Appendix D

Groundwater Model Documentation

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Groundwater Model Documentation

Implementation of conjunctive water management within the Sacramento Valley is one strategy being used to enhance the reliability of the existing water supply, as well as potentially improve water quality, within the San Francisco Bay-Delta. However, the operation of conjunctive water management, or groundwater substitution projects, can result in adverse impacts on water resources within the valley. The two most critical potential impacts of additional groundwater production are depression of local groundwater levels, with associated impacts on well yields from nearby water supply wells, and changes in the hydraulic relationship between the surface water and groundwater systems in the area. To support the evaluation of these potential impacts, a high-resolution, numerical groundwater modeling tool was developed to estimate the impacts of potential future conjunctive water management projects on surface water and groundwater resources within the Sacramento Valley. This model, known as the Sacramento Valley Finite Element Groundwater Model (SACFEM2013), is described herein.

In 2011, prior to selecting the SACFEM model for use in this EIS/EIR analysis, a model evaluation process was undertaken to select the best fitting tool for the groundwater analysis in the EIS/EIR. Each model evaluated, including the selected SACFEM model, has undergone changes and updates over the past few years since the model evaluation. Where appropriate, the text below includes notes as to the more recent model updates/additions.

D.1 Model Evaluation

D.1.1 Introduction

This EIS/EIR analyzes the environmental effects of a variety of types of transfers, including groundwater substitution transfers. For groundwater substitution transfers, a willing seller would pump additional groundwater for irrigation in lieu of a surface water supply. The surface water would then be transferred to the buyer. Additional groundwater pumping could affect the groundwater system through: (1) a decline in groundwater levels (resulting in potential water quality and subsidence concerns) and (2) a change in the groundwater/surface water interaction flows.

A quantitative model can help analyze these impacts by simulating groundwater conditions with the additional groundwater pumping. The distinction between the model code (the computational "engine" behind the simulation) and the model application (the use of the code to simulate conditions in a certain area) should be noted. The process evaluated several available groundwater models against criteria that were deemed relevant to the required EIS/EIR analysis.

D.1.2 Evaluation Criteria

The following criteria were used to evaluate the potential use of several available groundwater models.

- **Numerical Code.** The numerical modeling code must be available for use by others. The code should also have sufficient technical review and/or benchmarking tests to illustrate the model computationally performs in accordance with established solution techniques.

- **Spatial Extent.** The model must encompass most of the Sacramento Valley where potential sellers are located.

- **Grid.** The model's grid should be sufficiently refined such that accurate results (e.g., groundwater levels, changes to groundwater/surface water interaction flows) are simulated. Grid sizes that are too large will not provide accurate results at the scale needed for this study. If the grid is not acceptably discretized, the grid must be able to be refined relatively easily to accommodate the needs of this work.

- **Transient Calibration.** The model application should have been calibrated over transient conditions. A steady-state calibration is, likely, not sufficient for this study because groundwater substitution transfers have the potential to occur over varying hydrologic year types. Therefore, the model should be calibrated over a transient period long enough to encompass multiple hydrologic conditions.

- **Technical Review.** The model application has been thoroughly reviewed and deemed adequate for use in this type of modeling study.

- **Availability.** The model application must be available for public use in the time frame of this study.

D.1.3 Available Models

The majority of potential sellers that would be transferring water through groundwater substitution are in the Sacramento Valley. There are several groundwater models that encompass some or all of the Sacramento Valley. These models are briefly described below. The evaluation criteria from the previous section are included along with a brief discussion of the adequacy of the model to meet the criteria.

D.1.3.1 C2VSIM

The California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) was developed by the California Department of Water Resources (DWR) and uses the Integrated Water Flow Model (IWFM) numerical code. IWFM is a finite-element code that simulates groundwater flow and groundwater/surface water interaction. The model is capable of estimating the amount of historical and future groundwater pumping based on input data such as cropping, evapotranspiration, and surface water delivery patterns. At the time of the model selection, C2VSIM simulated conditions in the entire Central Valley over the period of Water Years[1] (WY) 1921 through 2003 on a monthly basis. The model grid was relatively coarse in both the horizontal and vertical directions (three layers, 1,393 nodes, and 1,392 elements). The model simulates 72 stream reaches, two lakes, and eight bypass canals. There are 97 surface water diversion points simulated in model. Water accounting is carried out over 21 subregions that use four land use types (agriculture, urban, native, and riparian).

- **Numerical Code.** The IWFM code used by C2VSIM is available for use. This code and many of its components have been tested by DWR.
- **Spatial Extent.** C2VSIM covers the entire Central Valley.
- **Grid.** C2VSIM's grid spacing varies throughout the model. In general, node spacing is on the order of miles. This node spacing is not adequate for simulation of potential impacts at the scale needed (see note below).
- **Transient Calibration.** C2VSIM is calibrated for WY 1921 through 2003 (see note below).
- **Technical Review.** The code has been tested and used.
- **Availability.** This model would be available for use.

Note: Since the model selection was completed, C2VSIM has been updated to include simulation through WY 2009. A "fine grid" version of C2VSIM has recently been developed and would be available for use. However, this version was not available at the time this study began.

D.1.3.2 CVHM

The Central Valley Hydrologic Model (CVHM) was developed by the U.S. Geologic Survey (USGS) to aid in making water management decisions throughout the Central Valley (Faunt 2009). The model focuses on groundwater availability and changes in storage. CVHM uses the MODFLOW-2000 finite-difference numerical model code. MODFLOW, developed and maintained by the USGS, is commonly believed to be the most widely accepted

[1] A water year runs from October 1 of the previous calendar year through September 30 of the current calendar year (for example, water year 1970 includes the period of October 1, 1969 through September 30, 1970).

numerical modeling code in use. To develop CVHM, the USGS conducted a "texture analysis" of 8,500 drillers' logs to describe the sediment characteristics of aquifer materials. These characteristics were used to assign hydraulic conductivities to the model. CVHM uses the Farm Management Process to estimate groundwater pumping based on land use patterns and applied surface water, similar to IWFM.

CVHM uses a uniform 1-mile square grid to simulate conditions from WY 1962 through WY 2003 over the entire Central Valley. Similar to IWFM, water budgets are developed over 21 regions that use urban, native, and crop land use categories. The model simulates 43 inflows to streams in the valley and 66 diversions from streams.

- **Numerical Code.** The MODFLOW-2000 code used by CVHM is available for use. MODFLOW is an industry standard modeling platform.
- **Spatial Extent.** CVHM covers the entire Central Valley.
- **Grid.** CVHM's grid has uniform 1-mile by 1-mile square cells. The 1-mile spacing is not adequate for simulation of potential impacts at the scale needed. Several post-processing routines exist that allow the subdivision of all model cells and the extraction of boundary conditions. For example, each 1-mile cell could be divided into four sections yielding 0.5-mile cell spacing. Further subdivision is also possible (e.g. 16 sections would yield 0.25-mile (1,320 ft) cell spacing). Model runtime will increase as the number of cells is increased.
- **Transient Calibration.** CVHM is calibrated for WY 1962 through 2003.
- **Technical Review.** CVHM has been peer reviewed and published by the USGS as Professional Paper 1766.
- **Availability.** CVHM is available for public use.

D.1.3.3 SACFEM

The SACFEM model was developed to simulate groundwater conditions in the Sacramento Valley using the MicroFEM© finite-element numerical code. This model is capable of simulating groundwater conditions and groundwater/surface water interactions in the valley. The model contains 88,992 nodes and 177,095 elements and covers the entire Sacramento Valley groundwater basin from the Cosumnes River in the south to just north of Red Bluff. The model does not include the Redding or San Joaquin Valley groundwater basins as C2VSIM and CVHM do. The node spacing varies from 500 ft to 5,800 ft depending on the location in the model. The areas of fine node discretization exist where detailed groundwater and groundwater/surface water results were required during the development of the model.

SACFEM uses input from the Integrated Demand Calculator (IDC) as guidance to assign deep percolation and groundwater pumping data. The IDC performs the water demand calculations (i.e., land use demand, surface water deliveries, and groundwater pumping) that IWFM and CVHM also conduct. The output from IDC is assigned as input to SACFEM.

- **Numerical Code.** The MicroFEM code used by SACFEM is available for purchase. MicroFEM has been reviewed by the National Groundwater Association's (NGWA) Ground Water Journal (Diodato 2000).

- **Spatial Extent.** SACFEM covers the entire Sacramento Valley groundwater basin.

- **Grid.** SACFEM's grid spacing varies from 500 to 5,800 ft. The current version of the model has already been sufficiently refined in the areas near potential groundwater substitution sellers. However, additional grid refinement may be necessary depending on the locations of potential substitution sellers. Several pre- and post-processing tools can be used to facilitate this process (see note below).

- **Transient Calibration.** SACFEM is calibrated for years 1982 through 2003 (also see note below).

- **Technical Review.** The SACFEM model was peer reviewed in late 2010. The peer review identified several items that could be improved. The review listed seven items as Tier 1 (requires attention and revision/modification), three items as Tier 2 (strengthen model defensibility), and two items as Tier 3 (improve model features/capabilities) [see note below].

- **Availability.** The current version of SACFEM is available for use.

Note: Several updates have been made to the SACFEM model since its initial selection for use in this analysis. The highest priority ("Tier 1") items identified during the peer review process were addressed to improve the technical accuracy of the model. The model's calibration period was extended through WY 2010. The grid of the model was also refined to include smaller node spacing in the areas surrounding the potential sellers and in the areas of the flood bypasses in the valley. After updating the model and incorporating the technical feedback, the model was renamed from SACFEM to SACFEM2013. Further information on SACFEM2013 is provided in the sections below.

D.1.3.4 HydroGeoSphere

The HydroGeoSphere (HGS) model code is being applied to the Sacramento Valley. HGS is likely the most computationally comprehensive of the models discussed here. The code simultaneously solves the groundwater and surface water flow equation and is capable of using sub-gridding (i.e., localized grid refinement) and sub-timing (i.e., varying time steps to improve accuracy) routines. The sub-gridding process would be valuable to improve the accuracy of simulated results near pumping centers, for example. At this time, little additional information regarding the Sacramento Valley application of HydroGeoSphere is known (e.g., number of nodes, elements, rivers, etc.). The construction and calibration of this model are understood to be on-going.

- **Numerical Code.** The HGS code is available for purchase. The extent of testing is unknown.
- **Spatial Extent.** The Sacramento Valley application of HGS covers the entire groundwater basin.
- **Grid.** Work on HGS is underway to allow for sub-gridding. The sub-gridding functionality may not be complete at this time.
- **Transient Calibration.** The transient calibration in the Sacramento Valley application of HGS is not complete at this point.
- **Technical Review.** The Sacramento Valley application of the HGS model is not complete and, therefore, has not had technical review.
- **Availability.** The Sacramento Valley application of the HGS model is not complete.

D.1.3.5 Local Models

In addition to the larger-scale models listed above which cover the Sacramento and/or Central Valleys, several smaller, local groundwater models also exist. These models include applications to the Butte County, Stony Creek Fan, Lower Colusa basin, North American River, Sacramento County, Yolo, and Yuba County areas. The combined extent of each of these models covers much of the Sacramento Valley. Many of the models have been developed in either IWFM or its predecessor, the Integrated Groundwater-Surface Water Model (IGSM). For the most part, each of these local models occupies a separate area and does not overlap extensively with another local model. Therefore, where adjoining models abut, separate boundary conditions have been established for each model. It is possible that the boundary conditions do not fully agree with each other. Additionally, each model may have differing interpretations of hydraulic conductivity and layering. Each model was developed separately and each may not have the most up-to date data included.

- **Numerical Code.** The majority of the local models were developed in either IWFM or IGSM. These codes would be available for use.

- **Spatial Extent.** The combined extent of the local models covers most of the Sacramento Valley. The areas east and west of Red Bluff are not covered by one of the local models. Even though the models cover most of the Sacramento Valley, the simulation of potential impacts may be difficult if the impacts exceed each of the separate model's areas.

- **Grid.** The grid spacing in some of the local models is likely sufficient, but grid spacing for some models is unknown. Revisions to the grid(s) and input data may be required if the grid spacing is deemed too large.

- **Transient Calibration.** Several of the local models (Stony Creek Fan, Butte County, Yuba County, and Yolo County) have been calibrated over an approximate 30-year period. The Lower Colusa model is calibrated for a 19-year period. The calibration period for the other models is not known at this point.

- **Technical Review.** The status of technical reviews of these models is not known. Most of the models have, likely, not undergone significant technical or peer reviews.

- **Availability.** The availability of each of the models would need to be determined by the model's owner. Because most of the models were developed for public agencies they should be available. However, the exact availability for each of the local models is not known.

D.1.4 Selection

Based on the evaluation criteria described above, the SACFEM model was selected for use in the analysis for this EIS/EIR. The model was updated to the SACFEM2013 version as part of this EIS/EIR to address the peer review comments. SACFEM2013 was used for this EIS/EIR.

D.2 SACFEM2013

This section provides a more detailed description of SACFEM2013. Appendix M is the SACFEM User's Manual.

D.2.1 Model Code Description

MicroFEM (Hemker 1997), a finite-element based, three-dimensional, integrated groundwater modeling package developed in The Netherlands, was chosen to simulate the groundwater flow systems in the Sacramento Valley Groundwater Basin. The current version of the program (4.10) has the ability to simulate up to 25 layers and 250,000 surface nodes. MicroFEM is capable of modeling saturated, single-density groundwater flow in layered systems.

Horizontal flow is assumed in each layer, as is vertical flow between adjacent layers.

MicroFEM was the chosen modeling platform for the following reasons:

- The finite-element scheme allowed the construction of a model grid covering large geographic areas (over 5,960 square miles in the Sacramento Valley Groundwater Basin) with coarse node spacing outside of the simulated project areas and finer node spacing in areas of interest (e.g., near potential project areas). The finer node spacing near simulated production wells provides greater resolution of simulated groundwater levels and stream impacts.

- The graphical interface allows rapid assignment of aquifer parameters and allows proofing of these values by graphical means.

- The flexible post-processing tools allow for rapid evaluation of transient water budgets for model simulations and identification of changes to stream discharges and other water fluxes across the model domain.

D.2.2 Sacramento Valley Groundwater Basin

The following briefly summarizes the geology and hydrology of the Sacramento Valley Groundwater Basin.

D.2.2.1 Geologic Setting

The Sacramento Valley Groundwater Basin is a north-northwestern trending asymmetrical trough filled with as much as ten miles of both marine and continental rocks and sediment (Page 1986). On the eastern side, the basin overlies basement bedrock that rises relatively gently to form the Sierra Nevada; and on the western side, the underlying basement bedrock rises more steeply to form the Coast Ranges. Marine sandstone, shale, and conglomerate rocks that generally contain brackish or saline water overlie the basement bedrock. The more recent continental deposits, overlying the marine sediments, contain fresh water. These continental deposits are generally 2,000 to 3,000 feet thick (Page 1986). The depth (below ground surface) to the base of fresh water typically ranges from 1,000 to 3,000 feet (Bertoldi et al. 1991).

In the Sacramento Valley Groundwater Basin, groundwater users pump primarily from deeper continental deposits. Groundwater is recharged by deep percolation of applied water and rainfall, infiltration from streambeds, and lateral inflow along the basin boundaries. The quantity and timing of snowpack melt are the predominant factors affecting the surface water and groundwater hydrology, and peak runoff in the basin typically lags peak precipitation by one to two months (Bertoldi et al. 1991).

D.2.2.2 Hydrology

The Sacramento River is the main surface water feature in the Sacramento Valley Groundwater Basin. It has several major tributaries draining the Sierra Nevada, including the Feather, Yuba, and American Rivers. The flow in these tributaries depends heavily on the precipitation in the Sierra Nevada. Stony, Cache, and Putah Creeks drain the Coast Range and are the main west side tributaries to the Sacramento River. The west side tributaries contribute significantly less streamflow than those on the eastside tributaries. The Sacramento River flows south through the center of the valley before heading west to flow out Suisun Bay.

Streamflow data for streams throughout the Sacramento Valley are collected at gaging stations operated by ~~the California Department of Water Resources~~DWR[2] ~~(DWR)~~ and the ~~U.S. Geological Survey~~USGS[3] ~~(USGS)~~.

D.2.3 Model Construction

This section discusses the development of the groundwater model grid and layering, the assignment of groundwater flux boundary conditions, and the basis for assignment of material properties to the aquifers within the model domain.

D.2.3.1 Spatial Grid

The SACFEM2013 grid used for the groundwater substitution transfer simulations consists of 153,812 nodes and 306,813 elements (see Figure D-1). The current grid was configured to support evaluation of potential conjunctive water management projects associated with the Long-Term Water Transfer Program; however, the SACFEM2013 model was designed to be grid independent, and geographic information system (GIS)-based tools have been developed to build a similar model of the valley on any grid developed to support a particular application. The nodal spacing of the current grid varies from as large as approximately 3,300 feet (1,000 meters) near the model boundary and in areas where long-term water transfer projects are not being evaluated, to as small as 410 feet (125 meters) in areas where long-term water transfer groundwater production is being evaluated. Nodal spacing of approximately 1,640 feet (500 meters) is included along streams and flood bypasses included in SACFEM2013. The finer node spacing near proposed project areas allows for more refined estimates of the effects of groundwater pumping on groundwater levels and groundwater/surface water interaction in the potential project areas. The model domain boundary coincides with the lateral extent of the freshwater aquifer within the Sacramento Valley Groundwater Basin.

D.2.3.2 Vertical Layering

The total model thickness is defined by the thickness of the freshwater aquifer (less than 3,000 micromhos), as defined by Berkstresser (1973) and

[2] http://cdec.water.ca.gov/
[3] http://waterdata.usgs.gov/nwis

subsequently refined in the northern portion of the valley by DWR (DWR ~~2002~~2005). For the southern portion of the model area, defined by Berkstresser data, elevation contour lines of the base of fresh water, along with information from boring locations (point measurements of the elevation of the base of fresh water), were digitized and used to generate a three-dimensional surface defining the elevation of the base of fresh groundwater. For the northern portion of the model area, the locations of geologic cross sections developed by DWR Northern District staff were plotted, along with the estimated base of freshwater elevations obtained from the cross section information; and a base of freshwater elevation contour map was constructed. These data sets were then merged to yield a single interpretation of the structural contour map of the base of freshwater across the Sacramento Valley (see Figure D-2).

Total Aquifer Thickness

The uppermost boundary of the SACFEM2013 model is defined at the water table. To develop a total saturated aquifer thickness distribution and, therefore, a total model thickness distribution, it was necessary to construct a groundwater elevation contour map and then subtract the depth to the base of freshwater from that groundwater elevation contour map. Average calendar year groundwater elevation measurements were obtained from the DWR Water Data Library. These measurements were primarily collected biannually, during the spring and fall periods; and these values were averaged at each well location to compute an average water level for each location. These values were then contoured, considering streambed elevations for the gaining reaches of the major streams included in the model, to develop a target groundwater elevation contour map for the year 2000. As described above, the distribution of the elevation of the base of freshwater was subtracted from this groundwater elevation contour map to provide an estimate of the distribution of the total saturated aquifer thickness across the model domain.

Model Layer Thickness

The strategy used to develop the overall layering of the SACFEM2013 model was to develop a tool that provided sufficient layers to assess the effects of groundwater pumping on shallow features such as wetlands and streams, but also to provide sufficient vertical resolution to allow assignment of pumping stresses to appropriate depths within the aquifer that reflect the major producing zones within the aquifer system. Additionally, to facilitate investigation of potential future conjunctive water management projects using the lower Tuscan aquifer, the layering strategy also provided for two layers explicitly representing this deep aquifer system.

Layer one of the SACFEM2013 model was assigned a maximum thickness of approximately 65 feet (20 meters). The thickness of this layer was limited to provide more accurate shallow groundwater elevations with which to support evaluations of the effects of changing groundwater levels on surface streams and wetland/riparian areas. Layers two through five represent the more regional groundwater-producing zones within the valley. The thicknesses of these layers were assigned using a specified percentage of the available aquifer thickness at a given location, to provide multiple-depth zones within which to assign regional pumping. The assumed layer thicknesses for layers two through five were also selected to reflect typical screened intervals of production wells in the Sacramento Valley. The thicknesses of layers two through four each represent approximately ten percent of the total aquifer thickness (one to 107 meters, three to 350 feet), and the thickness of layer five represents approximately 15 percent of the total aquifer thickness on average (one to 193 meters, three feet to 633 feet).

Where the lower Tuscan aquifer is present (the northeastern and central portions of the valley), the elevation of the top of layer six was defined by the structural contour surface of the top of the lower Tuscan aquifer. Two layers were assigned to represent this unit because in many areas of the model, the depth to the base of fresh water (the base of the model) is as much as 900 feet below the upper surface of the lower Tuscan. Groundwater production wells drilled into the lower Tuscan would almost certainly be screened over a much smaller depth interval. To allow representation of this condition in the model, layer six was assigned a thickness of between 250 to 360 feet (75 to 110 meters) in the central portion of the northern Sacramento Valley Groundwater Basin. The total range in layer six thickness is approximately three to 580 feet (one to 177 meters). The remaining lower Tuscan thickness not apportioned to layer six was assigned to layer 7. The exception to this convention is in the northeastern portion of the model near the City of Chico. The lower Tuscan outcrops in the foothills above Chico; thus, in these areas, all layers of the model represent the lower Tuscan aquifer. Moving west from Chico, a transition zone exists where a decreasing number of layers represent the lower Tuscan until it is limited to layers six and seven, as discussed above. In areas where the lower Tuscan is not present, the thicknesses of layers six and seven represent 18 and 27 percent of the total aquifer thickness, respectively. A contour map of the total saturated aquifer thickness is presented on Figure D-3.

D.2.3.3 Model Time Discretization

Time is continuous in the physical system, but a numerical model must describe the field problem at discrete time intervals. SACFEM2013 was set up to simulate transient flow conditions between Water Years[4] 1970 and 2010 with monthly stress periods. As such, model stresses (such as stream stage, groundwater pumping, deep percolation, etc.) and model output are assigned/evaluated on a monthly basis.

D.2.3.4 Boundary Conditions

A combination of no-flow, specified-flux, and head-dependent boundary conditions were used to simulate the groundwater flow system within the

[4] ~~A water year runs from October 1 of the previous calendar year through September 30 of the current calendar year (for example, water year 1970 includes the period of October 1, 1969 through September 30, 1970).~~

Sacramento Valley. Each of these boundary conditions is discussed in more detail below.

Head-dependent Boundaries

Surface Water Bodies. A head-dependent boundary condition was chosen to simulate the major streams, flood bypasses, and reservoirs within the Sacramento Valley. The MicroFEM wadi system was used to implement streams within the model domain. MicroFEM's wadi package is a two-way head-dependent boundary condition (that is, it can act as a source of groundwater recharge or as a groundwater sink) that calculates the magnitude and direction of nodal fluxes by using the relative values of the user-specified stream stage (wh1) and the calculated head in the upper aquifer (h1), but is limited by a critical depth (wl1). When calculated groundwater elevations fall below this critical depth, it is assumed that the water table de-couples from the river system, and the leakage rate from the river to the aquifer becomes constant. The equations that govern operation of the wadi package are as follows:

Groundwater discharge to a stream is simulated if h1 > wh1:

$$Q_{outflow} = a * (h1 - wh1) / | wc1 | \quad (1)$$

In coupled streams (groundwater elevation is above the stream bottom elevation), groundwater recharge from a stream is simulated if h1 < wh1:

$$Q_{inflow} = a * (wh1 - h1) / | wc1 | \quad (2)$$

In decoupled streams (groundwater elevation is below the stream bottom elevation), groundwater recharge from a stream is simulated if:

$$Q_{inflow} = a * (wh1 - wl1) / | wc1 | \quad (3)$$

Where:

Q = volumetric flux

a = nodal area

h1 = simulated groundwater elevation in layer 1

wh1 = simulated stream stage

wl1 = stream bottom elevation

wc1 = resistance across the streambed

Nodal area is a grid-dependent parameter that can be automatically calculated within MicroFEM. In general, the nodal area around a node that represents a discrete reach of a stream is greater than the surface area of that stream along the reach in the field. The effective resistance term (wc1) incorporates an areal correction factor to account for this discrepancy the wadi resistance term (wc1) is a measure of the resistivity of the streambed sediments. The resistances are calculated as follows:

$$wc1 = Dr/Kv\ ))^{*}\ (a/LW) \qquad (4)$$

Where:

Dr = thickness of streambed sediments

Kv = vertical hydraulic conductivity of streambed sediments

L = stream length represented by the model node

W = field width of the wetted river channel within the stream reach represented by L. Fifty individual streams are simulated with MicroFEM's wadi package in the current version of SACFEM2013.

Stream locations were digitized from existing base maps and USGS topographic quadrangle sheets, and imported into the model domain. Stream length within a given node is a grid-dependent variable calculated by MicroFEM at each river node. The stream-length term is generally overestimated by MicroFEM at stream confluences. Manual corrections of this term were made where necessary. Streambed thickness was assumed to be 3.28 feet (one meter) for all river nodes. Assumptions of streambed Kv were based on the type of streambed deposits expected given stream size. Streams draining the Sierra Nevada were generally assigned lower streambed Kv's, with all streams except the Bear River and Big Chico Creek having values of two meters per day (m/d) (0.0023 centimeters per second [cm/s]) or less. Westside streams were assigned higher values, with most being at or above five m/d (0.0058 cm/s). Wetted stream width was calculated from aerial photographs at two locations along each stream. Few streams showed greater variability in width such that it was necessary to develop a continuously variable distribution along the stream length. This was accomplished by estimating wetted stream width at several points via examination of aerial photographs and fitting a polynomial to the data points.

Streambed elevations (wl1) were estimated using data from 10-meter Digital Elevation Model (DEM) data. It was assumed that the minimum DEM elevation that at/near a given stream node represented the streambed elevation at that location. Polynomials were fitted to the distribution of streambed elevations and cumulative distance along each stream. These polynomials provided relationships that were used to both "smooth" the distribution of streambed elevations and populate values for nodes where the SACFEM2013 nodal resolution was finer than the DEM spacing.

As previously discussed, SACFEM2013 simulates transient conditions from water years 1970 through 2010 on a monthly basis. Monthly varying distributions of stream stage were developed for all streams included in SACFEM2013. Further historical measured stream stage data for model streams was analyzed to determine the timing and location of streams that experience seasonal drying. During months where a given stream is interpreted as experiencing no surface water flow, the SACFEM2013 nodes are converted from a MicroFEM wadi boundary condition to a MicroFEM drainage boundary condition, discussed in more detail below.

The current version of SACFEM2013 incorporates additional recharge from the major flood bypasses in the Sacramento Valley during wet periods. These include the Butte Bypass, the Sutter Bypass, and the Yolo Bypass. Historical weir data were evaluated to determine the timing and location of flood bypass inundation. During periods of bypass flow, the interpreted water surface elevation was compared to the DEM data to determine the spatial distribution of bypass inundation. Active flood bypass nodes were simulated using MicroFEM's wadi boundary condition. The wh1 value for each active flood node was assigned the interpreted water surface elevation (which varied on a monthly basis). The wc1 value was assumed to be ten for all active bypass nodes. During dry periods (and non-inundated bypass nodes), flood bypasses were simulated as groundwater sinks using MicroFEM's drainage package.

The final surface water bodies simulated in SACFEM2013 using MicroFEM's wadi package are the major reservoirs located within the interior of the Sacramento Valley Groundwater Basin, Black Butte Reservoir and Thermalito Afterbay. The lake bottom elevations were assumed to be constant for both reservoirs, and were simulated as 100 feet below the average DEM elevation (assumed to represent lake stage) for Black Butte reservoir and 40 feet below the average DEM elevation for Thermalito Afterbay. The wc1 values were assumed to be one for both reservoirs. The lake stage elevation was assumed to be constant spatially across each reservoir; however, historical data were evaluated to develop monthly-variable lake stage datasets for the SACFEM2013 simulation period.

Drains. MicroFEM's drainage package was used to simulate boundary conditions across the top surface of the model, excluding nodes where wadi boundaries exist. Drainage boundary conditions are one-way head-dependent boundaries that allow the transfer of water out of the model domain only. The elevation of the drain boundaries were set at the land surface. The drain boundaries were included in the model to represent a combination of surficial processes that occur in areas of shallow groundwater, including evapotranspiration and groundwater discharge to the surface. Additionally, as discussed above, specific streams and flood bypasses were converted from wadi boundary conditions to drain boundary conditions during periods when a given surface water body was interpreted as being dry.

Groundwater discharge to a drain is simulated if h1 > dh1:

$$Q_{outflow} = a * (h1 - dh1) / | dc1 | \text{ (where a = nodal area)} \quad (5)$$

Groundwater discharge to a drain is simulated if h1 < dh1:

$$Q_{outflow} = 0 \quad (6)$$

The parameter dc1 represents the drain conductance and is a measure of the resistance to flow across the drain boundary. The dc1 was assumed to be 500 throughout the model domain.

Specified-flux Boundaries. Three sets of specified-flux boundary conditions were implemented in the SACFEM2013 model. These conditions are as follows: (1) deep percolation of applied water and precipitation along with agricultural pumping, (2) mountain-front recharge, and (3) urban pumping. Each is discussed in more detail below.

Deep Percolation of Applied Water, and Precipitation and Agricultural Pumping. The first set of specified-flux boundary conditions reflects the deep percolation of precipitation and applied water across the valley, as well as the regional agricultural pumping. The deep percolation flux values were applied to every surface node in the model. The pumping stresses due to agricultural pumping were applied at selected locations in model layers two through four (the depths of the regional producing zones across the valley). The spatial distribution and magnitudes of these fluxes were derived from the surface water budget calculations described in full detail in the Surface Water Budget section below.

Mountain-front Recharge. The second set of specified-flux boundary conditions represents the subsurface inflow of precipitation falling within the Sacramento River watershed but outside the extent of the model domain. To estimate these flux values, the USGS 10-meter DEM along with GIS-based hydrography coverages for the Sacramento Valley were used to delineate the drainage areas that are tributary to the model domain but fall outside of the watersheds of the rivers explicitly represented in the model. It is these areas that can contribute water to the model domain but are not accounted for in the wadi boundary conditions defined in the model. After the extents of these watershed areas were defined, they were intersected with monthly Parameter – elevation Relationships on Independent Slopes Model (PRISM)[5] rainfall datasets using GIS tools, and the volume of precipitation falling on the watershed was computed. On the basis of the computed total volume of precipitation, the deep percolation to the groundwater system was calculated using the following empirical relationship developed by Turner (1991):

[5] http://prism.oregonstate.edu/

$$DP = (PPT-2.32)*(PPT)^{0.66} \quad (7)$$

Where:

DP = average annual deep percolation of precipitation (inches per year)
PPT = annual precipitation (inches per year)

A summary of the process that was used to estimate the quantity of subsurface inflow, otherwise known as mountain-front recharge, is as follows:

1. The area of each drainage basin tributary to the model domain that is not represented by streams explicitly simulated in SACFEM2013 was computed using a GIS-based analysis of the land surface topography. The extent of these smaller watersheds is shown on Figure D-1.

2. Each drainage area polygon was then intersected with a GIS coverage of annual total rainfall estimated using the PRISM model for each year of the simulation period. This distribution of annual average rainfall was then used to calculate the total volume of rainfall falling on the small watershed areas, and an overall average rainfall rate was computed (inches per year).

3. The total annual rainfall rate was then used to compute a deep percolation quantity using the relationship between annual rainfall and deep percolation rate developed by Turner (1991) and described above.

4. The annual volume of deep percolation computed in Step three was then converted into monthly values that were based on the monthly distribution of streamflow measured in ungauged sections of Deer Creek. These monthly deep percolation quantities were then introduced at the model domain boundary of each small watershed polygon using injection wells into layer one. The quantity applied to each model boundary node was proportional to boundary length of each element divided by the total boundary length of the drainage polygon.

5. The deep percolation rates for individual drainage basins were adjusted during SACFEM2013 calibration to improve the match between simulated and measured groundwater elevations. Final factors applied to the deep percolation rates range from 0.5 to 1.5.

Urban Pumping. The final set of specified-flux boundary conditions applied in the SACFEM2013 model reflects urban pumping within the model domain. The distribution of agricultural pumping that was developed using the surface water budgeting methodologies described below do not include urban pumping. As a first step to estimate the quantity of urban pumping to apply to the model, the year 2010 U.S. Census data were evaluated. Each municipal area with a population greater than 5,000 that used groundwater as a source of municipal supply was further assessed. For municipalities where urban water management plans were available, the reported annual groundwater use was simulated in SACFEM2013. For cities that do not have a current water management plan, a pumping volume that was based on an annual average per capita value of 271 gallons/capita/day was simulated. Further, municipalities in the northern Sacramento area pumping rates were assigned consistent with the Sacramento County Integrated Groundwater and Surface Water Model (SacIGSM) model. Urban pumping was assigned spatially to all SACFEM2013 nodes within a given city area and was apportioned equally to model layers two through four. The monthly variability in urban pumping quantity was distributed on the basis of typical seasonal trends for municipal water use.

No-flow Boundaries
A no-flow boundary was specified across the bottom boundary of the model, representing the freshwater/brackish water interface.

D.2.3.5 Surface Water Budget

Approach
One of the most critical components to the successful operation of ~~the~~ SACFEM2013 is computation of transient surface water budget components. These water budget components were estimated by using a variety of spatial information including land use, cropping patterns, source of irrigation water, surface water availability in different year types and locations, and the spatial distribution of precipitation. Surface water budget components include deep percolation of applied water, deep percolation of precipitation, and agricultural pumping.

Surface water budgets were developed by intersecting existing GIS data developed by DWR with the groundwater model grid to develop land use for each groundwater model node. Additionally, GIS data on water districts and surrounding areas were used to identify district and non-district areas. The resulting intersection provided land use, water district, and water source information for each of the over 150,000 groundwater model nodes.

Methodology
A semi-physically based soil moisture accounting model and historical precipitation data were used to simulate the root zone processes and calculate applied water demand and deep percolation past the root zone for each node. Calculated deep percolation was split between applied water and precipitation depending on the season and the availability of water from each source.

Calculated values for deep percolation were compared to estimated values prepared by DWR's Northern District for the year 2000. Northern District staff calculated detailed water budgets in 2000, which included some of the best available estimates of regional deep percolation. In some areas, soil parameters in the root zone model were adjusted to provide similar volumes of deep percolation. However, considerable uncertainty still exists in any estimate of regional deep percolation because soil conditions vary widely, and it is not possible to measure deep percolation on a regional basis.

The total demand for applied water was used in conjunction with the water source and water district attributes from the GIS intersection to estimate agricultural groundwater pumping. Some areas are supplied solely from groundwater, and calculated total applied water demand represents groundwater pumping. Other areas are supplied by a mix of groundwater and surface water. For these areas, estimates of the availability of surface water each year were made to determine the fraction of applied water demand met from surface water and groundwater. In these areas, additional information on the overlying water district was combined with district water rights and contracts to estimate available surface water. For example, districts within the Tehama-Colusa Canal Authority have water contracts with the Bureau of Reclamation that receive different allocations each year. An estimate of those allocations from an existing level of development simulation of Central Valley Project operations was used to calculate the availability of surface water for groundwater model elements within those districts. Any remaining applied water demand, after consideration of available surface water, is assumed to be met by groundwater pumping.

D.2.3.6 Aquifer Properties

The distribution of aquifer properties across the Sacramento Valley is poorly understood. In certain areas with significant levels of groundwater production, the collection of aquifer test data and the measurement of historical groundwater-level trends in response to known groundwater production rates have provided valuable information on aquifer properties. However, in the majority of the valley, these data are not available.

To estimate the spatial distribution of aquifer properties across the model domain for this numerical modeling effort, a database of well productivity information was used. In consultation with DWR staff, a database was obtained that included all of the specific capacity yield data that were available from well log records. These data were compiled along with well construction information for each production well to yield a representative data set of well productivity across the valley. Wells that did not have available construction data were omitted from further consideration. To protect owner privacy, the exact location of each well was modified by DWR staff to reflect the center of the section in which each well was located. This modification in well location did not adversely affect the use of the data to estimate the spatial distribution of aquifer properties, given the extremely large area encompassed by the model domain. Approximately 1,000 wells in the database within the model domain were used in this analysis.

The intent of the modeling analysis described herein is to simulate the effects of the operation of high-productivity irrigation wells screened within the major producing zones in the valley to support conjunctive water management projects. Therefore, the aquifer properties that are of primary interest are those of the major aquifer zones tapped by large-diameter irrigation wells. The well database described above was filtered to remove data obtained from tests on low-yield and shallow, domestic-type wells. All test data from wells that reported a well yield below 100 gallons per minute were eliminated from consideration, as were the test data from wells with a total depth of less than 100 feet. The only exception to this second consideration was for wells that were located along the basin margins – where aquifers are thin – that reported what appeared to be valid test results. Data from these wells were considered because they were often the only data available in the basin margin areas.

After the data set for consideration was finalized, the reported specific capacity data for each well were used to estimate an aquifer transmissivity for that location. The relationship used to estimate aquifer transmissivity was the following form of a simplified version of the Jacob non-equilibrium equation:

$$Sc = T/2000 \quad (8)$$

Where:

Sc = specific capacity of an operating production well (gallons per minute per foot of drawdown)

T = aquifer transmissivity (gallons per day per foot)

After a transmissivity estimate was computed for each location, the transmissivity value was then divided by the screen length of the production well to yield an estimate of the aquifer horizontal hydraulic conductivity (Kh). The final step in the process was to smooth the Kh field to provide regional-scale information. Individual well tests produce aquifer productivity estimates that are local in nature, and might reflect small-scale aquifer heterogeneity that is not necessarily representative of the basin as a whole. To average these smaller scale variations present in the data set, a FORTRAN program was developed that evaluated each independent Kh estimate in terms of the available surrounding estimates. When this program is executed, each Kh value is considered in conjunction with all others present within a user-specified critical radius, and the geometric mean of the available Kh values is calculated. This geometric mean value is then assigned as the representative regional hydraulic conductivity value for that location. The critical radius used in this analysis was 10,000 meters, or about six miles. The point values obtained by this process were then gridded using the kriging algorithm to develop a Kh distribution across the model domain. The aquifer transmissivity at each model node within each model layer was then computed using the geometric mean Kh values at that node times the thickness of the model layer. Insufficient data were available to attempt to subdivide the data set into depth-varying Kh distributions, and it was, therefore, assumed that the computed mean Kh values were representative of the major aquifer units in all model layers. The distribution of K used throughout most of the SACFEM2013 model layers is shown in Figure D-4. During model calibration, minor adjustments were made to the Kh of model layer one east of Dunnigan Hills and in model layers six and seven in the northern Sacramento Valley based on qualitative assessment of Lower Tuscan aquifer test data in this area.

MicroFEM computes vertical flow between adjacent model layers based on the simulated head difference between adjacent model layers and the vertical resistance term. The vertical resistance term in MicroFEM is calculated as follows:

$$V = \frac{\left(b_i / Kv_i + b_{i+1} / Kv_{i+1} \right)}{2} \qquad (9)$$

Where:

V = Vertical resistance to flow between an upper model layer (i) and adjacent lower model layer (i+1) (days^{-1})

b_i = Saturated thickness of model layer i (meters)

b_{i+1} = Saturated thickness of model layer i+1 (meters)

Kv_i = Vertical hydraulic conductivity of model layer i (m/d)

Kv_{i+1} = Vertical hydraulic conductivity of model layer i+1 (m/d)

The ratio of Kh to vertical hydraulic conductivity (Kv) were assumed to be 500:1 in layers two through seven and 50:1 in layer one at all model nodes except those representing bedrock areas. The Kh:Kv in areas of bedrock outcrop (such as the Sutter Buttes, Black Butte, and Dunnigan Hills) was assumed to be 1:1 in all model layers.

The specific yield of model layer one was assumed to be 12 percent throughout the SACFEM2013 model domain. The aquifer storativity of model layers two through seven is 6.5×10^{-5} multiplied by model layer thickness throughout the majority of the model domain, with variations along small portions of the model boundary.

D.3 Sensitivity

To test the sensitivity of the SACFEM2013 model to various hydrologic parameters, several sensitivity simulations have been run to-date. Each of these sensitivity simulations varied specific sets of hydraulic parameters. The following parameters were varied in simulations performed to-date.

1. Basin Deposits: The hydraulic conductivity of the Basin deposits (geologic terms Qb, Qm, and Qp) were decreased. Basin deposits are generally surficial deposits of fine grain nature. Decreasing the hydraulic conductivity of the basin deposits would have the tendency to slow the flow of water from the surface to the groundwater.

2. Stream Deposits: The hydraulic conductivity of the Stream deposits (geologic terms Qsc, Qa, and Qal) were increased. Stream deposits are located along the historic channel of the river and represent a coarser grained material. Increasing the hydraulic conductivity of these deposits can allow faster movement of water through this area.

3. Basin and Stream Deposits: The hydraulic conductivity of the Basin deposits (geologic terms Qb, Qm, and Qp) were decreased, and the hydraulic conductivity of the Stream deposits (Qsc, Qa, and Qal) were increased. This simulation combines the changes made in the previous two simulations.

4. Horizontal Hydraulic Conductivity: The horizontal hydraulic conductivity throughout the model was decreased by one order of magnitude (i.e., all values were multiplied by 0.1). A decrease in hydraulic conductivity slows the movement of water through the aquifer.

5. Anisotropy Ratio: The anisotropy ratio (the ratio of horizontal hydraulic conductivity to vertical hydraulic conductivity) was changed across the entire model from 500:1 to 1000:1. Increasing this ratio from 500:1 to 1000:1 increases the resistance to flow in the vertical direction by decreasing the vertical hydraulic conductivity of the aquifer.

6. Storage Coefficients: The values of the storage coefficients were increased. The specific yield was increased from 0.12 to 0.2. The storativity value was increased by a factor of 10 across the entire model. Changes to storage coefficients also result in a change in the velocity of groundwater movement within the aquifer.

7. Streambed Hydraulic Conductivity. The hydraulic conductivity of each streambed was decreased by a factor of 10. Decreasing the hydraulic conductivity of the streambeds would slow movement of water between the surface water and groundwater systems.

The SACFEM2013 model has been calibrated (as previously described). It should be noted that model was not recalibrated for each of the parameters sets listed above. The purpose of the sensitivity simulations is to determine which parameters the model results may or may not be sensitive to.

The sensitivity simulations were run with approximately 153,000 acre-feet of water pumped in a single year. This volume of water is roughly equivalent to the average of all pumping in transfer years under the Proposed Action.

Pumping was specified at the locations and depths of the wells used in the Proposed Action. The change in groundwater level (i.e., drawdown) between simulations with and without the 153,000 acre-feet of pumping was plotted at three locations. Locations 6, 21, and 30 were selected as they are spread across the area where drawdown due to the Proposed Action is simulated (Figures 3.3-28a through 3.3-33c). Simulated drawdown has been plotted at each location for the water table and at the depth of pumping in the area surrounding that location.

Figures D-5 and D-6 show the simulated drawdown at Location 6. Figure D-5 shows the drawdown at the water table (model layer 1). Figure D-6 shows the drawdown in model layer 7. At the water table (Figure D-5), each of the simulations show similar or less drawdown as compared to the calibrated model. Three of the sensitivity simulations (stream bed conductivity, anisotropy ratio, hydraulic conductivity) show recovery period that is longer than the calibrated model. In the pumping zone (Figure D-6), two simulations (hydraulic conductivity, anisotropy ratio) show more drawdown than the calibrated model. Three of the simulations show a longer recovery period following the pumping. The increase anisotropy simulation has a similar, but slower recovery, than the calibrated model. The higher storage coefficient and lower streambed conductivity simulations take additional years for the groundwater levels to recover from the pumping.

Figures D-7 and D-8 show similar results at Location 21. Figure D-7 shows the simulated drawdown in model layer 1. Figure D-8 shows the results in model layer 6, where pumping occurs in this area. The results at the water table (Figure D-7) are very similar to those shown for Location 6 (Figure D-5). In the pumping zone (Figure D-8), two simulations show an increase in the total drawdown (hydraulic conductivity, anisotropy ratio). The hydraulic conductivity simulation also shows a longer period to recover from the pumping. The simulation with altered storage coefficients also requires a longer period to recover, although drawdown in this simulation is significantly lower.

Figures D-9 and D-10 show the simulated drawdown at Location 30 in Layers 1 and 3, respectively. Similar to the other locations, the drawdown and recovery period at the water table (Figure D-9) show similar trends to those described for Location 6 (Figure D-5) and Location 21 (Figure D-7). At the depth of pumping (Figure D-10), two simulations (anisotropy ratio, hydraulic conductivity) show an increase in the amount of drawdown that is simulated as compared to the calibrated model. Two of the simulations (storage coefficients, hydraulic conductivity) require a longer period for groundwater levels to recover than the calibrated model.

D.4 References

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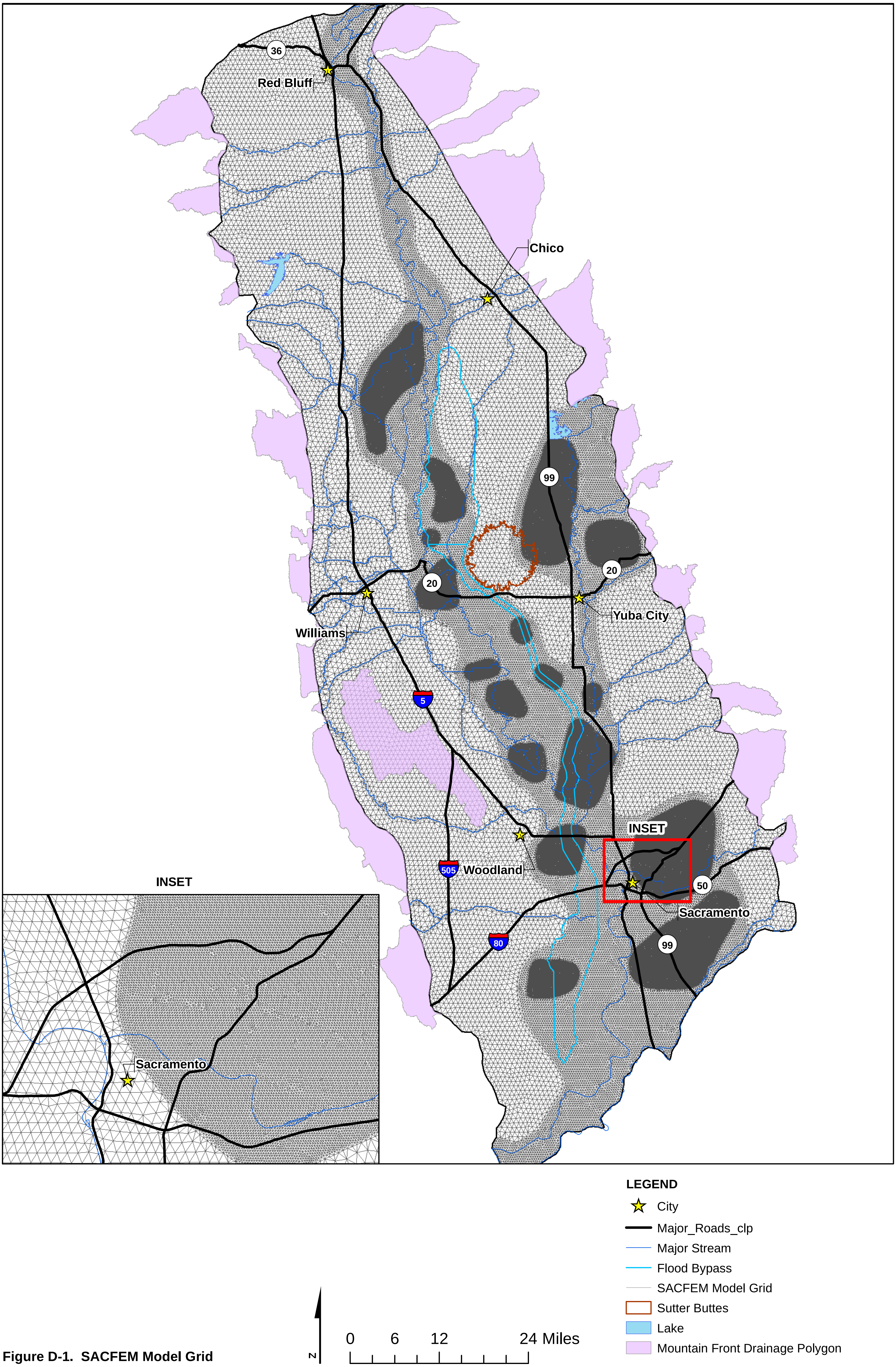

Figure D-1. SACFEM Model Grid

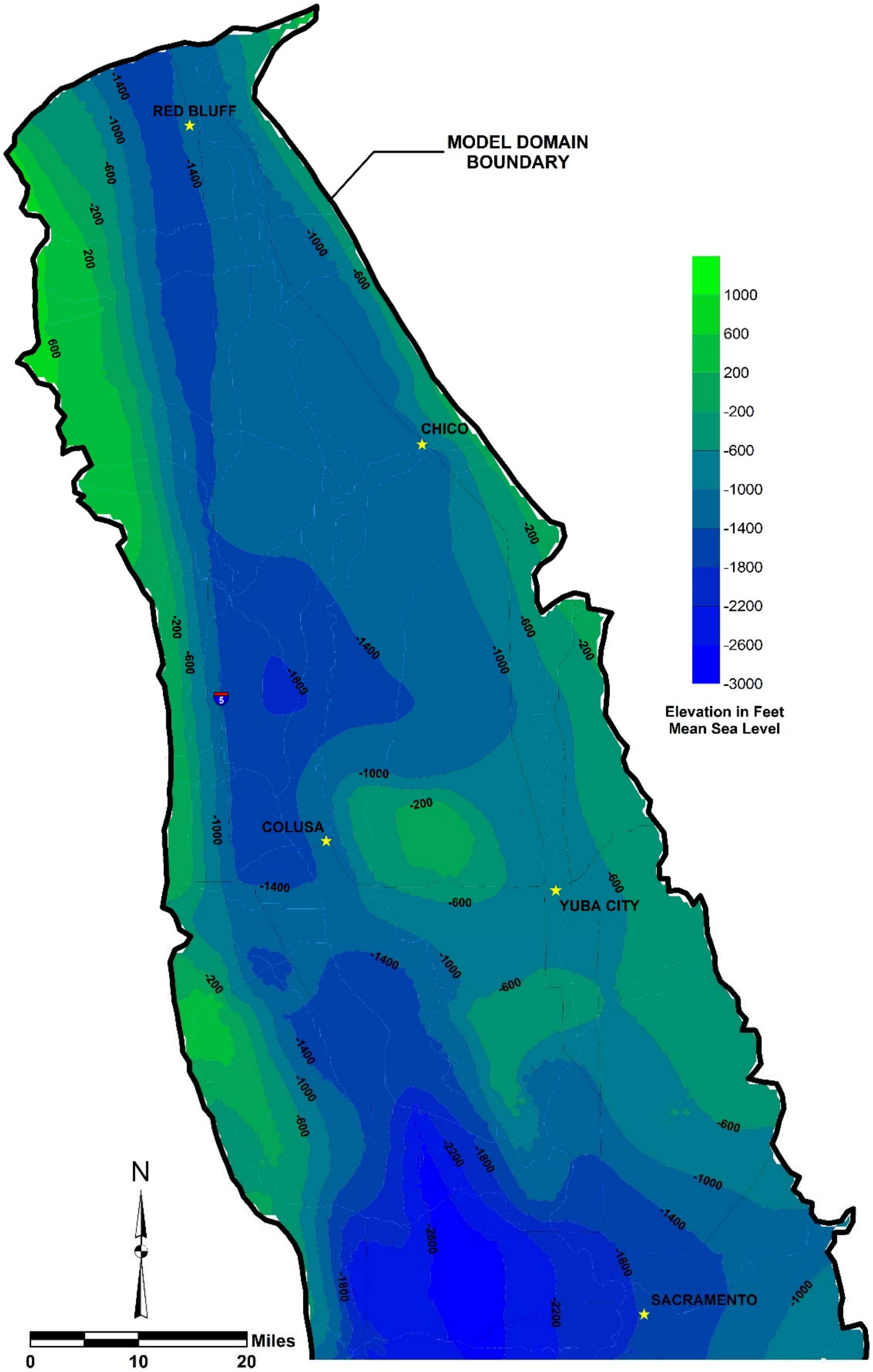

Figure D-2. Elevation of the Base of Fresh Water

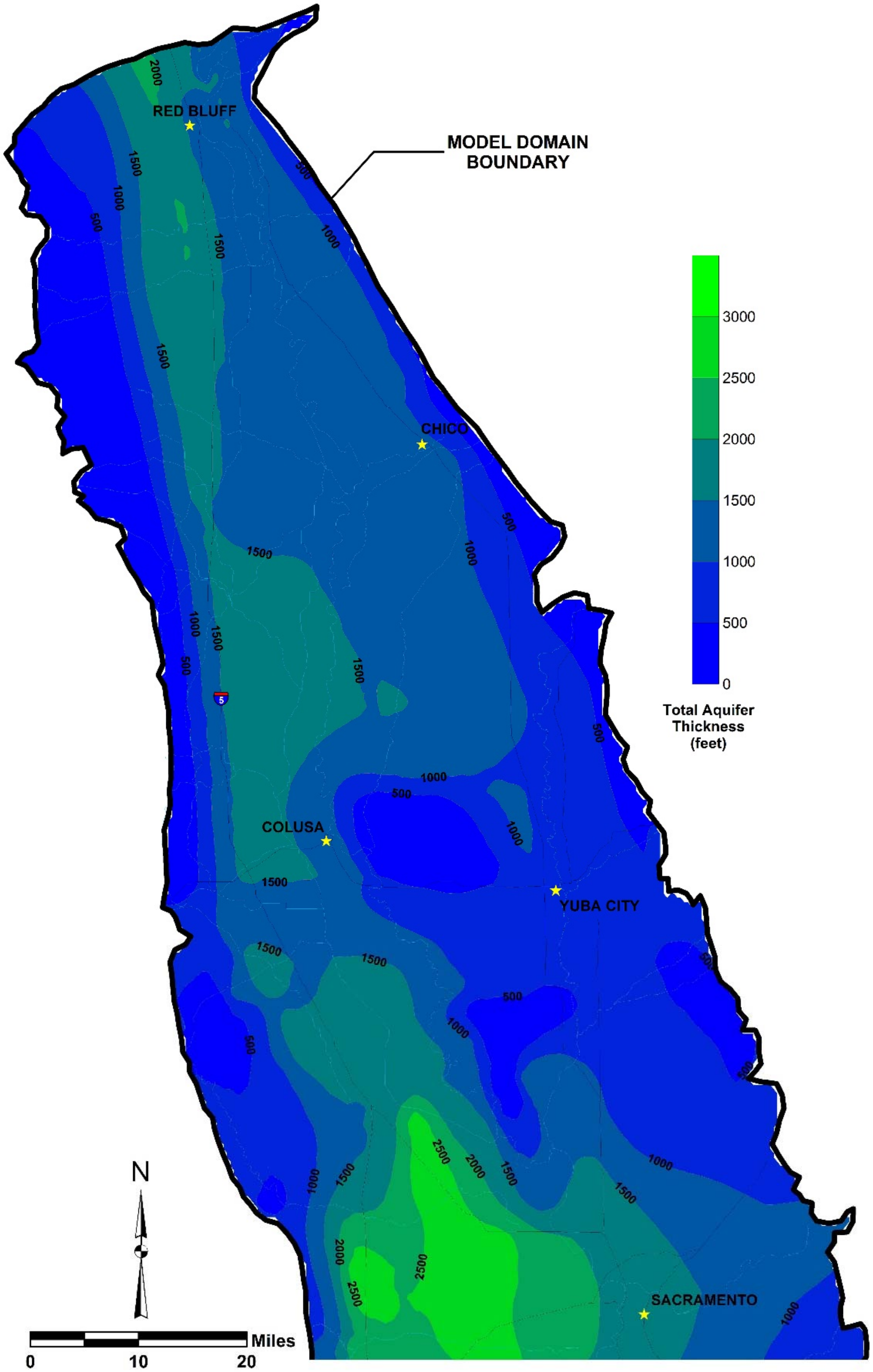

Figure D-3. Total Saturated Aquifer Thickness

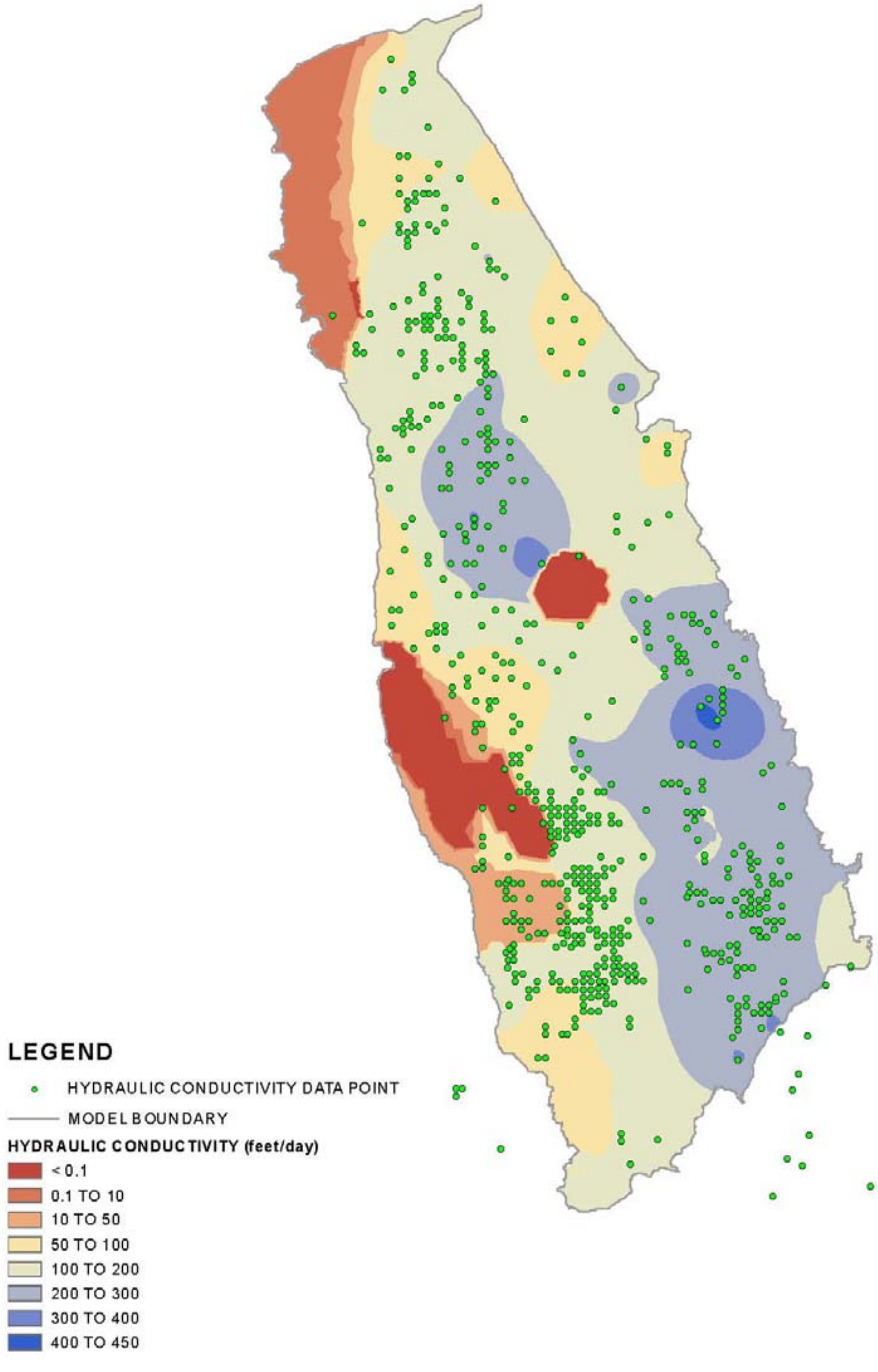

Figure D-4. SACFEM Hydraulic Conductivity Distribution

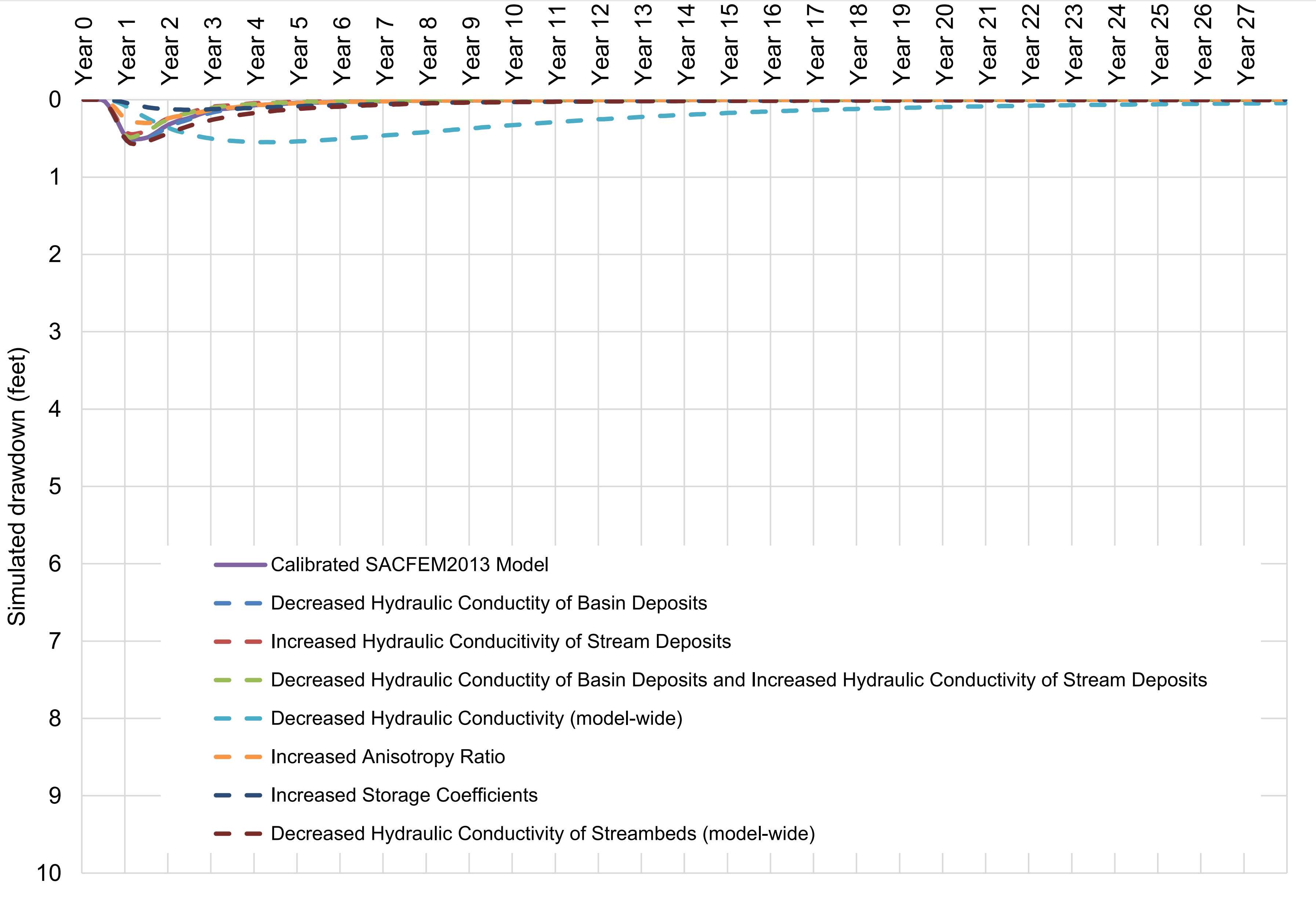

Figure D-5. Simulated Drawdown: Location 6, Layer 1 (Water Table)

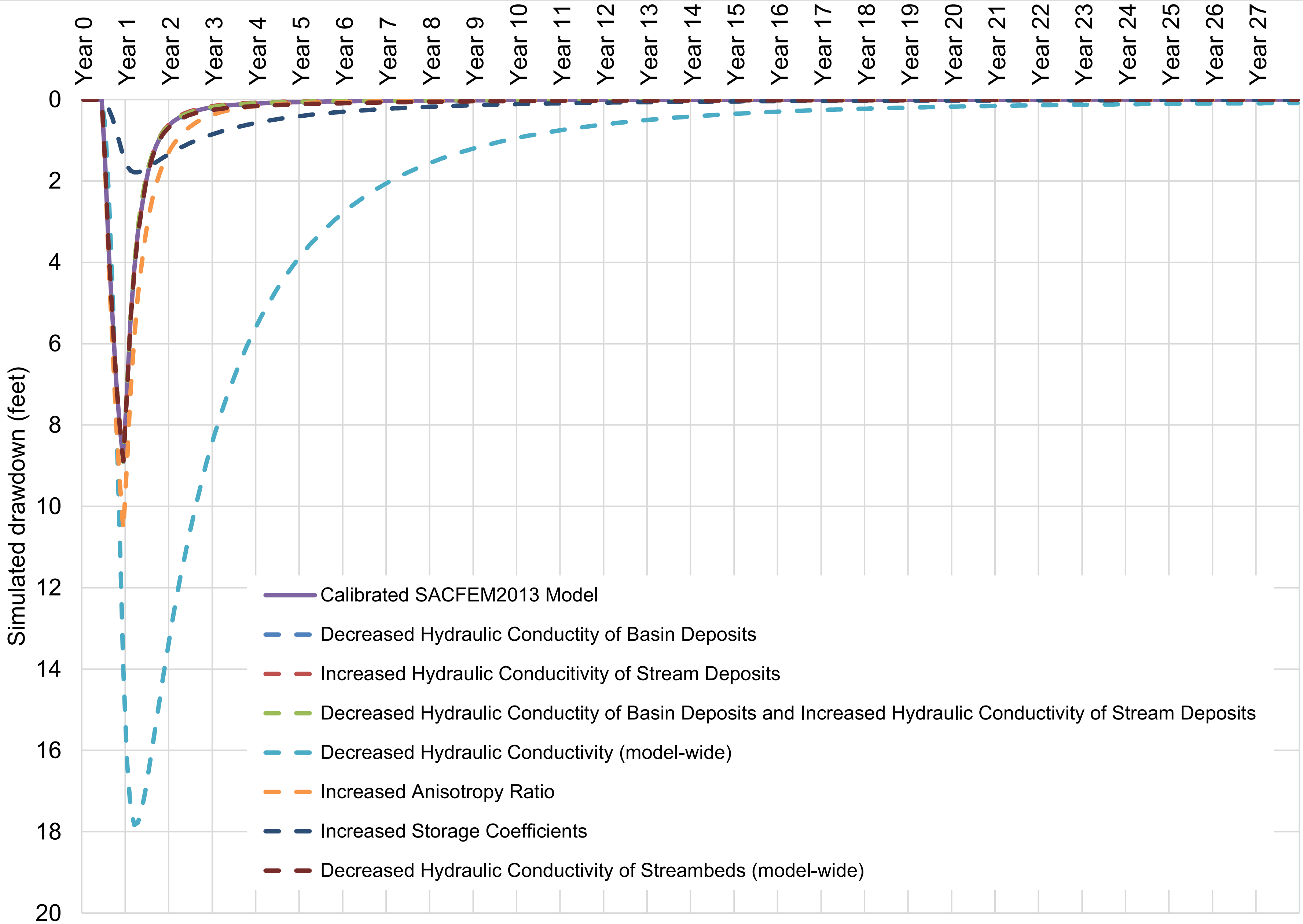

Figure D-6. Simulated Drawdown: Location 6, Layer 7 (Pumping Zone)

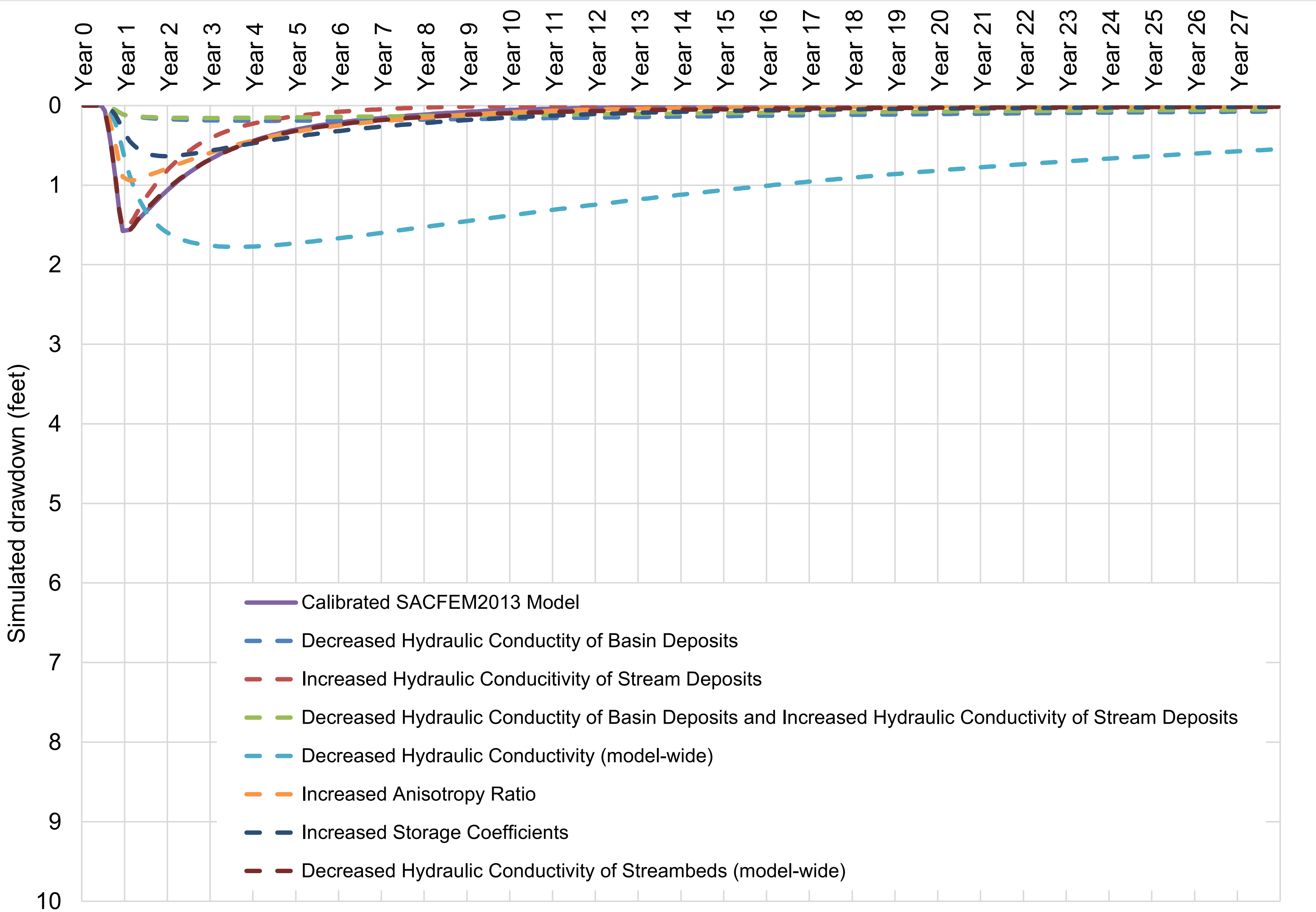

Figure D-7. Simulated Drawdown: Location 21, Layer 1 (Water Table)

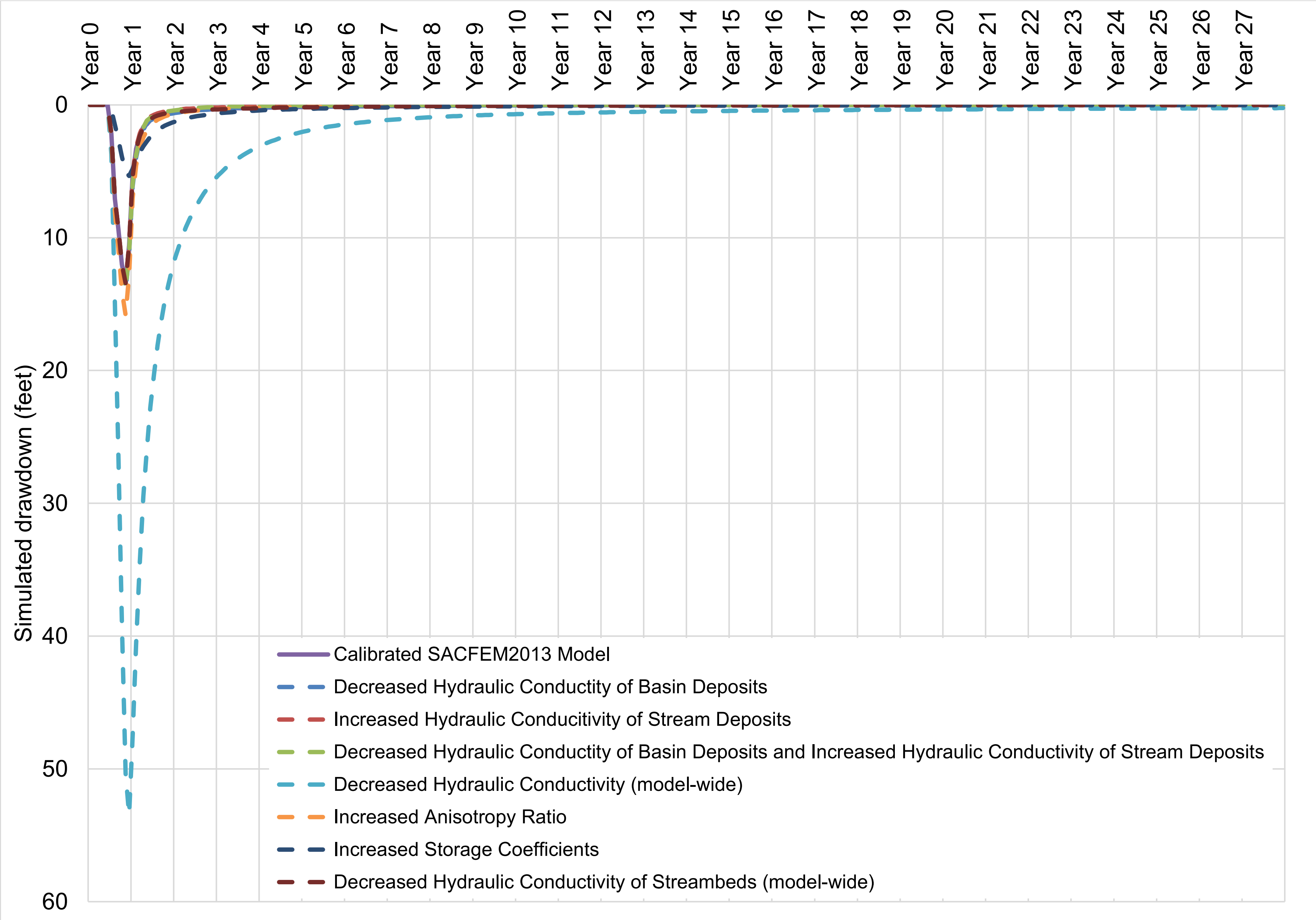

Figure D-8. Simulated Drawdown: Location 21, Layer 6 (Pumping Zone)

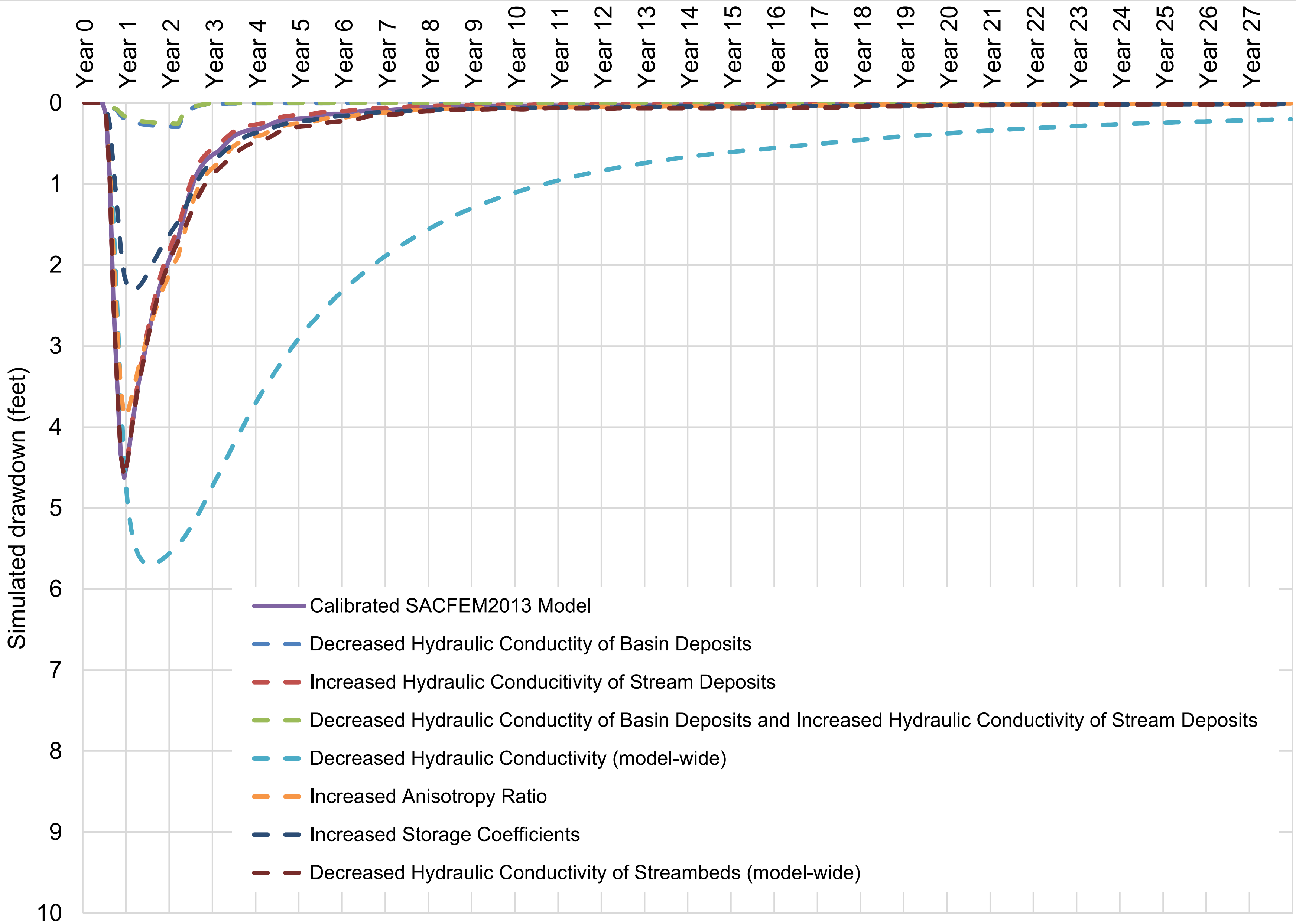

Figure D-9. Simulated Drawdown: Location 30, Layer 1 (Water Table)

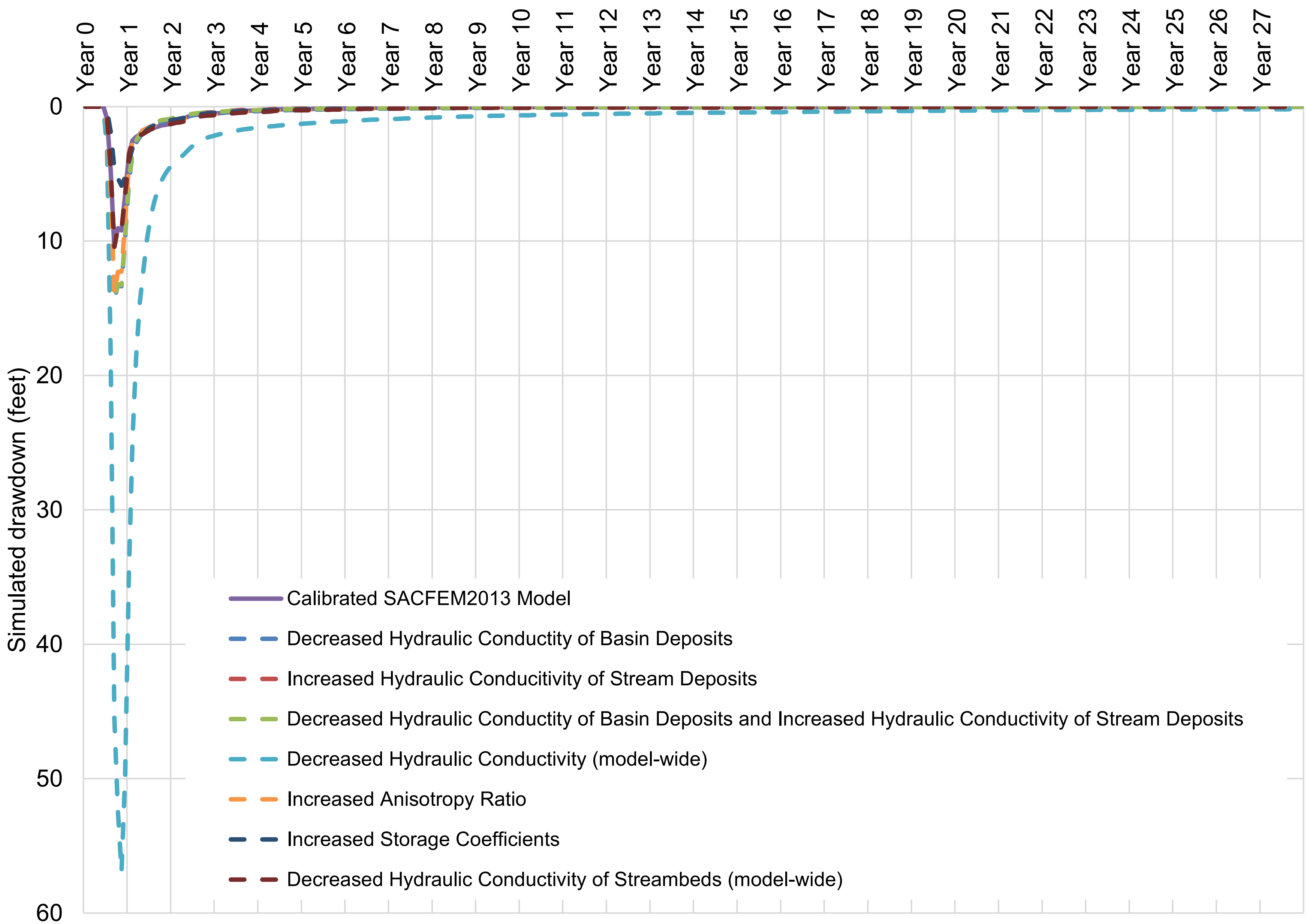

Figure D-10. Simulated Drawdown: Location 30, Layer 3 (Pumping Zone)

Appendix E

Groundwater Modeling Results

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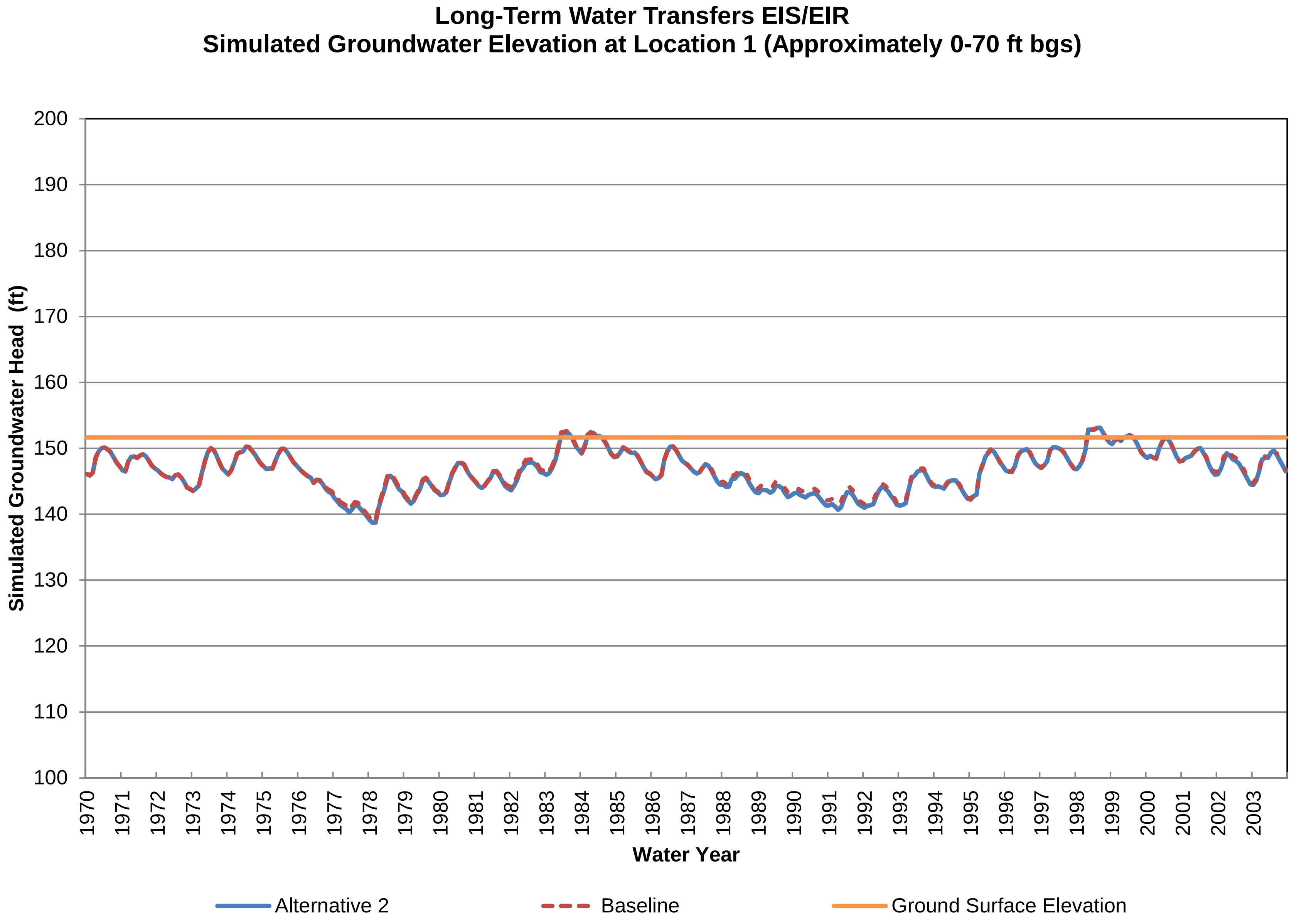
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 1 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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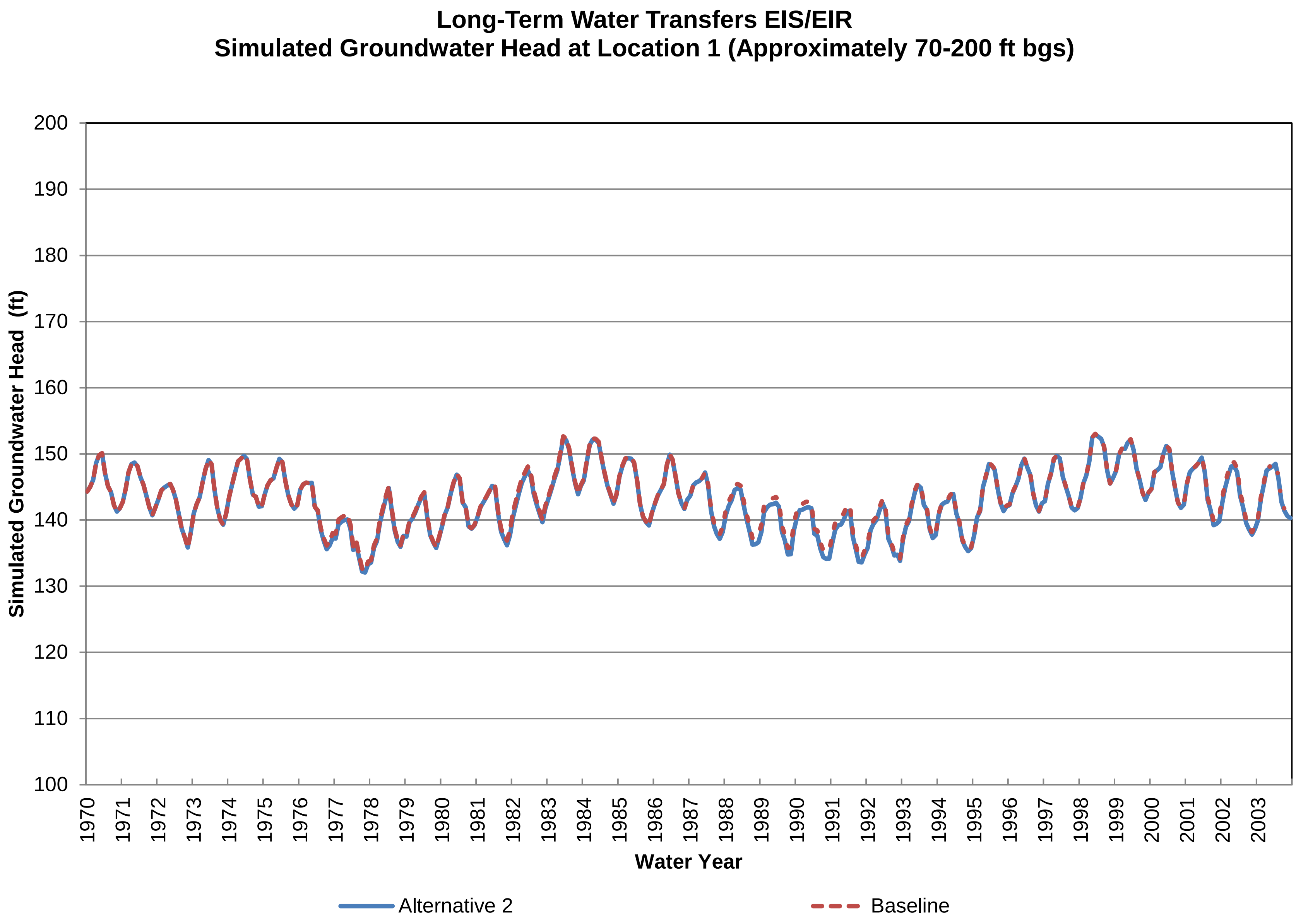
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 70-200 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1987
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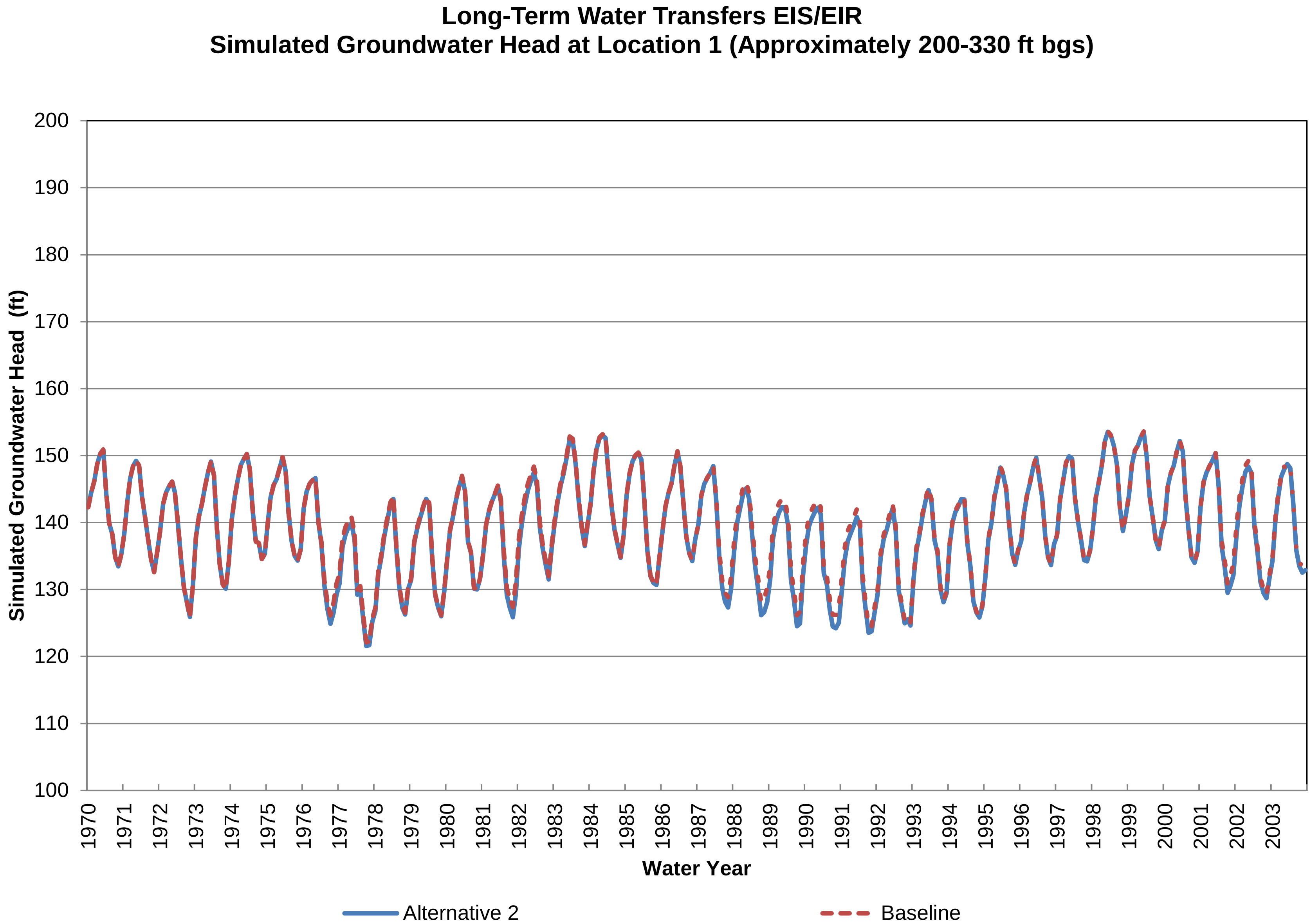
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 200-330 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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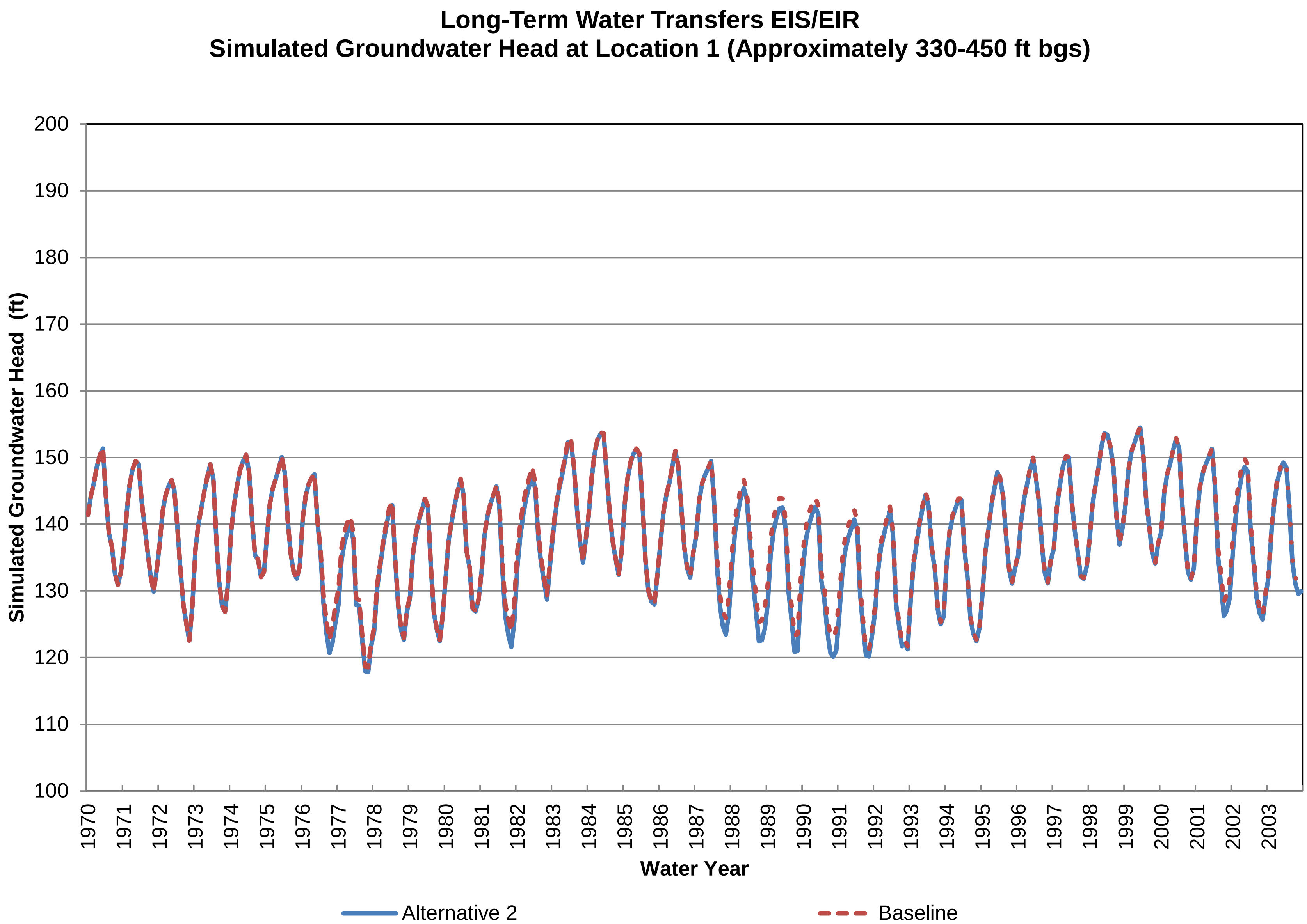
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 330-450 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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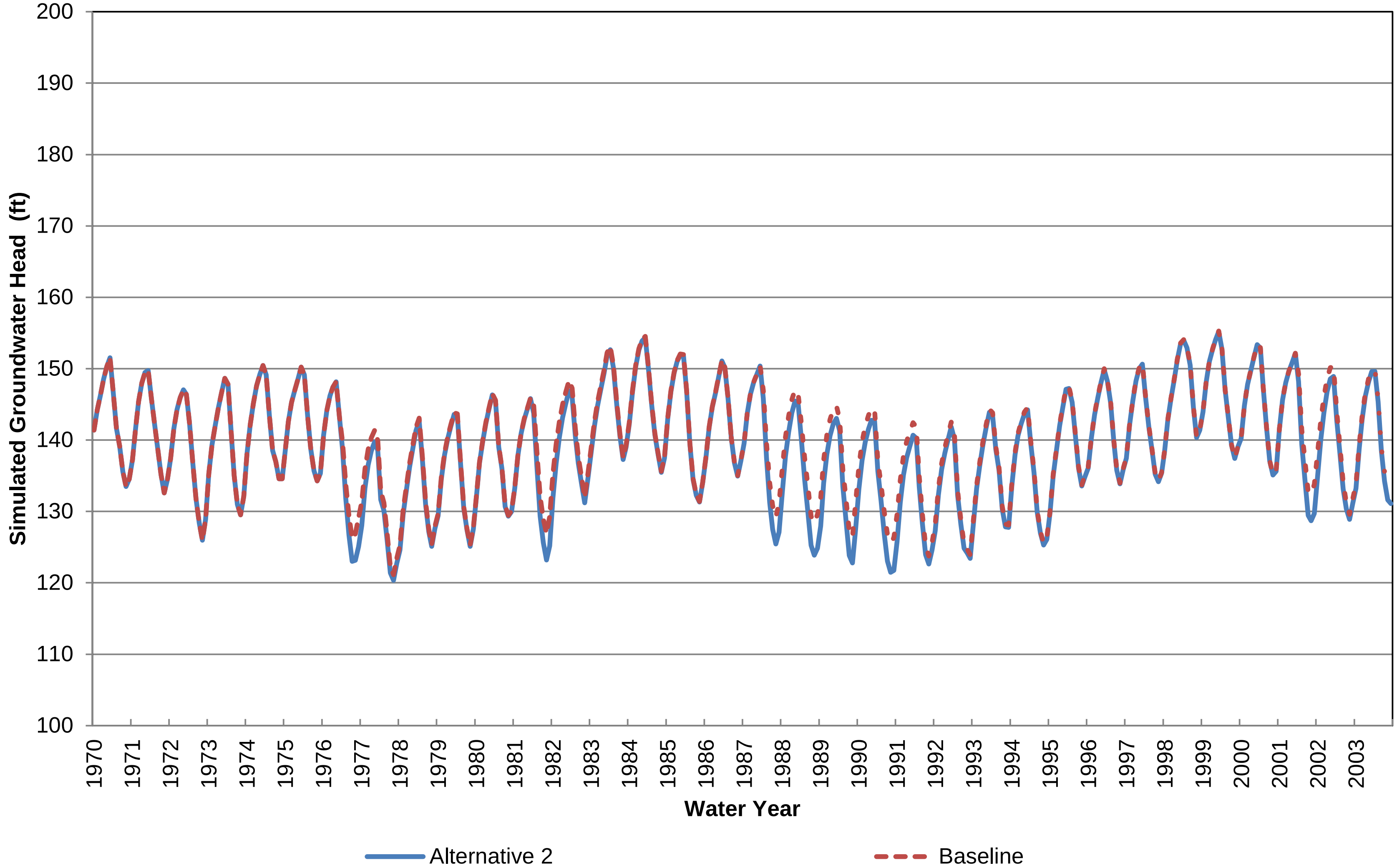
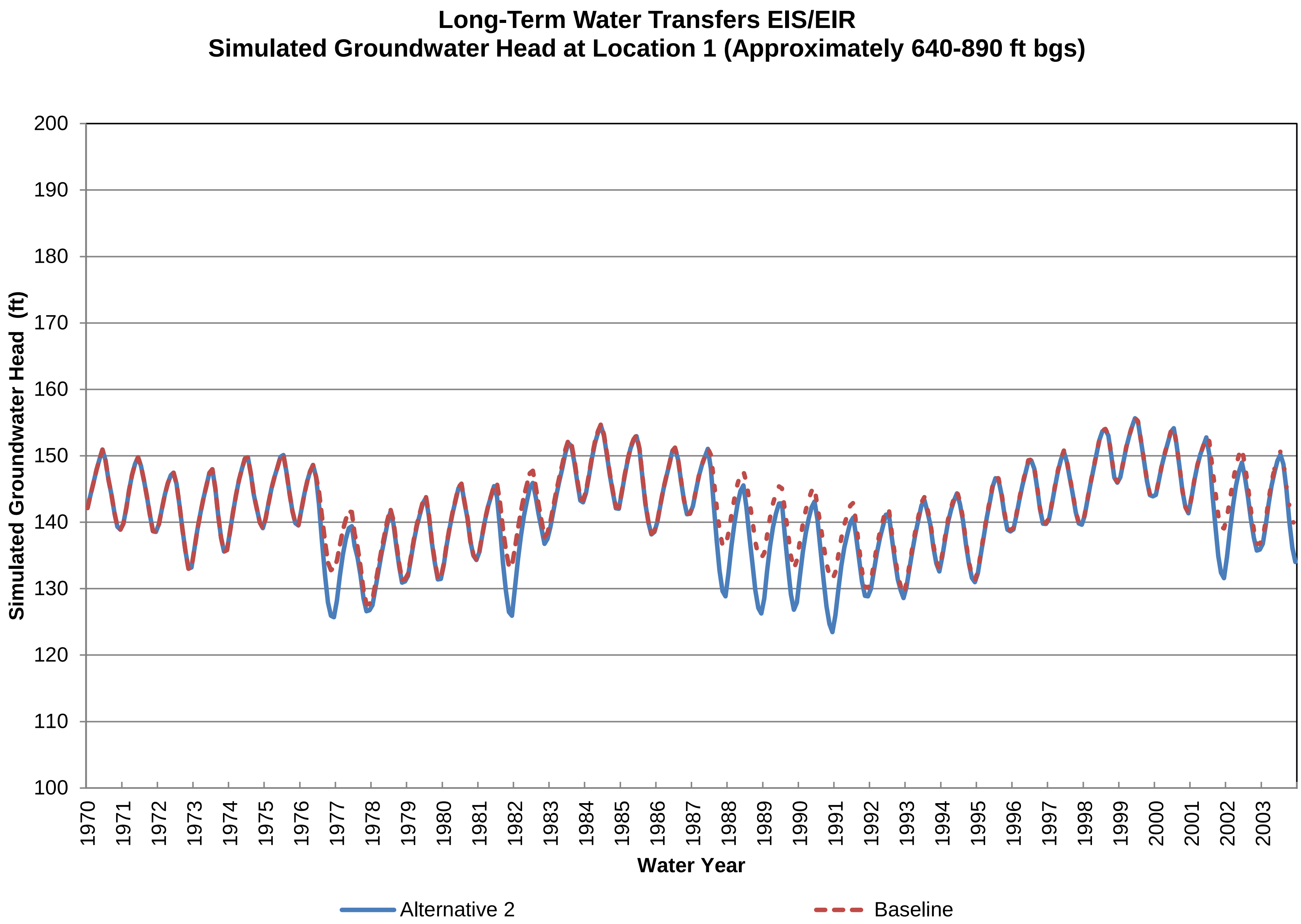
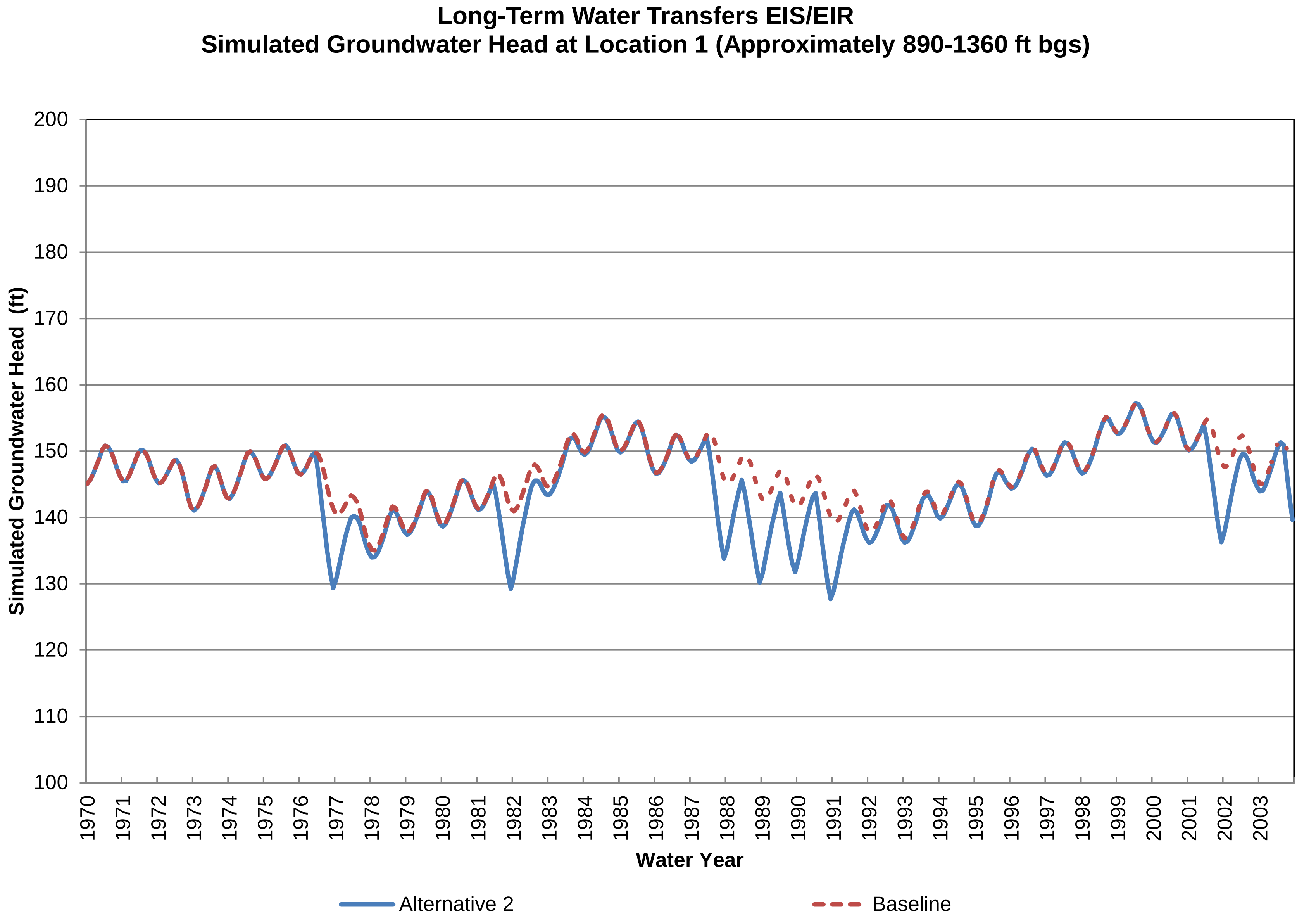
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 450-640 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 640-890 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 890-1360 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
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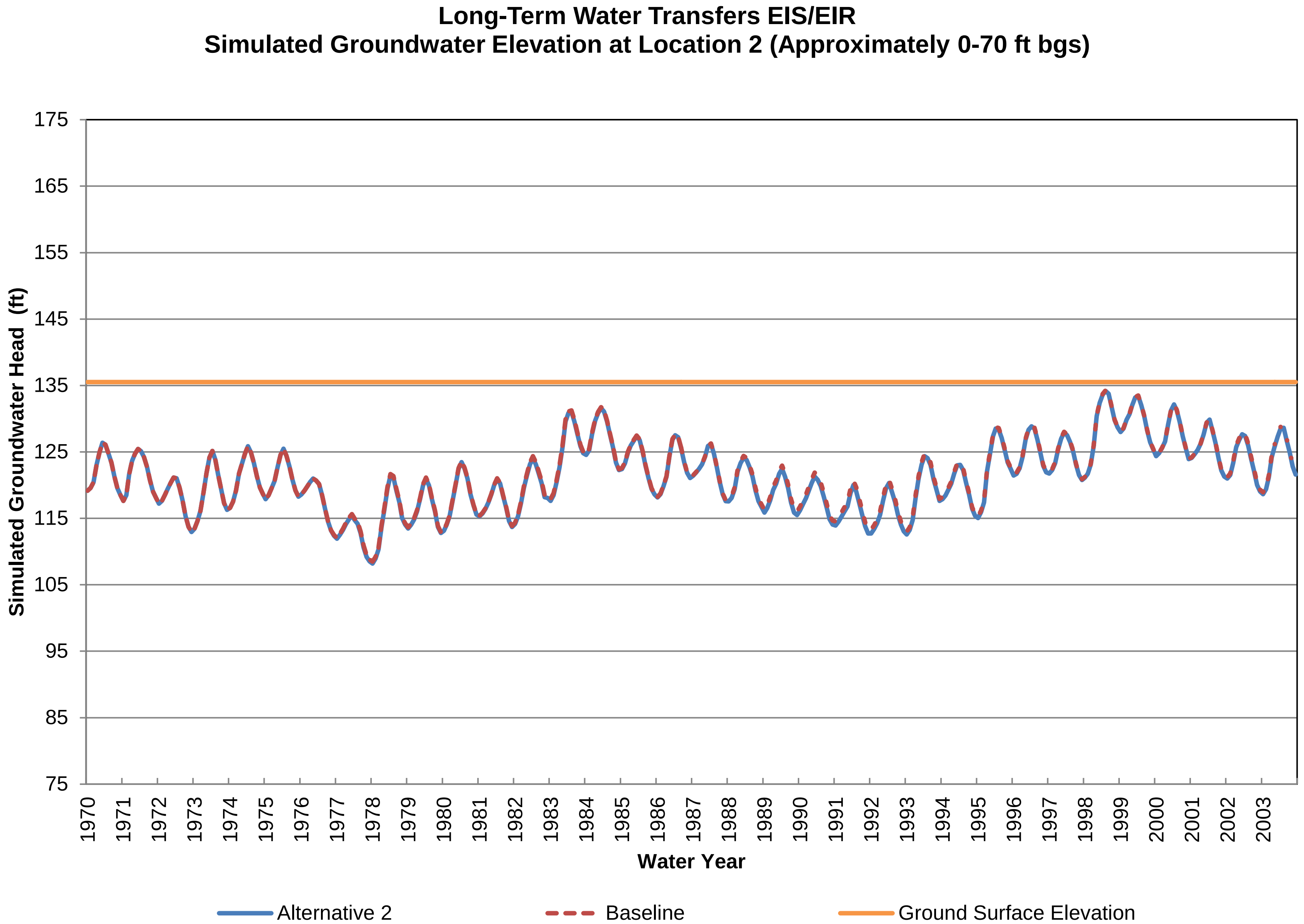
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 2 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
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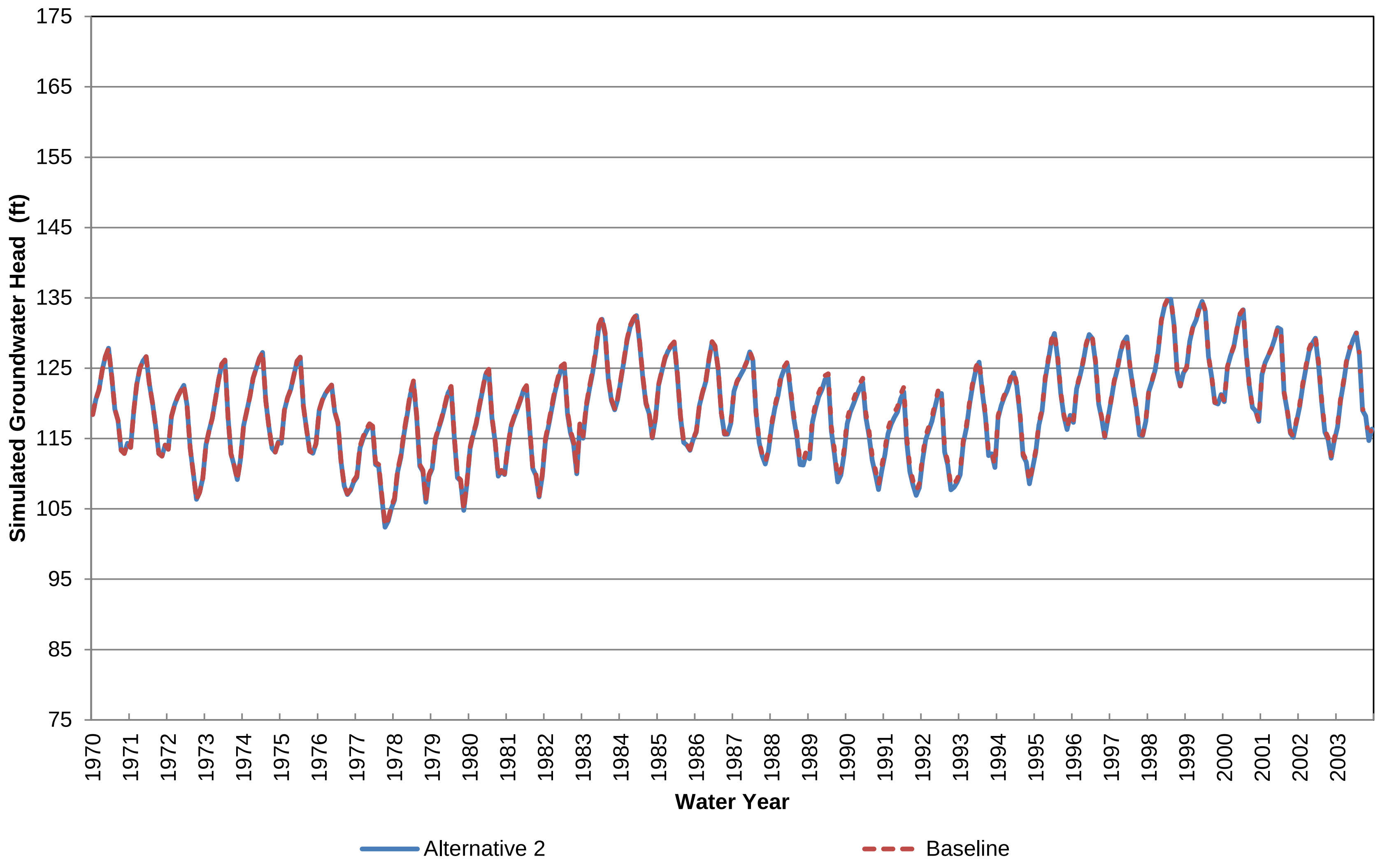
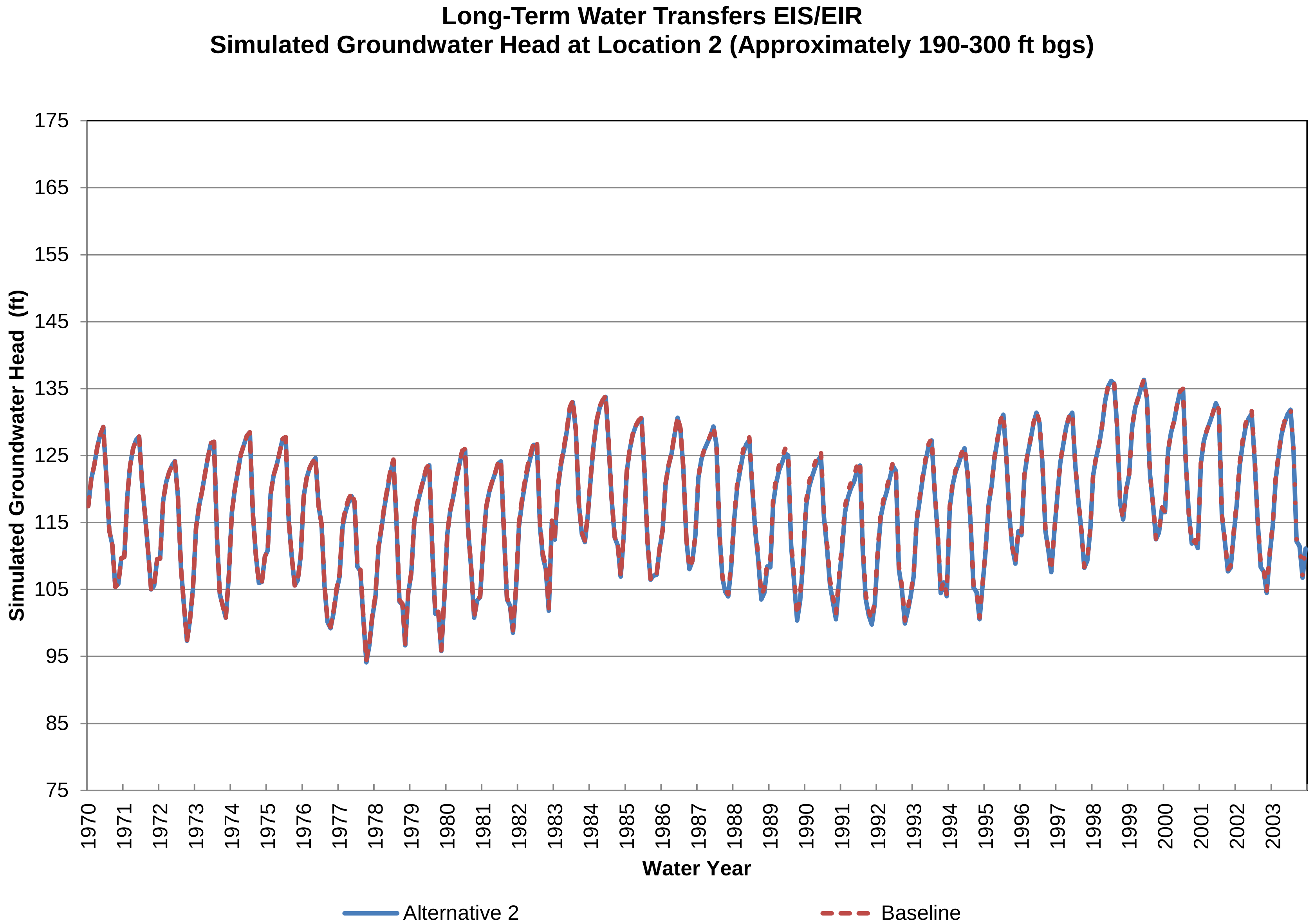
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 70-190 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 190-300 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1984
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1987
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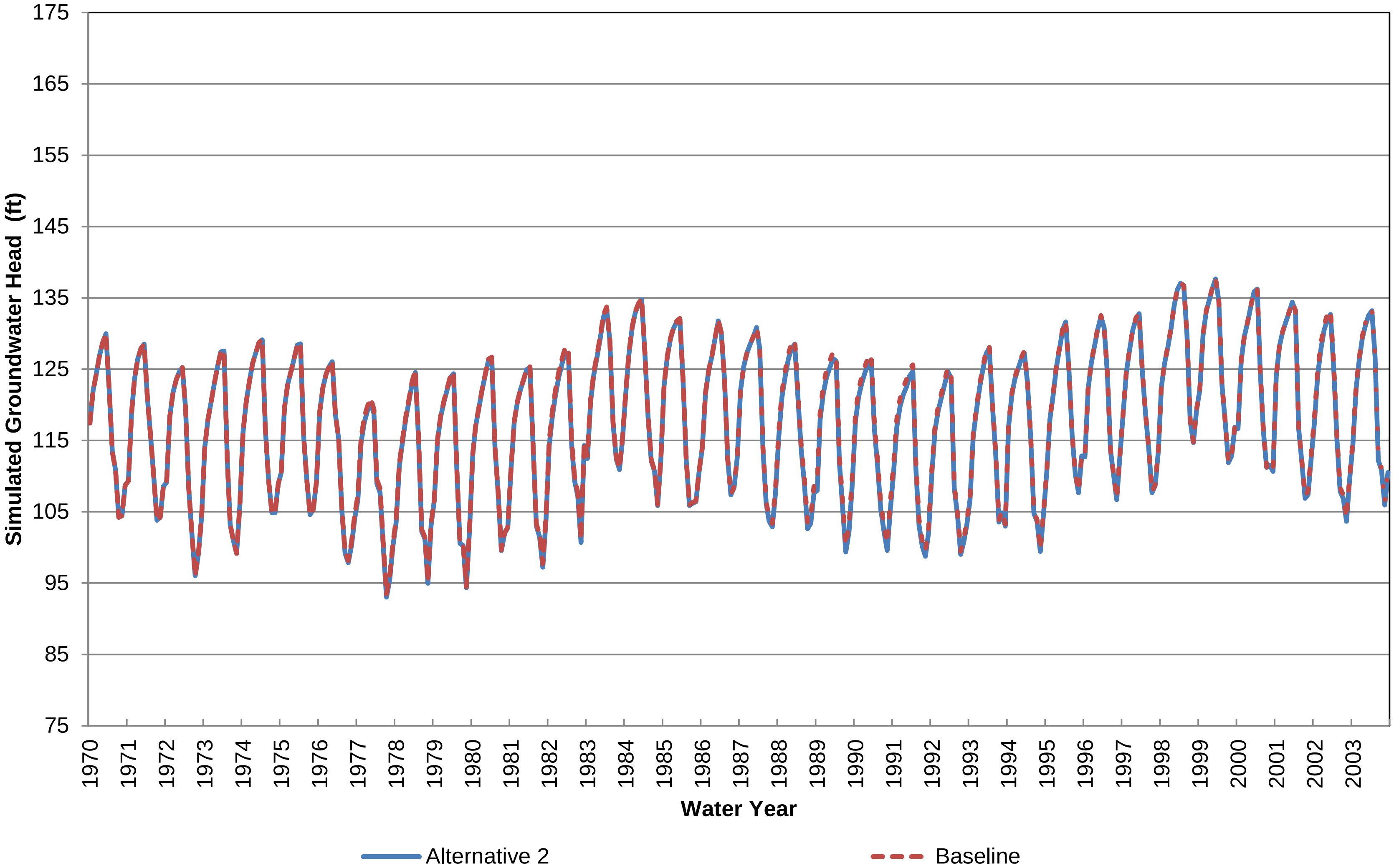
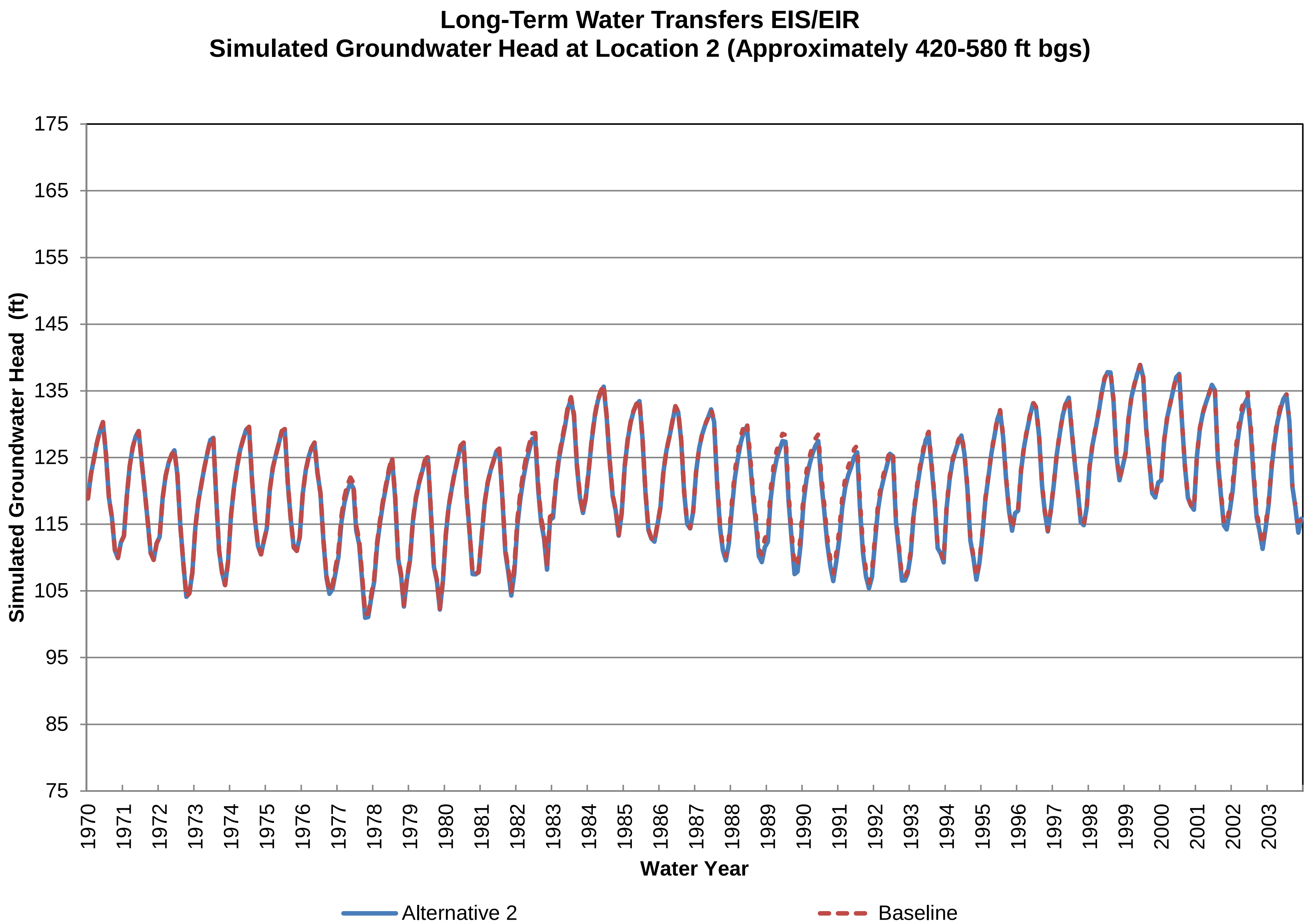
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 300-420 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 420-580 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
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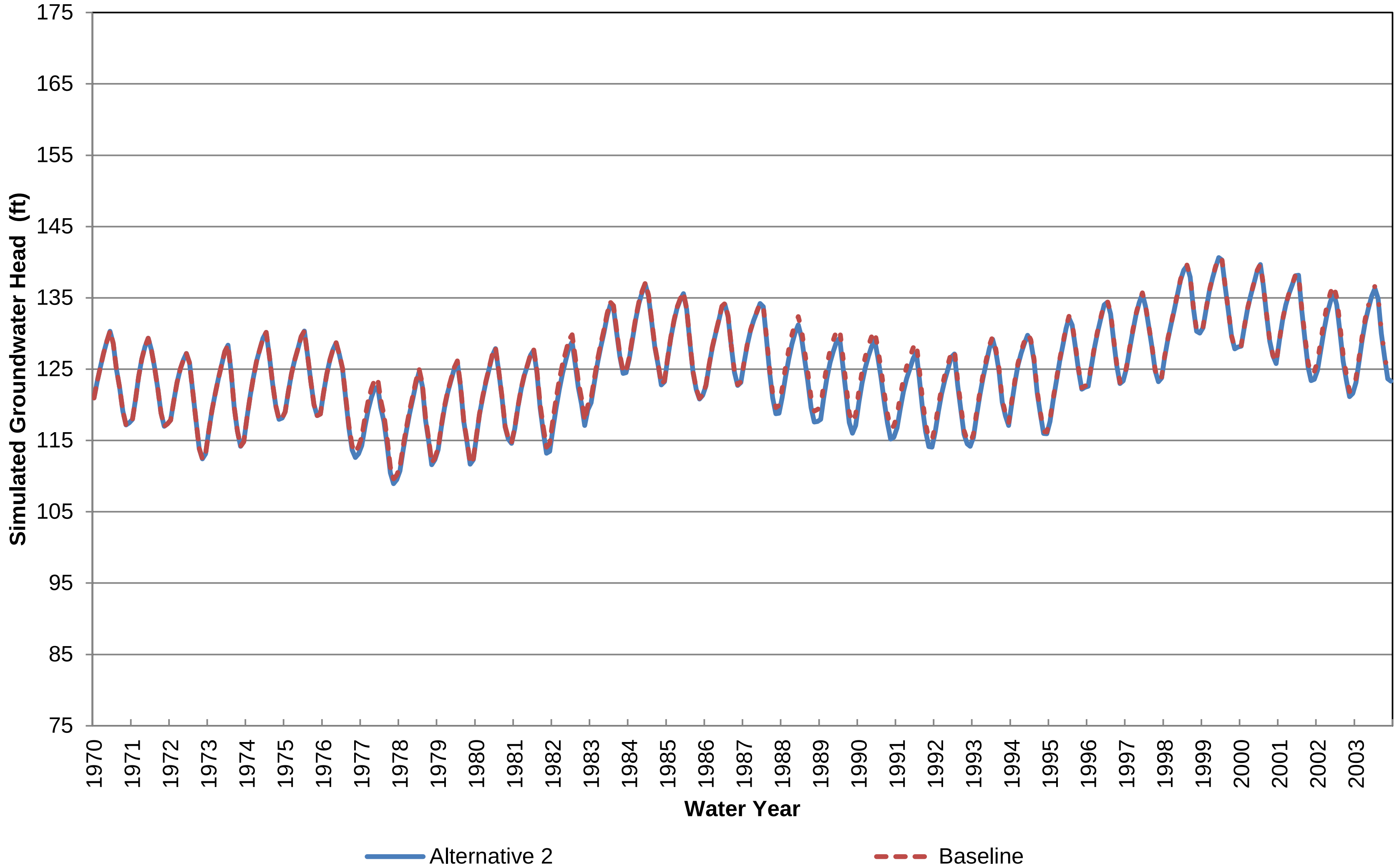
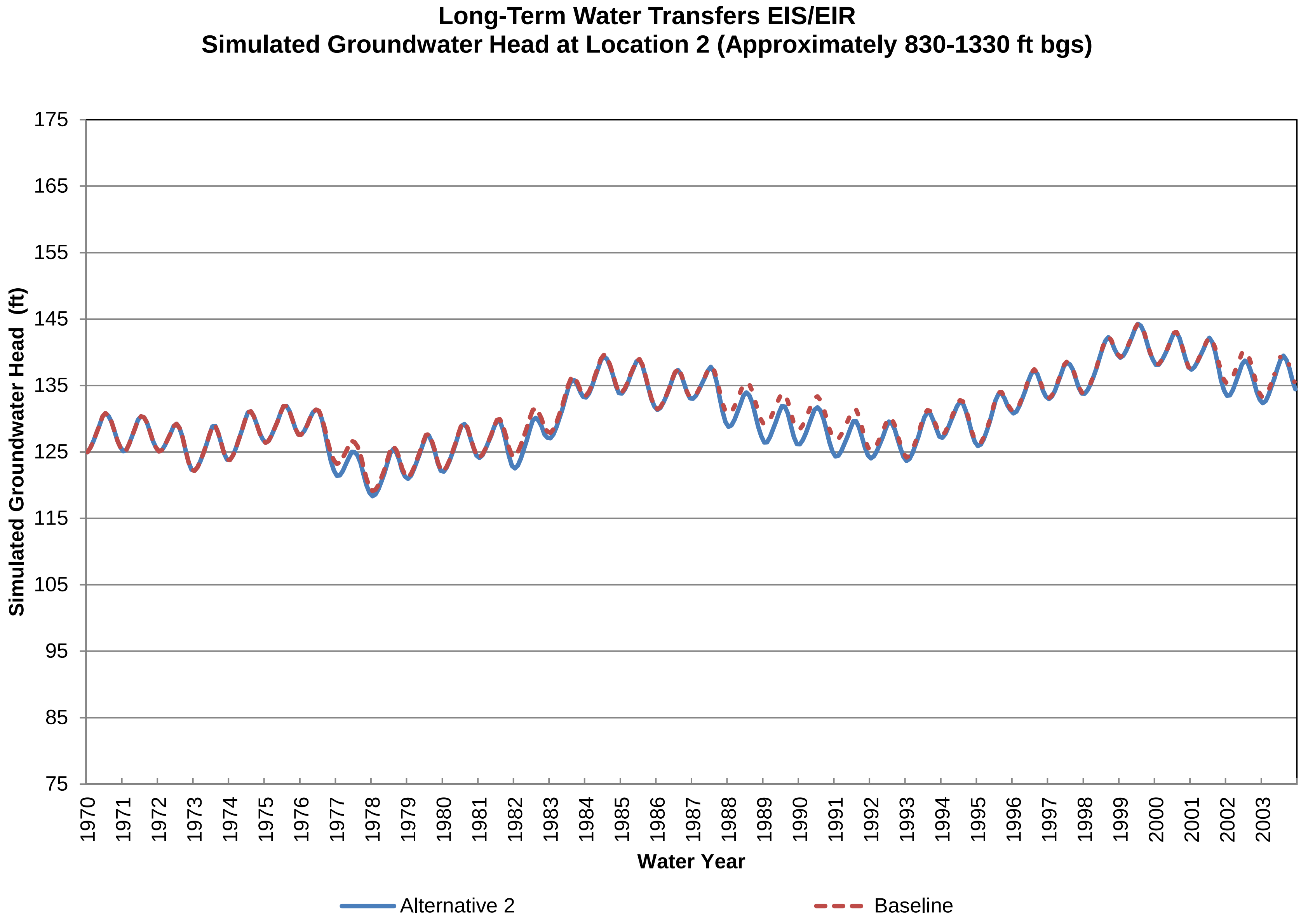
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 580-830 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 830-1330 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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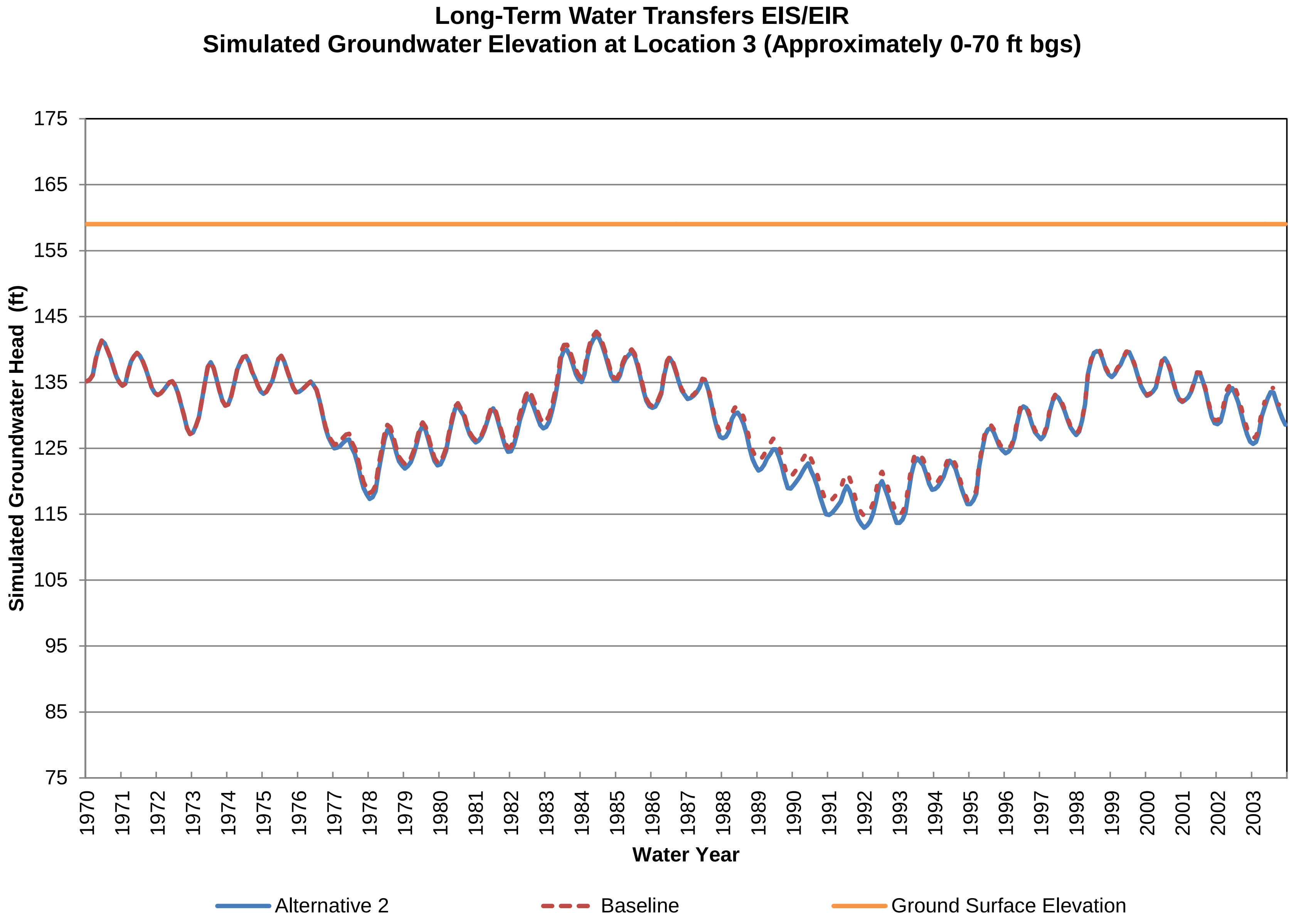
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 3 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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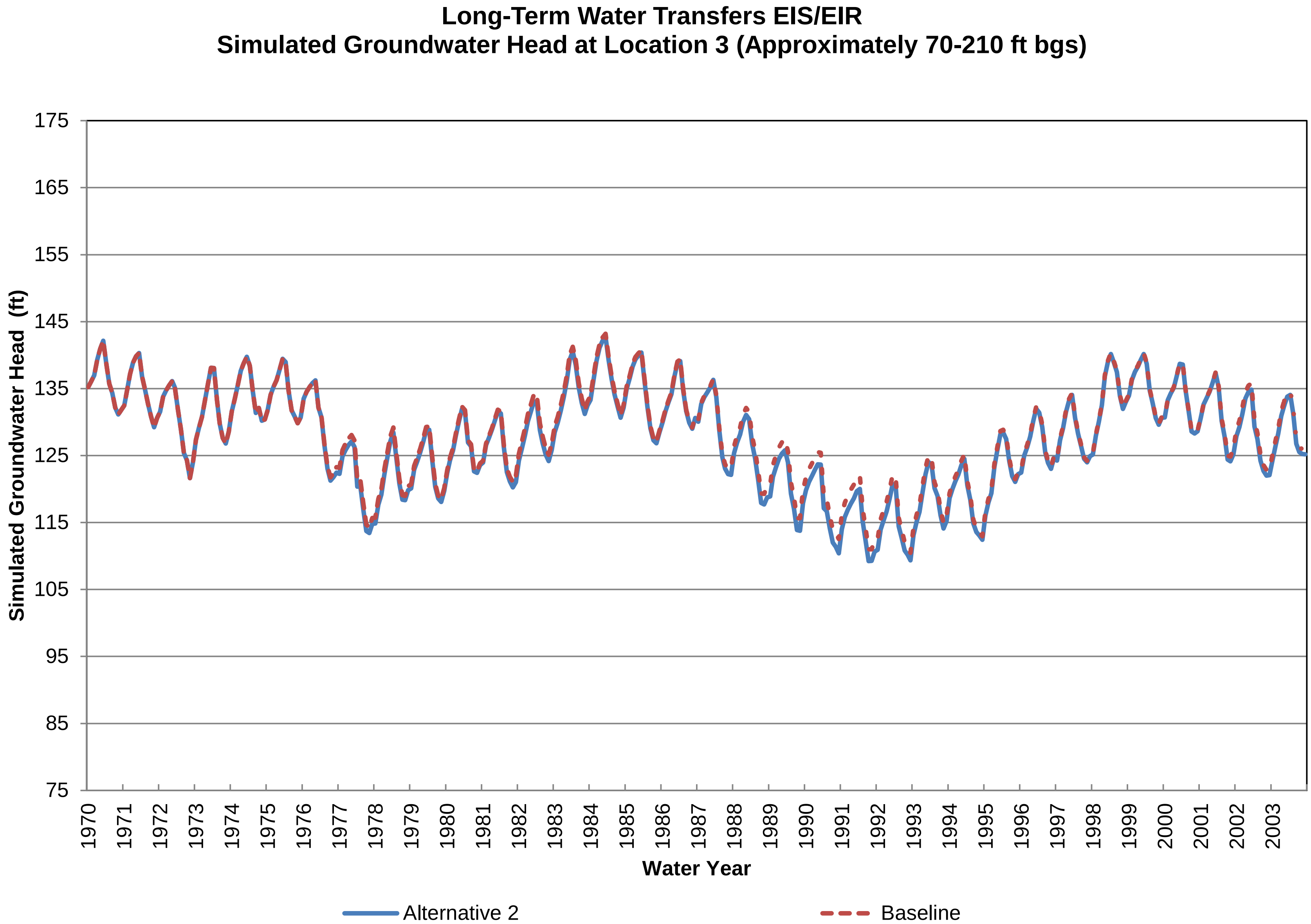
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 70-210 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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1998
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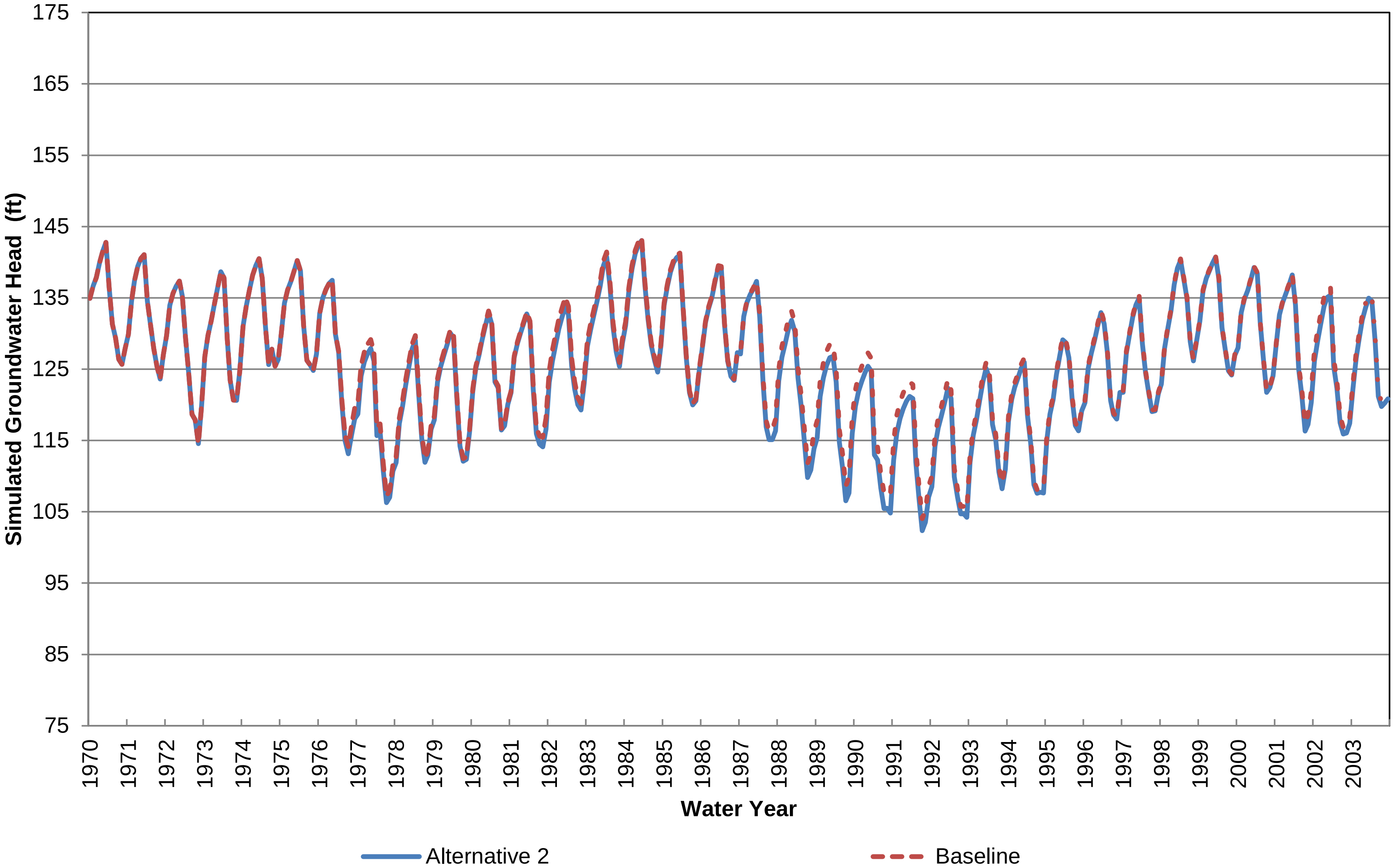
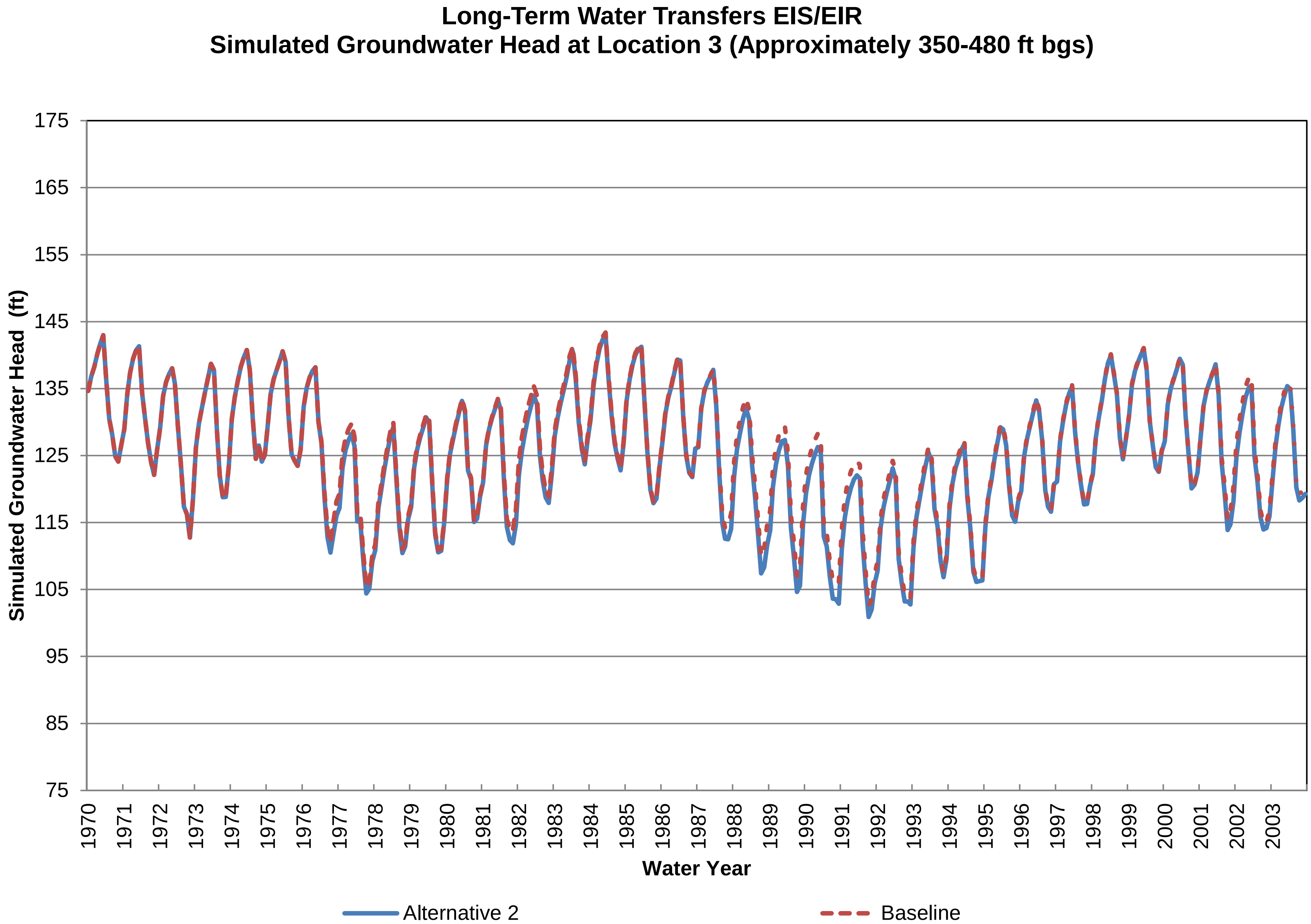
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 210-350 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 350-480 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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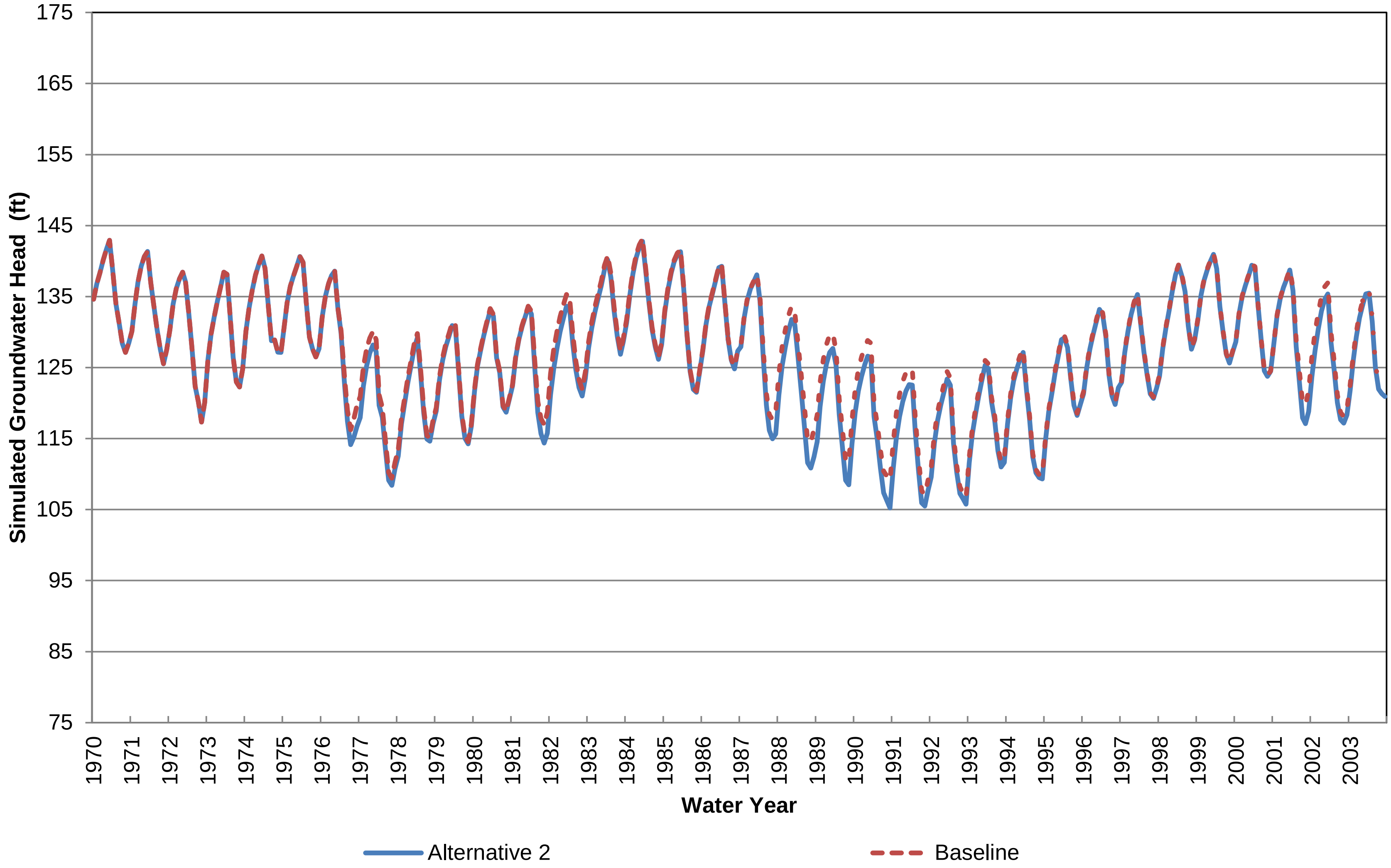
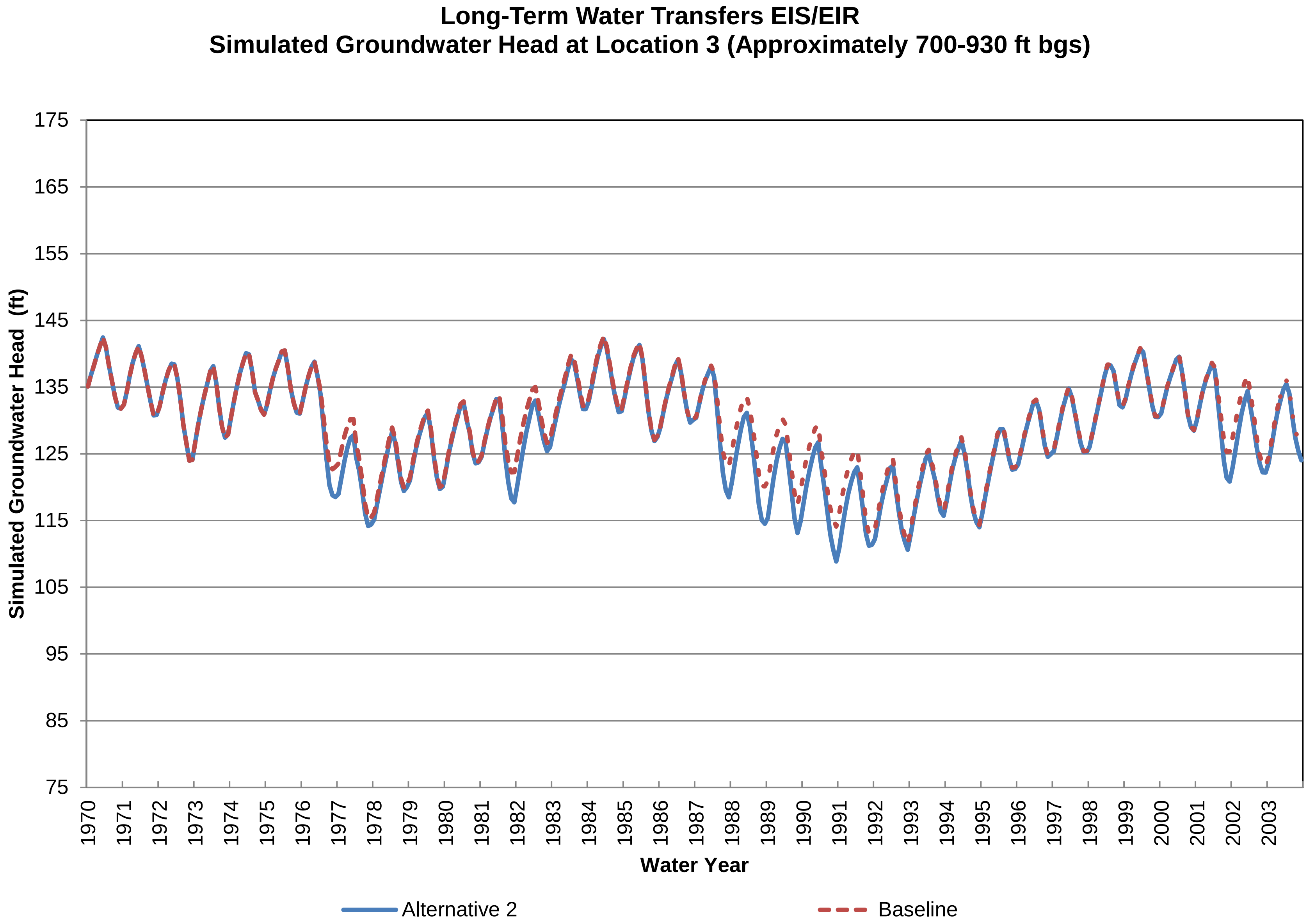
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 480-700 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 700-930 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
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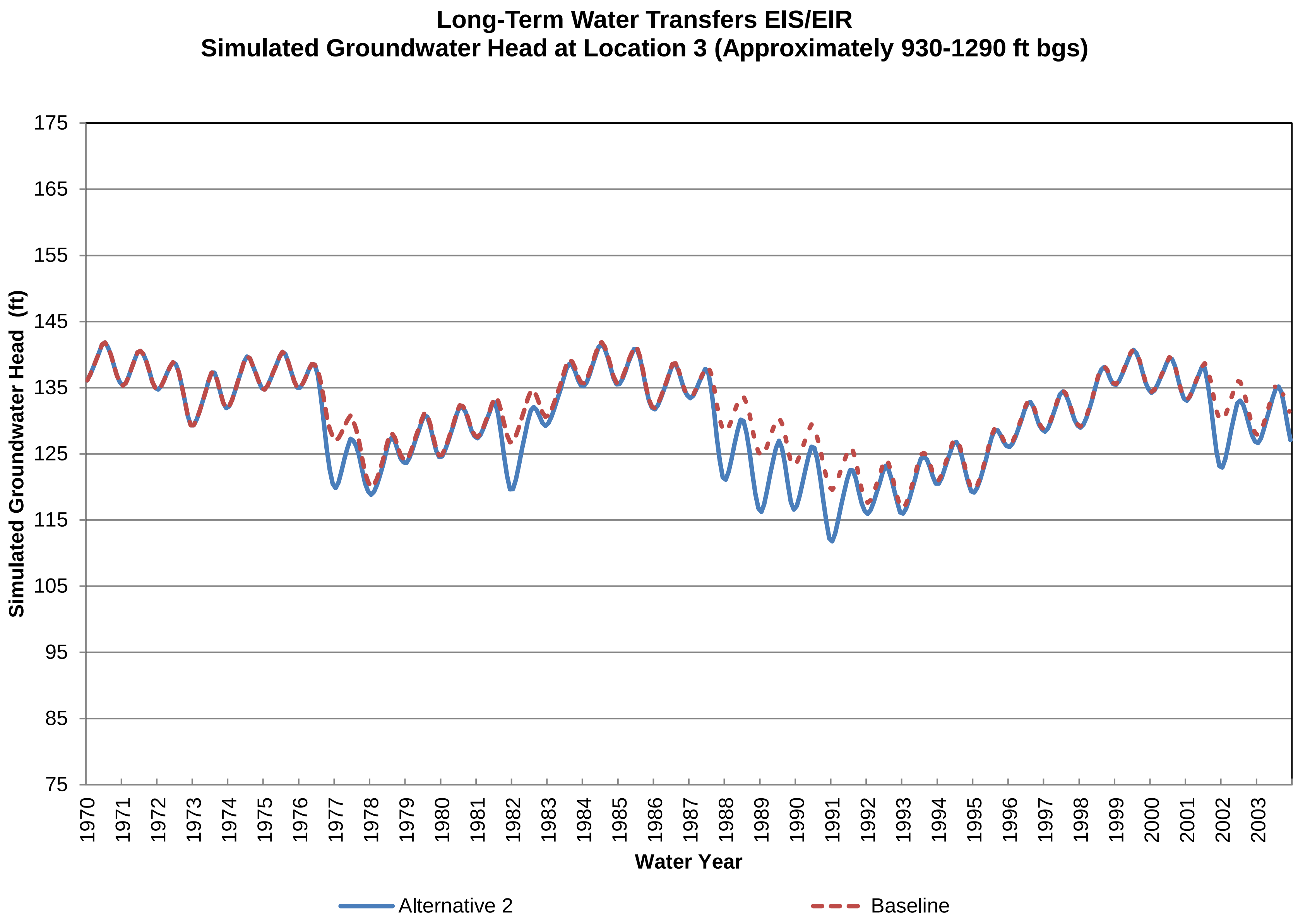
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 930-1290 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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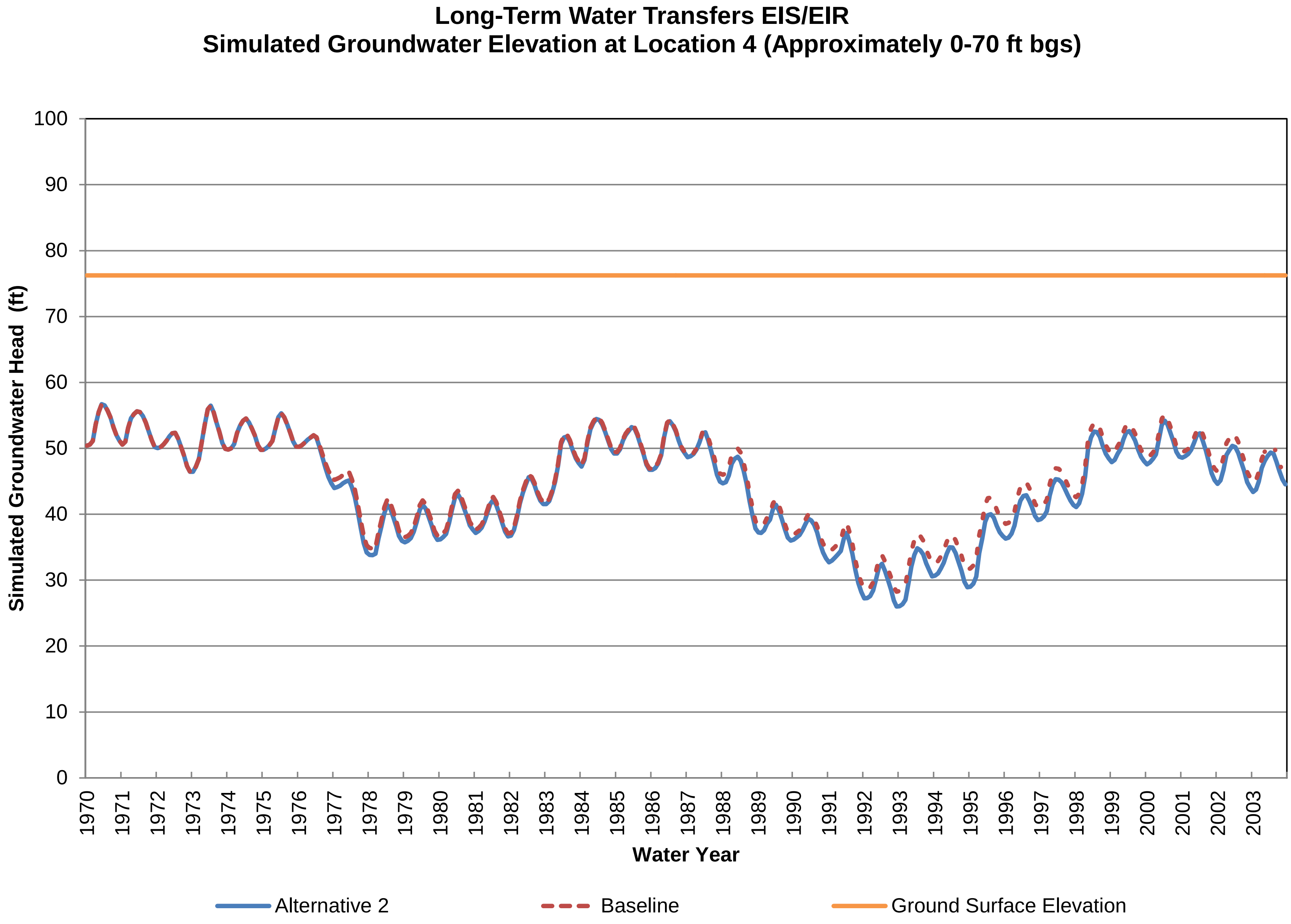
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 4 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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1987
1988
1989
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1992
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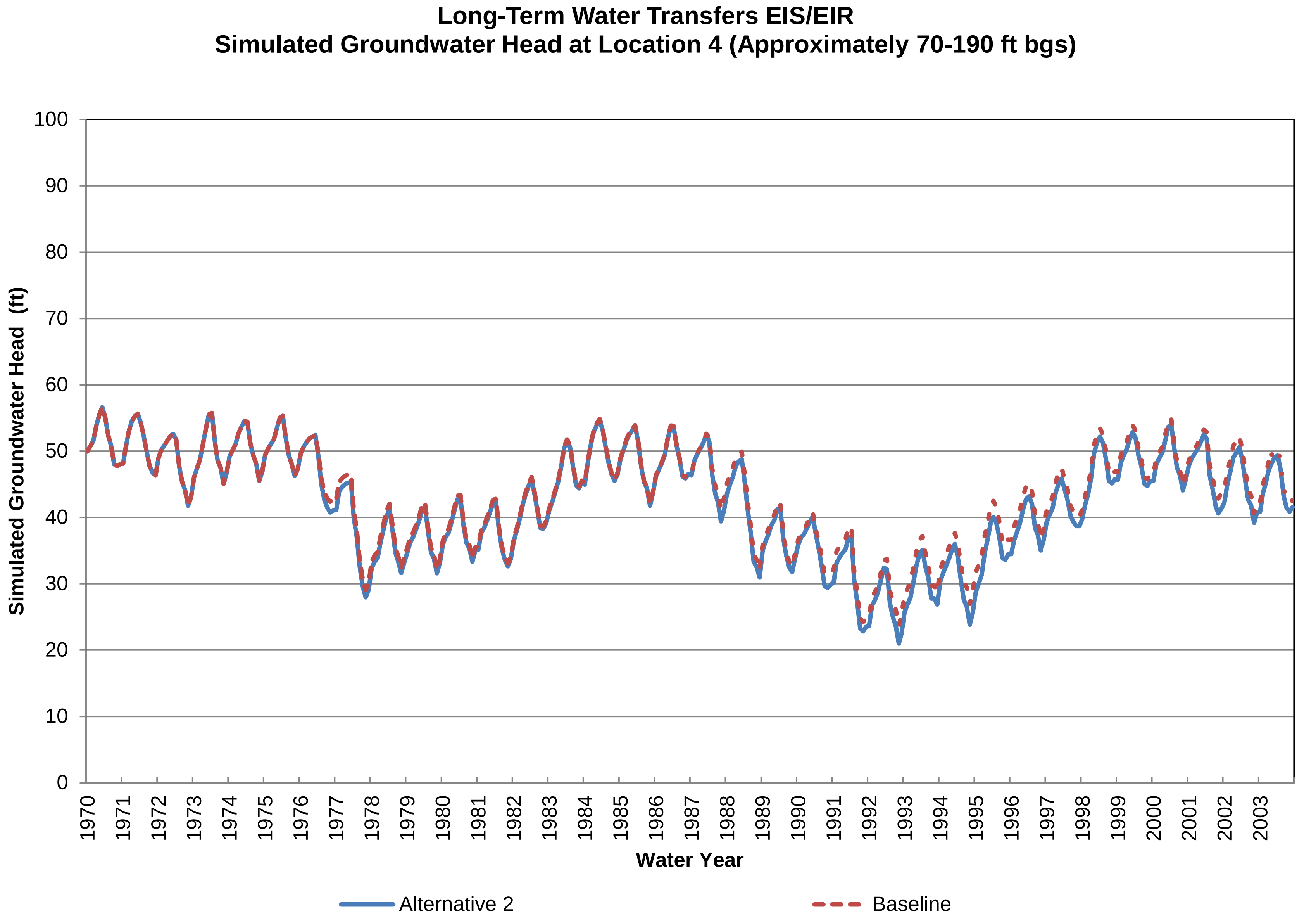
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 70-190 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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1986
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1988
1989
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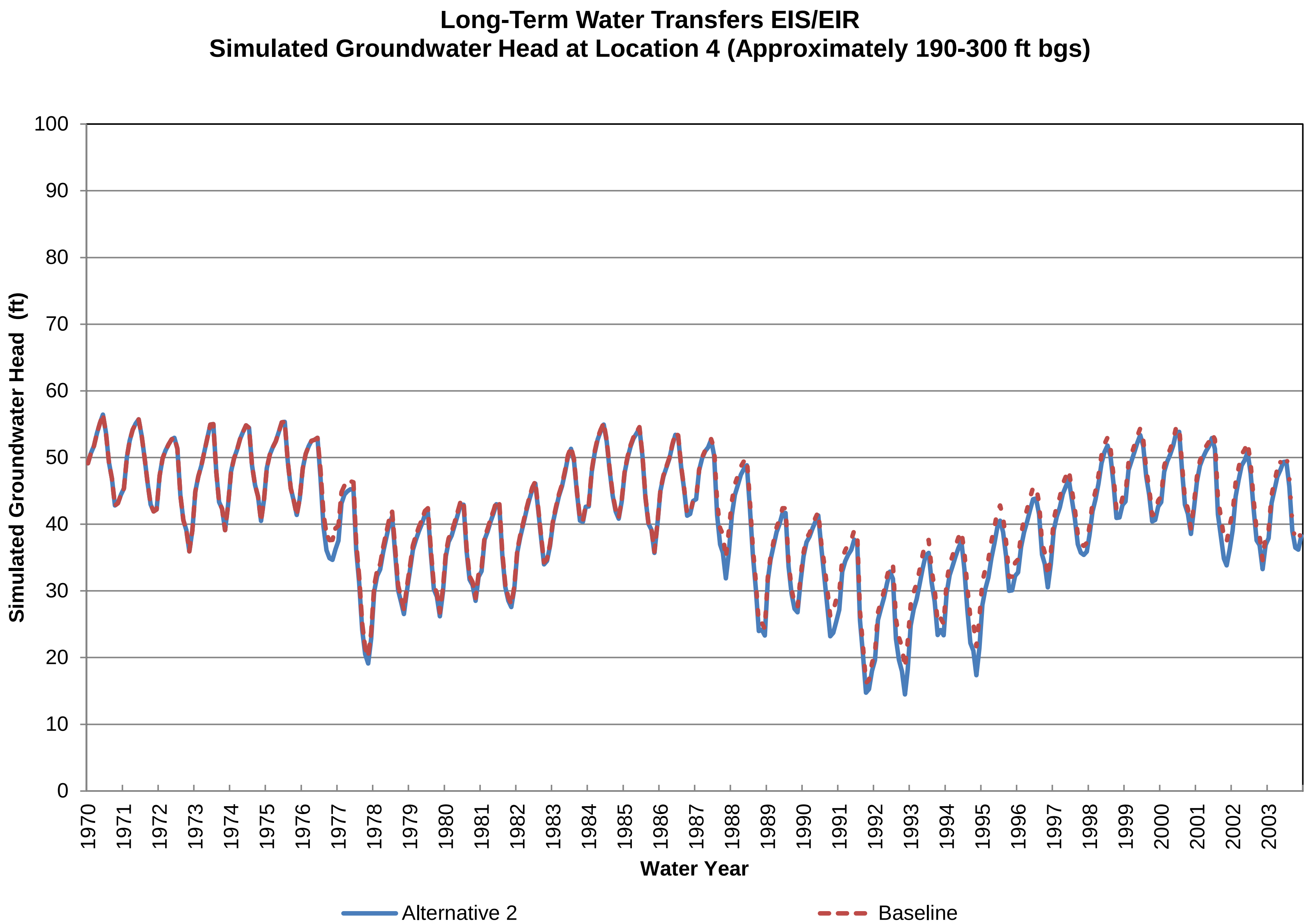
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 190-300 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1998
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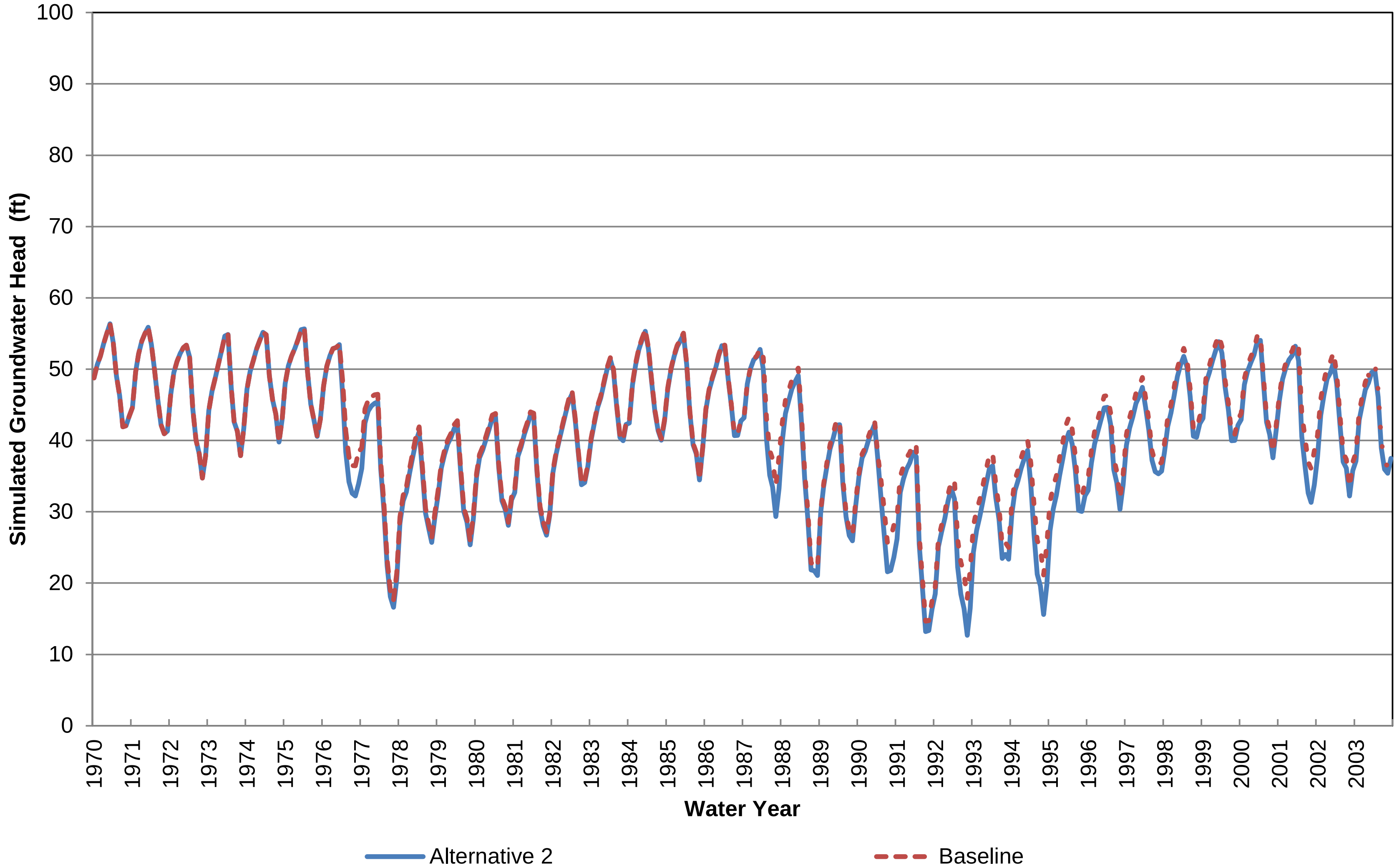
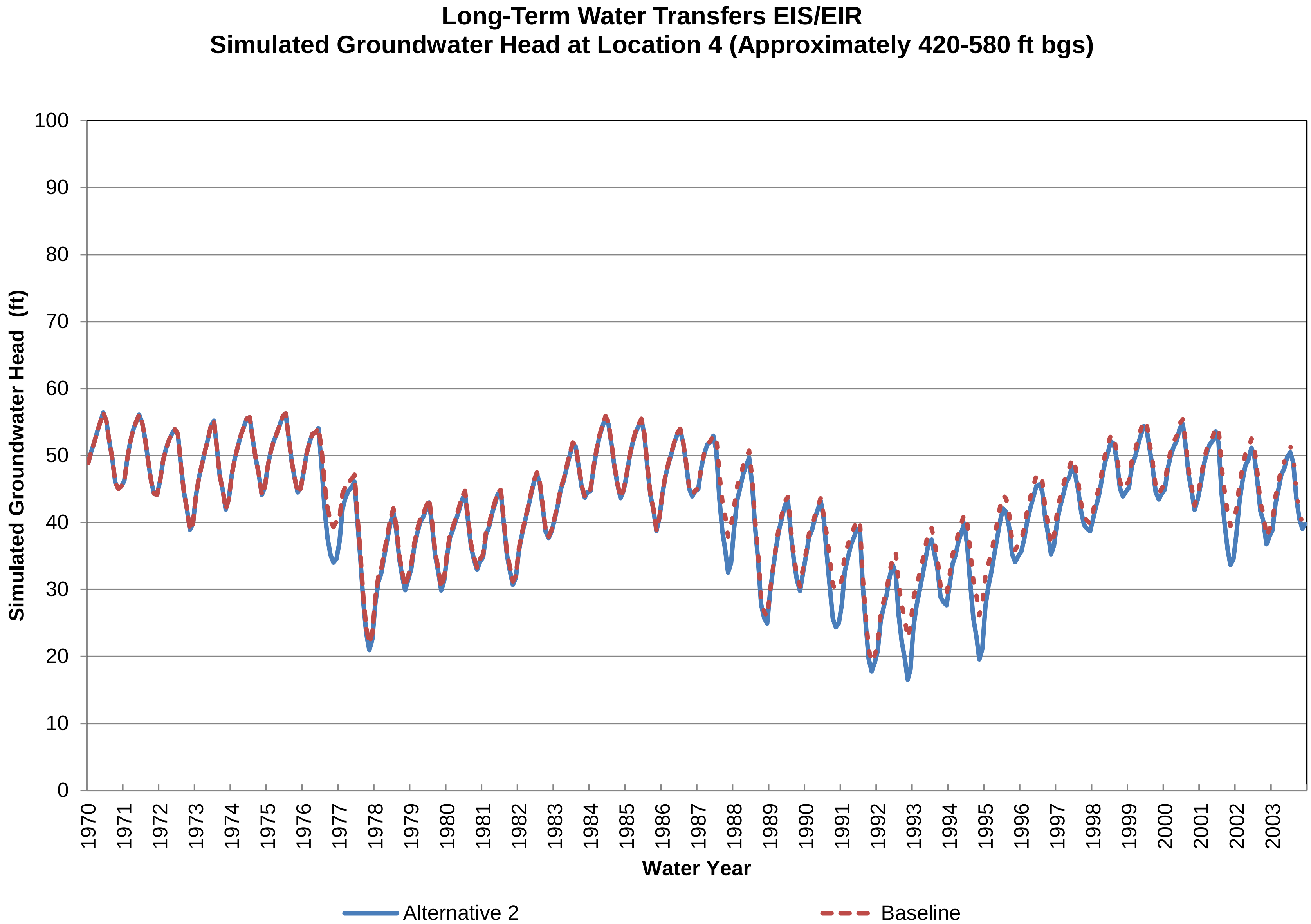
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 300-420 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 420-580 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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1997
1998
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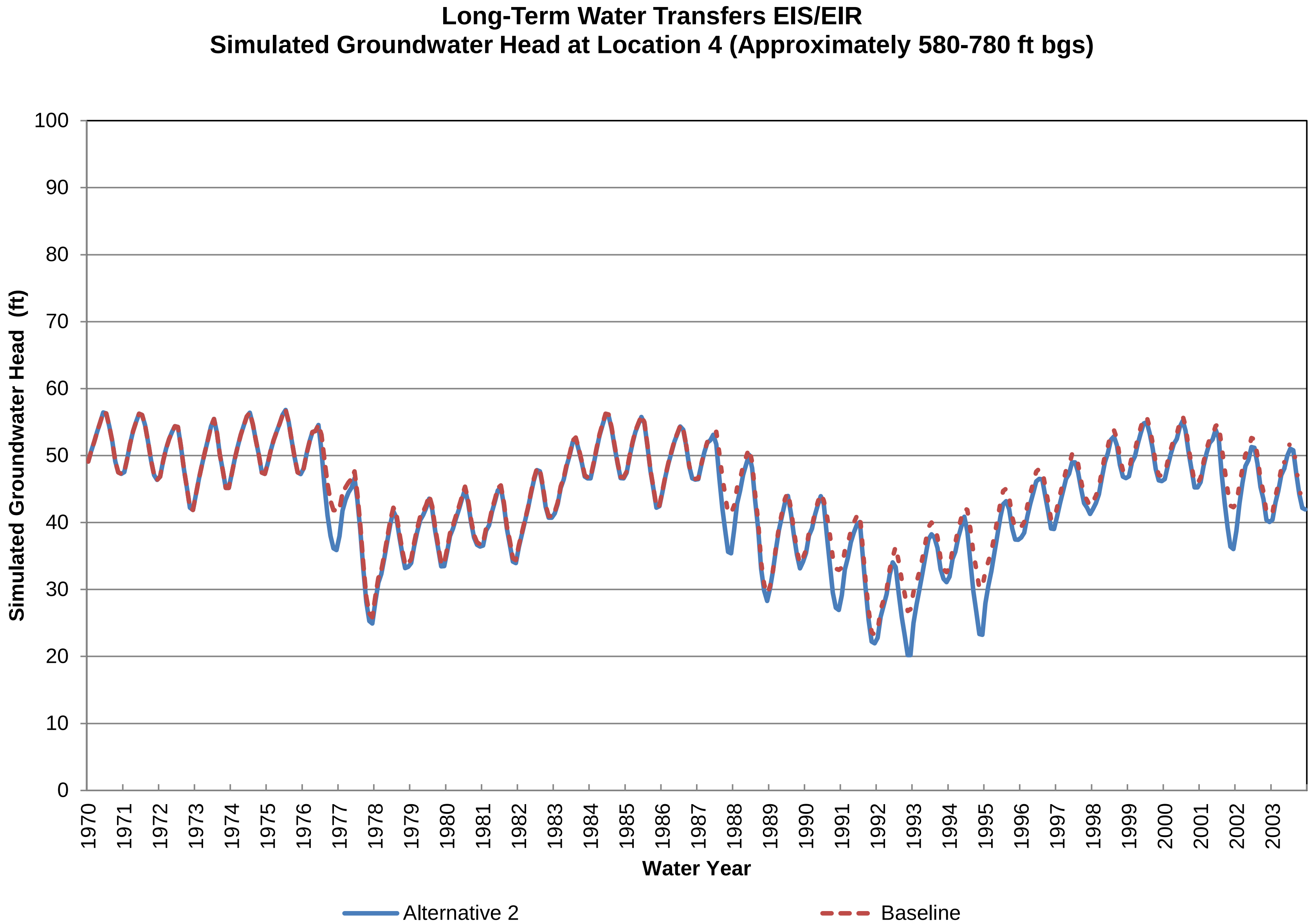
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 580-780 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1980
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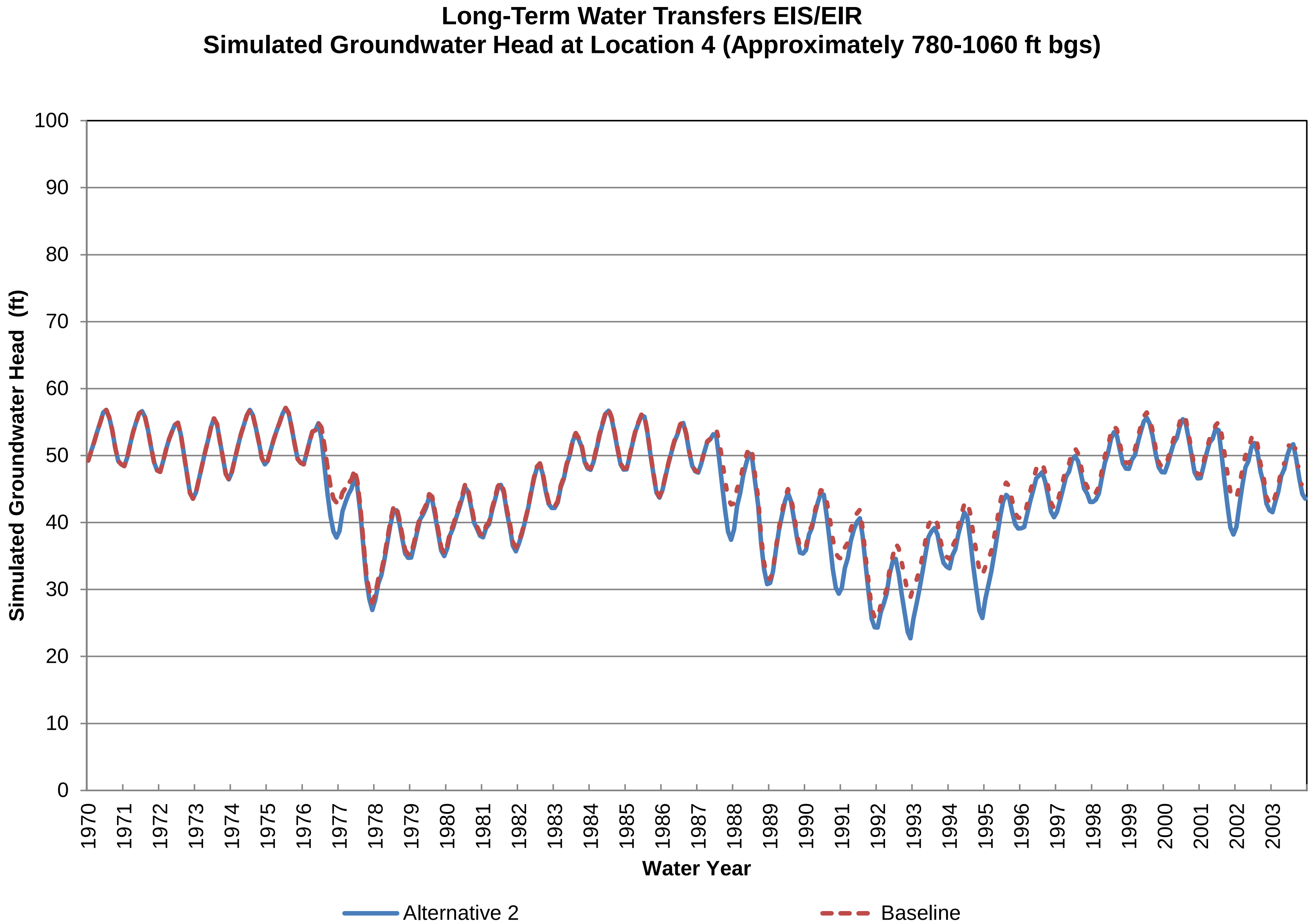
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 780-1060 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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1998
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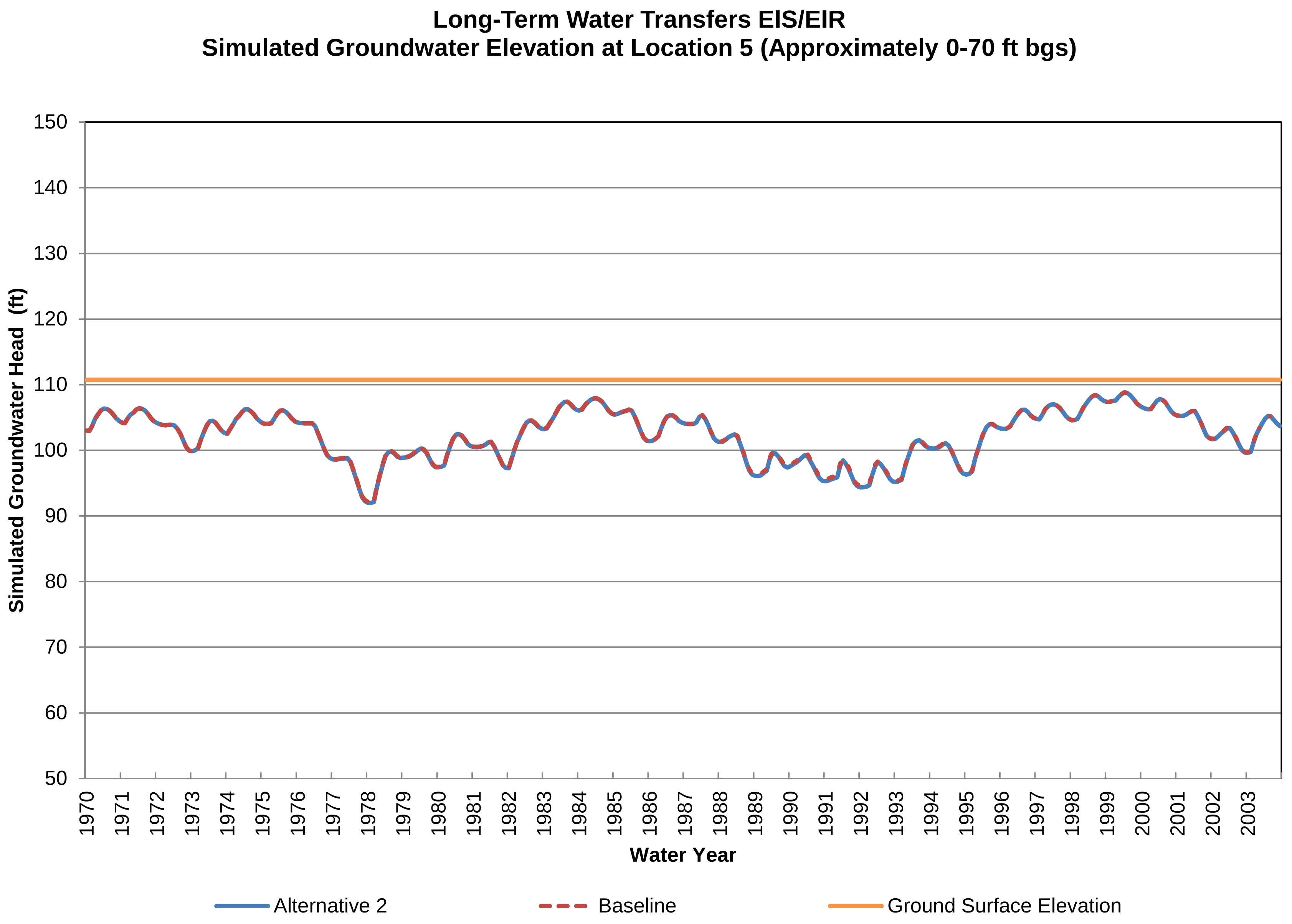
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 5 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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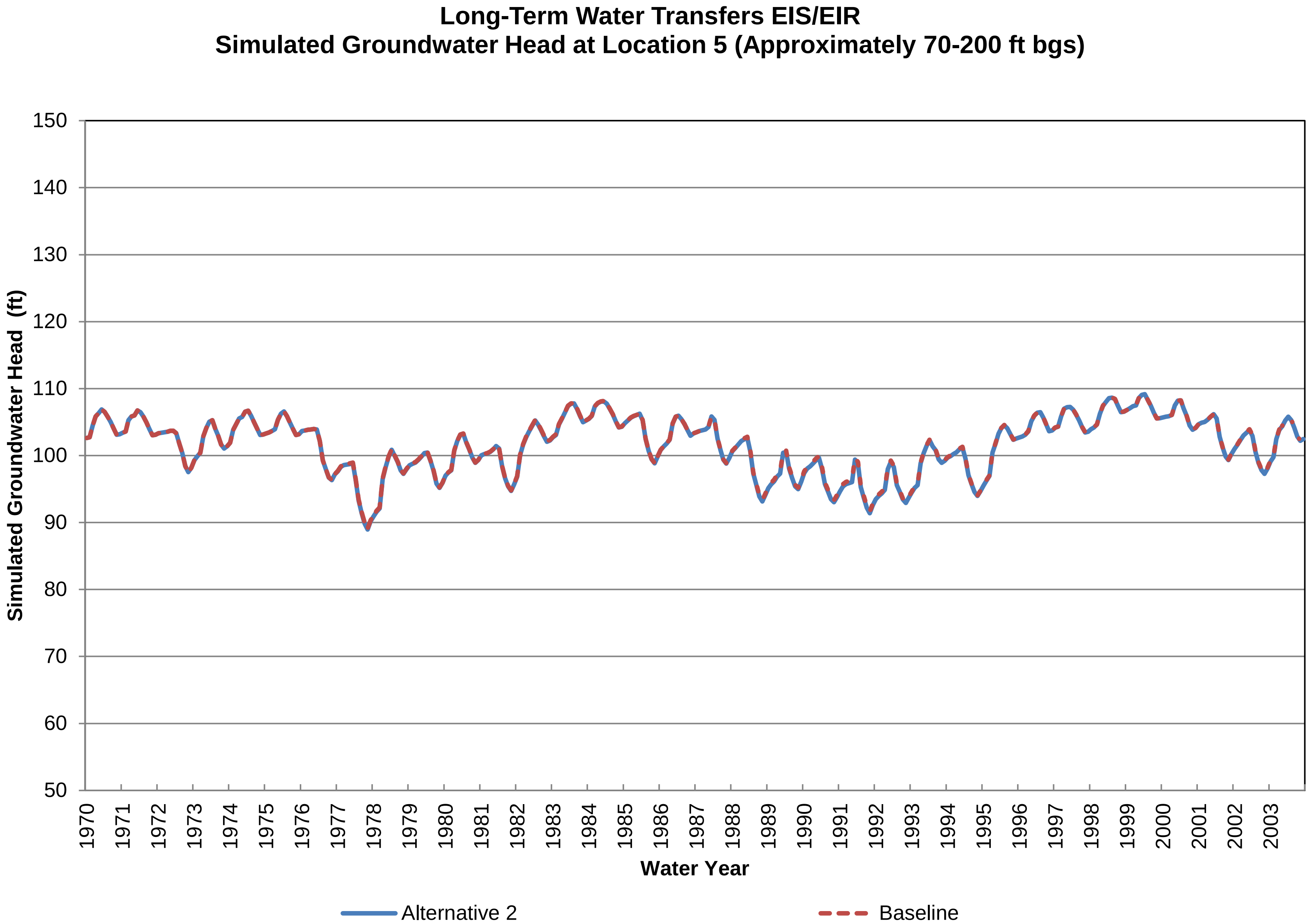
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 70-200 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
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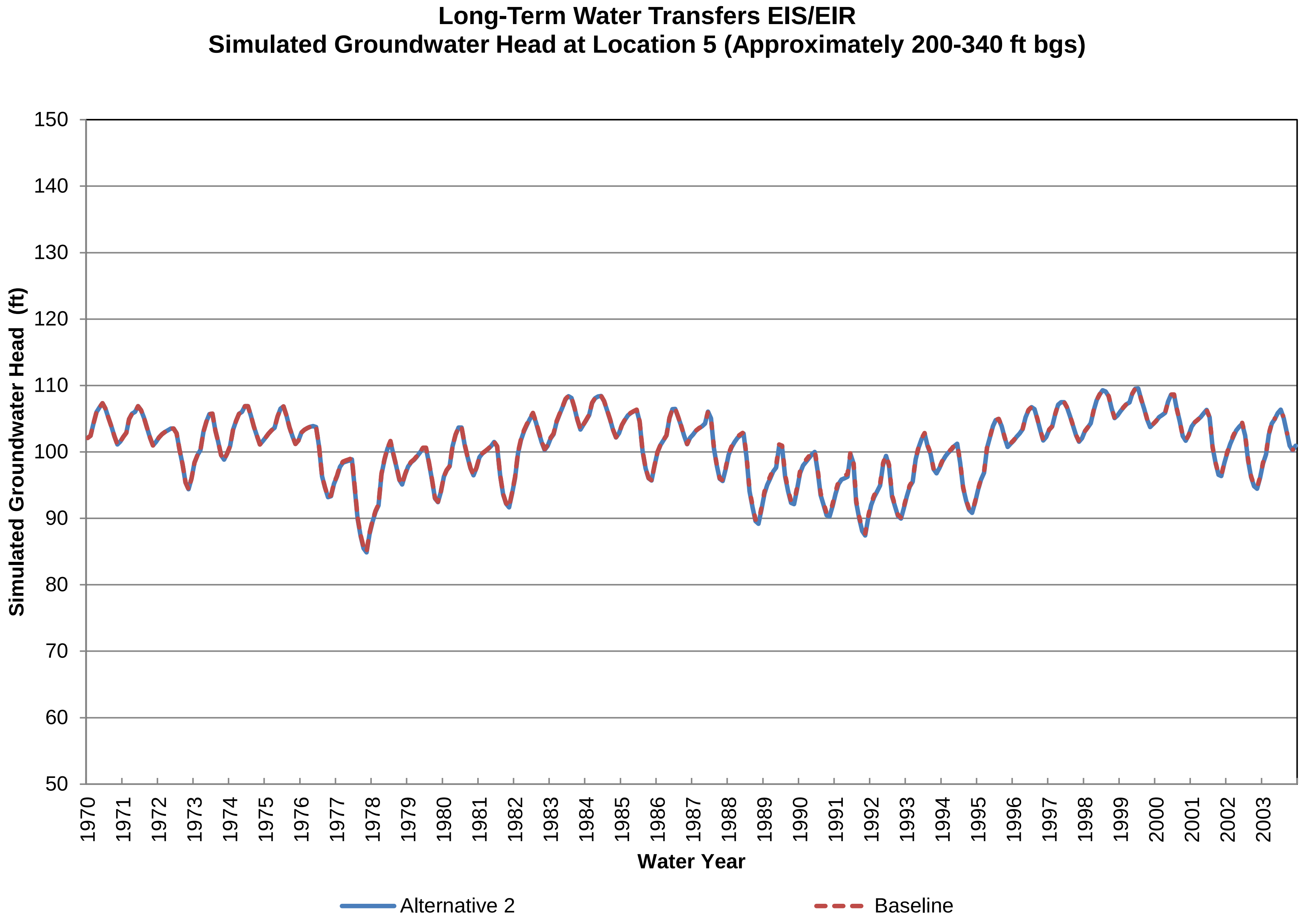
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 200-340 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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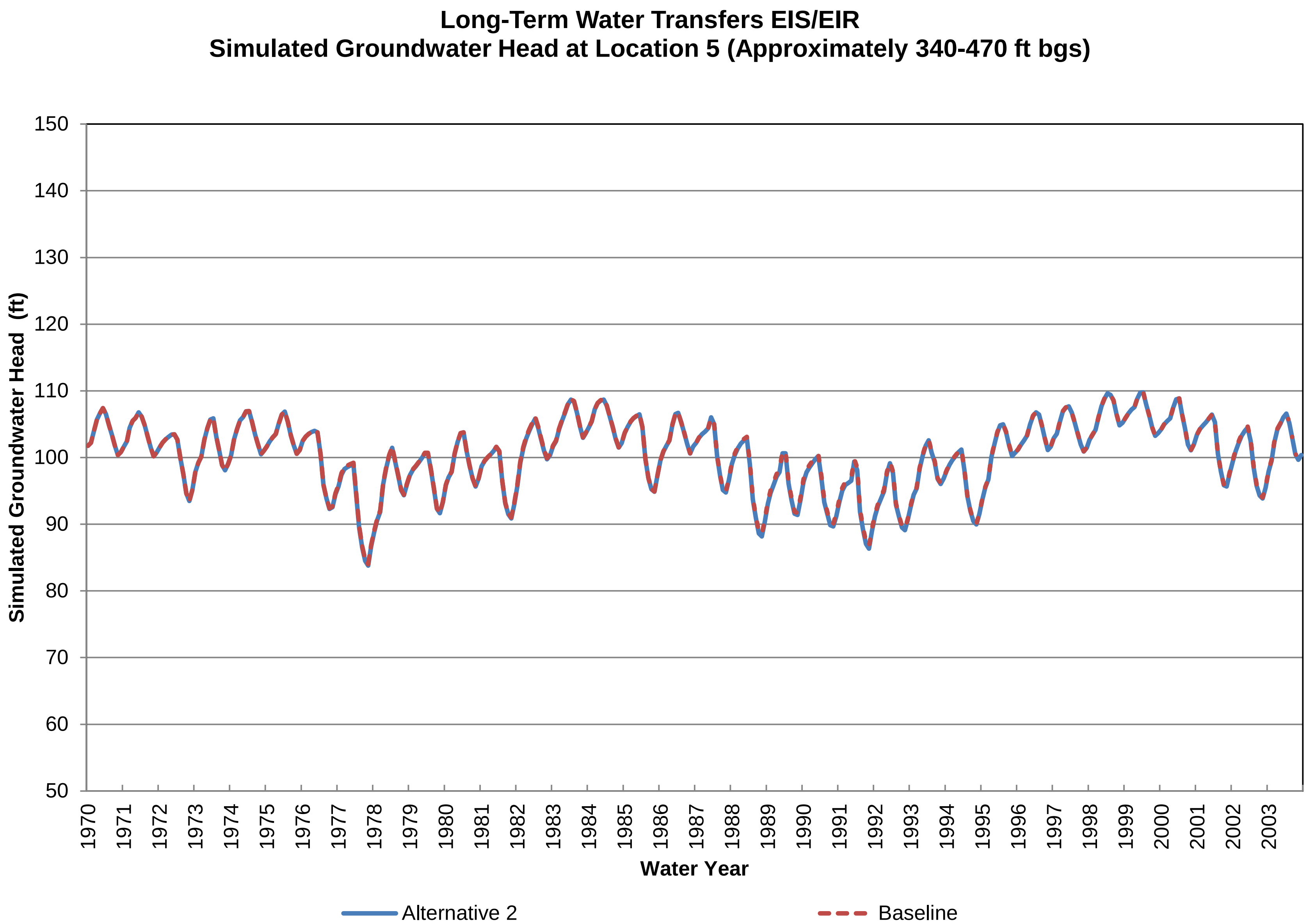
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 340-470 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
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1970
1971
1972
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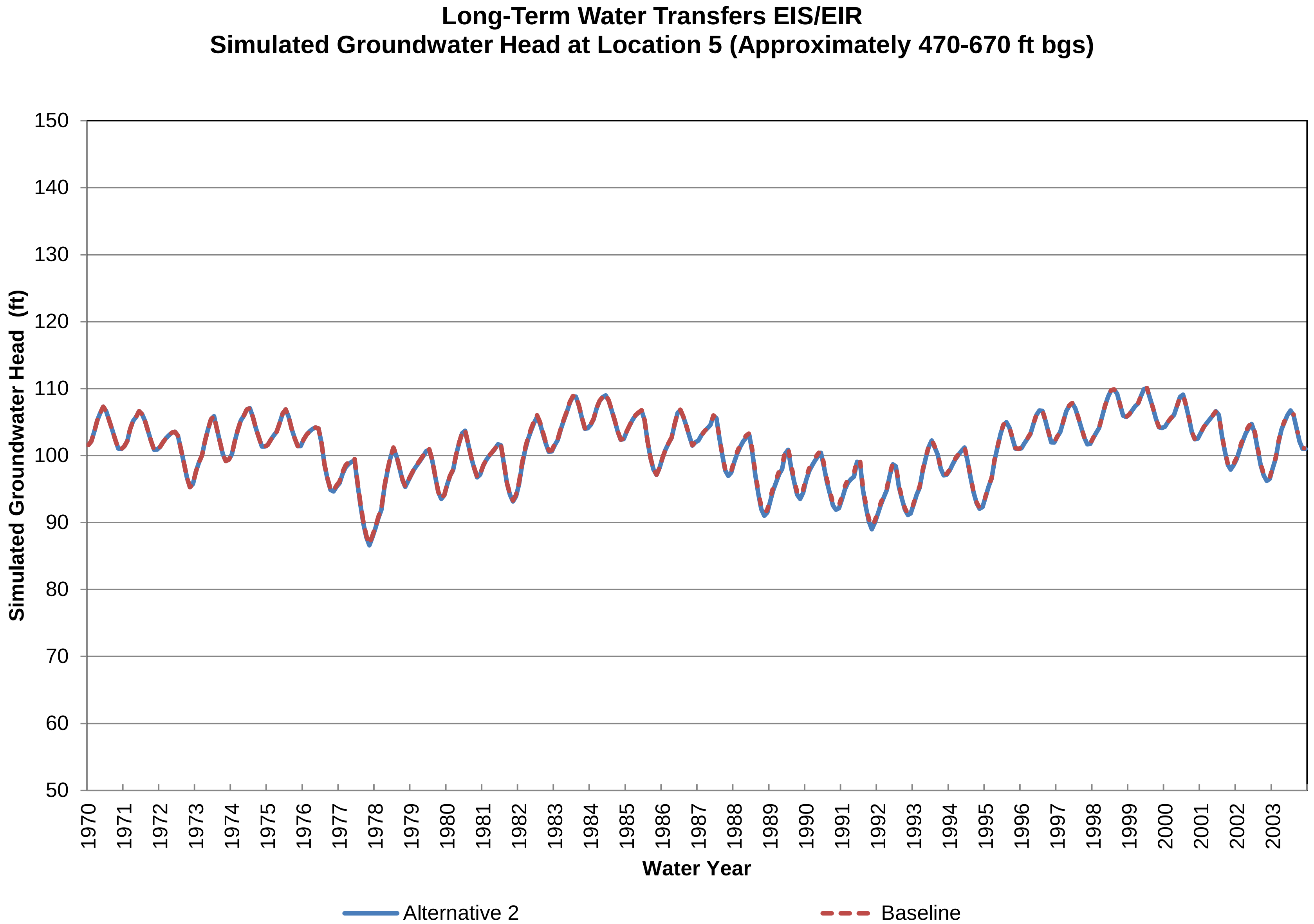
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 470-670 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
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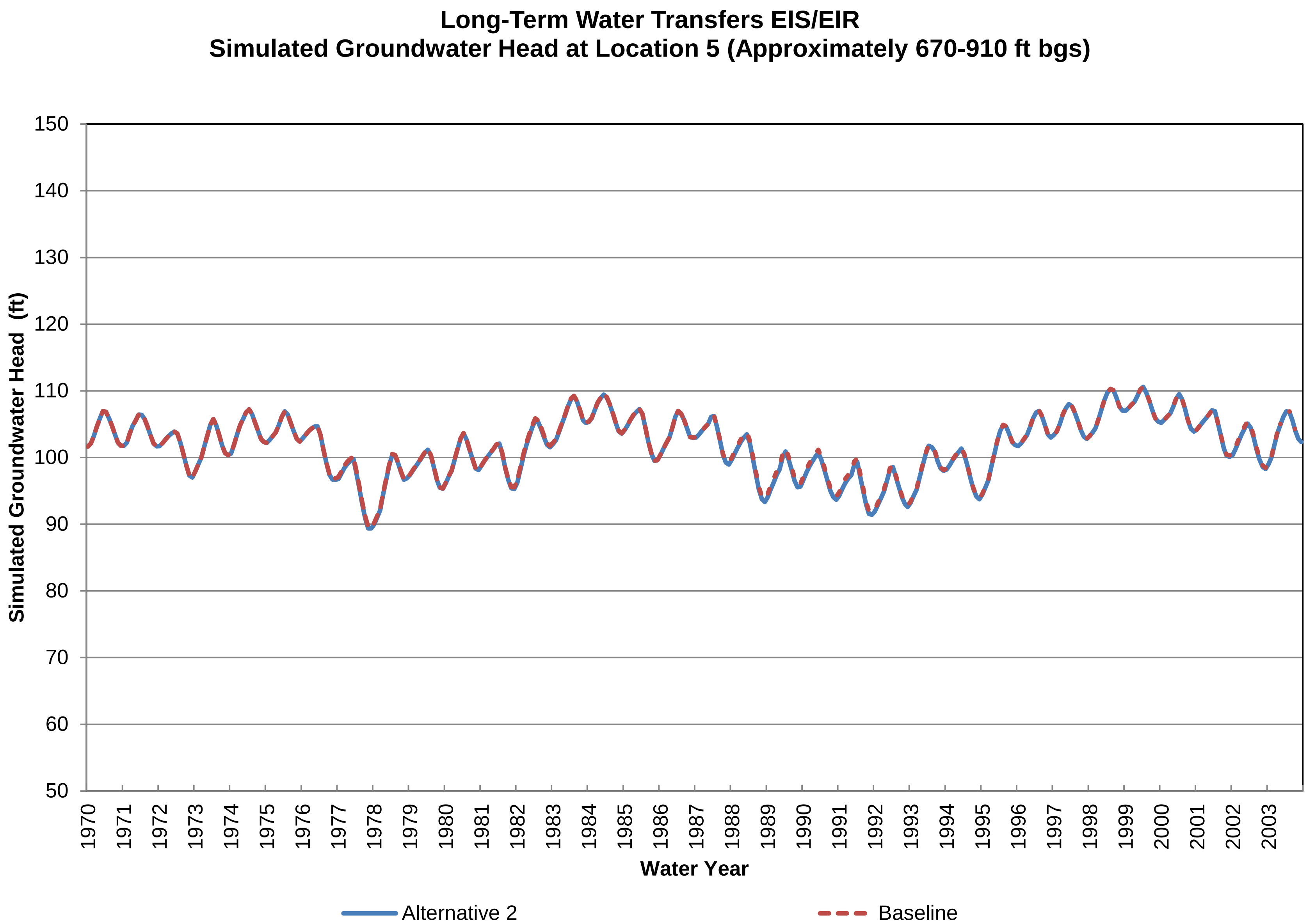
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 670-910 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
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110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
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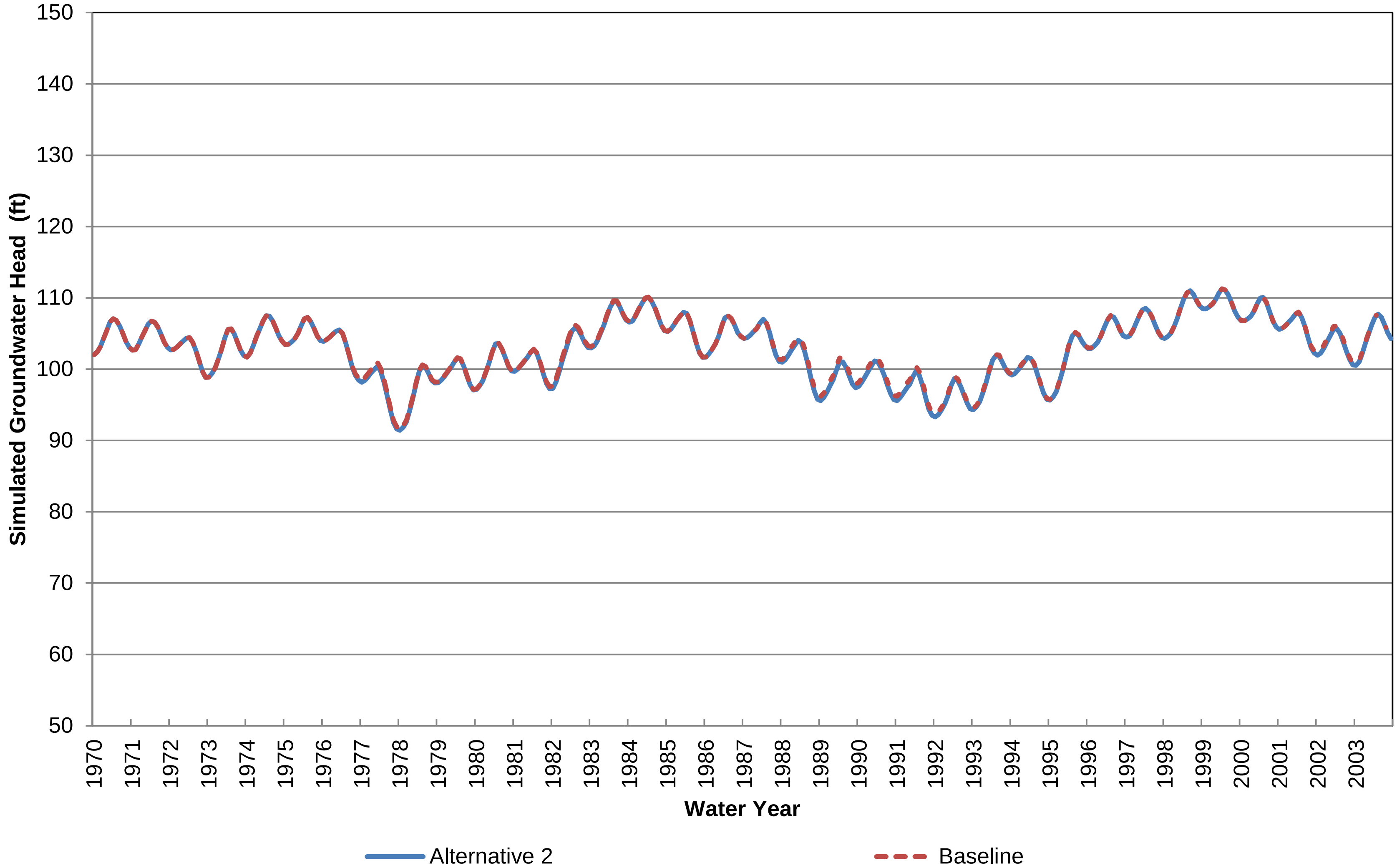
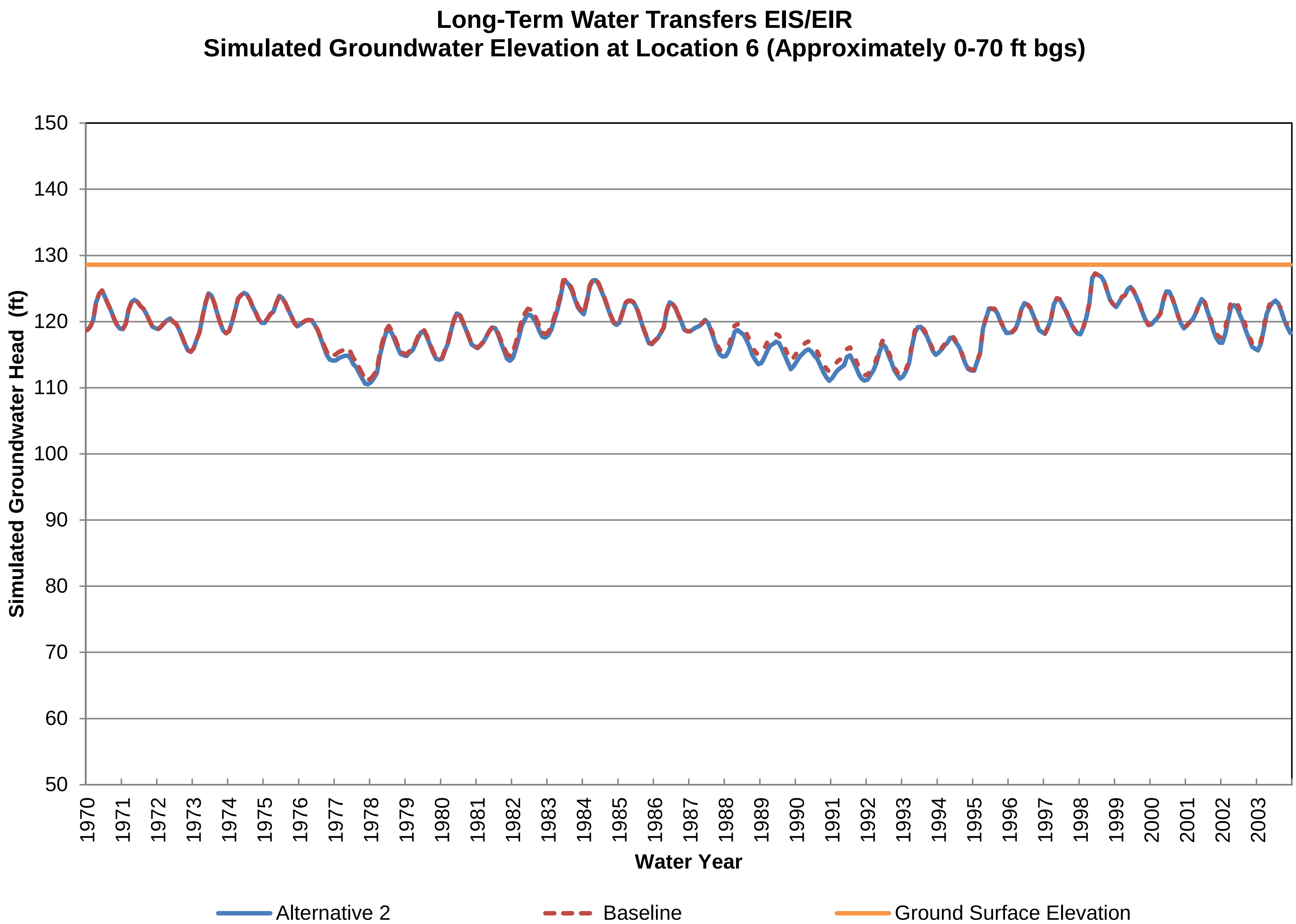
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 910-1310 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 6 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
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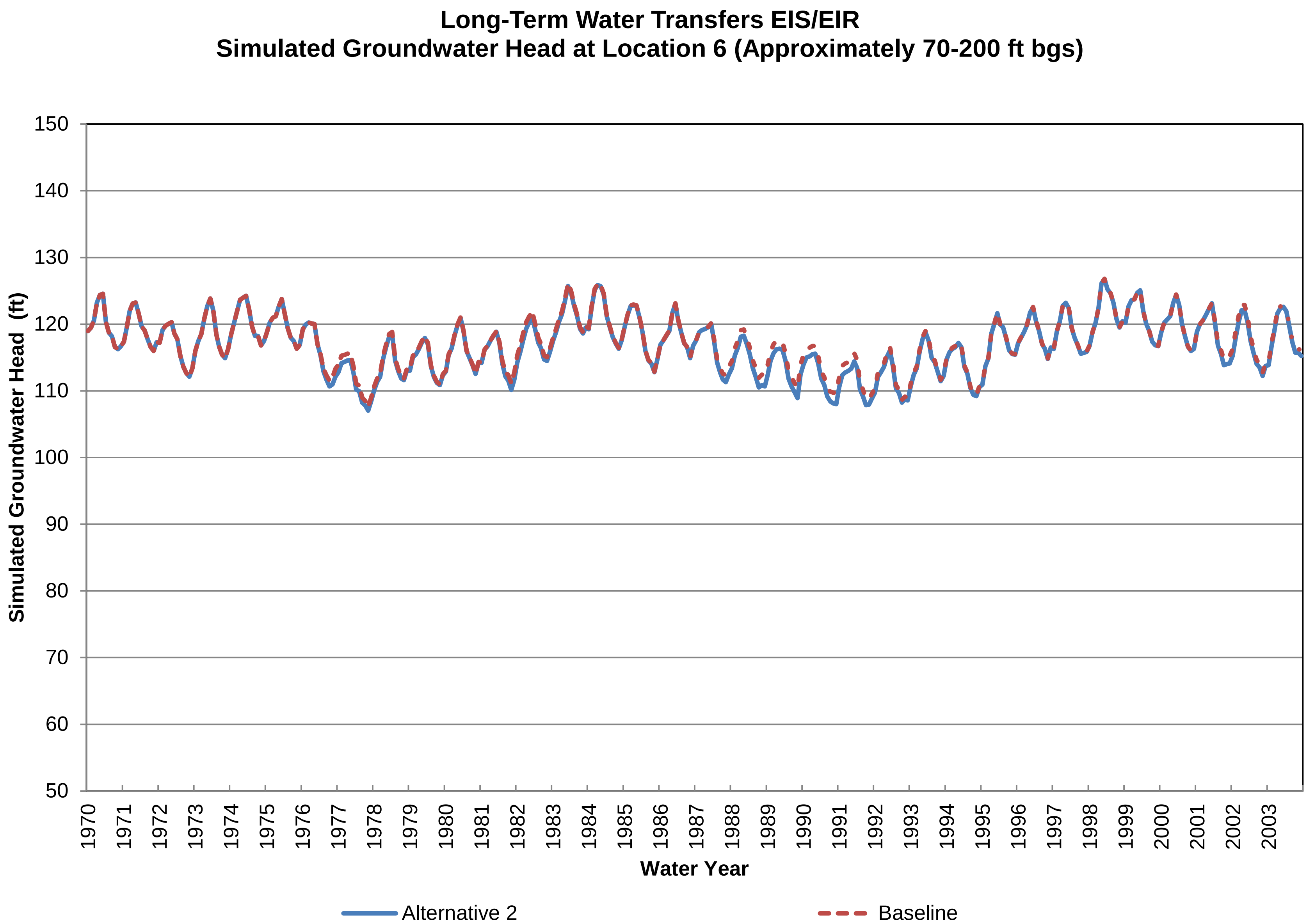
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 70-200 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
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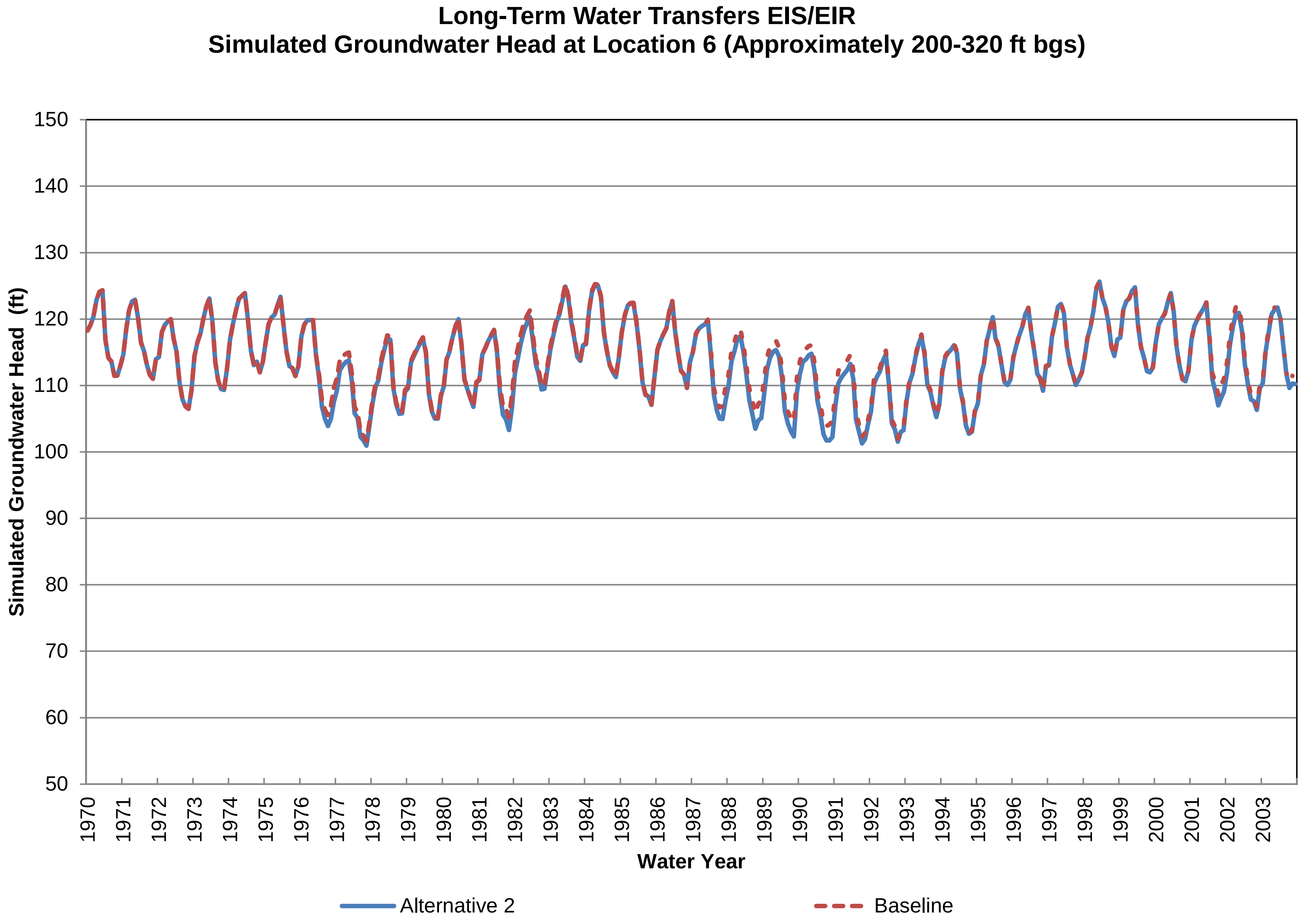
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 200-320 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
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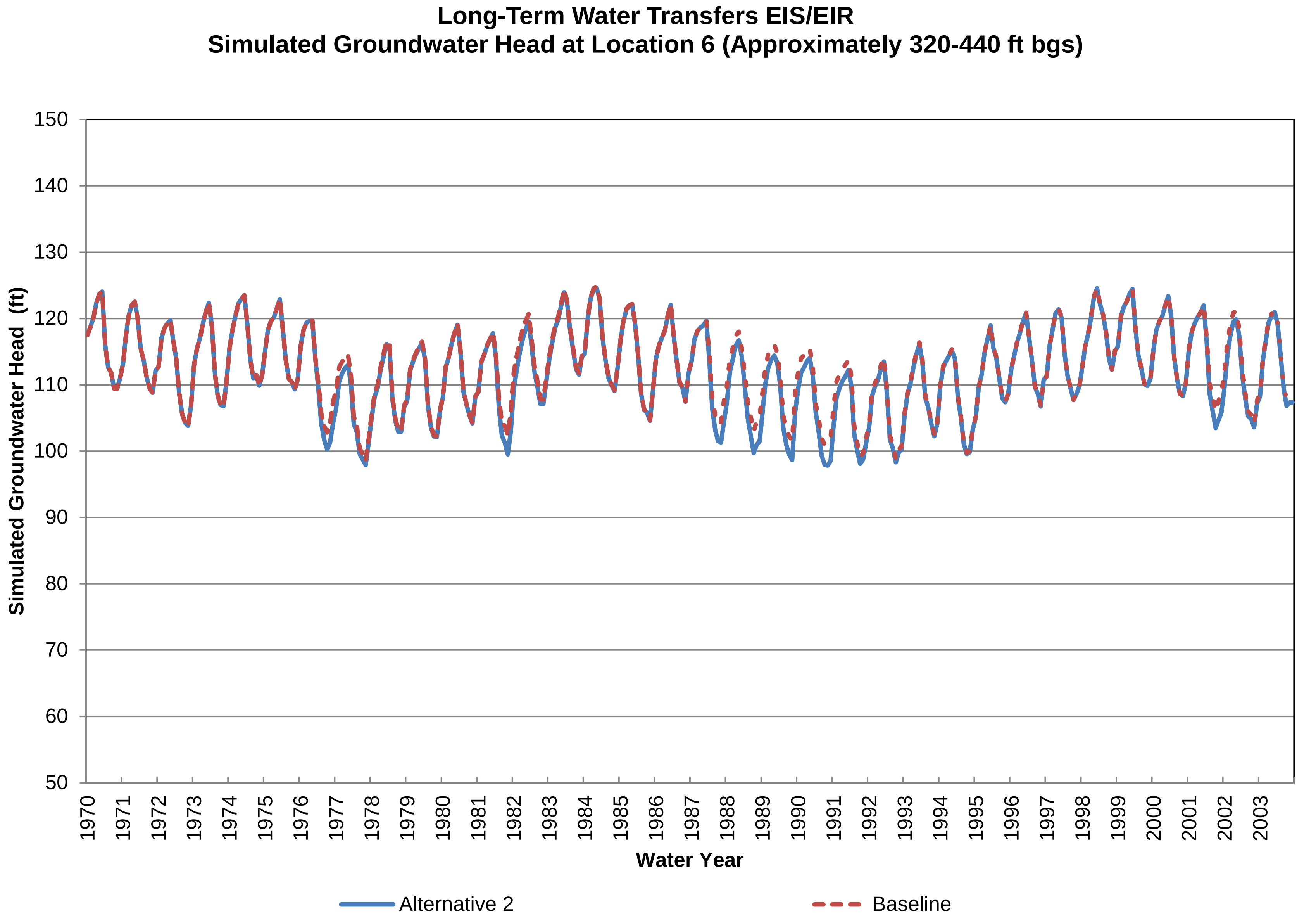
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 320-440 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
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1979
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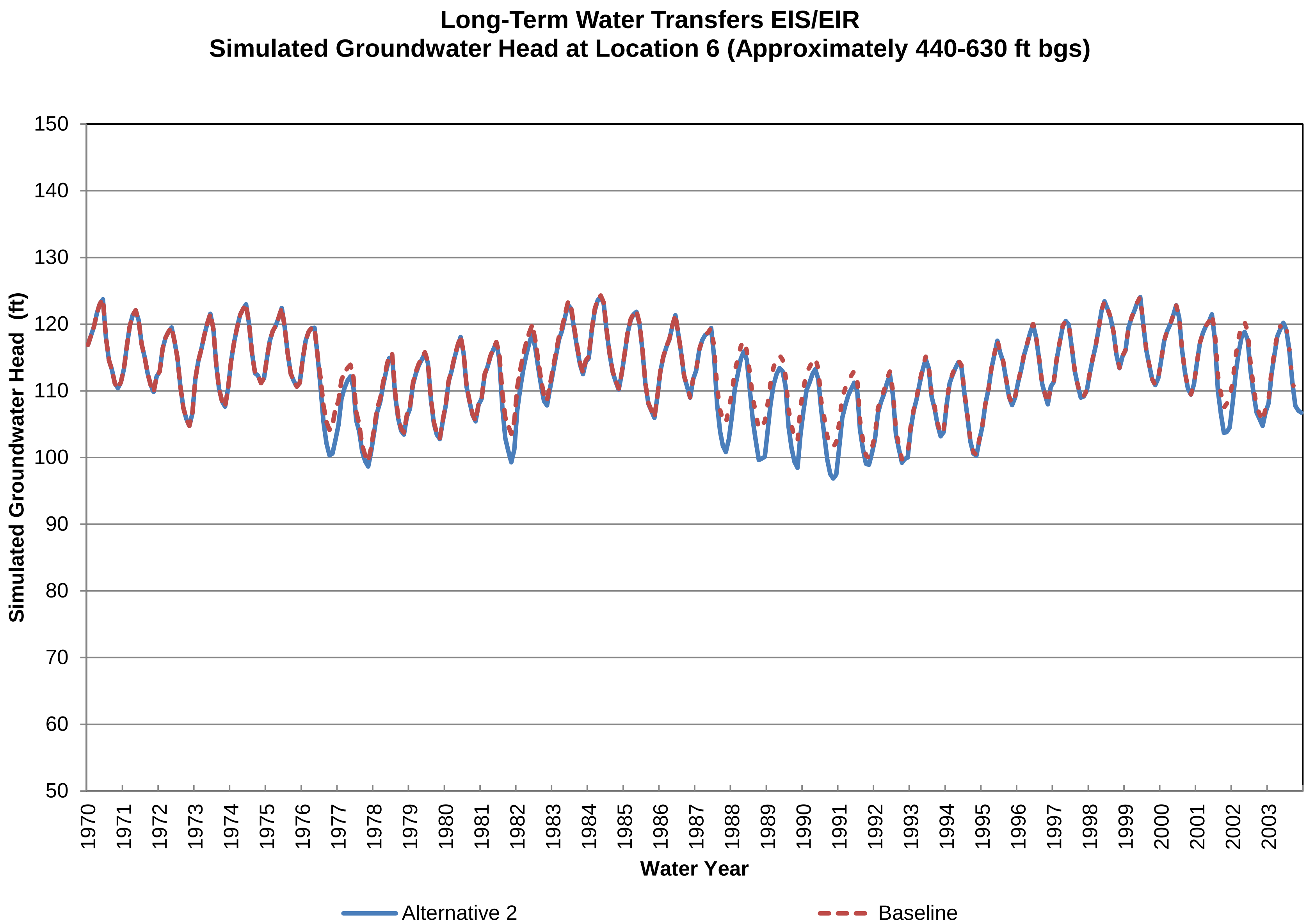
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 440-630 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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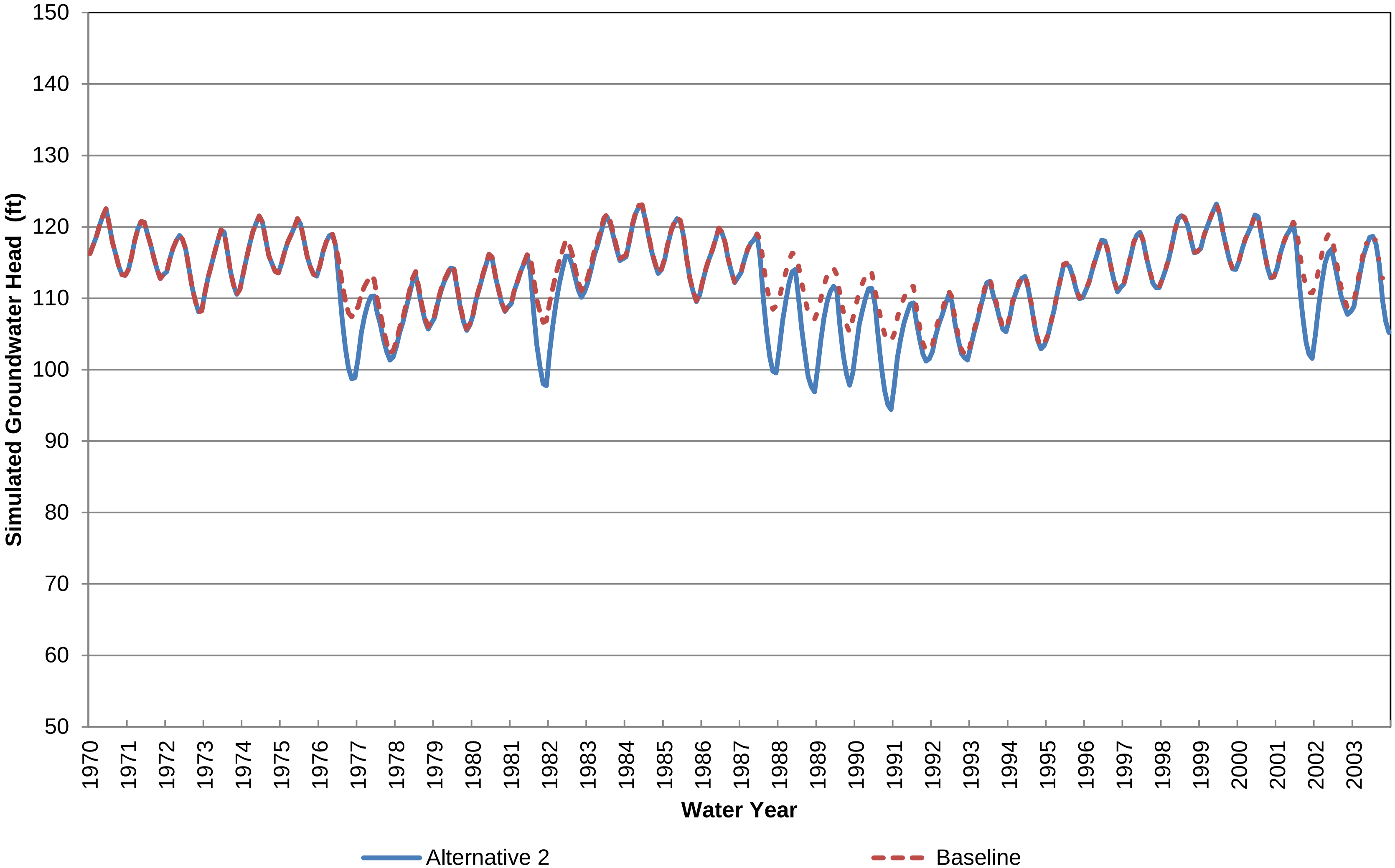
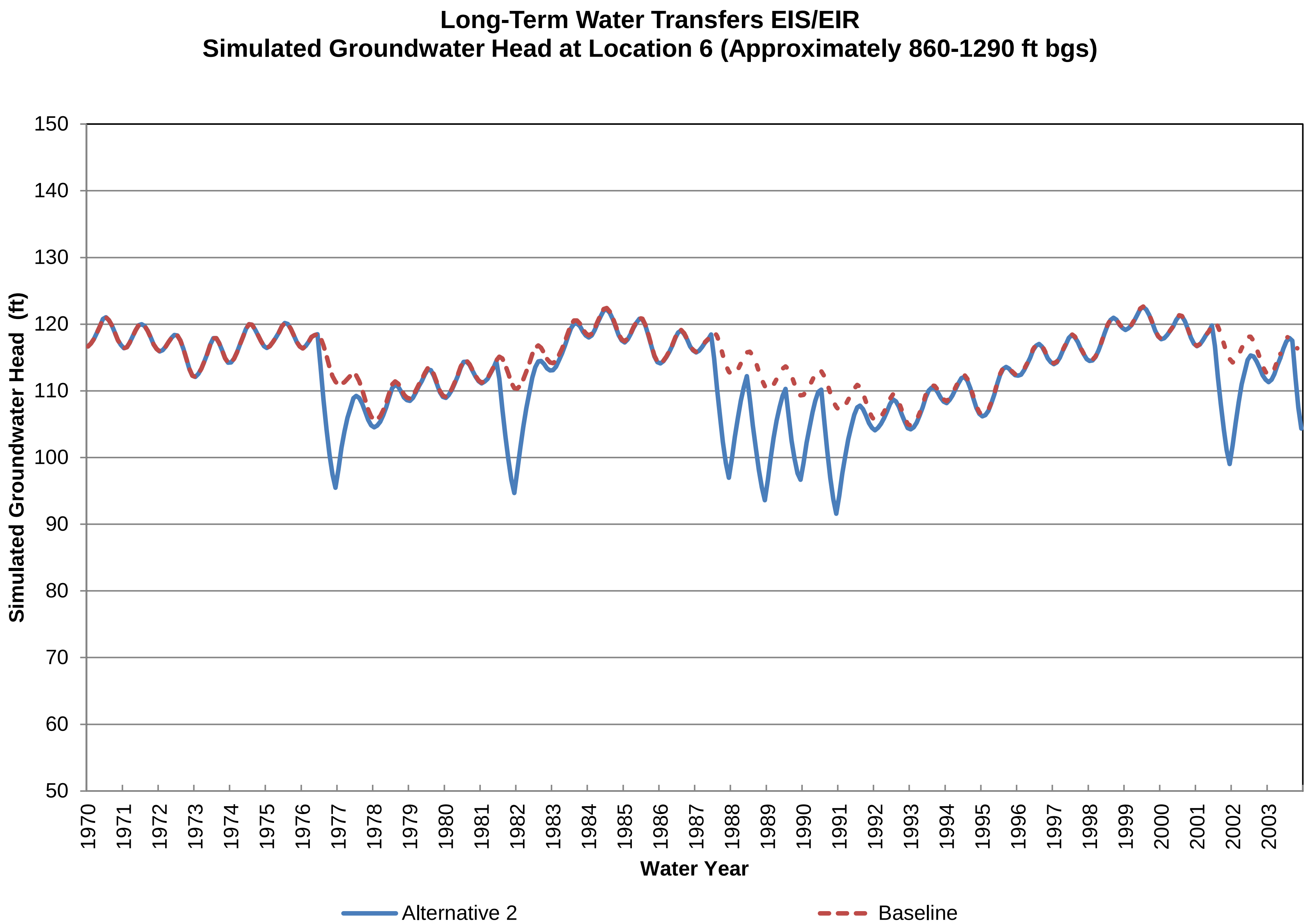
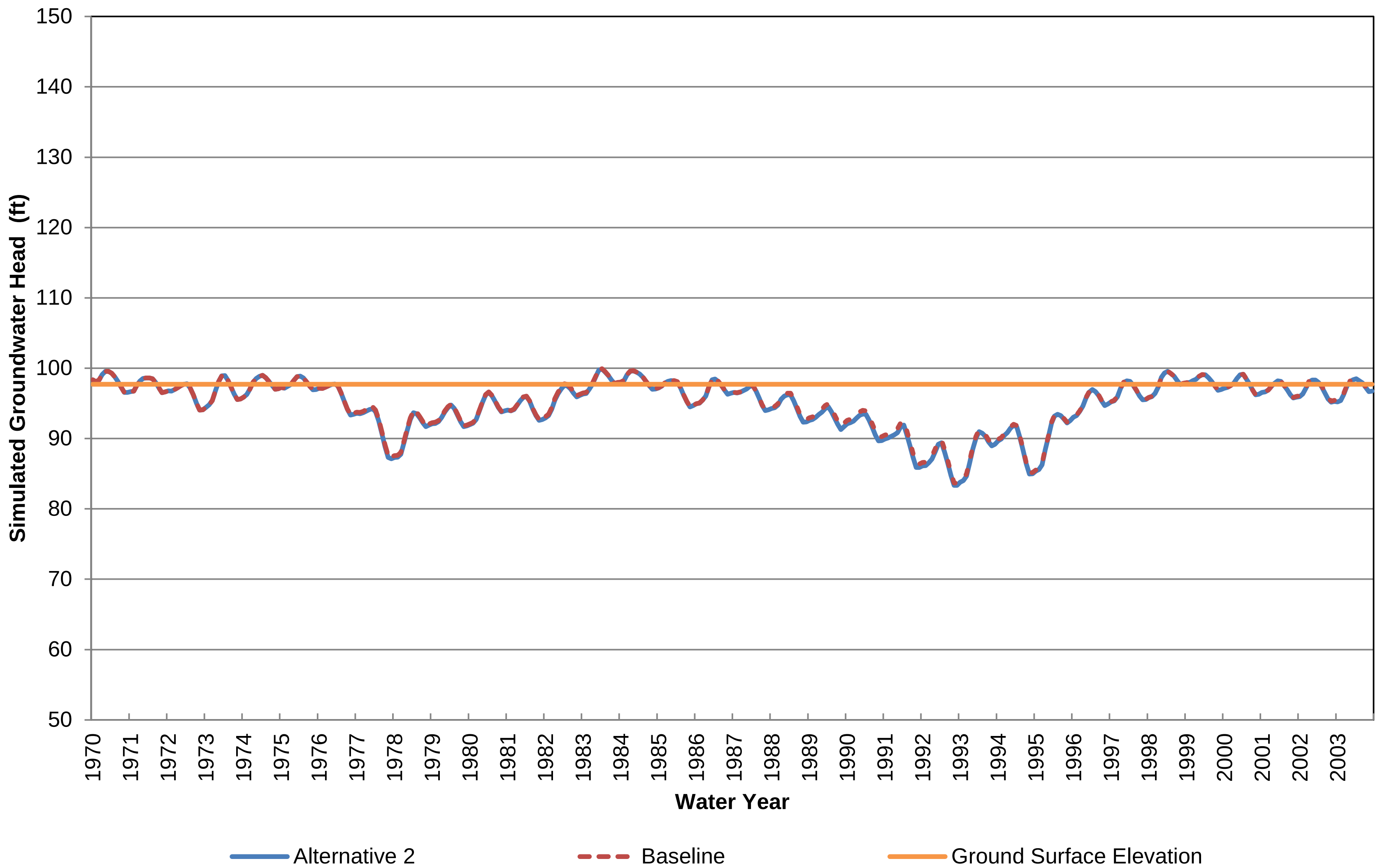
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

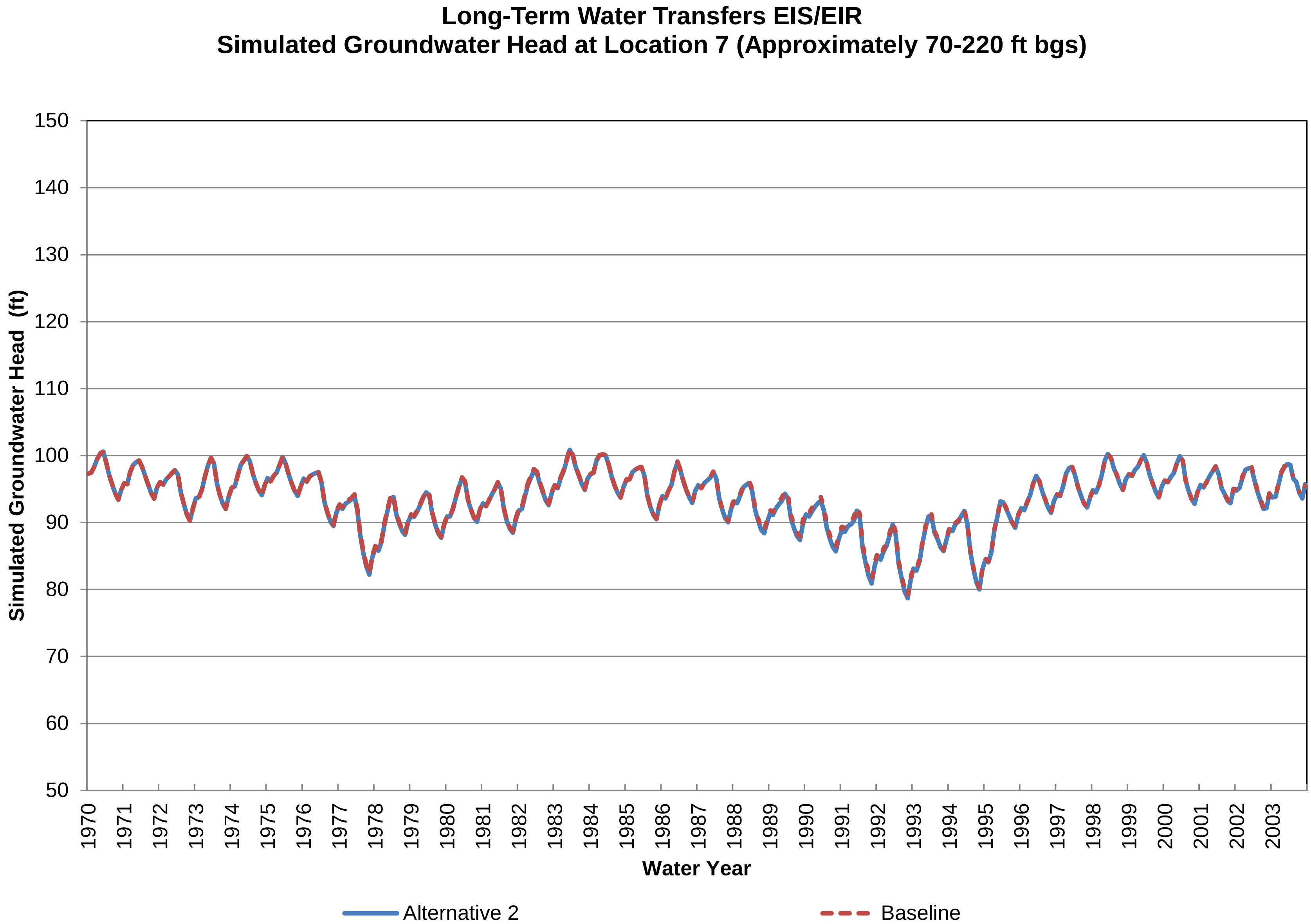
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 630-860 ft bgs)

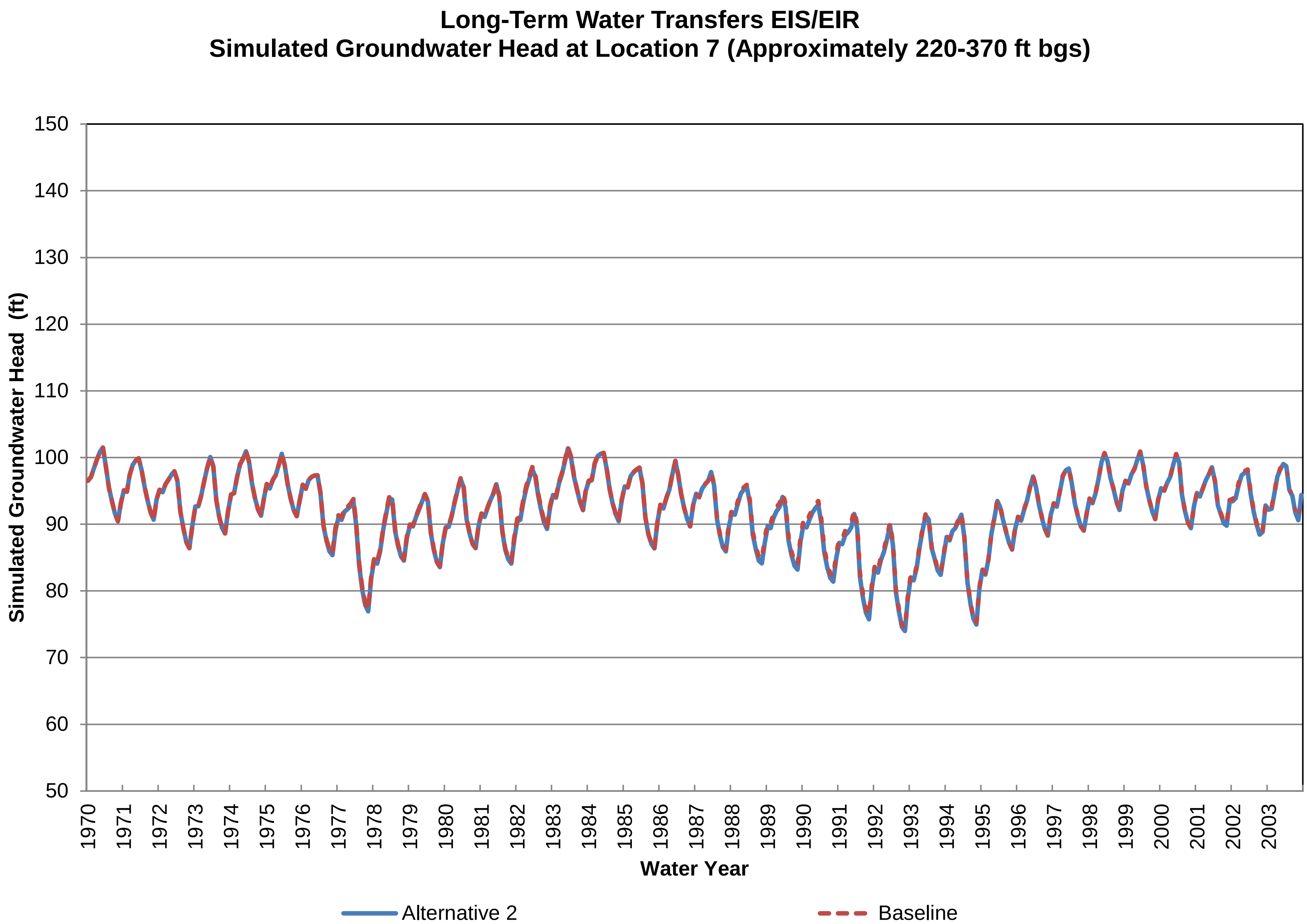


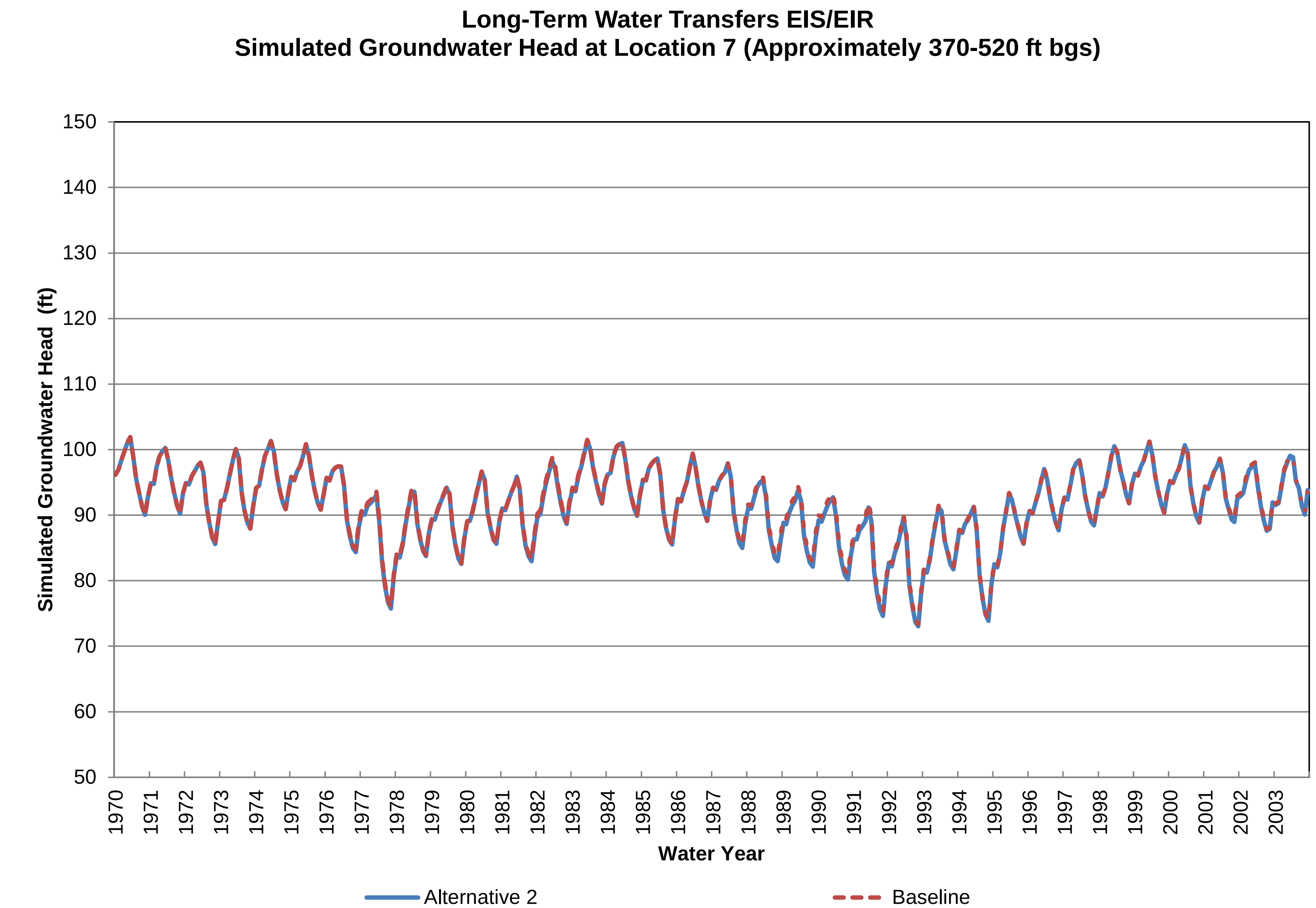

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 860-1290 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 7 (Approximately 0-70 ft bgs)

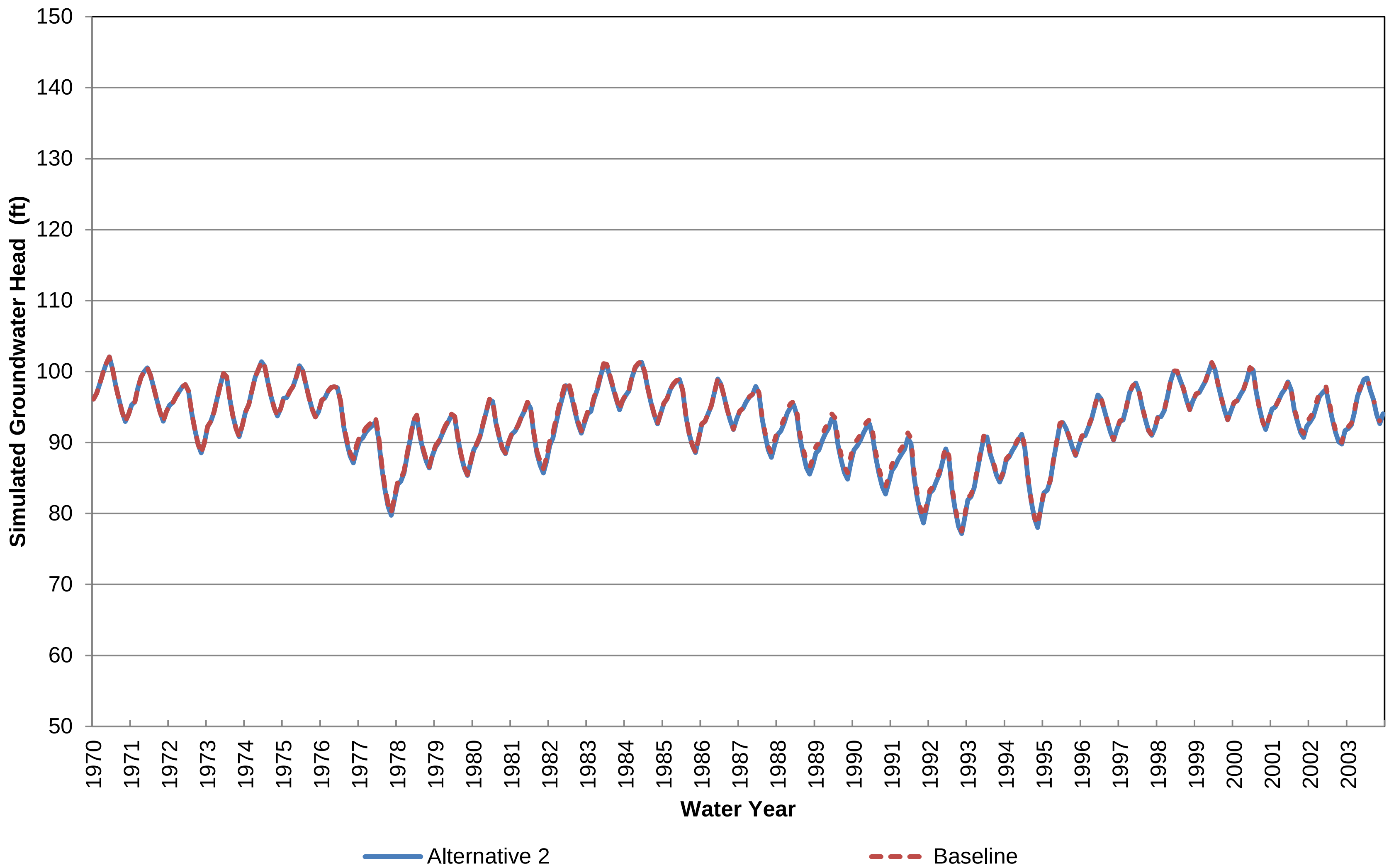


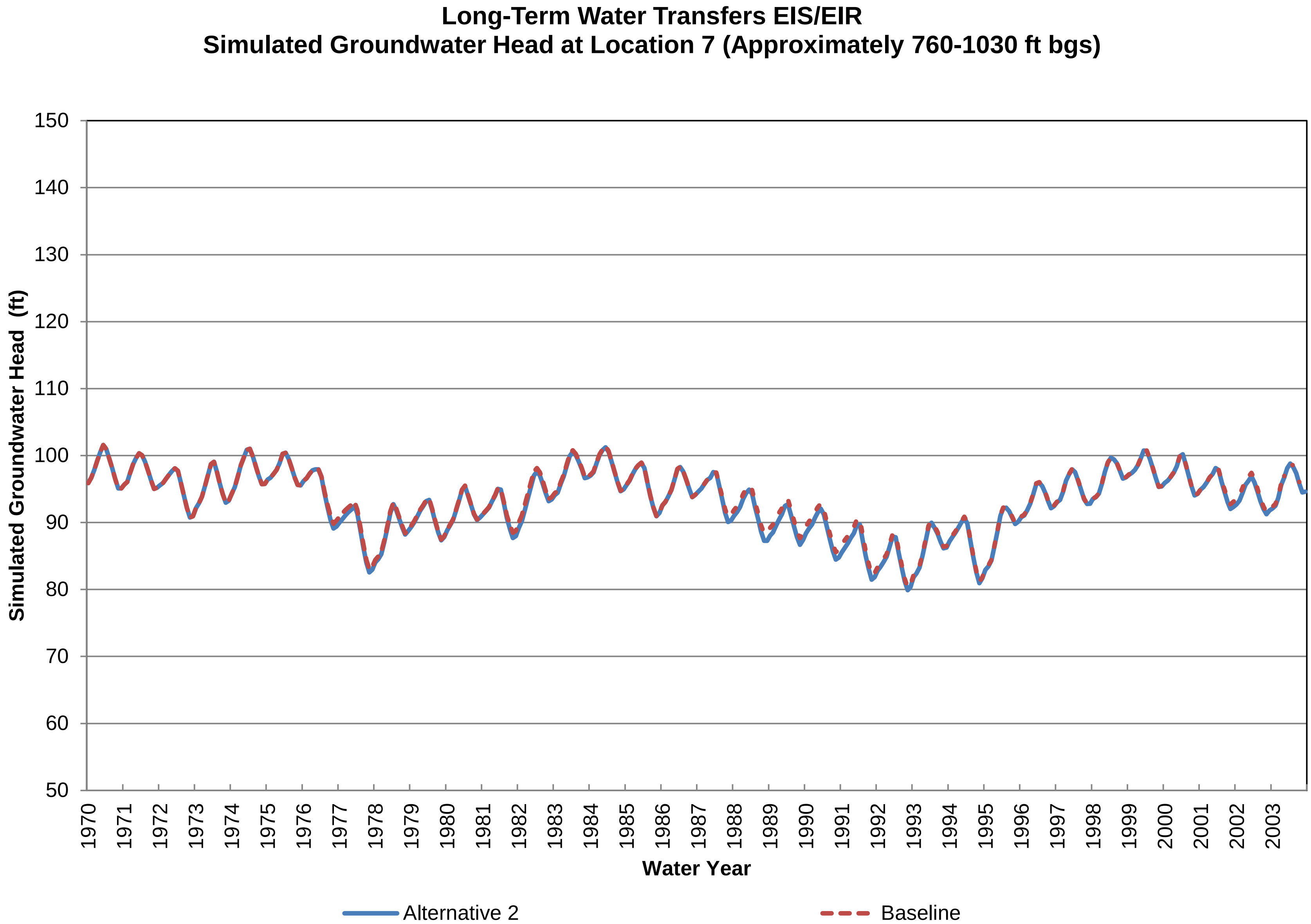

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 70-220 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

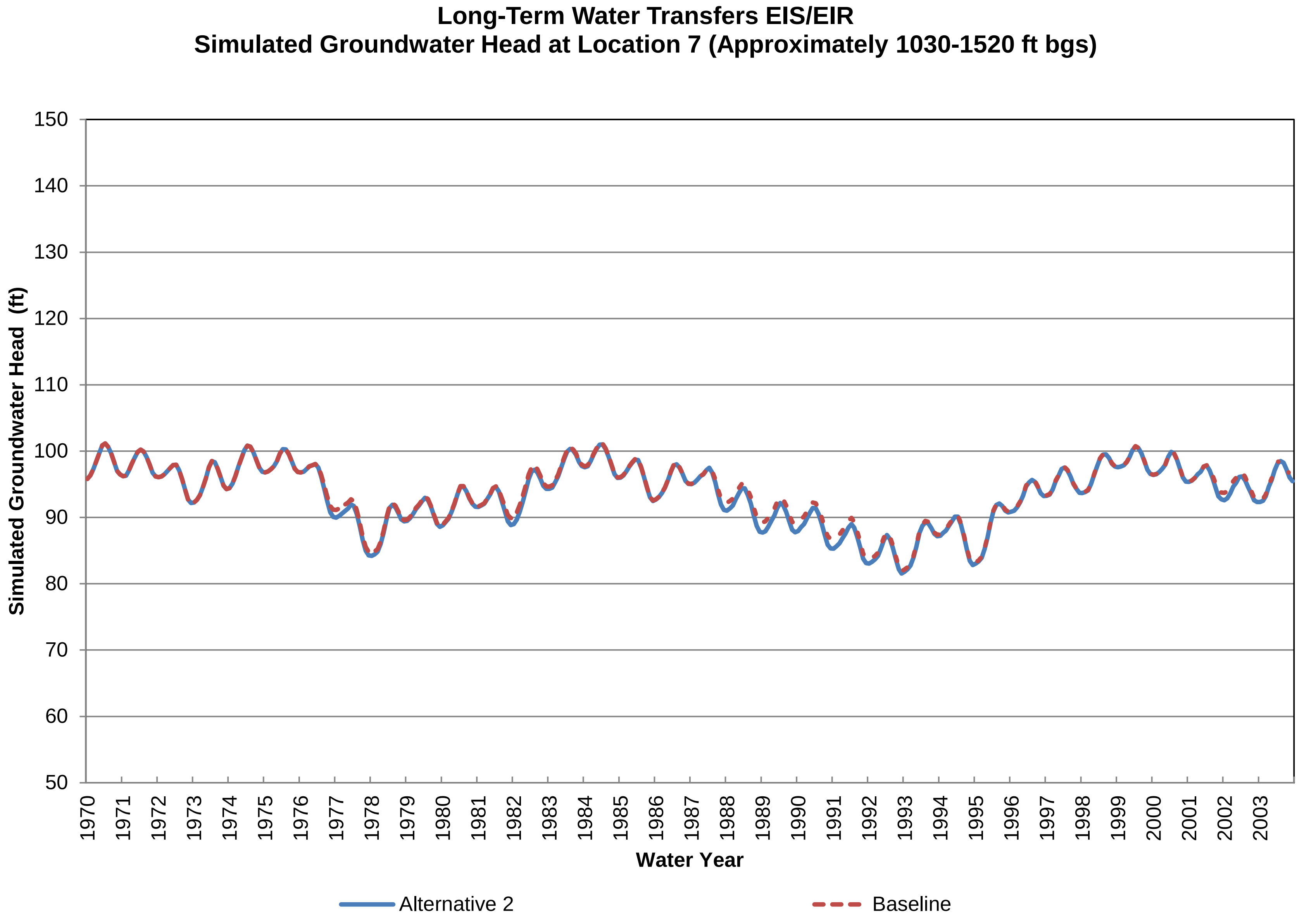

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 220-370 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 370-520 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 520-760 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 760-1030 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 1030-1520 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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1988
1989
1990
1991
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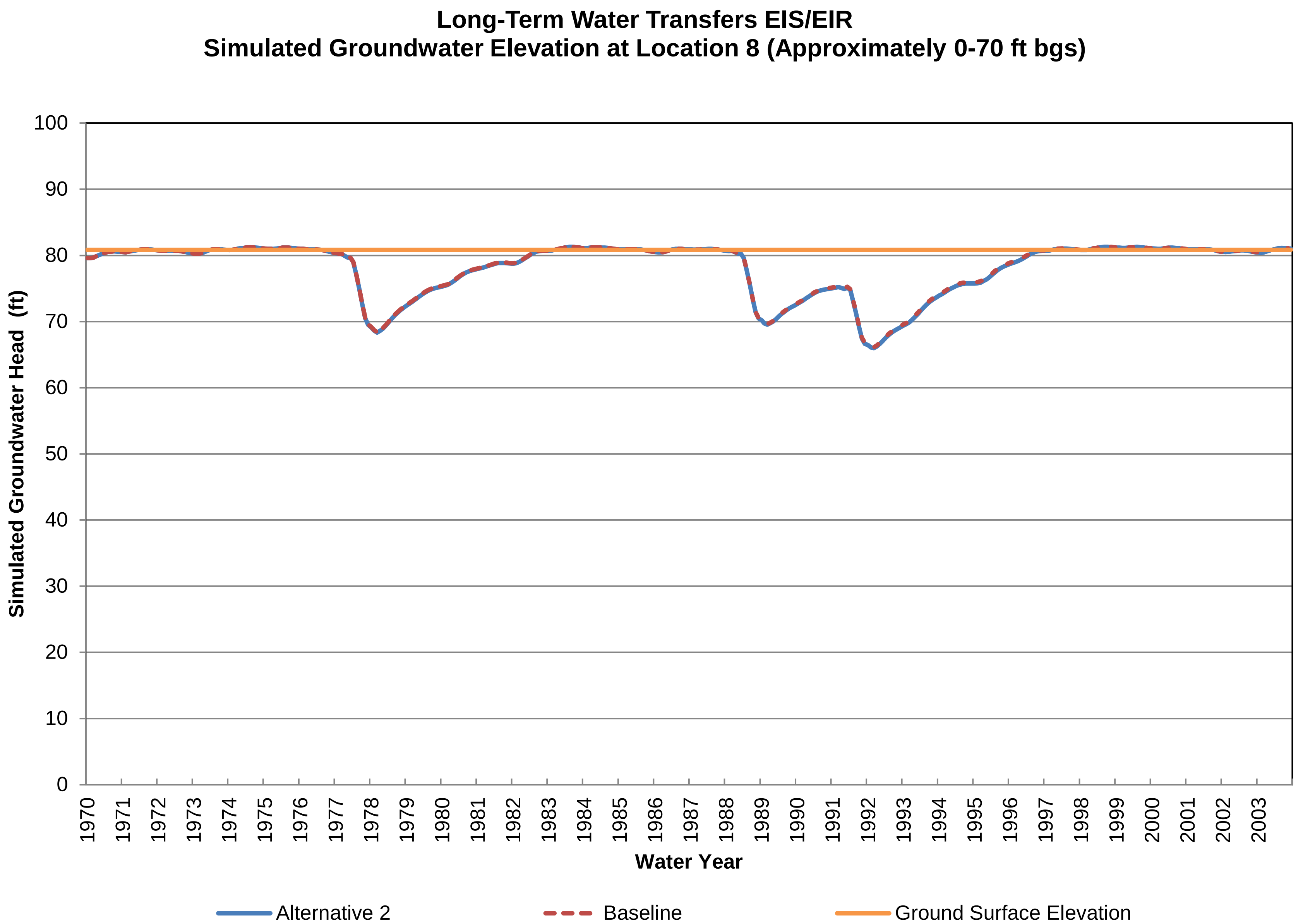
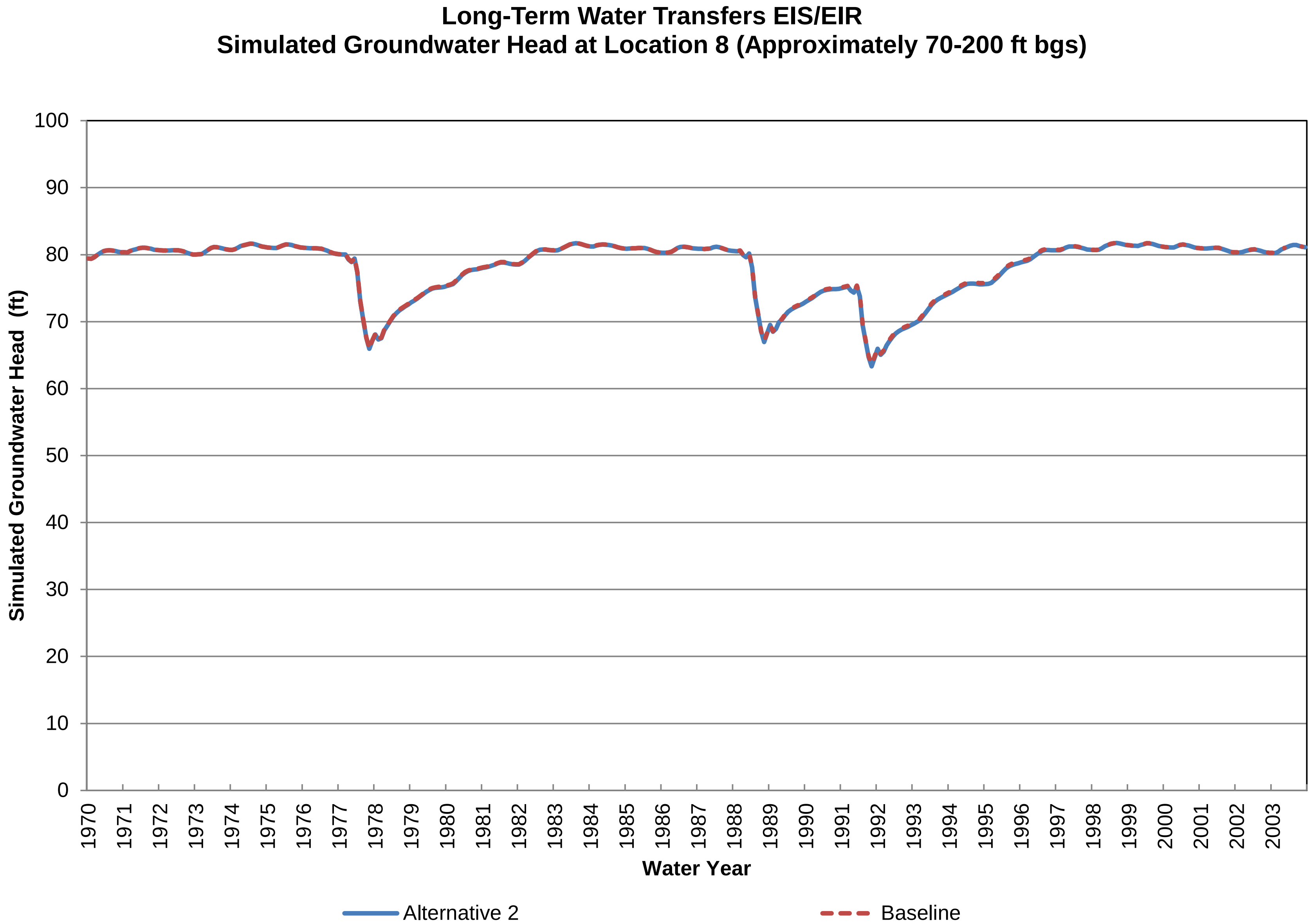
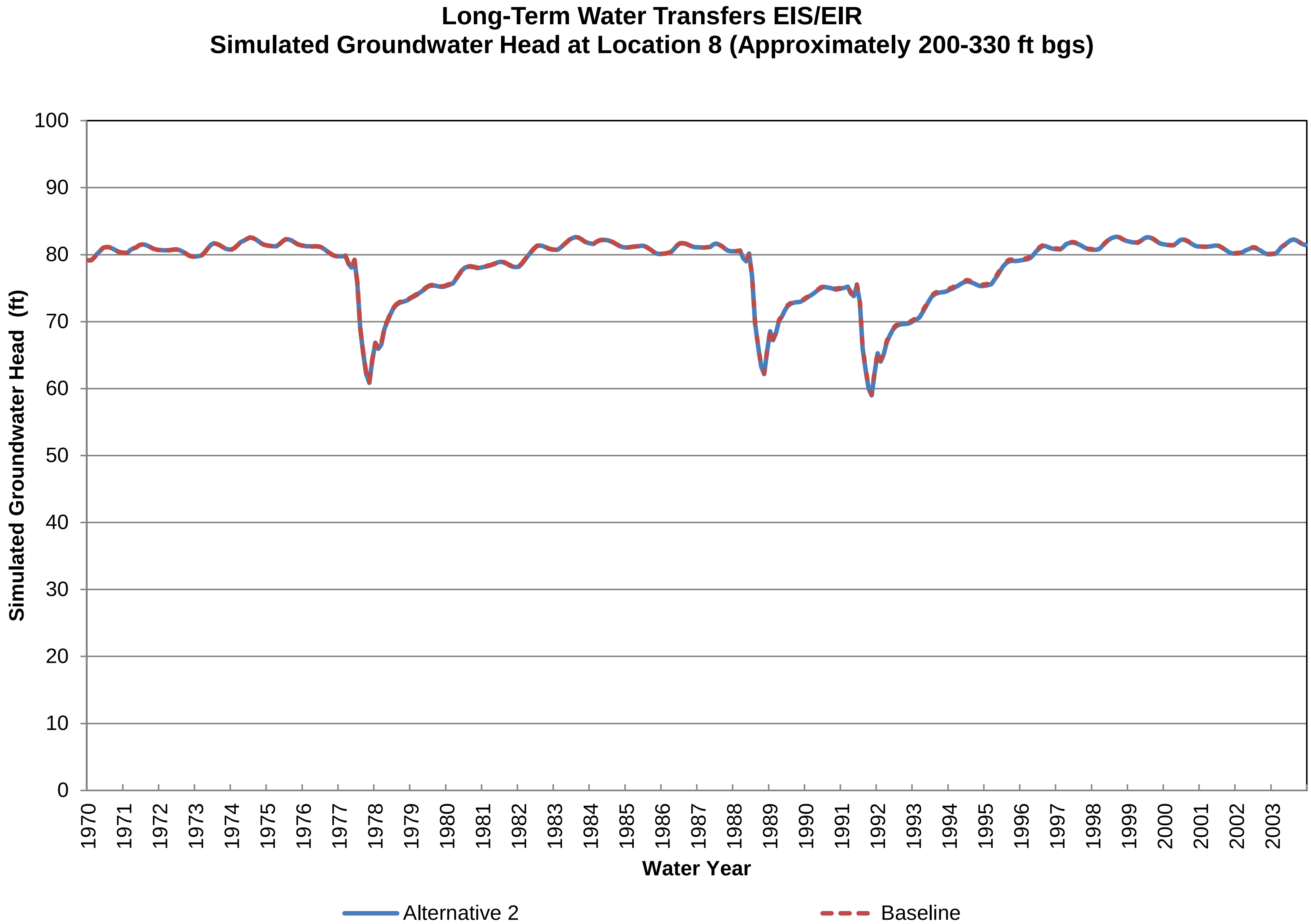
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 8 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 70-200 ft bgs)
100
90
80
70
60
50
40
30
20
10
0
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 200-330 ft bgs)
Simulated Groundwater Head (ft)
0
10
20
30
40
50
60
70
80
90
100
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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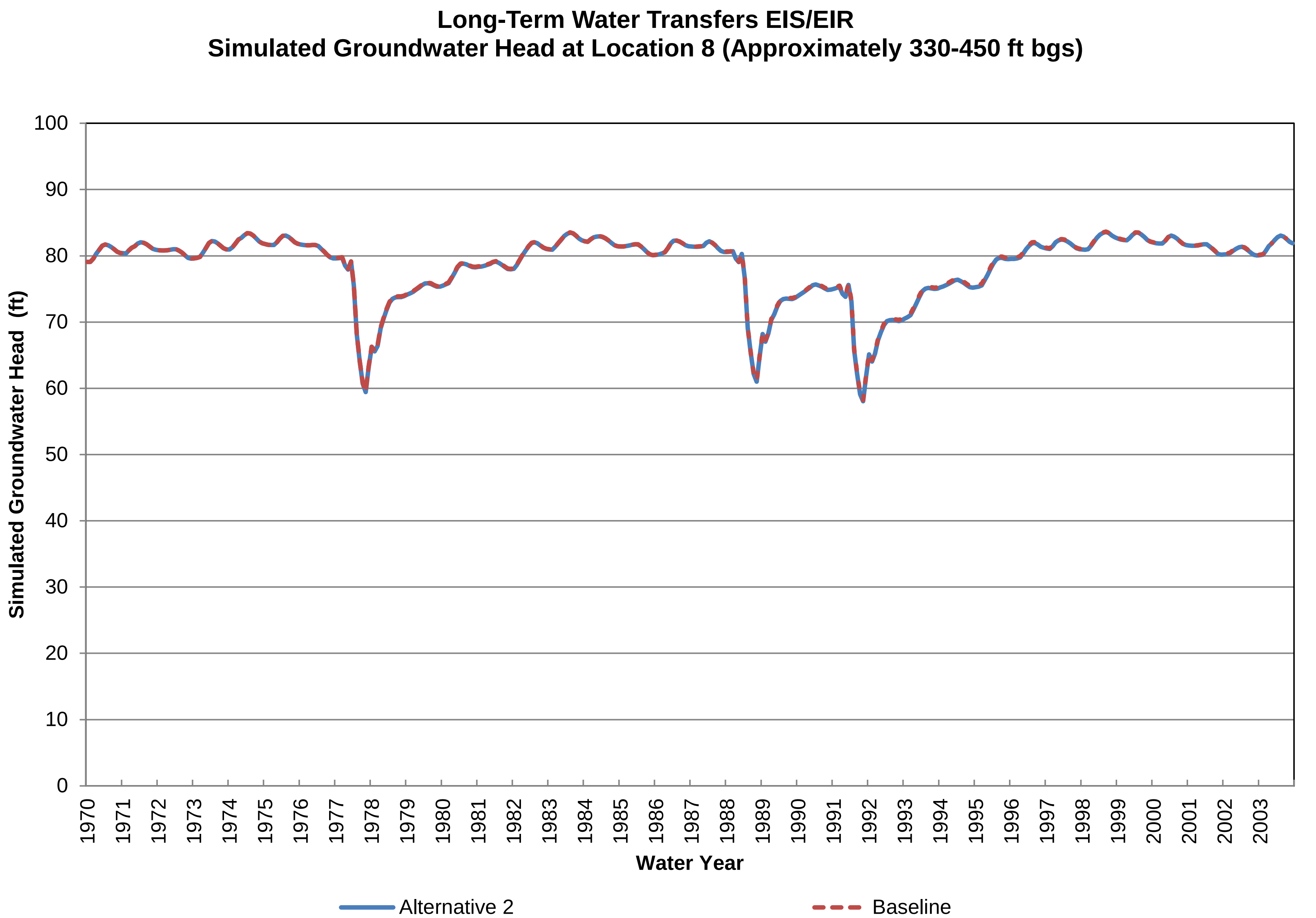
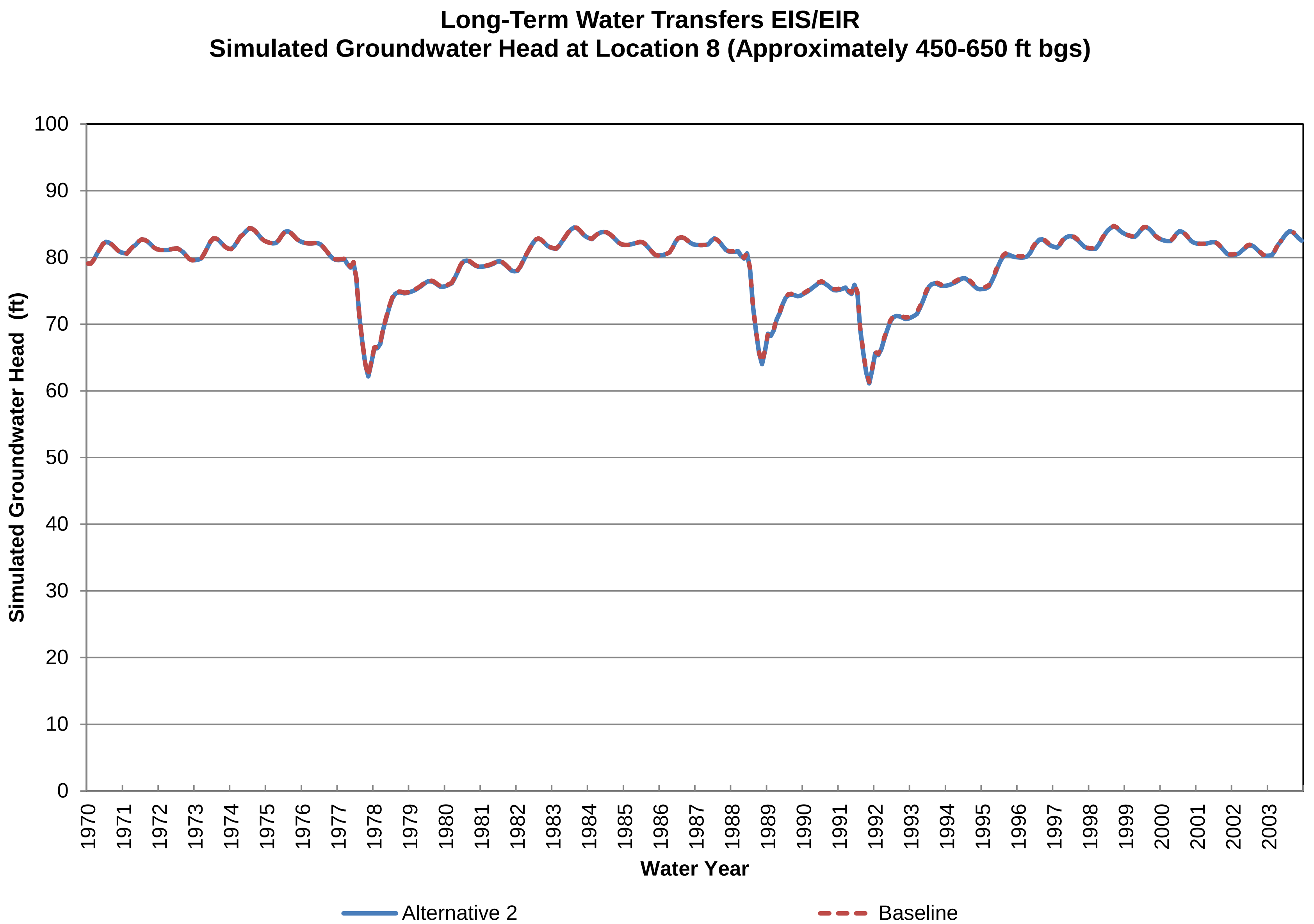
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 330-450 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 450-650 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1986
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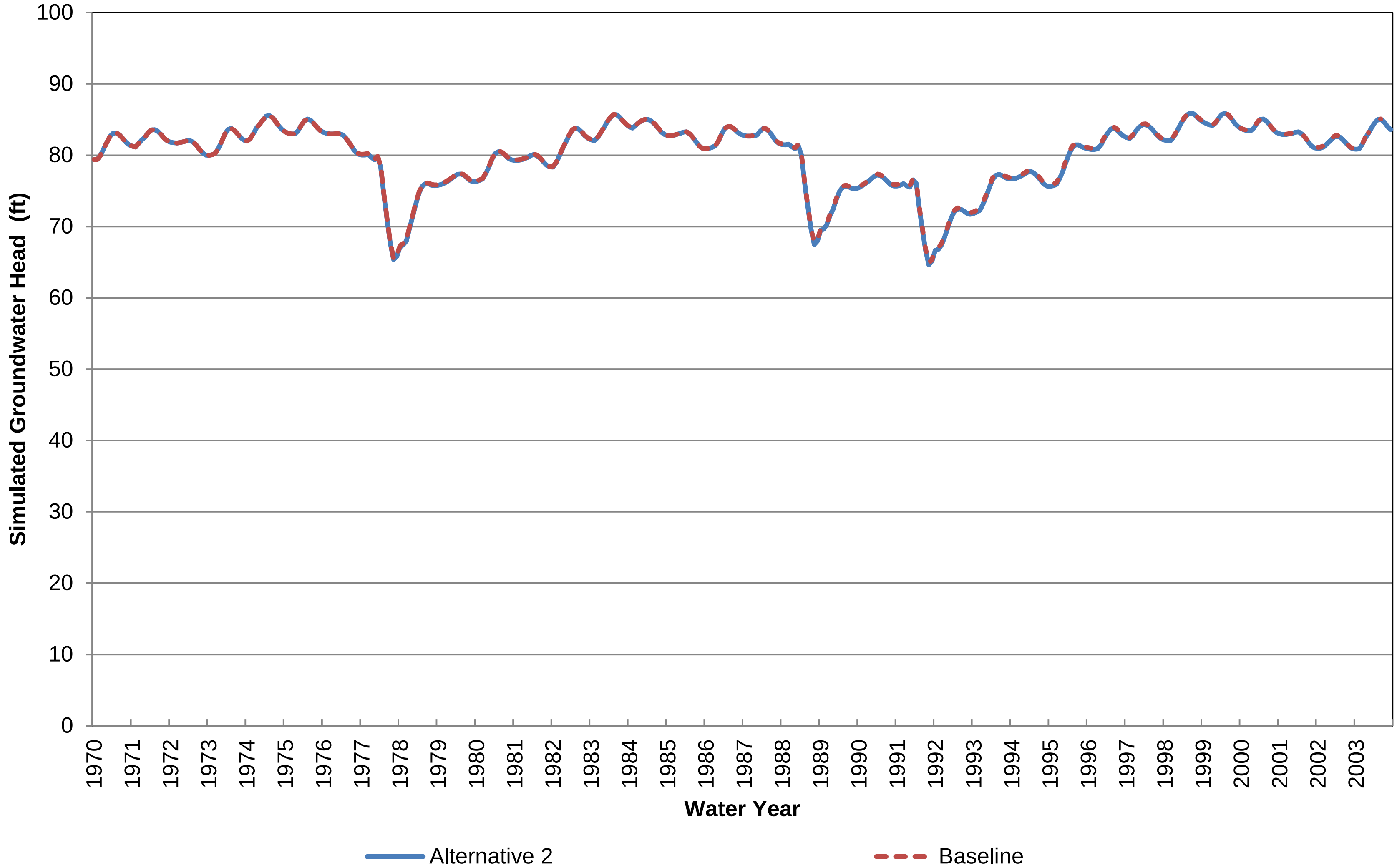
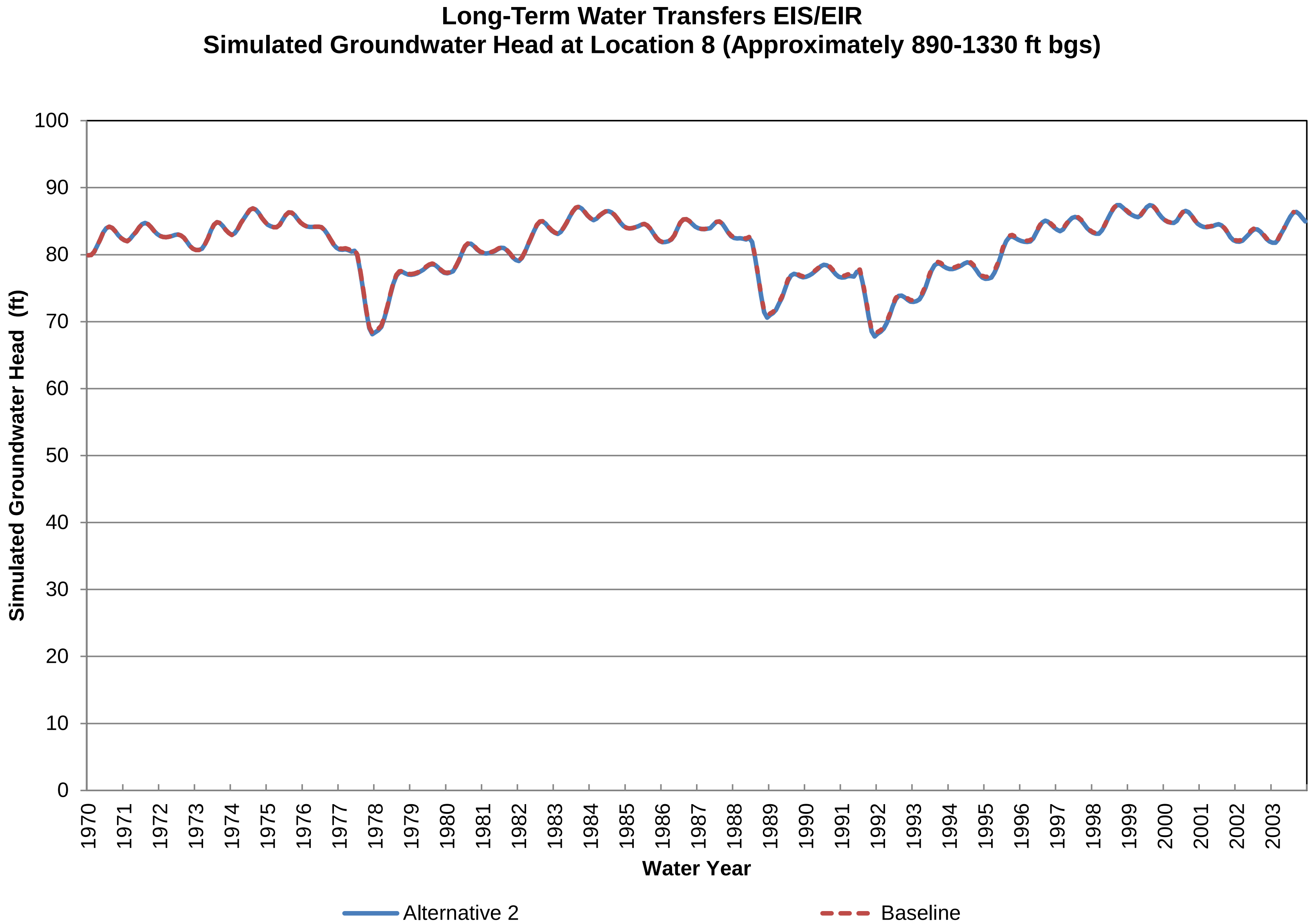
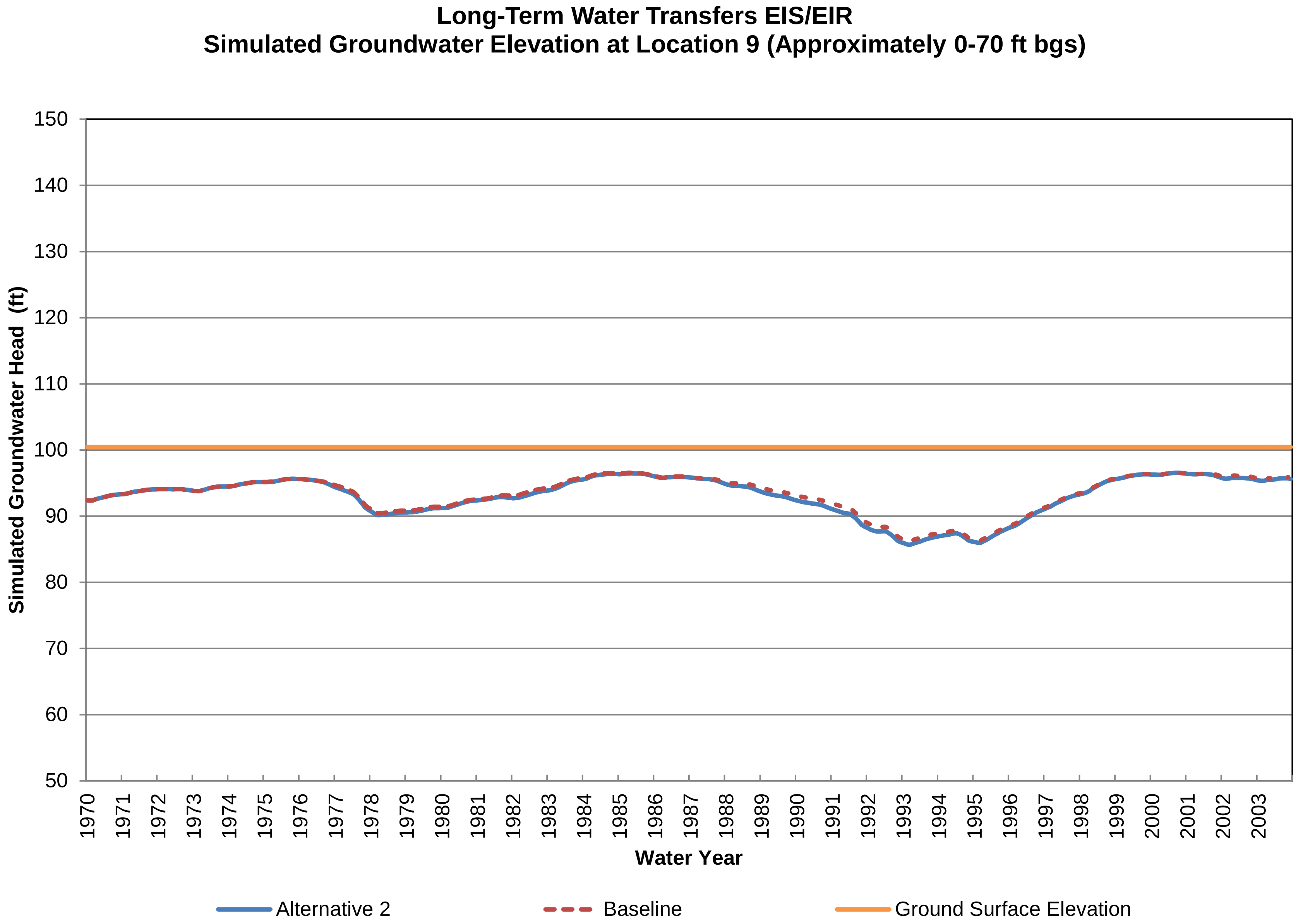
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 650-890 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 890-1330 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 9 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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1989
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1991
1992
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1994
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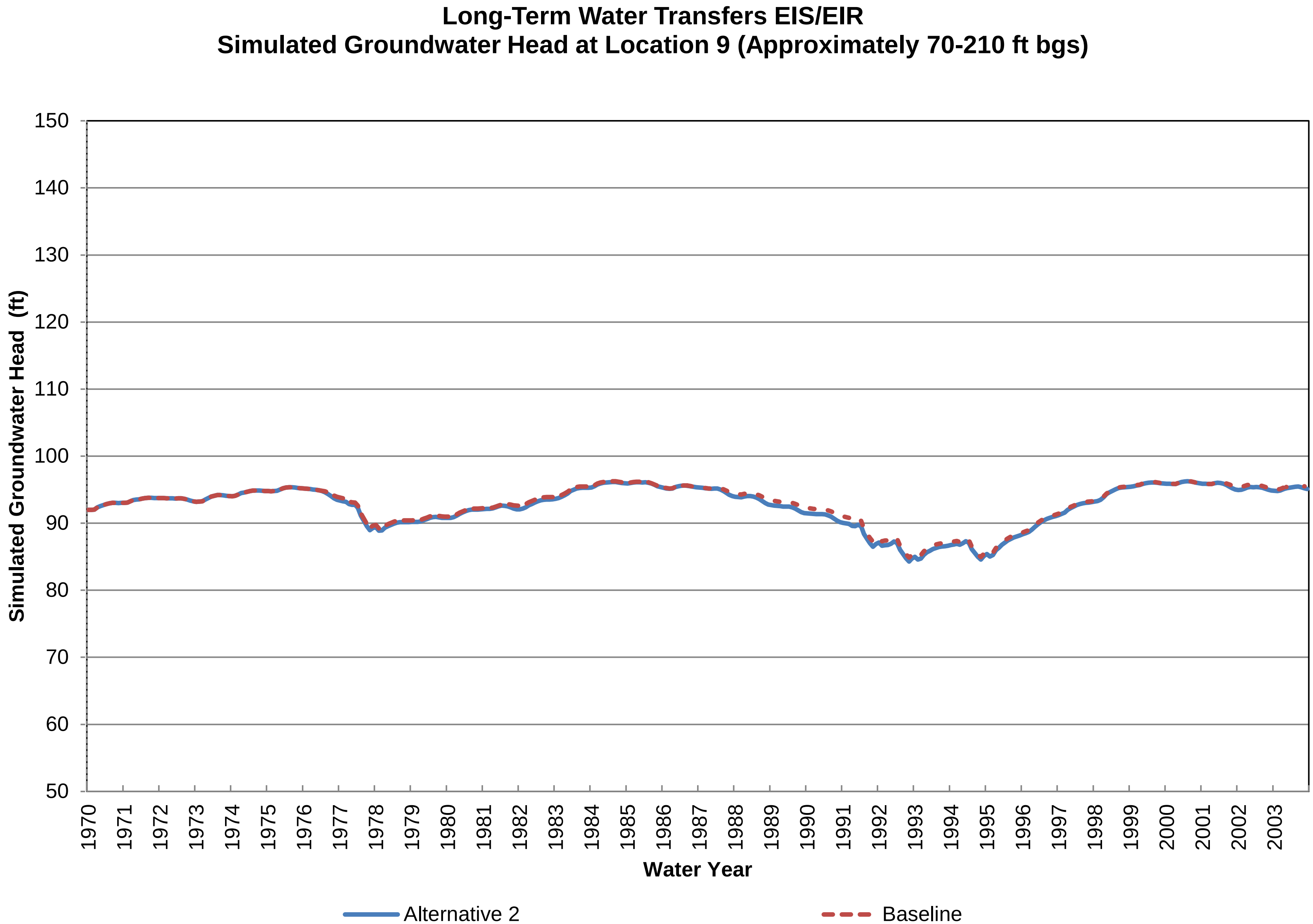
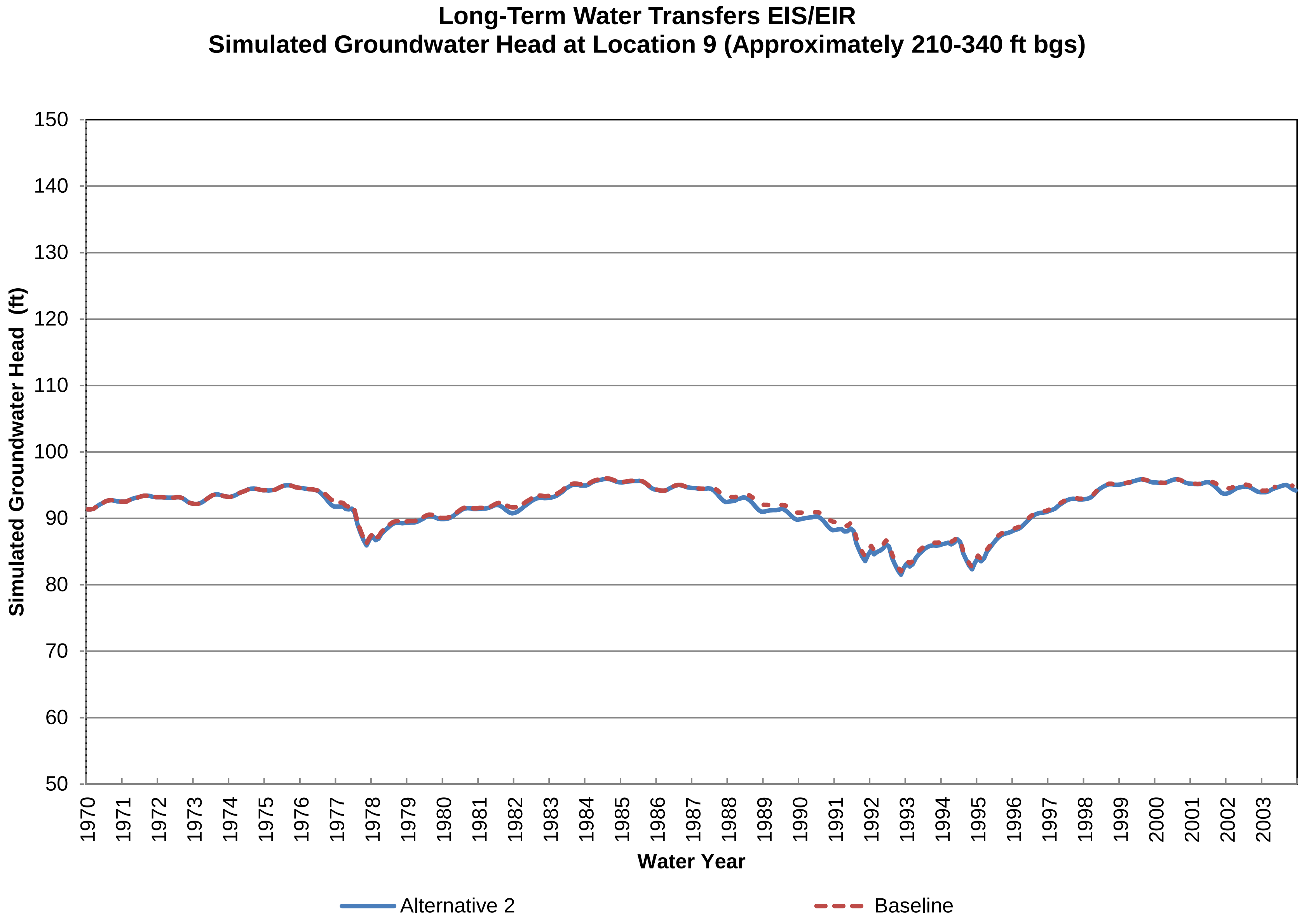
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 70-210 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 210-340 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1987
1988
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1992
1993
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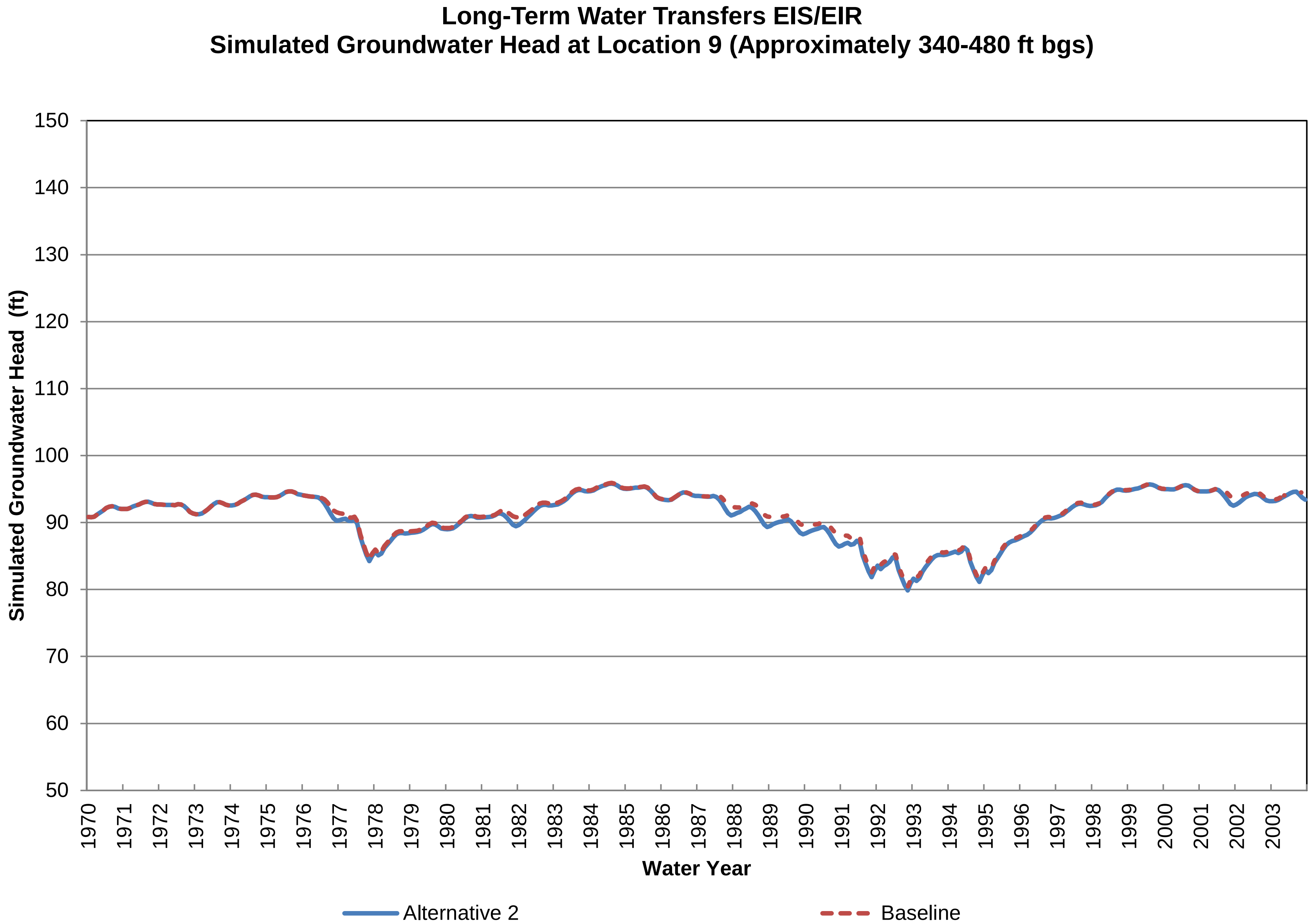
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 340-480 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1986
1987
1988
1989
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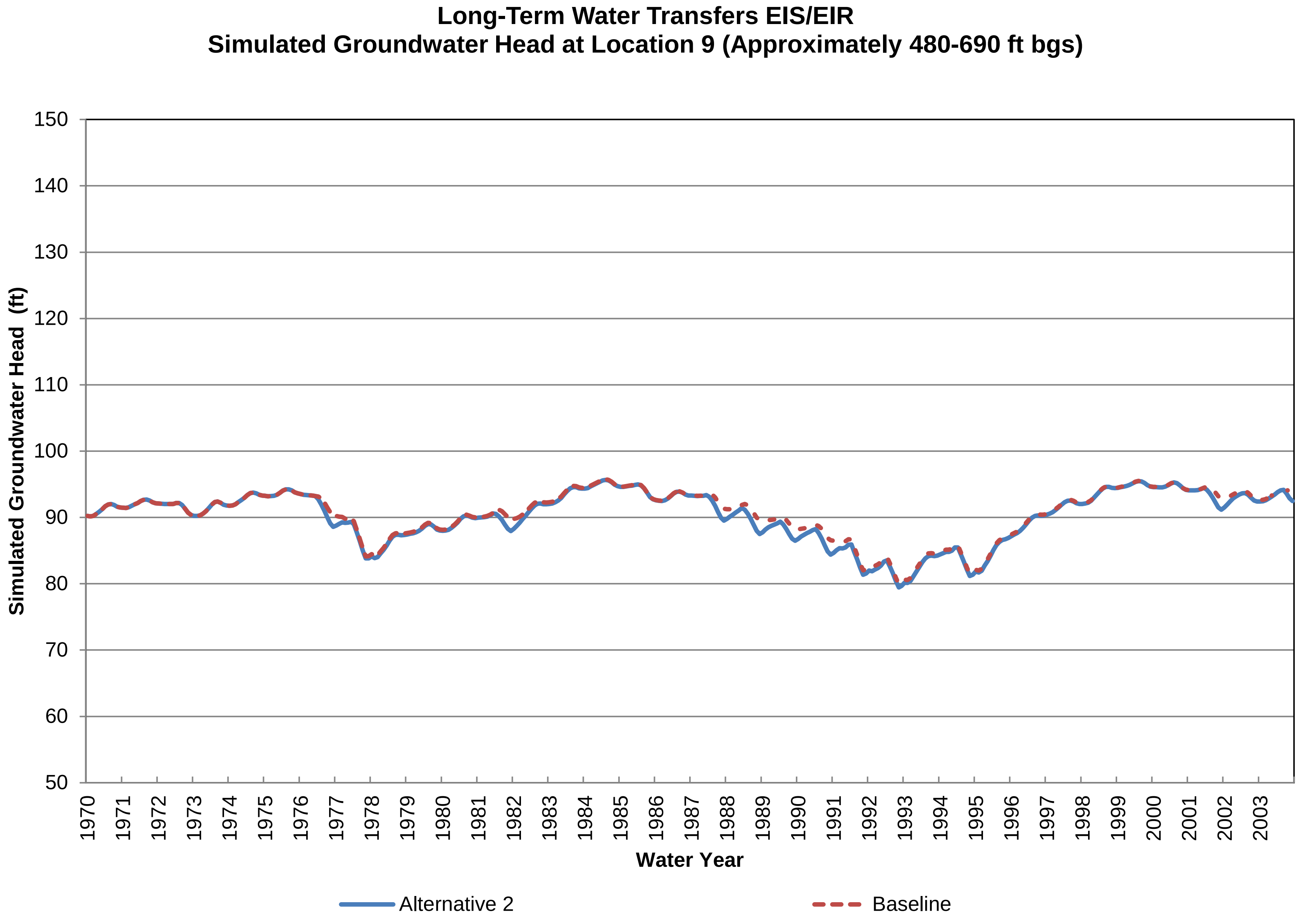
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 480-690 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1994
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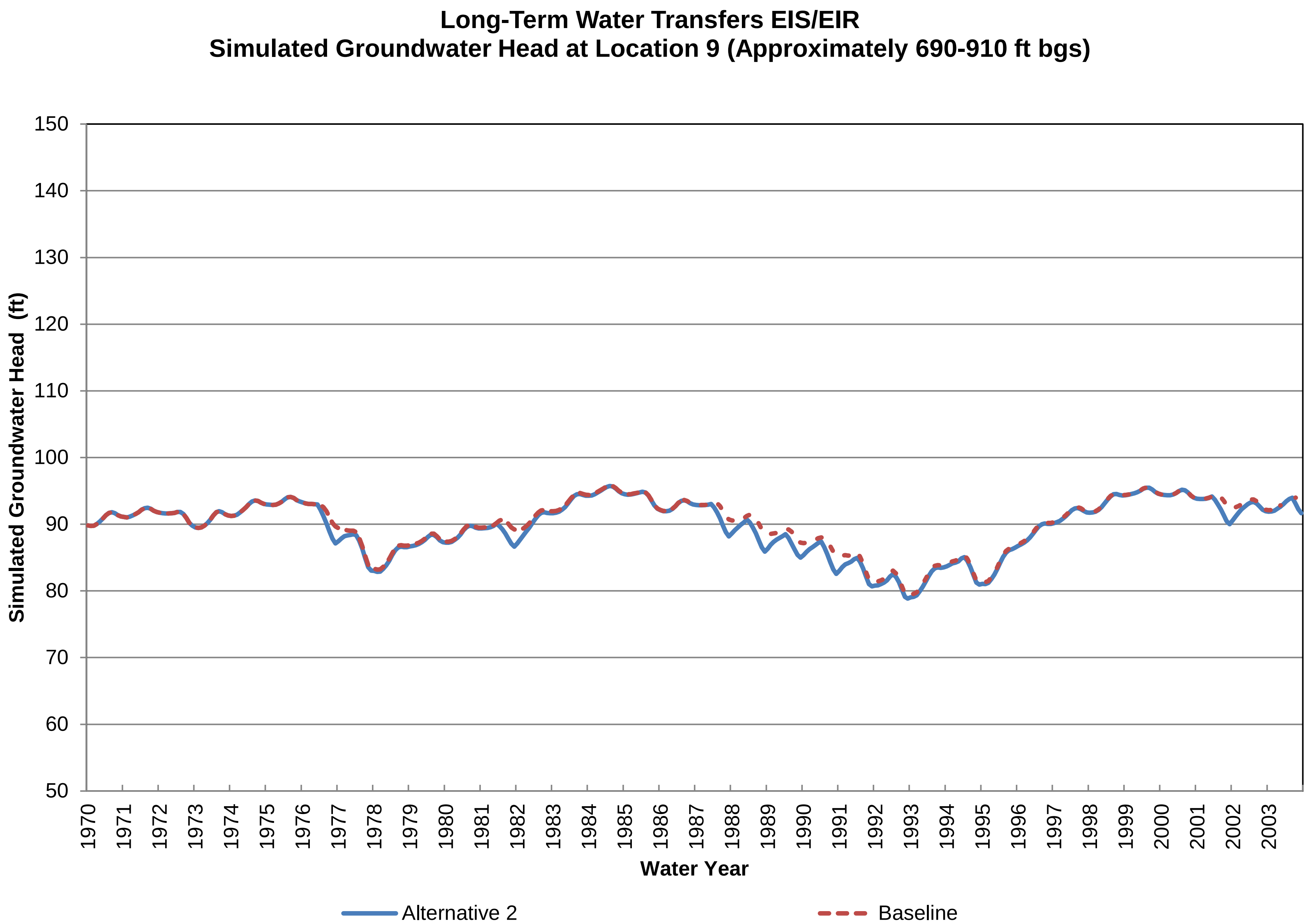
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 690-910 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1981
1982
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1989
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1992
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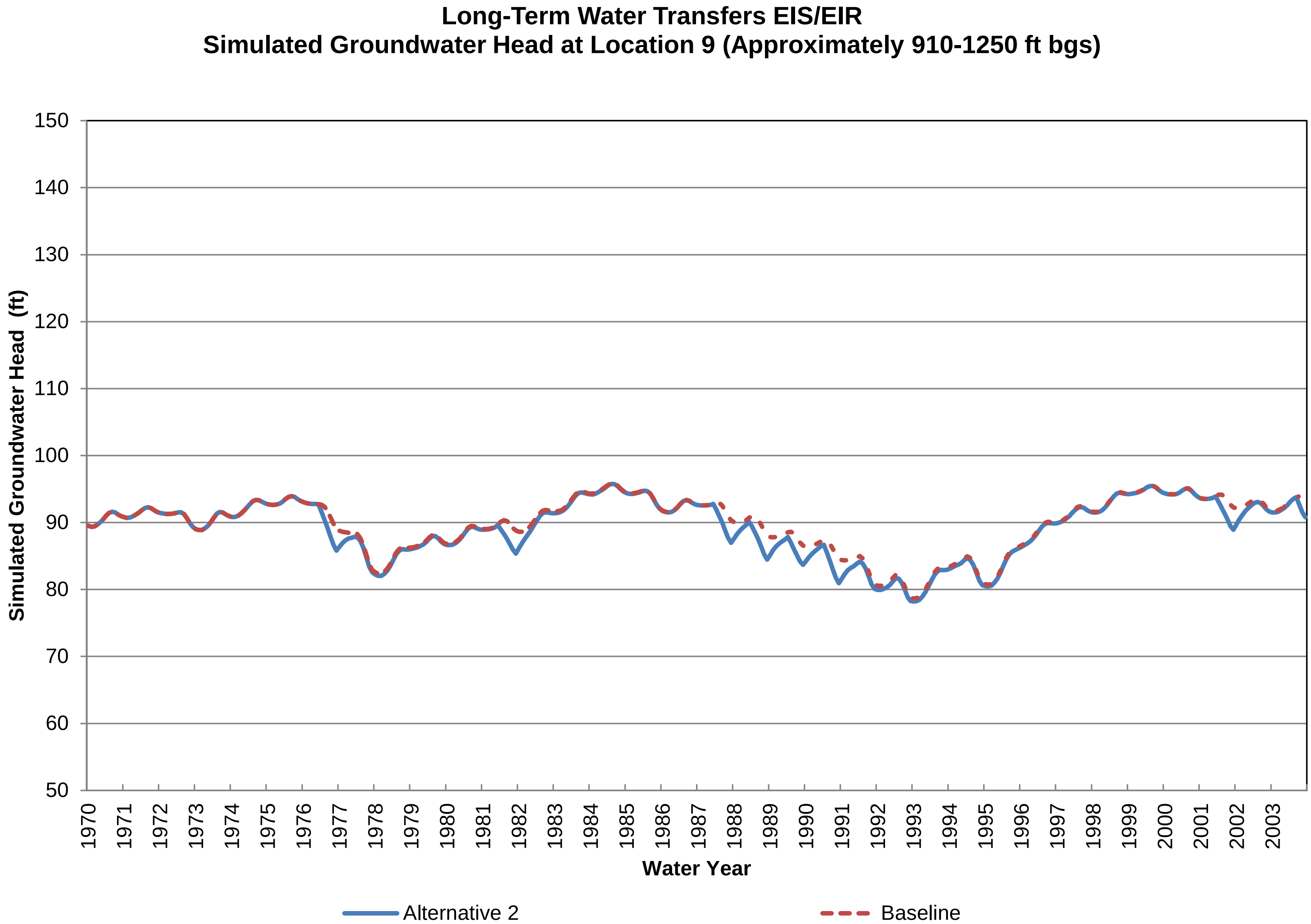
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 910-1250 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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1984
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1986
1987
1988
1989
1990
1991
1992
1993
1994
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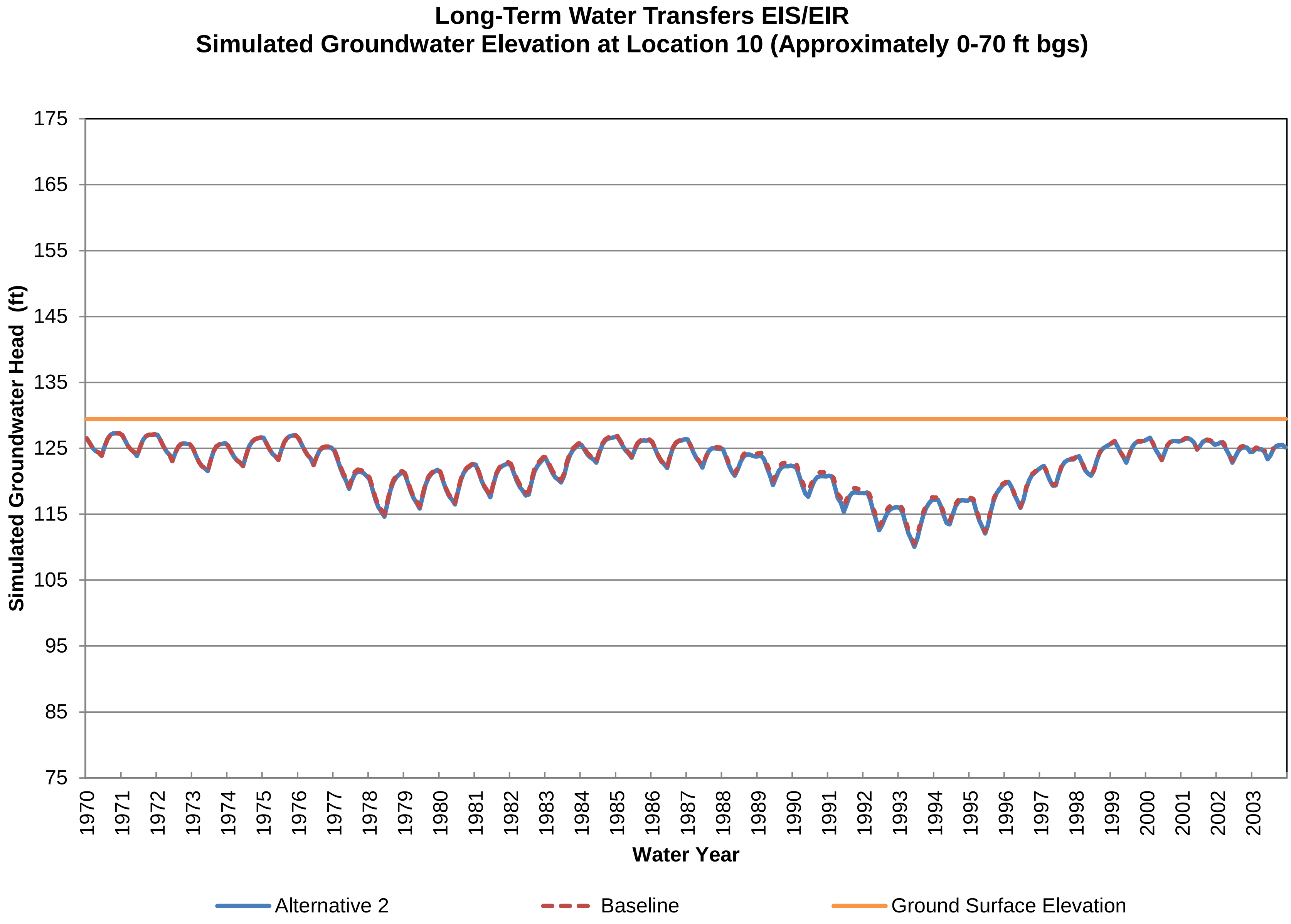
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 10 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1983
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1988
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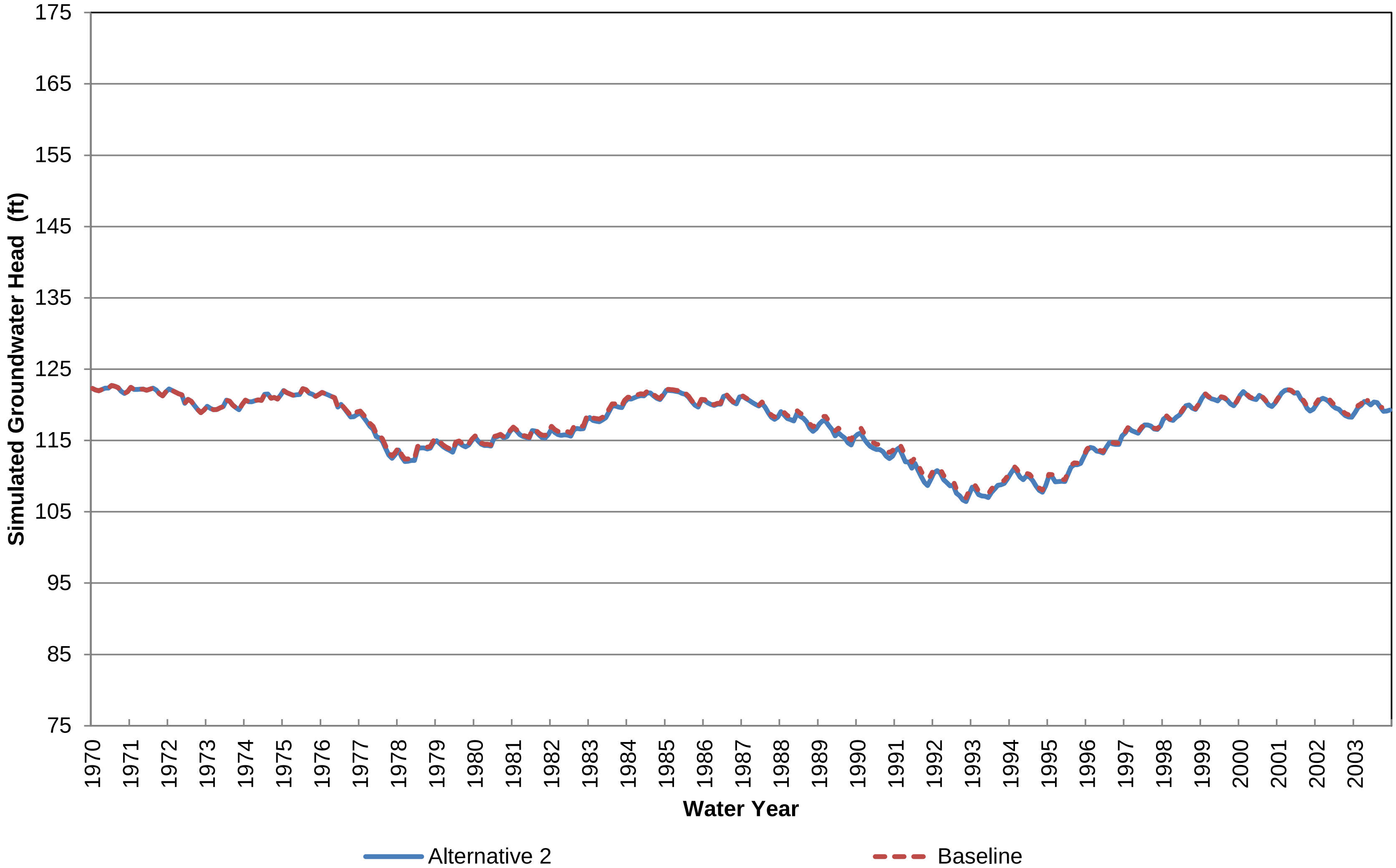
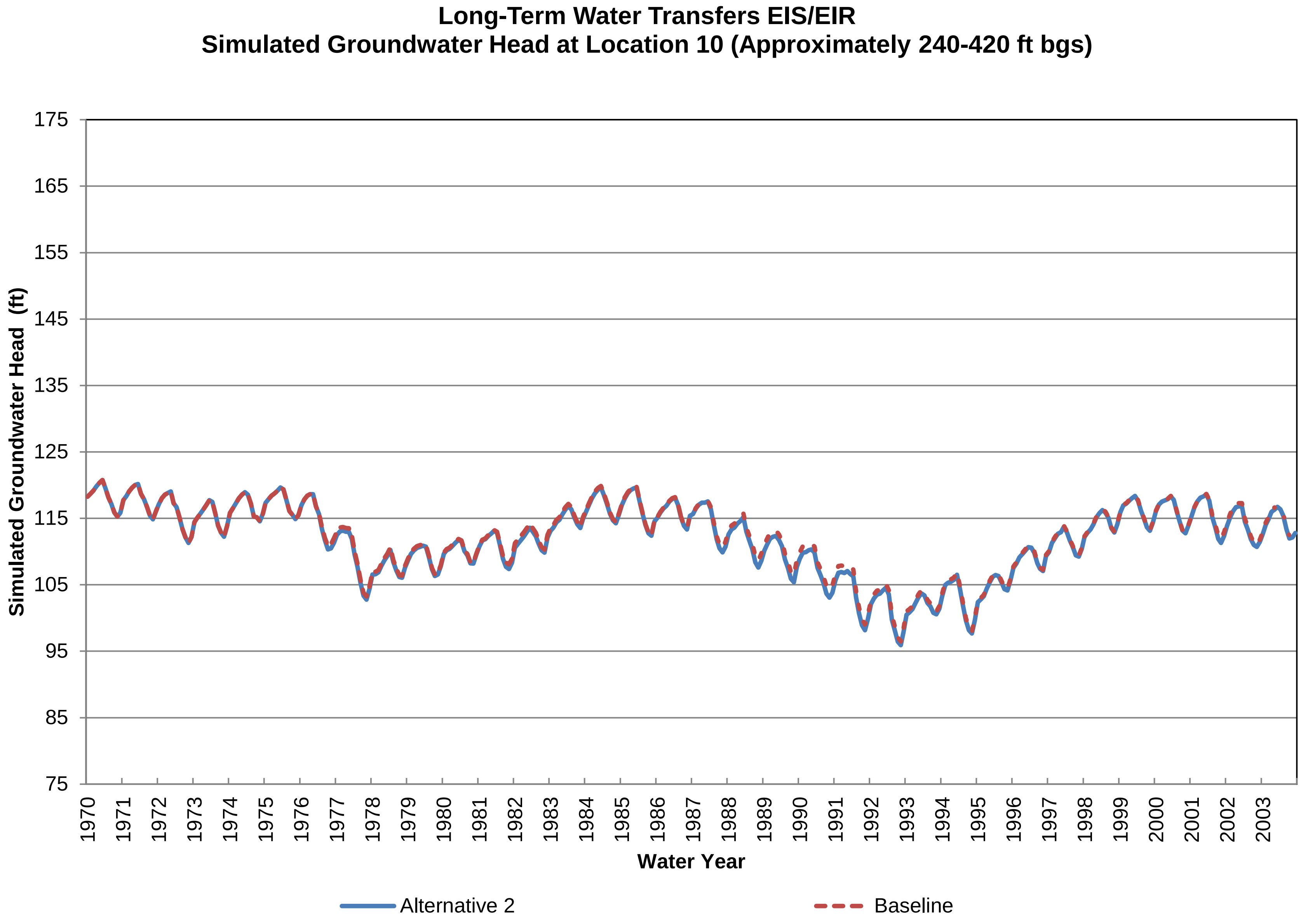
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 70-240 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 240-420 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
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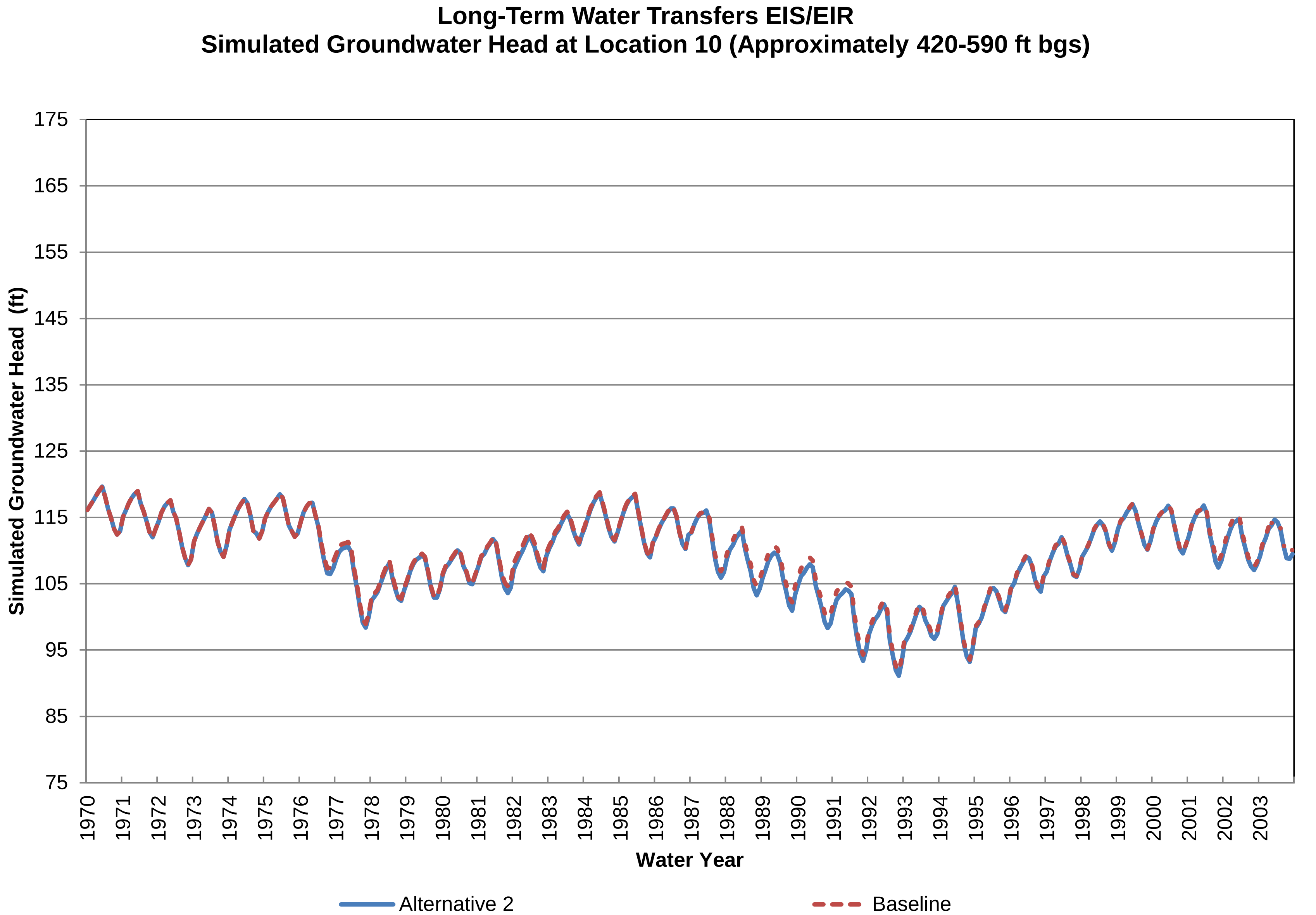
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 420-590 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
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1993
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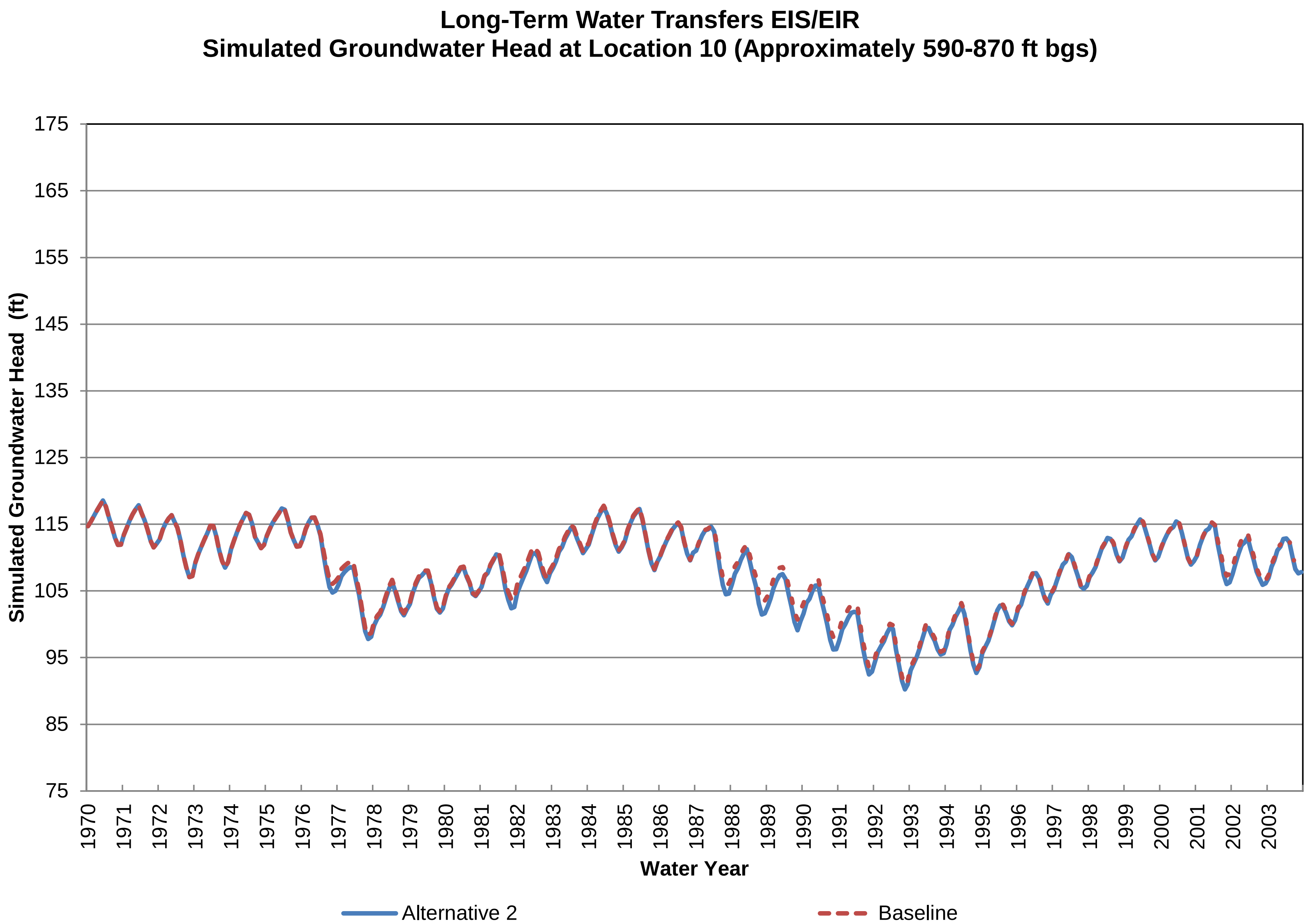
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 590-870 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1983
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1989
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1993
1994
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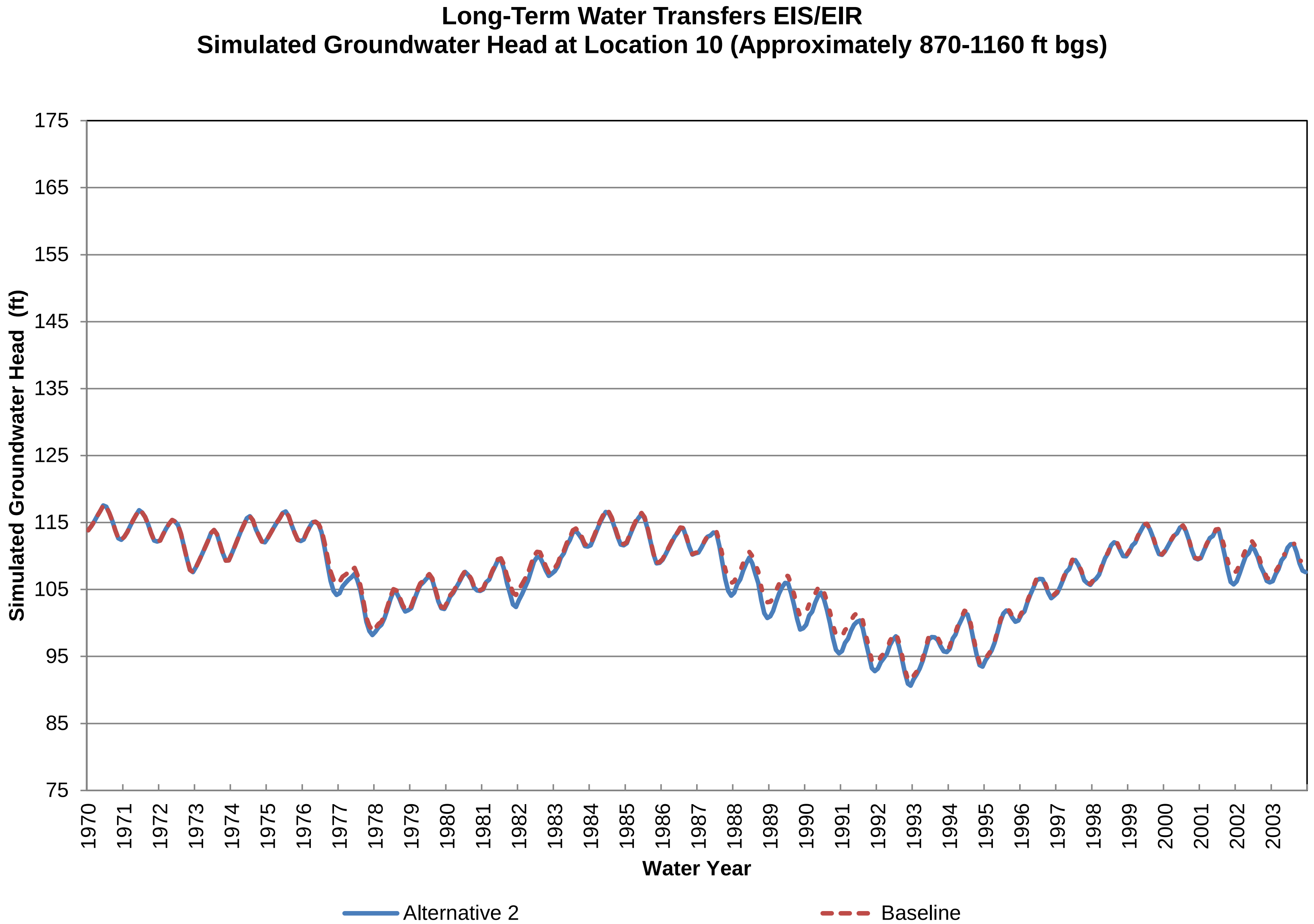
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 870-1160 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1983
1984
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1988
1989
1990
1991
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1994
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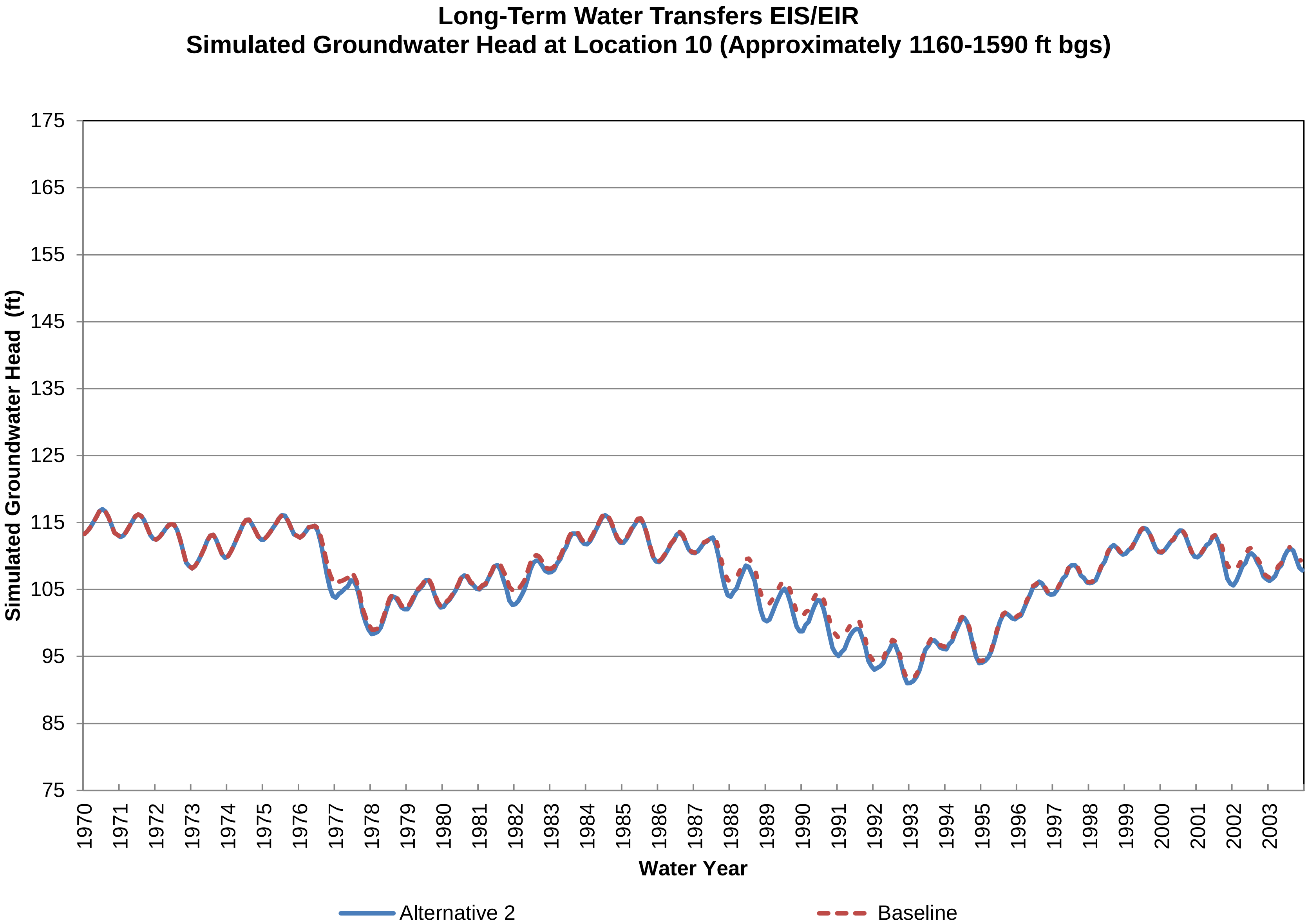
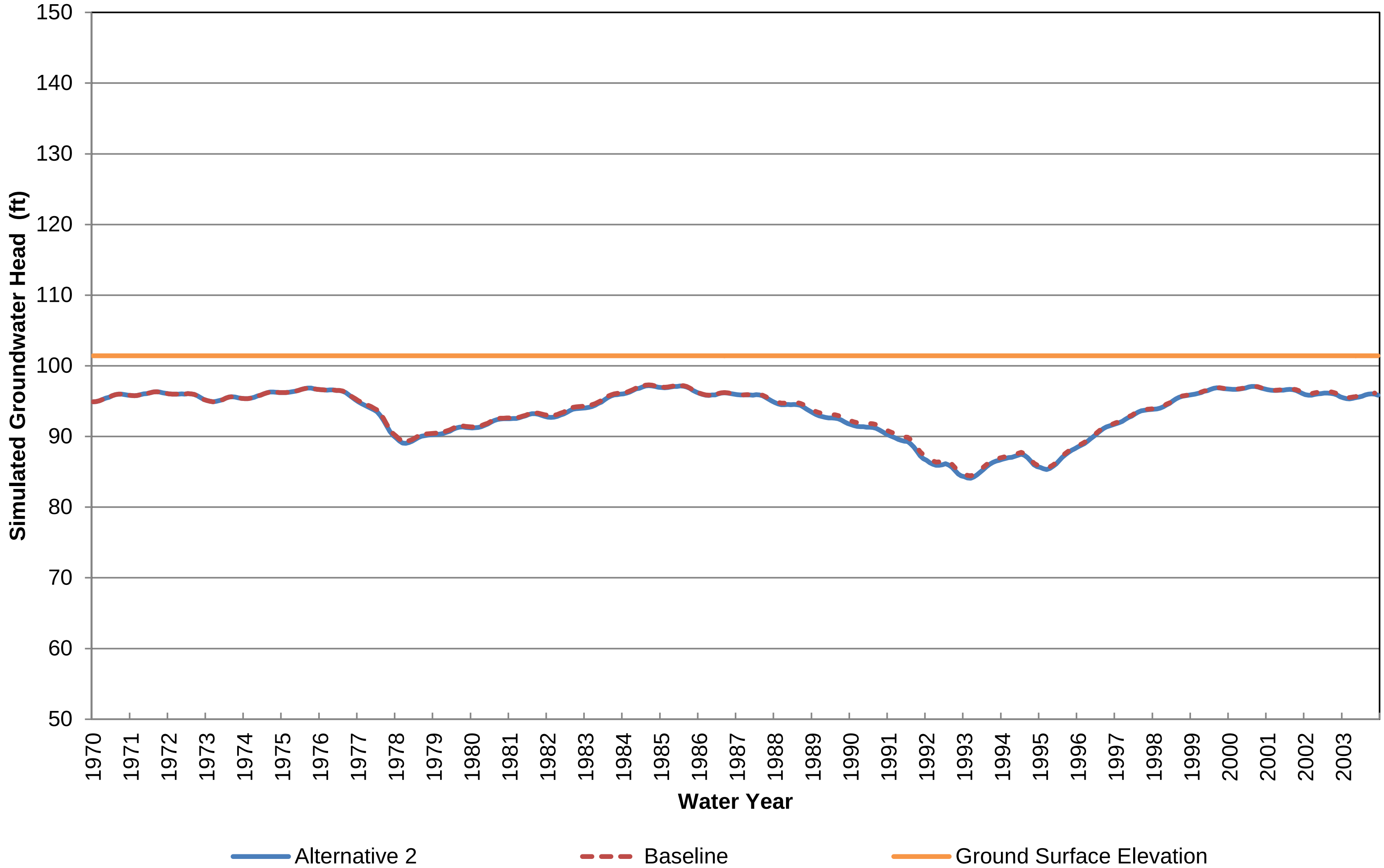
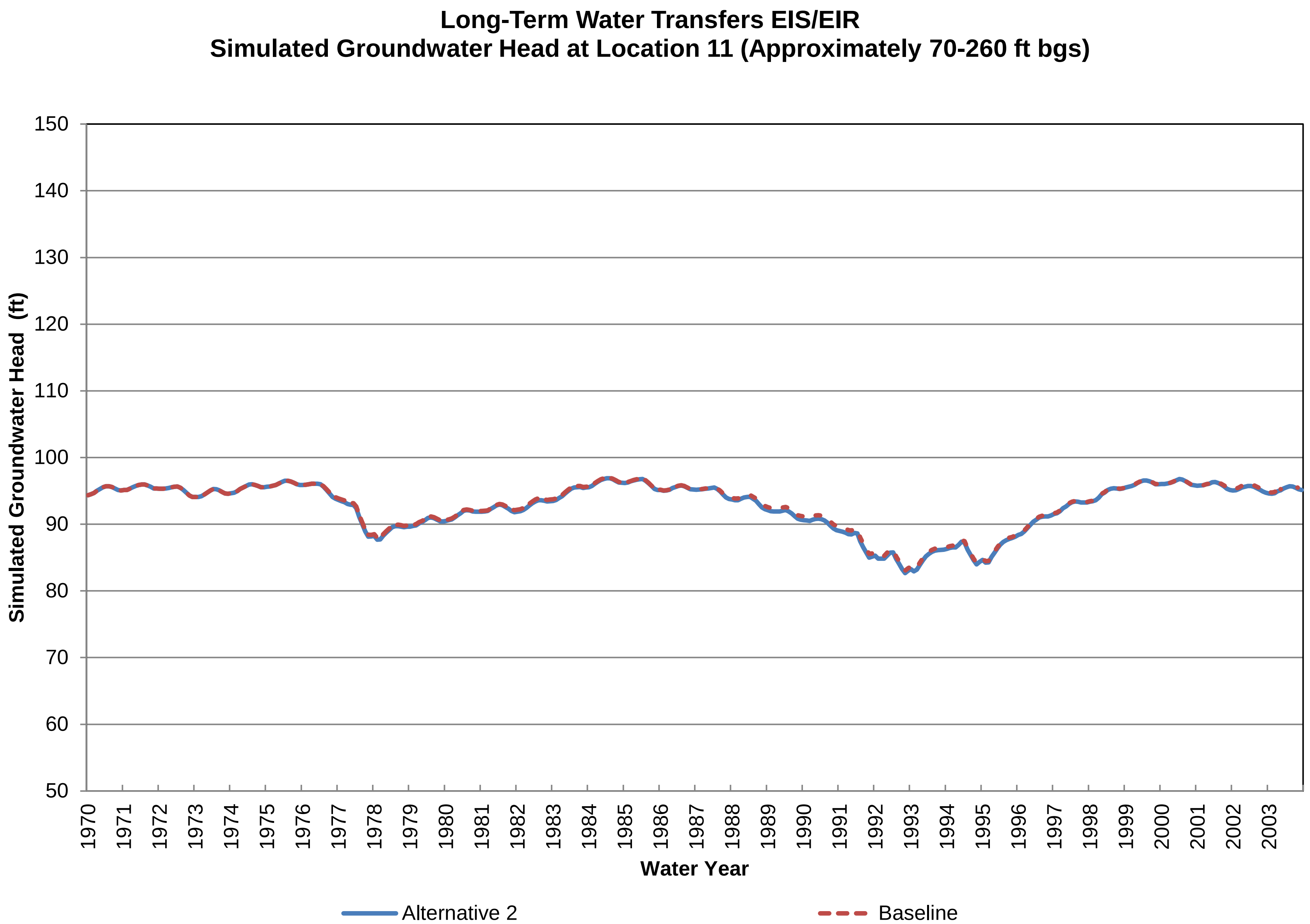
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 1160-1590 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 11 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 70-260 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
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1998
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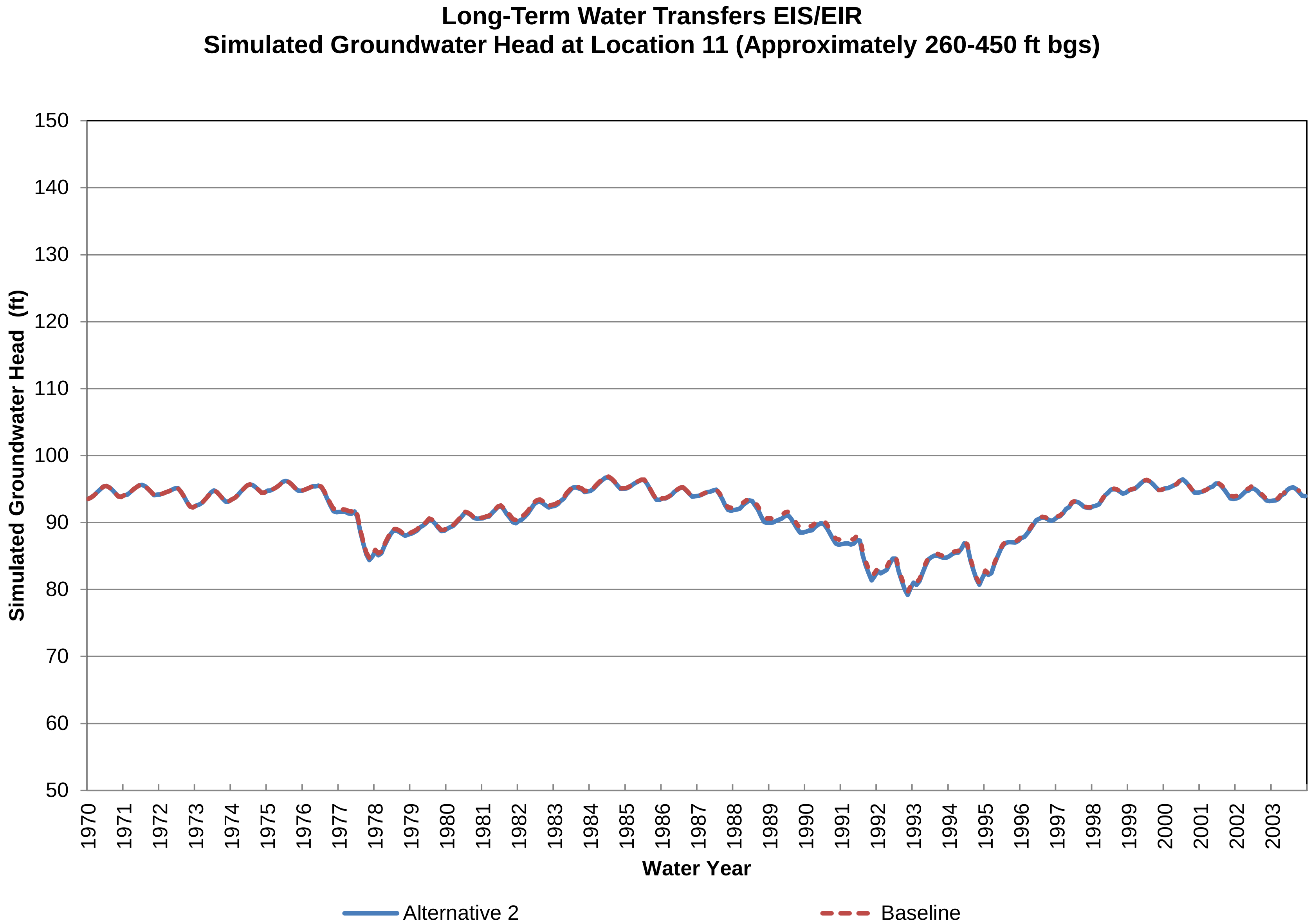
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 260-450 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1987
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1989
1990
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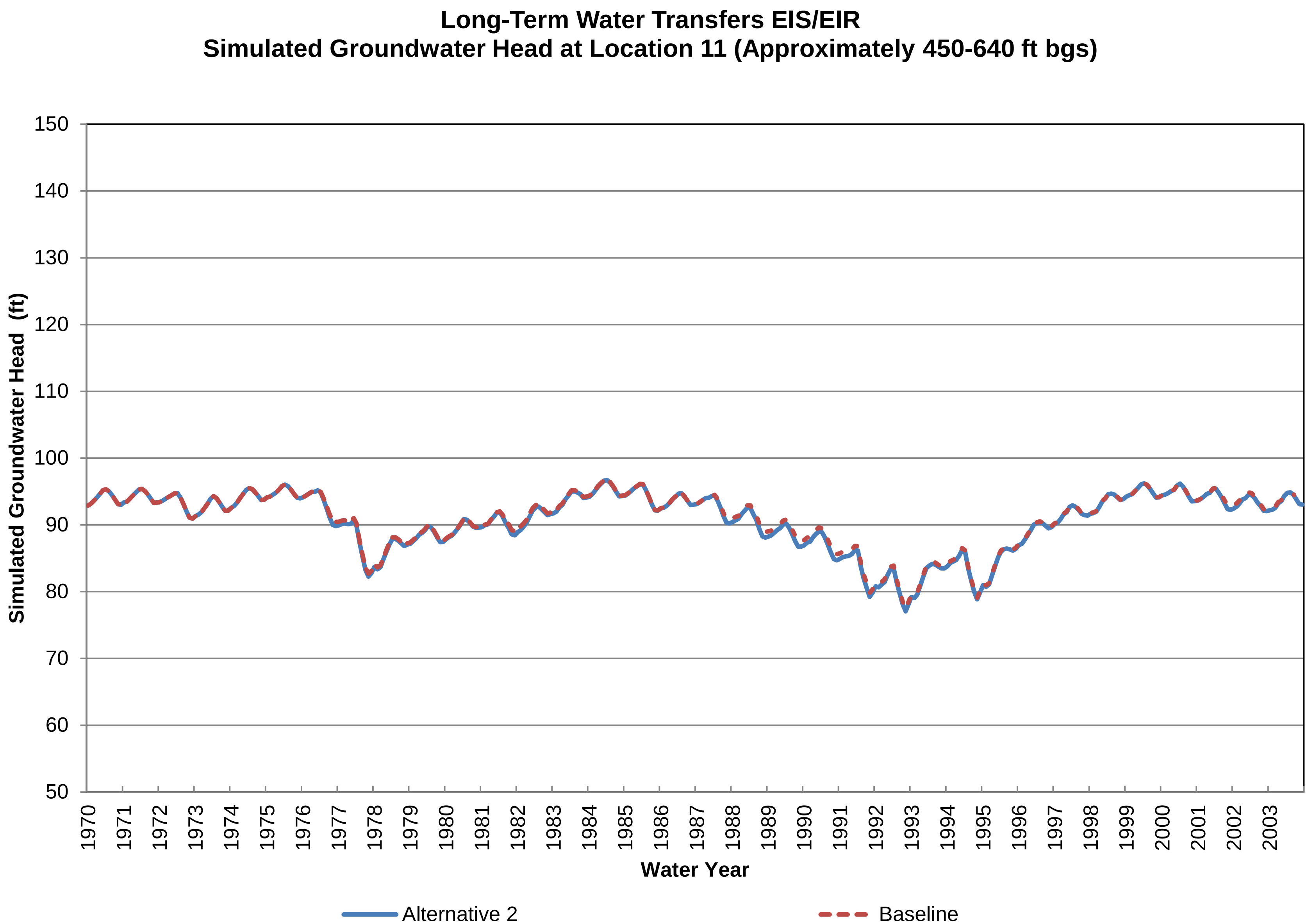
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 450-640 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1990
1991
1992
1993
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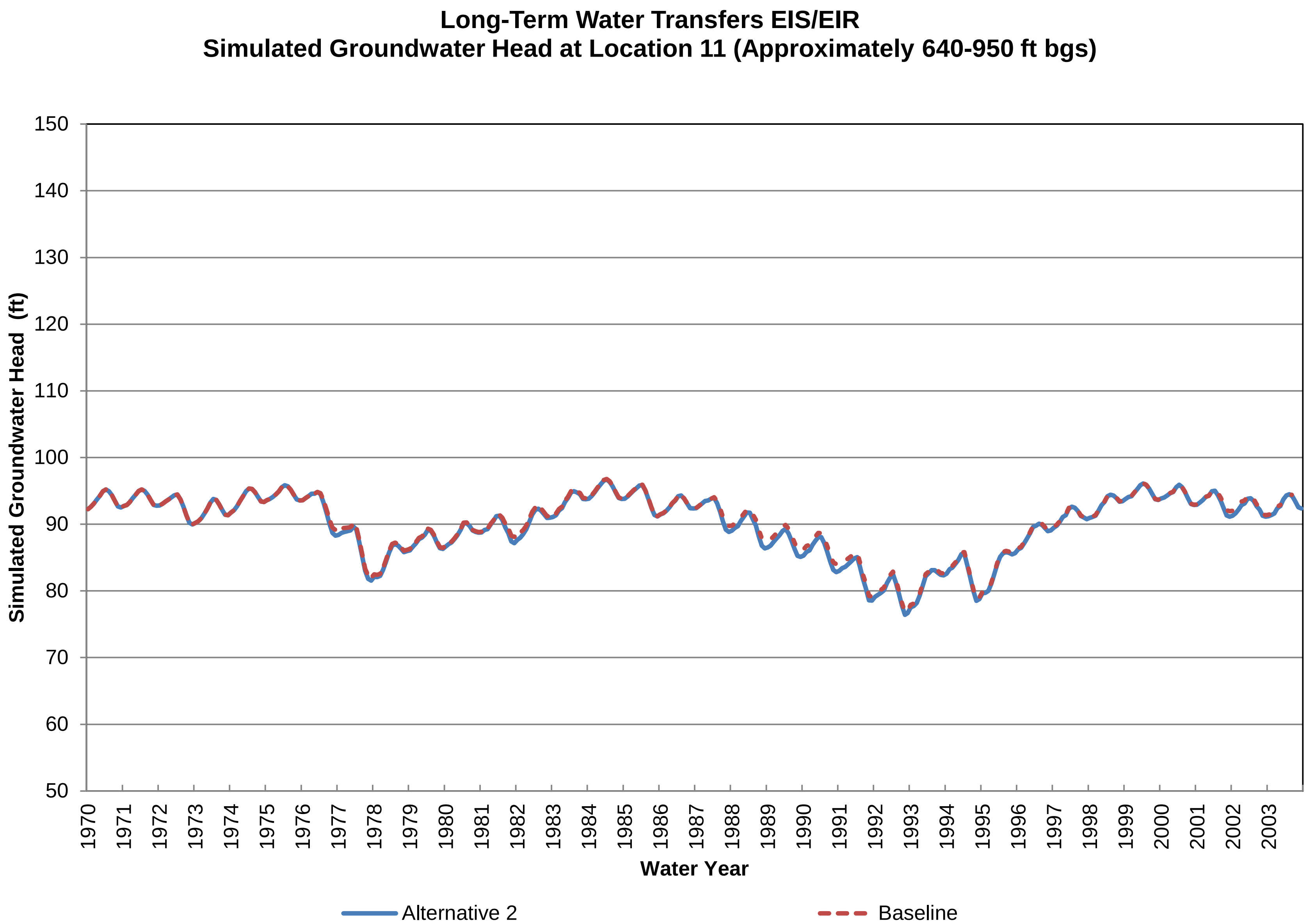
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 640-950 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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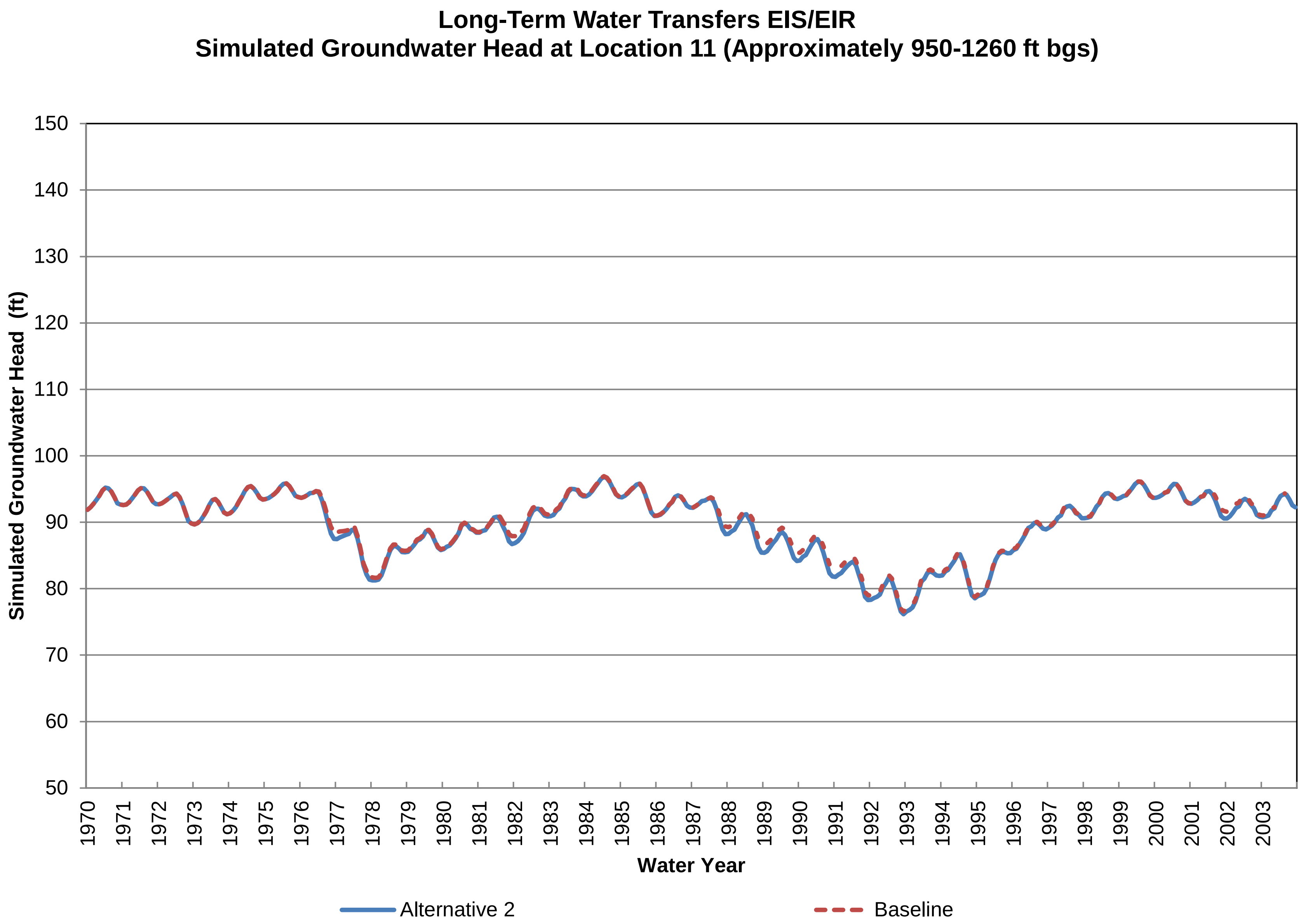
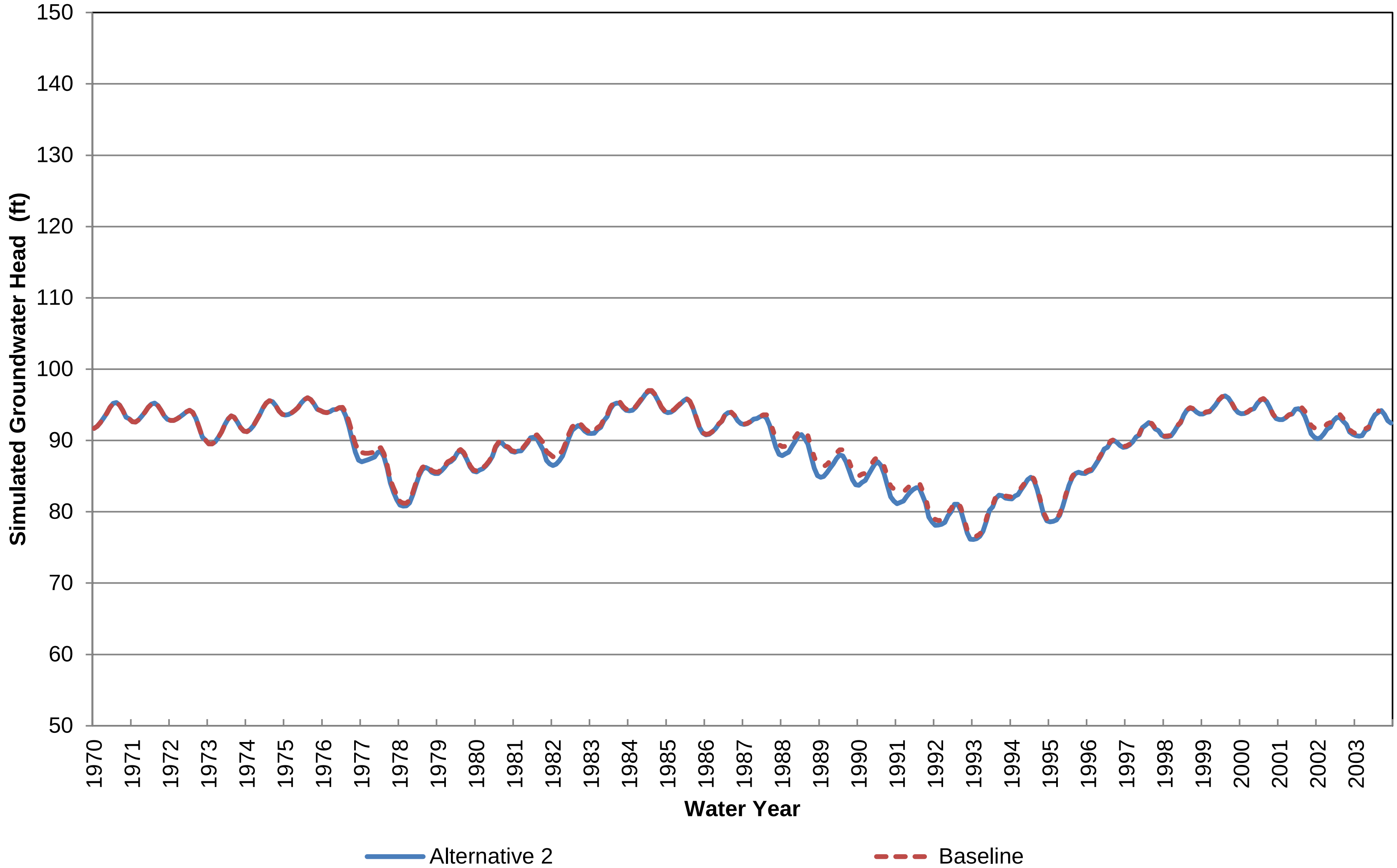
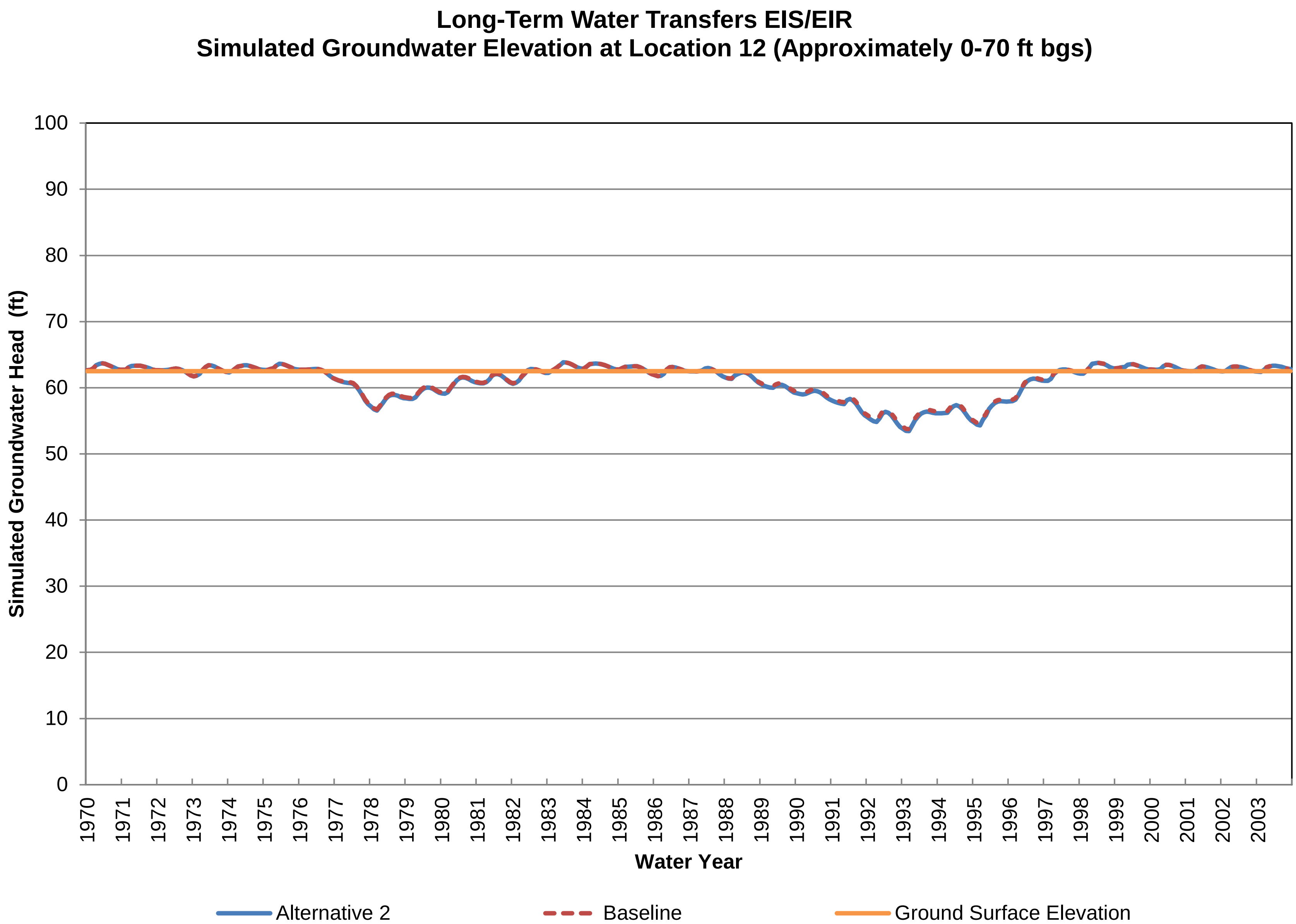
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 950-1260 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 1260-1740 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 12 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1988
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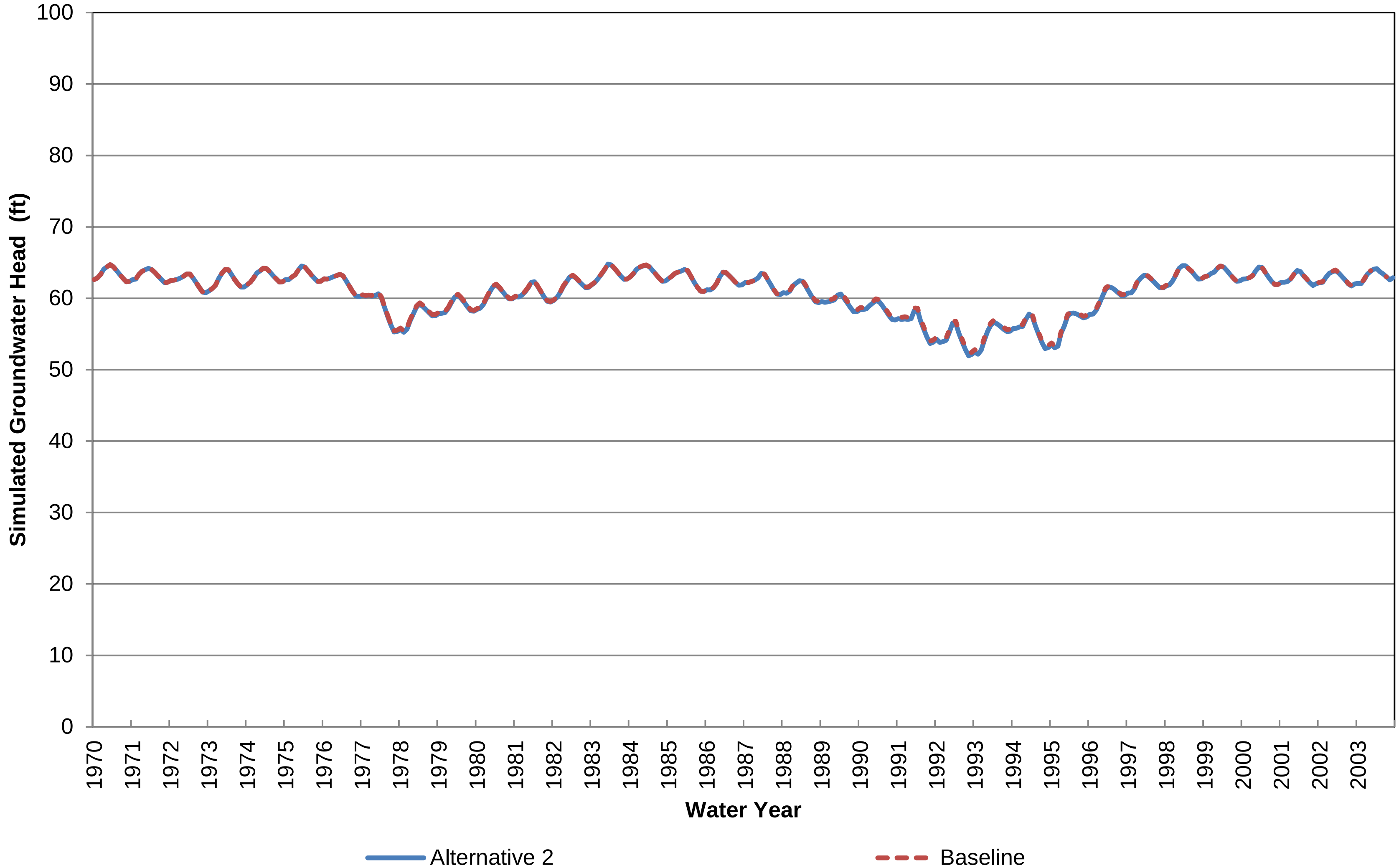
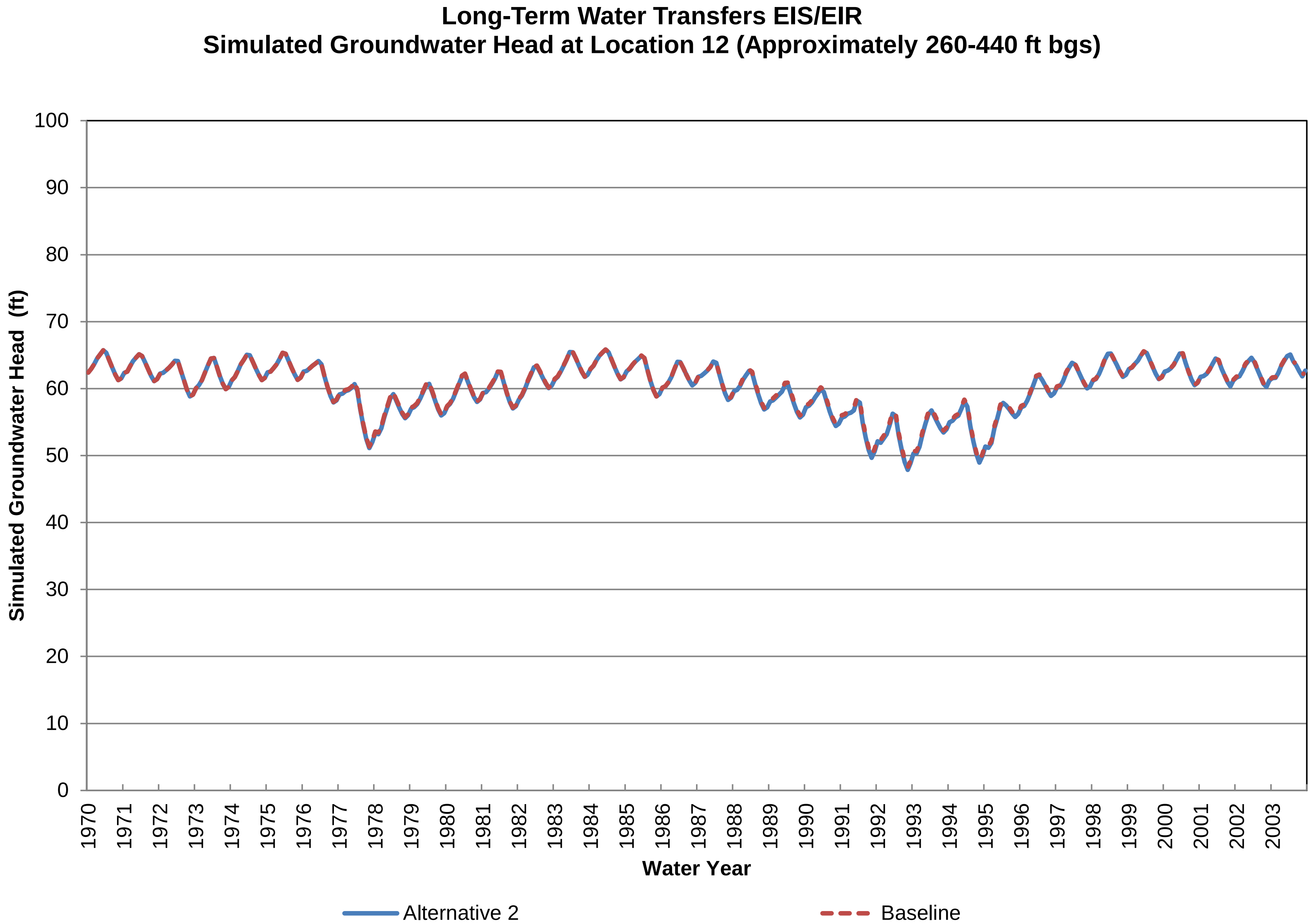
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 70-260 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 260-440 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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1988
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1992
1993
1994
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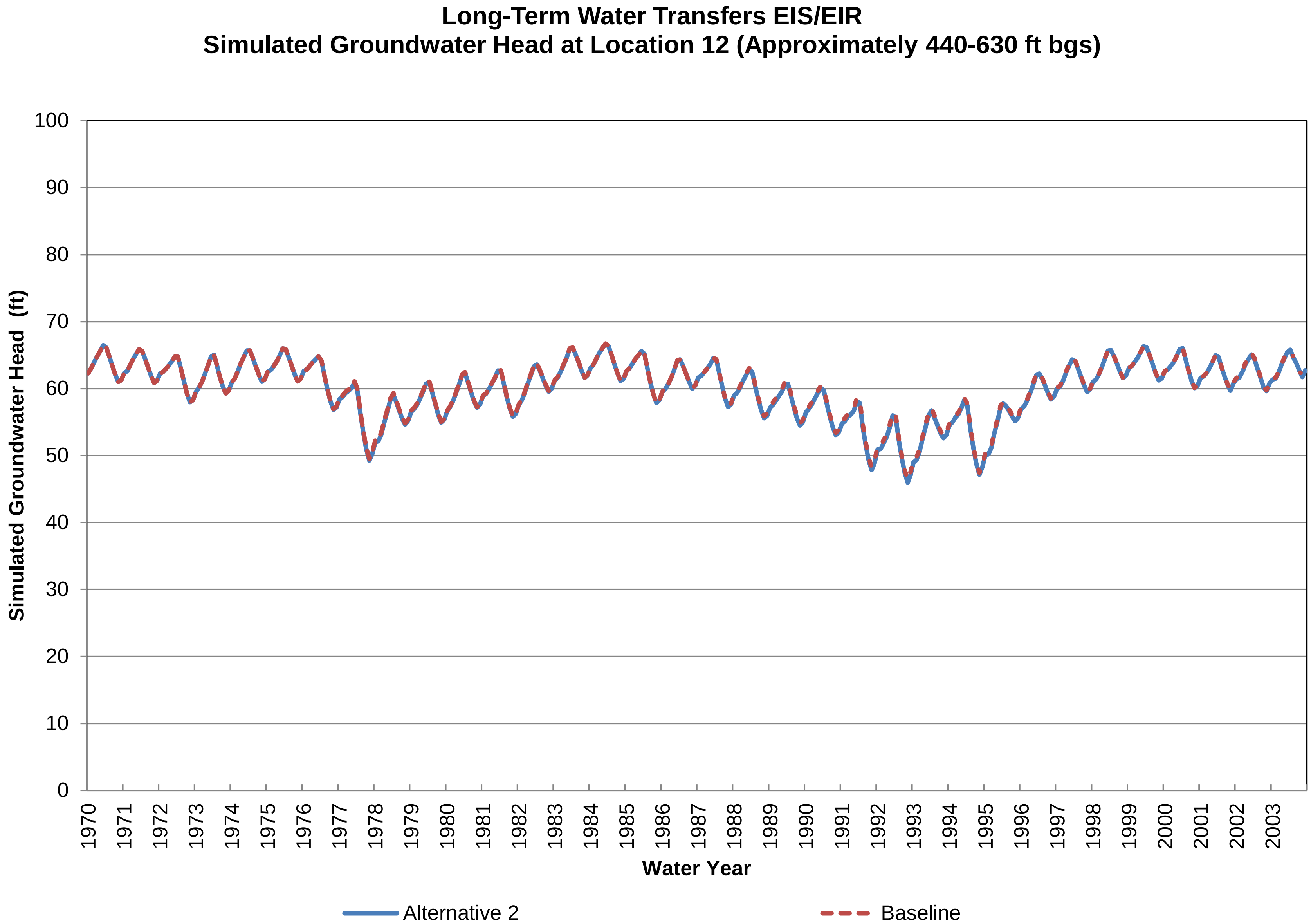
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 440-630 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1983
1984
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1993
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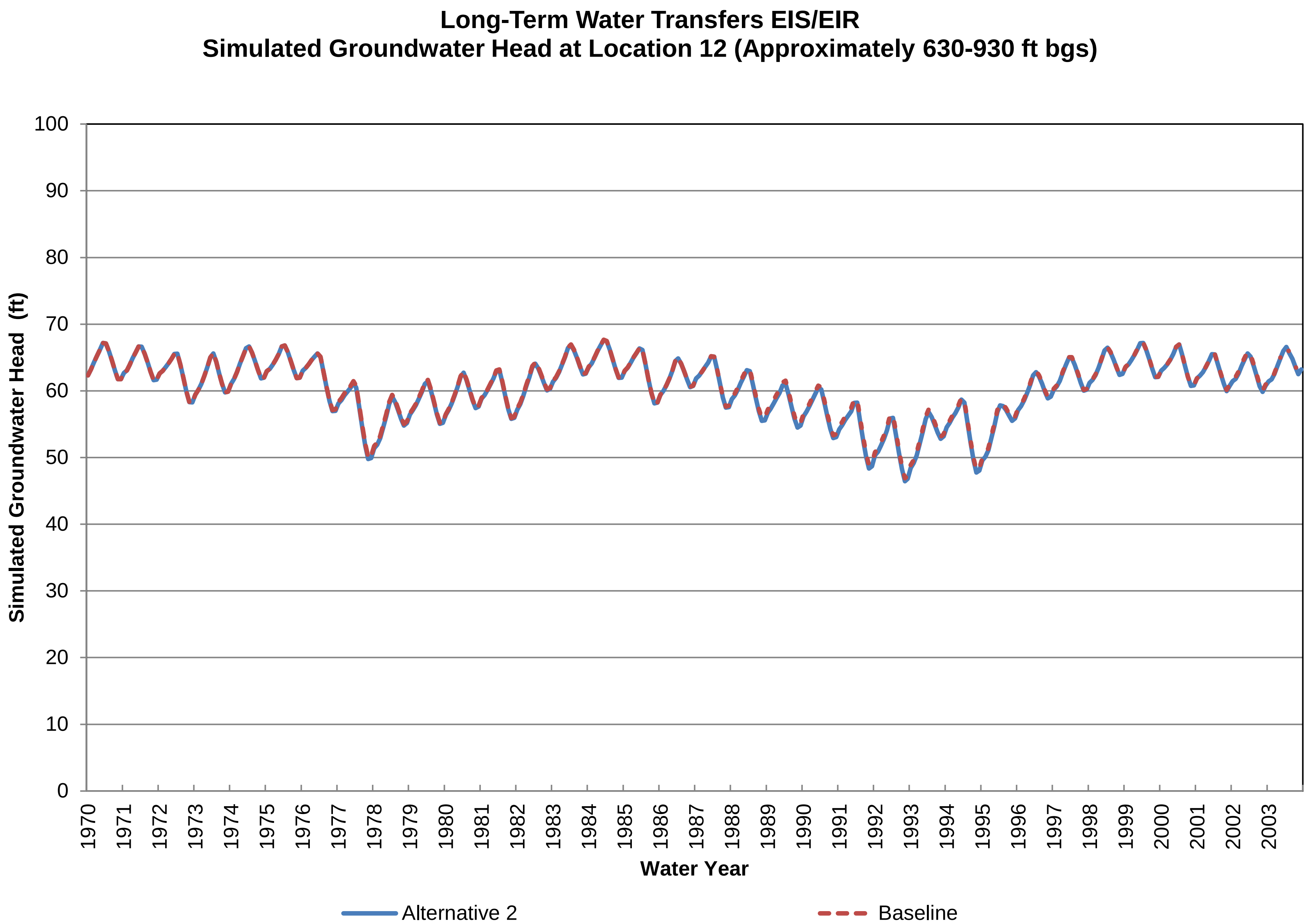
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 630-930 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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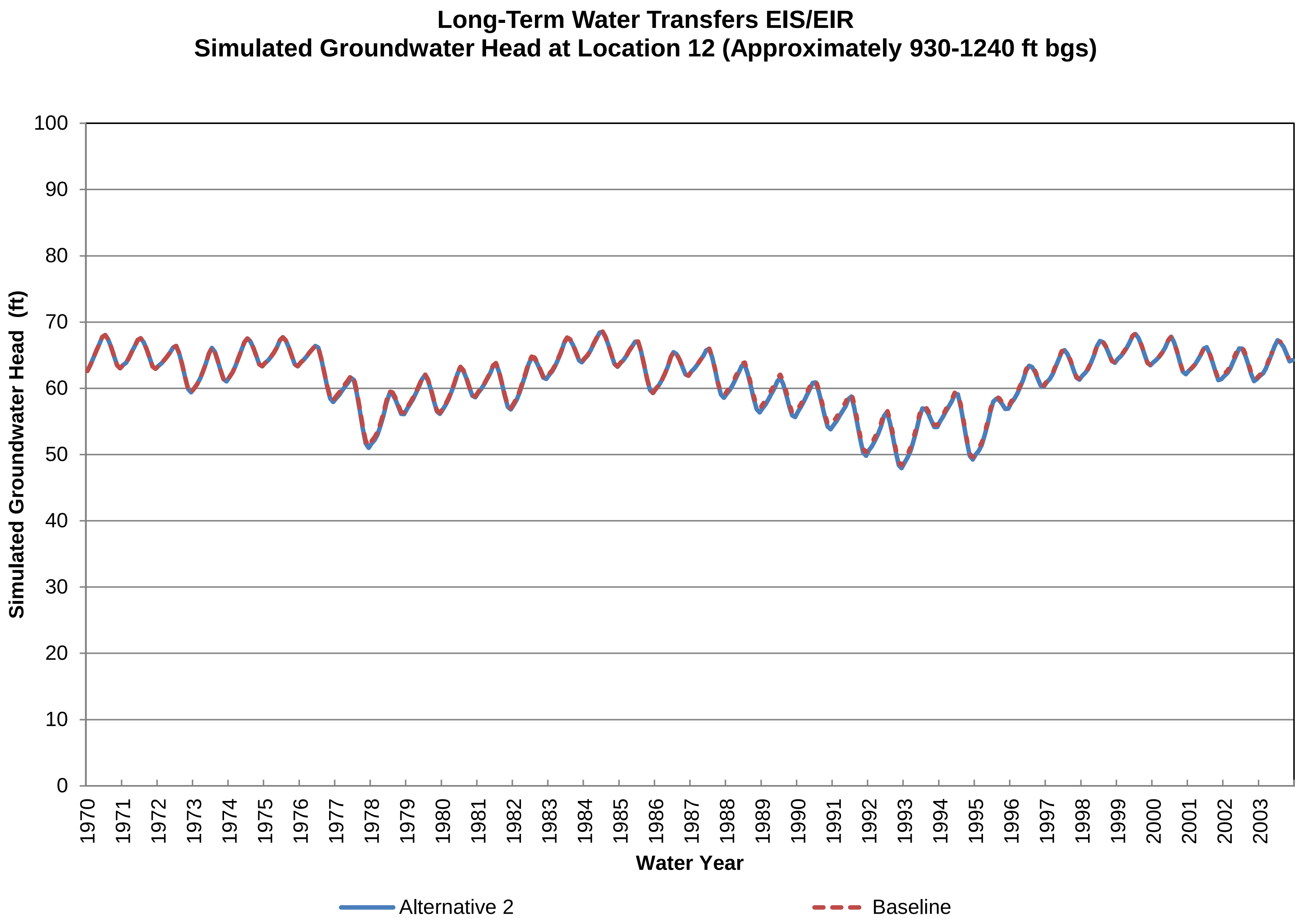
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 930-1240 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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1989
1990
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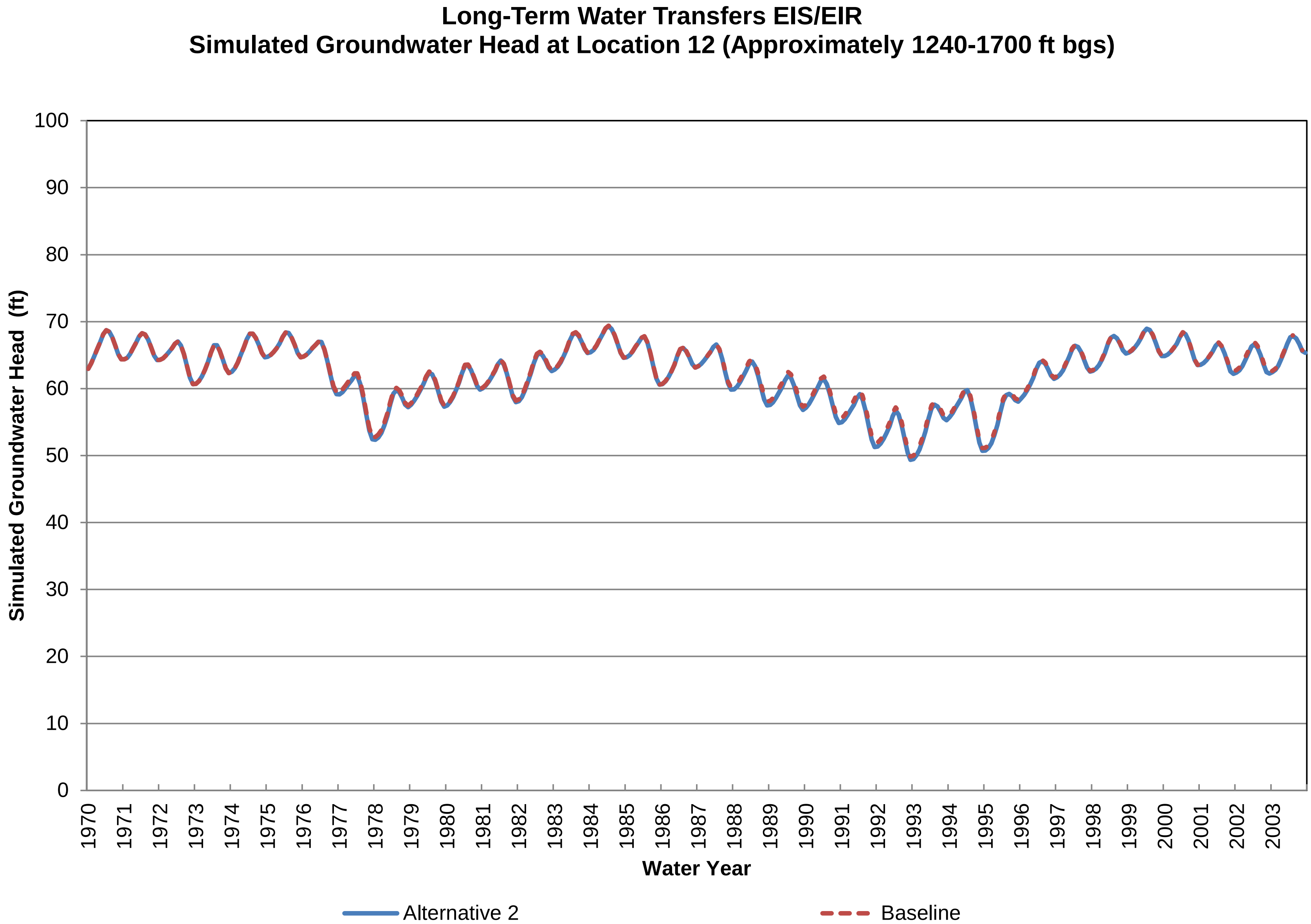
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 1240-1700 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
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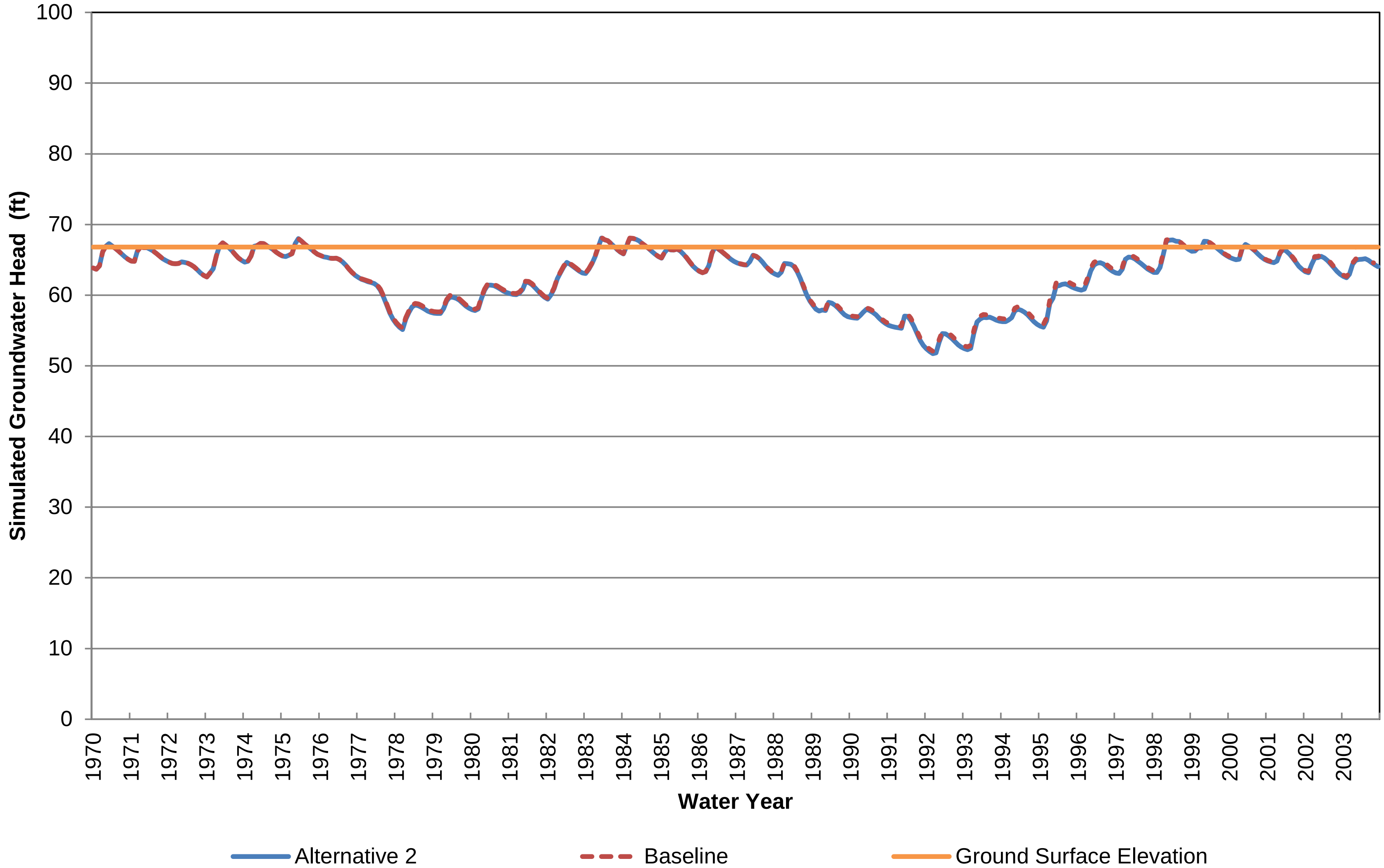
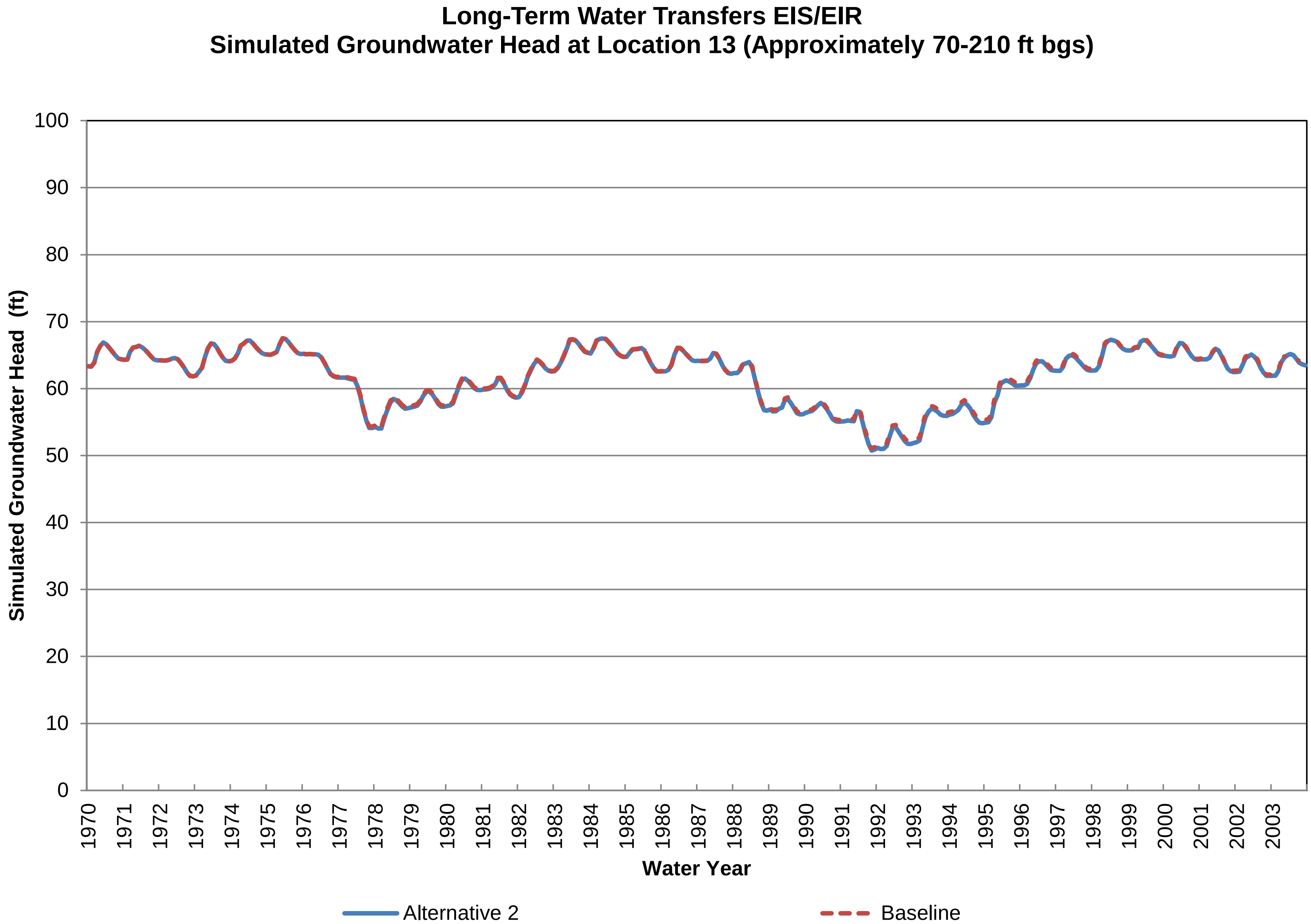
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 13 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 70-210 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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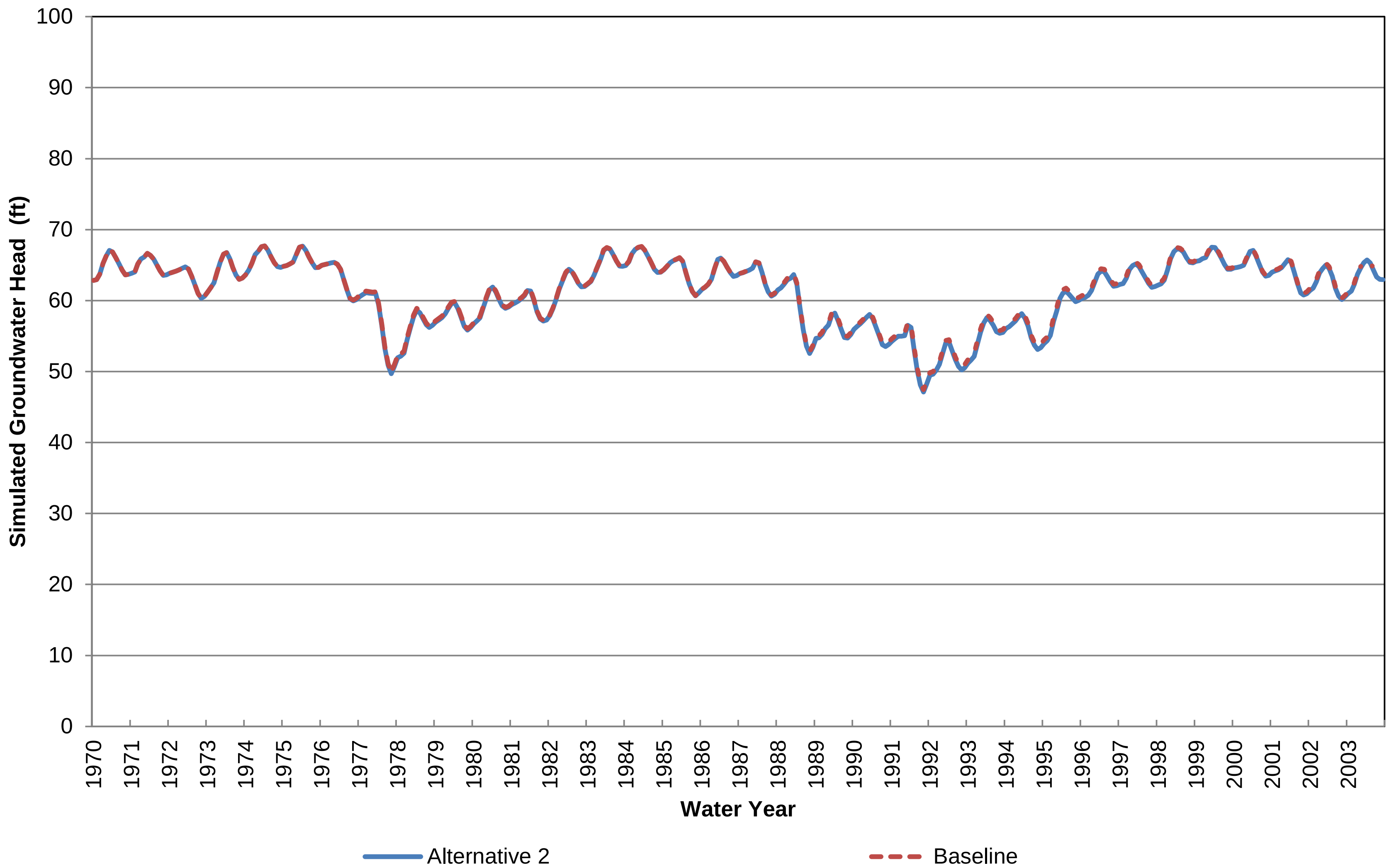
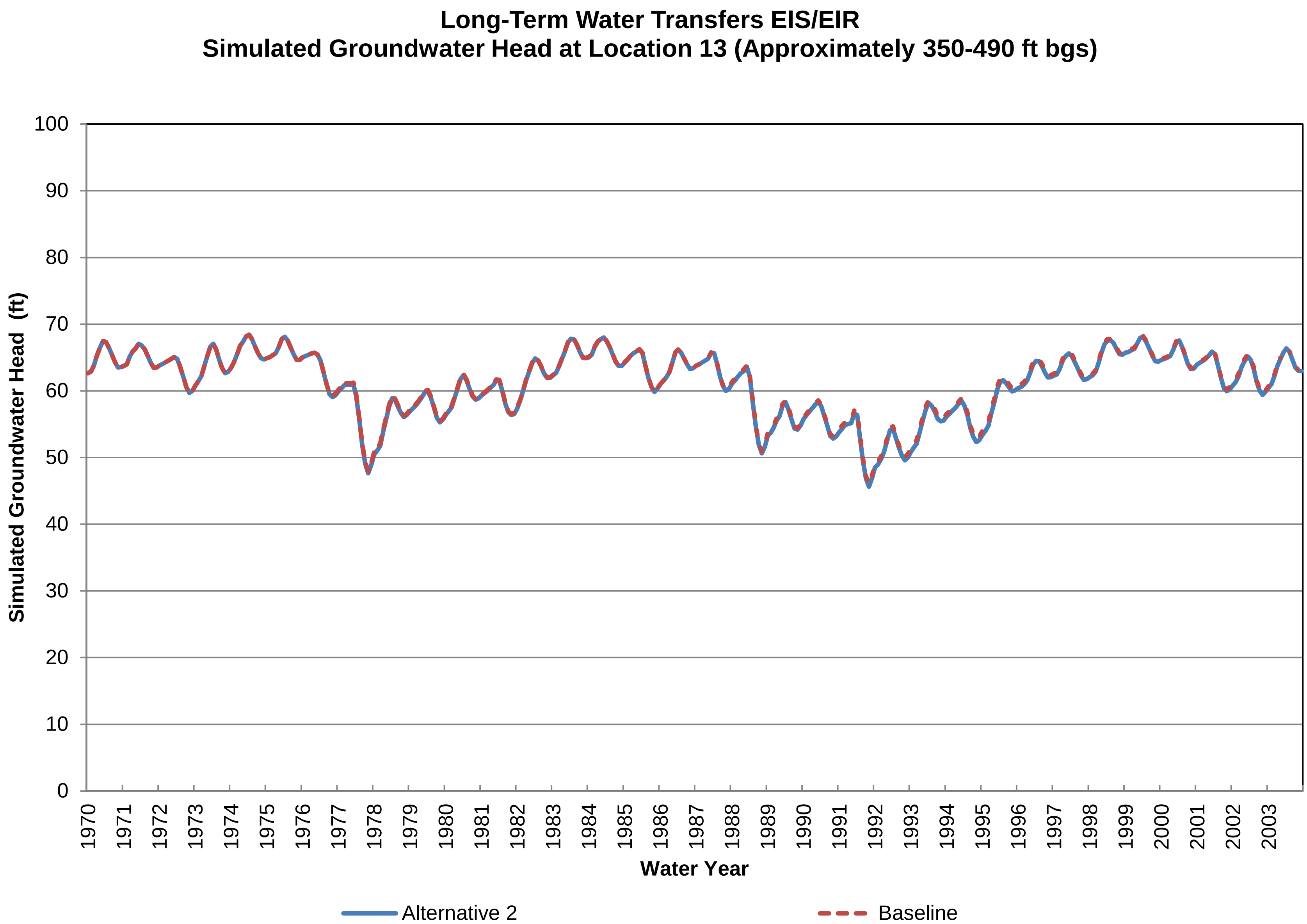
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 210-350 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 350-490 ft bgs)
100
90
80
70
60
50
40
30
20
10
0
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1989
1990
1991
1992
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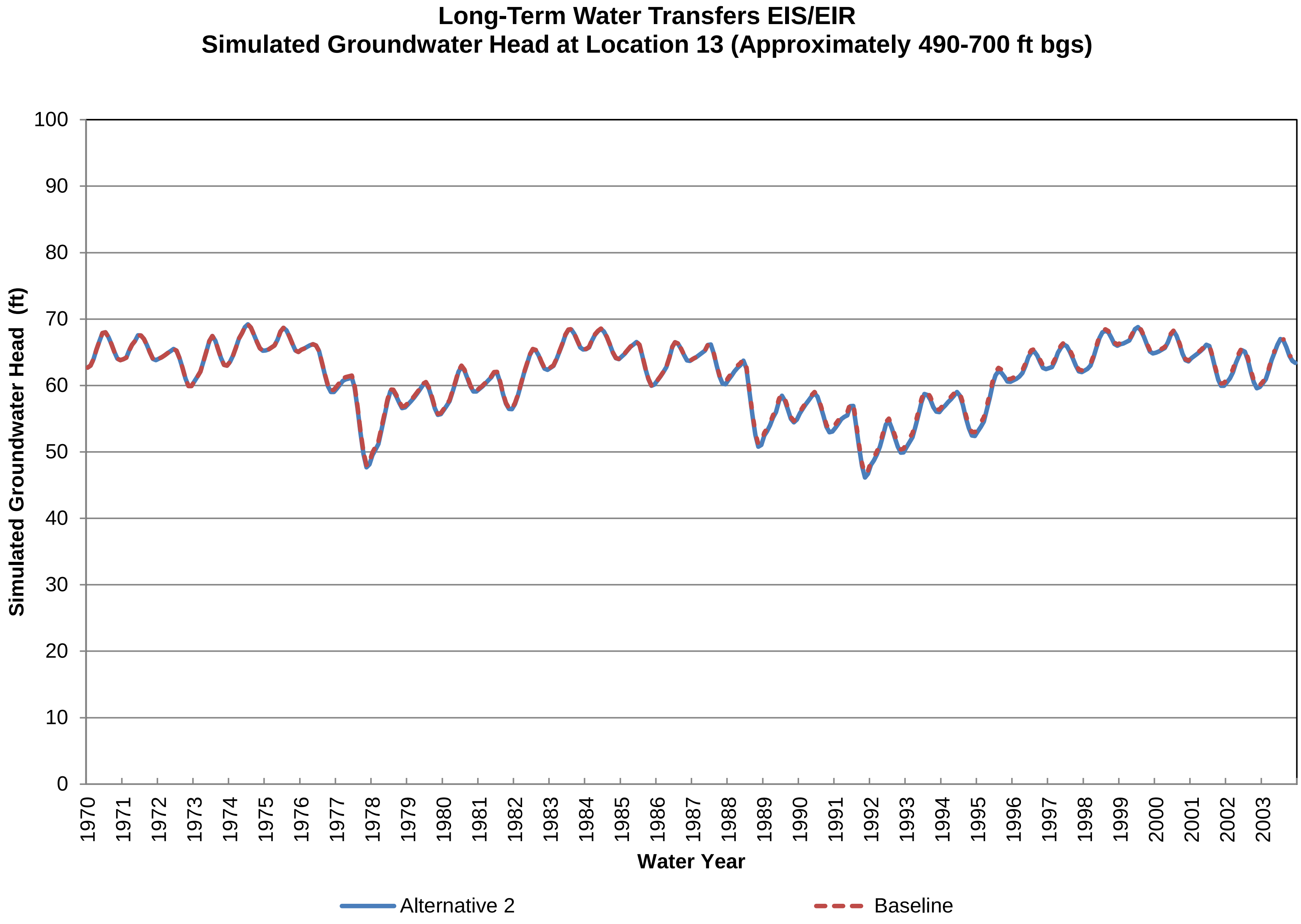
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 490-700 ft bgs)
100
90
80
70
60
50
40
30
20
10
0
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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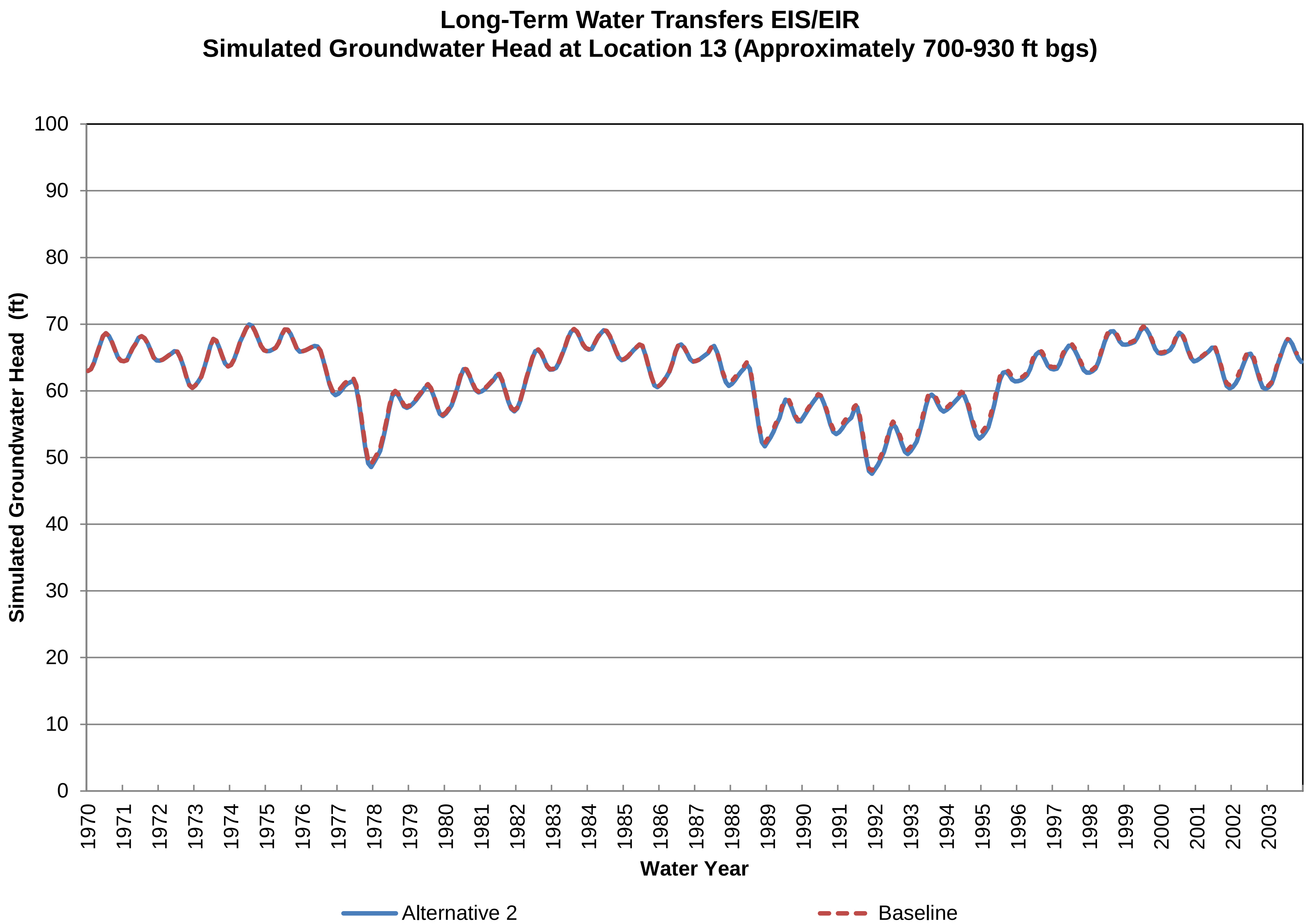
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 700-930 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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1984
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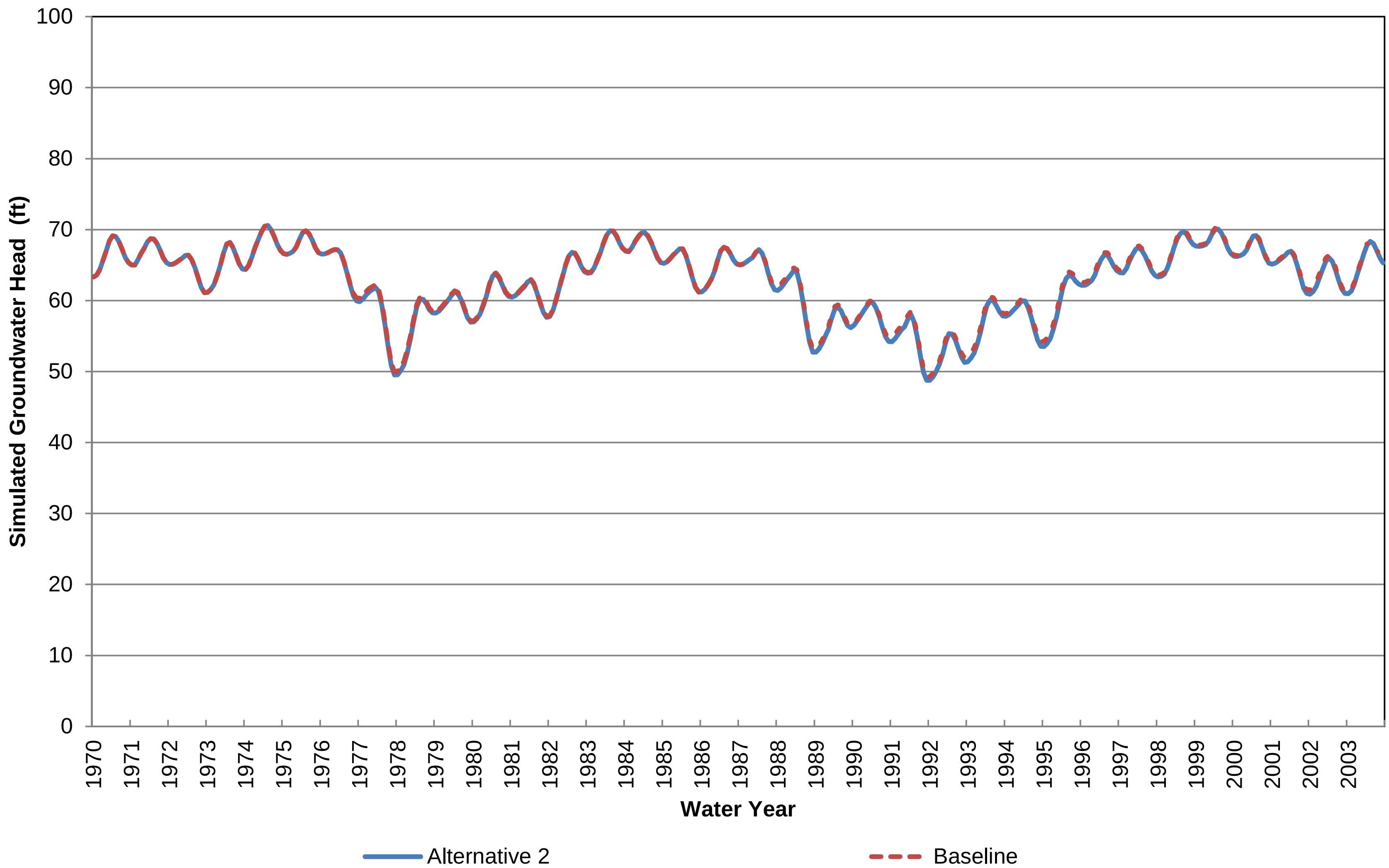
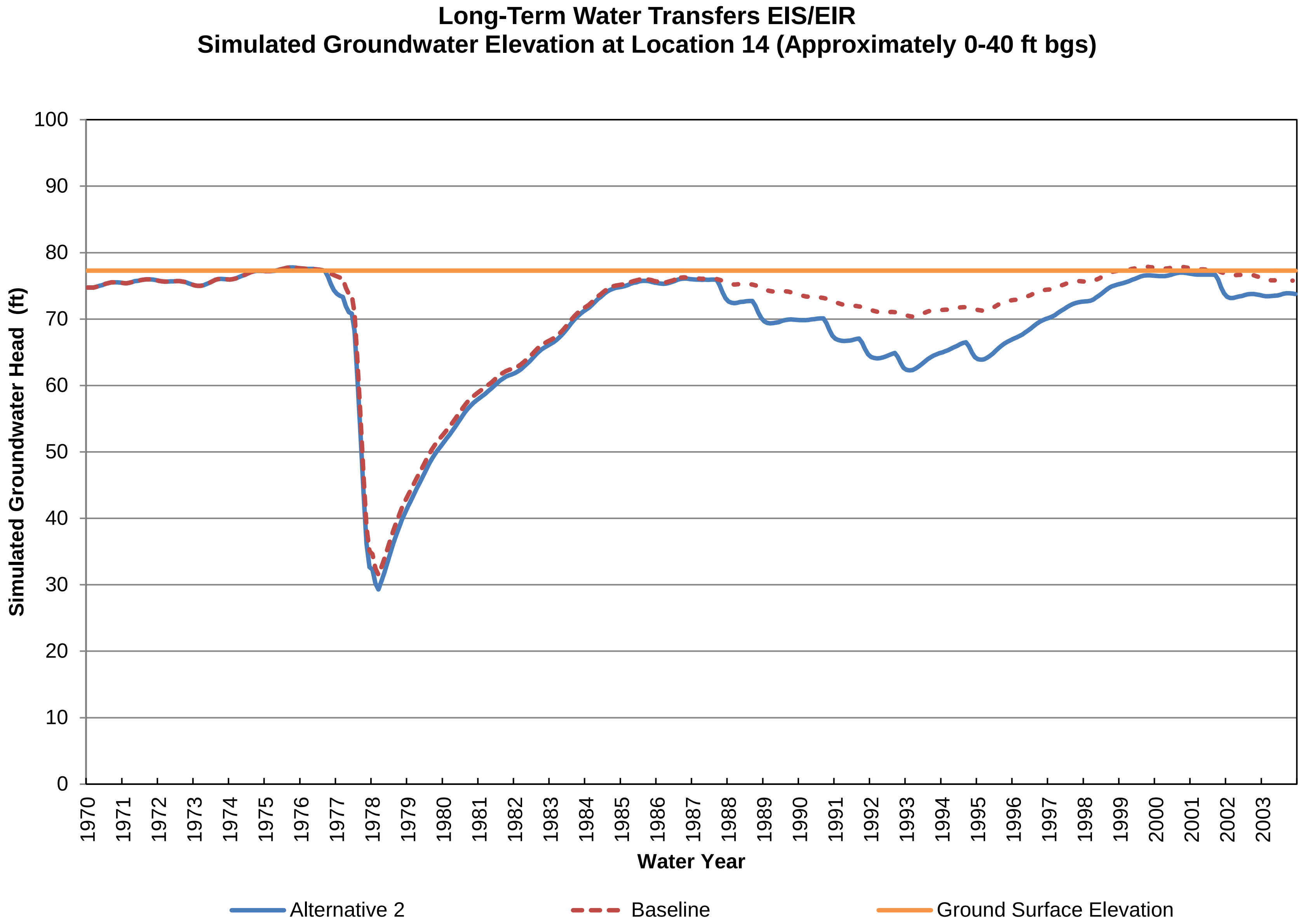
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 930-1280 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 14 (Approximately 0-40 ft bgs)
100
90
80
70
60
50
40
30
20
10
0
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
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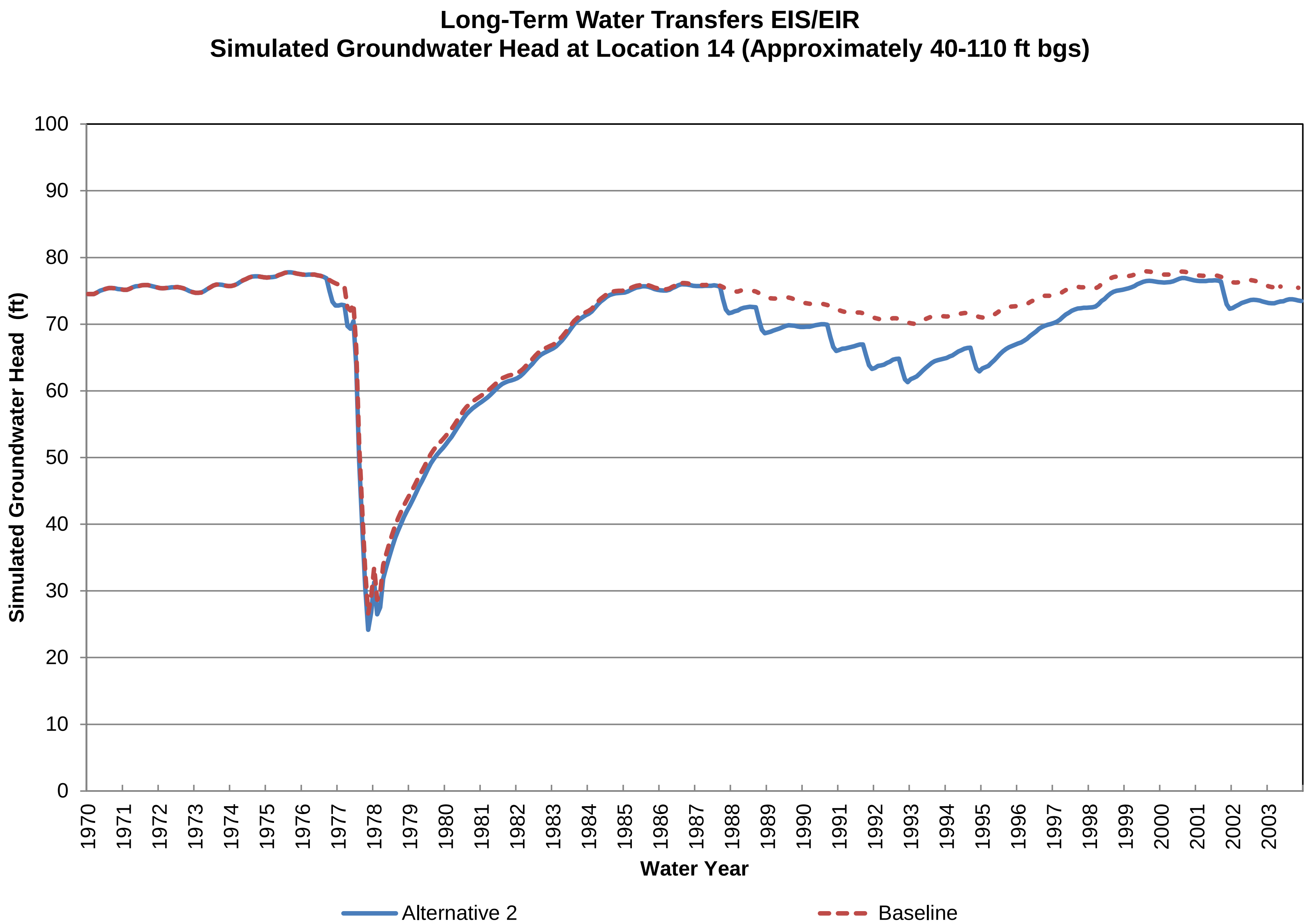
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 40-110 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
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1979
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1989
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1994
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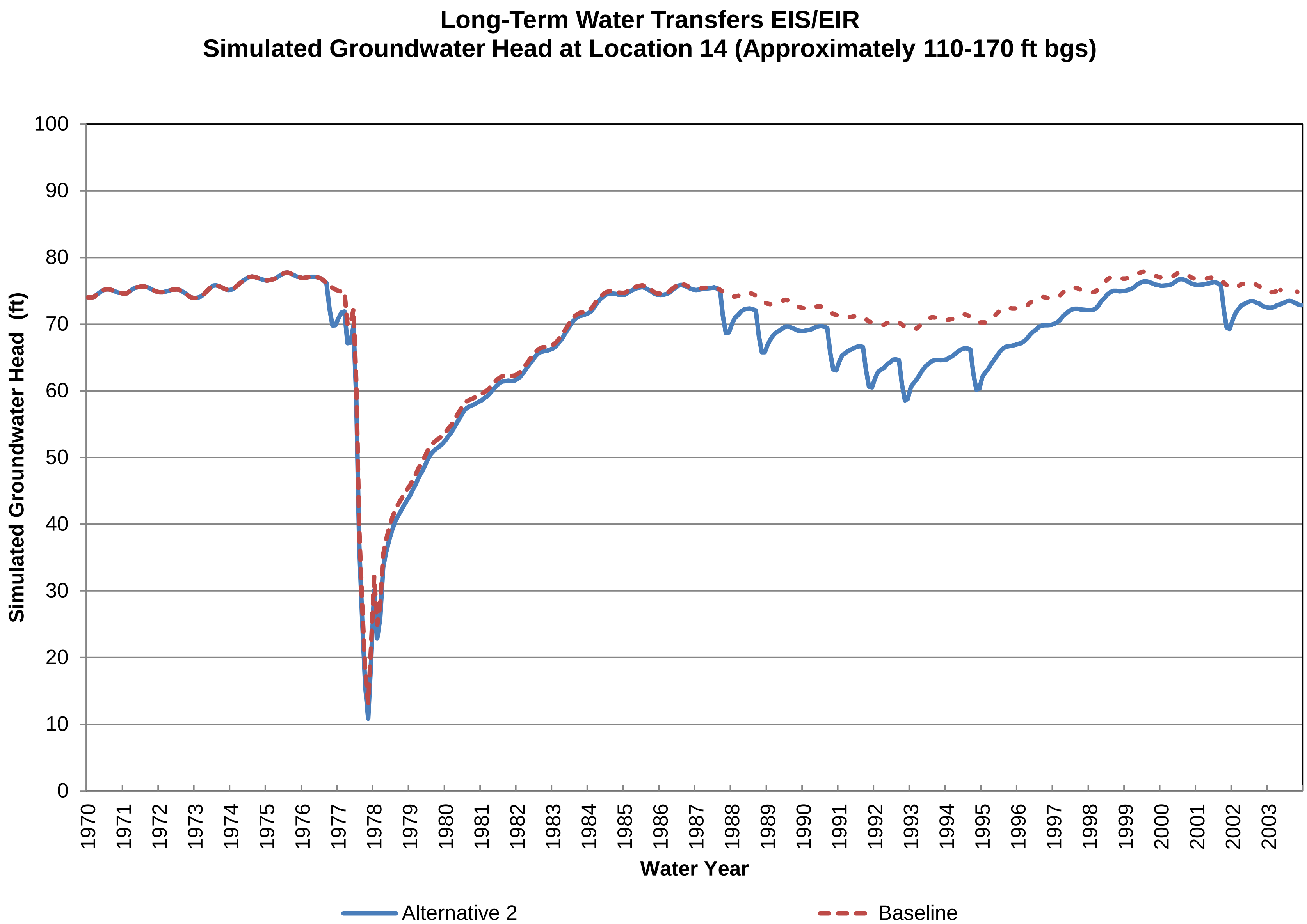
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 110-170 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
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1976
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1978
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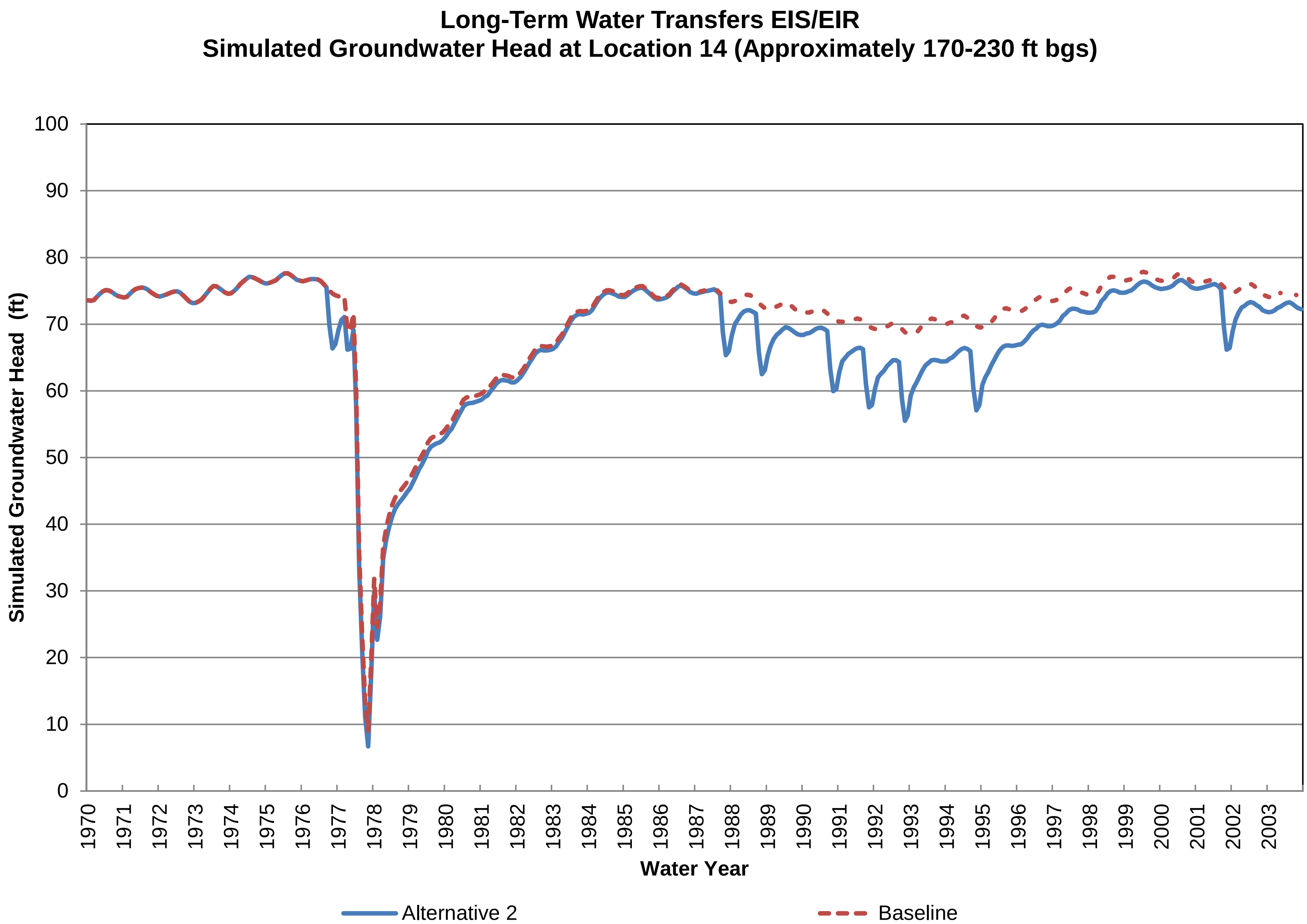
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 170-230 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
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1979
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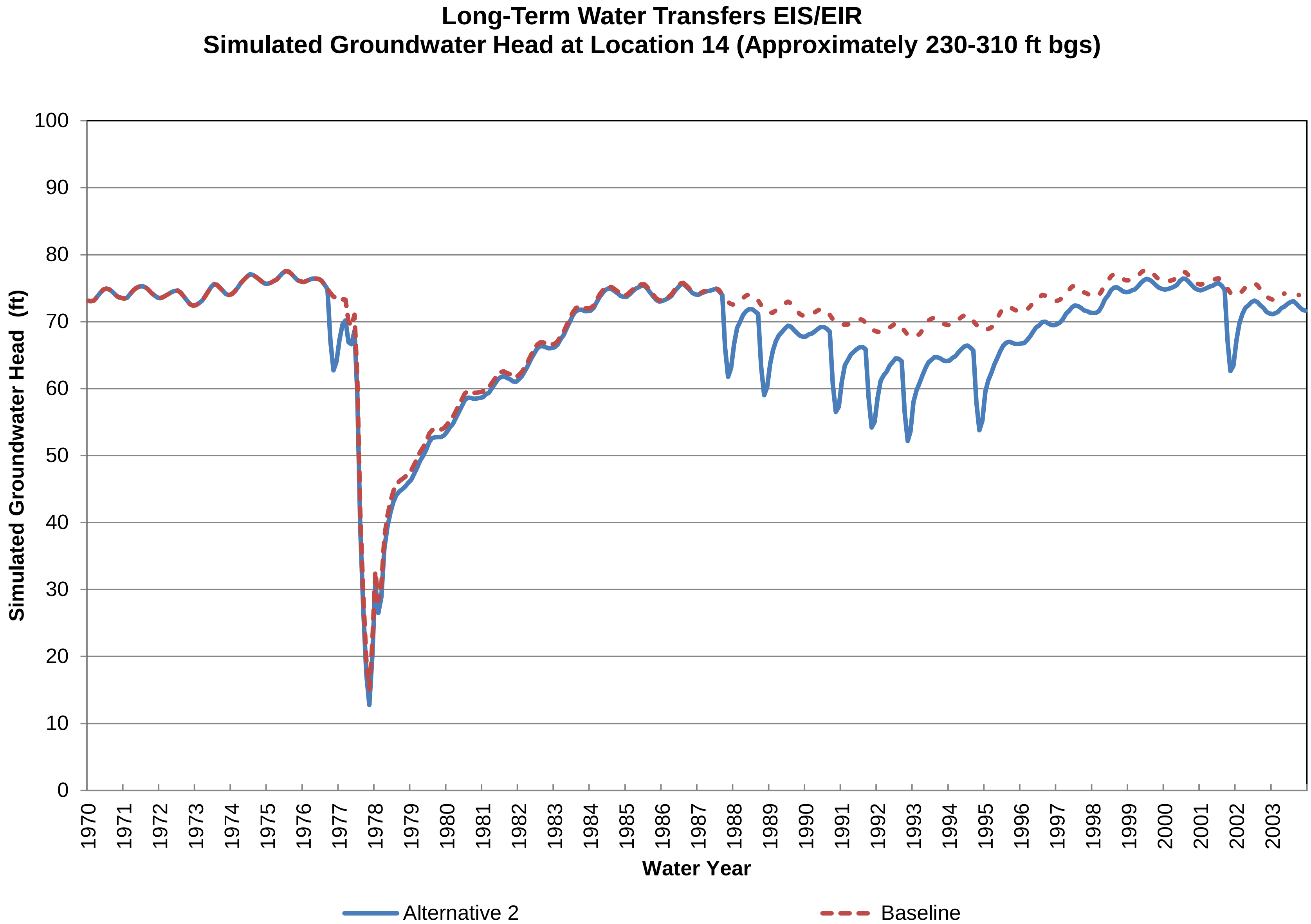
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 230-310 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
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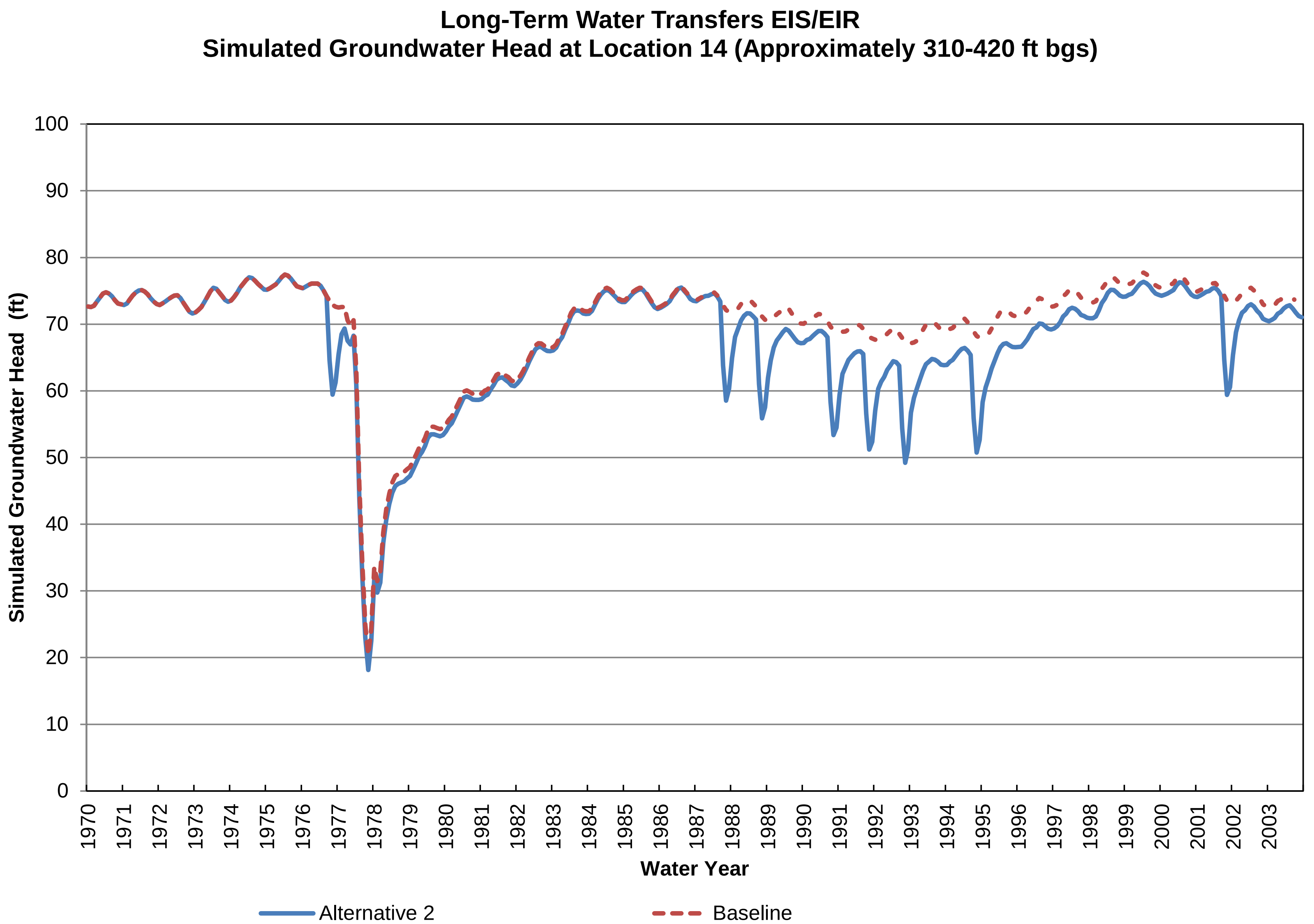
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 310-420 ft bgs)
100
90
80
70
60
50
40
30
20
10
0
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1983
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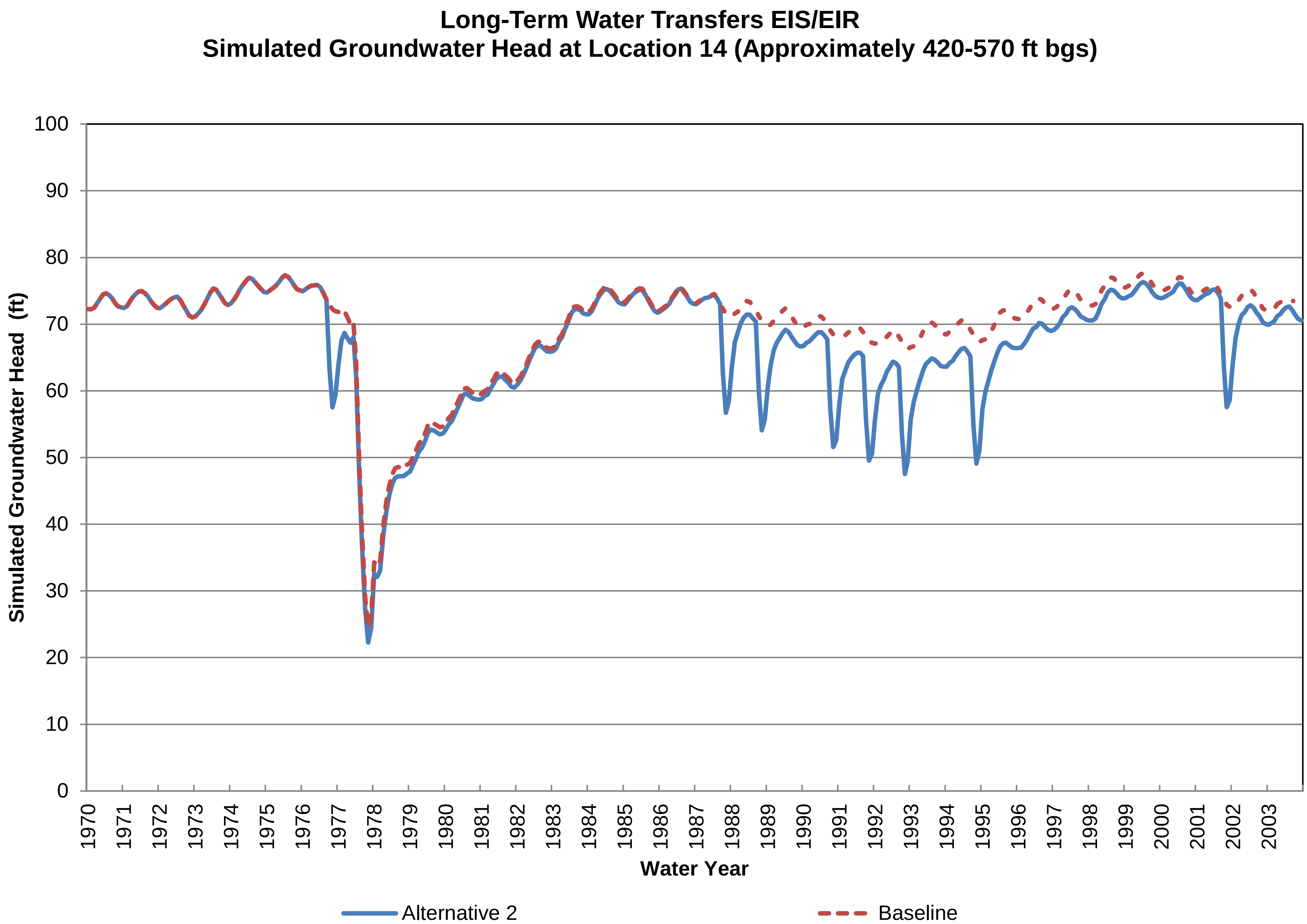
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 420-570 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
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1992
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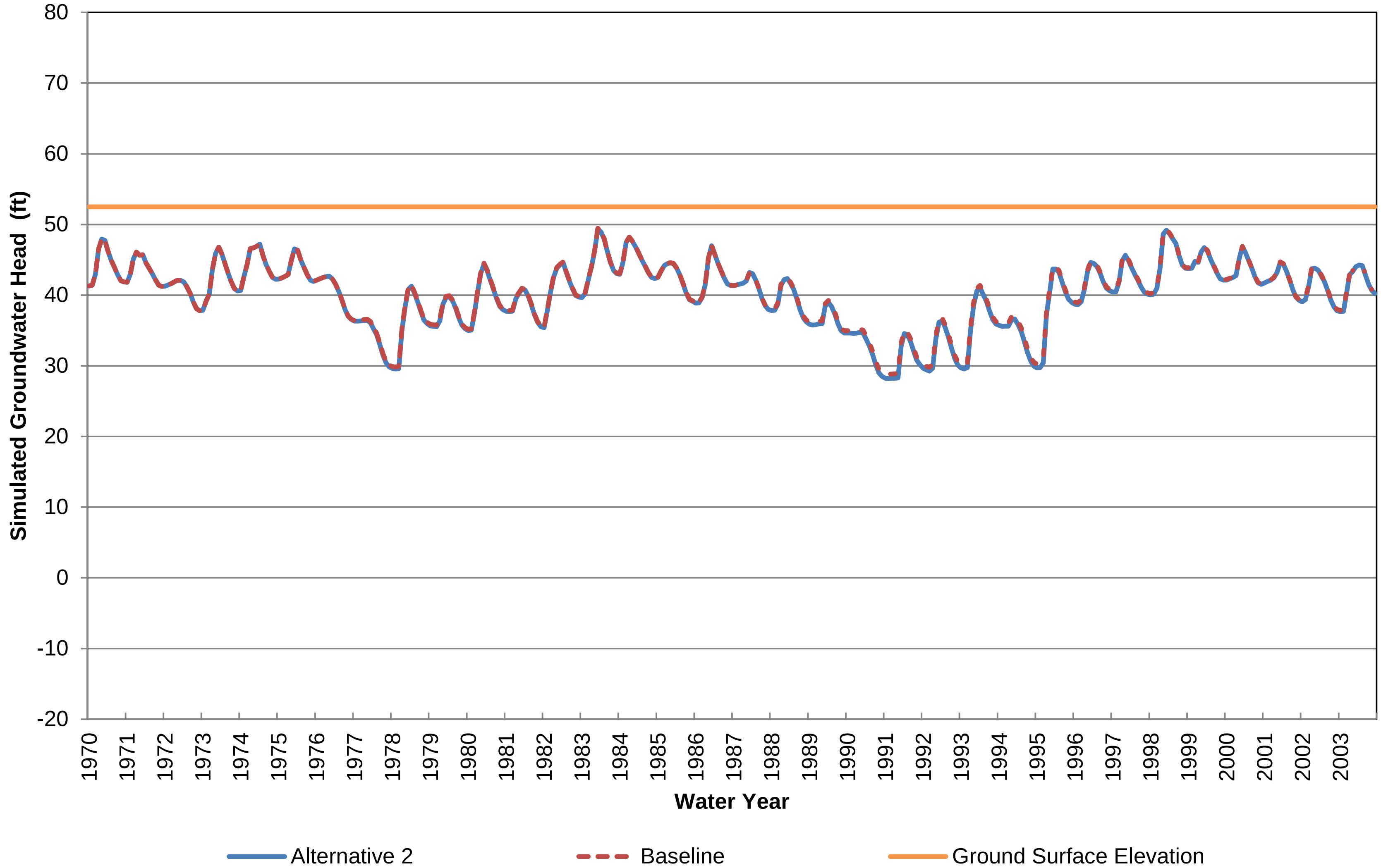
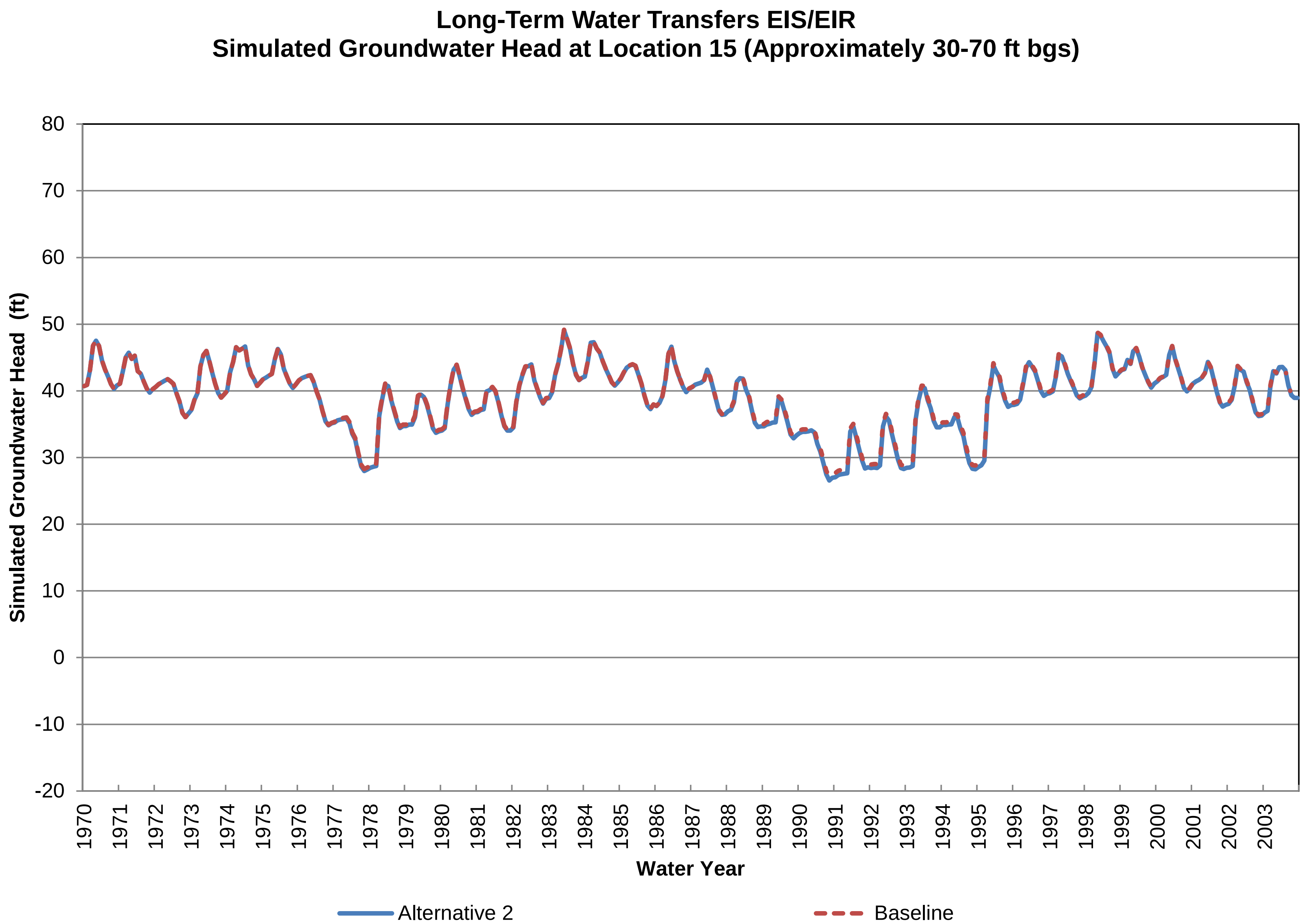
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 15 (Approximately 0-30 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 30-70 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
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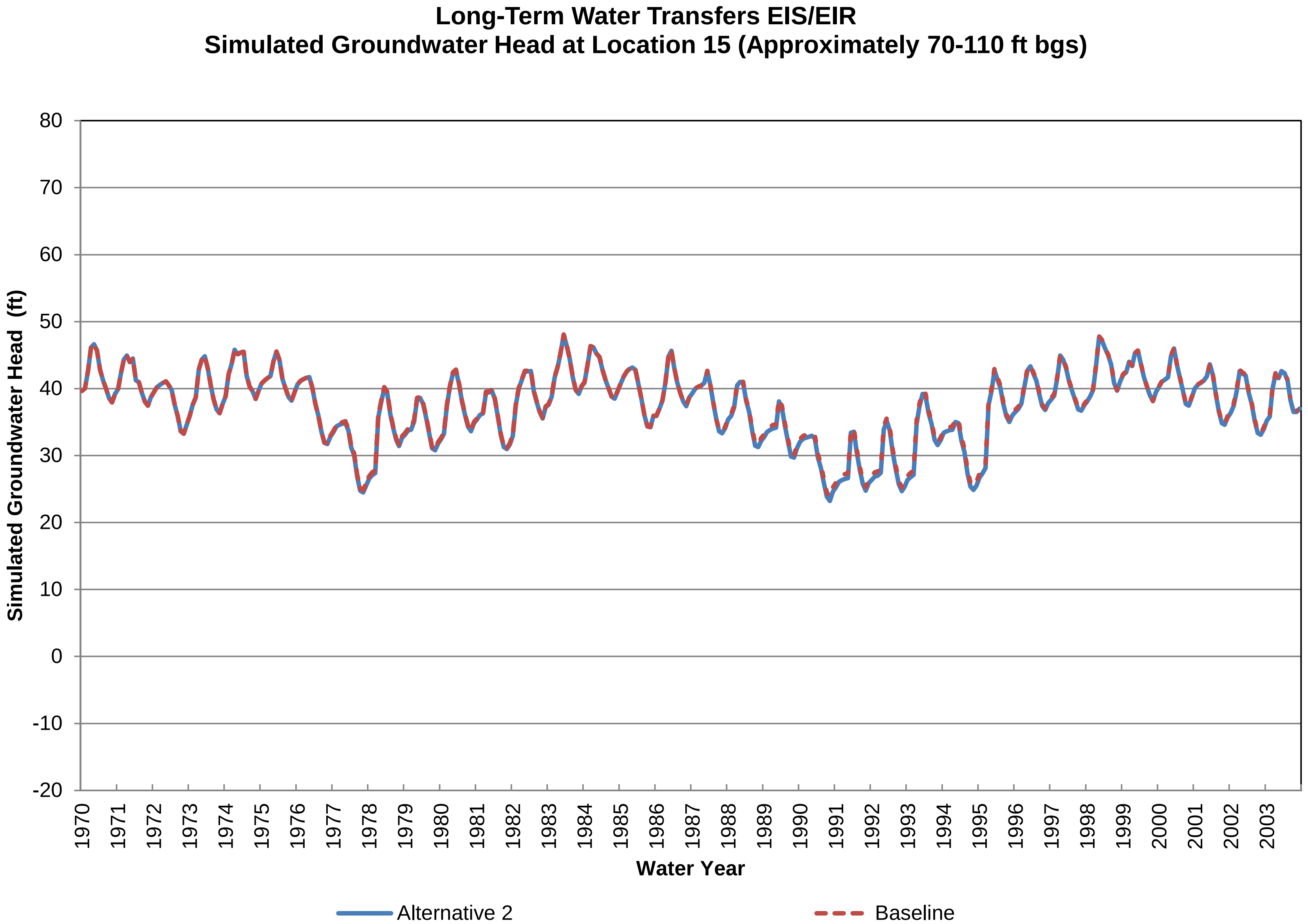
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 70-110 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1987
1988
1989
1990
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1994
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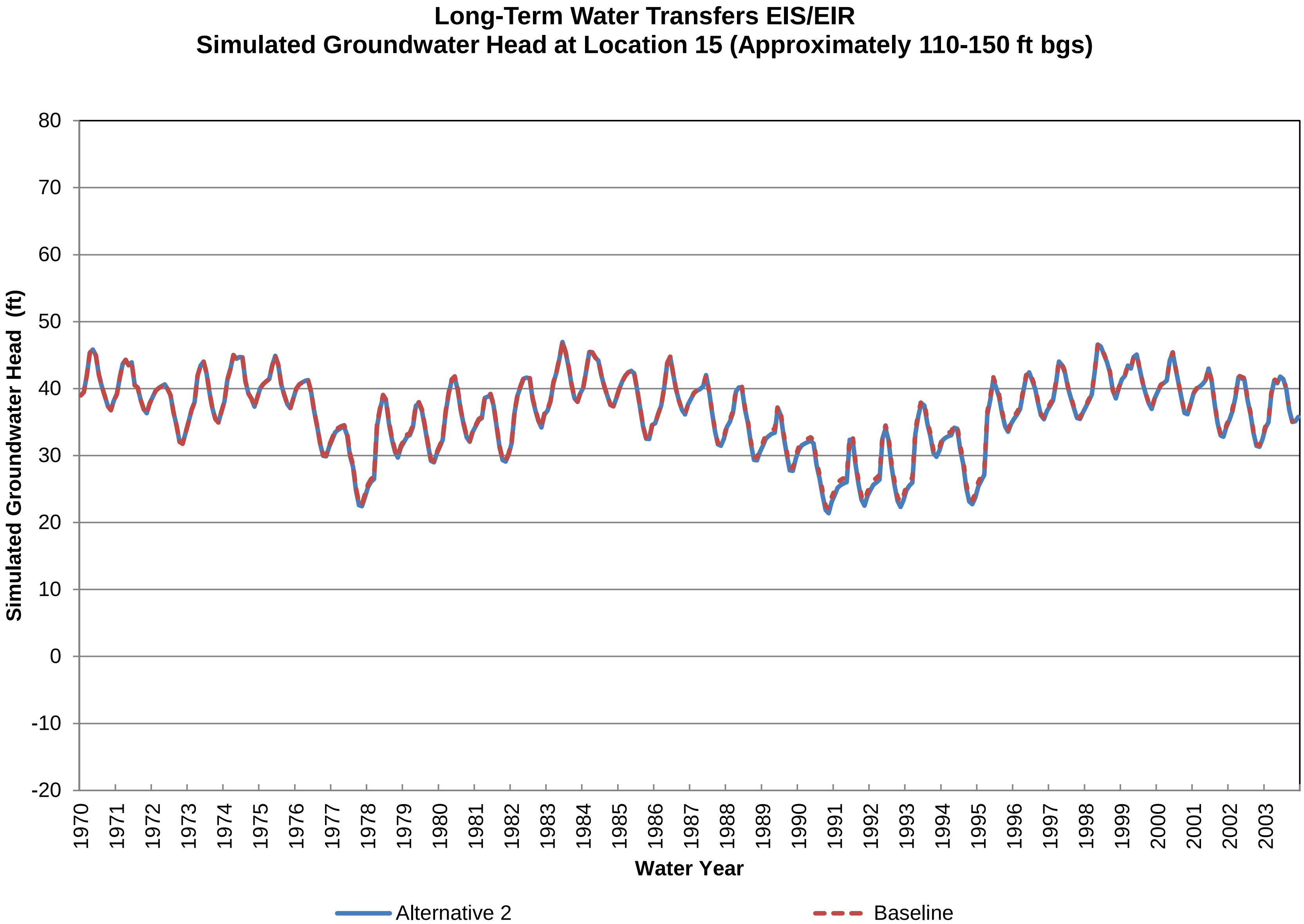
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 110-150 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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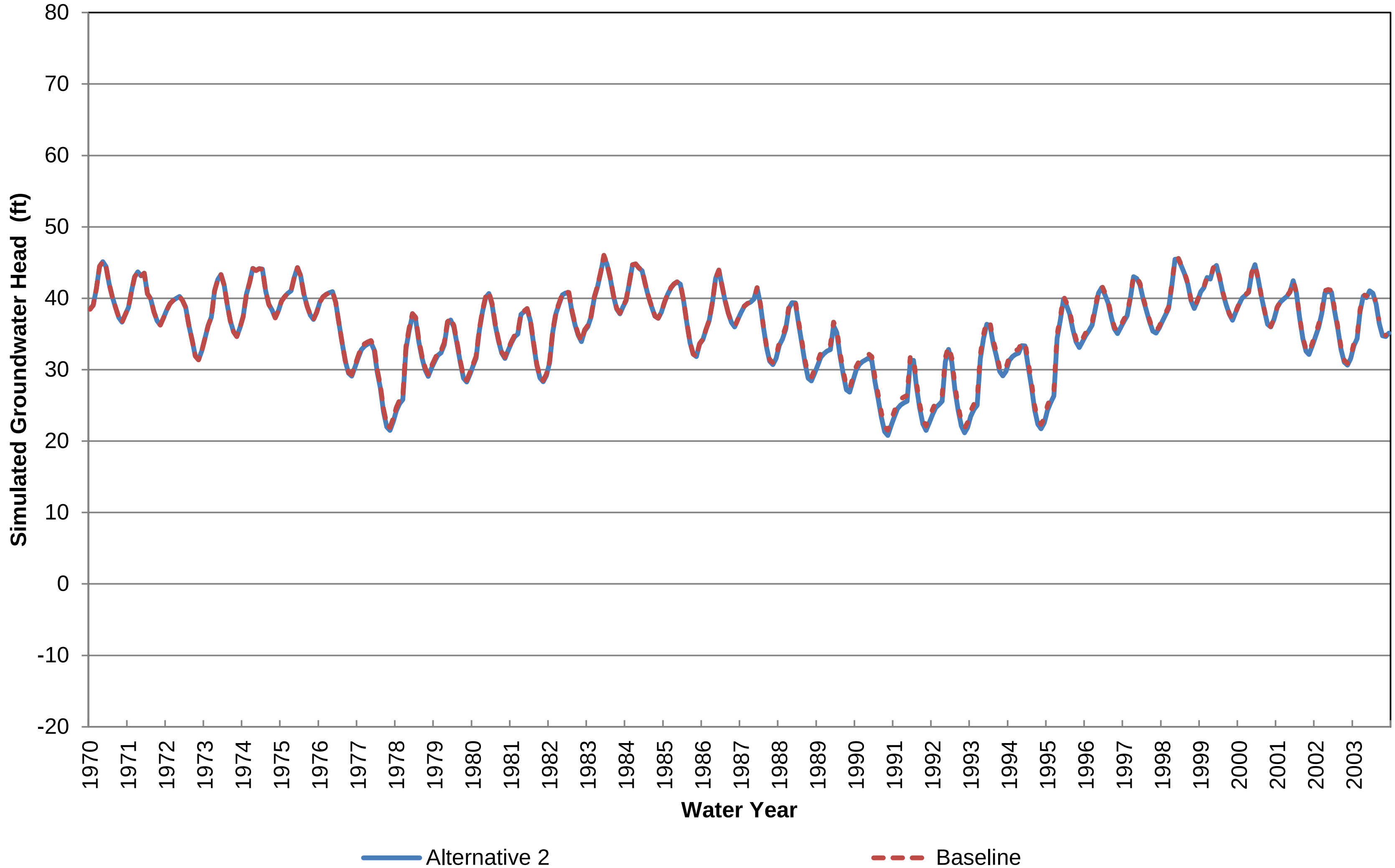
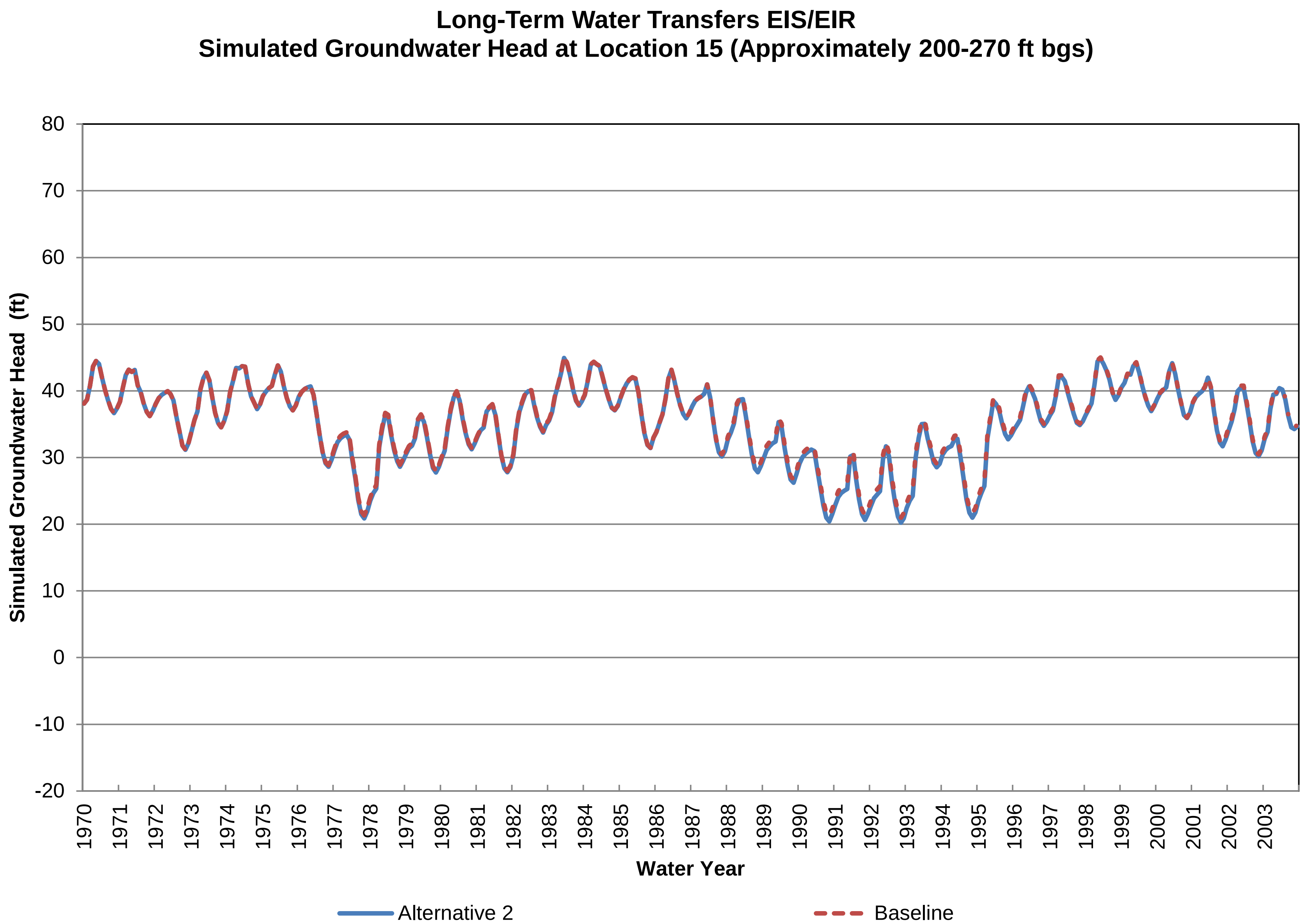
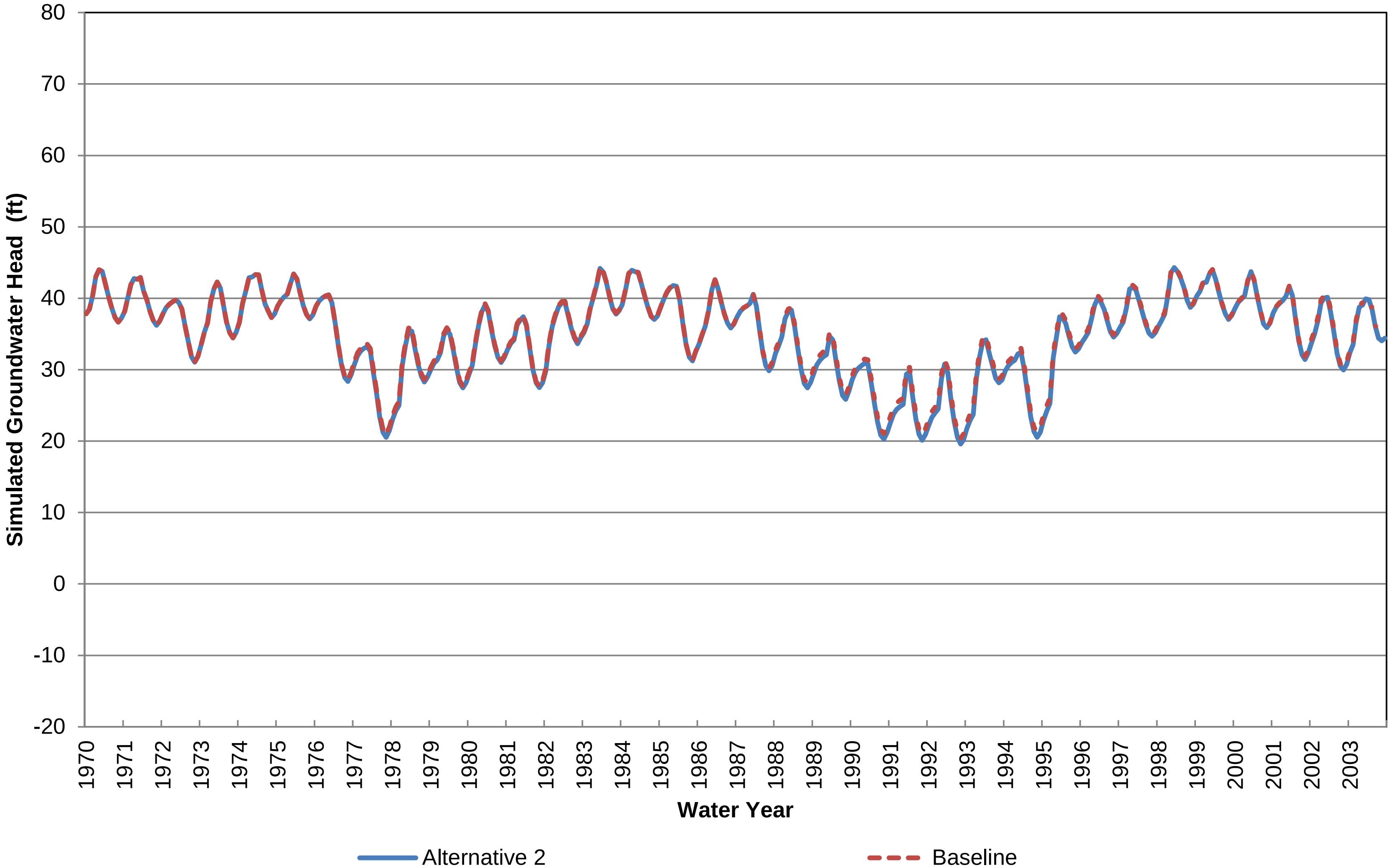
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

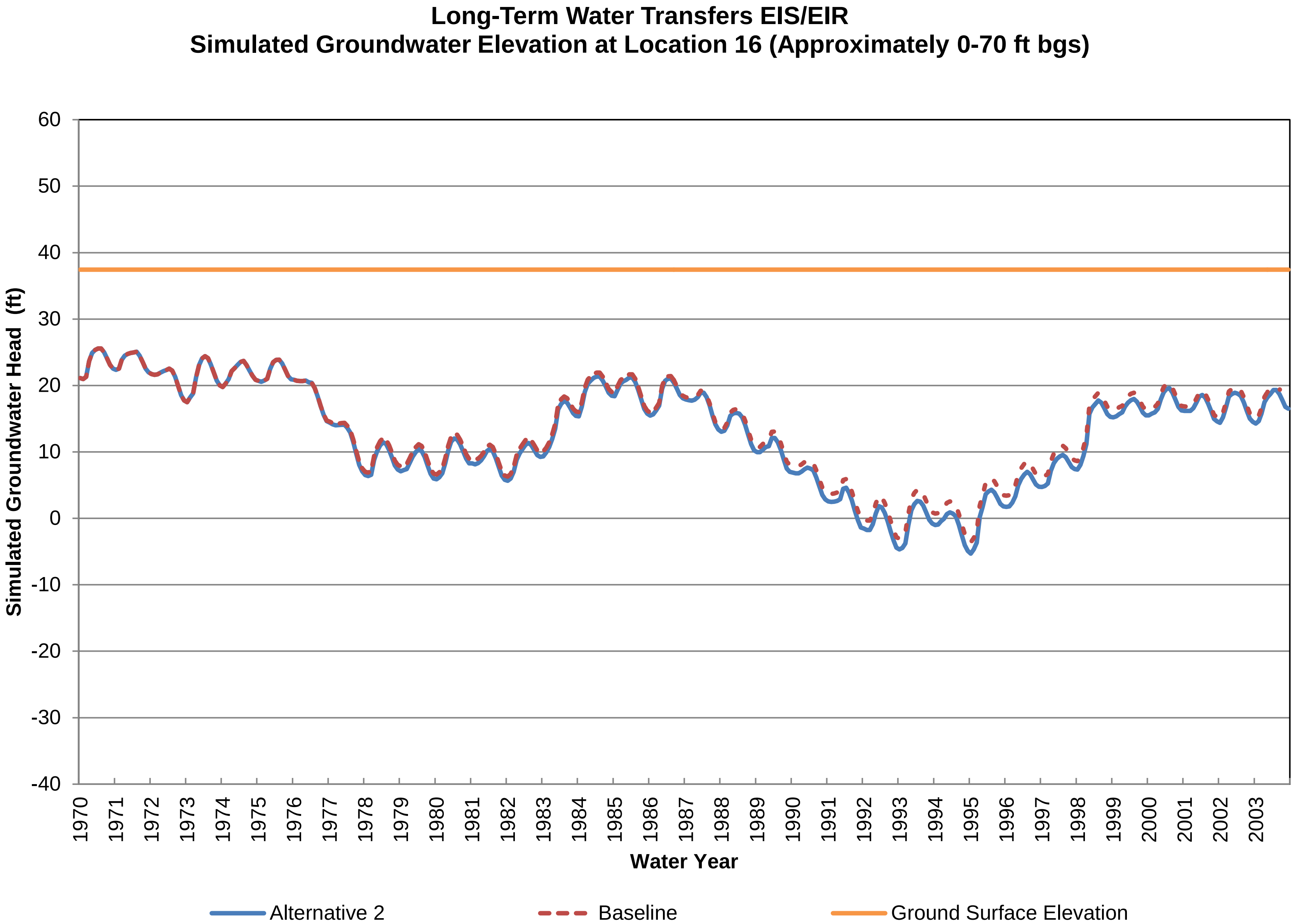
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 150-200 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 200-270 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 270-360 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 16 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
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1978
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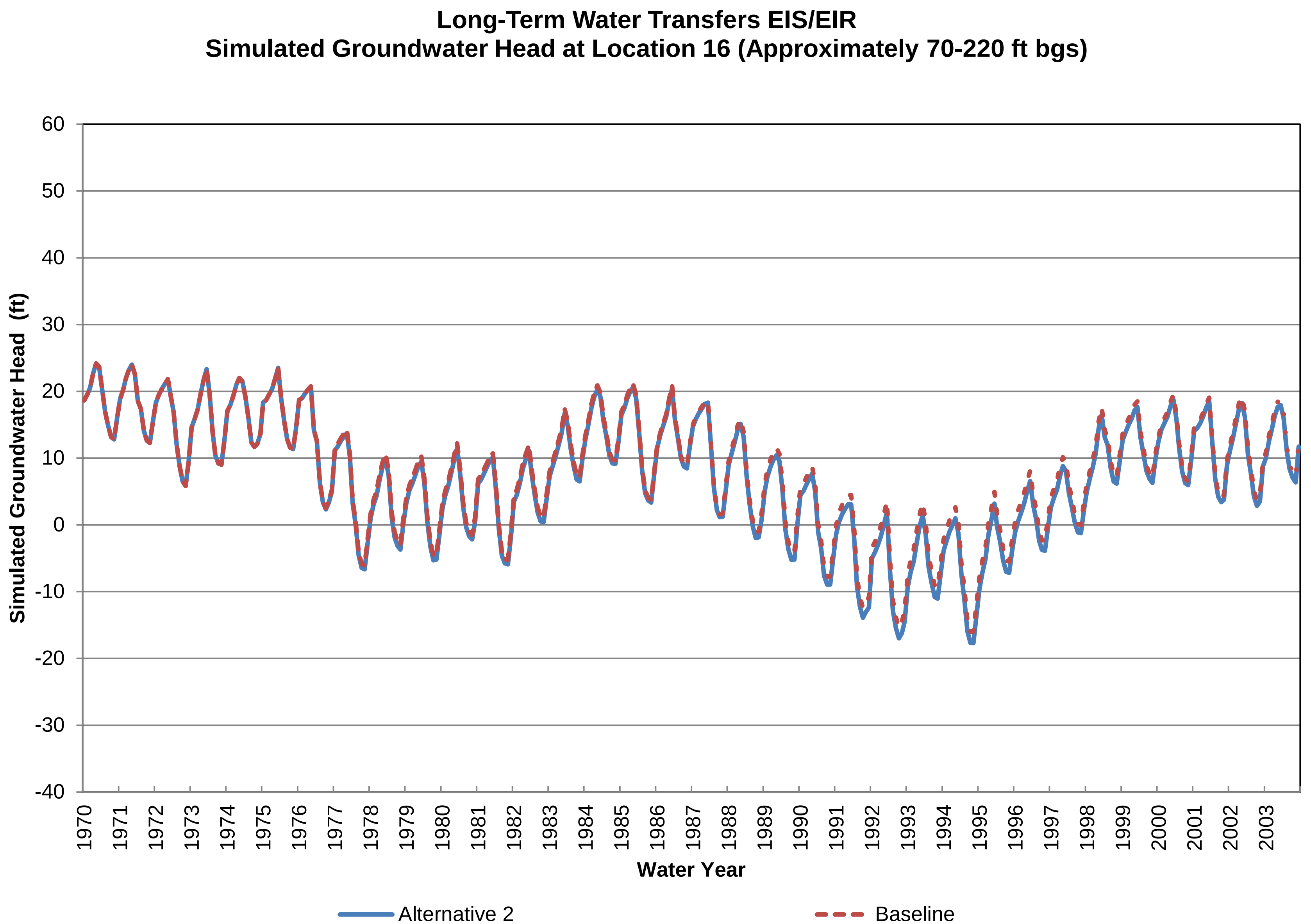
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 70-220 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1998
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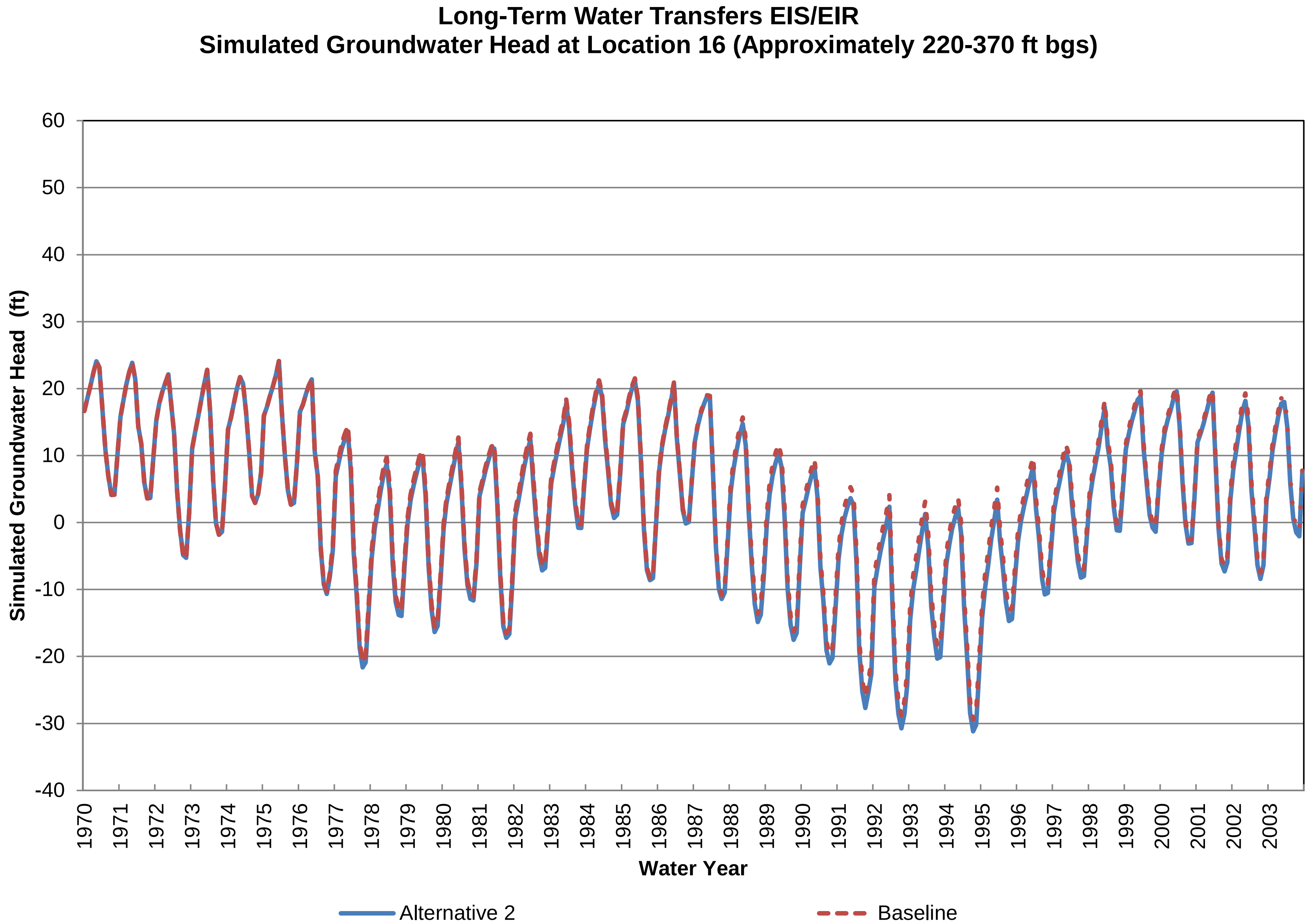
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 220-370 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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1984
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1987
1988
1989
1990
1991
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1993
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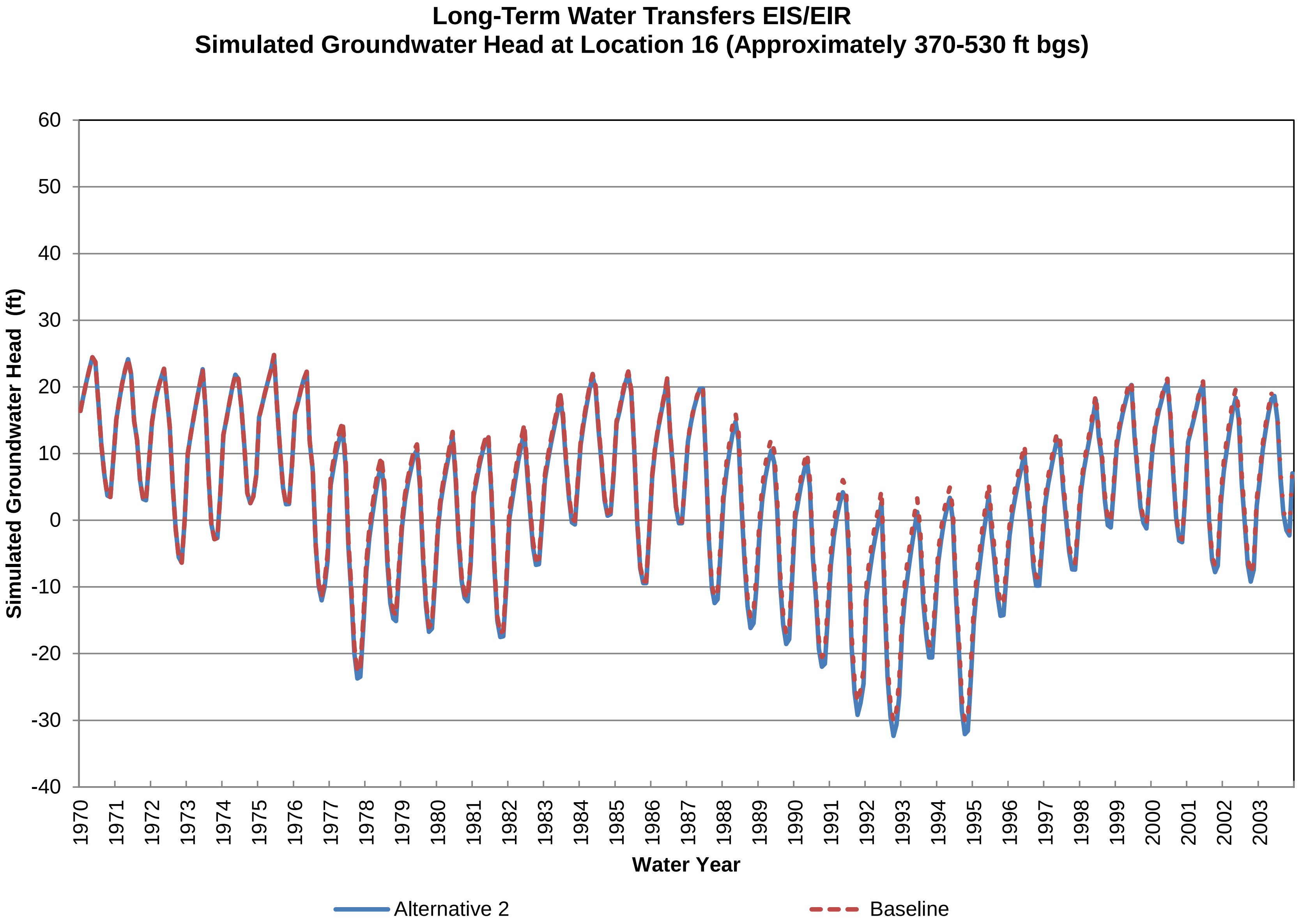
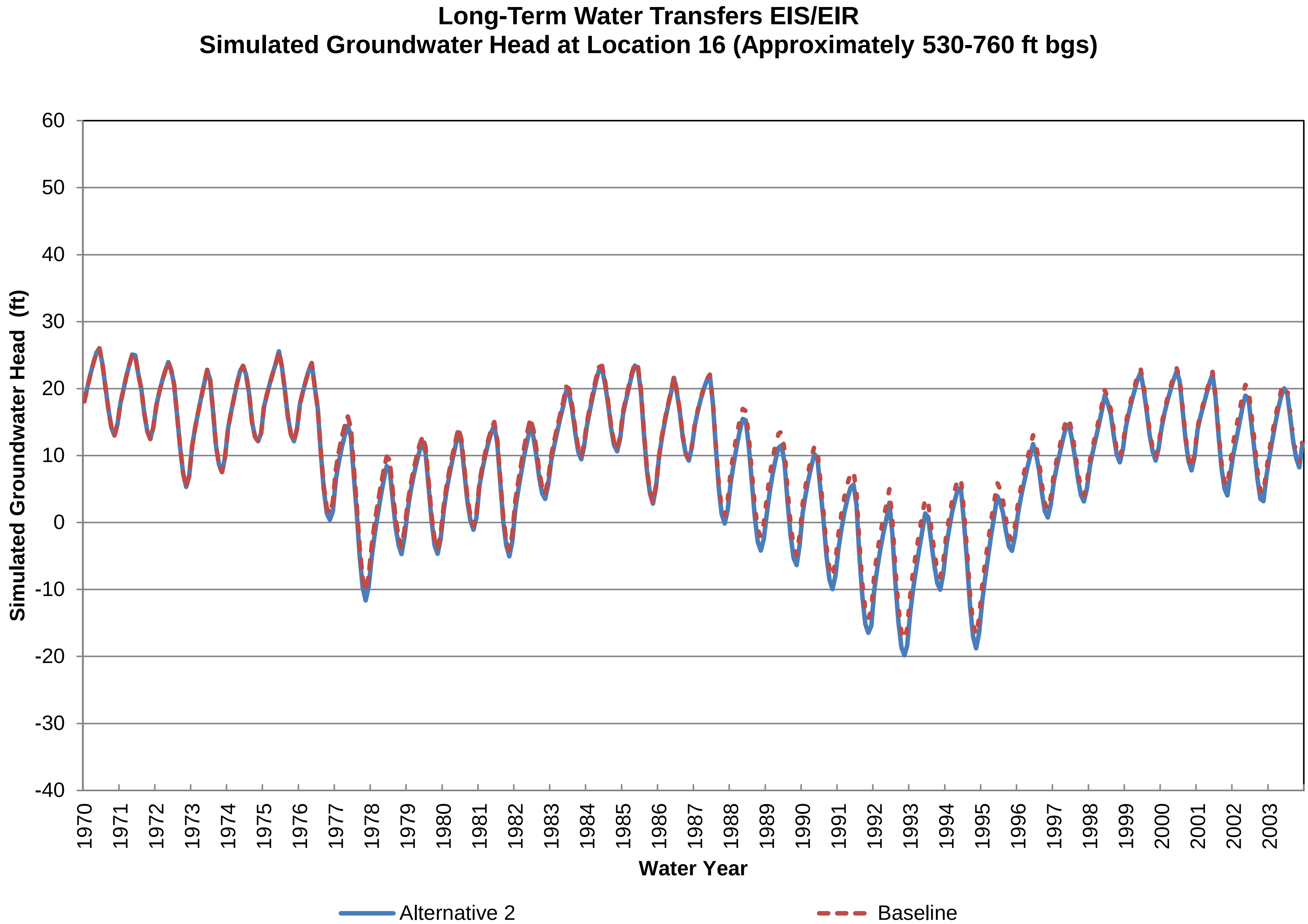
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 370-530 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 530-760 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1988
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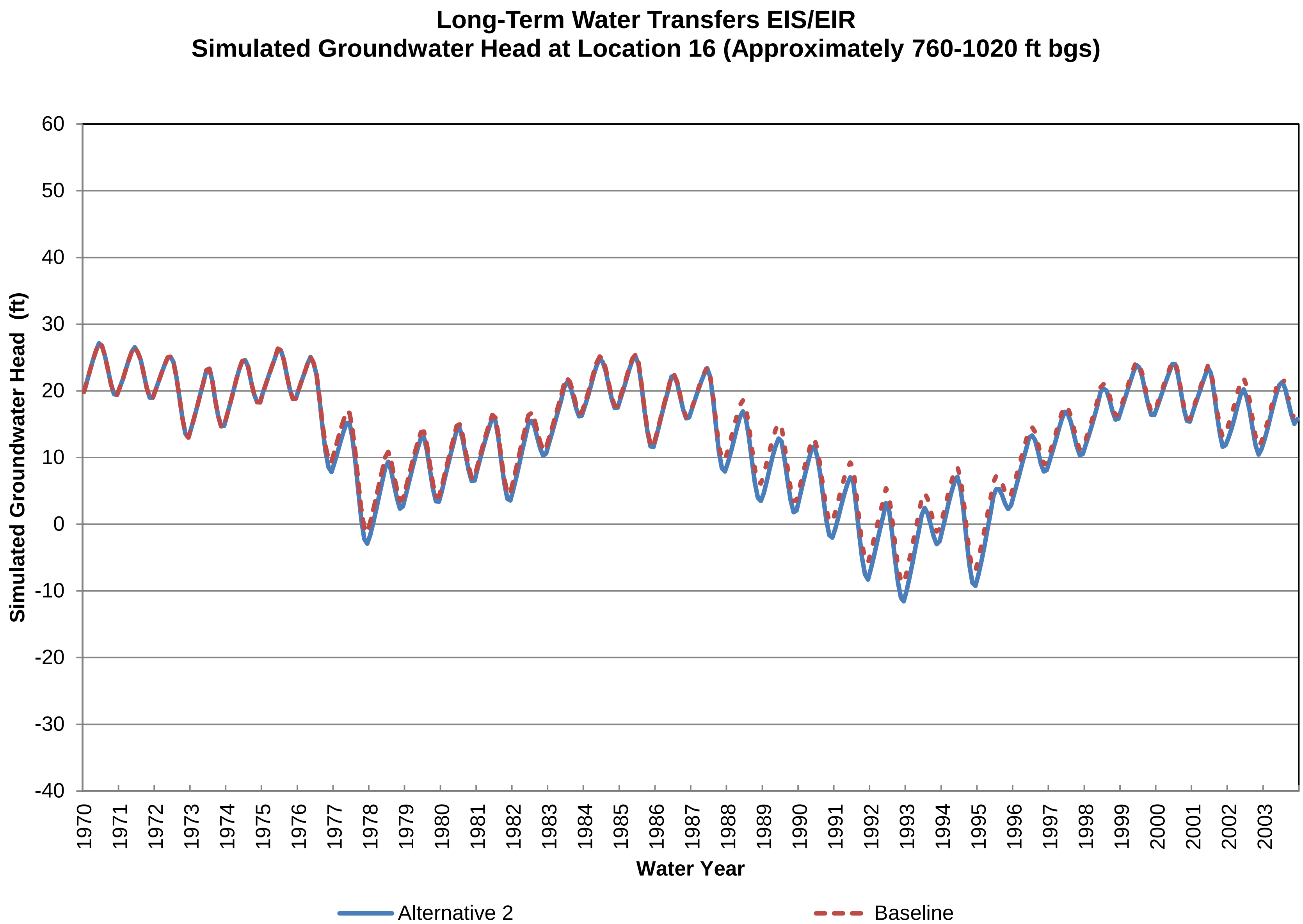
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 760-1020 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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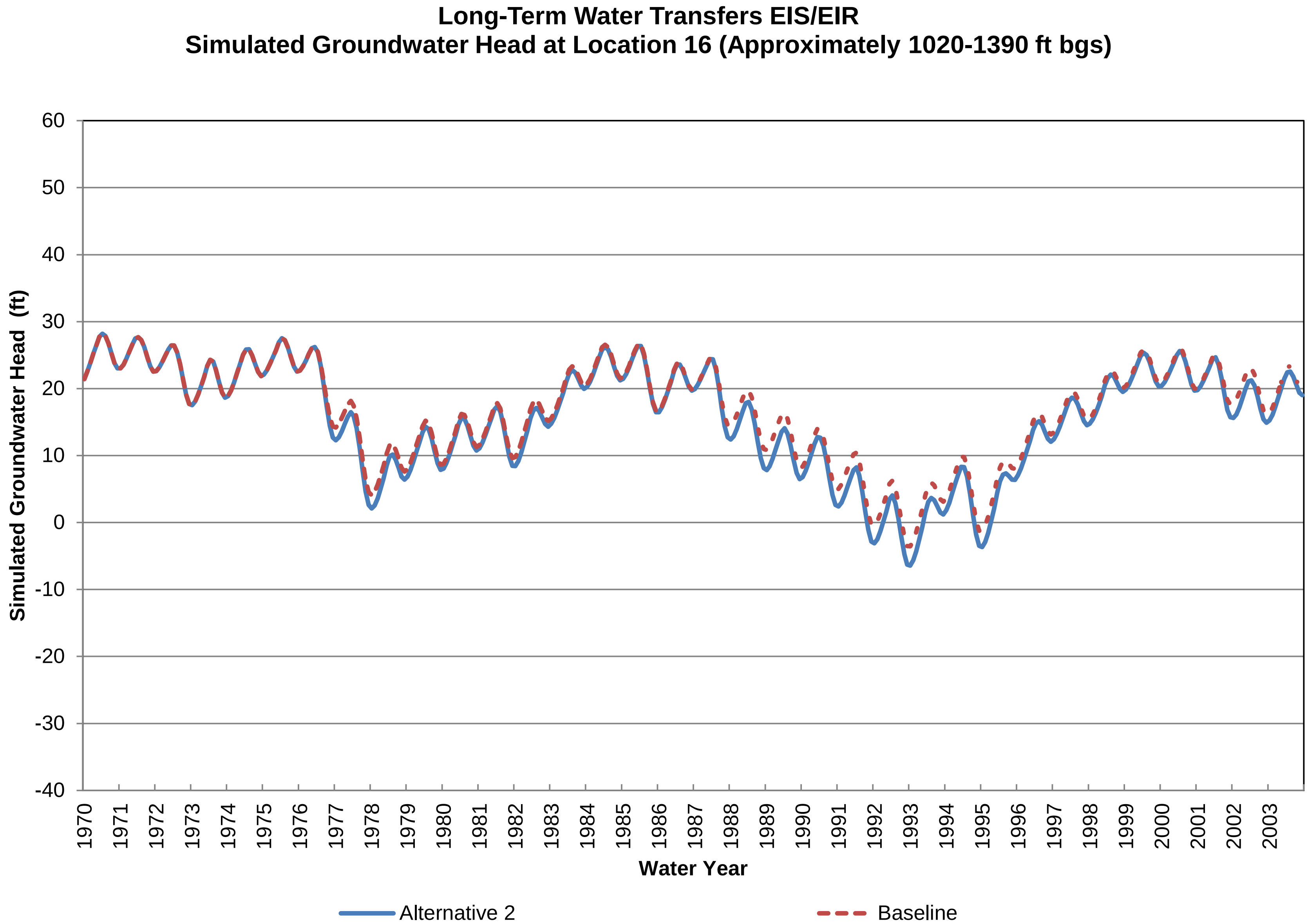
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 1020-1390 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
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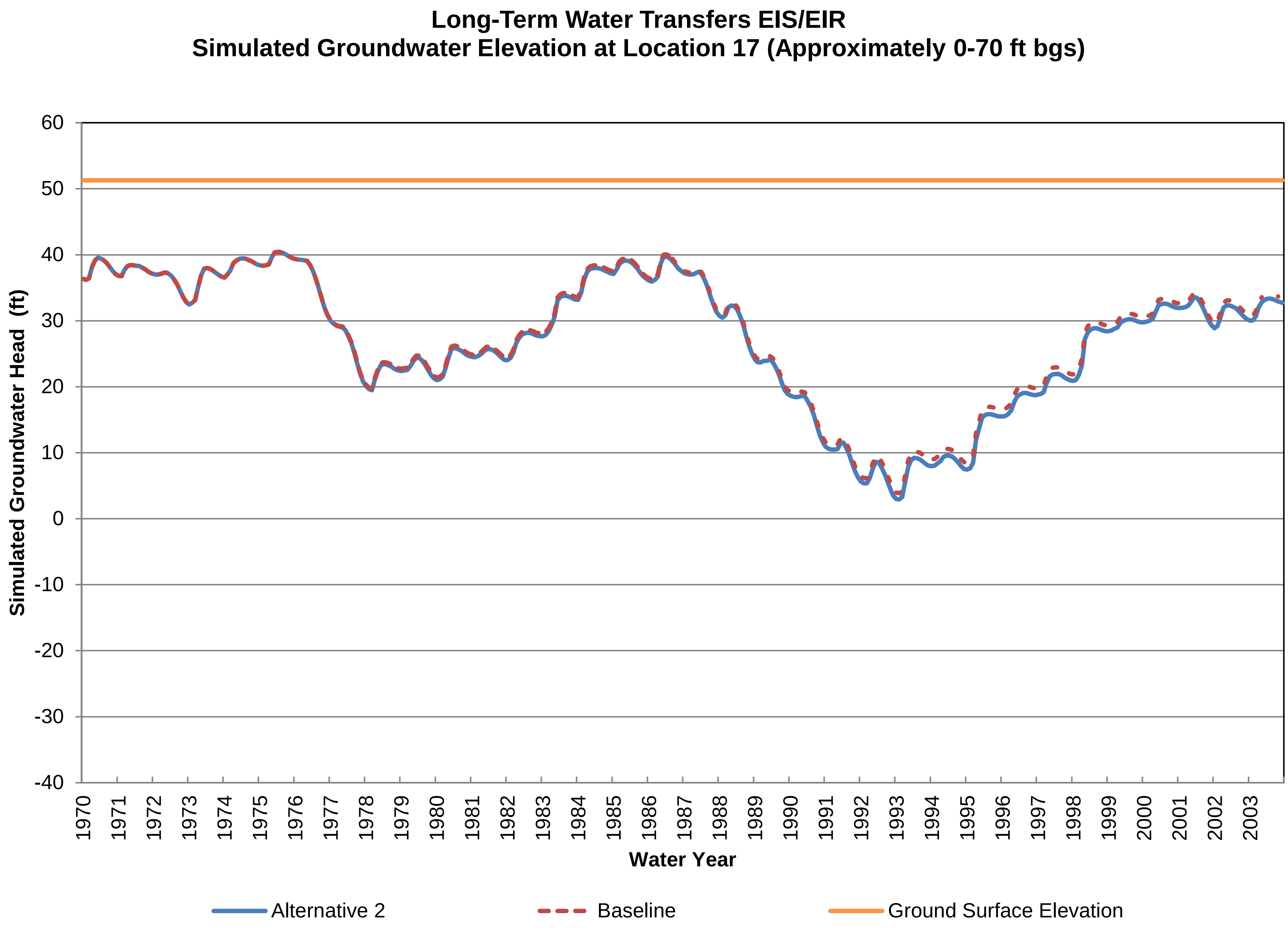
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 17 (Approximately 0-70 ft bgs)
60
50
40
30
20
10
0
-10
-20
-30
-40
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
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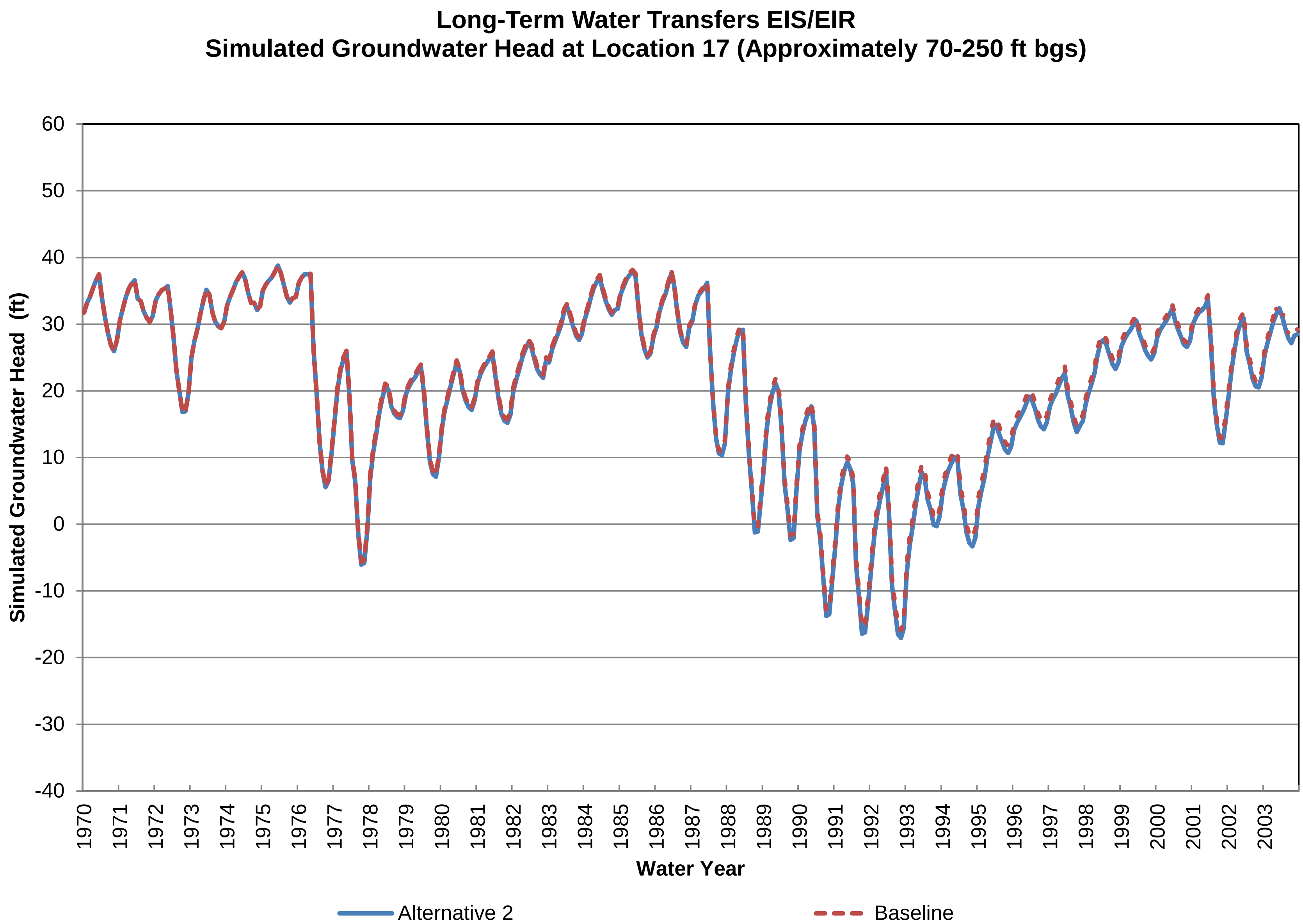
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 70-250 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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1994
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1998
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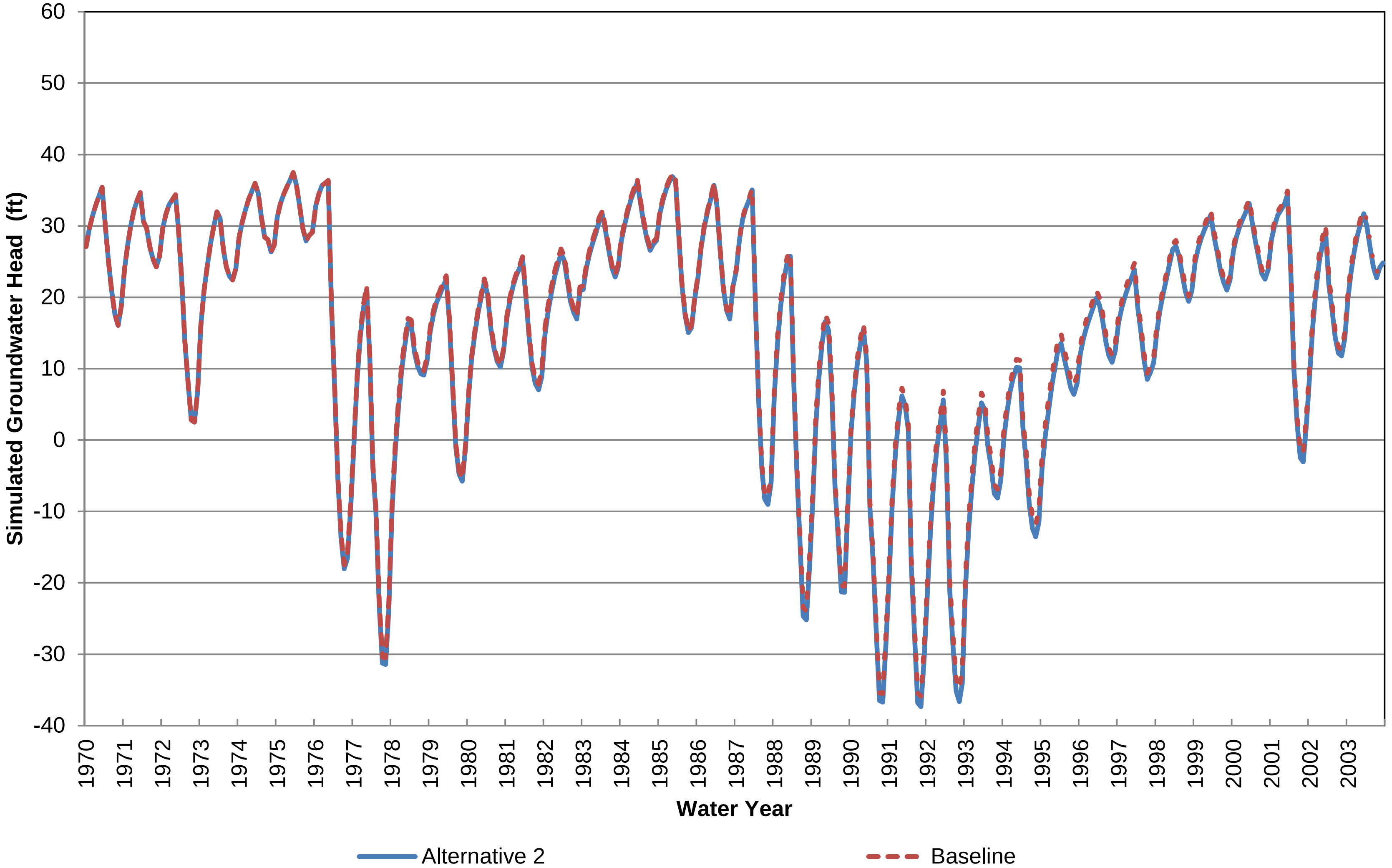
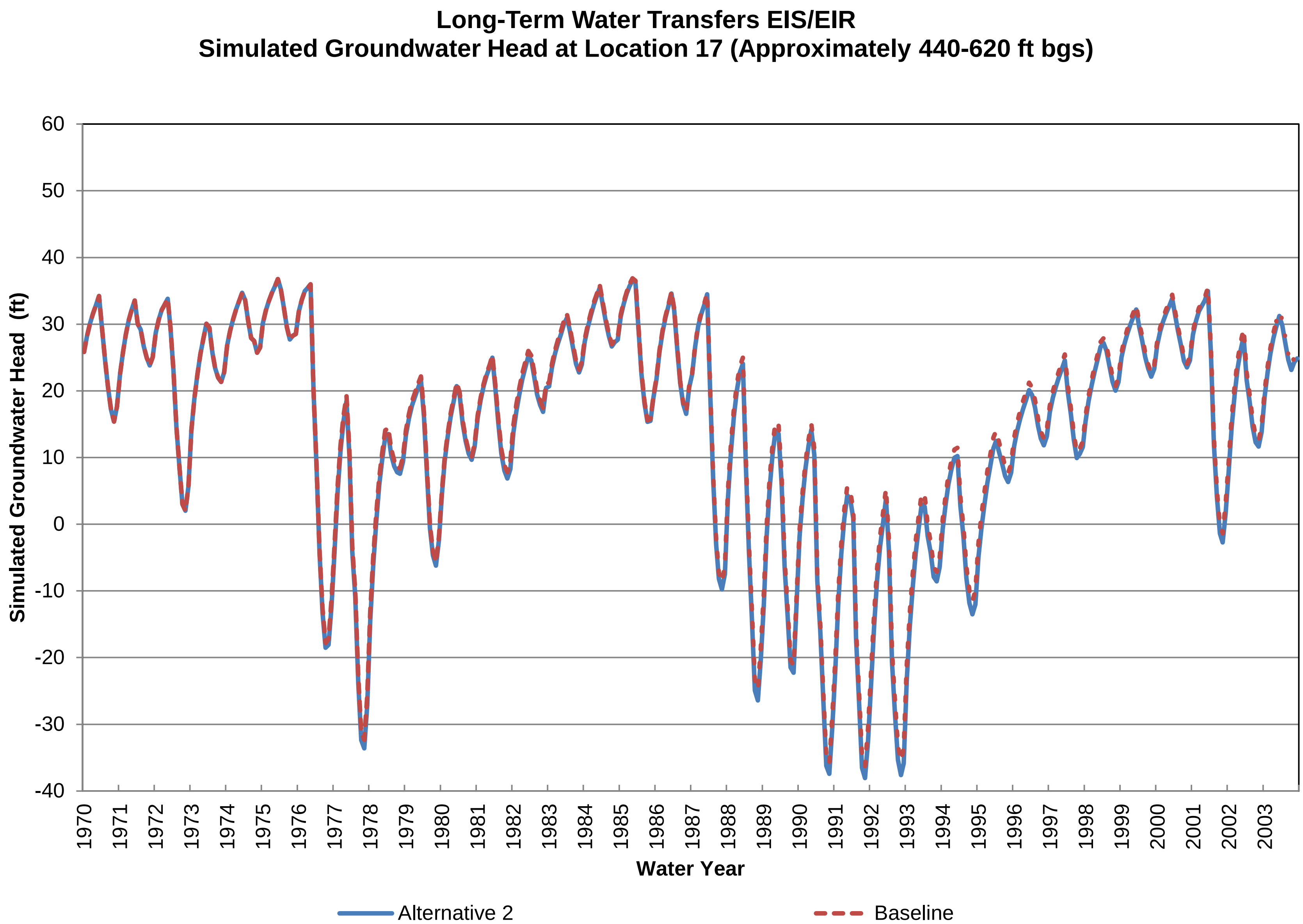
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 250-440 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 440-620 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
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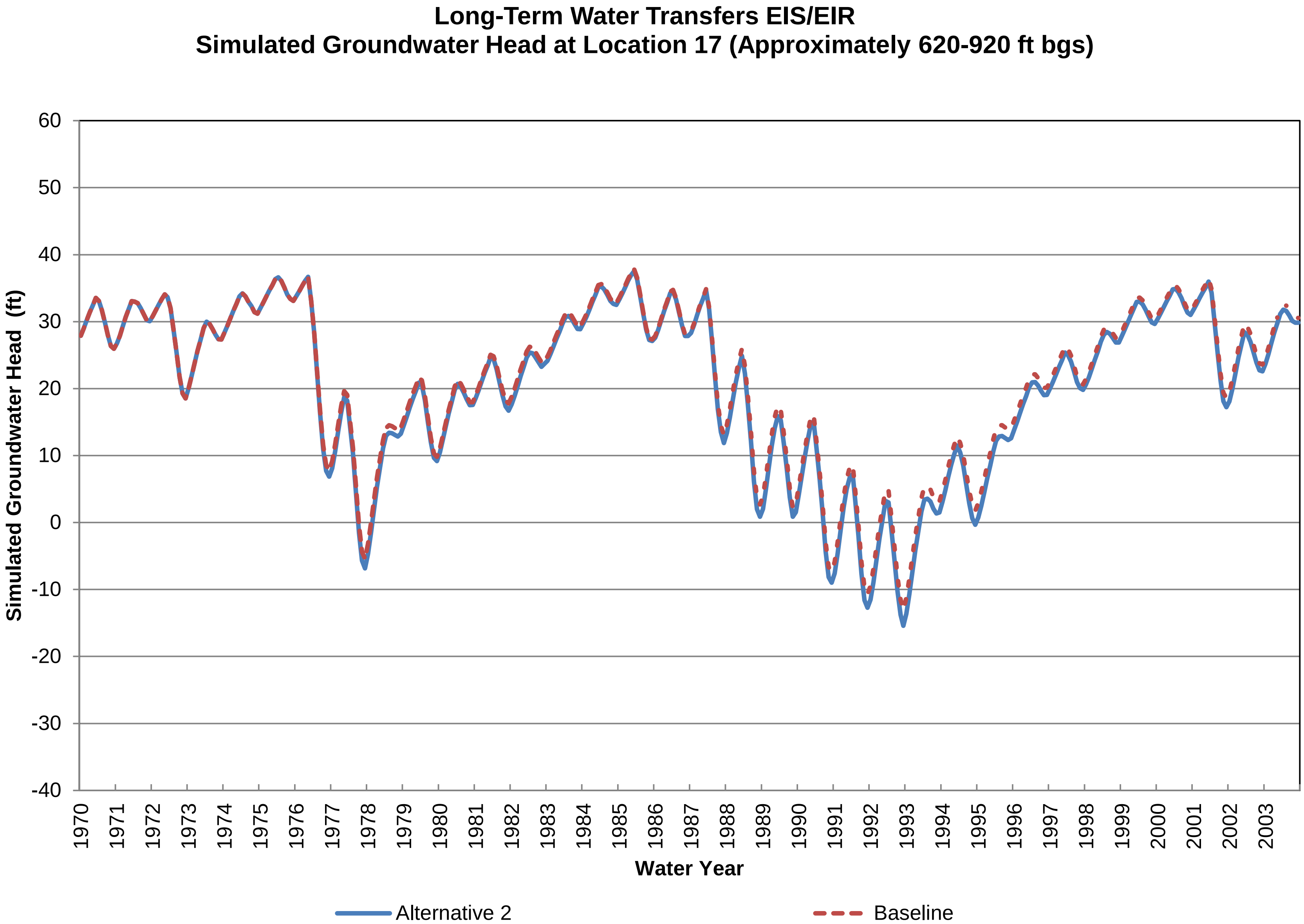
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 620-920 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1997
1998
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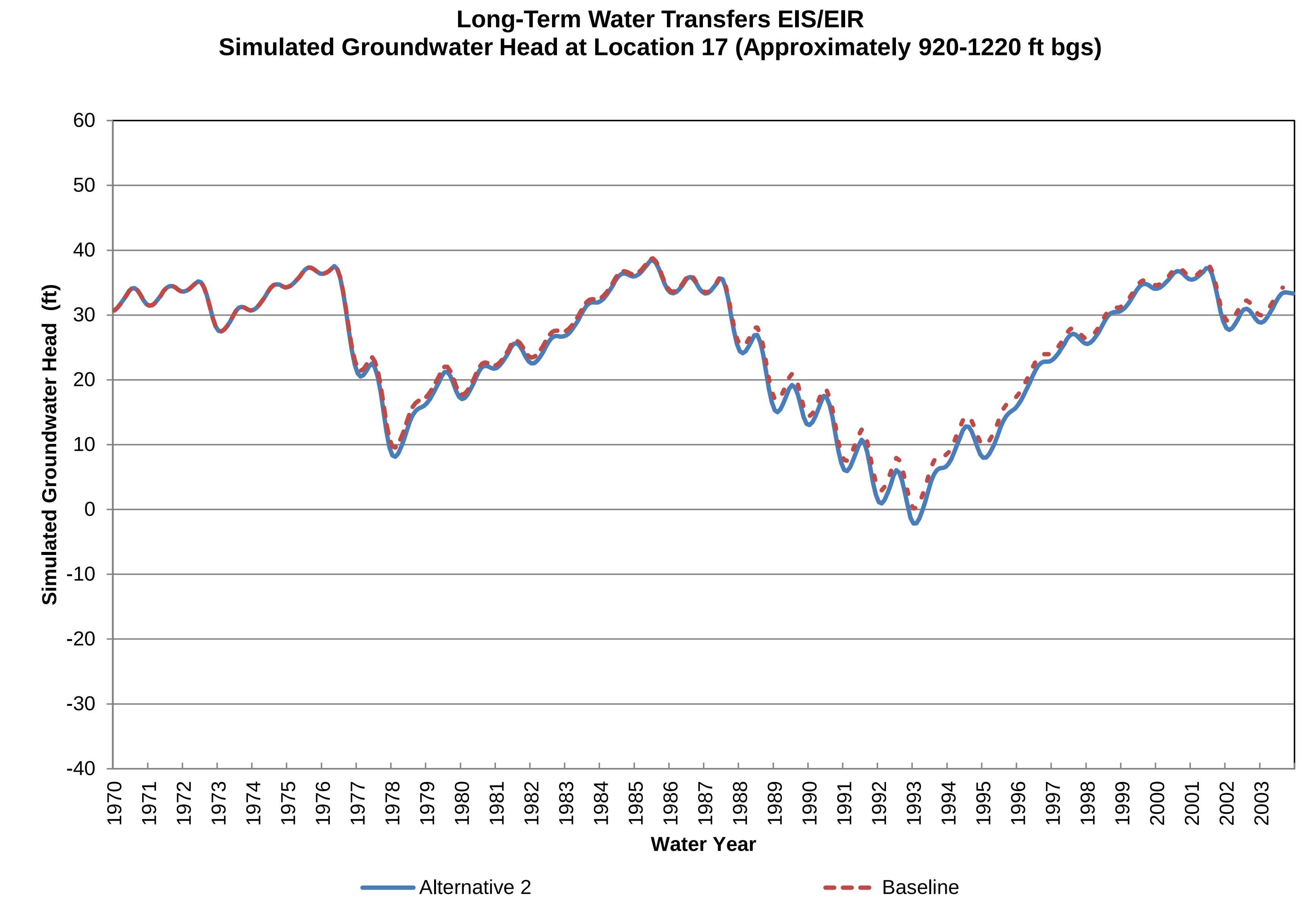
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 920-1220 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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1991
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1993
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1997
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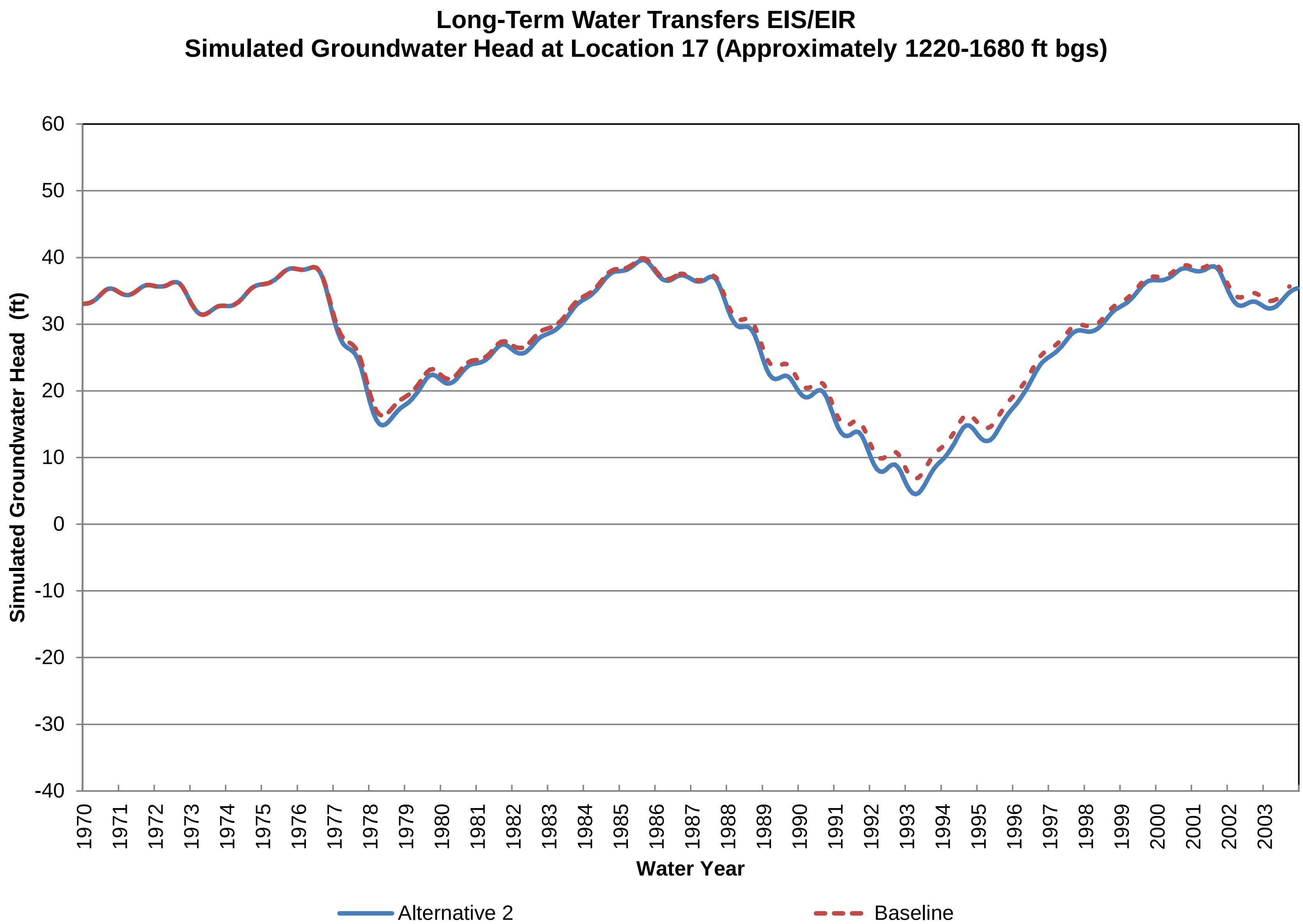
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 1220-1680 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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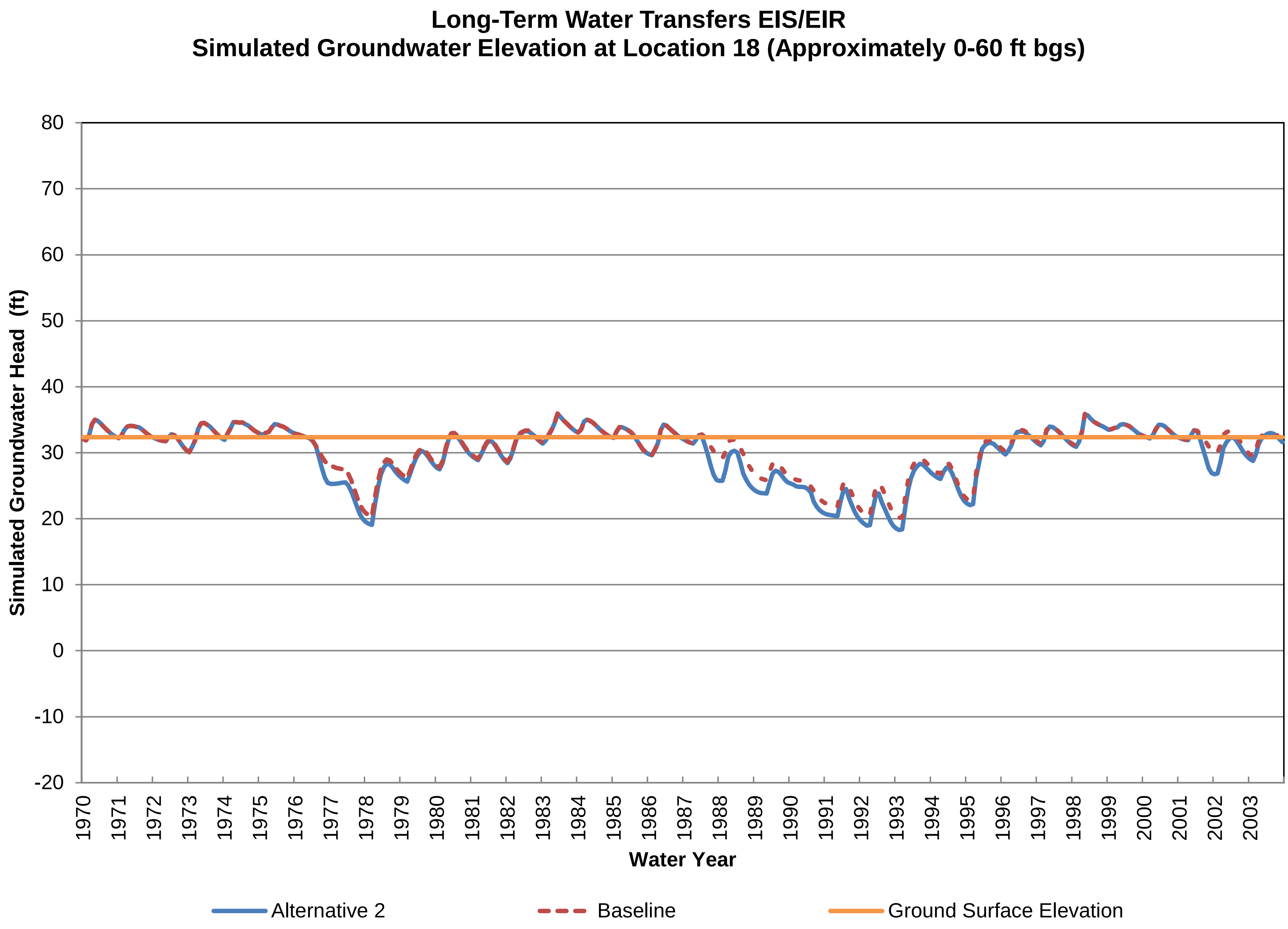
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 18 (Approximately 0-60 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
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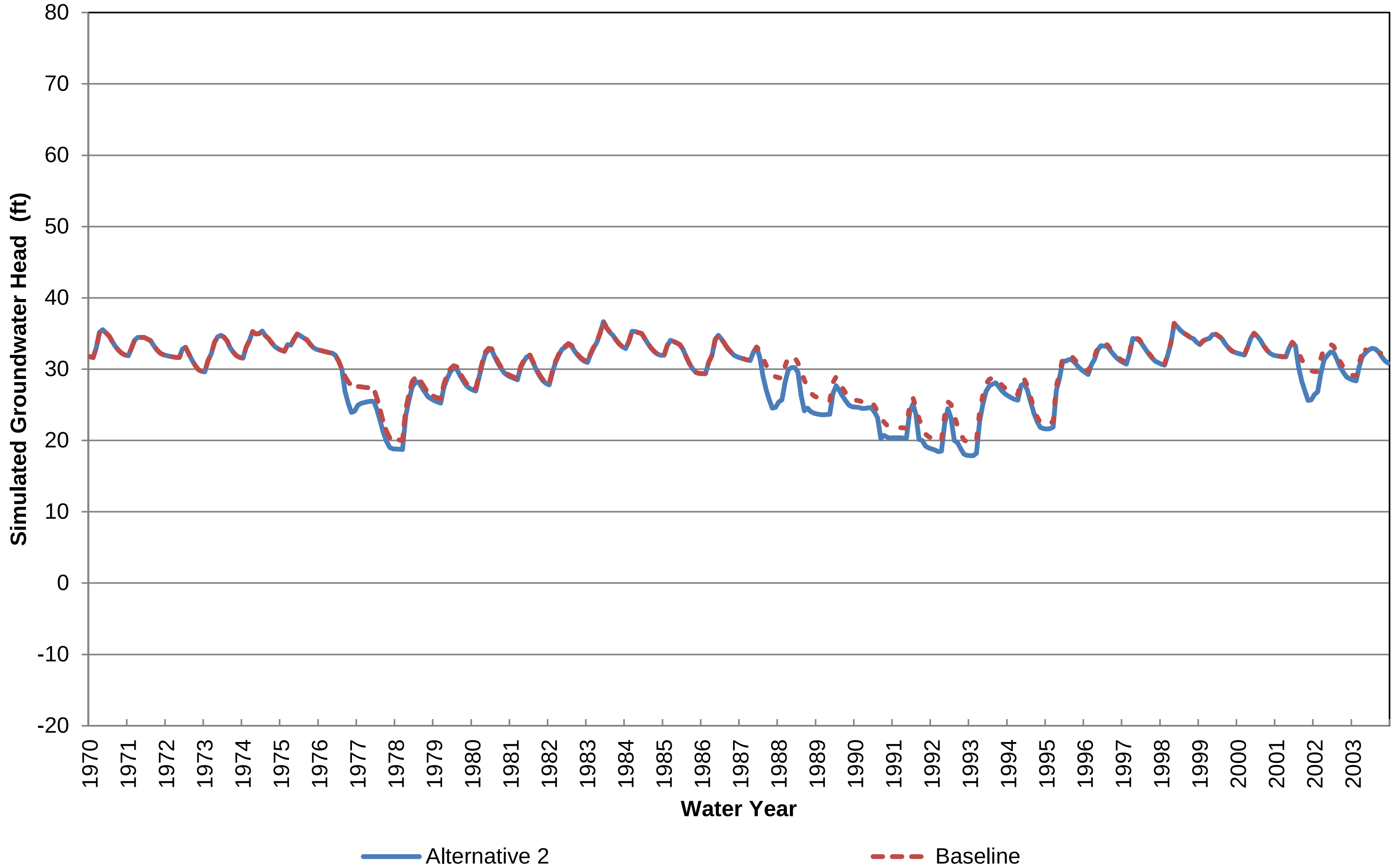
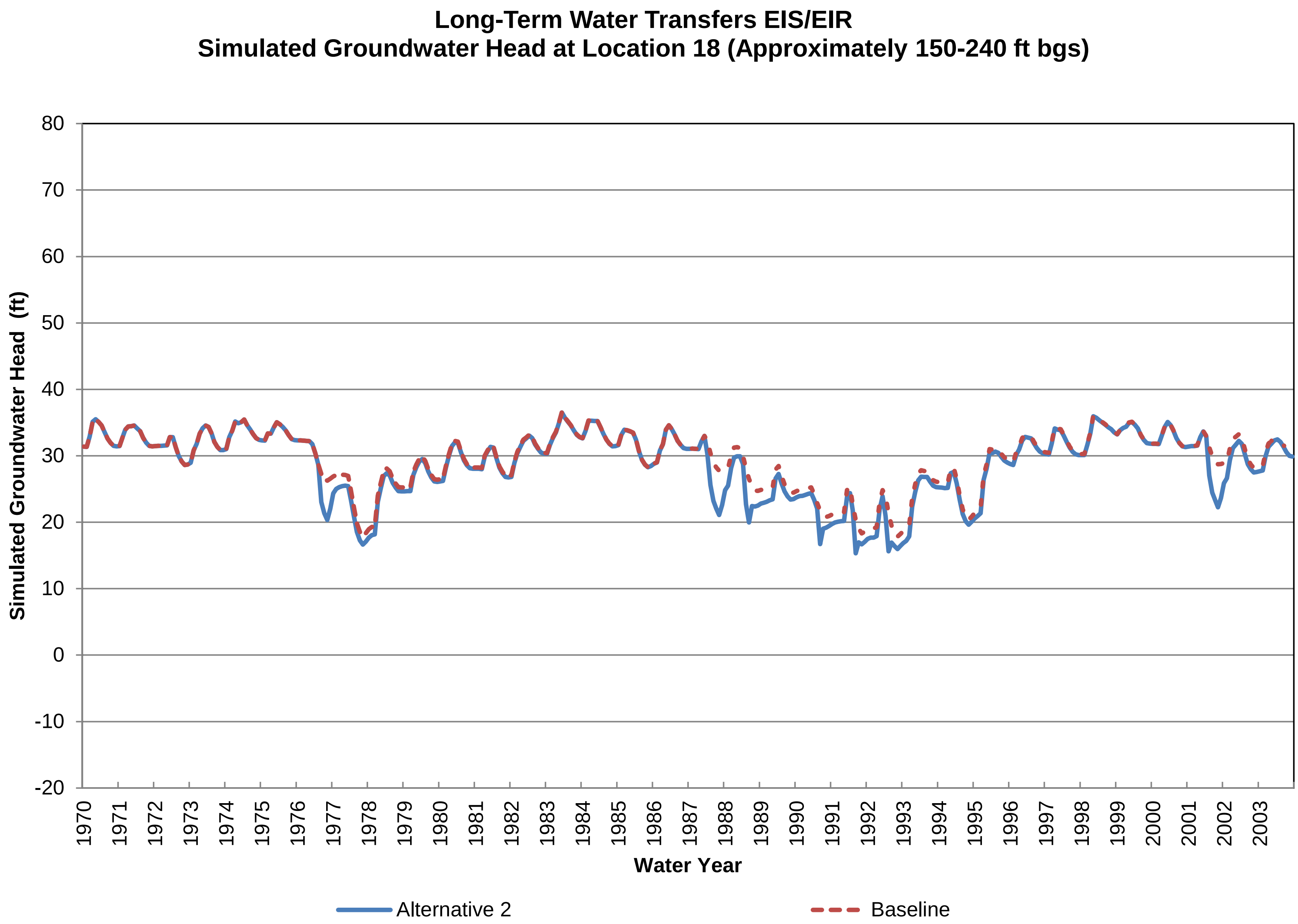
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 60-150 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 150-240 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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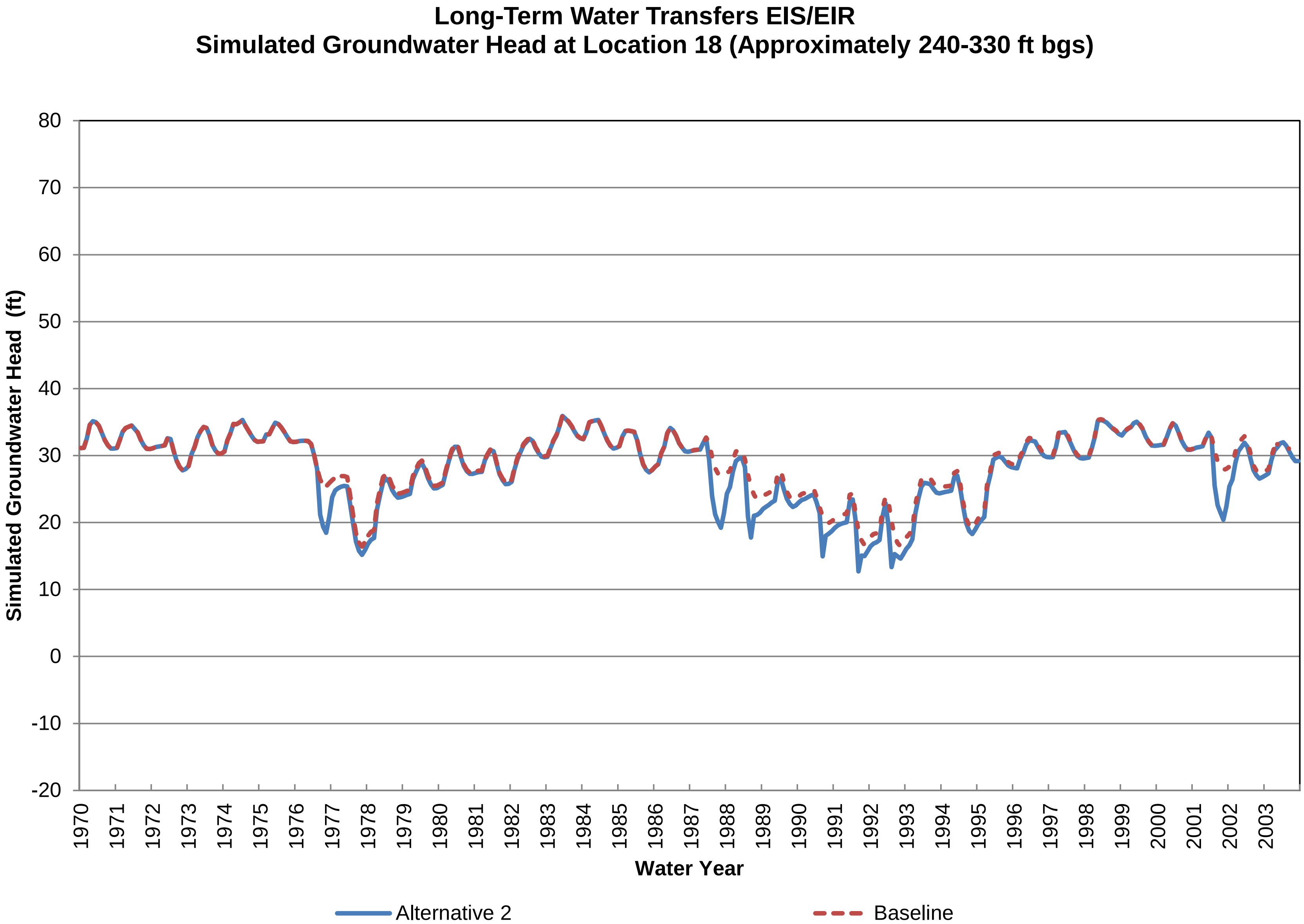
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 240-330 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
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1994
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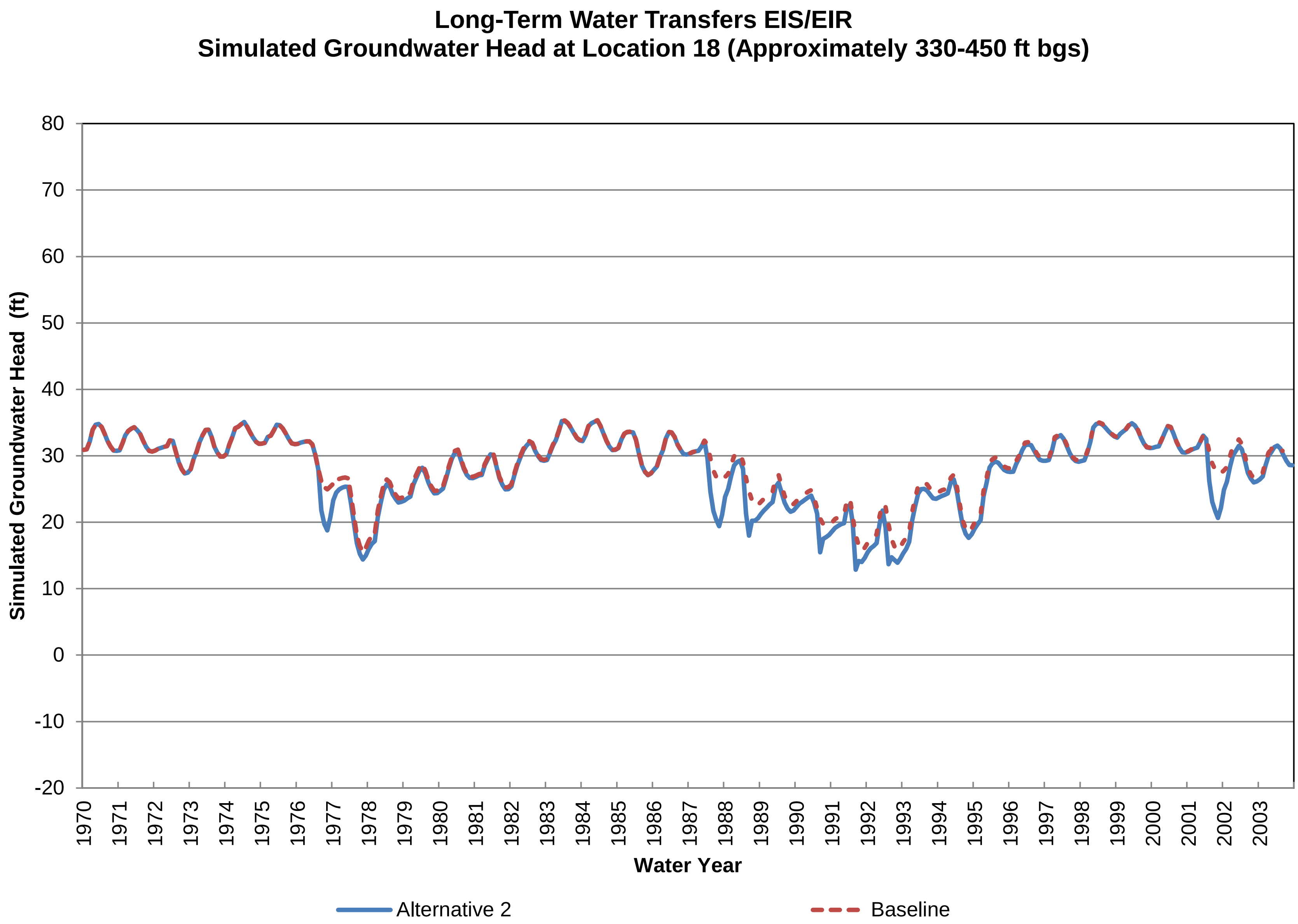
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 330-450 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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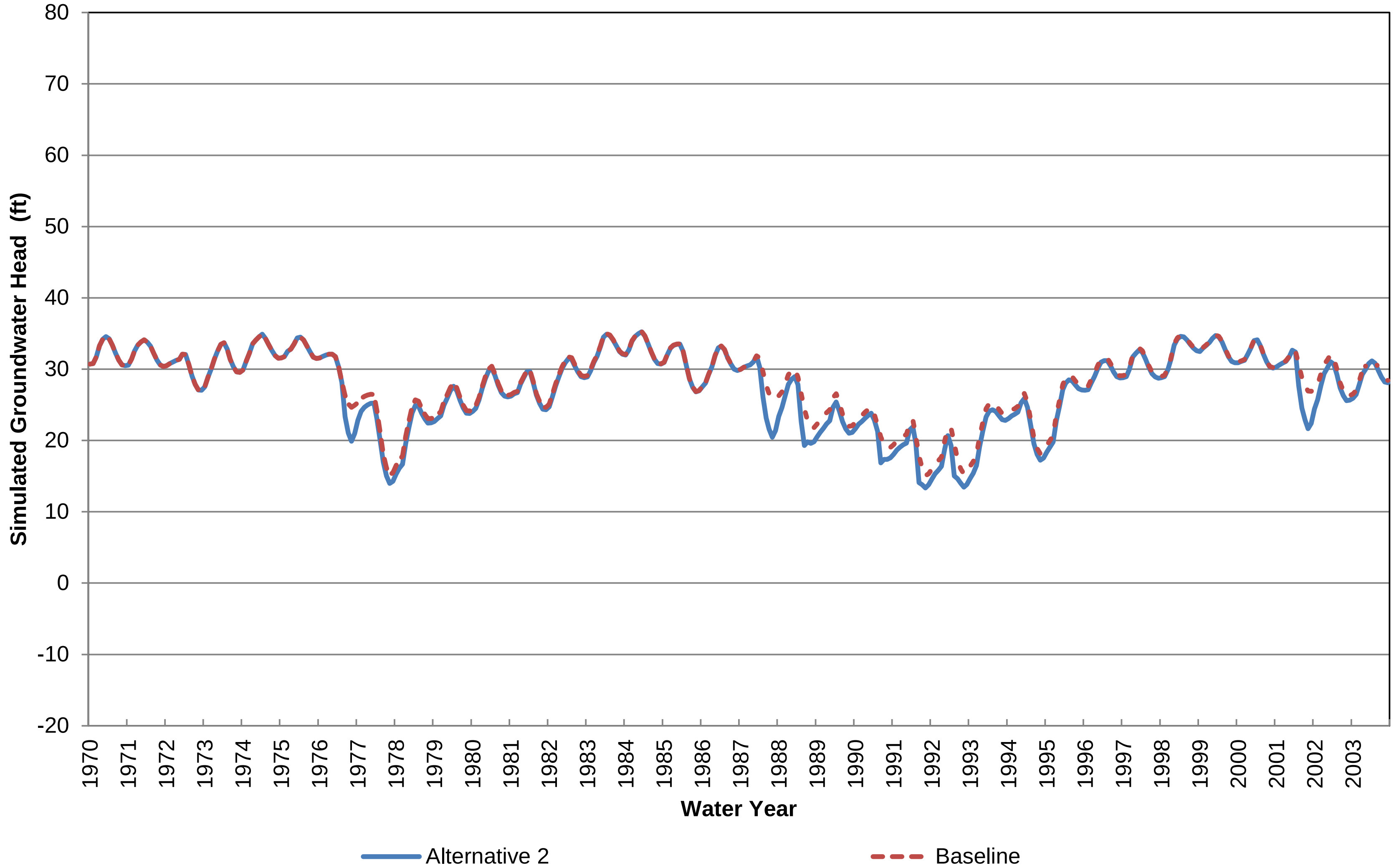
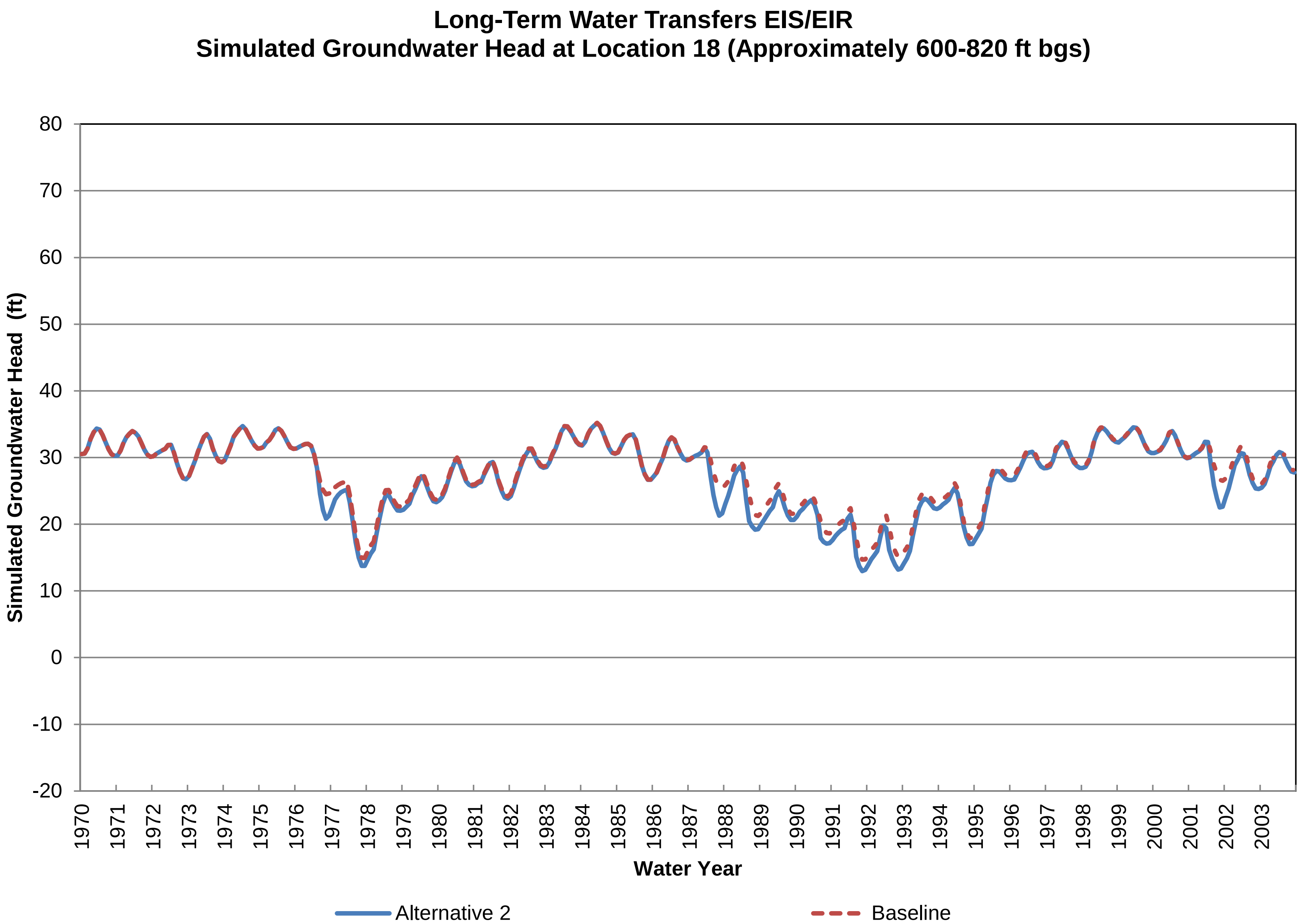
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 450-600 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 600-820 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1986
1987
1988
1989
1990
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1992
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1994
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1997
1998
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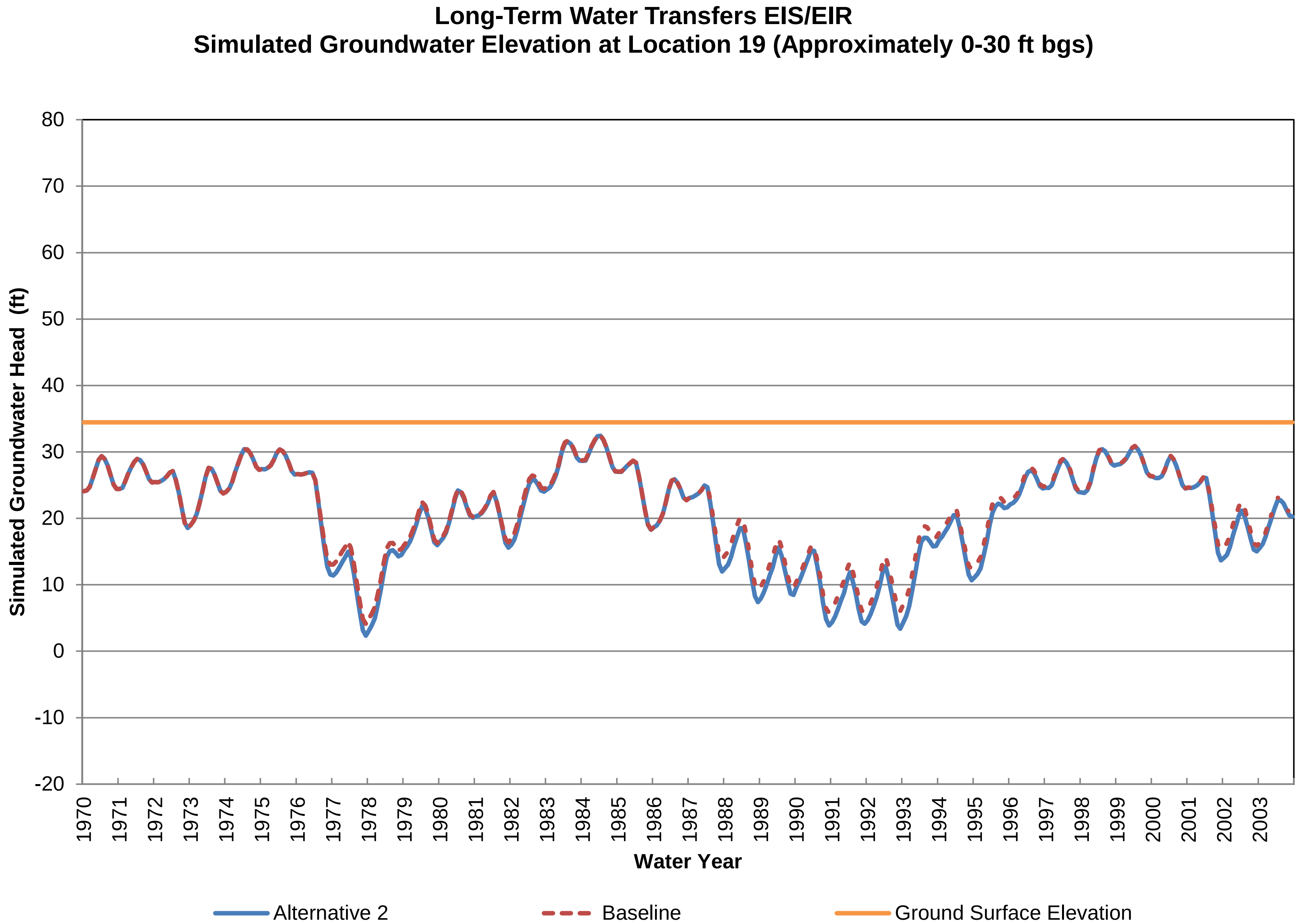
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 19 (Approximately 0-30 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
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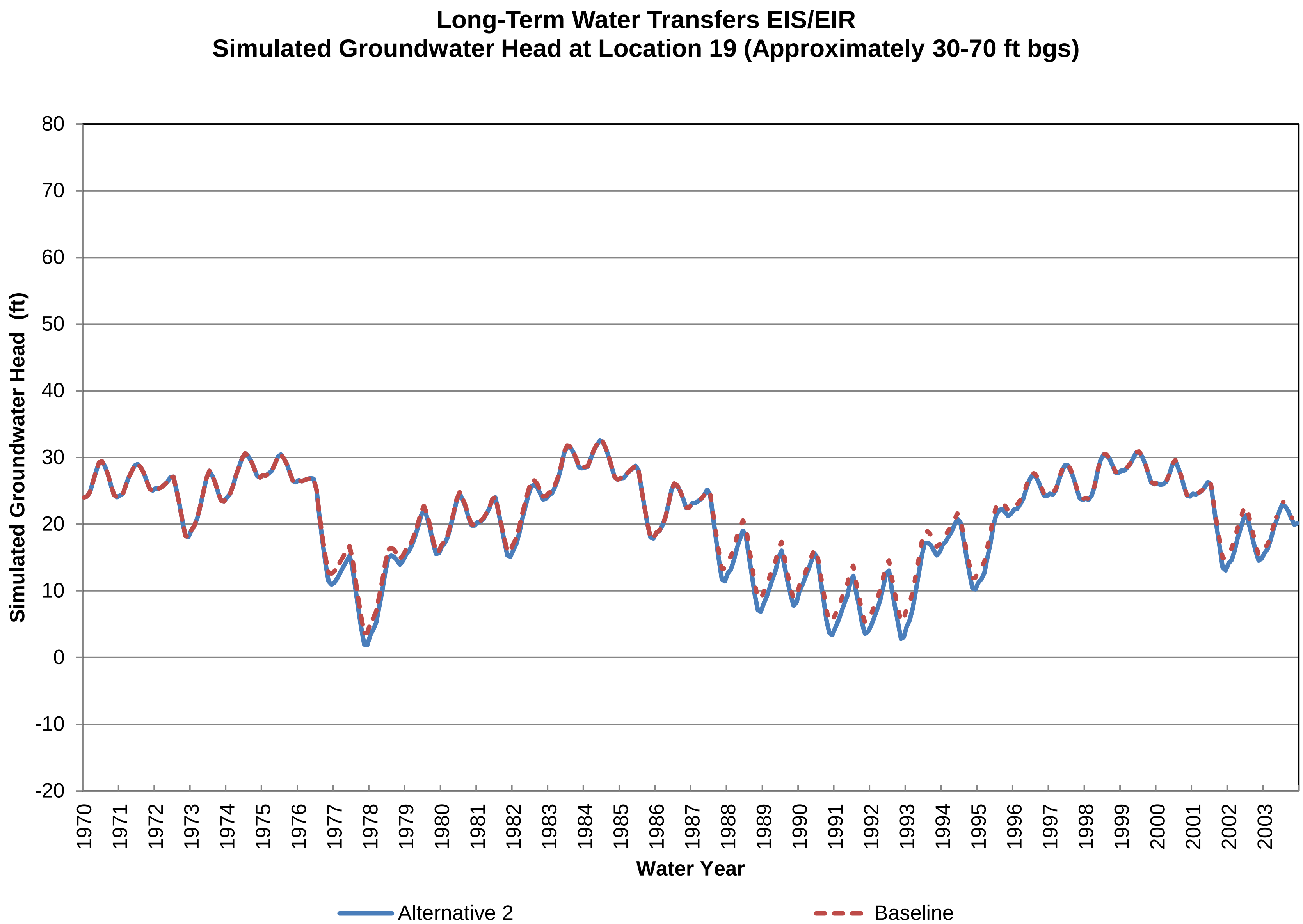
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 30-70 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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1989
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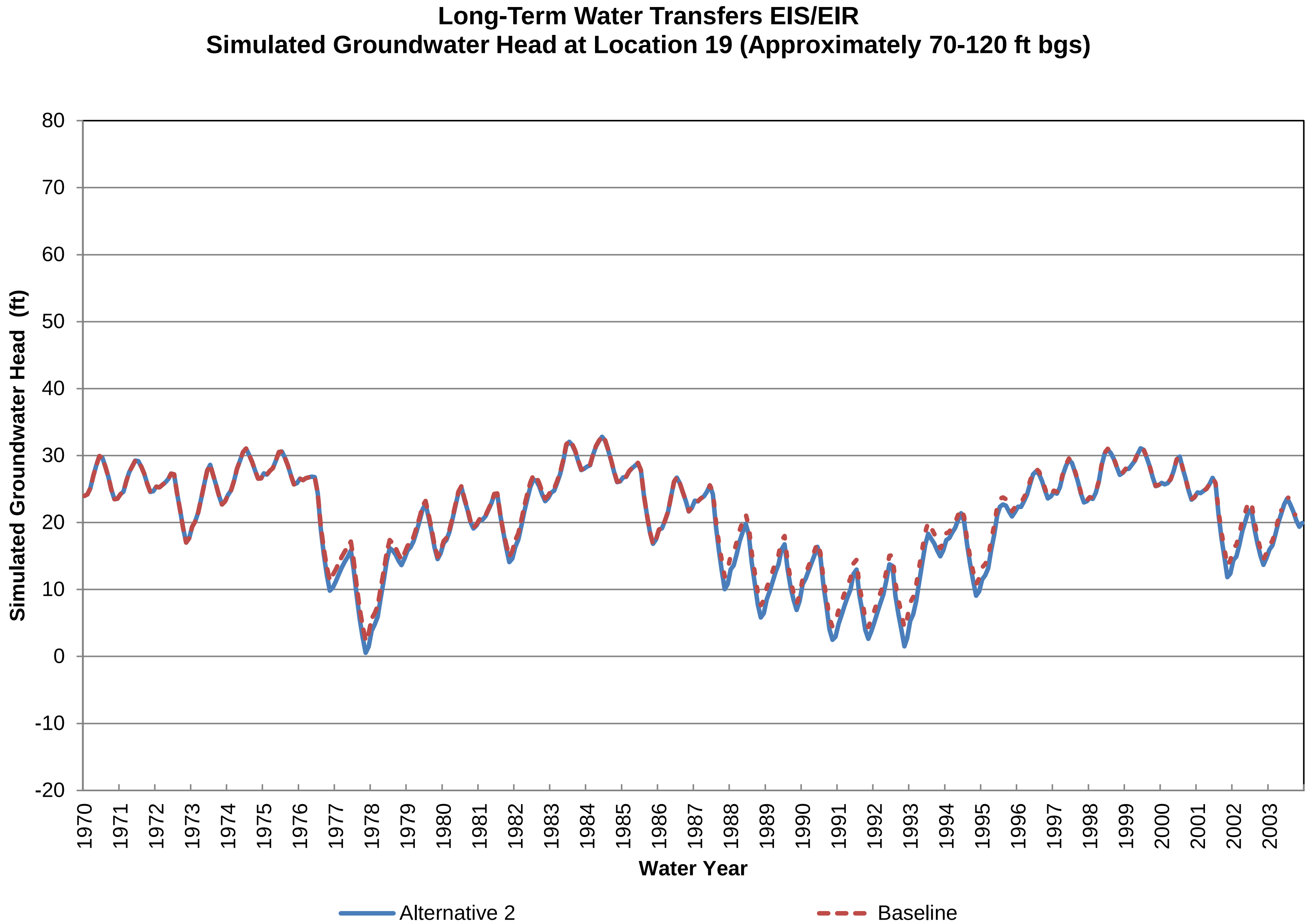
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 70-120 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1988
1989
1990
1991
1992
1993
1994
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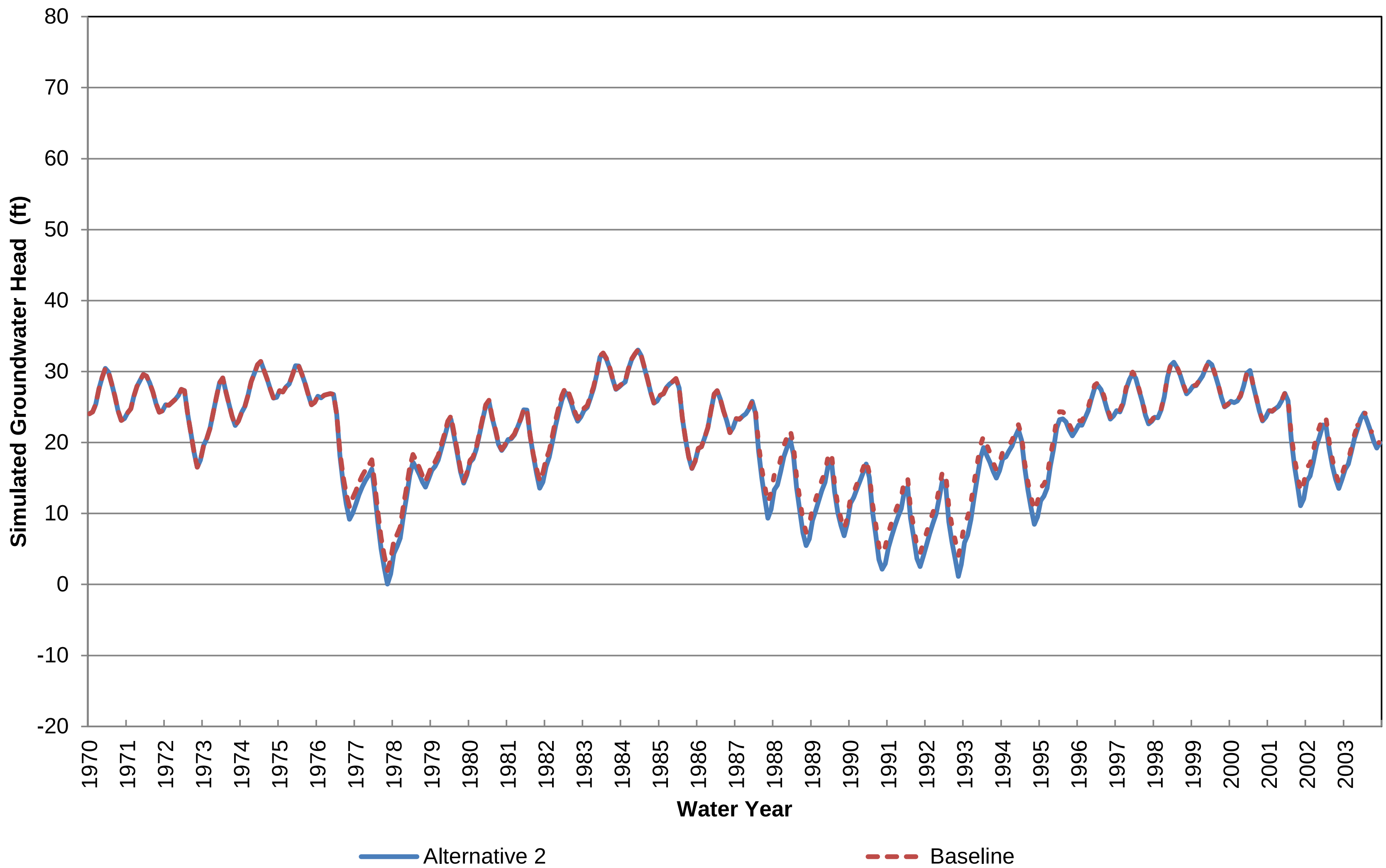
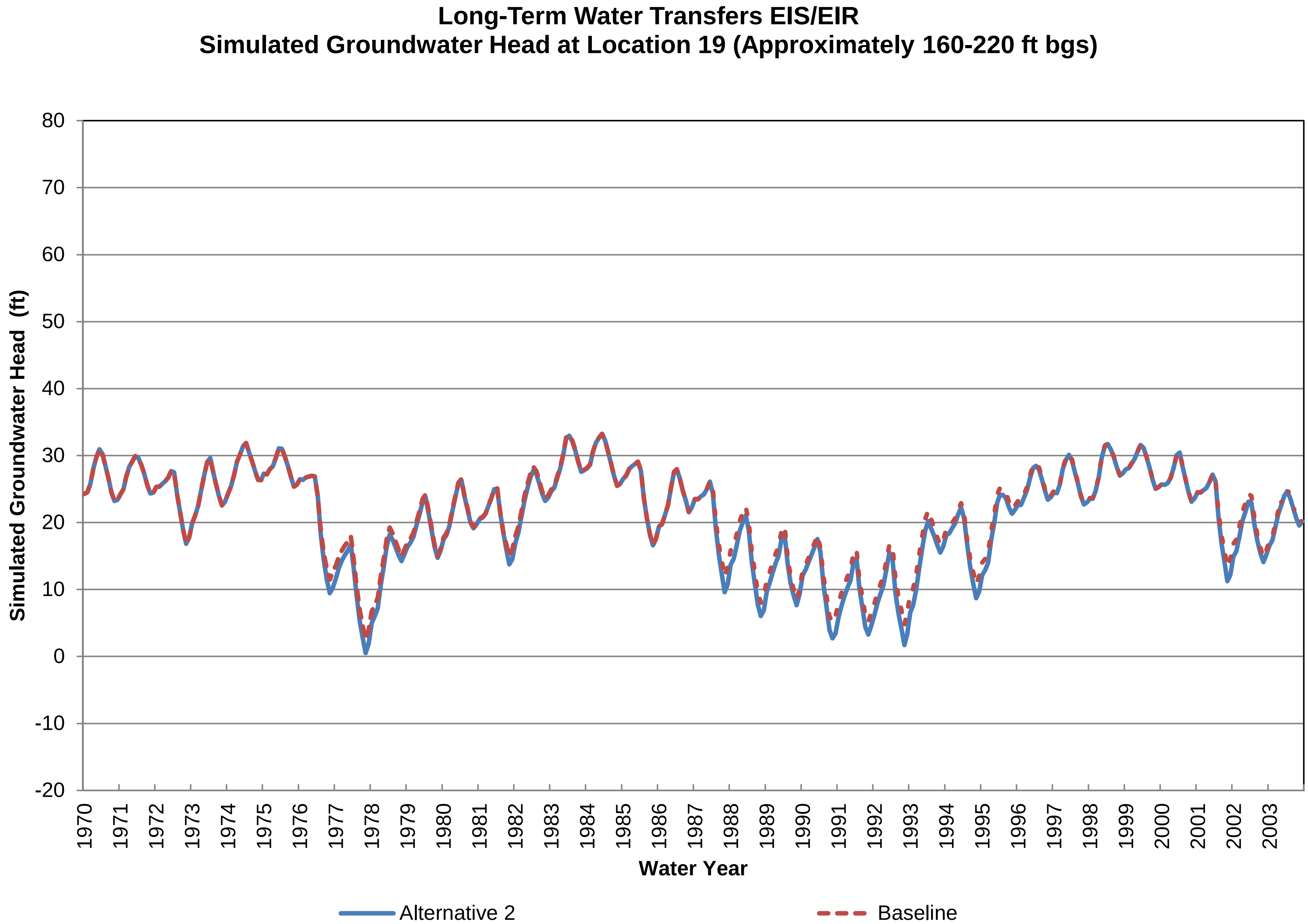
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 120-160 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 160-220 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1998
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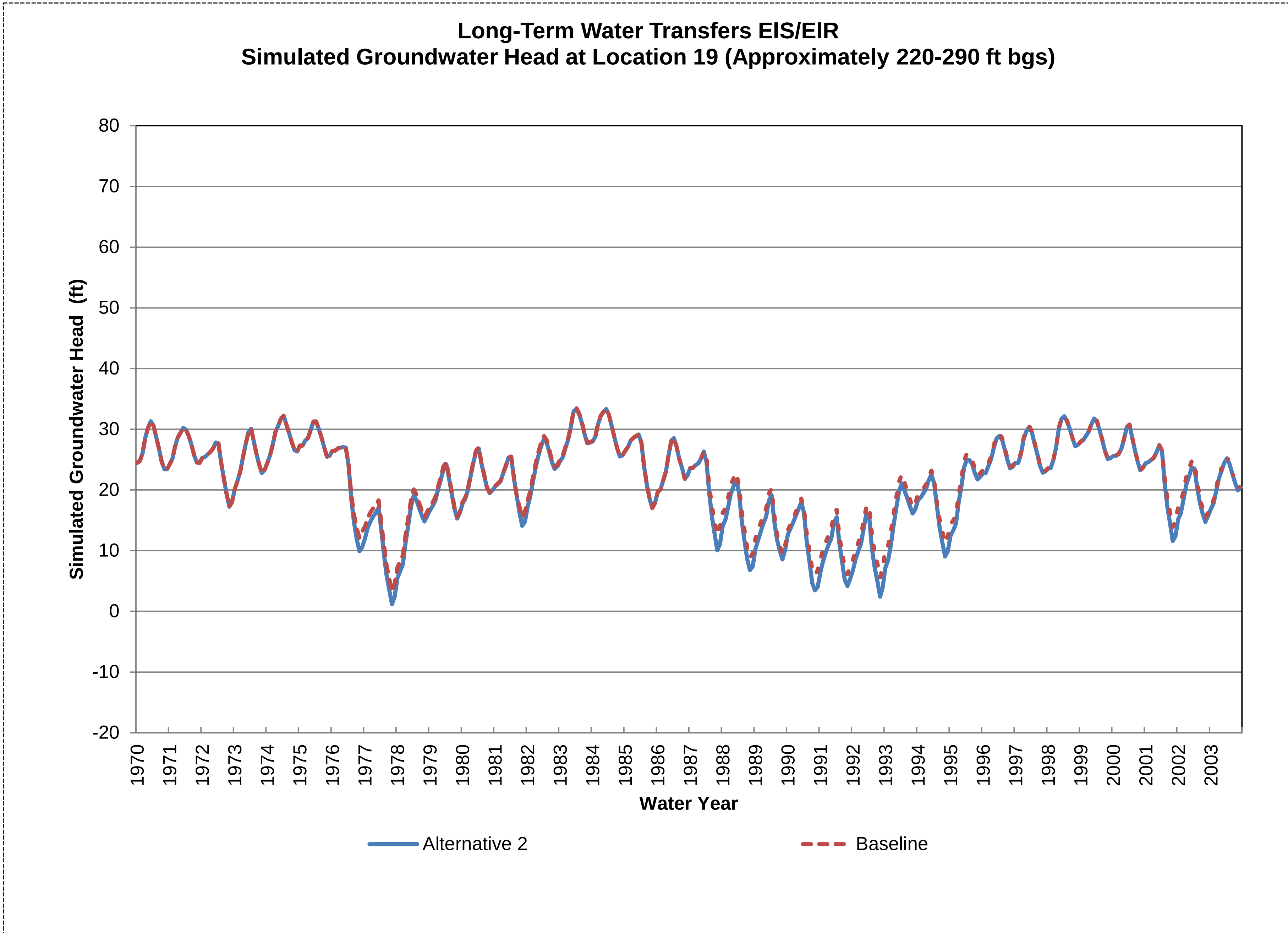
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 220-290 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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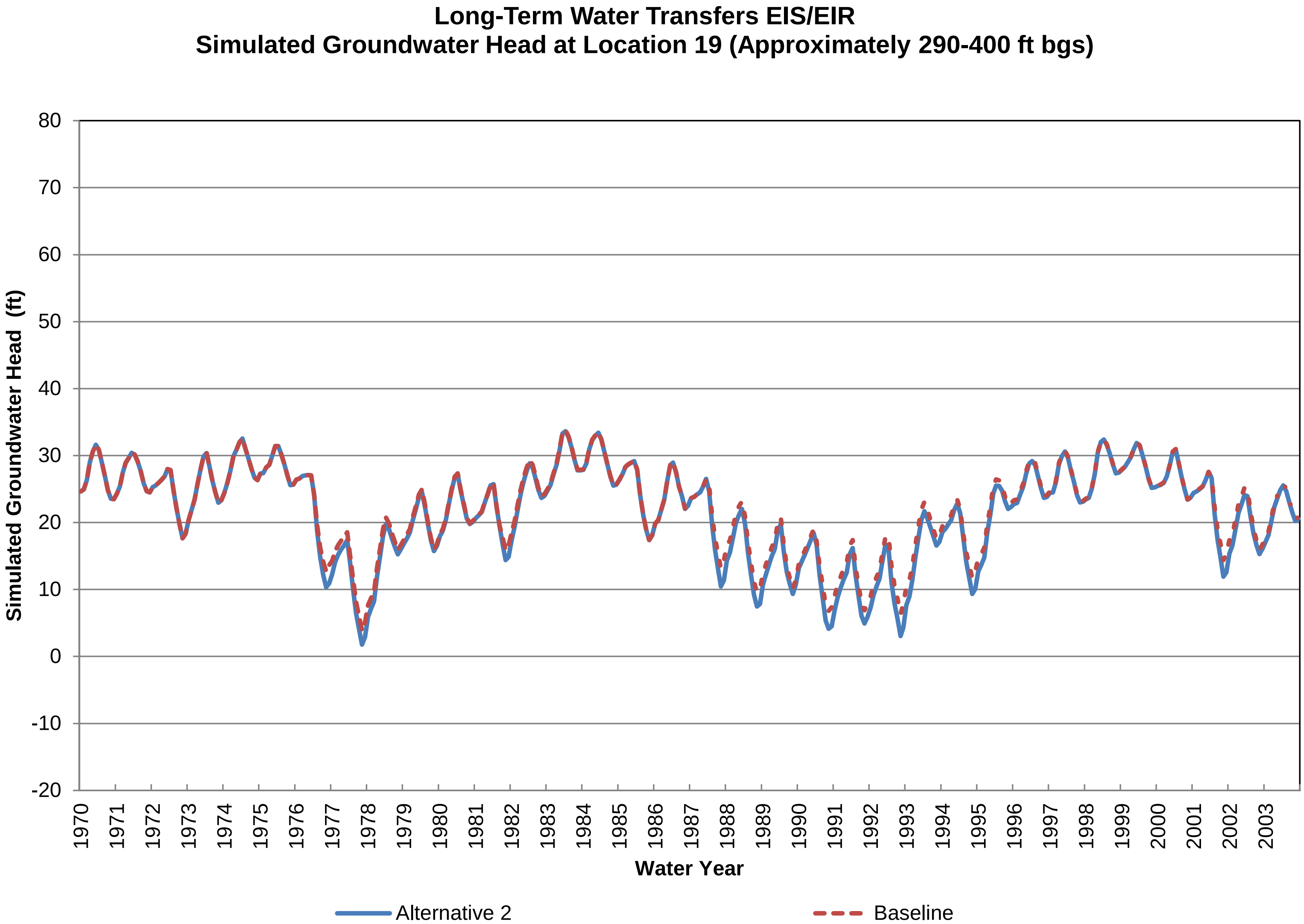
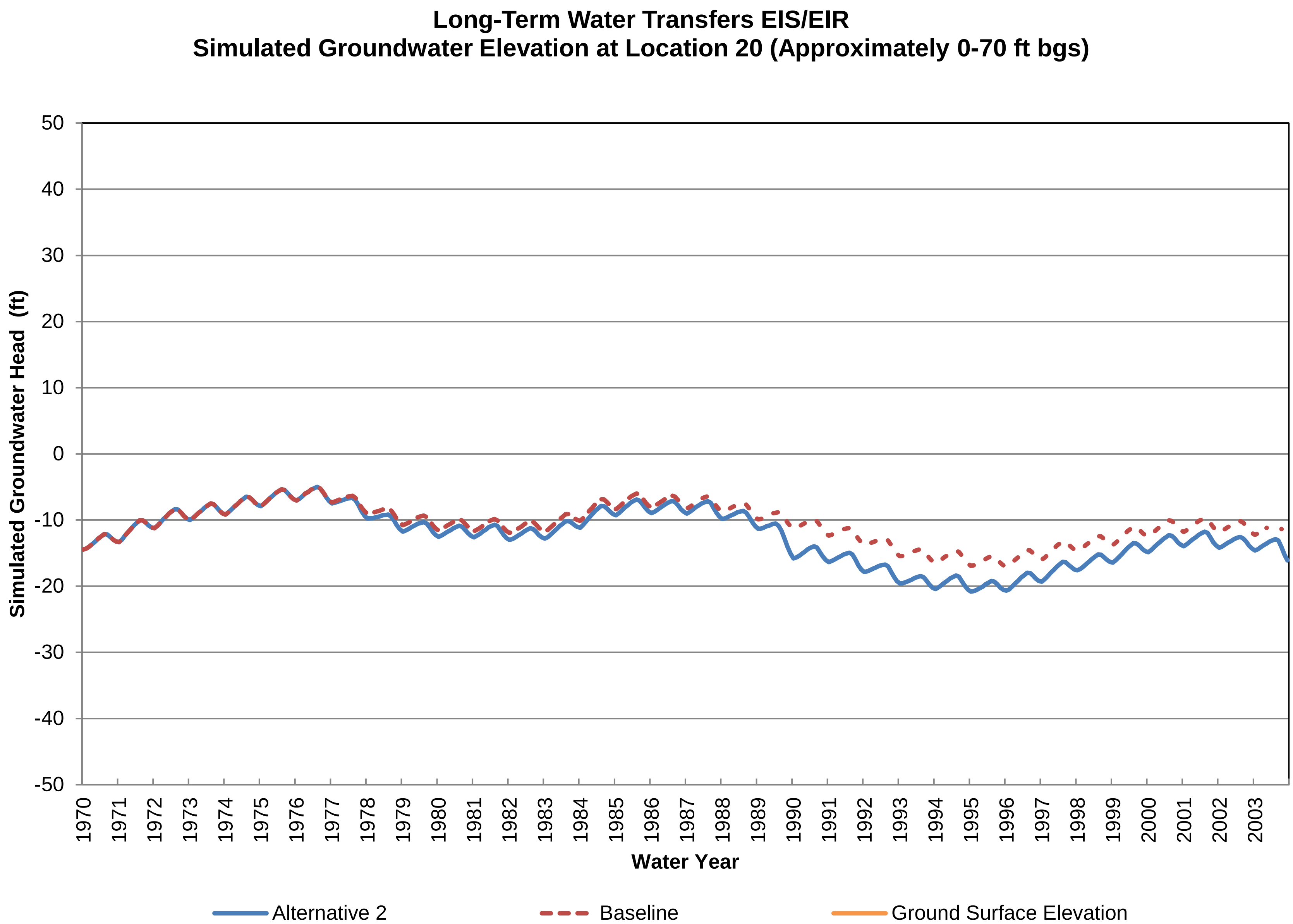
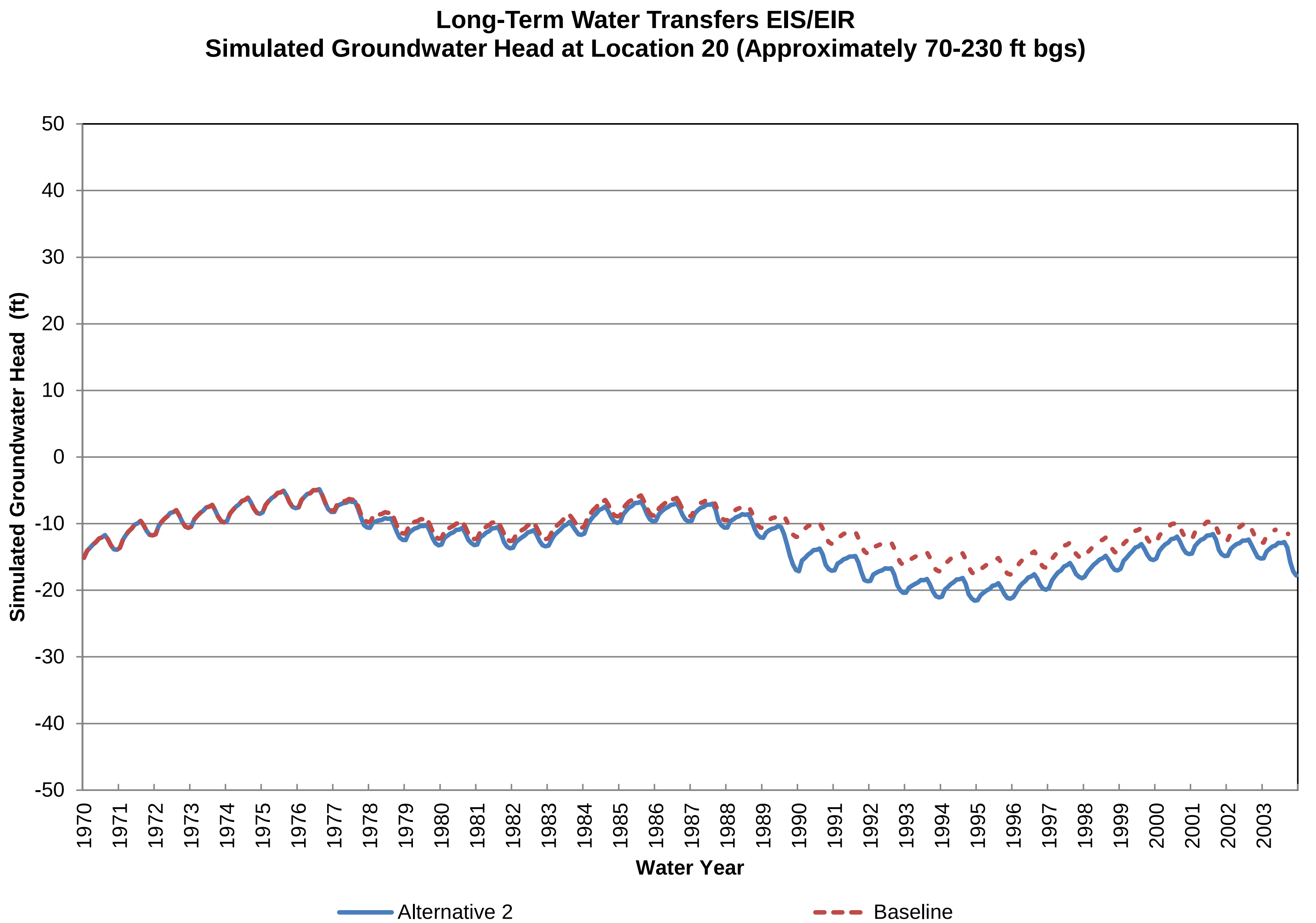
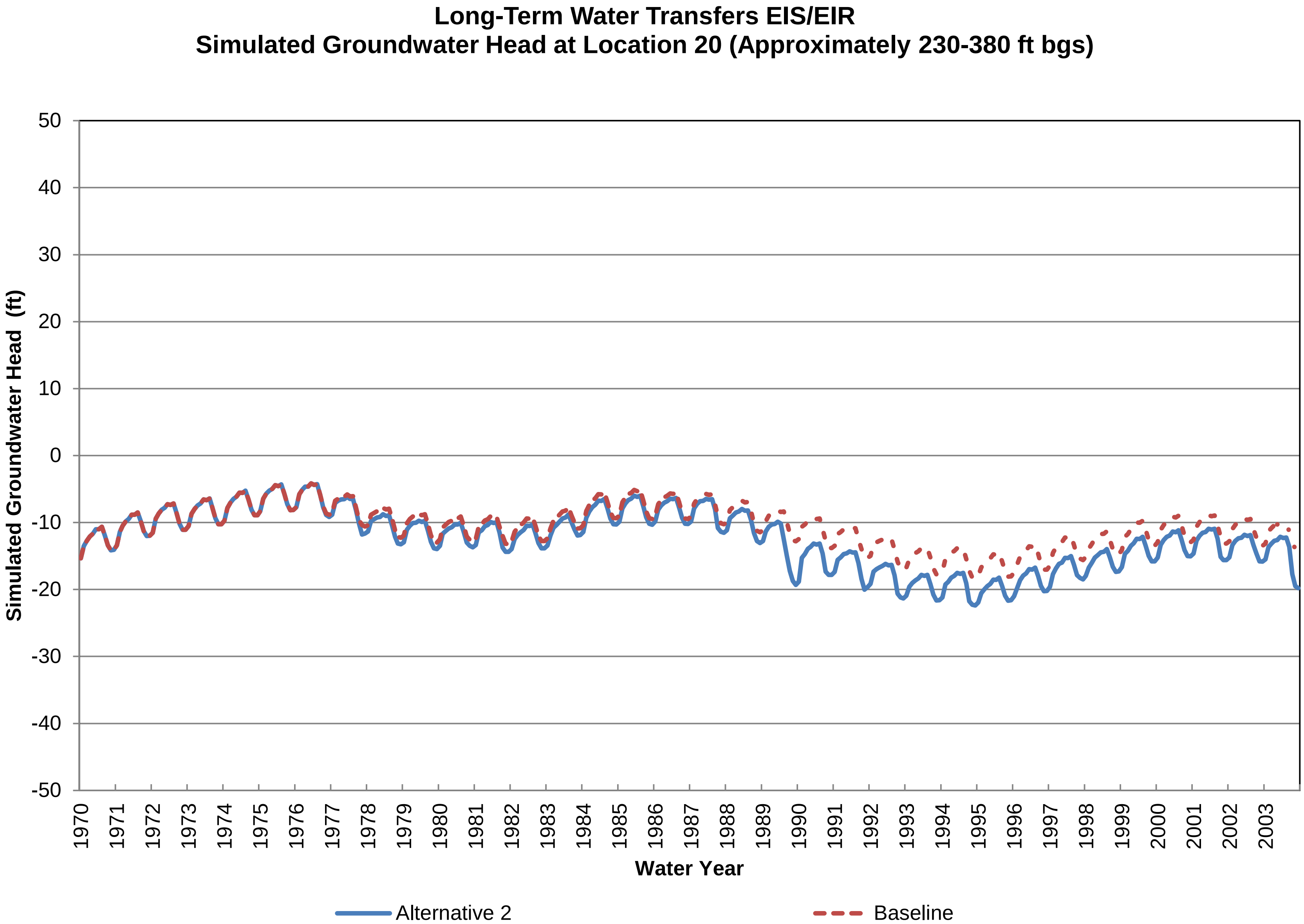
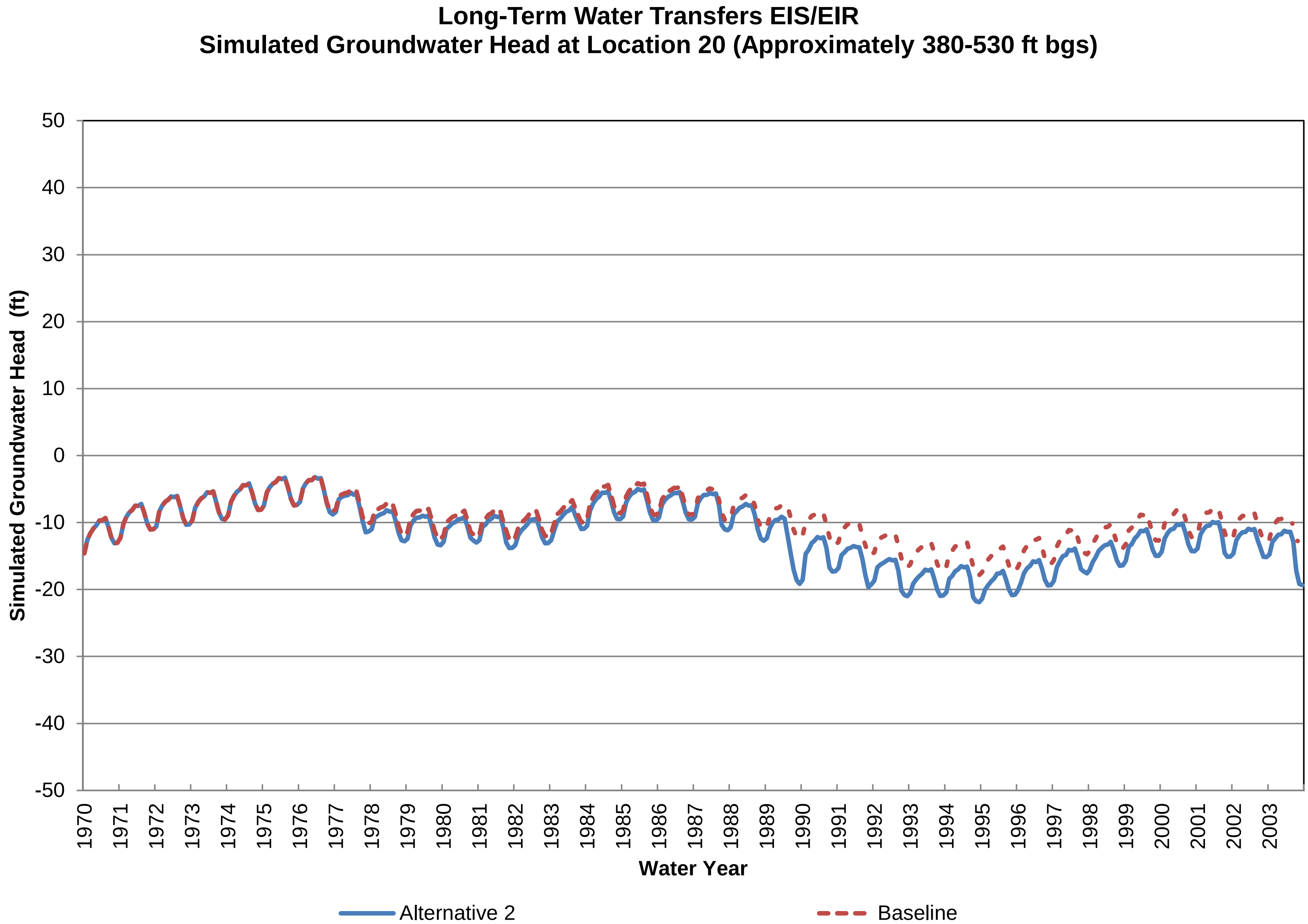
2001
2002
2003
Water Year
Alternative 2
Baseline

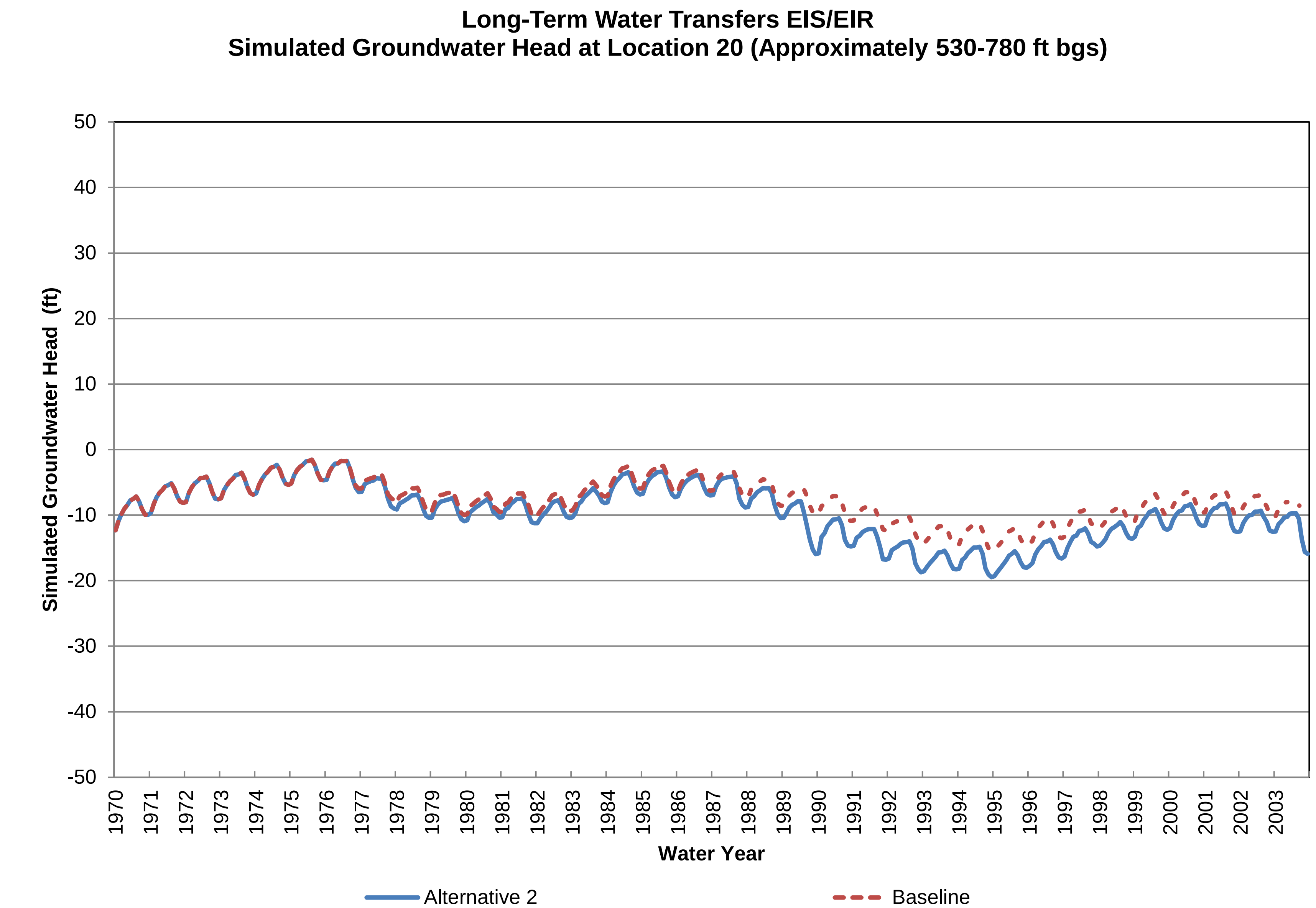

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 290-400 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003
Water Year
Alternative 2
Baseline

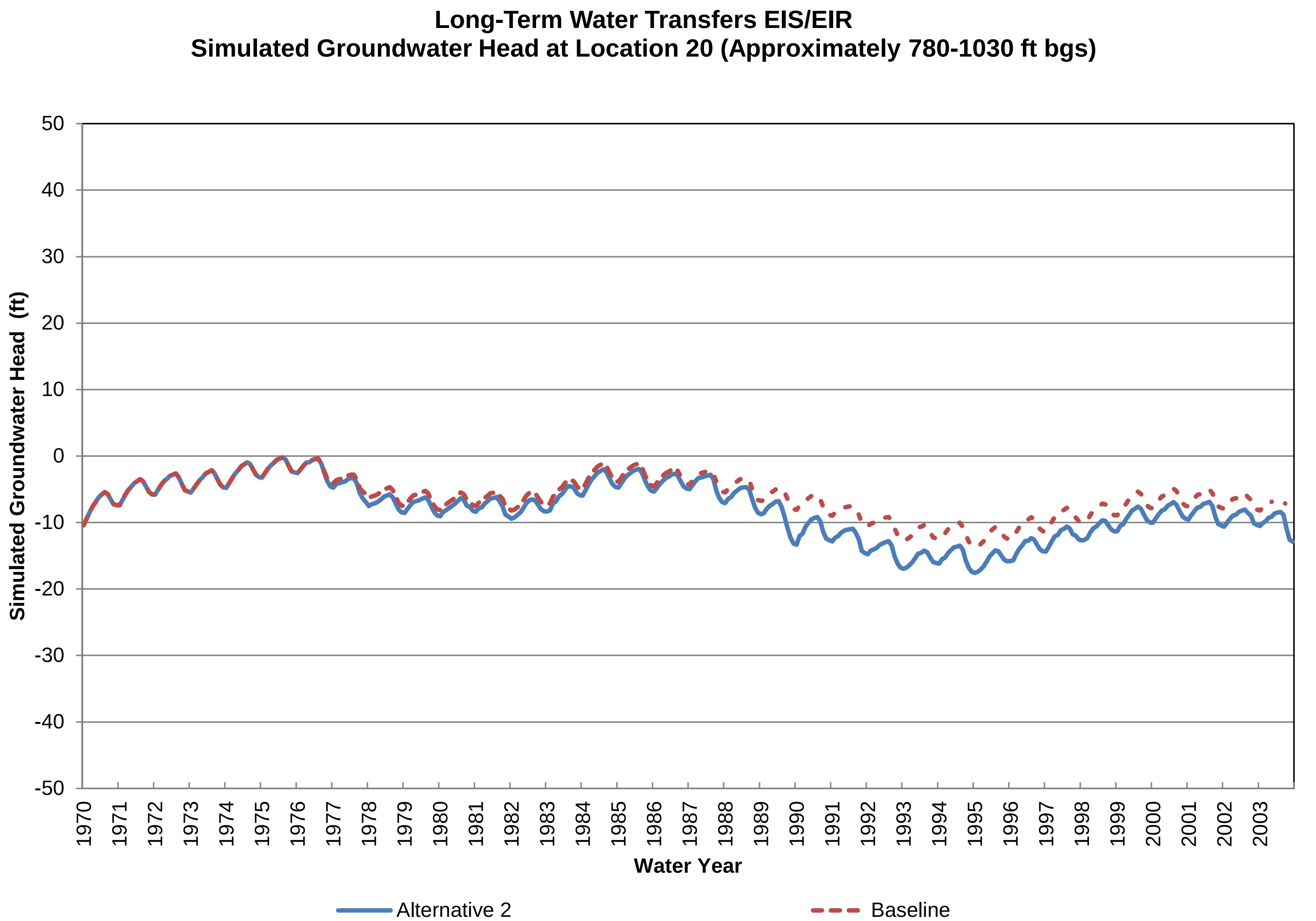

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 20 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

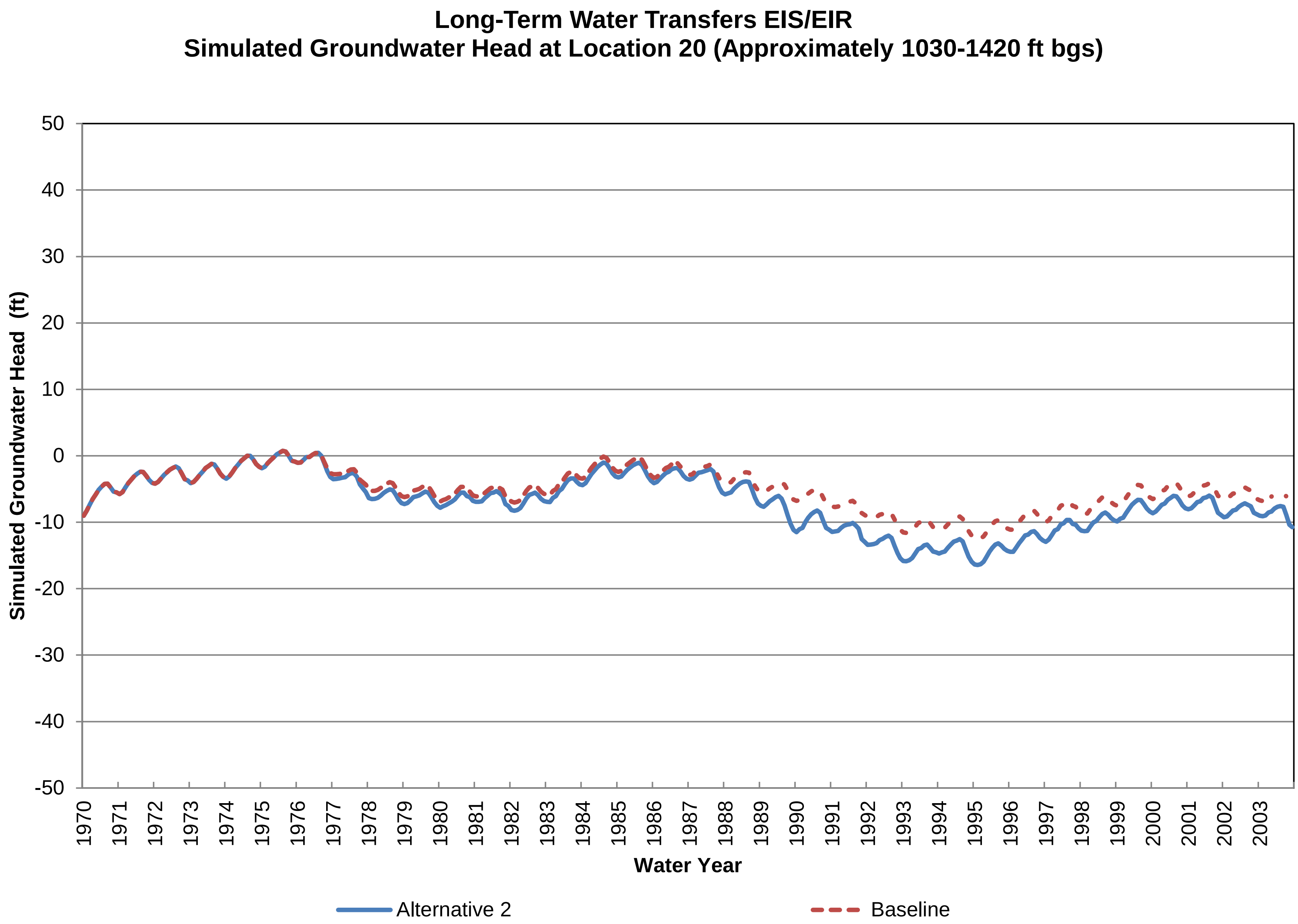

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 70-230 ft bgs)
50
40
30
20
10
0
-10
-20
-30
-40
-50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

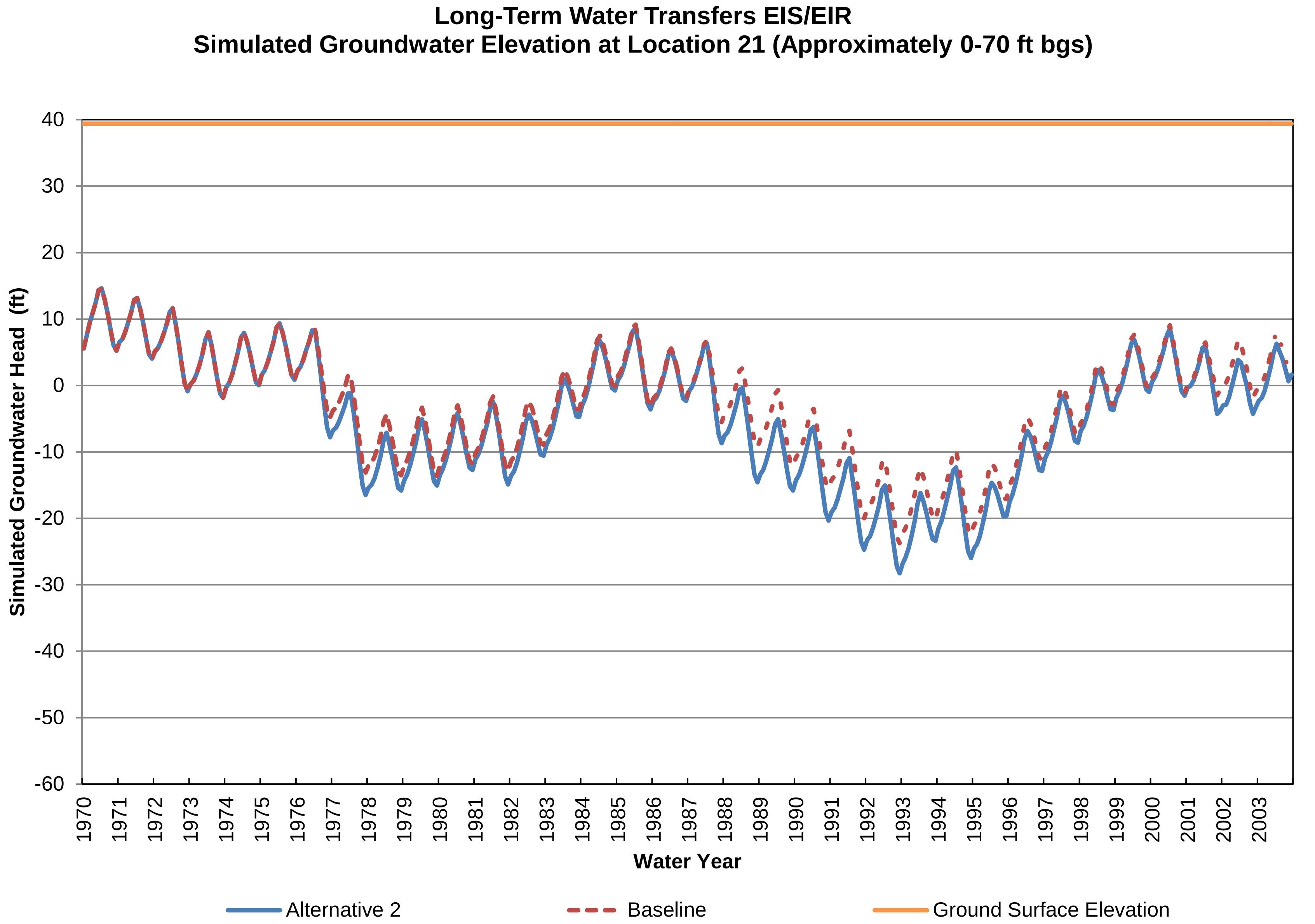

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 230-380 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 380-530 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 530-780 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 780-1030 ft bgs)
50
40
30
20
10
0
-10
-20
-30
-40
-50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 1030-1420 ft bgs)
50
40
30
20
10
0
-10
-20
-30
-40
-50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 21 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
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1994
1995
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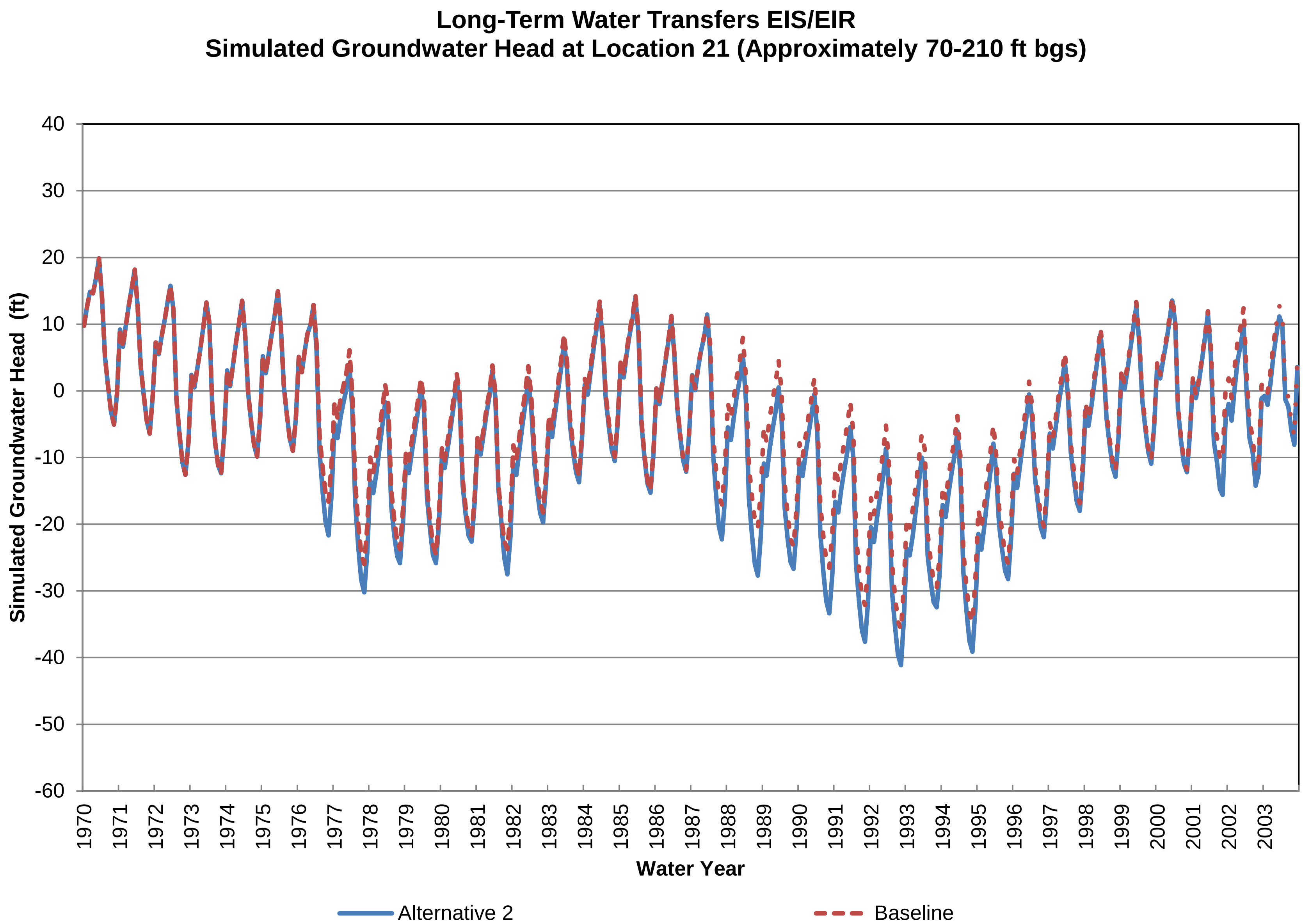
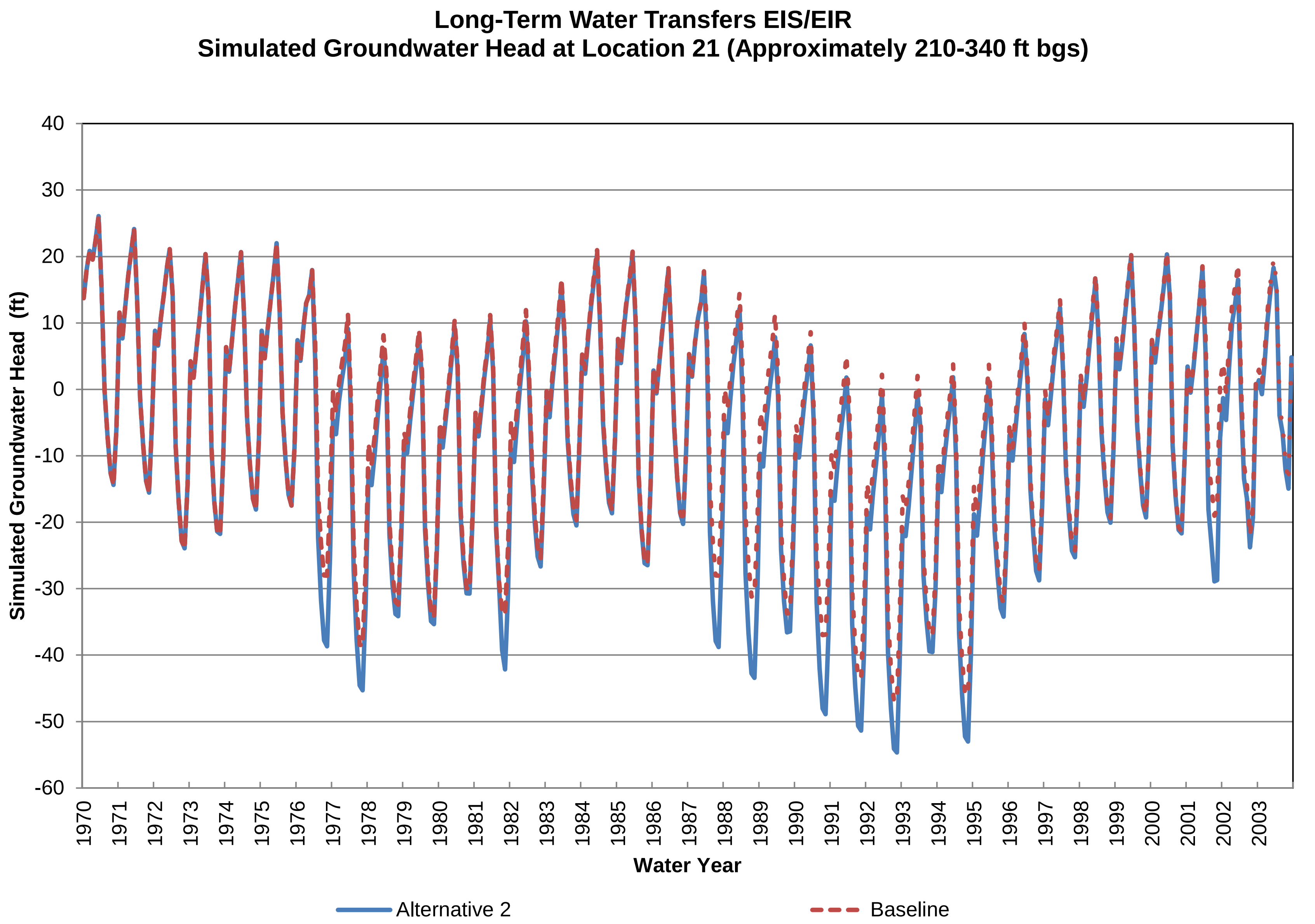
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 70-210 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 210-340 ft bgs)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
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1993
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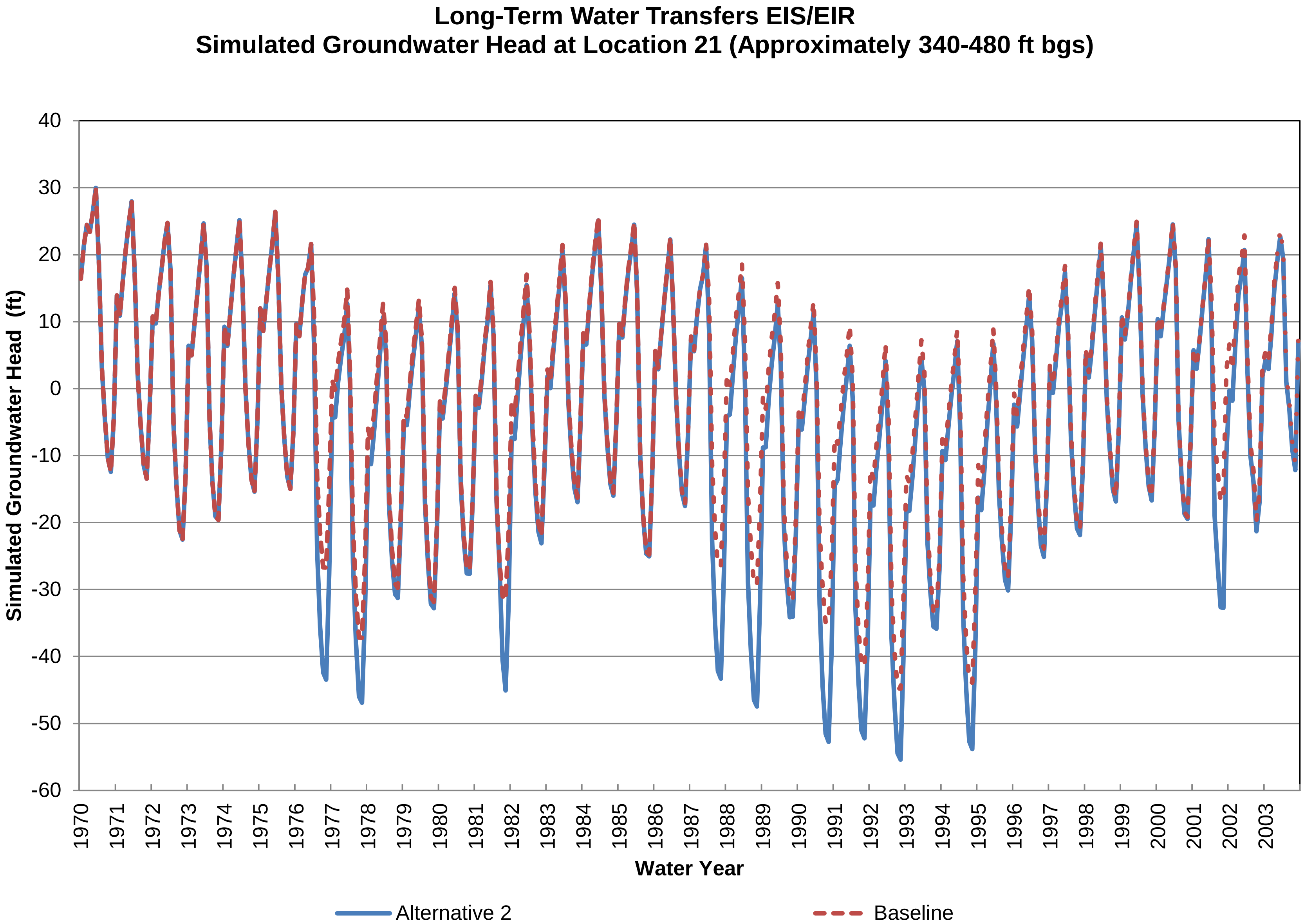
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 340-480 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
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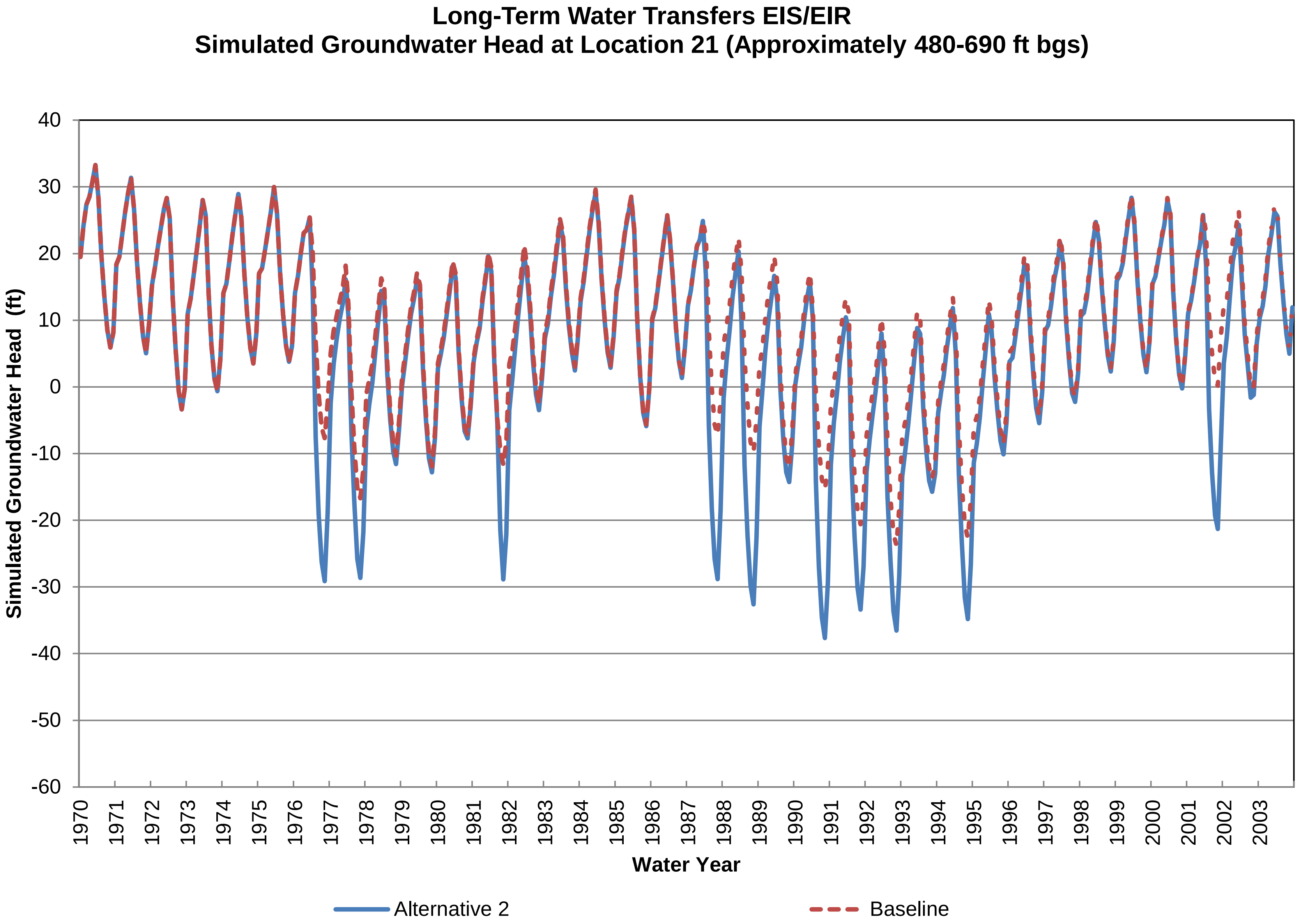
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 480-690 ft bgs)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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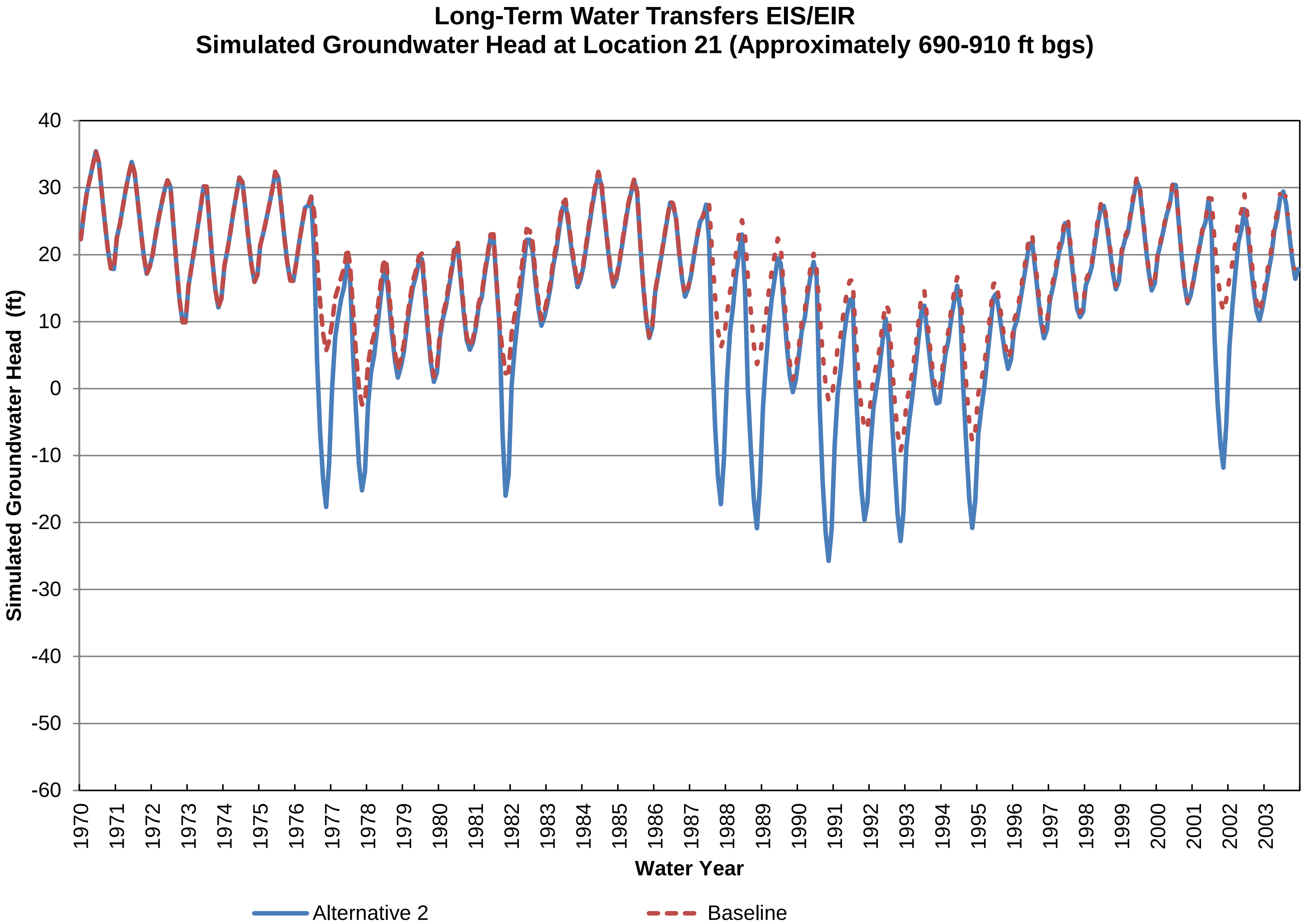
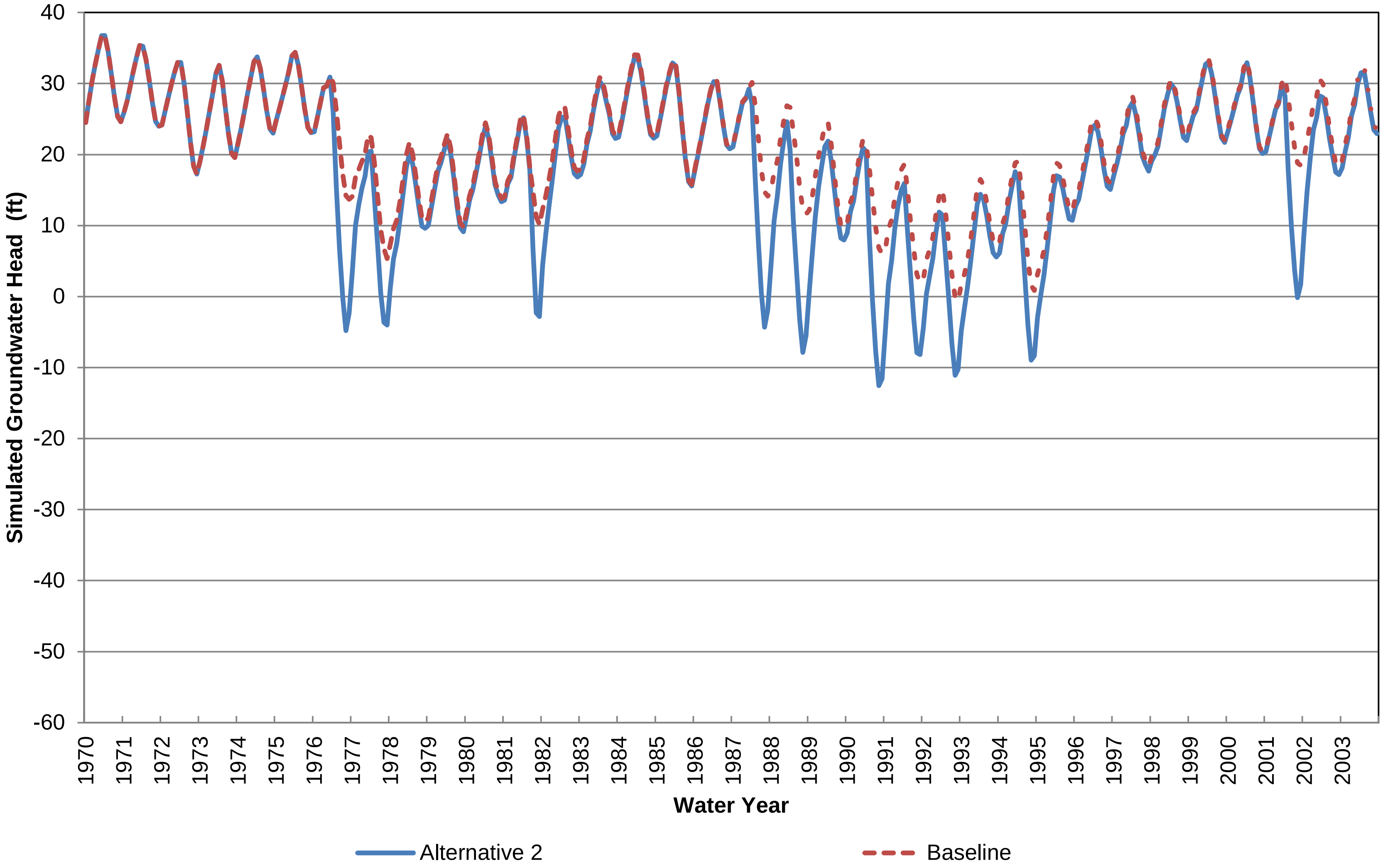
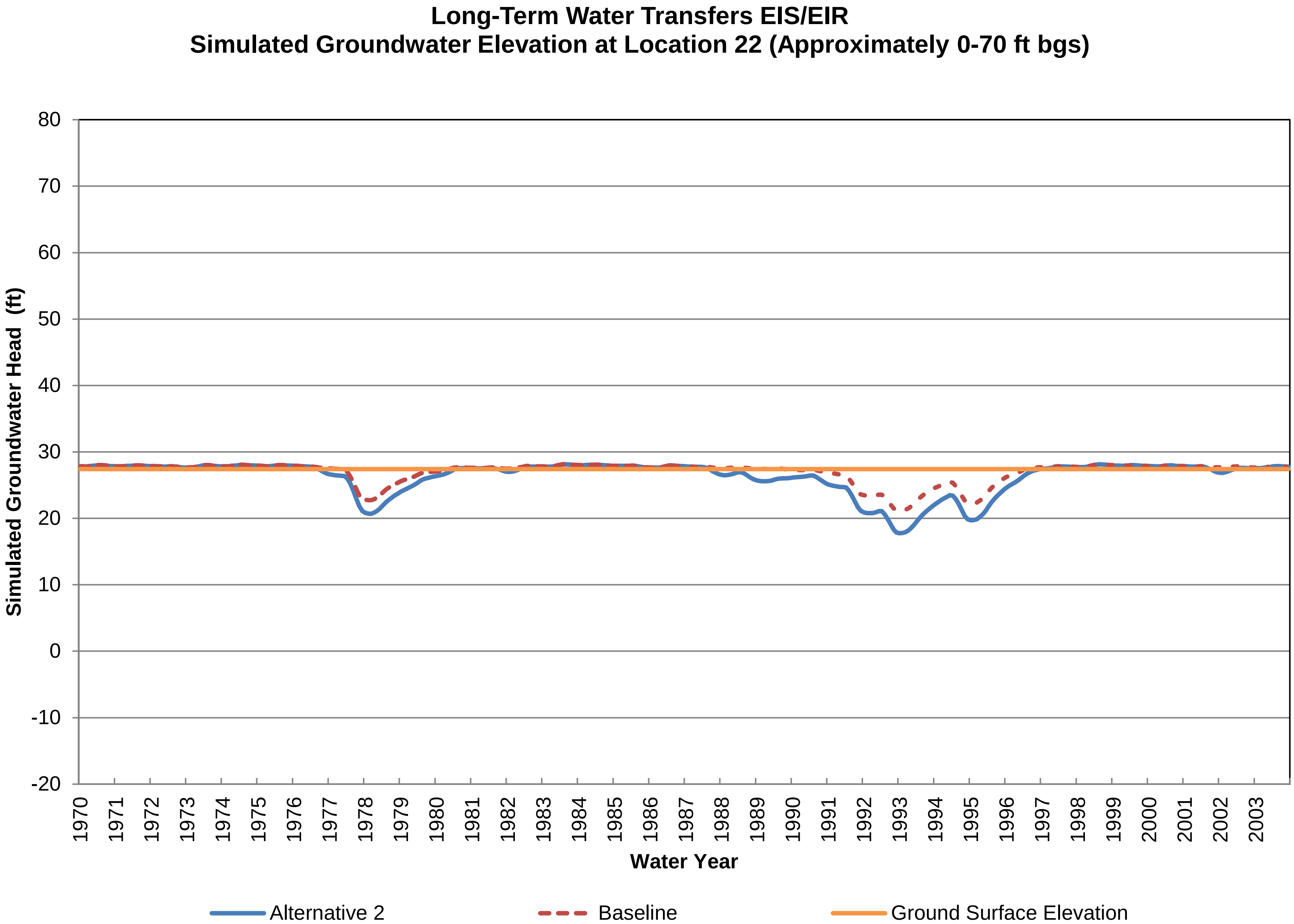
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

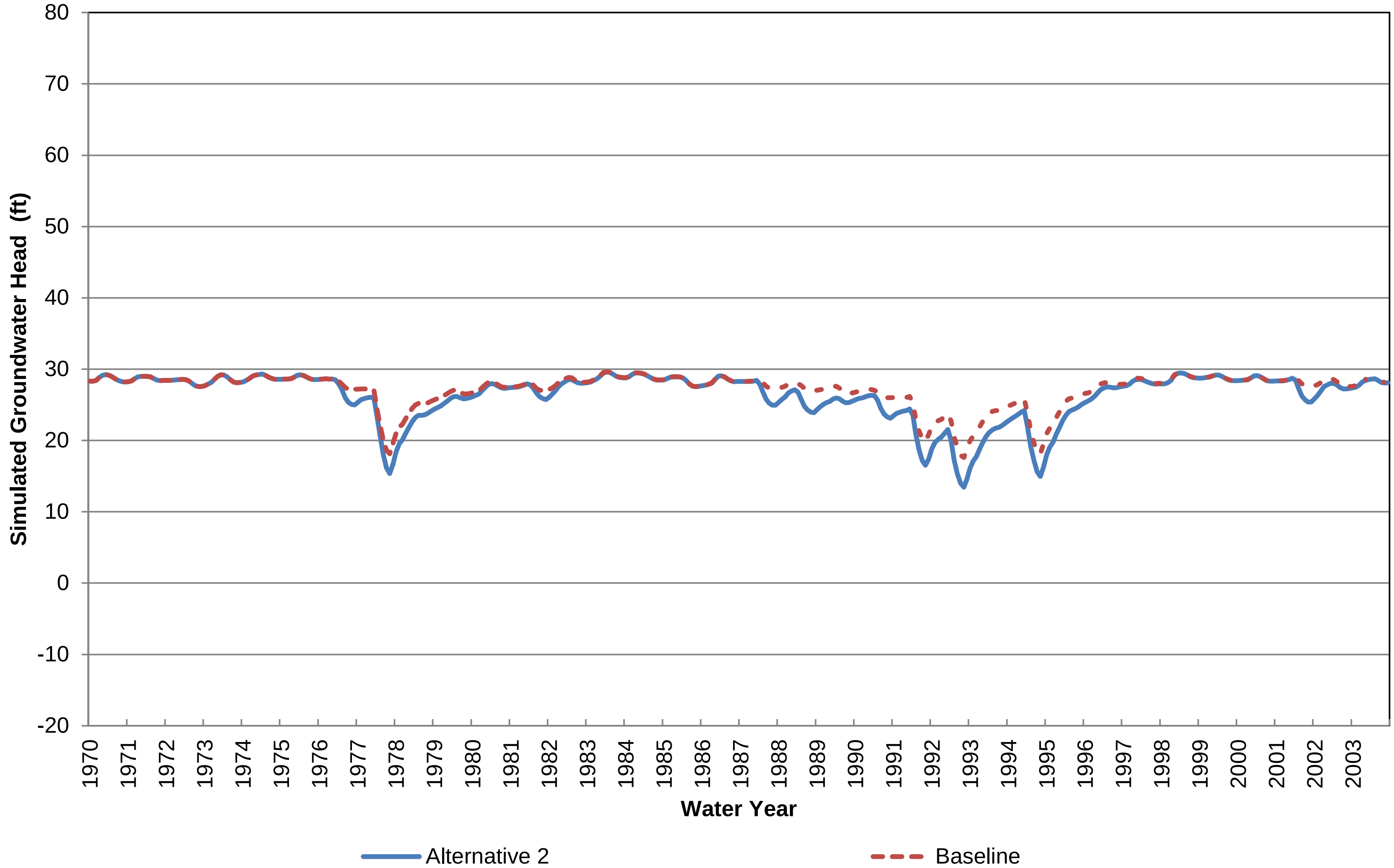

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 690-910 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 910-1250 ft bgs)

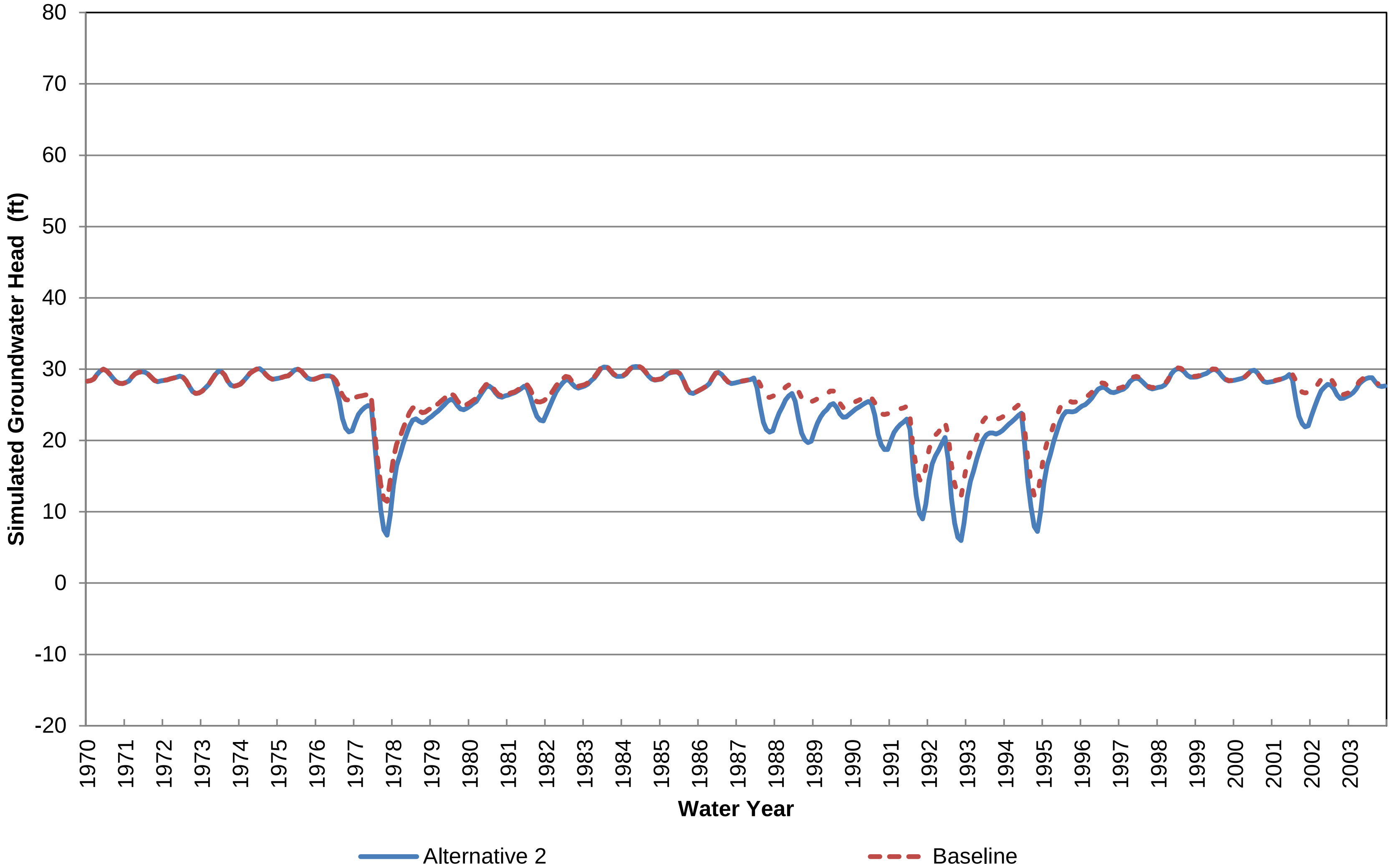


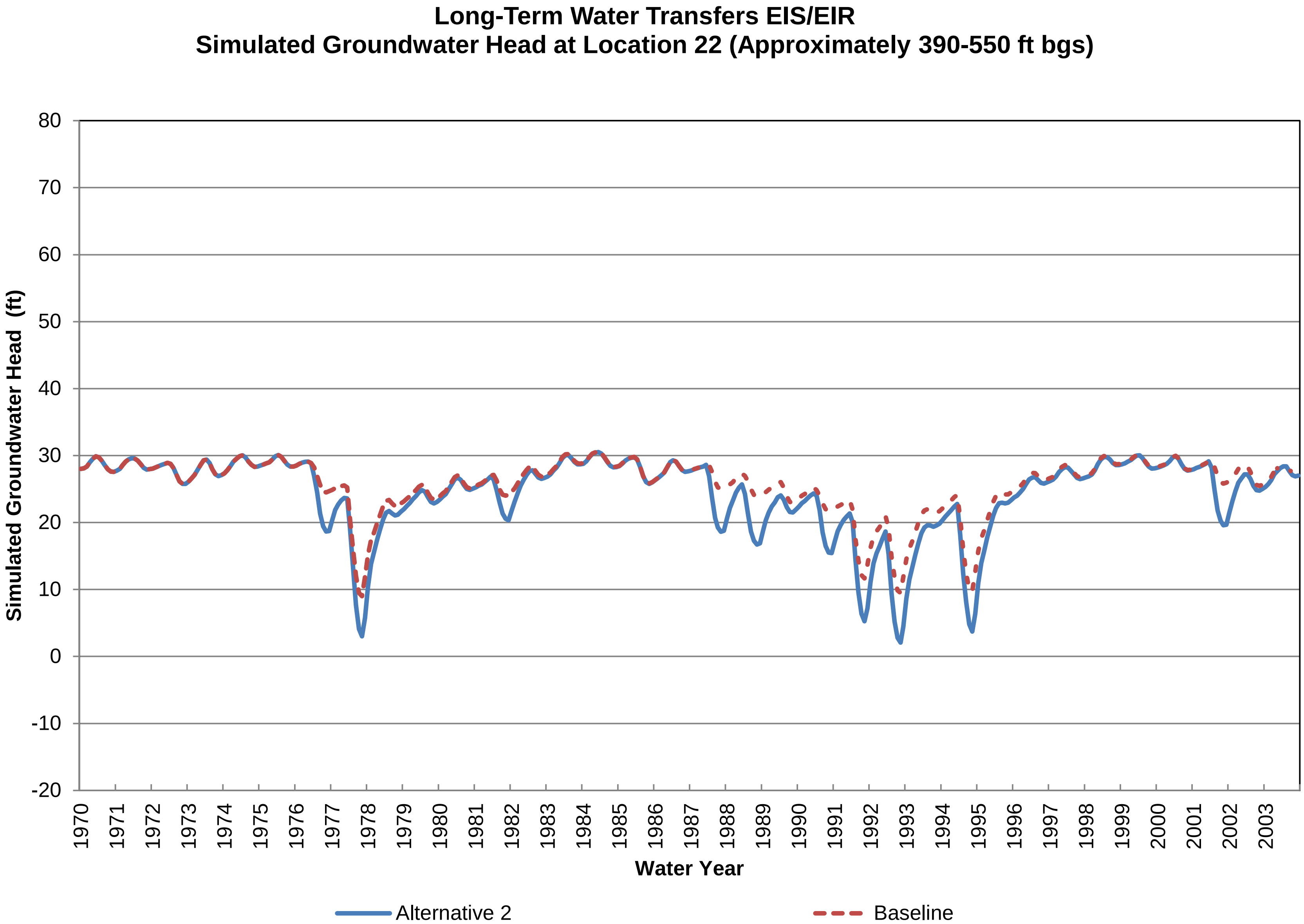

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 22 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

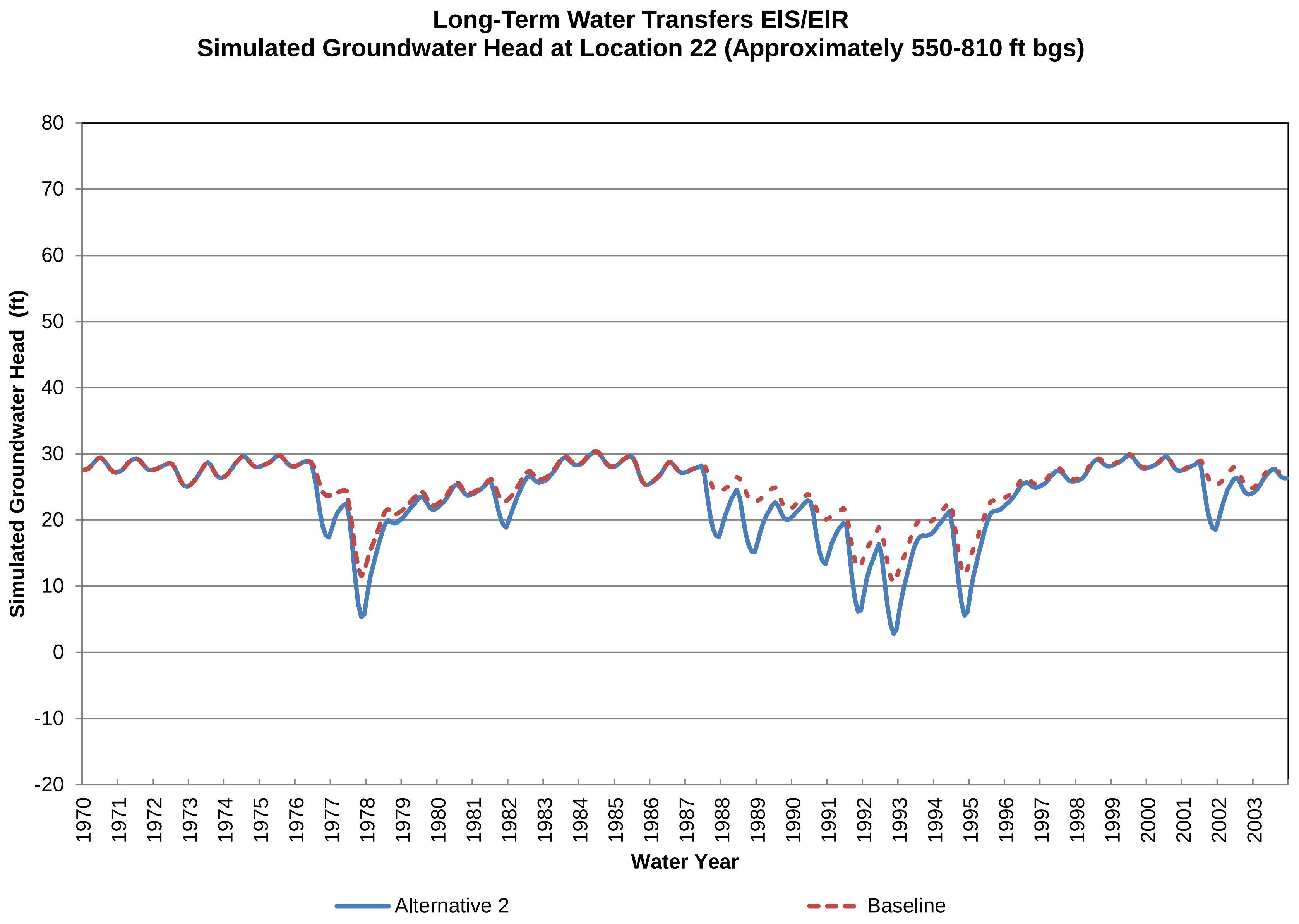
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 70-230 ft bgs)



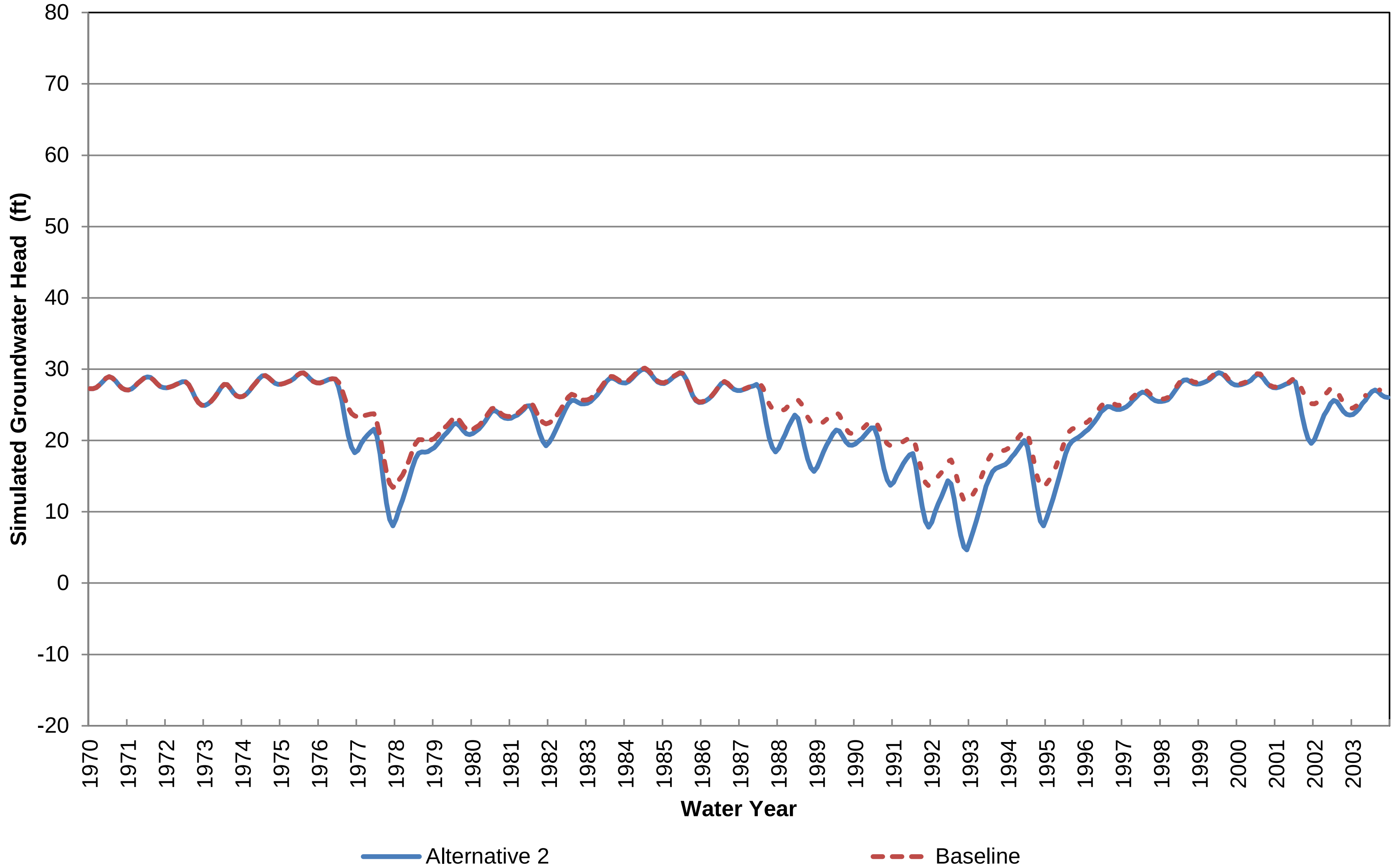
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 230-390 ft bgs)

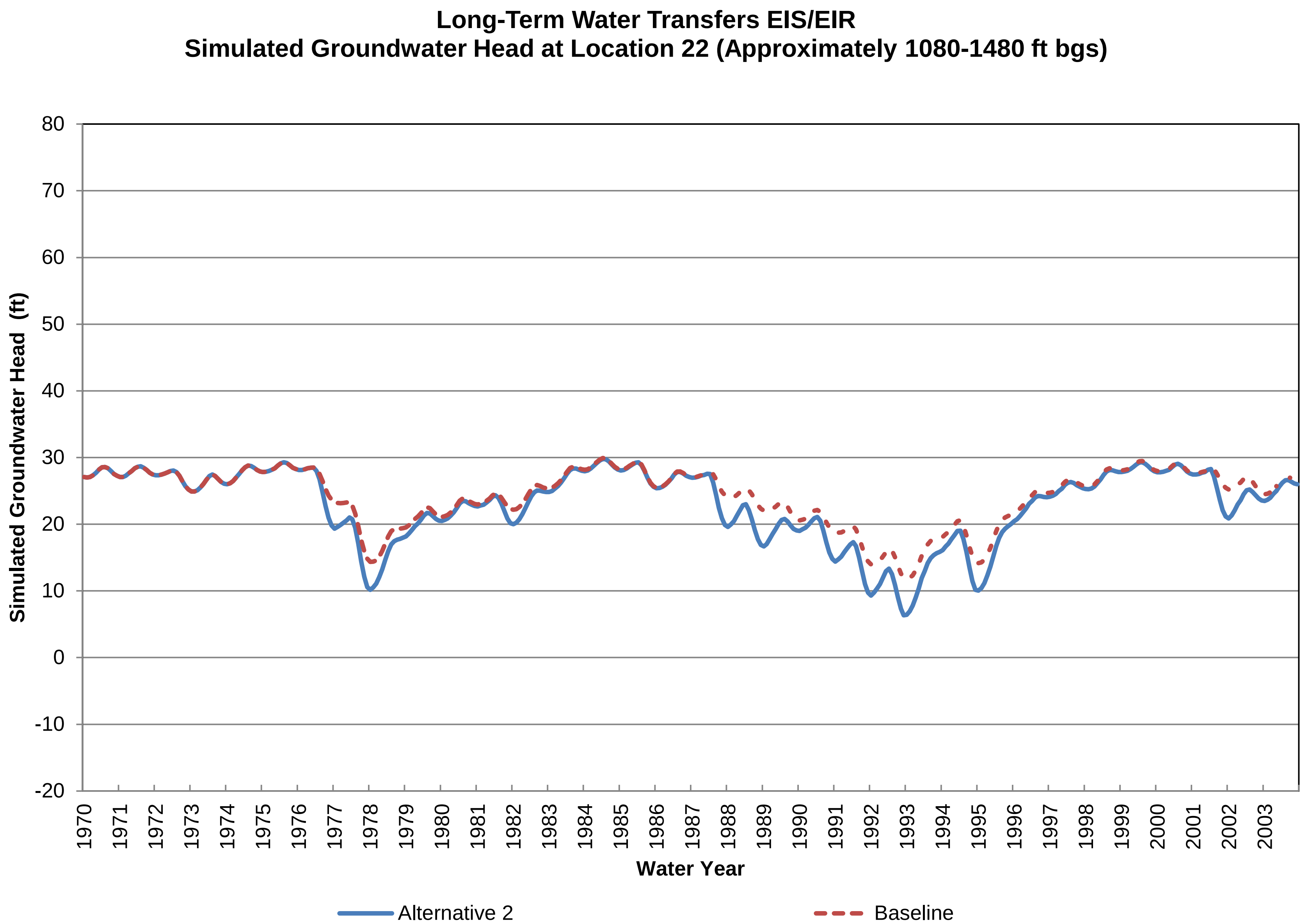



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 390-550 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

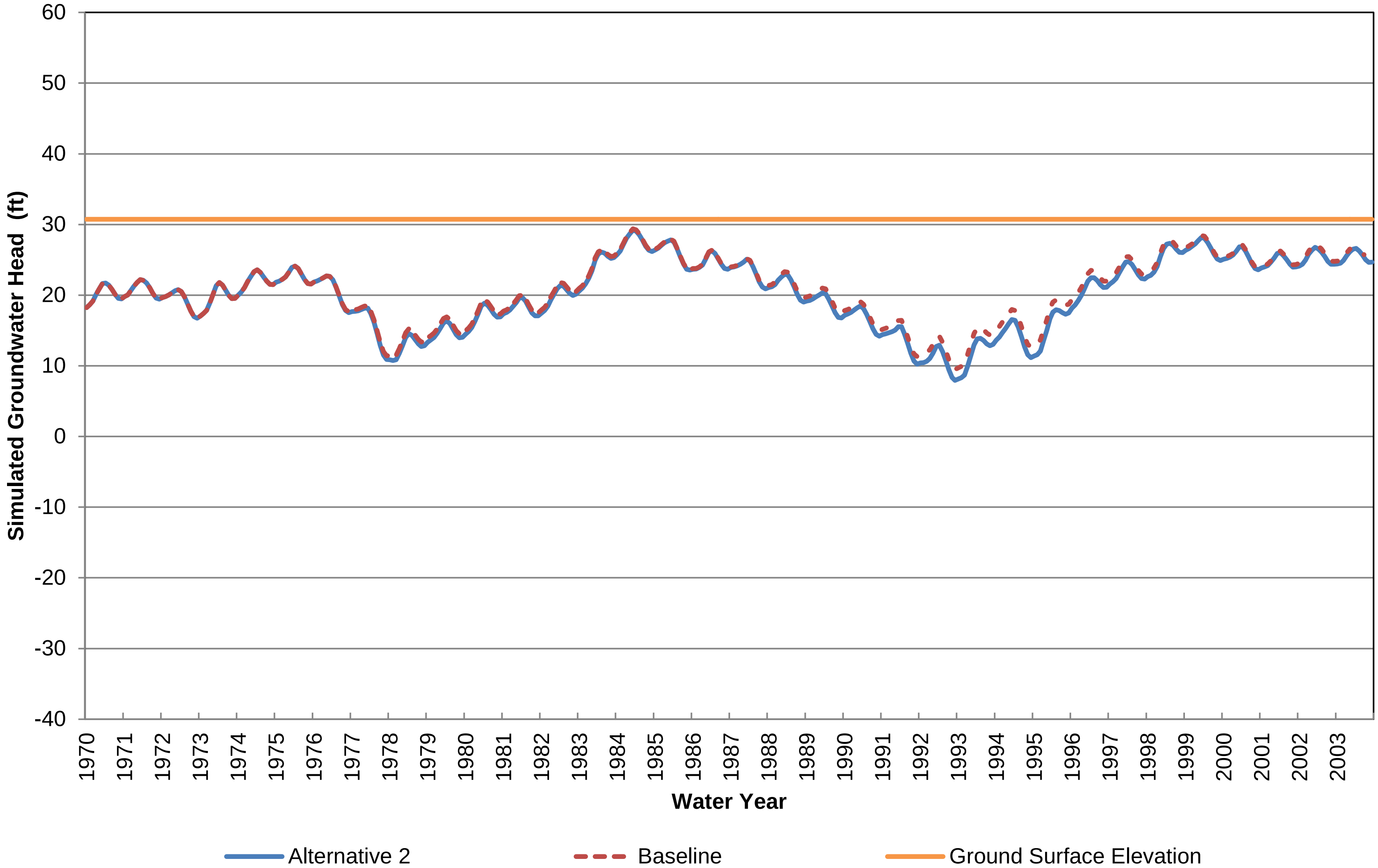

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 550-810 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

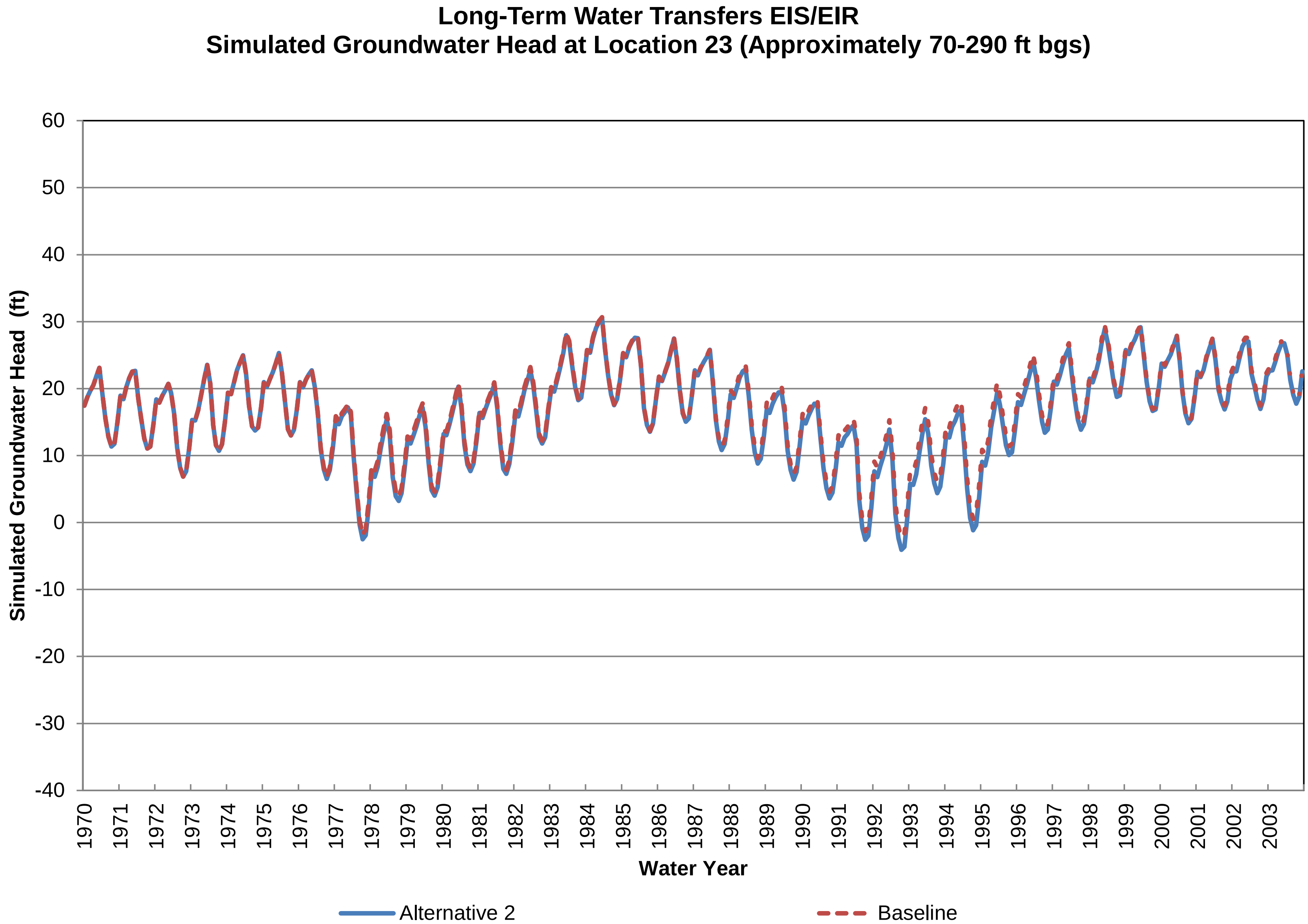
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 810-1080 ft bgs)



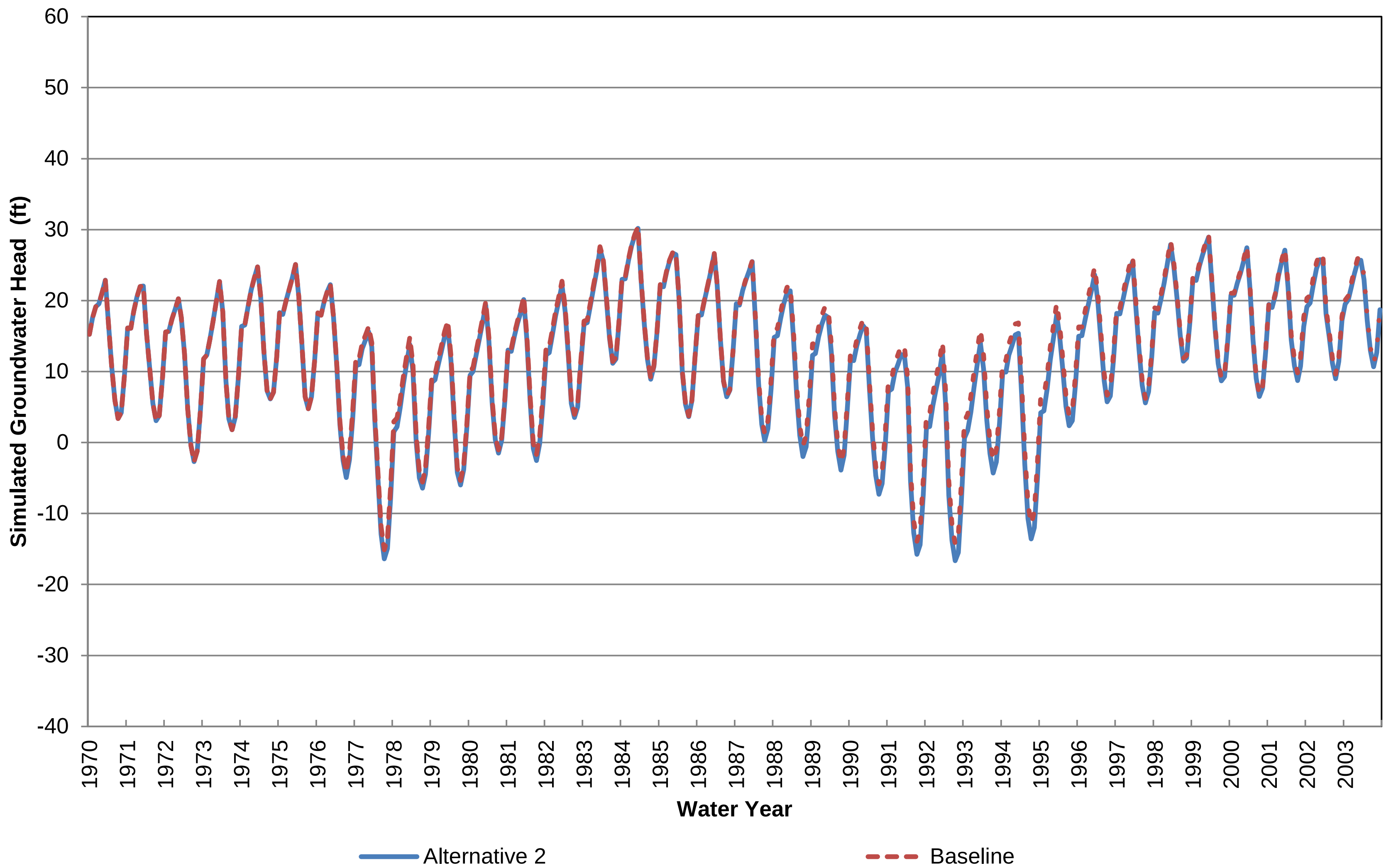

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 1080-1480 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

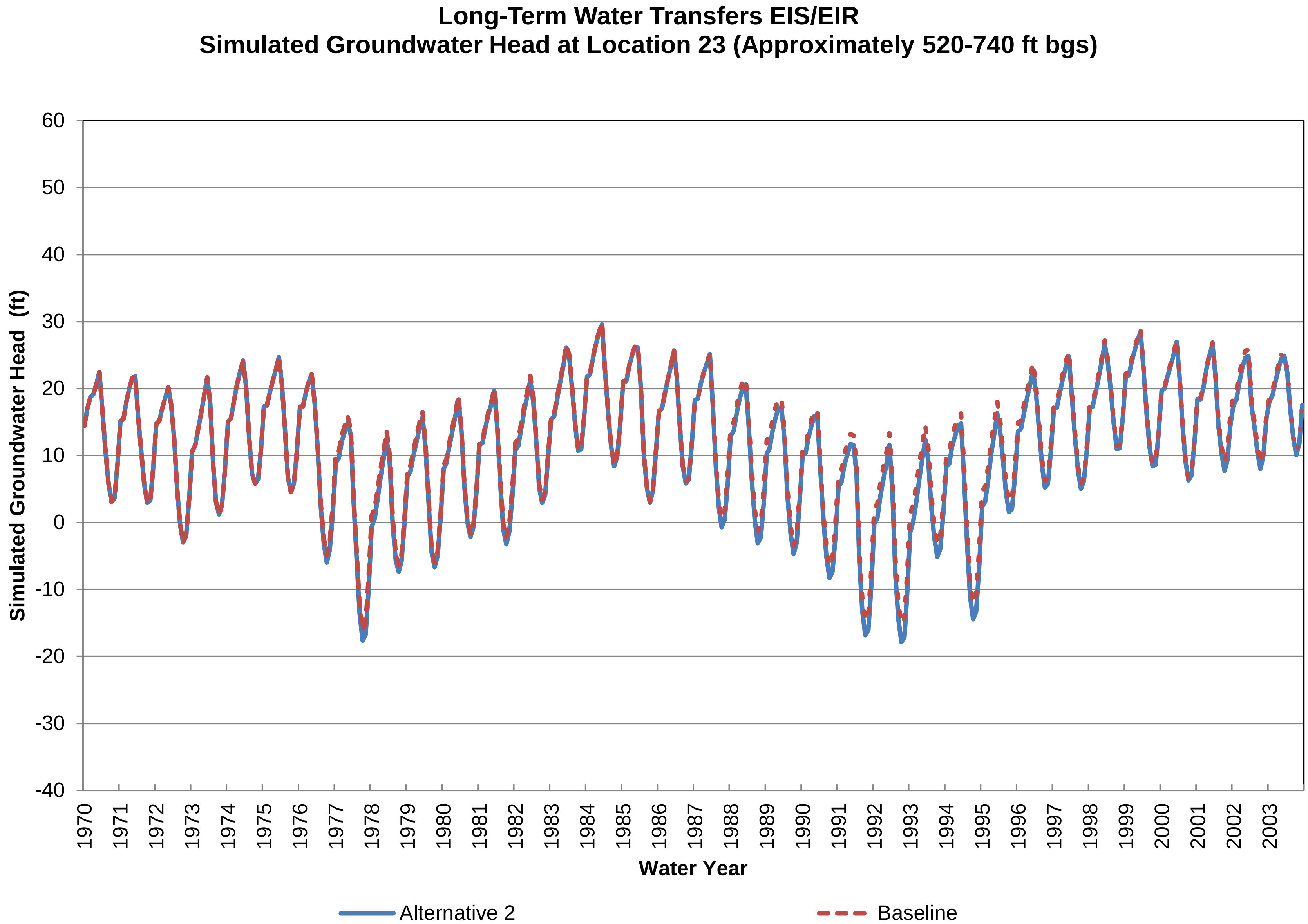
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 23 (Approximately 0-70 ft bgs)

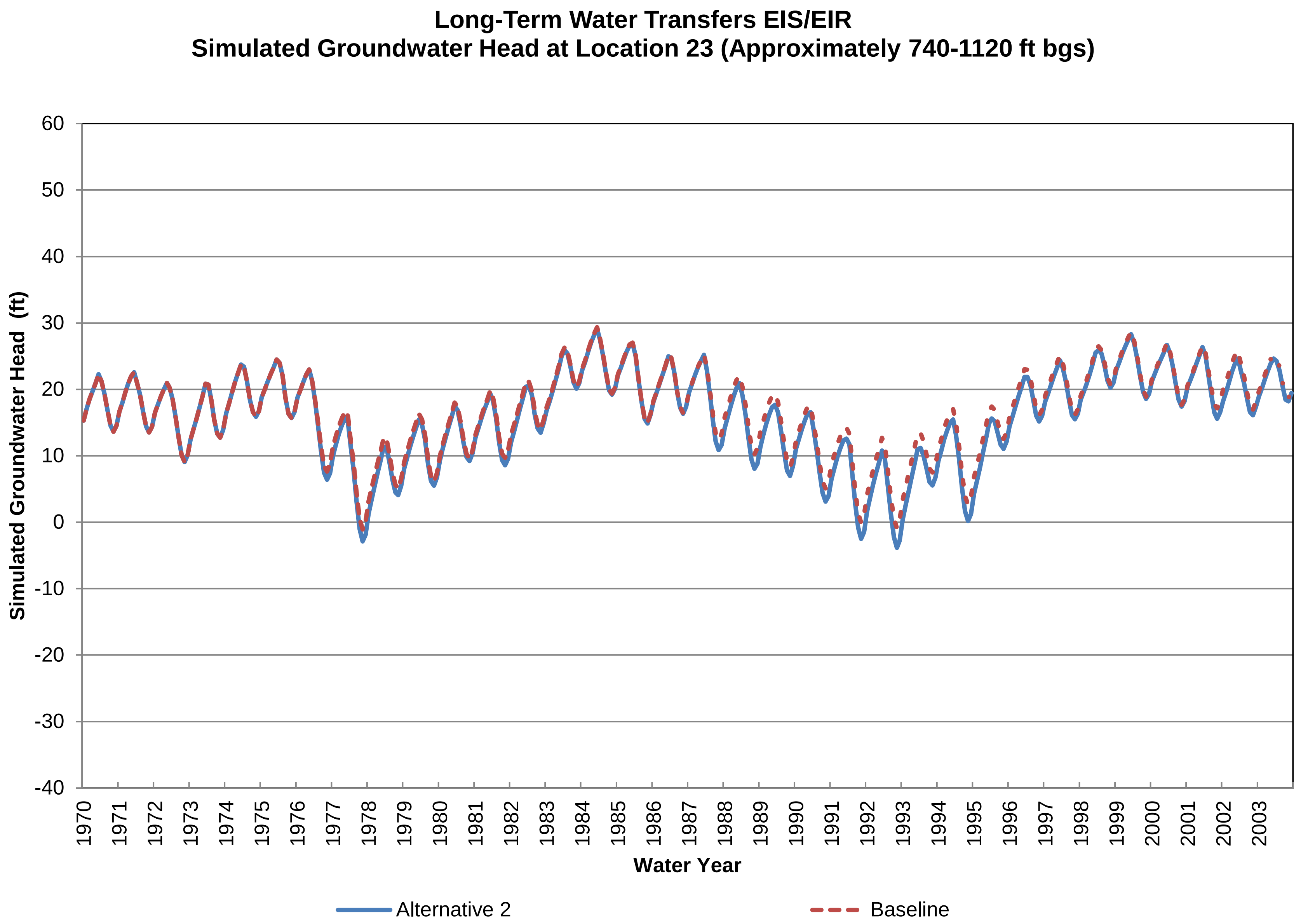


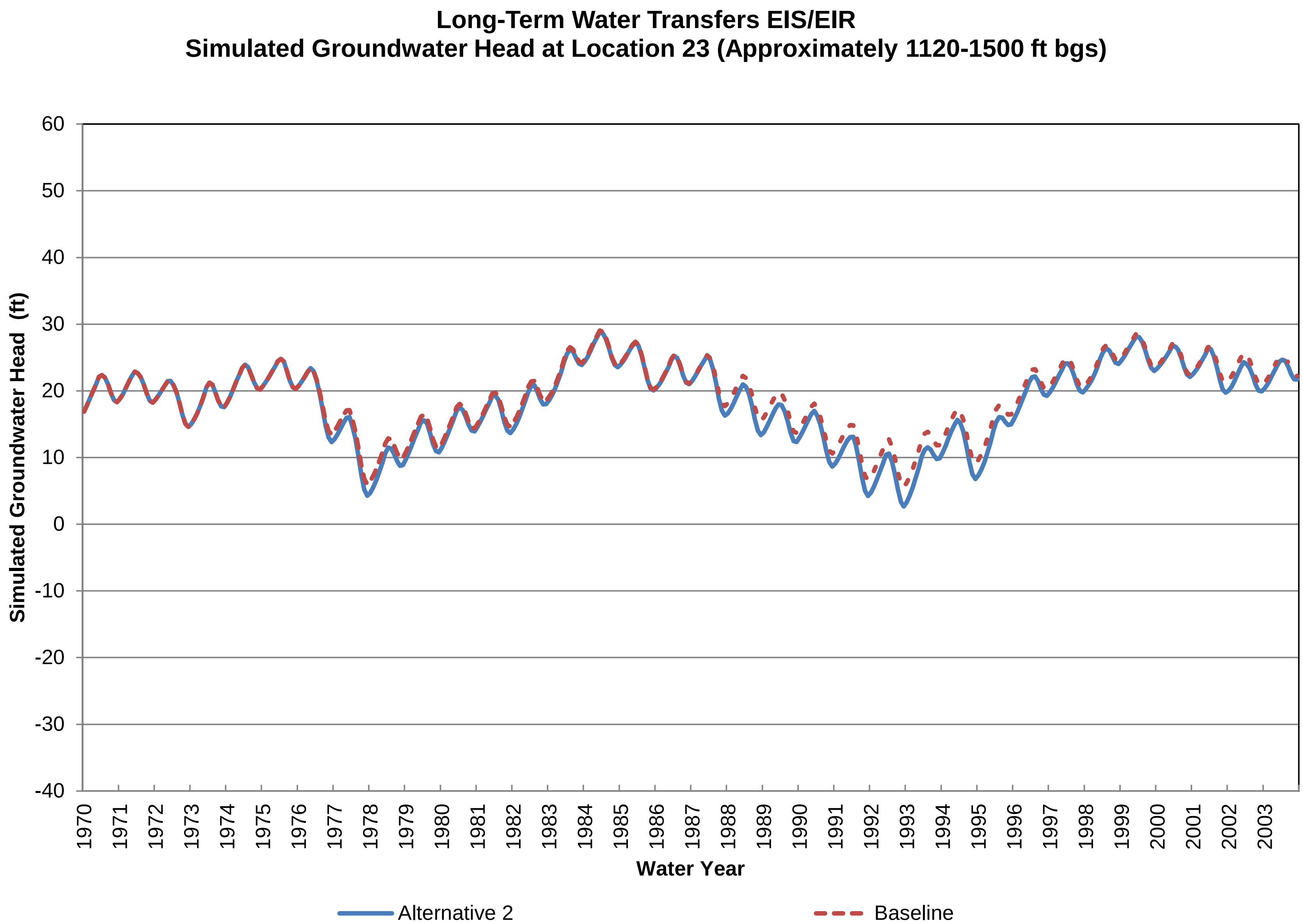

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 70-290 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 290-520 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 520-740 ft bgs)
60
50
40
30
20
10
0
-10
-20
-30
-40
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 740-1120 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 1120-1500 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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1981
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1986
1987
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1989
1990
1991
1992
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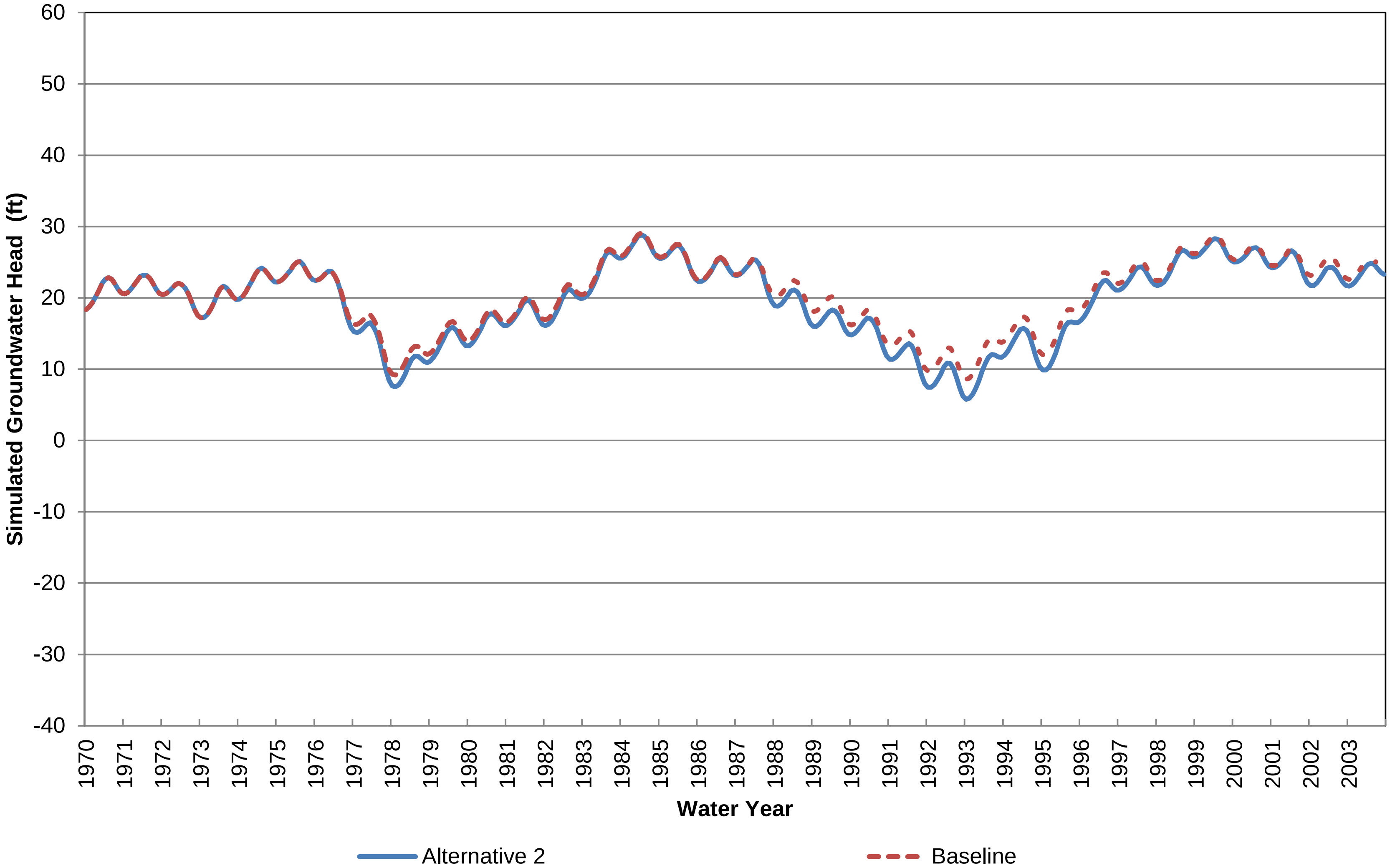
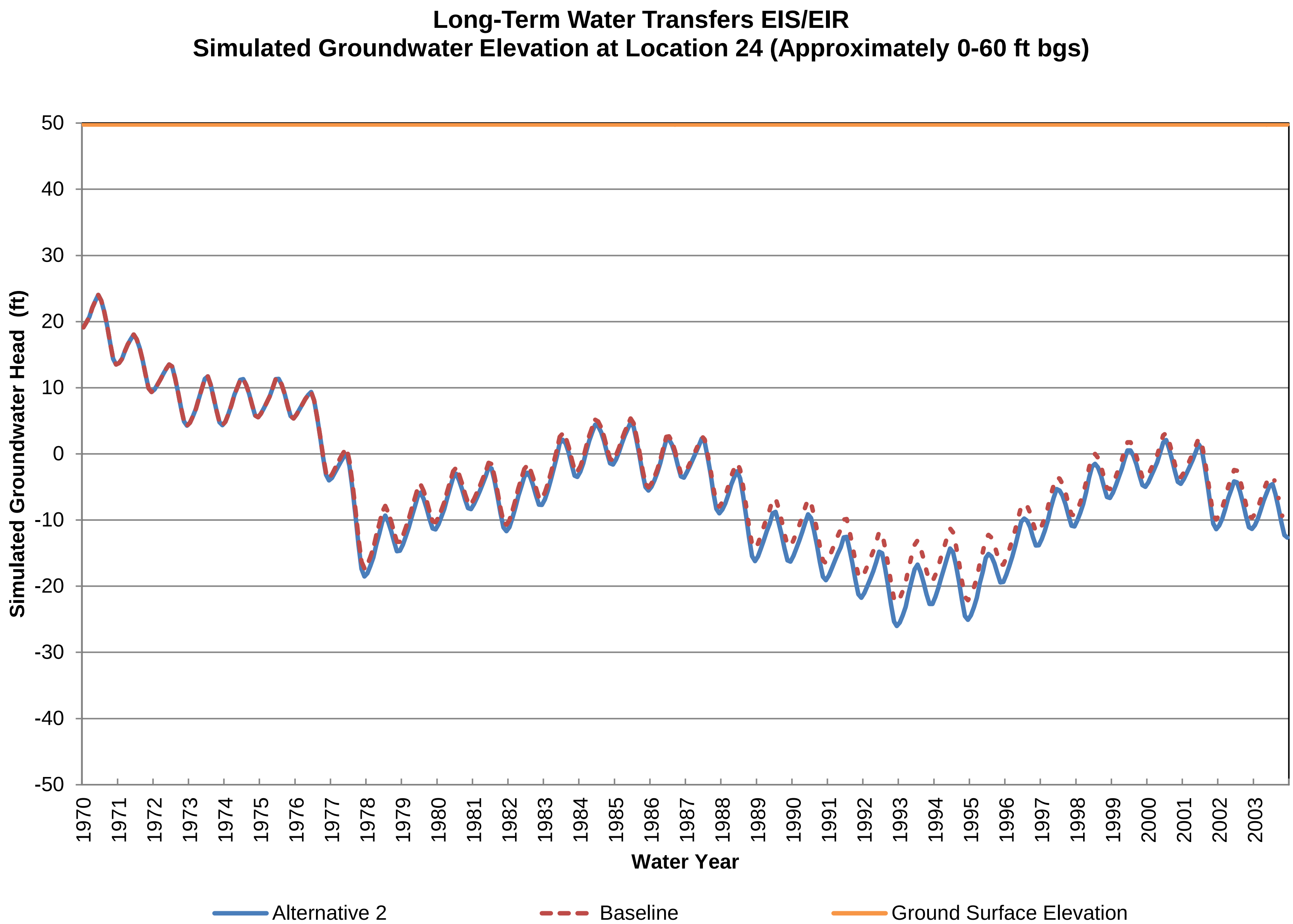
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 1500-2050 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 24 (Approximately 0-60 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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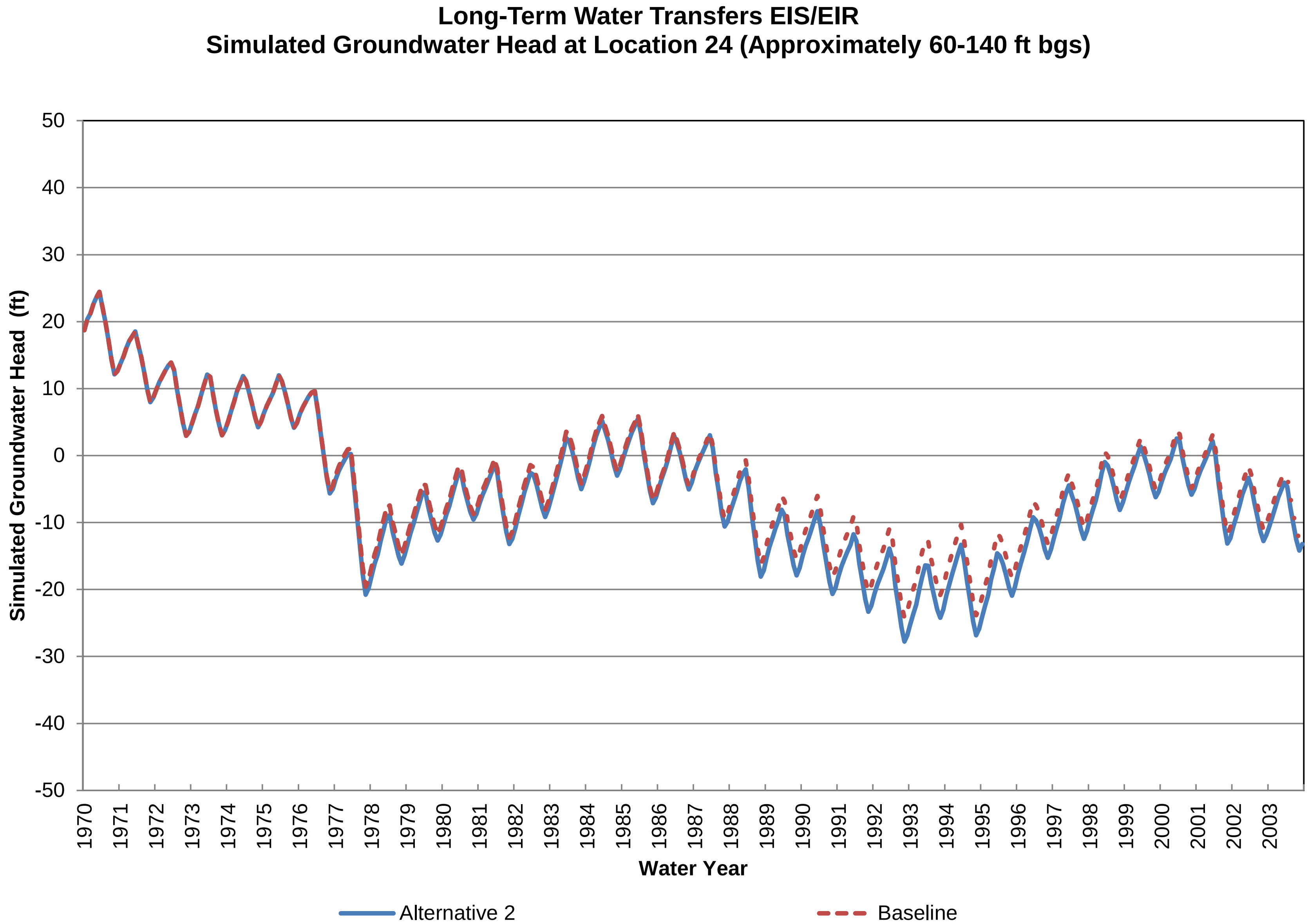
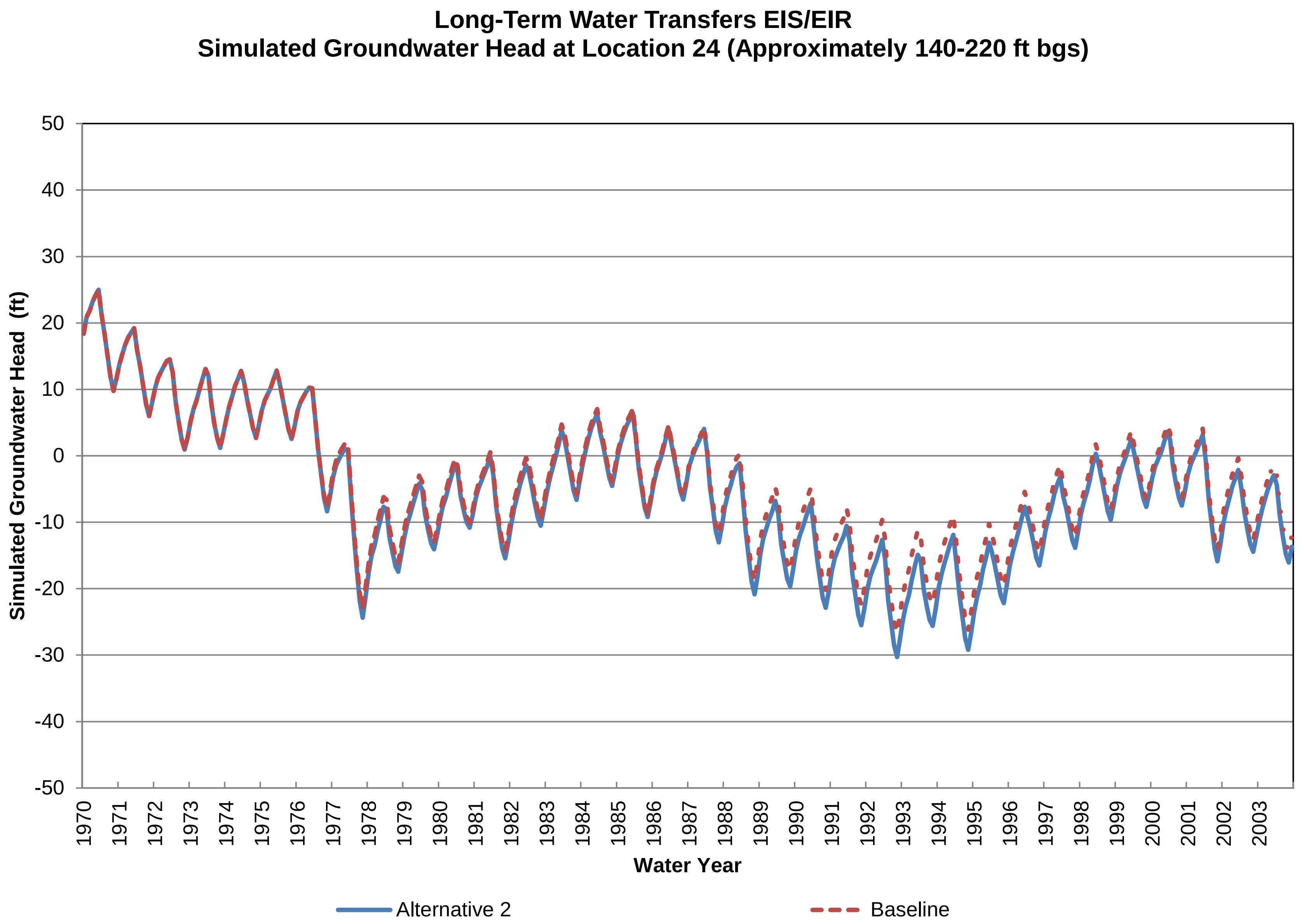
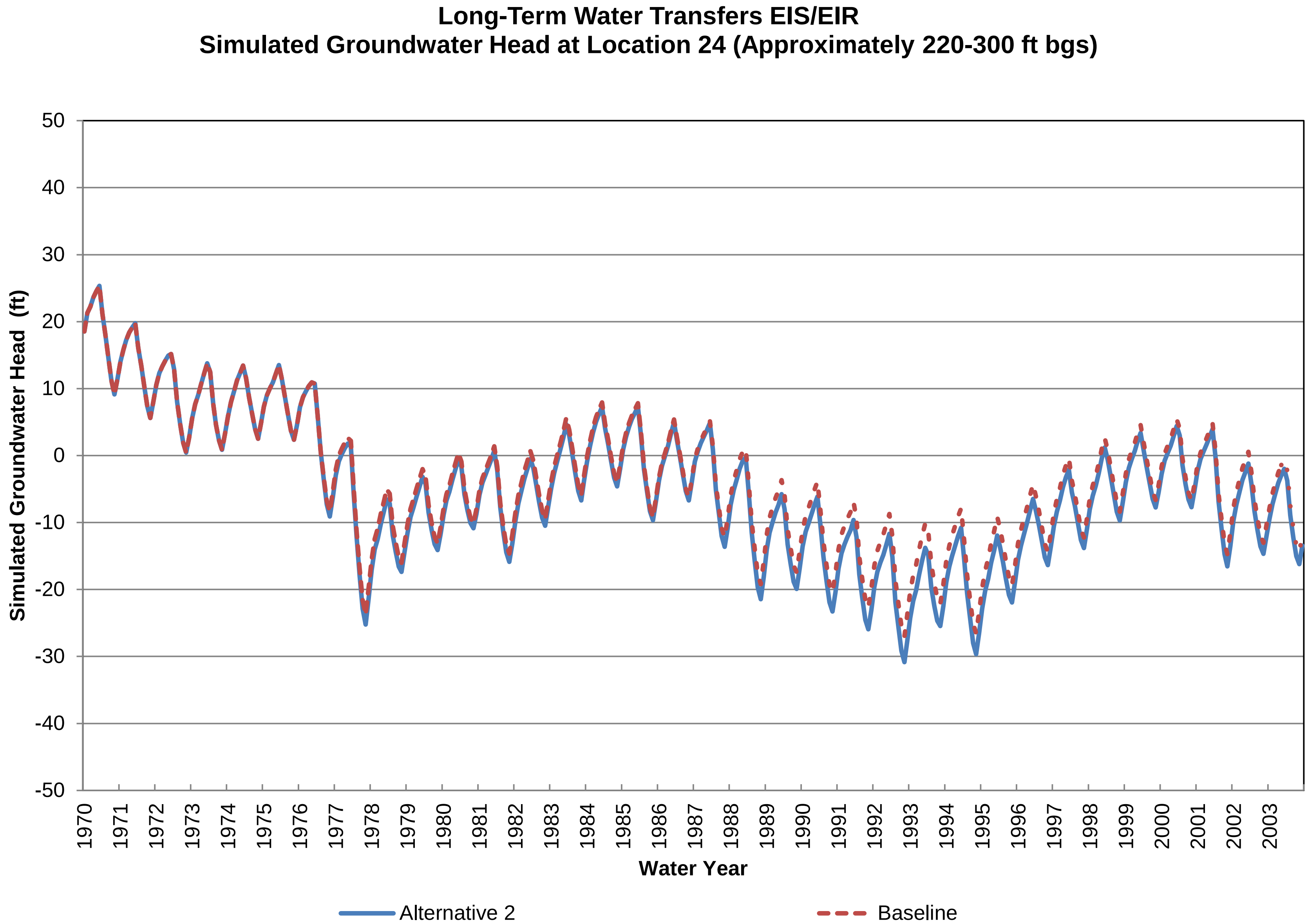
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 60-140 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 140-220 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 220-300 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
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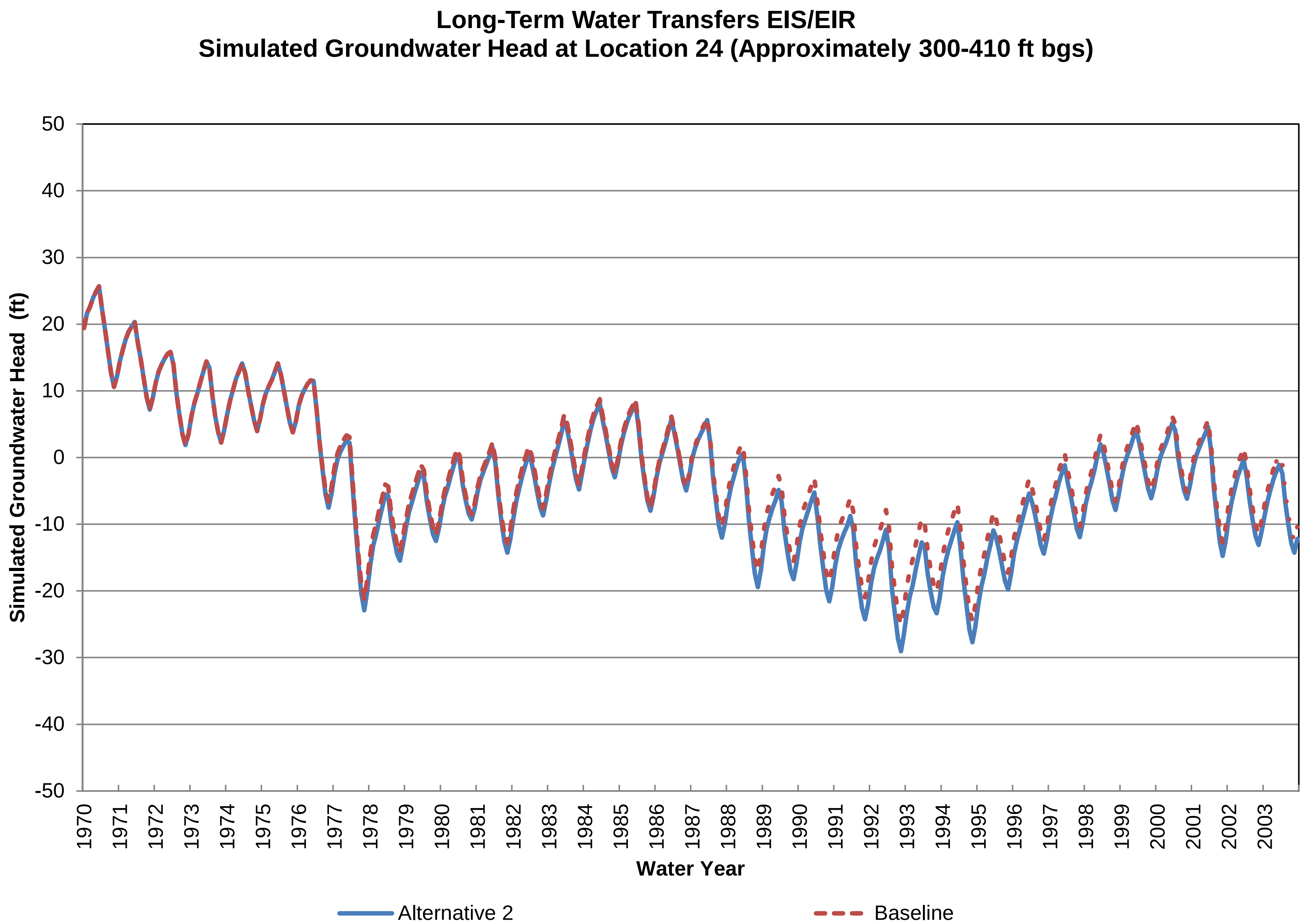
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 300-410 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
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1979
1980
1981
1982
1983
1984
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1990
1991
1992
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1994
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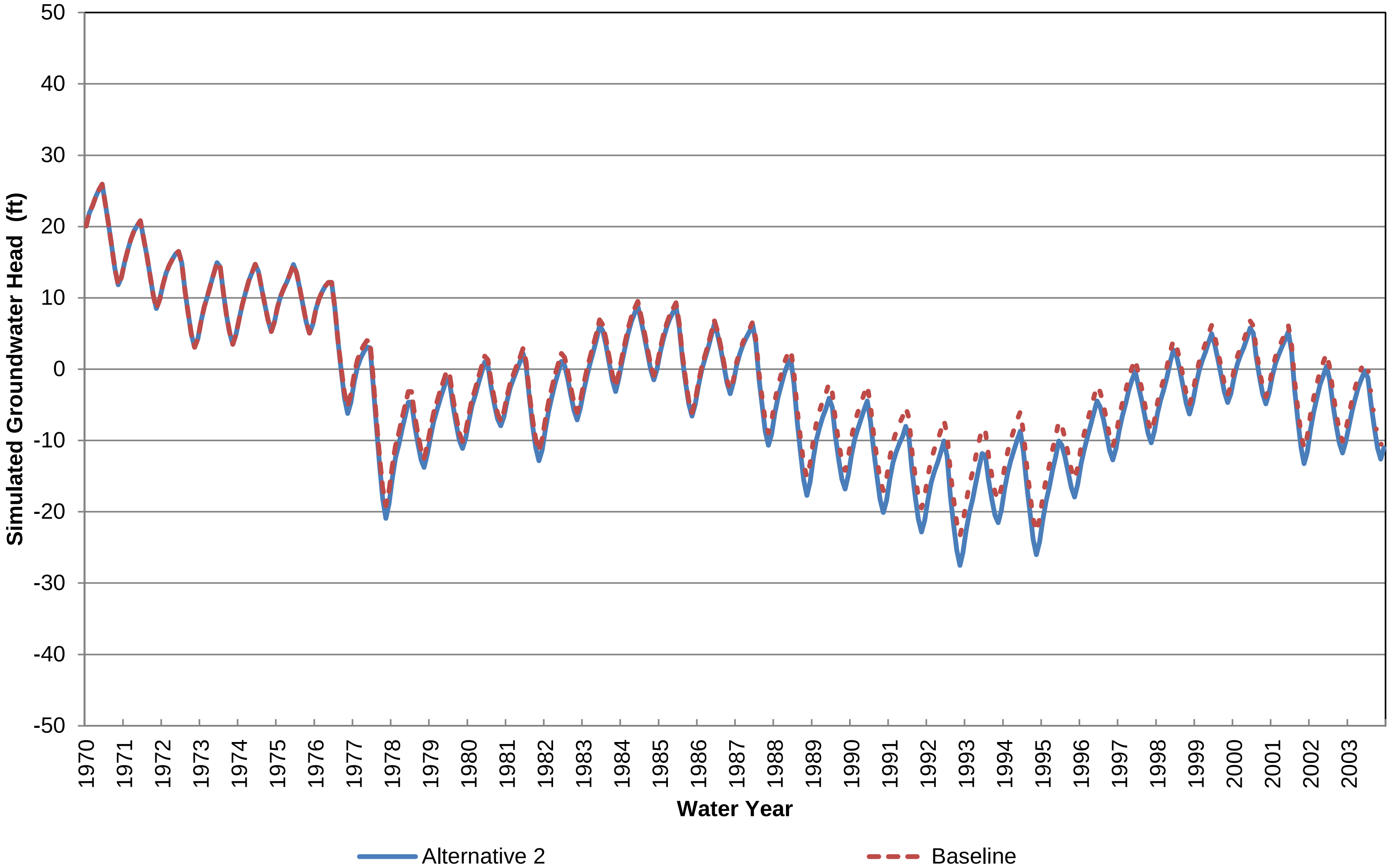
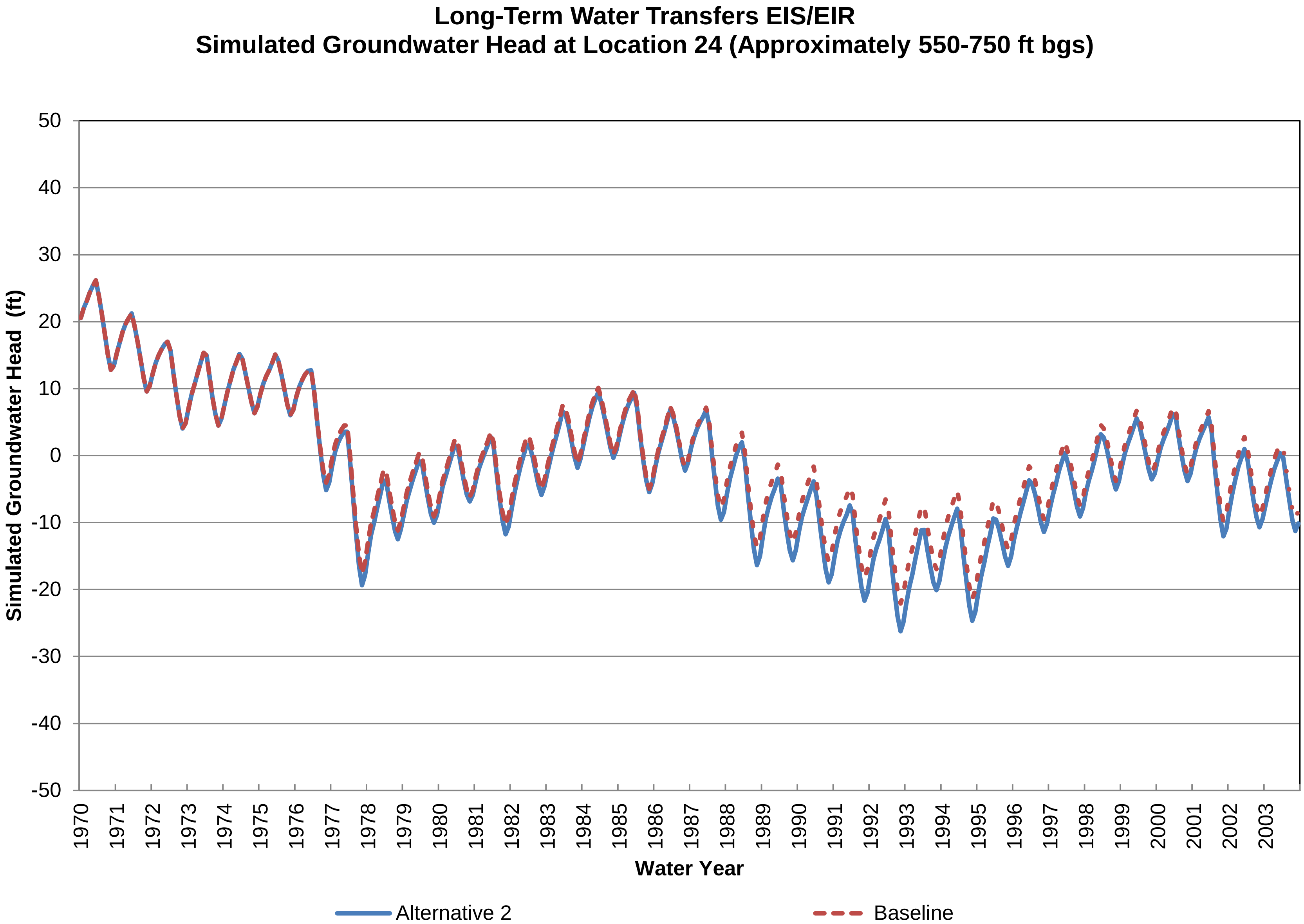
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 410-550 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 550-750 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1981
1982
1983
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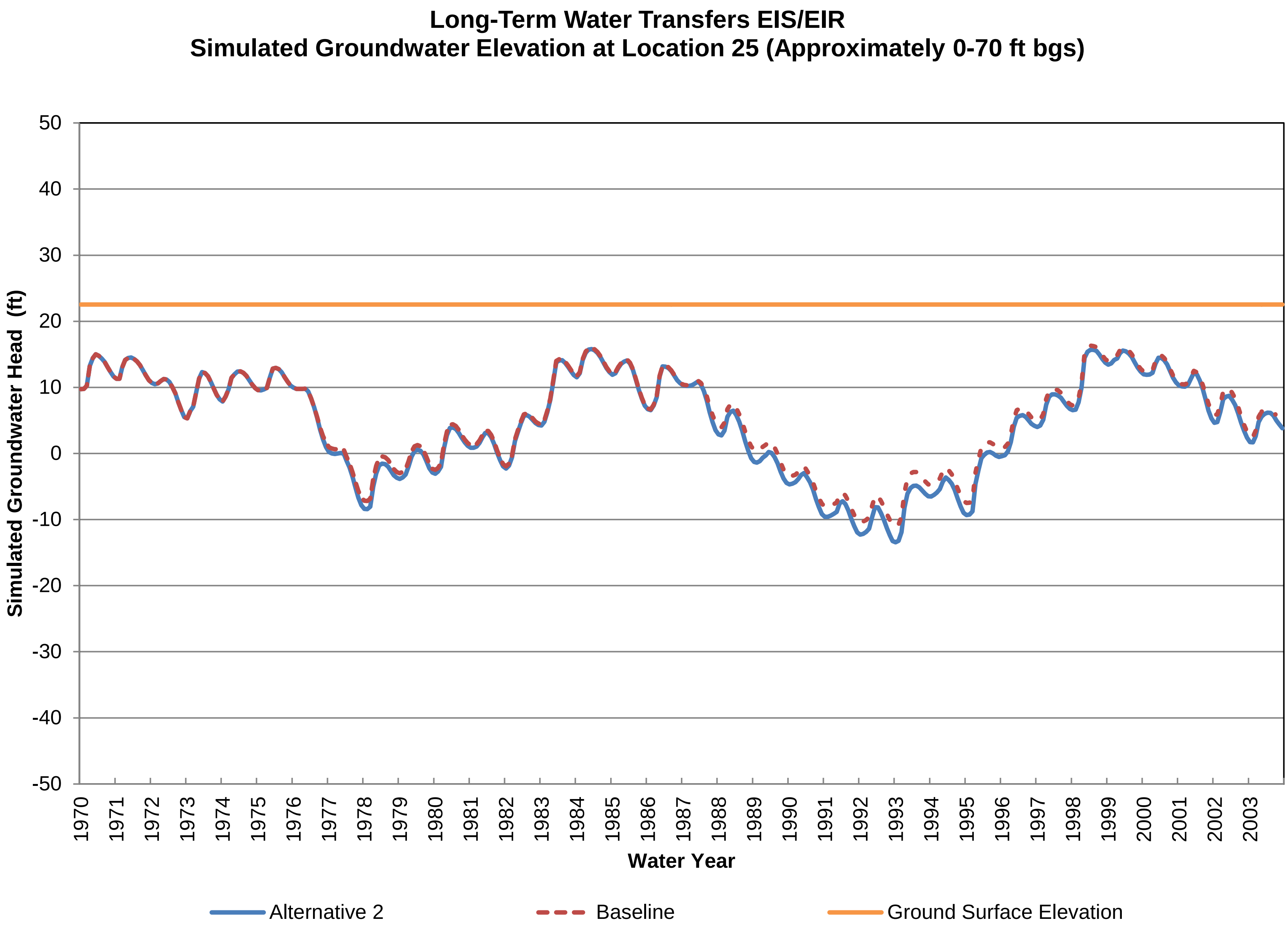
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 25 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
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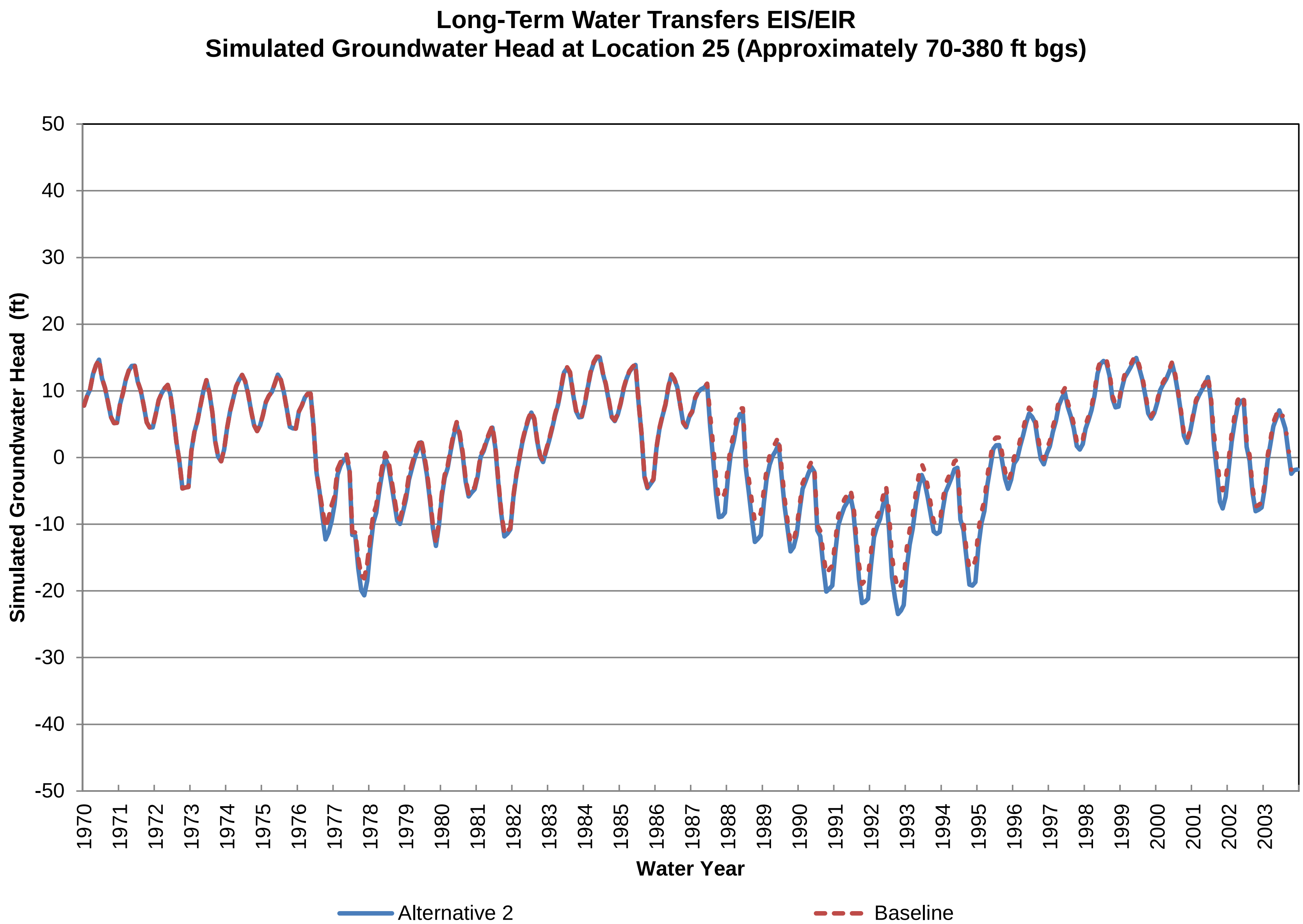
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 70-380 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
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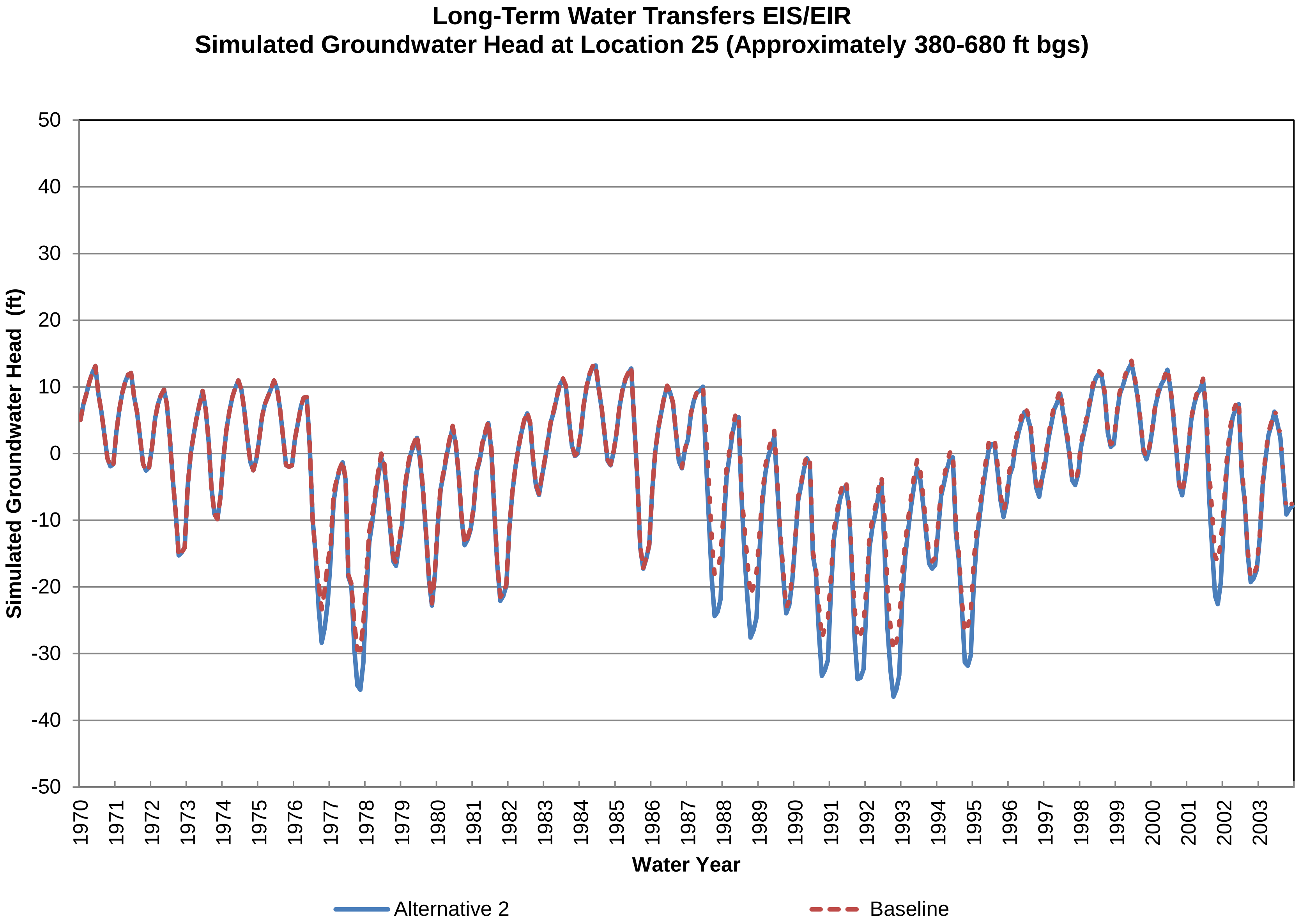
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 380-680 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
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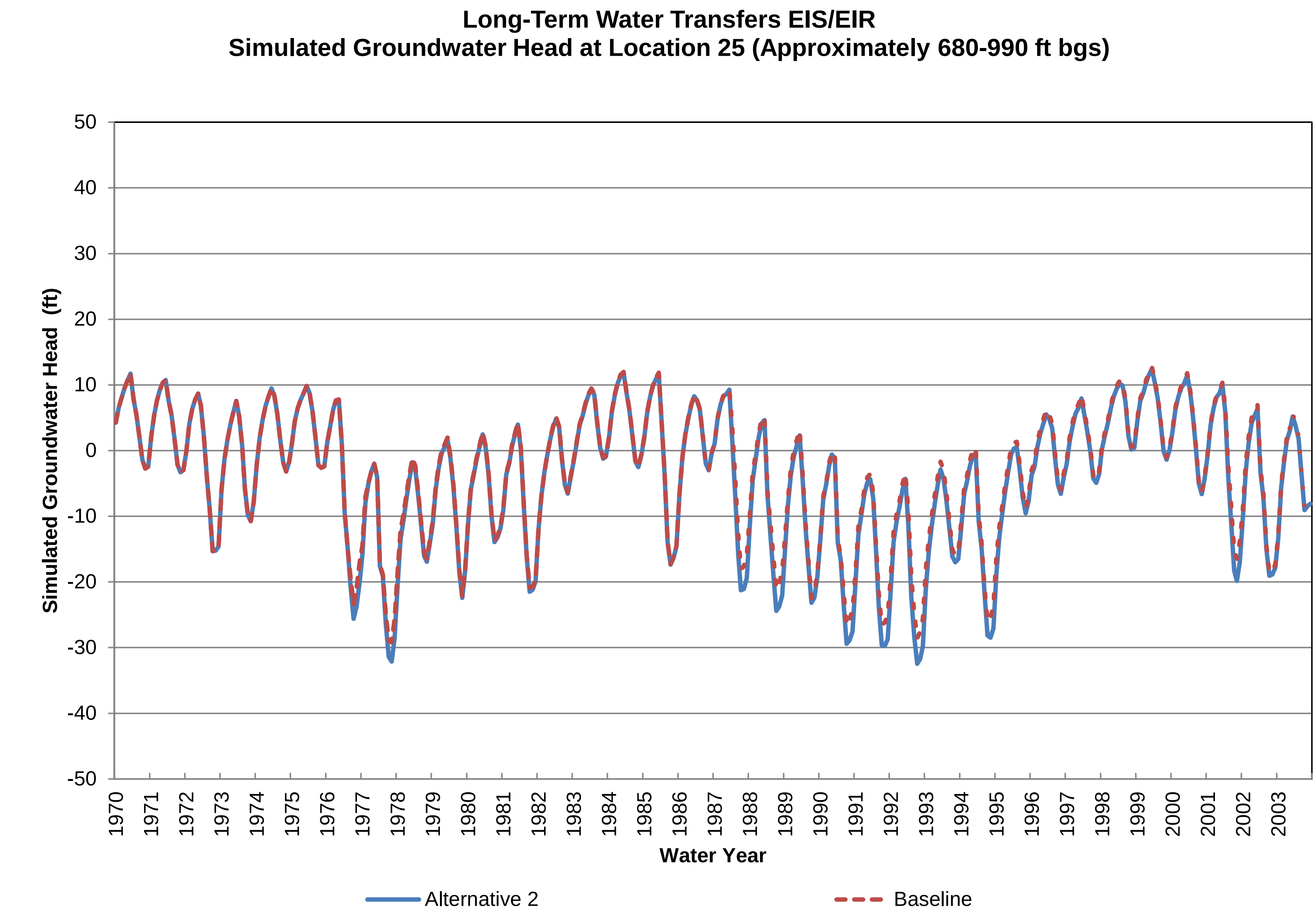
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 680-990 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
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1979
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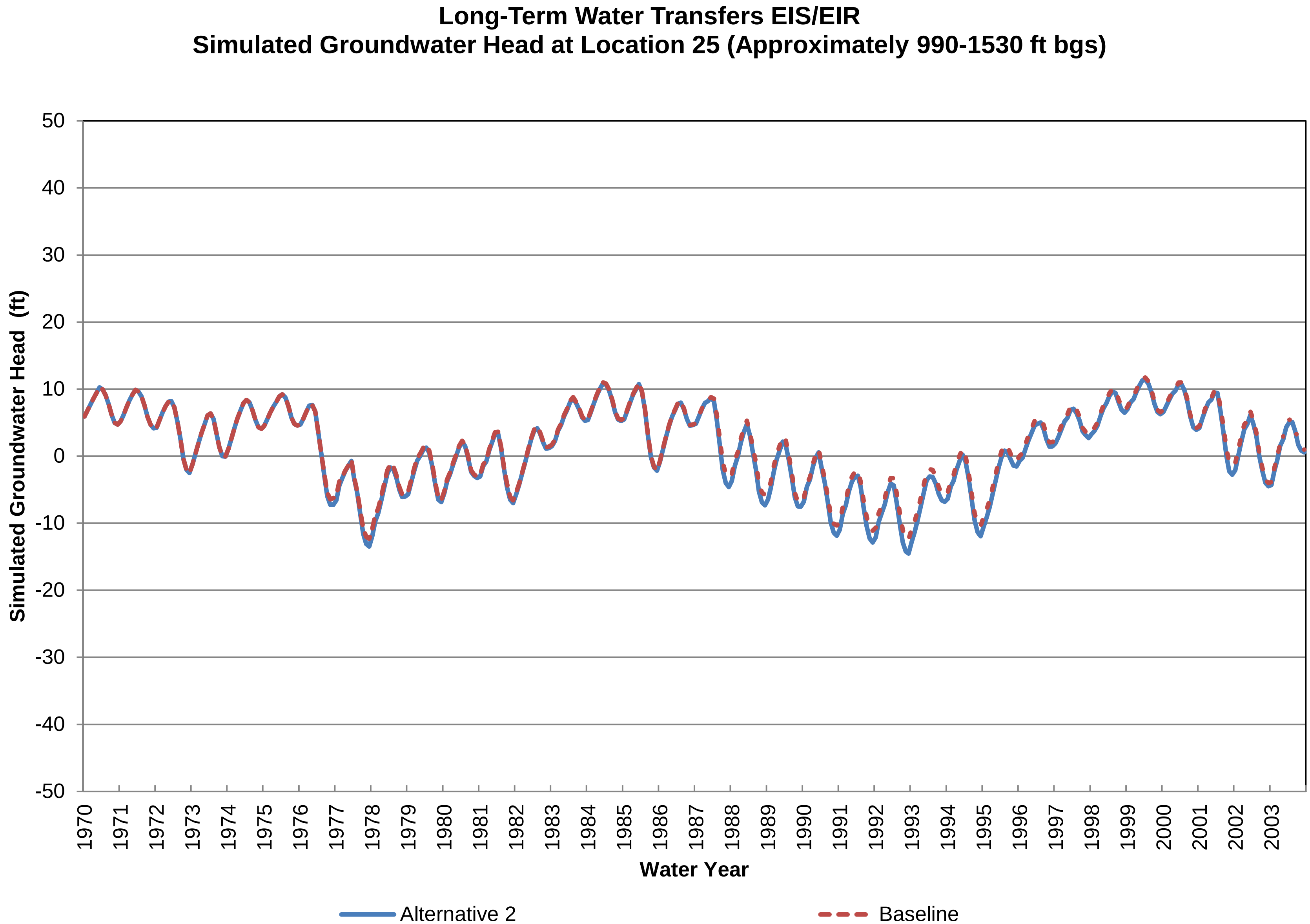
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 990-1530 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1980
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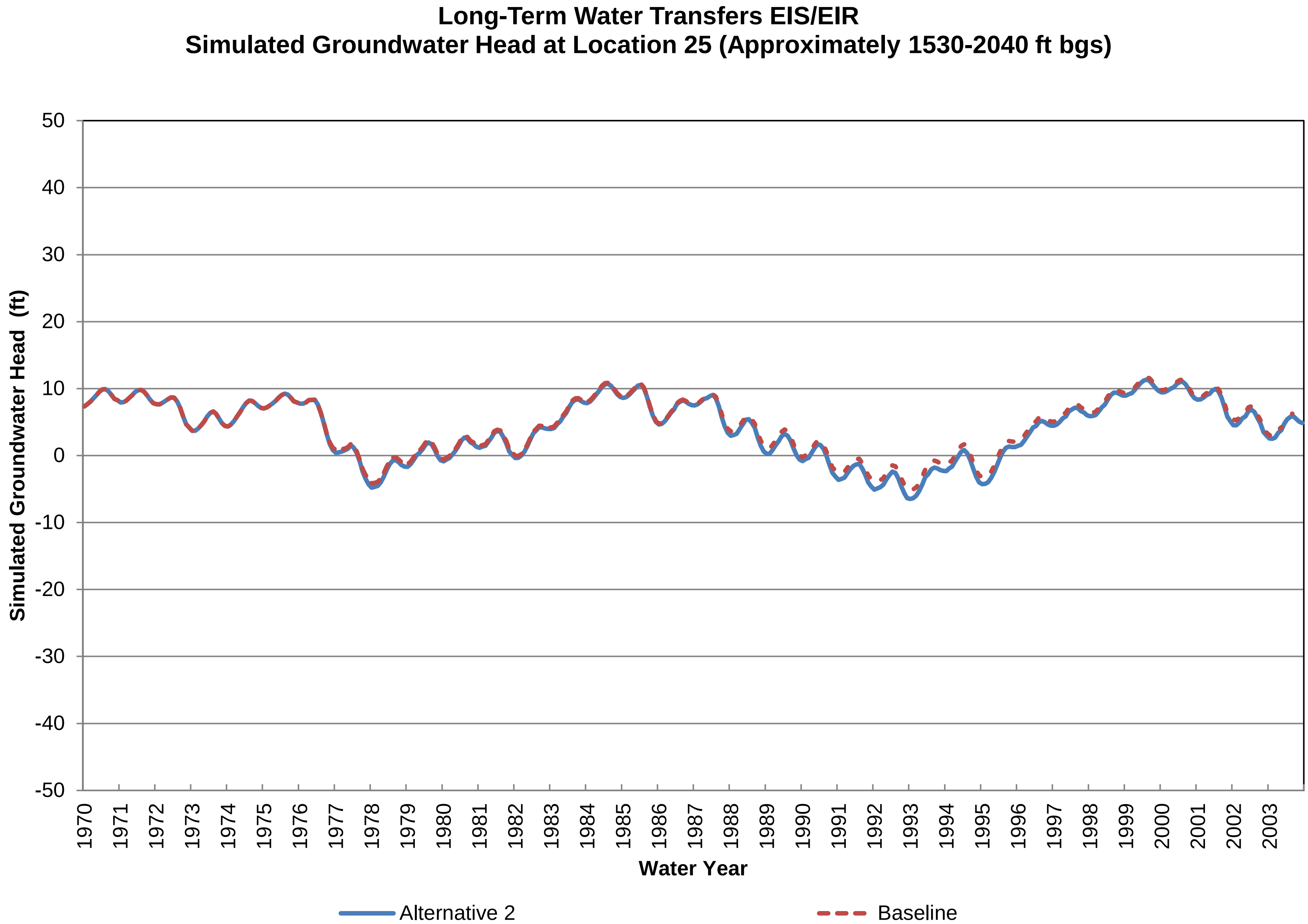
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 1530-2040 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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1990
1991
1992
1993
1994
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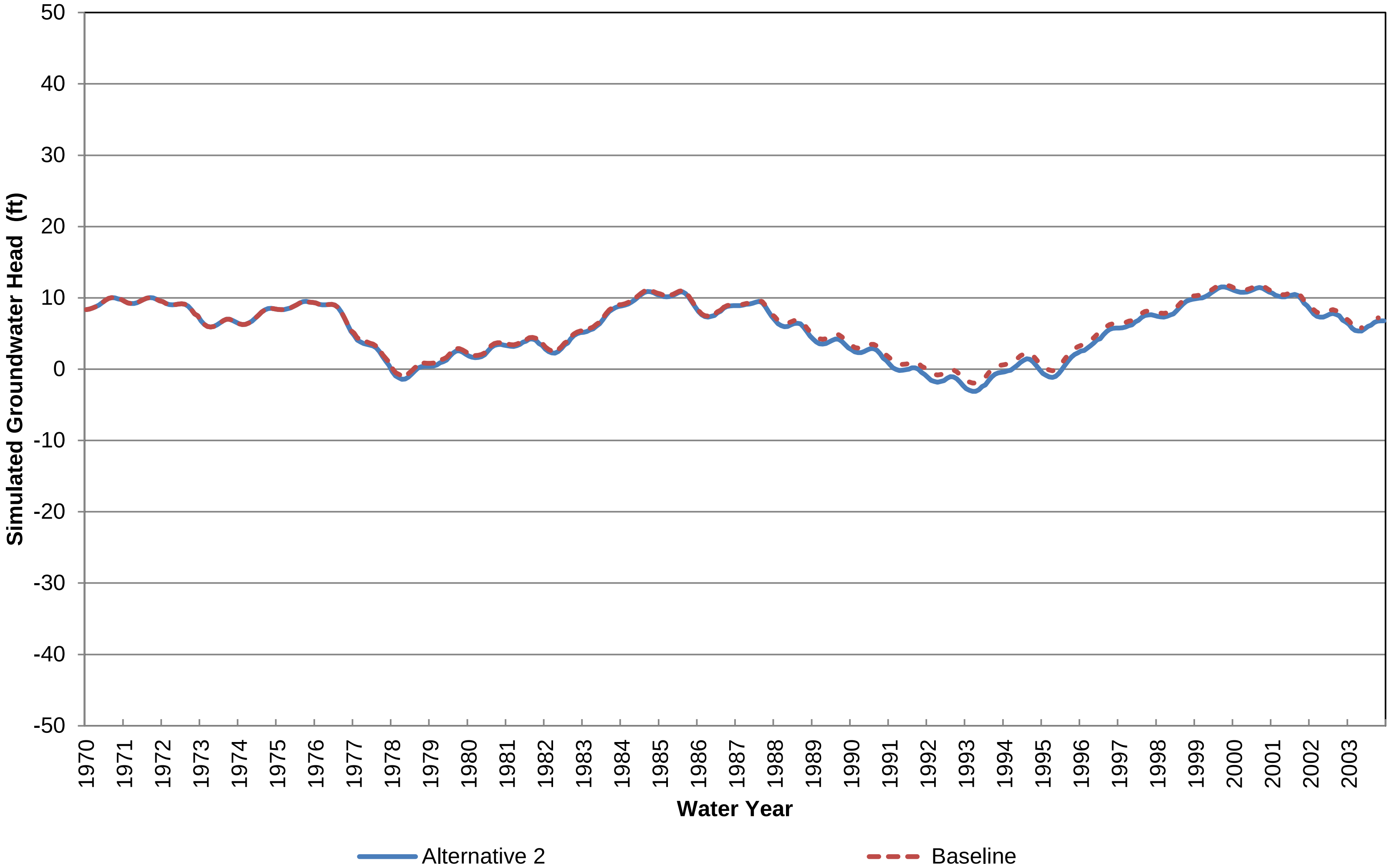
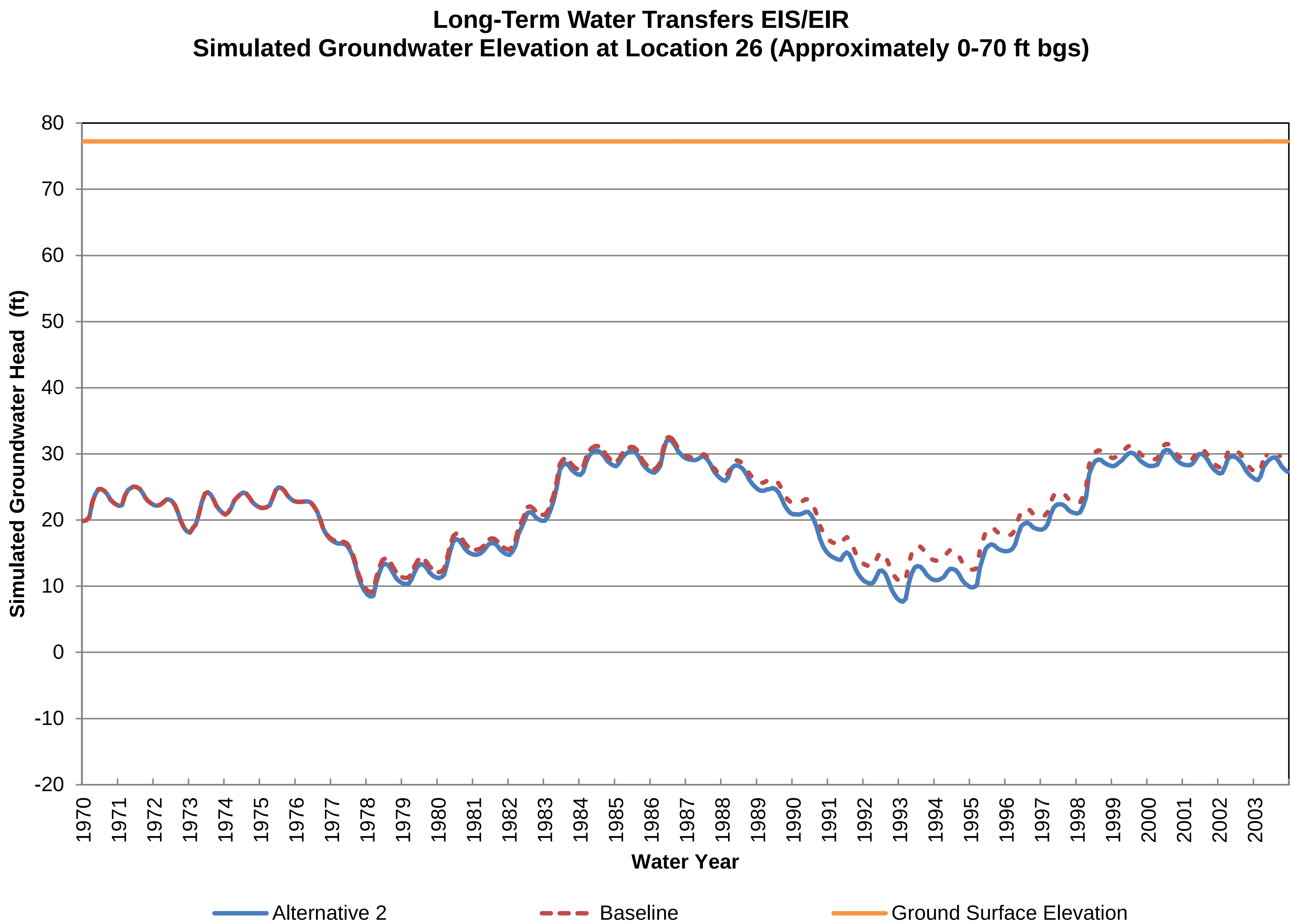
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 2040-2800 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 26 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
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1979
1980
1981
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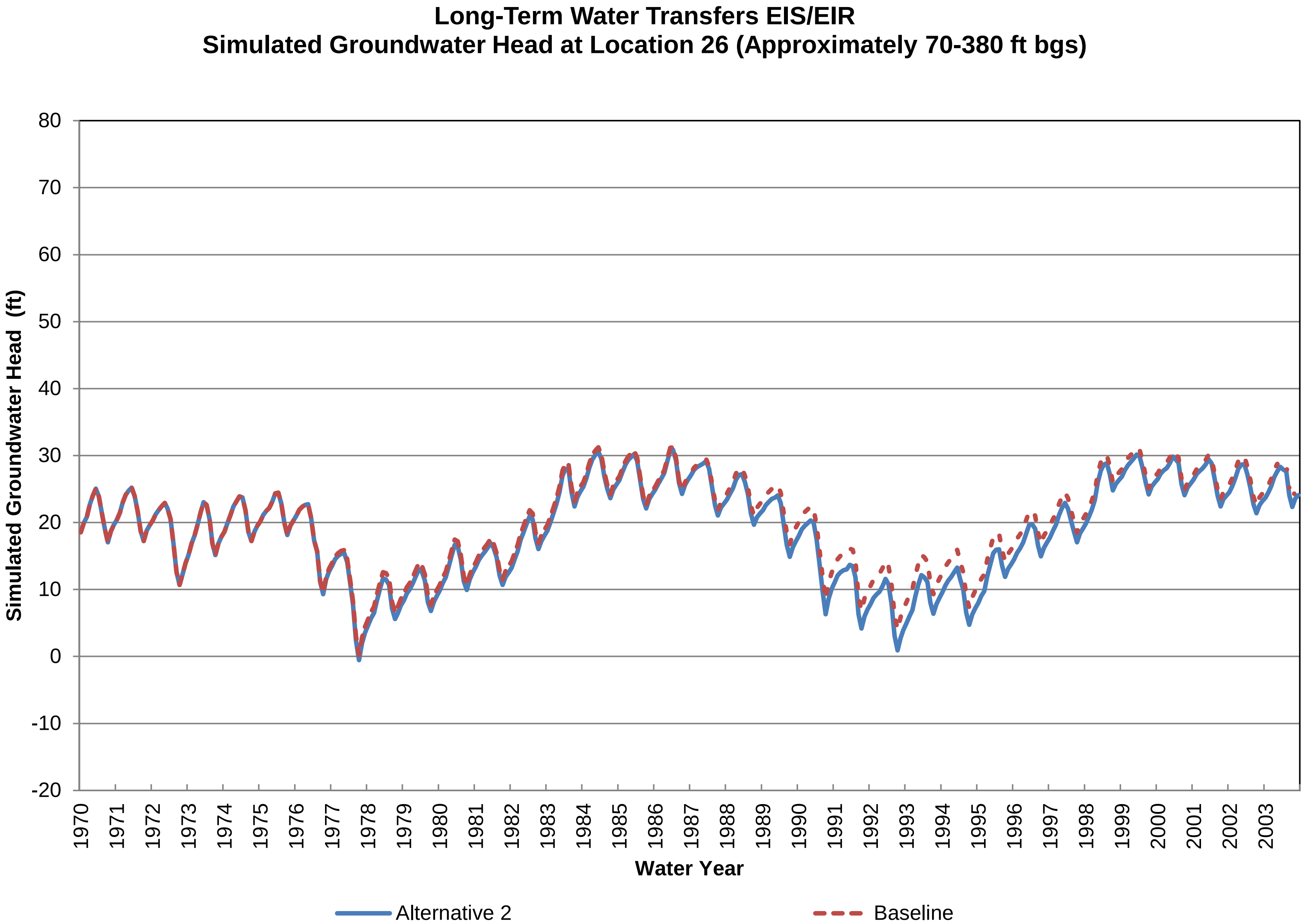
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 70-380 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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1988
1989
1990
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1993
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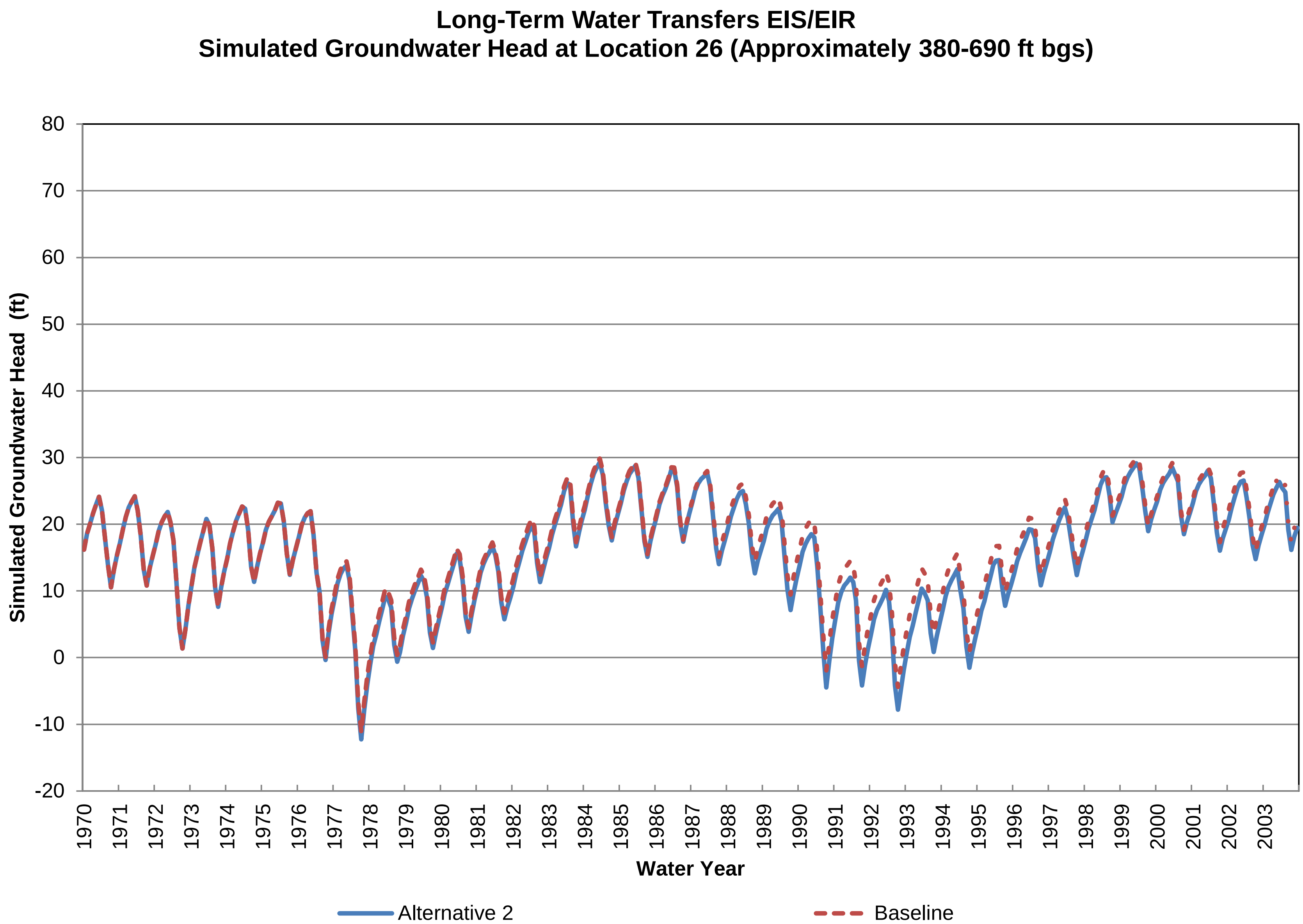
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 380-690 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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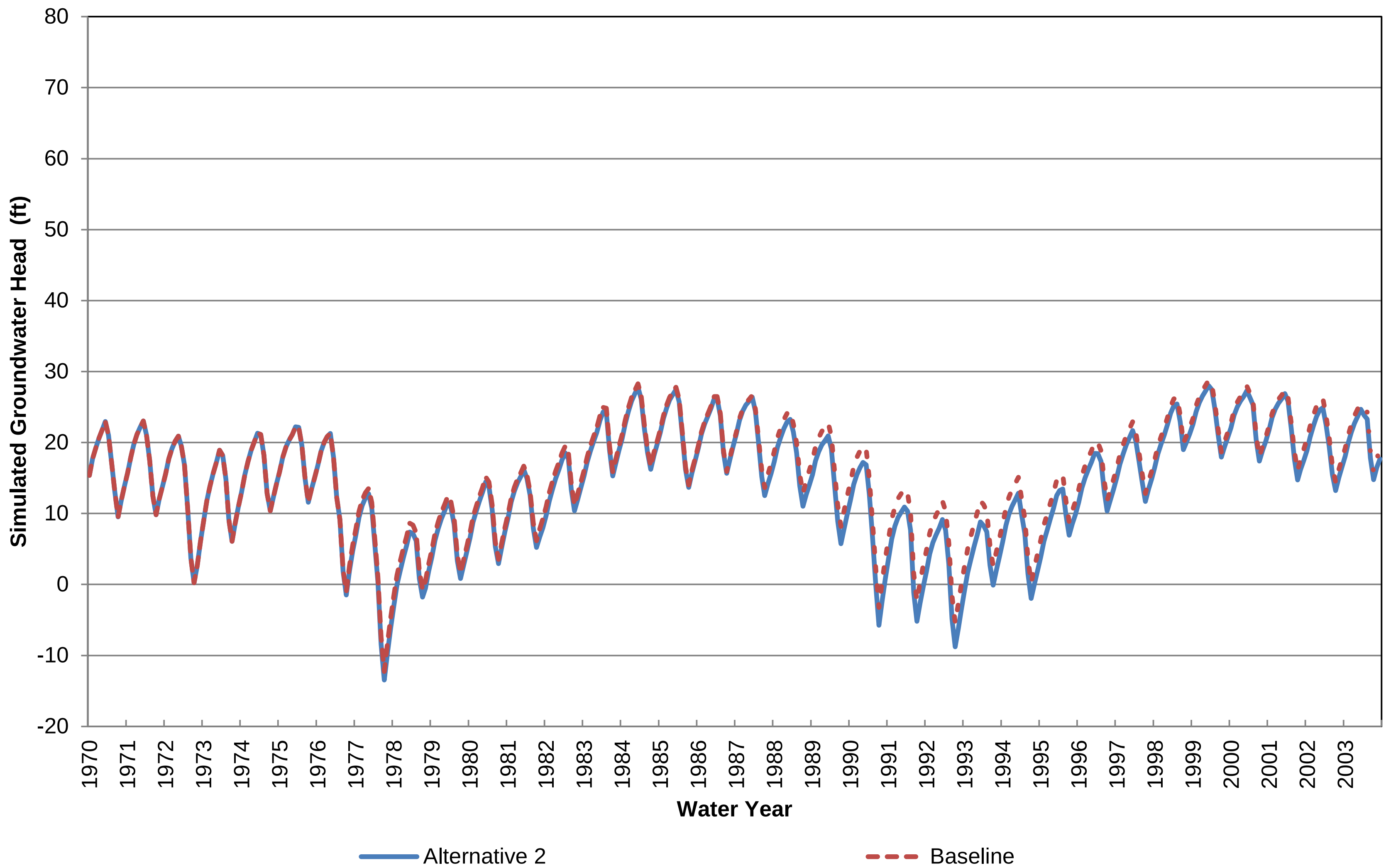
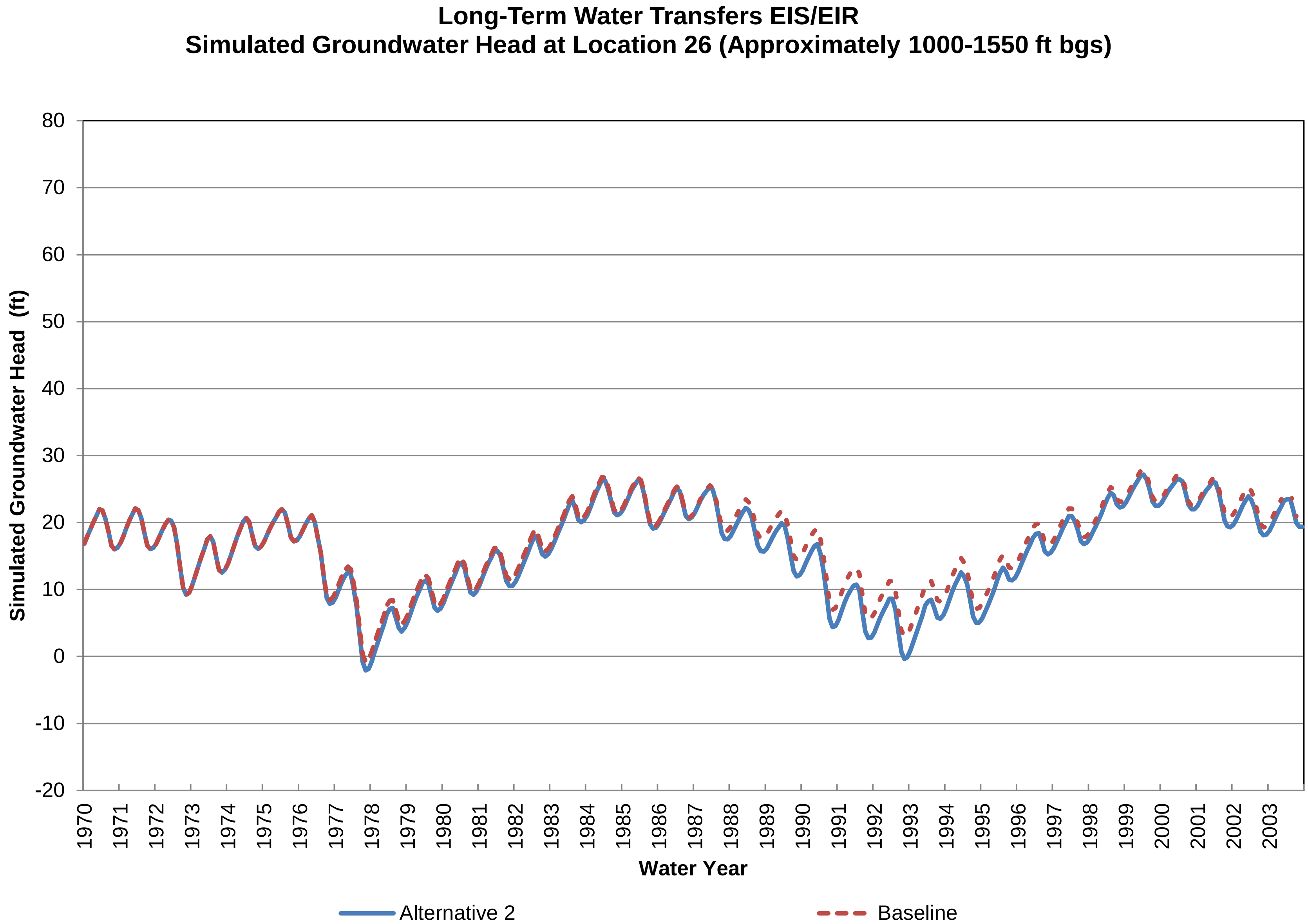
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 690-1000 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 1000-1550 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
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1992
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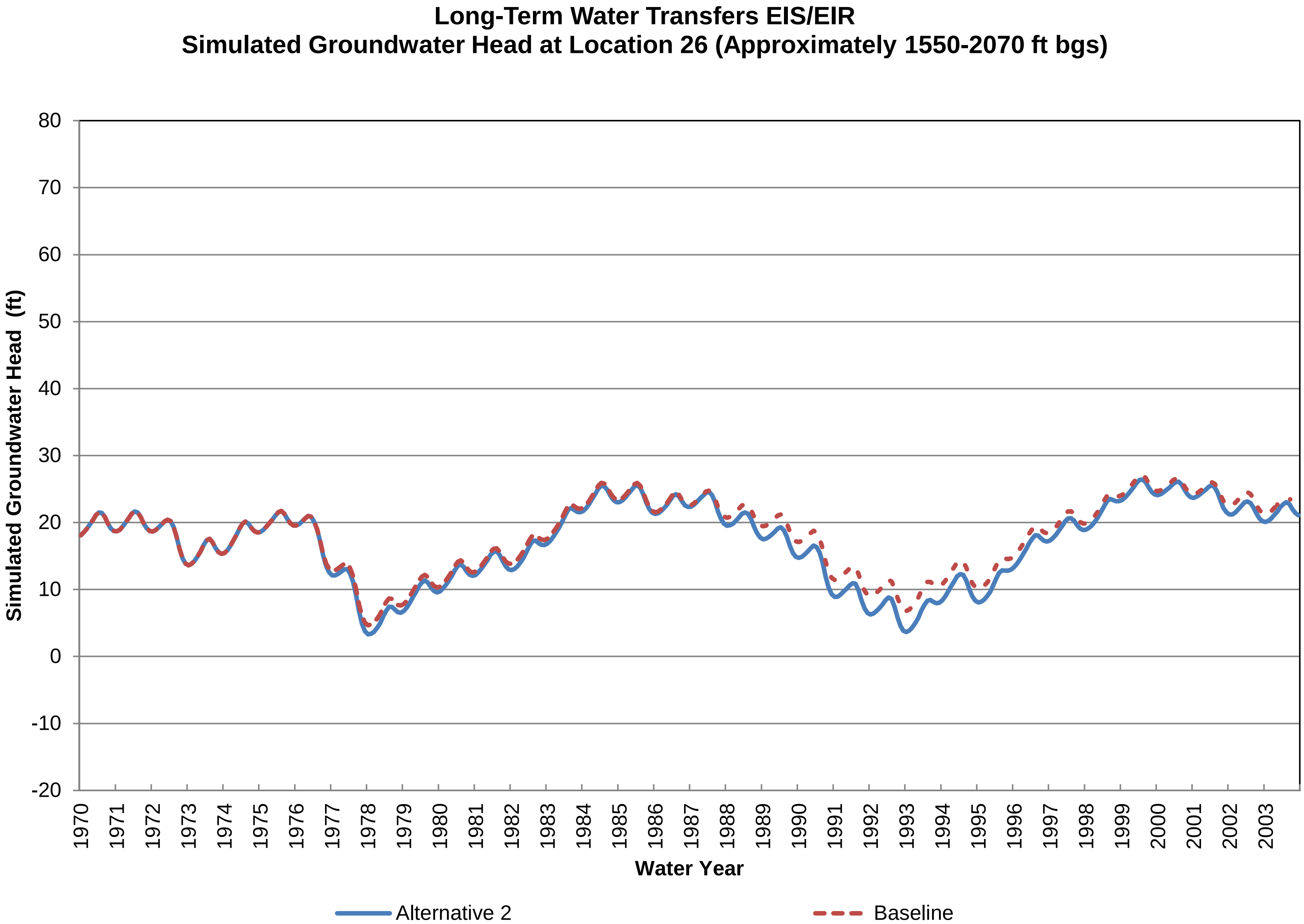
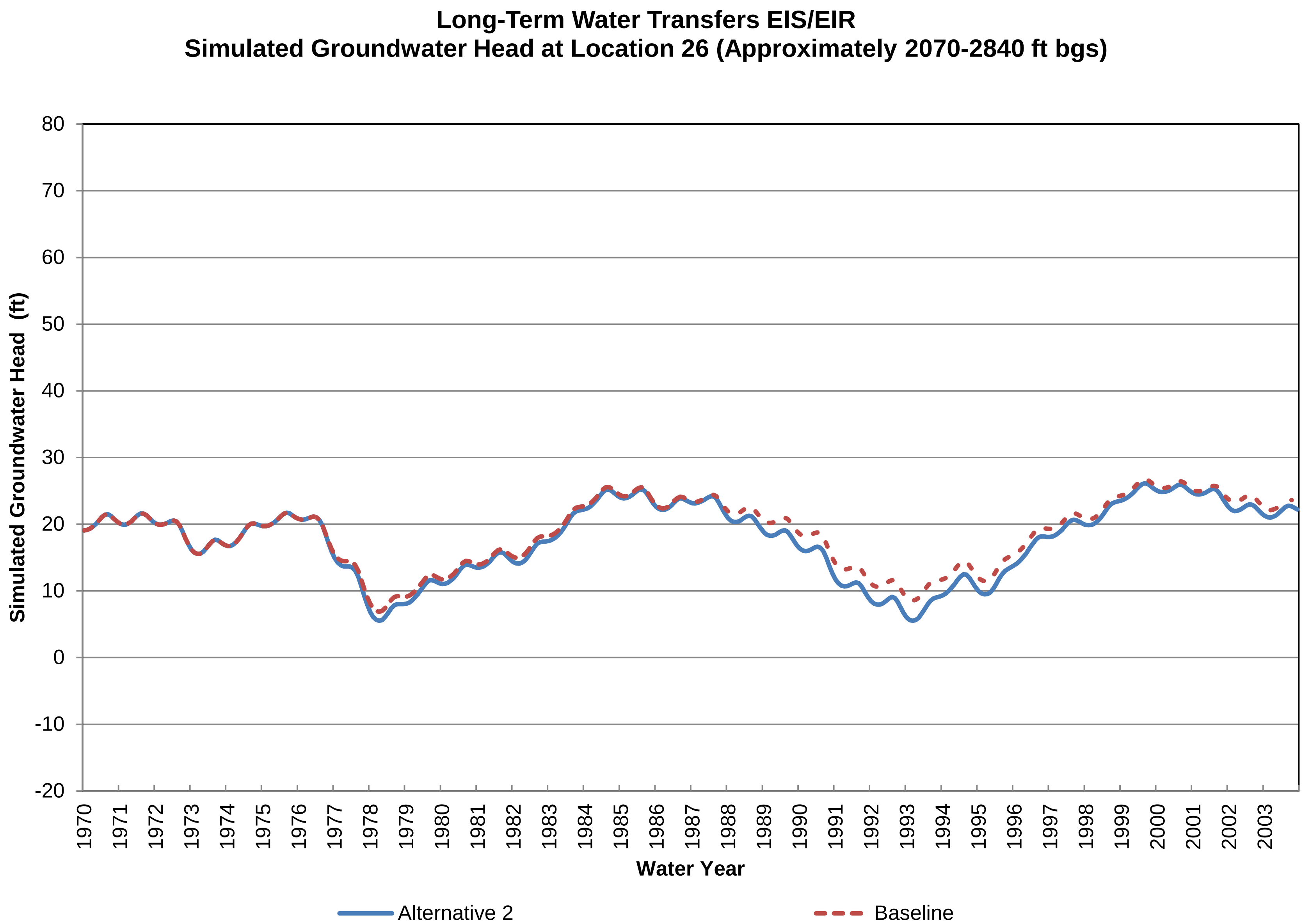
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 1550-2070 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 2070-2840 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1993
1994
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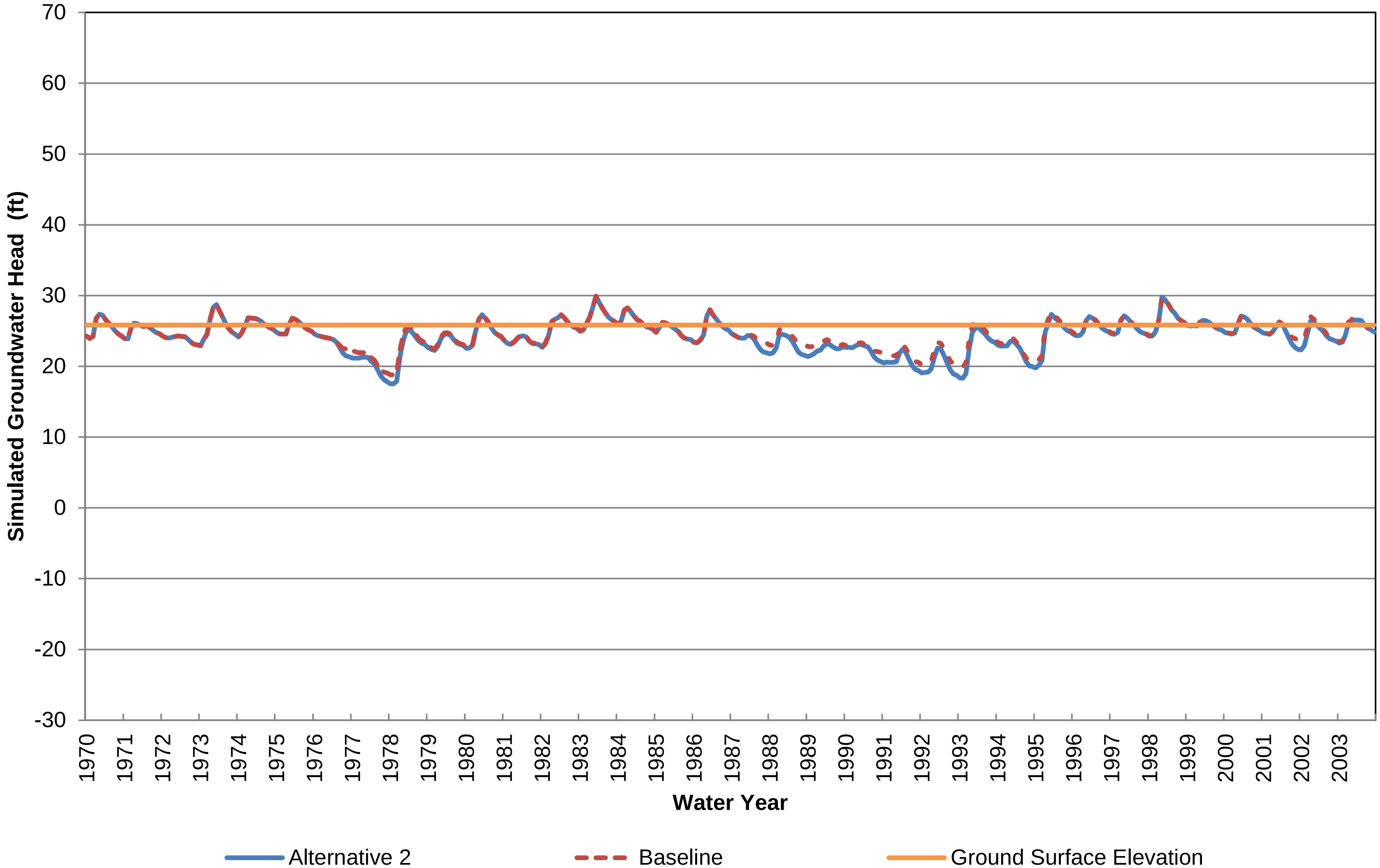
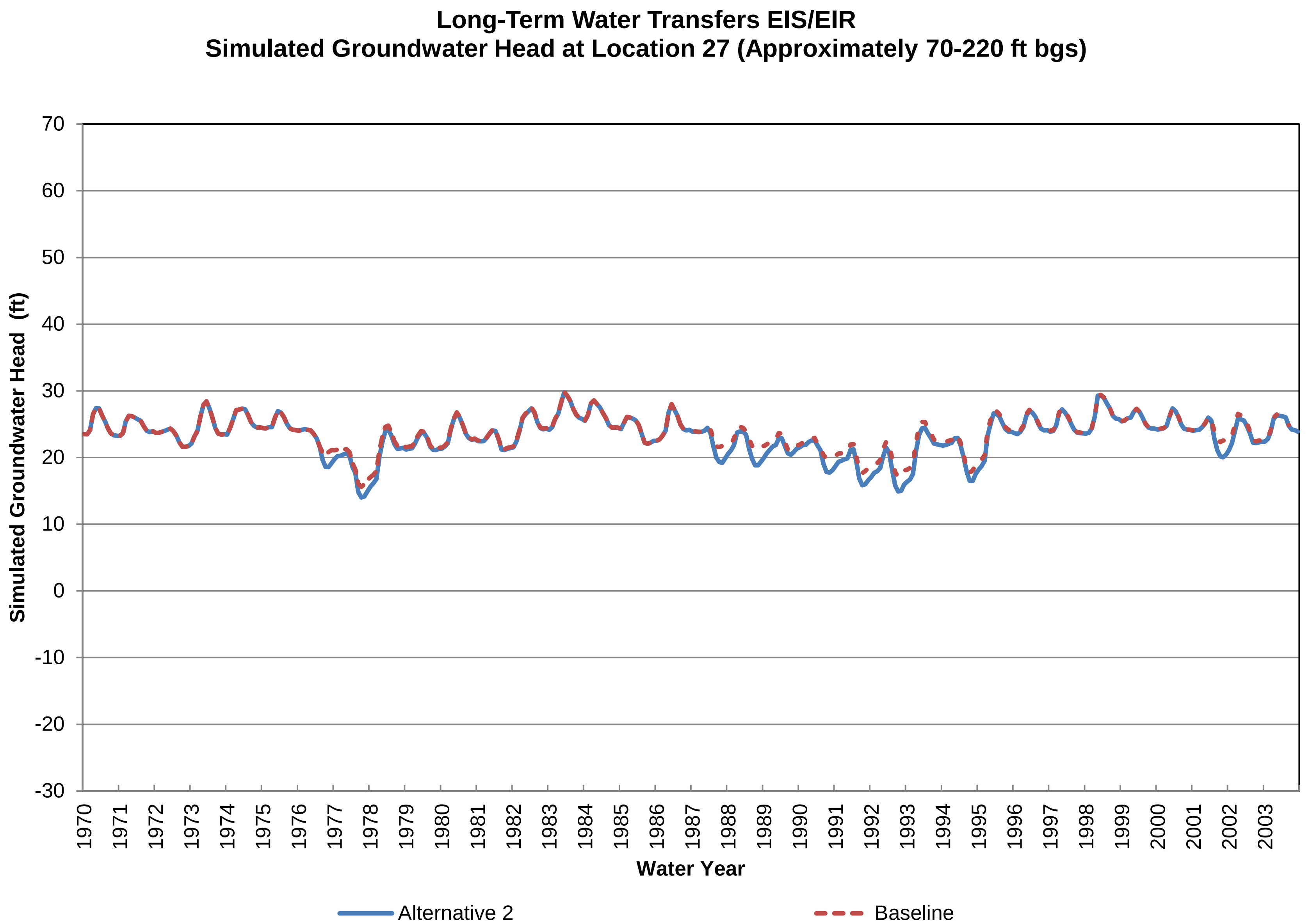
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 27 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 70-220 ft bgs)
Simulated Groundwater Head (ft)
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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1998
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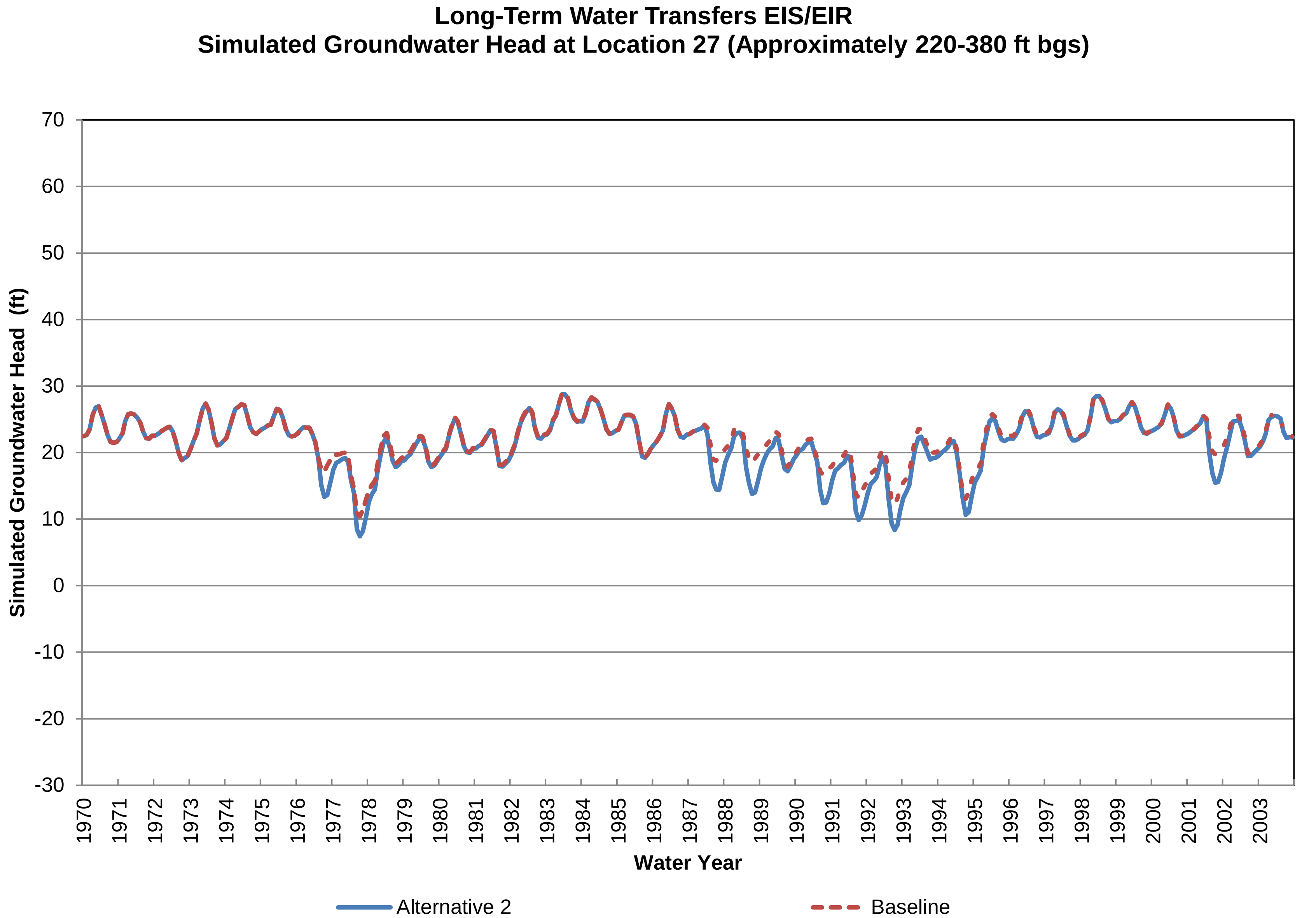
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 220-380 ft bgs)
70
60
50
40
30
20
10
0
-10
-20
-30
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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1982
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1987
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1996
1997
1998
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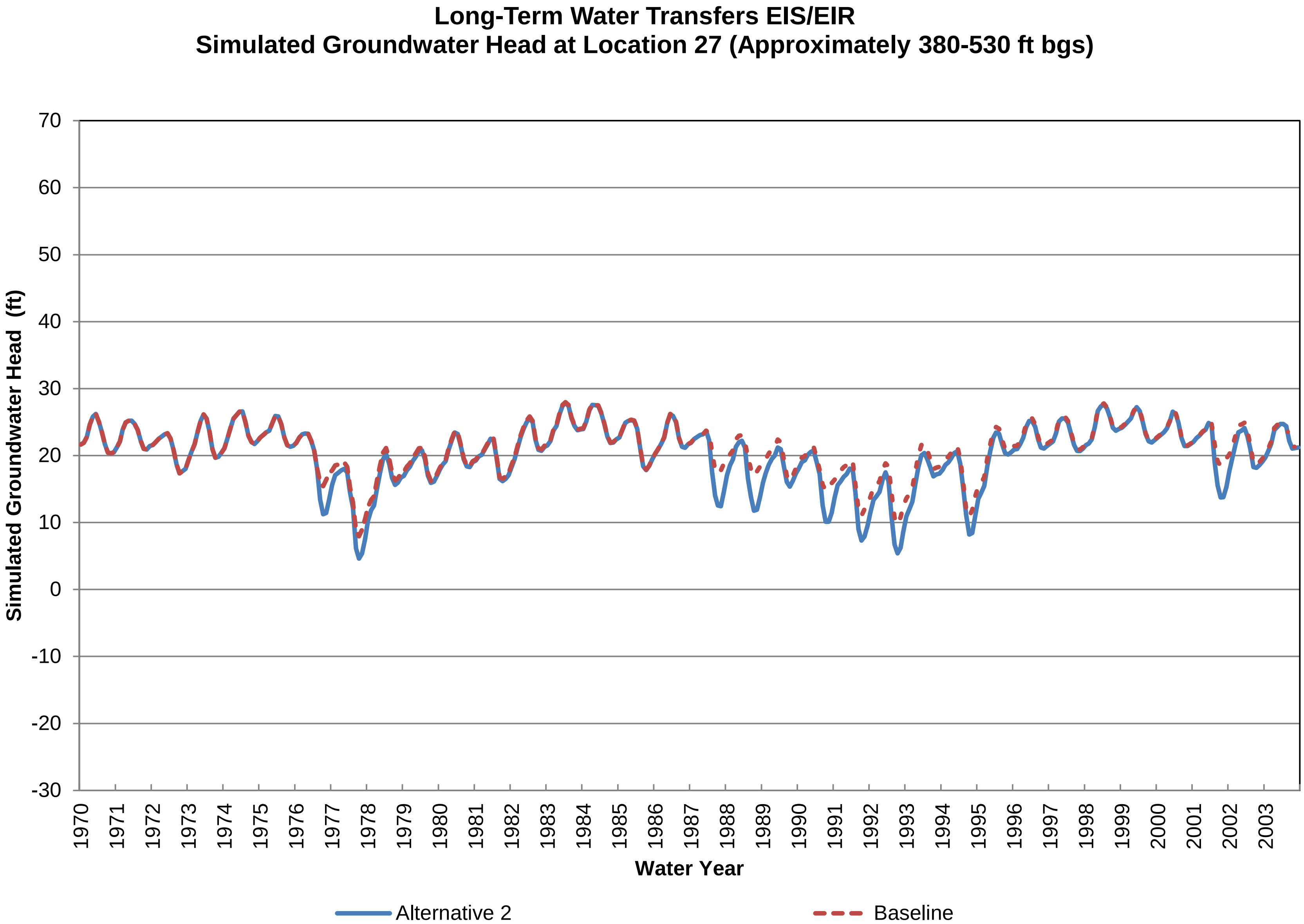
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 380-530 ft bgs)
Simulated Groundwater Head (ft)
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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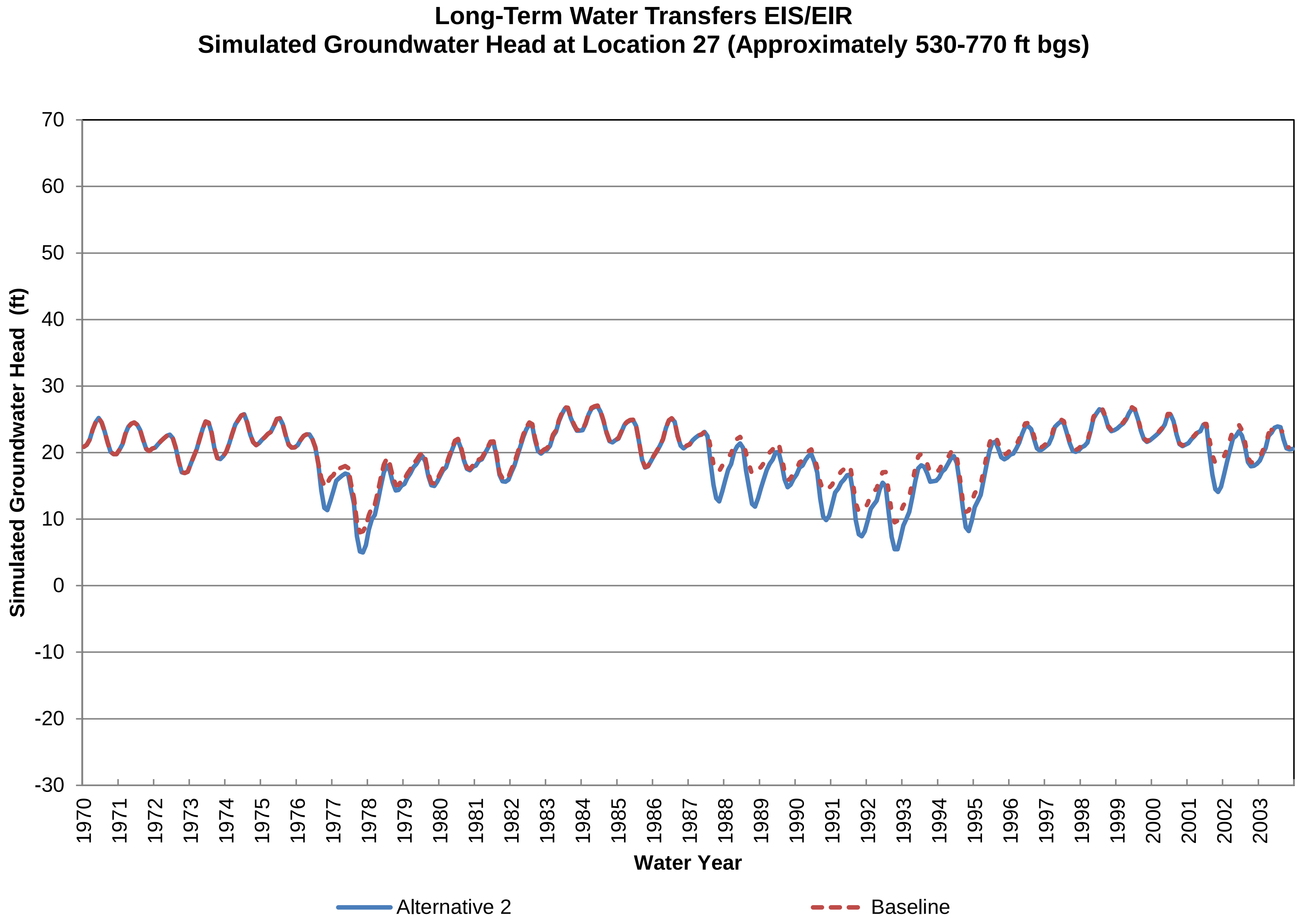
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 530-770 ft bgs)
Simulated Groundwater Head (ft)
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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1998
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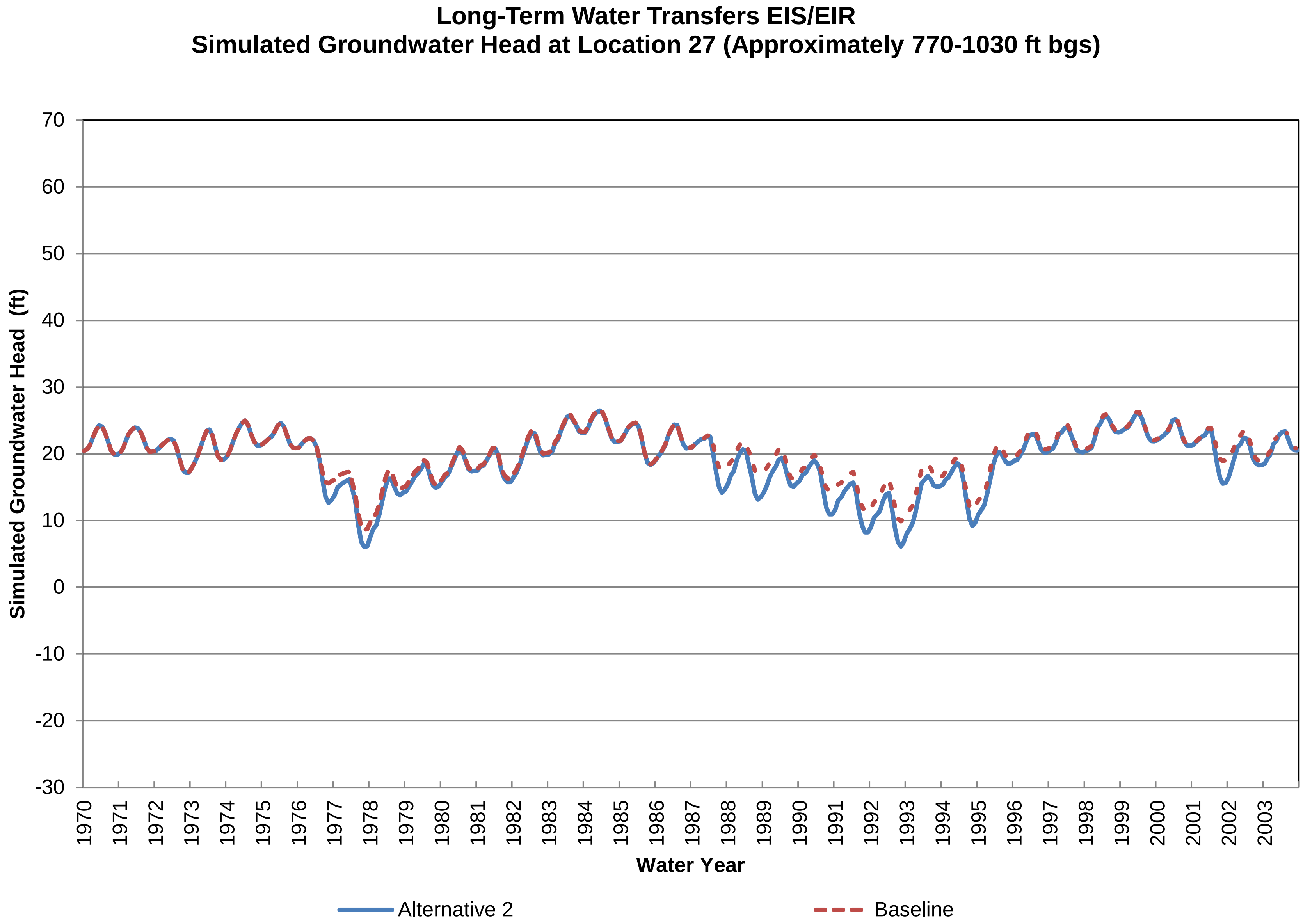
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 770-1030 ft bgs)
Simulated Groundwater Head (ft)
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
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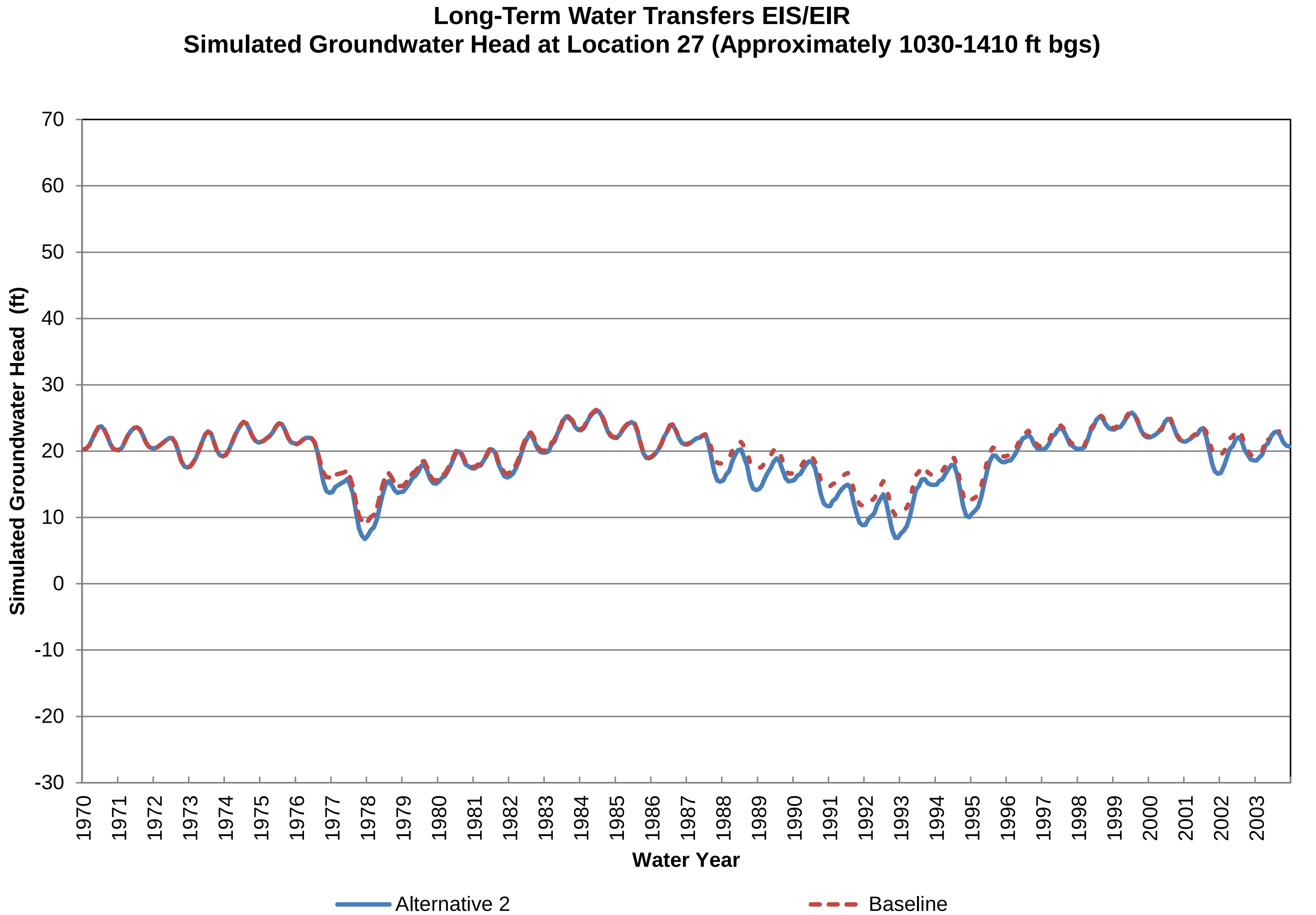
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 1030-1410 ft bgs)
70
60
50
40
30
20
10
0
-10
-20
-30
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1980
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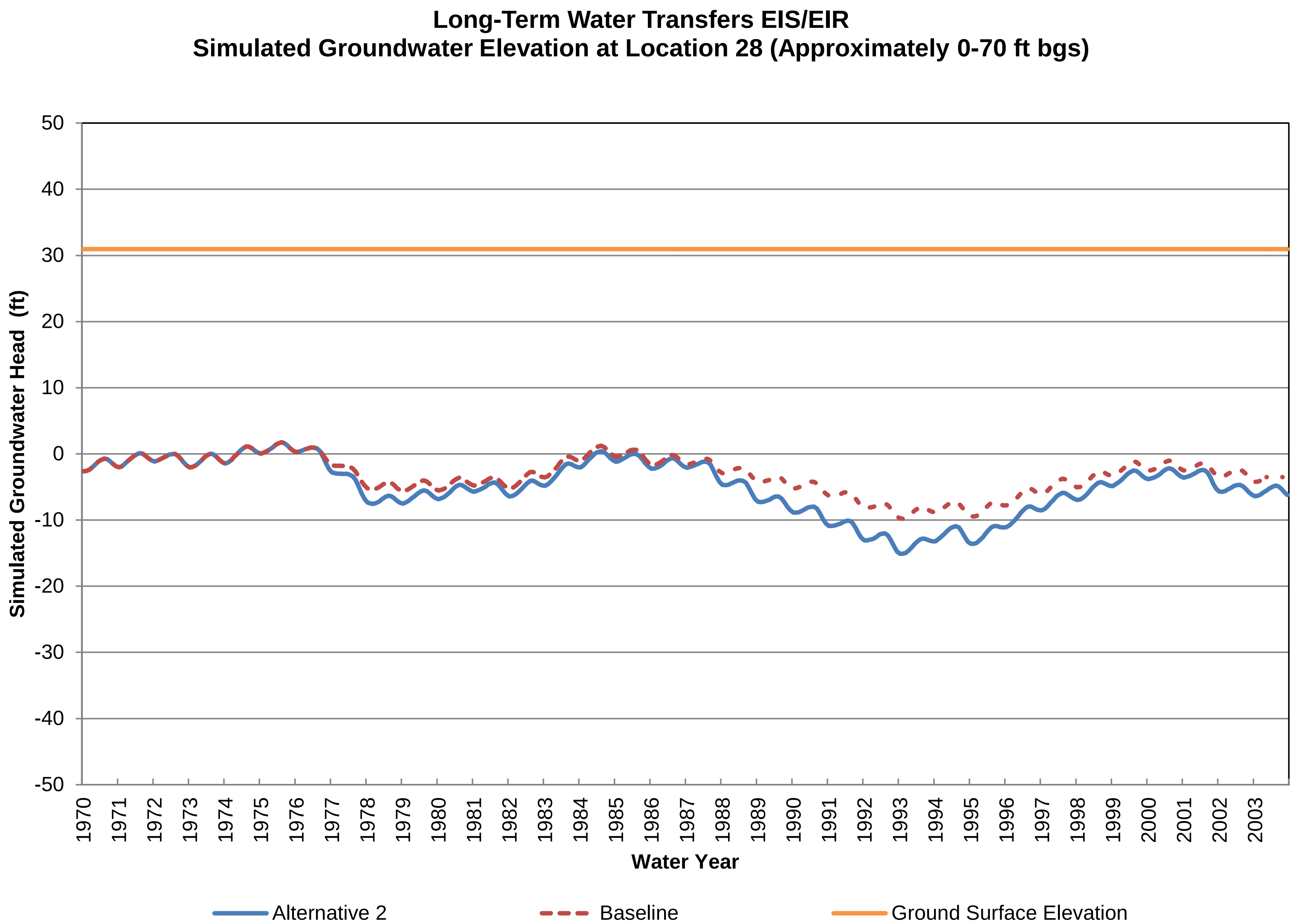
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 28 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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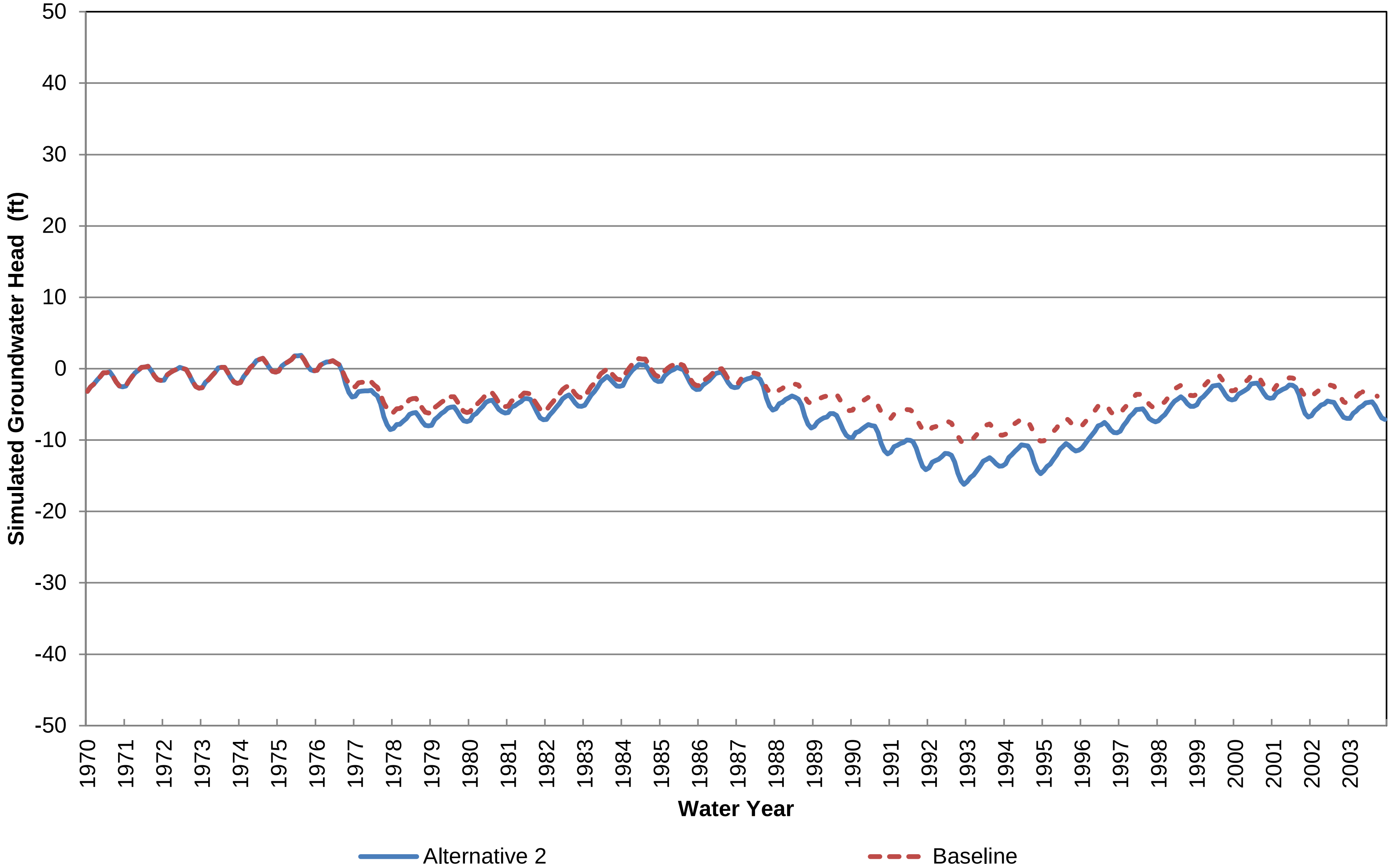
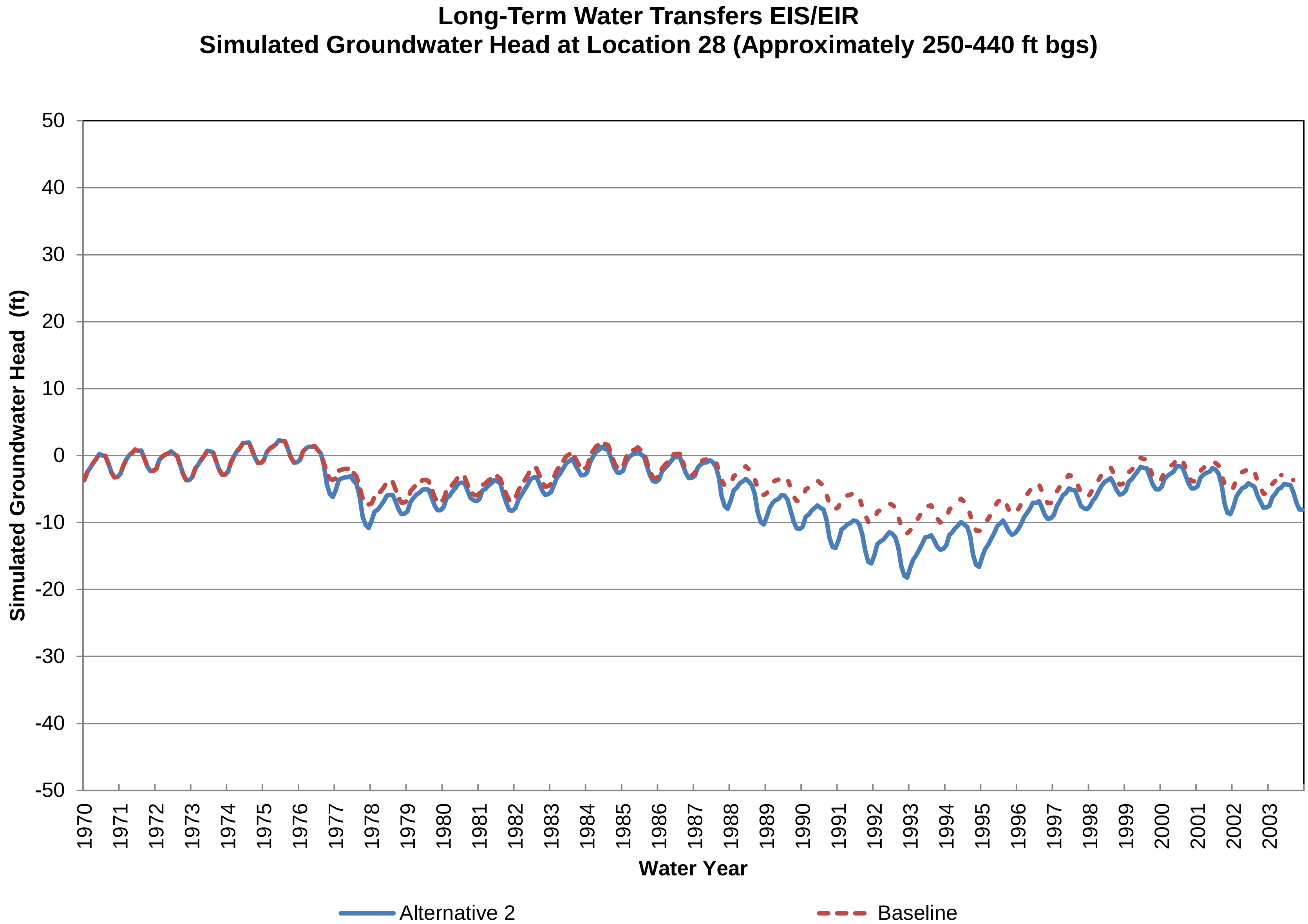
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 70-250 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 250-440 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
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1974
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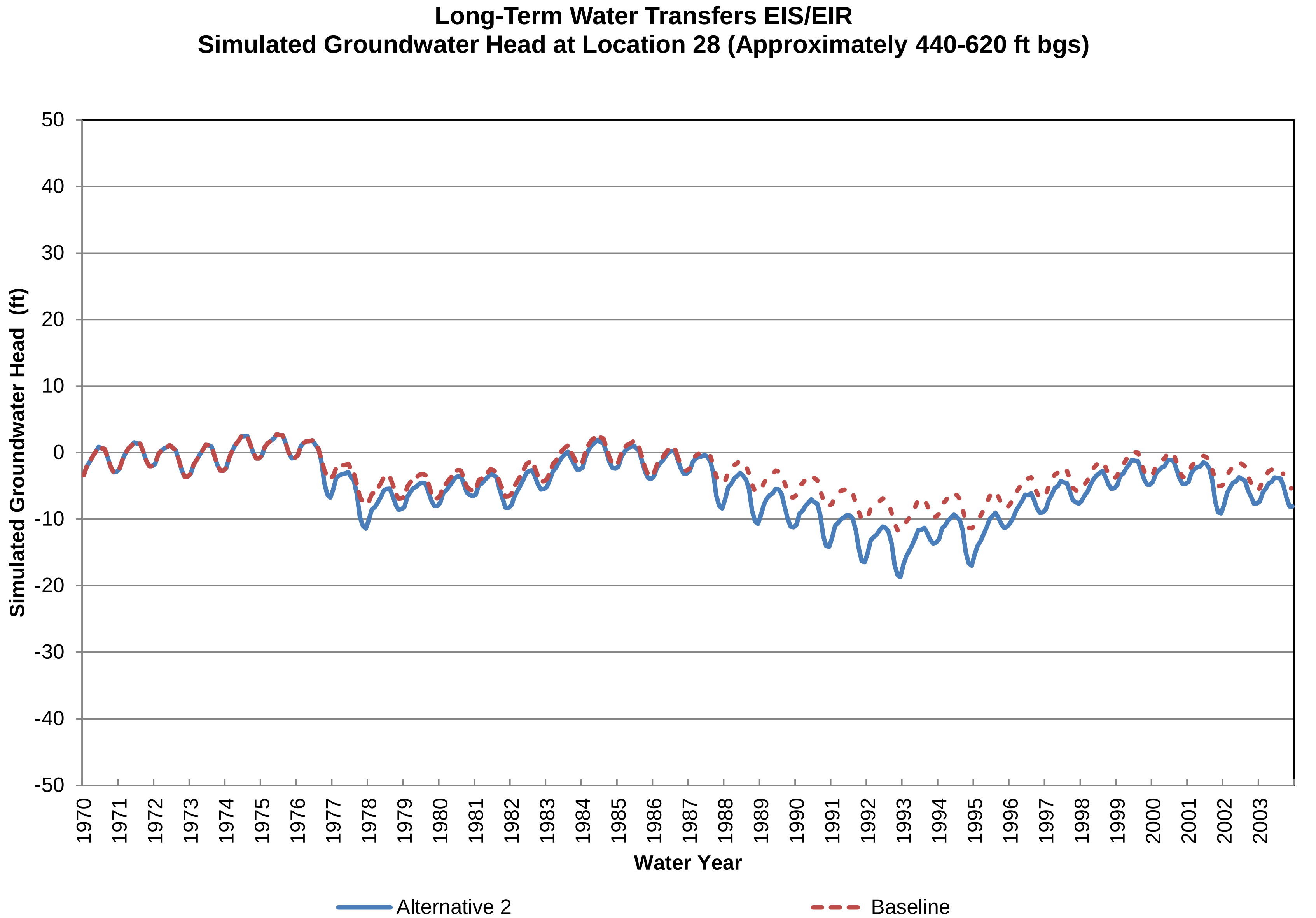
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 440-620 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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1981
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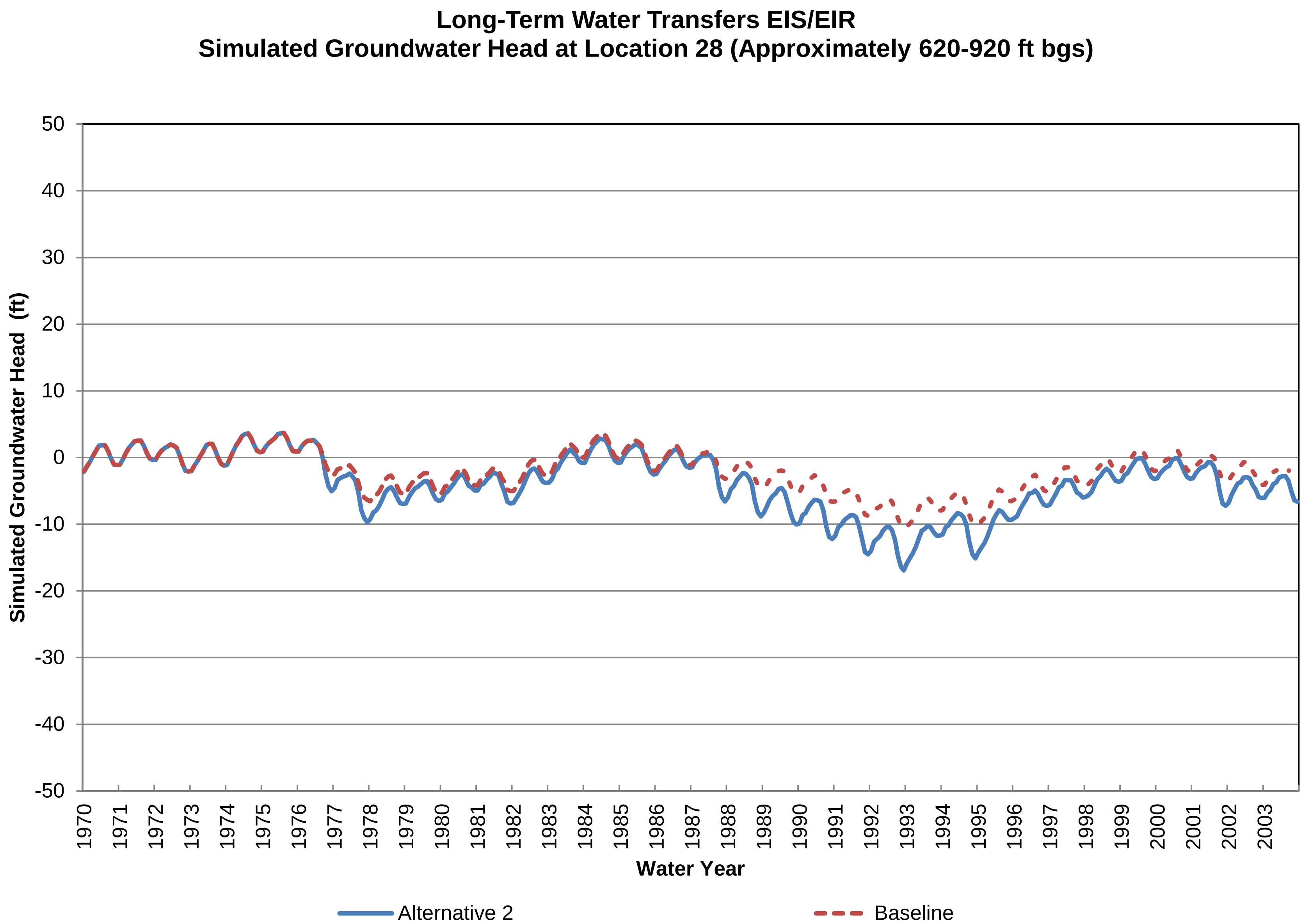
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 620-920 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
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1986
1987
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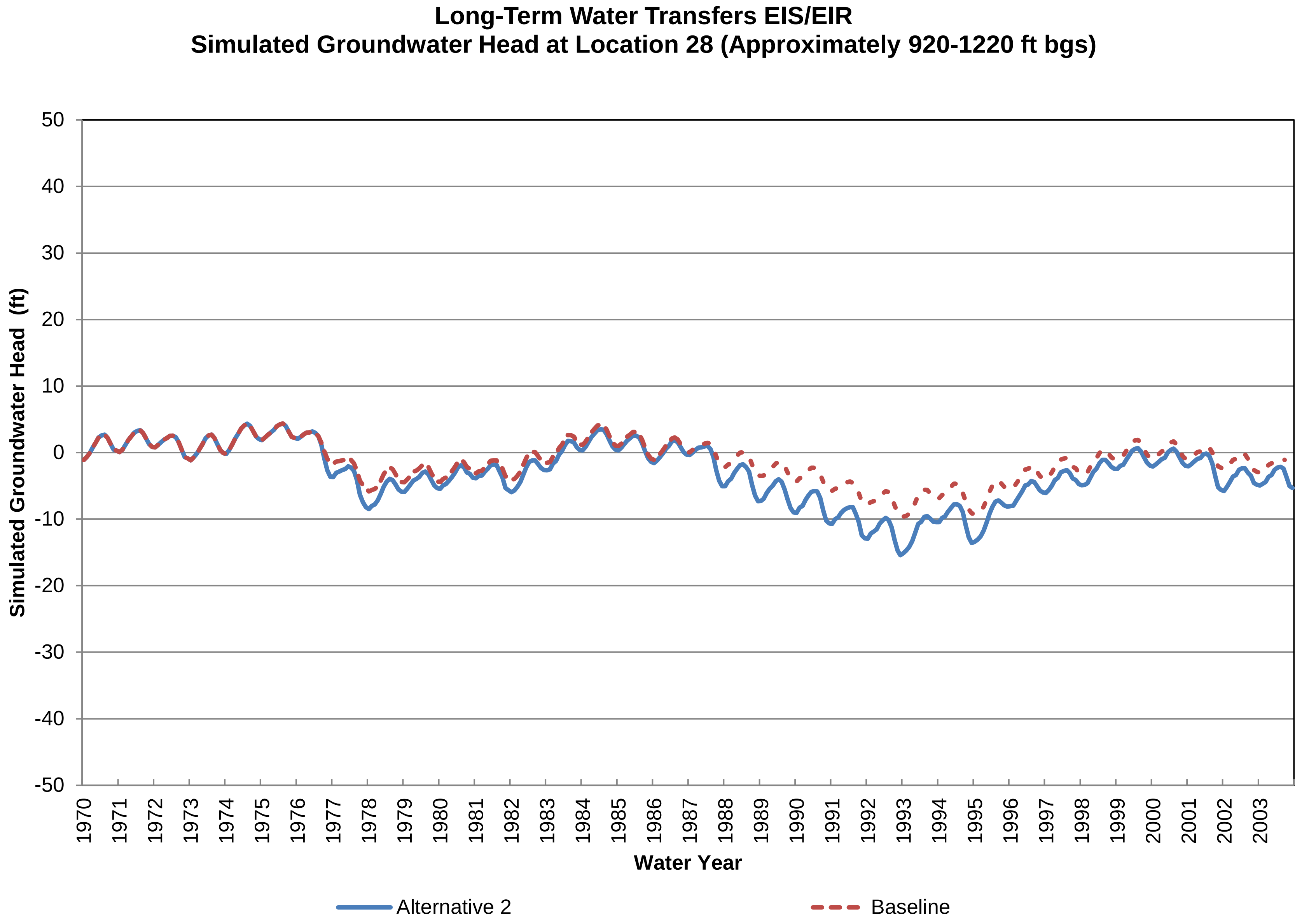
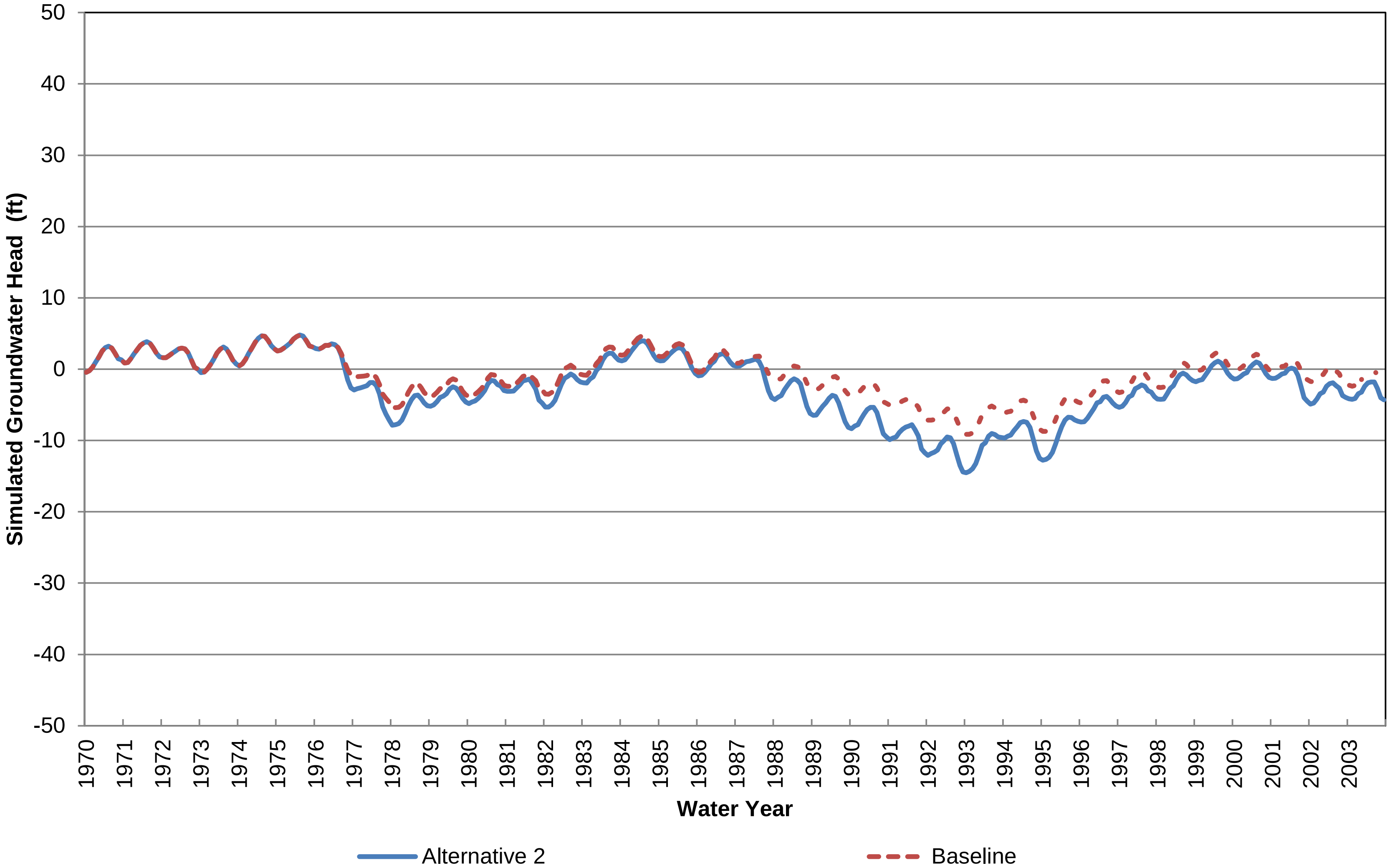
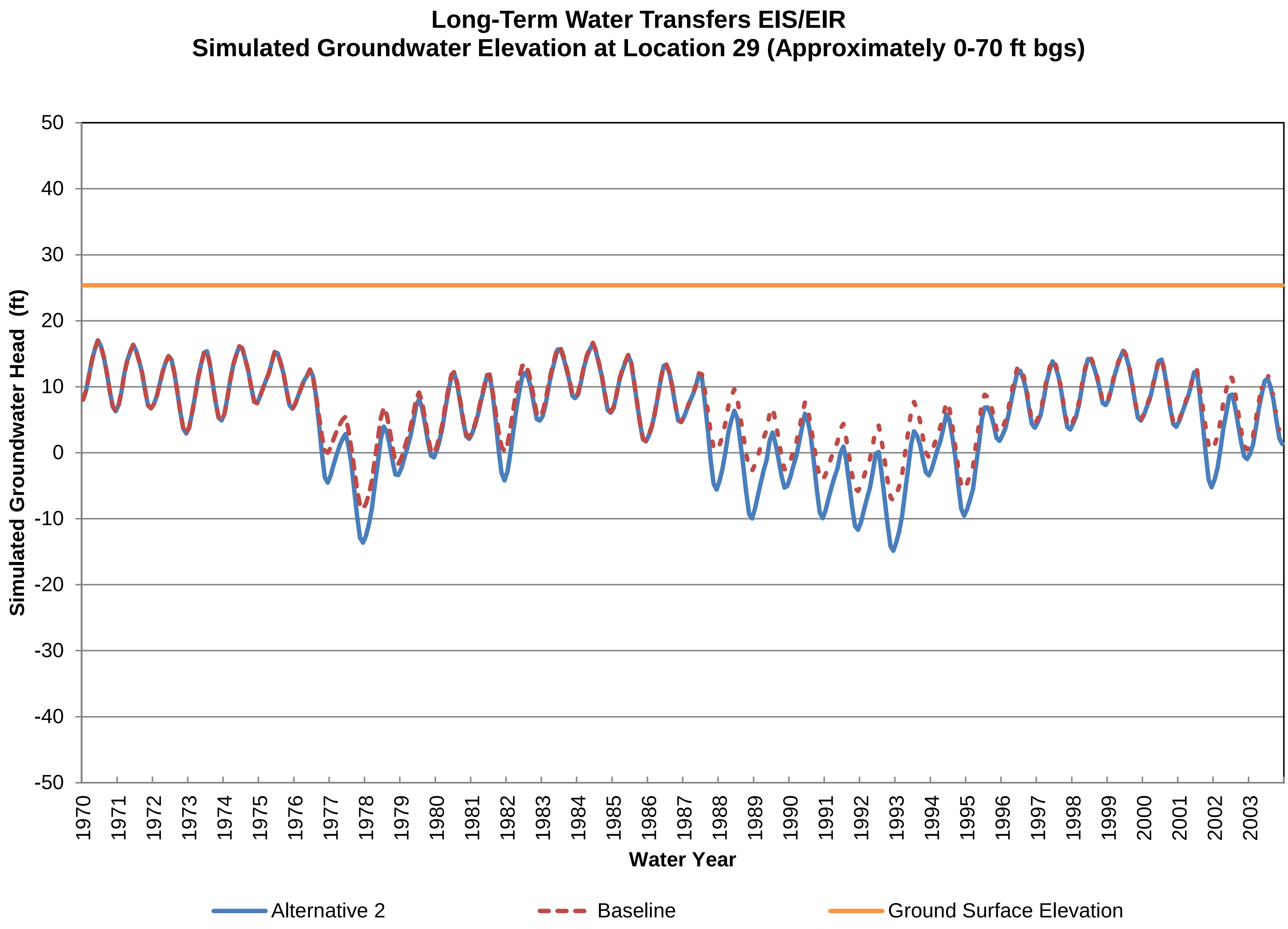
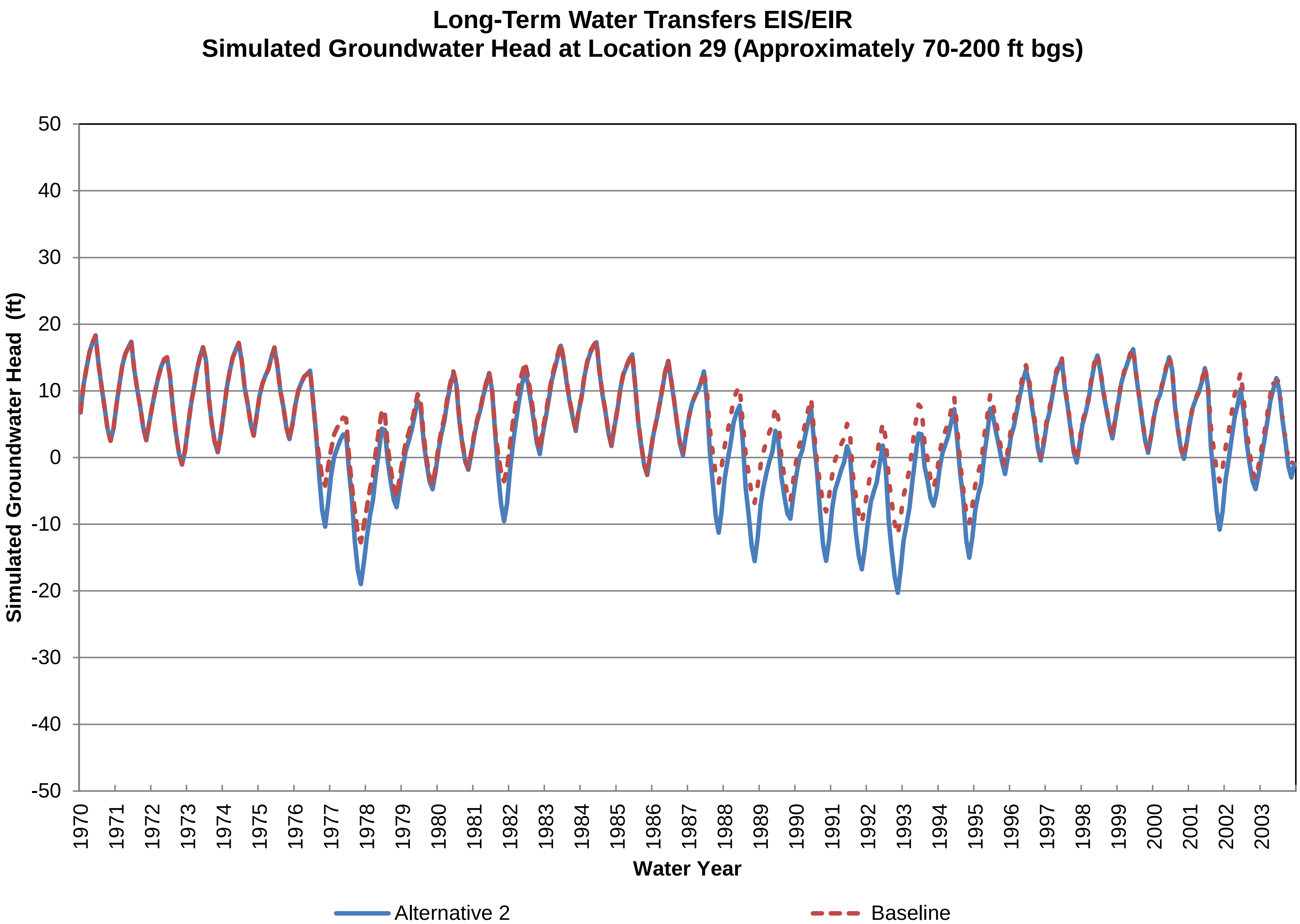
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 920-1220 ft bgs)
50
40
30
20
10
0
-10
-20
-30
-40
-50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

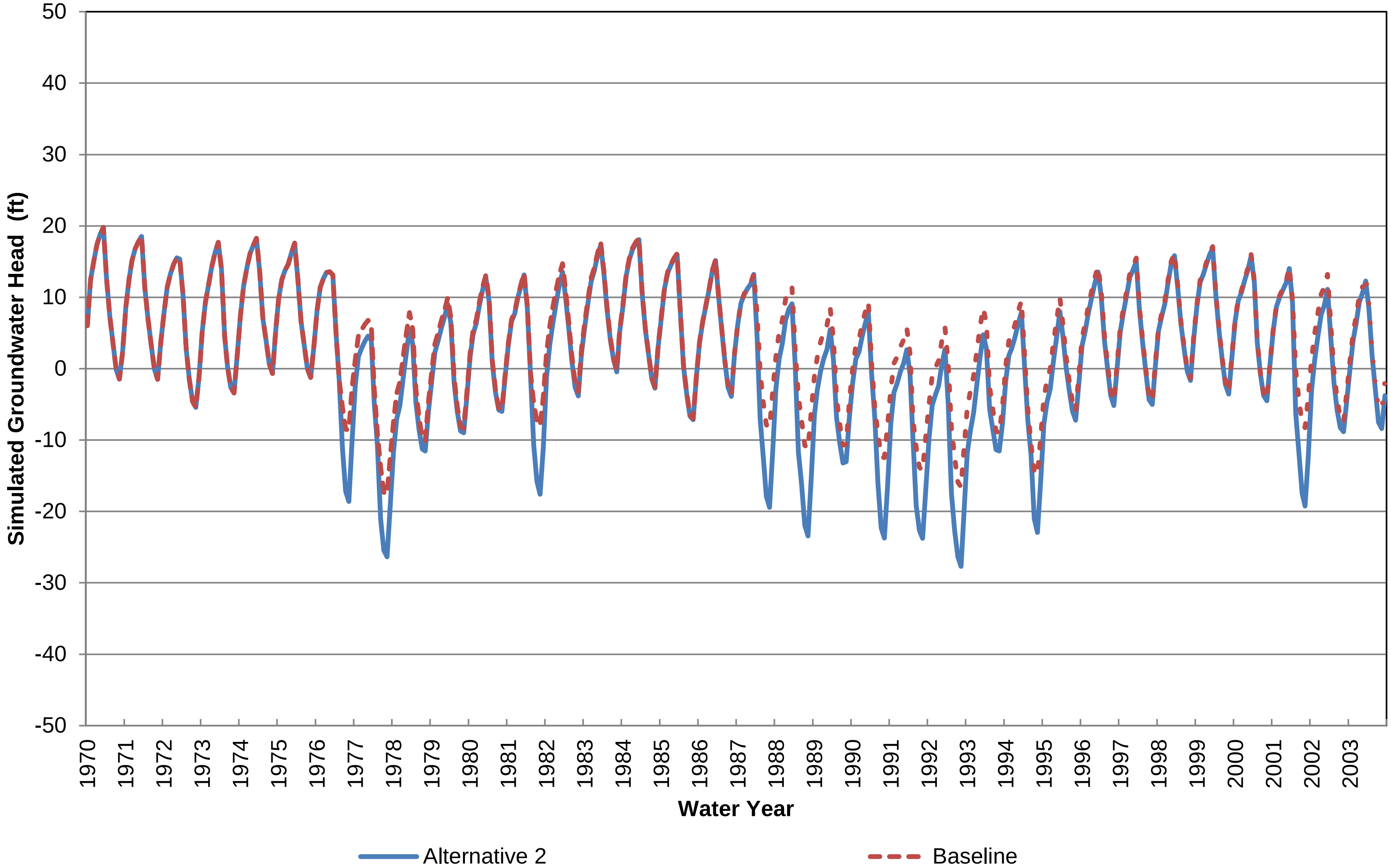
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 1220-1680 ft bgs)

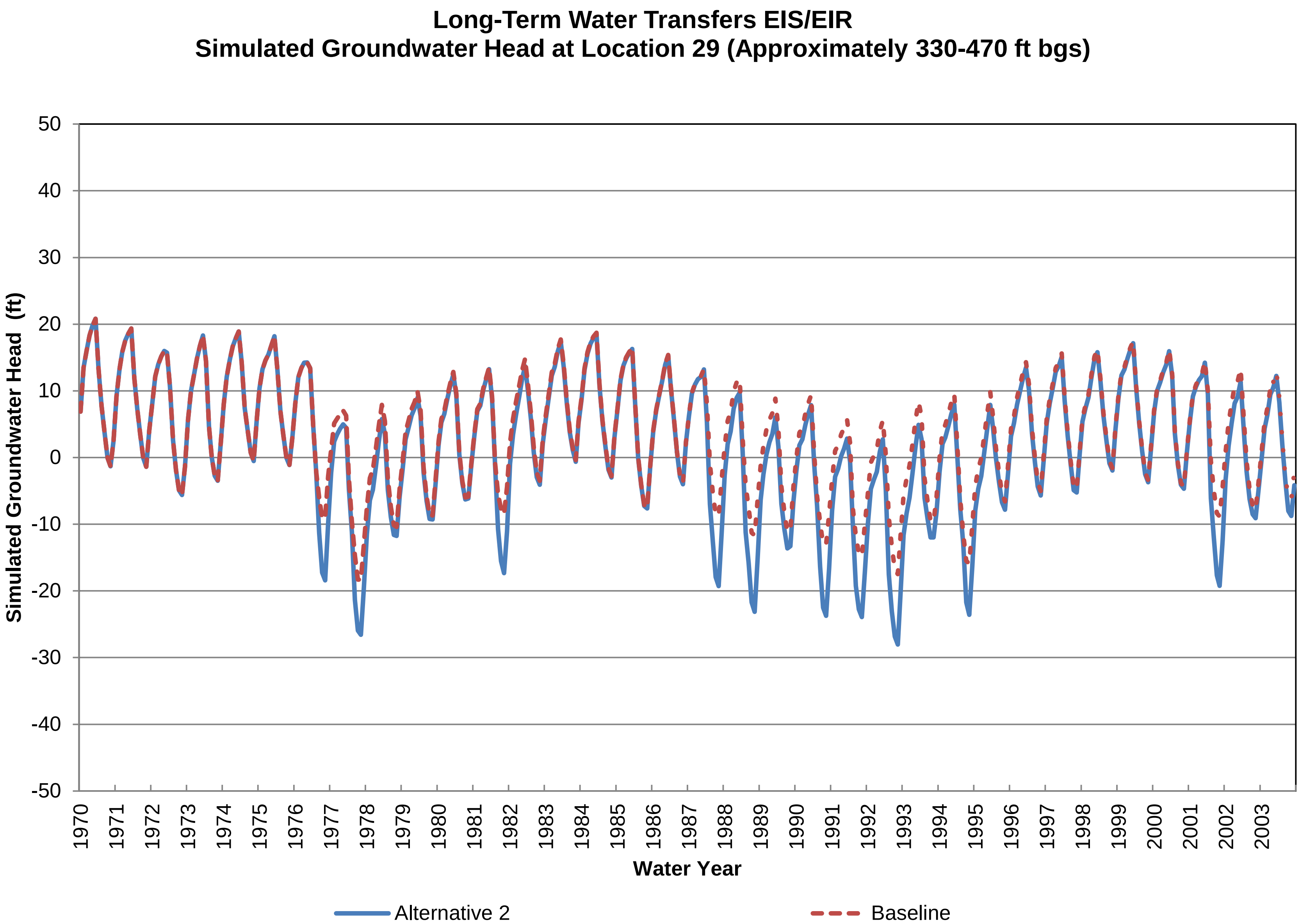



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 29 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

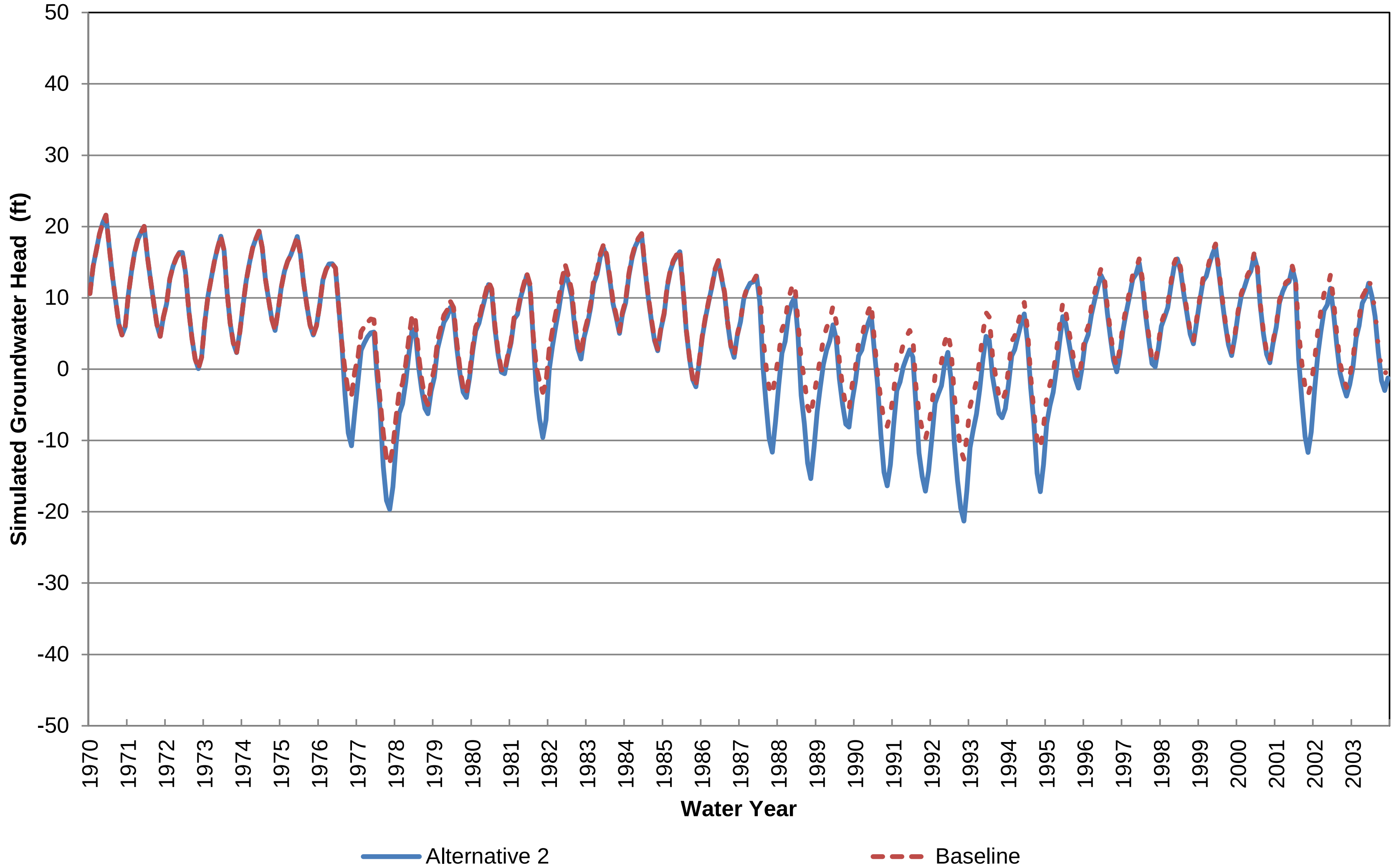

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 70-200 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

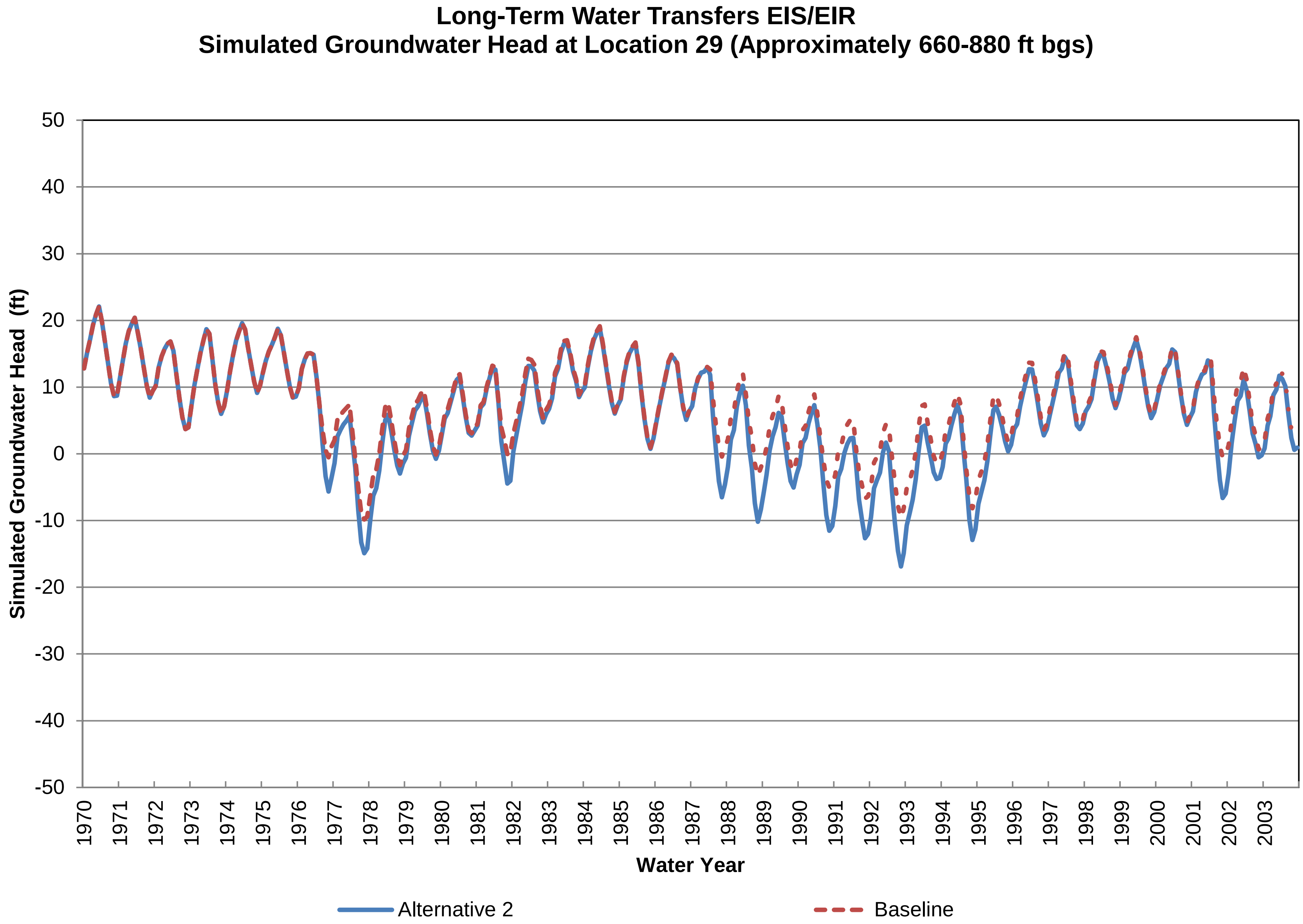
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 200-330 ft bgs)

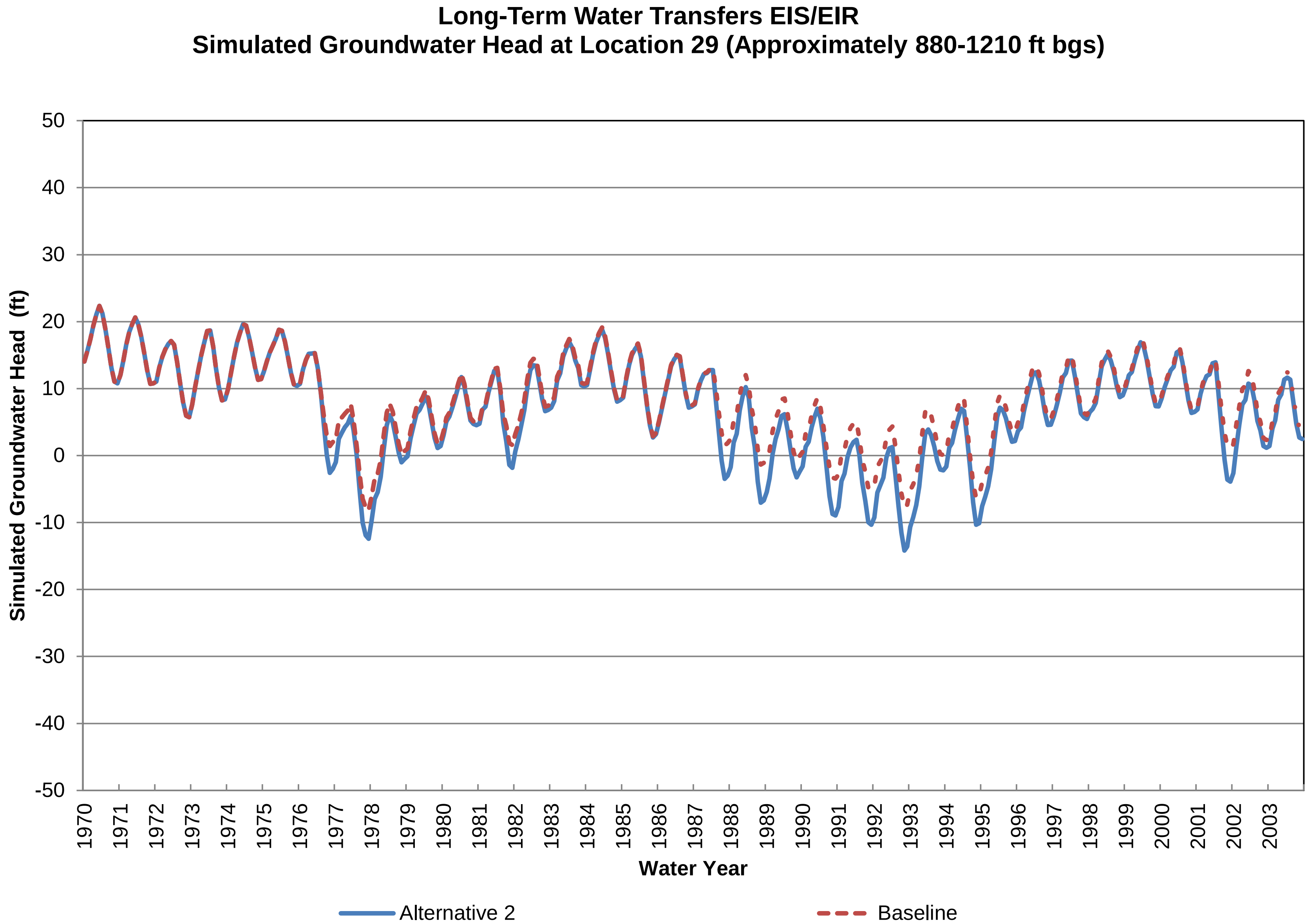


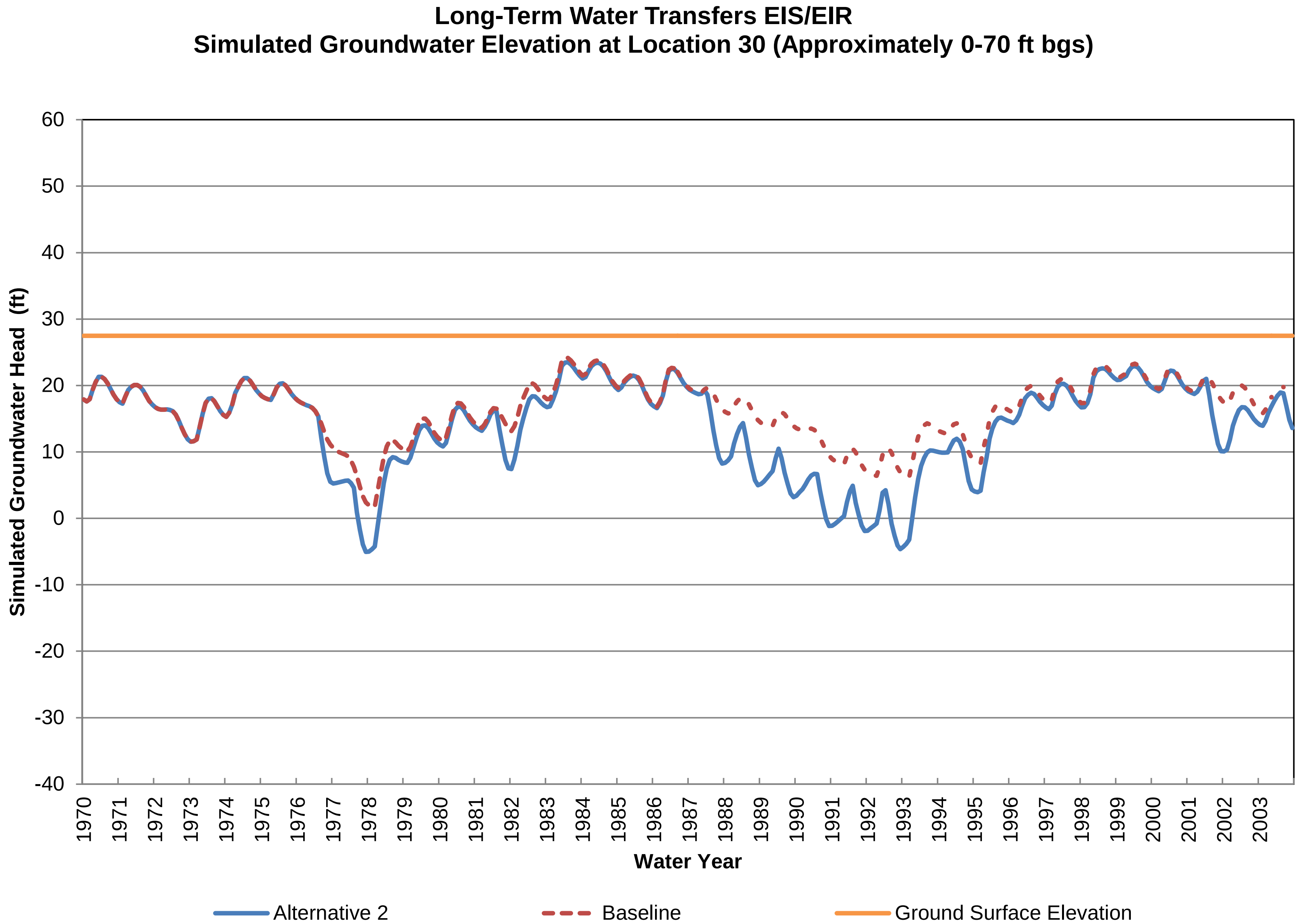

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 330-470 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 470-660 ft bgs)

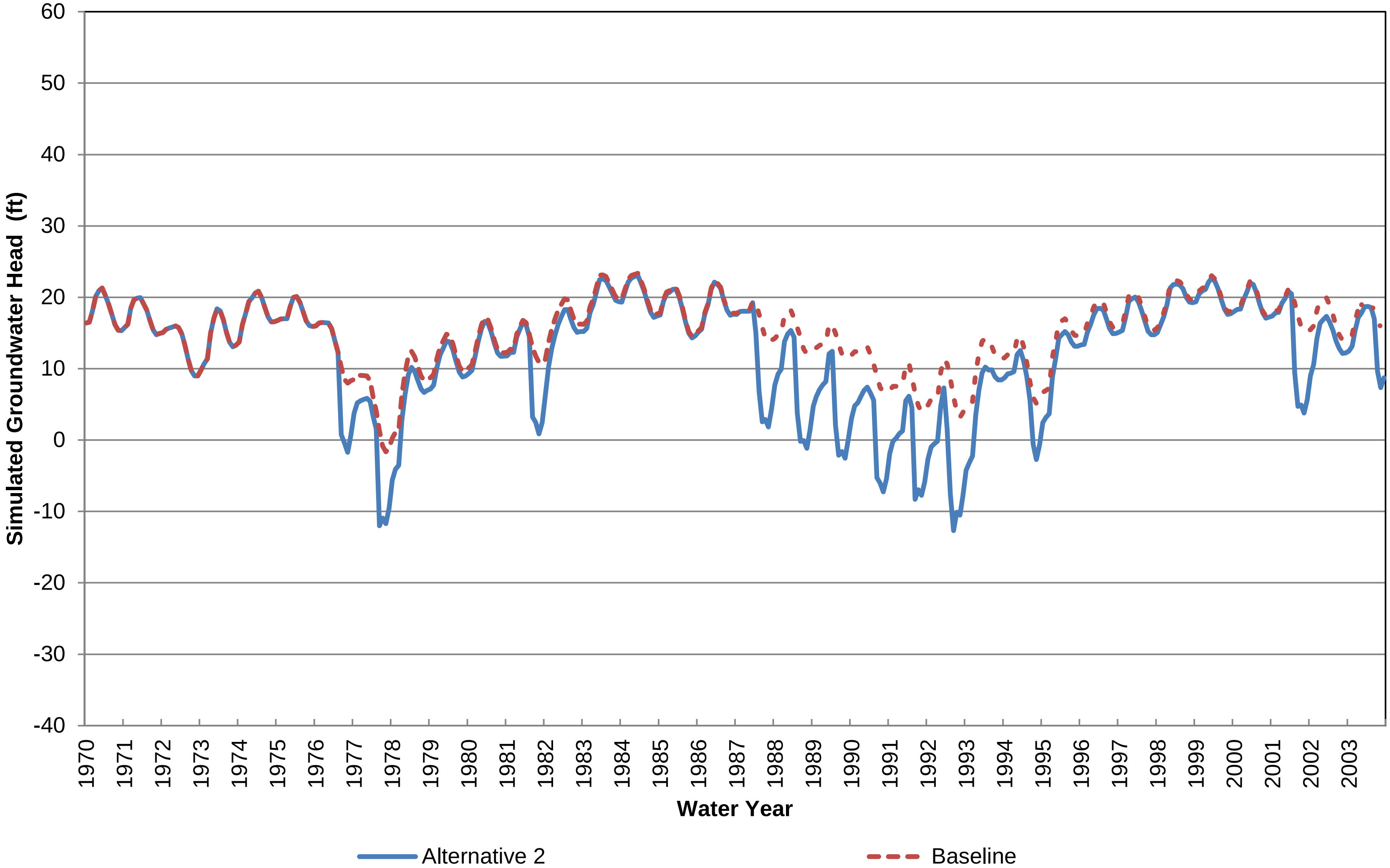


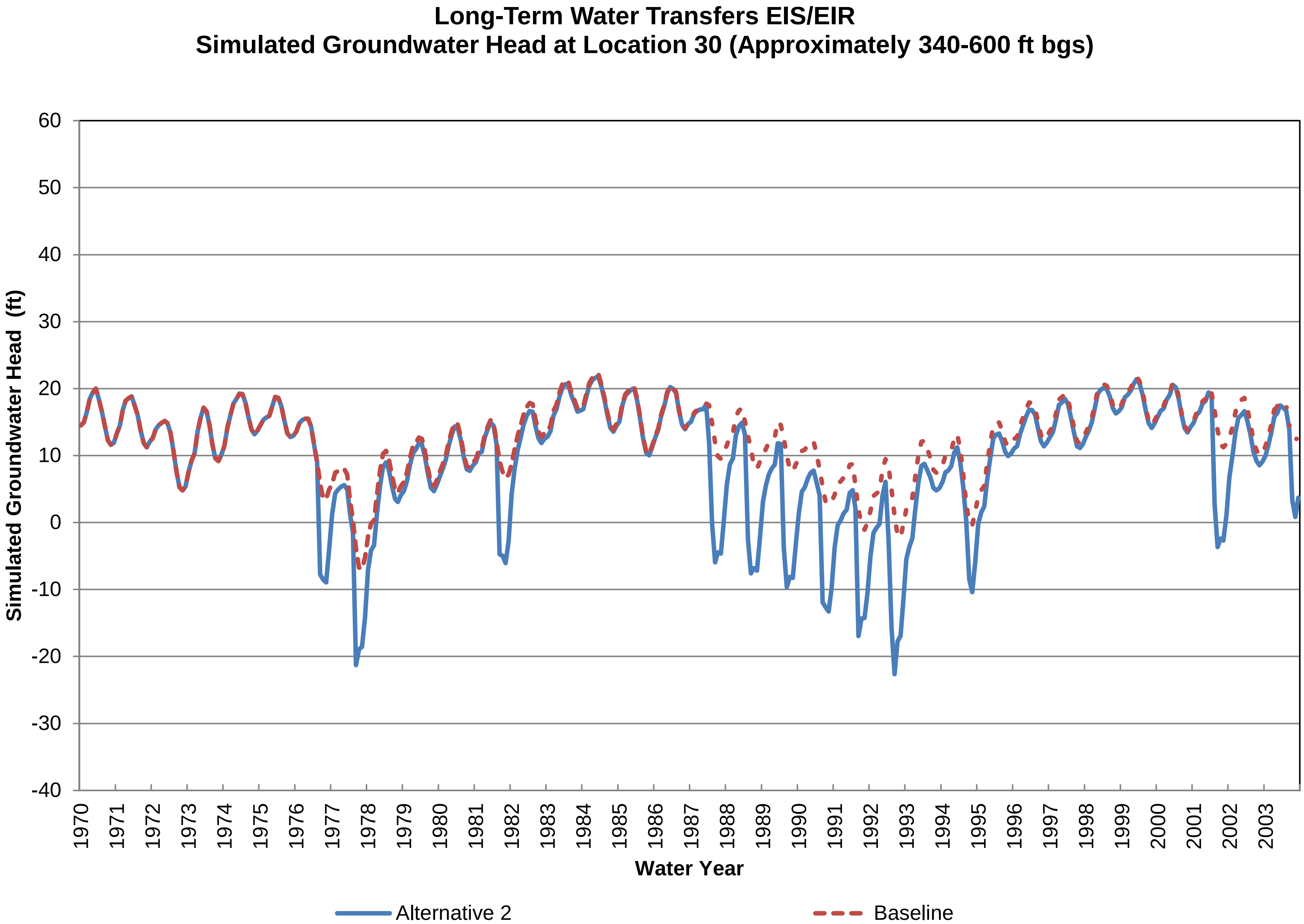

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 660-880 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 880-1210 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

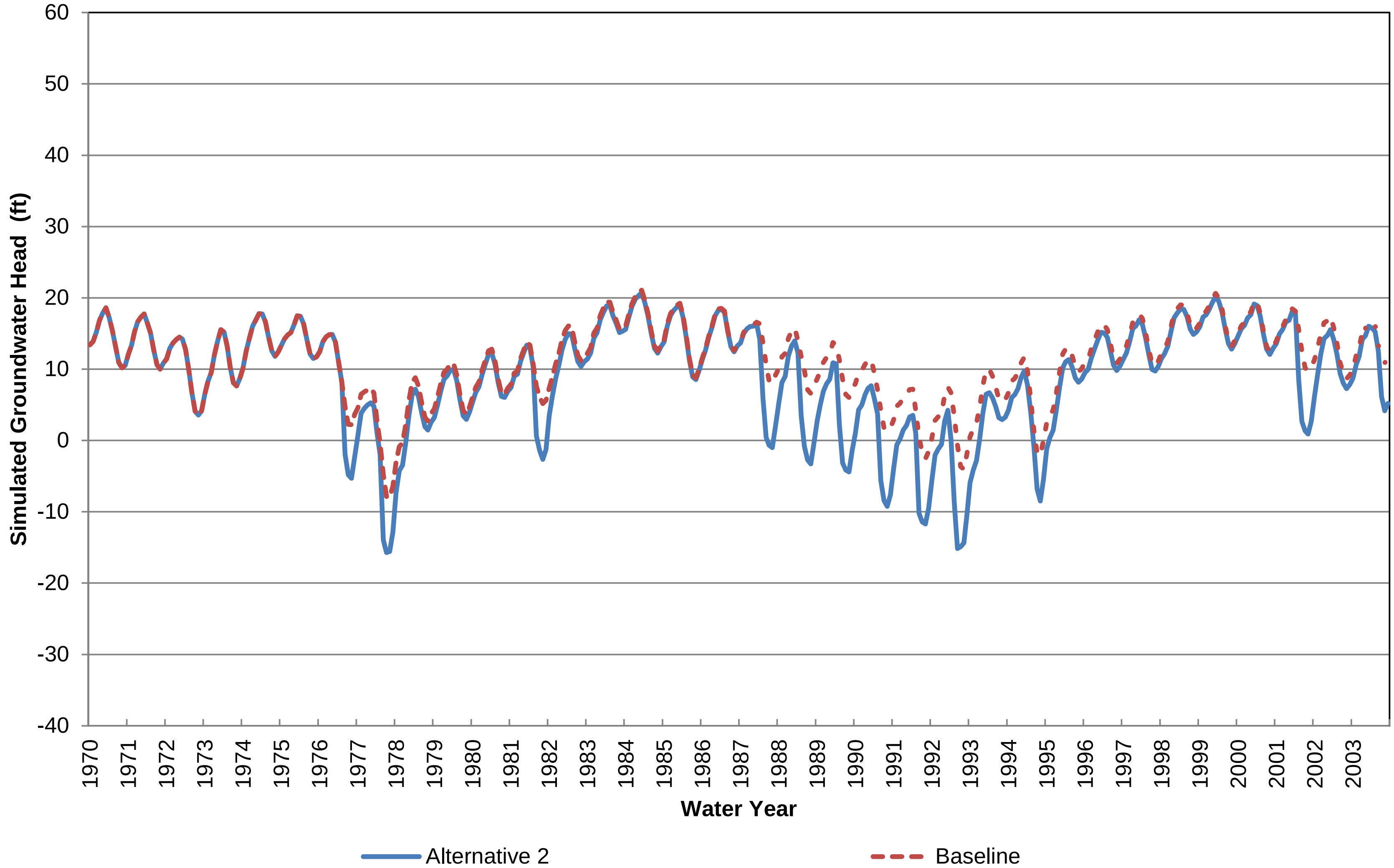

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 30 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

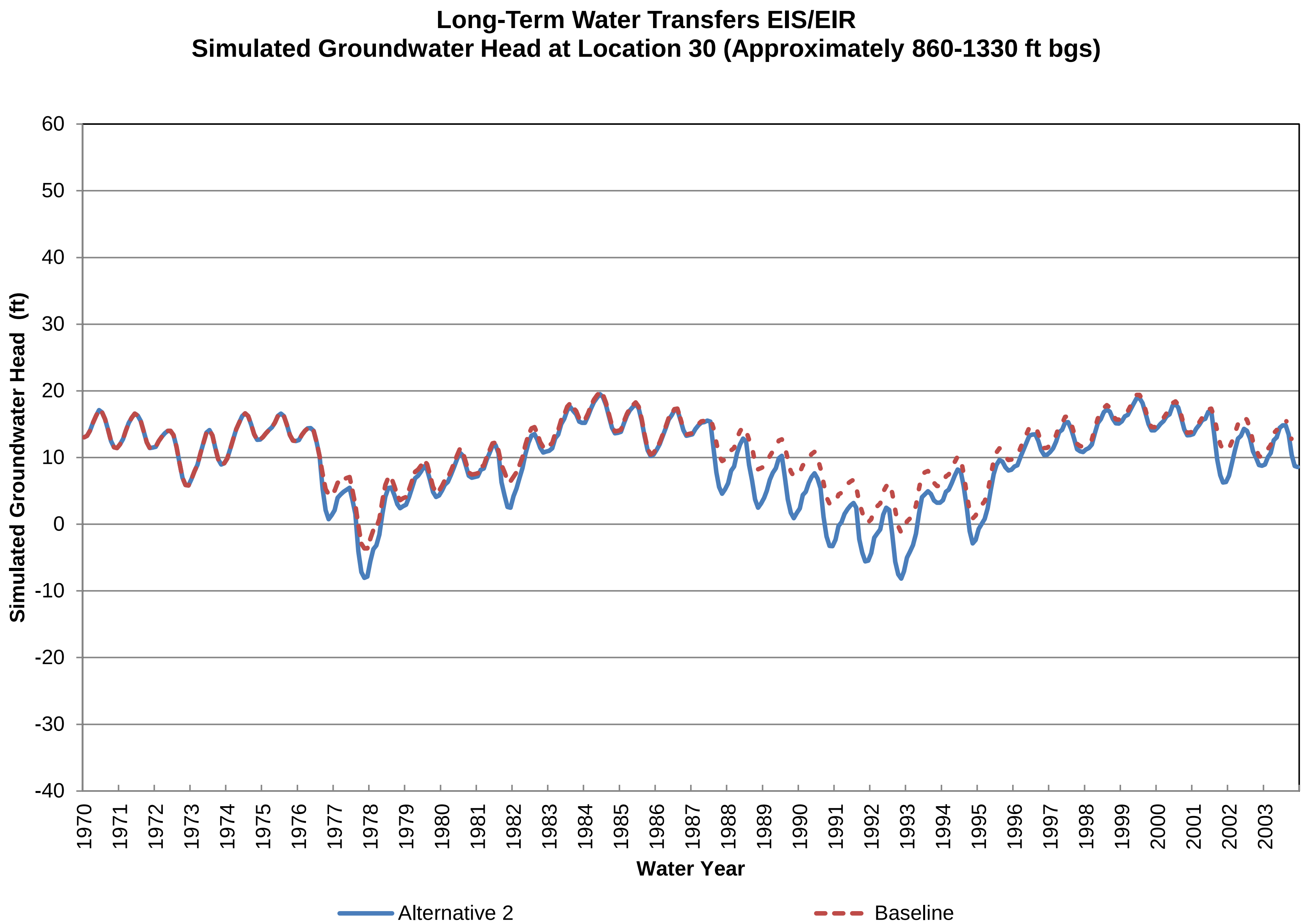
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 70-340 ft bgs)

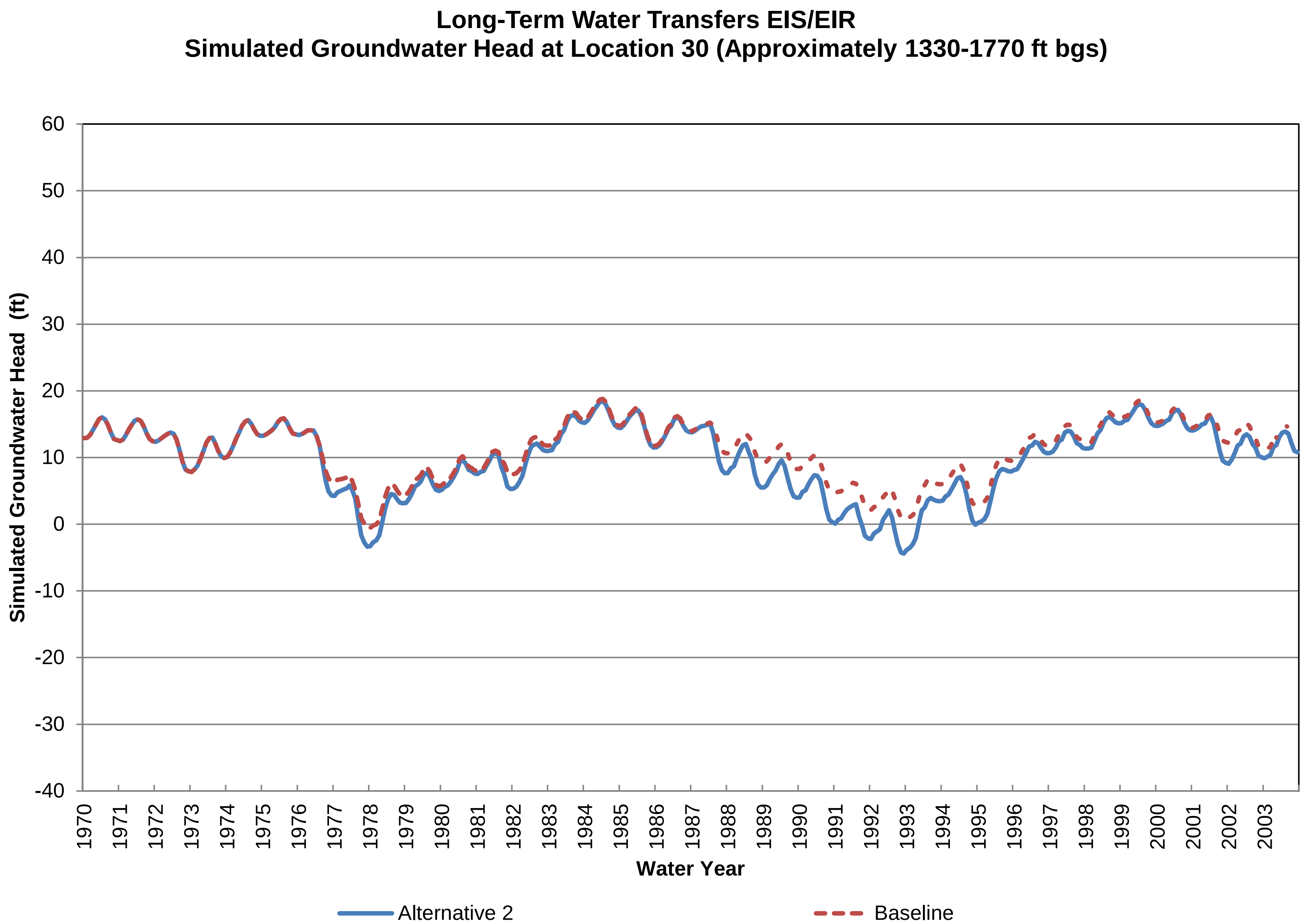


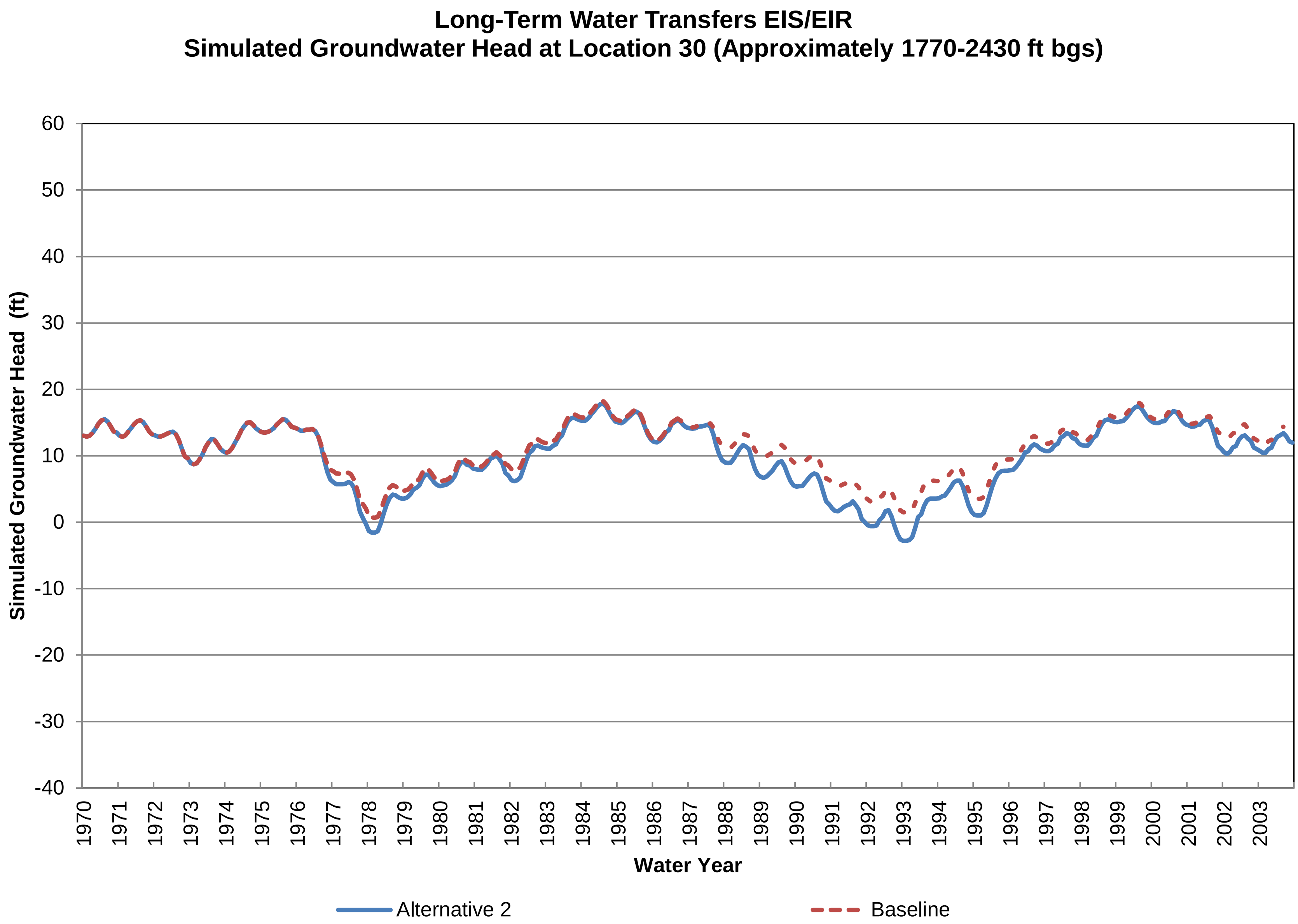

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 340-600 ft bgs)
60
50
40
30
20
10
0
-10
-20
-30
-40
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

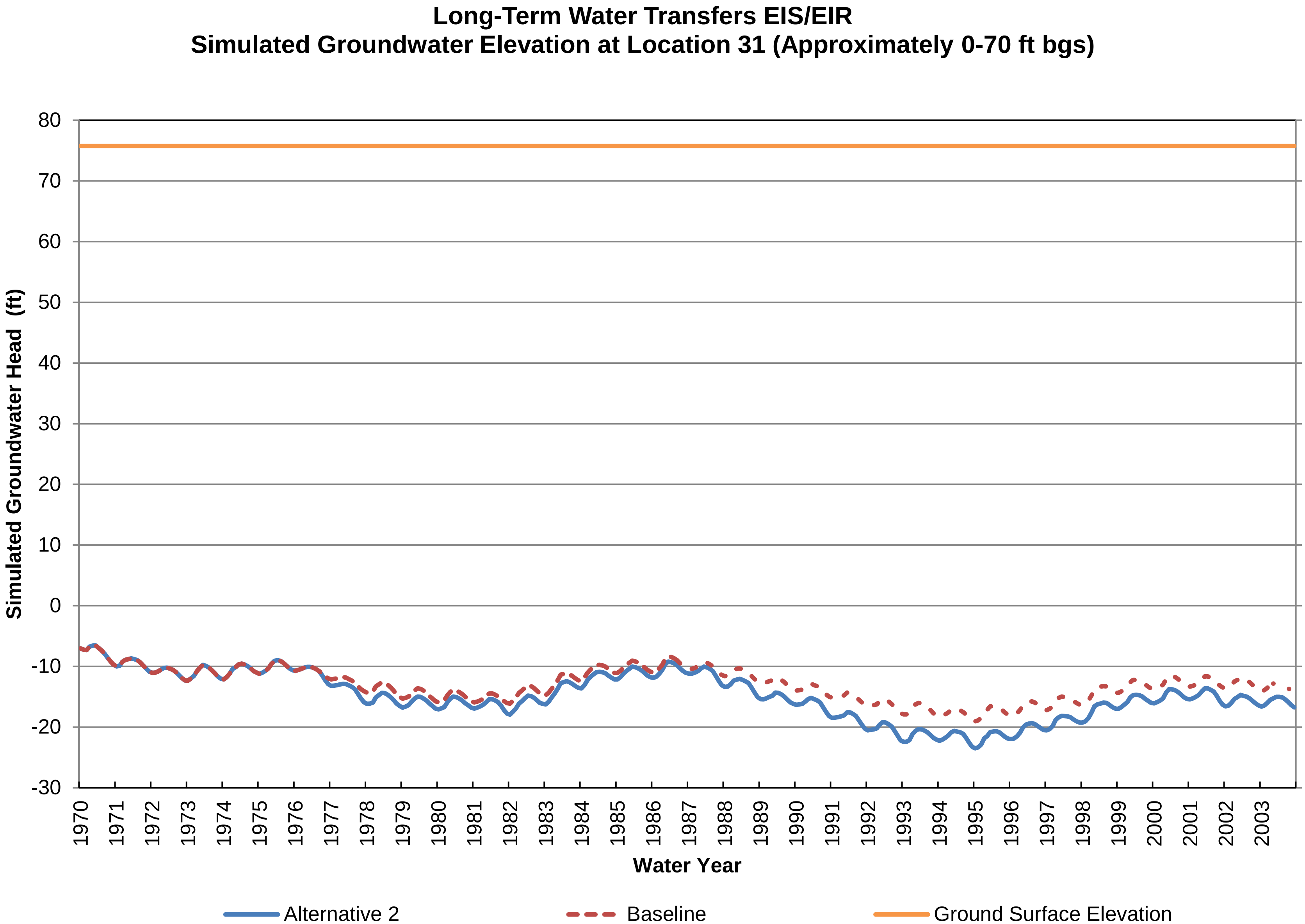
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 600-860 ft bgs)



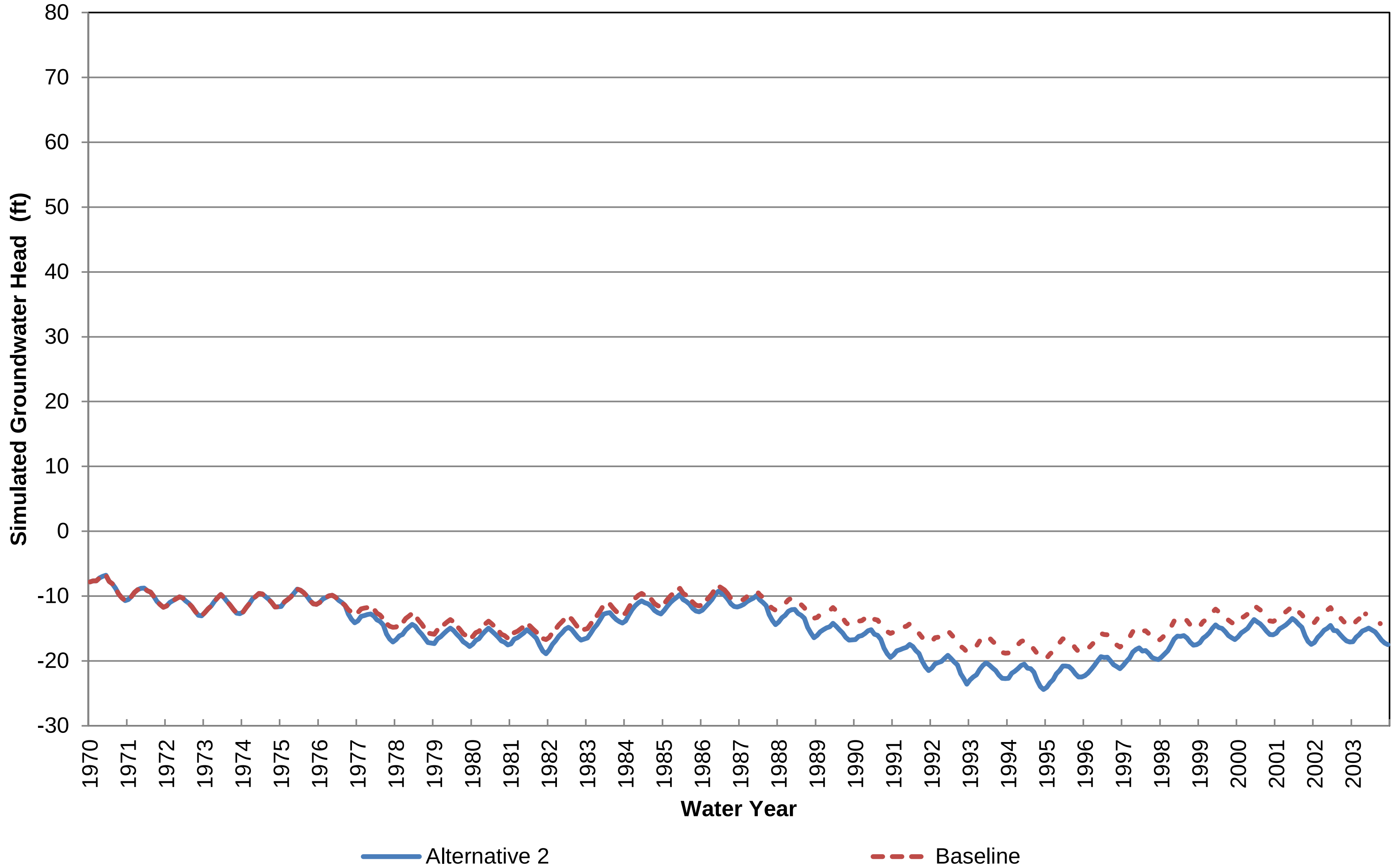

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 860-1330 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

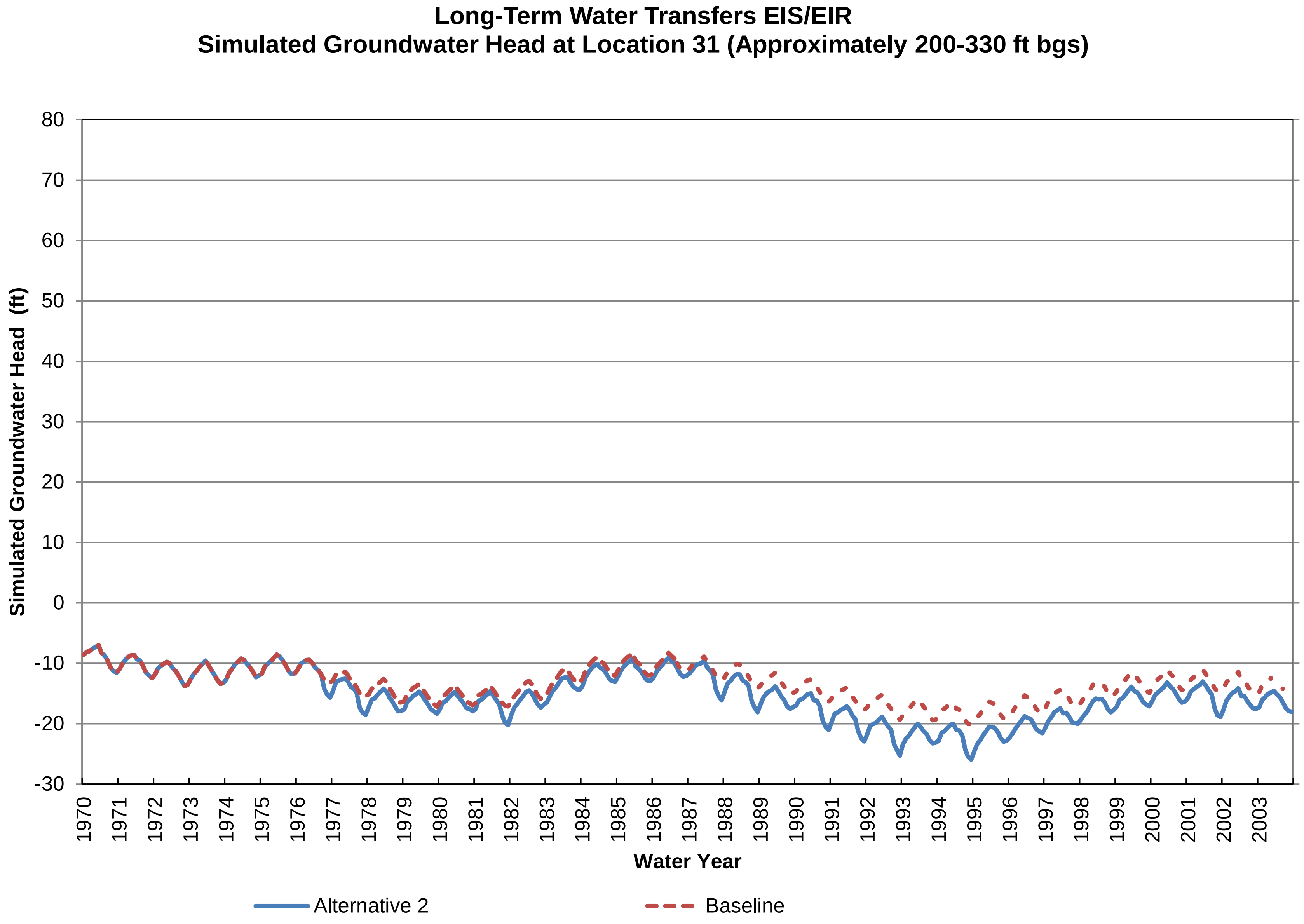

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 1330-1770 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

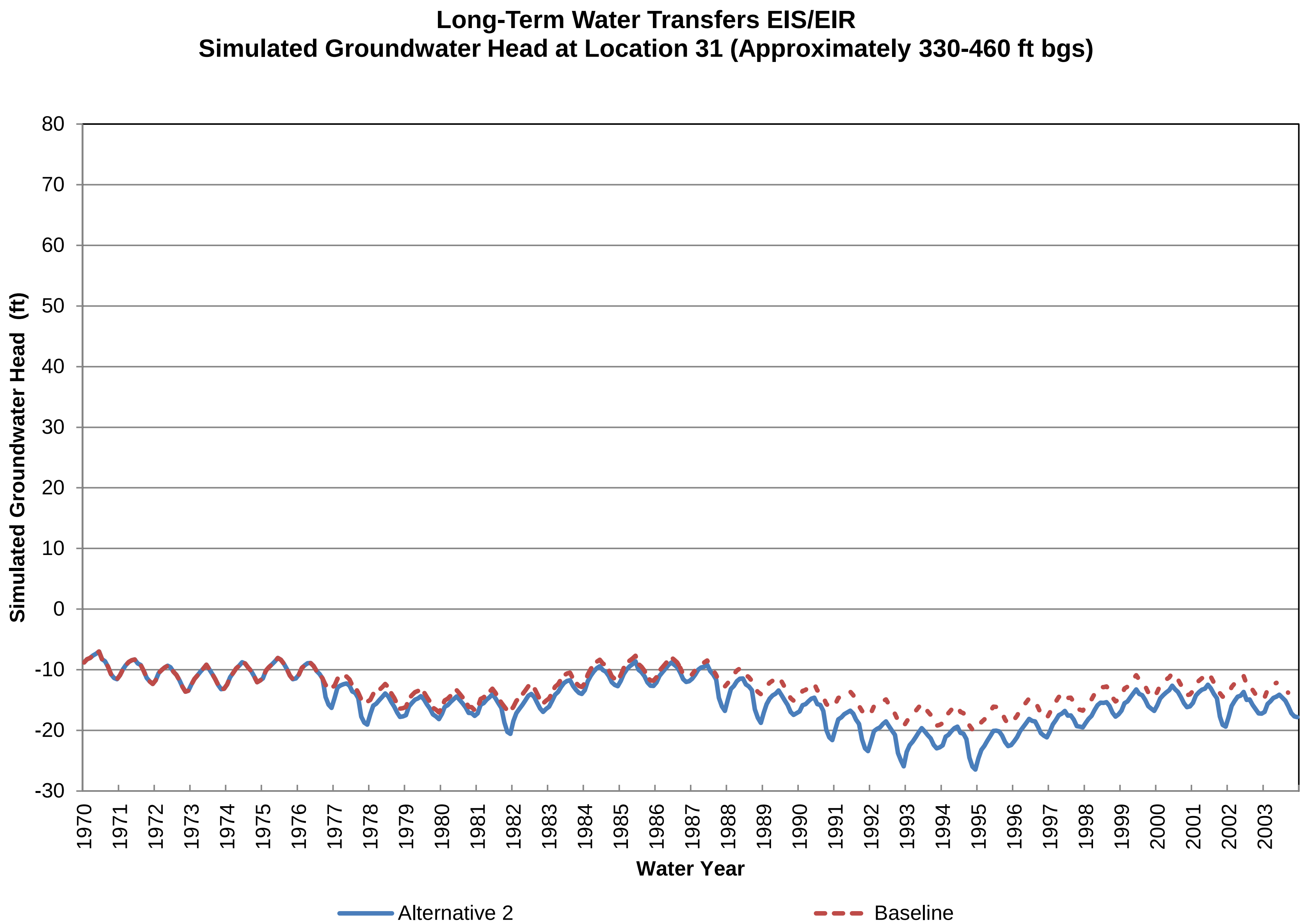

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 1770-2430 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

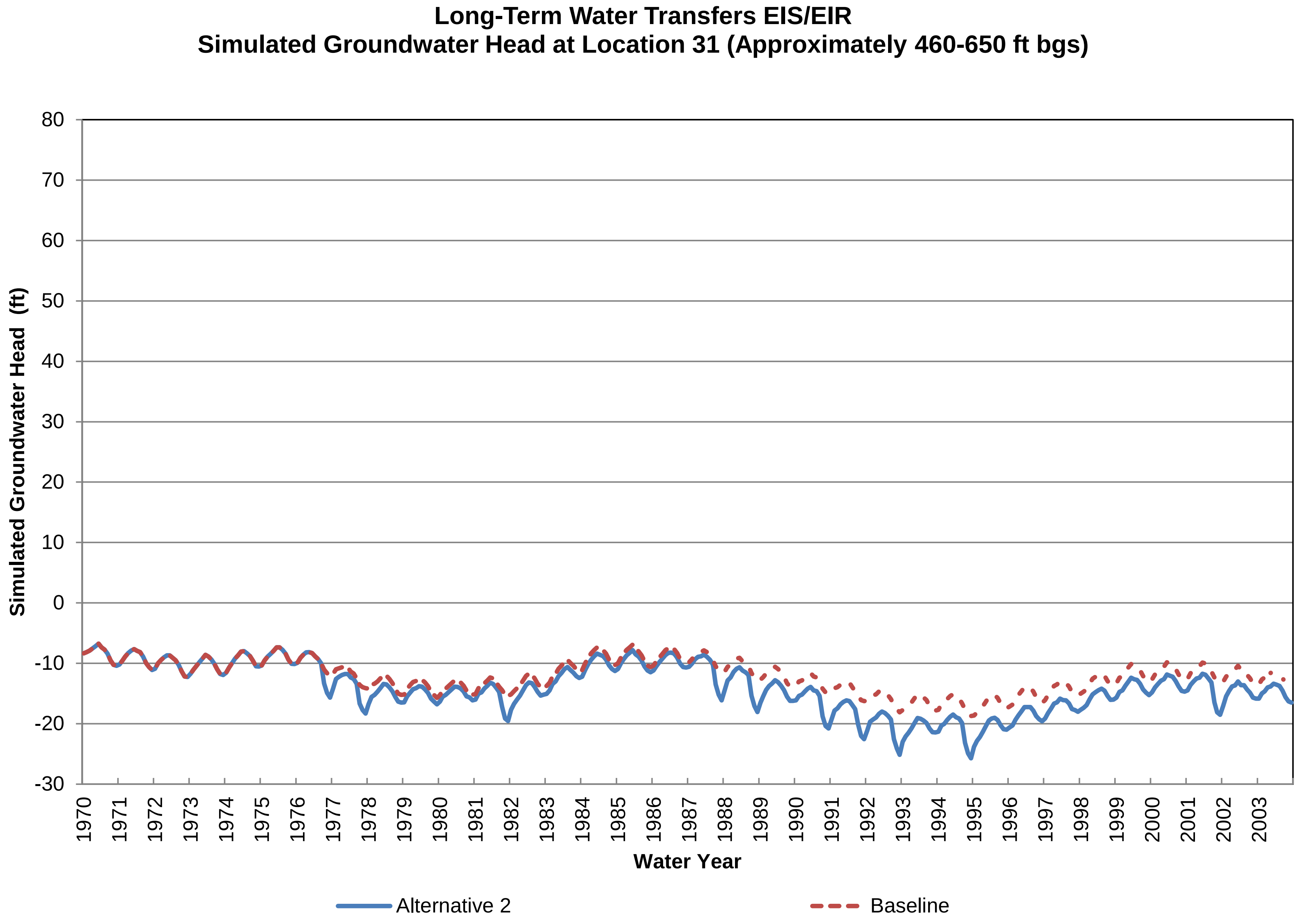

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 31 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

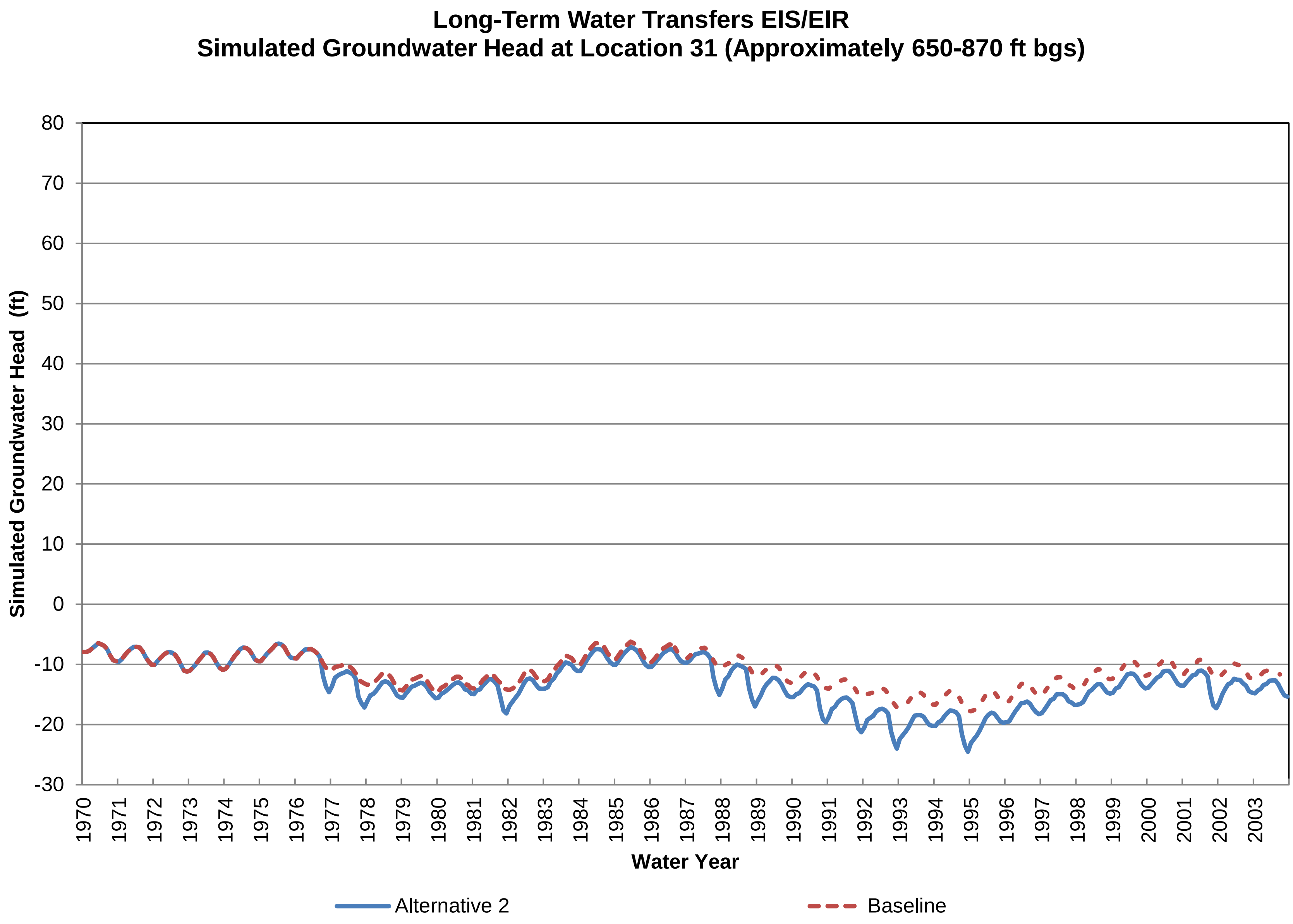
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 70-200 ft bgs)



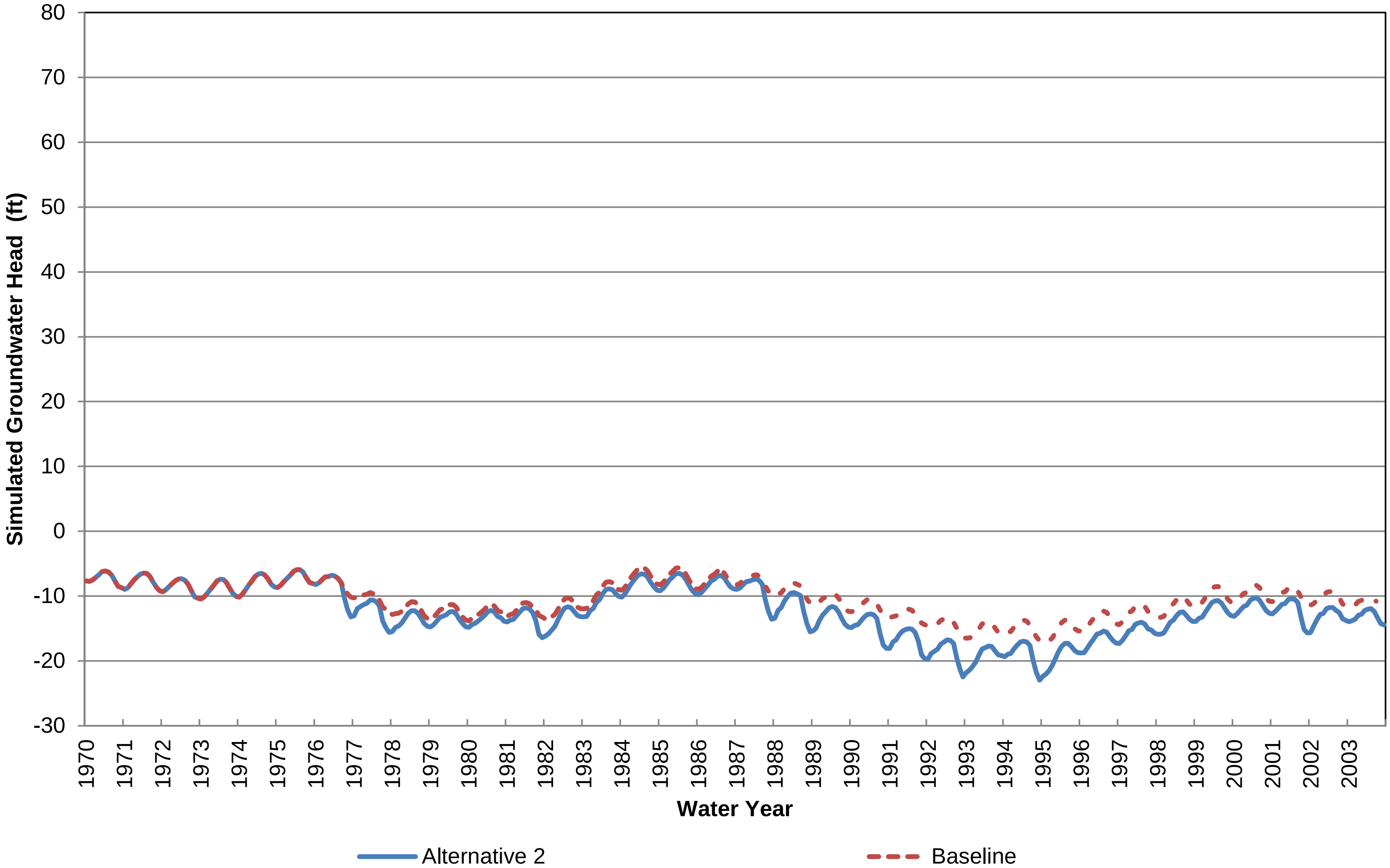

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 200-330 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

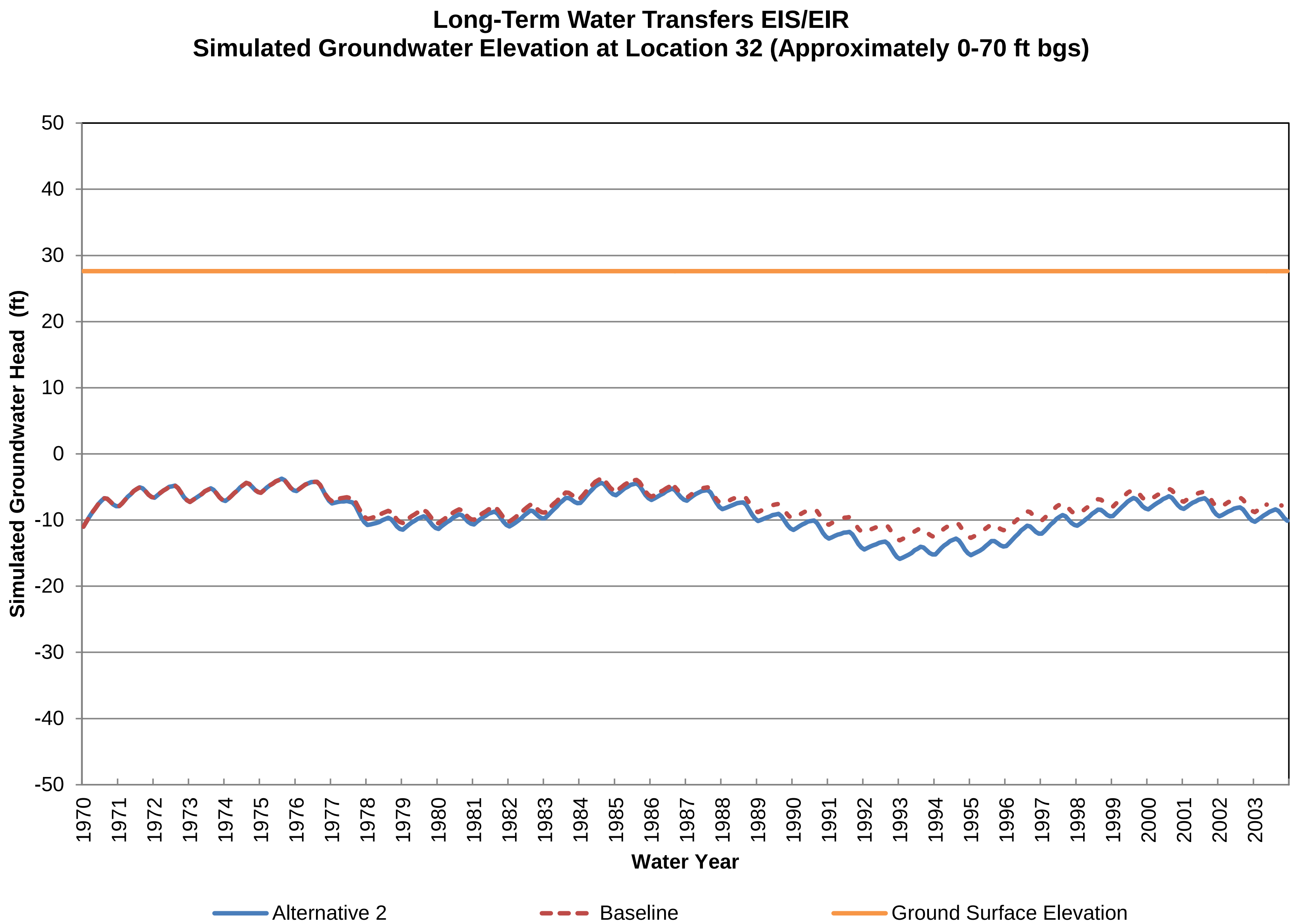

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 330-460 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 460-650 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

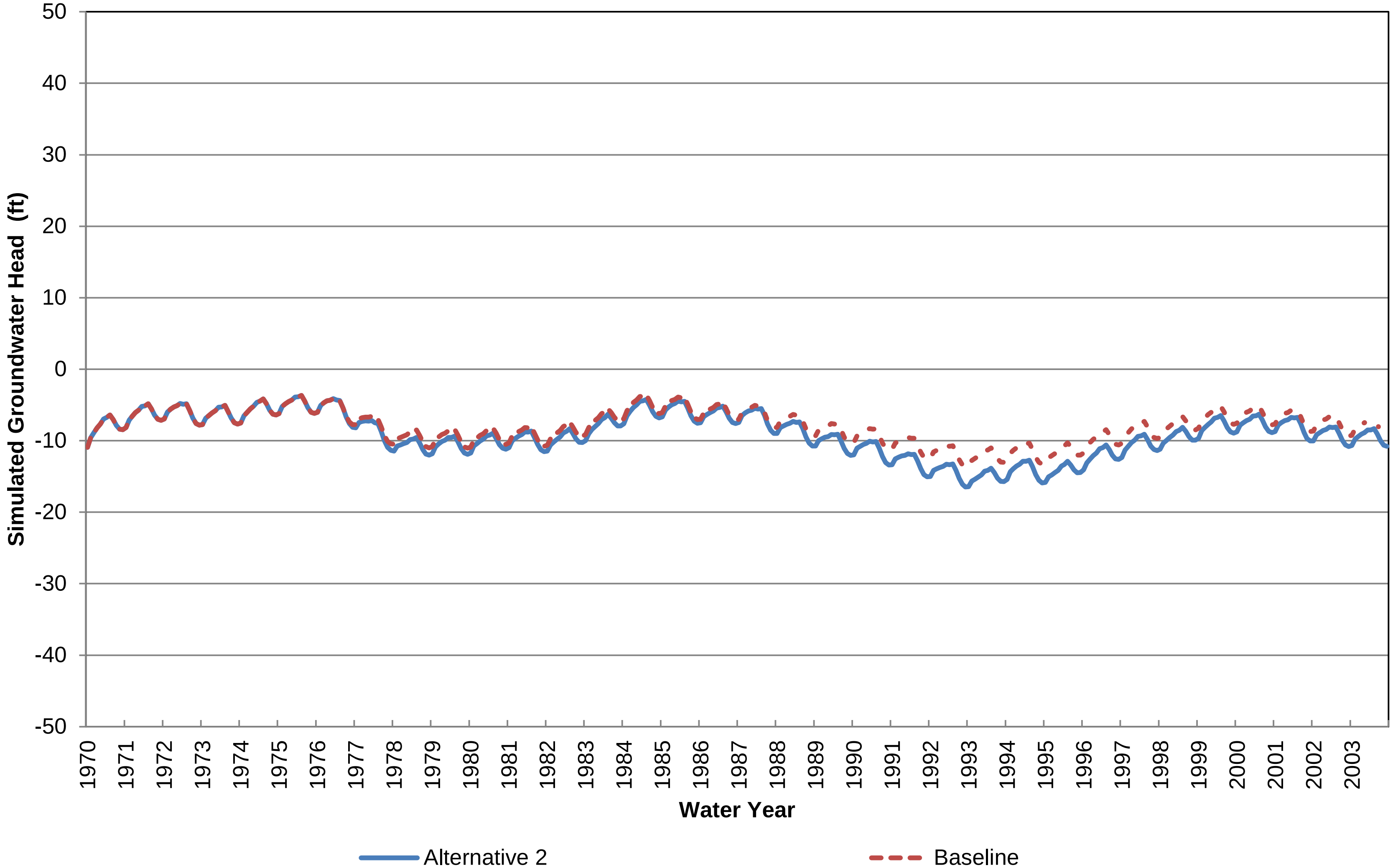

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 650-870 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

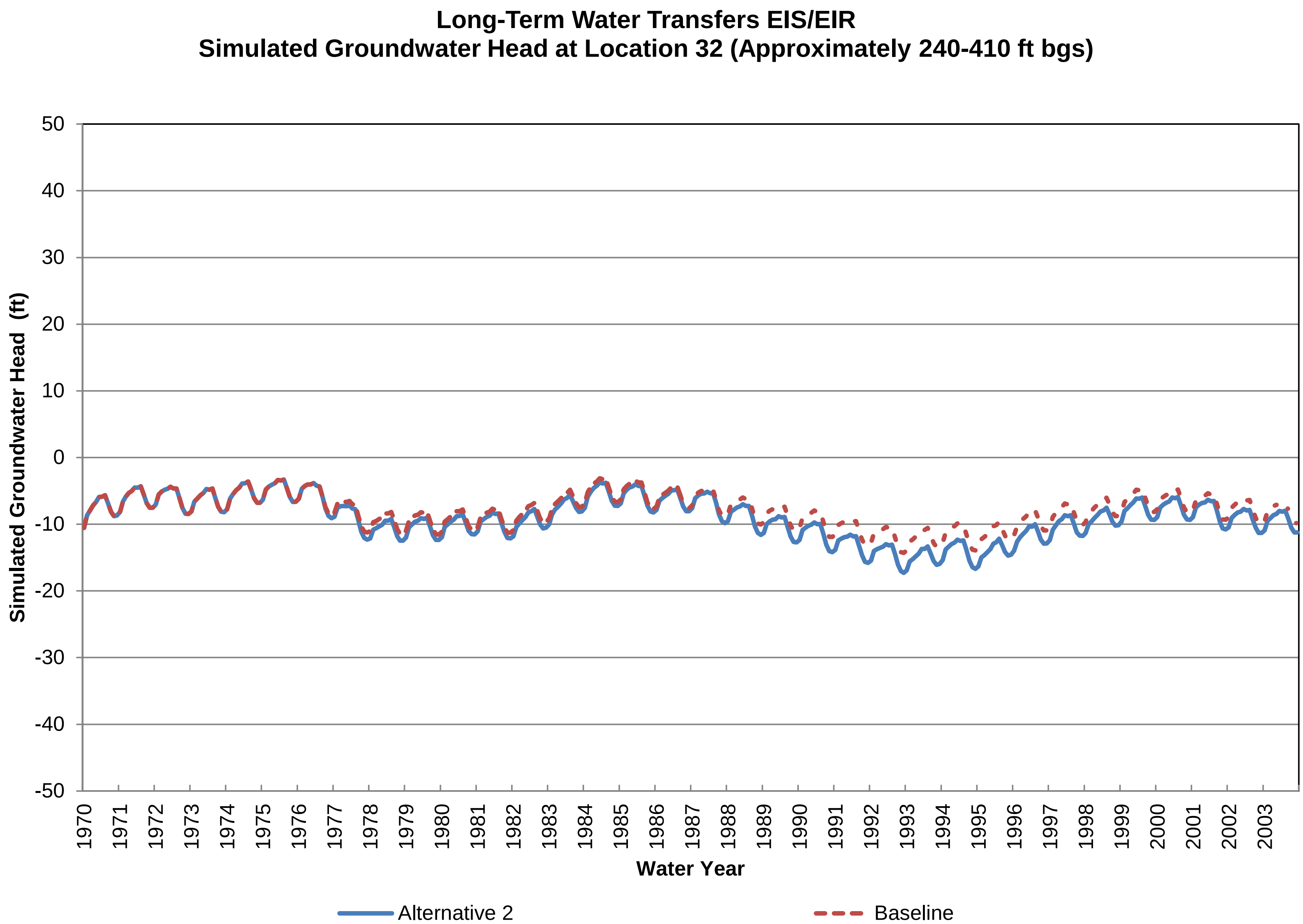
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 870-1190 ft bgs)



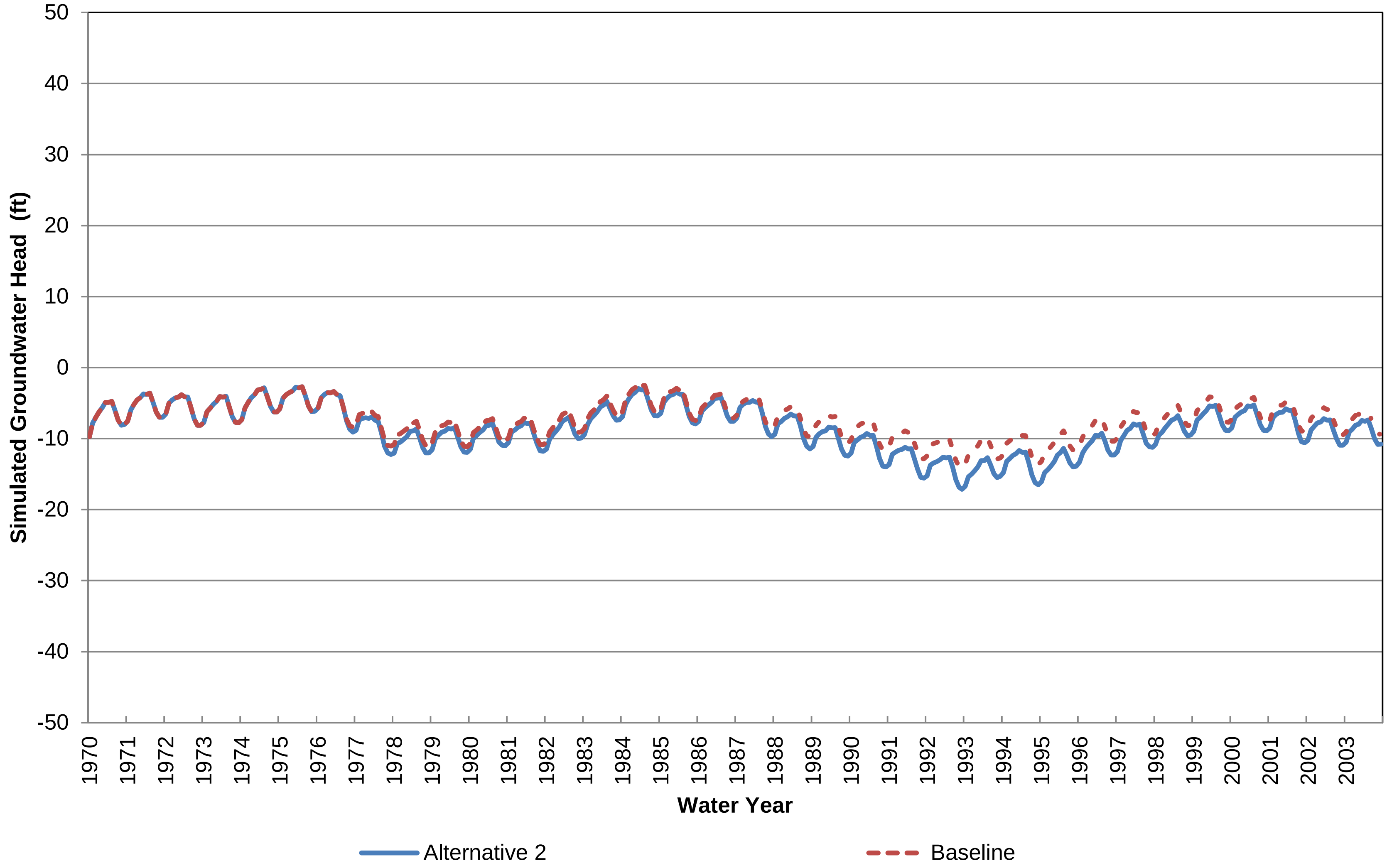

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 32 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

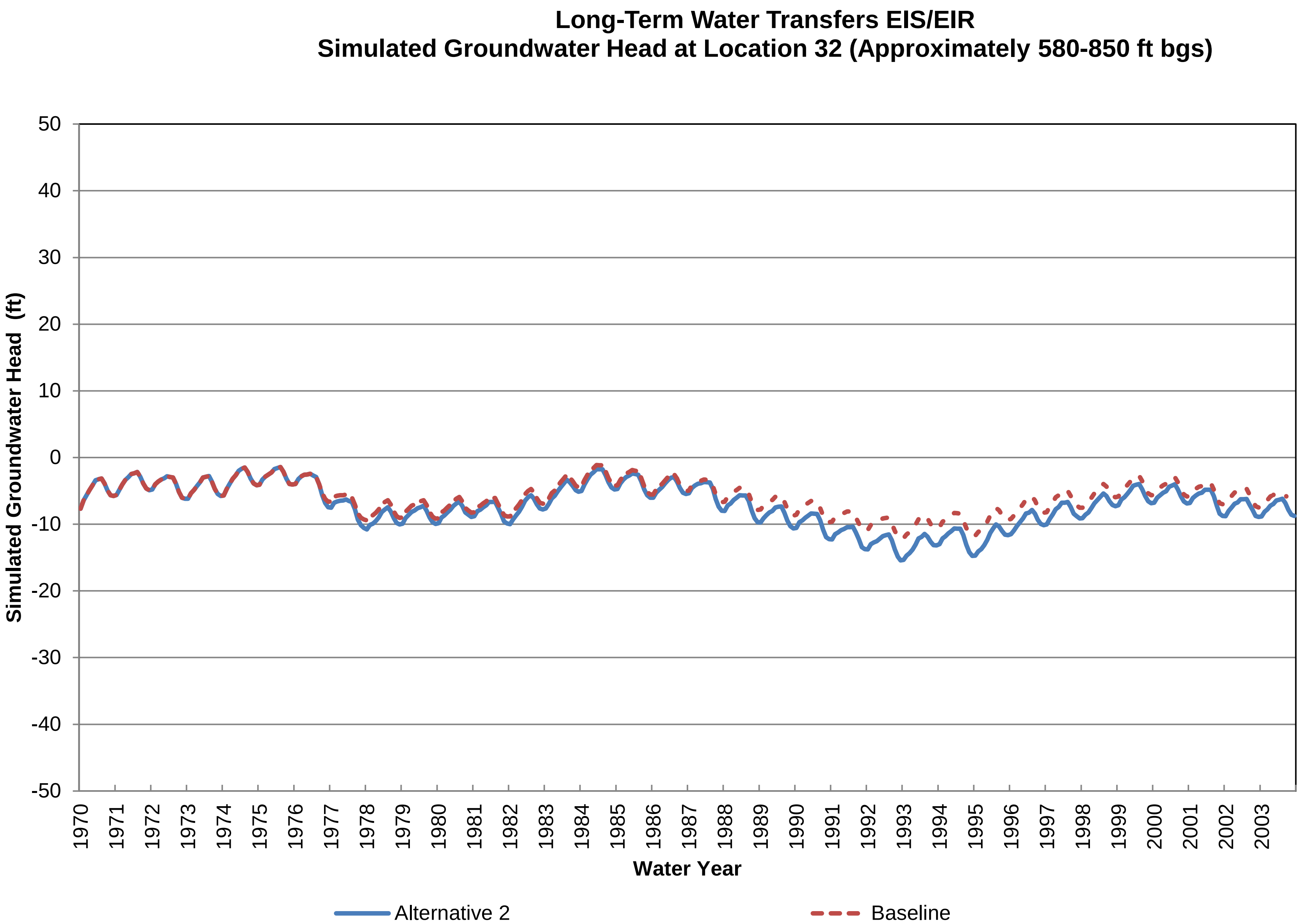
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 70-240 ft bgs)

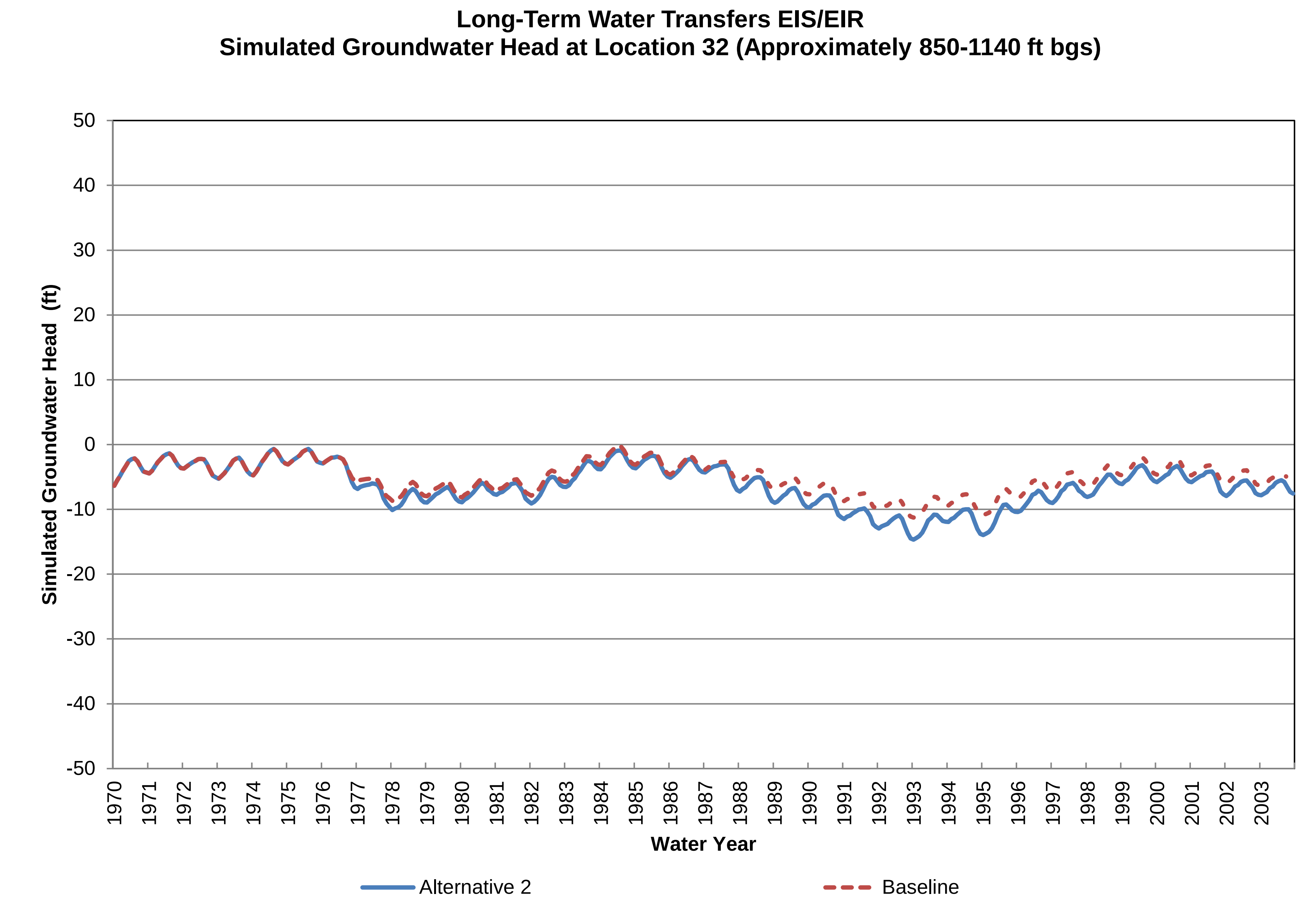


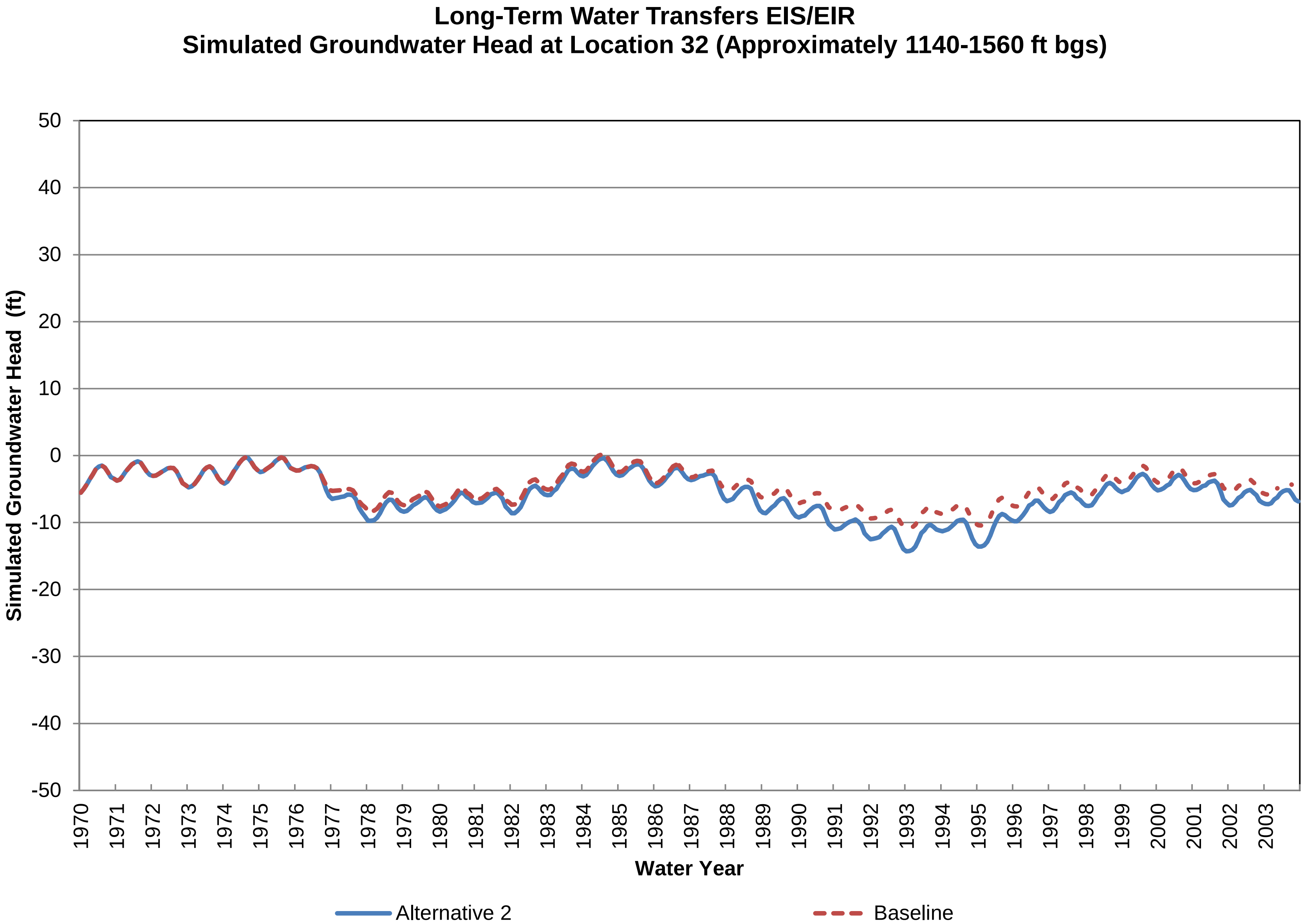

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 240-410 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 410-580 ft bgs)

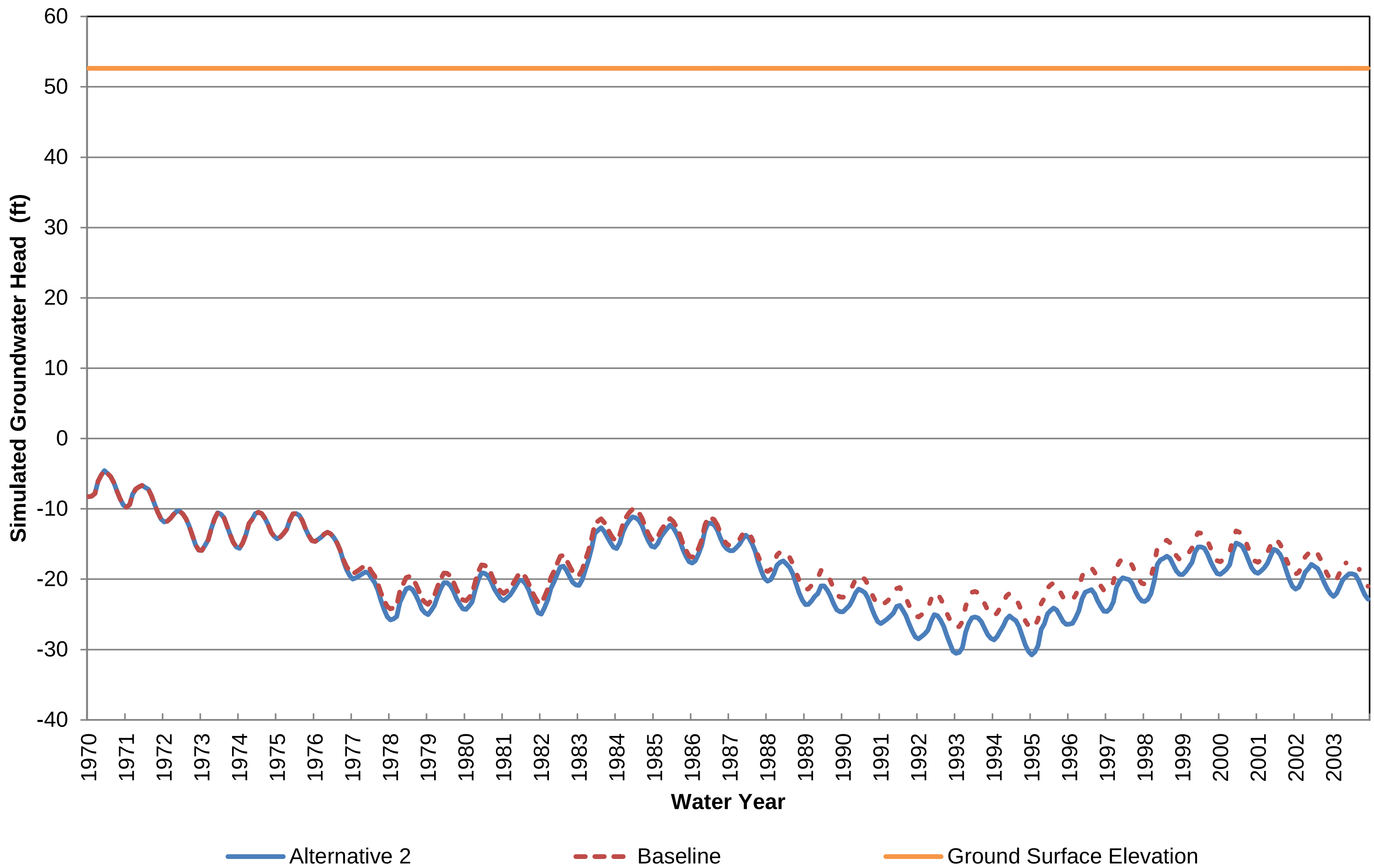


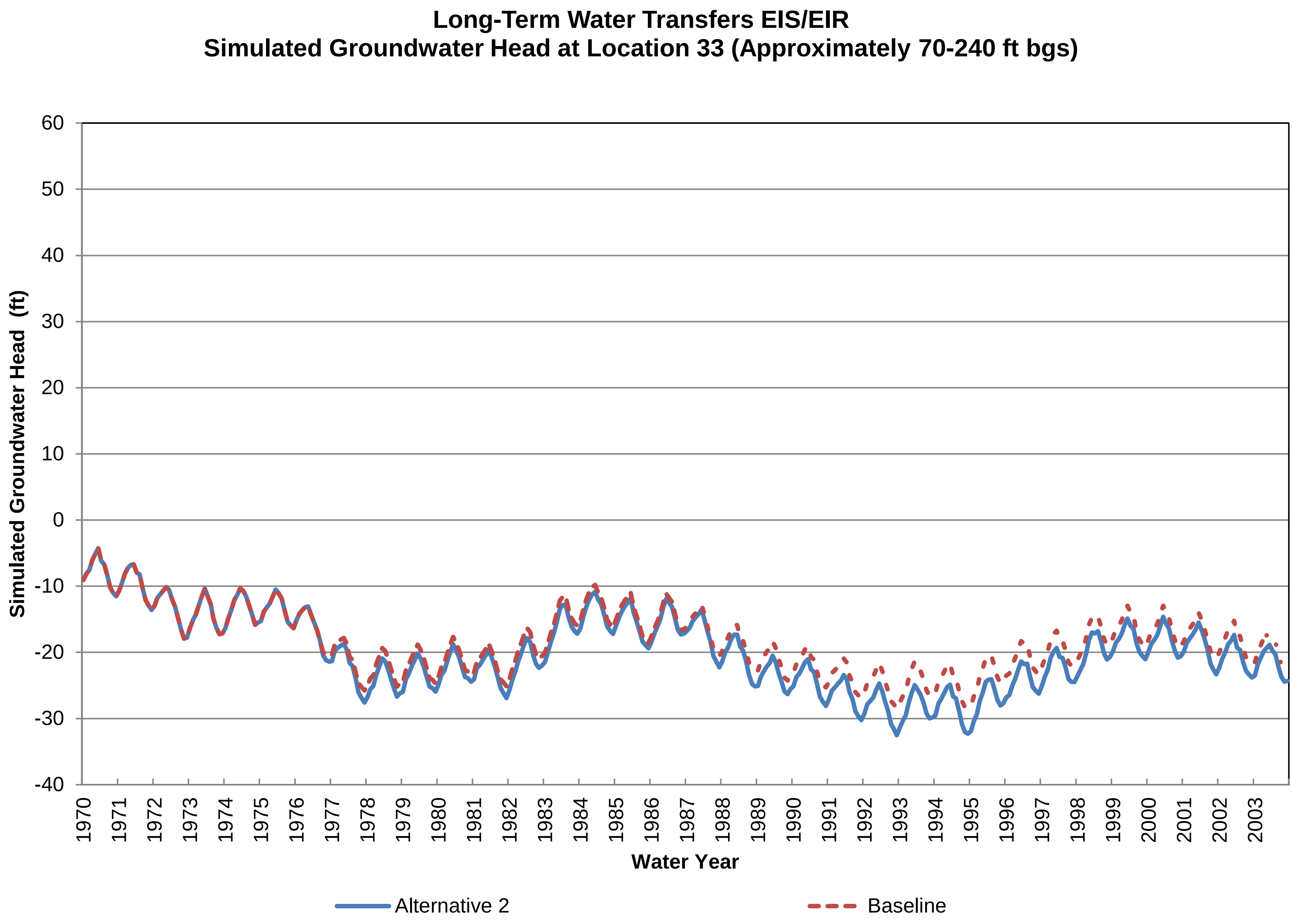

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 580-850 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

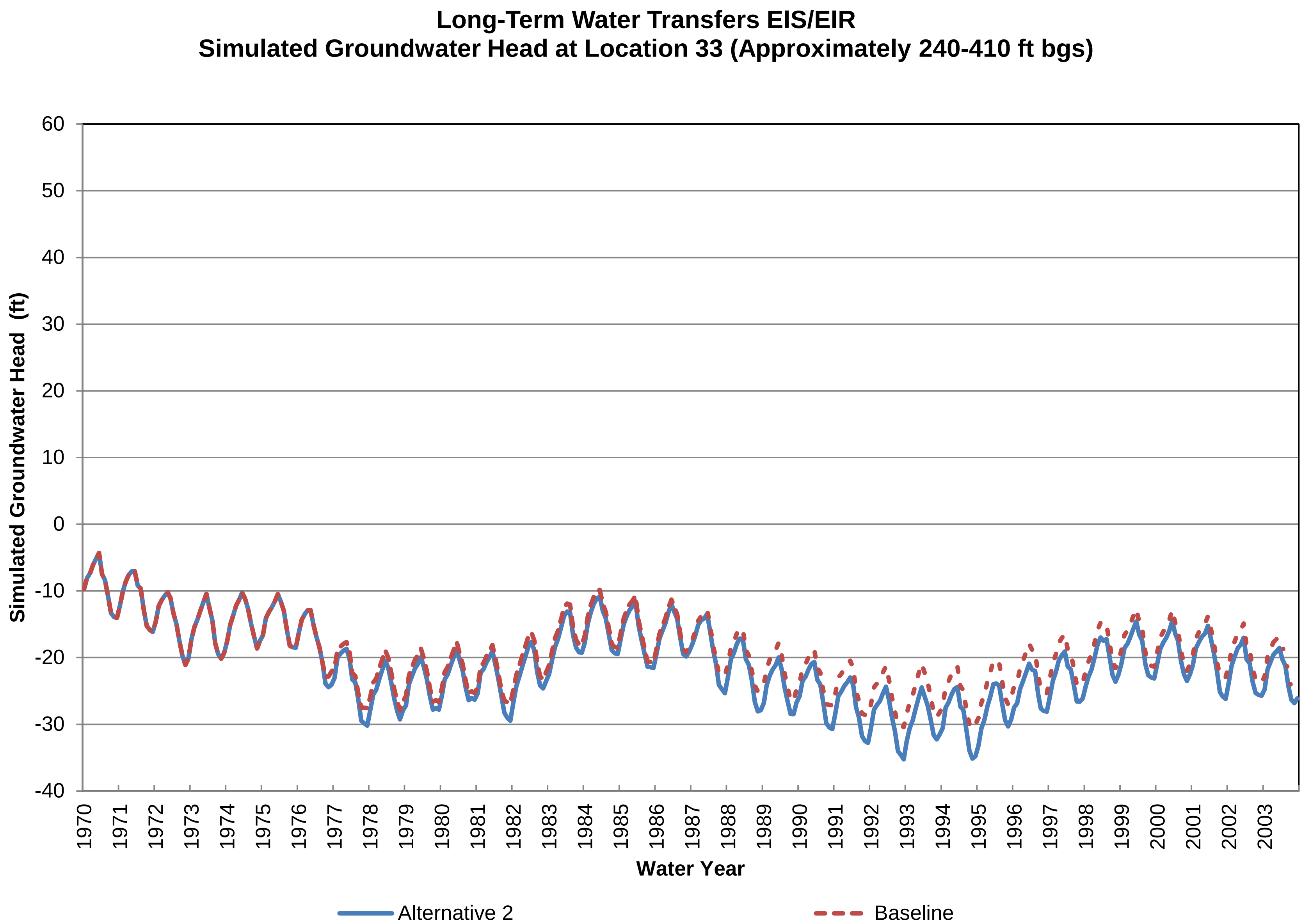

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 850-1140 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 1140-1560 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 33 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 70-240 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 240-410 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
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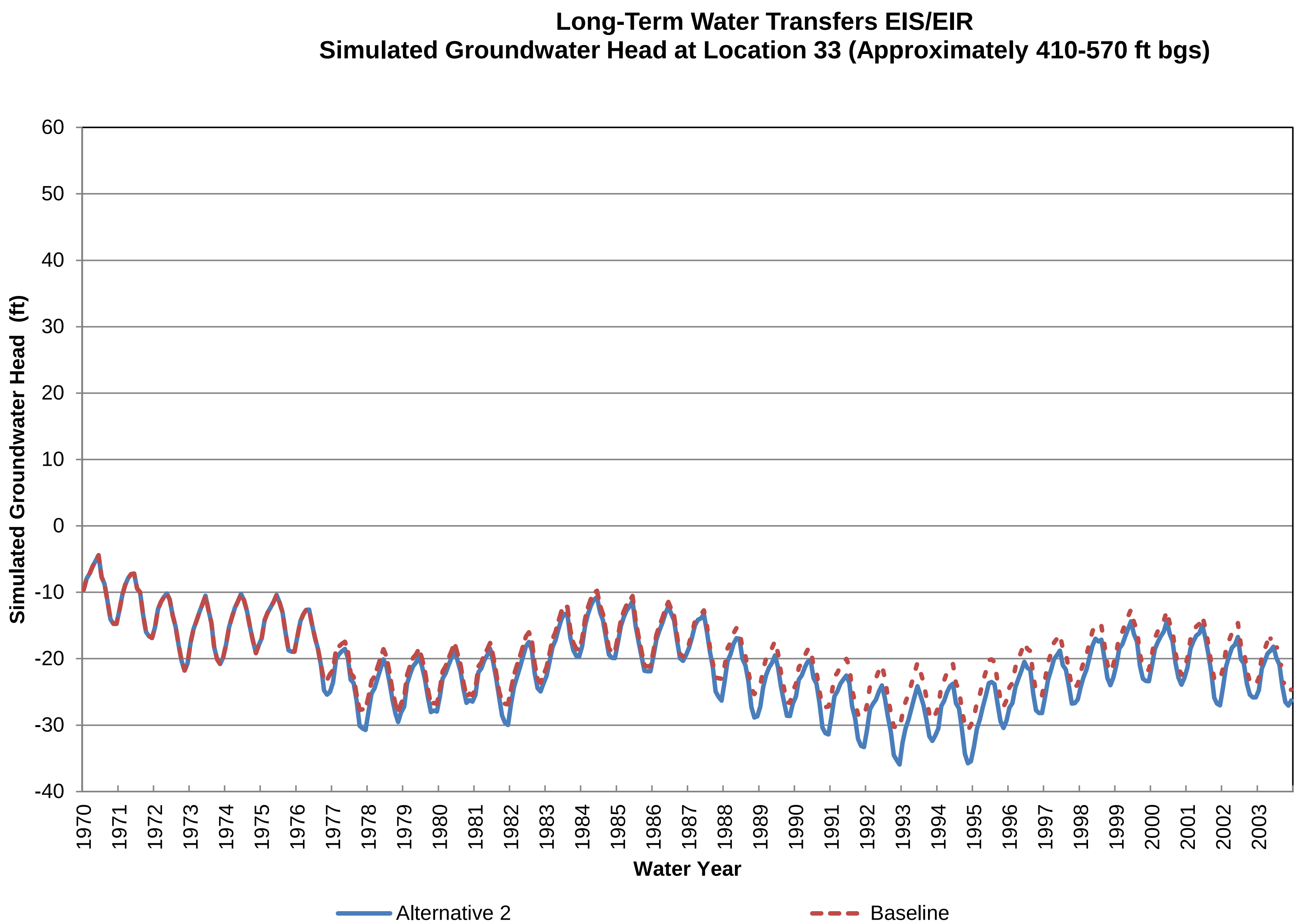
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 410-570 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
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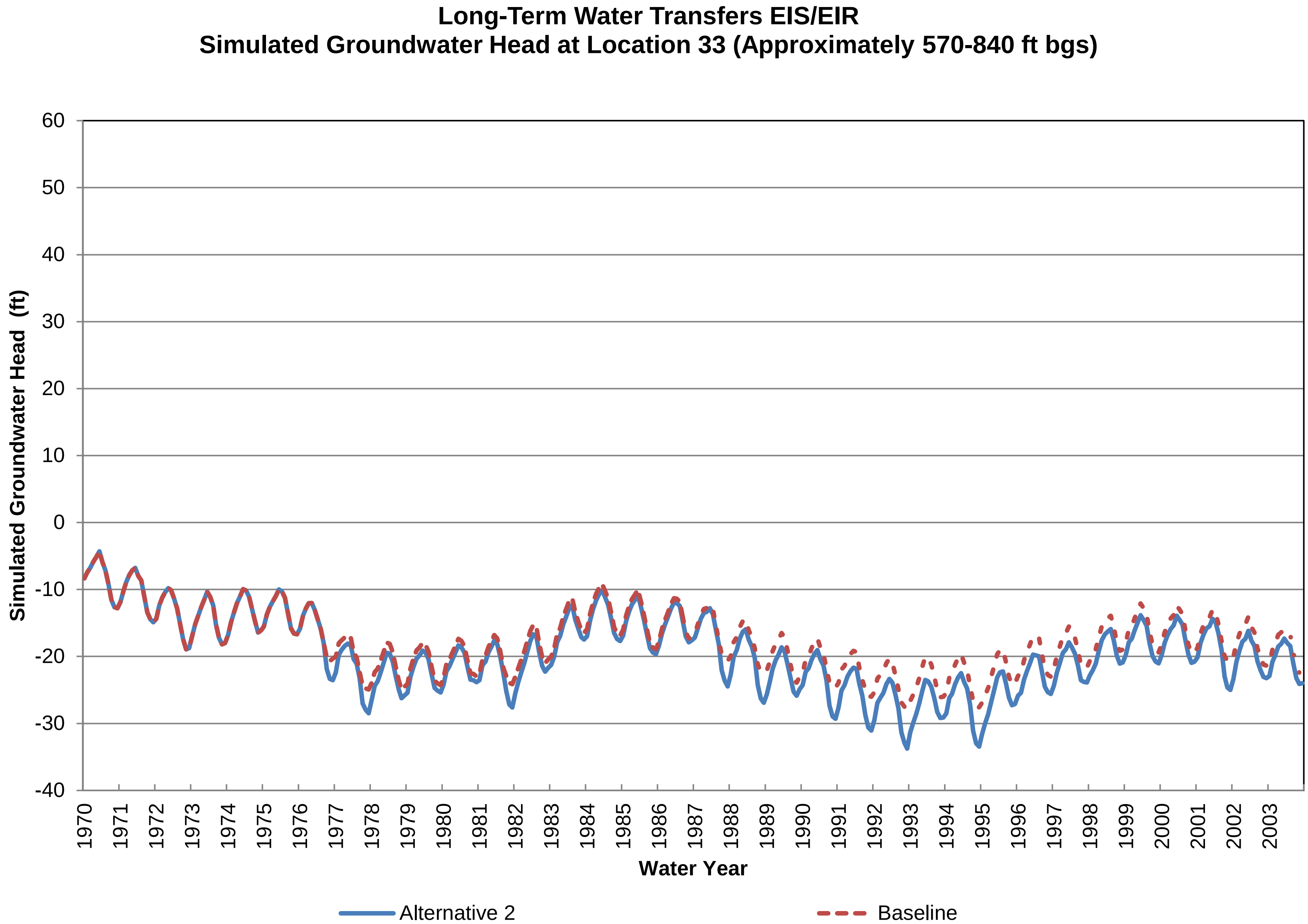
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 570-840 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
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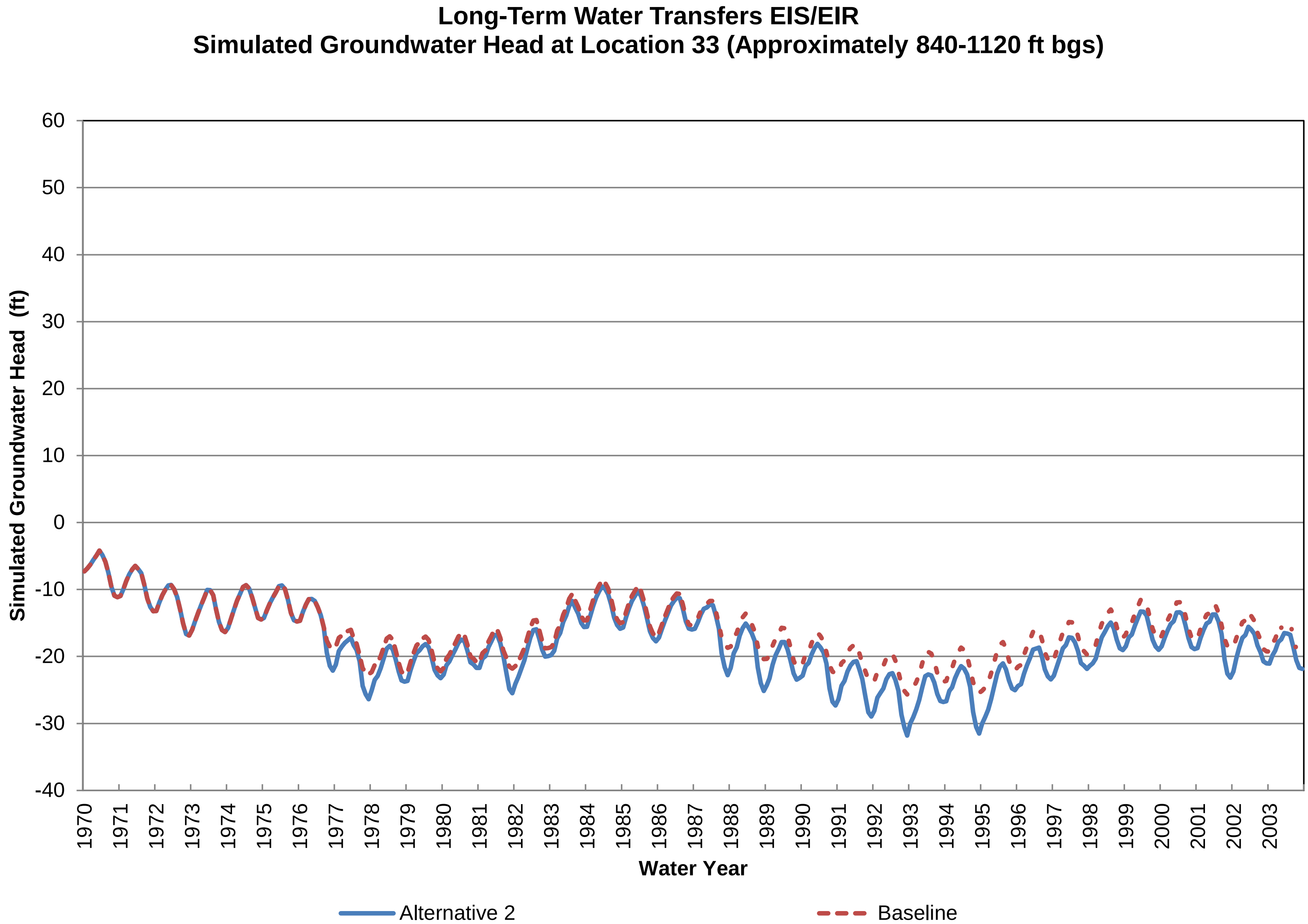
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 840-1120 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
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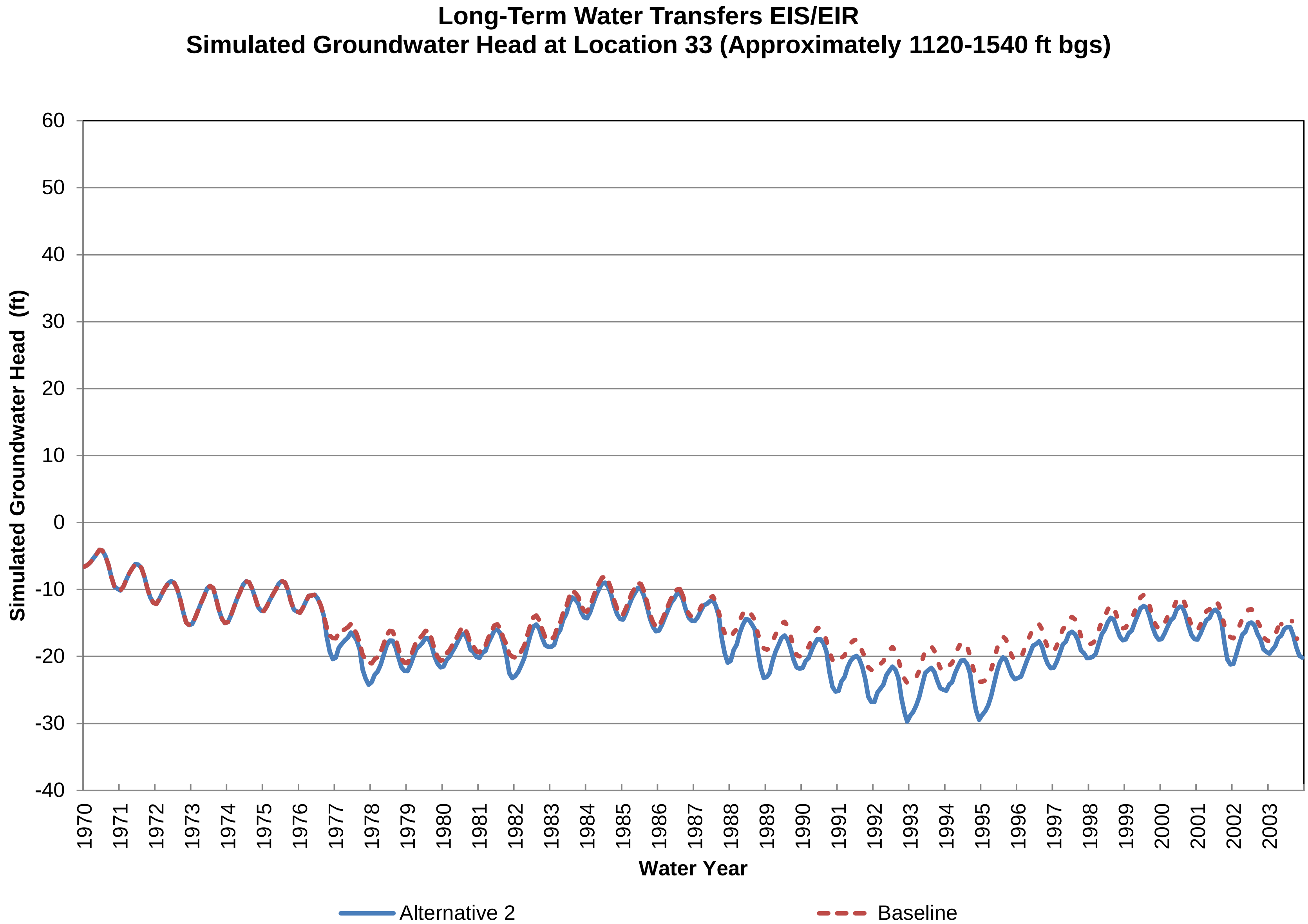
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 1120-1540 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
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1974
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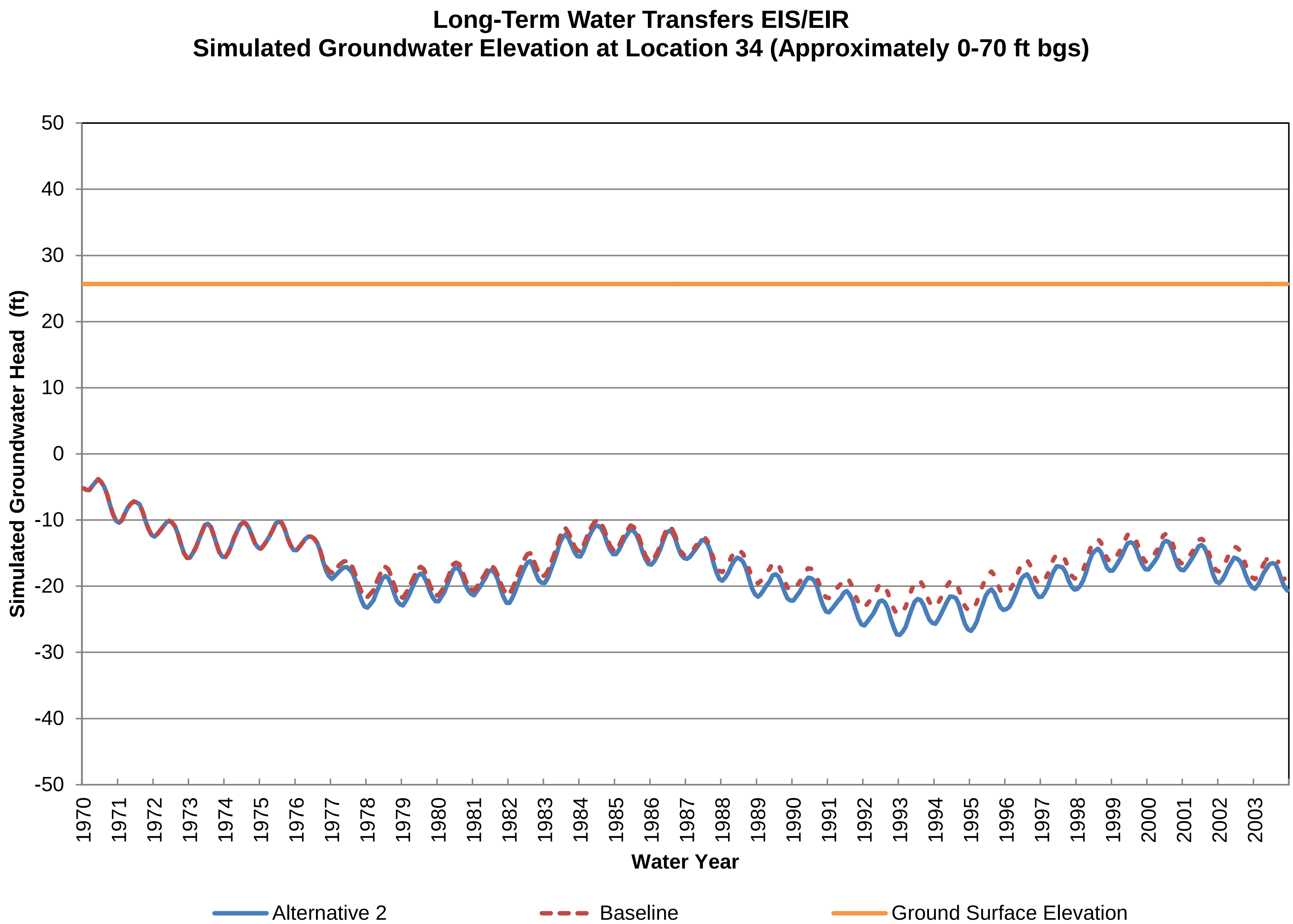
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 34 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
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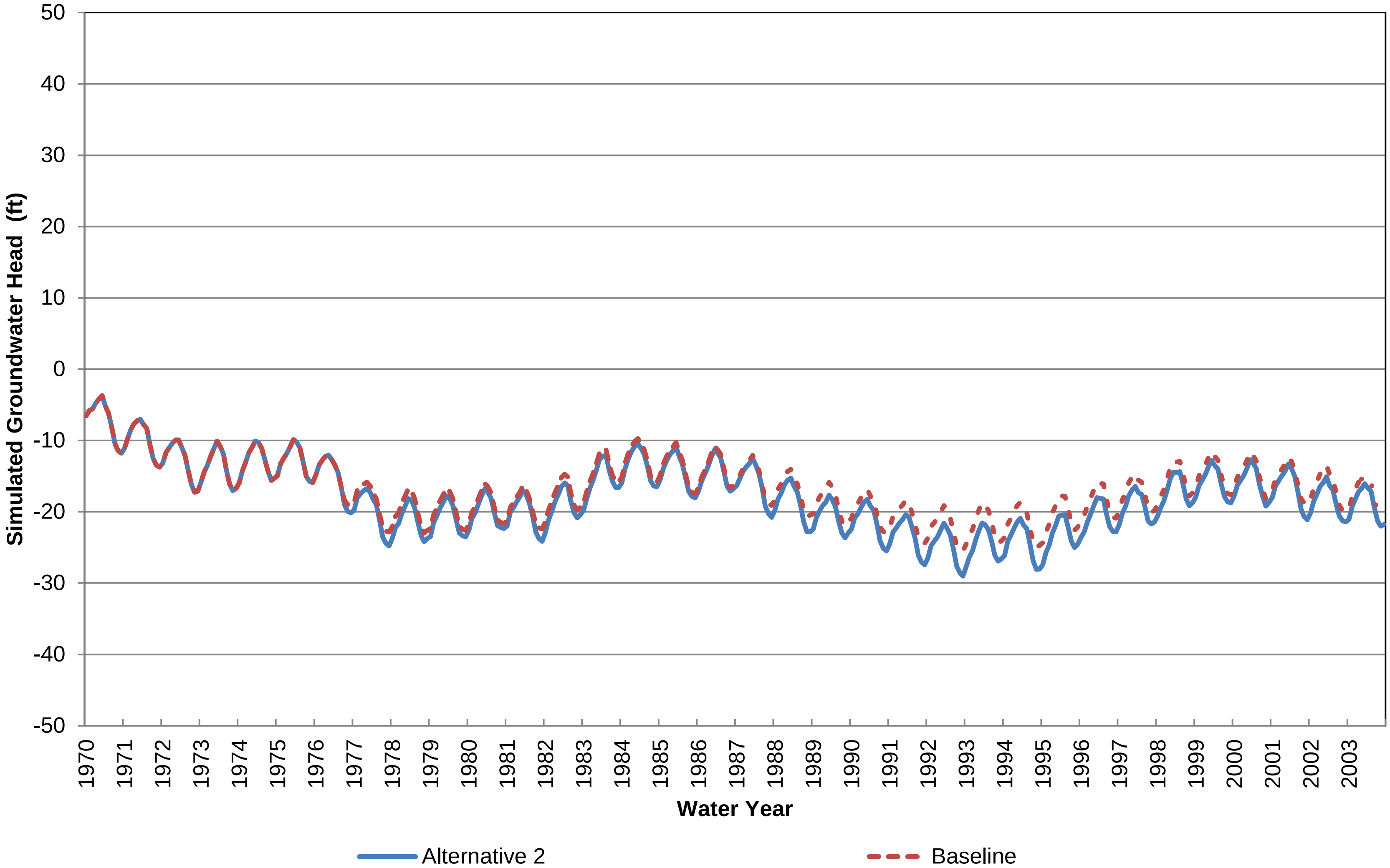
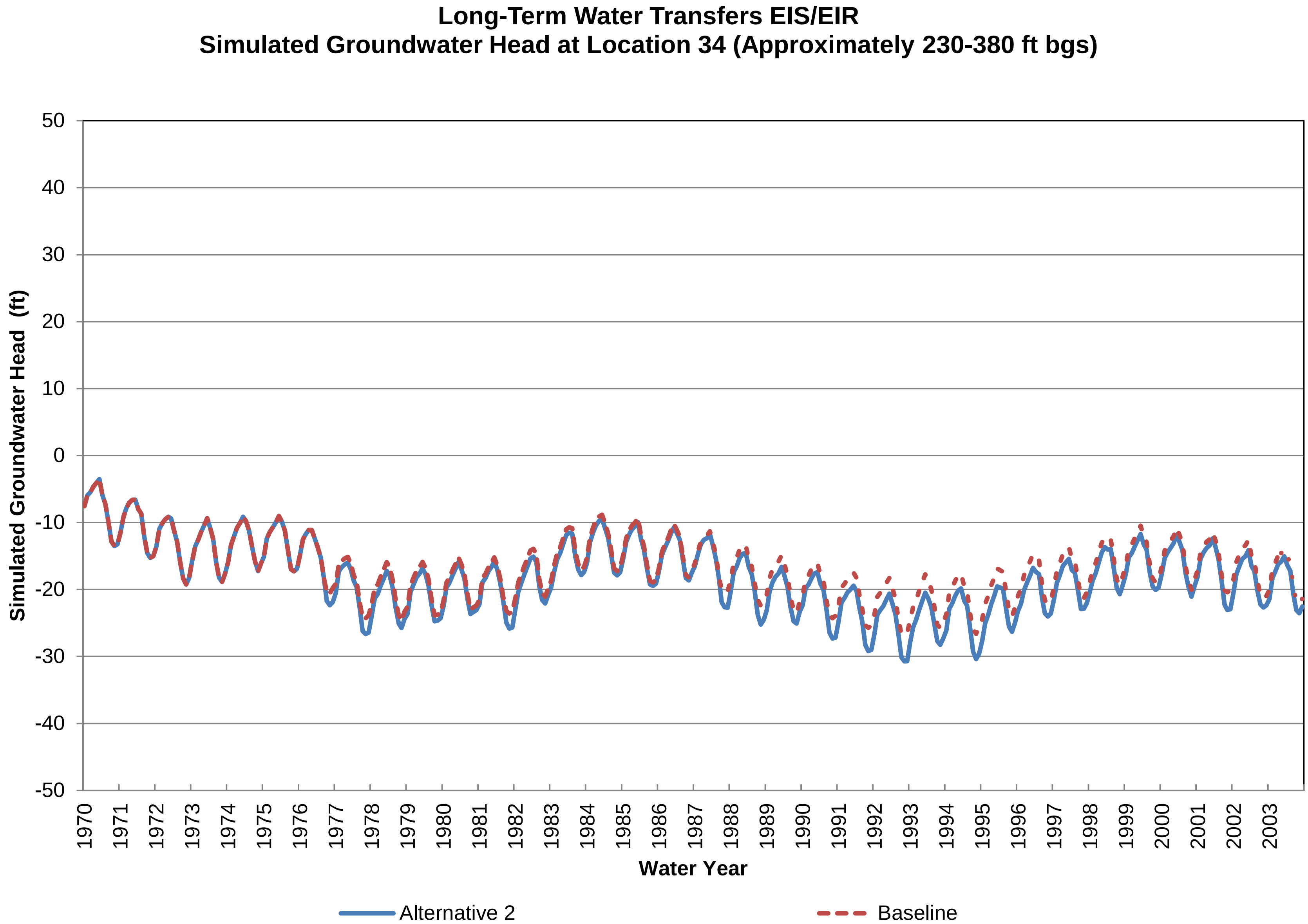
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 70-230 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 230-380 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
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1973
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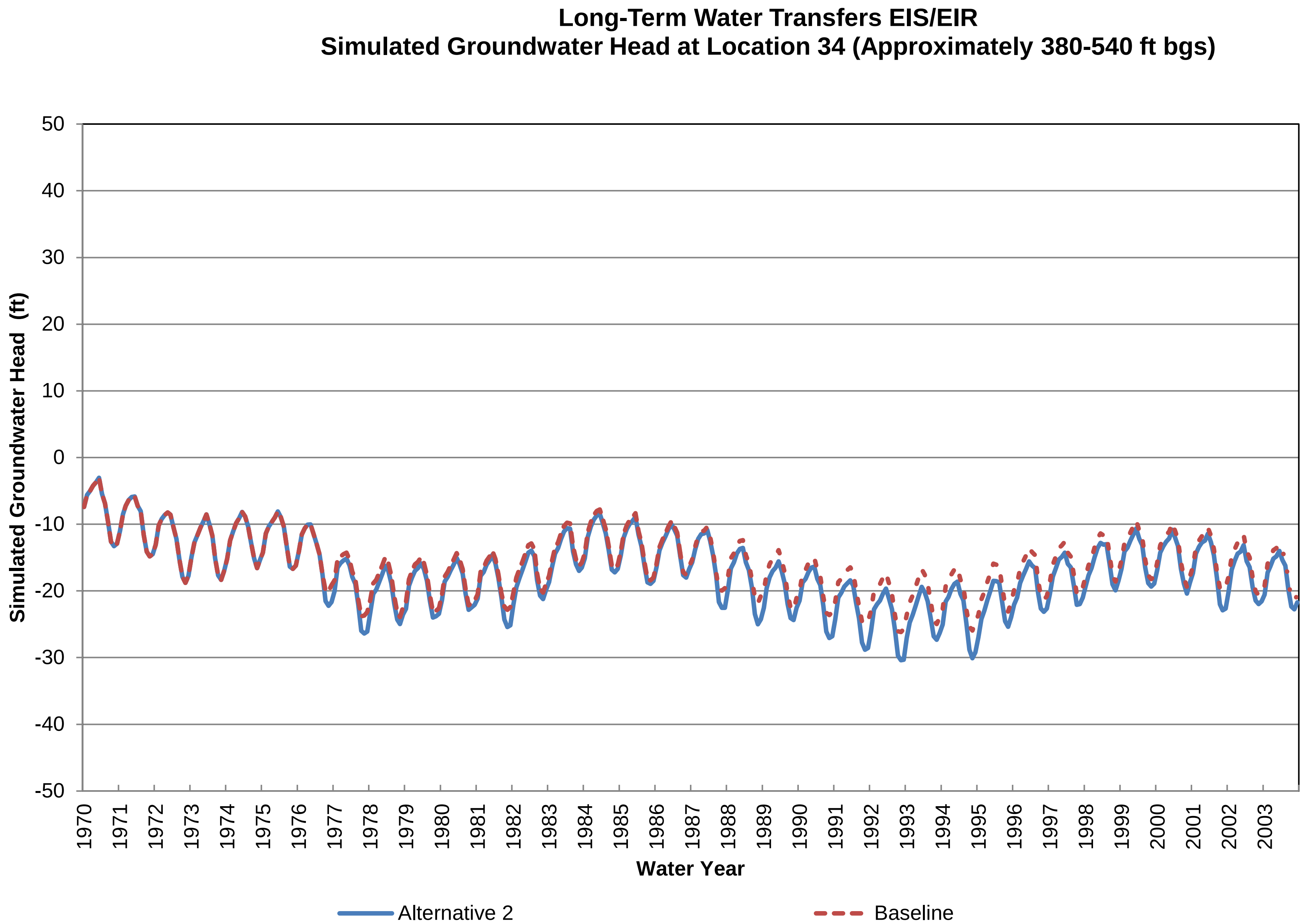
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 380-540 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
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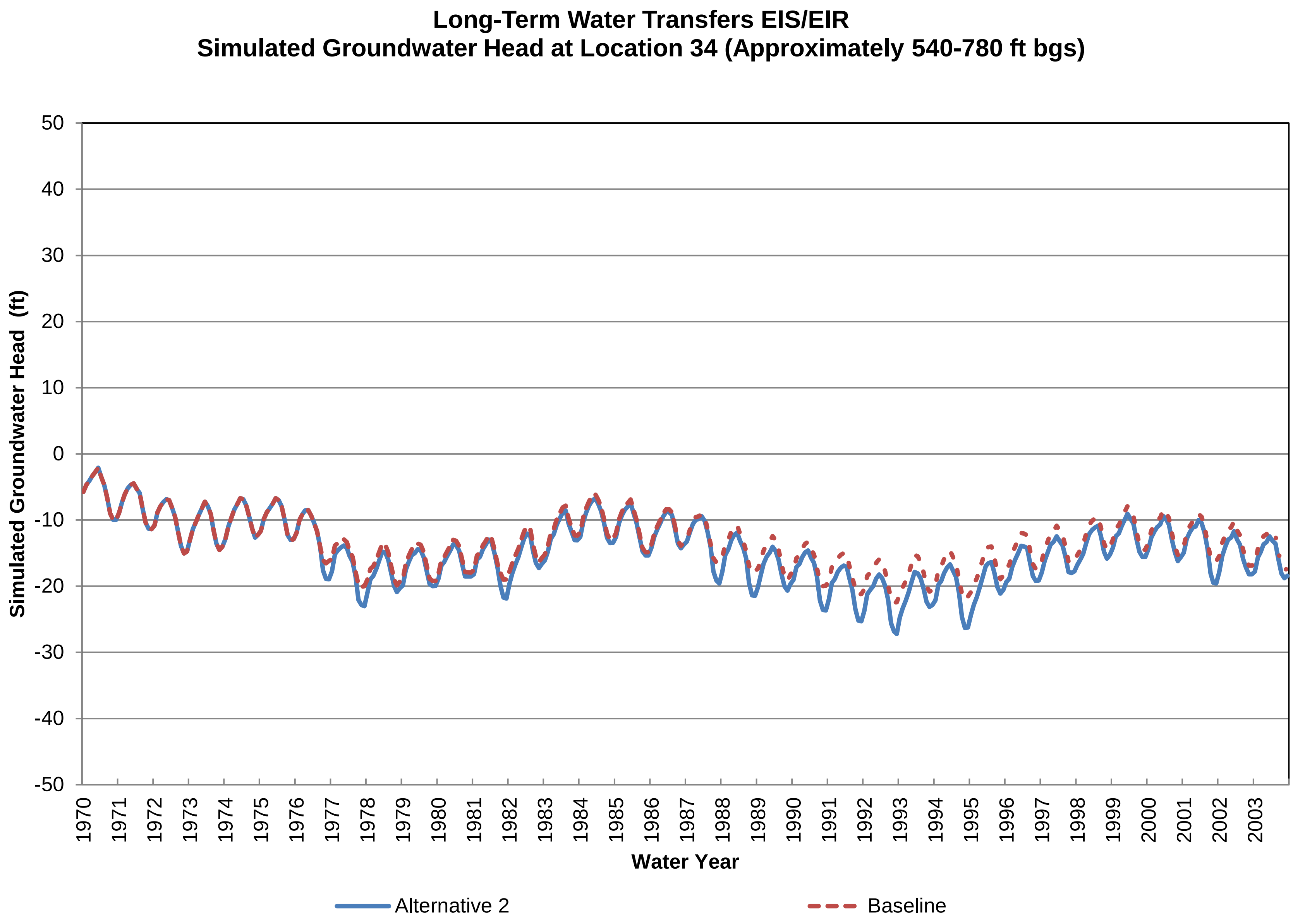
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 540-780 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
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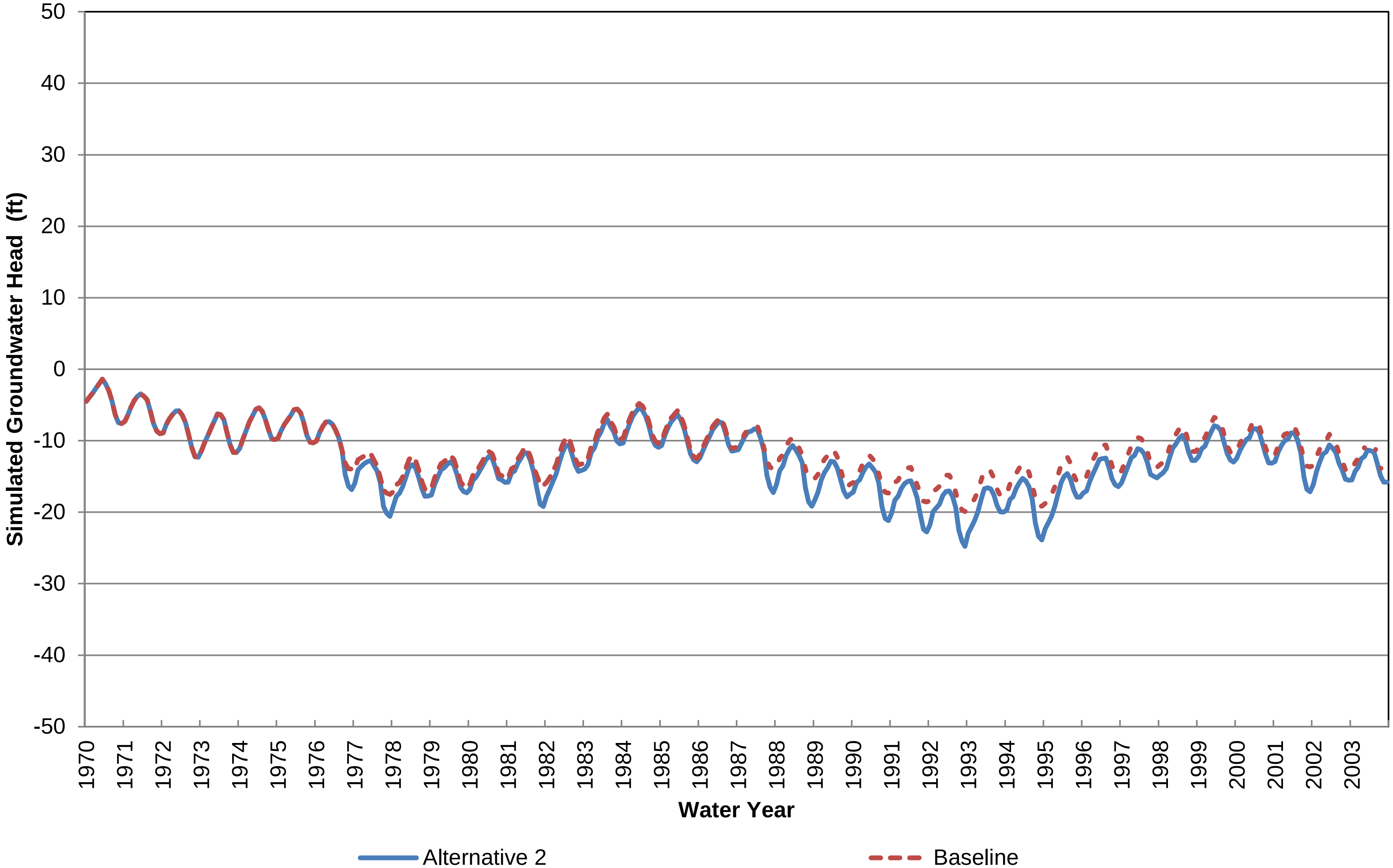
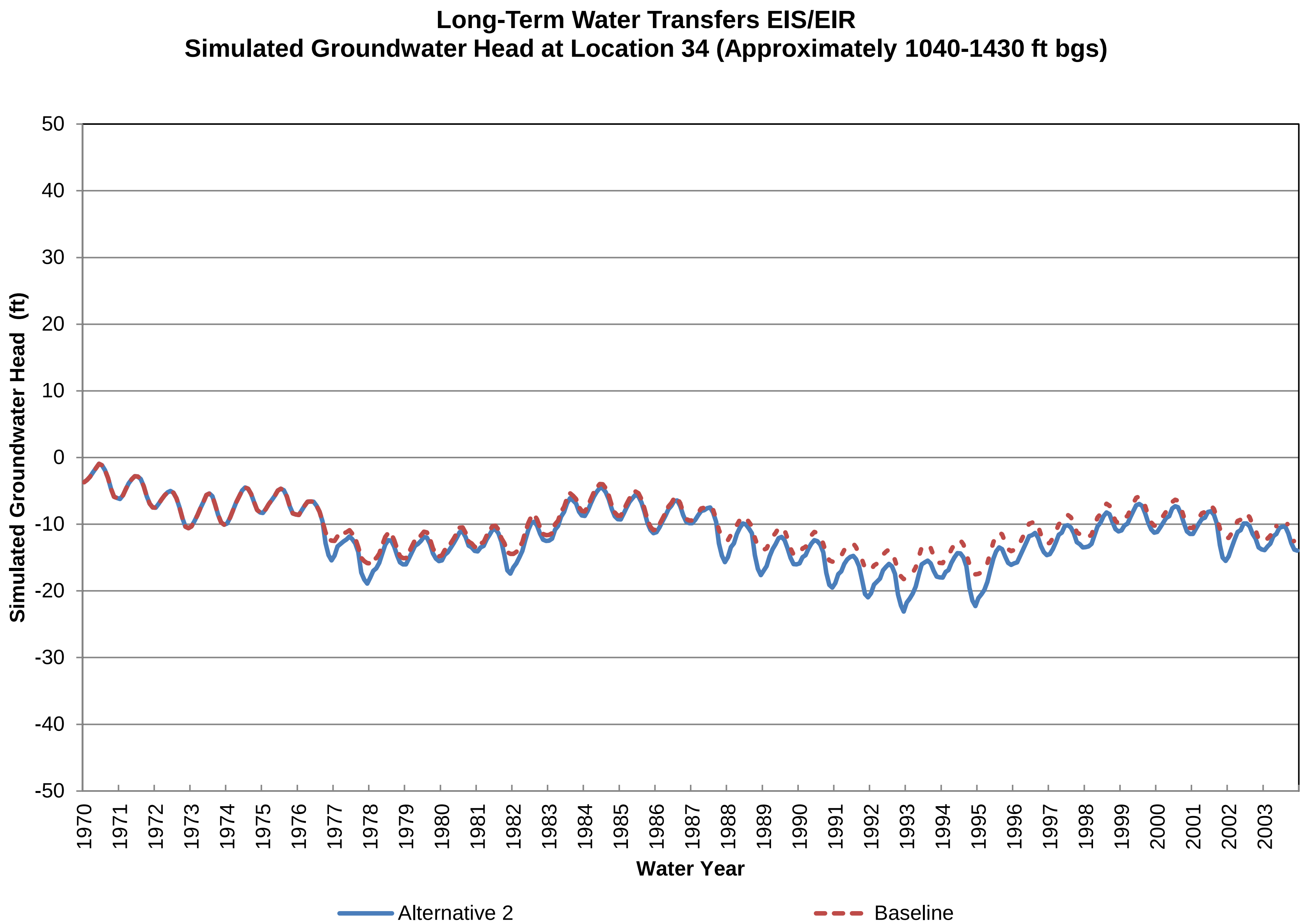
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 780-1040 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 1040-1430 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
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10
0
-10
-20
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-50
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Water Year
Alternative 2
Baseline

Appendix F

Air Quality Emission Calculations

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Table F-1. General Conformity Applicability Evaluation (Unmitigated Emissions)

County/ Nonattainment Area	Emissions (tons per year)							
	VOC	NOx	CO	SOx		PM10	PM2.5	
	Sacramento Metro[1,5]	Sacramento Metro[1,5]	Sacramento Area[2]	Sacramento[3,4]	Yuba City-Marysville[6]	Sacramento Co.	Sacramento[4]	Yuba City-Marysville[6]
Colusa	--	--	--	--	--	--	--	--
Glenn	--	--	--	--	--	--	--	--
Sacramento	2.1	71.9	5.6	0.010	--	0.2	0.2	--
Shasta	--	--	--	--	--	--	--	--
Solano	0.0	0.0	--	--	--	--	--	--
Sutter	2.3	19.5	--	--	3.1	--	--	0.8
Tehama	--	--	--	--	--	--	--	--
Yolo	0.7	7.9	--	--	--	--	--	--
Yuba	--	--	--	--	0.0	--	--	0.0
Total	5.1	99.3	5.6	0.010	3.1	0.2	0.2	0.8
Classification	Severe	Severe	Maintenance	PM2.5 Precursor	PM2.5 Precursor	Maintenance	Nonattainment	Nonattainment
De Minimis Threshold (tpy)	25	25	100	100	100	100	100	100
Exceed?	No	Yes	No	No	No	No	No	No

Note:

[1]The Sacramento Metro 8-hour O3 nonattainment area consists of Sacramento and Yolo Counties and parts of El Dorado, Placer, Solano, and Sutter Counties. Emissions occurring within the attainment area of these counties are excluded from the total emissions.

[2]The Sacramento Area CO maintenance area is based on the Census Bureau Urbanized Area and consists of parts of Placer, Sacramento, and Yolo Counties. The general conformity applicability evaluation is based on emissions that would occur within the entire county to be conservative.

[3]All counties are designated as attainment areas for SO2; however, since SO2 is a precursor to PM2.5, its emissions must be evaluated under general conformity.

[4]The 24-hour PM2.5 nonattainment area for Sacramento includes Sacramento County and parts of El Dorado, Placer, Solano, and Yolo Counties. The general conformity applicability analysis assumes that all emissions that could occur within each county would occur within the Sacramento nonattainment area to be conservative.

[5]VOC and NOx emissions are excluded from Sutter County for Cranmore Farms, Garden Highway Mutual Water Company, Gilsizer Slough Ranch, Pelger Mutual Water Company, Reclamation District 1004, and Tule Basin Farms because they are located in areas designated as attainment for the federal 8-hour O3 NAAQS.

[6]The Yuba City-Marysville PM2.5 nonattainment area contains all of Sutter County and a part of Yuba County.

Table F-2. Emissions Outside of 8-Hour Ozone Nonattainment Area (tons per year)

Water Agency	County	VOC	NOx
Cranmore Farms	Sutter	Electric	Electric
Garden Highway Mutual Water Company	Sutter	Electric	Electric
Gilsizer Slough Ranch	Sutter	0.7	8.8
Pelger Mutual Water Company	Sutter	0.1	1.2
Reclamation District 1004	Sutter	n/a	n/a
Tule Basin Farms	Sutter	0.3	9.4
Total		1.0	19.3

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-3. Daily VOC Emissions

Water Agency	Daily VOC Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									13.32		13.32
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.92				0.92
Pleasant Grove-Verona Mutual Water Company							33.08		Electric		33.08
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		27.07	3.98				n/a				31.05
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				22.78							22.78
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							9.62				9.62
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							3.70				3.70
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**28.61**	**3.98**	**22.78**	**0.00**	**0.00**	**47.32**	**0.00**	**13.32**	**0.00**	**116.02**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-4. Daily NOx Emissions

Water Agency	Daily NOx Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									147.70		147.70
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		29.38									29.38
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							17.49				17.49
Pleasant Grove-Verona Mutual Water Company							285.31		Electric		285.31
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		354.91	49.10				n/a				404.01
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				787.78							787.78
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							118.61				118.61
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							128.06				128.06
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**384.29**	**49.10**	**787.78**	**0.00**	**0.00**	**549.47**	**0.00**	**147.70**	**0.00**	**1,918.33**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-5. Daily CO Emissions

Water Agency	Daily CO Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									125.01		125.01
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		27.06									27.06
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							23.01				23.01
Pleasant Grove-Verona Mutual Water Company							125.64		Electric		125.64
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		118.57	10.58				n/a				129.15
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				61.21							61.21
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							25.56				25.56
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							9.95				9.95
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**145.63**	**10.58**	**61.21**	**0.00**	**0.00**	**184.16**	**0.00**	**125.01**	**0.00**	**526.59**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-6. Daily SOx Emissions

Water Agency	Daily SOx Emissions (lbs/day)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									25.40		25.40
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		9.63									9.63
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							5.73				5.73
Pleasant Grove-Verona Mutual Water Company							31.29		Electric		31.29
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		36.05	3.25				n/a				39.29
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.11							0.11
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							7.84				7.84
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**45.68**	**3.25**	**0.11**	**0.00**	**0.00**	**44.89**	**0.00**	**25.40**	**0.00**	**119.32**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-7. Daily PM10 Emissions

Water Agency	Daily PM10 Emissions (lbs/day)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.39		6.39
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.38				1.38
Pleasant Grove-Verona Mutual Water Company							8.13		Electric		8.13
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		6.37	0.52				n/a				6.90
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				1.93							1.93
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.86				1.86
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.31				0.31
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**7.92**	**0.52**	**1.93**	**0.00**	**0.00**	**11.68**	**0.00**	**6.39**	**0.00**	**28.43**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-8. Daily PM2.5 Emissions

Water Agency	Daily PM2.5 Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.39		6.39
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.38				1.38
Pleasant Grove-Verona Mutual Water Company							8.00		Electric		8.00
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		6.30	0.51				n/a				6.81
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				1.93							1.93
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.81				1.81
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.31				0.31
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**7.84**	**0.51**	**1.93**	**0.00**	**0.00**	**11.50**	**0.00**	**6.39**	**0.00**	**28.17**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-9. Annual VOC Emissions

Water Agency	Annual VOC Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.71		0.71
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.06				0.06
Pleasant Grove-Verona Mutual Water Company							2.26		Electric		2.26
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		1.03	0.15				n/a				1.18
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				2.08							2.08
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.71				0.71
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.27				0.27
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**1.14**	**0.15**	**2.08**	**0.00**	**0.00**	**3.31**	**0.00**	**0.71**	**0.00**	**7.39**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-10. Annual NOx Emissions

Water Agency	Annual NOx Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									7.89		7.89
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		2.14									2.14
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.16				1.16
Pleasant Grove-Verona Mutual Water Company							19.53		Electric		19.53
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		13.49	1.87				n/a				15.36
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				71.89							71.89
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							8.79				8.79
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							9.38				9.38
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**15.64**	**1.87**	**71.89**	**0.00**	**0.00**	**38.86**	**0.00**	**7.89**	**0.00**	**136.14**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-11. Annual CO Emissions

Water Agency	Annual CO Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.68		6.68
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.97									1.97
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.53				1.53
Pleasant Grove-Verona Mutual Water Company							8.60		Electric		8.60
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		4.51	0.40				n/a				4.91
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				5.59							5.59
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.89				1.89
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.73				0.73
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**6.48**	**0.40**	**5.59**	**0.00**	**0.00**	**12.75**	**0.00**	**6.68**	**0.00**	**31.89**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-12. Annual SOx Emissions

Water Agency	Annual SOx Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									1.36		1.36
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.70									0.70
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.38				0.38
Pleasant Grove-Verona Mutual Water Company							2.14		Electric		2.14
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		1.37	0.12				n/a				1.49
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.01							0.01
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.58				0.58
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.00				0.00
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**2.07**	**0.12**	**0.01**	**0.00**	**0.00**	**3.10**	**0.00**	**1.36**	**0.00**	**6.67**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-13. Annual PM10 Emissions

Water Agency	Annual PM10 Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.34		0.34
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.09				0.09
Pleasant Grove-Verona Mutual Water Company							0.56		Electric		0.56
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		0.24	0.02				n/a				0.26
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.18							0.18
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.14				0.14
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**0.36**	**0.02**	**0.18**	**0.00**	**0.00**	**0.81**	**0.00**	**0.34**	**0.00**	**1.70**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-14. Annual PM2.5 Emissions

Water Agency	Annual PM2.5 Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.34		0.34
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.09				0.09
Pleasant Grove-Verona Mutual Water Company							0.55		Electric		0.55
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		0.24	0.02				n/a				0.26
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.18							0.18
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.13				0.13
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**0.35**	**0.02**	**0.18**	**0.00**	**0.00**	**0.80**	**0.00**	**0.34**	**0.00**	**1.68**

Note:

Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Anderson-Cottonwood Irrigation District		Federal Attainment Status				
Transfer Volume	5,226	acre feet/year		*Shasta*	*Tehama*		
Location	Shasta	County	PM10	A	A	*Engines not subject to ATCM if remotely-located.*	
	Tehama	County	PM2.5	A	A		
			O3	A	A		

Table F-15. Anderson-Cottonwood Irrigation District Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Barney Street	Barney Street	Shasta	Electric	2012	200	n/a	5,500	85%	737	4,422	24	4,366
Crowley Gulch	Crowley Gulch	Shasta	Electric	2012	50	n/a	1,000	15%	134	804	24	4,366
						Total	**6,500**	**100%**	**871**	**5,226**	**48**	**8,733**
						Total (Shasta County)	**6,500**	**100%**	**871**	**5,226**	**48**	**8,733**
						Total (Tehama County)	**0**	**0**	**0**	**0**	**0**	**0**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Conaway Preservation Group	Federal Attainment Status			Peak Month		
Transfer Volume	35,000 acre feet/year	PM10	A	*Engines subject to ATCM.*	9,964	AF/month
Location	Yolo County	PM2.5	N		72,735	gallons/minute
		O3	N		74%	peak pump rate

Table F-16. Conaway Preservation Group Criteria Pollutant Emissions

		Well Location			Power Rating	Emission	Pump Rate		Transfer Volume		Operation		Fuel Consumption	Emission Factors (g/bhp-hr)						Daily Emissions (lbs/day)						Annual Emissions (tons per year)					
Description	Well	(County)	Fuel Type	Model Year	(hp)	Tier	(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)	(gal/yr)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
ConawayPG12W-1	12W-1	Yolo	Electric		250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG12W-2	12W-2	Yolo	Electric	TBD	250	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG12W-5	12W-5	Yolo	Electric	TBD	250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG13W-3	13W-3	Yolo	Electric		200	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG16W-2	16W-2	Yolo	Diesel	2005	227	T2	1,600	2%	163	573	18	1,944	24,751	0.2	4.7	2.6	0.93	0.15	0.15	2.24	42.60	23.78	8.47	1.36	1.36	0.12	2.28	1.27	0.45	0.07	0.07
ConawayPG17W-3	17W-3	Yolo	Diesel	2005	227	T2	1,700	2%	173	608	18	1,944	24,751	0.2	4.7	2.6	0.93	0.15	0.15	2.24	42.60	23.78	8.47	1.36	1.36	0.12	2.28	1.27	0.45	0.07	0.07
ConawayPG1W-3	1W-3	Yolo	Electric		250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG20W-1	20W-1	Yolo	Electric		100	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG21W-1	21W-1	Yolo	Electric	TBD	250	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG21W-3	21W-3	Yolo	Electric		100	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG24W-1	24W-1	Yolo	Electric	TBD	250	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG31W-1	31W-1	Yolo	Electric		100	n/a	2,300	2%	234	823	18	1,944	n/a																		
ConawayPG32NW-1	32NW-1	Yolo	Electric		100	n/a	3,300	3%	336	1,181	18	1,944	n/a																		
ConawayPG32NW-2	32NW-2	Yolo	Electric		250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG32W-3	32W-3	Yolo	Electric		250	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG33NW-1	33NW-1	Yolo	Electric		100	n/a	2,300	2%	234	823	18	1,944	n/a																		
ConawayPG33NW-2	33NW-2	Yolo	Electric		100	n/a	2,200	2%	224	787	18	1,944	n/a																		
ConawayPG33NW-3	33NW-3	Yolo	Electric		100	n/a	2,100	2%	214	752	18	1,944	n/a																		
ConawayPG33NW-4	33NW-4	Yolo	Electric		100	n/a	3,400	3%	346	1,217	18	1,944	n/a																		
ConawayPG33NW-5	33NW-5	Yolo	Electric		100	n/a	1,800	2%	183	644	18	1,944	n/a																		
ConawayPG33NW-6	33NW-6	Yolo	Electric		100	n/a	2,100	2%	214	752	18	1,944	n/a																		
ConawayPG33NW-7	33NW-7	Yolo	Electric		100	n/a	1,400	1%	143	501	18	1,944	n/a																		
ConawayPG33NW-8	33NW-8	Yolo	Electric		100	n/a	2,200	2%	224	787	18	1,944	n/a																		
ConawayPG5W-2	5W-2	Yolo	Electric		250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG5W-3	5W-3	Yolo	Electric		250	n/a	2,700	3%	275	966	18	1,944	n/a																		
ConawayPG6W-2	6W-2	Yolo	Electric		100	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG7W-1	7W-1	Yolo	Electric		75	n/a	1,800	2%	183	644	18	1,944	n/a																		
ConawayPG7W-2	7W-2	Yolo	Electric		250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG7W-4	7W-4	Yolo	Electric		200	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG7W-4S	7W-4S	Yolo	Electric		200	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG8W-2	8W-2	Yolo	Diesel	2002	227	T1	2,300	2%	234	823	18	1,944	24,751	1.0	6.9	8.5	0.93	0.40	0.40	8.83	62.50	77.45	8.47	3.67	3.67	0.47	3.34	4.14	0.45	0.20	0.20
ConawayPG8W-2N	8W-2N	Yolo	Electric		200	n/a	1,500	2%	153	537	18	1,944	n/a																		
ConawayPGOW-1	OW-1	Yolo	Electric		100	n/a	2,600	3%	265	930	18	1,944	n/a																		
ConawayPGOW-2	OW-2	Yolo	Electric		100	n/a	3,400	3%	346	1,217	18	1,944	n/a																		
ConawayPGOW-3	OW-3	Yolo	Electric		125	n/a	3,400	3%	346	1,217	18	1,944	n/a																		
ConawayPGOW-4	OW-4	Yolo	Electric		100	n/a	1,700	2%	173	608	18	1,944	n/a																		
ConawayPGOW-5	OW-5	Yolo	Electric		125	n/a	2,000	2%	204	716	18	1,944	n/a																		
						Total	**97,800**	**100%**	**9,964**	**35,000**	**673**	**71,912**	**74,253**							**13.32**	**147.70**	**125.01**	**25.40**	**6.39**	**6.39**	**0.71**	**7.89**	**6.68**	**1.36**	**0.34**	**0.34**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend
- Assumed to be electric (similar to 32W-2)
- Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type
- Emission factor based on NMHC+NOx emission standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Cordua Irrigation District		Federal Attainment Status		
Transfer Volume	12,000 acre feet/year		PM10	A	*Engines subject to ATCM.*
Location	Yuba County		PM2.5	N	
			O3	A	

Table F-17. Cordua Irrigation District Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
COR1	COR1	Yuba	Electric		60	n/a	1,000	3%	129	323	23	1,757
COR2	COR2	Yuba	Electric		50	n/a	900	2%	116	291	23	1,757
COR3	COR3	Yuba	Electric		60	n/a	1,000	3%	129	323	23	1,757
COR4	COR4	Yuba	Electric		75	n/a	1,400	4%	181	453	23	1,757
COR5	COR5	Yuba	Electric		75	n/a	1,300	4%	168	420	23	1,757
COR8	COR8	Yuba	Electric		75	n/a	2,000	5%	259	647	23	1,757
COR9	COR9	Yuba	Electric		60	n/a	1,000	3%	129	323	23	1,757
COR10	COR10	Yuba	Electric		75	n/a	1,300	4%	168	420	23	1,757
COR11	COR11	Yuba	Electric		60	n/a	1,800	5%	233	582	23	1,757
COR12	COR12	Yuba	Electric		100	n/a	1,400	4%	181	453	23	1,757
COR13	COR13	Yuba	Electric		100	n/a	2,100	6%	272	679	23	1,757
COR14	COR14	Yuba	Electric		75	n/a	1,800	5%	233	582	23	1,757
COR18	COR18	Yuba	Electric	2013	100	n/a	2,000	5%	259	647	23	1,757
COR20	COR20	Yuba	Electric	2013	125	n/a	2,150	6%	278	695	23	1,757
COR21	COR21	Yuba	Electric		75	n/a	1,250	3%	162	404	23	1,757
COR22	COR22	Yuba	Electric		60	n/a	1,750	5%	226	566	23	1,757
COR23	COR23	Yuba	Electric		75	n/a	1,150	3%	149	372	23	1,757
COR25	COR25	Yuba	Electric	2013	75	n/a	1,600	4%	207	518	23	1,757
COR26	COR26	Yuba	Electric	2013	100	n/a	1,800	5%	233	582	23	1,757
COR27	COR27	Yuba	Electric		100	n/a	1,700	5%	220	550	23	1,757
COR16	COR16	Yuba	Electric		100	n/a	2,300	6%	298	744	23	1,757
COR17	COR17	Yuba	Electric		100	n/a	2,400	6%	311	776	23	1,757
COR24	COR24	Yuba	Electric		100	n/a	2,000	5%	259	647	23	1,757
						Total	**37,100**	**100%**	**4,800**	**12,000**	**531**	**40,402**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Cranmore Farms		Federal Attainment Status		
Transfer Volume	8,000 acre feet/year		PM10	A	*Engines subject to ATCM.*
Location	Sutter County		PM2.5	N	
			O3	N	

Table F-18. Cranmore Farms Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Cranmore Farms1	1	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
Cranmore Farms2	2	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
Cranmore Farms3	3	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
Cranmore Farms4	4	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
Cranmore Farms5	5	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
Cranmore Farms6	6	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
						Total	**18,000**	**100%**	**2,056**	**8,000**	**122**	**14,482**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Eastside Mutual Water Company	Federal Attainment Status			Peak Month	
Transfer Volume	2,230 acre feet/year	PM10	A	*Engines not subject to ATCM if remotely-located.*	465	AF/month
Location	Colusa County	PM2.5	A		3,396	gallons/minute
		O3	A		89%	peak pump rate

Table F-19. Eastside Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (gal/yr)
7631T	7631T	Colusa	Diesel	2006	215	T3	3,800	100%	465	2,230	22	3,187	38,441
						n/a	**3,800**	**100%**	**465**	**2,230**	**22**	**3,187**	**38,441**

Description	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
7631T	0.1	2.8	2.6	0.93	0.15	0.15	1.55	29.38	27.06	9.63	1.55	1.55	0.11	2.14	1.97	0.70	0.11	0.11
							1.55	**29.38**	**27.06**	**9.63**	**1.55**	**1.55**	**0.11**	**2.14**	**1.97**	**0.70**	**0.11**	**0.11**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend
Emission factor based on NMHC+NOx emission standard

Conversion Factors
1 lb = 453.6 g
1 ton = 2,000 lbs
1 month = 30.4 days
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Glenn-Colusa Irrigation District	
Transfer Volume	25,000	acre feet/year
Location	Glenn	County
	Colusa	County

Federal Attainment Status

	Glenn	Colusa
PM10	A	A
PM2.5	A	A
O3	A	A

Engines not subject to ATCM if remotely-located.

Table F-20. Glenn-Colusa Irrigation District Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
GCID 1	GCID 1	Glenn	Electric		110	n/a	3,305	10%	437	2,622	24	4,309
GCID 2	GCID 2	Glenn	Electric		110	n/a	3,305	10%	437	2,622	24	4,309
GCID 3	GCID 3	Glenn	Electric		110	n/a	3,305	10%	437	2,622	24	4,309
GCID 4	GCID 4	Glenn	Electric		110	n/a	3,305	10%	437	2,622	24	4,309
GCID 5	GCID 5	Glenn	Electric		110	n/a	2,605	8%	345	2,067	24	4,309
GCID X1	GCID X1	Glenn	Electric		110	n/a	2,389	8%	316	1,896	24	4,309
GCID X2	GCID X2	Glenn	Electric		110	n/a	3,305	10%	437	2,622	24	4,309
GCID X3	GCID X3	Glenn	Electric		110	n/a	2,605	8%	345	2,067	24	4,309
GCID X4	GCID X4	Glenn	Electric		110	n/a	2,389	8%	316	1,896	24	4,309
GCID X5	GCID X5	Glenn	Electric		110	n/a	2,605	8%	345	2,067	24	4,309
Test Hole 7	Test Hole 7	Glenn	Electric		110	n/a	2,389	8%	316	1,896	24	4,309
						Total	**31,507**	**100%**	**4,167**	**25,000**	**260**	**47,402**
						Total (Glenn County)	**31,507**	**100%**	**4,167**	**25,000**	**260**	**47,402**
						Total (Colusa County)	**0**	**0%**	**0**	**0**	**0**	**0**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

(purple)	Assumed to be electric (similar to other wells operated by water agency)
(green)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Natomas Central Mutual Water Company		Federal Attainment Status			
Transfer Volume	30,000 acre feet/year			*Sacramento*	*Sutter*	
Location	Sacramento County		PM10	M	A	*Engines subject to ATCM.*
	Sutter County		PM2.5	N	N	
			O3	N	N	

Table F-21. Natomas Central Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Natomas Central MWCWilley, Ed	Willey, Ed	Sacramento	Electric		250	n/a	5,500	2%	128	638	4	630
Natomas Central MWCOse, Mary-site 8, well 1	Ose, Mary-site 8, well 1	Sacramento	Electric		200	n/a	5,500	2%	128	638	4	630
Natomas Central MWCOse, Mary-site 9, well 2	Ose, Mary-site 9, well 2	Sacramento	Electric		150	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert-site 1 well 2	Leal, Robert-site 1 well 2	Sutter	Electric		100	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-1	DeWitt, Jack-1	Sacramento	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-2	DeWitt, Jack-2	Sacramento	Electric		80	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-3	DeWitt, Jack-3	Sacramento	Electric		60	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-4	DeWitt, Jack-4	Sacramento	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-5	DeWitt, Jack-5	Sacramento	Electric		20	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-6	DeWitt, Jack-6	Sacramento	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-7	DeWitt, Jack-7	Sutter	Electric		25	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-7	DeWitt, Jack-7	Sutter	Electric		25	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack--8	DeWitt, Jack--8	Sacramento	Electric		250	n/a	5,500	2%	128	638	4	630
Natomas Central MWCMorrison, Phil #2-site 5 well 14	Morrison, Phil #2-site 5 well 14	Sutter	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCBianchi, John- site 2, well 10	Bianchi, John- site 2, well 10	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Natomas Central MWCBianchi, John-site 2 well 11	Bianchi, John-site 2 well 11	Sutter	Electric		80	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLauppe and Sons	Lauppe and Sons	Sutter	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCWiley, Wane-site 7 , well 18	Wiley, Wane-site 7 , well 18	Sacramento	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-1 (rice box)	Leal, Robert L-1 (rice box)	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-3	Leal, Robert L-3	Sutter	Electric		50	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-4	Leal, Robert L-4	Sutter	Electric		110	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-5	Leal, Robert L-5	Sutter	Electric		110	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-6	Leal, Robert L-6	Sutter	Electric		110	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-7	Leal, Robert L-7	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-8	Leal, Robert L-8	Sutter	Electric		200	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-9	Leal, Robert L-9	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-2	Leal, Robert L-2	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert #1	Leal, Robert #1	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert #2	Leal, Robert #2	Sutter	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCSpangler, Dan-site 4 well 13	Spangler, Dan-site 4 well 13	Sutter	Electric		80	n/a	5,500	2%	128	638	4	630
Natomas Central MWCVestal, Sid	Vestal, Sid	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Natomas Central MWCVestal, Sid-1	Vestal, Sid-1	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Dewitt, Jack-9 Housley N	Dewitt, Jack-9 Housley N	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Dewitt, Jack-10 Housley	Dewitt, Jack-10 Housley	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Dewitt, Jack-11 Housley	Dewitt, Jack-11 Housley	Sutter	Electric		20	n/a	5,500	2%	128	638	4	630
Natomas Central MWCMorrison, Phil-#3 site 5 well 15	Morrison, Phil-#3 site 5 well 15	Sutter	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCMorrison, Phil-#4 site 5 well 16	Morrison, Phil-#4 site 5 well 16	Sutter	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Frazer	NBC-Frazer	Sutter	Electric		50	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Lucich North	NBC-Lucich North	Sutter	Electric		75	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC- Natomas Farm#1	NBC- Natomas Farm#1	Sacramento	Electric		60	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Cummings	NBC-Cummings	Sacramento	Electric		20	n/a	5,500	2%	128	638	4	630
Natomas Central MWCMorrison, Phillip-#5	Morrison, Phillip-#5	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Natomas Central MWCPerry, Joe	Perry, Joe	Sacramento	Electric		125	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Kismat-2	NBC-Kismat-2	Sacramento	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Kismat-3	NBC-Kismat-3	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Kismat-4	NBC-Kismat-4	Sacramento	Electric		110	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Sliva	NBC-Sliva	Sacramento	Electric		50	n/a	5,500	2%	128	638	4	630
						Total	**258,500**	100%	**6,000**	**30,000**	**195**	**29,623**
						Total (Sacramento County)	**93,500**	**36%**	**2,170**	**10,851**	**70**	**10,715**
						Total (Sutter County)	**165,000**	**64%**	**3,830**	**19,149**	**124**	**18,908**

Legend

(purple)	Assumed to be electric
(green)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Pelger Mutual Water Company	Federal Attainment Status			Peak Month
Transfer Volume	3,750 acre feet/year	PM10	A	*Engines subject to ATCM.*	860 AF/month
Location	Sutter County	PM2.5	N		6,281 gallons/minute
		O3	N		66% peak pump rate

Table F-22. Pelger Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (gal/yr)
Pelger MWCWell 1 Tucker	Well 1 Tucker	Sutter	Electric	0	110	n/a	3,100	33%	281	1,224	16	2,144	n/a
Pelger MWCWell 2 Flopet	Well 2 Flopet	Sutter	Diesel	2008	173	T3	2,100	22%	190	829	16	2,144	20,806
Pelger MWCWell 3 Klein	Well 3 Klein	Sutter	Electric	0	110	n/a	4,300	45%	389	1,697	16	2,144	n/a
						Total	**9,500**	**100%**	**860**	**3,750**	**49**	**6,431**	**20,806**

Description	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Pelger MWCWell 1 Tucker																		
Pelger MWCWell 2 Flopet	0.1	2.8	3.7	0.93	0.22	0.22	0.92	17.49	23.01	5.73	1.38	1.38	0.06	1.16	1.53	0.38	0.09	0.09
Pelger MWCWell 3 Klein																		
Total							**0.92**	**17.49**	**23.01**	**5.73**	**1.38**	**1.38**	**0.06**	**1.16**	**1.53**	**0.38**	**0.09**	**0.09**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend
(green) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
(blue) Emission factor based on NMHC+NOx emission standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Pleasant Grove-Verona Mutual Water Company	Federal Attainment Status				Peak Month
Transfer Volume	18,000 acre feet/year		*Sutter*	*Yolo*		4,000 AF/month
Location	Sutter County	PM10	A	A	*Engines subject to ATCM.*	29,198 gallons/minute
	Yolo County	PM2.5	N	N		37% peak pump rate
		O3	N	N		

Table F-23. Pleasant Grove-Verona Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate		Transfer Volume		Operation		Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr)						Daily Emissions (lbs/day)						Annual Emissions (tons per year)					
							(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)		VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
PGVMWCWill-Lee 4A	Will-Lee 4A	Sutter	Diesel	2000	160	T1	1,500	2%	77	345	9	1,248	11,206	1.1	6.9	3.0	0.93	0.22	0.21	3.67	22.09	9.75	2.99	0.71	0.69	0.25	1.51	0.67	0.20	0.05	0.05
PGVMWCRiver Ranch #19	River Ranch #19	Sutter	Diesel	1995	200	T0	2,500	3%	128	575	9	1,248	14,008	1.1	14.1	3.0	0.93	0.15	0.15	4.59	56.55	12.19	3.74	0.60	0.59	0.31	3.87	0.83	0.26	0.04	0.04
PGVMWCMLF #1	MLF #1	Sutter	Electric		30	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCMLF #2	MLF #2	Sutter	Electric		250	n/a	5,000	6%	255	1,149	9	1,248	n/a																		
PGVMWCMLF Monster Well	MLF Monster Well	Sutter	Electric		60	n/a	3,100	4%	158	713	9	1,248	n/a																		
PGVMWCMLF #17/12	MLF #17/12	Sutter	Electric		50	n/a	1,500	2%	77	345	9	1,248	n/a																		
PGVMWCMLF #11	MLF #11	Sutter	Diesel	2004	250	T2	4,200	5%	215	966	9	1,248	17,510	0.2	4.7	2.6	0.93	0.15	0.15	1.24	23.52	13.13	4.67	0.75	0.75	0.08	1.61	0.90	0.32	0.05	0.05
PGVMWCMLF #13/15	MLF #13/15	Sutter	Electric		240	n/a	4,800	6%	245	1,103	9	1,248	n/a																		
PGVMWCMLF #16	MLF #16	Sutter	Electric		240	n/a	1,700	2%	87	391	9	1,248	n/a																		
PGVMWCWilley #1	Willey #1	Sutter	Diesel	2000	168	T1	3,000	4%	153	690	9	1,248	11,767	1.1	6.9	3.0	0.93	0.22	0.21	3.85	23.19	10.24	3.14	0.74	0.73	0.26	1.59	0.70	0.21	0.05	0.05
PGVMWCWilley #2	Willey #2	Sutter	Electric		250	n/a	3,000	4%	153	690	9	1,248	n/a																		
PGVMWCWilley #3	Willey #3	Sutter	Electric		250	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCWilley #4	Willey #4	Sutter	Diesel	1974	150	T0	3,000	4%	153	690	9	1,248	10,506	1.1	14.1	3.0	0.93	0.22	0.21	3.44	42.41	9.14	2.80	0.66	0.65	0.24	2.90	0.63	0.19	0.05	0.04
PGVMWCScheidel&Osterli #18A	Scheidel&Osterli #18A	Sutter	Electric	TBD	250	n/a	2,500	3%	128	575	9	1,248	n/a																		
PGVMWCWill-Lee 30	Will-Lee 30	Sutter	Diesel	2000	100	T1	1,500	2%	77	345	9	1,248	7,004	1.1	6.9	3.0	0.93	0.22	0.21	2.29	13.81	6.09	1.87	0.44	0.43	0.16	0.94	0.42	0.13	0.03	0.03
PGVMWCWill-Lee 31	Will-Lee 31	Sutter	Electric		250	n/a	2,500	3%	128	575	9	1,248	n/a																		
PGVMWCWill-Lee 32	Will-Lee 32	Sutter	Electric		250	n/a	2,500	3%	128	575	9	1,248	n/a																		
PGVMWCWill-Lee 33	Will-Lee 33	Sutter	Electric		250	n/a	2,500	3%	128	575	9	1,248	n/a																		
PGVMWCNicholas Sand Field Well	Nicholas Sand Field Well	Sutter	Diesel	2002	62.1	T1	2,000	3%	102	460	9	1,248	4,350	1.1	6.9	3.0	0.93	0.30	0.29	1.42	8.57	3.78	1.16	0.37	0.37	0.10	0.59	0.26	0.08	0.03	0.03
PGVMWCNicholas Filipino Camp #2	Nicholas Filipino Camp #2	Sutter	Electric		40	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCNicholas Filipino Camp South	Nicholas Filipino Camp South	Sutter	Diesel	2002	62.1	T1	2,000	3%	102	460	9	1,248	4,350	1.1	6.9	3.0	0.93	0.30	0.29	1.42	8.57	3.78	1.16	0.37	0.37	0.10	0.59	0.26	0.08	0.03	0.03
PGVMWCNicholas Johnston Field Well #2	Nicholas Johnston Field Well #2	Sutter	Electric		250	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCNicholas Johnston Well	Nicholas Johnston Well	Yolo	Electric		250	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCNicholas 72-acre Field South	Nicholas 72-acre Field South	Sutter	Diesel	2002	62.1	T1	2,000	3%	102	460	9	1,248	4,350	1.1	6.9	3.0	0.93	0.30	0.29	1.42	8.57	3.78	1.16	0.37	0.37	0.10	0.59	0.26	0.08	0.03	0.03
PGVMWCNicholas 72-Acre Field North	Nicholas 72-Acre Field North	Sutter	Electric		250	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCNicholas BBC Well	Nicholas BBC Well	Sutter	Electric		250	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCKelly 190 Field Well #2	Kelly 190 Field Well #2	Sutter	Electric		30	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCKelly Windmill Field Well #2	Kelly Windmill Field Well #2	Sutter	Diesel	2002	62.1	T1	2,000	3%	102	460	9	1,248	4,350	1.1	6.9	3.0	0.93	0.30	0.29	1.42	8.57	3.78	1.16	0.37	0.37	0.10	0.59	0.26	0.08	0.03	0.03
PGVMWCKelly Windmill North Field Well	Kelly Windmill North Field Well	Sutter	Diesel	2002	62.1	T1	2,000	3%	102	460	9	1,248	4,350	1.1	6.9	3.0	0.93	0.30	0.29	1.42	8.57	3.78	1.16	0.37	0.37	0.10	0.59	0.26	0.08	0.03	0.03
PGVMWCKelly 306 Well	Kelly 306 Well	Sutter	Electric		250	n/a	2,600	3%	133	598	9	1,248	n/a																		
PGVMWCScheidel&Osterli #16	Scheidel&Osterli #16	Sutter	Diesel	1997	234	T1	3,400	4%	174	782	9	1,248	16,389	1.0	6.9	8.5	0.93	0.40	0.40	4.56	32.31	40.03	4.38	1.90	1.90	0.31	2.21	2.74	0.30	0.13	0.13
PGVMWCScheidel&Osterli #17	Scheidel&Osterli #17	Sutter	Diesel	1999	101	T0	1,500	2%	77	345	9	1,248	7,074	1.1	14.1	3.0	0.93	0.22	0.21	2.32	28.56	6.15	1.89	0.45	0.44	0.16	1.95	0.42	0.13	0.03	0.03
						Total	**78,300**	**100%**	**4,000**	**18,000**	**292**	**39,951**	**117,213**							**33.08**	**285.31**	**125.64**	**31.29**	**8.13**	**8.00**	**2.26**	**19.53**	**8.60**	**2.14**	**0.56**	**0.55**
						Total (Sutter County)	**76,300**	**97%**	**3,898**	**17,540**	**283**	**38,703**	**117,213**							**33.08**	**285.31**	**125.64**	**31.29**	**8.13**	**8.00**	**2.26**	**19.53**	**8.60**	**2.14**	**0.56**	**0.55**
						Total (Yolo County)	**2,000**	**3%**	**102**	**460**	**9**	**1,248**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend
Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type
Emission factor based on NMHC+NOx emission standard
Emission factor based on AP-42 (engine not subject to emission standard for pollutant in ATCM)

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Reclamation District 108	Federal Attainment Status				
Transfer Volume	15,000 acre feet/year		*Colusa*	*Yolo*		
Location	Colusa County	PM10	A	A	*Engines subject to ATCM.*	
	Yolo County	PM2.5	A	N		
		O3	A	N		

Table F-24. Reclamation District 108 Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
RD 108Well#1 Heidrick	Well#1 Heidrick	Colusa	Electric		100	n/a	3,500	18%	458	2,749	23	4,265
RD 108Well #5 RiggsRanch	Well #5 RiggsRanch	Colusa	Electric		150	n/a	1,700	9%	223	1,335	23	4,265
RD 108Well #6 CountyLine	Well #6 CountyLine	Colusa	Electric		250	n/a	5,900	31%	772	4,634	23	4,265
RD 108Well#7 Tract 6	Well#7 Tract 6	Yolo	Electric		250	n/a	4,000	21%	524	3,141	23	4,265
RD 108Well #4 Huff	Well #4 Huff	Colusa	Electric		250	n/a	4,000	21%	524	3,141	23	4,265
						Total	**19,100**	**100%**	**2,500**	**15,000**	**117**	**21,325**
						Total (Colusa County)	**15,100**	**79%**	**1,976**	**11,859**	**93**	**17,060**
						Total (Yolo County)	**4,000**	**21%**	**524**	**3,141**	**23**	**4,265**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Reclamation District 1004		Federal Attainment Status					Peak Month
Transfer Volume	7,175 acre feet/year			*Colusa*	*Glenn*	*Sutter*		2,870 AF/month
Location	Colusa County		PM10	A	A	A	*Engines subject to ATCM.*	20,950 gallons/minute
	Glenn County		PM2.5	A	A	N		29% peak pump rate
	Sutter County		O3	A	A	N		

Table F-25. Reclamation District 1004 Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate		Transfer Volume		Operation		Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr)						Daily Emissions (lbs/day)						Annual Emissions (tons per year)					
							(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)		VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Gardener No. 374672	Gardener No. 374672	Colusa	Diesel	2008	215	T3	3,500	5%	138	345	7	535	6,456	0.1	2.8	2.6	0.93	0.15	0.15	0.50	9.46	8.71	3.10	0.50	0.50	0.02	0.36	0.33	0.12	0.02	0.02
Gardener No. 498178	Gardener No. 498178	Colusa	Diesel	2009	215	T3	3,500	5%	138	345	7	535	6,456	0.1	2.8	2.6	0.93	0.15	0.15	0.50	9.46	8.71	3.10	0.50	0.50	0.02	0.36	0.33	0.12	0.02	0.02
Stonewell #6 No. 11334	Stone Well #6 No.11334	Colusa	Electric	2006	40	n/a	1,800	2%	71	177	7	535	n/a																		
Drumheller Well #7	Drumheller Well No.7	Colusa	Diesel	TBD	225	T0	4,000	5%	158	394	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
Myers Well #1 No. 3457	Myers Well #1 No.3457	Colusa	Electric	2006	40	n/a	2,200	3%	87	217	7	535	n/a																		
Myers Well #2 No. 340884	Myers Well #2 No. 340884	Colusa	Electric	1982	100	n/a	4,100	6%	162	404	7	535	n/a																		
Sikes & Parachini #1 No. 93124	Sikes & Parachini Well #1 WS No.93124	Colusa	Diesel	2006	173	T2	4,000	5%	158	394	7	535	5,195	0.2	4.7	3.7	0.93	0.22	0.22	0.66	12.56	10.02	2.50	0.60	0.60	0.03	0.48	0.38	0.09	0.02	0.02
Sikes & Parachini #2 No. 374682	Sikes & Parachini Well #2 WS No. 374682	Colusa	Diesel	2008	150	T3	4,000	5%	158	394	7	535	4,504	0.1	2.8	3.7	0.93	0.22	0.22	0.35	6.60	8.69	2.16	0.52	0.52	0.01	0.25	0.33	0.08	0.02	0.02
Rancho Caleta No. 726883	Rancho Caleta No. 726883	Colusa	Diesel	2004	170	T2	4,500	6%	177	444	7	535	5,105	0.2	4.7	3.7	0.93	0.22	0.22	0.65	12.34	9.84	2.45	0.59	0.59	0.02	0.47	0.37	0.09	0.02	0.02
Behring Ranch Club House No. 496461	Behring Ranch Club House Well No.496461	Colusa	Electric		125	n/a	3,400	5%	134	335	7	535	n/a																		
Behring Ranch West Well No. 97863	Behring Ranch West Well No.97863	Colusa	Electric		125	n/a	2,300	3%	91	227	7	535	n/a																		
Behring Ranch 10 Field Well No. 496441	Behring Ranch 10 Field Well No. 496441	Colusa	Diesel	2008	225	T3	5,800	8%	229	572	7	535	6,756	0.1	2.8	2.6	0.93	0.15	0.15	0.52	9.90	9.12	3.25	0.52	0.52	0.02	0.38	0.35	0.12	0.02	0.02
Behring Ranch Pearl 20094	Behring Ranch Pearl Well No. 20094	Colusa	Diesel	TBD	225	T0	2,500	3%	99	246	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
Behring Ranch Nursery Well No. 17N1W10H1	Behring Ranch Nursery Well No. 17N1W10H1	Colusa	Diesel	TBD	225	T0	1,000	1%	39	99	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
Hall Well No. X	Hall Well No. X	Colusa	Electric	TBD	125	n/a	4,500	6%	177	444	7	535	n/a																		
Hall Well No. 369428	Hall Well No.369428	Colusa	Electric	2011	125	n/a	4,500	6%	177	444	7	535	n/a																		
East Morgan Well	East Morgan Well #1 No. 374667 17N01W14N001M	Colusa	Diesel	TBD	225	T0	2,600	4%	103	256	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
ast Morgan Well	East Morgan Well#2 No. 498195 17N01W15Q001M	Colusa	Diesel	TBD	225	T0	1,300	2%	51	128	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
Mohammad No.	Mohammad No.e0084085 17N01W02D001M	Colusa	Electric	TBD	125	n/a	4,500	6%	177	444	7	535	n/a																		
Southam Sartain	Southam Sartain Well 18N01W26D001M	Glenn	Diesel	TBD	225	T0	4,800	7%	189	473	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
Barale Well	Barale Well	Colusa	Diesel	TBD	225	T0	4,000	5%	158	394	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
						Total	**72,800**	**100%**	**2,870**	**7,175**	**148**	**11,240**	**81,767**							**31.05**	**404.01**	**129.15**	**39.29**	**6.90**	**6.81**	**1.18**	**15.36**	**4.91**	**1.49**	**0.26**	**0.26**
						Total (Colusa County)	**68,000**	**93%**	**2,681**	**6,702**	**141**	**10,705**	**75,010**							**27.07**	**354.91**	**118.57**	**36.05**	**6.37**	**6.30**	**1.03**	**13.49**	**4.51**	**1.37**	**0.24**	**0.24**
						Total (Glenn County)	**4,800**	**7%**	**189**	**473**	**7**	**535**	**6,756**							**3.98**	**49.10**	**10.58**	**3.25**	**0.52**	**0.51**	**0.15**	**1.87**	**0.40**	**0.12**	**0.02**	**0.02**
						Total (Sutter County)	**0**	**0%**	**0**	**0**	**0**	**0**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend
Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type
Emission factor based on NMHC+NOx emission standard

Conversion Factors

1 lb =	453.6 g
1 ton =	2,000 lbs
1 month =	30.4 days
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4 lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal	

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	River Garden Farms
Transfer Volume	9,000 acre feet/year
Location	Yolo County

Federal Attainment Status

PM10	A	*Engines subject to ATCM.*
PM2.5	N	
O3	N	

Table F-26. River Garden Farms Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
River Garden FarmsField 65 PW	Field 65 PW	Yolo	Electric	2008	110	n/a	2,500	14%	287	1,293	21	2,810
River Garden FarmsField 71 PW	Field 71 PW	Yolo	Electric	2001	110	n/a	1,700	10%	195	880	21	2,810
River Garden FarmsField 98 PW	Field 98 PW	Yolo	Electric	1963	110	n/a	2,900	17%	333	1,500	21	2,810
River Garden FarmsField 104 PW	Field 104 PW	Yolo	Electric	2008	110	n/a	2,500	14%	287	1,293	21	2,810
River Garden FarmsField 104-09 PW	Field 104-09 PW	Yolo	Electric	2009	110	n/a	2,990	17%	344	1,547	21	2,810
River Garden FarmsField 91-09 PW	Field 91-09 PW	Yolo	Electric	2009	110	n/a	2,840	16%	327	1,469	21	2,810
River Garden FarmsField 117 PW	Field 117 PW	Yolo	Electric	2009	110	n/a	1,965	11%	226	1,017	21	2,810
						Total	**17,395**	**100%**	**2,000**	**9,000**	**144**	**19,669**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

(shaded cell) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Sycamore Mutual Water Company		Federal Attainment Status		
Transfer Volume	15,000 acre feet/year		PM10	A	*Engines not subject to ATCM if remotely-located.*
Location	Colusa County		PM2.5	A	
			O3	A	

Table F-27. Sycamore Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Sycamore Family Trust1	1	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust2	2	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust3	3	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust4	4	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust5	5	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust6	6	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust7	7	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust8	8	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust11	11	Colusa	Electric		100	n/a	2,500	7%	214	1,071	15	2,328
Sycamore Family Trust14	14	Colusa	Electric		100	n/a	2,500	7%	214	1,071	15	2,328
Sycamore Family Trust15	15	Colusa	Electric		75	n/a	2,500	7%	214	1,071	15	2,328
Sycamore Family Trust17	17	Colusa	Electric		125	n/a	3,500	10%	300	1,500	15	2,328
						Total	**35,000**	**100%**	**3,000**	**15,000**	**184**	**27,930**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Te Velde Revocable Family Trust	Federal Attainment Status			
Transfer Volume	7,094 acre feet/year	PM10	A	*Engines subject to ATCM.*
Location	Yolo County	PM2.5	N	
		O3	N	

Table F-28. Te Velde Revocable Family Trust Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Te VeldeGW1	GW1	Yolo	Electric	N/A	127	n/a	4,656	29%	518	2,090	20	2,438
Te VeldeGW10	GW10	Yolo	Electric	N/A	143	n/a	2,833	18%	315	1,272	20	2,438
Te VeldeGW9	GW9	Yolo	Electric	N/A	104	n/a	2,200	14%	245	988	20	2,438
Te VeldeGW4	GW4	Yolo	Electric	N/A	125	n/a	3,715	24%	413	1,668	20	2,438
Te VeldeGW3	GW3	Yolo	Electric	N/A	52	n/a	2,400	15%	267	1,077	20	2,438
						Total	**15,804**	**100%**	**1,758**	**7,094**	**99**	**12,189**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	City of Sacramento	Federal Attainment Status		
Transfer Volume	5,000 acre feet/year	PM10	M	*Engines subject to ATCM.*
Location	Sacramento County	PM2.5	N	
		O3	N	

Table F-29. City of Sacramento Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
City of Sacramento WSA83	WELL83	Sacramento	electric		30	n/a	373	2%	29	88	14	1,278
City of Sacramento WSA92	WELL92	Sacramento	electric		50	n/a	785	4%	62	185	14	1,278
City of Sacramento WSA93	WELL93	Sacramento	electric		50	n/a	411	2%	32	97	14	1,278
City of Sacramento WSA94	WELL94	Sacramento	electric		50	n/a	879	4%	69	207	14	1,278
City of Sacramento WSA107	WELL107	Sacramento	electric		50	n/a	727	3%	57	171	14	1,278
City of Sacramento WSA116	WELL116	Sacramento	electric		75	n/a	673	3%	53	158	14	1,278
City of Sacramento WSA120	WELL120	Sacramento	electric		50	n/a	572	3%	45	135	14	1,278
City of Sacramento WSA122	WELL122	Sacramento	electric		50	n/a	470	2%	37	111	14	1,278
City of Sacramento WSA124	WELL124	Sacramento	electric		50	n/a	541	3%	42	127	14	1,278
City of Sacramento WSA126	WELL126	Sacramento	electric		50	n/a	433	2%	34	102	14	1,278
City of Sacramento WSA127	WELL127	Sacramento	electric		50	n/a	592	3%	46	139	14	1,278
City of Sacramento WSA129	WELL129	Sacramento	electric		50	n/a	466	2%	37	110	14	1,278
City of Sacramento WSA131	WELL131	Sacramento	electric		50	n/a	431	2%	34	101	14	1,278
City of Sacramento WSA133	WELL133	Sacramento	electric		150	n/a	757	4%	59	178	14	1,278
City of Sacramento WSA134	WELL134	Sacramento	electric		60	n/a	676	3%	53	159	14	1,278
City of Sacramento WSA137	WELL137	Sacramento	electric		75	n/a	541	3%	42	127	14	1,278
City of Sacramento WSA138	WELL138	Sacramento	electric		75	n/a	505	2%	40	119	14	1,278
City of Sacramento WSA139	WELL139	Sacramento	electric		50	n/a	818	4%	64	193	14	1,278
City of Sacramento WSA142	WELL142	Sacramento	electric		75	n/a	940	4%	74	221	14	1,278
City of Sacramento WSA143	WELL143	Sacramento	electric		50	n/a	379	2%	30	89	14	1,278
City of Sacramento WSA144	WELL144	Sacramento	electric		50	n/a	549	3%	43	129	14	1,278
City of Sacramento WSA153	WELL153	Sacramento	electric		100	n/a	1027	5%	81	242	14	1,278
City of Sacramento WSA154	WELL154	Sacramento	electric		50	n/a	502	2%	39	118	14	1,278
City of Sacramento WSA155	WELL155	Sacramento	electric		50	n/a	675	3%	53	159	14	1,278
City of Sacramento WSA156	WELL156	Sacramento	electric		75	n/a	525	2%	41	124	14	1,278
City of Sacramento WSA157	WELL157	Sacramento	electric		50	n/a	781	4%	61	184	14	1,278
City of Sacramento WSA158	WELL158	Sacramento	electric		50	n/a	781	4%	61	184	14	1,278
City of Sacramento WSA159	WELL159	Sacramento	electric		75	n/a	535	3%	42	126	14	1,278
City of Sacramento WSA164	WELL164	Sacramento	electric		150	n/a	1101	5%	86	259	14	1,278
City of Sacramento WSAX1	WELLX1	Sacramento	electric		150	n/a	1400	7%	110	329	14	1,278
City of Sacramento WSAX2	WELLX2	Sacramento	electric		150	n/a	1400	7%	110	329	14	1,278
						Total	**21,245**	**100%**	**1,667**	**5,000**	**434**	**39,623**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

(purple)	Assumed to be electric (similar to other wells operated by water agency)
(green)	Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Sacramento County Water Agency		Federal Attainment Status	
Transfer Volume	15,000 acre feet/year	PM10	M	*Engines subject to ATCM.*
Location	Sacramento County	PM2.5	N	
		O3	N	

Table F-30. Sacramento County Water Agency Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Sacramento County WAW 040	W 040	Sacramento	Electric		115	n/a	1,160	2%	104	312	16	1,463
Sacramento County WAW 041	W 041	Sacramento	Electric		65	n/a	676	1%	61	182	16	1,463
Sacramento County WAW 042	W 042	Sacramento	Electric		77	n/a	727	1%	65	196	16	1,463
Sacramento County WAW 043	W 043	Sacramento	Electric		94	n/a	918	2%	82	247	16	1,463
Sacramento County WAW 044	W 044	Sacramento	Electric		73	n/a	515	1%	46	139	16	1,463
Sacramento County WAW 047	W 047	Sacramento	Electric		88	n/a	1,030	2%	92	277	16	1,463
Sacramento County WAW 049	W 049	Sacramento	Electric		92	n/a	853	2%	77	230	16	1,463
Sacramento County WAW 052	W 052	Sacramento	Electric		120	n/a	1,192	2%	107	321	16	1,463
Sacramento County WAW 056	W 056	Sacramento	Electric		200	n/a	3,000	5%	269	808	16	1,463
Sacramento County WAW 061	W 061	Sacramento	Electric		145	n/a	1,570	3%	141	423	16	1,463
Sacramento County WAW 062	W 062	Sacramento	Electric		100	n/a	455	1%	41	123	16	1,463
Sacramento County WAW 063	W 063	Sacramento	Electric		100	n/a	1,119	2%	100	301	16	1,463
Sacramento County WAW 064	W 064	Sacramento	Electric		141	n/a	1,205	2%	108	325	16	1,463
Sacramento County WAW 065	W 065	Sacramento	Electric		57	n/a	589	1%	53	159	16	1,463
Sacramento County WAW 066	W 066	Sacramento	Electric		125	n/a	1,700	3%	153	458	16	1,463
Sacramento County WAW 067	W 067	Sacramento	Electric		135	n/a	1,425	3%	128	384	16	1,463
Sacramento County WAW 068	W 068	Sacramento	Electric		141	n/a	1,624	3%	146	437	16	1,463
Sacramento County WAW 069	W 069	Sacramento	Electric		154	n/a	1,663	3%	149	448	16	1,463
Sacramento County WAW 070	W 070	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 073	W 073	Sacramento	Electric		175	n/a	2,000	4%	180	539	16	1,463
Sacramento County WAW 074	W 074	Sacramento	Electric		50	n/a	500	1%	45	135	16	1,463
Sacramento County WAW 076	W 076	Sacramento	Electric		150	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 077	W 077	Sacramento	Electric		125	n/a	2,000	4%	180	539	16	1,463
Sacramento County WAW 078	W 078	Sacramento	Electric		125	n/a	2,400	4%	216	647	16	1,463
Sacramento County WAW 087	W 087	Sacramento	Electric		150	n/a	1,900	3%	171	512	16	1,463
Sacramento County WAW 092	W 092	Sacramento	Electric		75	n/a	1,160	2%	104	312	16	1,463
Sacramento County WAW 095	W 095	Sacramento	Electric		200	n/a	2,200	4%	198	593	16	1,463
Sacramento County WAW 096	W 096	Sacramento	Electric		150	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 105	W 105	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 106	W 106	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 109	W 109	Sacramento	Electric		200	n/a	2,600	5%	233	700	16	1,463
Sacramento County WAW 110	W 110	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 112	W 112	Sacramento	Electric		100	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 114	W 114	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 129	W 129	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 130	W 130	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 122	W 122	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 123	W 123	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 124	W 124	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
						Total	**55,681**	**100%**	**5,000**	**15,000**	**625**	**57,058**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

(shaded cell) Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Sacramento Suburban Water District	Federal Attainment Status			Peak Month	
Transfer Volume	30,000 acre feet/year	PM10	M	*Engines subject to ATCM.*	5,000	AF/month
Location	Sacramento County	PM2.5	N		36,498	gallons/minute
		O3	N		74%	peak pump rate

Table F-31. Sacramento Suburban Water District Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (MMBtu/yr)	Emission Factors (lb/MMBtu) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Sacramento Suburban WD5	5	Sacramento	Electric		110	n/a	330	1%	34	201	18	3,312	n/a																		
Sacramento Suburban WD7	7	Sacramento	Electric		110	n/a	180	0%	18	110	18	3,312	n/a																		
Sacramento Suburban WD9	9	Sacramento	Electric		110	n/a	625	1%	64	381	18	3,312	n/a																		
Sacramento Suburban WD12	12	Sacramento	Electric		110	n/a	540	1%	55	329	18	3,312	n/a																		
Sacramento Suburban WD13	13	Sacramento	Electric		110	n/a	820	2%	83	500	18	3,312	n/a																		
Sacramento Suburban WD14	14	Sacramento	Electric		110	n/a	570	1%	58	348	18	3,312	n/a																		
Sacramento Suburban WD18	18	Sacramento	Electric		110	n/a	840	2%	85	512	18	3,312	n/a																		
Sacramento Suburban WD19	19	Sacramento	Electric		110	n/a	950	2%	97	579	18	3,312	n/a																		
Sacramento Suburban WD22	22	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD23	23	Sacramento	Electric		110	n/a	550	1%	56	335	18	3,312	n/a																		
Sacramento Suburban WD24	24	Sacramento	Electric		110	n/a	590	1%	60	360	18	3,312	n/a																		
Sacramento Suburban WD25	25	Sacramento	Electric		110	n/a	750	2%	76	457	18	3,312	n/a																		
Sacramento Suburban WD26	26	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD28	28	Sacramento	Electric		110	n/a	585	1%	59	357	18	3,312	n/a																		
Sacramento Suburban WD30	30	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD35	35	Sacramento	Electric		110	n/a	1000	2%	102	610	18	3,312	n/a																		
Sacramento Suburban WD37	37	Sacramento	Natural Gas		190	n/a	700	1%	71	427	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD38	38	Sacramento	Natural Gas		190	n/a	500	1%	51	305	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD40	40	Sacramento	Natural Gas		190	n/a	675	1%	69	412	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD41	41	Sacramento	Electric/Natural Gas		190	n/a	600	1%	61	366	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD43	43	Sacramento	Electric/Natural Gas		190	n/a	850	2%	86	518	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD45	45	Sacramento	Natural Gas		190	n/a	750	2%	76	457	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD47	47	Sacramento	Electric/Natural Gas		190	n/a	885	2%	90	540	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD50	50	Sacramento	Electric		110	n/a	500	1%	51	305	18	3,312	n/a																		
Sacramento Suburban WD51	51	Sacramento	Electric		110	n/a	285	1%	29	174	18	3,312	n/a																		
Sacramento Suburban WD60	60	Sacramento	Electric		110	n/a	600	1%	61	366	18	3,312	n/a																		
Sacramento Suburban WD65	65	Sacramento	Electric		110	n/a	1250	3%	127	762	18	3,312	n/a																		
Sacramento Suburban WD66	66	Sacramento	Electric		110	n/a	1350	3%	137	823	18	3,312	n/a																		
Sacramento Suburban WD69	69	Sacramento	Electric		110	n/a	450	1%	46	274	18	3,312	n/a																		
Sacramento Suburban WD70	70	Sacramento	Electric		110	n/a	350	1%	36	213	18	3,312	n/a																		
Sacramento Suburban WD71	71	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD72	72	Sacramento	Electric		110	n/a	1850	4%	188	1,128	18	3,312	n/a																		
Sacramento Suburban WD73	73	Sacramento	Electric		110	n/a	3500	7%	356	2,134	18	3,312	n/a																		
Sacramento Suburban WD74	74	Sacramento	Electric		110	n/a	2700	5%	274	1,647	18	3,312	n/a																		
Sacramento Suburban WD75	75	Sacramento	Electric		110	n/a	1150	2%	117	701	18	3,312	n/a																		
Sacramento Suburban WD76	76	Sacramento	Electric		110	n/a	250	1%	25	152	18	3,312	n/a																		
Sacramento Suburban WD77	77	Sacramento	Electric		110	n/a	400	1%	41	244	18	3,312	n/a																		
Sacramento Suburban WD20A	20A	Sacramento	Electric		110	n/a	1100	2%	112	671	18	3,312	n/a																		
Sacramento Suburban WD2A	2A	Sacramento	Electric		110	n/a	995	2%	101	607	18	3,312	n/a																		
Sacramento Suburban WD32A	32A	Sacramento	Electric		110	n/a	1905	4%	194	1,162	18	3,312	n/a																		
Sacramento Suburban WD33A	33A	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD3A	3A	Sacramento	Electric		110	n/a	370	1%	38	226	18	3,312	n/a																		
Sacramento Suburban WD40A	40A	Sacramento	Electric		110	n/a	2525	5%	257	1,540	18	3,312	n/a																		
Sacramento Suburban WD46R	46R	Sacramento	Electric/Natural Gas		190	n/a	800	2%	81	488	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD4B	4B	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD55A	55A	Sacramento	Electric		110	n/a	2000	4%	203	1,220	18	3,312	n/a																		
Sacramento Suburban WD68R	68R	Sacramento	Electric		110	n/a	1600	3%	163	976	18	3,312	n/a																		
						Total	**49,195**	**100%**	**5,000**	**30,000**	**853**	**155,656**	**35,238**							**22.78**	**787.78**	**61.21**	**0.11**	**1.93**	**1.93**	**2.08**	**71.89**	**5.59**	**0.01**	**0.18**	**0.18**

Legend

Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 MMBtu =	1,000,000	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC =	7,000	Btu/bhp-hr	(Estimated from Waukesha engine specifications)
Higher Heating Value	1,020	Btu/scf	(AP-42, Chapter 3.2: Natural Gas-fired Reciprocating Engines)

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Butte Water District	
Transfer Volume	5,500	acre feet/year
Location	Butte	County
	Sutter	County

Federal Attainment Status

	Butte	Sutter	
PM10	A	A	*Engines subject to ATCM.*
PM2.5	N	N	
O3	N	N	

Table F-32. Butte Water District Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Butte Water District#1	#1	Sutter	Electric	2008 Floway 16 MKM	300	n/a	4,000	49%	447	2,683	20	3,643
Butte Water District#2	#2	Sutter	Electric	2008 Floway 16 DKH	350	n/a	4,200	51%	470	2,817	20	3,643
						Total	**8,200**	**100%**	**917**	**5,500**	**40**	**7,285**
						Total (Butte County)	**0**	**0%**	**0**	**0**	**0**	**0**
						Total (Sutter County)	**8,200**	**100%**	**917**	**5,500**	**40**	**7,285**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

			Federal Attainment Status		
Agency	Garden Highway Mutual Water Company		PM10	A	*Engines subject to ATCM.*
Transfer Volume	14,000	acre feet/year	PM2.5	N	
Location	Sutter	County	O3	N	

Table F-33. Garden Highway Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Garden Highway MWC4	#4	Sutter	Electric		110	n/a	2,300	12%	295	1,651	23	3,899
Garden Highway MWC17	#17	Sutter	Electric		110	n/a	3,100	16%	397	2,226	23	3,899
Garden Highway MWC19	#19	Sutter	Electric		110	n/a	2,800	14%	359	2,010	23	3,899
Garden Highway MWC22	#22	Sutter	Electric		110	n/a	2,700	14%	346	1,938	23	3,899
Garden Highway MWC23	#23	Sutter	Electric		110	n/a	2,200	11%	282	1,579	23	3,899
Garden Highway MWC24	#24	Sutter	Electric	TBD	110	n/a	3,200	16%	410	2,297	23	3,899
Garden Highway MWC25	#25	Sutter	Electric	TBD	110	n/a	3,200	16%	410	2,297	23	3,899
						Total	**19,500**	**100%**	**2,500**	**14,000**	**160**	**27,294**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

(shaded)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Gilsizer Slough Ranch	Federal Attainment Status			Peak Month		
Transfer Volume	3,900 acre feet/year	PM10	A	*Engines subject to ATCM.*	800	AF/month
Location	Sutter County	PM2.5	N		5,840	gallons/minute
		O3	N		97%	peak pump rate

Table F-34. Gilsizer Slough Ranch Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Gilsizer #1	Gilsizer #1	Sutter	Diesel		162	T0	2,016	33%	267	1,300	24	3,502	31,828	1.1	14.1	3.0	0.93	0.22	0.21	9.62	118.61	25.56	7.84	1.86	1.81	0.71	8.79	1.89	0.58	0.14	0.13
Gilsizer #2	Gilsizer #2	Sutter	Electric	TBD	110	n/a	2,016	33%	267	1,300	24	3,502	n/a																		
Gilsizer #3	Gilsizer #3	Sutter	Electric	TBD	110	n/a	2,016	33%	267	1,300	24	3,502	n/a																		
						Total	**6,048**	**100%**	**800**	**3,900**	**71**	**10,506**	**31,828**							**9.62**	**118.61**	**25.56**	**7.84**	**1.86**	**1.81**	**0.71**	**8.79**	**1.89**	**0.58**	**0.14**	**0.13**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend
[shaded cell] Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Goose Club Farms and Teichert Aggregates	Federal Attainment Status			
Transfer Volume	10,000 acre feet/year	PM10	A	*Engines subject to ATCM.*	
Location	Sutter County	PM2.5	N		
		O3	N		

Table F-35. Goose Club Farms and Teichert Aggregates Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Goose Club1	1	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club2	2	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club3	3	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club4	4	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club5	5	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club6	6	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club7	7	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club8	8	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club9	9	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club10	10	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club11	11	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club12	12	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club13	13	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
						Total	**39,000**	**100%**	**2,400**	**10,000**	**143**	**18,103**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Tule Basin Farms		Federal Attainment Status			Peak Month	
Transfer Volume	7,320 acre feet/year		PM10	A	*Engines subject to ATCM.*	1,520	AF/month
Location	Sutter County		PM2.5	N		11,095	gallons/minute
			O3	N		96%	peak pump rate

Table F-36. Tule Basin Farms Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate		Transfer Volume		Operation		Fuel Consumption
							(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)	(MMBtu/yr)
Tule Basin1	1	Sutter	Electric		125	n/a	3,050	27%	403	1,941	24	3,457	n/a
Tule Basin2	2	Sutter	Natural Gas	1985	190	n/a	3,600	31%	476	2,291	24	3,457	4,598
Tule Basin3	3	Sutter	Electric		125	n/a	4,850	42%	641	3,087	24	3,457	n/a
						Total	**11,500**	**100%**	**1,520**	**7,320**	**71**	**10,371**	**4,598**

Description	Emission Factors (lb/MMBtu)						Daily Emissions (lbs/day)						Annual Emissions (tons per year)					
	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Tule Basin1																		
Tule Basin2	0.118	4.08	0.317	0.00059	0.00999	0.00999	3.70	128.06	9.95	0.02	0.31	0.31	0.27	9.38	0.73	0.00	0.02	0.02
Tule Basin3																		
Total							**3.70**	**128.06**	**9.95**	**0.02**	**0.31**	**0.31**	**0.27**	**9.38**	**0.73**	**0.00**	**0.02**	**0.02**

Conversion Factors

1 MMBtu =	1,000,000	Btu
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC =	7,000	Btu/bhp-hr	(Estimated from Waukesha engine specifications)
Higher Heating Value	1,020	Btu/scf	(AP-42, Chapter 3.2: Natural Gas-fired Reciprocating Engines)

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Reclamation District 2068		Federal Attainment Status			
Transfer Volume	4,500	acre feet/year		*Solano*	*Yolo*	
Location	Solano	County	PM10	A	A	*Engines subject to ATCM.*
	Yolo	County	PM2.5	N	N	
			O3	N	N	

Table F-37. Reclamation District 2068 Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
RD-2068TP-1	TP-1	Solano	Electric		75	n/a	1,500	25%	188	1,125	22	4,073
RD-2068GW-2	GW-2	Solano	Electric	TBD	75	n/a	1,500	25%	188	1,125	22	4,073
RD-2068GW-3	GW-3	Solano	Electric	TBD	75	n/a	1,500	25%	188	1,125	22	4,073
RD-2068GW-4	GW-4	Solano	Electric	TBD	75	n/a	1,500	25%	188	1,125	22	4,073
						Total	**6,000**	**100%**	**750**	**4,500**	**89**	**16,293**
						Total (Solano County)	**6,000**	**100%**	**750**	**4,500**	**89**	**16,293**
						Total (Yolo County)	**0**	**0%**	**0**	**0**	**0**	**0**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Pope Ranch	
Transfer Volume	2,800	acre feet/year
Location	Yolo	County

Federal Attainment Status

PM10	A	*Engines subject to ATCM.*
PM2.5	N	
O3	N	

Table F-38. Pope Ranch Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Pope RanchX1	X1	Yolo	Electric	TBD	110	n/a	2,117	50%	280	1,400	24	3,591
Pope RanchX2	X2	Yolo	Electric	TBD	110	n/a	2,117	50%	280	1,400	24	3,591
						Total	**4,234**	**100%**	**560**	**2,800**	**47**	**7,183**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

CARB Airborne Toxic Control Measure (ATCM) for Stationary Compression Ignition Engines

Table F-39. Summary of the Emission Standards for New Stationary Diesel-Fueled CI Engines > 50 BHP used in Agricultural Operations

Horsepower Range	Diesel PM [1] (g/bhp-hr)	HC (g/bhp-hr)	NOx (g/bhp-hr)	NMHC+NOx (g/bhp-hr)	CO (g/bhp-hr)
50<HP<100	0.3				
100<=HP<175	0.22				
175<=HP	0.15				

Source: See Section 93115.8(a)

Notes:

[1] Less than or equal to the emission standard OR Off-Road CI Engine Certification Standard for an off-road engine of the maximum rated power, whichever is more stringent.

[2] Off-Road CI Engine Certification Standard for an off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard, or Tier 1 standards.

[3] Prior to January 1, 2008, these limits shall not apply to engines sold from one agricultural operation to another and funded under State or federal incentive.

Table F-40. Emission Standards for Noncertified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

Horsepower (HP) Range	Compliance Date [1]	PM (g/bhp-hr)	HC [2,3] (g/bhp-hr)	NOx [2,3] (g/bhp-hr)	NMHC+NOx [2,3] (g/bhp-hr)	CO [2,3] (g/bhp-hr)
50<HP<75	2011	0.3				
75<=HP<100	2011	0.3				
100<=HP<175	2010	0.22				
175<=HP<=750	2010	0.15				
750<HP	2014	0.075				

Source: See Sections 93115.8(b) (2) and (4)

Note:

[1] Compliance date on or after December 31

[2] Engine Certification Standards for off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard.

[3] If no limits have been established for an off-road engine of the same model year and maximum rated power, then the in-use stationary diesel-fueled engine used in an agricultural operation shall not exceed Tier 1 standards in Title 13.

Table F-41. Emission Standards Tier 1- and Tier 2-Certified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

Horsepower Range (hp)	Compliance Date	PM (g/bhp-hr)	HC [2,3] (g/bhp-hr)	NOx [2,3] (g/bhp-hr)	NMHC+NOx [2,3] (g/bhp-hr)	CO [2,3] (g/bhp-hr)
50<HP<75	2015	0.02				
75<=HP<175	2015	0.01				
175<=hp<=750	2014	0.01				
750<HP	2014	0.075				

Source: See Sections 93115.8(b)(3) and (4)

Notes:

[1] Compliance date on or after December 31 or 12 years after the date of initial installation, whichever is later.

[2] Off-Road CI Engine Certification Standards for an off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard.

[3] If no limits have been established for an off-road engine of the same model year and maximum rated power, then the in-use stationary diesel-fueled engine used in agricultural operation shall not exceed Tier 1 standards in Tier 13, CCR, section 2423 for an off-road engine of the same maximum rated power irrespective of model year.

Table F-42. Tier 1, Tier 2, and Tier 3 Exhaust Emission Standards

Maximum Rated Power	Tier	Model Year	(g/kW-hr)					(g/hp-hr)				
			NOx	HC	NMHC+NOx	CO	PM	NOx	HC	NMHC+NOx	CO	PM
kW<8 *hp <11*	T1	2000-2004	-	-	10.5	8.0	1	-	-	7.8	6.0	0.75
	T2	2005 -2007	-	-	7.5	8.0	0.8	-	-	5.6	6.0	0.60
8≤kW<19 *11<=hp<25*	T1	2000-2004	-	-	9.5	6.6	0.8	-	-	7.1	4.9	0.60
	T2	2005 -2007	-	-	7.5	6.6	0.8	-	-	5.6	4.9	0.60
19≤kW<37 *25<=hp<50*	T1	2000-2003	-	-	9.5	5.5	0.8	-	-	7.1	4.1	0.60
	T2	2004 -2007	-	-	7.5	5.5	0.6	-	-	5.6	4.1	0.45
37≤kW<56 *50<=hp<75*	T1	2000-2003	9.2	-	-	-	-	6.9	-	-	-	-
	T2	2004-2007	-	-	7.5	5.0	0.4	-	-	5.6	3.7	0.30
	T3	2008 -2011	-	-	4.7	5.0	0.4	-	-	3.5	3.7	0.30
56≤kW<75 *75<=hp<100*	T1	2000-2003	9.2	-	-	-	-	6.9	-	-	-	-
	T2	2004-2007	-	-	7.5	5.0	0.4	-	-	5.6	3.7	0.30
	T3	2008-2011	-	-	4.7	5.0	0.4	-	-	3.5	3.7	0.30
75≤kW<130 *100<=hp<175*	T1	2000-2002	9.2	-	-	-	-	6.9	-	-	-	-
	T2	2003-2006	-	-	6.6	5.0	0.3	-	-	4.9	3.7	0.22
	T3	2007 -2011	-	-	4.0	5.0	0.3	-	-	3.0	3.7	0.22
130≤kW<225 *175<=hp<300*	T1	1996-2002	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
	T2	2003-2005	-	-	6.6	3.5	0.2	-	-	4.9	2.6	0.15
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.15
225≤kW<450 *300<=hp<600*	T1	1996-2000	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
	T2	2001-2005	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.15
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.15
450≤kW≤560 *600<=hp<750*	T1	1996-2001	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
	T2	2002-2005	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.15
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.15
kW>560 *hp>750*	T1	2000-2005	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
	T2	2006 -2010	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.15

Source: Title 13, California Code of Regulations, Division 3, Chapter 9, Article 4, Section 2423, "Off-Road Compression-Ignition Engines and Equipment."

NOx and NMHC fraction - Table B-26

NOx	95%
NMHC	5%

http://www.arb.ca.gov/msprog/moyer/guidelines/cmp_guidelines_part4.pdf

PM Size Fractions

PM10	0.96
PM2.5	0.937
Ratio	0.98

CARB PMSIZE Profile No. 116 (STAT. I.C. ENGINE-DIESEL)

Table F-43. Tier 4 Exhaust Emission Standards

MAXIMUM ENGINE POWER	MODEL YEAR	TYPE	PM	NMHC+	NMHC	NOx	CO
			grams per horsepower-hour				
hp<11	2008 and later	FINAL	0.30	5.6	-	-	6.0
11<=hp<25							4.9
25<=hp<50	2008-2012	INTERIM	0.22	5.6	-	-	4.1
	2013 and later	FINAL	0.02	3.5			
50<=hp<75	2008-2012	INTERIM	0.22	3.5	-	-	3.7
	2013 and later	FINAL	0.02				
75<=hp<100	2012-2014	PHASE-IN	0.01	-	0.14	0.3	3.7
		PHASE-OUT		3.5	-	-	
		or/ ALT NOx			0.14	2.5	
	2015 and later	FINAL		-		0.3	
100<=hp<175	2012-2014	PHASE-IN	0.01	-	0.14	0.3	3.7
		PHASE-OUT		3.0	-	-	
		or/ ALT NOx		-	0.14	2.5	
	2015 and later	FINAL			0.14	0.3	
175<=hp<=750	2011-2013	PHASE-IN	0.01	-	0.14	0.3	2.6
	2014 and later	PHASE-OUT		3.0	-	-	
		or/ ALT NOx		-	0.14	1.5	
		FINAL				0.3	
750 hp<GEN<=1205 hp	2011-2014	INTERIM	0.07	-	0.30	2.6	2.6
	2015 and later	FINAL	0.02		0.14	0.5	
GEN>1205 hp	2011-2014	INTERIM	0.07	-	0.30		2.6
	2015 and later	FINAL	0.02		0.14	0.5	
ELSE>750 hp	2011-2014	INTERIM	0.07	-	0.30	2.6	2.6
	2015 and later	FINAL	0.03	-	0.14		

Source: Title 13, California Code of Regulations, Article 4, Section 2423, "Off-Road Compression-Ignition Engines and Equipment."

Table F-44. Engine Tier Matrix

HP Range	Year																			
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
hp <11	T0	T0	T0	T0	T1	T1	T1	T1	T1	T2	T2	T2	T4	T4	T4	T4	T4	T4	T4	T4
11<=hp<25	T0	T0	T0	T0	T1	T1	T1	T1	T1	T2	T2	T2	T4	T4	T4	T4	T4	T4	T4	T4
25<=hp<50	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4I	T4	T4	T4
50<=hp<75	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4I	T4	T4	T4
75<=hp<100	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T4I	T4I	T4I	T4
100<=hp<175	T0	T0	T0	T0	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4
175<=hp<300	T1	T1	T1	T1	T1	T1	T1	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
300<=hp<600	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
600<=hp<750	T1	T1	T1	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
hp>750	T0	T0	T0	T0	T1	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4

Key:

T0 = Tier 0 (Noncertified)
T1 = Tier 1
T2 = Tier 2
T3 = Tier 3
T4 = Tier 4
T4I = Tier 4 Interim

AP-42 Emission Factors

Table F-45. Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines [a]

Pollutant	Gasoline Fuel Emission Factor (lb/hp-hr) (power output)	Gasoline Fuel Emission Factor (lb/MMBtu) (fuel input)	Diesel Fuel Emission Factor (lb/hp-hr) (power output)	Diesel Fuel Emission Factor (lb/MMBtu) (fuel input)	Emission Factor Rating	Note
NOx	0.011	1.63	0.031	4.41	D	
CO	6.96E-03 [d]	0.99 [d]	6.68E-03	0.95	D	
SOx	5.91E-04	0.084	2.05E-03	0.29	D	
PM10	7.21E-04	0.1	2.20E-03	0.31	D	[b]
CO2	1.08	154	1.15	164	B	[c]
Aldehydes	4.85E-04	0.07	4.63E-04	0.07	D	
TOC						
Exhaust	0.015	2.1	2.47E-03	0.35	D	
Evaporative	6.61E-04	0.09	0.00	0.00	E	
Crankcase	4.85E-03	0.69	4.41E-05	0.01	E	
Refueling	1.08E-03	0.15	0.00	0.00	E	

Source: U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors (AP-42). Chapter 3.3: Gasoline and Diesel Industrial Engines.

Notes:

[a] References 2,5-6,9-14. When necessary, an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr was used to convert from lb/MMBtu to lb/hp-hr. To convert from lb/hp-hr to kg/kwhr, multiply by 0.608. To convert from lb/MMBtu to ng/J, multiply by 430. SCC = Source Classification Code. TOC = total organic compounds.

[b] PM-10 = particulate matter less than or equal to 10 :m aerodynamic diameter. All particulate is assumed to be 10 µm in size.

[c] Assumes 99% conversion of carbon in fuel to CO2 with 87 weight % carbon in diesel, 86 weight % carbon in gasoline, average BSFC of 7,000 Btu/hp-hr, diesel heating value of 19,300 Btu/lb, and gasoline heating value of 20,300 Btu/lb.

[d] Instead of 0.439 lb/hp-hr (power output) and 62.7 lb/mmBtu (fuel input), the correct emissions factors values are 6.96 E-03 lb/hp-hr (power output) and 0.99 lb/mmBtu (fuel input), respectively. This is an editorial correction. March 24, 2009

For large stationary diesel engines (greater than 600 horsepower [hp]) see Chapter 3.4: Large Stationary Diesel and All Stationary Dual-Fuel Engines.

Table F-46. Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines [a]

Pollutant	Emission Factor (lb/MMBtu) [b] (fuel input)	Emission Factor Rating
NOx [c] 90 - 105% Load	4.08E+00	B
NOx [c] <90% Load	8.47E-01	B
CO [c] 90 - 105% Load	3.17E-01	C
CO [c] <90% Load	5.57E-01	B
CO2 [d]	1.10E+02	A
SO2 [e]	5.88E-04	A
TOC [f]	1.47E+00	A
Methane[g]	1.25E+00	C
VOC [h]	1.18E-01	C
PM10 (filterable) [i]	7.71E-05	D
PM2.5 (filterable) [i]	7.71E-05	D
PM Condensable [j]	9.91E-03	D

Source: U.S. Environmental Protection Agency. 2000. Compilation of Air Pollutant Emission Factors (AP-42). Chapter 3.2: Natural Gas-Fired Reciprocating Engines. July.

Notes:

[a] Reference 7. Factors represent uncontrolled levels. For NOx, CO, and PM10, "uncontrolled" means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, the data set may include units with control techniques used for NOx control, such as PCC"uncontrolled" means no oxidation control; and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM-10 = Particulate Matter ≤ 10 microns (μ) aerodynamic diameter. A "<" sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

lb/hp-hr = (lb/MMBtu) (heat input, MMBtu/hr) (1/operating HP, 1/hp)

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO2. CO2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO2, C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and h = heating value of natural gas (assume 1020 Btu/scf at 60EF).

[e] Based on 100% conversion of fuel sulfur to SO2. Assumes sulfur content in natural gas of 2,000 gr/10^6scf.

[f] Emission factor for TOC is based on measured emission levels from 22 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor. Measured emission factor for methane compares well with the calculated emission factor, 1.31 lb/MMBtu vs. 1.25 lb/MMBtu, respectively.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds less ethane and methane.

[i] Considered ≤ 1 μ in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[j] PM Condensable = PM Condensable Inorganic + PM-Condensable Organic

Engine Size Summary

Table F-47. Summary of Average Engine Horsepower by Fuel Type

Average of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		125		125
Butte Water District		325		325
City of Sacramento		60		60
Conaway Preservation Group	227	138		147
Cordua Irrigation District		82		82
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	129	118		124
Reclamation District 1004	191	76		145
Reclamation District 108		200		200
Reclamation District 2068		75		75
Sacramento County Water Agency		116		116
Sycamore Mutual Water Company		117		117
Te Velde Revocable Family Trust		110		110
Tule Basin Farms		125	190	147
Grand Total	**162**	**110**	**190**	**117**

Table F-48. Summary of Maximum Engine Horsepower by Fuel Type

Max of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		200		200
Butte Water District		350		350
City of Sacramento		150		150
Conaway Preservation Group	227	250		250
Cordua Irrigation District		125		125
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	250	250		250
Reclamation District 1004	225	125		225
Reclamation District 108		250		250
Reclamation District 2068		75		75
Sacramento County Water Agency		200		200
Sycamore Mutual Water Company		125		125
Te Velde Revocable Family Trust		143		143
Tule Basin Farms		125	190	190
Grand Total	**250**	**350**	**190**	**350**

Table F-49. Summary of Minimum Engine Horsepower by Fuel Type

Min of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		50		50
Butte Water District		300		300
City of Sacramento		30		30
Conaway Preservation Group	227	75		75
Cordua Irrigation District		50		50
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	62	30		30
Reclamation District 1004	150	40		40
Reclamation District 108		100		100
Reclamation District 2068		75		75
Sacramento County Water Agency		50		50
Sycamore Mutual Water Company		75		75
Te Velde Revocable Family Trust		52		52
Tule Basin Farms		125	190	125
Grand Total	**62**	**30**	**190**	**30**

Table F-50. General Conformity Applicability Evaluation (Mitigated Emissions)

County/ Nonattainment Area	Emissions (tons per year)							
	VOC	NOx	CO	SOx		PM10	PM2.5	
	Sacramento Metro[1,5]	Sacramento Metro[1,5]	Sacramento Area[2]	Sacramento[3,4]	Yuba City-Marysville[6]	Sacramento Co.	Sacramento[4]	Yuba City-Marysville[6]
Colusa	--	--	--	--	--	--	--	--
Glenn	--	--	--	--	--	--	--	--
Sacramento	0.1	4.9	0.4	0.001	--	0.01	0.01	--
Shasta	--	--	--	--	--	--	--	--
Solano	0.0	0.0	--	--	--	--	--	--
Sutter	0.3	3.6	--	--	3.1	--	--	0.5
Tehama	--	--	--	--	--	--	--	--
Yolo	0.7	7.9	--	--	--	--	--	--
Yuba	--	--	--	--	0.0	--	--	0.0
Total	1.2	16.3	0.4	0.001	3.1	0.01	0.01	0.5
Classification	Severe	Severe	Maintenance	PM2.5 Precursor	PM2.5 Precursor	Maintenance	Nonattainment	Nonattainment
De Minimis Threshold (tpy)	25	25	100	100	100	100	100	100
Exceed?	No	No	No	No	No	No	No	No

Note:

[1]The Sacramento Metro 8-hour O3 nonattainment area consists of Sacramento and Yolo Counties and parts of El Dorado, Placer, Solano, and Sutter Counties. Emissions occurring within the attainment area of these counties are excluded from the total emissions.

[2]The Sacramento Area CO maintenance area is based on the Census Bureau Urbanized Area and consists of parts of Placer, Sacramento, and Yolo Counties. The general conformity applicability evaluation is based on emissions that would occur within the entire county to be conservative.

[3]All counties are designated as attainment areas for SO2; however, since SO2 is a precursor to PM2.5, its emissions must be evaluated under general conformity.

[4]The 24-hour PM2.5 nonattainment area for Sacramento includes Sacramento County and parts of El Dorado, Placer, Solano, and Yolo Counties. The general conformity applicability analysis assumes that all emissions that could occur within each county would occur within the Sacramento nonattainment area to be conservative.

[5]VOC and NOx emissions are excluded from Sutter County for Cranmore Farms, Garden Highway Mutual Water Company, Gilsizer Slough Ranch, Pelger Mutual Water Company, Reclamation District 1004, and Tule Basin Farms because they are located in areas designated as attainment for the federal 8-hour O3 NAAQS.

[6]The Yuba City-Marysville PM2.5 nonattainment area contains all of Sutter County and a part of Yuba County.

Table F-51. Emissions Outside of 8-Hour Ozone Nonattainment Area (tons per year)

Water Agency	County	VOC	NOx
Cranmore Farms	Sutter	Electric	Electric
Garden Highway Mutual Water Company	Sutter	Electric	Electric
Gilsizer Slough Ranch	Sutter	0.1	1.8
Pelger Mutual Water Company	Sutter	0.1	1.2
Reclamation District 1004	Sutter	n/a	n/a
Tule Basin Farms	Sutter	0.3	1.4
Total		0.4	4.3

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-52. Daily VOC Emissions

Water Agency	Daily VOC Emissions (lbs/day)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									13.32		13.32
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.92				0.92
Pleasant Grove-Verona Mutual Water Company							2.21		Electric		2.21
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		27.07	3.98				n/a				31.05
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				1.57							1.57
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.26				1.26
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							3.70				3.70
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**28.61**	**3.98**	**1.57**	**0.00**	**0.00**	**8.10**	**0.00**	**13.32**	**0.00**	**55.58**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-53. Daily NOx Emissions

Water Agency	Daily NOx Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									147.70		147.70
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		29.38									29.38
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							17.49				17.49
Pleasant Grove-Verona Mutual Water Company							22.80		Electric		22.80
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		354.91	49.10				n/a				404.01
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				54.26							54.26
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							23.92				23.92
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							19.21				19.21
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**384.29**	**49.10**	**54.26**	**0.00**	**0.00**	**83.42**	**0.00**	**147.70**	**0.00**	**718.77**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-54. Daily CO Emissions

Water Agency	Daily CO Emissions (lbs/day)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									125.01		125.01
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		27.06									27.06
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							23.01				23.01
Pleasant Grove-Verona Mutual Water Company							48.31		Electric		48.31
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		118.57	10.58				n/a				129.15
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				4.22							4.22
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							31.47				31.47
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							9.95				9.95
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**145.63**	**10.58**	**4.22**	**0.00**	**0.00**	**112.75**	**0.00**	**125.01**	**0.00**	**398.18**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-55. Daily SOx Emissions

Water Agency	Daily SOx Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									25.40		25.40
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		9.63									9.63
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							5.73				5.73
Pleasant Grove-Verona Mutual Water Company							13.72		Electric		13.72
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		36.05	3.25				n/a				39.29
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.01							0.01
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							7.84				7.84
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**45.68**	**3.25**	**0.01**	**0.00**	**0.00**	**27.32**	**0.00**	**25.40**	**0.00**	**101.65**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-56. Daily PM10 Emissions

Water Agency	Daily PM10 Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.39		6.39
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.38				1.38
Pleasant Grove-Verona Mutual Water Company							1.49		Electric		1.49
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		6.37	0.52				n/a				6.90
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.13							0.13
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.89				1.89
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.31				0.31
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**7.92**	**0.52**	**0.13**	**0.00**	**0.00**	**5.07**	**0.00**	**6.39**	**0.00**	**20.04**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-57. Daily PM2.5 Emissions

Water Agency	Daily PM2.5 Emissions (lbs/day)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.39		6.39
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.38				1.38
Pleasant Grove-Verona Mutual Water Company							1.47		Electric		1.47
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		6.30	0.51				n/a				6.81
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.13							0.13
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.89				1.89
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.31				0.31
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**7.84**	**0.51**	**0.13**	**0.00**	**0.00**	**5.06**	**0.00**	**6.39**	**0.00**	**19.93**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-58. Annual VOC Emissions

Water Agency	Annual VOC Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.71		0.71
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.06				0.06
Pleasant Grove-Verona Mutual Water Company							0.35		Electric		0.35
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		1.03	0.15				n/a				1.18
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.14							0.14
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.09				0.09
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.27				0.27
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**1.14**	**0.15**	**0.14**	**0.00**	**0.00**	**0.77**	**0.00**	**0.71**	**0.00**	**2.92**

Note:

Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-59. Annual NOx Emissions

Water Agency	Annual NOx Emissions (tons per year)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									7.89		7.89
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		2.14									2.14
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.16				1.16
Pleasant Grove-Verona Mutual Water Company							3.56		Electric		3.56
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		13.49	1.87				n/a				15.36
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				4.88							4.88
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.77				1.77
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							1.41				1.41
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**15.64**	**1.87**	**4.88**	**0.00**	**0.00**	**7.90**	**0.00**	**7.89**	**0.00**	**38.17**

Note:

Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-60. Annual CO Emissions

Water Agency	Annual CO Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.68		6.68
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.97									1.97
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.53				1.53
Pleasant Grove-Verona Mutual Water Company							7.54		Electric		7.54
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		4.51	0.40				n/a				4.91
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.38							0.38
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							2.33				2.33
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.73				0.73
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**6.48**	**0.40**	**0.38**	**0.00**	**0.00**	**12.13**	**0.00**	**6.68**	**0.00**	**26.07**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-61. Annual SOx Emissions

Water Agency	Annual SOx Emissions (tons per year)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									1.36		1.36
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.70									0.70
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.38				0.38
Pleasant Grove-Verona Mutual Water Company							2.14		Electric		2.14
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		1.37	0.12				n/a				1.49
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.00							0.00
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.58				0.58
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.00				0.00
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**2.07**	**0.12**	**0.00**	**0.00**	**0.00**	**3.10**	**0.00**	**1.36**	**0.00**	**6.66**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-62. Annual PM10 Emissions

Water Agency	Annual PM10 Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.34		0.34
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.09				0.09
Pleasant Grove-Verona Mutual Water Company							0.23		Electric		0.23
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		0.24	0.02				n/a				0.26
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.01							0.01
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.14				0.14
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**0.36**	**0.02**	**0.01**	**0.00**	**0.00**	**0.49**	**0.00**	**0.34**	**0.00**	**1.22**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-63. Annual PM2.5 Emissions

Water Agency	Annual PM2.5 Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.34		0.34
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.09				0.09
Pleasant Grove-Verona Mutual Water Company							0.23		Electric		0.23
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		0.24	0.02				n/a				0.26
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.01							0.01
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.14				0.14
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**0.35**	**0.02**	**0.01**	**0.00**	**0.00**	**0.48**	**0.00**	**0.34**	**0.00**	**1.21**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

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Groundwater Substitution Air Quality Emissions (Mitigated)

Agency	Pleasant Grove-Verona Mutual Water Company		Federal Attainment Status				Peak Month	
Transfer Volume	18,000	acre feet/year		Sutter	Yolo		4,000	AF/month
Location	Sutter	County	PM10	A	A	Engines subject to ATCM.	29,198	gallons/minute
	Yolo	County	PM2.5	N	N		37%	peak pump rate
			O3	N	N			

Table F-64. Pleasant Grove-Verona Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
PGVMWCWill-Lee 4A	Will-Lee 4A	Sutter	Diesel	2012	160	T4I	1,500	2%	77	345	4	1,248	11,206	0.14	0.3	3.7	0.93	0.01	0.01	0.20	0.42	5.26	1.31	0.02	0.02	0.03	0.07	0.82	0.20	0.00	0.00
PGVMWCRiver Ranch #19	River Ranch #19	Sutter	Diesel	2010	200	T3	2,500	3%	128	575	4	1,248	14,008	0.1	2.8	2.6	0.93	0.15	0.15	0.26	5.00	4.61	1.64	0.26	0.26	0.04	0.78	0.72	0.26	0.04	0.04
PGVMWCMLF #1	MLF #1	Sutter	Electric		30	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCMLF #2	MLF #2	Sutter	Electric		250	n/a	5,000	6%	255	1,149	4	1,248	n/a																		
PGVMWCMLF Monster Well	MLF Monster Well	Sutter	Electric		60	n/a	3,100	4%	158	713	4	1,248	n/a																		
PGVMWCMLF #17/12	MLF #17/12	Sutter	Electric		50	n/a	1,500	2%	77	345	4	1,248	n/a																		
PGVMWCMLF #11	MLF #11	Sutter	Diesel	2011	250	T4I	4,200	5%	215	966	4	1,248	17,510	0.14	0.3	2.6	0.93	0.01	0.01	0.31	0.66	5.76	2.05	0.03	0.03	0.05	0.10	0.90	0.32	0.01	0.01
PGVMWCMLF #13/15	MLF #13/15	Sutter	Electric		240	n/a	4,800	6%	245	1,103	4	1,248	n/a																		
PGVMWCMLF #16	MLF #16	Sutter	Electric		240	n/a	1,700	2%	87	391	4	1,248	n/a																		
PGVMWCWilley #1	Willey #1	Sutter	Diesel	2012	168	T4I	3,000	4%	153	690	4	1,248	11,767	0.14	0.3	3.7	0.93	0.01	0.01	0.21	0.44	5.53	1.38	0.02	0.02	0.03	0.07	0.86	0.21	0.00	0.00
PGVMWCWilley #2	Willey #2	Sutter	Electric		250	n/a	3,000	4%	153	690	4	1,248	n/a																		
PGVMWCWilley #3	Willey #3	Sutter	Electric		250	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCWilley #4	Willey #4	Sutter	Diesel	2010	150	T3	3,000	4%	153	690	4	1,248	10,506	0.1	2.8	3.7	0.93	0.22	0.22	0.20	3.75	4.94	1.23	0.30	0.30	0.03	0.59	0.77	0.19	0.05	0.05
PGVMWCScheidel&Osterli #18A	Scheidel&Osterli #18A	Sutter	Electric	TBD	250	n/a	2,500	3%	128	575	4	1,248	n/a																		
PGVMWCWill-Lee 30	Will-Lee 30	Sutter	Diesel	2012	100	T4I	1,500	2%	77	345	4	1,248	7,004	0.14	0.3	3.7	0.93	0.01	0.01	0.13	0.26	3.29	0.82	0.01	0.01	0.02	0.04	0.51	0.13	0.00	0.00
PGVMWCWill-Lee 31	Will-Lee 31	Sutter	Electric		250	n/a	2,500	3%	128	575	4	1,248	n/a																		
PGVMWCWill-Lee 32	Will-Lee 32	Sutter	Electric		250	n/a	2,500	3%	128	575	4	1,248	n/a																		
PGVMWCWill-Lee 33	Will-Lee 33	Sutter	Electric		250	n/a	2,500	3%	128	575	4	1,248	n/a																		
PGVMWCNicholas Sand Field Well	Nicholas Sand Field Well	Sutter	Diesel	2008	62.1	T4I	2,000	3%	102	460	4	1,248	4,350	0.2	3.3	3.7	0.93	0.22	0.22	0.10	1.82	2.04	0.51	0.12	0.12	0.01	0.28	0.32	0.08	0.02	0.02
PGVMWCNicholas Filipino Camp #2	Nicholas Filipino Camp #2	Sutter	Electric		40	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCNicholas Filipino Camp South	Nicholas Filipino Camp South	Sutter	Diesel	2008	62.1	T4I	2,000	3%	102	460	4	1,248	4,350	0.2	3.3	3.7	0.93	0.22	0.22	0.10	1.82	2.04	0.51	0.12	0.12	0.01	0.28	0.32	0.08	0.02	0.02
PGVMWCNicholas Johnston Field Well #2	Nicholas Johnston Field Well #2	Sutter	Electric		250	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCNicholas Johnston Well	Nicholas Johnston Well	Yolo	Electric		250	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCNicholas 72-acre Field South	Nicholas 72-acre Field South	Sutter	Diesel	2008	62.1	T4I	2,000	3%	102	460	4	1,248	4,350	0.2	3.3	3.7	0.93	0.22	0.22	0.10	1.82	2.04	0.51	0.12	0.12	0.01	0.28	0.32	0.08	0.02	0.02
PGVMWCNicholas 72-Acre Field North	Nicholas 72-Acre Field North	Sutter	Electric		250	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCNicholas BBC Well	Nicholas BBC Well	Sutter	Electric		250	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCKelly 190 Field Well #2	Kelly 190 Field Well #2	Sutter	Electric		30	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCKelly Windmill Field Well #2	Kelly Windmill Field Well #2	Sutter	Diesel	2008	62.1	T4I	2,000	3%	102	460	4	1,248	4,350	0.2	3.3	3.7	0.93	0.22	0.22	0.10	1.82	2.04	0.51	0.12	0.12	0.01	0.28	0.32	0.08	0.02	0.02
PGVMWCKelly Windmill North Field Well	Kelly Windmill North Field Well	Sutter	Diesel	2008	62.1	T4I	2,000	3%	102	460	4	1,248	4,350	0.2	3.3	3.7	0.93	0.22	0.22	0.10	1.82	2.04	0.51	0.12	0.12	0.01	0.28	0.32	0.08	0.02	0.02
PGVMWCKelly 306 Well	Kelly 306 Well	Sutter	Electric		250	n/a	2,600	3%	133	598	4	1,248	n/a																		
PGVMWCScheidel&Osterli #16	Scheidel&Osterli #16	Sutter	Diesel	2011	234	T4I	3,400	4%	174	782	4	1,248	16,389	0.14	0.3	2.6	0.93	0.01	0.01	0.29	0.62	5.39	1.92	0.03	0.03	0.05	0.10	0.84	0.30	0.00	0.00
PGVMWCScheidel&Osterli #17	Scheidel&Osterli #17	Sutter	Diesel	2010	101	T3	1,500	2%	77	345	4	1,248	7,074	0.1	2.8	3.7	0.93	0.22	0.22	0.13	2.53	3.32	0.83	0.20	0.20	0.02	0.39	0.52	0.13	0.03	0.03
						Total	**78,300**	**100%**	**4,000**	**18,000**	**128**	**39,951**	**117,213**							**2.21**	**22.80**	**48.31**	**13.72**	**1.49**	**1.47**	**0.35**	**3.56**	**7.54**	**2.14**	**0.23**	**0.23**
						Total (Sutter County)	**76,300**	**97%**	**3,898**	**17,540**	**124**	**38,703**	**117,213**							**2.21**	**22.80**	**48.31**	**13.72**	**1.49**	**1.47**	**0.35**	**3.56**	**7.54**	**2.14**	**0.23**	**0.23**
						Total (Yolo County)	**2,000**	**3%**	**102**	**460**	**4**	**1,248**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Notes:

If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).

AP-42 emission factors used for SOx in all cases.

If an emission standard is not available for a given pollutant, then AP-42 emission factors used.

PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend

(green)	Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type
(blue)	Emission factor based on NMHC+NOx emission standard
(purple)	Emissions of all pollutants consistent with the applicable tier necessary to control PM emissions under the ATCM for mitigation

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Daily Hours of Operation	4

Groundwater Substitution Air Quality Emissions (Mitigated)

Agency	Sacramento Suburban Water District	Federal Attainment Status			Peak Month	
Transfer Volume	30,000 acre feet/year	PM10	M	*Engines subject to ATCM.*	5,000	AF/month
Location	Sacramento County	PM2.5	N		36,498	gallons/minute
		O3	N		74%	peak pump rate

Table F-65. Sacramento Suburban Water District Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (MMBtu/yr)	Emission Factors (lb/MMBtu) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Sacramento Suburban WD5	5	Sacramento	Electric		110	n/a	330	1%	34	201	18	3,312	n/a																		
Sacramento Suburban WD7	7	Sacramento	Electric		110	n/a	180	0%	18	110	18	3,312	n/a																		
Sacramento Suburban WD9	9	Sacramento	Electric		110	n/a	625	1%	64	381	18	3,312	n/a																		
Sacramento Suburban WD12	12	Sacramento	Electric		110	n/a	540	1%	55	329	18	3,312	n/a																		
Sacramento Suburban WD13	13	Sacramento	Electric		110	n/a	820	2%	83	500	18	3,312	n/a																		
Sacramento Suburban WD14	14	Sacramento	Electric		110	n/a	570	1%	58	348	18	3,312	n/a																		
Sacramento Suburban WD18	18	Sacramento	Electric		110	n/a	840	2%	85	512	18	3,312	n/a																		
Sacramento Suburban WD19	19	Sacramento	Electric		110	n/a	950	2%	97	579	18	3,312	n/a																		
Sacramento Suburban WD22	22	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD23	23	Sacramento	Electric		110	n/a	550	1%	56	335	18	3,312	n/a																		
Sacramento Suburban WD24	24	Sacramento	Electric		110	n/a	590	1%	60	360	18	3,312	n/a																		
Sacramento Suburban WD25	25	Sacramento	Electric		110	n/a	750	2%	76	457	18	3,312	n/a																		
Sacramento Suburban WD26	26	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD28	28	Sacramento	Electric		110	n/a	585	1%	59	357	18	3,312	n/a																		
Sacramento Suburban WD30	30	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD35	35	Sacramento	Electric		110	n/a	1000	2%	102	610	18	3,312	n/a																		
Sacramento Suburban WD37	37	Sacramento	Natural Gas		190	n/a	700	1%	71	427	2.5	450	599	0.118	4.08	0.317	0.000588	0.009987	0.009987	0.39	13.57	1.05	0.00	0.03	0.03	0.04	1.22	0.09	0.00	0.00	0.00
Sacramento Suburban WD38	38	Sacramento	Natural Gas		190	n/a	500	1%	51	305	2.5	450	599	0.118	4.08	0.317	0.000588	0.009987	0.009987	0.39	13.57	1.05	0.00	0.03	0.03	0.04	1.22	0.09	0.00	0.00	0.00
Sacramento Suburban WD40	40	Sacramento	Natural Gas		190	n/a	675	1%	69	412	2.5	450	599	0.118	4.08	0.317	0.000588	0.009987	0.009987	0.39	13.57	1.05	0.00	0.03	0.03	0.04	1.22	0.09	0.00	0.00	0.00
Sacramento Suburban WD41	41	Sacramento	Electric		110	n/a	600	1%	61	366	18	3,312	n/a																		
Sacramento Suburban WD43	43	Sacramento	Electric		110	n/a	850	2%	86	518	18	3,312	n/a																		
Sacramento Suburban WD45	45	Sacramento	Natural Gas		190	n/a	750	2%	76	457	2.5	450	599	0.118	4.08	0.317	0.000588	0.009987	0.009987	0.39	13.57	1.05	0.00	0.03	0.03	0.04	1.22	0.09	0.00	0.00	0.00
Sacramento Suburban WD47	47	Sacramento	Electric		110	n/a	885	2%	90	540	18	3,312	n/a																		
Sacramento Suburban WD50	50	Sacramento	Electric		110	n/a	500	1%	51	305	18	3,312	n/a																		
Sacramento Suburban WD51	51	Sacramento	Electric		110	n/a	285	1%	29	174	18	3,312	n/a																		
Sacramento Suburban WD60	60	Sacramento	Electric		110	n/a	600	1%	61	366	18	3,312	n/a																		
Sacramento Suburban WD65	65	Sacramento	Electric		110	n/a	1250	3%	127	762	18	3,312	n/a																		
Sacramento Suburban WD66	66	Sacramento	Electric		110	n/a	1350	3%	137	823	18	3,312	n/a																		
Sacramento Suburban WD69	69	Sacramento	Electric		110	n/a	450	1%	46	274	18	3,312	n/a																		
Sacramento Suburban WD70	70	Sacramento	Electric		110	n/a	350	1%	36	213	18	3,312	n/a																		
Sacramento Suburban WD71	71	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD72	72	Sacramento	Electric		110	n/a	1850	4%	188	1,128	18	3,312	n/a																		
Sacramento Suburban WD73	73	Sacramento	Electric		110	n/a	3500	7%	356	2,134	18	3,312	n/a																		
Sacramento Suburban WD74	74	Sacramento	Electric		110	n/a	2700	5%	274	1,647	18	3,312	n/a																		
Sacramento Suburban WD75	75	Sacramento	Electric		110	n/a	1150	2%	117	701	18	3,312	n/a																		
Sacramento Suburban WD76	76	Sacramento	Electric		110	n/a	250	1%	25	152	18	3,312	n/a																		
Sacramento Suburban WD77	77	Sacramento	Electric		110	n/a	400	1%	41	244	18	3,312	n/a																		
Sacramento Suburban WD20A	20A	Sacramento	Electric		110	n/a	1100	2%	112	671	18	3,312	n/a																		
Sacramento Suburban WD2A	2A	Sacramento	Electric		110	n/a	995	2%	101	607	18	3,312	n/a																		
Sacramento Suburban WD32A	32A	Sacramento	Electric		110	n/a	1905	4%	194	1,162	18	3,312	n/a																		
Sacramento Suburban WD33A	33A	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD3A	3A	Sacramento	Electric		110	n/a	370	1%	38	226	18	3,312	n/a																		
Sacramento Suburban WD40A	40A	Sacramento	Electric		110	n/a	2525	5%	257	1,540	18	3,312	n/a																		
Sacramento Suburban WD46R	46R	Sacramento	Electric		110	n/a	800	2%	81	488	18	3,312	n/a																		
Sacramento Suburban WD4B	4B	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD55A	55A	Sacramento	Electric		110	n/a	2000	4%	203	1,220	18	3,312	n/a																		
Sacramento Suburban WD68R	68R	Sacramento	Electric		110	n/a	1600	3%	163	976	18	3,312	n/a																		
						Total	**49,195**	**100%**	**5,000**	**30,000**	**790**	**144,209**	**2,394**							**1.57**	**54.26**	**4.22**	**0.01**	**0.13**	**0.13**	**0.14**	**4.88**	**0.38**	**0.00**	**0.01**	**0.01**

Legend

(green)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
(purple)	Dual-fuel engine (electric and natural gas) required to operate in electric mode to mitigate emissions
(orange)	Operation of natural gas fired engines will be controlled to reduce emissions less than significance thresholds as mitigation

Conversion Factors

1 MMBtu =	1,000,000	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC =	7,000	Btu/bhp-hr	(Estimated from Waukesha engine specifications)
Higher Heating Value	1,020	Btu/scf	(AP-42, Chapter 3.2: Natural Gas-fired Reciprocating Engines)

Groundwater Substitution Air Quality Emissions (Mitigated)

Agency Gilsizer Slough Ranch
Transfer Volume 3,900 acre feet/year
Location Sutter County

Federal Attainment Status

PM10	A	*Engines subject to ATCM.*
PM2.5	N	
O3	N	

Peak Month
800 AF/month
5,840 gallons/minute
97% peak pump rate

Table F-66. Gilsizer Slough Ranch Criteria Pollutant Emissions

		Well Location			Power Rating	Emission	Pump Rate		Transfer Volume		Operation		Fuel Consumption	Emission Factors (g/bhp-hr)						Daily Emissions (lbs/day)						Annual Emissions (tons per year)					
Description	**Well**	**(County)**	**Fuel Type**	**Model Year**	**(hp)**	**Tier**	**(gpm)**	**(% of Total)**	**(AF/month)**	**(AF/year)**	**(hours/day)**	**(hours/year)**	**(gal/yr)**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Gilsizer #1	Gilsizer #1	Sutter	Diesel	2011	162	T3	2,016	33%	267	1,300	24	3,502	31,828	0.1	2.8	3.7	0.93	0.22	0.22	1.26	23.92	31.47	7.84	1.89	1.89	0.09	1.77	2.33	0.58	0.14	0.14
Gilsizer #2	Gilsizer #2	Sutter	Electric	TBD	110	n/a	2,016	33%	267	1,300	24	3,502	n/a																		
Gilsizer #3	Gilsizer #3	Sutter	Electric	TBD	110	n/a	2,016	33%	267	1,300	24	3,502	n/a																		
						Total	**6,048**	**100%**	**800**	**3,900**	**71**	**10,506**	**31,828**							**1.26**	**23.92**	**31.47**	**7.84**	**1.89**	**1.89**	**0.09**	**1.77**	**2.33**	**0.58**	**0.14**	**0.14**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend

(green)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
(blue)	Based on NMHC+NOx standard

Conversion Factors

1 lb =	453.6 g
1 ton =	2,000 lbs
1 month =	30.4 days
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4 lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal	

Groundwater Substitution Air Quality Emissions (Mitigated)

Agency	Tule Basin Farms		Federal Attainment Status			Peak Month
Transfer Volume	7,320 acre feet/year		PM10	A	*Engines subject to ATCM.*	1,520 AF/month
Location	Sutter County		PM2.5	N		11,095 gallons/minute
			O3	N		96% peak pump rate

Table F-67. Tule Basin Farms Criteria Pollutant Emissions

Description	Well	Well Location	Fuel Type	Model Year	Power Rating	Emission	Pump Rate		Transfer Volume		Operation		Fuel Consumption	Emission Factors (lb/MMBtu)						Daily Emissions (lbs/day)						Annual Emissions (tons per year)					
		(County)			(hp)	Tier	(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)	(MMBtu/yr)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Tule Basin1	1	Sutter	Electric		125	n/a	3,050	27%	403	1,941	24	3,457	n/a																		
Tule Basin2	2	Sutter	Natural Gas	1985	190	n/a	3,600	31%	476	2,291	24	3,457	4,598	0.118	0.61	0.317	0.000588	0.009987	0.009987	3.70	19.21	9.95	0.02	0.31	0.31	0.27	1.41	0.73	0.00	0.02	0.02
Tule Basin3	3	Sutter	Electric		125	n/a	4,850	42%	641	3,087	24	3,457	n/a																		
						Total	**11,500**	**100%**	**1,520**	**7,320**	**71**	**10,371**	**4,598**							**3.70**	**19.21**	**9.95**	**0.02**	**0.31**	**0.31**	**0.27**	**1.41**	**0.73**	**0.00**	**0.02**	**0.02**

Conversion Factors

1 MMBtu =	1,000,000 Btu
1 ton =	2,000 lbs
1 month =	30.4 days
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC =	7,000 Btu/bhp-hr	(Estimated from Waukesha engine specifications)
Higher Heating Value	1,020 Btu/scf	(AP-42, Chapter 3.2: Natural Gas-fired Reciprocating Engines)

SCR control efficiency	85%

Table F-68. Summary of Cropland Idling Emissions by Water Agency

	Daily Emissions (lbs per day)						Annual Emissions (tons per year)					
Water Agency	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Butte Water District												
Exhaust Emissions	(1)	(13)	(17)	(4)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(142)	(21)	--	--	--	--	(13)	(2)
Harvesting	--	--	--	--	(17)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	6	1	--	--	--	--	1	0
Butte Water District Subtotal	(1)	(13)	(17)	(4)	(153)	(23)	(0)	(1)	(1)	(0)	(14)	(2)
Conaway Preservation Group												
Exhaust Emissions	(1)	(23)	(31)	(8)	(2)	(2)	(0)	(2)	(2)	(1)	(0)	(0)
Land Preparation	--	--	--	--	(205)	(31)	--	--	--	--	(18)	(3)
Harvesting	--	--	--	--	(40)	(6)	--	--	--	--	(4)	(1)
Wind Erosion	--	--	--	--	18	4	--	--	--	--	2	0
Conaway Preservation Group Subtotal	(1)	(23)	(31)	(8)	(228)	(35)	(0)	(2)	(2)	(1)	(21)	(3)
Cranmore Farms												
Exhaust Emissions	(0)	(3)	(4)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(61)	(9)	--	--	--	--	(6)	(1)
Harvesting	--	--	--	--	(4)	(1)	--	--	--	--	(0)	(0)
Wind Erosion	--	--	--	--	1	0	--	--	--	--	0	0
Cranmore Farms Subtotal	(0)	(3)	(4)	(1)	(64)	(10)	(0)	(0)	(0)	(0)	(6)	(1)
Glenn-Colusa Irrigation District												
Exhaust Emissions	(4)	(72)	(95)	(24)	(6)	(6)	(0)	(5)	(6)	(2)	(0)	(0)
Land Preparation	--	--	--	--	(1,550)	(232)	--	--	--	--	(140)	(21)
Harvesting	--	--	--	--	(96)	(14)	--	--	--	--	(9)	(1)
Wind Erosion	--	--	--	--	416	83	--	--	--	--	37	7
Glenn-Colusa Irrigation District Subtotal	(4)	(72)	(95)	(24)	(1,236)	(169)	(0)	(5)	(6)	(2)	(111)	(15)
Goose Club Farms and Teichert Aggregates												
Exhaust Emissions	(1)	(11)	(14)	(4)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(245)	(37)	--	--	--	--	(22)	(3)
Harvesting	--	--	--	--	(15)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	6	1	--	--	--	--	1	0
Goose Club Farms and Teichert Aggregates Subtotal	(1)	(11)	(14)	(4)	(255)	(39)	(0)	(1)	(1)	(0)	(23)	(3)
Pelger Mutual Water Company												
Exhaust Emissions	(0)	(3)	(4)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(62)	(9)	--	--	--	--	(6)	(1)
Harvesting	--	--	--	--	(4)	(1)	--	--	--	--	(0)	(0)
Wind Erosion	--	--	--	--	1	0	--	--	--	--	0	0
Pelger Mutual Water Company Subtotal	(0)	(3)	(4)	(1)	(65)	(10)	(0)	(0)	(0)	(0)	(6)	(1)

Table F-68. Summary of Cropland Idling Emissions by Water Agency

	Daily Emissions (lbs per day)						Annual Emissions (tons per year)					
Water Agency	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Pleasant Grove-Verona Mutual Water Company												
Exhaust Emissions	(1)	(10)	(13)	(3)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(221)	(33)	--	--	--	--	(20)	(3)
Harvesting	--	--	--	--	(13)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	5	1	--	--	--	--	0	0
Pleasant Grove-Verona Mutual Water Company Subtotal	(1)	(10)	(13)	(3)	(230)	(35)	(0)	(1)	(1)	(0)	(21)	(3)
Reclamation District 108												
Exhaust Emissions	(1)	(22)	(29)	(7)	(2)	(2)	(0)	(1)	(2)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(338)	(51)	--	--	--	--	(30)	(5)
Harvesting	--	--	--	--	(33)	(5)	--	--	--	--	(3)	(0)
Wind Erosion	--	--	--	--	75	15	--	--	--	--	7	1
Reclamation District 108 Subtotal	(1)	(22)	(29)	(7)	(298)	(42)	(0)	(1)	(2)	(0)	(27)	(4)
Reclamation District 1004												
Exhaust Emissions	(1)	(11)	(14)	(4)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(238)	(36)	--	--	--	--	(21)	(3)
Harvesting	--	--	--	--	(15)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	44	9	--	--	--	--	4	1
Reclamation District 1004 Subtotal	(1)	(11)	(14)	(4)	(210)	(30)	(0)	(1)	(1)	(0)	(19)	(3)
Reclamation District 2068												
Exhaust Emissions	(0)	(8)	(11)	(3)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(39)	(6)	--	--	--	--	(4)	(1)
Harvesting	--	--	--	--	(7)	(1)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	5	1	--	--	--	--	0	0
Reclamation District 2068 Subtotal	(0)	(8)	(11)	(3)	(41)	(6)	(0)	(1)	(1)	(0)	(4)	(1)
Sycamore Mutual Water Company												
Exhaust Emissions	(1)	(11)	(14)	(4)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(242)	(36)	--	--	--	--	(22)	(3)
Harvesting	--	--	--	--	(15)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	66	13	--	--	--	--	6	1
Sycamore Mutual Water Company Subtotal	(1)	(11)	(14)	(4)	(191)	(26)	(0)	(1)	(1)	(0)	(17)	(2)

Table F-68. Summary of Cropland Idling Emissions by Water Agency

	Daily Emissions (lbs per day)						Annual Emissions (tons per year)					
Water Agency	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Te Velde Revocable Family Trust												
Exhaust Emissions	(0)	(8)	(10)	(3)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(67)	(10)	--	--	--	--	(6)	(1)
Harvesting	--	--	--	--	(13)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	6	1	--	--	--	--	1	0
Te Velde Revocable Family Trust Subtotal	(0)	(8)	(10)	(3)	(75)	(11)	(0)	(1)	(1)	(0)	(7)	(1)
Exhaust Emissions Total	(10)	(195)	(256)	(64)	(15)	(15)	(1)	(13)	(17)	(4)	(1)	(1)
Land Preparation Total	0	0	0	0	(3,409)	(511)	0	0	0	0	(307)	(46)
Harvesting Total	0	0	0	0	(271)	(41)	0	0	0	0	(24)	(4)
Wind Erosion Total	0	0	0	0	651	130	0	0	0	0	59	12
GRAND TOTAL	**(10)**	**(195)**	**(256)**	**(64)**	**(3,045)**	**(437)**	**(1)**	**(13)**	**(17)**	**(4)**	**(274)**	**(39)**

Size Fractions

Description	PM10	PM2.5	Ratio
PM Profile ID No. 411, Windblown Dust - Agricultural	0.5	0.1	0.2
PM Profile ID No. 417, Agricultural Tilling Dust	0.4543	0.0681	0.1499

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Table F-69. Reduced Exhaust Emissions from Cropland Idling

Water Agency	Groundwater Substitution	Cropland Idling/ Crop Shifting	GW Pumping Equivalent	Reduced Daily Emissions (lbs/day)						Reduced Annual Emissions (tons/year)					
	(acre-feet/year)	(acre-feet/year)	(acre-feet/year)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Butte Water District	5,500	11,500	2,706	1	13	17	4	1	1	0.0	0.8	1.1	0.3	0.1	0.1
Conaway Preservation Group	35,000	21,349	5,023	1	23	31	8	2	2	0.1	1.6	2.0	0.5	0.1	0.1
Cranmore Farms	8,000	2,500	588	0	3	4	1	0	0	0.0	0.2	0.2	0.1	0.0	0.0
Glenn-Colusa Irrigation District	25,000	66,000	15,529	4	72	95	24	6	6	0.3	4.8	6.3	1.6	0.4	0.4
Goose Club Farms and Teichert Aggregates	10,000	10,000	2,353	1	11	14	4	1	1	0.0	0.7	1.0	0.2	0.1	0.1
Pelger Mutual Water Company	3,750	2,538	597	0	3	4	1	0	0	0.0	0.2	0.2	0.1	0.0	0.0
Pleasant Grove-Verona Mutual Water Company	18,000	9,000	2,118	1	10	13	3	1	1	0.0	0.7	0.9	0.2	0.1	0.1
Reclamation District 108	15,000	20,000	4,706	1	22	29	7	2	2	0.1	1.5	1.9	0.5	0.1	0.1
Reclamation District 1004	7,175	10,000	2,353	1	11	14	4	1	1	0.0	0.7	1.0	0.2	0.1	0.1
Reclamation District 2068	4,500	7,500	1,765	0	8	11	3	1	1	0.0	0.5	0.7	0.2	0.0	0.0
Sycamore Mutual Water Company	15,000	10,000	2,353	1	11	14	4	1	1	0.0	0.7	1.0	0.2	0.1	0.1
Te Velde Revocable Family Trust	7,094	6,975	1,641	0	8	10	3	1	1	0.0	0.5	0.7	0.2	0.0	0.0
Total	**154,019**	**177,362**	**41,732**	**10**	**195**	**256**	**64**	**15**	**15**	**0.7**	**12.9**	**17.0**	**4.2**	**1.0**	**1.0**

Notes:

Pelger Mutual Water Company used to estimate emissions for other water agencies.

Engine power rating equal to 250 hp for Pelger Mutual Water Company engines.

The Byron Buck memo is based on diesel-fueled engines with sizes ranging from 121 to 225 hp; all engines are noncertified (Tier 0).

Pelger Mutual Water Company engines are therefore determined to be a sufficient proxy to estimate the difference in emissions between groundwater substitution and cropland idling.

1 acre-foot of groundwater pumped = 4.25 acre-feet produced by fallowing

Source: Byron Buck & Associates. 2009. "Comparison of Summertime Emission Credits from Land Fallowing Versus Groundwater Pumping."

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Fugitive Dust Emissions from Cropland Idling

Table F-70. Land Preparation (Reduced Emissions)

District	County	Acres Rice	Daily PM10 Emissions (lbs/day) Rice	Annual PM10 Emissions (tons per year) Rice
Sacramento River Area of Analysis				
Anderson-Cottonwood Irrigation District	Shasta/Tehama	0	0	0
Conaway Preservation Group	Yolo	6,469	205	18
Cordua Irrigation District	Yuba	0	0	0
Cranmore Farms	Sutter	758	61	6
Eastside Mutual Water Company	Colusa	0	0	0
Glenn-Colusa Irrigation District	Glenn/Colusa	20,000	1,550	140
Natomas Central Mutual Water Company	Sacramento/Sutter	0	0	0
Pelger Mutual Water Company	Sutter	769	62	6
Pleasant Grove-Verona Mutual Water Company	Sutter	2,727	221	20
Reclamation District 108	Colusa/Yolo	6,061	338	30
Reclamation District 1004	Colusa/Glenn/Sutter	3,030	238	21
River Garden Farms	Yolo	0	0	0
Sycamore Mutual Water Company	Colusa	3,030	242	22
Te Velde Revocable Family Trust	Yolo	2,114	67	6
American River Area of Analysis				
City of Sacramento	Sacramento	0	0	0
Placer County Water Agency	Placer	0	0	0
Sacramento County Water Agency	Sacramento	0	0	0
Sacramento Suburban Water District	Sacramento	0	0	0
Yuba River Area of Analysis				
Browns Valley Irrigation District	Yuba	0	0	0
Feather River Area of Analysis				
Butte Water District	Butte/Sutter	3,485	142	13
Garden Highway Mutual Water Company	Sutter	0	0	0
Gilsizer Slough Ranch	Sutter	0	0	0
Goose Club Farms and Teichert Aggregates	Sutter	3,030	245	22
South Sutter Water District	Sutter/Placer	0	0	0
Tule Basin Farms	Sutter	0	0	0
Merced River Area of Analysis				
Merced Irrigation District	Merced	0	0	0
Delta Region Area of Analysis				
Reclamation District 2068	Solano/Yolo	2,273	39	4
Pope Ranch	Yolo	0	0	0
Total		**53,746**	**3,409**	**307**

Table F-71. Harvesting (Reduced Emissions)

District	County	Acres	Daily PM10 Emissions (lbs/day)	Annual PM10 Emissions (tons per year)
		Rice	Rice	Rice
Sacramento River Area of Analysis				
Anderson-Cottonwood Irrigation District	Shasta/Tehama	0	0	0
Conaway Preservation Group	Yolo	6,469	40	4
Cordua Irrigation District	Yuba	0	0	0
Cranmore Farms	Sutter	758	4	0
Eastside Mutual Water Company	Colusa	0	0	0
Glenn-Colusa Irrigation District	Glenn/Colusa	20,000	96	9
Natomas Central Mutual Water Company	Sacramento/Sutter	0	0	0
Pelger Mutual Water Company	Sutter	769	4	0
Pleasant Grove-Verona Mutual Water Company	Sutter	2,727	13	1
Reclamation District 108	Colusa/Yolo	6,061	33	3
Reclamation District 1004	Colusa/Glenn/Sutter	3,030	15	1
River Garden Farms	Yolo	0	0	0
Sycamore Mutual Water Company	Colusa	3,030	15	1
Te Velde Revocable Family Trust	Yolo	2,114	13	1
American River Area of Analysis				
City of Sacramento	Sacramento	0	0	0
Placer County Water Agency	Placer	0	0	0
Sacramento County Water Agency	Sacramento	0	0	0
Sacramento Suburban Water District	Sacramento	0	0	0
Yuba River Area of Analysis				
Browns Valley Irrigation District	Yuba	0	0	0
Feather River Area of Analysis				
Butte Water District	Butte/Sutter	3,485	17	1
Garden Highway Mutual Water Company	Sutter	0	0	0
Gilsizer Slough Ranch	Sutter	0	0	0
Goose Club Farms and Teichert Aggregates	Sutter	3,030	15	1
South Sutter Water District	Sutter/Placer	0	0	0
Tule Basin Farms	Sutter	0	0	0
Merced River Area of Analysis				
Merced Irrigation District	Merced	0	0	0
Delta Region Area of Analysis				
Reclamation District 2068	Solano/Yolo	2,273	7	1
Pope Ranch	Yolo	0	0	0
Total		**53,746**	**271**	**24**

Table F-72. Windblown Dust (Increased Emissions)

District	County	Acres	Daily PM10 Emissions (lbs/day)	Annual PM10 Emissions (tons per year)
		Rice	Rice	Rice
Sacramento River Area of Analysis				
Anderson-Cottonwood Irrigation District	Shasta/Tehama	0	--	--
Conaway Preservation Group	Yolo	6,469	18	2
Cordua Irrigation District	Yuba	0	--	--
Cranmore Farms	Sutter	758	1	0
Eastside Mutual Water Company	Colusa	0	--	--
Glenn-Colusa Irrigation District	Glenn/Colusa	20,000	416	37
Natomas Central Mutual Water Company	Sacramento/Sutter	0	--	--
Pelger Mutual Water Company	Sutter	769	1	0
Pleasant Grove-Verona Mutual Water Company	Sutter	2,727	5	0
Reclamation District 108	Colusa/Yolo	6,061	75	7
Reclamation District 1004	Colusa/Glenn/Sutter	3,030	44	4
River Garden Farms	Yolo	0	--	--
Sycamore Mutual Water Company	Colusa	3,030	66	6
Te Velde Revocable Family Trust	Yolo	2,114	6	1
American River Area of Analysis				
City of Sacramento	Sacramento	0	--	--
Placer County Water Agency	Placer	0	--	--
Sacramento County Water Agency	Sacramento	0	--	--
Sacramento Suburban Water District	Sacramento	0	--	--
Yuba River Area of Analysis				
Browns Valley Irrigation District	Yuba	0	--	--
Feather River Area of Analysis				
Butte Water District	Butte/Sutter	3,485	6	1
Garden Highway Mutual Water Company	Sutter	0	--	--
Gilsizer Slough Ranch	Sutter	0	--	--
Goose Club Farms and Teichert Aggregates	Sutter	3,030	6	1
South Sutter Water District	Sutter/Placer	0	--	--
Tule Basin Farms	Sutter	0	--	--
Merced River Area of Analysis				
Merced Irrigation District	Merced	0	--	--
Delta Region Area of Analysis				
Reclamation District 2068	Solano/Yolo	2,273	5	0
Pope Ranch	Yolo	0	--	--
Total		**53,746**	**651**	**59**

Note:
Fraction of PM10 (FRPM10) from wind erosion: 0.50
(PM10 Emissions = PM x FRPM10)

Conversions

1 ton =	2,000	pounds	
Project duration =	180	days	(assumes 6-month crop idling season)

Legend

(green)	Windblown dust emission factor for pasture land used because emission factor for agricultural lands not available.
(blue)	Windblown dust emission factor for pasture land used because emission factor for agricultural lands not available (for Yolo County only).
(orange)	Windblown dust emission factor for pasture land used because emission factor for agricultural lands not available (for Sutter County only).

Agricultural Land Preparation

Table F-73. Summary of Crop Profile, Acre-Pass, and Emission Factor

Crop profile	Land Preparation Operations	Category	Acre-Pass	Emission Factor Operation (lbs PM10/Acre-pass)	Emission Factor Crop (lbs PM10/Acre/year)
Alfalfa	Unspecified	Discing	1.25	1.2	4
	Land Maintenance	Land Planing	0.2	12.5	
Almonds	Float	Land Planing	0.25	12.5	3.13
Citrus	Unspecified	Discing	0.06	1.2	0.07
Corn	List & Fertilize	Weeding	1	0.8	6.9
	Mulch Beds	Discing	1	1.2	
	Finish Disc	Discing	1	1.2	
	Land Maintenance	Land Planing	0.2	12.5	
	Stubble Disc	Discing	1	1.2	
Cotton	Land Preparation	Discing	4	1.2	8.9
	Land Maintenance	Land Planing	0.2	12.5	
	Seed Bed Preparation	Weeding	2	0.8	
DryBeans	Land Maintenance	Land Planing	0.2	12.5	7.7
	Chisel	Discing	1	1.2	
	Shaping	Weeding	1	0.8	
	Disc	Discing	2	1.2	
	Listing	Weeding	1	0.8	
Garbanzo	Chisel	Discing	1	1.2	7.7
	Listing	Weeding	1	0.8	
	Shaping	Weeding	1	0.8	
	Disc	Discing	2	1.2	
	Land Maintenance	Land Planing	0.2	12.5	
Garlic	Land Maintenance	Land Planing	0.2	12.5	6.5
	Disc & Roll	Discing	1	1.2	
	Chisel	Discing	1	1.2	
	List	Weeding	1	0.8	
	Shape Beds	Weeding	1	0.8	
Grapes-Raisin	Terrace	Weeding	1	0.8	2.6
	Spring Tooth	Weeding	0.2	0.8	
	Subsoil	Ripping	0.05	4.6	
	Disc & Furrow-out	Discing	1	1.2	
	Level (new vineyard)	Land Planing	0.02	12.5	
Grapes-Table	Subsoil	Ripping	0.05	4.6	0.83
	Disc & Furrow-out	Discing	0.5	1.2	
Grapes-Wine	Level (new vineyard)	Land Planing	0.02	12.5	1.5
	Spring Tooth	Weeding	0.2	0.8	
	Subsoil	Ripping	0.05	4.6	
	Disc & Furrow-out	Discing	0.75	1.2	
Lettuce*	Land Maintenance	Land Planing	0.2	12.5	12.75
	Disc & Roll	Discing	2/2	1.2	
	Chisel	Discing	2/2	1.2	
	List	Weeding	2/2	0.8	
	Plane	Land Planing	½	12.5	
	Shape Beds & Roll	Weeding	2/2	0.8	
Melon	Plow	Discing	1	1.2	5.7
	Shape Beds	Weeding	1	0.8	
	Land Maintenance	Land Planing	0.2	12.5	
	Disc	Discing	1	1.2	
No Land Prep.	Unspecified	Discing	0	1.2	0
Onions	List	Weeding	1	0.8	6.5
	Shape Beds	Weeding	1	0.8	
	Land Maintenance	Land Planing	0.2	12.5	
	Chisel	Discing	1	1.2	
	Disc & Roll	Discing	1	1.2	

Agricultural Land Preparation

Table F-73. Summary of Crop Profile, Acre-Pass, and Emission Factor

Crop profile	Land Preparation Operations	Category	Acre-Pass	Emission Factor	
				Operation (lbs PM10/Acre-pass)	Crop (lbs PM10/Acre/year)
Rice	Chisel	Discing	1	1.2	20
	Land Maintenance	Land Planing	0.2	12.5	
	Post Burn/Harvest Disc	Discing	0.5	1.2	
	Roll	Weeding	1	0.8	
	3 Wheel Plane	Land Planing	1	12.5	
	Harrow Disc	Discing	1	1.2	
	Stubble Disc	Discing	1	1.2	
Safflower	List	Weeding	1	0.8	4.5
	Land Maintenance	Land Planing	0.2	12.5	
	Stubble Disc	Discing	1	1.2	
Sugar Beets	Disc	Discing	1	1.2	22.8
	Land Plane	Land Planing	1	12.5	
	Subsoil-deep chisel	Ripping	1	4.6	
	Stubble Disc	Discing	1	1.2	
	List	Weeding	1	0.8	
	Land Maintenance	Land Planing	0.2	12.5	
Tomatoes	Bed Preparation	Weeding	2	0.8	10.1
	Land Preparation	Discing	5	1.2	
	Land Maintenance	Land Planing	0.2	12.5	
Vegetables	Land Maintenance	Land Planing	0.2	12.5	8.5
	Unspecified	Discing	5	1.2	
Wheat	Stubble Disc	Discing	1	1.2	3.7
	Land Maintenance	Land Planing	0.2	12.5	

Source:
CARB. 2003. Emission Inventory Documentation, Section 7.4: Agricultural Land Preparation. January.
Accessed on: May 5, 2012. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfarmop.htm

Agricultural Harvest Operations

Table F-74. Summary of Crop Emission Factor Assumptions

CDFA Crop Code	CDFA Crop Description	Crop Profile	Assumption	Emission Factor (lbs PM10/acre/yr)
101999	WHEAT ALL	Wheat	Wheat/1	5.8
104999	RYE FOR GRAIN	Wheat	Wheat/1	5.8
106199	RICE, FOR MILLING	Rice	Cotton/2	1.68
106269	FIELD CROP BY PRODUCTS	Cotton	Cotton/20	0.17
108999	FOOD GRAINS, MISC	Corn	Cotton/2	1.68
111559	CORN, WHITE	Corn	Cotton/40	0.08
111991	CORN FOR GRAIN	Corn	Cotton/2	1.68
111992	CORN FOR SILAGE	Corn	Cotton/20	0.17
112999	OATS FOR GRAIN	Wheat	Wheat/1	5.8
113994	BARLEY, MALTING	Wheat	Wheat/1	5.8
113995	BARLEY, FEED	Wheat	Wheat/1	5.8
113999	BARLEY, UNSPECIFIED	Wheat	Wheat/1	5.8
114991	SORGHUM, GRAIN	Wheat	Wheat/1	5.8
121219	COTTON LINT, UPLAND	Cotton	Cotton/1	3.37
121229	COTTON LINT, PIMA	Cotton	Cotton/1	3.37
121299	COTTON LINT, UNSPEC	Cotton	Cotton/1	3.37
132999	SUGAR BEETS	Sugar Beets	Cotton/2	1.68
151999	COTTONSEED	Cotton	Cotton/1	3.37
153999	PEANUTS, ALL	Safflower	Cotton/2	1.68
158269	SAFFLOWER	Safflower	Wheat/1	5.8
158316	SUNFLOWER SEED, PLANTING	Corn	Wheat/1	5.8
158319	SUNFLOWER SEED	Corn	Wheat/1	5.8
158499	JOJOBA	Melon	Cotton/40	0.08
161131	BEANS, LIMAS, LG. DRY	DryBeans	Cotton/2	1.68
161132	BEANS, LIMAS, BABY DRY	DryBeans	Cotton/2	1.68
161199	LIMA BEANS, UNSPECIFIED	DryBeans	Cotton/2	1.68
161717	BEANS, RED KIDNEY	DryBeans	Cotton/2	1.68
161721	BEANS, PINK	DryBeans	Cotton/2	1.68
161741	BEANS, BLACKEYE (PEAS)	DryBeans	Cotton/2	1.68
161742	BEANS, GARBANZO	Garbanzo	Cotton/2	1.68
162399	BEANS, FAVA	DryBeans	Cotton/2	1.68
163999	PEAS, DRY EDIBLE	DryBeans	Cotton/20	0.17
169999	BEANS,UNSPEC. DRY EDIBLE	DryBeans	Cotton/2	1.68
171019	SEED WHEAT	Wheat	Wheat/1	5.8
171049	SEED RYE	Wheat	Wheat/1	5.8
171069	SEED RICE	Rice	Cotton/2	1.68
171129	SEED OATS	Wheat	Wheat/1	5.8
171139	SEED BARLEY	Wheat	Wheat/1	5.8
171519	SEED, COTTON FOR PLANTING	Cotton	Cotton/1	3.37
171582	SEED, SAFFLOWER, PLANTING	Safflower	Wheat/1	5.8
171619	SEED BEANS	DryBeans	Cotton/2	1.68
171639	SEED PEAS	DryBeans	Cotton/20	0.17
171949	SEED, MISC FIELD CROP	Corn	Cotton/20	0.17
171959	SEED, VEG & VINECROP	Vegetables	Cotton/20	0.17
172119	SEED, ALFALFA	Alfalfa	Zero/1	0
172289	CLOVER, UNSPECIFIED SEED	Alfalfa	Zero/1	0
173079	SEED, BERMUDA GRASS	Alfalfa	Zero/1	0
173669	SEED, SUDAN GRASS	Alfalfa	Zero/1	0
173999	SEED, GRASS, UNSPECIFIED	Alfalfa	Zero/1	0
178999	SEED, OTHER (NO FLOWERS)	Alfalfa	Cotton/20	0.17
181999	HAY, ALFALFA	Alfalfa	Zero/1	0
188499	HAY, GRAIN	Alfalfa	Cotton/2	1.68
188799	HAY, WILD	Alfalfa	Cotton/2	1.68
188899	HAY, SUDAN	Alfalfa	Zero/1	0
188999	HAY, OTHER UNSPECIFIED	Alfalfa	Cotton/2	1.68

Agricultural Harvest Operations

Table F-74. Summary of Crop Emission Factor Assumptions

CDFA Crop Code	CDFA Crop Description	Crop Profile	Assumption	Emission Factor (lbs PM10/acre/yr)
194599	PASTURE, IRRIGATED	No Land	Zero/1	0
194699	PASTURE, RANGE	No Land	Zero/1	0
194799	PASTURE, MISC. FORAGE	No Land	Zero/1	0
195199	SILAGE	Wheat	Cotton/20	0.17
195299	HAY, GREEN CHOP	Alfalfa	Zero/1	0
195399	STRAW	Alfalfa	Wheat/1	5.8
198199	RICE, WILD	Rice	Cotton/2	1.68
198999	FIELD CROPS, UNSPEC.	Corn	Cotton/20	0.17
201119	ORANGES, NAVEL	Citrus	Cotton/40	0.08
201519	ORANGES, VALENCIAS	Citrus	Cotton/40	0.08
201999	ORANGES, UNSPECIFIED	Citrus	Cotton/40	0.08
202999	GRAPEFRUIT, ALL	Citrus	Cotton/40	0.08
203999	TANGERINES & MANDARINS	Citrus	Cotton/40	0.08
204999	LEMONS, ALL	Citrus	Cotton/40	0.08
205999	LIMES, ALL	Citrus	Cotton/40	0.08
206999	TANGELOS	Citrus	Cotton/40	0.08
207999	KUMQUATS	Citrus	Cotton/40	0.08
208059	CITRUS, MISC BY-PROD	Citrus	Cotton/40	0.08
209999	CITRUS, UNSPECIFIED	Citrus	Cotton/40	0.08
211999	APPLES, ALL	Citrus	Cotton/40	0.08
212199	PEACHES, FREESTONE	Citrus	Cotton/40	0.08
212399	PEACHES, CLINGSTONE	Citrus	Cotton/40	0.08
212999	PEACHES, UNSPECIFIED	Citrus	Cotton/40	0.08
213199	CHERRIES, SWEET	Citrus	Cotton/40	0.08
214199	PEARS, BARLETT	Citrus	Cotton/40	0.08
214899	PEARS, ASIAN	Citrus	Cotton/40	0.08
214999	PEARS, UNSPECIFIED	Citrus	Cotton/40	0.08
215199	PLUMS	Citrus	Cotton/40	0.08
215399	PLUMCOTS	Citrus	Cotton/40	0.08
215999	PRUNES, DRIED	Citrus	Cotton/40	0.08
216199	GRAPES, TABLE	Grapes-Table	Cotton/20	0.17
216299	GRAPES, WINE	Grapes-Wine	Cotton/20	0.17
216399	GRAPES, RAISIN	Grapes-Raisin	Cotton/20	0.17
216999	GRAPES, UNSPECIFIED	Grapes-Wine	Cotton/20	0.17
217999	APRICOTS, ALL	Citrus	Cotton/40	0.08
218199	NECTARINES	Citrus	Cotton/40	0.08
218299	PERSIMMONS	Citrus	Cotton/40	0.08
218399	POMEGRANATES	Citrus	Cotton/40	0.08
218499	QUINCE	Citrus	Cotton/40	0.08
218839	CHERIMOYAS	Citrus	Cotton/40	0.08
218889	ORCHARD BIOMASS	Almonds	Cotton/40	0.08
218899	FRUITS & NUTS, UNSPEC.	Citrus	Cotton/40	0.08
221999	AVOCADOS, ALL	Citrus	Cotton/40	0.08
224999	DATES	Citrus	Almonds/20	2.04
225999	FIGS, DRIED	Citrus	Almonds/20	2.04
226999	OLIVES	Citrus	Cotton/40	0.08
228019	GUAVAS	Citrus	Cotton/40	0.08
229999	KIWIFRUIT	Citrus	Cotton/40	0.08
230639	BERRIES, BLACKBERRIES	Grapes-Table	Cotton/40	0.08
230869	BERRIES, BOYSENBERRIES	Grapes-Table	Cotton/40	0.08
234799	BERRIES, LOGANBERRIES	Grapes-Table	Cotton/40	0.08
236199	BERRIES, RASPBERRIES	Grapes-Table	Cotton/40	0.08
237199	STRAWBERRIES, FRESH MKT	Melon	Cotton/40	0.08
237299	STRAWBERRIES, PROC	Melon	Cotton/40	0.08
237999	STRAWBERRIES, UNSPECIFIED	Melon	Cotton/40	0.08

Agricultural Harvest Operations

Table F-74. Summary of Crop Emission Factor Assumptions

CDFA Crop Code	CDFA Crop Description	Crop Profile	Assumption	Emission Factor (lbs PM10/acre/yr)
239999	BERRIES, BUSH, UNSPECIFIED	Grapes-Table	Cotton/40	0.08
261999	ALMONDS, ALL	Almonds	Almonds/1	40.77
263999	WALNUTS, ENGLISH	Almonds	Almonds/1	40.77
264999	PECANS	Almonds	Almonds/10	4.08
265999	WALNUTS, BLACK	Almonds	Almonds/1	40.77
266999	CHESTNUTS	Almonds	Almonds/10	4.08
267999	MACADAMIA NUT	Almonds	Almonds/10	4.08
268079	PISTACHIOS	Almonds	Almonds/10	4.08
268099	ALMOND HULLS	Almonds	Almonds/1	40.77
301999	ARTICHOKES	Melon	Cotton/40	0.08
302199	ASPARAGUS, FRESH MKT	Melon	Cotton/2	1.68
302299	ASPARAGUS, PROC	Melon	Cotton/2	1.68
302999	ASPARAGUS, UNSPECIFIED	Melon	Cotton/2	1.68
303999	BEANS, GREEN LIMAS	DryBeans	Cotton/2	1.68
304199	BEANS, SNAP FR MKT	DryBeans	Cotton/20	0.17
304299	BEANS, SNAP PROC	DryBeans	Cotton/20	0.17
304399	BEANS FRESH UNSPECIFIED	DryBeans	Cotton/20	0.17
304999	BEANS, UNSPECIFIED SNAP	DryBeans	Cotton/20	0.17
305999	BEETS, GARDEN	Sugar Beets	Cotton/2	1.68
306999	RAPINI	Sugar Beets	Cotton/40	0.08
307189	BROCCOLI,FOOD SERV	Vegetables	Cotton/40	0.08
307199	BROCCOLI, FR MKT	Vegetables	Cotton/40	0.08
307299	BROCCOLI, PROC	Vegetables	Cotton/40	0.08
307919	BROCCOLI, UNSPECIFIED	Vegetables	Cotton/40	0.08
308999	BRUSSELS SPROUTS	Melon	Cotton/40	0.08
309999	CABBAGE, CH. & SPECIALTY	Lettuce	Cotton/40	0.08
310999	CABBAGE, HEAD	Lettuce	Cotton/40	0.08
313189	CARROTS, FOOD SERV	Sugar Beets	Cotton/20	0.17
313199	CARROTS, FR MKT	Sugar Beets	Cotton/20	0.17
313299	CARROTS, PROC	Sugar Beets	Cotton/20	0.17
313999	CARROTS, UNSPECIFIED	Sugar Beets	Cotton/20	0.17
314189	CAULIFLOWER, FOOD SERV	Vegetables	Cotton/40	0.08
314199	CAULIFLOWER, FR MKT	Vegetables	Cotton/40	0.08
314299	CAULIFLOWER, PROC	Vegetables	Cotton/40	0.08
314999	CAULIFLOWER, UNSPECIFIED	Vegetables	Cotton/40	0.08
316189	CELERY, FOOD SERV	Lettuce	Cotton/40	0.08
316199	CELERY, FR MKT	Lettuce	Cotton/40	0.08
316299	CELERY, PROC	Lettuce	Cotton/40	0.08
316999	CELERY, UNSPECIFIED	Lettuce	Cotton/40	0.08
318999	RADICCHIO	Lettuce	Cotton/40	0.08
320999	CHIVES	Lettuce	Cotton/40	0.08
322999	COLLARD GREENS	Lettuce	Cotton/40	0.08
323999	CORN, SWEET ALL	Corn	Cotton/40	0.08
325999	CUCUMBERS	Vegetables	Cotton/40	0.08
330999	EGGPLANT, ALL	Vegetables	Cotton/40	0.08
331999	ENDIVE, ALL	Lettuce	Cotton/40	0.08
332999	ESCAROLE, ALL	Lettuce	Cotton/40	0.08
333999	ANISE (FENNEL)	Lettuce	Cotton/2	1.68
335999	GARLIC, ALL	Garlic	Cotton/2	1.68
337999	KALE	Lettuce	Cotton/40	0.08
338999	KOHLRABI	Lettuce	Cotton/40	0.08
339196	LETTUCE, BULK SALAD PRODS.	Lettuce	Cotton/40	0.08
339999	LETTUCE, UNSPECIFIED	Lettuce	Cotton/40	0.08
340999	LETTUCE, HEAD	Lettuce	Cotton/40	0.08
341999	LETTUCE, ROMAINE	Lettuce	Cotton/40	0.08

Agricultural Harvest Operations

Table F-74. Summary of Crop Emission Factor Assumptions

CDFA Crop Code	CDFA Crop Description	Crop Profile	Assumption	Emission Factor (lbs PM10/acre/yr)
342999	LETTUCE, LEAF	Lettuce	Cotton/40	0.08
343999	MELON, CANTALOUPE	Melon	Cotton/40	0.08
348999	MELON, HONEYDEW	Melon	Cotton/40	0.08
354299	MELON, UNSPECIFIED	Melon	Cotton/40	0.08
354999	MELON, WATER MELONS	Melon	Cotton/40	0.08
355999	MUSHROOMS	No Land Prep.	Zero/1	0
356999	MUSTARD	Lettuce	Cotton/40	0.08
357999	OKRA	Lettuce	Cotton/40	0.08
358999	ONIONS	Onions	Cotton/2	1.68
359999	PARSLEY	Lettuce	Cotton/40	0.08
361299	PEAS, GREEN, PROCESSING	DryBeans	Cotton/20	0.17
361999	PEAS, GREEN, UNSPECIFIED	DryBeans	Cotton/20	0.17
363999	PEPPERS, BELL	Tomatoes	Cotton/40	0.08
364999	PEPPERS, CHILI, HOT	Tomatoes	Cotton/40	0.08
366999	PUMPKINS	Melon	Cotton/20	0.17
367999	RADISHES	Sugar Beets	Cotton/40	0.08
368999	RHUBARB	Lettuce	Cotton/40	0.08
370999	RUTABAGAS	Sugar Beets	Cotton/2	1.68
372999	ONIONS, GREEN & SHALLOTS	Onions	Cotton/40	0.08
374189	SPINACH, FOOD SERV	Lettuce	Cotton/40	0.08
374199	SPINACH, FR MKT	Lettuce	Cotton/40	0.08
374299	SPINACH, PROC	Lettuce	Cotton/40	0.08
374999	SPINACH UNSPECIFIED	Lettuce	Cotton/40	0.08
375999	SQUASH	Melon	Cotton/20	0.17
376999	SWISSCHARD	Lettuce	Cotton/40	0.08
378199	TOMATOES, FRESH MARKET	Tomatoes	Cotton/40	0.08
378299	TOMATOES, PROCESSING	Tomatoes	Cotton/20	0.17
378999	TOMATOES, UNSPECIFIED	Tomatoes	Cotton/20	0.17
380999	TURNIPS, ALL	Sugar Beets	Cotton/2	1.68
381999	GREENS, TURNIP & MUSTARD	Lettuce	Cotton/40	0.08
387999	LEEKS	Onions	Cotton/40	0.08
391999	POTATOES, IRISH ALL	Sugar Beets	Cotton/2	1.68
392999	SWEET POTATOES	Sugar Beets	Cotton/2	1.68
393999	HORSERADISH	Onions	Cotton/40	0.08
394199	SALAD GREENS NEC	Lettuce	Cotton/40	0.08
394999	PEAS, EDIBLE POD (SNOW)	DryBeans	Cotton/20	0.17
395999	VEGETABLES, ORIENTAL, ALL	Vegetables	Cotton/40	0.08
396999	SPROUTS, ALFALFA & BEAN	Lettuce	Cotton/40	0.08
398199	CUCUMBERS, GREENHOUSE	No Land Prep.	Zero/1	0
398299	TOMATOES, GREENHOUSE	No Land Prep.	Zero/1	0
398399	TOMATOES, CHERRY	Tomatoes	Cotton/40	0.08
398499	TOMATILLO	Tomatoes	Cotton/40	0.08
398559	CILANTRO	Lettuce	Cotton/40	0.08
398599	SPICES AND HERBS	Lettuce	Cotton/40	0.08
398899	VEGETABLES, BABY	Vegetables	Cotton/40	0.08
398999	VEGETABLES, UNSPECIFIED	Vegetables	Cotton/20	0.17
832919	POTATOES SEED	Sugar Beets	Cotton/2	1.68
892999	NURSERY TURF	No Land Prep.	Zero 1	0

Source:
CARB. 2003. Emission Inventory Documentation, Section 7.5: Agricultural Harvest Operations. January.
Accessed on: May 5, 2012. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfarmop.htm.

Windblown Dust - Agricultural Lands

Table F-75. Windblown Dust - Agricultural Lands

Air Basin Code	County Name	Emission Factor (tons/acre/yr)	Process Rate (acres)	PM Emissions (tons/year)
NCC	Monterey	0.020478	279,178.00	5,717.07
	San Benito	0.015936	50,009.00	796.96
	Santa Cruz	0.002485	14,873.00	36.97
SCC	San Luis Obispo	0.006876	109,694.00	754.2
	Santa Barbara	0.00319	80,732.00	257.56
	Ventura	0.018418	54,568.00	1,005.02
SED	Imperial	0.141666	490,409.00	69,474.43
SJV	Fresno	0.013761	864,164.00	11,891.35
	Kern	0.008662	408,313.48	3,536.73
	Kings	0.012856	473,817.00	6,091.62
	Madera	0.008032	141,617.00	1,137.47
	Merced	0.013659	364,804.00	4,982.86
	San Joaquin	0.003527	387,278.00	1,365.96
	Stanislaus	0.009052	229,805.00	2,080.26
	Tulare	0.004693	471,664.00	2,213.29
SV	Butte	0.001154	116,869.00	134.87
	Colusa	0.004702	229,747.00	1,080.31
	Glenn	0.004957	186,067.00	922.39
	Placer	0.002172	6,962.90	15.12
	Sacramento	0.002479	117,770.00	291.92

Note:
Fraction of PM10 (FRPM10): 0.50
(PM10 Emissions = PM x FRPM10)

Table F-76. Windblown Dust - Pasture Lands

Air Basin Code	County Name	Emission Factor (tons/acre/yr)	Process Rate (acres)	PM Emissions (tons/year)
NCC	Monterey	0.00110562	1,108,000	1,225.03
	San Benito	0.00109336	512,000	559.8
	Santa Cruz	0.0001605	8,000	1.28
SCC	Santa Barbara	0.00021801	602,913	131.44
	San Luis Obispo	0.00046964	1,102,500	517.78
	Ventura	0.00050356	210,918	106.21
SED	Imperial	0.00867346	158,449	1,374.30
SJV	Fresno	0.00149089	907,300	1,352.69
	Kern	0.00082834	1,527,603	1,265.37
	Kings	0.00146875	142,777	209.7
	Madera	0.00116178	421,000	489.11
	Merced	0.00155578	642,700	999.9
	San Joaquin	0.0005228	167,700	87.67
	Stanislaus	0.00107875	434,300	468.5
	Tulare	0.00063424	713,400	452.47
SV	Butte	0.00014292	288,500	41.23
	Colusa	0.00046444	181,900	84.48
	Glenn	0.00048846	256,575	125.33
	Placer	0.00026499	65,656	17.4
	Sacramento	0.00019538	118,000	23.05
	Shasta	0.00034146	459,000	156.73
	Solano	0.00039453	131,360	51.83
	Sutter	0.00037084	71,500	26.51
	Tehama	0.00035146	955,350	335.76
	Yolo	0.00061919	136,870	84.75
	Yuba	0.00023892	207,600	49.6

Note:
Fraction of PM10 (FRPM10): 0.50
(PM10 Emissions = PM x FRPM10)

Source:
CARB. 1997. Emission Inventory Documentation, Section 7.12: Windblown Dust - Agricultural Lands. July.
Accessed on: May 5, 2012. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocfugwbdst.htm.

Seasonal Profiles

Table F-77. Agricultural Land Preparation Seasonal Profile for Land Preparation

AB	ID #	County	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SV	4	BUTTE	0.005	0.004	0.081	0.387	0.387	0.001	0.001	0.001	0.001	0.015	0.06	0.058
	6	COLUSA	0.009	0.016	0.079	0.355	0.355	0.002	0.002	0.002	0.002	0.035	0.074	0.07
	11	GLENN	0.018	0.013	0.094	0.331	0.331	0.003	0.004	0.004	0.004	0.028	0.087	0.082
	31	PLACER	0.005	0	0.076	0.415	0.415	0	0	0	0	0.026	0.031	0.031
	34	SACRAMENTO	0.078	0.014	0.123	0.117	0.123	0.016	0.016	0.016	0.016	0.071	0.205	0.205
	45	SHASTA	0.051	0	0.028	0.152	0.152	0	0.039	0	0	0.208	0.188	0.182
	48	SOLANO	0.075	0.039	0.089	0.003	0.004	0.004	0.004	0.004	0.004	0.128	0.328	0.318
	51	SUTTER	0.011	0.012	0.086	0.362	0.362	0.001	0.001	0.001	0.001	0.028	0.071	0.067
	52	TEHAMA	0.051	0.024	0.083	0.054	0.054	0	0	0	0	0.083	0.331	0.32
	57	YOLO	0.062	0.021	0.088	0.136	0.137	0.003	0.003	0.003	0.003	0.095	0.223	0.223
	58	YUBA	0.006	0	0.082	0.405	0.405	0	0	0	0	0.015	0.043	0.043

Source:
CARB. 2003. Emission Inventory Documentation, Section 7.4: Agricultural Land Preparation. January.
Accessed on: May 5, 2012. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfarmop.htm

Table F-78. Seasonal Profile for Agricultural Harvest Emissions

AB	ID #	County	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SV	4	BUTTE	0	0	0	0	0	0.003	0.004	0.001	0.483	0.484	0.025	0
	6	COLUSA	0	0	0.001	0.001	0.001	0.037	0.052	0.016	0.408	0.411	0.073	0
	11	GLENN	0	0	0.001	0.001	0.001	0.03	0.032	0.002	0.446	0.45	0.036	0
	31	PLACER	0	0	0.014	0.014	0.014	0.014	0.014	0.014	0.409	0.395	0.112	0
	34	SACRAMENTO	0.002	0.002	0.009	0.009	0.009	0.222	0.284	0.071	0.206	0.137	0.044	0.002
	45	SHASTA	0	0	0.059	0.059	0.059	0.083	0.083	0.059	0.316	0.258	0.025	0
	48	SOLANO	0	0	0.003	0.003	0.003	0.196	0.229	0.035	0.274	0.247	0.01	0
	51	SUTTER	0	0	0.001	0.001	0.001	0.025	0.05	0.026	0.427	0.407	0.059	0
	52	TEHAMA	0	0	0.002	0.002	0.002	0.005	0.006	0.002	0.489	0.489	0.002	0
	57	YOLO	0	0	0.002	0.002	0.002	0.111	0.155	0.046	0.348	0.308	0.026	0
	58	YUBA	0	0	0.002	0.002	0.002	0.005	0.005	0.002	0.471	0.469	0.042	0

Source:
CARB. 2003. Emission Inventory Documentation, Section 7.5: Agricultural Harvest Operations. January.
Accessed on: May 5, 2012. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfarmop.htm.

Table F-79. Final Normalized Monthly Emission Profiles: Nonpasture

Basin	County	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SV	Butte	0.0114	0.0316	0.0333	0.2697	0.2156	0.0556	0.1253	0.0977	0.0498	0.0721	0.0227	0.0152
	Colusa	0.0037	0.0075	0.0171	0.1868	0.1818	0.1461	0.0998	0.1141	0.1099	0.1169	0.0106	0.0059
	Glenn	0.004	0.0116	0.0162	0.2311	0.0859	0.2114	0.0773	0.0466	0.0623	0.1652	0.0764	0.0122
	Placer	0.0052	0.0081	0.013	0.2733	0.261	0.0962	0.0877	0.0964	0.1024	0.0411	0.0107	0.0049
	Sacramento	0.0015	0.0025	0.0046	0.1199	0.1443	0.3286	0.13	0.1012	0.1297	0.0306	0.0046	0.0024
	Shasta	0.0019	0.0071	0.0082	0.0756	0.0984	0.3371	0.2219	0.1439	0.0436	0.055	0.0055	0.0018
	Solano	0.0008	0.0011	0.0021	0.0461	0.0884	0.1865	0.1423	0.145	0.1875	0.1902	0.0087	0.0013
	Sutter	0.0038	0.0057	0.0088	0.1846	0.2083	0.2042	0.0906	0.099	0.1433	0.0397	0.0084	0.0036
	Tehama	0.0021	0.0055	0.0059	0.0528	0.0666	0.3714	0.2149	0.157	0.0664	0.0505	0.0047	0.0021
	Yolo	0.0015	0.0022	0.0036	0.0787	0.1309	0.2377	0.1079	0.1054	0.1682	0.1528	0.0091	0.0019
	Yuba	0.0076	0.012	0.0182	0.2745	0.2564	0.1158	0.0768	0.0478	0.0804	0.066	0.0372	0.0073

Table F-80. Final Normalized Monthly Emission Profiles: Pasture

Basin	County	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SV	Butte	0.001	0.0029	0.0031	0.0294	0.0515	0.094	0.3024	0.2379	0.2041	0.0688	0.0034	0.0015
	Colusa	0.0005	0.0009	0.0022	0.0291	0.0582	0.218	0.1974	0.161	0.2281	0.1018	0.0019	0.0008
	Glenn	0.0006	0.0018	0.0025	0.0412	0.0287	0.2338	0.1275	0.0827	0.2331	0.2277	0.0185	0.002
	Placer	0.0005	0.0008	0.0013	0.0314	0.0677	0.2348	0.1734	0.1379	0.3101	0.0399	0.0017	0.0005
	Sacramento	0.0004	0.0006	0.0012	0.036	0.0571	0.2216	0.1705	0.1299	0.331	0.0495	0.0016	0.0006
	Shasta	0.0007	0.0019	0.0021	0.0214	0.0365	0.3573	0.2451	0.144	0.1219	0.0665	0.0018	0.0007
	Solano	0.0002	0.0003	0.0007	0.0182	0.0447	0.1497	0.148	0.1119	0.2964	0.2266	0.0028	0.0004
	Sutter	0.0005	0.0007	0.0012	0.0286	0.0617	0.2125	0.1566	0.1249	0.3636	0.0477	0.0016	0.0005
	Tehama	0.0007	0.0019	0.0021	0.0217	0.037	0.3624	0.2488	0.1461	0.1147	0.0621	0.0018	0.0007
	Yolo	0.0003	0.0005	0.0009	0.0226	0.0528	0.1794	0.1598	0.1228	0.2924	0.1656	0.0025	0.0004
	Yuba	0.0004	0.0006	0.001	0.0169	0.0356	0.1527	0.1783	0.1611	0.4092	0.0405	0.0033	0.0004

Appendix G

Climate Change Analysis Emission Calculations

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Summary of Annual Groundwater Substitution GHG Emissions by County

Table G-1. GHG Emissions from Groundwater Substitution

Water Agency	Emissions (MTCO2e per year)			
	CO2	CH4	N2O	Total
Sacramento River of Analysis				
Anderson-Cottonwood Irrigation District	164	0.26	0.66	165
Conaway Preservation Group	2,360	3.33	8.30	2,371
Cordua Irrigation District	496	0.79	2.00	499
Cranmore Farms	272	0.44	1.10	274
Eastside Mutual Water Company	392	0.40	0.95	394
Glenn-Colusa Irrigation District	785	1.26	3.17	789
Natomas Central Mutual Water Company	376	0.51	1.29	378
Pelger Mutual Water Company	283	0.33	0.80	285
Pleasant Grove-Verona Mutual Water Company	1,890	2.32	5.69	1,898
Reclamation District 108	642	1.03	2.59	646
Reclamation District 1004	900	0.95	2.28	903
River Garden Farms	326	0.52	1.32	327
Sycamore Mutual Water Company	490	0.79	1.98	493
Te Velde Revocable Family Trust	202	0.32	0.82	203
American River Area of Analysis				
City of Sacramento	483	0.66	1.66	485
Sacramento County Water Agency	1,427	1.95	4.92	1,434
Sacramento Suburban Water District	4,379	4.31	9.69	4,393
Feather River Area of Analysis				
Butte Water District	356	0.57	1.44	358
Garden Highway Mutual Water Company	452	0.72	1.83	454
Gilsizer Slough Ranch	441	0.52	1.25	443
Goose Club Farms and Teichert Aggregates	341	0.55	1.38	342
Tule Basin Farms	374	0.32	0.66	375
Delta Region Area of Analysis				
Reclamation District 2068	184	0.29	0.74	185
Pope Ranch	119	0.19	0.48	120
Total	**18,134**	**23.34**	**57.03**	**18,215**

Groundwater Substitution GHG Emissions

Agency	Anderson-Cottonwood Irrigation District	
Transfer Volume	5,226	acre feet/year
Location	Shasta	County
	Tehama	County

Table G-2. Anderson-Cottonwood Irrigation District Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Barney Street	Barney Street	Electric	200	5,500	85%	4,422	4,366	651,702	n/a	131	0.0084	0.0018	131	0.21	0.53	132
Crowley Gulch	Crowley Gulch	Electric	50	1,000	15%	804	4,366	162,926	n/a	33	0.0021	0.0004	33	0.05	0.13	33
			Total	**6,500**	**100%**	**5,226**	**8,733**	**814,628**	**0**	**164**	**0.0105**	**0.0022**	**164**	**0.26**	**0.66**	**165**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Conaway Preservation Group	
Transfer Volume	35,000	acre feet/year
Location	Yolo	County

Table G-3. Conaway Preservation Group Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
ConawayPG12W-1	12W-1	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG12W-2	12W-2	Electric	250	2,500	3%	895	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG12W-5	12W-5	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG13W-3	13W-3	Electric	200	3,500	4%	1,253	1,944	290,083	n/a	59	0.0037	0.0008	59	0.09	0.24	59
ConawayPG16W-2	16W-2	Diesel	227	1,600	2%	573	1,944	n/a	24,751	253	0.0102	0.0020	253	0.26	0.61	254
ConawayPG17W-3	17W-3	Diesel	227	1,700	2%	608	1,944	n/a	24,751	253	0.0102	0.0020	253	0.26	0.61	254
ConawayPG1W-3	1W-3	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG20W-1	20W-1	Electric	100	2,500	3%	895	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG21W-1	21W-1	Electric	250	2,500	3%	895	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG21W-3	21W-3	Electric	100	2,500	3%	895	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG24W-1	24W-1	Electric	250	2,500	3%	895	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG31W-1	31W-1	Electric	100	2,300	2%	823	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG32NW-1	32NW-1	Electric	100	3,300	3%	1,181	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG32NW-2	32NW-2	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG32W-3	32W-3	Electric	250	2,500	3%	895	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG33NW-1	33NW-1	Electric	100	2,300	2%	823	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-2	33NW-2	Electric	100	2,200	2%	787	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-3	33NW-3	Electric	100	2,100	2%	752	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-4	33NW-4	Electric	100	3,400	3%	1,217	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-5	33NW-5	Electric	100	1,800	2%	644	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-6	33NW-6	Electric	100	2,100	2%	752	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-7	33NW-7	Electric	100	1,400	1%	501	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-8	33NW-8	Electric	100	2,200	2%	787	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG5W-2	5W-2	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG5W-3	5W-3	Electric	250	2,700	3%	966	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG6W-2	6W-2	Electric	100	3,500	4%	1,253	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG7W-1	7W-1	Electric	75	1,800	2%	644	1,944	108,781	n/a	22	0.0014	0.0003	22	0.04	0.09	22
ConawayPG7W-2	7W-2	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG7W-4	7W-4	Electric	200	3,500	4%	1,253	1,944	290,083	n/a	59	0.0037	0.0008	59	0.09	0.24	59
ConawayPG7W-4S	7W-4S	Electric	200	3,500	4%	1,253	1,944	290,083	n/a	59	0.0037	0.0008	59	0.09	0.24	59
ConawayPG8W-2	8W-2	Diesel	227	2,300	2%	823	1,944	n/a	24,751	253	0.0102	0.0020	253	0.26	0.61	254
ConawayPG8W-2N	8W-2N	Electric	200	1,500	2%	537	1,944	290,083	n/a	59	0.0037	0.0008	59	0.09	0.24	59
ConawayPGOW-1	OW-1	Electric	100	2,600	3%	930	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPGOW-2	OW-2	Electric	100	3,400	3%	1,217	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPGOW-3	OW-3	Electric	125	3,400	3%	1,217	1,944	181,302	n/a	37	0.0023	0.0005	37	0.06	0.15	37
ConawayPGOW-4	OW-4	Electric	100	1,700	2%	608	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPGOW-5	OW-5	Electric	125	2,000	2%	716	1,944	181,302	n/a	37	0.0023	0.0005	37	0.06	0.15	37
			Total	**97,800**	**100%**	**35,000**	**71,912**	**7,941,021**	**74,253**	**2,360**	**0.1334**	**0.0279**	**2,360**	**3.33**	**8.30**	**2,371**

Legend

(purple)	Assumed to be electric (similar to 32W-2)
(green)	Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO_2	1
CH_4	25
N_2O	298

Groundwater Substitution GHG Emissions

Agency	Cordua Irrigation District	
Transfer Volume	12,000	acre feet/year
Location	Yuba	County

Table G-4. Cordua Irrigation District Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
COR1	COR1	Electric	60	1,000	3%	323	1,757	78,654	n/a	16	0.0010	0.0002	16	0.03	0.06	16
COR2	COR2	Electric	50	900	2%	291	1,757	65,545	n/a	13	0.0008	0.0002	13	0.02	0.05	13
COR3	COR3	Electric	60	1,000	3%	323	1,757	78,654	n/a	16	0.0010	0.0002	16	0.03	0.06	16
COR4	COR4	Electric	75	1,400	4%	453	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR5	COR5	Electric	75	1,300	4%	420	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR8	COR8	Electric	75	2,000	5%	647	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR9	COR9	Electric	60	1,000	3%	323	1,757	78,654	n/a	16	0.0010	0.0002	16	0.03	0.06	16
COR10	COR10	Electric	75	1,300	4%	420	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR11	COR11	Electric	60	1,800	5%	582	1,757	78,654	n/a	16	0.0010	0.0002	16	0.03	0.06	16
COR12	COR12	Electric	100	1,400	4%	453	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR13	COR13	Electric	100	2,100	6%	679	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR14	COR14	Electric	75	1,800	5%	582	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR18	COR18	Electric	100	2,000	5%	647	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR20	COR20	Electric	125	2,150	6%	695	1,757	163,863	n/a	33	0.0021	0.0004	33	0.05	0.13	33
COR21	COR21	Electric	75	1,250	3%	404	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR22	COR22	Electric	60	1,750	5%	566	1,757	78,654	n/a	16	0.0010	0.0002	16	0.03	0.06	16
COR23	COR23	Electric	75	1,150	3%	372	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR25	COR25	Electric	75	1,600	4%	518	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR26	COR26	Electric	100	1,800	5%	582	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR27	COR27	Electric	100	1,700	5%	550	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR16	COR16	Electric	100	2,300	6%	744	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR17	COR17	Electric	100	2,400	6%	776	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR24	COR24	Electric	100	2,000	5%	647	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
			Total	**37,100**	**100%**	**12,000**	**40,402**	**2,457,942**	**0**	**496**	**0.0318**	**0.0067**	**496**	**0.79**	**2.00**	**499**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Cranmore Farms	
Transfer Volume	8,000	acre feet/year
Location	Sutter	County

Table G-5. Cranmore Farms Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Cranmore Farms1	1	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
Cranmore Farms2	2	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
Cranmore Farms3	3	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
Cranmore Farms4	4	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
Cranmore Farms5	5	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
Cranmore Farms6	6	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
			Total	**18,000**	**100%**	**8,000**	**14,482**	**1,350,958**	**0**	**272**	**0.0175**	**0.0037**	**272**	**0.44**	**1.10**	**274**

<u>Conversion Factors</u>

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

<u>Global Warming Potential</u>

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Eastside Mutual Water Company
Transfer Volume	2,230 acre feet/year
Location	Colusa County

Table G-6. Eastside Mutual Water Company Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
7631T	7631T	Diesel	215	3,800	100%	2,230	3,187	n/a	38,441	392	0.0159	0.0032	392	0.40	0.95	394
			Total	**3,800**	**100%**	**2,230**	**3,187**	**0**	**38,441**	**392**	**0.0159**	**0.0032**	**392**	**0.40**	**0.95**	**394**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Glenn-Colusa Irrigation District	
Transfer Volume	25,000	acre feet/year
Location	Glenn	County
	Colusa	County

Table G-7. Glenn-Colusa Irrigation District Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
GCID 1	GCID 1	Electric	110	3,305	10%	2,622	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID 2	GCID 2	Electric	110	3,305	10%	2,622	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID 3	GCID 3	Electric	110	3,305	10%	2,622	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID 4	GCID 4	Electric	110	3,305	10%	2,622	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID 5	GCID 5	Electric	110	2,605	8%	2,067	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID X1	GCID X1	Electric	110	2,389	8%	1,896	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID X2	GCID X2	Electric	110	3,305	10%	2,622	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID X3	GCID X3	Electric	110	2,605	8%	2,067	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID X4	GCID X4	Electric	110	2,389	8%	1,896	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID X5	GCID X5	Electric	110	2,605	8%	2,067	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
Test Hole 7	Test Hole 7	Electric	110	2,389	8%	1,896	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
			Total	**31,507**	**100%**	**25,000**	**47,402**	**3,891,180**	**0**	**785**	**0.0503**	**0.0106**	**785**	**1.26**	**3.17**	**789**

Legend

(purple)	Assumed to be electric (similar to other wells operated by water agency)
(green)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Natomas Central Mutual Water Company	
Transfer Volume	30,000	acre feet/year
Location	Sacramento	County
	Sutter	County

Table G-8. Natomas Central Mutual Water Company Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	**Well**	**Fuel Type**	**(hp)**	**(gpm)**	**(% of Total)**	**(AF/year)**	**(hours/year)**	**(kWh/yr)**	**(gal/yr)**	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	**Total**
Natomas Central MWCWilley, Ed	Willey, Ed	Electric	250	5,500	2%	698	689	128,527	n/a	30	0.0017	0.0004	30	0.04	0.10	31
Natomas Central MWCOse, Mary-site 8, well 1	Ose, Mary-site 8, well 1	Electric	200	5,500	2%	698	689	102,821	n/a	24	0.0013	0.0003	24	0.03	0.08	24
Natomas Central MWCOse, Mary-site 9, well 2	Ose, Mary-site 9, well 2	Electric	150	5,500	2%	698	689	77,116	n/a	18	0.0010	0.0002	18	0.02	0.06	18
Natomas Central MWCLeal, Robert-site 1 well 2	Leal, Robert-site 1 well 2	Electric	100	5,500	2%	698	689	51,411	n/a	12	0.0007	0.0001	12	0.02	0.04	12
Natomas Central MWCDeWitt, Jack-1	DeWitt, Jack-1	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCDeWitt, Jack-2	DeWitt, Jack-2	Electric	80	5,500	2%	698	689	41,129	n/a	10	0.0005	0.0001	10	0.01	0.03	10
Natomas Central MWCDeWitt, Jack-3	DeWitt, Jack-3	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Natomas Central MWCDeWitt, Jack-4	DeWitt, Jack-4	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCDeWitt, Jack-5	DeWitt, Jack-5	Electric	20	5,500	2%	698	689	10,282	n/a	2	0.0001	0.0000	2	0.00	0.01	2
Natomas Central MWCDeWitt, Jack-6	DeWitt, Jack-6	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCDeWitt, Jack-7	DeWitt, Jack-7	Electric	25	5,500	2%	698	689	12,853	n/a	3	0.0002	0.0000	3	0.00	0.01	3
Natomas Central MWCDeWitt, Jack-7	DeWitt, Jack-7	Electric	25	5,500	2%	698	689	12,853	n/a	3	0.0002	0.0000	3	0.00	0.01	3
Natomas Central MWCDeWitt, Jack--8	DeWitt, Jack--8	Electric	250	5,500	2%	698	689	128,527	n/a	30	0.0017	0.0004	30	0.04	0.10	31
Natomas Central MWCMorrison, Phil #2-site 5 well 14	Morrison, Phil #2-site 5 well 14	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCBianchi, John- site 2, well 10	Bianchi, John- site 2, well 10	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Natomas Central MWCBianchi, John-site 2 well 11	Bianchi, John-site 2 well 11	Electric	80	5,500	2%	698	689	41,129	n/a	10	0.0005	0.0001	10	0.01	0.03	10
Natomas Central MWCLauppe and Sons	Lauppe and Sons	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCWiley, Wane-site 7 , well 18	Wiley, Wane-site 7 , well 18	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCLeal, Robert L-1 (rice box)	Leal, Robert L-1 (rice box)	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCLeal, Robert L-3	Leal, Robert L-3	Electric	50	5,500	2%	698	689	25,705	n/a	6	0.0003	0.0001	6	0.01	0.02	6
Natomas Central MWCLeal, Robert L-4	Leal, Robert L-4	Electric	110	5,500	2%	698	689	56,552	n/a	13	0.0007	0.0002	13	0.02	0.05	13
Natomas Central MWCLeal, Robert L-5	Leal, Robert L-5	Electric	110	5,500	2%	698	689	56,552	n/a	13	0.0007	0.0002	13	0.02	0.05	13
Natomas Central MWCLeal, Robert L-6	Leal, Robert L-6	Electric	110	5,500	2%	698	689	56,552	n/a	13	0.0007	0.0002	13	0.02	0.05	13
Natomas Central MWCLeal, Robert L-7	Leal, Robert L-7	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCLeal, Robert L-8	Leal, Robert L-8	Electric	200	5,500	2%	698	689	102,821	n/a	24	0.0013	0.0003	24	0.03	0.08	24
Natomas Central MWCLeal, Robert L-9	Leal, Robert L-9	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCLeal, Robert L-2	Leal, Robert L-2	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCLeal, Robert #1	Leal, Robert #1	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCLeal, Robert #2	Leal, Robert #2	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCSpangler, Dan-site 4 well 13	Spangler, Dan-site 4 well 13	Electric	80	5,500	2%	698	689	41,129	n/a	10	0.0005	0.0001	10	0.01	0.03	10
Natomas Central MWCVestal, Sid	Vestal, Sid	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Natomas Central MWCVestal, Sid-1	Vestal, Sid-1	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Dewitt, Jack-9 Housley N	Dewitt, Jack-9 Housley N	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Dewitt, Jack-10 Housley	Dewitt, Jack-10 Housley	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Dewitt, Jack-11 Housley	Dewitt, Jack-11 Housley	Electric	20	5,500	2%	698	689	10,282	n/a	2	0.0001	0.0000	2	0.00	0.01	2
Natomas Central MWCMorrison, Phil-#3 site 5 well 15	Morrison, Phil-#3 site 5 well 15	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCMorrison, Phil-#4 site 5 well 16	Morrison, Phil-#4 site 5 well 16	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCNBC-Frazer	NBC-Frazer	Electric	50	5,500	2%	698	689	25,705	n/a	6	0.0003	0.0001	6	0.01	0.02	6
Natomas Central MWCNBC-Lucich North	NBC-Lucich North	Electric	75	5,500	2%	698	689	38,558	n/a	9	0.0005	0.0001	9	0.01	0.03	9
Natomas Central MWCNBC- Natomas Farm#1	NBC- Natomas Farm#1	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Natomas Central MWCNBC-Cummings	NBC-Cummings	Electric	20	5,500	2%	698	689	10,282	n/a	2	0.0001	0.0000	2	0.00	0.01	2
Natomas Central MWCMorrison, Phillip-#5	Morrison, Phillip-#5	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Natomas Central MWCPerry, Joe	Perry, Joe	Electric	125	5,500	2%	698	689	64,263	n/a	15	0.0008	0.0002	15	0.02	0.05	15
Natomas Central MWCNBC-Kismat-2	NBC-Kismat-2	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCNBC-Kismat-3	NBC-Kismat-3	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCNBC-Kismat-4	NBC-Kismat-4	Electric	110	5,500	2%	698	689	56,552	n/a	13	0.0007	0.0002	13	0.02	0.05	13
Natomas Central MWCNBC-Sliva	NBC-Sliva	Electric	50	5,500	2%	698	689	25,705	n/a	6	0.0003	0.0001	6	0.01	0.02	6
			Total	**236,500**	**100%**	**30,000**	**29,623**	**1,588,589**	**0**	**376**	**0.0205**	**0.0043**	**376**	**0.51**	**1.29**	**378**

Legend

(purple)	Assumed to be electric
(green)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Pelger Mutual Water Company	
Transfer Volume	3,750	acre feet/year
Location	Sutter	County

Table G-9. Pelger Mutual Water Company Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Pelger MWCWell 1 Tucker	Well 1 Tucker	Electric	110	3,100	33%	1,224	2,144	175,980	n/a	35	0.0023	0.0005	35	0.06	0.14	36
Pelger MWCWell 2 Flopet	Well 2 Flopet	Diesel	173	2,100	22%	829	2,144	n/a	20,806	212	0.0086	0.0017	212	0.22	0.51	213
Pelger MWCWell 3 Klein	Well 3 Klein	Electric	110	4,300	45%	1,697	2,144	175,980	n/a	35	0.0023	0.0005	35	0.06	0.14	36
			Total	**9,500**	**100%**	**3,750**	**6,431**	**351,960**	**20,806**	**283**	**0.0132**	**0.0027**	**283**	**0.33**	**0.80**	**285**

Legend

(shaded cell) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Pleasant Grove-Verona Mutual Water Company
Transfer Volume	18,000 acre feet/year
Location	Sutter County

Table G-10. Pleasant Grove-Verona Mutual Water Company Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	**Well**	**Fuel Type**	**(hp)**	**(gpm)**	**(% of Total)**	**(AF/year)**	**(hours/year)**	**(kWh/yr)**	**(gal/yr)**	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	**Total**
PGVMWCWill-Lee 4A	Will-Lee 4A	Diesel	160	1,500	2%	345	1,248	n/a	11,206	114	0.0046	0.0009	114	0.12	0.28	115
PGVMWCRiver Ranch #19	River Ranch #19	Diesel	200	2,500	3%	575	1,248	n/a	14,008	143	0.0058	0.0012	143	0.14	0.35	144
PGVMWCMLF #1	MLF #1	Electric	30	2,000	3%	460	1,248	27,951	n/a	6	0.0004	0.0001	6	0.01	0.02	6
PGVMWCMLF #2	MLF #2	Electric	250	5,000	6%	1,149	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCMLF Monster Well	MLF Monster Well	Electric	60	3,100	4%	713	1,248	55,902	n/a	11	0.0007	0.0002	11	0.02	0.05	11
PGVMWCMLF #17/12	MLF #17/12	Electric	50	1,500	2%	345	1,248	46,585	n/a	9	0.0006	0.0001	9	0.02	0.04	9
PGVMWCMLF #11	MLF #11	Diesel	250	4,200	5%	966	1,248	n/a	17,510	179	0.0072	0.0014	179	0.18	0.43	179
PGVMWCMLF #13/15	MLF #13/15	Electric	240	4,800	6%	1,103	1,248	223,607	n/a	45	0.0029	0.0006	45	0.07	0.18	45
PGVMWCMLF #16	MLF #16	Electric	240	1,700	2%	391	1,248	223,607	n/a	45	0.0029	0.0006	45	0.07	0.18	45
PGVMWCWilley #1	Willey #1	Diesel	168	3,000	4%	690	1,248	n/a	11,767	120	0.0049	0.0010	120	0.12	0.29	121
PGVMWCWilley #2	Willey #2	Electric	250	3,000	4%	690	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCWilley #3	Willey #3	Electric	250	2,000	3%	460	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCWilley #4	Willey #4	Diesel	150	3,000	4%	690	1,248	n/a	10,506	107	0.0043	0.0009	107	0.11	0.26	108
PGVMWCScheidel&Osterli #18A	Scheidel&Osterli #18A	Electric	250	2,500	3%	575	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCWill-Lee 30	Will-Lee 30	Diesel	100	1,500	2%	345	1,248	n/a	7,004	72	0.0029	0.0006	72	0.07	0.17	72
PGVMWCWill-Lee 31	Will-Lee 31	Electric	250	2,500	3%	575	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCWill-Lee 32	Will-Lee 32	Electric	250	2,500	3%	575	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCWill-Lee 33	Will-Lee 33	Electric	250	2,500	3%	575	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCNicholas Sand Field Well	Nicholas Sand Field Well	Diesel	62.1	2,000	3%	460	1,248	n/a	4,350	44	0.0018	0.0004	44	0.05	0.11	45
PGVMWCNicholas Filipino Camp #2	Nicholas Filipino Camp #2	Electric	40	2,000	3%	460	1,248	37,268	n/a	8	0.0005	0.0001	8	0.01	0.03	8
PGVMWCNicholas Filipino Camp South	Nicholas Filipino Camp South	Diesel	62.1	2,000	3%	460	1,248	n/a	4,350	44	0.0018	0.0004	44	0.05	0.11	45
PGVMWCNicholas Johnston Field Well #2	Nicholas Johnston Field Well #2	Electric	250	2,000	3%	460	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCNicholas Johnston Well	Nicholas Johnston Well	Electric	250	2,000	3%	460	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCNicholas 72-acre Field South	Nicholas 72-acre Field South	Diesel	62.1	2,000	3%	460	1,248	n/a	4,350	44	0.0018	0.0004	44	0.05	0.11	45
PGVMWCNicholas 72-Acre Field North	Nicholas 72-Acre Field North	Electric	250	2,000	3%	460	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCNicholas BBC Well	Nicholas BBC Well	Electric	250	2,000	3%	460	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCKelly 190 Field Well #2	Kelly 190 Field Well #2	Electric	30	2,000	3%	460	1,248	27,951	n/a	6	0.0004	0.0001	6	0.01	0.02	6
PGVMWCKelly Windmill Field Well #2	Kelly Windmill Field Well #2	Diesel	62.1	2,000	3%	460	1,248	n/a	4,350	44	0.0018	0.0004	44	0.05	0.11	45
PGVMWCKelly Windmill North Field Well	Kelly Windmill North Field Well	Diesel	62.1	2,000	3%	460	1,248	n/a	4,350	44	0.0018	0.0004	44	0.05	0.11	45
PGVMWCKelly 306 Well	Kelly 306 Well	Electric	250	2,600	3%	598	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCScheidel&Osterli #16	Scheidel&Osterli #16	Diesel	234	3,400	4%	782	1,248	n/a	16,389	167	0.0068	0.0014	167	0.17	0.40	168
PGVMWCScheidel&Osterli #17	Scheidel&Osterli #17	Diesel	101	1,500	2%	345	1,248	n/a	7,074	72	0.0029	0.0006	72	0.07	0.17	72
			Total	**78,300**	**100%**	**18,000**	**39,951**	**3,437,954**	**117,213**	**1,890**	**0.0930**	**0.0191**	**1,890**	**2.32**	**5.69**	**1,898**

Legend

(shaded cell) Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors	
1 lb =	453.6 g
1 tonne =	1,000 kg
1 tonne =	1,000,000 g
1 MWh =	1,000 kWh
1 GWh =	1,000,000 kWh
1 kW =	1.34 hp
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential	
CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Reclamation District 108	
Transfer Volume	15,000	acre feet/year
Location	Colusa	County
	Yolo	County

Table G-11. Reclamation District 108 Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
RD 108Well#1 Heidrick	Well#1 Heidrick	Electric	100	3,500	18%	2,749	4,265	318,288	n/a	64	0.0041	0.0009	64	0.10	0.26	65
RD 108Well #5 RiggsRanch	Well #5 RiggsRanch	Electric	150	1,700	9%	1,335	4,265	477,433	n/a	96	0.0062	0.0013	96	0.15	0.39	97
RD 108Well #6 CountyLine	Well #6 CountyLine	Electric	250	5,900	31%	4,634	4,265	795,721	n/a	160	0.0103	0.0022	160	0.26	0.65	161
RD 108Well#7 Tract 6	Well#7 Tract 6	Electric	250	4,000	21%	3,141	4,265	795,721	n/a	160	0.0103	0.0022	160	0.26	0.65	161
RD 108Well #4 Huff	Well #4 Huff	Electric	250	4,000	21%	3,141	4,265	795,721	n/a	160	0.0103	0.0022	160	0.26	0.65	161
			Total	**19,100**	**100%**	**15,000**	**21,325**	**3,182,885**	**0**	**642**	**0.0411**	**0.0087**	**642**	**1.03**	**2.59**	**646**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Reclamation District 1004	
Transfer Volume	7,175	acre feet/year
Location	Colusa	County
	Glenn	County
	Sutter	County

Table G-12. Reclamation District 1004 Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
Gardener No. 374672	Gardener No. 374672	Diesel	215	3,500	5%	345	535	n/a	6,456	66	0.0027	0.0005	66	0.07	0.16	66
Gardener No. 498178	Gardener No. 498178	Diesel	215	3,500	5%	345	535	n/a	6,456	66	0.0027	0.0005	66	0.07	0.16	66
Stonewell #6 No. 11334	Stone Well #6 No.11334	Electric	40	1,800	2%	177	535	15,978	n/a	3	0.0002	0.0000	3	0.01	0.01	3
Drumheller Well #7	Drumheller Well No.7	Diesel	225	4,000	5%	394	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Myers Well #1 No. 3457	Myers Well #1 No.3457	Electric	40	2,200	3%	217	535	15,978	n/a	3	0.0002	0.0000	3	0.01	0.01	3
Myers Well #2 No. 340884	Myers Well #2 No. 340884	Electric	100	4,100	6%	404	535	39,944	n/a	8	0.0005	0.0001	8	0.01	0.03	8
Sikes & Parachini #1 No. 93124	Sikes & Parachini Well #1 WS No.93124	Diesel	173	4,000	5%	394	535	n/a	5,195	53	0.0022	0.0004	53	0.05	0.13	53
Sikes & Parachini #2 No. 374682	Sikes & Parachini Well #2 WS No. 374682	Diesel	150	4,000	5%	394	535	n/a	4,504	46	0.0019	0.0004	46	0.05	0.11	46
Rancho Caleta No. 726883	Rancho Caleta No. 726883	Diesel	170	4,500	6%	444	535	n/a	5,105	52	0.0021	0.0004	52	0.05	0.13	52
Behring Ranch Club House No. 496461	Behring Ranch Club House Well No.496461	Electric	125	3,400	5%	335	535	49,930	n/a	10	0.0006	0.0001	10	0.02	0.04	10
Behring Ranch West Well No. 97863	Behring Ranch West Well No.97863	Electric	125	2,300	3%	227	535	49,930	n/a	10	0.0006	0.0001	10	0.02	0.04	10
Behring Ranch 10 Field Well No. 496441	Behring Ranch 10 Field Well No. 496441	Diesel	225	5,800	8%	572	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Behring Ranch Pearl 20094	Behring Ranch Pearl Well No. 20094	Diesel	225	2,500	3%	246	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Behring Ranch Nursery Well No. 17N1W10H1	Behring Ranch Nursery Well No. 17N1W10H1	Diesel	225	1,000	1%	99	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Hall Well No. X	Hall Well No. X	Electric	125	4,500	6%	444	535	49,930	n/a	10	0.0006	0.0001	10	0.02	0.04	10
Hall Well No. 369428	Hall Well No.369428	Electric	125	4,500	6%	444	535	49,930	n/a	10	0.0006	0.0001	10	0.02	0.04	10
East Morgan Well	East Morgan Well #1 No. 374667 17N01W14N001M	Diesel	225	2,600	4%	256	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
ast Morgan Well	East Morgan Well#2 No. 498195 17N01W15Q001M	Diesel	225	1,300	2%	128	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Mohammad No.	Mohammad No.e0084085 17N01W02D001M	Electric	125	4,500	6%	444	535	49,930	n/a	10	0.0006	0.0001	10	0.02	0.04	10
Southam Sartain	Southam Sartain Well 18N01W26D001M	Diesel	225	4,800	7%	473	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Barale Well	Barale Well	Diesel	225	4,000	5%	394	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
			Total	**72,800**	**100%**	**7,175**	**11,240**	**321,551**	**81,767**	**900**	**0.0380**	**0.0076**	**900**	**0.95**	**2.28**	**903**

Legend

Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	River Garden Farms	
Transfer Volume	9,000	acre feet/year
Location	Yolo	County

Table G-13. River Garden Farms Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
River Garden FarmsField 65 PW	Field 65 PW	Electric	110	2,500	14%	1,293	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 71 PW	Field 71 PW	Electric	110	1,700	10%	880	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 98 PW	Field 98 PW	Electric	110	2,900	17%	1,500	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 104 PW	Field 104 PW	Electric	110	2,500	14%	1,293	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 104-09 PW	Field 104-09 PW	Electric	110	2,990	17%	1,547	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 91-09 PW	Field 91-09 PW	Electric	110	2,840	16%	1,469	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 117 PW	Field 117 PW	Electric	110	1,965	11%	1,017	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
			Total	**17,395**	**100%**	**9,000**	**19,669**	**1,614,626**	**0**	**326**	**0.0209**	**0.0044**	**326**	**0.52**	**1.32**	**327**

Legend

Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Sycamore Mutual Water Company	
Transfer Volume	15,000	acre feet/year
Location	Colusa	County

Table G-14. Sycamore Mutual Water Company Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Sycamore Family Trust1	1	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust2	2	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust3	3	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust4	4	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust5	5	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust6	6	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust7	7	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust8	8	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust11	11	Electric	100	2,500	7%	1,071	2,328	173,695	n/a	35	0.0022	0.0005	35	0.06	0.14	35
Sycamore Family Trust14	14	Electric	100	2,500	7%	1,071	2,328	173,695	n/a	35	0.0022	0.0005	35	0.06	0.14	35
Sycamore Family Trust15	15	Electric	75	2,500	7%	1,071	2,328	130,271	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Sycamore Family Trust17	17	Electric	125	3,500	10%	1,500	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
			Total	**35,000**	**100%**	**15,000**	**27,930**	**2,431,724**	**0**	**490**	**0.0314**	**0.0067**	**490**	**0.79**	**1.98**	**493**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Te Velde Revocable Family Trust
Transfer Volume	7,094 acre feet/year
Location	Yolo County

Table G-15. Te Velde Revocable Family Trust Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Te VeldeGW1	GW1	Electric	127	4,656	29%	2,090	2,438	231,042	n/a	47	0.0030	0.0006	47	0.07	0.19	47
Te VeldeGW10	GW10	Electric	143	2,833	18%	1,272	2,438	260,150	n/a	52	0.0034	0.0007	52	0.08	0.21	53
Te VeldeGW9	GW9	Electric	104	2,200	14%	988	2,438	189,200	n/a	38	0.0024	0.0005	38	0.06	0.15	38
Te VeldeGW4	GW4	Electric	125	3,715	24%	1,668	2,438	227,404	n/a	46	0.0029	0.0006	46	0.07	0.19	46
Te VeldeGW3	GW3	Electric	52	2,400	15%	1,077	2,438	94,600	n/a	19	0.0012	0.0003	19	0.03	0.08	19
			Total	**15,804**	**100%**	**7,094**	**12,189**	**1,002,395**	**0**	**202**	**0.0130**	**0.0027**	**202**	**0.32**	**0.82**	**203**

<u>Conversion Factors</u>

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

<u>Global Warming Potential</u>

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency City of Sacramento
Transfer Volume 5,000 acre feet/year
Location Sacramento County

Table G-16. City of Sacramento Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
City of Sacramento WSA83	WELL83	electric	30	373	2%	88	1,278	28,615	n/a	7	0.0004	0.0001	7	0.01	0.02	7
City of Sacramento WSA92	WELL92	electric	50	785	4%	185	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA93	WELL93	electric	50	411	2%	97	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA94	WELL94	electric	50	879	4%	207	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA107	WELL107	electric	50	727	3%	171	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA116	WELL116	electric	75	673	3%	158	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA120	WELL120	electric	50	572	3%	135	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA122	WELL122	electric	50	470	2%	111	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA124	WELL124	electric	50	541	3%	127	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA126	WELL126	electric	50	433	2%	102	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA127	WELL127	electric	50	592	3%	139	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA129	WELL129	electric	50	466	2%	110	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA131	WELL131	electric	50	431	2%	101	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA133	WELL133	electric	150	757	4%	178	1,278	143,076	n/a	34	0.0018	0.0004	34	0.05	0.12	34
City of Sacramento WSA134	WELL134	electric	60	676	3%	159	1,278	57,230	n/a	14	0.0007	0.0002	14	0.02	0.05	14
City of Sacramento WSA137	WELL137	electric	75	541	3%	127	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA138	WELL138	electric	75	505	2%	119	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA139	WELL139	electric	50	818	4%	193	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA142	WELL142	electric	75	940	4%	221	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA143	WELL143	electric	50	379	2%	89	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA144	WELL144	electric	50	549	3%	129	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA153	WELL153	electric	100	1027	5%	242	1,278	95,384	n/a	23	0.0012	0.0003	23	0.03	0.08	23
City of Sacramento WSA154	WELL154	electric	50	502	2%	118	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA155	WELL155	electric	50	675	3%	159	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA156	WELL156	electric	75	525	2%	124	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA157	WELL157	electric	50	781	4%	184	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA158	WELL158	electric	50	781	4%	184	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA159	WELL159	electric	75	535	3%	126	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA164	WELL164	electric	150	1101	5%	259	1,278	143,076	n/a	34	0.0018	0.0004	34	0.05	0.12	34
City of Sacramento WSAX1	WELLX1	electric	150	1400	7%	329	1,278	143,076	n/a	34	0.0018	0.0004	34	0.05	0.12	34
City of Sacramento WSAX2	WELLX2	electric	150	1400	7%	329	1,278	143,076	n/a	34	0.0018	0.0004	34	0.05	0.12	34
			Total	**21,245**	**100%**	**5,000**	**39,623**	**2,041,221**	**0**	**483**	**0.0264**	**0.0056**	**483**	**0.66**	**1.66**	**485**

Legend

(purple)	Assumed to be electric (similar to other wells operated by water agency)
(green)	Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6 g
1 tonne =	1,000 kg
1 tonne =	1,000,000 g
1 MWh =	1,000 kWh
1 GWh =	1,000,000 kWh
1 kW =	1.34 hp
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Sacramento County Water Agency
Transfer Volume	15,000 acre feet/year
Location	Sacramento County

Table G-17. Sacramento County Water Agency Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
Sacramento County WAW 040	W 040	Electric	115	1,160	2%	312	1,463	126,082	n/a	30	0.0016	0.0003	30	0.04	0.10	30
Sacramento County WAW 041	W 041	Electric	65	676	1%	182	1,463	71,349	n/a	17	0.0009	0.0002	17	0.02	0.06	17
Sacramento County WAW 042	W 042	Electric	77	727	1%	196	1,463	83,960	n/a	20	0.0011	0.0002	20	0.03	0.07	20
Sacramento County WAW 043	W 043	Electric	94	918	2%	247	1,463	103,064	n/a	24	0.0013	0.0003	24	0.03	0.08	25
Sacramento County WAW 044	W 044	Electric	73	515	1%	139	1,463	79,808	n/a	19	0.0010	0.0002	19	0.03	0.07	19
Sacramento County WAW 047	W 047	Electric	88	1,030	2%	277	1,463	95,585	n/a	23	0.0012	0.0003	23	0.03	0.08	23
Sacramento County WAW 049	W 049	Electric	92	853	2%	230	1,463	100,474	n/a	24	0.0013	0.0003	24	0.03	0.08	24
Sacramento County WAW 052	W 052	Electric	120	1,192	2%	321	1,463	130,941	n/a	31	0.0017	0.0004	31	0.04	0.11	31
Sacramento County WAW 056	W 056	Electric	200	3,000	5%	808	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 061	W 061	Electric	145	1,570	3%	423	1,463	158,061	n/a	37	0.0020	0.0004	37	0.05	0.13	38
Sacramento County WAW 062	W 062	Electric	100	455	1%	123	1,463	109,181	n/a	26	0.0014	0.0003	26	0.04	0.09	26
Sacramento County WAW 063	W 063	Electric	100	1,119	2%	301	1,463	109,181	n/a	26	0.0014	0.0003	26	0.04	0.09	26
Sacramento County WAW 064	W 064	Electric	141	1,205	2%	325	1,463	153,945	n/a	36	0.0020	0.0004	36	0.05	0.13	37
Sacramento County WAW 065	W 065	Electric	57	589	1%	159	1,463	62,670	n/a	15	0.0008	0.0002	15	0.02	0.05	15
Sacramento County WAW 066	W 066	Electric	125	1,700	3%	458	1,463	136,476	n/a	32	0.0018	0.0004	32	0.04	0.11	32
Sacramento County WAW 067	W 067	Electric	135	1,425	3%	384	1,463	147,820	n/a	35	0.0019	0.0004	35	0.05	0.12	35
Sacramento County WAW 068	W 068	Electric	141	1,624	3%	437	1,463	153,836	n/a	36	0.0020	0.0004	36	0.05	0.13	37
Sacramento County WAW 069	W 069	Electric	154	1,663	3%	448	1,463	168,019	n/a	40	0.0022	0.0005	40	0.05	0.14	40
Sacramento County WAW 070	W 070	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 073	W 073	Electric	175	2,000	4%	539	1,463	191,067	n/a	45	0.0025	0.0005	45	0.06	0.16	45
Sacramento County WAW 074	W 074	Electric	50	500	1%	135	1,463	54,591	n/a	13	0.0007	0.0001	13	0.02	0.04	13
Sacramento County WAW 076	W 076	Electric	150	1,500	3%	404	1,463	163,772	n/a	39	0.0021	0.0004	39	0.05	0.13	39
Sacramento County WAW 077	W 077	Electric	125	2,000	4%	539	1,463	136,476	n/a	32	0.0018	0.0004	32	0.04	0.11	32
Sacramento County WAW 078	W 078	Electric	125	2,400	4%	647	1,463	136,476	n/a	32	0.0018	0.0004	32	0.04	0.11	32
Sacramento County WAW 087	W 087	Electric	150	1,900	3%	512	1,463	163,772	n/a	39	0.0021	0.0004	39	0.05	0.13	39
Sacramento County WAW 092	W 092	Electric	75	1,160	2%	312	1,463	81,886	n/a	19	0.0011	0.0002	19	0.03	0.07	19
Sacramento County WAW 095	W 095	Electric	200	2,200	4%	593	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 096	W 096	Electric	150	1,500	3%	404	1,463	163,772	n/a	39	0.0021	0.0004	39	0.05	0.13	39
Sacramento County WAW 105	W 105	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 106	W 106	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 109	W 109	Electric	200	2,600	5%	700	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 110	W 110	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 112	W 112	Electric	100	1,500	3%	404	1,463	109,181	n/a	26	0.0014	0.0003	26	0.04	0.09	26
Sacramento County WAW 114	W 114	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 129	W 129	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 130	W 130	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 122	W 122	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 123	W 123	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 124	W 124	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
			Total	**55,681**	**100%**	**15,000**	**57,058**	**6,030,151**	**0**	**1,427**	**0.0779**	**0.0165**	**1,427**	**1.95**	**4.92**	**1,434**

Legend

Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Sacramento Suburban Water District
Transfer Volume	30,000 acre feet/year
Location	Sacramento County

Table G-18. Sacramento Suburban Water District Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	**Well**	**Fuel Type**	**(hp)**	**(gpm)**	**(% of Total)**	**(AF/year)**	**(hours/year)**	**(kWh/yr)**	**(MMBtu/yr)**	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	**Total**
Sacramento Suburban WD5	5	Electric	110	330	1%	201	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD7	7	Electric	110	180	0%	110	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD9	9	Electric	110	625	1%	381	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD12	12	Electric	110	540	1%	329	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD13	13	Electric	110	820	2%	500	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD14	14	Electric	110	570	1%	348	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD18	18	Electric	110	840	2%	512	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD19	19	Electric	110	950	2%	579	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD22	22	Electric	110	650	1%	396	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD23	23	Electric	110	550	1%	335	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD24	24	Electric	110	590	1%	360	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD25	25	Electric	110	750	2%	457	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD26	26	Electric	110	650	1%	396	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD28	28	Electric	110	585	1%	357	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD30	30	Electric	110	650	1%	396	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD35	35	Electric	110	1000	2%	610	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD37	37	Natural Gas	190	700	1%	427	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD38	38	Natural Gas	190	500	1%	305	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD40	40	Natural Gas	190	675	1%	412	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD41	41	Electric/Natural Gas	190	600	1%	366	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD43	43	Electric/Natural Gas	190	850	2%	518	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD45	45	Natural Gas	190	750	2%	457	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD47	47	Electric/Natural Gas	190	885	2%	540	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD50	50	Electric	110	500	1%	305	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD51	51	Electric	110	285	1%	174	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD60	60	Electric	110	600	1%	366	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD65	65	Electric	110	1250	3%	762	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD66	66	Electric	110	1350	3%	823	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD69	69	Electric	110	450	1%	274	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD70	70	Electric	110	350	1%	213	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD71	71	Electric	110	2675	5%	1,631	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD72	72	Electric	110	1850	4%	1,128	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD73	73	Electric	110	3500	7%	2,134	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD74	74	Electric	110	2700	5%	1,647	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD75	75	Electric	110	1150	2%	701	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD76	76	Electric	110	250	1%	152	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD77	77	Electric	110	400	1%	244	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD20A	20A	Electric	110	1100	2%	671	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD2A	2A	Electric	110	995	2%	607	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD32A	32A	Electric	110	1905	4%	1,162	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD33A	33A	Electric	110	2675	5%	1,631	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD3A	3A	Electric	110	370	1%	226	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD40A	40A	Electric	110	2525	5%	1,540	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD46R	46R	Electric/Natural Gas	190	800	2%	488	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD4B	4B	Electric	110	2675	5%	1,631	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD55A	55A	Electric	110	2000	4%	1,220	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD68R	68R	Electric	110	1600	3%	976	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
			Total	**49,195**	**100%**	**30,000**	**155,656**	**10,602,801**	**35,238**	**4,379**	**0.1723**	**0.0325**	**4,379**	**4.31**	**9.69**	**4,393**

Legend

Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC =	7,000	Btu/bhp-hr
Higher Heating Valı	1,020	Btu/scf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Butte Water District	
Transfer Volume	5,500	acre feet/year
Location	Butte	County
	Sutter	County

Table G-19. Butte Water District Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Butte Water District#1	#1	Electric	300	4,000	49%	2,683	3,643	815,517	n/a	164	0.0105	0.0022	164	0.26	0.66	165
Butte Water District#2	#2	Electric	350	4,200	51%	2,817	3,643	951,437	n/a	192	0.0123	0.0026	192	0.31	0.78	193
			Total	**8,200**	**100%**	**5,500**	**7,285**	**1,766,954**	**0**	**356**	**0.0228**	**0.0048**	**356**	**0.57**	**1.44**	**358**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Garden Highway Mutual Water Company
Transfer Volume	14,000 acre feet/year
Location	Sutter County

Table G-20. Garden Highway Mutual Water Company Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Garden Highway MWC4	#4	Electric	110	2,300	12%	1,651	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC17	#17	Electric	110	3,100	16%	2,226	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC19	#19	Electric	110	2,800	14%	2,010	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC22	#22	Electric	110	2,700	14%	1,938	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC23	#23	Electric	110	2,200	11%	1,579	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC24	#24	Electric	110	3,200	16%	2,297	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC25	#25	Electric	110	3,200	16%	2,297	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
			Total	**19,500**	**100%**	**14,000**	**27,294**	**2,240,511**	**0**	**452**	**0.0290**	**0.0061**	**452**	**0.72**	**1.83**	**454**

Legend

(shaded cell) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Gilsizer Slough Ranch	
Transfer Volume	3,900	acre feet/year
Location	Sutter	County

Table G-21. Gilsizer Slough Ranch Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Gilsizer #1	Gilsizer #1	Diesel	162	2,016	33%	1,300	3,502	n/a	31,828	325	0.0132	0.0026	325	0.33	0.79	326
Gilsizer #2	Gilsizer #2	Electric	110	2,016	33%	1,300	3,502	287,481	n/a	58	0.0037	0.0008	58	0.09	0.23	58
Gilsizer #3	Gilsizer #3	Electric	110	2,016	33%	1,300	3,502	287,481	n/a	58	0.0037	0.0008	58	0.09	0.23	58
			Total	**6,048**	**100%**	**3,900**	**10,506**	**574,961**	**31,828**	**441**	**0.0206**	**0.0042**	**441**	**0.52**	**1.25**	**443**

Legend

Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Goose Club Farms and Teichert Aggregates	
Transfer Volume	10,000	acre feet/year
Location	Sutter	County

Table G-22. Goose Club Farms and Teichert Aggregates Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Goose Club1	1	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club2	2	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club3	3	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club4	4	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club5	5	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club6	6	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club7	7	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club8	8	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club9	9	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club10	10	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club11	11	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club12	12	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club13	13	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
			Total	**39,000**	**100%**	**10,000**	**18,103**	**1,688,697**	**0**	**341**	**0.0218**	**0.0046**	**341**	**0.55**	**1.38**	**342**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Tule Basin Farms	
Transfer Volume	7,320	acre feet/year
Location	Sutter	County

Table G-23. Tule Basin Farms Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	**Well**	**Fuel Type**	**(hp)**	**(gpm)**	**(% of Total)**	**(AF/year)**	**(hours/year)**	**(kWh/yr)**	**(MMBtu/yr)**	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	**Total**
Tule Basin1	1	Electric	125	3,050	27%	1,941	3,457	322,468	n/a	65	0.004	0.001	65	0.10	0.26	65
Tule Basin2	2	Natural Gas	190	3,600	31%	2,291	3,457	n/a	4,598	244	0.005	0.000	244	0.11	0.14	244
Tule Basin3	3	Electric	125	4,850	42%	3,087	3,457	322,468	n/a	65	0.004	0.001	65	0.10	0.26	65
			Total	**11,500**	**100%**	**7,320**	**10,371**	**644,935**	**4,598**	**374**	**0.0129**	**0.0022**	**374**	**0.32**	**0.66**	**375**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC =	7,000	Btu/bhp-hr
Higher Heating Value	1,020	Btu/scf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Reclamation District 2068	
Transfer Volume	4,500	acre feet/year
Location	Solano	County
	Yolo	County

Table G-24. Reclamation District 2068 Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
RD-2068TP-1	TP-1	Electric	75	1,500	25%	1,125	4,073	227,974	n/a	46	0.0029	0.0006	46	0.07	0.19	46
RD-2068GW-2	GW-2	Electric	75	1,500	25%	1,125	4,073	227,974	n/a	46	0.0029	0.0006	46	0.07	0.19	46
RD-2068GW-3	GW-3	Electric	75	1,500	25%	1,125	4,073	227,974	n/a	46	0.0029	0.0006	46	0.07	0.19	46
RD-2068GW-4	GW-4	Electric	75	1,500	25%	1,125	4,073	227,974	n/a	46	0.0029	0.0006	46	0.07	0.19	46
			Total	**6,000**	**100%**	**4,500**	**16,293**	**911,896**	**0**	**184**	**0.0118**	**0.0025**	**184**	**0.29**	**0.74**	**185**

Legend

Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Pope Ranch	
Transfer Volume	2,800	acre feet/year
Location	Yolo	County

Table G-25. Pope Ranch Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	GHG Emissions (metric tons per year) CH4	GHG Emissions (metric tons per year) N2O	GHG Emissions (metric tons CO2e per year) CO2	GHG Emissions (metric tons CO2e per year) CH4	GHG Emissions (metric tons CO2e per year) N2O	GHG Emissions (metric tons CO2e per year) Total
Pope RanchX1	X1	Electric	110	2,117	50%	1,400	3,591	294,824	n/a	59	0.0038	0.0008	59	0.10	0.24	60
Pope RanchX2	X2	Electric	110	2,117	50%	1,400	3,591	294,824	n/a	59	0.0038	0.0008	59	0.10	0.24	60
			Total	**4,234**	**100%**	**2,800**	**7,183**	**589,648**	**0**	**119**	**0.0076**	**0.0016**	**119**	**0.19**	**0.48**	**120**

Legend

Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Engine Size Summary

Table G-26. Summary of Average Engine Horsepower by Fuel Type

Average of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		125		125
Butte Water District		325		325
City of Sacramento		60		60
Conaway Preservation Group	227	138		147
Cordua Irrigation District		82		82
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	129	118		124
Reclamation District 1004	191	76		145
Reclamation District 108		200		200
Reclamation District 2068		75		75
Sacramento County Water Agency		116		116
Sycamore Mutual Water Company		117		117
Te Velde Revocable Family Trust		110		110
Tule Basin Farms		125	190	147
Grand Total	**162**	**110**	**190**	**117**

Table G-27. Summary of Maximum Engine Horsepower by Fuel Type

Max of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		200		200
Butte Water District		350		350
City of Sacramento		150		150
Conaway Preservation Group	227	250		250
Cordua Irrigation District		125		125
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	250	250		250
Reclamation District 1004	225	125		225
Reclamation District 108		250		250
Reclamation District 2068		75		75
Sacramento County Water Agency		200		200
Sycamore Mutual Water Company		125		125
Te Velde Revocable Family Trust		143		143
Tule Basin Farms		125	190	190
Grand Total	**250**	**350**	**190**	**350**

Table G-28. Summary of Minimum Engine Horsepower by Fuel Type

Min of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		50		50
Butte Water District		300		300
City of Sacramento		30		30
Conaway Preservation Group	227	75		75
Cordua Irrigation District		50		50
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	62	30		30
Reclamation District 1004	150	40		40
Reclamation District 108		100		100
Reclamation District 2068		75		75
Sacramento County Water Agency		50		50
Sycamore Mutual Water Company		75		75
Te Velde Revocable Family Trust		52		52
Tule Basin Farms		125	190	125
Grand Total	**62**	**30**	**190**	**30**

GHG Emission Factors

Table G-29. GHG Emission Factors for Electric Pumps

County	Utility Company	Emission Factors CO2 (lbs/MWh)	CH4 (lbs/GWh)	N2O (lbs/GWh)
Colusa	Pacific Gas & Electric	444.62	28.49	6.03
Glenn	Pacific Gas & Electric	444.62	28.49	6.03
Merced	Pacific Gas & Electric	444.62	28.49	6.03
Placer	Pacific Gas & Electric	444.62	28.49	6.03
Sacramento	Sacramento Municipal Utility District	521.73	28.49	6.03
San Joaquin	Pacific Gas & Electric	444.62	28.49	6.03
Shasta	Pacific Gas & Electric	444.62	28.49	6.03
Solano	Pacific Gas & Electric	444.62	28.49	6.03
Sutter	Pacific Gas & Electric	444.62	28.49	6.03
Yolo	Pacific Gas & Electric	444.62	28.49	6.03
Yuba	Pacific Gas & Electric	444.62	28.49	6.03

Table G-30. Utility-Specific CO2 Emission Factors

2009 Emission Rates		
Utility	**Factor Type**	**Emission Factor (lbs CO_2/MWh)**
Modesto Irrigation District	Retail Power	1,036.17
	Special Power	0
	Wholesale Power	2,048.09
Pacific Gas & Electric	System Average	575.38
Bonneville Power Authority	System Average	93.17
2010 Emission Rates		
Utility	**Factor Type**	**Emission Factor (lbs CO_2/MWh)**
Sacramento Municipal Utility District	Retail Power	526.47
	Special Power	0.00
	Wholesale Power	828.58
Newmont Nevada Energy Investment	Wholesale Power	2,055.79
Pacific Gas & Electric	System Average	444.64
City of Vernon, Light and Power	System Average	775.83
Modesto Irrigation District	Retail Power	942.99
	Special Power	0.00
	Wholesale Power	2,026.12
Northern States Power Company (Xcel Energy)	System Average	1,047.20
Public Service Company of Colorado (Xcel Energy)	System Average	1,675.51
Southwestern Public Service Company (Xcel Energy)	System Average	1,552.05
Seattle City Light	Retail Power	45.57
	Special Power	0.00
	Wholesale Power	537.64
Bonneville Power Authority	System Average	134.70

2011 Emission Rates		
Utility	Factor Type	Emission Factor (lbs CO_2/MWh)
Pacific Gas & Electric	System Average	392.87
Bonneville Power Authority	System Average	47.86
Seattle City Light	Retail Power	13.77
	Special Power	0.00
	Wholesale Power	218.75
Sacramento Municipal Utility District	Retail Power	429.29
	Special Power	0.00
	Wholesale Power	795.14
City of Vernon, Light and Power	System Average	731.49
Northern States Power Company (Xcel Energy)	System Average	1,071.45
Public Service Company of Colorado (Xcel Energy)	System Average	1,618.19
Southwestern Public Service Company (Xcel Energy)	System Average	1,472.69
2012 Emission Rates		
Utility	**Factor Type**	**Emission Factor (lbs CO_2/MWh)**
City of Vernon, Light and Power	System Average	765.97
Pacific Gas & Electric	System Average	444.62
Sacramento Municipal Utility District	Retail Power	521.73
	Special Power	0.00
	Wholesale Power	799.77
Seattle City Light	Retail Power	25.62
	Special Power	0.00
	Wholesale Power	362.85
Metropolitan Water District of Southern California	Wholesale Power	658.73
	Self-consumed Power	157.87

Source:

The Climate Registry. 2014. Utility-Specific Emission Factors. Accessed on: May 12, 2014. Available at: http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/.

Table G-31. eGRID GHG Emission Factors

eGRID Subregion	eGRID Subregion Name	2010 Emission Rates		
		(lbs CO2/MWh)	(lbs CH4/GWh)	(lbs N2O/GWh)
AKGD	ASCC Alaska Grid	1,256.87	26.08	7.18
AKMS	ASCC Miscellaneous	448.57	18.74	3.68
AZNM	WECC Southwest	1,177.61	19.21	15.72
CAMX	WECC California	610.82	28.49	6.03
ERCT	ERCOT All	1,218.17	16.85	14.07
FRCC	FRCC All	1,196.71	38.91	13.75
HIMS	HICC Miscellaneous	1,330.16	73.98	13.88
HIOA	HICC Oahu	1,621.86	99.3	22.41
MROE	MRO East	1,610.80	24.29	27.52
MROW	MRO West	1,536.36	28.53	26.29
NEWE	NPCC New England	722.07	71.76	12.98
NWPP	WECC Northwest	842.58	16.05	13.07
NYCW	NPCC NYC/Westchester	622.42	23.81	2.8
NYLI	NPCC Long Island	1,336.11	81.49	10.28
NYUP	NPCC Upstate NY	545.79	16.3	7.24
RFCE	RFC East	1,001.72	27.07	15.33
RFCM	RFC Michigan	1,629.38	30.46	26.84
RFCW	RFC West	1,503.47	18.2	24.75
RMPA	WECC Rockies	1,896.74	22.66	29.21
SPNO	SPP North	1,799.45	20.81	28.62
SPSO	SPP South	1,580.60	23.2	20.85
SRMV	SERC Mississippi Valley	1,029.82	20.66	10.76
SRMW	SERC Midwest	1,810.83	20.48	29.57
SRSO	SERC South	1,354.09	22.82	20.89
SRTV	SERC Tennessee Valley	*1,389.20*	17.7	22.41
SRVC	SERC Virginia/Carolina	1,073.65	21.69	17.64

Source: U.S. Environmental Protection Agency. 2014. eGRID 9th edition Version 1.0 Year 2010 GHG Annual Output Emission Rates. Accessed on: May 12, 2014. Available at: http://www.epa.gov/cleanenergy/documents/egridzips/eGRID_9th_edition_V1-0_year_2010_GHG_Rates.pdf.

Table G-32. Diesel Emission Factors

Pollutant	Emission Factor	Unit	Emission Factor Description
CO2	10.21	kg/gallon	Table 12.1, Distillate Fuel Oil No. 2
CH4	0.003	kg/MMBtu	Table 12.9, Petroleum Products, Industrial
N2O	0.0006	kg/MMBtu	Table 12.9, Petroleum Products, Industrial
Heat Content	0.138	MMBtu/gallon	Table 12.1, Distillate Fuel Oil No. 2

Source: The Climate Registry. 2014. 2014 Climate Registry Default Emission Factors with U.S. EPA 11/29/2013 Update (Released: March 14, 2014). Accessed on: May 12, 2014. Available at: http://www.theclimateregistry.org/downloads/2014/03/2014-TCR-Default-EFs-with-EPA-11.29.2013-update.pdf

Table G-33. Natural Gas Emission Factors

Pollutant	Emission Factor	Unit	Emission Factor Description
CO2	53.06	kg/MMBtu	Table 12.1, US Weighted Average
CH4	0.001	kg/MMBtu	Table 12.9, Natural Gas, Industrial
N2O	0.0001	kg/MMBtu	Table 12.9, Natural Gas, Industrial
Heat Content	1,026	Btu/scf	Table 12.1, US Weighted Average

Source: The Climate Registry. 2014. 2014 Climate Registry Default Emission Factors with U.S. EPA 11/29/2013 Update (Released: March 14, 2014). Accessed on: May 12, 2014. Available at: http://www.theclimateregistry.org/downloads/2014/03/2014-TCR-Default-EFs-with-EPA-11.29.2013-update.pdf

Table G-34. Reduced Exhaust Emissions from Cropland Idling

Water Agency	Groundwater Substitution	Cropland Idling/ Crop	GW Pumping Equivalent	Annual Emissions (MT/year)			Annual Emissions (MTCO2e/year)			
	(acre-feet/year)	(acre-feet/year)	(acre-feet/year)	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
Anderson-Cottonwood Irrigation District	5,226	0	0	--	--	--	--	--	--	--
Browns Valley Irrigation District	0	0	0	--	--	--	--	--	--	--
Butte Water District	5,500	11,500	2,706	205	0.009	0.002	205	0.24	0.58	205
City of Sacramento	5,000	0	0	--	--	--	--	--	--	--
Conaway Preservation Group	35,000	21,349	5,023	380	0.018	0.004	380	0.44	1.07	381
Cordua Irrigation District	12,000	0	0	--	--	--	--	--	--	--
Cranmore Farms	8,000	2,500	588	44	0.002	0.000	44	0.05	0.13	45
Eastside Mutual Water Company	2,230	0	0	--	--	--	--	--	--	--
Garden Highway Mutual Water Company	14,000	0	0	--	--	--	--	--	--	--
Gilsizer Slough Ranch	3,900	0	0	--	--	--	--	--	--	--
Glenn-Colusa Irrigation District	25,000	66,000	15,529	1,174	0.055	0.011	1,174	1.36	3.31	1,178
Goose Club Farms and Teichert Aggregates	10,000	10,000	2,353	178	0.008	0.002	178	0.21	0.50	179
Merced Irrigation District	0	0	0	--	--	--	--	--	--	--
Natomas Central Mutual Water Company	30,000	0	0	--	--	--	--	--	--	--
Pelger Mutual Water Company	3,750	2,538	597	45	0.002	0.000	45	0.05	0.13	45
Placer County Water Agency	0	0	0	--	--	--	--	--	--	--
Pleasant Grove-Verona Mutual Water Company	18,000	9,000	2,118	160	0.007	0.002	160	0.19	0.45	161
Pope Ranch	2,800	0	0	--	--	--	--	--	--	--
Reclamation District 1004	7,175	10,000	2,353	178	0.008	0.002	178	0.21	0.50	179
Reclamation District 108	15,000	20,000	4,706	356	0.017	0.003	356	0.41	1.00	357
Reclamation District 2068	4,500	7,500	1,765	133	0.006	0.001	133	0.15	0.38	134
River Garden Farms	9,000	0	0	--	--	--	--	--	--	--
Sacramento County Water Agency	15,000	0	0	--	--	--	--	--	--	--
Sacramento Suburban Water District	30,000	0	0	--	--	--	--	--	--	--
South Sutter Water District	0	0	0	--	--	--	--	--	--	--
Sycamore Mutual Water Company	15,000	10,000	2,353	178	0.008	0.002	178	0.21	0.50	179
Te Velde Revocable Family Trust	7,094	6,975	1,641	124	0.006	0.001	124	0.14	0.35	125
Tule Basin Farms	7,320	0	0	--	--	--	--	--	--	--
Total	**290,495**	**177,362**	**41,732**	**3,154**	**0.146**	**0.030**	**3,154**	**3.66**	**8.91**	**3,167**

Notes:

Pelger Mutual Water Company used to estimate emissions for other water agencies.

Engine power rating equal to 250 hp for Pelger Mutual Water Company engines.

The Byron Buck memo is based on diesel-fueled engines with sizes ranging from 121 to 225 hp; all engines are noncertified (Tier 0).

Pelger Mutual Water Company engines are therefore determined to be a sufficient proxy to estimate the difference in emissions between groundwater substitution and cropland idling.

1 acre-foot of groundwater pumped = 4.25 acre-feet produced by fallowing

Source: Byron Buck & Associates. 2009. "Comparison of Summertime Emission Credits from Land Fallowing Versus Groundwater Pumping."

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Appendix H

Biological Regulatory Setting

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Appendix H
Biological Resources Regulatory Setting

The following section describes laws, rules, regulations and policies that apply to the natural communities, common plants and wildlife, fisheries, and special-status species that occur within the area of analysis.

H.1 Federal

H.1.1 Endangered Species Act (ESA)

The Federal ESA defines “endangered” species as those in danger of extinction throughout all or a significant portion of their range. A “threatened” species is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Additional special-status species include “candidate” species and “species of concern.” Candidate species are those for which the U.S. Fish and Wildlife Service (USFWS), or National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) if applicable, has enough information on file to propose listing as endangered or threatened. A species that has been “delisted” is one whose population has met its recovery goal target and is no longer found to be in jeopardy of extinction. These agencies also may designate Critical Habitat for listed species.

Section 4 of the Federal ESA prohibits “take” of federally listed species without a permit that specifically authorizes that take. Take may be authorized through either a Section 10a1(a) permit for directed take of the species for scientific research, or through an incidental take permit, which allows an action to take of the species (under specifically prescribed conditions) where such take is incidental to the implementation of an otherwise lawful activity. Incidental take of a federally listed species may be addressed for a proposed project in one of two ways depending on whether the or not the project has a federal nexus. A federal nexus occurs when a project is authorized or funded by a federal agency. Projects without a federal nexus may address potential adverse impacts to species protected under Federal ESA Section 10, or (2) a federal lead agency regulates a proposed project in accordance with Federal ESA Section 7. As this project has a federal nexus, the Section 7 process will be followed. Section 7 defines a process for the federal lead agency to consult with the responsible federal resource agency (the USFWS or NOAA Fisheries), to determine whether proposed long-term water transfers are likely to adversely affect species that are listed or proposed for listing. The Section 7 process typically requires the preparation of a biological assessment (BA) by the federal lead agency followed by the preparation of biological opinion (BO) by the responsible federal resource agency.

H.1.2 Fish and Wildlife Coordination Act (FWCA)

The FWCA (16 U.S. Code [USC] 661 et seq.) requires Federal agencies to consult with USFWS, or, in some instances, with NOAA Fisheries and with State fish and wildlife resource agencies before undertaking or approving water projects that control or modify surface water. The purpose of this consultation is to ensure that wildlife concerns receive equal consideration water resource development projects and are coordinated with the features of these projects. The consultation is intended to promote the conservation of fish and wildlife resources by preventing their loss or damage and to provide for the development and improvement of fish and wildlife resources in connection with water projects. Federal agencies undertaking water projects are required to fully consider recommendations made by USFWS, NOAA Fisheries, and State fish and wildlife resource agencies in project reports and to include measures to reduce impacts on fish and wildlife in project plans.

The 1988 amendment to the Fish and Wildlife Conservation Act mandates USFWS to identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA of 1973. In 2008, USFWS issued the most recent version of the National list of *Bird Species of Conservation Concern.*

H.1.3 Magnuson-Stevens Fisheries Act of 2006

The Amended Magnuson-Stevens Fishery Conservation and Management Act, also known as the Sustainable Fisheries Act (Public Law 104-297) is the primary law governing the marine fisheries of the United States. The law establishes requirements to provide for the sustainable management of these fisheries and to promote the protection of essential fish habitat. This Act requires all Federal agencies to consult with the Secretary of Commerce on activities, or proposed activities, authorized, funded, or undertaken by that agency that may adversely affect Essential Fish Habitat. The Essential Fish Habitat provisions of the Sustainable Fisheries Act are designed to protect fisheries habitat from being lost due to disturbance and degradation.

H.1.4 Migratory Bird Treaty Act (MBTA)

The MBTA domestically implements a series of international treaties that provide for migratory bird protection. The MBTA authorizes the Secretary of the Interior to regulate the taking of migratory birds. The act further provides that it is unlawful, except as permitted by regulations, “to pursue, take, or kill any migratory bird, or any part, nest or egg of any such bird…” (16 USC 703). This prohibition includes both direct and indirect acts, although harassment and habitat modification are not included unless they result in direct loss of birds, nests, or eggs. The current list of species protected by the MBTA can be found in the March 1, 2010 Federal Register (75 FR 9281). This list comprises several hundred species, including essentially all native birds. Permits for take of nongame migratory birds can be issued only for specific activities, such as scientific collecting, rehabilitation, propagation, education, taxidermy, and protection of human health and safety and of personal property. USFWS publishes a list of birds of conservation concern (BCC) to identify migratory nongame birds that are likely to become candidates for listing under ESA without additional conservation actions. The BCC list is intended to stimulate coordinated and collaborative conservation efforts among federal, state, tribal, and private parties.

H.1.5 Executive Order 11990 (Protection of Wetlands)

Executive Order 11990 (Protection of Wetlands) requires Federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking Federal activities and programs. Any agency considering a proposal that might affect wetlands must evaluate factors affecting wetland quality and survival. These factors should include the proposal’s effects on the public health, safety, and welfare due to modifications in water supply and water quality; maintenance of natural ecosystems and conservation of flora and fauna; and other recreational, scientific, and cultural uses.

H.2 State

H.2.1 California Endangered Species Act (CESA)

CESA (California Fish and Game Code Sections 2050–2116) was implemented in 1984 to prohibit the take of species that are listed as endangered and or threatened. CESA defines “endangered” species as those whose continued existence in California is jeopardized. State-listed “threatened” species are those not presently threatened with extinction, but which may become endangered if their environments change or deteriorate. Section 86 of the California Department of Fish and Game Code defines take as to "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill.” California Department of Fish and Wildlife (CDFW) administers CESA and authorizes incidental take through either California Fish and Game Code Section 2080.1 (consistency determination) or Section 2081 (Incidental Take Permit).

H.2.2 Fully Protected Species

Sections 3511, 3513, 4700, and 5050 of the California Fish and Game Code pertain to fully protected wildlife species (birds in Sections 3511 and 3513, mammals in Section 4700, and reptiles and amphibians in Section 5050) and strictly prohibit the take of these species. CDFW cannot issue a take permit for fully protected species, except under narrow conditions for scientific research or the protection of livestock, or if a Natural Community Conservation Plan (NCCP) has been adopted. Specifically, Section 3513 prohibits any take or possession of birds designated by the MBTA as migratory nongame birds except as allowed by federal rules and regulations pursuant to the MBTA.

H.2.3 Protection of Birds and Raptors

Section 3503 of the Fish and Game Code prohibits the killing of birds and/or the destruction of bird nests. Section 3503.5 prohibits the killing of raptor species and/or the destruction of raptor nests. Typical violations include destruction of active bird and raptor nests as a result of tree removal, and failure of nesting attempts (loss of eggs and/or young) as a result of disturbance of nesting pairs caused by nearby human activity.

H.2.4 California Native Plant Protection Act (CNPPA)

The CNPPA of 1977 prohibits importation of rare and endangered plants into California, take of rare and endangered plants, or sale of rare and endangered plants. CESA defers to the CNPPA, which ensures that state-listed plant species are protected when state agencies are involved in projects subject to California Environmental Quality Act.

H.2.5 Natural Community Conservation Planning Act (NCCPA)

The NCCPA, California Fish and Game Code, Section 2800, et seq., was enacted to form a basis for broad-based planning to provide for effective protection and conservation of the State's wildlife heritage, while continuing to allow appropriate development and growth. The purpose of natural community conservation planning is to sustain and restore those species and their habitat identified by CDFW that are necessary to maintain the continued viability of biological communities impacted by human changes to the landscape. A NCCP identifies and provides for those measures necessary to conserve and manage natural biological diversity within the plan area while allowing compatible use of the land. CDFW may authorize the take of any identified species, including listed and non-listed species, pursuant to Section 2835 of the NCCPA, if the conservation and management of such species is provided for in an NCCP approved by CDFW. NCCPs in the planning area are described in greater detail in Section 3.6.1.2.5 Regional/Local Requirements. The proposed water transfers occurring in NCCP planning areas will not require separate incidental take permits pursuant to CESA for covered species if the project adheres to the requirements of the relevant plans.

H.2.6 Requirements of the 1995 Bay Delta Plan Water Quality Control Plan (1995 Delta WQCP) and Decision 1641

The State Water Resources Control Board (SWRCB) adopted its WQCP for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary in May 1995 and incorporated several elements of U.S. Environmental Protection Agency (USEPA), NOAA Fisheries, and USFWS regulatory objectives for water salinity and endangered species protection. The WQCP identifies the beneficial uses of the Bay-Delta that are to be protected and includes flow and water quality objectives that are intended to protect the beneficial uses. The plan also includes an implementation program for achieving the water quality objectives.

Under the Clean Water Act, the water quality standards comprise the uses and the quality objectives established to protect them.

Features of the current WQCP affect the proposed water transfers because they require certain Delta outflows and regulate actions that may be used to protect fish and benefit the environment.

H.3 State and Federal Laws and Regulations Governing Water Transfers and Water Acquisitions

H.3.1 The Water Code

Both State and Federal laws contain provisions that authorize, acknowledge, or support water transfers. The Water Code protects legal users of water and fish and wildlife during water transfers through the “no injury rule,” analyses of impacts to fish and wildlife, evaluation of third-party impacts, and the 1707 process.

Water Code Sections 1435, 1725, and 1736 require that the SWRCB make a finding that certain proposed transfers not result in unreasonable effects on fish and wildlife or other instream beneficial uses. These Code Sections apply to specific types of water transfers (urgent, temporary, and long-term transfers) related to post-1914 water rights. Pre-1914 water rights are not subject to the permit system, although a change in use for instream flow may be permitted under Section 1707 on petition to the SWRCB. The proposed water transfers were conceived in compliance with these codes.

In the context of the proposed water transfers “third parties” are any persons and resources other than the entities transferring or receiving water. Although the Water Code does not define “third party impacts,” they traditionally include impacts related to downstream water rights; adjacent groundwater users; fish and wildlife; and recreation, economic, and social impacts. Most third-party impacts are evaluated under Water Code Sections that protect prior rights and fish and wildlife as discussed above. However, Water Code Sections 386 and 1810 require evaluation of other third-party impacts for some specific transfers and prohibit such transfers from affecting the overall economy of the area or county from which the water is being transferred. Water Code Section 1810 states that transferors can utilize public water conveyance facilities as long as “this use of a water conveyance facility is to be made without injuring any legal user of water and without unreasonably affecting fish, wildlife, or other instream beneficial uses and without unreasonably affecting the overall economy or the environment of the county from which the water is being transferred.”

Section 1707 of the Water Code allows water rights holders, including riparian rights holders, to dedicate their rights to instream uses “for the purpose of preserving or enhancing wetlands, fish and wildlife resources, or recreation in, or on, the water." These transfers, from a consumptive use to a non-consumptive use with an identified need, may be temporary or permanent. The transfer must meet the following requirements for the SWRCB to consider approving the change in use:

- Will not increase the amount of water the person is entitled to use;
- Will not unreasonably affect any legal user of water; and
- Otherwise meets the requirements of Division 2 of the Water Code.

The petitioner can request that the water subject to transfer approval be in addition to water required for "Federal, State, or local regulatory requirements governing water quantity, water quality, instream flows, fish and wildlife, wetlands, recreation and other instream beneficial uses." If the petitioner does not submit this request to the SWRCB, then the water shall be used to meet any of the above requirements.

H.4 Other Pertinent Programs, Documents, Laws, and Agreements

Potential biological effects of water transfers in the project area have been previously addressed in documents.

H.4.1 Central Valley Project Improvement Act (CVPIA)

The CVPIA is a Federal statute passed in 1992 with the following purposes:

> *"To protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California; To address impacts of the Central Valley Project on fish, wildlife and associated habitats; To improve the operational flexibility of the Central Valley Project; To increase water-related benefits provided by the Central Valley Project to the State of California through expanded use of voluntary water transfers and improved water conservation; To contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; To achieve a reasonable balance among competing demands for use of Central Valley Project water, including the requirements of fish and wildlife, agricultural, municipal and industrial and power contractors."*

The CVPIA changed the relative priorities of the various project purposes of the Central Valley Project (CVP) by making fish and wildlife protection, as a project purpose, equal to water supply for agricultural and urban uses.

CVPIA Section 3406(b)(2) (CVPIA[b][2]) authorized and directed the Secretary to dedicate and manage 800,000 acre-feet (AF) of CVP yield annually for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized in CVPIA, to assist the State of California in its efforts to protect the waters of the Bay-Delta Estuary, and to help meet obligations legally imposed on the CVP under State or Federal law following the date of enactment of the CVPIA. This dedicated 800,000 AF of water, known as (b)(2) water, was included as a component of the CALFED Programmatic Environmental Impact Statement/Environmental Impact Report (PEIS/EIR) existing regulatory baseline for fishery protection conditions for environmental and fisheries protection measures.

The operation of CVP and the State Water Project (SWP) facilities is subject to BOs issued by USFWS and the NOAA Fisheries. These BOs are subject to ongoing litigation and are currently under review by the two services:

- Biological Opinion on Implementation of the CVPIA and Continued Operation and Maintenance of the Central Valley Project (NOAA Fisheries 2000),
- Biological Opinion on the Effects of the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan (NOAA Fisheries 2004),
- Consultation on Long-Term Renewal of Water Service Contracts in the Delta-Mendota Canal Unit (NOAA Fisheries 2005),
- Reinitiation of Formal and Early Section 7 Endangered Species Consultation on the Coordinated Operations of the Central Valley Project and State Water Project and the Operational Criteria and Plan to Address Potential Critical Habitat Issues (USFWS 2005a),
- Conclusion of Consultation on Long-Term Renewal of Water Service Contracts in the Delta-Mendota Canal Unit (USFWS 2005b),
- Formal Endangered Species Consultation on the Operations and Maintenance Program Occurring on Bureau of Reclamation Lands within the South-Central California Area Office: Biological Opinion (USFWS 2005c),
- Biological opinions for CVP Water contracts,
- Biological Opinion on the Coordinated Operations of the CVP and SWP in California. (USFWS 2008), and
- Biological Opinion on California’s Central Valley Water Project (NOAA Fisheries 2009).

H.5 Regional/Local Requirements

Both the ESA and the NCCPA include provisions for the development of conservation plans to protect vegetation and wildlife resources.

A Habitat Conservation Plan (HCP) is a planning document that is required for issuance of an incidental take permit under section 10 of the ESA. The HCP process provides opportunities to conserve listed species, while streamlining permitting for participants' development projects within the planning area. HCP documents typically includes the following information: the anticipated take of the proposed project; measures to avoid, minimize or mitigate impacts to the maximum extent practicable, and a funding mechanism for acquiring and managing lands containing the habitats on which the covered species depend. Covered species may include both listed and non-listed species. This may provide an extra level of certainty for permittees, given that no amendments to the plan would be required if a covered species becomes listed under the ESA before the completion of project activities.

A NCCP is a similar process provided under state law, with some key differences. While the federal and state ESAs focus on protection and recovery of species that have already declined, NCCPs take a broader approach, seeking to anticipate and avoid future conflicts between preservation and development, as well as compliance with the CESA. NCCPs focus on regional-scale protection of ecosystems along with compatible development. A local agency oversees cooperative development of an NCCP by landowners, environmental groups, and other stakeholders, with support provided by CDFW and USFWS.

Project actions within the HCP/NCCP areas will comply with applicable requirements for covered activities within plan areas for existing HCPs/NCCPs. A separate Section 7 Consultation will also be undertaken for the long-term water transfers.

There are 11 HCPs or NCCPs that are either adopted or under development for areas that overlap with, or occur in the vicinity of, the long-term water transfers area of analysis (CDFW 2014a):

- Butte Regional Conservation Plan (BRCP) – The BRCP is a cooperative planning effort between the Cities of Biggs, Chico, Gridley, Oroville, County of Butte, and Butte County Association of Governments. The plan will provide streamlined ESA permitting for transportation projects, land development and covered activities such as construction and maintenance of facilities and infrastructure, residential construction, and recreational activity-related construction. The BRCP also aims to provide comprehensive conservation of species, wetlands and ecosystems, specifically contributing to the protection of 41 plant, fish, and wildlife species within the 564,270 acre plan area (CDFW 2014b). The BRCP covers nine of the focal species for the long-term water transfers including Red Bluff dwarf rush, Sacramento River winter-run Chinook salmon, and green sturgeon. This plan is under development.

- Bay-Delta Conservation Plan (BDCP) – The BDCP is a comprehensive conservation strategy for the Sacramento–San Joaquin River Delta (Delta) to protect ecosystem health, water quality, water supply, and California's economy, while permitting the operation of the CVP and State Water Project (SWP). The BDCP covers 56 species, including 11 of the focal species for the long-term water transfers including Central Valley Spring-run Chinook salmon, longfin smelt, and greater sandhill crane. This plan is under development. The draft BDCP and its corresponding draft EIS/EIR were published for public review and comment in December 2013 (Reclamation et al. 2013).

- East Contra Costa County HCP/NCCP – The East Contra Costa County HCP/NCCP was developed partially to address indirect and cumulative effects on terrestrial species from development supported by increases in water supply provided by Contra Costa Water District. Activities covered under the plan include public infrastructure projects, construction of residential and business development, and public infrastructure projects. The plan has been adopted by Contra Costa County, the Cities of Brentwood, Clayton, Pittsburg, and Oakley. The HCP/NCCP provides regional conservation and development guidelines to protect natural resources while improving the permit process for endangered species and wetland regulations. The plan will encompass a preserve system covering 30,300 acres of land that will be managed for the benefit of 28 species and the natural communities they depend upon (East Contra Costa County HCP Association 2006). The East Contra Costa County HCP covers 4 of the focal species for the long-term water transfers including giant garter snake, San Joaquin kit fox, and Western pond turtle.

- Natomas Basin HCP (NBHCP) - The NBHCP establishes a multi-species conservation program to mitigate the expected loss of habitat and incidental take and/or loss of covered species that would result from planned urban development. The plan covers 53,537 acres within the levees surrounding the Natomas Basin and 22 plant and wildlife species (The Natomas Basin Conservancy 2003). Covered activities under the plan include urban development, public and drainage improvements, water agency projects, and approved activities of the Natomas Basin Conservancy. Plan participants include the City of Sacramento, Sutter County, Sacramento County, and the acting regulatory agencies. The NBHCP covers four of the focal species for the long-term water transfers including giant garter snake, Western pond turtle, and white-faced ibis.

- Placer County Conservation Plan (PCCP) HCP/NCCP – The PCCP HCP/NCCP is intended to address the impacts associated primarily with unincorporated growth in western Placer County in addition to growth associated with the build-out of Lincoln's updated General Plan. The PCCP is intended to protect 31 special status species and federally regulated wetlands, as well as indirectly protect the habitat of hundreds of plant and wildlife species across approximately 201,000 acres of Western Placer County (Placer County Planning Services Division 2011). Covered activities include: urban development, in-stream projects, capital projects, operation and maintenance, rural development, conservation strategy implementation, and other Placer County conservation programs. Participants include the City of Lincoln, Placer County, Placer County Water Agency and South Placer Regional Transportation Authority. PCCP covers five of the focal species for the long-term water transfers including Ahart's dwarf rush, Red bluff dwarf rush, and Central Valley Steelhead. This plan is under development.

- San Joaquin County Multi-Species Habitat Conservation and Open Space Plan (SJMSCP) – The SJMSCP was developed to provide guidelines for converting open space to other land uses, preserving agriculture, and protecting plant and wildlife species. Activities covered under the plan include urban development, mining, non-agricultural activities occurring outside of urban boundaries, transportation projects, non-federal flood control projects, maintenance activities, and similar public agency projects. San Joaquin County, the Cities of Stockton, Lodi, Manteca, Tracy, Ripon, Escalon, and Lathrop are the plan participants. The plan addresses 97 special-status plant, fish and wildlife species in over 900,000 acres of the San Joaquin County (San Joaquin County 2000). The SJMSCP covers 12 of the focal species for the long-term water transfers including Sandford's arrowhead, Red Bluff dwarf rush, and Delta smelt.

- Santa Clara Valley (SCV) HCP/NCCP – The SCV HCP/NCCP is a regional partnership between the County of Santa Clara, Santa Clara Valley Transportation Authority, Santa Clara Valley Water District, and the Cities of San Jose, Gilroy and Morgan Hill, and regulatory agencies. The plan encompasses approximately 440,318 acres and will address impacts primarily associated with the future uses of land identified in the plan area (CDFW 2014c). Land preservation would mitigate for the environmental impacts of planned urban and rural development, instream activities, public infrastructure operations and maintenance activities (e.g. water, transportation, etc.) and would enhance the long term viability of 21 threatened or endangered plant and wildlife species (CDFW 2014c). SCV HCP/NCCP covers three of the focal species for the long-term water transfers including San Joaquin kit fox, Western pond turtle, and tricolored blackbird.

- Solano Multispecies HCP (SMSHCP) – The SMSHCP plan area covers 585,000 acres (Solano County Water Agency 2009). It was developed to address species conservation in conjunction with urban development, flood control/infrastructure improvement activities, and to support the issuance of an incidental take permit under the Federal ESA for the Bureau of Reclamation's Solano Project Contract Renewal. Activities covered under the plan include preservation, restoration, invasive species control, and water quality improvement. Covered species include federally and state-listed fish species and other wildlife species of concern. Plan participants include Solano County, a small portion of Yolo County, Solano County Water Agency's contract service area, including the Cities of Fairfield, Vacaville, Vallejo, Suisun City, Solano Irrigation District, and the Main Prairie Water District. The SMSHCP covers eight of the focal species for the long-term water transfers including winter-run Chinook salmon, Central Valley steelhead, and longfin smelt. This plan is still under development.

- South Sacramento HCP (SSHCP) – The proposed SSHCP would address issues related to species conservation, agricultural protection, and urban development in 341,000 acres of south Sacramento County. Activities covered under the plan include construction of residential, commercial, and industrial buildings, and associated infrastructure. The plan is being prepared by Sacramento County, the Cities of Sacramento, Elk Grove, and Galt, and Rancho Powers Authority. The plan would cover 40 plant and wildlife species, including ten species that are listed by the state or federal governments. The SSHCP covers five of the focal species for the long-term water transfers including Ahart's dwarf rush, Greater sandhill crane, and giant garter snake. This plan is still under development.

- Yolo Natural Heritage Program (YNHP) – This plan is still under development and the program released a draft plan on June 28, 2013 (Yolo Natural Heritage Program 2013). This 653,818-acre county-wide HCP/NCCP will provide for the conservation of 32 sensitive species in five habitat types: wetland, riparian, oak woodland, grassland, and agriculture (Yolo Natural Heritage Program 2013). No aquatic species will be addressed in the YNHP. The plan describes measures that local agencies will implement to conserve biological resources, obtain permits for urban growth and public infrastructure projects, maintain the agricultural heritage of the county, and acquire permanent conservation easements for sensitive plant and wildlife species in the plan area. Plan participants include Yolo County, the Cities of Davis, Woodland, West Sacramento, and Winters. The YNHP covers four of the focal species for the long-term water transfers including giant garter snake, Western pond turtle, and purple martin.

- Yuba-Sutter NCCP/HCP – This plan is still under development. The Yuba-Sutter NCCP/HCP is a cooperative planning effort initiated by Yuba and Sutter Counties in connection with improvements to Highways 99 and 70, as well as future development in the area surrounding those highways. The plan covers approximately 210,000 acres and provides for the regional protection and management of 31 listed and other special-status species and their habitats (CDFW 2014d). Plan participants include the Counties of Yuba and Sutter, Cities of Yuba, Live Oak, and Wheatland. The Yuba-Sutter HCP covers five of the focal species for the long-term water transfers including greater sandhill crane, Western pond turtle, and tricolored blackbird.

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