
APPENDIX A

QUALITATIVE HABITAT EVALUATION INDEX ANALYSIS

Method of Habitat Analysis

QHEI data are collected on every site throughout the watershed in which biological attainment is determined. Within the Twin Creek basin, these determinations were completed upon multiple locations upon streams of varying drainage areas. Figures 1 and 2 represent the QHEI score for each sampling location versus its drainage area for WWH and EWH sites. The biological attainment status of an individual site is shown by color shading of the data points.

The first step in this analysis method is to determine if habitat is a plausible impairment within Twin Creek watershed. A review of the cause and source listings within the Attainment Table (Ohio EPA 2007) clearly notes poor habitat is a high-magnitude cause of biological impairment. Therefore, the habitat data must be more closely analyzed. To determine if the QHEI values indicate habitat issues with respect to biological attainment groups, box plots of the data for WWH and EWH full and partial attainment groups were generated (Figures 3 and 4).

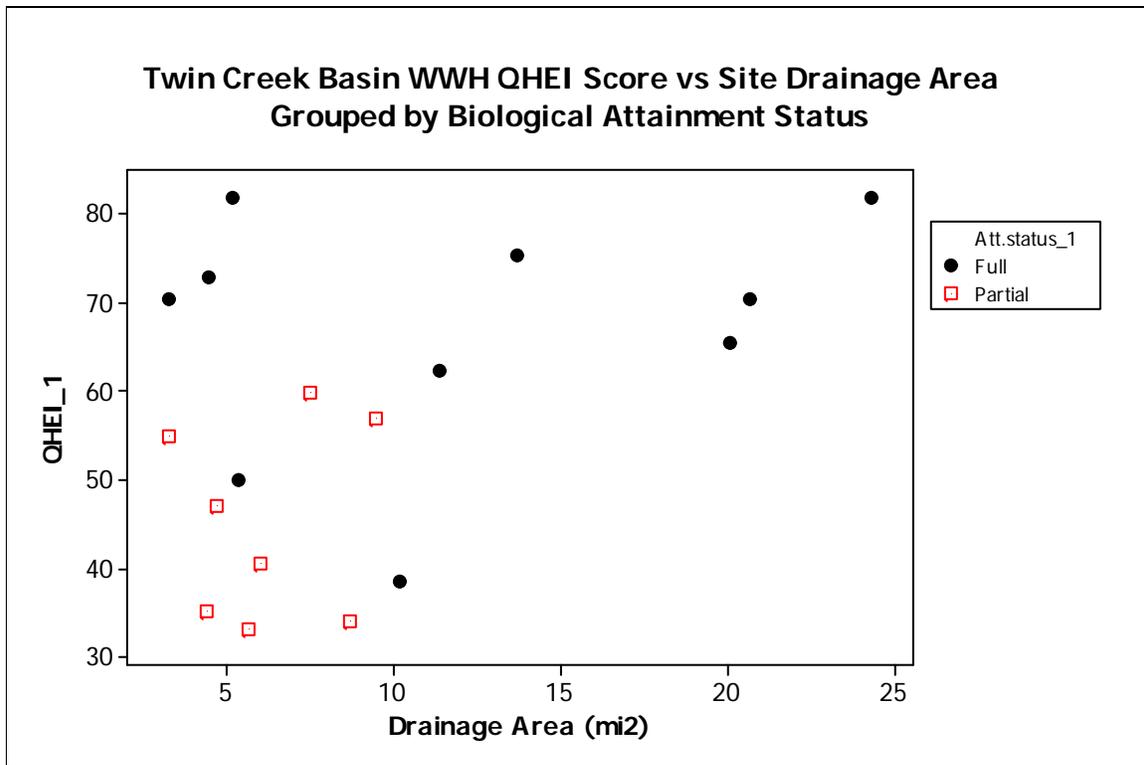


Figure 1. WWH QHEI Scores for the Twin Creek vs. Drainage Area by Attainment Group.

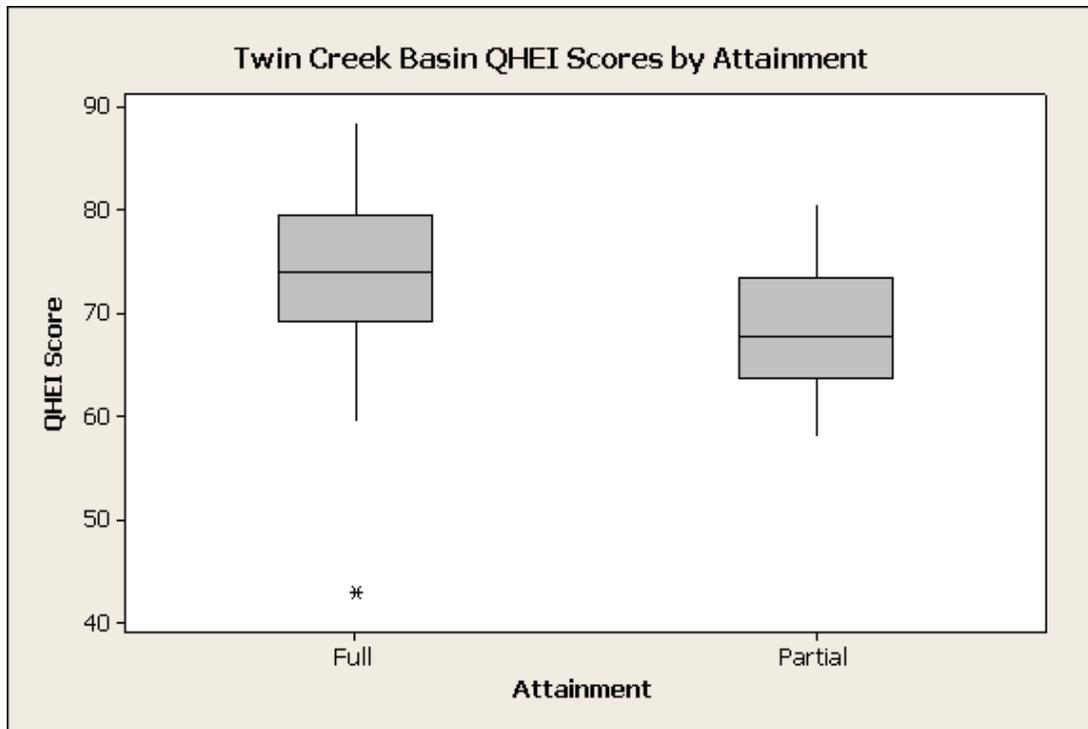


Figure 4. Box-whisker plots of Twin Creek Basin EWH QHEI scores by attainment group.

As can be observed from the box plots, for both WWH and EWH, the partial attainment group QHEI values are lower than the full attainment group. An increase in habitat quality is needed to offset lower QHEI values in partial attainment groups. Therefore, the TMDL for QHEI and the individual subcategories can be developed from the full attainment group values. For both WWH and EWH a target value for QHEI and for each subcategory was chosen to be the lowest value of the 95th percent confidence interval of the full attainment group median. This value was chosen to reduce the effects of skewed data sets and to ensure that the full data set values mostly achieve the TMDL goal. In addition, this value statically assures with 95 percent confidence that the population median of the QHEI or subcategory is at least greater than this value. This goal provides assurance that an acceptable intrinsic safety factor for the TMDL is provided.

Because the QHEI total score is comprised of seven subcategories of habitat, the value of this index can be significantly affected by a large depletion in one category as well as small depletion in multiple categories. Therefore, TMDL goals were created individually for the QHEI total score and its subcategories. This technique ensures that the subcategory of the QHEI that is causing the impairment at a particular site is slated for mitigation. In addition, this procedure will provide an estimate of effort required to eliminate the impairment cause.

Statistical Analysis of Habitat

Figures 5 and 6 provide descriptive statistics of the QHEI full attainment WWH and EWH data sets. The minimum overall score targets for WWH and EWH attainment are set at 49 and 71.8, respectively. Those values are the lowest value of the 95 percent confidence interval of the median. The values constitute the TMDL for QHEI scores of warmwater and exceptional

warmwater habitat streams within the Twin Creek watershed. Therefore, all WWH and EWH partial attainment site data are compared to the target scores of 49 and 71.8, respectively.

For each subcategory of the QHEI, a boxplot of the full and partial attainment sites has been provided. Figures 7 through 34 provide the QHEI subcategory scores for substrate, cover, channel, riparian, pool, riffle, and gradient based on WWH and EWH locations; as well as descriptive statistics for the full attainment data for each subcategory based on WWH and EWH locations.

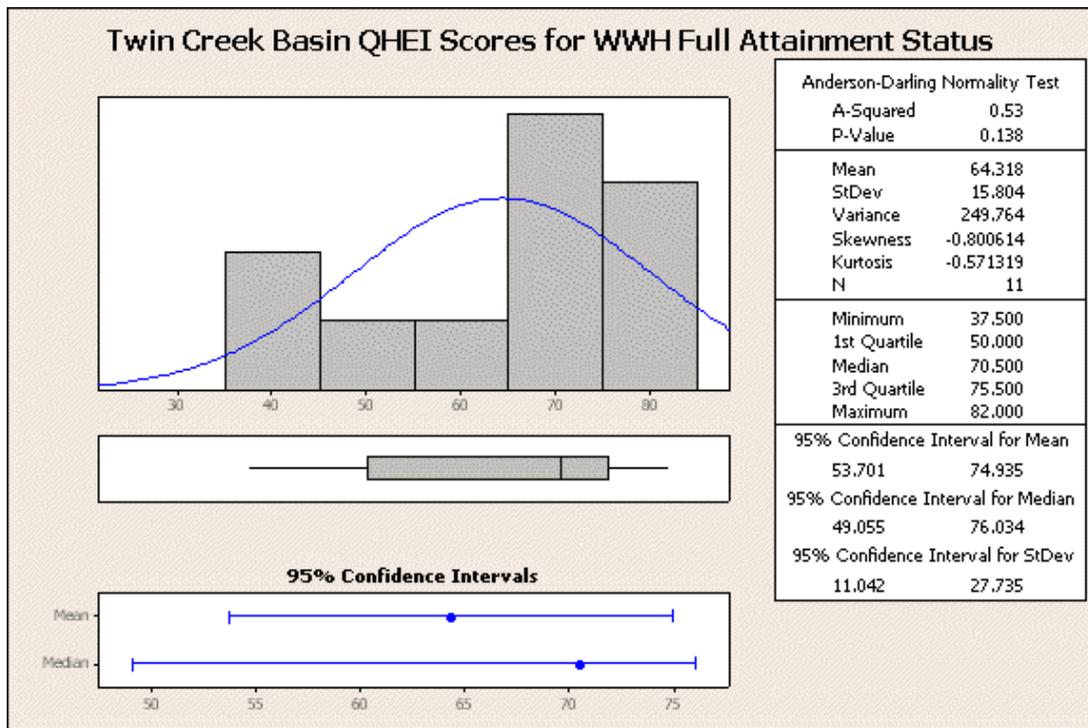


Figure 5. Histogram of Twin Creek QHEI scores for WWH full attainment status locations.

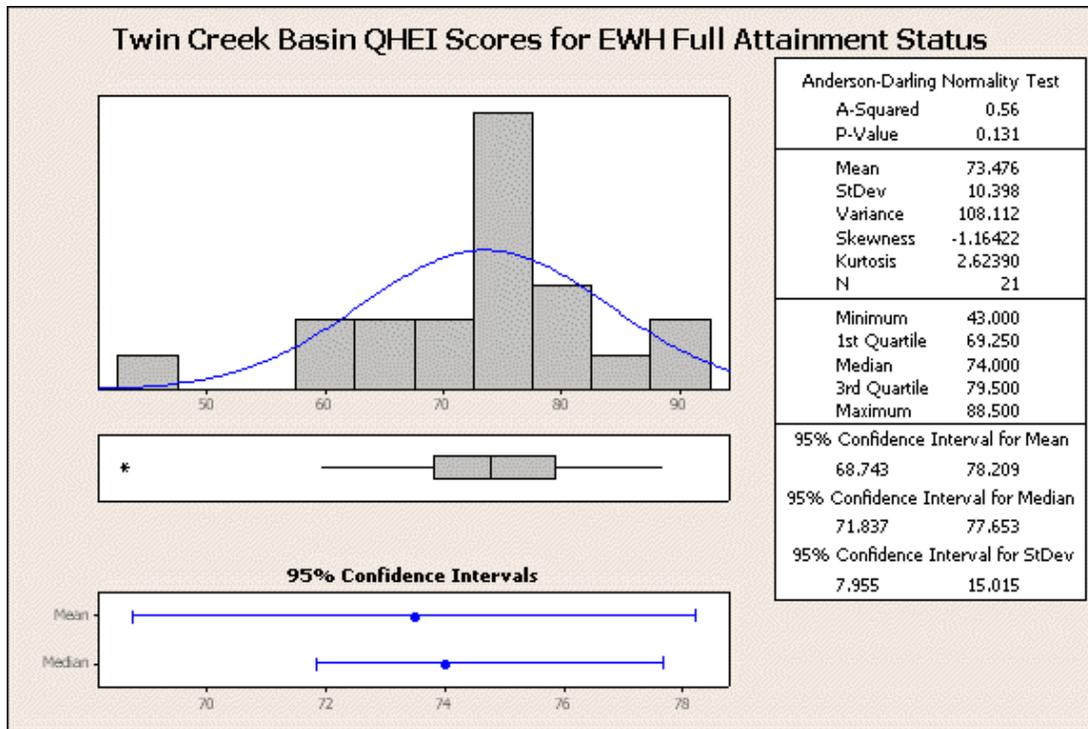


Figure 6. Histogram of Twin Creek QHEI scores for EWH full attainment status locations.

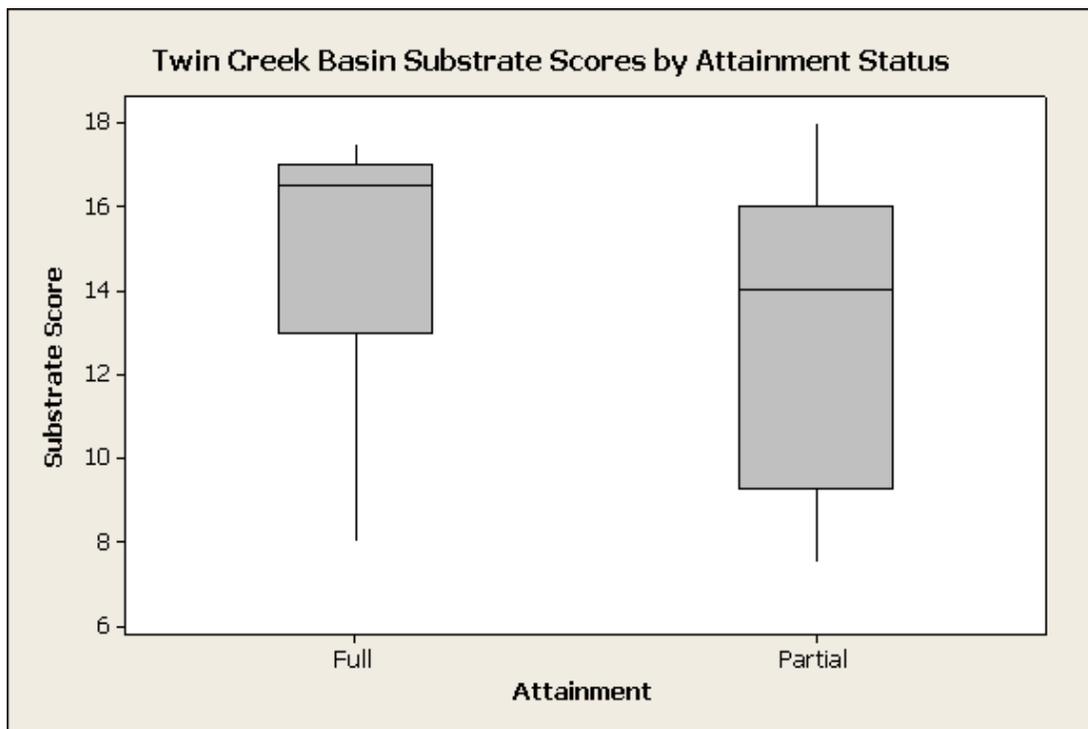


Figure 7. Box-whisker plots of Twin Creek Basin WWH substrate scores by attainment group.

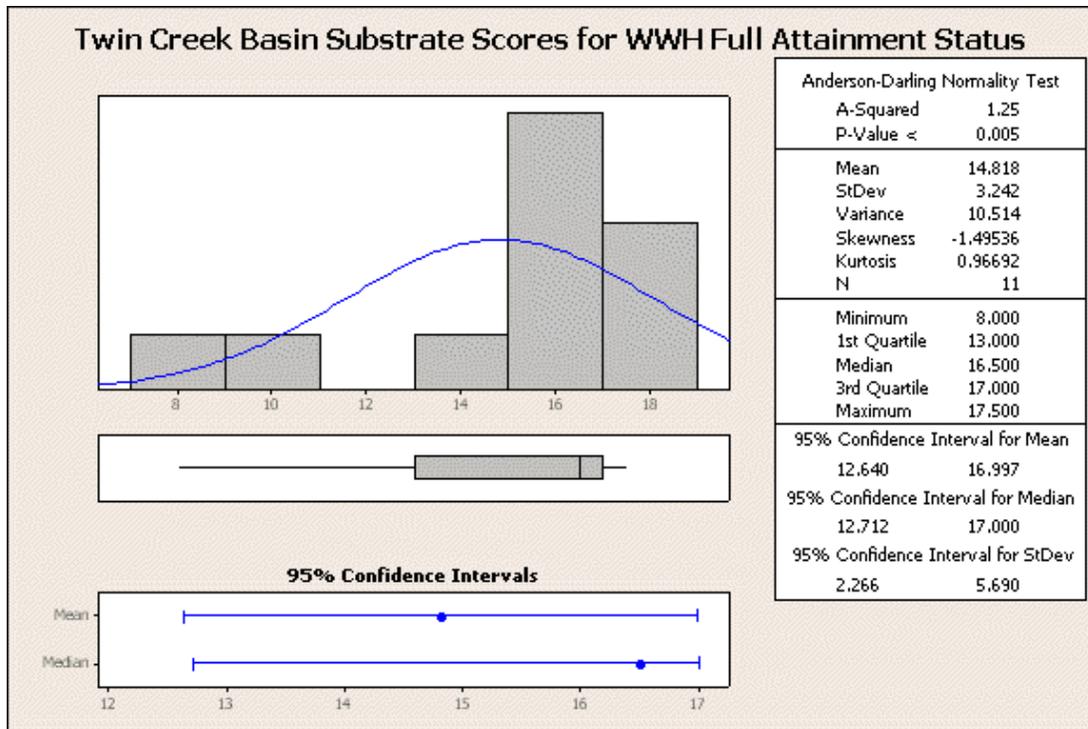


Figure 8. Histogram of Twin Creek substrate scores for WWH full attainment status locations.

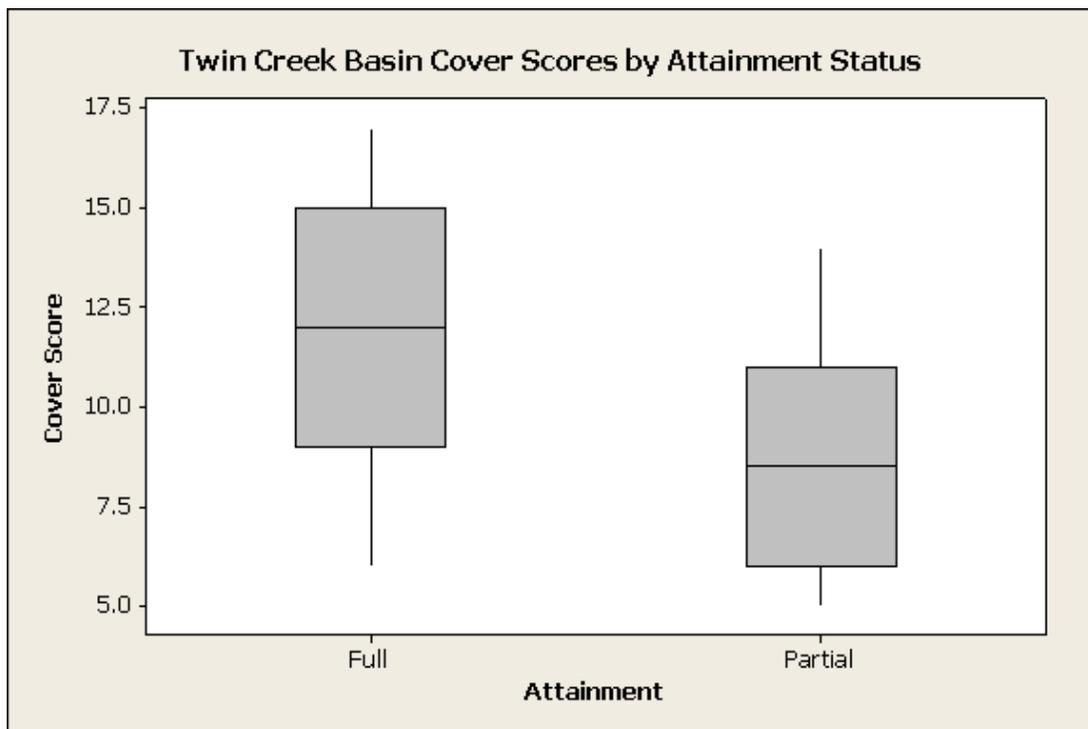


Figure 9. Box-whisker plots of Twin Creek Basin WWH cover scores by attainment group.

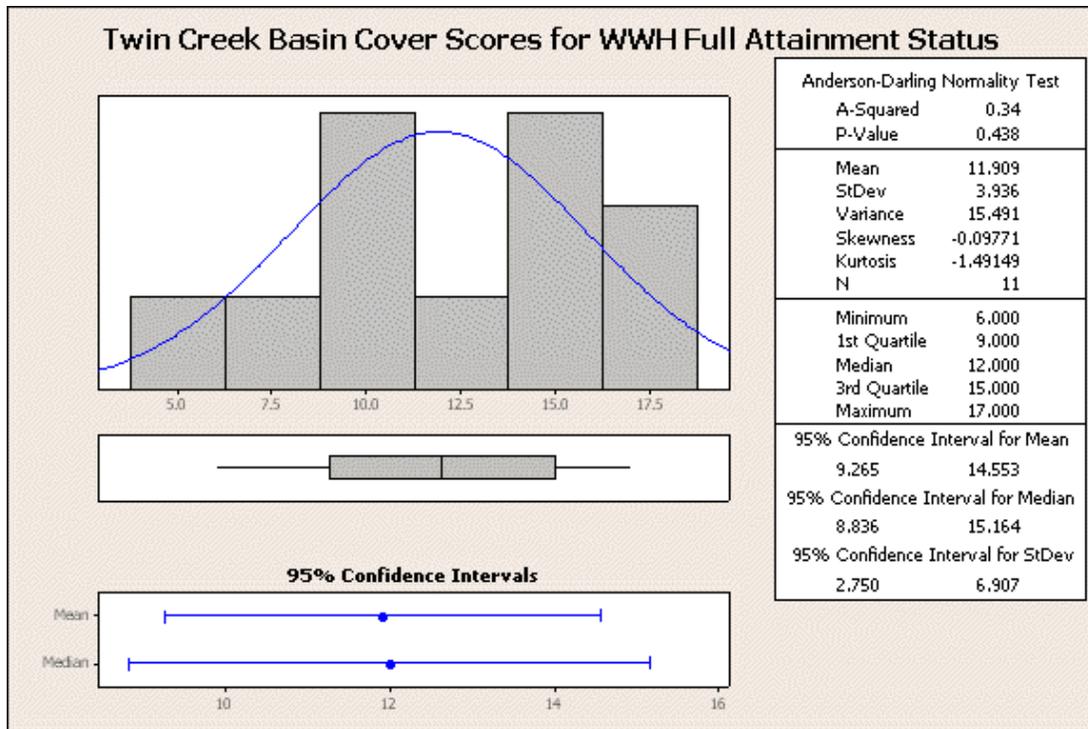


Figure 10. Histogram of Twin Creek cover scores for WWH full attainment status locations.

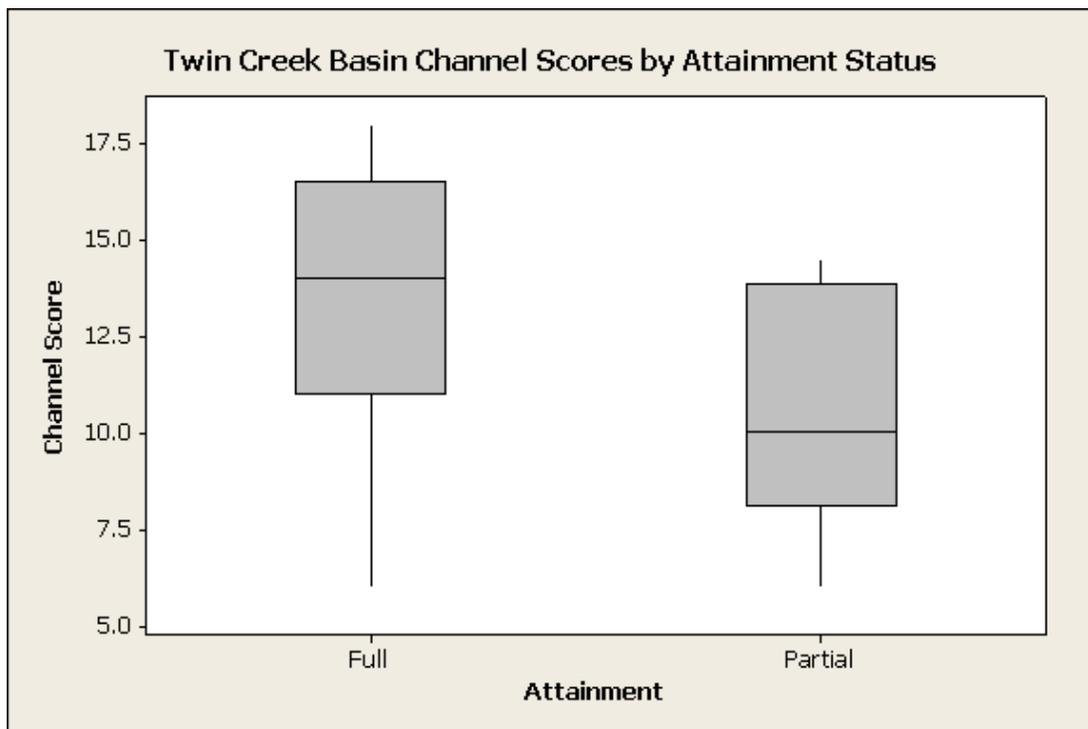


Figure 11. Box-whisker plots of Twin Creek Basin WWH channel scores by attainment group.

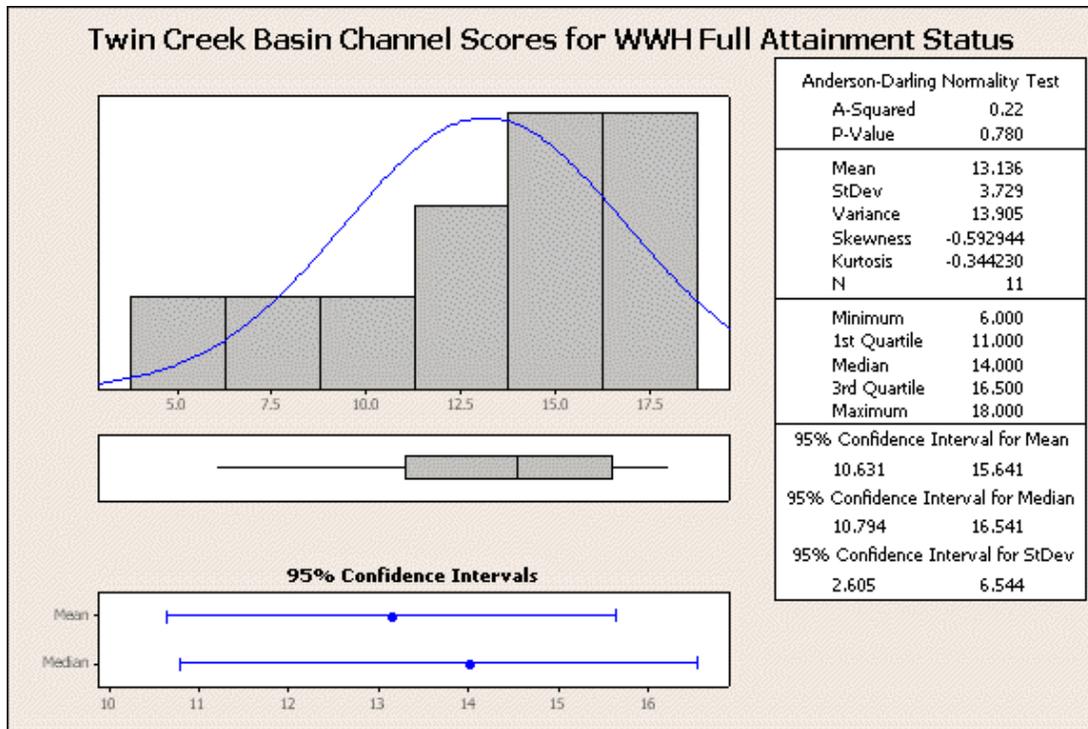


Figure 12. Histogram of Twin Creek channel scores for WWH full attainment status locations.

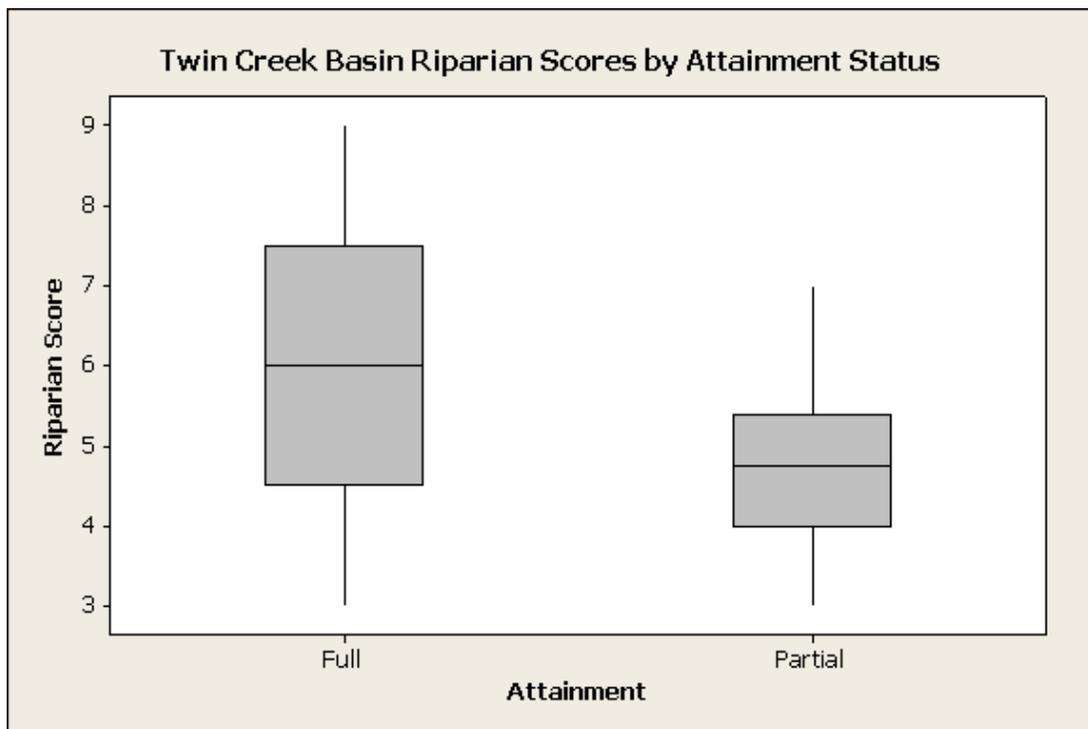


Figure 13. Box-whisker plots of Twin Creek Basin WWH riparian scores by attainment group.

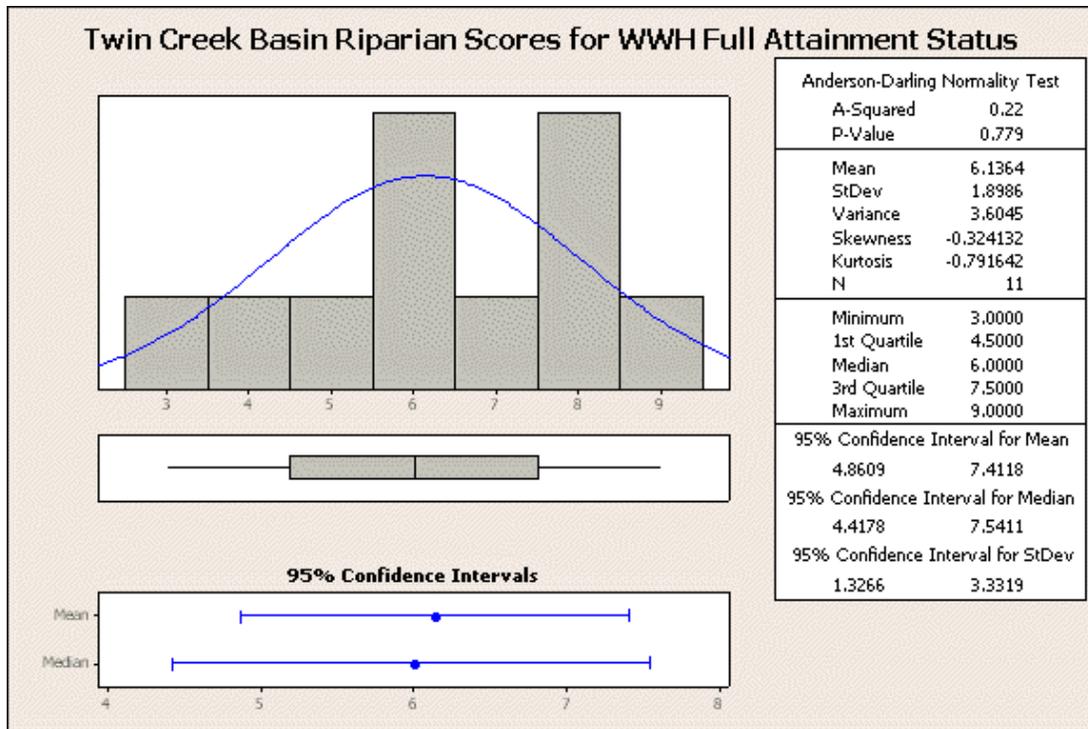


Figure 14. Histogram of Twin Creek riparian scores for WWH full attainment status locations.

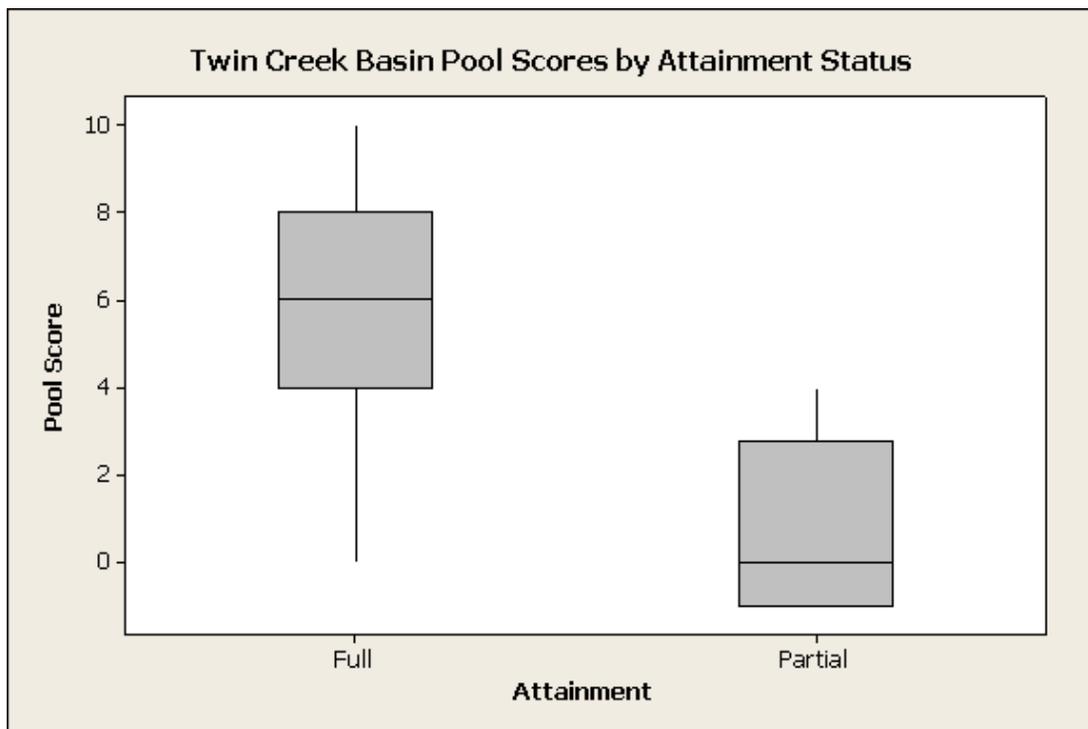


Figure 15. Box-whisker plots of Twin Creek Basin WWH pool scores by attainment group.

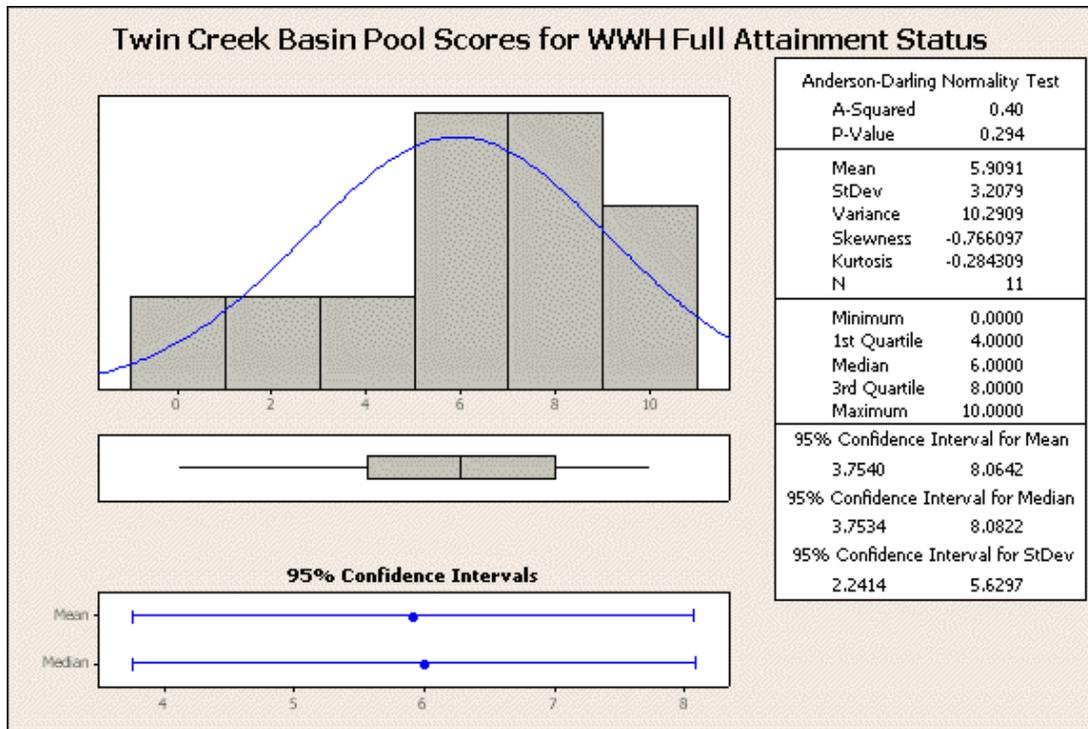


Figure 16. Histogram of Twin Creek pool scores for WWH full attainment status locations.

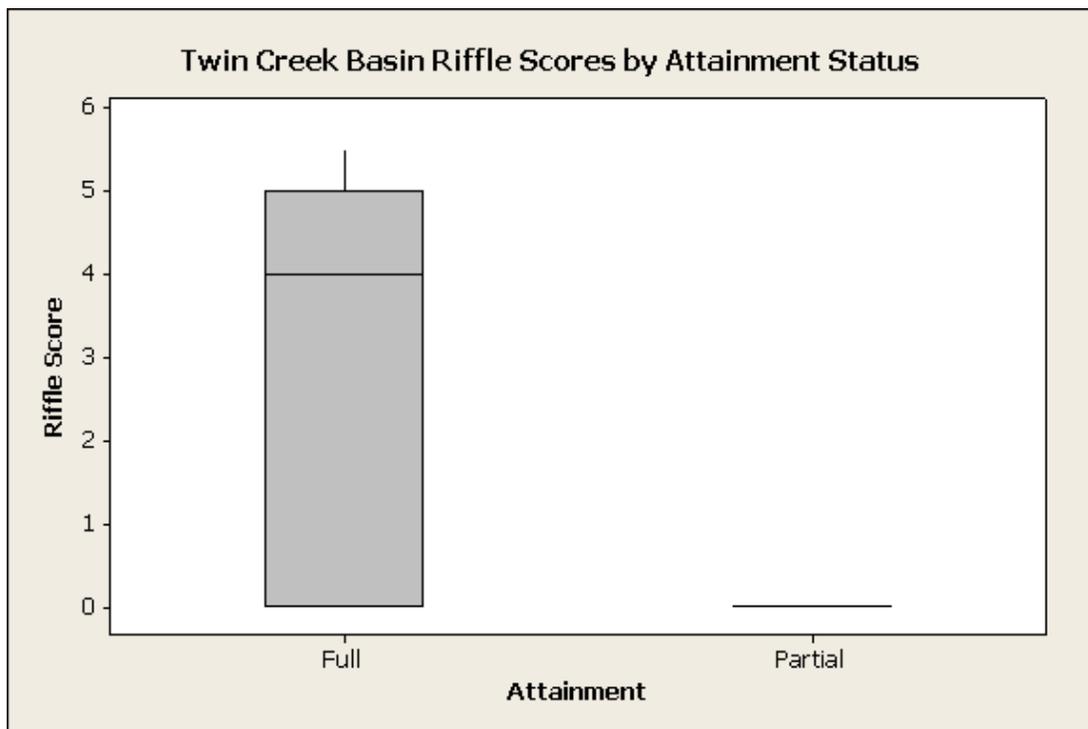


Figure 17. Box-whisker plots of Twin Creek Basin WWH riffle scores by attainment group.

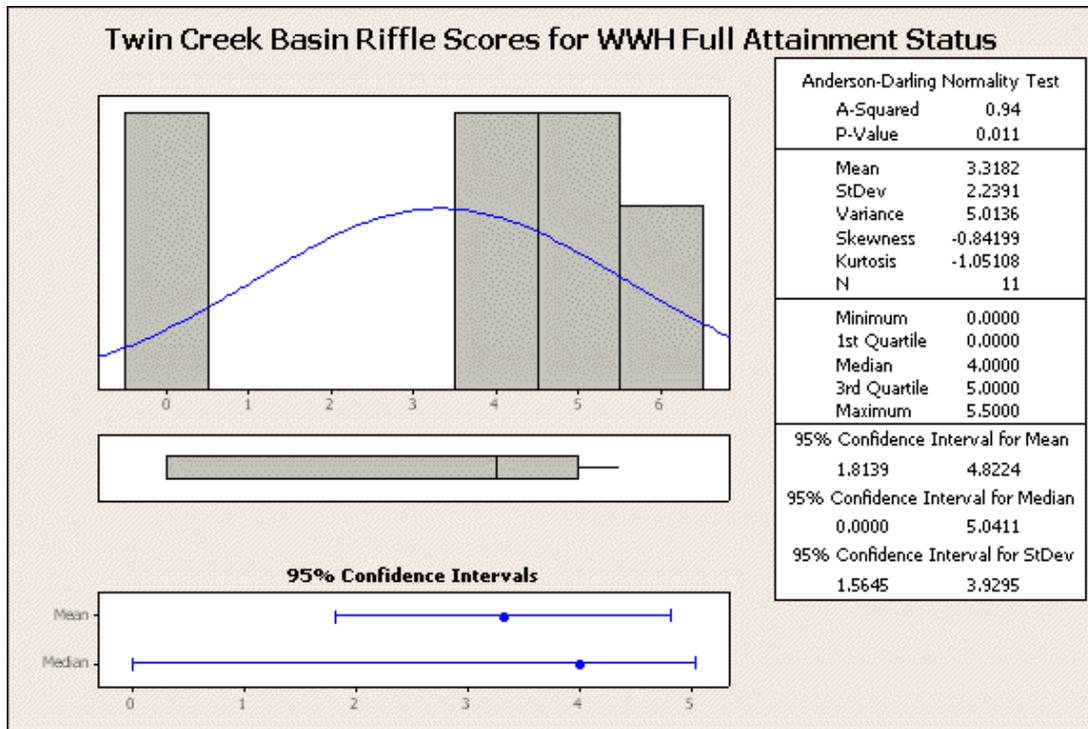


Figure 18. Histogram of Twin Creek riffle scores for WWH full attainment status locations.

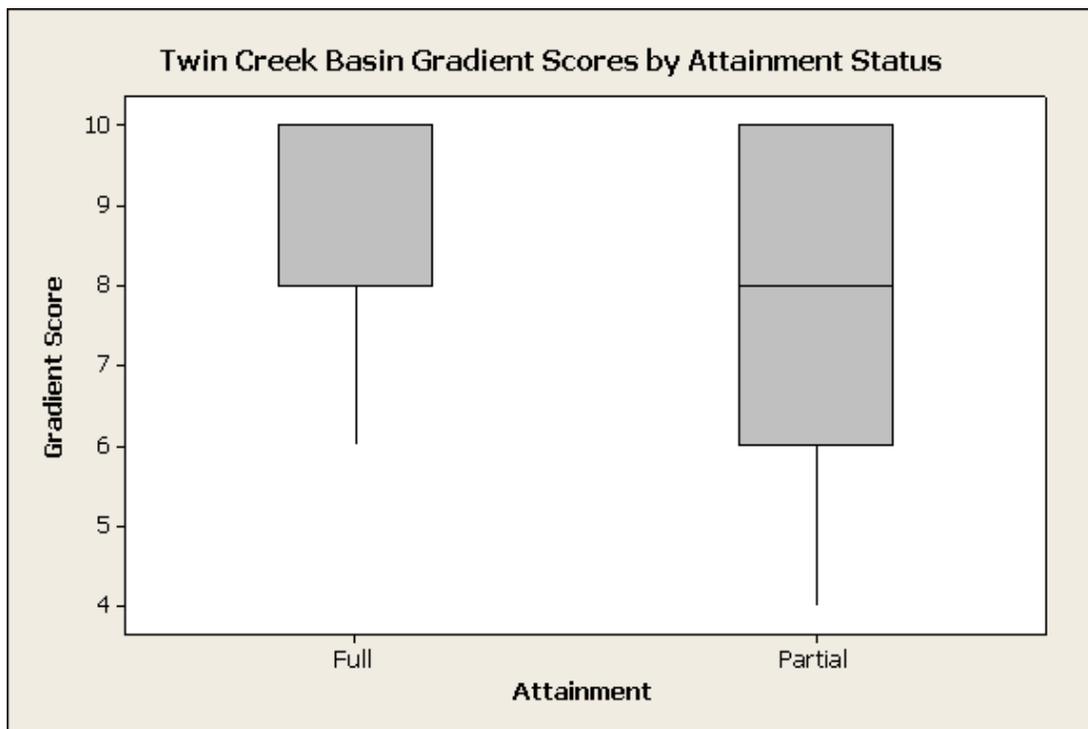


Figure 19. Box-whisker plots of Twin Creek Basin WWH gradient scores by attainment group.

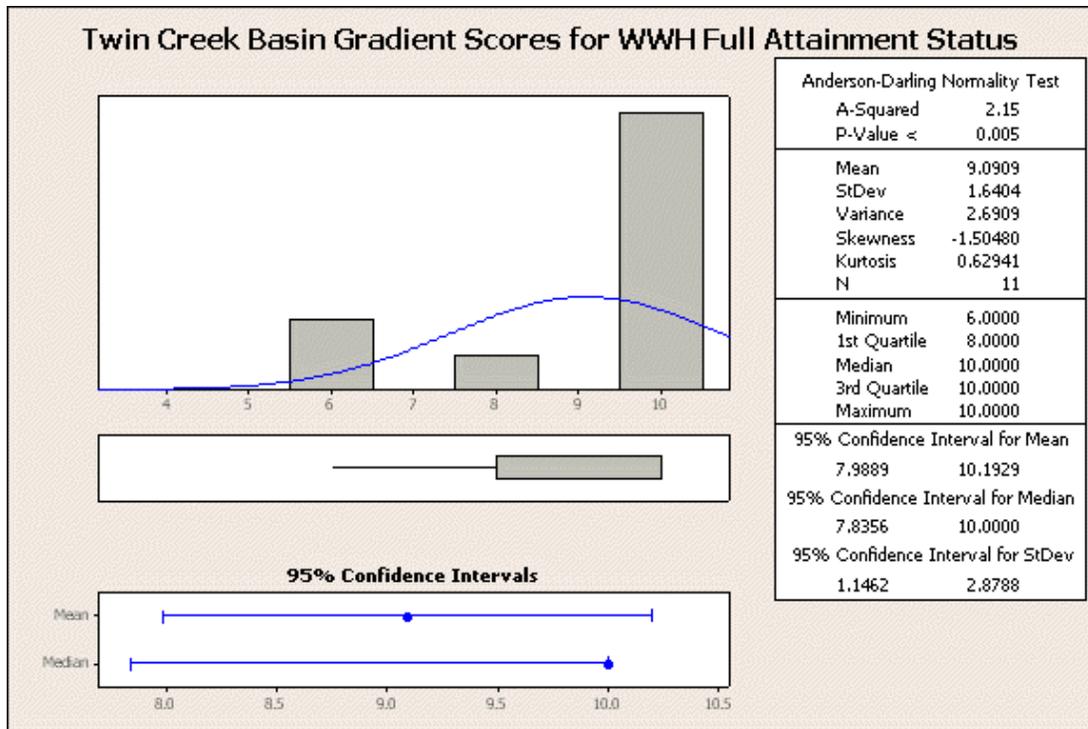


Figure 20. Histogram of Twin Creek gradient scores for WWH full attainment status locations.

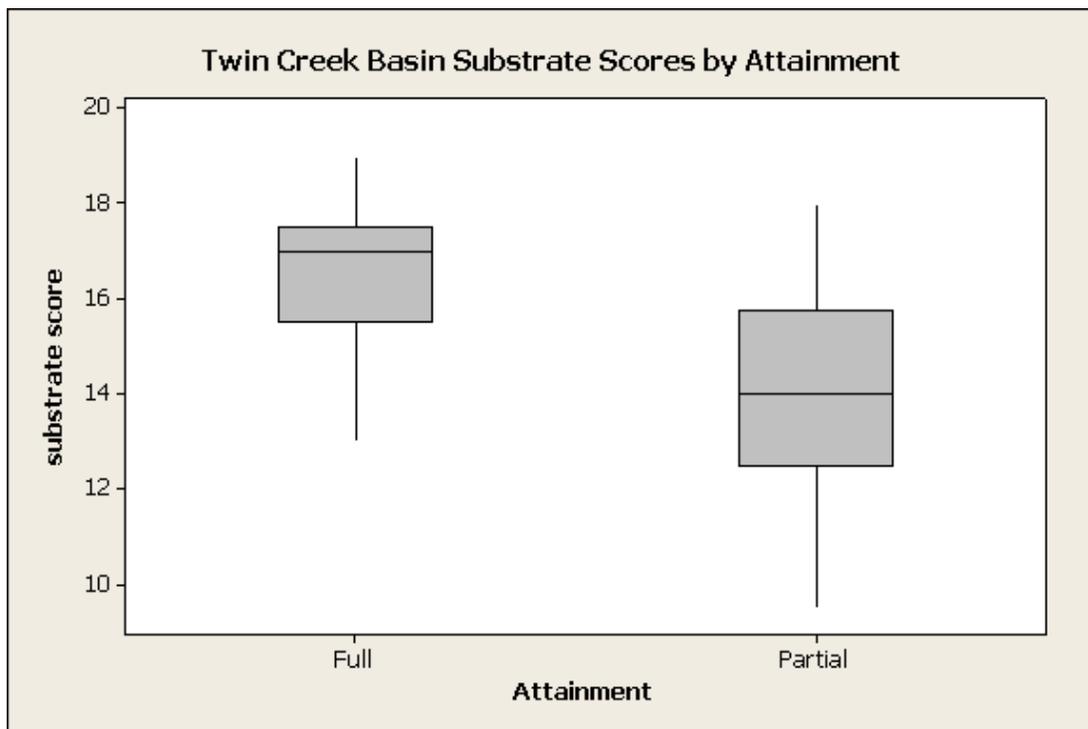


Figure 21. Box-whisker plots of Twin Creek Basin EWH substrate scores by attainment group.

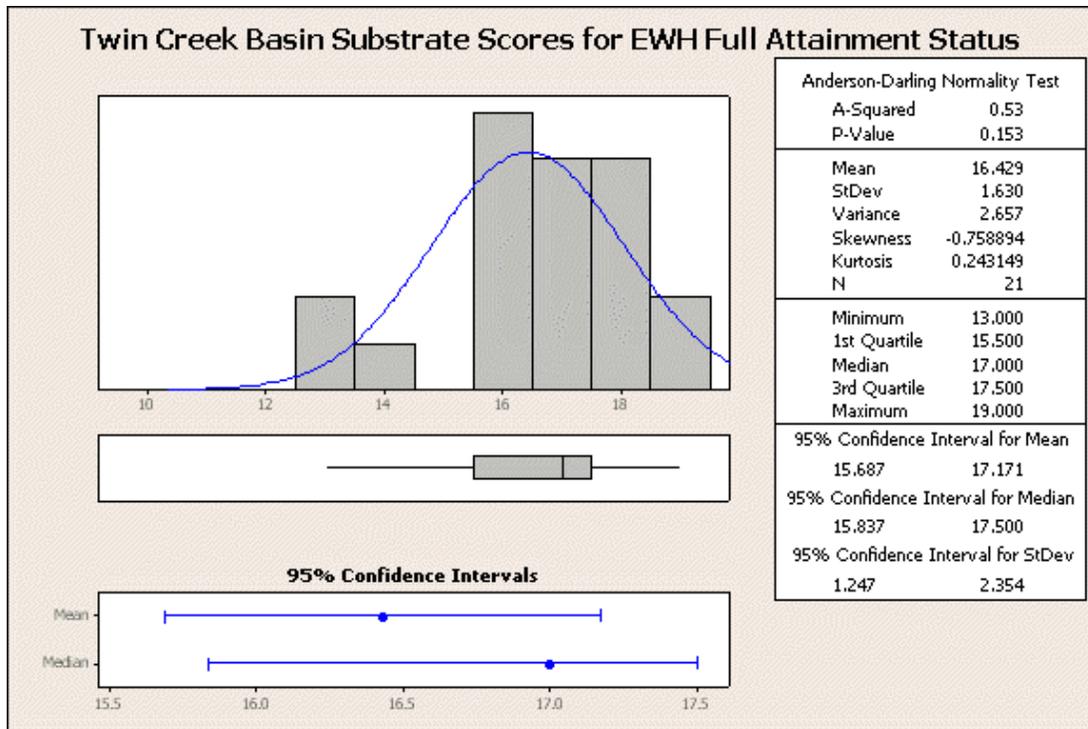


Figure 22. Histogram of Twin Creek substrate scores for EWH full attainment status locations.

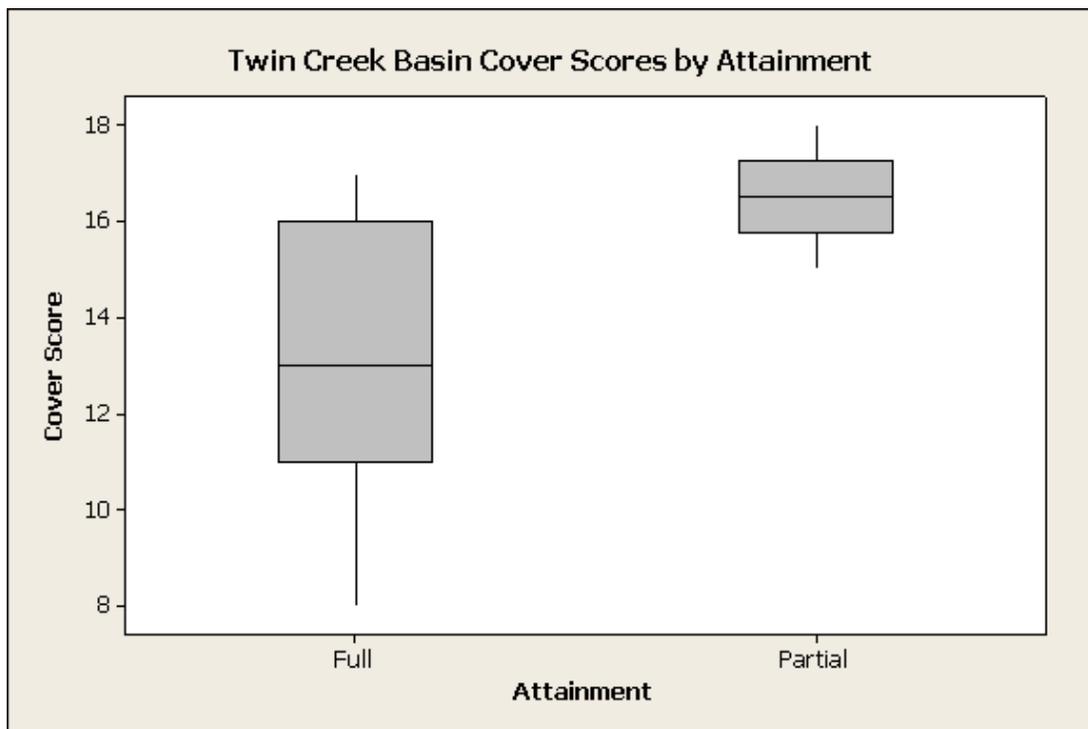


Figure 23. Box-whisker plots of Twin Creek Basin EWH cover scores by attainment group.

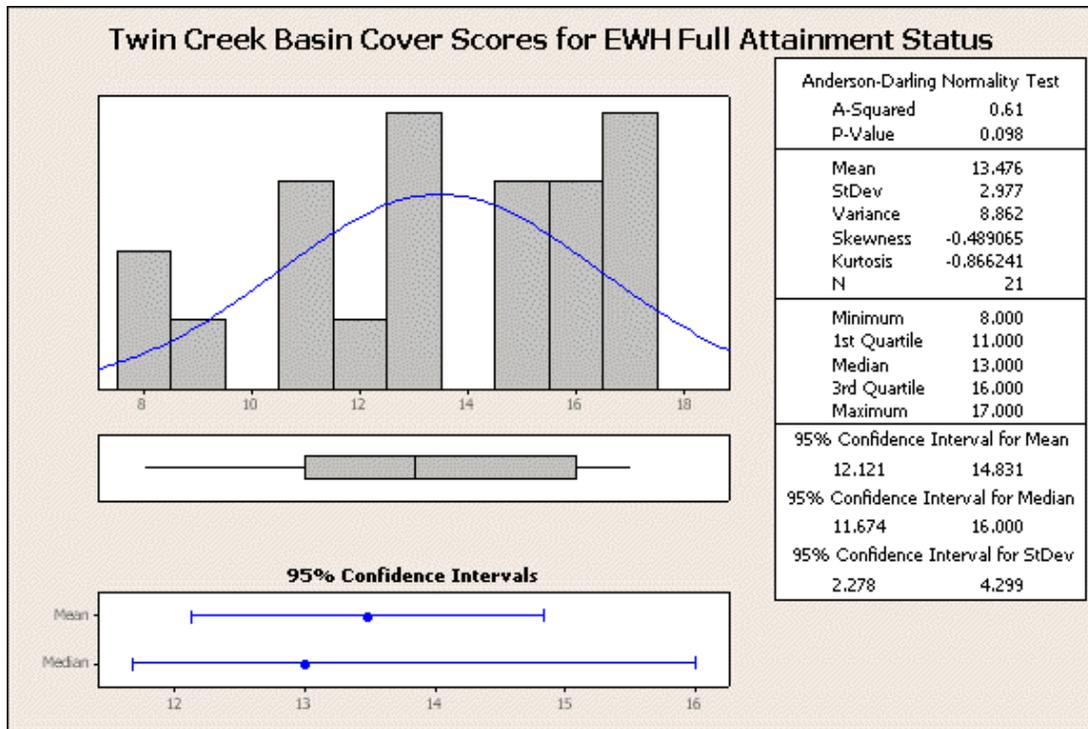


Figure 24. Histogram of Twin Creek cover scores for EWH full attainment status locations.

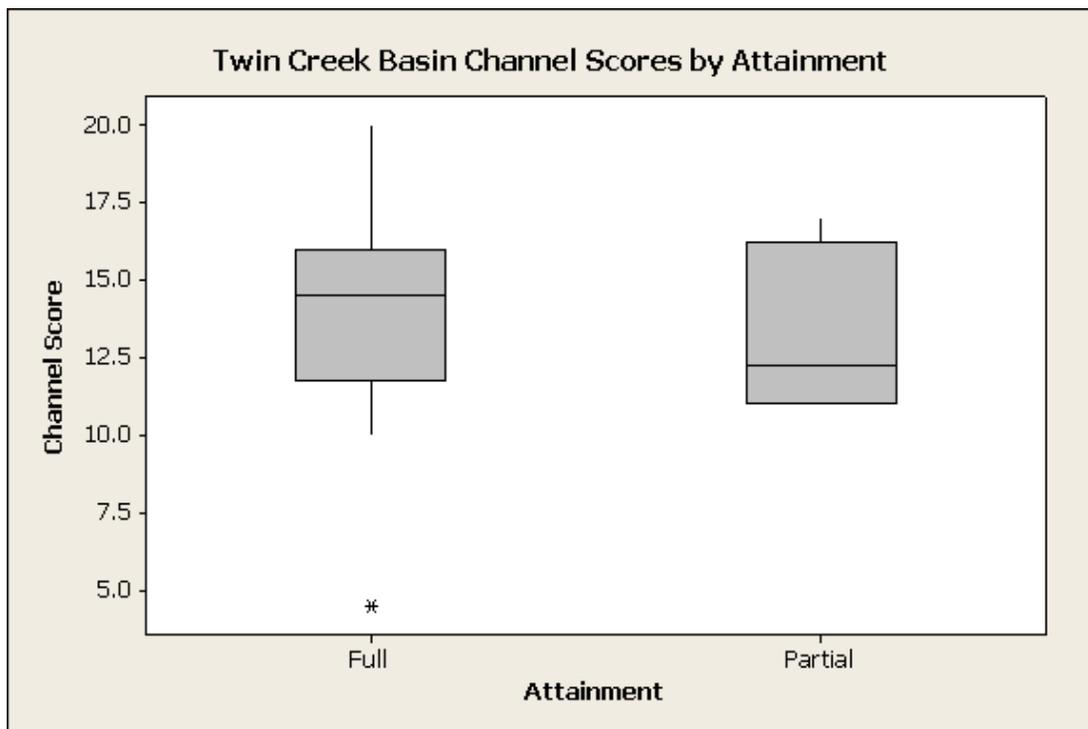


Figure 25. Box-whisker plots of Twin Creek Basin EWH channel scores by attainment group.

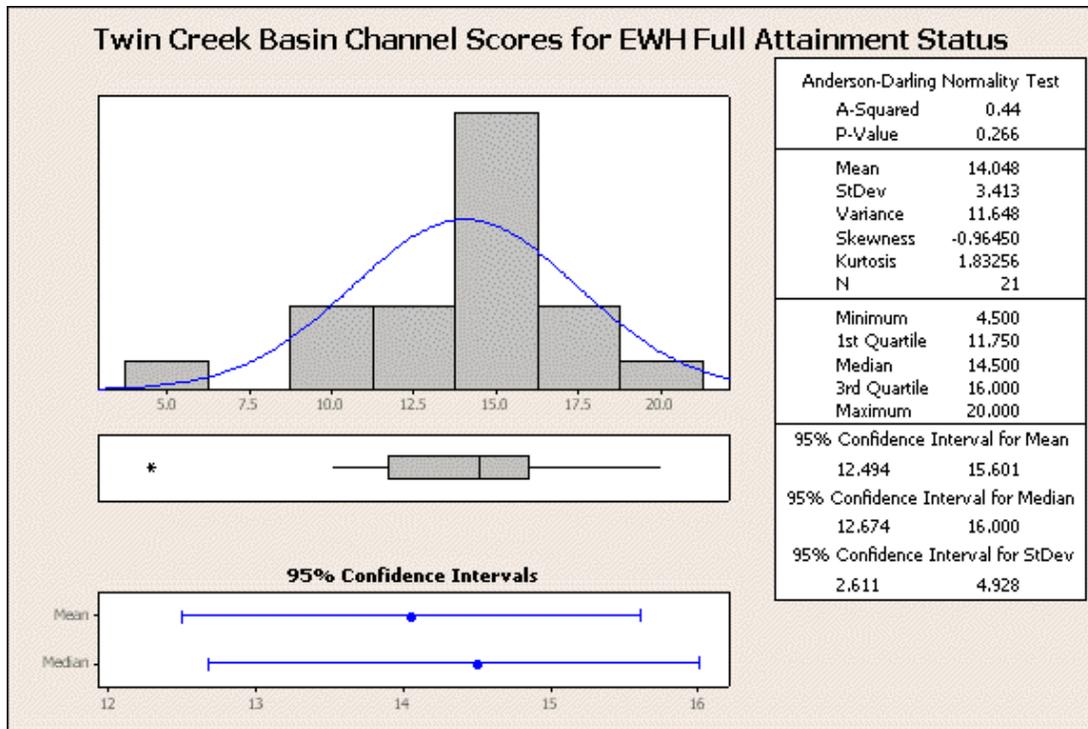


Figure 26. Histogram of Twin Creek channel scores for EWH full attainment status locations.

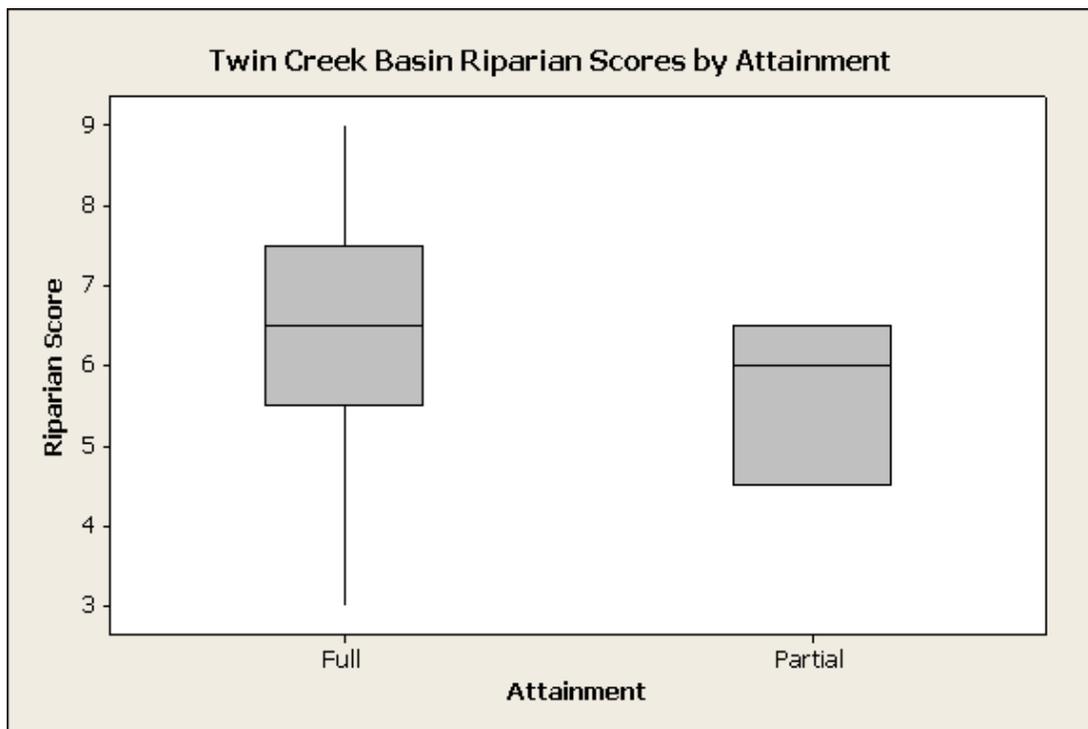


Figure 27. Box-whisker plots of Twin Creek Basin EWH riparian scores by attainment group.

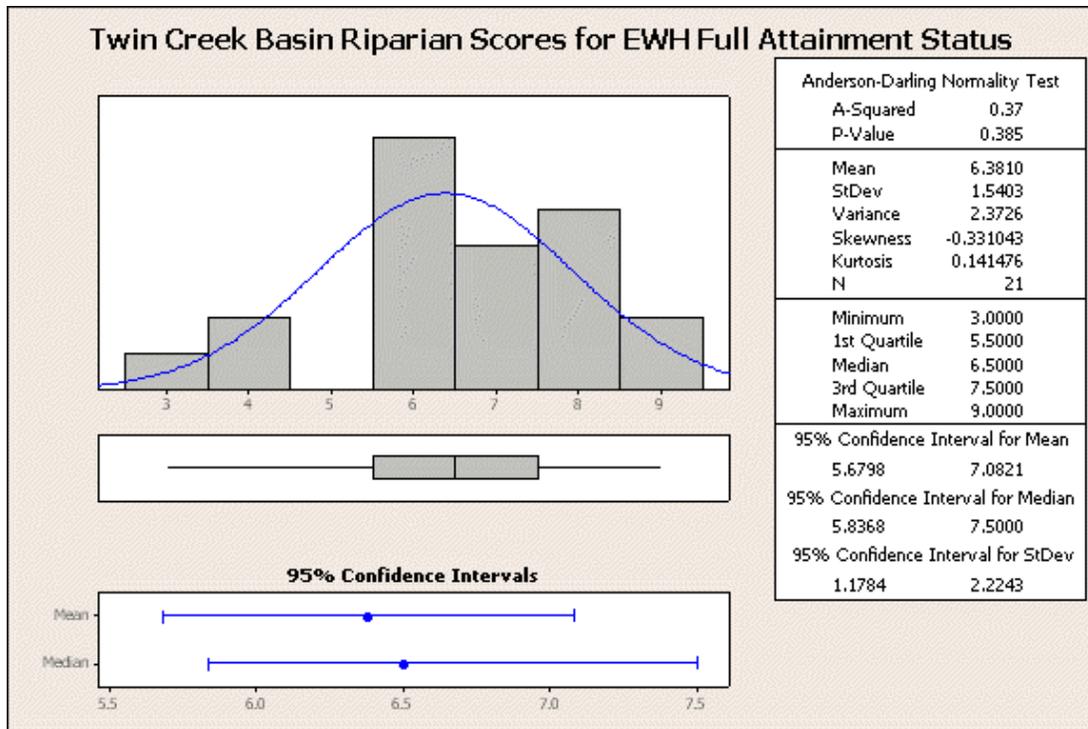


Figure 28. Histogram of Twin Creek riparian scores for EWH full attainment status locations.

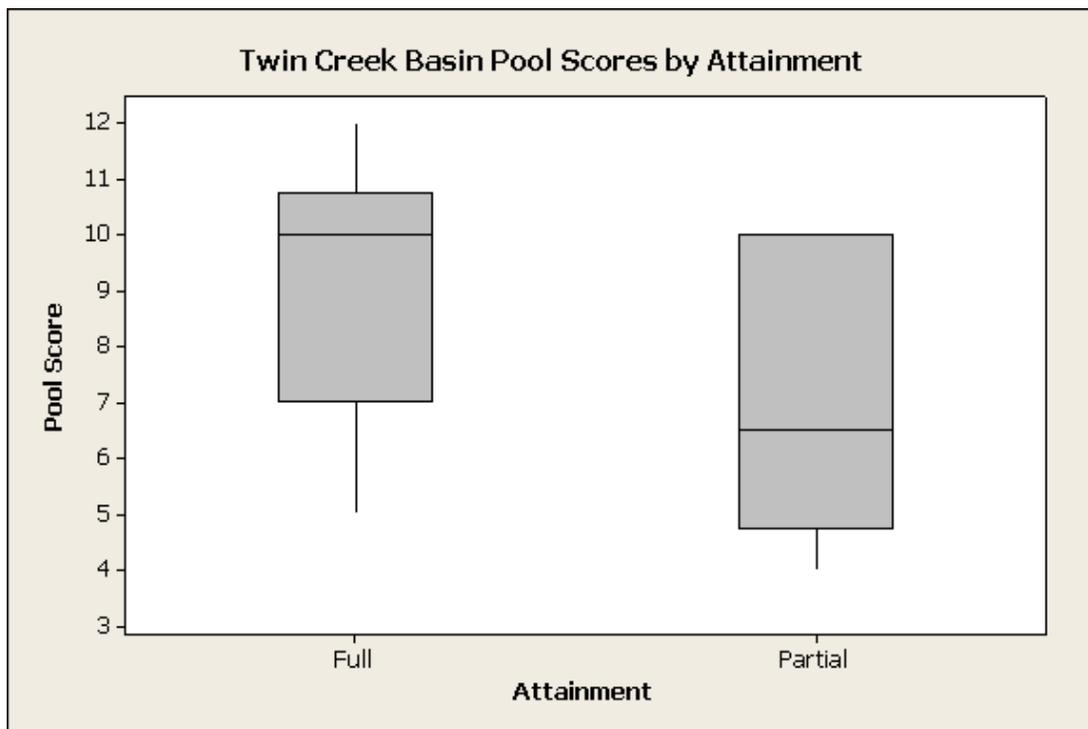


Figure 29. Box-whisker plots of Twin Creek Basin EWH pool scores by attainment group.

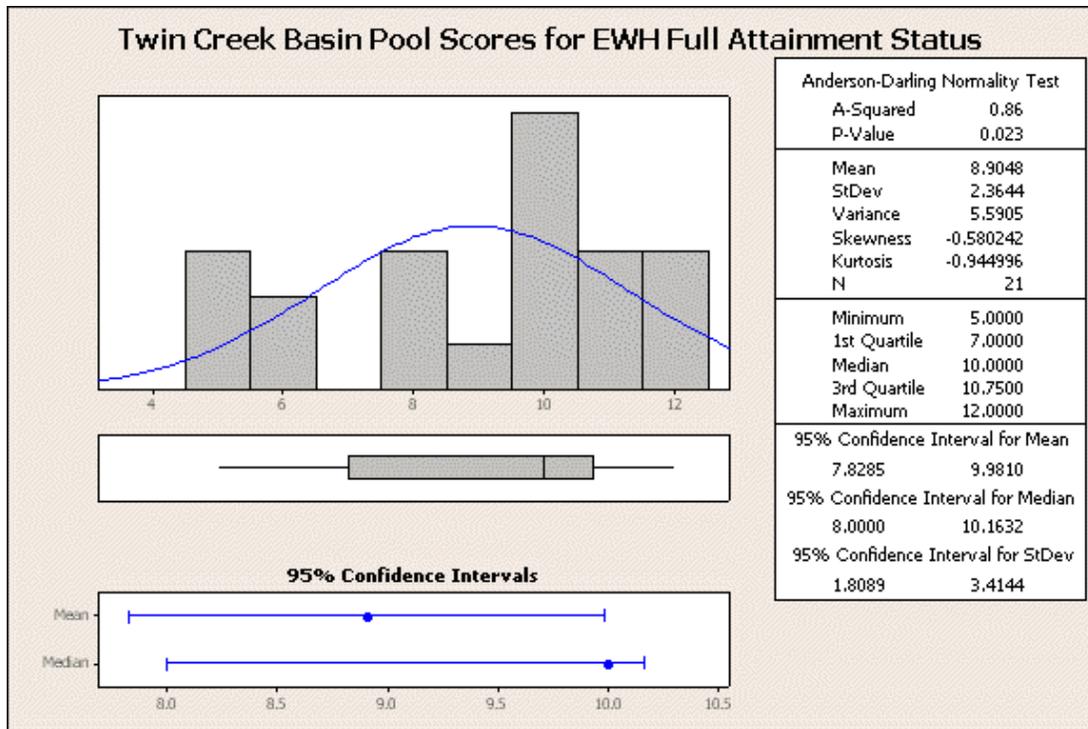


Figure 30. Histogram of Twin Creek pool scores for EWH full attainment status locations.

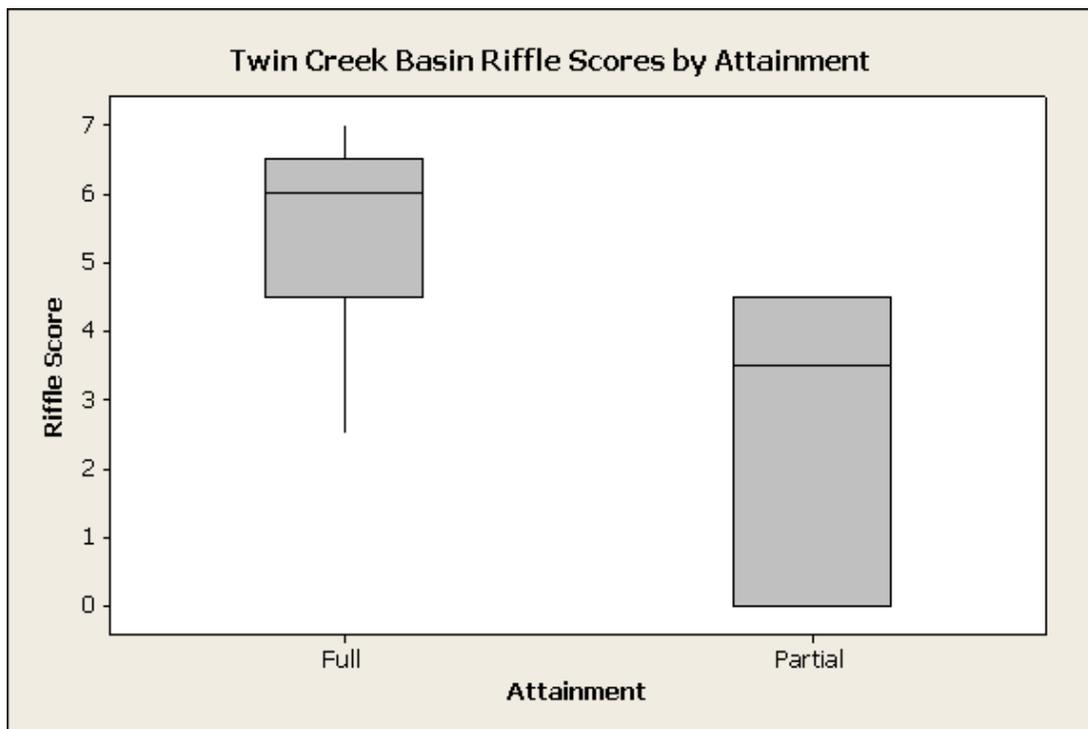


Figure 31. Box-whisker plots of Twin Creek Basin EWH riffle scores by attainment group.

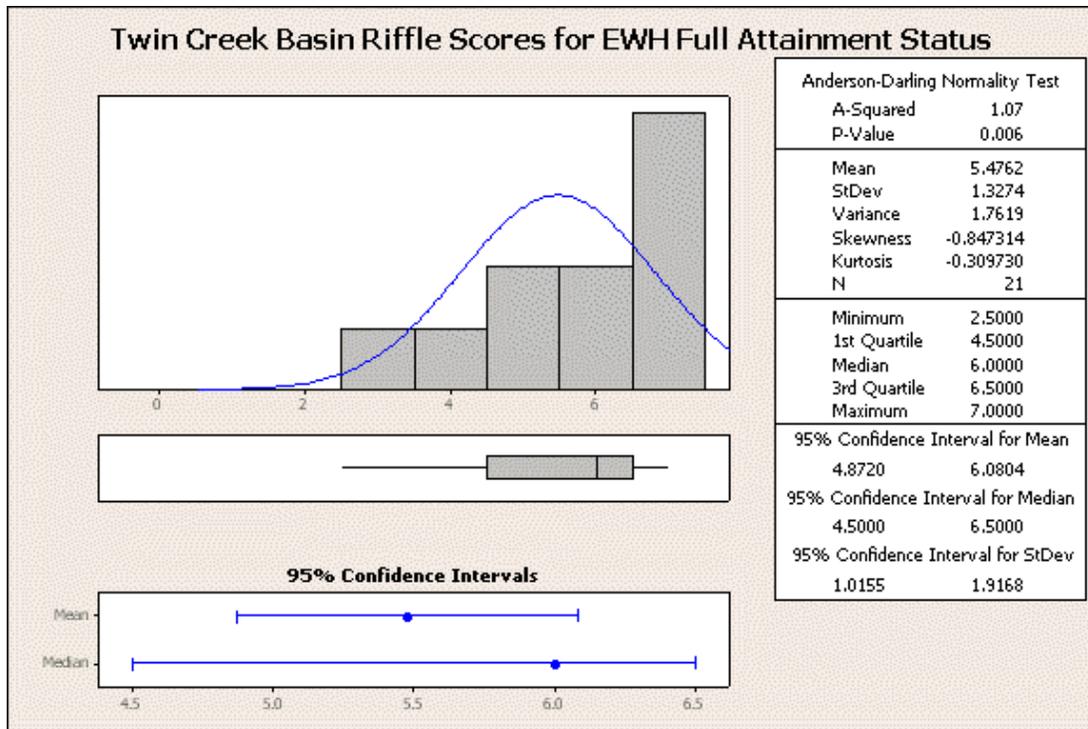


Figure 32. Histogram of Twin Creek riffle scores for EWH full attainment status locations.

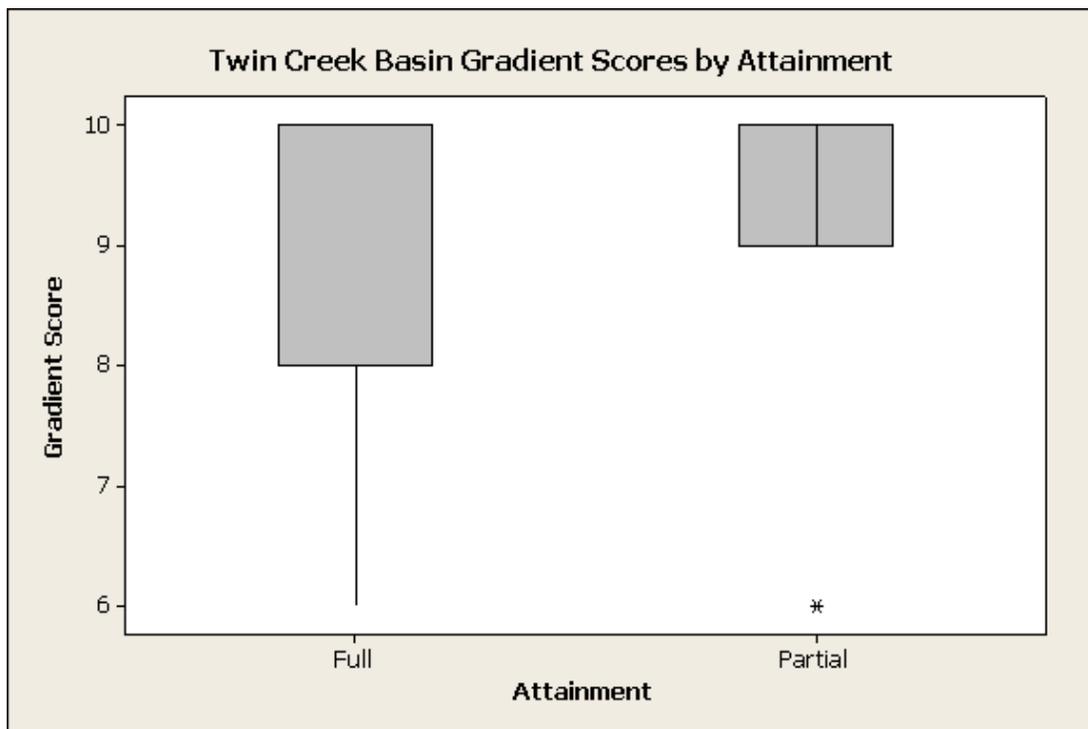


Figure 33. Box-whisker plots of Twin Creek Basin EWH gradient scores by attainment group.

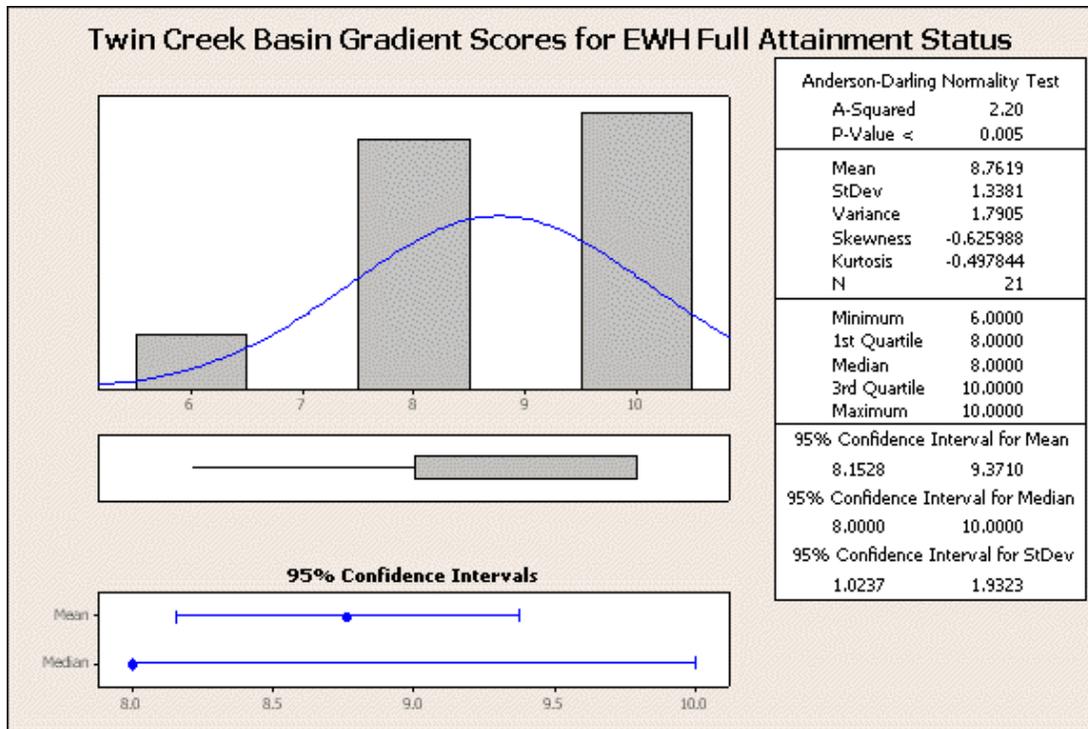


Figure 34. Histogram of Twin Creek gradient scores for EWH full attainment status locations.

Results of the Habitat Analysis

The TMDL deficiencies were reviewed on a watershed scale. Both the number of sites with deficiencies for each subcategory and the magnitude (percent) deficiency were plotted. Figures 35 and 36 indicate the number of sites for QHEI and the subcategories for WWH and EWH that do not meet the watershed TMDL. As can be seen in Figures 37 and 38, most deficiencies in the watershed are in the subcategories of channel, riffle and cover.

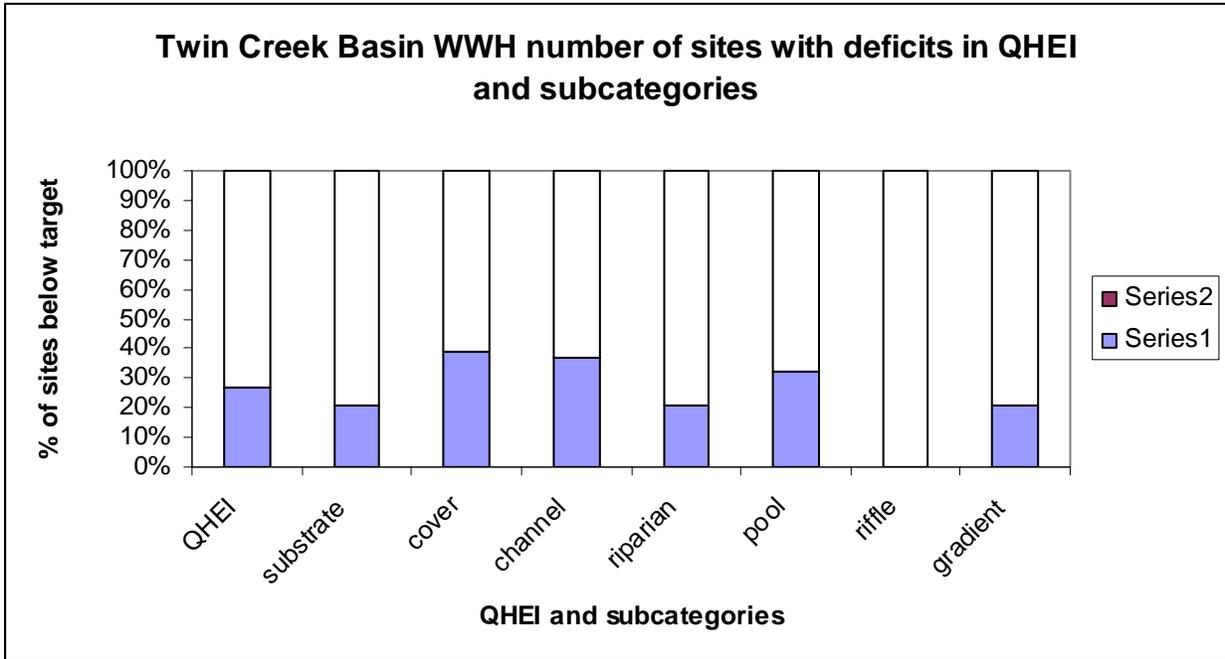


Figure 35. Frequency of sites below WWH habitat and bedload TMDLs.

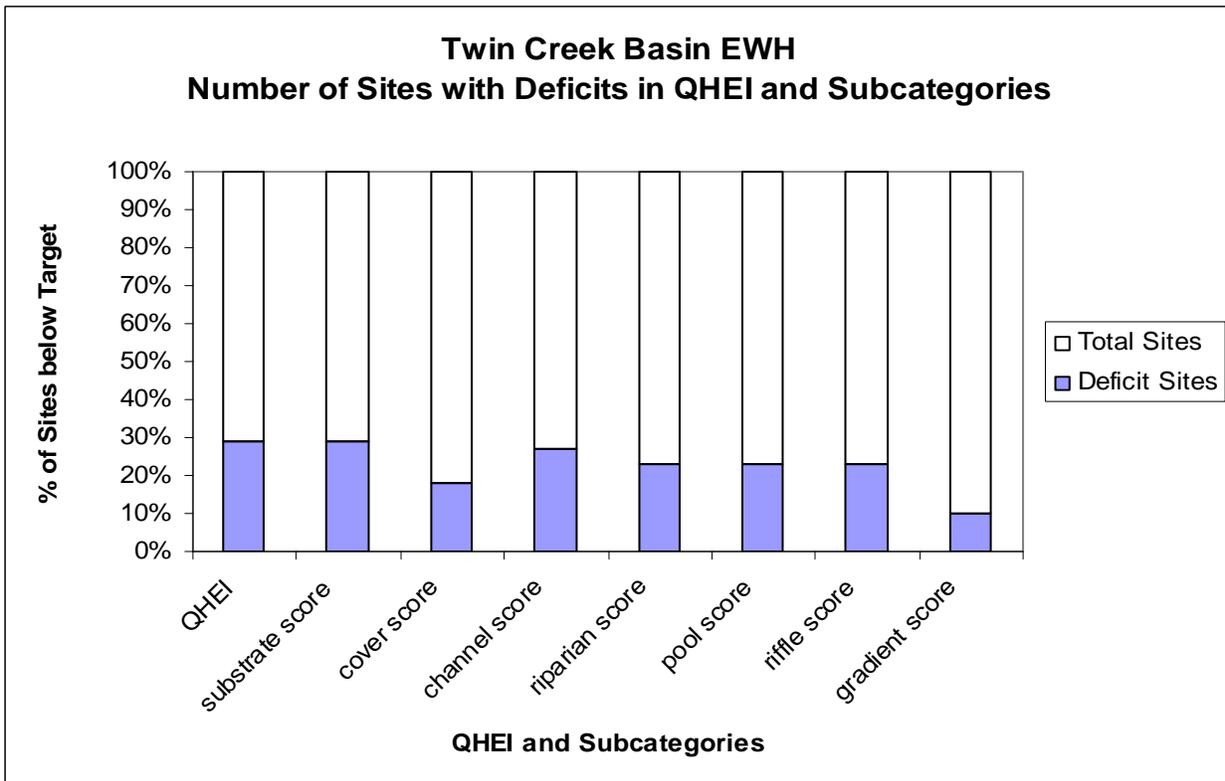


Figure 36. Frequency of sites below EWH habitat and bedload TMDLs.

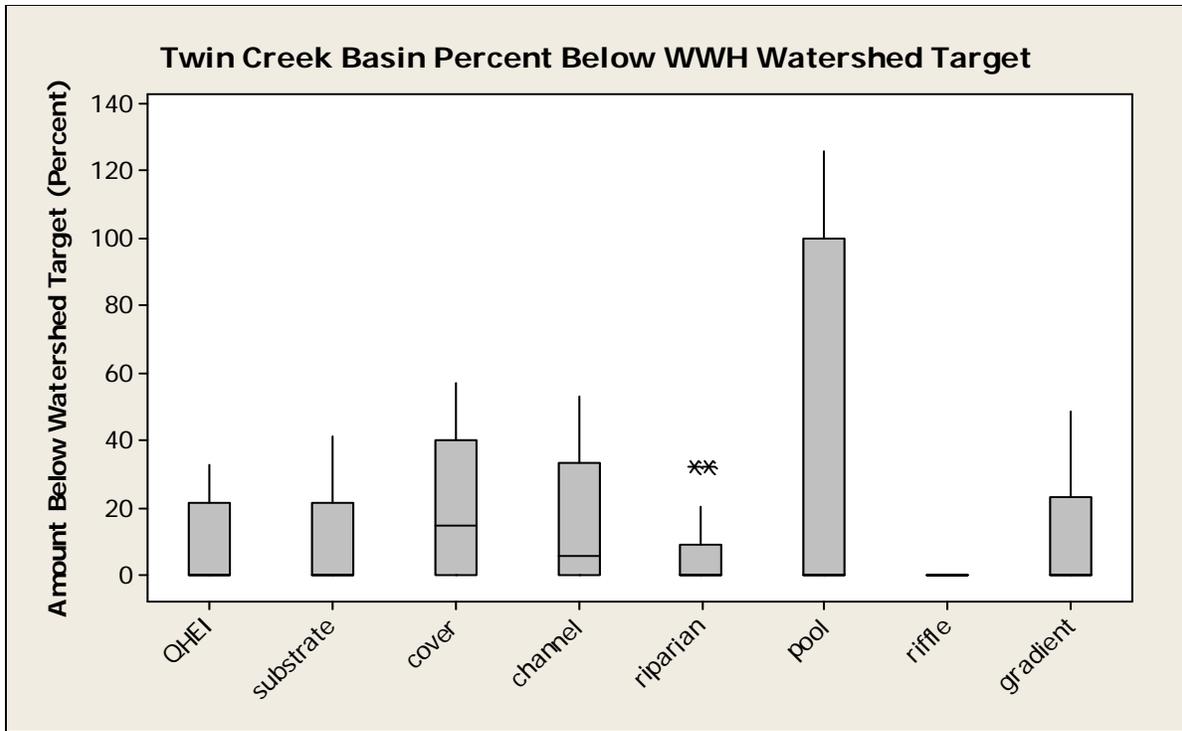


Figure 37. Site deficits of habitat and bedload TMDL for partial attainment WWH sites.

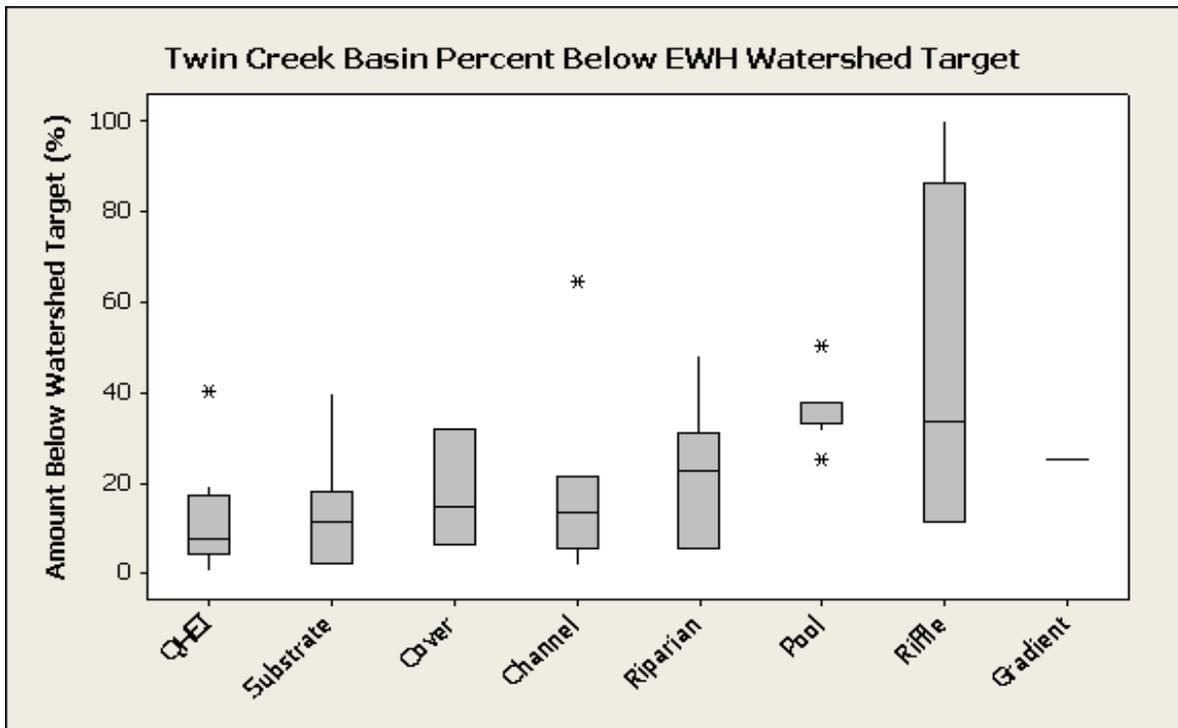


Figure 38. Site deficits of habitat and bedload TMDL for partial attainment EWH sites.

References

Ohio EPA. 2007. *Biological and Water Quality Study of Twin Creek and Select Tributaries 2005. Darke, Preble, Montgomery, and Warren Counties, Ohio*. Division of Surface Water. Columbus, Ohio.