize the use of the cold water pool in New Bullards Bar Reservoir to support all life stages of salmon and steelhead in the lower Yuba River between Englebright Dam and Narrows 1 Powerhouse (FERC Project No. 1403) through the use of the multi-level intake for the New Colgate Power Tunnel*." [Underline emphasis added].

The United States Department of the Interior (USDOI) Comment Letter (pg. 87) states – "*Putting colder water into the Yuba River has an advantage when air temperatures are warm and colder water is needed to sustain spring-run Chinook salmon holding in the lower Yuba River. When air and ambient temperatures are cool, using the low-level outlet depletes water from the cold-water-pool in New Bullards Bar Reservoir. Too much cold water during the juvenile growth periods of instream and anadromous salmonids can reduce individual fitness by suppressing growth and causing those smaller fish to be at a competitive disadvantage with larger fish. This proposed condition will allow the water temperatures in the North and lower Yuba River to allow for greater growth and reproduction of both instream and anadromous salmonids*." [Underline emphasis added].

The USDOI Comment Letter (pg. 88) further states – "*Due to the depletion of cold water pool available to the New Colgate Power Tunnel, the resulting downstream temperatures throughout the lower Yuba River rise in the fall months during which spring-run Chinook salmon spawn. This Recommended Condition is designed to save cold water in the spring during the first months of reservoir stratification so that colder water will be available in the fall*." [Underline emphasis added].

1.2 Response to Commenters' Recommended New Condition: Use of the New Colgate Power Tunnel Intake

It is inconceivable that CDFW and FWS actually intended to limit their recommended condition with the stated goal of…*"support all life stages of salmon and steelhead"* to the short reach (approximately 0.2 river miles) "*between Englebright Dam and Narrows 1 Powerhouse*," as stated in the CDFW Rationale Report (pg. 121). No salmon or steelhead spawning, embryo incubation or fry emergence, occurs in this bedrock-dominated section of the river, nor has it been reported that any post-emergent fry rearing or juvenile rearing occurs in this uppermost reach of the lower Yuba River. If CDFW and FWS actually intended to limit their recommended condition to this short river reach, then there is no foundation for their recommendation, their stated goal cannot be met, and there is no need for YCWA to provide any further comments on the recommendation.

Moreover, the rationale statement in the USDOI Comment Letter (pg. 87) that "*This proposed condition will allow the water temperatures in the North and lower Yuba River to allow for greater growth and reproduction of both instream and anadromous salmonids*" is erroneous. The New Colgate Powerhouse discharges water into the upper Yuba River downstream of the confluence of the North and Middle Yuba rivers, so the recommended condition could not have any effect on water temperatures in the North Yuba River.

If CDFW and FWS actually intended that their recommended new condition be applied to address water temperatures in the entire lower Yuba River, then YCWA provides the following comments.

FERC should not adopt the CDFW and FWS recommendation for the following reasons.

1) CDFW and FWS do not provide any substantial evidence regarding the need for different water temperature regimes in the lower Yuba River, and they have not demonstrated that water temperatures associated with current or proposed AFLA minimum instream flow requirements adversely affect anadromous salmonid populations.

   The CDFW and FWS rationale statements do not recognize that the River Management Team (RMT) (2013) concluded that implementation of the Yuba Accord provides a suitable thermal regime for target species (including spring-run Chinook salmon, fall-run Chinook salmon and steelhead) in the lower Yuba River, and therefore did not recommend water temperature-related operational or infrastructure modifications. Also, the Applicant-Prepared Draft Biological Assessment (BA), analyzed water temperature regimes and concluded that they are a low stressor for spring-run Chinook salmon and steelhead in the lower Yuba River.

2) CDFW and FWS do not discuss whether their recommended new license condition would be implementable. In fact, implementation of this condition would be limited during the driest years, because the upper intake often is not available for use in such years due to low storage and resulting inadequate submergence of the intake.

   The CDFW and FWS rationale statements for this measure provide recorded water temperature profiles in New Bullards Bar Reservoir and data from the lower Yuba River during 2014 and 2015 to anecdotally support the recommendation. However, due to low storage during 2014, the upper intake would not have been available for use during any part of March or during the first half of April, and during 2015 the upper intake would not have been available for use at all during the months when CDFW and FWS recommend that FERC require YCWA to use it.

Based on U. S. Army Corps of Engineers technical guidance (USACE Engineering Manual 1110-2-1602 "Hydraulic Design of Reservoir Outlet Works") the estimated minimum submergence of the upper intake is 57.7 feet (ft). Because the top of intake tunnel is at elevation 1,823.5 ft mean sea level (msl), the minimum operable storage elevation at which the upper intake can be used is elevation 1,881.2 ft msl, which corresponds to a reservoir storage of 649,138 acre-ft. During 2014, New Bullards Bar Reservoir storage elevation did not exceed this level until April 14 and dropped below this level on May 28. During 2015, the maximum springtime storage level only reached 1868.14 ft, which is 13 ft lower than the minimum elevation at which the upper level intake can be used (USGS New Bullards Bar Reservoir Elevation Gage 11413515).

Additionally, as evidenced by the 41 years (1970 – 2010) of model simulation under Base Case and YCWA AFLA conditions, the New Bullards Bar Reservoir water surface elevation would have been below the upper intake elevation plus the minimum submergence of 57.7 ft during the springs of both 1977 and 1988.

3) The USDOI Comment Letter (pg. 87) states – "….*using the low-level outlet depletes water from the cold-water-pool in New Bullards Bar Reservoir*." This rationale for the recommended condition is misleading and not supported by facts.

During years that are not as extremely dry as the critical years of 1977 and 2015, New Bullards Bar Reservoir has a large cold-water pool and YCWA can release this cold water all summer and fall through the lower intake of the New Colgate Power Tunnel. This conclusion is supported by the water temperature monitoring and modeling studies YCWA has submitted to FERC. Results from study Technical Memorandum (TM) 2-5, *Water Temperature Monitoring*, demonstrate that recorded New Colgate Penstock mean daily temperatures during the summer and early fall do not exceed 50°F (10°C). Also, the results of TM 2-6 "Water Temperature Modeling," show that under Base Case conditions (except in 1977 when the upper intake would not be available for use during the spring), New Colgate Penstock monthly average of mean daily temperatures remain below 50°F for each month of June through August, and remain below 52°F for September and October for all years except for September 2006, when the modeled monthly average temperature was 52.4°F.

4) CDFW and FWS do not provide any evidence that their recommendation would accomplish their stated objectives or produce any substantial benefits to the fisheries resources of the lower Yuba River. CDFW and FWS have not provided any analysis to demonstrate that operating the upper intake in the spring would have any substantial benefits for summer and fall water temperatures in the lower Yuba River.

YCWA analyzed the water temperatures that would result from the CDFW and FWS recommended condition by modeling a scenario with that condition, and comparing it to a scenario where YCWA would operate only the lower intake, using the YRDP water temperature model (see Section 2.1 and **Attachment 1**). To examine whether the CDFW and FWS recommendation would accomplish their stated objective of lowering water temperatures during the summer and fall, YCWA's examination of water temperature modeling output focused on modeled water temperatures for June through October. Overall, with the exception of causing warmer water temperatures during June, the CDFW and FWS recommendation would generally result in only slightly lower (typically 1°F or less) water temperatures during the remainder of the summer and fall.

5) The CDFW rationale for this measure (CDFW Comment Letter p. 105) states that *"In-river water temperatures were even higher in 2015 (Schedule 6) then the high temperatures observed in 2014 (Schedule 5) and likely resulted in a thermal barrier to spring-run Chinook salmon migration."* [Underline emphasis added]. However this suggestion of a thermal barrier in the lower Yuba River is not supported by the data.

   Thermal barriers to the upstream migration of adult anadromous salmonids exist when upstream waters have elevated temperatures relative to downstream waters. RMT (2013) included a comprehensive discussion of the relative differences between water temperatures in the lower Yuba River (the "upstream water") and the lower Feather River (the "downstream water") during the spring-run Chinook salmon upstream migration period. That comprehensive discussion (p. 6-26) demonstrated that water temperatures are substantially lower in the lower Yuba River relative to water temperatures in the lower Feather River during the spring-run Chinook salmon upstream migration period in most years. Water temperatures begin exhibiting substantial divergences between the lower Yuba River and the lower Feather River typically by early May, but this divergence can begin as early as early-April. Water temperatures typically remain highly divergent through mid-September. The maximum difference between lower Yuba and lower Feather River water temperatures generally occurs during June through August, when lower Yuba River water temperatures commonly are 10 to 12 °F cooler than the lower Feather River temperatures. When such Yuba River water temperatures are lower than Feather River water temperatures, there is no thermal barrier in the Yuba River.

   On the lower Feather River, the closest location of available water temperature monitoring data during 2015 to the mouth of the lower Yuba River is near Gridley, which is located about 20 miles upstream of the mouth of the Yuba River. Examination of publically available information (CDEC website https://cdec.water.ca.gov/index.html) demonstrates that water temperatures in the lower Feather River near Gridley (CDEC station 'FOW') were, on the average, relatively similar (0.5°F warmer, 0.2°F warmer, and 1.2°F cooler) to water temperatures in the lower Yuba River at Marysville during the March, April, and May portion of the spring-run Chinook salmon upstream migration period during 2015, respectively. Consequently, these data do not support the CDFW statement that water temperatures during 2015 *"likely resulted in a thermal barrier to spring-run Chinook salmon migration."*

Also, although the CDFW and FWS suggestion of a thermal barrier is not supported by water temperature evaluations conducted by the agencies, it is illogical for CDFW and FWS to recommend raising springtime lower Yuba River water temperatures, given their concerns that such higher temperatures might create a thermal barrier to spring-run Chinook salmon adult upstream migration.

6) Review of the water temperature results and the species and lifestage-specific evaluation (Section 2.1) demonstrate that the CDFW and FWS recommendation would not provide any substantive benefits to spring-run Chinook salmon, fall-run Chinook salmon, or steelhead.

   Overall, the CDFW and FWS recommendation would result in slightly cooler water temperatures during some months of a particular lifestage, slightly warmer water temperatures during other months of the same lifestage, and similar temperatures during yet other months of a given lifestage, relative to the "lower intake only" scenario. While the CDFW and FWS recommendation would, overall, more frequently provide cooler water temperatures from July through October, the differences relative to the "lower intake only" scenario were minimal, typically less than 1°F and exceeding a Water Temperature Index (WTI) value (particularly the EPA (2003) 7DADM index values) with a difference of 5 percent probability. In other words, the differences in exceeding a specified WTI value between the CDFW and FWS recommendation and the "lower intake only" scenario were typically less than 1°F about 5 percent of the time. Also, water temperatures under the CDFW and FWS recommendation were consistently slightly less (about 1°F or less) than under the "lower intake only" scenario when temperatures would exceed specified WTI values. Consequently, the CDFW and FWS recommendation would not provide a substantive benefit relative to the "lower intake only" scenario.

7) At the direction of CDFW, YCWA has released all water from New Bullards Bar Reservoir for generation at the New Colgate Powerhouse through the New Colgate Power Tunnel lower intake, and has not used the upper intake since 1993. As a result, the upper intake has remained closed by its bulkhead for over 25 years and currently is not in working condition. Consequently, YCWA has not used the systems to routinely shift reservoir withdrawals to the powerhouse between the upper and lower intakes, and restoring the upper intake into operation and restoring the operational flexibility to switch between intakes on a monthly basis, as proposed by CDFW and FWS, would require substantial repairs and refurbishment. Changing between the lower and upper intakes on a monthly basis also would substantially increase annual operation and maintenance costs. Neither the CDFW nor the FWS rationale statement has any cost estimates and their statements only briefly discuss some of the safety inspection and equipment activities that YCWA would have undertake to implement their recommendation. YCWA's high level estimate is that the initial refurbishments, repair and replacements and annual operation and maintenance would cost approximately $33,000,000 over 30 years ($1,100,000/yr). Considering these high costs and the fact that the proposed new condition would not provide any substantial benefits, it is not justified.

1.2.1 Analysis of the Recommended New Condition - Use of New Colgate Power

Tunnel Intake

YCWA's analysis in this report includes evaluations of the resulting water temperatures from the use of both the upper and lower outlets from New Bullards Bar Reservoir, versus from use of the lower outlet only. To evaluate the potential differences between these two operational regimes, the YRDP water temperature model was run for the following two scenarios:

- The scenario that includes both the ***CDFW's recommended condition 2.7 - Use of Upper New Colgate Power Tunnel Intake*** and the ***FWS recommended condition 13 - Use of New Colgate Power Tunnel Intake*** is referred to as the "YCWA_AFLA_SW_Upper_FlowTemp" scenario, with figures labeled in this analysis as "Dual Intake".[1]

- The scenario characterizing YCWA's proposed AFLA referred to as the "YCWA_AFLA_SW_FlowTemp" scenario, with figures labeled in this analysis as "Lower Intake".

These two scenarios are evaluated in this report to determine whether, and to what degree, CDFW's and FWS's recommended condition would accomplish their stated objectives, whether the CDFW and FWS recommendations would provide any substantial benefit to aquatic habitat conditions, and whether the CDFW and FWS recommendations would result in any re-directed adverse impacts to aquatic resources the lower Yuba River. Numerous lifestages of spring-run Chinook salmon, fall-run Chinook salmon, and steelhead were examined and evaluated under these two scenarios. The resulting water temperature exceedance probabilities, overlaid with lifestage-specific Water Temperature Index (WTI) suitabilities for spring-run Chinook salmon, fall-run Chinook salmon and steelhead, are presented in **Attachment 1**.

1.2.1.1 Species and Lifestage Specific Analysis

Spring-run Chinook Salmon

Lifestage periodicities and associated upper optimum (UO) and upper tolerable (UT) WTI values for spring-run Chinook salmon are presented in **Table 1**.

[1] The AFLA scenario is available in Appendix 6 of YCWA's October 9, 2017, Response to Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions.

Table 1. Lifestage-specific periodicities for spring-run Chinook salmon in the lower Yuba River.

Lifestage	UO WTI	UT WTI	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Adult Migration	64°F	68°F							■	■	■	■	■	■	■	■	■	■	■	■						
Adult Holding	61°F	65°F							■	■	■	■	■	■	■	■	■	■	■	■						
Spawning	56°F	58°F																	■	■	■					
Embryo Incubation	56°F	58°F																	■	■	■	■	■	■	■	■
Fry Rearing	61°F	65°F	■	■	■																			■	■	■
Juvenile Rearing	61°F	65°F	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Juvenile Downstream Movement	61°F	65°F	■	■	■	■	■	■	■	■	■	■	■	■										■	■	■
Smolt (Yearling+) Emigration	63°F	68°F	■	■	■	■	■	■	■	■	■										■	■	■	■	■	■

Source: RMT 2013.

Note: EPA (2003) Criteria – salmon/trout migration (64°F); adult holding (61°F); spawning and incubation (55°F); salmon/trout core rearing (61°F); salmon/trout non-core rearing (64°F).

<u>Adult Immigration and Holding</u>

Migration

The CDFW and FWS recommendations scenario would result in the following water temperature conditions:

- Less suitable water temperatures, exceeding the EPA (2003) 7DADM value of 64°F nearly 5 percent more often during April at Marysville.
- Less suitable conditions during May, exceeding the EPA (2003) 7DADM value of 64°F about 10 percent more often at Marysville.
- More suitable conditions during July, remaining below the UO WTI value of 64°F about 5 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 64°F about 5 percent more often at Marysville and Daguerre Point Dam (DPD).
- More suitable conditions during August, remaining below the UO WTI value of 64°F about 8 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 64°F about 5 percent more often at Marysville and DPD.
- More suitable conditions during September, remaining below the UO WTI value of 64°F about 5 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 64°F about 8 percent more often at DPD.

Holding

The CDFW and FWS recommendations scenario would result in in the following water temperature conditions:

- Less suitable conditions during May, exceeding the UO WTI value of 61°F over 5 percent more often at Marysville, and exceeding the EPA (2003) 7DADM value of 61°F nearly 8 percent more often at Marysville and 5 percent more often at DPD.
- More suitable conditions during July, remaining below the UO WTI value of 61°F about 8 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 61°F about 5 percent more often at Marysville and nearly 10 percent more often at DPD.
- More suitable conditions during August, remaining below the UO WTI value of 61°F over 5 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 61°F nearly 15percent more often at DPD.
- More suitable conditions during September, remaining below the UO WTI value of 61°F nearly 5 percent more often at DPD, and remaining below the EPA (2003) 7DADM value of 61°F about 10 percent more often at DPD.

Spawning

The CDFW and FWS recommendations scenario would result in the following water temperature conditions:

- More suitable water temperatures during September, remaining below the UT WTI value of 58°F over 5 percent more often at DPD, and remaining below the EPA (2003) 7DADM value of 55°F nearly 15 percent more often at Smartsville

- More suitable conditions during October, remaining below the EPA (2003) 7DADM value of 55°F nearly 10 percent more often at Smartsville.

Embryo Incubation

The CDFW and FWS recommendations would result in the following water temperature conditions:

- More suitable water temperatures during September, remaining below the UT WTI value of 58°F over 5 percent more often at DPD, and remaining below the EPA (2003) 7DADM value of 55°F nearly 15 percent more often at Smartsville

- More suitable conditions during October, remaining below the EPA (2003) 7DADM value of 55°F nearly 10 percent more often at Smartsville.

Under both the CDFW and FWS recommendations scenario and the lower outlet only scenario, water temperatures would remain below all WTIs during the remainder of the spring-run Chinook salmon embryo incubation period.

Fry Rearing

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would remain below all WTIs during the spring-run Chinook salmon fry rearing period.

Juvenile Rearing

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would remain below all WTIs during the November through March period of the year-round juvenile rearing lifestage periodicity.

The CDFW and FWS recommendations scenario would result in the following water temperature conditions:

- Less suitable conditions during May, exceeding the UO WTI value of 61°F over 5 percent more often at Marysville, and exceeding the EPA (2003) 7DADM value of 61°F nearly 8 percent more often at Marysville and 5 percent more often at DPD.
- More suitable conditions during July, remaining below the UO WTI value of 61°F about 8 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 61°F about 5 percent more often at Marysville and nearly 10 percent more often at DPD.
- More suitable conditions during August, remaining below the UO WTI value of 61°F over 5 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 61°F nearly 15 percent more often at DPD.
- More suitable conditions during September, remaining below the UO WTI value of 61°F nearly 5 percent more often at DPD, and remaining below the EPA (2003) 7DADM value of 61°F about 10 percent more often at DPD.
- More suitable conditions during October, remaining below the EPA (2003) 7DADM value of 61°F over 5 percent more often at DPD.

Juvenile Downstream Movement

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would remain below all WTIs during the November through March period of the November through June juvenile downstream movement lifestage periodicity.

The CDFW and FWS recommendations scenario would result in less suitable conditions during May, exceeding the UO WTI value of 61°F over 5 percent at Marysville, and the EPA (2003) 7DADM value of 61°F nearly 8 percent more often at Marysville and 5 percent more often at DPD.

Smolt (yearling+) Emigration

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would generally remain below all WTIs during the November through March portion of the October through mid-May smolt emigration period. No substantive differences between the two scenarios were identified during the remainder of the smolt emigration period.

Fall-run Chinook Salmon

Lifestage periodicities and associated UO and UT WTI values for fall-run Chinook salmon are presented in **Table 2**.

Table 2. Lifestage-specific periodicities for fall-run Chinook salmon in the lower Yuba River.

Lifestage	UO WTI	UT WTI	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Adult Immigration & Staging	64°F	68°F													■	■	■	■	■	■	■	■	■	■	■	■
Spawning	56°F	58°F																			■	■	■	■	■	■
Embryo Incubation	56°F	58°F	■	■	■	■	■	■													■	■	■	■	■	■
Fry Rearing	61°F	65°F	■	■	■	■	■	■	■	■																■
Juvenile Rearing	61°F	65°F		■	■	■	■	■	■	■	■	■	■	■												
Fry & Juvenile Downstream Movement	61°F	65°F	■	■	■	■	■	■	■	■	■	■	■	■												■

Source: RMT 2013

Note: EPA (2003) Criteria – salmon/trout migration (64°F); adult holding (61°F); spawning and incubation (55°F); salmon/trout core rearing (61°F); salmon/trout non-core rearing (64°F).

Adult Immigration and Staging

The CDFW and FWS recommendations scenario would result in the following water temperature conditions:

- More suitable water temperatures during July, remaining below the UO WTI value of 64°F about 5 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 64°F about 5 percent more often at DPD and Marysville.
- More suitable conditions during August, remaining below the UO WTI value of 64°F over 5 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 64°F about 5 percent more often at Marysville and DPD.
- More suitable conditions during September, remaining below the UO WTI value of 64°F about 5 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 64°F about 8 percent more often at DPD.

Spawning

The CDFW and FWS recommendations scenario would result in more suitable water temperatures, remaining below the EPA (2003) 7DADM value of 55°F about 8 percent more often at Smartsville during October. Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would remain below all WTIs during the November and December period of the spawning lifestage.

Embryo Incubation

The CDFW and FWS recommendations scenario would result in more suitable water temperatures, remaining below the EPA (2003) 7DADM value of 55°F about 8 percent more often at Smartsville during October. Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would remain below all WTIs during the remainder of the embryo incubation lifestage.

Fry Rearing

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would generally remain below all WTIs during the December through March period of the fry rearing lifestage. During April, water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would generally remain below the UO and UT WTIs, and would exceed the EPA (2003) 7DADM value of 61°F with similar frequency at Marysville.

Juvenile Rearing

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would generally remain below all WTIs during the January through March period of the January through June juvenile rearing lifestage periodicity.

The CDFW and FWS recommendations scenario would result in less suitable water temperatures during May, exceeding the UO WTI value of 61°F over 5 percent more often at Marysville, and exceeding the EPA (2003) 7DADM value of 61°F about 7 percent more often at Marysville and over 5 percent more often at DPD.

Juvenile Downstream Movement

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would generally remain below all WTIs during the December through March period of the December through June juvenile downstream movement lifestage periodicity.

The CDFW and FWS recommendations scenario would result in less suitable conditions during May, exceeding the UO WTI value of 61°F over 5 percent more often at Marysville, and exceeding the EPA (2003) 7DADM value of 61°F nearly 8 percent more often at Marysville and 5 percent more often at DPD.

Steelhead

Lifestage periodicities and associated UO and UT WTI values for steelhead are presented in **Table 3**.

Table 3. Lifestage-specific periodicities for steelhead in the lower Yuba River.

Lifestage	UO WTI	UT WTI	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult Migration	64°F	68°F	■■	■■	■■					■■	■■	■■	■■	■■
Adult Holding	61°F	65°F	■■	■■	■■					■■	■■	■■	■■	■■
Spawning	54°F	57°F	■■	■■	■■	■■								
Embryo Incubation	54°F	57°F	■■	■■	■■	■■	■■							
Fry Rearing	65°F	68°F				■■	■■	■■	■■					
Juvenile Rearing	65°F	68°F	■■	■■	■■	■■	■■	■■	■■	■■	■■	■■	■■	■■
Fry & Juvenile Downstream Movement	65°F	68°F				■■	■■	■■	■■	■■	■■			
Smolt (Yearling+) Emigration	52°F	55°F	■■	■■	■■	■□						■■	■■	■■

Source: RMT 2013

Note: EPA (2003) Criteria – salmon/trout migration (64°F); spawning and incubation (55°F); salmon/trout core rearing (61°F); salmon/trout non-core rearing (64°F); steelhead smoltification (57°F).

Adult Immigration and Holding

Migration

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would generally remain below all WTIs during the October through March period of the August through March adult steelhead immigration lifestage periodicity.

The CDFW and FWS recommendations scenario would result in the following water temperature conditions:

- More suitable conditions during August, remaining below the UO WTI value of 64°F about 8 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 64°F about 5 percent more often at Marysville and DPD.
- More suitable conditions during September, remaining below the UO WTI value of 64°F about 5 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 64°F about 8 percent more often at DPD.

Holding

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would generally remain below all WTIs during the October through March period of the August through March adult holding lifestage periodicity.

The CDFW and FWS recommendations scenario would result in the following water temperature conditions:

- More suitable conditions during August, remaining below the UO WTI value of 61°F over 5 percent more often at Marysville, and remaining below the EPA (2003) 7DADM value of 61°F nearly 15percent more often at DPD.
- More suitable conditions during September, remaining below the UO WTI value of 61°F nearly 5 percent more often at DPD, and remaining below the EPA (2003) 7DADM value of 61°F about 10 percent more often at DPD.

Spawning

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would generally remain below all WTIs during the January through March period of the spawning lifestage. Relative to the lower outlet only scenario, the CDFW and FWS recommendations scenario would result in the following water temperature conditions:

- Less suitable water temperatures during April, exceeding the UO WTI value of 54°F about 5 percent more often at DPD and Smartsville, exceeding the UT WTI value of 57°F over 5 percent more often at DPD, and exceeding the EPA (2003) 7DADM value of 55°F about 5 percent more often at DPD and Smartsville.

Embryo Incubation

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would generally remain below all WTIs during the January through March period of the embryo incubation lifestage. Relative to the lower outlet only scenario, the CDFW and FWS recommendations scenario would result in the following water temperature conditions:

- Less suitable water temperatures during April, exceeding the UO WTI value of 54°F about 5 percent more often at DPD and Smartsville, exceeding the UT WTI value of 57°F over 5 percent more often at DPD, and exceeding the EPA (2003) 7DADM value of 55°F about 5 percent more often at DPD and Smartsville.

- Less suitable conditions during May, exceeding the UO WTI value of 54°F over 10 percent more often at DPD and at Smartsville, exceeding the UT WTI value of 57°F about 10 percent more often at DPD, and exceeding the EPA (2003) 7DADM value of 55°F over 5 percent more often at DPD and over 10 percent more often at Smartsville.

Fry Rearing

The CDFW and FWS recommendations scenario would result in the following water temperature conditions:

- Less suitable water temperatures during May, exceeding the EPA (2003) 7DADM value of 61°F about 8 percent more often at Marysville and about 5 percent more often at DPD.
- More suitable conditions during July, remaining below the EPA (2003) 7DADM value of 61°F over 5 percent more often at Marysville and nearly 15 percent more often at DPD.

Juvenile Rearing

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would generally remain below all WTIs during the November through March period of the year-round juvenile rearing lifestage periodicity.

The CDFW and FWS recommendations scenario would result in the following water temperature conditions:

- Less suitable water temperature conditions during May, exceeding the EPA (2003) 7DADM value of 61°F about 8 percent more often at Marysville and over 5 percent more often at DPD.
- More suitable conditions during July, remaining below the EPA (2003) 7DADM value of 61°F about 5 percent more often at Marysville and nearly 15 percent more often at DPD.
- More suitable conditions during August, remaining below the EPA (2003) 7DADM value of 61°F nearly 15 percent more often at DPD.
- More suitable conditions during September, remaining below the EPA (2003) 7DADM value of 61°F nearly 10 percent more often at DPD.
- More suitable conditions during October, remaining below the EPA (2003) 7DADM value of 61°F over 5 percent more often at DPD.

Juvenile Downstream Movement

The CDFW and FWS recommendations scenario would result in the following water temperature conditions:

- Less suitable water temperatures during May, exceeding the EPA (2003) 7DADM value of 61°F about 8 percent more often at Marysville and about 5 percent more often at DPD.
- More suitable conditions during July, remaining below the EPA (2003) 7DADM value of 61°F over 5 percent more often at Marysville and nearly 15 percent more often at DPD.
- More suitable conditions during August, remaining below the EPA (2003) 7DADM value of 61°F nearly 15 percent more often at DPD.

- More suitable conditions during September, remaining below the EPA (2003) 7DADM value of 61°F nearly 10 percent more often at DPD.

Smolt (yearling+) Emigration

Water temperatures under both the CDFW and FWS recommendations scenario and the lower outlet only scenario would generally remain below all WTIs during the December through February period of the October through April smolt emigration lifestage periodicity. Also, water temperatures under both scenarios exceed the WTIs with similar frequency during the months of October, November and March.

The CDFW and FWS recommendations scenario would result in less suitable conditions during April, exceeding the UO WTI value of 52°F over 5 percent more often at Marysville, DPD, and Smartsville, and exceeding the UT WTI value of 55°F about 5 percent more often at Marysville.

1.2.1.2 Implementation Issues and Costs

As discussed above, at the direction of CDFW, YCWA has not used the New Colgate Power Tunnel upper intake since 1993, and, as a result the upper intake has remained closed by its bulkhead for over 25 years and YCWA has not used the facilities that routinely shift withdrawals between the upper and lower intakes.

Restoring the upper intake into operation and restoring the operational flexibility to switch between intakes on a monthly basis, as would be required by the CDFW and FWS recommendation, would require substantial repairs and refurbishment. Some, but not all, of the key elements of these repair actions would include:

- Detailed inspections of the upper penstock (i.e., the portion of the penstock from the upper intake to the lower intake)
- Repair of any problems identified as part of the upper intake detailed inspections
- Refurbishing the upper intake track racks and cleaning debris from inside the intake
- Modifying or upgrading the shutter control system for more efficient adjustment of shutters
- Repairing or upgrading the shutters to accommodate the modified or upgraded shutter control system
- Refurbishing and replacing the upper and lower bulkhead components
- Replacing the crane controls and refurbishing the associated mechanical and power systems

In addition, changing between the lower and upper intakes on a monthly basis would substantially increase YCWA's annual operation and maintenance costs. Intake or shutter adjustments (installing or removing bulkhead gates or shutter panels) require the New Colgate Powerhouse to be shut down for a minimum of eight hours, resulting in lost generation opportunity and additional personnel hours dedicated to coordination, planning, and implementing each adjustment to ensure that all applicable minimum instream flow requirements are met during and after the adjustments. The process to make adjustments would not be easily achieved and would involve hoisting shutters or bulkhead gates from or to underwater positions, with limited ability to confirm equipment positioning except through operational testing following each adjustment. If the shutters or bulkhead gates were found to be out of position following an attempted adjustment, the entire process would have to be re-initiated, which would extend the outage duration.

Neither CDFW's nor FWS's rationale statement contains any estimated costs or otherwise addresses the activities that YCWA would have to undertake to implement their recommendation. YCWA's high level estimate is that it would cost approximately $33,000,000 over 30 years ($1,100,000/yr) for the initial refurbishments, repair and replacements and the annual operation and maintenance.

2. References Cited

California Department of Water Resources (DWR). 2015. California Data Exchange Center (CDEC). Available online: https:// https://cdec.water.ca.gov/index.html. Last accessed 2017.

United States Army Corps of Engineers (USACE). 1980. Engineering Manual 1110-2-1602. Hydraulic Design of Reservoir Outlet Works. October 1980.

United States Environmental Protection Agency (EPA). 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards. EPA 910-B-03-002. Seattle, WA: Region 10 Office of Water.

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Attachment 1

Water Temperature Suitabilities

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Spring-run Chinook Salmon
Water Temperature Exceedance Curves

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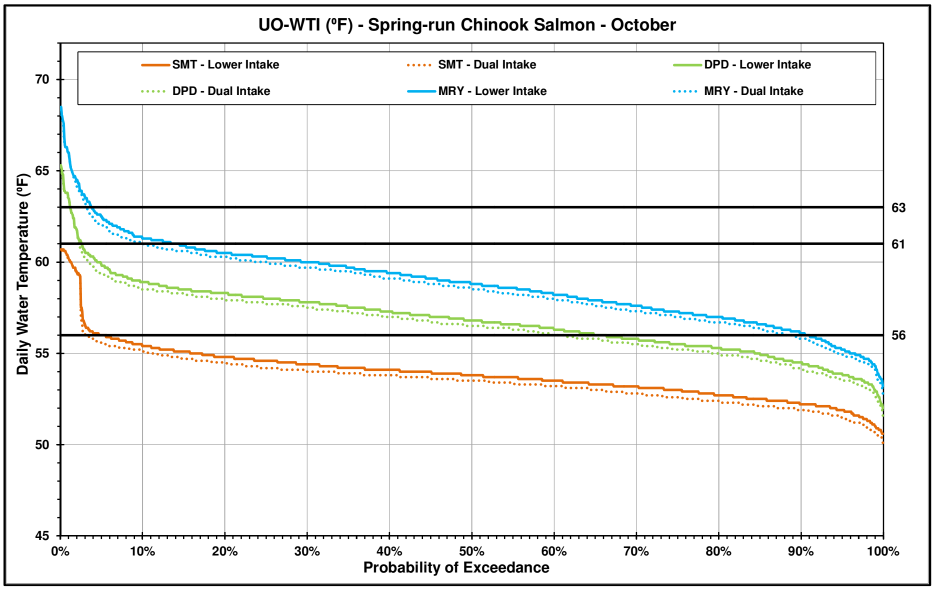
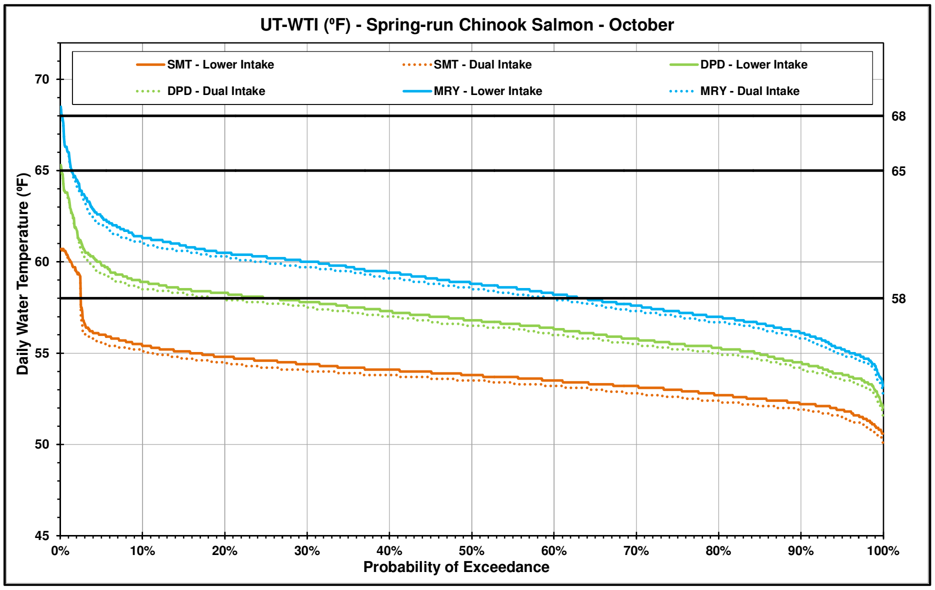

UO-WTI (ºF) - Spring-run Chinook Salmon - October
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
63
61
56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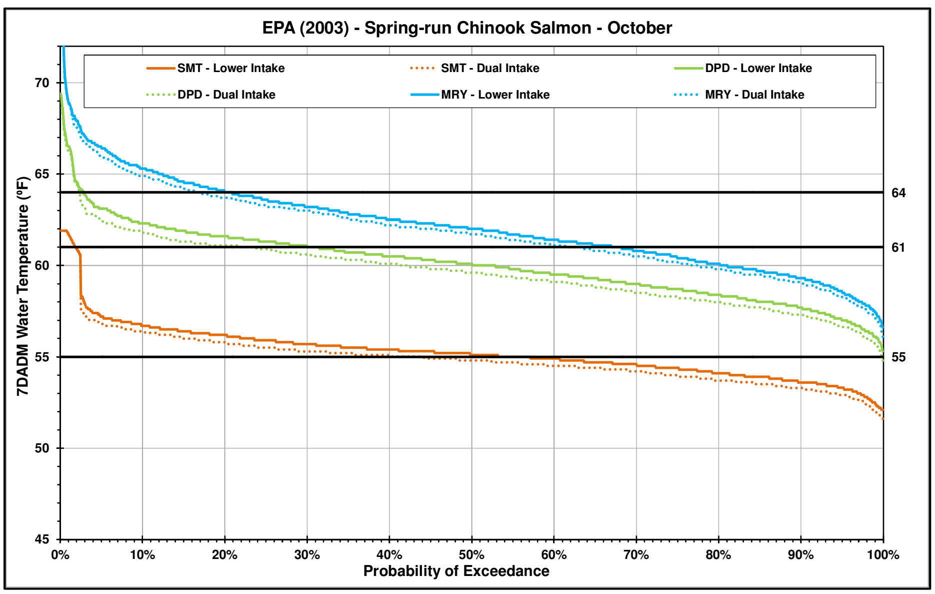
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
58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SMT - Dual Intake
DPD - Lower Intake
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MRY - Lower Intake
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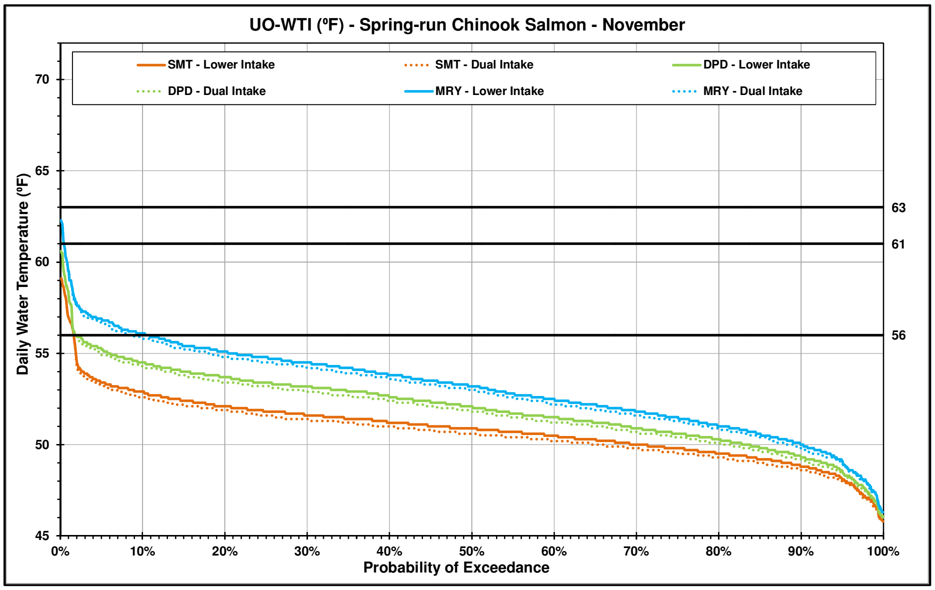
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
55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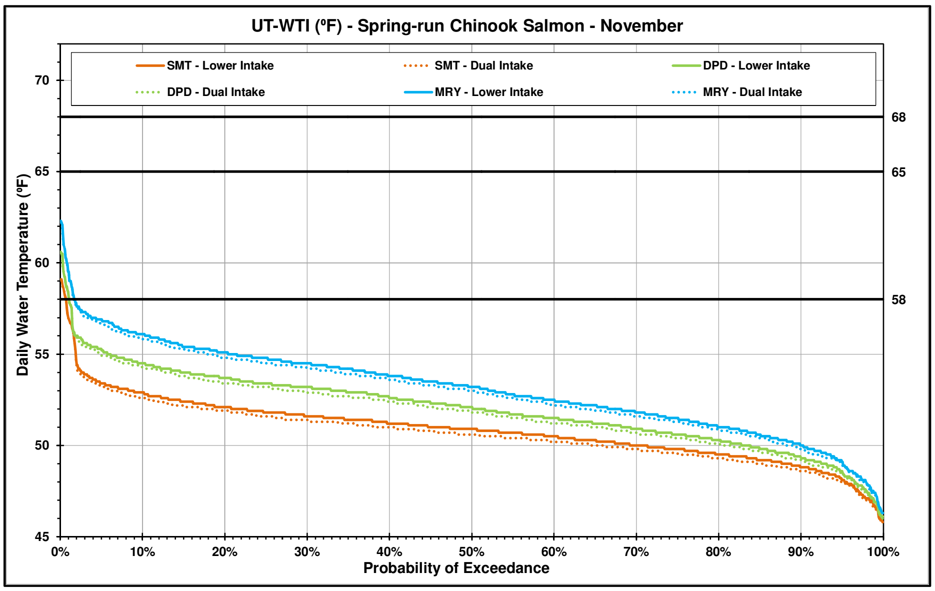
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
63
61
56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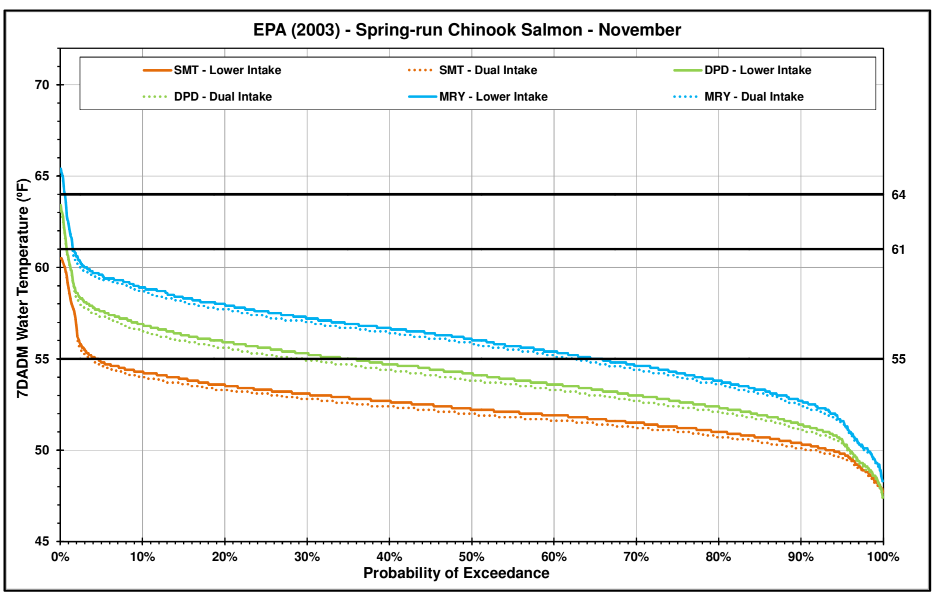
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
58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MRY - Lower Intake
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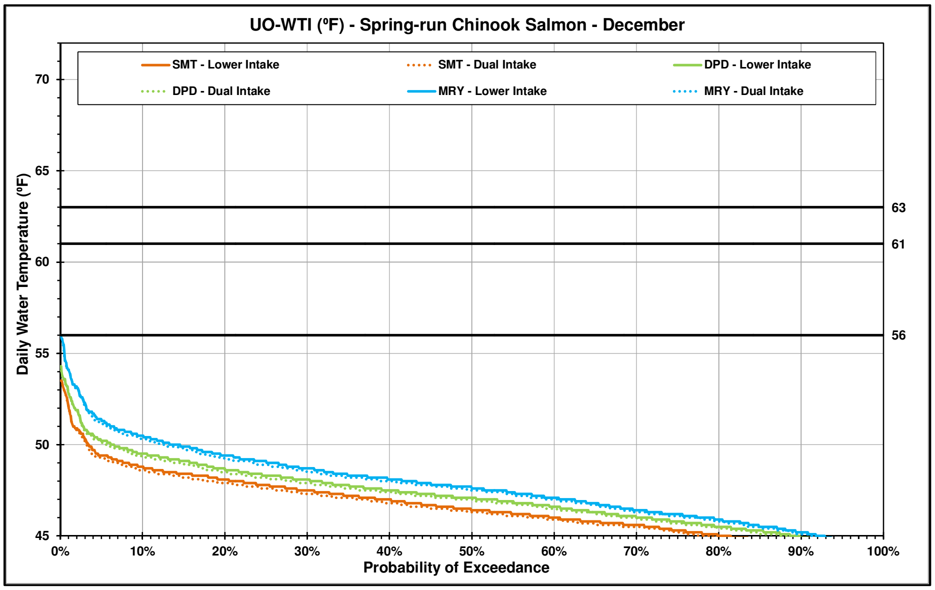
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
55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SMT - Dual Intake
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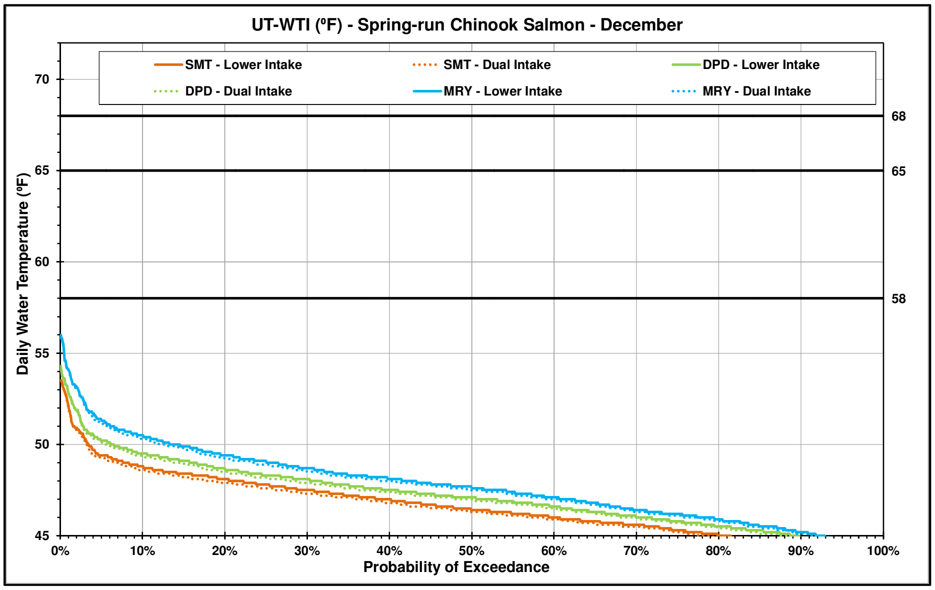
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
63
61
56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DPD - Lower Intake
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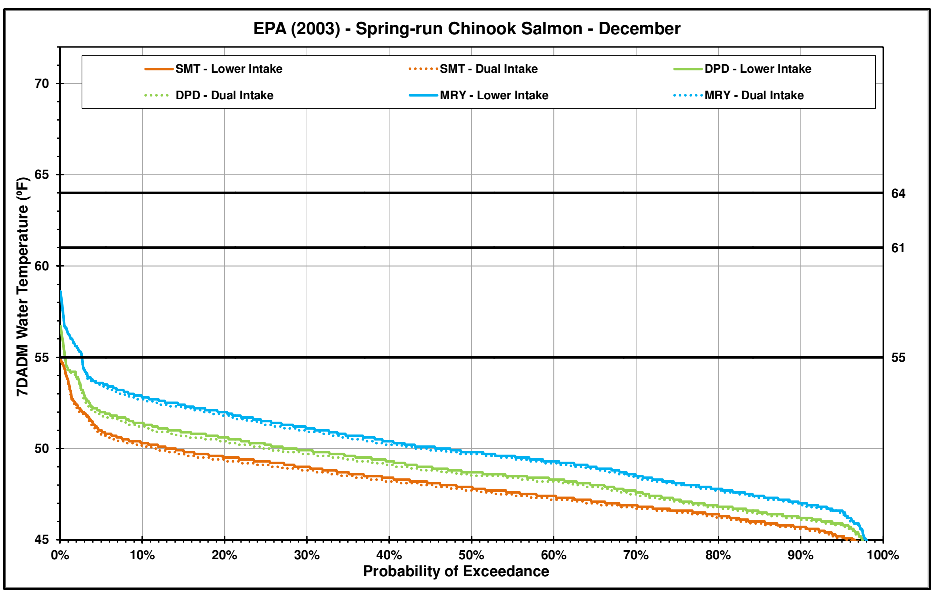
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
58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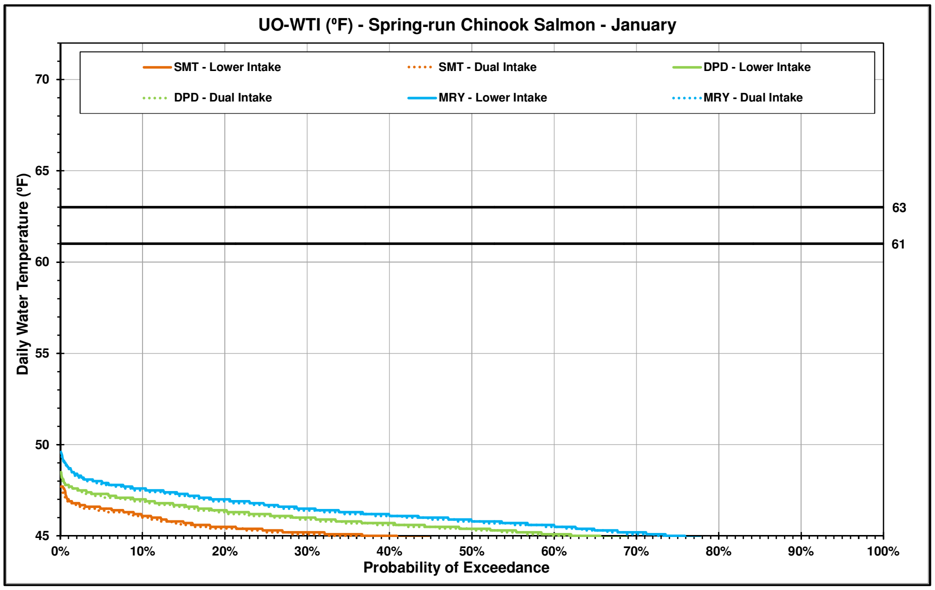
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
55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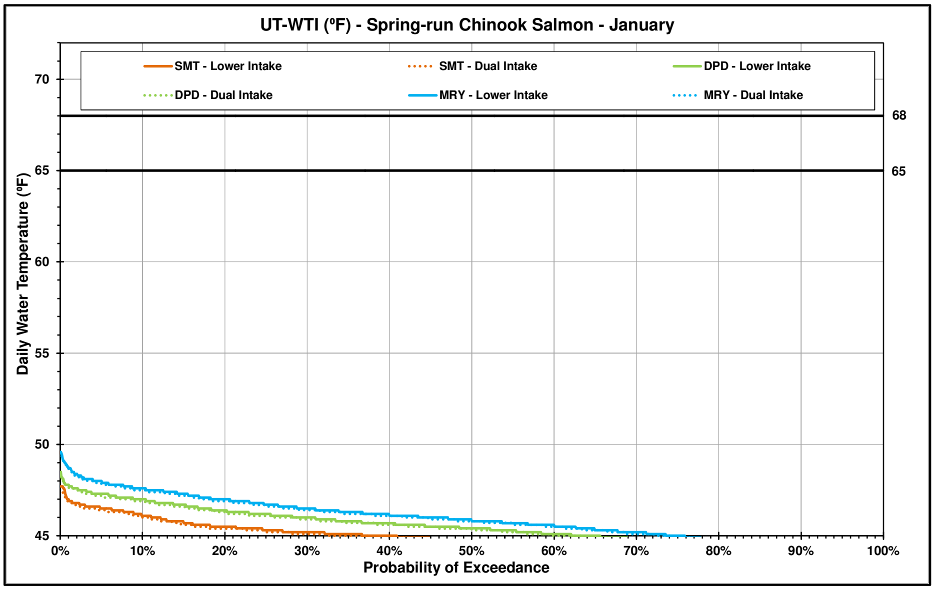
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
63
61
45
50
55
60
65
70
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%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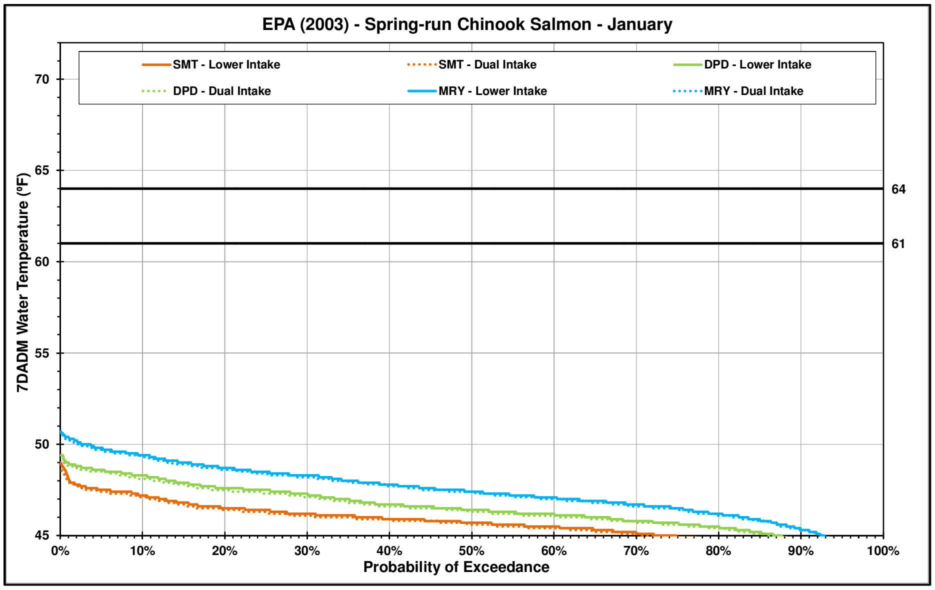
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
45
50
55
60
65
70
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%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SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
45
50
55
60
65
70
0%
10%
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30%
40%
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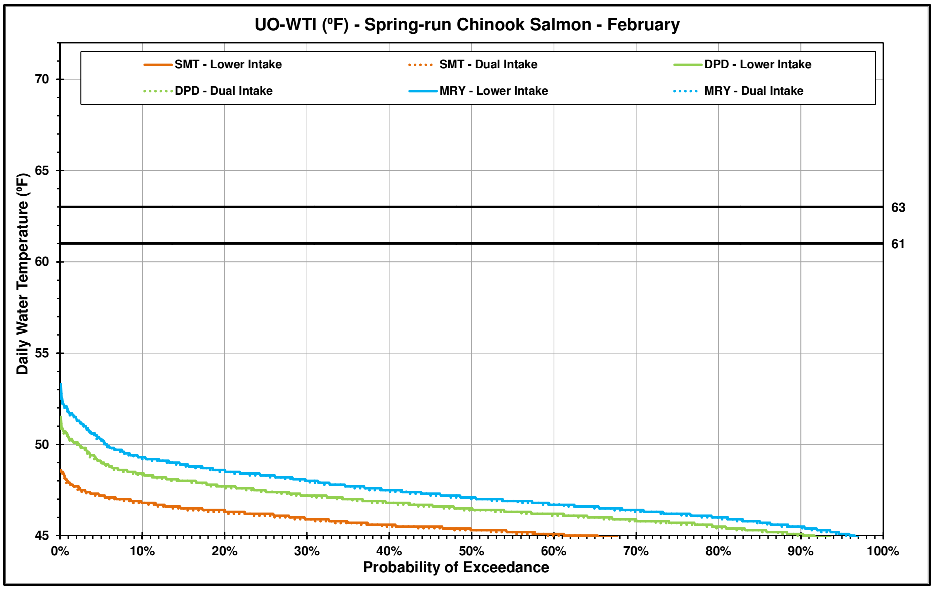
70%
80%
90%
100%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SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
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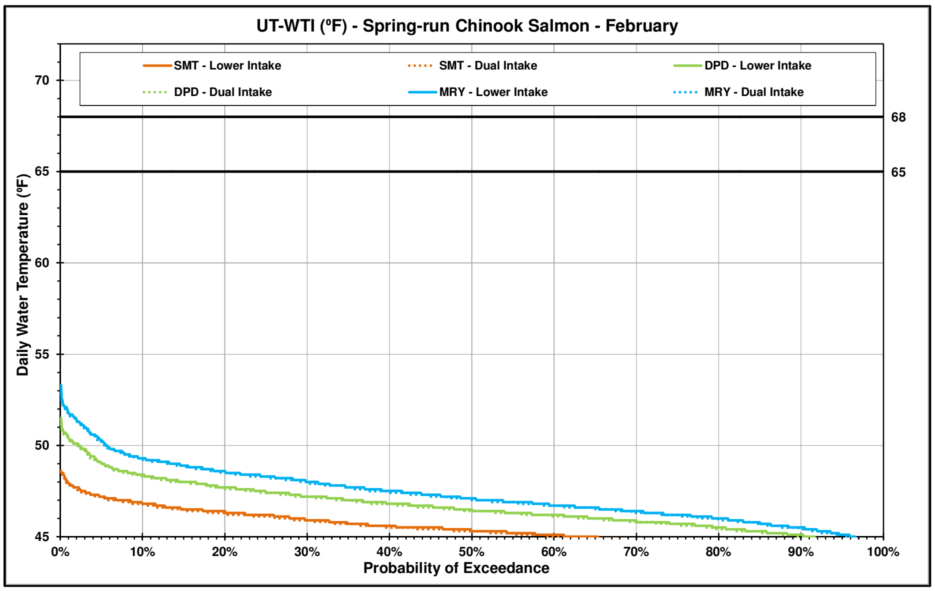
Daily Water Temperature (ºF)
Probability of Exceedance
63
61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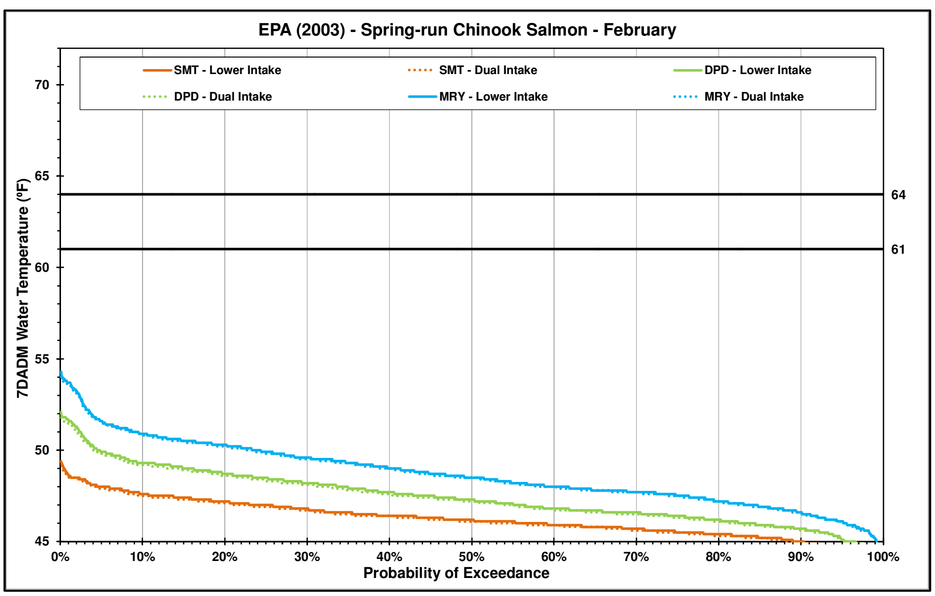
Daily Water Temperature (ºF)
Probability of Exceedance
68
65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DPD - Dual Intake
MRY - Lower Intake
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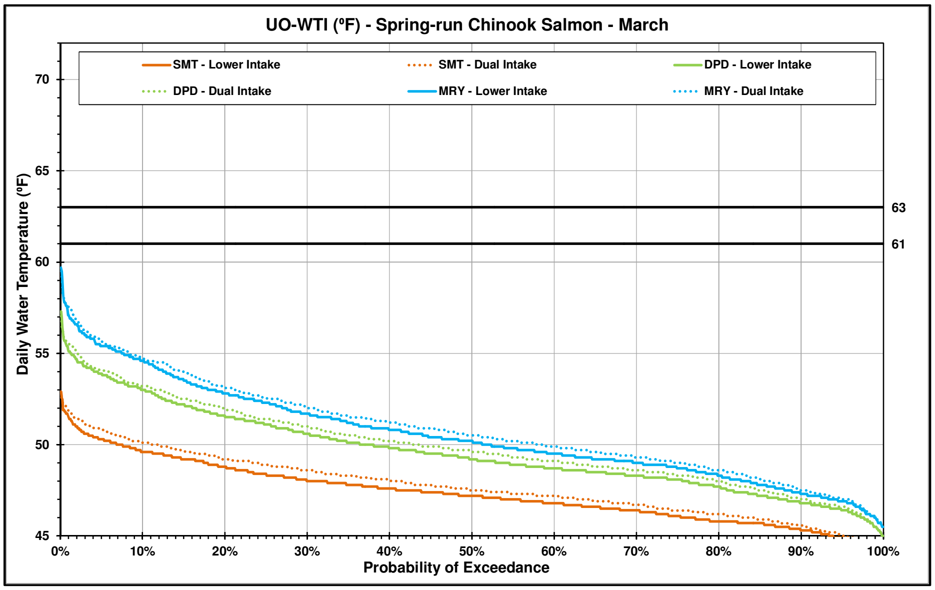
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61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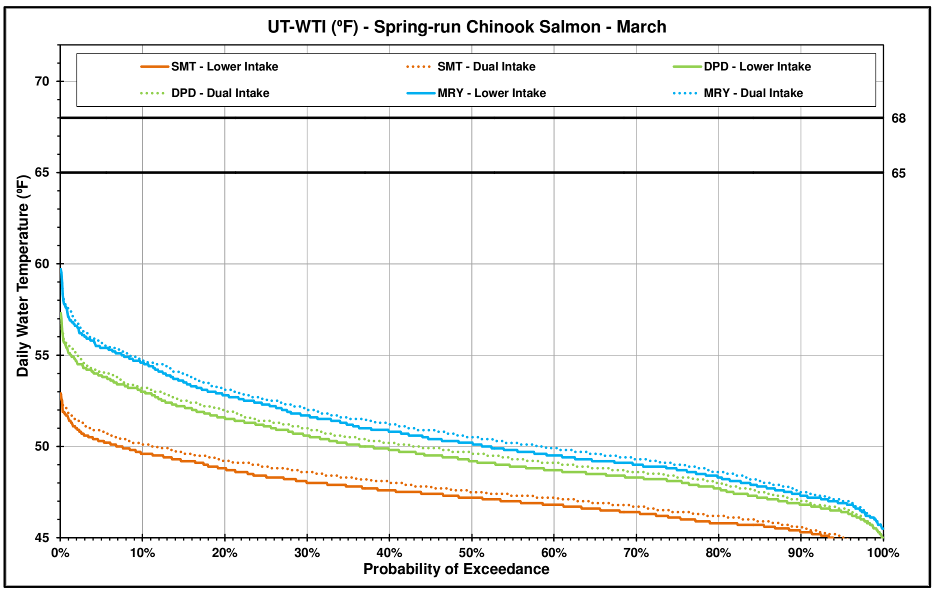
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (°F)
Probability of Exceedance
63
61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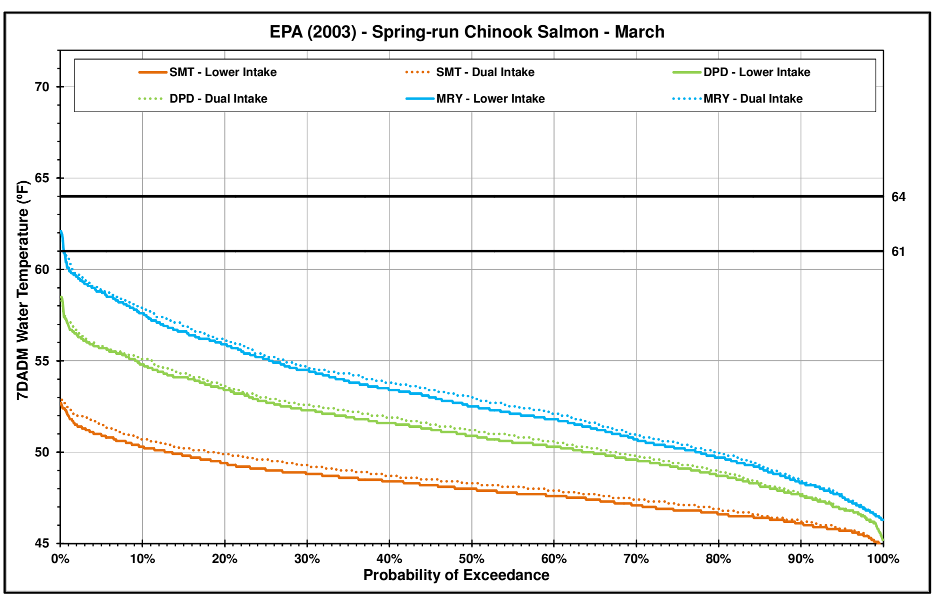
Probability of Exceedance
68
65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MRY - Lower Intake
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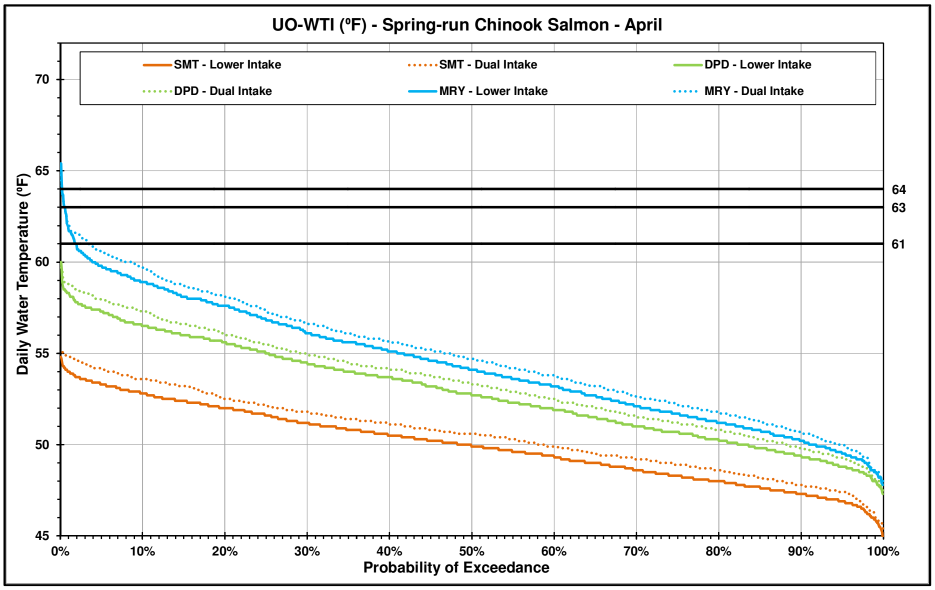
7DADM Water Temperature (°F)
Probability of Exceedance
64
61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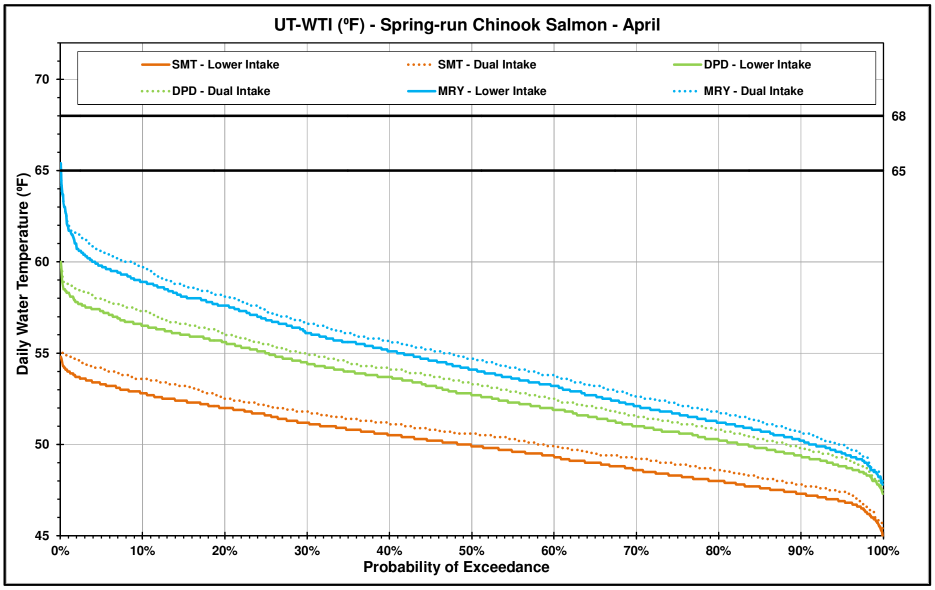
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
64
63
61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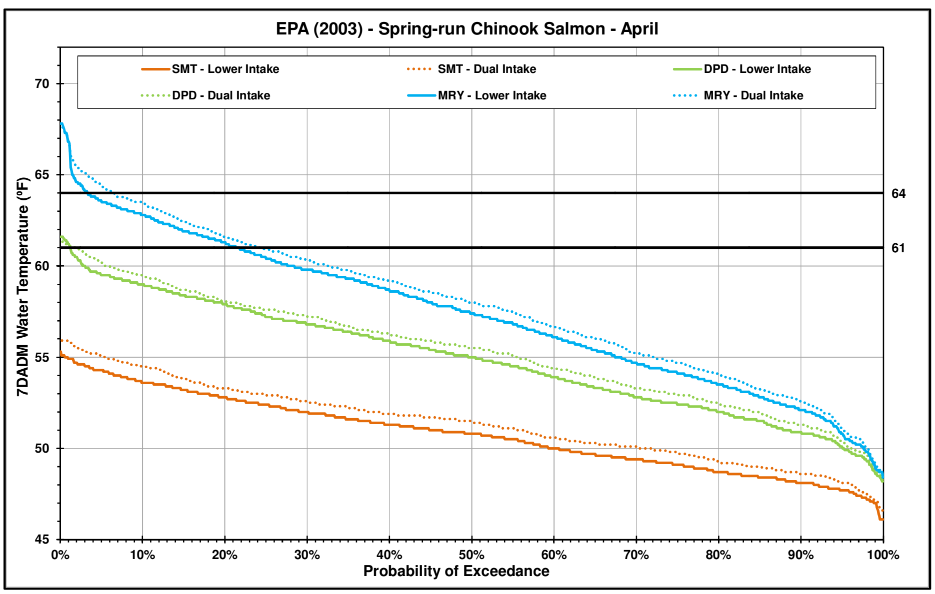
Daily Water Temperature (ºF)
Probability of Exceedance
68
65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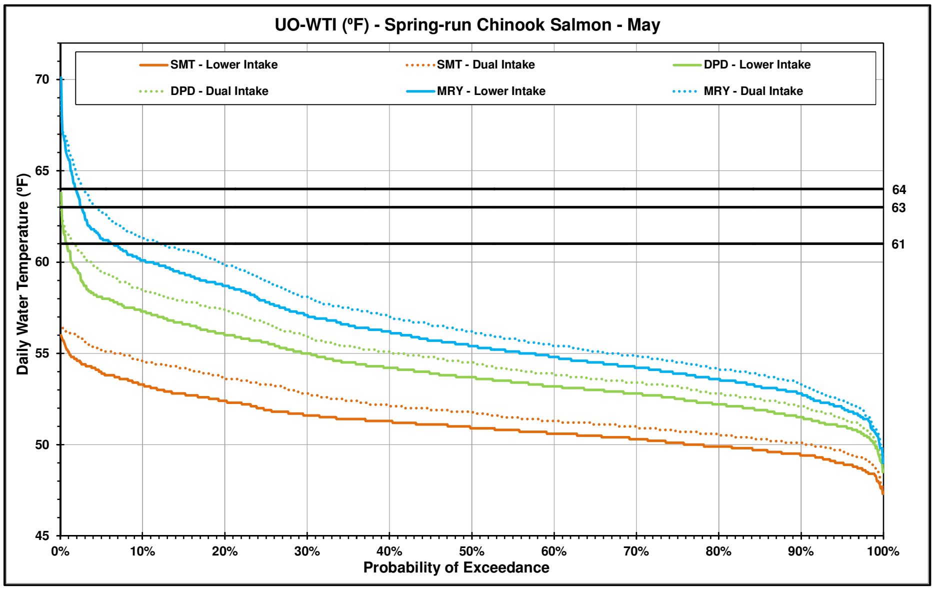
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61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SMT - Dual Intake
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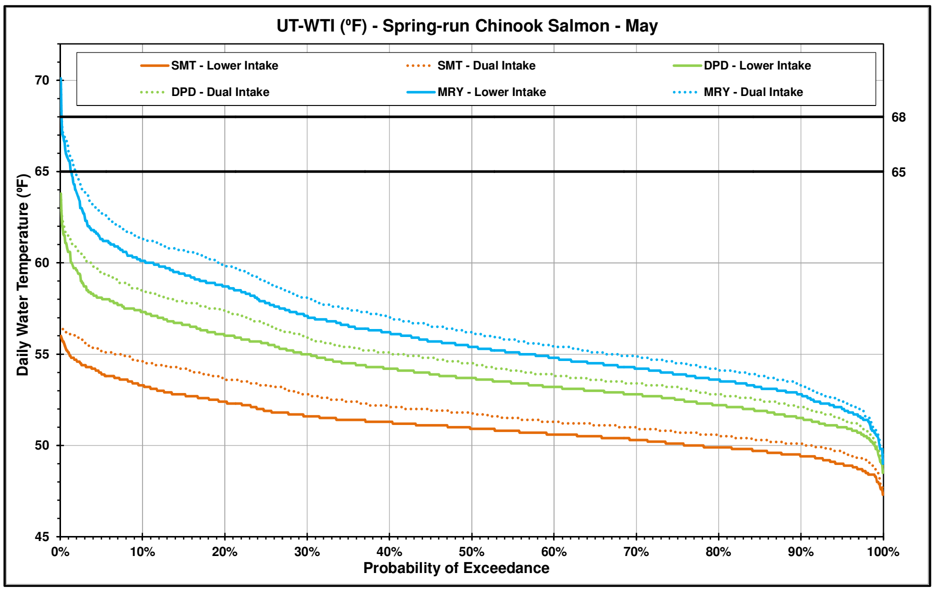
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
64
63
61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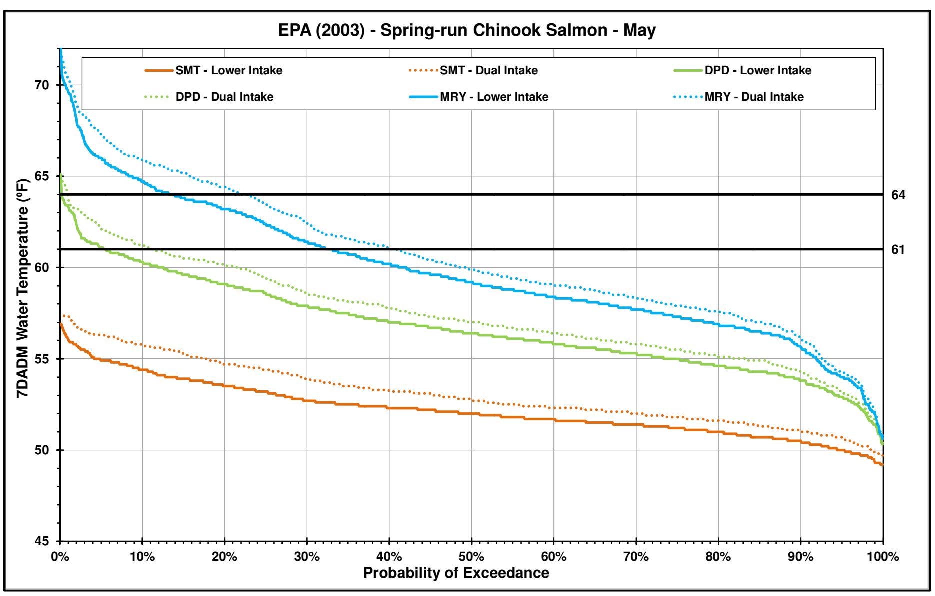
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65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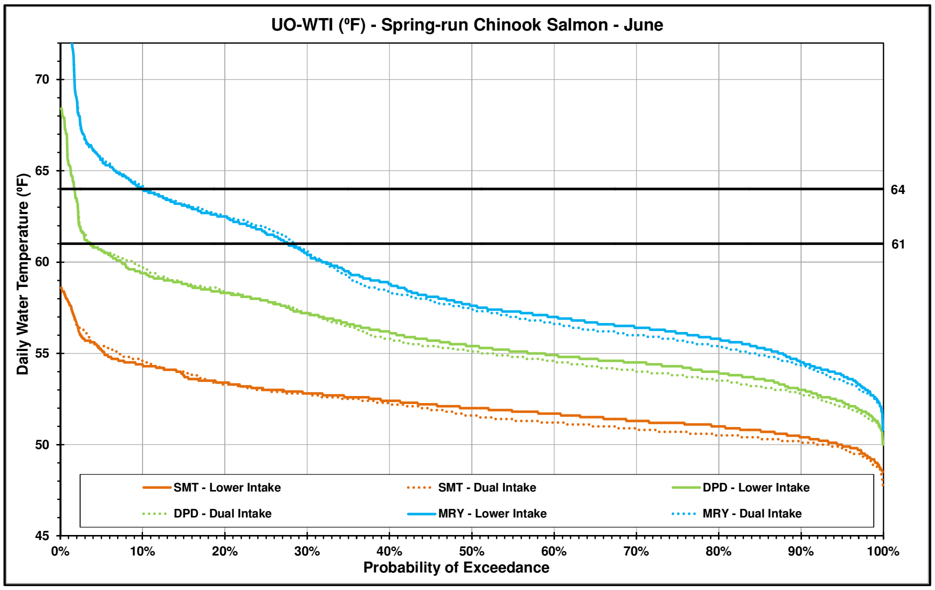
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61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Daily Water Temperature (ºF)
Probability of Exceedance
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61
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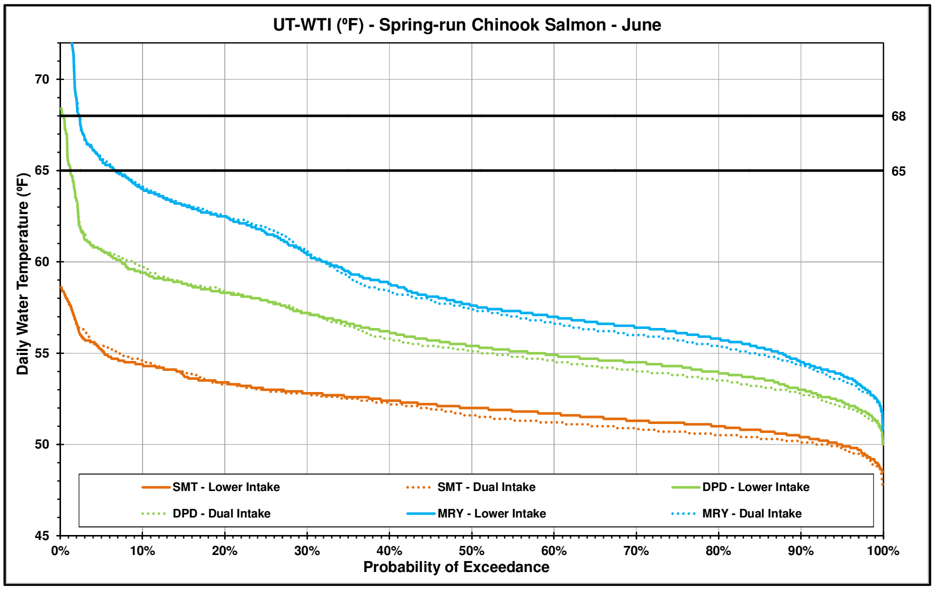
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake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Daily Water Temperature (ºF)
Probability of Exceedance
68
65
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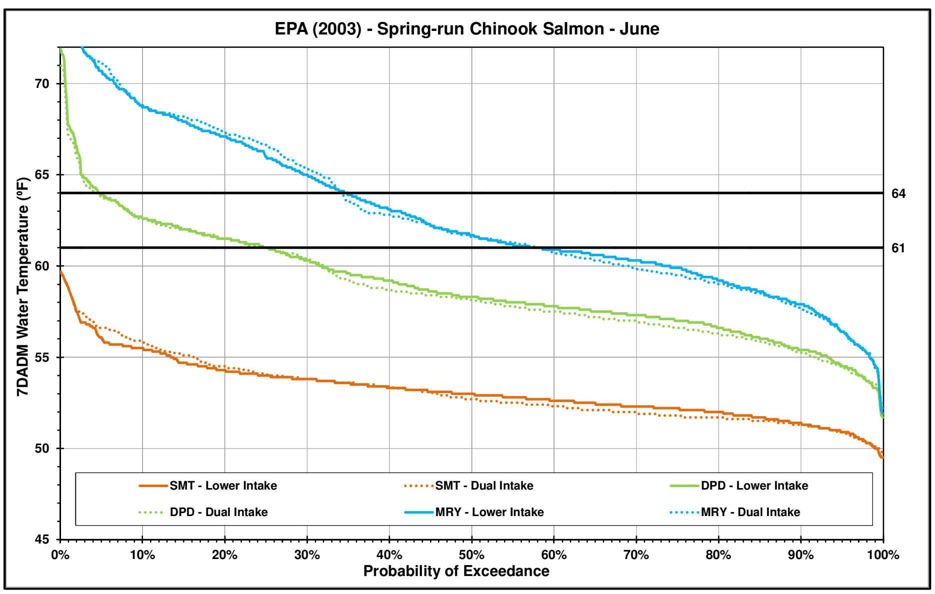
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake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7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
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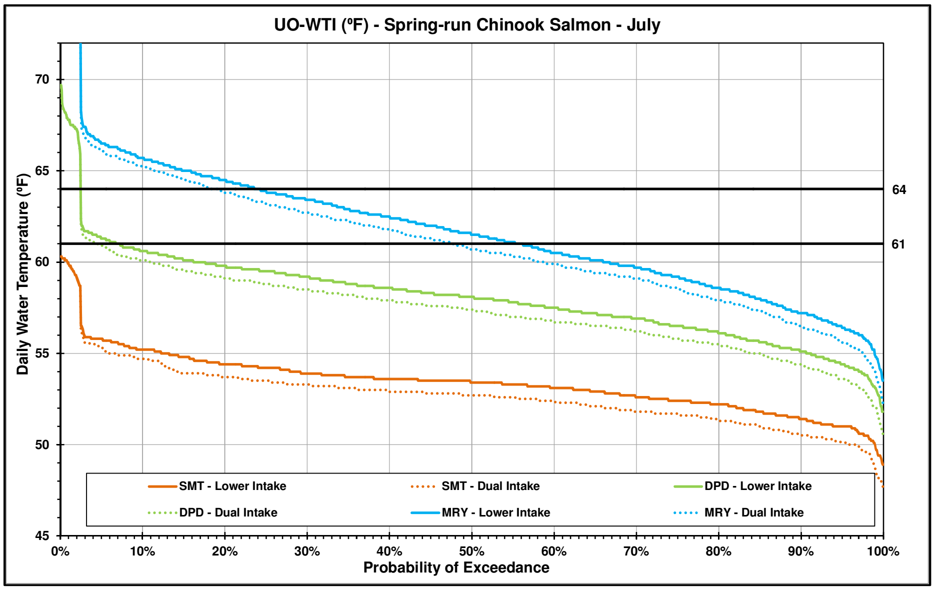
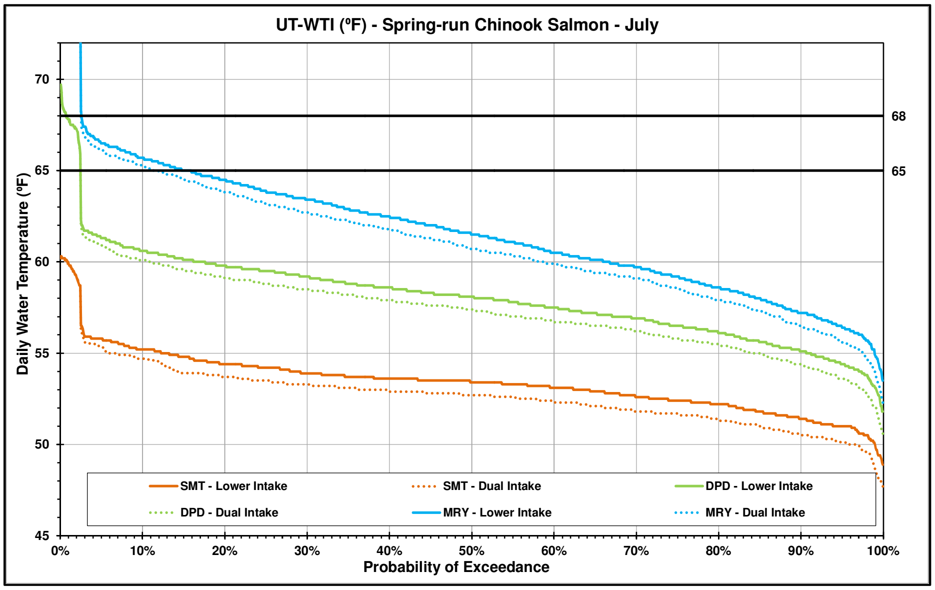
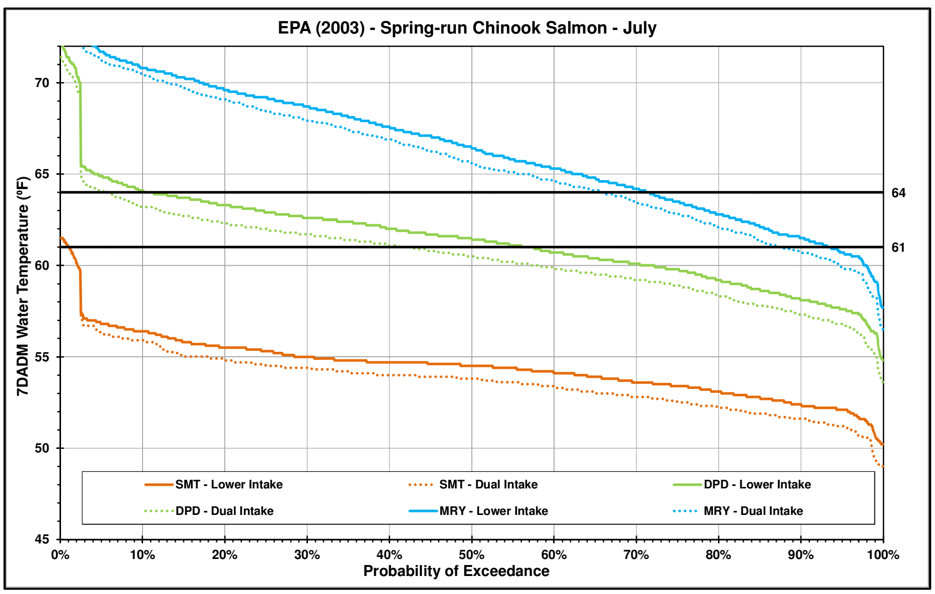
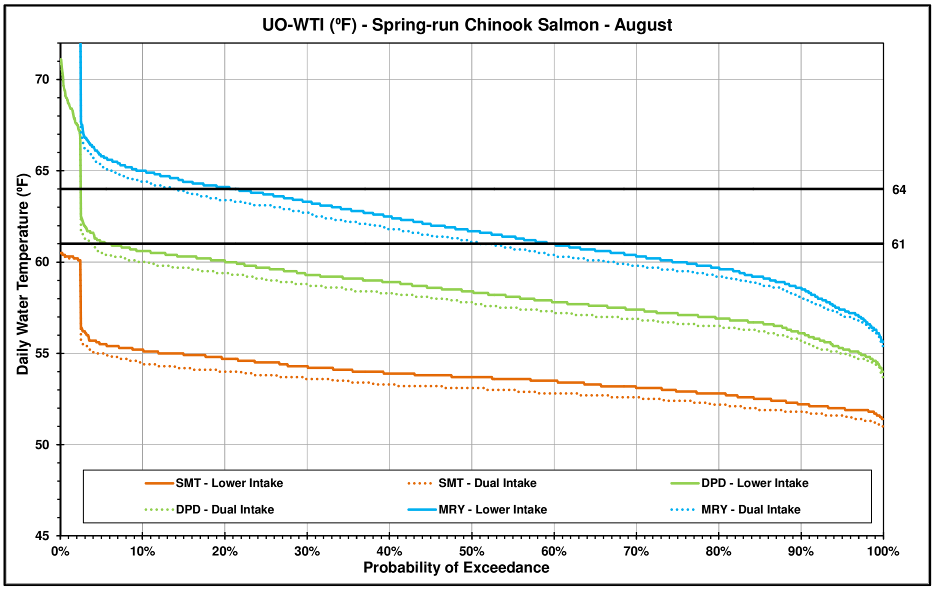
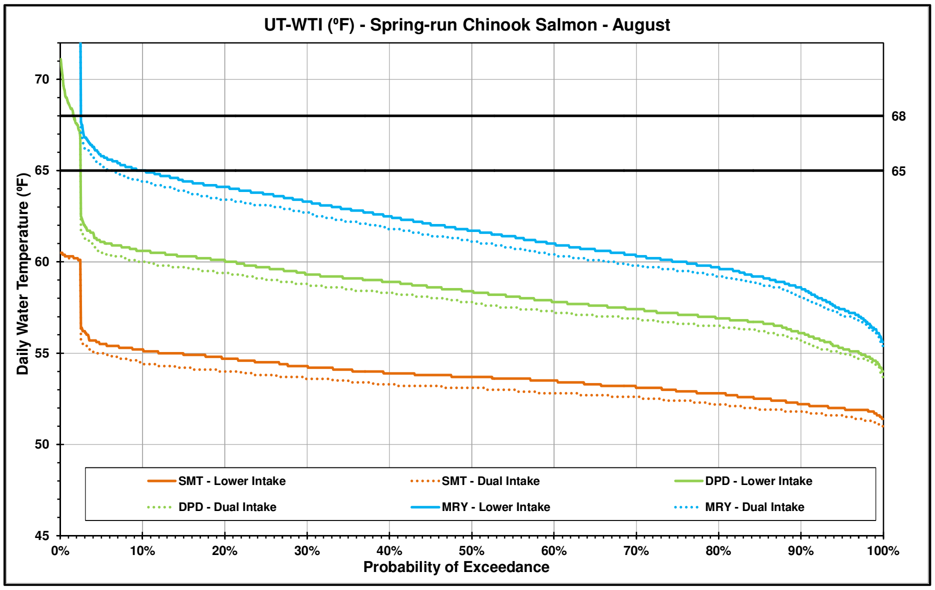
MRY - Dual Intake


UO-WTI (ºF) - Spring-run Chinook Salmon - July
Daily Water Temperature (ºF)
Probability of Exceedance
64
61
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UT-WTI (ºF) - Spring-run Chinook Salmon - July
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


EPA (2003) - Spring-run Chinook Salmon - July
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UO-WTI (ºF) - Spring-run Chinook Salmon - August
Daily Water Temperature (ºF)
Probability of Exceedance
64
61
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UT-WTI (ºF) - Spring-run Chinook Salmon - August
Daily Water Temperature (ºF)
Probability of Exceedance
68
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SMT - Lower Intake
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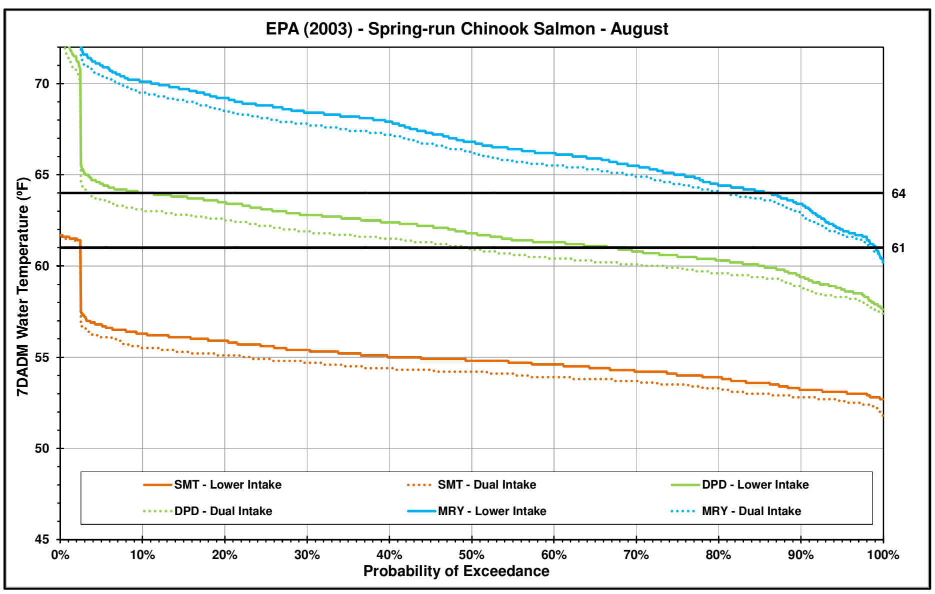
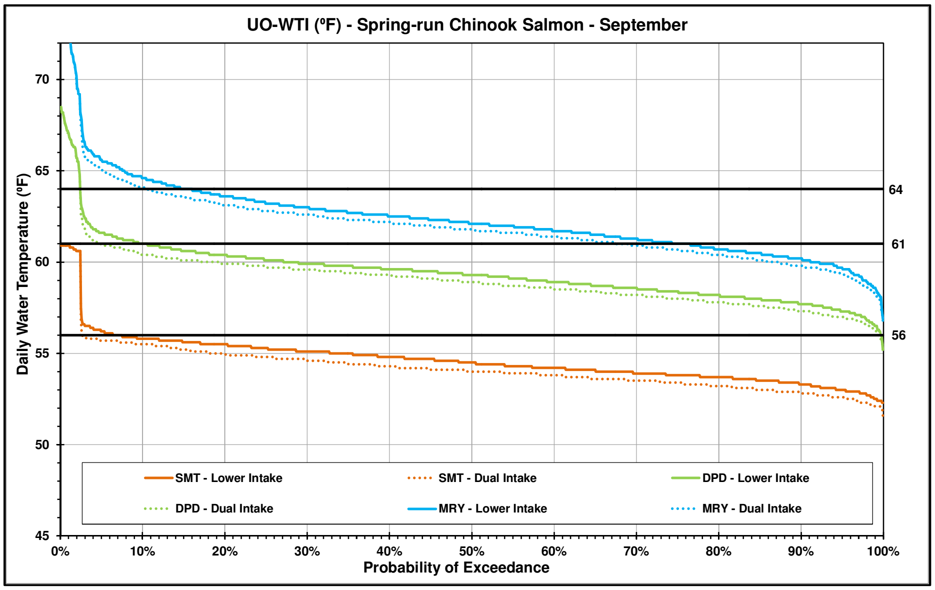
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


EPA (2003) - Spring-run Chinook Salmon - August
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UO-WTI (ºF) - Spring-run Chinook Salmon - September
Daily Water Temperature (ºF)
Probability of Exceedance
64
61
56
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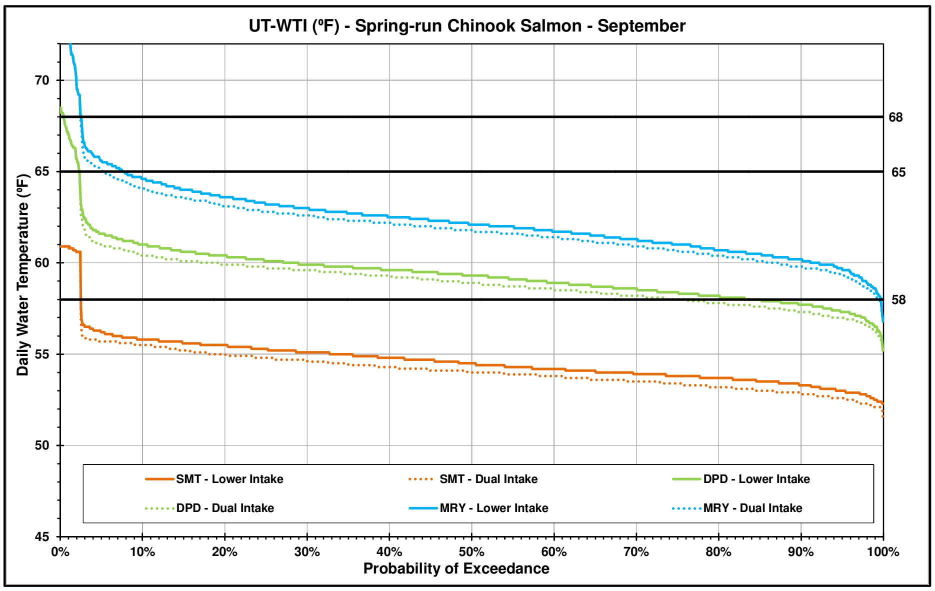
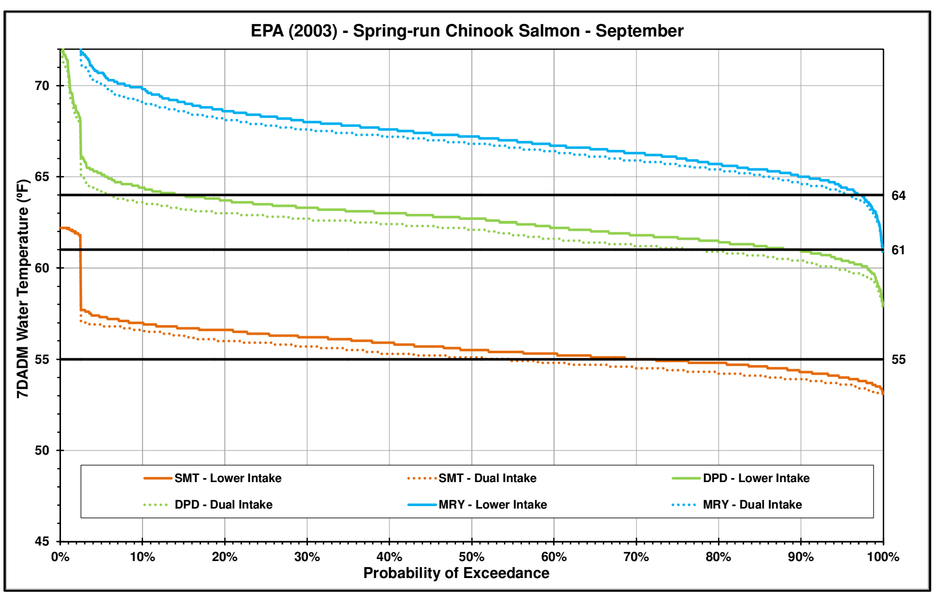
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UT-WTI (ºF) - Spring-run Chinook Salmon - September
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
58
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake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7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
55
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake

Fall-run Chinook Salmon
Water Temperature Exceedance Curves

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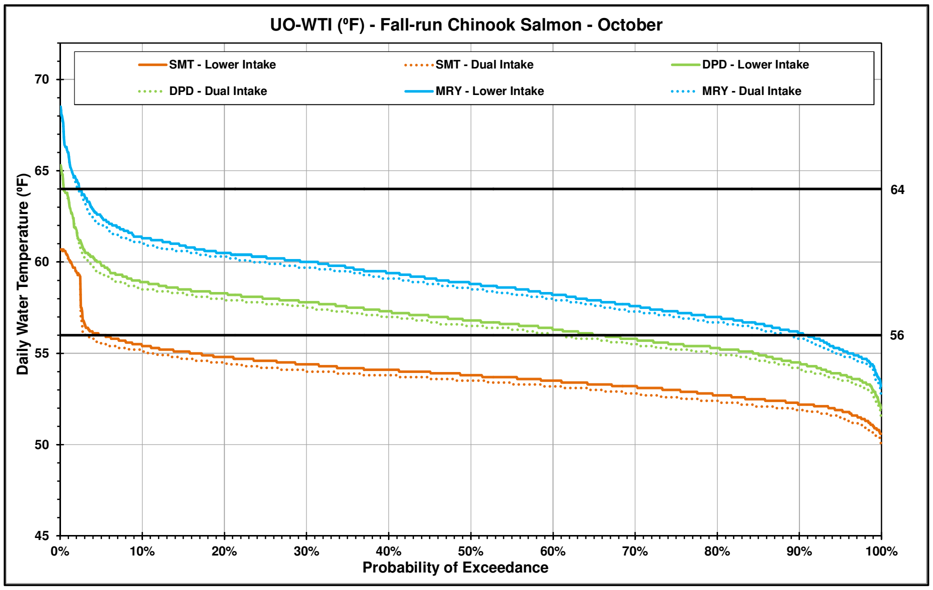
UO-WTI (ºF) - Fall-run Chinook Salmon - October
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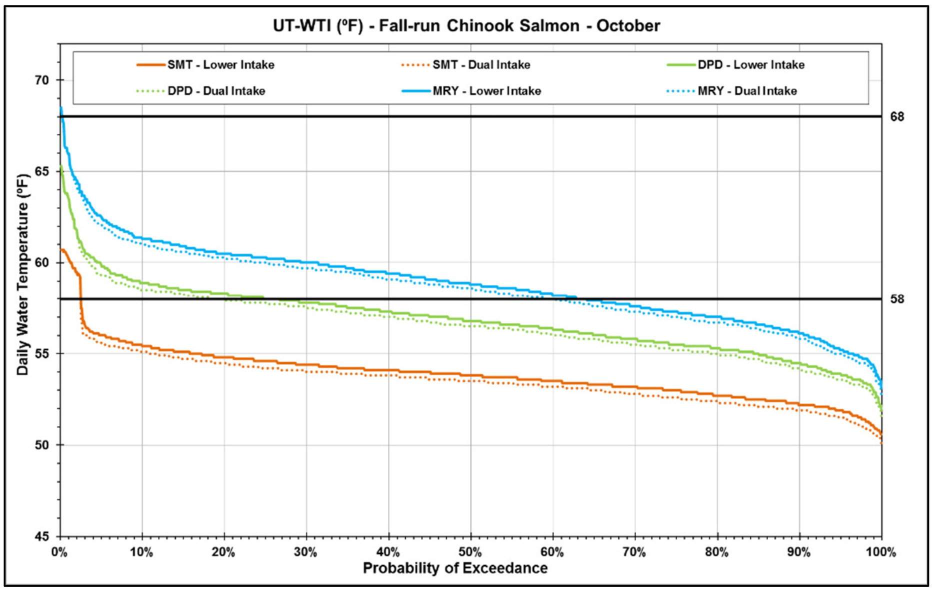
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
64
56


UT-WTI (ºF) - Fall-run Chinook Salmon - October
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DPD - Lower Intake
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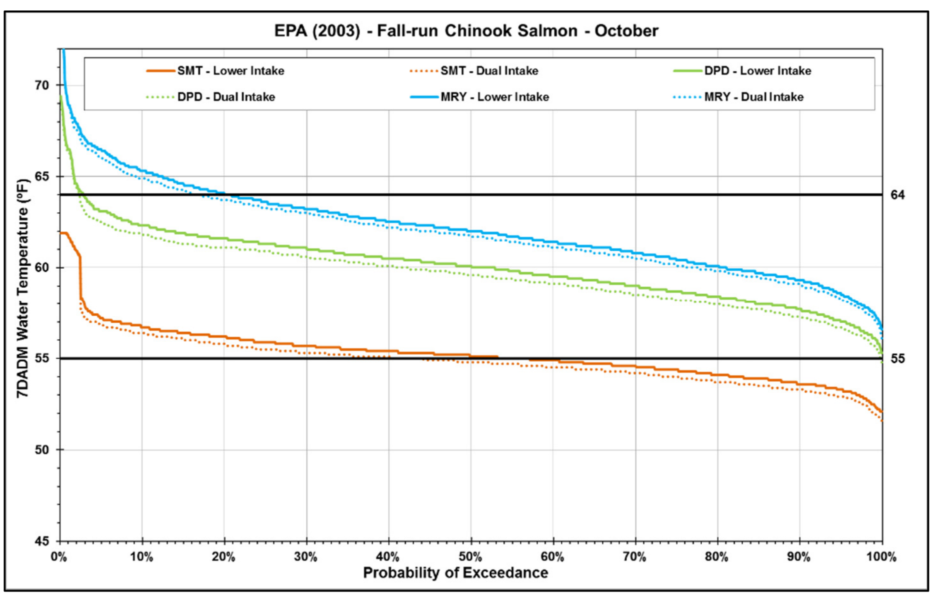
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
58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SMT - Lower Intake
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MRY - Lower Intake
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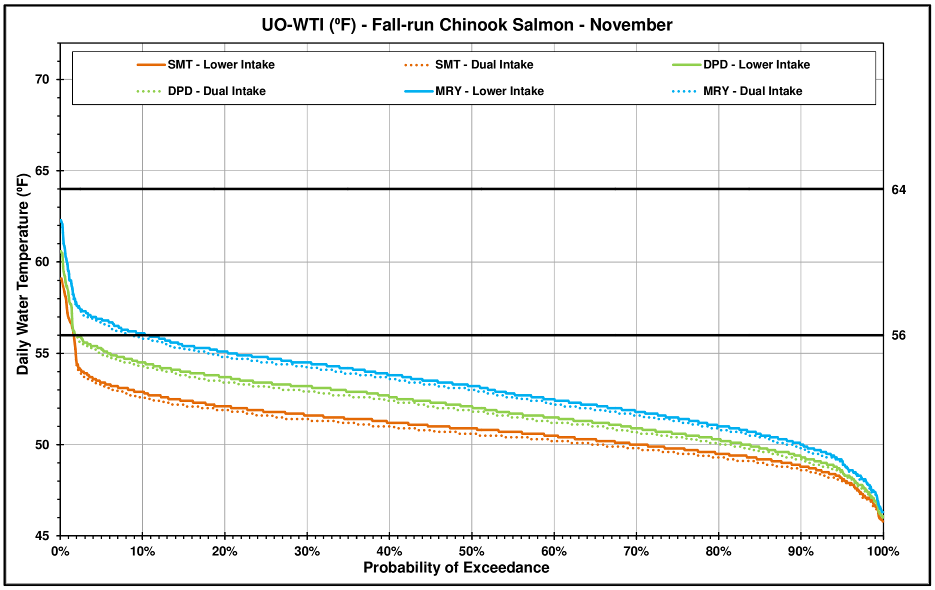
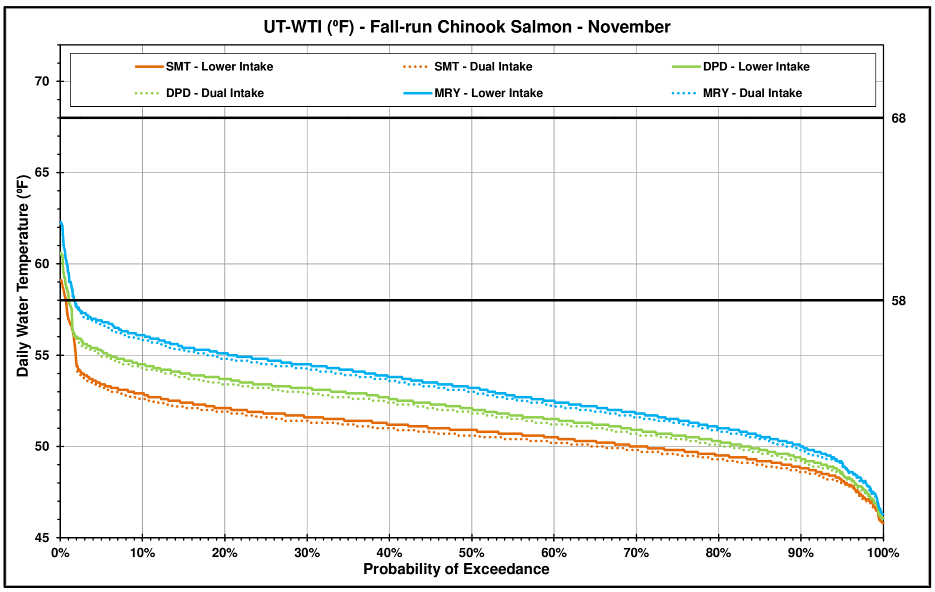
7DADM Water Temperature (ºF)
Probability of Exceedance
64
55


UO-WTI (ºF) - Fall-run Chinook Salmon - November
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
64
56


UT-WTI (ºF) - Fall-run Chinook Salmon - November
SMT - Lower Intake
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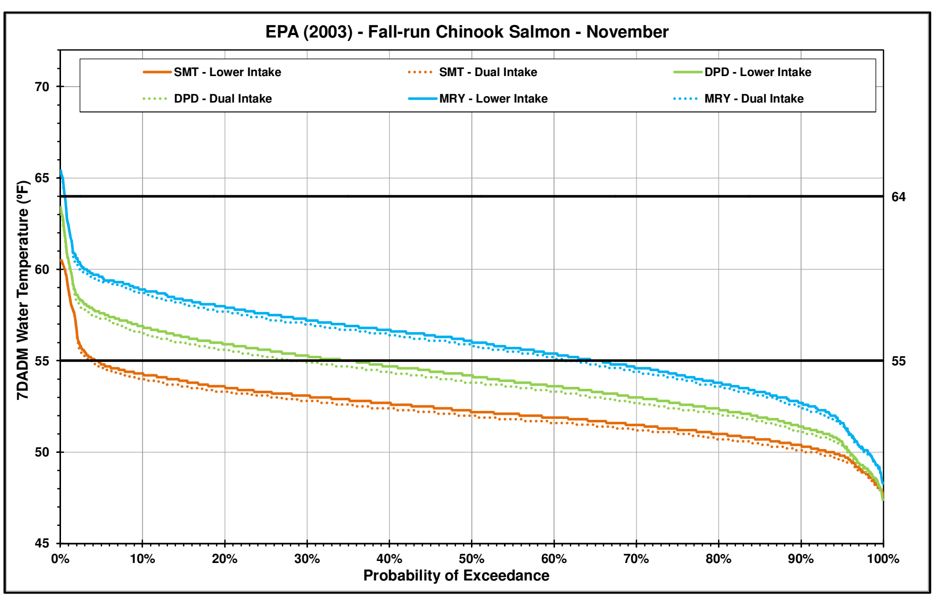
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
58


EPA (2003) - Fall-run Chinook Salmon - November
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
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MRY - Lower Intake
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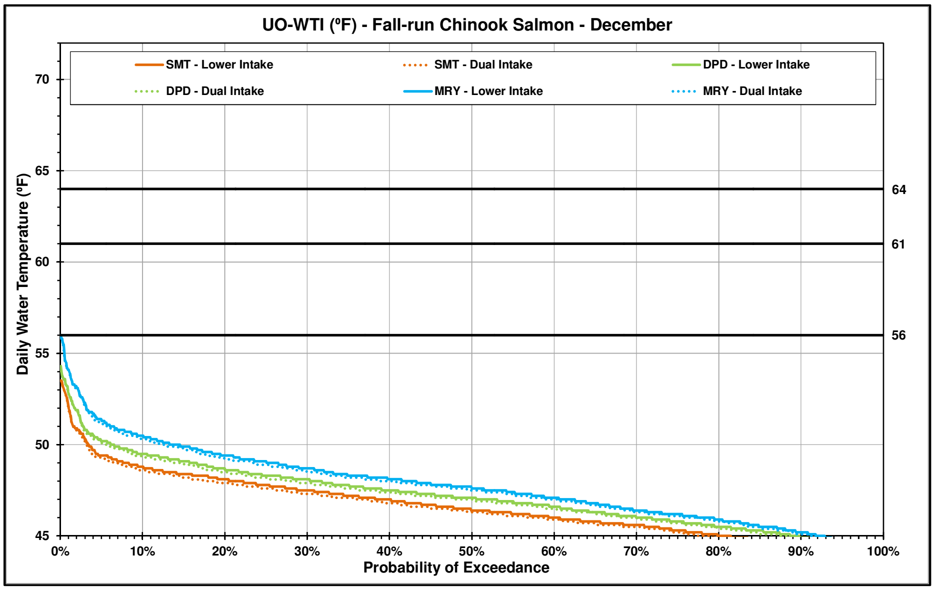
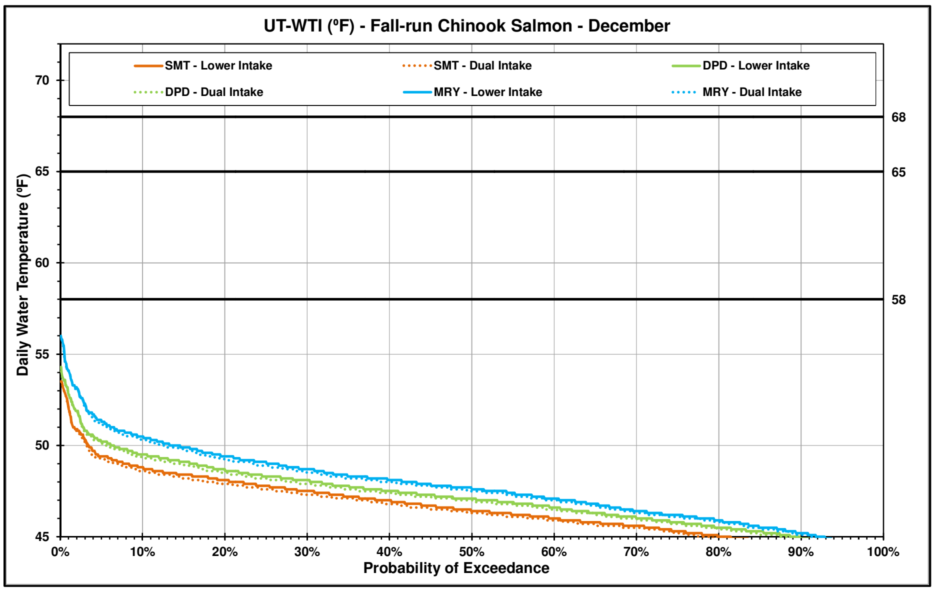
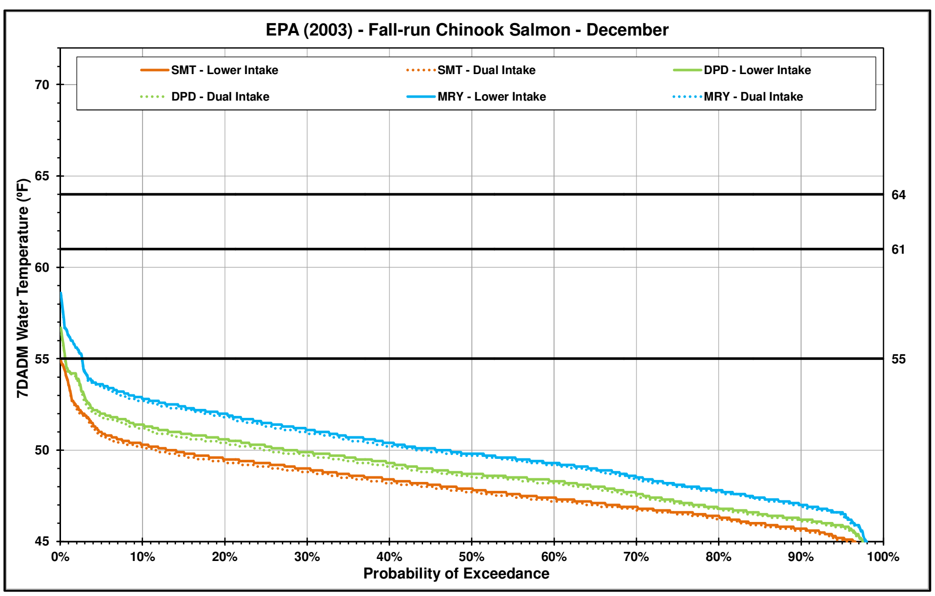
7DADM Water Temperature (ºF)
Probability of Exceedance
64
55


UO-WTI (ºF) - Fall-run Chinook Salmon - December
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
64
61
56


UT-WTI (ºF) - Fall-run Chinook Salmon - December
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
58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SMT - Dual Intake
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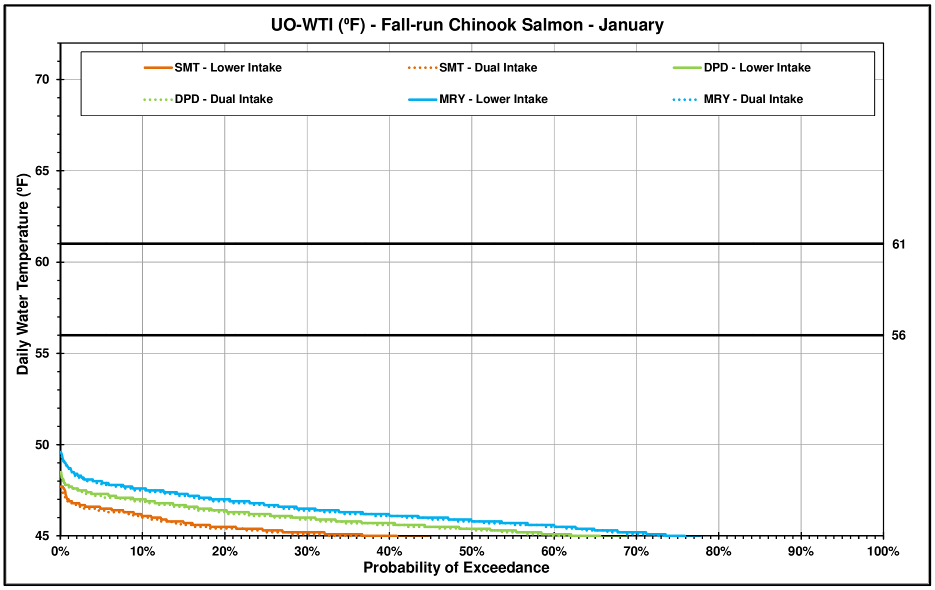
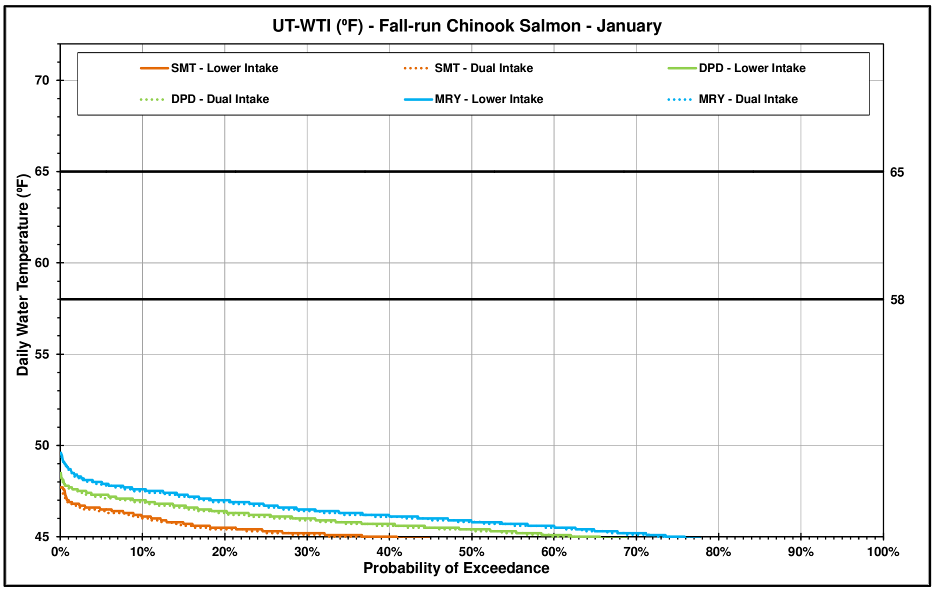
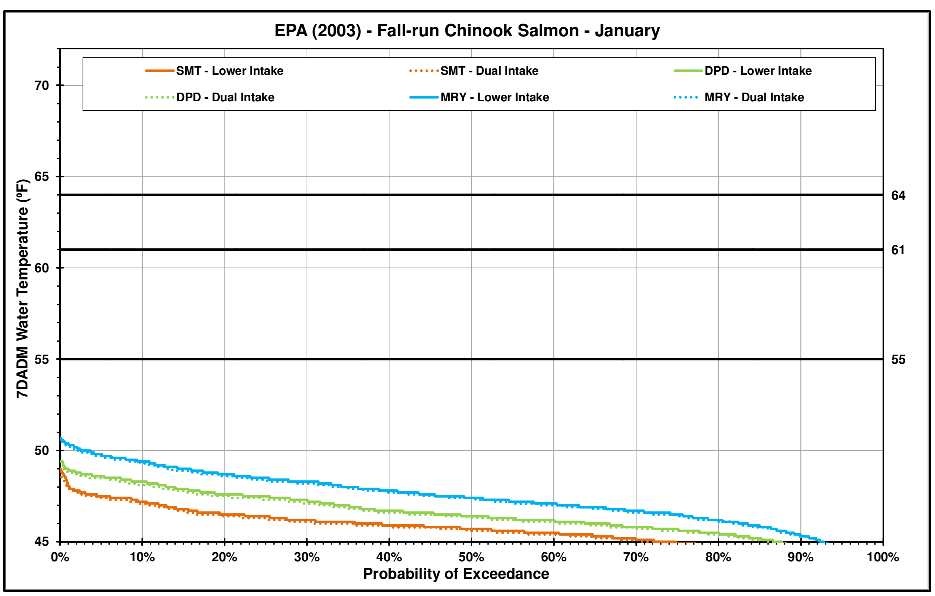
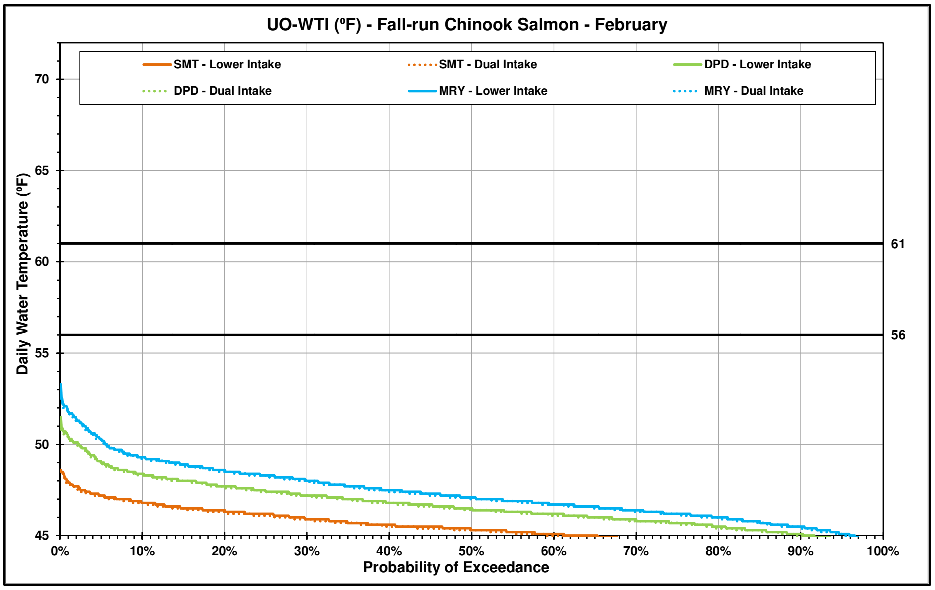
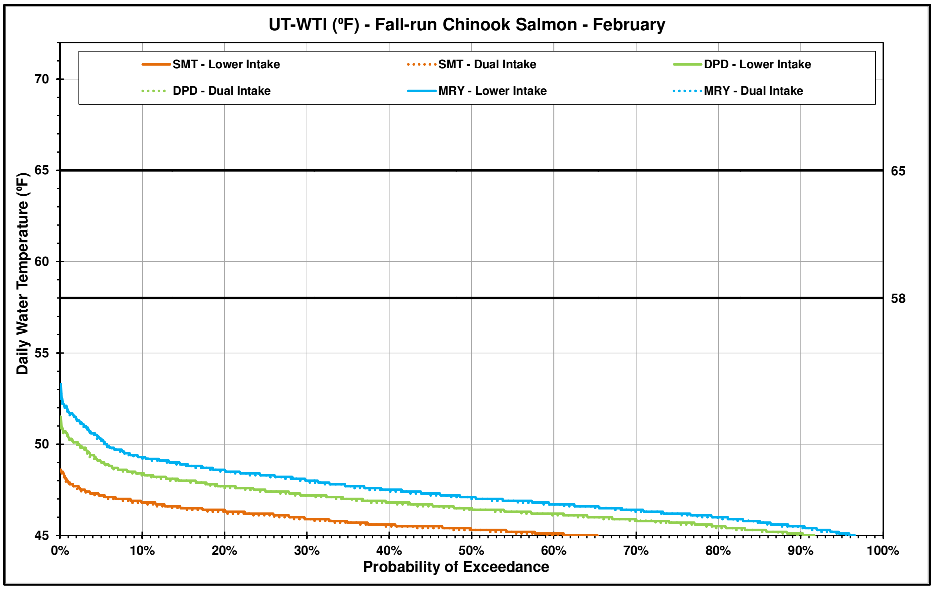
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
55


UO-WTI (ºF) - Fall-run Chinook Salmon - January
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
61
56
Probability of Exceedance


UT-WTI (ºF) - Fall-run Chinook Salmon - January
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
65
58
Probability of Exceedance


EPA (2003) - Fall-run Chinook Salmon - January
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
64
61
55
Probability of Exceedance


UO-WTI (ºF) - Fall-run Chinook Salmon - February
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
70
65
60
55
50
45
61
56
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Probability of Exceedance


UT-WTI (ºF) - Fall-run Chinook Salmon - February
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
70
65
60
55
50
45
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58
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40%
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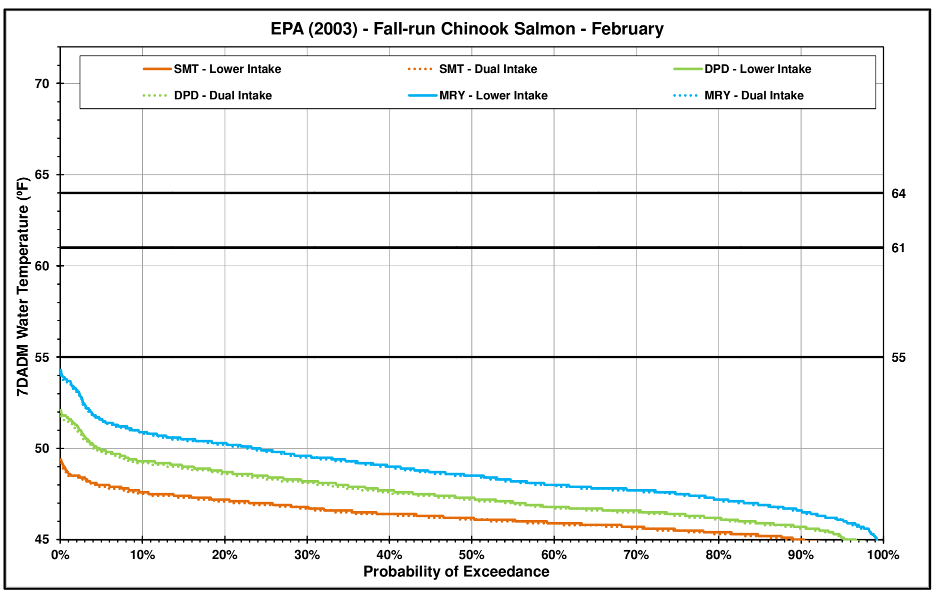
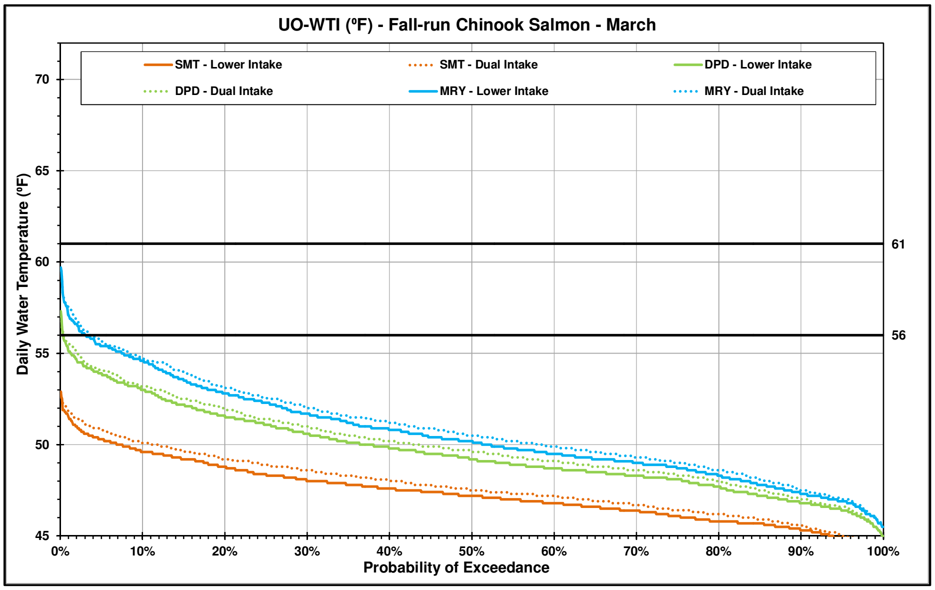
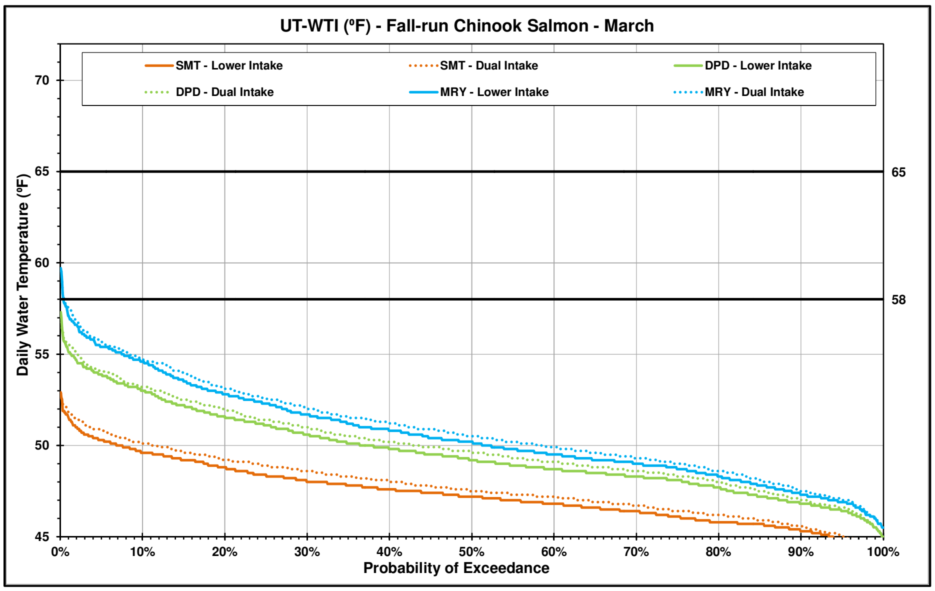
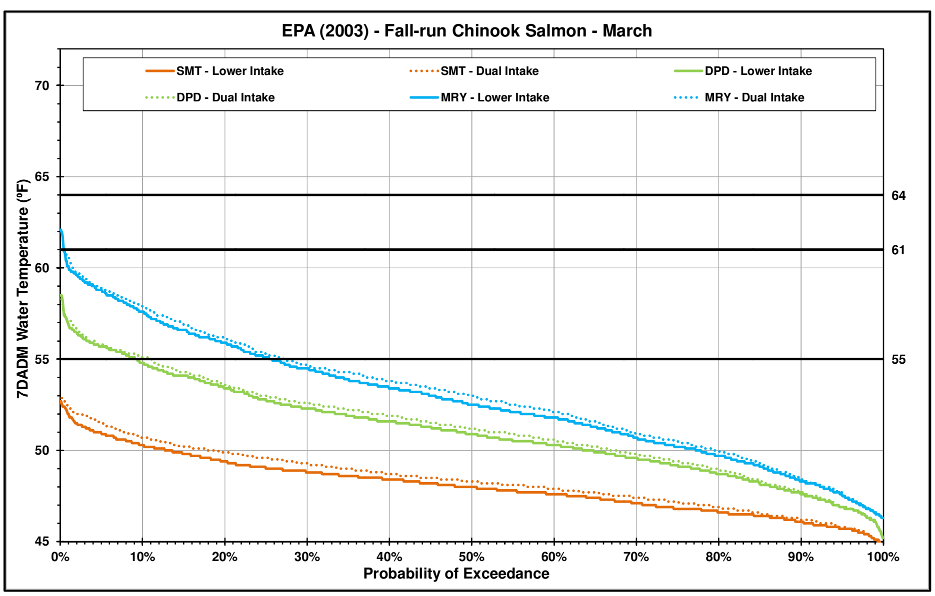
80%
90%
100%
Probability of Exceedance


EPA (2003) - Fall-run Chinook Salmon - February
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
70
65
60
55
50
45
64
61
55
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Probability of Exceedance


UO-WTI (°F) - Fall-run Chinook Salmon - March
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (°F)
Probability of Exceedance
61
56


UT-WTI (°F) - Fall-run Chinook Salmon - March
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (°F)
Probability of Exceedance
65
58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SMT - Lower Intake
SMT - Dual Intake
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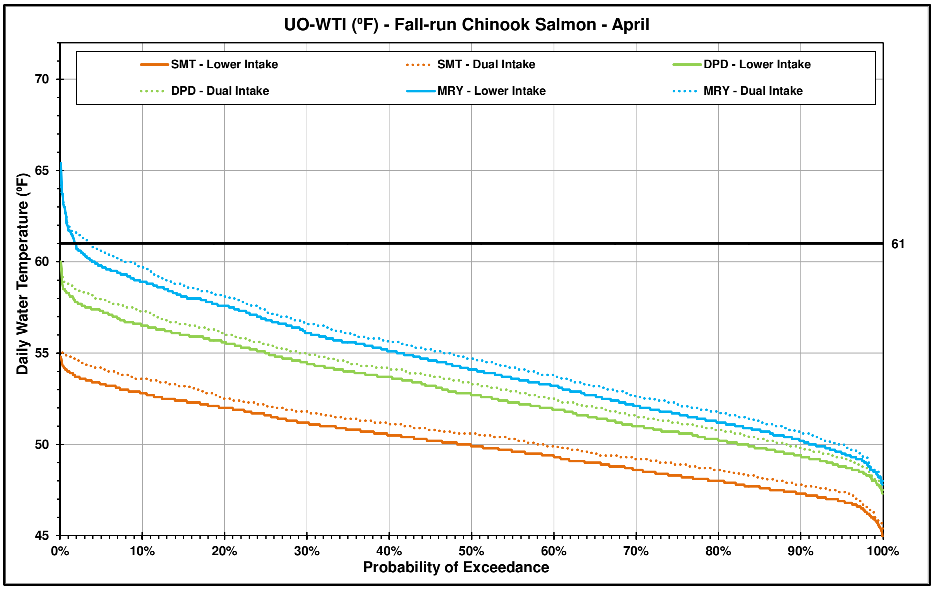
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (°F)
Probability of Exceedance
64
61
55


UO-WTI (ºF) - Fall-run Chinook Salmon - April
SMT - Lower Intake
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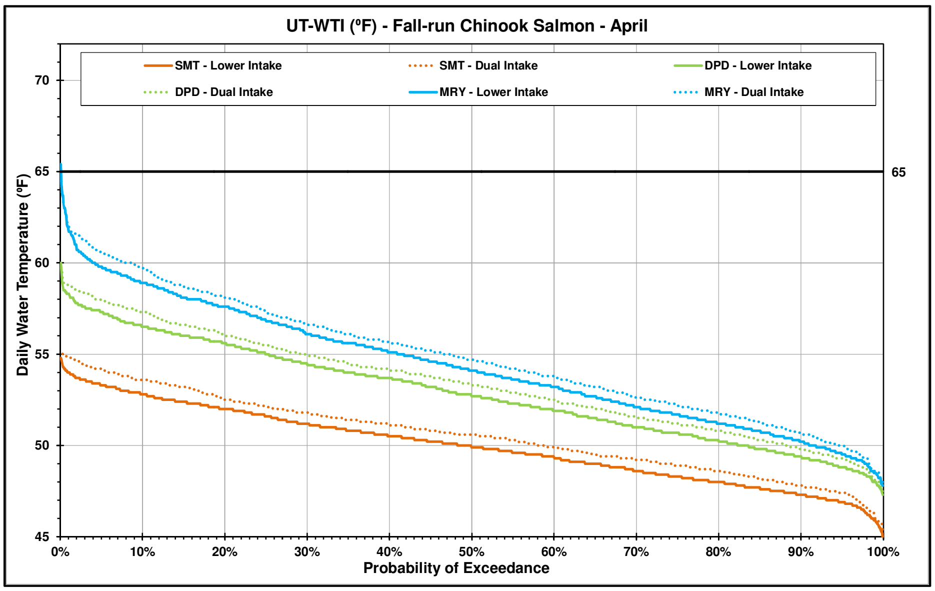
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
61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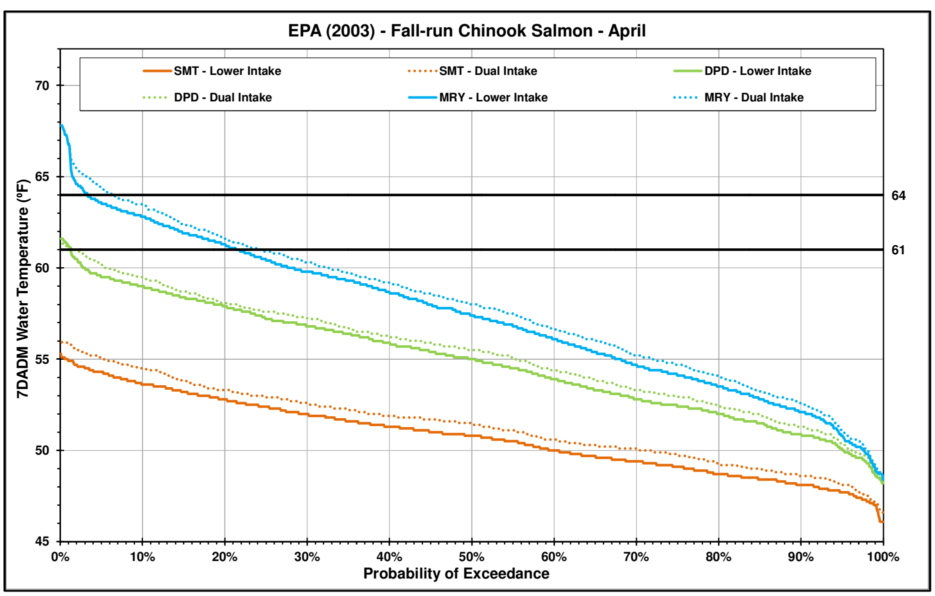
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
65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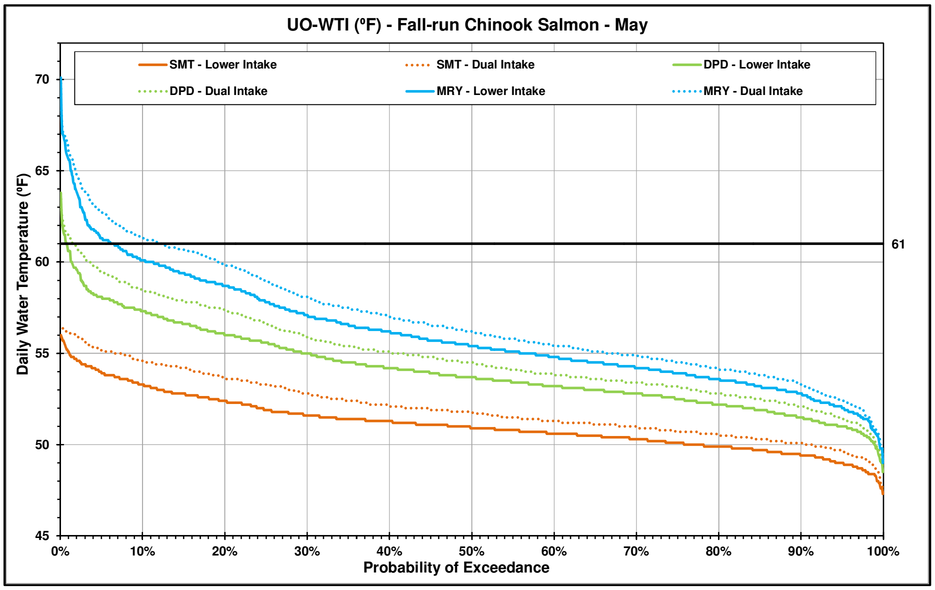
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61


UO-WTI (ºF) - Fall-run Chinook Salmon - May
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
61
45
50
55
60
65
70
0%
10%
20%
30%
40%
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70%
80%
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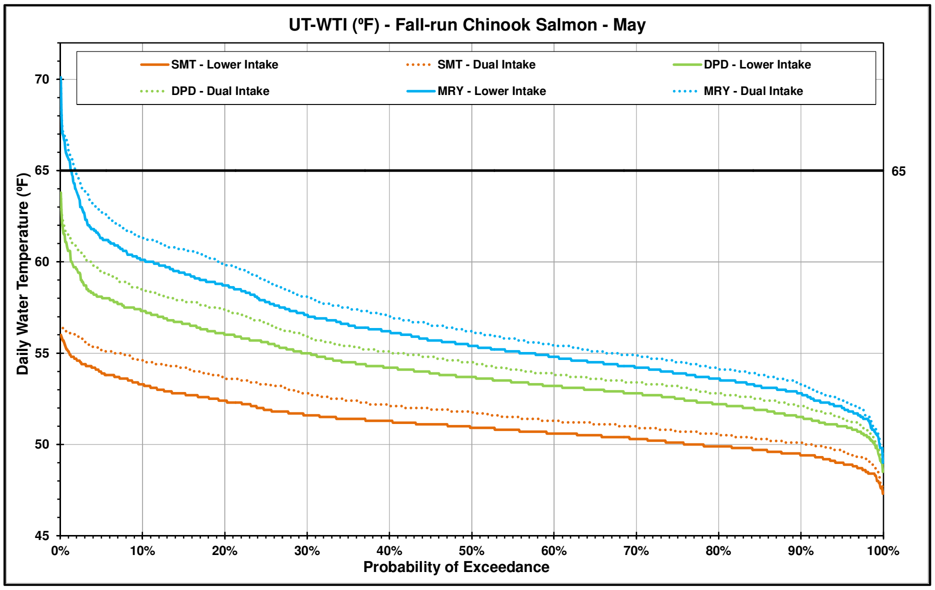
100%


UT-WTI (ºF) - Fall-run Chinook Salmon - May
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
65
45
50
55
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65
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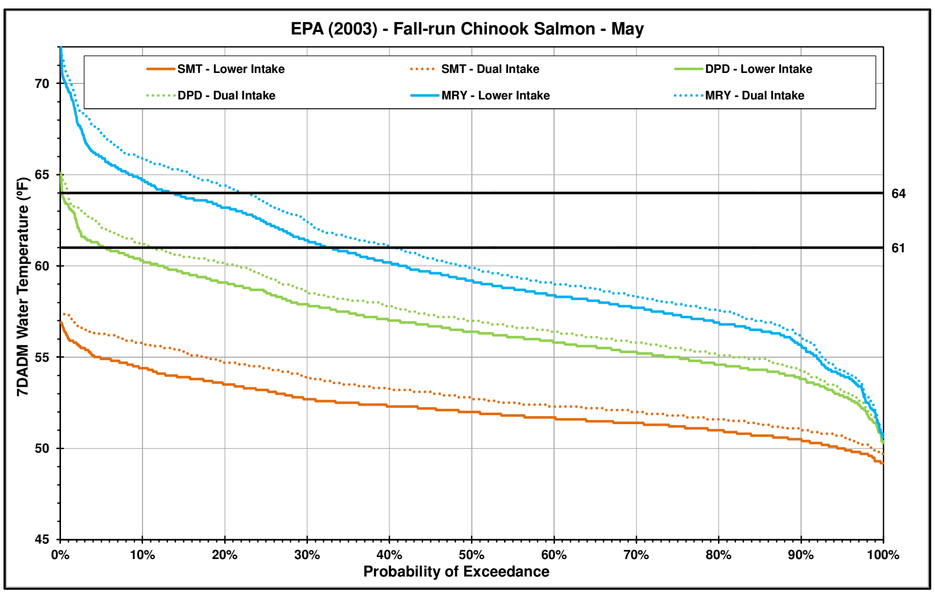
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SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
45
50
55
60
65
70
0%
10%
20%
30%
40%
50%
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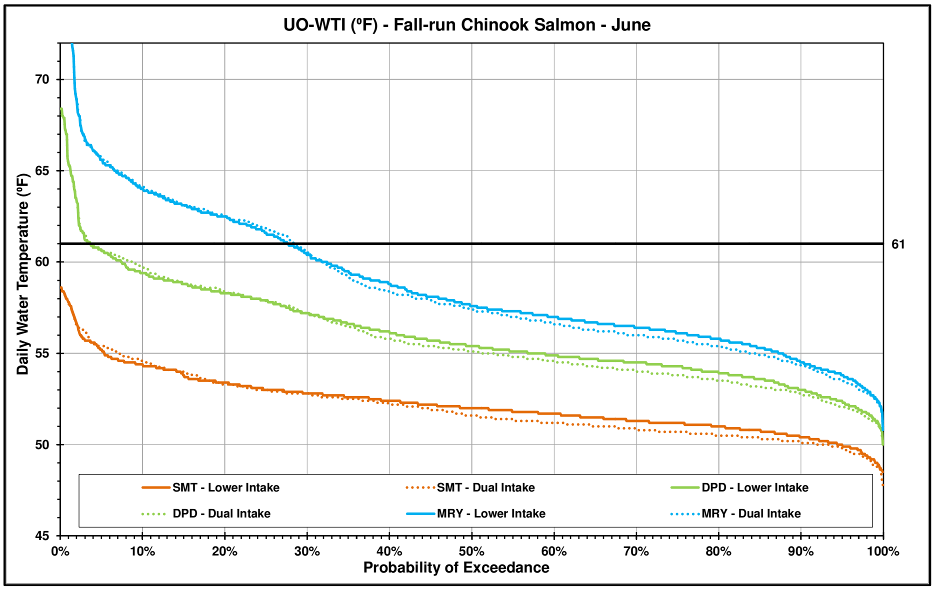
80%
90%
100%


UO-WTI (ºF) - Fall-run Chinook Salmon - June
Daily Water Temperature (ºF)
Probability of Exceedance
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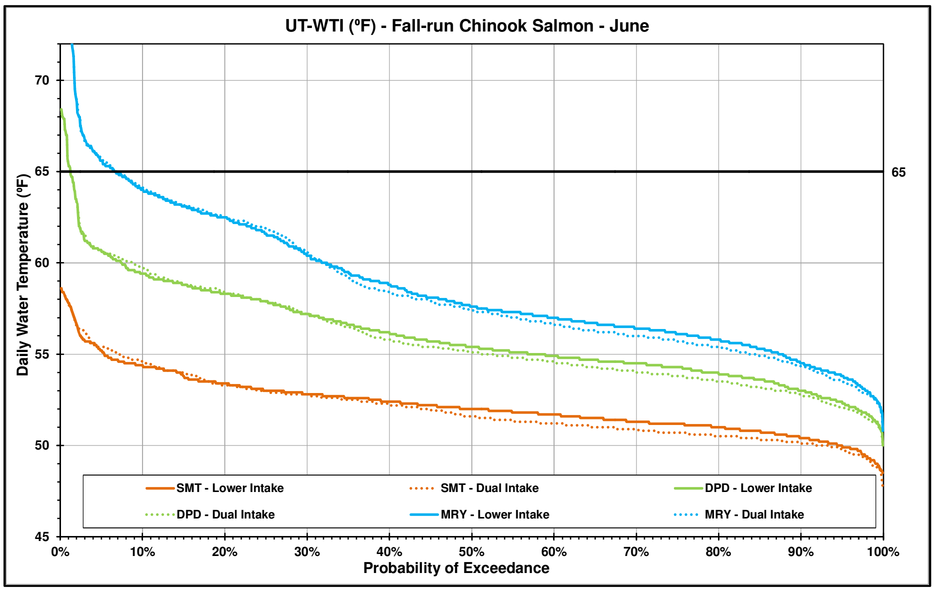
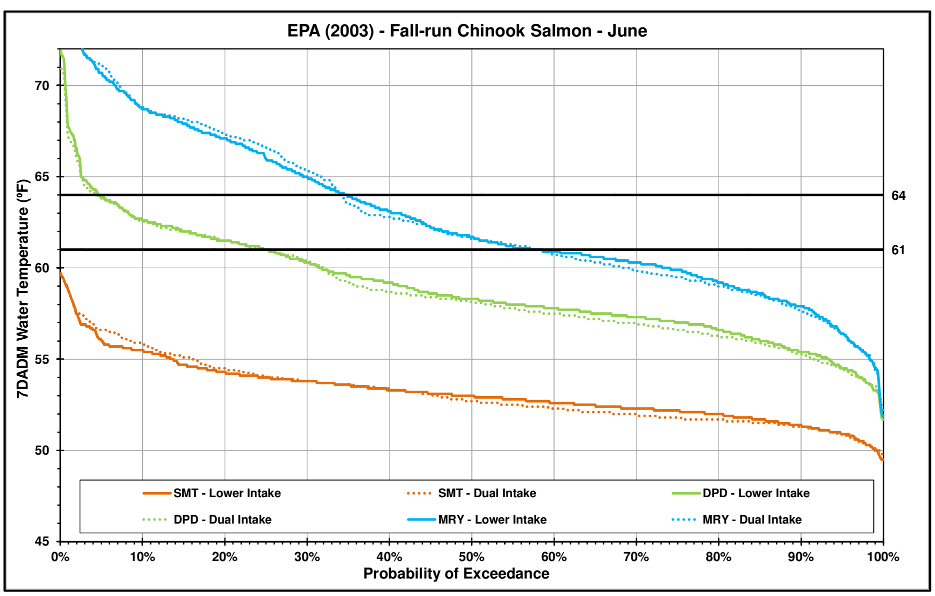
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UT-WTI (ºF) - Fall-run Chinook Salmon - June
Daily Water Temperature (ºF)
Probability of Exceedance
65
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake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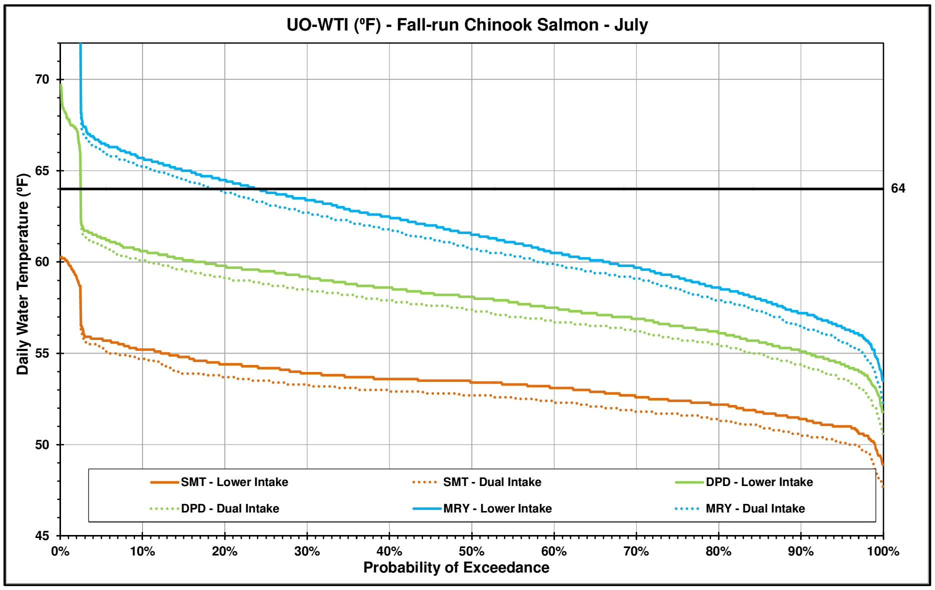
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UO-WTI (ºF) - Fall-run Chinook Salmon - July
Daily Water Temperature (ºF)
Probability of Exceedance
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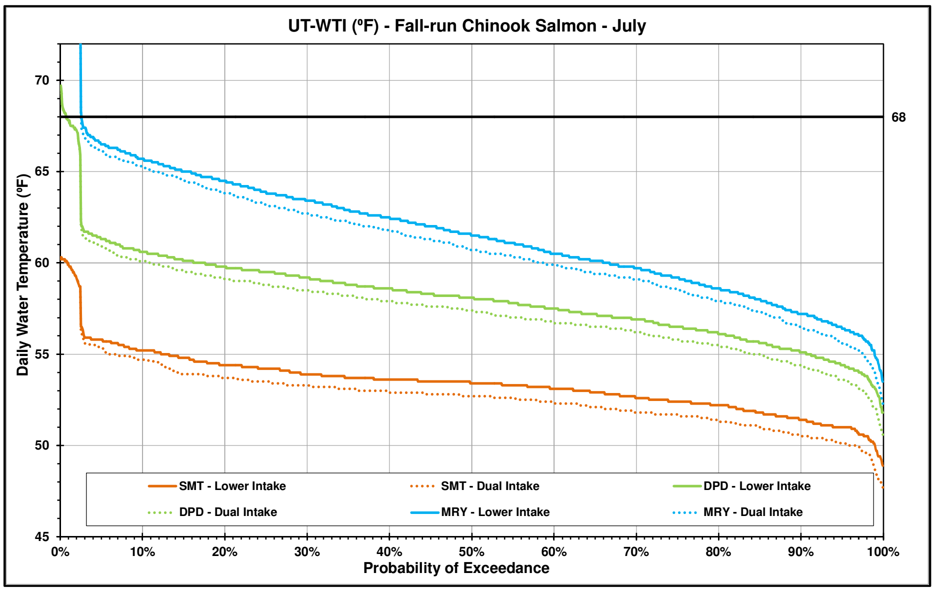
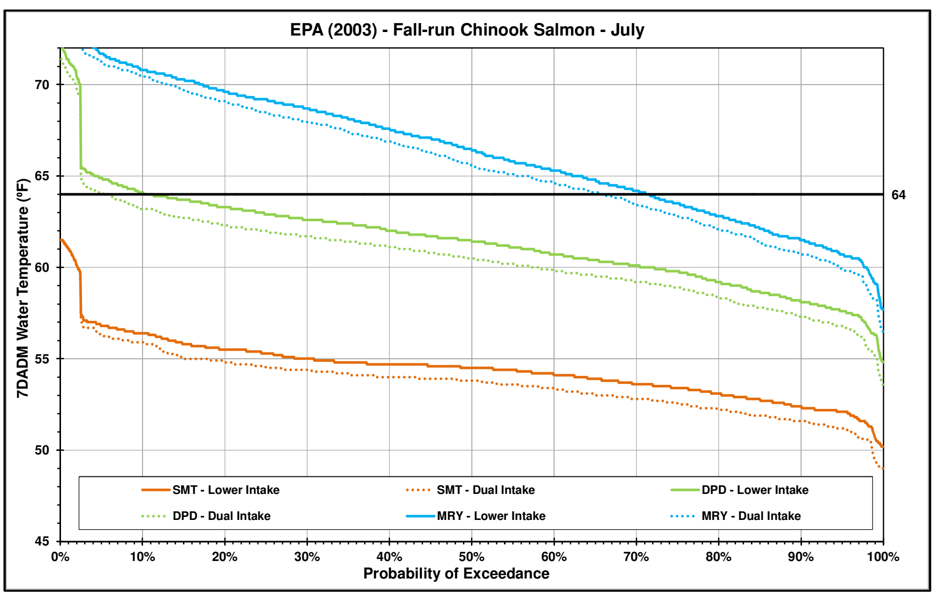
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UT-WTI (ºF) - Fall-run Chinook Salmon - July
Daily Water Temperature (ºF)
Probability of Exceedance
68
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


EPA (2003) - Fall-run Chinook Salmon - July
7DADM Water Temperature (ºF)
Probability of Exceedance
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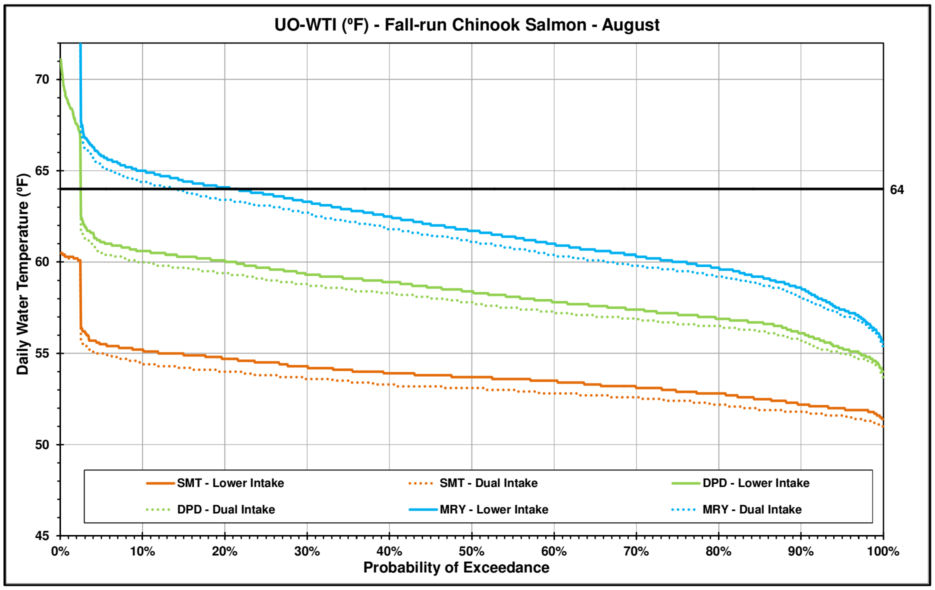
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UO-WTI (ºF) - Fall-run Chinook Salmon - August
Daily Water Temperature (ºF)
Probability of Exceedance
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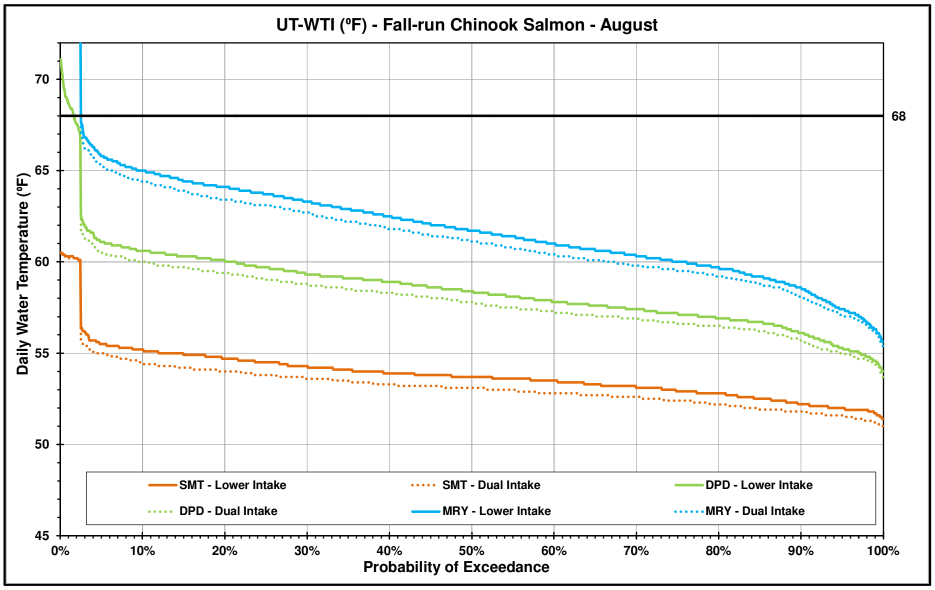
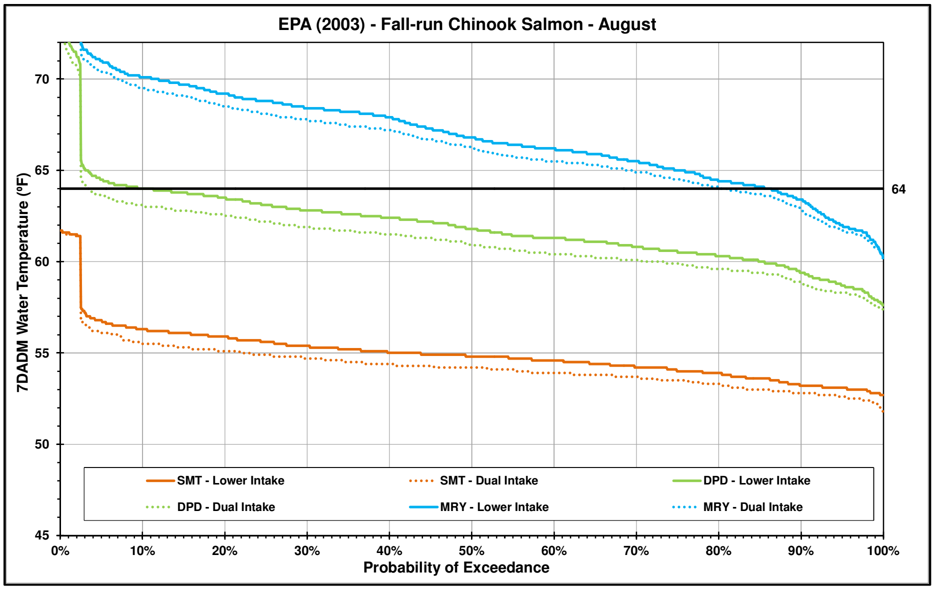
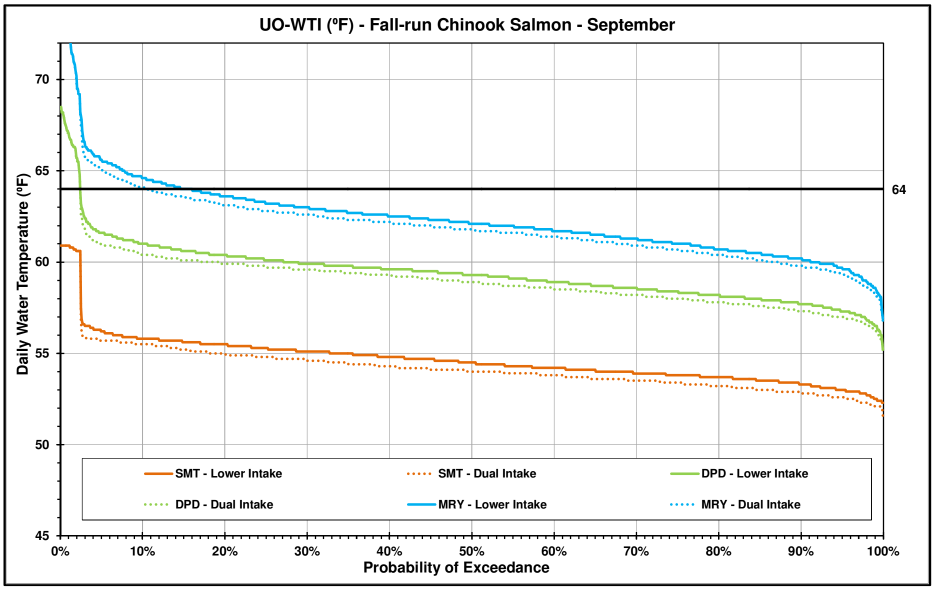
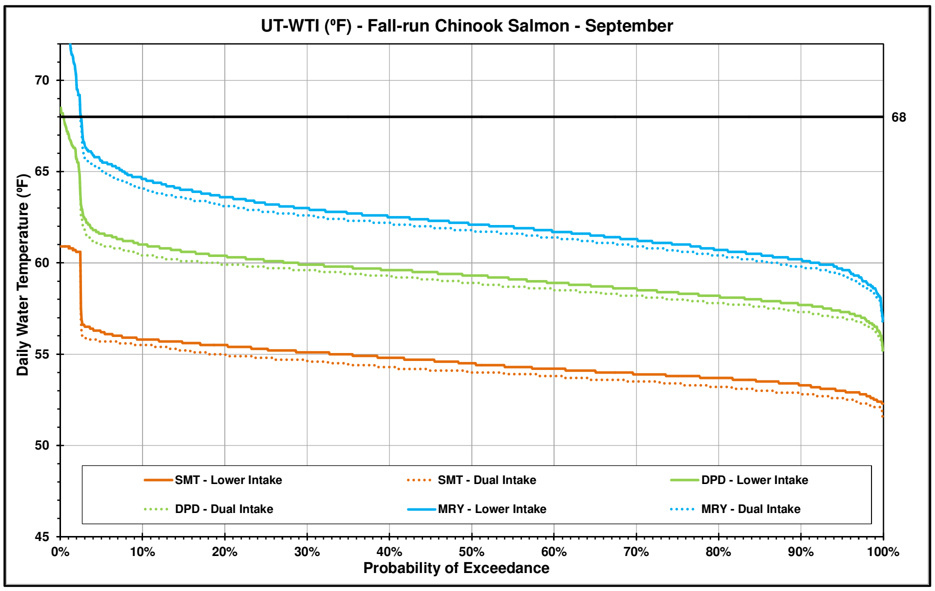
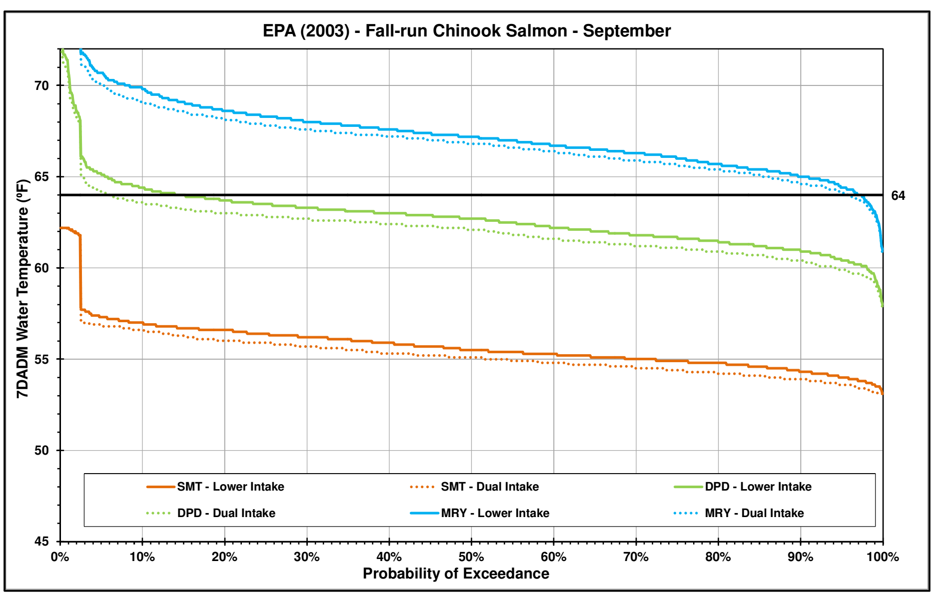
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UT-WTI (ºF) - Fall-run Chinook Salmon - August
Daily Water Temperature (ºF)
Probability of Exceedance
68
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


EPA (2003) - Fall-run Chinook Salmon - August
7DADM Water Temperature (ºF)
Probability of Exceedance
64
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UO-WTI (ºF) - Fall-run Chinook Salmon - September
Daily Water Temperature (ºF)
Probability of Exceedance
64
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UT-WTI (ºF) - Fall-run Chinook Salmon - September
Daily Water Temperature (ºF)
Probability of Exceedance
68
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


EPA (2003) - Fall-run Chinook Salmon - September
7DADM Water Temperature (ºF)
Probability of Exceedance
64
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake

Steelhead
Water Temperature Exceedance Curves

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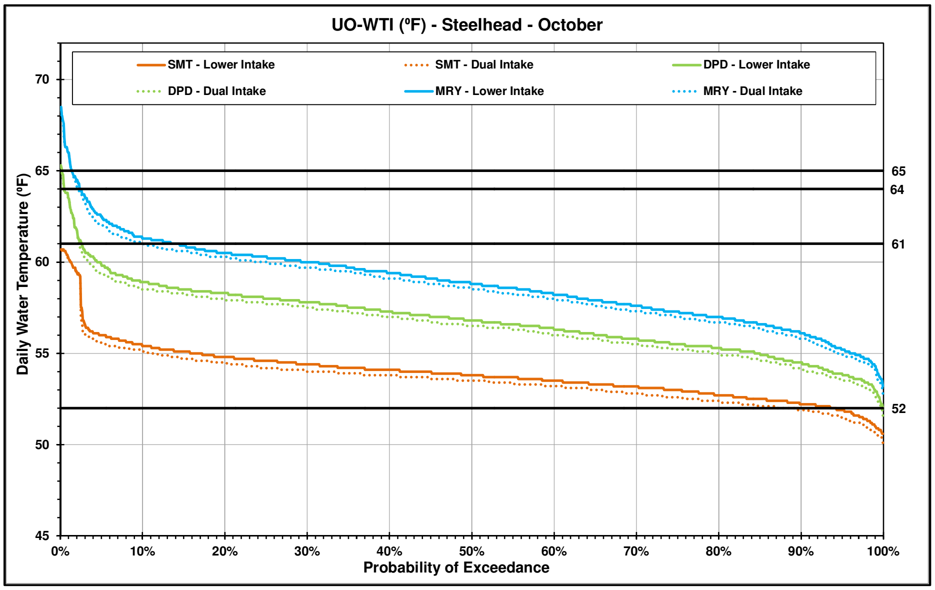
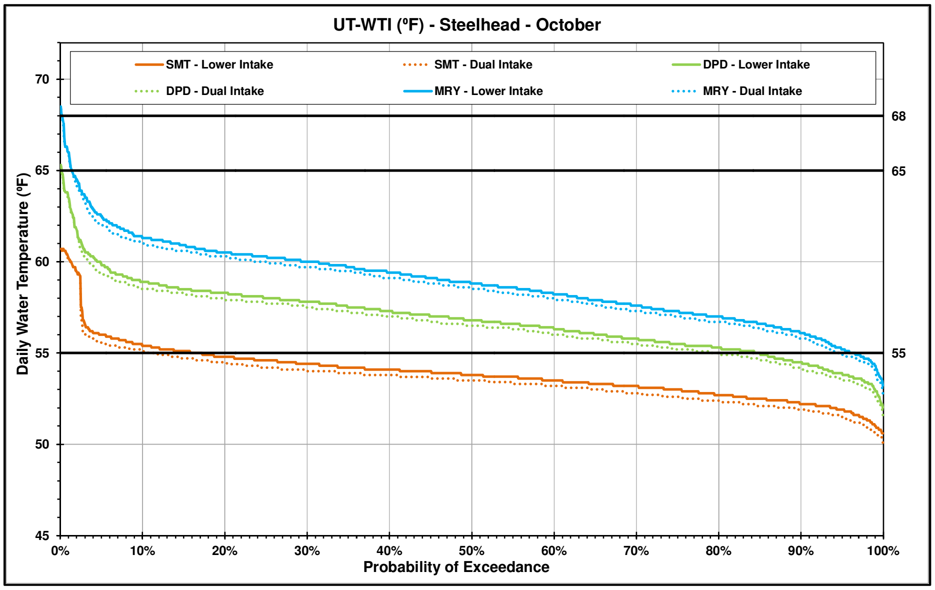
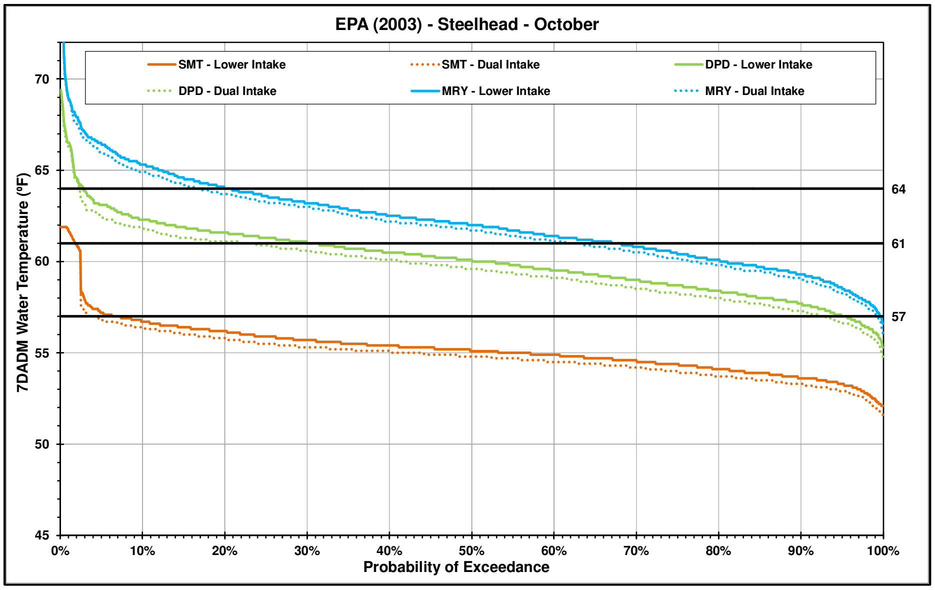
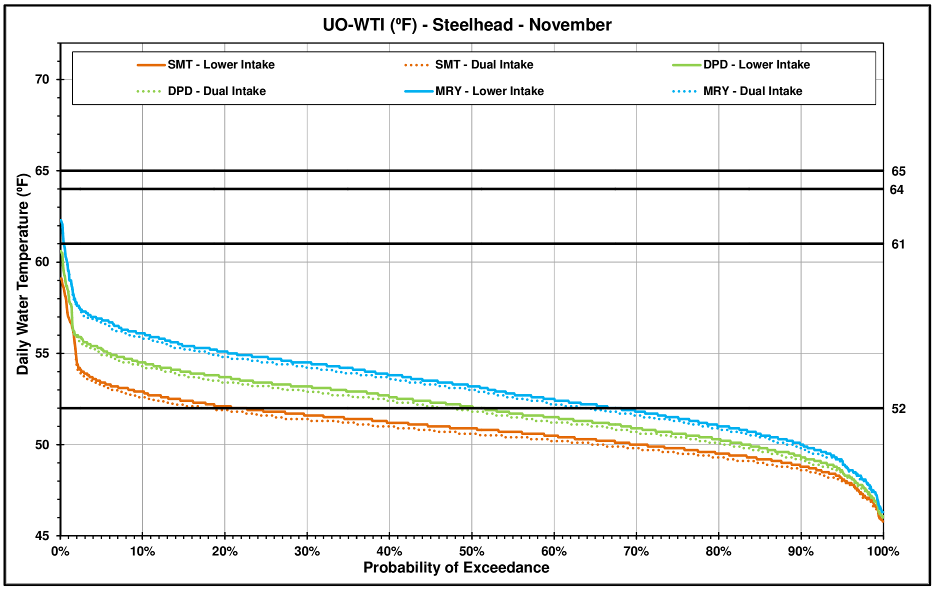
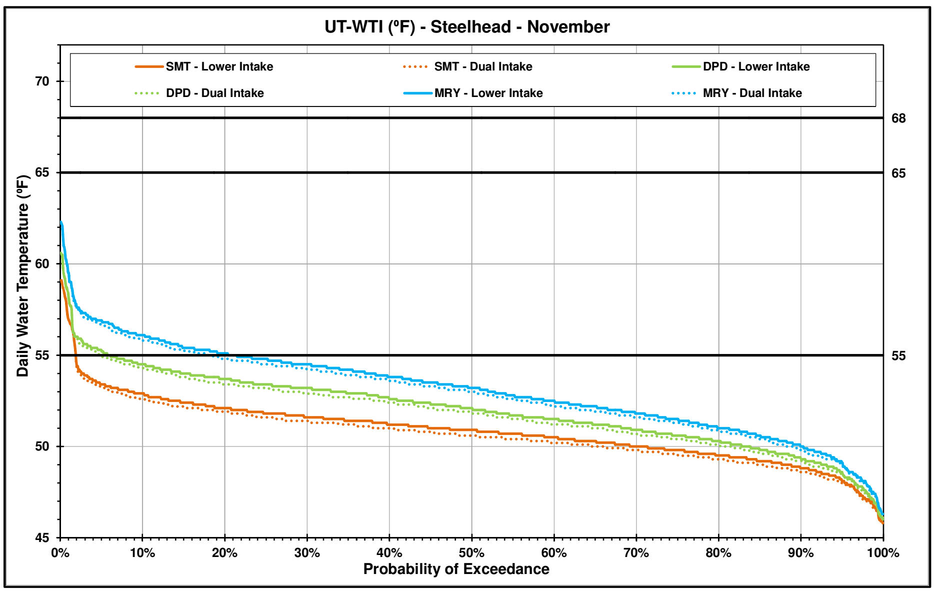
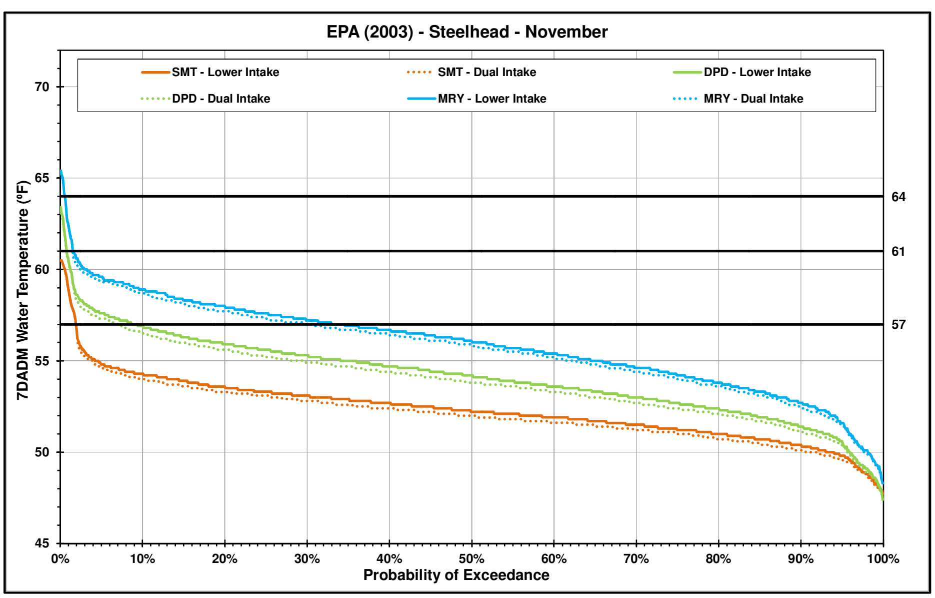

UO-WTI (ºF) - Steelhead - October
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
65
64
61
52

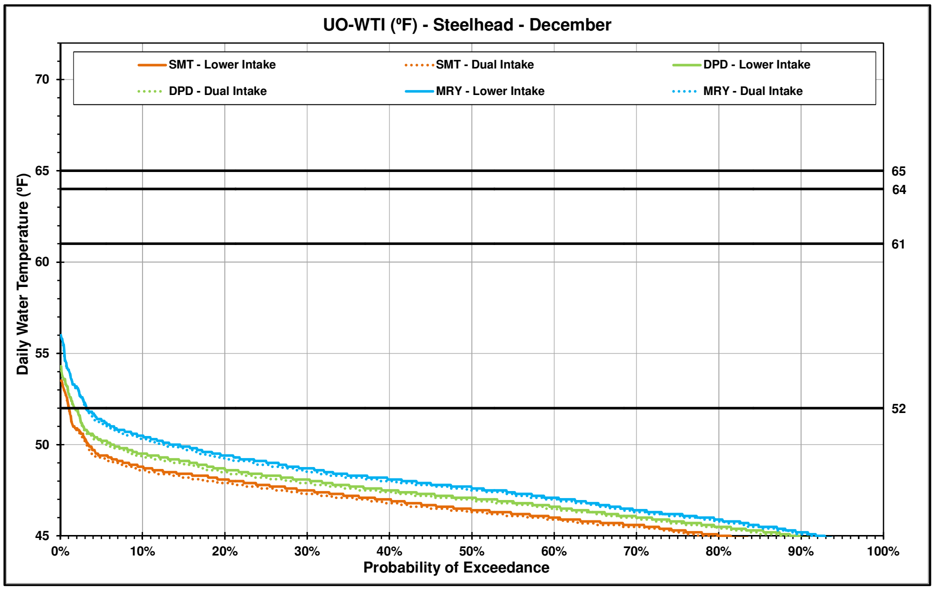

UT-WTI (ºF) - Steelhead - October
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
55

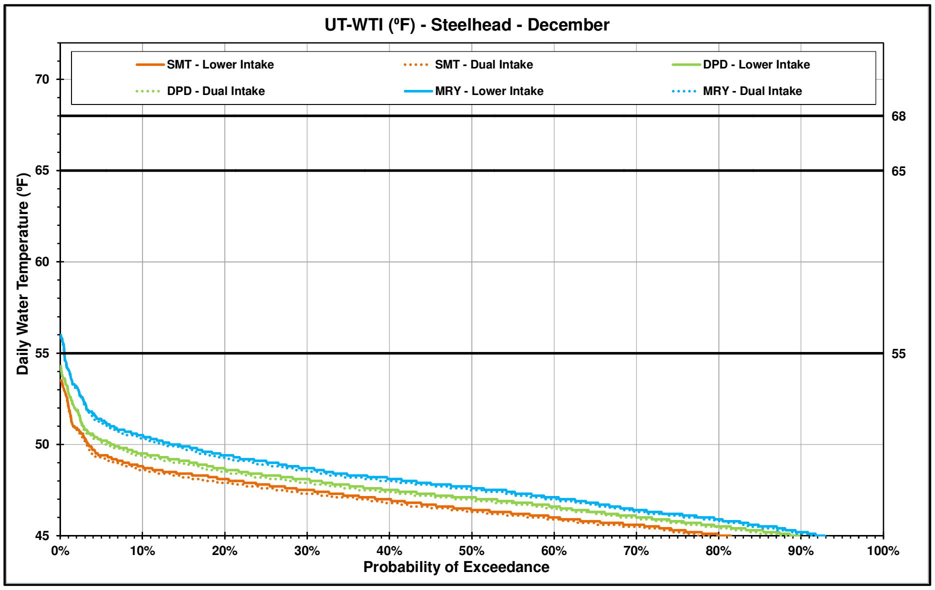

EPA (2003) - Steelhead - October
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
57

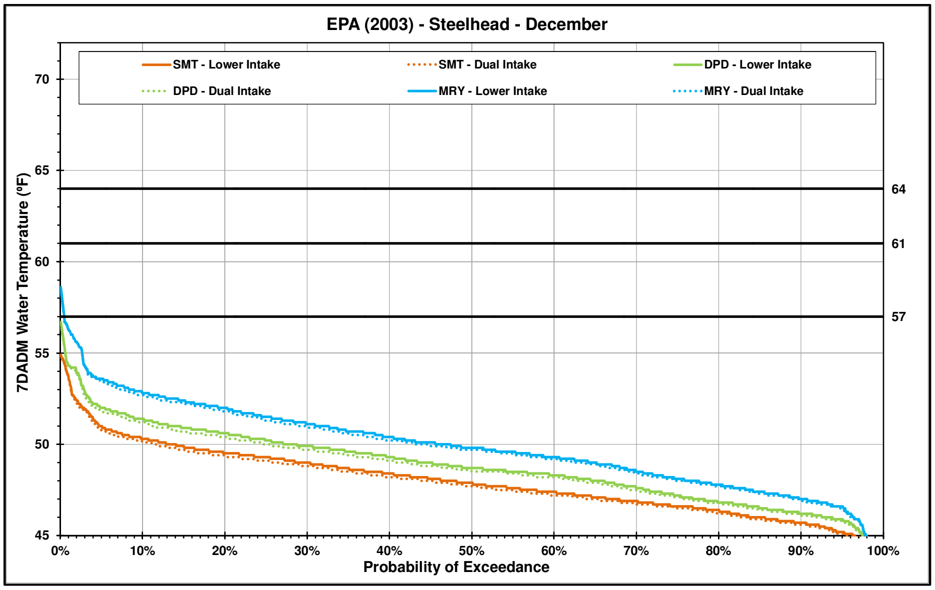

UO-WTI (ºF) - Steelhead - November
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
65
64
61
52


UT-WTI (ºF) - Steelhead - November
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
55


EPA (2003) - Steelhead - November
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
57


UO-WTI (ºF) - Steelhead - December
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
65
64
61
52


UT-WTI (ºF) - Steelhead - December
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
55


EPA (2003) - Steelhead - December
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
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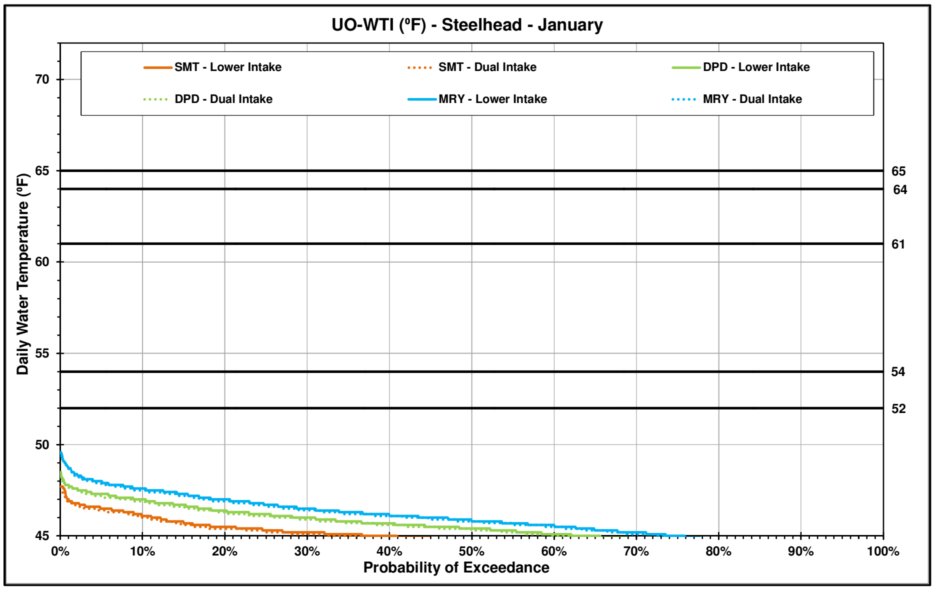
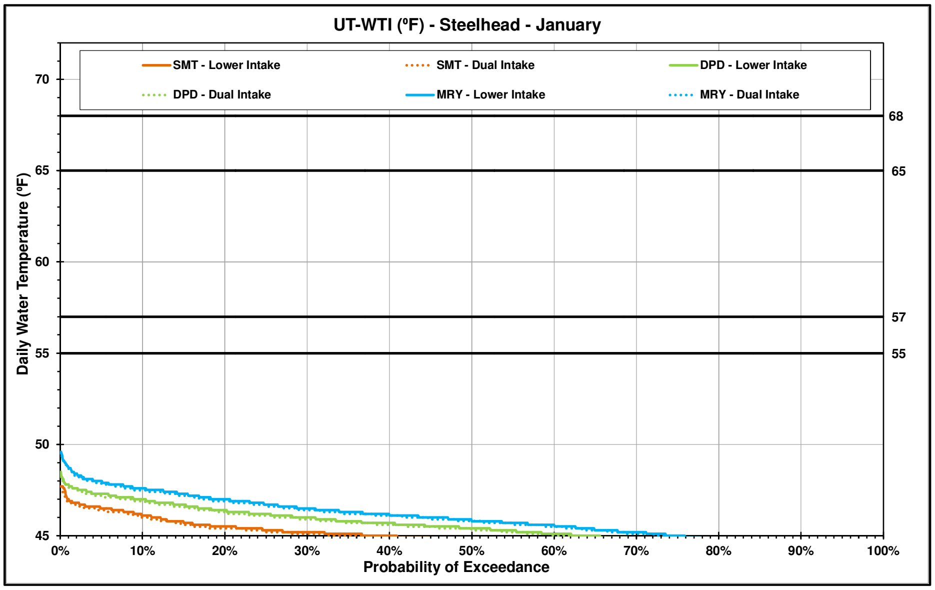
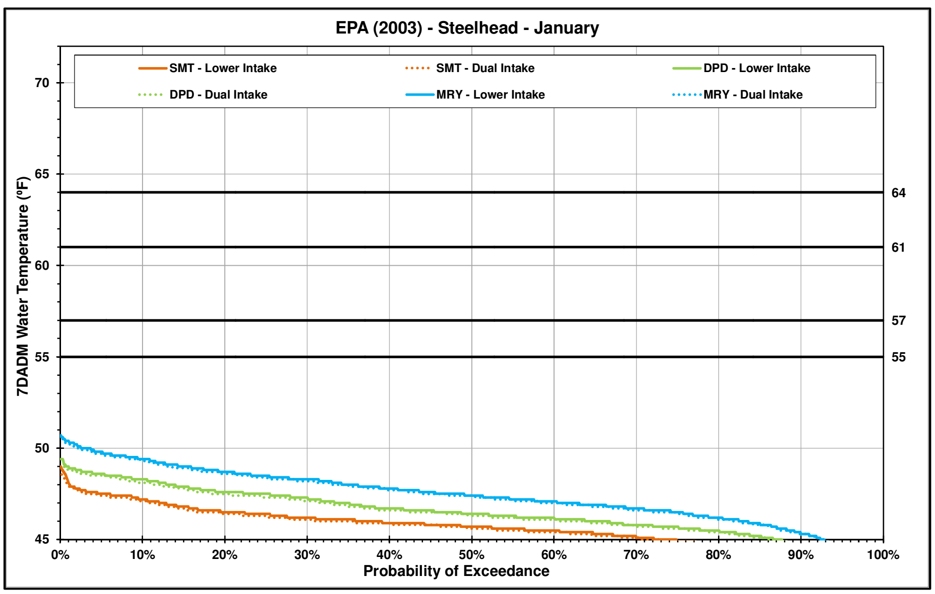
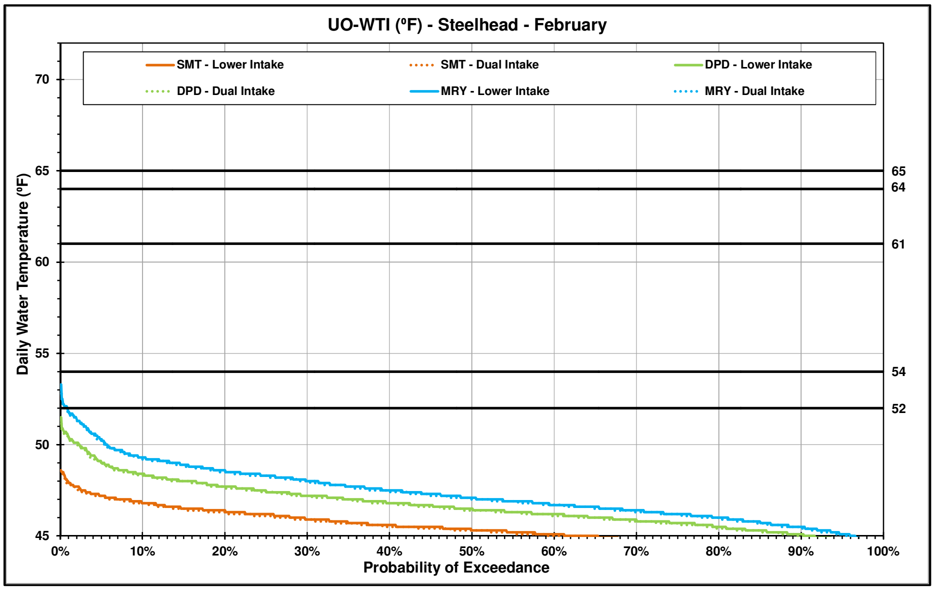
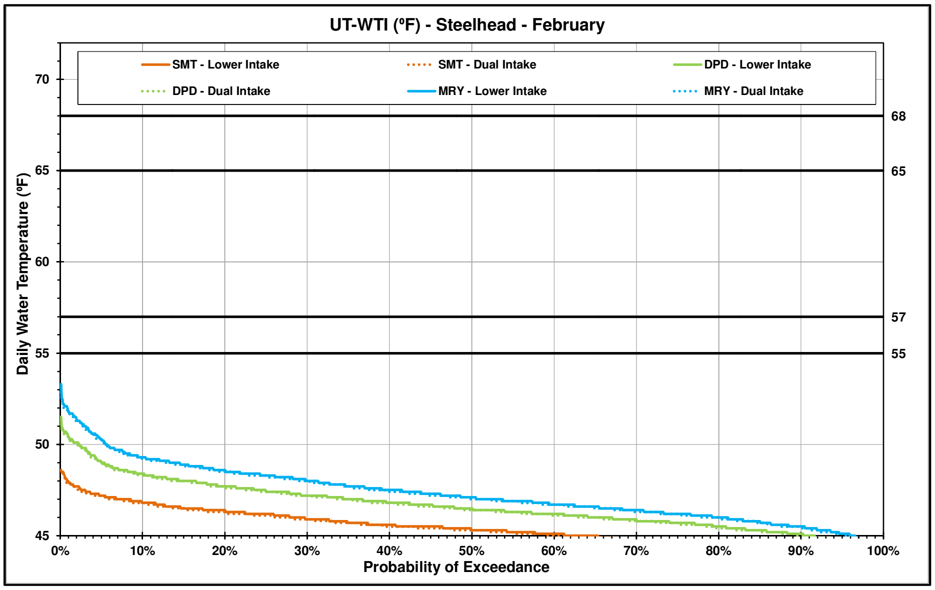
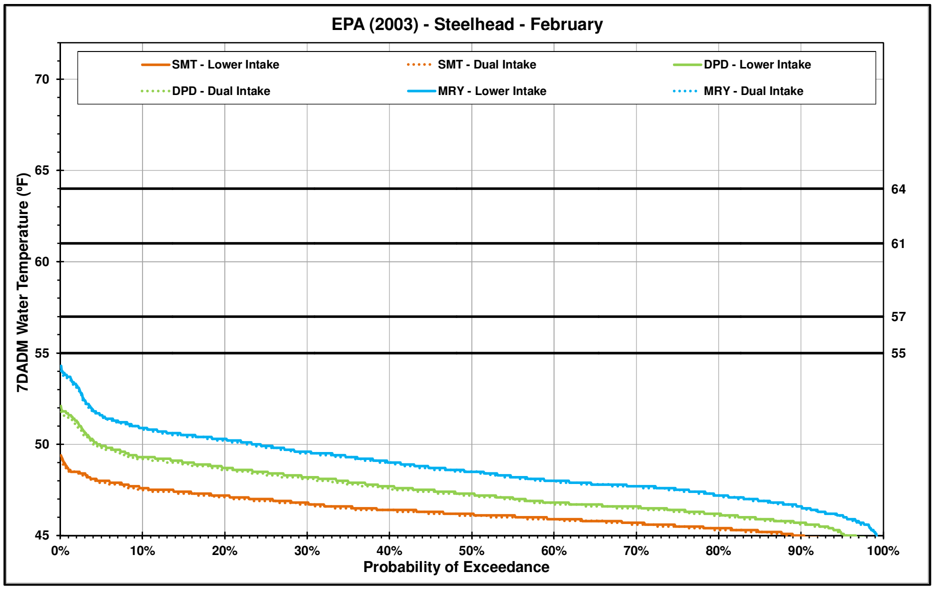

UO-WTI (ºF) - Steelhead - January
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
65
64
61
54
52

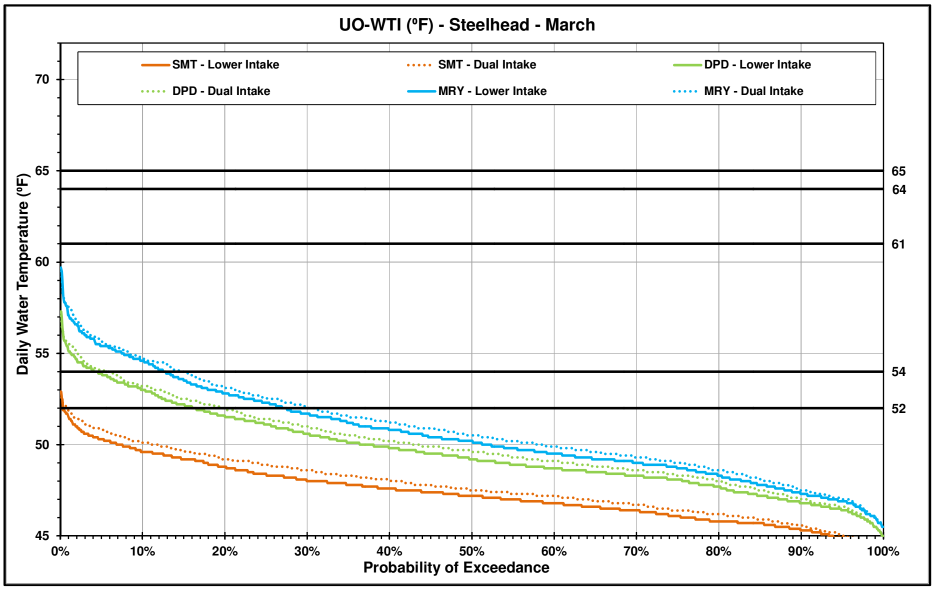

UT-WTI (ºF) - Steelhead - January
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
57
55

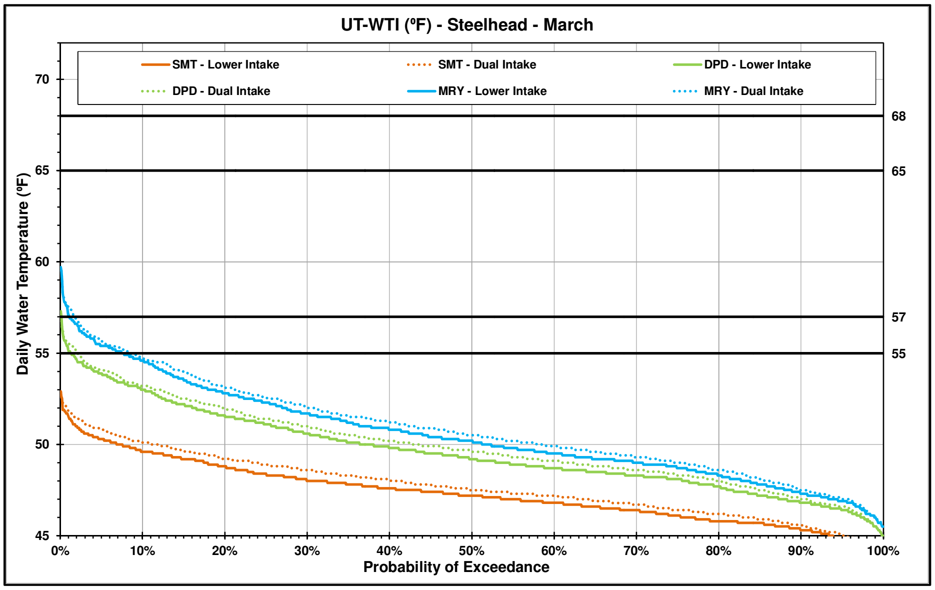

EPA (2003) - Steelhead - January
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
57
55

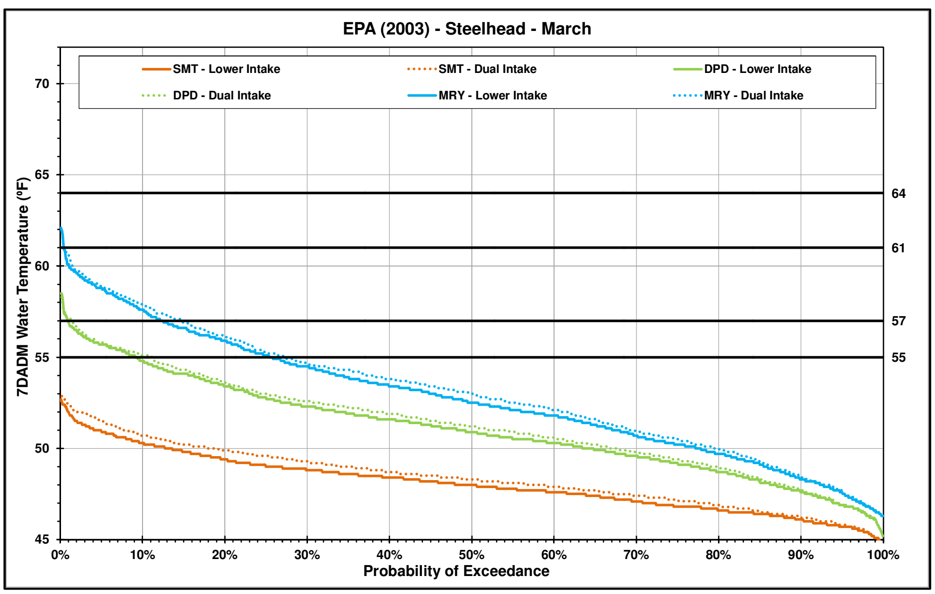

UO-WTI (ºF) - Steelhead - February
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
65
64
61
54
52

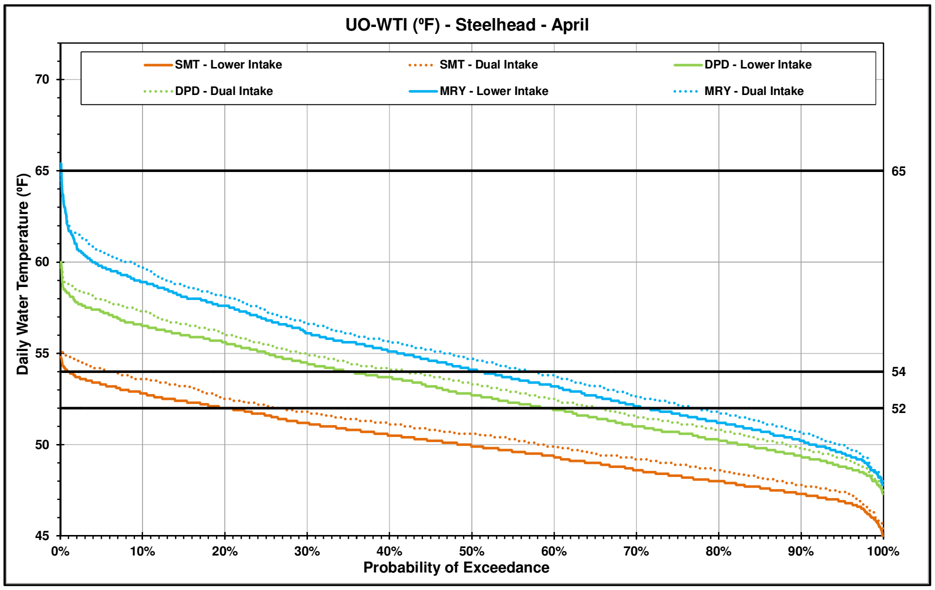

UT-WTI (ºF) - Steelhead - February
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
57
55

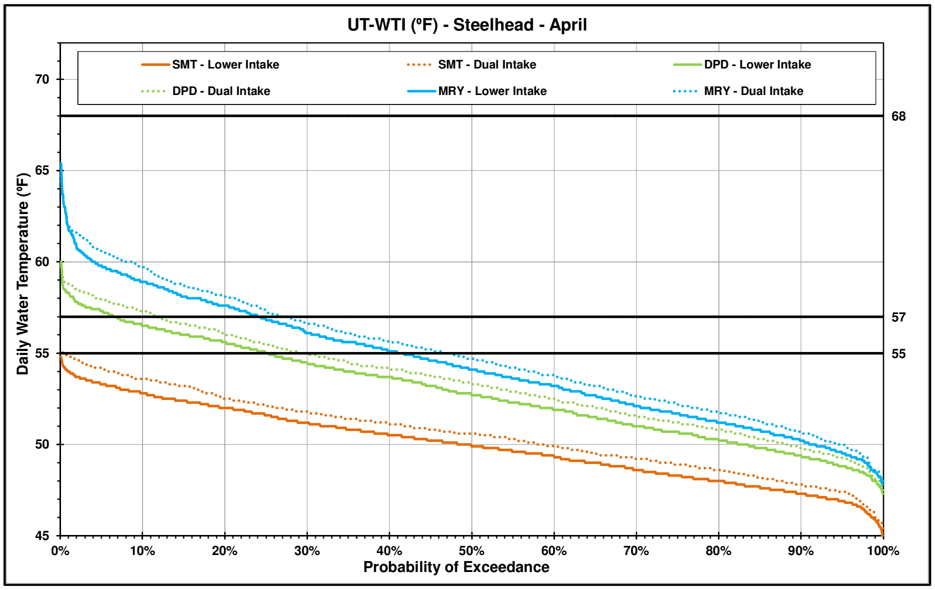

EPA (2003) - Steelhead - February
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
57
55

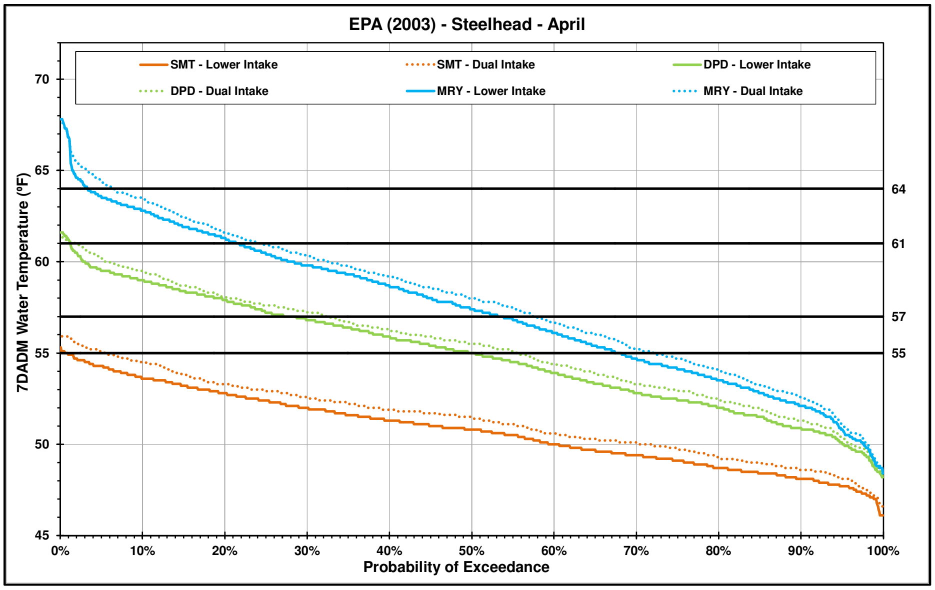

UO-WTI (ºF) - Steelhead - March
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
65
64
61
54
52

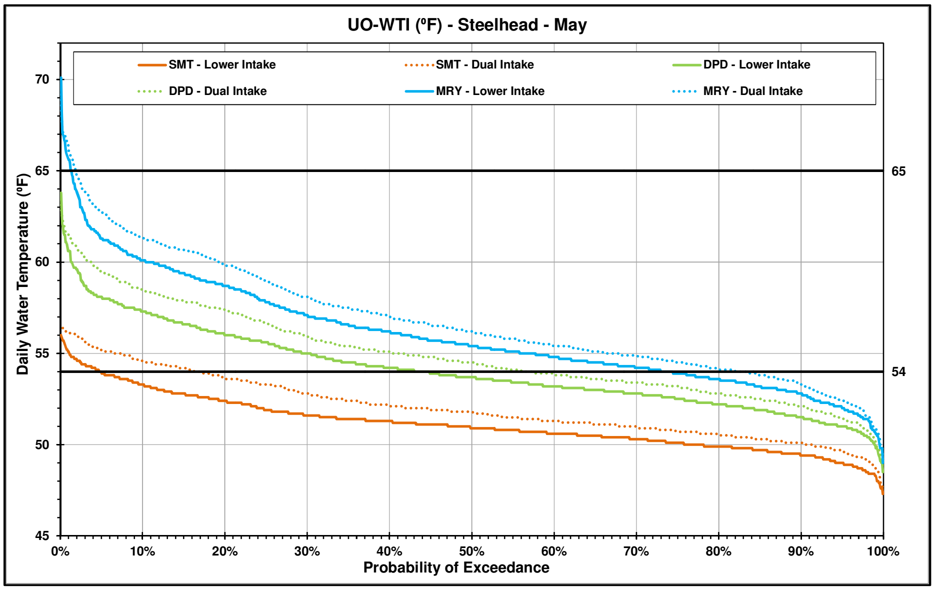

UT-WTI (ºF) - Steelhead - March
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
65
57
55

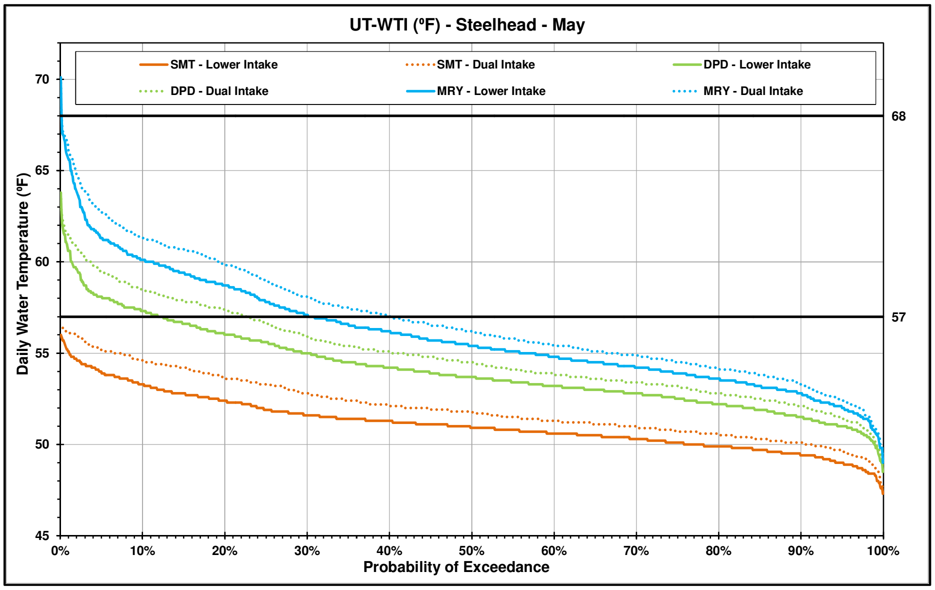

EPA (2003) - Steelhead - March
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
57
55


UO-WTI (ºF) - Steelhead - April
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
65
54
52


UT-WTI (ºF) - Steelhead - April
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
57
55


EPA (2003) - Steelhead - April
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
57
55


UO-WTI (ºF) - Steelhead - May
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
65
54


UT-WTI (ºF) - Steelhead - May
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
Daily Water Temperature (ºF)
Probability of Exceedance
68
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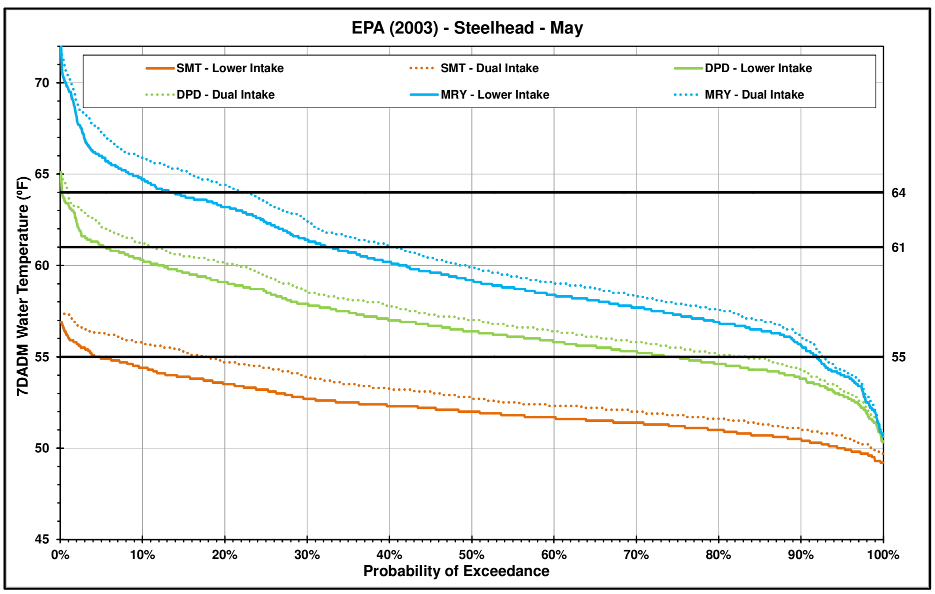
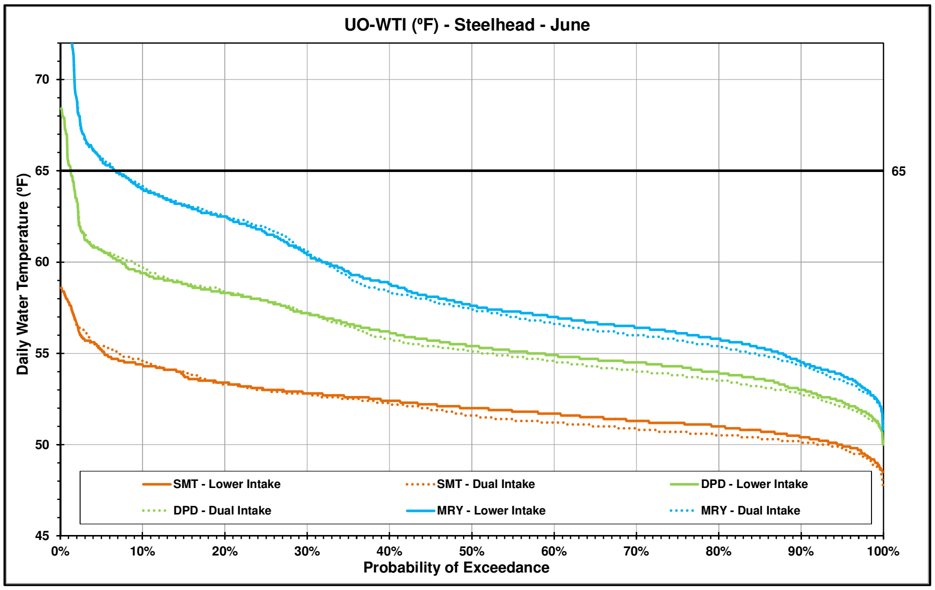

EPA (2003) - Steelhead - May
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
7DADM Water Temperature (ºF)
Probability of Exceedance
64
61
55


UO-WTI (ºF) - Steelhead - June
Daily Water Temperature (ºF)
Probability of Exceedance
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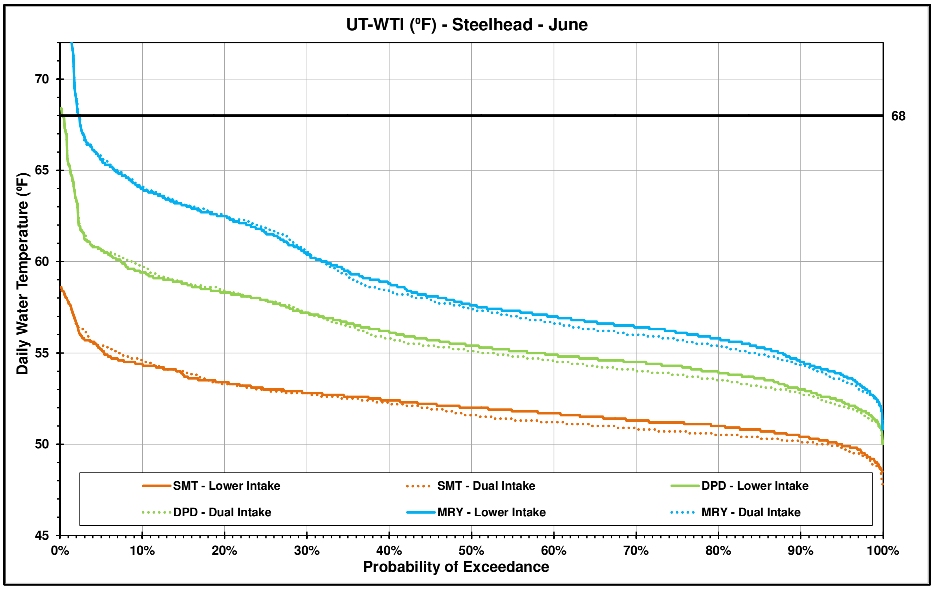
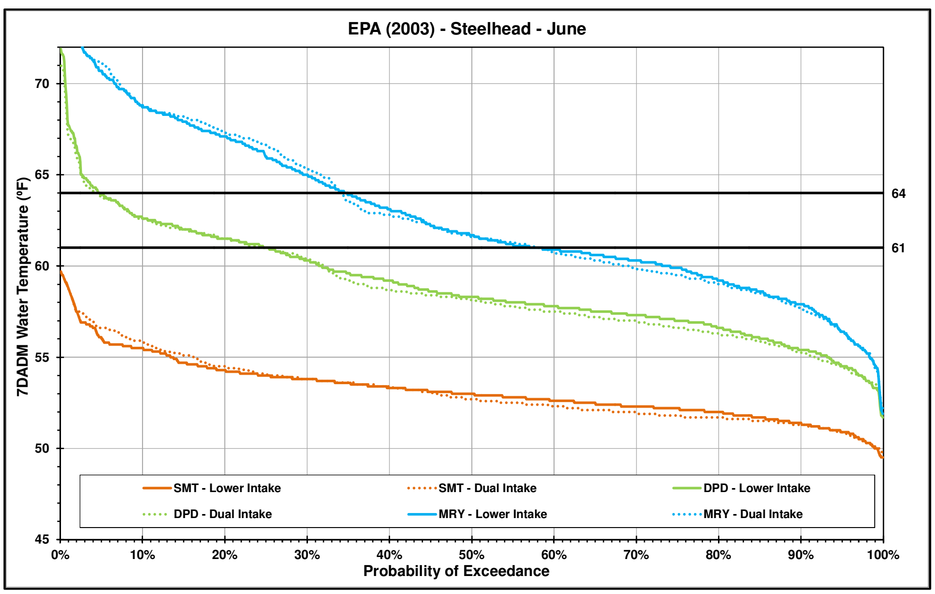
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UT-WTI (ºF) - Steelhead - June
Daily Water Temperature (ºF)
Probability of Exceedance
68
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


EPA (2003) - Steelhead - June
7DADM Water Temperature (ºF)
Probability of Exceedance
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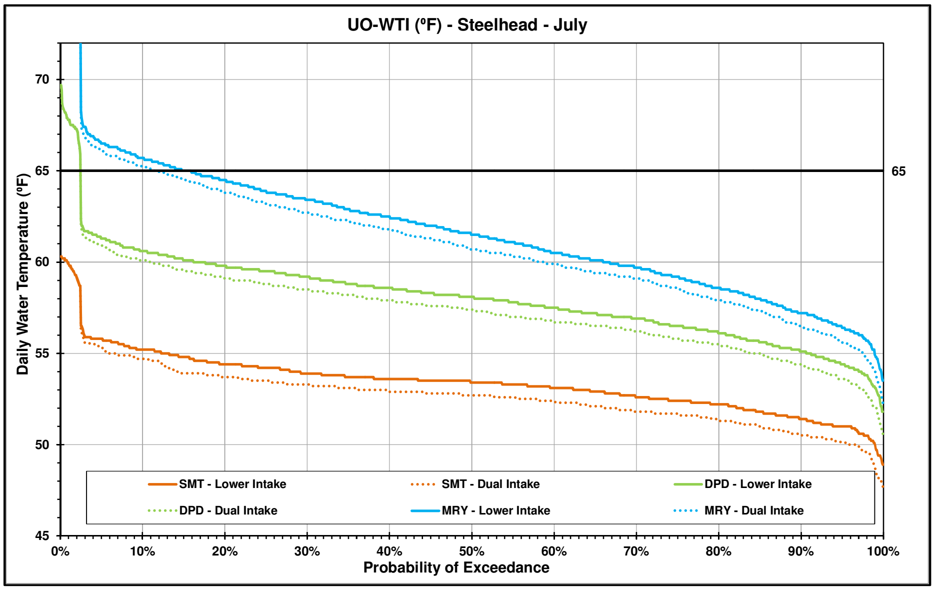
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UO-WTI (°F) - Steelhead - July
Daily Water Temperature (°F)
70
65
60
55
50
45
65
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
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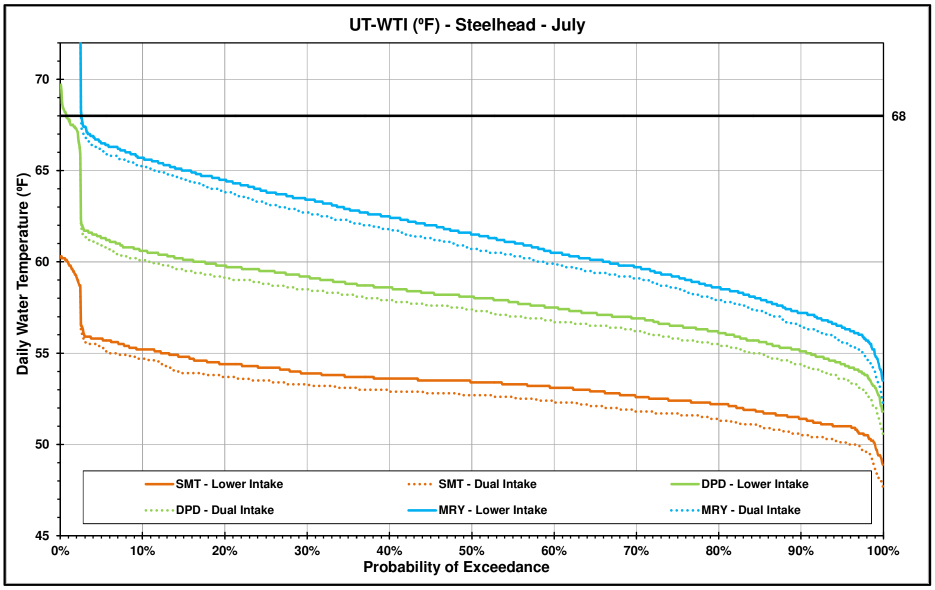
40%
50%
60%
70%
80%
90%
100%
Probability of Exceedance


UT-WTI (°F) - Steelhead - July
Daily Water Temperature (°F)
70
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60
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68
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
0%
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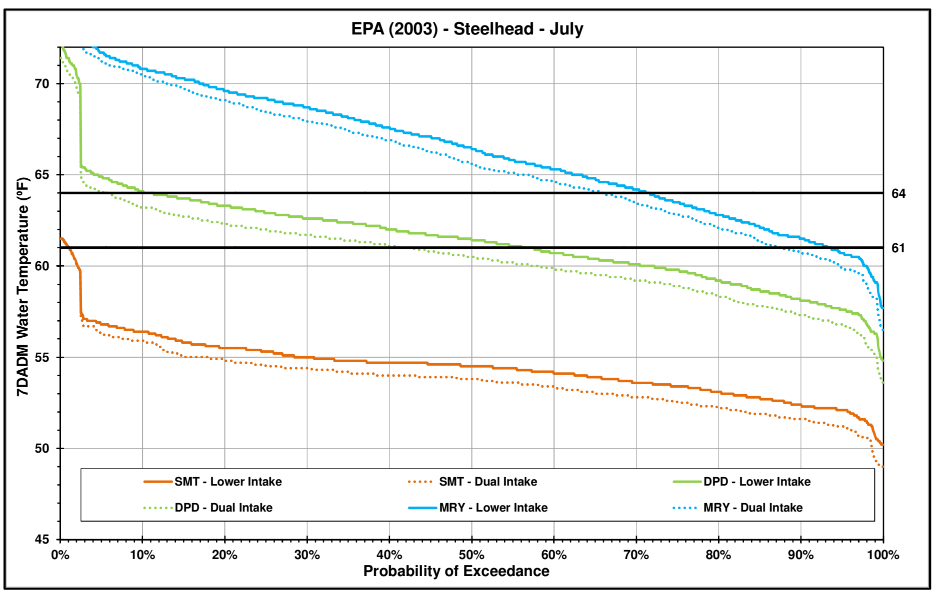
60%
70%
80%
90%
100%
Probability of Exceedance


EPA (2003) - Steelhead - July
7DADM Water Temperature (°F)
70
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60
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SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake
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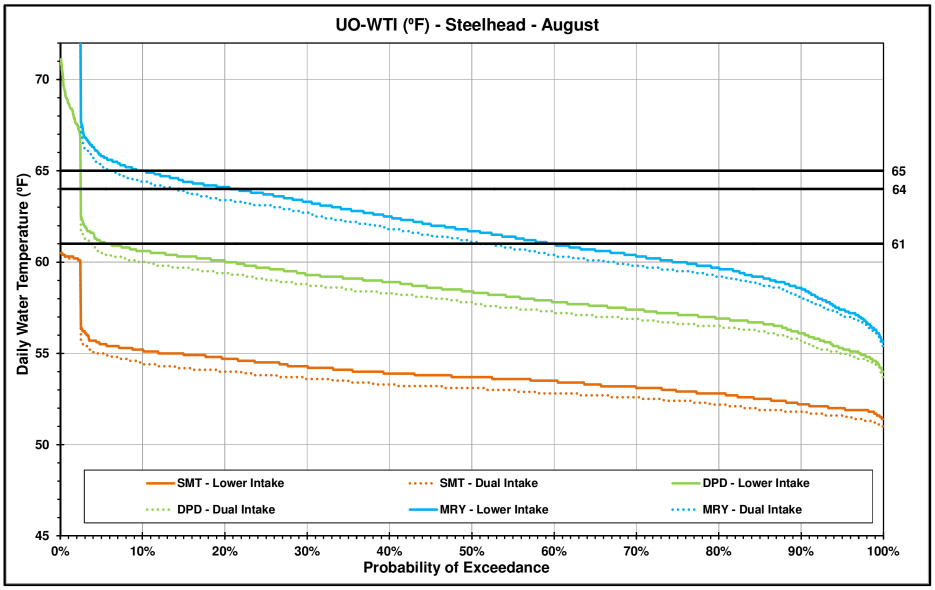
100%
Probability of Exceedance


UO-WTI (ºF) - Steelhead - August
Daily Water Temperature (ºF)
Probability of Exceedance
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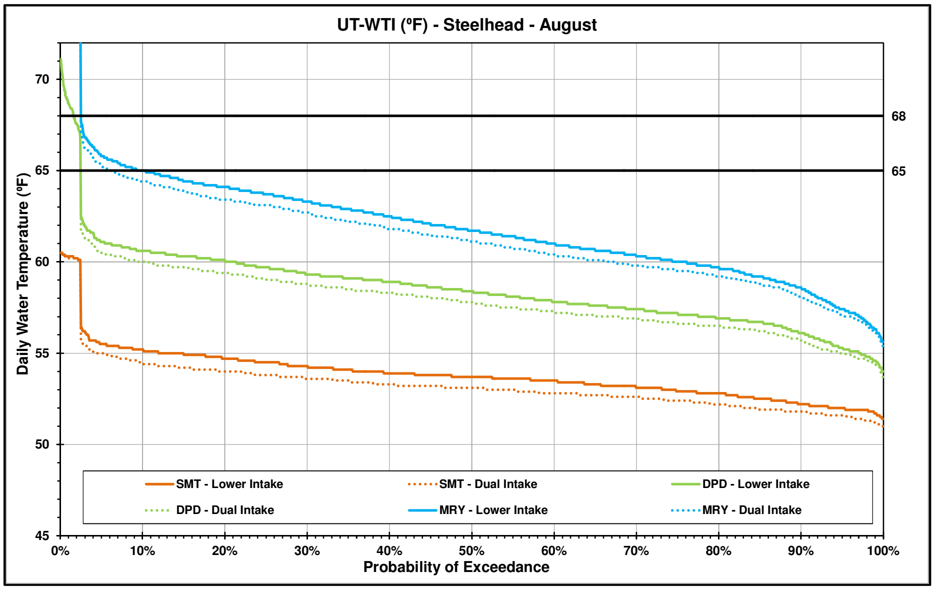
64
61
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UT-WTI (ºF) - Steelhead - August
Daily Water Temperature (ºF)
Probability of Exceedance
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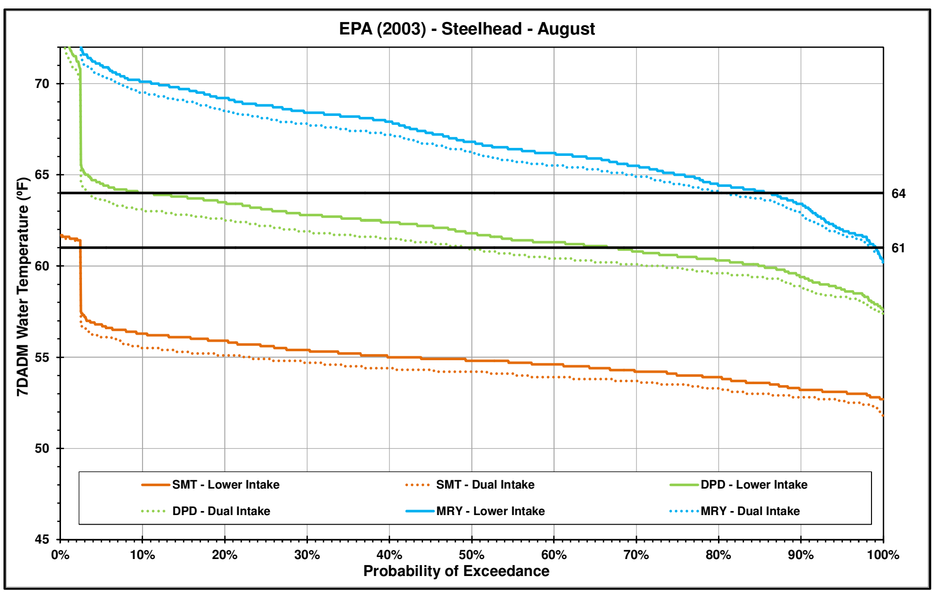
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


EPA (2003) - Steelhead - August
7DADM Water Temperature (ºF)
Probability of Exceedance
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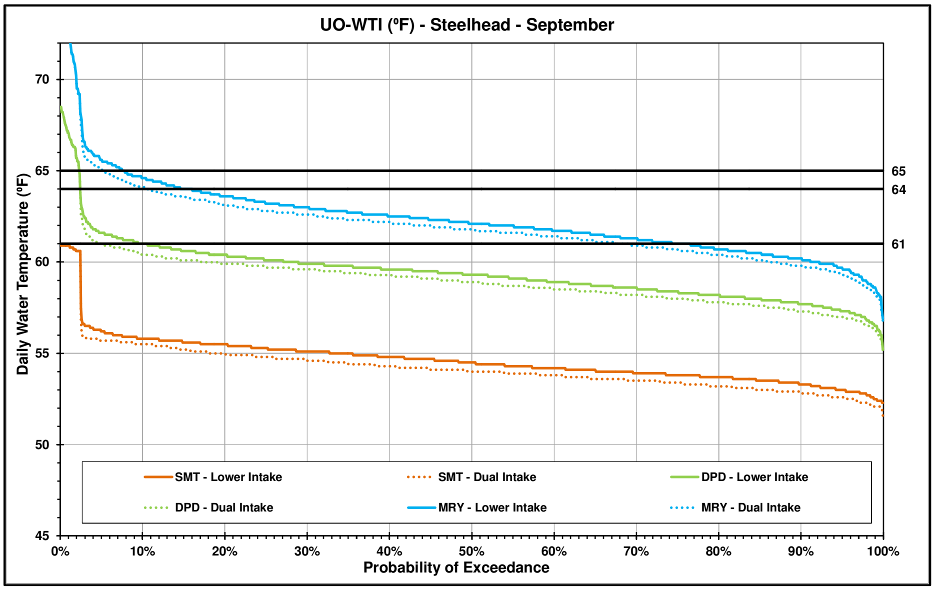
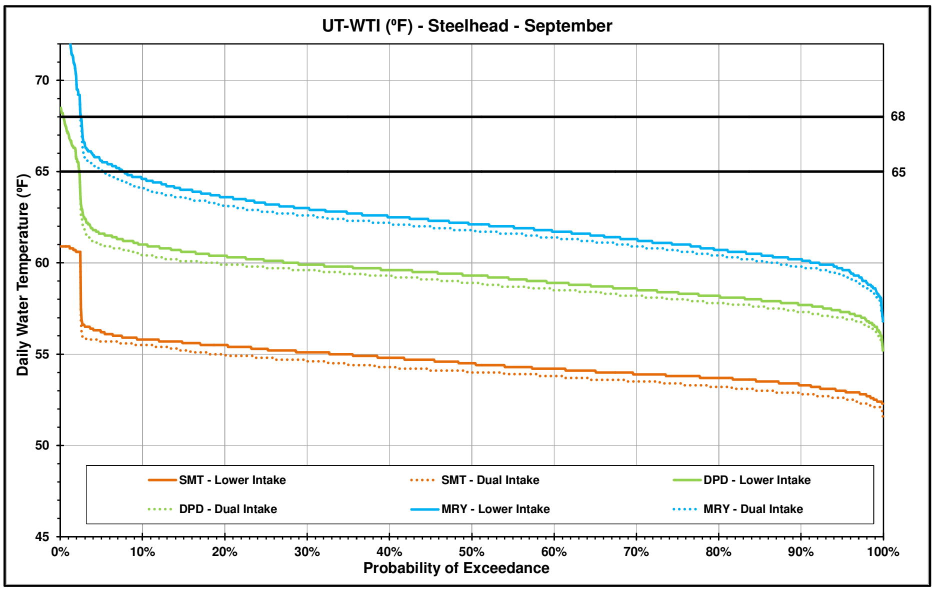
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UO-WTI (°F) - Steelhead - September
Daily Water Temperature (°F)
Probability of Exceedance
65
64
61
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


UT-WTI (°F) - Steelhead - September
Daily Water Temperature (°F)
Probability of Exceedance
68
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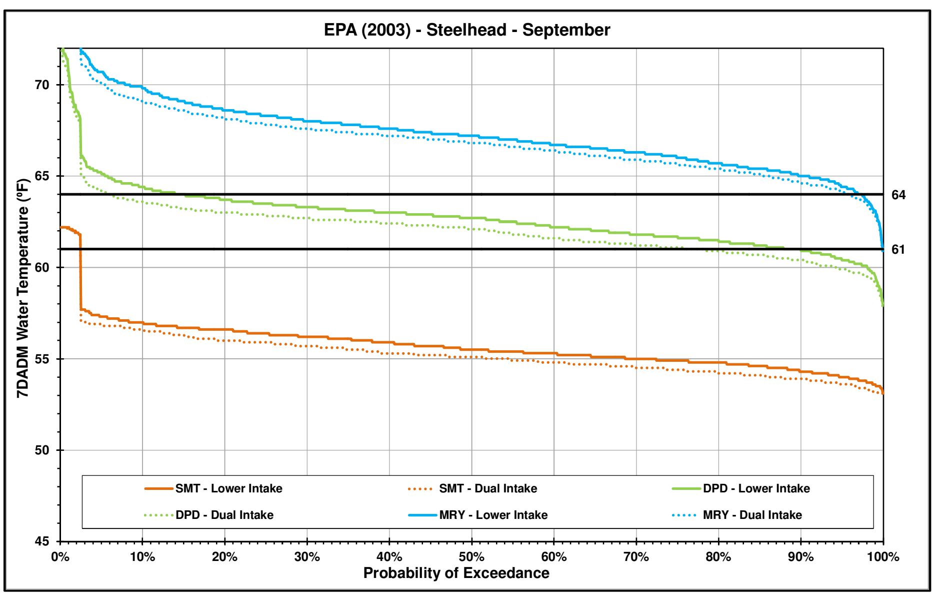
SMT - Lower Intake
SMT - Dual Intake
DPD - Lower Intake
DPD - Dual Intake
MRY - Lower Intake
MRY - Dual Intake


EPA (2003) - Steelhead - September
7DADM Water Temperature (°F)
Probability of Exceedance
64
61
SMT - Lower Intake
SMT - Dual Intake
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