S. S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

Memorandum

Date: August 27, 2012

From: Deborah L. Hathaway

To: Craig Tucker, Klamath Coordinator, Karuk Tribe

Subject: Stream Depletion Impacts Associated with Pumping from within or beyond the "Interconnected Groundwater" Area as Defined in the 1980 Scott Valley Adjudication

Introduction

This memorandum describes an analysis of stream depletion impacts associated with pumping from two areas within the Scott Valley. One area is that within the zone of "Interconnected Groundwater" as delineated in the 1980 Scott Valley Adjudication. The second area is the area of alluvial fill within the Scott Valley that falls outside of the boundaries of the above-referenced zone. The analysis uses the Scott Valley Groundwater Model prepared by S.S. Papadopulos & Associates, Inc. (July 2012).

Background

The 1980 Scott Valley Adjudication (Decree 30662, Superior Court for Siskiyou County, 1980) provided limits on the development of new groundwater uses within a zone of "Interconnected Groundwater", defined as (Paragraph 4):

> "all ground water so closely and freely connected with the surface flow of the Scott River that any extraction of such ground water causes a reduction in the surface flow in the Scott River prior to the end of a current irrigation season. The surface projection of such interconnected ground water as defined herein is that area adjacent to the Scott River as delineated on the SWRCB map in the reach from the confluence of Clarks Creek and Scott River to Meamber Bridge."

The SWRCB map is later referenced (Paragraph 12) as the map entitled "Scott River Stream System showing Diversions and Irrigated Lands, Siskiyou County, 1979", comprised of 20 sheets.

The "Zone of Interconnected Groundwater" shown on the the 1979 map was initially published by the California State Water Resources Control Board, 1975, in a report entitled "Report on Hydrogeologic Conditions, Scott River Valley". The 1975 report discusses characteristics of valley alluvial materials referencing information on driller's logs, including the driller's description of lithology and specific capacity derived from initial pumping. From this information, the author makes inferences as to where pumping from groundwater might be expected to impact the river within the same season. The author did not make stream depletion calculations or otherwise quantify impacts to support delineation of the "Zone of Interconnected Groundwater". Nor did the author consider the cumulative depletion impact that would result from lagged stream impacts following the cessation of pumping in the non-irrigation season that subsequently accrue in the following irrigation season. While the delineation reflects a qualitative mapping of coarser versus finer alluvial sediments, the process does not support a conclusion that pumping from beyond the zone would not result in a stream depletion impact within the same irrigation season or in future years.

Stream Depletion Analysis of Pumping within and beyond the Adjudication Zone of Interconnected Groundwater

In order to provide a quantitative assessment of stream depletion impacts from pumping within the Scott Valley, both within and beyond the zone of Interconnected Groundwater (Adjudication Zone), two scenarios were evaluated using the Scott Valley Groundwater Model (S.S. Papadopulos & Associates, 2012):

- Stream Depletion Impacts of Irrigation Wells beyond Adjudication Zone
- Stream Depletion Impacts of Irrigation Wells within Adjudication Zone

The runs are based on distribution of irrigation wells to correspond with the location and amount of irrigated acreage as mapped for the year 2000. In structuring a stream depletion simulation, ratios of stream depletion can be derived from any change in pumping quantity. In this case, the amounts selected correspond to the difference between the amount pumped under the Partial Build-Out and the Recent Pumping Level cases described in the Scott Valley Groundwater Model report (S.S. Papadopulos & Associates, Inc., 2012). The stream depletion impact is calculated as the difference in net stream losses/gains between the two simulations, which differ only in the amount of irrigation pumping within the zone of interest. Figures 1 through 4 illustrate the results of this stream depletion analysis.

Figure 1 shows the annual average stream depletion in acre-feet associated with pumping outside of the Adjudication Zone. The simulated, incremental, amount of irrigation pumping between the Partial Build-Out and the Recent Pumping Level case is 8,177 acre-feet per year. Figure 1 shows the depletion to the Scott River and the total depletion to the Scott River and tributaries. In the first season of pumping, the total stream depletion is greater than 25% of the pumped volume; in the second season, the total stream depletion exceeds 75% of the pumped volume. Approximately 60 to 65% of the impact accrues to the Scott River mainstem with the remainder accruing to the tributaries. By the seventh year of pumping, stream depletion impacts are nearly equal to the amount of pumping. Figure 2 shows results of the same simulation expressed in terms of cubic feet per second in the late summer/early fall period. This amount is associated with the incremental simulated pumping of 8,177 acre-feet per year as noted above, averaging about 11.3 cubic feet per second. The impact in the late summer/early fall period approaches 12 cubic feet per second, reflecting the fact that impacts are greater during this season due to the timing of pumping.

These results can be used to characterize the stream depletion as a proportion of pumping for a set of wells that are distributed outside of the Adjudication Zone throughout the existing irrigated areas. The stream depletion from any specific well will vary, some being higher and some being lower than the composite, or average, effect shown on Figure 1 and 2 for all wells beyond the Adjudication Zone. Generally speaking, these results can be extended to other pumping amounts by scaling the impact according to the change in pumping, assuming that the spatial and temporal distribution of pumping remains the same. For example, if pumping were to increase or decrease by 20% from the quantity simulated here, the impacts would correspondingly increase or decrease by 20%.

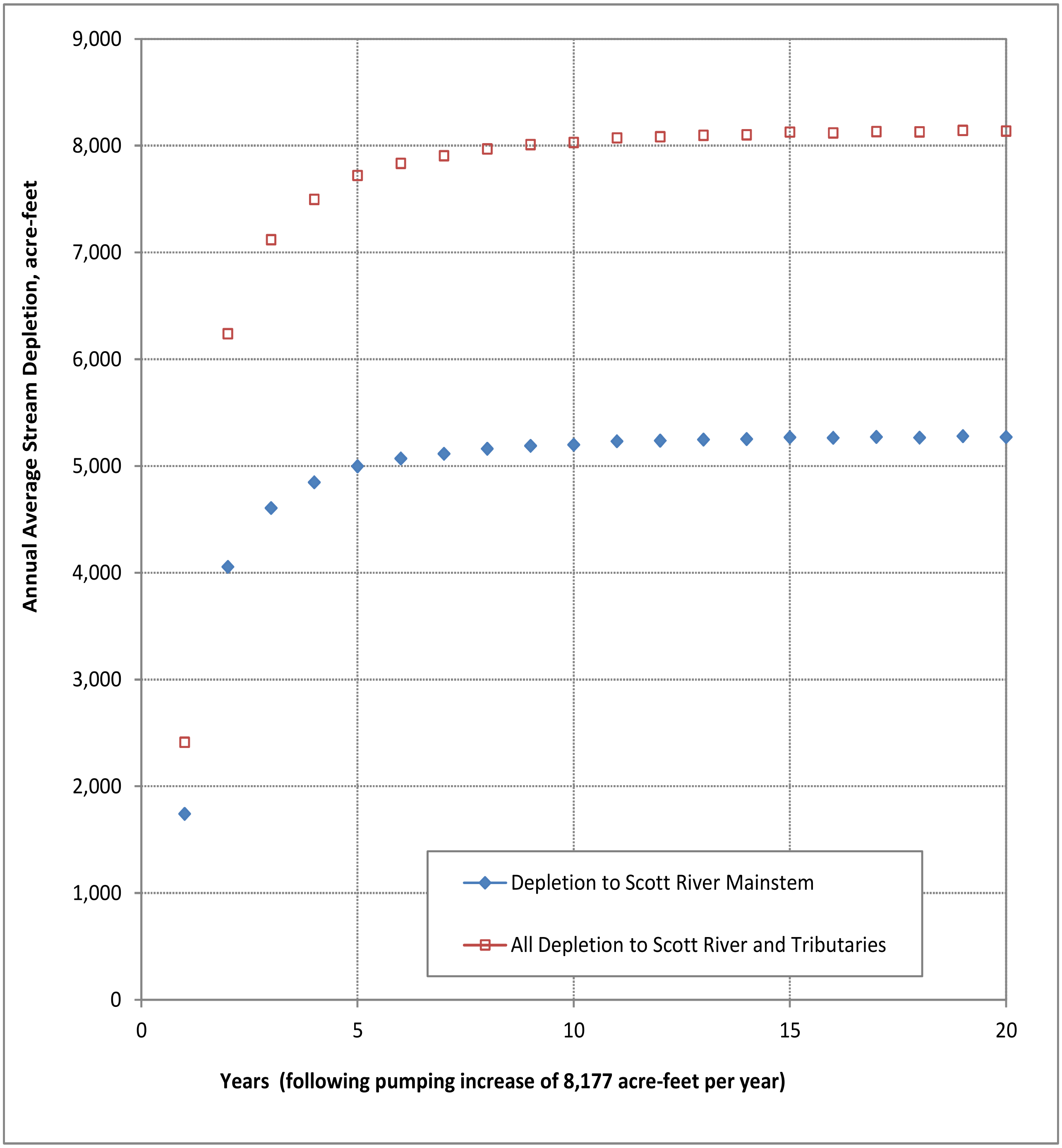
Figures 3 and 4 show stream depletion impacts for pumping within the Adjudication Zone. In these cases, the change in pumping (corresponding to the difference between the Partial Buildout and Recent Condition cases) is simulated as 4,348 acre-feet per year. As would be expected, pumping from within the Adjudication Zone has a more rapid impact on the Scott River and tributaries due to the coarser sediments and the closer proximity to the streams. The stream depletion impact is about 45% of pumping within the first year and rapidly increases, being nearly equal to the pumping amount within a period of 3 to 4 years. Approximately 80% of the depletion impact accrues to the Scott River mainstem with the remainder accruing to the tributaries.

Summary

This quantitative analysis of stream depletion impacts from pumping groundwater within and beyond the Adjudication Zone using the Scott Valley Groundwater Model illustrates the proportion of pumping that can be expected to impact the streams over a multi-year period under average seasonal conditions. The seasonal conditions include winter and spring recharge, mountain-front recharge, recharge from irrigation percolation and groundwater pumping to supplement surface water in meeting crop demand.

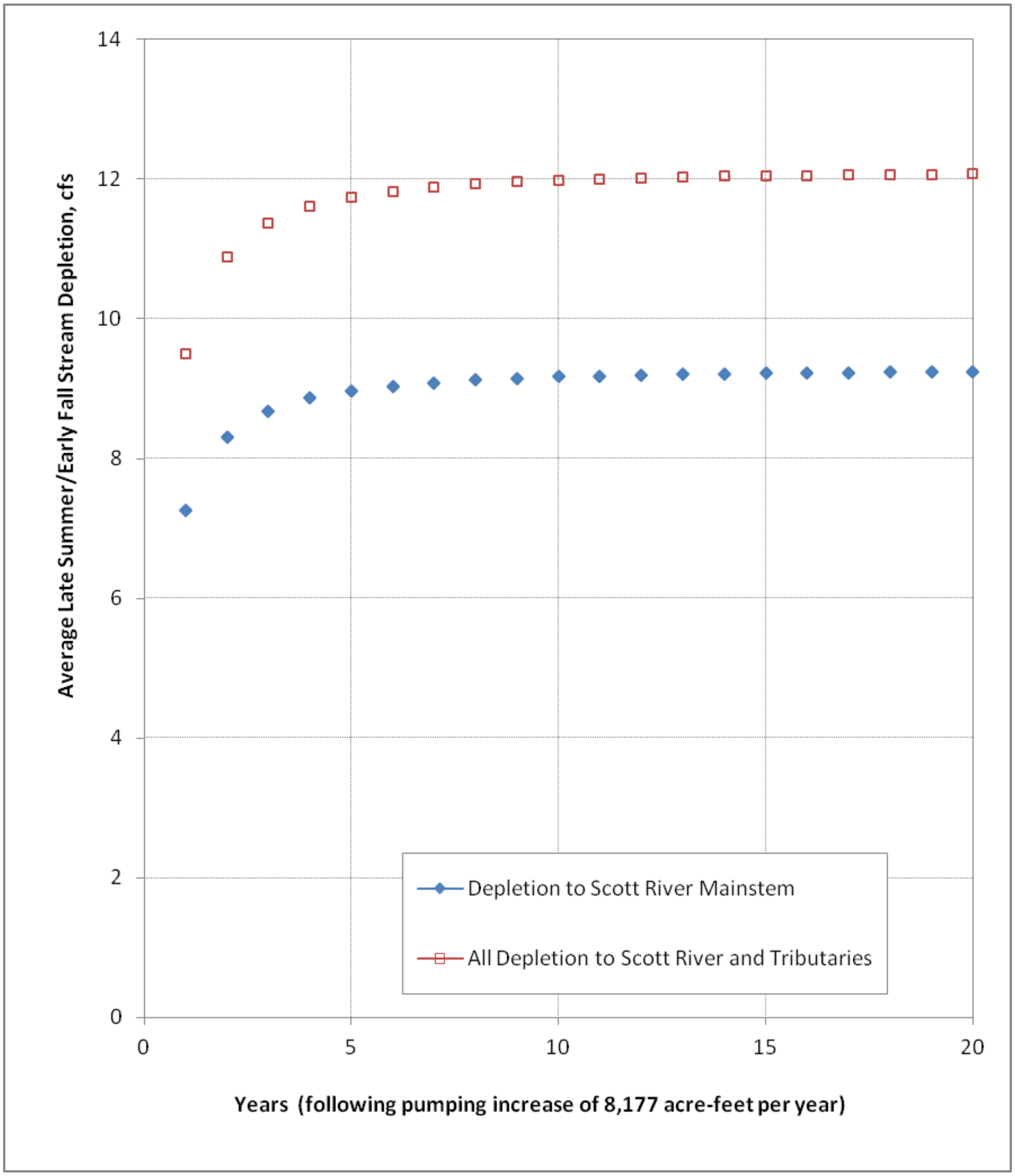
Figures 1 through 4 illustrate the stream depletion impacts from distributed pumping from within and beyond the Adjudication Zone. In both cases, stream depletion impacts are evident within the first season of pumping and increase thereafter. Pumping from within the Adjudication Zone rapidly reaches a steady-state condition with nearly all pumping offset by impacts to the flow in streams within a matter of 3 to 4 years. Approximately 80% of the depletion impact accrues to the Scott River mainstem with the remainder accruing to the tributaries. Pumping from beyond the Adjudication Zone also impacts the Scott River and tributaries, with a higher proportion of impacts accruing to tributaries than as seen for pumping from within the Adjudication Zone. Approximately 60-65% of the impact accrues to the Scott River mainstem with the remainder accruing to the tributaries.

The results indicate that the Adjudication Zone as defined in 1975 is too narrowly drawn to meet the objective of identifying areas wherein pumping would have the effect of reducing surface water flows within the same irrigation season. Furthermore, the results indicate that despite the cessation of pumping during the non-irrigation season and the occurrence of recharge, that stream depletion impacts continue to accumulate over time and have the potential for significantly higher impacts than are seen within the first or same season of pumping.



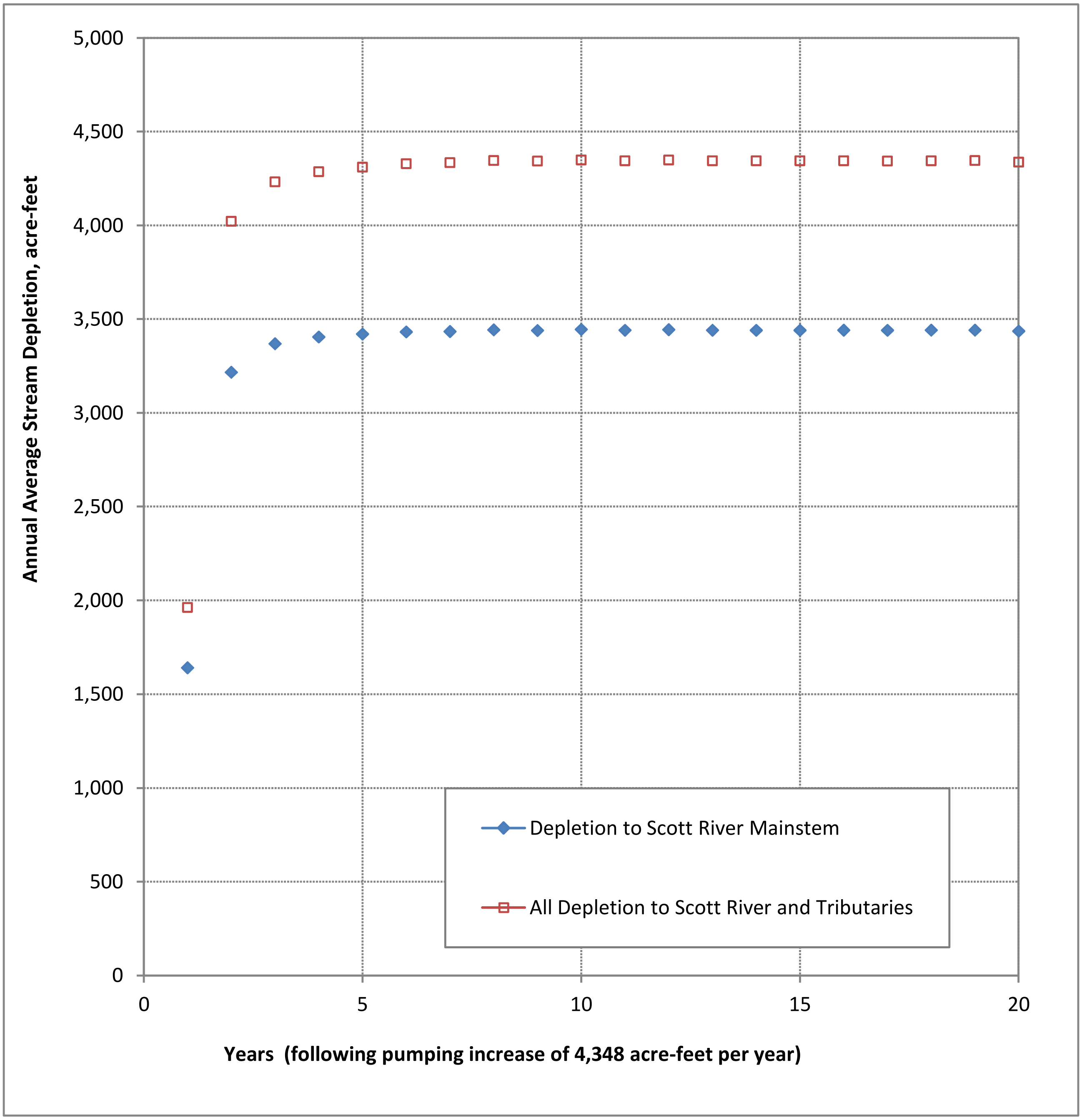
Note: The net increase in pumping is simulated as occurring as a single step; the resulting depletion curve can be used to identify lagged depletion impacts from a gradual change in pumping.

Figure 1. Stream Depletion Impact to Scott River and Tributaries from Increased Groundwater Use, Outside of Adjudication (1980) Interconnected Groundwater Zone



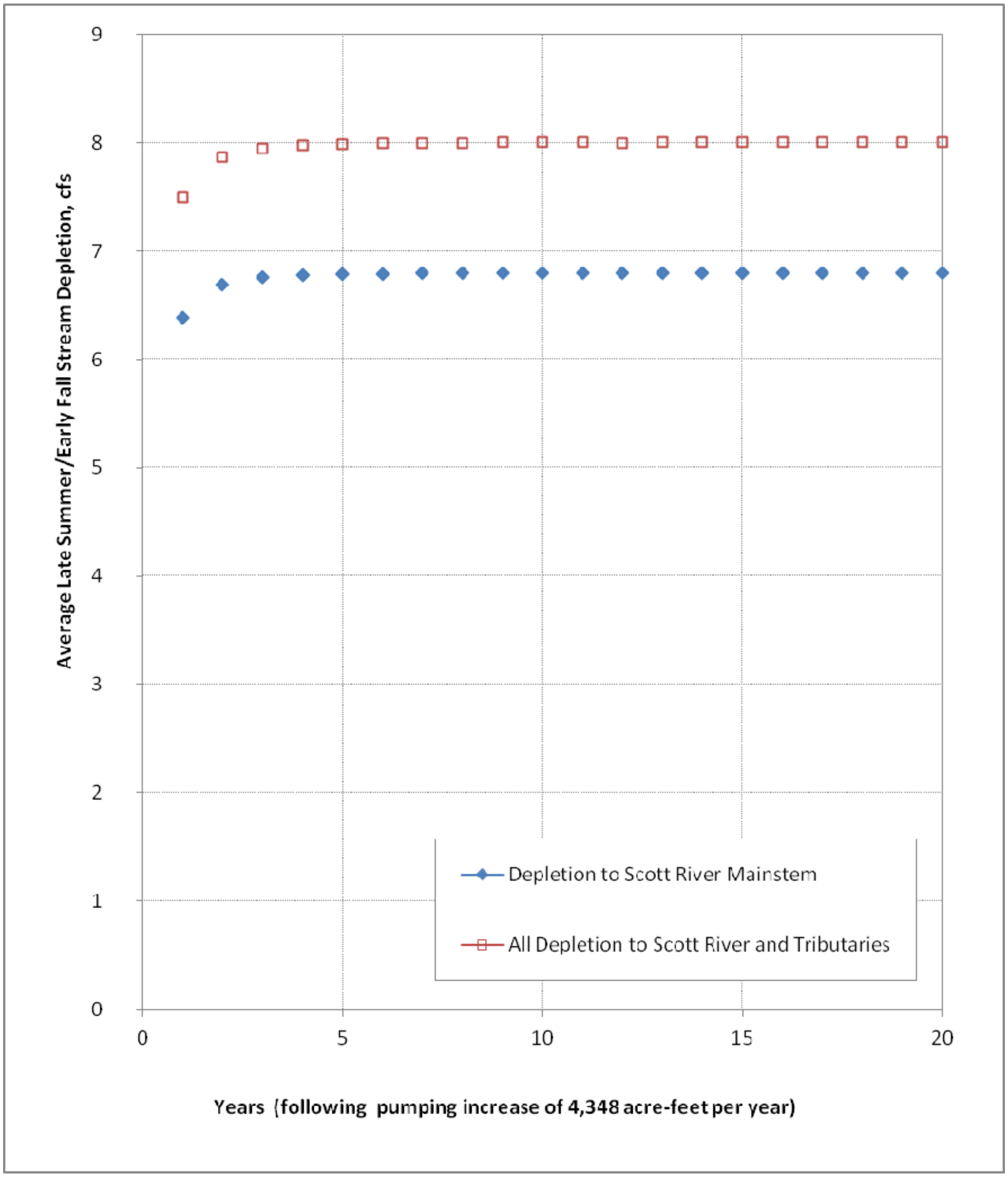
Note: The net increase in pumping is simulated as occurring as a single step; the resulting depletion curve can be used to identify lagged depletion impacts from a gradual change in pumping

Figure 2. Late Summer/Early Fall Stream Depletion Impact to Scott River and Tributaries from Increased Groundwater Use, Outside of Adjudication (1980) Interconnected Groundwater Zone



Note: The net increase in pumping is simulated as occurring as a single step; the resulting depletion curve can be used to identify lagged depletion impacts from a gradual change in pumping.

Figure 3. Stream Depletion Impact to Scott River and Tributaries from Increased Groundwater Use, Inside of Adjudication (1980) Interconnected Groundwater Zone



Note: The net increase in pumping is simulated as occurring as a single step; the resulting depletion curve can be used to identify lagged depletion impacts from a gradual change in pumping

Figure 4. Late Summer/Early Fall Stream Depletion Impact to Scott River and Tributaries from Increased Groundwater Use, Inside of Adjudication (1980) Interconnected Groundwater Zone