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**Update to United States Geological Survey
Borrego Valley Hydrologic Model for the Borrego Valley
Sustainability Agency**

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1 INTRODUCTION

In 2009, the United States Geological Survey (USGS) initiated a study of the Borrego Valley Groundwater Basin (BVGB) with the Borrego Water District (BWD). The goals of the study were to enhance the understanding of groundwater conditions in BVGB, and develop a numerical model as a tool to manage groundwater resources and evaluate possible future conditions in the basin. The USGS used the MODFLOW numerical modeling code One-Water Hydrologic Flow Model, or MF-OWHM, to simulate the interaction between surface water (e.g., stream flow and applied irrigation) and groundwater in Borrego Valley. From a Sustainable Groundwater Management Act (SGMA) perspective, MF-OWHM provides a fully integrated numerical modelling system capable of simulating the full hydrologic cycle to evaluate potential undesirable effects like declining groundwater storage, declining groundwater levels in areas with groundwater-dependent habitat, subsidence, and seawater intrusion.

2 2015 BORREGO VALLEY HYDROLOGIC MODEL

The Borrego Valley Hydrologic Model (BVHM) was developed as part of a cooperative study between the USGS and the BWD. The study began in 2009, with the objectives of 1) improving the understanding groundwater conditions and land subsidence, 2) incorporating this improved understanding into a model that would assist in the management of groundwater resources in the BVGB, and 3) using this model to test several management scenarios (Faunt et al., 2015). The BVHM simulates the use, movement, and storage of water throughout the BVGB through time. The BVHM is a finite-difference groundwater model that was developed using the MODFLOW numerical code MF-OWHM. It was anticipated the model developed as part of the study would be used to help the BWD quantify the relative benefits of various groundwater management options that would need to be undertaken in the basin in order to comply with SGMA.

2.1 Simulation Period

The BVHM simulated conditions using monthly stress periods from October 1929 to December 2010. There were 975 monthly stress periods in the simulation. Faunt et al., (2015) noted that, “the first 192 stress periods (years 1930-45) are considered a model spin-up period, and the model calibration as well as the target simulation period used for analysis was October 1945 through December 2010.” The 16-year “spin-up” was used in the model to “eliminate significant effects caused by uncertainty in the initial conditions” defined in the model. Because there was groundwater development and irrigation before the simulation period, the initial conditions defined in the model, per groundwater levels mapped in 1945, may not have represented steady-state conditions.

Each monthly stress period has two time steps, with the exception of the first stress period with 16 time steps. The time step multiplier was 0.75 for each stress period, meaning that the duration of the first time step (excluding the first stress period) ranged from 16 days to 17.7 days depending on the number of days in the month. The second time step ranged from 12 days to 13.3 days.

2.2 Model Domain

The boundaries of the active model domain of the BVHM were defined by the Coyote Creek fault on the northeast and east of the alluvial valley, the Vallecito Mountains to the south, and the San Ysidro Mountains to the west and northwest. The southeastern boundary of the model was defined at a surface-water divide southwest of Ocotillo Wells. This boundary marks an area of the alluvial valley where subsurface flow leaves the basin.

The model domain is defined by a finite-difference grid of uniform cells, or nodes, with each cell being 2,000-feet by 2,000-feet, or approximately 92 acres in area. The model domain includes 30 rows and 75 columns with 2,250 active cells (Figure 1). The total area simulated in the model is 73,876 acres. The model was divided vertically into three layers. The top layer represents the upper unconfined aquifer unit consisting of Quaternary alluvium. The thickness of the top layer ranged from 50 feet to 643 feet. The middle aquifer unit (Layer 2) is Pleistocene age continental deposits with a thickness ranging from 50 feet to 908 feet. The lower aquifer unit (Layer 3) includes the lower Palm Spring and Imperial Formations with a thickness ranging from 50 feet to 3,831 feet.

2.3 Hydrogeological Characteristics

Layer 1 represents the upper unconfined aquifer, which historically has been the main source of water in the valley with well yields as high as 2,000 gallons per minute (GPM). The upper aquifer includes unconsolidated gravel, sand silt and clay of Holocene to Pleistocene age. Layer 2 represents the middle aquifer, which includes Pleistocene age continental deposits of gravel to silt with moderate amounts of consolidation and cementation. The middle aquifer yields moderate amounts of water north of San Felipe Creek. Layer 3 represents the lower aquifer and includes deposits of the lower Palm Springs and Imperial Formations. It is comprised of sandstone, siltstone, and conglomerate with low well yields. All three layers were simulated as convertible between unconfined and confined, meaning that when the water table declines below the top elevation of a layer that was fully saturated (i.e., confined), then the layer was converted to unconfined to account for a change in the saturated thickness and unsaturated portion of the layer.

The USGS used a geostatistical approach on grain size and texture characterized from various lithologic and geophysical logs recorded in Borrego Valley to simulate the heterogeneity of the aquifer units in the Borrego Basin. The textural map was based on the percentage of coarse-grain material described in each lithologic log. Coarse-grained sediments were characterized with having primarily boulders, cobbles, pebbles, gravel, and sand.

The distribution of coarse-grain sediment across the basin was interpolated between locations of borings and geophysical logs using kriging or cokriging algorithms over a grid matching the finite-difference grid utilized in the BVHM. Coarse-grain sediments were predominantly defined at the base of the foothills in the alluvial valley, and along major streambeds like Coyote Creek. The upper aquifer had the largest percentage of coarse-grain sediment, which reflected the depositional and geomorphic environments originating from the watersheds and drainages tributary to Borrego Valley. The middle and lower aquifers had finer sediments.

2.3.1 Hydraulic Conductivity

Hydraulic conductivity in the BVHM was defined based on the distribution of coarse-grain sediments defined by the textural map created from lithologic and geophysical logs. Horizontal hydraulic conductivity was “calculated as the weighted arithmetic mean of the hydraulic conductivities of the coarse-grained and fine-grained lithologic end members and the distribution of sediment texture for each model cell” (USGS, 2015). Faunt et al., (2015) noted that, “hydraulic conductivities generally decrease with depth and with increasing distances from the original source of the sediments in adjacent mountain ranges and river channels, which is consistent with the fining-down and fining-toward-the-basin-center sequences observed in the aquifer sediments and texture model. Coarser grained sediments were assumed to be present near stream channels in the alluvium in the upper reaches of all three aquifers.”

The saturated horizontal hydraulic conductivity in the upper aquifer ranged from 0.3 feet per day (ft/day) to 184 ft/day. The highest hydraulic conductivities were defined in the central portion of the valley where sand deposits of Quaternary age were characterized and older fan deposits at the base of the San Ysidro and Vallecito Mountains (Figure 2). Lower hydraulic conductivities were identified in areas characterized with younger fan deposits and consolidated continental deposits. The Borrego Sink was characterized with a uniform hydraulic conductivity of 6 ft/day in all three aquifer units. The saturated hydraulic conductivity in the middle and lower aquifer units ranged from 0.02 ft/day to 7 ft/day. The lower hydraulic conductivity in the middle and lower aquifers relative to the upper aquifer were based on a lower energy depositional environment to the valley prior to activity along the Coyote Creek fault that opened the northern portion of the valley to sediment deposition from Coyote Creek.

Faunt et al., (2015) reported estimated hydraulic conductivities based on previous aquifer tests conducted in the valley. Four constant-rate aquifer tests yielded an estimated hydraulic conductivity of 2 ft/day in a clay interbedded with sand to 336 ft/day in a coarse sand unit. The lower aquifer unit, which included the Palm Springs Formation characterized with cemented interbedded clays and gravels, had an estimated hydraulic conductivity of 10 ft/day. A previous numerical model included hydraulic conductivities that ranged from 0.1 to 178 ft/day, with a ratio of horizontal to vertical hydraulic conductivity at 10 for the upper and middle aquifers, and 1 for the lower aquifer.

2.3.2 Storage Properties

Specific yield, which represents unconfined aquifer storage and equals the percentage of bulk aquifer volume that would drain under gravity, ranged from 12% to 17% (average was 15%) for the upper aquifer. Specific yield was defined in the BVHM similarly to how hydraulic conductivity was defined using a textural map to simulate the heterogeneity of the aquifer units. The specific yield for the middle aquifer ranged from 15% to 21% with an average of 17.5% (Figure 3). The specific yield for the lower aquifer ranged from 0.7% to 5.6% with an average of 3%. A specific yield was defined for each aquifer unit because they were simulated as convertible between confined and unconfined layers based on hydraulic head in relation to the top elevation at each model node.

Faunt et al., (2015) reported that the specific storage defined for each aquifer unit under confined conditions ranged from 5.1×10^{-7} in the upper aquifer to 1.6×10^{-6} in the middle aquifer. The specific storage terms were defined uniformly for each layer.

2.4 Boundary Conditions

The boundaries of the model domain were mostly defined as no-flow boundaries coinciding with the Coyote Creek fault and the foothills of the San Ysidro and Vallecitos mountains. There were a few exceptions: specified fluxes were defined at 44 cells representing underflow originating from the upstream watersheds draining to Borrego Valley, twenty-four (24) stream flow entry points were defined at nodes representing the locations where stream flow entered the valley via Coyote Creek, San Felipe Creek, Borrego Palm Creek, and other drainages, and three constant-head boundary nodes simulating the outflow of groundwater at the southern end of the BVHM. The natural recharge of underflow and surface water runoff from the adjoining watersheds was estimated from data obtained from the regional-scale USGS Basin Characterization Model (BCM).

2.4.1 Basin Characterization Model

The BCM was developed by the USGS in 2004 and provides a “deterministic water-balance approach to estimate recharge and runoff in a basin” on a regional scale. The BCM “uses the distribution of precipitation, snow accumulation and melt, [potential evapotranspiration] PET, soil-water storage, and bedrock permeability to estimate a monthly water balance for the groundwater system” (Faunt et al., 2015). The result is an estimate of water recharging a basin (of which some may leave the basin as underflow to an adjacent basin) and potential runoff. Potential underflow and runoff to Borrego Valley was estimated from the BCM using the watersheds surrounding Borrego Valley. Water entering BVGB via underflow was represented by 44 cells along the mountain boundaries in the valley each defined with a constant specified flux based on estimates from the BCM. Water entering BVGB via surface water runoff was represented by 24 cells defined as entry points to the stream segments defined in the stream-flow routing (SFR) package (Figure 4).

Runoff and underflow entering the BVGB, as estimated by the BCM, were “simulated for the watersheds draining into the Borrego Valley on a monthly basis for years 1940 – 2007 as spatially distributed among the watersheds draining into Borrego Basin” (Faunt, 2015). The average annual underflow entering the BVGB was approximately 10% of the estimated recharge to the adjacent watersheds, or approximately 900 acre-feet per year. Typically, there was little to no stream flow to the BVGB from 1940 to 2007. Only after major wet seasons or large individual rainfall events did runoff to BVGB exceed 10,000 acre-feet per year or more. This only occurred during 7 years in the 1940 to 2007 period. Runoff to the BVGB ranged from less than 10 acre-feet per year to 44,000 acre-feet per year with an average annual rate of 3,600 acre-feet per year. The BVHM includes perennial flow entering Coyote Creek at 0.014 cubic feet per second (cfs) and an unnamed tributary at 0.002 cfs from a minor watershed to the southwest of the BVGB.

2.5 Farm Process

MF-OWHM is a fully coupled integrated hydrologic numerical modeling code capable of simulating all interactions of surface water and groundwater in the hydrosphere. Integrated within MF-OWHM is the Farm Process Package, or FMP, which simulates the movement of water over a landscape. Water may originate from natural (e.g., rainfall) and/or anthropogenic sources (e.g., applied irrigation) and move via surface water runoff, evapotranspiration, and infiltration into the unsaturated zone. A landscape is characterized by a land-use type (e.g. farm, golf course) with certain characteristics defined, like rooting depth, soil moisture characteristics, and application inefficiencies defined for irrigation and precipitation. The FMP simulates the water budget over a landscape defined at each cell, or node, in the model domain. Water inputs may include rainfall, applied irrigation, and stream flow. Water outputs may include

evapotranspiration, surface water runoff, and, when coupled with MODFLOW, infiltration in the unsaturated zone and groundwater pumping from the saturated zone.

The USGS (2015) defined fifty-two (52) water-balance subregions (WBS), or “farms,” in the BVHM. These 52 farms were defined based on a parcel map showing land ownership from 2010. The definition of these farms in the model domain were held constant throughout the simulation. Each farm was assigned one or more land-use types, of which there were 15 classifications that included golf course, urban, fallow, native, and certain crop types like grapes, citrus, and palm. The USGS redefined land-use types on a near annual basis, with some land uses changing due to urbanization, zoning, and/or farming restrictions through the simulation. For example, Faunt et al., (2015) noted that “before development, about 10 percent of land use consisted of phreatophytes, and 90 percent was other types of native vegetation and bare ground. In 2009, 78 percent was natural vegetation (6 percent phreatophytes and 72 percent other native types), 11 percent residential/municipal, 8 percent developed agricultural land, and about 3 percent recreational uses (golf courses).”

Land-use type was assigned on a cell-by-cell basis (Figure 5). The coarse grid of the BVHM, with cells of uniform dimensions of 2,000-feet by 2,000-feet (or 92 acres), however, meant that the land-use type that comprised the largest fraction of a cell was assigned to that cell. For example, the farm representing Rams Hill Golf Course included 10 cells comprising a total of 920 acres, but only two of those cells (total of 184 acres) were assigned a golf course land-use type after 2009. The other 8 cells were assigned a “native classes” land-use type designation.

Pumping data for agricultural uses was not available to the USGS when designing the BVHM. The FMP estimates agricultural pumping by calculating estimated water demands for the various crop types receiving applied irrigation. The FMP calculates the water demand for a specific crop using potential evapotranspiration (PET) provided by the BCM and crop coefficients assigned to each crop type simulated in the BVHM. The FMP then calculates a crop irrigation requirement (CIR), or residual water demand, after accounting for water supplied via precipitation and root uptake via groundwater. The CIR was increased to compensate for evaporative losses and estimated inefficiencies of delivering water for irrigation supply. The result is a total farm delivery requirement (TFDR) that is satisfied in the BVHM via estimated pumping in the FMP.

2.6 Water Budget

An annual water budget was calculated for the BVGB for every water year. A water year spans the year from October 1 to the subsequent September 30.

2.6.1 Inflow from Stream Leakage

Faunt et al., (2015) noted that “the primary source of natural recharge to the basin is infiltration from the ephemeral stream and washes entering the Borrego Valley from the adjacent mountains.” Surface water runoff entering the model domain was simulated using the SFR package. The SFR package is a head-dependent boundary condition that can simulate stream flow routing, groundwater discharges in reaches characterized as gaining streams, stream flow leakage in reaches characterized as losing streams, and the capture and conveyance of surface runoff. The BVHM includes 84 stream segments defined in the SFR package, where multiple segments were joined to represent stream flow in Coyote Creek, San Felipe Creek, Borrego Palm Creek, and other minor tributaries. The streams received inflow at 24 entry points that represented runoff from the adjoining upstream watersheds in the San Ysidro and Vallecitos mountains.

Recharge from stream leakage ranged from 97 acre-feet (AF) in 1929 to 22,500 AF in 1978 (Figure 6). The annual average recharge rate from stream leakage was 4,016 acre-feet per year (AFY) with a standard deviation of 4,853 AFY.

2.6.2 Inflow from Applied Irrigation Return Flows

Another source of inflow to the basin, particularly as the valley became more developed, was return flow from applied irrigation at agricultural areas. Applied irrigation at agricultural areas was estimated using the FMP. The volume of applied water in excess of losses to evapotranspiration, irrigation inefficiencies, and surface runoff was simulated as infiltrating below the root zone and entering the unsaturated zone. The FMP was linked to the unsaturated zone flow package, or UZF, of MODFLOW. The UZF simulates the movement of water through the unsaturated zone based on soil moisture characteristics and a uniform definition of vertical hydraulic conductivity in the unsaturated zone.

Early versions of MODFLOW simulated an instantaneous contribution of infiltrating water from land surface to the water table. However, water does not infiltrate instantaneously, but moves through an unsaturated zone where the movement of water is a function of soil moisture content (i.e., degree of saturation) and highly variable hydraulic conductivities based on the moisture content. Faunt et al., (2015) noted, “depending on the unsaturated-zone thickness, permeability, and residual moisture content, it can take years to decades for irrigation return flow to pass through the unsaturated zone.” The UZF provides a more realistic estimation of irrigation return flows in the BVHM.

Recharge from applied irrigation return flows ranged from 572 AF to 5,703 AF (Figure 6). The annual average recharge rate from stream leakage was 1,657 AFY with a standard deviation of 973 AFY.

2.6.3 Septic System Return Flows

The USGS cited a previous study that estimated an average use of 100 gallons per day per household and assumed that 50% of the water used was lost to evaporation and transpiration. Therefore, the USGS estimated that return flow from septic tank systems in the valley was constant at 0.056 AFY per home, or 5.14×10^{-7} cubic meters per day (m^3/day). The USGS identified residential and/or developed areas in the valley and estimated a number of septic tank systems associated with those land use types on a per node basis in the numerical model. The number of septic tank systems were periodically defined in the model and used for subsequent monthly stress periods until the next count. The last count of septic tank systems defined in the numerical model was based on development identified in 2009. The USGS reported that, “the infiltration from irrigation of municipal lawns and treated and untreated wastewater was assumed to be negligible.”

2.6.4 Inflow from Subsurface Flow

Underflow entering the BVGB from the adjoining upstream watersheds was simulated using the Flow Head Boundary (FHB) package. Underflow from these watersheds was distributed over 44 cells aligned at the model domain boundaries with the San Ysidro and Vallecitos mountains. The rate of underflow entering the BVHM for each cell was based on monthly data obtained from the BCM. The USGS defined an average rate of underflow at each cell to the model domain and held these rates constant throughout the simulation. The total underflow to the model domain was 3.7 acre-feet per day, or 1,367 AFY (Figure 6).

Inflow from subsurface flow (i.e., underflow) ranged from 1,366 AF to 1,370 AF. The annual average recharge rate from stream leakage was 1,367 AFY with a standard deviation of 2 AFY.

2.6.5 Outflow via Pumping

The BVHM simulated municipal pumping using metered data obtained from BWD, and agricultural and recreational pumping estimated using the FMP. Before 1944, groundwater pumping in the basin averaged less than 300 AFY, which was used mostly for domestic purposes (USGS, 2015). No pumping was simulated in the BVHM from 1929 to 1943. Population growth in Borrego Valley after World War II led to increasing groundwater production with the majority of water produced for irrigation purposes. Groundwater production ramped up from essentially 0 AFY in 1943 to over 10,000 AFY in 1955 (Figure 7). Annual production declined to less than 7,000 AFY beginning in 1965, but began increasing again in the mid-1970s with a peak

production of almost 20,000 AFY in 2006. Faunt et al., (2015) reported that, “about 70 percent of the groundwater used each year has been for agriculture, about 20 percent for golf courses and other recreational uses, and about 10 percent for municipal and domestic use (residential, commercial, and the Anza-Borrego Desert State Park).”

Pumping for agricultural, recreational and municipal uses were simulated using the MODFLOW multi-node well package (MNW2). The MNW2 package simulates the effects of pumping from wells that intersect multiple aquifer units that contribute flow under different hydraulic heads. A number of wells were completed in more than one of the aquifer units in Borrego Valley. Faunt et al., (2015) identified up to 82 wells operating in the basin. Seventy of those wells were assigned to farms identified in the model domain with pumping determined from the FMP package. These wells represented pumping for agricultural and recreational uses in Borrego Valley. Municipal pumping, which was based on metered data, was provided by BWD.

2.6.6 Outflow via Evapotranspiration

Monthly potential evapotranspiration data was obtained from the BCM and included as part of the water-balance calculations in the FMP. Direct evapotranspiration from groundwater was estimated in the FMP by calculating the monthly PET values by monthly crop coefficients assigned to each land-use type (e.g. phreatophytes, citrus, golf courses, native, etc.), the rooting depths defined for each land-use type, the depth to groundwater and height of capillary fringe. Phreatophytes, found mostly in the northern part of Borrego Valley and around the Borrego Sink, had the deepest rooting depth at 15.3 feet. They were responsible for most of the groundwater losses from the basin prior to the mid-1940s. Faunt et al., (2015) reported that approximately 4,300 AFY was lost via evapotranspiration from phreatophytes before 1946. The amount of water extracted by pumping from the basin surpassed losses by evapotranspiration by 1954 (Figure 7). This was attributed to declining water levels in the basin, which reduced the amount of water available for transpiration. Evapotranspiration losses were less than 2,000 AFY by 1990 and less than 1,000 AFY by 2000.

2.6.7 Outflow at Southern Boundary of BVGB

A constant-head boundary condition was assigned to three cells marking the southern boundary of the BVGB. This boundary was identified by the USGS based on water level data from other sources that indicated this area was not influenced by water level fluctuations and hydraulic conditions to the north. The average outflow at this boundary throughout the simulation was 1.4 acre-feet per day. No water flowed into the model domain at this boundary.

Annual outflow from the BVGB at the southern boundary of the basin ranged from 499 AF to 573 AF. The annual average was 525 AFY with a standard deviation of 15 AFY.

2.6.8 Water Balance

The BVGB has experienced more in water losses via pumping and evapotranspiration than inflows from stream leakage and underflow from the adjoining watersheds since the 1929-1930 water year (Figure 8). The exceptions were during more-than-normal wet years, like 1976, 1978, and 1991, when stream flow leakage was a significant contributor of inflow to the basin. In those years, there was a net influx of 13,000 to 18,000 AF of water to the basin. Outside of those wet years, the average annual loss from the basin was approximately 13,100 AFY. The average annual loss from the basin from the 2004-2005 water year to the 2009-2010 water year was 19,000 AFY (Appendix A).

Faunt et al., (2015) reported that the average annual natural recharge of water reaching the saturated zone, which includes stream leakage and infiltrating water through the unsaturated zone, was 5,700 AFY. This estimate was derived from the full simulation period from 1929 to 2010. In addition to natural recharge from stream leakage and infiltrating water (mostly from irrigation return flows), the BVGB received underflow originating from the adjacent watersheds at an average annual rate of 1,400 AFY. Therefore, the average annual recharge to the BVGB is approximately 7,100 AFY.

The average annual loss in storage in the BVGB from 1929 to 2010 was approximately 6,000 AFY.

2.7 Model Calibration and Sensitivity

2.7.1 Calibration

The model was calibrated to observed hydraulic heads (i.e. measured groundwater levels at wells) collected from 1945 to 2010. Faunt et al., (2015) reported that 2,224 groundwater level measurements were obtained from databases maintained by BWD, USGS, and California Department of Water Resources. The groundwater level data was collected at 73 wells in the basin. Model calibration was evaluated by calculating the difference (i.e. residual) between the observed groundwater level measured at a well to the corresponding simulated groundwater level. The USGS employed a combination of manual modifications and the use of an automated parameterization algorithm, or parameter estimation tool (PEST), to adjust parameters (e.g. hydraulic conductivity, storage, stream inflows) over a series of simulation runs to minimize the residuals between observed and simulated hydraulic heads.

Faunt et al., (2015) reported that “the overall model fit for groundwater-level comparisons is generally good when the simulated head values are compared against the measured groundwater levels. About 90 percent of the residuals were between -20 and +20 feet, and more than 50 percent were between -5 and +5 feet” (Appendix C). The mean residual from 1945 to 2010 was

+2.41 feet (from 2,258 residuals ranging from -249.48 to +235.9 feet), indicating that the model tended to underestimate hydraulic heads compared to observed values (Figure 9).

A plot of simulated versus observed hydraulic heads from 1945 to 2010 shows a bias of the model to overestimate lower observed hydraulic heads and underestimate higher observed hydraulic heads (Figure 10). A perfect match of simulated heads with observed heads would yield a uniform slope. A linear trend line fitted to the observed and simulated hydraulic head data had a slope of 0.65, which may indicate a flatter hydraulic gradient simulated across the basin than one estimated from the observed hydraulic heads.

A measure of the average error in the model simulating observed hydraulic heads is indicated by the root mean squared error (RMSE) of the residuals. The RMSE is the best measure of error if the residuals are normally distributed in the basin. An acceptable error is gaged by the magnitude of the change in hydraulic head in the simulation compared to the RMSE. The RMSE was 17.88 feet between observed and simulated hydraulic heads from 1945 to 2010. Hydraulic heads declined 10 feet to 130 feet from the 1950s to 2010 with an average decline of 57.3 feet. The ratio of the RMSE (17.88 feet) to the average decline in hydraulic head in the basin (57.3 feet) is 0.31, which is an acceptable level of error given the coarse grid (2,000 feet by 2,000 feet) and layer thicknesses of 50 feet to 643 feet in the upper aquifer (layer 1) of the model domain.

2.7.2 Sensitivity

The parameter estimation process using PEST was used to evaluate the sensitivity of the BVHM to parameters defined in the model. A sensitivity analysis, as conducted by the USGS for the BVHM, provides a measure of the uncertainty in the model results arising from the assumptions made in defining the hydrogeology and parameters in the model. Faunt et al., (2015) reported that the BVHM was most sensitive to scaling factors used in estimating runoff from precipitation and applied irrigation, crop coefficients, and irrigation efficiency, all of which were included in the FMP and contribute to calculating the water demand for the various land-use types defined in the model. The next most sensitive parameters were specific yield and scaling factors used to adjust the amount of runoff and underflow estimated by the BCM that entered the BVGB.

The highest levels of uncertainty in the model were from agricultural pumping, specific yield, and stream flow entering the valley. Agricultural pumping (and to a lesser extent recreational pumping) was estimated using the FMP package, which calculates a water demand on a cell-by-cell basis for each land-use type. The water demand is based on an estimated water consumption factoring in evapotranspiration, applied water (via irrigation or rainfall), efficiencies of applied irrigation water, soil moisture content, rooting depth, and potential runoff. The following measures could be taken to improve the uncertainty in the model: 1) information on actual pumping for agricultural and recreational uses can be used to improve the accuracy of the FMP

in estimating pumping; 2) long-term constant-rate aquifer tests in the upper and middle aquifer units would improve the estimates of specific yield; and 3) the installation of stream gaging stations in Coyote Creek and other major drainages to the valley would improve the estimates of runoff to the basin.

3 UPDATE OF THE BORREGO VALLEY HYDROLOGIC MODEL

The BVHM was updated to extend the simulation period to September 2016. This required increasing the number of monthly stress periods from 975 to 1,044. The additional stress periods were configured with the same number of time steps (2) and time-step multiplier (0.75) used in the original stress periods of the model. Inflow from subsurface flow representing underflow to the basin and outflow represented by the constant-heads at the southern end of the basin were maintained at their same respective rates and heads from January 2011 to September 2016. No changes were made to hydraulic properties like saturated hydraulic conductivity and storativity (specific yield and specific storage) and to hydraulic properties of the unsaturated zone.

Monthly precipitation and evapotranspiration data for January 2011 to September 2016 were obtained from the BCM. The Farm Process package was updated to incorporate the monthly precipitation and evapotranspiration data, and changes to land-use type were made in the FMP based on a review of aerial imagery and documented fallowed land through the BWD and County of San Diego (County) Water Credits Program. Municipal pumping by District wells from January 2011 to September 2016 was included in the updated files.

3.1 Updating the Farm Process Package

3.1.1 Land Use Types

Land use types were updated after reviewing aerial imagery of the Borrego Valley from 2011 to 2016, and reviewing Water Credits filed with the County. The following modifications were made to the last land use type characterization from the original file: in September 2013, the land use at one cell was changed from citrus to fallow; in August 2014, one cell was changed from native to residential; in December 2014, one cell was changed from citrus to fallow; in July 2015, one cell was changed from palms to fallow; and in May 2016, one cell was changed from citrus to fallow. All other land-use types defined in the original model remained the same.

3.1.2 Precipitation and Evapotranspiration

Monthly precipitation and evapotranspiration data were obtained from the BCM for January 2011 to September 2016. The precipitation and evapotranspiration data were compiled in separate files for each month. The FMP was updated to read each precipitation and evapotranspiration data file corresponding to the additional stress periods in the updated model.

The FMP used the monthly precipitation and evapotranspiration data to calculate a water balance on a cell-by-cell basis. The data from the BCM are in units of millimeters per month. The FMP includes a multiplier of 3.29e^{-5} that is applied to each value from the BCM to convert it to units of meters per day.

3.2 Stream Flow

Runoff to the 24 stream flow entry points were taken from historical stream gage and precipitation data. An attempt was made to repeat the methodology the USGS used in defining runoff to the 24 stream flow entry points using BCM data, but the process utilized by the USGS was not understood and could not be discerned when comparing BCM data to runoff values used in the numerical model for earlier stress periods.

Therefore, stream flow entering the valley after December 2010 was simulated based on historical rainfall compared to runoff. Precipitation data recorded at climatic stations from 2011 to 2016 in the BVGB were compared to historical (i.e. pre-2011) monthly precipitation data recorded at the same climatic stations to find months with similar precipitation. These months were then used to pull stream gage data from stream gages on Coyote Creek, Palm Canyon Creek, and San Filipe Creek during historical periods when these stream gages were active. These monthly values were added to the appropriate stress periods for the extended model simulation.

3.3 Pumping

Monthly municipal pumping data from January 2011 to September 2016 was obtained from BWD. The pumping data was converted from acre-feet per month to cubic meters per day and incorporated in the updated BVHM. The average monthly pumping rates for municipal wells ranged from $0\text{ m}^3/\text{day}$ to $2,011\text{ m}^3/\text{day}$ at well ID4-11. Agricultural and recreational pumping continued to be estimated using the FMP.

3.4 Septic System Return Flows

The number of septic tank systems were periodically defined in the model and used for subsequent monthly stress periods until the next count. The last count of septic tank systems defined in the numerical model was based on development identified in 2009. The updated model repeated this information from 2009 during the extended period from January 2011 to September 2016.

4 WATER BALANCE OF UPDATED MODEL

An annual water balance from the 2010-2011 to 2015-2016 water years was calculated for the BVGB using the updated BVHM. Stream leakage was the largest contributor of inflow to the basin, which ranged from 1,180 AF to 6,500 AF. The 6,500 AF occurred during the winter of 2011. The average annual inflow from stream leakage was 2,550 AFY. Recharge from irrigation return flows averaged 1,630 AFY. Underflow was held constant from the original model and averaged 1,400 AFY. The average annual total inflow, or recharge, to the BVGB was 5,550 AFY from the 2010-2011 to 2015-2016 water years (Appendix B).

Pumping was the largest outflow component from the basin. The average annual outflow via pumping from the basin was 15,800 AFY. Other sources of outflow included evapotranspiration (435 AFY) and the southern constant-head boundary of the basin (520 AFY). Pumping constituted 94% of the total outflow. The average annual total outflow from the BVGB was 16,700 AFY from the 2010-2011 to 2015-2016 water years.

The average annual water balance from the 2010-2011 to 2015-2016 water years was a deficit of 11,000 AFY, which further contributed to a decline in groundwater storage in the BVGB (Figure 8).

5 MODEL VALIDATION

All hydraulic head and stream flow data collected up through 2010 were used to calibrate the numerical model. No exercise was conducted by the USGS to verify, or validate, the results of the BVHM. Model validation is a means of establishing greater confidence in the model and its accuracy in predicting future conditions. “A model is verified if its accuracy and predictive capability have been proven to lie within acceptable limits of error by tests independent of the calibration data” (Anderson, 1992). Updating the BVHM with data collected outside the calibration period from January 2011 to September 2016 presented the opportunity of validating the model. As described previously, only climatic parameters (precipitation, evapotranspiration, stream flow) and metered pumping were added to the additional stress periods defined in the updated model. Parameters defining hydraulic properties (hydraulic conductivity, storage) and uniform boundary conditions (constant underflow and heads at the southern boundary) were consistent in the updated model.

The simulation results from January 2011 to September 2016 were compared to observed hydraulic heads recorded in this period to validate the numerical model. The mean residual from October 2010 to September 2016, which included the 2010-2011 to 2015-2016 water years, was +6.18 feet (from 225 residuals ranging from -55.72 to +52.71 feet), indicating that the model

continued to underestimate hydraulic heads compared to observed values (Figure 6, Appendix C).

A plot of simulated versus observed hydraulic heads from 1945 to September 2016 continues to show a bias of the model to overestimate lower observed hydraulic heads and underestimate higher observed hydraulic heads (Figure 7). A linear trend line fitted to the observed and simulated hydraulic head data from January 2011 to September 2016 was parallel (slope of 0.65) to the linear trend line matched to the 1945 to 2010 data. The BVHM, updated with recent data outside the calibration period, provided similar results with similar error.

The RMSE between observed and simulated hydraulic heads from January 2011 to September 2016 was 18.78 feet, which was comparable to the RMSE of 17.88 feet calculated for the residuals from 1945 to 2010. Hydraulic heads declined an additional 2 to 18.5 feet from 2011 to 2016 with an average decline of 9.3 feet over the 6 year period.

6 RECOMMENDATIONS

The sensitivity analysis conducted by the USGS indicated the greatest uncertainty in the numerical model was in agricultural pumping, stream flow leakage, and storage. The FMP estimates agricultural pumping using precipitation and evapotranspiration data obtained from the BCM, assumptions about soil types and their associated soil moisture characteristics, rooting depths, crop coefficients, overland runoff, and estimated efficiencies of applied irrigation. Additionally, the coarse uniform grid of the model domain may overstate the water demands of certain land-use types, like golf courses, and, consequently, overestimate the amount of groundwater pumped to meet the water demand.

The simulated hydraulic heads compared to observed hydraulic heads indicated a slight bias of the model in underestimating hydraulic heads. This may be the result of the model simulating too much pumping compared to actual usage, or underestimating storage values like specific yield for the upper aquifer, or underestimating the amount of recharge to the BVGB, or a combination of all three. To improve the accuracy of the BVHM in simulating actual conditions and provide greater confidence in predictive simulations, the following are recommended actions to undertake to obtain additional data and further study the hydrogeology of the basin:

- Collect actual agricultural pumping data via existing or installing new flow meters at farm wells. The pumping data may be incorporated in the numerical model to calibrate the FMP to more accurately estimate the water demands for the various crops and golf courses being irrigated.
- Install stream gaging stations at major drainages that convey most of the surface water runoff to the valley, either from perennial flows or flash flows from major precipitation

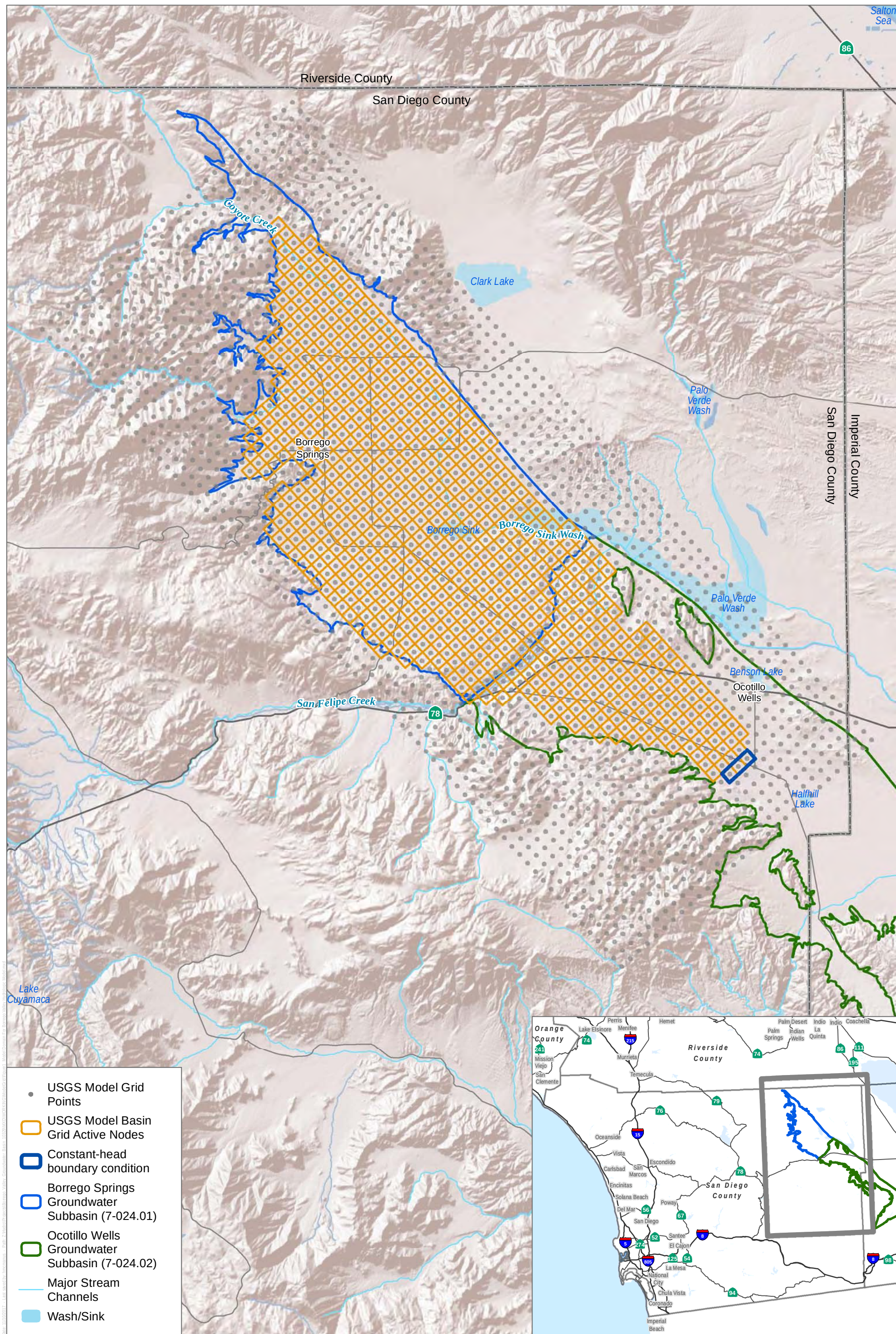
DRAFT – Update to Borrego Valley Hydrologic Model

events. The goal would be to install two gaging streams in the same creek to measure differences in flow. This information would provide a more accurate estimate of stream leakage.

- Conduct aquifer tests at wells screened only in the upper aquifer and only in the middle aquifer to obtain site-specific estimates of hydraulic conductivity and specific yield for each aquifer unit. This information may be used to enhance the calibration of the model to these hydraulic properties and our understanding of storage in the BVGB.

7 REFERENCES

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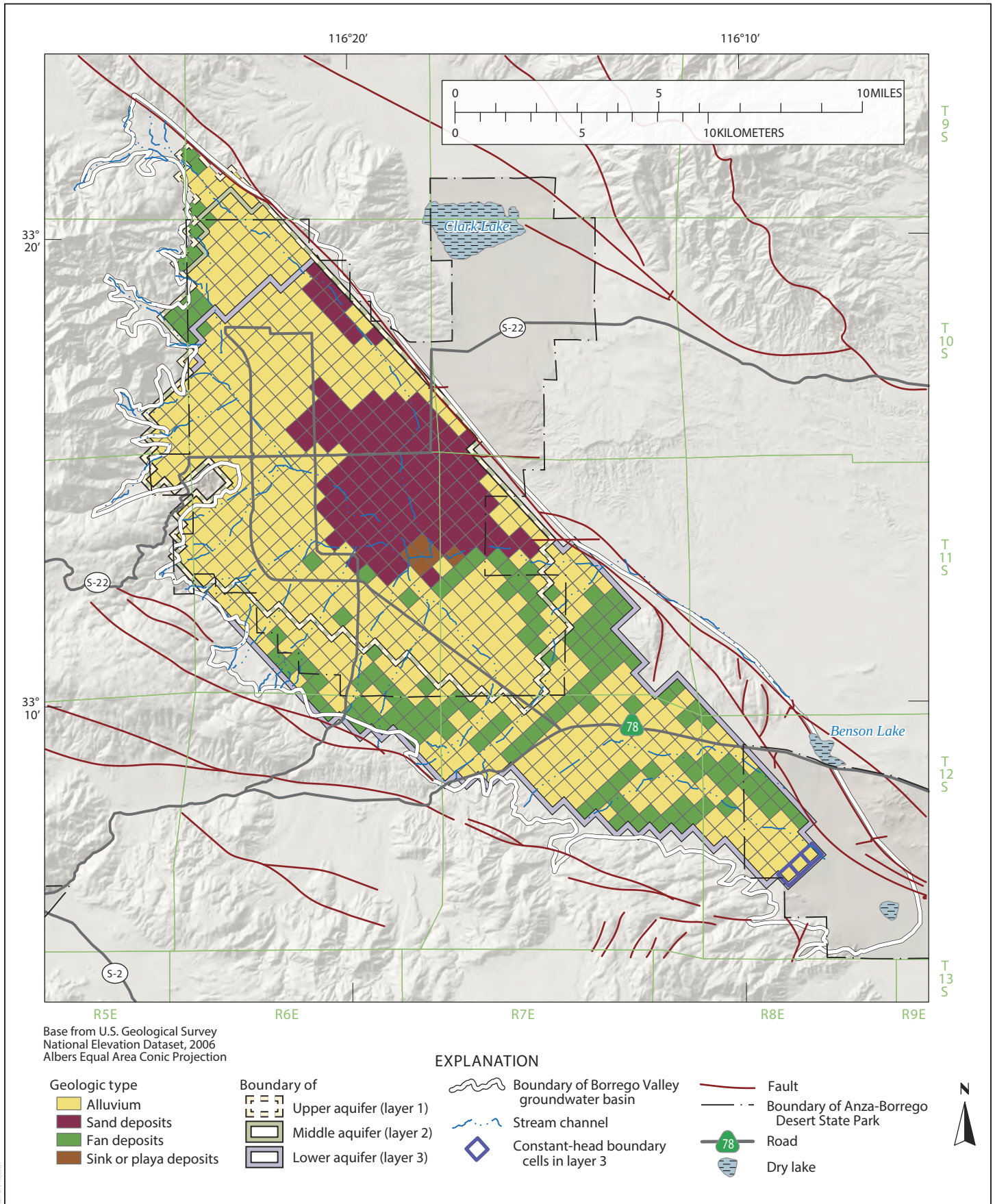
SOURCE: Faunt et al., 2015

DUDEK



0 10,000 20,000 Feet

Figure 1
Model Domain for Borrego Valley Hydrologic Model
Update to United States Geological Survey Borrego Valley Hydrologic Model

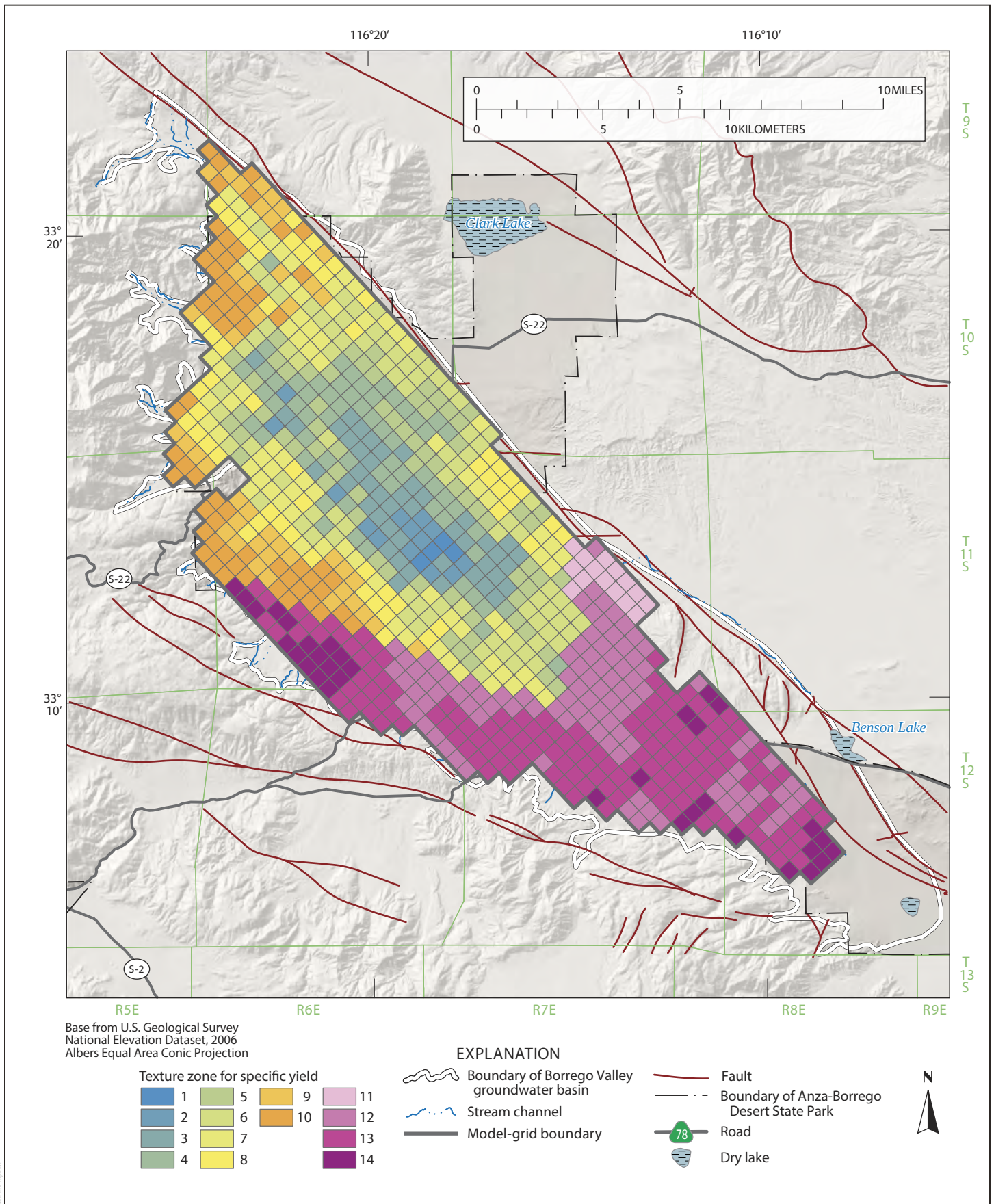


SOURCE: Faunt et al., 2015

FIGURE 2

Hydrogeologic Parameter Zones in Borrego Valley Hydrologic Model

Update to United States Geologic Survey Borrego Valley Hydrologic Model

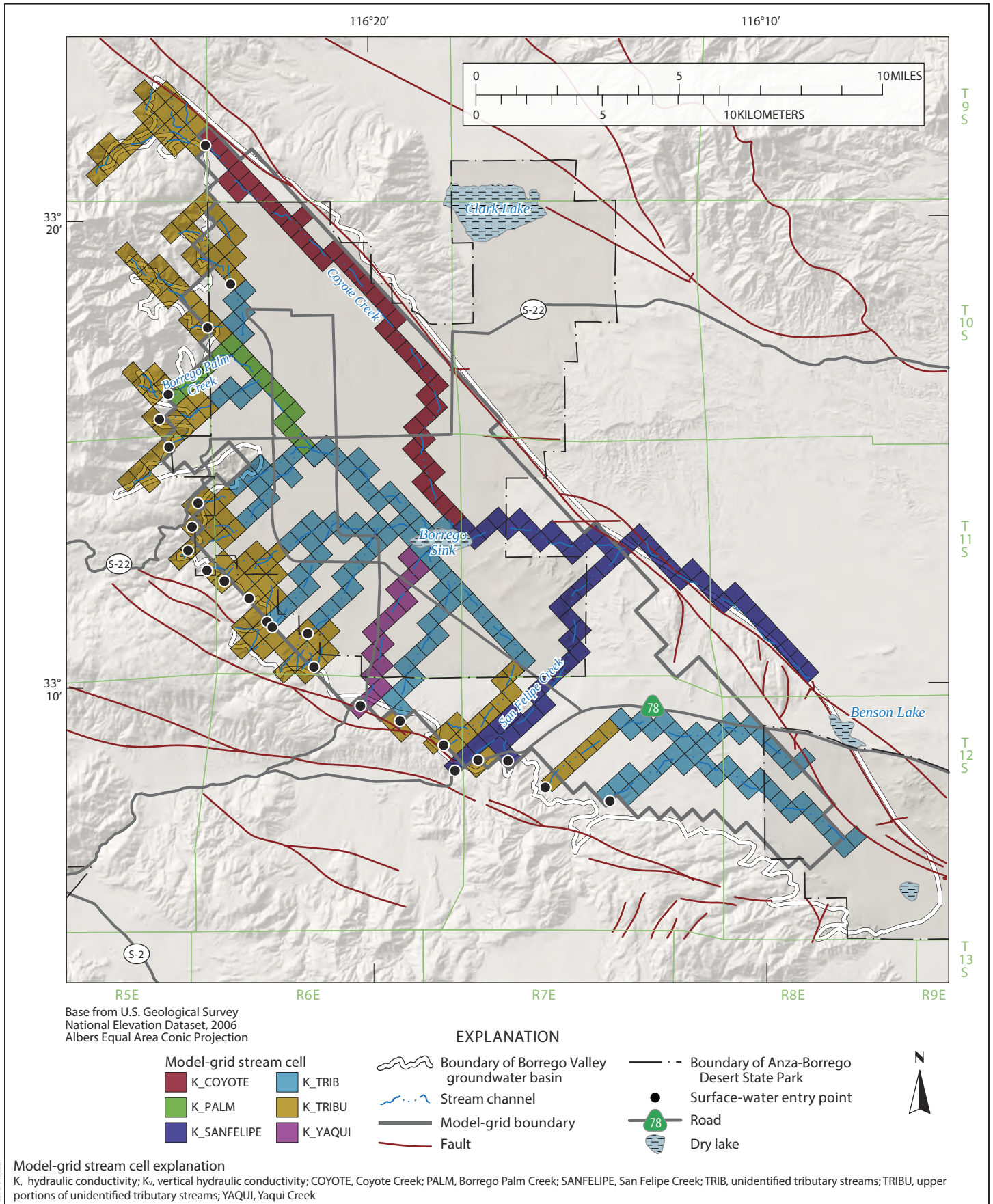


SOURCE: Faunt et al., 2015

FIGURE 3

Textural Map of Specific Yield in Borrego Valley Hydrologic Model

Update to United States Geologic Survey Borrego Valley Hydrologic Model

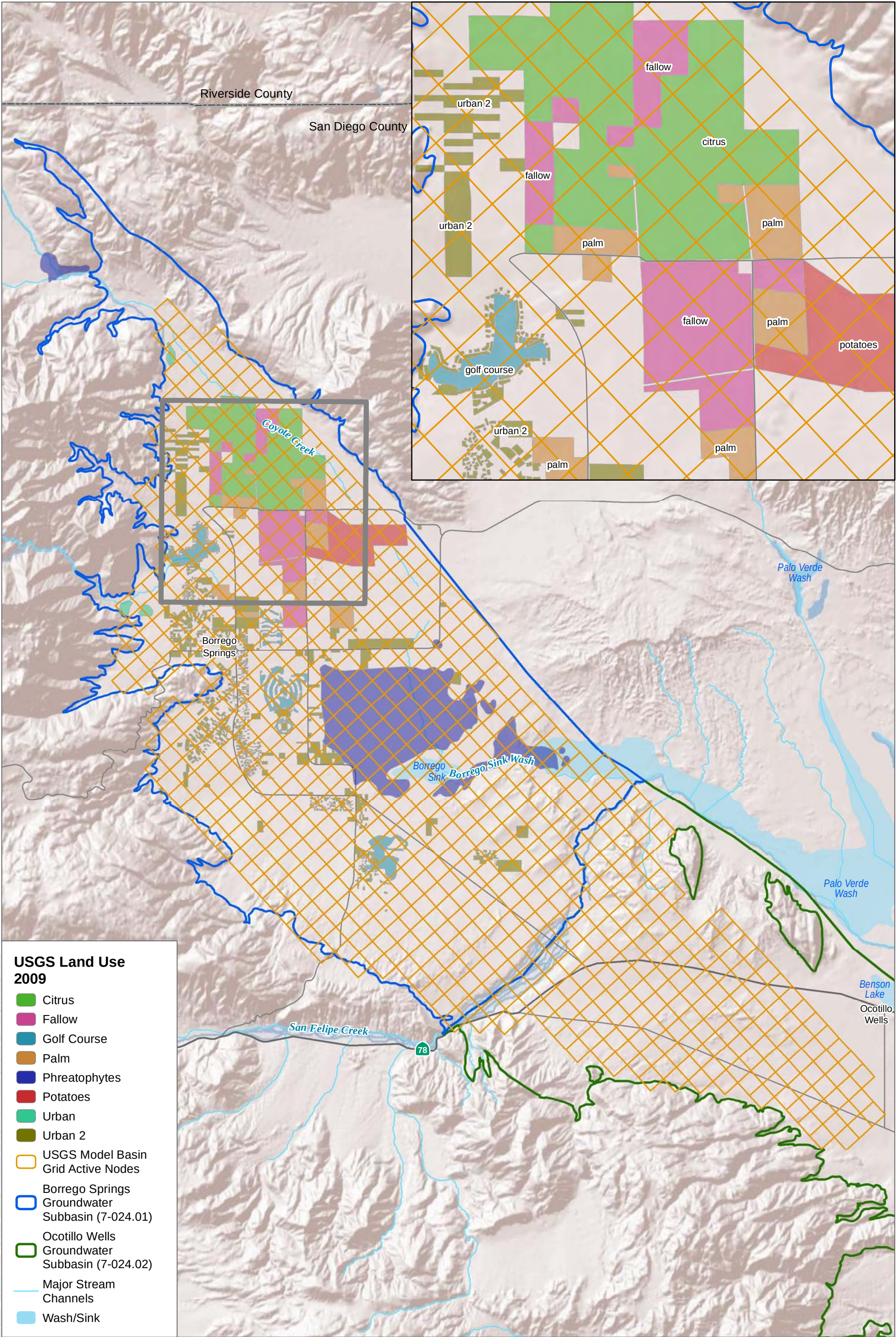


SOURCE: Faunt et al., 2015

FIGURE 4

Simulated Stream Flow in Borrego Valley Hydrologic Model

Update to United States Geological Survey Borrego Valley Hydrologic Model



SOURCE: Faunt et al., 2015

Figure 6. Inflows to Borrego Valley Groundwater Basin

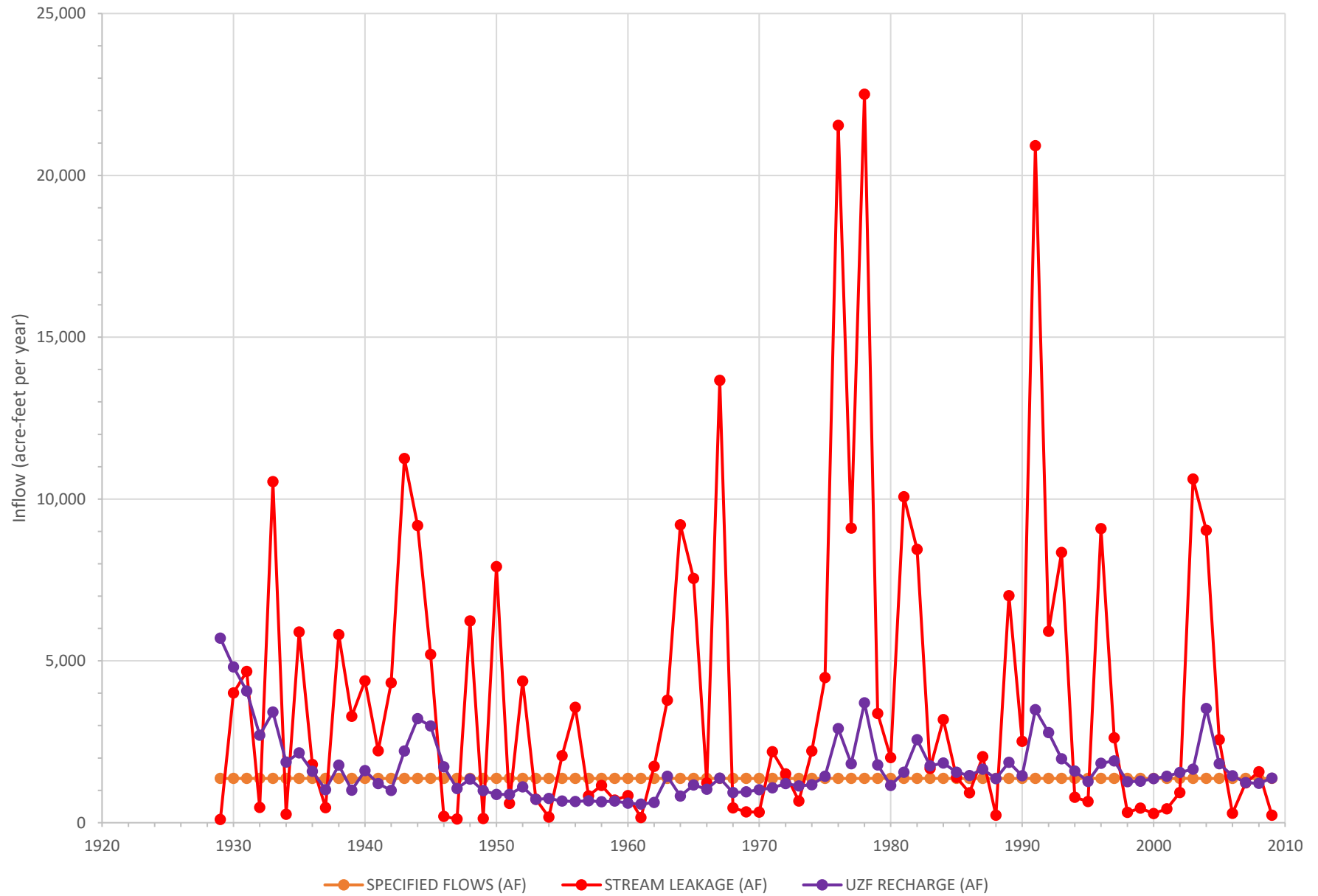


Figure 7. Outflows from Borrego Valley Groundwater Basin

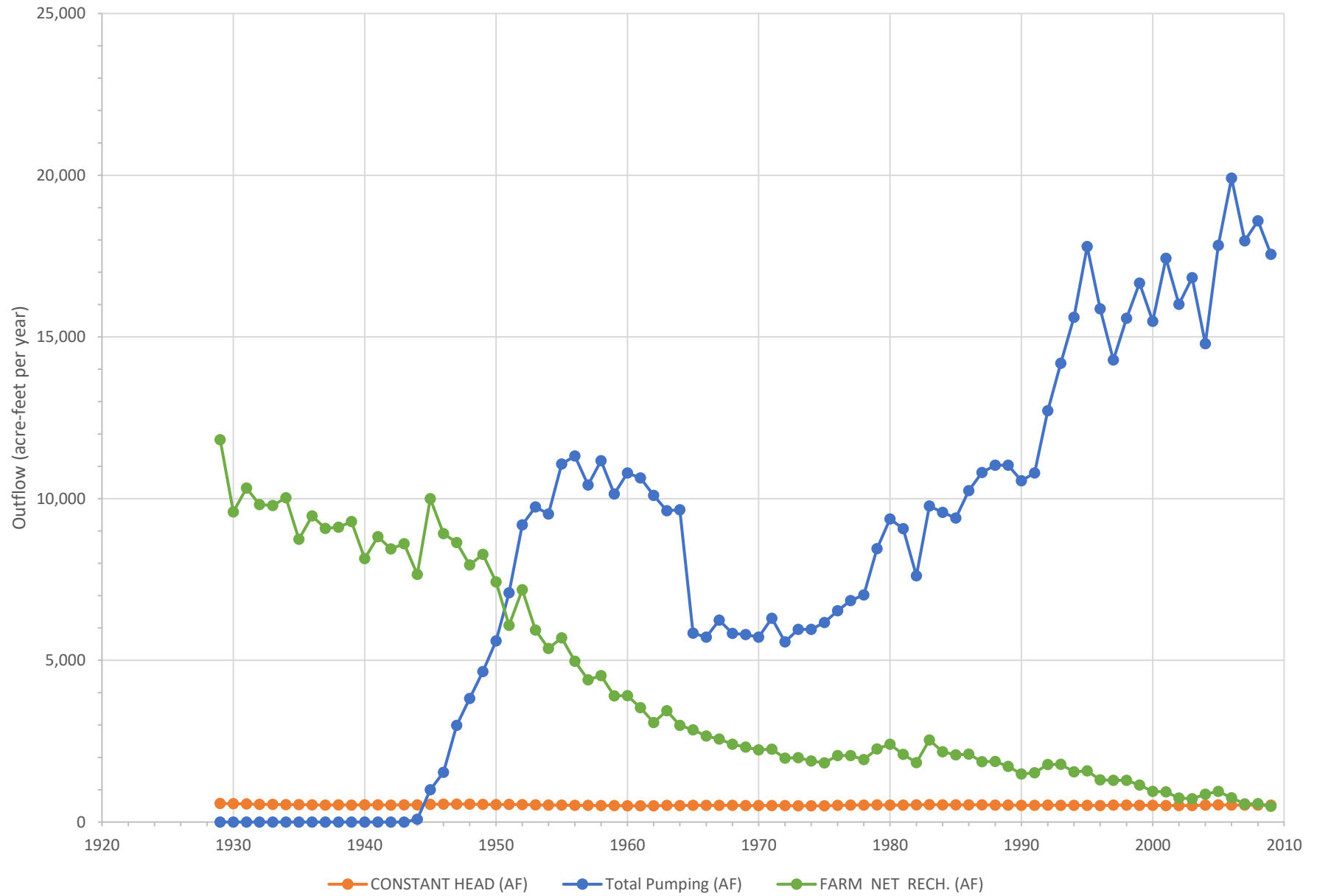


Figure 8. Cumulative Change in Storage in Borrego Valley Groundwater Basin from 1945 to 2010

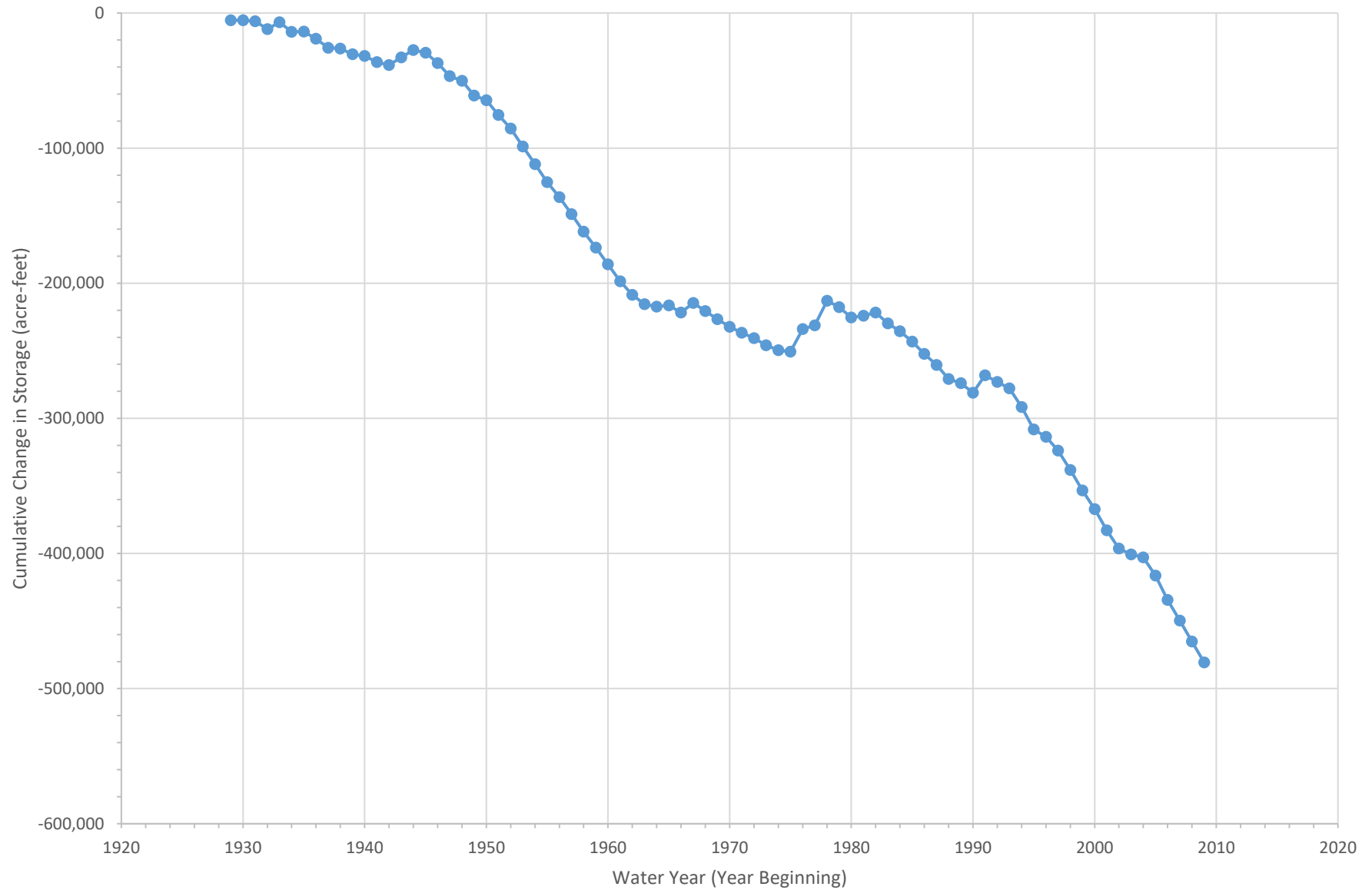


Figure 9. Observed - Simulated Hydraulic Heads (Residuals) from 1945 to 2010

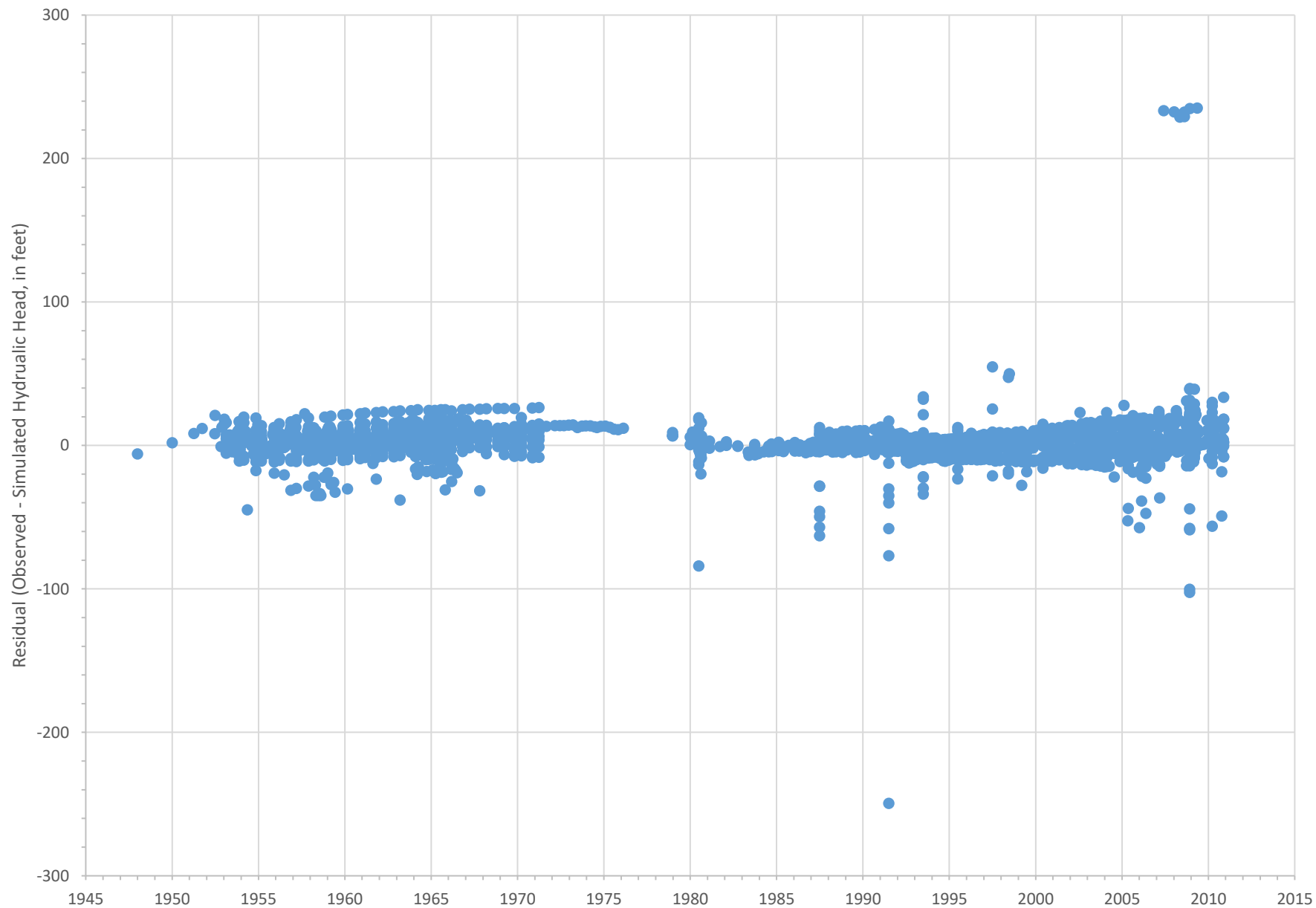


Figure 10. Observed vs. Simulated Hydraulic Heads in the Borrego Valley Groundwater Basin from 1945 to 2010

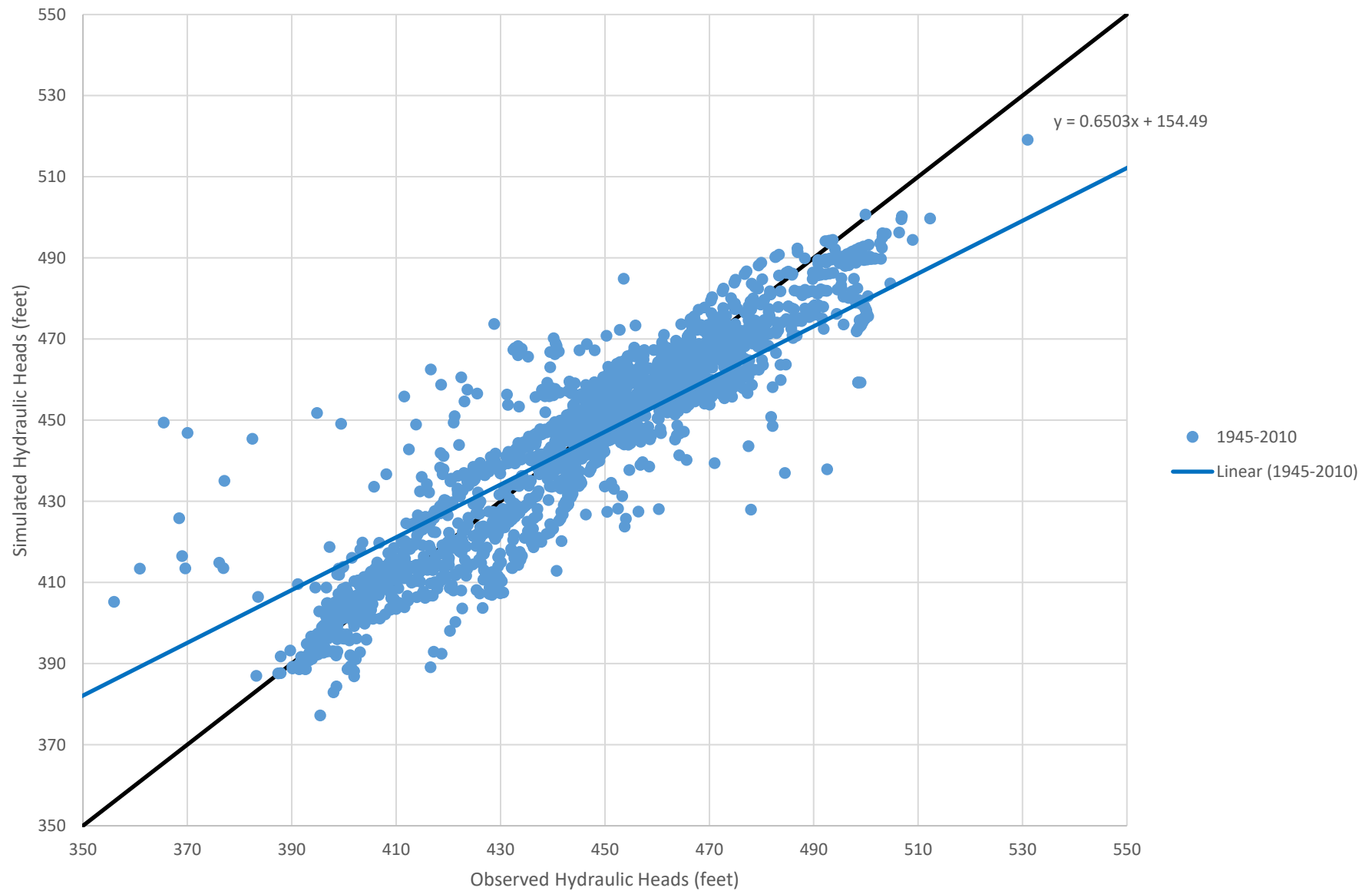


Figure 11. Observed - Simulated Hydraulic Heads (Residuals) from 1945 to 2016

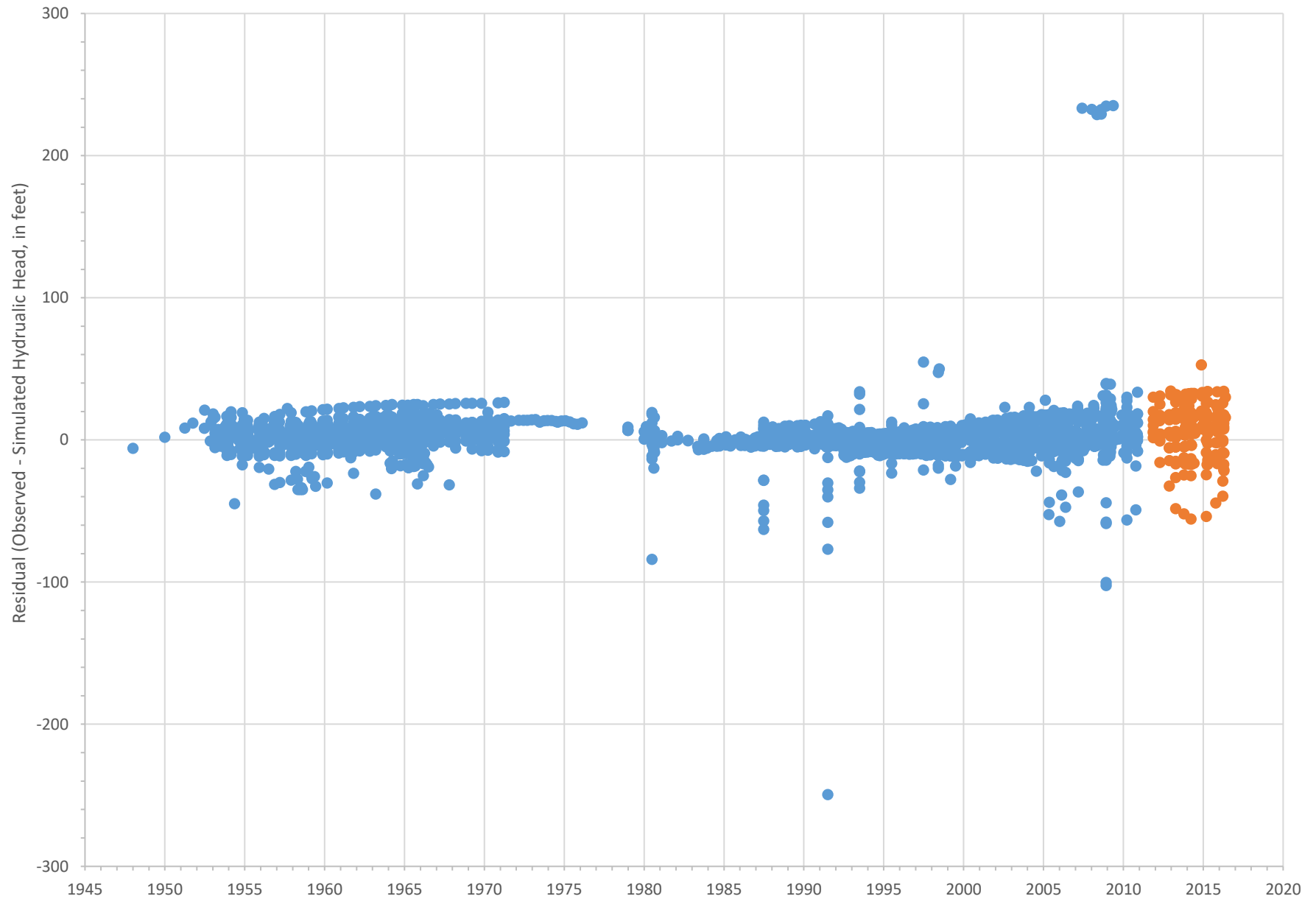


Figure 12. Observed vs. Simulated Hydraulic Heads in the Borrego Valley Groundwater Basin from 1945 to 2016

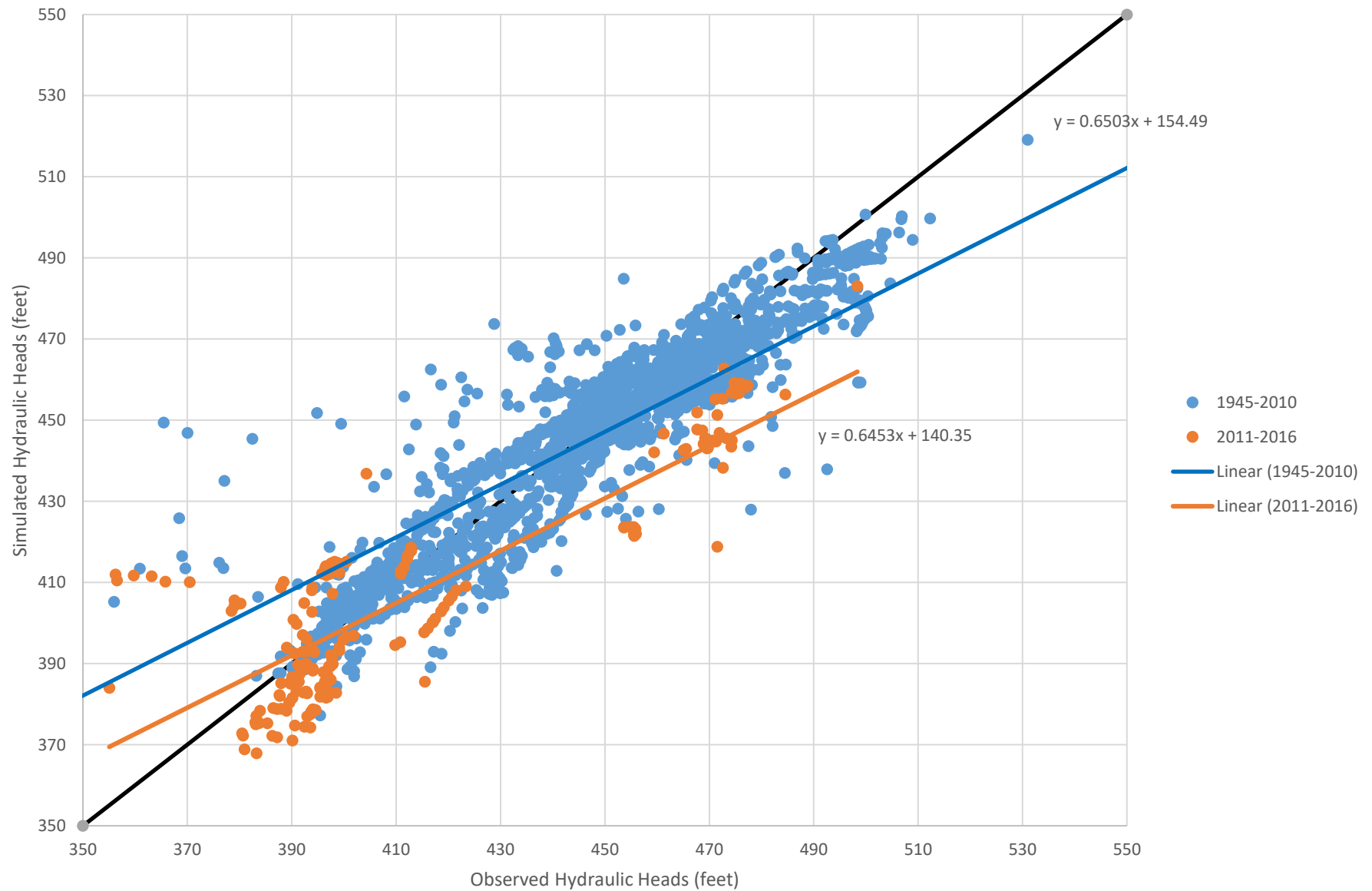
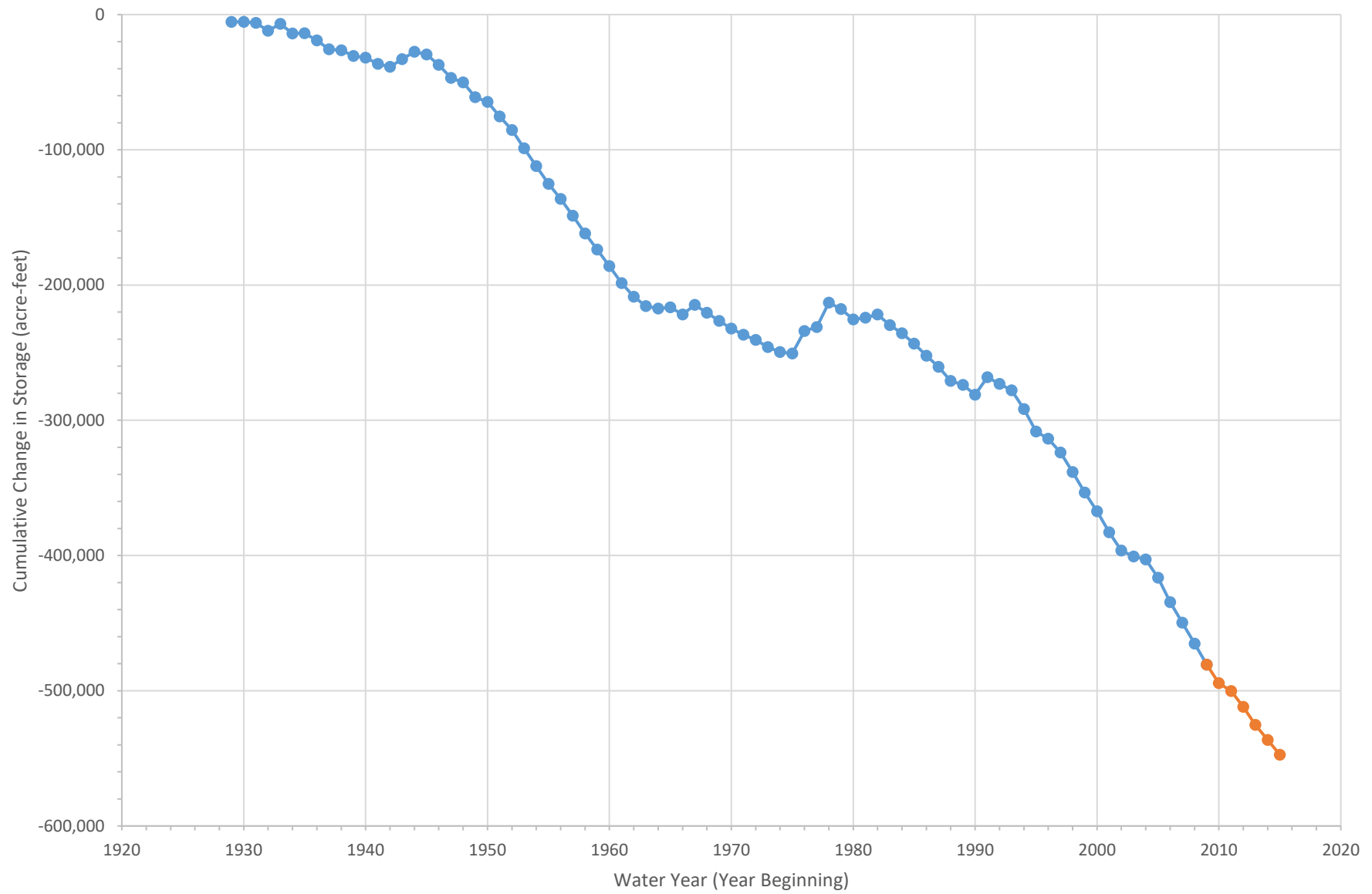


Figure 13. Cumulative Change in Storage in Borrego Valley Groundwater Basin from 1945 to 2016



Appendix A. Annual Water Balance for Borrego Valley Hydrologic Model

Water Year Beginning								OUTFLOWS								Water Balance	Δ Storage
	STORAGE (AF)	SPECIFIED FLOWS (AF)	STREAM LEAKAGE (AF)	UZF RECHARGE (AF)	MNW2 (AF)	TOTAL IN (AF)	Natural Recharge (AF)	STORAGE (AF)	CONSTANT HEAD (AF)	MNW2 (AF)	FARM WELLS (AF)	Total Pumping (AF)	FARM NET RECH. (AF)	Total Out (AF)	Discharge (AF)		
1929	11,164.65	1,366.27	97.40	5,702.64	0.00	18,330.95	7,166.30	5,730.49	573.29	0.00	0.00	0.00	11,822.97	18,126.75	12,396.26	-5,229.96	-5,434.16
1930	6,564.56	1,366.27	4,006.82	4,815.95	0.00	16,753.60	10,189.04	6,587.16	566.45	0.00	0.00	0.00	9,589.55	16,743.15	10,155.99	33.05	22.60
1931	7,727.41	1,370.01	4,671.00	4,069.45	0.00	17,837.87	10,110.46	6,963.86	559.46	0.00	0.00	0.00	10,325.88	17,849.20	10,885.34	-774.87	-763.55
1932	7,489.29	1,366.27	470.35	2,704.38	0.00	12,030.29	4,541.00	1,745.51	545.31	0.00	0.00	0.00	9,816.30	12,107.12	10,361.61	-5,820.61	-5,743.78
1933	8,391.33	1,366.27	10,540.11	3,422.88	0.00	23,720.59	15,329.26	13,392.66	544.34	0.00	0.00	0.00	9,789.97	23,726.97	10,334.31	4,994.95	5,001.33
1934	8,687.88	1,366.27	259.12	1,869.70	0.00	12,182.96	3,495.08	1,670.78	535.83	0.00	0.00	0.00	10,028.54	12,235.15	10,564.36	-7,069.28	-7,017.09
1935	7,055.88	1,370.01	5,893.96	2,154.58	0.00	16,474.44	9,418.56	7,207.68	537.00	0.00	0.00	0.00	8,739.95	16,484.63	9,276.95	141.61	151.80
1936	8,147.76	1,366.27	1,802.50	1,585.55	0.00	12,902.08	4,754.32	2,938.35	532.92	0.00	0.00	0.00	9,464.21	12,935.47	9,997.13	-5,242.81	-5,209.41
1937	8,229.59	1,366.27	466.59	1,019.48	0.00	11,081.93	2,852.33	1,523.34	526.04	0.00	0.00	0.00	9,078.35	11,127.72	9,604.38	-6,752.05	-6,706.25
1938	8,007.00	1,366.27	5,807.98	1,777.60	0.00	16,958.85	8,951.85	7,330.01	529.87	0.00	0.00	0.00	9,114.70	16,974.59	9,644.57	-692.73	-676.99
1939	8,323.85	1,370.01	3,291.39	1,002.93	0.00	13,988.19	5,664.34	4,200.11	526.55	0.00	0.00	0.00	9,292.28	14,018.95	9,818.84	-4,154.50	-4,123.74
1940	6,902.92	1,366.27	4,380.06	1,607.52	0.00	14,256.77	7,353.85	5,596.57	527.83	0.00	0.00	0.00	8,142.31	14,266.71	8,670.14	-1,316.29	-1,306.35
1941	7,727.33	1,366.27	2,222.73	1,206.88	0.00	12,523.21	4,795.88	3,191.10	529.21	0.00	0.00	0.00	8,821.64	12,541.96	9,350.85	-4,554.98	-4,536.23
1942	7,872.03	1,366.27	4,324.76	994.25	0.00	14,557.31	6,685.28	5,613.54	525.80	0.00	0.00	0.00	8,441.68	14,581.03	8,967.49	-2,282.21	-2,258.49
1943	8,781.49	1,370.01	11,249.22	2,215.77	0.00	23,616.49	14,835.00	14,475.99	532.46	0.00	0.00	0.00	8,608.10	23,616.55	9,140.56	5,694.44	5,694.50
1944	6,743.86	1,366.27	9,181.62	3,212.55	1.27	20,505.56	13,760.43	12,220.58	532.26	88.63	0.00	88.63	7,658.60	20,500.07	8,279.49	5,482.21	5,476.72
1945	10,236.99	1,366.27	5,201.31	2,988.91	1.71	19,795.20	9,556.49	8,252.91	549.24	996.16	0.00	996.16	9,998.39	19,796.71	11,543.80	-1,985.59	-1,984.08
1946	9,334.75	1,366.27	196.05	1,730.47	1.77	12,629.31	3,292.79	1,627.18	550.88	1,534.08	0.00	1,534.08	8,917.02	12,629.16	11,001.99	-7,707.43	-7,707.57
1947	10,922.73	1,370.01	112.19	1,059.47	0.93	13,465.33	2,541.68	1,287.80	550.77	2,770.43	215.03	2,985.45	8,642.13	13,466.16	12,178.36	-9,635.75	-9,634.93
1948	10,476.17	1,366.27	6,232.29	1,350.82	0.68	19,426.23	8,949.37	7,099.47	555.20	3,589.05	231.55	3,820.60	7,949.71	19,424.98	12,325.50	-3,375.45	-3,376.70
1949	12,127.20	1,366.27	126.71	989.46	0.64	14,610.27	2,482.44	1,141.28	546.61	4,425.95	223.31	4,649.26	8,274.42	14,611.58	13,470.29	-10,987.22	-10,985.91
1950	11,335.03	1,366.27	7,915.42	871.22	0.50	21,488.43	10,152.90	7,926.75	541.98	5,260.83	336.44	5,597.27	7,421.59	21,487.60	13,560.84	-3,407.44	-3,408.27
1951	13,059.68	1,370.01	594.36	876.51	0.80	15,901.37	2,840.89	2,189.66	542.09	6,596.19	493.44	7,089.63	6,079.95	15,901.33	13,711.67	-10,869.98	-10,870.02
1952	15,186.40	1,366.27	4,375.11	1,108.86	1.63	22,038.27	8,502.24	5,129.63	538.02	8,173.89	1,012.42	9,186.31	7,183.63	22,037.59	16,097.96	-10,056.09	-10,056.76
1953	14,817.73	1,366.27	724.52	718.10	3.68	17,630.29	2,808.89	1,419.82	530.85	8,633.96	1,109.13	9,743.09	5,937.38	17,631.14	16,211.32	-13,398.76	-13,397.90
1954	14,477.67	1,366.27	174.09	749.18	4.06	16,771.27	2,289.55	1,359.66	524.91	8,462.30	1,059.26	9,521.56	5,366.80	16,772.94	15,413.28	-13,119.68	-13,118.00
1955	15,506.87	1,370.01	2,067.48	669.49	2.76	19,616.61	4,106.98	2,335.93	520.56	9,896.81	1,173.85	11,070.66	5,692.14	19,619.28	17,283.36	-13,173.61	-13,170.94
1956	14,959.72	1,366.27	3,565.63	656.46	2.78	20,550.86	5,588.36	3,745.89	515.57	9,945.73	1,371.60	11,317.32	4,972.94	20,551.72	16,805.83	-11,214.69	-11,213.83
1957	14,065.91	1,366.27	828.34	676.13	2.99	16,939.64	2,870.74	1,605.74	512.90	8,979.94	1,443.77	10,423.71	4,397.77	16,940.12	15,334.38	-12,460.65	-12,460.18
1958	14,598.36	1,366.27	1,150.74	644.93	2.61	17,762.91	3,161.93	1,550.67	508.96	9,518.32	1,655.41	11,173.73	4,531.07	17,764.42	16,213.75	-13,049.21	-13,047.69
1959	13,640.41	1,370.01	695.95	669.55	2.77	16,378.69	2,735.51	1,829.93	509.20	8,642.83	1,501.45	10,144.28	3,903.23	16,386.64	14,556.71	-11,818.42	-11,810.47
1960	13,760.82	1,366.27	835.39	607.24	2.18	16,571.90	2,808.90	1,378.33	504.82	9,197.43	1,598.39	10,795.83	3,905.18	16,584.16	15,205.82	-12,394.74	-12,382.48
1961	13,546.30	1,366.27	162.71	572.10	2.19	15,649.57	2,101.08	970.00	501.92	9,071.85	1,568.97	10,640.82	3,538.32	15,651.06	14,681.06	-12,577.79	-12,576.30
1962	12,212.91	1,366.27	1,741.39	622.76	2.04	15,945.36	3,730.41	2,279.58	498.78	8,628.29	1,469.48	10,097.77	3,075.17	15,951.29	13,671.72	-9,939.27	-9,933.33
1963	12,227.76	1,370.01	3,785.26	1,438.11	3.15	18,824.29	6,593.38	5,239.41	515.77	8,152.32	1,471.47	9,623.79	3,444.70	18,823.67	13,584.26	-6,987.73	-6,988.35
1964	11,695.82	1,366.27	9,204.15	820.80	5.73	23,092.77	11,391.22	9,935.95	510.02	8,163.31	1,494.93	9,658.23	2,988.73	23,092.93	13,156.98	-1,760.04	-1,759.87
1965	8,827.72	1,366.27	7,548.36	1,165.22	7.21	18,914.78	10,079.85	9,702.20	516.95	4,400.06	1,441.40	5,841.46	2,852.77	18,913.38	9,211.18	875.88	874.48
1966	7,302.93	1,366.27	1,230.53	1,035.33	3.91	10,938.96	3,632.13	2,044.91	516.18	4,244.66	1,474.20	5,718.86	2,659.44	10,939.38	8,894.48	-5,258.44	-5,258.02
1967	8,257.79	1,370.01	13,665.71	1,378.84	9.31	24,681.67	16,414.57	15,356.16	515.97	4,860.43	1,380.11	6,240.54	2,566.51	24,679.18	9,323.02	7,100.86	7,098.37
1968	8,646.63	1,366.27	458.96	933.04	5.98	11,410.88	2,758.27	2,671.12	514.10	4,493.98	1,338.48	5,832.46	2,404.05	11,421.73	8,750.62	-5,986.37	-5,975.52
1969	6,974.17	1,366.27	337.26	951.13	4.10	9,632.93	2,654.66	1,014.47	512.40	4,193.85	1,602.89	5,796.74	2,318.17	9,641.78	8,627.31	-5,968.55	-5,959.70
1970	6,678.45	1,366.27	330.25	1,016.85	3.59	9,395.42	2,713.37	948.17	508.73	4,065.23	1,654.84	5,720.07	2,227.37	9,404.34	8,456.17	-5,739.21	-5,730.29
1971	6,932.95	1,370.01	2,192.97	1,076.44	3.21	11,575.57	4,639.41	2,519.07	509.38	4,578.80	1,720.91	6,299.70	2,250.31	11,578.45	9,059.38	-4,416.76	-4,413.88
1972	6,091.90	1,366.27	1,511.96	1,211.05	3.28	10,184.47	4,089.29	2,135.59	506.74	3,976.97	1,593.72	5,570.68	1,977.73	10,190.74	8,055.16	-3,962.59	-3,956.31
1973	6,402.21	1,366.27	670.80	1,139.95	4.02	9,583.24	3,177.01	1,145.68	504.91	4,317.47	1,641.45	5,958.92	1,987.13	9,596.64	8,450.96	-5,269.93	-5,256.54
1974	6,105.25	1,366.27	2,215.20	1,170.82	3.47	10,861.01	4,752.29	2,528.92	503.19	4,358.26	1,598.76	5,957.02	1,888.94	10,878.07	8,349.14	-3,593.38	-3,576.33
1975	6,430.62	1,370.01	4,482.20	1,432.99	4.53	13,720.35	7,285.19	5,220.02	505.38	4,678.19	1,488.74	6,166.93	1,828.76	13,721.09	8,501.07	-1,211.34	-1,210.61
1976	7,221.49	1,366.27	21,545.32	2,910.56	10.00	33,053.63	25,822.15	23,955.63	514.80	4,975.02	1,558.62	6,533.64	2,056.57	33,060.65	9,105.02	16,727.13	16,734.15
1977	8,608.59	1,366.27	9,100.41	1,822.69	10.69	20,908.65	12,289.36	11,482.01	522.51	5,287.61	1,562.36	6,849.97	2,051.80	20,906.29	9,424.28	2,875.78	2,873.42
1978	9,980.94	1,366.27	22,504.37	3,706.44	12.78	37,570.81	27,577.08	28,103.65	521.61	5,569.13	1,456.47	7,025.60	1,931.97	37,582.82	9,479.17	18,110.69	18,122.71
1979	11,578.46	1,370.01	3,372.44	1,784.84	10.35	18,116.10	6,527.29	6,864.35	528.64	6,728.95	1,720.93	8,449.88	2,260.29	18,103.16	11,238.81	-4,701.17	-4,714.11
1980	10,116.67	1,366.27	2,010.57	1,147.53	5.82	14,646.86	4,524.37	2,367.07	524.58	7,415.02	1,956.47	9,371.49	2,402.89	14,666.03	12,298.96	-7,768.78	-7,749.60
1981	8,678.39	1,366.27	10,070.52	1,555.96	6.25	21,677.39	12,992.75	9,994.0									

Appendix A. Annual Water Balance for Borrego Valley Hydrologic Model

Water Year Beginning								OUTFLOWS							Water Balance	Δ Storage	
	STORAGE (AF)	SPECIFIED FLOWS (AF)	STREAM LEAKAGE (AF)	UZF RECHARGE (AF)	MNW2 (AF)	TOTAL IN (AFY)	Natural Recharge (AF)	STORAGE (AF)	CONSTANT HEAD (AF)	MNW2 (AF)	FARM WELLS (AF)	Total Pumping (AF)	FARM NET RECH. (AF)	Total Out (AF)			Discharge (AF)
1984	9,629.04	1,366.27	3,182.71	1,841.77	18.69	16,038.47	6,390.74	3,761.00	533.87	7,722.91	1,849.74	9,572.65	2,172.11	16,039.63	12,278.63	-5,869.20	-5,868.03
1985	9,910.09	1,366.27	1,402.37	1,559.51	20.46	14,258.70	4,328.15	2,251.65	533.98	7,588.52	1,810.21	9,398.73	2,074.40	14,258.76	12,007.11	-7,658.50	-7,658.44
1986	10,375.36	1,366.27	926.43	1,454.34	19.45	14,141.85	3,747.04	1,266.15	530.20	8,282.97	1,966.51	10,249.48	2,096.30	14,142.13	12,875.97	-9,109.48	-9,109.21
1987	10,934.85	1,370.01	2,038.69	1,654.10	22.53	16,020.18	5,062.80	2,820.28	531.26	8,983.53	1,822.15	10,805.67	1,863.77	16,020.97	13,200.70	-8,115.36	-8,114.57
1988	11,506.53	1,366.27	233.41	1,364.98	23.74	14,494.92	2,964.65	1,064.87	524.27	9,030.12	2,005.64	11,035.76	1,872.89	14,497.78	13,432.91	-10,444.52	-10,441.66
1989	10,826.51	1,366.27	7,016.01	1,868.39	24.50	21,101.68	10,250.67	7,827.69	521.45	9,069.61	1,965.15	11,034.76	1,721.44	21,105.34	13,277.65	-3,002.48	-2,998.81
1990	10,636.74	1,366.27	2,515.30	1,453.41	19.05	15,990.77	5,334.98	3,434.20	518.06	8,772.85	1,776.15	10,549.00	1,489.41	15,990.68	12,556.48	-7,202.45	-7,202.54
1991	11,707.80	1,370.01	20,913.16	3,494.77	36.82	37,522.57	25,777.94	24,694.41	513.90	9,018.37	1,778.19	10,796.56	1,520.21	37,525.08	12,830.67	12,984.10	12,986.60
1992	14,569.90	1,366.27	5,915.43	2,785.29	44.27	24,681.15	10,066.99	9,666.34	521.54	10,959.33	1,755.96	12,715.29	1,777.29	24,680.47	15,014.12	-4,902.87	-4,903.56
1993	12,610.91	1,366.27	8,347.66	1,978.52	29.77	24,333.13	11,692.44	7,845.73	517.77	12,333.54	1,847.84	14,181.38	1,788.13	24,333.00	16,487.28	-4,765.06	-4,765.18
1994	15,805.11	1,366.27	787.19	1,592.92	31.50	19,582.99	3,746.37	1,903.71	516.31	13,780.52	1,828.68	15,609.20	1,553.51	19,582.72	17,679.01	-13,901.14	-13,901.40
1995	17,536.31	1,370.01	656.24	1,277.18	30.93	20,870.67	3,303.42	973.73	515.34	15,772.36	2,022.79	17,795.15	1,581.69	20,865.91	19,892.18	-16,557.82	-16,562.58
1996	14,585.62	1,366.27	9,087.98	1,834.52	28.05	26,902.44	12,288.78	9,214.69	511.86	14,041.17	1,826.88	15,868.05	1,307.77	26,902.36	17,687.67	-5,370.85	-5,370.93
1997	14,384.23	1,366.27	2,625.43	1,909.47	36.17	20,321.56	5,901.16	4,221.20	523.49	12,565.50	1,718.59	14,284.08	1,292.65	20,321.42	16,100.23	-10,162.89	-10,163.03
1998	15,335.63	1,366.27	317.60	1,268.15	27.95	18,315.60	2,952.01	935.58	520.86	13,650.77	1,926.98	15,577.76	1,291.44	18,325.64	17,390.05	-14,410.09	-14,400.05
1999	16,190.26	1,370.01	450.22	1,280.74	34.00	19,325.23	3,100.97	1,014.02	519.23	14,507.72	2,155.29	16,663.01	1,146.80	19,343.05	18,329.04	-15,194.07	-15,176.24
2000	15,569.67	1,366.27	283.49	1,362.17	29.63	18,611.23	3,011.93	1,659.64	515.78	13,413.67	2,067.40	15,481.07	950.13	18,606.61	16,946.98	-13,905.41	-13,910.03
2001	16,905.68	1,366.27	428.29	1,434.40	33.98	20,168.62	3,228.96	1,292.43	512.82	15,108.61	2,320.53	17,429.14	934.45	20,168.84	18,876.41	-15,613.47	-15,613.25
2002	15,642.91	1,366.27	931.91	1,551.15	33.38	19,525.63	3,849.33	2,265.52	510.42	13,675.08	2,331.81	16,006.89	744.89	19,527.72	17,262.20	-13,379.49	-13,377.39
2003	15,308.80	1,370.01	10,614.50	1,655.06	35.78	28,984.15	13,639.57	10,928.22	509.89	14,373.88	2,454.67	16,828.55	719.22	28,985.88	18,057.66	-4,382.31	-4,380.58
2004	15,596.97	1,366.27	9,034.46	3,529.99	45.84	29,573.53	13,930.71	13,394.40	527.26	12,873.56	1,916.17	14,789.73	862.87	29,574.25	16,179.86	-2,203.30	-2,202.58
2005	16,951.16	1,366.27	2,563.05	1,820.33	34.10	22,734.91	5,749.64	3,423.90	529.56	15,473.65	2,359.42	17,833.08	946.16	22,732.70	19,308.81	-13,525.06	-13,527.26
2006	19,091.07	1,366.27	291.71	1,448.80	31.62	22,229.47	3,106.78	1,040.39	524.86	17,389.64	2,521.67	19,911.31	752.59	22,229.15	21,188.76	-18,050.35	-18,050.68
2007	17,754.85	1,370.01	1,228.89	1,239.57	35.87	21,629.19	3,838.48	2,579.28	522.74	15,650.88	2,316.60	17,967.48	562.38	21,631.88	19,052.60	-15,178.26	-15,175.57
2008	18,160.59	1,366.27	1,572.16	1,215.03	37.57	22,351.62	4,153.46	2,665.27	522.44	16,220.74	2,370.20	18,590.94	571.12	22,349.77	19,684.50	-15,493.47	-15,495.32
2009	17,393.45	1,366.27	234.31	1,378.10	35.75	20,407.88	2,978.68	1,868.07	520.48	15,179.83	2,377.39	17,557.21	487.48	20,433.23	18,565.17	-15,550.73	-15,525.38
MIN (1929 - 2009)	6,092	1,366	97	572	0	9,395	2,101	936	499	0	0		487	9,404	8,055	-18,050	-18,051
MAX (1929 - 2009)	19,091	1,370	22,504	5,703	46	37,571	27,577	28,104	573	17,390	2,522		11,823	37,583	21,189	18,111	18,123
AVG (1929 - 2009)	11,292	1,367	4,016	1,657	12	18,344	7,040	5,358	525	6,982	1,271		4,212	18,348	12,990	-5,937	-5,933
STDEV (1929 - 2009)	3,556	2	4,853	973	14	5,681	5,363	5,487	15	5,053	824		3,298	5,676	3,577	7,175	7,175
MIN (1944 - 2009)	6,092	1,366	112	572	1	9,395	2,101	936	499	89	0	89	487	9,404	8,055	-18,050	-18,051
MAX (1944 - 2009)	19,091	1,370	22,504	3,706	46	37,571	27,577	28,104	555	17,390	2,522	19,911	9,998	37,583	21,189	18,111	18,123
AVG (1944 - 2009)	12,024	1,367	4,028	1,486	15	18,919	6,881	5,240	522	8,569	1,560	10,128	3,032	18,922	13,682	-6,786	-6,783
STDEV (1944 - 2009)	3,518	2	5,142	737	14	5,884	5,673	5,811	13	4,198	614	4,672	2,361	5,883	3,597	7,490	7,489

Appendix B. Annual Water Budget from 1929 to 2016 for Borrego Valley Hydrologic Model

Water Year Beginning	INFLOWS							OUTFLOWS							Water Balance	Δ Storage	
	STORAGE (AF)	SPECIFIED FLOWS (AF)	STREAM LEAKAGE (AF)	UZF RECHARGE (AF)	MNW2 (AF)	TOTAL IN (AFY)	Natural Recharge (AF)	STORAGE (AF)	CONSTANT HEAD (AF)	MNW2 (AF)	FARM WELLS (AF)	Total Pumping (AF)	FARM NET RECH. (AF)	Total Out (AF)	Discharge (AF)		
1929	11,164.65	1,366.27	97.40	5,702.64	0.00	18,330.95	7,166.30	5,730.49	573.29	0.00	0.00	0.00	11,822.97	18,126.75	12,396.26	-5,229.96	-5,434.16
1930	6,564.56	1,366.27	4,006.82	4,815.95	0.00	16,753.60	10,189.04	6,587.16	566.45	0.00	0.00	0.00	9,589.55	16,743.15	10,155.99	33.05	22.60
1931	7,727.41	1,370.01	4,671.00	4,069.45	0.00	17,837.87	10,110.46	6,963.86	559.46	0.00	0.00	0.00	10,325.88	17,849.20	10,885.34	-774.87	-763.55
1932	7,489.29	1,366.27	470.35	2,704.38	0.00	12,030.29	4,541.00	1,745.51	545.31	0.00	0.00	0.00	9,816.30	12,107.12	10,361.61	-5,820.61	-5,743.78
1933	8,391.33	1,366.27	10,540.11	3,422.88	0.00	23,720.59	15,329.26	13,392.66	544.34	0.00	0.00	0.00	9,789.97	23,726.97	10,334.31	4,994.95	5,001.33
1934	8,687.88	1,366.27	259.12	1,869.70	0.00	12,182.96	3,495.08	1,670.78	535.83	0.00	0.00	0.00	10,028.54	12,235.15	10,564.36	-7,069.28	-7,017.09
1935	7,055.88	1,370.01	5,893.96	2,154.58	0.00	16,474.44	9,418.56	7,207.68	537.00	0.00	0.00	0.00	8,739.95	16,484.63	9,276.95	141.61	151.80
1936	8,147.76	1,366.27	1,802.50	1,585.55	0.00	12,902.08	4,754.32	2,938.35	532.92	0.00	0.00	0.00	9,464.21	12,935.47	9,997.13	-5,242.81	-5,209.41
1937	8,229.59	1,366.27	466.59	1,019.48	0.00	11,081.93	2,852.33	1,523.34	526.04	0.00	0.00	0.00	9,078.35	11,127.72	9,604.38	-6,752.05	-6,706.25
1938	8,007.00	1,366.27	5,807.98	1,777.60	0.00	16,958.85	8,951.85	7,330.01	529.87	0.00	0.00	0.00	9,114.70	16,974.59	9,644.57	-692.73	-676.99
1939	8,323.85	1,370.01	3,291.39	1,002.93	0.00	13,988.19	5,664.34	4,200.11	526.55	0.00	0.00	0.00	9,292.28	14,018.95	9,818.84	-4,154.50	-4,123.74
1940	6,902.92	1,366.27	4,380.06	1,607.52	0.00	14,256.77	7,353.85	5,596.57	527.83	0.00	0.00	0.00	8,142.31	14,266.71	8,670.14	-1,316.29	-1,306.35
1941	7,727.33	1,366.27	2,222.73	1,206.88	0.00	12,523.21	4,795.88	3,191.10	529.21	0.00	0.00	0.00	8,821.64	12,541.96	9,350.85	-4,554.98	-4,536.23
1942	7,872.03	1,366.27	4,324.76	994.25	0.00	14,557.31	6,685.28	5,613.54	525.80	0.00	0.00	0.00	8,441.68	14,581.03	8,967.49	-2,282.21	-2,258.49
1943	8,781.49	1,370.01	11,249.22	2,215.77	0.00	23,616.49	14,835.00	14,475.99	532.46	0.00	0.00	0.00	8,608.10	23,616.55	9,140.56	5,694.44	5,694.50
1944	6,743.86	1,366.27	9,181.62	3,212.55	1.27	20,505.56	13,760.43	12,220.58	532.26	88.63	0.00	88.63	7,658.60	20,500.07	8,279.49	5,482.21	5,476.72
1945	10,236.99	1,366.27	5,201.31	2,988.91	1.71	19,795.20	9,556.49	8,252.91	549.24	996.16	0.00	996.16	9,998.39	19,796.71	11,543.80	-1,985.59	-1,984.08
1946	9,334.75	1,366.27	196.05	1,730.47	1.77	12,629.31	3,292.79	1,627.18	550.88	1,534.08	0.00	1,534.08	8,917.02	12,629.16	11,001.99	-7,707.43	-7,707.57
1947	10,922.73	1,370.01	112.19	1,059.47	0.93	13,465.33	2,541.68	1,287.80	550.77	2,770.43	215.03	2,985.45	8,642.13	13,466.16	12,178.36	-9,635.75	-9,634.93
1948	10,476.17	1,366.27	6,232.29	1,350.82	0.68	19,426.23	8,949.37	7,099.47	555.20	3,589.05	231.55	3,820.60	7,949.71	19,424.98	12,325.50	-3,375.45	-3,376.70
1949	12,127.20	1,366.27	126.71	989.46	0.64	14,610.27	2,482.44	1,141.28	546.61	4,425.95	223.31	4,649.26	8,274.42	14,611.58	10,740.29	-10,987.22	-10,985.91
1950	11,335.03	1,366.27	7,915.42	871.22	0.50	21,488.43	10,152.90	7,926.75	541.98	5,260.83	336.44	5,597.27	7,421.59	21,487.60	13,560.84	-3,407.44	-3,408.27
1951	13,059.68	1,370.01	594.36	876.51	0.80	15,901.37	2,840.89	2,189.66	542.09	6,596.19	493.44	7,089.63	6,079.95	15,901.33	13,711.67	-10,869.98	-10,870.02
1952	15,186.40	1,366.27	4,375.11	1,108.86	1.63	22,038.27	6,850.24	5,129.63	538.02	8,173.89	1,012.42	9,186.31	7,183.63	22,037.59	16,907.96	-10,056.09	-10,056.76
1953	14,817.73	1,366.27	724.52	718.10	3.68	17,630.29	2,808.89	1,419.82	530.85	8,633.96	1,109.13	9,743.09	5,937.38	17,631.14	16,211.32	-13,398.76	-13,397.90
1954	14,477.67	1,366.27	174.09	749.18	4.06	16,771.27	2,289.55	1,359.66	524.91	8,462.30	1,059.26	9,521.56	5,366.80	16,772.94	15,413.28	-13,119.68	-13,118.00
1955	15,506.87	1,370.01	2,067.48	669.49	2.76	19,616.61	4,106.98	2,335.93	520.56	9,896.81	1,173.85	11,070.66	5,692.14	19,619.28	17,283.36	-13,173.61	-13,170.94
1956	14,959.72	1,366.27	3,565.63	656.46	2.78	20,550.86	5,588.36	3,745.89	515.57	9,945.73	1,371.60	11,317.32	4,972.94	20,551.72	16,805.83	-11,214.69	-11,213.83
1957	14,065.91	1,366.27	828.34	676.13	2.99	16,939.64	2,870.74	1,605.74	512.90	8,979.94	1,443.77	10,423.71	4,397.77	16,940.12	15,334.38	-12,460.65	-12,460.18
1958	14,598.36	1,366.27	1,150.74	644.93	2.61	17,762.91	3,161.93	1,550.67	508.96	9,518.32	1,655.41	11,173.73	4,531.07	17,764.42	16,213.75	-13,049.21	-13,047.69
1959	13,640.41	1,370.01	695.95	669.55	2.77	16,378.69	2,735.51	1,829.93	509.20	8,642.83	1,501.45	10,144.28	3,903.23	16,386.64	14,556.71	-11,818.42	-11,810.47
1960	13,760.82	1,366.27	835.39	607.24	2.18	16,571.90	2,808.90	1,378.33	504.82	9,197.43	1,598.39	10,795.83	3,905.18	16,584.16	15,205.82	-12,394.74	-12,382.48
1961	13,546.30	1,366.27	162.71	572.10	2.19	15,649.57	2,101.08	970.00	501.92	9,071.85	1,568.97	10,640.82	3,538.32	15,651.06	14,681.06	-12,577.79	-12,576.30
1962	12,212.91	1,366.27	1,741.39	622.76	2.04	15,945.36	3,730.41	2,279.58	498.78	8,628.29	1,469.48	10,097.77	3,075.17	15,951.29	13,671.72	-9,939.27	-9,933.33
1963	12,227.76	1,370.01	3,785.26	1,438.11	3.15	18,824.29	6,593.38	5,239.41	515.77	8,152.32	1,471.47	9,623.79	3,444.70	18,823.67	13,584.26	-6,987.73	-6,988.35
1964	11,695.82	1,366.27	9,204.15	820.80	5.73	23,092.77	11,391.22	9,935.95	510.02	8,163.31	1,494.93	9,658.23	2,988.73	23,092.93	13,156.98	-1,760.04	-1,759.87
1965	8,827.72	1,366.27	7,548.36	1,165.22	7.21	18,914.78	10,079.85	9,702.20	516.95	4,400.06	1,441.40	5,841.46	2,852.77	18,913.38	9,211.18	875.88	874.48
1966	7,302.93	1,366.27	1,230.53	1,035.33	3.91	10,938.96	3,632.13	2,044.91	516.18	4,244.66	1,474.20	5,718.86	2,659.44	10,939.38	8,894.48	-5,058.44	-5,258.02
1967	8,257.79	1,370.01	13,665.71	1,378.84	9.31	24,681.67	16,414.57	15,356.16	515.97	4,860.43	1,380.11	6,240.54	2,566.51	24,679.18	9,323.02	7,100.86	7,098.37
1968	8,646.63	1,366.27	458.96	933.04	5.98	11,410.88	2,758.27	2,671.12	514.10	4,493.98	1,338.48	5,832.46	2,404.05	11,421.73	8,750.62	-5,986.37	-5,975.52
1969	6,974.17	1,366.27	337.26	951.13	4.10	9,632.93	2,654.66	1,014.47	512.40	4,193.85	1,602.89	5,796.74	2,318.17	9,641.78	8,627.31	-5,968.55	-5,959.70
1970	6,678.45	1,366.27	330.25	1,016.85	3.59	9,395.42	2,713.37	948.17	508.73	4,065.23	1,654.84	5,720.07	2,227.37	9,404.34	8,456.17	-5,739.21	-5,730.29
1971	6,932.95	1,370.01	2,192.97	1,076.44	3.21	11,575.57	4,639.41	2,519.07	509.38	4,578.80	1,720.91	6,299.70	2,250.31	11,578.45	9,059.38	-4,416.76	-4,413.88
1972	6,091.90	1,366.27	1,511.96	1,211.05	3.28	10,184.47	4,089.29	2,135.59	506.74	3,976.97	1,593.72	5,570.68	1,977.73	10,190.74	8,055.16	-3,962.59	-3,956.31
1973	6,402.21	1,366.27	670.80	1,139.95	4.02	9,583.24	3,177.01	1,145.68	504.91	4,317.47	1,641.45	5,958.92	1,987.13	9,596.64	8,450.96	-5,269.93	-5,256.54
1974	6,105.25	1,366.27	2,215.20	1,170.82	3.47	10,861.01	4,752.29	2,528.92	503.19	4,358.26	1,598.76	5,957.02	1,888.94	10,878.07	8,349.14	-3,593.38	-3,576.33
1975	6,430.62	1,370.01	4,482.20	1,432.99	4.53	13,720.35	7,285.19	5,220.02	505.38	4,678.19	1,488.74	6,166.93	1,828.76	13,721.09	8,501.07	-1,211.34	-1,210.61
1976	7,221.49	1,366.27	21,545.32	2,910.56	10.00	33,053.63	25,822.15	23,955.63	514.80	4,975.02	1,558.62	6,533.64	2,056.57	33,060.65	9,105.02	16,727.13	16,734.15
1977	8,608.59	1,366.27	9,100.41	1,822.69	10.69	20,908.65	12,289.36	11,482.01	522.51	5,287.61	1,562.36	6,849.97	2,051.80	20,906.29	9,424.28	2,875.78	2,873.42
1978	9,980.94	1,366.27	22,504.37	3,706.44	12.78	37,570.81	27,577.08	28,103.65	521.61	5,569.13	1,456.47	7,025.60	1,931.97	37,582.82	9,479.17	18,110.69	18,122.71
1979	11,578.46	1,370.01	3,372.44	1,784.84	10.35	18,116.10	6,527.29	6,864.35	528.64	6,728.95	1,720.93	8,449.88	2,260.29	18,103.16	11,238.81	-4,701.17	-4,714.11
1980	10,116.67	1,366.27	2,010.57	1,147.53	5.82	14,646.86	4,524.37	2,367.07	524.58	7,415.02	1,956.47	9,371.49	2,402.89	14,666.03	12,298.96	-7,768.78	-7,749.60
1981	8,678.39	1,366.27	10,070.52	1,555.96	6.25	21,677.39	12,992.75										

Appendix B. Annual Water Budget from 1929 to 2016 for Borrego Valley Hydrologic Model

Water Year Beginning	INFLOWS							OUTFLOWS							Water Balance	Δ Storage	
	STORAGE (AF)	SPECIFIED FLOWS (AF)	STREAM LEAKAGE (AF)	UZF RECHARGE (AF)	MNW2 (AF)	TOTAL IN (AFY)	Natural Recharge (AF)	STORAGE (AF)	CONSTANT HEAD (AF)	MNW2 (AF)	FARM WELLS (AF)	Total Pumping (AF)	FARM NET RECH. (AF)	Total Out (AF)			Discharge (AF)
1984	9,629.04	1,366.27	3,182.71	1,841.77	18.69	16,038.47	6,390.74	3,761.00	533.87	7,722.91	1,849.74	9,572.65	2,172.11	16,039.63	12,278.63	-5,869.20	-5,868.03
1985	9,910.09	1,366.27	1,402.37	1,559.51	20.46	14,258.70	4,328.15	2,251.65	533.98	7,588.52	1,810.21	9,398.73	2,074.40	14,258.76	12,007.11	-7,658.50	-7,658.44
1986	10,375.36	1,366.27	926.43	1,454.34	19.45	14,141.85	3,747.04	1,266.15	530.20	8,282.97	1,966.51	10,249.48	2,096.30	14,142.13	12,875.97	-9,109.48	-9,109.21
1987	10,934.85	1,370.01	2,038.69	1,654.10	22.53	16,020.18	5,062.80	2,820.28	531.26	8,983.53	1,822.15	10,805.67	1,863.77	16,020.97	13,200.70	-8,115.36	-8,114.57
1988	11,506.53	1,366.27	233.41	1,364.98	23.74	14,494.92	2,964.65	1,064.87	524.27	9,030.12	2,005.64	11,035.76	1,872.89	14,497.78	13,432.91	-10,444.52	-10,441.66
1989	10,826.51	1,366.27	7,016.01	1,868.39	24.50	21,101.68	10,250.67	7,827.69	521.45	9,069.61	1,965.15	11,034.76	1,721.44	21,105.34	13,277.65	-3,002.48	-2,998.81
1990	10,636.74	1,366.27	2,515.30	1,453.41	19.05	15,990.77	5,334.98	3,434.20	518.06	8,772.85	1,776.15	10,549.00	1,489.41	15,990.68	12,556.48	-7,202.45	-7,202.54
1991	11,707.80	1,370.01	20,913.16	3,494.77	36.82	37,522.57	25,777.94	24,694.41	513.90	9,018.37	1,778.19	10,796.56	1,520.21	37,525.08	12,830.67	12,984.10	12,986.60
1992	14,569.90	1,366.27	5,915.43	2,785.29	44.27	24,681.15	10,066.99	9,666.34	521.54	10,959.33	1,755.96	12,715.29	1,777.29	24,680.47	15,014.12	-4,902.87	-4,903.56
1993	12,610.91	1,366.27	8,347.66	1,978.52	29.77	24,333.13	11,692.44	7,845.73	517.77	12,333.54	1,847.84	14,181.38	1,788.13	24,333.00	16,487.28	-4,765.06	-4,765.18
1994	15,805.11	1,366.27	787.19	1,592.92	31.50	19,582.99	3,746.37	1,903.71	516.31	13,780.52	1,828.68	15,609.20	1,553.51	19,582.72	17,679.01	-13,901.14	-13,901.40
1995	17,536.31	1,370.01	656.24	1,277.18	30.93	20,870.67	3,303.42	973.73	515.34	15,772.36	2,022.79	17,795.15	1,581.69	20,865.91	19,892.18	-16,557.82	-16,562.58
1996	14,585.62	1,366.27	9,087.98	1,834.52	28.05	26,902.44	12,288.78	9,214.69	511.86	14,041.17	1,826.88	15,868.05	1,307.77	26,902.36	17,687.67	-5,370.85	-5,370.93
1997	14,384.23	1,366.27	2,625.43	1,909.47	36.17	20,321.56	5,901.16	4,221.20	523.49	12,565.50	1,718.59	14,284.08	1,292.65	20,321.42	16,100.23	-10,162.89	-10,163.03
1998	15,335.63	1,366.27	317.60	1,268.15	27.95	18,315.60	2,952.01	935.58	520.86	13,650.77	1,926.98	15,577.76	1,291.44	18,325.64	17,390.05	-14,410.09	-14,400.05
1999	16,190.26	1,370.01	450.22	1,280.74	34.00	19,325.23	3,100.97	1,014.02	519.23	14,507.72	2,155.29	16,663.01	1,146.80	19,343.05	18,329.04	-15,194.07	-15,176.24
2000	15,569.67	1,366.27	283.49	1,362.17	29.63	18,611.23	3,011.93	1,659.64	515.78	13,413.67	2,067.40	15,481.07	950.13	18,606.61	16,946.98	-13,905.41	-13,910.03
2001	16,905.68	1,366.27	428.29	1,434.40	33.98	20,168.62	3,228.96	1,292.43	512.82	15,108.61	2,320.53	17,429.14	934.45	20,168.84	18,876.41	-15,613.47	-15,613.25
2002	15,642.91	1,366.27	931.91	1,551.15	33.38	19,525.63	3,849.33	2,265.52	510.42	13,675.08	2,331.81	16,006.89	744.89	19,527.72	17,262.20	-13,379.49	-13,377.39
2003	15,308.80	1,370.01	10,614.50	1,655.06	35.78	28,984.15	13,639.57	10,928.22	509.89	14,373.88	2,454.67	16,828.55	719.22	28,985.88	18,057.66	-4,382.31	-4,380.58
2004	15,596.97	1,366.27	9,034.46	3,529.99	45.84	29,573.53	13,930.71	13,394.40	527.26	12,873.56	1,916.17	14,789.73	862.87	29,574.25	16,179.86	-2,203.30	-2,202.58
2005	16,951.16	1,366.27	2,563.05	1,820.33	34.10	22,734.91	5,749.64	3,423.90	529.56	15,473.65	2,359.42	17,833.08	946.16	22,732.70	19,308.81	-13,525.06	-13,527.26
2006	19,091.07	1,366.27	291.71	1,448.80	31.62	22,229.47	3,106.78	1,040.39	524.86	17,389.64	2,521.67	19,911.31	752.59	22,229.15	21,188.76	-18,050.35	-18,050.68
2007	17,754.85	1,370.01	1,228.89	1,239.57	35.87	21,629.19	3,838.48	2,579.28	522.74	15,650.88	2,316.60	17,967.48	562.38	21,631.88	19,052.60	-15,178.26	-15,175.57
2008	18,160.59	1,366.27	1,572.16	1,215.03	37.57	22,351.62	4,153.46	2,665.27	522.44	16,220.74	2,370.20	18,590.94	571.12	22,349.77	19,684.50	-15,493.47	-15,495.32
2009	17,393.45	1,366.27	234.31	1,378.10	35.75	20,407.88	2,978.68	1,868.07	520.48	15,179.83	2,377.39	17,557.21	487.48	20,433.23	18,565.17	-15,550.73	-15,525.38
2010	16,130.33	1,366.27	1,181.97	1,302.35	34.87	20,015.79	3,850.58	2,417.32	516.93	14,400.91	2,294.19	16,695.10	424.42	20,053.78	17,636.46	-13,751.00	-13,713.01
2011	13,210.35	1,370.01	6,492.76	1,919.11	35.17	23,027.41	9,781.88	7,214.16	528.96	12,638.51	2,126.67	14,765.18	494.37	23,002.67	15,788.51	-5,971.46	-5,996.20
2012	14,318.19	1,366.27	1,947.54	1,801.13	29.37	19,462.48	5,114.93	2,682.44	524.77	13,544.96	2,246.37	15,791.33	488.45	19,486.99	16,804.55	-11,660.26	-11,635.75
2013	14,970.90	1,366.27	1,617.06	1,542.79	29.50	19,526.52	4,526.12	1,596.00	522.11	14,584.80	2,380.29	16,965.08	464.46	19,547.65	17,951.66	-13,396.04	-13,374.90
2014	13,948.97	1,366.27	2,312.90	1,594.99	35.10	19,258.23	5,274.16	2,819.32	520.15	13,388.54	2,166.69	15,555.23	364.41	19,259.11	16,439.79	-11,130.52	-11,129.64
2015	14,067.64	1,370.01	1,768.14	1,603.61	29.27	18,838.67	4,741.76	3,184.87	522.85	12,634.53	2,124.42	14,758.95	373.53	18,840.20	15,655.32	-10,884.29	-10,882.77
MIN (2010 - 2015)	13,210	1,366	1,182	1,302	29	18,839	3,851	1,596	517	12,635	2,124	14,759	364	18,840	15,655	-11,760.44	-11,614.36
MAX (2010 - 2015)	16,130	1,370	6,493	1,919	35	23,027	9,782	7,214	529	14,585	2,380	16,965	494	23,003	17,952	-8,171.36	-8,916.18
AVG (2010 - 2015)	14,441	1,368	2,553	1,627	32	20,022	5,548	3,319	523	13,532	2,223	15,755	435	20,032	16,713	-11,132.26	-11,122.05
STDEV (2010 - 2015)	1,005	2	1,966	214	3	1,521	2,134	1,981	4	835	102	934	57	1,508	943	1,186.39	976.70

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
7/21/1965	145.59	144.07	-1.52	5E25R010008
7/21/1965	145.04	144.02	-1.02	5E36A010009
4/27/1987	142.49	142.86	0.37	5E36A010010
7/27/1987	142.26	142.77	0.51	5E36A010011
11/19/1987	142.00	142.37	0.37	5E36A010012
1/20/1988	141.90	142.22	0.32	5E36A010013
4/1/1988	141.77	142.04	0.27	5E36A010014
6/8/1988	141.63	141.92	0.29	5E36A010015
10/25/1988	141.24	141.55	0.31	5E36A010016
8/8/1989	140.61	140.82	0.21	5E36A010017
10/26/1989	140.42	140.64	0.21	5E36A010018
2/6/1990	140.21	140.82	0.61	5E36A010019
9/1/1990	141.06	139.75	-1.31	5E36A010020
1/14/1991	140.66	140.27	-0.39	5E36A010021
2/19/1991	140.52	140.27	-0.25	5E36A010022
3/5/1991	140.48	140.27	-0.21	5E36A010023
3/19/1991	140.43	140.24	-0.19	5E36A010024
4/11/1991	140.37	140.24	-0.13	5E36A010025
5/9/1991	140.29	139.48	-0.81	5E36A010026
5/30/1991	140.24	139.51	-0.73	5E36A010027
7/23/1991	140.69	139.36	-1.34	5E36A010028
1/7/1992	140.52	139.26	-1.26	5E36A010029
3/12/1992	140.29	139.33	-0.97	5E36A010030
5/12/1992	140.37	139.11	-1.26	5E36A010031
7/7/1992	142.37	139.02	-3.35	5E36A010032
9/2/1992	142.62	138.87	-3.75	5E36A010033
10/13/1992	142.39	138.87	-3.53	5E36A010034
12/8/1992	142.06	138.69	-3.37	5E36A010035
1/12/1993	141.94	138.93	-3.01	5E36A010036
2/3/1993	142.03	139.02	-3.01	5E36A010037
2/12/1993	142.04	139.08	-2.96	5E36A010038
2/24/1993	142.03	139.17	-2.85	5E36A010039
3/11/1993	141.98	139.26	-2.71	5E36A010040
3/27/1993	141.91	139.39	-2.52	5E36A010041
4/16/1993	141.83	139.36	-2.47	5E36A010042
5/11/1993	141.72	139.42	-2.30	5E36A010043
7/2/1993	141.49	139.30	-2.19	5E36A010044
8/19/1993	141.28	139.23	-2.05	5E36A010045
10/20/1993	141.03	139.08	-1.95	5E36A010046
12/24/1993	140.79	139.08	-1.71	5E36A010047
2/11/1994	140.63	139.02	-1.61	5E36A010048
3/25/1994	140.51	139.26	-1.25	5E36A010049
5/25/1994	140.94	139.36	-1.58	5E36A010050
8/24/1994	142.13	138.84	-3.29	5E36A010051
10/6/1994	142.01	138.66	-3.35	5E36A010052
12/21/1994	141.57	138.44	-3.13	5E36A010053
2/24/1995	141.24	138.38	-2.86	5E36A010054
4/4/1995	141.07	138.56	-2.51	5E36A010055

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
6/21/1995	140.75	138.53	-2.21	5E36A010056
10/2/1995	140.31	138.20	-2.11	5E36A010057
12/28/1995	139.95	137.86	-2.09	5E36A010058
4/11/1996	139.59	137.53	-2.06	5E36A010059
8/9/1996	139.17	137.16	-2.01	5E36A010060
10/23/1996	138.88	136.67	-2.20	5E36A010061
1/3/1997	138.60	136.67	-1.93	5E36A010062
9/3/1997	139.12	135.79	-3.33	5E36A010063
12/3/1997	138.88	135.64	-3.24	5E36A010064
5/13/1998	138.27	135.30	-2.97	5E36A010065
11/12/1998	137.60	135.09	-2.51	5E36A010066
3/12/1999	137.20	135.09	-2.11	5E36A010067
5/17/1999	137.02	134.24	-2.78	5E36A010068
11/22/1999	136.48	133.38	-3.10	5E36A010069
3/24/2000	136.15	133.14	-3.01	5E36A010070
6/29/2000	135.92	132.71	-3.21	5E36A010071
12/18/2000	135.45	132.10	-3.35	5E36A010072
11/14/2001	134.65	130.76	-3.89	5E36A010073
2/22/2002	134.40	130.49	-3.91	5E36A010074
8/30/2002	133.95	129.88	-4.07	5E36A010075
12/13/2002	133.66	129.48	-4.18	5E36A010076
3/17/2003	133.42	129.45	-3.97	5E36A010077
6/30/2003	133.18	128.93	-4.25	5E36A010078
10/6/2003	132.96	128.57	-4.40	5E36A010079
12/29/2003	132.76	128.20	-4.56	5E36A010080
2/12/2004	132.65	128.17	-4.48	5E36A010081
4/8/2004	132.55	128.14	-4.41	5E36A010082
7/23/2004	134.47	127.74	-6.73	5E36A010083
8/23/2005	133.46	127.74	-5.72	5E36A010084
1/5/2006	133.09	127.68	-5.41	5E36A010085
6/14/2006	132.60	129.11	-3.49	5E36A010086
2/24/1993	139.54	137.45	-2.09	6E04Q010087
6/25/1998	130.43	145.68	15.25	6E04Q010088
4/10/2005	125.43	123.74	-1.69	6E04Q010089
2/23/2006	123.62	122.53	-1.09	6E04Q010090
5/12/2008	119.40	118.22	-1.18	6E04Q010091
12/1/2008	118.12	118.08	-0.04	6E04Q010092
12/2/2008	118.14	118.22	0.08	6E04Q010093
10/1/1951	158.23	161.84	3.61	6E05F010094
12/4/2008	118.69	122.31	3.63	6E05F010095
11/28/1955	149.19	150.99	1.79	6E08B010096
11/16/1956	147.78	151.70	3.91	6E08B010097
11/16/1956	147.78	138.26	-9.53	6E08B010098
11/26/1957	147.02	150.98	3.96	6E08B010099
3/15/1958	147.30	150.95	3.66	6E08B010100

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
11/5/1958	145.92	144.76	-1.16	6E08B010101
11/24/1959	144.60	148.64	4.04	6E08B010102
2/27/1960	144.90	149.08	4.19	6E08B010103
11/22/1960	143.51	148.36	4.85	6E08B010104
3/8/1961	143.54	148.11	4.58	6E08B010105
10/26/1961	142.20	147.15	4.94	6E08B010106
3/15/1962	142.46	142.10	-0.36	6E08B010107
11/2/1962	141.13	143.05	1.92	6E08B010108
3/15/1963	141.30	146.39	5.08	6E08B010109
10/31/1963	140.42	143.04	2.62	6E08B010110
3/20/1964	140.63	144.42	3.79	6E08B010111
11/12/1964	139.55	145.24	5.69	6E08B010112
3/19/1965	139.81	145.74	5.94	6E08B010113
7/23/1965	140.61	144.81	4.20	6E08B010114
10/26/1965	140.68	144.79	4.10	6E08B010115
3/3/1966	141.28	144.78	3.49	6E08B010116
10/26/1966	142.55	144.57	2.01	6E08B010117
3/23/1967	142.35	144.63	2.28	6E08B010118
10/24/1967	142.02	144.57	2.56	6E08B010119
3/13/1968	141.60	144.82	3.23	6E08B010120
11/8/1968	143.92	144.56	0.65	6E08B010121
3/27/1969	143.86	145.13	1.27	6E08B010122
10/28/1969	142.87	145.09	2.22	6E08B010123
3/23/1970	142.71	145.33	2.63	6E08B010124
11/12/1970	141.91	145.17	3.26	6E08B010125
3/30/1971	141.77	145.32	3.56	6E08B010126
12/5/2008	117.90	122.52	4.62	6E08F010127
3/12/2009	118.29	122.52	4.23	6E08F010128
3/25/2010	116.71	121.31	4.60	6E08F010129
11/18/2010	114.98	120.54	5.56	6E08F010130
12/2/2008	117.95	116.81	-1.15	6E09C010129
7/26/1965	140.59	141.92	1.33	6E09L010130
5/26/1983	142.61	140.51	-2.09	6E09L010131
9/30/1983	142.39	140.39	-2.00	6E09L010132
12/11/1983	142.27	140.51	-1.76	6E09L010133
4/6/1984	142.02	140.73	-1.30	6E09L010134
7/19/1984	141.53	140.27	-1.26	6E09L010135
2/18/1985	141.16	140.82	-0.35	6E09L010136
5/26/1985	140.86	140.58	-0.29	6E09L010137
1/20/1986	140.38	140.36	-0.02	6E09L010138
4/22/1986	140.30	140.06	-0.25	6E09L010139
9/11/1986	139.65	139.42	-0.23	6E09L010140
12/8/1986	139.51	139.78	0.27	6E09L010141
4/27/1987	139.30	139.75	0.46	6E09L010142
7/27/1987	138.84	139.42	0.58	6E09L010143

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
11/15/1987	138.59	139.54	0.95	6E09L010144
1/20/1988	138.62	139.78	1.17	6E09L010145
4/1/1988	138.47	139.63	1.16	6E09L010146
6/8/1988	138.12	139.42	1.30	6E09L010147
10/25/1988	137.39	138.93	1.54	6E09L010148
2/3/1989	137.36	139.14	1.79	6E09L010149
8/8/1989	136.51	138.47	1.96	6E09L010150
10/26/1989	136.22	138.23	2.01	6E09L010151
2/6/1990	136.16	139.23	3.07	6E09L010152
9/1/1990	137.35	137.53	0.18	6E09L010153
1/14/1991	136.76	138.20	1.43	6E09L010154
2/19/1991	136.75	138.26	1.51	6E09L010155
3/5/1991	136.76	138.44	1.68	6E09L010156
3/19/1991	136.73	138.47	1.75	6E09L010157
4/11/1991	136.60	138.38	1.78	6E09L010158
5/9/1991	136.35	138.17	1.82	6E09L010159
5/30/1991	136.17	137.19	1.02	6E09L010160
7/23/1991	135.71	136.64	0.93	6E09L010161
10/31/1991	135.43	136.84	1.41	6E09L010162
1/7/1992	135.65	137.25	1.61	6E09L010163
3/12/1992	135.83	137.41	1.57	6E09L010164
5/12/1992	136.30	136.86	0.56	6E09L010165
7/7/1992	139.64	136.51	-3.13	6E09L010166
9/2/1992	139.03	136.06	-2.97	6E09L010167
10/13/1992	138.69	135.94	-2.75	6E09L010168
12/8/1992	138.47	136.43	-2.04	6E09L010169
1/21/1993	138.63	136.61	-2.01	6E09L010170
2/3/1993	138.70	136.52	-2.18	6E09L010171
2/12/1993	138.69	136.80	-1.89	6E09L010172
2/24/1993	138.67	136.70	-1.96	6E09L010173
3/11/1993	138.51	136.55	-1.96	6E09L010174
3/27/1993	138.31	136.43	-1.88	6E09L010175
4/16/1993	138.03	136.22	-1.81	6E09L010176
5/11/1993	137.68	136.06	-1.61	6E09L010177
7/2/1993	136.92	135.58	-1.34	6E09L010178
8/19/1993	136.29	135.12	-1.17	6E09L010179
10/20/1993	135.92	135.00	-0.92	6E09L010180
12/24/1993	135.93	135.24	-0.69	6E09L010181
2/11/1994	135.84	135.06	-0.78	6E09L010182
3/25/1994	135.67	135.03	-0.64	6E09L010183
5/25/1994	136.15	135.03	-1.12	6E09L010184
8/24/1994	135.14	133.99	-1.15	6E09L010185
10/6/1994	134.87	133.87	-1.00	6E09L010186
12/21/1994	134.99	134.21	-0.79	6E09L010187
2/24/1995	135.15	134.54	-0.61	6E09L010188
4/12/1995	134.89	134.33	-0.56	6E09L010189
6/21/1995	133.84	133.87	0.03	6E09L010190
10/2/1995	132.59	132.80	0.21	6E09L010191

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
12/26/1995	132.61	132.83	0.23	6E09L010192
4/11/1996	132.22	132.71	0.49	6E09L010193
8/9/1996	130.45	131.43	0.98	6E09L010194
10/23/1996	130.09	131.43	1.34	6E09L010195
1/3/1997	130.34	131.74	1.40	6E09L010196
9/3/1997	130.22	130.85	0.64	6E09L010197
12/3/1997	130.49	131.19	0.70	6E09L010198
5/13/1998	130.40	131.16	0.76	6E09L010199
11/12/1998	129.05	130.03	0.98	6E09L010200
3/12/1999	129.12	129.88	0.76	6E09L010201
5/17/1999	128.63	130.09	1.46	6E09L010202
11/22/1999	127.53	128.47	0.94	6E09L010203
2/17/2000	127.71	129.63	1.93	6E09L010204
3/24/2000	127.66	129.05	1.40	6E09L010205
6/29/2000	126.58	128.02	1.44	6E09L010206
9/15/2000	126.04	127.77	1.73	6E09L010207
12/18/2000	126.27	128.05	1.78	6E09L010208
10/17/2001	124.89	126.98	2.09	6E09L010209
11/14/2001	124.99	127.23	2.24	6E09L010210
2/22/2002	125.17	127.65	2.48	6E09L010211
8/30/2002	123.41	125.12	1.71	6E09L010212
9/27/2002	123.42	125.15	1.73	6E09L010213
12/13/2002	123.79	125.70	1.91	6E09L010214
3/17/2003	124.09	126.49	2.40	6E09L010215
6/30/2003	123.00	124.60	1.60	6E09L010216
12/29/2003	122.97	124.97	2.00	6E09L010217
2/12/2004	123.11	125.46	2.35	6E09L010218
4/8/2004	122.92	124.63	1.72	6E09L010219
11/18/2004	124.41	124.15	-0.27	6E09L010220
2/10/2005	125.18	124.85	-0.33	6E09L010221
1/5/2006	123.33	123.60	0.26	6E09L010222
	140.31	134.49	-5.82	6E09N010223
2/12/2004	124.50	127.38	2.88	6E10L010224
2/10/2005	125.93	126.77	0.84	6E10L010225
1/5/2006	124.39	129.66	5.28	6E10L010226
8/23/1980	143.33	148.15	4.81	6E10M010227
2/12/2004	124.21	131.22	7.01	6E10M010228
2/10/2005	125.83	134.33	8.50	6E10M010229
5/5/2005	125.33	130.77	5.43	6E10M010230
8/24/2005	124.09	130.40	6.31	6E10M010231
1/5/2006	124.14	129.85	5.71	6E10M010232
5/15/2009	119.20	122.61	3.41	6E17J010235
6/30/1987	138.54	140.96	2.42	6E18J010236

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
6/30/1991	135.31	138.52	3.21	6E18J010237
6/30/1993	136.04	136.08	0.04	6E18J010238
6/30/1995	134.09	135.29	1.20	6E18J010239
6/30/1997	130.49	133.22	2.73	6E18J010240
6/2/1998	130.71	132.03	1.32	6E18J010241
6/29/1999	128.76	130.93	2.17	6E18J010242
6/5/2000	127.71	129.74	2.03	6E18J010243
6/8/2001	126.65	128.98	2.33	6E18J010244
7/29/2002	124.77	128.22	3.45	6E18J010245
7/31/2003	123.81	126.66	2.86	6E18J010246
2/10/2004	123.64	122.95	-0.69	6E18J010247
2/12/2005	125.18	125.81	0.63	6E18J010248
3/3/2006	123.78	124.68	0.91	6E18J010249
5/21/2006	123.42	120.96	-2.46	6E18J010250
3/8/2007	122.15	123.01	0.85	6E18J010251
12/1/2008	119.48	121.47	1.98	6E18J010252
12/3/2008	119.50	122.29	2.79	6E18J010253
3/25/2010	118.48	122.37	3.89	6E18J010254
10/12/2010	117.14	121.48	4.34	6E18J010255
4/9/2013	115.06	119.96	4.90	6E18J010256
10/18/2013	114.12	119.62	5.50	6E18J010257
3/28/2014	114.07	119.96	5.89	6E18J010258
3/10/2015	113.09	118.92	5.83	6E18J010259
10/12/2015	112.13	116.82	4.69	6E18J010260
3/23/2016	112.42	116.12	3.70	6E18J010261
6/30/1980	142.69	144.68	1.99	6E18R010254
6/30/1987	138.40	140.72	2.32	6E18R010255
6/30/1991	135.33	138.28	2.95	6E18R010256
6/30/1993	136.02	134.62	-1.40	6E18R010257
6/30/1995	134.26	134.95	0.69	6E18R010258
6/30/1997	131.16	133.86	2.70	6E18R010259
6/2/1998	130.91	131.88	0.97	6E18R010260
6/29/1999	129.60	130.96	1.36	6E18R010261
6/5/2000	128.30	132.82	4.52	6E18R010262
7/31/2003	124.55	128.10	3.55	6E18R010263
5/13/2005	125.21	124.87	-0.34	6E18R010264
3/3/2006	124.23	124.62	0.39	6E18R010265
5/21/2006	123.87	116.91	-6.96	6E18R010266
3/8/2007	122.84	122.88	0.04	6E18R010267
12/1/2008	120.74	121.93	1.20	6E18R010268
12/3/2008	120.75	122.64	1.89	6E18R010269
5/14/2009	120.67	123.24	2.57	6E18R010270
3/25/2010	119.72	122.86	3.14	6E18R010271
11/18/2010	118.44	122.13	3.69	6E18R010272
11/14/2012	116.36	120.98	4.62	6E18R010273
4/9/2013	116.30	120.88	4.58	6E18R010274
11/13/2013	115.37	120.26	4.89	6E18R010275

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
11/25/2013	115.39	120.26	4.87	6E18R010276
2/5/2014	115.44	120.10	4.66	6E18R010277
4/9/2014	115.25	120.00	4.75	6E18R010278
6/3/2014	114.90	119.77	4.87	6E18R010279
4/15/2015	114.21	119.05	4.84	6E18R010280
11/19/2015	113.33	118.02	4.69	6E18R010281
4/12/2016	113.44	117.74	4.30	6E18R010282
7/27/1987	138.41	140.73	2.32	6E20L010271
11/19/1987	138.23	140.54	2.31	6E20L010272
1/20/1988	138.26	141.06	2.81	6E20L010273
4/1/1988	138.15	140.30	2.15	6E20L010274
6/8/1988	137.87	140.33	2.46	6E20L010275
10/25/1988	137.31	140.24	2.93	6E20L010276
2/3/1989	137.26	140.30	3.04	6E20L010277
8/8/1989	136.66	139.69	3.04	6E20L010278
10/26/1989	136.46	139.63	3.17	6E20L010279
2/6/1990	136.40	139.57	3.17	6E20L010280
9/1/1990	135.84	139.23	3.39	6E20L010281
1/14/1991	135.94	139.84	3.90	6E20L010282
2/19/1991	136.06	139.78	3.73	6E20L010283
3/5/1991	136.09	139.87	3.79	6E20L010284
3/19/1991	136.09	139.81	3.73	6E20L010285
4/11/1991	136.07	139.72	3.65	6E20L010286
5/30/1991	135.95	138.87	2.92	6E20L010287
7/23/1991	135.80	137.53	1.73	6E20L010288
10/31/1991	135.68	137.44	1.76	6E20L010289
1/7/1992	135.75	138.11	2.36	6E20L010290
3/12/1992	135.83	138.41	2.59	6E20L010291
5/12/1992	135.72	137.53	1.81	6E20L010292
7/7/1992	135.75	137.04	1.29	6E20L010293
9/2/1992	135.79	137.01	1.22	6E20L010294
12/8/1992	136.16	137.47	1.31	6E20L010295
1/21/1993	136.43	138.02	1.58	6E20L010296
2/3/1993	136.52	138.02	1.49	6E20L010297
2/12/1993	136.56	138.08	1.52	6E20L010298
2/24/1993	136.62	138.11	1.49	6E20L010299
3/11/1993	136.65	138.02	1.37	6E20L010300
3/27/1993	136.67	137.83	1.17	6E20L010301
4/16/1993	136.67	137.50	0.83	6E20L010302
5/11/1993	136.65	137.19	0.54	6E20L010303
7/2/1993	136.52	136.98	0.46	6E20L010304
8/19/1993	136.35	136.89	0.54	6E20L010305
10/20/1993	136.21	136.95	0.74	6E20L010306
12/24/1993	136.17	137.19	1.02	6E20L010307
2/11/1994	136.15	137.34	1.19	6E20L010308
3/25/1994	136.11	137.71	1.60	6E20L010309
5/25/1994	135.92	137.10	1.18	6E20L010310

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
8/24/1994	135.67	136.67	1.01	6E20L010311
10/6/1994	135.60	136.64	1.04	6E20L010312
12/21/1994	135.61	136.67	1.07	6E20L010313
2/24/1995	135.66	137.01	1.35	6E20L010314
4/12/1995	135.60	136.70	1.10	6E20L010315
6/21/1995	135.29	136.16	0.86	6E20L010316
10/2/1995	134.74	135.94	1.20	6E20L010317
12/25/1995	134.53	136.06	1.53	6E20L010318
4/11/1996	134.26	135.82	1.56	6E20L010319
8/9/1996	133.52	134.97	1.45	6E20L010320
10/23/1996	133.16	134.94	1.78	6E20L010321
1/3/1997	132.99	135.09	2.10	6E20L010322
5/9/1997	132.60	134.48	1.87	6E20L010323
9/3/1997	132.16	134.05	1.89	6E20L010324
12/3/1997	132.21	134.24	2.02	6E20L010325
5/13/1998	132.20	133.93	1.73	6E20L010326
11/12/1998	131.61	133.23	1.62	6E20L010327
3/12/1999	131.45	133.17	1.72	6E20L010328
5/17/1999	131.24	132.74	1.50	6E20L010329
11/22/1999	130.54	131.98	1.44	6E20L010330
2/17/2000	130.40	131.98	1.58	6E20L010331
3/24/2000	130.33	132.01	1.68	6E20L010332
6/29/2000	129.89	131.16	1.26	6E20L010333
9/15/2000	129.56	131.25	1.69	6E20L010334
12/18/2000	129.39	131.04	1.64	6E20L010335
5/17/2001	129.12	130.88	1.76	6E20L010336
10/17/2001	128.49	130.67	2.18	6E20L010337
11/14/2001	128.44	129.48	1.04	6E20L010338
2/22/2002	128.30	129.88	1.58	6E20L010339
8/30/2002	127.50	128.63	1.13	6E20L010340
12/13/2002	127.31	128.66	1.34	6E20L010341
3/17/2003	127.21	128.78	1.57	6E20L010342
6/30/2003	126.80	128.05	1.25	6E20L010343
10/6/2003	126.42	127.93	1.51	6E20L010344
12/29/2003	126.31	127.83	1.53	6E20L010345
2/12/2004	126.27	127.80	1.54	6E20L010346
7/23/2004	125.91	126.80	0.89	6E20L010347
2/10/2005	126.38	127.35	0.97	6E20L010348
8/23/2005	125.93	126.34	0.41	6E20L010349
1/5/2006	125.74	126.34	0.60	6E20L010350
6/14/2006	125.28	125.46	0.18	6E20L010351
1/10/2007	124.53	125.09	0.57	6E20L010352
6/4/2007	123.97	123.60	-0.37	6E20L010353
9/21/2007	123.39	122.47	-0.92	6E20L010354
1/8/2008	123.18	122.44	-0.74	6E20L010355
5/8/2008	122.84	122.32	-0.53	6E20L010356
8/12/2008	122.36	122.32	-0.05	6E20L010357
12/1/2008	122.06	122.73	0.67	6E20L010358

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
12/3/2008	122.06	123.08	1.02	6E20L010359
4/15/2009	121.87	123.13	1.27	6E20L010360
2/5/2014	116.63	119.77	3.14	6E20L010361
6/24/1952	150.88	153.37	2.48	6E21A010361
1/3/1953	150.70	155.14	4.44	6E21A010362
5/1/1953	150.33	152.56	2.23	6E21A010363
5/15/1953	150.20	152.25	2.05	6E21A010364
5/28/1953	150.09	152.03	1.94	6E21A010365
6/11/1953	149.96	151.83	1.86	6E21A010366
6/25/1953	149.83	151.62	1.78	6E21A010367
7/1/1953	149.78	148.42	-1.37	6E21A010368
7/3/1953	149.75	151.50	1.75	6E21A010369
7/11/1953	149.63	151.29	1.66	6E21A010370
7/25/1953	149.43	151.14	1.71	6E21A010371
8/3/1953	149.33	151.41	2.08	6E21A010372
8/5/1953	149.31	148.82	-0.49	6E21A010373
8/19/1953	149.23	150.39	1.16	6E21A010374
9/2/1953	149.15	151.36	2.21	6E21A010375
9/17/1953	149.14	151.45	2.31	6E21A010376
10/1/1953	149.13	151.81	2.68	6E21A010377
10/16/1953	149.17	151.96	2.79	6E21A010378
10/21/1953	149.18	149.60	0.42	6E21A010379
10/29/1953	149.20	152.28	3.09	6E21A010380
11/11/1953	149.23	152.47	3.24	6E21A010381
11/19/1953	149.24	150.03	0.79	6E21A010382
11/25/1953	149.26	152.70	3.44	6E21A010383
12/10/1953	149.29	152.92	3.63	6E21A010384
12/17/1953	149.31	150.27	0.97	6E21A010385
12/21/1953	149.31	152.93	3.61	6E21A010386
1/6/1954	149.36	152.74	3.38	6E21A010387
1/7/1954	149.36	152.72	3.36	6E21A010388
1/21/1954	149.42	152.40	2.98	6E21A010389
2/3/1954	149.46	152.55	3.09	6E21A010390
2/18/1954	149.46	150.95	1.50	6E21A010391
2/24/1954	149.46	152.62	3.17	6E21A010392
3/4/1954	149.45	152.26	2.81	6E21A010393
3/17/1954	149.43	152.20	2.77	6E21A010394
4/2/1954	149.41	152.39	2.98	6E21A010395
4/15/1954	149.29	151.23	1.94	6E21A010396
5/17/1954	149.01	150.08	1.07	6E21A010397
5/28/1954	148.92	149.62	0.70	6E21A010398
8/13/1954	148.18	148.11	-0.07	6E21A010399
8/27/1954	148.08	148.08	0.00	6E21A010400
10/21/1954	148.05	149.60	1.55	6E21A010401
11/9/1954	148.09	149.76	1.67	6E21A010402
11/19/1954	148.13	150.03	1.90	6E21A010403
12/17/1954	148.18	150.27	2.10	6E21A010404

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
1/12/1955	148.23	150.49	2.26	6E21A010405
2/10/1955	148.29	149.66	1.37	6E21A010406
3/7/1955	148.25	149.30	1.05	6E21A010407
3/16/1955	148.20	149.39	1.20	6E21A010408
4/14/1955	148.02	147.32	-0.71	6E21A010409
5/19/1955	147.76	146.34	-1.42	6E21A010410
6/29/1955	147.42	145.73	-1.69	6E21A010411
7/20/1955	147.18	145.92	-1.26	6E21A010412
8/3/1955	147.04	146.10	-0.94	6E21A010413
9/20/1955	146.85	146.80	-0.05	6E21A010414
10/25/1955	146.85	149.18	2.32	6E21A010415
11/28/1955	146.89	150.09	3.20	6E21A010416
11/29/1955	146.89	150.12	3.23	6E21A010417
1/4/1956	146.97	150.73	3.76	6E21A010418
2/7/1956	147.00	149.76	2.76	6E21A010419
3/8/1956	146.95	148.84	1.89	6E21A010420
3/18/1956	146.89	148.23	1.34	6E21A010421
4/4/1956	146.80	148.51	1.71	6E21A010422
5/3/1956	146.61	146.83	0.22	6E21A010423
6/6/1956	146.32	145.82	-0.49	6E21A010424
7/2/1956	146.09	145.67	-0.43	6E21A010425
8/2/1956	145.71	145.55	-0.16	6E21A010426
9/4/1956	145.51	146.74	1.23	6E21A010427
10/3/1956	145.49	148.20	2.71	6E21A010428
11/1/1956	145.55	148.84	3.29	6E21A010429
11/16/1956	145.58	149.21	3.63	6E21A010430
12/3/1956	145.61	149.51	3.90	6E21A010431
1/3/1957	145.68	149.91	4.23	6E21A010432
2/4/1957	145.80	149.39	3.59	6E21A010433
3/1/1957	145.80	149.63	3.84	6E21A010434
3/15/1957	145.72	147.87	2.15	6E21A010435
3/27/1957	145.67	147.29	1.62	6E21A010436
4/25/1957	145.48	145.70	0.22	6E21A010437
5/27/1957	145.25	145.34	0.09	6E21A010438
6/26/1957	144.99	144.24	-0.76	6E21A010439
7/24/1957	144.65	143.75	-0.90	6E21A010440
8/22/1957	144.42	143.75	-0.67	6E21A010441
9/3/1957	144.35	151.10	6.75	6E21A010442
9/26/1957	144.36	146.04	1.68	6E21A010443
11/6/1957	144.51	147.50	2.99	6E21A010444
11/26/1957	144.56	147.98	3.42	6E21A010445
12/11/1957	144.60	148.29	3.69	6E21A010446
1/7/1958	144.68	148.57	3.89	6E21A010447
2/11/1958	144.78	148.14	3.36	6E21A010448
3/15/1958	144.84	148.62	3.78	6E21A010449
4/21/1958	144.74	145.70	0.96	6E21A010450
5/5/1958	144.66	145.55	0.89	6E21A010451
6/23/1958	144.28	143.78	-0.50	6E21A010452

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
7/23/1958	143.99	143.54	-0.45	6E21A010453
8/14/1958	143.81	143.26	-0.55	6E21A010454
9/23/1958	143.67	143.11	-0.56	6E21A010455
10/20/1958	143.70	145.64	1.94	6E21A010456
11/5/1958	143.72	146.21	2.49	6E21A010457
11/12/1958	143.73	146.13	2.40	6E21A010458
12/3/1958	143.76	145.55	1.79	6E21A010459
1/5/1959	143.82	147.10	3.28	6E21A010460
1/26/1959	143.87	146.49	2.62	6E21A010461
2/18/1959	143.95	146.28	2.34	6E21A010462
3/12/1959	143.93	147.29	3.36	6E21A010463
3/19/1959	143.89	147.26	3.36	6E21A010464
4/16/1959	143.77	146.25	2.48	6E21A010465
5/12/1959	143.64	144.60	0.97	6E21A010466
6/11/1959	143.46	144.00	0.53	6E21A010467
7/28/1959	143.09	144.09	1.00	6E21A010468
8/11/1959	143.01	143.05	0.04	6E21A010469
9/8/1959	142.90	141.89	-1.01	6E21A010470
10/6/1959	142.88	144.97	2.09	6E21A010471
11/10/1959	142.94	145.76	2.83	6E21A010472
11/24/1959	142.95	145.76	2.81	6E21A010473
12/10/1959	142.99	145.76	2.77	6E21A010474
12/29/1959	143.05	146.25	3.20	6E21A010475
1/13/1960	143.09	145.70	2.61	6E21A010476
2/11/1960	143.15	144.85	1.69	6E21A010477
2/27/1960	143.18	145.13	1.96	6E21A010478
3/8/1960	143.15	146.37	3.23	6E21A010479
3/23/1960	143.08	146.22	3.14	6E21A010480
4/4/1960	143.04	144.76	1.72	6E21A010481
4/21/1960	142.95	143.81	0.86	6E21A010482
5/2/1960	142.90	142.38	-0.52	6E21A010483
5/17/1960	142.81	142.59	-0.21	6E21A010484
6/2/1960	142.71	142.84	0.12	6E21A010485
6/16/1960	142.62	141.83	-0.79	6E21A010486
6/30/1960	142.54	142.20	-0.34	6E21A010487
7/14/1960	142.40	142.23	-0.17	6E21A010488
8/11/1960	142.18	142.59	0.41	6E21A010489
9/19/1960	142.07	143.63	1.56	6E21A010490
10/21/1960	142.07	144.12	2.05	6E21A010491
11/17/1960	142.11	144.48	2.37	6E21A010492
11/22/1960	142.12	144.53	2.41	6E21A010493
12/16/1960	142.15	145.06	2.92	6E21A010494
1/16/1961	142.18	144.88	2.70	6E21A010495
2/14/1961	142.20	143.60	1.40	6E21A010496
3/8/1961	142.17	143.78	1.61	6E21A010497
3/13/1961	142.15	144.94	2.79	6E21A010498
5/5/1961	141.90	141.62	-0.29	6E21A010499
5/29/1961	141.77	141.62	-0.15	6E21A010500

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
6/28/1961	141.58	140.73	-0.84	6E21A010501
8/20/1961	141.17	137.35	-3.82	6E21A010502
10/8/1961	141.09	143.05	1.96	6E21A010503
10/26/1961	141.10	143.43	2.33	6E21A010504
11/30/1961	141.12	143.02	1.90	6E21A010505
12/28/1961	141.19	143.14	1.95	6E21A010506
1/30/1962	141.25	141.83	0.58	6E21A010507
3/6/1962	141.28	144.18	2.90	6E21A010508
3/15/1962	141.24	144.12	2.88	6E21A010509
4/6/1962	141.16	141.74	0.58	6E21A010510
6/28/1962	140.68	140.58	-0.10	6E21A010511
7/25/1962	140.43	140.34	-0.09	6E21A010512
8/23/1962	140.24	140.31	0.07	6E21A010513
9/25/1962	140.16	141.53	1.36	6E21A010514
10/22/1962	140.18	142.90	2.72	6E21A010515
11/2/1962	140.18	143.26	3.07	6E21A010516
1/10/1963	140.28	142.62	2.34	6E21A010517
2/12/1963	140.32	141.82	1.50	6E21A010518
3/11/1963	140.30	143.81	3.51	6E21A010519
3/15/1963	140.29	144.07	3.78	6E21A010520
4/10/1963	140.20	142.29	2.09	6E21A010521
5/7/1963	140.07	141.17	1.10	6E21A010522
6/18/1963	139.81	140.49	0.68	6E21A010523
7/2/1963	139.73	139.97	0.24	6E21A010524
7/9/1963	139.66	140.12	0.47	6E21A010525
7/15/1963	139.59	140.15	0.56	6E21A010526
7/16/1963	139.58	140.28	0.69	6E21A010527
8/1/1963	139.44	139.97	0.54	6E21A010528
8/8/1963	139.42	140.18	0.76	6E21A010529
8/15/1963	139.40	139.70	0.29	6E21A010530
9/1/1963	139.35	140.00	0.65	6E21A010531
9/4/1963	139.35	140.31	0.96	6E21A010532
9/16/1963	139.38	141.22	1.84	6E21A010533
10/3/1963	139.40	142.01	2.61	6E21A010534
10/8/1963	139.43	142.26	2.82	6E21A010535
10/15/1963	139.48	142.01	2.54	6E21A010536
10/31/1963	139.56	143.47	3.91	6E21A010537
11/1/1963	139.56	142.65	3.09	6E21A010538
11/12/1963	139.59	142.93	3.34	6E21A010539
11/15/1963	139.59	142.87	3.28	6E21A010540
12/1/1963	139.62	143.14	3.52	6E21A010541
12/5/1963	139.63	143.37	3.74	6E21A010542
12/15/1963	139.64	145.15	5.51	6E21A010543
1/2/1964	139.67	143.17	3.50	6E21A010544
1/6/1964	139.68	142.74	3.07	6E21A010545
1/15/1964	139.69	142.93	3.23	6E21A010546
2/1/1964	139.72	142.01	2.29	6E21A010547
2/5/1964	139.72	142.00	2.28	6E21A010548

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
2/18/1964	139.73	140.83	1.09	6E21A010549
3/1/1964	139.74	143.08	3.34	6E21A010550
3/9/1964	139.72	143.31	3.59	6E21A010551
3/15/1964	139.71	143.17	3.46	6E21A010552
3/20/1964	139.70	144.02	4.32	6E21A010553
4/1/1964	139.67	141.07	1.40	6E21A010554
4/3/1964	139.66	141.07	1.41	6E21A010555
4/15/1964	139.60	141.71	2.11	6E21A010556
5/1/1964	139.53	140.64	1.12	6E21A010557
5/8/1964	139.48	140.37	0.88	6E21A010558
5/11/1964	139.47	141.34	1.88	6E21A010559
5/15/1964	139.44	140.06	0.62	6E21A010560
6/1/1964	139.35	139.73	0.38	6E21A010561
6/3/1964	139.34	139.61	0.27	6E21A010562
6/15/1964	139.27	139.42	0.16	6E21A010563
6/30/1964	139.18	139.15	-0.03	6E21A010564
7/7/1964	139.12	140.25	1.13	6E21A010565
7/23/1964	138.96	139.48	0.52	6E21A010566
8/5/1964	138.86	139.48	0.61	6E21A010567
9/11/1964	138.73	140.58	1.85	6E21A010568
9/30/1964	138.72	141.51	2.79	6E21A010569
11/2/1964	138.76	142.54	3.78	6E21A010570
12/1/1964	138.87	143.14	4.27	6E21A010571
1/6/1965	138.89	143.18	4.29	6E21A010572
2/1/1965	138.92	142.72	3.80	6E21A010573
3/3/1965	138.93	143.40	4.47	6E21A010574
3/16/1965	138.97	141.80	2.84	6E21A010575
4/5/1965	139.15	143.47	4.33	6E21A010576
5/5/1965	139.37	140.93	1.56	6E21A010577
5/24/1965	139.38	141.71	2.33	6E21A010578
6/29/1965	139.30	141.48	2.18	6E21A010579
7/7/1965	139.25	141.72	2.47	6E21A010580
7/20/1965	139.15	140.28	1.12	6E21A010581
7/22/1965	139.14	138.39	-0.75	6E21A010582
8/3/1965	139.06	140.89	1.82	6E21A010583
10/4/1965	138.94	142.66	3.72	6E21A010584
10/25/1965	138.96	142.72	3.76	6E21A010585
10/26/1965	138.96	142.82	3.87	6E21A010586
11/5/1965	138.98	143.00	4.02	6E21A010587
12/10/1965	139.14	143.18	4.03	6E21A010588
1/4/1966	139.23	143.00	3.77	6E21A010589
2/1/1966	139.31	143.00	3.68	6E21A010590
3/3/1966	139.38	142.93	3.55	6E21A010591
3/10/1966	139.40	142.94	3.55	6E21A010592
4/5/1966	139.46	142.32	2.86	6E21A010593
5/3/1966	139.66	142.39	2.73	6E21A010594
6/2/1966	139.94	141.13	1.19	6E21A010595
7/6/1966	140.12	142.32	2.20	6E21A010596

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
8/1/1966	140.18	142.67	2.49	6E21A010597
9/7/1966	140.21	142.82	2.61	6E21A010598
10/5/1966	140.22	143.11	2.90	6E21A010599
10/26/1966	140.22	143.32	3.11	6E21A010600
1/13/1967	140.23	143.72	3.49	6E21A010601
2/13/1967	140.24	143.84	3.60	6E21A010602
3/7/1967	140.24	143.75	3.51	6E21A010603
3/23/1967	140.24	143.87	3.64	6E21A010604
4/24/1967	140.23	143.78	3.55	6E21A010605
8/17/1967	140.14	143.45	3.30	6E21A010606
10/13/1967	140.10	143.78	3.68	6E21A010607
3/13/1968	140.07	144.33	4.26	6E21A010608
6/27/1968	141.15	144.12	2.96	6E21A010609
11/8/1968	142.08	144.15	2.07	6E21A010610
3/26/1969	141.76	144.39	2.63	6E21A010611
3/27/1969	141.76	144.60	2.85	6E21A010612
10/3/1969	141.32	144.48	3.16	6E21A010613
10/28/1969	141.27	144.79	3.51	6E21A010614
1/29/1970	141.14	144.45	3.32	6E21A010615
3/23/1970	141.07	144.76	3.68	6E21A010616
4/3/1970	141.06	144.51	3.45	6E21A010617
8/6/1970	140.89	144.42	3.54	6E21A010618
11/10/1970	140.74	144.48	3.74	6E21A010619
3/30/1971	140.61	144.60	3.99	6E21A010620
5/19/1971	140.56	144.54	3.99	6E21A010621
9/1/1971	140.41	144.48	4.07	6E21A010622
3/1/1972	140.22	144.42	4.20	6E21A010623
6/15/1972	140.11	144.33	4.22	6E21A010624
9/7/1972	139.99	144.18	4.19	6E21A010625
12/20/1972	139.90	144.21	4.30	6E21A010626
3/16/1973	139.89	144.24	4.35	6E21A010627
6/21/1973	139.86	143.66	3.80	6E21A010628
9/25/1973	139.78	143.90	4.13	6E21A010629
12/14/1973	139.72	143.90	4.18	6E21A010630
3/20/1974	139.67	143.84	4.17	6E21A010631
6/20/1974	139.57	143.54	3.97	6E21A010632
8/6/1974	139.50	143.29	3.79	6E21A010633
10/29/1974	139.40	143.48	4.07	6E21A010634
1/30/1975	139.36	143.45	4.09	6E21A010635
5/8/1975	139.28	143.14	3.86	6E21A010636
8/5/1975	139.16	142.62	3.47	6E21A010637
10/31/1975	139.08	142.44	3.36	6E21A010638
2/17/1976	139.04	142.72	3.67	6E21A010639
12/26/1978	140.80	142.86	2.06	6E21A010640
7/22/1980	142.20	140.70	-1.50	6E21A010641
8/25/1980	142.00	140.76	-1.24	6E21A010642
2/12/1981	141.76	141.19	-0.57	6E21A010643
9/22/1981	140.77	140.53	-0.23	6E21A010644

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
2/4/1982	140.84	140.86	0.02	6E21A010645
10/1/1982	140.23	140.12	-0.11	6E21A010646
9/27/1983	140.56	140.31	-0.25	6E21A010647
9/17/1984	139.92	139.66	-0.25	6E21A010648
2/26/1985	140.03	140.19	0.15	6E21A010649
9/12/1985	139.28	139.28	0.00	6E21A010650
5/7/1986	139.24	139.33	0.09	6E21A010651
2/18/1987	138.75	139.43	0.68	6E21A010652
9/17/1987	137.91	138.16	0.26	6E21A010653
3/10/1988	138.09	138.70	0.62	6E21A010654
9/27/1988	137.16	137.55	0.40	6E21A010655
3/31/1989	137.05	137.74	0.69	6E21A010656
9/27/1989	136.20	137.21	1.00	6E21A010657
3/13/1990	136.16	137.51	1.35	6E21A010658
9/27/1990	136.28	136.65	0.37	6E21A010659
3/11/1991	136.44	137.12	0.68	6E21A010660
9/23/1991	135.47	136.22	0.76	6E21A010661
3/16/1992	135.61	136.60	0.99	6E21A010662
9/24/1992	137.42	135.75	-1.67	6E21A010663
4/12/1993	137.40	135.65	-1.75	6E21A010664
9/17/1993	136.21	135.20	-1.00	6E21A010665
4/28/1994	135.60	135.00	-0.60	6E21A010666
7/15/2004	125.40	124.56	-0.84	6E21A020667
8/1/2004	125.35	124.23	-1.12	6E21A020668
8/15/2004	125.33	124.20	-1.13	6E21A020669
9/1/2004	125.30	124.02	-1.28	6E21A020670
9/15/2004	125.32	124.59	-0.72	6E21A020671
10/1/2004	125.33	124.41	-0.92	6E21A020672
10/15/2004	125.46	124.41	-1.05	6E21A020673
11/5/2004	125.65	124.83	-0.83	6E21A020674
11/15/2004	125.72	124.98	-0.74	6E21A020675
12/1/2004	125.81	124.98	-0.83	6E21A020676
12/15/2004	125.90	125.53	-0.37	6E21A020677
1/1/2005	126.01	126.11	0.10	6E21A020678
1/15/2005	126.08	126.30	0.21	6E21A020679
2/1/2005	126.17	126.00	-0.17	6E21A020680
2/10/2005	126.21	125.68	-0.53	6E21A020681
2/15/2005	126.23	126.08	-0.15	6E21A020682
3/1/2005	126.29	126.33	0.03	6E21A020683
3/15/2005	126.23	124.99	-1.24	6E21A020684
4/1/2005	126.15	124.19	-1.96	6E21A020685
4/16/2005	126.06	124.39	-1.67	6E21A020686
5/1/2005	125.97	124.23	-1.73	6E21A020687
5/16/2005	125.84	124.45	-1.39	6E21A020688
5/31/2005	125.72	124.29	-1.43	6E21A020689
6/15/2005	125.60	124.20	-1.40	6E21A020690
7/1/2005	125.47	123.54	-1.93	6E21A020691

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
7/15/2005	125.37	123.09	-2.27	6E21A020692
8/1/2005	125.25	123.09	-2.16	6E21A020693
8/15/2005	125.19	123.99	-1.19	6E21A020694
9/1/2005	125.11	122.73	-2.38	6E21A020695
9/15/2005	125.07	122.72	-2.35	6E21A020696
9/30/2005	125.02	122.83	-2.19	6E21A020697
10/15/2005	125.08	123.32	-1.76	6E21A020698
10/25/2005	125.12	123.97	-1.15	6E21A020699
12/23/2005	125.17	124.13	-1.04	6E21A020700
12/31/2005	125.17	123.95	-1.22	6E21A020701
1/15/2006	125.15	124.12	-1.03	6E21A020702
1/26/2006	125.13	123.90	-1.23	6E21A020703
2/16/2006	125.09	123.81	-1.28	6E21A020704
3/1/2006	125.06	123.96	-1.10	6E21A020705
3/15/2006	125.04	124.60	-0.44	6E21A020706
3/30/2006	125.01	123.44	-1.57	6E21A020707
5/6/2006	124.80	122.88	-1.93	6E21A020708
5/15/2006	124.72	122.83	-1.90	6E21A020709
6/1/2006	124.59	122.04	-2.54	6E21A020710
6/15/2006	124.47	121.84	-2.63	6E21A020711
7/1/2006	124.34	122.10	-2.23	6E21A020712
7/15/2006	124.22	122.13	-2.09	6E21A020713
8/1/2006	124.08	121.75	-2.33	6E21A020714
8/9/2006	124.03	121.72	-2.31	6E21A020715
10/6/2006	123.81	122.11	-1.70	6E21A020716
10/20/2006	123.80	123.26	-0.54	6E21A020717
10/31/2006	123.78	123.33	-0.45	6E21A020718
11/15/2006	123.79	122.25	-1.54	6E21A020719
11/30/2006	123.79	122.42	-1.37	6E21A020720
12/15/2006	123.79	122.47	-1.32	6E21A020721
12/31/2006	123.78	122.52	-1.27	6E21A020722
1/15/2007	123.77	122.13	-1.64	6E21A020723
1/31/2007	123.76	122.36	-1.40	6E21A020724
2/15/2007	123.72	122.14	-1.58	6E21A020725
2/28/2007	123.69	122.37	-1.32	6E21A020726
3/15/2007	123.62	121.63	-1.99	6E21A020727
3/27/2007	123.57	121.77	-1.80	6E21A020728
4/12/2007	123.47	121.39	-2.07	6E21A020729
5/16/2007	123.19	121.13	-2.06	6E21A020730
5/21/2007	123.14	121.04	-2.10	6E21A020731
5/31/2007	123.05	121.35	-1.71	6E21A020732
6/14/2007	122.92	121.14	-1.78	6E21A020733
6/30/2007	122.78	120.47	-2.31	6E21A020734
7/12/2007	122.67	120.82	-1.86	6E21A020735
8/9/2007	122.44	120.86	-1.58	6E21A020736
8/14/2007	122.41	120.91	-1.49	6E21A020737
8/31/2007	122.29	121.19	-1.10	6E21A020738
9/13/2007	122.25	121.05	-1.20	6E21A020739

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
12/5/2007	122.21	123.32	1.11	6E21A020740
12/14/2007	122.23	123.61	1.39	6E21A020741
12/31/2007	122.25	122.49	0.23	6E21A020742
1/15/2008	122.32	122.83	0.51	6E21A020743
1/31/2008	122.40	123.20	0.81	6E21A020744
2/14/2008	122.37	122.80	0.43	6E21A020745
2/21/2008	122.35	122.53	0.18	6E21A020746
2/29/2008	122.33	122.10	-0.23	6E21A020747
3/14/2008	122.26	121.82	-0.44	6E21A020748
3/20/2008	122.23	121.81	-0.43	6E21A020749
4/11/2008	122.09	121.41	-0.68	6E21A020750
4/15/2008	122.06	121.57	-0.49	6E21A020751
4/30/2008	121.95	120.91	-1.04	6E21A020752
5/14/2008	121.85	121.25	-0.59	6E21A020753
5/31/2008	121.73	120.73	-0.99	6E21A020754
6/14/2008	121.60	120.64	-0.96	6E21A020755
6/30/2008	121.45	120.85	-0.61	6E21A020756
7/15/2008	121.33	120.92	-0.41	6E21A020757
7/31/2008	121.21	120.74	-0.47	6E21A020758
8/14/2008	121.12	120.39	-0.73	6E21A020759
8/31/2008	121.02	120.31	-0.71	6E21A020760
9/11/2008	120.98	120.80	-0.19	6E21A020761
9/16/2008	120.97	120.54	-0.43	6E21A020762
9/30/2008	120.92	120.54	-0.38	6E21A020763
10/14/2008	120.91	120.00	-0.90	6E21A020764
10/31/2008	120.89	120.44	-0.45	6E21A020765
11/15/2008	120.90	120.82	-0.08	6E21A020766
11/30/2008	120.92	121.58	0.66	6E21A020767
12/1/2008	120.92	120.88	-0.04	6E21A020768
12/2/2008	120.93	120.87	-0.06	6E21A020769
12/5/2008	120.94	120.88	-0.07	6E21A020770
12/14/2008	121.00	121.22	0.22	6E21A020771
12/29/2008	121.09	121.82	0.74	6E21A020772
1/14/2009	121.09	121.48	0.39	6E21A020773
1/29/2009	121.07	121.48	0.41	6E21A020774
2/14/2009	121.07	122.09	1.02	6E21A020775
2/28/2009	121.08	121.38	0.30	6E21A020776
3/14/2009	121.03	120.88	-0.15	6E21A020777
3/31/2009	120.96	120.72	-0.24	6E21A020778
4/14/2009	120.86	120.79	-0.07	6E21A020779
4/30/2009	120.76	120.99	0.24	6E21A020780
5/15/2009	120.62	120.52	-0.10	6E21A020781
5/31/2009	120.47	120.35	-0.11	6E21A020782
6/15/2009	120.34	120.48	0.14	6E21A020783
6/30/2009	120.21	120.68	0.47	6E21A020784
7/14/2009	120.09	120.54	0.45	6E21A020785
7/31/2009	119.94	120.04	0.10	6E21A020786
8/14/2009	119.85	120.01	0.16	6E21A020787

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
8/31/2009	119.73	120.11	0.38	6E21A020788
9/14/2009	119.70	120.08	0.38	6E21A020789
9/30/2009	119.66	119.88	0.22	6E21A020790
10/14/2009	119.66	120.03	0.38	6E21A020791
10/31/2009	119.65	120.28	0.63	6E21A020792
11/15/2009	119.67	120.34	0.67	6E21A020793
11/30/2009	119.69	120.72	1.03	6E21A020794
12/25/2009	119.77	120.89	1.12	6E21A020795
12/31/2009	119.79	120.99	1.20	6E21A020796
1/15/2010	119.78	120.46	0.68	6E21A020797
1/31/2010	119.77	121.20	1.43	6E21A020798
2/15/2010	119.78	121.54	1.76	6E21A020799
2/28/2010	119.79	121.31	1.51	6E21A020800
3/15/2010	119.75	121.31	1.56	6E21A020801
3/31/2010	119.69	120.53	0.85	6E21A020802
4/15/2010	119.59	120.39	0.80	6E21A020803
4/30/2010	119.50	120.25	0.75	6E21A020804
5/14/2010	119.37	119.92	0.55	6E21A020805
5/31/2010	119.22	120.06	0.83	6E21A020806
6/15/2010	119.10	119.88	0.78	6E21A020807
6/30/2010	118.98	119.50	0.52	6E21A020808
7/15/2010	118.86	119.31	0.46	6E21A020809
7/31/2010	118.72	119.30	0.58	6E21A020810
8/15/2010	118.63	118.91	0.28	6E21A020811
8/31/2010	118.53	119.22	0.69	6E21A020812
9/15/2010	118.49	118.91	0.42	6E21A020813
9/30/2010	118.46	119.29	0.83	6E21A020814
10/15/2010	118.45	119.32	0.87	6E21A020815
10/31/2010	118.44	119.67	1.22	6E21A020816
11/15/2010	118.46	119.70	1.23	6E21A020817
11/18/2011	117.50	119.29	1.79	6E21A020818
4/17/2012	117.49	118.78	1.29	6E21A020819
5/3/2012	117.38	118.26	0.88	6E21A020820
11/14/2012	116.51	118.15	1.64	6E21A020821
4/9/2013	116.44	118.18	1.75	6E21A020822
11/13/2013	115.46	118.02	2.56	6E21A020823
11/25/2013	115.48	118.25	2.78	6E21A020824
2/5/2014	115.52	117.79	2.27	6E21A020825
4/9/2014	115.32	117.02	1.70	6E21A020826
6/3/2014	114.94	116.80	1.86	6E21A020827
8/6/2014	114.45	116.75	2.30	6E21A020828
12/9/2014	114.37	117.44	3.07	6E21A020829
3/30/2015	114.40	116.97	2.57	6E21A020830
4/15/2015	114.31	116.78	2.47	6E21A020831
11/19/2015	113.46	116.03	2.57	6E21A020832
4/12/2016	113.62	115.97	2.35	6E21A020833
11/9/1954	148.23	147.74	-0.49	6E21B010817

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
2/12/2004	125.38	127.62	2.25	6E21B010818
8/25/1980	142.05	139.41	-2.64	6E21B020819
2/12/2004	125.60	124.06	-1.54	6E21B020820
2/10/2005	125.79	123.51	-2.28	6E21B020821
5/5/2005	125.73	123.48	-2.26	6E21B020822
8/23/2005	125.06	122.53	-2.52	6E21B020823
1/5/2006	124.99	122.68	-2.31	6E21B020824
6/14/2006	124.46	121.86	-2.60	6E21B020825
8/25/1980	142.04	141.92	-0.12	6E21F010826
7/26/1965	138.91	141.93	3.02	6E23M010827
3/25/1994	136.72	134.68	-2.05	6E23M010828
8/24/1994	136.35	134.34	-2.01	6E23M010829
10/6/1994	136.27	134.40	-1.86	6E23M010830
12/21/1994	136.13	134.22	-1.91	6E23M010831
4/12/1995	135.60	134.25	-1.35	6E23M010832
6/21/1995	135.02	134.13	-0.89	6E23M010833
10/2/1995	134.61	133.92	-0.69	6E23M010834
12/28/1995	134.55	134.07	-0.48	6E23M010835
4/11/1996	134.29	133.31	-0.98	6E23M010836
8/9/1996	133.64	133.18	-0.46	6E23M010837
10/23/1996	133.50	134.01	0.51	6E23M010838
1/3/1997	133.49	133.28	-0.21	6E23M010839
5/9/1997	132.97	132.30	-0.67	6E23M010840
9/3/1997	132.67	132.15	-0.53	6E23M010841
12/3/1997	132.97	132.36	-0.61	6E23M010842
5/13/1998	132.74	132.21	-0.54	6E23M010843
11/12/1998	132.32	131.90	-0.41	6E23M010844
3/12/1999	132.16	123.67	-8.48	6E23M010845
5/17/1999	131.91	131.26	-0.64	6E23M010846
11/12/1999	131.56	130.99	-0.57	6E23M010847
9/15/2000	131.04	129.89	-1.15	6E23M010848
12/18/2000	130.85	129.80	-1.05	6E23M010849
5/17/2001	130.29	130.38	0.09	6E23M010850
10/17/2001	130.17	129.65	-0.53	6E23M010851
11/14/2001	130.13	129.83	-0.30	6E23M010852
2/12/2002	129.82	129.19	-0.63	6E23M010853
8/30/2002	129.28	129.16	-0.12	6E23M010854
12/13/2002	129.12	129.04	-0.08	6E23M010855
3/17/2003	128.77	128.86	0.08	6E23M010856
6/30/2003	128.30	128.79	0.50	6E23M010857
10/6/2003	128.36	128.76	0.40	6E23M010858
12/29/2003	128.18	128.64	0.46	6E23M010859
2/12/2004	128.01	128.86	0.85	6E23M010860
4/8/2004	127.57	128.25	0.67	6E23M010861
11/18/2004	127.81	128.15	0.34	6E23M010862

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
2/10/2005	127.95	128.49	0.54	6E23M010863
8/24/2005	127.27	127.79	0.52	6E23M010864
1/5/2006	127.04	127.94	0.90	6E23M010865
6/14/2006	126.08	127.21	1.13	6E23M010866
8/17/2006	126.28	126.14	-0.13	6E23M010867
1/10/2007	125.93	126.42	0.48	6E23M010868
6/1/2007	124.94	125.87	0.93	6E23M010869
9/21/2007	125.07	126.11	1.05	6E23M010870
5/8/2008	123.86	126.17	2.31	6E23M010871
8/12/2008	123.96	125.62	1.66	6E23M010872
5/13/1998	134.68	135.31	0.62	6E25R010890
11/12/1998	134.40	135.15	0.75	6E25R010891
3/12/1999	134.20	134.97	0.77	6E25R010892
5/17/1999	134.10	134.94	0.84	6E25R010893
11/22/1999	133.77	134.39	0.62	6E25R010894
3/24/2000	133.55	134.48	0.93	6E25R010895
6/29/2000	133.37	134.24	0.87	6E25R010896
9/15/2000	133.22	133.99	0.77	6E25R010897
12/18/2000	133.04	134.03	0.98	6E25R010898
5/17/2001	132.75	133.81	1.06	6E25R010899
10/17/2001	132.45	135.79	3.35	6E25R010900
11/17/2001	132.39	135.76	3.38	6E25R010901
2/12/2002	132.21	135.64	3.43	6E25R010902
8/20/2002	131.82	133.29	1.47	6E25R010903
12/13/2002	131.57	133.20	1.63	6E25R010904
3/17/2003	131.37	133.05	1.68	6E25R010905
6/30/2003	131.15	132.87	1.72	6E25R010906
10/6/2003	130.94	132.75	1.80	6E25R010907
12/29/2003	130.77	132.56	1.79	6E25R010908
2/12/2004	130.67	132.47	1.80	6E25R010909
4/8/2004	130.55	132.38	1.83	6E25R010910
11/18/2004	130.22	132.17	1.95	6E25R010911
5/5/2005	129.98	131.80	1.82	6E25R010912
8/23/2005	129.77	131.59	1.82	6E25R010913
10/12/2005	129.67	131.54	1.87	6E25R010914
1/5/2006	129.56	130.61	1.05	6E25R010915
2/22/2006	129.47	131.37	1.90	6E25R010916
6/12/2006	129.25	131.22	1.98	6E25R010917
6/14/2006	129.24	131.31	2.07	6E25R010918
8/17/2006	129.11	131.31	2.21	6E25R010919
1/10/2007	128.79	130.89	2.10	6E25R010920
2/12/2004	128.59	129.71	1.11	6E28Q010921
2/21/2008	124.89	127.45	2.56	6E28Q010922
12/1/2008	123.96	126.91	2.95	6E28Q010923
12/3/2008	123.97	127.11	3.14	6E28Q010924
5/20/2016	116.66	121.47	4.81	6E28Q010925

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
6/30/1980	140.65	140.99	0.33	6E29K020925
6/30/1987	138.11	141.90	3.79	6E29K020926
6/30/1991	135.99	139.46	3.47	6E29K020927
6/30/1993	136.61	134.71	-1.90	6E29K020928
6/30/1997	133.46	150.13	16.67	6E29K020929
6/2/1998	133.18	147.66	14.48	6E29K020930
6/29/1999	132.22	132.15	-0.07	6E29K020931
6/5/2000	131.25	131.60	0.35	6E29K020932
6/8/2001	130.27	130.62	0.36	6E29K020933
7/29/2002	129.42	128.58	-0.84	6E29K020934
7/31/2003	127.98	127.97	-0.01	6E29K020935
2/10/2004	127.75	127.67	-0.08	6E29K020936
2/12/2005	127.73	126.91	-0.82	6E29K020937
2/17/2006	126.90	126.57	-0.33	6E29K020938
5/21/2006	126.44	126.51	0.07	6E29K020939
3/8/2007	125.23	125.20	-0.03	6E29K020940
12/1/2008	122.92	123.13	0.21	6E29K020941
12/3/2008	122.91	123.45	0.54	6E29K020942
3/25/2010	121.68	122.51	0.83	6E29K020943
10/12/2010	120.70	121.53	0.83	6E29K020944
4/9/2013	118.37	119.49	1.12	6E29K020945
10/18/2013	118.39	119.49	1.10	6E29K020946
3/28/2014	117.58	119.15	1.57	6E29K020947
3/10/2015	116.27	118.91	2.64	6E29K020948
3/23/2016	115.33	118.57	3.24	6E29K020949
11/19/1952	152.31	156.15	3.84	6E29N010943
11/19/1953	151.26	154.34	3.08	6E29N010944
2/3/1954	151.21	153.37	2.16	6E29N010945
2/24/1954	151.16	153.57	2.41	6E29N010946
11/9/1954	150.11	153.34	3.23	6E29N010947
11/29/1955	148.96	150.85	1.89	6E29N010948
3/18/1956	148.80	151.40	2.60	6E29N010949
11/16/1956	147.82	150.97	3.15	6E29N010950
3/15/1957	147.76	149.29	1.53	6E29N010951
11/26/1957	146.90	149.96	3.06	6E29N010952
3/15/1958	146.86	149.30	2.44	6E29N010953
11/5/1958	145.81	145.78	-0.03	6E29N010954
11/24/1959	144.68	148.04	3.37	6E29N010955
2/27/1960	144.76	147.75	2.99	6E29N010956
11/22/1960	143.71	147.19	3.48	6E29N010957
3/8/1961	143.65	146.75	3.10	6E29N010958
10/26/1961	142.69	146.33	3.63	6E29N010959
3/15/1962	142.69	146.09	3.41	6E29N010960
11/2/1962	141.68	146.34	4.66	6E29N010961
3/15/1963	141.65	145.58	3.93	6E29N010962
10/31/1963	140.95	146.14	5.19	6E29N010963

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
3/20/1964	140.94	145.87	4.93	6E29N010964
11/12/1964	140.03	144.91	4.88	6E29N010965
3/19/1965	140.45	145.32	4.87	6E29N010966
7/29/1965	140.40	141.27	0.87	6E29N010967
7/30/1965	140.39	141.27	0.88	6E29N010968
10/26/1965	140.05	144.41	4.37	6E29N010969
3/3/1966	140.24	144.58	4.34	6E29N010970
10/26/1966	140.14	144.36	4.22	6E29N010971
3/23/1967	140.23	144.46	4.24	6E29N010972
10/24/1967	139.98	144.33	4.35	6E29N010973
3/13/1968	140.07	144.35	4.27	6E29N010974
11/8/1968	140.69	144.34	3.65	6E29N010975
3/27/1969	140.77	144.51	3.74	6E29N010976
10/28/1969	140.54	144.57	4.03	6E29N010977
3/23/1970	140.62	144.68	4.07	6E29N010978
11/10/1970	140.33	144.59	4.26	6E29N010979
3/30/1971	140.39	144.65	4.26	6E29N010980
3/10/2009	123.60	125.67	2.07	6E29N020981
6/30/1995	137.68	137.69	0.01	6E32D010982
6/30/1997	135.19	135.55	0.36	6E32D010983
6/2/1998	135.04	134.46	-0.59	6E32D010984
6/29/1999	133.19	133.51	0.32	6E32D010985
6/5/2000	132.54	132.38	-0.16	6E32D010986
6/8/2001	131.75	131.35	-0.40	6E32D010987
7/29/2002	129.19	130.07	0.88	6E32D010988
7/31/2003	128.19	128.24	0.04	6E32D010989
5/13/2005	127.13	127.60	0.47	6E32D010990
5/21/2006	127.42	126.99	-0.44	6E32D010991
10/12/2010	120.61	122.24	1.63	6E32D010992
4/9/2013	119.52	121.15	1.63	6E32D010993
10/18/2013	116.67	121.15	4.48	6E32D010994
3/28/2014	117.65	121.15	3.50	6E32D010995
3/10/2015	117.08	120.54	3.46	6E32D010996
3/23/2016	116.38	120.54	4.16	6E32D010997
6/30/1980	139.95	138.93	-1.02	6E32R010992
5/10/1983	140.23	138.81	-1.42	6E32R010993
5/26/1983	140.21	138.75	-1.46	6E32R010994
9/30/1983	140.46	138.81	-1.65	6E32R010995
12/11/1983	140.34	138.87	-1.47	6E32R010996
4/6/1984	140.26	138.90	-1.36	6E32R010997
7/19/1984	140.11	138.75	-1.36	6E32R010998
9/21/1984	140.01	138.72	-1.29	6E32R010999
2/16/1985	140.00	138.90	-1.10	6E32R011000
5/26/1985	139.89	138.59	-1.29	6E32R011001
1/20/1986	139.65	138.44	-1.20	6E32R011002

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
4/22/1986	139.60	138.41	-1.19	6E32R011003
9/11/1986	139.33	137.77	-1.56	6E32R011004
12/8/1986	139.24	137.92	-1.32	6E32R011005
4/27/1987	139.13	137.83	-1.30	6E32R011006
6/30/1987	139.01	138.02	-0.99	6E32R011007
7/27/1987	138.95	137.74	-1.21	6E32R011008
11/19/1987	138.83	137.89	-0.94	6E32R011009
1/20/1988	138.81	137.92	-0.88	6E32R011010
4/1/1988	138.75	137.34	-1.40	6E32R011011
6/8/1988	138.63	137.28	-1.35	6E32R011012
10/25/1988	138.33	137.10	-1.23	6E32R011013
2/3/1989	138.21	137.25	-0.95	6E32R011014
8/8/1989	137.90	136.40	-1.50	6E32R011015
10/26/1989	137.73	136.31	-1.42	6E32R011016
2/6/1990	137.59	136.49	-1.10	6E32R011017
9/1/1990	137.78	135.85	-1.93	6E32R011018
1/14/1991	137.36	136.73	-0.63	6E32R011019
2/19/1991	137.30	136.40	-0.90	6E32R011020
3/5/1991	137.28	136.61	-0.67	6E32R011021
3/19/1991	137.27	136.49	-0.78	6E32R011022
4/11/1991	137.24	136.48	-0.76	6E32R011023
5/30/1991	137.16	135.63	-1.52	6E32R011024
6/30/1991	137.10	135.58	-1.52	6E32R011025
10/31/1991	136.88	135.67	-1.21	6E32R011026
1/7/1992	136.81	135.85	-0.96	6E32R011027
3/12/1992	136.78	135.97	-0.80	6E32R011028
5/12/1992	136.91	135.55	-1.37	6E32R011029
7/7/1992	137.73	135.39	-2.34	6E32R011030
9/2/1992	137.44	135.23	-2.22	6E32R011031
10/13/1992	137.26	135.21	-2.05	6E32R011032
12/8/1992	137.10	135.30	-1.80	6E32R011033
1/21/1993	137.32	135.52	-1.80	6E32R011034
2/3/1993	137.48	135.52	-1.96	6E32R011035
2/12/1993	137.49	135.52	-1.97	6E32R011036
2/24/1993	137.48	135.55	-1.94	6E32R011037
3/11/1993	137.45	135.39	-2.06	6E32R011038
3/27/1993	137.41	135.18	-2.23	6E32R011039
4/16/1993	137.35	135.09	-2.27	6E32R011040
5/11/1993	137.29	135.09	-2.20	6E32R011041
6/30/1993	137.16	135.58	-1.58	6E32R011042
7/2/1993	137.15	134.88	-2.28	6E32R011043
8/19/1993	137.03	134.81	-2.22	6E32R011044
10/20/1993	136.91	134.75	-2.16	6E32R011045
12/24/1993	136.85	134.75	-2.10	6E32R011046
2/11/1994	136.82	134.97	-1.86	6E32R011047
3/25/1994	136.81	134.85	-1.96	6E32R011048
5/25/1994	137.13	134.54	-2.59	6E32R011049
8/24/1994	137.00	134.36	-2.65	6E32R011050

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
10/6/1994	136.87	134.36	-2.52	6E32R011051
12/21/1994	136.74	134.27	-2.47	6E32R011052
2/24/1995	136.71	134.36	-2.35	6E32R011053
4/4/1995	136.68	134.21	-2.48	6E32R011054
6/21/1995	136.57	133.96	-2.61	6E32R011055
10/2/1995	136.36	133.84	-2.52	6E32R011056
12/28/1995	136.24	133.75	-2.49	6E32R011057
4/11/1996	136.10	133.47	-2.62	6E32R011058
8/9/1996	135.76	133.14	-2.62	6E32R011059
10/23/1996	135.53	133.14	-2.39	6E32R011060
1/3/1997	135.36	133.11	-2.25	6E32R011061
5/9/1997	135.11	132.71	-2.40	6E32R011062
9/3/1997	135.23	132.32	-2.92	6E32R011063
12/3/1997	135.04	132.38	-2.66	6E32R011064
5/13/1998	134.78	132.04	-2.74	6E32R011065
6/2/1998	134.72	132.19	-2.53	6E32R011066
11/12/1998	134.20	131.61	-2.59	6E32R011067
3/12/1999	133.92	131.49	-2.43	6E32R011068
2/22/2002	130.87	129.48	-1.38	6E32R011069
12/5/2008	124.16	123.96	-0.19	6E32R011070
3/11/2009	124.02	123.96	-0.06	6E32R011071
2/9/2010	122.90	123.51	0.61	6E32R011072
3/25/2010	122.80	123.29	0.49	6E32R011073
11/18/2010	121.93	122.49	0.56	6E32R011074
11/18/2011	120.97	122.48	1.51	6E32R011075
2/6/2012	120.88	122.08	1.20	6E32R011076
5/3/2012	120.67	121.88	1.21	6E32R011077
11/14/2012	120.07	121.64	1.57	6E32R011078
4/9/2013	119.83	121.66	1.83	6E32R011079
11/13/2013	119.18	121.24	2.06	6E32R011080
4/9/2014	118.84	121.26	2.42	6E32R011081
6/3/2014	118.67	121.05	2.37	6E32R011082
12/9/2014	118.09	120.94	2.86	6E32R011083
3/30/2015	117.87	121.00	3.13	6E32R011084
4/15/2015	117.83	120.91	3.08	6E32R011085
11/18/2015	117.23	120.85	3.62	6E32R011086
3/23/2016	117.04	108.22	-8.82	6E32R011087
4/12/2016	117.00	120.53	3.53	6E32R011088
2/12/2004	128.49	126.19	-2.30	6E33C021072
2/10/2005	127.92	126.16	-1.76	6E33C021073
12/1/2008	123.45	122.77	-0.68	6E33C021074
12/3/2008	123.48	123.30	-0.18	6E33C021075
2/12/2004	128.54	131.85	3.31	6E33J011076
2/10/2005	127.90	132.88	4.98	6E33J011077
10/12/2005	127.27	132.18	4.91	6E33J011078
2/17/2006	127.08	129.98	2.91	6E33J011079

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
2/22/2006	127.07	132.22	5.15	6E33J011080
6/12/2006	126.80	131.87	5.07	6E33J011081
1/23/2007	126.07	131.72	5.65	6E33J011082
1/26/2007	126.07	131.75	5.69	6E33J011083
2/22/2007	126.04	131.76	5.72	6E33J011084
9/28/2007	125.28	131.02	5.74	6E33J011085
2/13/2008	125.05	131.13	6.08	6E33J011086
2/21/2008	125.05	131.08	6.03	6E33J011087
12/1/2008	124.16	130.61	6.45	6E33J011088
12/2/2008	124.16	131.05	6.89	6E33J011089
4/14/2009	124.03	130.57	6.53	6E33J011090
3/25/2010	123.05	130.02	6.97	6E33J011091
5/20/2016	117.50	126.65	9.15	6E33J011092
6/30/1980	138.70	140.20	1.50	6E33Q011090
6/30/1987	137.73	140.81	3.08	6E33Q011091
6/30/1991	135.92	134.41	-1.51	6E33Q011092
6/30/1993	135.92	132.89	-3.04	6E33Q011093
6/30/1995	135.45	132.89	-2.57	6E33Q011094
2/12/2004	127.45	125.66	-1.79	6E33Q011095
2/10/2005	127.23	125.36	-1.88	6E33Q011096
2/21/2008	123.81	122.88	-0.93	6E33Q011097
12/1/2008	122.74	122.50	-0.24	6E33Q011098
3/25/2010	121.74	121.56	-0.18	6E33Q011099
11/18/2010	120.06	120.80	0.74	6E33Q011100
11/18/2011	119.72	120.19	0.47	6E33Q011101
4/17/2012	119.76	119.52	-0.24	6E33Q011102
12/21/2012	118.87	119.70	0.83	6E33Q011103
4/9/2013	118.77	119.24	0.47	6E33Q011104
11/13/2013	117.87	118.91	1.03	6E33Q011105
6/25/2014	117.36	118.80	1.44	6E33Q011106
12/9/2014	116.79	119.15	2.36	6E33Q011107
3/30/2015	116.76	119.71	2.95	6E33Q011108
4/15/2015	116.70	119.56	2.86	6E33Q011109
11/19/2015	115.93	118.73	2.80	6E33Q011110
4/12/2016	115.94	118.72	2.78	6E33Q011111
2/16/1985	139.15	139.82	0.67	6E34D011099
5/26/1985	139.10	138.42	-0.68	6E34D011100
1/20/1986	138.86	139.48	0.62	6E34D011101
4/22/1986	138.83	138.08	-0.75	6E34D011102
9/11/1986	138.66	138.51	-0.15	6E34D011103
12/8/1986	138.56	138.97	0.40	6E34D011104
4/27/1987	138.46	138.57	0.11	6E34D011105
7/27/1987	138.34	138.63	0.29	6E34D011106
11/19/1987	138.18	138.72	0.54	6E34D011107
1/20/1988	138.15	139.30	1.15	6E34D011108
4/1/1988	138.11	137.78	-0.33	6E34D011109

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
6/8/1988	138.03	137.14	-0.89	6E34D011110
10/25/1988	137.80	136.31	-1.49	6E34D011111
2/3/1989	137.67	137.20	-0.47	6E34D011112
8/8/1989	137.37	137.56	0.19	6E34D011113
10/26/1989	137.22	138.17	0.96	6E34D011114
2/6/1990	137.08	137.99	0.91	6E34D011115
9/1/1990	136.74	137.81	1.06	6E34D011116
1/14/1991	136.61	139.00	2.38	6E34D011117
2/19/1991	136.60	138.78	2.18	6E34D011118
3/5/1991	136.59	139.21	2.62	6E34D011119
3/19/1991	136.59	138.65	2.06	6E34D011120
4/11/1991	136.58	138.91	2.33	6E34D011121
5/9/1991	136.56	138.95	2.39	6E34D011122
5/30/1991	136.53	138.36	1.82	6E34D011123
7/23/1991	136.46	138.48	2.02	6E34D011124
10/31/1991	136.32	138.69	2.38	6E34D011125
1/7/1992	136.25	138.69	2.44	6E34D011126
3/12/1992	136.21	138.65	2.43	6E34D011127
5/12/1992	136.16	138.45	2.29	6E34D011128
7/7/1992	136.18	137.84	1.66	6E34D011129
9/2/1992	136.25	137.84	1.59	6E34D011130
10/13/1992	136.30	137.78	1.47	6E34D011131
12/8/1992	136.38	137.96	1.58	6E34D011132
1/21/1993	136.46	138.30	1.84	6E34D011133
2/3/1993	136.49	138.20	1.72	6E34D011134
2/12/1993	136.51	138.23	1.73	6E34D011135
2/24/1993	136.53	138.20	1.67	6E34D011136
3/11/1993	136.56	137.96	1.40	6E34D011137
3/27/1993	136.58	137.90	1.32	6E34D011138
4/16/1993	136.61	137.44	0.84	6E34D011139
5/11/1993	136.63	137.69	1.06	6E34D011140
7/2/1993	136.63	137.72	1.08	6E34D011141
8/19/1993	136.61	137.87	1.26	6E34D011142
10/20/1993	136.57	137.99	1.42	6E34D011143
12/24/1993	136.55	138.05	1.51	6E34D011144
2/11/1994	136.53	138.05	1.52	6E34D011145
3/25/1994	136.52	137.29	0.77	6E34D011146
5/25/1994	136.48	136.71	0.23	6E34D011147
8/24/1994	136.39	136.68	0.29	6E34D011148
10/6/1994	136.33	136.95	0.62	6E34D011149
12/21/1994	136.25	136.95	0.70	6E34D011150
2/24/1995	136.21	137.35	1.14	6E34D011151
4/12/1995	136.17	137.17	1.00	6E34D011152
6/21/1995	136.07	137.26	1.19	6E34D011153
10/2/1995	135.84	137.35	1.51	6E34D011154
12/28/1995	135.66	137.41	1.76	6E34D011155
4/11/1996	135.47	138.08	2.61	6E34D011156
8/9/1996	135.18	137.05	1.86	6E34D011157

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
10/23/1996	134.97	137.08	2.11	6E34D011158
1/3/1997	134.80	137.14	2.34	6E34D011159
5/9/1997	134.55	136.92	2.38	6E34D011160
9/3/1997	134.27	136.80	2.54	6E34D011161
12/3/1997	134.10	136.83	2.74	6E34D011162
5/13/1998	133.92	135.46	1.54	6E34D011163
11/12/1998	133.54	135.31	1.77	6E34D011164
3/12/1999	133.33	135.67	2.35	6E34D011165
11/22/1999	132.73	134.76	2.03	6E34D011166
3/24/2000	132.49	134.94	2.45	6E34D011167
6/29/2000	132.27	134.70	2.43	6E34D011168
9/15/2000	132.03	134.58	2.55	6E34D011169
5/17/2001	131.50	135.00	3.50	6E34D011170
10/17/2001	131.07	134.88	3.82	6E34D011171
11/14/2001	130.99	134.85	3.86	6E34D011172
2/12/2002	130.79	134.76	3.97	6E34D011173
8/30/2002	130.28	134.61	4.33	6E34D011174
12/13/2002	129.98	133.21	3.23	6E34D011175
3/17/2003	129.79	133.02	3.23	6E34D011176
6/30/2003	129.53	132.63	3.09	6E34D011177
10/6/2003	129.22	132.81	3.59	6E34D011178
12/29/2003	129.00	132.96	3.96	6E34D011179
4/8/2004	128.80	132.66	3.86	6E34D011180
10/7/2004	128.30	132.47	4.17	6E34D011181
2/10/2005	128.16	131.80	3.64	6E34D011182
1/5/2006	127.48	131.68	4.21	6E34D011183
6/14/2006	127.12	131.04	3.92	6E34D011184
8/17/2006	126.88	130.92	4.04	6E34D011185
1/10/2007	126.49	131.10	4.61	6E34D011186
6/4/2007	126.16	130.92	4.76	6E34D011187
8/12/2007	125.89	130.10	4.21	6E34D011188
9/21/2007	125.74	130.58	4.85	6E34D011189
1/8/2008	125.48	130.89	5.41	6E34D011190
5/8/2008	125.26	130.52	5.26	6E34D011191
12/1/2008	124.57	130.42	5.85	6E34D011192
12/4/2008	124.57	130.83	6.26	6E34D011193
6/26/1952	147.43	153.83	6.39	6E34K011194
2/24/1954	146.48	152.52	6.04	6E34K011195
11/9/1954	145.99	151.82	5.83	6E34K011196
7/29/1965	139.19	145.49	6.30	6E34K011197
8/27/1980	139.39	141.37	1.98	6E34K011198
12/1/2008	125.17	130.07	4.90	6E34K011199
12/4/2008	125.16	130.57	5.40	6E34K011200
7/19/1984	139.14	139.02	-0.11	6E34M011202
2/16/1985	139.05	139.30	0.25	6E34M011203
5/26/1985	138.98	137.71	-1.27	6E34M011204

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
1/20/1986	138.75	139.08	0.33	6E34M011205
4/22/1986	138.73	137.92	-0.81	6E34M011206
9/11/1986	138.53	137.89	-0.63	6E34M011207
12/8/1986	138.44	138.53	0.09	6E34M011208
4/27/1987	138.36	138.23	-0.13	6E34M011209
7/27/1987	138.21	138.29	0.08	6E34M011210
11/19/1987	138.06	138.75	0.69	6E34M011211
1/20/1988	138.06	138.87	0.81	6E34M011212
4/1/1988	138.03	137.53	-0.50	6E34M011213
6/8/1988	137.93	137.59	-0.34	6E34M011214
10/25/1988	137.68	138.14	0.46	6E34M011215
2/3/1989	137.56	138.35	0.79	6E34M011216
8/8/1989	137.22	137.71	0.49	6E34M011217
10/26/1989	137.06	138.14	1.08	6E34M011218
2/6/1990	136.95	137.92	0.97	6E34M011219
9/1/1990	136.62	136.49	-0.13	6E34M011220
1/14/1991	136.52	139.11	2.59	6E34M011221
2/19/1991	136.52	138.96	2.44	6E34M011222
3/5/1991	136.52	139.19	2.66	6E34M011223
3/19/1991	136.52	138.78	2.25	6E34M011224
4/11/1991	136.52	138.88	2.37	6E34M011225
5/9/1991	136.49	138.75	2.26	6E34M011226
5/30/1991	136.46	138.14	1.68	6E34M011227
7/23/1991	136.37	138.08	1.71	6E34M011228
10/31/1991	136.21	138.08	1.86	6E34M011229
1/7/1992	136.16	138.08	1.91	6E34M011230
3/12/1992	136.14	138.29	2.15	6E34M011231
5/12/1992	136.10	137.83	1.74	6E34M011232
7/7/1992	136.12	137.50	1.38	6E34M011233
9/2/1992	136.18	137.65	1.47	6E34M011234
9/13/1992	136.19	137.62	1.42	6E34M011235
12/8/1992	136.29	137.83	1.54	6E34M011236
1/21/1993	136.38	138.11	1.73	6E34M011237
2/3/1993	136.41	138.05	1.63	6E34M011238
2/12/1993	136.44	138.08	1.64	6E34M011239
2/24/1993	136.46	138.05	1.58	6E34M011240
3/11/1993	136.49	137.86	1.37	6E34M011241
3/27/1993	136.52	137.77	1.25	6E34M011242
4/16/1993	136.54	137.47	0.93	6E34M011243
5/11/1993	136.55	137.59	1.04	6E34M011244
7/2/1993	136.53	137.56	1.03	6E34M011245
8/19/1993	136.48	137.53	1.04	6E34M011246
10/20/1993	136.43	137.68	1.25	6E34M011247
12/24/1993	136.41	137.74	1.33	6E34M011248
2/11/1994	136.42	137.83	1.42	6E34M011249
3/25/1994	136.41	137.80	1.39	6E34M011250
5/25/1994	136.38	137.56	1.18	6E34M011251
8/24/1994	136.29	137.50	1.21	6E34M011252

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
10/6/1994	136.23	137.50	1.27	6E34M011253
12/21/1994	136.17	137.50	1.33	6E34M011254
2/24/1995	136.15	137.53	1.38	6E34M011255
4/12/1995	136.11	137.41	1.29	6E34M011256
6/21/1995	136.00	137.25	1.25	6E34M011257
10/2/1995	135.76	137.28	1.52	6E34M011258
12/26/1995	135.61	137.28	1.68	6E34M011259
4/11/1996	135.44	137.10	1.66	6E34M011260
8/9/1996	135.11	136.95	1.83	6E34M011261
10/23/1996	134.89	136.92	2.03	6E34M011262
1/3/1997	134.74	136.95	2.21	6E34M011263
5/9/1997	134.51	136.73	2.22	6E34M011264
9/3/1997	134.23	136.58	2.36	6E34M011265
12/3/1997	134.08	136.73	2.66	6E34M011266
5/13/1998	133.93	136.58	2.65	6E34M011267
11/12/1998	133.48	136.34	2.86	6E34M011268
3/12/1999	133.28	136.25	2.96	6E34M011269
11/22/1999	132.62	135.73	3.10	6E34M011270
2/17/2000	132.47	135.73	3.26	6E34M011271
3/24/2000	132.41	135.67	3.25	6E34M011272
6/29/2000	132.15	135.30	3.15	6E34M011273
9/15/2000	131.87	135.24	3.37	6E34M011274
12/18/2000	131.62	135.27	3.66	6E34M011275
5/17/2001	131.37	135.18	3.81	6E34M011276
10/17/2001	130.87	135.03	4.16	6E34M011277
11/17/2001	130.79	135.00	4.21	6E34M011278
2/12/2002	130.62	134.88	4.26	6E34M011279
8/30/2002	130.06	134.69	4.63	6E34M011280
12/13/2002	129.76	134.57	4.81	6E34M011281
3/17/2003	129.61	134.48	4.87	6E34M011282
6/30/2003	129.34	133.96	4.62	6E34M011283
10/6/2003	128.99	134.14	5.15	6E34M011284
12/29/2003	128.78	133.96	5.18	6E34M011285
2/12/2004	128.71	133.93	5.22	6E34M011286
4/8/2004	128.62	133.75	5.13	6E34M011287
7/23/2004	128.33	133.29	4.96	6E34M011288
11/16/2004	128.01	133.44	5.43	6E34M011289
2/10/2005	128.03	133.35	5.32	6E34M011290
8/23/2005	127.60	132.99	5.38	6E34M011291
10/20/2005	127.41	130.04	2.63	6E34M011292
1/5/2006	127.29	131.71	4.41	6E34M011293
6/12/2006	126.95	132.32	5.37	6E34M011294
6/14/2006	126.95	131.95	5.00	6E34M011295
8/17/2006	126.67	132.22	5.55	6E34M011296
1/10/2007	126.27	132.10	5.83	6E34M011297
9/21/2007	125.51	128.44	2.94	6E34M011298
12/1/2008	124.35	128.31	3.96	6E34M011299
12/4/2008	124.35	128.77	4.42	6E34M011300

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
12/21/1954	145.09	149.48	4.39	6E35N011301
3/7/1955	145.03	149.26	4.23	6E35N011302
11/28/1955	144.63	148.44	3.81	6E35N011303
3/18/1956	144.51	147.19	2.68	6E35N011304
11/16/1956	144.04	148.05	4.00	6E35N011305
3/15/1957	143.90	145.78	1.88	6E35N011306
11/26/1957	143.42	144.30	0.89	6E35N011307
3/15/1958	143.29	145.59	2.30	6E35N011308
4/21/1958	143.25	145.30	2.06	6E35N011309
5/5/1958	143.22	146.31	3.09	6E35N011310
6/23/1958	143.13	141.31	-1.82	6E35N011311
7/22/1958	143.08	142.01	-1.06	6E35N011312
8/14/1958	143.03	141.34	-1.69	6E35N011313
9/23/1958	142.95	141.49	-1.45	6E35N011314
10/20/1958	142.90	142.65	-0.25	6E35N011315
11/12/1958	142.86	144.21	1.34	6E35N011316
1/5/1959	142.79	146.22	3.43	6E35N011317
1/26/1959	142.76	146.64	3.88	6E35N011318
2/18/1959	142.74	146.71	3.97	6E35N011319
3/12/1959	142.71	144.33	1.62	6E35N011320
3/19/1959	142.70	144.42	1.72	6E35N011321
5/12/1959	142.60	142.07	-0.53	6E35N011322
6/11/1959	142.54	142.86	0.32	6E35N011323
11/24/1959	142.23	144.95	2.72	6E35N011324
2/27/1960	142.15	143.41	1.26	6E35N011325
11/22/1960	141.69	144.74	3.05	6E35N011326
3/8/1961	141.56	143.07	1.51	6E35N011327
10/26/1961	141.14	133.97	-7.17	6E35N011328
3/15/1962	140.97	145.39	4.42	6E35N011329
11/2/1962	140.55	144.31	3.76	6E35N011330
1/23/1963	140.45	145.55	5.10	6E35N011331
2/12/1963	140.42	145.39	4.97	6E35N011332
3/15/1963	140.38	128.78	-11.61	6E35N011333
4/10/1963	140.35	142.41	2.07	6E35N011334
8/8/1963	140.13	144.84	4.71	6E35N011335
9/4/1963	140.08	144.15	4.07	6E35N011336
10/31/1963	140.05	144.59	4.54	6E35N011337
11/12/1963	140.05	144.69	4.64	6E35N011338
12/5/1963	140.04	144.56	4.52	6E35N011339
1/6/1964	140.02	145.03	5.01	6E35N011340
2/5/1964	139.99	137.65	-2.34	6E35N011341
3/9/1964	139.96	133.80	-6.17	6E35N011342
3/20/1964	139.95	144.40	4.45	6E35N011343
4/3/1964	139.94	135.41	-4.53	6E35N011344
7/7/1964	139.80	143.70	3.90	6E35N011345
7/17/1964	139.78	143.69	3.91	6E35N011346
8/5/1964	139.75	139.61	-0.14	6E35N011347

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
11/2/1964	139.61	144.51	4.91	6E35N011348
12/1/1964	139.58	144.62	5.04	6E35N011349
1/6/1965	139.54	141.76	2.22	6E35N011350
2/1/1965	139.51	134.25	-5.27	6E35N011351
4/5/1965	139.44	144.48	5.04	6E35N011352
5/24/1965	139.37	144.37	5.00	6E35N011353
6/24/1965	139.33	144.50	5.18	6E35N011354
6/29/1965	139.32	144.50	5.18	6E35N011355
7/30/1965	139.27	144.22	4.95	6E35N011356
8/3/1965	139.27	141.61	2.35	6E35N011357
10/4/1965	139.18	144.41	5.23	6E35N011358
10/26/1965	139.15	129.70	-9.45	6E35N011359
12/10/1965	139.14	144.39	5.25	6E35N011360
1/10/1966	139.13	142.50	3.37	6E35N011361
2/1/1966	139.12	144.39	5.27	6E35N011362
3/4/1966	139.10	143.97	4.87	6E35N011363
3/10/1966	139.09	131.43	-7.66	6E35N011364
7/6/1966	138.94	144.19	5.25	6E35N011365
8/1/1966	138.91	144.58	5.67	6E35N011366
10/26/1966	138.82	138.56	-0.25	6E35N011367
1/13/1967	138.80	144.14	5.35	6E35N011368
3/23/1967	138.77	140.83	2.06	6E35N011369
10/24/1967	138.58	128.96	-9.62	6E35N011370
11/8/1968	138.39	138.14	-0.25	6E35N011371
3/27/1969	138.49	140.41	1.92	6E35N011372
10/28/1969	138.43	137.50	-0.93	6E35N011373
3/23/1970	138.48	142.99	4.51	6E35N011374
11/12/1970	138.39	136.33	-2.06	6E35N011375
3/30/1971	138.40	142.97	4.58	6E35N011376
12/26/1978	137.92	140.68	2.76	6E35N011377
8/8/1980	139.04	140.27	1.23	6E35N011378
2/12/2004	129.96	131.40	1.44	6E35N011379
2/10/2005	129.33	131.10	1.77	6E35N011380
5/5/2005	129.25	130.58	1.33	6E35N011381
10/12/2005	128.91	130.26	1.35	6E35N011382
6/12/2006	128.45	129.90	1.44	6E35N011383
6/9/2009	125.91	128.68	2.76	6E35N011384
11/19/2015	120.48	125.21	4.73	6E35N011385
4/12/2016	120.25	124.91	4.66	6E35N011386
12/11/2008	127.10	130.08	2.98	6E35Q011385
12/1/2009	126.31	129.45	3.14	6E35Q011386
5/4/2010	125.96	129.11	3.15	6E35Q011387
11/18/2010	125.47	129.06	3.59	6E35Q011388
11/18/2011	124.66	129.04	4.38	6E35Q011389
4/11/2012	124.38	128.47	4.09	6E35Q011390
11/14/2012	123.91	128.23	4.31	6E35Q011391
4/9/2013	123.60	128.04	4.44	6E35Q011392

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
11/13/2013	123.11	127.75	4.64	6E35Q011393
4/10/2014	122.79	127.60	4.80	6E35Q011394
12/9/2014	122.23	127.24	5.01	6E35Q011395
3/30/2015	121.99	127.14	5.15	6E35Q011396
4/15/2015	121.96	127.09	5.13	6E35Q011397
11/19/2015	121.50	126.82	5.32	6E35Q011398
4/12/2016	121.22	126.60	5.38	6E35Q011399
4/4/1951	145.55	148.10	2.55	6E36Q011387
11/19/1953	144.72	146.68	1.96	6E36Q011388
2/24/1954	144.62	146.54	1.93	6E36Q011389
11/9/1954	144.30	144.34	0.04	6E36Q011390
3/7/1955	144.21	145.57	1.37	6E36Q011391
11/28/1955	143.89	144.20	0.31	6E36Q011392
3/18/1956	143.78	143.42	-0.36	6E36Q011393
7/2/1956	143.61	143.85	0.23	6E36Q011394
11/16/1956	143.38	143.69	0.30	6E36Q011395
3/15/1957	143.24	143.32	0.08	6E36Q011396
11/26/1957	142.84	142.63	-0.21	6E36Q011397
3/15/1958	142.72	143.27	0.55	6E36Q011398
4/21/1958	142.67	142.43	-0.24	6E36Q011399
5/5/1958	142.65	141.39	-1.26	6E36Q011400
6/23/1958	142.59	140.81	-1.77	6E36Q011401
7/22/1958	142.54	142.00	-0.54	6E36Q011402
8/14/1958	142.51	140.42	-2.09	6E36Q011403
9/23/1958	142.45	140.51	-1.94	6E36Q011404
10/20/1958	142.41	140.39	-2.02	6E36Q011405
11/5/1958	142.39	141.02	-1.36	6E36Q011406
11/12/1958	142.38	140.94	-1.44	6E36Q011407
1/5/1959	142.31	142.67	0.37	6E36Q011408
1/26/1959	142.28	143.19	0.91	6E36Q011409
3/12/1959	142.22	143.34	1.12	6E36Q011410
3/19/1959	142.22	142.67	0.46	6E36Q011411
5/12/1959	142.14	141.51	-0.62	6E36Q011412
6/11/1959	142.09	140.87	-1.21	6E36Q011413
11/24/1959	141.82	141.74	-0.07	6E36Q011414
2/27/1960	141.72	141.71	-0.01	6E36Q011415
11/22/1960	141.34	141.47	0.13	6E36Q011416
3/8/1961	141.21	142.43	1.22	6E36Q011417
10/26/1961	140.85	141.86	1.01	6E36Q011418
3/15/1962	140.67	142.43	1.77	6E36Q011419
11/2/1962	140.32	141.90	1.58	6E36Q011420
1/10/1963	140.23	142.79	2.57	6E36Q011421
2/12/1963	140.19	142.62	2.43	6E36Q011422
3/11/1963	140.15	142.22	2.06	6E36Q011423
3/15/1963	140.15	142.32	2.18	6E36Q011424
4/10/1963	140.11	141.79	1.68	6E36Q011425
5/7/1963	140.08	141.62	1.54	6E36Q011426

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
6/18/1963	140.01	140.88	0.87	6E36Q011427
7/9/1963	139.98	141.03	1.04	6E36Q011428
8/8/1963	139.94	140.93	0.99	6E36Q011429
9/4/1963	139.89	140.92	1.03	6E36Q011430
10/8/1963	139.86	141.15	1.28	6E36Q011431
10/31/1963	139.87	142.18	2.30	6E36Q011432
11/12/1963	139.88	141.89	2.01	6E36Q011433
12/5/1963	139.87	142.03	2.16	6E36Q011434
1/6/1964	139.84	142.89	3.05	6E36Q011435
2/5/1964	139.81	142.30	2.49	6E36Q011436
3/9/1964	139.78	141.80	2.02	6E36Q011437
3/20/1964	139.77	142.39	2.62	6E36Q011438
4/3/1964	139.76	141.60	1.84	6E36Q011439
5/8/1964	139.72	141.04	1.32	6E36Q011440
6/3/1964	139.69	140.31	0.62	6E36Q011441
7/7/1964	139.65	139.91	0.26	6E36Q011442
8/5/1964	139.61	139.89	0.28	6E36Q011443
9/11/1964	139.56	140.24	0.67	6E36Q011444
9/30/1964	139.54	140.42	0.89	6E36Q011445
11/2/1964	139.49	141.28	1.79	6E36Q011446
12/1/1964	139.46	141.78	2.33	6E36Q011447
1/6/1965	139.41	141.98	2.56	6E36Q011448
2/1/1965	139.38	142.04	2.66	6E36Q011449
3/3/1965	139.35	141.93	2.58	6E36Q011450
4/5/1965	139.31	141.29	1.98	6E36Q011451
5/5/1965	139.28	141.03	1.76	6E36Q011452
5/24/1965	139.25	140.78	1.53	6E36Q011453
6/29/1965	139.21	140.88	1.68	6E36Q011454
7/23/1965	139.18	140.73	1.55	6E36Q011455
8/3/1965	139.16	140.56	1.40	6E36Q011456
9/7/1965	139.12	140.28	1.16	6E36Q011457
10/4/1965	139.09	140.49	1.40	6E36Q011458
10/26/1965	139.06	141.02	1.96	6E36Q011459
11/5/1965	139.05	141.29	2.24	6E36Q011460
12/10/1965	139.03	141.42	2.40	6E36Q011461
1/10/1966	139.01	141.86	2.85	6E36Q011462
2/1/1966	139.00	141.85	2.85	6E36Q011463
3/4/1966	138.98	141.63	2.65	6E36Q011464
3/10/1966	138.97	141.39	2.42	6E36Q011465
4/5/1966	138.95	141.39	2.44	6E36Q011466
5/3/1966	138.93	141.11	2.18	6E36Q011467
6/2/1966	138.90	140.97	2.07	6E36Q011468
7/6/1966	138.86	140.56	1.69	6E36Q011469
8/1/1966	138.84	140.48	1.64	6E36Q011470
10/26/1966	138.75	141.36	2.61	6E36Q011471
1/13/1967	138.68	141.73	3.04	6E36Q011472
3/23/1967	138.64	141.82	3.18	6E36Q011473
10/24/1967	138.47	141.60	3.13	6E36Q011474

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
3/13/1968	138.39	141.83	3.44	6E36Q011475
11/8/1968	138.27	141.64	3.37	6E36Q011476
3/27/1969	138.26	141.74	3.48	6E36Q011477
10/28/1969	138.23	141.42	3.19	6E36Q011478
3/23/1970	138.21	141.62	3.42	6E36Q011479
11/12/1970	138.15	141.29	3.14	6E36Q011480
3/30/1971	138.12	141.05	2.93	6E36Q011481
8/8/1980	138.87	138.41	-0.46	6E36Q011482
2/12/2004	130.99	128.26	-2.73	6E36Q011483
10/12/2005	130.02	127.98	-2.04	6E36Q011484
3/10/2009	127.55	124.84	-2.70	6E36Q011485
1/7/1953	145.14	150.70	5.56	6E01C011522
11/19/1953	144.79	149.85	5.06	6E01C011523
1/1/1980	138.86	140.64	1.78	6E01C011524
5/5/2005	130.17	132.16	1.98	6E01C011525
10/12/2005	129.90	131.92	2.01	6E01C011526
1/5/2006	129.79	112.29	-17.50	6E01C011527
2/22/2006	129.70	131.74	2.03	6E01C011528
6/12/2006	129.51	131.59	2.08	6E01C011529
9/26/2007	128.54	130.89	2.35	6E01C011530
2/13/2008	128.23	130.76	2.52	6E01C011531
12/2/2008	127.60	130.27	2.67	6E01C011532
3/24/2009	127.37	130.14	2.77	6E01C011533
12/8/1992	136.77	134.64	-2.13	6E02C031534
1/12/1993	136.78	134.85	-1.93	6E02C031535
2/3/1993	136.82	134.88	-1.93	6E02C031536
2/12/1993	136.82	134.88	-1.94	6E02C031537
2/24/1993	136.83	134.88	-1.95	6E02C031538
3/11/1993	136.84	134.82	-2.01	6E02C031539
3/27/1993	136.84	134.61	-2.23	6E02C031540
4/16/1993	136.83	134.43	-2.40	6E02C031541
5/11/1993	136.82	134.34	-2.48	6E02C031542
7/2/1993	136.78	134.18	-2.59	6E02C031543
8/19/1993	136.73	134.09	-2.64	6E02C031544
10/20/1993	136.67	134.00	-2.67	6E02C031545
12/24/1993	136.63	134.00	-2.62	6E02C031546
2/11/1994	136.59	134.15	-2.44	6E02C031547
3/25/1994	136.57	134.15	-2.41	6E02C031548
5/25/1994	136.53	133.91	-2.62	6E02C031549
8/24/1994	136.45	133.67	-2.79	6E02C031550
10/6/1994	136.40	133.54	-2.86	6E02C031551
12/21/1994	136.33	133.48	-2.84	6E02C031552
2/24/1995	136.27	133.70	-2.58	6E02C031553
4/12/1995	136.23	133.48	-2.75	6E02C031554
6/21/1995	136.15	133.24	-2.91	6E02C031555
10/2/1995	136.01	132.99	-3.01	6E02C031556

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
12/28/1995	135.89	132.93	-2.95	6E02C031557
4/11/1996	135.73	132.78	-2.95	6E02C031558
8/9/1996	135.50	132.42	-3.09	6E02C031559
10/23/1996	135.34	132.32	-3.02	6E02C031560
1/3/1997	135.21	132.29	-2.92	6E02C031561
5/9/1997	134.99	131.96	-3.03	6E02C031562
9/3/1997	134.77	131.53	-3.24	6E02C031563
12/3/1997	134.64	131.59	-3.05	6E02C031564
5/13/1998	134.45	131.38	-3.07	6E02C031565
11/12/1998	134.11	130.74	-3.37	6E02C031566
3/12/1999	133.91	130.71	-3.20	6E02C031567
5/17/1999	133.80	130.47	-3.33	6E02C031568
11/22/1999	133.39	129.95	-3.44	6E02C031569
3/24/2000	133.17	129.98	-3.19	6E02C031570
9/15/2000	132.74	129.43	-3.31	6E02C031571
12/18/2000	132.52	129.12	-3.40	6E02C031572
5/17/2001	132.25	129.18	-3.06	6E02C031573
10/17/2001	131.87	128.85	-3.02	6E02C031574
11/14/2001	131.80	128.58	-3.22	6E02C031575
2/22/2002	131.60	128.58	-3.03	6E02C031576
8/30/2002	131.16	127.78	-3.37	6E02C031577
12/13/2002	130.90	127.69	-3.21	6E02C031578
3/17/2003	130.72	127.90	-2.82	6E02C031579
11/18/2004	129.38	125.95	-3.43	6E02C031580
2/10/2005	129.34	126.26	-3.08	6E02C031581
2/22/2006	128.70	128.06	-0.65	6E02C031582
1/10/2007	127.94	123.97	-3.97	6E02C031583
2/12/2004	125.20	130.09	4.89	6E04F011584
2/10/2005	126.42	129.94	3.52	6E04F011585
4/6/2006	123.01	128.83	5.82	6E04F011586
2/22/2007	122.00	128.43	6.43	6E04F011587
2/26/2008	121.32	128.11	6.79	6E04F011588
12/2/2008	119.61	127.62	8.02	6E04F011589
3/26/2009	119.76	127.16	7.39	6E04F011590
3/25/2010	118.58	126.98	8.40	6E04F011591
2/18/1953	150.07	148.40	-1.67	6E05P011590
11/19/1953	149.59	147.33	-2.26	6E05P011591
2/3/1954	149.45	147.15	-2.30	6E05P011592
2/24/1954	149.42	147.11	-2.30	6E05P011593
11/9/1954	148.98	146.30	-2.68	6E05P011594
3/7/1955	148.78	146.13	-2.65	6E05P011595
11/29/1955	148.33	145.43	-2.90	6E05P011596
3/18/1956	148.15	145.32	-2.82	6E05P011597
11/16/1956	147.72	144.79	-2.93	6E05P011598
3/15/1957	147.50	144.71	-2.79	6E05P011599
11/26/1957	147.04	144.08	-2.96	6E05P011600

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
3/15/1958	146.85	144.02	-2.83	6E05P011601
11/5/1958	146.40	143.42	-2.98	6E05P011602
3/12/1959	146.14	143.35	-2.80	6E05P011603
11/24/1959	145.63	142.98	-2.65	6E05P011604
2/28/1960	145.45	142.64	-2.82	6E05P011605
11/22/1960	144.96	142.37	-2.59	6E05P011606
3/8/1961	144.75	142.40	-2.36	6E05P011607
10/26/1961	144.31	142.22	-2.09	6E05P011608
3/15/1962	144.03	142.26	-1.77	6E05P011609
11/2/1962	143.60	142.08	-1.53	6E05P011610
3/15/1963	143.35	142.15	-1.20	6E05P011611
10/31/1963	143.44	141.99	-1.44	6E05P011612
3/20/1964	143.30	142.03	-1.27	6E05P011613
11/12/1964	142.73	141.74	-1.00	6E05P011614
3/19/1965	142.45	141.79	-0.66	6E05P011615
8/11/1965	142.19	141.53	-0.66	6E05P011616
10/26/1965	142.06	141.33	-0.73	6E05P011617
3/3/1966	142.15	141.33	-0.82	6E05P011618
10/26/1966	141.75	140.43	-1.31	6E05P011619
3/23/1967	141.54	141.07	-0.47	6E05P011620
10/24/1967	141.23	140.79	-0.44	6E05P011621
3/13/1968	141.06	140.76	-0.29	6E05P011622
11/8/1968	140.89	140.74	-0.15	6E05P011623
3/27/1969	140.78	140.52	-0.26	6E05P011624
10/28/1969	140.61	140.26	-0.35	6E05P011625
3/23/1970	140.47	140.19	-0.29	6E05P011626
11/10/1970	140.27	139.95	-0.32	6E05P011627
3/30/1971	140.14	139.86	-0.28	6E05P011628
8/7/1980	139.86	137.61	-2.25	6E05P011629
6/30/1980	137.76	133.68	-4.08	6E07K031630
6/30/1987	136.14	135.20	-0.93	6E07K031631
6/30/1991	134.99	133.99	-1.00	6E07K031632
6/30/1993	134.28	131.91	-2.37	6E07K031633
6/30/1995	132.24	131.55	-0.69	6E07K031634
6/30/1997	130.80	128.29	-2.51	6E07K031635
6/2/1998	131.14	127.83	-3.31	6E07K031636
6/29/1999	130.01	127.25	-2.76	6E07K031637
6/8/2001	128.07	125.48	-2.58	6E07K031638
7/29/2002	127.17	124.51	-2.67	6E07K031639
7/31/2003	126.47	123.87	-2.61	6E07K031640
5/13/2005	126.14	121.88	-4.25	6E07K031641
3/3/2006	126.00	121.61	-4.39	6E07K031642
5/21/2006	125.92	121.70	-4.22	6E07K031643
3/8/2007	125.58	121.52	-4.06	6E07K031644
12/1/2008	124.57	120.25	-4.32	6E07K031645
12/3/2008	124.57	120.90	-3.67	6E07K031646
3/25/2010	124.10	121.60	-2.50	6E07K031647

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
11/18/2010	125.77	125.61	-0.16	6E07K031648
4/17/2012	126.43	121.57	-4.86	6E07K031649
11/14/2012	126.52	122.07	-4.45	6E07K031650
4/9/2013	126.52	121.38	-5.14	6E07K031651
11/13/2013	126.44	121.30	-5.14	6E07K031652
11/25/2013	126.44	121.29	-5.15	6E07K031653
2/5/2014	126.41	121.22	-5.19	6E07K031654
4/9/2014	126.38	121.16	-5.22	6E07K031655
6/3/2014	126.36	121.38	-4.98	6E07K031656
3/30/2015	126.18	120.87	-5.31	6E07K031657
4/15/2015	126.17	120.91	-5.26	6E07K031658
11/19/2015	126.08	120.99	-5.09	6E07K031659
4/13/2016	126.05	120.82	-5.23	6E07K031660
2/12/2004	126.14	124.77	-1.37	6E09E011647
4/13/2007	123.32	122.43	-0.89	6E09E011648
2/22/2008	122.75	122.02	-0.74	6E09E011649
10/12/2010	119.56	120.41	0.85	6E09E011650
4/9/2013	118.33	120.11	1.78	6E09E011651
10/18/2013	118.48	120.11	1.63	6E09E011652
11/13/2013	118.47	119.57	1.10	6E09E011653
3/28/2014	118.66	121.14	2.48	6E09E011654
4/9/2014	118.60	119.85	1.25	6E09E011655
3/10/2015	118.21	120.72	2.51	6E09E011656
4/15/2015	118.10	119.35	1.25	6E09E011657
11/19/2015	117.41	119.15	1.74	6E09E011658
3/23/2016	117.50	120.80	3.30	6E09E011659
2/18/1953	146.19	146.46	0.28	6E10N011650
12/8/1953	145.79	144.64	-1.16	6E10N011651
2/28/1960	143.00	140.49	-2.51	6E10N011652
11/22/1960	142.53	140.49	-2.04	6E10N011653
3/8/1961	142.42	141.22	-1.20	6E10N011654
10/26/1961	141.98	140.99	-0.99	6E10N011655
3/15/1962	141.89	141.56	-0.33	6E10N011656
11/2/1962	141.45	141.25	-0.20	6E10N011657
3/15/1963	141.35	141.62	0.27	6E10N011658
10/31/1963	141.10	141.49	0.39	6E10N011659
3/20/1964	141.00	141.64	0.64	6E10N011660
11/12/1964	140.61	140.53	-0.08	6E10N011661
3/19/1965	140.47	140.94	0.47	6E10N011662
8/4/1965	140.18	140.12	-0.06	6E10N011663
10/25/1965	140.08	140.17	0.09	6E10N011664
3/3/1966	140.12	140.52	0.40	6E10N011665
10/26/1966	139.75	140.17	0.43	6E10N011666
3/23/1967	139.65	140.76	1.11	6E10N011667
10/24/1967	139.33	140.11	0.77	6E10N011668
3/12/1968	139.29	140.45	1.16	6E10N011669

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
11/8/1968	139.01	140.20	1.19	6E10N011670
3/27/1969	139.03	140.44	1.42	6E10N011671
10/28/1969	138.74	140.12	1.37	6E10N011672
3/23/1970	138.87	140.29	1.42	6E10N011673
11/12/1970	138.74	139.95	1.22	6E10N011674
3/30/1971	138.72	139.92	1.19	6E10N011675
8/13/1980	137.99	138.41	0.43	6E10N011676
3/11/2009	122.65	123.25	0.61	6E10N011677
3/11/2009	122.69	121.67	-1.03	6E10N041678
11/16/1953	144.68	146.46	1.78	6E11D021679
2/24/1954	144.60	145.86	1.27	6E11D021680
5/14/1954	144.38	130.69	-13.69	6E11D021681
11/8/1954	144.27	138.94	-5.33	6E11D021682
3/7/1955	144.25	145.79	1.54	6E11D021683
11/29/1955	143.93	138.03	-5.90	6E11D021684
3/18/1956	143.75	144.46	0.71	6E11D021685
7/2/1956	143.49	137.25	-6.24	6E11D021686
11/16/1956	143.41	144.07	0.65	6E11D021687
3/14/1957	143.31	134.17	-9.14	6E11D021688
11/27/1957	142.93	134.28	-8.65	6E11D021689
3/15/1958	142.87	136.10	-6.77	6E11D021690
4/21/1958	142.75	134.34	-8.41	6E11D021691
5/1/1958	142.73	132.08	-10.65	6E11D021692
6/23/1958	142.57	131.90	-10.67	6E11D021693
7/22/1958	142.53	132.29	-10.23	6E11D021694
8/14/1958	142.45	131.81	-10.64	6E11D021695
9/23/1958	142.43	139.46	-2.97	6E11D021696
10/20/1958	142.42	135.68	-6.74	6E11D021697
11/5/1958	142.41	140.25	-2.17	6E11D021698
11/12/1958	142.42	140.01	-2.42	6E11D021699
1/5/1959	142.42	136.56	-5.86	6E11D021700
1/26/1959	142.40	143.85	1.45	6E11D021701
2/18/1959	142.39	143.66	1.27	6E11D021702
3/12/1959	142.32	134.46	-7.86	6E11D021703
3/19/1959	142.28	133.97	-8.31	6E11D021704
5/12/1959	142.12	134.24	-7.87	6E11D021705
6/11/1959	142.05	132.08	-9.97	6E11D021706
11/24/1959	141.93	142.17	0.25	6E11D021707
2/28/1960	141.92	132.68	-9.24	6E11D021708
11/22/1960	141.46	141.45	-0.01	6E11D021709
3/8/1961	141.33	142.03	0.70	6E11D021710
10/26/1961	140.91	141.55	0.65	6E11D021711
3/15/1962	140.82	140.67	-0.15	6E11D021712
11/2/1962	140.39	141.62	1.23	6E11D021713
3/15/1963	140.31	142.30	1.99	6E11D021714
10/31/1963	140.19	142.02	1.83	6E11D021715

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
1/6/1964	140.09	142.52	2.43	6E11D021716
2/5/1964	140.06	135.08	-4.98	6E11D021717
3/9/1964	140.01	141.39	1.38	6E11D021718
3/20/1964	139.98	142.23	2.25	6E11D021719
4/3/1964	139.95	135.13	-4.82	6E11D021720
5/8/1964	139.83	138.22	-1.61	6E11D021721
7/7/1964	139.70	139.48	-0.22	6E11D021722
9/11/1964	139.57	136.57	-3.00	6E11D021723
9/30/1964	139.58	134.02	-5.56	6E11D021724
11/2/1964	139.55	141.65	2.10	6E11D021725
12/1/1964	139.63	142.11	2.48	6E11D021726
1/6/1965	139.57	141.90	2.34	6E11D021727
2/1/1965	139.54	142.28	2.74	6E11D021728
3/3/1965	139.49	141.36	1.86	6E11D021729
4/2/1965	139.43	133.49	-5.94	6E11D021730
4/5/1965	139.43	133.49	-5.93	6E11D021731
5/24/1965	139.30	133.84	-5.45	6E11D021732
6/29/1965	139.24	134.53	-4.72	6E11D021733
7/1/1965	139.24	142.28	3.05	6E11D021734
7/30/1965	139.19	133.51	-5.68	6E11D021735
8/3/1965	139.18	135.19	-3.99	6E11D021736
9/7/1965	139.10	133.52	-5.58	6E11D021737
10/4/1965	139.11	140.51	1.39	6E11D021738
10/25/1965	139.09	136.71	-2.38	6E11D021739
11/5/1965	139.12	141.44	2.32	6E11D021740
12/10/1965	139.28	141.73	2.45	6E11D021741
2/1/1966	139.22	135.98	-3.23	6E11D021742
3/4/1966	139.18	134.06	-5.12	6E11D021743
3/10/1966	139.16	135.33	-3.83	6E11D021744
4/5/1966	139.11	136.24	-2.87	6E11D021745
5/3/1966	139.03	134.15	-4.88	6E11D021746
6/2/1966	138.95	133.67	-5.28	6E11D021747
7/6/1966	138.90	133.10	-5.79	6E11D021748
10/27/1966	138.80	141.47	2.68	6E11D021749
1/13/1967	138.83	141.78	2.95	6E11D021750
3/23/1967	138.73	141.82	3.09	6E11D021751
6/22/1967	138.56	141.46	2.90	6E11D021752
9/26/1967	138.49	141.52	3.03	6E11D021753
9/27/1967	138.49	141.52	3.03	6E11D021754
10/24/1967	138.46	141.45	2.99	6E11D021755
3/13/1968	138.46	141.86	3.39	6E11D021756
11/8/1968	138.25	141.51	3.26	6E11D021757
3/27/1969	138.30	142.06	3.76	6E11D021758
10/28/1969	138.11	141.30	3.19	6E11D021759
3/13/1970	138.20	138.55	0.35	6E11D021760
3/23/1970	138.20	138.55	0.35	6E11D021761
11/12/1970	138.06	141.20	3.14	6E11D021762
3/30/1971	138.07	141.30	3.23	6E11D021763

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
12/26/1978	137.50	139.52	2.02	6E11D021764
12/27/1978	137.50	139.52	2.02	6E11D021765
7/22/1980	138.22	138.57	0.35	6E11D021766
8/13/1980	138.18	132.14	-6.03	6E11D021767
2/12/1981	138.30	139.20	0.90	6E11D021768
2/4/1982	138.23	139.00	0.77	6E11D021769
10/1/1982	138.08	137.87	-0.21	6E11D021770
9/27/1983	138.29	138.49	0.20	6E11D021771
9/17/1984	137.98	138.28	0.30	6E11D021772
2/26/1985	138.06	138.55	0.49	6E11D021773
9/13/1985	137.79	137.59	-0.20	6E11D021774
5/7/1986	137.71	136.76	-0.95	6E11D021775
2/18/1987	137.55	137.87	0.32	6E11D021776
9/17/1987	137.23	137.09	-0.14	6E11D021777
3/10/1988	137.29	136.97	-0.31	6E11D021778
9/27/1988	136.94	136.71	-0.23	6E11D021779
3/31/1989	136.92	136.74	-0.18	6E11D021780
9/27/1989	136.67	136.19	-0.48	6E11D021781
3/13/1990	136.51	136.33	-0.18	6E11D021782
9/29/1990	136.30	135.33	-0.98	6E11D021783
3/11/1991	136.12	136.21	0.09	6E11D021784
9/23/1991	135.85	135.56	-0.29	6E11D021785
3/16/1992	135.72	135.93	0.21	6E11D021786
9/24/1992	136.18	135.24	-0.94	6E11D021787
4/12/1993	136.34	134.86	-1.48	6E11D021788
9/17/1993	136.17	134.67	-1.50	6E11D021789
4/28/1994	136.09	134.66	-1.43	6E11D021790
2/10/2005	128.91	129.03	0.12	6E11D021791
3/3/2006	128.21	128.12	-0.09	6E11D021792
3/10/2009	125.76	126.36	0.60	6E11D021793
3/18/2009	125.75	126.26	0.51	6E11D021794
2/18/1953	144.44	146.60	2.16	6E11M011795
12/8/1953	144.03	146.25	2.22	6E11M011796
2/3/1954	143.98	146.27	2.29	6E11M011797
2/24/1954	143.85	145.42	1.57	6E11M011798
11/8/1954	143.62	144.97	1.35	6E11M011799
3/7/1955	143.60	145.46	1.87	6E11M011800
11/29/1955	143.39	144.02	0.63	6E11M011801
3/18/1956	143.13	144.12	0.99	6E11M011802
11/16/1956	142.91	143.71	0.79	6E11M011803
3/14/1957	142.81	142.19	-0.62	6E11M011804
11/27/1957	142.54	141.74	-0.80	6E11M011805
3/15/1958	142.44	142.71	0.27	6E11M011806
11/4/1958	142.08	140.85	-1.23	6E11M011807
3/12/1959	141.99	141.94	-0.04	6E11M011808
11/24/1959	141.67	142.25	0.59	6E11M011809
2/28/1960	141.69	140.64	-1.05	6E11M011810

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
11/22/1960	141.26	141.52	0.27	6E11M011811
3/8/1961	141.15	141.89	0.74	6E11M011812
10/26/1961	140.77	141.24	0.47	6E11M011813
3/15/1962	140.70	141.77	1.07	6E11M011814
11/2/1962	140.32	141.10	0.78	6E11M011815
3/15/1963	140.24	141.67	1.43	6E11M011816
10/31/1963	140.23	141.38	1.15	6E11M011817
3/20/1964	140.02	141.59	1.57	6E11M011818
11/13/1964	139.63	141.02	1.40	6E11M011819
3/19/1965	139.51	140.94	1.43	6E11M011820
7/30/1965	139.27	139.41	0.14	6E11M011821
10/25/1965	139.17	140.06	0.89	6E11M011822
3/4/1966	139.28	140.60	1.32	6E11M011823
10/27/1966	138.91	140.29	1.38	6E11M011824
3/23/1967	138.84	140.69	1.84	6E11M011825
10/24/1967	138.58	139.77	1.19	6E11M011826
3/13/1968	138.56	140.32	1.77	6E11M011827
3/27/1969	138.35	140.23	1.88	6E11M011828
10/28/1969	138.14	139.26	1.11	6E11M011829
3/23/1970	138.19	136.85	-1.34	6E11M011830
3/30/1970	138.19	139.59	1.41	6E11M011831
11/12/1970	138.06	139.19	1.13	6E11M011832
8/13/1980	137.99	135.90	-2.09	6E11M011833
7/31/1965	138.64	137.27	-1.36	6E12G011834
3/13/1968	137.96	136.22	-1.74	6E12G011835
3/27/1969	137.76	135.80	-1.96	6E12G011836
10/28/1969	137.65	135.32	-2.33	6E12G011837
3/23/1970	137.62	135.40	-2.22	6E12G011838
11/12/1970	137.53	134.93	-2.60	6E12G011839
3/30/1971	137.51	135.01	-2.50	6E12G011840
3/10/2009	128.76	127.13	-1.63	6E12G011841
3/26/2009	128.74	127.26	-1.47	6E12G011842
12/9/1953	145.55	144.88	-0.68	6E15E021843
9/17/1954	145.21	143.37	-1.83	6E15E021844
3/26/1956	144.75	142.15	-2.59	6E15E021845
3/29/1957	144.31	142.76	-1.54	6E15E021846
6/1/1961	142.36	141.51	-0.84	6E15E021847
6/25/1961	142.31	141.64	-0.68	6E15E021848
10/17/1963	141.30	140.22	-1.08	6E15E021849
8/4/1965	140.55	140.33	-0.22	6E15E021850
12/8/1986	136.35	135.81	-0.54	6E15E021851
4/27/1987	136.54	135.91	-0.64	6E15E021852
7/27/1987	135.92	135.78	-0.13	6E15E021853
11/19/1987	136.07	135.75	-0.32	6E15E021854
1/20/1988	136.22	135.72	-0.50	6E15E021855
4/1/1988	135.87	135.66	-0.21	6E15E021856

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
6/8/1988	135.30	135.51	0.21	6E15E021857
10/25/1988	134.85	135.39	0.54	6E15E021858
2/3/1989	135.29	135.36	0.07	6E15E021859
8/8/1989	134.61	134.99	0.38	6E15E021860
10/26/1989	134.39	134.81	0.42	6E15E021861
2/6/1990	134.63	134.78	0.15	6E15E021862
9/1/1990	134.03	134.50	0.47	6E15E021863
1/14/1991	133.86	135.08	1.22	6E15E021864
2/19/1991	133.98	134.81	0.83	6E15E021865
3/5/1991	133.98	134.84	0.86	6E15E021866
3/19/1991	133.98	134.75	0.76	6E15E021867
4/11/1991	133.94	134.69	0.75	6E15E021868
5/9/1991	133.83	134.47	0.65	6E15E021869
7/23/1991	133.49	133.64	0.14	6E15E021870
10/31/1991	133.33	133.56	0.23	6E15E021871
1/7/1992	133.31	133.83	0.52	6E15E021872
3/12/1992	133.88	134.02	0.14	6E15E021873
5/12/1992	133.95	133.62	-0.33	6E15E021874
7/7/1992	134.00	133.41	-0.59	6E15E021875
9/2/1992	133.94	133.32	-0.62	6E15E021876
10/13/1992	133.74	133.25	-0.49	6E15E021877
12/8/1992	133.83	133.35	-0.48	6E15E021878
1/21/1993	134.20	133.50	-0.70	6E15E021879
2/3/1993	134.42	133.53	-0.89	6E15E021880
2/12/1993	134.49	133.53	-0.96	6E15E021881
2/24/1993	134.56	133.56	-1.00	6E15E021882
3/11/1993	134.58	133.50	-1.08	6E15E021883
3/27/1993	134.59	133.44	-1.15	6E15E021884
4/16/1993	134.57	133.38	-1.19	6E15E021885
5/11/1993	134.54	133.28	-1.26	6E15E021886
7/2/1993	134.38	133.13	-1.25	6E15E021887
8/19/1993	134.23	133.01	-1.22	6E15E021888
10/20/1993	134.13	132.83	-1.30	6E15E021889
12/24/1993	134.15	132.89	-1.27	6E15E021890
2/11/1994	134.30	132.92	-1.38	6E15E021891
3/25/1994	134.40	132.95	-1.45	6E15E021892
5/25/1994	134.31	132.77	-1.54	6E15E021893
8/24/1994	134.21	132.28	-1.93	6E15E021894
10/6/1994	134.18	132.13	-2.06	6E15E021895
12/2/1994	133.92	131.91	-2.00	6E15E021896
2/24/1995	134.26	132.22	-2.04	6E15E021897
4/12/1995	134.25	131.94	-2.31	6E15E021898
6/21/1995	134.07	131.61	-2.46	6E15E021899
10/2/1995	133.72	131.12	-2.59	6E15E021900
12/28/1995	133.67	130.85	-2.83	6E15E021901
4/11/1996	133.65	130.66	-2.98	6E15E021902
8/9/1996	133.30	130.39	-2.91	6E15E021903
10/23/1996	133.21	130.24	-2.98	6E15E021904

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
1/3/1997	133.02	130.15	-2.87	6E15E021905
5/9/1997	133.07	130.08	-2.98	6E15E021906
9/3/1997	132.71	129.57	-3.14	6E15E021907
12/3/1997	132.61	129.47	-3.13	6E15E021908
5/13/1998	132.47	129.23	-3.24	6E15E021909
11/12/1998	131.96	128.56	-3.40	6E15E021910
3/12/1999	132.02	128.56	-3.46	6E15E021911
5/17/1999	131.72	128.59	-3.13	6E15E021912
11/12/1999	131.11	127.86	-3.25	6E15E021913
3/24/2000	131.08	127.89	-3.19	6E15E021914
6/30/2000	130.67	127.52	-3.15	6E15E021915
9/15/2000	130.33	127.22	-3.11	6E15E021916
12/18/2000	130.03	127.10	-2.93	6E15E021917
5/17/2001	129.85	127.16	-2.69	6E15E021918
10/17/2001	129.33	126.67	-2.66	6E15E021919
11/14/2001	129.23	126.64	-2.59	6E15E021920
2/22/2002	128.94	126.52	-2.42	6E15E021921
8/30/2002	127.75	126.00	-1.75	6E15E021922
12/13/2002	127.49	125.76	-1.74	6E15E021923
3/17/2003	127.48	125.79	-1.70	6E15E021924
6/30/2003	126.76	125.48	-1.28	6E15E021925
10/6/2003	126.17	124.87	-1.30	6E15E021926
12/29/2003	126.46	124.63	-1.83	6E15E021927
2/12/2004	126.48	124.60	-1.88	6E15E021928
4/8/2004	126.39	124.54	-1.85	6E15E021929
7/23/2004	125.86	124.17	-1.69	6E15E021930
11/18/2004	126.03	123.74	-2.28	6E15E021931
1/2/1950	146.84	147.41	0.57	6E15F011932
2/19/1953	145.84	146.26	0.42	6E15F011933
12/8/1953	145.50	144.76	-0.74	6E15F011934
3/7/1955	145.11	144.04	-1.07	6E15F011935
11/29/1955	144.79	143.50	-1.30	6E15F011936
3/18/1956	144.73	144.06	-0.67	6E15F011937
11/16/1956	144.38	141.62	-2.76	6E15F011938
3/15/1957	144.31	143.16	-1.15	6E15F011939
11/27/1957	143.95	142.55	-1.40	6E15F011940
3/5/1958	143.89	142.90	-0.99	6E15F011941
11/4/1958	143.57	140.62	-2.95	6E15F011942
8/5/1965	140.73	140.30	-0.43	6E15F011943
3/11/2009	125.52	124.83	-0.70	6E15G011944
6/30/1987	136.29	134.92	-1.37	6E16A021945
6/30/1991	133.42	138.58	5.16	6E16A021946
6/30/1993	133.70	136.38	2.68	6E16A021947
6/30/1995	133.15	131.05	-2.10	6E16A021948
6/30/1997	131.72	129.74	-1.98	6E16A021949

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
6/2/1998	131.44	128.70	-2.74	6E16A021950
6/29/1999	130.15	127.55	-2.61	6E16A021951
6/5/2000	129.51	127.00	-2.52	6E16A021952
7/29/2002	126.39	125.11	-1.29	6E16A021953
7/31/2003	124.60	124.56	-0.05	6E16A021954
5/13/2005	125.20	123.86	-1.34	6E16A021955
5/21/2006	124.33	123.16	-1.18	6E16A021956
3/8/2007	123.51	122.00	-1.51	6E16A021957
3/10/2008	122.91	121.51	-1.40	6E16A021958
12/1/2008	121.35	121.08	-0.27	6E16A021959
10/12/2010	120.35	119.74	-0.61	6E16A021960
4/9/2013	121.01	119.52	-1.49	6E16A021961
10/18/2013	120.07	118.58	-1.49	6E16A021962
3/28/2014	120.72	119.74	-0.98	6E16A021963
3/10/2015	119.80	119.77	-0.03	6E16A021964
10/12/2015	119.64	119.06	-0.58	6E16A021965
3/23/2016	120.05	120.01	-0.04	6E16A021966
6/30/1991	136.82	135.23	-1.59	6E16N011960
6/30/1993	128.06	134.62	6.56	6E16N011961
6/30/1995	126.67	129.81	3.14	6E16N011962
6/30/1997	125.57	128.40	2.84	6E16N011963
6/2/1998	126.83	127.25	0.42	6E16N011964
6/29/1999	126.05	126.79	0.74	6E16N011965
6/5/2000	123.73	124.84	1.11	6E16N011966
6/8/2001	126.41	125.23	-1.17	6E16N011967
7/29/2002	122.56	124.32	1.76	6E16N011968
7/31/2003	122.24	124.02	1.77	6E16N011969
2/10/2005	124.40	123.69	-0.71	6E16N011970
5/13/2005	123.44	122.83	-0.61	6E16N011971
5/21/2006	124.02	123.25	-0.77	6E16N011972
3/8/2007	123.11	121.27	-1.84	6E16N011973
3/20/2008	121.49	120.75	-0.74	6E16N011974
12/1/2008	119.37	119.41	0.04	6E16N011975
12/2/2008	119.42	119.93	0.51	6E16N011976
3/25/2010	120.76	121.86	1.10	6E16N011977
10/12/2010	119.85	118.78	-1.07	6E16N011978
10/18/2013	123.42	119.60	-3.82	6E16N011979
3/10/2015	121.85	119.15	-2.70	6E16N011980
10/12/2015	122.15	118.97	-3.18	6E16N011981
3/23/2016	122.74	120.06	-2.68	6E16N011982
6/30/1991	139.24	138.27	-0.97	6E18L011976
6/30/1993	137.51	136.14	-1.37	6E18L011977
6/30/1995	134.29	135.53	1.24	6E18L011978
6/30/1997	133.09	133.33	0.24	6E18L011979
6/2/1998	131.80	126.35	-5.45	6E18L011980
6/29/1999	130.02	126.23	-3.79	6E18L011981

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
6/5/2000	129.39	125.56	-3.83	6E18L011982
6/8/2001	128.04	125.29	-2.76	6E18L011983
7/29/2002	126.79	124.83	-1.96	6E18L011984
7/31/2003	125.66	124.16	-1.51	6E18L011985
5/13/2005	127.96	123.00	-4.96	6E18L011986
3/3/2006	127.62	121.08	-6.54	6E18L011987
5/21/2006	127.42	122.88	-4.54	6E18L011988
3/8/2007	126.81	122.39	-4.42	6E18L011989
12/1/2008	125.91	94.67	-31.24	6E18L011990
12/3/2008	125.91	95.33	-30.57	6E18L011991
3/25/2010	125.53	121.64	-3.89	6E18L011992
10/12/2010	124.85	119.23	-5.62	6E18L011993
4/9/2013	123.62	115.52	-8.10	6E18L011994
10/18/2013	123.38	115.88	-7.50	6E18L011995
3/28/2014	123.21	115.52	-7.69	6E18L011996
3/10/2015	122.82	115.36	-7.46	6E18L011997
4/20/2016	124.12	121.25	-2.87	6E18L011998
6/5/2000	125.44	127.90	2.46	6E20A011992
6/8/2001	127.88	125.89	-1.99	6E20A011993
7/29/2002	124.57	127.35	2.78	6E20A011994
7/31/2003	124.29	126.56	2.27	6E20A011995
2/12/2004	125.02	126.37	1.35	6E20A011996
2/10/2005	126.48	125.49	-0.99	6E20A011997
5/5/2005	125.78	124.91	-0.87	6E20A011998
5/13/2005	125.88	127.11	1.22	6E20A011999
2/17/2006	127.04	124.67	-2.37	6E20A012000
5/21/2006	126.45	126.86	0.41	6E20A012001
3/20/2008	123.99	122.66	-1.33	6E20A012002
3/12/2009	123.39	120.92	-2.47	6E20A012003
3/25/2010	122.95	121.66	-1.29	6E20A012004
10/12/2010	122.38	121.38	-1.00	6E20A012005
4/9/2013	125.49	120.89	-4.60	6E20A012006
10/18/2013	125.61	121.11	-4.50	6E20A012007
11/13/2013	125.63	120.64	-4.99	6E20A012008
3/28/2014	125.69	121.66	-4.03	6E20A012009
4/9/2014	125.70	120.95	-4.75	6E20A012010
4/15/2015	124.37	120.04	-4.33	6E20A012011
11/19/2015	124.58	120.08	-4.50	6E20A012012
4/13/2016	124.58	118.24	-6.34	6E20A012013
4/22/2016	125.00	118.40	-6.60	6E20A012014
1/1/1948	146.33	144.52	-1.81	6E22A012004
2/19/1953	145.30	146.72	1.42	6E22A012005
11/30/1953	145.00	146.78	1.77	6E22A012006
2/24/1954	144.97	145.55	0.58	6E22A012007
11/10/1954	144.67	145.75	1.08	6E22A012008
3/7/1955	144.65	145.93	1.28	6E22A012009

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
11/29/1955	144.38	144.76	0.38	6E22A012010
3/18/1956	144.33	145.78	1.44	6E22A012011
11/16/1956	144.03	145.58	1.55	6E22A012012
3/14/1957	144.00	145.78	1.78	6E22A012013
11/27/1957	143.69	145.60	1.92	6E22A012014
3/15/1958	143.65	145.65	2.00	6E22A012015
11/4/1958	143.38	144.90	1.53	6E22A012016
1/5/1959	143.36	144.98	1.62	6E22A012017
1/26/1959	143.35	144.98	1.63	6E22A012018
2/18/1959	143.33	145.01	1.68	6E22A012019
3/12/1959	143.32	145.16	1.84	6E22A012020
3/19/1959	143.31	145.04	1.73	6E22A012021
5/12/1959	143.24	144.98	1.74	6E22A012022
6/11/1959	143.19	144.98	1.79	6E22A012023
11/24/1959	142.98	144.86	1.88	6E22A012024
2/27/1960	142.98	144.97	1.99	6E22A012025
11/22/1960	142.64	144.66	2.02	6E22A012026
3/8/1961	142.59	144.74	2.15	6E22A012027
10/26/1961	142.27	144.28	2.01	6E22A012028
3/15/1962	142.19	144.31	2.12	6E22A012029
11/2/1962	141.88	143.88	2.01	6E22A012030
3/14/1963	141.81	143.85	2.04	6E22A012031
10/31/1963	141.73	143.81	2.08	6E22A012032
1/6/1964	141.72	143.57	1.85	6E22A012033
2/5/1964	141.72	143.44	1.72	6E22A012034
3/9/1964	141.71	143.50	1.79	6E22A012035
3/20/1964	141.70	143.85	2.14	6E22A012036
4/3/1964	141.69	143.42	1.73	6E22A012037
5/8/1964	141.65	143.31	1.66	6E22A012038
6/3/1964	141.61	143.14	1.52	6E22A012039
7/7/1964	141.56	143.15	1.59	6E22A012040
8/5/1964	141.51	143.04	1.53	6E22A012041
9/11/1964	141.46	142.87	1.41	6E22A012042
9/30/1964	141.44	142.85	1.41	6E22A012043
11/2/1964	141.40	142.90	1.50	6E22A012044
12/1/1964	141.38	142.99	1.61	6E22A012045
1/6/1965	141.37	143.07	1.70	6E22A012046
2/1/1965	141.36	143.08	1.72	6E22A012047
3/3/1965	141.34	143.09	1.75	6E22A012048
4/5/1965	141.32	143.09	1.77	6E22A012049
5/5/1965	141.28	142.94	1.66	6E22A012050
5/24/1965	141.25	142.91	1.66	6E22A012051
6/29/1965	141.19	142.67	1.48	6E22A012052
8/2/1965	141.14	142.76	1.63	6E22A012053
8/3/1965	141.14	142.71	1.58	6E22A012054
9/7/1965	141.09	142.71	1.62	6E22A012055
10/4/1965	141.05	142.69	1.63	6E22A012056
10/25/1965	141.03	142.71	1.69	6E22A012057

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
11/5/1965	141.02	142.69	1.67	6E22A012058
12/10/1965	141.05	142.83	1.78	6E22A012059
1/10/1966	141.07	142.94	1.88	6E22A012060
2/1/1966	141.07	142.85	1.78	6E22A012061
3/3/1966	141.06	143.04	1.98	6E22A012062
3/10/1966	141.06	142.81	1.75	6E22A012063
4/5/1966	141.05	142.77	1.72	6E22A012064
5/3/1966	141.01	142.66	1.64	6E22A012065
6/2/1966	140.97	142.61	1.63	6E22A012066
7/6/1966	140.92	142.73	1.81	6E22A012067
8/1/1966	140.88	142.68	1.80	6E22A012068
10/26/1966	140.77	142.64	1.87	6E22A012069
1/13/1967	140.74	142.69	1.95	6E22A012070
3/23/1967	140.71	142.71	2.00	6E22A012071
6/22/1967	140.58	142.53	1.95	6E22A012072
9/26/1967	140.44	142.09	1.65	6E22A012073
10/24/1967	140.41	142.11	1.70	6E22A012074
3/12/1968	140.36	142.34	1.98	6E22A012075
11/8/1968	140.06	142.08	2.02	6E22A012076
3/27/1969	140.03	140.34	0.31	6E22A012077
10/28/1969	139.75	142.00	2.25	6E22A012078
3/23/1970	139.69	141.64	1.95	6E22A012079
11/10/1970	139.42	141.23	1.82	6E22A012080
3/30/1971	139.39	141.33	1.93	6E22A012081
3/24/2009	130.06	136.05	5.99	6E22A012082
6/30/1980	136.98	111.39	-25.59	6E22A022083
6/30/1987	135.75	116.58	-19.18	6E22A022084
6/30/1991	134.97	125.72	-9.25	6E22A022085
6/30/1993	135.29	128.65	-6.65	6E22A022086
6/2/1998	135.18	135.53	0.36	6E22A022087
6/29/1999	134.83	136.54	1.71	6E22A022088
6/5/2000	134.46	136.84	2.38	6E22A022089
6/8/2001	133.99	136.66	2.67	6E22A022090
7/29/2002	133.37	135.38	2.02	6E22A022091
7/31/2003	132.81	135.50	2.69	6E22A022092
3/11/2009	130.30	139.12	8.82	6E22A022093
3/24/2009	130.28	137.29	7.01	6E22A022094
6/30/1987	136.89	121.76	-15.13	6E22B012095
6/30/1991	135.92	59.88	-76.04	6E22B012096
6/2/1998	135.61	134.87	-0.75	6E22B012097
2/12/2004	132.18	137.15	4.97	6E22B012098
2/10/2005	132.44	137.52	5.07	6E22B012099
2/17/2006	131.98	137.70	5.72	6E22B012100
2/22/2007	131.45	138.17	6.72	6E22B012101
2/21/2008	130.51	137.92	7.41	6E22B012102
12/1/2008	129.76	138.39	8.63	6E22B012103

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
3/25/2010	129.16	138.31	9.15	6E22B012104
11/18/2011	129.09	138.27	9.18	6E22B012105
4/17/2012	129.17	138.60	9.43	6E22B012106
12/21/2012	129.08	138.74	9.66	6E22B012107
4/9/2013	129.12	138.84	9.72	6E22B012108
5/3/2013	129.11	138.79	9.69	6E22B012109
11/25/2013	129.01	138.84	9.82	6E22B012110
2/5/2014	128.99	138.92	9.93	6E22B012111
4/9/2014	128.97	138.94	9.97	6E22B012112
6/3/2014	128.92	138.90	9.98	6E22B012113
12/9/2014	128.67	138.86	10.18	6E22B012114
3/30/2015	128.62	138.95	10.33	6E22B012115
4/15/2015	128.61	138.97	10.36	6E22B012116
11/18/2015	128.53	138.86	10.33	6E22B012117
4/13/2016	128.47	138.87	10.40	6E22B012118
6/30/1980	136.30	141.76	5.47	6E22D012103
6/30/1987	133.09	124.39	-8.70	6E22D012104
6/30/1991	132.60	114.94	-17.66	6E22D012105
6/30/1993	135.21	145.54	10.33	6E22D012106
6/30/1995	134.68	127.56	-7.12	6E22D012107
6/30/1997	132.90	126.46	-6.44	6E22D012108
6/2/1998	133.60	127.53	-6.07	6E22D012109
6/29/1999	132.36	126.77	-5.60	6E22D012110
6/5/2000	131.73	126.89	-4.84	6E22D012111
6/8/2001	129.18	126.86	-2.32	6E22D012112
2/12/2004	127.76	126.49	-1.27	6E22D012113
5/5/2005	125.99	110.00	-15.99	6E22D012114
5/13/2005	126.01	112.66	-13.36	6E22D012115
2/17/2006	126.45	114.64	-11.82	6E22D012116
5/21/2006	126.94	112.47	-14.47	6E22D012117
3/8/2007	126.03	114.88	-11.15	6E22D012118
12/1/2008	122.71	104.76	-17.95	6E22D012119
12/2/2008	122.72	105.11	-17.61	6E22D012120
3/25/2010	123.31	106.11	-17.20	6E22D012121
10/12/2010	123.51	108.49	-15.02	6E22D012122
4/9/2013	125.42	110.69	-14.73	6E22D012123
10/18/2013	125.49	109.65	-15.84	6E22D012124
3/28/2014	125.56	108.58	-16.98	6E22D012125
3/10/2015	125.11	108.67	-16.44	6E22D012126
10/12/2015	125.02	111.49	-13.53	6E22D012127
3/23/2016	124.98	112.92	-12.06	6E22D012128
6/30/1980	139.23	142.90	3.67	6E23E012121
6/30/1987	137.69	120.34	-17.35	6E23E012122
6/30/1991	136.83	126.13	-10.69	6E23E012123
6/30/1993	137.45	128.39	-9.06	6E23E012124
6/2/1998	137.54	136.16	-1.37	6E23E012125

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
6/29/1999	137.12	136.86	-0.26	6E23E012126
6/5/2000	136.76	137.14	0.38	6E23E012127
6/8/2001	136.41	137.99	1.58	6E23E012128
7/29/2002	135.81	137.23	1.42	6E23E012129
7/31/2003	135.42	138.66	3.24	6E23E012130
5/13/2005	135.53	139.24	3.71	6E23E012131
3/20/2008	134.01	139.36	5.36	6E23E012132
1/9/2009	133.80	139.23	5.43	6E23E012133
3/12/2009	133.67	139.75	6.07	6E23E012134
11/14/2012	133.13	123.23	-9.90	6E23E012135
6/30/1980	139.82	145.71	5.89	6E23J012135
6/30/1987	136.98	128.33	-8.65	6E23J012136
6/30/1991	136.21	112.79	-23.42	6E23J012137
6/30/1993	138.31	131.50	-6.81	6E23J012138
6/30/1995	138.95	133.91	-5.04	6E23J012139
6/30/1997	138.49	136.96	-1.54	6E23J012140
6/2/1998	139.33	138.30	-1.03	6E23J012141
6/29/1999	139.04	137.57	-1.47	6E23J012142
6/5/2000	138.83	139.88	1.05	6E23J012143
6/8/2001	138.67	139.82	1.15	6E23J012144
7/29/2002	138.19	140.55	2.36	6E23J012145
7/31/2003	138.15	140.83	2.68	6E23J012146
2/10/2004	138.26	139.58	1.32	6E23J012147
2/12/2005	138.93	142.11	3.17	6E23J012148
5/13/2005	138.56	142.41	3.85	6E23J012149
5/21/2006	138.20	140.43	2.23	6E23J012150
3/8/2007	137.32	138.39	1.07	6E23J012151
3/10/2008	136.72	137.51	0.78	6E23J012152
12/1/2008	136.30	139.40	3.10	6E23J012153
3/25/2010	136.75	141.39	4.64	6E23J012154
10/12/2010	136.52	140.39	3.87	6E23J012155
4/9/2013	136.14	140.60	4.46	6E23J012156
10/18/2013	136.38	142.85	6.47	6E23J012157
3/10/2015	135.63	143.46	7.83	6E23J012158
10/12/2015	135.38	142.92	7.54	6E23J012159
3/23/2016	135.43	143.31	7.88	6E23J012160
5/19/2004	137.73	140.41	2.68	6E23J022154
2/10/2005	138.33	143.27	4.94	6E23J022155
2/17/2006	137.83	141.44	3.61	6E23J022156
6/12/2006	137.59	141.26	3.66	6E23J022157
9/26/2008	135.72	139.79	4.07	6E23J022158
2/26/2009	136.19	140.44	4.25	6E23J022159
12/1/2009	136.01	141.35	5.34	6E23J022160
5/4/2010	136.17	141.53	5.36	6E23J022161
11/18/2010	135.70	141.26	5.56	6E23J022162
11/18/2011	136.46	142.54	6.08	6E23J022163

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
4/17/2012	136.20	143.85	7.65	6E23J022164
12/21/2012	133.58	144.05	10.46	6E23J022165
4/9/2013	135.55	143.65	8.10	6E23J022166
11/13/2013	135.80	143.01	7.21	6E23J022167
11/25/2013	135.79	144.26	8.46	6E23J022168
2/5/2014	135.77	143.07	7.30	6E23J022169
4/9/2014	135.69	144.48	8.79	6E23J022170
12/9/2014	135.16	144.53	9.37	6E23J022171
3/30/2015	135.07	143.18	8.11	6E23J022172
4/15/2015	135.04	143.12	8.08	6E23J022173
11/19/2015	134.91	141.75	6.84	6E23J022174
12/23/2015	135.01	141.90	6.89	6E23J022175
4/13/2016	134.74	140.04	5.30	6E23J022176
6/30/1980	141.97	138.48	-3.49	6E25A012158
6/30/1987	141.10	140.61	-0.49	6E25A012159
6/30/1991	139.81	136.04	-3.77	6E25A012160
6/30/1993	130.48	140.31	9.83	6E25A012161
6/30/1995	140.48	144.27	3.79	6E25A012162
6/30/1997	134.17	141.92	7.75	6E25A012163
6/2/1998	140.90	142.35	1.45	6E25A012164
6/29/1999	140.69	142.72	2.03	6E25A012165
6/5/2000	139.49	142.17	2.68	6E25A012166
6/8/2001	140.44	142.01	1.57	6E25A012167
7/29/2002	134.52	141.50	6.98	6E25A012168
7/31/2003	139.31	141.13	1.82	6E25A012169
2/12/2004	140.13	143.75	3.62	6E25A012170
5/21/2006	140.55	144.54	3.99	6E25A012171
6/12/2006	140.38	144.21	3.83	6E25A012172
2/22/2007	140.17	147.43	7.26	6E25A012173
3/8/2007	140.18	144.06	3.88	6E25A012174
1/20/2008	139.36	143.87	4.51	6E25A012175
9/26/2008	137.41	146.87	9.46	6E25A012176
12/1/2008	133.93	143.56	9.63	6E25A012177
2/26/2009	139.63	146.95	7.32	6E25A012178
11/18/2010	136.72	146.95	10.23	6E25A012179
4/17/2012	139.42	144.69	5.27	6E25A012180
11/14/2012	139.36	144.76	5.40	6E25A012181
4/9/2013	139.19	145.01	5.81	6E25A012182
11/25/2013	139.15	144.87	5.72	6E25A012183
2/5/2014	139.08	147.69	8.61	6E25A012184
4/9/2014	135.65	144.57	8.91	6E25A012185
11/20/2014	127.65	143.72	16.07	6E25A012186
6/30/1980	142.34	144.36	2.02	6E25C012176
6/30/1987	140.96	126.99	-13.97	6E25C012177
6/30/1991	139.83	127.60	-12.23	6E25C012178
6/30/1993	139.45	129.12	-10.33	6E25C012179

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
6/30/1995	140.73	138.21	-2.52	6E25C012180
6/30/1997	139.87	140.22	0.34	6E25C012181
6/2/1998	141.22	141.96	0.73	6E25C012182
6/29/1999	141.06	142.84	1.78	6E25C012183
6/5/2000	140.85	141.26	0.41	6E25C012184
6/8/2001	140.84	141.53	0.69	6E25C012185
7/29/2002	139.92	140.83	0.91	6E25C012186
7/31/2003	140.30	140.92	0.62	6E25C012187
2/12/2004	140.58	141.68	1.10	6E25C012188
2/17/2006	141.24	141.80	0.56	6E25C012189
6/12/2006	141.07	143.10	2.02	6E25C012190
2/22/2007	140.60	137.79	-2.81	6E25C012191
3/8/2007	140.58	142.05	1.46	6E25C012192
3/10/2008	140.15	142.44	2.29	6E25C012193
9/26/2008	139.35	135.00	-4.35	6E25C012194
12/1/2008	138.94	125.44	-13.50	6E25C012195
2/26/2009	140.01	136.55	-3.46	6E25C012196
3/25/2010	139.88	142.01	2.13	6E25C012197
11/18/2011	141.05	144.13	3.08	6E25C012198
4/17/2012	139.98	144.72	4.74	6E25C012199
11/14/2012	139.92	145.08	5.16	6E25C012200
4/9/2013	139.75	145.32	5.57	6E25C012201
11/13/2013	139.76	145.48	5.72	6E25C012202
11/25/2013	139.73	144.87	5.14	6E25C012203
2/5/2014	139.66	145.42	5.76	6E25C012204
4/9/2014	139.22	144.57	5.35	6E25C012205
11/20/2014	137.54	143.72	6.18	6E25C012206
2/5/2015	138.77	144.03	5.26	6E25C012207
11/9/2015	137.73	142.54	4.81	6E25C012208
4/28/2016	138.73	143.61	4.88	6E25C012209
1/1/1980	146.65	146.81	0.15	6E34A012194
5/5/2005	150.60	150.03	-0.57	6E34A012195
8/23/2005	150.47	150.34	-0.13	6E34A012196
10/12/2005	150.47	150.27	-0.19	6E34A012197
1/5/2006	150.71	150.47	-0.24	6E34A012198
2/22/2006	150.66	150.26	-0.40	6E34A012199
6/12/2006	150.48	150.35	-0.13	6E34A012200
2/22/2007	150.01	150.59	0.58	6E34A012201
2/13/2008	149.32	150.90	1.58	6E34A012202
12/1/2008	148.75	151.19	2.44	6E34A012203
3/25/2009	149.09	151.21	2.12	6E34A012204
11/13/2013	147.23	151.90	4.67	6E34A012205
11/20/1953	141.61	138.29	-3.32	7E07N012205
2/24/1954	141.57	138.44	-3.13	7E07N012206
11/8/1954	141.52	138.04	-3.48	7E07N012207
3/7/1955	141.52	138.21	-3.31	7E07N012208

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
11/29/1955	141.39	137.85	-3.54	7E07N012209
3/18/1956	141.12	137.96	-3.16	7E07N012210
11/16/1956	140.97	137.65	-3.32	7E07N012211
3/14/1957	140.87	137.47	-3.40	7E07N012212
11/27/1957	140.71	137.38	-3.32	7E07N012213
3/15/1958	140.57	137.52	-3.05	7E07N012214
11/4/1958	140.40	137.06	-3.34	7E07N012215
3/12/1959	140.22	137.27	-2.95	7E07N012216
11/24/1959	140.01	136.85	-3.16	7E07N012217
2/28/1960	140.01	136.98	-3.03	7E07N012218
11/22/1960	139.70	136.86	-2.84	7E07N012219
3/8/1961	139.53	136.95	-2.57	7E07N012220
10/26/1961	139.25	136.66	-2.60	7E07N012221
3/15/1962	139.14	136.75	-2.38	7E07N012222
11/2/1962	138.88	136.48	-2.41	7E07N012223
3/15/1963	138.74	136.56	-2.18	7E07N012224
3/20/1964	138.58	136.48	-2.10	7E07N012225
11/13/1964	138.36	135.38	-2.99	7E07N012226
3/19/1965	138.21	135.31	-2.91	7E07N012227
10/25/1965	138.00	136.09	-1.91	7E07N012228
10/3/2008	129.88	126.68	-3.20	7E07R012229
12/1/2008	129.81	127.17	-2.63	7E07R012230
12/4/2008	129.80	127.07	-2.73	7E07R012231
11/18/2010	128.69	126.26	-2.43	7E07R012232
11/14/2012	127.58	125.85	-1.73	7E07R012233
4/9/2013	127.34	125.84	-1.50	7E07R012234
11/13/2013	127.01	125.66	-1.35	7E07R012235
4/9/2014	126.76	125.62	-1.14	7E07R012236
4/15/2015	126.15	125.44	-0.71	7E07R012237
11/19/2015	125.81	125.25	-0.56	7E07R012238
3/23/2016	125.60	125.24	-0.36	7E07R012239
10/3/2008	129.88	126.68	-3.20	7E07R022231
12/1/2008	129.80	127.16	-2.65	7E07R022232
12/4/2008	129.80	127.06	-2.74	7E07R022233
1/12/2010	129.19	126.45	-2.74	7E07R022234
11/18/2010	128.69	126.26	-2.43	7E07R022235
11/14/2012	127.58	125.85	-1.73	7E07R022236
4/9/2013	127.34	125.84	-1.50	7E07R022237
11/13/2013	127.00	125.66	-1.34	7E07R022238
4/9/2014	126.76	125.62	-1.14	7E07R022239
4/15/2015	126.15	125.44	-0.71	7E07R022240
11/19/2015	125.81	125.26	-0.55	7E07R022241
3/23/2016	125.60	125.24	-0.36	7E07R022242
2/18/1953	147.06	151.91	4.85	7E20P012233
12/9/1953	146.91	149.80	2.90	7E20P012234

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
2/23/1954	146.84	151.61	4.77	7E20P012235
2/24/1954	146.84	151.68	4.84	7E20P012236
11/8/1954	146.75	148.99	2.24	7E20P012237
3/7/1955	146.66	149.58	2.92	7E20P012238
11/29/1955	146.55	148.69	2.14	7E20P012239
3/18/1956	146.44	151.08	4.63	7E20P012240
11/16/1956	146.35	151.39	5.04	7E20P012241
3/15/1957	146.26	151.72	5.46	7E20P012242
11/27/1957	146.17	152.00	5.83	7E20P012243
11/4/1958	146.00	152.00	6.00	7E20P012244
3/12/1959	145.88	152.13	6.25	7E20P012245
11/24/1959	145.79	152.26	6.47	7E20P012246
2/28/1960	145.73	152.31	6.58	7E20P012247
11/23/1960	145.61	152.34	6.73	7E20P012248
3/8/1961	145.51	152.37	6.87	7E20P012249
10/26/1961	145.42	152.42	7.00	7E20P012250
3/15/1962	145.31	152.44	7.13	7E20P012251
11/1/1962	145.22	152.43	7.21	7E20P012252
3/14/1963	145.11	152.46	7.35	7E20P012253
10/31/1963	145.08	152.47	7.39	7E20P012254
3/20/1964	144.95	152.54	7.59	7E20P012255
11/13/1964	144.90	152.35	7.45	7E20P012256
3/19/1965	144.79	152.25	7.46	7E20P012257
7/28/1965	144.76	152.33	7.58	7E20P012258
10/25/1965	144.73	152.32	7.59	7E20P012259
3/4/1966	144.67	152.04	7.36	7E20P012260
10/26/1966	144.61	152.23	7.62	7E20P012261
3/23/1967	144.50	152.20	7.70	7E20P012262
10/24/1967	144.45	152.13	7.68	7E20P012263
3/12/1968	144.35	152.13	7.78	7E20P012264
11/8/1968	144.28	152.11	7.83	7E20P012265
3/27/1969	144.18	152.04	7.86	7E20P012266
10/28/1969	144.11	151.97	7.86	7E20P012267
3/23/1970	144.01	149.94	5.93	7E20P012268
11/10/1970	143.93	151.88	7.95	7E20P012269
3/30/1971	143.82	151.85	8.03	7E20P012270
12/1/2008	139.98	151.95	11.97	7E20P012271
12/5/2008	139.99	152.09	12.10	7E20P012272
3/13/2009	139.99	151.95	11.96	7E20P012273
12/1/2008	141.32	147.40	6.08	7E30G042274
12/4/2008	141.33	147.73	6.40	7E30G042275
11/2/1952	152.60	152.37	-0.23	7E32Q012276
12/10/1953	152.48	154.51	2.03	7E32Q012277
11/10/1954	152.26	154.47	2.22	7E32Q012278
7/29/1965	150.46	153.22	2.76	7E32Q012279
2/20/1980	148.98	151.81	2.83	7E32Q012280

Appendix C. Residuals

Date	SIMULATED EQUIVALENT (feet)	OBSERVED VALUE (feet)	Residual (Observed - Simulated)	OBSERVATION NAME
12/5/2008	149.28	153.28	4.00	7E32Q012281
3/12/2009	148.32	147.87	-0.46	7E03M022282
6/4/2007	127.99	199.11	71.13	6E31E030001
1/8/2008	126.78	197.63	70.85	6E31E030002
5/8/2008	126.91	196.69	69.78	6E31E030003
8/11/2008	126.83	197.64	70.82	6E31E030004
8/12/2008	126.82	196.66	69.84	6E31E030005
12/5/2008	126.06	197.64	71.59	6E31E030006
5/13/2009	125.35	197.01	71.66	6E31E030007