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FinalEIS	Appendices
25 pages (2.64 MB)	26 pages (3.07 MB)
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Appendix Z
Tree Management Plan

Tree Management Plan

1.0 Introduction

As indicated in the impacts evaluation (Chapter 4 of the FR/EIS), some trees would be killed as a result of the increase in pool elevation and attendant inundation under the proposed reallocation alternatives. Dead trees would be a potential hazard to boaters and other park visitors, and to dam operations. The trees would also be difficult to remove after inundation occurred. Because of these safety and logistical concerns, it was decided that trees that would most likely be impacted by inundation should be removed before inundation occurs. This plan provides an evaluation of the acres of trees that would need to be removed, the options for removing the trees, and the estimated costs if the Proposed Action (Alternative 3 - 20,600 acre-ft of storage, target pool elevation 5444 ft msl) is approved. If Alternative 4 (7,700 acre-ft of storage, target pool elevation 5437 ft msl) is selected, the acres of trees and costs of removal would be proportionately less since the target pool elevation is 7 feet lower than Alternative 3.

2.0 Evaluation of Tree Mortality and Target Elevation for Tree Removal

Trees are more susceptible to the impacts of flooding and inundation during the growing season (Kozlowski 1997); flooding during the dormant season typically has little impact on trees (Bell and Johnson 1974). Therefore, the analysis of impacts on trees under the proposed reallocation alternatives focused on the pool elevations that could be reached during the growing season.

The growing season in the Chatfield study area was estimated from data from the Colorado Climate Center for a weather station at Kassler, Colorado (Doesken 2006). The boundaries of the growing season were based on the median dates when 28 degrees Fahrenheit (the temperature at which hardier plants freeze) is last reached in the spring and first reached in the fall, based on the years 1975 to 2005. These dates are April 25 and October 11, respectively, and correspond to a growing season of approximately 170 days.

The evaluation of potential tree mortality focuses on the plains cottonwood (*Populus deltoides* var. *occidentalis*) because they are the dominant tree species in the area potentially inundated by increased water storage in Chatfield Reservoir. Trees that are tolerant of flooding, including the plains cottonwood, may withstand an entire growing season of inundation. However, they are killed when they are inundated for two consecutive growing seasons (USFS 1993, Teskey and Hinckley 1978, Whitlow and Harris 1979). Some studies (such as Yin et al. 1994) indicate that flooding for even one growing season can result in significant mortality in mature cottonwoods. Saplings are even more susceptible to flooding than mature trees (Yin et al. 1994).

Willows (*Salix* spp.) also occur in the area potentially inundated by increased water storage. Information on their susceptibility to flooding is more limited than the literature for

cottonwoods, however, willows are generally somewhat more flood tolerant than cottonwoods. However, willows at Chatfield occur closer to the reservoir (see Figure 1) and would experience more significant levels of inundation than cottonwoods. The increased intensity of inundation could somewhat offset their greater flood tolerance, and thus put them at similar risk of impacts due to flooding.

2.1 Inundation of Trees under the Proposed Action (Alternative 3)

The Corps' reservoir modeling results were used to calculate the frequency and duration that trees could be inundated under Alternative 3. One-foot increments in pool elevations between 5432 and 5444 ft msl were evaluated by counting the number of days in the growing season that each pool elevation would be exceeded during each year of the period of record (POR) in the Corps' model. For each pool elevation, this value was divided by the total number of days in the growing season (i.e., 170) to calculate the percent of the growing season that the pool elevation would be exceeded during each growing season in the POR. For example, the Corps' model predicts that pool elevation 5438 ft msl would be exceeded for all 170 days of the growing season in the first year of the POR; thus the percent of the growing season that would be exceeded for that year is 100%. This value is plotted on the chart for 5438 ft msl (see Figure A-7 in Attachment A). This calculation was repeated for each year in the POR and plotted on the chart for that elevation (see Attachment A). Based on the review of the literature, 90% was selected as a threshold representing a significant portion of the growing season. For each pool elevation, a count was made of the number of years in the POR where the duration of inundation would be 90% or greater. For example, at 5438 ft msl, the Corps' model predicts that an inundation duration of 90% would be reached 25 times out of the 59-year POR, or 42% of the growing seasons in the POR (see Figure A-7). As indicated above, consecutive years of inundation is considered a very important factor in estimating lethality to trees, so a count was made of the instances of consecutive years in the POR where inundation during the growing season was predicted to be 90% or greater. For example, at 5438 ft msl, there were six instances during the POR where consecutive years would reach at least 90%, including one instance of six consecutive years. The results are summarized in Table 1 for each one-foot elevation increment between 5432 and 5444 ft msl. Individual charts for each pool elevation are included in Attachment A.

Table 1. Projected Inundation During the Growing Season

Elevation (ft msl)	Number of Years with ≥ 90% Inundation During the Growing Season (*percent of POR shown in parentheses*)	Number of Instances of Consecutive Years with ≥ 90% Inundation During the Growing Season (*maximum number of consecutive years shown in parentheses*)
5432	43 (73%)	4 (32)

5433	41 (69%)	4 (32)
5434	40 (68%)	4 (32)
5435	39 (66%)	5 (27)
5436	35 (59%)	6 (12)
5437	31 (53%)	7 (8)
5438	25 (42%)	6 (5)
5439	18 (31%)	6 (3)
5440	13 (22%)	3 (2)
5441	8 (14%)	1 (2)
5442	4 (7%)	1 (2)
5443	1 (2%)	0
5444	0 (0%)	0

Table 1 shows that the elevations from 5432 to 5437 ft msl have a significant number of years in the POR (>50%) where inundation would occur for at least 90% of the growing season. These elevations also include multiple instances of consecutive years of inundation, including lengthy periods (from 8 to 32 consecutive years) of ≥90% inundation. Given the substantial duration and frequency of inundation during the growing season, it is assumed that cottonwoods from 5432 to 5437 ft msl would have a high likelihood of being killed under Alternative 3. At the 5438 and 5439 ft msl elevations, though not as pronounced as the 5432 to 5437 ft msl interval, significant inundation still would be expected during the growing season, as well as multiple instances of consecutive years of significant inundation. At 5438 ft msl, the Corps' model predicts that 42% of the years in the POR would have inundation for at least 90% of the growing season, and six instances of consecutive years of ≥90% inundation would occur. At 5439 ft msl, 31% of the years in the POR have inundation for at least 90% of the growing season, and six instances of consecutive years of ≥90% inundation are predicted. Based on these results, it is likely that trees at these elevations also would be killed under Alternative 3. At 5440 ft msl, 22% of the years have at least 90% inundation; however, there are only three instances of consecutive years of ≥90% inundation. This reduced degree of inundation does not strongly indicate there would be significant tree mortality at this elevation. Above 5440 ft msl, from 5441 to 5444 ft msl, the frequency of inundation would be even less, and the percent of years with significant inundation would be relatively low (2 to 14 %). In addition, in this elevation interval the number of instances of consecutive years of significant inundation would be very low, with

5441 and 5442 ft msl each having only one instance of consecutive years with significant inundation, and with no instances of consecutive years with significant inundation at 5443 ft msl. Given these low frequencies of inundation, it is unlikely that cottonwoods would be killed at pool elevations above 5440 ft msl.

In summary, the modeling results indicate that trees would likely be killed at elevations up to 5439 ft msl, and would not likely be killed above 5440 ft msl. The results are less clear for the area between 5439 to 5440 ft msl. It is possible that some portion of the trees in this area could survive the expected frequency of inundation. This plan takes a conservative approach by proposing to remove trees up to 5439 ft msl, and to use an adaptive management approach for trees above 5439 ft msl, as discussed below.

Adaptive Management. There is some degree of uncertainty in estimating the elevation at which trees would likely be killed. The uncertainty is due in part to the reservoir model, the availability of water for storage and how reservoir operations would occur under the proposed reallocation, and in part due to predicting how the trees would respond to inundation. A conservative approach has been taken by limiting the trees to be removed to those areas where it is highly likely that the trees would be killed (i.e., up to 5439 ft msl). For areas between 5439 and 5444 ft msl, an adaptive management approach would be used. The area between 5439 and 5444 ft msl includes approximately 61.1 acres of trees (see Table 2 in Section 2.2). The adaptive management approach would entail leaving these trees in place and then monitoring the trees for signs of severe stress and mortality, and removing unhealthy and dead trees from this area on an as needed basis to eliminate potential risks to visitor and dam safety.

2.2 Number of Acres Affected

In order to develop cost estimates for tree removal, it was necessary to calculate the acres of trees targeted for clearing (i.e., up to 5439 ft msl). The trees considered for removal included areas defined as plains cottonwoods, narrowleaf cottonwoods (*Populus angustifolia*), cottonwood seedlings, sandbar willows (*Salix exigua*), or areas that included a mix of species that included at least one of these species, as described in the Colorado State Park's 2001 report "Vegetation Assessment Report, Chatfield State Park". Peachleaf willow (*Salix amygdaloides*) also occurs in this area, but was not delineated in the 2001 report. Figure 1 shows the area covered by cottonwoods and willows below 5444 ft msl. The figure includes a red line highlighting the 5439 ft msl elevation. Table 2 shows the acres of trees at eight elevation intervals up to an elevation of 5444 ft msl, with a total of approximately 357.4 acres of trees at or below 5444 ft msl. Table 2 also shows that up to 5439 ft msl there are approximately 296.3 acres of trees, including approximately 243.5 acres of cottonwoods and 52.8 acres of willows. Most of the trees are approximately 8 to 12 inches in diameter. The mature cottonwoods are much larger and may range from 30 to 50 inches in diameter.

There is some uncertainty associated with the estimated acres of trees to be cleared; this is due in part to limitations in the available data and mapping. For example, there is a small area of trees along the dam and north-northeast of the mouth of Plum Creek, however the available GIS mapping does not show these trees. In addition, there is a small area of trees along the shoreline of the large pond south of the main road. This pond would be protected

from direct inundation by the proposed berm, however, the water level in the pond would likely still increase due to seepage from the berm and elevation of the water table, and thus potentially inundate these trees. To be conservative these trees have been included in the estimate of the area to be cleared.

There is an interest in leaving a small portion of trees in place below 5439 ft msl to provide wildlife and fisheries habitat. Specific trees to be left in place would be identified and evaluated by a team of representatives from the Corps, Colorado State Parks (Parks), and the Colorado Division of Wildlife (CDOW). The Chatfield project's designated Special Technical Advisors would be given the opportunity to provide input to this process. The Corps would have the final determination on what trees would be retained or removed. Under Alternative 3 some trees near the mouths of the South Platte River and Plum Creek would be left in place for wildlife and fisheries habitat. These areas are well south of the buoy areas and are inside the no-wake boating zones. Tree selected for wildlife habitat would be left standing, and trees selected for fisheries habitat would be felled and anchored in the water. The trees would be marked as necessary for public safety, and would be monitored to ensure that they do not become hazardous to park visitors or dam safety. The trees would be removed if they became a safety hazard that could not effectively be controlled. Another area of interest for retaining some trees for wildlife habitat is the area of mature cottonwoods that are located south of the main park road and between the South Platte River and the proposed berm (see Figure 1). As seen on Figure 1, most of this area is below 5439 ft msl. It is anticipated that a small portion of these trees would be left in place for wildlife habitat. These trees would also be monitored to ensure that they would not become a hazard. As previously indicated, if the tree hazards could not effectively be controlled, then the trees would be removed.

In addition, some of the cut trees could be moved to elevations above 5444 ft msl to provide downed woody debris for enhancement of Preble's meadow jumping mouse habitat. Decisions regarding placement of woody debris would also be reviewed and approved by the team of representatives from the Corps, Parks, and CDOW.

Table 2. Number of Acres of Trees at Each Elevation Interval

Elevation Interval (ft msl)	Vegetation Types			Total Acres of Trees in this Elevation Interval (3)	Cumulative Total Acres of Trees at this Elevation (3)
	Cottonwoods (1)	Mix with Cottonwoods (2)	Sandbar Willow		
<5432	94.5	10.2	42.5	147.2	147.2
5432-5434	53.5	0.6	2.2	56.3	203.6
5434-5436	35.6	0.9	1.7	38.2	241.8
5436-5438	33.5	0.0	5.4	38.9	280.7
5438-5439	14.5	0.0	1.1	15.6	296.3
5439-5440	14.0	0.0	1.0	15.0	311.3
5440-5442	19.7	0.0	3.0	22.7	334.0

5442-5444	20.3	0.0	3.1	23.5	357.4
Total =	285.7	11.7	60.0	357.4	

(1) Includes GIS vegetation layers designated as "plains cottonwoods", "narrowleaf cottonwoods", and "cottonwood seedlings" ("Vegetation Assessment Report, Chatfield State Park", Colorado State Parks, 2001).

(2) Includes GIS vegetation layers designated as including cottonwoods and at least one non-cottonwood species such as grasses, weeds, and willows.

(3) Includes all - "Cottonwoods","Mix with Cottonwoods", and "Sandbar Willow".

3.0 Tree Removal Options

A field trip was conducted at the Park on December 9, 2009 to begin evaluating the options for tree removal. The following determinations were made during this meeting, which included the Colorado State Forest Service (CSFS), Colorado State Parks, the Corps, and Tetra Tech. Tree stumps would need to be ground or removed to eliminate hazards to boaters. To minimize impacts to water quality an effort should be made to remove all woody vegetation from the area below 5439 ft msl, including woody debris already on the forest floor and wood waste generated from felling trees and grinding stumps. CSFS indicated that there is not a significant market for the cottonwood and willow trees. Therefore the cut trees, mulch, and debris would need to be hauled and disposed of off-site.

Based on these conditions, a clearing and grubbing operation was identified as the most appropriate approach for removing the trees and preparing the area for inundation.

4.0 Cost Estimate for Clearing and Grubbing

Standard construction industry cost information from the RSMeans database (Reed Construction Data 2010) was evaluated for the Denver area to develop the cost estimate for clearing and grubbing the area up to 5439 ft msl. Several CSI[1] cost categories in RSMeans were used to account for the mix of tree sizes in the area to be cleared and grubbed: CSI#31111 010 0250 – for trees and stumps to 12 inches in diameter, and CSI#31111 010 0350 – for larger trees and stumps. For the cost estimate it was assumed that the area to be cleared and grubbed is composed of approximately 26.8 acres of mature cottonwoods (based on GIS analysis), and 269.5 acres of smaller trees (up to 12 inches in diameter). Clearing and grubbing unit costs are $3,950 per acre for trees up to 12 inches in diameter, and $7,850 per acre for larger trees. The estimated cost for clearing and grubbing 296.3 acres is approximately $1,280,000. As previously noted, there is some uncertainty in the number of acres that would need to be cleared and grubbed, and the total cost would vary accordingly. A cost of $6 per cubic yard was assumed for hauling tree waste off-site, based on information from facilities in the Denver area that generate mulch products from wood waste. The volume of tree waste was estimated based on general assumptions of tree density

[1] CSI = Construction Specifications Institute

and size, and information on tree volumes in Pillsbury et al. (1998). The estimated cost of hauling the tree waste off-site for mulch is approximately $240,000. Hauling costs could be offset in the event the contractor is able to resale the material as mulch, firewood or some other forest product. An additional $80,000 is included for planning and project management. The total estimated cost (including clearing and grubbing, hauling, and project management) is approximately $1,600,000.

5.0 Schedule

The schedule for clearing and grubbing the area up to 5439 ft msl would be integrated with the phased schedule for filling the pool that is contingent on the completion of environmental mitigation milestones. The area to be cleared would coincide with the elevation approved for filling. In addition, the schedule would be coordinated with the construction schedule for the Recreation Modification Plan proposed under Alternative 3 to minimize disruption to Park activities and visitors. The Tree Management Plan would be carried out in compliance with the Migratory Bird Treaty Act to avoid impacts to migratory birds during migration and breeding periods at Chatfield. In addition, tree removal would be performed to minimize potential impacts to Preble's mouse during their active season, as well as during hibernation. Depending on the number of crews working simultaneously, the project could be completed in approximately one to three months.

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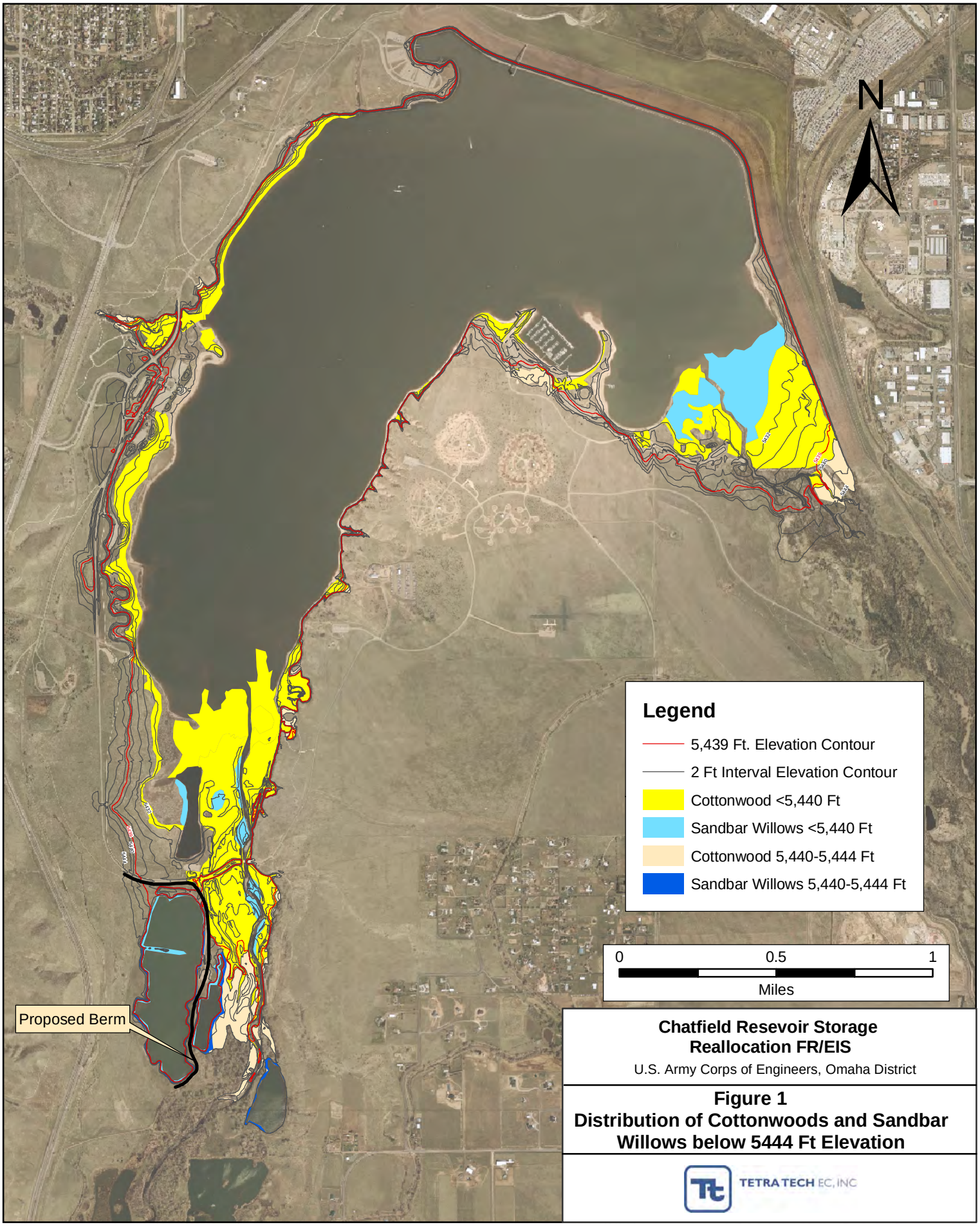
Figure 1



Chatfield Resevoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 1
Distribution of Cottonwoods and Sandbar Willows below 5444 Ft Elevation

TETRA TECH EC, INC

Attachment A

Figure A-1. Percent of Growing Season Pool Exceeds 5432 ft msl (under Alt 3)

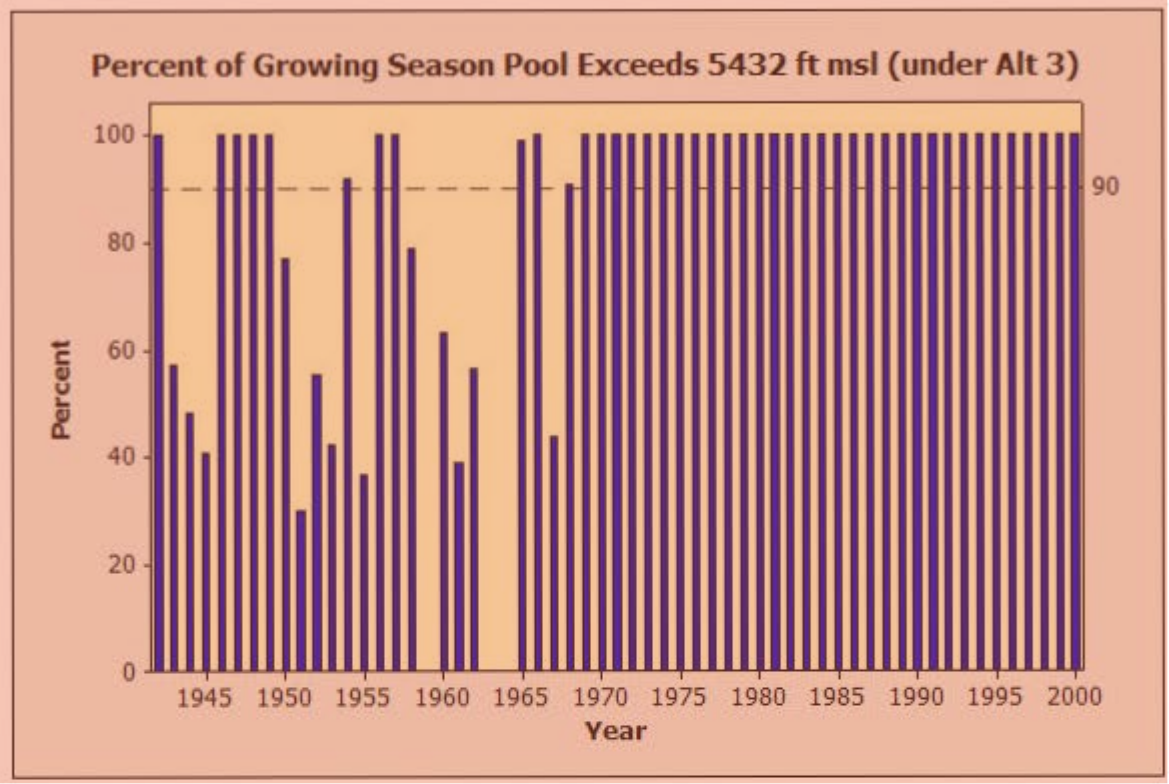


Figure A-2. Percent of Growing Season Pool Exceeds 5433 ft msl (under Alt 3)

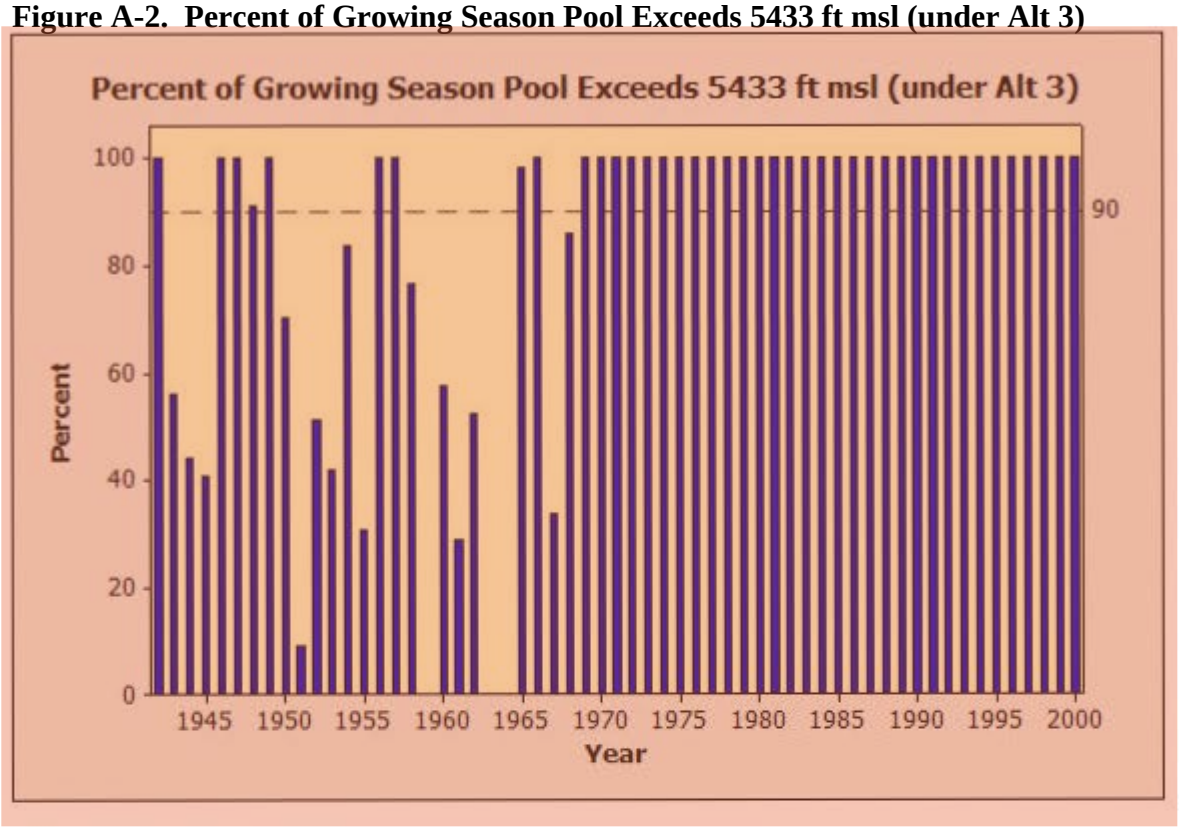


Figure A-3. Percent of Growing Season Pool Exceeds 5434 ft msl (under Alt 3)

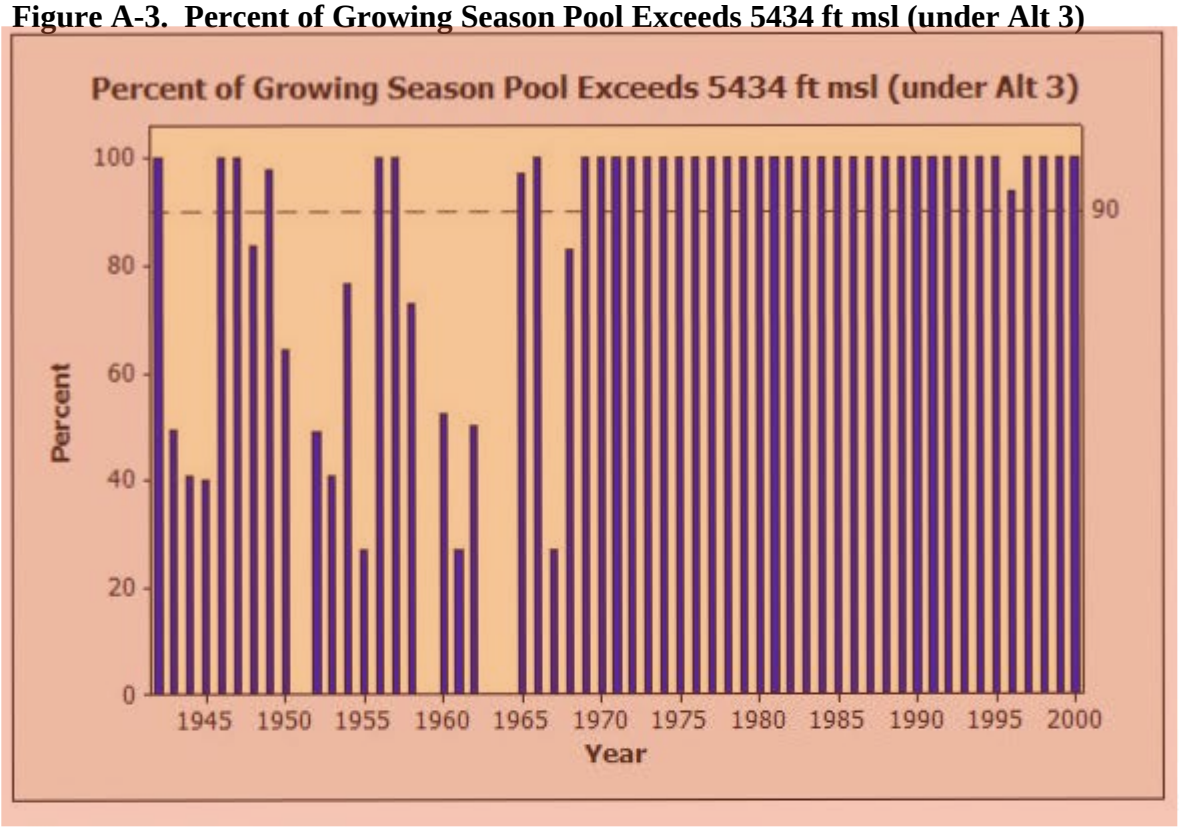


Figure A-4. Percent of Growing Season Pool Exceeds 5435 ft msl (under Alt 3)

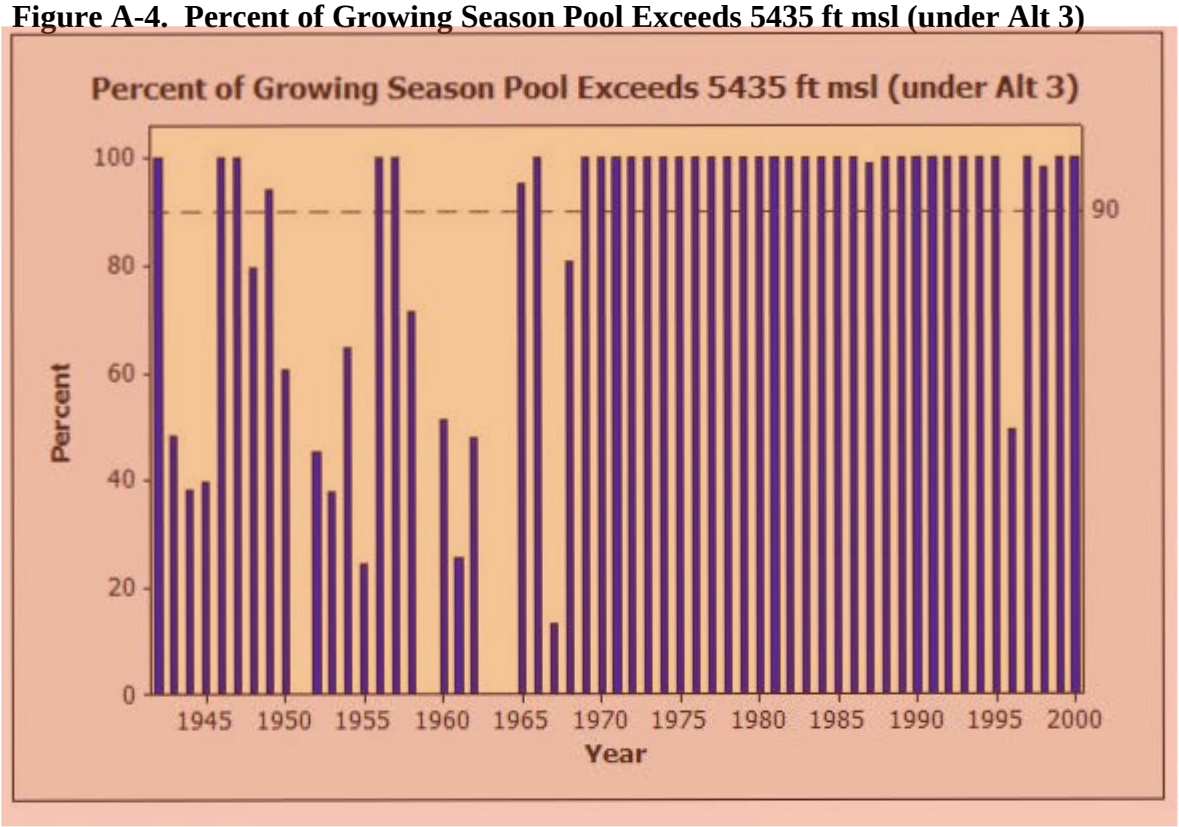


Figure A-5. Percent of Growing Season Pool Exceeds 5436 ft msl (under Alt 3)

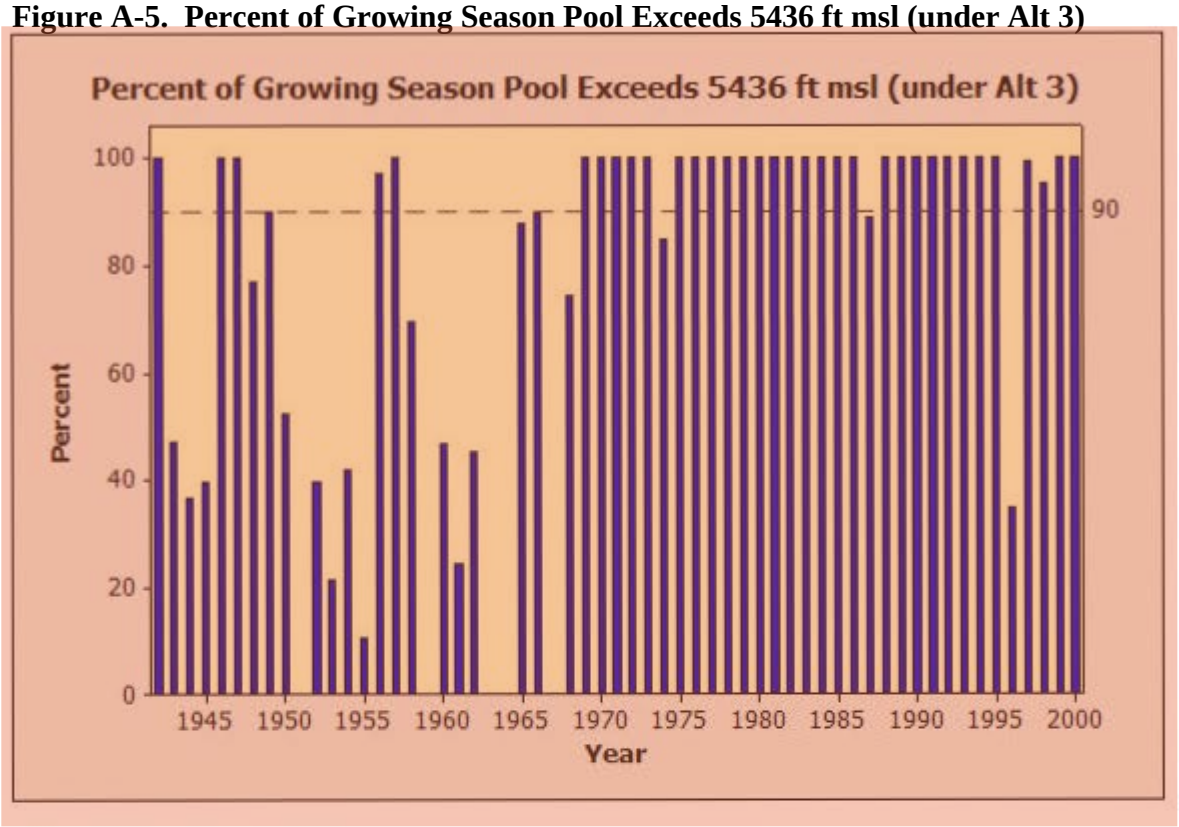


Figure A-6. Percent of Growing Season Pool Exceeds 5437 ft msl (under Alt 3)

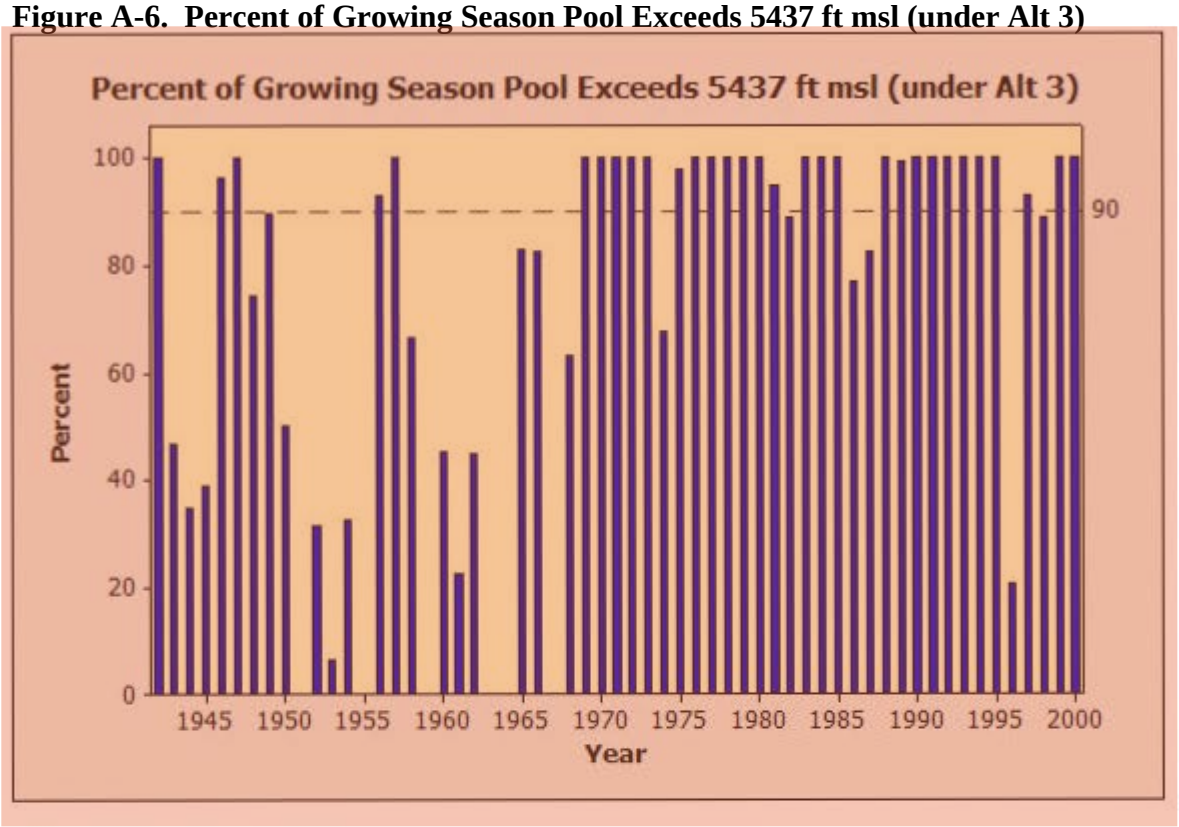


Figure A-7. Percent of Growing Season Pool Exceeds 5438 ft msl (under Alt 3)

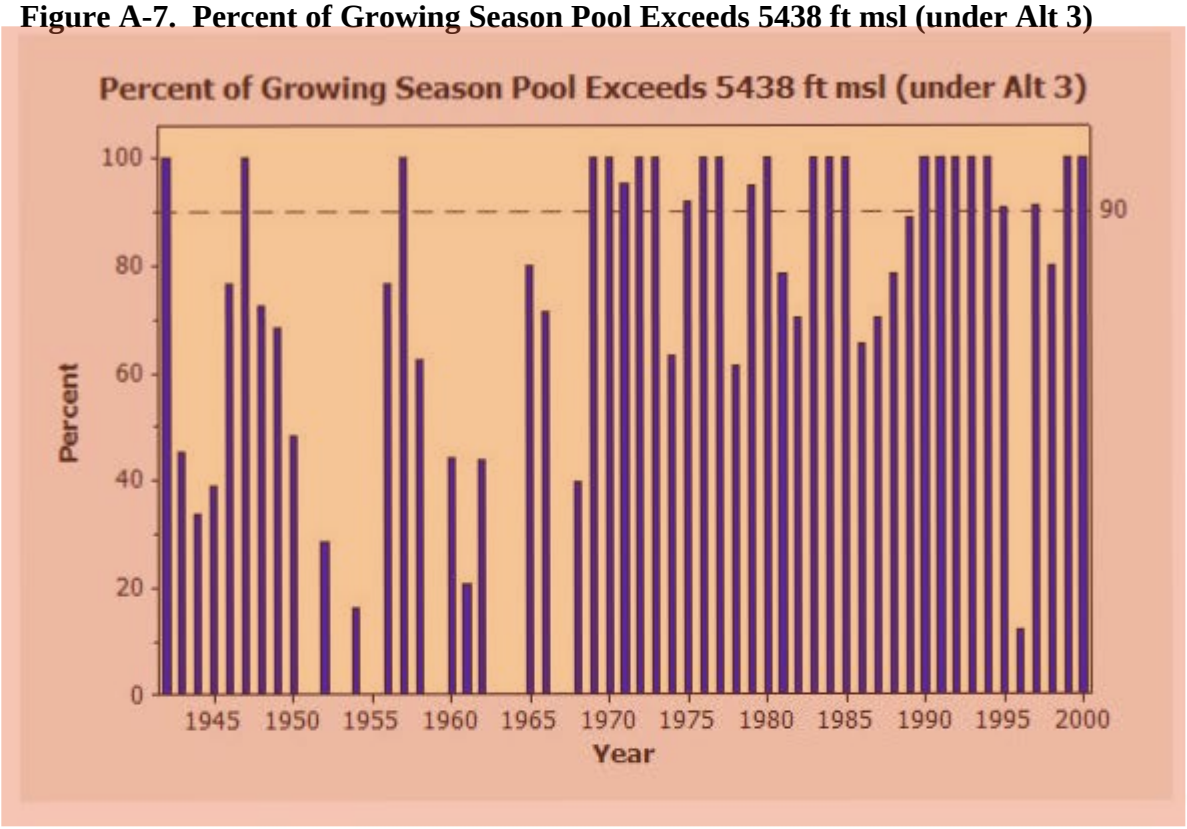


Figure A-8. Percent of Growing Season Pool Exceeds 5439 ft msl (under Alt 3)

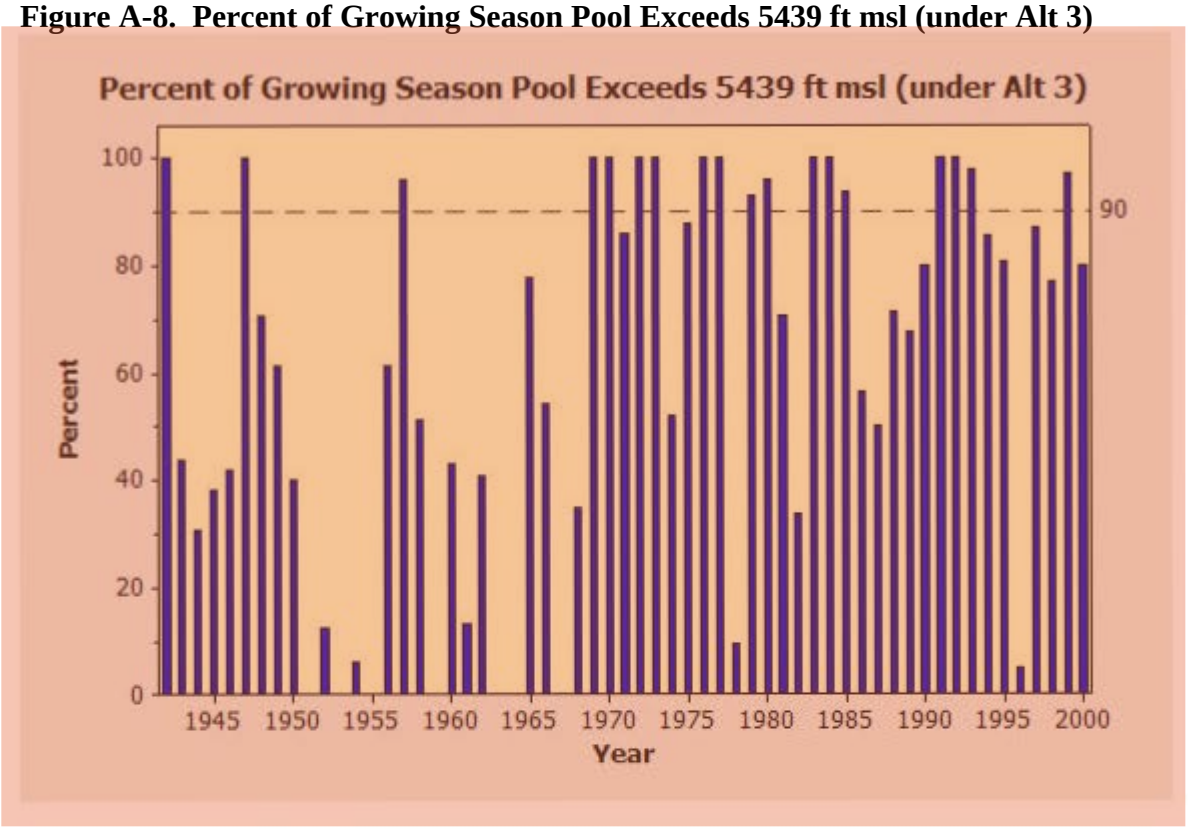


Figure A-9. Percent of Growing Season Pool Exceeds 5440 ft msl (under Alt 3)

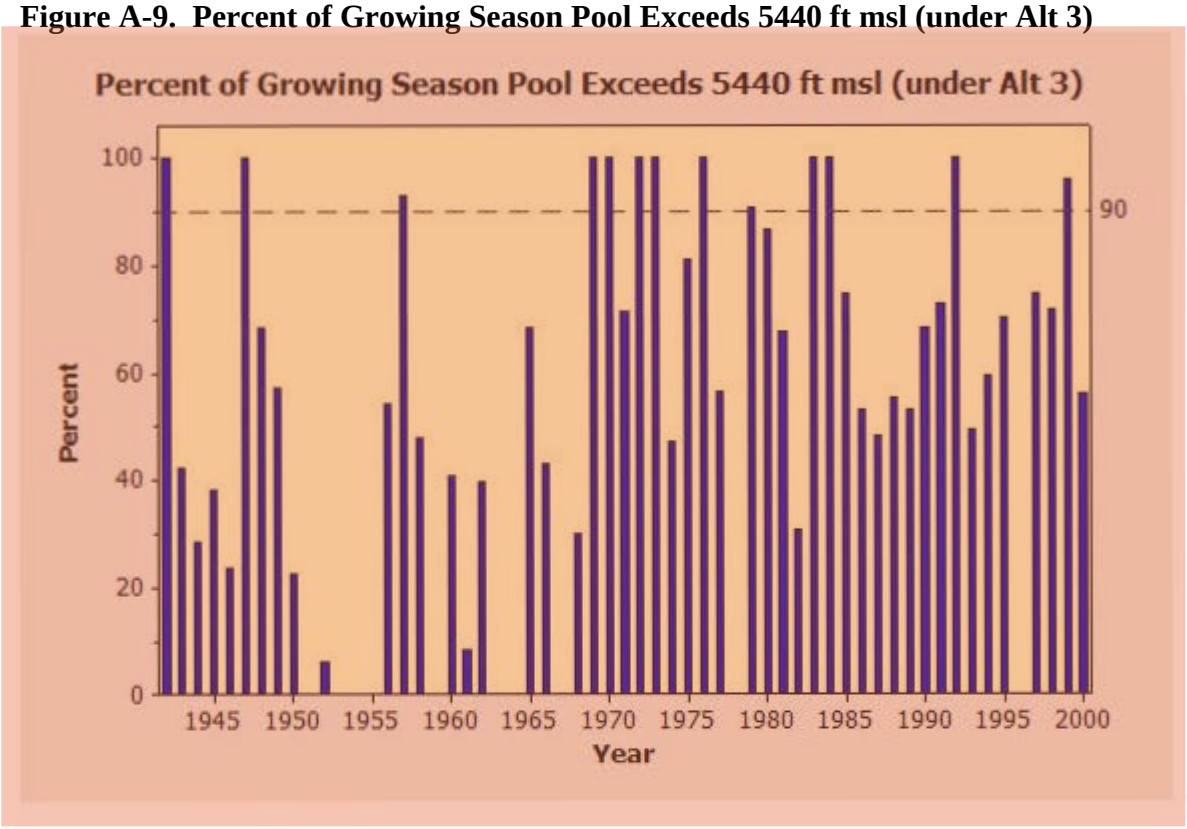


Figure A-10. Percent of Growing Season Pool Exceeds 5441 ft msl (under Alt 3)

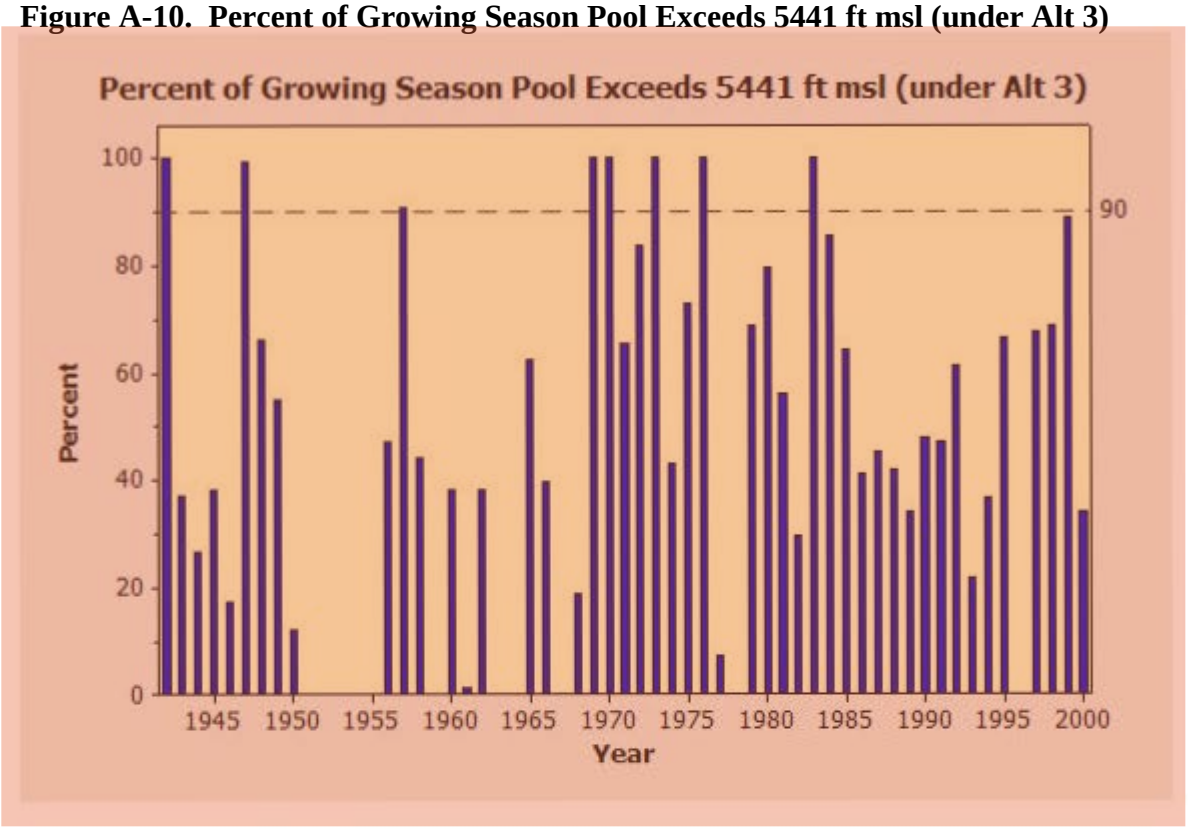


Figure A-11. Percent of Growing Season Pool Exceeds 5442 ft msl (under Alt 3)

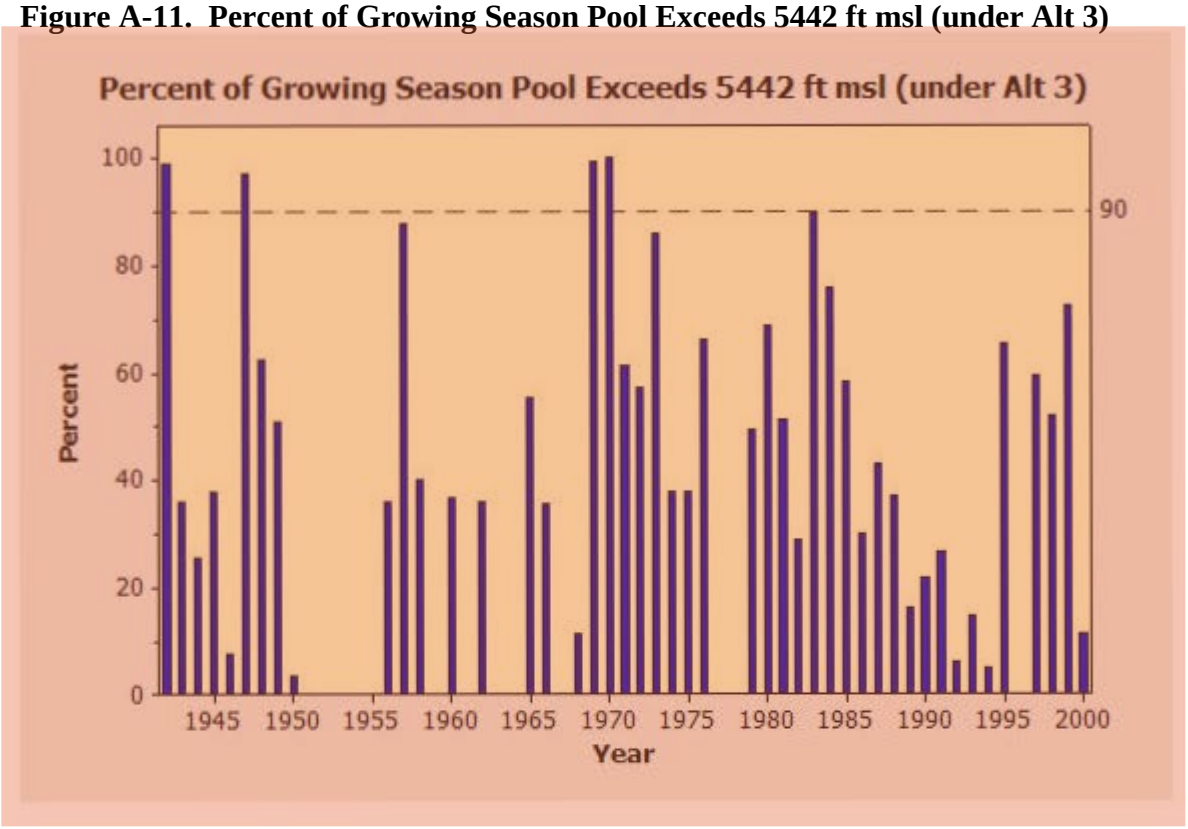


Figure A-12. Percent of Growing Season Pool Exceeds 5443 ft msl (under Alt 3)

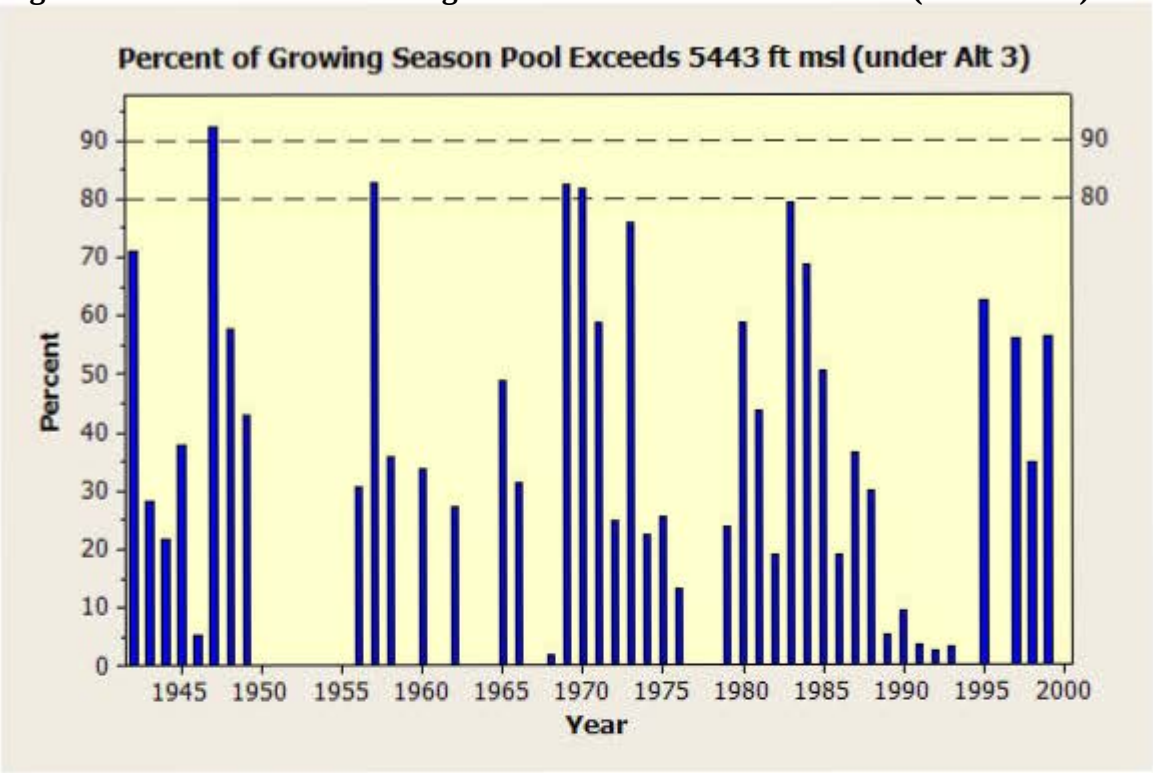


Figure A-13. Percent of Growing Season Pool Exceeds 5444 ft msl (under Alt 3)