Appendix A

Supplemental Material

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Appendix A Supplemental Material

A.1 List of Preparers

Table A-1.
Lead NEPA and CEQA Agencies

Preparers	Agency	Participation
Jeff Sutton	Tehama-Colusa Canal Authority	Lead CEQA Agency Project Manager
Adam Nickels	Reclamation	Manager, Resource Management

Table A-2.
Consultants

Name	Qualifications	Background/Expertise	Participation
CDM Smith			
Anusha Kashyap	M.S. Environmental Engineering 10 years experience	Environmental Engineer	Project Technical Lead
Gina Veronese	M.S. Agricultural and Resource Economics 16 years experience	Water Resources Planner	Technical Review
Laura Lawson	B.S. Environmental Studies: Natural Resource Management and Conservation 3 years experience	Water Resources Planner	Deliverable Support, Primary Author: Biological Resources, Air Quality, and GHG
Abbie Woodruff	M.S. Urban and Environmental Planning 4 years experience	Water Resources Planner	Primary Author: Hydrology and Water Quality, Groundwater and Cumulative Impacts

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Name	Qualifications	Background/Expertise	Participation
Gwen Pelletier, ENV SP	M.S. Environmental Studies 16 years experience	Environmental Scientist	Technical Review: Air Quality and GHG
Jennifer Jones	M.S. Environmental Science 20 years experience	Environmental Scientist	Technical Review: Biological Resources
Elise Takebeyashi, PE	M.S. Environmental Engineering 7 years experience	Environmental Engineer	Groundwater Modeler
Brian Heywood, PE	M.S. Environmental Engineering 23 years experience	Environmental Engineer	Technical Review: Groundwater

Key:
ENV SP = Envision Sustainability Professional
P.E. = Professional Engineer

A.2 Acronyms

AF	acre-feet
APCD	Air Pollution Control District
AQAP	Air Quality Attainment Plan
AQMD	Air Quality Management District
ATCM	Airborne Toxic Control Measure
bgs	below ground surface
BMO	basin management objective
C2VSim	Central Valley Groundwater-Surface Water Simulation Model
CAAQS	California Ambient Air Quality Standard
CARB	California Air Resources Board
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEQ	Council of Environmental Quality
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent

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CVHM	Central Valley Hydrologic Model
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
dB	decibel
dBA	A-weighted decibel
dbh	diameter at breast height
DWR	Department of Water Resources
EA	Environmental Assessment
EDD	Employment Development Department
eGRID	Emissions & Generation Resource Integrated Database
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
ESA	Endangered Species Acts
ETAW	evapotranspiration of applied water
GAMA	Groundwater Ambient Monitoring and Assessment
GGS	giant gartersnake
GHG	greenhouse gas
GIS	geographic information system
GMP	Groundwater Management Plan
GPS	global positioning system
GSP	Groundwater Sustainability Plan
GWP	global warming potential
HCP	Habitat Conservation Plan
hp	horsepower
ID	Irrigation District
IS	Initial Study
ITA	Indian Trust Asset
Ldn	day-night average sound level
MCL	maximum contaminant level
mg/L	milligrams per liter
MUD	Municipal Utility District
MWC	Mutual Water Company
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standard
NCCP	Natural Community Conservation Plan
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOx	nitrogen oxides
NRCS	Natural Resources Conservation Service
NSVPA	Northern Sacramento Valley Planning Area

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O_3	ozone
PM_{10}	inhalable particulate matter
$PM_{2.5}$	fine particulate matter
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
ROD	Record of Decision
SGMA	Sustainable Groundwater Management Act
SIP	state implementation plan
SLDMWA	San Luis & Delta-Mendota Water Authority
SRTTG	Sacramento River Temperature Task Group
SVSim	Sacramento Valley Groundwater-Surface Water Simulation Model
SWP	State Water Project
SWRCB	State Water Resources Control Board
TCCA	Tehama-Colusa Canal Authority
TCR	The Climate Registry
TDS	total dissolved solids
USC	United States Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
WY	water year
YSRCP	Yuba-Sutter Regional Conservation Plan

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Appendix B
Special Status Wildlife Species with Potential to Occur

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Special Status Species With Potential to Occur

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Invertebrates						
California Freshwater shrimp *Syncaris pacifica*	**E**	--	Found in 16 stream segements within Marin, Sonoma and Napa counties	Inhabits small, perennial coastal streams with exposed live roots of trees such as alder and willow along undercut banks with overhanging woody debris or stream vegetation.	December to early May	None. No CNDDB occurences have been documented iwhtin the Seller Service Area. In addition, no impacts to coastal streams are anticipated.
Conservancy fairy shrimp *Branchinecta conservation*	**E**	--	Northern two-thirds of the Central Valley. It ranges from Vina Plains of Tehama County; Sacramento NWR in Glenn County; Jepson Prairie Preserve and surrounding area east of Travis Air Force Base, Solano County; Mapes Ranch west of Modesto, Stanislaus County.	Inhabits the ephemeral water of swales and vernal pools. It is most commonly found in grass or mud bottomed swales, earth sump, or basalt flow depression pools in unplowed grasslands.	Has been collected from early December to early May.	None. Occurrences have been documented within the Seller Service Area. Suitable habitat occurs within the project area. No impacts to vernal pool or other habitats occupied by this species are anticipated. The species is not likely to occur to occur in crop fields and canals due to lack of suitable habitat.
Crotch bumble bee *Bombus crotchii*	--	**CE**	Primarily in California, including the Mediterranean region, Pacific Coast, Western Desert, Great Valley, and adjacent foothills through most of southwestern California. This species was historically common in the Central Valley of Caliofmia but not appears to be absent from most of it.	Inhabits open grassland and scrub habitats	Active late February to late October	None. There are three CNDDB occurences within five years within the Seller Service Area. However, water transfers are not anticipated to impact open grasslands and scrub habitats.
Delta Green ground beetle *Elaphrus viridis*	**T**	--	Found in the greater Jepson prairie area in south-central Solano County, California.	Associated with vernal pool habitats, seasonally wet pools that accumlate in low areas with poor drainge.	Emerges in January, breed in February and March, enters dormancy in May	None. No CNDDB occurences have been documented iwhtin the Seller Service Area. In addition, no impacts to prairie area in south-central Solano County.
Lange's Metalmark butterfly *Apodemia mormo langei*	**E**	--	Restricted to sand dunes along the southern bank of the Sacramento-San Joaquin River. Within Contra Costa County, it is currently found only at Antioch Sand Dunes.	Inhabits stabilized dunes along the San Joaquin river and is endemic to Antioch sand dunes, Contra Costa county. The butterfly's primary host plant is Eriogonum nudum var. auriculatum. It feeds on nectar of other wildflowers, as well as host plant.	Breeding season is August -September, Larvae hatch during rainy months.	None. No CNDDB occurrences have been documented within the Seller Service Area, In addition, no impacts to sand dunes are anticipated.
San Bruno Elfin butterfly *Callophryus mossii bayensis*	**E**	--	Found in vicinity of San Bruno mountains, San Mateo County (ESSIG 2012b).	Found in coastal, mountainous areas with grassy ground cover. Colonies are located on steep, north-facing slopes within the fog belt. Larval host plant is Sedum spathulifolium.	Year round	None. No occurrences have been documented in the Seller Service Area and suitable habitat is not present in the area. No impacts are anticipated to mountainous areas near San Bruno. Therefore no impacts to the species are expected.
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	**T,X**	--	Central Valley and surrounding foothills below 3,000 feet elevation.	Dependent on elderberry shrubs (host plant) as a food source. Potential habitat is shrubs with stems 1 inch in diameter within Central Valley.	Year round for host plant and exit holes; March-June for adults	None. Elderberry shrubs will not be impacted, therefore no impact to beetles will occur.
Vernal pool fairy shrimp *Branchinecta lynchi*	**T,X**	--	Endemic to the Central Valley, Central Coast Mountains, and South Coast Mountains of California. It ranges from the Stillwater Plain in Shasta County through most of the length of the Central Valley to Paisley in Tulare County, and along the central Coast Range from northern Solano County to Pinnacles National Monument in San Benito County. Disjunct populations were also reported to occur in San Luis Obispo County, Santa Barbara County, and Riverside County.	Inhabits the ephemeral water of swales and vernal pools. It is most commonly found in grassed or mud bottomed swales, earth sump, or basalt flow depression pools in unplowed grasslands.	Has been collected from early December to early May.	None. Occurrences have been documented in the Seller Service areas. Crop fields and canals are not likely to support this species due to lack of suitable habitat. The project is not expected to impact vernal pools or natural wetlands.Therefore, no impacts to the species are expected.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Vernal pool tadpole shrimp *Lepidurus packardi*	**E,X**	--	Endemic to the Central Valley of California, with the majority of the populations occurring in the Sacramento Valley. This species has also been reported from the Sacramento River Delta to the east side of San Francisco Bay, and from a few scattered localities in the San Joaquin Valley from San Joaquin County to Madera County	Found in a variety of natural and artificial seasonally ponded habitat types including: vernal pools, swales, ephemeral drainages, stock ponds, reservoirs, ditches, backhoe pits, and ruts caused by vehicular activities.	Has been collected from early December to early May.	None. Occurrences have been documented in the Seller Service area. Suitable habitat is present in the project area. Crop fields and canals are not likely to support this species due to lack of suitable habitat. The project is not expected to impact vernal pools or natural wetlands. Therefore, no impacts to the species are expected.
Western bumble bee *Bombus occidentalis*	--	**CE**	Historically broadly distributed in western North America along the pacific coast and western interior of North America	Iinhabits meadows and grasslands with abundant floral resources, largely confined to high elevation sites	Year round	None. There are no recent CNDDB occurrences within the Seller Service Area.Water transfers are not anticipated to impact meadows and grasslands. No impact to the species is expected.
Amphibians						
California Red-legged frog *Rana draytonii*	**T**	--	Through the Central Valley and coastal regions of central and southern California	Found mostly near ponds in humid forests, woodlands, grasslands, coastal scrub, and streamsides with plant cover. Frequently found in woods adajcent to streams.	Year round	None. No CNDDB occurences have been documented in the Seller Service Area. The project is not expected to impact the species suitable habitat. No impacts to the species is expected.
California tiger salamander *Ambystoma californiense*	**T,X**	**T, WL**	Found in annual grassland habitat, grassy understories of valley-foothill hardwood habitats, and uncommonly along stream courses in valley-foothill riparian habitats. Occurs from near Petaluma, Sonoma Co., east through the Central Valley to Yolo and Sacramento Counties and south to Tulare Co.; and from the vicinity of San Francisco Bay south to Santa Barbara County.	Lives in vacant or mammal-occupied burrows, occasionally other underground retreats, throughout most of the year, in grassland, savanna, or open woodland habitats. Lays eggs on submerged stems and leaves, usually in shallow ephemeral or semi permanent pools and ponds that fill during heavy winter rains, sometimes in permanent ponds; breeding takes place in fish free pools and ponds.	Migrates up to about 2 km between terrestrial habitat and breeding pond. Migrations may occur from November through April.	None. Occurrences have been documented within the Seller Service Areas. Suitable habitat may occur within the project area, but will not be impacted by the project. Cropland idling has the potential to improve habitat for the species.
Foothill yellow-legged frog *Rana boylii*	--	**CT, SSC**	This species is known from the Pacific drainages from Oregon to the upper San Gabriel River, Los Angeles County, California, including the coast ranges and Sierra Nevada foothills in the United States.	This species inhabits partially shaded, rocky streams at low to moderate elevations, in areas of chaparral, open woodland, and forest.	Year round	None. Occurrences have been documented within the Seller Service Area. Suitable habitat is present within the project area. However, the project is not expected to impact any suitable rocky stream and woodland habitats. No impact to the species is expected.
Western spadefoot *Spea hammondii*	--	**SSC**	This species occurs in the Central Valley and bordering foothills of California and along the Coast Ranges into northwestern Baja California, Mexico.	Lowlands to foothills, grasslands, open chaparral, pine-oak woodlands. Prefers shortgrass plains, sandy or gravelly soil. It is fossorial and breeds in temporary rain pools and slow-moving streams that do not contain bullfrogs, fish, or crayfish.	Year round. Usually in underground burrows most of year, but will travel several meters on rainy nights. Movement is rarely extensive.	None. Occurrences have been documented from Seller Service Areas. Suitable habitat is present in the project area. The project will not impact suitable upland habitat types. The species is not likely to occur in crop fields or canals due to the presence of predatory fish, bullfrogs etc. Cropland idling has the potential to improve habitat for the species.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Reptiles						
Giant garter snake *Thamnophis gigas*	**T**	**T**	Sacramento and San Joaquin Valleys from Butte County in the north to Kern County in the south.	Primarily associated with marshes, sloughs, and irrigation ditches. Generally absent in larger rivers.	Year round	High. In recent years, there have been 34 occurrences of this species in the Seller Service Area. Suitable habitat is present within the Seller Service Areas. Suitable habitat in the Seller Service Area is intermittent based on normal variation in cropping. Impacts may include reduction in suitable aquatic habitat within the Seller Service Area. Conservation measures are in place to maintain aquatic habitat corridors within irrigation ditches.
Western pond turtle/ Pacific pond turtle *Actinemys marmorata*	**--**	**SSC**	Ranged from extreme western Washington and British Columbia to northern Baja California, mostly to the west of the Cascade-Sierra crest.	The western pond turtle occupies a wide variety of wetland habitats including rivers and streams (both permanent and intermittent), lakes, ponds, reservoirs, permanent and ephemeral shallow wetlands, abandoned gravel pits, stock ponds, and sewage treatment.	Year round	High. Suitable habitat occurs within the project area. Pond turtles may occur in ditches, canals, rice fields, etc. In recent years, there have been numerous occurrence of this species in the Seller Service Area. Impacts may include reduction in suitable aquatic habitat within the Seller Service Area. Conservation measures are in place to maintain aquatic habitat corridors within irrigation ditches.
Birds						
Aleutian Cackling Goose *Branta hutchinsii leucopareia*	**D**	**--**	Northern San Joaquin Valley, the delta of central California, and the Humboldt Bay area	Lakes, marshes and fields, often foraging in open prairies and farm fields	Wintering in California from mid-October to mid-April	None. Suitable foraging habitat is located within the Seller Service Area, however there are no recent CNDDB occurrences within the Seller Service Area. No impacts to the species is anticipated.
American peregrine falcon *Falco peregrinus anatum*	**D, MNBMC**	**D, FP**	Throughout California.	Breeds in woodland, forest and coastal habitats on protected cliffs and ledges. Riparian areas and coastal and inland wetlands are important habitats yearlong especially during the non-breeding season.	Year round	None. Crop fields may provide suitable foraging habitat for the species, but birds could relocate to other habitat areas in the vicinity. No nesting habitat will be affected by the project.
Bald eagle *Haliaeetus leucocephalus*	**D, BGEPA**	**E, FP**	Throughout California.	Riparian areas near coasts, rivers, and lakes. Nesting generally occurs in large old-growth trees in areas with little disturbance.	Year round	None. Occurrences have been documented within the Seller Service Area and both areas provide suitable habitat. No impacts to suitable nesting habitat are anticipated. Crop fields represent marginal foraging habitat. Birds would be able to relocate to other suitable habitat areas in the vicinity if fields were fallowed. Environmental commitments limit the amount of land that can be fallowed in a given county.
Bank swallow *Riparia riparia*	**--**	**T**	A neotropical migrant found primarily in riparian and other lowland habitats in California west of the deserts during the spring-fall period. Breeding population in California occurs along banks of the Sacramento and Feather rivers in the northern Central Valley.	Requires vertical banks and cliffs with fine-textured or sandy soils near streams, rivers, ponds, lakes, and the ocean for nesting. Feeds primarily over grassland, shrub land, savannah, and open riparian areas during breeding season and over grassland, brushland, wetlands, and cropland during migration.	March-mid-September	None. Known within the Seller Service Areas. No suitable nesting habitat (i.e. cliffs along rivers) will be affected from small changes in river flow. There is potential that the project would reduce the area of cropland habitat used for foraging during migration (wetlands and croplands) due to changes in water application. However, fallow cropland would still providing suitable foraging habitat, and birds could forage at other croplands in the vicinity.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Black tern *Chlidonias niger*	--	**SSC**	Common spring and summer visitor to fresh emergent wetlands of California.	Uses fresh emergent wetlands, lakes, ponds, moist grasslands, and agricultural fields. In migration, some take coastal routes and forage offshore.	April-September	Moderate. No occurrences have been documented within either the Buyer or Seller Service Areas. However, suitable habitat is present within the project area (i.e. rice fields) and the project area is within the known range for the species. Water transfers could reduce suitable habitat for the species within the Seller Service Area. Conservation strategies are in place that would reduce potential impacts to this species to negligible.
Burrowing owl *Athene cunicularia*	--	**SSC**	Central and southern coastal habitats, Central Valley, Great Basin, and deserts.	Open annual grasslands or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation. Dependent upon burrowing mammals (especially California ground squirrel) for burrows.	Year round	None. Occurrences have been documented within Seller Service Area. Suitable habitat occurs within the project area. Agricultural ditches may be suitable habitat for burrowing owl burrow and nesting activity. Water transfers would not affect the suitability of habitat for burrowing owl in the project area.
California black rail *Laterallus jamaicensis coturniculus*	--	**T, FP**	Pacific coast of California, along the lower Colorado River. During breeding season, the species can be found north of San Francisco	Tidal marshes and freshwater marshes, inhabit the drier portions of wetlands with vegetation dominated by fine-stemmed bulrush or grasses.	Year round	None. There are CNDDB records within Sacramento, Sutter, and Yolo counties. However, suitable habitat is unlikely to be impacted by water transfers.
California clapper rail *Rallus longirostris obsoletus*	**E**	--	Common locally around San Francisco, Monterey, and Morro bay.	Found in salt-water and brackish marshes traversed by tidal sloughs. The bird is associated with abundant growths of pickle weed, but feeds on mud-bottomed sloughs.	Year round. Non-migratory in coastal wetlands. Juveniles may disperse to freshwater wetlands late summer and autumn.	None. No occurrences have been documented within the Seller Service Area. Suitable habitat does not occur within the project area. Transfers are not expected to impact any suitable habitat (i.e. salt-water marshes).
California least tern *Sterna antillarum browni*	**E**	--	Nests along the coast from San Francisco Bay south to northern Baja California. Migratory in California. Breeding colonies in Southern California near marine and estuarine shores. In SF Bay found near salt ponds and estuarine shores.	Breeds on bare or sparsely vegetated, flat substrates, sand beaches, alkali flats, landfills or paved areas. Feeds in shallow, estuarine waters.	Late April in southern California to mid-May in northern California. Winters south of California. Absent from mid-October to late April.	None. No occurrences have been documented in the Seller Service Area. Suitable habitat is not found within the project area. No impacts are expected to suitable foraging or breeding habitat (i.e. sand beaches, alkali flats).

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Cooper's hawk *Accipiter cooperii*	--	**WL**	Throughout California	Frequents landscapes where wooded areas occur in patches and groves. Often uses patchy woodlands and edges with snags for perching. Dense stands with moderate crown-depths used for nesting.	Year round	None. Occurrences have been documented in Seller Service Area. Suitable habitat occurs within the project area. No potential impacts to preferred foraging or nesting habitat are anticipated.
Double-crested cormorant *Phalacrocorax auritus*	--	**WL**	Along the entire coast of California and on inland lakes, in fresh, salt and estuarine waters. Uncommon from San Luis Obispo County south and very rare to the north. Common on Colorado River reservoirs and common in the Central Valley.	Open water with offshore rocks, islands, steep cliffs, dead branches of trees, wharfs, jetties, or even transmission lines. Requires undisturbed nest-sites beside water, on islands or mainland. Uses wide rock ledges on cliffs; rugged slopes; and live or dead trees, especially tall ones. Found on inland lakes, fresh, and estuarine waters.	Year round along coastal regions. Winters inland.	None. No occurrences have been documented within the project area. No negative impacts to foraging or breeding habitat are expected.
Ferruginous hawk *Buteo regalis*	--	**WL**	Winter resident and migrant at lower elevations and open grasslands in Modoc Plateau, Central Valley, and Coast ranges. Common winter resident of grassland and agriculture areas in southwestern California. Casual in northeast in summer.	Found in open grasslands, sagebrush flats, desert scrub, low foothills and fringes of pinyon-juniper habitats.	Migratory. Present in CA from Sept. to mid-April.	None. Occurrences have been documented in Sacramento County. Suitable habitat occurs within the project area. No potential impacts to preferred habitat are anticipated.
Golden eagle *Aquila chrysaetos*	**BGEPA**	**FP**	Throughout California	Riparian areas near coasts, rivers, and lakes. Nesting generally occurs in large old-growth trees in areas with little disturbance.	Year round	None. Occurrences have been documented within both the Buyer and Seller Service Areas. Suitable habitat occurs within the project area. No impacts to nesting habitat are expected.
Grasshopper sparrow *Ammodramus savannarum*	--	**SSC**	Throughout California's coastline and central valley	Breeds in open grasslands, prairies, hayfields, and pastures, typically with some bare gound.	Year round	None. There are CNDDB records of this species in Sacramento and Yolo counties. This species is unlikely to breed within dense crop fields, and therefore is unlikely to be affected by water transfers.
Greater sandhill crane *Grus canadensis tabida*	--	**T, FP**	Breeds only in Siskiyou, Modoc and Lassen counties and in Sierra Valley, Plumas and Sierra counties. Winters primarily in the Sacramento and San Joaquin valleys from Tehama south to Kings Counties.	In summer, this race occurs in and near wet meadow, shallow lacustrine, and fresh emergent wetland habitats. Frequents annual and perennial grassland habitats, moist croplands with rice or corn stubble, and open, emergent wetlands. It prefers relatively treeless plains.	Migration southward is September-October and northward is March-April.	Moderate. No occurrences have been documented within the project area, but occurrences have been recorded in Butte and Sutter Counties. Suitable foraging and winter roosting habitat is present within the project area (i.e. rice fields). Water transfers could reduce suitable habitat for the species within the Seller Service Area. Conservation strategies are in place for this species and birds will have other suitable wintering sites available.
Least bell's vireo *Vireo bellii pusillus*	**E**	**E**	California to northern Baja.	Inhabits low, dense riparian growth along water or along dry parts of intermittent streams. Typically associated with willow, cottonwood, baccharis, wild blackberry, or mesquite in desert localities.	March-August	None. No occurrences have been documented in the Buyer Service Area. Suitable habitat may occur within the project action area. The project is not expected to impact any suitable willow or dense riparian habitat due to small changes in river flow, therefore no impacts to the species are anticipated.

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Merlin *Falco columbarius*	--	**WL**	Occurs in most of the western half of California below 3,900 ft. Rare in Mojave Desert and Channel Islands.	Frequents coastlines, open grasslands, savannahs, woodlands, lakes, wetlands, edges, and early successional stages. Ranges from annual grasslands to ponderosa pine and montane hardwood-conifer habitats.	Winter migrant from September-May	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present in project area. Foraging habitat may be altered, but Transfers would not decrease suitability. No negative impacts are anticipated.
Mountain plover *Charadrius montanus*	--	**SSC**	Found in Central Valley from Sutter and Yuba counties southward, foothill valleys west of San Joaquin Valley, Imperial Valley, plowed fields of Los Angeles and western San Bernardino County, and central Colorado river valley. Does not breed in California.	Found in short grasslands, freshly plowed fields, newly sprouting grain fields, and sod farms. Prefers grazed areas and areas with burrowing rodents.	Winter resident Sept. - March.	None. Occurrences have been documented in Seller Service Area. Suitable habitat occurs within the project area. Foraging habitat may be affected, but Transfers would not reduce suitability and individuals can relocate to other habitats within the area.
Northern goshawk *Accipiter gentilis*	--	**SSC**	Throughout California	Nests in mature and old-growth forests with a majority of closed canopy.	Year round	None. There are two CNDDB occurrences in Glenn County. Suitable habitat is not present in the project area (i.e. old-growth forests). Water transfers would not affect this species.
Northern harrier *Circus cyaneus*	--	**SSC**	Throughout lowland California, concentrated in the Central Valley and coastal valleys.	Breeds in annual grasslands and wetlands. Prefers marshes and grasslands for foraging and nesting. Also uses agricultural fields for nesting and foraging, although nests may be destroyed by agricultural activities.	Year round	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present in project area. Foraging and breeding habitat may be affected, but fallow fields would still represent suitable habitat. Birds can relocate to other habitats within the area.
Northern spotted owl *Strix occidentalis caurina*	**T,X**	--	Distributed through the Cascade Range, coastal ranges, and as far south as Marin County.	Associated with forests characterized by dense canopy closer of mature and old-growth tree, abundant logs, and live trees with broken tops.	Year round	None. There are no occurrences of this species in the Seller Service Area. In addition, suitable habitat for the species is not present in the project area. This species will not be impacted by water transfers.
Osprey *Pandion haliaetus*	--	**WL**	Northern California from Cascade Ranges south to Lake Tahoe, and along the coast south to Marin County.	Associated strictly with large, fish-bearing waters, primarily in ponderosa pine through mixed conifer habitats.	Year round	None. Occurrences have been documented in Seller Service Area. Suitable habitat occurs within the project area. Water transfers would be subject to flow requirements. Therefore no impacts to foraging area expected. No impacts to nesting sites are anticipated.
Prairie falcon *Falco mexicanus*	--	**WL**	Found from southeastern deserts northwest throughout Central Valley and inner Coast Ranges and Sierra Nevada. Mostly absent from northern coastal fog belt. Not found in upper elevation of Sierra Nevada.	Inhabits dry, open level or hilly terrain. Breeds on cliffs, forages far afield. Annual grassland to alpine meadows, but primarily perennial grasslands, rangeland, agricultural fields and desert scrub.	Permanent resident. Northern migrants winter in California. Upslope in summer, down slope in winter.	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present within the project area. Foraging habitat (i.e. agricultural fields) may be altered, but Transfers would not reduce suitability.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Purple martin *Progne subis*	--	**SSC**	In south, found on the coast and interior mountain ranges. Absent from higher desert regions. In north, found on coast and inland to Modoc and Lassen counties. Absent from higher slopes of Sierra Nevada. Current breeding populations are known from western Santa Clara and Alameda counties, and western Placer County.	Inhabits woodlands, low elevation coniferous forest of Douglas-fir, ponderosa pine and Monterey pine. Uses open habitats during migration, including grassland, wet meadows, and fresh emergent wetlands.	Summer resident throughout California.	Low. CNDDB occurrences have been documented in Sacramento County. This species is restricted to fairly limited nesting sites with suitable cavities free of brood parasites. When wetlands are unavailable, rice fields may represent relatively high quality foraging habitat. This habitat may be slightly reduced by Transfers, but the species can relocate to other suitable habitat in the vicinity. Crop idling limitations are in place in the environmental commitments.
Saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	--	**SSC**	Resident and summer visitor in San Francisco Bay area. Winter south along coast to San Diego county. Found in No. CA in summer months.	Found in fresh and salt water marshes. Requires thick, continuous cover to water surface for foraging and tall grasses, tulle and willows for nesting.	Year-round in southern California and San Francisco Bay, Summer resident in northern California.	None. Occurrences have been documented in the Seller Service area and suitable habitat may be present in the project area. Not known from rice fields. Water transfers would not affect suitable breeding or foraging habitat.
Song sparrow ("Modesto" population) Melospiza melodia	--	**SSC**	Distributed through the Central Valley from Butte to Stanislaus counties	Enormous variety of open habitats, including tidal marshes, arctic grasslands, desert scrub, chapparral agricultural fields, forest edges, and deciduous woodlands.	Year round. Breeds from mid-March to early August	None. Occurrences have been documents in the Seller Service area and suitable habitat may be present, i.e. agricultural fields. This species has a wide range of suitable habitat and therefore birds can relocate to other habitats within the area.
Suisun song sparrow *Melospiz melodia maxillaris*	--	**SSC**	Endemic, restrict to Suisun Marsh from Carquinez Strait east to the confluence of the Sacramento and San Joaquin rivers near Antioch. Highest numbers near Benicia State Park and Martinez shoreline.	Resident of brackish-water marshes. Inhabits cattails, tulles, sedges, and salicornia.	Year round. Non-migratory. Breeds early March to July.	None. Occurrences have been documented in Sacramento County and suitable habitat may be present in the project area. However, no impacts are expected to brackish-water marshes.
Swainson's hawk *Buteo swainsoni*	**MNBMC**	**T**	Lower Sacramento and San Joaquin Valleys, the Klamath Basin, and Butte Valley.	Nests in mature trees, including valley oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain and row crop fields.	Spring and Summer; small wintering population in the Delta	None. CNDDB occurrences have been documented within both the Seller Service Area. Suitable habitat is present within the project area. The project may alter the composition of foraging habitat in the Seller Service Areas, but these areas would still be suitable for the species, and additional habitats in the vicinity would be available. No impacts to riparian breeding habitat are expected from small changes in river flow.
Tricolored blackbird *Agelaius tricolor*	--	**T, SSC**	A resident in California found throughout the Central Valley and in coastal districts from Sonoma County south.	Breeds near fresh water, preferably in emergent wetlands with tall, dense cattails or tules, but also in thickets of willow, blackberry, wild rose, tall herbs. Feeds in grassland and cropland habitats.	Year round	Moderate. In recent years, CNDDB occurrences have been documented in the Seller Service Area. Suitable habitat is present within the project area. Foraging habitat may be affected by the project. Environmental commitments limit cropland idling and birds can relocate to other adjacent foraging habitats within the area.
Western snowy plover *Charadrius alexandrinus nivosus*	**T**	**SSC**	Along the west coast states, with inland nesting taking place at the Salton Sea, Mono Lake, and at isolated sites on the shores of alkali lakes in northeastern California, in the Central Valley, and southeastern deserts.	Nests, feeds, and takes cover on sandy or gravelly beaches along the coast, on estuarine salt ponds, alkali lakes, and at the Salton Sea.	Migration is from July-March (some year round populations).	None. Occurrences have been documented in Yolo County. There is a CNDDB occurrence in Yolo County, however this species is not likely to occur in rice fields. Suitable habitat may occur within the project area. However, Transfers are not expected to impact any suitable breeding or foraging habitat (i.e. sandy beaches or estuarine salt ponds).

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Western yellow-billed cuckoo *Coccyzus americanus*	**T,PX**	**E**	Uncommon to rare summer resident in scattered locations throughout California. Breeding population along Colorado river, Sacramento and Owen Valley, along South Fork of Kern River, Santa Ana River and Amargosa River. May be present along San Luis Rey River.	Deciduous riparian thickets or forests with dense, low-level or understory foliage, and which abut on slow-moving watercourses, backwaters, or seeps. Willow almost always a dominant component of the vegetation. In Sacramento Valley, also utilizes adjacent orchards, especially of walnut. Nests in sites with some willows, dense low-level or understory foliage, high humidity, and wooded foraging spaces.	Summer migration is from June-September.	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present within the project area. However this species is not likely to occur in crop fields due to lack of suitable foraging and roosting habitat (i.e. dense riparian thickets). No impacts are anticipated to riparian breeding habitat due to small changes in river flow.
White-faced ibis *Plegadis chihi*	--	**WL**	Uncommon summer resident in sections of southern California, a rare visitor in the Central Valley, and is more widespread in migration.	Feeds in fresh emergent wetlands, shallow lacustrine waters, muddy grounds of wet meadows, and irrigated or flooded pastures and croplands. Nests in dense, fresh emergent wetlands.	Present in California from April-October.	Low. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in project area. Low potential impact to foraging habitat in the Seller Service Area. No potential impacts are expected to roosting habitat. Can relocate to other habitats within the area. Environmental committments would limit acreage of allowable cropland idling.
White-tailed kite *Elanus leucurus*	**MNBMC**	**FP**	Central Valley, coastal valleys, San Francisco Bay area, and low foothills of Sierra Nevada.	Savanna, open woodlands, marshes, partially cleared lands and cultivated fields, mostly in lowland situations (Tropical to Temperate zones).	Year round	None. CNDDB occurrences have been documented in the Seller Service Area. Suitable habitat is present within the project area. Foraging habitat may be altered, but will still be suitable for the species. No potential impacts to breeding habitat are anticipated.
Yellow-headed blackbird *Xanthocephalus xanthocephalus*	--	**SSC**	Breeds in deep-water, emergent wetlands throughout nonforested regions of western North America.	Breed and roost in freshwater wetlands with dense, emergent vegetation such as cattails. They often forage in fields, typically wintering in large, open agricultural areas.	Year round	Low. Suitable habitat is present within the project area. Foraging habitat may be affected by the project. Environmental commitments limit cropland idling and birds can relocate to other adjacent foraging habitats within the area.
Mammals						
American badger *Taxidea taxus*	--	**SSC**	Throughout California.	Found in dry, open stages of most shrub, forest, and herbaceous habitats with friable soils.	Year round. Permanent resident except in North Coast area.	None. Occurrences have been documented in Seller Service Area and suitable habitat is present within the project area. Suitable habitats are not expected to be impacted.
Fisher- West Coast DPS *Pekania pennanti*	**PT**	**T, SSC**	Found throughout Washington, Oregon, and California	Late-successional coniferous or mixed forests, with relatively large diameter trees, high canopy closure, large trees (hardwood and conifer) with cavities, and large down wood.	Year round.	None. Occurrences have been documented in Glenn and Colusa counties. Suitable habitat is not present and will not be impacted due to water transfers.
Humboldt marten *Martes caurina humboldtensis*	--	**CE, SSC**	Found in the northern counties of California along the Oregon state border	Largest patches of old-growth and late-mature forests and serpentine habitat.	Year round.	None. There is one occurrence of this species in the Seller Service Area. Suitable habitat is not present within the project area. The species is not likely to be impacted by water transfers.
Marysville California kangaroo rat *Dipodomys californicus eximius*	--	**SSC**	Known only from the Sutter Buttes area in Sutter County	Friable soils in chaparral and valley & foothill grasslands	Year round.	None. There are two occurrences of this species in Sutter County. Suitable habitat is not present within the project area. The species is not likely to be impacted by water transfers.
Pallid bat *Antrozous pallidus*	--	**SSC**	Throughout California, except for high Sierra Nevada from Shasta to Kern counties, northwestern corner of state from Del Norte & western Siskiyou county. To northern Mendocino County.	Found in deserts, grasslands, scrublands, woodlands and forests. Most common in open, dry habitats with rocky areas for roosting.	Year round.	None. Occurrences have been documented within the Seller Service Area. Suitable habitat may occur within the project area. No impacts would occur to suitable habitat.
Riparian brush rabbit *Sylvilagus bachmani riparius*	**E**	--	Isolated populations on Caswell Memorial State Park on the Stanislaus River and along an overflow channel of the San Joaquin River.	Riparian thickets	Year round	None. No CNDDB records of this species have been documented in the project area. Suitable habitat is present in the project area, however, no potential impacts are expected to suitable habitat (i.e. riparian thickets).

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Salt-marsh harvest mouse *Reithrodontomys raviventris*	**E**	**E, FP**	Found in San Francisco Bay and its tributaries.	Found in saline emergent wetlands. Pickle weed is the primary habitat for the species. Requires higher grassland areas for flood escape.	Year round.	None. One CNDDB occurrence has been documented in the Seller Service Area and suitable habitat may be present in the project area. Transfers would not impact saline wetlands and salt marshes.
San Joaquin kit fox *Vulpes macrotis mutica*	**E**	**T**	Found only in the Central Valley area of California. Kit foxes currently inhabit suitable habitat in the San Joaquin valley and in surrounding foothills of the Coast Ranges, Sierra Nevada, and Tehachapi Mountains; from southern Kern County north to Contra Costa, Alameda, and San Joaquin counties on the west; and near La Grange, Stanislaus County on the east.	Found in annual grasslands or grassy open stages of vegetation dominated by scattered brush, shrubs, and scrub. Build dens for cover. Some agricultural areas may support these foxes.	Year round (mostly nocturnal, but often active during daytime in cool weather)	None. No occurrences have been documented within the Seller Service Area. Suitable habitat, i.e. agricultural fields is present within the project area. However due to the lack of local occurrences, the proposed project is not likely to impact this species.
Townsend's big-eared bat *Corynorhinus townsendii*	--	**SSC**	Along the California coastline	Habitat associations include coniferous forests, deserts, native prairies, riparian communties, active agricultural areas, and coastal habitat types. Populations centers occuring in areas dominated by exposed, cavity forming rock and/or historic mining districts.	Year round.	None. There are CNDDB records for this species in Yolo and Colusa counties. Appropriate rock formations are not present in the project area and will not be impacts by water tranfsers.
Western mastiff bat *Eumops perotis californicus*	--	**SSC**	Found in southeastern San Joaquin Valley and Coastal ranges from Monterey County southward through southern California and from the coast eastward to Colorado Desert.	Found in open, semi-arid habitats, including conifer and deciduous woodlands, coastal scrub, grasslands, and chaparral. Roost in crevices in cliff faces, high buildings, trees and tunnels.	Year round	None. There is one CNDDB occurrence in the Seller Service Area and suitable habitat is present within the project area. No impacts are anticipated to feeding or roosting habitat.
Western red bat *Lasiurus blossevillii*	--	**SSC**	Occurs from Shasta County to Mexican border, west of Sierra Nevada/Cascade crest and deserts. Winters in western lowlands and coastal regions south of SF bay. Not found in desert areas.	Found in trees 2-40ft above ground, from sea level up through mixed conifer forests. Prefers habitat edges and mosaics with trees. Feeds over a wide variety of habitats including grasslands, scrublands and croplands.	Year round. Migrates in spring (March-May) and autumn (Sept.-Oct). Migrates between summer and winter range	None. Occurrences have been documented in the Seller Service Area and suitable habitat is present within the project area. No impacts to roosting habitat are anticipated. Transfers could alter the configuration of foraging habitat, but would not reduce suitability.
Fish						
Chinook Salmon (Winter-run) *Oncorhynchus tshawytscha*	**E**	**E**	Distributed throughout northern California	Utilizing both fresh and salt water habitats, this species requires spawning sites within the stream or iver where water velocity, depth, and gravel size are optimal for the incubation of developing eggs.	Spawning December - Early August	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Central Valley Steelhead *Oncorhynchus mykiss*	**T**	--	Native to streams along the Pacific coast of North America	Populations inhabit small headwater streams, large rivers, lakes, or reservoirs; often in cool clear lakes and cool swift streams with silt-free substrate. Usually requires a gravel riffle for successful spawning.	Year round	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.
Delta Smelt *Hypomesus transpacificus*	**T,X**	**E**	Restricted to the upper reaches of the San Francisco Bay and Sacramento-San Joaquin Delta Estuary, from San Pablo Bay upstream to Sacramento on the Sacramento River and Mossdale on the San Joaquin River.	This species can tolerate a wide range of salinity and temperatures. Shallow, fresh, or slightly brackish backwater sloughs and edgewaters with good water quality and substrate are used for spawning.	Year round	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.
Eulachon *Thaleichthys pacificus*	**T**	--	Foundf from nothern California to southwest Alaska.	Adults spend most of their life in the ocean and migrate into freshwater to spawn. Most spawning occurs within tidal influence through some spawning areas area located farther upstream of the river mouth. The species is susceptible to poor water quality.	Spawning between December and May	None. There are no recent CNDDB occurrences within the Seller Service Area. Suitable spawning habitat is present in the project area. However, flow reductions as a resullt of this project would be low and would not affect this species.
Longfin smelt *Spirinchus thaleichthys*	**C**	**T**	Found on the Sacramento and San Joaquin Rivers in the Delta through Suisun Bay and Suisun Marsh, San Pablo Bay, San Francisco Bay, the Gulf of the Farallones, Humboldt Bay, Eel river estuary and other local coastal areas.	Adult longfin smelt migrate into low salinity or freshwater reaches of coastal rivers and tributary streams to spawn. Encounter a wide variety of water temperatures and salinities during their life cycle but are rarely found in water temperatures greater than 71 degress F.	Spawning in January - March	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.
Sacramento perch *Archoplites interruptus*	**--**	**SSC**	Found in Clear Lake and Alameda Creek/Calaveras Reservoir, as well as in some farm ponds and reservoirs. The species has been introduced through the state including the upper Klamath basin, upper Pit River watershed, Walker River watershed, Mono Lake watershed, and Owens River watershed, and may exist in Sonoma Reservoir in the Russian River watershed.	Inhabit warm reservoirs and ponds where summer temperatures range from 64 to 82 degrees F. Often found in clear water among beds of aquatic vegetation, but can thrive in turbid lakes absent of plants. The species is found along the bottom of inshore regions.	Spawning March through early August	None. There are no recent CNDDB occurrences within the Seller Service Area. Suitable spawning habitat is present in the project area. However, flow reductions as a resullt of this project would be low and would not affect this species.
Sacramento splittail *Pogonichthys macrolepidotus*	**--**	**SSC**	Largely confined to the Delta, Suisun Bay, Suisun Marsh, Napa River, Petaluma River, and other parts of the San Francisco Estuary, while spawning on upstream floodplains and channel edges.	Adapted to estuarine life so thet are tolerant of a wide range of salinities and temperatures. Require a rising hydrograph for upstream migration and flooded vegetation for spawning and rearing areas for their early life history stages.	Year round	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.

Federal

T = listed as threatened under the federal Endangered Species Act

C = Candidate for listing as threatened or endangered

SC = species of concern; formerly Category 2 candidate for federal listing

BGEPA = Bald and Golden Eagle Protection Act

MNBMC = Fish and Wildlife Service: Migratory Nongame Birds of Management Concern

-- = no designations

X = critical habitat

PX = proposed critical habitat

D = delisted

State

E = listed as endangered under the California Endangered Species Act

T = listed as threatened under the California Endangered Species Act

PT- listed as proposed threatened under Federal Endangered Species Act

CE = candidate endangered under the California Endangered Species Act

FP = fully protected under the California Fish and Game Code

SSC = species of special concern

D= delisted

WL = Watch List

-- = no designations

Appendix C
Special Status Plant Species with Potential to Occur

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Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Adobe-lily *Fritillaria pluriflora*	-/-/ 1B	Butte, Colusa, Glenn, Lake, Napa, Solano, Tehama, and Yolo Counties	Often adobe, chaparral, cismontane woodland, and valley/ foothill grassland	February-April	None. Not likely to occur in crop fields, no suitable habitat present.
Ahart's dwarf rush *Juncus leiospermus* var. *ahartii*	-/-/ 1B	Butte, Calaveras, Placer, Sacramento, Tehama, and Yuba Counties.	Valley and foothill grassland (mesic).	March-May	None. Not likely to occur in crop fields, no suitable habitat present.
Alkali milk-vetch *Astragalus tener var. tener*	-/-/ 1B	Central western California including Yolo County.	Subalkaline flats and areas around vernal pools.	March-June	None. Not likely to occur in crop fields, no suitable habitat present (i.e. subalkali flats).
alkai-sink goldfields *Lasthenia chrysantha*	-/-/ 1B	Saccramento and San Joaquin valleys	Vernal pools and wet saline flats	February-April	None. Not likely to occur in crop fields, no suitable habitat is present (i.e. vernal pools).
Anthony Peak lupine *Lupinus antoninus*	-/-/ 1B	Colusa, Lake, Mendocino, Tehama, and Trinity Counties	Rocky lower and upper montane coniferous forest	May-July	None. Not likely to occur in crop fields, no suitable habitat present (i.e. coniferous forest).
Antioch Dunes evening-primrose *Oenothera deltoides* ssp. *howellii*	E,X/E/ 1B	Found only in Contra Costa and Sacramento Counties.	Occurs in inland dunes.	March-September	None. Not likely to occur in crop fields, no suitable habitat present.
Baker's navarretia *Navarretia leucocephala ssp. bakeri*	-/-/1B	Colusa, Glenn, Lake, Lassen, Mendocino, Marin, Napa, Solano, Sonoma, Sutter, Tehama, and Yolo Counties.	Cismontane woodland, meadows and seeps, vernal pools, valley and foothill grassland, lower montane coniferous forest. Vernal pools and swales, adobe or alkaline soils from 5 - 950m.	April - July	None. The CNDDB contains records of this species within the Seller Service Area. It is very unlikely that Baker's navarretia would establish in rice fields, given the lack of adobe or alkaline soils.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
bearded popcornflower *Plagiobothrys hystriculus*	-/-/1B	Napa, Solano, and Yolo Counties.	Vernal pools, valley and foothill grassland in wet sites from 10-50m. This species is only known from a few very limited occurrences at the edges of vernal pools, such as at Jepson Prairie and in the Montezuma Hills.	April - May	None. Previous records of bearded popcorn-flower exist within the Seller Service Area. This species is not expected to occur in rice fields. No vernal pools or grassland habitats would be affected by the proposed Transfers.
bent-flowered fiddleneck *Amsinckia lunaris*	-/-/1B	Alameda, Contra Costa, Colusa, Lake, Marin, Napa, San Benito, Santa Clara, Santa Cruz, San Mateo, Sonoma, and Yolo Counties.	Cismontane woodland, valley and foothill grassland from 50 - 500m.	March - June	None. Bent-flowered fiddleneck has been previously documented within the Buyer Service Area. Although suitable habitat occurs within the area of analysis, none would be affected by the proposed actions.
big-scale balsamroot *Balsamorhiza macrolepis*	-/-/1B	Alameda, Butte, Colusa, El Dorado, Lake, Mariposa, Napa, Placer, Santa Clara, Solano, Sonoma, Tehama, and Tuolumne Counties.	Valley and foothill grassland, cismontane woodland. Sometimes on serpentine. 35 - 1000m	March - June	None. This species has been previously documented within both the Buyer Service Areas. However, it is not expected to occur in rice fields due to lack of suitable habitat.
Boggs Lake hedge-hyssop *Gratiola hetersepela*	-/-/1B	Dispersed throughout the Sacramento and Central Valley. Also in Oregon.	Marsh's, swamps, and vernal pools (clay).	April-August	None. There is a CNDDB occurrence within Sacramento County. Suitable habitat is present but has low potential to occur. No effects anticipated from small changes in river flow.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Bolander's horkelia *Horkelia bolanderi*	-/-/1B	Colusa, Lake, and Mendocino counties	The edges and vernally mesic areas of chaparral, lower montane coniferous forest, meadows and seeps, and valley/ foothill grassland.	May-August	None. There is a CNDDB occurrence within Colusa County. However, it is not expected to occur in rice fields due to lack of suitable habitat and no effects are anticipated from small changes in river flow.
Brittlescale *Atriplex depressa*	-/-/1B	Western Central Valley and valleys of adjacent foothills.	Alkali grassland, alkali meadow, alkali scrub, and vernal pools.	April-October	There is a CNDDB occurrence within Glenn, Colusa, and Yolo counties, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. alkali and vernal pools).
Burke's Goldfields *Lasthenia burkei*	E/-/-	Lake, Mendocino, Napa, and Sonoma counties	Meadows and seeps (mesic), and vernal pools	April-June	None. Although suitable habitat may be present, no CNDDB occurrences were reported in the Seller Service Area. No effects anticipated from small changes in river flow.
Butte County Meadowfoam *Limnanthes floccosa ssp. californica*	E/-/-	Butte County	Valley and foothill grassland (mesic) and vernal pools	March-May	None. Suitable habitat is not present and no CNDDB occurrences were reported in the Seller Service Area. No effects anticipated from small changes in river flow.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
California alkali grass *Puccinellia simplex*	-/-/1B	Alameda, Butte, Contra Costa, Colusa, Fresno, Glenn, Kings, Kern, Lake, Los Angeles, Madera, Merced, Napa, San Bernardino, Santa Clara, Santa Cruz, San Luis Obispo, Solano, Stanislaus, Tulare, and Yolo counties	Alkaline, vernally mesic sinks, flats, and lake margins of chenopod scrub, meadows and seeps, valley and foothill grasslands, and vernal pools	March-May	None. CNDDB records exist for the Seller Service Area. Transfers are not expected to impact suitable habitat for this species.
caper-fruited tropidocarpum *Tropidocarpum capparideum*	-/-/1B	Alameda, Contra Costa, Fresno, Glenn, Monterey, Santa Clara, San Joaquin, and San Luis Obispo Counties.	Valley and foothill grassland in alkaline clay 0 - 455m asl.	March - April	None. CNDDB records exist in Glenn County. Transfers are not expected to impact suitable habitat for this species.
Cobb Mountain lupine *Lupinus sericatus*	-/-/1B	Colusa, Lake, Napa, and Sonoma Counties	Broadleafed upland forest, chaparral, cismontane woodland, and lower montane coniferous forest	March-June	None. There is a CNDDB occurrence within Colusa County, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. coniferous forest).
Colusa grass *Neostapfia colusana*	T,X/E/1B	Southern Sacramento Valley, and northern San Joaquin Valley.	Vernal pools.	May-July	None. There is a CNDDB occurrence within Glenn and Colusa counties, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Colusa layia *Layia septentrionalis*	-/-/1B	Colusa, Glenn, Lake, Mendocino, Napa, Sonoma, Sutter, Tehama, and Yolo Counties.	Chaparral, cismontane woodland, valley and foothill grassland. Scattered colonies in fields and grassy slopes in sandy or serpentine soil 145 - 1095m asl.	April - May	None. CNDDB records exist for the Seller Service Area. Transfers are not expected to impact suitable habitat for this species given that rice fields do not provide appropriate conditions.
Contra Costa Goldfields *Lasthenia conjugens*	E/-/-	San Francisco Bay Delta Regions, and scattered coastal areas.	Cismontane woodlands, playas, valley and foothill grasslands, and vernal pools. Often occurs in vernal pools, swales, and low depressions in open grassy areas 1 - 445m asl.	March-June	None. Suitable habitat is not present and no CNDDB occurrences were reported in the Seller Service Area. No effects anticipated from small changes in river flow.
Contra Costa Wallflower *Erysimum capitatum var. angustatum*	E,X/-/-	Contra Costa County	Inland dunes. Stabilized dunes of sand and clay near Antioch along the San Joaquin River 3 - 20m asl.	March - July	None. Suitable habitat is not present and no CNDDB occurrences were reported in the Seller Service Area. No effects anticipated from small changes in river flow.
Coulter's goldfields *Lasthenia glabrata ssp. coulteri*	-/-/1B	Colusa, Kern, Los Angeles, Merced, Orange, Riverside, Santa Barbara, San Bernardino, San Diego, San Luis Obispo, Tehama, Tulare, Ventura, and Yolo counties	Marshes and swamps, playas, and vernal pools	February-June	None. CNDDB records exist in Colusa and Glenn counties. Transfers are not expected to impact suitable habitat for this species.
Crampton's tuctoria (Solano grass) *Tuctoria mucronata*	E,X/E/1B	Located only in Yolo and Solano Counties.	Valley and foothill grassland (mesic), and vernal pools.	April-August	None. Not likely to occur in crop fields, no suitable habitat present.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Deep-scarred cryptantha *Cryptantha excavata*	-/-/1B	Colusa, Lake, Mendocino, and Yolo counties	Sandy and gravelly portions of cismontane woodland	April-May	None. There are CNDDB records of this species within Yolo and Colusa counties. However, it is not expected to occur in rice fields due to lack of suitable habitat and no effects are anticipated from small changes in river flow.
Delta tule pea *Lathyrus jepsonii var. jepsonii*	-/-/1B	Contra Costa, Napa, Sacramento, San Joaquin, Solano, Sonoma and Yolo Counties.	Marshes and swamps (freshwater and brackish)	May-July	None. This species has been previously documented within the Seller Service Area. No impacts to suitable habitat is anticipated.
Diamond-petaled California poppy *Eschscholzia rhombipetala*	-/-/1B	Alameda, Contra Costa, Colusa, San Joaquin, San Luis Obispo, Stanislaus Counties.	Valley and foothill grassland. Alkaline clay slopes and flats. 0 - 975m asl.	March - April	None. This species has been previously documented in Colusa County. No impacts to suitable habitat are anticipated.
Drymaria-like western flax *Hesperolinon drymarioides*	-/-/1B	Colusa, Glenn, Lake, Napa, and Yolo Counties	Serpentinite closed-cone coniferous forest, chaparral, cismontane woodland, and valley and foothill grassland.	May-August	None. There are CNDDB occurrences in Glenn and Colusa counties, however this species is not likely to occur in crop fields due
Dwarf soaproot *Chlorogalum pomeridianum var. minus*	-/-/1B	Alameda, Colusa, Glenn, Lake, Santa Clara, San Luis Obispo, Sonoma, and Tehama Counties	Chaparral (serpentinite)	May-August	None. There are CNDDB records in Glenn and Colusa counties; however not likely to occur in crop fields, no suitable habitat will be impacted.
El Dorado bedstraw *Galium californicum ssp. sierrae*	E/-/-	El Dorado County	Gabbroic chaparral, cismontane woodland, and lower montane coniferous forest	May-June	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Ferris' milk-vetch *Astragalus tener* var. *ferrisae*	-/-/1B	Sacramento Valley.	Subalkaline flats and areas around vernal pools.	March-June	None. Although there are CNDDB occurrences within the Seller Service Area, the species is not likely to occur in crop fields, no suitable habitat will be impacted.
Fleshy Owl's-clover *Castilleja campestris ssp. succulenta*	T,X/-/-	Fresno, Madera, Merced, Mariposa, San Joaquin, and Stanislaus Counties	Vernal pools, oftern acidic	March-May	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
green jewelflower *Streptanthus hesperidis*	-/-/1B	Colusa, Glenn, Lake, Napa, Sonoma, and Yolo Counties	Serpentinite, rocky chaparral and cismontane woodlands	May-July	None. There are CNDDB records in Glenn and Yolo counties; however not likely to occur in crop fields, no suitable habitat will be impacted.
Greene's narrow-leaved daisy *Erigeron greenei*	-/-/1B	Colusa, Lake, Napa, and Sonoma Counties	Serpentinite or volcanic chaparral	May-September	None. There are CNDDB records in Colusa County; however not likely to occur in crop fields, no suitable habitat is present.
Greene's tuctoria *Tuctoria greeni*	E/SSC/1B	Butte, Colusa, Fresno, Glenn, Madera, Merced, Modoc, Shasta, San Joaquin, Stanislaus, Tehama, and Tulare Counties.	Vernal pools.	May-July	There is a CNDDB occurrence, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Hairy Orcutt grass *Orcuttia pilosa*	E/E/1B	Northern Sacramento Valley, Pit River Valley; isolated populations in Lake and Sacramento counties.	Vernal pools.	May-September	None. There is a CNDDB occurrence within Butte and Glenn counties, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).
Hall's harmonia *Harmonia hallii*	-/-/1B	Colusa, Lake, Napa, and Yolo Counties	Serpentinite chaparral	April-June	None. CNDDB records exist for the Seller Service Area. Transfers are not expected to impact suitable habitat for this species.
Hartweg's golden sunburst *Pseudobahia bahiifolia*	E/-/1B	Fresno, Madera, Merced, Stanislaus, Tuolumne, and Yuba counties	Clay and often acidic, cismontane woodland, and valley and foothill grassland	March-April	None. CNDDB records exist within Sutter County. Transfers are not expected to impact suitable habitat for this species.
Heartscale *Atriplex cordulata*	-/-/1B	Western Central Valley and valleys of adjacent foothills.	Alkali grasslands, alkali meadows, and alkali scrub.	May-October	None. There is a CNDDB occurrence within Butte, Colusa, Yolo, and Glenn counties, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. alkali areas).
Heckard's pepper-grass *Lepidium latipes* var**.** *heckardii*	-/-/1B	Glenn, Solano, and Yolo Counties.	Valley and foothill grassland alkaline flats.	March-May	None. There is a CNDDB occurrence, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. alkali flats).

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Hoover's cryptantha *Cryptantha hooveri*	-/-/1A	Contra Costa, Kern, Madera, Stanislaus Counties.	Valley and foothill grassland in coarse sand up to 150m asl.	April - May	None. Hoover's cryptantha has been observed within the Seller Service Area. No impacts to suitable habitat for this species are anticipated.
Hoover's spurge *Chamaesyce hooveri*	T/-/ 1B	Scattered in Glenn, Butte, Colusa, Merced, Stanislaus, Tehama, and Tulare Counties.	Vernal pools.	July-September	None. There is a CNDDB occurrence, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).
Indian valley brodiaea *Broiaea coronaria* ssp. *rosea*	-/E/-	Scattered in Glenn, Lake, Colusa, and Tehama Counties.	Closed cone coniferous forest, chaparral, valley and foothill grasslands (serpentinite).	May-June	None. There is a CNDDB occurrence, however this species is not likely to occur in crop fields due to lack of suitable habitat.
Ione (incl. Irish Hill) Buckwheat *Eriogonum apricum (incl. var. prostratum)*	E/-/-	Amador and Sacramento Counties	Chaparral	July-October	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Ione Manzanita *Arctostaphylos myrtifolia*	T/-/-	Amador and Calaveras counties	Acidic, ione soil, clay or sandy chaparral and cismontane woodland	November-March	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Jepson's coyote-thistle *Eryngium jepsonii*	-/-/1B	Alameda, Amador, Calaveras, Contra Costa, Fresno, Napa, San Mateo, Solano, Stanislaus, Tuolumne, and Yolo counties	Clay soils of valley and foothill grassland and vernal pools	April-August	None. The species has been observed within the Seller Service Area. No impacts to suitable habitat for this species are anticipated.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Jepson's leptosiphon *Leptosiphon jepsonii*	-/-/1B	Lake, Napa, Sonoma, and Yolo counties	Usually volcanic soils of chaparral, cismontane woodland, and valley and foothill grassland	March-May	None. The species has been observed within Yolo County. No impacts to suitable habitat for this species are anticipated.
Jepson's milk-vetch *Astragalus rattanii var. jepsonianus*	-/-/1B	Colusa, Glenn, Lake, Napa, Tehama, and Yolo counties.	Chaparral, cismontane woodland, valley and foothill grassland, often serpentinite.	April-June	None. There are CNDDB occurrences, however this species is not likely to occur in crop fields due to lack of suitable habitat.
Keck's checkerbloom *Sidalcea keckii*	E/-/1B	Colusa, Fresno, Merced, Napa, Solano, Tulare, and Yolo counties.	Cismontane woodlands, foothill and valley grasslands (serpentinite).	April-May	None. Thereare CNDDB occurrences, however this species is not likely to occur in crop fields due to lack of suitable habitat.
Klamath sedge *Carex klamathensis*	-/-/1B	Colusa, Lake, and Tehama counties	Serpentinite chaparral, cismontane woodland, and meadows/ seeps	--	None. Klamath sedge has been recorded by the CNDDB within the Seller Service Area. No impacts would occur to suitable habitat.
Konocti manzanita *Arctostaphylos manzanita ssp. elegans*	-/-/1B	Colusa, Glenn, Humbodlt, Lake, Mendocino, Napa, Shasta, Sonoma, Tehama, and Trinity counties	Volcanic soils of chaparral, cismontane woodland, and lower montane coniferous forest	January-July	None. There is a CNDDB occurrence within Glenn and Colusa counties, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. coniferous forest).
Large-flowered fiddleneck *Amsinckia grandiflora*	E/-/-	Alameda, Contra Costa, and San Joaquin Counties.	Cismontane woodland, valley and foothill grassland. Annual grassland in various soils 275 - 550m asl.	April - May	None. Large-flowered fiddleneck has been recorded by the CNDDB within the Seller Service Area. No impacts would occur to suitable habitat.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Layne's Butterweed *Senecio layneae*	T/-/1B	El Dorado, Placer, Tuolumne, and Yuba counties	Serpentinite or gabbroic, rocky soils of chaparral and cismontane woodland	April-August	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Legenere *Legenere limosa*	SC/-/1B	Sacramento Valley and south of the North Coast Ranges.	Vernal pools.	May-June	None. Not likely to occur in crop fields, no suitable habitat present (i.e. vernal pools)
Marsh checkerbloom *Sidalcea oregana* ssp. *hydrophila*	-/-/1B	Glenn, Lake, Mendocino, and Napa Counties.	Meadows and seeps, and riparian forest.	June-August	None. There are CNDDB records of this species within the Seller Service Area. Not likely to establish in crop fields and no effects anticipated from small changes in river flow.
Mason's lilaeopsis *Lilaeopsis masonii*	-/R/1B	Alameda, Contra Costa, Marin, Napa, Sacramento, San Joaquin, Solano, and Yolo Counties.	Freshwater and brackish marshes, riparian scrub. Tidal zones, in muddy or silty soil formed through river deposition or river bank erosion 0 - 10m asl. Populations may be ephemeral, using freshly deposited	April - November	None. Previous records of this species exist within the Buyer Service Area. This species is not expected to establish within rice fields.
Milo Baker's lupine *Lupinus milo-bakeri*	-/T/1B	Glenn and Mendocino Counties.	Cismontane woodlands, foothill and valley grasslands.	June-September	None. There is a CNDDB occurrence, however this species is not likely to occur in crop fields due to lack of suitable habitat.
Northern California black walnut *Juglans hindsii*	-/-/1B	Inner North Coast ranges, Sacramento and San Joaquin Valleys, San Francisco Bay Area	Located along stream and disturbed slopes	April-May	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields. No impacts to the species is anticipated.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Oregon fireweed *Epilobium oreganum*	-/-/1B	Del Norte, El Dorado, Glenn, Humboldt, Mendocino, Nevada, Placer, Shasta, Siskiyou, Tehama, and Trinity counties	Mesic soils of bogs, fens, lower montane coniferous forest, meadows, seeps, and upper montane coniferous forest	June-September	None. CNDDB records of this species exist within Glenn County. Suitable habitat is not present and species is not likely to be impacted by water transfers.
Palmate-bracted bird's-beak *Chloropyron palmatum*	E/E/1B	Found in Glenn and Colusa Counties and within the Central Valley.	Alkali meadow, alkali scrub, valley and grasslands.	May-October	None. CNDDB records of this species exist for the Seller Service Area. Not likely to occur in rice fields; no suitable habitat is present (i.e. alkali areas).
Pappose tarplant *Centromadia parryi ssp. parryi*	-/-/1B	Butte, Colusa, Glenn, Lake, Napa, San Mateo, Solano, Sonoma, and Yolo counties	Often alkaline soils of chaparral, coastal prairie, meadows and seeps, marshes and swamps, and valley and foothill grassland	May-November	None. There are occurrences within Glenn, Colusa, and Yolo counties. This species is not expected to establish within rice fields.
Pincushion navarretia *Navarretia myersii ssp. myersii*	-/-/1B	Amamdor, Calaveras, Merced, Placer, and Sacramento Counties.	Vernal pools (often acidic).	May	None. Previously documented in Sacramento County. No vernal pools would be affected by Transfers.
Pine Hill ceanothus *Ceanothus roderickii*	E/-/-	El Dorado County	Serpentinite or gabbroic soils of chaparral and cismontane woodland	April-June	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Pine Hill flannelbush *Fremonodendron californicum ssp. decumbens*	E/-/-	El Dorado, Nevada, and Yuba counties	Rocky, Gabbroic or serpentinite soils of chaparral and cismontane woodland	April-July	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
pink creamsacs *Castilleja rubicundula var. rubicundula*	-/-/1B	Butte, Contra Costa, Colusa, Glenn, Lake, Napa, Santa Clara, and Shasta counties	Serpentinite soils of chapparal, cismontane woodland, meadows and seeps, and valley and foothill grassland habitat	April-June	None. CNDDB records of the species have been documented in Yolo, Colusa, and Glenn counties. The species is not likely to occur within crop fields and is not anticipated to be affected by transfering water.
Porter's navarretia *Navarretia paradoxinota*	-/-/1B	Colusa, Lake, and Napa counties	Serpentinite, openings, vernally mesic, and drainages of meadows and seeps	May-July	None. There is a CNDDB record in Colusa County, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. meadows and seeps).
Recurved larkspur *Delphinium recurvatum*	-/-/1B	Disbursed throughout the Sacramento and Central Valley.	Chenopod scrub, cismontane, valley and foothill grasslands (alkali).	March-June	None. There is a CNDDB occurrence, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. alkali soil).
red-flowered bird's-foot trefoil *Acmispon rubriflorus*	-/-/1B	Colusa, Stanislaus, and Tehama counties	Cismontane woodland and valley and foothill grassland	April-June	None. CNDDB records of this species exist within Colusa County. Suitable habitat is not present and species is not likely to be impacted by water transfers.
Sacramento orcutt grass *Orcuttia viscida*	E,X/E/1B	Valley grasslands and freshwater wetlands.	Vernal pools.	May-June	None. There is a CNDDB occurrence, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
saline clover *Trifolium hydrophilum*	-/-/1B	California's Central coast and Bay Area.	Marshes and swamps, valley and foothill grassland, vernal pools. Mesic, alkaline sites 0 - 300m asl.	April - June	None. Records of saline clover exist within the Seller Service Areas. Rice fields may represent marginally suitable habitat for this species, even so this species is unlikely to be affected by water transfers.
San Joaquin spearscale *Atriplex joaquiniana*	-/-/1B	Western Central Valley and valleys of adjacent foothills.	Alkali grasslands, and alkali scrub.	April-September	None. There are CNDDB records within the Seller Service Area, however the species is not likely to occur in crop fields, no suitable habitat present (i.e. alkali soils).
Sanford's arrowhead *Sagittaria sanfordii*	-/-/1B	Central Valley.	Freshwater marshes, shallow streams, and ditches.	May-August	None. Suitable habitat on present in ditches; not yet detected. Not likely to establish in crop fieldsand no effects anticipated from small changes in river flow.
Scabrid alpine tarplant *Anisocarpus scabridus*	-/-/1B	Colusa, Humboldt, Lake, Mendocino, Shasta, Tehama, and Trinity counties	Metamorphic, rocky soils of upper montane coniferous forest	June-September	None. There is a CNDDB record in Colusa County, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. montane coniferous forest)
Serpentine cryptantha *Cryptantha dissita*	-/-/1B	Colusa, Lake, Mendocino, Napa, Shasta, Siskiyou, and Sonoma counties	Chaparral (serpentinite)	April-June	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Shining navarretia *Navarretia nigelliformis ssp. radians*	-/-/1B	Alameda, Contra Costa, Fresno, Merced, Monterey, San Benito, San Joaquin, and San Luis Obispo Counties.	Cismontane woodland, valley and foothill grassland, and vernal pools 200 - 1000m asl. Known from grassland, and may not necessarily occur in vernal pools.	April - July	None. There are previous CNDDB records of shining navarettia exist for the Seller Service Area. This species is unlikely to establish within rice fields due to lack of suitable habitat (i.e., vernal pools and native grassland).
Showy Indian Clover *Trifolium amoenum*	E/-/1B	North Coast Ranges, Central Coast and San Francisco Bay	Valley grassland, wetland-riparian	April - June	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields. No impacts to the species is anticipated.
Silky cryptantha *Cryptantha crinita*	-/-/1B	Glenn, Shasta, and Tehama counties	Gravelly streambeds of cismontane woodland, lower montane coniferous forest, riparian forest, riparian woodland, and valley and foothill grassland	April-May	None. There is a previous CNDDB record in Glenn County. The species is not likely to occur in crop fields, no suitable habitat present (i.e. gravelly streambeds).
Slender Orcutt grass *Orcuttia tenuis*	T,X/E/1B	Northern Sacramento Valley, Pit River Valley; isolated populations in Lake and Sacramento Counties	Vernal pools.	May-July	None. There are CNDDB occurrences, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).
Small-flowered calycadenia *Calycadenia micrantha*	-/-/1B	Colusa, Humboldt, Lake, Monterey, Napa, and Trinity counties	Roadsides, rocky, talus, scree and sparsely vegetated areas of chaparral, meadows, and valley and foothill grassland	June-September	None. There is a single CNDDB occurrence in Colusa County. Suitable habitat for this species is not likely to be impacted by water transfers.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Snow Mountain buckwheat *Eriogonum nervulosum*	-/-/1B	Colusa, Glenn, Lake, Napa, Sonoma, and Yolo Counties	Chaparral (serpentinite)	June-September	None. The CNDDB contains records of this species within the Seller Service Area. It is very unlikely that Baker's navarretia would establish in rice fields, given the lack of chaparral.
Snow Mountain willowherb *Epilobium nivium*	-/-/1B	Colusa, Glenn, Lake, Mendocino, Tehama, and Trinity	Rocky chaparral and upper montane coniferous forest	June-October	None. Snow mountain willowherb has been recorded by the CNDDB within the Seller Service Area. No impacts would occur to suitable habitat.
Soft salty bird's beak *Chloropyron molle* ssp. *Molle*	E/R/1B	Contra Costa, Marin, Napa, Sacrmaneto, Solano, and Sonoma counties	Marshes and swamps	June-November	None. There is a single CNDDB occurrence in Sacramento County. Suitable habitat for this species is not likely to be impacted by water transfers.
Stebbins' Morning-glory *Calystegia stebbinsii*	E/-/-	El Dorado and Nevada counties	Gabbroic and serpentinite soils of chaparral and cismontane woodland	April-June	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Stony Creek spurge *Euphorbia ocellata ssp. rattanii*	-/-/1B	Glenn and Tehama counties	Chaparral, riparian scrub, and valley and foothill grassland	May-October	None. There are multiple CNDDB occurrences in Glenn County. However this species is not likely to occur within crop fields and is not likely to be impacted.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Suisun Marsh aster *Symphyotrichum lentum*	-/-/1B	Contra Costa, Napa, Sacramento, San Joaquin, Solano, and Yolo Counties.	Saline and freshwater marshes and swamps. Most often seen along sloughs with Phragmites, Scirpus, blackberry, Typha, etc. at 0-3m asl.	May - November	None. This species has been previously documented in Sacramento and Yolo counties. This species is not expected to occur within rice fields given
Tehama County western flax *Hesperolinon tehamense*	-/-/1B	Alameda, Glenn, Lake, Napa, Stanislaus, and Tehama counties	Serpentinite chaparral and cismontane woodland	May-July	None. Previously documented in Glenn County. No chaparral and cismontane woodland habitat would be affected by Transfers.
Three-fingered morning-glory *Calystegia collina ssp. tridactylosa*	-/-/1B	Colusa, Glenn, Lake, Mendocino, and Sonoma counties	Serpentinite, rocky, gravelly, openings of chaparral and Cismontane woodlands.	April-June	None. There is a single occurrence in Colusa County. Not likely to occur in crop fields, no suitable habitat is present.
Tuolumne button-celery *Eryngium pinnatisectum*	-/-/1B	Amador, Calaveras, Sacramento, Sonoma, and Tuolumne counties	Cismontane woodlands, lower montane coniferous forest, and vernal pools	May- August	None. There is a single occurrence of this species in Sacramento County. Not likely to occur in crop fields, no suitable habitat present (i.e. vernal pools).
Veiny monardella ***Monardella venosa***	-/-/1B	Butte, Sutter, Tuolumne, and Yuba counties	Clay soils of cismontane woodland and valley/foothill grasslands	May-July	None. There is a single occurrence of this species in Sutter County. Not likely to occur in crop fields, no suitable habitat present.
Vernal pool smallscale *Atriplex persistens*	-/-/1B	Colusa, Madera, Merced, Solano, Stanislaus, and Tulare counties	Vernal pools	June, August, September, October	None. There are CNDDB occurrences in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present (i.e. vernal pools).

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Woolly rose-mallow *Hibiscus lasiocarpos var. occidentalis*	-/-/1B	Butte, Contra Costa, Colusa, Glenn, Sacramento, San Joaquin, Solano, Sutter, and Yolo Counties.	Marshes and swamps (freshwater). Moist, freshwater-soaked river banks and low peat islands in sloughs. Known from the Delta watershed 0 - 150m asl.	June - September	None. Previously observed in the Seller Service Area. Not likely to establish in rice fields given the lack of suitable habitat (marsh and swamp). This species is sensitive to habitat disturbance and agricultural amendments.

***Status explanations:**
x= critical habitat

F=Federal
E=Endangered
T=Threatened
SC= Special Concern

S=State
E=Endangered
T=Threatened
SSC=Species of Special Concern

CNPS=California Native Plant Society
1B=Rare, threatened, or endangered in California and elsewhere
2=Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere
3=Plants about which we need more information - A review list

Appendix D

Groundwater Existing Conditions

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Appendix D
Groundwater Existing Conditions

Table D-1 provides a summary of the Sustainable Groundwater Management Act (SGMA) basin prioritization for each subbasin within the Seller Service Area. High- and medium-priority groundwater subbasins are required to have Groundwater Sustainability Plans (GSP) developed by January 31, 2022. GSPs for all the subbasins in the Seller Service Area are under development.

Table D-1. Sustainable Groundwater Management Act Basin Prioritization

Subbasin	Groundwater Sustainability Agency/Agencies (GSA)	Priority
Anderson	Enterprise-Anderson GSA	Medium
Enterprise	Enterprise-Anderson GSA	Medium
Colusa	Reclamation District No. 1004 GSA - Colusa Colusa Groundwater Authority GSA - Colusa Glenn Groundwater Authority GSA County of Glenn GSA - Colusa	High
Sutter	Sutter Community Service District GSA Butte Water District GSA - Sutter Sutter Extension Water District GSA City of Live Oak GSA County of Sutter GSA - Sutter Reclamation District No. 1500 GSA City of Yuba City GSA Reclamation District No. 70 GSA Reclamation District No. 1660 GSA	Medium
Yolo	Yolo Subbasin GSA	High
North American	Sacramento Groundwater Authority GSA West Placer GSA South Sutter Water District GSA Reclamation District No. 1001 GSA County of Sutter GSA - North American	High

Source: California Department of Water Resources, 2020. Basin Prioritization. https://water.ca.gov/Programs/Groundwater-Management/Basin-Prioritization.

This appendix includes the following figures:

Figures D-1 through D-3: Spring 2004 to Spring 2020 change in groundwater elevation in shallow (<200 feet bgs), intermediate (200-600 feet bgs), and deep (>600 feet bgs) wells. These figures were retrieved from DWR's Groundwater Open Data Portal (https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps)

Figures D-4 through D-6: Spring 2011 to Spring 2020 change in groundwater elevation in shallow (<200 feet bgs), intermediate (200-600 feet bgs), and deep (>600 feet bgs) wells. These figures were retrieved from DWR's Groundwater Open Data Portal (https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps)

Figures D-7 through D-9: Spring 2015 to Spring 2020 change in groundwater elevation in shallow (<200 feet bgs), intermediate (200-600 feet bgs), and deep (>600 feet bgs) wells. These figures were retrieved from DWR's Groundwater Open Data Portal (https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps)

Figures D-10 through D-12: Spring 2019 to Spring 2020 change in groundwater elevation in shallow (<200 feet bgs), intermediate (200-600 feet bgs), and deep (>600 feet bgs) wells. These figures were retrieved from DWR's Open Data Portal (https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps)

Figures D-13 through D-15: Spring 2004 to Spring 2015 change in groundwater elevation in shallow (<200 feet bgs), intermediate (200-600 feet bgs), and deep (>600 feet bgs) wells. These figures were retrieved from DWR's Open Data Portal (https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps)

Figures D-16 through D-40: Groundwater monitoring data for wells within the seller districts. DWR's CASGEM website and was used to obtain the monitoring data. The process to query out the groundwater level data is explained below.

Direction to manually lookup groundwater level data from DWR's CASGEM website:

Example Well 29N04W15E002M

1. Go to CASGEM Public Login website: http://www.water.ca.gov/groundwater/casgem/online_system.cfm (setup login if not previously done)

2. Select Well Information> State Well Number. Input well number (29N04W15E002M for this example)

3. Go to Well Details: View> View Hydrograph

Figure 41: Zamora Extensometer 11N01E24Q008M Land Subsidence Extensometer Plot. This figure was retrieved from DWR's Water Data Library (https://wdl.water.ca.gov/WaterDataLibrary/StationDetailsNew.aspx?Station=11N01E24Q008M&source=map)

Figure 42: Conaway Ranch Extensometer 09N03E08C004M Land Subsidence Extensometer Plot. This figure was retrieved from DWR's Water Data Library (https://wdl.water.ca.gov/WaterDataLibrary/StationDetailsNew.aspx?Station=09N03E08C004M&source=map)

Figure 43: Sutter Extensometer 11N04E04N005M Land Subsidence Extensometer Plot. This figure was retrieved from DWR's Water Data Library (https://wdl.water.ca.gov/WaterDataLibrary/StationDetailsNew.aspx?Station=11N04E04N005M&source=map)

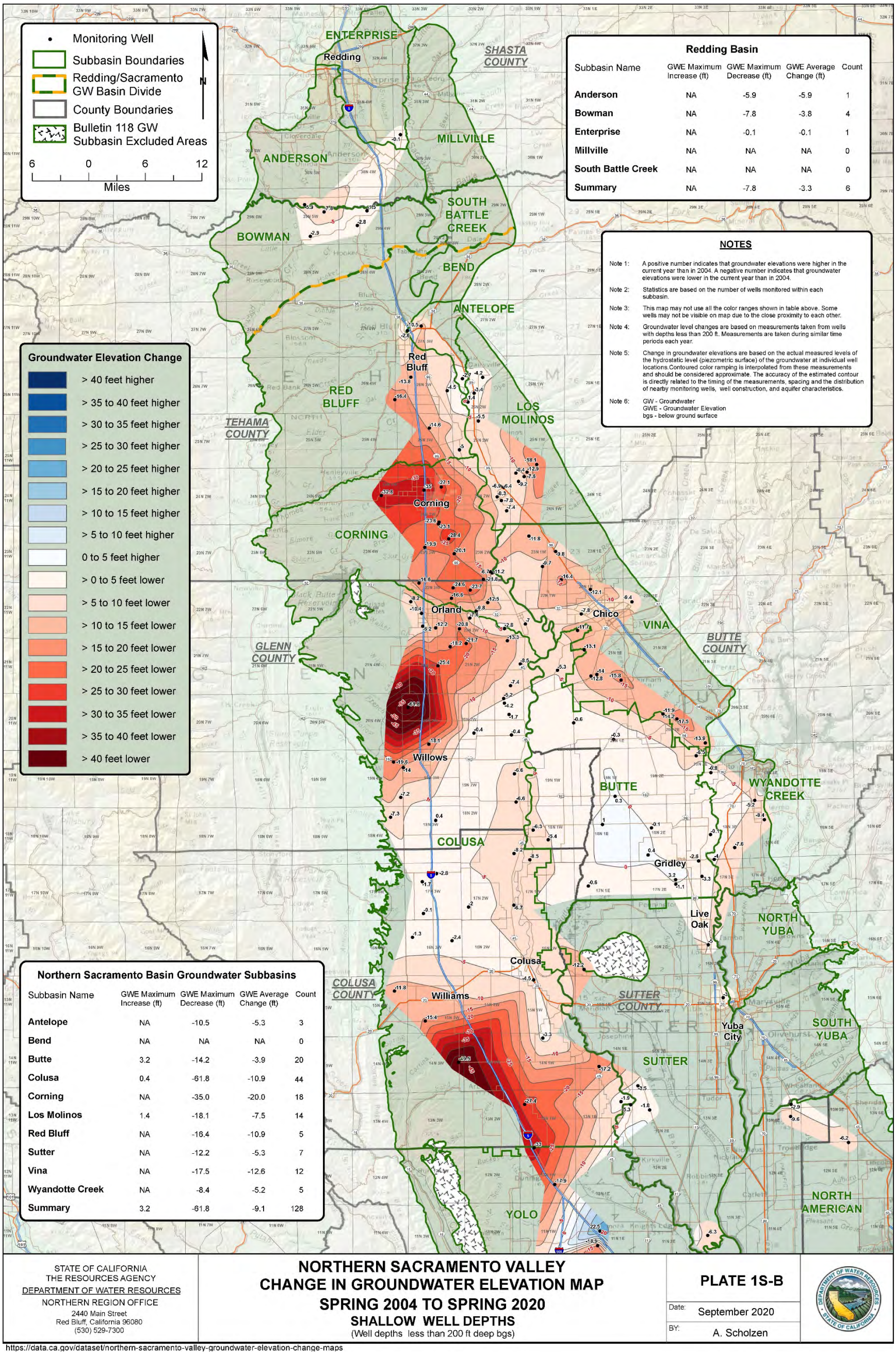


Figure D-1. Spring 2004 to Spring 2020 Change in Groundwater Elevation in Shallow Wells (< 200 ft bgs)

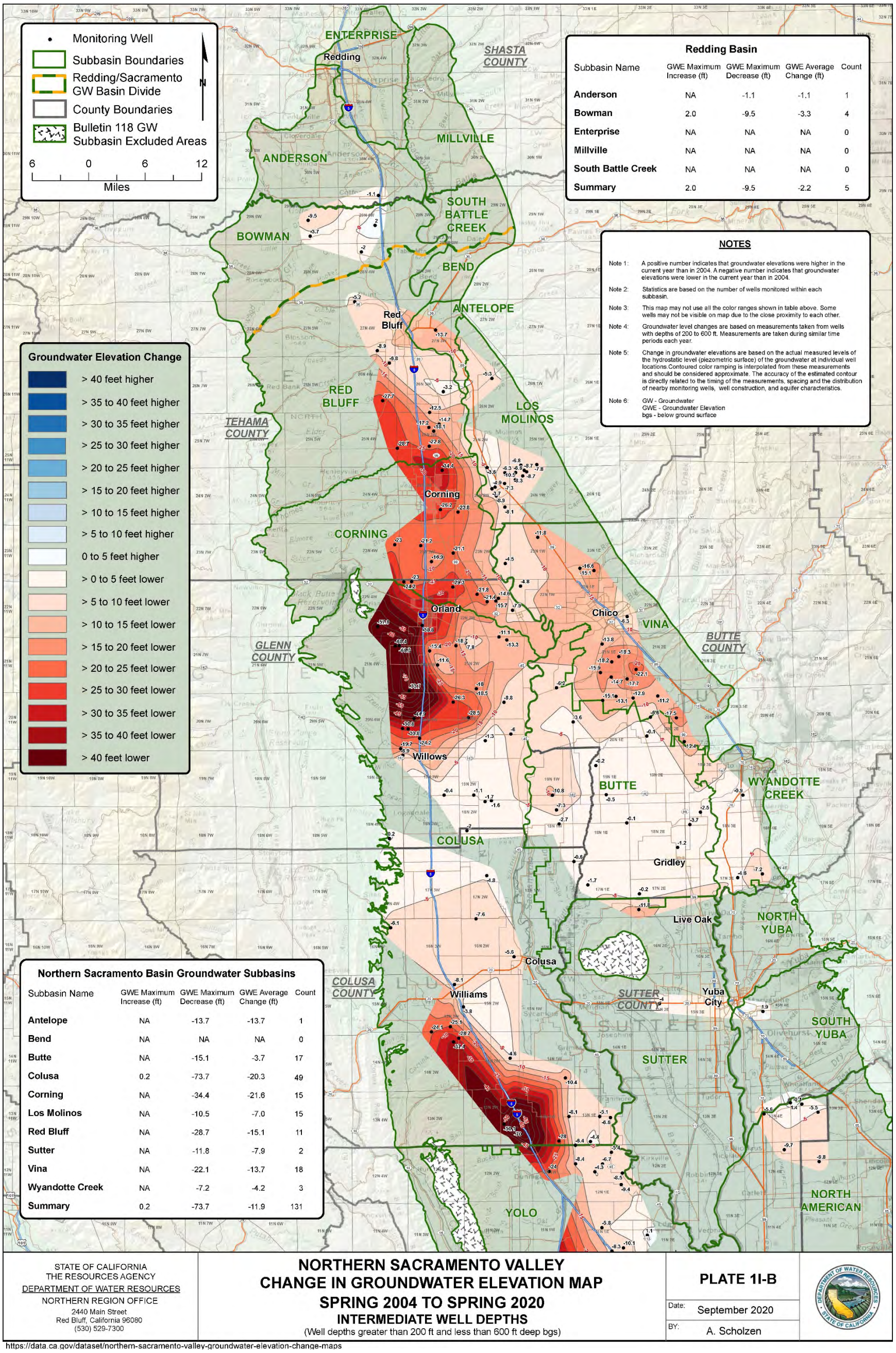
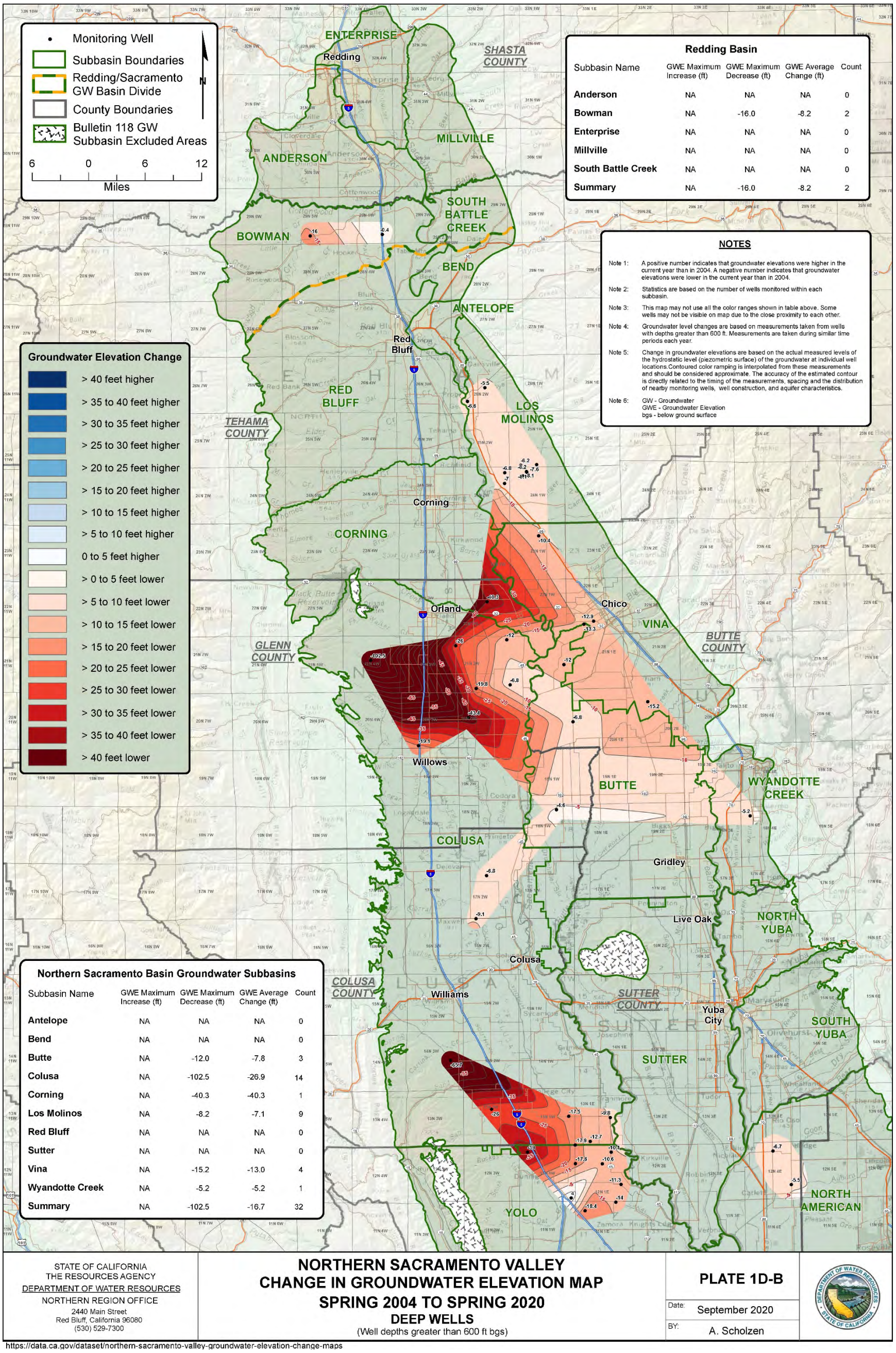


Figure D-2. Spring 2004 to Spring 2020 Change in Groundwater Elevation in Intermediate Wells (200-600 ft bgs)



Redding Basin

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Anderson	NA	NA	NA	0
Bowman	NA	-16.0	-8.2	2
Enterprise	NA	NA	NA	0
Millville	NA	NA	NA	0
South Battle Creek	NA	NA	NA	0
Summary	NA	-16.0	-8.2	2

NOTES

Note 1: A positive number indicates that groundwater elevations were higher in the current year than in 2004. A negative number indicates that groundwater elevations were lower in the current year than in 2004.

Note 2: Statistics are based on the number of wells monitored within each subbasin.

Note 3: This map may not use all the color ranges shown in table above. Some wells may not be visible on map due to the close proximity to each other.

Note 4: Groundwater level changes are based on measurements taken from wells with depths greater than 600 ft. Measurements are taken during similar time periods each year.

Note 5: Change in groundwater elevations are based on the actual measured levels of the hydrostatic level (piezometric surface) of the groundwater at individual well locations.Contoured color ramping is interpolated from these measurements and should be considered approximate. The accuracy of the estimated contour is directly related to the timing of the measurements, spacing and the distribution of nearby monitoring wells, well construction, and aquifer characteristics.

Note 6: GW - Groundwater
GWE - Groundwater Elevation
bgs - below ground surface

Northern Sacramento Basin Groundwater Subbasins

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Antelope	NA	NA	NA	0
Bend	NA	NA	NA	0
Butte	NA	-12.0	-7.8	3
Colusa	NA	-102.5	-26.9	14
Corning	NA	-40.3	-40.3	1
Los Molinos	NA	-8.2	-7.1	9
Red Bluff	NA	NA	NA	0
Sutter	NA	NA	NA	0
Vina	NA	-15.2	-13.0	4
Wyandotte Creek	NA	-5.2	-5.2	1
Summary	NA	-102.5	-16.7	32

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NORTHERN REGION OFFICE
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Red Bluff, California 96080
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NORTHERN SACRAMENTO VALLEY
CHANGE IN GROUNDWATER ELEVATION MAP
SPRING 2004 TO SPRING 2020
DEEP WELLS
(Well depths greater than 600 ft bgs)

PLATE 1D-B
Date: September 2020
BY: A. Scholzen

https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps

Figure D-3. Spring 2004 to Spring 2020 Change in Groundwater Elevation in Deep Wells (>600 ft bgs)

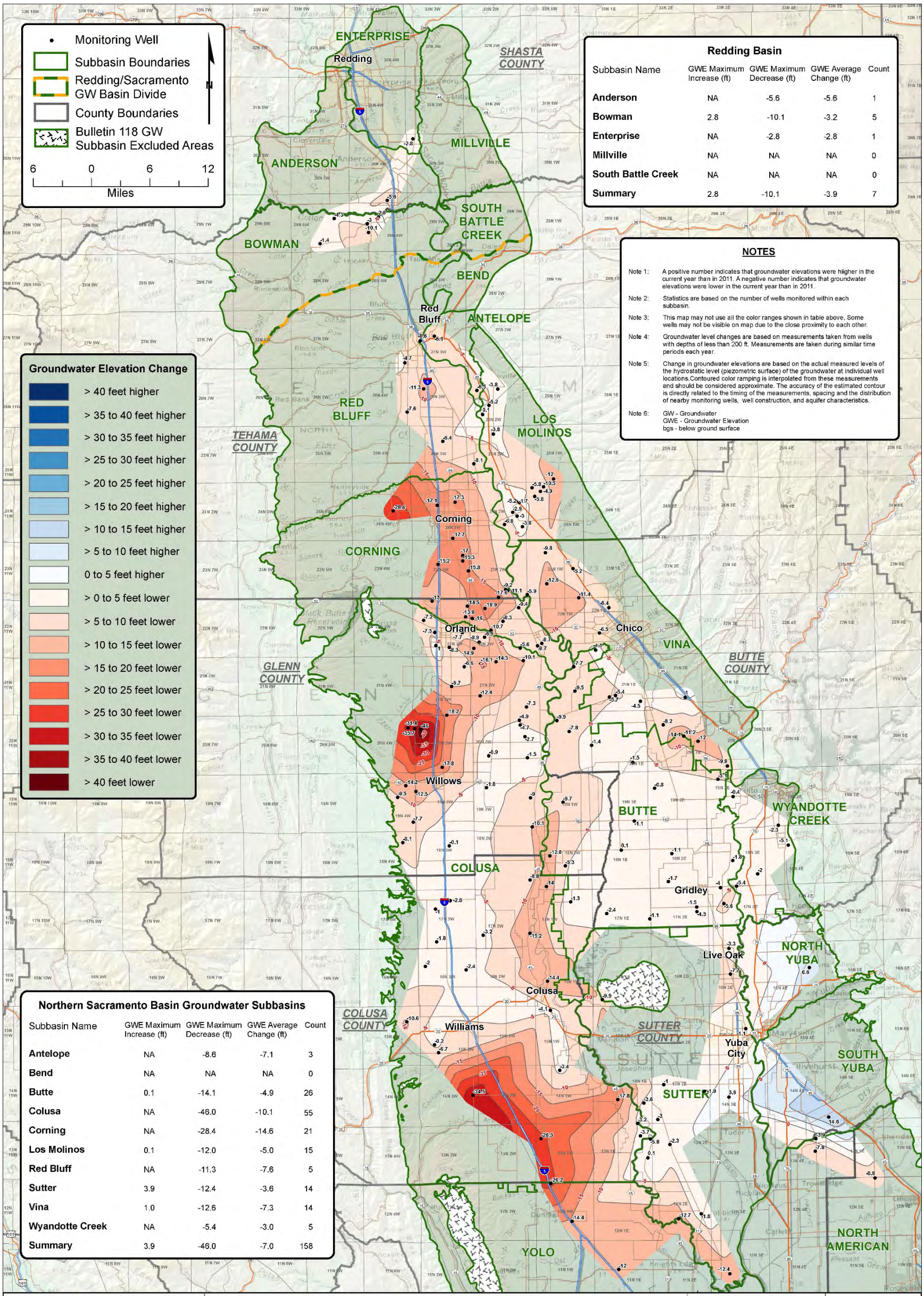


Figure D-4. Spring 2011 to Spring 2020 Change in Groundwater Elevation in Shallow Wells (<200 ft bgs)

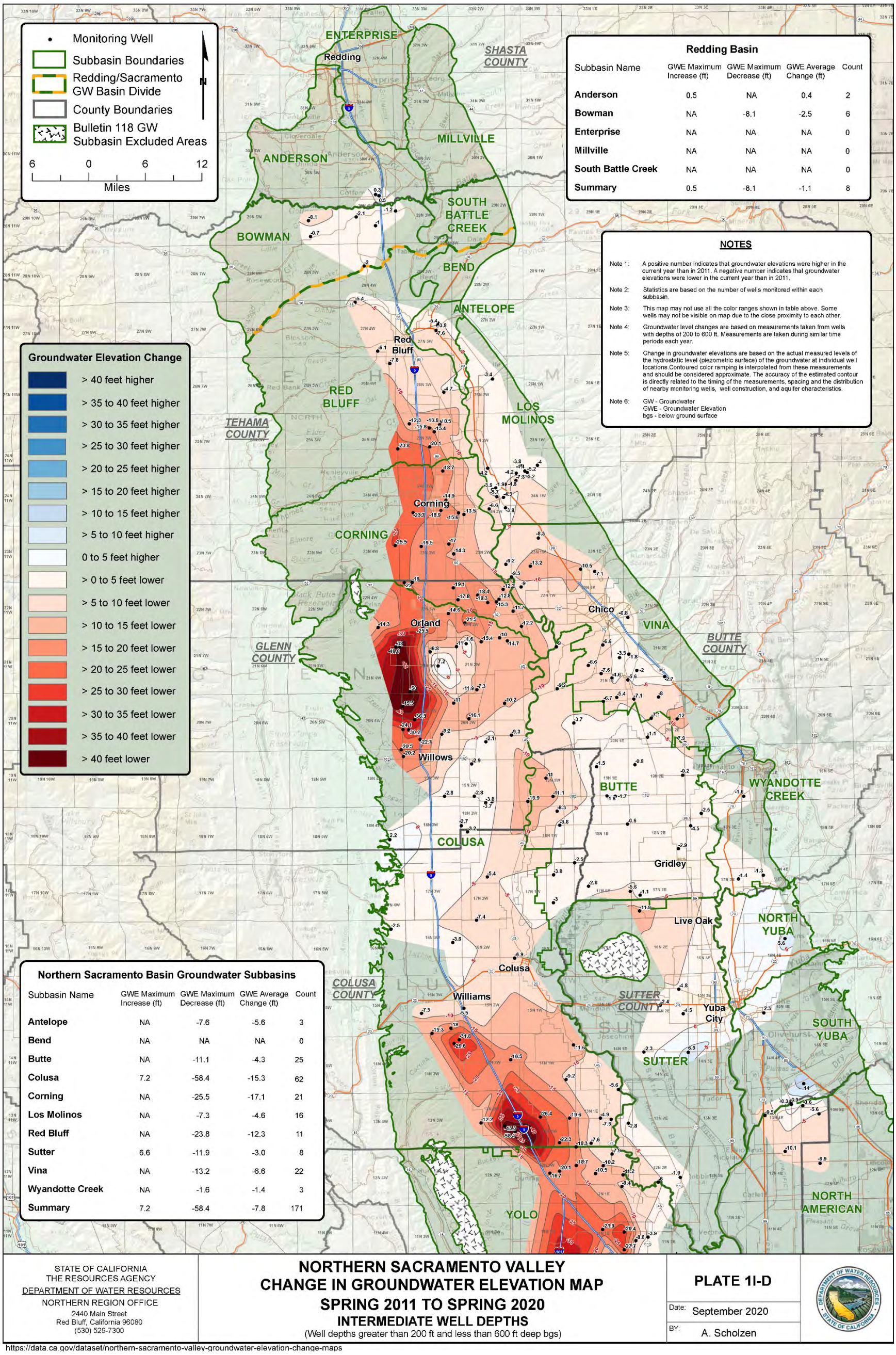
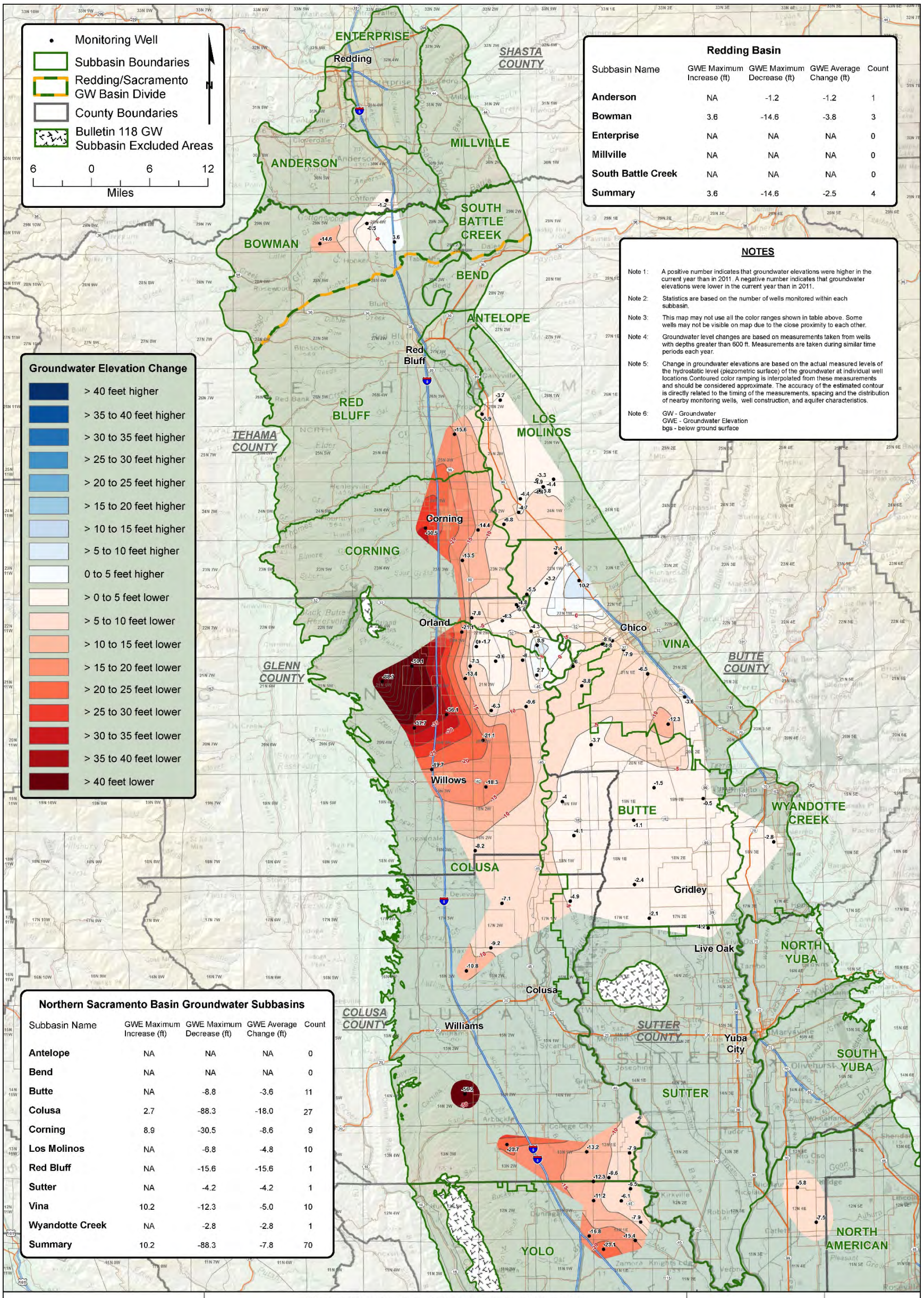


Figure D-5. Spring 2011 to Spring 2020 Change in Groundwater Elevation in Intermediate Wells (200-600 ft bgs)



Redding Basin

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Anderson	NA	-1.2	-1.2	1
Bowman	3.6	-14.6	-3.8	3
Enterprise	NA	NA	NA	0
Millville	NA	NA	NA	0
South Battle Creek	NA	NA	NA	0
Summary	3.6	-14.6	-2.5	4

NOTES

Note 1: A positive number indicates that groundwater elevations were higher in the current year than in 2011. A negative number indicates that groundwater elevations were lower in the current year than in 2011.

Note 2: Statistics are based on the number of wells monitored within each subbasin.

Note 3: This map may not use all the color ranges shown in table above. Some wells may not be visible on map due to the close proximity to each other.

Note 4: Groundwater level changes are based on measurements taken from wells with depths greater than 600 ft. Measurements are taken during similar time periods each year.

Note 5: Change in groundwater elevations are based on the actual measured levels of the hydrostatic level (piezometric surface) of the groundwater at individual well locations.Contoured color ramping is interpolated from these measurements and should be considered approximate. The accuracy of the estimated contour is directly related to the timing of the measurements, spacing and the distribution of nearby monitoring wells, well construction, and aquifer characteristics.

Note 6: GW - Groundwater
GWE - Groundwater Elevation
bgs - below ground surface

Northern Sacramento Basin Groundwater Subbasins

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Antelope	NA	NA	NA	0
Bend	NA	NA	NA	0
Butte	NA	-8.8	-3.6	11
Colusa	2.7	-88.3	-18.0	27
Corning	8.9	-30.5	-8.6	9
Los Molinos	NA	-6.8	-4.8	10
Red Bluff	NA	-15.6	-15.6	1
Sutter	NA	-4.2	-4.2	1
Vina	10.2	-12.3	-5.0	10
Wyandotte Creek	NA	-2.8	-2.8	1
Summary	10.2	-88.3	-7.8	70

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NORTHERN SACRAMENTO VALLEY
CHANGE IN GROUNDWATER ELEVATION MAP
SPRING 2011 TO SPRING 2020
DEEP WELLS
(Well depths greater than 600 ft bgs)

PLATE 1D-D
Date: June 2020
BY: A. Scholzen

https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps

Figure D-6. Spring 2011 to Spring 2020 Change in Groundwater Elevation in Deep Wells (>600 ft bgs)

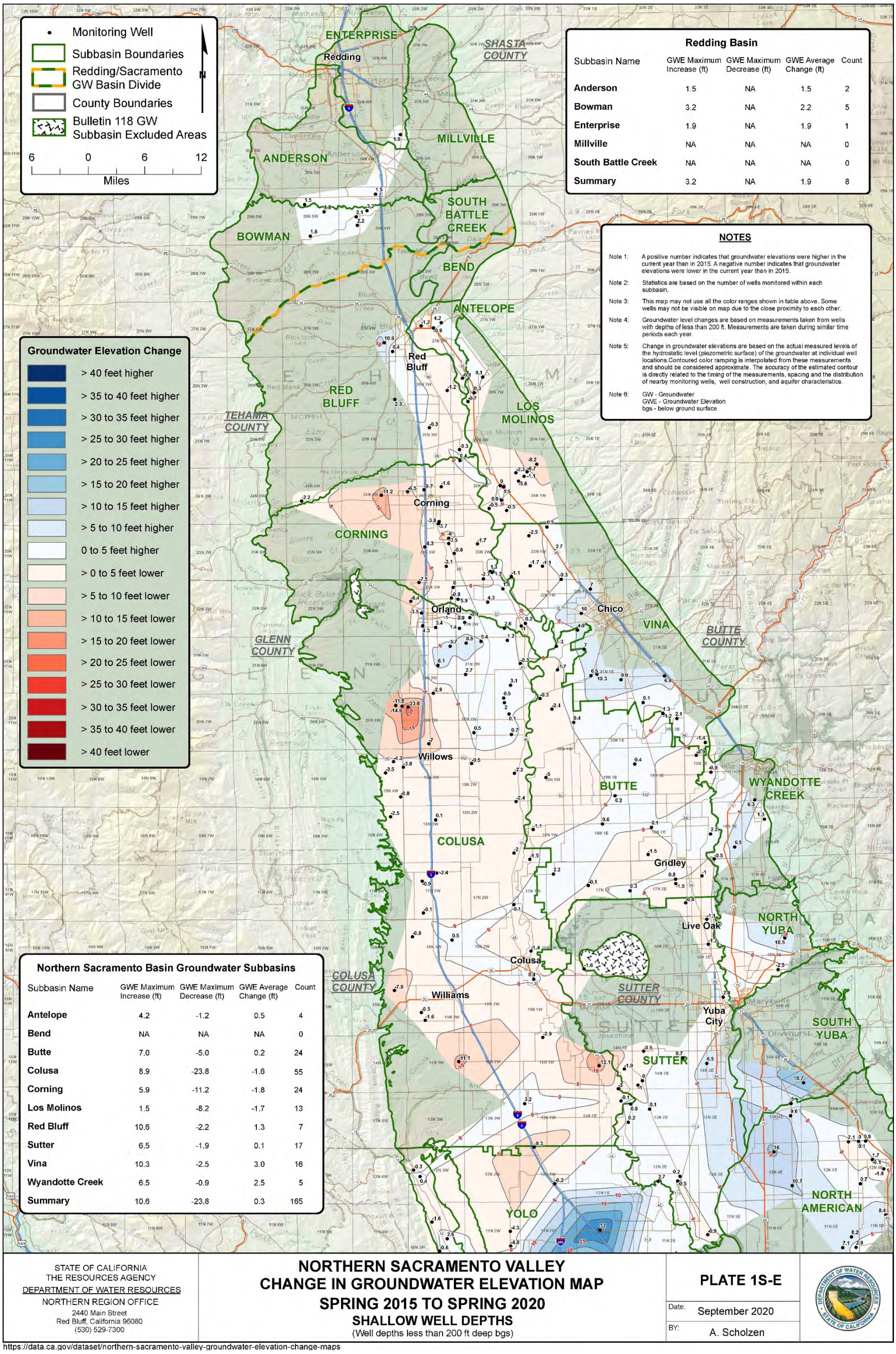
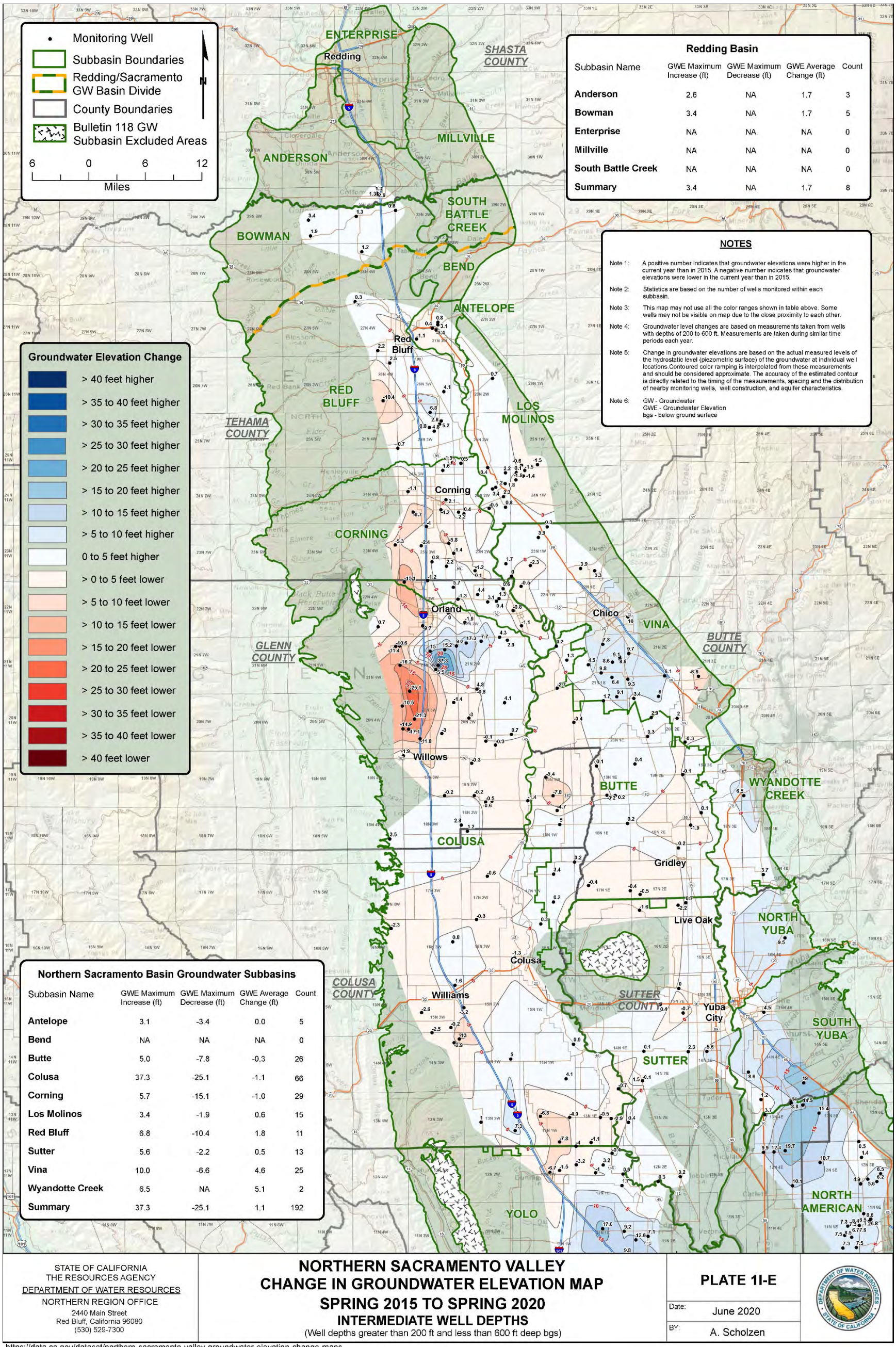


Figure D-7. Spring 2015 to Spring 2020 Change in Groundwater Elevation in Shallow Wells (<200 ft bgs)



Redding Basin

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Anderson	2.6	NA	1.7	3
Bowman	3.4	NA	1.7	5
Enterprise	NA	NA	NA	0
Millville	NA	NA	NA	0
South Battle Creek	NA	NA	NA	0
Summary	3.4	NA	1.7	8

NOTES

Note 1: A positive number indicates that groundwater elevations were higher in the current year than in 2015. A negative number indicates that groundwater elevations were lower in the current year than in 2015.

Note 2: Statistics are based on the number of wells monitored within each subbasin.

Note 3: This map may not use all the color ranges shown in table above. Some wells may not be visible on map due to the close proximity to each other.

Note 4: Groundwater level changes are based on measurements taken from wells with depths of 200 to 600 ft. Measurements are taken during similar time periods each year.

Note 5: Change in groundwater elevations are based on the actual measured levels of the hydrostatic level (piezometric surface) of the groundwater at individual well locations.Contoured color ramping is interpolated from these measurements and should be considered approximate. The accuracy of the estimated contour is directly related to the timing of the measurements, spacing and the distribution of nearby monitoring wells, well construction, and aquifer characteristics.

Note 6: GW - Groundwater
GWE - Groundwater Elevation
bgs - below ground surface

Northern Sacramento Basin Groundwater Subbasins

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Antelope	3.1	-3.4	0.0	5
Bend	NA	NA	NA	0
Butte	5.0	-7.8	-0.3	26
Colusa	37.3	-25.1	-1.1	66
Corning	5.7	-15.1	-1.0	29
Los Molinos	3.4	-1.9	0.6	15
Red Bluff	6.8	-10.4	1.8	11
Sutter	5.6	-2.2	0.5	13
Vina	10.0	-6.6	4.6	25
Wyandotte Creek	6.5	NA	5.1	2
Summary	37.3	-25.1	1.1	192

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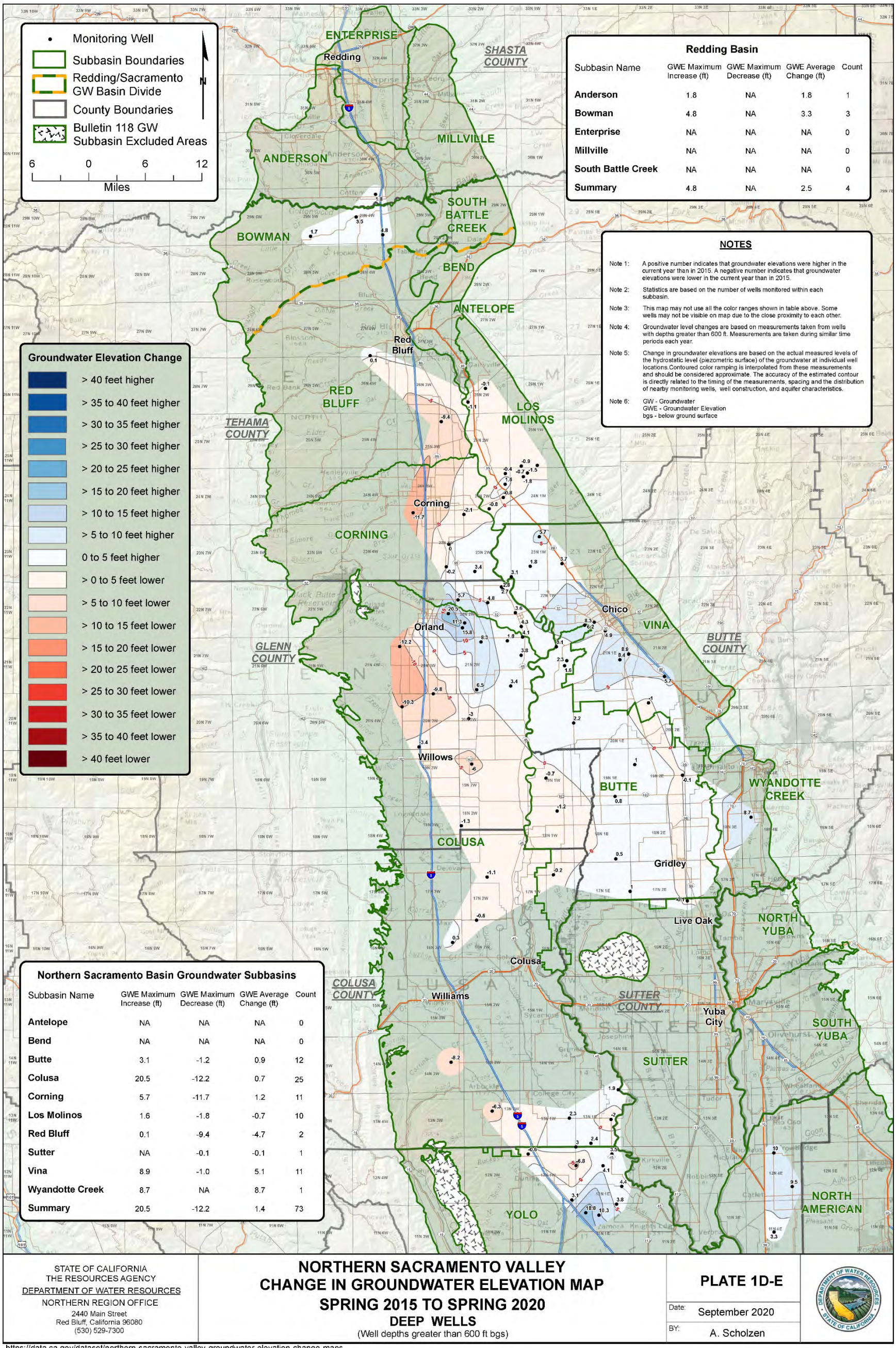
NORTHERN SACRAMENTO VALLEY
CHANGE IN GROUNDWATER ELEVATION MAP
SPRING 2015 TO SPRING 2020
INTERMEDIATE WELL DEPTHS
(Well depths greater than 200 ft and less than 600 ft deep bgs)

PLATE 1I-E
Date: June 2020
BY: A. Scholzen

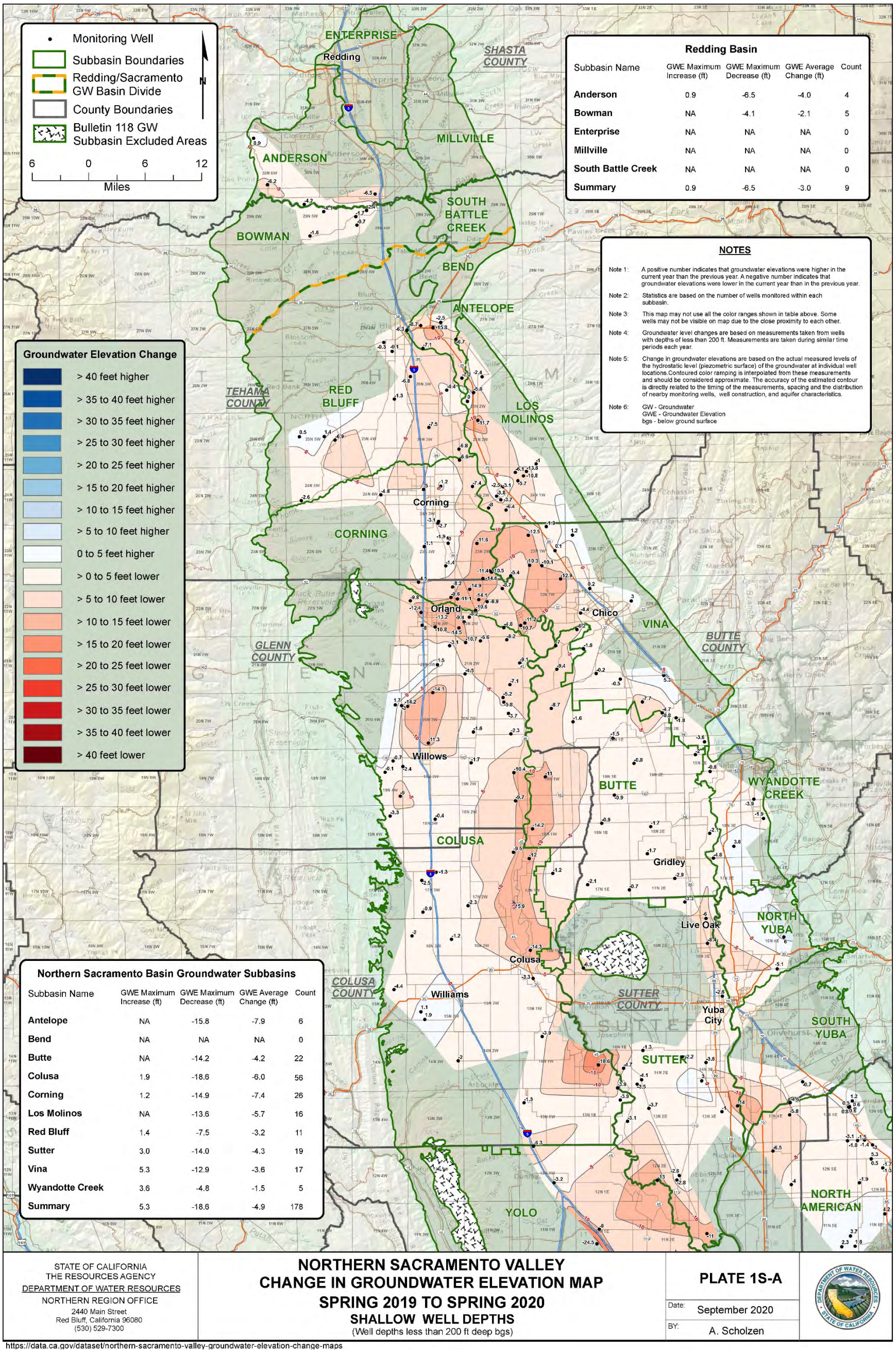
https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps

Figure D-8. Spring 2015 to Spring 2020 Change in Groundwater Elevation in Intermediate Wells (200-600 ft bgs)



https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps

Figure D-9. Spring 2015 to Spring 2020 Change in Groundwater Elevation in Deep Wells (>600 ft bgs)



Redding Basin

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Anderson	0.9	-6.5	-4.0	4
Bowman	NA	-4.1	-2.1	5
Enterprise	NA	NA	NA	0
Millville	NA	NA	NA	0
South Battle Creek	NA	NA	NA	0
Summary	0.9	-6.5	-3.0	9

NOTES

Note 1: A positive number indicates that groundwater elevations were higher in the current year than the previous year. A negative number indicates that groundwater elevations were lower in the current year than in the previous year.

Note 2: Statistics are based on the number of wells monitored within each subbasin.

Note 3: This map may not use all the color ranges shown in table above. Some wells may not be visible on map due to the close proximity to each other.

Note 4: Groundwater level changes are based on measurements taken from wells with depths of less than 200 ft. Measurements are taken during similar time periods each year.

Note 5: Change in groundwater elevations are based on the actual measured levels of the hydrostatic level (piezometric surface) of the groundwater at individual well locations.Contoured color ramping is interpolated from these measurements and should be considered approximate. The accuracy of the estimated contour is directly related to the timing of the measurements, spacing and the distribution of nearby monitoring wells, well construction, and aquifer characteristics.

Note 6: GW - Groundwater
GWE - Groundwater Elevation
bgs - below ground surface

Northern Sacramento Basin Groundwater Subbasins

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Antelope	NA	-15.8	-7.9	6
Bend	NA	NA	NA	0
Butte	NA	-14.2	-4.2	22
Colusa	1.9	-18.6	-6.0	56
Corning	1.2	-14.9	-7.4	26
Los Molinos	NA	-13.6	-5.7	16
Red Bluff	1.4	-7.5	-3.2	11
Sutter	3.0	-14.0	-4.3	19
Vina	5.3	-12.9	-3.6	17
Wyandotte Creek	3.6	-4.8	-1.5	5
Summary	5.3	-18.6	-4.9	178

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NORTHERN SACRAMENTO VALLEY
CHANGE IN GROUNDWATER ELEVATION MAP
SPRING 2019 TO SPRING 2020
SHALLOW WELL DEPTHS
(Well depths less than 200 ft deep bgs)

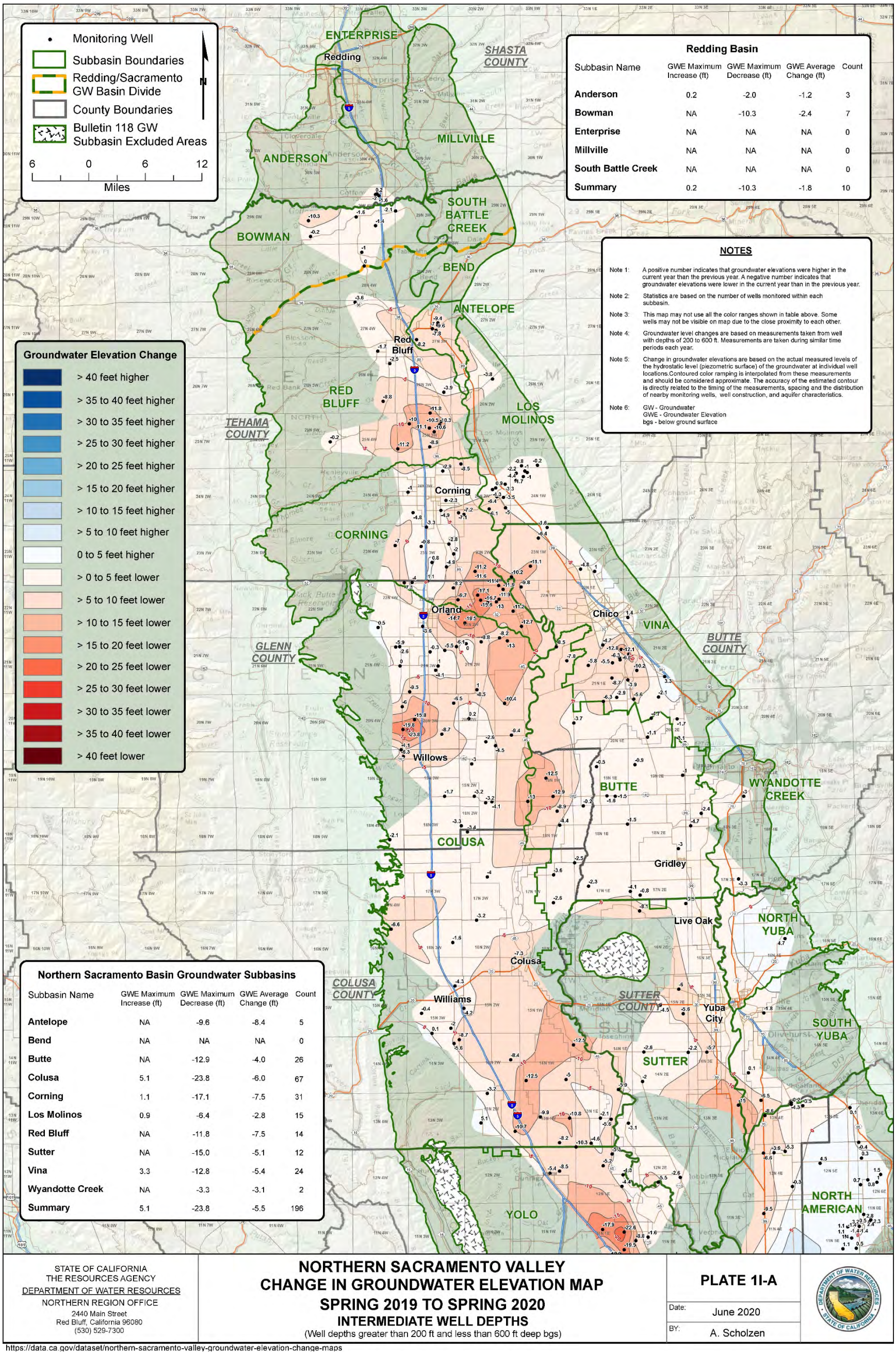
PLATE 1S-A

Date: September 2020

BY: A. Scholzen

https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps

Figure D-10. Spring 2019 to Spring 2020 Change in Groundwater Elevation in Shallow Wells (<200 ft bgs)



Redding Basin

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Anderson	0.2	-2.0	-1.2	3
Bowman	NA	-10.3	-2.4	7
Enterprise	NA	NA	NA	0
Millville	NA	NA	NA	0
South Battle Creek	NA	NA	NA	0
Summary	0.2	-10.3	-1.8	10

NOTES

Note 1: A positive number indicates that groundwater elevations were higher in the current year than the previous year. A negative number indicates that groundwater elevations were lower in the current year than in the previous year.

Note 2: Statistics are based on the number of wells monitored within each subbasin.

Note 3: This map may not use all the color ranges shown in table above. Some wells may not be visible on map due to the close proximity to each other.

Note 4: Groundwater level changes are based on measurements taken from well with depths of 200 to 600 ft. Measurements are taken during similar time periods each year.

Note 5: Change in groundwater elevations are based on the actual measured levels of the hydrostatic level (piezometric surface) of the groundwater at individual well locations.Contoured color ramping is interpolated from these measurements and should be considered approximate. The accuracy of the estimated contour is directly related to the timing of the measurements, spacing and the distribution of nearby monitoring wells, well construction, and aquifer characteristics.

Note 6: GW - Groundwater
GWE - Groundwater Elevation
bgs - below ground surface

Northern Sacramento Basin Groundwater Subbasins

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Antelope	NA	-9.6	-8.4	5
Bend	NA	NA	NA	0
Butte	NA	-12.9	-4.0	26
Colusa	5.1	-23.8	-6.0	67
Corning	1.1	-17.1	-7.5	31
Los Molinos	0.9	-6.4	-2.8	15
Red Bluff	NA	-11.8	-7.5	14
Sutter	NA	-15.0	-5.1	12
Vina	3.3	-12.8	-5.4	24
Wyandotte Creek	NA	-3.3	-3.1	2
Summary	5.1	-23.8	-5.5	196

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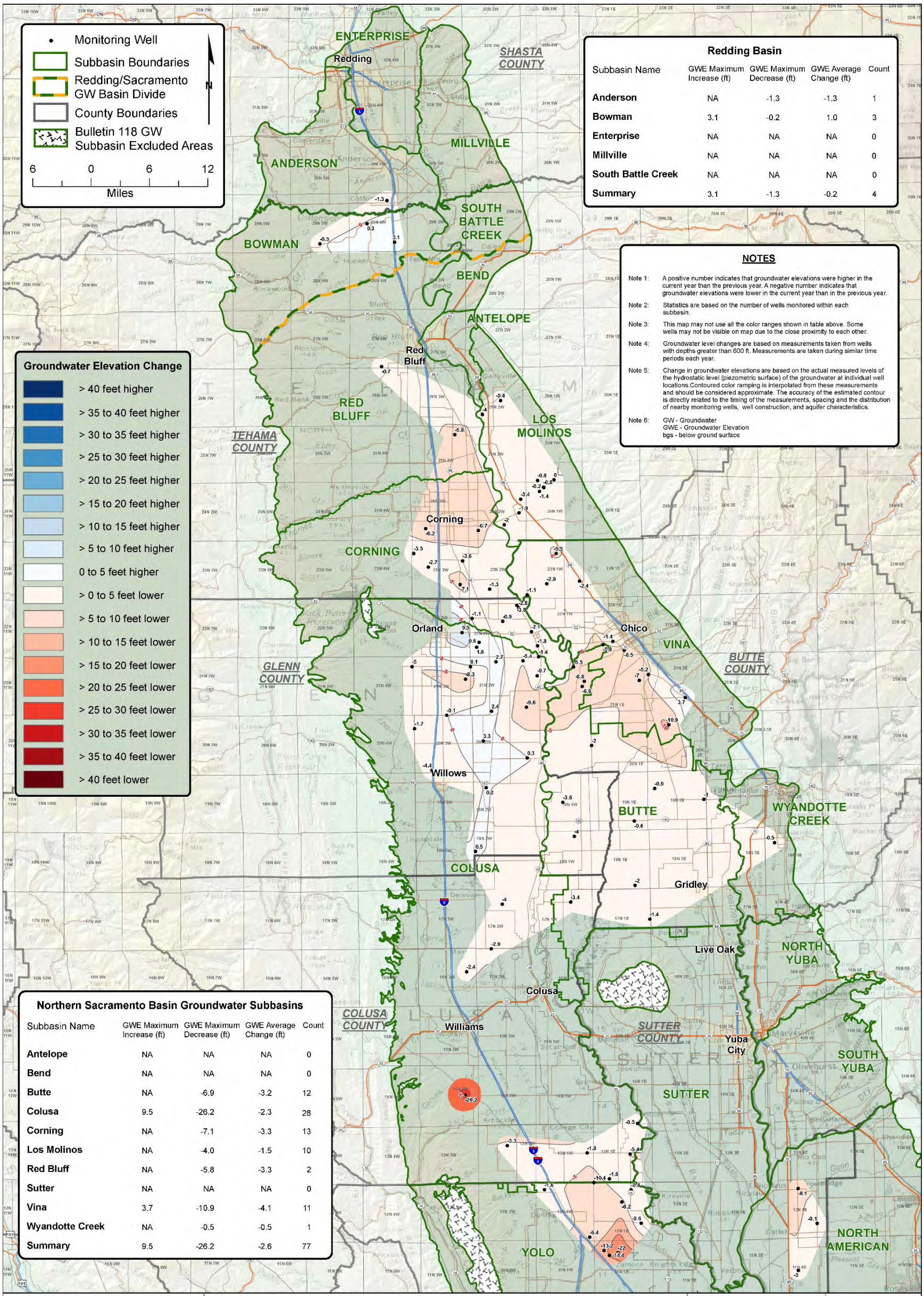
NORTHERN SACRAMENTO VALLEY
CHANGE IN GROUNDWATER ELEVATION MAP
SPRING 2019 TO SPRING 2020
INTERMEDIATE WELL DEPTHS
(Well depths greater than 200 ft and less than 600 ft deep bgs)

PLATE 1I-A
Date: June 2020
BY: A. Scholzen

https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps

Figure D-11. Spring 2019 to Spring 2020 Change in Groundwater Elevation in Intermediate Wells (200-600 ft bgs)



Redding Basin

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Anderson	NA	-1.3	-1.3	1
Bowman	3.1	-0.2	1.0	3
Enterprise	NA	NA	NA	0
Millville	NA	NA	NA	0
South Battle Creek	NA	NA	NA	0
Summary	3.1	-1.3	-0.2	4

NOTES

Note 1: A positive number indicates that groundwater elevations were higher in the current year than the previous year. A negative number indicates that groundwater elevations were lower in the current year than in the previous year.

Note 2: Statistics are based on the number of wells monitored within each subbasin.

Note 3: This map may not use all the color ranges shown in table above. Some wells may not be visible on map due to the close proximity to each other.

Note 4: Groundwater level changes are based on measurements taken from wells with depths greater than 600 ft. Measurements are taken during similar time periods each year.

Note 5: Change in groundwater elevations are based on the actual measured levels of the hydrostatic level (piezometric surface) of the groundwater at individual well locations.Contoured color ramping is interpolated from these measurements and should be considered approximate. The accuracy of the estimated contour is directly related to the timing of the measurements, spacing and the distribution of nearby monitoring wells, well construction, and aquifer characteristics.

Note 6: GW - Groundwater
GWE - Groundwater Elevation
bgs - below ground surface

Northern Sacramento Basin Groundwater Subbasins

Subbasin Name	GWE Maximum Increase (ft)	GWE Maximum Decrease (ft)	GWE Average Change (ft)	Count
Antelope	NA	NA	NA	0
Bend	NA	NA	NA	0
Butte	NA	-6.9	-3.2	12
Colusa	9.5	-26.2	-2.3	28
Corning	NA	-7.1	-3.3	13
Los Molinos	NA	-4.0	-1.5	10
Red Bluff	NA	-5.8	-3.3	2
Sutter	NA	NA	NA	0
Vina	3.7	-10.9	-4.1	11
Wyandotte Creek	NA	-0.5	-0.5	1
Summary	9.5	-26.2	-2.6	77

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NORTHERN SACRAMENTO VALLEY
CHANGE IN GROUNDWATER ELEVATION MAP
SPRING 2019 TO FALL 2020
DEEP WELLS
(Well depths greater than 600 ft bgs)

PLATE 1D-A

Date: September 2020

BY: A. Scholzen

https://data.ca.gov/dataset/northern-sacramento-valley-groundwater-elevation-change-maps

Figure D-12. Spring 2019 to Spring 2020 Change in Groundwater Elevation in Deep Wells (>600 ft bgs)

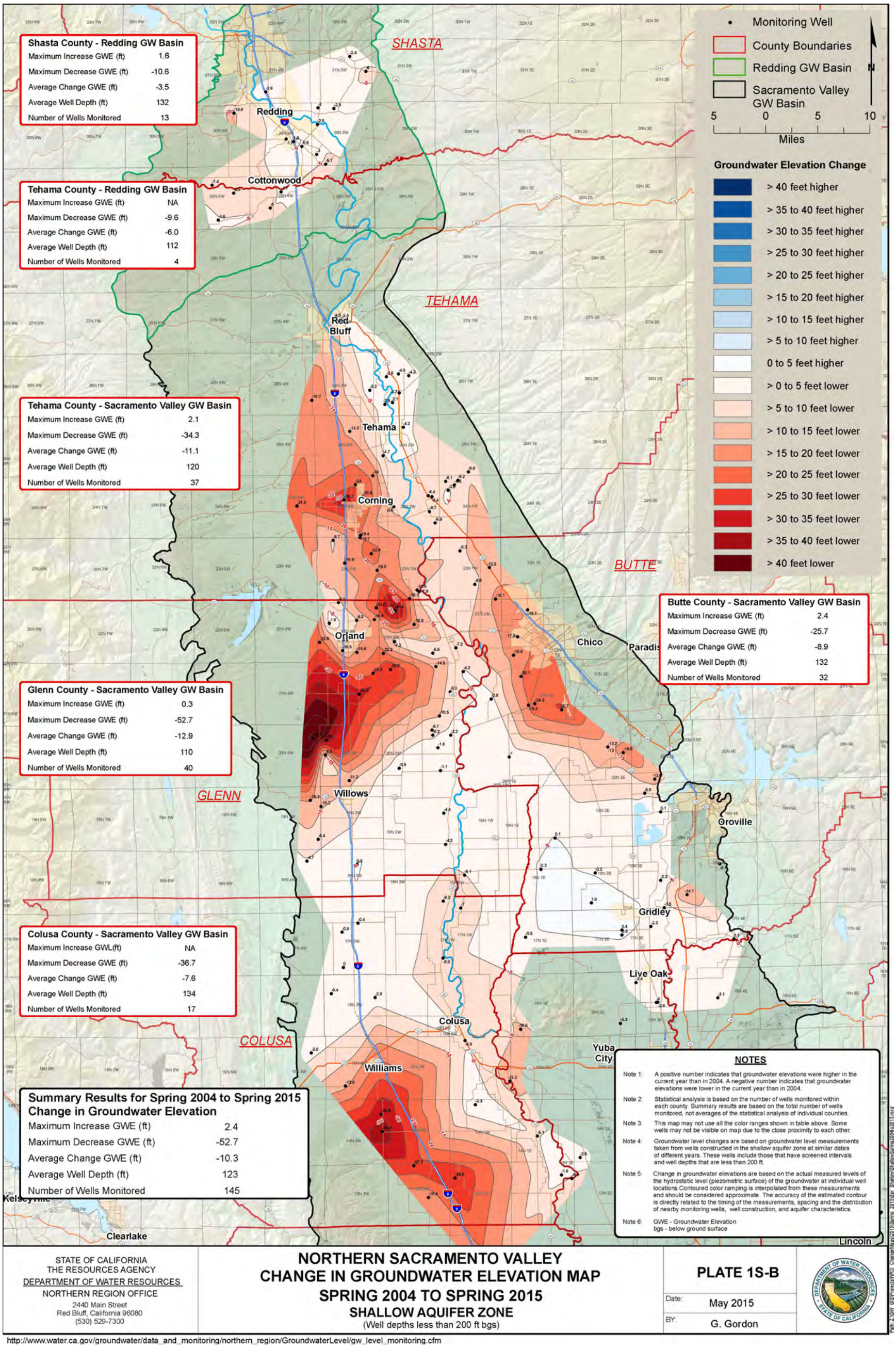

Figure D-13. Spring 2004 to Spring 2015 Change in Groundwater Elevation in Shallow Wells (<200 ft bgs)

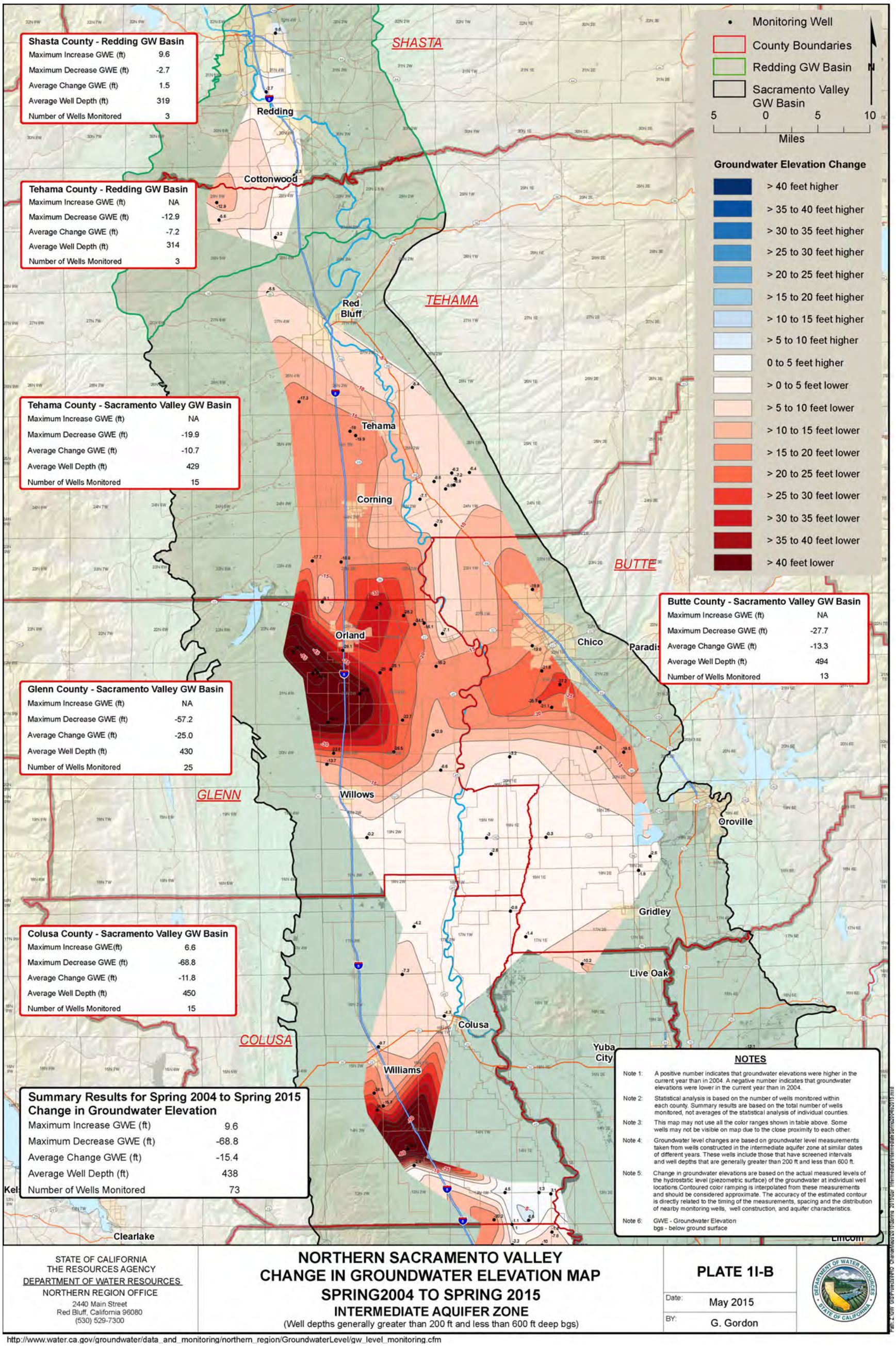

Figure D-14. Spring 2004 to Spring 2015 Change in Groundwater Elevation in Intermediate Wells (200-600 ft bgs)

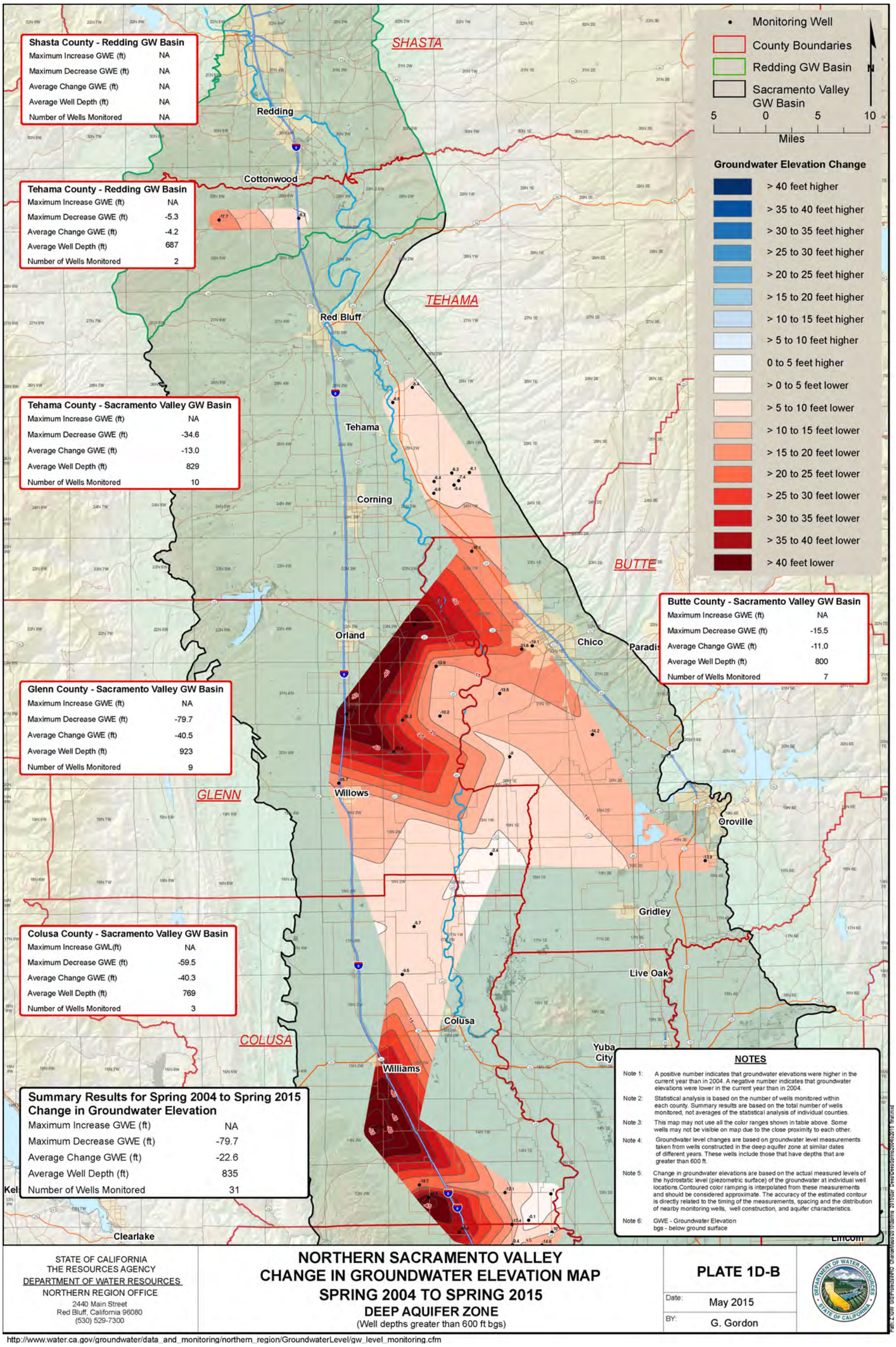

Figure D-15. Spring 2004 to Spring 2015 Change in Groundwater Elevation in Deep Wells (>600 ft bgs)

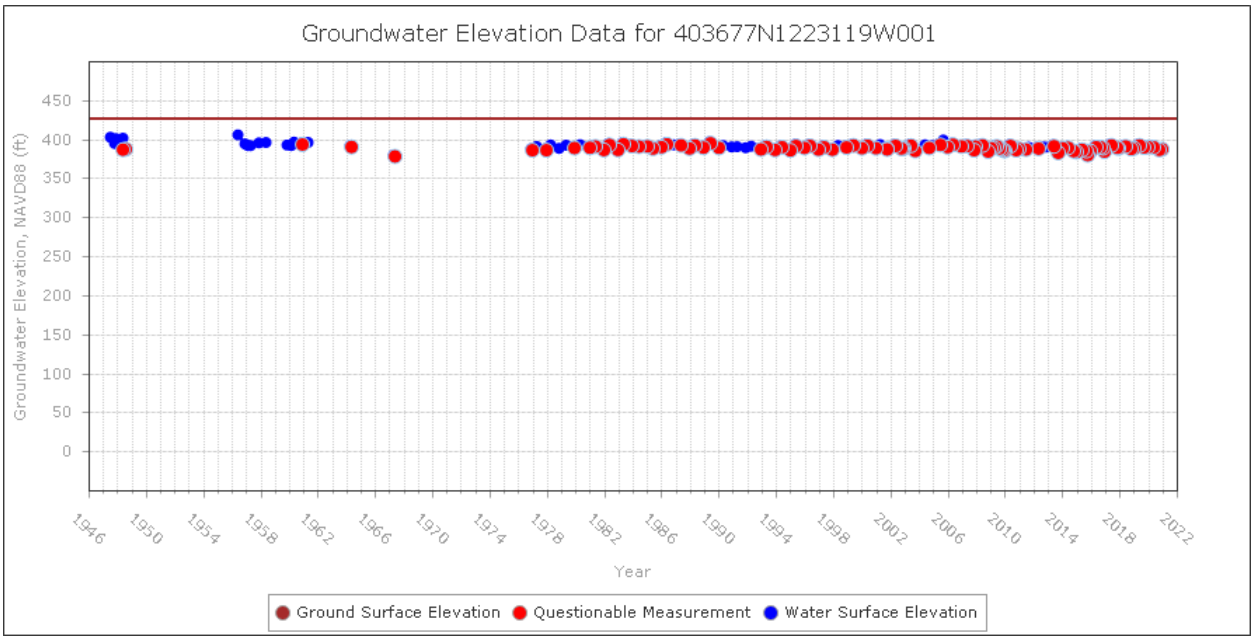

Figure D-16. Anderson-Cottonwood Irrigation District, State Well ID 29N04W15E002M
Source: DWR's CASGEM website.
Note: Well number in the title of the figure is the CASGEM Well Number.

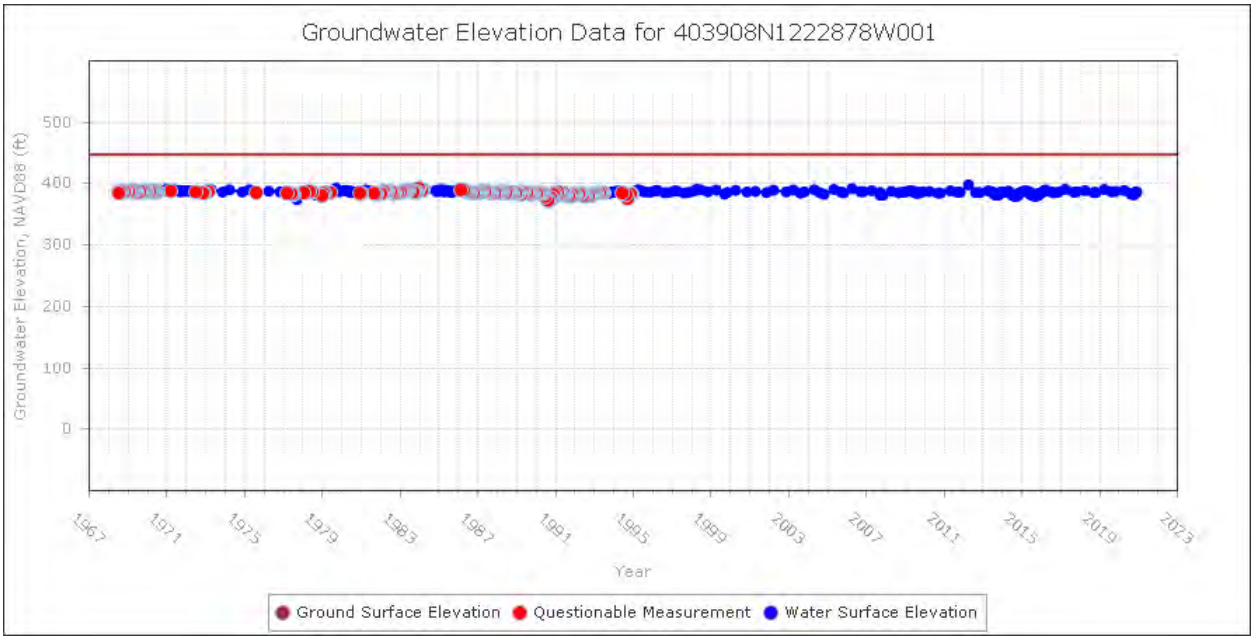

Figure D-17. Anderson-Cottonwood Irrigation District, State Well ID 29N04W02P001M
Source: DWR's CASGEM website.
Note: Well number in the title of the figure is the CASGEM Well Number.

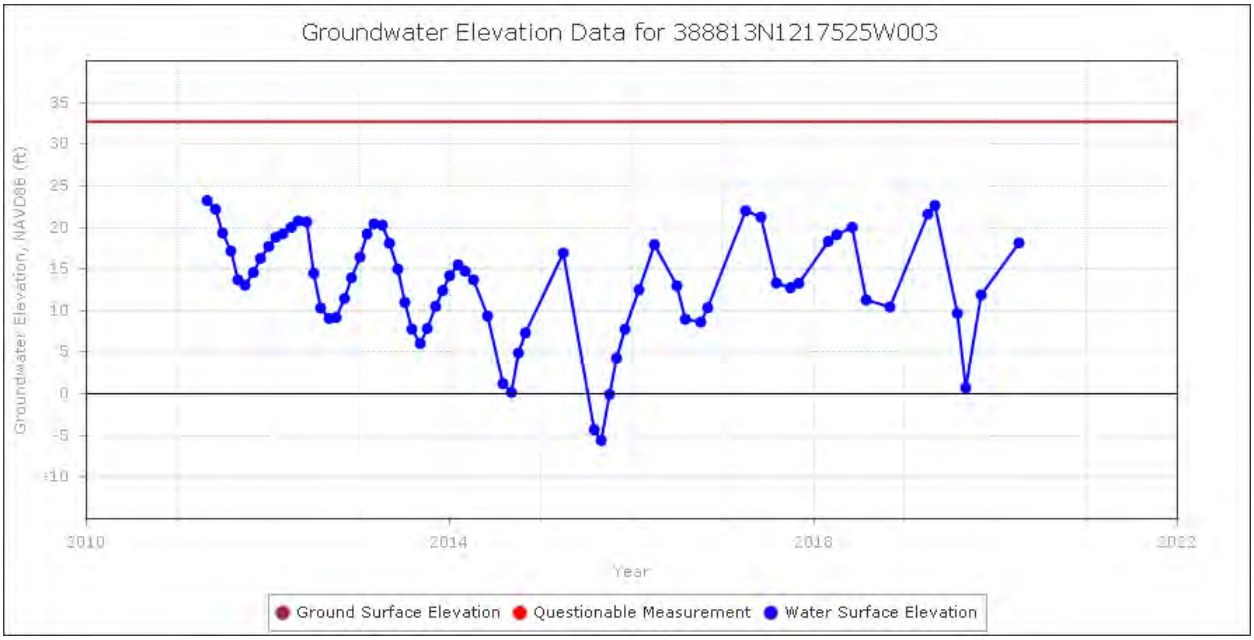

Figure D-18. Burroughs Farms, State Well ID 12N02E21Q003M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

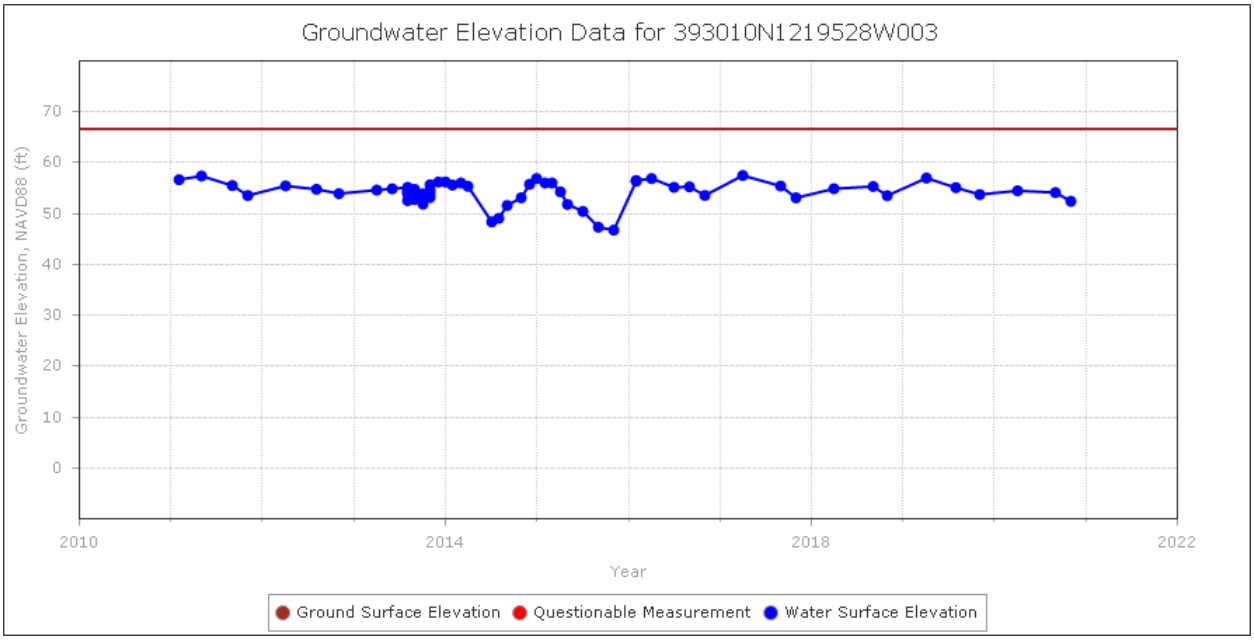

Figure D-19. Canal Farms, State Well ID 17N01W27A003M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

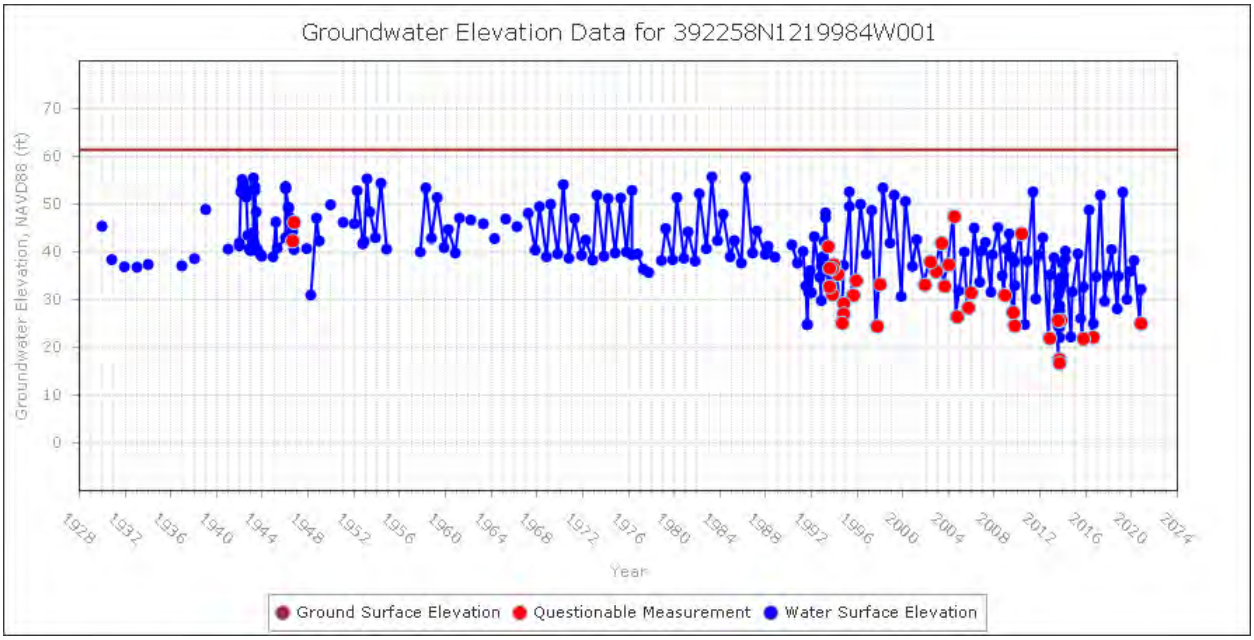

Figure D-20. Eastside Mutual Water Company, State Well ID 16N01W20F001M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

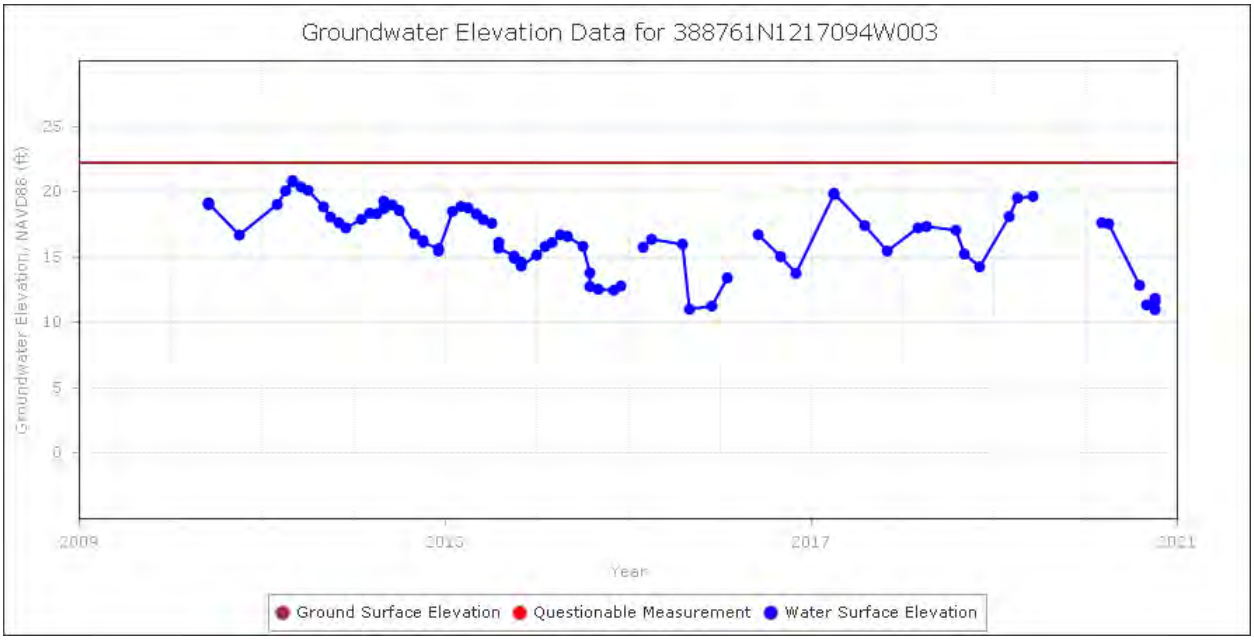

Figure D-21. Giusti Farms, State Well ID 12N02E23H003M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

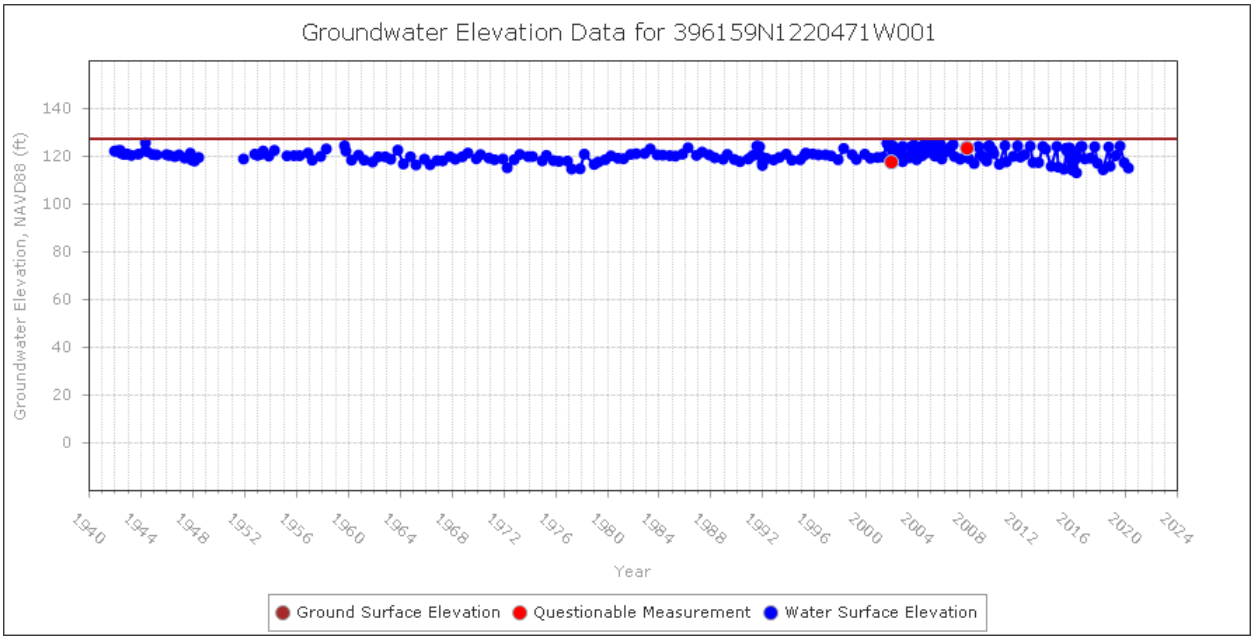

Figure D-22. Glenn-Colusa Irrigation District, State Well ID 20N02W02J001M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

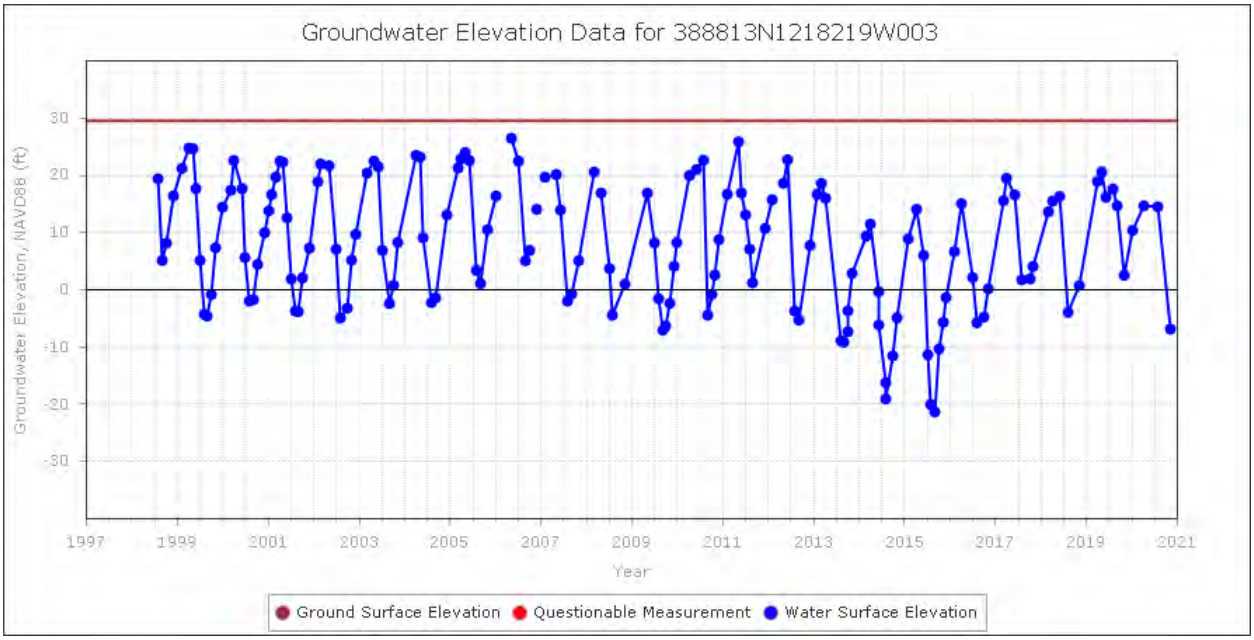

Figure D-23. Henle Family Farms, State Well ID 12N01E14R003M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

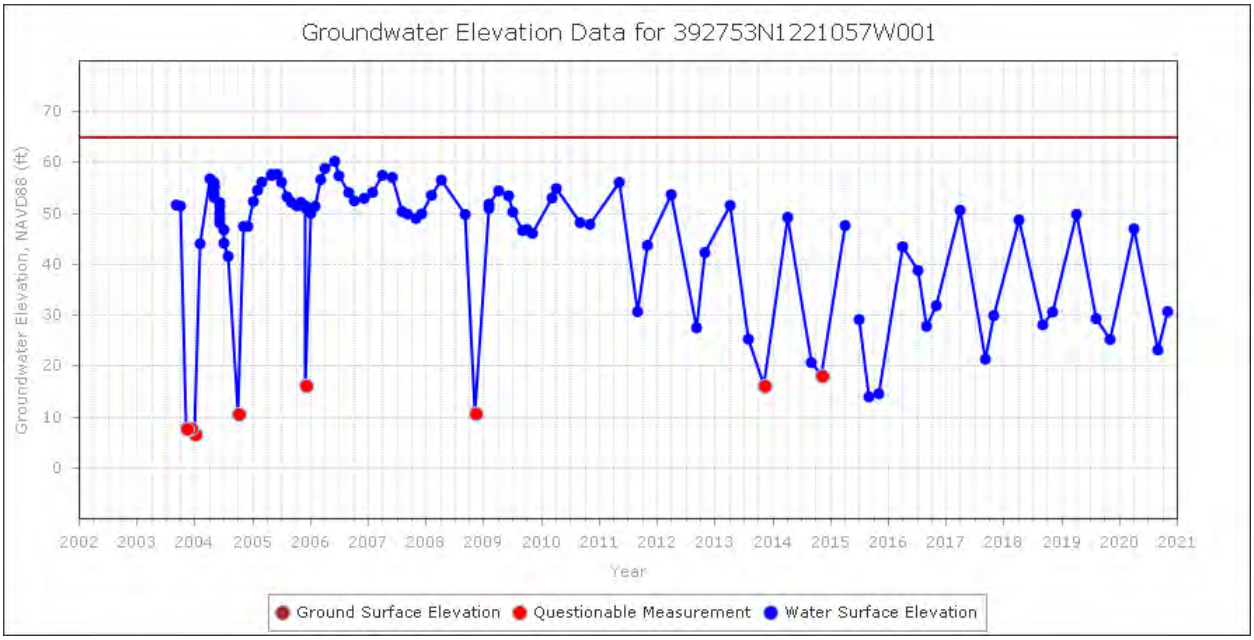

Figure D-24. Maxwell Irrigation District, State Well ID 16N02W05B001M (Deep well; Depth=797 feet)

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

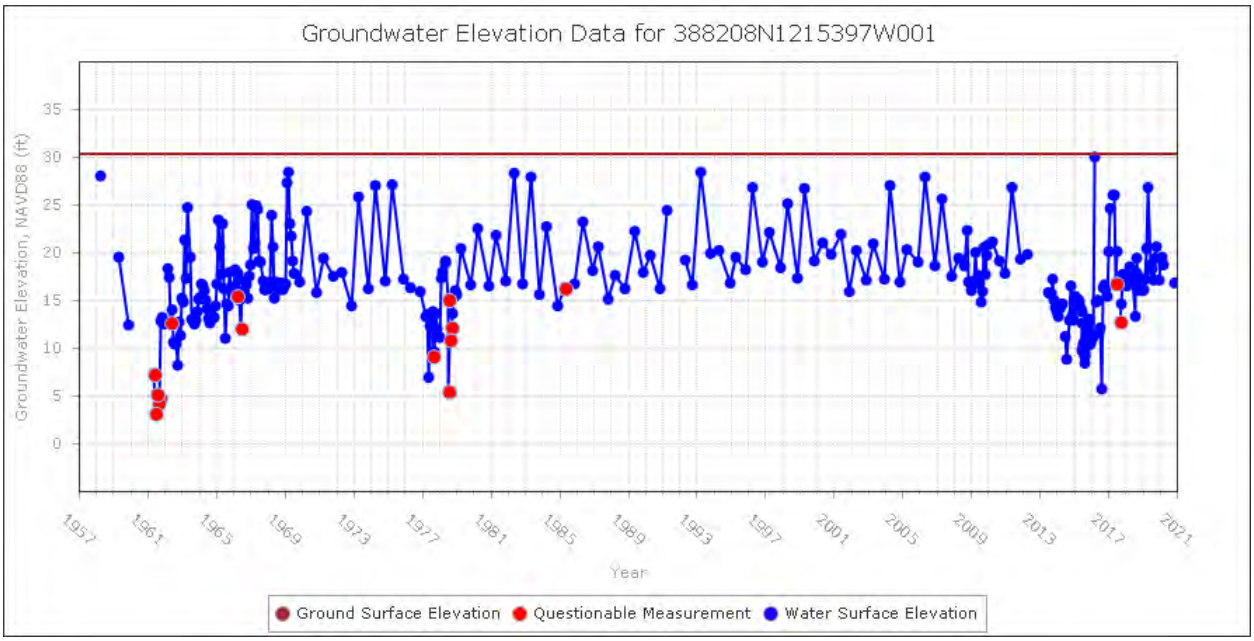

Figure D-25. Natomas Central Mutual Water Company, State Well ID 11N04E09D002M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

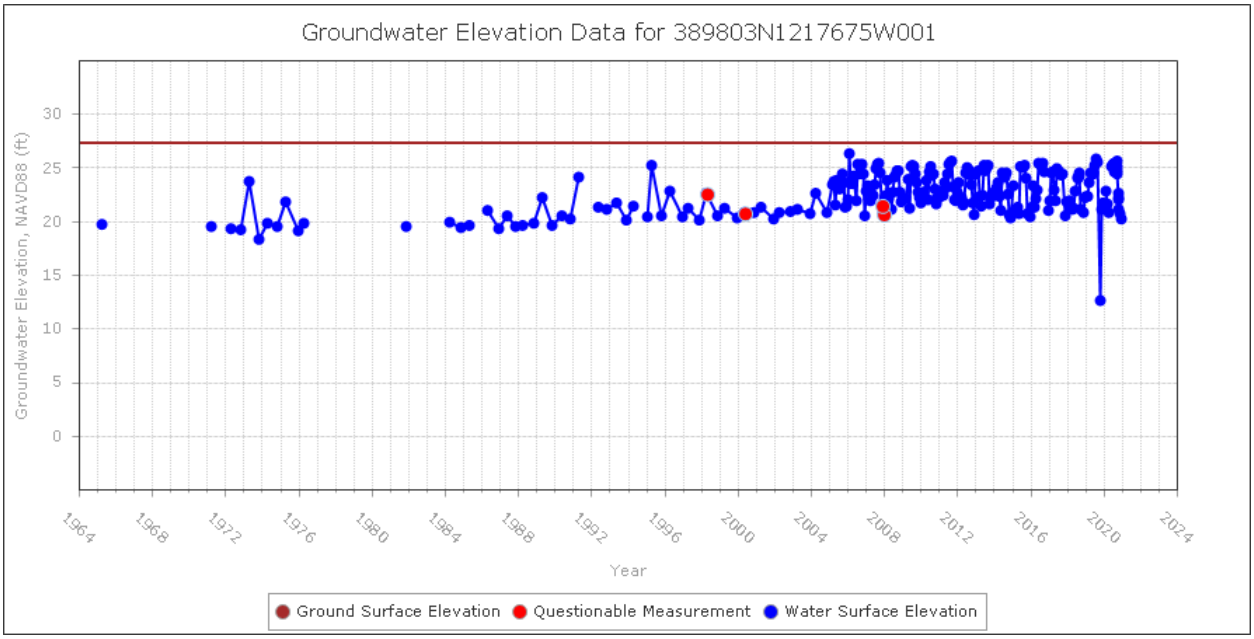

Figure D-26. Pelger Mutual Water Company, State Well ID 13N02E17A001M
Source: DWR's CASGEM website.
Note: Well number in the title of the figure is the CASGEM Well Number.

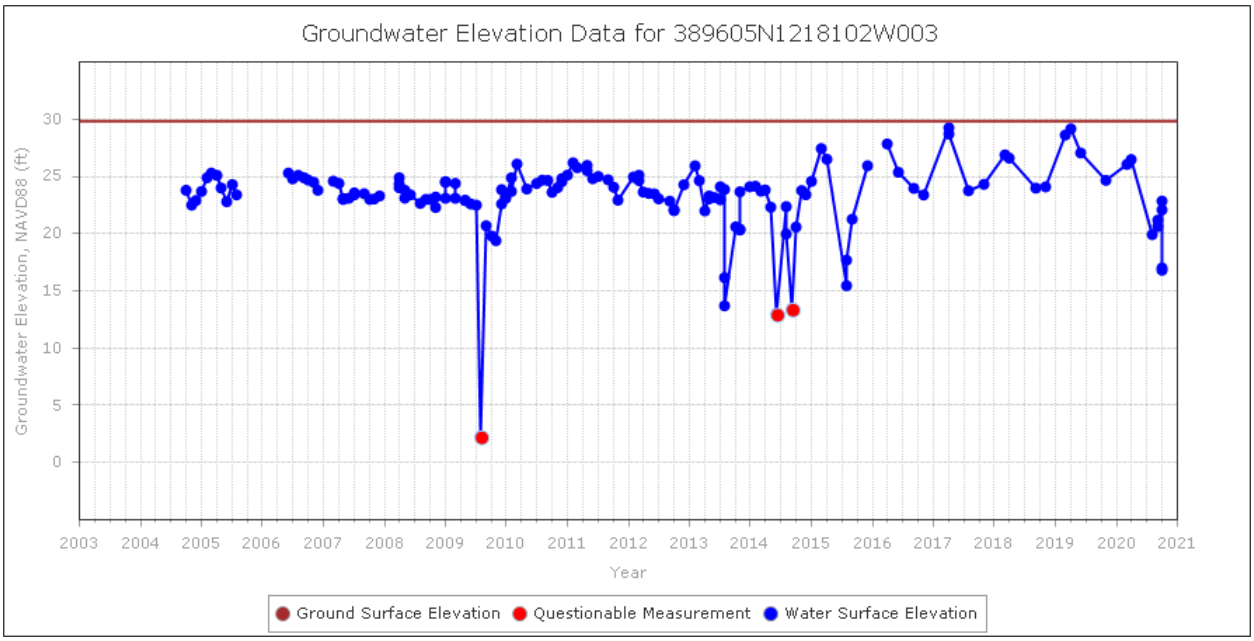

Figure D-27. Pelger Road 1700 LLC, State Well ID 13N01E24G004M (Shallow well; Depth=100 feet)
Source: DWR's CASGEM website.
Note: Well number in the title of the figure is the CASGEM Well Number.

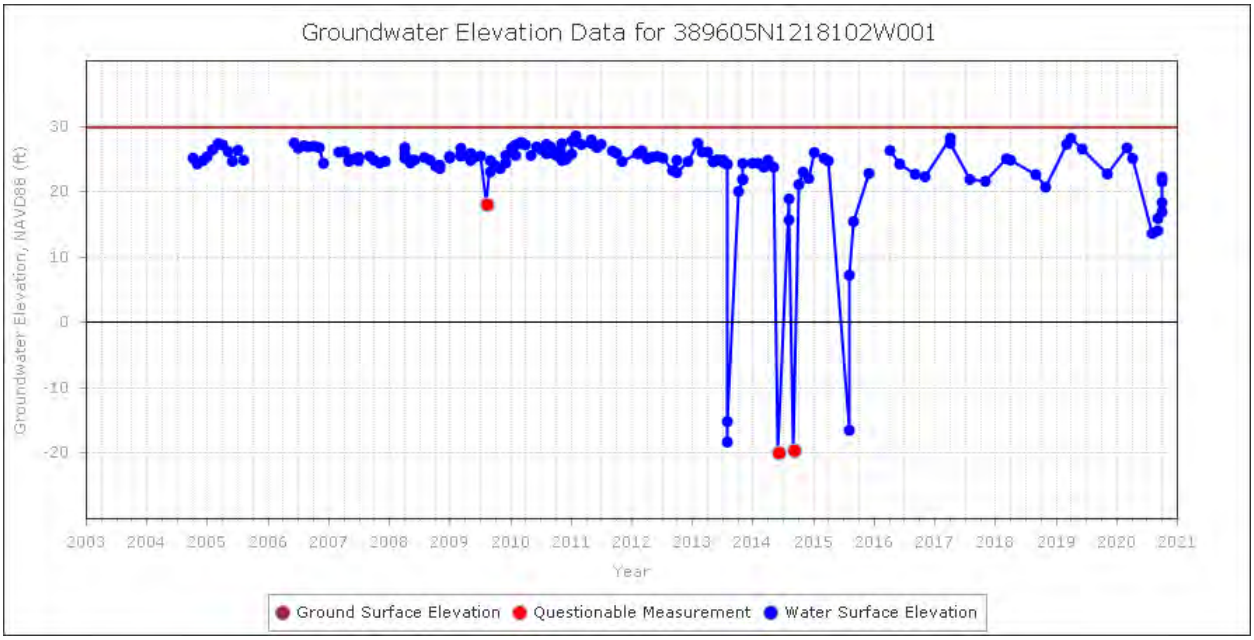

Figure D-28. Pelger Road 1700 LLC, State Well ID 13N01E24G002M (Deep well; Depth=310 feet)

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

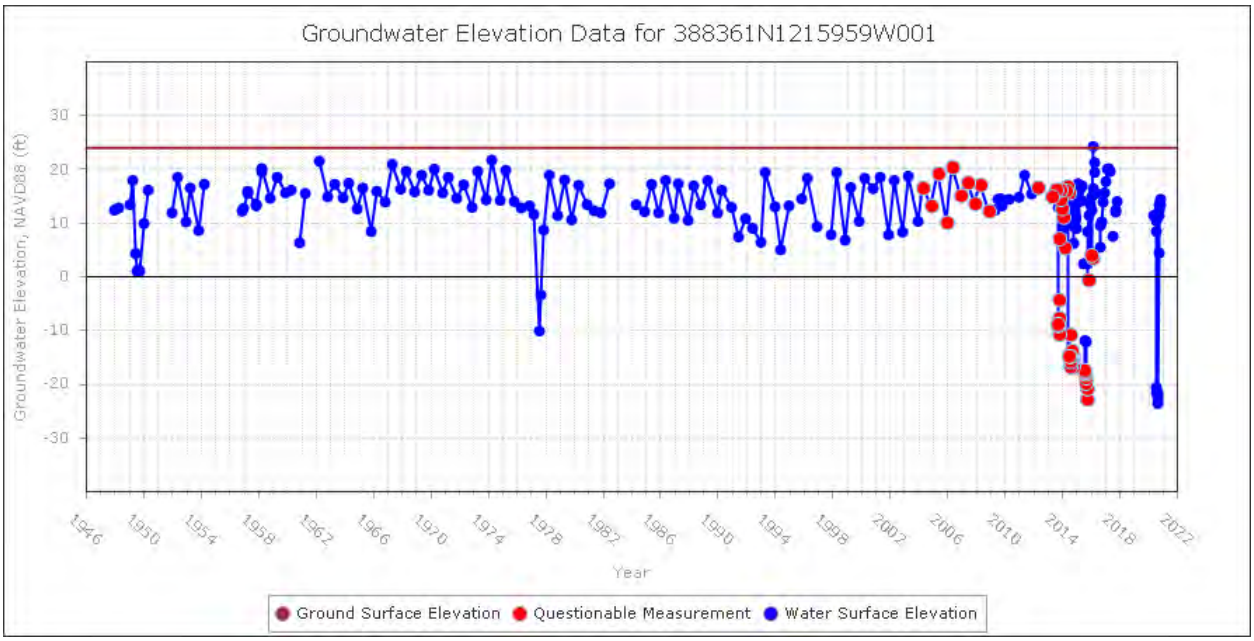

Figure D-29. Pleasant Grove-Verona Mutual Water Company, State Well ID 11N03E01D001M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

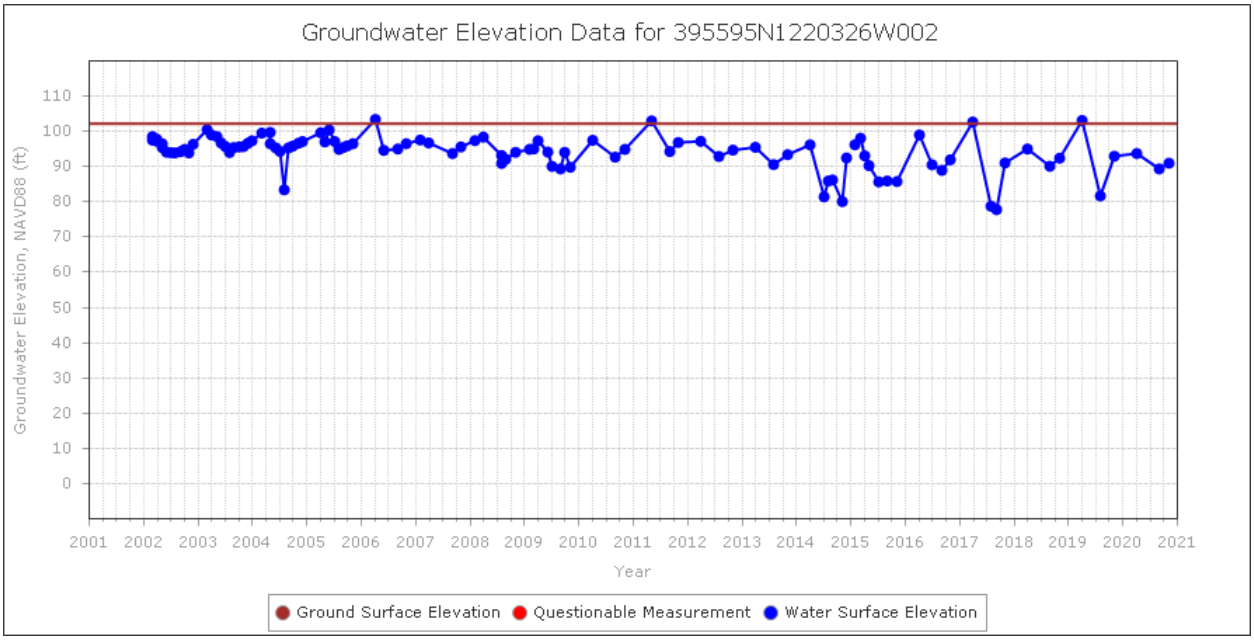

Figure D-30. Princeton-Codora-Glenn Irrigation District and Provident Irrigation District, State Well ID 20N02W25F002M (Depth= 513 ft)

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

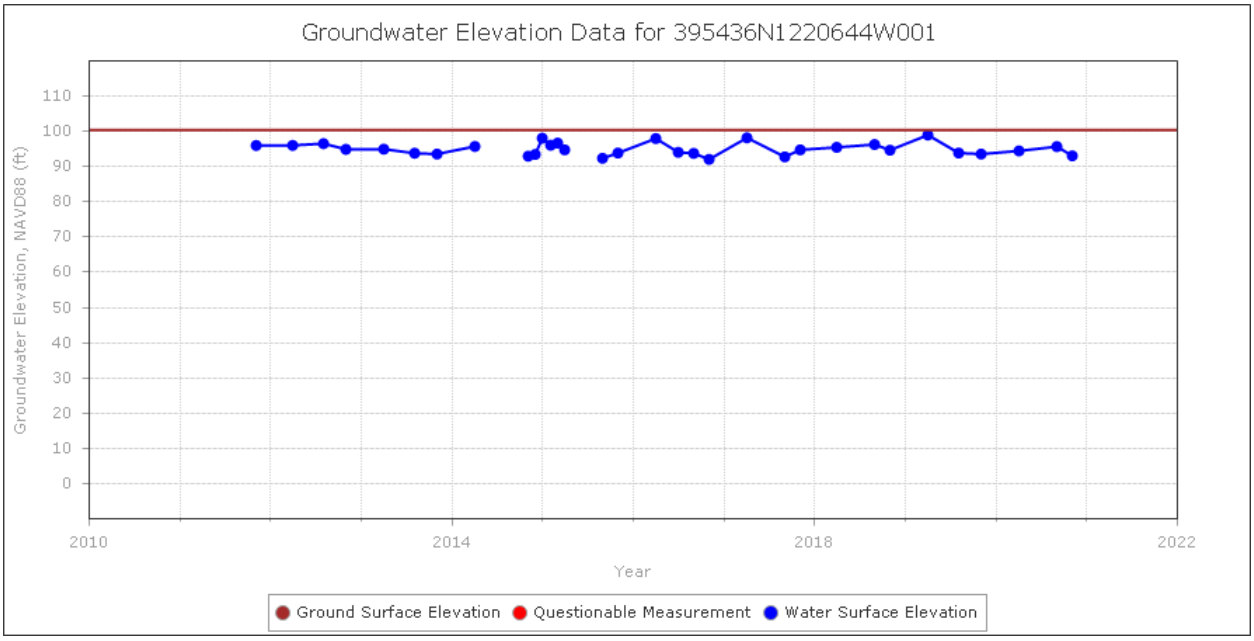

Figure D-31 Princeton-Codora-Glenn Irrigation District and Provident Irrigation District, State Well ID 20N02W34J001M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

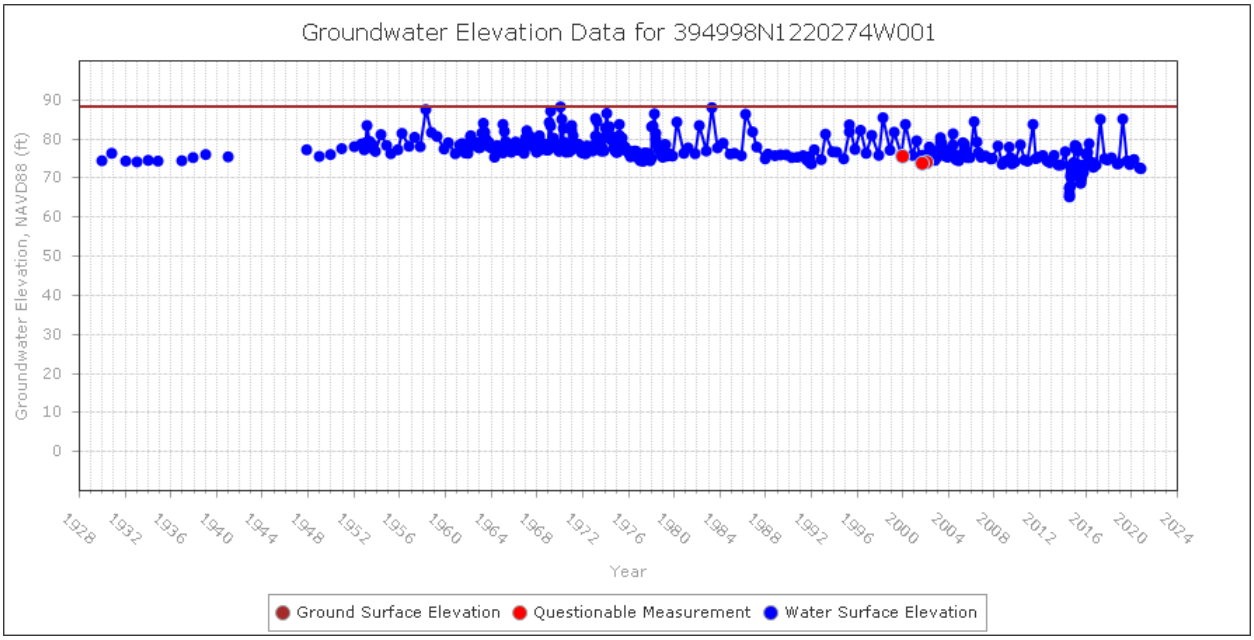

Figure D-32. Princeton-Codora-Glenn Irrigation District and Provident Irrigation District, State Well ID 19N02W13J001M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number

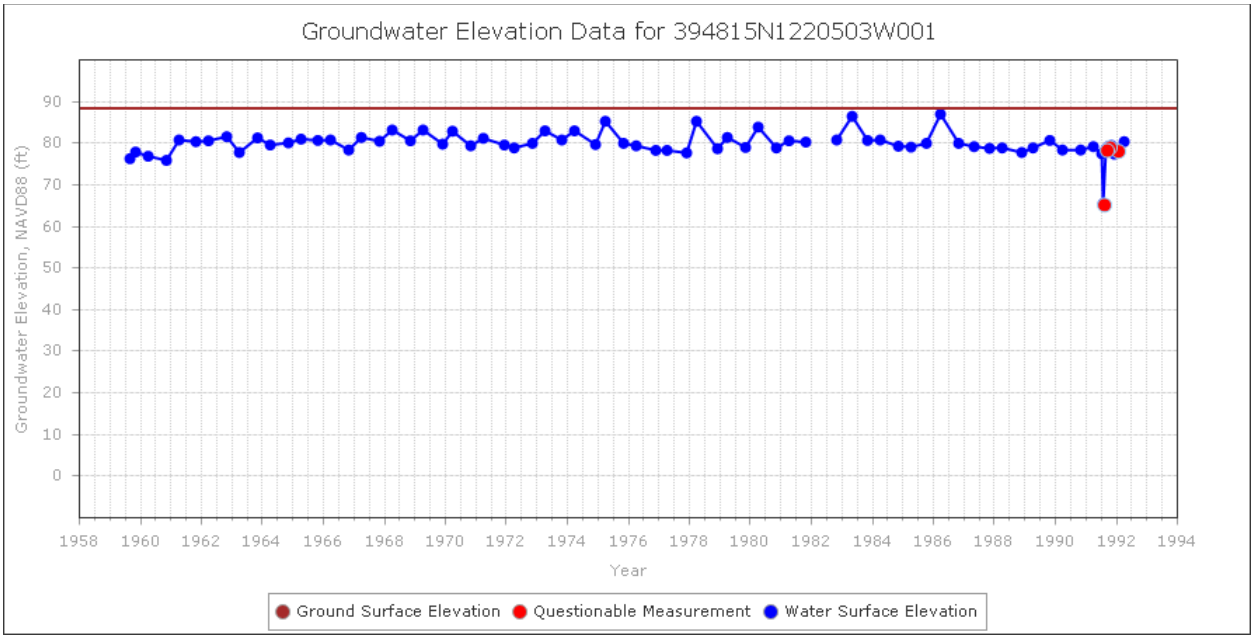

Figure D-33. Provident Irrigation District, State Well ID 19N02W23Q002M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

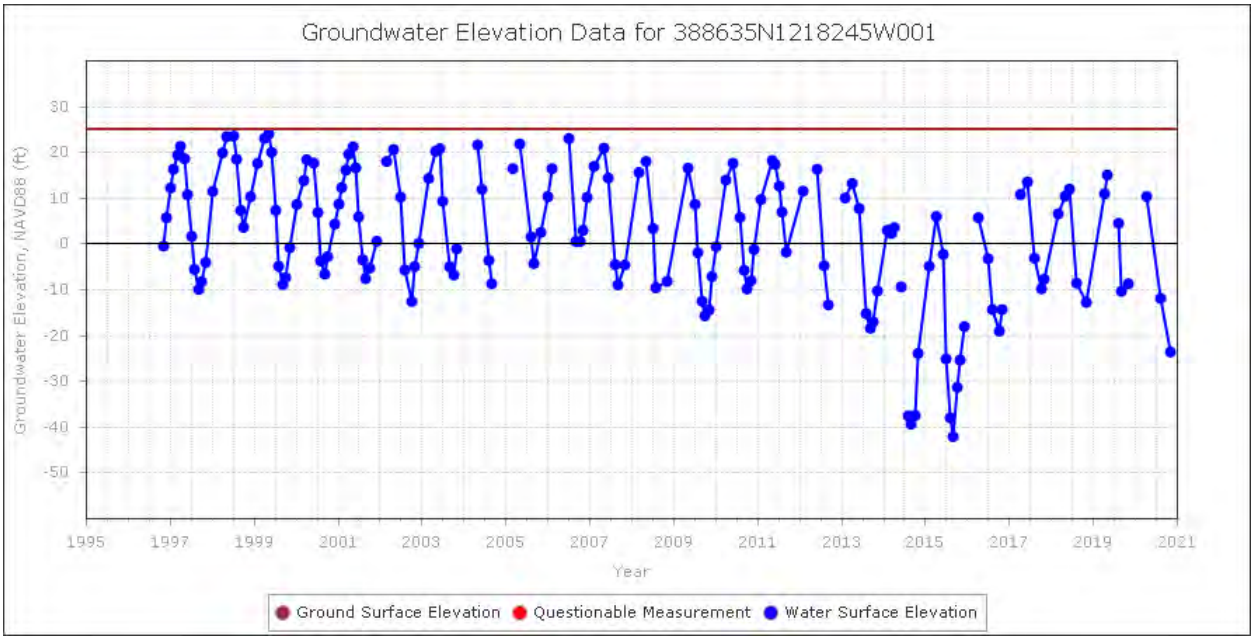

Figure D-34. Reclamation District 108, State Well ID 12N01E26A001M (Deep; Depth= 670 ft)

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

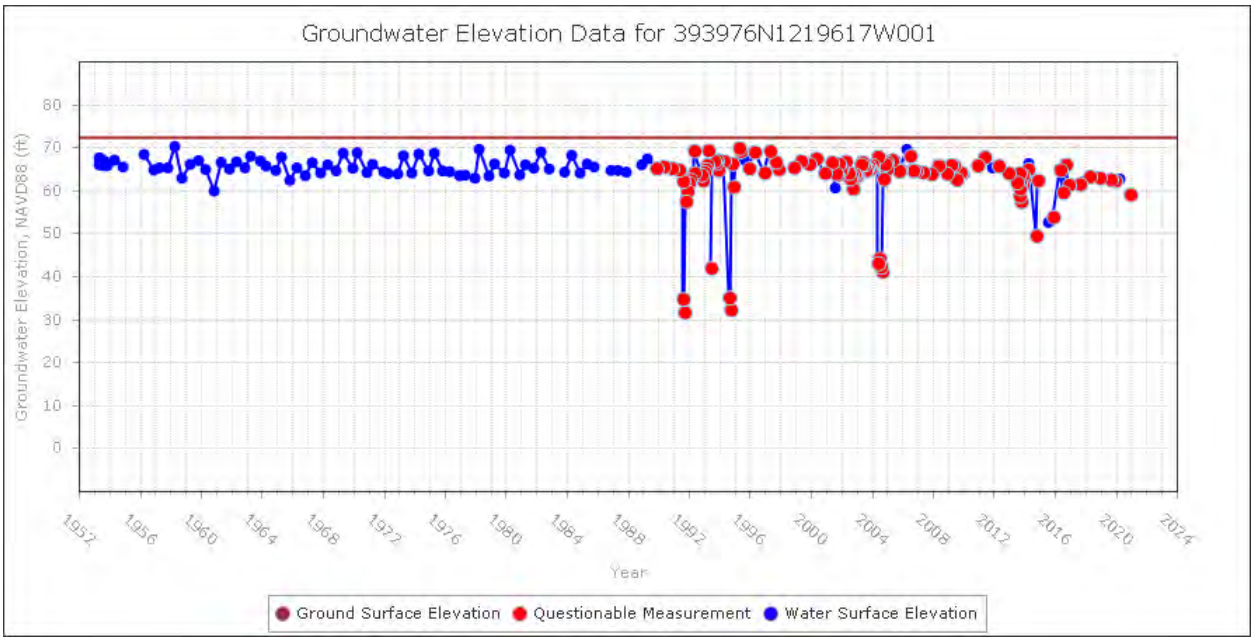

Figure D-35. Reclamation District 1004, State Well ID 18N01W22L001M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

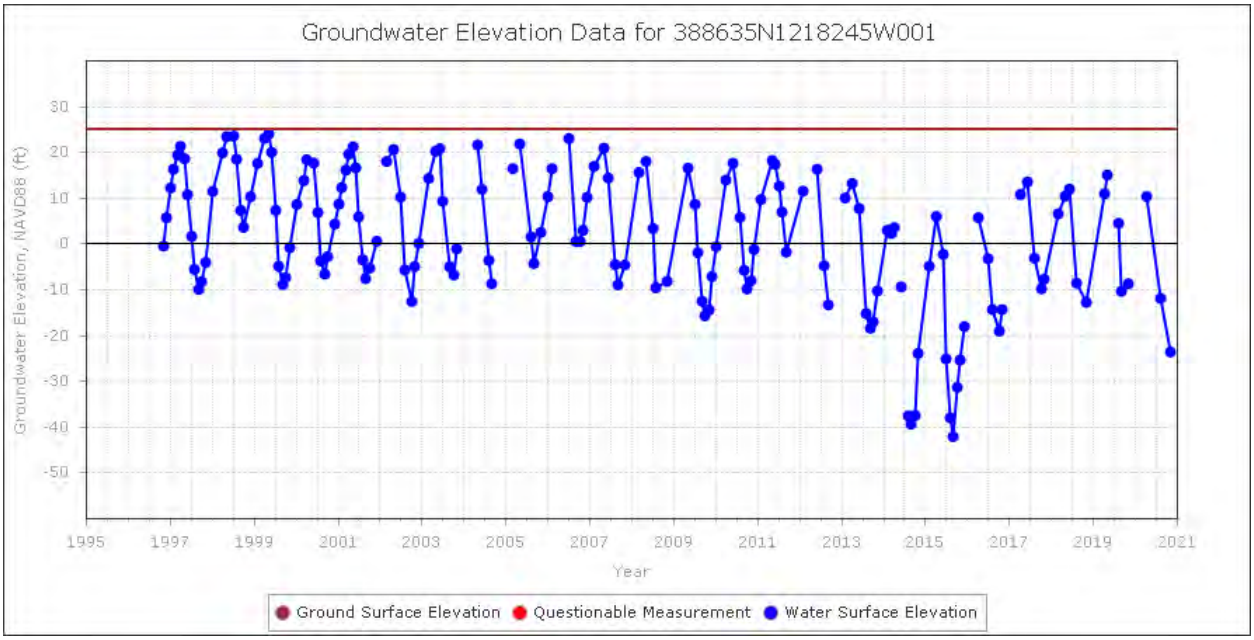

Figure D-36. River Garden Farms, State Well ID 12N01E26A001M (Deep Well; Depth = 670 ft)

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

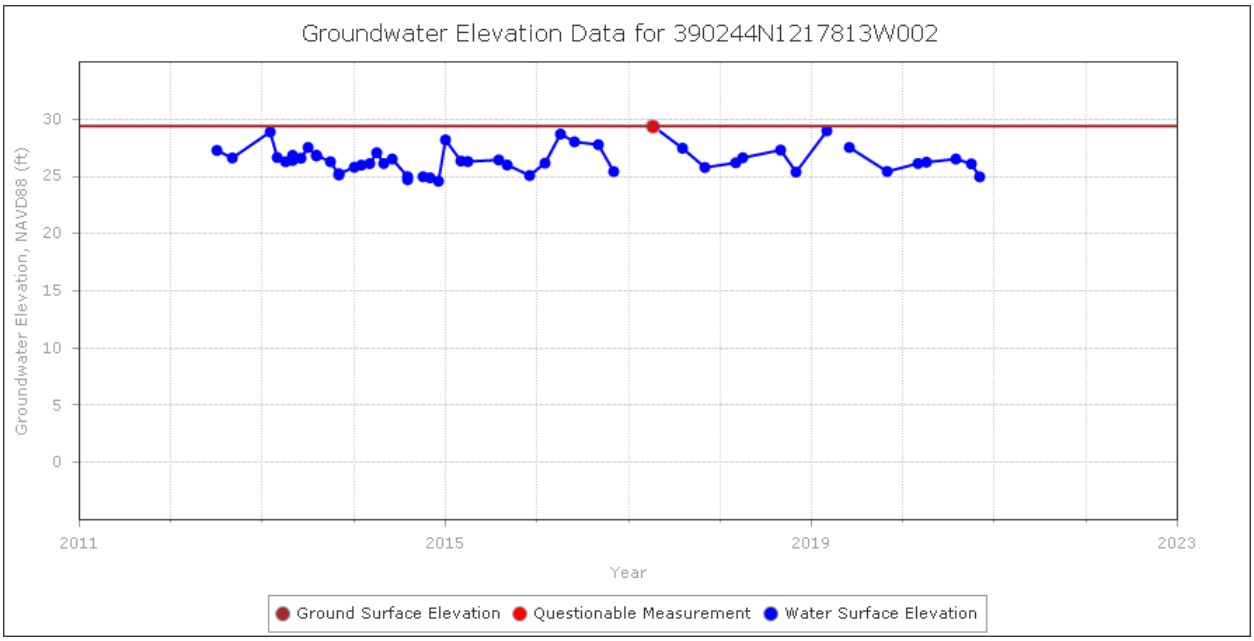

Figure D-37. Sutter Mutual Water Company, State Well ID 14N02E32D002M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

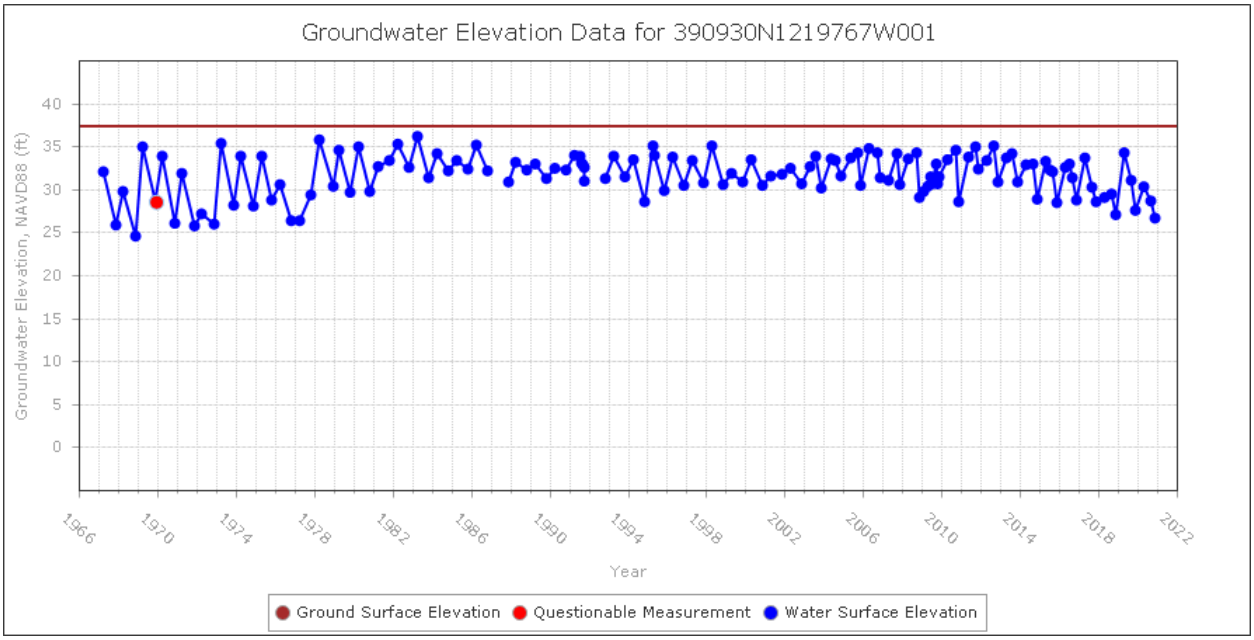

Figure D-38. Sycamore Mutual Water Company, State Well ID 14N01W04K003M (Shallow Well; Depth = 73 ft)

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

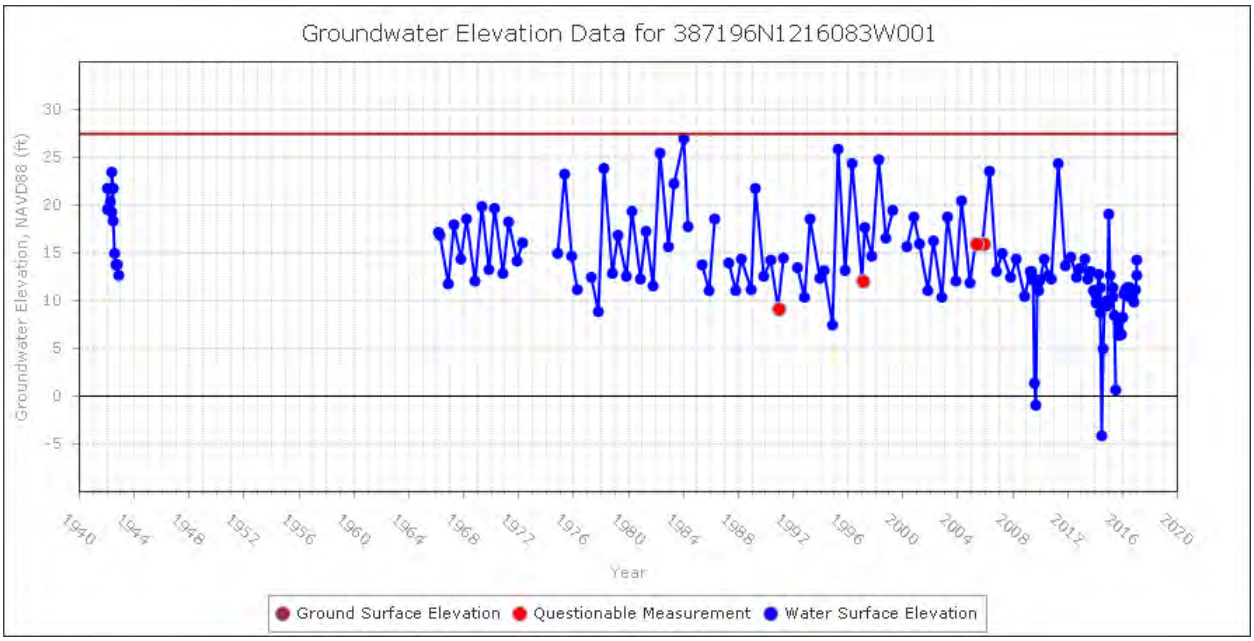

Figure D-39. Te Velde Revocable Family Trust, State Well ID 10N03E14C001M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

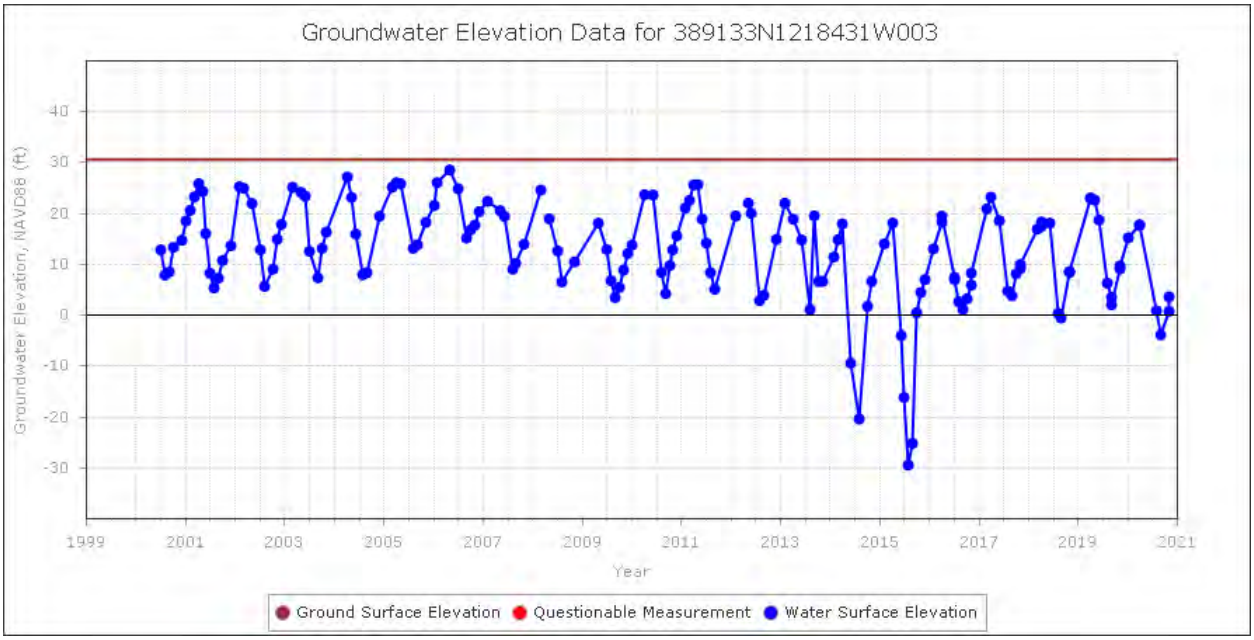

Figure D-40. Windswept Land & Livestock, State Well ID 12N01E03R003M

Source: DWR's CASGEM website.

Note: Well number in the title of the figure is the CASGEM Well Number.

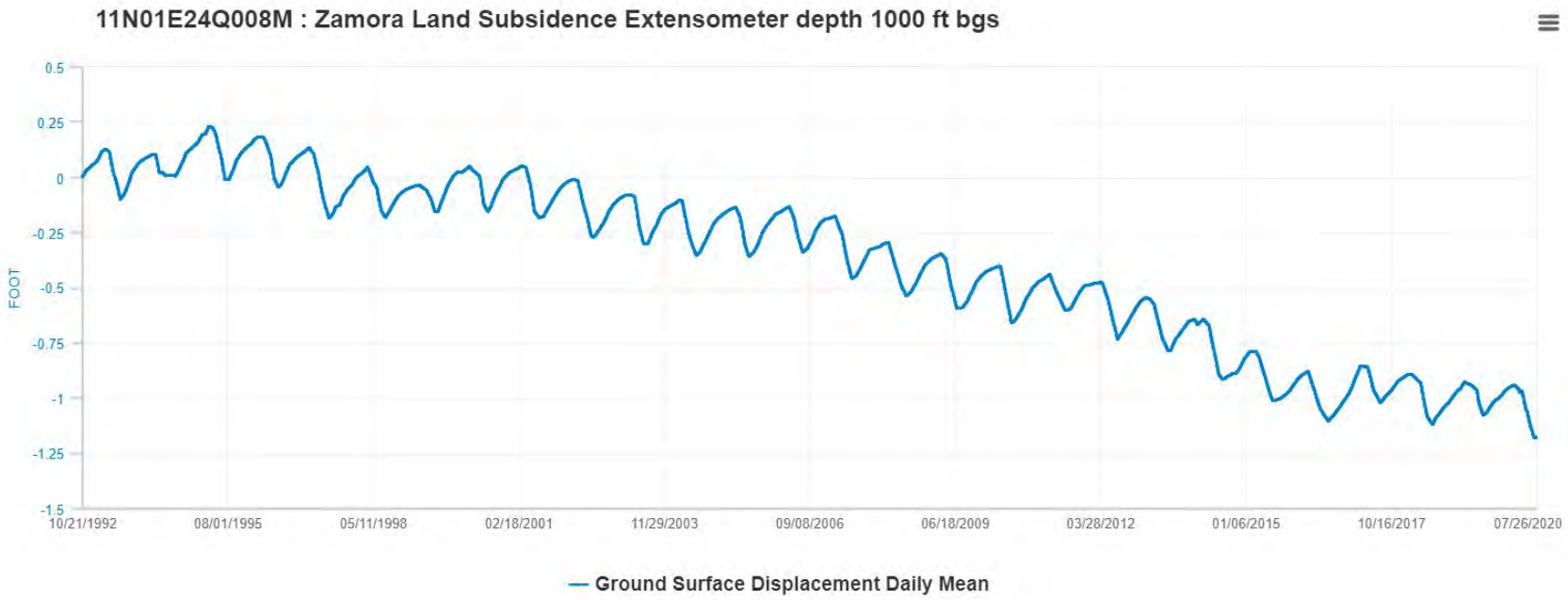

Figure D-41. Zamora Extensometer (11N01E24Q008M) Ground Surface Displacement Plot

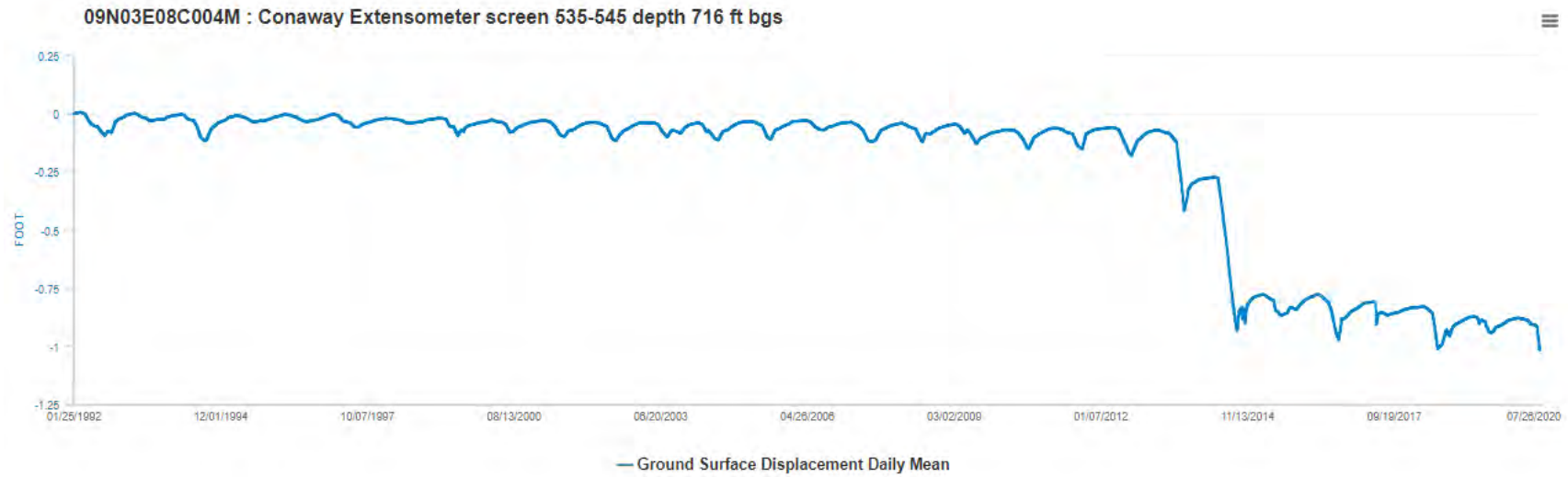

Figure D-42. Conaway Ranch Extensometer (09N03E08C004M) Ground Surface Displacement Plot

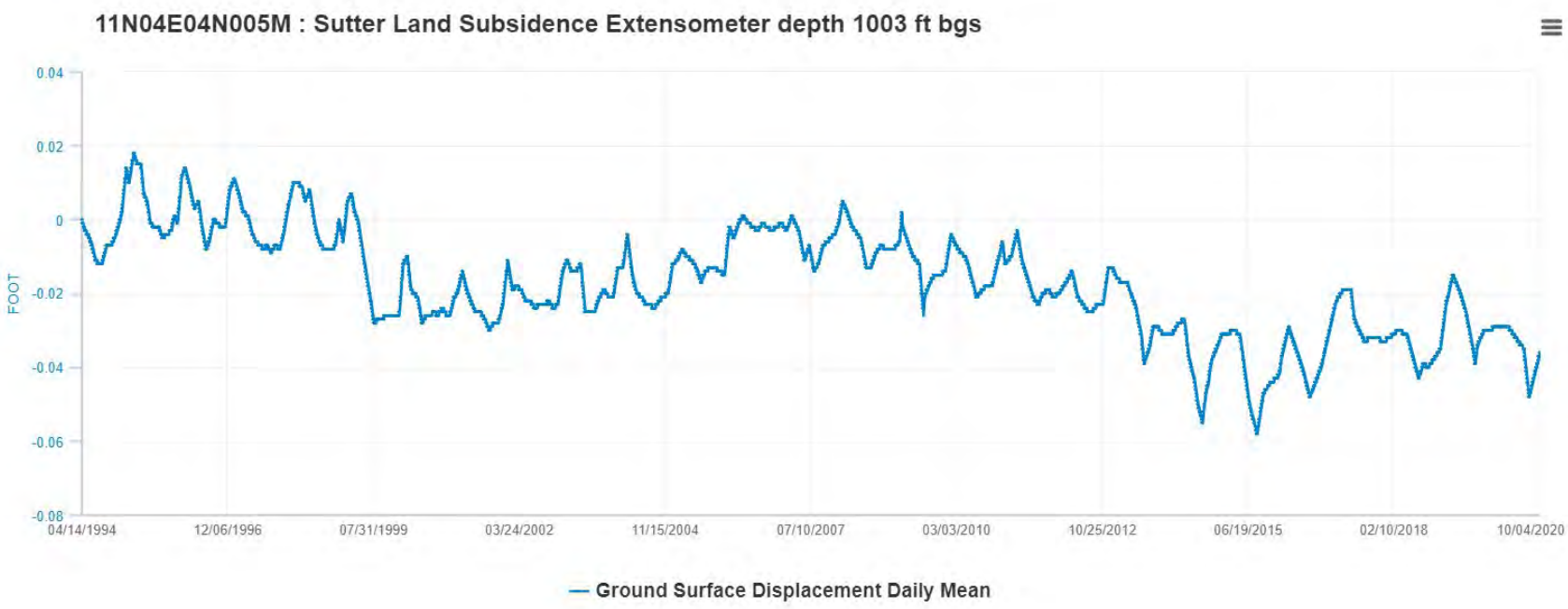

Figure D-43. Sutter Extensometer (11N04E04N005M) Ground Surface Displacement Plot

Appendix E
Air Quality Emissions Calculations

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

County/ Nonattainment Area	Emissions (tons per year)					
	VOC	NOx	CO	SOx	PM10	PM2.5
	Sacramento Metro[1]	Sacramento Metro[1]	Sacramento Area[2]	Sacramento[3,4]	Sacramento Co.	Sacramento[4]
Colusa	n/a	n/a	n/a	n/a	n/a	n/a
Glenn	n/a	n/a	n/a	n/a	n/a	n/a
Sacramento	1.1	15.3	2.9	1.8	0.2	0.2
Shasta	n/a	n/a	n/a	n/a	n/a	n/a
Sutter[5]	6.9	58.9	n/a	6.3	n/a	1.1
Tehama	n/a	n/a	n/a	n/a	n/a	n/a
Yolo	0.0	0.0	0.0	0.0	n/a	0.0
Total	7.9	74.2	2.9	8.1	0.2	1.3
Classification	Severe-15	Severe-15	Maintenance	PM2.5 Precursor	Maintenance	Nonattainment
De Minimis Threshold (tpy)	25	25	100	100	100	100
Exceed?	No	Yes	No	No	No	No

Note:

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

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

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

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

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

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

Water Agency	County	VOC	NOx
Pelger Road 1700 LLC	Sutter	All Electric	All Electric
Pelger Mutual Water Company	Sutter	0.0	0.7
Reclamation District 1004	Sutter	No Engines	No Engines
Total		**0.0**	**0.7**

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table E-3. Daily VOC Emissions (Unmitigated)

Water Agency	Daily VOC Emissions (pounds per day)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	2.10							2.10
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	43.07							43.07
Glenn-Colusa Irrigation District	14.23	3.56						17.78
Guisti Farms					3.02			3.02
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			11.73		7.79			19.52
Pelger Mutual Water Company					0.99			0.99
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					37.04			37.04
Princeton-Codora-Glenn Irrigation District	6.58	20.89						27.47
Provident Irrigation District	No Engines	54.54						54.54
Reclamation District 1004	31.70	2.69			No Engines			34.39
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					57.96			57.96
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**100.17**	**81.68**	**11.73**	**0.00**	**106.79**	**0.00**	**0.00**	**300.37**

Key:
VOC = volatile organic compounds

Table E-4. Daily NOx Emissions (Unmitigated)

Water Agency	Daily NOx Emissions (pounds per day)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	4.21							4.21
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	29.93							29.93
Glenn-Colusa Irrigation District	175.42	43.86						219.28
Guisti Farms					6.03			6.03
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	47.21							47.21
Natomas Central Mutual Water Company			164.73		96.02			260.76
Pelger Mutual Water Company					18.76			18.76
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					302.69			302.69
Princeton-Codora-Glenn Irrigation District	81.17	253.40						334.58
Provident Irrigation District	No Engines	672.56						672.56
Reclamation District 1004	405.20	33.13			No Engines			438.33
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					495.54			495.54
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total								0.00

Key:
NOx = nitrogen oxides

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table E-5. Daily CO Emissions (Unmitigated)

Water Agency	Daily CO Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	8.41							8.41
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	45.35							45.35
Glenn-Colusa Irrigation District	37.80	9.45						47.25
Guisti Farms					12.07			12.07
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	43.49							43.49
Natomas Central Mutual Water Company			31.56		20.69			52.25
Pelger Mutual Water Company					24.68			24.68
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					165.56			165.56
Princeton-Codora-Glenn Irrigation District	17.49	61.96						79.45
Provident Irrigation District	No Engines	144.93						144.93
Reclamation District 1004	115.72	7.14			No Engines			122.86
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					191.09			191.09
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**268.26**	**223.47**	**31.56**	**0.00**	**414.09**	**0.00**	**0.00**	**937.38**

Key:
CO = carbon monoxide

Table E-6. Daily SOx Emissions (Unmitigated)

Water Agency	Daily SOx Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	13.78							13.78
Glenn-Colusa Irrigation District	11.60	2.90						14.50
Guisti Farms					0.00			0.00
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	15.48							15.48
Natomas Central Mutual Water Company			19.39		6.35			25.74
Pelger Mutual Water Company					6.15			6.15
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					38.36			38.36
Princeton-Codora-Glenn Irrigation District	5.37	19.38						24.75
Provident Irrigation District	No Engines	44.48						44.48
Reclamation District 1004	35.28	2.19			No Engines			37.47
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					51.64			51.64
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**81.52**	**68.95**	**19.39**	**0.00**	**102.50**	**0.00**	**0.00**	**272.35**

Key:
SOx = sulfur oxides

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table E-7. Daily PM10 Emissions (Unmitigated)

Water Agency	Daily PM10 Emissions (pounds per day)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.02							0.02
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.65							2.65
Glenn-Colusa Irrigation District	2.74	0.69						3.43
Guisti Farms					0.03			0.03
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			2.34		1.50			3.84
Pelger Mutual Water Company					1.48			1.48
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					8.55			8.55
Princeton-Codora-Glenn Irrigation District	0.87	2.74						3.60
Provident Irrigation District	No Engines	8.02						8.02
Reclamation District 1004	6.07	0.35			No Engines			6.42
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					7.69			7.69
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**14.84**	**11.80**	**2.34**	**0.00**	**19.26**	**0.00**	**0.00**	**48.24**

Key:
PM10 = inhalable particulate matter

Table E-8. Daily PM2.5 Emissions (Unmitigated)

Water Agency	Daily PM2.5 Emissions (pounds per day)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.02							0.02
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.62							2.62
Glenn-Colusa Irrigation District	2.68	0.67						3.35
Guisti Farms					0.03			0.03
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			2.28		1.47			3.75
Pelger Mutual Water Company					1.48			1.48
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					8.39			8.39
Princeton-Codora-Glenn Irrigation District	0.85	2.67						3.52
Provident Irrigation District	No Engines	7.83						7.83
Reclamation District 1004	5.97	0.34			No Engines			6.32
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					7.52			7.52
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**14.63**	**11.52**	**2.28**	**0.00**	**18.89**	**0.00**	**0.00**	**47.32**

Key:
PM2.5 = fine particulate matter

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table E-9. Annual VOC Emissions (Unmitigated)

Water Agency	Annual VOC Emissions (tons per year)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.17							0.17
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.35							2.35
Glenn-Colusa Irrigation District	1.32	0.33						1.65
Guisti Farms					0.28			0.28
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			1.09		0.72			1.82
Pelger Mutual Water Company					0.04			0.04
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					1.81			1.81
Princeton-Codora-Glenn Irrigation District	0.41	1.30						1.71
Provident Irrigation District	No Engines	3.52						3.52
Reclamation District 1004	1.29	0.11			No Engines			1.40
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					4.04			4.04
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**5.69**	**5.27**	**1.09**	**0.00**	**6.90**	**0.00**	**0.00**	**18.94**

Key:
VOC = volatile organic compounds

Table E-10. Annual NOx Emissions (Unmitigated)

Water Agency	Annual NOx Emissions (tons per year)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.34							0.34
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	1.63							1.63
Glenn-Colusa Irrigation District	16.31	4.08						20.39
Guisti Farms					0.56			0.56
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.88							2.88
Natomas Central Mutual Water Company			15.32		8.93			24.25
Pelger Mutual Water Company					0.72			0.72
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					14.79			14.79
Princeton-Codora-Glenn Irrigation District	5.06	15.81						20.87
Provident Irrigation District	No Engines	43.44						43.44
Reclamation District 1004	16.49	1.35			No Engines			17.83
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					34.56			34.56
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**42.72**	**64.67**	**15.32**	**0.00**	**59.57**	**0.00**	**0.00**	**182.27**

Key:
NOx = nitrogen oxides

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table E-11. Annual CO Emissions (Unmitigated)

Water Agency	Annual CO Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.68							0.68
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.47							2.47
Glenn-Colusa Irrigation District	3.52	0.88						4.39
Guisti Farms					1.12			1.12
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.65							2.65
Natomas Central Mutual Water Company			2.94		1.92			4.86
Pelger Mutual Water Company					0.94			0.94
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					8.09			8.09
Princeton-Codora-Glenn Irrigation District	1.09	3.86						4.96
Provident Irrigation District	No Engines	9.36						9.36
Reclamation District 1004	4.71	0.29			No Engines			5.00
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					13.33			13.33
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**15.12**	**14.39**	**2.94**	**0.00**	**25.41**	**0.00**	**0.00**	**57.86**

Key:
CO = carbon monoxide

Table E-12. Annual SOx Emissions (Unmitigated)

Water Agency	Annual SOx Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.75							0.75
Glenn-Colusa Irrigation District	1.08	0.27						1.35
Guisti Farms					0.00			0.00
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.94							0.94
Natomas Central Mutual Water Company			1.80		0.59			2.39
Pelger Mutual Water Company					0.24			0.24
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					1.87			1.87
Princeton-Codora-Glenn Irrigation District	0.33	1.21						1.54
Provident Irrigation District	No Engines	2.87						2.87
Reclamation District 1004	1.44	0.09			No Engines			1.52
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					3.60			3.60
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**4.55**	**4.44**	**1.80**	**0.00**	**6.30**	**0.00**	**0.00**	**17.09**

Key:
SOx = sulfur oxides

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table E-13. Annual PM10 Emissions (Unmitigated)

Water Agency	Annual PM10 Emissions (tons per year)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.14							0.14
Glenn-Colusa Irrigation District	0.26	0.06						0.32
Guisti Farms					0.00			0.00
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			0.22		0.14			0.36
Pelger Mutual Water Company					0.06			0.06
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					0.42			0.42
Princeton-Codora-Glenn Irrigation District	0.05	0.17						0.22
Provident Irrigation District	No Engines	0.52						0.52
Reclamation District 1004	0.25	0.01			No Engines			0.26
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					0.54			0.54
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**0.85**	**0.77**	**0.22**	**0.00**	**1.15**	**0.00**	**0.00**	**2.99**

Key:
PM10 = inhalable particulate matter

Table E-14. Annual PM2.5 Emissions (Unmitigated)

Water Agency	Annual PM2.5 Emissions (tons per year)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.14							0.14
Glenn-Colusa Irrigation District	0.25	0.06						0.31
Guisti Farms					0.00			0.00
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			0.21		0.14			0.35
Pelger Mutual Water Company					0.06			0.06
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					0.41			0.41
Princeton-Codora-Glenn Irrigation District	0.05	0.17						0.22
Provident Irrigation District	No Engines	0.51						0.51
Reclamation District 1004	0.24	0.01			No Engines			0.26
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					0.52			0.52
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**0.84**	**0.75**	**0.21**	**0.00**	**1.13**	**0.00**	**0.00**	**2.93**

Key:
PM2.5 = fine particulate matter

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Anderson-Cottonwood Irrigation District			Peak Pumping by Transfer Period
Transfer Volume	2,400	acre-feet	(Apr-Jun)	800 AF/month
	2,400	acre-feet	(Jul-Sep)	800 AF/month
	4,800	acre-feet/year		

Table E-15. Anderson-Cottonwood Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Shasta	0	2	0	0	2
Tehama	0	0	0	0	0
Total	0	2	0	0	2

Table E-16. Anderson-Cottonwood Irrigation District Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
Barney Street	Shasta	Electric	2012	200	n/a	5,500	85%	677	4,062	22	4,010
Crowley Gulch	Shasta	Electric	2012	50	n/a	1,000	15%	123	738	22	4,010
					Total	**6,500**	**100%**	**800**	**4,800**	**43**	**8,021**
					Total (Shasta County)	**6,500**	**100%**	**800**	**4,800**	**43**	**8,021**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Shasta	Tehama
PM10	A	A
PM2.5	A	A
O3	A	A

Engines not subject to ATCM if remotely-located.

Peak Month

800	AF/month
5,840	gallons/minute
90%	peak pump rate

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency Canal Farms

Transfer Volume
575 acre-feet (Apr-Jun)
425 acre-feet (Jul-Sep)
1,000 acre-feet/year

Peak Pumping by Transfer Period
192 AF/month
142 AF/month

Table E-17. Canal Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	2	0	1	3
Total	0	2	0	1	3

Table E-18. Canal Farms Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (MMBtu/yr)	Emission Factors (g/hp-hr) VOC	NOx	CO	Emission Factors (lb/MMBtu) SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Dennis Well North	Colusa	Electric	unknown	125	n/a	1,900	22%	41	216	4	617	n/a																		
Dennis Well South	Colusa	Electric	unknown	125	n/a	1,900	22%	41	216	4	617	n/a																		
East Well	Colusa	Propane	unknown	250	n/a	5,000	57%	109	568	4	617	392	1.0	2.0	4.0	0.000588	0.00999	0.00999	2.10	4.21	8.41	0.00	0.02	0.02	0.17	0.34	0.68	0.000115	0.0020	0.0020
Total						**8,800**	**100%**	**192**	**1,000**	**11**	**1,851**	**392**							**2.10**	**4.21**	**8.41**	**0.00**	**0.02**	**0.02**	**0.17**	**0.34**	**0.68**	**0.000115**	**0.0020**	**0.0020**
Total (Colusa County)						**8,800**	**100%**	**192**	**1,000**	**11**	**1,851**	**392**							**2.10**	**4.21**	**8.41**	**0.00**	**0.02**	**0.02**	**0.17**	**0.34**	**0.68**	**0.000115**	**0.0020**	**0.0020**

Note: Natural gas emission factors used for propane.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa
PM10	A
PM2.5	A
O3	A

Engines not subject to ATCM if remotely-located.

Peak Month
192 AF/month
1,399 gallons/minute
16% peak pump rate

Legend
Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008
Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Propane Emission Factor Sources
http://www.valleyair.org/notices/Docs/2013/08-19-13%20(C-1132198)/Prelim%20C-1132198.pdf
https://www.valleyair.org/busind/pto/gears/GEAR11_Emergcy_Engns.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency: Eastside Mutual Water Company
Transfer Volume: 1,067 acre-feet (Apr-Jun); 1,163 acre-feet (Jul-Sep); 2,230 acre-feet/year

Peak Pumping by Transfer Period: 634 AF/month; 443 AF/month

Table E-19. Eastside Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	2	0	0	0	2
Total	2	0	0	0	2

Table E-20. Eastside Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
ATW-1	Colusa	Diesel	2006	150	T2	3,000	48%	307	1,079	18	1,953	16,438	0.2	4.7	3.7	0.93	0.22	0.22	1.46	27.74	22.12	5.51	1.33	1.33	0.08	1.51	1.21	0.30	0.07	0.07
ATW-2	Colusa	Diesel	2002	225	T2	3,200	52%	327	1,151	18	1,953	24,657	4.7	0.2	2.6	0.93	0.15	0.15	41.61	2.19	23.23	8.27	1.33	1.30	2.27	0.12	1.27	0.45	0.07	0.07
					Total	**6,200**	**100%**	**634**	**2,230**	**36**	**3,907**	**41,094**							**43.07**	**29.93**	**45.35**	**13.78**	**2.65**	**2.62**	**2.35**	**1.63**	**2.47**	**0.75**	**0.14**	**0.14**
					Total (Colusa County)	**6,200**	**100%**	**634**	**2,230**	**36**	**3,907**	**41,094**							**43.07**	**29.93**	**45.35**	**13.78**	**2.65**	**2.62**	**2.35**	**1.63**	**2.47**	**0.75**	**0.14**	**0.14**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa
PM10	A
PM2.5	A
O3	A

Engines not subject to ATCM if remotely-located.

Peak Month
634 AF/month
4,631 gallons/minute
75% peak pump rate

Legend
Emission factors based on NMHC+NOx standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency: Glenn-Colusa Irrigation District
Transfer Volume: 5,650 acre-feet (Apr-Jun); 5,650 acre-feet (Jul-Sep); 11,300 acre-feet/year

Peak Pumping by Transfer Period: 1,883 AF/month; 1,883 AF/month

Table E-21. Glenn-Colusa Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	1	6	0	0	7
Colusa	4	6	0	0	10
Total	5	12	0	0	17

Table E-22. Glenn-Colusa Irrigation District Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
15-3-22H-3	Colusa	Diesel	unknown	121	T0	630	2%	42	252	12	2,175	14,762	1.1	14.1	3.0	0.93	0.22	0.21	3.56	43.86	9.45	2.90	0.69	0.67	0.33	4.08	0.88	0.27	0.06	0.06
17-2-6B-1	Colusa	Electric	unknown	121	n/a	2,050	7%	137	821	12	2,175	n/a																		
GRS-22H-1	Glenn	Electric	unknown	121	n/a	2,300	8%	153	921	12	2,175	n/a																		
GRS-34N-1	Glenn	Diesel	unknown	121	T0	1,500	5%	100	601	12	2,175	14,762	1.1	14.1	3.0	0.93	0.22	0.21	3.56	43.86	9.45	2.90	0.69	0.67	0.33	4.08	0.88	0.27	0.06	0.06
GRS-35A-2	Glenn	Electric	unknown	121	n/a	3,600	13%	240	1,442	12	2,175	n/a																		
GRS-84A-1	Glenn	Electric	unknown	121	n/a	3,000	11%	200	1,201	12	2,175	n/a																		
Haymen	Colusa	Diesel	unknown	121	T0	2,000	7%	133	801	12	2,175	14,762	1.1	14.1	3.0	0.93	0.22	0.21	3.56	43.86	9.45	2.90	0.69	0.67	0.33	4.08	0.88	0.27	0.06	0.06
LaCroix 1	Glenn	Electric	unknown	121	n/a	600	2%	40	240	12	2,175	n/a																		
LaCroix 2	Glenn	Electric	unknown	121	n/a	600	2%	40	240	12	2,175	n/a																		
LaCroix 3	Glenn	Electric	unknown	121	n/a	600	2%	40	240	12	2,175	n/a																		
Lagrande	Colusa	Diesel	unknown	121	T0	2,900	10%	194	1,161	12	2,175	14,762	1.1	14.1	3.0	0.93	0.22	0.21	3.56	43.86	9.45	2.90	0.69	0.67	0.33	4.08	0.88	0.27	0.06	0.06
Reister 1	Colusa	Electric	unknown	121	n/a	850	3%	57	340	12	2,175	n/a																		
Reister 2	Colusa	Electric	unknown	121	n/a	850	3%	57	340	12	2,175	n/a																		
Reister 3	Colusa	Electric	unknown	121	n/a	850	3%	57	340	12	2,175	n/a																		
Reister 4	Colusa	Electric	unknown	121	n/a	890	3%	59	356	12	2,175	n/a																		
Vann 1	Colusa	Diesel	unknown	121	T0	1,500	5%	100	601	12	2,175	14,762	1.1	14.1	3.0	0.93	0.22	0.21	3.56	43.86	9.45	2.90	0.69	0.67	0.33	4.08	0.88	0.27	0.06	0.06
Vann 2	Colusa	Electric	unknown	121	n/a	3,500	12%	234	1,401	12	2,175	n/a																		
					Total	**28,220**	**100%**	**1,883**	**11,300**	**199**	**36,969**	**73,810**							**17.78**	**219.28**	**47.25**	**14.50**	**3.43**	**3.35**	**1.65**	**20.39**	**4.39**	**1.35**	**0.32**	**0.31**
					Total (Glenn County)	**12,200**	**43%**	**814**	**4,885**	**82**	**15,223**	**14,762**							**3.56**	**43.86**	**9.45**	**2.90**	**0.69**	**0.67**	**0.33**	**4.08**	**0.88**	**0.27**	**0.06**	**0.06**
					Total (Colusa County)	**16,020**	**57%**	**1,069**	**6,415**	**117**	**21,746**	**59,048**							**14.23**	**175.42**	**37.80**	**11.60**	**2.74**	**2.68**	**1.32**	**16.31**	**3.52**	**1.08**	**0.26**	**0.25**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

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

Engines not subject to ATCM if remotely-located.

Peak Month
1,883 AF/month
13,747 gallons/minute
49% peak pump rate

Legend
Engine power rating equal to average horsepower of all wells in GCID's well database

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency Guisti Farms

Transfer Volume
500 acre-feet (Apr-Jun)
500 acre-feet (Jul-Sep)
1,000 acre-feet/year

Peak Pumping by Transfer Period
167 AF/month
167 AF/month

Table E-23. Guisti Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	0	0	2	2
Total	0	0	0	2	2

Table E-24. Guisti Farms Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Guisti Well 1	Sutter	Propane	2015	150	n/a	3,200	50%	83	500	5	849	7,141	1.0	2.0	4.0	0.000588	0.00999	0.00999	1.51	3.02	6.03	0.00	0.02	0.02	0.14	0.28	0.56	0.000095	0.0016	0.0016
Guisti Well 2	Sutter	Propane	2015	150	n/a	3,200	50%	83	500	5	849	7,141	1.0	2.0	4.0	0.000588	0.00999	0.00999	1.51	3.02	6.03	0.00	0.02	0.02	0.14	0.28	0.56	0.000095	0.0016	0.0016
			Total			**6,400**	**100%**	**167**	**1,000**	**9**	**1,697**	**14,282**							**3.02**	**6.03**	**12.07**	**0.00**	**0.03**	**0.03**	**0.28**	**0.56**	**1.12**	**0.00019**	**0.0032**	**0.0032**
			Total (Sutter County)			**6,400**	**100%**	**167**	**1,000**	**9**	**1,697**	**14,282**							**3.02**	**6.03**	**12.07**	**0.00**	**0.03**	**0.03**	**0.28**	**0.56**	**1.12**	**0.00019**	**0.0032**	**0.0032**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
167 AF/month
10 gallons/minute
0% peak pump rate

Legend
Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency Henle Family LP

Transfer Volume 350 acre-feet (Apr-Jun)
350 acre-feet (Jul-Sep)
700 acre-feet/year

Peak Pumping by Transfer Period
167 AF/month
167 AF/month

Table E-25. Henle Family LP Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	1	0	0	1
Total	0	1	0	0	1

Table E-26. Henle Family LP Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
Well #2	Sutter	Electric	unknown	125	n/a	3,200	100%	167	700	9	1,188
					Total	**3,200**	**100%**	**167**	**700**	**9**	**1,188**
					Total (Sutter County)	**3,200**	**100%**	**167**	**700**	**9**	**1,188**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
167 AF/month
10 gallons/minute
0% peak pump rate

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

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency: Maxwell Irrigation District
Transfer Volume: 1,000 acre-feet (Apr-Jun); 2,000 acre-feet (Jul-Sep); 3,000 acre-feet/year

Peak Pumping by Transfer Period
595 AF/month
762 AF/month

Table E-27. Maxwell Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	2	0	0	0	2
Total	2	0	0	0	2

Table E-28. Maxwell Irrigation District Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
MainWell	Colusa	Diesel	2006	215	T3	3,800	50%	381	1,500	18	2,144	25,857	0.1	2.8	2.6	0.93	0.14925	0.15	1.24	23.61	21.74	7.74	1.24	1.24	0.08	1.44	1.33	0.47	0.08	0.08
TuttleWell	Colusa	Diesel	2006	215	T3	3,800	50%	381	1,500	18	2,144	25,857	0.1	2.8	2.6	0.93	0.14925	0.15	1.24	23.61	21.74	7.74	1.24	1.24	0.08	1.44	1.33	0.47	0.08	0.08
					Total	**7,600**	**100%**	**762**	**3,000**	**35**	**4,288**	**51,715**							**2.48**	**47.21**	**43.49**	**15.48**	**2.48**	**2.48**	**0.15**	**2.88**	**2.65**	**0.94**	**0.15**	**0.15**
					Total (Colusa County)	**7,600**	**100%**	**762**	**3,000**	**35**	**4,288**	**51,715**							**2.48**	**47.21**	**43.49**	**15.48**	**2.48**	**2.48**	**0.15**	**2.88**	**2.65**	**0.94**	**0.15**	**0.15**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa
PM10	A
PM2.5	A
O3	A

Engines not subject to ATCM if remotely-located.

Peak Month
762 AF/month
5,562 gallons/minute
73% peak pump rate

Legend
Engine information assumed to be equivalent to Eastside MWC because it is the adjacent water district.
Emission factors based on NMHC+NOx standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Natomas Central Mutual Water Company			Peak Pumping by Transfer Period
Transfer Volume	10,000	acre-feet	(Apr-Jun)	3,333 AF/month
	10,000	acre-feet	(Jul-Sep)	3,333 AF/month
	20,000	acre-feet/year		

Table E-29. Natomas Central Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sacramento	6	10	0	0	16
Sutter	2	15	0	0	17
Total	8	25	0	0	33

Table E-30. Natomas Central Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
L-2	Sutter	Electric	unknown	30	n/a	1,900	3%	99	593	9	1,694	n/a																		
L-3	Sutter	Electric	unknown	125	n/a	1,300	2%	68	406	9	1,694	n/a																		
L-4	Sutter	Electric	unknown	125	n/a	1,300	2%	68	406	9	1,694	n/a																		
L-6	Sutter	Electric	unknown	125	n/a	2,000	3%	104	624	9	1,694	n/a																		
L-7	Sutter	Electric	unknown	125	n/a	1,200	2%	62	374	9	1,694	n/a																		
L-8	Sutter	Electric	unknown	125	n/a	2,800	4%	146	874	9	1,694	n/a																		
L-9	Sutter	Electric	unknown	125	n/a	1,500	2%	78	468	9	1,694	n/a																		
L-10	Sutter	Electric	unknown	125	n/a	1,000	2%	52	312	9	1,694	n/a																		
L-11	Sutter	Electric	unknown	125	n/a	1,500	2%	78	468	9	1,694	n/a																		
L-12	Sutter	Electric	unknown	125	n/a	1,500	2%	78	468	9	1,694	n/a																		
L-13 Bolen Pasture	Sutter	Diesel	unknown	170	T0	2,800	4%	146	874	9	1,694	16,161	1.1	14.1	3.0	0.93	0.22	0.21	3.89	48.01	10.35	3.17	0.75	0.73	0.36	4.46	0.96	0.30	0.07	0.07
L-14 Chappell	Sutter	Electric	unknown	125	n/a	1,800	3%	94	562	9	1,694	n/a																		
MAP	Sacramento	Electric	unknown	125	n/a	2,000	3%	104	624	9	1,694	n/a																		
Ose-1	Sacramento	Diesel	2013	200	T4I	1,800	3%	94	562	9	1,694	19,013	0.003	1.7	0.03	0.93	0.01	0.01	0.01	6.83	0.12	3.74	0.04	0.04	0.00	0.64	0.01	0.35	0.00	0.00
Ose-2	Sacramento	Electric	unknown	150	n/a	2,400	4%	125	749	9	1,694	n/a																		
Perry	Sacramento	Electric	unknown	125	n/a	2,600	4%	135	811	9	1,694	n/a																		
Spangler	Sutter	Electric	unknown	80	n/a	2,500	4%	130	780	9	1,694	n/a																		
TNBC Frazer	Sutter	Electric	unknown	125	n/a	2,000	3%	104	624	9	1,694	n/a																		
TNBC Lucich North	Sutter	Diesel	unknown	170	T0	2,500	4%	130	780	9	1,694	16,161	1.1	14.1	3.0	0.93	0.22	0.21	3.89	48.01	10.35	3.17	0.75	0.73	0.36	4.46	0.96	0.30	0.07	0.07
TNBC Bennett North	Sutter	Electric	unknown	125	n/a	2,200	3%	114	686	9	1,694	n/a																		
TNBC Atkinson	Sutter	Electric	unknown	125	n/a	1,800	3%	94	562	9	1,694	n/a																		
TNBC Fisherman's Lake	Sacramento	Electric	unknown	125	n/a	1,500	2%	78	468	9	1,694	n/a																		
TNBC Silva Dairy	Sacramento	Electric	unknown	125	n/a	1,000	2%	52	312	9	1,694	n/a																		
TNBC Betts	Sacramento	Electric	unknown	125	n/a	1,500	2%	78	468	9	1,694	n/a																		
Dhaliwal	Sacramento	Diesel	2013	180	T4I	3,000	5%	156	936	9	1,694	17,111	0.003	1.7	0.03	0.93	0.01	0.01	0.01	6.15	0.11	3.36	0.04	0.04	0.00	0.57	0.01	0.31	0.00	0.00
Willey	Sacramento	Diesel	2012	148	T4I	2,000	3%	104	624	9	1,694	14,069	0.01	2.6	0.10	0.93	0.003	0.003	0.03	7.73	0.30	2.76	0.01	0.01	0.00	0.72	0.03	0.26	0.00	0.00
Elkhorn	Sacramento	Electric	unknown	125	n/a	2,700	4%	140	842	9	1,694	n/a																		
Ameral	Sacramento	Diesel	unknown	170	T0	1,500	2%	78	468	9	1,694	16,161	1.1	14.1	3.0	0.93	0.22	0.21	3.89	48.01	10.35	3.17	0.75	0.73	0.36	4.46	0.96	0.30	0.07	0.07
Kubo	Sacramento	Electric	unknown	125	n/a	1,300	2%	68	406	9	1,694	n/a																		
Greenbriar	Sacramento	Diesel	unknown	170	T0	3,200	5%	166	998	9	1,694	16,161	1.1	14.1	3.0	0.93	0.22	0.21	3.89	48.01	10.35	3.17	0.75	0.73	0.36	4.46	0.96	0.30	0.07	0.07
Souza	Sacramento	Electric	unknown	125	n/a	1,200	2%	62	374	9	1,694	n/a																		
Plant 3	Sacramento	Diesel	unknown	170	T0	2,500	4%	130	780	9	1,694	16,161	1.1	14.1	3.0	0.93	0.22	0.21	3.89	48.01	10.35	3.17	0.75	0.73	0.36	4.46	0.96	0.30	0.07	0.07
Pond R	Sacramento	Electric	unknown	125	n/a	2,300	4%	120	718	9	1,694	n/a																		
					Total	**64,100**	**100%**	**3,333**	**20,000**	**301**	**55,918**	**130,996**							**19.52**	**260.76**	**52.25**	**25.74**	**3.84**	**3.75**	**1.82**	**24.25**	**4.86**	**2.39**	**0.36**	**0.35**
					Total (Sacramento County)	**32,500**	**51%**	**1,690**	**10,140**	**146**	**27,112**	**98,675**							**11.73**	**164.73**	**31.56**	**19.39**	**2.34**	**2.28**	**1.09**	**15.32**	**2.94**	**1.80**	**0.22**	**0.21**
					Total (Sutter County)	**31,600**	**49%**	**1,643**	**9,860**	**155**	**28,806**	**32,321**							**7.79**	**96.02**	**20.69**	**6.35**	**1.50**	**1.47**	**0.72**	**8.93**	**1.92**	**0.59**	**0.14**	**0.14**
					Total (0 County)	**0**	**0%**	**0**	**0**	**0**	**0**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sacramento	Sutter
PM10	M	A
PM2.5	N	M
O3	N	N

Engines subject to ATCM.

Peak Month
3,333 AF/month
24,332 gallons/minute
38% peak pump rate

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

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency: Pelger Mutual Water Company
Transfer Volume: 2,000 acre-feet (Apr-Jun); 2,670 acre-feet (Jul-Sep); 4,670 acre-feet/year

Peak Pumping by Transfer Period
1,189 AF/month
1,017 AF/month

Table E-31. Pelger Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	1	2	0	0	3
Total	1	2	0	0	3

Table E-32. Pelger Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
PMWC#1	Sutter	Electric	unknown	150	n/a	4,800	25%	293	1,149	24	1,300	n/a																		
Well 1 Tucker	Sutter	Electric	unknown	75	n/a	3,100	25%	293	1,149	24	2,013	n/a																		
Well 2 Flopet	Sutter	Diesel	2,008	125	T3	2,300	17%	198	778	24	1,837	12,882	0.1	2.8	3.7	0.93	0.22	0.22	0.99	18.76	24.68	6.15	1.48	1.48	0.04	0.72	0.94	0.24	0.06	0.06
Well 3 Klein	Sutter	Electric	unknown	150	n/a	4,300	34%	406	1,594	24	2,013	n/a																		
					Total	**14,500**	**100%**	**1,190**	**4,670**	**96**	**7,163**	**12,882**							**0.99**	**18.76**	**24.68**	**6.15**	**1.48**	**1.48**	**0.04**	**0.72**	**0.94**	**0.24**	**0.06**	**0.06**
					Total (Sutter County)	**14,500**	**100%**	**1,190**	**4,670**	**96**	**7,163**	**12,882**							**0.99**	**18.76**	**24.68**	**6.15**	**1.48**	**1.48**	**0.04**	**0.72**	**0.94**	**0.24**	**0.06**	**0.06**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
1,189 AF/month
8,681 gallons/minute
60% peak pump rate

Legend
Emission factors based on NMHC+NOx standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency Pelger Road 1700 LLC
Transfer Volume 2,600 acre-feet (Apr-Jun)
2,600 acre-feet (Jul-Sep)
5,200 acre-feet/year

Peak Pumping by Transfer Period
867 AF/month
867 AF/month

Table E-33. Pelger Road 1700 LLC Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	4	0	0	4
Total	0	4	0	0	4

Table E-34. Pelger Road 1700 LLC Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
North Well	Sutter	Electric	unknown	125	n/a	3,500	28%	243	1,456	12	2,259
South Well	Sutter	Electric	unknown	125	n/a	3,000	24%	208	1,248	12	2,259
North Well B	Sutter	Electric	unknown	125	n/a	3,000	24%	208	1,248	12	2,259
South Well B	Sutter	Electric	unknown	125	n/a	3,000	24%	208	1,248	12	2,259
					Total	**12,500**	**100%**	**867**	**5,200**	**49**	**9,037**
					Total (Sutter County)	**12,500**	**100%**	**867**	**5,200**	**49**	**9,037**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
867 AF/month
6,326 gallons/minute
51% peak pump rate

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

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency: Pleasant Grove-Verona Mutual Water Company
Transfer Volume: 8,000 acre-feet (Apr-Jun); 7,000 acre-feet (Jul-Sep); 15,000 acre-feet/year

Peak Pumping by Transfer Period: 4,757 AF/month; 2,667 AF/month

Table E-35. Pleasant Grove-Verona Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	13	20	0	3	36
Total	13	20	0	3	36

Table E-36. Pleasant Grove-Verona Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane	Emission Factors (g/bhp-hr) - diesel and VOC, NOx, and CO for propane (lb/MMBtu) - SOx, PM10, and PM2.5 for propane: VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day): VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year): VOC	NOx	CO	SOx	PM10	PM2.5
Kelly 190 Field Well #2	Sutter	Electric	unknown	30	n/a	2,100	3%	126	397	11	1,027	n/a																		
Kelly Windmill Field Well #2	Sutter	Electric	2002	62	n/a	2,000	3%	120	378	11	1,027	n/a																		
Kelly Windmill North Field Well	Sutter	Propane	2014	133	T2	1,800	2%	108	340	11	1,027	347	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	3.08	6.16	12.32	0.00	0.04	0.04	0.15	0.30	0.60	0.00	0.00	0.00
Kelly306	Sutter	Electric	unknown	60	n/a	3,500	4%	210	662	11	1,027	n/a																		
MLF Clubhouse B Well	Sutter	Electric	unknown	300	n/a	3,600	5%	216	681	11	1,027	n/a																		
MLF Marsh Well	Sutter	Electric	unknown	300	n/a	3,200	4%	192	605	11	1,027	n/a																		
MLF Monster Well	Sutter	Electric	unknown	60	n/a	3,100	4%	186	586	11	1,027	n/a																		
MLF Well #1	Sutter	Electric	unknown	30	n/a	2,000	3%	120	378	11	1,027	n/a																		
MLF Well #16	Sutter	Electric	unknown	50	n/a	1,700	2%	102	322	11	1,027	n/a																		
MLF Well#11	Sutter	Diesel	2004	250	T2	1,400	2%	84	265	11	1,027	14,408	0.2	4.7	2.6	0.93	0.15	0.15	1.43	27.10	15.13	5.39	0.86	0.86	0.07	1.32	0.74	0.26	0.04	0.04
MLF Well#12/17	Sutter	Electric	unknown	50	n/a	2,200	3%	132	416	11	1,027	n/a																		
MLF Well#13&#15	Sutter	Electric	2000	215	n/a	1,900	2%	114	359	11	1,027	n/a																		
MLF Well#2B	Sutter	Electric	2000	300	n/a	2,800	4%	168	530	11	1,027	n/a																		
Nicholas 72-Acre Field North	Sutter	Electric	unknown	40	n/a	1,700	2%	102	322	11	1,027	n/a																		
Nicholas 72-Acre Field South	Sutter	Diesel	2002	62	T1	2,000	3%	120	378	11	1,027	3,579	1.1	6.9	3.0	0.93	0.30	0.29	1.64	9.88	4.36	1.34	0.43	0.42	0.08	0.48	0.21	0.07	0.02	0.02
Nicholas BBC Well	Sutter	Electric	unknown	30	n/a	2,000	3%	120	378	11	1,027	n/a																		
Nicholas Filipino Camp South	Sutter	Diesel	2002	62	T1	800	1%	48	151	11	1,027	3,579	1.1	6.9	3.0	0.93	0.30	0.29	1.64	9.88	4.36	1.34	0.43	0.42	0.08	0.48	0.21	0.07	0.02	0.02
Nicholas Filipino Camp#2	Sutter	Electric	unknown	40	n/a	2,300	3%	138	435	11	1,027	n/a																		
Nicholas Johnston Field Well #2	Sutter	Electric	unknown	40	n/a	2,000	3%	120	378	11	1,027	n/a																		
Nicholas Sand Field Well	Sutter	Diesel	2002	62	T2	2,000	3%	120	378	11	1,027	3,579	0.3	5.3	3.7	0.93	0.30	0.29	0.40	7.65	5.37	1.34	0.43	0.42	0.02	0.37	0.26	0.07	0.02	0.02
RiverRanch#19	Sutter	Diesel	2008	99	T3	2,500	3%	150	473	11	1,027	5,705	0.2	3.3	3.7	0.93	0.30	0.29	0.40	7.64	8.56	2.13	0.69	0.67	0.02	0.37	0.42	0.10	0.03	0.03
S&O#16	Sutter	Electric	2014	159	n/a	2,000	3%	120	378	11	1,027	n/a																		
S&O#17	Sutter	Diesel	1999	101	T0	3,000	4%	180	567	11	1,027	5,821	1.1	14.1	3.0	0.93	0.22	0.21	2.67	32.90	7.09	2.18	0.51	0.50	0.13	1.61	0.35	0.11	0.03	0.02
S&O#18A	Sutter	Diesel	1999	101	T0	1,800	2%	108	340	11	1,027	5,821	1.1	14.1	3.0	0.93	0.22	0.21	2.67	32.90	7.09	2.18	0.51	0.50	0.13	1.61	0.35	0.11	0.03	0.02
S&O#19	Sutter	Diesel	2007	215	T3	1,800	2%	108	340	11	1,027	12,391	0.1	2.8	2.6	0.93	0.15	0.15	0.74	14.12	13.01	4.63	0.74	0.74	0.04	0.69	0.64	0.23	0.04	0.04
S&O#20	Sutter	Propane	2014	154	n/a	1,800	2%	108	340	11	1,027	402	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	3.57	7.14	14.27	0.00	0.04	0.04	0.17	0.35	0.70	0.00	0.00	0.00
Willey#1	Sutter	Diesel	2000	168	T1	3,000	4%	180	567	11	1,027	9,682	1.1	6.9	3.0	0.93	0.22	0.21	4.44	26.72	11.79	3.62	0.86	0.84	0.22	1.31	0.58	0.18	0.04	0.04
Willey#2	Sutter	Diesel	unknown	250	T2	3,000	4%	180	567	11	1,027	14,408	0.2	4.7	2.6	0.93	0.15	0.15	1.43	27.10	15.13	5.39	0.87	0.85	0.07	1.32	0.74	0.26	0.04	0.04
Willey#3	Sutter	Electric	unknown	75	n/a	1,800	2%	108	340	11	1,027	n/a																		
Willey#4	Sutter	Diesel	1974	150	T0	2,000	3%	120	378	11	1,027	8,645	1.1	14.1	3.0	0.93	0.22	0.21	3.96	48.86	10.53	3.23	0.76	0.75	0.19	2.39	0.51	0.16	0.04	0.04
Willey#5	Sutter	Propane	unknown	180	n/a	2,000	3%	120	378	11	1,027	470	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	4.17	8.34	16.68	0.00	0.04	0.04	0.20	0.41	0.82	0.00	0.00	0.00
Will-Lee Well#30	Sutter	Diesel	2000	100	T2	2,500	3%	150	473	11	1,027	5,763	0.2	4.7	3.7	0.93	0.22	0.21	0.57	10.84	8.64	2.15	0.51	0.50	0.03	0.53	0.42	0.11	0.02	0.02
Will-Lee Well#31	Sutter	Electric	unknown	50	n/a	1,500	2%	90	284	11	1,027	n/a																		
Will-Lee Well#32	Sutter	Electric	unknown	300	n/a	2,500	3%	150	473	11	1,027	n/a																		
Will-Lee Well#33	Sutter	Electric	unknown	75	n/a	2,500	3%	150	473	11	1,027	n/a																		
Will-Lee Well#4A	Sutter	Diesel	2000	160	T1	1,500	2%	90	284	11	1,027	9,221	1.1	6.9	3.0	0.93	0.22	0.21	4.23	25.45	11.23	3.45	0.82	0.80	0.21	1.24	0.55	0.17	0.04	0.04
					Total	**79,300**	**100%**	**4,757**	**15,000**	**378**	**36,982**	**103,820**							**37.04**	**302.69**	**165.56**	**38.36**	**8.55**	**8.39**	**1.81**	**14.79**	**8.09**	**1.87**	**0.42**	**0.41**
					Total (Sutter County)	**79,300**	**100%**	**4,757**	**15,000**	**378**	**36,982**	**103,820**							**37.04**	**302.69**	**165.56**	**38.36**	**8.55**	**8.39**	**1.81**	**14.79**	**8.09**	**1.87**	**0.42**	**0.41**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
4,757 AF/month
34,722 gallons/minute
44% peak pump rate

Legend
- Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008
- Emission factors based on NMHC+NOx standard
- Emission factor from AP-42 because emission standards for pollutant not available for emissions tier
- Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Princeton-Codora-Glenn Irrigation District		Peak Pumping by Transfer Period
Transfer Volume	2,500	acre-feet (Apr-Jun)	1,640 AF/month
	4,100	acre-feet (Jul-Sep)	1,640 AF/month
	6,600	acre-feet/year	

Table E-37. Princeton-Codora-Glenn Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	7	3	0	0	10
Colusa	2	1	0	0	3
Total	9	4	0	0	13

Table E-38. Princeton-Codora-Glenn Irrigation District Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Joel Mann	Glenn	Diesel	unknown	180	T0	3,500	9%	145	585	7	907	9,163	1.1	14.1	3.0	0.93	0.15	0.15	3.29	40.59	8.75	2.68	0.43	0.42	0.21	2.53	0.55	0.17	0.03	0.03
D.Withrow	Glenn	Diesel	unknown	180	T0	1,000	3%	42	167	7	907	9,163	1.1	14.1	3.0	0.93	0.15	0.15	3.29	40.59	8.75	2.68	0.43	0.42	0.21	2.53	0.55	0.17	0.03	0.03
Chrisman	Glenn	Diesel	unknown	180	T0	2,000	5%	83	334	7	907	9,163	1.1	14.1	3.0	0.93	0.15	0.15	3.29	40.59	8.75	2.68	0.43	0.42	0.21	2.53	0.55	0.17	0.03	0.03
D.Schmidt	Glenn	Diesel	2013	180	T4I	3,000	8%	125	501	7	907	9,163	0.14	0.3	2.6	0.93	0.01	0.01	0.41	0.86	7.54	2.68	0.04	0.04	0.03	0.05	0.47	0.17	0.00	0.00
Argo B	Glenn	Diesel	unknown	200	T0	3,000	8%	125	501	7	907	10,182	1.1	14.1	3.0	0.93	0.15	0.15	3.66	45.10	9.72	2.98	0.48	0.47	0.23	2.81	0.61	0.19	0.03	0.03
Argo C	Glenn	Diesel	unknown	200	T0	3,000	8%	125	501	7	907	10,182	1.1	14.1	3.0	0.93	0.15	0.15	3.66	45.10	9.72	2.98	0.48	0.47	0.23	2.81	0.61	0.19	0.03	0.03
F. Gomes	Colusa	Diesel	unknown	180	T0	2,500	6%	104	418	7	907	9,163	1.1	14.1	3.0	0.93	0.15	0.15	3.29	40.59	8.75	2.68	0.43	0.42	0.21	2.53	0.55	0.17	0.03	0.03
Jones Well	Glenn	Electric	2012	200	n/a	3,500	9%	145	585	7	907	n/a																		
M. Cota	Colusa	Diesel	unknown	180	T0	3,000	8%	125	501	7	907	9,163	1.1	14.1	3.0	0.93	0.15	0.15	3.29	40.59	8.75	2.68	0.43	0.42	0.21	2.53	0.55	0.17	0.03	0.03
Zoller A	Glenn	Diesel	unknown	180	T0	3,000	8%	125	501	7	907	9,163	1.1	14.1	3.0	0.93	0.15	0.15	3.29	40.59	8.75	2.68	0.43	0.42	0.21	2.53	0.55	0.17	0.03	0.03
Clark #1	Glenn	Electric	unknown	200	n/a	4,000	10%	166	668	7	907	n/a																		
Clark #2	Glenn	Electric	unknown	200	n/a	4,000	10%	166	668	7	907	n/a																		
J. Southam	Colusa	Electric	unknown	200	n/a	4,000	10%	166	668	7	907	n/a																		
					Total	**39,500**	**100%**	**1,640**	**6,600**	**95**	**11,797**	**84,507**							**27.47**	**334.58**	**79.45**	**24.75**	**3.60**	**3.52**	**1.71**	**20.87**	**4.96**	**1.54**	**0.22**	**0.22**
					Total (Glenn County)	**30,000**	**76%**	**1,246**	**5,013**	**73**	**9,074**	**66,180**							**20.89**	**253.40**	**61.96**	**19.38**	**2.74**	**2.67**	**1.30**	**15.81**	**3.86**	**1.21**	**0.17**	**0.17**
					Total (Colusa County)	**9,500**	**24%**	**394**	**1,587**	**22**	**2,722**	**18,327**							**6.58**	**81.17**	**17.49**	**5.37**	**0.87**	**0.85**	**0.41**	**5.06**	**1.09**	**0.33**	**0.05**	**0.05**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

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

Engines not subject to ATCM if remotely-located.

Peak Month
1,640 AF/month
11,971 gallons/minute
30% peak pump rate

Legend
Tier 4 Exhaust Emission Standards, Phase-In (100<=hp<=175, 2012-2014 model year)

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency: Provident Irrigation District
Transfer Volume: 4,000 acre-feet (Apr-Jun); 6,000 acre-feet (Jul-Sep); 10,000 acre-feet/year

Peak Pumping by Transfer Period: 2,400 AF/month; 2,400 AF/month

Table E-39. Provident Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	13	3	0	0	16
Colusa	0	0	0	0	0
Total	13	3	0	0	16

Table E-40. Provident Irrigation District Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Weller62V	Glenn	Diesel	unknown	200	T0	2,000	4%	96	400	8	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	4.23	52.14	11.23	3.45	0.56	0.54	0.27	3.37	0.73	0.22	0.04	0.04
L Hansen#1	Glenn	Diesel	unknown	200	T0	3,800	8%	182	760	8	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	4.23	52.14	11.23	3.45	0.56	0.54	0.27	3.37	0.73	0.22	0.04	0.04
L Hansen#2	Glenn	Diesel	unknown	200	T0	4,500	9%	216	900	8	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	4.23	52.14	11.23	3.45	0.56	0.54	0.27	3.37	0.73	0.22	0.04	0.04
K Hansen#1	Glenn	Diesel	unknown	200	T0	2,600	5%	125	520	8	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	4.23	52.14	11.23	3.45	0.56	0.54	0.27	3.37	0.73	0.22	0.04	0.04
K Hansen#2	Glenn	Electric	unknown	120	n/a	3,500	7%	168	700	8	1,086	n/a																		
E Weller	Glenn	Diesel	unknown	200	T0	2,500	5%	120	500	8	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	4.23	52.14	11.23	3.45	0.56	0.54	0.27	3.37	0.73	0.22	0.04	0.04
Weller#4	Glenn	Electric	unknown	120	n/a	3,500	7%	168	700	8	1,086	n/a																		
Calvert	Glenn	Diesel	unknown	150	T0	3,000	6%	144	600	8	1,086	9,140	1.1	14.1	3.0	0.93	0.22	0.21	3.17	39.10	8.43	2.59	0.61	0.60	0.20	2.53	0.54	0.17	0.04	0.04
D. Alves	Glenn	Diesel	unknown	165	T0	3,000	6%	144	600	8	1,086	10,054	1.1	14.1	3.0	0.93	0.22	0.21	3.49	43.01	9.27	2.84	0.67	0.66	0.23	2.78	0.60	0.18	0.04	0.04
D. Kennedy	Glenn	Electric	unknown	120	n/a	3,000	6%	144	600	8	1,086	n/a																		
G. Clark #1	Glenn	Diesel	unknown	200	T0	3,000	6%	144	600	8	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	4.23	52.14	11.23	3.45	0.56	0.54	0.27	3.37	0.73	0.22	0.04	0.04
M. Jones #1	Glenn	Diesel	unknown	275	T0	3,000	6%	144	600	8	1,086	16,757	1.1	14.1	3.0	0.93	0.15	0.15	5.81	71.69	15.45	4.74	0.76	0.75	0.38	4.63	1.00	0.31	0.05	0.05
M. Jones #2	Glenn	Diesel	unknown	250	T0	3,000	6%	144	600	8	1,086	15,234	1.1	14.1	3.0	0.93	0.15	0.15	5.29	65.17	14.04	4.31	0.70	0.68	0.34	4.21	0.91	0.28	0.04	0.04
Perez and Perez	Glenn	Diesel	unknown	200	T0	3,200	6%	154	640	8	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	4.23	52.14	11.23	3.45	0.56	0.54	0.27	3.37	0.73	0.22	0.04	0.04
S. Jones #1	Glenn	Diesel	unknown	170	T0	3,200	6%	154	640	8	1,086	10,359	1.1	14.1	3.0	0.93	0.22	0.21	3.59	44.32	9.55	2.93	0.69	0.68	0.23	2.86	0.62	0.19	0.04	0.04
S. Jones #2	Glenn	Diesel	unknown	170	T0	3,200	6%	154	640	8	1,086	10,359	1.1	14.1	3.0	0.93	0.22	0.21	3.59	44.32	9.55	2.93	0.69	0.68	0.23	2.86	0.62	0.19	0.04	0.04
Total						**50,000**	**100%**	**2,400**	**10,000**	**135**	**17,379**	**157,213**							**54.54**	**672.56**	**144.93**	**44.48**	**8.02**	**7.83**	**3.52**	**43.44**	**9.36**	**2.87**	**0.52**	**0.51**
Total (Glenn County)						**50,000**	**100%**	**2,400**	**10,000**	**135**	**17,379**	**157,213**							**54.54**	**672.56**	**144.93**	**44.48**	**8.02**	**7.83**	**3.52**	**43.44**	**9.36**	**2.87**	**0.52**	**0.51**
Total (Colusa County)						**0**	**0%**	**0**	**0**	**0**	**0**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

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

Engines not subject to ATCM if remotely-located.

Peak Month
2,400 AF/month
17,519 gallons/minute
35% peak pump rate

Legend
Information on engine not available; therefore, engine assumed to be diesel as worst-case.
Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Reclamation District 108			Peak Pumping by Transfer Period
Transfer Volume	7,500	acre-feet	(Apr-Jun)	2,500 AF/month
	7,500	acre-feet	(Jul-Sep)	2,500 AF/month
	15,000	acre-feet/year		

Table E-41. Reclamation District 108 Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	3	0	0	3
Yolo	0	2	0	0	2
Total	0	5	0	0	5

Table E-42. Reclamation District 108 Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
Well #4 Huff	Colusa	Electric	unknown	250	n/a	1,420	8%	193	1,160	24	4,437
Well #5 RiggsRanch	Colusa	Electric	unknown	150	n/a	5,450	30%	742	4,453	24	4,437
Well #6 CountyLine	Yolo	Electric	unknown	250	n/a	3,840	21%	523	3,137	24	4,437
Well#1 Heidrick	Colusa	Electric	unknown	100	n/a	3,600	20%	490	2,941	24	4,437
Well#7 Tract 6	Yolo	Electric	unknown	250	n/a	4,050	22%	551	3,309	24	4,437
					Total	**18,360**	**100%**	**2,500**	**15,000**	**119**	**22,185**
					Total (Colusa County)	**10,470**	**57%**	**1,426**	**8,554**	**72**	**13,311**
					Total (Yolo County)	**7,890**	**43%**	**1,074**	**6,446**	**48**	**8,874**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa	Yolo
PM10	A	A
PM2.5	A	N
O3	A	N

Engines subject to ATCM.

Peak Month

2,500	AF/month
18,249	gallons/minute
99%	peak pump rate

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency: Reclamation District 1004
Transfer Volume: 0 acre-feet (Apr-Jun); 7,175 acre-feet (Jul-Sep); 7,175 acre-feet/year

Peak Pumping by Transfer Period: 0 AF/month; 2,733 AF/month

Table E-43. Reclamation District 1004 Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	1	7	0	0	8
Colusa	17	5	0	0	22
Sutter	0	0	0	0	0
Total	18	12	0	0	30

Table E-44. Reclamation District 1004 Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Barale Well	Colusa	Diesel	TBD	225	T0	4,000	4%	108	285	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Behring Ranch 10 Field Well No. 496441	Colusa	Diesel	2,008	225	T3	5,800	6%	157	413	5	387	4,880	0.1	2.8	2.6	0.93	0.15	0.15	0.35	6.68	6.15	2.19	0.35	0.35	0.01	0.27	0.25	0.09	0.01	0.01
Behring Ranch Club House Well No.496461	Colusa	Electric	unknown	125	n/a	3,400	3%	92	242	5	387	n/a																		
Behring Ranch Nursery Well No. 17N1W10H1	Colusa	Diesel	TBD	225	T0	1,000	1%	27	71	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Behring Ranch Pearl Well No. 20094	Colusa	Diesel	TBD	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Behring Ranch West Well No.97863	Colusa	Electric	unknown	unknown	n/a	2,300	2%	62	164	5	387	n/a																		
Drumheller Well No.7	Colusa	Diesel	TBD	225	T0	4,000	4%	108	285	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
17N01W14N001M	Colusa	Diesel	TBD	225	T0	2,600	3%	71	185	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
17N01W15Q001M	Colusa	Diesel	TBD	225	T0	1,300	1%	35	93	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Gardener No. 374672	Colusa	Diesel	2,008	215	T3	3,500	3%	95	249	5	387	4,663	0.1	2.8	2.6	0.93	0.15	0.15	0.34	6.39	5.88	2.09	0.34	0.34	0.01	0.26	0.24	0.09	0.01	0.01
Gardener No. 498178	Colusa	Diesel	2,009	215	T3	3,500	3%	95	249	5	387	4,663	0.1	2.8	2.6	0.93	0.15	0.15	0.34	6.39	5.88	2.09	0.34	0.34	0.01	0.26	0.24	0.09	0.01	0.01
Hall Well No. X	Glenn	Electric	TBD	125	n/a	4,500	4%	122	320	5	387	n/a																		
Hall Well No.369428	Glenn	Electric	2,011	125	n/a	4,500	4%	122	320	5	387	n/a																		
Mohammad No.e0084085 17N01W02D001M	Colusa	Electric	TBD	125	n/a	4,500	4%	122	320	5	387	n/a																		
Myers Well #1 No.3457	Glenn	Electric	2,006	40	n/a	2,200	2%	60	157	5	387	n/a																		
Myers Well #2 No. 340884	Glenn	Electric	1,982	100	n/a	4,100	4%	111	292	5	387	n/a																		
Rancho Caleta No. 726883	Colusa	Diesel	2,004	170	T2	4,500	4%	122	320	5	387	3,687	0.2	4.7	3.7	0.93	0.22	0.22	0.44	8.33	6.64	1.66	0.40	0.40	0.02	0.34	0.27	0.07	0.02	0.02
Sikes & Parachini Well #1 WS No.93124	Colusa	Diesel	2,006	173	T2	4,000	4%	108	285	5	387	3,752	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.48	6.76	1.68	0.41	0.41	0.02	0.34	0.28	0.07	0.02	0.02
Sikes & Parachini Well #2 WS No. 374682	Colusa	Diesel	2,008	150	T3	4,000	4%	108	285	5	387	3,253	0.1	2.8	3.7	0.93	0.22	0.22	0.23	4.45	5.86	1.46	0.35	0.35	0.01	0.18	0.24	0.06	0.01	0.01
Southam Sartain Well 18N01W26D001M	Glenn	Diesel	TBD	225	T0	4,800	5%	130	342	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Stone Well #6 No.11334	Colusa	Electric	2,006	40	n/a	1,800	2%	49	128	5	387	n/a																		
Wilder Farms Well	Glenn	Electric	unknown	125	n/a	2,500	2%	68	178	5	387	n/a																		
Dan Charter Well#1	Colusa	Diesel	unknown	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Dan Charter Well#2	Colusa	Diesel	unknown	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
GVL Well#1	Colusa	Diesel	unknown	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Behring Ranch Well	Colusa	Electric	unknown	125	n/a	4,000	4%	108	285	5	387	n/a																		
Claudia Charter	Colusa	Diesel	unknown	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
GVL Well#2	Colusa	Diesel	unknown	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Glenn West	Glenn	Electric	unknown	125	n/a	4,500	4%	122	320	5	387	n/a					0.22	1.15												
Glenn East	Glenn	Electric	unknown	125	n/a	4,500	4%	122	320	5	387	n/a					0.22	2.15												
Total						**100,800**	**100%**	**2,733**	**7,175**	**143**	**11,597**	**83,452**							**34**	**438**	**123**	**37**	**6**	**6**	**1**	**18**	**5**	**2**	**0**	**0**
Total (Glenn County)						**31,600**	**31%**	**857**	**2,249**	**38**	**3,093**	**4,880**							**2.69**	**33.13**	**7.14**	**2.19**	**0.35**	**0.34**	**0.11**	**1.35**	**0.29**	**0.09**	**0.01**	**0.01**
Total (Colusa County)						**69,200**	**69%**	**1,876**	**4,926**	**105**	**8,505**	**78,572**							**31.70**	**405.20**	**115.72**	**35.28**	**6.07**	**5.97**	**1.29**	**16.49**	**4.71**	**1.44**	**0.25**	**0.24**
Total (Sutter County)						**0**	**0%**	**0**	**0**	**0**	**0**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Glenn	Colusa	Sutter
PM10	A	A	A
PM2.5	A	A	M
O3	A	A	N

Engines subject to ATCM.

Peak Month
2,733 AF/month
19,952 gallons/minute
20% peak pump rate

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

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency River Garden Farms
Transfer Volume 5,000 acre-feet (Apr-Jun)
5,000 acre-feet (Jul-Sep)
10,000 acre-feet/year

Peak Pumping by Transfer Period
1,667 AF/month
1,667 AF/month

Table E-45. River Garden Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Yolo	0	8	0	0	8
Total	0	8	0	0	8

Table E-46. River Garden Farms Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
Field 65 PW	Yolo	Electric	2008	unknown	n/a	3,200	12%	203	1,220	11	2,070
Field 71 PW	Yolo	Electric	2001	unknown	n/a	2,200	8%	140	838	11	2,070
Field 98 PW	Yolo	Electric	1963	unknown	n/a	3,177	12%	202	1,211	11	2,070
Field 104 PW	Yolo	Electric	2008	unknown	n/a	2,800	11%	178	1,067	11	2,070
Field 104-09 PW	Yolo	Electric	2009	unknown	n/a	3,276	12%	208	1,248	11	2,070
Field 93 PW	Yolo	Electric	unknown	unknown	n/a	2,200	8%	140	838	11	2,070
Field 91-09 PW	Yolo	Electric	2009	unknown	n/a	3,300	13%	210	1,258	11	2,070
Field 117 PW	Yolo	Electric	2009	unknown	n/a	2,800	11%	178	1,067	11	2,070
Shop PW	Yolo	unknown	2009	unknown	n/a	3,287	13%	209	1,253	11	2,070
					Total	**26,240**	**100%**	**1,667**	**10,000**	**100**	**18,627**
					Total (Yolo County)	**26,240**	**100%**	**1,667**	**10,000**	**100**	**18,627**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Yolo
PM10	A
PM2.5	N
O3	N

Engines subject to ATCM.

Peak Month
1,667 AF/month
12,166 gallons/minute
46% peak pump rate

Conversion Factors
1 lb = 453.6 g
1 ton = 2,000 lbs
1 kW = 1.34 hp
1 day = 24 hours
1 month = 31 days
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Sutter Mutual Water Company		Peak Pumping by Transfer Period
Transfer Volume	8,000 acre-feet	(Apr-Jun)	3,200 AF/month
	10,000 acre-feet	(Jul-Sep)	4,000 AF/month
	18,000 acre-feet/year		

Table E-29. Sutter Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	13	10	0	8	31
Total	13	10	0	8	31

Table E-30. Sutter Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
G-16	Sutter	Electric	unknown	125	n/a	4,200	4%	167	751	7	971	n/a																		
QHR	Sutter	Propane	unknown	180	n/a	5,200	5%	207	929	7	971	9,803	1.0	2.0	4.0	0.93	0.01	0.01	2.76	5.52	11.05	2.57	0.03	0.03	0.19	0.39	0.77	0.18	0.00	0.00
MB-1	Sutter	Propane	unknown	180	n/a	5,300	5%	211	947	7	971	9,803	1.0	2.0	4.0	0.93	0.01	0.01	2.76	5.52	11.05	2.57	0.03	0.03	0.19	0.39	0.77	0.18	0.00	0.00
LM-53	Sutter	Electric	unknown	125	n/a	4,000	4%	159	715	7	971	n/a																		
BD-1	Sutter	Diesel	unknown	170	T0	2,500	2%	99	447	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
L1-1	Sutter	Diesel	unknown	170	T0	4,000	4%	159	715	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
L1-2	Sutter	Diesel	unknown	170	T0	5,000	5%	199	894	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
L2-1	Sutter	Diesel	unknown	170	T0	5,500	5%	218	983	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
LM-11	Sutter	Electric	unknown	125	n/a	3,100	3%	123	554	7	971	n/a																		
S-18	Sutter	Electric	unknown	125	n/a	2,700	3%	107	483	7	971	n/a																		
BD-2	Sutter	Diesel	unknown	170	T0	4,000	4%	159	715	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
BD-3	Sutter	Propane	unknown	180	n/a	3,000	3%	119	536	7	971	9,803	1.0	2.0	4.0	0.93	0.01	0.01	2.76	5.52	11.05	2.57	0.03	0.03	0.19	0.39	0.77	0.18	0.00	0.00
FG	Sutter	Propane	unknown	180	n/a	1,500	1%	60	268	7	971	9,803	1.0	2.0	4.0	0.93	0.01	0.01	2.76	5.52	11.05	2.57	0.03	0.03	0.19	0.39	0.77	0.18	0.00	0.00
H-1	Sutter	Electric	unknown	125	n/a	2,600	3%	103	465	7	971	n/a																		
R-29	Sutter	Diesel	unknown	170	T0	2,500	2%	99	447	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
TVN	Sutter	Electric	unknown	125	n/a	3,000	3%	119	536	7	971	n/a																		
DB-1	Sutter	Diesel	unknown	170	T0	4,500	4%	179	804	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
ME-1	Sutter	Diesel	unknown	170	T0	1,300	1%	52	232	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
R-24	Sutter	Diesel	unknown	170	T0	2,500	2%	99	447	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
G-2	Sutter	Propane	unknown	180	n/a	3,500	3%	139	626	7	971	9,803	1.0	2.0	4.0	0.93	0.01	0.01	2.76	5.52	11.05	2.57	0.03	0.03	0.19	0.39	0.77	0.18	0.00	0.00
Hoppin	Sutter	Electric	unknown	125	n/a	2,500	2%	99	447	7	971	n/a																		
Ag Industries - Sioux Creek	Sutter	Diesel	unknown	170	T0	2,800	3%	111	500	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
Ag Industries - Sutter Basin	Sutter	Diesel	unknown	170	T0	3,000	3%	119	536	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
TVN proposed well	Sutter	Propane	unknown	180	n/a	5,000	5%	199	894	7	971	9,803	1.0	2.0	4.0	0.93	0.01	0.01	2.76	5.52	11.05	2.57	0.03	0.03	0.19	0.39	0.77	0.18	0.00	0.00
Driver proposed well	Sutter	Diesel	unknown	170	T0	2,500	2%	99	447	7	971	9,258	1.1	14.1	3.0	0.93	0.22	0.21	2.97	36.67	7.90	2.43	0.57	0.56	0.21	2.56	0.55	0.17	0.04	0.04
Well #1	Sutter	Electric	unknown	250	n/a	2,500	2%	99	447	7	971	n/a																		
Well #2	Sutter	Electric	unknown	150	n/a	2,500	2%	99	447	7	971	n/a																		
Well #3	Sutter	Electric	unknown	150	n/a	2,500	2%	99	447	7	971	n/a																		
Well #4	Sutter	Propane	unknown	150	n/a	2,500	2%	99	447	7	971	8,169	1.0	2.0	4.0	0.93	0.01	0.01	2.30	4.60	9.20	2.14	0.02	0.02	0.16	0.32	0.64	0.15	0.00	0.00
Well #5	Sutter	Propane	unknown	180	T2	2,500	2%	99	447	7	971	9,803	1.0	2.0	4.0	0.93	0.01	0.01	2.76	5.52	11.05	2.57	0.03	0.03	0.19	0.39	0.77	0.18	0.00	0.00
Well #6	Sutter	Diesel	unknown	170	T2	2,500	2%	99	447	7	971	9,258	0.2	4.7	3.7	0.93	0.22	0.22	0.64	12.20	9.73	2.43	0.58	0.58	0.04	0.85	0.68	0.17	0.04	0.04
Total						**100,700**	**100%**	**4,000**	**18,000**	**216**	**30,093**	**197,147**							**57.96**	**495.54**	**191.09**	**51.64**	**7.69**	**7.52**	**4.04**	**34.56**	**13.33**	**3.60**	**0.54**	**0.52**
Total (Sutter County)						**100,700**	**100%**	**4,000**	**18,000**	**216**	**30,093**	**197,147**							**57.96**	**495.54**	**191.09**	**51.64**	**7.69**	**7.52**	**4.04**	**34.56**	**13.33**	**3.60**	**0.54**	**0.52**
Total (County)						**0**	**0**	**0**	**0**	**0**	**0**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Total (County)						**0**	**0**	**0**	**0**	**0**	**0**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
4,000 AF/month
29,198 gallons/minute
29% peak pump rate

Legend
- Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
- Tier 4 Exhaust Emission Standards, Phase-In (100<=hp<=175, 2012-2014 model year)
- Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008
- Engine tier adjusted to be consistent with minimum emission standard required to meet requirements of 17 CCR 93115.
- Emission factors based on NMHC+NOx standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Sycamore Mutual Water Company			
Transfer Volume	4,000	acre-feet	(Apr-Jun)	
	4,000	acre-feet	(Jul-Sep)	
	8,000	acre-feet/year		

Peak Pumping by Transfer Period
1,333 AF/month
1,333 AF/month

Table E-47. Sycamore Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	5	0	0	5
Total	0	5	0	0	5

Table E-48. Sycamore Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)
Well #15	Colusa	Electric	unknown	unknown	n/a	3,270	15%	197	1,183	11	1,966	n/a
Well #14	Colusa	Electric	unknown	unknown	n/a	3,270	15%	197	1,183	11	1,966	n/a
Well #11	Colusa	Electric	unknown	unknown	n/a	6,409	29%	387	2,320	11	1,966	n/a
Well #2b	Colusa	Electric	unknown	unknown	n/a	4,578	21%	276	1,657	11	1,966	n/a
Well #2a	Colusa	Electric	unknown	unknown	n/a	4,578	21%	276	1,657	11	1,966	n/a
					Total	**22,104**	**100%**	**1,333**	**8,000**	**53**	**9,828**	**0**
					Total (Colusa County)	**22,104**	**100%**	**1,333**	**8,000**	**53**	**9,828**	**0**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa
PM10	A
PM2.5	A
O3	A

Engines not subject to ATCM if remotely-located.

Peak Month
1,333 AF/month
9,733 gallons/minute
44% peak pump rate

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

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	T&P Farms			Peak Pumping by Transfer Period
Transfer Volume	650	acre-feet	(Apr-Jun)	386 AF/month
	550	acre-feet	(Jul-Sep)	210 AF/month
	1,200	acre-feet/year		

Table E-49. T&P Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	2	0	0	2
Total	0	2	0	0	2

Table E-50. T&P Farms Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
NW-1	Colusa	Electric	unknown	125	n/a	3,500	58%	225	700	11	1,086
NW-2	Colusa	Electric	unknown	75	n/a	2,500	42%	161	500	11	1,086
					Total	**6,000**	**100%**	**386**	**1,200**	**23**	**2,172**
					Total (Colusa County)	**6,000**	**100%**	**386**	**1,200**	**23**	**2,172**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa
PM10	A
PM2.5	A
O3	A

Engines not subject to ATCM if remotely-located.

Peak Month

386	AF/month
2,821	gallons/minute
47%	peak pump rate

Legend

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

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency Te Velde Revocable Family Trust

Transfer Volume
2,700 acre-feet (Apr-Jun)
4,394 acre-feet (Jul-Sep)
7,094 acre-feet/year

Peak Pumping by Transfer Period
1,605 AF/month
1,674 AF/month

Table E-51. Te Velde Revocable Family Trust Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Yolo	0	4	0	0	4
Total	0	4	0	0	4

Table E-52. Te Velde Revocable Family Trust Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
GW1	Yolo	Electric	unknown	unknown	n/a	4,200	35%	592	2,507	25	3,242
GW10	Yolo	Electric	unknown	unknown	n/a	2,833	24%	399	1,691	25	3,242
GW4	Yolo	Electric	unknown	unknown	n/a	2,600	22%	366	1,552	25	3,242
GW11	Yolo	Electric	unknown	unknown	n/a	2,250	19%	317	1,343	25	3,242
					Total	**11,883**	**100%**	**1,674**	**7,094**	**99**	**12,969**
					Total (Yolo County)	**11,883**	**100%**	**1,674**	**7,094**	**99**	**12,969**
					Total (0 County)	**0**	**0%**	**0**	**0**	**0**	**0**
					Total (0 County)	**0**	**0%**	**0**	**0**	**0**	**0**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Yolo
PM10	A
PM2.5	N
O3	N

Engines subject to ATCM.

Peak Month
1,674 AF/month
12,219 gallons/minute
103% peak pump rate

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Windswept Land & Livestock			
Transfer Volume	1,000	acre-feet	(Apr-Jun)	
	1,000	acre-feet	(Jul-Sep)	
	2,000	acre-feet/year		

Peak Pumping by Transfer Period
333 AF/month
333 AF/month

Table E-53. Windswept Land & Livestock Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	4	0	0	4
Total	0	4	0	0	4

Table E-54. Windswept Land & Livestock Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
Ag Well #1	Sutter	Electric	2013	200	n/a	3,200	34%	113	681	6	1,156
Ag Well #2	Sutter	Electric	unknown	unknown	n/a	1,700	18%	60	362	6	1,156
Ag Well #3	Sutter	Electric	unknown	unknown	n/a	2,500	27%	89	532	6	1,156
Ag Well #4	Sutter	Electric	unknown	unknown	n/a	2,000	21%	71	426	6	1,156
					Total	**9,400**	**100%**	**333**	**2,000**	**25**	**4,622**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
333 AF/month
2,433 gallons/minute
26% peak pump rate

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Table 60. Engine Tier Matrix

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

Key:

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

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

Table 55. Summary of the Emission Standards for New Stationary Diesel-Fueled CI Engines > 50 BHP used in Agricultural Operations

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

Source: See Section 93115.8(a)

Notes:

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

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

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

Table 56. Emission Standards for Noncertified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

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

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

Note:

[1] Compliance date on or after December 31

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

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

Table 57. Emission Standards Tier 1- and Tier 2-Certified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

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

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

Notes:

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

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

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

Table 58. Tier 1, Tier 2, and Tier 3 Exhaust Emission Standards

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

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

NOx and NMHC fraction - Table B-26

NOx	95%
NMHC	5%

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

PM Size Fractions

PM10	0.96
PM2.5	0.937
Ratio	0.98

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

Table 59. Tier 4 Exhaust Emission Standards

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

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

AP-42 Emission Factors

Table 61. Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines [a]

	Gasoline Fuel		Diesel Fuel		
	Emission Factor		Emission Factor		Emission
Pollutant	(lb/hp-hr) (power output)	(lb/MMBtu) (fuel input)	(lb/hp-hr) (power output)	(lb/MMBtu) (fuel input)	Factor Rating
NOx	0.011	1.63	0.031	4.41	D
CO	6.96E-03 [d]	0.99 [d]	6.68E-03	0.95	D
SOx	5.91E-04	0.084	2.05E-03	0.29	D
PM-10 [b]	7.21E-04	0.1	2.20E-03	0.31	D
CO2 [c]	1.08	154	1.15	164	B
Aldehydes	4.85E-04	0.07	4.63E-04	0.07	D
TOC					
Exhaust	0.015	2.1	2.47E-03	0.35	D
Evaporative	6.61E-04	0.09	0.00	0.00	E
Crankcase	4.85E-03	0.69	4.41E-05	0.01	E
Refueling	1.08E-03	0.15	0.00	0.00	E

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

[a] References 2,5-6,9-14. When necessary, an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr was used to convert from lb/MMBtu to lb/hp-hr. To convert from lb/hp-hr to kg/kwhr, multiply by 0.608. To convert from lb/MMBtu to ng/J, multiply by 430. SCC = Source Classification Code. TOC = total organic compounds.
[b] PM-10 = particulate matter less than or equal to 10 :m aerodynamic diameter. All particulate is assumed to be 10 µm in size.

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

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

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

Table 62. Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines [a]

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

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

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

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

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

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

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

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

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

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

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

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

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

Engine Size Summary

Table 63. Engine Power Rating Summary by Fuel Type

Fuel Type	No. Engines	Avg. HP	Max HP	Min HP
Diesel	23	170	250	60
Electric	47	125	300	30
Natural Gas	0	n/a	0	0
Propane	3	180	250	135

Table E-55. General Conformity Applicability Evaluation (Mitigated Emissions)

County/ Nonattainment Area	Emissions (tons per year)					
	VOC	NOx	CO	SOx	PM10	PM2.5
	Sacramento Metro[1]	Sacramento Metro[1]	Sacramento Area[2]	Sacramento[3,4]	Sacramento Co.	Sacramento[4]
Colusa	n/a	n/a	n/a	n/a	n/a	n/a
Glenn	n/a	n/a	n/a	n/a	n/a	n/a
Sacramento	0.1	2.2	3.6	1.8	0.0	0.0
Shasta	n/a	n/a	n/a	n/a	n/a	n/a
Sutter[5]	1.5	9.3	n/a	3.3	n/a	0.2
Tehama	n/a	n/a	n/a	n/a	n/a	n/a
Yolo	0.0	0.0	0.0	0.0	n/a	0.0
Total	1.6	11.5	3.6	5.1	0.0	0.2
Classification	Severe-15	Severe-15	Maintenance	PM2.5 Precursor	Maintenance	Nonattainment
De Minimis Threshold (tpy)	25	25	100	100	100	100
Exceed?	No	No	No	No	No	No

Note:

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

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

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

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

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

Table E-56. Emissions Outside of 8-Hour Ozone Nonattainment Area (tons per year)

Water Agency	County	VOC	NOx
Pelger Road 1700 LLC	Sutter	All Electric	All Electric
Pelger Mutual Water Company	Sutter	0.0	18.8
Reclamation District 1004	Sutter	No Engines	No Engines
Total		**0.0**	**18.8**

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table E-57. Daily VOC Emissions (Mitigated)

Water Agency	Daily VOC Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	2.10							2.10
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	43.07							43.07
Glenn-Colusa Irrigation District	14.23	3.56						17.78
Guisti Farms					3.02			3.02
Henle Family LP								
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			1.51		0.97			2.48
Pelger Mutual Water Company					0.99			0.99
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					9.07			9.07
Princeton-Codora-Glenn Irrigation District	6.58	20.89						27.47
Provident Irrigation District	No Engines	54.54						54.54
Reclamation District 1004	31.70	2.69			No Engines			34.39
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					3.34			3.34
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**100.17**	**81.68**	**1.51**	**0.00**	**17.39**	**0.00**	**0.00**	**200.74**

Key:
VOC = volatile organic compounds

Table E-58. Daily NOx Emissions (Mitigated)

Water Agency	Daily NOx Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	4.21							4.21
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	29.93							29.93
Glenn-Colusa Irrigation District	175.42	43.86						219.28
Guisti Farms					6.03			6.03
Henle Family LP					All Electric			
Maxwell Irrigation District	47.21							47.21
Natomas Central Mutual Water Company			23.83		2.04			25.88
Pelger Mutual Water Company					18.76			18.76
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					25.00			25.00
Princeton-Codora-Glenn Irrigation District	81.17	253.40						334.58
Provident Irrigation District	No Engines	672.56						672.56
Reclamation District 1004	405.20	33.13			No Engines			438.33
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					8.10			8.10
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**743.14**	**1,002.95**	**23.83**	**0.00**	**59.94**	**0.00**	**0.00**	**1,829.86**

Key:
NOx = nitrogen oxides

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table E-59. Daily CO Emissions (Mitigated)

Water Agency	Daily CO Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	8.41							8.41
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	45.35							45.35
Glenn-Colusa Irrigation District	37.80	9.45						47.25
Guisti Farms					12.07			12.07
Henle Family LP					All Electric			
Maxwell Irrigation District	43.49							43.49
Natomas Central Mutual Water Company			38.87		25.56			64.43
Pelger Mutual Water Company					24.68			24.68
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					185.74			185.74
Princeton-Codora-Glenn Irrigation District	17.49	61.96						79.45
Provident Irrigation District	No Engines	144.93						144.93
Reclamation District 1004	115.72	7.14			No Engines			122.86
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					26.63			26.63
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**268.26**	**223.47**	**38.87**	**0.00**	**274.68**	**0.00**	**0.00**	**805.28**

Key:
CO = carbon monoxide

Table E-60. Daily SOx Emissions (Mitigated)

Water Agency	Daily SOx Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	13.78							13.78
Glenn-Colusa Irrigation District	11.60	2.90						14.50
Guisti Farms					0.00			0.00
Henle Family LP					All Electric			
Maxwell Irrigation District	15.48							15.48
Natomas Central Mutual Water Company			19.45		6.37			25.82
Pelger Mutual Water Company					6.15			6.15
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					50.92			50.92
Princeton-Codora-Glenn Irrigation District	5.37	19.38						24.75
Provident Irrigation District	No Engines	44.48						44.48
Reclamation District 1004	35.28	2.19			No Engines			37.47
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					6.46			6.46
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**81.52**	**68.95**	**19.45**	**0.00**	**69.90**	**0.00**	**0.00**	**239.81**

Key:
SOx = sulfur oxides

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table E-61. Daily PM10 Emissions (Mitigated)

Water Agency	Daily PM10 Emissions (pounds per day)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.02							0.02
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.65							2.65
Glenn-Colusa Irrigation District	2.74	0.69						3.43
Guisti Farms					0.03			0.03
Henle Family LP					All Electric			
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			0.24		0.10			0.34
Pelger Mutual Water Company					1.48			1.48
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					1.26			1.26
Princeton-Codora-Glenn Irrigation District	0.87	2.74						3.60
Provident Irrigation District	No Engines	8.02						8.02
Reclamation District 1004	6.07	0.35			No Engines			6.42
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					0.16			0.16
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**14.84**	**11.80**	**0.24**	**0.00**	**3.03**	**0.00**	**0.00**	**29.91**

Key:
PM10 = inhalable particulate matter

Table E-62. Daily PM2.5 Emissions (Mitigated)

Water Agency	Daily PM2.5 Emissions (pounds per day)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.02							0.02
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.62							2.62
Glenn-Colusa Irrigation District	2.68	0.67						3.35
Guisti Farms					0.03			0.03
Henle Family LP					All Electric			
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			0.24		0.10			0.34
Pelger Mutual Water Company					1.48			1.48
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					1.26			1.26
Princeton-Codora-Glenn Irrigation District	0.85	2.67						3.52
Provident Irrigation District	No Engines	7.83						7.83
Reclamation District 1004	5.97	0.34			No Engines			6.32
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					0.16			0.16
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**14.63**	**11.52**	**0.24**	**0.00**	**3.03**	**0.00**	**0.00**	**29.42**

Key:
PM2.5 = fine particulate matter

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table E-63. Annual VOC Emissions (Mitigated)

Water Agency	Annual VOC Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.17							0.17
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.35							2.35
Glenn-Colusa Irrigation District	1.32	0.33						1.65
Guisti Farms					0.28			0.28
Henle Family LP								
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			0.14		0.09			0.23
Pelger Mutual Water Company					0.04			0.04
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					0.82			0.82
Princeton-Codora-Glenn Irrigation District	0.41	1.30						1.71
Provident Irrigation District	No Engines	3.52						3.52
Reclamation District 1004	1.29	0.11			No Engines			1.40
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					0.31			0.31
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**5.69**	**5.27**	**0.14**	**0.00**	**1.54**	**0.00**	**0.00**	**12.64**

Key:
VOC = volatile organic compounds

Table E-64. Annual NOx Emissions (Mitigated)

Water Agency	Annual NOx Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	4.21							4.21
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	29.93							29.93
Glenn-Colusa Irrigation District	175.42	43.86						219.28
Guisti Farms					6.03			6.03
Henle Family LP					All Electric			
Maxwell Irrigation District	47.21							47.21
Natomas Central Mutual Water Company			2.22		0.19			2.41
Pelger Mutual Water Company					18.76			18.76
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					2.30			2.30
Princeton-Codora-Glenn Irrigation District	81.17	253.40						334.58
Provident Irrigation District	No Engines	672.56						672.56
Reclamation District 1004	405.20	33.13			No Engines			438.33
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					0.75			0.75
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**743.14**	**1,002.95**	**2.22**	**0.00**	**28.03**	**0.00**	**0.00**	**1,776.34**

Key:
NOx = nitrogen oxides

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table E-65. Annual CO Emissions (Mitigated)

Water Agency	Annual CO Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							#N/A
Canal Farms	0.68							#N/A
Conaway Preservation Group	No Groundwater Substitution							#N/A
Eastside Mutual Water Company	2.47							#N/A
Glenn-Colusa Irrigation District	3.52	0.88						#N/A
Guisti Farms					1.12			#N/A
Henle Family LP					All Electric			
Maxwell Irrigation District	2.65							#N/A
Natomas Central Mutual Water Company			3.61		2.38			5.99
Pelger Mutual Water Company					0.94			#N/A
Pelger Road 1700 LLC					All Electric			#N/A
Pleasant Grove-Verona Mutual Water Company					8.73			8.73
Princeton-Codora-Glenn Irrigation District	1.09	3.86						4.96
Provident Irrigation District	No Engines	9.36						9.36
Reclamation District 1004	4.71	0.29			No Engines			5.00
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					2.48			2.48
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			#N/A
Total	**15.12**	**14.39**	**3.61**	**0.00**	**15.65**	**0.00**	**0.00**	**#N/A**

Key:
CO = carbon monoxide

Table E-66. Annual SOx Emissions (Mitigated)

Water Agency	Annual SOx Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.75							0.75
Glenn-Colusa Irrigation District	1.08	0.27						1.35
Guisti Farms					0.00			0.00
Henle Family LP					All Electric			
Maxwell Irrigation District	0.94							0.94
Natomas Central Mutual Water Company			1.81		0.59			2.40
Pelger Mutual Water Company					0.24			0.24
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					1.87			1.87
Princeton-Codora-Glenn Irrigation District	0.33	1.21						1.54
Provident Irrigation District	No Engines	2.87						2.87
Reclamation District 1004	1.44	0.09			No Engines			1.52
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					0.60			0.60
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**4.55**	**4.44**	**1.81**	**0.00**	**3.30**	**0.00**	**0.00**	**14.10**

Key:
SOx = sulfur oxides

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table E-67. Annual PM10 Emissions (Mitigated)

Water Agency	Annual PM10 Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.14							0.14
Glenn-Colusa Irrigation District	0.26	0.06						0.32
Guisti Farms					0.00			0.00
Henle Family LP					All Electric			
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			0.02		0.01			0.03
Pelger Mutual Water Company					0.06			0.06
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					0.08			0.08
Princeton-Codora-Glenn Irrigation District	0.05	0.17						0.22
Provident Irrigation District	No Engines	0.52						0.52
Reclamation District 1004	0.25	0.01			No Engines			0.26
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					0.01			0.01
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**0.85**	**0.77**	**0.02**	**0.00**	**0.16**	**0.00**	**0.00**	**1.81**

Key:
PM10 = inhalable particulate matter

Table E-68. Annual PM2.5 Emissions (Mitigated)

Water Agency	Annual PM2.5 Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.14							0.14
Glenn-Colusa Irrigation District	0.25	0.06						0.31
Guisti Farms					0.00			0.00
Henle Family LP					All Electric			
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			0.02		0.01			0.03
Pelger Mutual Water Company					0.06			0.06
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					0.08			0.08
Princeton-Codora-Glenn Irrigation District	0.05	0.17						0.22
Provident Irrigation District	No Engines	0.51						0.51
Reclamation District 1004	0.24	0.01			No Engines			0.26
Reclamation District 108	All Electric						All Electric	0.00
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company					0.01			0.01
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**0.84**	**0.75**	**0.02**	**0.00**	**0.16**	**0.00**	**0.00**	**1.78**

Key:
PM2.5 = fine particulate matter

Groundwater Substitution Air Quality Emissions (Mitigated)

Agency	Natomas Central Mutual Water Company			Peak Pumping by Transfer Period
Transfer Volume	10,000	acre-feet	(Apr-Jun)	3,333 AF/month
	10,000	acre-feet	(Jul-Sep)	3,333 AF/month
	20,000	acre-feet/year		

Table E-69. Natomas Central Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sacramento	6	10	0	0	16
Sutter	2	15	0	0	17
	0	0	0	0	0
Total	8	25	0	0	33

Table E-70. Natomas Central Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
L-2	Sutter	Electric	unknown	30	n/a	1,900	3%	99	595	9	1,700
L-3	Sutter	Electric	unknown	125	n/a	1,300	2%	68	407	9	1,700
L-4	Sutter	Electric	unknown	125	n/a	1,300	2%	68	407	9	1,700
L-6	Sutter	Electric	unknown	125	n/a	2,000	3%	104	626	9	1,700
L-7	Sutter	Electric	unknown	125	n/a	1,200	2%	63	376	9	1,700
L-8	Sutter	Electric	unknown	125	n/a	2,800	4%	146	876	9	1,700
L-9	Sutter	Electric	unknown	125	n/a	1,500	2%	78	469	9	1,700
L-10	Sutter	Electric	unknown	125	n/a	1,000	2%	52	313	9	1,700
L-11	Sutter	Electric	unknown	125	n/a	1,500	2%	78	469	9	1,700
L-12	Sutter	Electric	unknown	125	n/a	1,500	2%	78	469	9	1,700
L-13 Bolen Pasture	Sutter	Diesel	2012	170	T4I	2,800	4%	146	876	9	1,700
L-14 Chappell	Sutter	Electric	unknown	125	n/a	1,800	3%	94	563	9	1,700
MAP	Sacramento	Electric	unknown	125	n/a	2,000	3%	104	626	9	1,700
Ose-1	Sacramento	Diesel	2013	200	T4I	1,800	3%	94	563	9	1,700
Ose-2	Sacramento	Electric	unknown	150	n/a	2,400	4%	125	751	9	1,700
Perry	Sacramento	Electric	unknown	125	n/a	2,600	4%	136	814	9	1,700
Spangler	Sutter	Electric	unknown	80	n/a	2,500	4%	130	782	9	1,700
TNBC Frazer	Sutter	Electric	unknown	125	n/a	2,000	3%	104	626	9	1,700
TNBC Lucich North	Sutter	Diesel	2012	170	T4I	2,500	4%	130	782	9	1,700
TNBC Bennett North	Sutter	Electric	unknown	125	n/a	2,200	3%	115	689	9	1,700
TNBC Atkinson	Sutter	Electric	unknown	125	n/a	1,800	3%	94	563	9	1,700
TNBC Fisherman's Lake	Sacramento	Electric	unknown	125	n/a	1,500	2%	78	469	9	1,700
TNBC Silva Dairy	Sacramento	Electric	unknown	125	n/a	1,000	2%	52	313	9	1,700
TNBC Betts	Sacramento	Electric	unknown	125	n/a	1,500	2%	78	469	9	1,700
Dhaliwal	Sacramento	Diesel	2013	180	T4I	3,000	5%	156	939	9	1,700
Willey	Sacramento	Diesel	2012	148	T4I	1,800	3%	94	563	9	1,700
Elkhorn	Sacramento	Electric	unknown	125	n/a	2,700	4%	141	845	9	1,700
Ameral	Sacramento	Diesel	2012	170	T4I	1,500	2%	78	469	9	1,700
Kubo	Sacramento	Electric	unknown	125	n/a	1,300	2%	68	407	9	1,700
Greenbriar	Sacramento	Diesel	2012	170	T4I	3,200	5%	167	1,002	9	1,700
Souza	Sacramento	Electric	unknown	125	n/a	1,200	2%	63	376	9	1,700
Plant 3	Sacramento	Diesel	2012	170	T4I	2,500	4%	130	782	9	1,700
Pond R	Sacramento	Electric	unknown	125	n/a	2,300	4%	120	720	9	1,700
					Total	**63,900**	**100%**	**3,333**	**20,000**	**302**	**56,093**
					Total (Sacramento County)	**32,300**	**51%**	**1,685**	**10,110**	**146**	**27,197**
					Total (Sutter County)	**31,600**	**49%**	**1,648**	**9,890**	**155**	**28,897**
					Total (0 County)	**0**	**0%**	**0**	**0**	**0**	**0**

Fuel Consumption	Emission Factors (g/bhp-hr)						Daily Emissions (pounds per day)						Annual Emissions (tons per year)					
(gal/yr)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
n/a																		
n/a																		
n/a																		
n/a																		
n/a																		
n/a																		
n/a																		
n/a																		
n/a																		
n/a																		
16,211	0.14	0.30	3.73	0.93	0.01	0.01	0.49	1.02	12.78	3.18	0.05	0.05	0.05	0.10	1.19	0.30	0.00	0.00
n/a																		
n/a																		
19,072	0.003	1.7	0.03	0.93	0.01	0.01	0.01	6.85	0.12	3.75	0.04	0.04	0.00	0.64	0.01	0.35	0.00	0.00
n/a																		
n/a																		
n/a																		
n/a																		
n/a																		
n/a																		
16,211	0.14	0.30	3.73	0.93	0.01	0.01	0.49	1.02	12.78	3.18	0.05	0.05	0.05	0.10	1.19	0.30	0.00	0.00
n/a																		
n/a																		
n/a																		
n/a																		
n/a																		
17,165	0.003	1.7	0.03	0.93	0.01	0.01	0.01	6.16	0.11	3.37	0.04	0.04	0.00	0.57	0.01	0.31	0.00	0.00
14,113	0.01	2.6	0.10	0.93	0.003	0.003	0.03	7.75	0.30	2.77	0.01	0.01	0.00	0.72	0.03	0.26	0.00	0.00
n/a																		
16,211	0.14	0.30	3.73	0.93	0.01	0.01	0.49	1.02	12.78	3.18	0.05	0.05	0.05	0.10	1.19	0.30	0.00	0.00
n/a																		
16,211	0.14	0.30	3.73	0.93	0.01	0.01	0.49	1.02	12.78	3.18	0.05	0.05	0.05	0.10	1.19	0.30	0.00	0.00
n/a																		
16,211	0.14	0.30	3.73	0.93	0.01	0.01	0.49	1.02	12.78	3.18	0.05	0.05	0.05	0.10	1.19	0.30	0.00	0.00
n/a																		
131,406							**2.48**	**25.88**	**64.43**	**25.82**	**0.34**	**0.34**	**0.23**	**2.41**	**5.99**	**2.40**	**0.03**	**0.03**
98,984							**1.51**	**23.83**	**38.87**	**19.45**	**0.24**	**0.24**	**0.14**	**2.22**	**3.61**	**1.81**	**0.02**	**0.02**
32,422							**0.97**	**2.04**	**25.56**	**6.37**	**0.10**	**0.10**	**0.09**	**0.19**	**2.38**	**0.59**	**0.01**	**0.01**
0							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sacramento	Sutter
PM10	M	A
PM2.5	N	M
O3	N	N

Engines subject to ATCM.

Peak Month

3,333	AF/month
24,332	gallons/minute
38%	peak pump rate

Legend

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

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Pleasant Grove-Verona Mutual Water Company		Peak Pumping by Transfer Period
Transfer Volume	8,000	acre-feet (Apr-Jun)	4,757 AF/month
	7,000	acre-feet (Jul-Sep)	2,667 AF/month
	15,000	acre-feet/year	

Table E-71. Pleasant Grove-Verona Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	13	20	0	3	36
Total	13	20	0	3	36

Table E-72. Pleasant Grove-Verona Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane	Emission Factors (g/bhp-hr) - diesel and VOC, NOx, and CO for propane (lb/MMBtu) - SOx, PM10, and PM2.5 for propane VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Kelly 190 Field Well #2	Sutter	Electric	unknown	30	n/a	2,100	3%	126	397	21	1,027	n/a																		
Kelly Windmill Field Well #2	Sutter	Electric	2002	62.1	n/a	2,000	3%	120	378	21	1,027	n/a																		
Kelly Windmill North Field Well	Sutter	Propane	2014	133	n/a	1,800	2%	108	340	2	1,027	347	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.47	0.94	1.87	0.00	0.01	0.01	0.15	0.30	0.60	0.00	0.00	0.00
Kelly306	Sutter	Electric	unknown	60	n/a	3,500	4%	210	662	21	1,027	n/a																		
MLF Clubhouse B Well	Sutter	Electric	unknown	300	n/a	3,600	5%	216	681	21	1,027	n/a																		
MLF Marsh Well	Sutter	Electric	unknown	300	n/a	3,200	4%	192	605	21	1,027	n/a																		
MLF Monster Well	Sutter	Electric	unknown	60	n/a	3,100	4%	186	586	21	1,027	n/a																		
MLF Well #1	Sutter	Electric	unknown	30	n/a	2,000	3%	120	378	21	1,027	n/a																		
MLF Well #16	Sutter	Electric	unknown	50	n/a	1,700	2%	102	322	21	1,027	n/a																		
MLF Well#11	Sutter	Diesel	2011	250	T4I	1,400	2%	84	265	13	1,027	14,408	0.14	0.30	2.61	0.93	0.01	0.01	1.02	2.15	18.81	6.70	0.11	0.11	0.04	0.08	0.74	0.26	0.00	0.00
MLF Well#12/17	Sutter	Electric	unknown	50	n/a	2,200	3%	132	416	21	1,027	n/a																		
MLF Well#13&#15	Sutter	Electric	2000	215	n/a	1,900	2%	114	359	21	1,027	n/a																		
MLF Well#2B	Sutter	Electric	2000	300	n/a	2,800	4%	168	530	21	1,027	n/a																		
Nicholas 72-Acre Field North	Sutter	Electric	unknown	40	n/a	1,700	2%	102	322	21	1,027	n/a																		
Nicholas 72-Acre Field South	Sutter	Diesel	2008	62.1	T4I	2,000	3%	120	378	5	1,027	3,579	0.18	3.33	3.73	0.93	0.22	0.22	0.12	2.26	2.53	0.63	0.15	0.15	0.01	0.23	0.26	0.07	0.02	0.02
Nicholas BBC Well	Sutter	Electric	unknown	30	n/a	2,000	3%	120	378	21	1,027	n/a																		
Nicholas Filipino Camp South	Sutter	Diesel	2008	62.1	T4I	800	1%	48	151	5	1,027	3,579	0.18	3.33	3.73	0.93	0.22	0.22	0.12	2.26	2.53	0.63	0.15	0.15	0.01	0.23	0.26	0.07	0.02	0.02
Nicholas Filipino Camp#2	Sutter	Electric	unknown	40	n/a	2,300	3%	138	435	21	1,027	n/a																		
Nicholas Johnston Field Well #2	Sutter	Electric	unknown	40	n/a	2,000	3%	120	378	21	1,027	n/a																		
Nicholas Sand Field Well	Sutter	Diesel	2008	62.1	T4I	2,000	3%	120	378	5	1,027	3,579	0.18	3.33	3.73	0.93	0.22	0.22	0.12	2.26	2.53	0.63	0.15	0.15	0.01	0.23	0.26	0.07	0.02	0.02
RiverRanch#19	Sutter	Diesel	2012	99	T4I	2,500	3%	150	473	17	1,027	5,705	0.14	0.30	3.73	0.93	0.01	0.01	0.54	1.13	14.17	3.53	0.06	0.06	0.02	0.03	0.42	0.10	0.00	0.00
S&O#16	Sutter	Electric	2014	159	n/a	2,000	3%	120	378	21	1,027	n/a																		
S&O#17	Sutter	Diesel	2012	101	T4I	3,000	4%	180	567	17	1,027	5,821	0.14	0.30	3.73	0.93	0.01	0.01	0.55	1.15	14.41	3.59	0.06	0.06	0.02	0.03	0.43	0.11	0.00	0.00
S&O#18A	Sutter	Diesel	2012	101	T4I	1,800	2%	108	340	17	1,027	5,821	0.14	0.30	3.73	0.93	0.01	0.01	0.55	1.15	14.41	3.59	0.06	0.06	0.02	0.03	0.43	0.11	0.00	0.00
S&O#19	Sutter	Diesel	2011	215	T4I	1,800	2%	108	340	14	1,027	12,391	0.14	0.30	2.61	0.93	0.01	0.01	0.94	1.98	17.29	6.16	0.10	0.10	0.03	0.07	0.64	0.23	0.00	0.00
S&O#20	Sutter	Propane	2014	154	n/a	1,800	2%	108	340	0	1,027	402	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.35	0.70	0.00	0.00	0.00
Willey#1	Sutter	Diesel	2012	168	T4I	3,000	4%	180	567	15	1,027	9,682	0.14	0.30	3.73	0.93	0.01	0.01	0.80	1.69	21.10	5.26	0.08	0.08	0.03	0.06	0.71	0.18	0.00	0.00
Willey#2	Sutter	Diesel	2011	250	T4I	3,000	4%	180	567	13	1,027	14,408	0.14	0.30	2.61	0.93	0.01	0.01	1.02	2.15	18.81	6.70	0.11	0.11	0.04	0.08	0.74	0.26	0.00	0.00
Willey#3	Sutter	Electric	unknown	75	n/a	1,800	2%	108	340	21	1,027	n/a																		
Willey#4	Sutter	Diesel	2012	150	T4I	2,000	3%	120	378	16	1,027	8,645	0.14	0.30	3.73	0.93	0.01	0.01	0.74	1.56	19.49	4.86	0.08	0.08	0.02	0.05	0.63	0.16	0.00	0.00
Willey#5	Sutter	Propane	unknown	180	n/a	2,000	3%	120	378	2	1,027	470	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.77	1.54	3.08	0.00	0.01	0.01	0.20	0.41	0.82	0.00	0.00	0.00
Will-Lee Well#30	Sutter	Diesel	2012	100	T4I	2,500	3%	150	473	17	1,027	5,763	0.14	0.30	3.73	0.93	0.01	0.01	0.54	1.14	14.29	3.56	0.06	0.06	0.02	0.03	0.42	0.11	0.00	0.00
Will-Lee Well#31	Sutter	Electric	unknown	50	n/a	1,500	2%	90	284	21	1,027	n/a																		
Will-Lee Well#32	Sutter	Electric	unknown	300	n/a	2,500	3%	150	473	21	1,027	n/a																		
Will-Lee Well#33	Sutter	Electric	unknown	75	n/a	2,500	3%	150	473	21	1,027	n/a																		
Will-Lee Well#4A	Sutter	Diesel	2012	160	T4I	1,500	2%	90	284	16	1,027	9,221	0.14	0.30	3.73	0.93	0.01	0.01	0.78	1.63	20.40	5.08	0.08	0.08	0.03	0.05	0.68	0.17	0.00	0.00
					Total	**79,300**	**100%**	**4,757**	**15,000**	**595**	**36,982**	**103,820**							**9.07**	**25.00**	**185.74**	**50.92**	**1.26**	**1.26**	**0.82**	**2.30**	**8.73**	**1.87**	**0.08**	**0.08**
					Total (Sutter County)	**79,300**	**100%**	**4,757**	**15,000**	**595**	**36,982**	**103,820**							**9.07**	**25.00**	**185.74**	**50.92**	**1.26**	**1.26**	**0.82**	**2.30**	**8.73**	**1.87**	**0.08**	**0.08**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
4,757 AF/month
34,722 gallons/minute
44% peak pump rate

Legend
Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008
Mitigation requirement

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

Groundwater Substitution Air Quality Emissions (Mitigated)

Agency Sutter Mutual Water Company

Table E-73. Sutter Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	13	10	0	8	31
Total	13	10	0	8	31

Table E-74. Sutter Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
G-16	Sutter	Electric	unknown	125	n/a	4,200	4%	21	125	1	162	n/a																		
QHR	Sutter	Propane	unknown	180	n/a	5,200	5%	26	155	1	162	1,634	1.0	2.0	4.0	0.93	0.01	0.01	0.35	0.69	1.38	0.32	0.00	0.00	0.03	0.06	0.13	0.03	0.00	0.00
MB-1	Sutter	Propane	unknown	180	n/a	5,300	5%	26	158	1	162	1,634	1.0	2.0	4.0	0.93	0.01	0.01	0.35	0.69	1.38	0.32	0.00	0.00	0.03	0.06	0.13	0.03	0.00	0.00
LM-53	Sutter	Electric	unknown	125	n/a	4,000	4%	20	119	1	162	n/a																		
BD-1	Sutter	Diesel	2012	170	T4I	2,500	2%	12	74	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
L1-1	Sutter	Diesel	2012	170	T4I	4,000	4%	20	119	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
L1-2	Sutter	Diesel	2012	170	T4I	5,000	5%	25	149	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
L2-1	Sutter	Diesel	2012	170	T4I	5,500	5%	27	164	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
LM-11	Sutter	Electric	unknown	125	n/a	3,100	3%	15	92	1	162	n/a																		
S-18	Sutter	Electric	unknown	125	n/a	2,700	3%	13	80	1	162	n/a																		
BD-2	Sutter	Diesel	2012	170	T4I	4,000	4%	20	119	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
BD-3	Sutter	Propane	unknown	180	n/a	3,000	3%	15	89	1	162	1,634	1.0	2.0	4.0	0.93	0.01	0.01	0.35	0.69	1.38	0.32	0.00	0.00	0.03	0.06	0.13	0.03	0.00	0.00
FG	Sutter	Propane	unknown	180	n/a	1,500	1%	7	45	1	162	1,634	1.0	2.0	4.0	0.93	0.01	0.01	0.35	0.69	1.38	0.32	0.00	0.00	0.03	0.06	0.13	0.03	0.00	0.00
H-1	Sutter	Electric	unknown	125	n/a	2,600	3%	13	77	1	162	n/a																		
R-29	Sutter	Diesel	2012	170	T4I	2,500	2%	12	74	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
TVN	Sutter	Electric	unknown	125	n/a	3,000	3%	15	89	1	162	n/a																		
DB-1	Sutter	Diesel	2012	170	T4I	4,500	4%	22	134	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
ME-1	Sutter	Diesel	2012	170	T4I	1,300	1%	6	39	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
R-24	Sutter	Diesel	2012	170	T4I	2,500	2%	12	74	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
G-2	Sutter	Propane	unknown	180	n/a	3,500	3%	17	104	1	162	1,634	1.0	2.0	4.0	0.93	0.01	0.01	0.35	0.69	1.38	0.32	0.00	0.00	0.03	0.06	0.13	0.03	0.00	0.00
Hoppin	Sutter	Electric	unknown	125	n/a	2,500	2%	12	74	1	162	n/a																		
Ag Industries - Sioux Creek	Sutter	Diesel	2012	170	T4I	2,800	3%	14	83	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
Ag Industries - Sutter Basin	Sutter	Diesel	2012	170	T4I	3,000	3%	15	89	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
TVN proposed well	Sutter	Propane	unknown	180	n/a	5,000	5%	25	149	1	162	1,634	1.0	2.0	4.0	0.93	0.01	0.01	0.35	0.69	1.38	0.32	0.00	0.00	0.03	0.06	0.13	0.03	0.00	0.00
Driver proposed well	Sutter	Diesel	2012	170	T4I	2,500	2%	12	74	1	162	1,543	0.14	0.30	3.73	0.93	0.01	0.01	0.05	0.10	1.22	0.30	0.00	0.00	0.00	0.01	0.11	0.03	0.00	0.00
Well #1	Sutter	Electric	unknown	250	n/a	2,500	2%	12	74	1	162	n/a																		
Well #2	Sutter	Electric	unknown	150	n/a	2,500	2%	12	74	1	162	n/a																		
Well #3	Sutter	Electric	unknown	150	n/a	2,500	2%	12	74	1	162	n/a	1.0	2.0	4.0															
Well #4	Sutter	Propane	unknown	150	n/a	2,500	2%	12	74	1	162	1,362	1.0	2.0	4.0	0.93	0.01	0.01	0.29	0.58	1.15	0.27	0.00	0.00	0.03	0.05	0.11	0.02	0.00	0.00
Well #5	Sutter	Propane	unknown	180	T2	2,500	2%	12	74	1	162	1,634	1.0	2.0	4.0	0.93	0.01	0.01	0.35	0.69	1.38	0.32	0.00	0.00	0.03	0.06	0.13	0.03	0.00	0.00
Well #6	Sutter	Diesel	unknown	170	T2	2,500	2%	12	74	1	162	1,543	0.2	4.7	3.7	0.93	0.22	0.22	0.08	1.53	1.22	0.30	0.07	0.07	0.01	0.14	0.11	0.03	0.01	0.01
Total						**100,700**	**100%**	**500**	**3,000**	**27**	**5,016**	**32,858**							**3.34**	**8.10**	**26.63**	**6.46**	**0.16**	**0.16**	**0.31**	**0.75**	**2.48**	**0.60**	**0.01**	**0.01**
Total (Sutter County)						**100,700**	**100%**	**500**	**3,000**	**27**	**5,016**	**32,858**							**3.34**	**8.10**	**26.63**	**6.46**	**0.16**	**0.16**	**0.31**	**0.75**	**2.48**	**0.60**	**0.01**	**0.01**
Total (County)						**0**	**0**	**0**	**0**	**0**	**0**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Total (County)						**0**	**0**	**0**	**0**	**0**	**0**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month

500	AF/month
3,650	gallons/minute
4%	peak pump rate

Legend

	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
	Tier 4 Exhaust Emission Standards, Phase-In (100<=hp<=175, 2012-2014 model year)
	Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008
	Engine tier adjusted to be consistent with minimum emission standard required to meet requirements of 17 CCR 93115.
	Emission factors based on NMHC+NOx standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Diesel Engine Fuel Consumption

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

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

Table E-75. Summary of the Emission Standards for New Stationary Diesel-Fueled CI Engines > 50 BHP used in Agricultural Operations

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

Source: See Section 93115.8(a)
Notes:
[1] Less than or equal to the emission standard OR Off-Road CI Engine Certification Standard for an off-road engine of the maximum rated power, whichever is more stringent.

[2] Off-Road CI Engine Certification Standard for an off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard, or Tier 1 standards.
[3] Prior to January 1, 2008, these limits shall not apply to engines sold from one agricultural operation to another and funded under State or federal incentive.

Table E-76. Emission Standards for Noncertified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

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

Source: See Sections 93115.8(b) (2) and (4)
Note:
[1] Compliance date on or after December 31
[2] Engine Certification Standards for off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard.
[3] If no limits have been established for an off-road engine of the same model year and maximum rated power, then the in-use stationary diesel-fueled engine used in an agricultural operation shall not exceed Tier 1 standards in Title 13.

Table E-77. Emission Standards Tier 1- and Tier 2-Certified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

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

Source: See Sections 93115.8(b)(3) and (4)
Notes:
[1] Compliance date on or after December 31 or 12 years after the date of initial installation, whichever is later.
[2] Off-Road CI Engine Certification Standards for an off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard.
[3] If no limits have been established for an off-road engine of the same model year and maximum rated power, then the in-use stationary diesel-fueled engine used in agricultural operation shall not exceed Tier 1 standards in Tier 13, CCR, section 2423 for an off-road engine of the same maximum rated power irrespective of model year.

Table E-78. Tier 1, Tier 2, and Tier 3 Exhaust Emission Standards

Maximum Rated Power	Tier	Model Year	(g/kW-hr)					(g/hp-hr)				
			NOx	HC	NMHC+NOx	CO	PM	NOx	HC	NMHC+NOx	CO	PM
kW<8	T1	2000-2004	-	-	10.5	8.0	1	-	-	7.8	6.0	0.7
hp <11	T2	2005 -2007	-	-	7.5	8.0	0.8	-	-	5.6	6.0	0.6
8≤kW<19	T1	2000-2004	-	-	9.5	6.6	0.8	-	-	7.1	4.9	0.6
11<=hp<25	T2	2005 -2007	-	-	7.5	6.6	0.8	-	-	5.6	4.9	0.6
19≤kW<37	T1	2000-2003	-	-	9.5	5.5	0.8	-	-	7.1	4.1	0.6
25<=hp<50	T2	2004 -2007	-	-	7.5	5.5	0.6	-	-	5.6	4.1	0.4
37≤kW<56	T1	2000-2003	9.2	-	-	-	-	6.9	-	-	-	-
50<=hp<75	T2	2004-2007	-	-	7.5	5.0	0.4	-	-	5.6	3.7	0.3
	T3	2008 -2011	-	-	4.7	5.0	0.4	-	-	3.5	3.7	0.3
56≤kW<75	T1	2000-2003	9.2	-	-	-	-	6.9	-	-	-	-
75<=hp<100	T2	2004-2007	-	-	7.5	5.0	0.4	-	-	5.6	3.7	0.3
	T3	2008-2011	-	-	4.7	5.0	0.4	-	-	3.5	3.7	0.3
75≤kW<130	T1	2000-2002	9.2	-	-	-	-	6.9	-	-	-	-
100<=hp<175	T2	2003-2006	-	-	6.6	5.0	0.3	-	-	4.9	3.7	0.2
	T3	2007 -2011	-	-	4.0	5.0	0.3	-	-	3.0	3.7	0.2
130≤kW<225	T1	1996-2002	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.4
175<=hp<300	T2	2003-2005	-	-	6.6	3.5	0.2	-	-	4.9	2.6	0.1
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.1
225≤kW<450	T1	1996-2000	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.4
300<=hp<600	T2	2001-2005	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.1
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.1
450≤kW≤560	T1	1996-2001	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.4
600<=hp<750	T2	2002-2005	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.1
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.1
kW>560	T1	2000-2005	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.4
hp>750	T2	2006 -2010	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.1

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

NOx and NMHC fraction - Table B-26

NOx	95%
NMHC	5%

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

PM Size Fractions

PM10	0.96
PM2.5	0.937
Ratio	0.98

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

Table E-79. Tier 4 Exhaust Emission Standards

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

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

Table E-80. Engine Tier Matrix

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

Key:

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

AP-42 Emission Factors

Table E-81. Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines [a]

	Gasoline Fuel		Diesel Fuel		
	Emission Factor		Emission Factor		Emission
Pollutant	(lb/hp-hr) (power output)	(lb/MMBtu) (fuel input)	(lb/hp-hr) (power output)	(lb/MMBtu) (fuel input)	Factor Rating
NOx	0.011	1.63	0.031	4.41	D
CO	6.96E-03 [d]	0.99 [d]	6.68E-03	0.95	D
SOx	5.91E-04	0.084	2.05E-03	0.29	D
PM-10 [b]	7.21E-04	0.1	2.20E-03	0.31	D
CO2 [c]	1.08	154	1.15	164	B
Aldehydes	4.85E-04	0.07	4.63E-04	0.07	D
TOC					
Exhaust	0.015	2.1	2.47E-03	0.35	D
Evaporative	6.61E-04	0.09	0.00	0.00	E
Crankcase	4.85E-03	0.69	4.41E-05	0.01	E
Refueling	1.08E-03	0.15	0.00	0.00	E

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

[a] References 2,5-6,9-14. When necessary, an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr was used to convert from lb/MMBtu to lb/hp-hr. To convert from lb/hp-hr to kg/kwhr, multiply by 0.608. To convert from lb/MMBtu to ng/J, multiply by 430. SCC = Source Classification Code. TOC = total organic compounds.
[b] PM-10 = particulate matter less than or equal to 10 :m aerodynamic diameter. All particulate is assumed to be 10 µm in size.

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

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

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

Table E-82. Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines [a]

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

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

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

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

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

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

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

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

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

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

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

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

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

Engine Size Summary

Table E-83. Engine Power Rating Summary by Fuel Type

Fuel Type	No. Engines	Avg. HP	Max HP	Min HP
Diesel	23	170	250	60
Electric	47	125	300	30
Natural Gas	0	n/a	0	0
Propane	3	180	250	135

Summary of Crop Idling Emissions by Air District

Table E-84. Reduced Exhaust Emissions from Cropland Idling

	Peak Daily Emissions (lbs/day)						Annual Project Emissions (tpy)					
Air District	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Colusa County APCD												
Baber, Jack et al.	(1)	(17)	(22)	(6)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Canal Farms	(0)	(5)	(6)	(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Eastside Mutual Water Company	(1)	(14)	(18)	(4)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Glenn-Colusa Irrigation District	(6)	(122)	(160)	(40)	(10)	(10)	(0)	(5)	(6)	(2)	(0)	(0)
Maxwell Irrigation District	(1)	(15)	(19)	(5)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Princeton-Codora-Glenn Irrigation District	(1)	(24)	(32)	(8)	(2)	(2)	(0)	(1)	(1)	(0)	(0)	(0)
Provident Irrigation District	(2)	(37)	(48)	(12)	(3)	(3)	(0)	(1)	(2)	(0)	(0)	(0)
Reclamation District 1004	(3)	(49)	(65)	(16)	(4)	(4)	(0)	(2)	(2)	(1)	(0)	(0)
Reclamation District 108	(4)	(74)	(97)	(24)	(6)	(6)	(0)	(3)	(4)	(1)	(0)	(0)
Sycamore Mutual Water Company	(3)	(52)	(68)	(17)	(4)	(4)	(0)	(2)	(3)	(1)	(0)	(0)
T&P Farms	(0)	(7)	(9)	(2)	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)
Colusa County APCD Subtotal	(22)	(415)	(546)	(136)	(33)	(33)	(1)	(16)	(21)	(5)	(1)	(1)
Glenn County APCD												
Glenn-Colusa Irrigation District	(6)	(122)	(160)	(40)	(10)	(10)	(0)	(5)	(6)	(2)	(0)	(0)
Princeton-Codora-Glenn Irrigation District	(1)	(24)	(32)	(8)	(2)	(2)	(0)	(1)	(1)	(0)	(0)	(0)
Provident Irrigation District	(2)	(37)	(48)	(12)	(3)	(3)	(0)	(1)	(2)	(0)	(0)	(0)
Reclamation District 1004	(3)	(49)	(65)	(16)	(4)	(4)	(0)	(2)	(2)	(1)	(0)	(0)
Glenn County APCD Subtotal	(12)	(232)	(306)	(76)	(18)	(18)	(0)	(9)	(12)	(3)	(1)	(1)
Feather River AQMD												
Guisti Farms	0	0	0	0	0	0	0	0	0	0	0	0
Henle Family LP	0	0	0	0	0	0	0	0	0	0	0	0
Natomas Central Mutual Water Company	0	0	0	0	0	0	0	0	0	0	0	0
Pelger Mutual Water Company	(1)	(19)	(25)	(6)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Pelger Road 1700 LLC	0	0	0	0	0	0	0	0	0	0	0	0
Pleasant Grove-Verona Mutual Water Company	(4)	(67)	(88)	(22)	(5)	(5)	(0)	(3)	(3)	(1)	(0)	(0)
Reclamation District 1004	(3)	(49)	(65)	(16)	(4)	(4)	(0)	(2)	(2)	(1)	(0)	(0)
Sutter Mutual Water Company	(7)	(133)	(175)	(44)	(11)	(11)	(0)	(5)	(7)	(2)	(0)	(0)
Windswept Land & Livestock	0	0	0	0	0	0	0	0	0	0	0	0
Feather River AQMD Subtotal	(14)	(268)	(352)	(88)	(21)	(21)	(1)	(10)	(13)	(3)	(1)	(1)
Yolo-Solano AQMD												
Conaway Preservation Group	(8)	(158)	(208)	(52)	(12)	(12)	(0)	(6)	(8)	(2)	(0)	(0)
Reclamation District 108	(4)	(74)	(97)	(24)	(6)	(6)	(0)	(3)	(4)	(1)	(0)	(0)
River Garden Farms	(4)	(74)	(97)	(24)	(6)	(6)	(0)	(3)	(4)	(1)	(0)	(0)
Te Velde Revocable Family Trust	(3)	(52)	(68)	(17)	(4)	(4)	(0)	(2)	(3)	(1)	(0)	(0)
Yolo-Solano AQMD Subtotal	(19)	(357)	(470)	(117)	(28)	(28)	(1)	(14)	(18)	(4)	(1)	(1)
GRAND TOTAL	(67)	(1,272)	(1,673)	(417)	(100)	(100)	(3)	(49)	(64)	(16)	(4)	(4)

Table E-85. Reduced Peak Daily Fugitive Dust Emissions from Cropland Idling

	Peak Daily PM10 Emissions (lbs/day)				Peak Daily PM2.5 Emissions (lbs/day)			
Air District	**Land Prep**	**Harvest**	**Wind Erosion**	**Total**	**Land Prep**	**Harvest**	**Wind Erosion**	**Total**
Colusa County APCD								
Baber, Jack et al.	(38)	(3)	9	(33)	(6)	(0)	2	(4)
Canal Farms	(11)	(1)	2	(9)	(2)	(0)	0	(1)
Eastside Mutual Water Company	(31)	(3)	7	(26)	(5)	(0)	1	(4)
Glenn-Colusa Irrigation District	(274)	(23)	66	(231)	(41)	(3)	13	(31)
Maxwell Irrigation District	(33)	(3)	8	(28)	(5)	(0)	2	(4)
Princeton-Codora-Glenn Irrigation District	(55)	(5)	13	(46)	(8)	(1)	3	(6)
Provident Irrigation District	(82)	(7)	20	(69)	(12)	(1)	4	(9)
Reclamation District 1004	(111)	(9)	19	(101)	(17)	(1)	4	(14)
Reclamation District 108	(166)	(14)	22	(158)	(25)	(2)	4	(23)
Sycamore Mutual Water Company	(116)	(10)	27	(99)	(17)	(1)	5	(13)
T&P Farms	(15)	(1)	3	(13)	(2)	(0)	1	(2)
Colusa County APCD Subtotal	(932)	(78)	197	(813)	(140)	(12)	39	(112)
Glenn County APCD								
Glenn-Colusa Irrigation District	(274)	(23)	66	(231)	(41)	(3)	13	(31)
Princeton-Codora-Glenn Irrigation District	(55)	(5)	13	(46)	(8)	(1)	3	(6)
Provident Irrigation District	(82)	(7)	20	(69)	(12)	(1)	4	(9)
Reclamation District 1004	(111)	(9)	19	(101)	(17)	(1)	4	(14)
Glenn County APCD Subtotal	(522)	(44)	118	(448)	(78)	(7)	24	(61)
Feather River AQMD								
Guisti Farms	0	0	0	0	0	0	0	0
Henle Family LP	0	0	0	0	0	0	0	0
Natomas Central Mutual Water Company	0	0	0	0	0	0	0	0
Pelger Mutual Water Company	(42)	(4)	1	(45)	(6)	(1)	0	(7)
Pelger Road 1700 LLC	0	0	0	0	0	0	0	0
Pleasant Grove-Verona Mutual Water Company	(149)	(13)	3	(159)	(22)	(2)	1	(24)
Reclamation District 1004	(111)	(9)	19	(101)	(17)	(1)	4	(14)
Sutter Mutual Water Company	(299)	(25)	6	(318)	(45)	(4)	1	(47)
Windswept Land & Livestock	0	0	0	0	0	0	0	0
Feather River AQMD Subtotal	(601)	(50)	28	(624)	(90)	(8)	6	(92)
Yolo-Solano AQMD								
Conaway Preservation Group	(355)	(30)	11	(373)	(53)	(4)	2	(55)
Reclamation District 108	(166)	(14)	22	(158)	(25)	(2)	4	(23)
River Garden Farms	(166)	(14)	5	(175)	(25)	(2)	1	(26)
Te Velde Revocable Family Trust	(116)	(10)	4	(122)	(17)	(1)	1	(18)
Yolo-Solano AQMD Subtotal	(802)	(67)	42	(828)	(120)	(10)	8	(122)
GRAND TOTAL	(2,857)	(240)	384	(2,712)	(428)	(36)	77	(387)

Table E-86. Reduced Annual Fugitive Dust Emissions from Cropland Idling

	Annual PM10 Emissions (tpy)				Annual PM2.5 Emissions (tpy)			
Air District	**Land Prep**	**Harvest**	**Wind Erosion**	**Total**	**Land Prep**	**Harvest**	**Wind Erosion**	**Total**
Colusa County APCD								
Baber, Jack et al.	(3)	(0)	1	(3)	(1)	(0)	0	(0)
Canal Farms	(1)	(0)	0	(1)	(0)	(0)	0	(0)
Eastside Mutual Water Company	(3)	(0)	1	(2)	(0)	(0)	0	(0)
Glenn-Colusa Irrigation District	(25)	(2)	6	(21)	(4)	(0)	1	(3)
Maxwell Irrigation District	(3)	(0)	1	(3)	(0)	(0)	0	(0)
Princeton-Codora-Glenn Irrigation District	(5)	(0)	1	(4)	(1)	(0)	0	(1)
Provident Irrigation District	(7)	(1)	2	(6)	(1)	(0)	0	(1)
Reclamation District 1004	(10)	(1)	2	(9)	(1)	(0)	0	(1)
Reclamation District 108	(15)	(1)	2	(14)	(2)	(0)	0	(2)
Sycamore Mutual Water Company	(10)	(1)	2	(9)	(2)	(0)	0	(1)
T&P Farms	(1)	(0)	0	(1)	(0)	(0)	0	(0)
Colusa County APCD Subtotal	(84)	(7)	18	(73)	(13)	(1)	4	(10)
Glenn County APCD								
Glenn-Colusa Irrigation District	(25)	(2)	6	(21)	(4)	(0)	1	(3)
Princeton-Codora-Glenn Irrigation District	(5)	(0)	1	(4)	(1)	(0)	0	(1)
Provident Irrigation District	(7)	(1)	2	(6)	(1)	(0)	0	(1)
Reclamation District 1004	(10)	(1)	2	(9)	(1)	(0)	0	(1)
Glenn County APCD Subtotal	(47)	(4)	11	(40)	(7)	(1)	2	(6)
Feather River AQMD								
Guisti Farms	0	0	0	0	0	0	0	0
Henle Family LP	0	0	0	0	0	0	0	0
Natomas Central Mutual Water Company	0	0	0	0	0	0	0	0
Pelger Mutual Water Company	(4)	(0)	0	(4)	(1)	(0)	0	(1)
Pelger Road 1700 LLC	0	0	0	0	0	0	0	0
Pleasant Grove-Verona Mutual Water Company	(13)	(1)	0	(14)	(2)	(0)	0	(2)
Reclamation District 1004	(10)	(1)	2	(9)	(1)	(0)	0	(1)
Sutter Mutual Water Company	(27)	(2)	0	(29)	(4)	(0)	0	(4)
Windswept Land & Livestock	0	0	0	0	0	0	0	0
Feather River AQMD Subtotal	(54)	(5)	2	(56)	(8)	(1)	0	(8)
Yolo-Solano AQMD								
Conaway Preservation Group	(32)	(3)	1	(34)	(5)	(0)	0	(5)
Reclamation District 108	(15)	(1)	2	(14)	(2)	(0)	0	(2)
River Garden Farms	(15)	(1)	0	(16)	(2)	(0)	0	(2)
Te Velde Revocable Family Trust	(10)	(1)	0	(11)	(2)	(0)	0	(2)
Yolo-Solano AQMD Subtotal	(72)	(6)	4	(75)	(11)	(1)	1	(11)
GRAND TOTAL	(257)	(22)	35	(244)	(39)	(3)	7	(35)

Table E-87. Combined Emissions by Air District

	Peak Daily Emissions (lbs/day)						Annual Project Emissions (tpy)					
Air District	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Colusa County APCD												
Baber, Jack et al.	(1)	(17)	(22)	(6)	(34)	(6)	(0)	(1)	(1)	(0)	(3)	(0)
Canal Farms	(0)	(5)	(6)	(2)	(9)	(2)	(0)	(0)	(0)	(0)	(1)	(0)
Eastside Mutual Water Company	(1)	(14)	(18)	(4)	(27)	(5)	(0)	(1)	(1)	(0)	(2)	(0)
Glenn-Colusa Irrigation District	(6)	(122)	(160)	(40)	(240)	(41)	(0)	(5)	(6)	(2)	(21)	(3)
Maxwell Irrigation District	(1)	(15)	(19)	(5)	(29)	(5)	(0)	(1)	(1)	(0)	(3)	(0)
Princeton-Codora-Glenn Irrigation District	(1)	(24)	(32)	(8)	(48)	(8)	(0)	(1)	(1)	(0)	(4)	(1)
Provident Irrigation District	(2)	(37)	(48)	(12)	(72)	(12)	(0)	(1)	(2)	(0)	(6)	(1)
Reclamation District 1004	(3)	(49)	(65)	(16)	(105)	(18)	(0)	(2)	(2)	(1)	(9)	(1)
Reclamation District 108	(4)	(74)	(97)	(24)	(164)	(28)	(0)	(3)	(4)	(1)	(14)	(2)
Sycamore Mutual Water Company	(3)	(52)	(68)	(17)	(103)	(18)	(0)	(2)	(3)	(1)	(9)	(1)
T&P Farms	(0)	(7)	(9)	(2)	(13)	(2)	(0)	(0)	(0)	(0)	(1)	(0)
Colusa County APCD Subtotal	(22)	(415)	(546)	(136)	(845)	(145)	(1)	(16)	(21)	(5)	(74)	(11)
Glenn County APCD												
Glenn-Colusa Irrigation District	(6)	(122)	(160)	(40)	(240)	(41)	(0)	(5)	(6)	(2)	(21)	(3)
Princeton-Codora-Glenn Irrigation District	(1)	(24)	(32)	(8)	(48)	(8)	(0)	(1)	(1)	(0)	(4)	(1)
Provident Irrigation District	(2)	(37)	(48)	(12)	(72)	(12)	(0)	(1)	(2)	(0)	(6)	(1)
Reclamation District 1004	(3)	(49)	(65)	(16)	(105)	(18)	(0)	(2)	(2)	(1)	(9)	(1)
Glenn County APCD Subtotal	(12)	(232)	(306)	(76)	(466)	(80)	(0)	(9)	(12)	(3)	(41)	(6)
Feather River AQMD												
Guisti Farms	0	0	0	0	0	0	0	0	0	0	0	0
Henle Family LP	0	0	0	0	0	0	0	0	0	0	0	0
Natomas Central Mutual Water Company	0	0	0	0	0	0	0	0	0	0	0	0
Pelger Mutual Water Company	(1)	(19)	(25)	(6)	(46)	(8)	(0)	(1)	(1)	(0)	(4)	(1)
Pelger Road 1700 LLC	0	0	0	0	0	0	0	0	0	0	0	0
Pleasant Grove-Verona Mutual Water Company	(4)	(67)	(88)	(22)	(164)	(29)	(0)	(3)	(3)	(1)	(15)	(2)
Reclamation District 1004	(3)	(49)	(65)	(16)	(105)	(18)	(0)	(2)	(2)	(1)	(9)	(1)
Sutter Mutual Water Company	(7)	(133)	(175)	(44)	(329)	(58)	(0)	(5)	(7)	(2)	(29)	(5)
Windswept Land & Livestock	0	0	0	0	0	0	0	0	0	0	0	0
Feather River AQMD Subtotal	(14)	(268)	(352)	(88)	(645)	(113)	(1)	(10)	(13)	(3)	(57)	(9)
Yolo-Solano AQMD												
Conaway Preservation Group	(8)	(158)	(208)	(52)	(386)	(68)	(0)	(6)	(8)	(2)	(34)	(5)
Reclamation District 108	(4)	(74)	(97)	(24)	(164)	(28)	(0)	(3)	(4)	(1)	(14)	(2)
River Garden Farms	(4)	(74)	(97)	(24)	(181)	(32)	(0)	(3)	(4)	(1)	(16)	(3)
Te Velde Revocable Family Trust	(3)	(52)	(68)	(17)	(126)	(22)	(0)	(2)	(3)	(1)	(11)	(2)
Yolo-Solano AQMD Subtotal	(19)	(357)	(470)	(117)	(856)	(150)	(1)	(14)	(18)	(4)	(76)	(12)
GRAND TOTAL	(67)	(1,272)	(1,673)	(417)	(2,813)	(488)	(3)	(49)	(64)	(16)	(248)	(39)

Table E-88. Summary of Cropland Idling Emissions by Water Agency

	Daily Emissions (lbs per day)						Annual Emissions (tons per year)					
Water Agency	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Anderson-Cottonwood Irrigation District												
Exhaust Emissions	0	0	0	0	0	0	0	0	0	0	0	0
Land Preparation	--	--	--	--	0	0	--	--	--	--	0	0
Harvesting	--	--	--	--	0	0	--	--	--	--	0	0
Wind Erosion	--	--	--	--	--	--	--	--	--	--	--	-
Anderson-Cottonwood Irrigation District Subtotal	0	0	0	0	0	0	0	0	0	0	0	0
Baber, Jack et al.												
Exhaust Emissions	(1)	(17)	(22)	(6)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(38)	(6)	--	--	--	--	(3)	(1)
Harvesting	--	--	--	--	(3)	(0)	--	--	--	--	(0)	(0)
Wind Erosion	--	--	--	--	9	2	--	--	--	--	1	0
Baber, Jack et al. Subtotal	(1)	(17)	(22)	(6)	(34)	(6)	(0)	(1)	(1)	(0)	(3)	(0)
Canal Farms												
Exhaust Emissions	(0)	(5)	(6)	(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(11)	(2)	--	--	--	--	(1)	(0)
Harvesting	--	--	--	--	(1)	(0)	--	--	--	--	(0)	(0)
Wind Erosion	--	--	--	--	2	0	--	--	--	--	0	0
Canal Farms Subtotal	(0)	(5)	(6)	(2)	(9)	(2)	(0)	(0)	(0)	(0)	(1)	(0)
Conaway Preservation Group												
Exhaust Emissions	(8)	(158)	(208)	(52)	(12)	(12)	(0)	(6)	(8)	(2)	(0)	(0)
Land Preparation	--	--	--	--	(355)	(53)	--	--	--	--	(32)	(5)
Harvesting	--	--	--	--	(30)	(4)	--	--	--	--	(3)	(0)
Wind Erosion	--	--	--	--	11	2	--	--	--	--	1	0
Conaway Preservation Group Subtotal	(8)	(158)	(208)	(52)	(386)	(68)	(0)	(6)	(8)	(2)	(34)	(5)
Eastside Mutual Water Company												
Exhaust Emissions	(1)	(14)	(18)	(4)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(31)	(5)	--	--	--	--	(3)	(0)
Harvesting	--	--	--	--	(3)	(0)	--	--	--	--	(0)	(0)
Wind Erosion	--	--	--	--	7	1	--	--	--	--	1	0
Eastside Mutual Water Company Subtotal	(1)	(14)	(18)	(4)	(27)	(5)	(0)	(1)	(1)	(0)	(2)	(0)
Guisti Farms												
Exhaust Emissions	0	0	0	0	0	0	0	0	0	0	0	0
Land Preparation	--	--	--	--	0	0	--	--	--	--	0	0
Harvesting	--	--	--	--	0	0	--	--	--	--	0	0
Wind Erosion	--	--	--	--	--	--	--	--	--	--	--	-
Guisti Farms Subtotal	0	0	0	0	0	0	0	0	0	0	0	0
Glenn-Colusa Irrigation District												
Exhaust Emissions	(13)	(244)	(321)	(80)	(19)	(19)	(0)	(9)	(12)	(3)	(1)	(1)
Land Preparation	--	--	--	--	(548)	(82)	--	--	--	--	(49)	(7)
Harvesting	--	--	--	--	(46)	(7)	--	--	--	--	(4)	(1)
Wind Erosion	--	--	--	--	132	26	--	--	--	--	12	2
Glenn-Colusa Irrigation District Subtotal	(13)	(244)	(321)	(80)	(481)	(82)	(0)	(9)	(12)	(3)	(42)	(6)

Table E-88. Summary of Cropland Idling Emissions by Water Agency

	Daily Emissions (lbs per day)						Annual Emissions (tons per year)					
Water Agency	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Henle Family LP												
Exhaust Emissions	0	0	0	0	0	0	0	0	0	0	0	0
Land Preparation	--	--	--	--	0	0	--	--	--	--	0	0
Harvesting	--	--	--	--	0	0	--	--	--	--	0	0
Wind Erosion	--	--	--	--	--	--	--	--	--	--	--	-
Henle Family LP Subtotal	0	0	0	0	0	0	0	0	0	0	0	0
Maxwell Irrigation District												
Exhaust Emissions	(1)	(15)	(19)	(5)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(33)	(5)	--	--	--	--	(3)	(0)
Harvesting	--	--	--	--	(3)	(0)	--	--	--	--	(0)	(0)
Wind Erosion	--	--	--	--	8	2	--	--	--	--	1	0
Maxwell Irrigation District Subtotal	(1)	(15)	(19)	(5)	(29)	(5)	(0)	(1)	(1)	(0)	(3)	(0)
Natomas Central Mutual Water Company												
Exhaust Emissions	0	0	0	0	0	0	0	0	0	0	0	0
Land Preparation	--	--	--	--	0	0	--	--	--	--	0	0
Harvesting	--	--	--	--	0	0	--	--	--	--	0	0
Wind Erosion	--	--	--	--	--	--	--	--	--	--	--	-
Natomas Central Mutual Water Company Subtotal	0	0	0	0	0	0	0	0	0	0	0	0
Pelger Mutual Water Company												
Exhaust Emissions	(1)	(19)	(25)	(6)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(42)	(6)	--	--	--	--	(4)	(1)
Harvesting	--	--	--	--	(4)	(1)	--	--	--	--	(0)	(0)
Wind Erosion	--	--	--	--	1	0	--	--	--	--	0	0
Pelger Mutual Water Company Subtotal	(1)	(19)	(25)	(6)	(46)	(8)	(0)	(1)	(1)	(0)	(4)	(1)
Pelger Road 1700 LLC												
Exhaust Emissions	0	0	0	0	0	0	0	0	0	0	0	0
Land Preparation	--	--	--	--	0	0	--	--	--	--	0	0
Harvesting	--	--	--	--	0	0	--	--	--	--	0	0
Wind Erosion	--	--	--	--	--	--	--	--	--	--	--	-
Pelger Road 1700 LLC Subtotal	0	0	0	0	0	0	0	0	0	0	0	0
Pleasant Grove-Verona Mutual Water Company												
Exhaust Emissions	(4)	(67)	(88)	(22)	(5)	(5)	(0)	(3)	(3)	(1)	(0)	(0)
Land Preparation	--	--	--	--	(149)	(22)	--	--	--	--	(13)	(2)
Harvesting	--	--	--	--	(13)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	3	1	--	--	--	--	0	0
Pleasant Grove-Verona Mutual Water Company Subtotal	(4)	(67)	(88)	(22)	(164)	(29)	(0)	(3)	(3)	(1)	(15)	(2)
Princeton-Codora-Glenn Irrigation District												
Exhaust Emissions	(3)	(49)	(64)	(16)	(4)	(4)	(0)	(2)	(2)	(1)	(0)	(0)
Land Preparation	--	--	--	--	(110)	(16)	--	--	--	--	(10)	(1)
Harvesting	--	--	--	--	(9)	(1)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	26	5	--	--	--	--	2	0
Princeton-Codora-Glenn Irrigation District Subtotal	(3)	(49)	(64)	(16)	(96)	(16)	(0)	(2)	(2)	(1)	(8)	(1)

Table E-88. Summary of Cropland Idling Emissions by Water Agency

	Daily Emissions (lbs per day)						Annual Emissions (tons per year)					
Water Agency	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Provident Irrigation District												
Exhaust Emissions	(4)	(73)	(96)	(24)	(6)	(6)	(0)	(3)	(4)	(1)	(0)	(0)
Land Preparation	--	--	--	--	(164)	(25)	--	--	--	--	(15)	(2)
Harvesting	--	--	--	--	(14)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	40	8	--	--	--	--	4	1
Provident Irrigation District Subtotal	(4)	(73)	(96)	(24)	(144)	(25)	(0)	(3)	(4)	(1)	(13)	(2)
Reclamation District 108												
Exhaust Emissions	(8)	(148)	(195)	(48)	(12)	(12)	(0)	(6)	(7)	(2)	(0)	(0)
Land Preparation	--	--	--	--	(332)	(50)	--	--	--	--	(30)	(4)
Harvesting	--	--	--	--	(28)	(4)	--	--	--	--	(3)	(0)
Wind Erosion	--	--	--	--	44	9	--	--	--	--	4	1
Reclamation District 108 Subtotal	(8)	(148)	(195)	(48)	(327)	(57)	(0)	(6)	(7)	(2)	(29)	(5)
Reclamation District 1004												
Exhaust Emissions	(8)	(148)	(195)	(48)	(12)	(12)	(0)	(6)	(7)	(2)	(0)	(0)
Land Preparation	--	--	--	--	(332)	(50)	--	--	--	--	(30)	(4)
Harvesting	--	--	--	--	(28)	(4)	--	--	--	--	(3)	(0)
Wind Erosion	--	--	--	--	56	11	--	--	--	--	5	1
Reclamation District 1004 Subtotal	(8)	(148)	(195)	(48)	(316)	(55)	(0)	(6)	(7)	(2)	(28)	(4)
River Garden Farms												
Exhaust Emissions	(4)	(74)	(97)	(24)	(6)	(6)	(0)	(3)	(4)	(1)	(0)	(0)
Land Preparation	--	--	--	--	(166)	(25)	--	--	--	--	(15)	(2)
Harvesting	--	--	--	--	(14)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	5	1	--	--	--	--	0	0
River Garden Farms Subtotal	(4)	(74)	(97)	(24)	(181)	(32)	(0)	(3)	(4)	(1)	(16)	(3)
Sutter Mutual Water Company												
Exhaust Emissions	(7)	(133)	(175)	(44)	(11)	(11)	(0)	(5)	(7)	(2)	(0)	(0)
Land Preparation	--	--	--	--	(299)	(45)	--	--	--	--	(27)	(4)
Harvesting	--	--	--	--	(25)	(4)	--	--	--	--	(2)	(0)
Wind Erosion	--	--	--	--	6	1	--	--	--	--	0	0
Sutter Mutual Water Company Subtotal	(7)	(133)	(175)	(44)	(329)	(58)	(0)	(5)	(7)	(2)	(29)	(5)
Sycamore Mutual Water Company												
Exhaust Emissions	(3)	(52)	(68)	(17)	(4)	(4)	(0)	(2)	(3)	(1)	(0)	(0)
Land Preparation	--	--	--	--	(116)	(17)	--	--	--	--	(10)	(2)
Harvesting	--	--	--	--	(10)	(1)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	27	5	--	--	--	--	2	0
Sycamore Mutual Water Company Subtotal	(3)	(52)	(68)	(17)	(103)	(18)	(0)	(2)	(3)	(1)	(9)	(1)
T&P Farms												
Exhaust Emissions	(0)	(7)	(9)	(2)	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(15)	(2)	--	--	--	--	(1)	(0)
Harvesting	--	--	--	--	(1)	(0)	--	--	--	--	(0)	(0)
Wind Erosion	--	--	--	--	3	1	--	--	--	--	0	0
T&P Farms Subtotal	(0)	(7)	(9)	(2)	(13)	(2)	(0)	(0)	(0)	(0)	(1)	(0)

Table E-88. Summary of Cropland Idling Emissions by Water Agency

	Daily Emissions (lbs per day)						Annual Emissions (tons per year)					
Water Agency	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Te Velde Revocable Family Trust												
Exhaust Emissions	(3)	(52)	(68)	(17)	(4)	(4)	(0)	(2)	(3)	(1)	(0)	(0)
Land Preparation	--	--	--	--	(116)	(17)	--	--	--	--	(10)	(2)
Harvesting	--	--	--	--	(10)	(1)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	4	1	--	--	--	--	0	0
Te Velde Revocable Family Trust Subtotal	(3)	(52)	(68)	(17)	(126)	(22)	(0)	(2)	(3)	(1)	(11)	(2)
Windswept Land & Livestock												
Exhaust Emissions	0	0	0	0	0	0	0	0	0	0	0	0
Land Preparation	--	--	--	--	0	0	--	--	--	--	0	0
Harvesting	--	--	--	--	0	0	--	--	--	--	0	0
Wind Erosion	--	--	--	--	--	--	--	--	--	--	--	-
Windswept Land & Livestock Subtotal	0	0	0	0	0	0	0	0	0	0	0	0
Exhaust Emissions Total	(67)	(1,272)	(1,673)	(417)	(100)	(100)	(3)	(49)	(64)	(16)	(4)	(4)
Land Preparation Total	0	0	0	0	(2,857)	(428)	0	0	0	0	(257)	(39)
Harvesting Total	0	0	0	0	(240)	(36)	0	0	0	0	(22)	(3)
Wind Erosion Total	0	0	0	0	384	77	0	0	0	0	35	7
GRAND TOTAL	**(67)**	**(1,272)**	**(1,673)**	**(417)**	**(2,813)**	**(488)**	**(3)**	**(49)**	**(64)**	**(16)**	**(248)**	**(39)**

Table E-89. Summary of Cropland Idling Emissions by County

	Daily Emissions (lbs/day)						Annual Emissions (tons/yr)					
County	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Colusa												
Baber, Jack et al.	(1)	(17)	(22)	(6)	(34)	(6)	(0)	(1)	(1)	(0)	(3)	(0)
Canal Farms	(0)	(5)	(6)	(2)	(9)	(2)	(0)	(0)	(0)	(0)	(1)	(0)
Eastside Mutual Water Company	(1)	(14)	(18)	(4)	(27)	(5)	(0)	(1)	(1)	(0)	(2)	(0)
Glenn-Colusa Irrigation District	(6)	(122)	(160)	(40)	(240)	(41)	(0)	(5)	(6)	(2)	(21)	(3)
Maxwell Irrigation District	(1)	(15)	(19)	(5)	(29)	(5)	(0)	(1)	(1)	(0)	(3)	(0)
Princeton-Codora-Glenn Irrigation District	(1)	(24)	(32)	(8)	(48)	(8)	(0)	(1)	(1)	(0)	(4)	(1)
Provident Irrigation District	(2)	(37)	(48)	(12)	(72)	(12)	(0)	(1)	(2)	(0)	(6)	(1)
Reclamation District 1004	(3)	(49)	(65)	(16)	(105)	(18)	(0)	(2)	(2)	(1)	(9)	(1)
Reclamation District 108	(4)	(74)	(97)	(24)	(164)	(28)	(0)	(3)	(4)	(1)	(14)	(2)
Sycamore Mutual Water Company	(3)	(52)	(68)	(17)	(103)	(18)	(0)	(2)	(3)	(1)	(9)	(1)
T&P Farms	(0)	(7)	(9)	(2)	(13)	(2)	(0)	(0)	(0)	(0)	(1)	(0)
Colusa Subtotal	(22)	(415)	(546)	(136)	(845)	(145)	(1)	(16)	(21)	(5)	(74)	(11)
Glenn												
Glenn-Colusa Irrigation District	(6)	(122)	(160)	(40)	(240)	(41)	(0)	(5)	(6)	(2)	(21)	(3)
Princeton-Codora-Glenn Irrigation District	(1)	(24)	(32)	(8)	(48)	(8)	(0)	(1)	(1)	(0)	(4)	(1)
Provident Irrigation District	(2)	(37)	(48)	(12)	(72)	(12)	(0)	(1)	(2)	(0)	(6)	(1)
Reclamation District 1004	(3)	(49)	(65)	(16)	(105)	(18)	(0)	(2)	(2)	(1)	(9)	(1)
Glenn Subtotal	(12)	(232)	(306)	(76)	(466)	(80)	(0)	(9)	(12)	(3)	(41)	(6)
Sutter												
Guisti Farms	0	0	0	0	0	0	0	0	0	0	0	0
Henle Family LP	0	0	0	0	0	0	0	0	0	0	0	0
Natomas Central Mutual Water Company	0	0	0	0	0	0	0	0	0	0	0	0
Pelger Mutual Water Company	(1)	(19)	(25)	(6)	(46)	(8)	(0)	(1)	(1)	(0)	(4)	(1)
Pelger Road 1700 LLC	0	0	0	0	0	0	0	0	0	0	0	0
Pleasant Grove-Verona Mutual Water Company	(4)	(67)	(88)	(22)	(164)	(29)	(0)	(3)	(3)	(1)	(15)	(2)
Reclamation District 1004	(3)	(49)	(65)	(16)	(105)	(18)	(0)	(2)	(2)	(1)	(9)	(1)
Sutter Mutual Water Company	(7)	(133)	(175)	(44)	(329)	(58)	(0)	(5)	(7)	(2)	(29)	(5)
Windswept Land & Livestock	0	0	0	0	0	0	0	0	0	0	0	0
Sutter Subtotal	(11)	(201)	(265)	(66)	(481)	(84)	(0)	(8)	(10)	(3)	(42)	(7)
Yolo												
Conaway Preservation Group	(8)	(158)	(208)	(52)	(386)	(68)	(0)	(6)	(8)	(2)	(34)	(5)
Reclamation District 108	(4)	(74)	(97)	(24)	(164)	(28)	(0)	(3)	(4)	(1)	(14)	(2)
River Garden Farms	(4)	(74)	(97)	(24)	(181)	(32)	(0)	(3)	(4)	(1)	(16)	(3)
Te Velde Revocable Family Trust	(3)	(52)	(68)	(17)	(126)	(22)	(0)	(2)	(3)	(1)	(11)	(2)
Yolo Subtotal	(19)	(357)	(470)	(117)	(856)	(150)	(1)	(14)	(18)	(4)	(76)	(12)
GRAND TOTAL	(63)	(1,205)	(1,586)	(395)	(2,648)	(459)	(2)	(46)	(61)	(15)	(233)	(36)

Table E-90. Reduced Exhaust Emissions from Cropland Idling

Water Agency	Groundwater Substitution	Cropland Idling/ Crop Shifting	GW Pumping Equivalent	Reduced Daily Emissions (lbs/day)						Reduced Annual Emissions (tons/year)					
	(acre-feet/year)	(acre-feet/year)	(acre-feet/year)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Anderson-Cottonwood Irrigation District	4,800	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Baber, Jack et al.	0	2,310	544	0.90	17.09	22.49	5.60	1.35	1.35	0.03	0.65	0.86	0.21	0.05	0.05
Canal Farms	1,000	635	149	0.25	4.68	6.16	1.53	0.37	0.37	0.01	0.18	0.24	0.06	0.01	0.01
Conaway Preservation Group	0	21,350	5,024	8.31	157.83	207.68	51.75	12.46	12.46	0.32	6.04	7.95	1.98	0.48	0.48
Eastside Mutual Water Company	2,230	1,846	434	0.72	13.63	17.94	4.47	1.08	1.08	0.03	0.52	0.69	0.17	0.04	0.04
Glenn-Colusa Irrigation District	11,300	33,000	7,765	12.84	243.95	320.98	79.99	19.26	19.26	0.49	9.34	12.28	3.06	0.74	0.74
Guisti Farms	1,000	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Henle Family LP	700	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maxwell Irrigation District	3,000	2,003	471	0.78	14.80	19.47	4.85	1.17	1.17	0.03	0.57	0.75	0.19	0.04	0.04
Natomas Central Mutual Water Company	20,000	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pelger Mutual Water Company	4,670	2,538	597	0.99	18.76	24.68	6.15	1.48	1.48	0.04	0.72	0.94	0.24	0.06	0.06
Pelger Road 1700 LLC	5,200	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pleasant Grove-Verona Mutual Water Company	15,000	9,000	2,118	3.50	66.54	87.55	21.82	5.25	5.25	0.13	2.55	3.35	0.84	0.20	0.20
Princeton-Codora-Glenn Irrigation District	6,600	6,600	1,553	2.57	48.79	64.20	16.00	3.85	3.85	0.10	1.87	2.46	0.61	0.15	0.15
Provident Irrigation District	10,000	9,900	2,329	3.85	73.17	96.27	23.99	5.78	5.78	0.15	2.80	3.68	0.92	0.22	0.22
Reclamation District 1004	7,175	20,000	4,706	7.78	147.84	194.53	48.48	11.67	11.67	0.30	5.66	7.45	1.86	0.45	0.45
Reclamation District 108	15,000	20,000	4,706	7.78	147.84	194.53	48.48	11.67	11.67	0.30	5.66	7.45	1.86	0.45	0.45
River Garden Farms	10,000	10,000	2,353	3.89	73.92	97.27	24.24	5.84	5.84	0.15	2.83	3.72	0.93	0.22	0.22
Sutter Mutual Water Company	18,000	18,000	4,235	7.00	133.05	175.06	43.63	10.50	10.50	0.27	5.09	6.70	1.67	0.40	0.40
Sycamore Mutual Water Company	8,000	7,000	1,647	2.72	51.74	68.08	16.97	4.08	4.08	0.10	1.98	2.61	0.65	0.16	0.16
T&P Farms	1,200	890	209	0.35	6.57	8.64	2.15	0.52	0.52	0.01	0.25	0.33	0.08	0.02	0.02
Te Velde Revocable Family Trust	7,094	6,975	1,641	2.71	51.55	67.83	16.90	4.07	4.07	0.10	1.97	2.60	0.65	0.16	0.16
Windswept Land & Livestock	2,000	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**153,969**	**172,047**	**40,481**	**66.93**	**1,271.76**	**1,673.36**	**417.02**	**100.40**	**100.40**	**2.56**	**48.67**	**64.04**	**15.96**	**3.84**	**3.84**

Notes:

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

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

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

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

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

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

Fugitive Dust Emissions from Cropland Idling

Table E-91. Land Preparation (Reduced Emissions)

District	County	Acres	Daily PM10 Emissions (lbs/day)	Annual PM10 Emissions (tons per year)
		Rice	Rice	Rice
Sacramento River Area of Analysis				
Anderson-Cottonwood Irrigation District	Shasta/Tehama	0	0	0
Baber, Jack et al.	Colusa	700	38	3
Canal Farms	Colusa	192	11	1
Conaway Preservation Group	Yolo	6,470	355	32
Eastside Mutual Water Company	Colusa	559	31	3
Glenn-Colusa Irrigation District	Glenn/Colusa	10,000	548	49
Guisti Farms	Sutter	0	0	0
Henle Family LP	Sutter	0	0	0
Maxwell Irrigation District	Colusa	607	33	3
Natomas Central Mutual Water Company	Sacramento/Sutter	0	0	0
Pelger Mutual Water Company	Sutter	769	42	4
Pelger Road 1700 LLC	Sutter	0	0	0
Pleasant Grove-Verona Mutual Water Company	Sutter	2,727	149	13
Princeton-Codora-Glenn Irrigation District	Glenn/Colusa	2,000	110	10
Provident Irrigation District	Glenn/Colusa	3,000	164	15
Reclamation District 1004	Glenn/Colusa/Sutter	6,061	332	30
Reclamation District 108	Colusa/Yolo	6,061	332	30
River Garden Farms	Yolo	3,030	166	15
Sutter Mutual Water Company	Sutter	5,455	299	27
Sycamore Mutual Water Company	Colusa	2,121	116	10
T&P Farms	Colusa	270	15	1
Te Velde Revocable Family Trust	Yolo	2,114	116	10
Windswept Land & Livestock	Sutter	0	0	0
Total		**52,135**	**2,857**	**257**

Table E-92. Harvesting (Reduced Emissions)

District	County	Acres	Daily PM10 Emissions (lbs/day)	Annual PM10 Emissions (tons per year)
		Rice	Rice	Rice
Sacramento River Area of Analysis				
Anderson-Cottonwood Irrigation District	Shasta/Tehama	0	0	0
Baber, Jack et al.	Colusa	700	3	0
Canal Farms	Colusa	192	1	0
Conaway Preservation Group	Yolo	6,470	30	3
Eastside Mutual Water Company	Colusa	559	3	0
Glenn-Colusa Irrigation District	Glenn/Colusa	10,000	46	4
Guisti Farms	Sutter	0	0	0
Henle Family LP	Sutter	0	0	0
Maxwell Irrigation District	Colusa	607	3	0
Natomas Central Mutual Water Company	Sacramento/Sutter	0	0	0
Pelger Mutual Water Company	Sutter	769	4	0
Pelger Road 1700 LLC	Sutter	0	0	0
Pleasant Grove-Verona Mutual Water Company	Sutter	2,727	13	1
Princeton-Codora-Glenn Irrigation District	Glenn/Colusa	2,000	9	1
Provident Irrigation District	Glenn/Colusa	3,000	14	1
Reclamation District 1004	Glenn/Colusa/Sutter	6,061	28	3
Reclamation District 108	Colusa/Yolo	6,061	28	3
River Garden Farms	Yolo	3,030	14	1
Sutter Mutual Water Company	Sutter	5,455	25	2
Sycamore Mutual Water Company	Colusa	2,121	10	1
T&P Farms	Colusa	270	1	0
Te Velde Revocable Family Trust	Yolo	2,114	10	1
Windswept Land & Livestock	Sutter	0	0	0
Total		**52,135**	**240**	**22**

Table E-93. Windblown Dust (Increased Emissions)

District	County	Acres	Daily PM10 Emissions (lbs/day)	Annual PM10 Emissions (tons per year)
		Rice	Rice	Rice
Sacramento River Area of Analysis				
Anderson-Cottonwood Irrigation District	Shasta/Tehama	0	--	--
Baber, Jack et al.	Colusa	700	9	1
Canal Farms	Colusa	192	2	0
Conaway Preservation Group	Yolo	6,470	11	1
Eastside Mutual Water Company	Colusa	559	7	1
Glenn-Colusa Irrigation District	Glenn/Colusa	10,000	132	12
Guisti Farms	Sutter	0	--	--
Henle Family LP	Sutter	0	--	--
Maxwell Irrigation District	Colusa	607	8	1
Natomas Central Mutual Water Company	Sacramento/Sutter	0	--	--
Pelger Mutual Water Company	Sutter	769	1	0
Pelger Road 1700 LLC	Sutter	0	--	--
Pleasant Grove-Verona Mutual Water Company	Sutter	2,727	3	0
Princeton-Codora-Glenn Irrigation District	Glenn/Colusa	2,000	26	2
Provident Irrigation District	Glenn/Colusa	3,000	40	4
Reclamation District 1004	Glenn/Colusa/Sutter	6,061	56	5
Reclamation District 108	Colusa/Yolo	6,061	44	4
River Garden Farms	Yolo	3,030	5	0
Sutter Mutual Water Company	Sutter	5,455	6	0
Sycamore Mutual Water Company	Colusa	2,121	27	2
T&P Farms	Colusa	270	3	0
Te Velde Revocable Family Trust	Yolo	2,114	4	0
Windswept Land & Livestock	Sutter	0	--	--
Total		**52,135**	**384**	**35**

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

Conversions

1 ton =	2,000	pounds	
1 year =	365	days	
Project duration =	180	days	(assumes 6-month crop idling season)

Legend

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

Agricultural Land Preparation

Table E-94. Summary of Crop Profile, Acre-Pass, and Emission Factor

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

Agricultural Land Preparation

Table E-94. Summary of Crop Profile, Acre-Pass, and Emission Factor

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

Source:
CARB. 2003. Emission Inventory Documentation, Section 7.4: Agricultural Land Preparation. January.
Accessed on: January 21, 2015. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfarmop.htm.

Agricultural Harvest Operations

Table E-95. Summary of Crop Emission Factor Assumptions

CDFA Crop Code	CDFA Crop Description	Crop Profile	Assumption	Emission Factor (lbs PM10/acre/yr)
101999	WHEAT ALL	Wheat	Wheat/1	5.8
104999	RYE FOR GRAIN	Wheat	Wheat/1	5.8
106199	RICE, FOR MILLING	Rice	Cotton/2	1.68
106269	FIELD CROP BY PRODUCTS	Cotton	Cotton/20	0.17
108999	FOOD GRAINS, MISC	Corn	Cotton/2	1.68
111559	CORN, WHITE	Corn	Cotton/40	0.08
111991	CORN FOR GRAIN	Corn	Cotton/2	1.68
111992	CORN FOR SILAGE	Corn	Cotton/20	0.17
112999	OATS FOR GRAIN	Wheat	Wheat/1	5.8
113994	BARLEY, MALTING	Wheat	Wheat/1	5.8
113995	BARLEY, FEED	Wheat	Wheat/1	5.8
113999	BARLEY, UNSPECIFIED	Wheat	Wheat/1	5.8
114991	SORGHUM, GRAIN	Wheat	Wheat/1	5.8
121219	COTTON LINT, UPLAND	Cotton	Cotton/1	3.37
121229	COTTON LINT, PIMA	Cotton	Cotton/1	3.37
121299	COTTON LINT, UNSPEC	Cotton	Cotton/1	3.37
132999	SUGAR BEETS	Sugar Beets	Cotton/2	1.68
151999	COTTONSEED	Cotton	Cotton/1	3.37
153999	PEANUTS, ALL	Safflower	Cotton/2	1.68
158269	SAFFLOWER	Safflower	Wheat/1	5.8
158316	SUNFLOWER SEED, PLANTING	Corn	Wheat/1	5.8
158319	SUNFLOWER SEED	Corn	Wheat/1	5.8
158499	JOJOBA	Melon	Cotton/40	0.08
161131	BEANS, LIMAS, LG. DRY	DryBeans	Cotton/2	1.68
161132	BEANS, LIMAS, BABY DRY	DryBeans	Cotton/2	1.68
161199	LIMA BEANS, UNSPECIFIED	DryBeans	Cotton/2	1.68
161717	BEANS, RED KIDNEY	DryBeans	Cotton/2	1.68
161721	BEANS, PINK	DryBeans	Cotton/2	1.68
161741	BEANS, BLACKEYE (PEAS)	DryBeans	Cotton/2	1.68
161742	BEANS, GARBANZO	Garbanzo	Cotton/2	1.68
162399	BEANS, FAVA	DryBeans	Cotton/2	1.68
163999	PEAS, DRY EDIBLE	DryBeans	Cotton/20	0.17
169999	BEANS,UNSPEC. DRY EDIBLE	DryBeans	Cotton/2	1.68
171019	SEED WHEAT	Wheat	Wheat/1	5.8
171049	SEED RYE	Wheat	Wheat/1	5.8
171069	SEED RICE	Rice	Cotton/2	1.68
171129	SEED OATS	Wheat	Wheat/1	5.8
171139	SEED BARLEY	Wheat	Wheat/1	5.8
171519	SEED, COTTON FOR PLANTING	Cotton	Cotton/1	3.37
171582	SEED, SAFFLOWER, PLANTING	Safflower	Wheat/1	5.8
171619	SEED BEANS	DryBeans	Cotton/2	1.68
171639	SEED PEAS	DryBeans	Cotton/20	0.17
171949	SEED, MISC FIELD CROP	Corn	Cotton/20	0.17
171959	SEED, VEG & VINECROP	Vegetables	Cotton/20	0.17
172119	SEED, ALFALFA	Alfalfa	Zero/1	0
172289	CLOVER, UNSPECIFIED SEED	Alfalfa	Zero/1	0
173079	SEED, BERMUDA GRASS	Alfalfa	Zero/1	0
173669	SEED, SUDAN GRASS	Alfalfa	Zero/1	0
173999	SEED, GRASS, UNSPECIFIED	Alfalfa	Zero/1	0
178999	SEED, OTHER (NO FLOWERS)	Alfalfa	Cotton/20	0.17
181999	HAY, ALFALFA	Alfalfa	Zero/1	0
188499	HAY, GRAIN	Alfalfa	Cotton/2	1.68
188799	HAY, WILD	Alfalfa	Cotton/2	1.68
188899	HAY, SUDAN	Alfalfa	Zero/1	0
188999	HAY, OTHER UNSPECIFIED	Alfalfa	Cotton/2	1.68
194599	PASTURE, IRRIGATED	No Land	Zero/1	0
194699	PASTURE, RANGE	No Land	Zero/1	0
194799	PASTURE, MISC. FORAGE	No Land	Zero/1	0

Agricultural Harvest Operations

Table E-95. Summary of Crop Emission Factor Assumptions

CDFA Crop Code	CDFA Crop Description	Crop Profile	Assumption	Emission Factor (lbs PM10/acre/yr)
195199	SILAGE	Wheat	Cotton/20	0.17
195299	HAY, GREEN CHOP	Alfalfa	Zero/1	0
195399	STRAW	Alfalfa	Wheat/1	5.8
198199	RICE, WILD	Rice	Cotton/2	1.68
198999	FIELD CROPS, UNSPEC.	Corn	Cotton/20	0.17
201119	ORANGES, NAVEL	Citrus	Cotton/40	0.08
201519	ORANGES, VALENCIAS	Citrus	Cotton/40	0.08
201999	ORANGES, UNSPECIFIED	Citrus	Cotton/40	0.08
202999	GRAPEFRUIT, ALL	Citrus	Cotton/40	0.08
203999	TANGERINES & MANDARINS	Citrus	Cotton/40	0.08
204999	LEMONS, ALL	Citrus	Cotton/40	0.08
205999	LIMES, ALL	Citrus	Cotton/40	0.08
206999	TANGELOS	Citrus	Cotton/40	0.08
207999	KUMQUATS	Citrus	Cotton/40	0.08
208059	CITRUS, MISC BY-PROD	Citrus	Cotton/40	0.08
209999	CITRUS, UNSPECIFIED	Citrus	Cotton/40	0.08
211999	APPLES, ALL	Citrus	Cotton/40	0.08
212199	PEACHES, FREESTONE	Citrus	Cotton/40	0.08
212399	PEACHES, CLINGSTONE	Citrus	Cotton/40	0.08
212999	PEACHES, UNSPECIFIED	Citrus	Cotton/40	0.08
213199	CHERRIES, SWEET	Citrus	Cotton/40	0.08
214199	PEARS, BARLETT	Citrus	Cotton/40	0.08
214899	PEARS, ASIAN	Citrus	Cotton/40	0.08
214999	PEARS, UNSPECIFIED	Citrus	Cotton/40	0.08
215199	PLUMS	Citrus	Cotton/40	0.08
215399	PLUMCOTS	Citrus	Cotton/40	0.08
215999	PRUNES, DRIED	Citrus	Cotton/40	0.08
216199	GRAPES, TABLE	Grapes-Table	Cotton/20	0.17
216299	GRAPES, WINE	Grapes-Wine	Cotton/20	0.17
216399	GRAPES, RAISIN	Grapes-Raisin	Cotton/20	0.17
216999	GRAPES, UNSPECIFIED	Grapes-Wine	Cotton/20	0.17
217999	APRICOTS, ALL	Citrus	Cotton/40	0.08
218199	NECTARINES	Citrus	Cotton/40	0.08
218299	PERSIMMONS	Citrus	Cotton/40	0.08
218399	POMEGRANATES	Citrus	Cotton/40	0.08
218499	QUINCE	Citrus	Cotton/40	0.08
218839	CHERIMOYAS	Citrus	Cotton/40	0.08
218889	ORCHARD BIOMASS	Almonds	Cotton/40	0.08
218899	FRUITS & NUTS, UNSPEC.	Citrus	Cotton/40	0.08
221999	AVOCADOS, ALL	Citrus	Cotton/40	0.08
224999	DATES	Citrus	Almonds/20	2.04
225999	FIGS, DRIED	Citrus	Almonds/20	2.04
226999	OLIVES	Citrus	Cotton/40	0.08
228019	GUAVAS	Citrus	Cotton/40	0.08
229999	KIWIFRUIT	Citrus	Cotton/40	0.08
230639	BERRIES, BLACKBERRIES	Grapes-Table	Cotton/40	0.08
230869	BERRIES, BOYSENBERRIES	Grapes-Table	Cotton/40	0.08
234799	BERRIES, LOGANBERRIES	Grapes-Table	Cotton/40	0.08
236199	BERRIES, RASPBERRIES	Grapes-Table	Cotton/40	0.08
237199	STRAWBERRIES, FRESH MKT	Melon	Cotton/40	0.08
237299	STRAWBERRIES, PROC	Melon	Cotton/40	0.08
237999	STRAWBERRIES, UNSPECIFIED	Melon	Cotton/40	0.08
239999	BERRIES, BUSH, UNSPECIFIED	Grapes-Table	Cotton/40	0.08
261999	ALMONDS, ALL	Almonds	Almonds/1	40.77
263999	WALNUTS, ENGLISH	Almonds	Almonds/1	40.77
264999	PECANS	Almonds	Almonds/10	4.08
265999	WALNUTS, BLACK	Almonds	Almonds/1	40.77
266999	CHESTNUTS	Almonds	Almonds/10	4.08

Agricultural Harvest Operations

Table E-95. Summary of Crop Emission Factor Assumptions

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

Agricultural Harvest Operations

Table E-95. Summary of Crop Emission Factor Assumptions

CDFA Crop Code	CDFA Crop Description	Crop Profile	Assumption	Emission Factor (lbs PM10/acre/yr)
337999	KALE	Lettuce	Cotton/40	0.08
338999	KOHLRABI	Lettuce	Cotton/40	0.08
339196	LETTUCE, BULK SALAD PRODS.	Lettuce	Cotton/40	0.08
339999	LETTUCE, UNSPECIFIED	Lettuce	Cotton/40	0.08
340999	LETTUCE, HEAD	Lettuce	Cotton/40	0.08
341999	LETTUCE, ROMAINE	Lettuce	Cotton/40	0.08
342999	LETTUCE, LEAF	Lettuce	Cotton/40	0.08
343999	MELON, CANTALOUPE	Melon	Cotton/40	0.08
348999	MELON, HONEYDEW	Melon	Cotton/40	0.08
354299	MELON, UNSPECIFIED	Melon	Cotton/40	0.08
354999	MELON, WATER MELONS	Melon	Cotton/40	0.08
355999	MUSHROOMS	No Land Prep.	Zero/1	0
356999	MUSTARD	Lettuce	Cotton/40	0.08
357999	OKRA	Lettuce	Cotton/40	0.08
358999	ONIONS	Onions	Cotton/2	1.68
359999	PARSLEY	Lettuce	Cotton/40	0.08
361299	PEAS, GREEN, PROCESSING	DryBeans	Cotton/20	0.17
361999	PEAS, GREEN, UNSPECIFIED	DryBeans	Cotton/20	0.17
363999	PEPPERS, BELL	Tomatoes	Cotton/40	0.08
364999	PEPPERS, CHILI, HOT	Tomatoes	Cotton/40	0.08
366999	PUMPKINS	Melon	Cotton/20	0.17
367999	RADISHES	Sugar Beets	Cotton/40	0.08
368999	RHUBARB	Lettuce	Cotton/40	0.08
370999	RUTABAGAS	Sugar Beets	Cotton/2	1.68
372999	ONIONS, GREEN & SHALLOTS	Onions	Cotton/40	0.08
374189	SPINACH, FOOD SERV	Lettuce	Cotton/40	0.08
374199	SPINACH, FR MKT	Lettuce	Cotton/40	0.08
374299	SPINACH, PROC	Lettuce	Cotton/40	0.08
374999	SPINACH UNSPECIFIED	Lettuce	Cotton/40	0.08
375999	SQUASH	Melon	Cotton/20	0.17
376999	SWISSCHARD	Lettuce	Cotton/40	0.08
378199	TOMATOES, FRESH MARKET	Tomatoes	Cotton/40	0.08
378299	TOMATOES, PROCESSING	Tomatoes	Cotton/20	0.17
378999	TOMATOES, UNSPECIFIED	Tomatoes	Cotton/20	0.17
380999	TURNIPS, ALL	Sugar Beets	Cotton/2	1.68
381999	GREENS, TURNIP & MUSTARD	Lettuce	Cotton/40	0.08
387999	LEEKS	Onions	Cotton/40	0.08
391999	POTATOES, IRISH ALL	Sugar Beets	Cotton/2	1.68
392999	SWEET POTATOES	Sugar Beets	Cotton/2	1.68
393999	HORSERADISH	Onions	Cotton/40	0.08
394199	SALAD GREENS NEC	Lettuce	Cotton/40	0.08
394999	PEAS, EDIBLE POD (SNOW)	DryBeans	Cotton/20	0.17
395999	VEGETABLES, ORIENTAL, ALL	Vegetables	Cotton/40	0.08
396999	SPROUTS, ALFALFA & BEAN	Lettuce	Cotton/40	0.08
398199	CUCUMBERS, GREENHOUSE	No Land Prep.	Zero/1	0
398299	TOMATOES, GREENHOUSE	No Land Prep.	Zero/1	0
398399	TOMATOES, CHERRY	Tomatoes	Cotton/40	0.08
398499	TOMATILLO	Tomatoes	Cotton/40	0.08
398559	CILANTRO	Lettuce	Cotton/40	0.08
398599	SPICES AND HERBS	Lettuce	Cotton/40	0.08
398899	VEGETABLES, BABY	Vegetables	Cotton/40	0.08
398999	VEGETABLES, UNSPECIFIED	Vegetables	Cotton/20	0.17
832919	POTATOES SEED	Sugar Beets	Cotton/2	1.68
892999	NURSERY TURF	No Land Prep.	Zero 1	0

Source:

CARB. 2003. Emission Inventory Documentation, Section 7.5: Agricultural Harvest Operations. January. Accessed on: January 21, 2015. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfarmop.htm.

Windblown Dust - Agricultural Lands

Table E-96. Windblown Dust - Agricultural Lands

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

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

Table E-97. Windblown Dust - Pasture Lands

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

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

Table E-98. County Size

County	Area (acres)	
	Non-Pasture	Pasture
Butte	n/a	n/a
Colusa	n/a	n/a
Fresno	n/a	n/a
Glenn	n/a	n/a
Imperial	n/a	n/a
Kern	n/a	n/a
Kings	n/a	n/a
Madera	n/a	n/a
Merced	n/a	n/a
Monterey	n/a	n/a
Placer	n/a	n/a
Sacramento	n/a	n/a
San Benito	n/a	n/a
San Joaquin	n/a	n/a
San Luis Obispo	n/a	n/a
Santa Barbara	n/a	n/a
Santa Cruz	n/a	n/a
Shasta	n/a	n/a
Solano	n/a	n/a
Stanislaus	n/a	n/a
Sutter	n/a	n/a
Tehama	n/a	n/a
Tulare	n/a	n/a
Ventura	n/a	n/a
Yolo	n/a	n/a
Yuba	n/a	n/a
Total	**0**	**0**

Source:
CARB. 1997. Emission Inventory Documentation, Section 7.12: Windblown Dust - Agricultural Lands. July. Accessed on: January 21, 2015. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocfugwbdst.htm.

As discussed in Section 3, Environmental Impacts, Figure 1 below shows the CO maintenance area; Figure 2 displays the O3 nonattainment area; Figure 3 shows the PM10 maintenance area; and Figure 4 displays the PM2.5 nonattainment area.

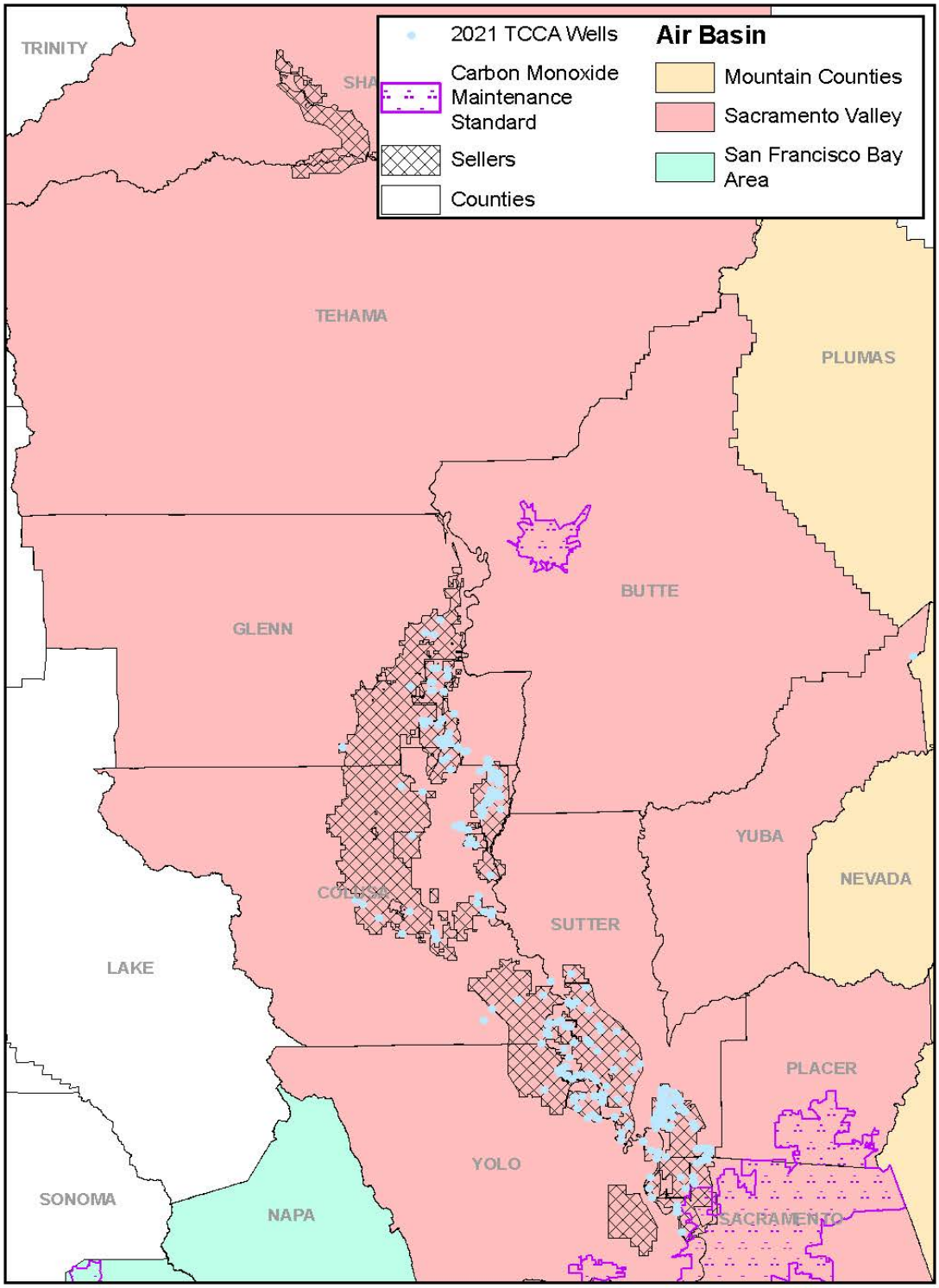

Figure 1. Location of CO Maintenance Area in Seller Service Area

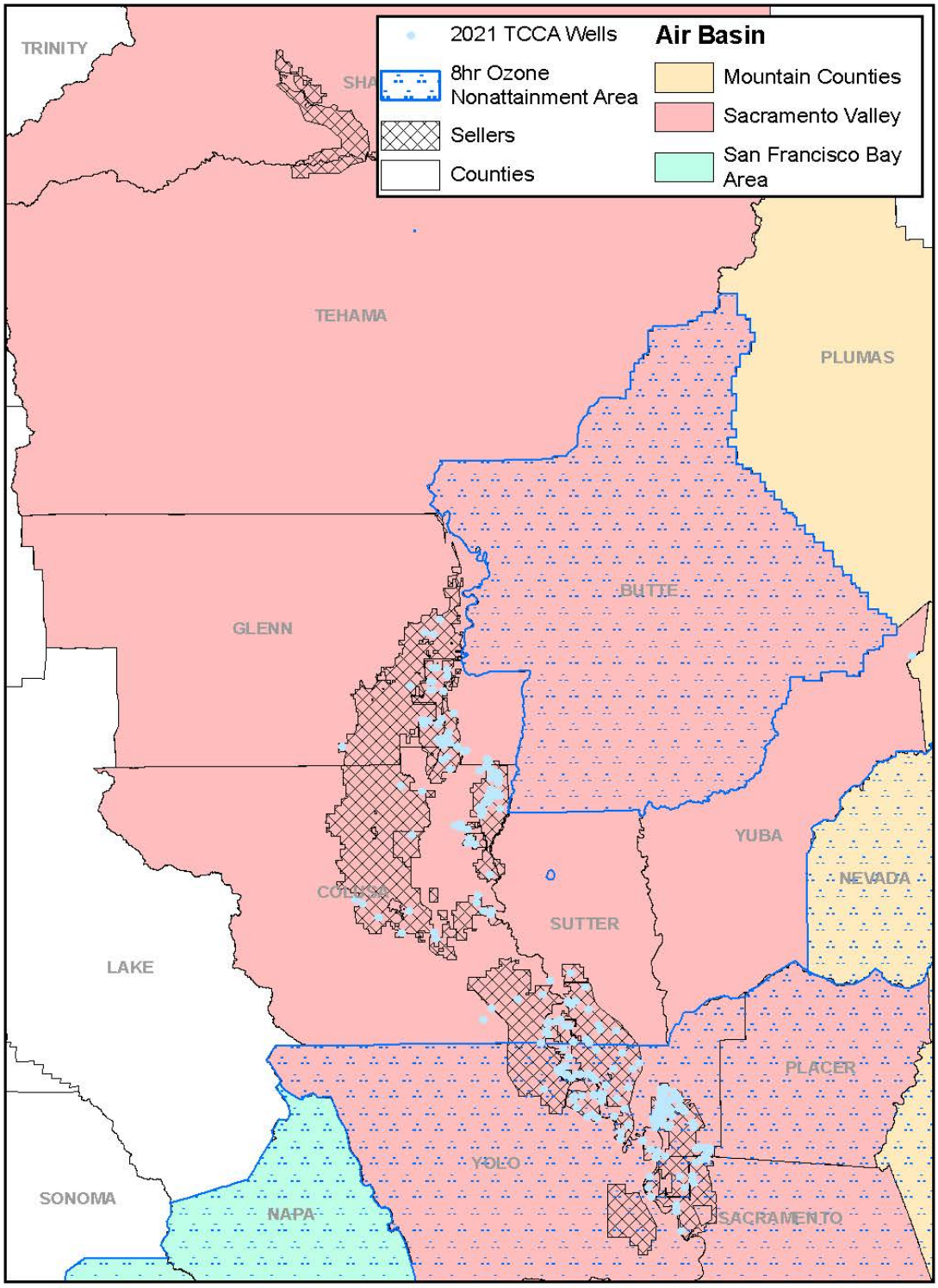

Figure 2. Location of O_3 Nonattainment Area in Seller Service Area

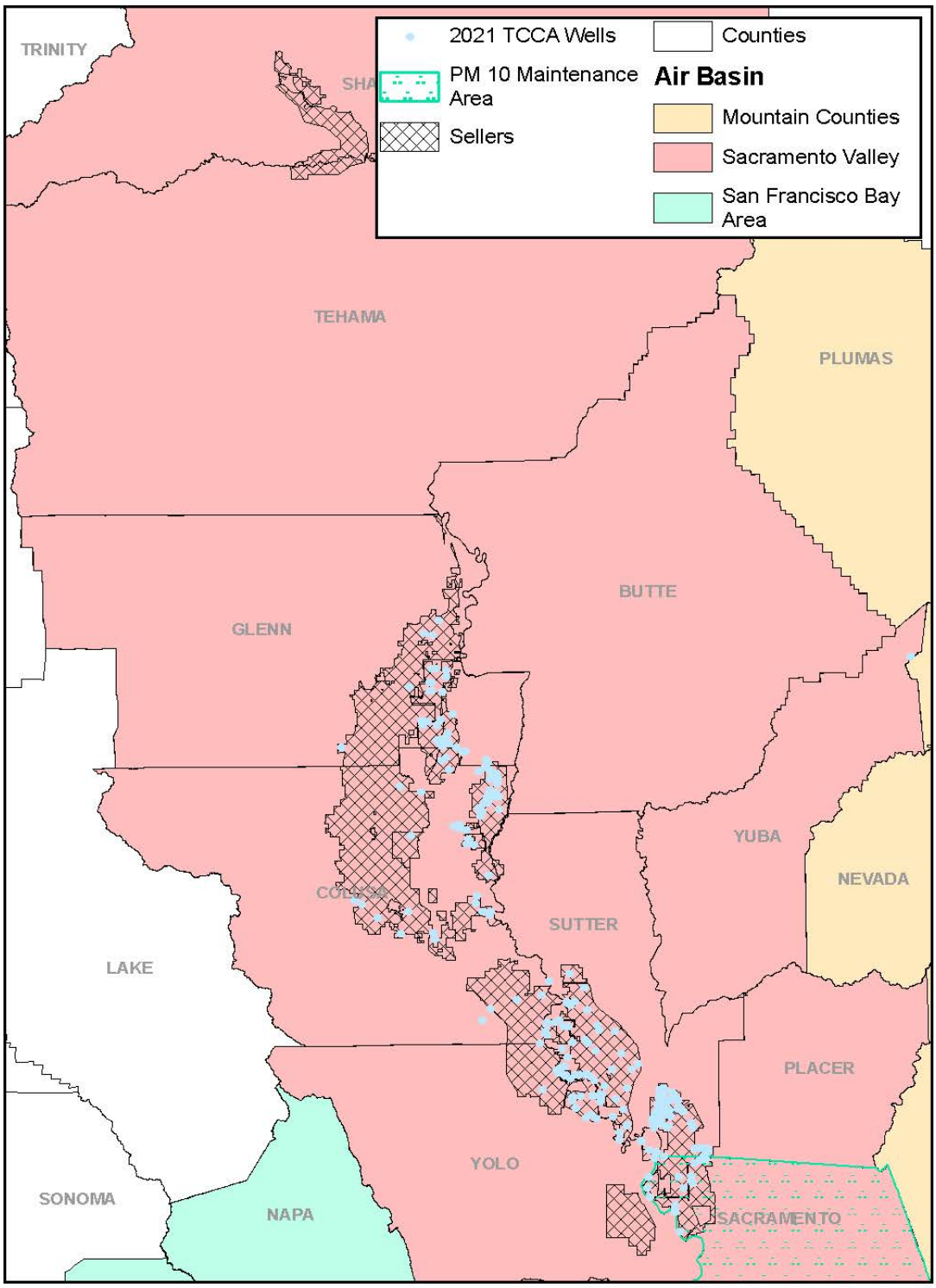

Figure 3. Location of PM_{10} Maintenance Area in Seller Service Area

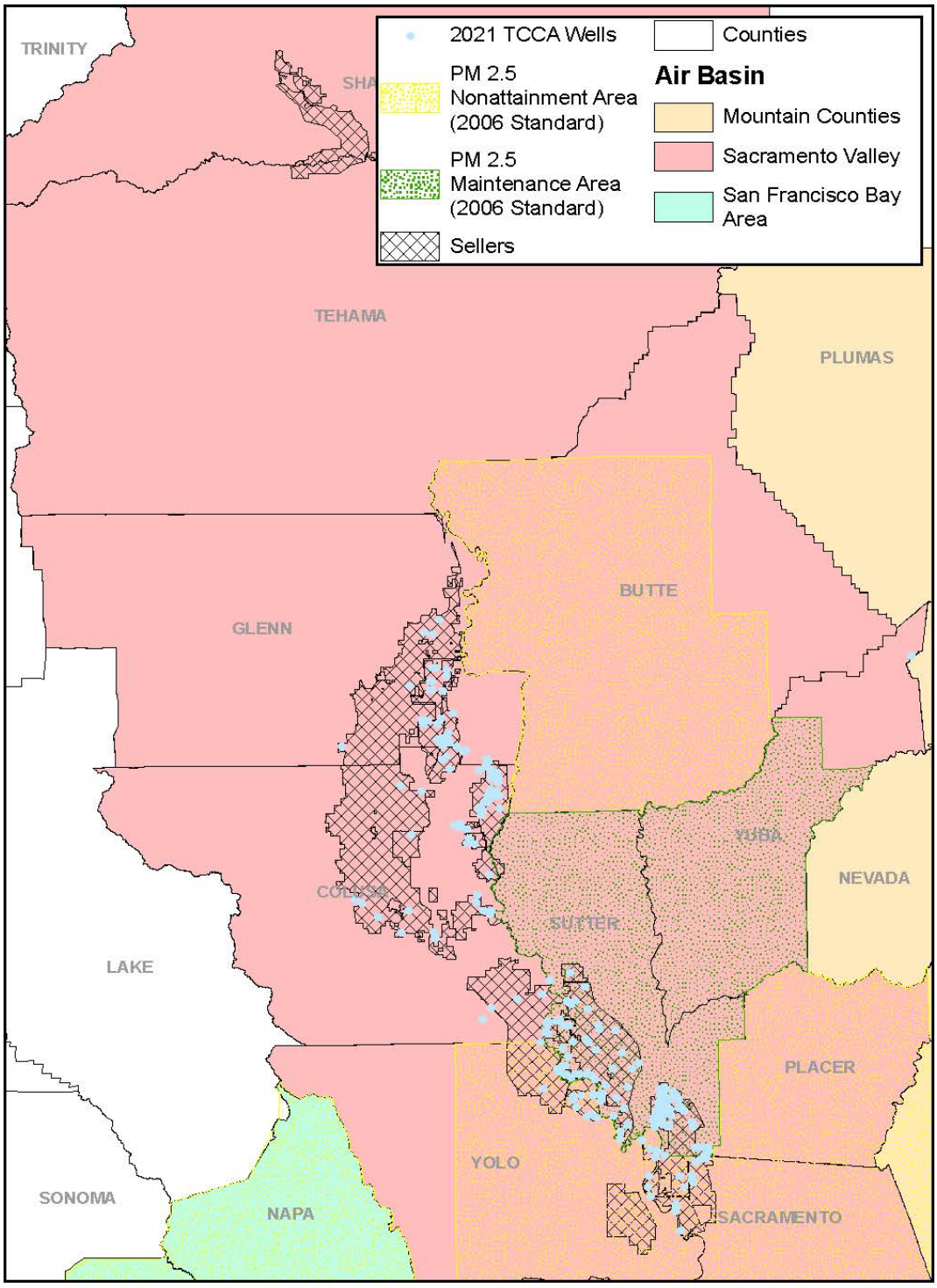

Figure 4. Location of $PM_{2.5}$ Nonattainment and Maintenance Areas in Seller Service Area

Appendix F

Greenhouse Gas Emissions Calculations

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Summary of Annual Greenhouse Gas Emissions

Table F-1. GHG Emissions from Groundwater Substitution

Water Agency	Emissions (MTCO2e/year)			
	CO2	CH4	N2O	Total
Anderson-Cottonwood Irrigation District	70	0	0	71
Baber, Jack et al.	No Groundwater Substitution			0
Canal Farms	35	0	0	36
Conaway Preservation Group	No Groundwater Substitution			0
Eastside Mutual Water Company	418	0	1	420
Glenn-Colusa Irrigation District	972	2	3	977
Guisti Farms	898	1	3	902
Henle Family LP	15	0	0	15
Maxwell Irrigation District	526	1	1	528
Natomas Central Mutual Water Company	1,879	3	5	1,887
Pelger Mutual Water Company	171	0	1	172
Pelger Road 1700 LLC	79	0	0	80
Pleasant Grove-Verona Mutual Water Company	1,284	2	4	1,289
Princeton-Cordora-Glenn Irrigation District	911	1	2	914
Provident Irrigation District	1,628	2	4	1,634
Reclamation District 1004	885	1	2	888
Reclamation District 108	310	1	2	313
River Garden Farms	163	1	1	164
Sutter Mutual Water Company	97	0	1	98
Sycamore Mutual Water Company	86	0	0	87
T&P Farms	15	0	0	15
Te Velde Revocable Family Trust	122	1	1	123
Windswept Land & Livestock	65	0	0	65
Total	**10,628**	**17**	**32**	**10,677**

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Anderson-Cottonwood Irrigation District
Transfer Volume 4,800 acre-feet/year

Table F-2. Anderson-Cottonwood Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Shasta	0	2	0	0	2
Tehama	0	0	0	0	0
Total	0	2	0	0	2

Table F-3. Anderson-Cottonwood Irrigation District GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
Barney Street	Shasta	Electric	2012	200	5,500	85%	4,062	4,010	598,578	n/a	56	0.0092	0.0011	56	0.23	0.32	57
Crowley Gulch	Shasta	Electric	2012	50	1,000	15%	738	4,010	149,645	n/a	14	0.0023	0.0003	14	0.06	0.08	14
			Total		**6,500**	**100%**	**4,800**	**8,021**	**748,223**	**0**	**70**	**0.0115**	**0.0014**	**70**	**0.29**	**0.40**	**71**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Canal Farms
Transfer Volume 1,000 acre-feet/year

Table F-4. Canal Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	2	0	1	3
Total	0	2	0	1	3

Table F-5. Canal Farms GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (MMBtu/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
Dennis Well North	Colusa	Electric	unknown	125	1,900	22%	216	617	57,569	n/a	5	0.0009	0.0001	5	0.02	0.03	5
Dennis Well South	Colusa	Electric	unknown	125	1,900	22%	216	617	57,569	n/a	5	0.0009	0.0001	5	0.02	0.03	5
East Well	Colusa	Propane	unknown	250	5,000	57%	568	617	n/a	392	25	0.0012	0.0002	25	0.03	0.07	25
			Total	**8,800**	**100%**	**1,000**	**1,851**	**115,138**	**392**	**35**	**0.0030**	**0.0004**	**35**	**0.07**	**0.13**	**36**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

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

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Eastside Mutual Water Company
Transfer Volume 2,230 acre-feet/year

Table F-6. Eastside Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	2	0	0	0	2
Total	2	0	0	0	2

Table F-7. Eastside Mutual Water Company GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
ATW-1	Colusa	Diesel	2006	150	3,000	48%	1,079	1,953	n/a	16,438	167	0.007	0.0014	167	0.17	0.41	168
ATW-2	Colusa	Diesel	2002	225	3,200	52%	1,151	1,953	n/a	24,657	251	0.010	0.0021	251	0.26	0.61	252
			Total	**6,200**	**100%**	**2,230**	**3,907**	**0**	**41,094**	**418**	**0.017**	**0.0034**	**418**	**0.43**	**1.02**	**420**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Glenn-Colusa Irrigation District
Transfer Volume 11,300 acre-feet/year

Table F-8. Glenn-Colusa Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	1	6	0	0	7
Colusa	4	6	0	0	10
Total	5	12	0	0	17

Table F-9. Glenn-Colusa Irrigation District GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
15-3-22H-3	Colusa	Diesel	unknown	121	630	2%	252	2,175	n/a	14,762	150	0.0062	0.0012	150	0.15	0.37	151
17-2-6B-1	Colusa	Electric	unknown	121	2,050	7%	821	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
GRS-22H-1	Glenn	Electric	unknown	121	2,300	8%	921	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
GRS-34N-1	Glenn	Diesel	unknown	121	1,500	5%	601	2,175	n/a	14,762	150	0.0062	0.0012	150	0.15	0.37	151
GRS-35A-2	Glenn	Electric	unknown	121	3,600	13%	1,442	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
GRS-84A-1	Glenn	Electric	unknown	121	3,000	11%	1,201	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
Haymen	Colusa	Diesel	unknown	121	2,000	7%	801	2,175	n/a	14,762	150	0.0062	0.0012	150	0.15	0.37	151
LaCroix 1	Glenn	Electric	unknown	121	600	2%	240	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
LaCroix 2	Glenn	Electric	unknown	121	600	2%	240	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
LaCroix 3	Glenn	Electric	unknown	121	600	2%	240	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
Lagrande	Colusa	Diesel	unknown	121	2,900	10%	1,161	2,175	n/a	14,762	150	0.0062	0.0012	150	0.15	0.37	151
Reister 1	Colusa	Electric	unknown	121	850	3%	340	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
Reister 2	Colusa	Electric	unknown	121	850	3%	340	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
Reister 3	Colusa	Electric	unknown	121	850	3%	340	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
Reister 4	Colusa	Electric	unknown	121	890	3%	356	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
Vann 1	Colusa	Diesel	unknown	121	1,500	5%	601	2,175	n/a	14,762	150	0.0062	0.0012	150	0.15	0.37	151
Vann 2	Colusa	Electric	unknown	121	3,500	12%	1,401	2,175	196,368	n/a	18	0.0030	0.0004	18	0.08	0.11	19
			Total		**28,220**	**100%**	**11,300**	**36,969**	**2,356,411**	**73,810**	**972**	**0.0671**	**0.0104**	**972**	**1.68**	**3.11**	**977**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

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

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Guisti Farms
Transfer Volume 1,000 acre-feet/year

Table F-10. Guisti Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	0	0	2	2
Total	0	0	0	2	2

Table F-11. Guisti Farms GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	GHG Emissions (MTCO2e per year) CO2	CH4	N2O	Total
Guisti Well 1	Sutter	Propane	2015	150	3,200	50%	500	849	n/a	7,141	449	0.0214	0.0043	449	0.54	1.28	451
Guisti Well 2	Sutter	Propane	2015	150	3,200	50%	500	849	n/a	7,141	449	0.0214	0.0043	449	0.54	1.28	451
			Total		**6,400**	**100%**	**1,000**	**1,697**	**0**	**14,282**	**898**	**0.0428**	**0.0086**	**898**	**1.07**	**2.55**	**902**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

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

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Henle Family LP
Transfer Volume 1,000 acre-feet/year

Table F-12. Henle Family LP Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	1	0	0	1
Total	0	1	0	0	1

Table F-13. Henle Family LP GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
Well #2	Sutter	Electric	unknown	125	3,200	100%	1,000	1,697	158,315	n/a	15	0.0024	0.0003	15	0.06	0.09	15
				Total	**3,200**	**100%**	**1,000**	**1,697**	**158,315**	**0**	**15**	**0.0024**	**0.0003**	**15**	**0.06**	**0.09**	**15**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Maxwell Irrigation District
Transfer Volume 3,000 acre-feet/year

Table F-14. Maxwell Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	2	0	0	0	2
Total	2	0	0	0	2

Table F-15. Maxwell Irrigation District GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
MainWell	Colusa	Diesel	2006	215	3,800	50%	1,500	2,144	n/a	25,857	263	0.0108	0.0022	263	0.27	0.64	264
TuttleWell	Colusa	Diesel	2006	215	3,800	50%	1,500	2,144	n/a	25,857	263	0.0108	0.0022	263	0.27	0.64	264
			Total		**7,600**	**100%**	**3,000**	**4,288**	**0**	**51,715**	**526**	**0.0216**	**0.0043**	**526**	**0.54**	**1.29**	**528**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

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

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Natomas Central Mutual Water Company
Transfer Volume 20,000 acre-feet/year

Table F-16. Natomas Central Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sacramento	6	10	0	0	16
Sutter	2	15	0	0	17
Total	8	25	0	0	33

Table F-17. Natomas Central Mutual Water Company GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating	Pump Rate		Transfer Volume	Operation		Fuel Consumption	GHG Emissions (tonnes per year)			GHG Emissions (MTCO2e per year)			
				(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
L-2	Sutter	Electric	unknown	30	1,900	3%	593	1,694	37,936	n/a	4	0.0006	0.0001	4	0.01	0.02	4
L-3	Sutter	Electric	unknown	125	1,300	2%	406	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
L-4	Sutter	Electric	unknown	125	1,300	2%	406	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
L-6	Sutter	Electric	unknown	125	2,000	3%	624	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
L-7	Sutter	Electric	unknown	125	1,200	2%	374	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
L-8	Sutter	Electric	unknown	125	2,800	4%	874	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
L-9	Sutter	Electric	unknown	125	1,500	2%	468	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
L-10	Sutter	Electric	unknown	125	1,000	2%	312	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
L-11	Sutter	Electric	unknown	125	1,500	2%	468	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
L-12	Sutter	Electric	unknown	125	1,500	2%	468	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
L-13 Bolen Pasture	Sutter	Diesel	unknown	170	2,800	4%	874	1,694	n/a	16,161	165	0.0067	0.0013	165	0.17	0.40	165
L-14 Chappell	Sutter	Electric	unknown	125	1,800	3%	562	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
MAP	Sacramento	Electric	unknown	125	2,000	3%	624	1,694	158,068	n/a	33	0.0024	0.0003	33	0.06	0.09	33
Ose-1	Sacramento	Diesel	2013	200	1,800	3%	562	1,694	n/a	19,013	194	0.0079	0.0016	194	0.20	0.47	194
Ose-2	Sacramento	Electric	unknown	150	2,400	4%	749	1,694	189,682	n/a	40	0.0029	0.0003	40	0.07	0.10	40
Perry	Sacramento	Electric	unknown	125	2,600	4%	811	1,694	158,068	n/a	33	0.0024	0.0003	33	0.06	0.09	33
Spangler	Sutter	Electric	unknown	80	2,500	4%	780	1,694	101,164	n/a	9	0.0016	0.0002	9	0.04	0.05	10
TNBC Frazer	Sutter	Electric	unknown	125	2,000	3%	624	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
TNBC Lucich North	Sutter	Diesel	unknown	170	2,500	4%	780	1,694	n/a	16,161	165	0.0067	0.0013	165	0.17	0.40	165
TNBC Bennett North	Sutter	Electric	unknown	125	2,200	3%	686	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
TNBC Atkinson	Sutter	Electric	unknown	125	1,800	3%	562	1,694	158,068	n/a	15	0.0024	0.0003	15	0.06	0.09	15
TNBC Fisherman's Lake	Sacramento	Electric	unknown	125	1,500	2%	468	1,694	158,068	n/a	33	0.0024	0.0003	33	0.06	0.09	33
TNBC Silva Dairy	Sacramento	Electric	unknown	125	1,000	2%	312	1,694	158,068	n/a	33	0.0024	0.0003	33	0.06	0.09	33
TNBC Betts	Sacramento	Electric	unknown	125	1,500	2%	468	1,694	158,068	n/a	33	0.0024	0.0003	33	0.06	0.09	33
Dhaliwal	Sacramento	Diesel	2013	180	3,000	5%	936	1,694	n/a	17,111	174	0.0071	0.0014	174	0.18	0.43	175
Willey	Sacramento	Diesel	2012	148	2,000	3%	624	1,694	n/a	14,069	143	0.0059	0.0012	143	0.15	0.35	144
Elkhorn	Sacramento	Electric	unknown	125	2,700	4%	842	1,694	158,068	n/a	33	0.0024	0.0003	33	0.06	0.09	33
Ameral	Sacramento	Diesel	unknown	170	1,500	2%	468	1,694	n/a	16,161	165	0.0067	0.0013	165	0.17	0.40	165
Kubo	Sacramento	Electric	unknown	125	1,300	2%	406	1,694	158,068	n/a	33	0.0024	0.0003	33	0.06	0.09	33
Greenbriar	Sacramento	Diesel	unknown	170	3,200	5%	998	1,694	n/a	16,161	165	0.0067	0.0013	165	0.17	0.40	165
Souza	Sacramento	Electric	unknown	125	1,200	2%	374	1,694	158,068	n/a	33	0.0024	0.0003	33	0.06	0.09	33
Plant 3	Sacramento	Diesel	unknown	170	2,500	4%	780	1,694	n/a	16,161	165	0.0067	0.0013	165	0.17	0.40	165
Pond R	Sacramento	Electric	unknown	125	2,300	4%	718	1,694	158,068	n/a	33	0.0024	0.0003	33	0.06	0.09	33
			Total		**64,100**	**100%**	**20,000**	**55,918**	**3,806,286**	**130,996**	**1,879**	**0**	**0**	**1,879**	**3**	**5**	**1,887**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend

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

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Pelger Mutual Water Company
Transfer Volume 4,670 acre-feet/year

Table F-18. Pelger Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	1	3	0	0	4
Total	1	3	0	0	4

Table F-19. Pelger Mutual Water Company GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
PMWC#1	Sutter	Electric	unknown	150	4,800	33%	1,546	1,749	195,796	n/a	18	0.0030	0.0004	18	0.08	0.11	19
Well 1 Tucker	Sutter	Electric	unknown	75	3,100	21%	998	1,749	97,898	n/a	9	0.0015	0.0002	9	0.04	0.05	9
Well 2 Flopet	Sutter	Diesel	2008	125	2,300	16%	741	1,749	n/a	12,266	125	0.0051	0.0010	125	0.13	0.30	125
Well 3 Klein	Sutter	Electric	unknown	150	4,300	30%	1,385	1,749	195,796	n/a	18	0.0030	0.0004	18	0.08	0.11	19
			Total	**14,500**	**100%**		**4,670**	**6,996**	**489,489**	**12,266**	**171**	**0.0127**	**0.0019**	**171**	**0.32**	**0.57**	**172**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Pelger Road 1700 LLC
Transfer Volume 5,200 acre-feet/year

Table F-20. Pelger Road 1700 LLC Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	4	0	0	4
Total	0	4	0	0	4

Table F-21. Pelger Road 1700 LLC GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
North Well	Sutter	Electric	unknown	125	3,500	28%	1,456	2,259	210,749	n/a	20	0.0033	0.0004	20	0.08	0.11	20
South Well	Sutter	Electric	unknown	125	3,000	24%	1,248	2,259	210,749	n/a	20	0.0033	0.0004	20	0.08	0.11	20
North Well B	Sutter	Electric	unknown	125	3,000	24%	1,248	2,259	210,749	n/a	20	0.0033	0.0004	20	0.08	0.11	20
South Well B	Sutter	Electric	unknown	125	3,000	24%	1,248	2,259	210,749	n/a	20	0.0033	0.0004	20	0.08	0.11	20
			Total		**12,500**	**100%**	**5,200**	**9,037**	**842,998**	**0**	**79**	**0.0130**	**0.0015**	**79**	**0.33**	**0.46**	**80**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

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

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Pleasant Grove-Verona Mutual Water Company
Transfer Volume 15,000 acre-feet/year

Table F-22. Pleasant Grove-Verona Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	13	20	0	3	36
Total	13	20	0	3	36

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

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
Kelly 190 Field Well #2	Sutter	Electric	unknown	30	2,100	3%	397	1,027	22,999	n/a	2	0.0004	0.0000	2	0.01	0.01	2
Kelly Windmill Field Well #2	Sutter	Electric	2002	62.1	2,000	3%	378	1,027	47,607	n/a	4	0.0007	0.0001	4	0.02	0.03	4
Kelly Windmill North Field Well	Sutter	Propane	2014	133	1,800	2%	340	1,027	n/a	347	22	0.0010	0.0002	22	0.03	0.06	22
Kelly306	Sutter	Electric	unknown	60	3,500	4%	662	1,027	45,997	n/a	4	0.0007	0.0001	4	0.02	0.02	4
MLF Clubhouse B Well	Sutter	Electric	unknown	300	3,600	5%	681	1,027	229,986	n/a	22	0.0035	0.0004	22	0.09	0.12	22
MLF Marsh Well	Sutter	Electric	unknown	300	3,200	4%	605	1,027	229,986	n/a	22	0.0035	0.0004	22	0.09	0.12	22
MLF Monster Well	Sutter	Electric	unknown	60	3,100	4%	586	1,027	45,997	n/a	4	0.0007	0.0001	4	0.02	0.02	4
MLF Well #1	Sutter	Electric	unknown	30	2,000	3%	378	1,027	22,999	n/a	2	0.0004	0.0000	2	0.01	0.01	2
MLF Well #16	Sutter	Electric	unknown	50	1,700	2%	322	1,027	38,331	n/a	4	0.0006	0.0001	4	0.01	0.02	4
MLF Well#11	Sutter	Diesel	2004	250	1,400	2%	265	1,027	n/a	14,408	147	0.0060	0.0012	147	0.15	0.36	147
MLF Well#12/17	Sutter	Electric	unknown	50	2,200	3%	416	1,027	38,331	n/a	4	0.0006	0.0001	4	0.01	0.02	4
MLF Well#13&#15	Sutter	Electric	2000	215	1,900	2%	359	1,027	164,824	n/a	15	0.0025	0.0003	15	0.06	0.09	16
MLF Well#2B	Sutter	Electric	2000	300	2,800	4%	530	1,027	229,986	n/a	22	0.0035	0.0004	22	0.09	0.12	22
Nicholas 72-Acre Field North	Sutter	Electric	unknown	40	1,700	2%	322	1,027	30,665	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Nicholas 72-Acre Field South	Sutter	Diesel	2002	62.1	2,000	3%	378	1,027	n/a	3,579	36	0.0015	0.0003	36	0.04	0.09	37
Nicholas BBC Well	Sutter	Electric	unknown	30	2,000	3%	378	1,027	22,999	n/a	2	0.0004	0.0000	2	0.01	0.01	2
Nicholas Filipino Camp South	Sutter	Diesel	2002	62.1	800	1%	151	1,027	n/a	3,579	36	0.0015	0.0003	36	0.04	0.09	37
Nicholas Filipino Camp#2	Sutter	Electric	unknown	40	2,300	3%	435	1,027	30,665	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Nicholas Johnston Field Well #2	Sutter	Electric	unknown	40	2,000	3%	378	1,027	30,665	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Nicholas Sand Field Well	Sutter	Diesel	2002	62.1	2,000	3%	378	1,027	n/a	3,579	36	0.0015	0.0003	36	0.04	0.09	37
RiverRanch#19	Sutter	Diesel	2008	99	2,500	3%	473	1,027	n/a	5,705	58	0.0024	0.0005	58	0.06	0.14	58
S&O#16	Sutter	Electric	2014	159	2,000	3%	378	1,027	121,893	n/a	11	0.0019	0.0002	11	0.05	0.07	12
S&O#17	Sutter	Diesel	1999	101	3,000	4%	567	1,027	n/a	5,821	59	0.0024	0.0005	59	0.06	0.14	59
S&O#18A	Sutter	Diesel	1999	101	1,800	2%	340	1,027	n/a	5,821	59	0.0024	0.0005	59	0.06	0.14	59
S&O#19	Sutter	Diesel	2007	215	1,800	2%	340	1,027	n/a	12,391	126	0.0052	0.0010	126	0.13	0.31	127
S&O#20	Sutter	Propane	2014	154	1,800	2%	340	1,027	n/a	402	25	0.0012	0.0002	25	0.03	0.07	25
Willey#1	Sutter	Diesel	2000	168	3,000	4%	567	1,027	n/a	9,682	99	0.0040	0.0008	99	0.10	0.24	99
Willey#2	Sutter	Diesel	unknown	250	3,000	4%	567	1,027	n/a	14,408	147	0.0060	0.0012	147	0.15	0.36	147
Willey#3	Sutter	Electric	unknown	75	1,800	2%	340	1,027	57,497	n/a	5	0.0009	0.0001	5	0.02	0.03	5
Willey#4	Sutter	Diesel	1974	150	2,000	3%	378	1,027	n/a	8,645	88	0.0036	0.0007	88	0.09	0.21	88
Willey#5	Sutter	Propane	unknown	180	2,000	3%	378	1,027	n/a	470	30	0.0014	0.0003	30	0.04	0.08	30
Will-Lee Well#30	Sutter	Diesel	2000	100	2,500	3%	473	1,027	n/a	5,763	59	0.0024	0.0005	59	0.06	0.14	59
Will-Lee Well#31	Sutter	Electric	unknown	50	1,500	2%	284	1,027	38,331	n/a	4	0.0006	0.0001	4	0.01	0.02	4
Will-Lee Well#32	Sutter	Electric	unknown	300	2,500	3%	473	1,027	229,986	n/a	22	0.0035	0.0004	22	0.09	0.12	22
Will-Lee Well#33	Sutter	Electric	unknown	75	2,500	3%	473	1,027	57,497	n/a	5	0.0009	0.0001	5	0.02	0.03	5
Will-Lee Well#4A	Sutter	Diesel	2000	160	1,500	2%	284	1,027	n/a	9,221	94	0.0038	0.0008	94	0.10	0.23	94
			Total		**79,300**	**100%**	**15,000**	**36,982**	**1,737,241**	**n/a**	**1,284**	**0.0732**	**0.0124**	**1,284**	**1.83**	**3.71**	**1,289**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Princeton-Codora-Glenn Irrigation District
Transfer Volume 6,600 acre-feet/year

Table F-24. Princeton-Codora-Glenn Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	7	3	0	0	10
Colusa	2	1	0	0	3
Total	9	4	0	0	13

Table F-25. Princeton-Codora-Glenn Irrigation District GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
Joel Mann	Glenn	Diesel	unknown	180	3,500	9%	585	907	n/a	9,163	93	0.0038	0.0008	93	0.10	0.23	94
D.Withrow	Glenn	Diesel	unknown	180	1,000	3%	167	907	n/a	9,163	93	0.0038	0.0008	93	0.10	0.23	94
Chrisman	Glenn	Diesel	unknown	180	2,000	5%	334	907	n/a	9,163	93	0.0038	0.0008	93	0.10	0.23	94
D.Schmidt	Glenn	Diesel	2013	180	3,000	8%	501	907	n/a	9,163	93	0.0038	0.0008	93	0.10	0.23	94
Argo B	Glenn	Diesel	unknown	200	3,000	8%	501	907	n/a	10,182	104	0.0042	0.0008	104	0.11	0.25	104
Argo C	Glenn	Diesel	unknown	200	3,000	8%	501	907	n/a	10,182	104	0.0042	0.0008	104	0.11	0.25	104
F. Gomes	Colusa	Diesel	unknown	180	2,500	6%	418	907	n/a	9,163	93	0.0038	0.0008	93	0.10	0.23	94
Jones Well	Glenn	Electric	2012	200	3,500	9%	585	907	135,438	n/a	13	0.0021	0.0002	13	0.05	0.07	13
M. Cota	Colusa	Diesel	unknown	180	3,000	8%	501	907	n/a	9,163	93	0.0038	0.0008	93	0.10	0.23	94
Zoller A	Glenn	Diesel	unknown	180	3,000	8%	501	907	n/a	9,163	93	0.0038	0.0008	93	0.10	0.23	94
Clark #1	Glenn	Electric	unknown	200	4,000	10%	668	907	135,438	n/a	13	0.0021	0.0002	13	0.05	0.07	13
Clark #2	Glenn	Electric	unknown	200	4,000	10%	668	907	135,438	n/a	13	0.0021	0.0002	13	0.05	0.07	13
J. Southam	Colusa	Electric	unknown	200	4,000	10%	668	907	135,438	n/a	13	0.0021	0.0002	13	0.05	0.07	13
			Total		**39,500**	**100%**	**6,600**	**11,797**	**541,751**	**84,507**	**911**	**0.0436**	**0.0080**	**911**	**1.09**	**2.39**	**914**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Provident Irrigation District
Transfer Volume 10,000 acre-feet/year

Table F-26. Provident Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	13	3	0	0	16
Colusa	0	0	0	0	0
Total	13	3	0	0	16

Table F-27. Provident Irrigation District GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
Weller62V	Glenn	Diesel	unknown	200	2,000	4%	400	1,086	n/a	12,187	124	0.0051	0.0010	124	0.13	0.30	124
L Hansen#1	Glenn	Diesel	unknown	200	3,800	8%	760	1,086	n/a	12,187	124	0.0051	0.0010	124	0.13	0.30	124
L Hansen#2	Glenn	Diesel	unknown	200	4,500	9%	900	1,086	n/a	12,187	124	0.0051	0.0010	124	0.13	0.30	124
K Hansen#1	Glenn	Diesel	unknown	200	2,600	5%	520	1,086	n/a	12,187	124	0.0051	0.0010	124	0.13	0.30	124
K Hansen#2	Glenn	Electric	unknown	120	3,500	7%	700	1,086	97,269	n/a	9	0.0015	0.0002	9	0.04	0.05	9
E Weller	Glenn	Diesel	unknown	200	2,500	5%	500	1,086	n/a	12,187	124	0.0051	0.0010	124	0.13	0.30	124
Weller#4	Glenn	Electric	unknown	120	3,500	7%	700	1,086	97,269	n/a	9	0.0015	0.0002	9	0.04	0.05	9
Calvert	Glenn	Diesel	unknown	150	3,000	6%	600	1,086	n/a	9,140	93	0.0038	0.0008	93	0.10	0.23	93
D. Alves	Glenn	Diesel	unknown	165	3,000	6%	600	1,086	n/a	10,054	102	0.0042	0.0008	102	0.10	0.25	103
D. Kennedy	Glenn	Electric	unknown	120	3,000	6%	600	1,086	97,269	n/a	9	0.0015	0.0002	9	0.04	0.05	9
G. Clark #1	Glenn	Diesel	unknown	200	3,000	6%	600	1,086	n/a	12,187	124	0.0051	0.0010	124	0.13	0.30	124
M. Jones #1	Glenn	Diesel	unknown	275	3,000	6%	600	1,086	n/a	16,757	171	0.0070	0.0014	171	0.17	0.42	171
M. Jones #2	Glenn	Diesel	unknown	250	3,000	6%	600	1,086	n/a	15,234	155	0.0064	0.0013	155	0.16	0.38	156
Perez and Perez	Glenn	Diesel	unknown	200	3,200	6%	640	1,086	n/a	12,187	124	0.0051	0.0010	124	0.13	0.30	124
S. Jones #1	Glenn	Diesel	unknown	170	3,200	6%	640	1,086	n/a	10,359	105	0.0043	0.0009	105	0.11	0.26	106
S. Jones #2	Glenn	Diesel	unknown	170	3,200	6%	640	1,086	n/a	10,359	105	0.0043	0.0009	105	0.11	0.26	106
			Total		**50,000**	**100%**	**10,000**	**17,379**	**291,807**	**157,213**	**1,628**	**0.0701**	**0.0136**	**1,628**	**1.75**	**4.07**	**1,634**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Reclamation District 108
Transfer Volume 15,000 acre-feet/year

Table F-28. Reclamation District 108 Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	3	0	0	3
Yolo	0	2	0	0	2
Total	0	5	0	0	5

Table F-29. Reclamation District 108 GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
Well #4 Huff	Colusa	Electric	unknown	250	1,420	8%	1,160	4,437	827,793	n/a	77	0.0128	0.0015	77	0.32	0.45	78
Well #5 RiggsRanch	Colusa	Electric	unknown	150	5,450	30%	4,453	4,437	496,676	n/a	46	0.0077	0.0009	46	0.19	0.27	47
Well #6 CountyLine	Yolo	Electric	unknown	250	3,840	21%	3,137	4,437	827,793	n/a	77	0.0128	0.0015	77	0.32	0.45	78
Well#1 Heidrick	Colusa	Electric	unknown	100	3,600	20%	2,941	4,437	331,117	n/a	31	0.0051	0.0006	31	0.13	0.18	31
Well#7 Tract 6	Yolo	Electric	unknown	250	4,050	22%	3,309	4,437	827,793	n/a	77	0.0128	0.0015	77	0.32	0.45	78
			Total		**18,360**	**100%**	**15,000**	**22,185**	**3,311,171**	**0**	**310**	**0.0511**	**0.0060**	**310**	**1.28**	**1.79**	**313**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency: Reclamation District 1004
Transfer Volume: 7,175 acre-feet/year

Table F-30. Reclamation District 1004 Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	1	7	0	0	8
Colusa	17	5	0	0	22
Sutter	0	0	0	0	0
Total	18	12	0	0	30

Table F-31. Reclamation District 1004 GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
Barale Well	Colusa	Diesel	TBD	225	4,000	4%	285	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Behring Ranch 10 Field Well No. 496441	Colusa	Diesel	2008	225	5,800	6%	413	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Behring Ranch Club House Well No.496461	Colusa	Electric	unknown	125	3,400	3%	242	387	36,061	n/a	3	0.0006	0.0001	3	0.01	0.02	3
Behring Ranch Nursery Well No. 17N1W10H1	Colusa	Diesel	TBD	225	1,000	1%	71	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Behring Ranch Pearl Well No. 20094	Colusa	Diesel	TBD	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Behring Ranch West Well No.97863	Colusa	Electric	unknown	125	2,300	2%	164	387	36,061	n/a	3	0.0006	0.0001	3	0.01	0.02	3
Drumheller Well No.7	Colusa	Diesel	TBD	225	4,000	4%	285	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
East Morgan Well #1 No. 374667 17N01W14N001M	Colusa	Diesel	TBD	225	2,600	3%	185	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
East Morgan Well#2 No. 498195 17N01W15Q001M	Colusa	Diesel	TBD	225	1,300	1%	93	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Gardener No. 374672	Colusa	Diesel	2008	215	3,500	3%	249	387	n/a	4,663	47	0.0019	0.0004	47	0.05	0.12	48
Gardener No. 498178	Colusa	Diesel	2009	215	3,500	3%	249	387	n/a	4,663	47	0.0019	0.0004	47	0.05	0.12	48
Hall Well No. X	Glenn	Electric	TBD	125	4,500	4%	320	387	36,061	n/a	3	0.0006	0.0001	3	0.01	0.02	3
Hall Well No.369428	Glenn	Electric	2011	125	4,500	4%	320	387	36,061	n/a	3	0.0006	0.0001	3	0.01	0.02	3
Mohammad No.e0084085 17N01W02D001M	Colusa	Electric	TBD	125	4,500	4%	320	387	36,061	n/a	3	0.0006	0.0001	3	0.01	0.02	3
Myers Well #1 No.3457	Glenn	Electric	2006	40	2,200	2%	157	387	11,539	n/a	1	0.0002	0.0000	1	0.00	0.01	1
Myers Well #2 No. 340884	Glenn	Electric	1982	100	4,100	4%	292	387	28,849	n/a	3	0.0004	0.0001	3	0.01	0.02	3
Rancho Caleta No. 726883	Colusa	Diesel	2004	170	4,500	4%	320	387	n/a	3,687	38	0.0015	0.0003	38	0.04	0.09	38
Sikes & Parachini Well #1 WS No.93124	Colusa	Diesel	2006	173	4,000	4%	285	387	n/a	3,752	38	0.0016	0.0003	38	0.04	0.09	38
Sikes & Parachini Well #2 WS No. 374682	Colusa	Diesel	2008	150	4,000	4%	285	387	n/a	3,253	33	0.0014	0.0003	33	0.03	0.08	33
Southam Sartain Well 18N01W26D001M	Glenn	Diesel	TBD	225	4,800	5%	342	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Stone Well #6 No.11334	Colusa	Electric	2006	40	1,800	2%	128	387	11,539	n/a	1	0.0002	0.0000	1	0.00	0.01	1
Wilder Farms Well	Glenn	Electric	unknown	125	2,500	2%	178	387	36,061	n/a	3	0.0006	0.0001	3	0.01	0.02	3
Dan Charter Well#1	Colusa	Diesel	unknown	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Dan Charter Well#2	Colusa	Diesel	unknown	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
GVL Well#1	Colusa	Diesel	unknown	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Behring Ranch Well	Colusa	Electric	unknown	125	4,000	4%	285	387	36,061	n/a	3	0.0006	0.0001	3	0.01	0.02	3
Claudia Charter	Colusa	Diesel	unknown	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
GVL Well#2	Colusa	Diesel	unknown	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Glenn West	Glenn	Electric	unknown	125	4,500	4%	320	387	36,061	n/a	3	0.0006	0.0001	3	0.01	0.02	3
Glenn East	Glenn	Electric	unknown	125	4,500	4%	320	387	36,061	n/a	3	0.0006	0.0001	3	0.01	0.02	3
			Total		**100,800**	**100%**	**7,175**	**11,597**	**376,474**	**83,452**	**885**	**0.041**	**0.008**	**885**	**1.02**	**2.28**	**888**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency River Garden Farms
Transfer Volume 10,000 acre-feet/year

Table F-32. River Garden Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Yolo	0	9	0	0	9
Total	0	9	0	0	9

Table F-33. River Garden Farms GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
Field 65 PW	Yolo	Electric	2008	125	3,200	12%	1,220	2,070	193,068	n/a	18	0.0030	0.0004	18	0.07	0.10	18
Field 71 PW	Yolo	Electric	2001	125	2,200	8%	838	2,070	193,068	n/a	18	0.0030	0.0004	18	0.07	0.10	18
Field 98 PW	Yolo	Electric	1963	125	3,177	12%	1,211	2,070	193,068	n/a	18	0.0030	0.0004	18	0.07	0.10	18
Field 104 PW	Yolo	Electric	2008	125	2,800	11%	1,067	2,070	193,068	n/a	18	0.0030	0.0004	18	0.07	0.10	18
Field 104-09 PW	Yolo	Electric	2009	125	3,276	12%	1,248	2,070	193,068	n/a	18	0.0030	0.0004	18	0.07	0.10	18
Field 93 PW	Yolo	Electric	unknown	125	2,200	8%	838	2,070	193,068	n/a	18	0.0030	0.0004	18	0.07	0.10	18
Field 91-09 PW	Yolo	Electric	2009	125	3,300	13%	1,258	2,070	193,068	n/a	18	0.0030	0.0004	18	0.07	0.10	18
Field 117 PW	Yolo	Electric	2009	125	2,800	11%	1,067	2,070	193,068	n/a	18	0.0030	0.0004	18	0.07	0.10	18
Shop PW	Yolo	Electric	2009	125	3,287	13%	1,253	2,070	193,068	n/a	18	0.0030	0.0004	18	0.07	0.10	18
			Total		**26,240**	**100%**	**10,000**	**18,627**	**1,737,608**	**0**	**163**	**0.0268**	**0.0032**	**163**	**0.67**	**0.94**	**164**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend

	Information on engine not available; engine assumed to be electric based on other engines used by water agency.
	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Sutter Mutual Water Company
Transfer Volume 18,000 acre-feet/year

Table F-34. Sutter Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	13	10	0	8	31
Total	13	10	0	8	31

Table F-35. Sutter Mutual Water Company GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
G-16	Sutter	Electric	unknown	125	4,200	4%	751	971	90,556	n/a	8	0.0014	0.0002	8	0.03	0.05	9
QHR	Sutter	Propane	unknown	180	5,200	5%	929	971	n/a	9,803	0	0.0000	0.0000	0	0.00	0.00	0
MB-1	Sutter	Propane	unknown	180	5,300	5%	947	971	n/a	9,803	0	0.0000	0.0000	0	0.00	0.00	0
LM-53	Sutter	Electric	unknown	125	4,000	4%	715	971	90,556	n/a	8	0.0014	0.0002	8	0.03	0.05	9
BD-1	Sutter	Diesel	unknown	170	2,500	2%	447	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
L1-1	Sutter	Diesel	unknown	170	4,000	4%	715	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
L1-2	Sutter	Diesel	unknown	170	5,000	5%	894	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
L2-1	Sutter	Diesel	unknown	170	5,500	5%	983	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
LM-11	Sutter	Electric	unknown	125	3,100	3%	554	971	90,556	n/a	8	0.0014	0.0002	8	0.03	0.05	9
S-18	Sutter	Electric	unknown	125	2,700	3%	483	971	90,556	n/a	8	0.0014	0.0002	8	0.03	0.05	9
BD-2	Sutter	Diesel	unknown	170	4,000	4%	715	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
BD-3	Sutter	Propane	unknown	180	3,000	3%	536	971	n/a	9,803	0	0.0000	0.0000	0	0.00	0.00	0
FG	Sutter	Propane	unknown	180	1,500	1%	268	971	n/a	9,803	0	0.0000	0.0000	0	0.00	0.00	0
H-1	Sutter	Electric	unknown	125	2,600	3%	465	971	90,556	n/a	8	0.0014	0.0002	8	0.03	0.05	9
R-29	Sutter	Diesel	unknown	170	2,500	2%	447	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
TVN	Sutter	Electric	unknown	125	3,000	3%	536	971	90,556	n/a	8	0.0014	0.0002	8	0.03	0.05	9
DB-1	Sutter	Diesel	unknown	170	4,500	4%	804	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
ME-1	Sutter	Diesel	unknown	170	1,300	1%	232	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
R-24	Sutter	Diesel	unknown	170	2,500	2%	447	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
G-2	Sutter	Propane	unknown	180	3,500	3%	626	971	n/a	9,803	0	0.0000	0.0000	0	0.00	0.00	0
Hoppin	Sutter	Electric	unknown	125	2,500	2%	447	971	90,556	n/a	8	0.0014	0.0002	8	0.03	0.05	9
Industries - Sioux Cre	Sutter	Diesel	unknown	170	2,800	3%	500	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
Industries - Sutter Ba	Sutter	Diesel	unknown	170	3,000	3%	536	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
TVN proposed well	Sutter	Propane	unknown	180	5,000	5%	894	971	n/a	9,803	0	0.0000	0.0000	0	0.00	0.00	0
Driver proposed well	Sutter	Diesel	unknown	170	2,500	2%	447	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
Well #1	Sutter	Electric	unknown	250	2,500	2%	447	971	181,112	n/a	17	0.0028	0.0003	17	0.07	0.10	17
Well #2	Sutter	Electric	unknown	150	2,500	2%	447	971	108,667	n/a	10	0.0017	0.0002	10	0.04	0.06	10
Well #3	Sutter	Electric	unknown	150	2,500	2%	447	971	108,667	n/a	10	0.0017	0.0002	10	0.04	0.06	10
Well #4	Sutter	Propane	unknown	150	2,500	2%	447	971	n/a	8,169	0	0.0000	0.0000	0	0.00	0.00	0
Well #5	Sutter	Propane	unknown	180	2,500	2%	447	971	n/a	9,803	0	0.0000	0.0000	0	0.00	0.00	0
Well #6	Sutter	Diesel	unknown	170	2,500	2%	447	971	n/a	9,258	0	0.0000	0.0000	0	0.00	0.00	0
			Total	**100,700**	**100%**	**18,000**	**30,093**	**1,032,336**	**197,147**	**97**	**0.0159**	**0.0019**	**97**	**0.40**	**0.56**	**98**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

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

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Sycamore Mutual Water Company
Transfer Volume 8,000 acre-feet/year

Table F-36. Sycamore Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	5	0	0	5
Total	0	5	0	0	5

Table F-37. Sycamore Mutual Water Company GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
Well #15	Colusa	Electric	unknown	125	3,270	15%	1,183	1,966	183,356	n/a	17	0.0028	0.0003	17	0.07	0.10	17
Well #14	Colusa	Electric	unknown	125	3,270	15%	1,183	1,966	183,356	n/a	17	0.0028	0.0003	17	0.07	0.10	17
Well #11	Colusa	Electric	unknown	125	6,409	29%	2,320	1,966	183,356	n/a	17	0.0028	0.0003	17	0.07	0.10	17
Well #2b	Colusa	Electric	unknown	125	4,578	21%	1,657	1,966	183,356	n/a	17	0.0028	0.0003	17	0.07	0.10	17
Well #2a	Colusa	Electric	unknown	125	4,578	21%	1,657	1,966	183,356	n/a	17	0.0028	0.0003	17	0.07	0.10	17
			Total		**22,104**	**100%**	**8,000**	**9,828**	**916,778**	**0**	**86**	**0.0141**	**0.0017**	**86**	**0.35**	**0.50**	**87**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

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

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency T&P Farms
Transfer Volume 1,200 acre-feet/year

Table F-38. T&P Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	2	0	0	2
Total	0	2	0	0	2

Table F-39. T&P Farms GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
NW-1	Colusa	Electric	unknown	125	3,500	58%	700	1,086	101,322	n/a	9	0.0016	0.0002	9	0.04	0.05	10
NW-2	Colusa	Electric	unknown	75	2,500	42%	500	1,086	60,793	n/a	6	0.0009	0.0001	6	0.02	0.03	6
			Total	**6,000**	**100%**	**1,200**	**2,172**	**162,115**	**0**	**15**	**0.0025**	**0.0003**	**15**	**0.06**	**0.09**	**15**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

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

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

Legend

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Te Velde Revocable Family Trust
Transfer Volume 7,094 acre-feet/year

Table F-40. Te Velde Revocable Family Trust Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Yolo	0	4	0	0	4
Total	0	4	0	0	4

Table F-41. Te Velde Revocable Family Trust GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
GW1	Yolo	Electric	unknown	127	4,200	35%	2,507	3,242	307,278	n/a	29	0.0047	0.0006	29	0.12	0.17	29
GW10	Yolo	Electric	unknown	143	2,833	24%	1,691	3,242	345,990	n/a	32	0.0053	0.0006	32	0.13	0.19	33
GW4	Yolo	Electric	unknown	125	2,600	22%	1,552	3,242	302,439	n/a	28	0.0047	0.0005	28	0.12	0.16	29
GW11	Yolo	Electric	unknown	143	2,250	19%	1,343	3,242	345,990	n/a	32	0.0053	0.0006	32	0.13	0.19	33
			Total	**11,883**	**100%**	**7,094**	**12,969**	**1,301,698**	**0**	**122**	**0.0201**	**0.0024**	**122**	**0.50**	**0.70**	**123**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

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

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Windswept Land & Livestock
Transfer Volume 2,000 acre-feet/year

Table F-42. Windswept Land & Livestock Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	4	0	0	4
Total	0	4	0	0	4

Table F-43. Windswept Land & Livestock GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	(MTCO2e per year) CO2	CH4	N2O	Total
Ag Well #1	Sutter	Electric	2013	200	3,200	34%	681	1,156	172,463	n/a	16	0.0027	0.0003	16	0.07	0.09	16
Ag Well #2	Sutter	Electric	unknown	200	1,700	18%	362	1,156	172,463	n/a	16	0.0027	0.0003	16	0.07	0.09	16
Ag Well #3	Sutter	Electric	unknown	200	2,500	27%	532	1,156	172,463	n/a	16	0.0027	0.0003	16	0.07	0.09	16
Ag Well #4	Sutter	Electric	unknown	200	2,000	21%	426	1,156	172,463	n/a	16	0.0027	0.0003	16	0.07	0.09	16
			Total	**9,400**	**100%**	**2,000**	**4,622**	**689,851**	**0**	**65**	**0.0106**	**0.0013**	**65**	**0.27**	**0.37**	**65**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

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

Conversion Factors

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

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

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

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

Engine Size Summary

Table F-44. Engine Power Rating Summary by Fuel Type

Fuel Type	No. Engines	Avg. HP	Max HP	Min HP
Diesel	23	170	250	60
Electric	47	125	300	30
Natural Gas	0	n/a	0	0
Propane	3	180	250	135

GHG Emission Factors

Table F-45. GHG Emission Factors for Electric Pumps

County	Utility Company	Emission Factors		
		CO2 (lbs/MWh)	CH4 (lbs/GWh)	N2O (lbs/GWh)
Colusa	Pacific Gas & Electric	206.29	34.0	4.0
Glenn	Pacific Gas & Electric	206.29	34.0	4.0
Sacramento	Sacramento Municipal Utility District	465.17	34.0	4.0
Shasta	Pacific Gas & Electric	206.29	34.0	4.0
Sutter	Pacific Gas & Electric	206.29	34.0	4.0
Tehama	Pacific Gas & Electric	206.29	34.0	4.0
Yolo	Pacific Gas & Electric	206.29	34.0	4.0

Table F-46. Utility-Specific CO2 Emission Factors

2017 Emission Rates		
Utility	Factor Type	Emission Factor (lbs CO_2/MWh)
Sacramento Municipal Utility District	Retail Power	465.17
	Special Power	0.00
	Wholesale Power	590.84
Pacific Gas & Electric	System average	206.29

Source:

The Climate Registry. 2020. Utility-Specific Emission Factors. Accessed on: December 11, 2020. Available at: https://www.theclimateregistry.org/our-members/cris-public-reports/

Table F-47. Diesel Emission Factors

Pollutant	Emission Factor	Unit	Emission Factor Description
CO2	10.18	kg/gallon	Table 1.1, Distillate Fuel Oil No. 2
CH4	3.00E-03	kg/MMBtu	Table 1.9, Petroleum Products, Industrial
N2O	6.00E-04	kg/MMBtu	Table 1.9, Petroleum Products, Industrial
Heat Content	0.139	MMBtu/gallon	Table 1.1, Distillate Fuel Oil No. 2

Source: The Climate Registry. 2020. 2020 Climate Registry Default Emission Factors. Accessed on: December 11, 2020. Available at: https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf

Table F-48. Natural Gas Emission Factors

Pollutant	Emission Factor	Unit	Emission Factor Description
CO2	53.06	kg/MMBtu	Table 1.1, US Weighted Average
CH4	1.00E-03	kg/MMBtu	Table 1.9, Natural Gas, Industrial
N2O	1.00E-04	kg/MMBtu	Table 1.9, Natural Gas, Industrial
Heat Content	1,026	Btu/scf	Table 1.1, US Weighted Average

Source: The Climate Registry. 2020. 2020 Climate Registry Default Emission Factors. Accessed on: December 11, 2020. Available at: https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf

Table F-49. Propane Emission Factors

Pollutant	Emission Factor	Unit	Emission Factor Description
CO2	62.87	kg/MMBtu	Table 1.1, Propane (liquid)
CH4	3.00E-03	kg/MMBtu	Table 1.9, Petroleum Products, Industrial
N2O	6.00E-04	kg/MMBtu	Table 1.9, Petroleum Products, Industrial
Heat Content	0.091	MMBtu/gal	Table 1.1, Propane (liquid)

Source: The Climate Registry. 2020. 2020 Climate Registry Default Emission Factors. Accessed on: December 11, 2020. Available at: https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf

Table 50. Subregion Output Emission Rates (eGRID2018)

		Total output emission rate (lb/MWh)							Non-baseload output emission rates (lb/MWh)							
eGRID subregion acronym	eGRID subregion name	CO2	CH4	N2O	CO2e	Annual NOx	Ozone Season NOx	SO2	CO2	CH4	N2O	CO2e	Annual NOx	Ozone Season NOx	SO2	Grid Gross Loss (%)
AKGD	ASCC Alaska Grid	1,039.6	0.082	0.011	1,045.0	5.5	5.4	1.1	1,262.5	0.110	0.015	1,269.6	6.5	6.4	1.1	5.12%
AKMS	ASCC Miscellaneous	525.1	0.024	0.004	527.0	7.7	7.8	0.7	1,528.3	0.068	0.012	1,533.6	22.8	23.0	2.0	5.12%
AZNM	WECC Southwest	1,022.4	0.077	0.011	1,027.5	0.7	0.7	0.3	1,435.3	0.097	0.014	1,441.8	1.0	0.9	0.3	4.80%
CAMX	WECC California	496.5	0.034	0.004	498.7	0.5	0.4	0.0	929.5	0.047	0.006	932.5	0.8	0.7	0.0	4.80%
ERCT	ERCOT All	931.7	0.066	0.009	936.1	0.5	0.6	0.8	1,261.0	0.083	0.012	1,266.5	0.8	0.8	1.1	4.87%
FRCC	FRCC All	931.8	0.066	0.009	936.1	0.4	0.4	0.3	1,123.9	0.068	0.009	1,128.3	0.4	0.4	0.4	4.88%
HIMS	HICC Miscellaneous	1,110.7	0.118	0.018	1,119.1	7.6	7.6	4.0	1,535.7	0.139	0.022	1,545.8	11.8	11.5	5.0	5.14%
HIOA	HICC Oahu	1,669.9	0.180	0.027	1,682.6	3.5	3.8	8.0	1,682.1	0.159	0.025	1,693.6	4.2	4.2	8.4	5.14%
MROE	MRO East	1,678.0	0.169	0.025	1,689.7	0.9	0.9	0.9	1,634.3	0.149	0.022	1,644.5	0.9	1.0	1.0	4.88%
MROW	MRO West	1,239.8	0.138	0.020	1,249.2	1.0	1.0	1.4	1,764.3	0.192	0.027	1,777.0	1.5	1.4	1.8	4.88%
NEWE	NPCC New England	522.3	0.082	0.011	527.6	0.4	0.4	0.1	931.0	0.086	0.011	936.5	0.5	0.4	0.3	4.88%
NWPP	WECC Northwest	639.0	0.064	0.009	643.4	0.6	0.6	0.4	1,575.1	0.148	0.021	1,585.2	1.4	1.4	0.8	4.80%
NYCW	NPCC NYC/Westchester	596.4	0.022	0.003	597.8	0.3	0.2	0.0	1,067.6	0.022	0.002	1,068.9	0.5	0.5	0.1	4.88%
NYLI	NPCC Long Island	1,184.2	0.139	0.018	1,193.1	0.9	0.8	0.2	1,320.3	0.040	0.005	1,322.8	1.0	0.9	0.4	4.88%
NYUP	NPCC Upstate NY	253.1	0.018	0.002	253.9	0.1	0.1	0.1	931.5	0.043	0.005	934.0	0.5	0.5	0.5	4.88%
RFCE	RFC East	716.0	0.061	0.008	720.0	0.3	0.3	0.5	1,242.6	0.091	0.013	1,248.6	0.7	0.6	0.8	4.88%
RFCM	RFC Michigan	1,312.6	0.129	0.018	1,321.2	0.8	0.8	1.3	1,748.9	0.171	0.024	1,760.3	1.2	1.2	2.1	4.88%
RFCW	RFC West	1,166.1	0.117	0.017	1,174.0	0.8	0.7	0.9	1,828.3	0.179	0.026	1,840.5	1.4	1.1	1.4	4.88%
RMPA	WECC Rockies	1,273.6	0.123	0.018	1,281.9	0.7	0.7	0.4	1,542.6	0.120	0.017	1,550.7	0.8	0.8	0.4	4.80%
SPNO	SPP North	1,163.2	0.124	0.018	1,171.6	0.6	0.7	0.3	1,945.5	0.201	0.029	1,959.2	1.2	1.3	0.7	4.88%
SPSO	SPP South	1,166.6	0.091	0.013	1,172.8	0.8	0.9	1.2	1,603.5	0.118	0.017	1,611.5	1.3	1.3	1.9	4.88%
SRMV	SERC Mississippi Valley	854.6	0.055	0.008	858.4	0.6	0.7	1.0	1,137.6	0.069	0.010	1,142.2	0.9	0.9	1.4	4.88%
SRMW	SERC Midwest	1,664.2	0.185	0.027	1,676.8	1.1	0.8	2.5	1,907.0	0.204	0.030	1,920.9	1.1	0.9	2.7	4.88%
SRSO	SERC South	1,027.9	0.081	0.012	1,033.5	0.5	0.4	0.3	1,413.7	0.107	0.015	1,420.9	0.8	0.7	0.5	4.88%
SRTV	SERC Tennessee Valley	1,031.5	0.097	0.014	1,038.1	0.6	0.5	0.6	1,644.3	0.149	0.021	1,654.4	0.8	0.8	0.9	4.88%
SRVC	SERC Virginia/Carolina	743.3	0.067	0.009	747.5	0.4	0.4	0.3	1,422.6	0.128	0.018	1,430.9	0.9	0.8	0.5	4.88%

Source: U.S. Environmental Protection Agency. 2020. eGRID20186, Summary Tables. March 9. Available online at: https://www.epa.gov/sites/production/files/2020-01/documents/egrid2018_summary_tables.pdf [Accessed on December 11, 2020].

Table F-51. Reduced Exhaust Emissions from Cropland Idling

Water Agency	Groundwater Substitution	Cropland Idling/ Crop Shifting	GW Pumping Equivalent	Annual Emission (MT/year)			Annual Emissions (MTCO2e/year)			
	(acre-feet/year)	(acre-feet/year)	(acre-feet/year)	CO2	CH4	N2O	CO2	CH4	N2O	Total
Anderson-Cottonwood Irrigation District	4,800	--	--	--	--	--	--	--	--	--
Baber, Jack et al.	--	2,310	544	524	0	0	524	1	1	526
Canal Farms	1,000	635	149	144	0	0	144	0	0	144
Conaway Preservation Group	--	21,350	5,024	4,843	0	0	4,843	5	12	4,860
Pelger Road 1700 LLC	5,200	--	--	--	--	--	--	--	--	--
Eastside Mutual Water Company	2,230	1,846	434	418	0	0	418	0	1	420
Guisti Farms	1,000	--	--	--	--	--	--	--	--	--
Glenn-Colusa Irrigation District	11,300	33,000	7,765	7,485	0	0	7,485	8	18	7,511
Henle Family LP	700	--	--	--	--	--	--	--	--	--
Maxwell Irrigation District	3,000	2,003	471	454	0	0	454	0	1	456
Natomas Central Mutual Water Company	20,000	--	--	--	--	--	--	--	--	--
Pelger Mutual Water Company	4,670	2,538	597	575	0	0	575	1	1	577
Pleasant Grove-Verona Mutual Water Company	15,000	9,000	2,118	2,042	0	0	2,042	2	5	2,049
Princeton-Codora-Glenn Irrigation District	6,600	6,600	1,553	1,497	0	0	1,497	2	4	1,502
Provident Irrigation District	10,000	9,900	2,329	2,245	0	0	2,245	2	5	2,253
Reclamation District 108	15,000	20,000	4,706	4,536	0	0	4,536	5	11	4,552
Reclamation District 1004	7,175	20,000	4,706	4,536	0	0	4,536	5	11	4,552
River Garden Farms	10,000	10,000	2,353	2,268	0	0	2,268	2	6	2,276
Sutter Mutual Water Company	18,000	18,000	4,235	4,082	0	0	4,082	4	10	4,096
Sycamore Mutual Water Company	8,000	7,000	1,647	1,588	0	0	1,588	2	4	1,593
T&P Farms	1,200	890	209	201	0	0	201	0	0	202
Te Velde Revocable Family Trust	7,094	6,975	1,641	1,582	0	0	1,582	2	4	1,587
Windswept Land & Livestock	2,000	--	--	--	--	--	--	--	--	--
Total	**153,969**	**172,047**	**40,481**	**39,020**	**1.60**	**0.32**	**39,020**	**40**	**95**	**39,156**

Notes:
Eastside Mutual Water Company used to estimate emissions for other water agencies.
Engine power rating equal to 150 hp and 225 hp for Eastside MWC engines.
The Byron Buck memo is based on diesel-fueled engines with sizes ranging from 121 to 225 hp; all engines are noncertified (Tier 0).
Eastside MWC engines are therefore determined to be a sufficient proxy to estimate the difference in emissions between groundwater substitution and cropland idling.

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

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

Appendix G

Giant Garter Snake Important Populations Maps

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2021 Tehama-Colusa Canal Authority Water Transfers Initial Study/ Environmental Assessment

Appendix G: Giant Garter Snake Important Population Maps

IMPORTANT GIANT GARTER SNAKE POPULATIONS

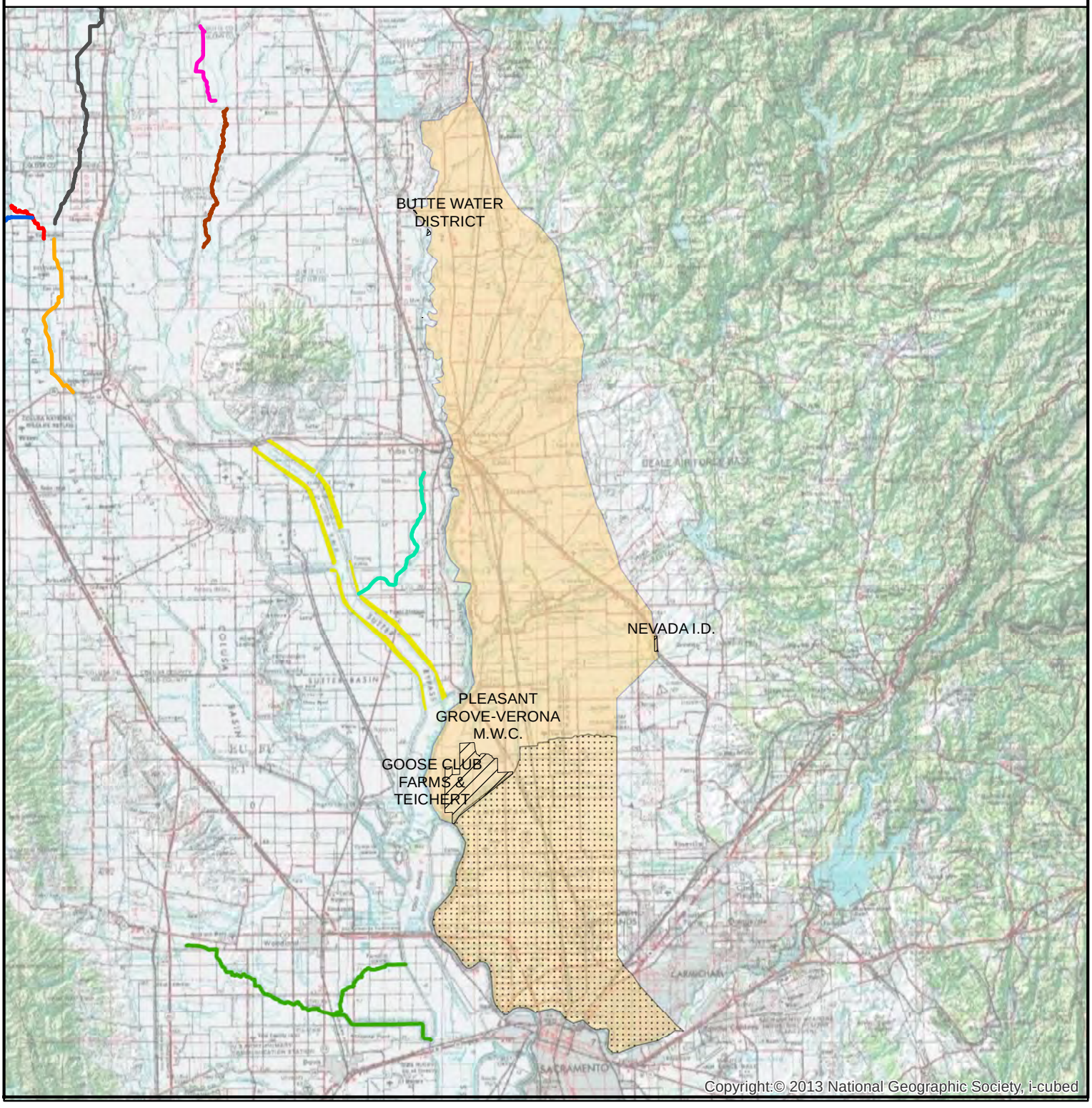
American Basin Recovery Unit

- Seller Areas in American Basin
- American Basin (376,104 acres)
- Butte Creek Selection
- Colusa Basin Drainage Canal Selection
- Colusa Drainage Canal
- Gilsizer Slough
- Hunters Creek Selection
- Logan Creek Selection
- Little Butte Creek
- Natomas Basin
- Sutter Bypass Toe Drain
- Willow Slough & Bypass

SELLER AREAS IN AMERICAN BASIN (acres)	
BUTTE WATER DISTRICT	55
GOOSE CLUB FARMS & TEICHERT	4
NEVADA IRRIGATION DISTRICT	132
PLEASANT-GROVE-VERONA MUTUAL WATER COMPANY	7429

Datum: NAD 1983

0 2.75 5.5 11 Miles



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IMPORTANT GIANT GARTER SNAKE POPULATIONS

Butte Basin Recovery Unit

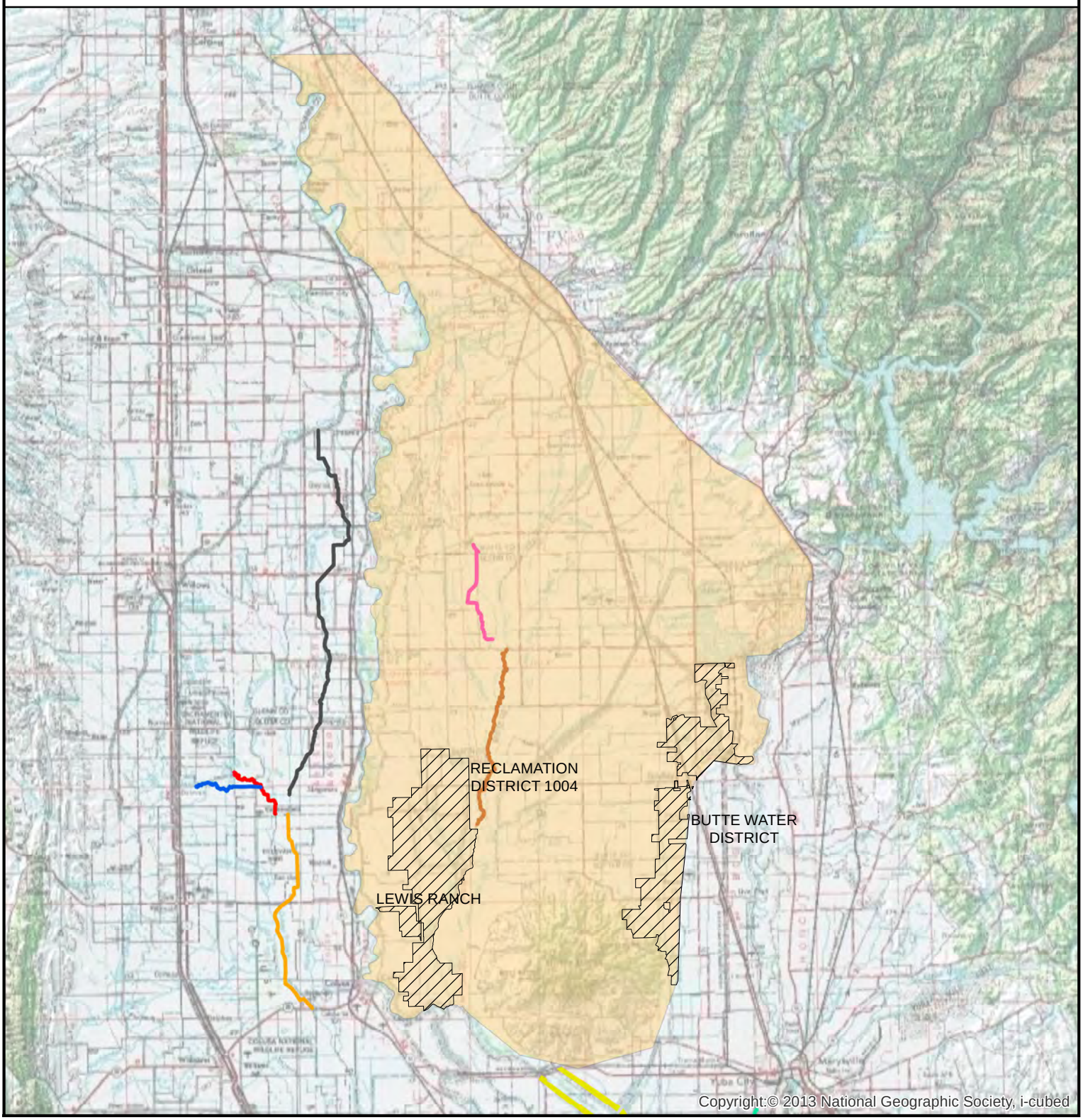
N

- Seller Areas in Butte Basin
- Butte Basin (479,117 acres)
- Butte Creek Selection
- Colusa Basin Drainage Canal Selection
- Colusa Drainage Canal
- Gilsizer Slough
- Hunters Creek Selection
- Little Butte Creek
- Logan Creek Selection
- Natomas Basin
- Willow Slough & Bypass
- Sutter Bypass Toe Drain

SELLER AREAS IN BUTTE BASIN (acres)	
BUTTE WATER DISTRICT	17656
LEWIS RANCH	1172
RECLAMATION DISTRICT 1004	23159

Datum: NAD 1983

0 2.25 4.5 9 Miles



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IMPORTANT GIANT GARTER SNAKE POPULATIONS

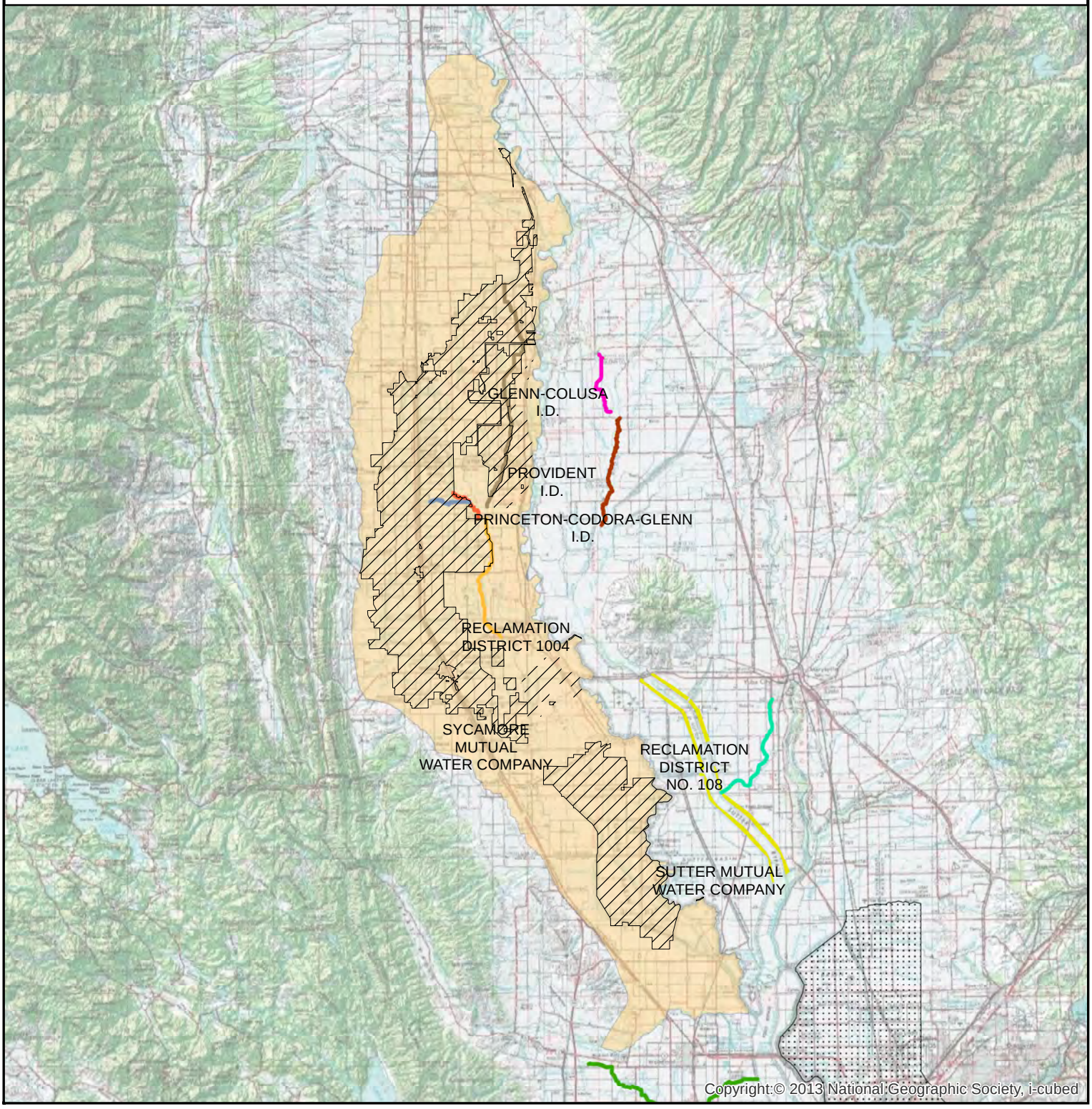
Colusa Basin Recovery Unit

- Seller Areas in Colusa Basin
- Colusa Basin (686,096 acres)
- Butte Creek Selection
- Colusa Basin Drainage Canal Selection
- Colusa Drainage Canal
- Gilsizer Slough
- Hunters Creek Selection
- Little Butte Creek
- Logan Creek Selection
- Natomas Basin
- Sutter Bypass Toe Drain
- Willow Slough & Bypass

SELLER AREAS IN COLUSA BASIN (acres)	
GLENN-COLUSA IRRIGATION DISTRICT	174886
PRINCETON-CORDORA-GLENN IRRIGATION DISTRCIT	12112
PROVIDENT IRRIGATION DISTRICT	17019
RECLAMATION DISTRICT 1004	54
RECLAMATION DISTRICT 108	58821
SUTTER MUTUAL WATER COMPANY	33
SYCAMORE MUTUAL WATER COMPANY	8431

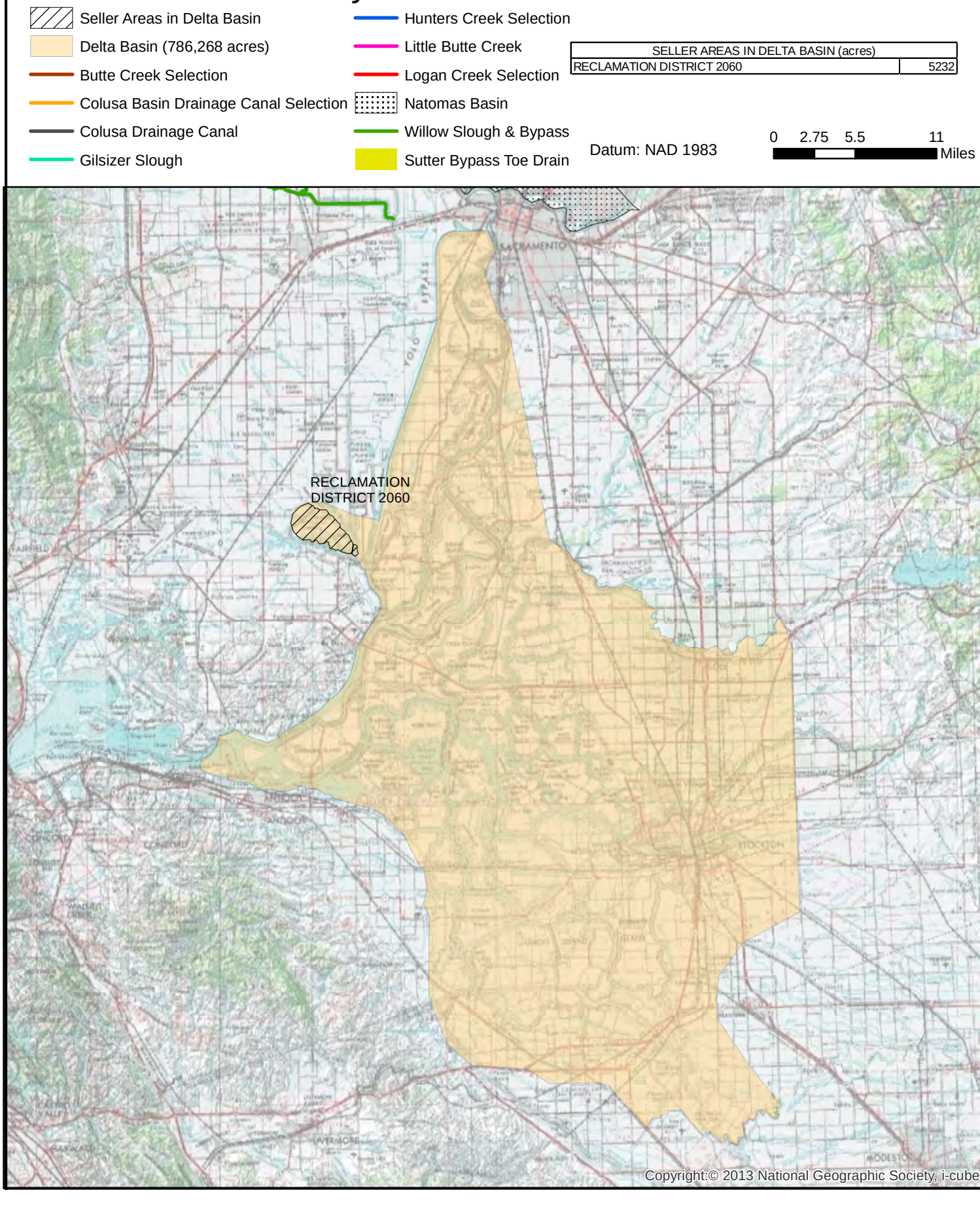
Datum: NAD 1983

0 3.75 7.5 15 Miles



IMPORTANT GIANT GARTER SNAKE POPULATIONS

Delta Basin Recovery Unit



IMPORTANT GIANT GARTER SNAKE POPULATIONS

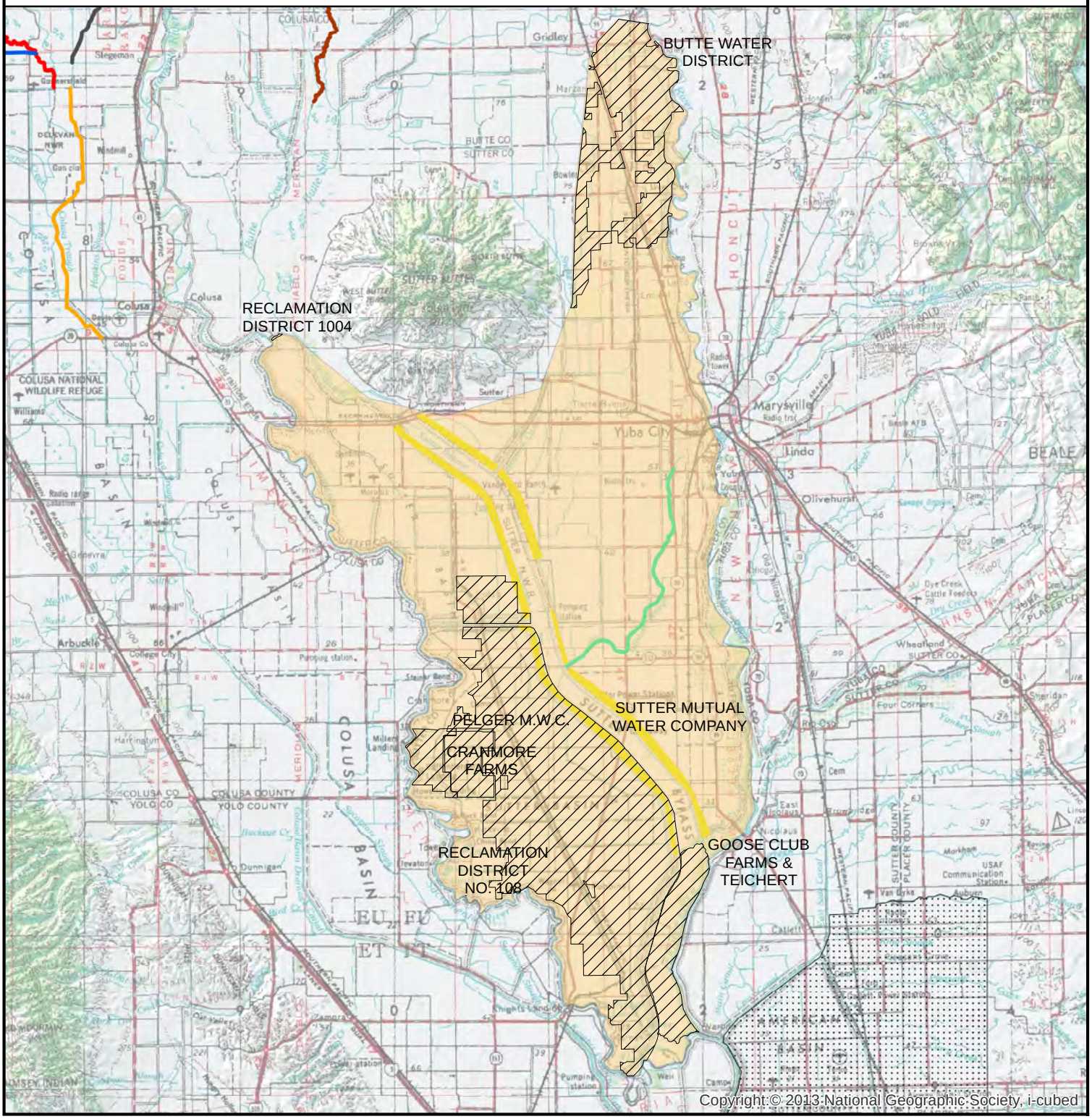
Sutter Basin Recovery Unit

- Seller Areas in Sutter Basin
- Sutter Basin (239,927 acres)
- Butte Creek Selection
- Colusa Basin Drainage Canal Selection
- Colusa Drainage Canal
- Gilsizer Slough
- Hunters Creek Selection
- Little Butte Creek
- Logan Creek Selection
- Natomas Basin
- Willow Slough & Bypass
- Sutter Bypass Toe Drain

SELLER AREAS IN SUTTER BASIN (acres)	
BUTTE WATER DISTRICT	14508
CRANMORE FARMS	2219
GOOSE CLUB FARMS & TEICHERT	5724
PELGER MUTUAL WATER COMPANY	2970
RECLAMATION DISTRICT 1004	23
RECLAMATION DISTRICT 108	0.02
SUTTER MUTUAL WATER COMPANY	51085

Datum: NAD 1983

0 1.75 3.5 7 Miles



IMPORTANT GIANT GARTER SNAKE POPULATIONS

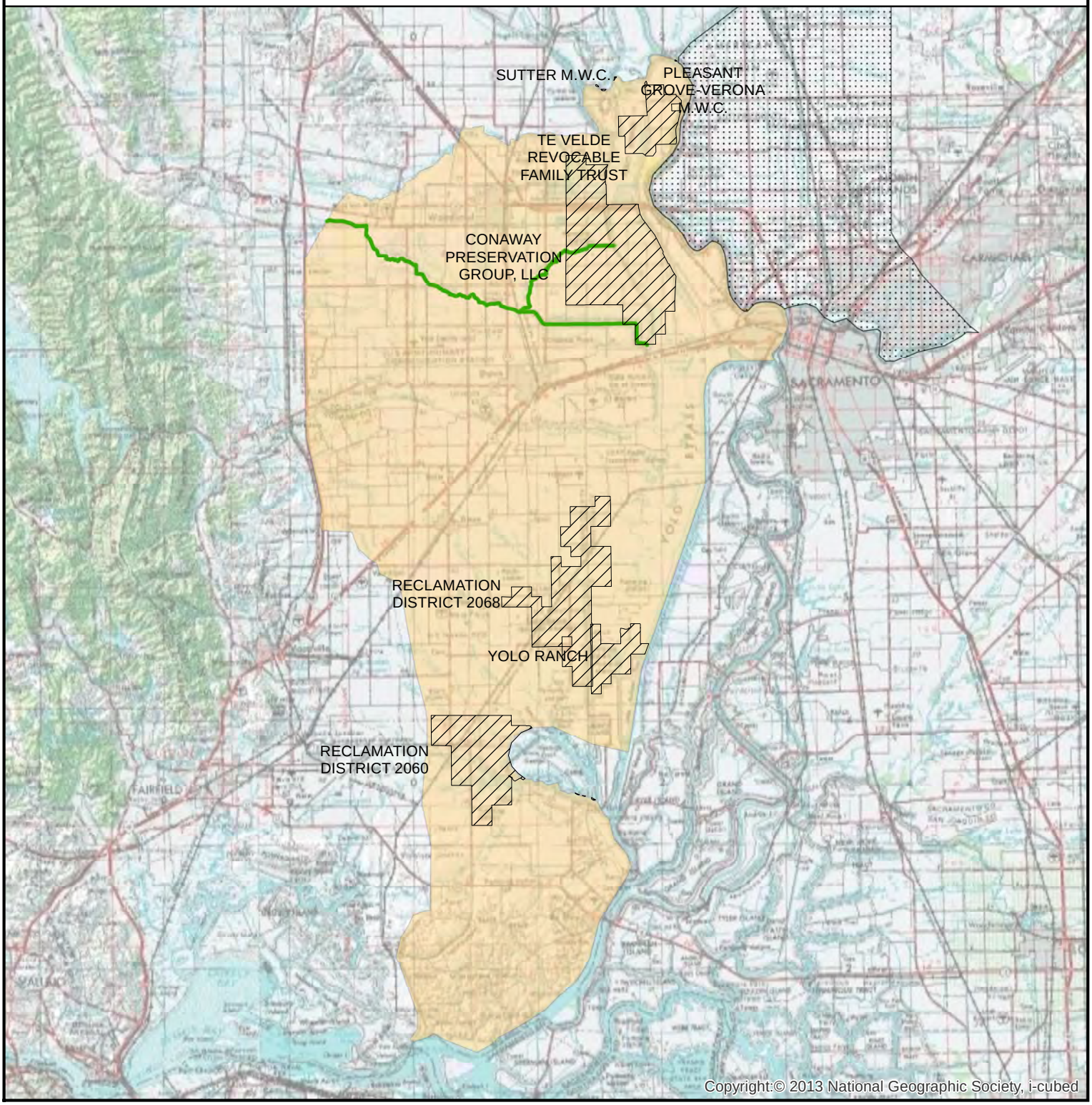
Yolo Basin Recovery Unit

- Seller Areas in Yolo Basin
- Yolo Basin (410,915 acres)
- Butte Creek Selection
- Colusa Basin Drainage Canal Selection
- Colusa Drainage Canal
- Gilsizer Slough
- Hunters Creek Selection
- Little Butte Creek
- Logan Creek Selection
- Natomas Basin
- Sutter Bypass Toe Drain
- Willow Slough & Bypass

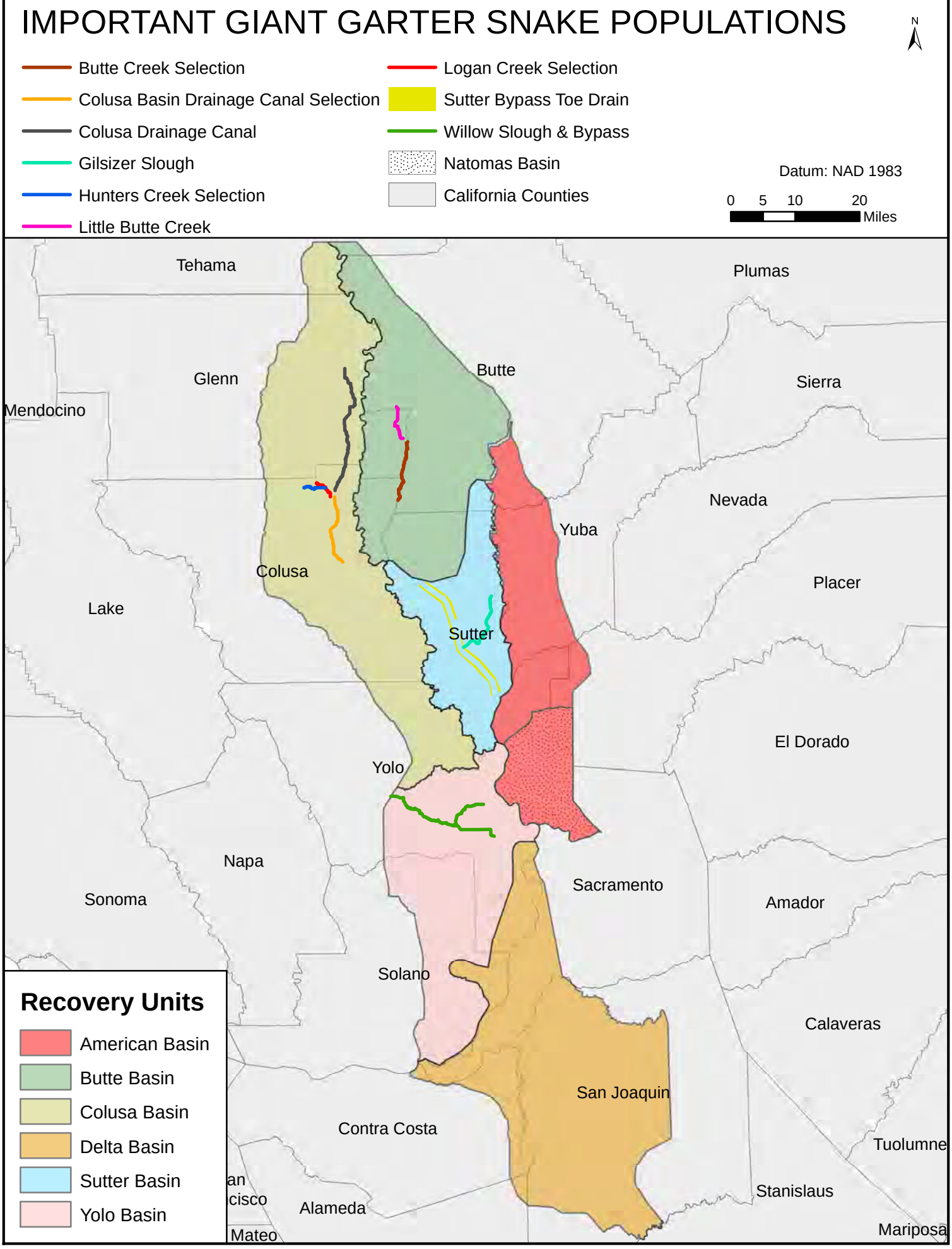
SELLER AREAS IN YOLO BASIN (acres)	
CONAWAY PRESERVATION GROUP, LLC	20463
PLEASANT-GROVE-VERONA MUTUAL WATER COMPANY	3
RECLAMATION DISTRICT 2060	9982
RECLAMATION DISTRICT 2068	13262
TE VELDE REVOCABLE FAMILY TRUST	4406
SUTTER MUTUAL WATER COMPANY	21
YOLO RANCH	3350

Datum: NAD 1983

0 2.25 4.5 9 Miles



IMPORTANT GIANT GARTER SNAKE POPULATIONS



Appendix H

Groundwater Modeling Results

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Appendix H
Groundwater Modeling Results

H.1 Numerical Groundwater Modeling Analysis

Numerical groundwater modeling analysis was performed using the Sacramento Valley Finite Element Groundwater Model (SACFEM2013) developed to simulate groundwater conditions in the Sacramento Valley Groundwater Basin. SACFEM2013 was selected as the numerical modeling tool for this analysis based on the state of the model and its capabilities to simulate groundwater conditions at a greater level of detail than other potential modeling tools within the Seller Service Area. Reclamation commissioned a peer review of the SACFEM2013 model in 2010 (WRIME 2011). Revisions were made to the model and the revised model was used for the impacts analysis described here.

SACFEM2013 uses the MicroFEM finite-element numerical modeling code. MicroFEM is capable of simulating multiple aquifer systems in both steady state and transient conditions. The model is capable of simulating groundwater conditions and groundwater/surface water interactions in the valley. SACFEM2013 was also used to estimate how groundwater pumping and recharge affects surface water.

SACFEM2013 covers the entire Sacramento Valley Groundwater Basin from just north of Red Bluff to the Cosumnes River in the south (see Figure H-2). The model was calibrated to historic conditions from Water Years (WY) 1970 through WY 2009. This SACFEM2013 model simulation, which includes highly variable hydrology (from very wet periods to very dry periods), was used as a basis for simulating groundwater substitution pumping. Potential water transfers for 2021 were simulated in SACFEM2013 using September 1977 hydrologic conditions because this year represents the driest condition available during the SACFEM2013 simulation period (WY 1970 to WY 2003).

Groundwater drawdown impacts were assessed based on SACFEM2013 model simulations of the contemplated 2017 TCCA Water Transfers (i.e., groundwater substitution locations and pumping volumes). These simulation results were used to determine the effects to groundwater resources. Some of the 184 well locations used in the contemplated 2017 transfer vary slightly from the well locations that would be proposed for a potential 2021 water transfer. A potential 2021 water transfer would include the addition of 41 transfer wells and the removal of 8 transfer wells compared to 2017. Figure H-1 shows the location of the modeled 2017 groundwater substitution pumping locations and groundwater substitution pumping locations for a potential 2021 water transfer.

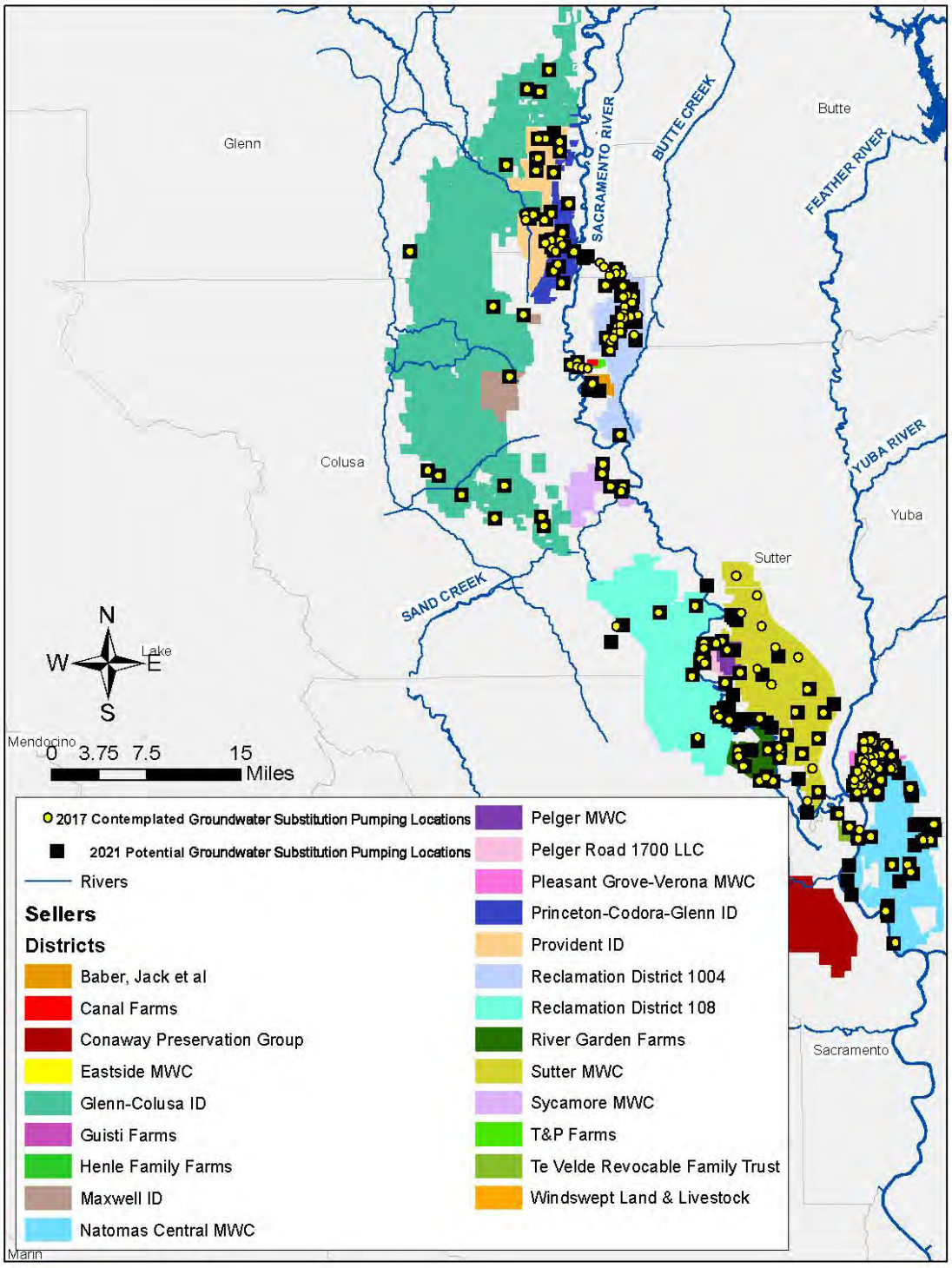

Figure H-1. 2017 and Potential 2021 Groundwater Substitution Pumping Well Locations

Table H-1 summarizes the number of groundwater substitution pumping wells, pumping rates, and range of screened intervals modeled for the contemplated 2017 groundwater substitution transfers. The locations and depths of these wells are specified in the model based on data collected from the potential groundwater substitution sellers. Table H-2 summarizes the pumping details of the potential 2021 groundwater substitution pumping wells for comparison. Table H-3 summarizes the difference between the number of 2017 pumping wells and the number of pumping wells for a potential 2021 water transfer shown in Table H-1 and Table H-2.

Table H-1. Water Transfers through Groundwater Substitution under the Contemplated 2017 TCCA Water Transfers (2017 Modeled Wells)

Potential Seller	Number of Wells	Pumping Rate or Range of Rates (gpm)	Range of Screened Interval(s) (feet bgs)
Redding Area Groundwater Basin[1]			
Anderson- Cottonwood Irrigation District	2	1,000-5,500	150-455
Sacramento Valley Groundwater Basin			
Burroughs Farms	3	2,000 – 3,200	120 - 580
Canal Farms	3	3,500 - 5,000	65 - 660
Eastside Mutual Water Company	1	4,720	150 - 240
Giusti Farms	2	3,200	150 - 400
Glenn-Colusa Irrigation District	13	800 – 4,300	25 –945
Maxwell Irrigation District	2	3,800	150 - 240
Natomas Central Mutual Water Company	14	1,000 - 2,500	10 - 952
Pelger Mutual Water Company	4	1,500 - 5,000	101 - 485
Pelger Road 1700 LLC	4	3,000 - 3,500	200 - 820
Pleasant Grove-Verona Mutual Water Company	34	1,500 - 5,000	99 - 260
Princeton-Codora- Glenn Irrigation District	13	1,000 - 3,000	120 - 380
Provident Irrigation District	16	2,000 – 4,500	100 - 420
Reclamation District 108	5	1,700 - 5,900	250 - 680
Reclamation District 1004	28	1,000 - 5,800	56 - 430
River Garden Farms	8	1,700 - 3,000	170 - 686
Sutter Mutual Water Company	20	2,500 – 5,000	160 - 400
Sycamore Mutual Water Company	5	3,200 - 6,500	160 - 906
T&P Farms	2	3,500 - 4,000	256 - 862
Te Velde Revocable Family Trust	5	2,200 - 4,700	115 - 455

Note:
[1] Anderson-Cottonwood ID's proposed transfer was not simulated in the Sacramento Valley Finite Element Groundwater Model (SACFEM2013) because the model area does not include the Redding Area Groundwater Basin.
Key:
gpm = gallons per minute
bgs = below ground surface

Table H-2. Water Transfers through Groundwater Substitution under the Proposed Action (Potential 2021 Wells)

Potential Seller	Number of Wells	Pumping Rate or Range of Rates (gpm)	Range of Screened Interval(s)(feet bgs)
Redding Area Groundwater Basin[1]			
Anderson- Cottonwood Irrigation District	2	1,000-5,500	150-455
Sacramento Valley Groundwater Basin			
Burroughs Farms	1	3,000	120 - 580
Canal Farms	3	1,900-5,000	210-660
Eastside Mutual Water Company	3	4,000-4,720	160-450
Giusti Farms	2	3,200	160-400
Glenn-Colusa Irrigation District	13	600-3,600	604-945
Henle Family Farms	1		
Maxwell Irrigation District	2	3,800	150-240
Natomas Central Mutual Water Company	33	1,000-3,200	310-952
Pelger Mutual Water Company	4	2,300-4,800	140-485
Pelger Road 1700 LLC	6	3,000-3,500	340-820
Pleasant Grove-Verona Mutual Water Company	35	0-3,600	174-520
Princeton-Codora- Glenn Irrigation District	13	1,000-4,000	220-380
Provident Irrigation District	13	2,000-3,800	160-420
Reclamation District 108	5	1,700-5,900	335-680
Reclamation District 1004	30	1,000-5,800	410-730
River Garden Farms	9	2,200-3,300	365-686
Sutter Mutual Water Company	30	1,300-5,500	300-600
Sycamore Mutual Water Company	5	3,270-6,409	256-906
Te Velde Revocable Family Trust	4	2,250-4,200	200-455
Windswept Land & Livestock	3	2,000-3,200	320-580

Note:
[1] Anderson-Cottonwood ID's proposed transfer was not simulated in the Sacramento Valley Finite Element Groundwater Model (SACFEM2013) because the model area does not include the Redding Area Groundwater Basin.
Key:
gpm = gallons per minute
bgs = below ground surface

Table H-3. Change in Number of Potential 2021 Groundwater Substitution Wells Compared to the Number of 2017 Groundwater Substitution Wells

Potential Seller	Total Number of 2017 Wells	Number of Wells Removed	Number of Wells Added	Total Number of 2021 Wells
Redding Area Groundwater Basin				
Anderson- Cottonwood Irrigation District	2	--	--	2
Sacramento Valley Groundwater Basin				
Burroughs Farms	3	2	--	1
Canal Farms	3	--	--	3
Eastside Mutual Water Company	1	--	2	3
Giusti Farms	2	--	--	2
Glenn-Colusa Irrigation District	13	--	--	13
Henle Family Farms	--	--	1	1
Maxwell Irrigation District	2	--	--	2
Natomas Central Mutual Water Company	14	--	19	33
Pelger Mutual Water Company	4	--	--	4
Pelger Road 1700 LLC	4	--	2	6
Pleasant Grove-Verona Mutual Water Company	34	--	1	35
Princeton-Codora- Glenn Irrigation District	13	--	--	13
Provident Irrigation District	16	3	--	13
Reclamation District 108	5	--	--	5
Reclamation District 1004	28	--	2	30
River Garden Farms	8	--	1	9
Sutter Mutual Water Company	20	--	10	30
Sycamore Mutual Water Company	5	--	--	5
T&P Farms	2	2	--	--
Te Velde Revocable Family Trust	5	1	--	4
Windswept Land & Livestock	--	--	3	3
Total Number of Wells	**184**	**8**	**41**	**217**

Figures H-2 through H-5 show the simulated drawdown due to the Proposed Action under September 1977 hydrologic conditions. During dry years, surface water resources are limited and users have historically increased groundwater pumping to address shortages. Simulating transfers during this period illustrates the potential to compound impacts from dry-year pumping as compared to the No Action Alternative.

- Figure H-2 shows the simulated drawdown at the water table based on results from the top layer of the SACFEM2013 model. This layer has a depth of up to 35 feet below ground surface (bgs).

- Figure H-3 shows simulated drawdown at approximately 200 to 300 feet bgs.
- Figure H-4 presents the simulated drawdown at approximately 300 to 400 feet bgs.
- Figure H-5 presents the simulated drawdown at approximately 700 to 900 feet bgs.
- Figure H-6 overlays the Indian Trust Assets (ITAs) within the Sacramento Valley Groundwater Basin over the simulated drawdown at the water table.

Drawdown at the water table (Figure H-6) represents the estimated decline in the groundwater surface within the shallow, unconfined portion of the aquifer (i.e., the height of water within a shallow groundwater well). The drawdown in the deeper portions of the aquifer (Figures H-3 through H-5) represents a change in hydraulic head (i.e., water pressure) in a well that is screened in this deeper portion of the aquifer.

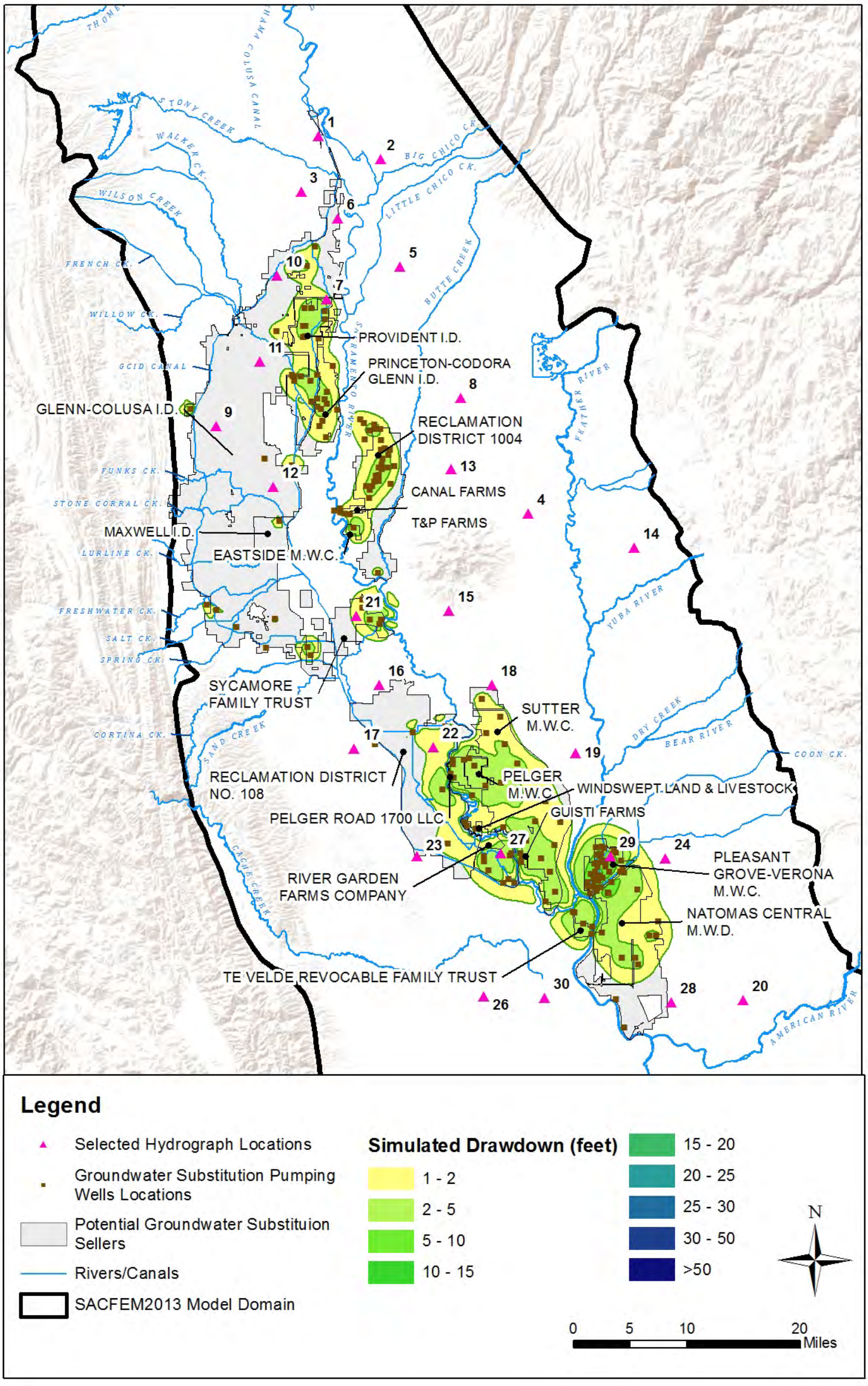

Figure H-2. Simulated Drawdown in Water Table Elevation (0 to approximately 35 feet bgs), Based on September 1977 Hydrologic Conditions

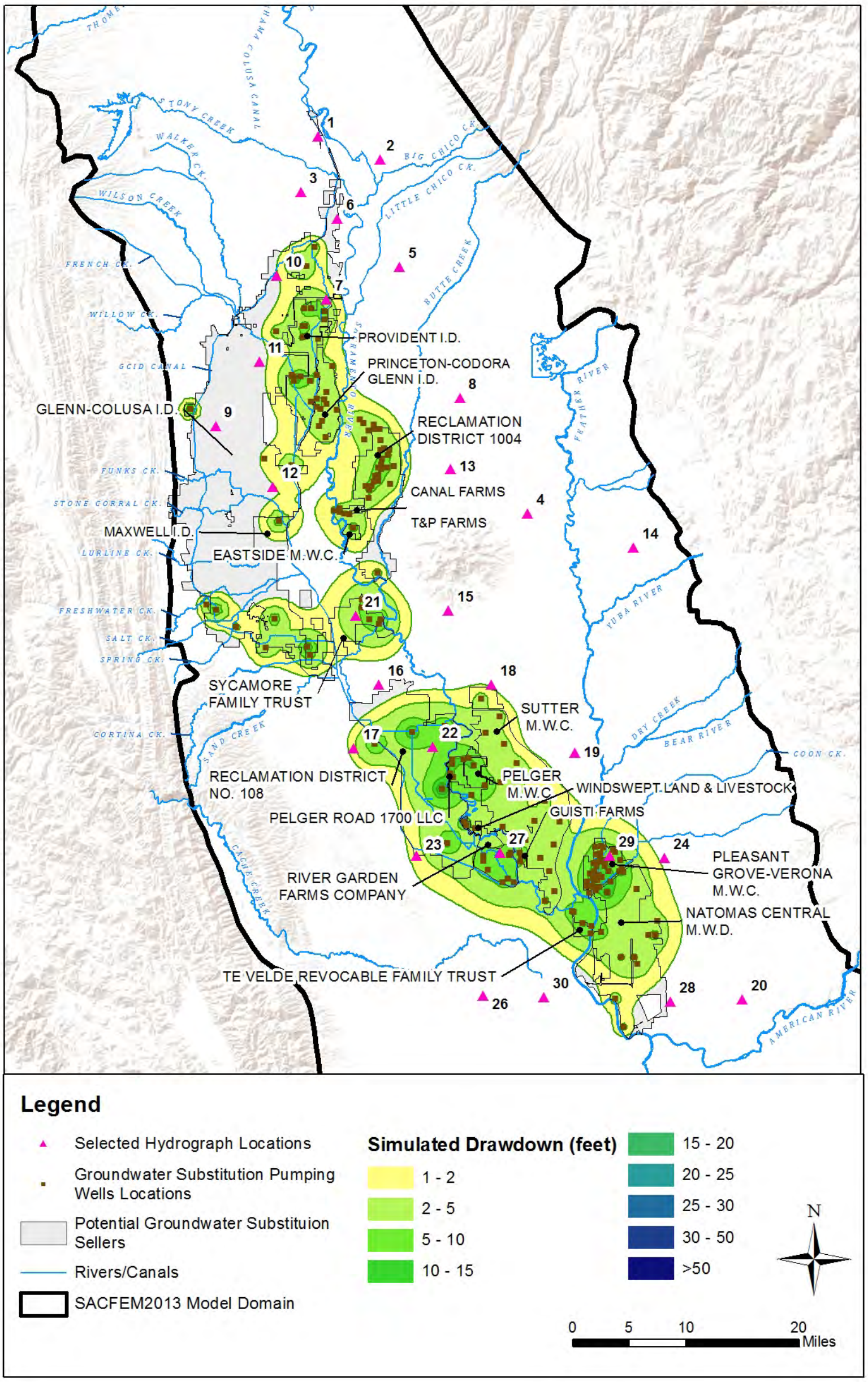

Figure H-3. Simulated Drawdown in Groundwater Head (approximately 200 to 300 feet bgs), Based on September 1977 Hydrologic Conditions

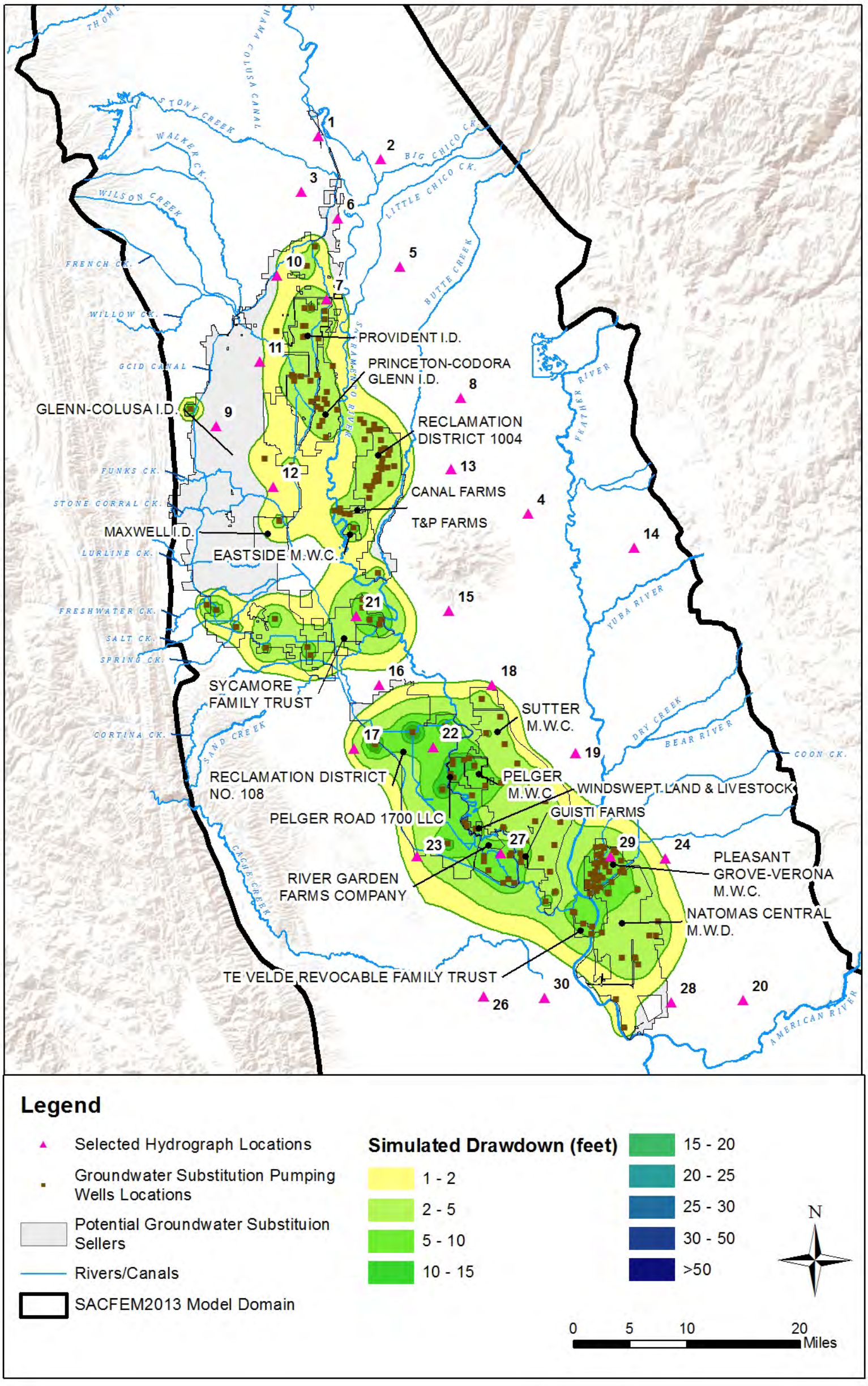

Figure H-4. Simulated Drawdown in Groundwater Head (approximately 300 to 400 feet bgs), Based on September 1977 Hydrologic Conditions

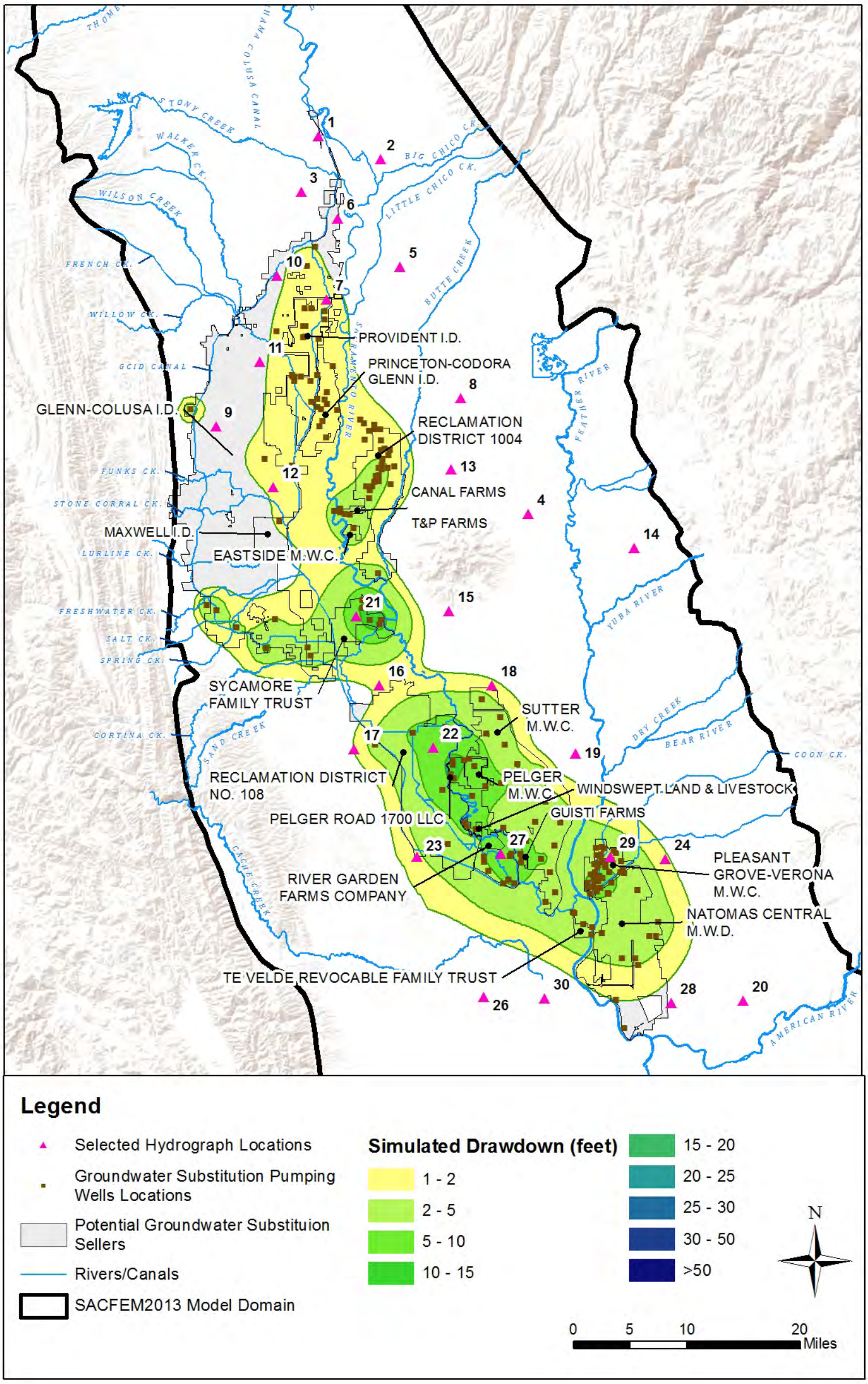

Figure H-5. Simulated Drawdown in Groundwater Head (approximately 700 to 900 feet bgs), Based on September 1977 Hydrologic Conditions

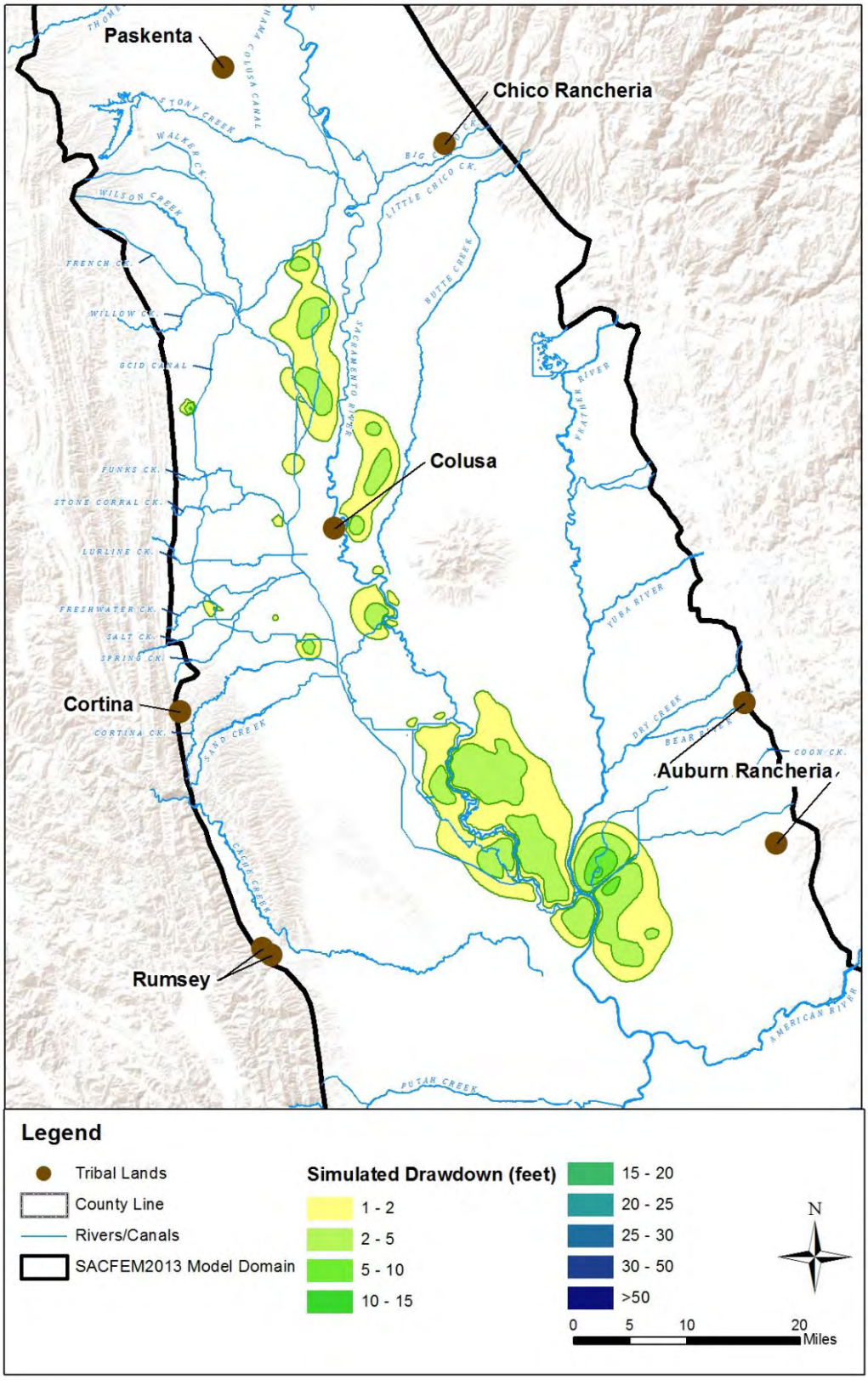

Figure H-6. Groundwater Effects to ITAs in the Sacramento Valley Groundwater Basin (simulated drawdown at the water table)

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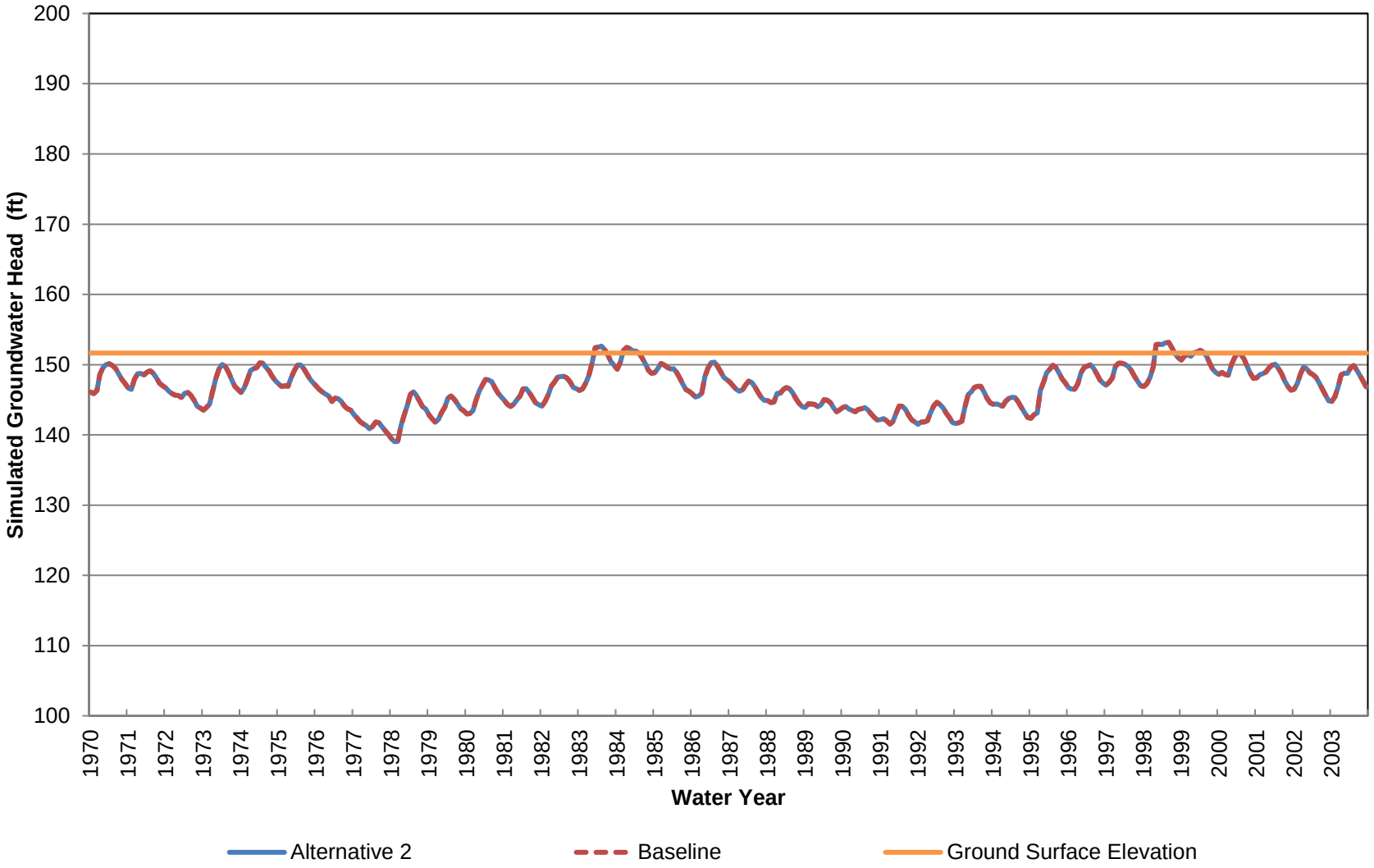
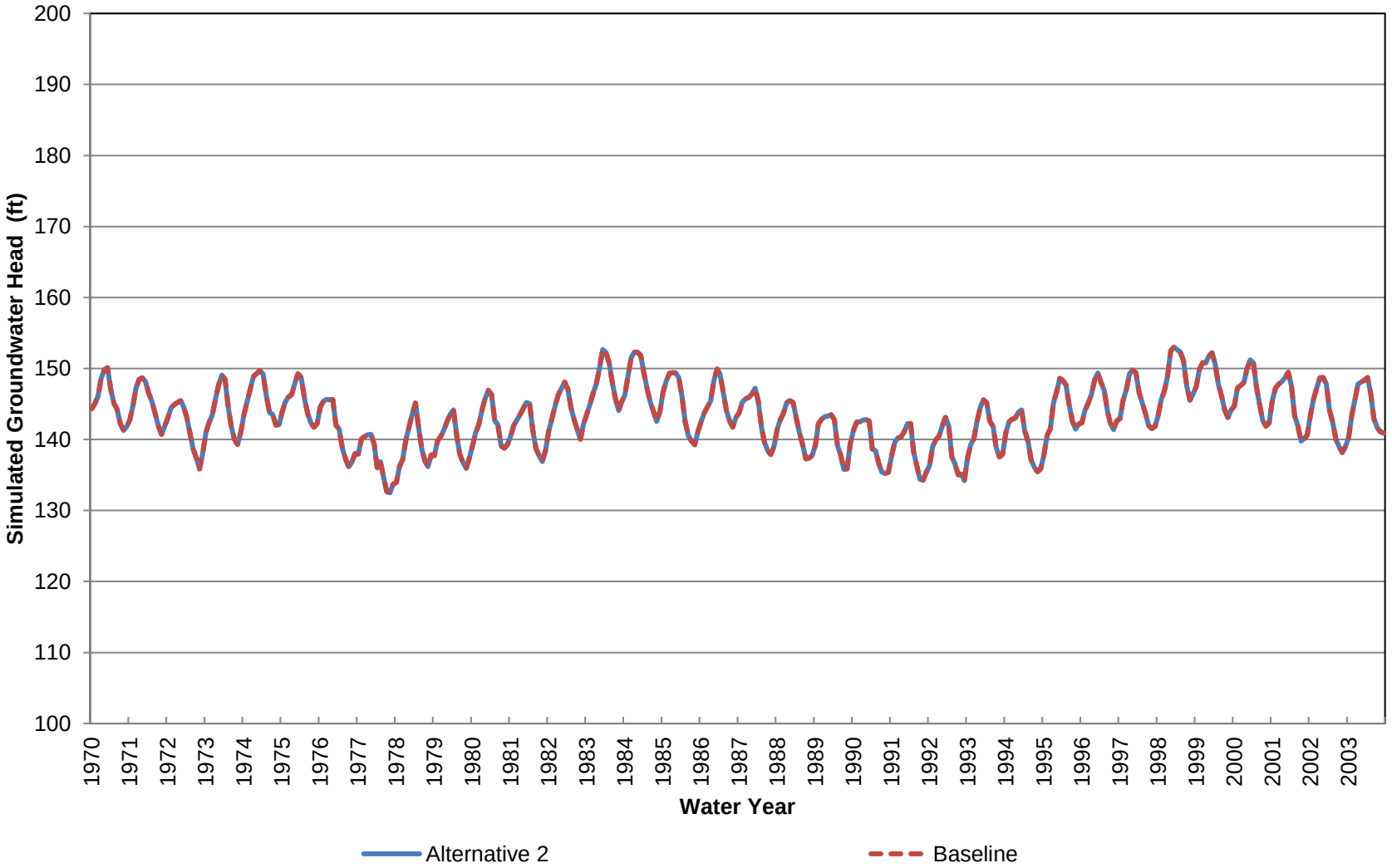
Groundwater head hydrographs for Locations 1 to 34

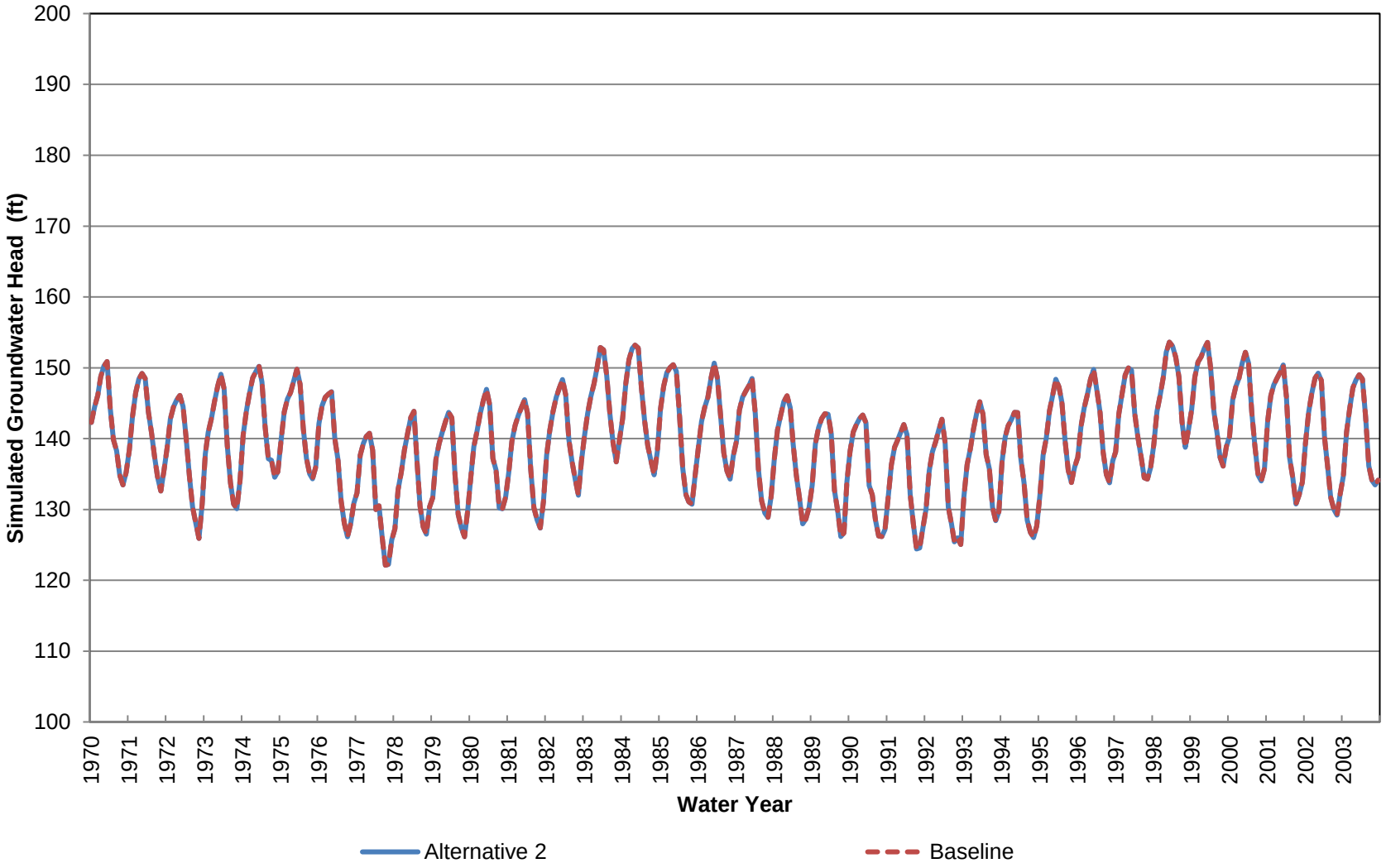
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 1 (Approximately 0-70 ft bgs)



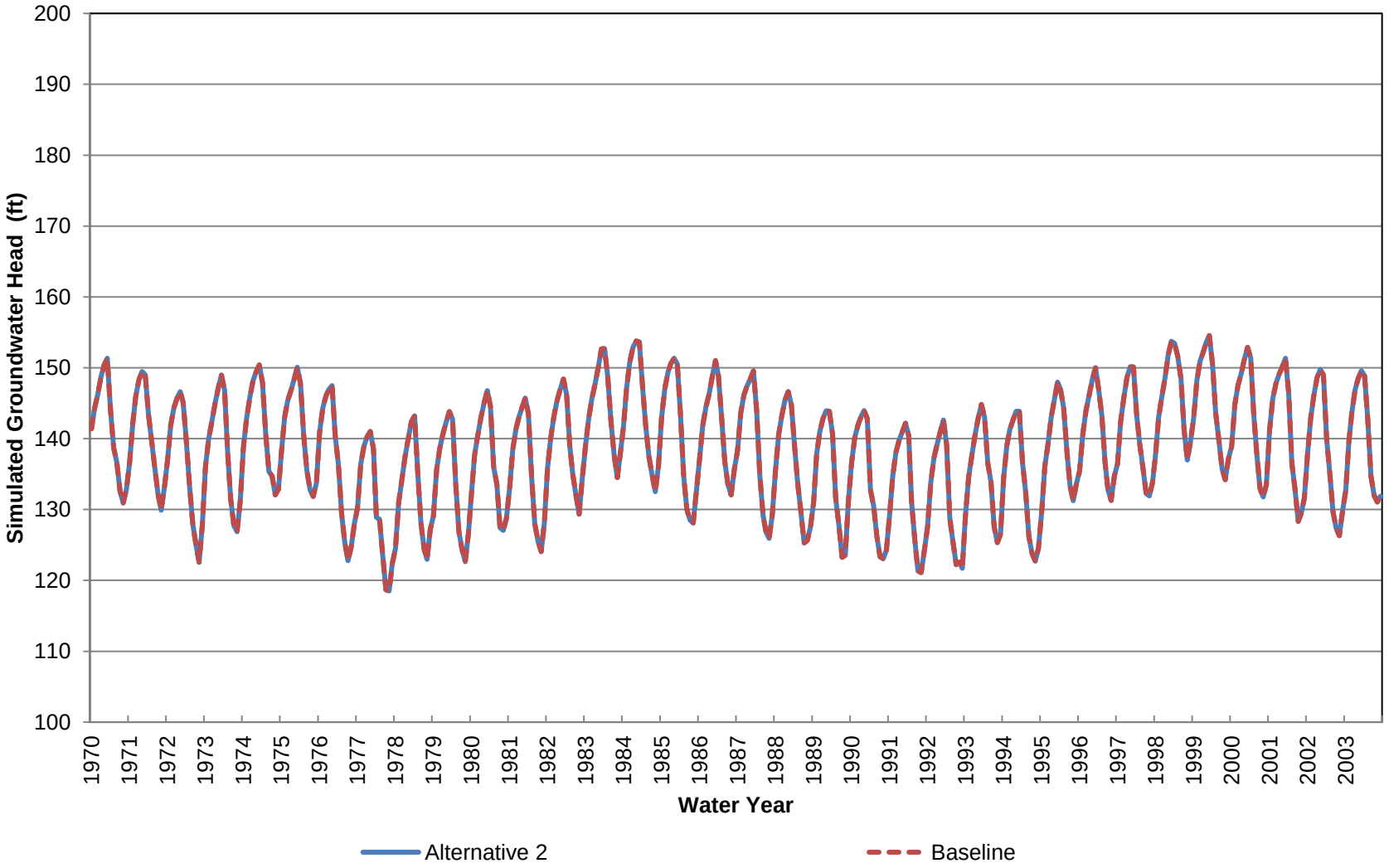
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 1 (Approximately 70-200 ft bgs)



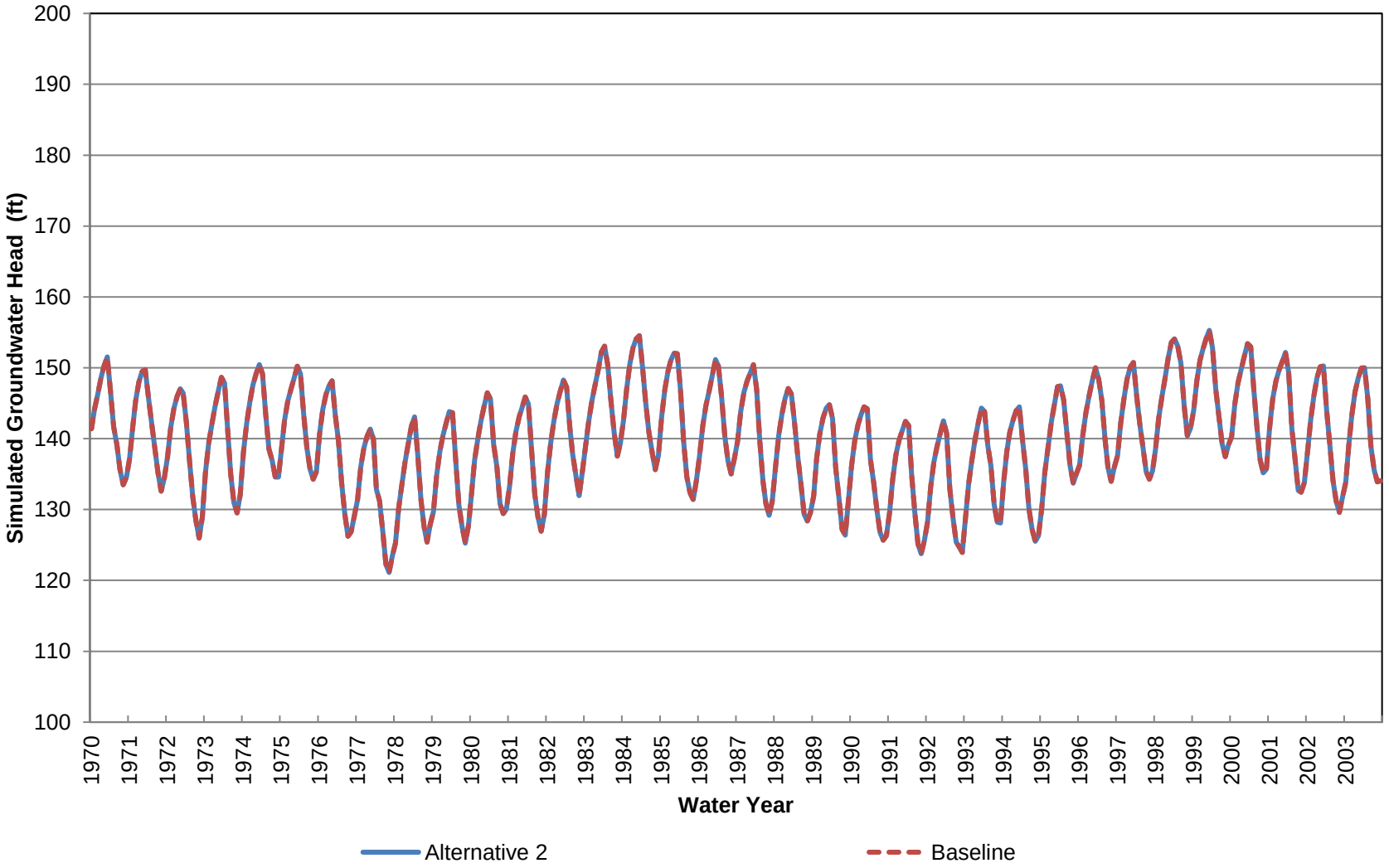
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 1 (Approximately 200-330 ft bgs)



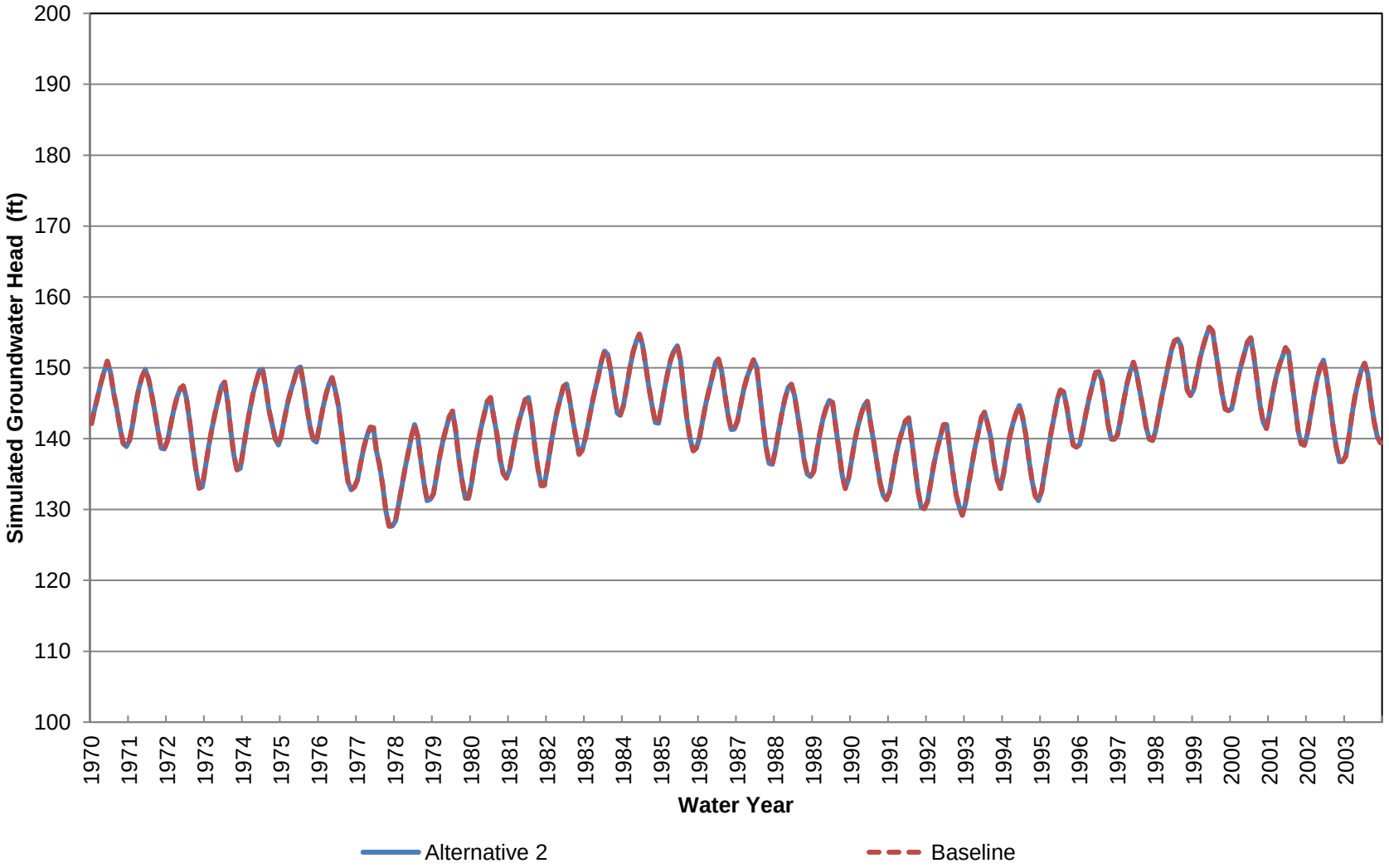
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 1 (Approximately 330-450 ft bgs)



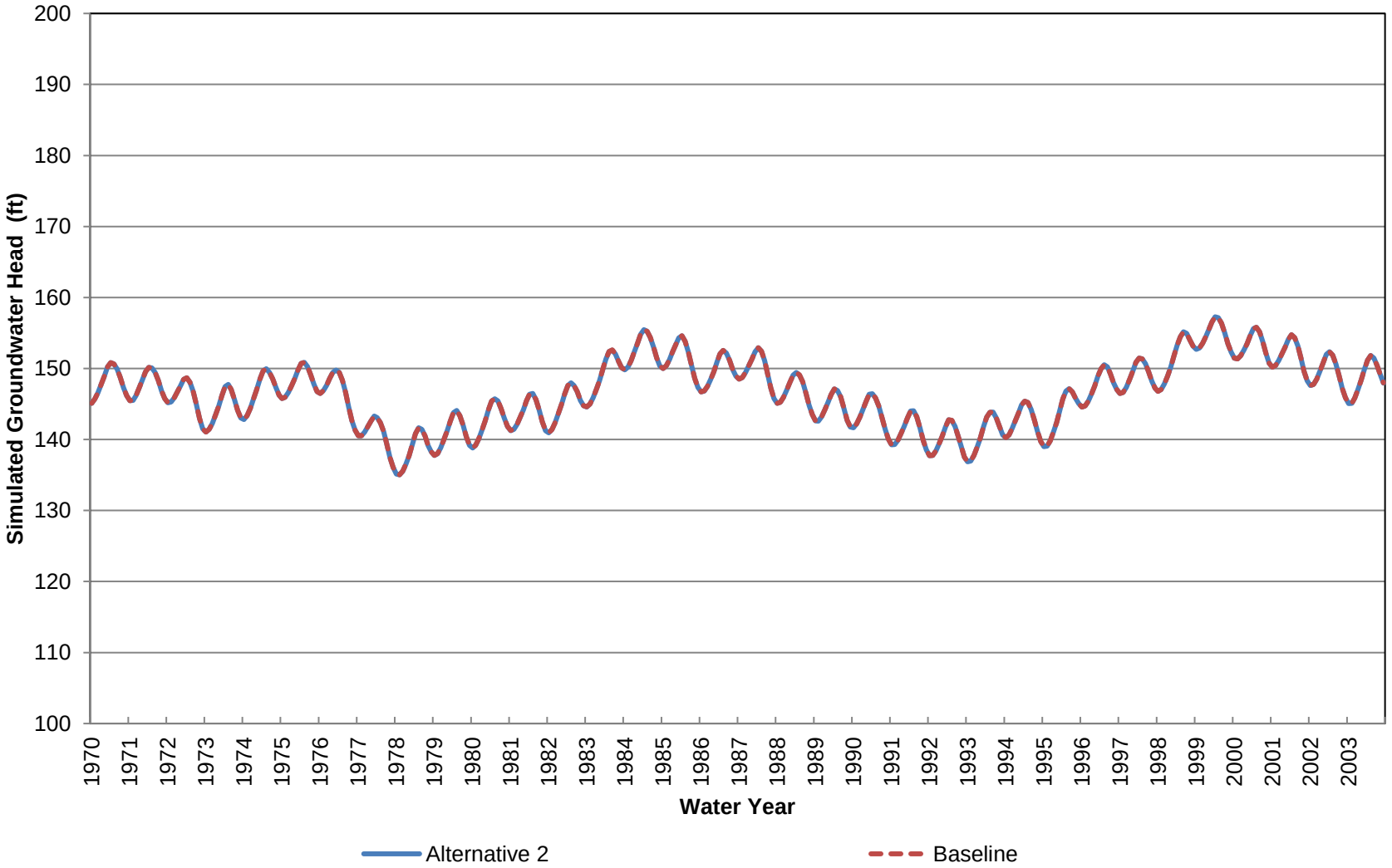
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 1 (Approximately 450-640 ft bgs)



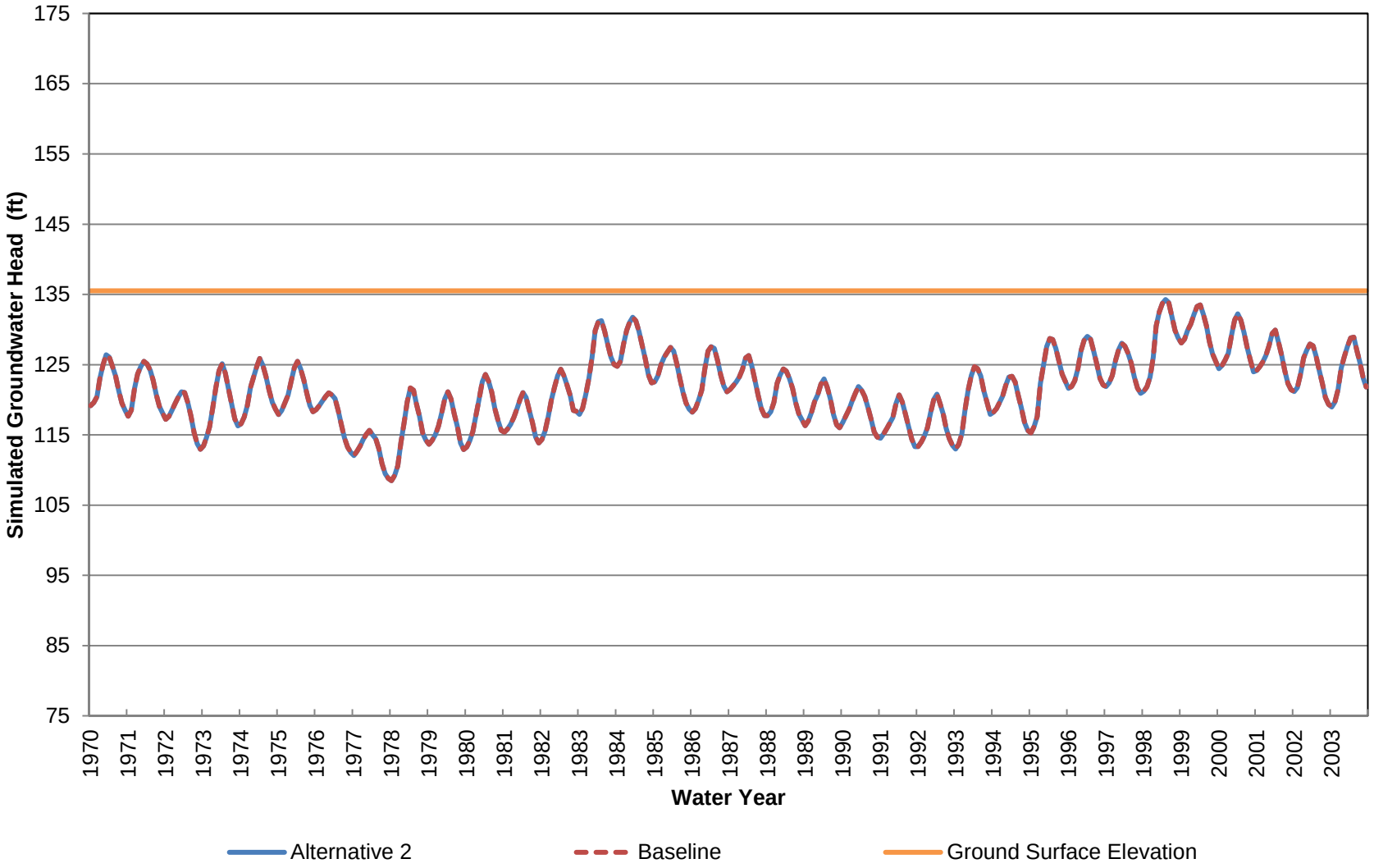
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 1 (Approximately 640-890 ft bgs)



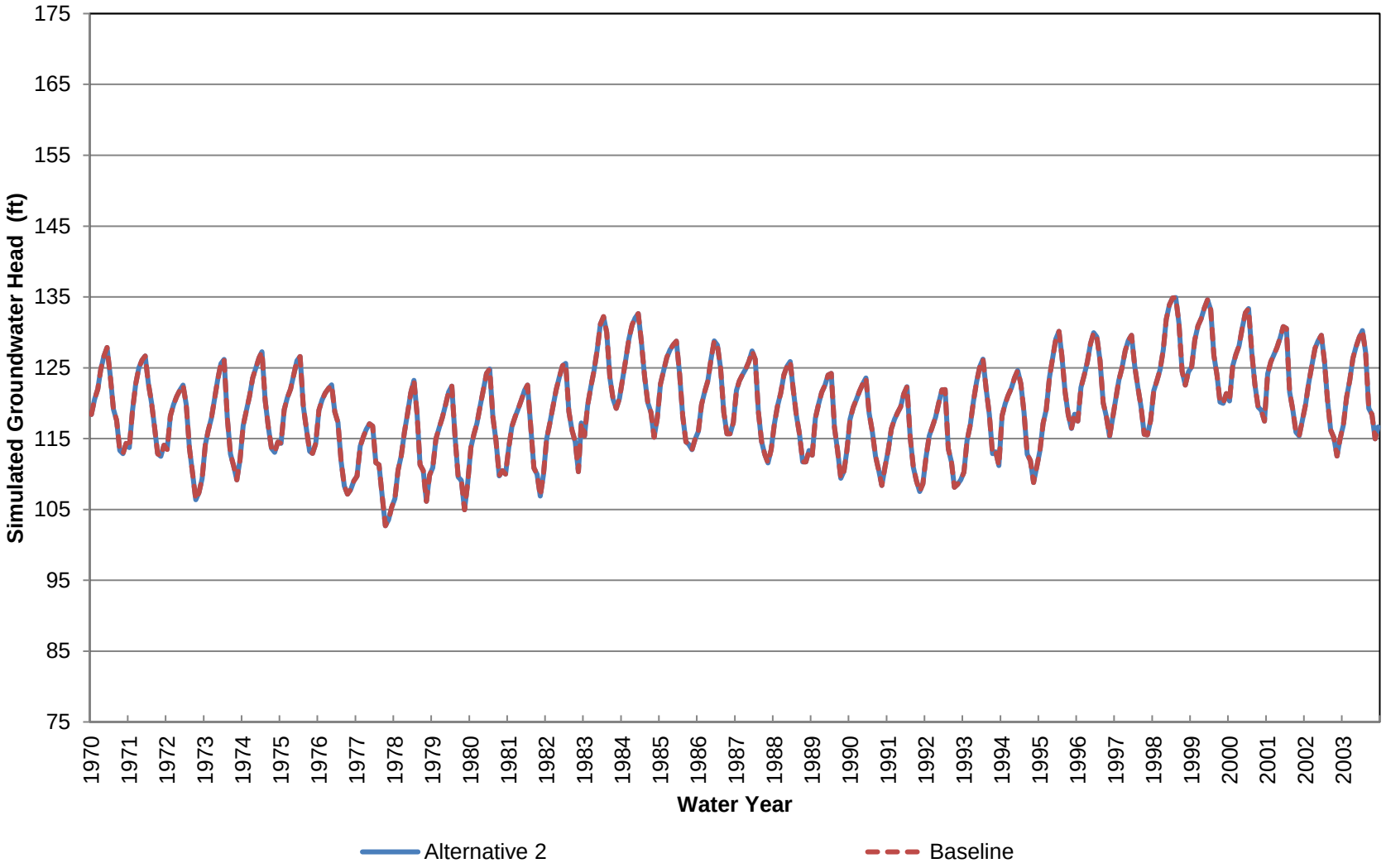
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 1 (Approximately 890-1360 ft bgs)



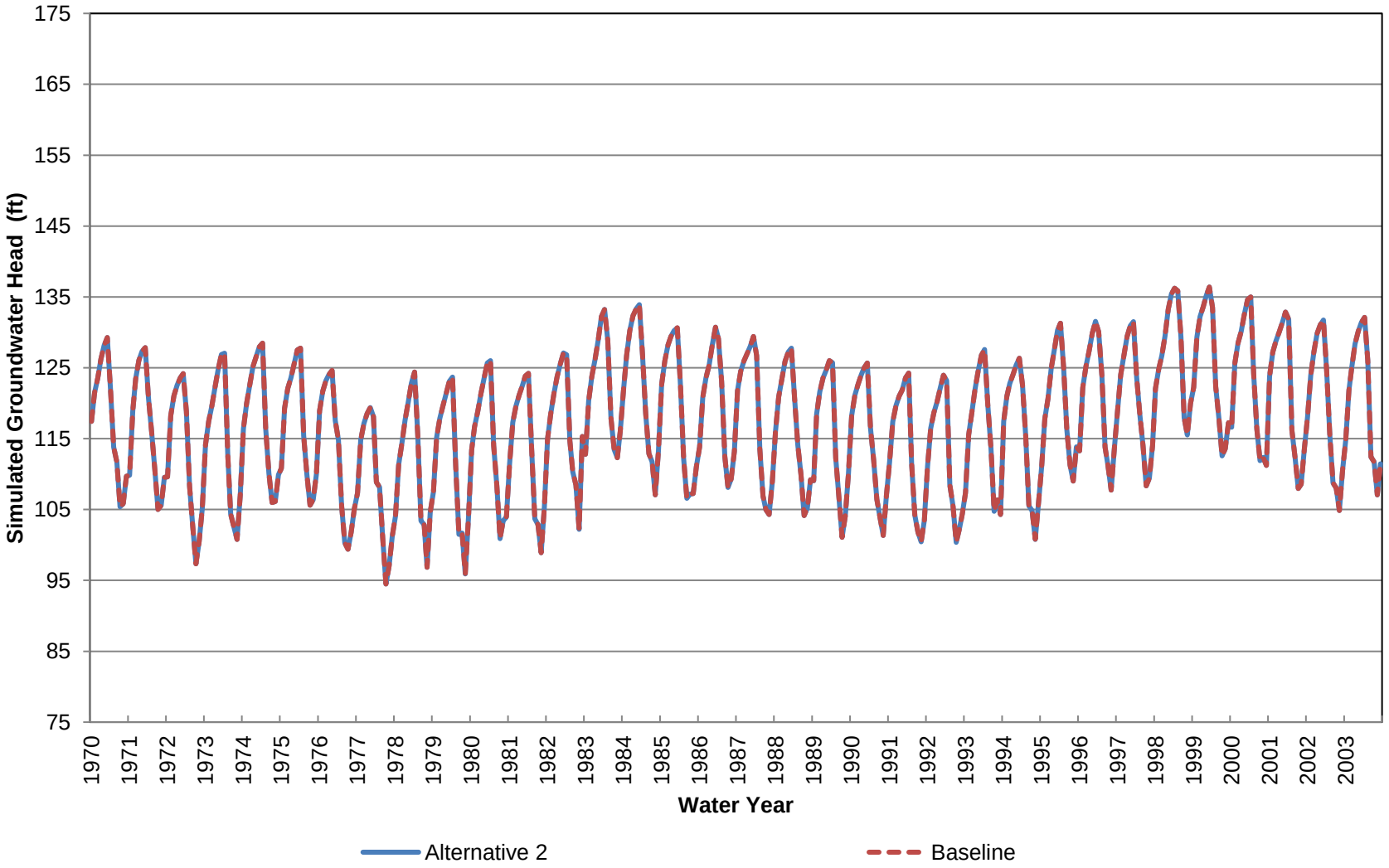
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 2 (Approximately 0-70 ft bgs)



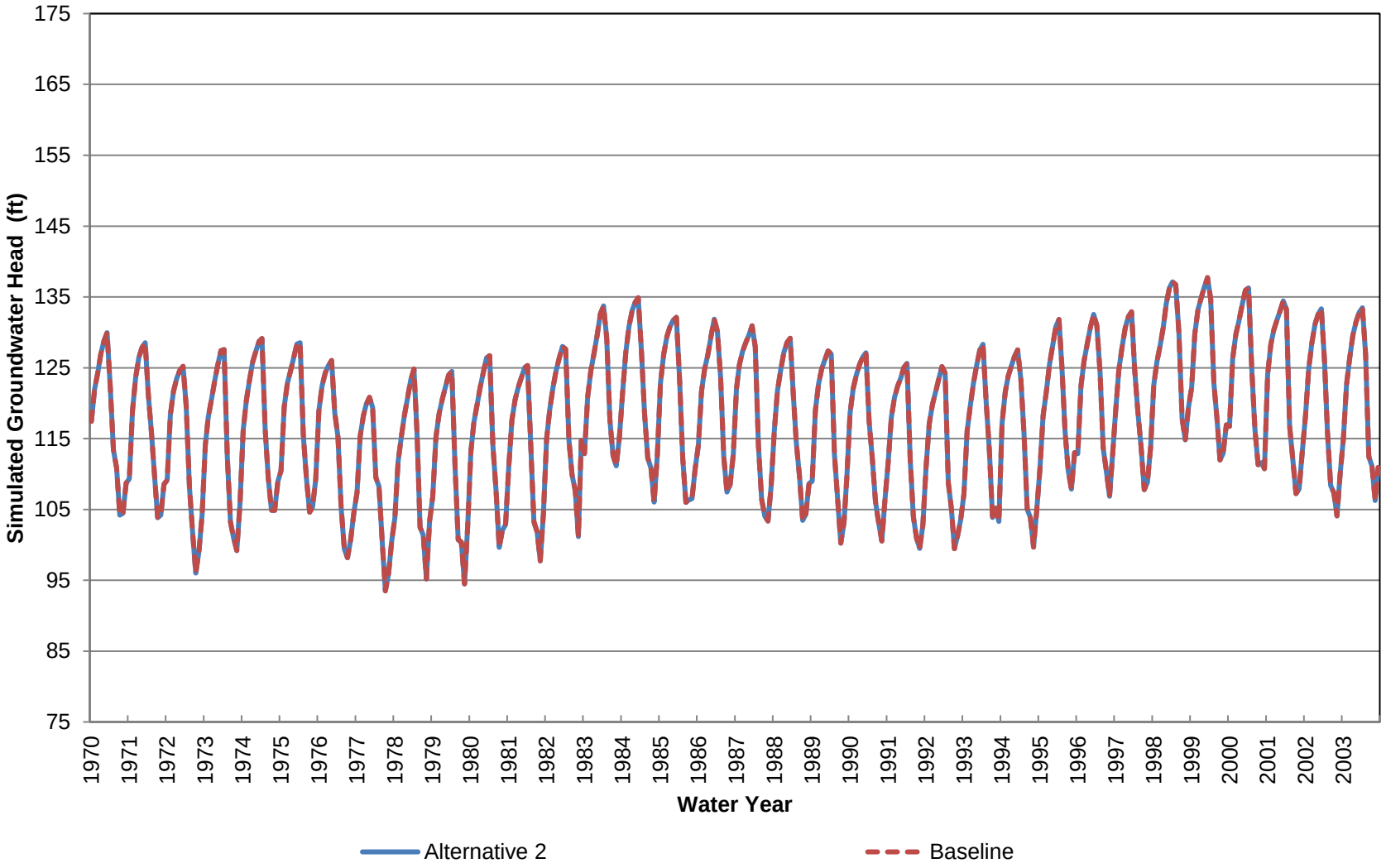
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 2 (Approximately 70-190 ft bgs)



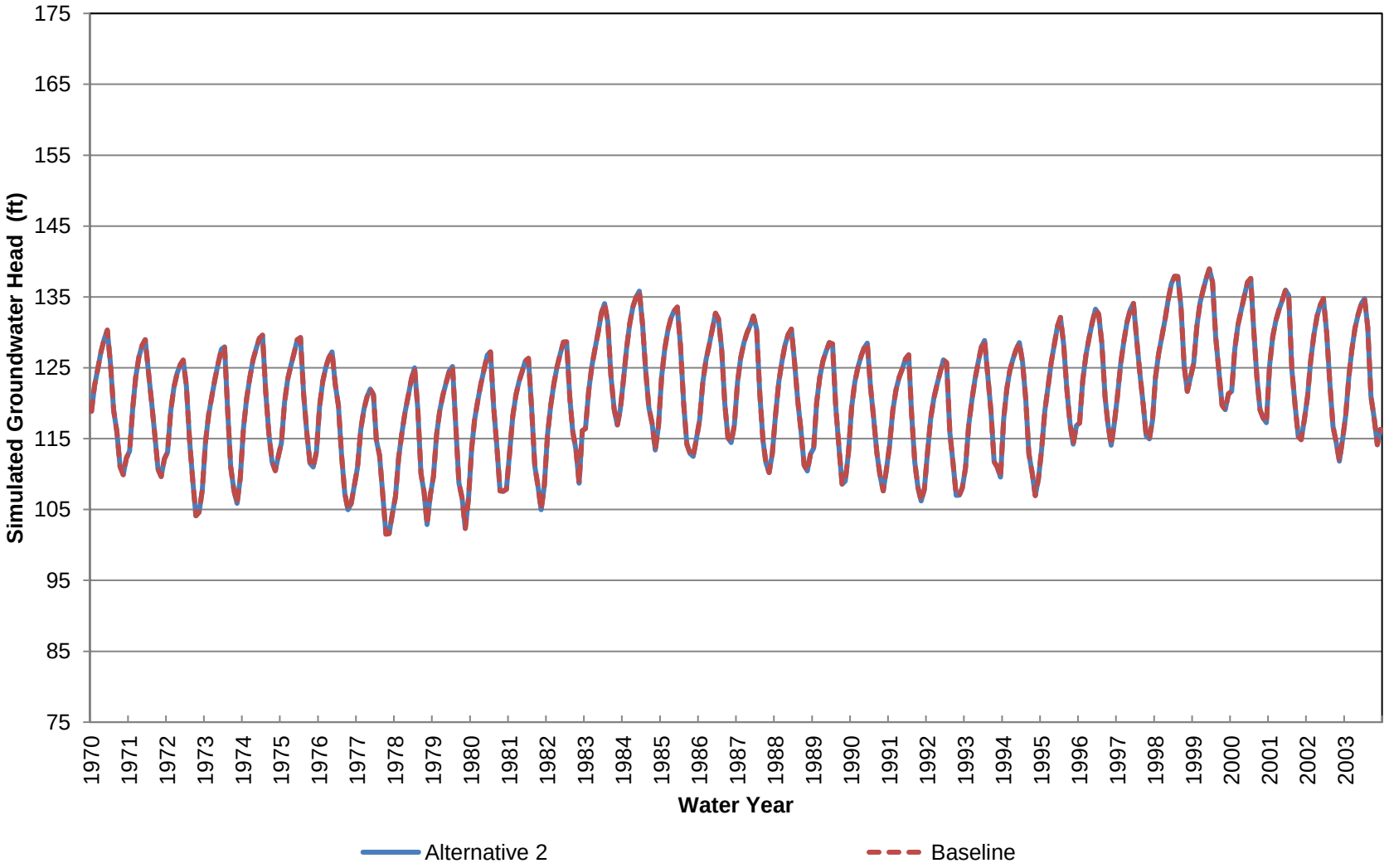
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 2 (Approximately 190-300 ft bgs)



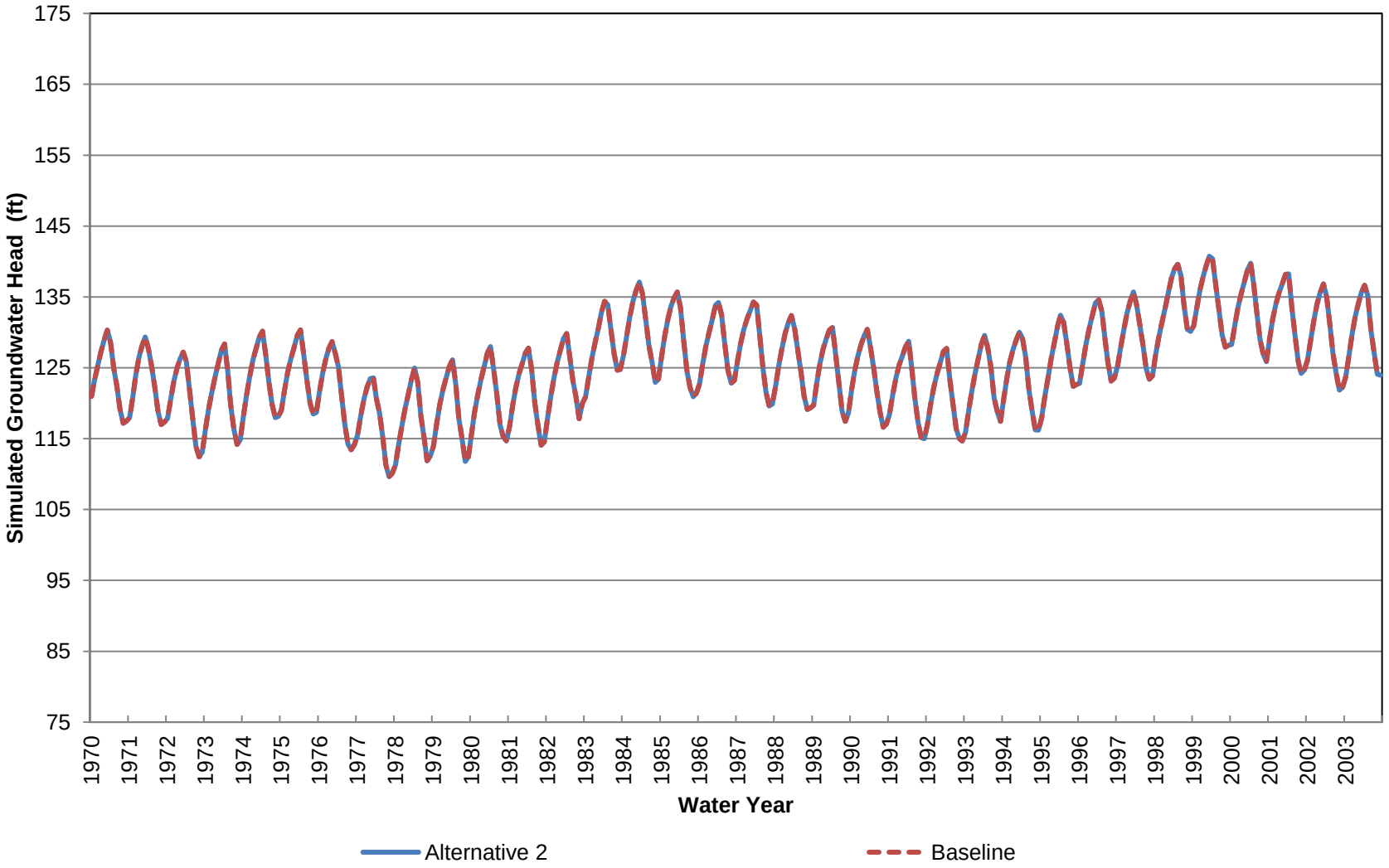
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 2 (Approximately 300-420 ft bgs)



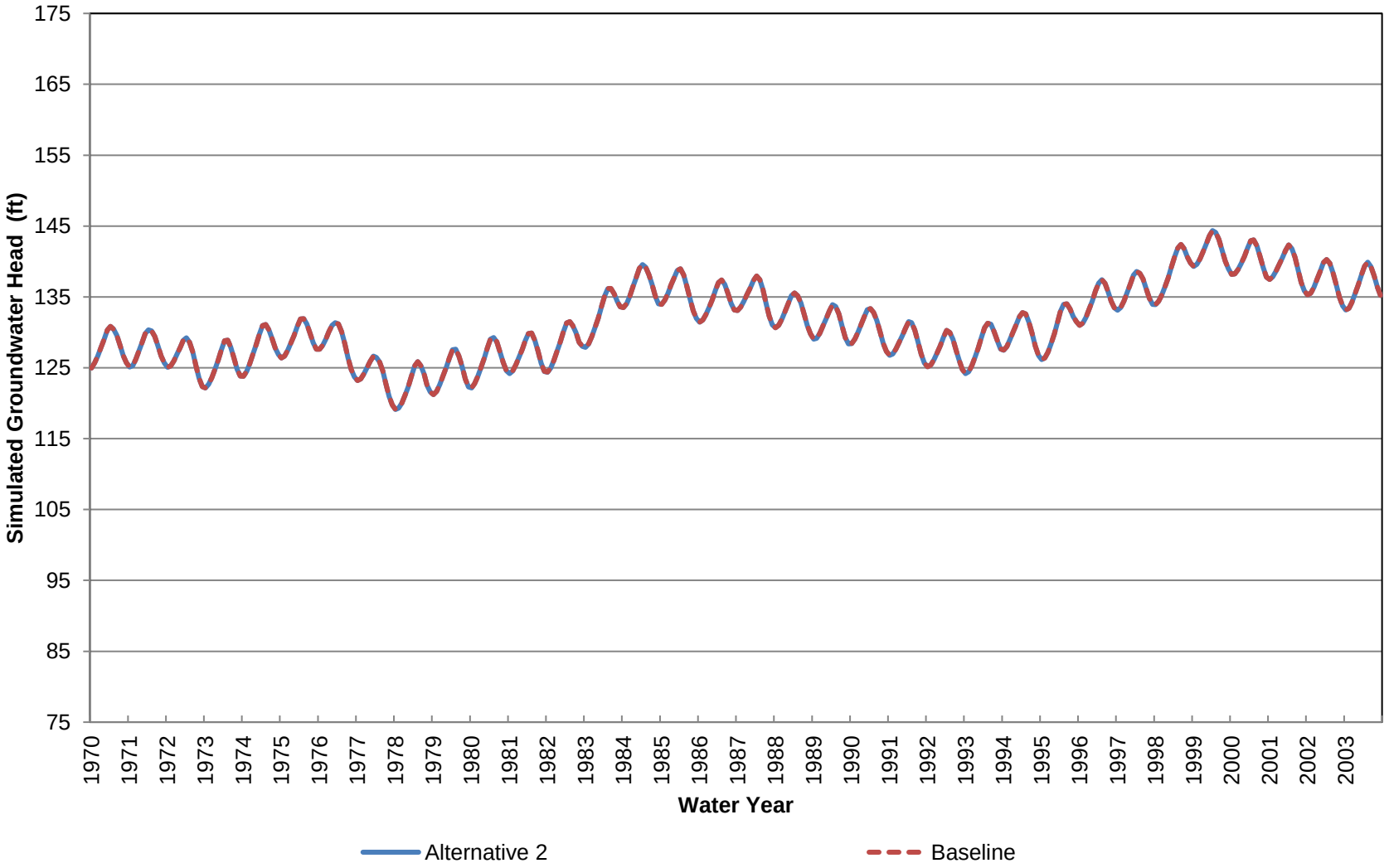
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 2 (Approximately 420-580 ft bgs)



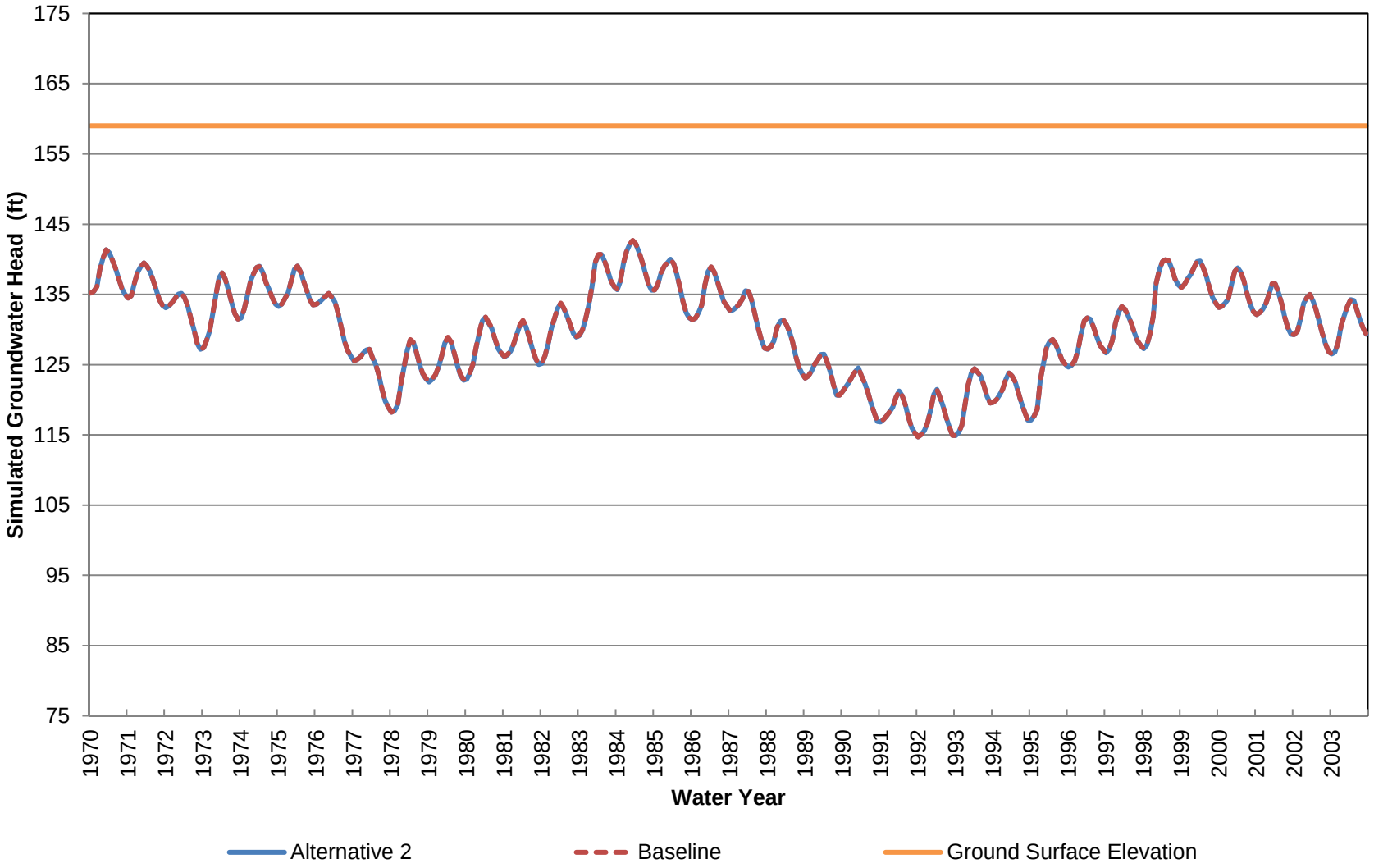
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 2 (Approximately 580-830 ft bgs)



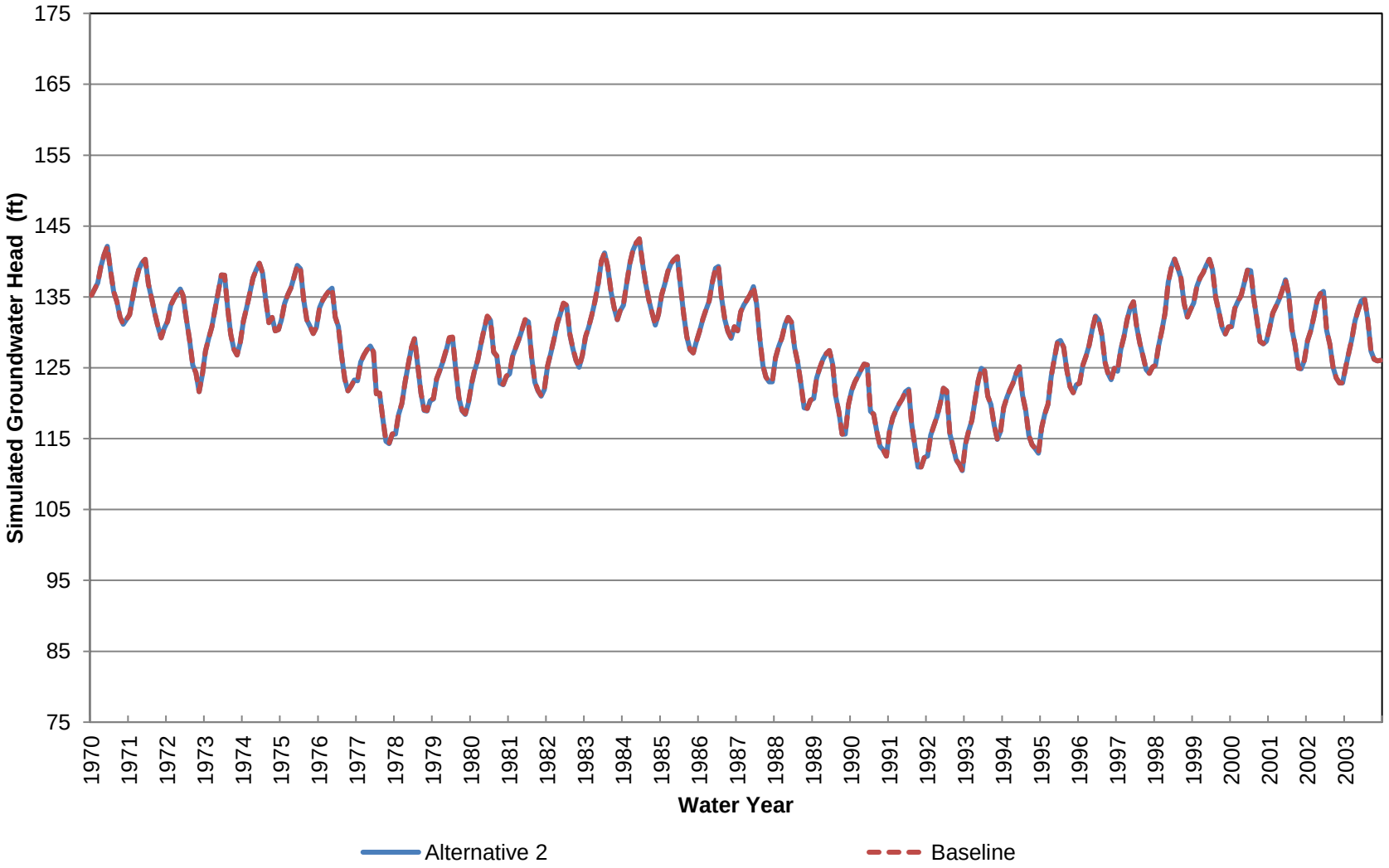
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 2 (Approximately 830-1330 ft bgs)



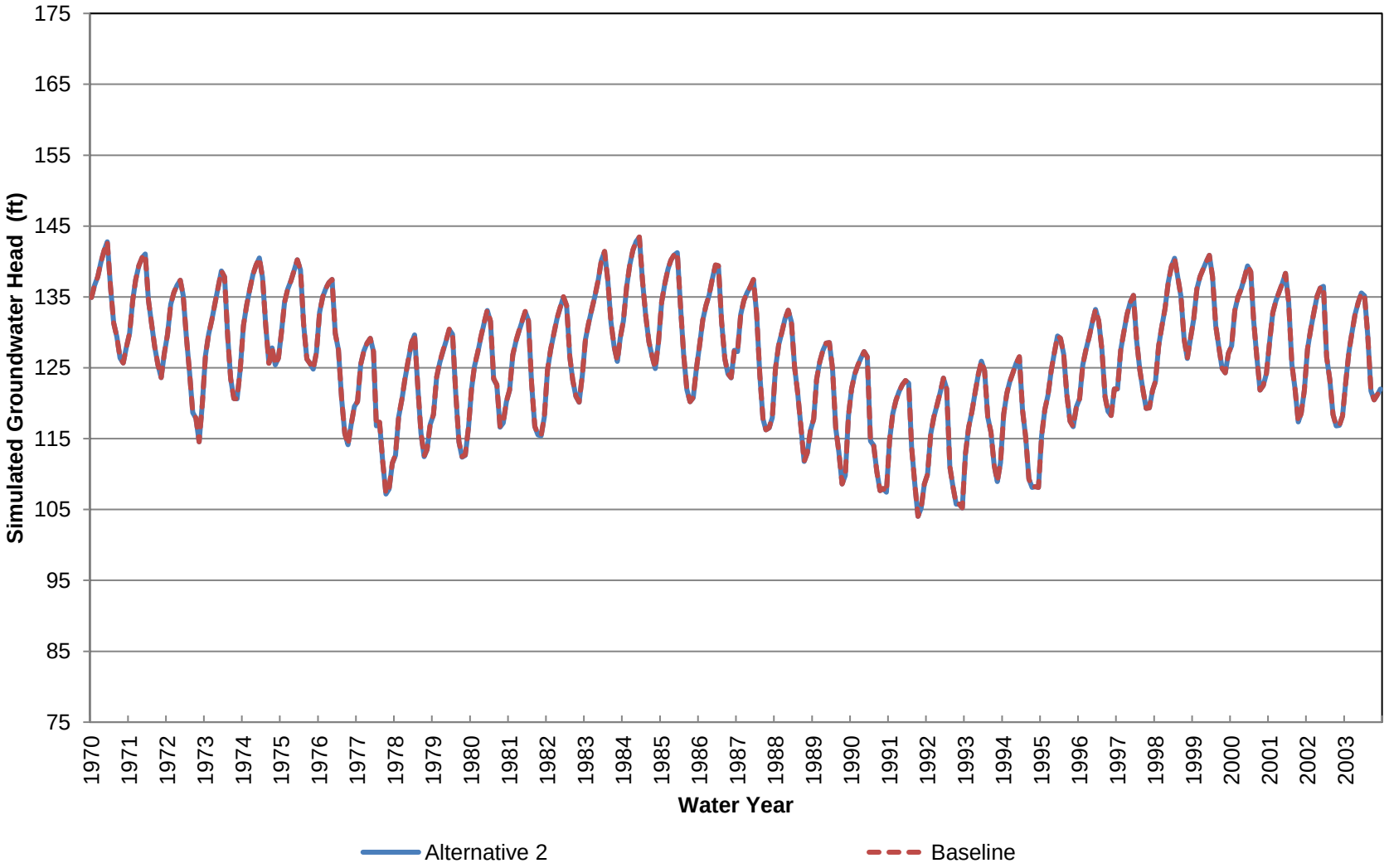
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 3 (Approximately 0-70 ft bgs)



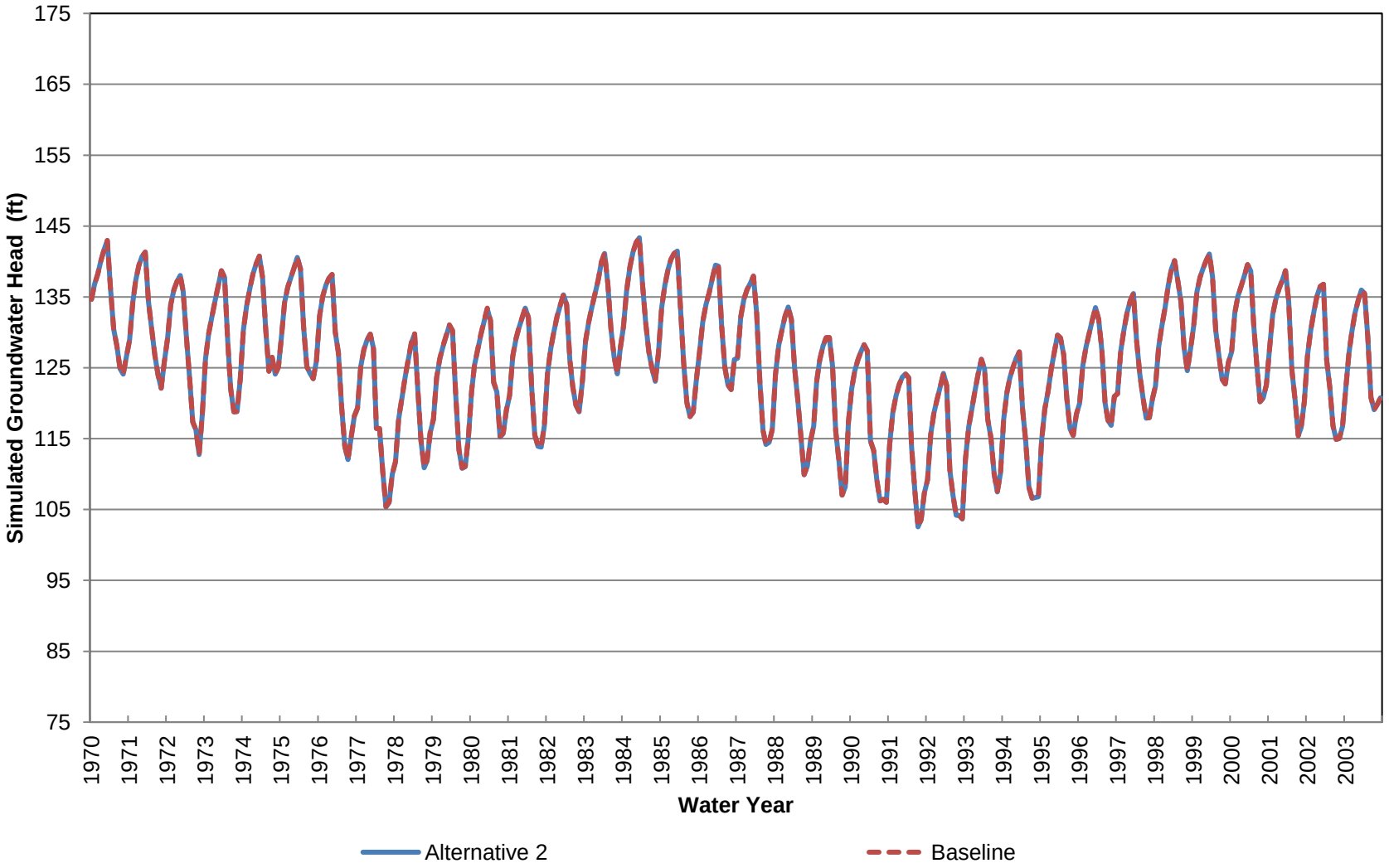
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 3 (Approximately 70-210 ft bgs)



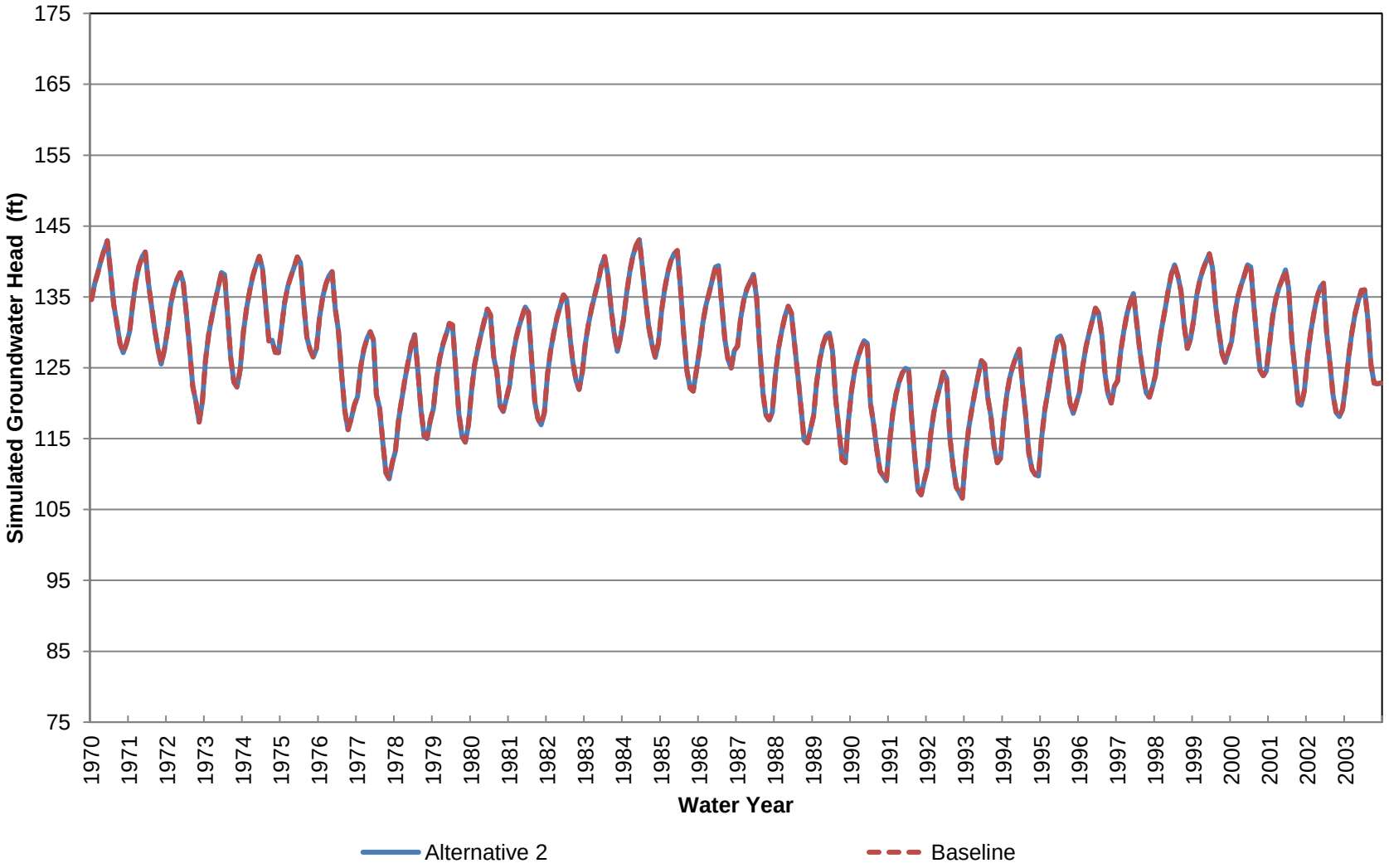
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 3 (Approximately 210-350 ft bgs)



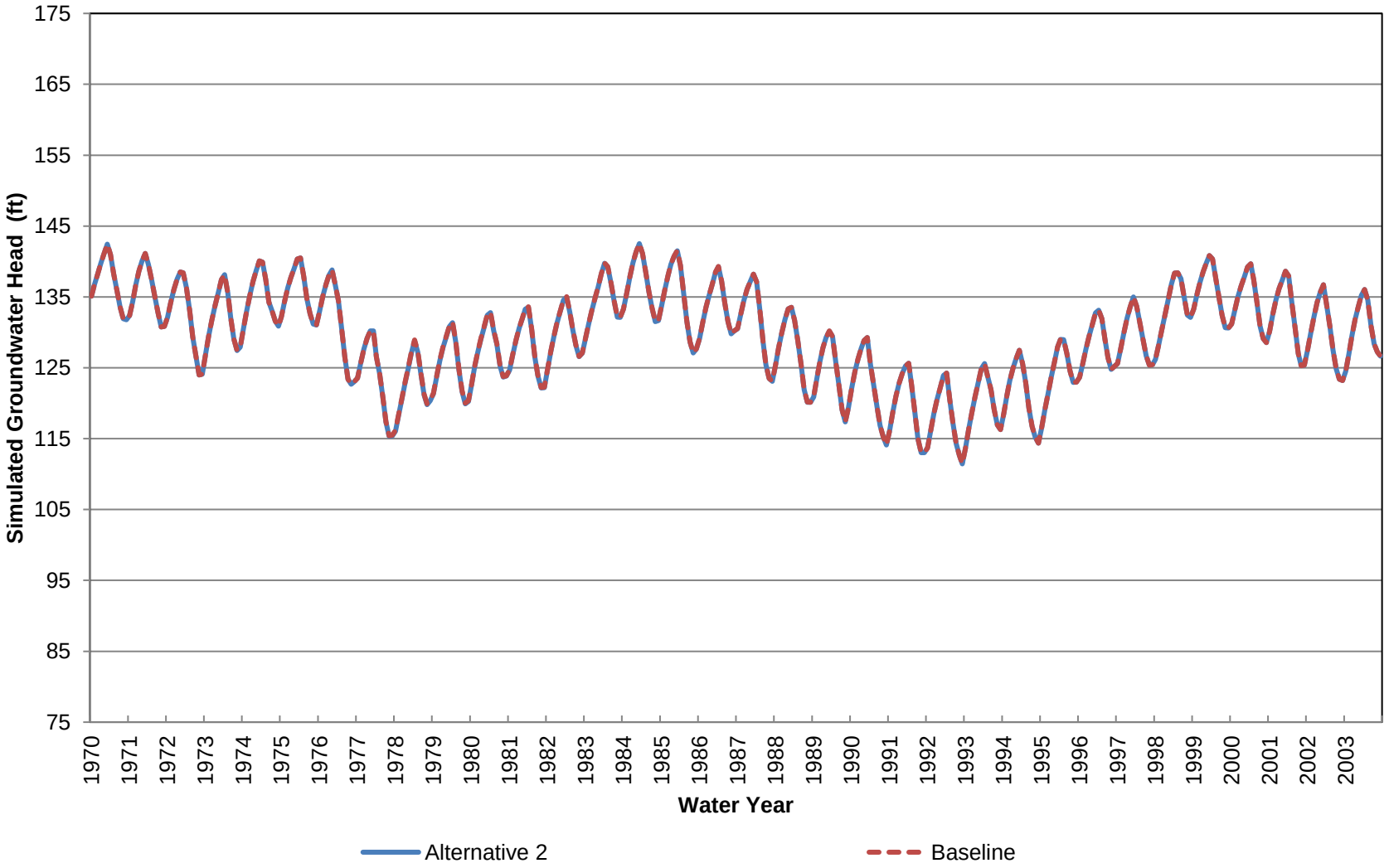
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 3 (Approximately 350-480 ft bgs)



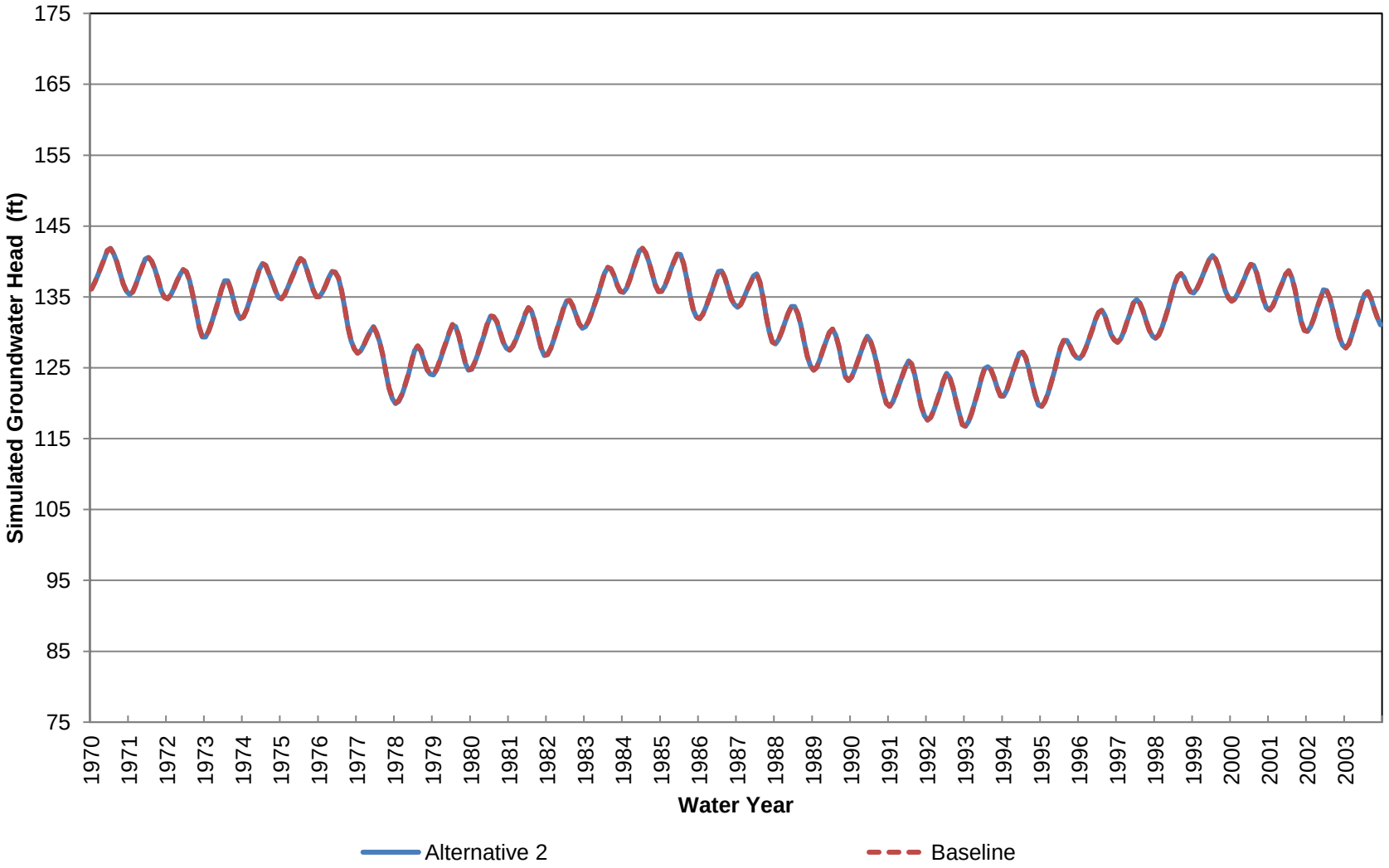
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 3 (Approximately 480-700 ft bgs)



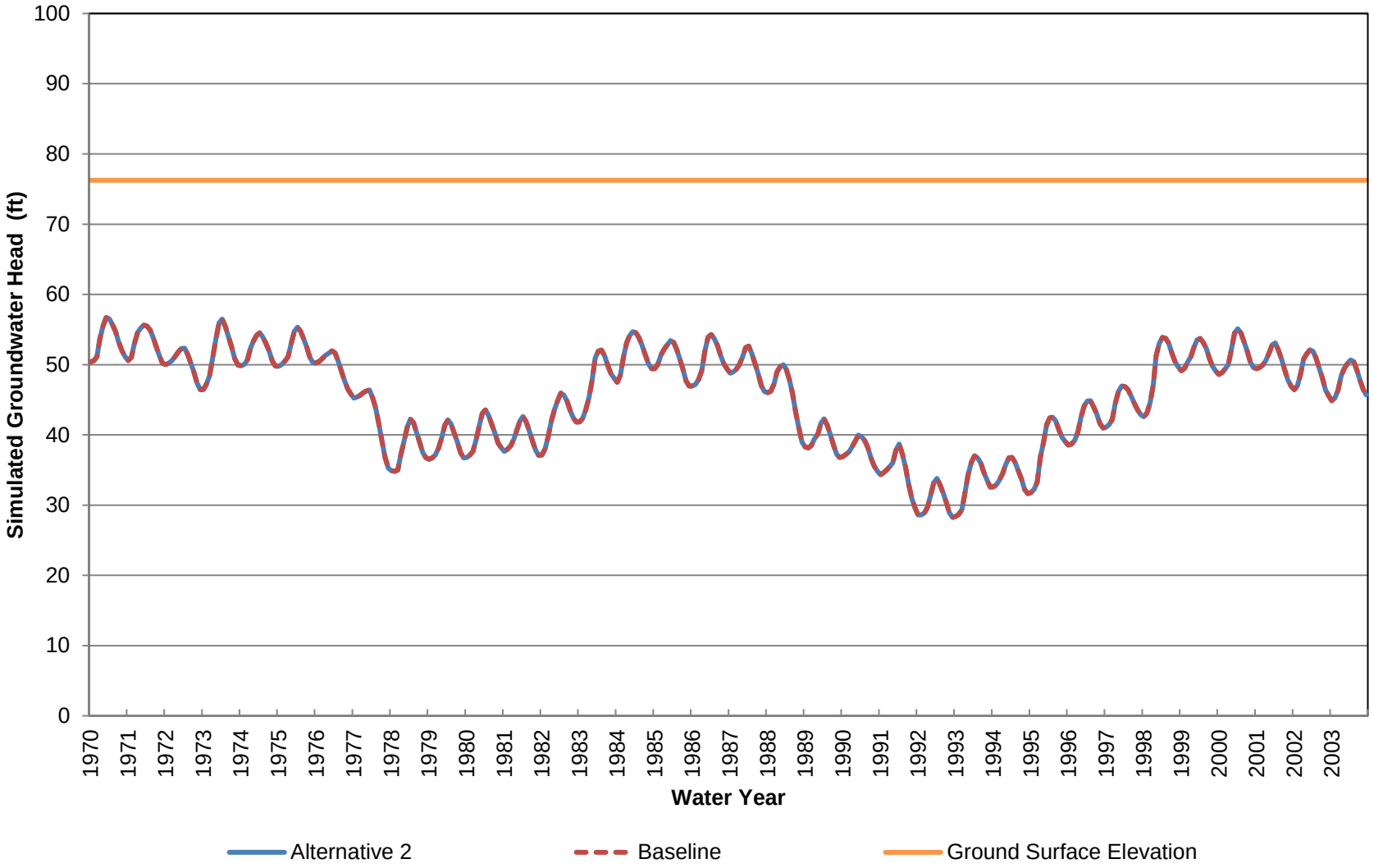
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 3 (Approximately 700-930 ft bgs)



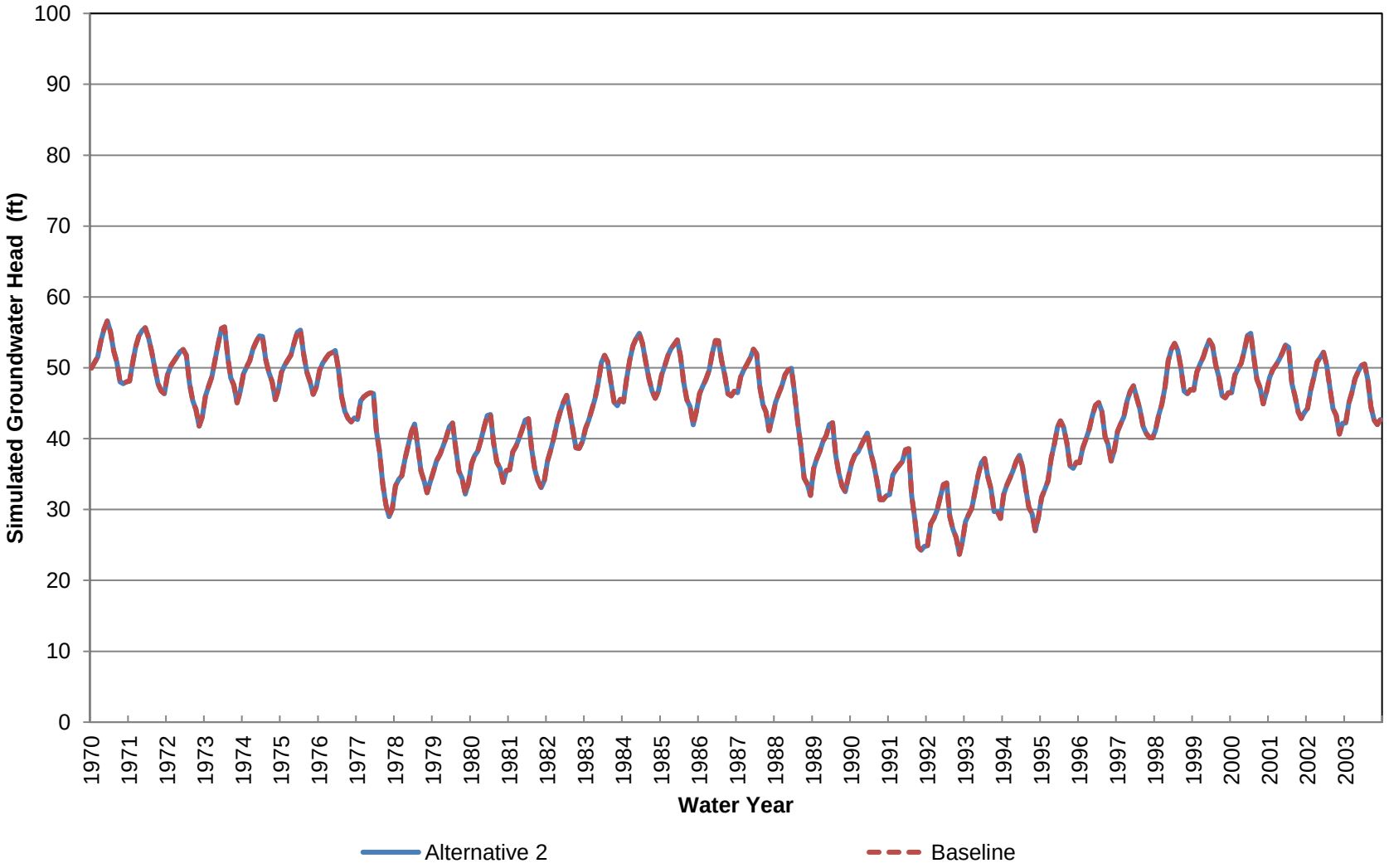
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 3 (Approximately 930-1290 ft bgs)



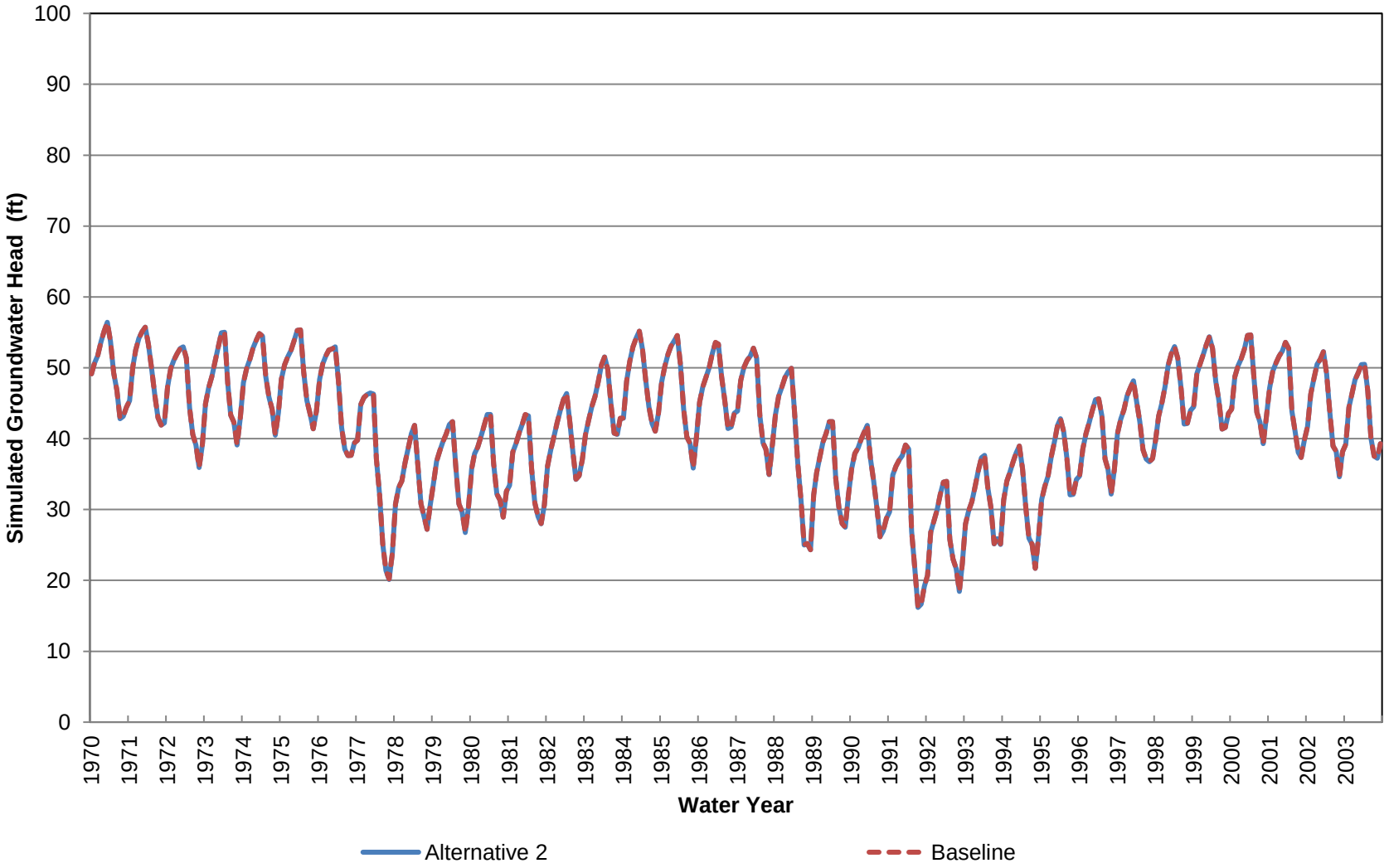
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 4 (Approximately 0-70 ft bgs)



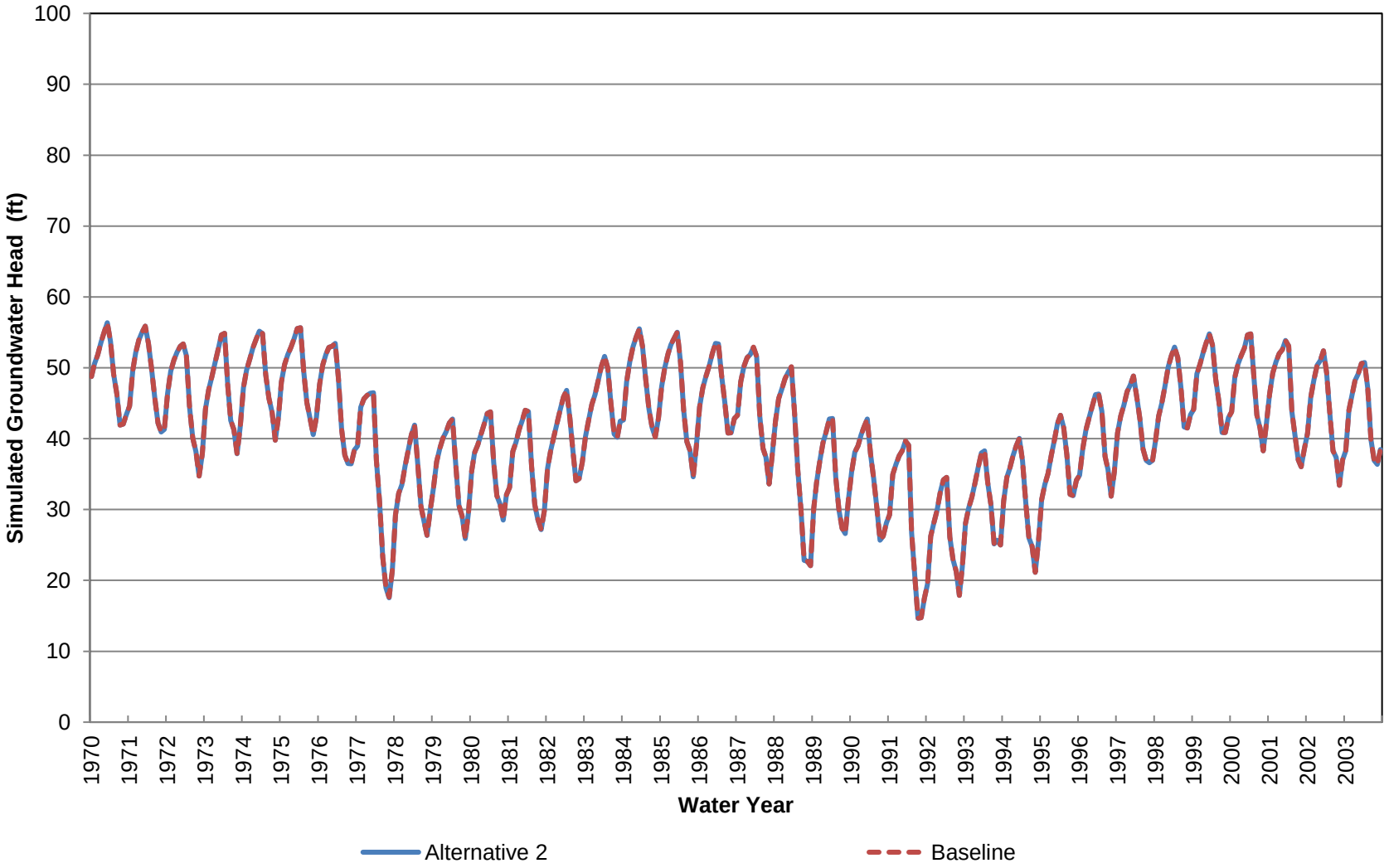
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 4 (Approximately 70-190 ft bgs)



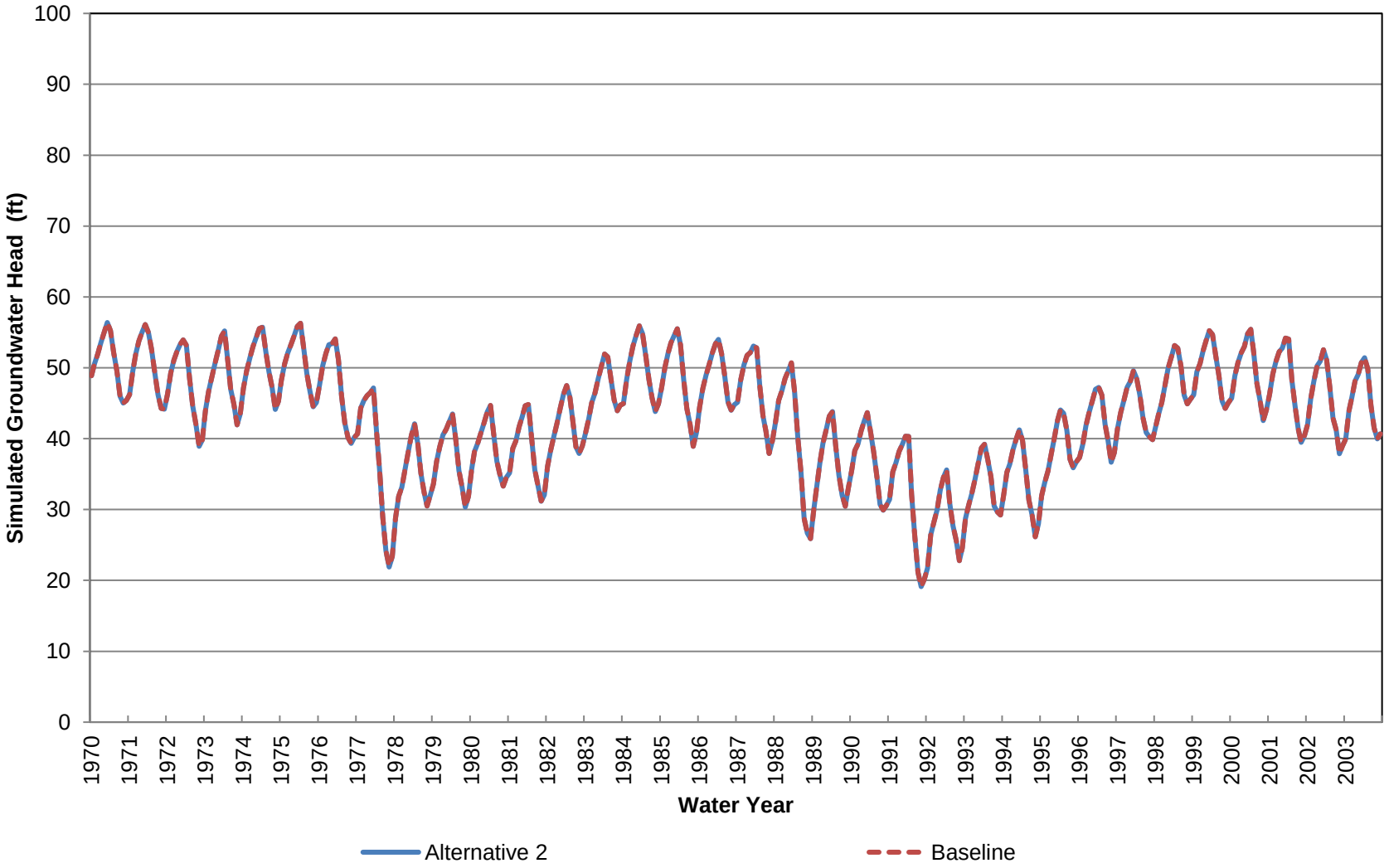
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 4 (Approximately 190-300 ft bgs)



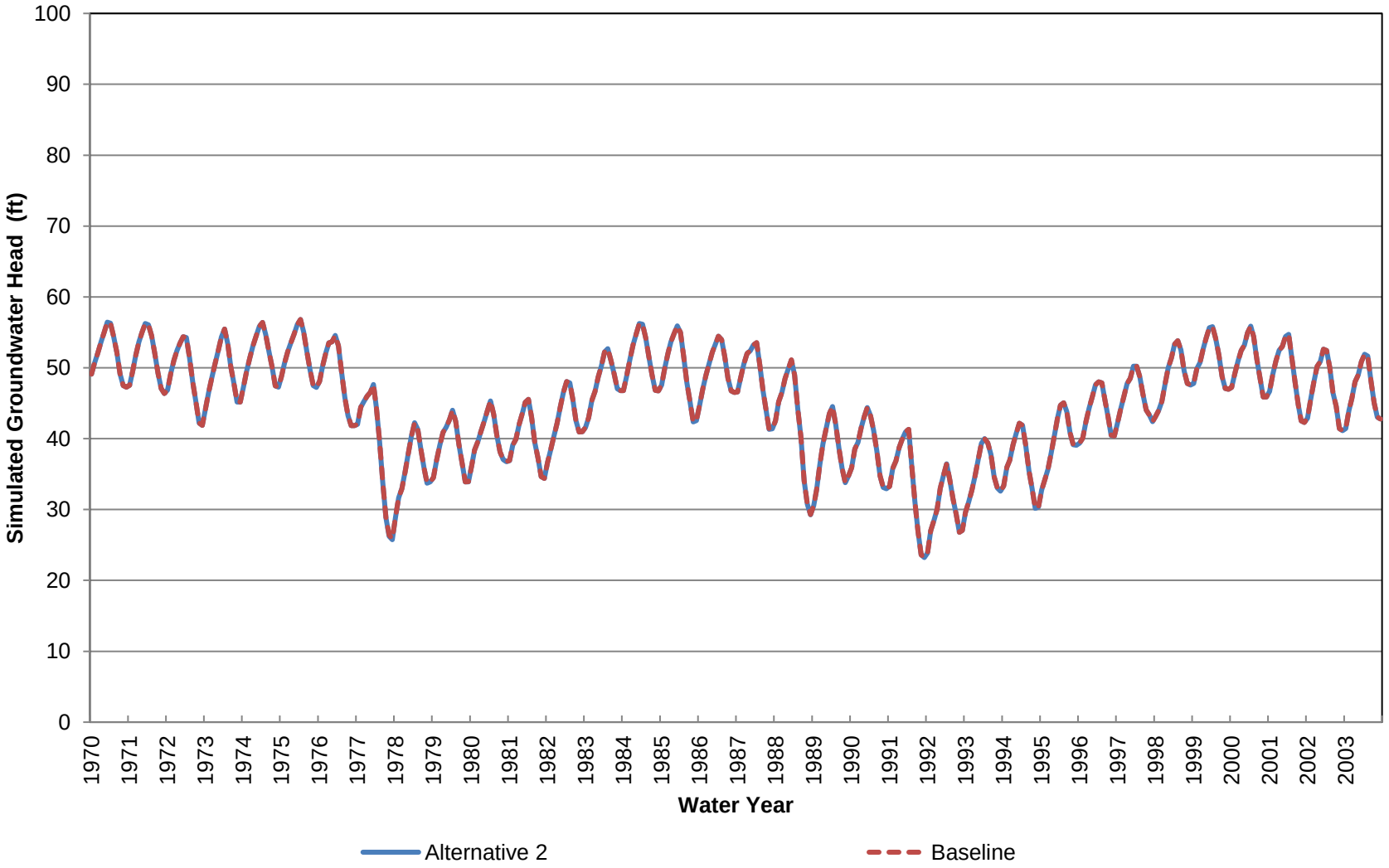
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 4 (Approximately 300-420 ft bgs)



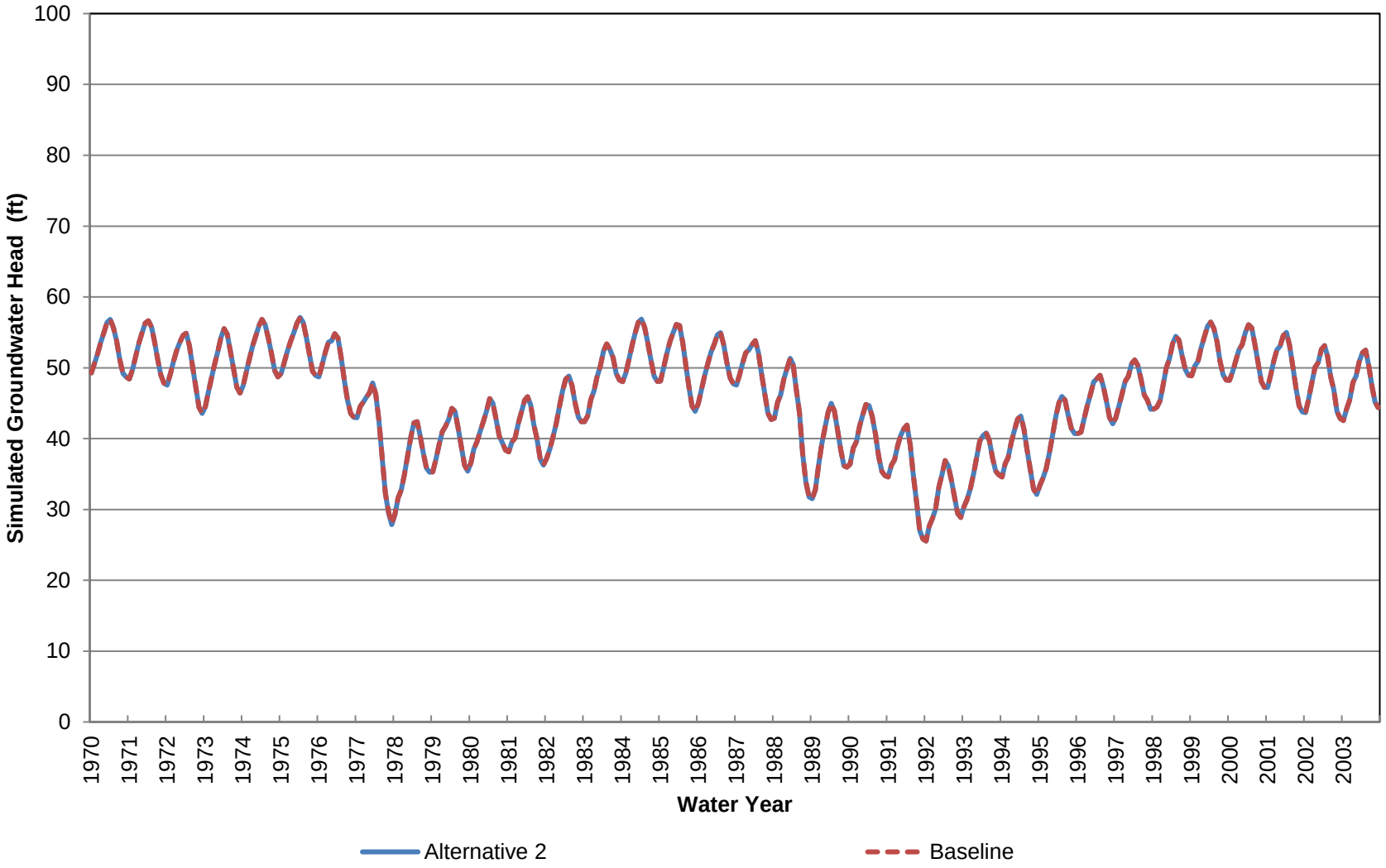
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 4 (Approximately 420-580 ft bgs)



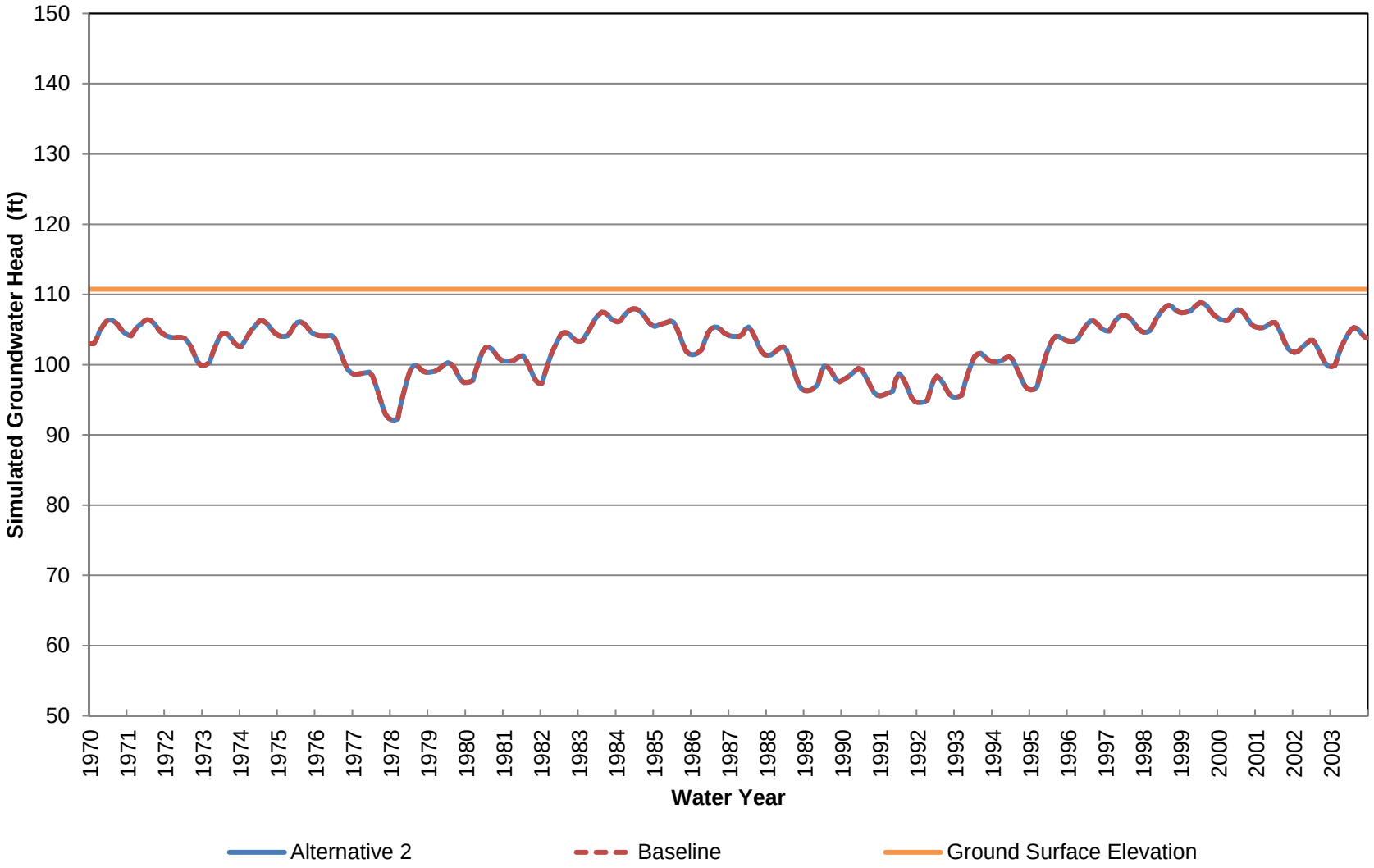
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 4 (Approximately 580-780 ft bgs)



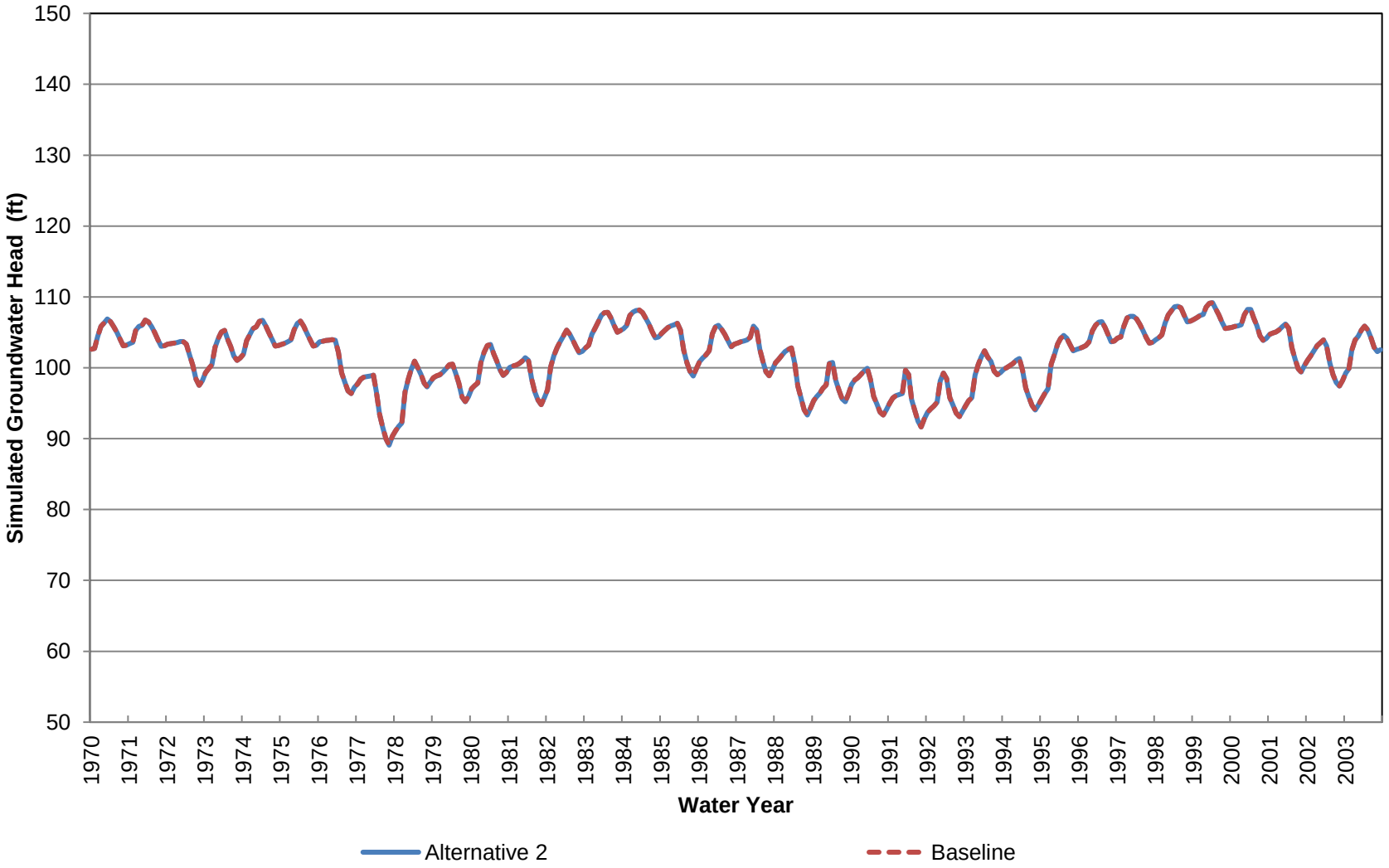
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 4 (Approximately 780-1060 ft bgs)



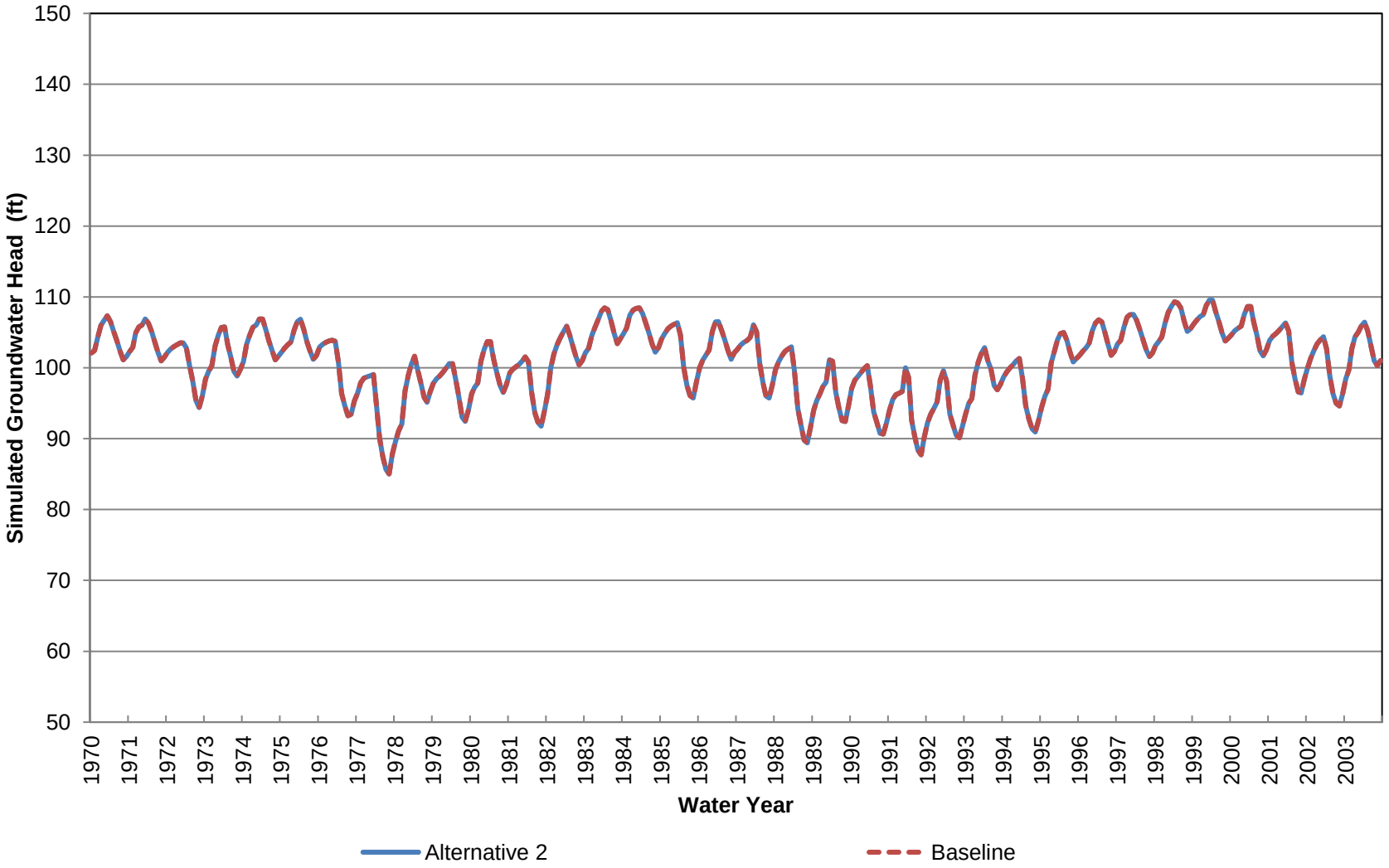
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 5 (Approximately 0-70 ft bgs)



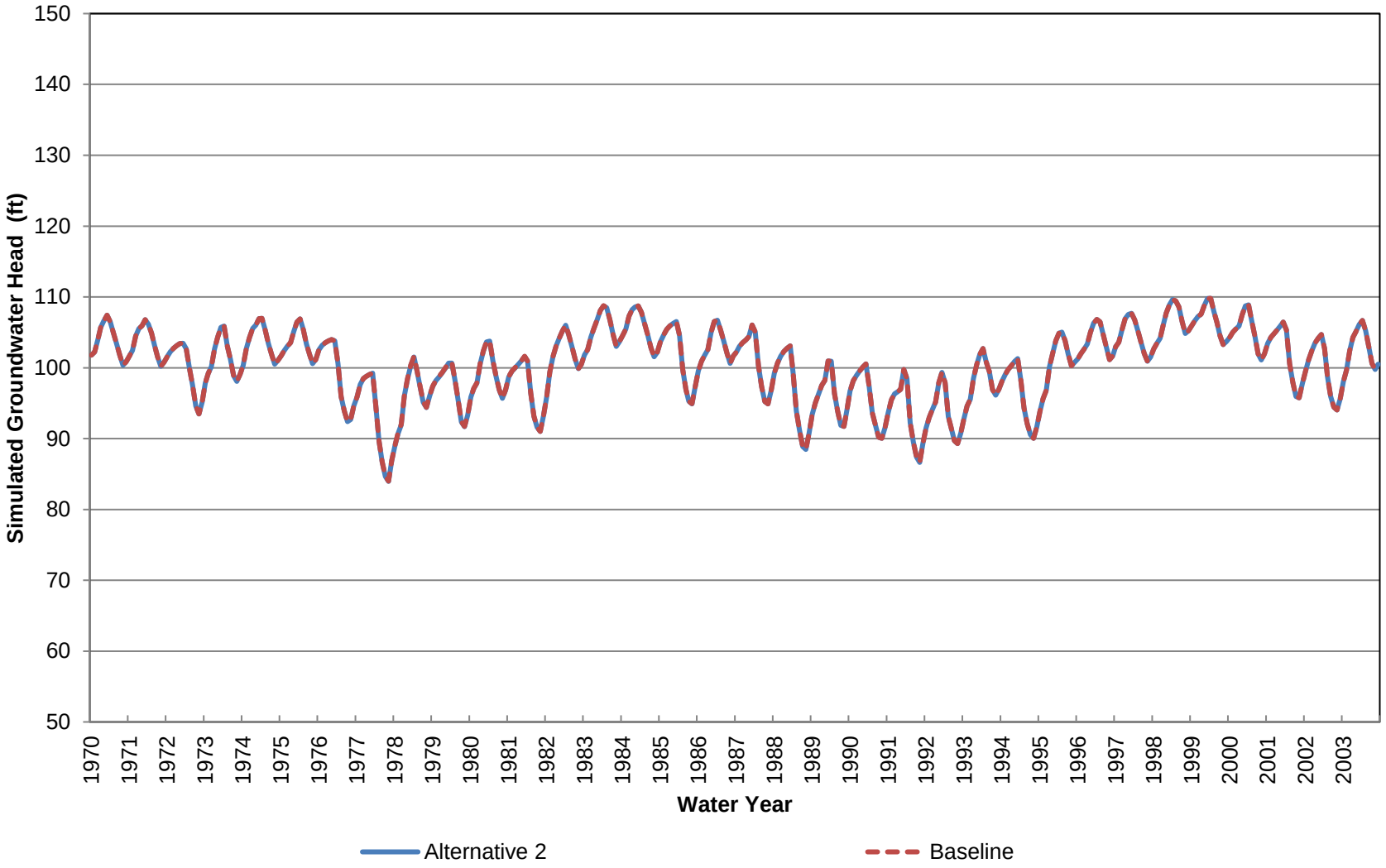
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 5 (Approximately 70-200 ft bgs)



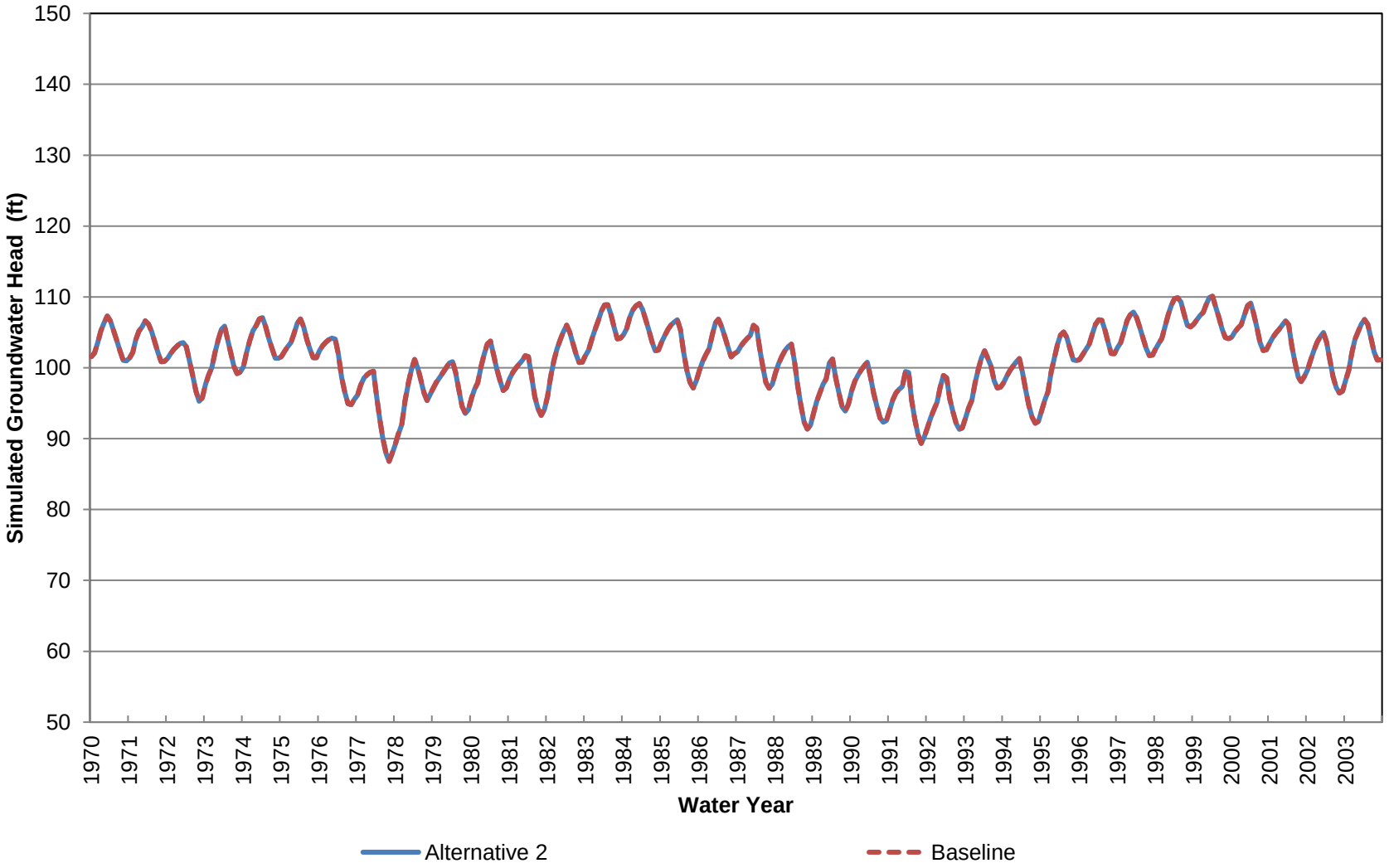
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 5 (Approximately 200-340 ft bgs)



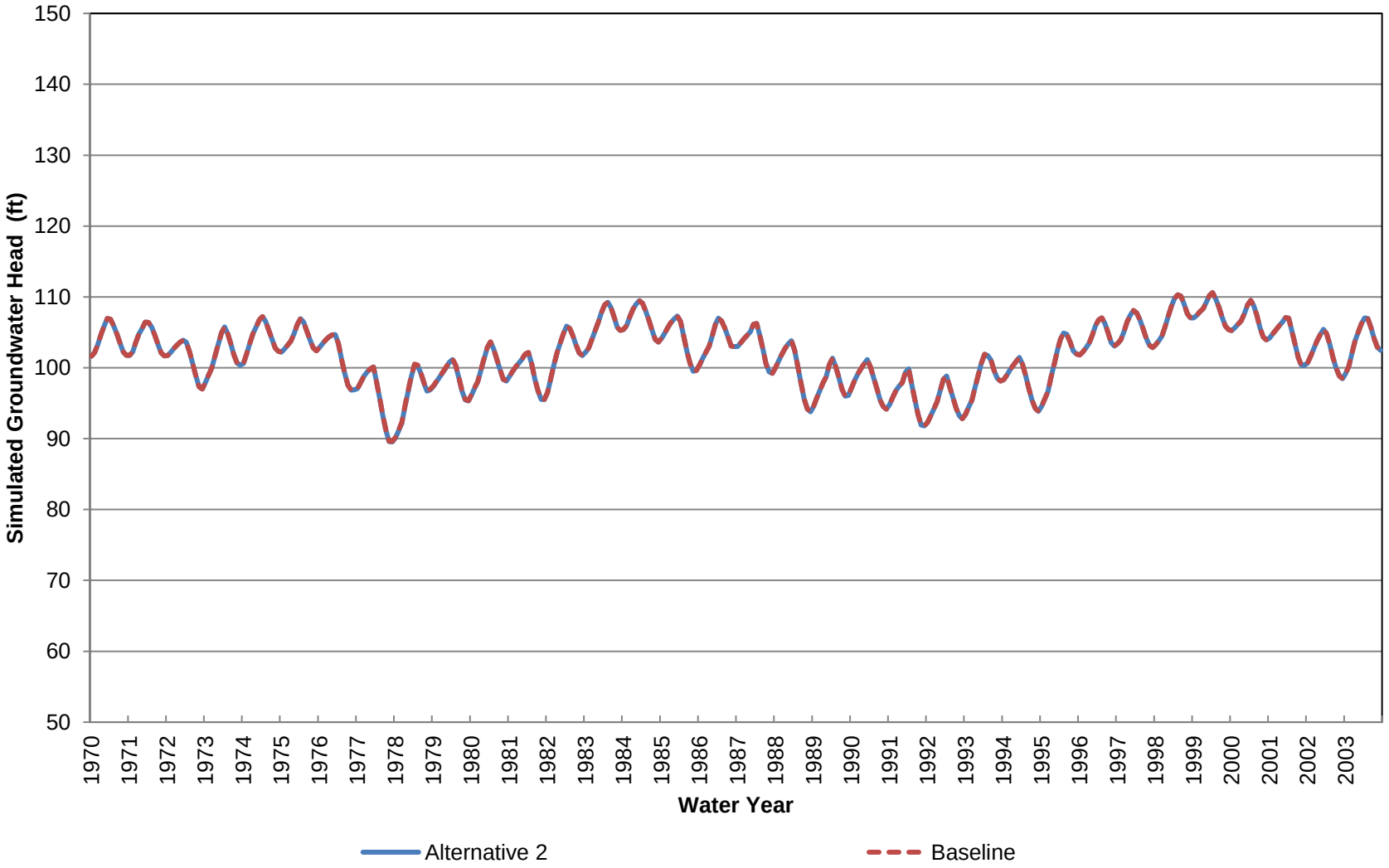
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 5 (Approximately 340-470 ft bgs)



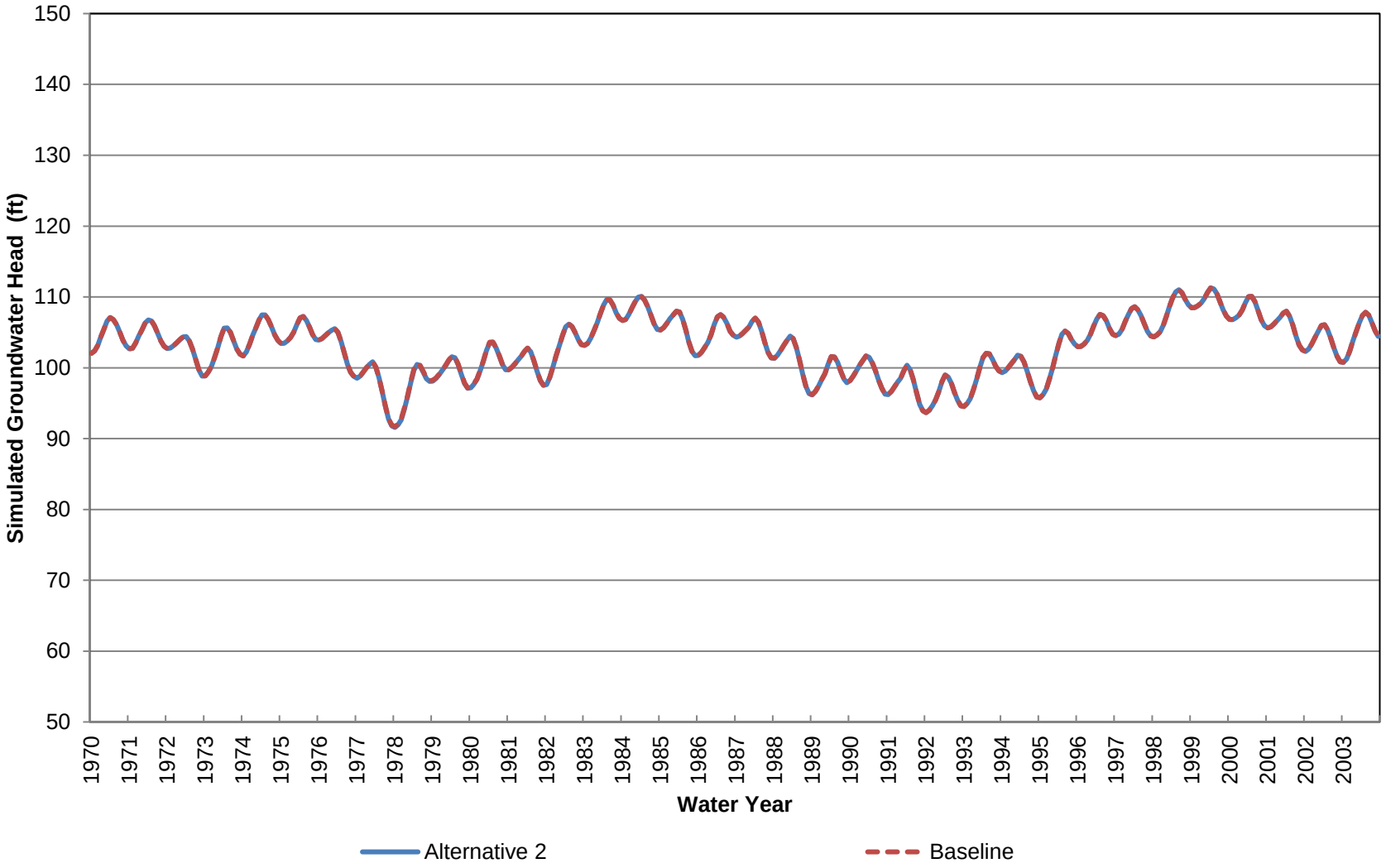
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 5 (Approximately 470-670 ft bgs)



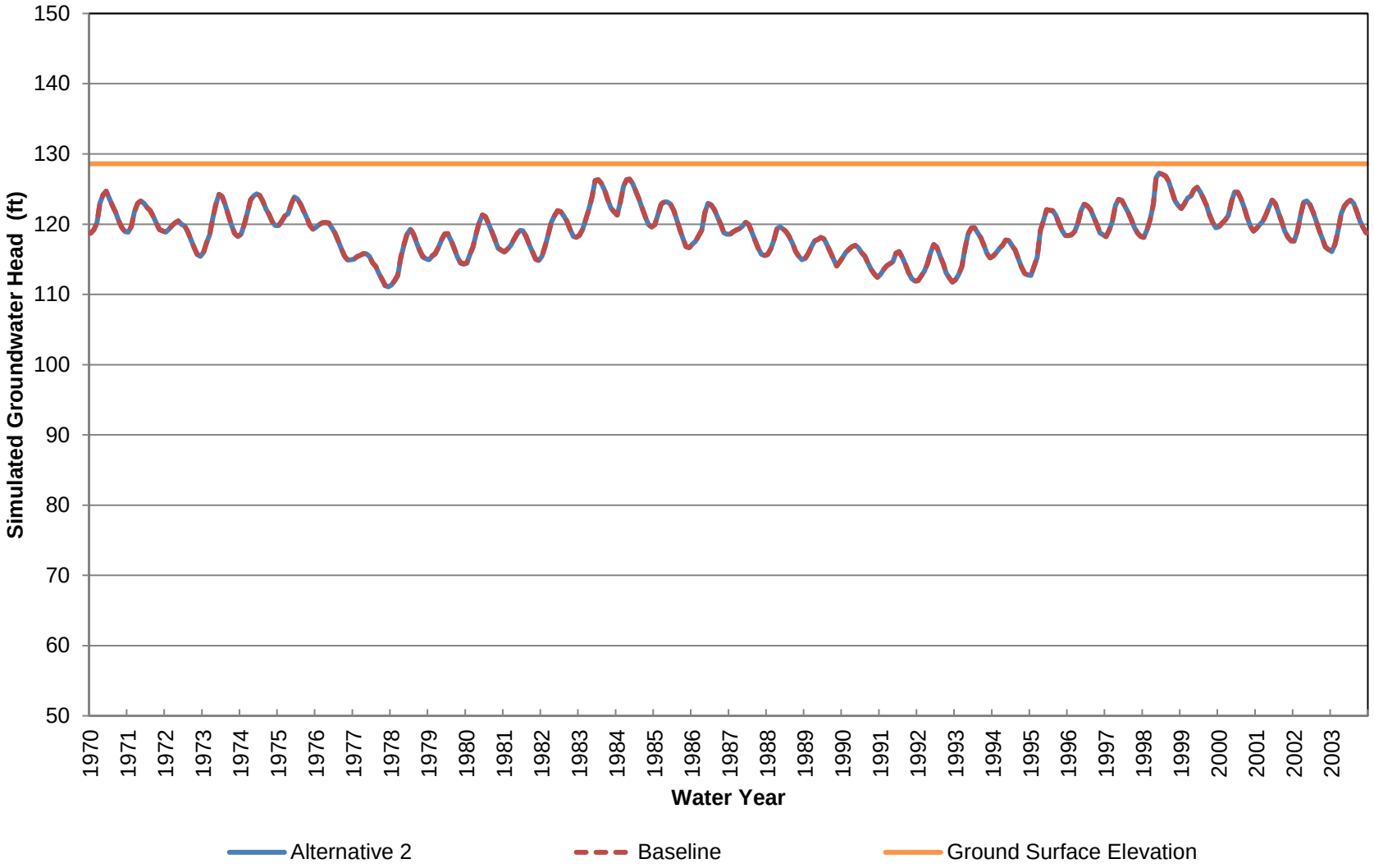
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 5 (Approximately 670-910 ft bgs)



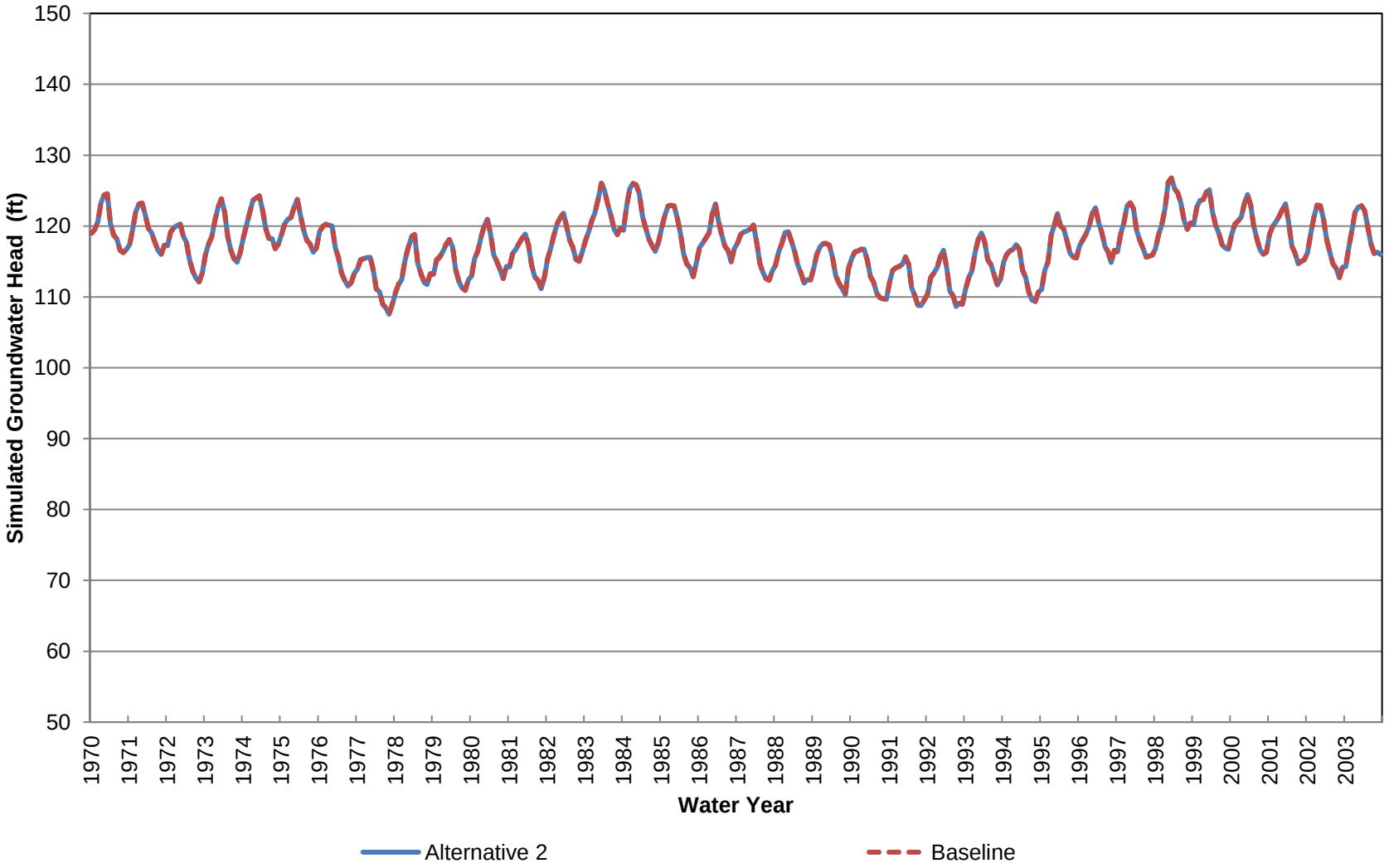
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 5 (Approximately 910-1310 ft bgs)



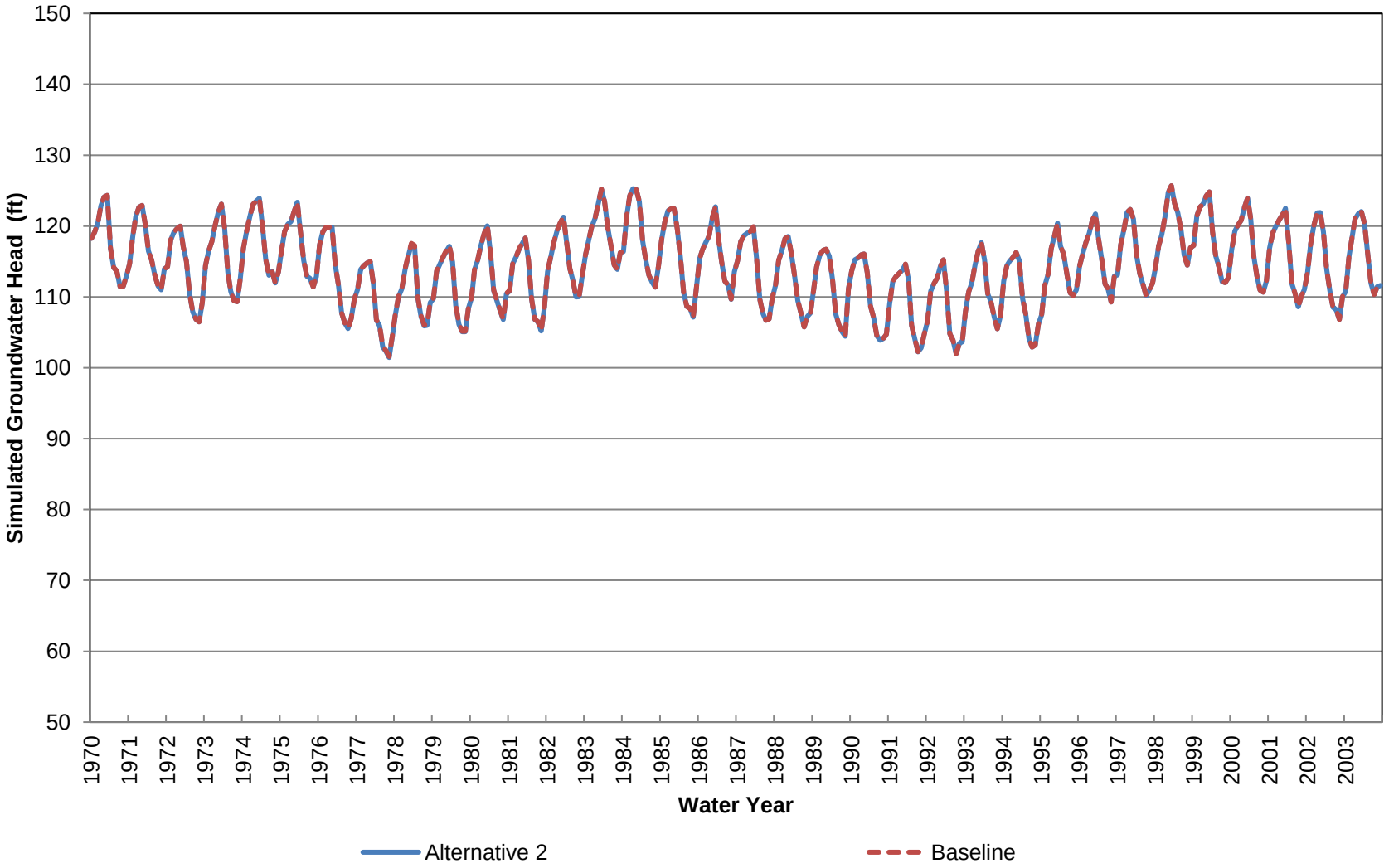
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 6 (Approximately 0-70 ft bgs)



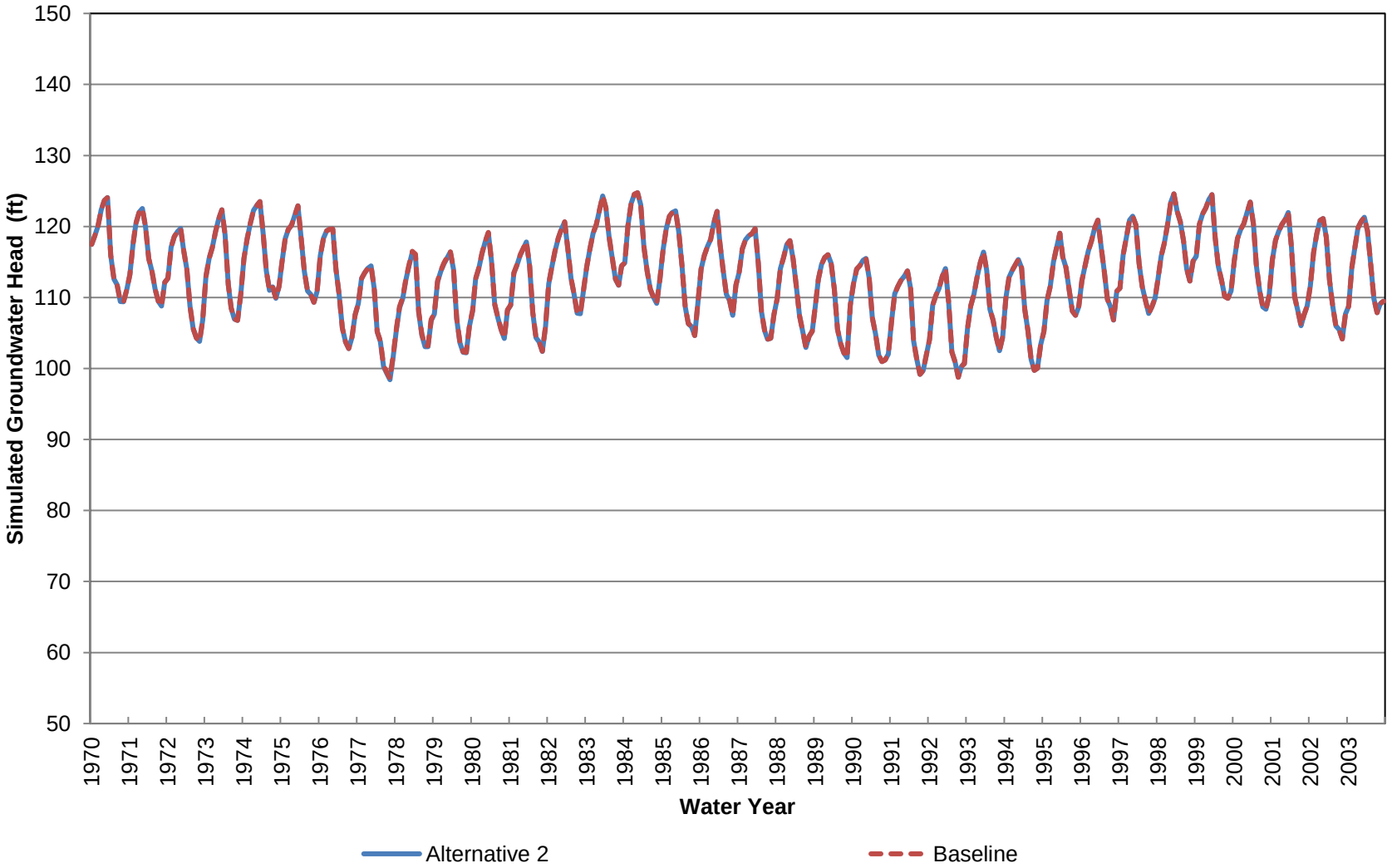
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 6 (Approximately 70-200 ft bgs)



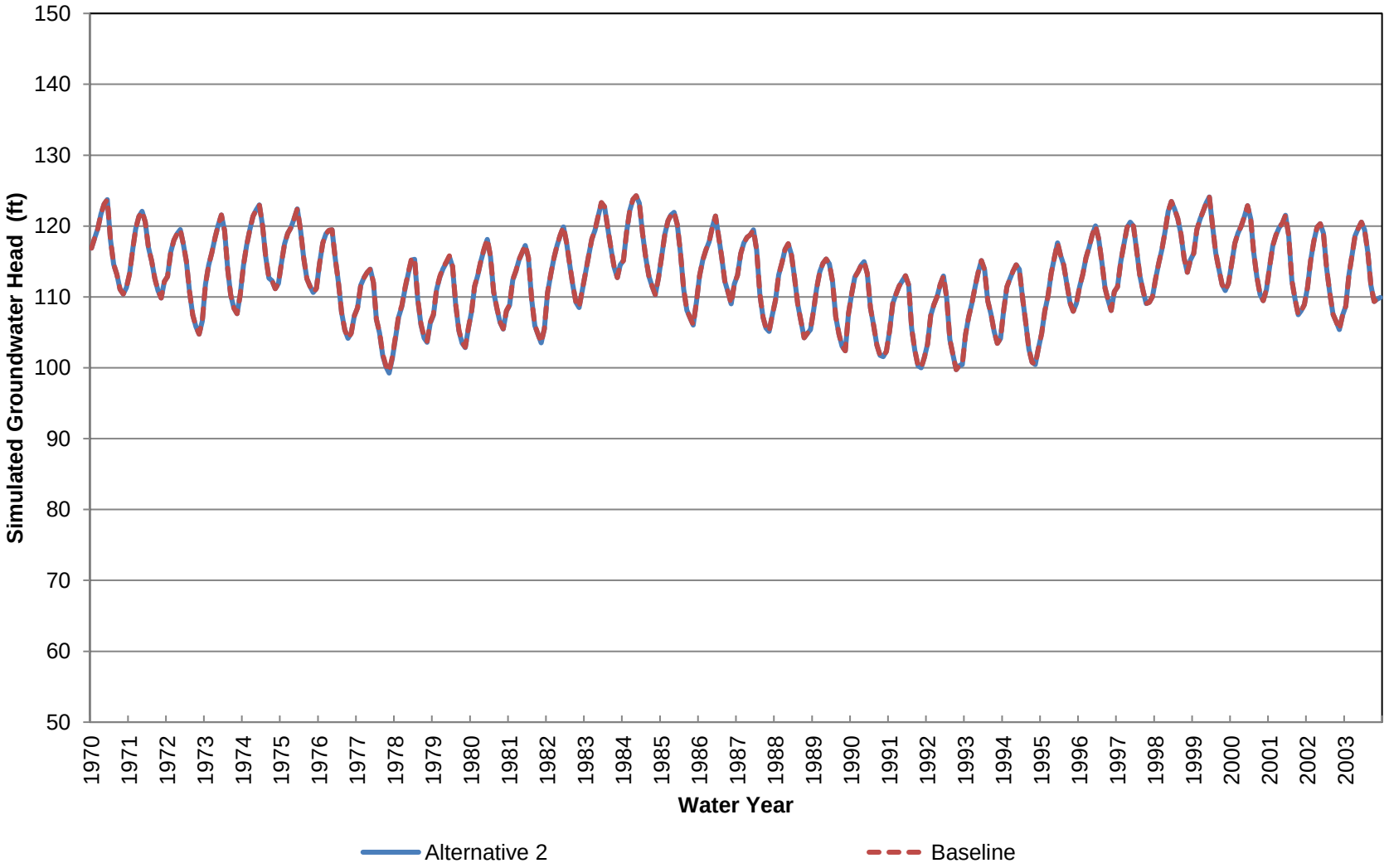
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 6 (Approximately 200-320 ft bgs)



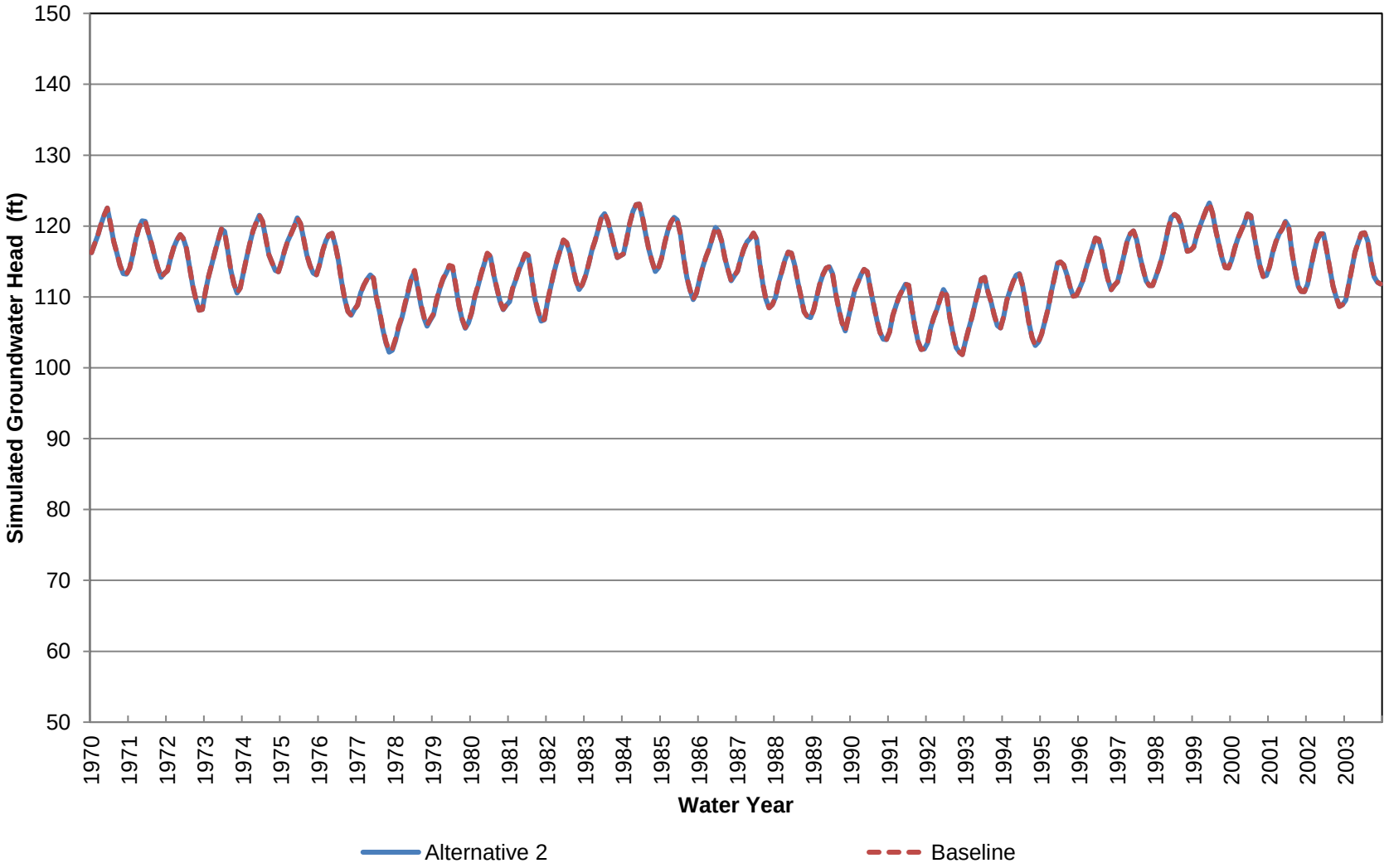
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 6 (Approximately 320-440 ft bgs)



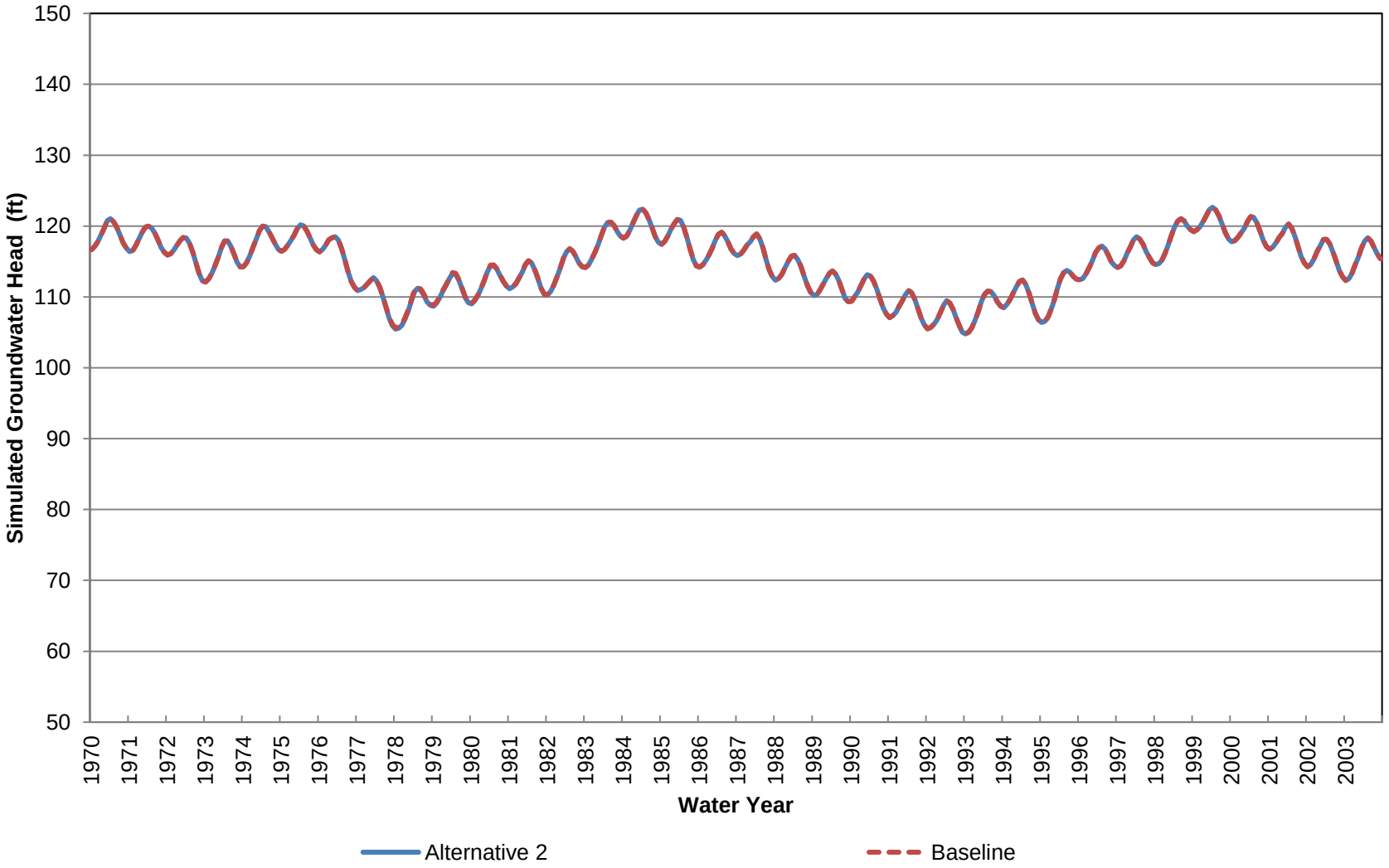
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 6 (Approximately 440-630 ft bgs)



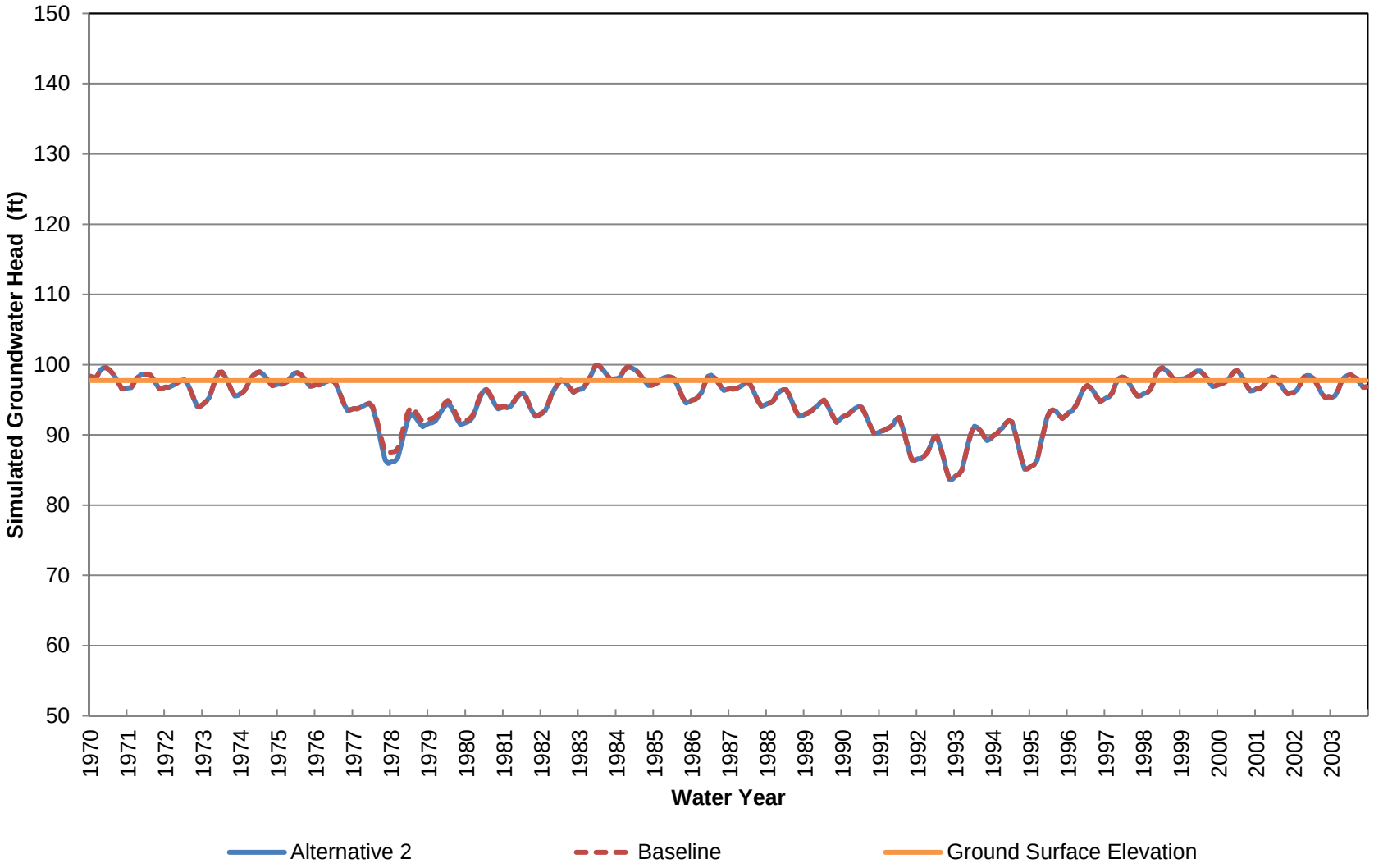
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 6 (Approximately 630-860 ft bgs)



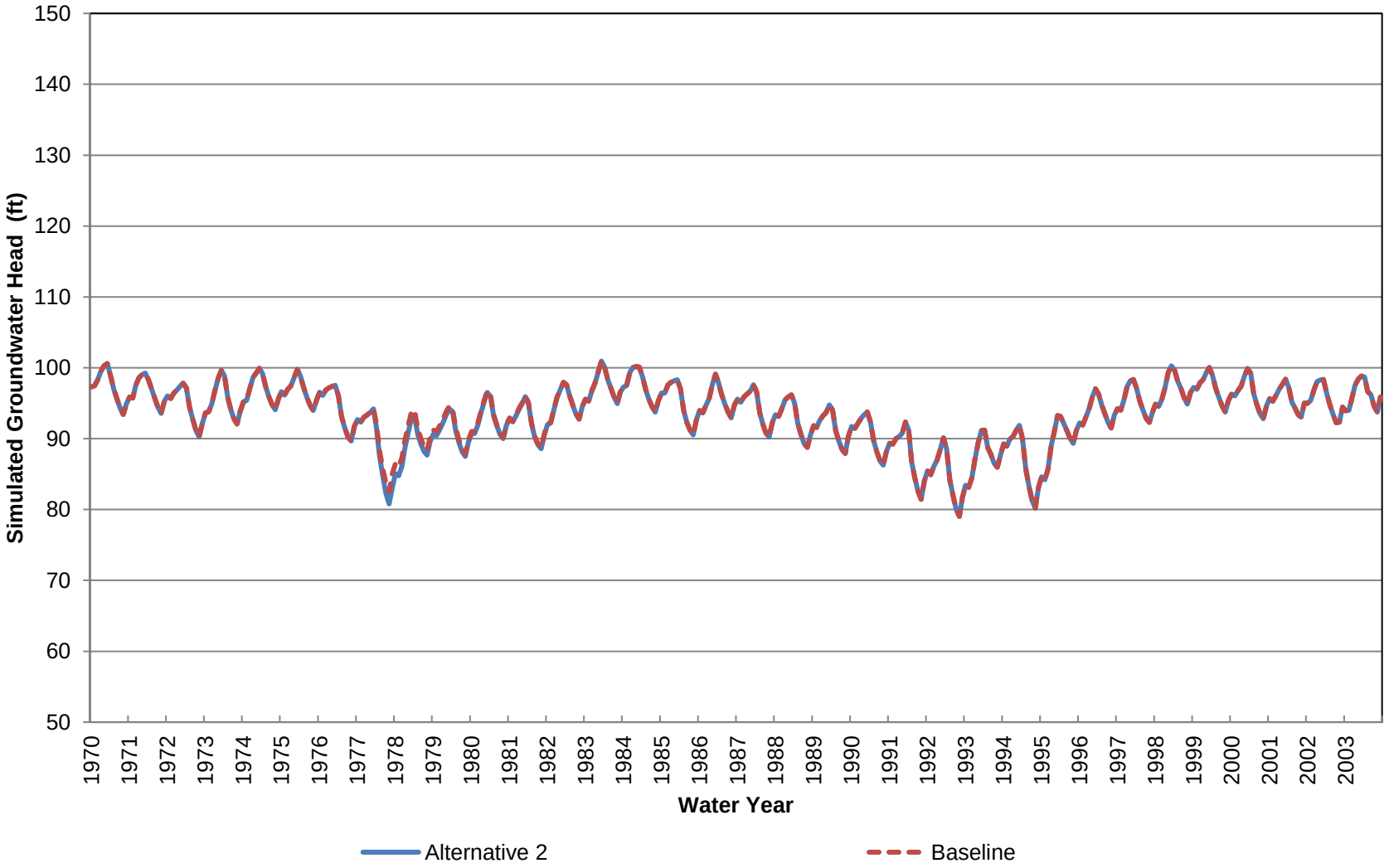
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 6 (Approximately 860-1290 ft bgs)



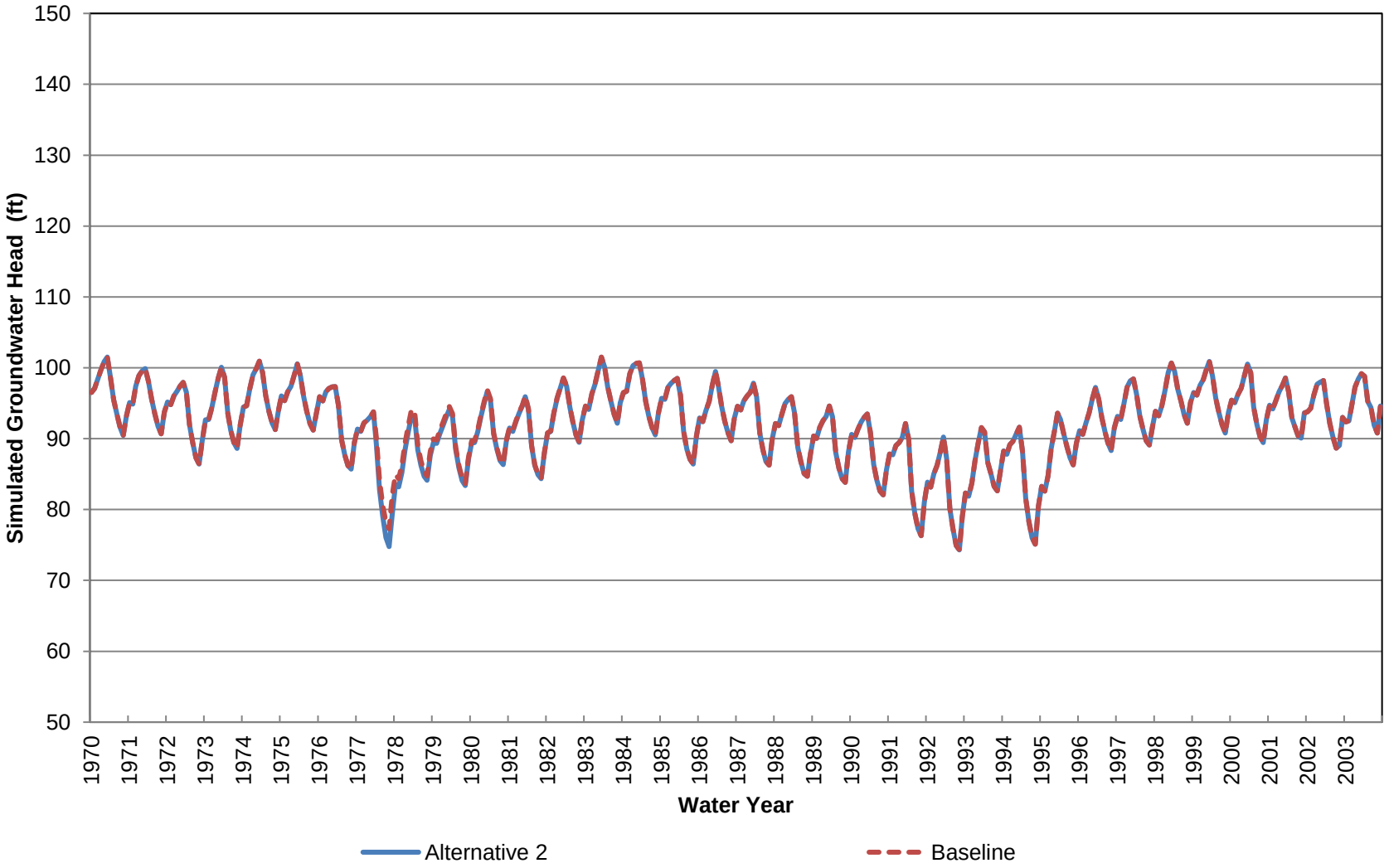
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 7 (Approximately 0-70 ft bgs)



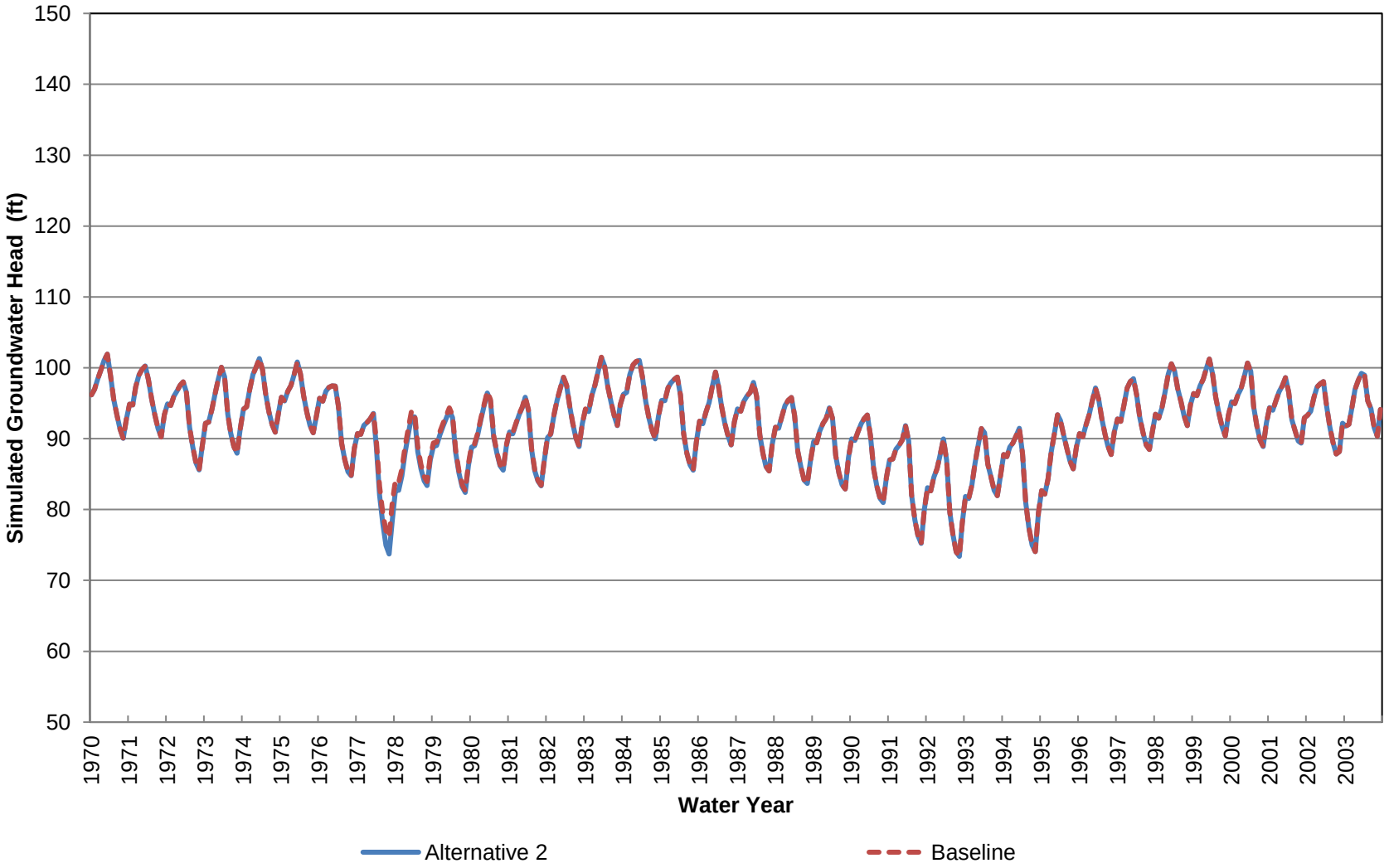
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 7 (Approximately 70-220 ft bgs)



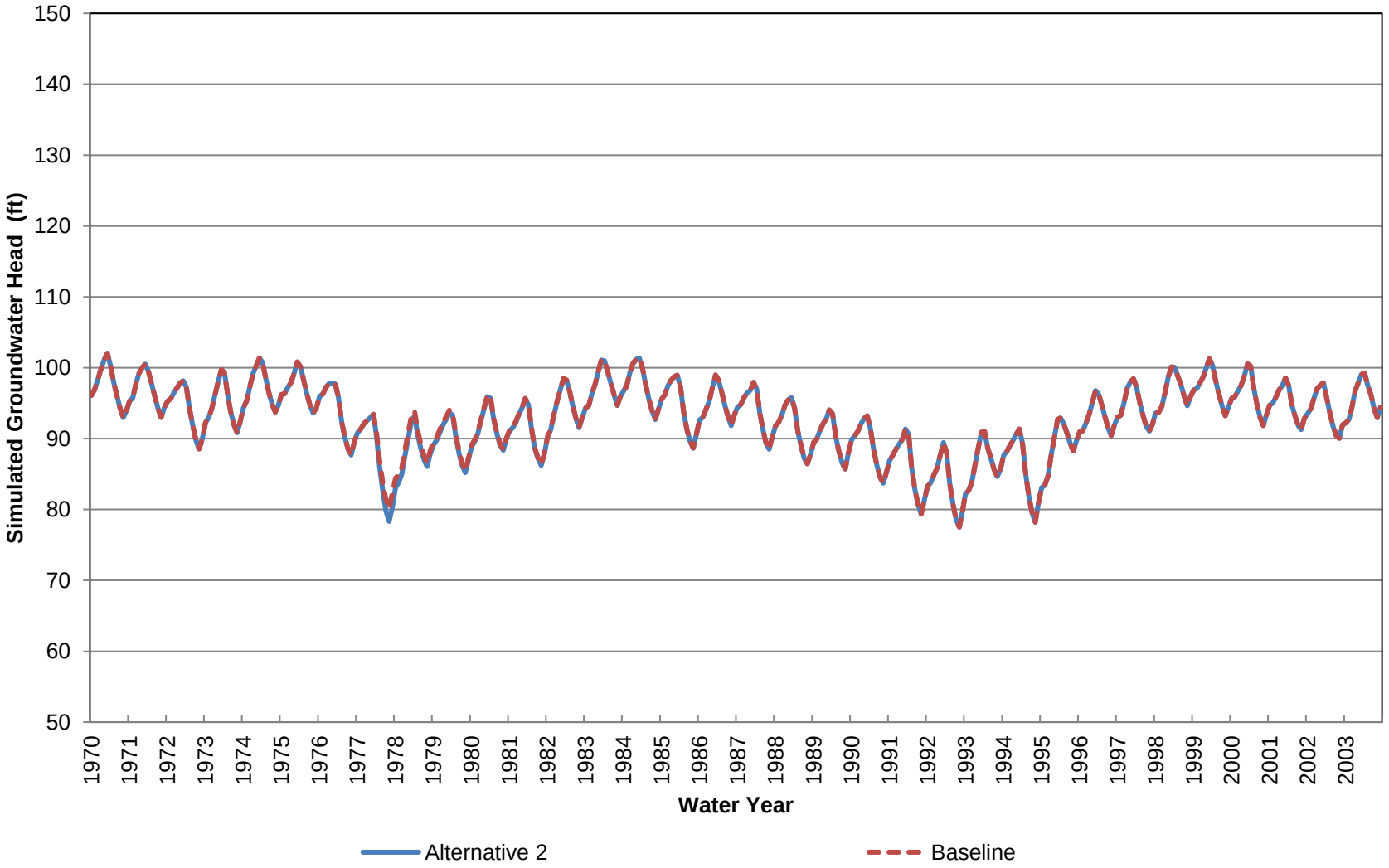
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 7 (Approximately 220-370 ft bgs)



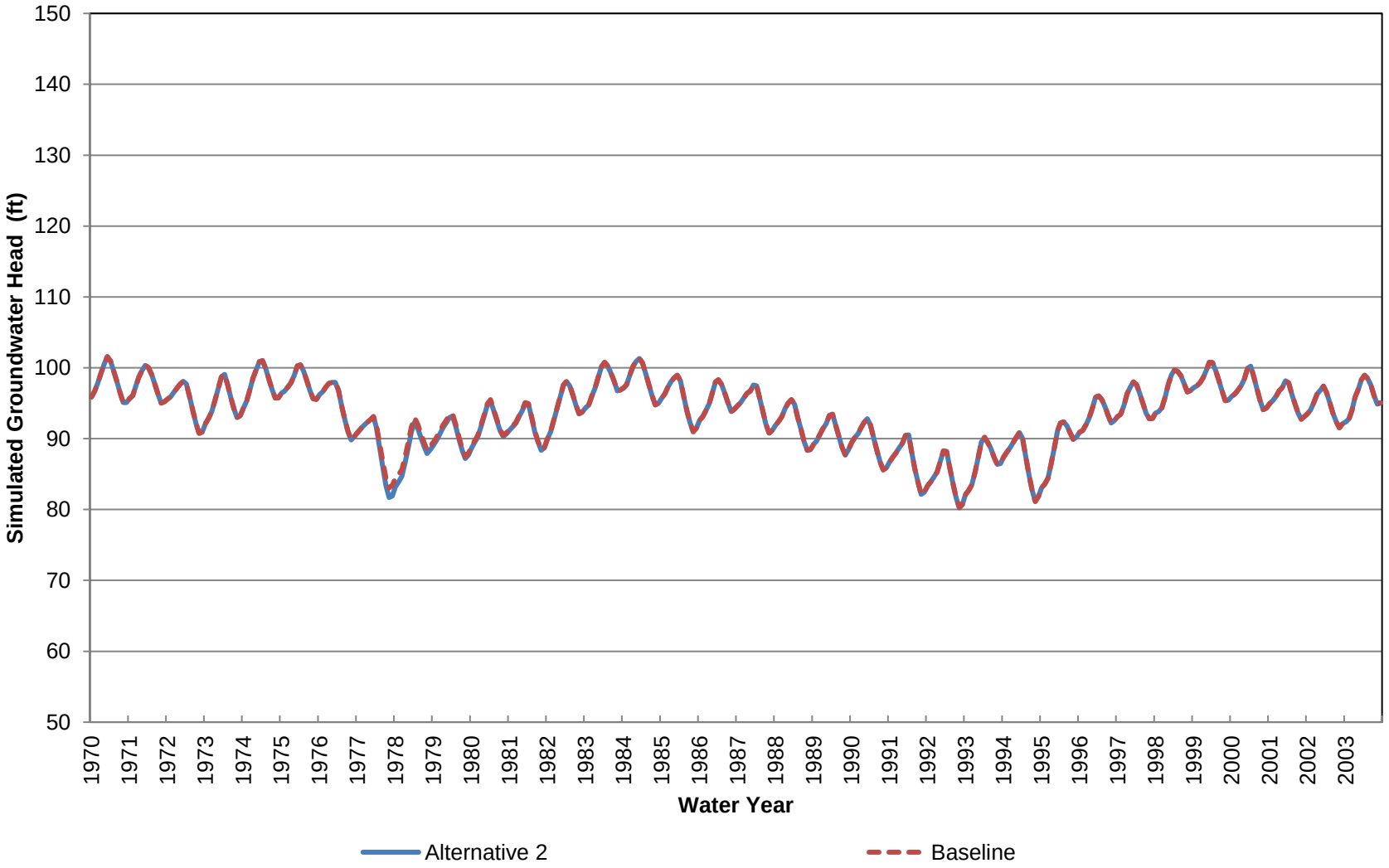
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 7 (Approximately 370-520 ft bgs)



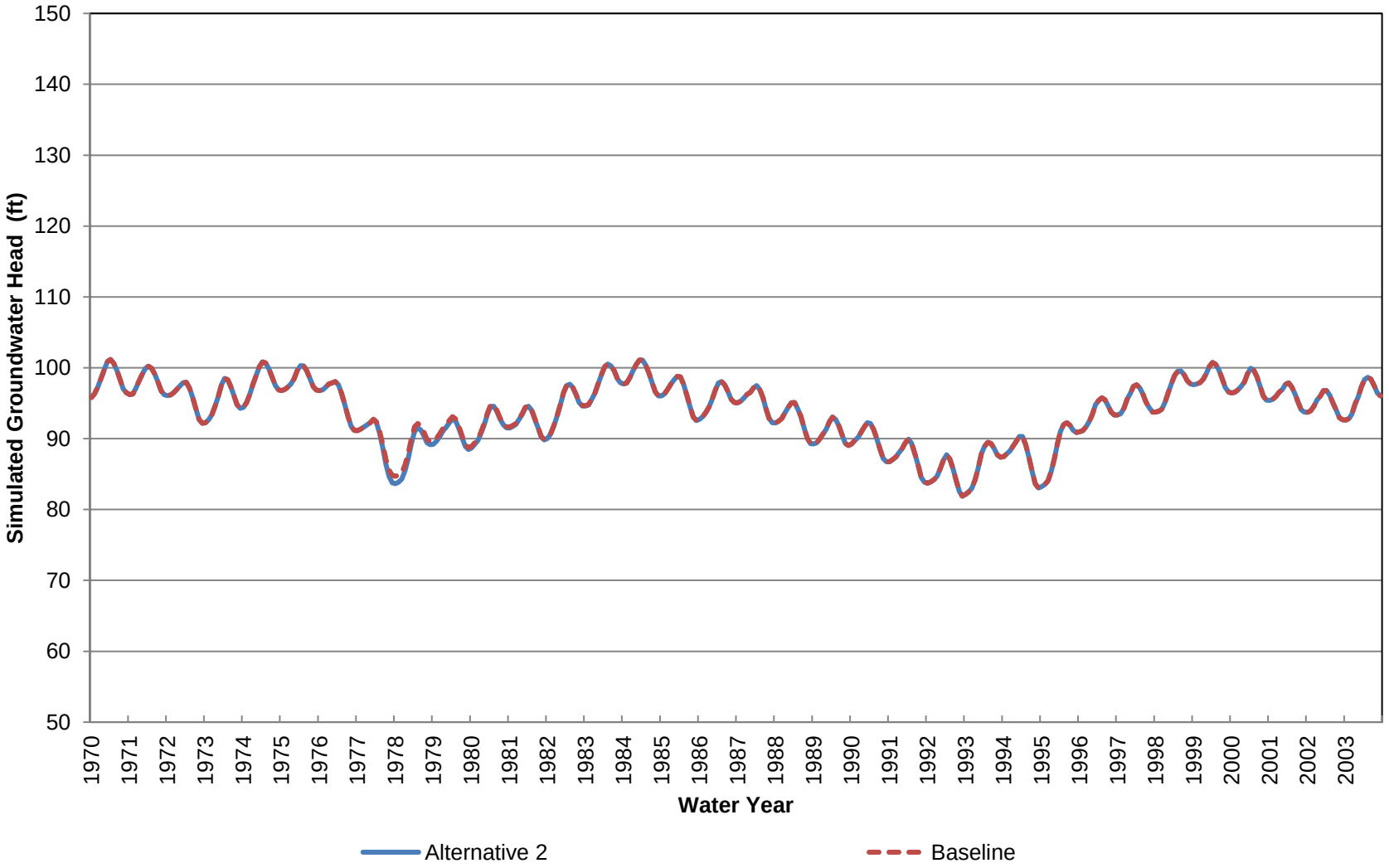
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 7 (Approximately 520-760 ft bgs)



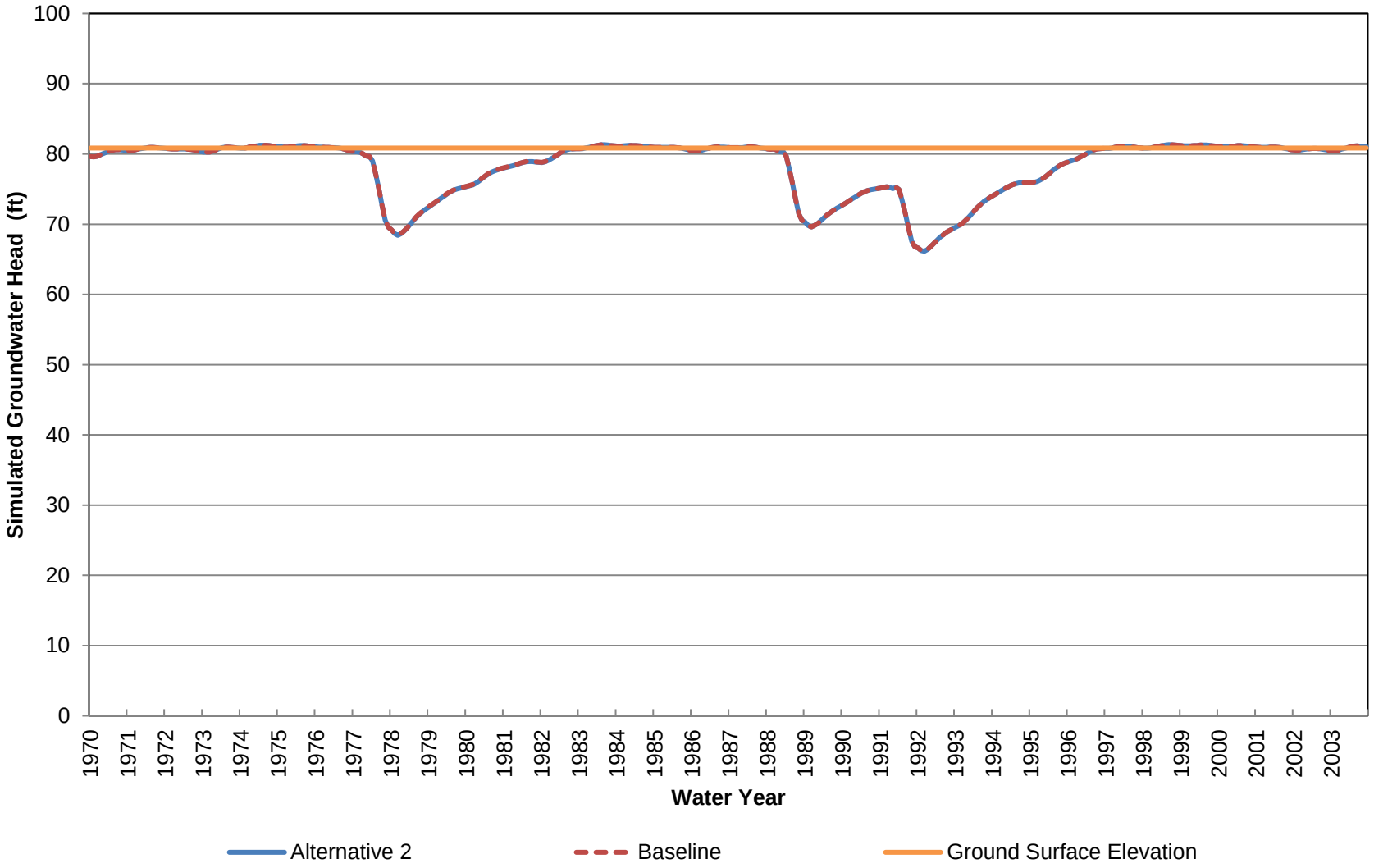
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 7 (Approximately 760-1030 ft bgs)



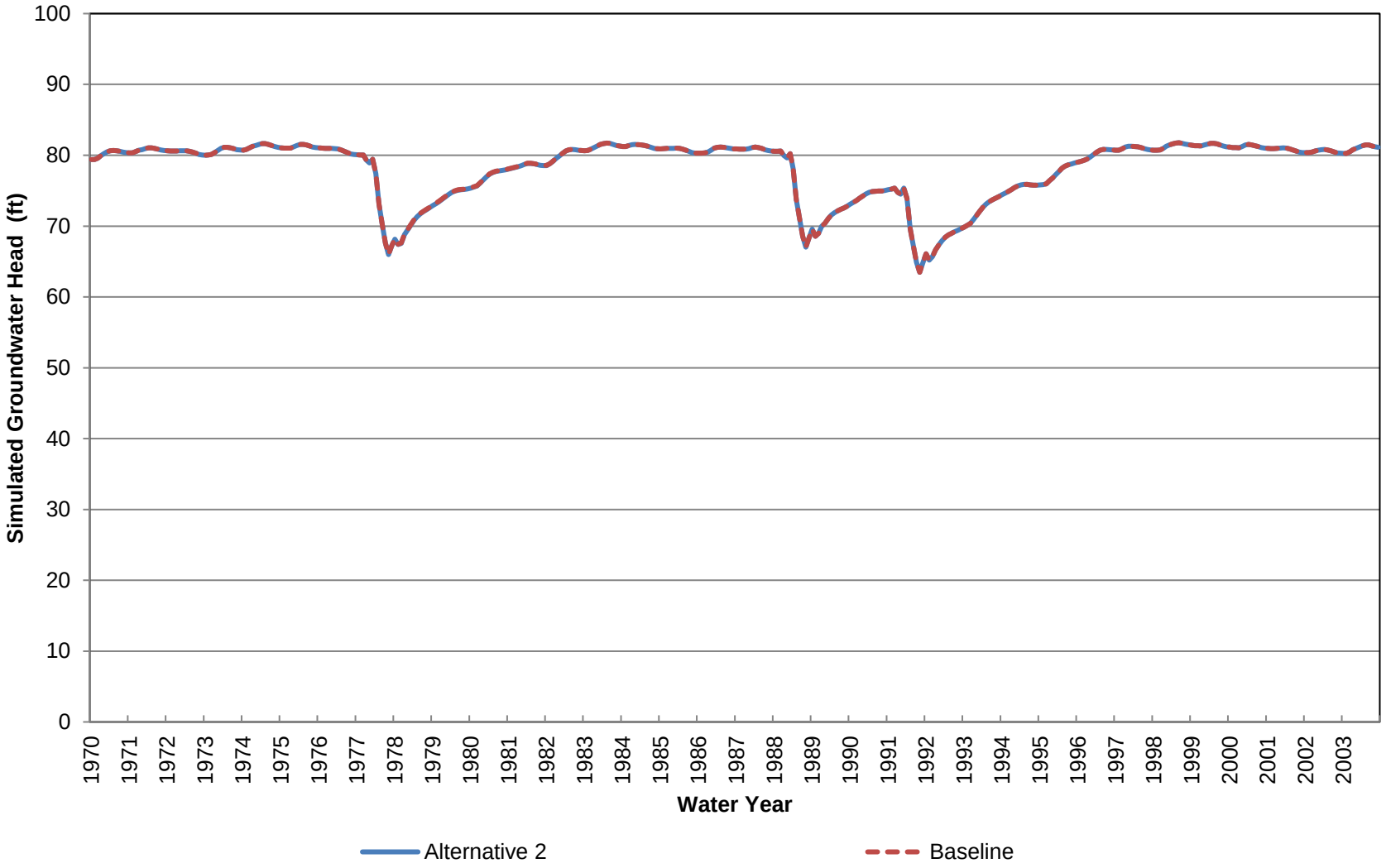
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 7 (Approximately 1030-1520 ft bgs)



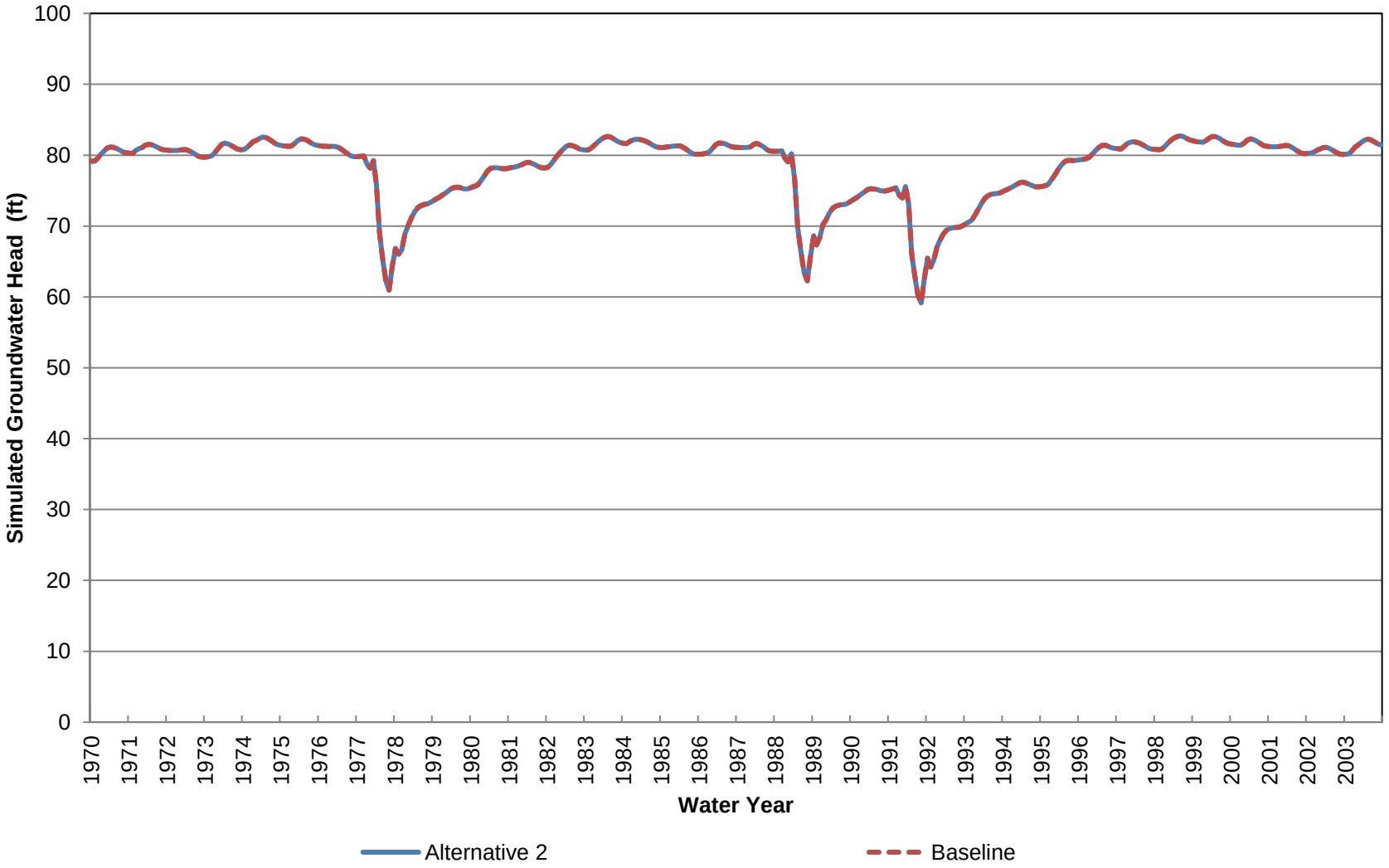
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 8 (Approximately 0-70 ft bgs)



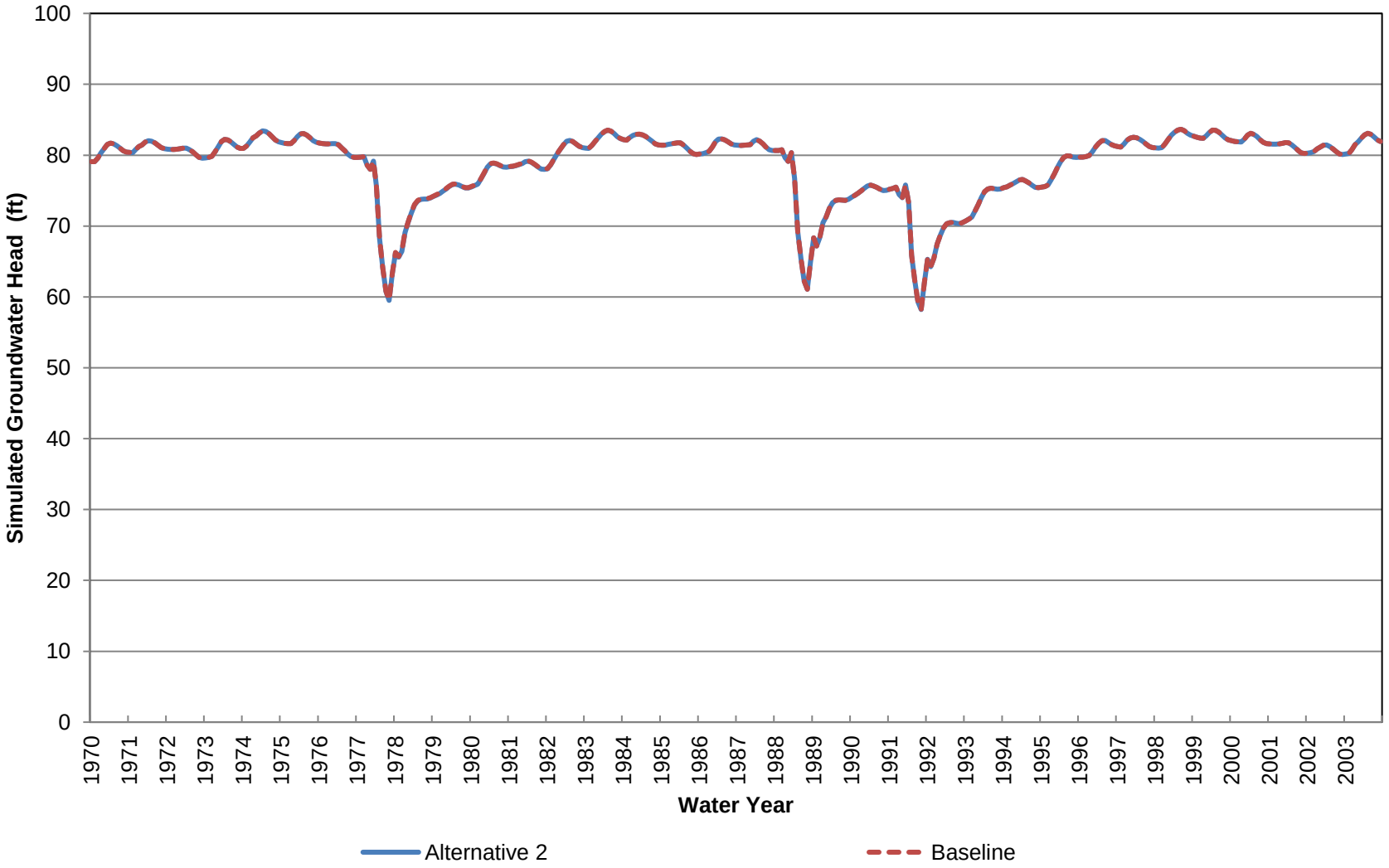
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 8 (Approximately 70-200 ft bgs)



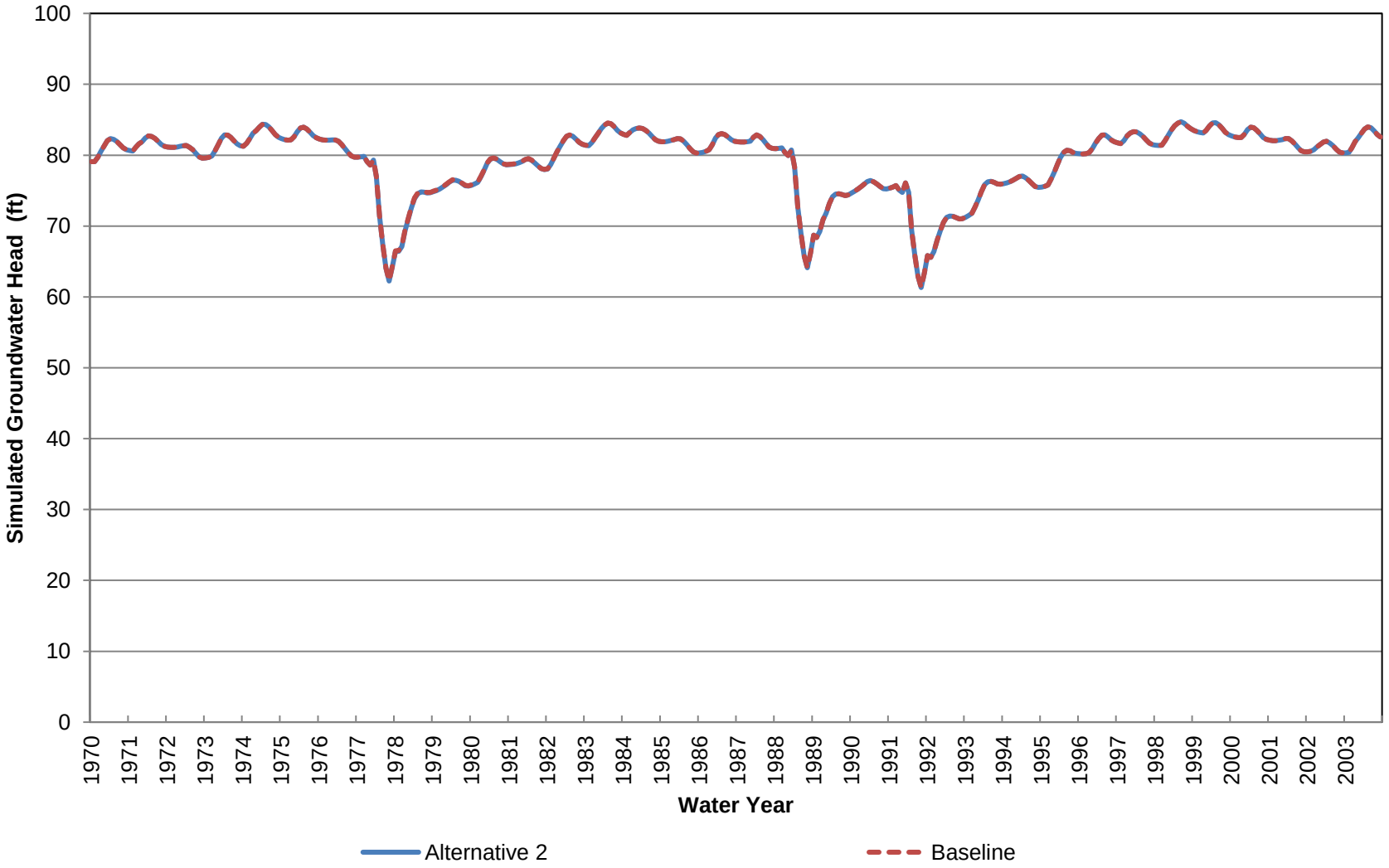
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 8 (Approximately 200-330 ft bgs)



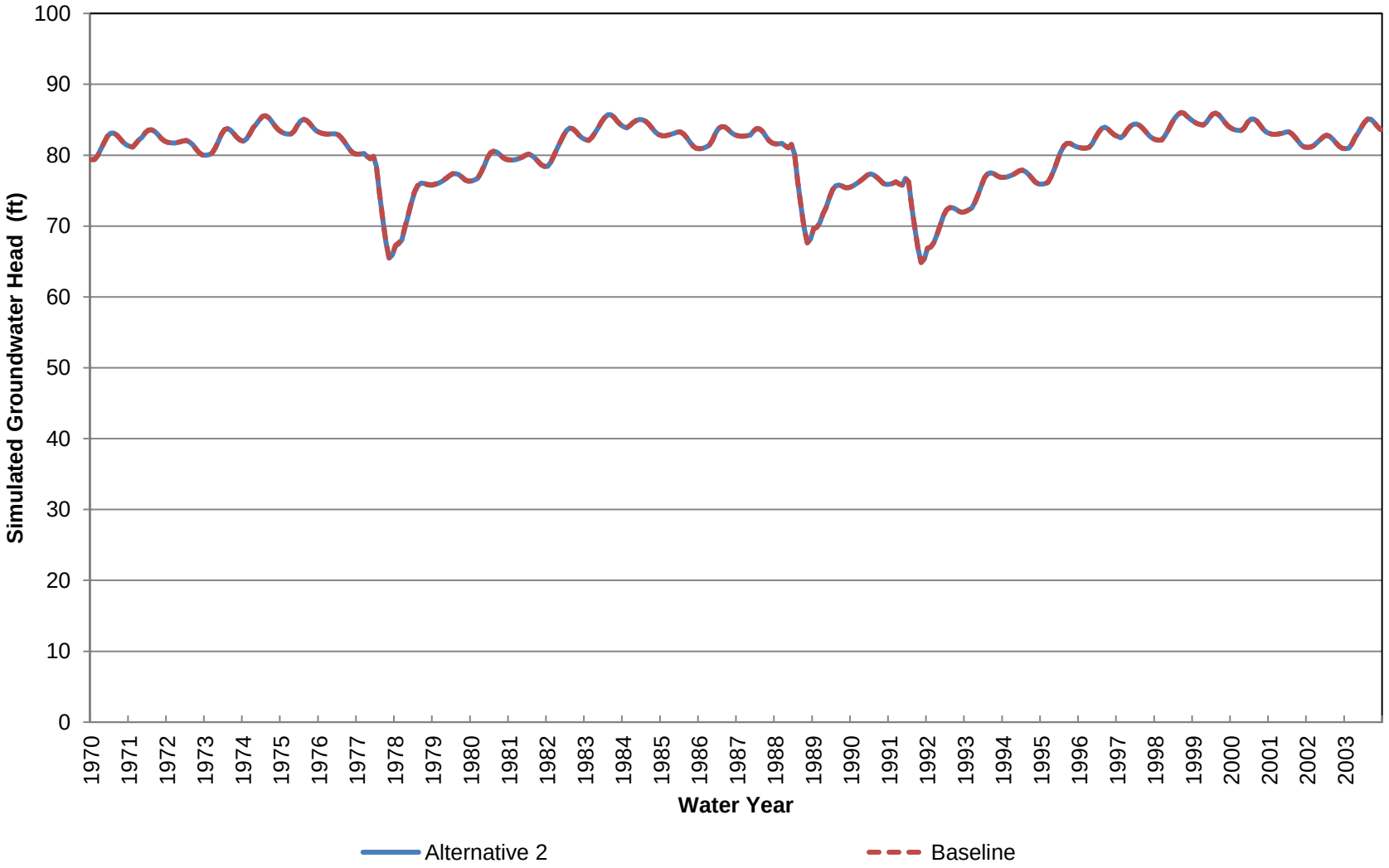
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 8 (Approximately 330-450 ft bgs)



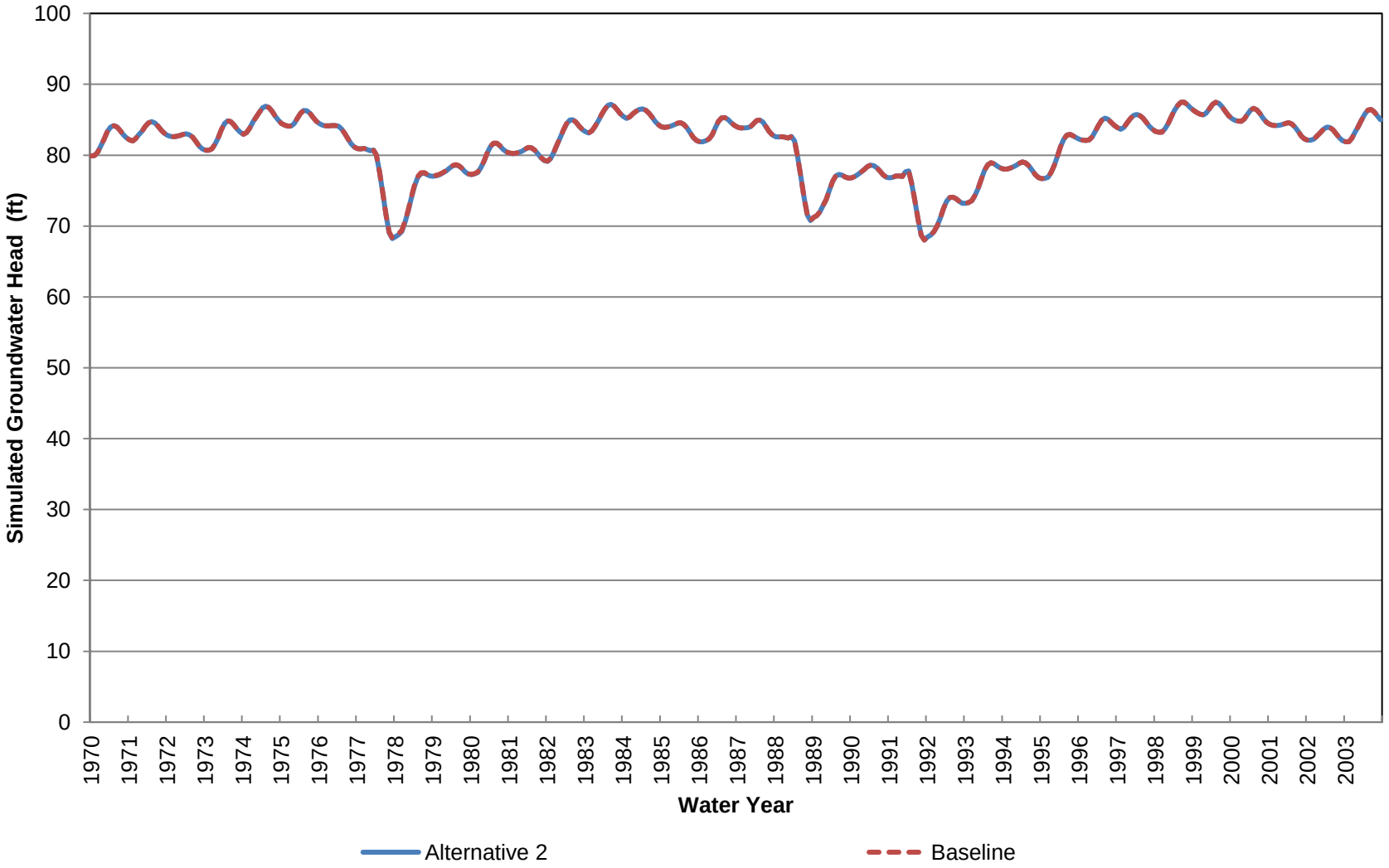
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 8 (Approximately 450-650 ft bgs)



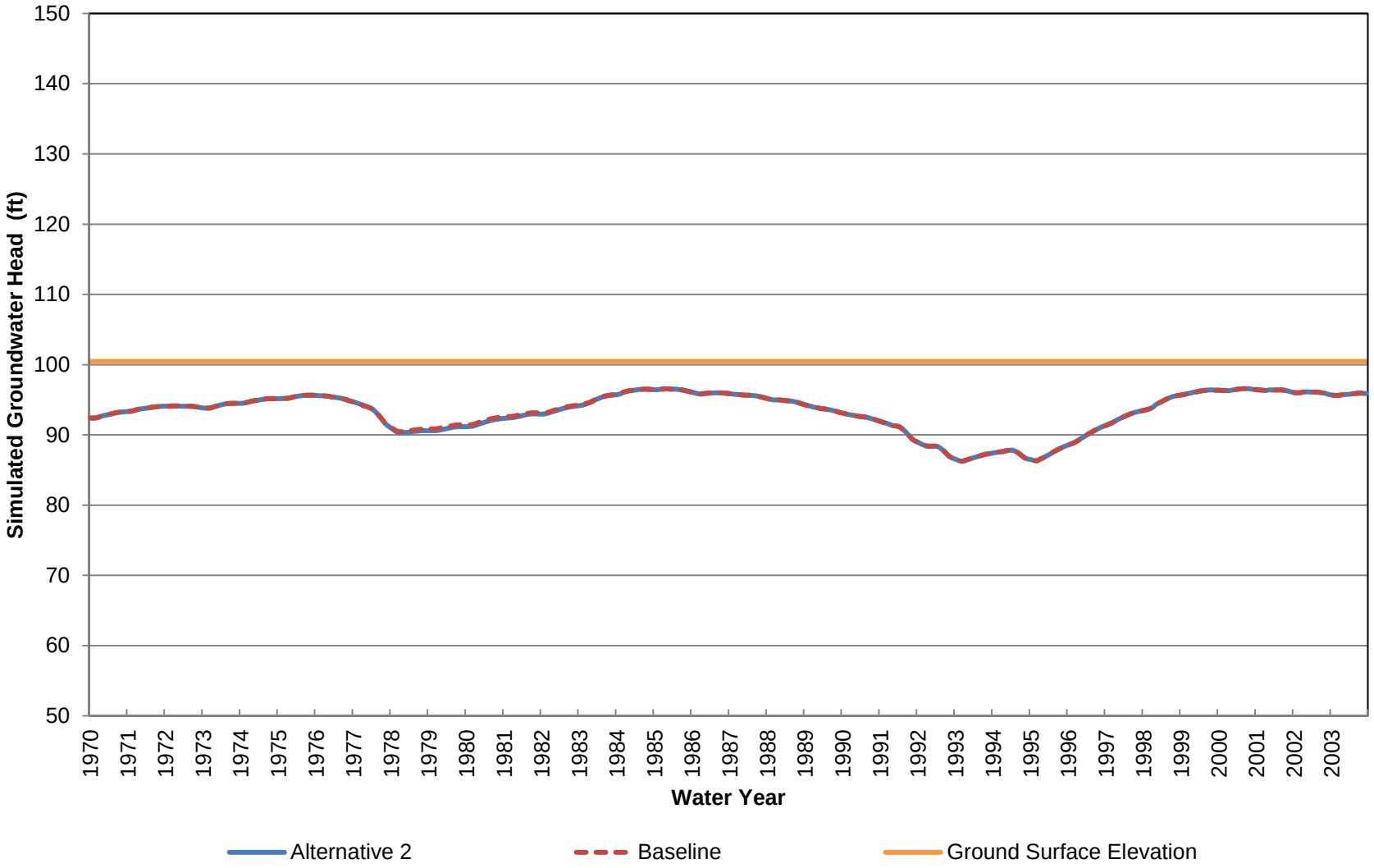
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 8 (Approximately 650-890 ft bgs)



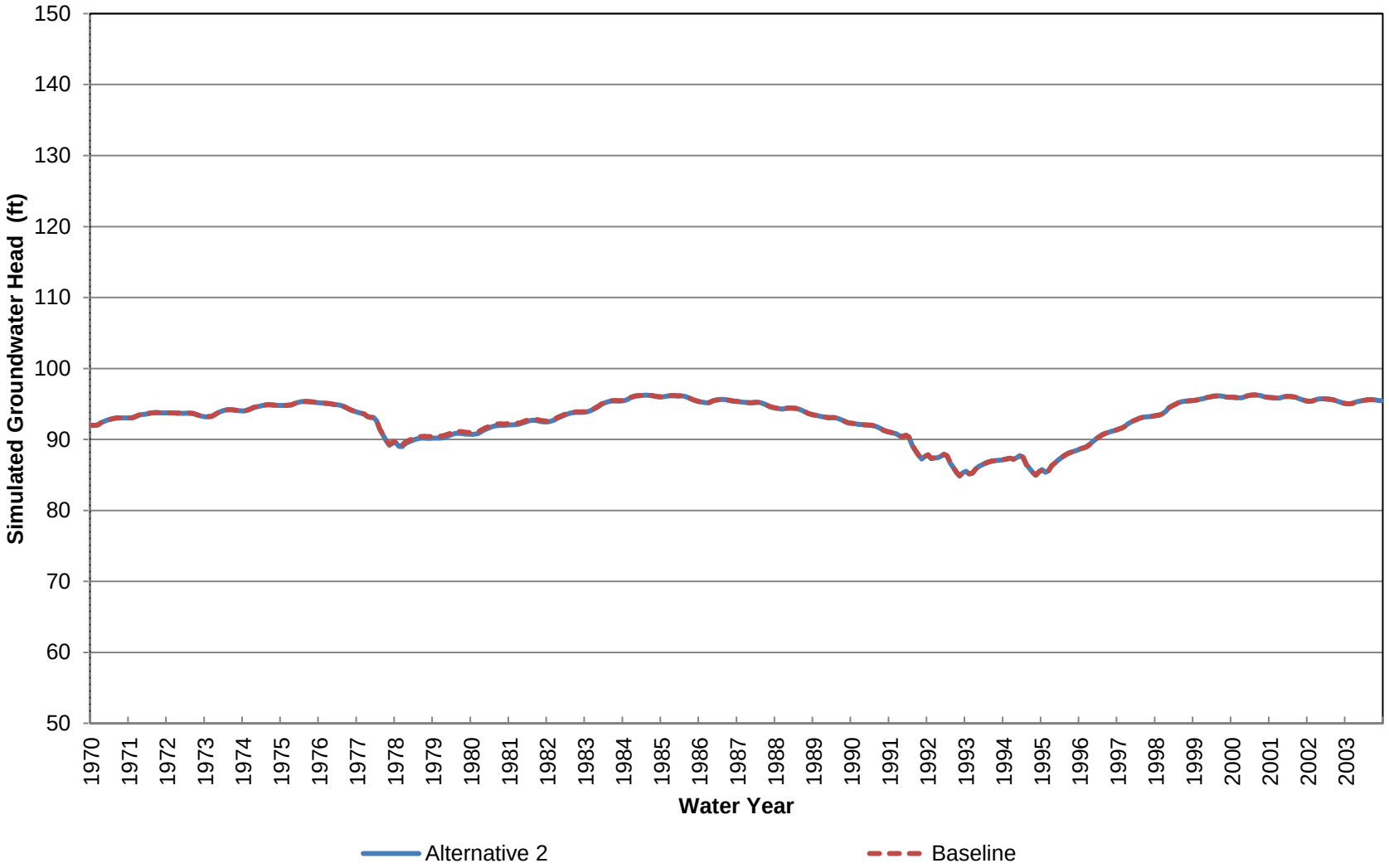
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 8 (Approximately 890-1330 ft bgs)



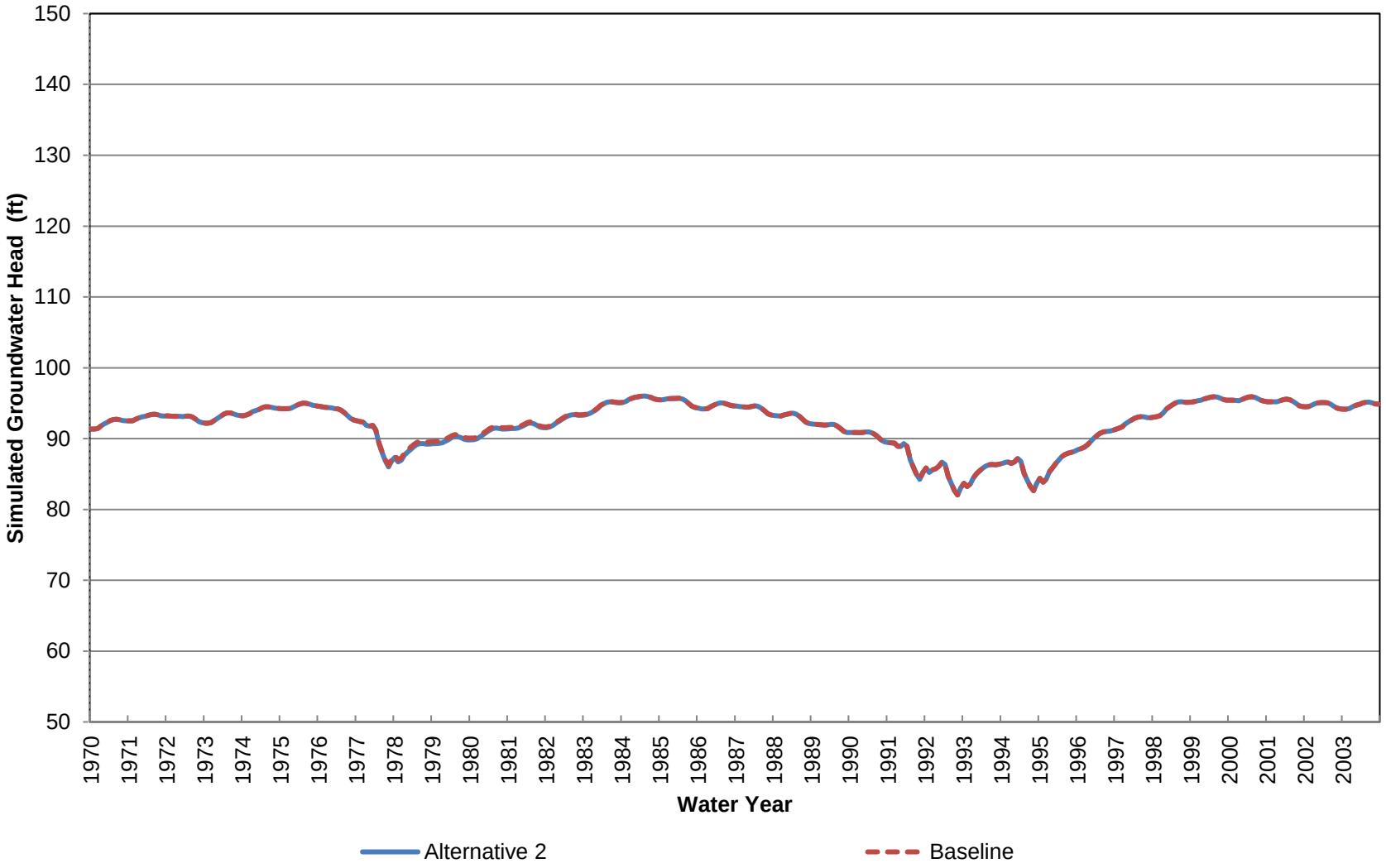
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 9 (Approximately 0-70 ft bgs)



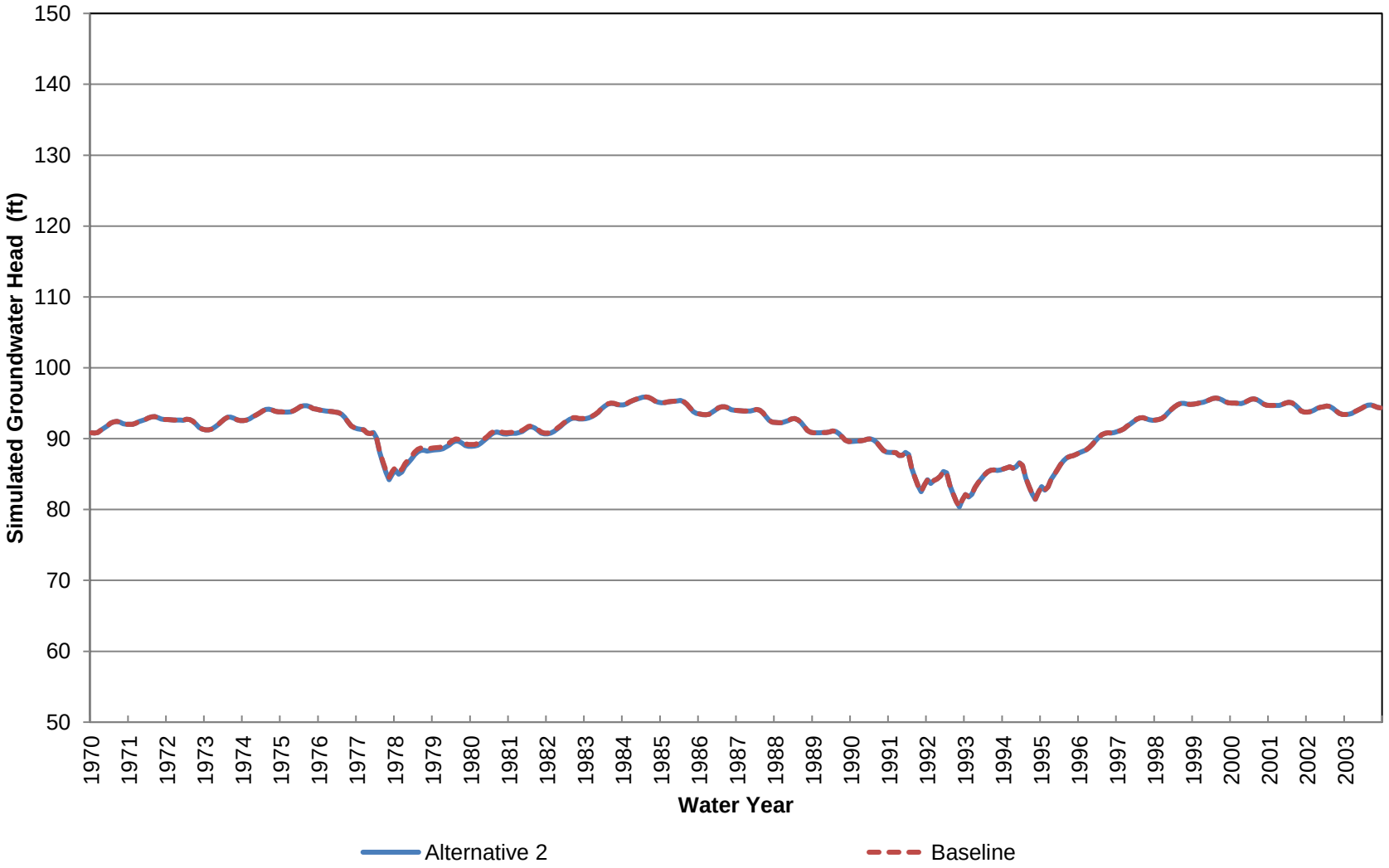
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 9 (Approximately 70-210 ft bgs)



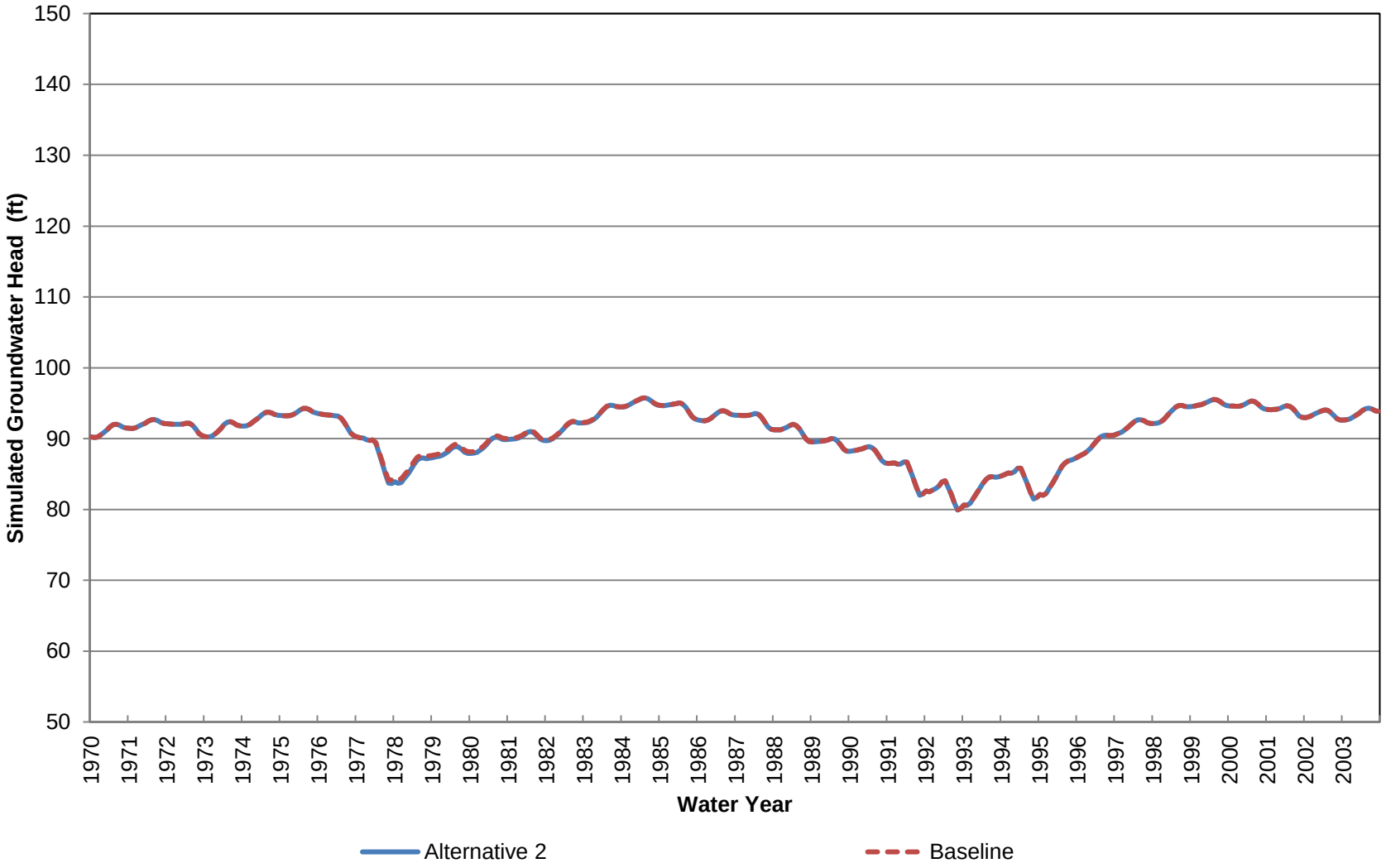
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 9 (Approximately 210-340 ft bgs)



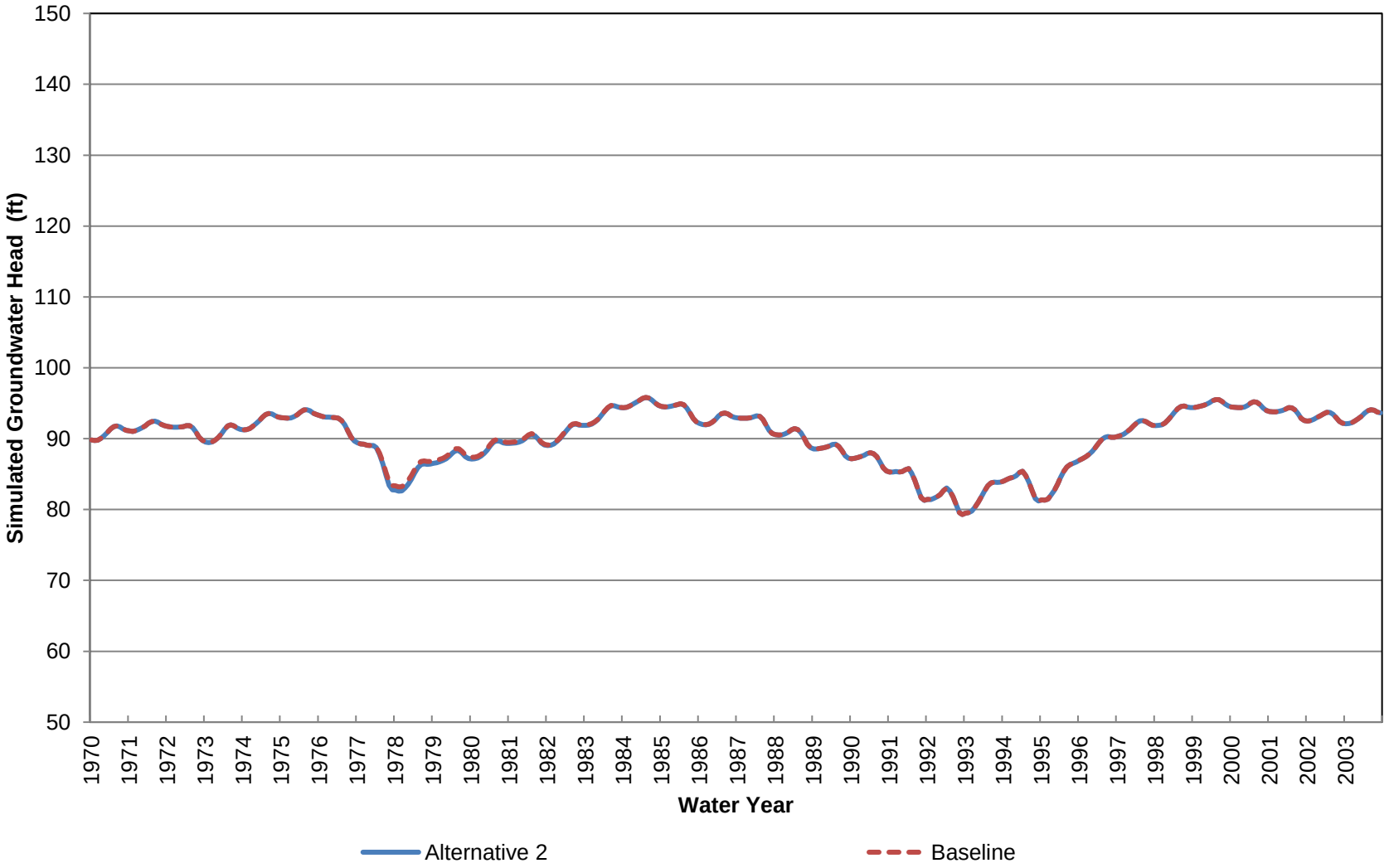
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 9 (Approximately 340-480 ft bgs)



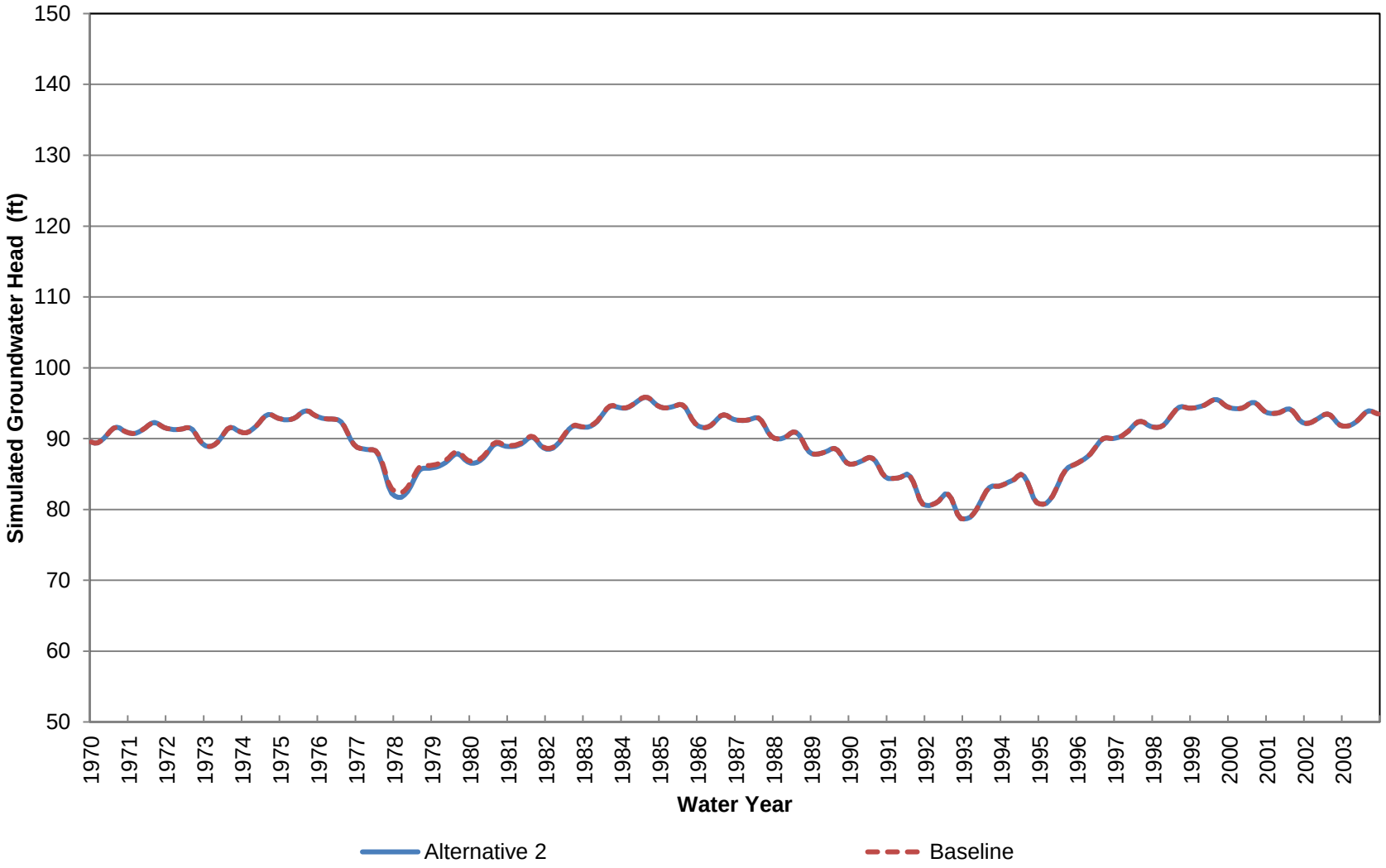
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 9 (Approximately 480-690 ft bgs)



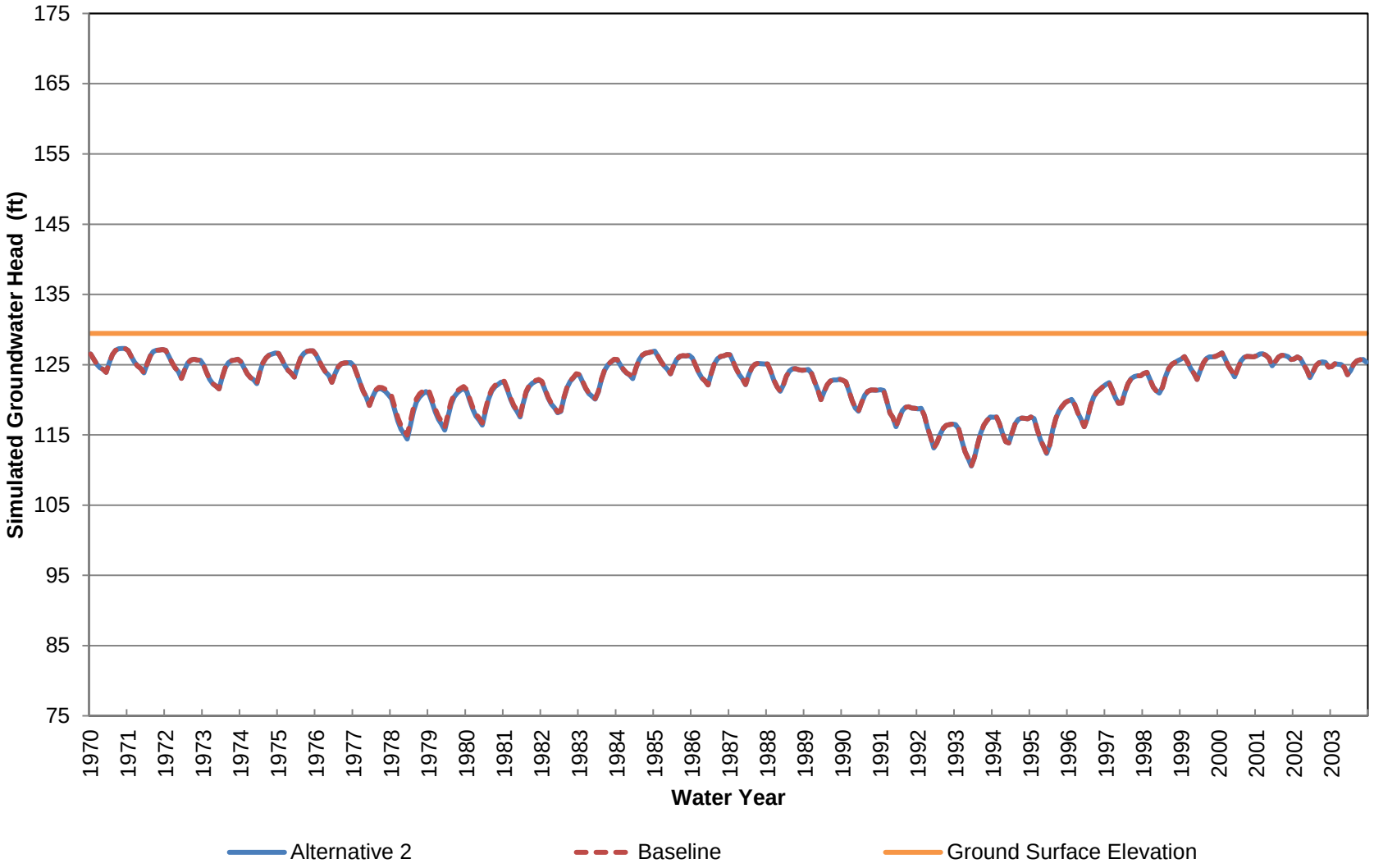
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 9 (Approximately 690-910 ft bgs)



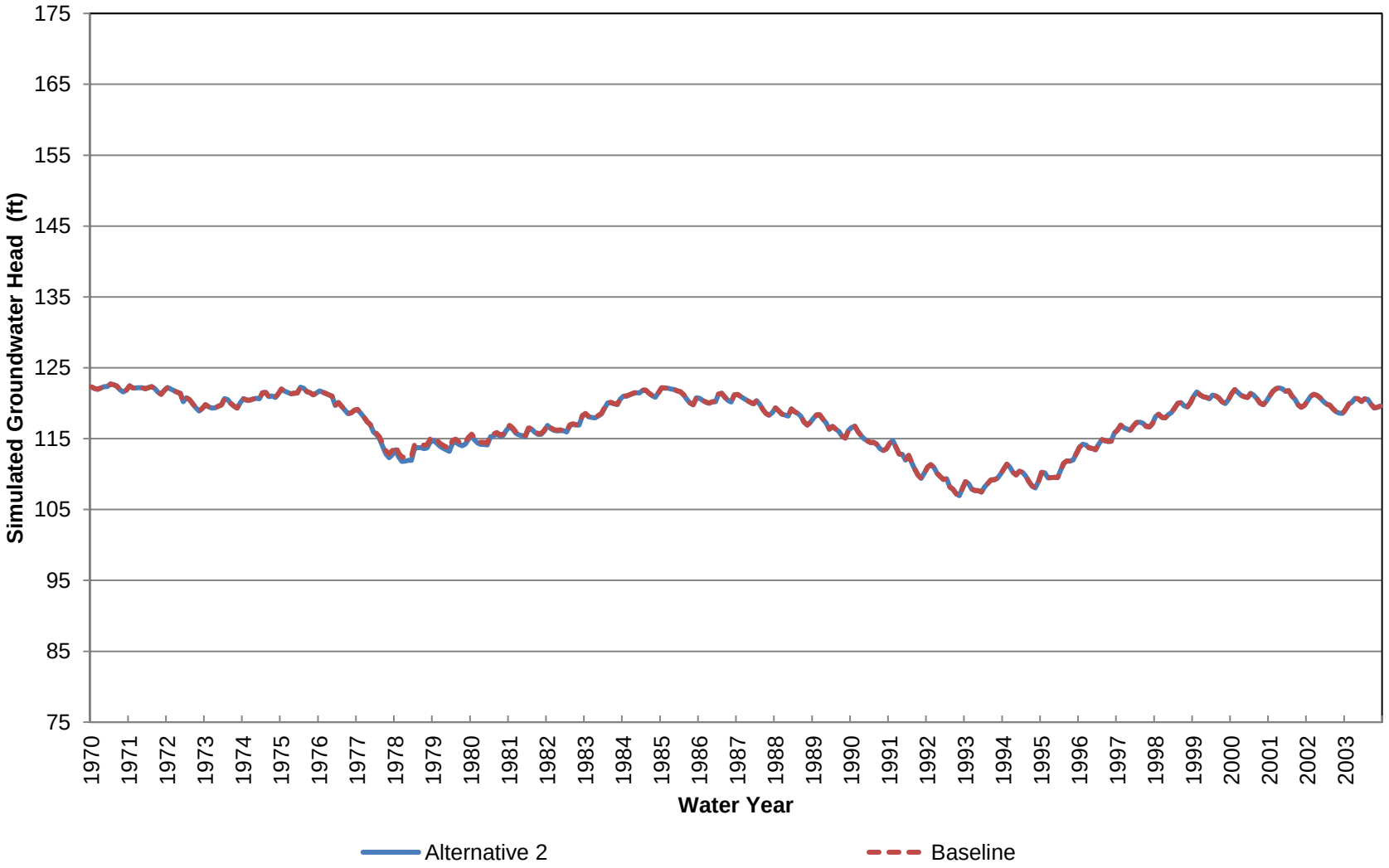
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 9 (Approximately 910-1250 ft bgs)



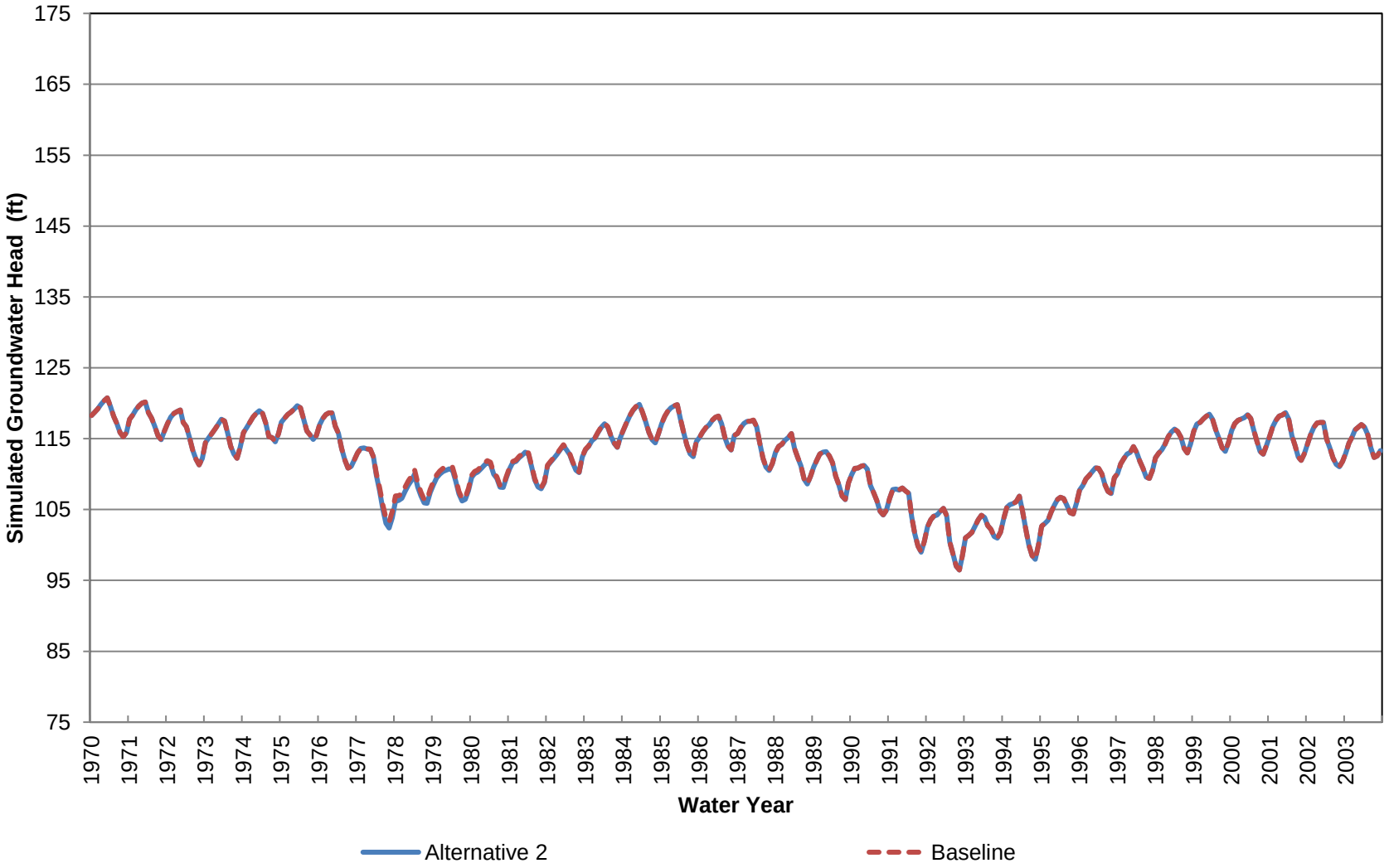
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 10 (Approximately 0-70 ft bgs)



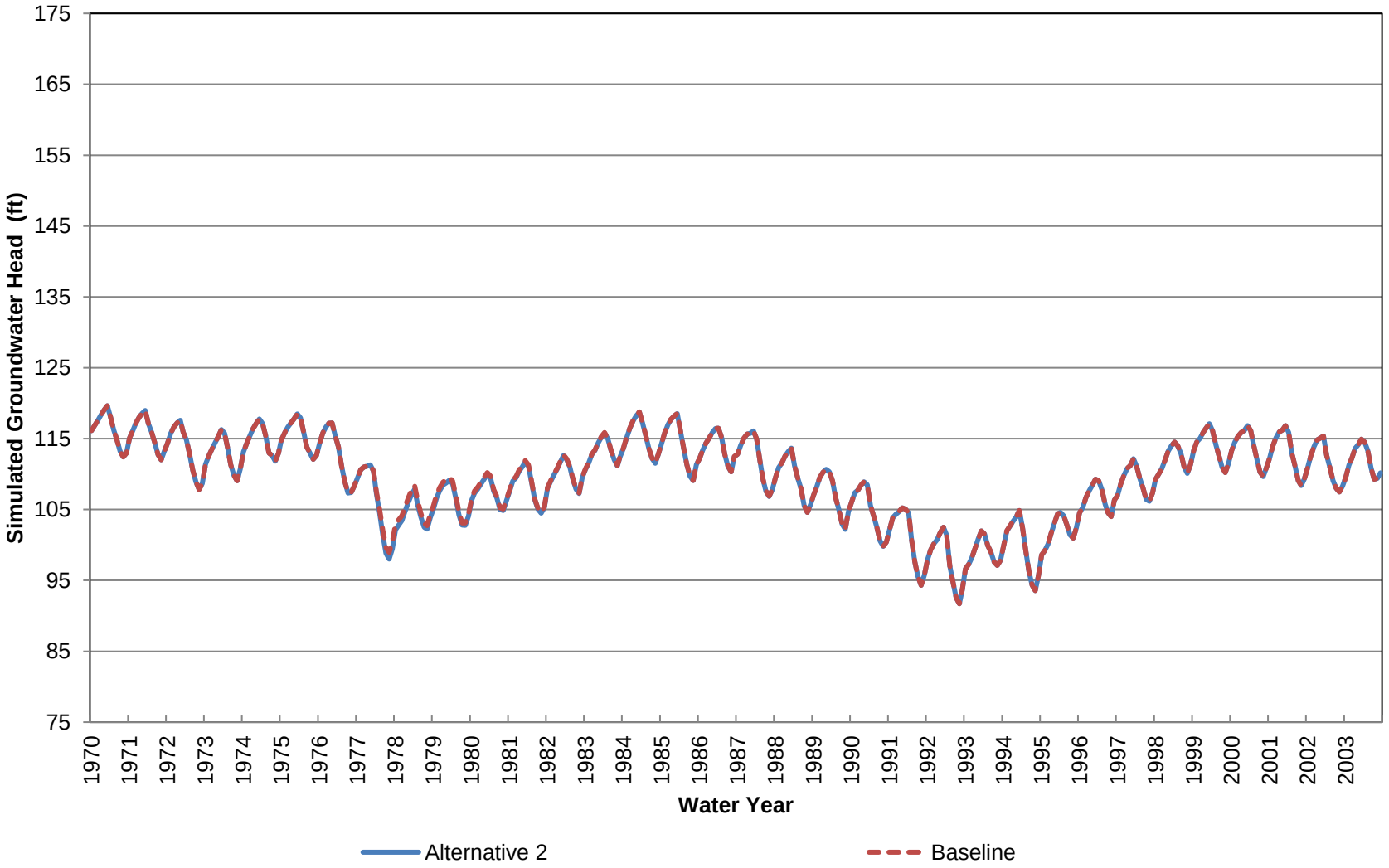
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 10 (Approximately 70-240 ft bgs)



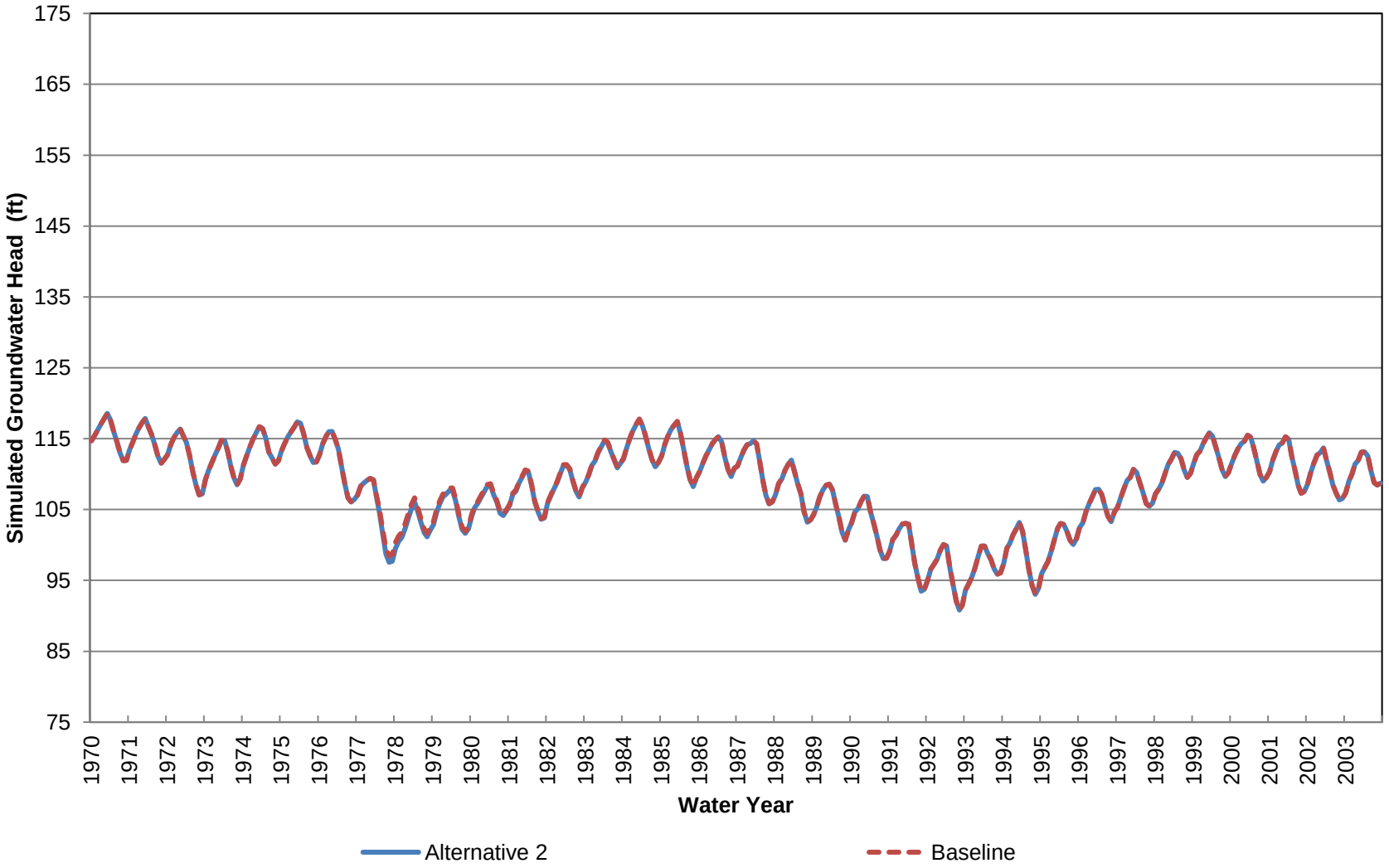
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 10 (Approximately 240-420 ft bgs)



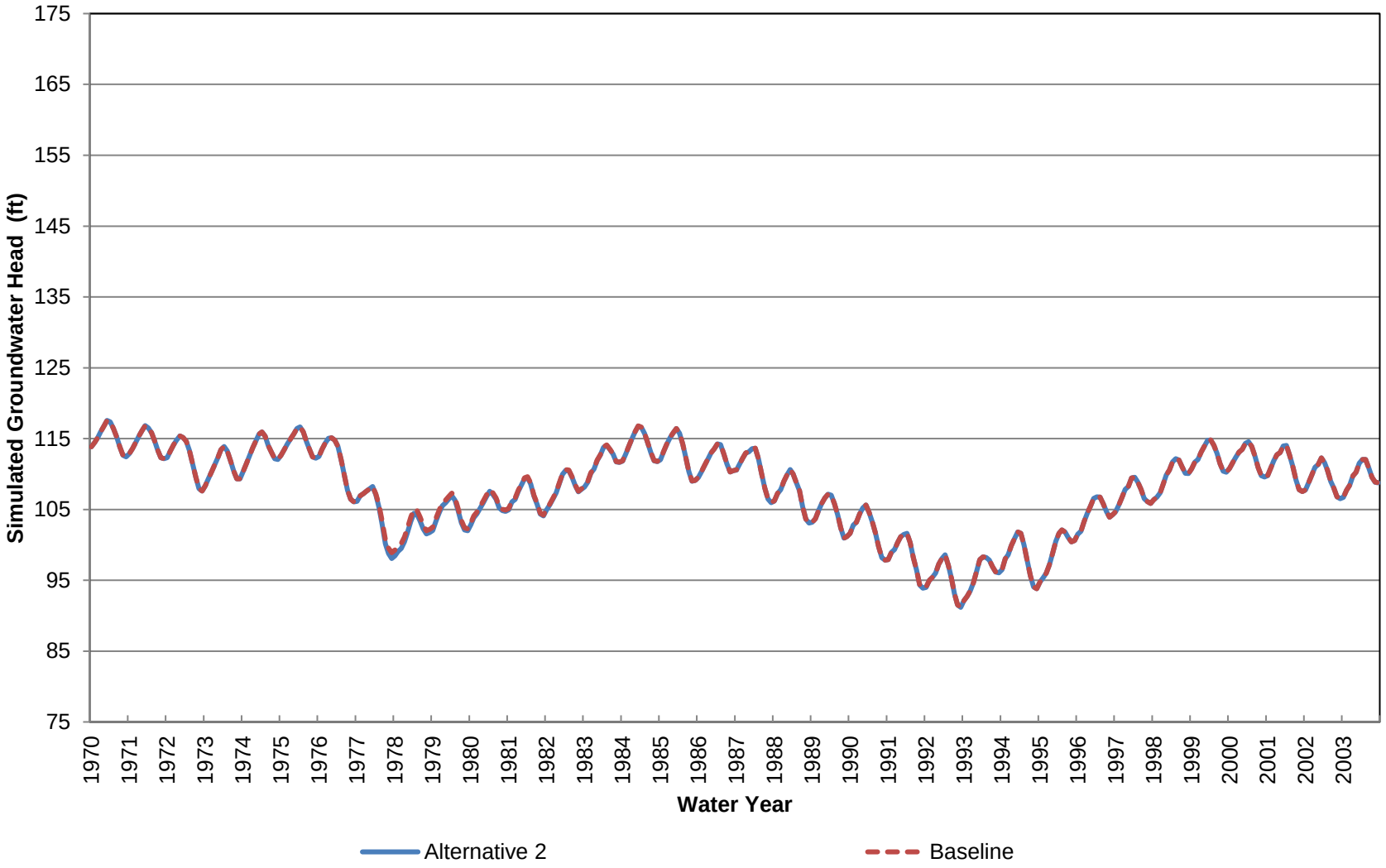
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 10 (Approximately 420-590 ft bgs)



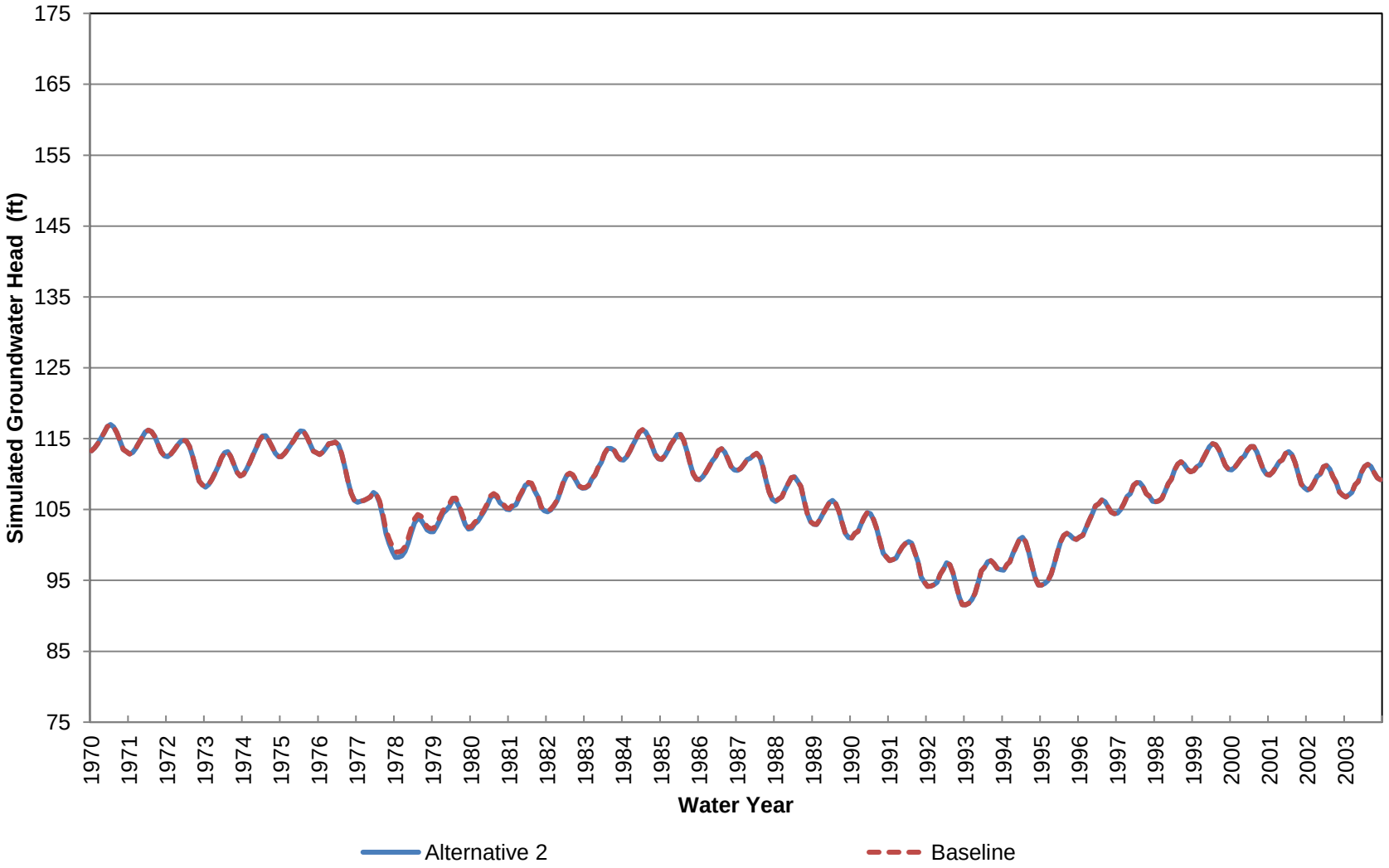
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 10 (Approximately 590-870 ft bgs)



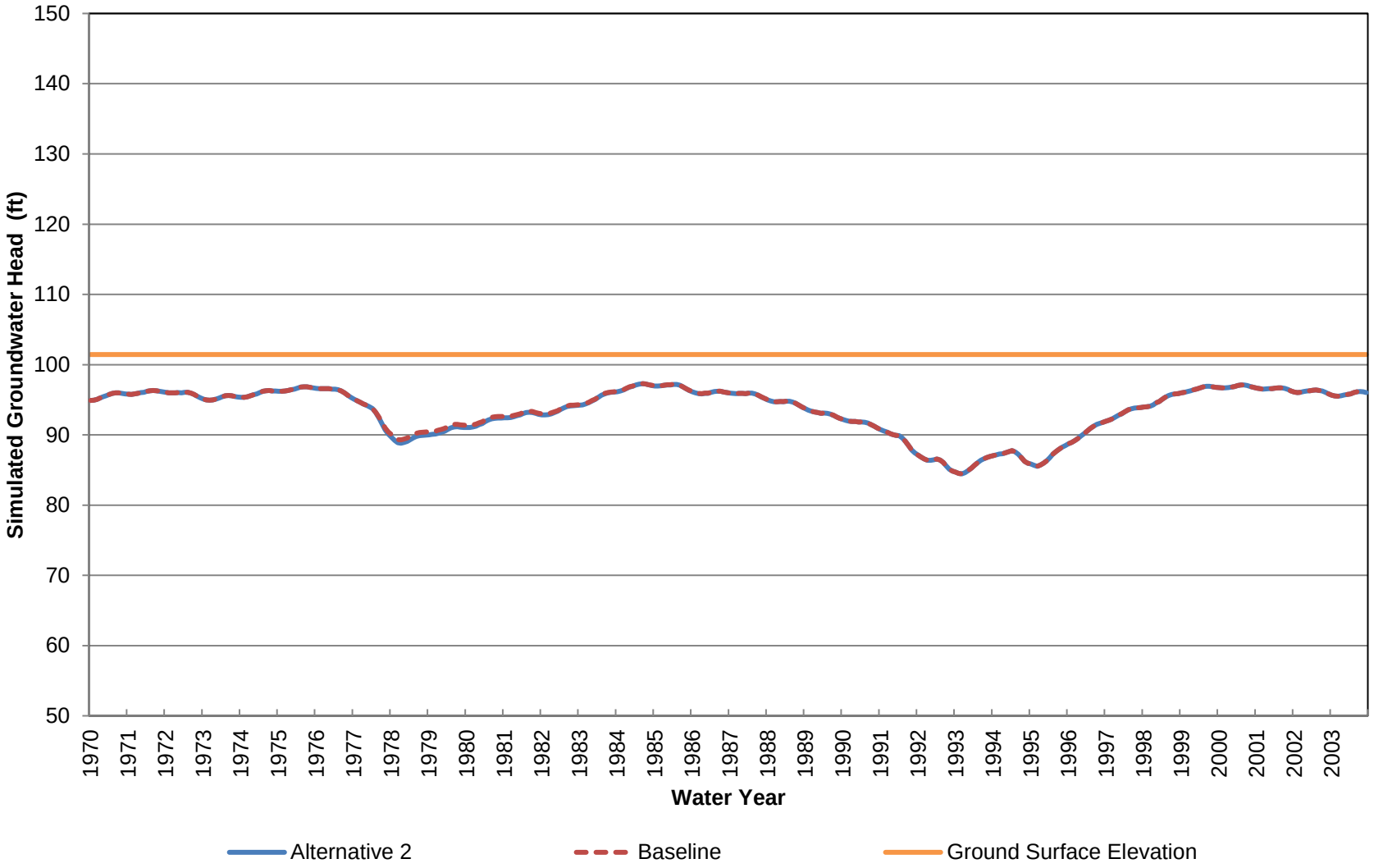
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 10 (Approximately 870-1160 ft bgs)



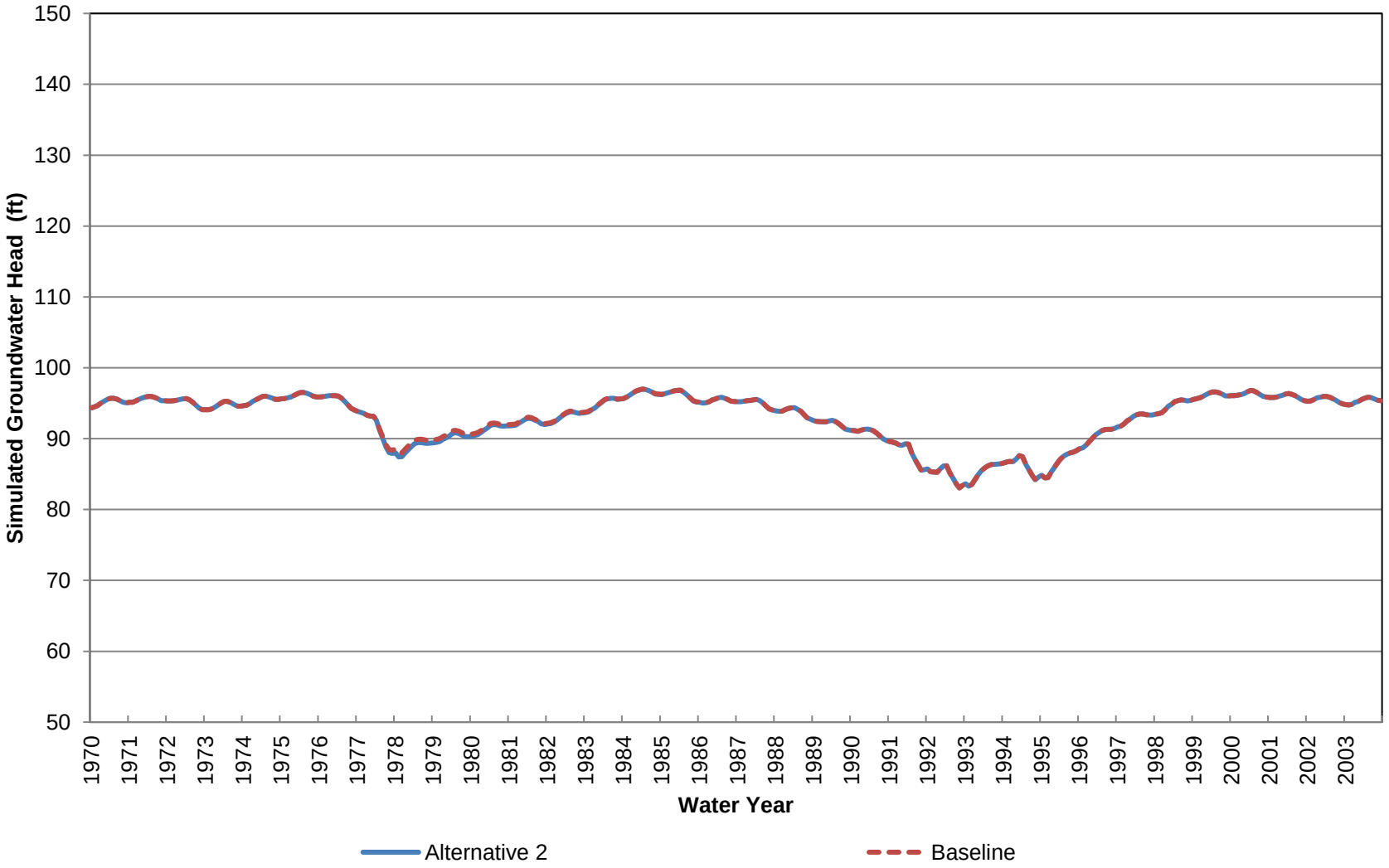
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 10 (Approximately 1160-1590 ft bgs)



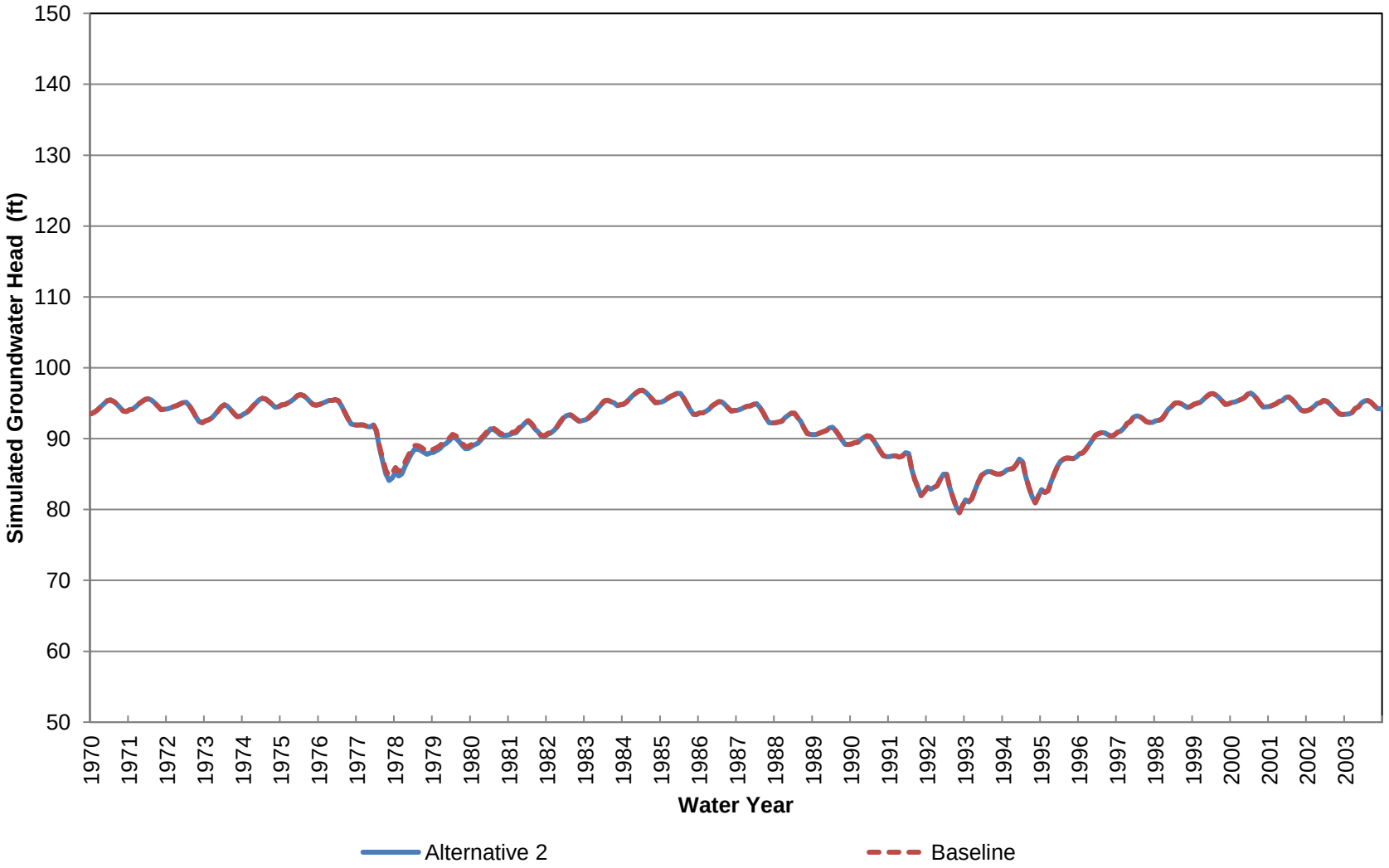
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 11 (Approximately 0-70 ft bgs)



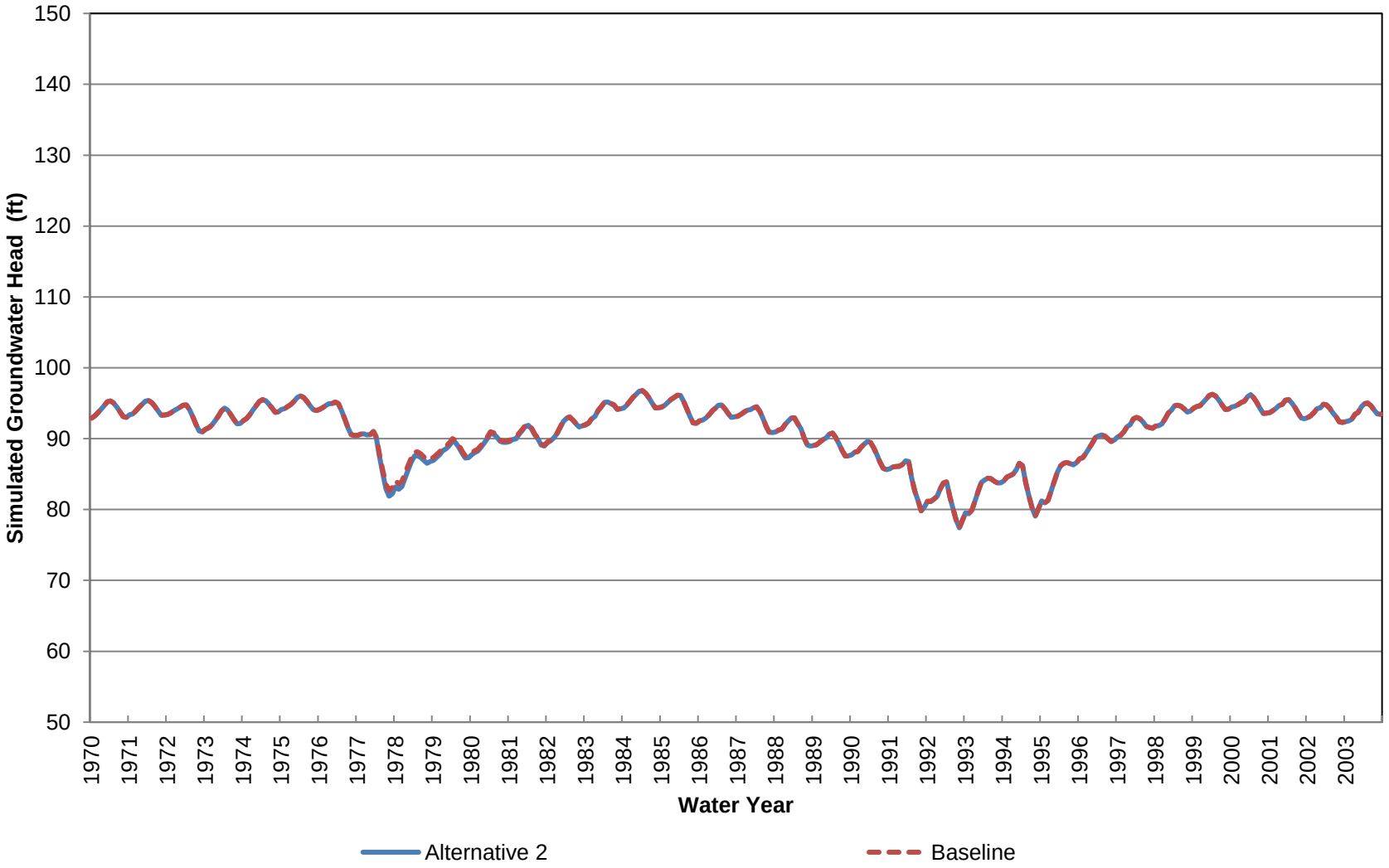
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 11 (Approximately 70-260 ft bgs)



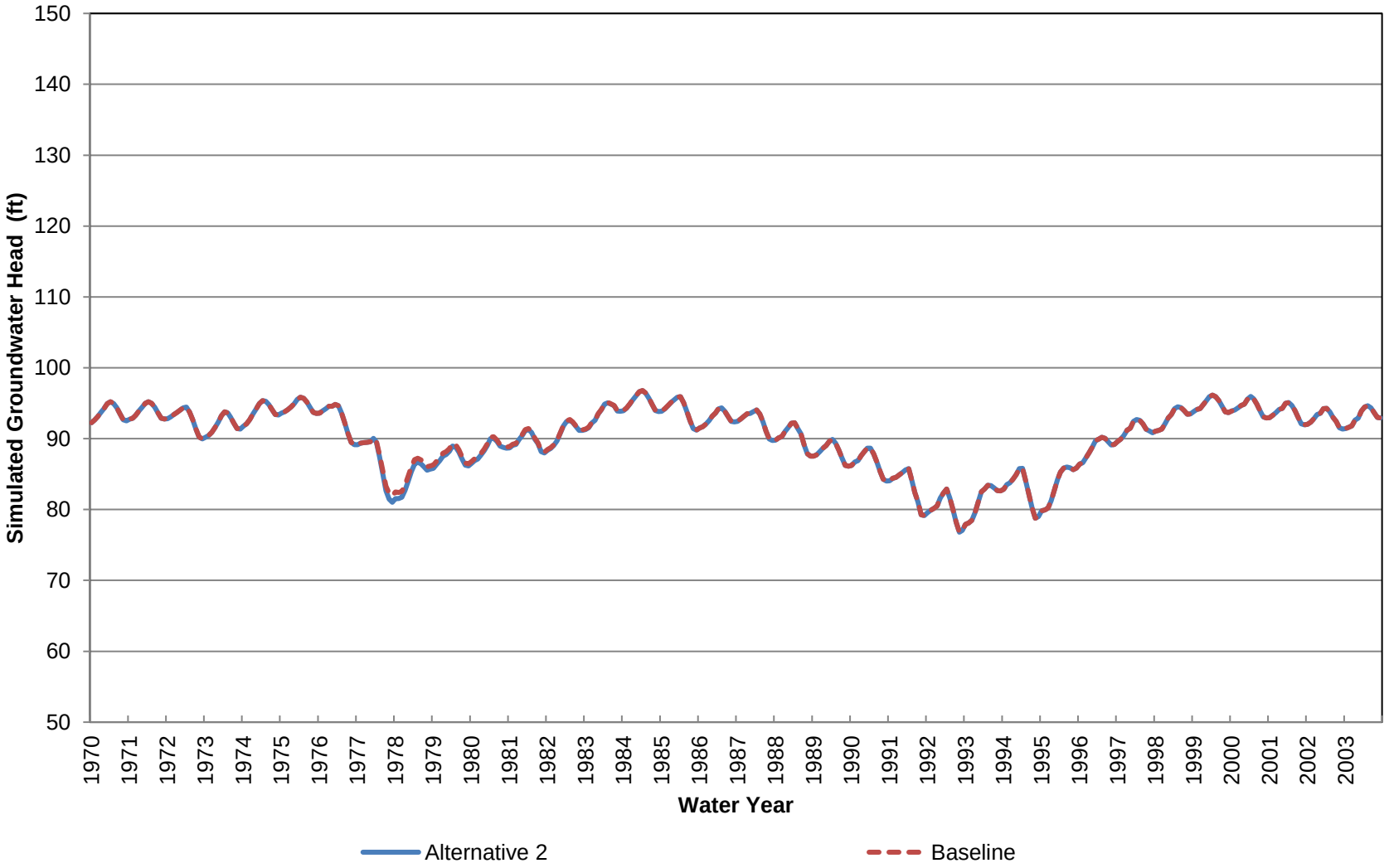
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 11 (Approximately 260-450 ft bgs)



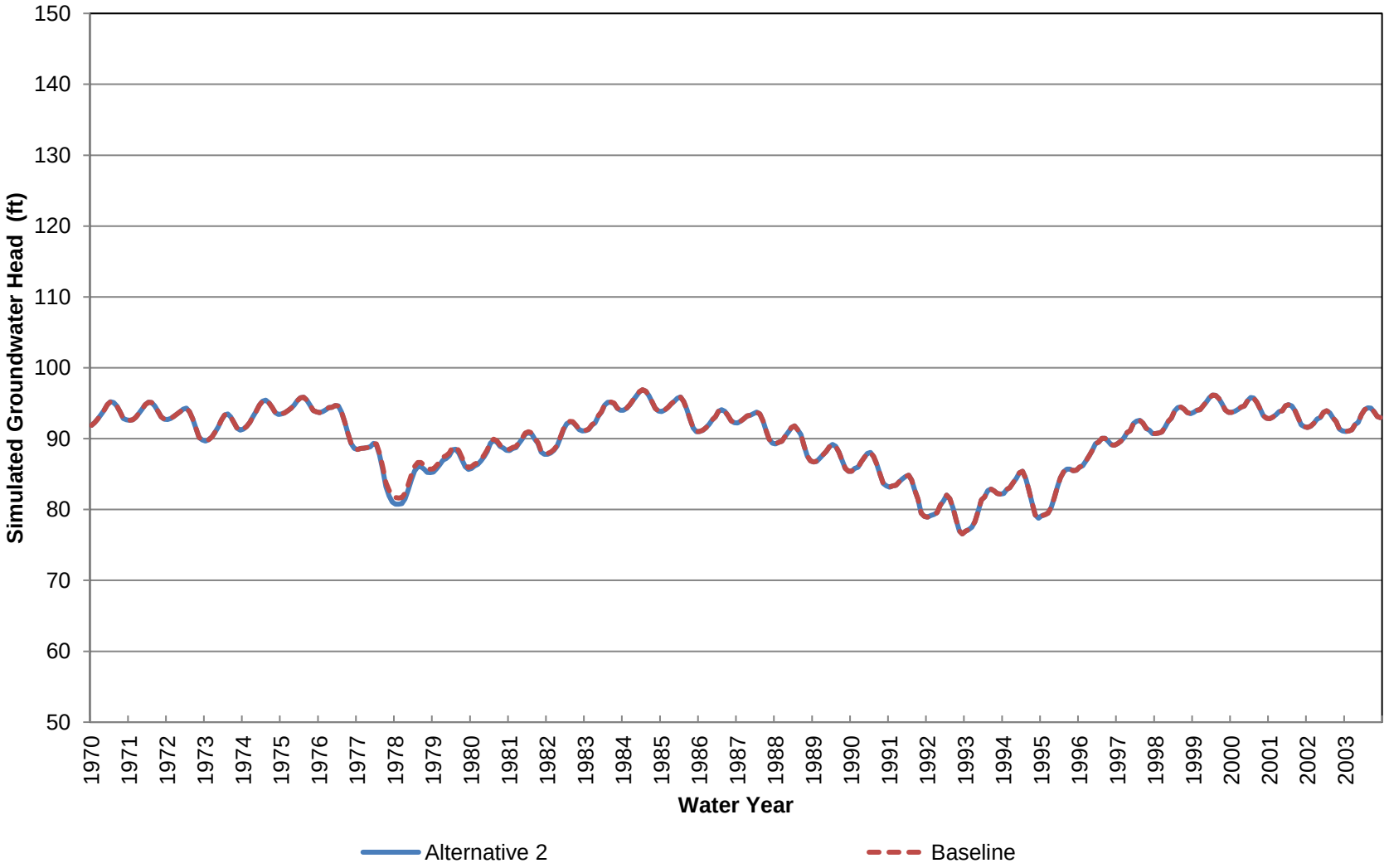
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 11 (Approximately 450-640 ft bgs)



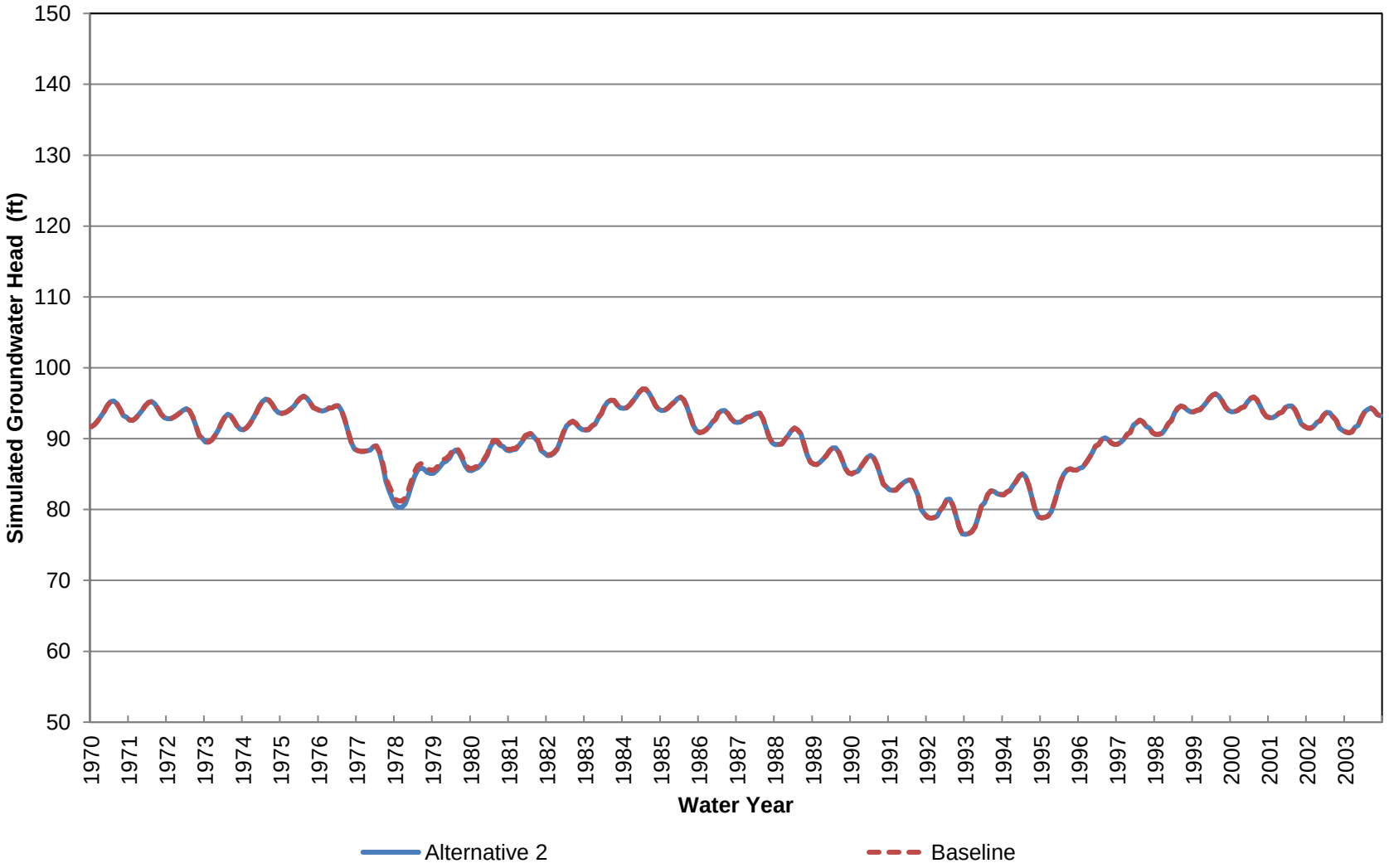
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 11 (Approximately 640-950 ft bgs)



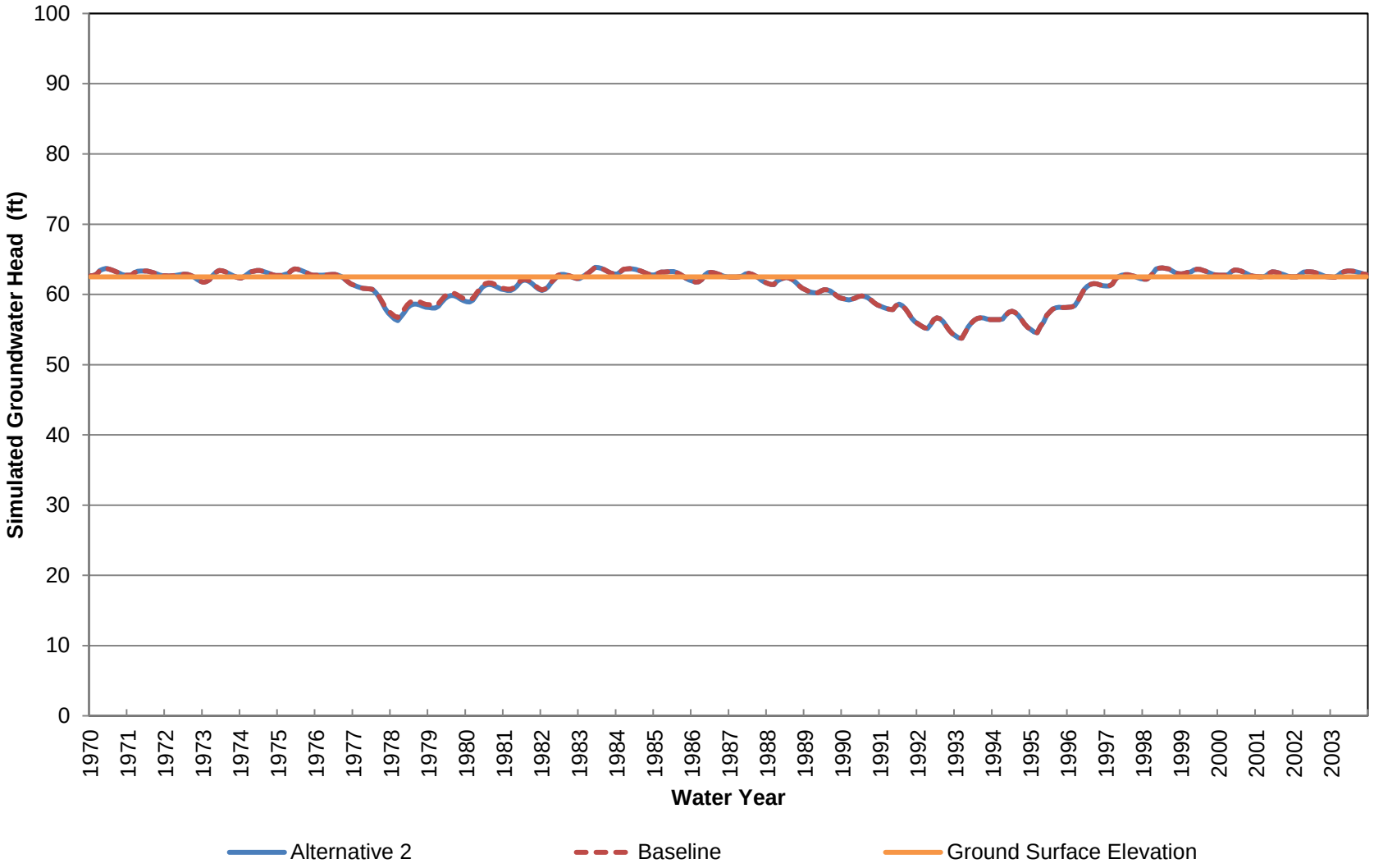
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 11 (Approximately 950-1260 ft bgs)



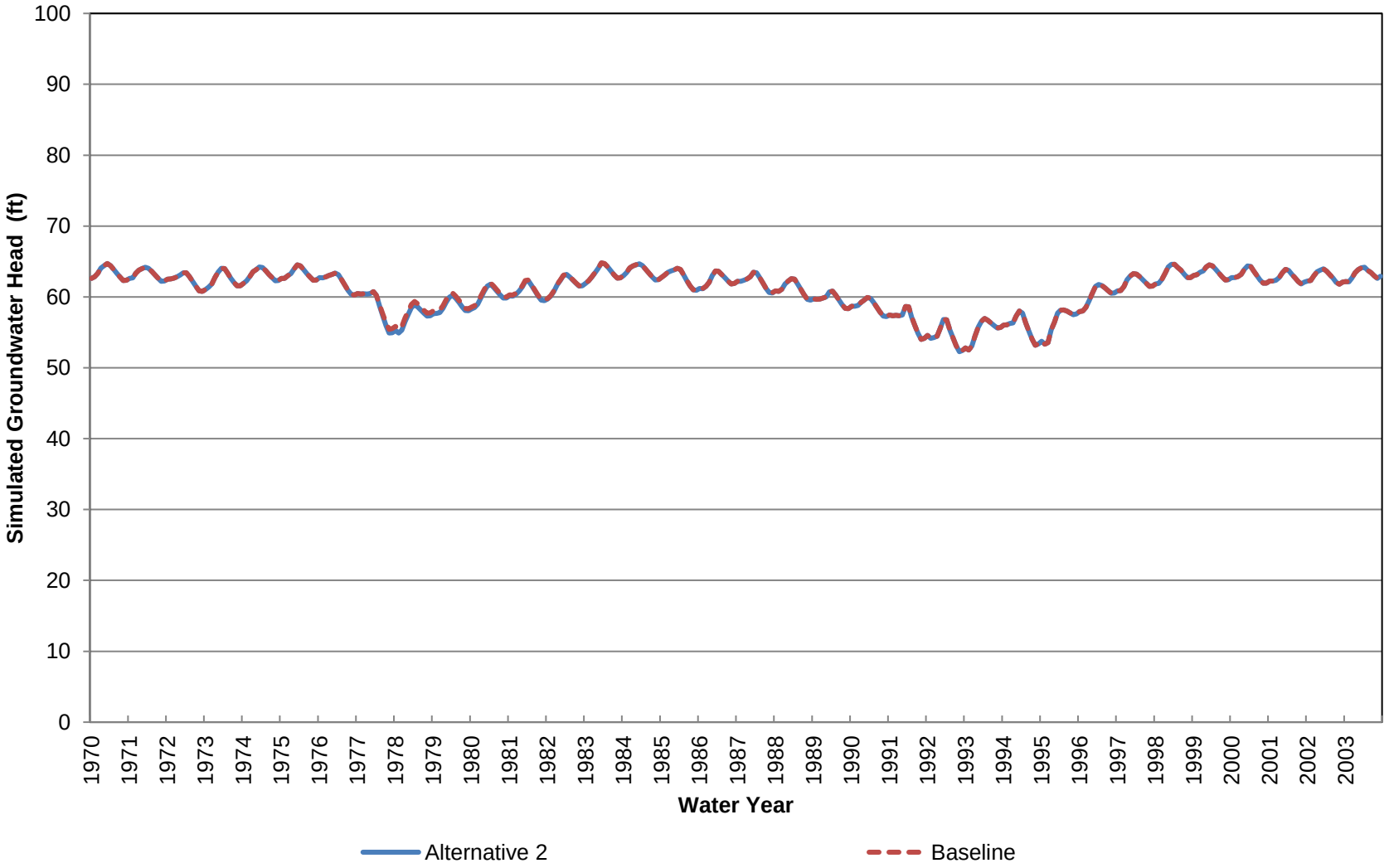
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 11 (Approximately 1260-1740 ft bgs)



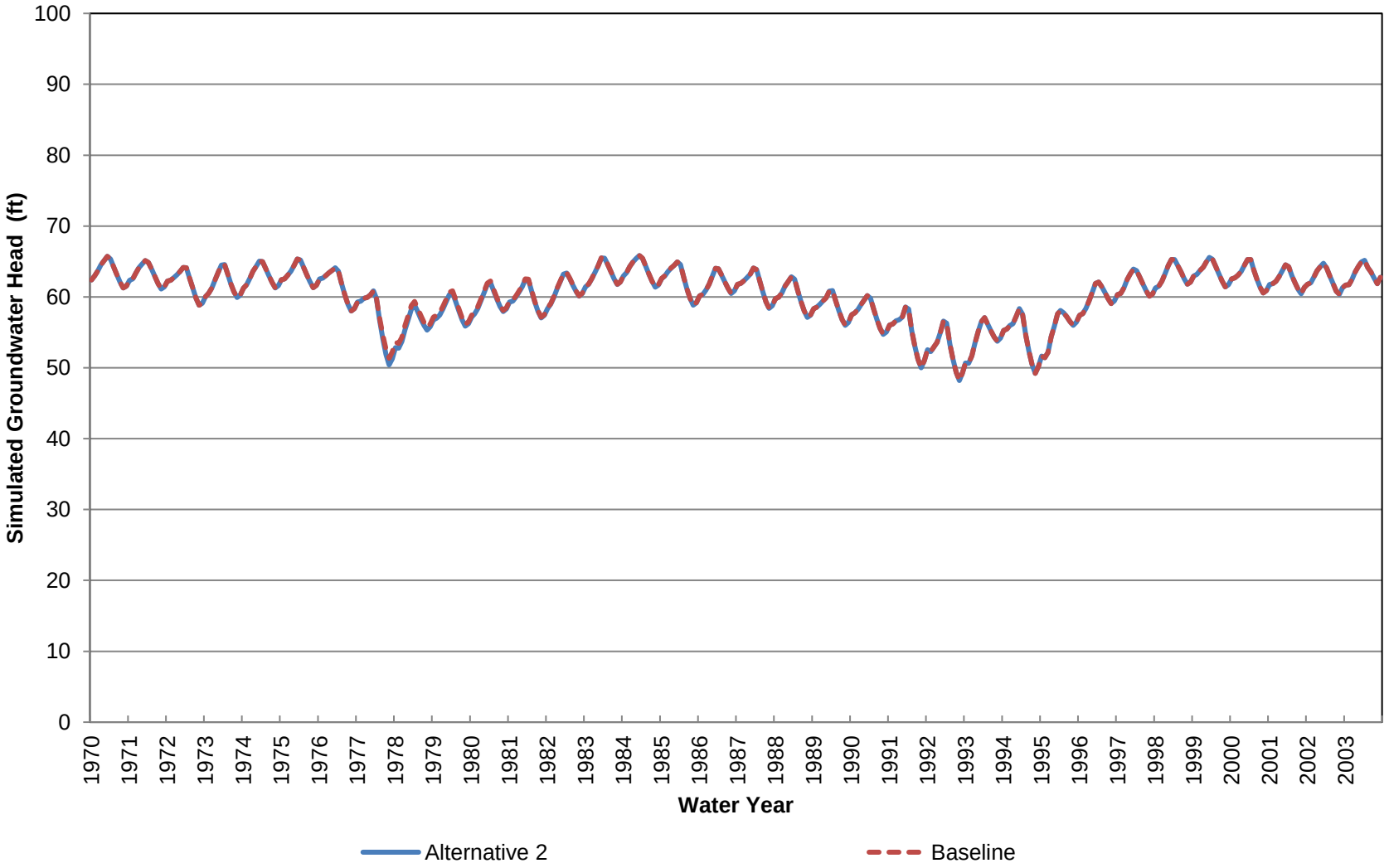
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 12 (Approximately 0-70 ft bgs)



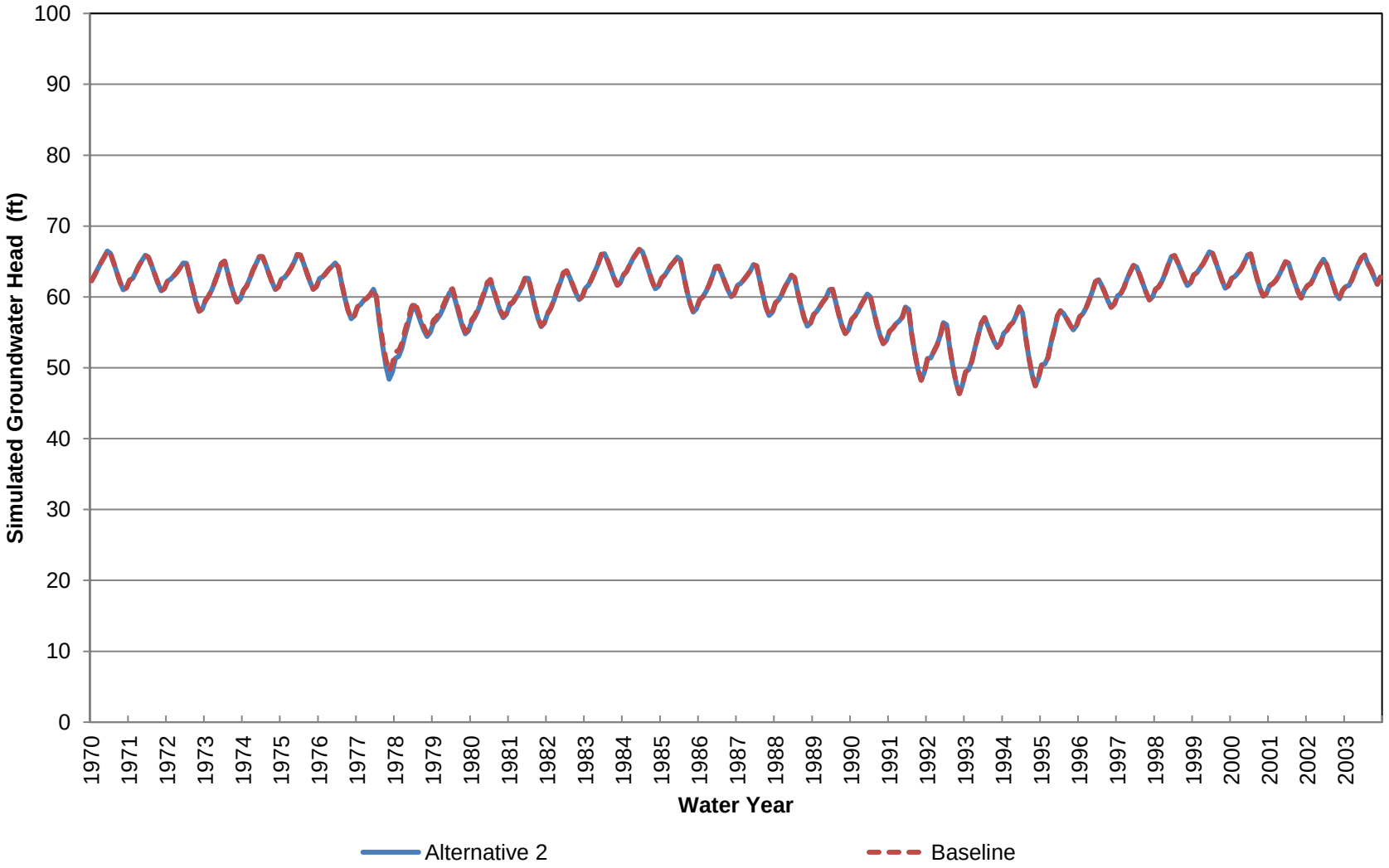
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 12 (Approximately 70-260 ft bgs)



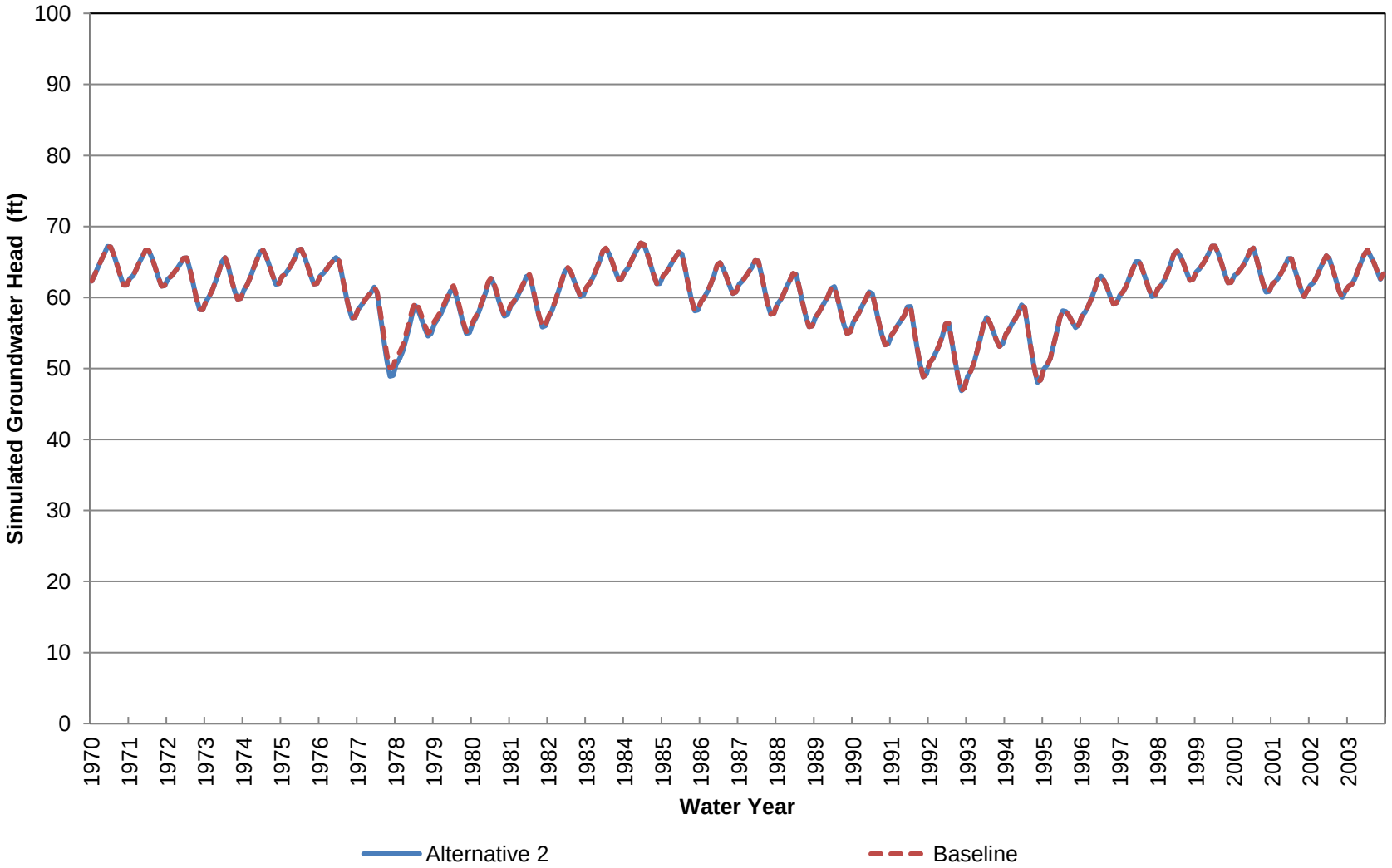
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 12 (Approximately 260-440 ft bgs)



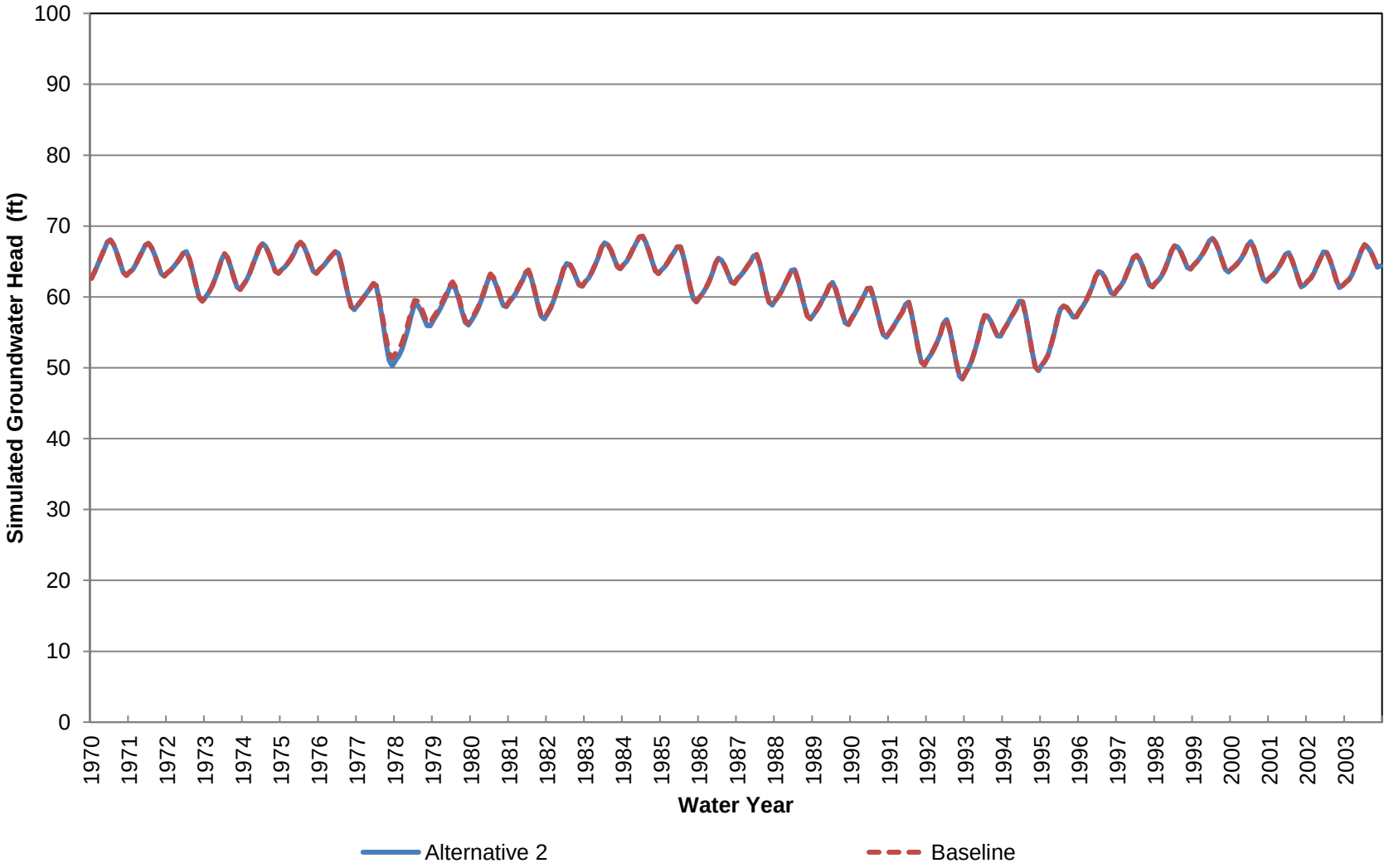
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 12 (Approximately 440-630 ft bgs)



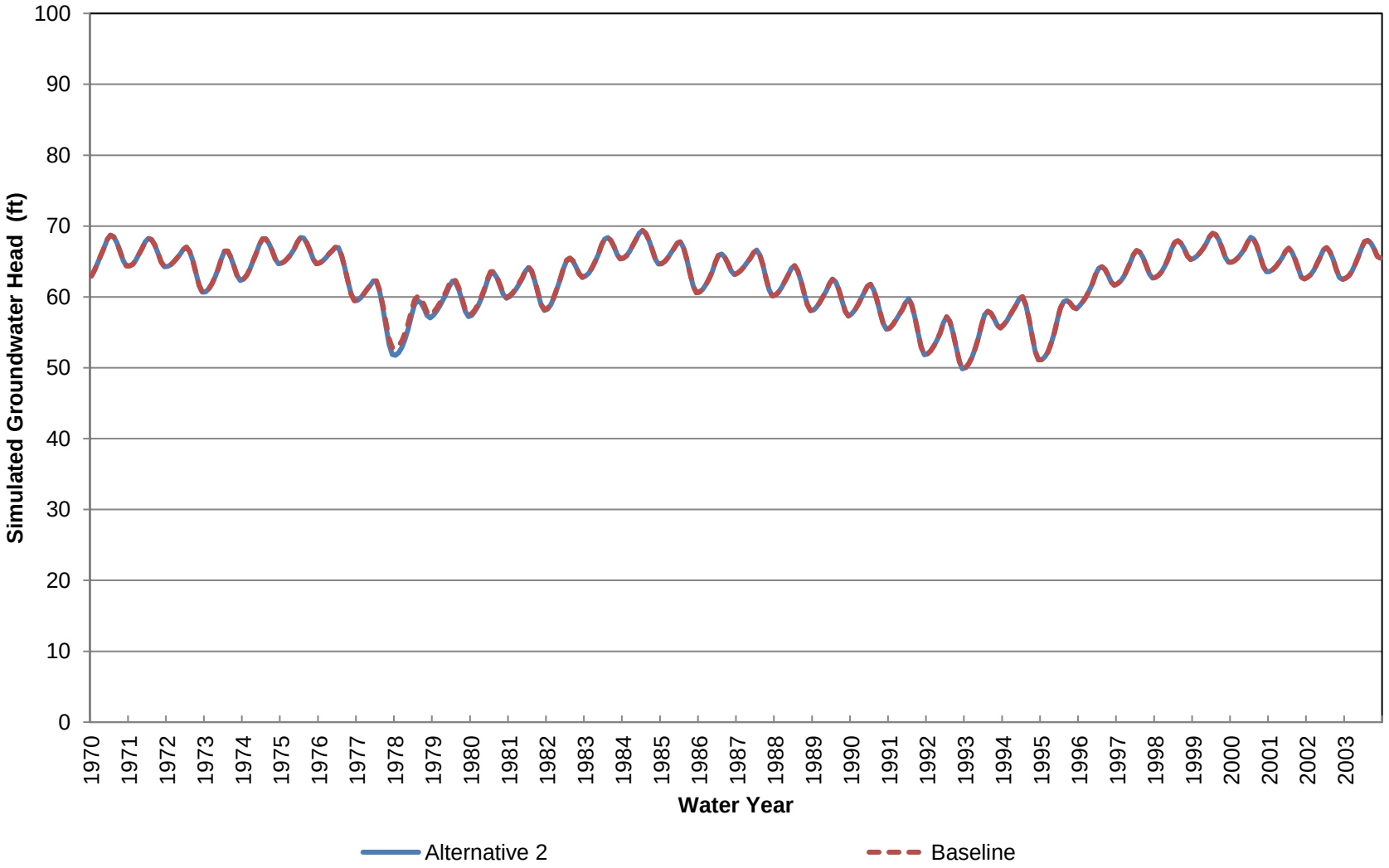
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 12 (Approximately 630-930 ft bgs)



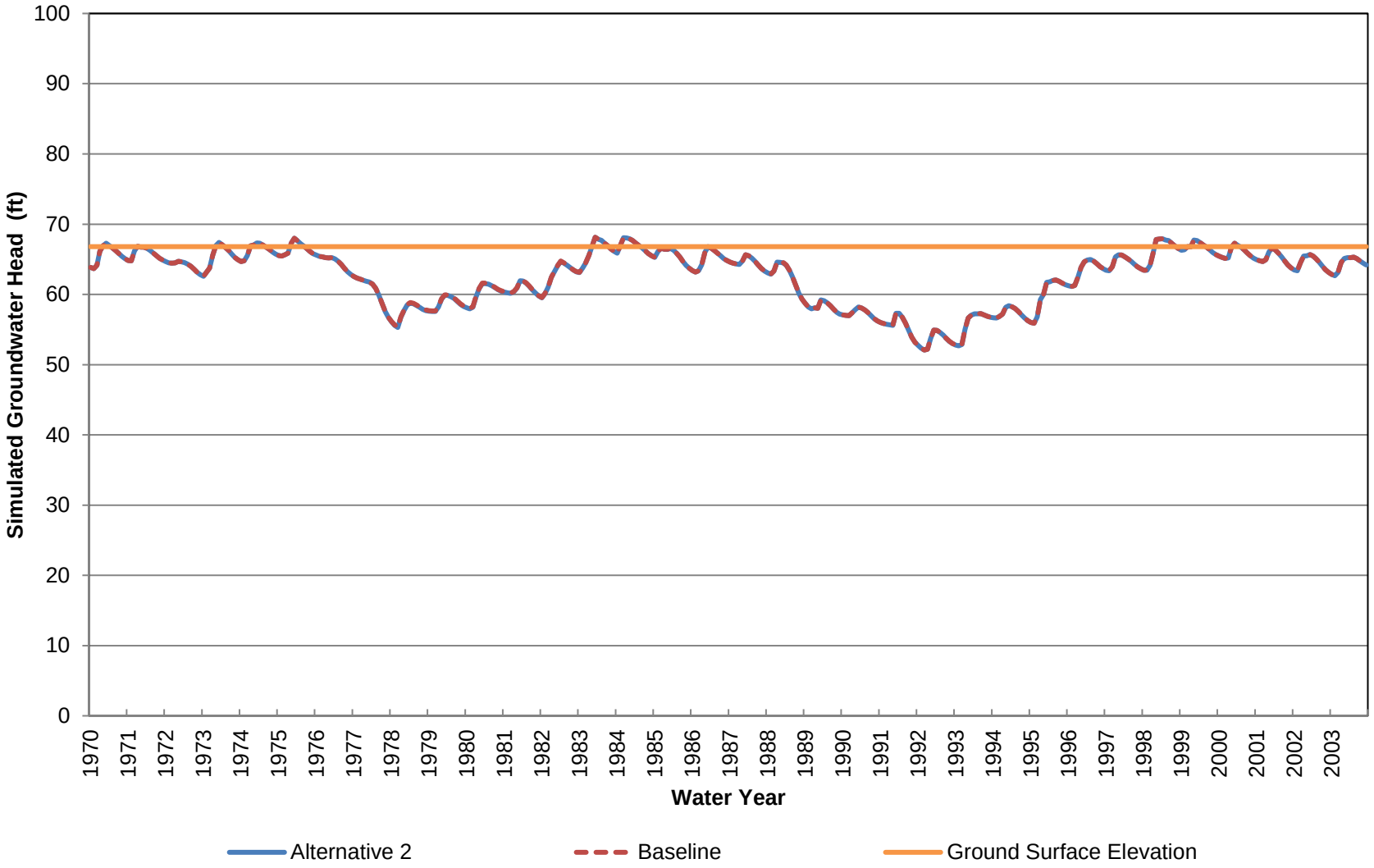
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 12 (Approximately 930-1240 ft bgs)



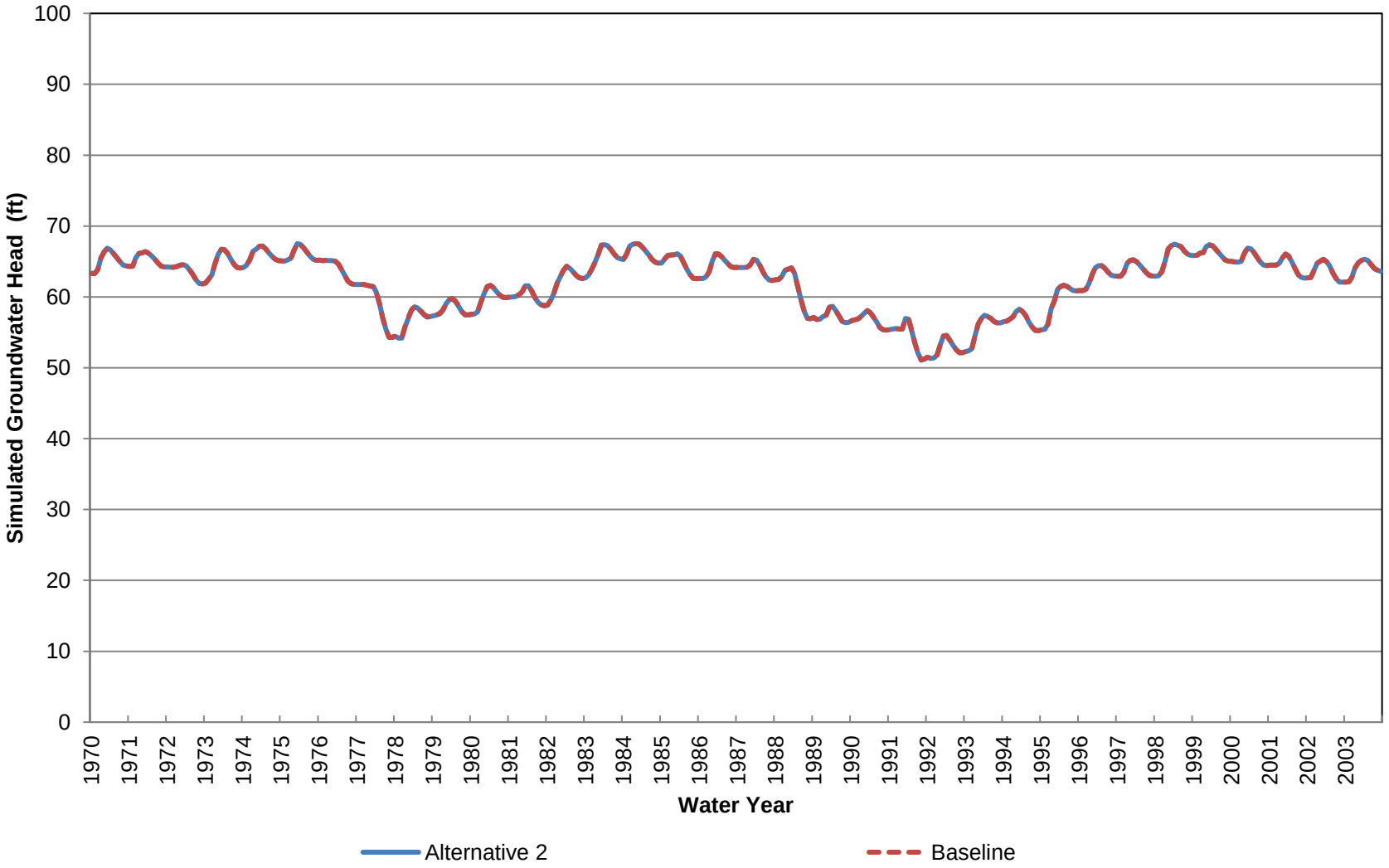
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 12 (Approximately 1240-1700 ft bgs)



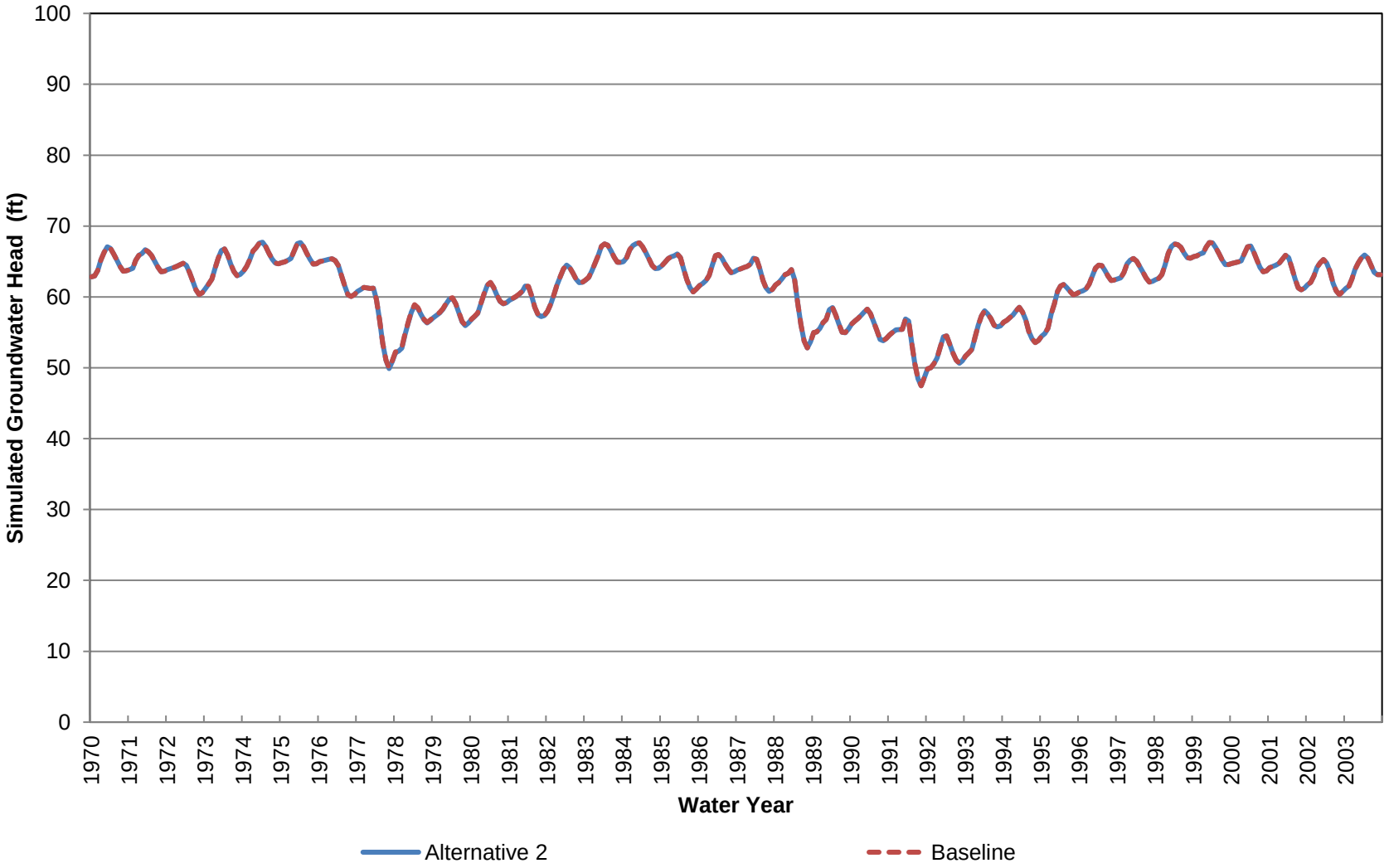
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 13 (Approximately 0-70 ft bgs)



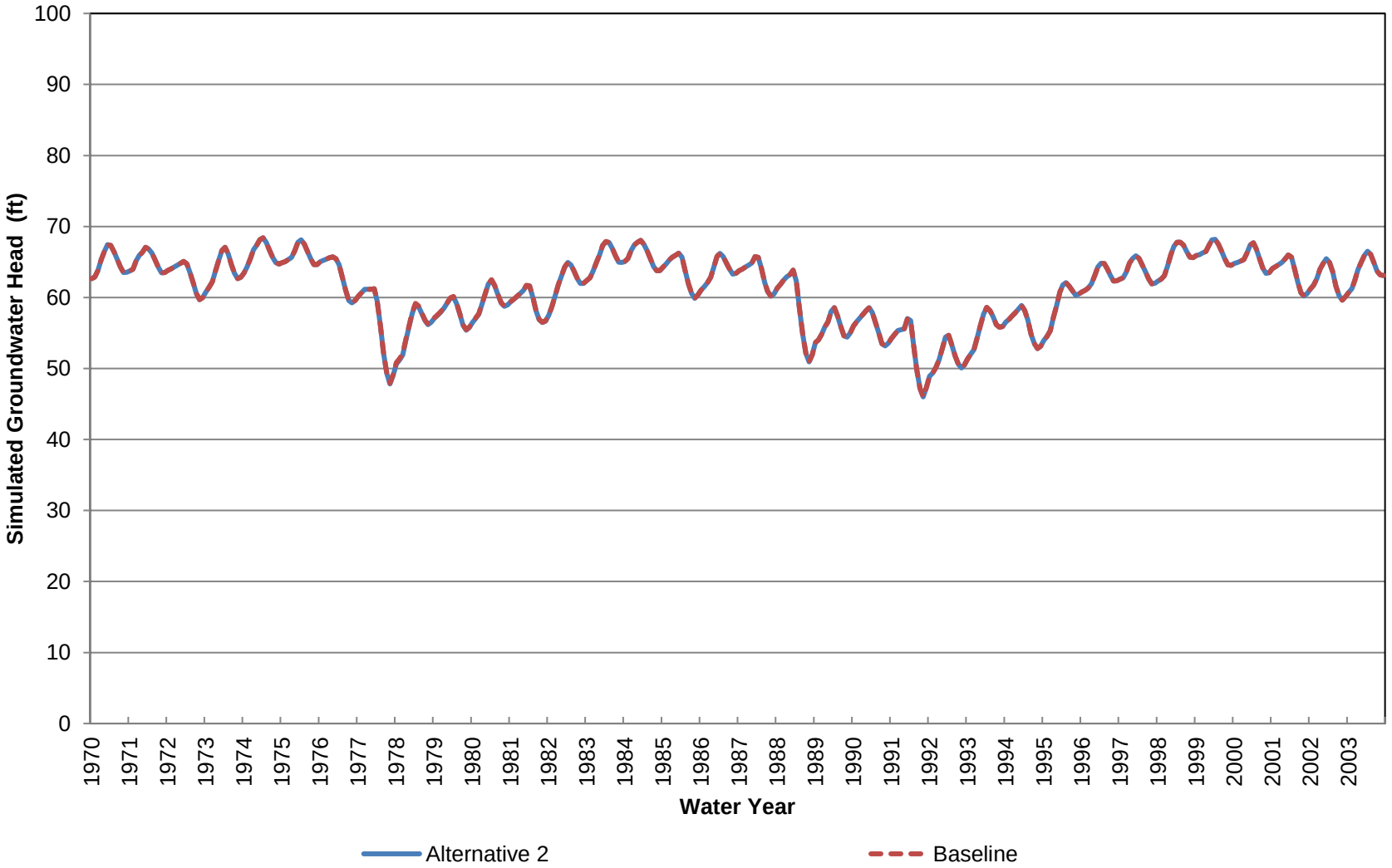
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 13 (Approximately 70-210 ft bgs)



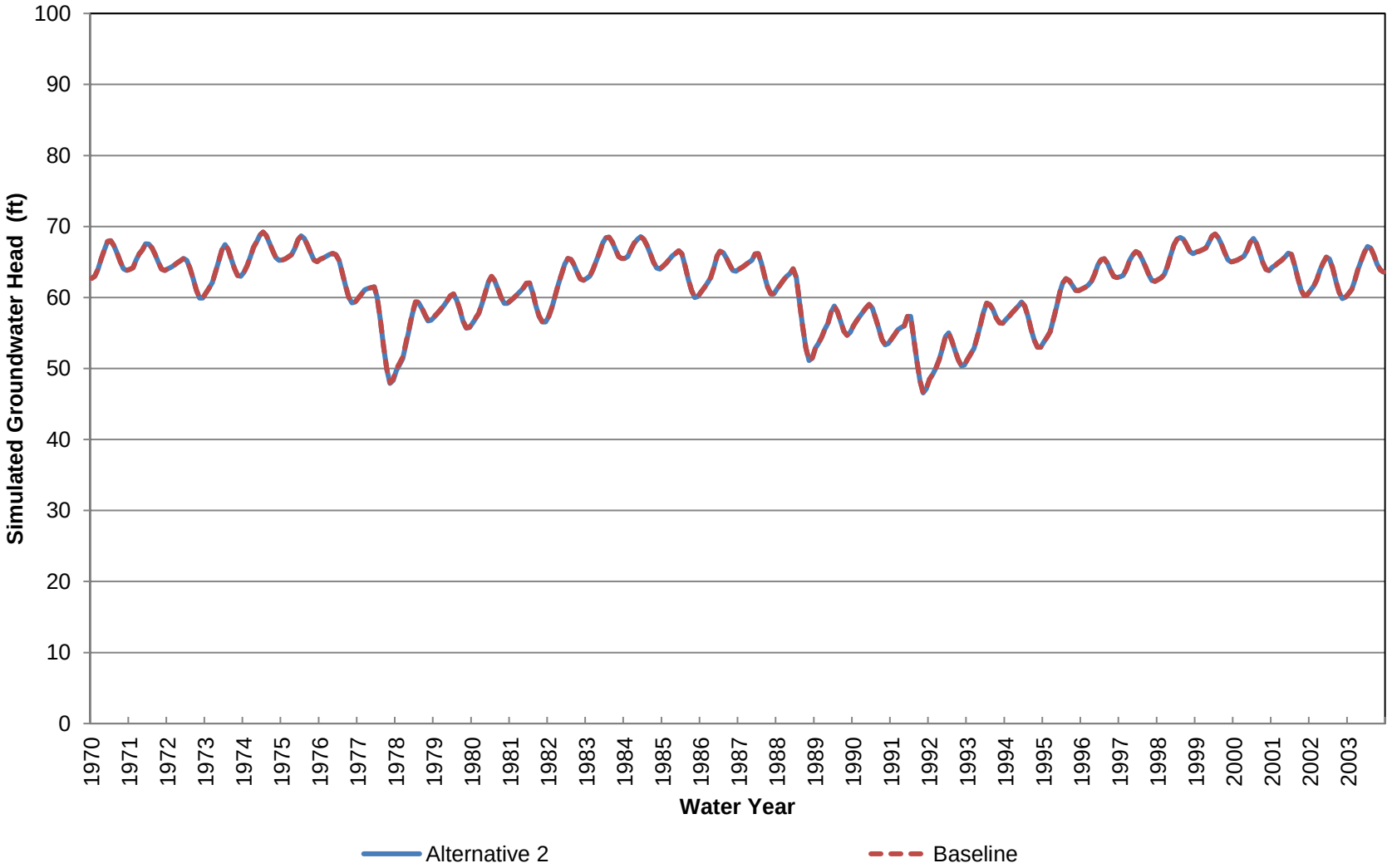
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 13 (Approximately 210-350 ft bgs)



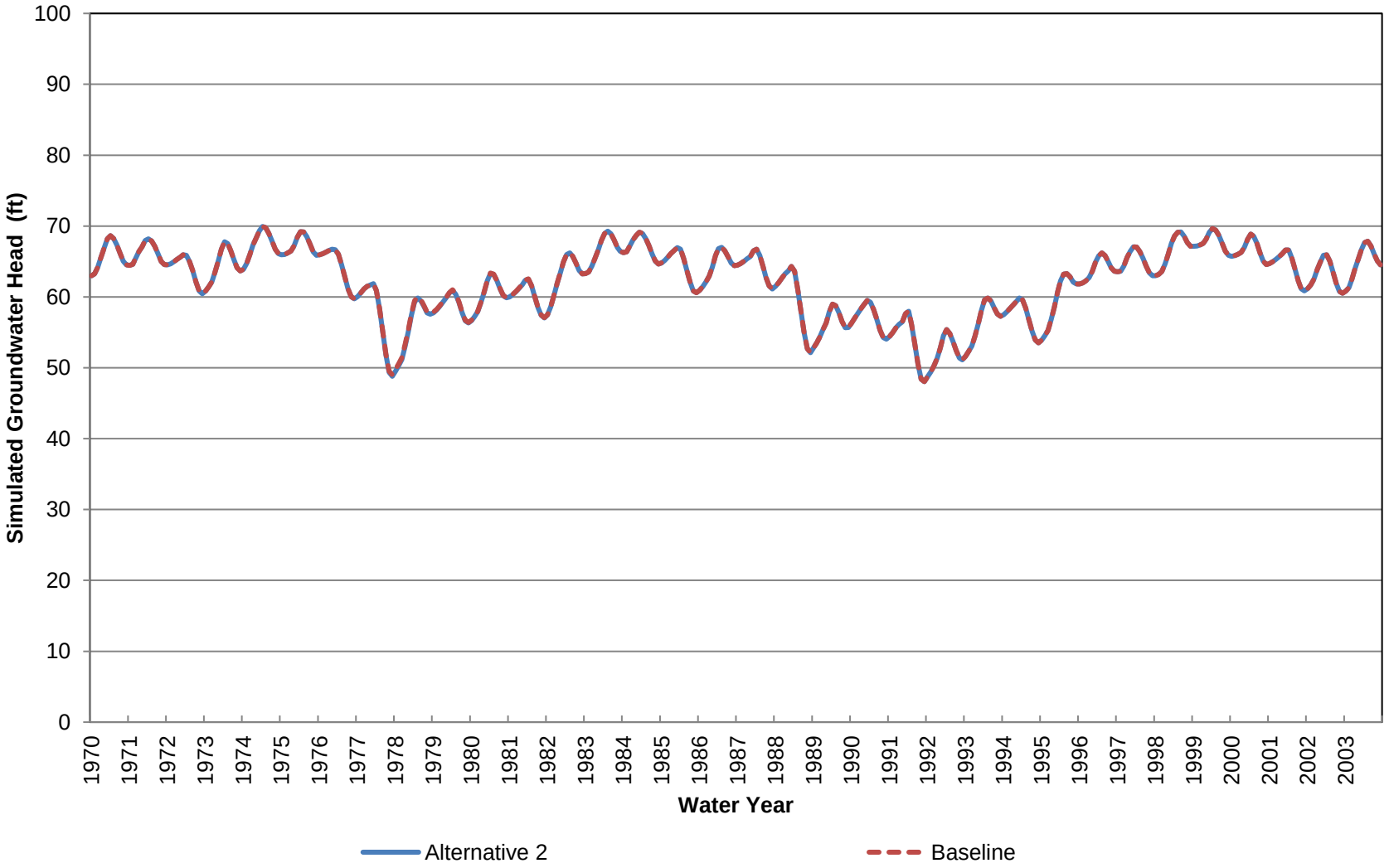
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 13 (Approximately 350-490 ft bgs)



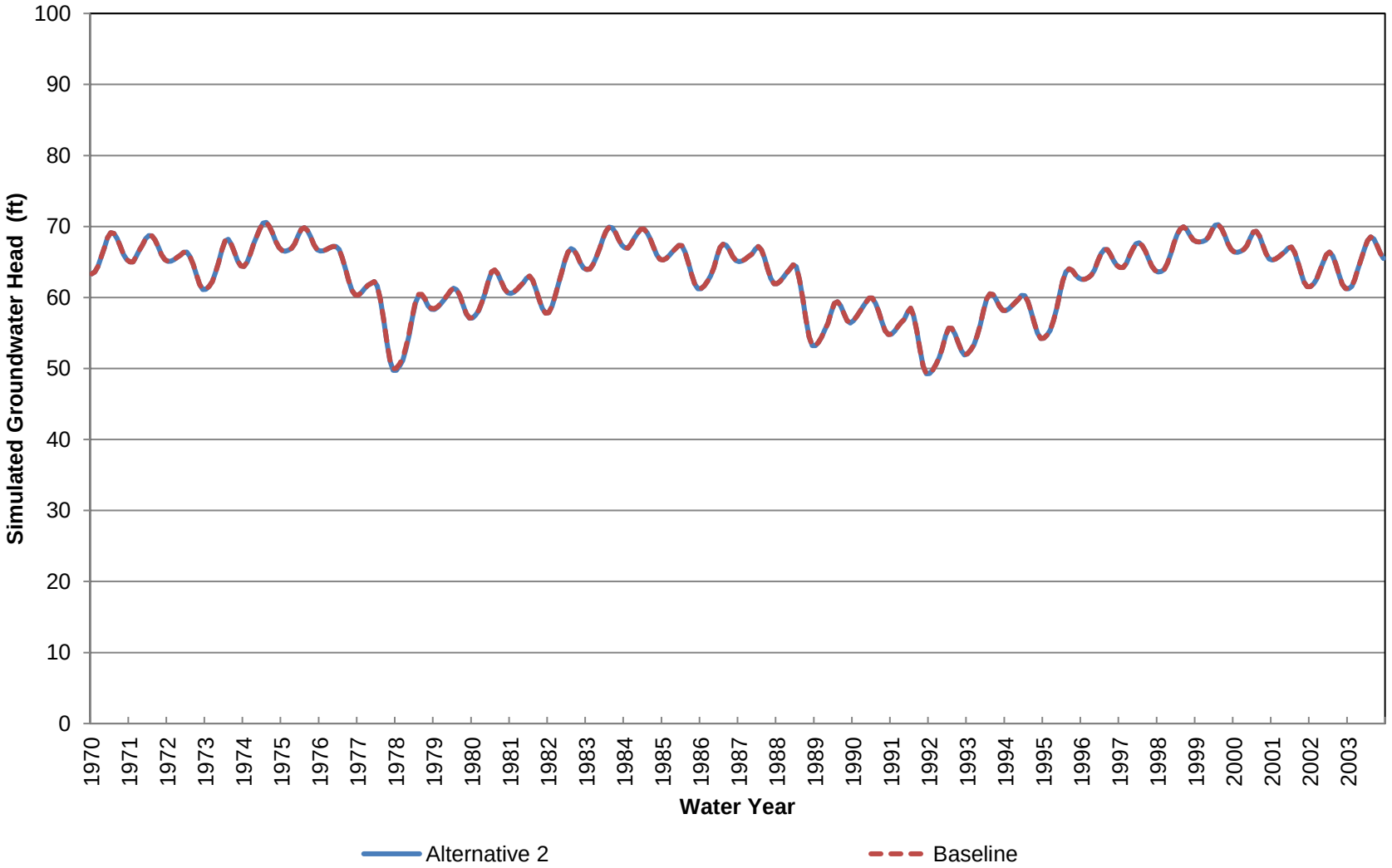
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 13 (Approximately 490-700 ft bgs)



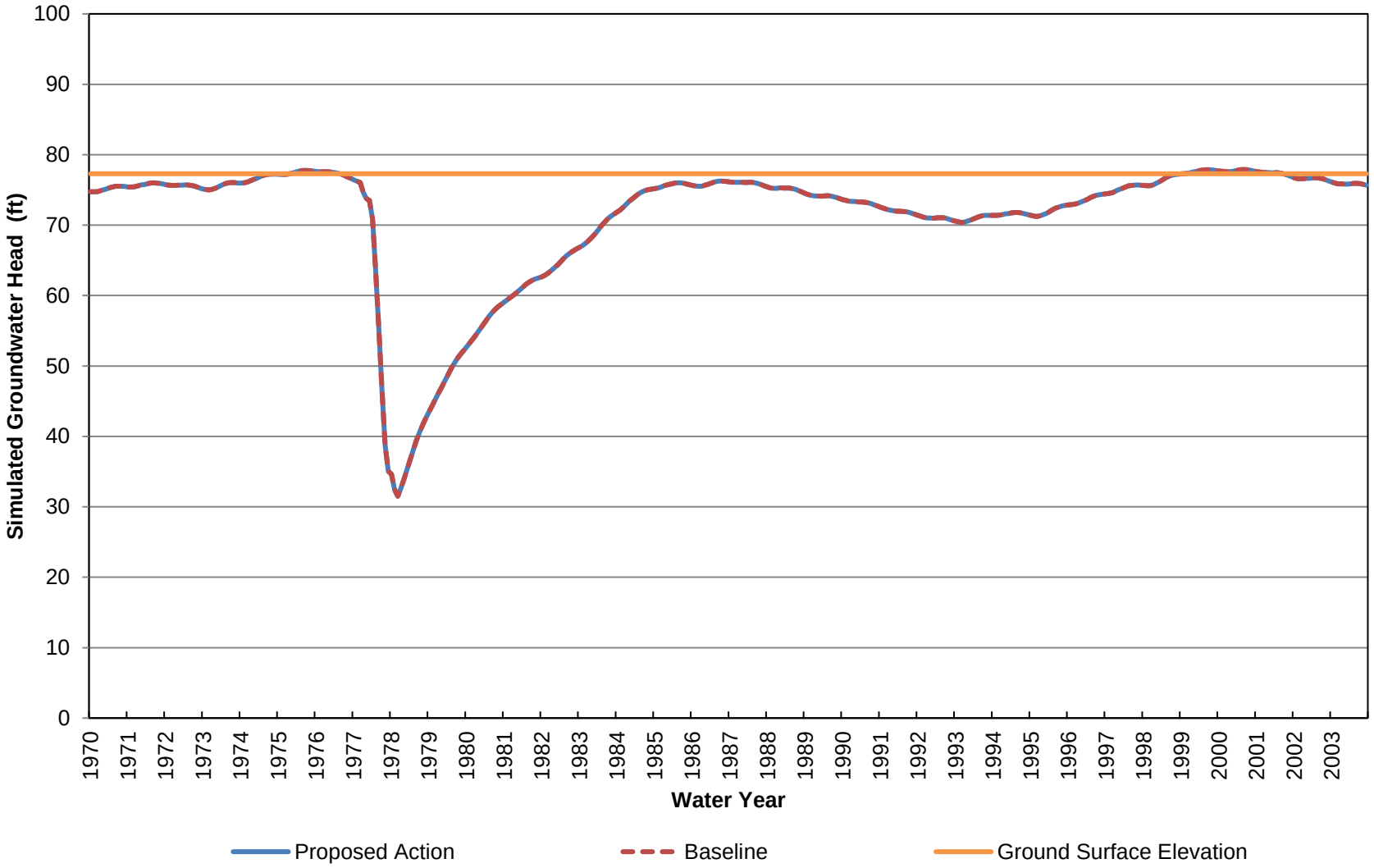
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 13 (Approximately 700-930 ft bgs)



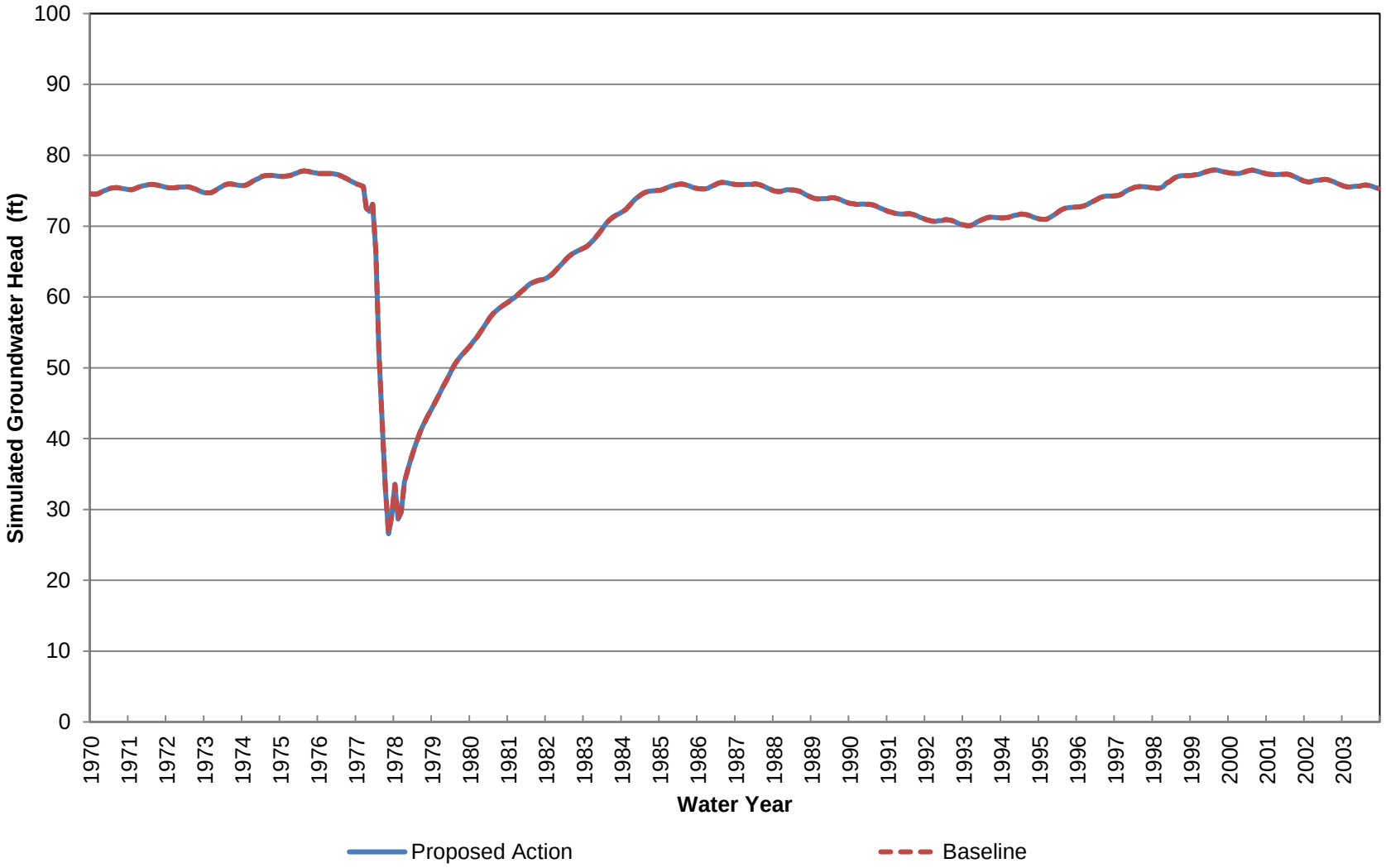
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 13 (Approximately 930-1280 ft bgs)



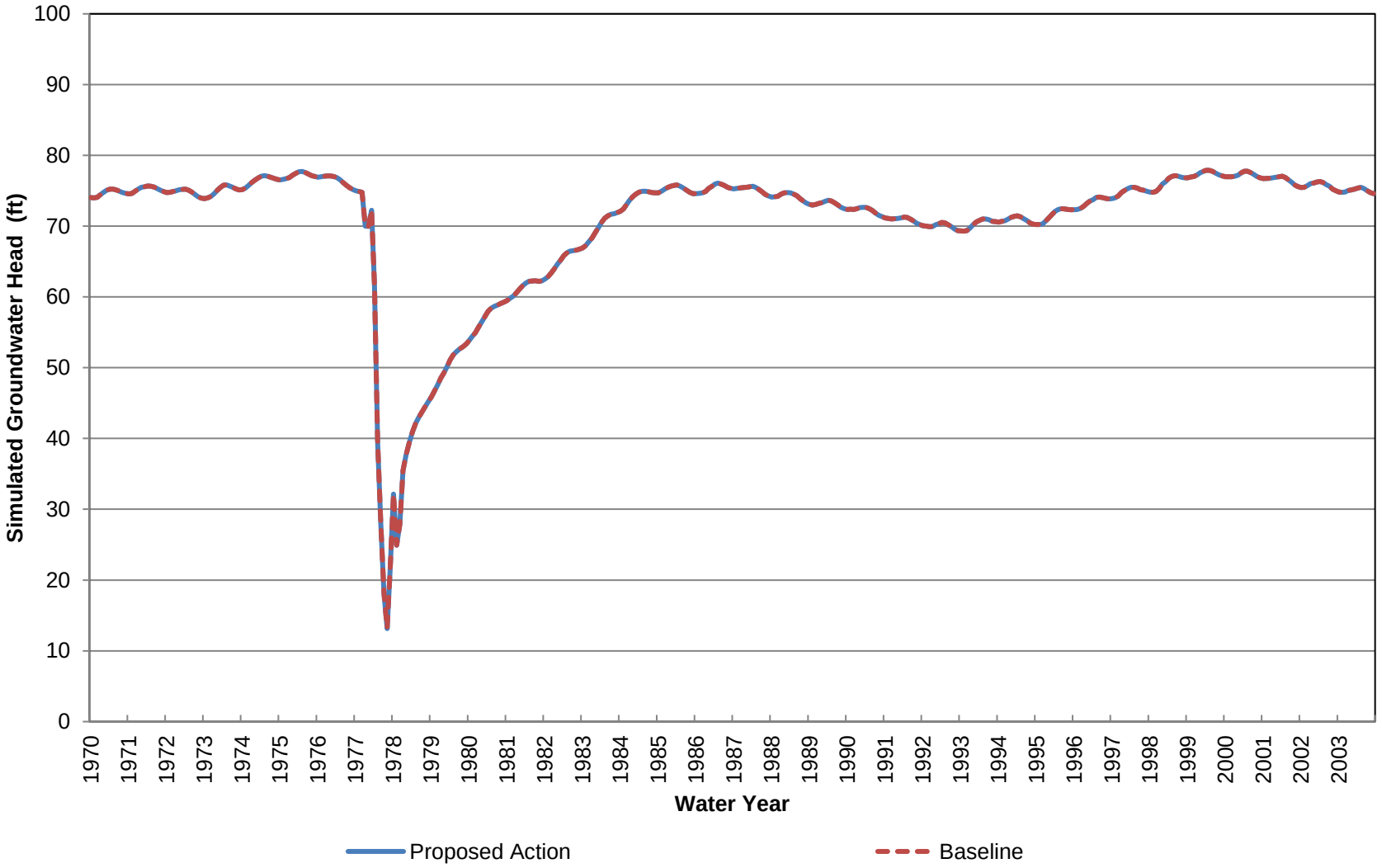
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 14 (Approximately 0-40 ft bgs)



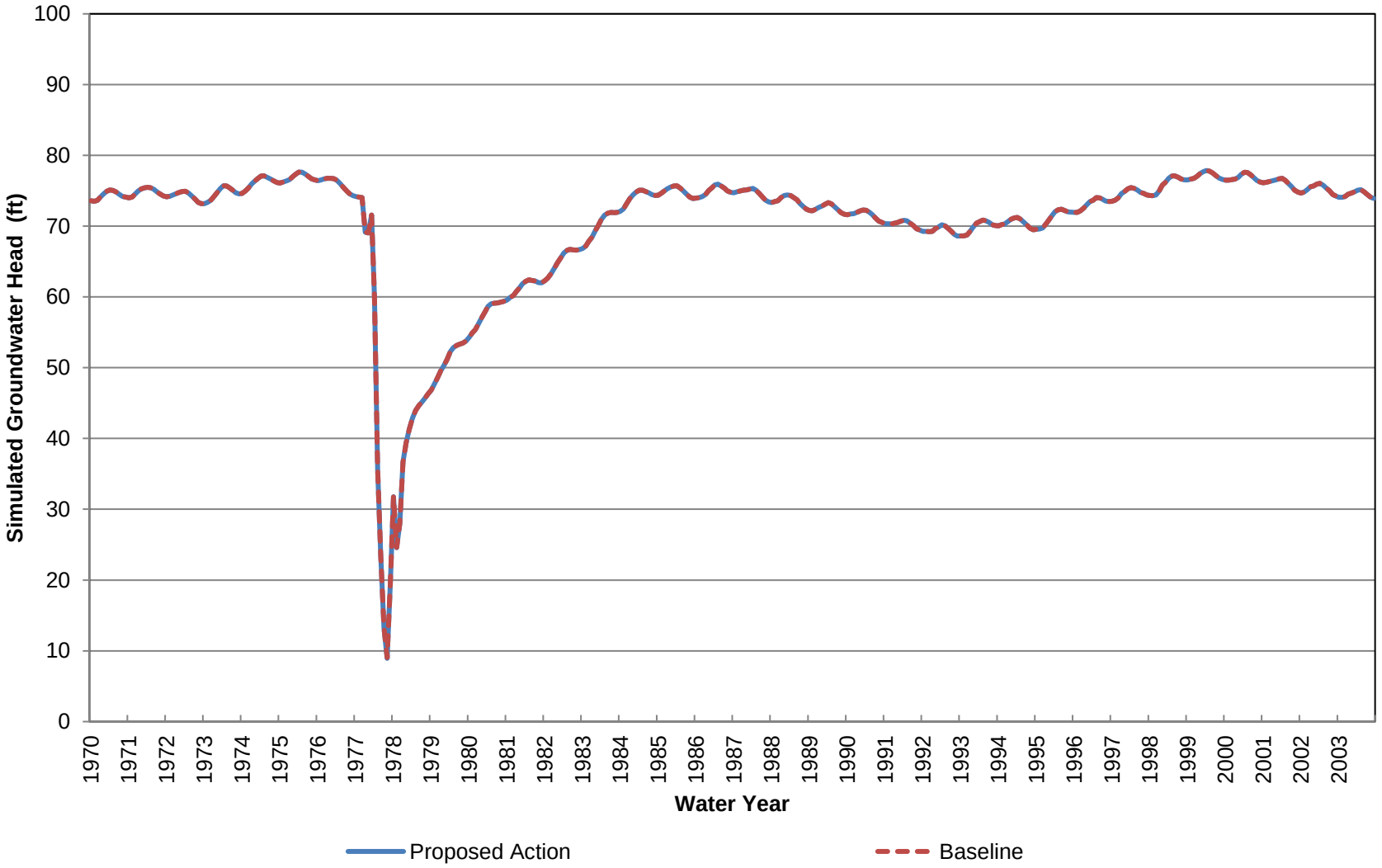
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 14 (Approximately 40-110 ft bgs)



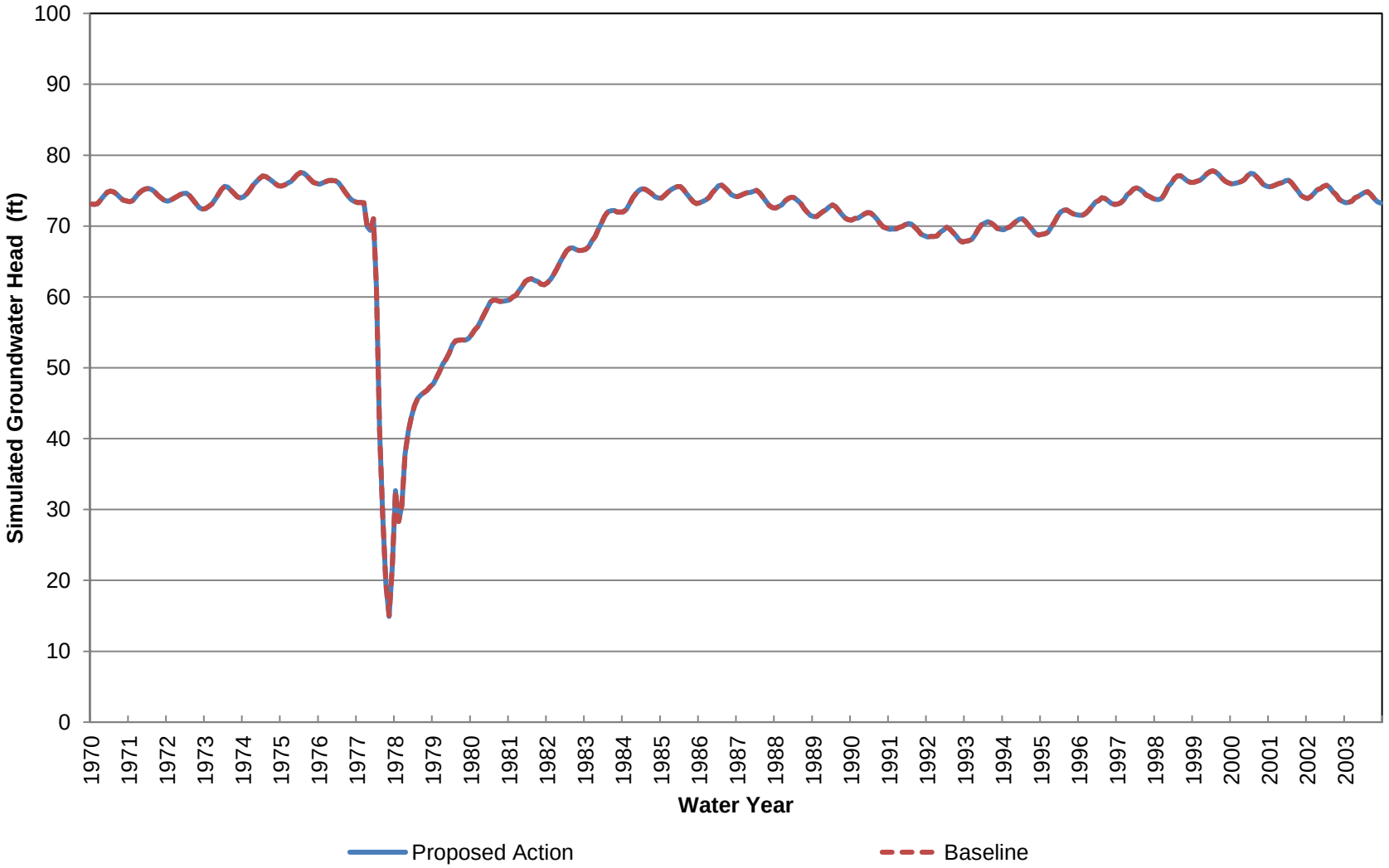
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 14 (Approximately 110-170 ft bgs)



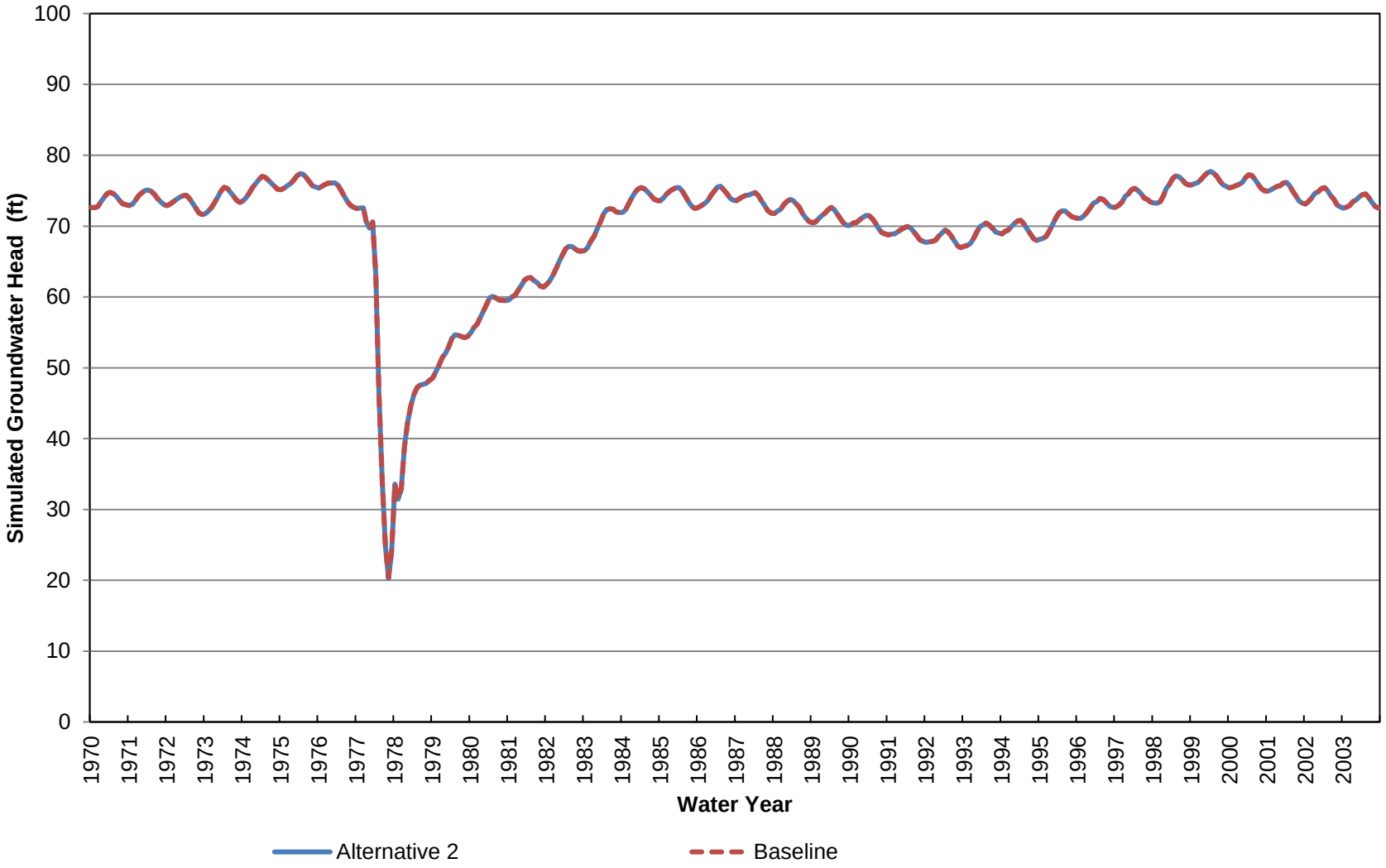
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 14 (Approximately 170-230 ft bgs)



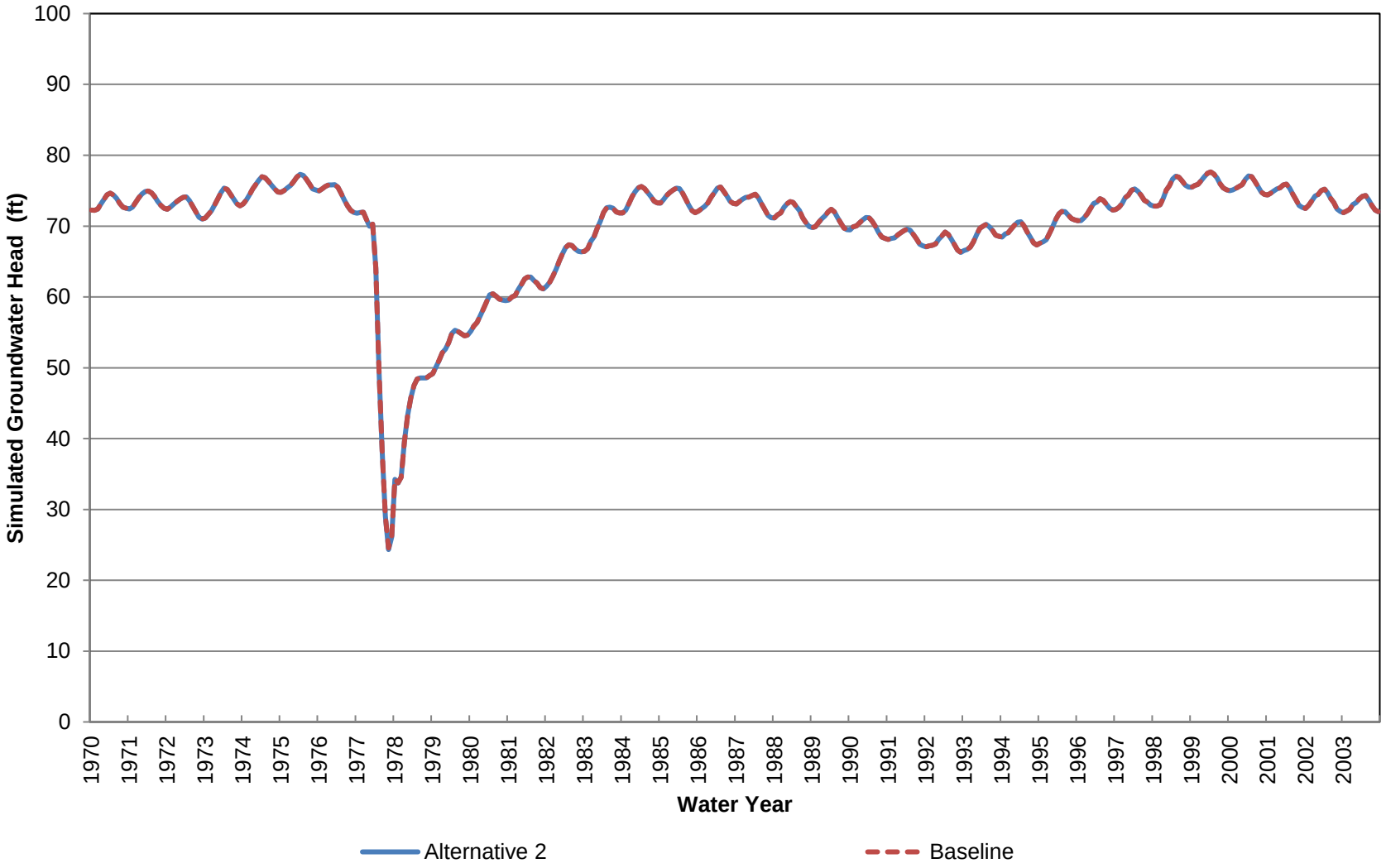
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 14 (Approximately 230-310 ft bgs)



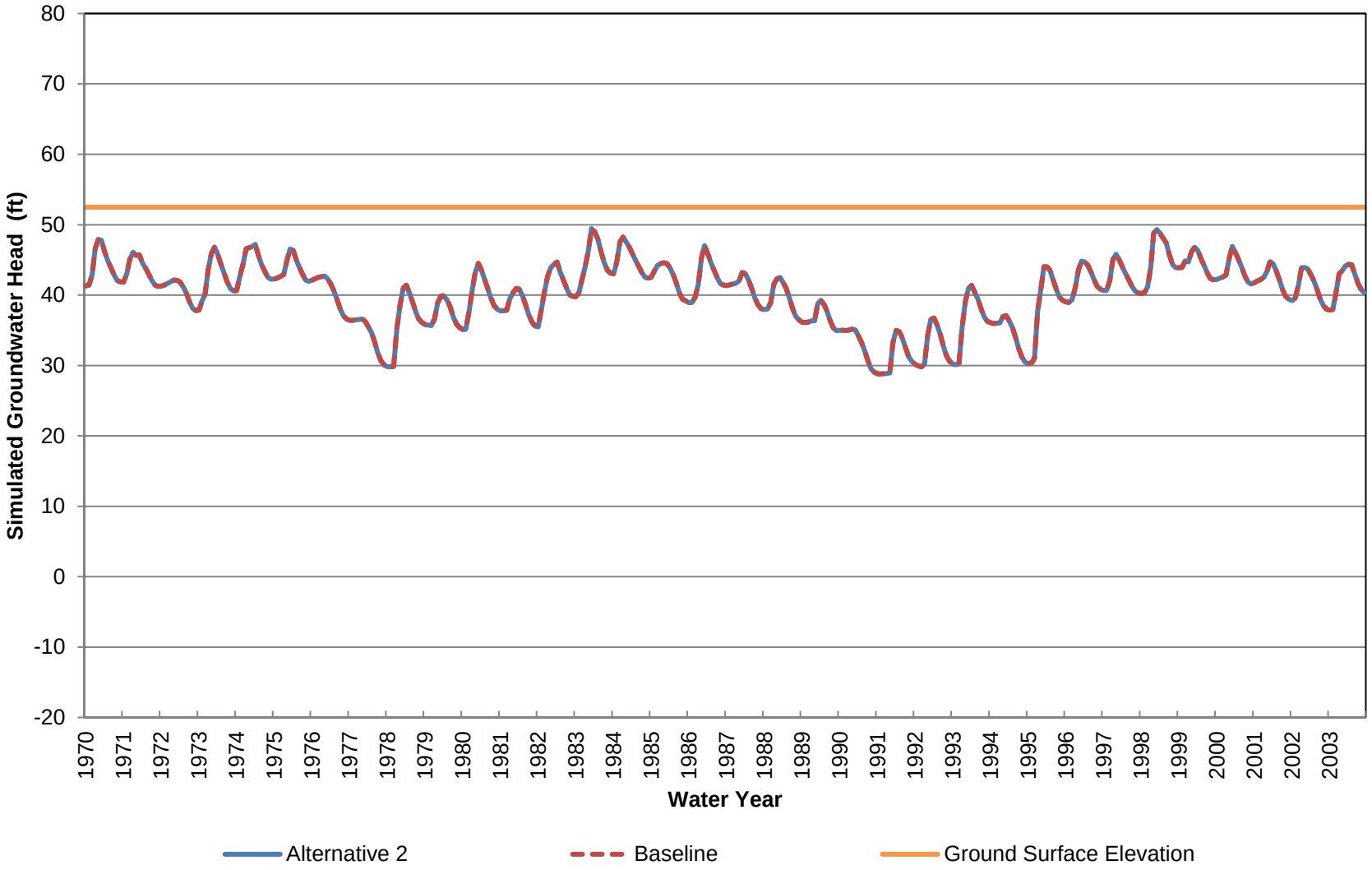
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 14 (Approximately 310-420 ft bgs)



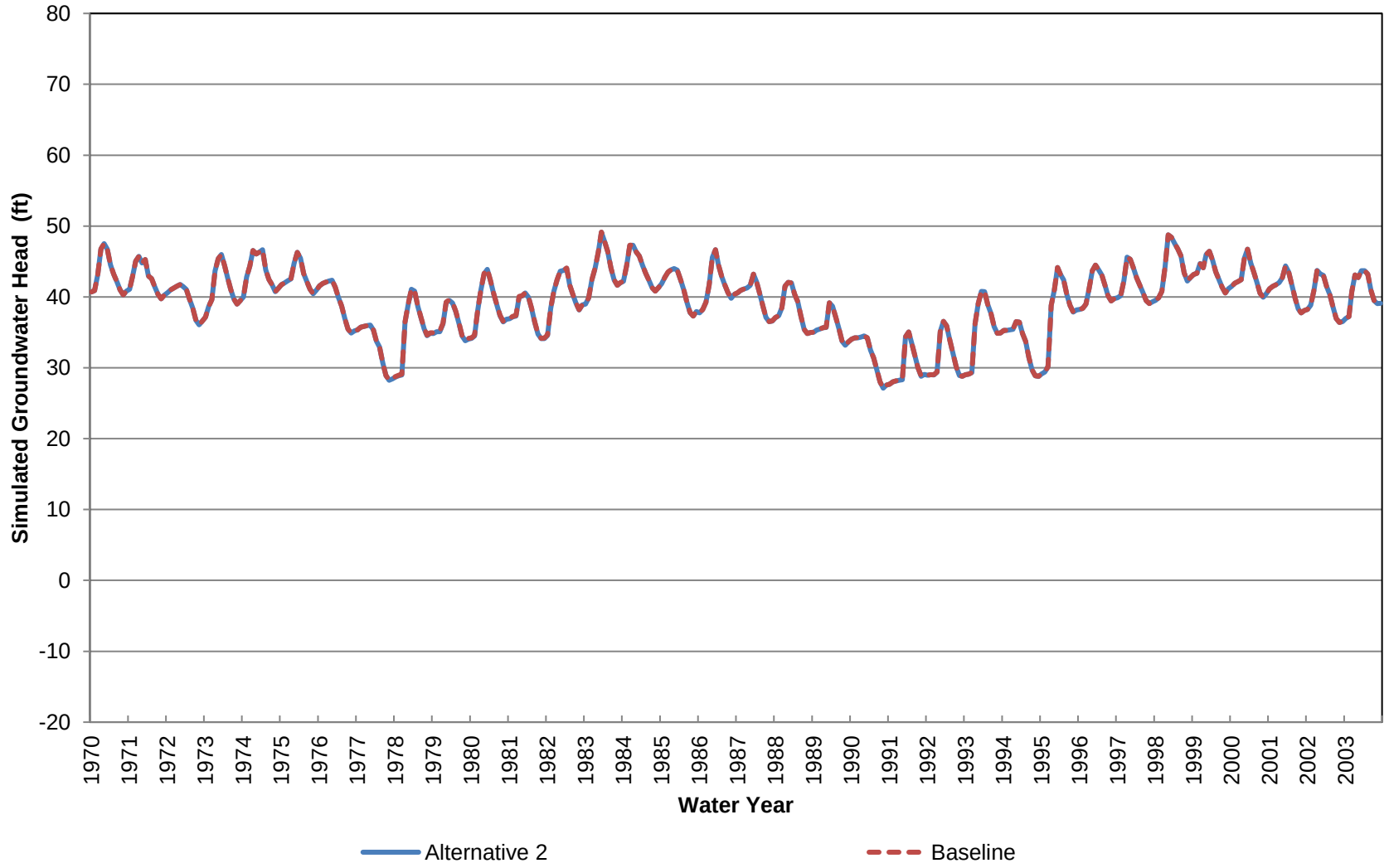
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 14 (Approximately 420-570 ft bgs)



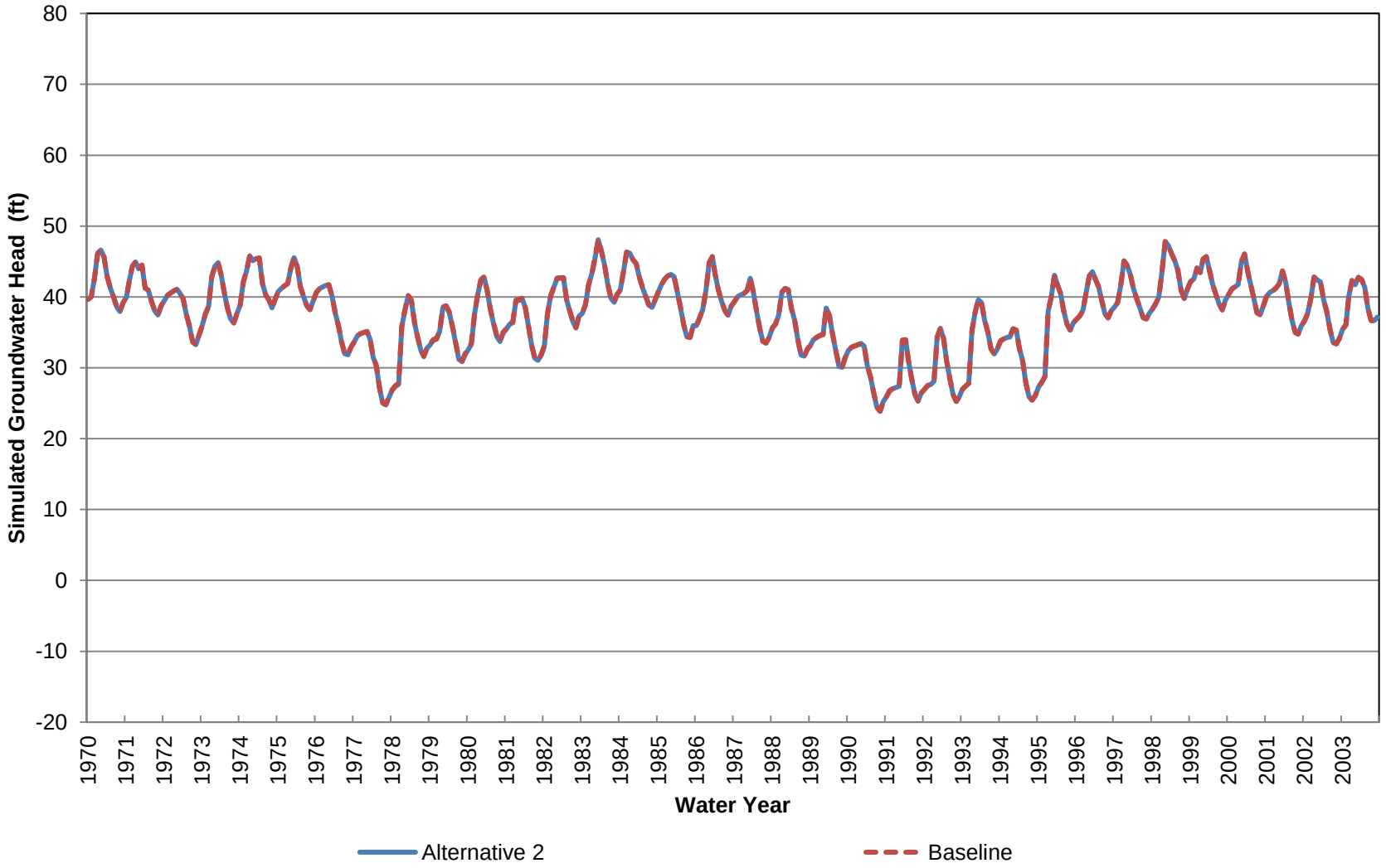
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 15 (Approximately 0-30 ft bgs)



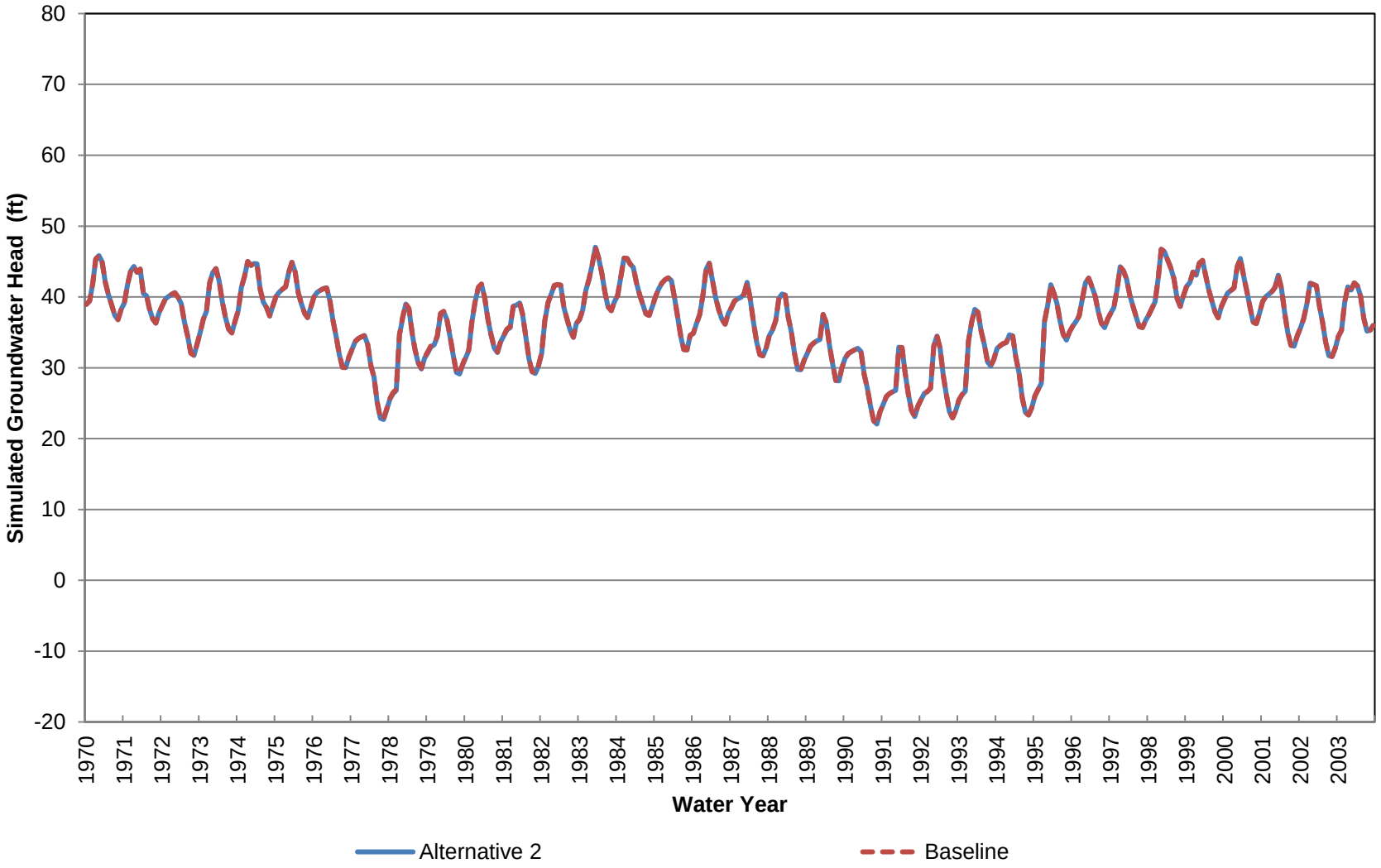
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 15 (Approximately 30-70 ft bgs)



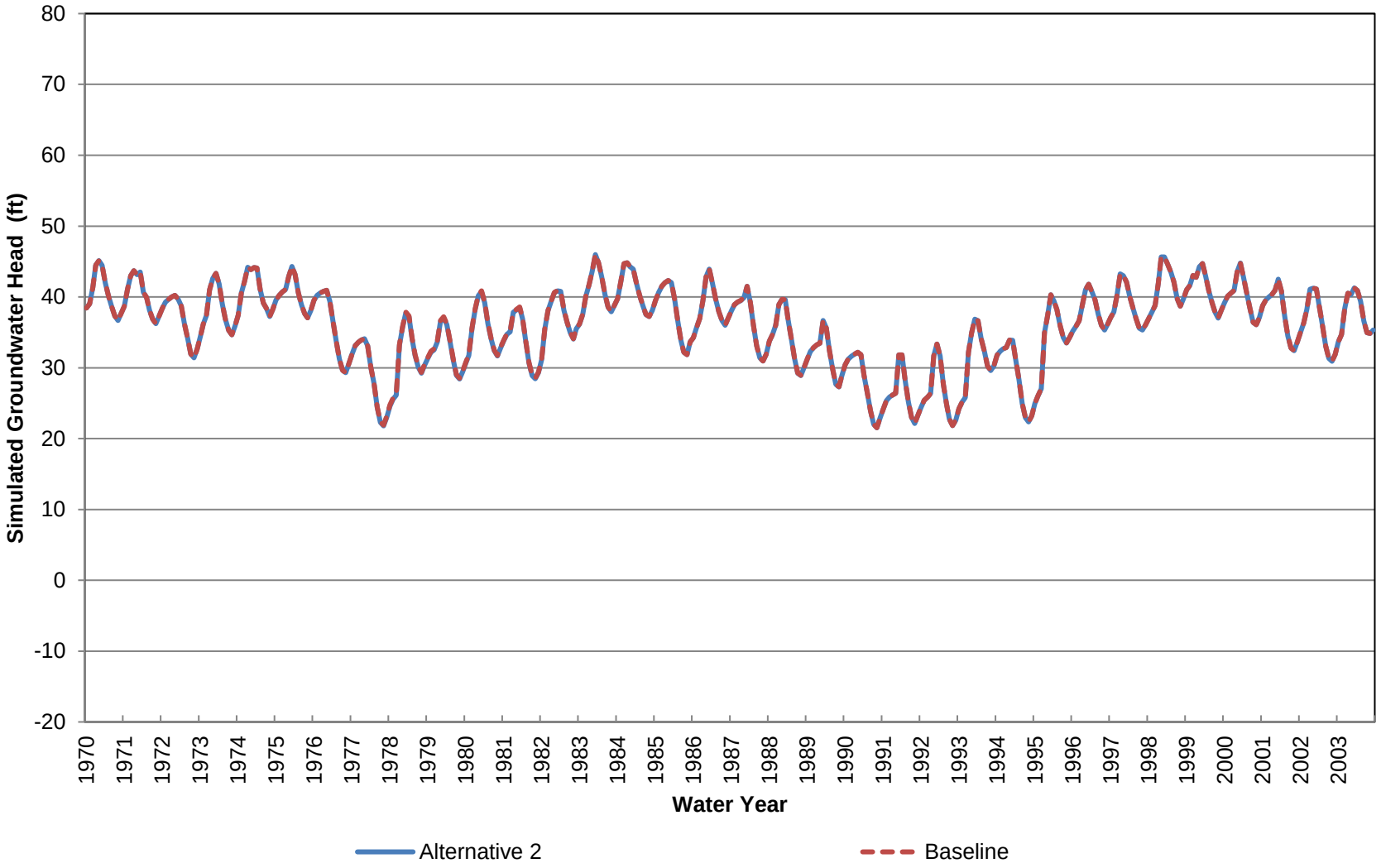
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 15 (Approximately 70-110 ft bgs)



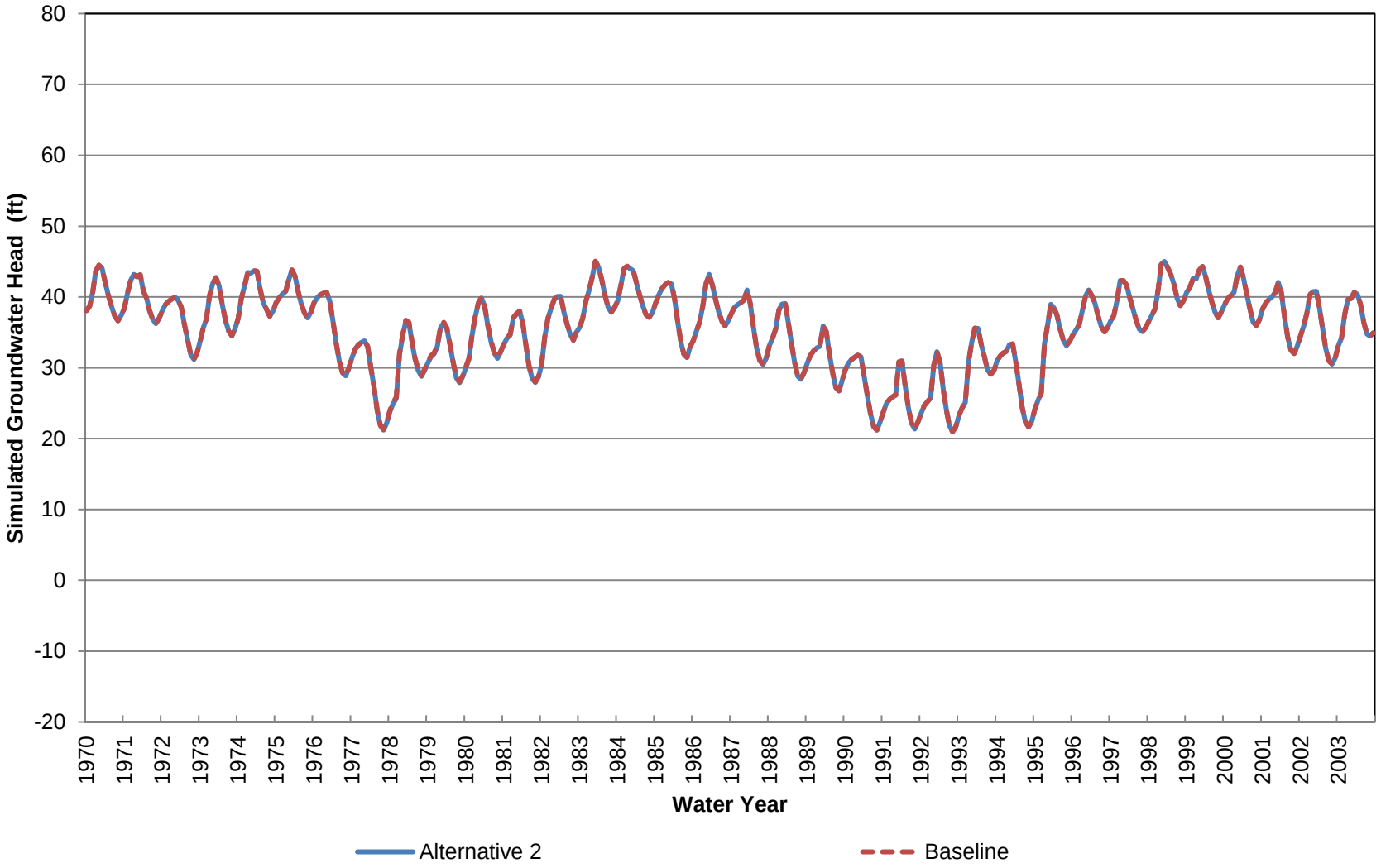
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 15 (Approximately 110-150 ft bgs)



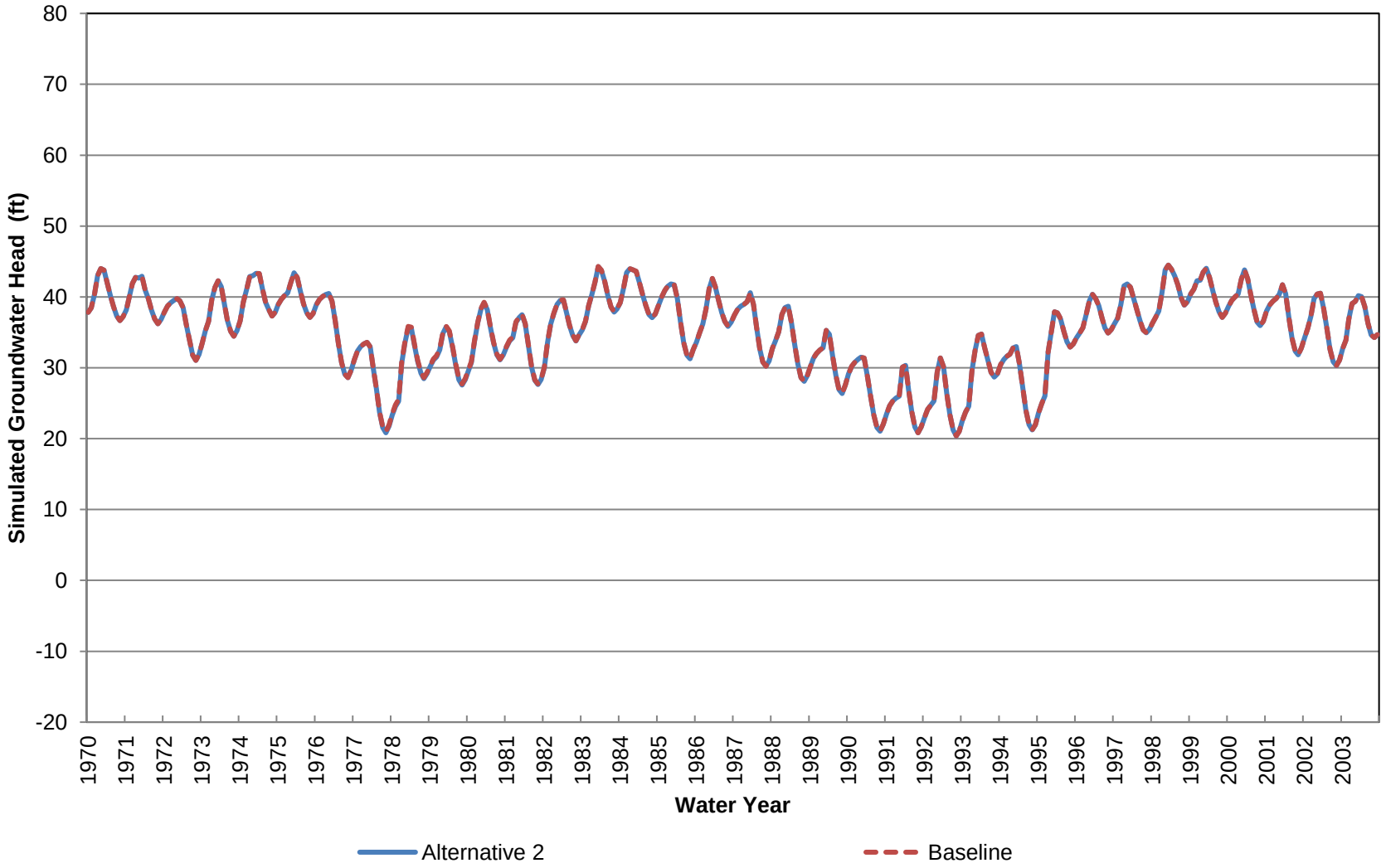
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 15 (Approximately 150-200 ft bgs)



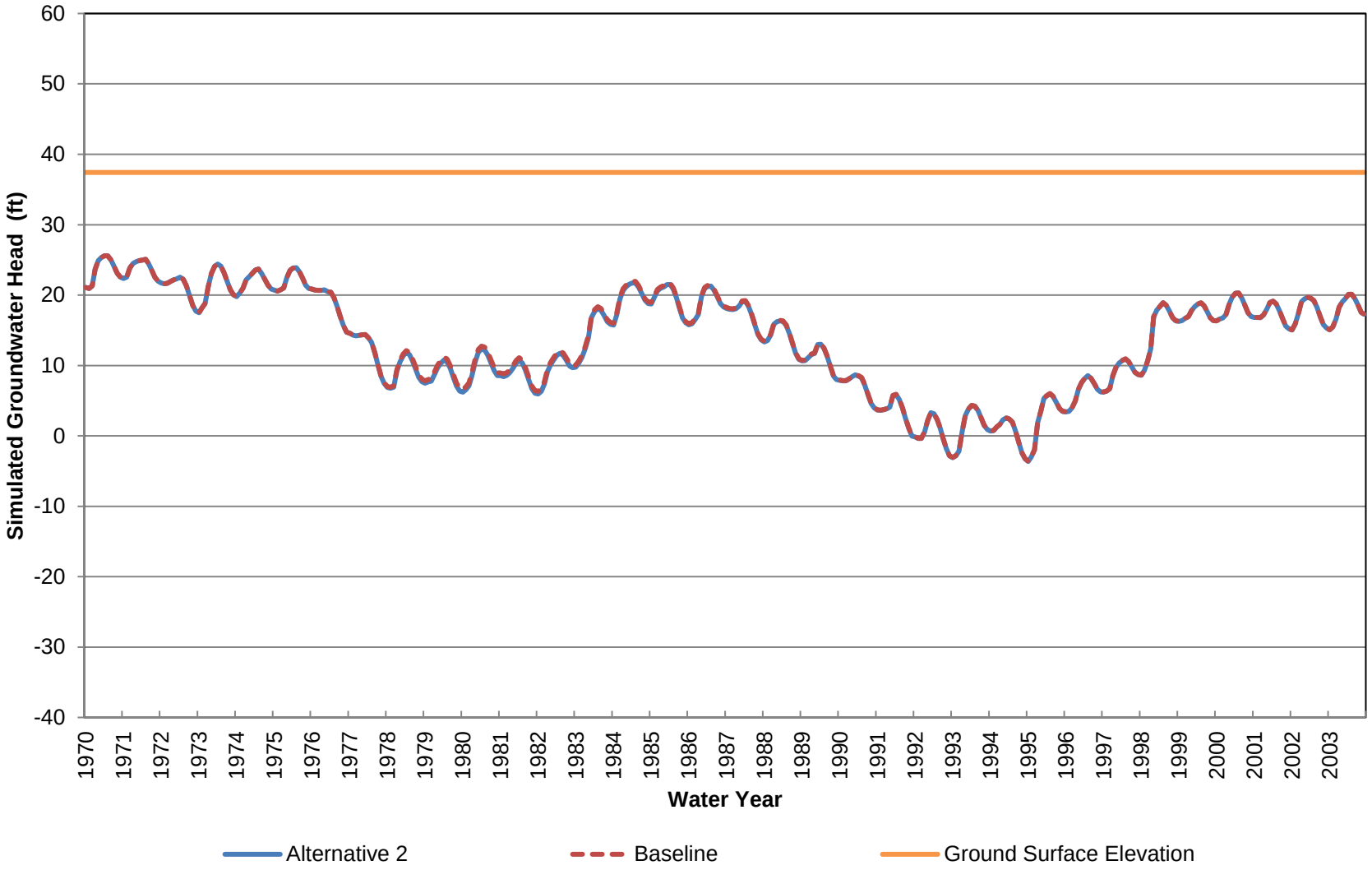
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 15 (Approximately 200-270 ft bgs)



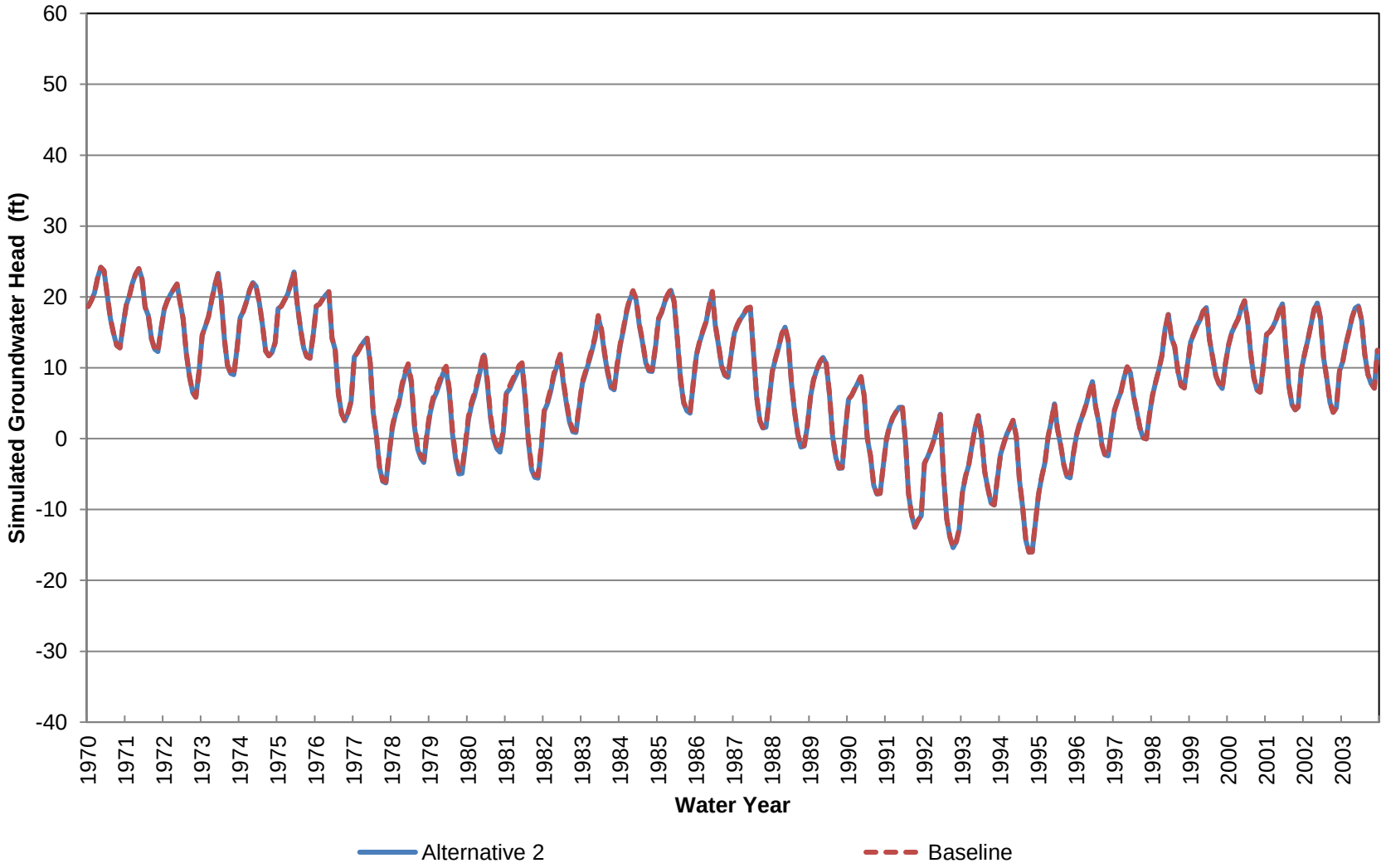
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 15 (Approximately 270-360 ft bgs)



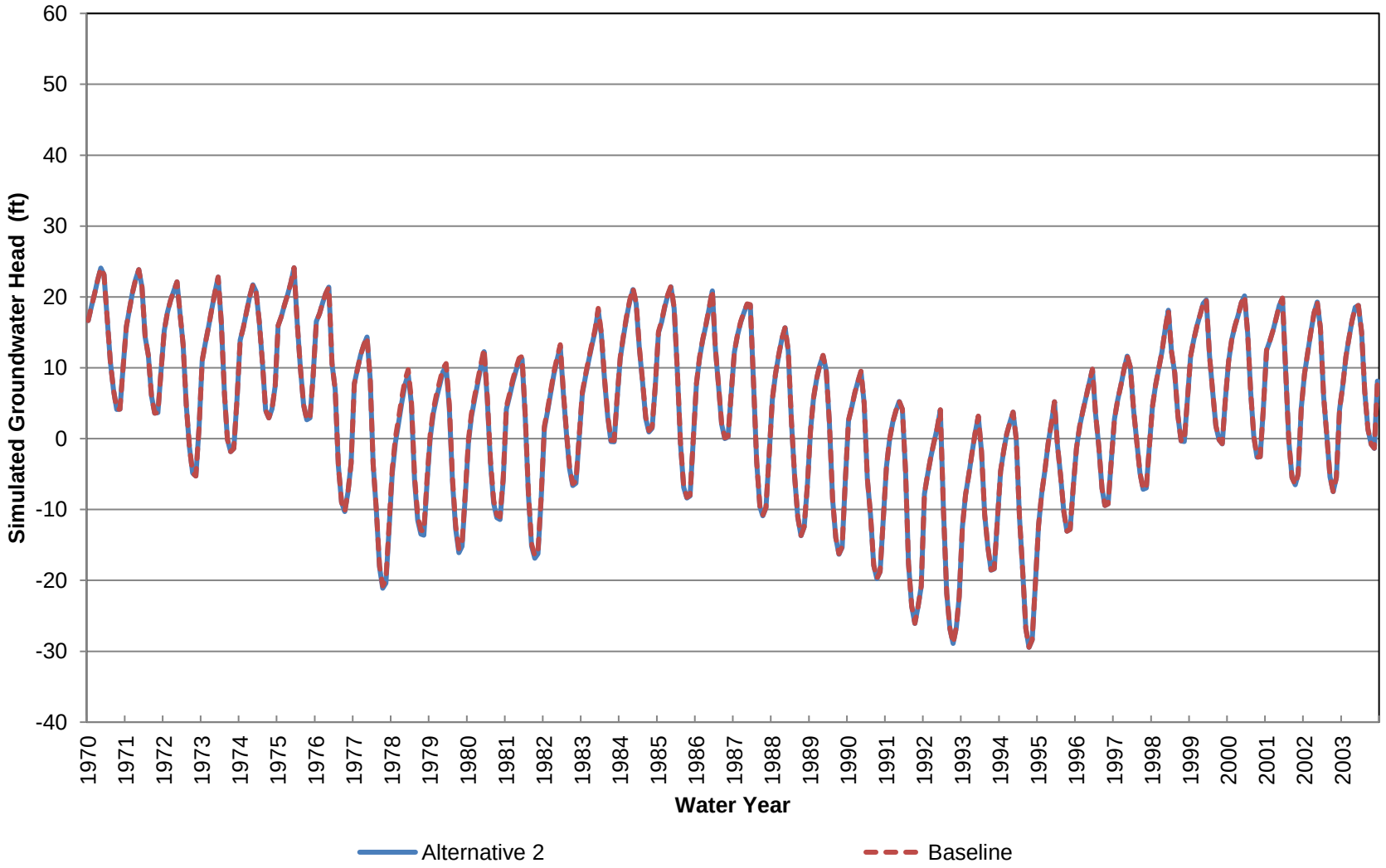
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 16 (Approximately 0-70 ft bgs)



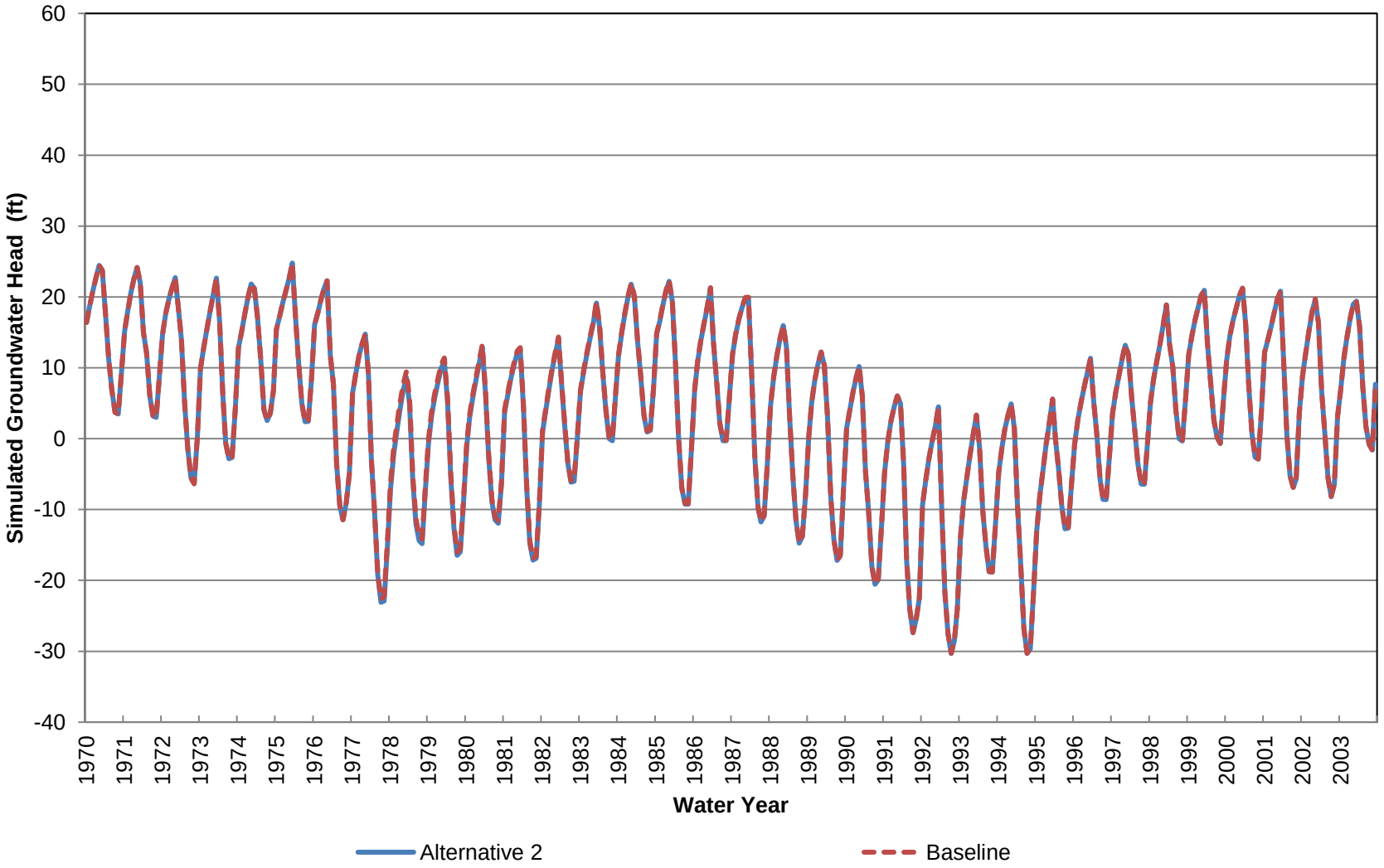
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 16 (Approximately 70-220 ft bgs)



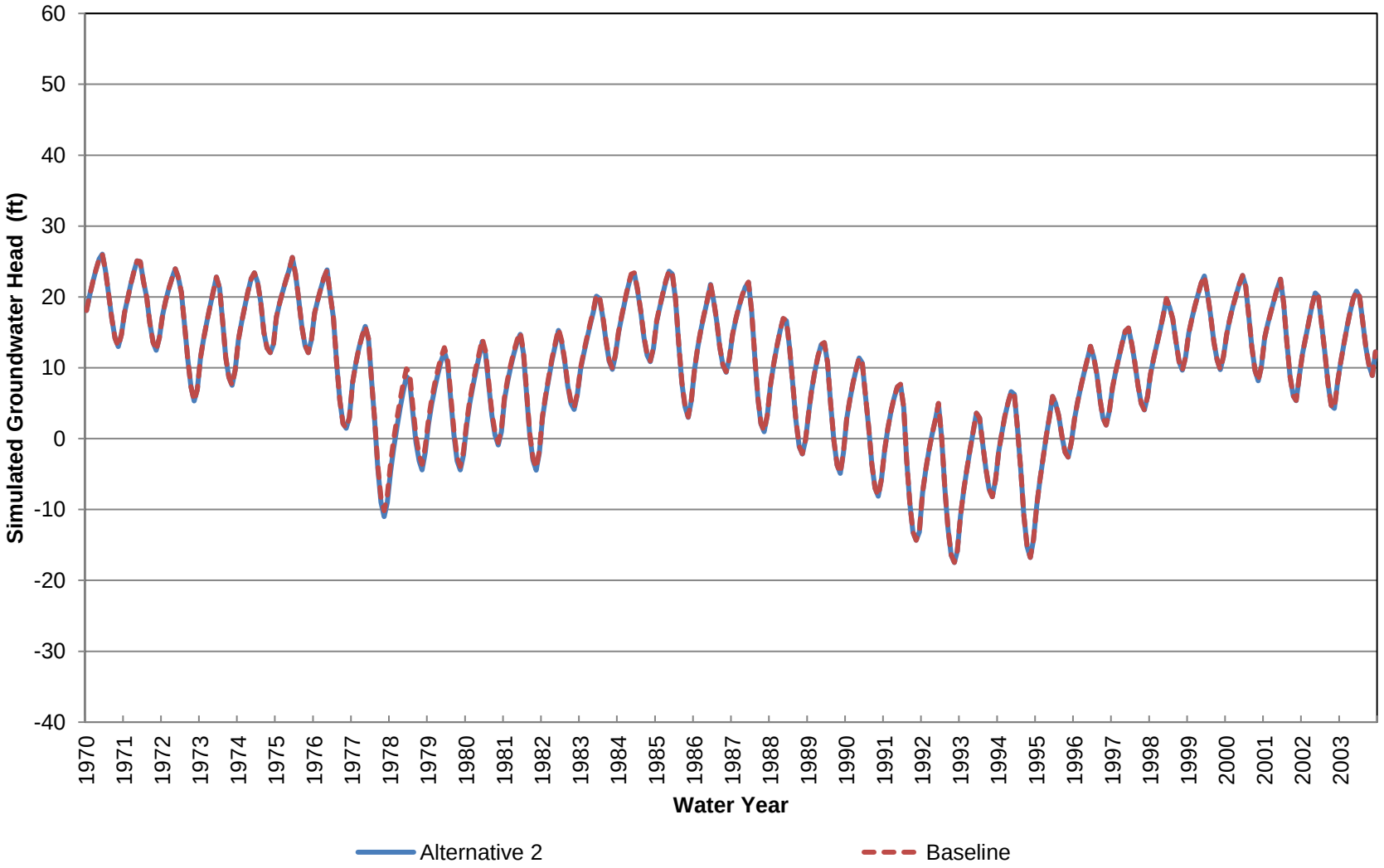
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 16 (Approximately 220-370 ft bgs)



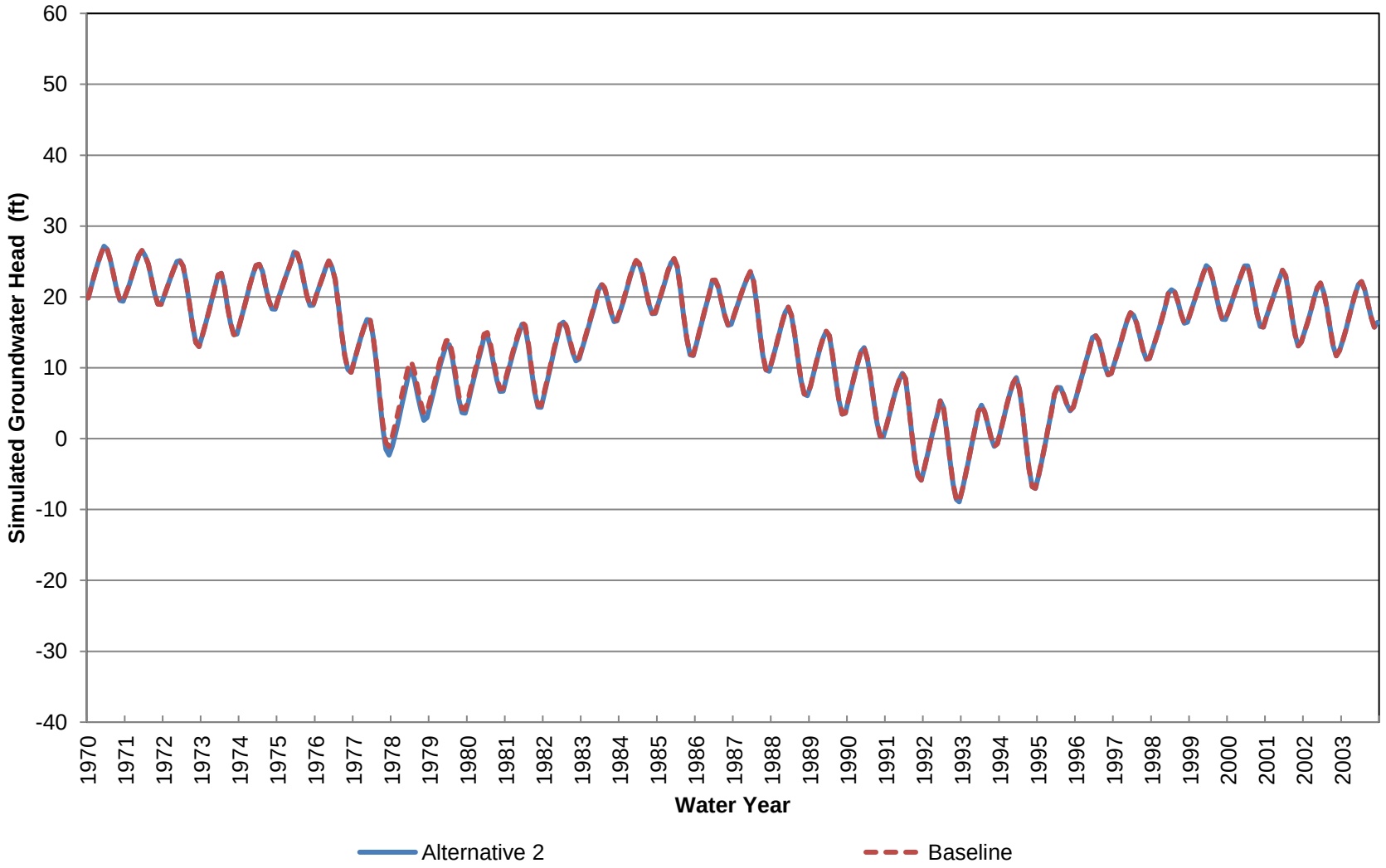
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 16 (Approximately 370-530 ft bgs)



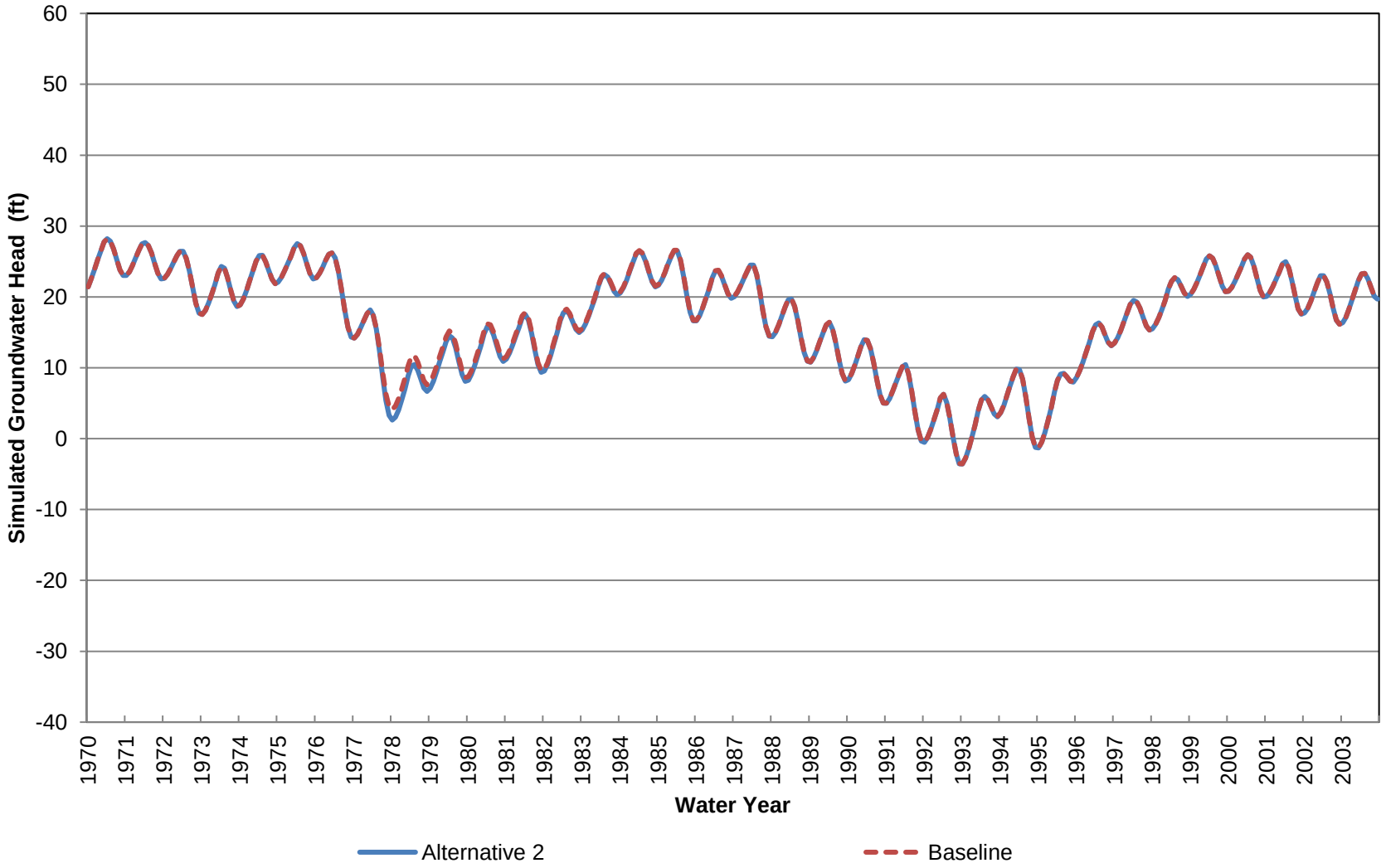
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 16 (Approximately 530-760 ft bgs)



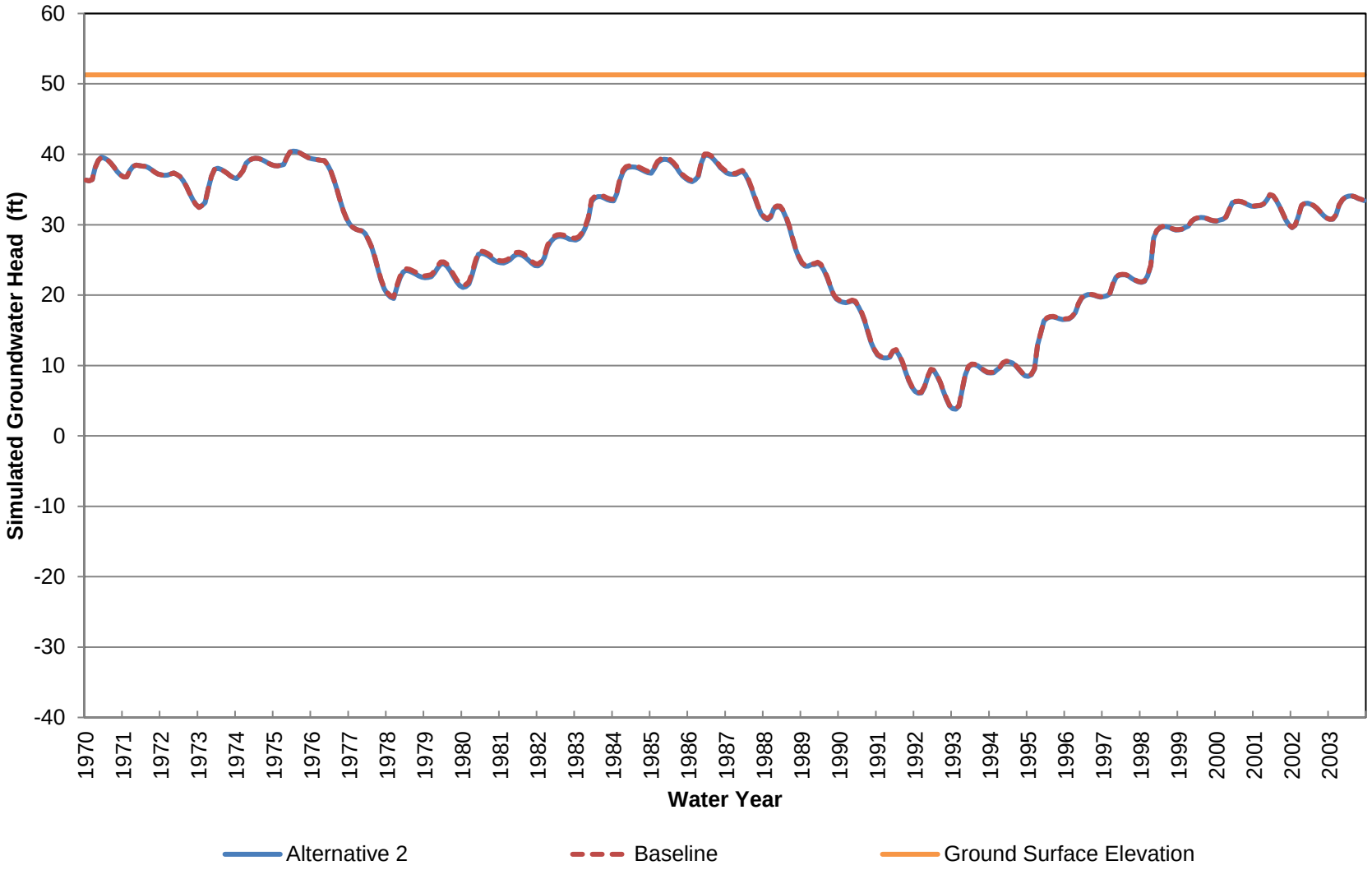
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 16 (Approximately 760-1020 ft bgs)



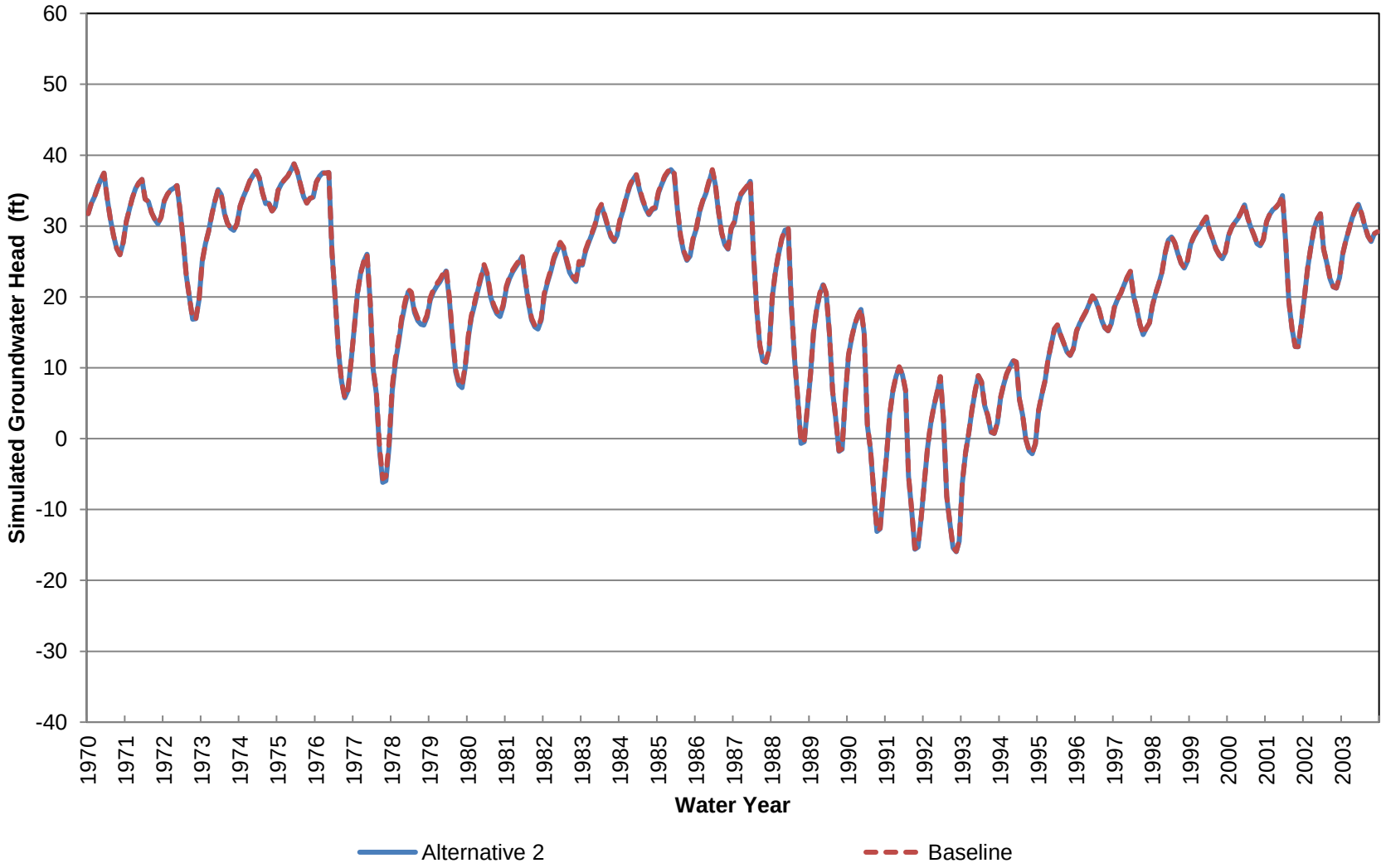
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 16 (Approximately 1020-1390 ft bgs)



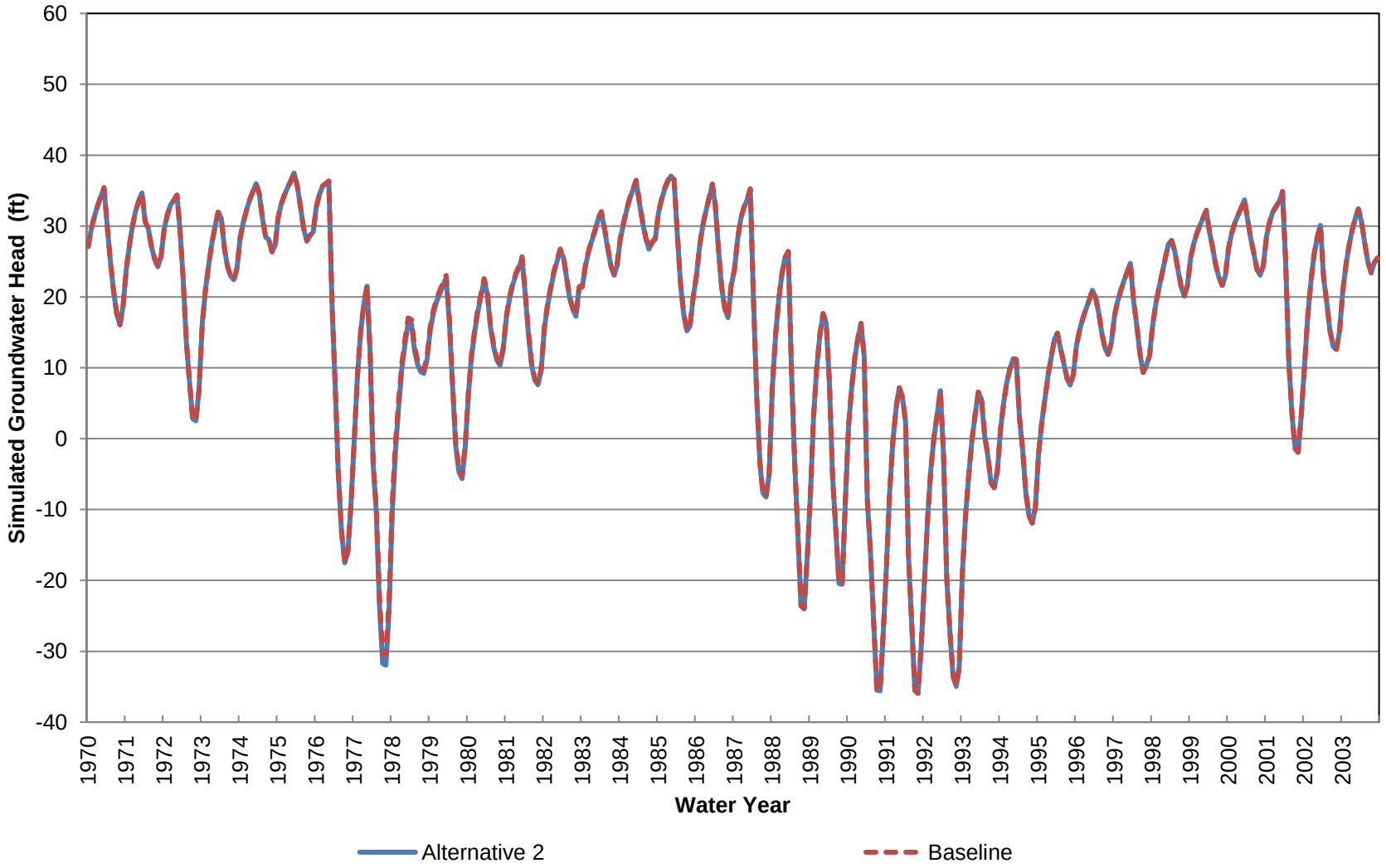
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 17 (Approximately 0-70 ft bgs)



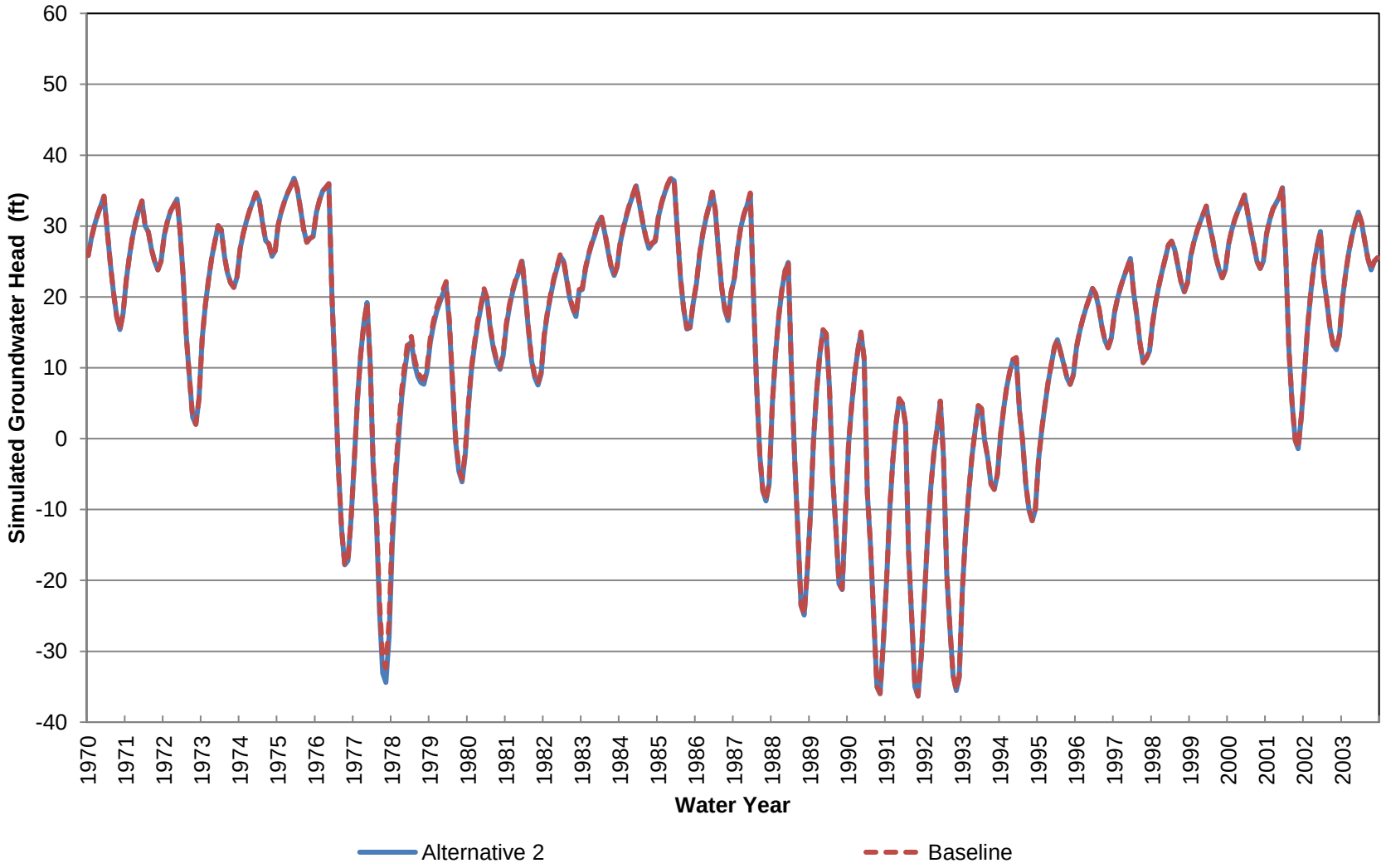
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 17 (Approximately 70-250 ft bgs)



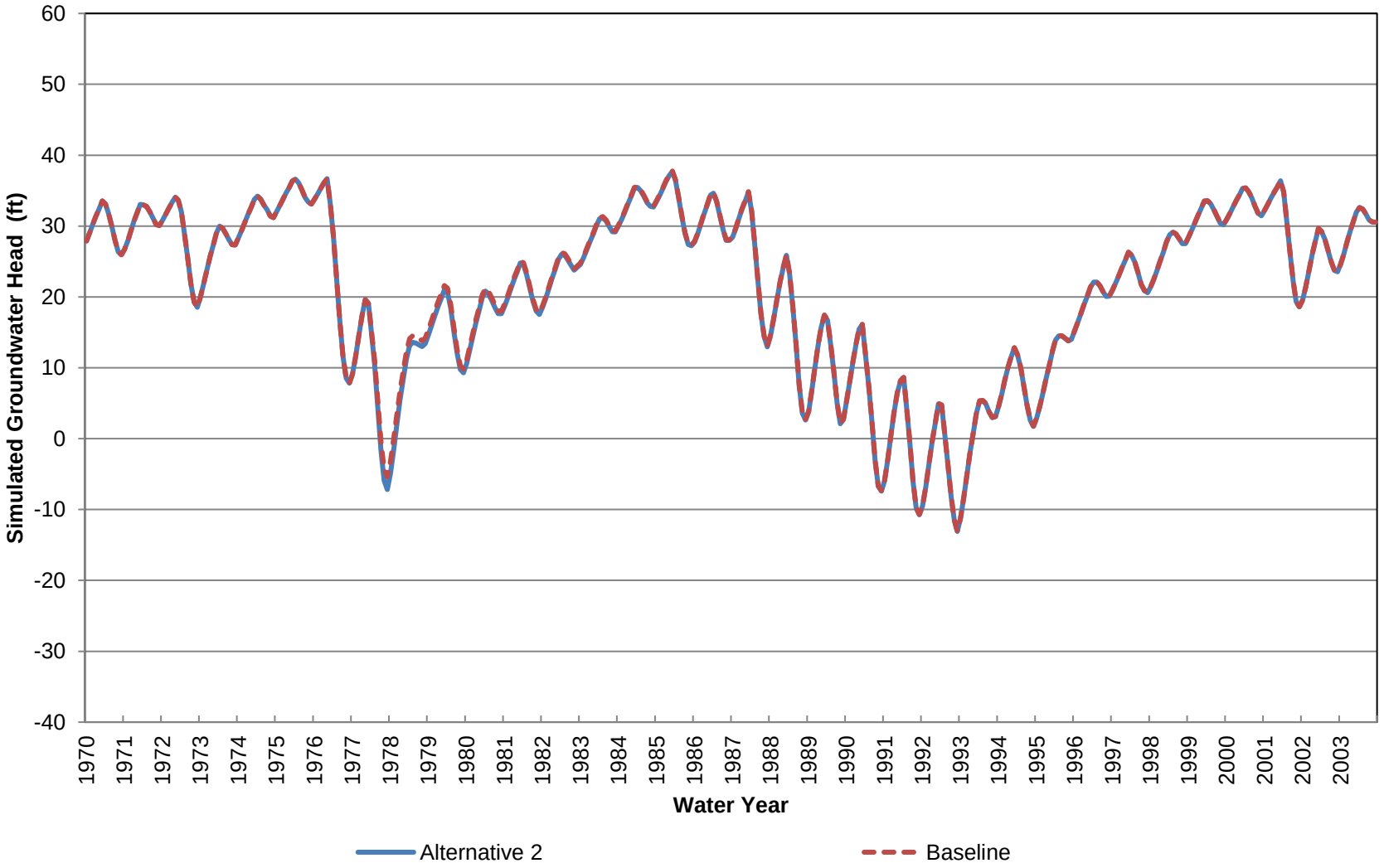
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 17 (Approximately 250-440 ft bgs)



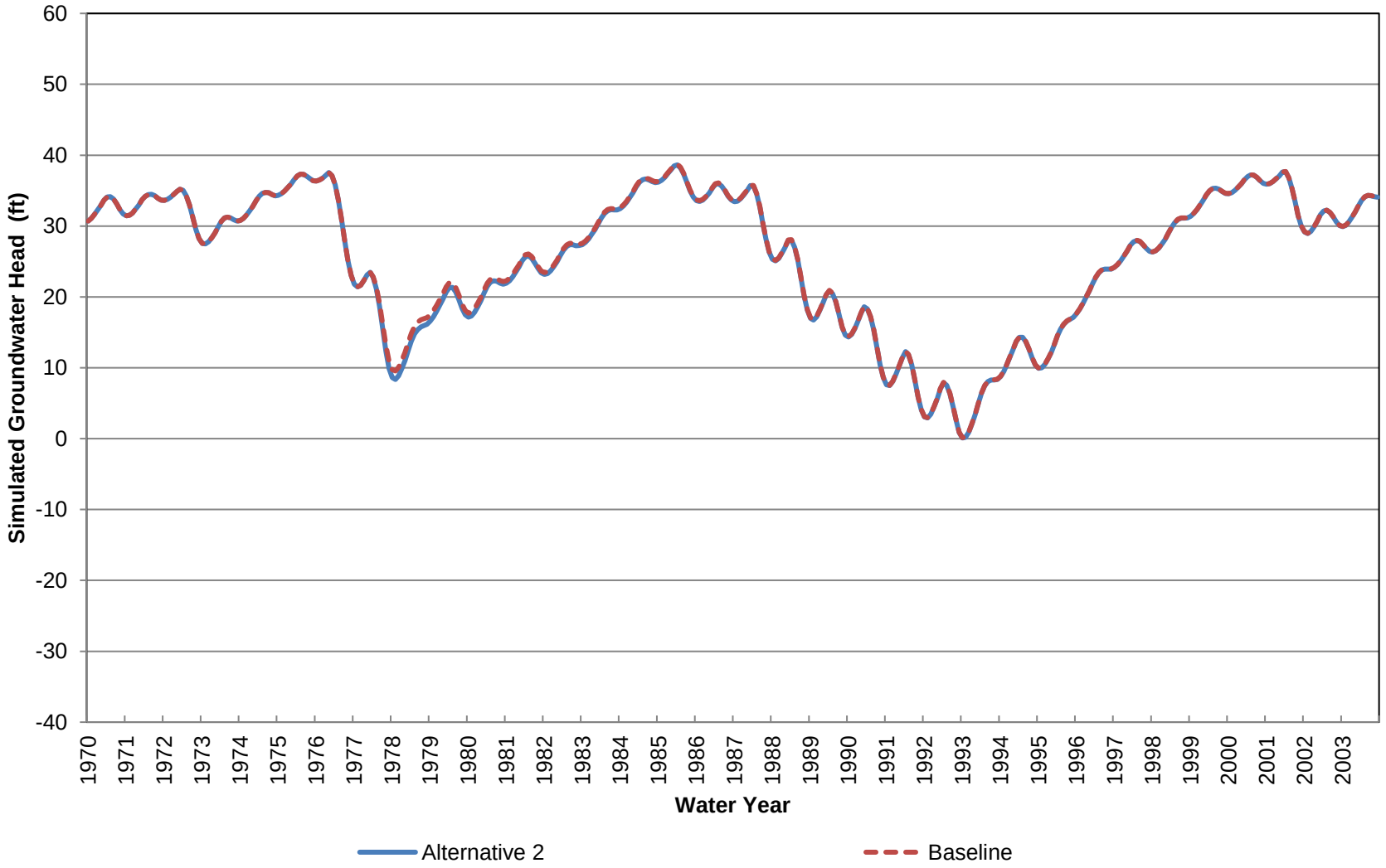
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 17 (Approximately 440-620 ft bgs)



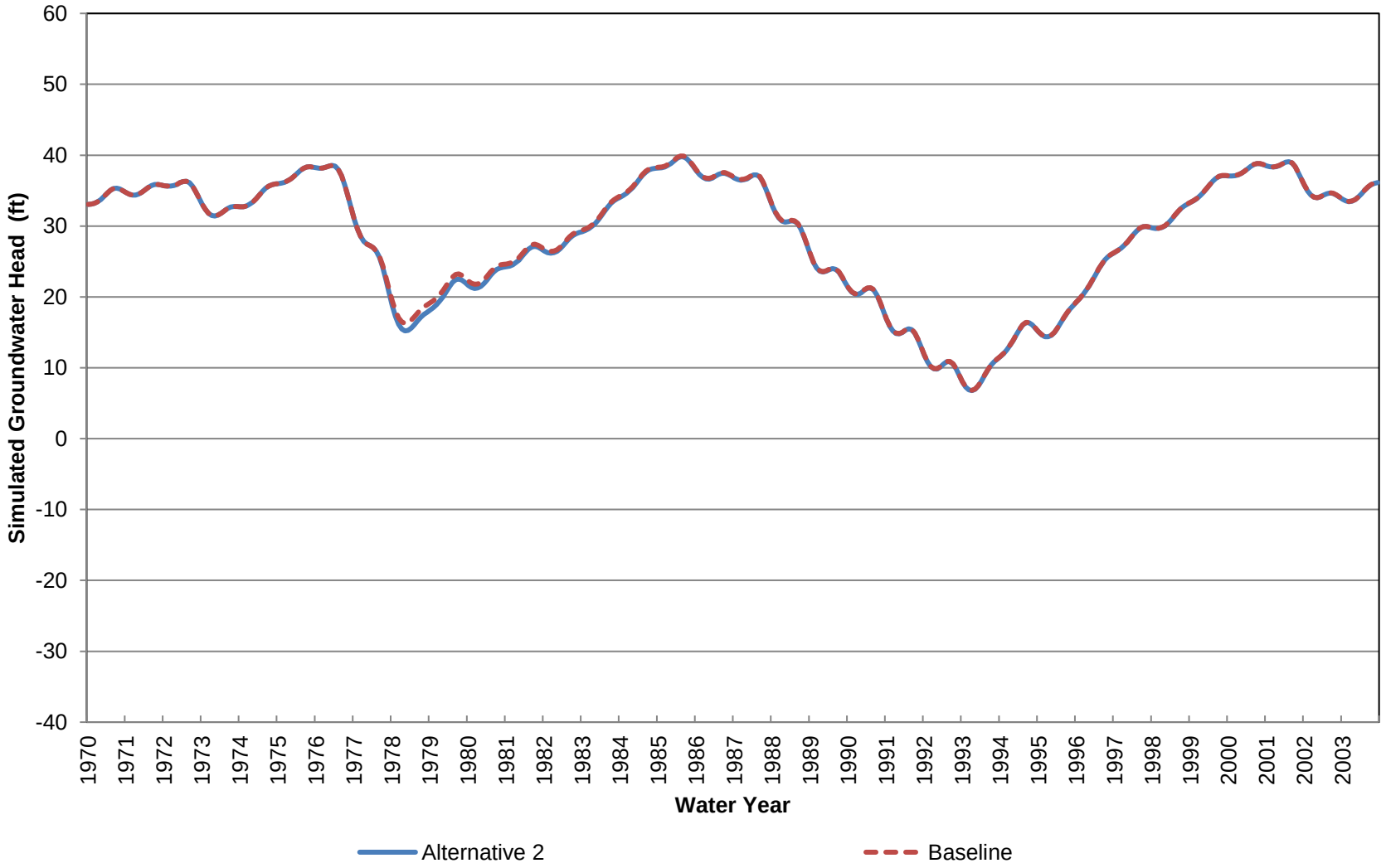
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 17 (Approximately 620-920 ft bgs)



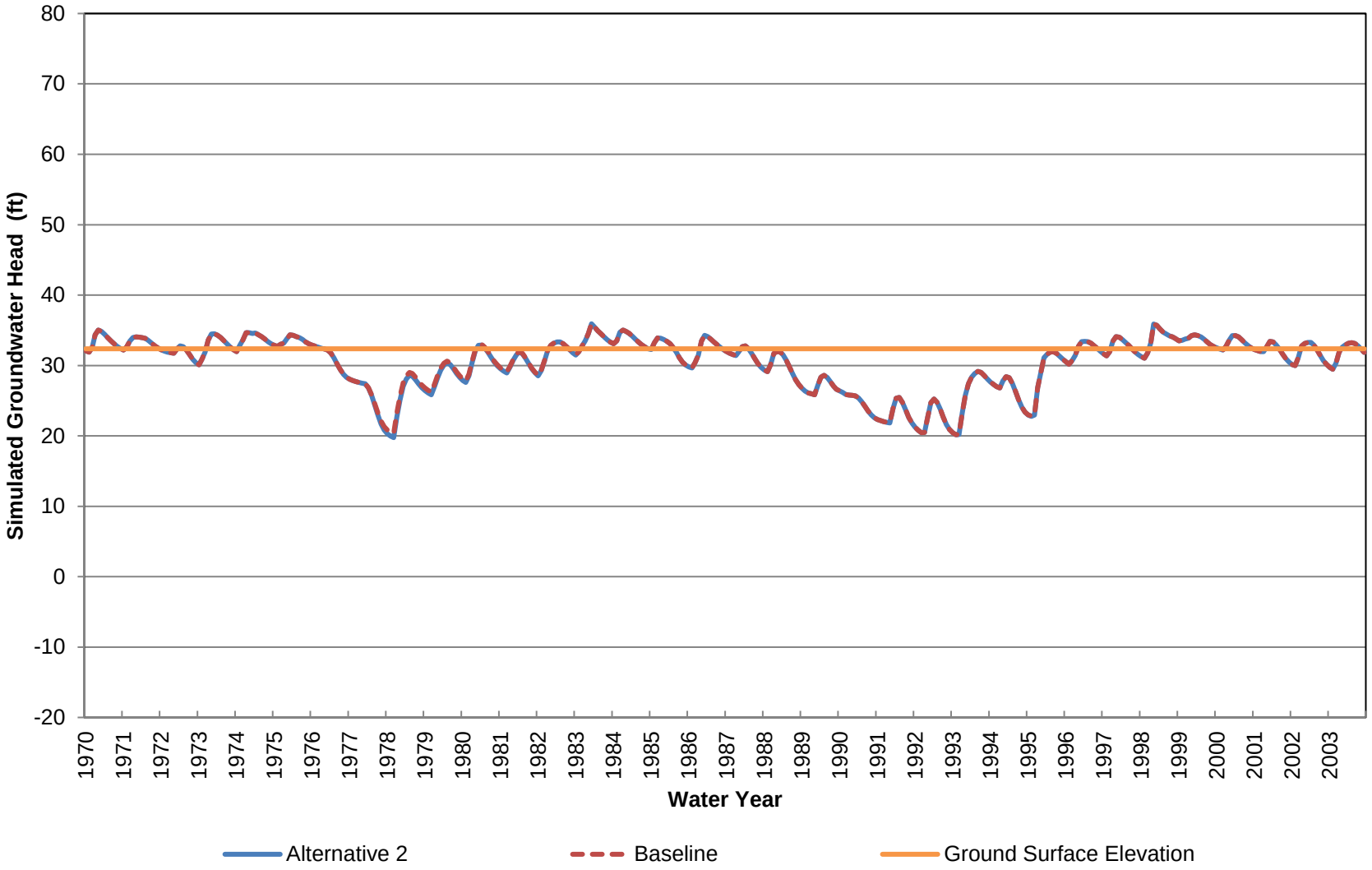
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 17 (Approximately 920-1220 ft bgs)



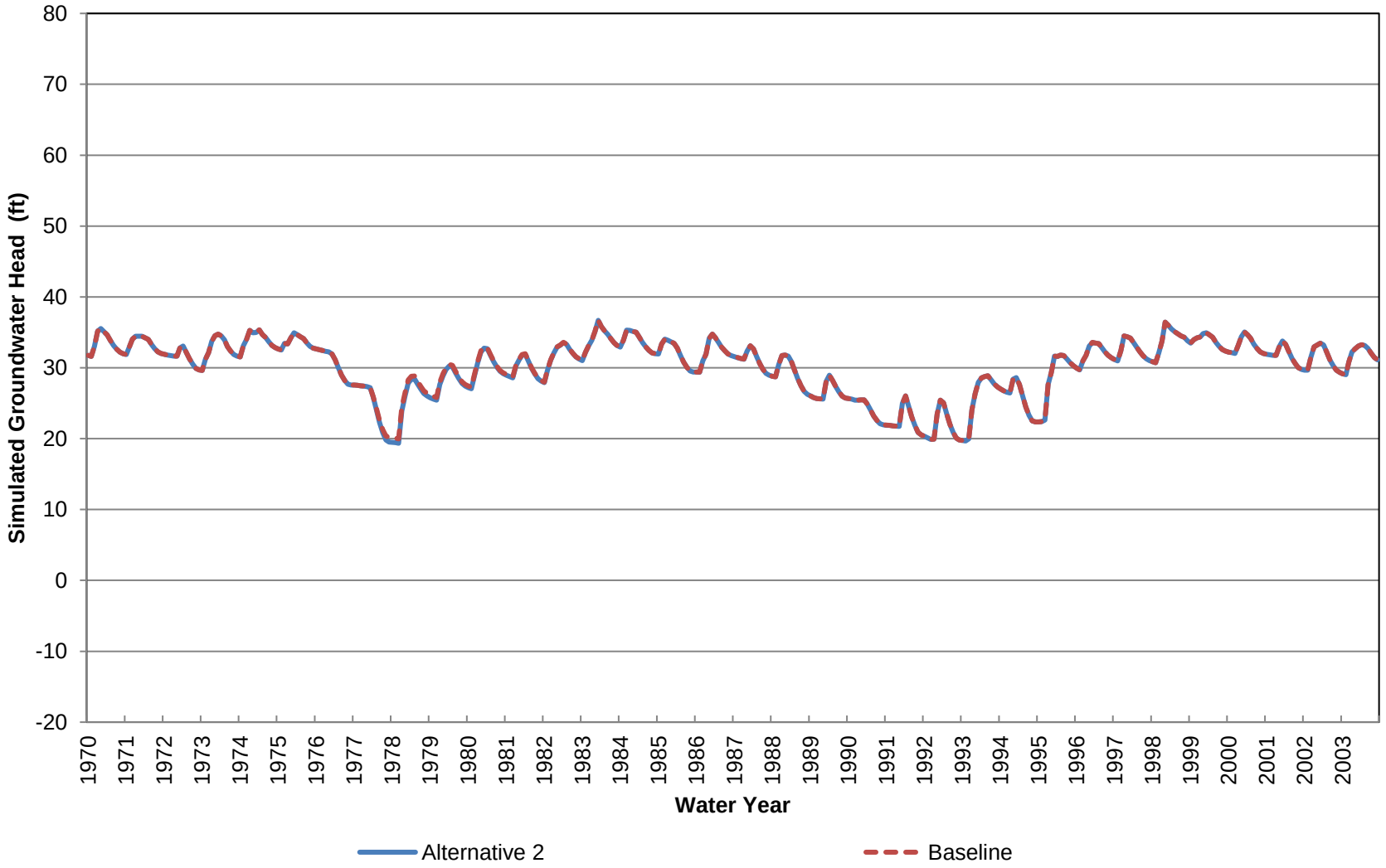
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 17 (Approximately 1220-1680 ft bgs)



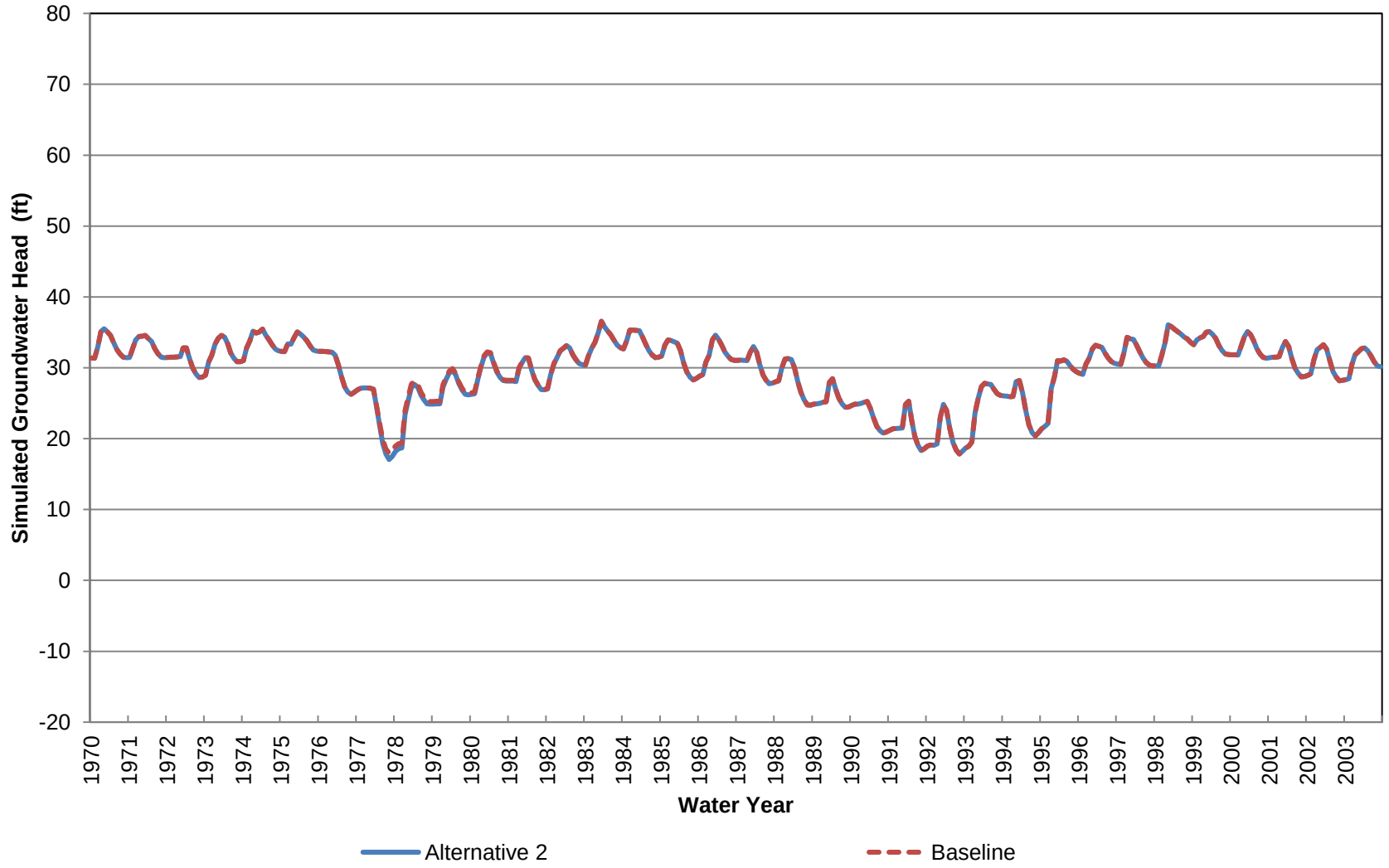
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 18 (Approximately 0-60 ft bgs)



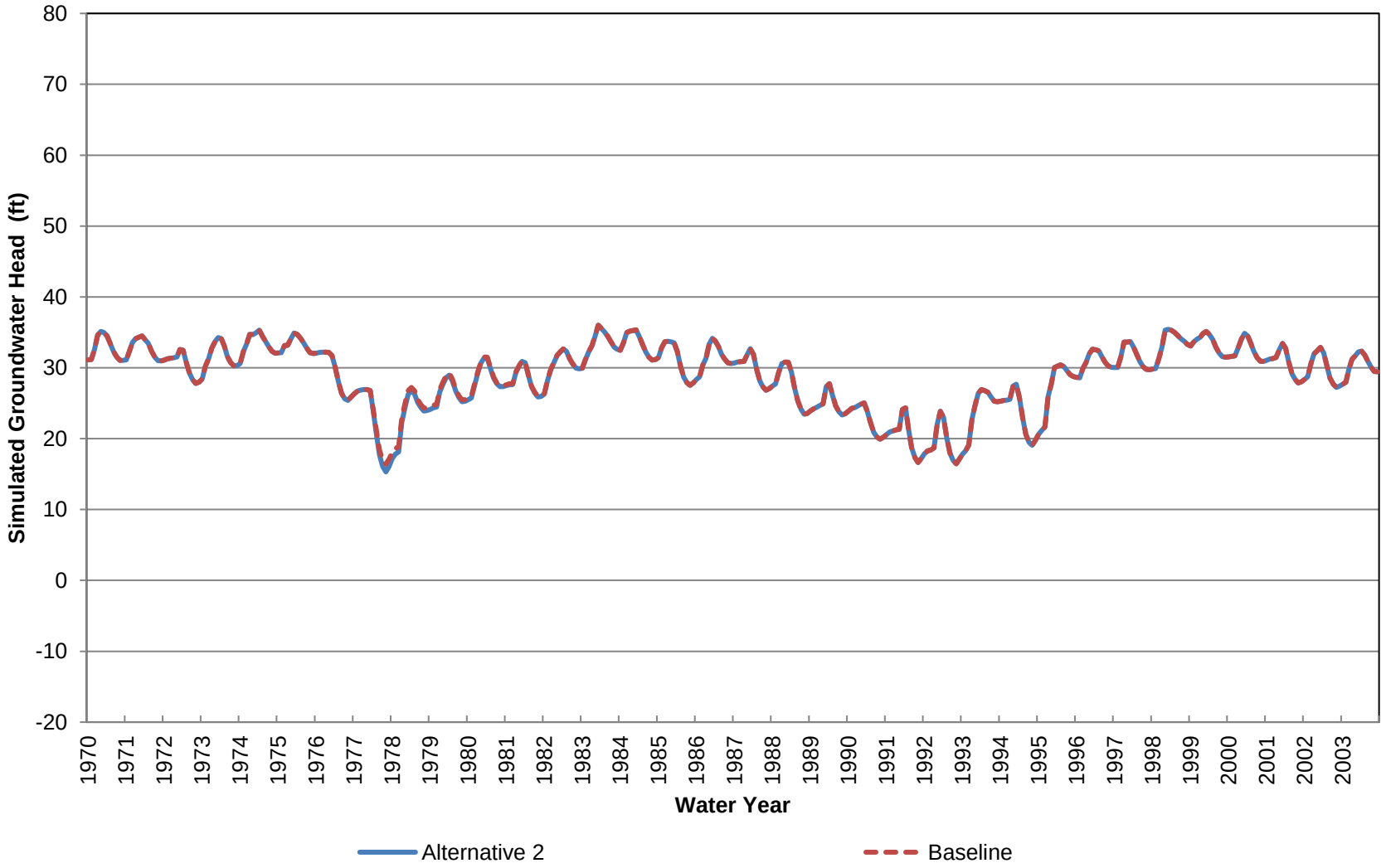
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 18 (Approximately 60-150 ft bgs)



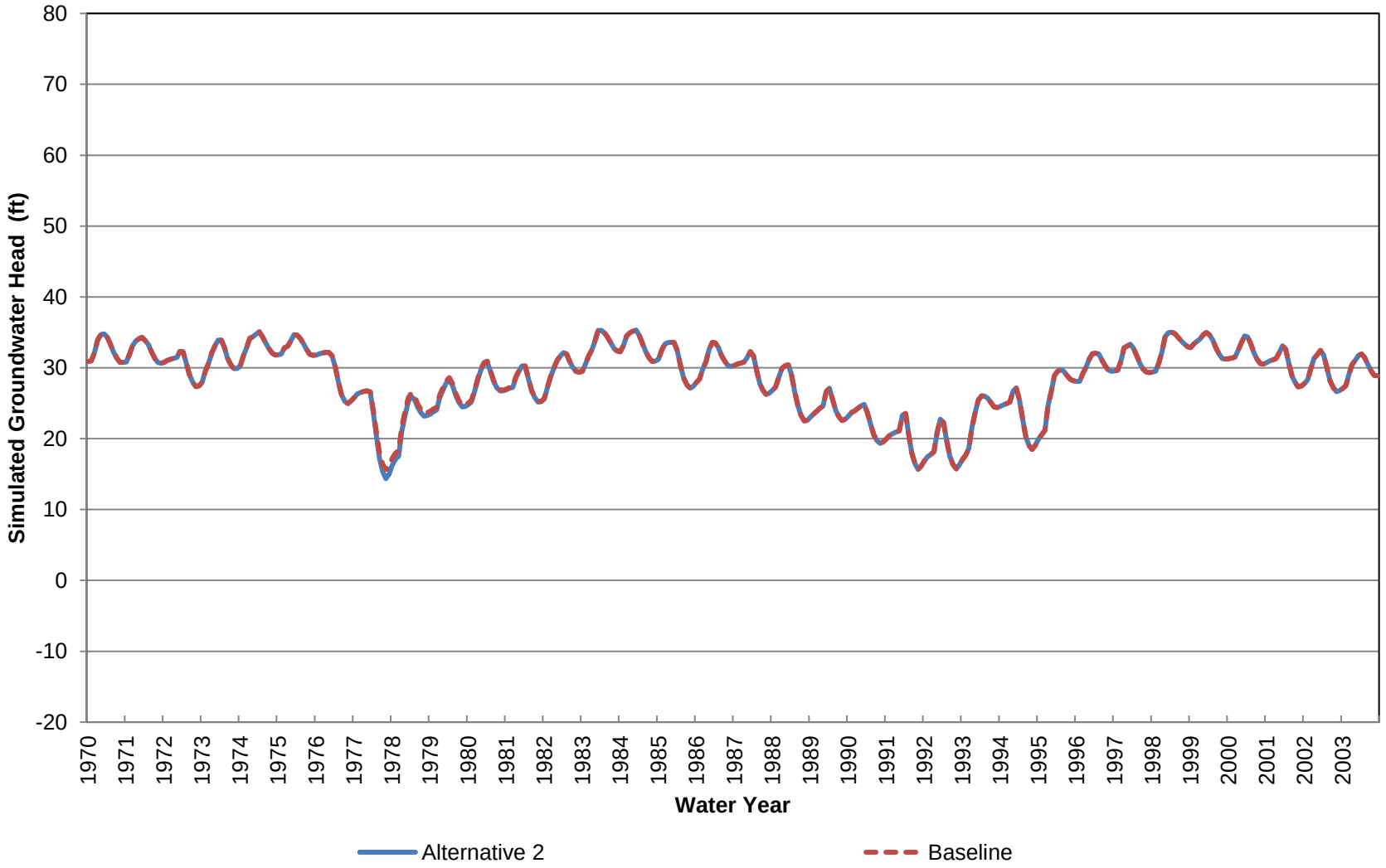
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 18 (Approximately 150-240 ft bgs)



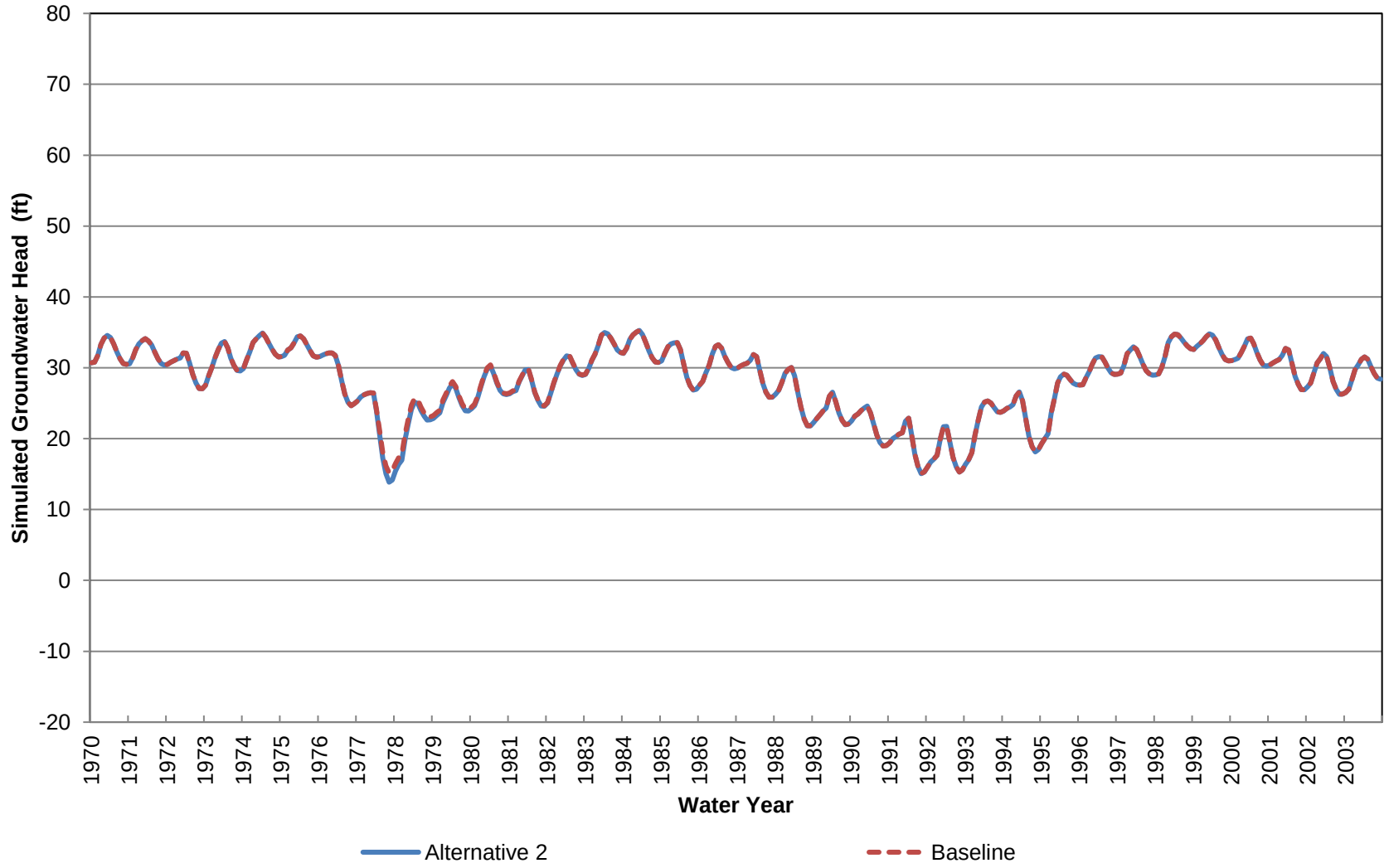
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 18 (Approximately 240-330 ft bgs)



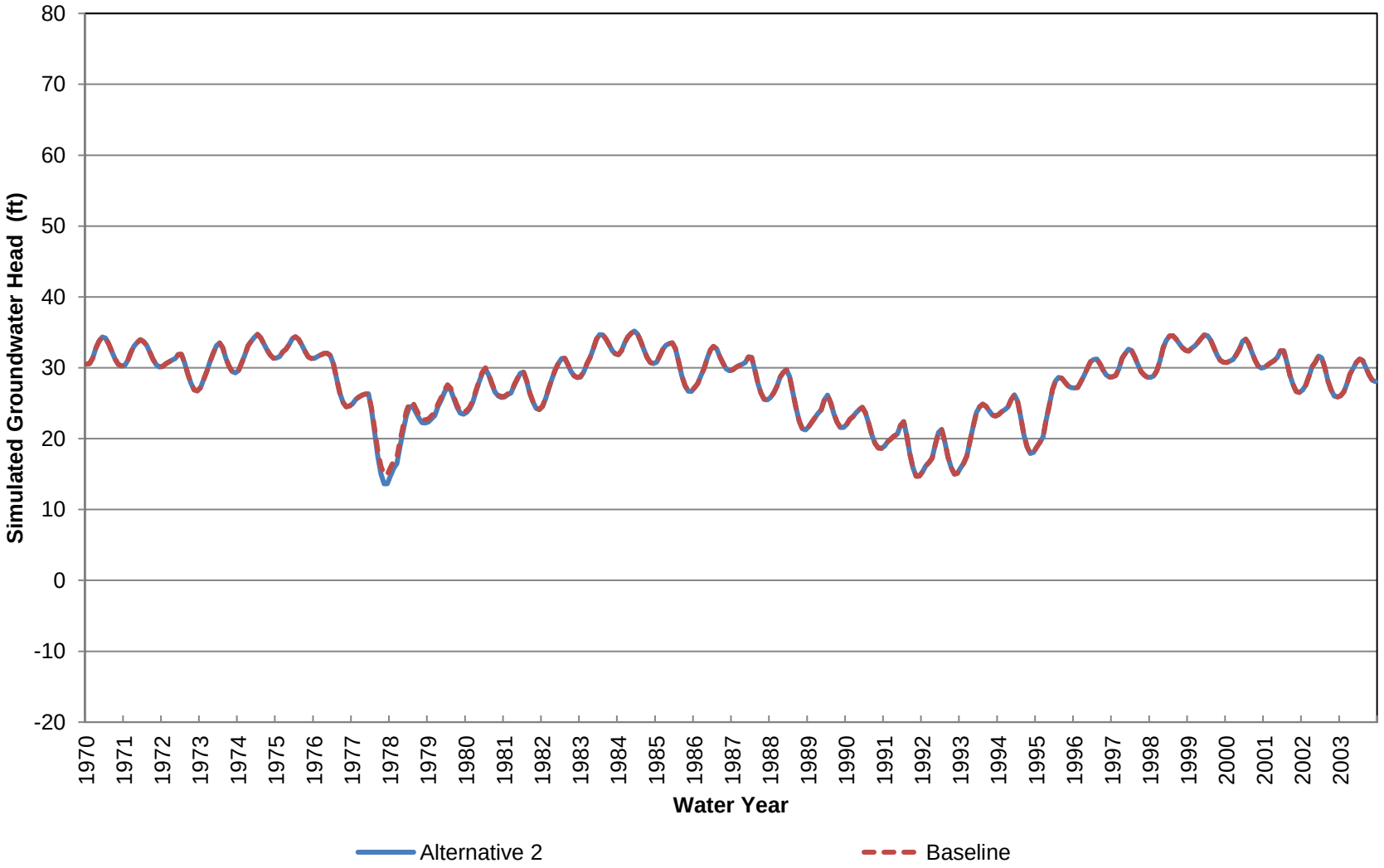
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 18 (Approximately 330-450 ft bgs)



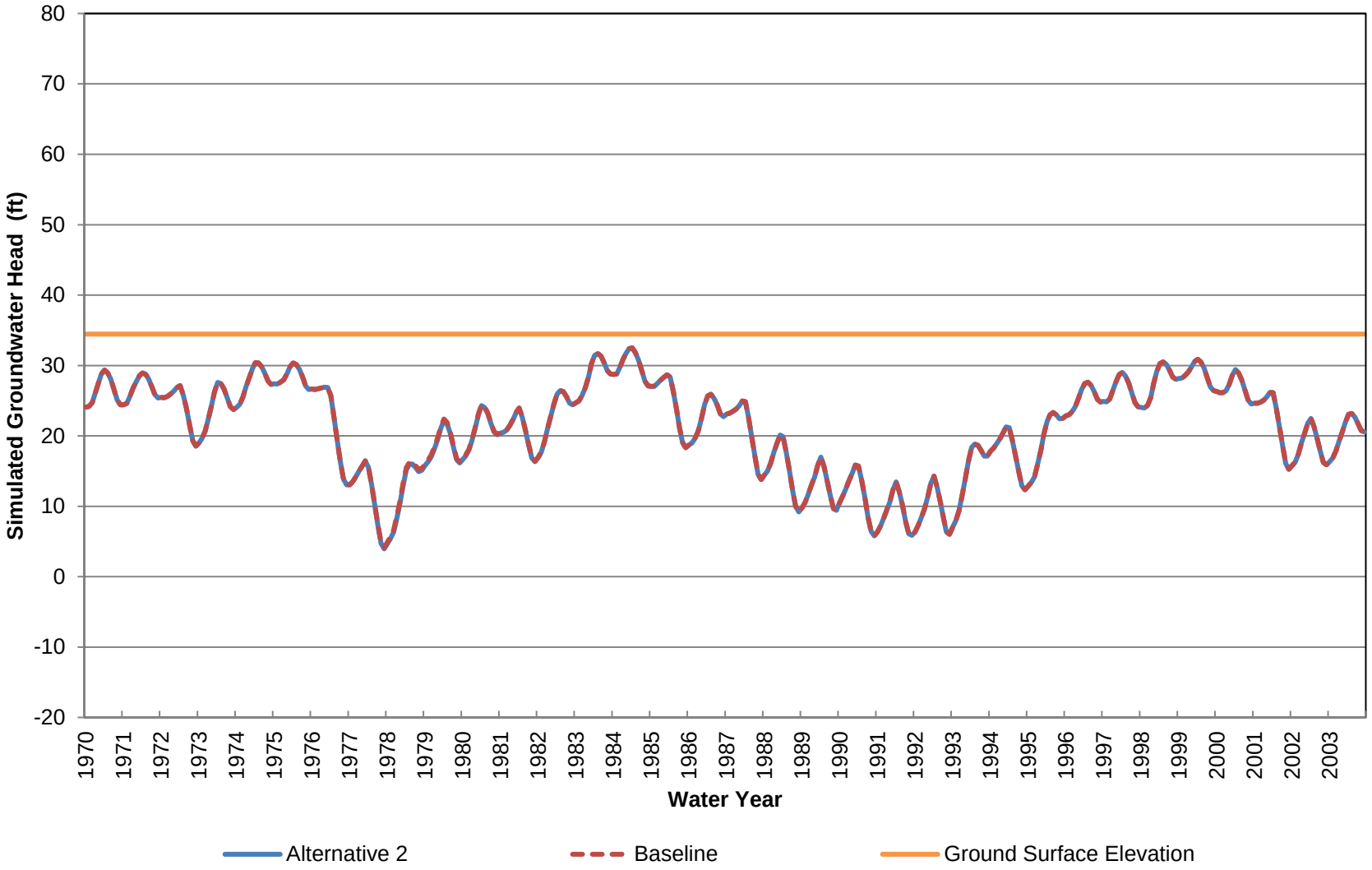
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 18 (Approximately 450-600 ft bgs)



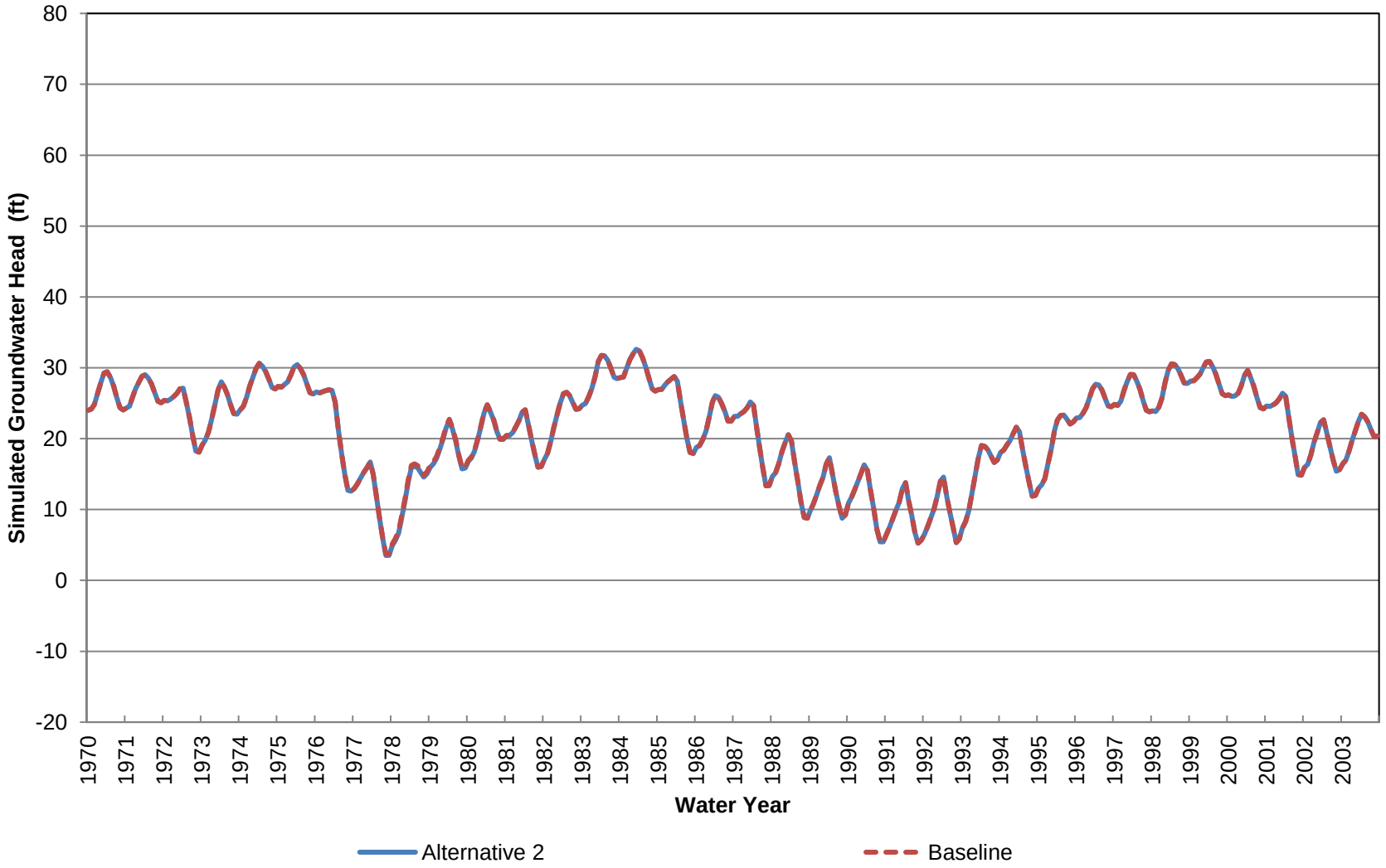
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 18 (Approximately 600-820 ft bgs)



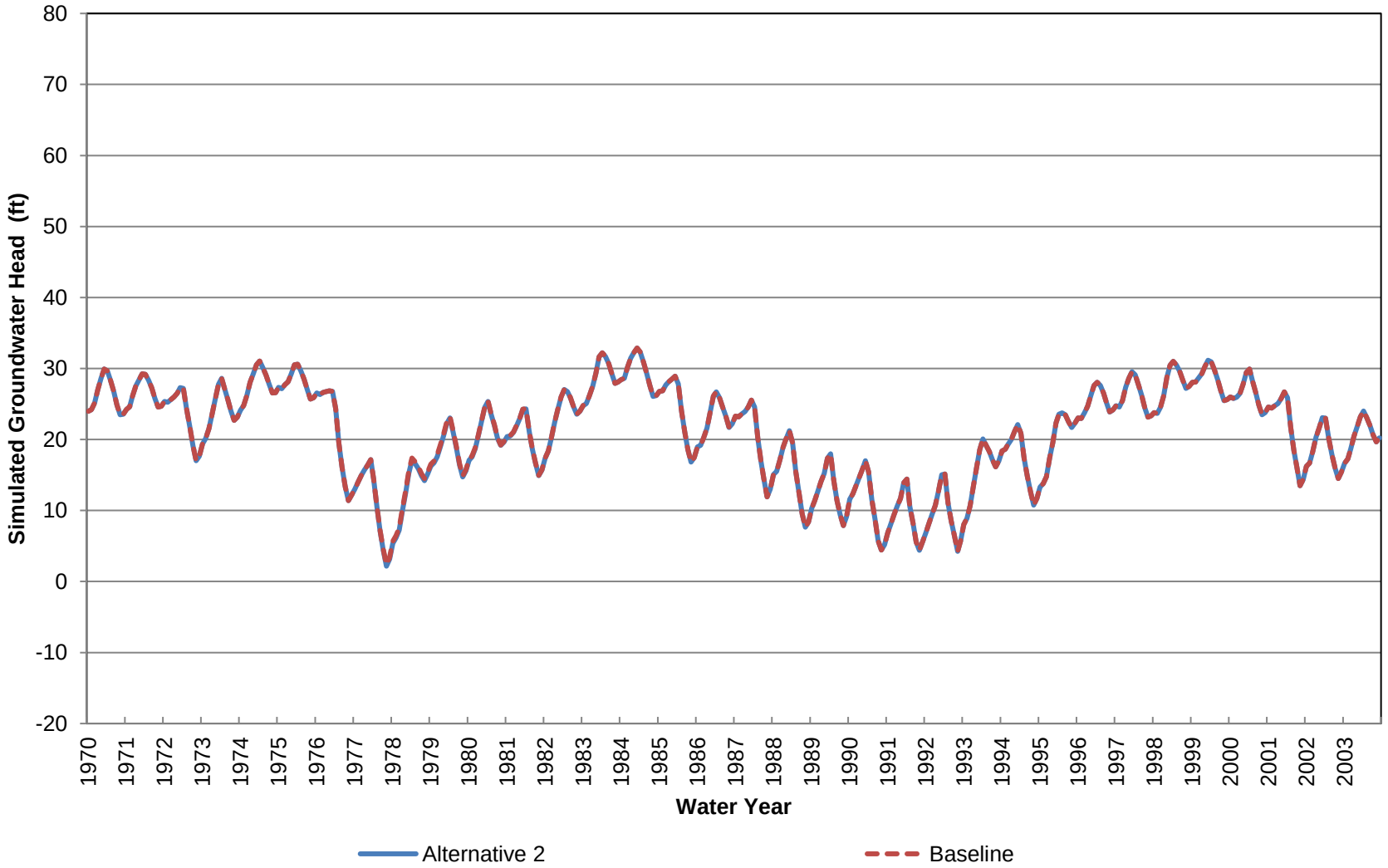
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 19 (Approximately 0-30 ft bgs)



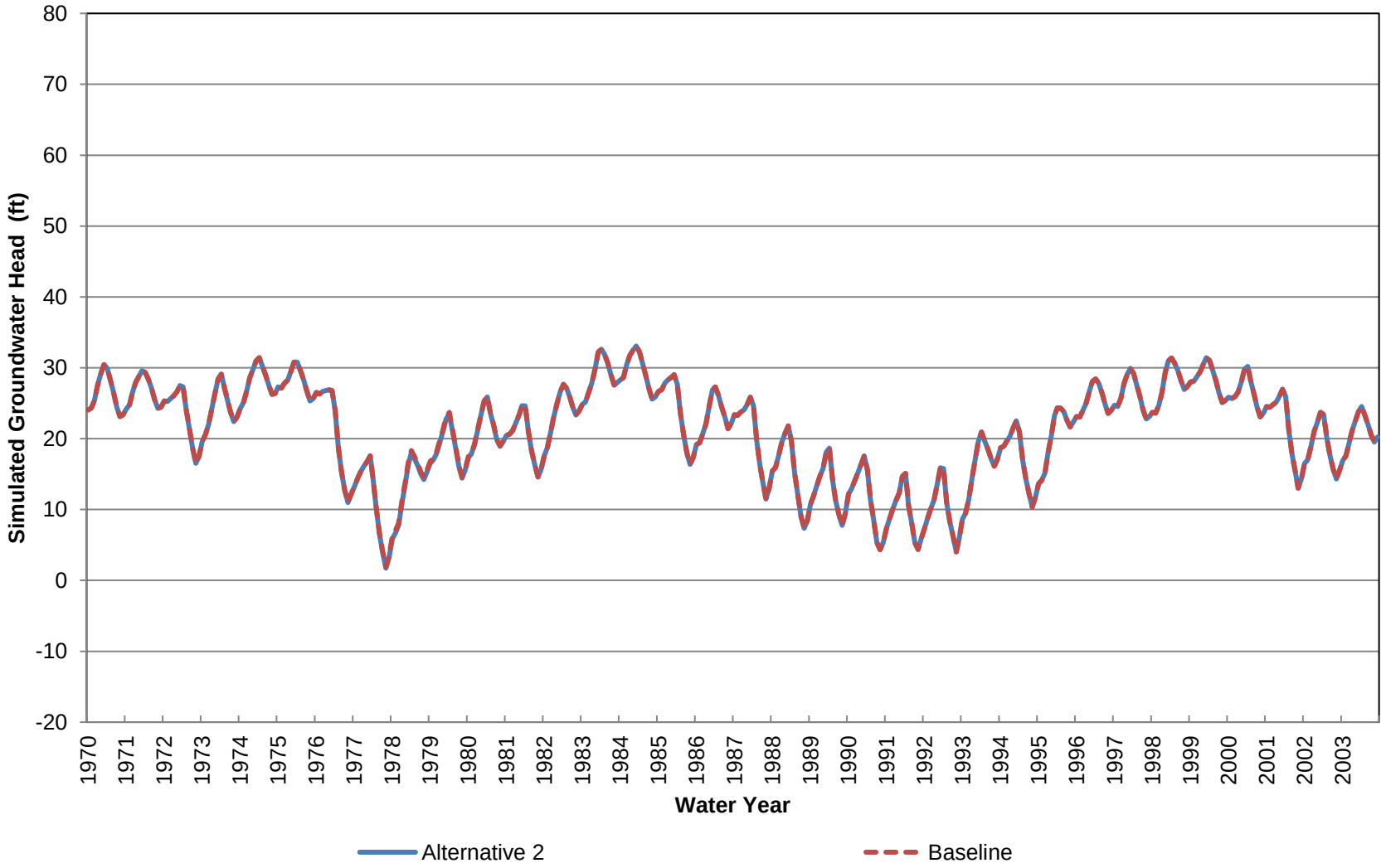
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 19 (Approximately 30-70 ft bgs)



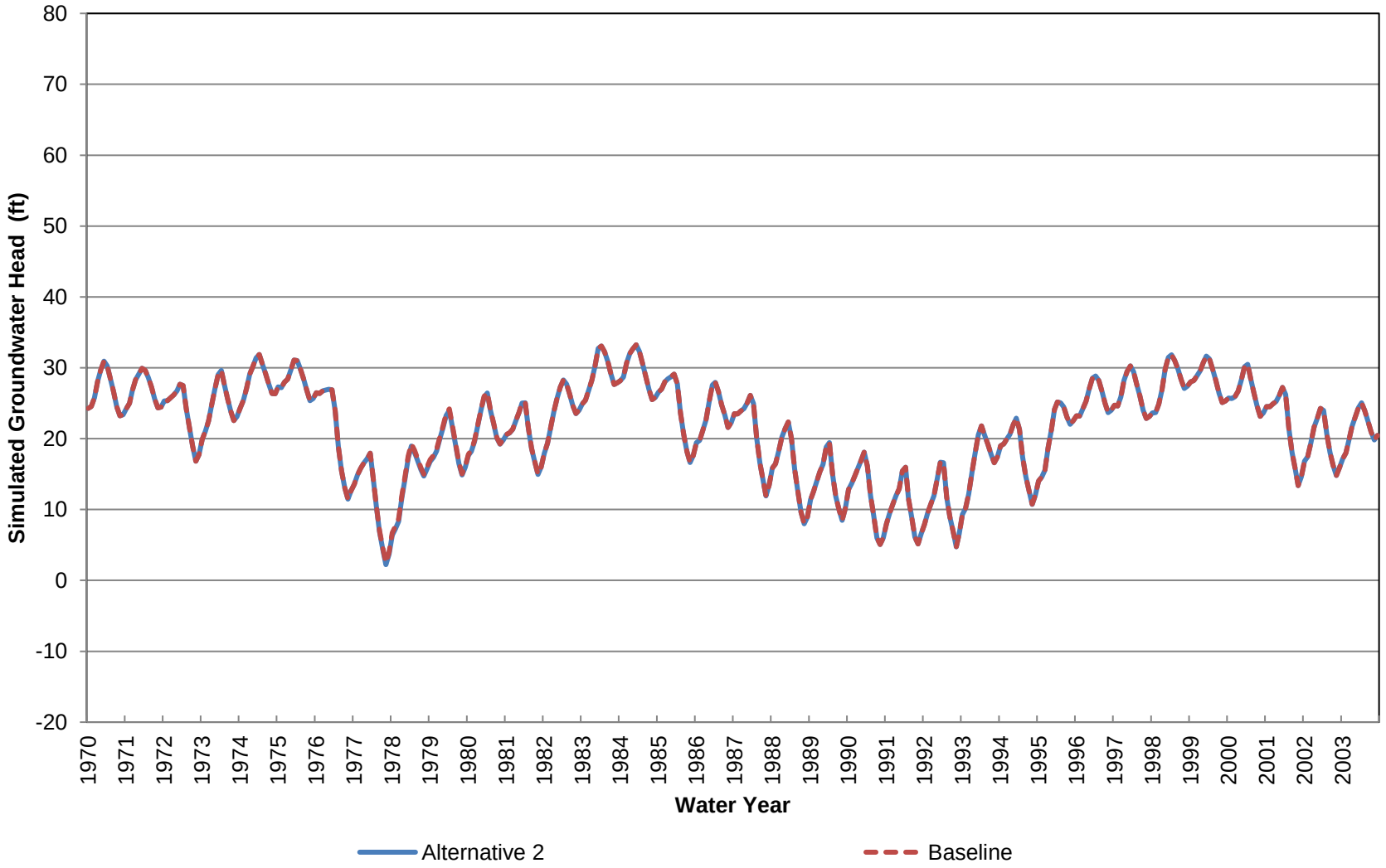
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 19 (Approximately 70-120 ft bgs)



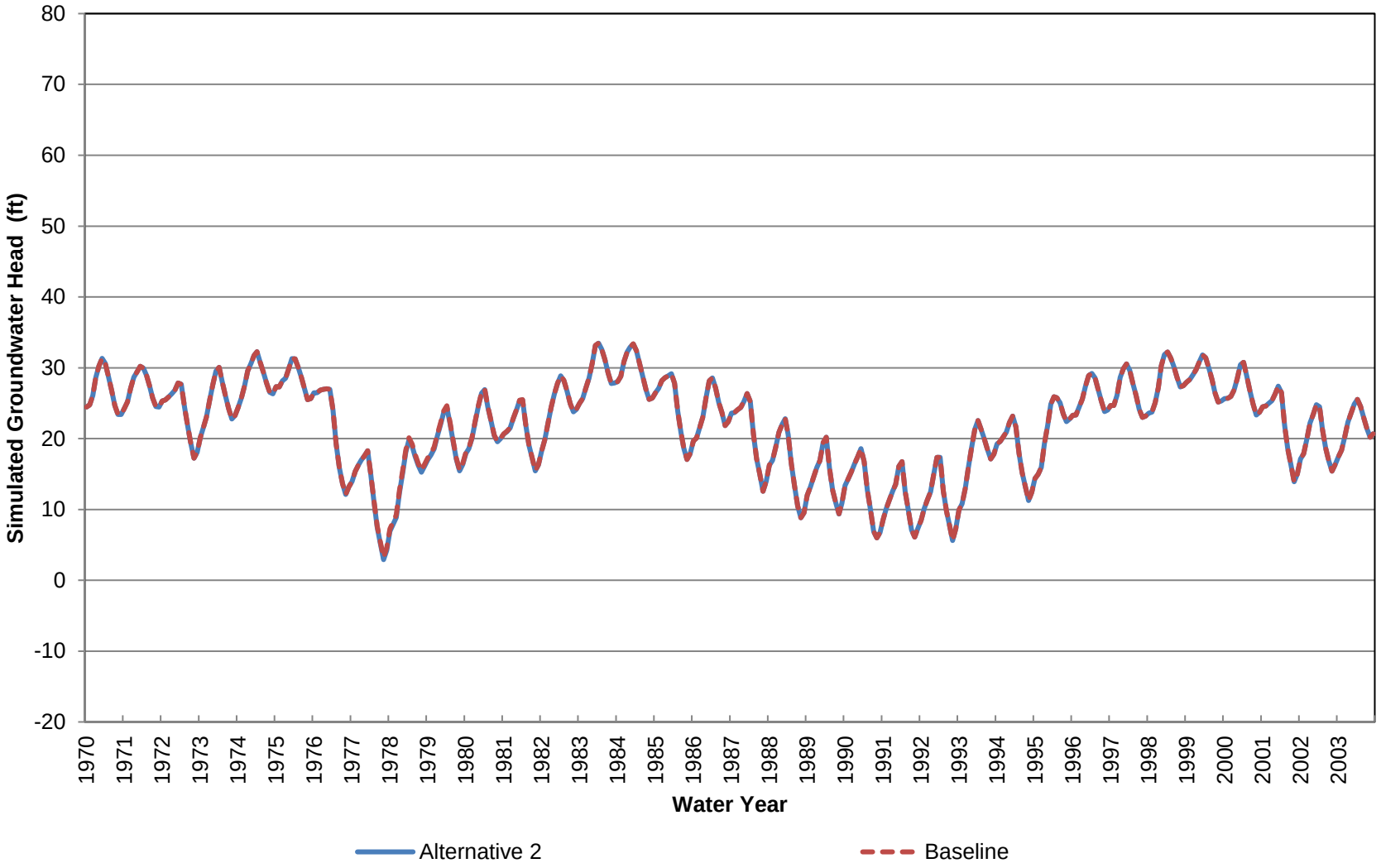
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 19 (Approximately 120-160 ft bgs)



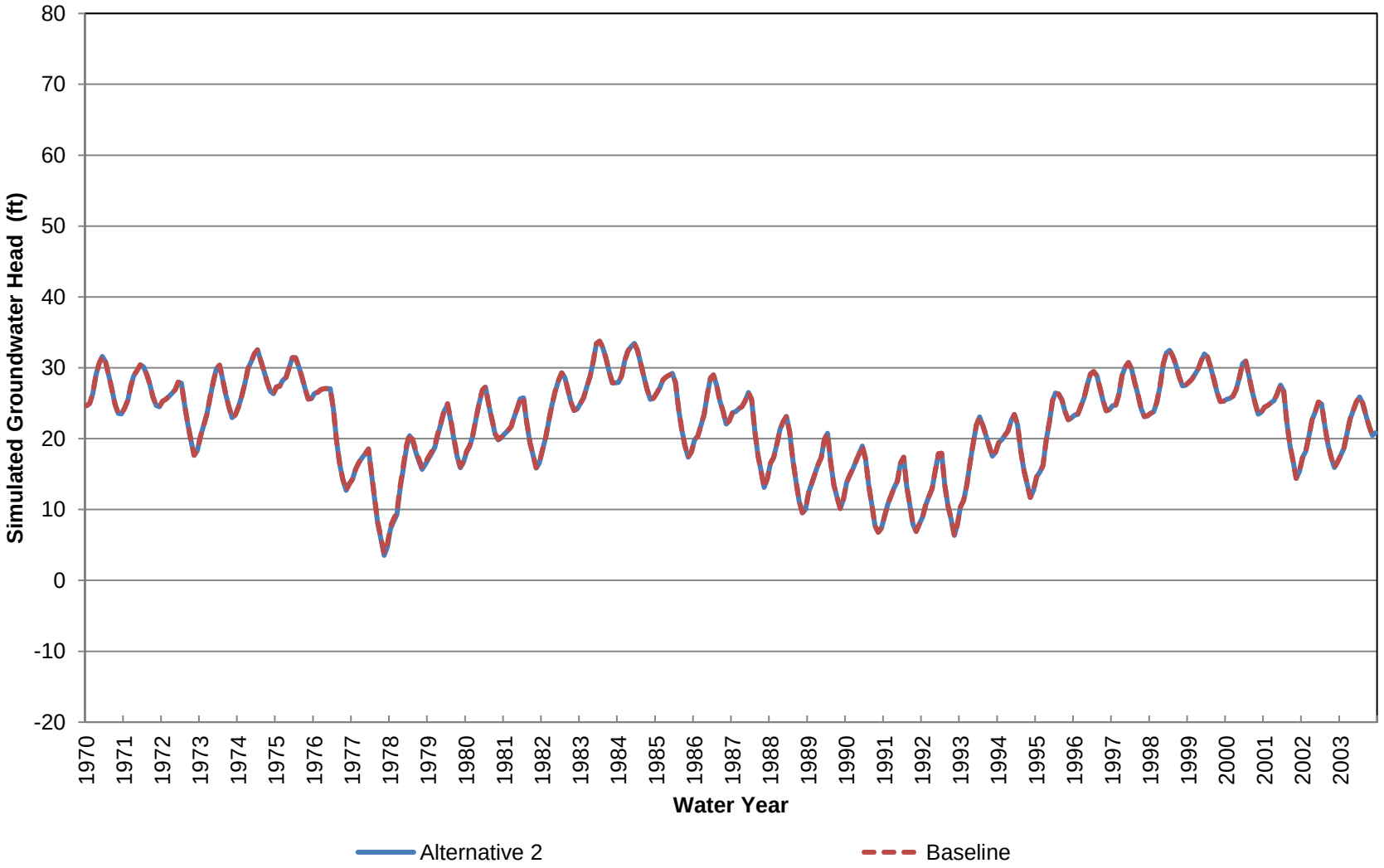
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 19 (Approximately 160-220 ft bgs)



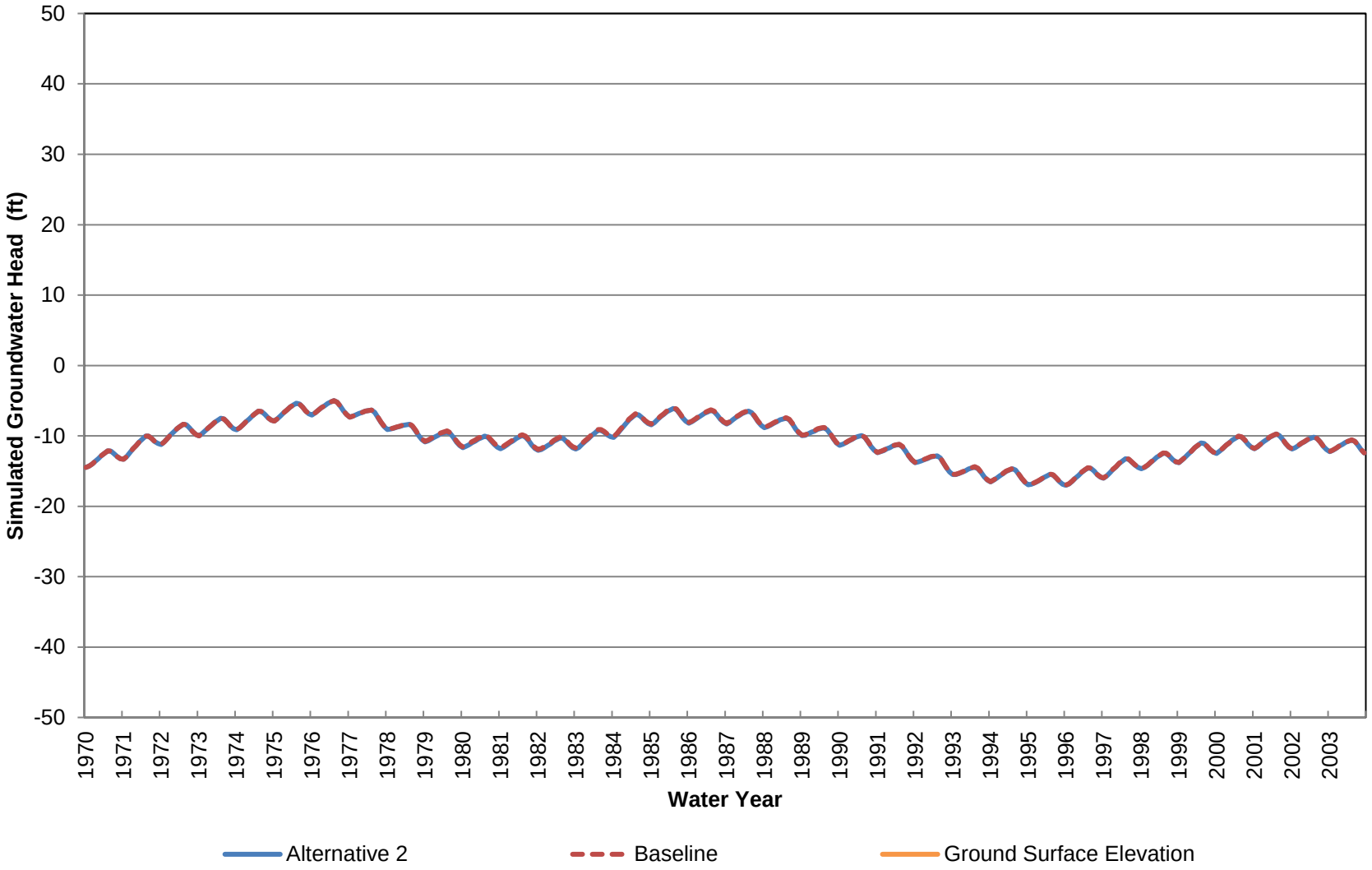
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 19 (Approximately 220-290 ft bgs)



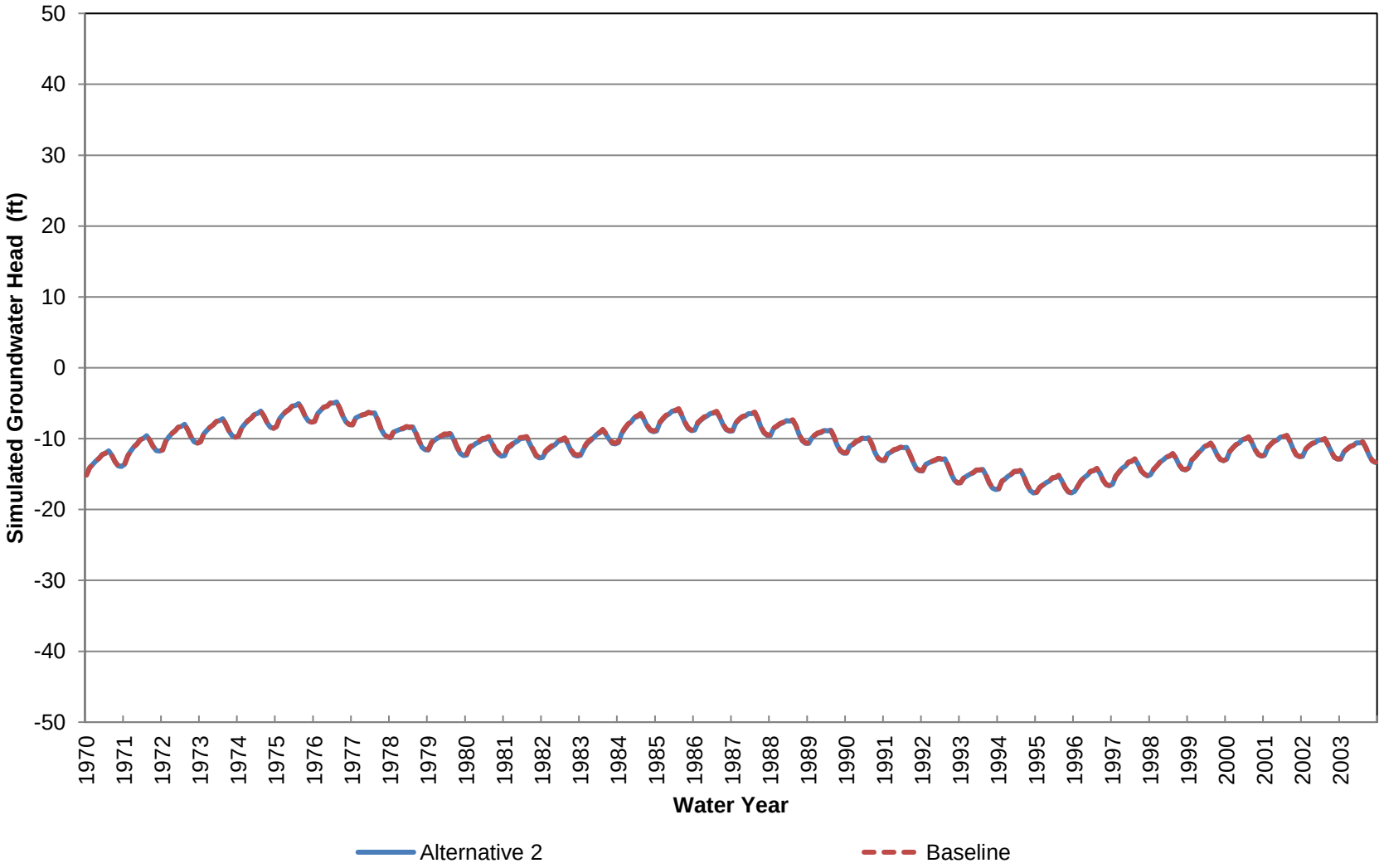
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 19 (Approximately 290-400 ft bgs)



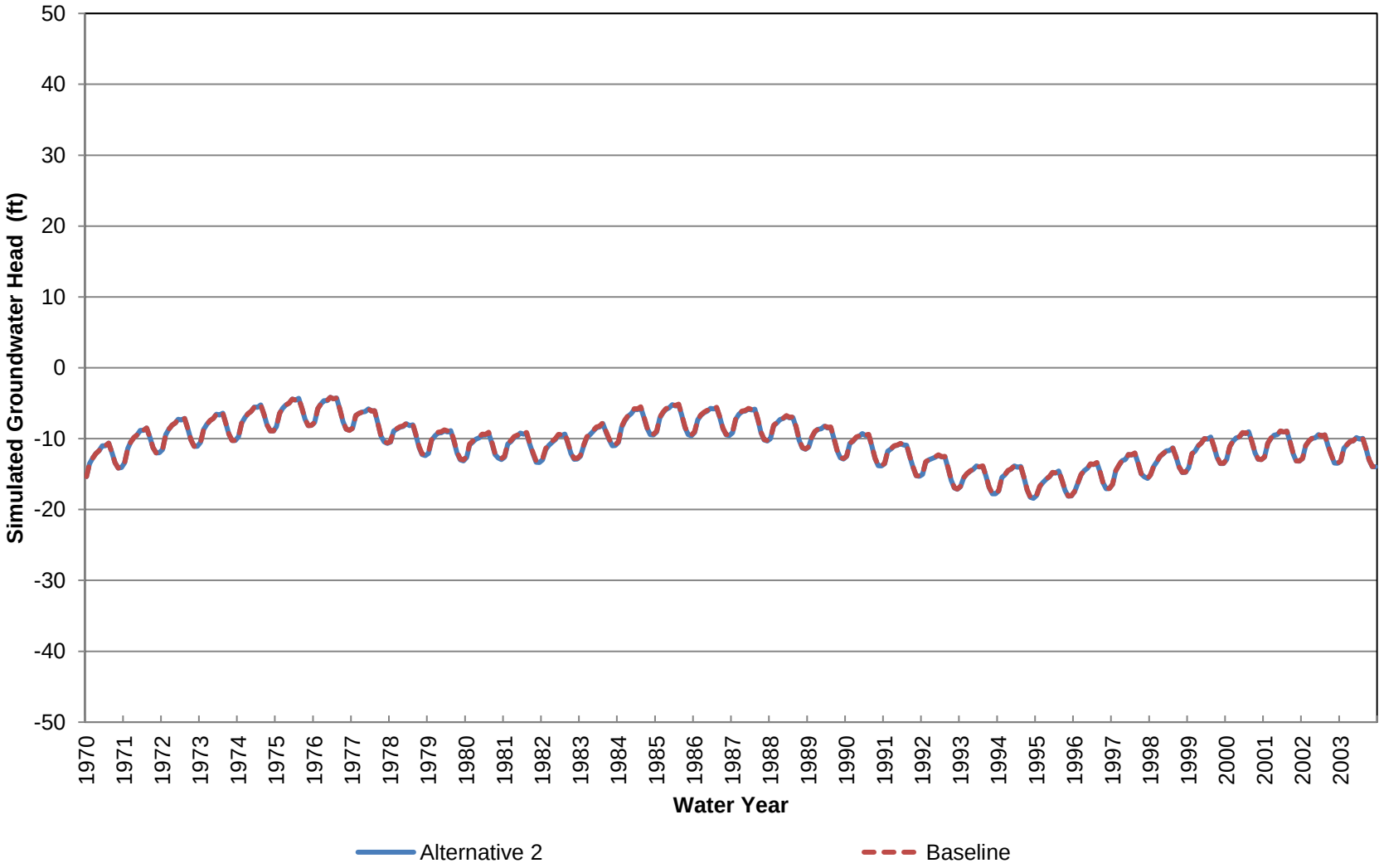
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 20 (Approximately 0-70 ft bgs)



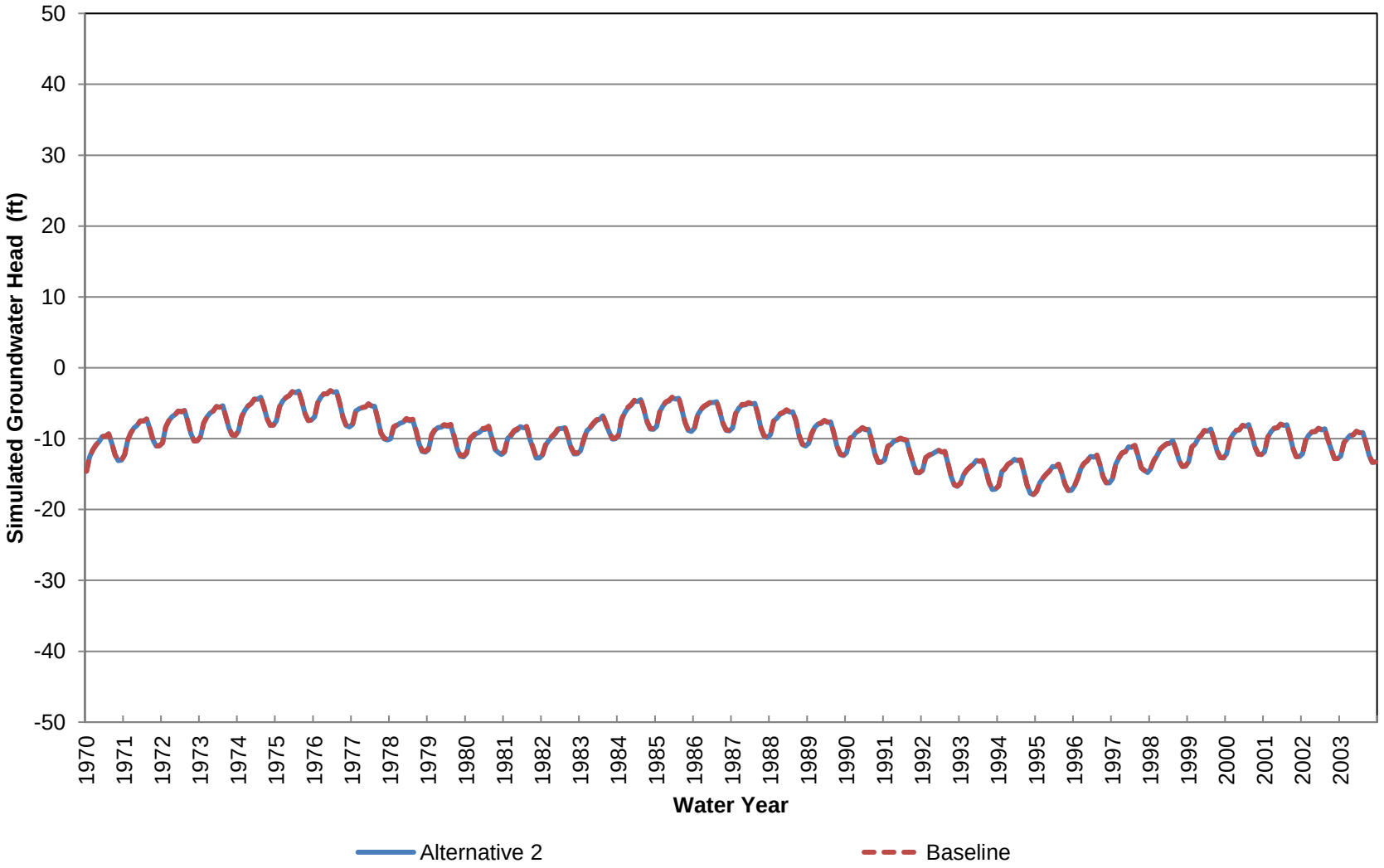
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 20 (Approximately 70-230 ft bgs)



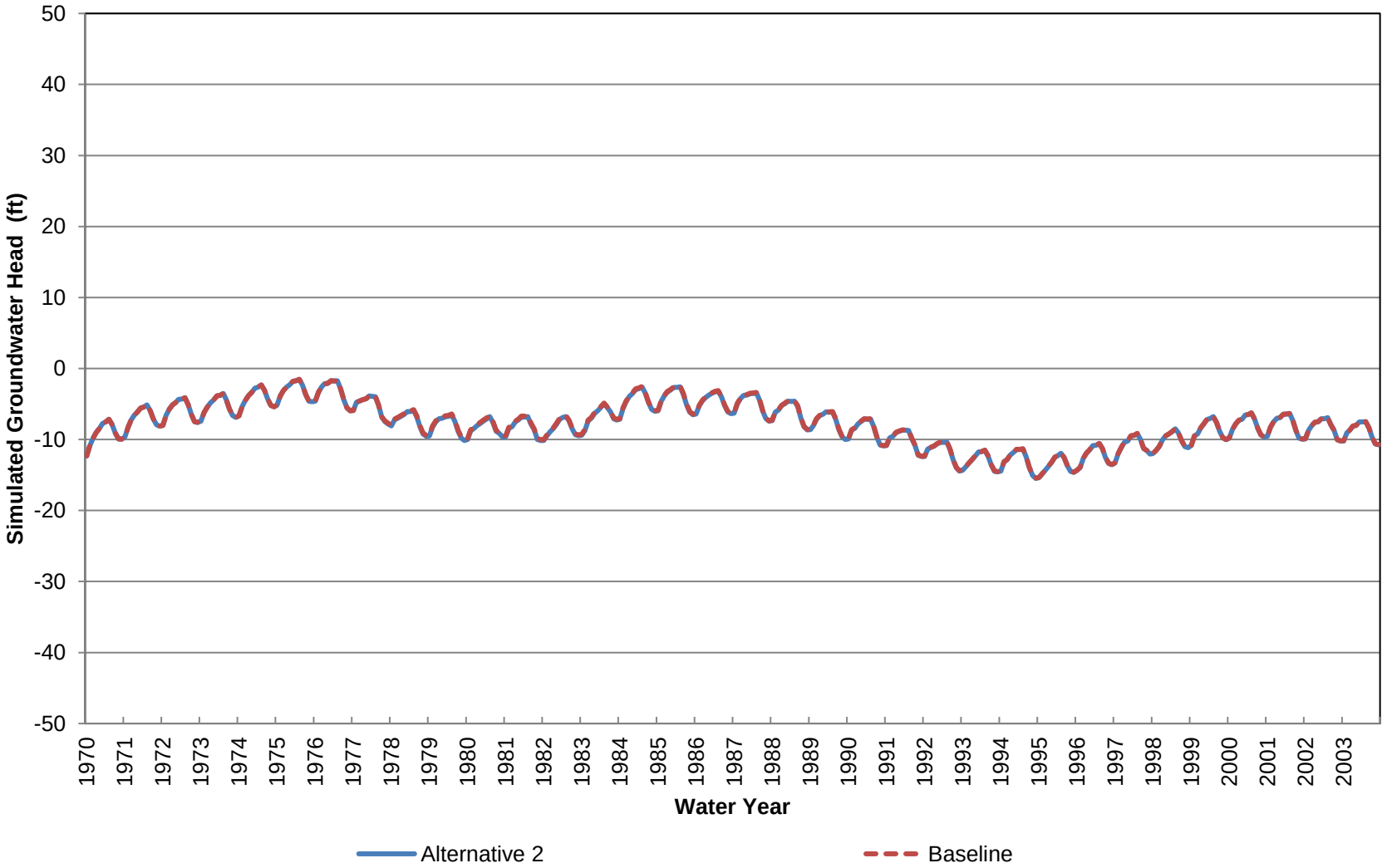
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 20 (Approximately 230-380 ft bgs)



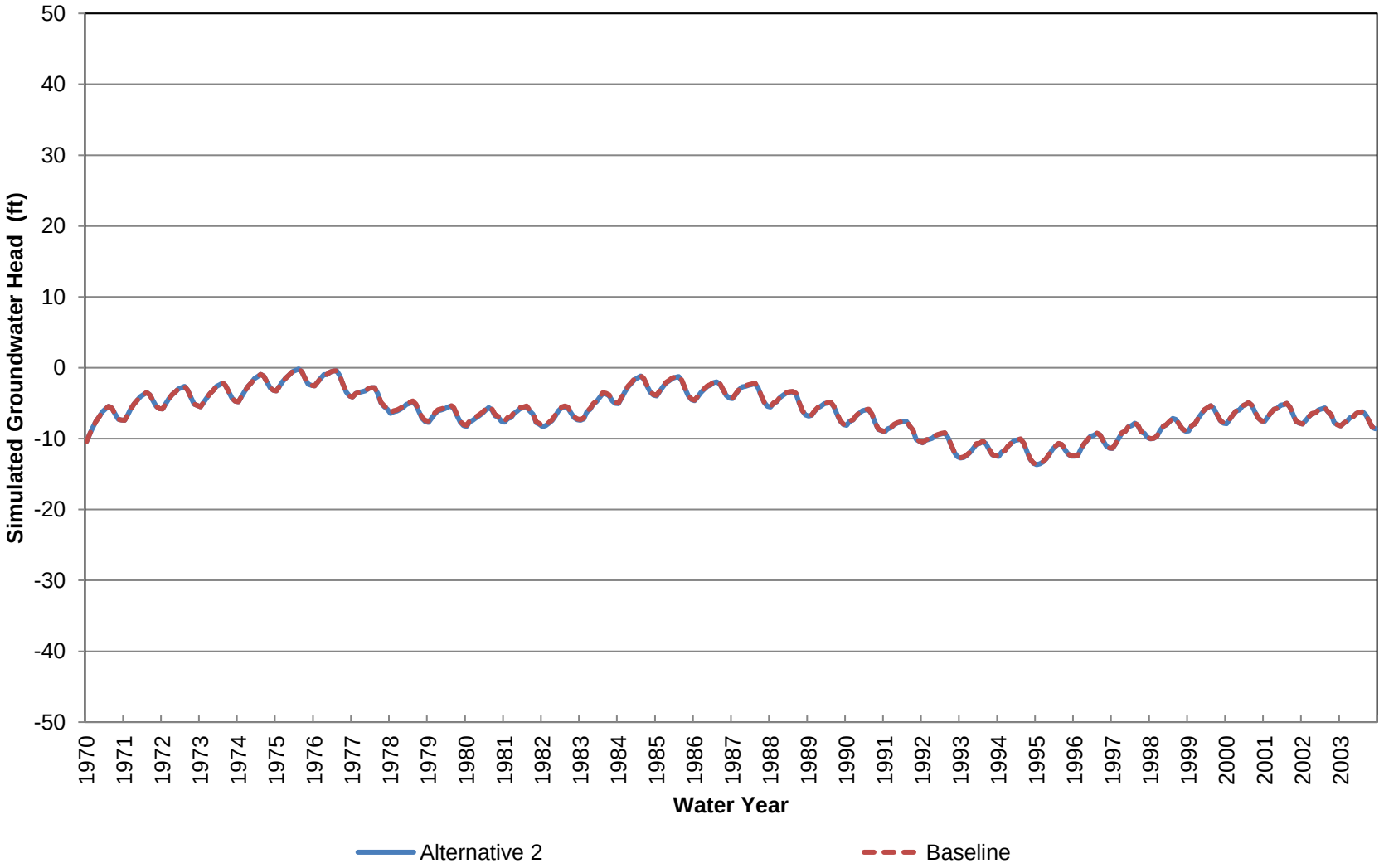
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 20 (Approximately 380-530 ft bgs)



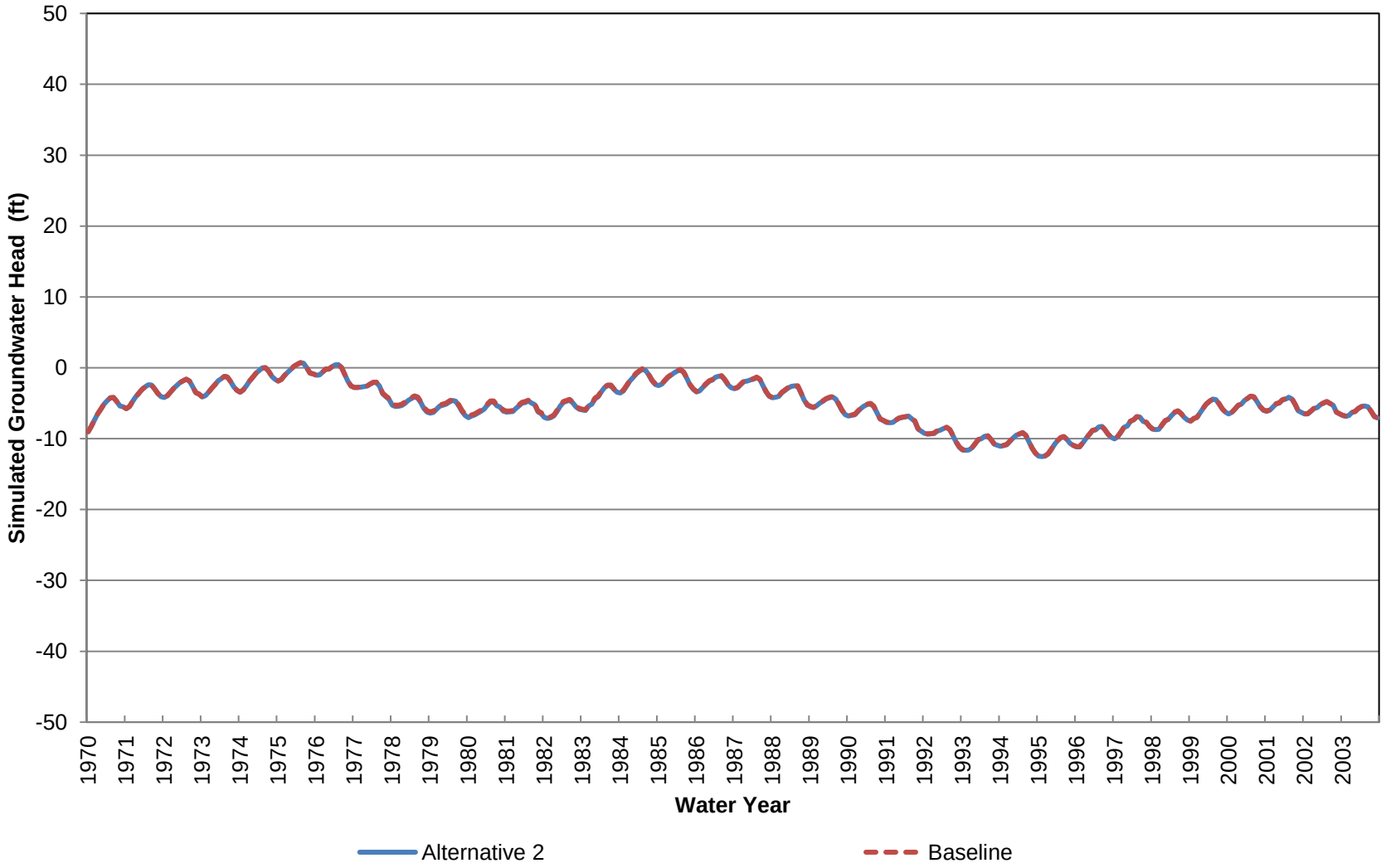
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 20 (Approximately 530-780 ft bgs)



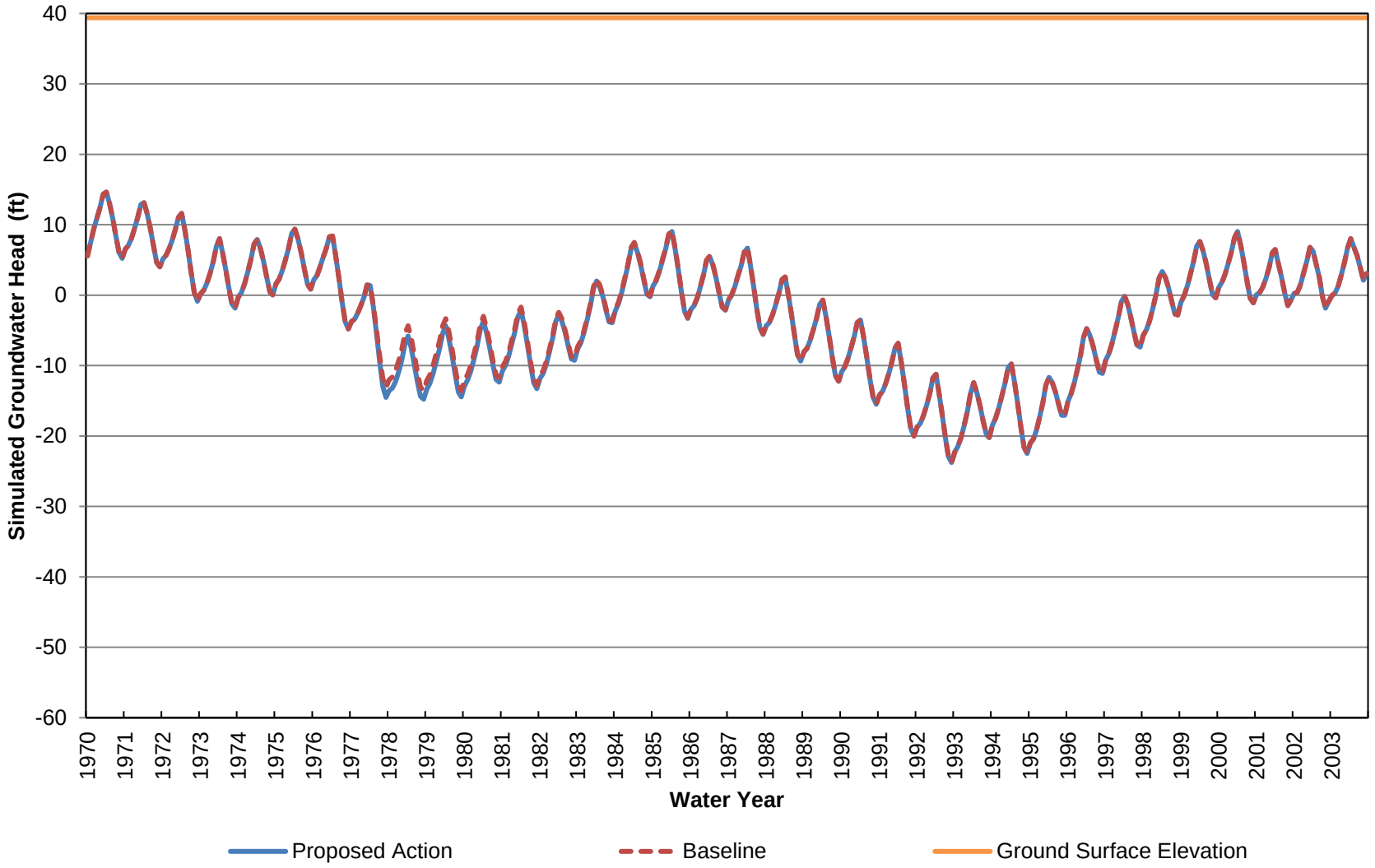
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 20 (Approximately 780-1030 ft bgs)



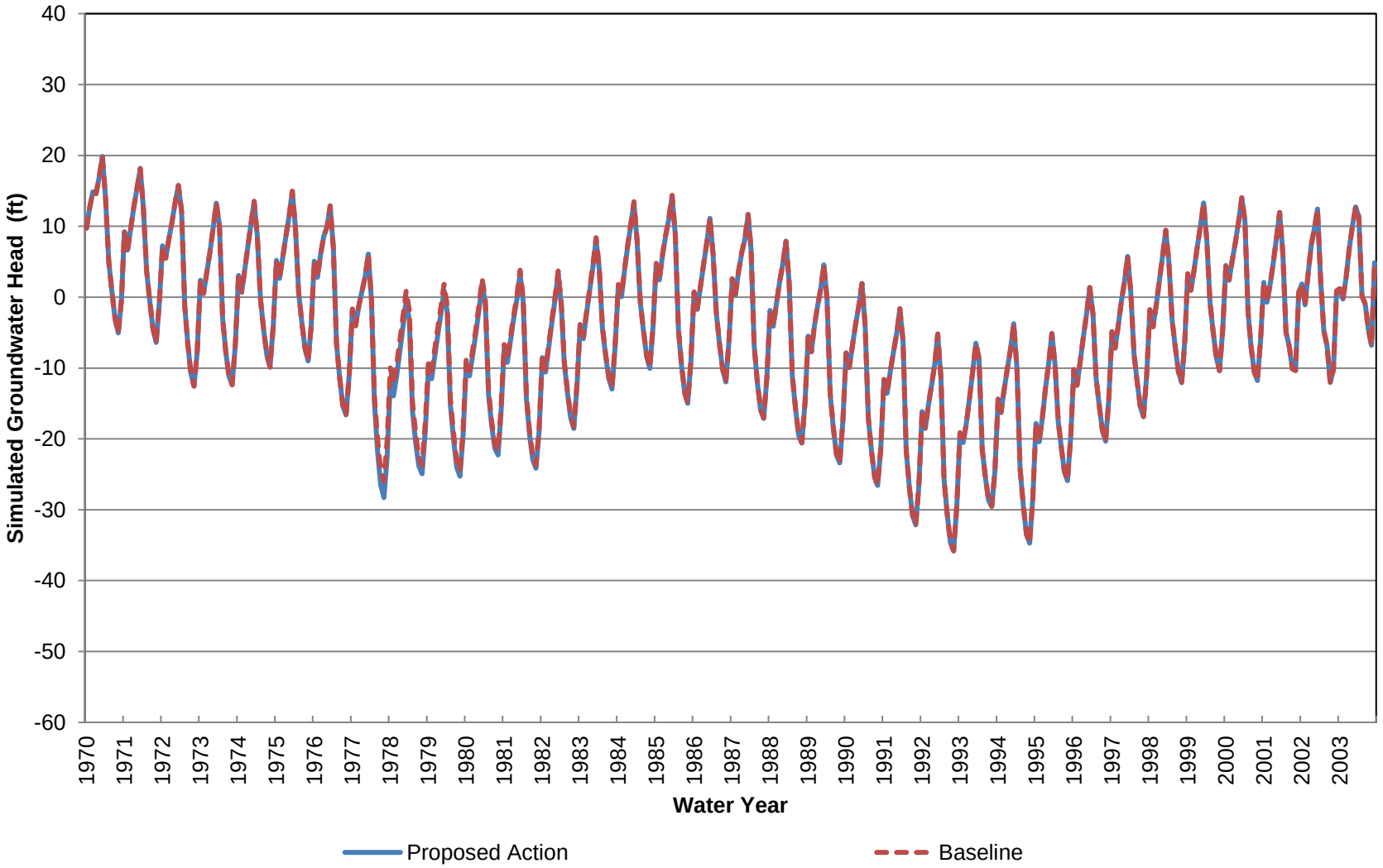
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 20 (Approximately 1030-1420 ft bgs)



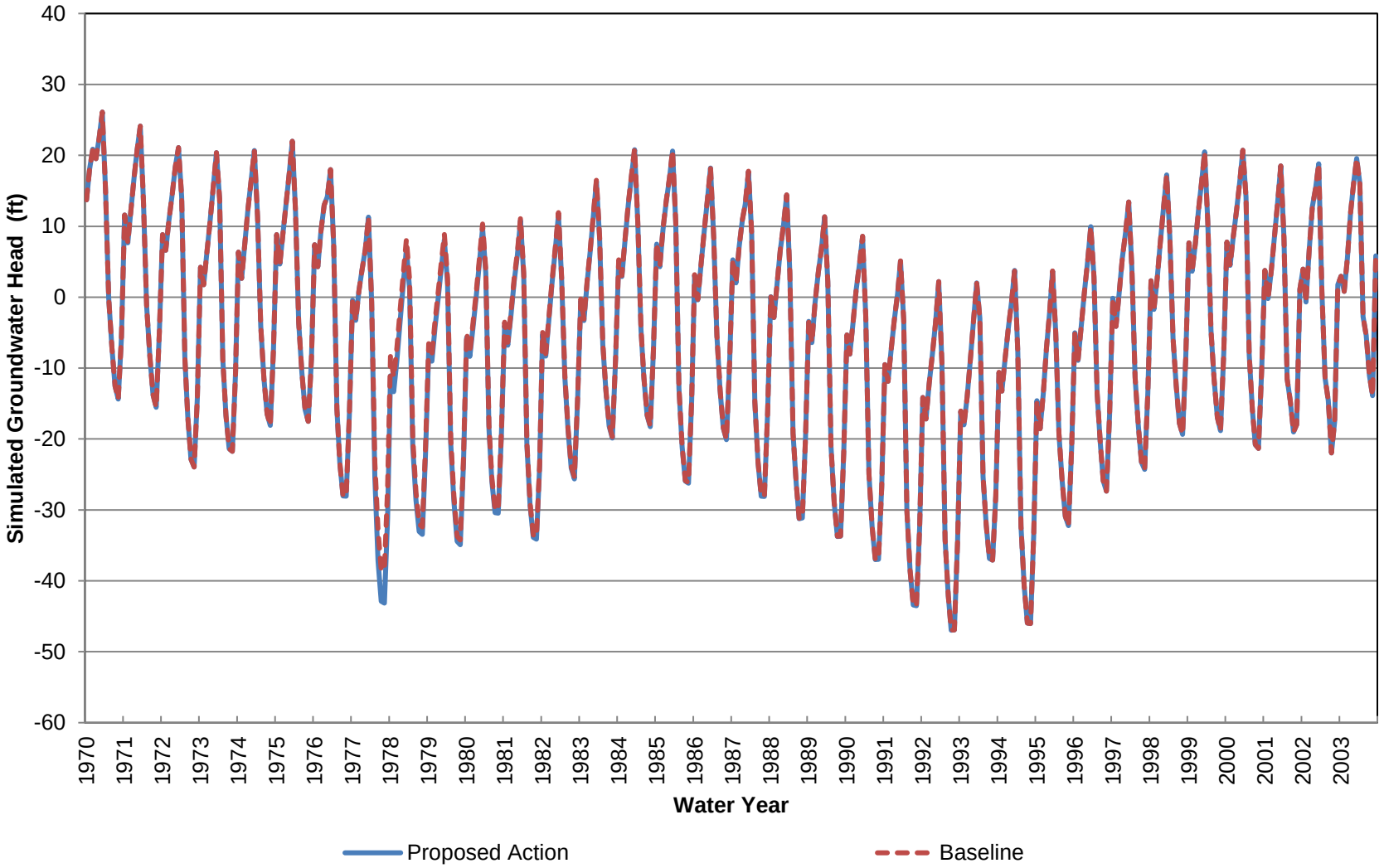
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 21 (Approximately 0-70 ft bgs)



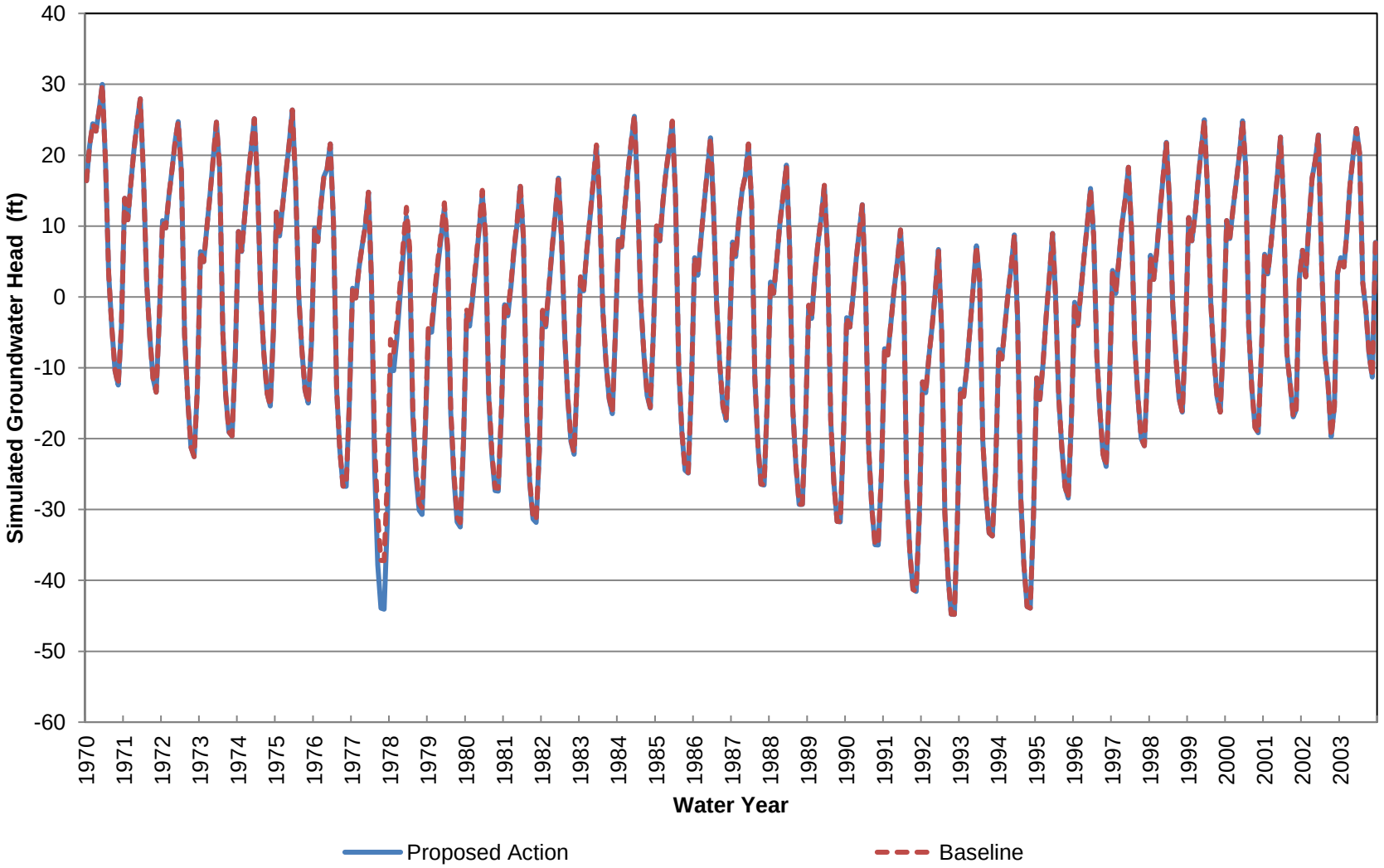
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 21 (Approximately 70-210 ft bgs)



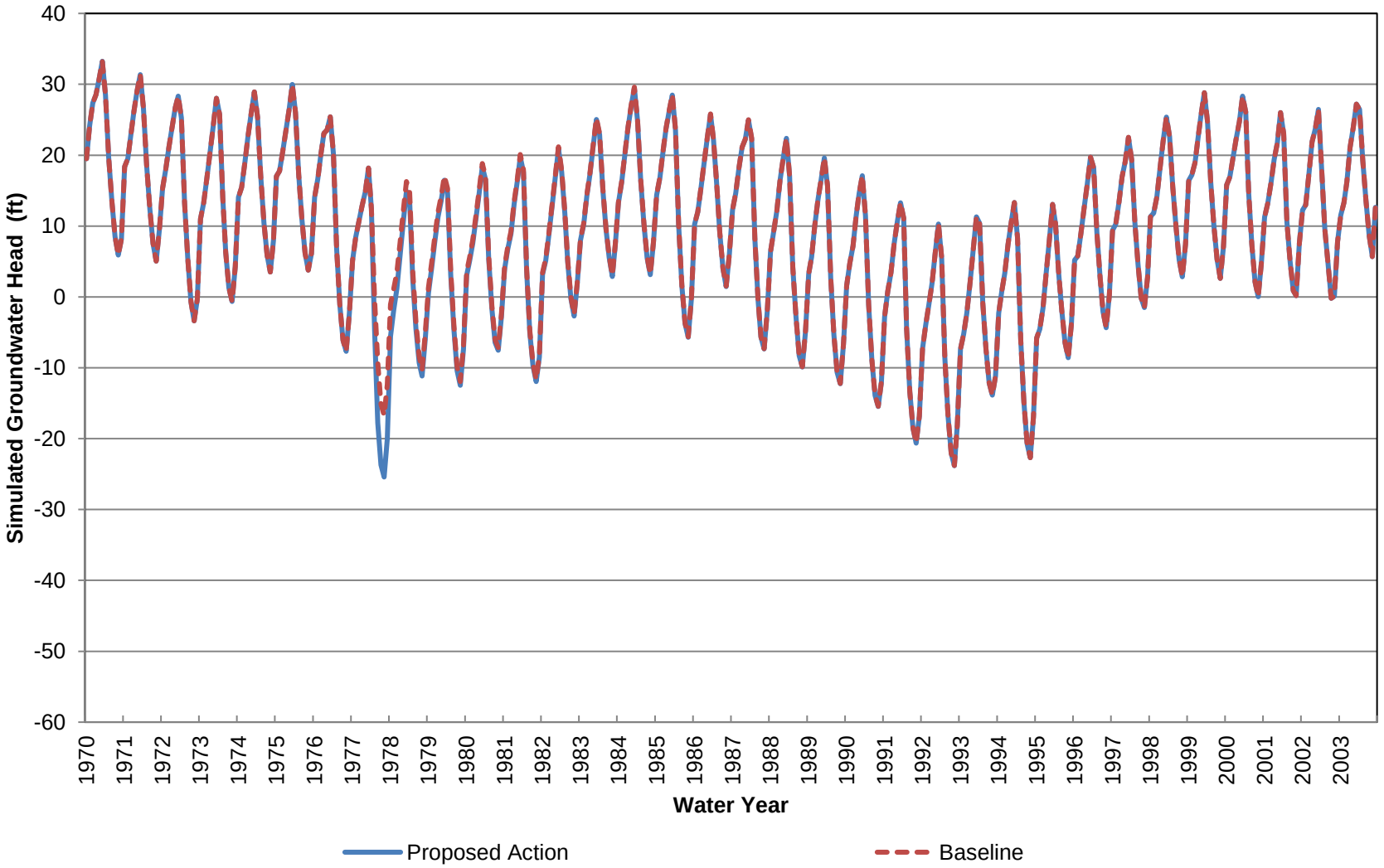
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 21 (Approximately 210-340 ft bgs)



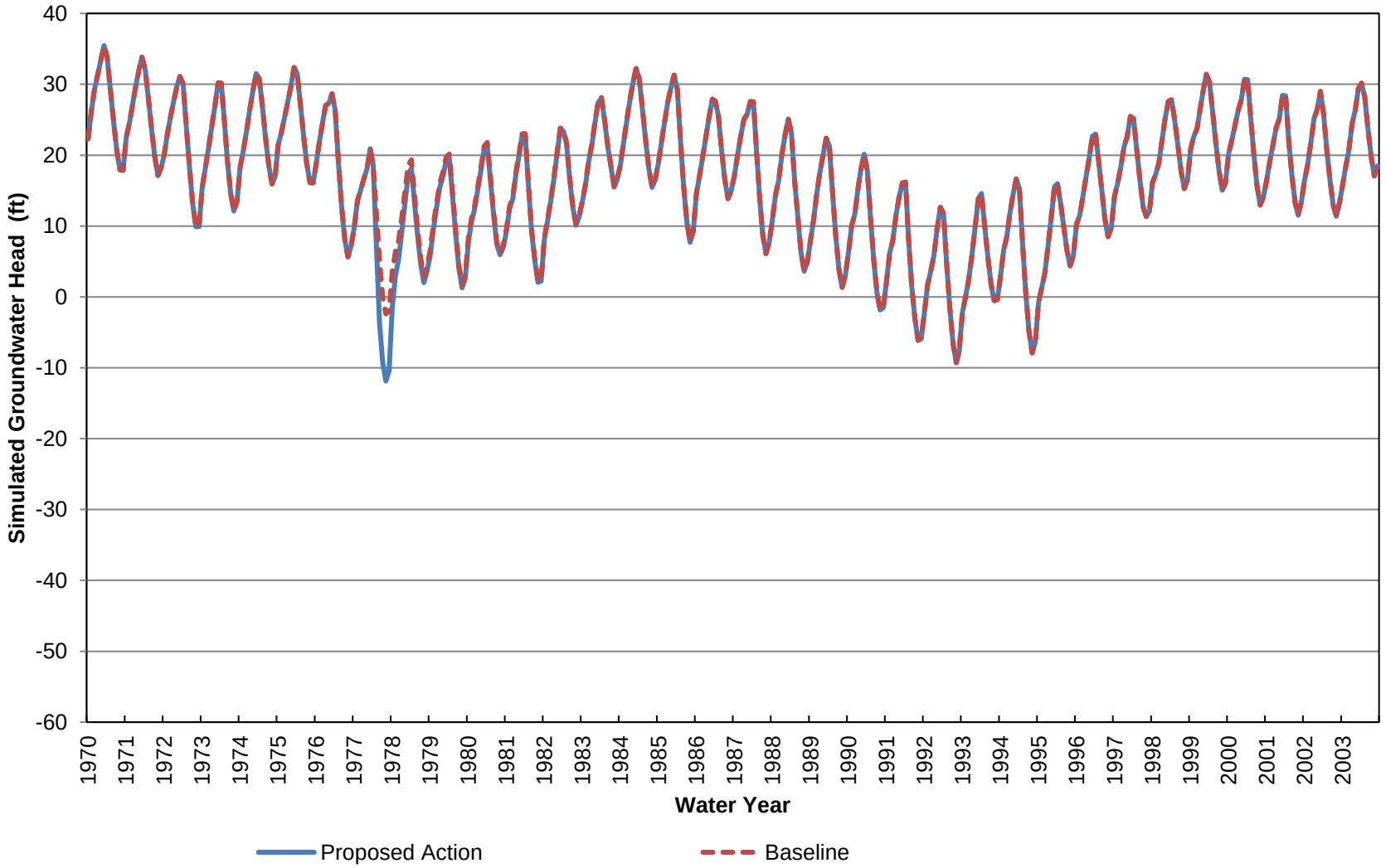
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 21 (Approximately 340-480 ft bgs)



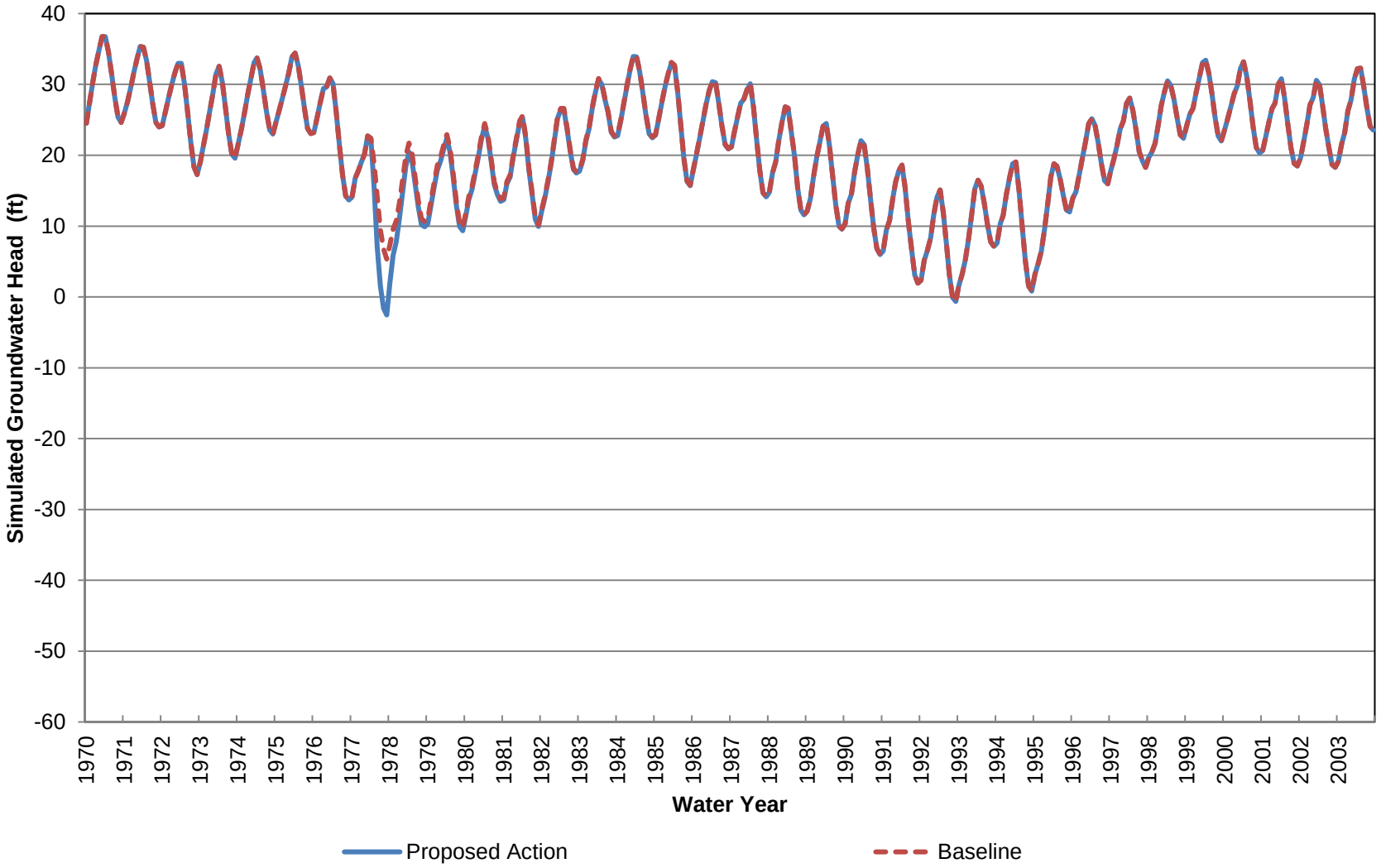
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 21 (Approximately 480-690 ft bgs)



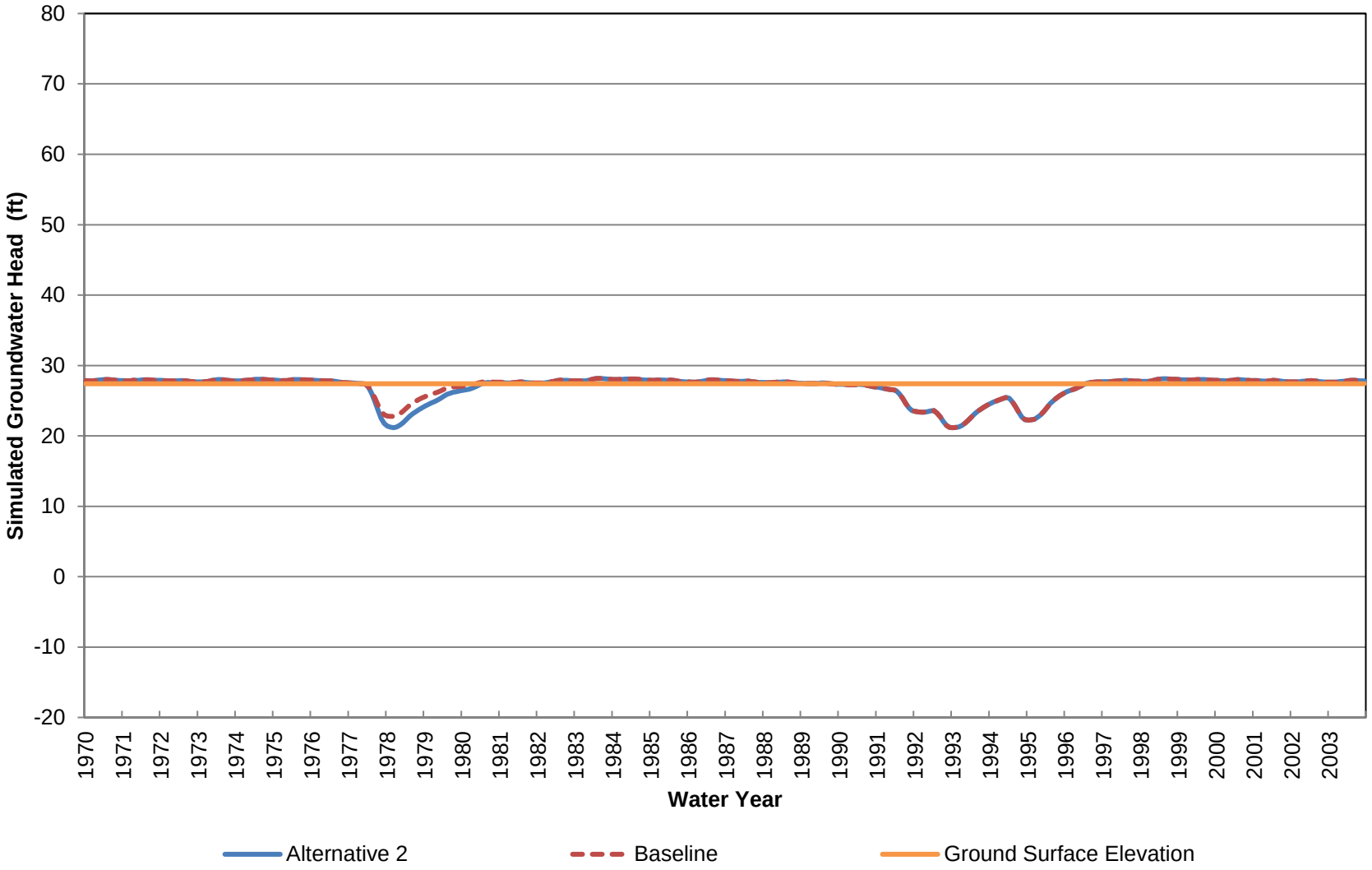
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 21 (Approximately 690-910 ft bgs)



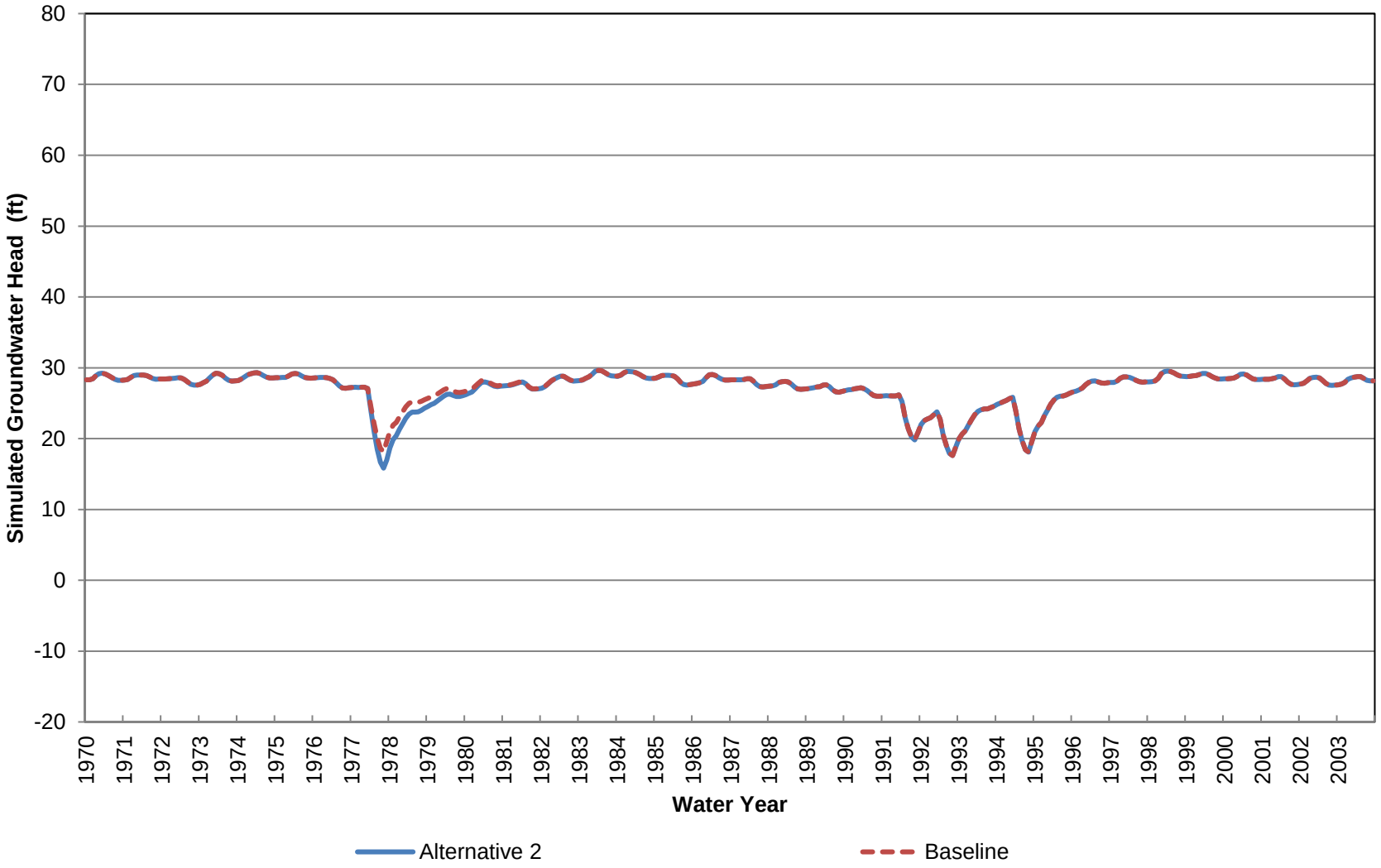
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 21 (Approximately 910-1250 ft bgs)



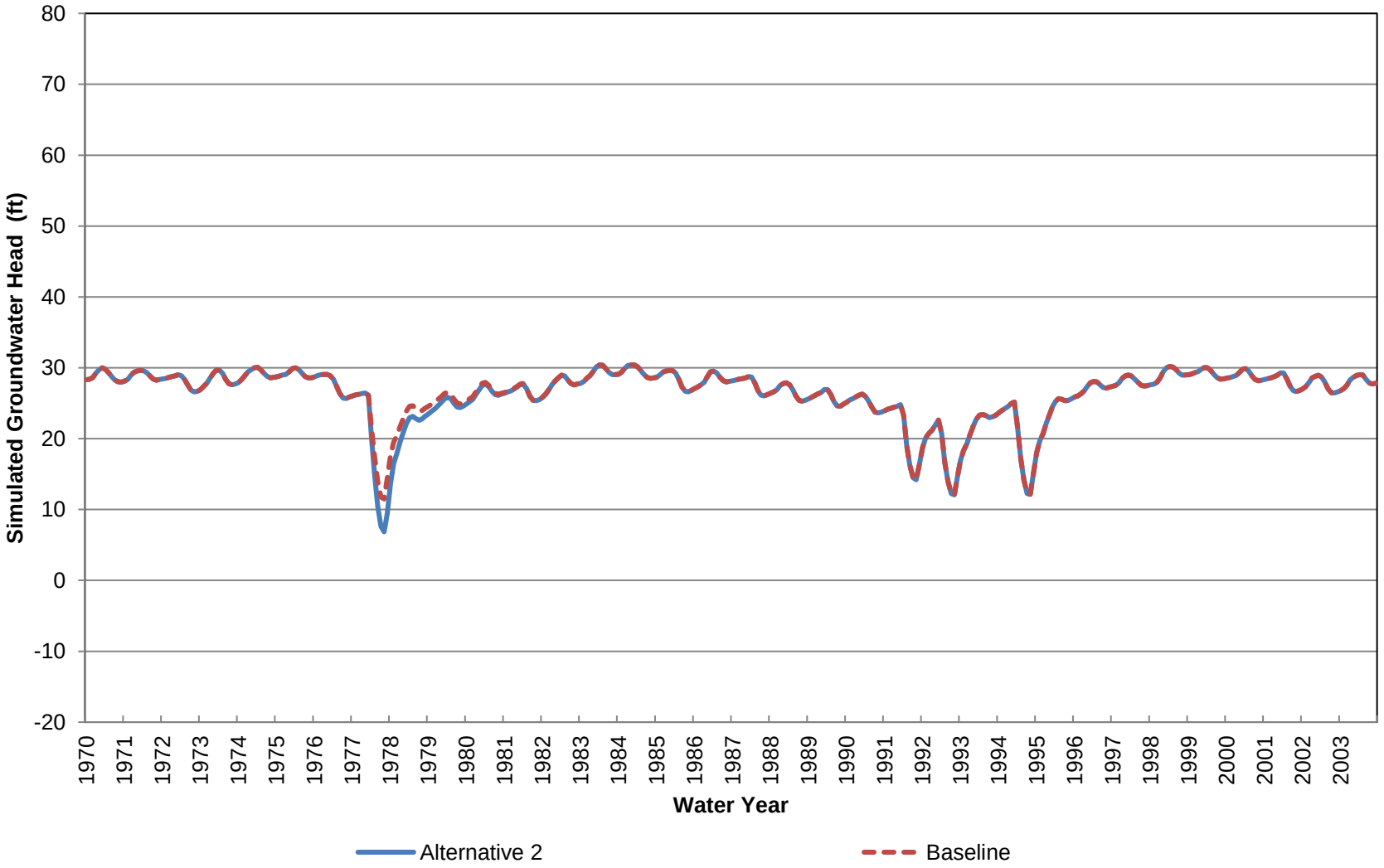
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 22 (Approximately 0-70 ft bgs)



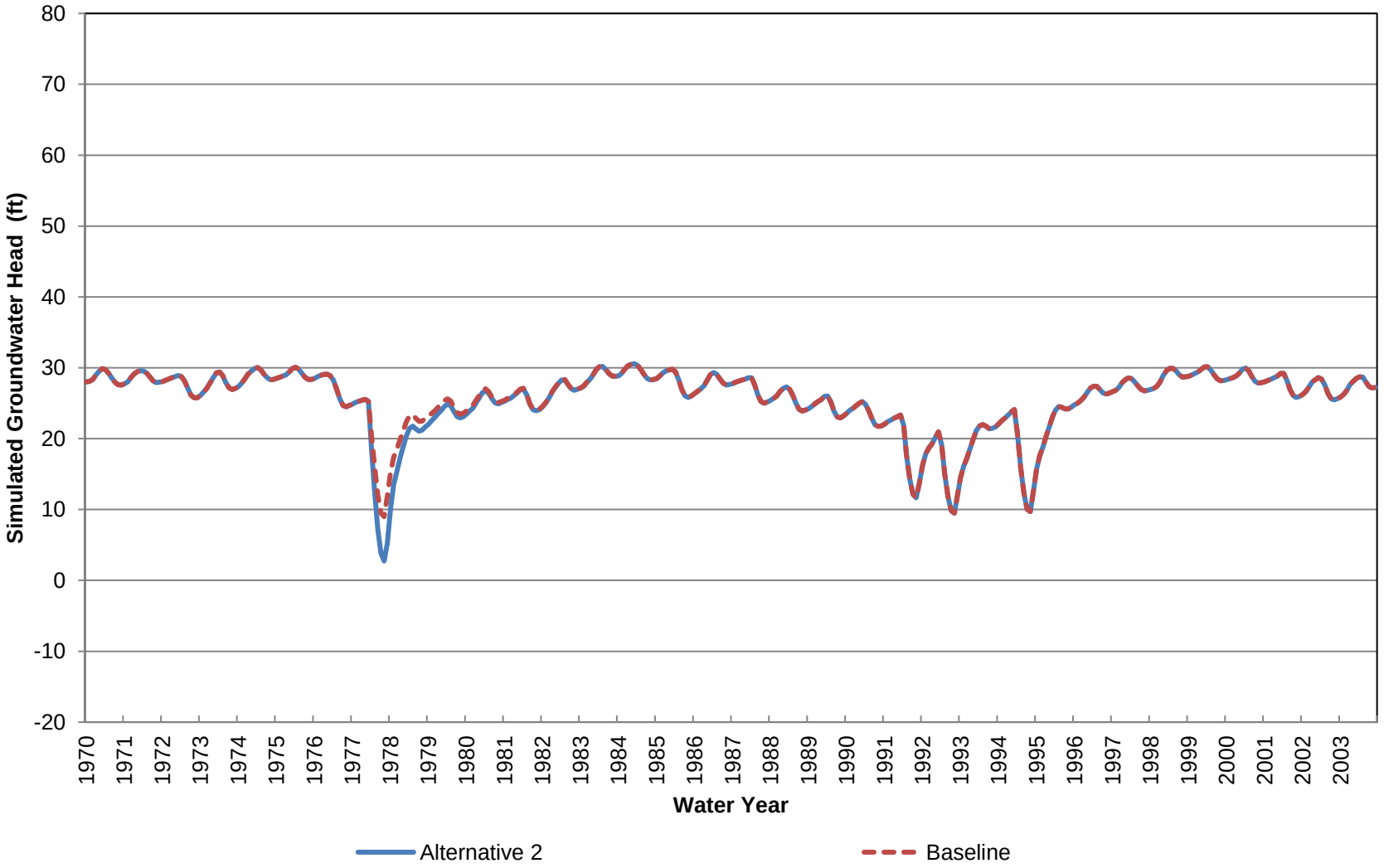
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 22 (Approximately 70-230 ft bgs)



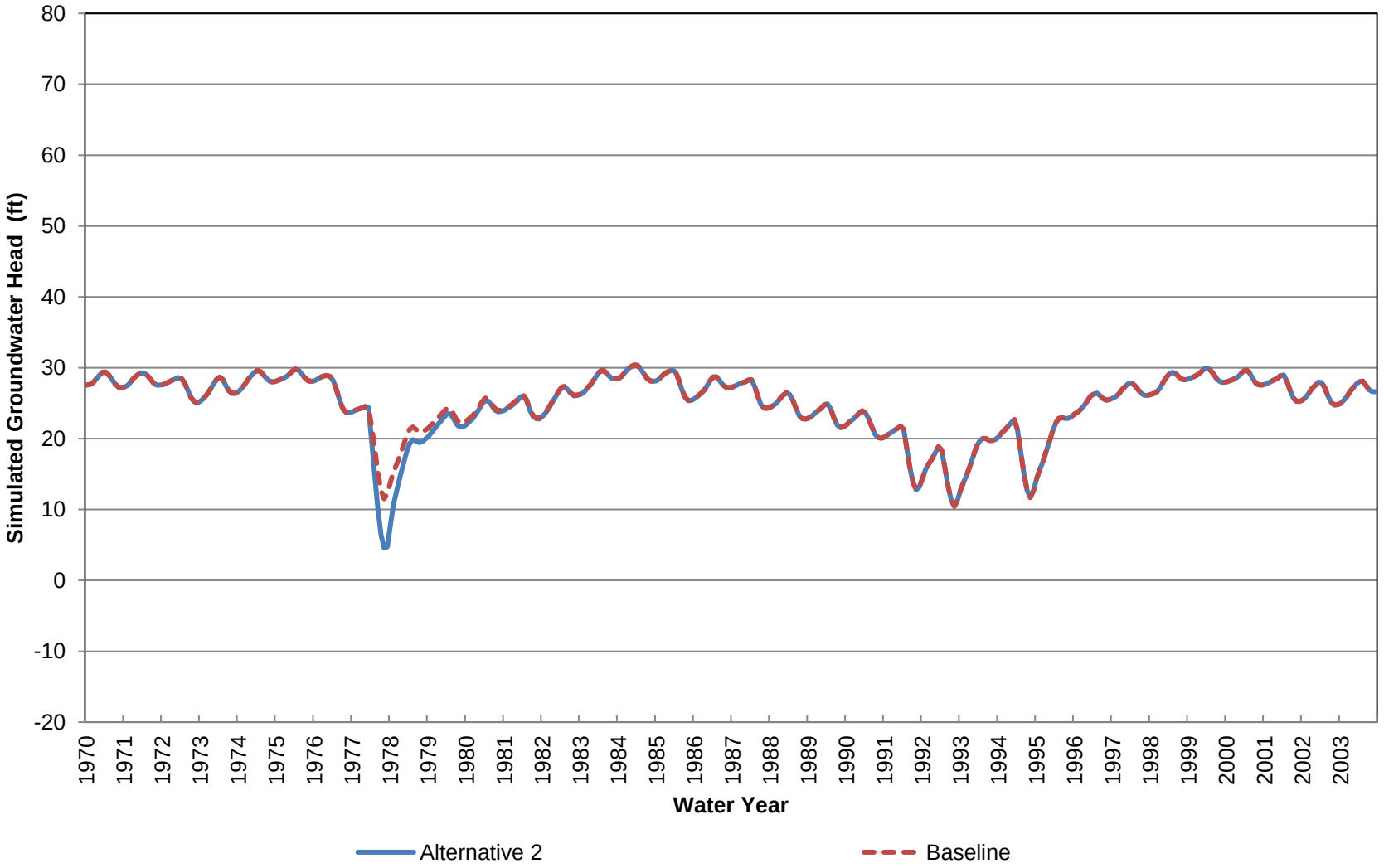
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 22 (Approximately 230-390 ft bgs)



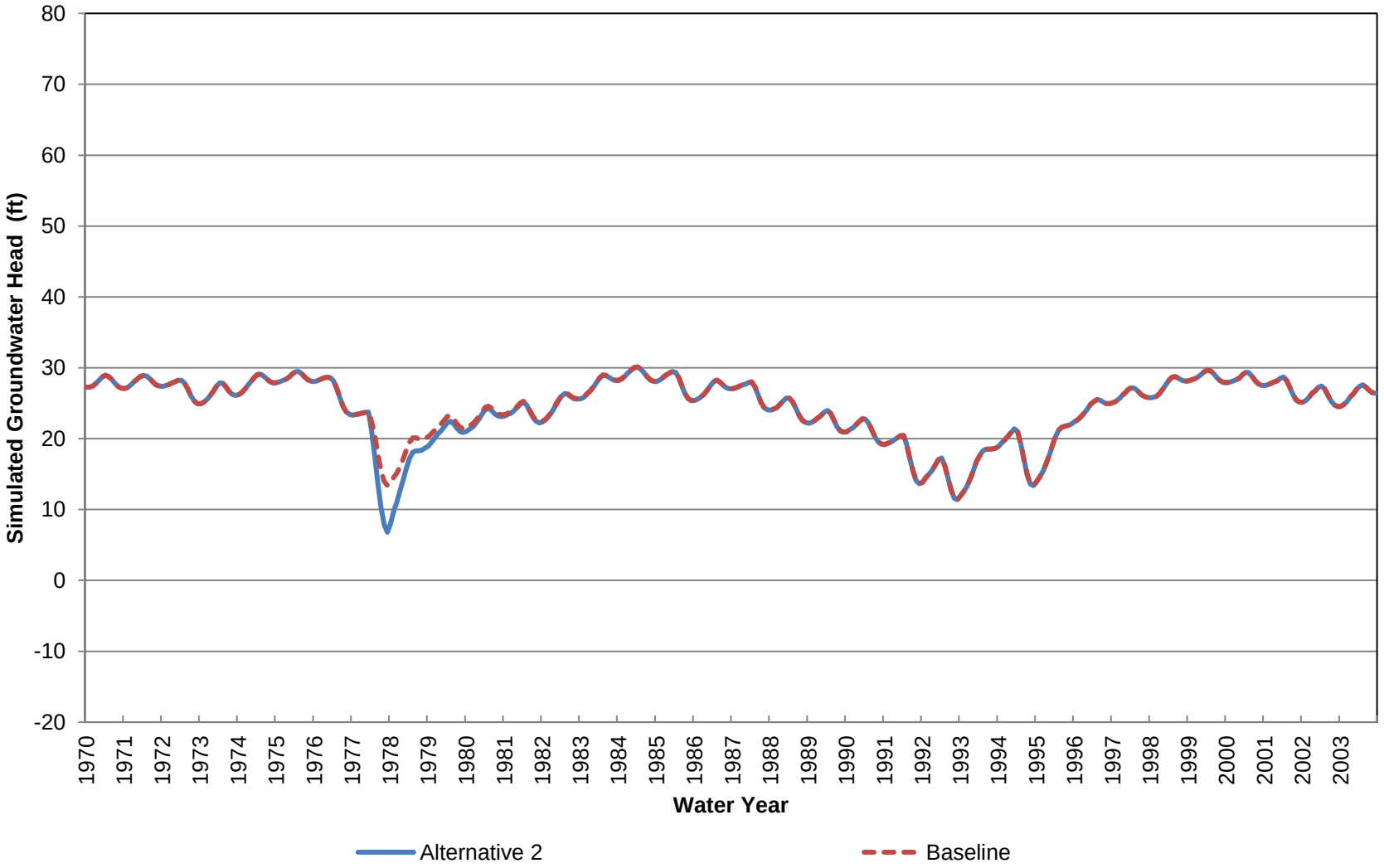
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 22 (Approximately 390-550 ft bgs)



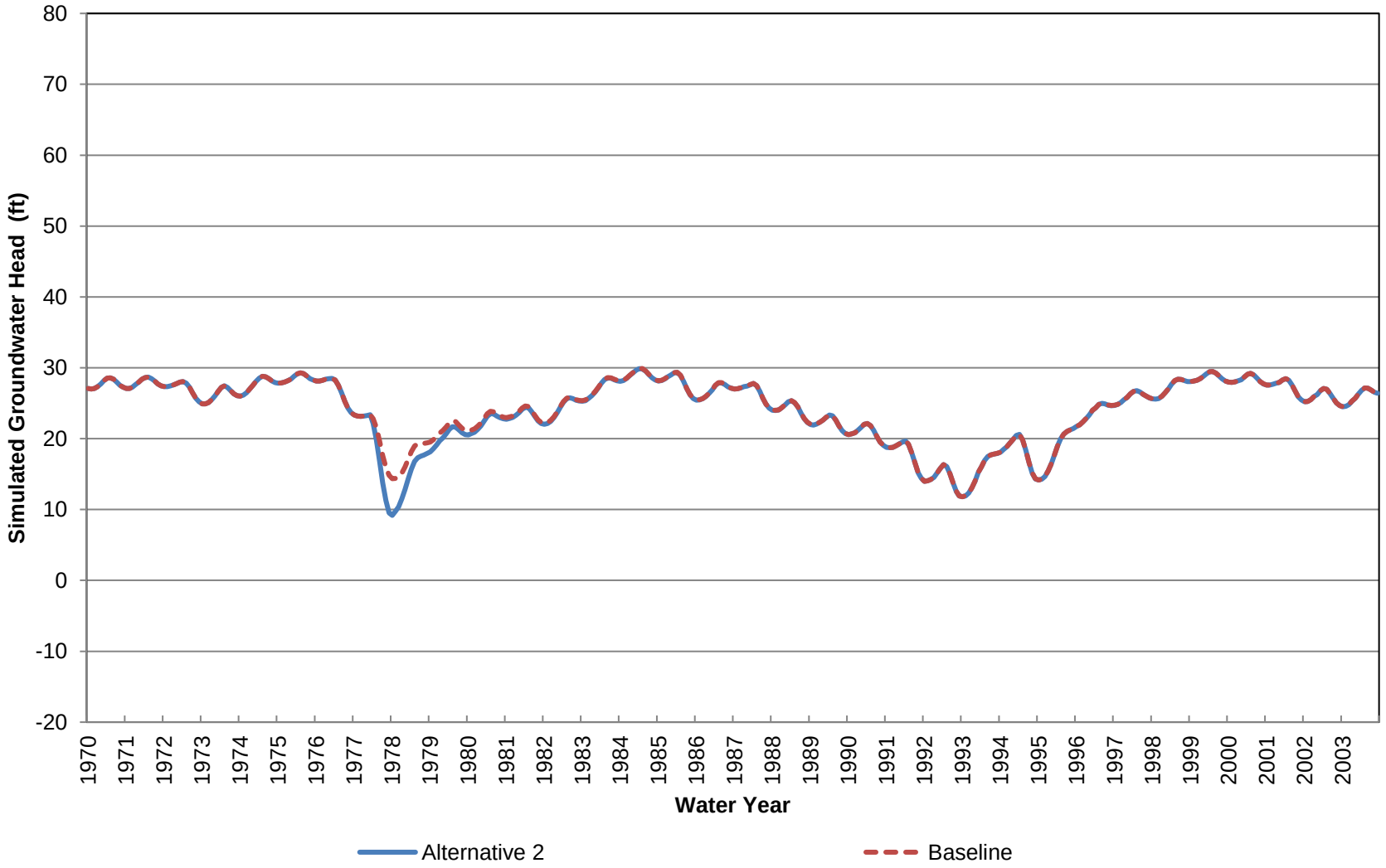
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 22 (Approximately 550-810 ft bgs)



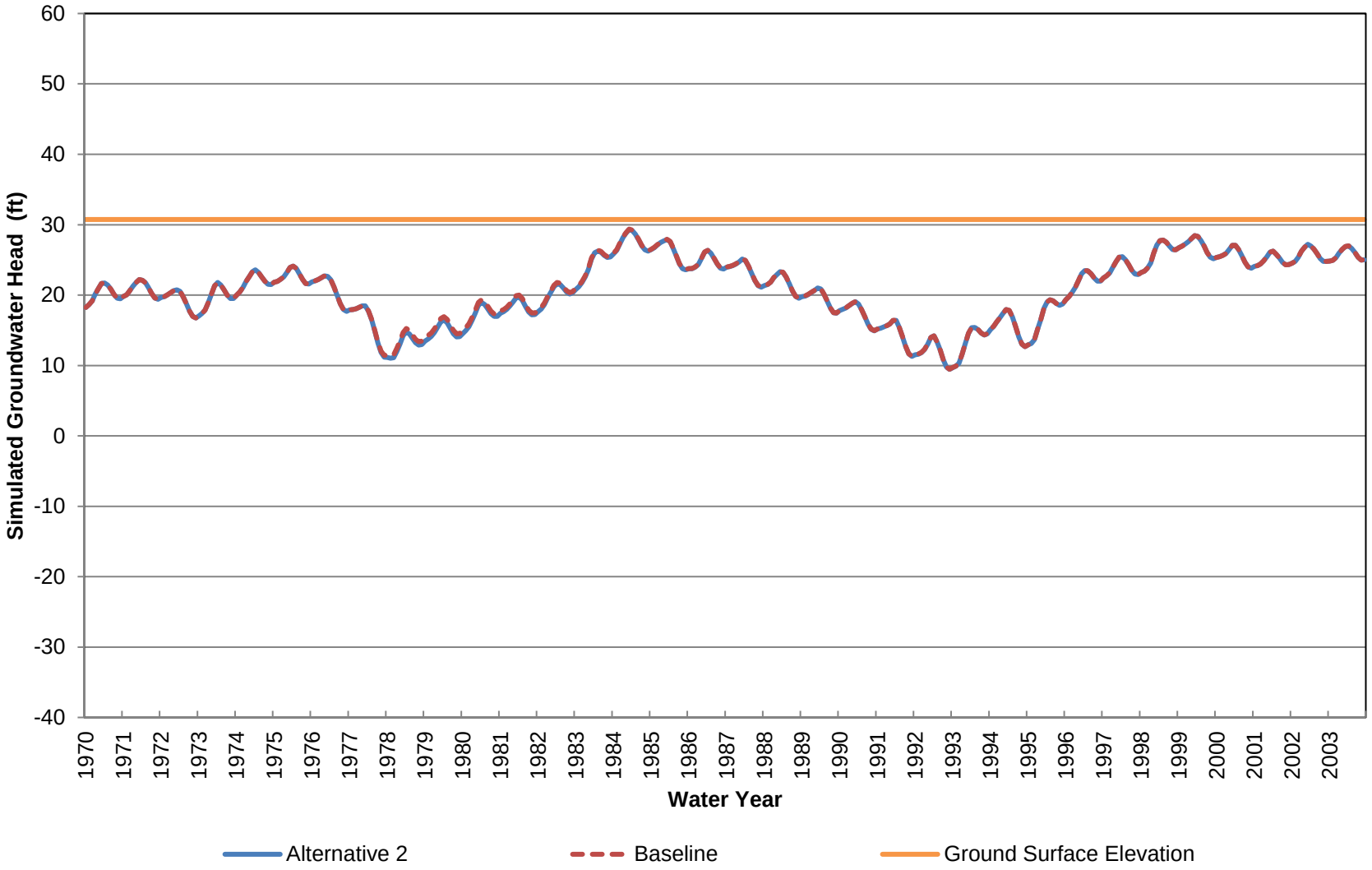
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 22 (Approximately 810-1080 ft bgs)



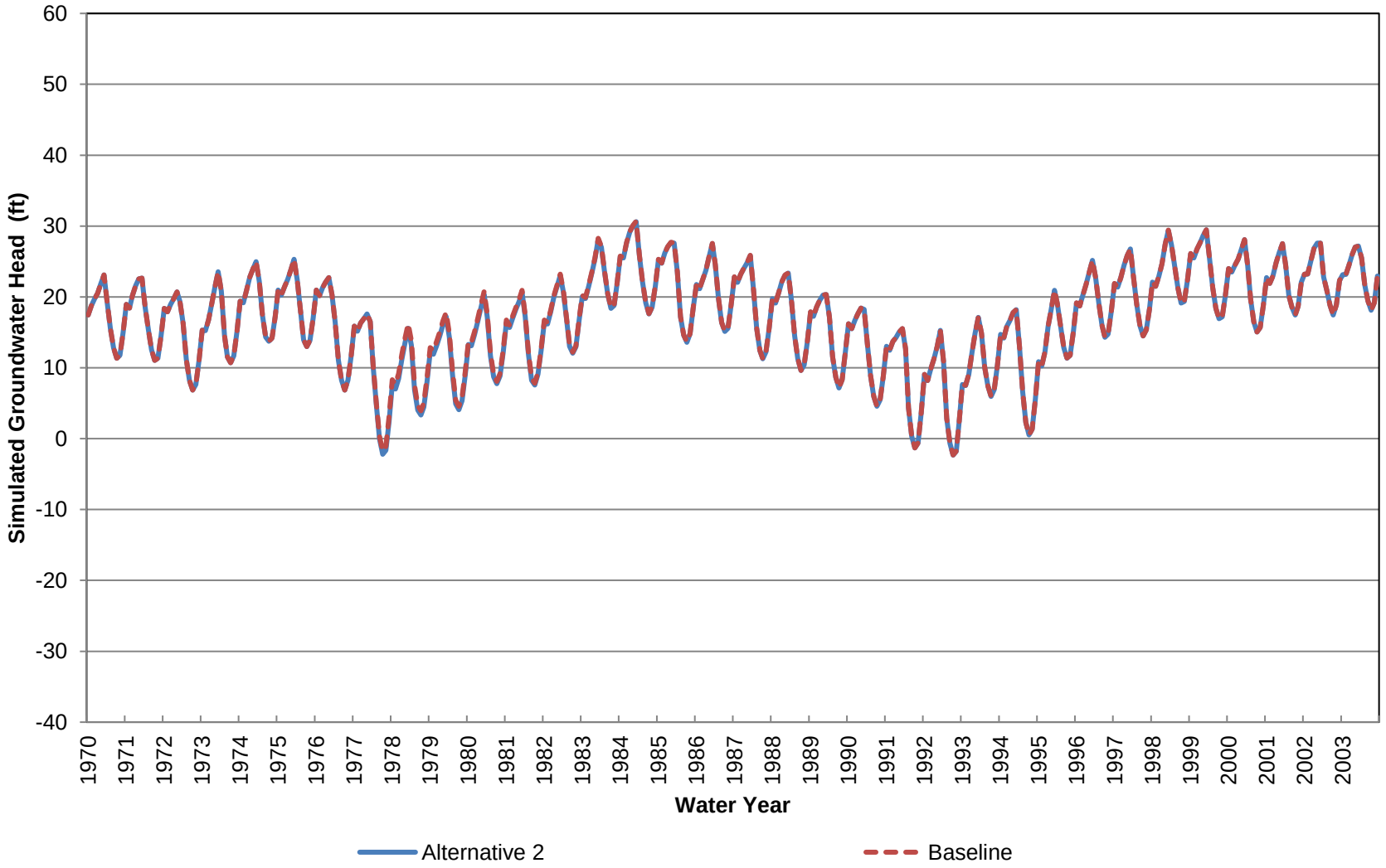
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 22 (Approximately 1080-1480 ft bgs)



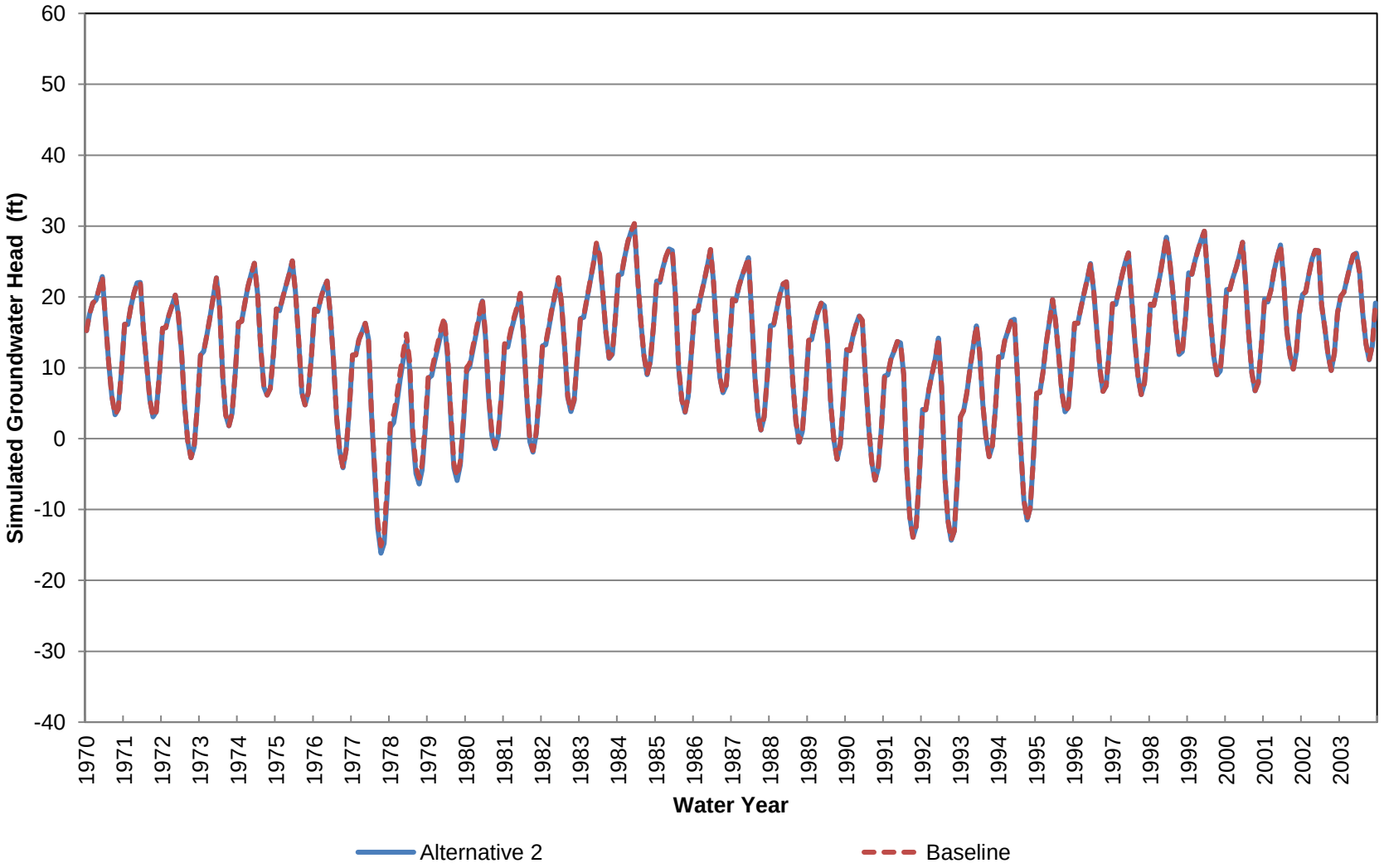
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 23 (Approximately 0-70 ft bgs)



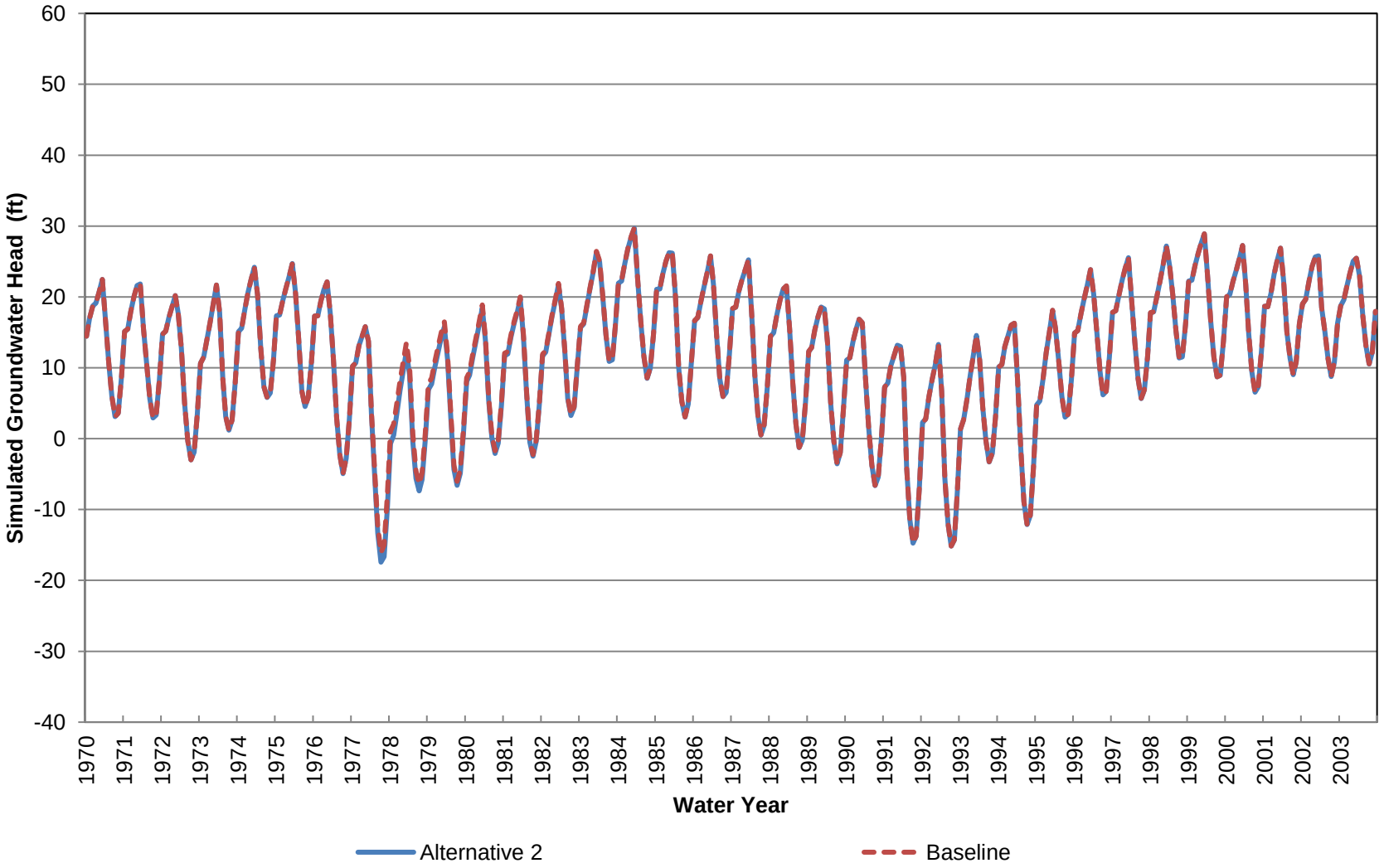
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 23 (Approximately 70-290 ft bgs)



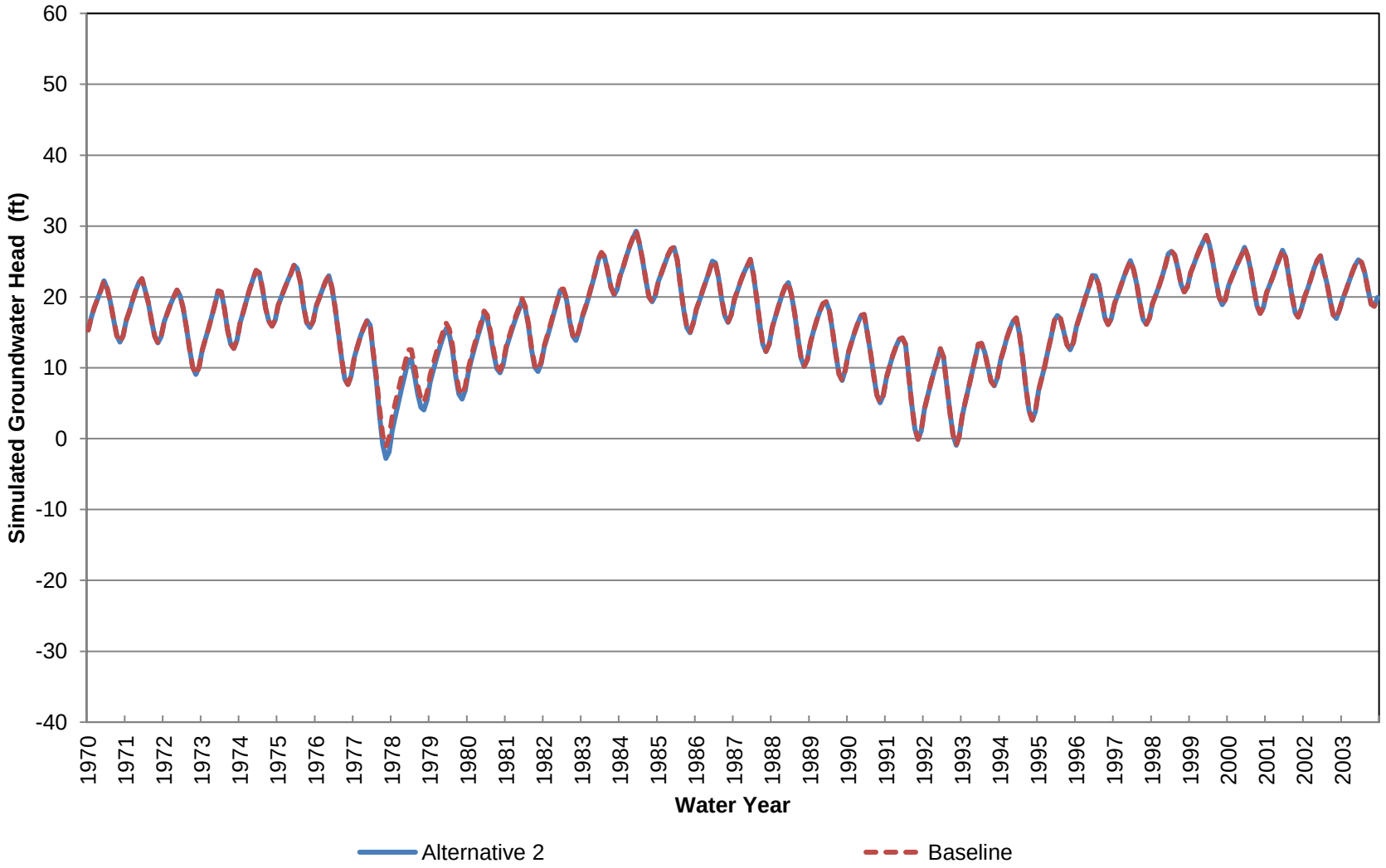
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 23 (Approximately 290-520 ft bgs)



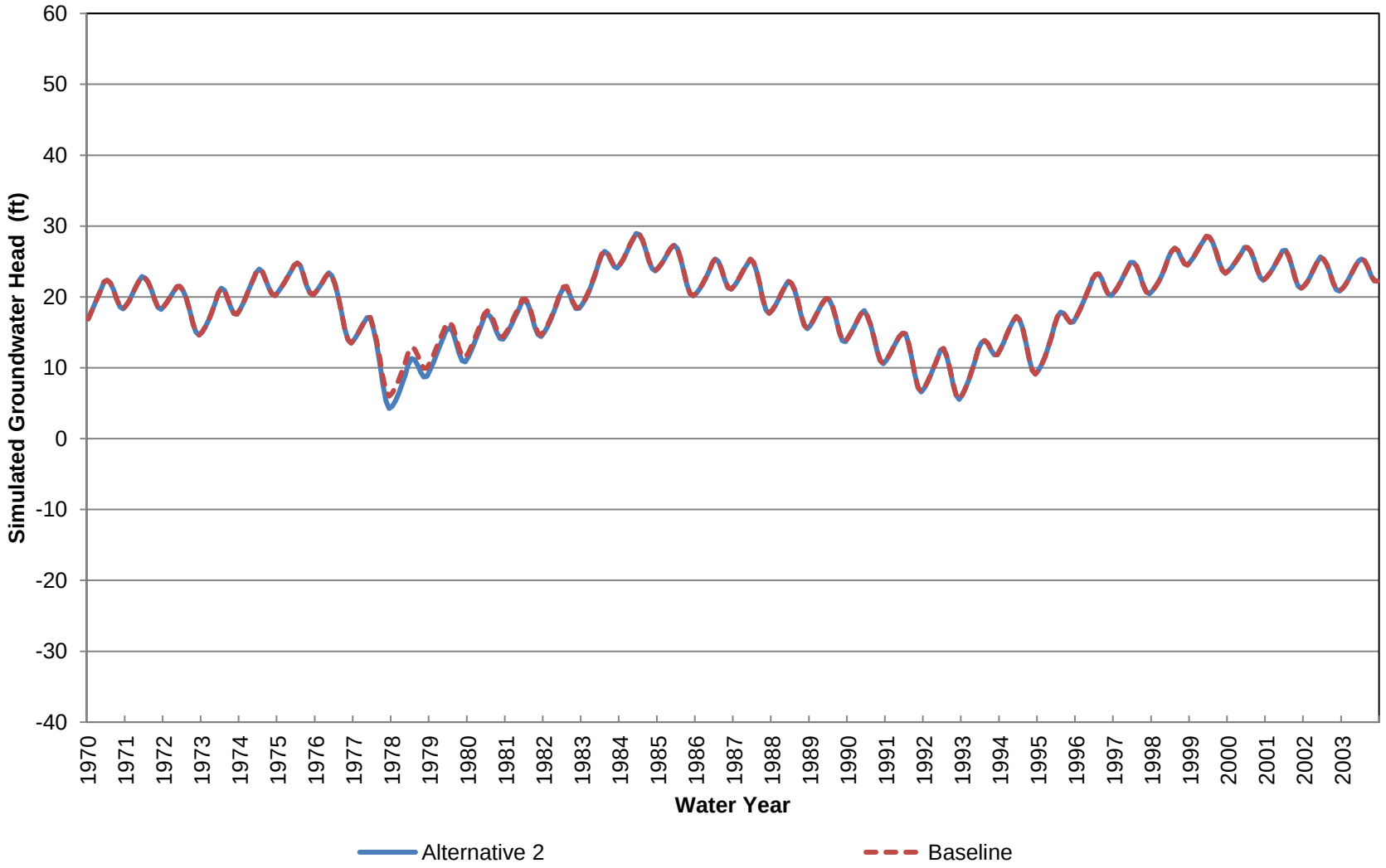
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 23 (Approximately 520-740 ft bgs)



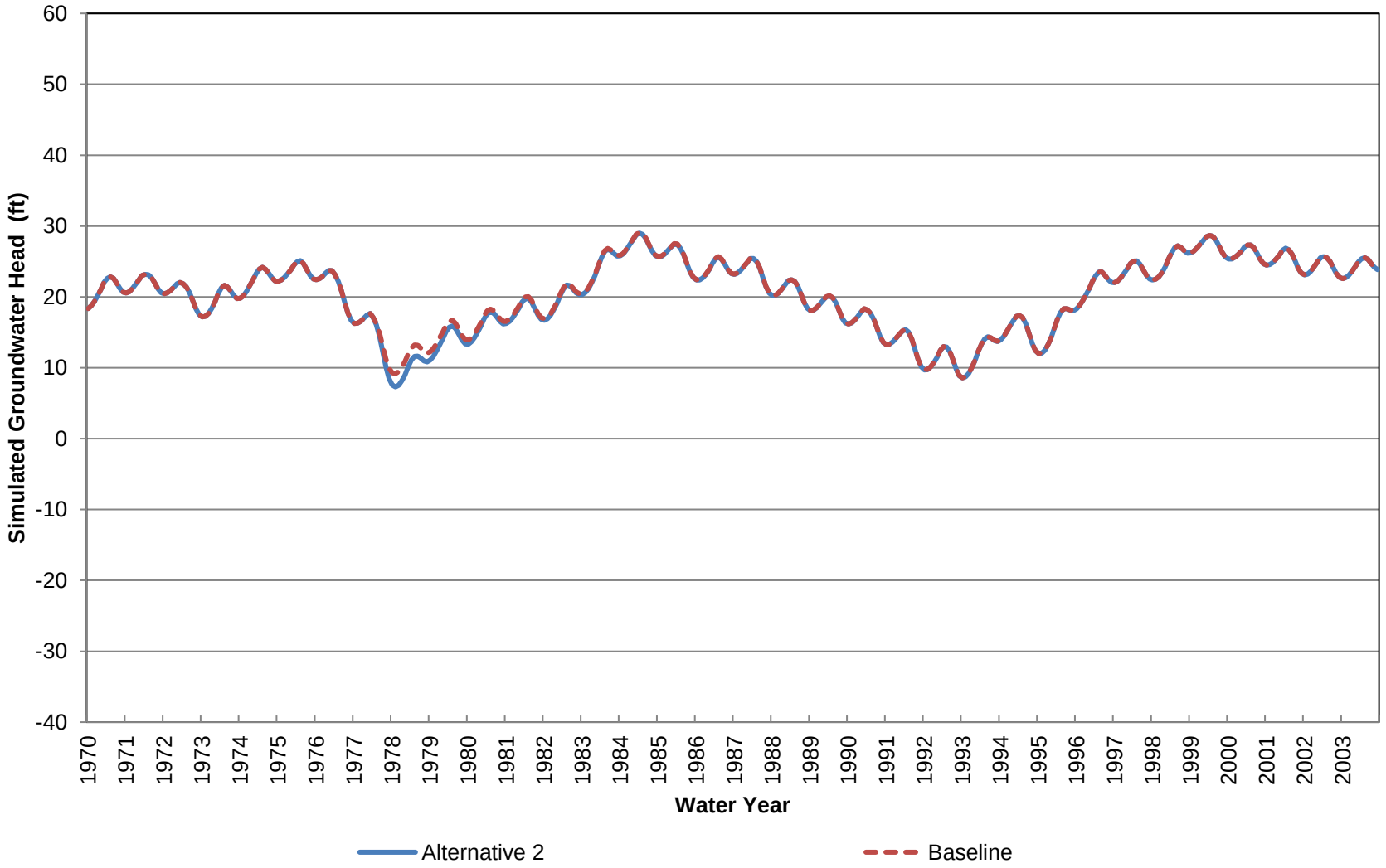
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 23 (Approximately 740-1120 ft bgs)



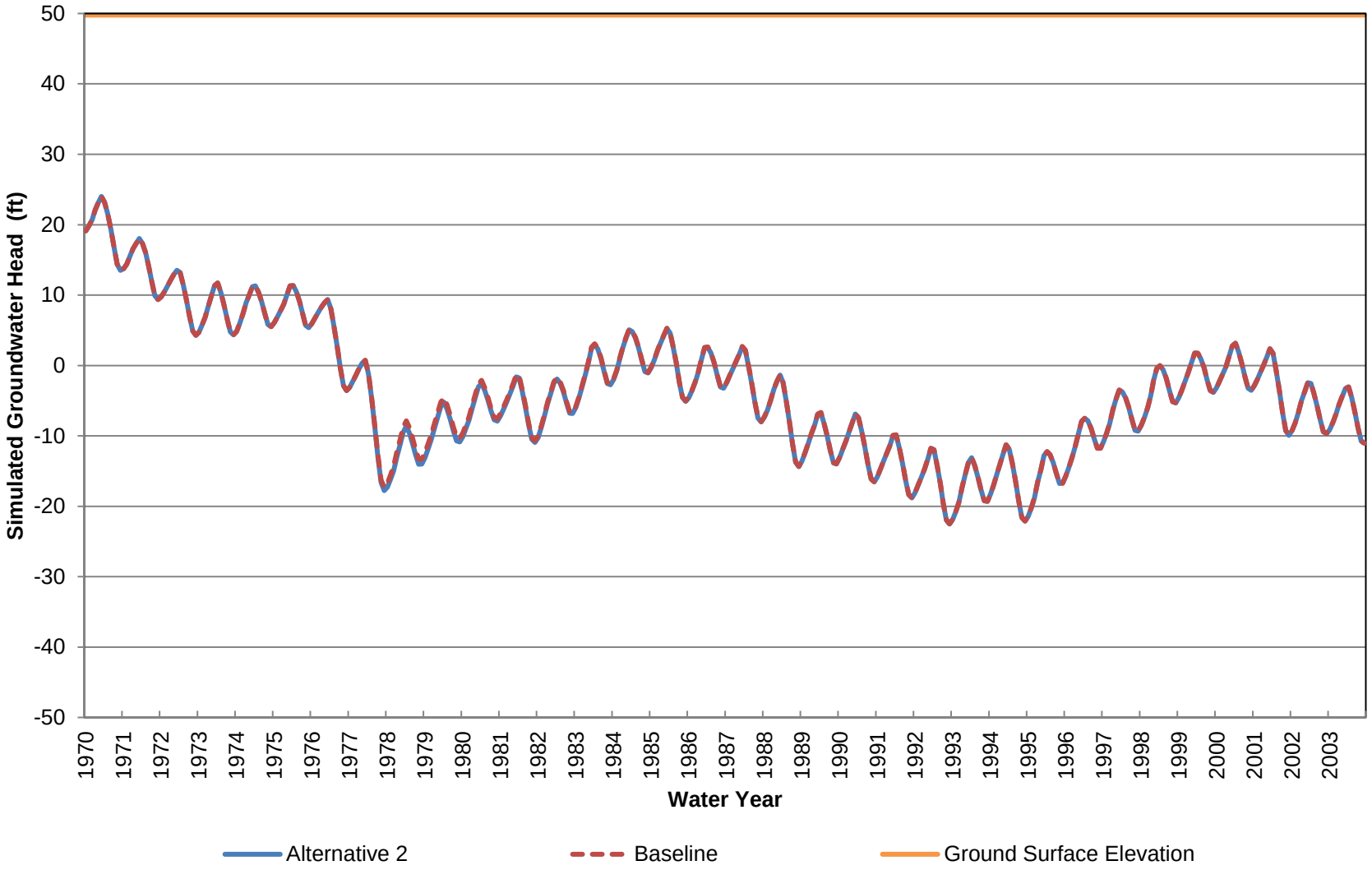
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 23 (Approximately 1120-1500 ft bgs)



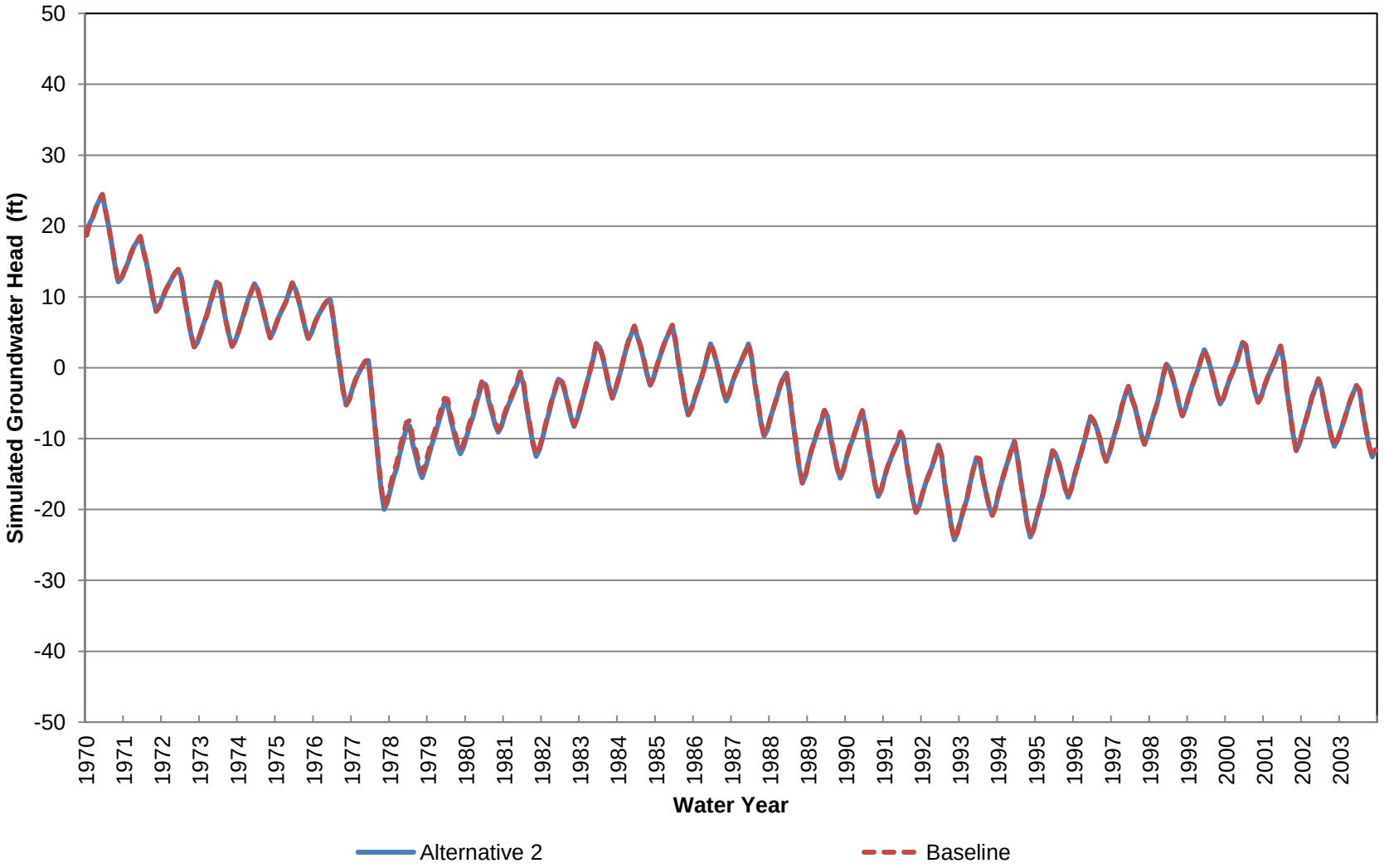
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 23 (Approximately 1500-2050 ft bgs)



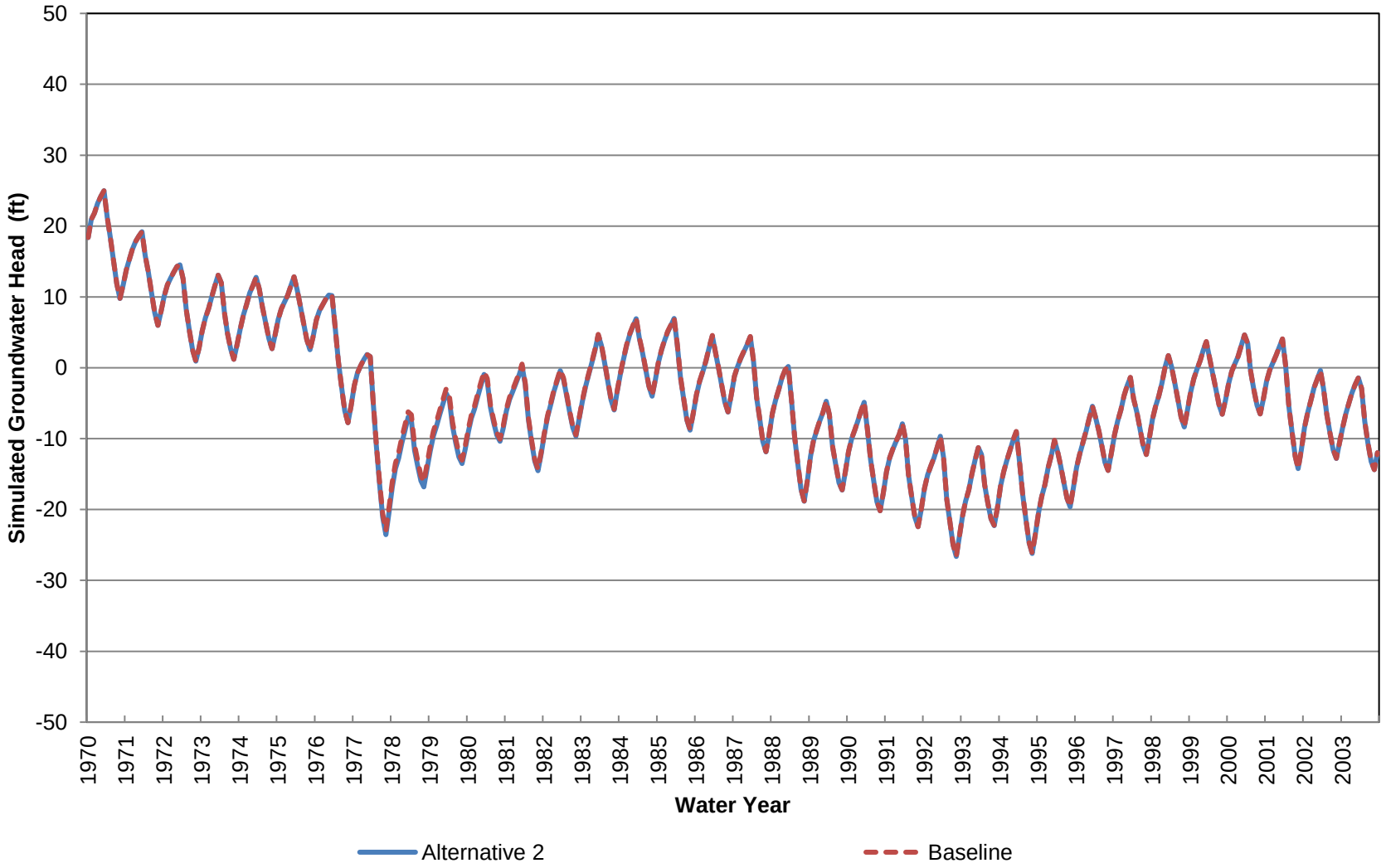
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 24 (Approximately 0-60 ft bgs)



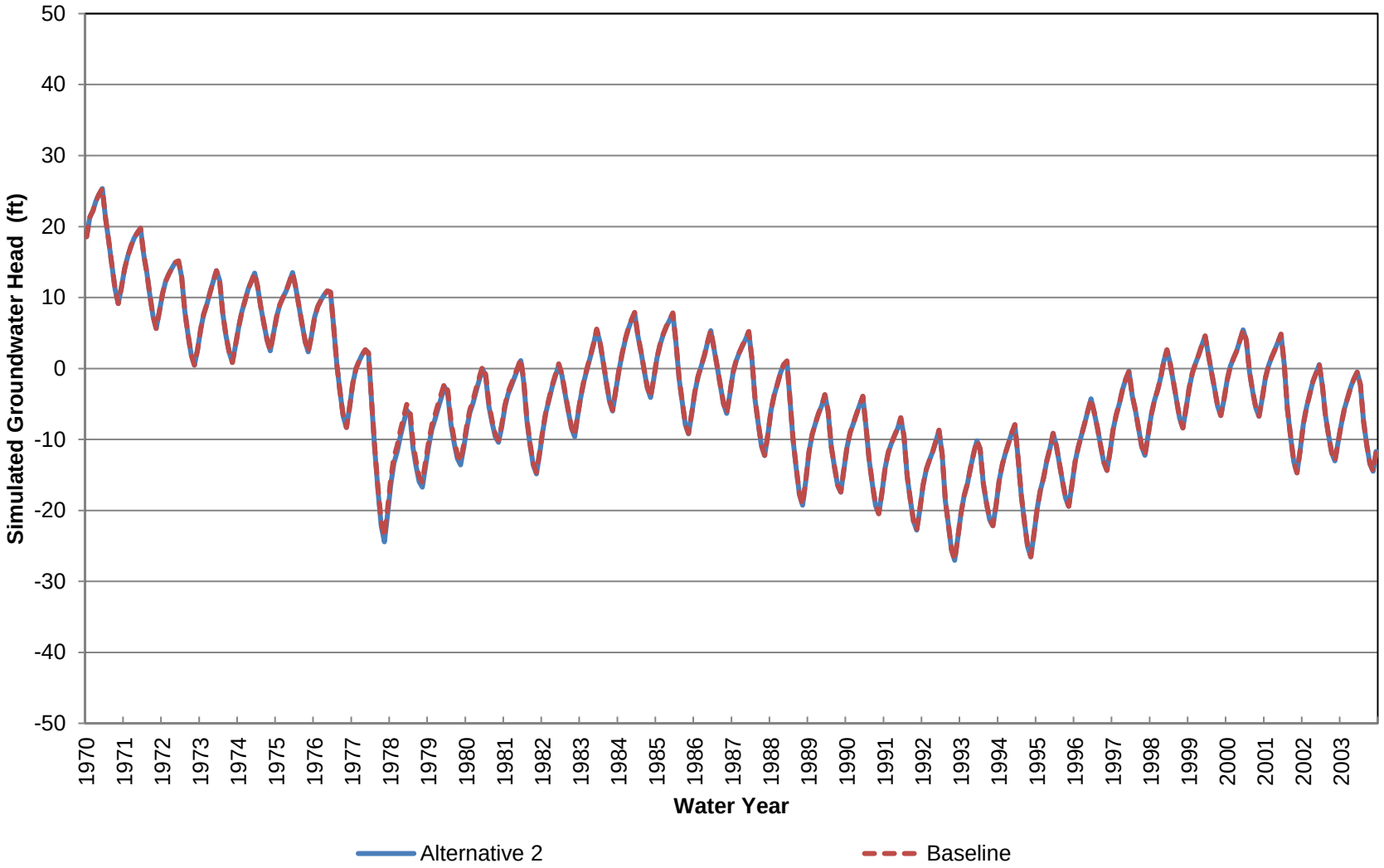
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 24 (Approximately 60-140 ft bgs)



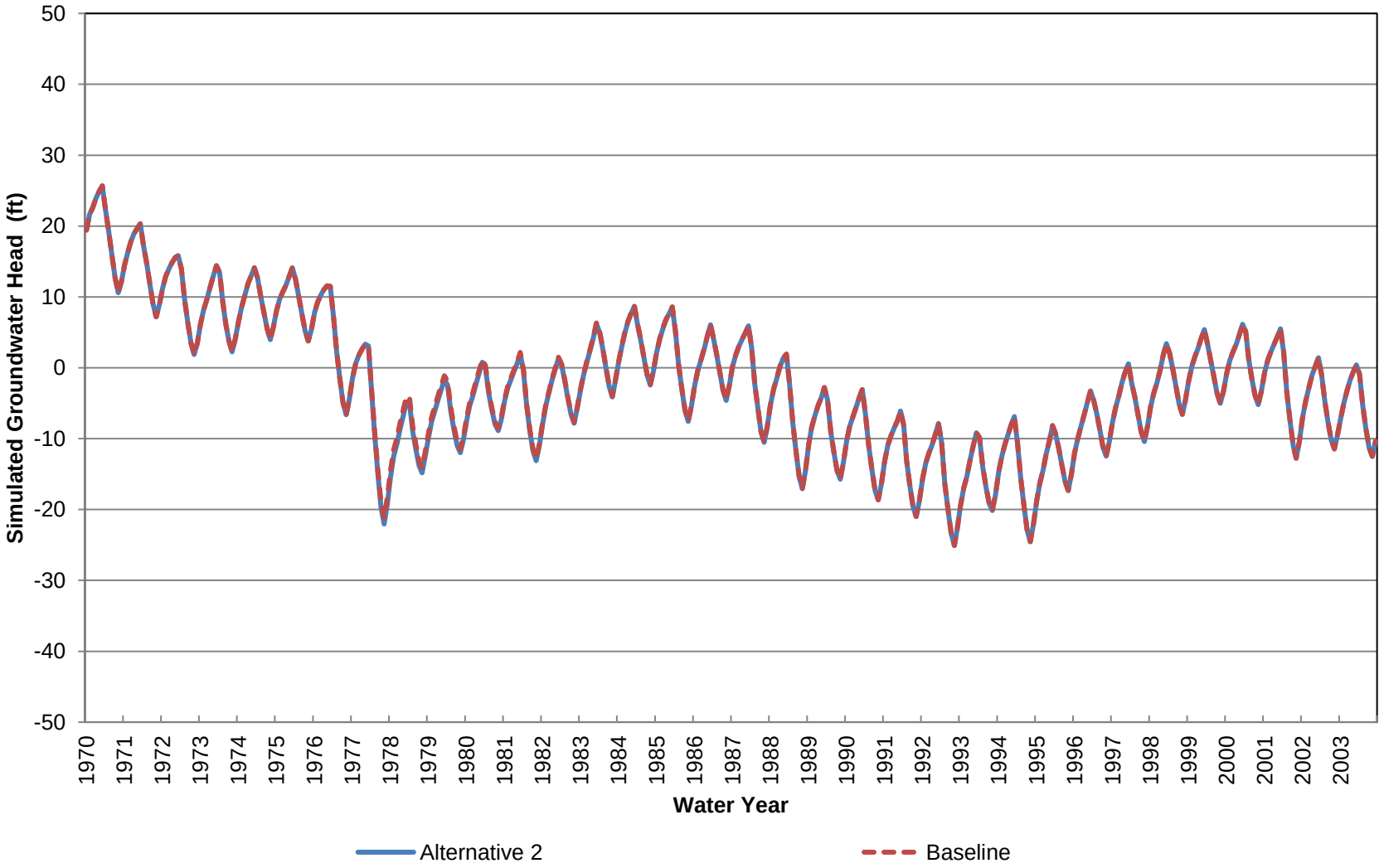
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 24 (Approximately 140-220 ft bgs)



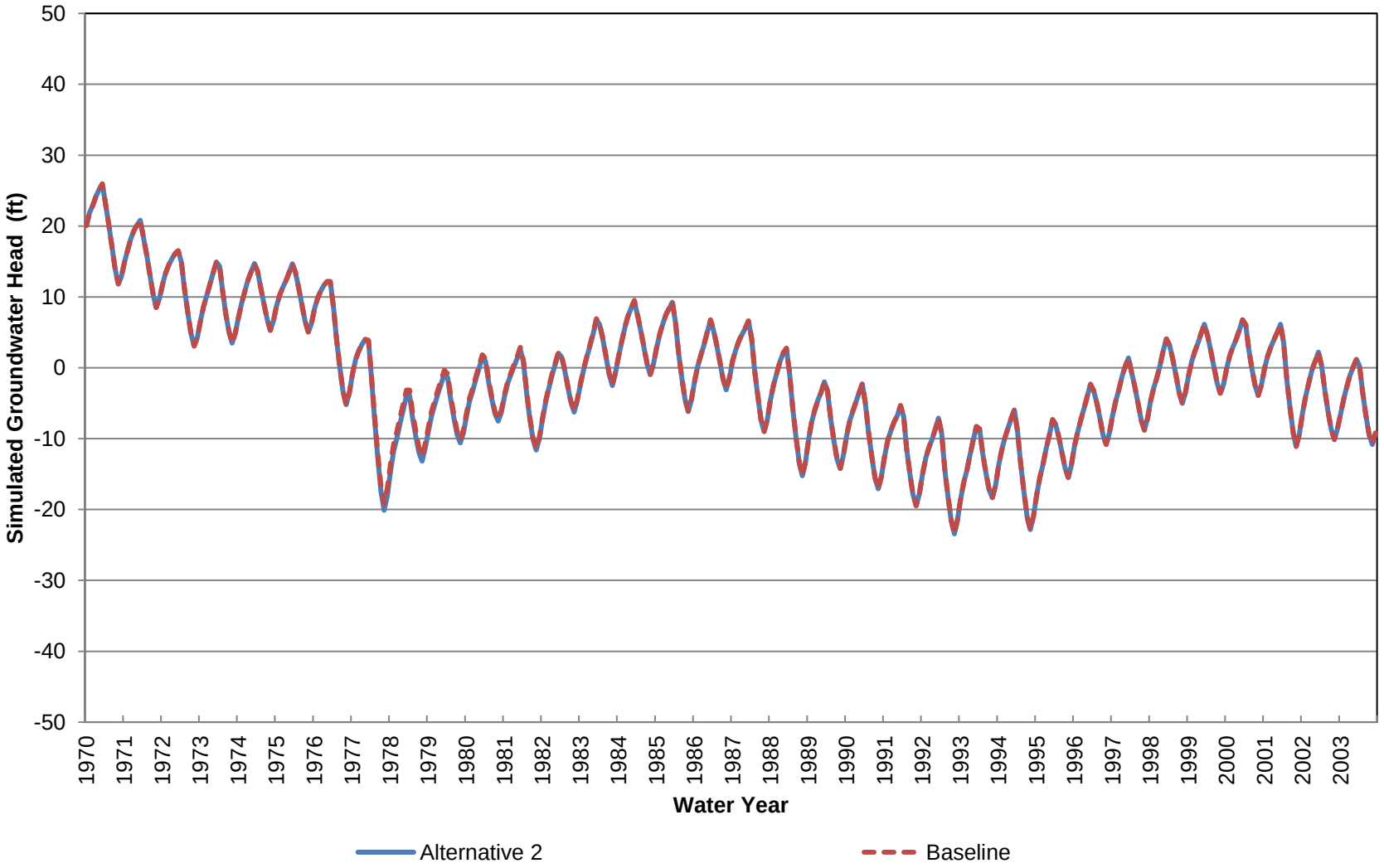
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 24 (Approximately 220-300 ft bgs)



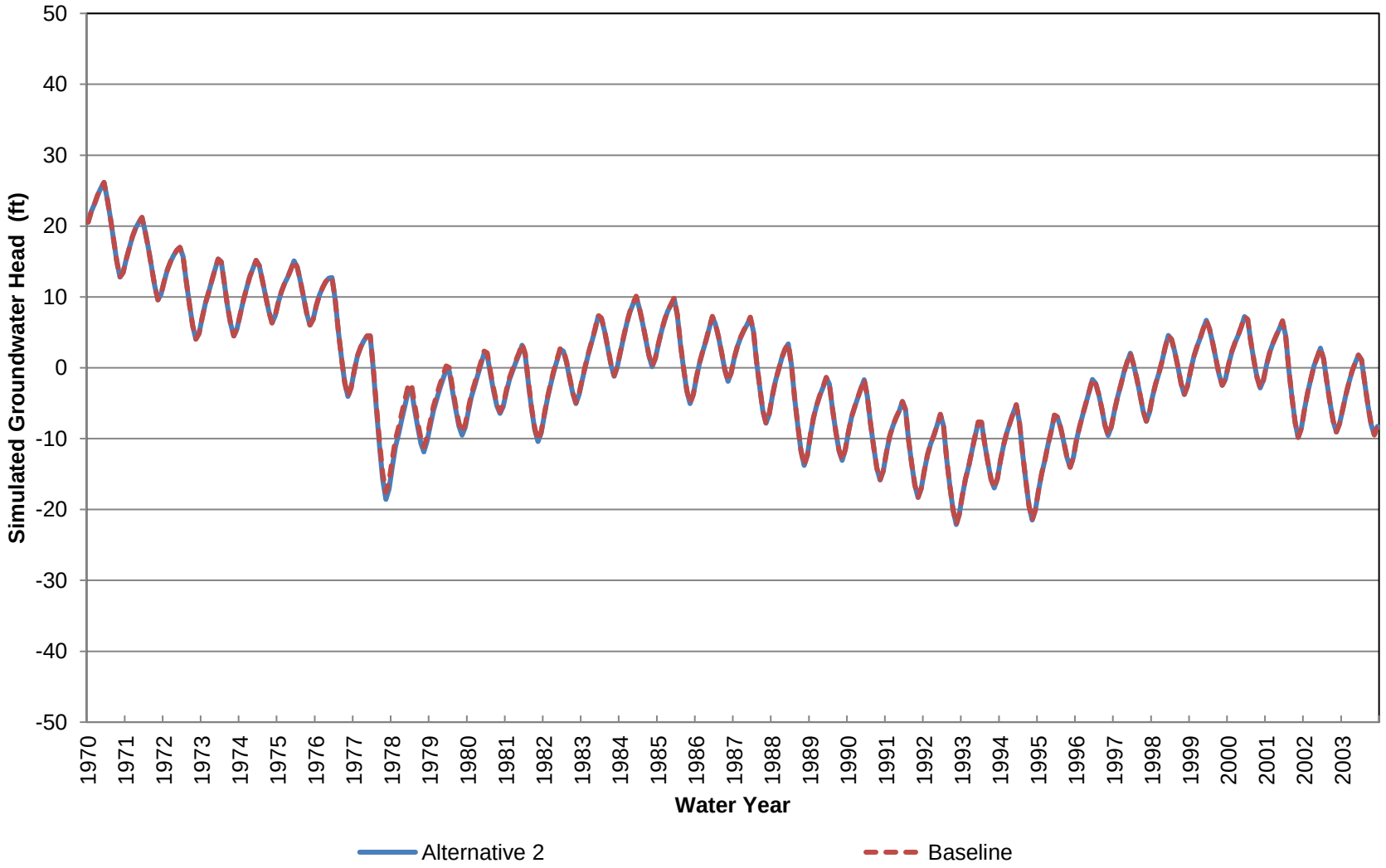
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 24 (Approximately 300-410 ft bgs)



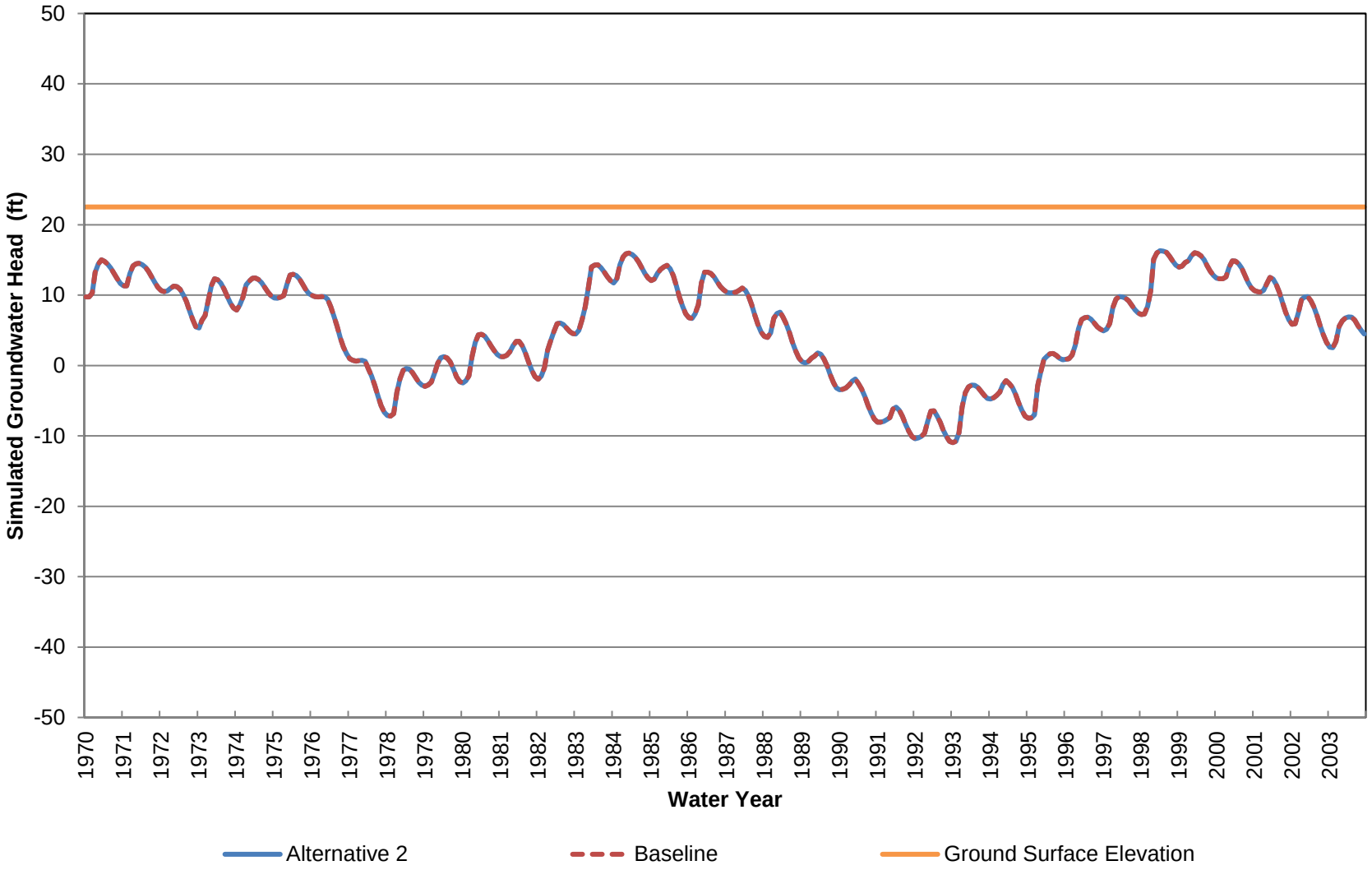
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 24 (Approximately 410-550 ft bgs)



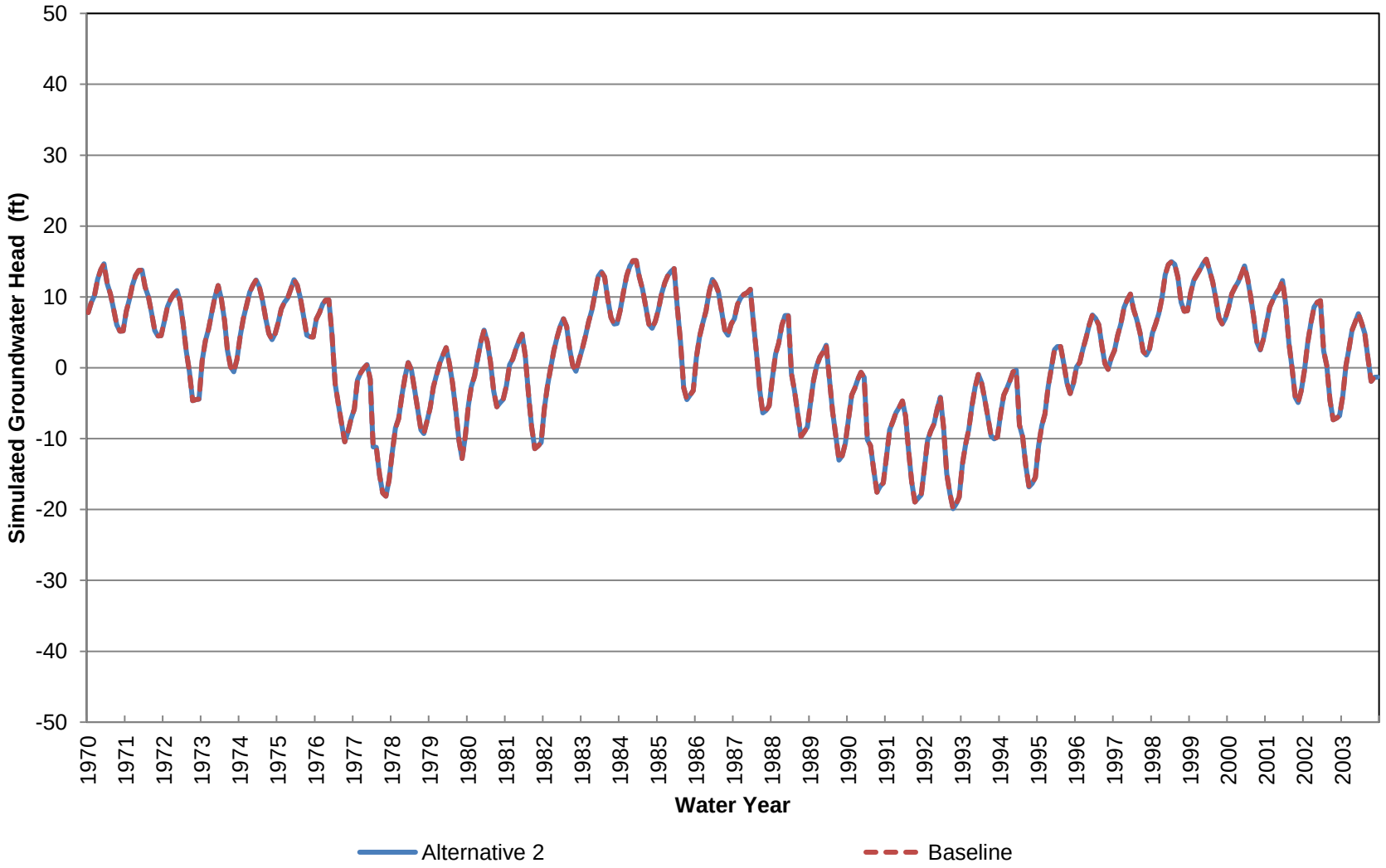
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 24 (Approximately 550-750 ft bgs)



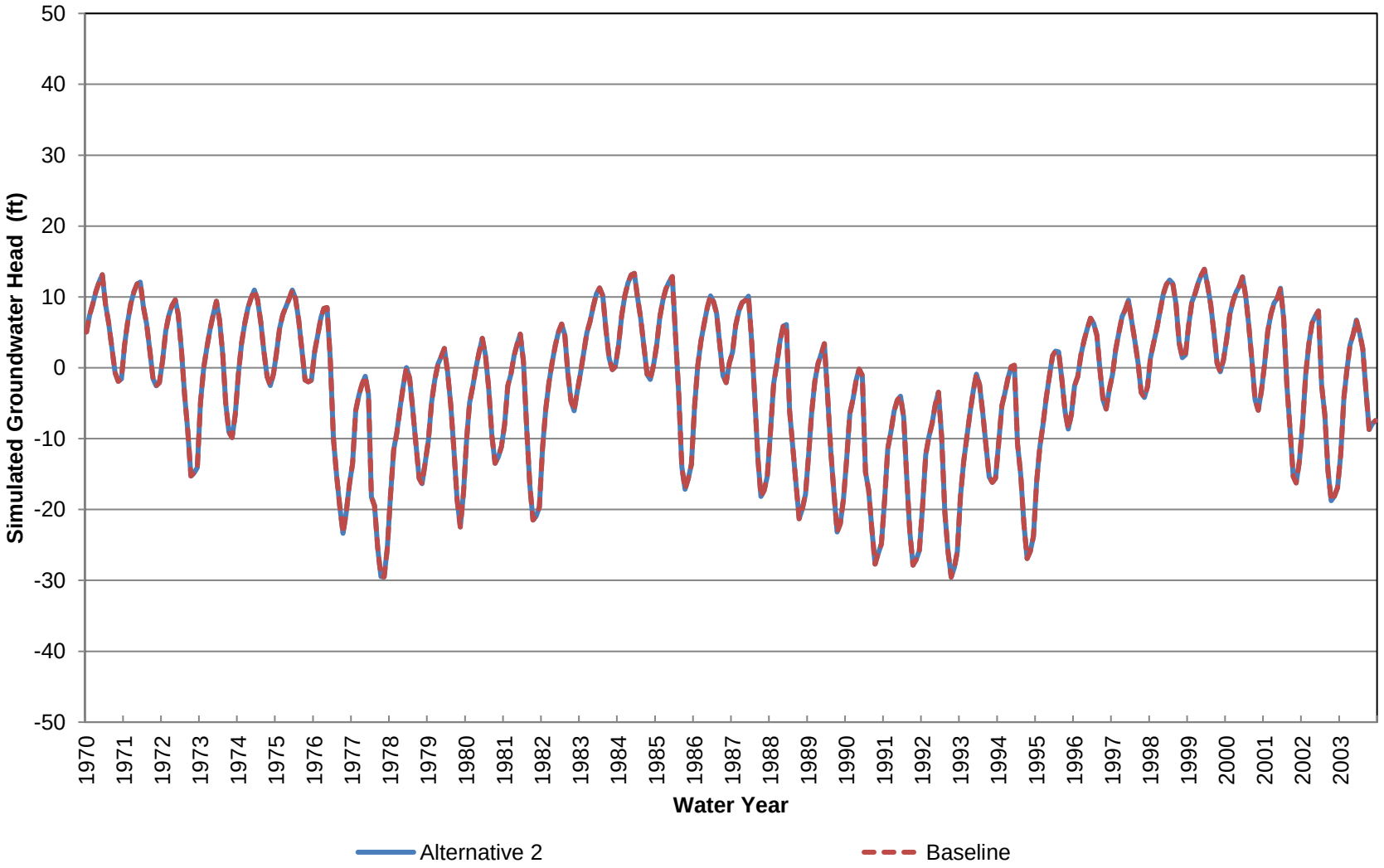
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 25 (Approximately 0-70 ft bgs)



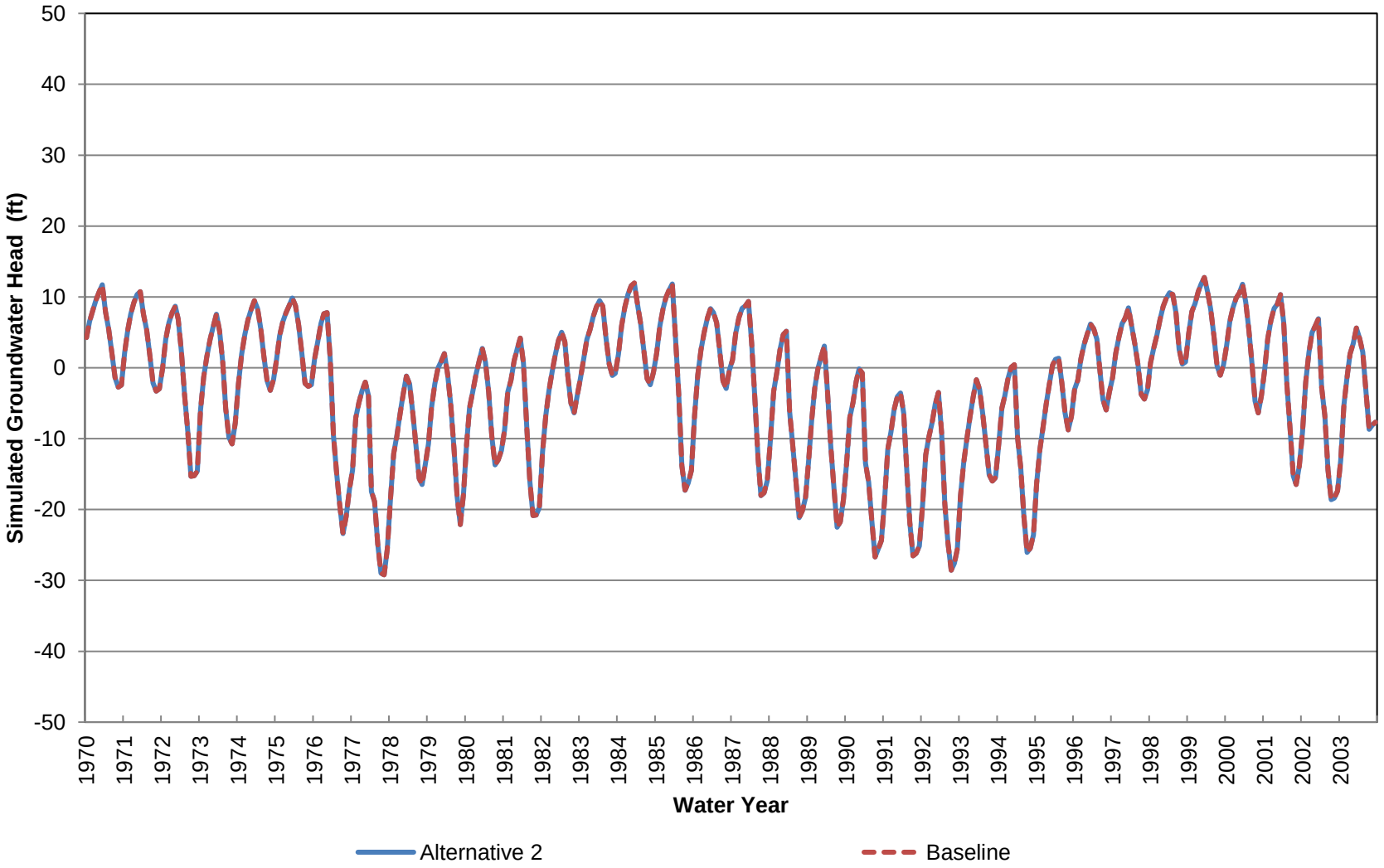
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 25 (Approximately 70-380 ft bgs)



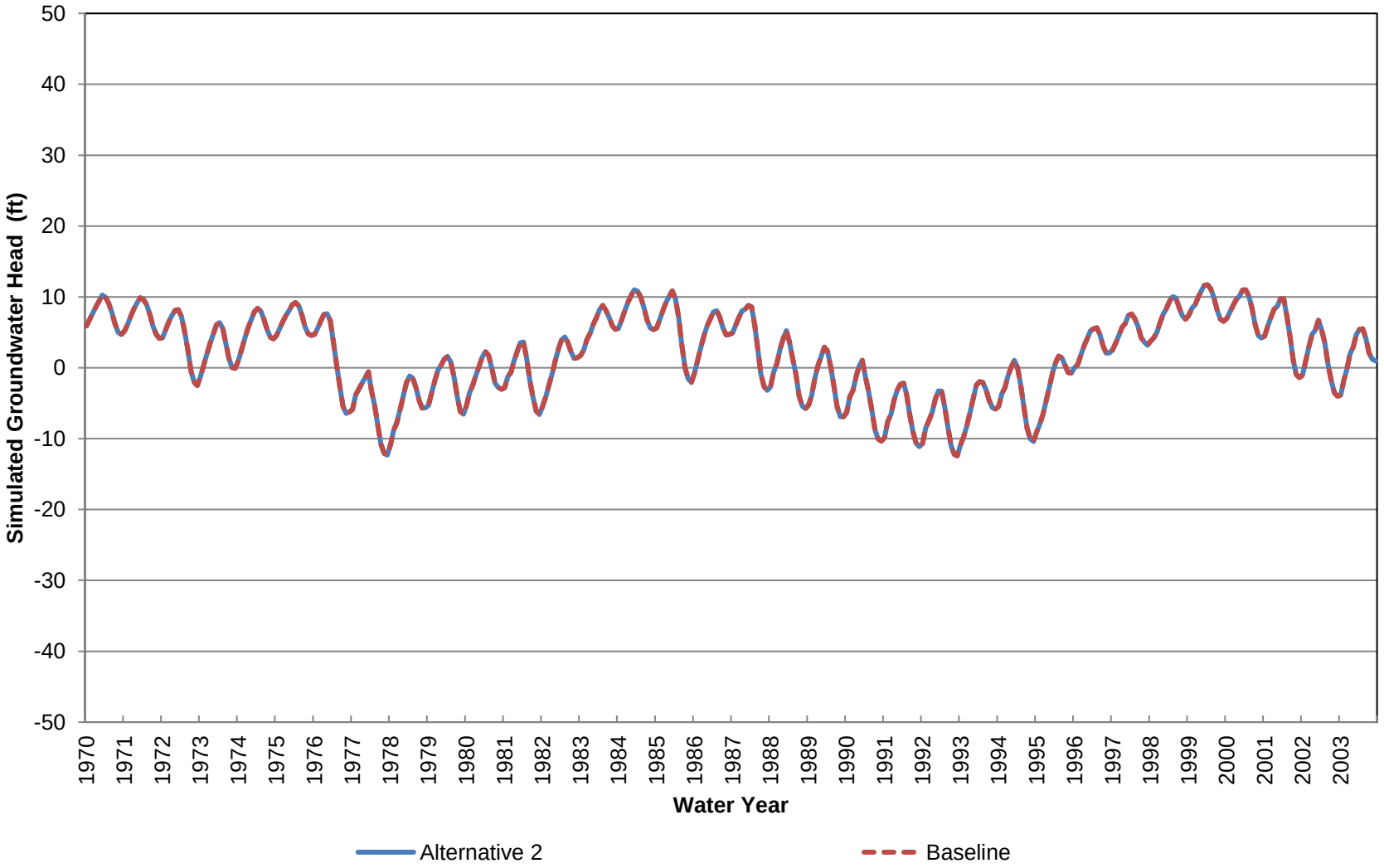
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 25 (Approximately 380-680 ft bgs)



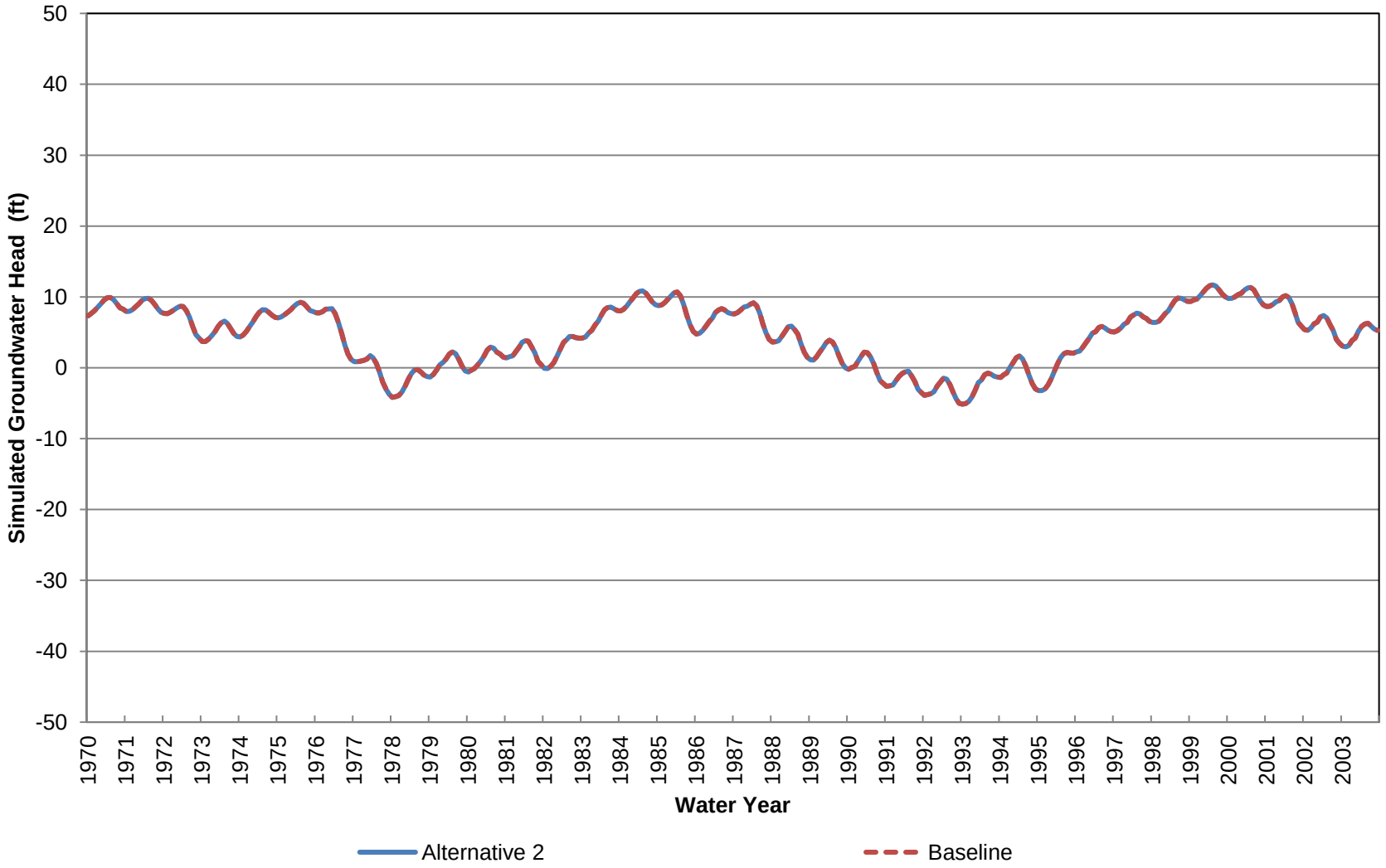
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 25 (Approximately 680-990 ft bgs)



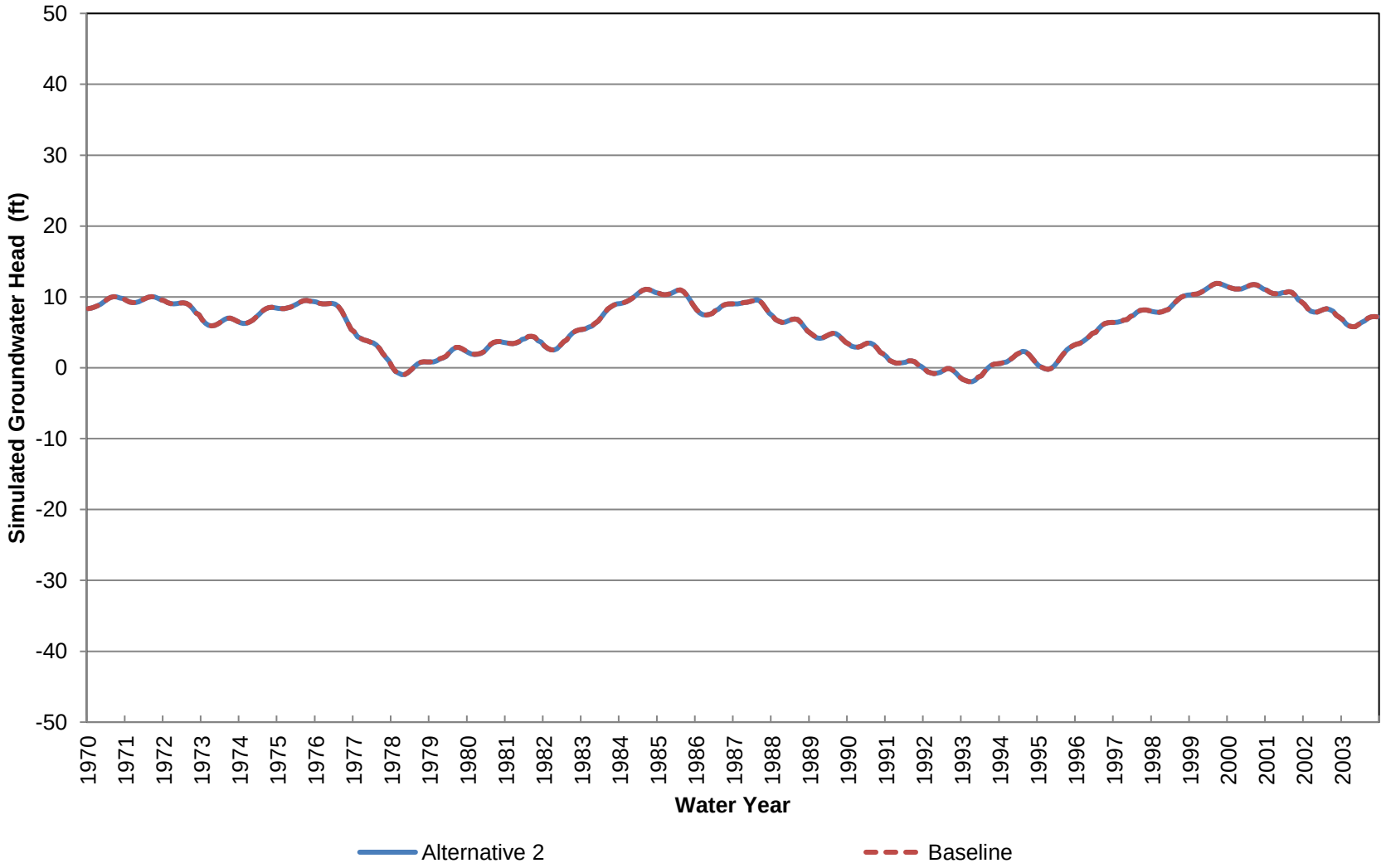
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 25 (Approximately 990-1530 ft bgs)



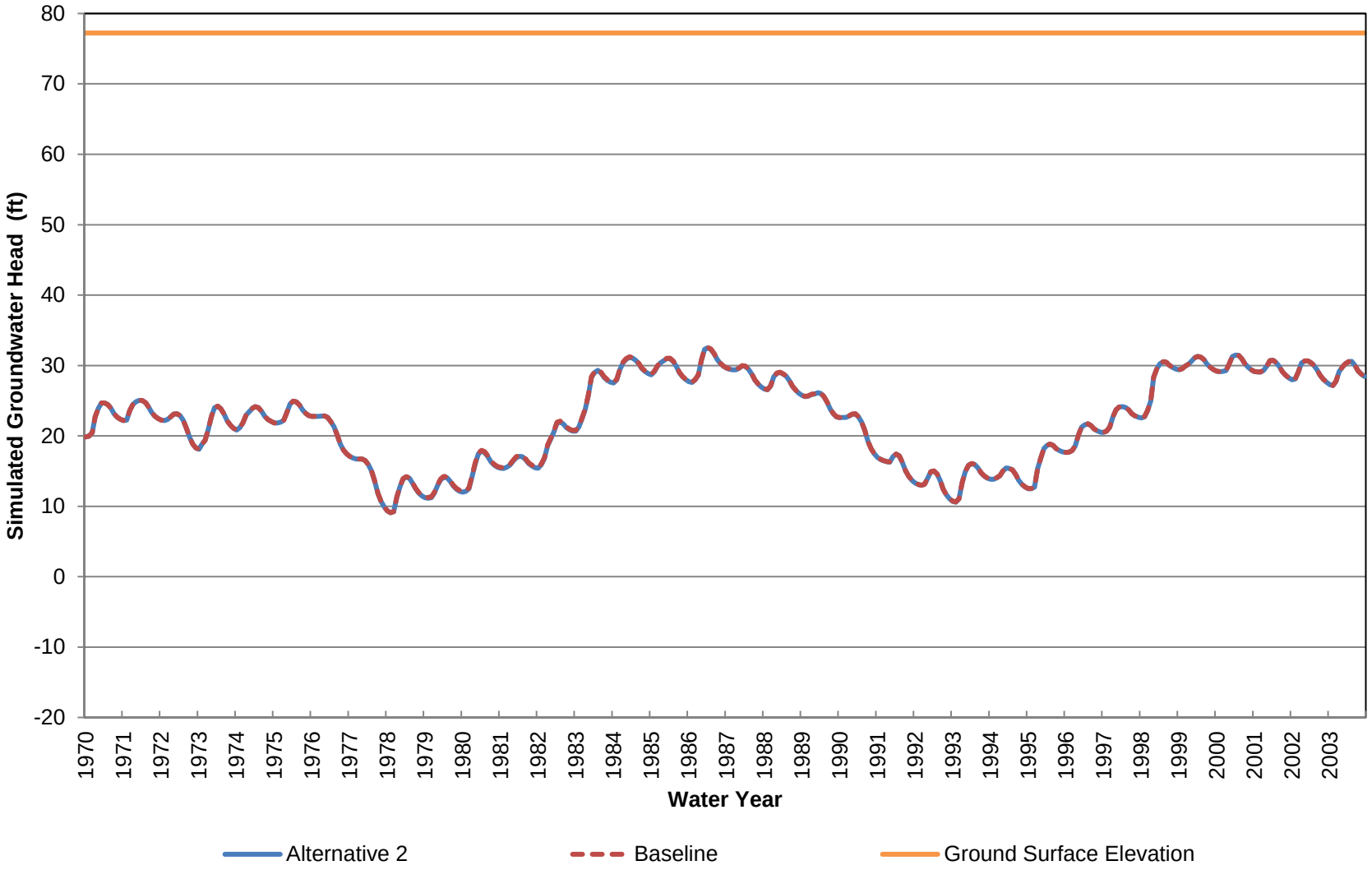
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 25 (Approximately 1530-2040 ft bgs)



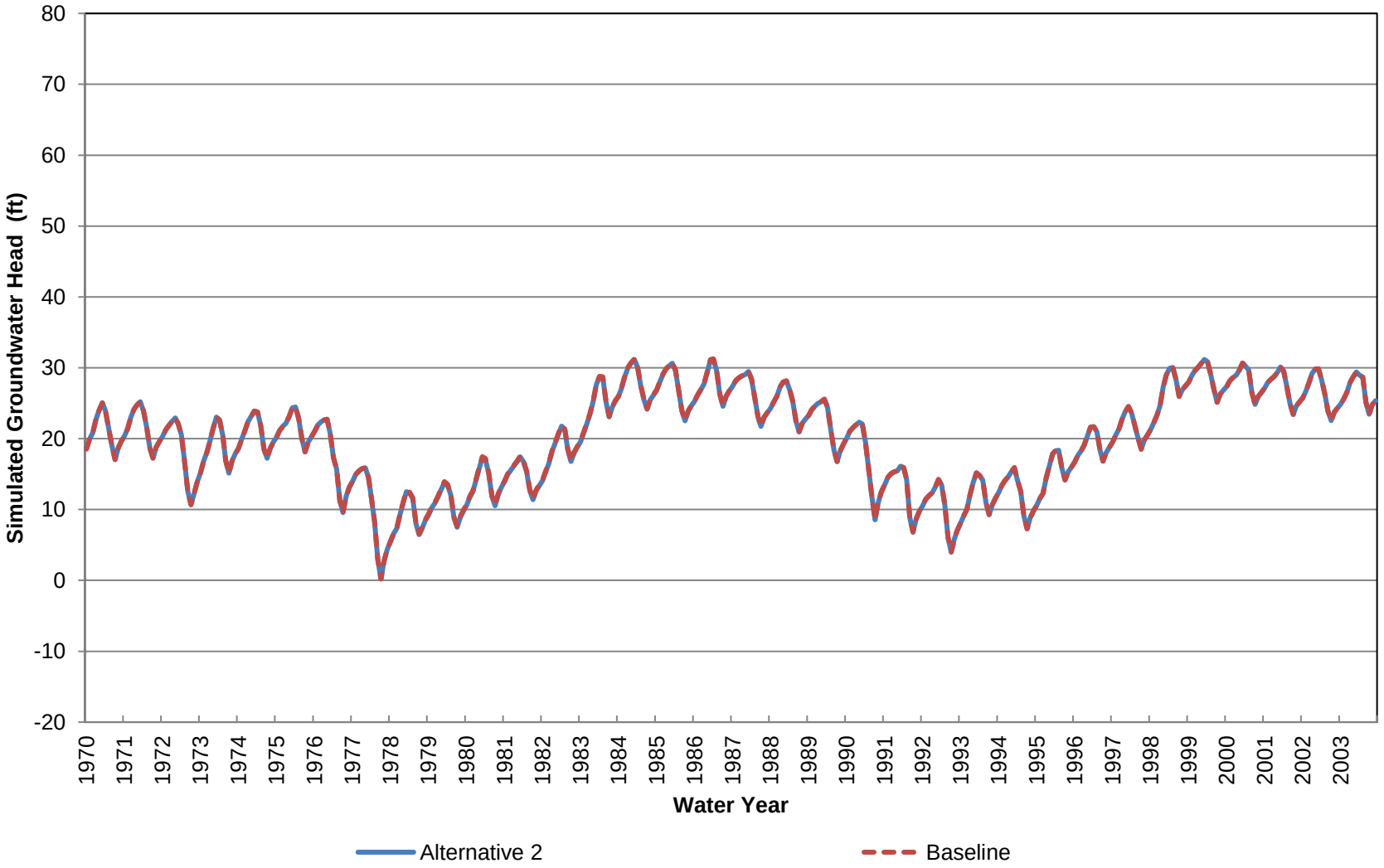
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 25 (Approximately 2040-2800 ft bgs)



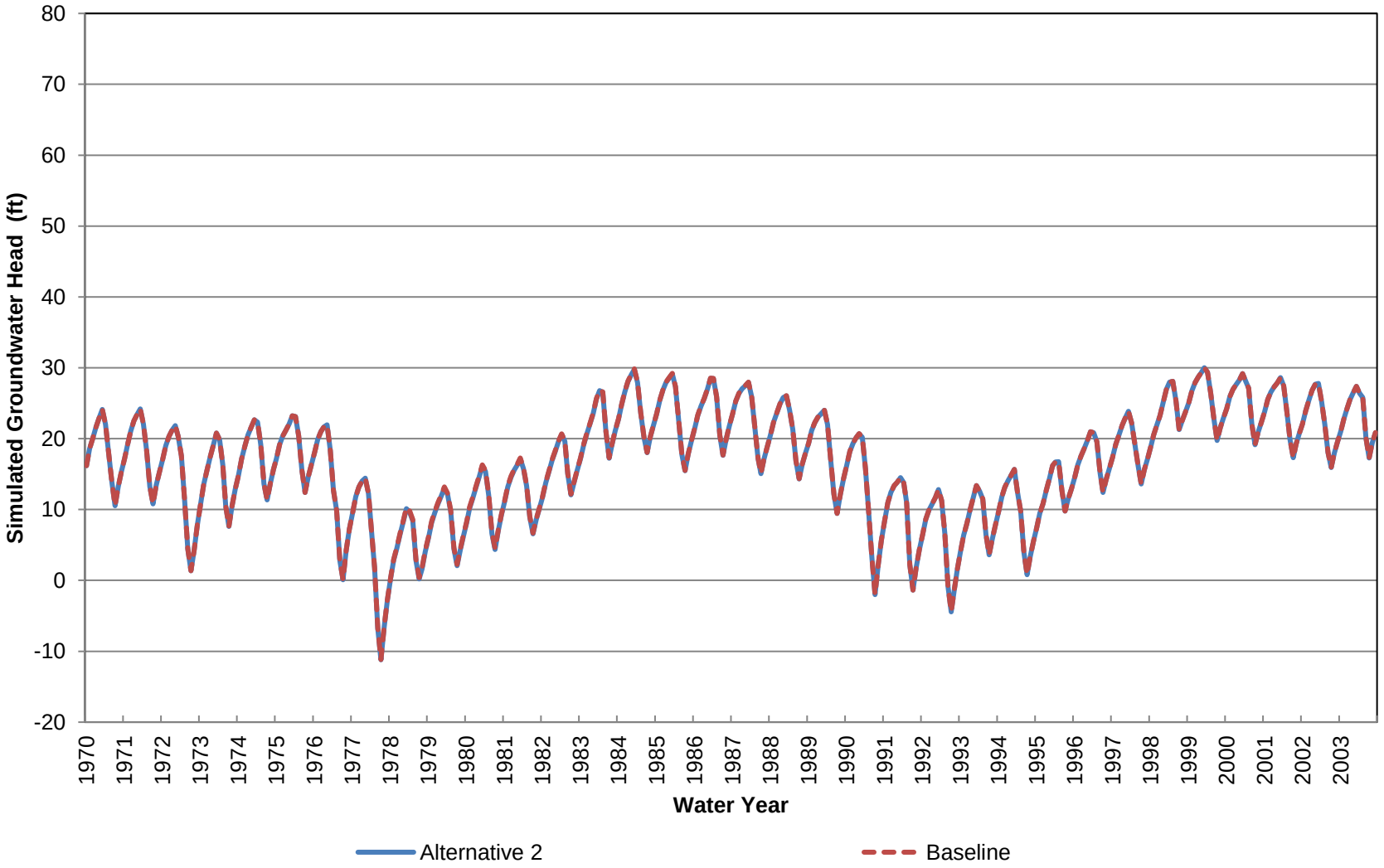
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 26 (Approximately 0-70 ft bgs)



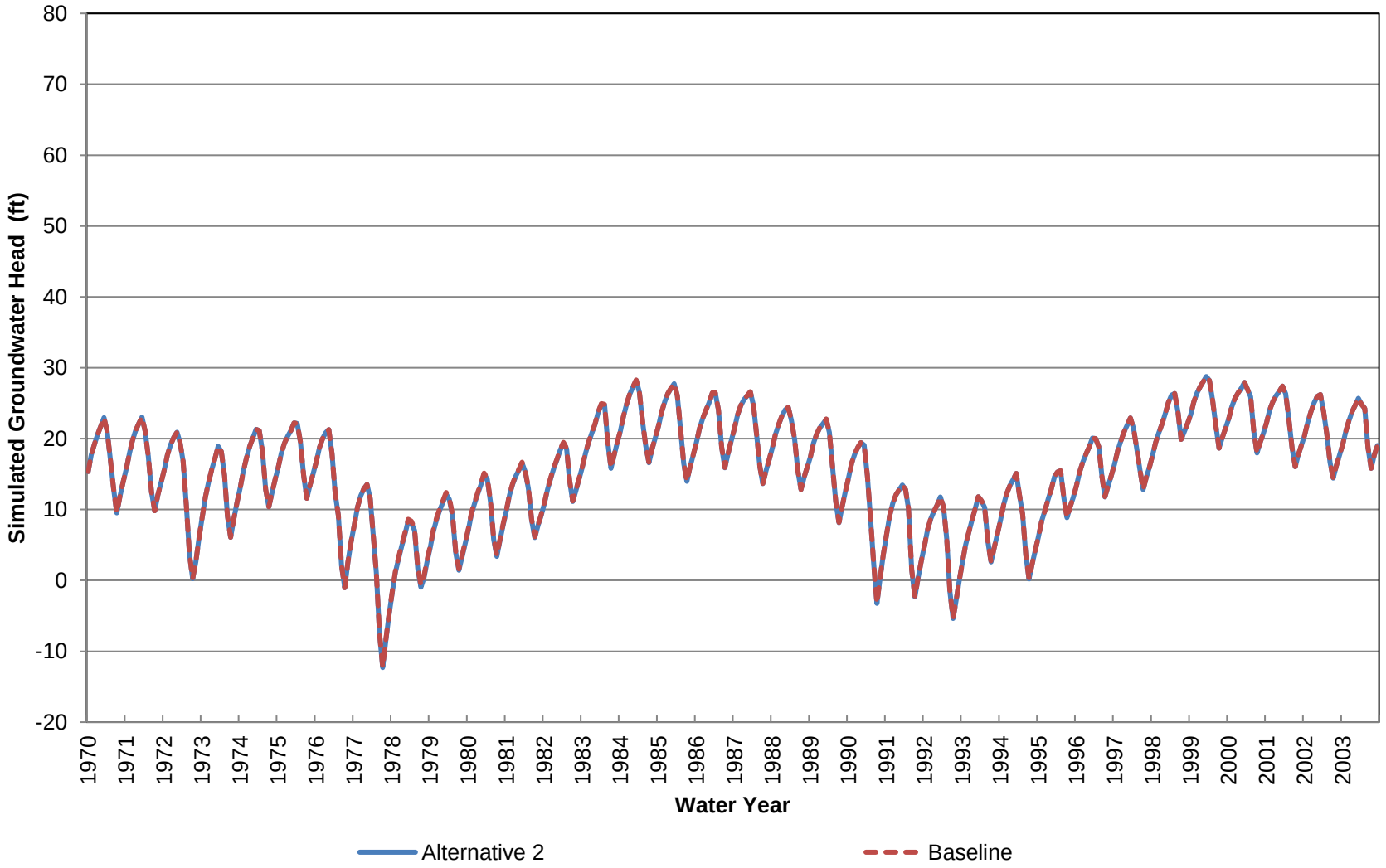
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 26 (Approximately 70-380 ft bgs)



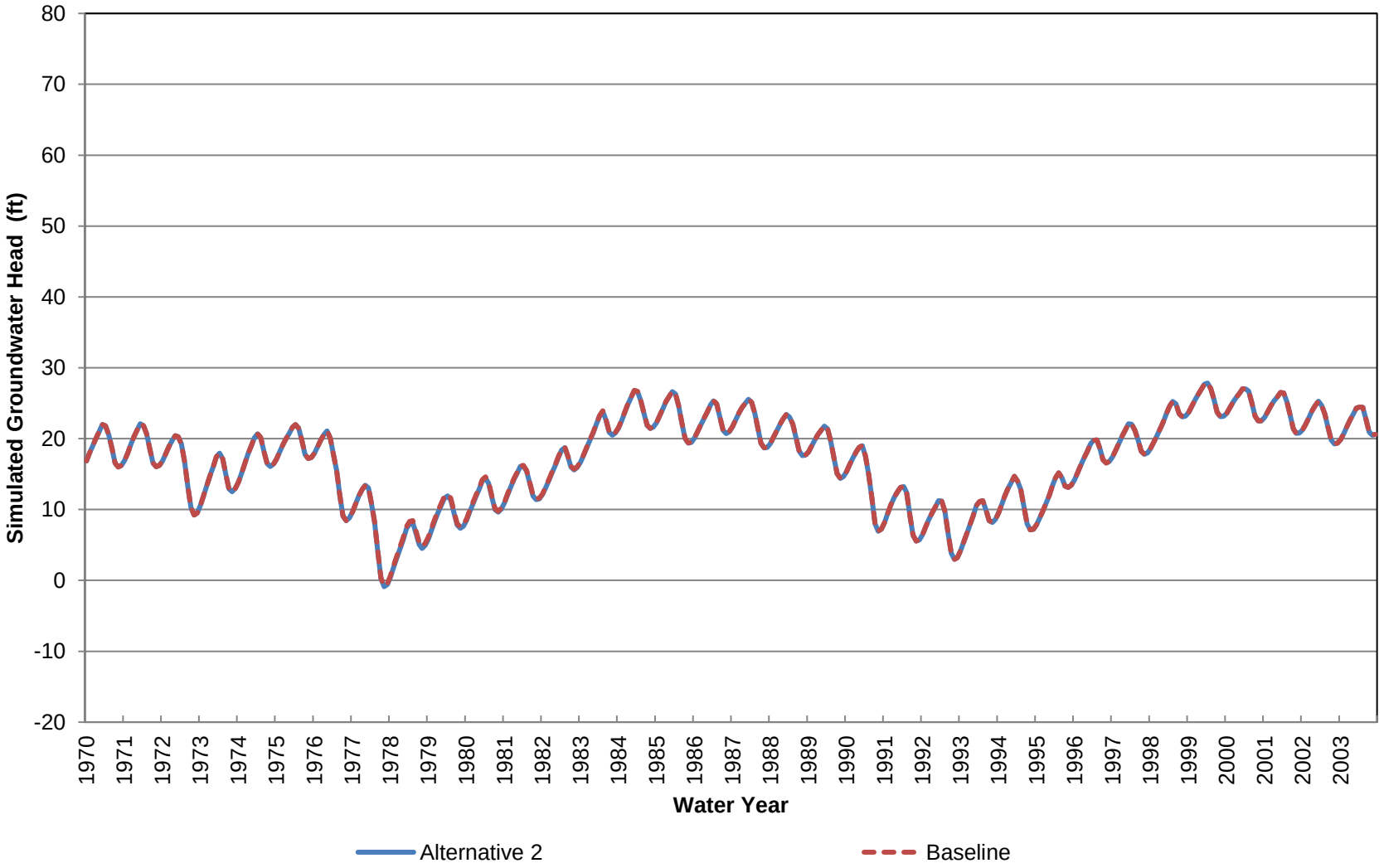
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 26 (Approximately 380-690 ft bgs)



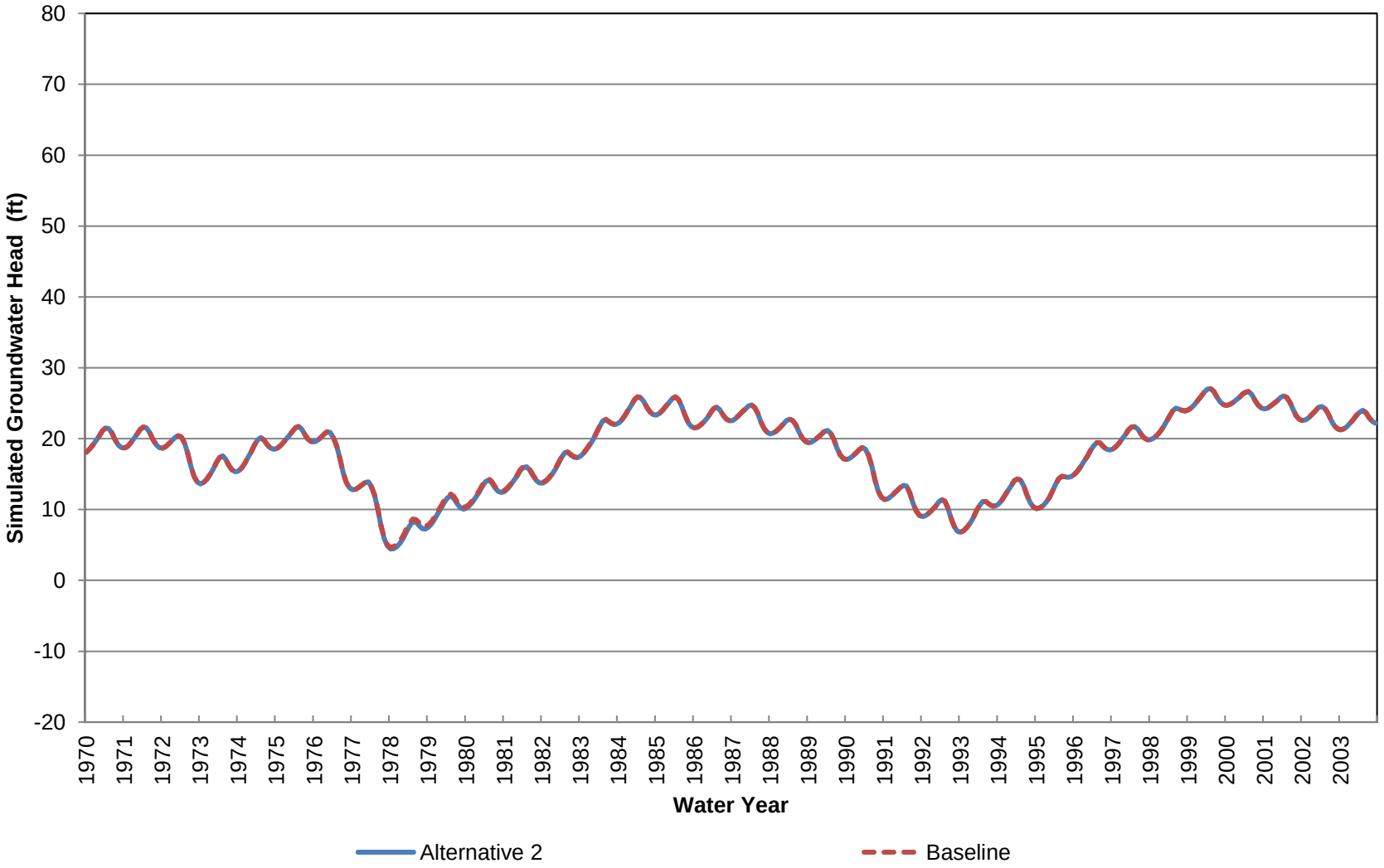
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 26 (Approximately 690-1000 ft bgs)



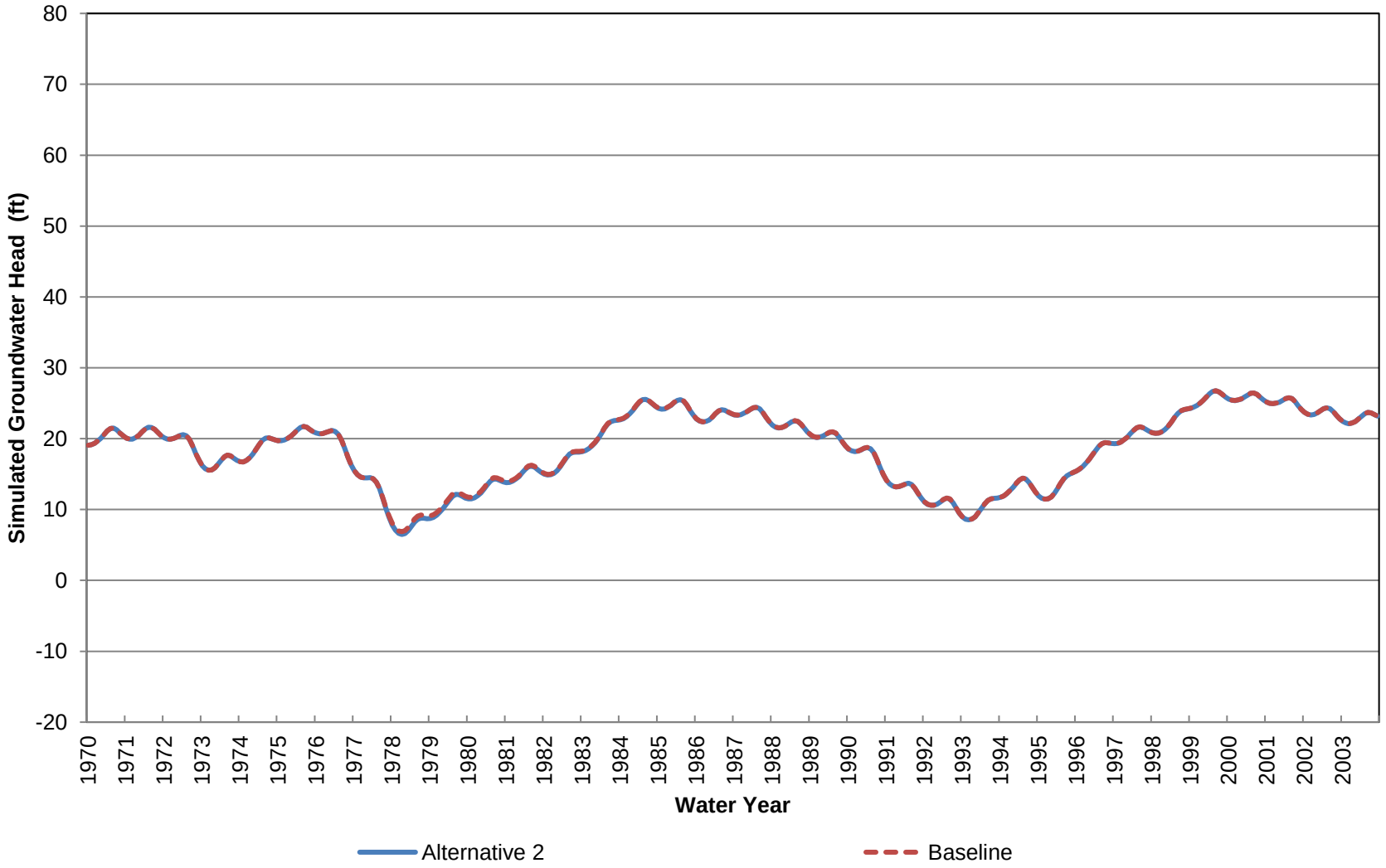
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 26 (Approximately 1000-1550 ft bgs)



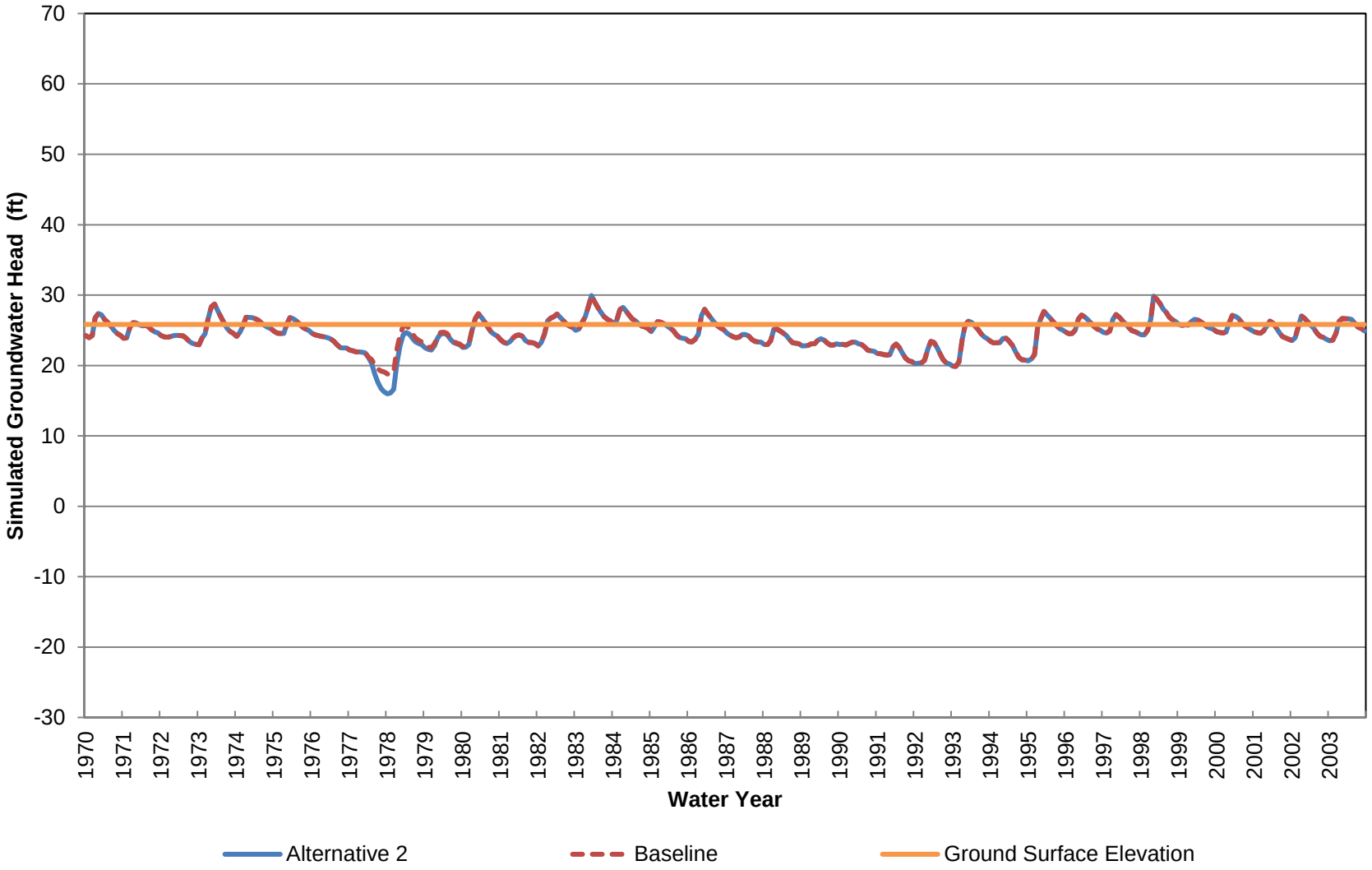
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 26 (Approximately 1550-2070 ft bgs)



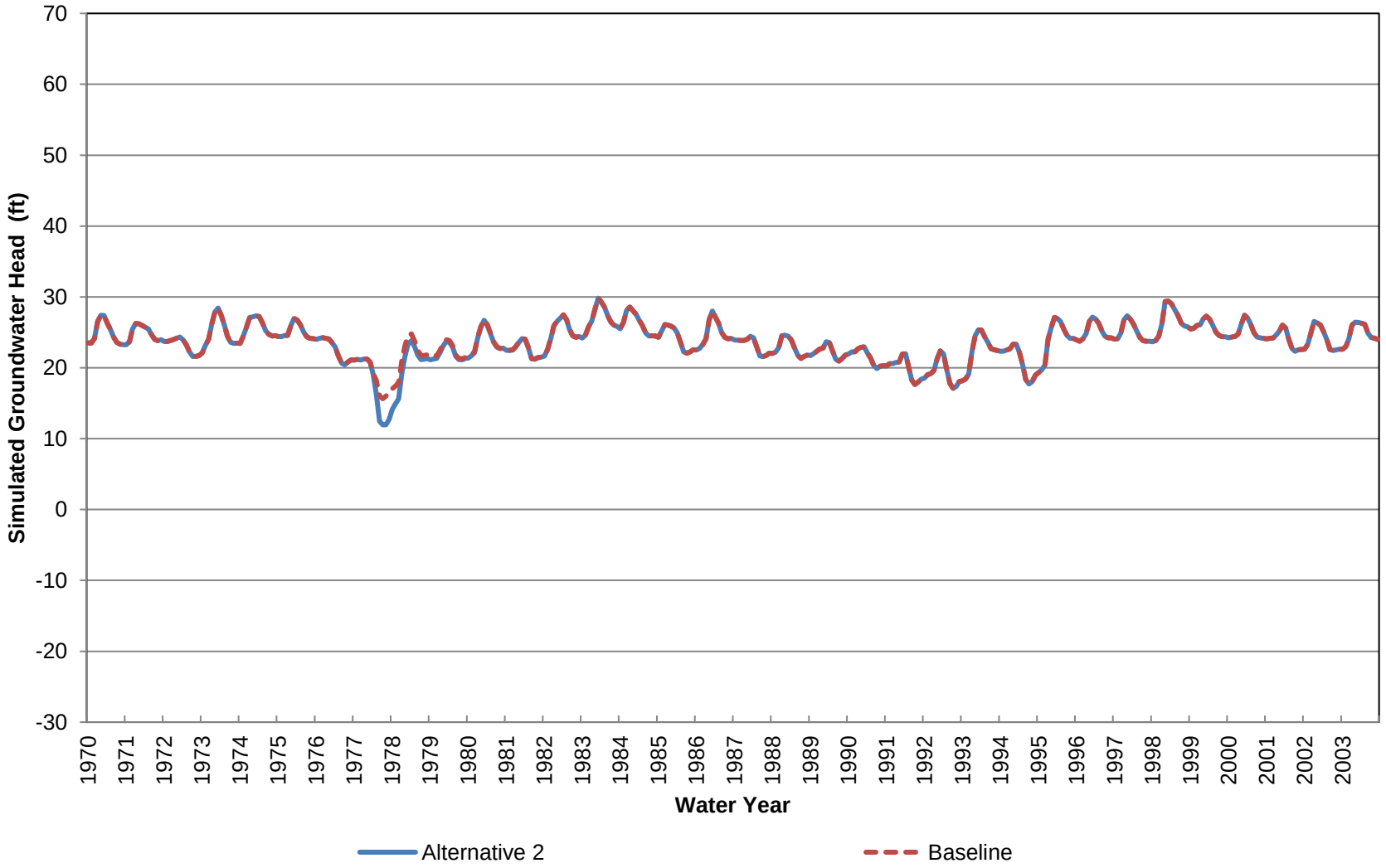
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 26 (Approximately 2070-2840 ft bgs)



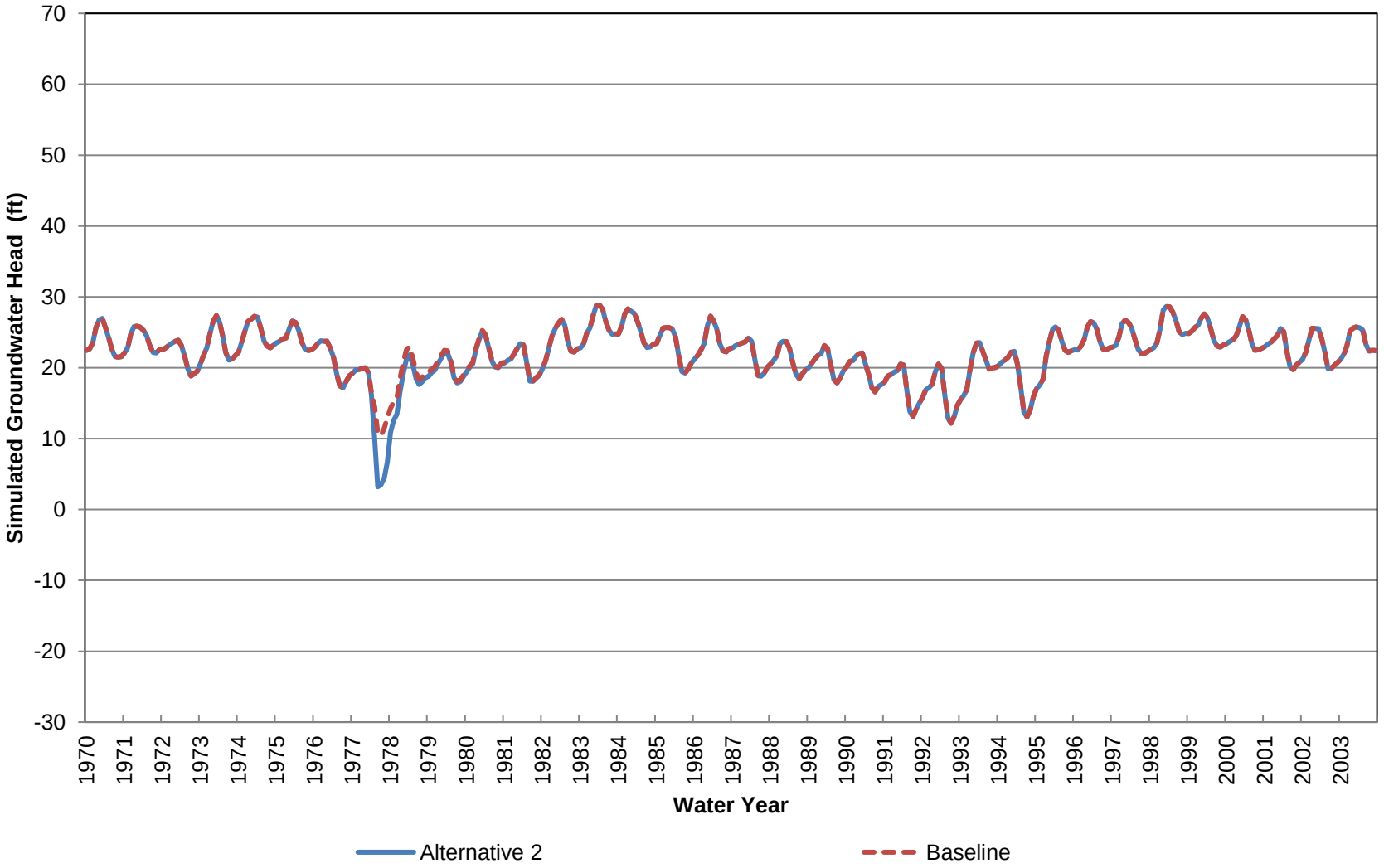
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 27 (Approximately 0-70 ft bgs)



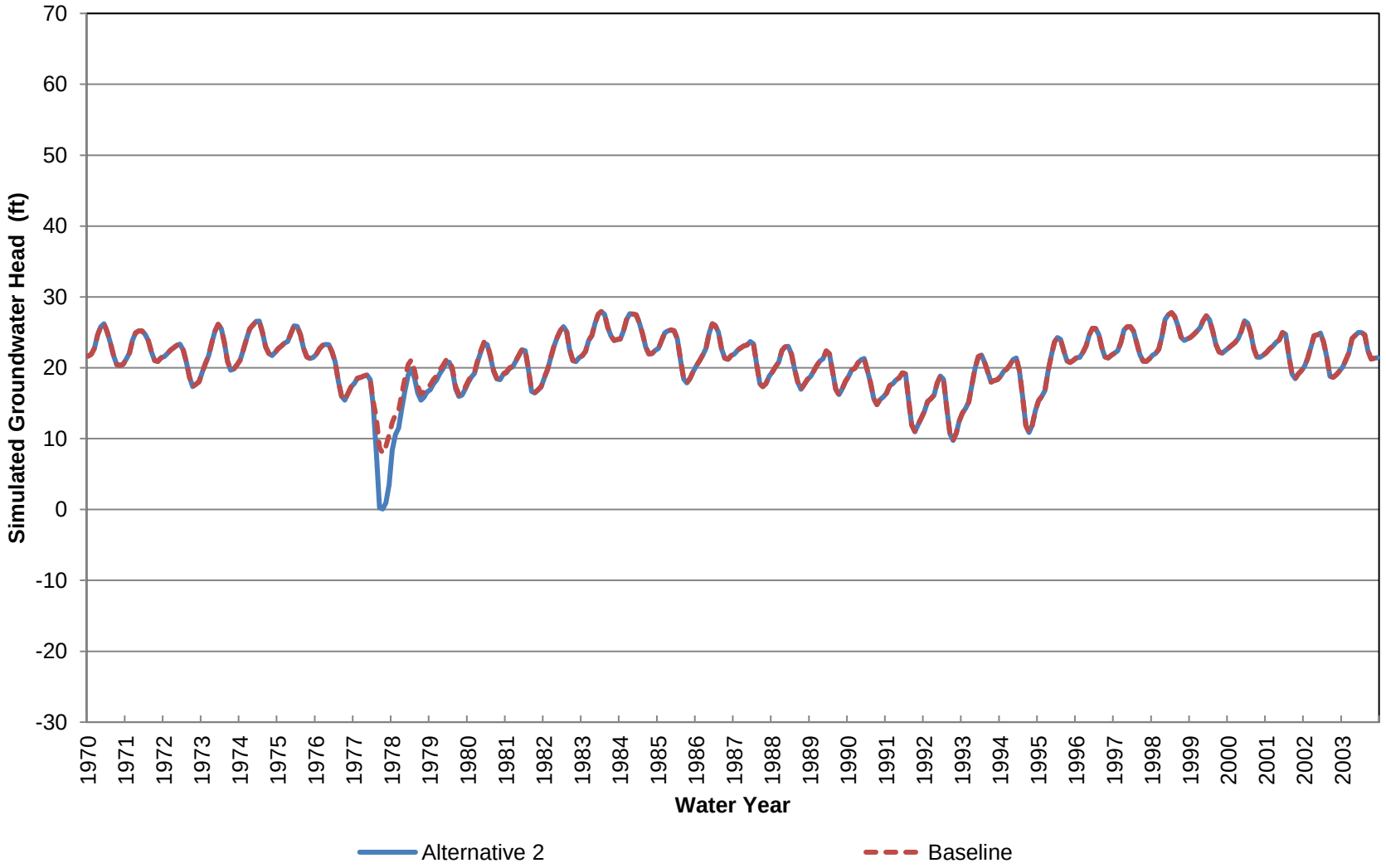
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 27 (Approximately 70-220 ft bgs)



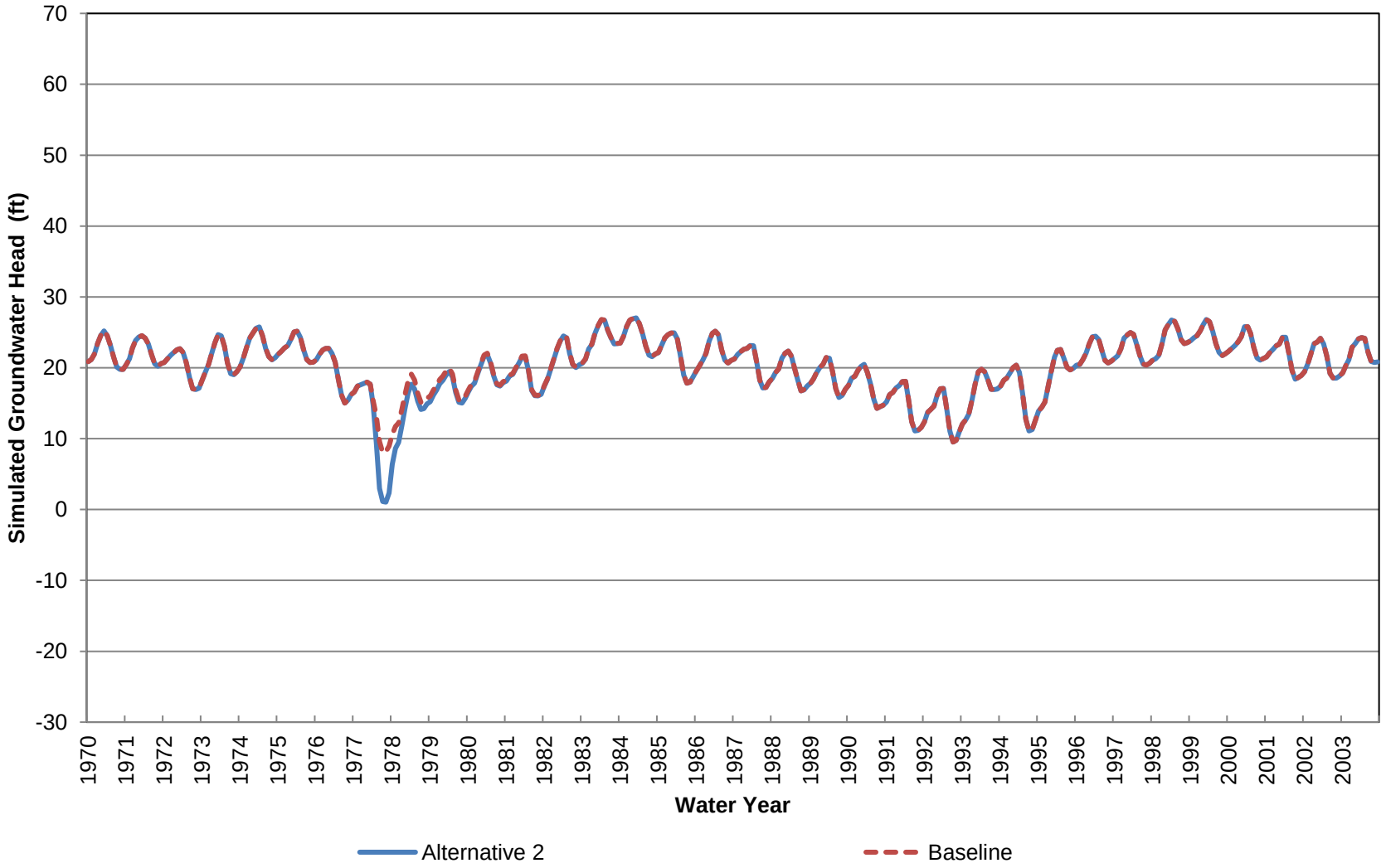
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 27 (Approximately 220-380 ft bgs)



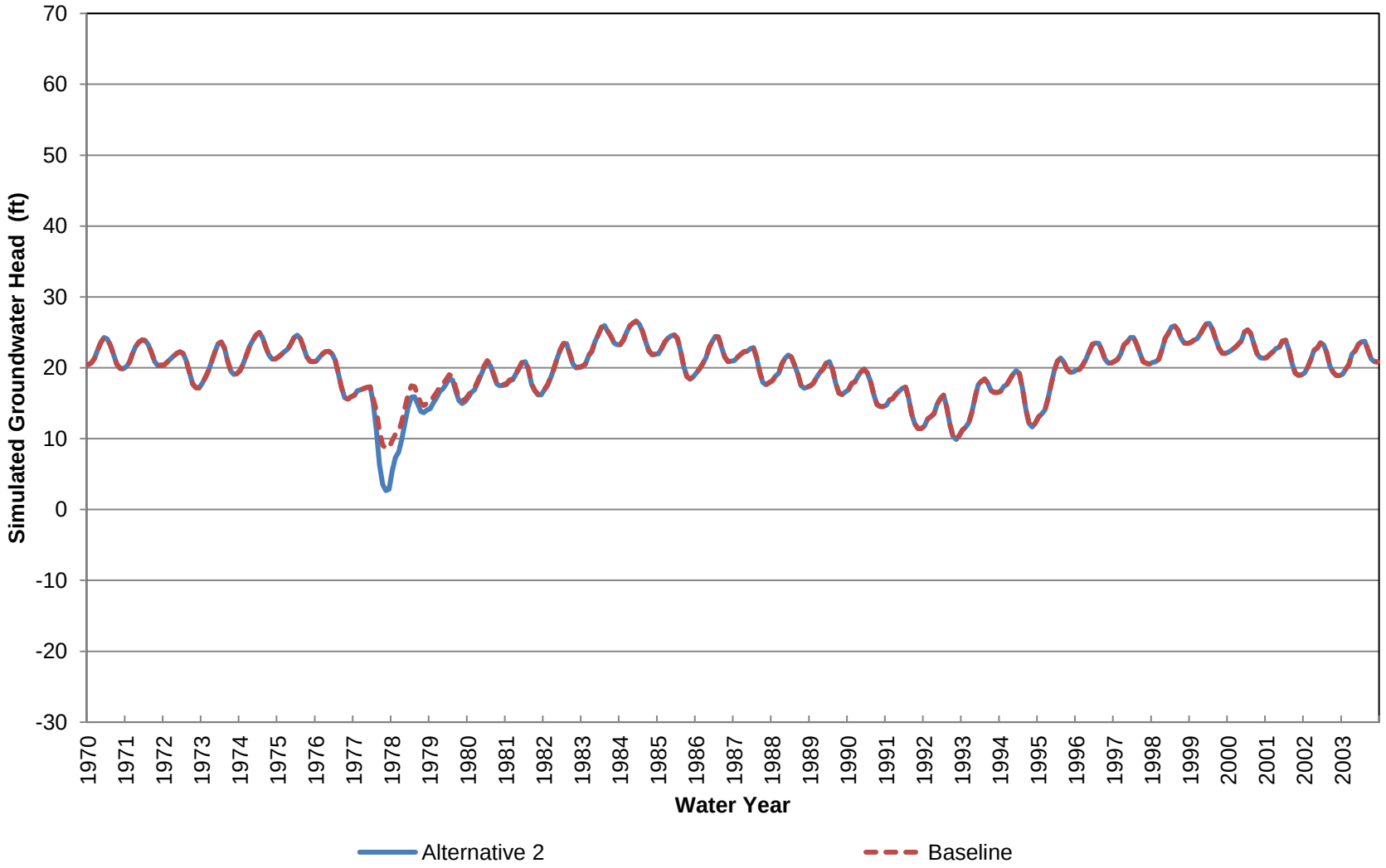
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 27 (Approximately 380-530 ft bgs)



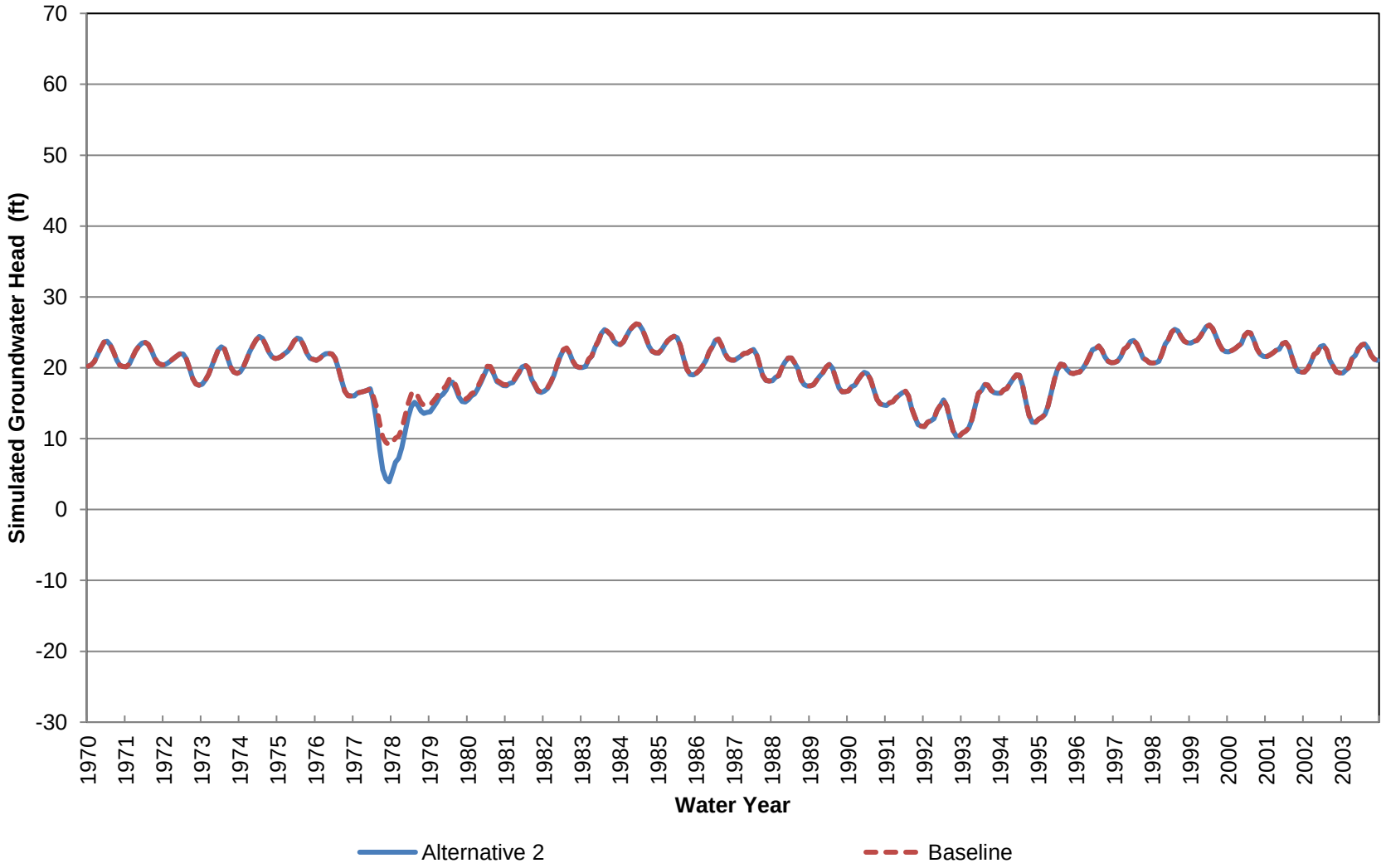
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 27 (Approximately 530-770 ft bgs)



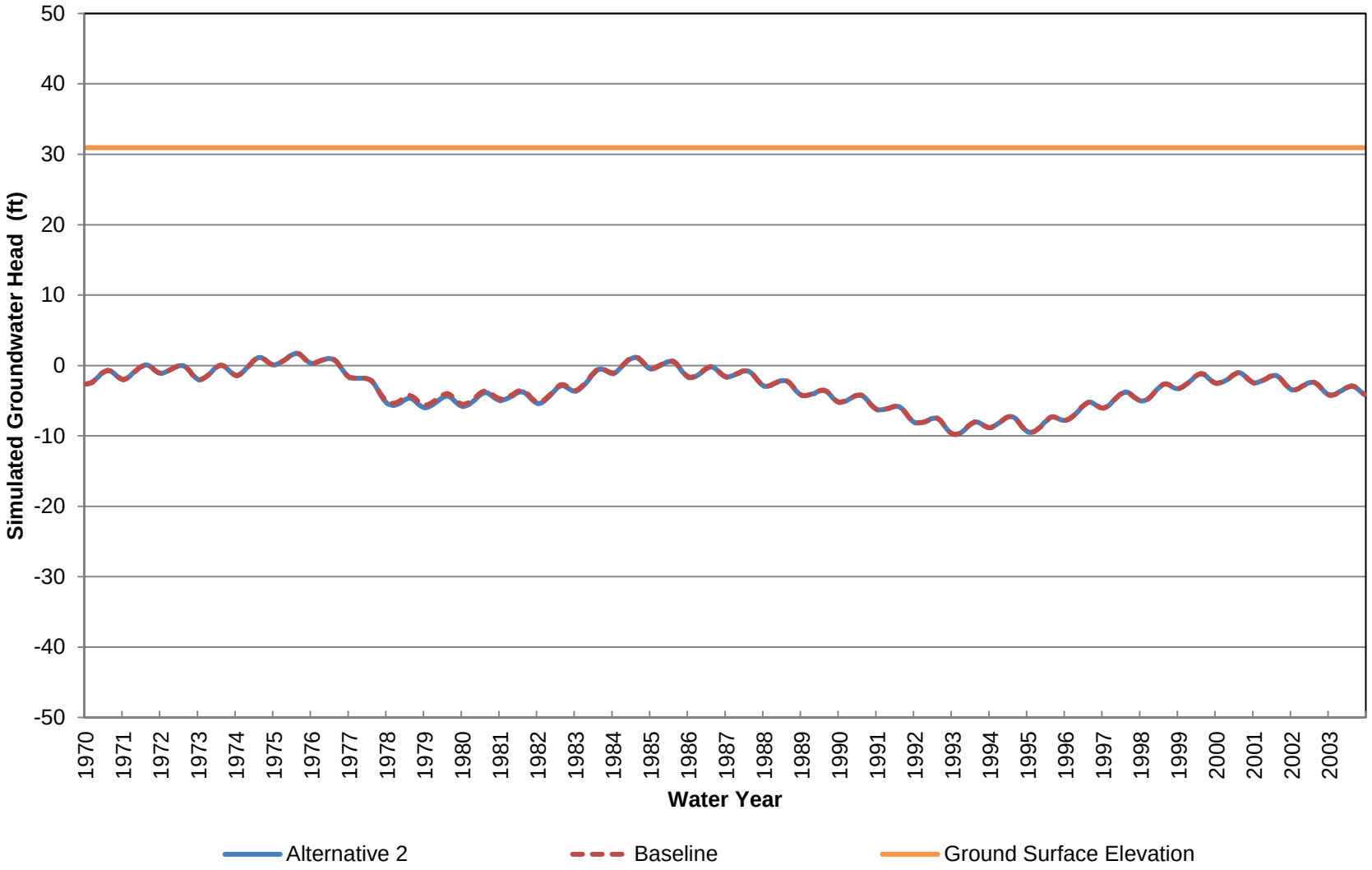
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 27 (Approximately 770-1030 ft bgs)



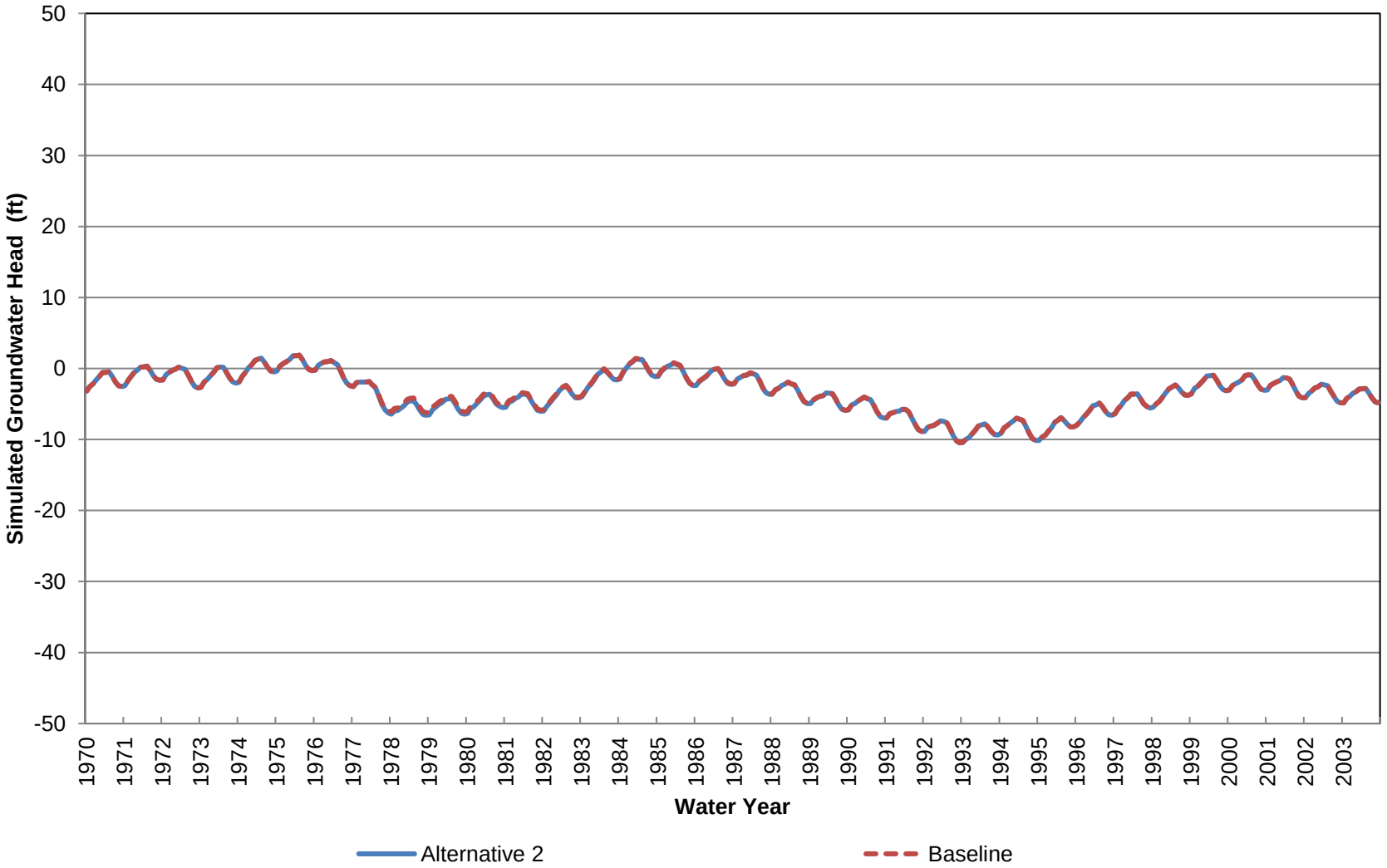
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 27 (Approximately 1030-1410 ft bgs)



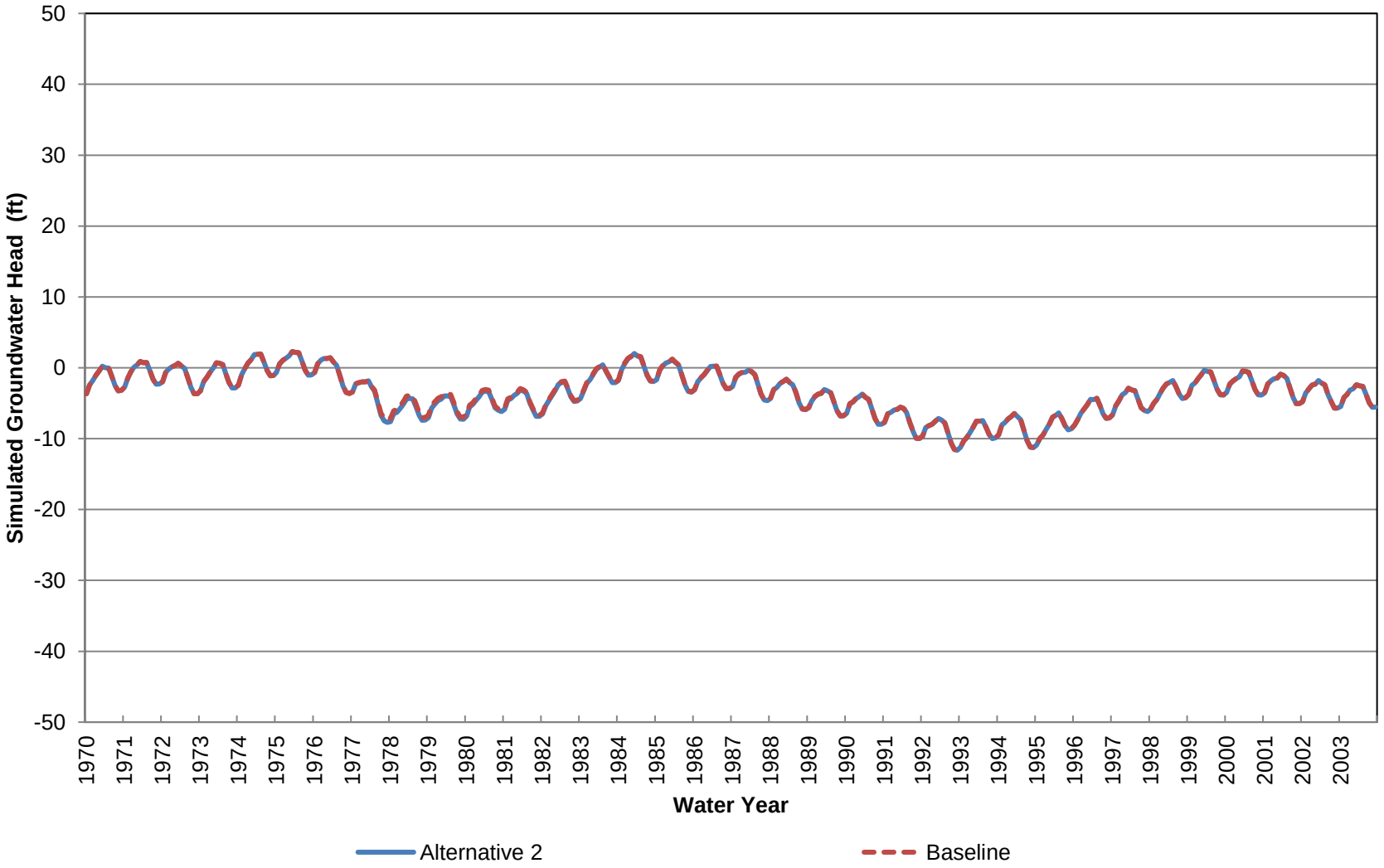
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 28 (Approximately 0-70 ft bgs)



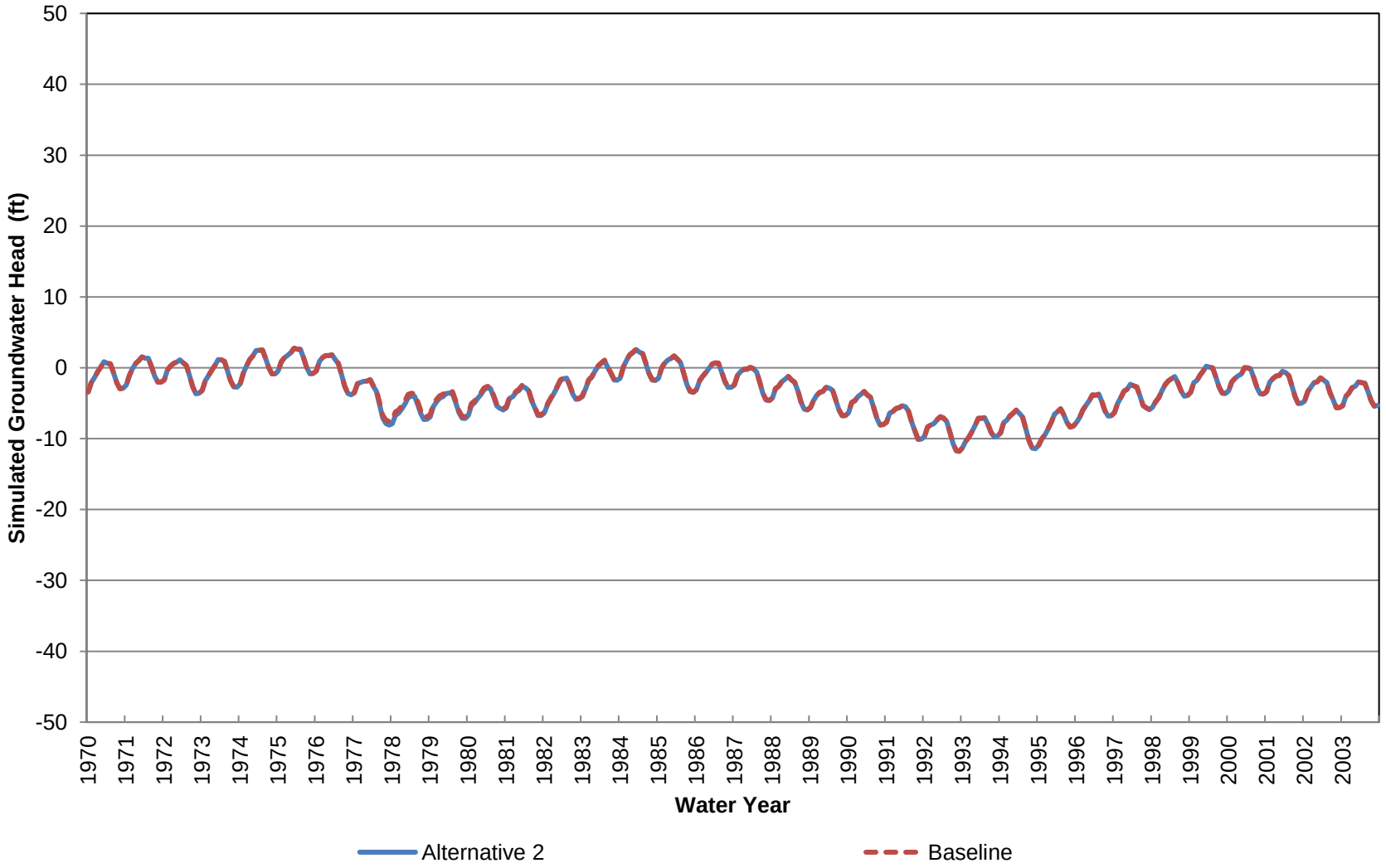
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 28 (Approximately 70-250 ft bgs)



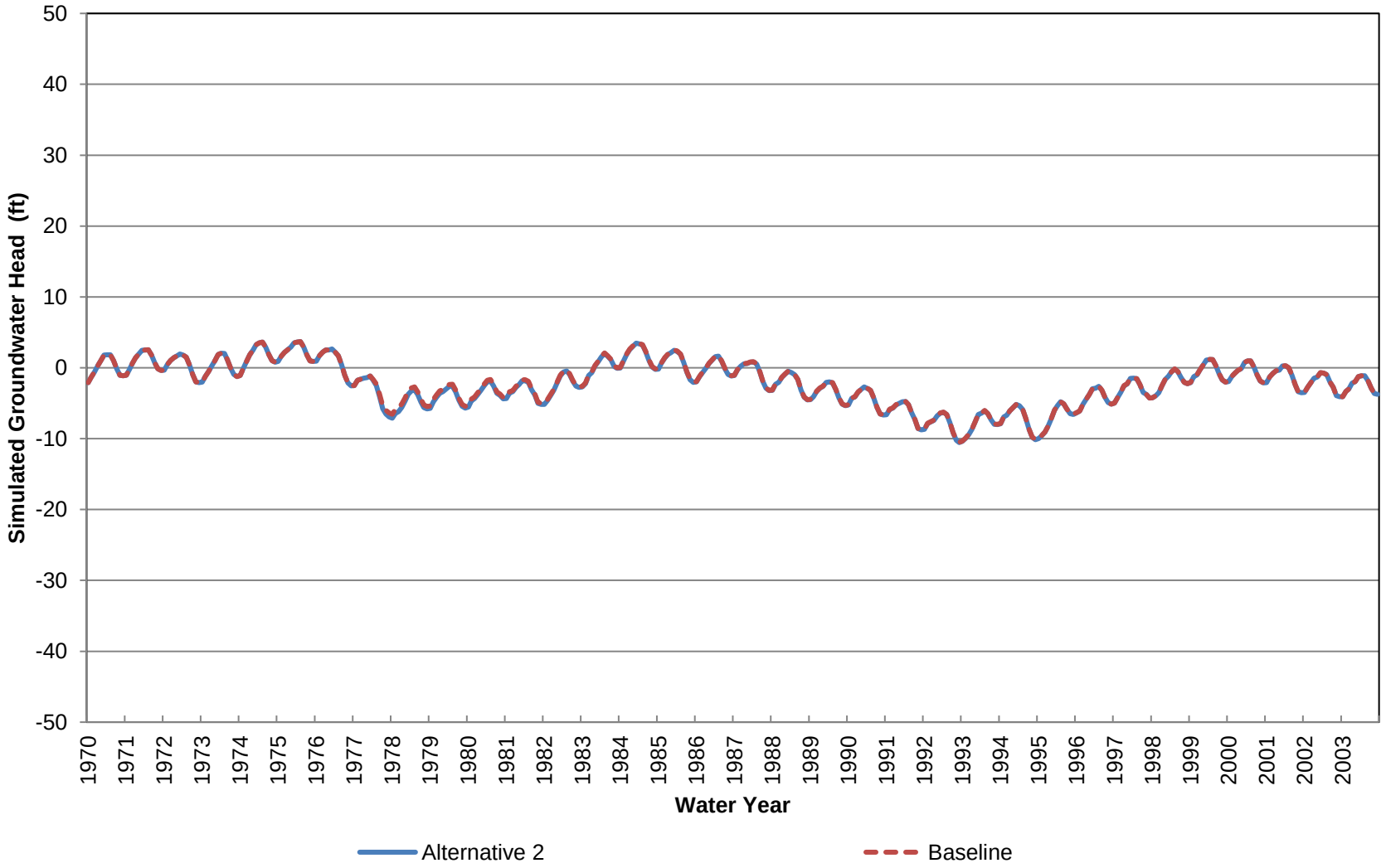
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 28 (Approximately 250-440 ft bgs)



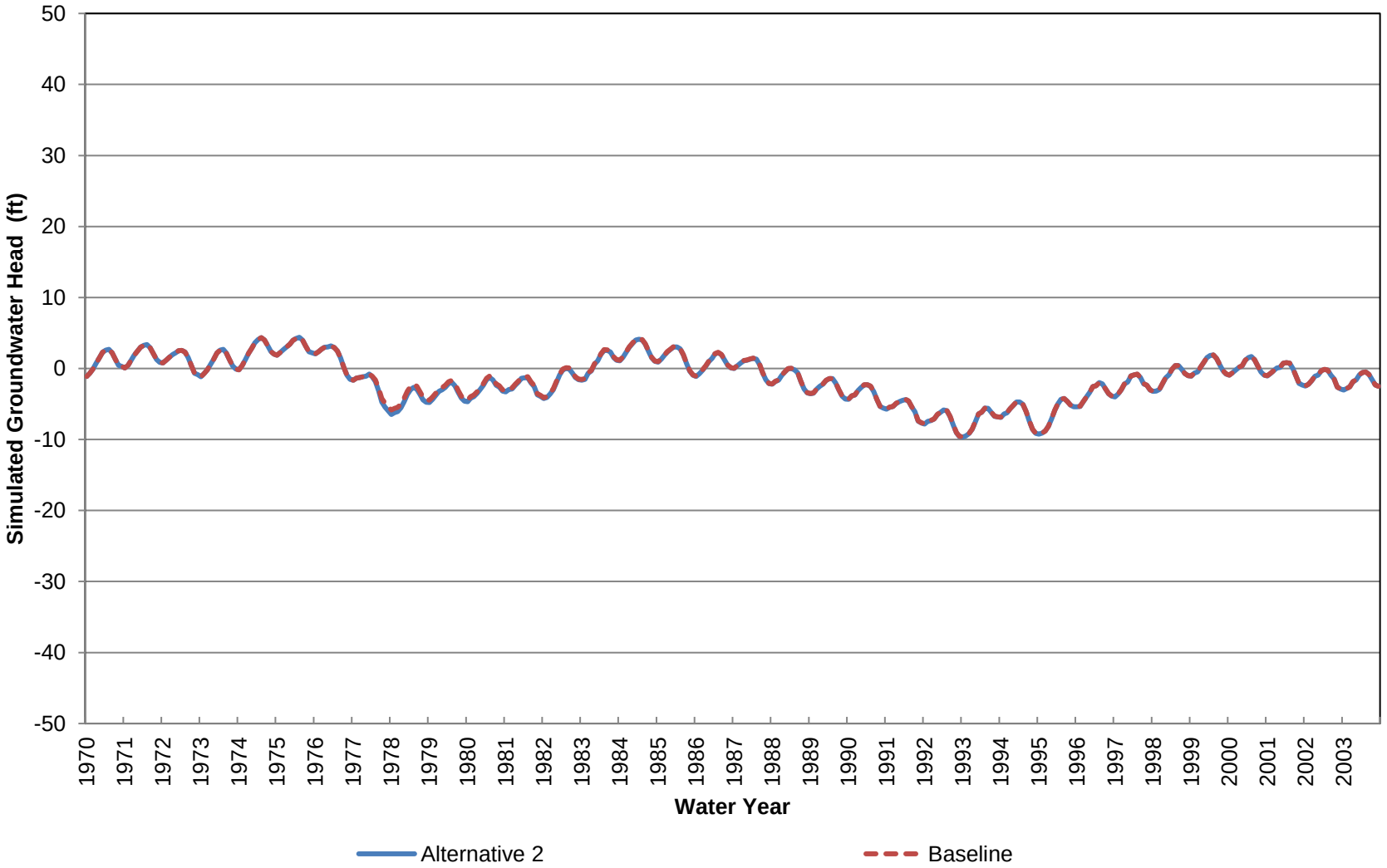
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 28 (Approximately 440-620 ft bgs)



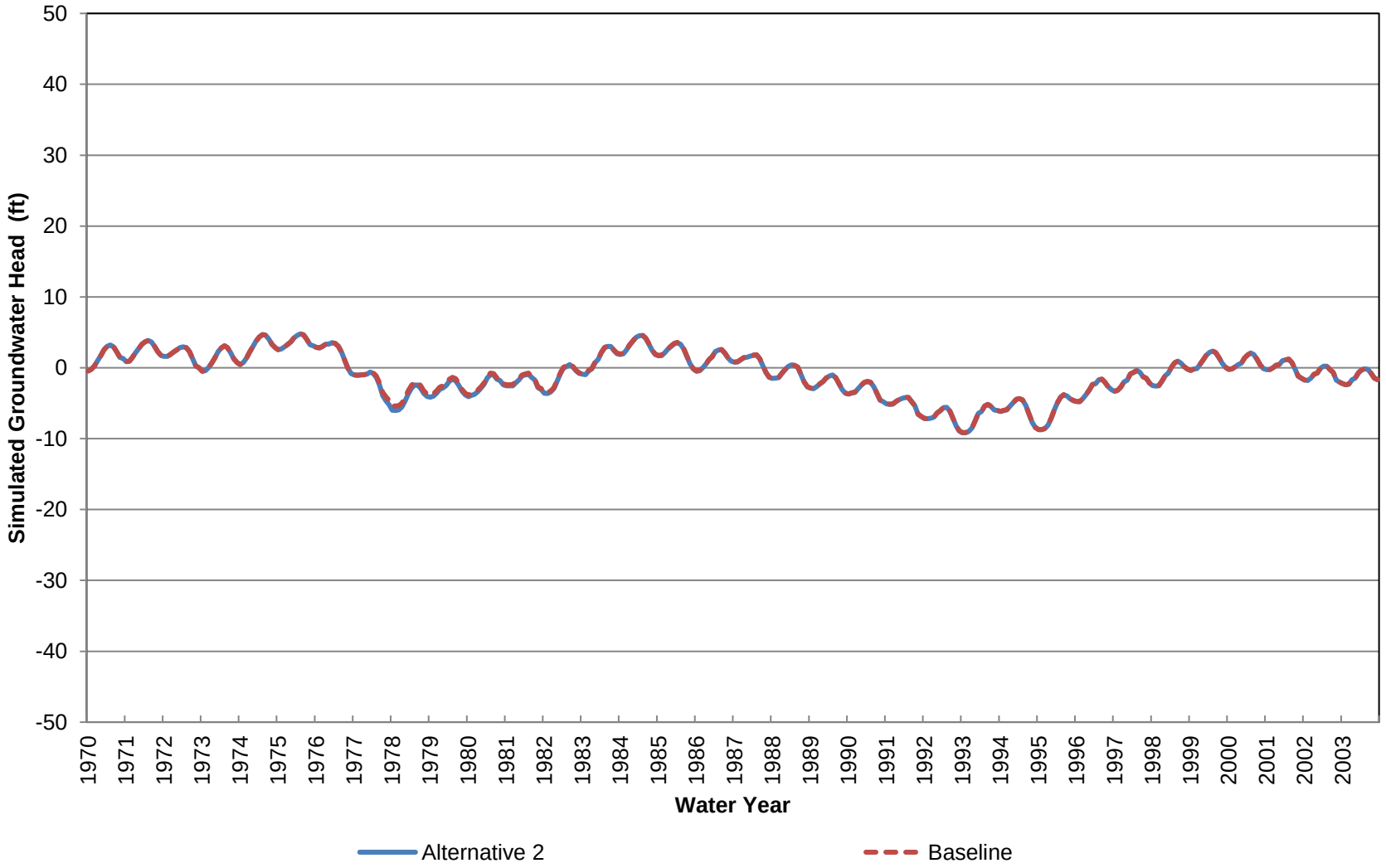
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 28 (Approximately 620-920 ft bgs)



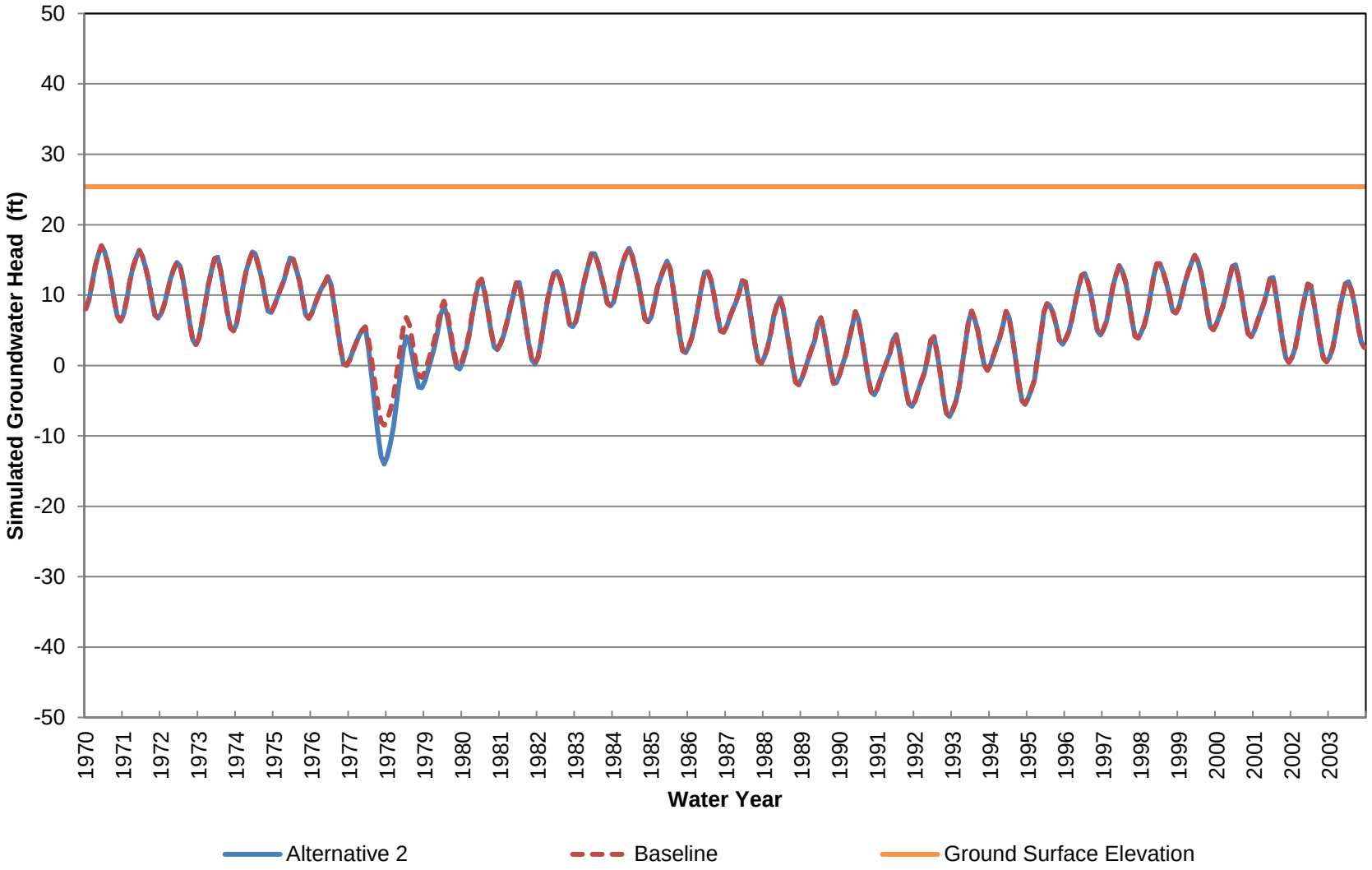
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 28 (Approximately 920-1220 ft bgs)



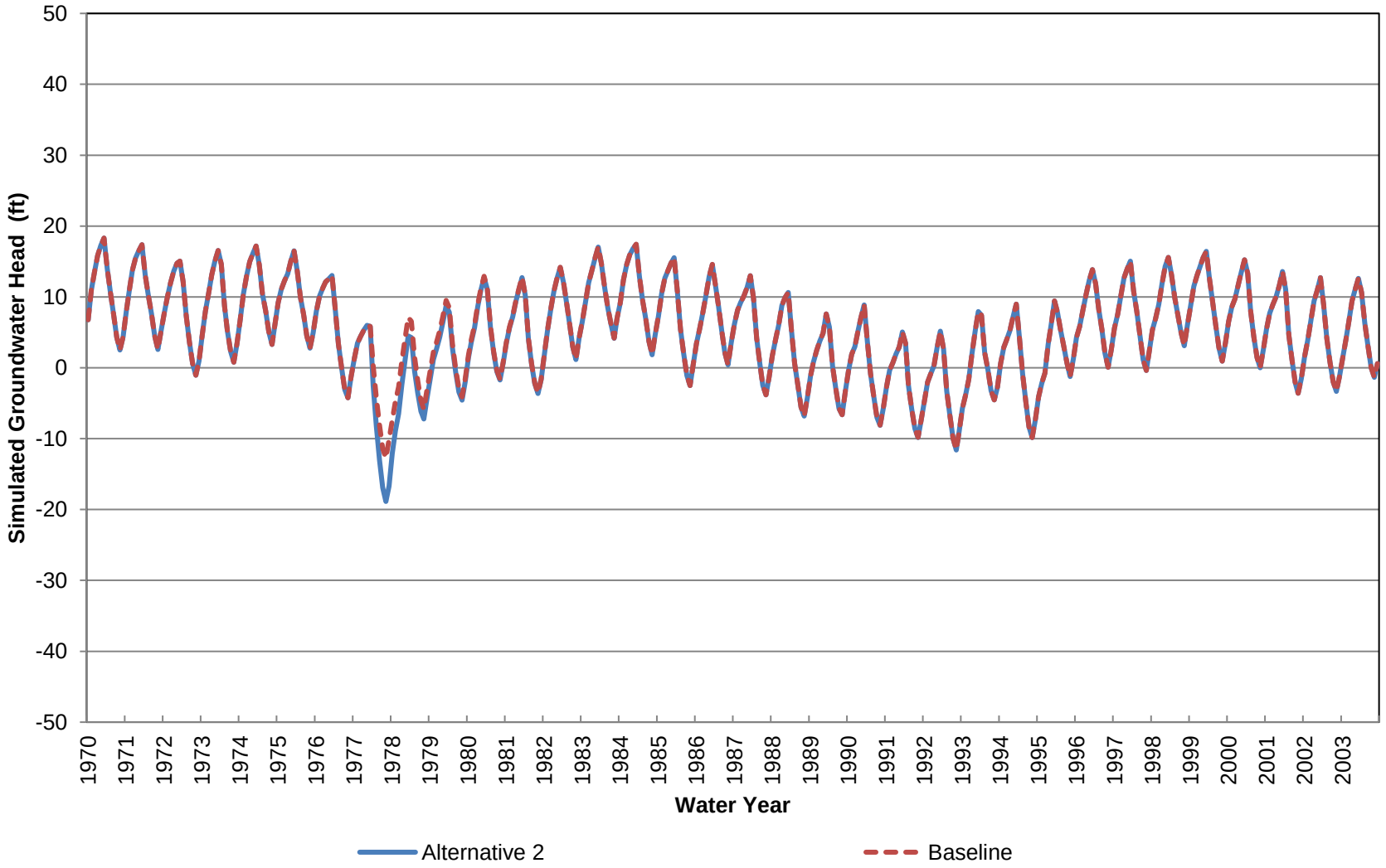
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 28 (Approximately 1220-1680 ft bgs)



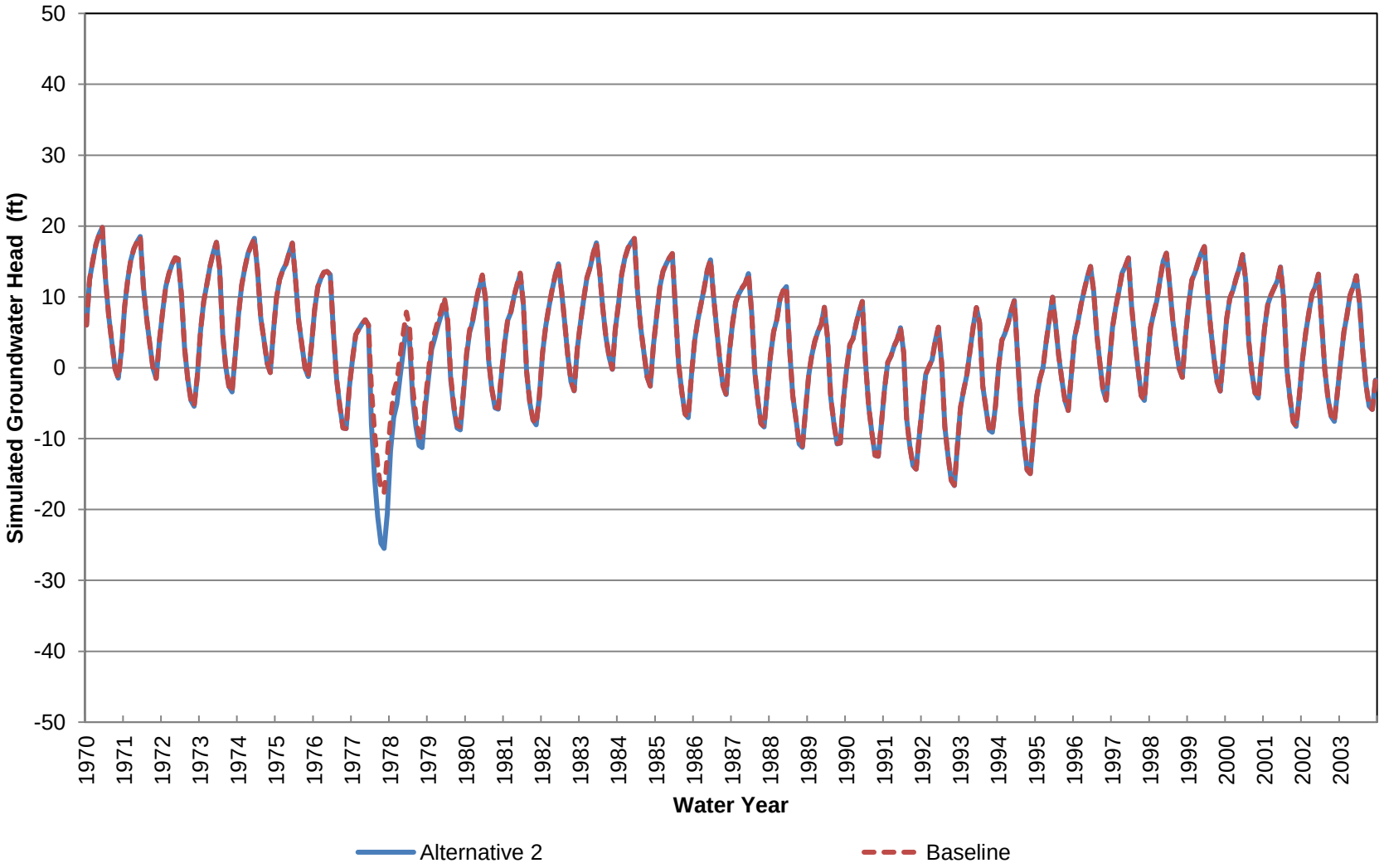
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 29 (Approximately 0-70 ft bgs)



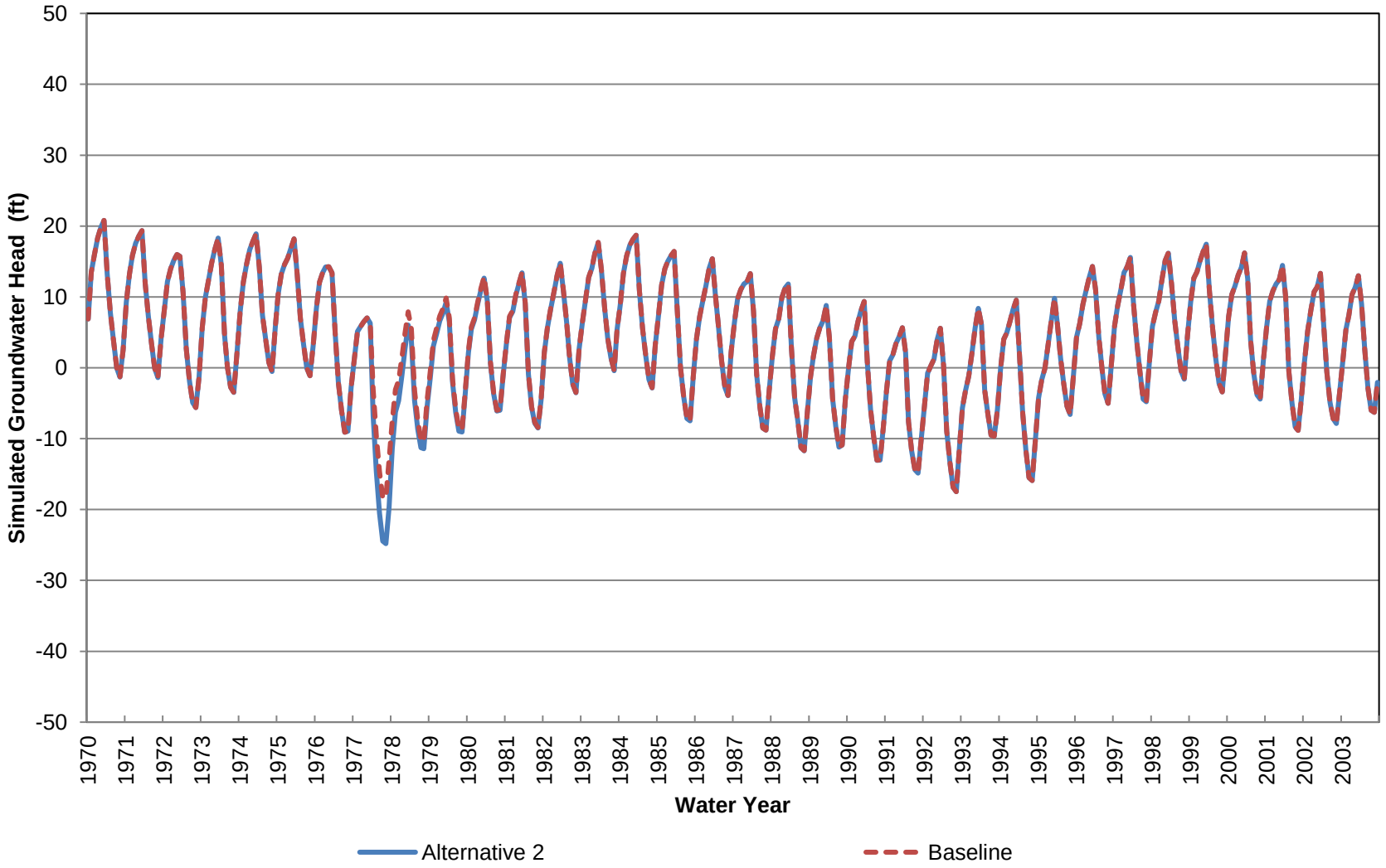
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 29 (Approximately 70-200 ft bgs)



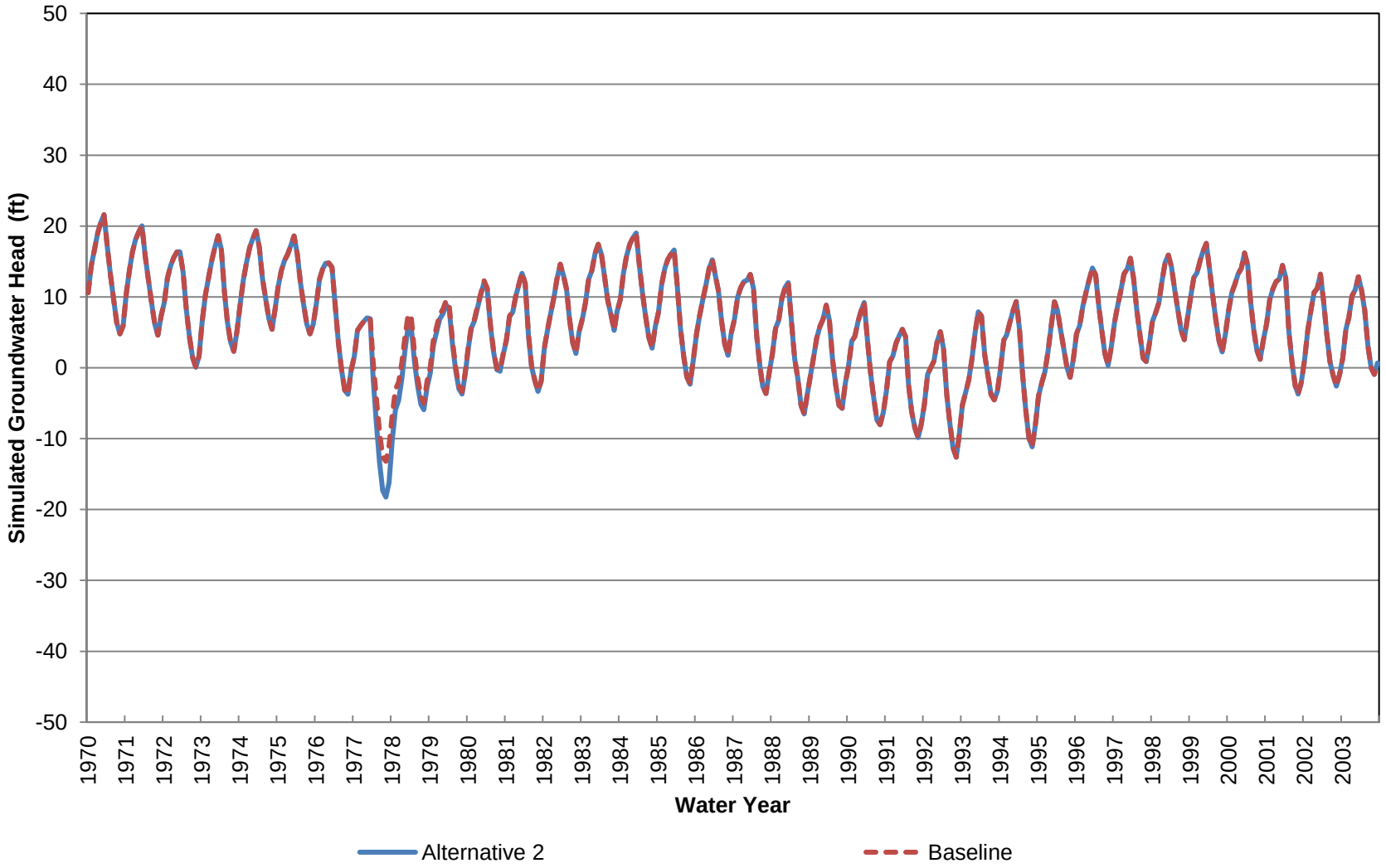
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 29 (Approximately 200-330 ft bgs)



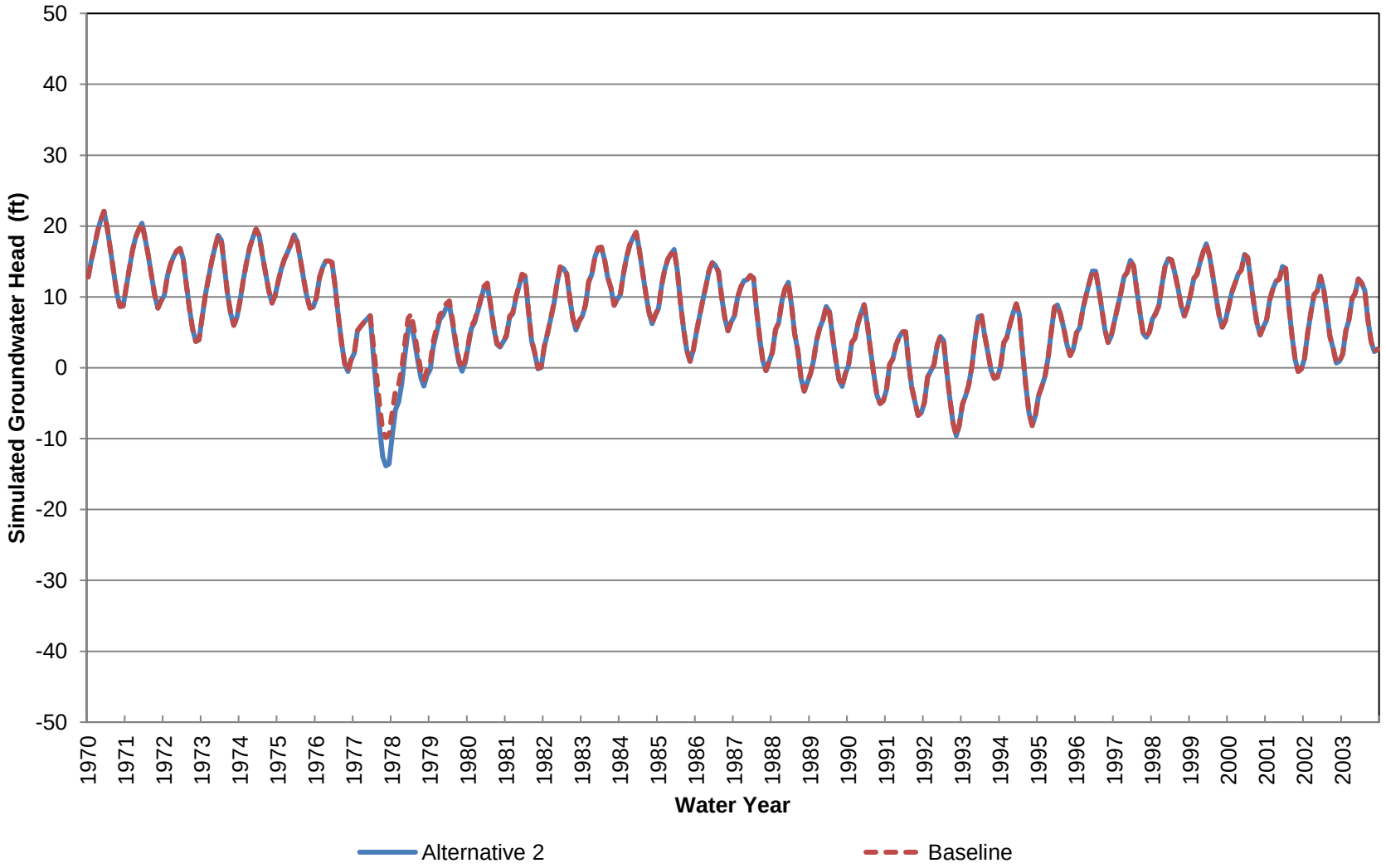
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 29 (Approximately 330-470 ft bgs)



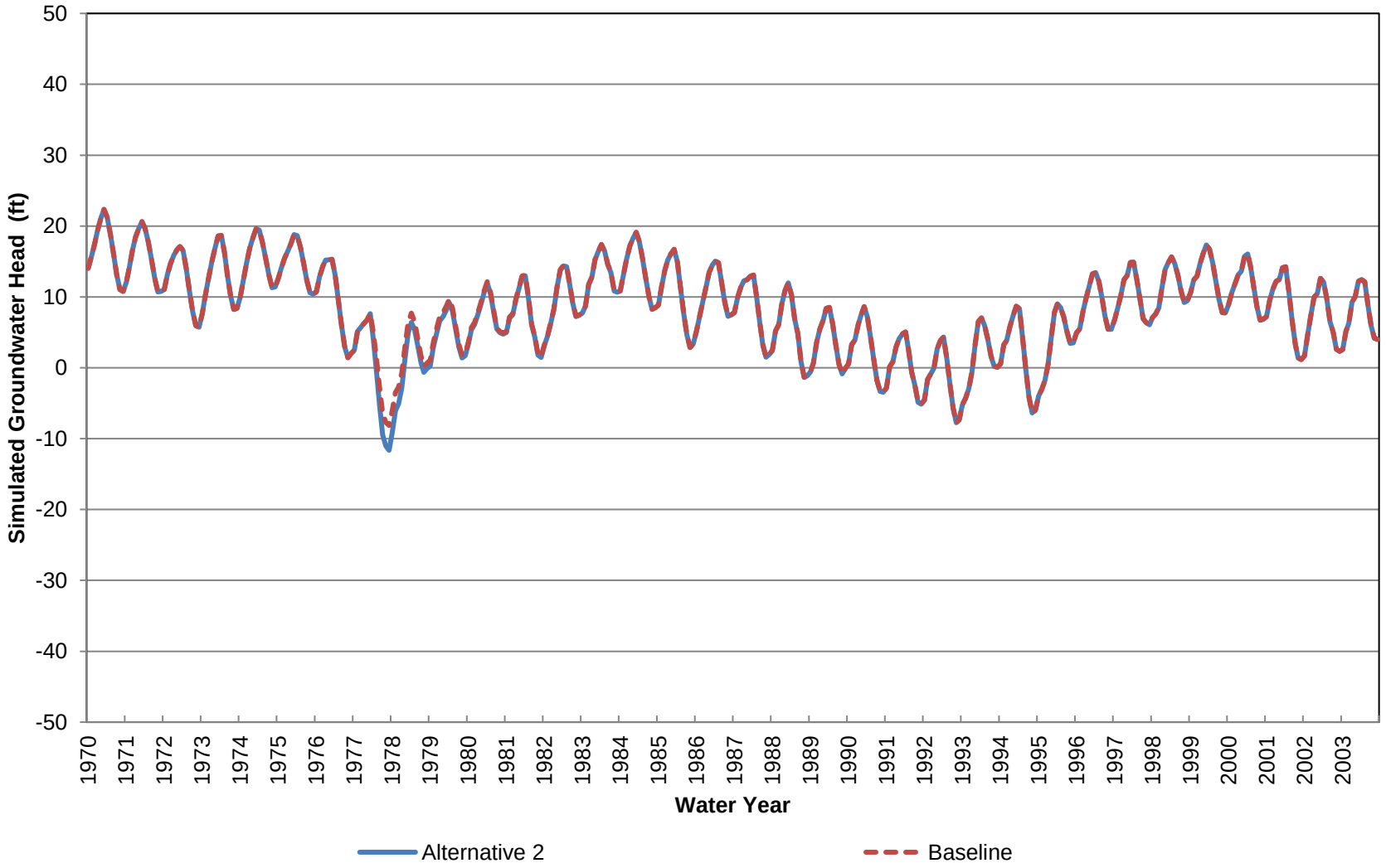
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 29 (Approximately 470-660 ft bgs)



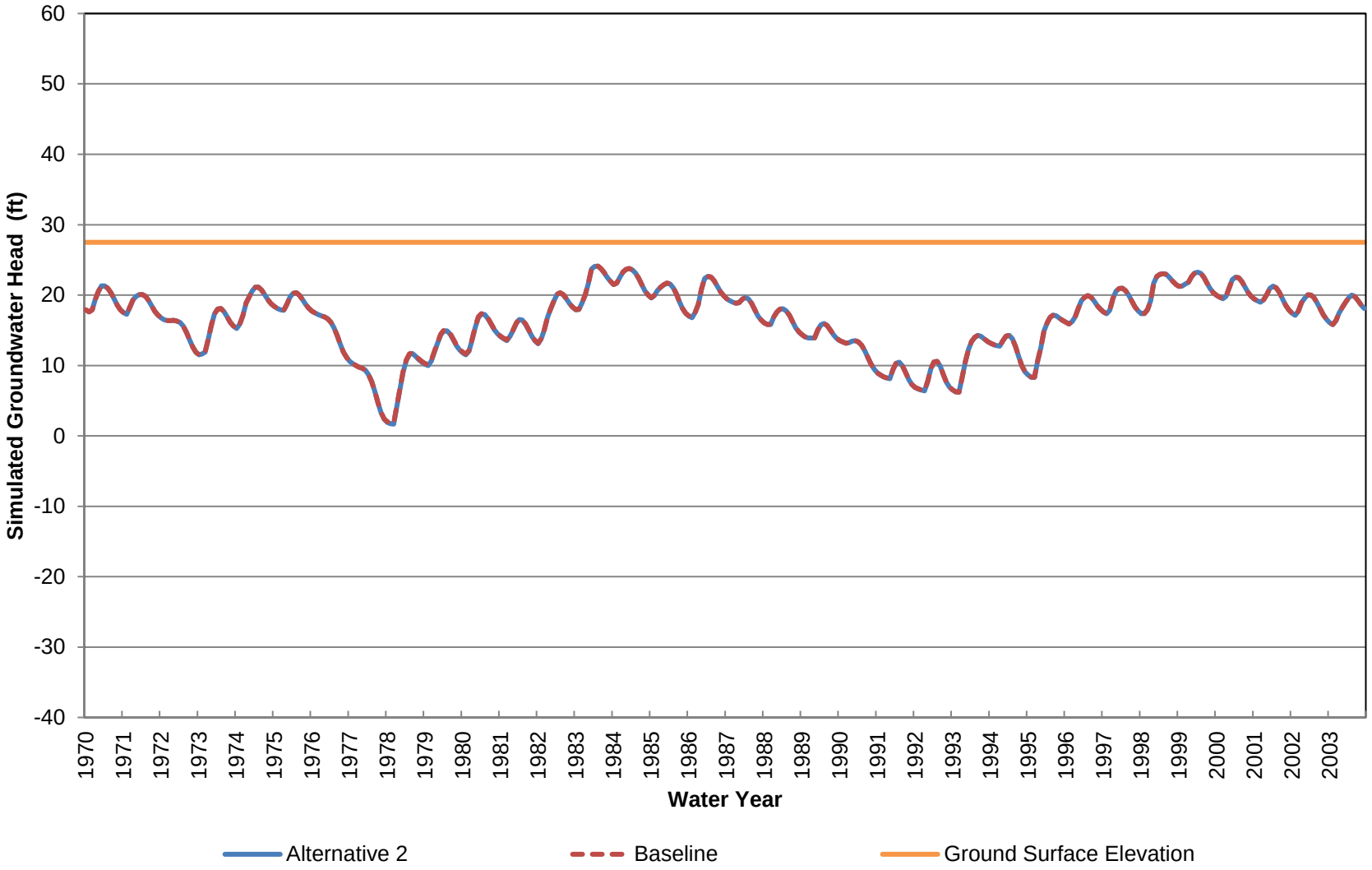
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 29 (Approximately 660-880 ft bgs)



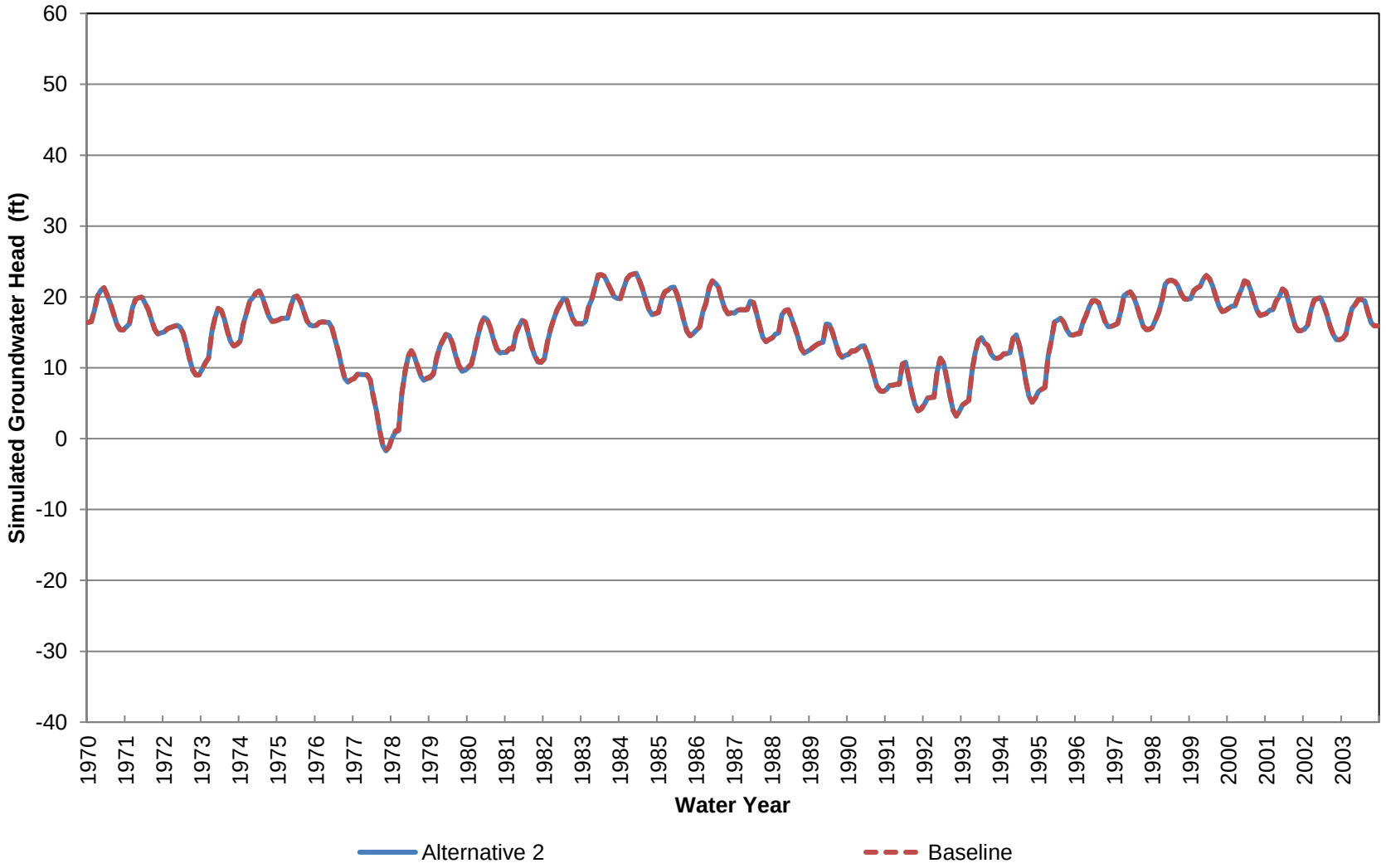
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 29 (Approximately 880-1210 ft bgs)



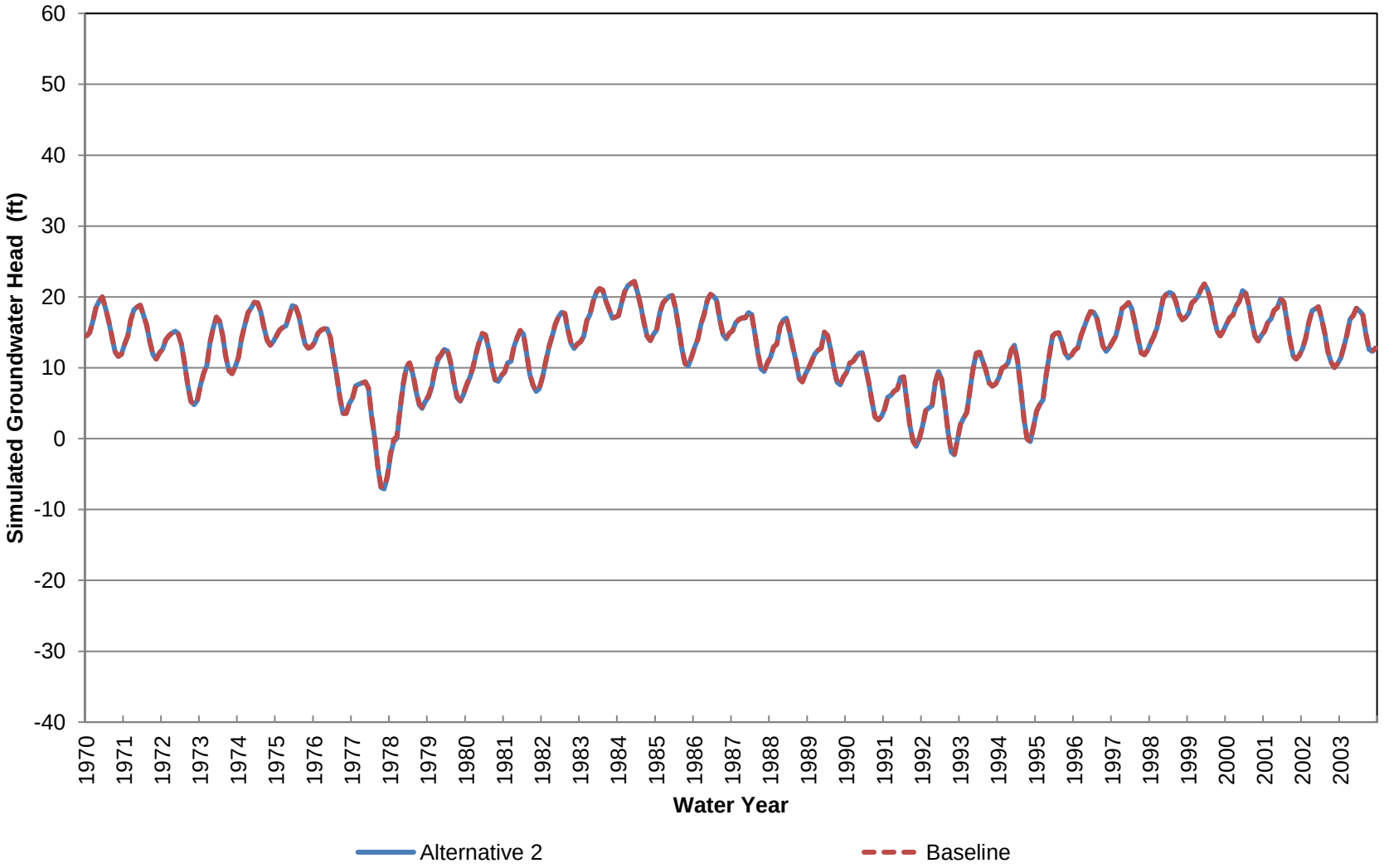
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 30 (Approximately 0-70 ft bgs)



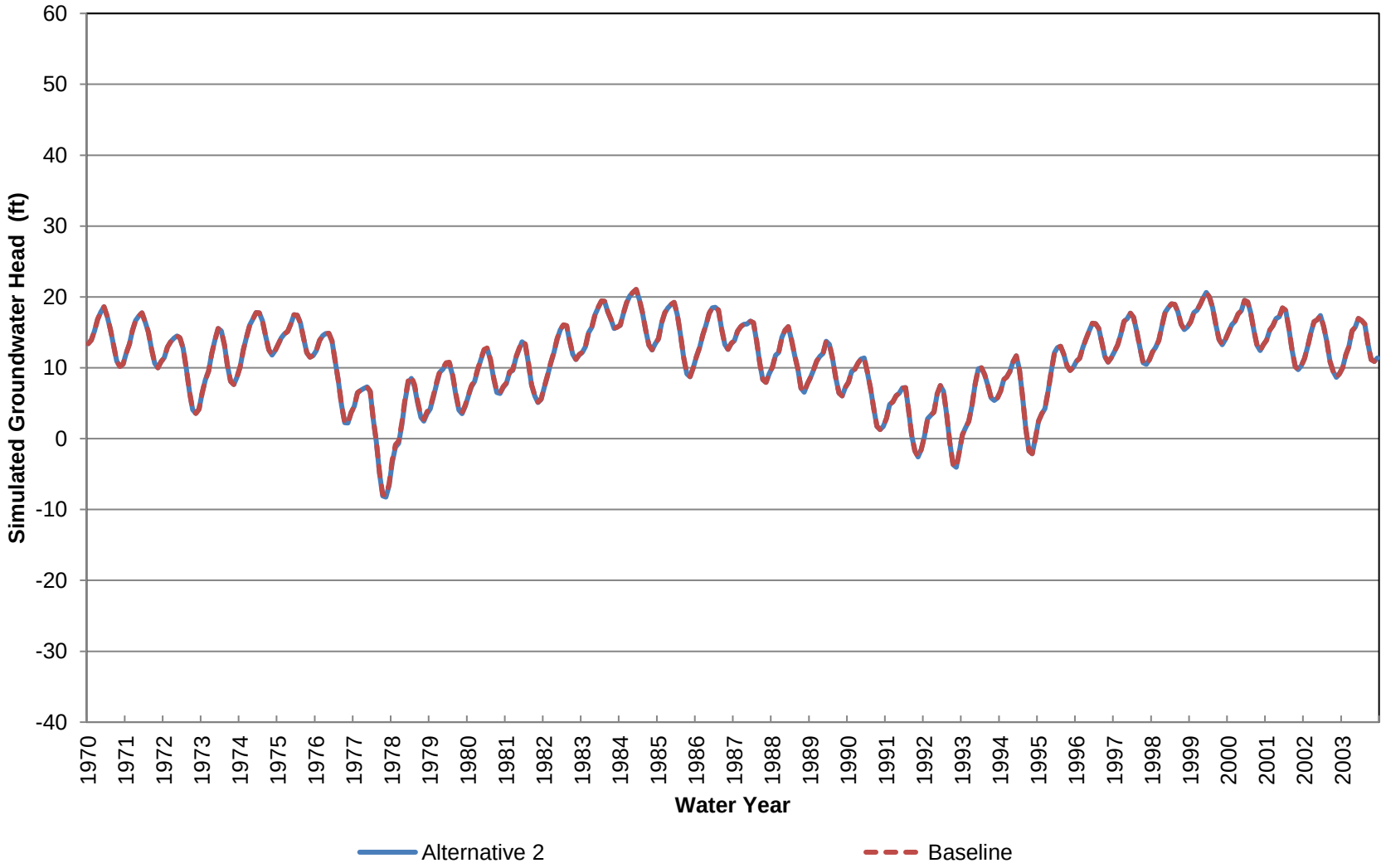
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 30 (Approximately 70-340 ft bgs)



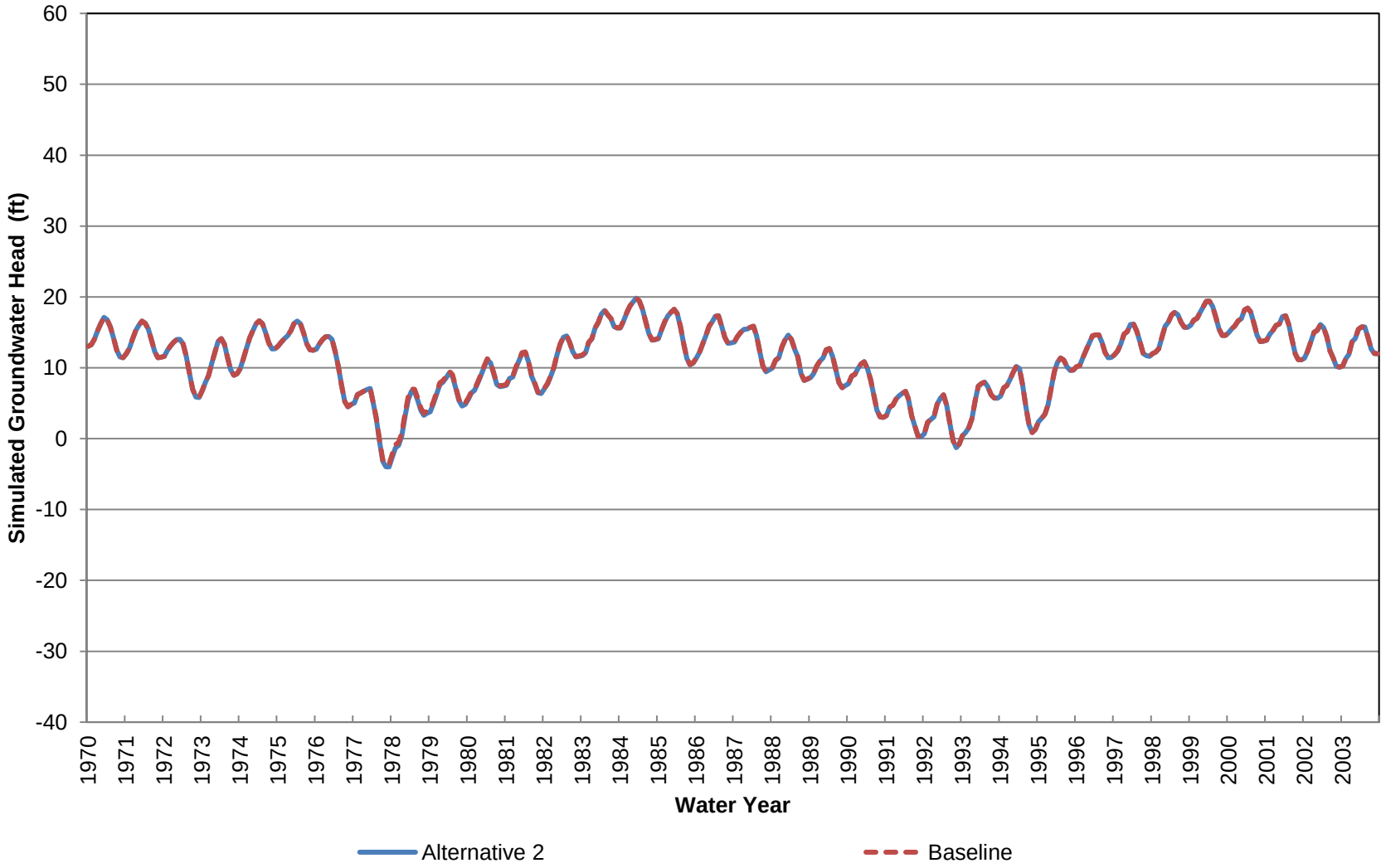
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 30 (Approximately 340-600 ft bgs)



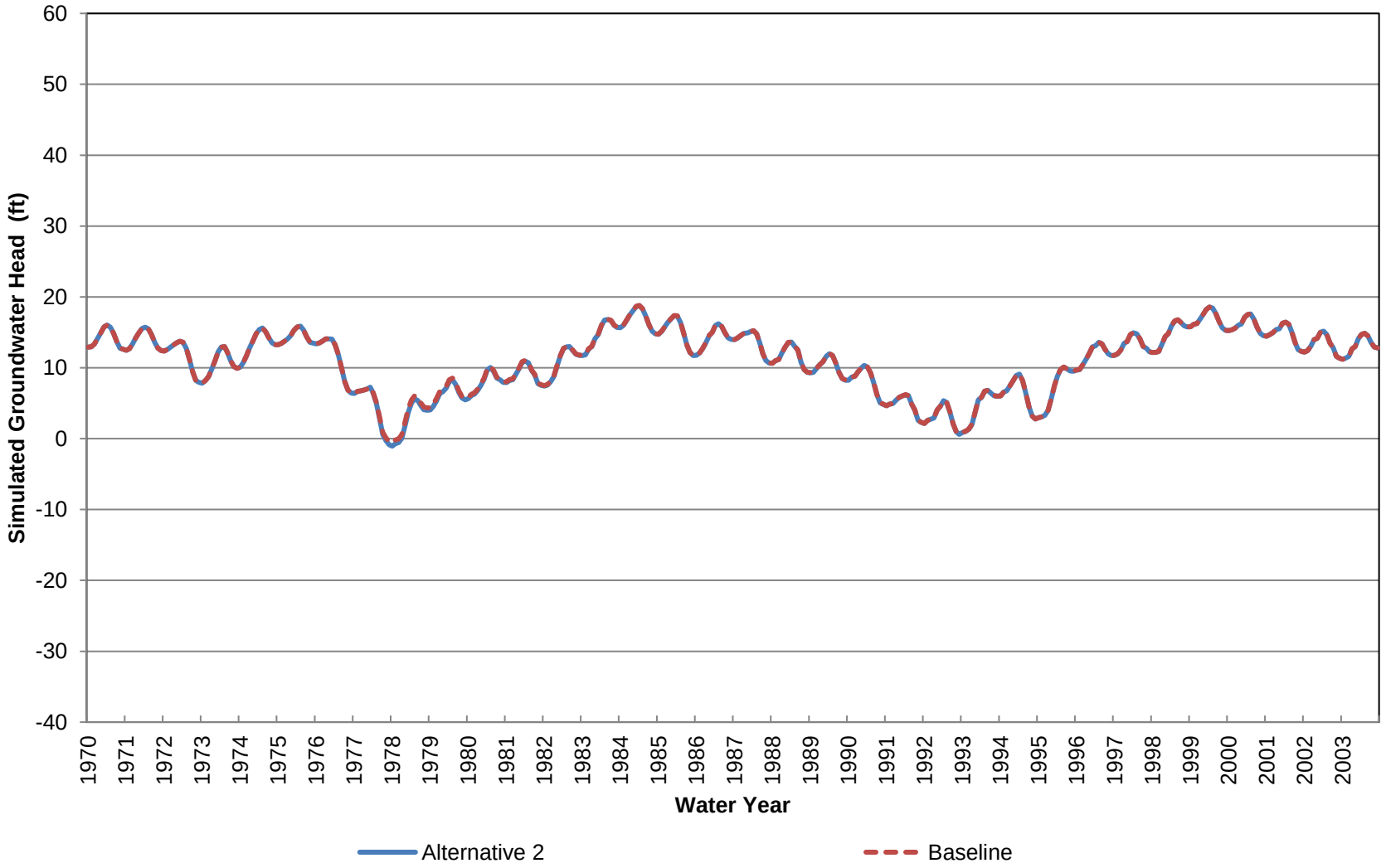
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 30 (Approximately 600-860 ft bgs)



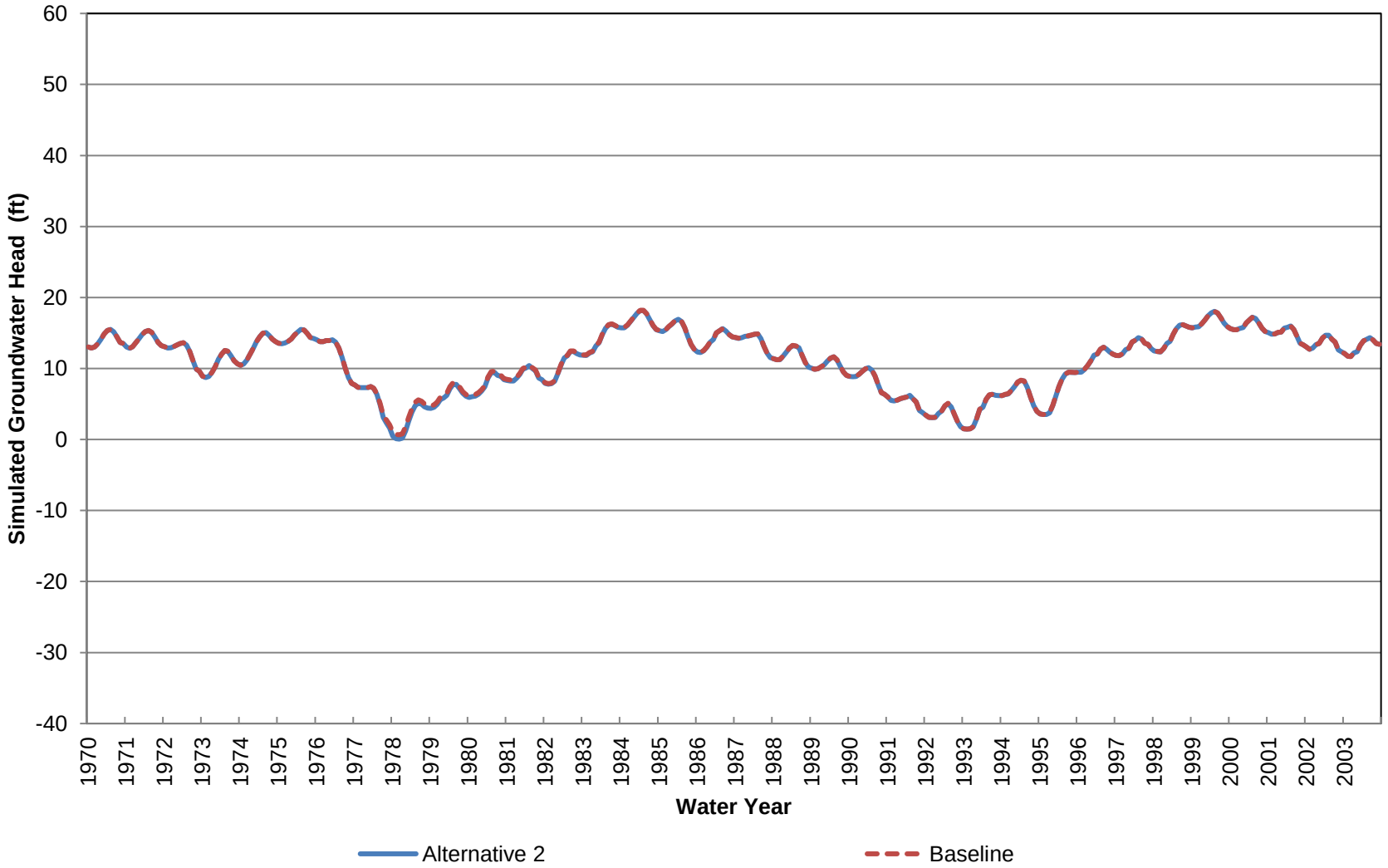
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 30 (Approximately 860-1330 ft bgs)



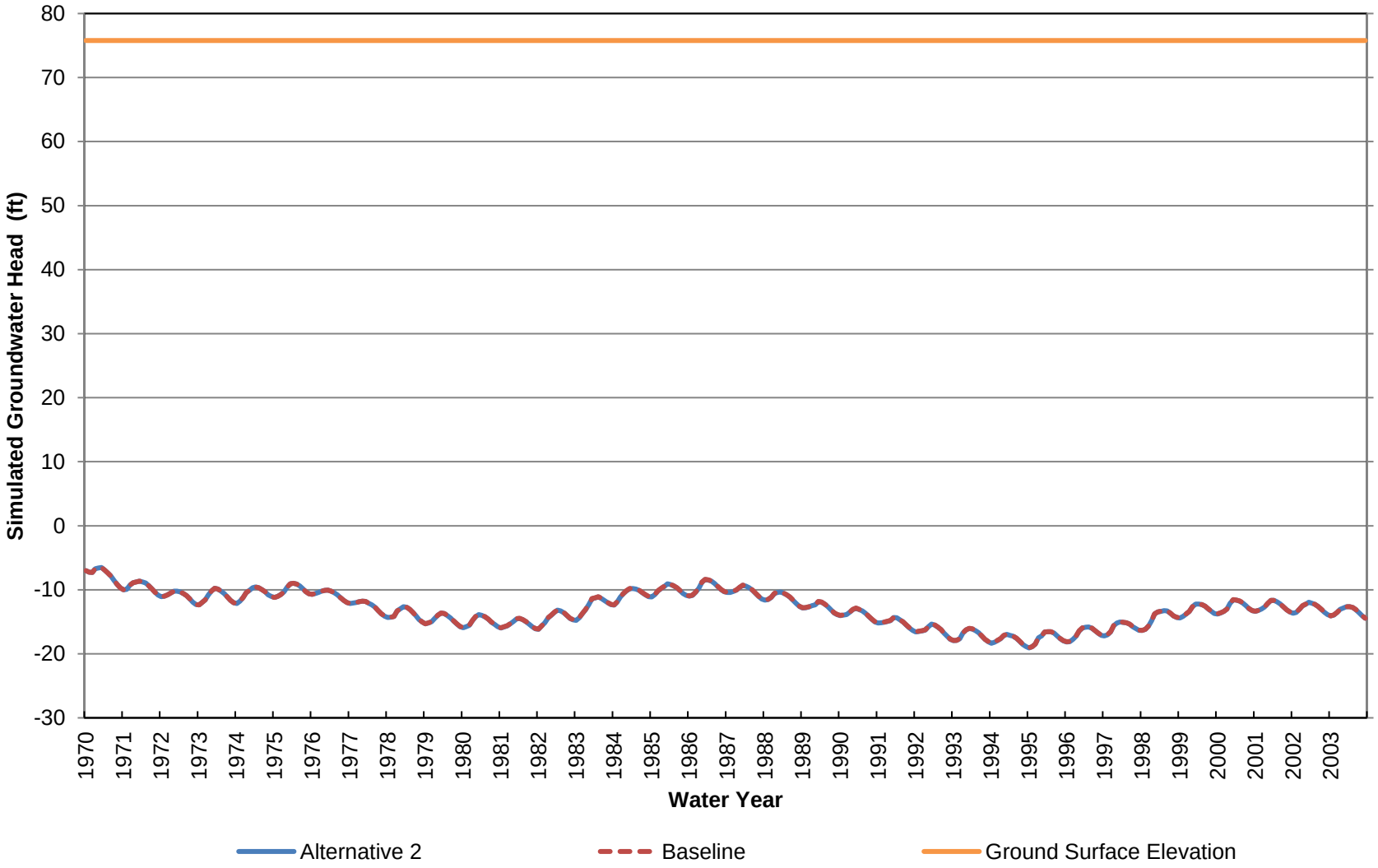
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 30 (Approximately 1330-1770 ft bgs)



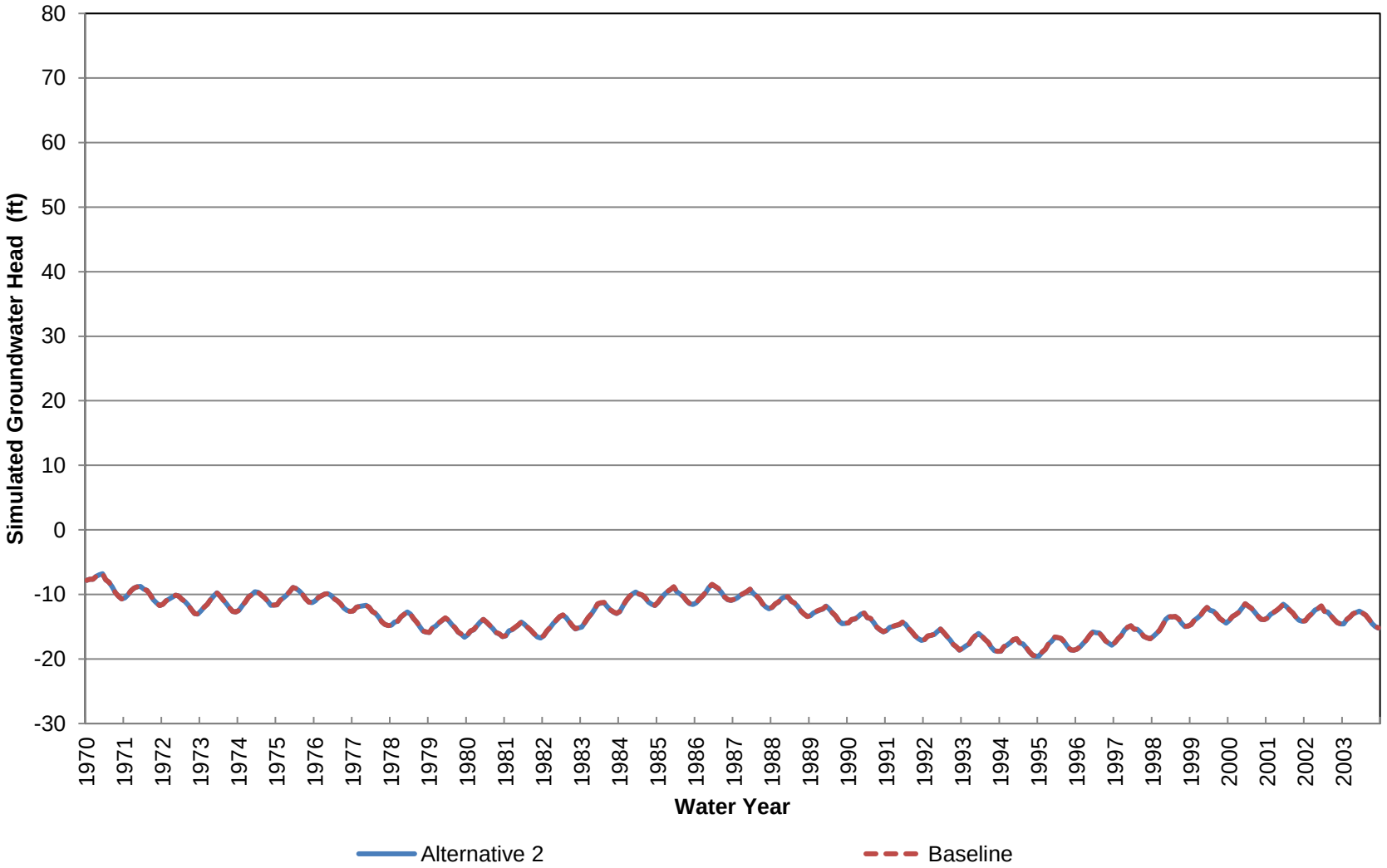
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 30 (Approximately 1770-2430 ft bgs)



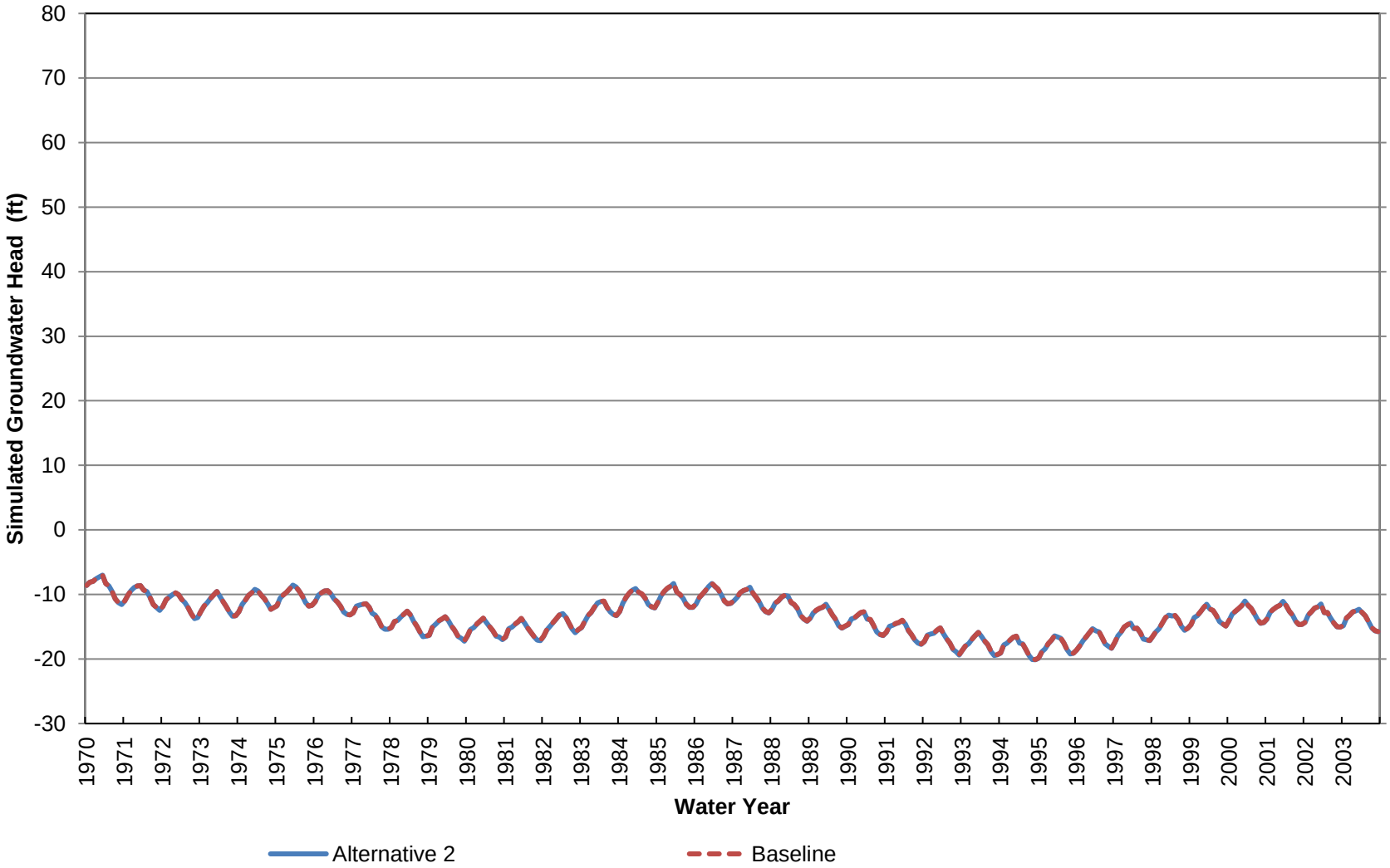
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 31 (Approximately 0-70 ft bgs)



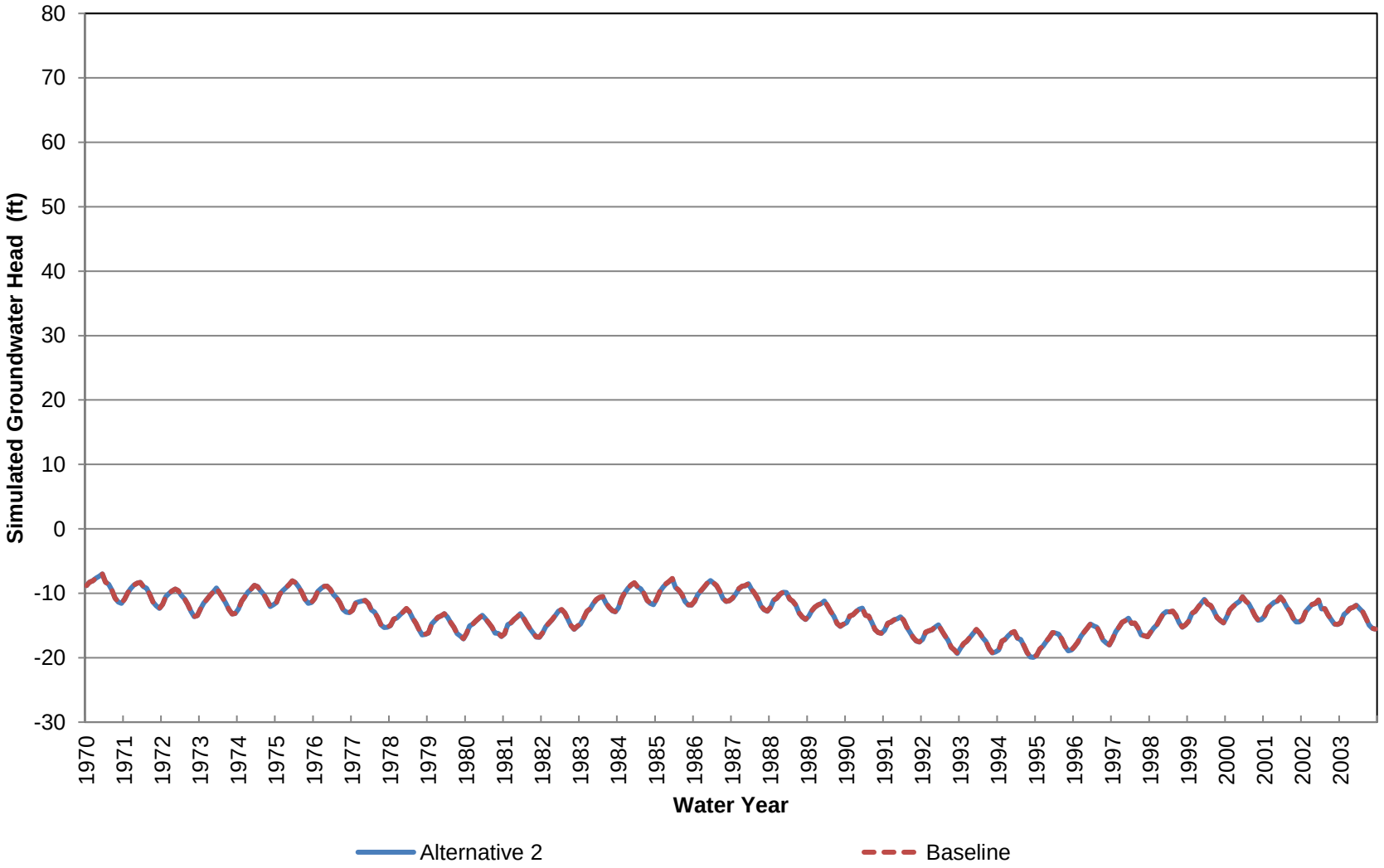
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 31 (Approximately 70-200 ft bgs)



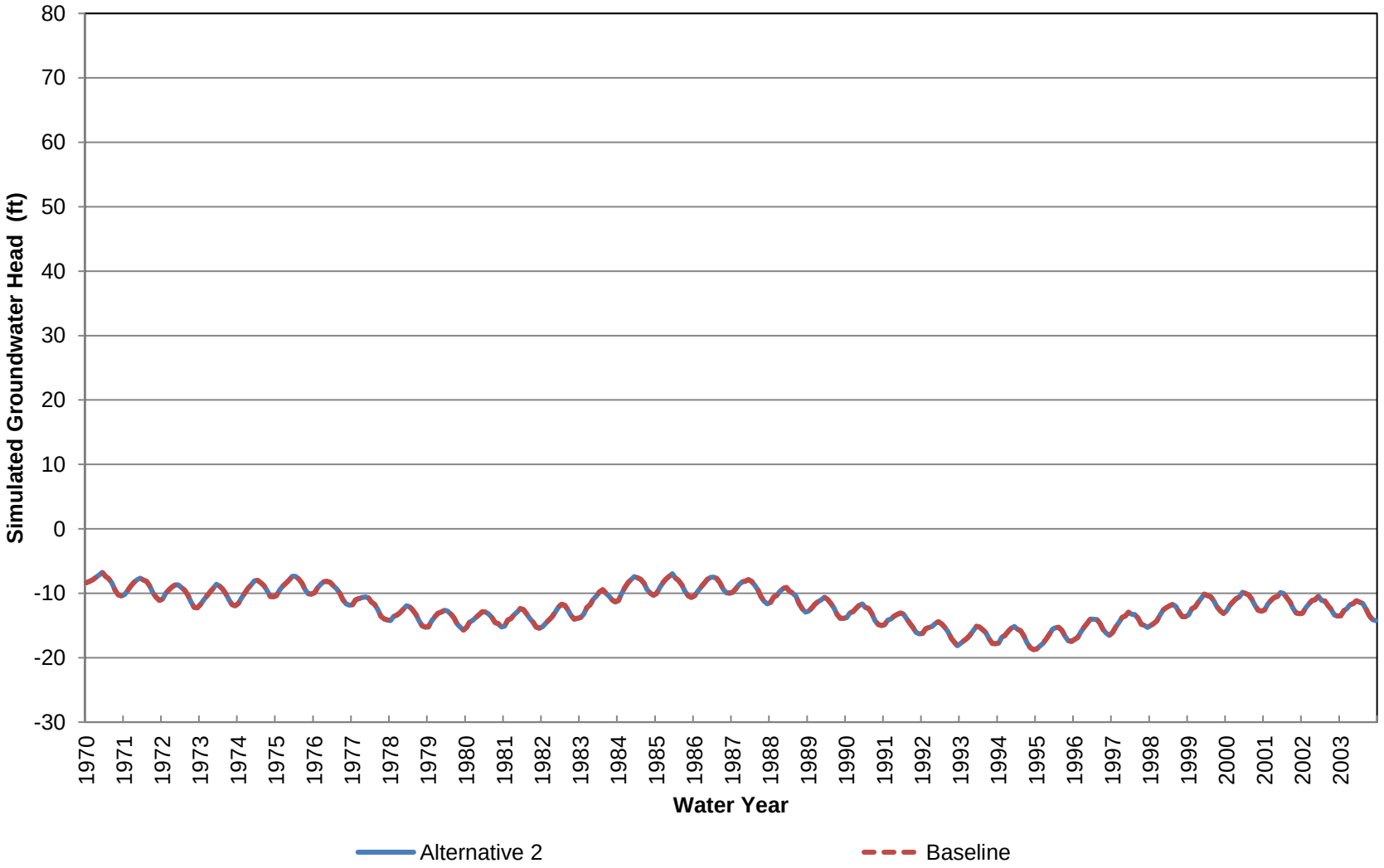
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 31 (Approximately 200-330 ft bgs)



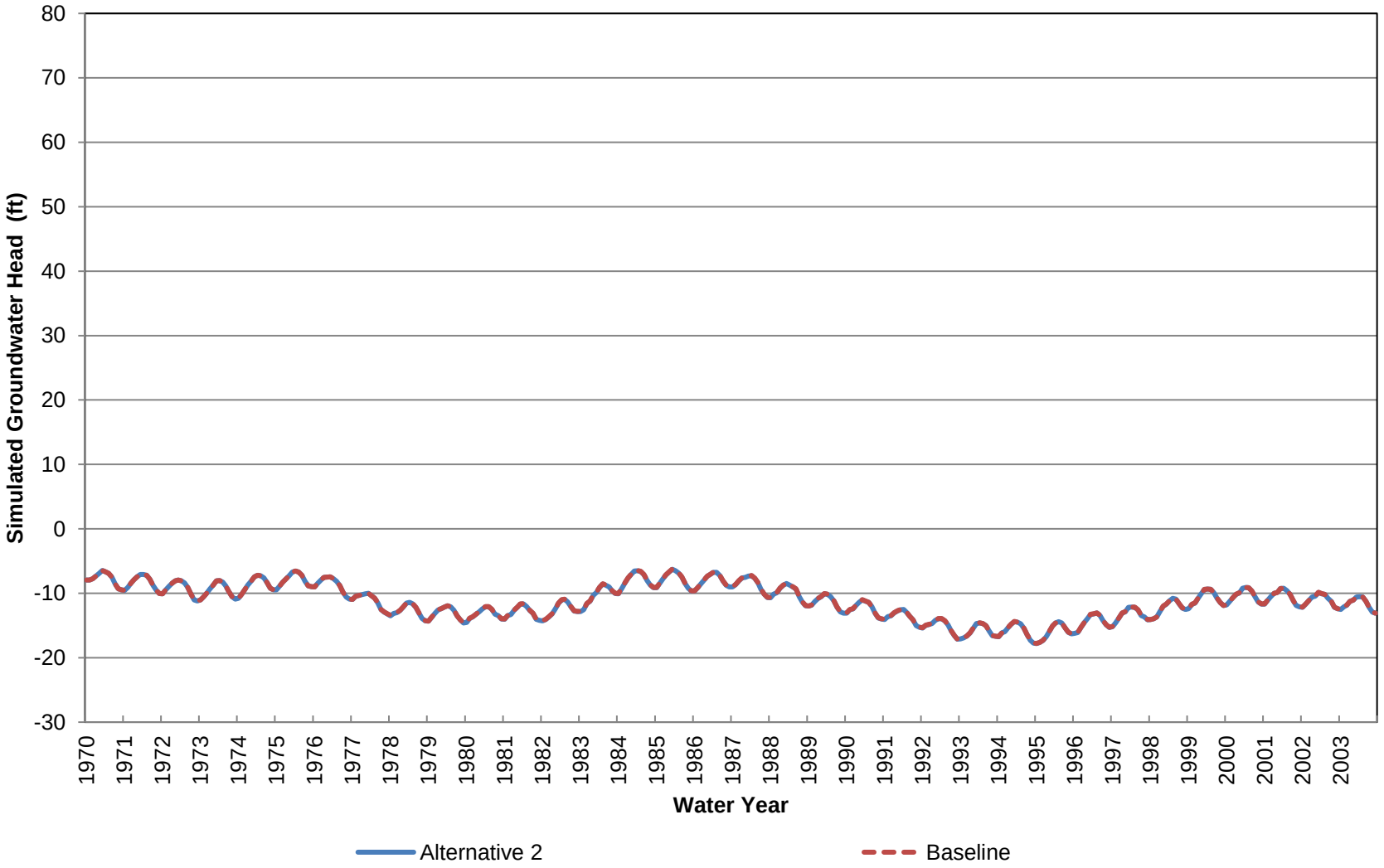
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 31 (Approximately 330-460 ft bgs)



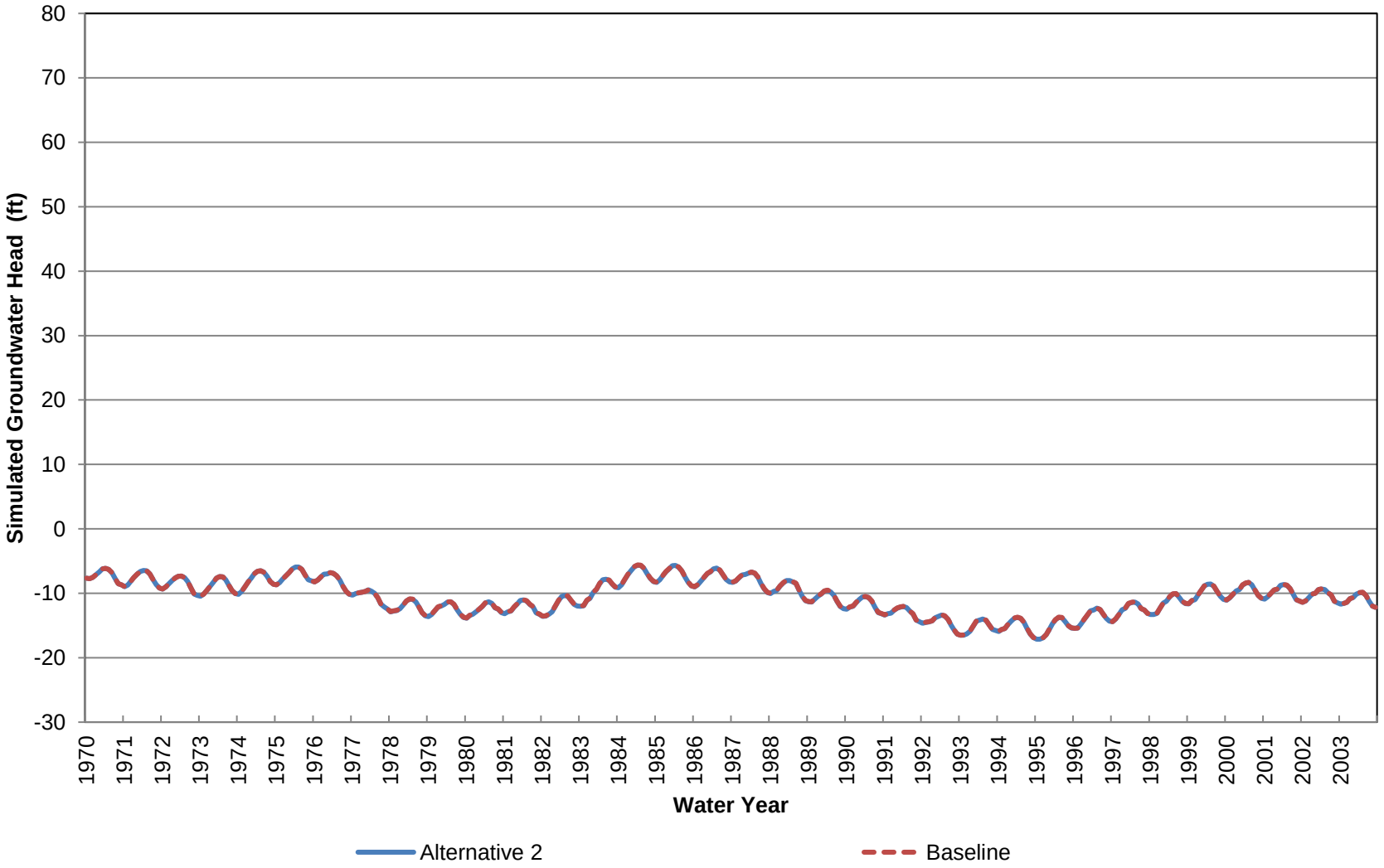
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 31 (Approximately 460-650 ft bgs)



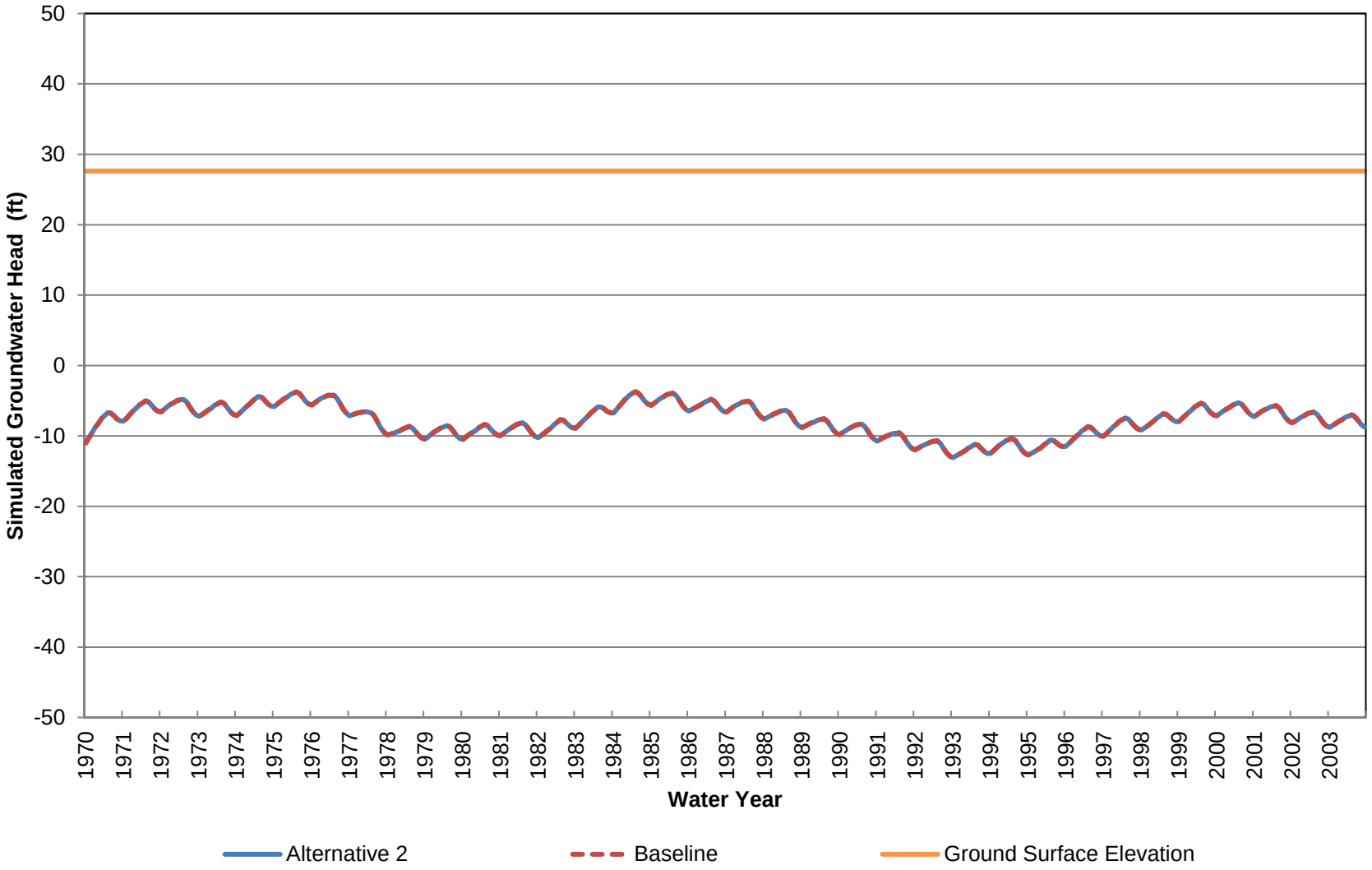
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 31 (Approximately 650-870 ft bgs)



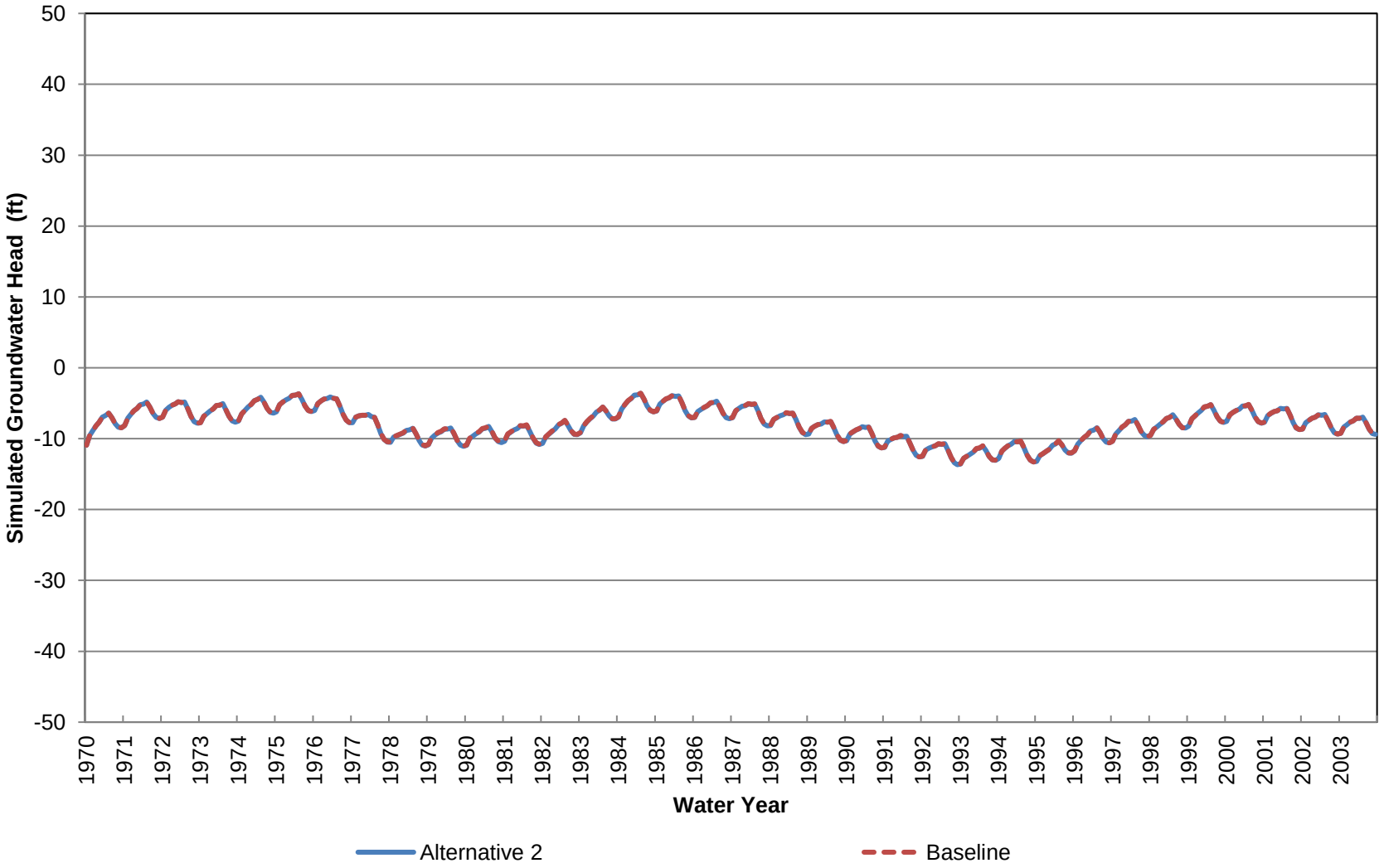
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 31 (Approximately 870-1190 ft bgs)



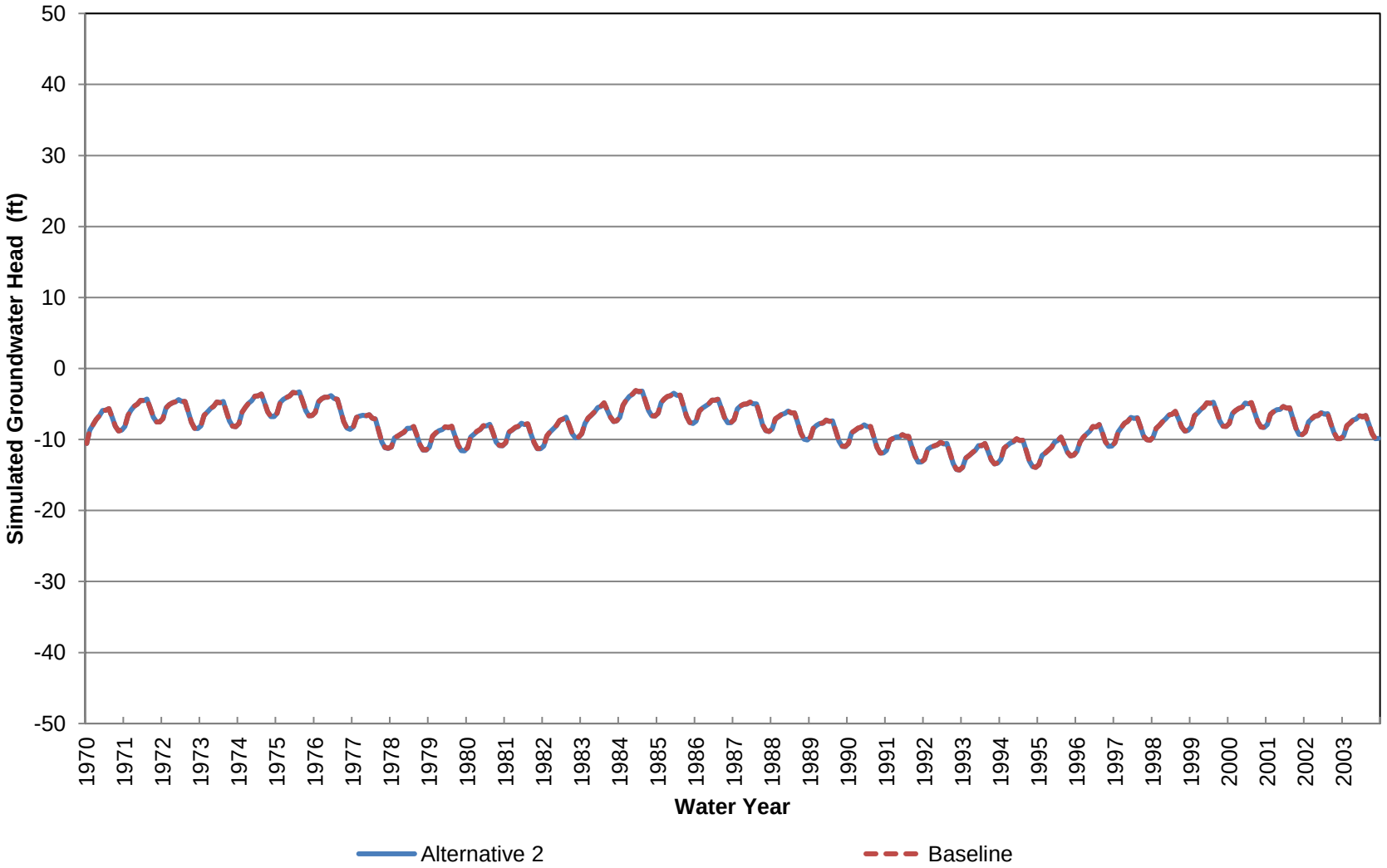
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 32 (Approximately 0-70 ft bgs)



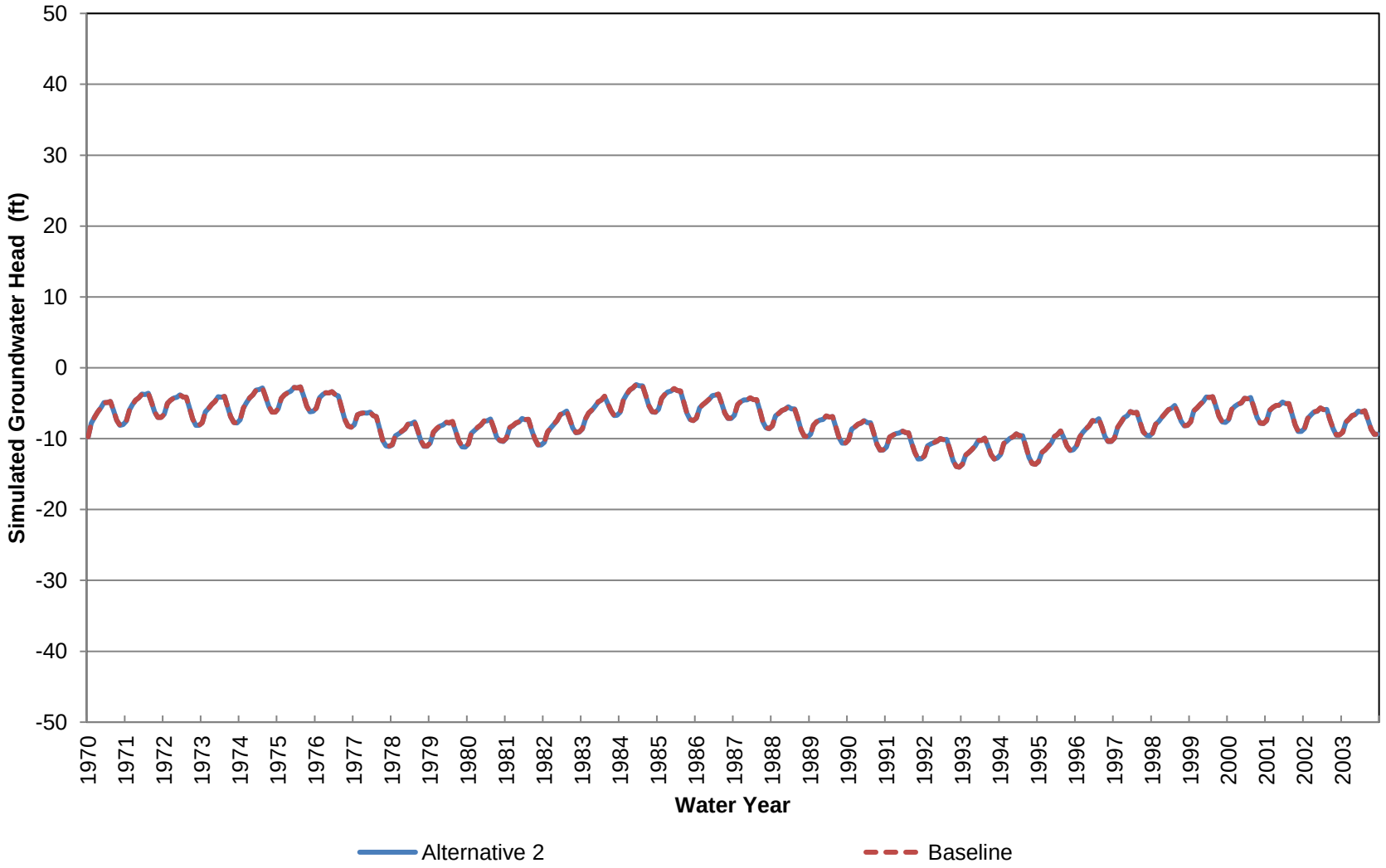
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 32 (Approximately 70-240 ft bgs)



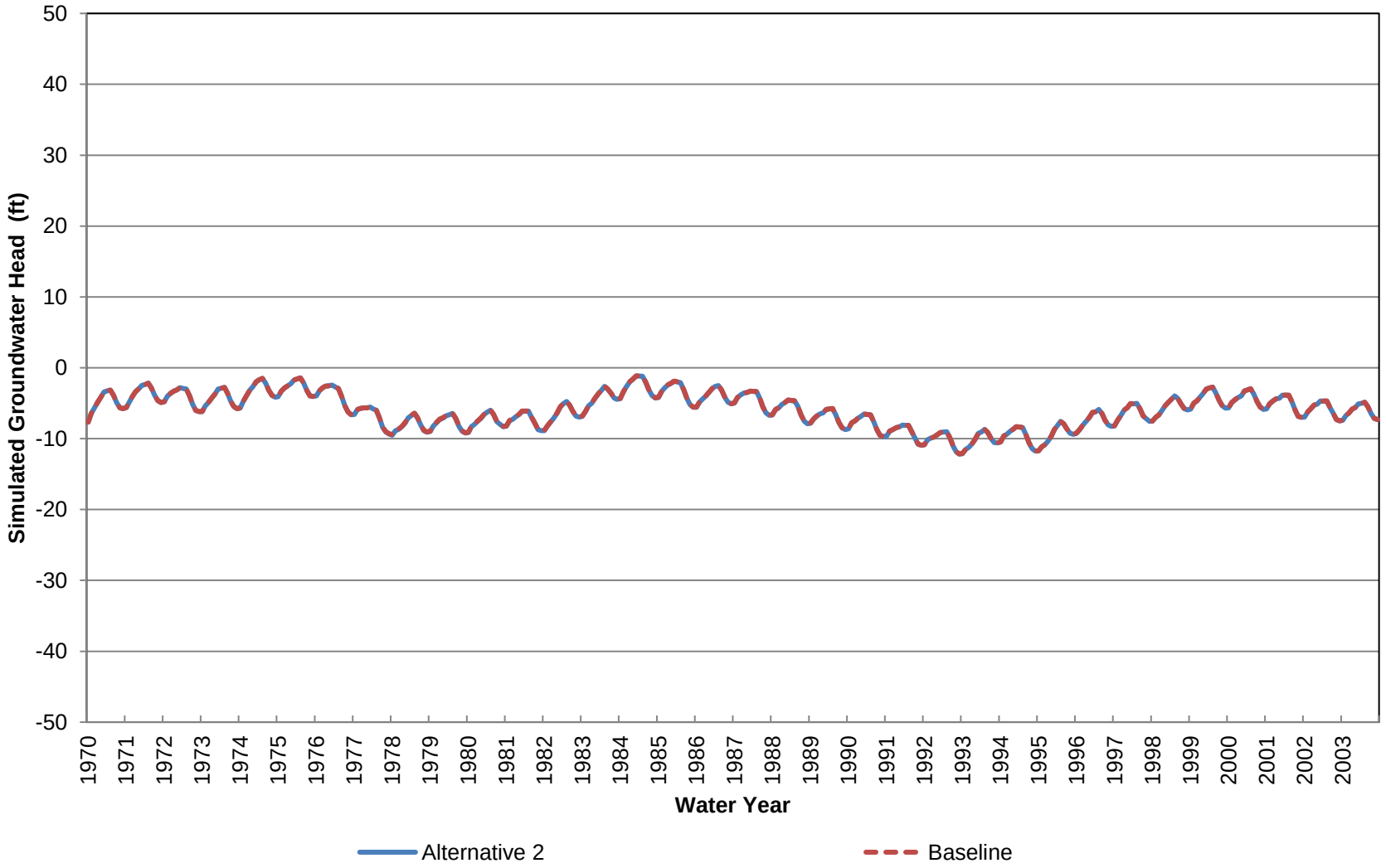
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 32 (Approximately 240-410 ft bgs)



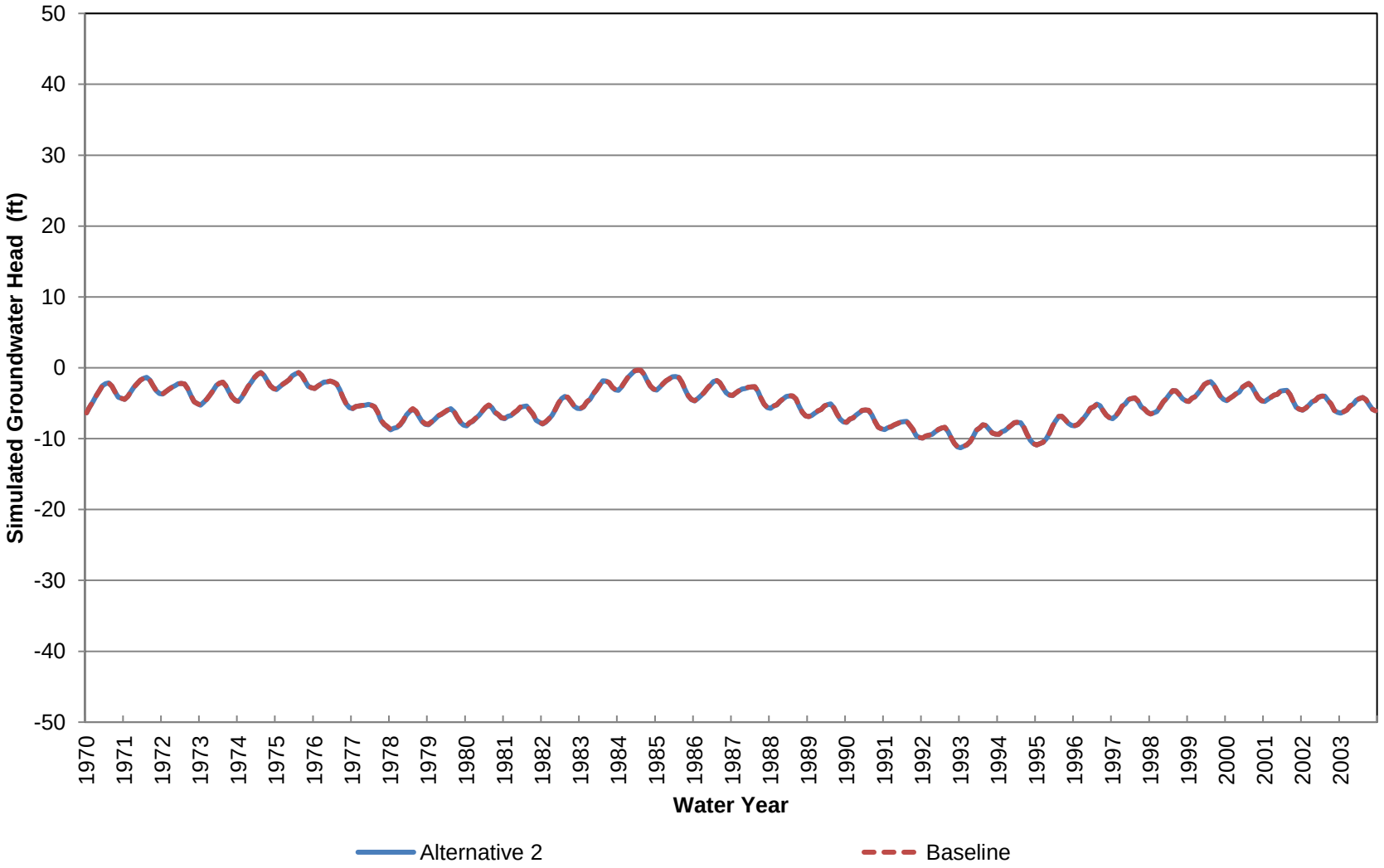
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 32 (Approximately 410-580 ft bgs)



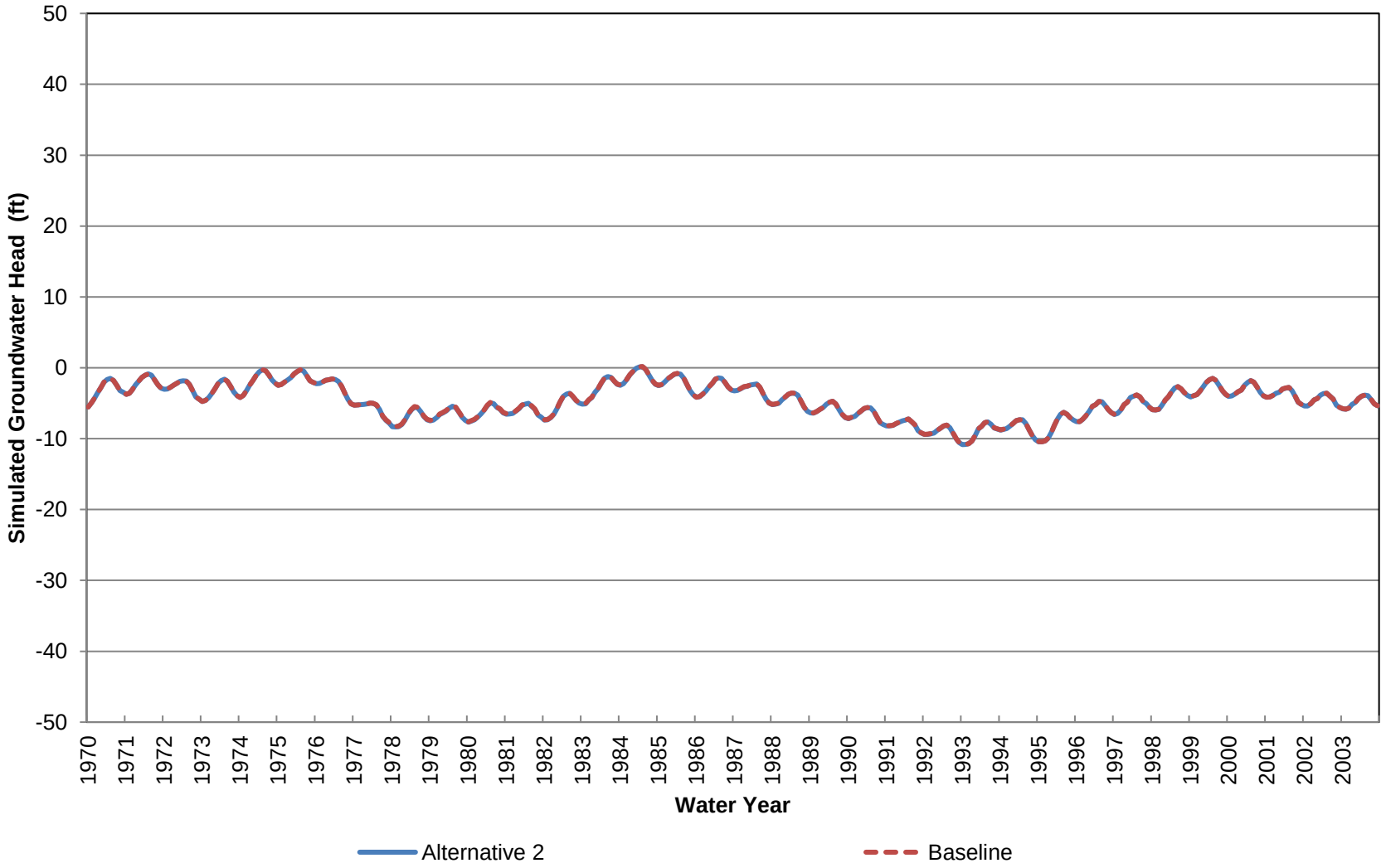
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 32 (Approximately 580-850 ft bgs)



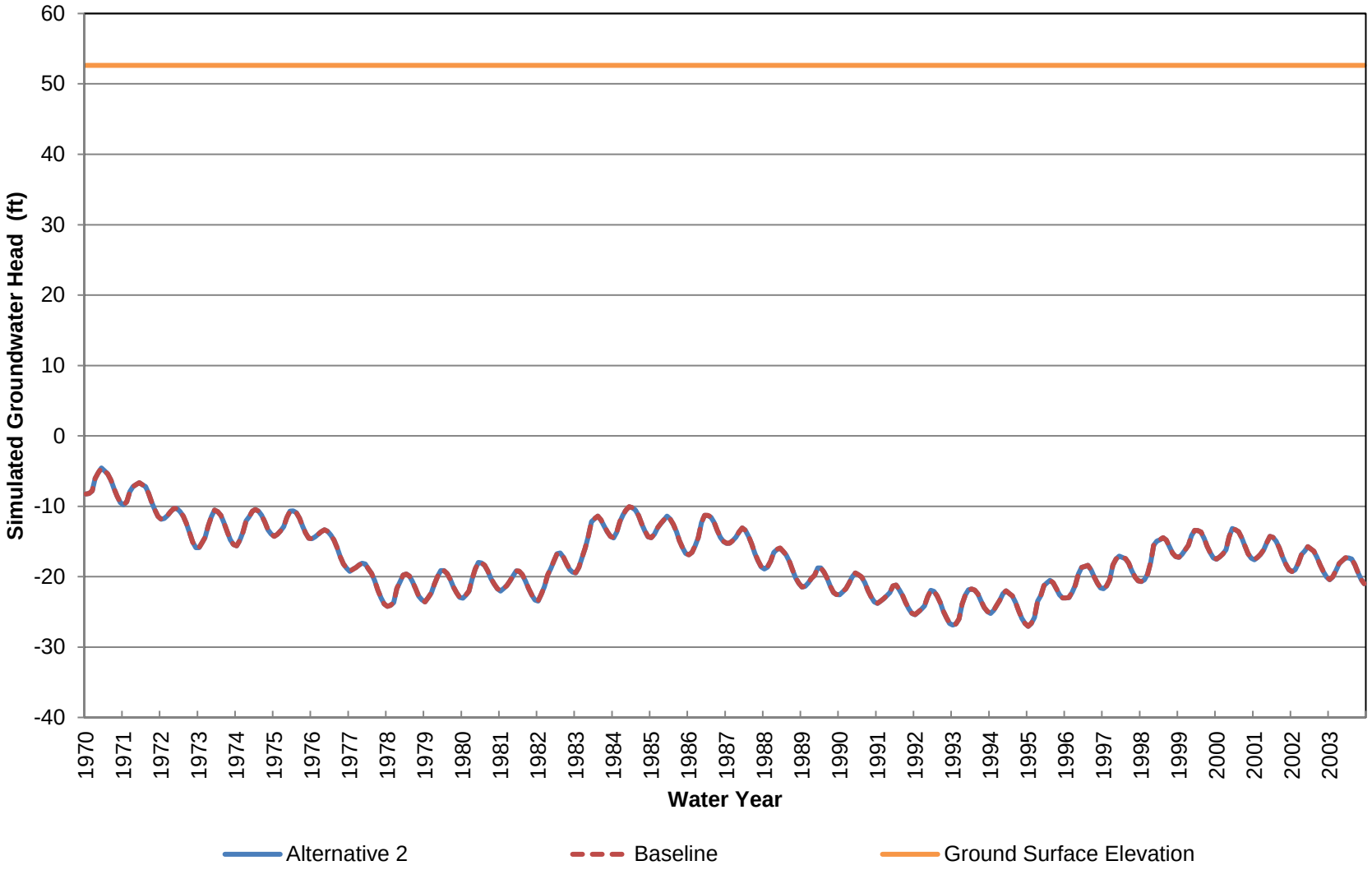
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 32 (Approximately 850-1140 ft bgs)



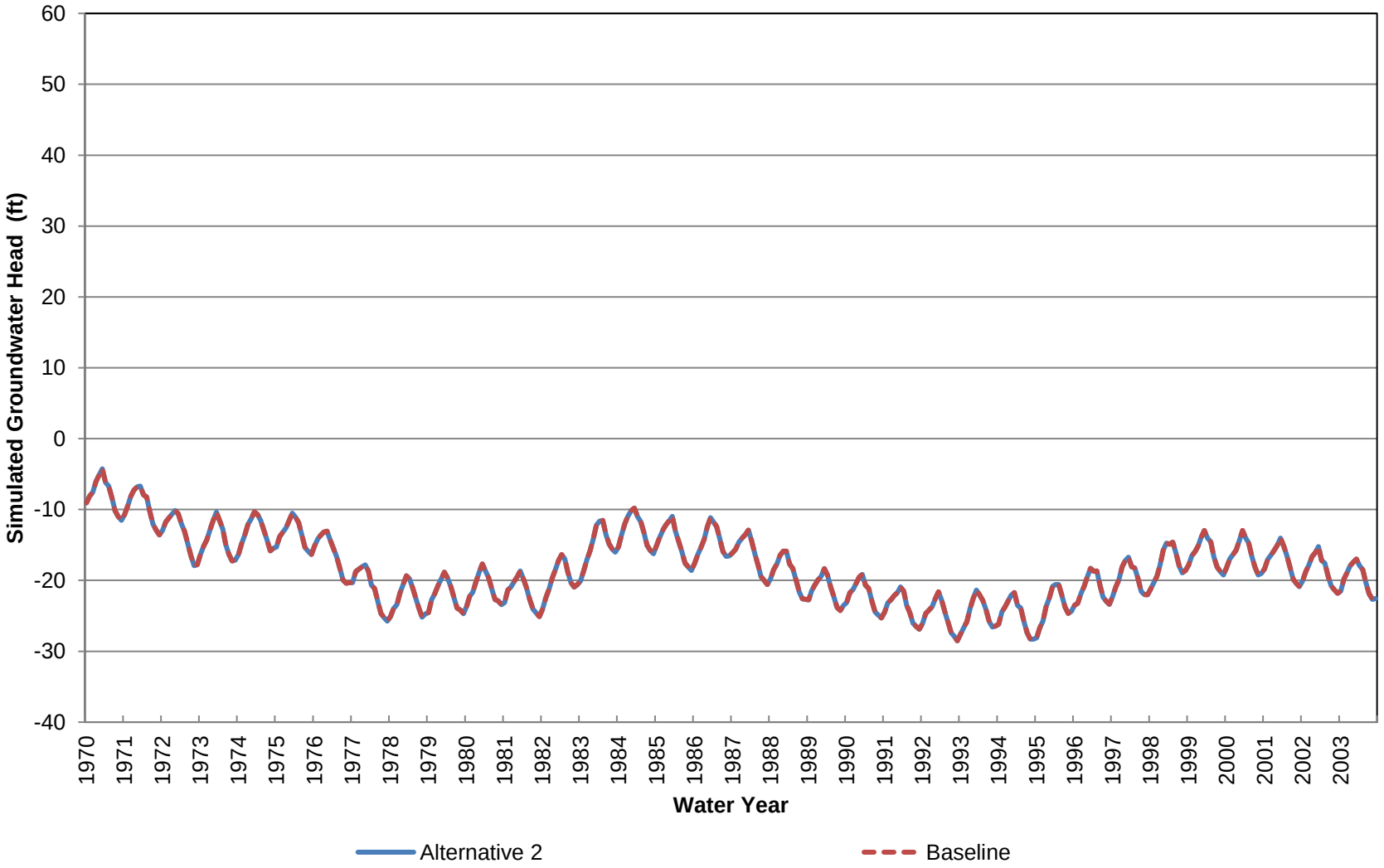
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 32 (Approximately 1140-1560 ft bgs)



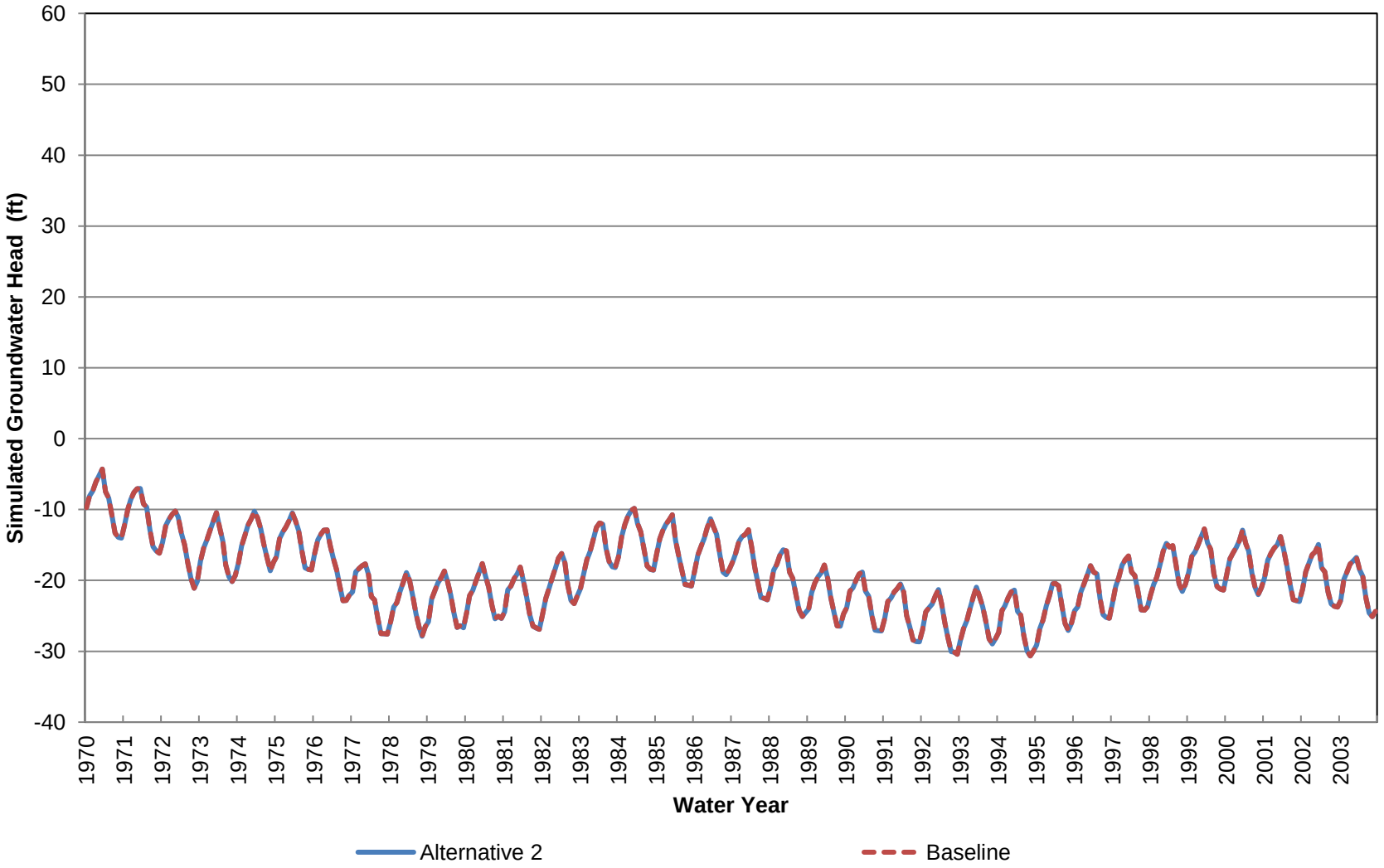
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 33 (Approximately 0-70 ft bgs)



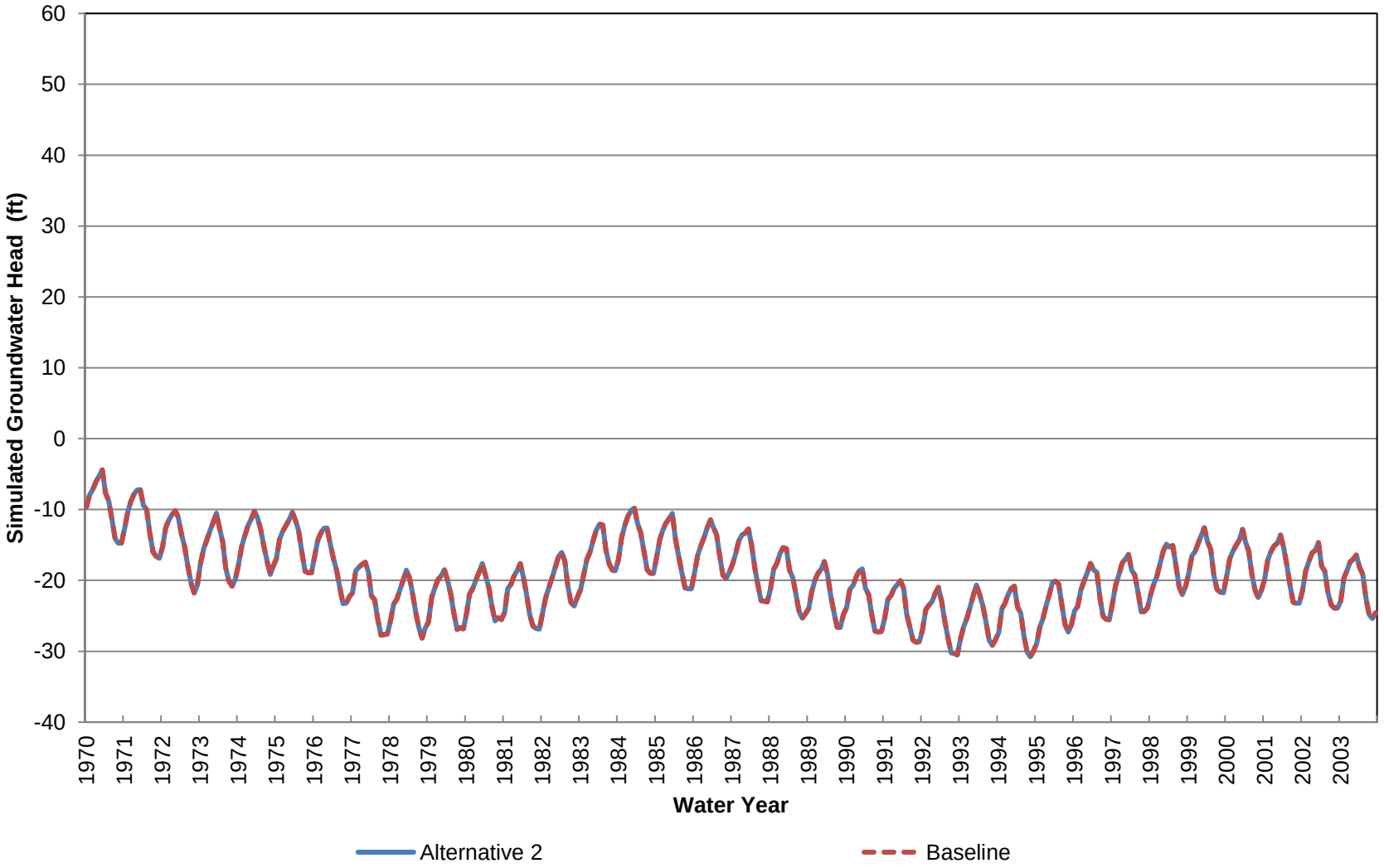
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 33 (Approximately 70-240 ft bgs)



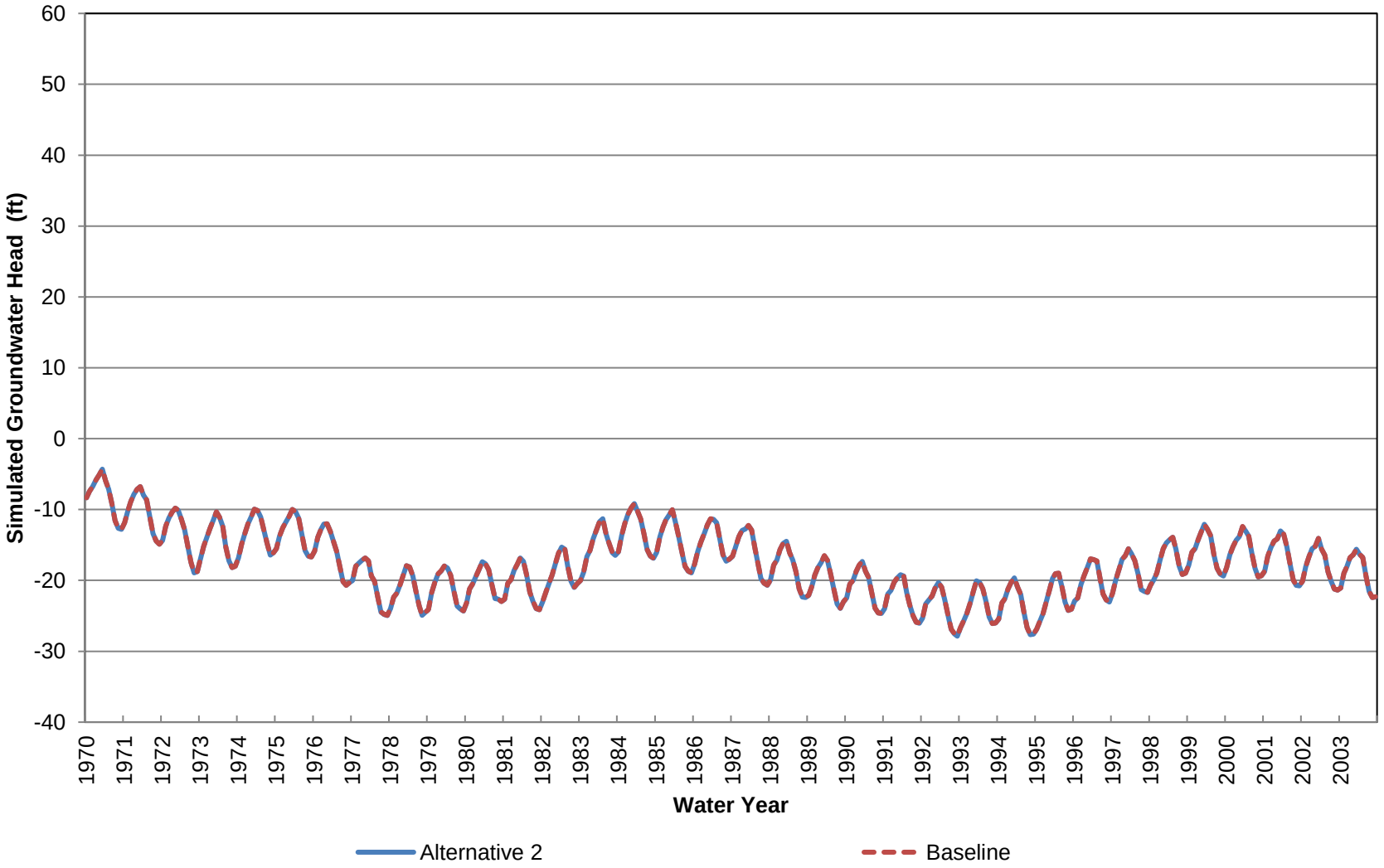
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 33 (Approximately 240-410 ft bgs)



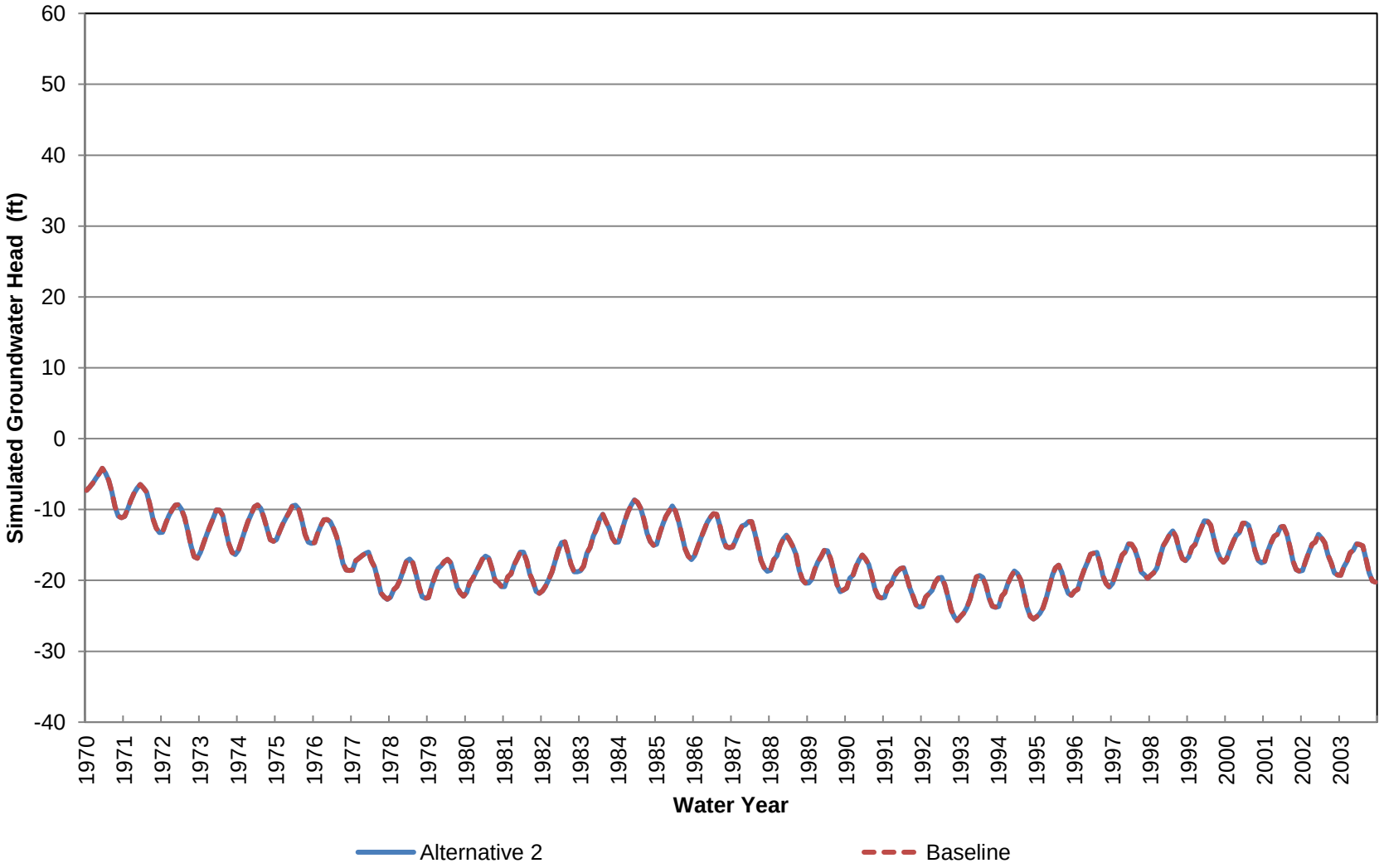
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 33 (Approximately 410-570 ft bgs)



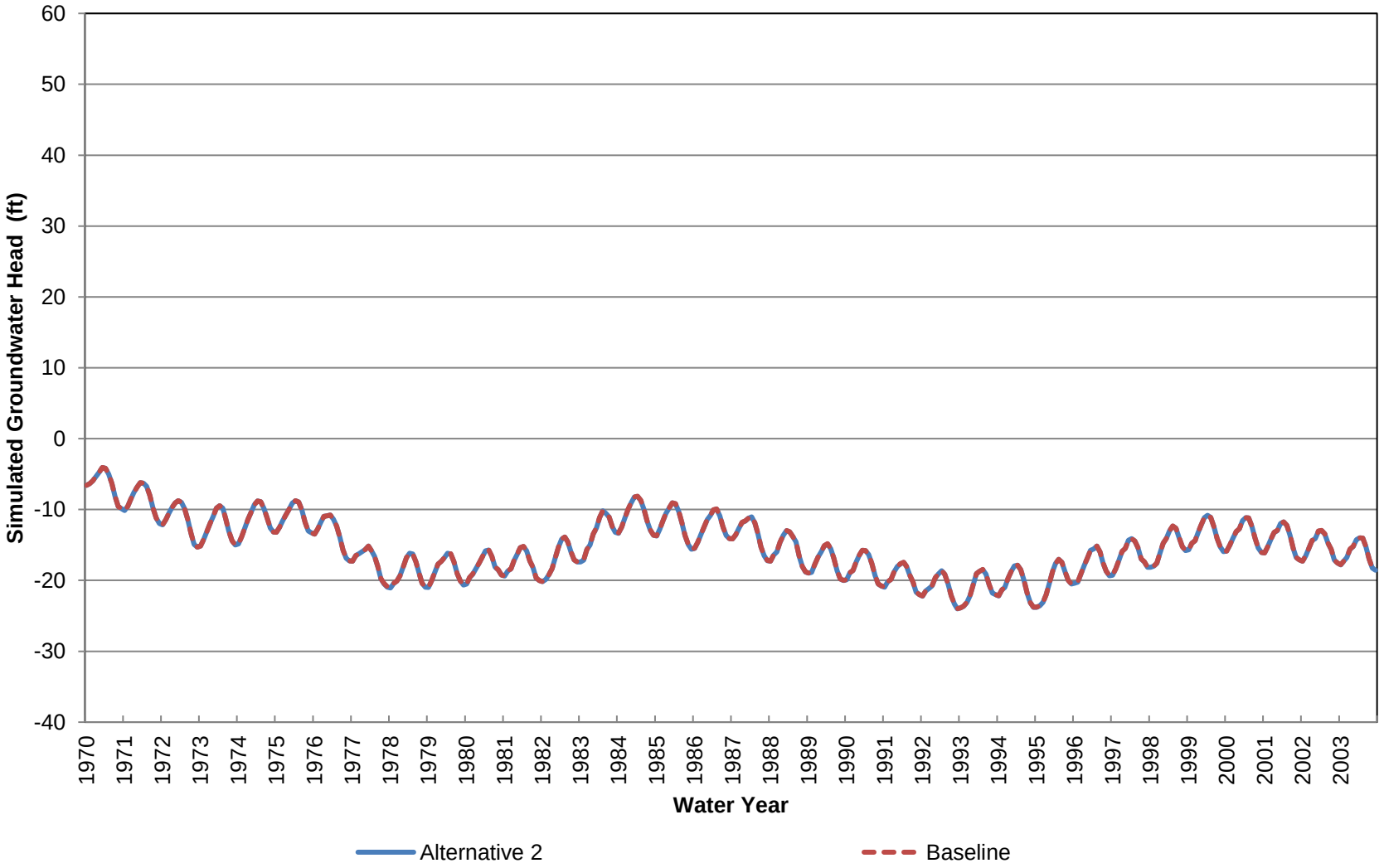
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 33 (Approximately 570-840 ft bgs)



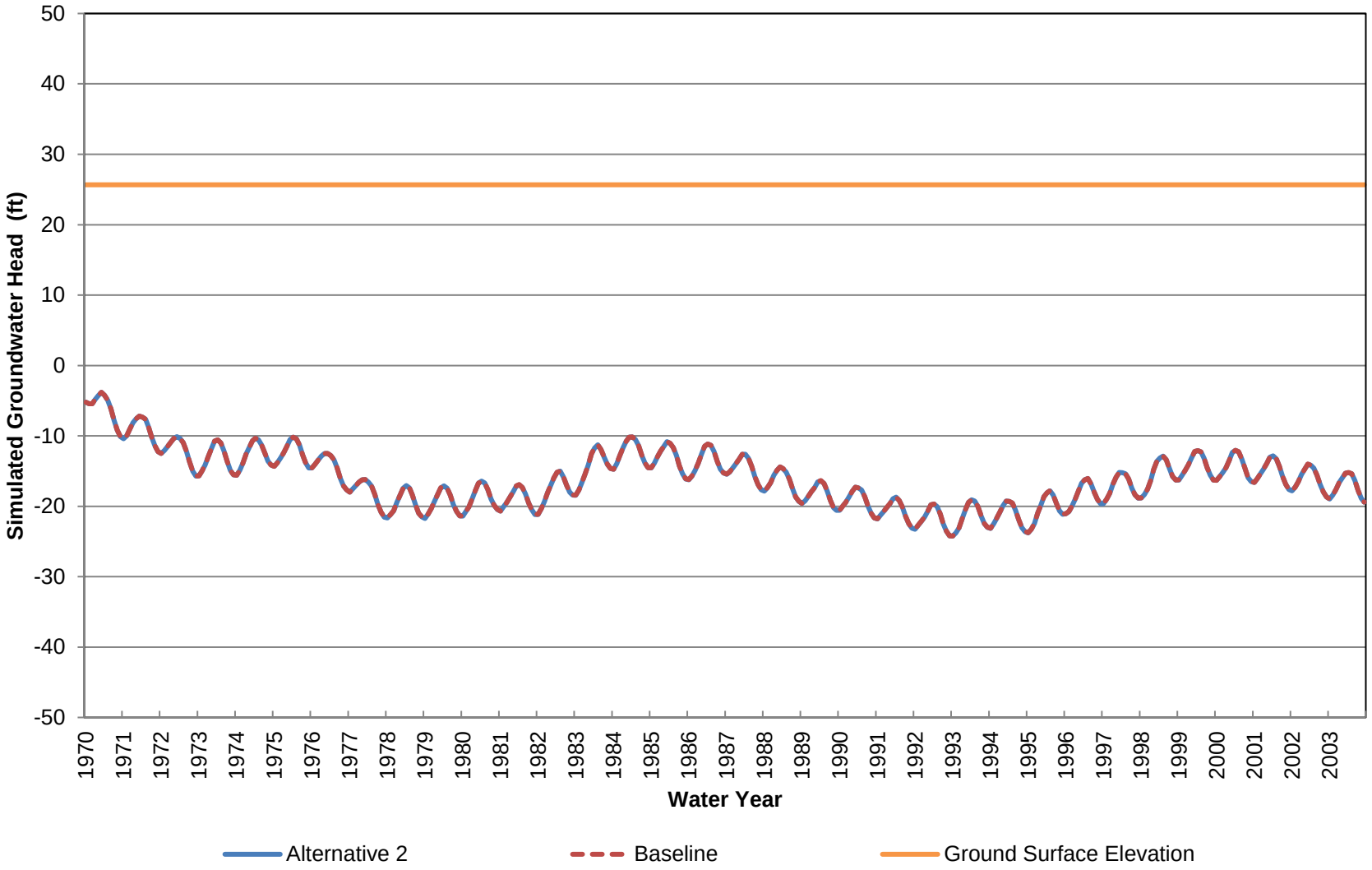
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 33 (Approximately 840-1120 ft bgs)



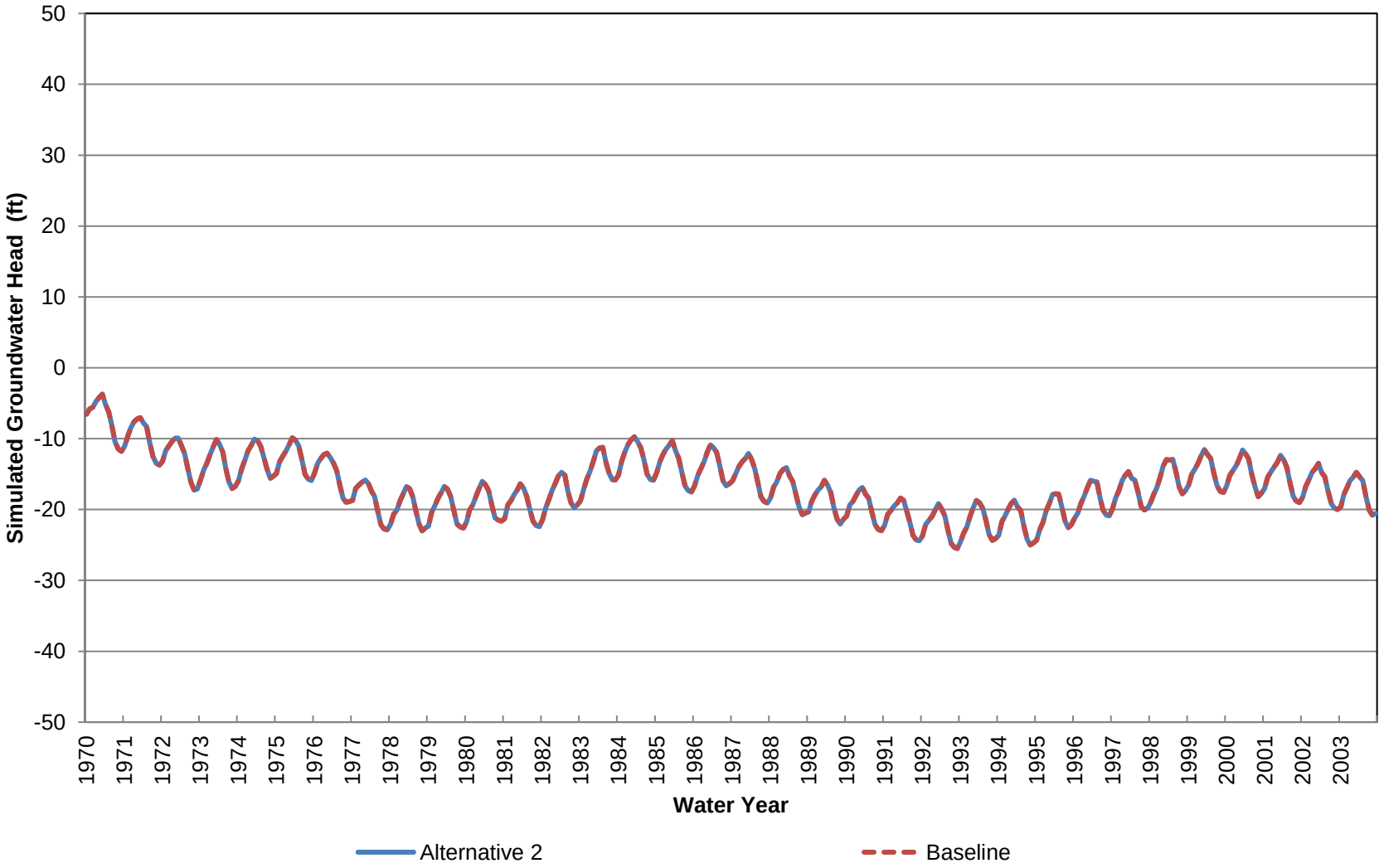
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 33 (Approximately 1120-1540 ft bgs)



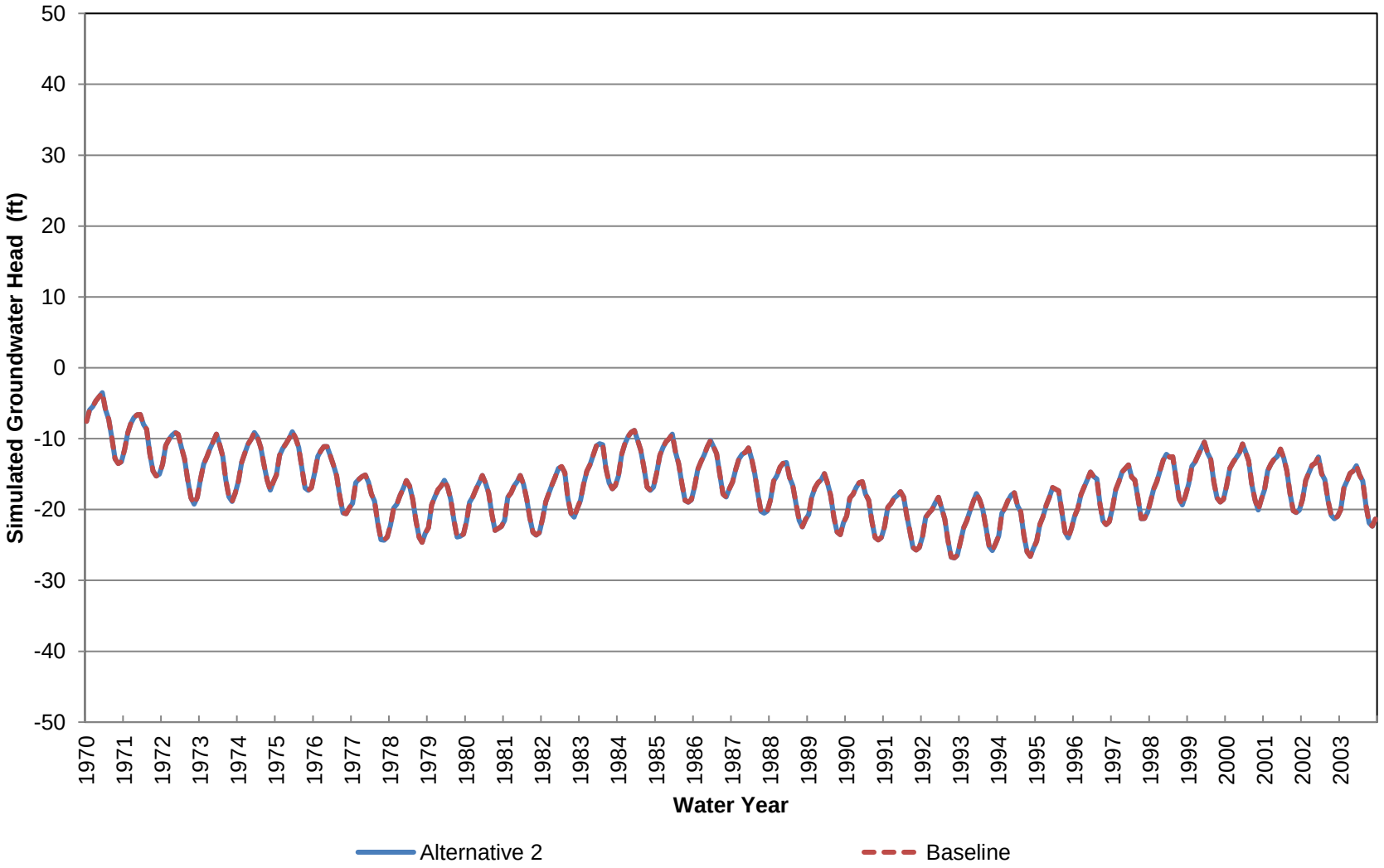
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Elevation at Location 34 (Approximately 0-70 ft bgs)



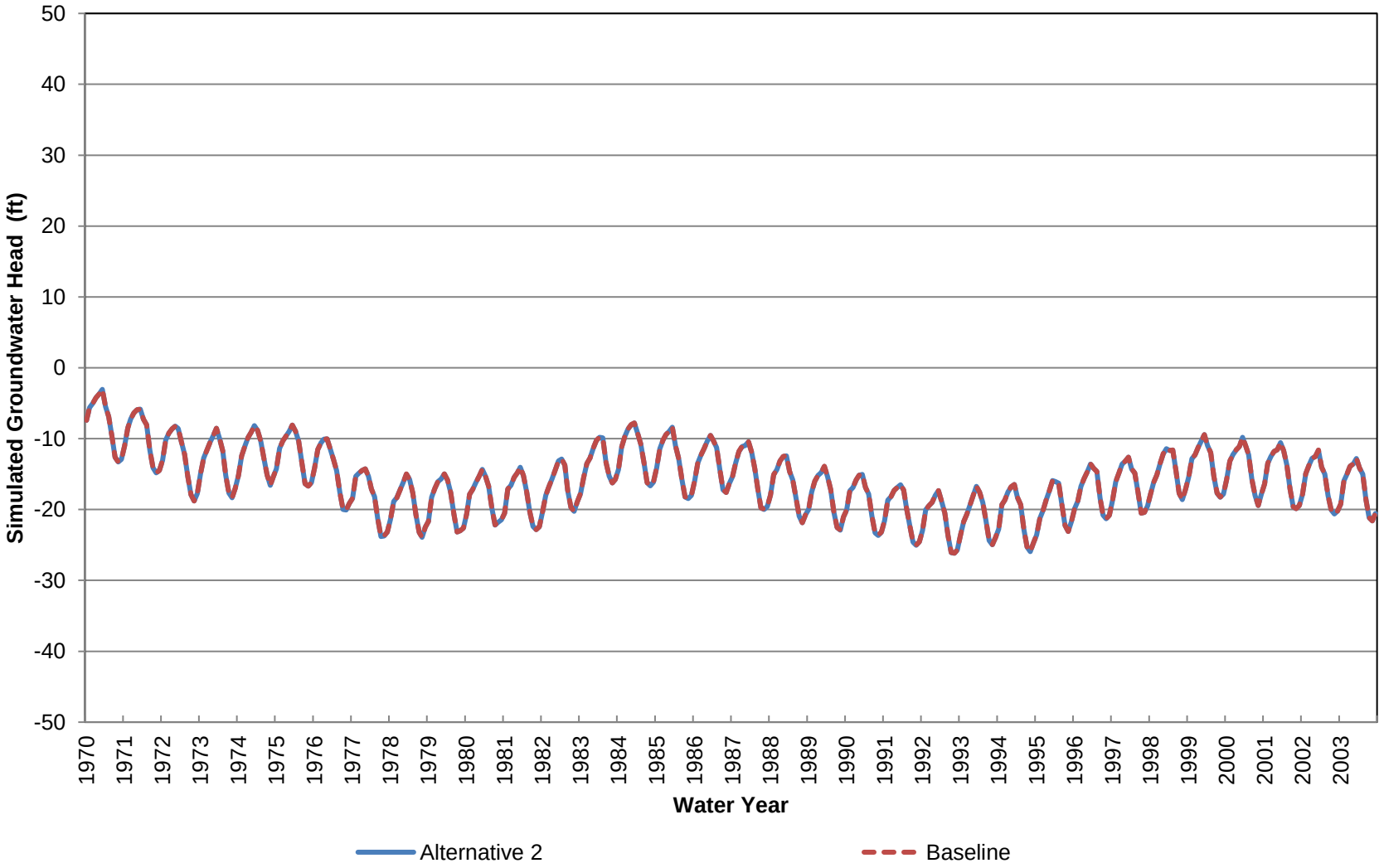
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 34 (Approximately 70-230 ft bgs)



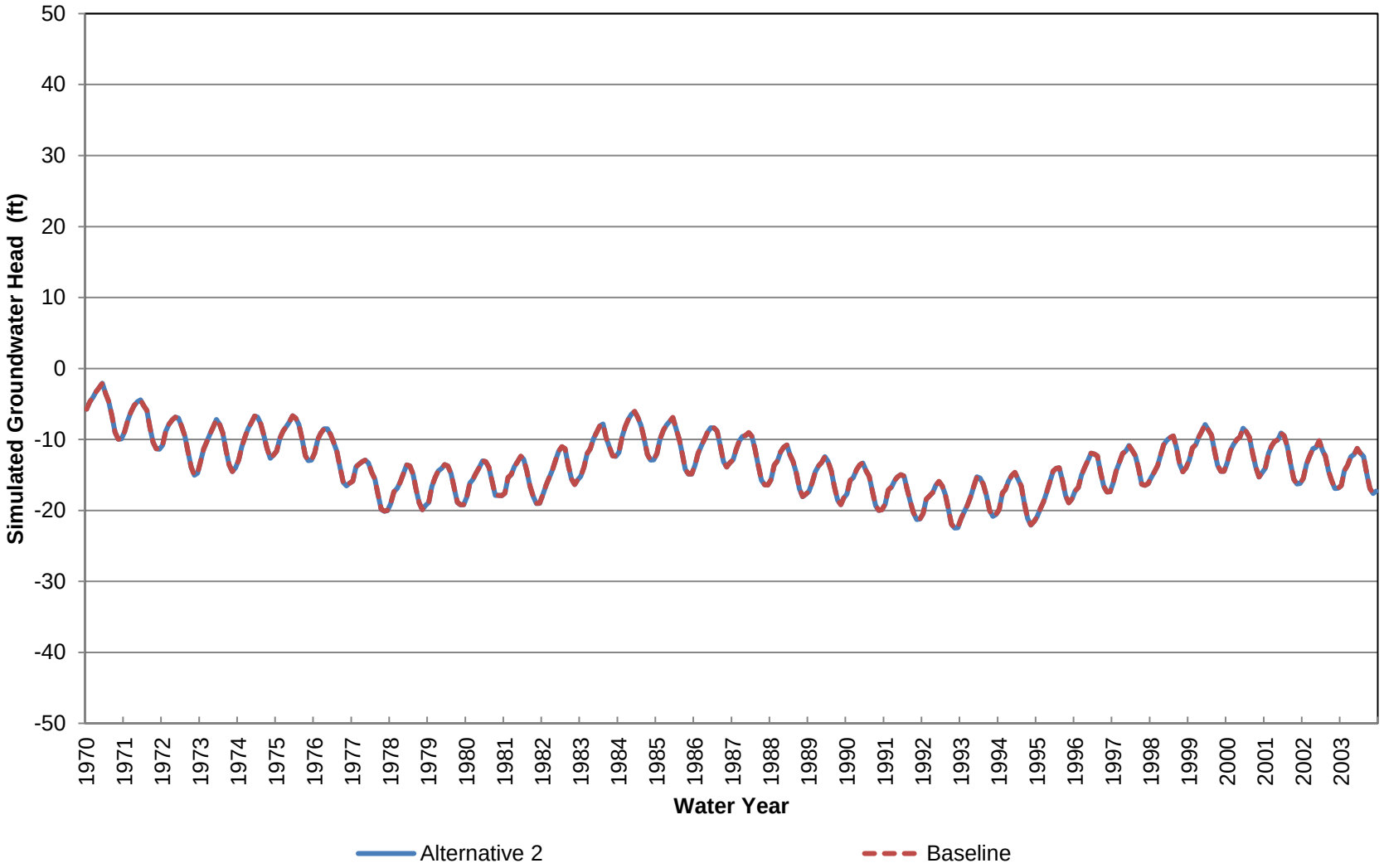
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 34 (Approximately 230-380 ft bgs)



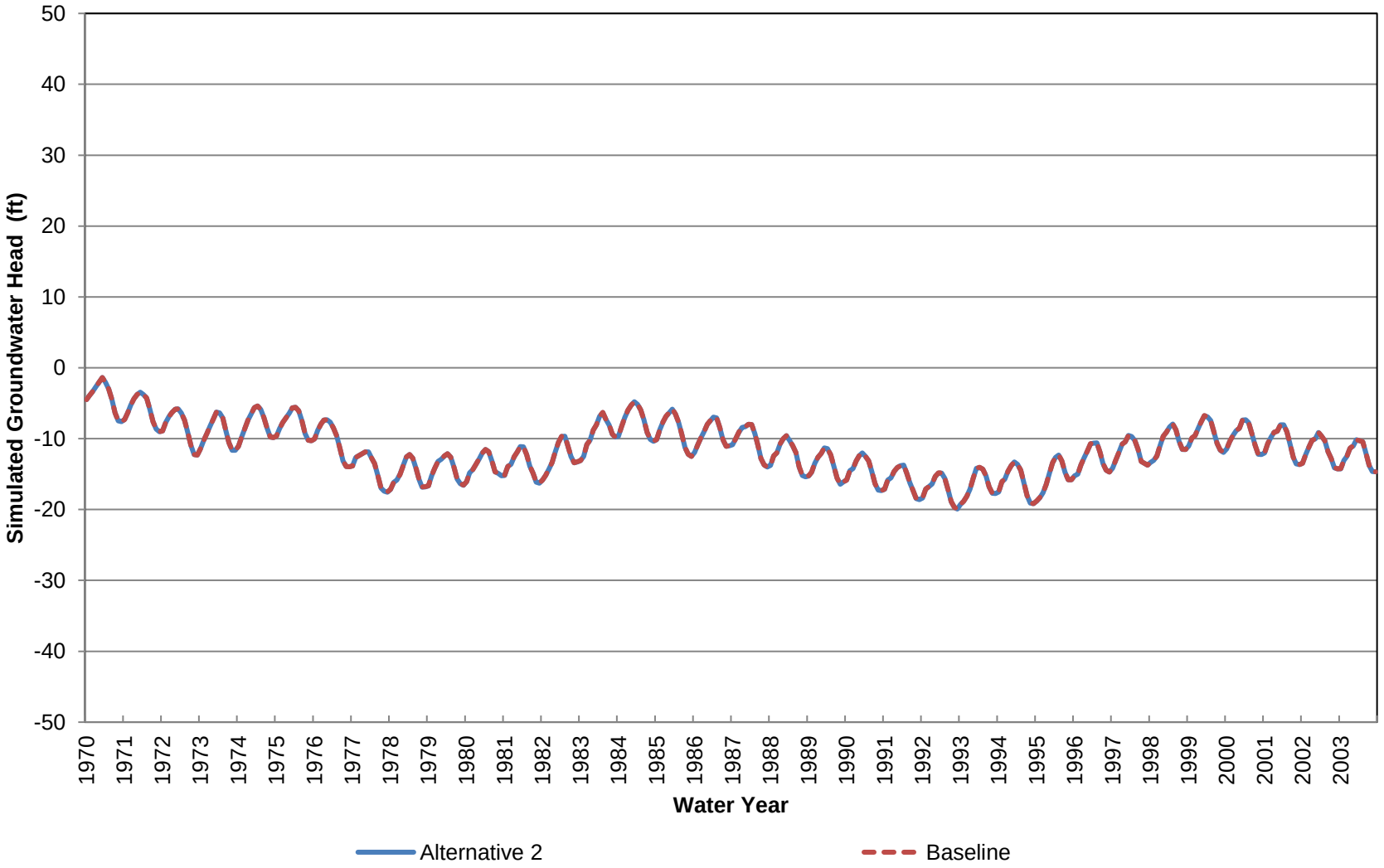
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 34 (Approximately 380-540 ft bgs)



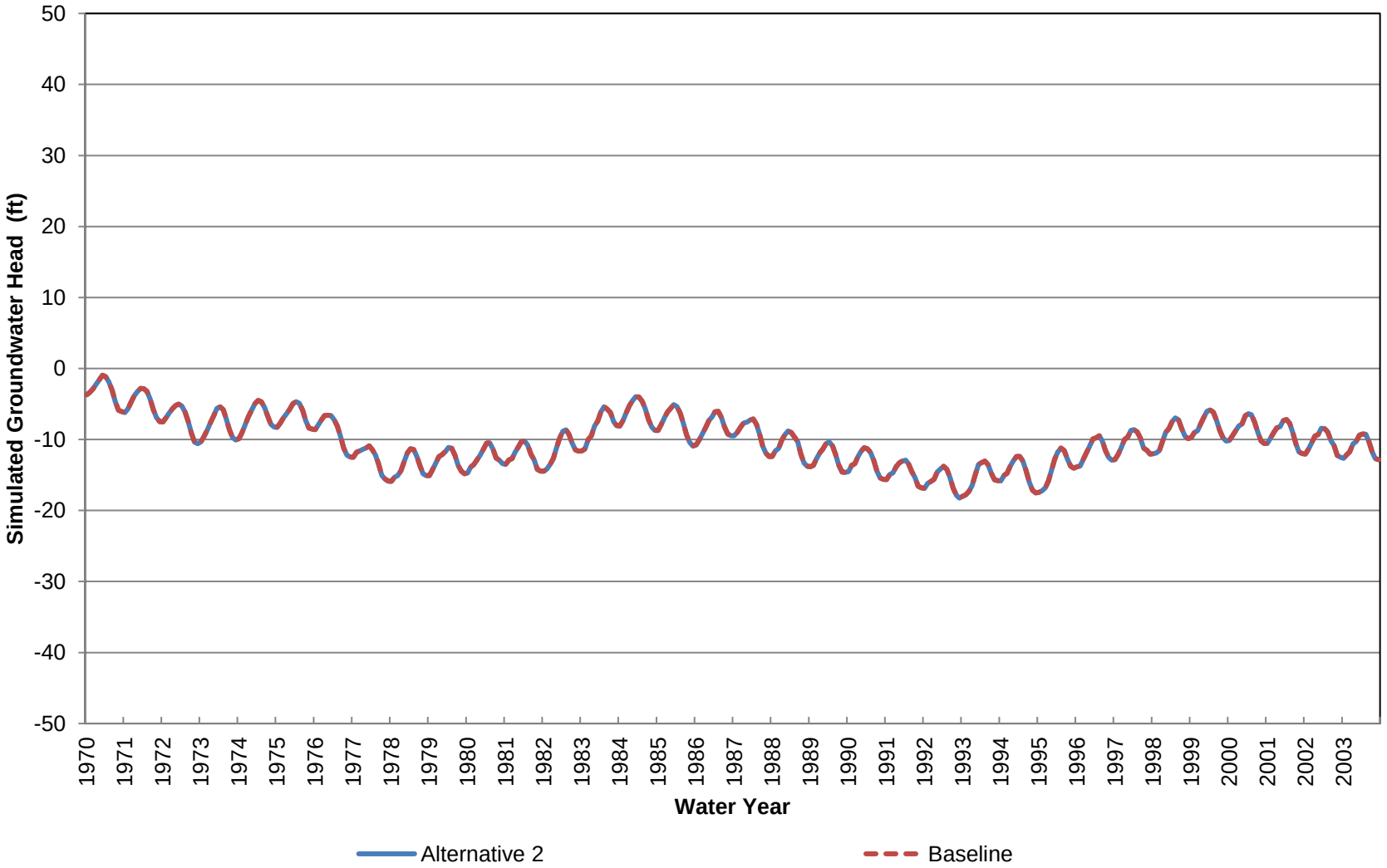
2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 34 (Approximately 540-780 ft bgs)



2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 34 (Approximately 780-1040 ft bgs)



2021 Tehama-Colusa Canal Authority Water Transfers
Simulated Groundwater Head at Location 34 (Approximately 1040-1430 ft bgs)



Appendix I

2015 Water Transfers Data Reports

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Anderson-Cottonwood Irrigation District

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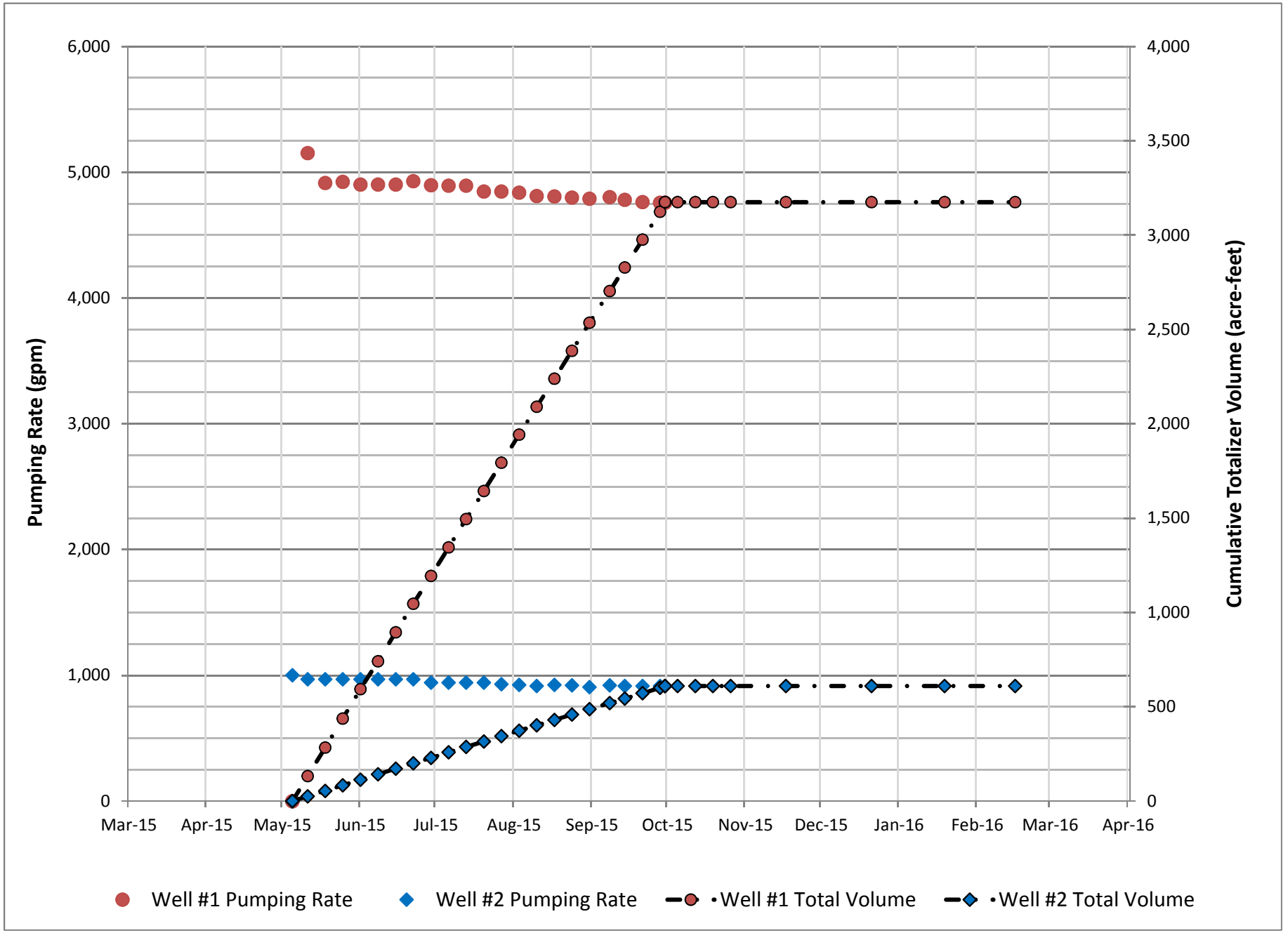
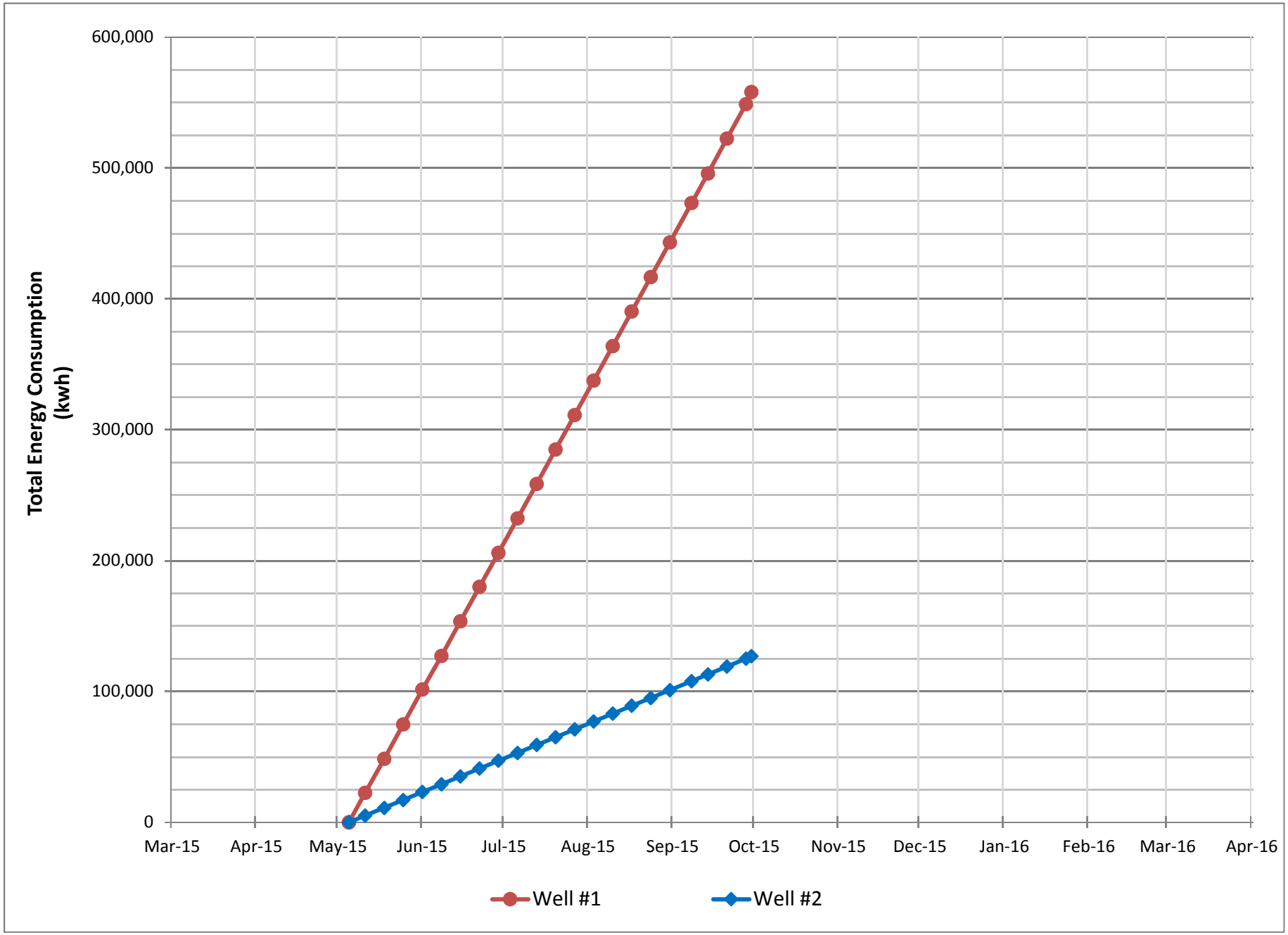
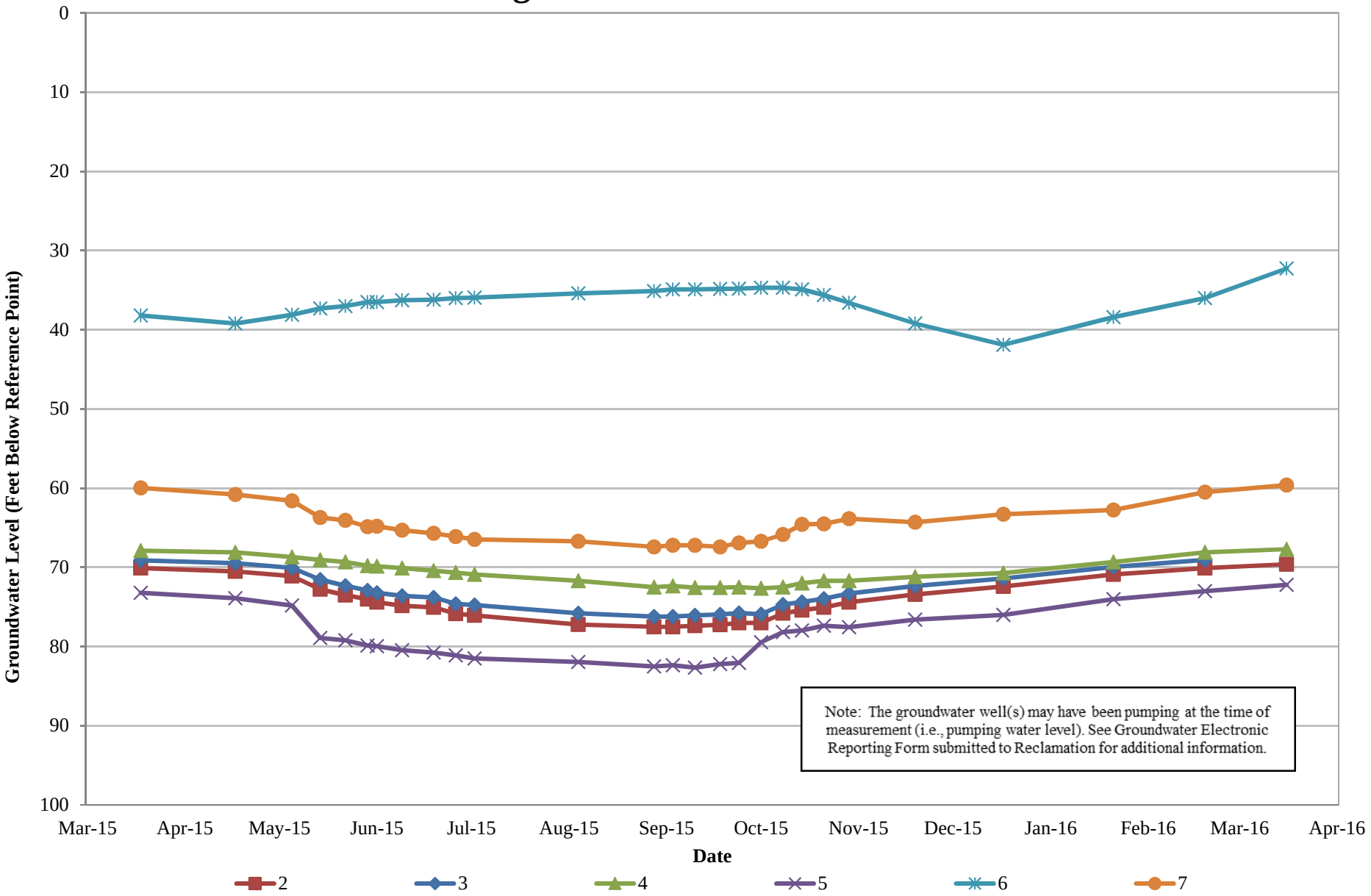
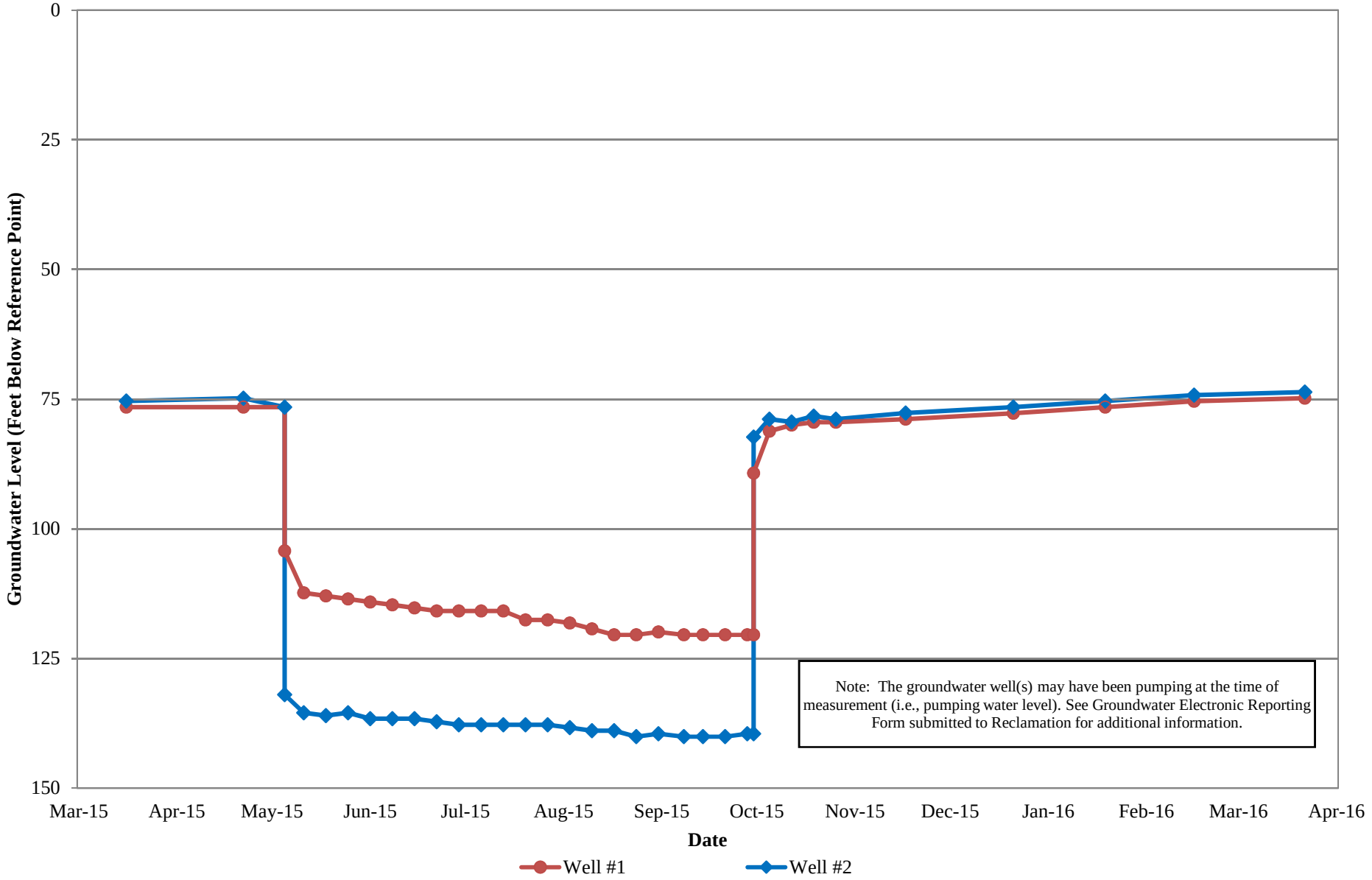

6,000
5,000
4,000
3,000
2,000
1,000
0
Pumping Rate (gpm)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Cumulative Totalizer Volume (acre-feet)
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15
Sep-15
Oct-15
Nov-15
Dec-15
Jan-16
Feb-16
Mar-16
Apr-16
Well #1 Pumping Rate
Well #2 Pumping Rate
Well #1 Total Volume
Well #2 Total Volume

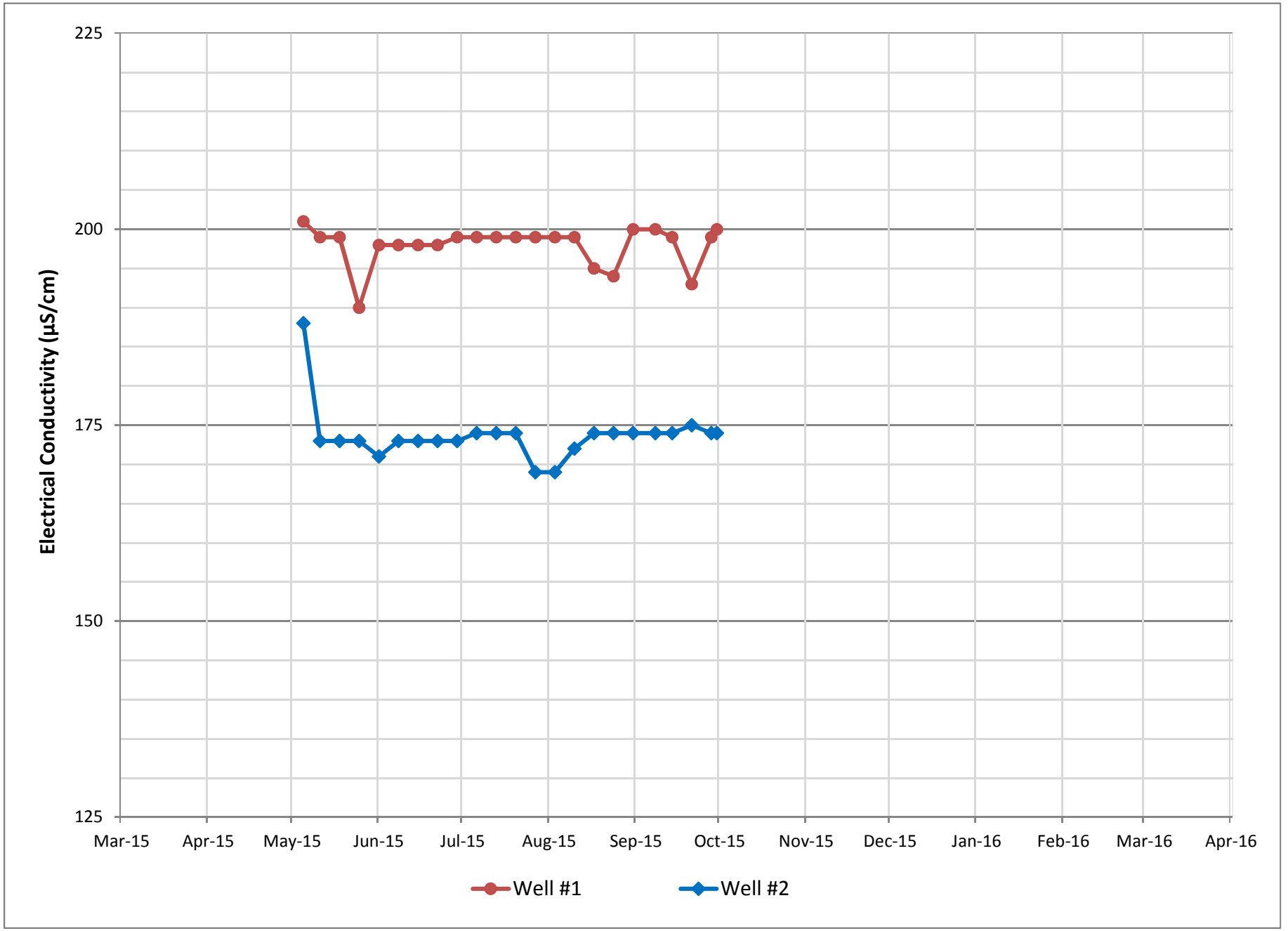

Total Energy Consumption (kwh)
600,000
500,000
400,000
300,000
200,000
100,000
0
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15
Sep-15
Oct-15
Nov-15
Dec-15
Jan-16
Feb-16
Mar-16
Apr-16
Well #1
Well #2

Anderson-Cottonwood Irrigation District
Monitoring Well Groundwater Level Data

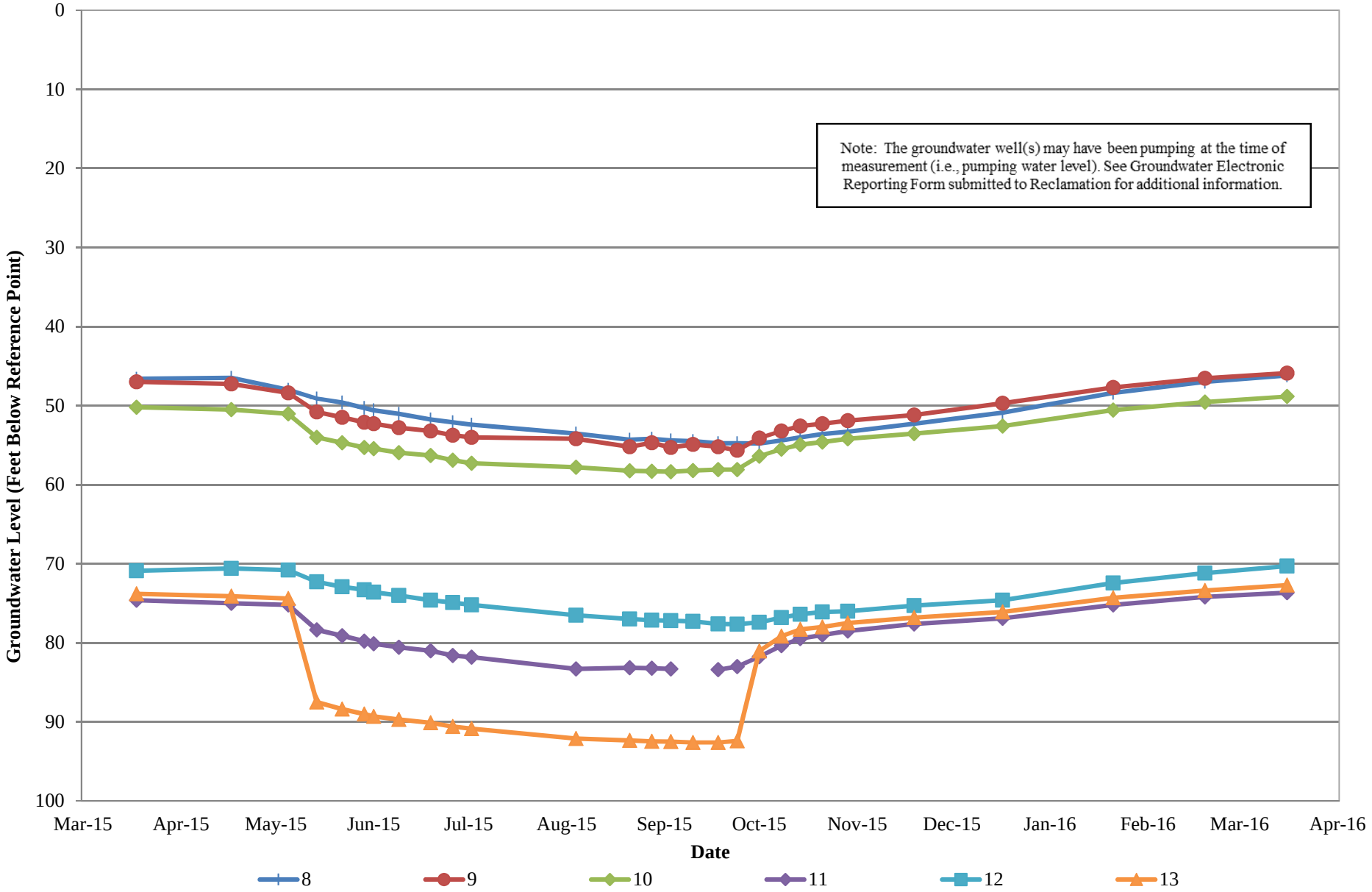


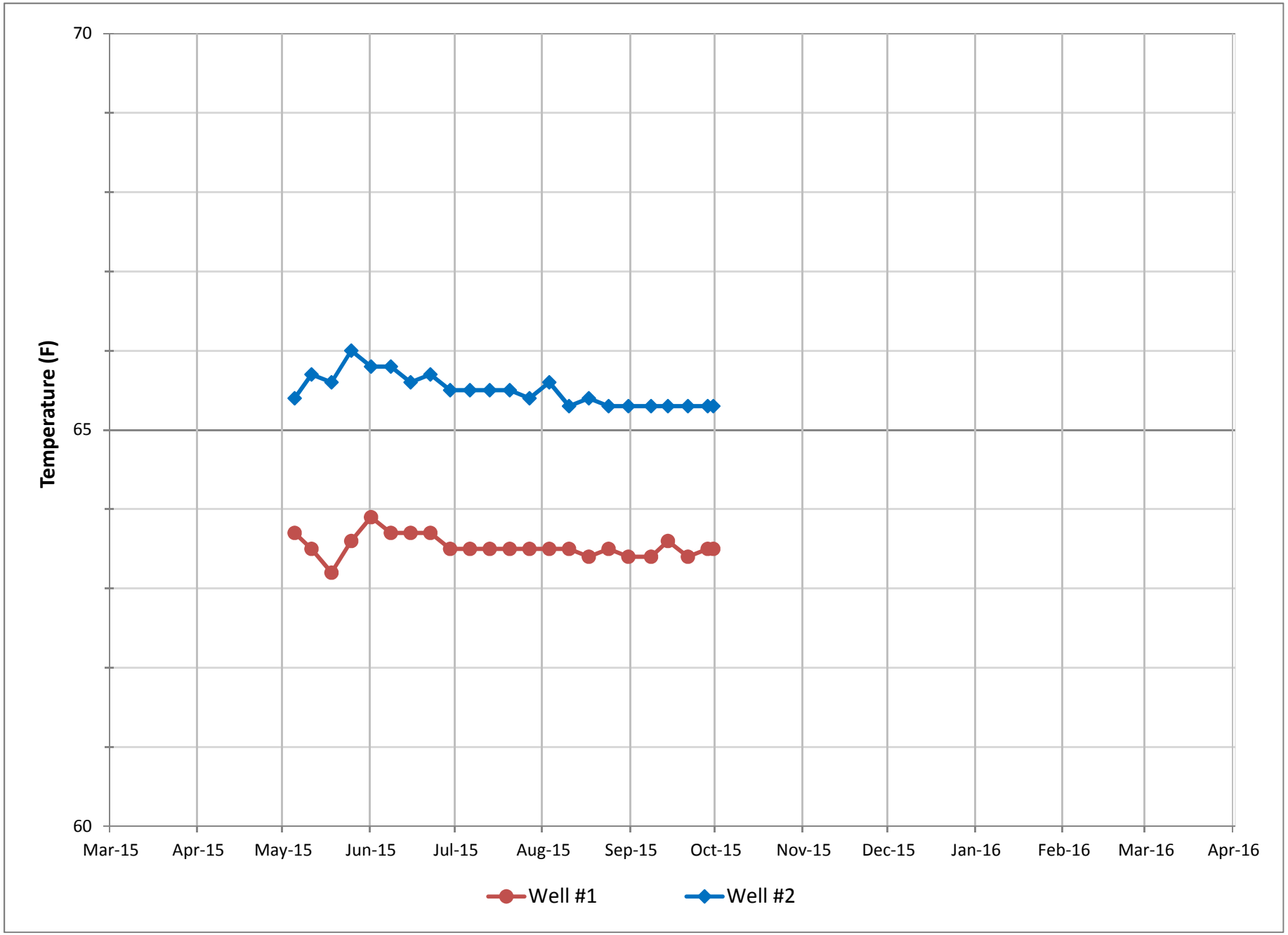
Anderson-Cottonwood Irrigation District
Production Well Groundwater Level Data




225
200
175
150
125
Electrical Conductivity (µS/cm)
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15
Sep-15
Oct-15
Nov-15
Dec-15
Jan-16
Feb-16
Mar-16
Apr-16
Well #1
Well #2

Anderson-Cottonwood Irrigation District
Monitoring Well Groundwater Level Data




70
65
60
Temperature (F)
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15
Sep-15
Oct-15
Nov-15
Dec-15
Jan-16
Feb-16
Mar-16
Apr-16
Well #1
Well #2

Canal Farms

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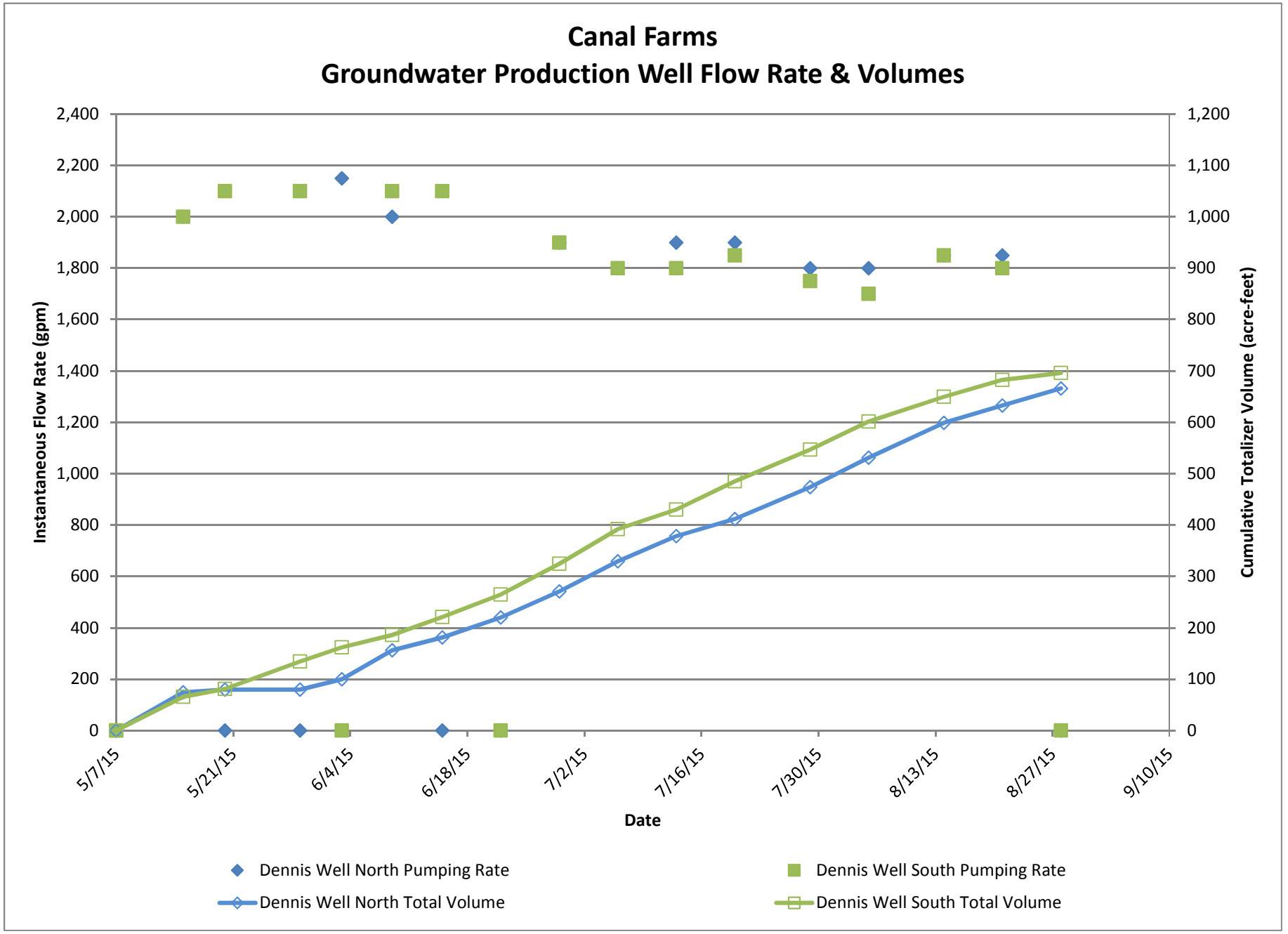
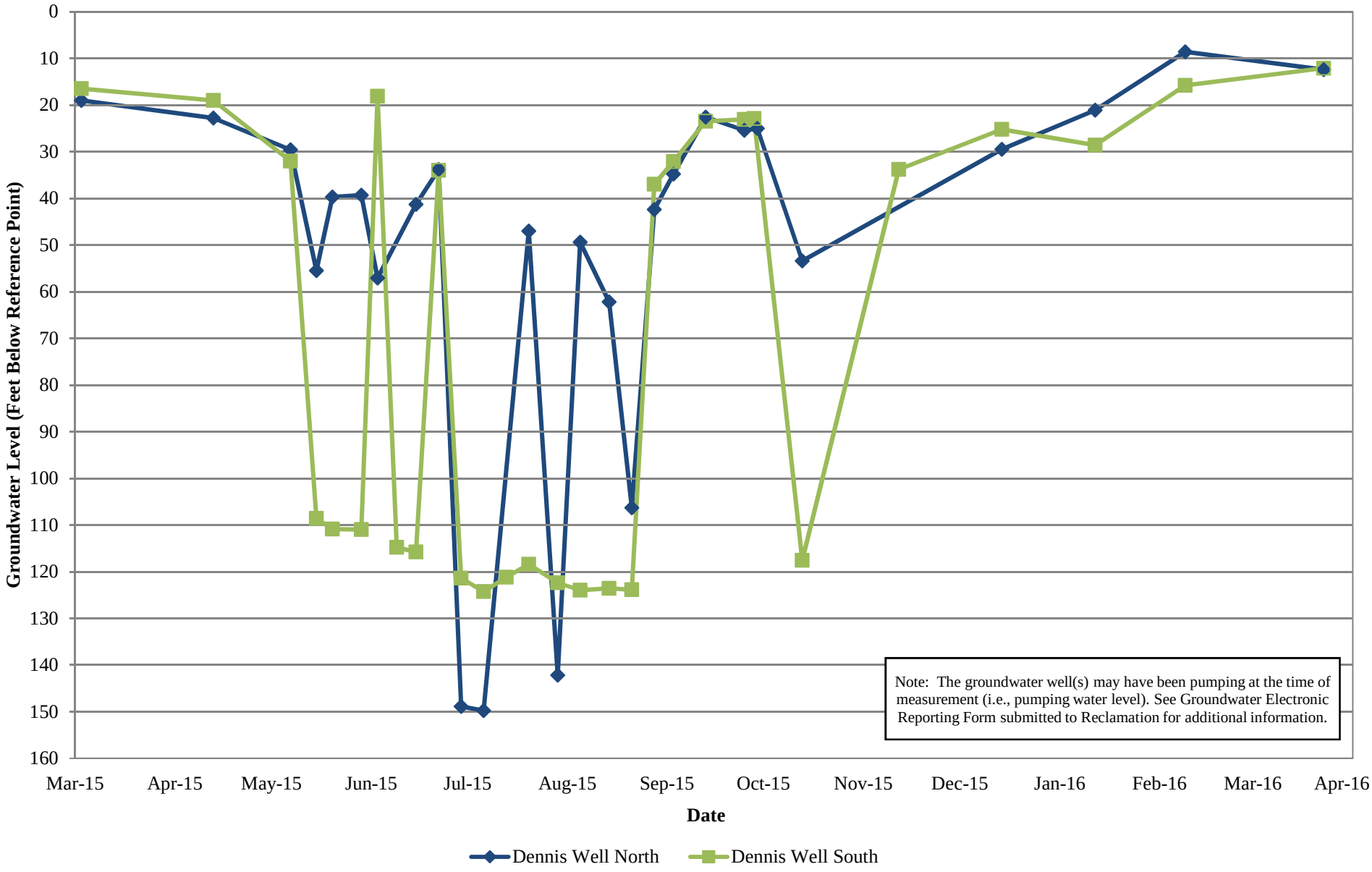
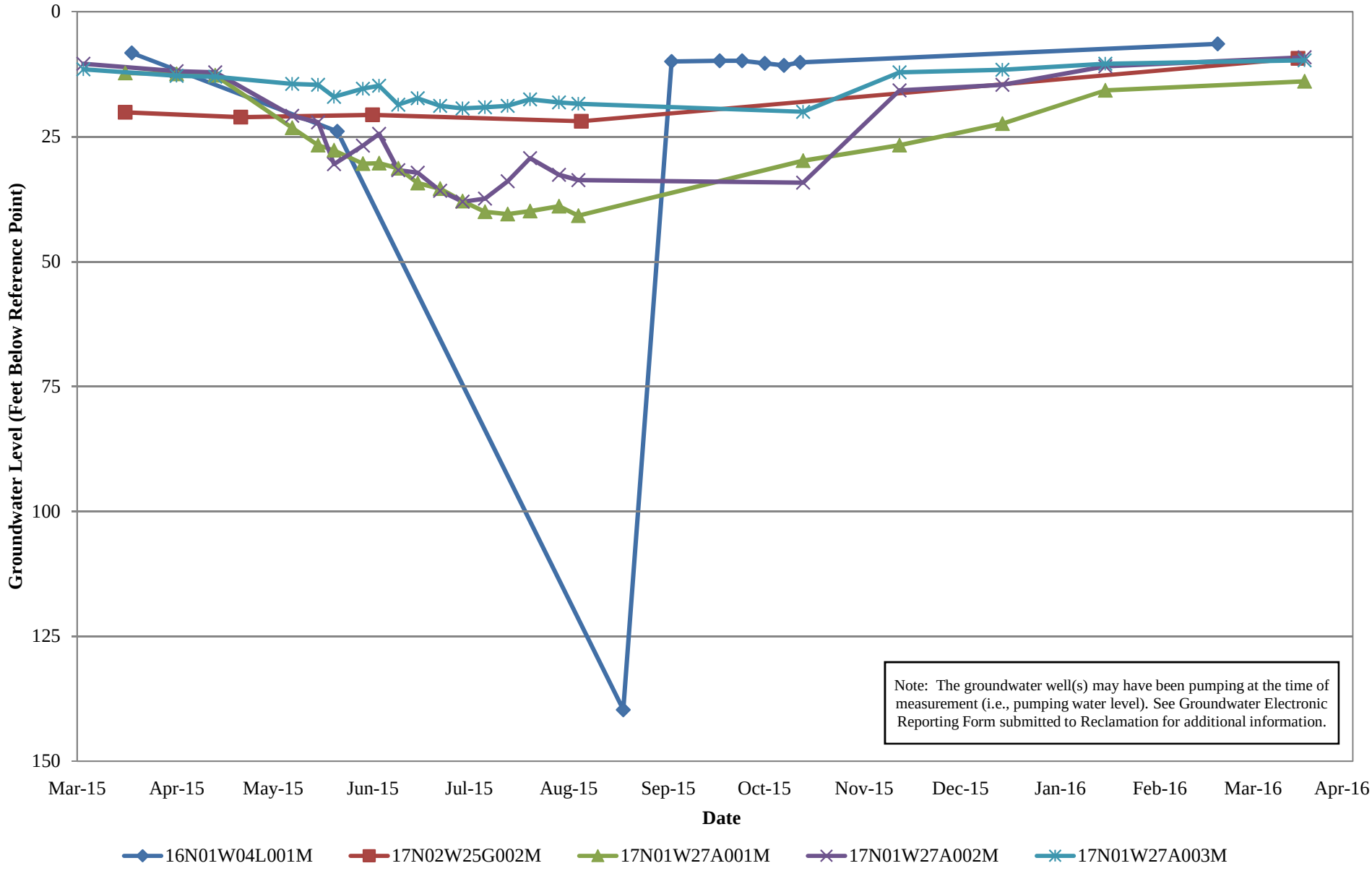

Canal Farms
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
5/7/15
5/21/15
6/4/15
6/18/15
7/2/15
7/16/15
7/30/15
8/13/15
8/27/15
9/10/15
Date
Dennis Well North Pumping Rate
Dennis Well South Pumping Rate
Dennis Well North Total Volume
Dennis Well South Total Volume

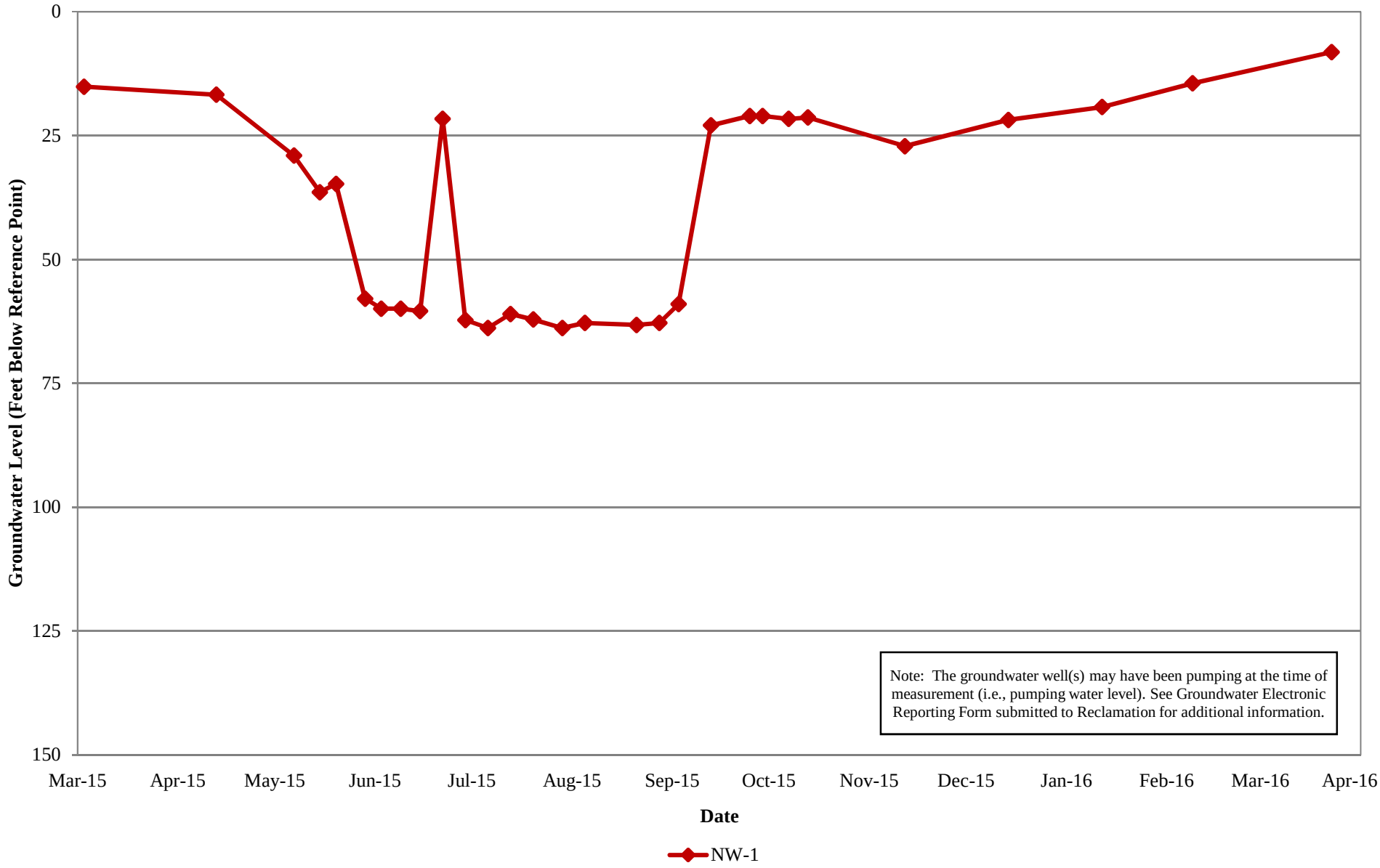
Canal Farms
Production Well Groundwater Level Data



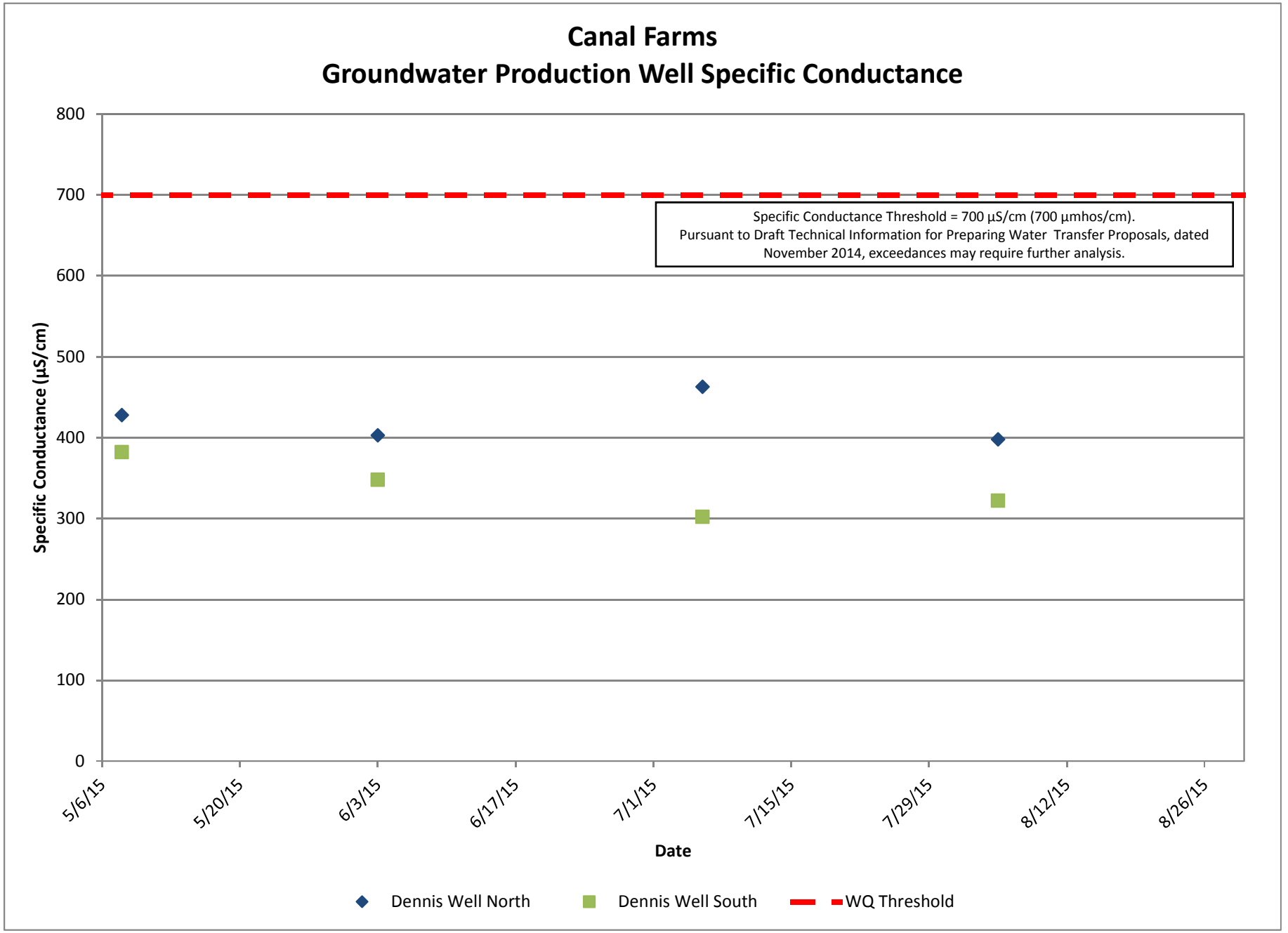
Canal Farms
DWR Monitoring Well Groundwater Level Data



Canal Farms
Monitoring Well Groundwater Level Data



Canal Farms
Groundwater Production Well Specific Conductance



Conaway Preservation Group

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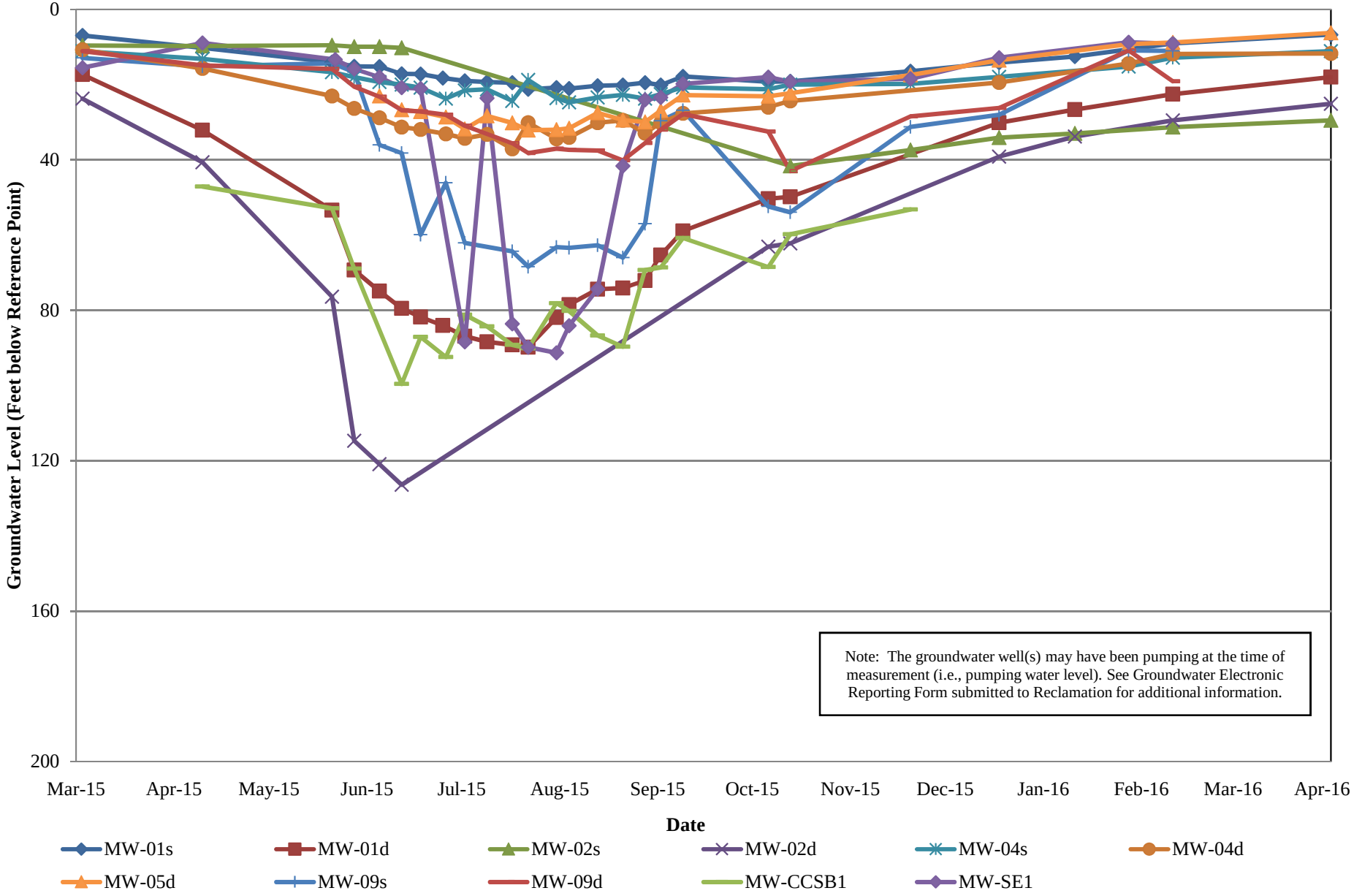
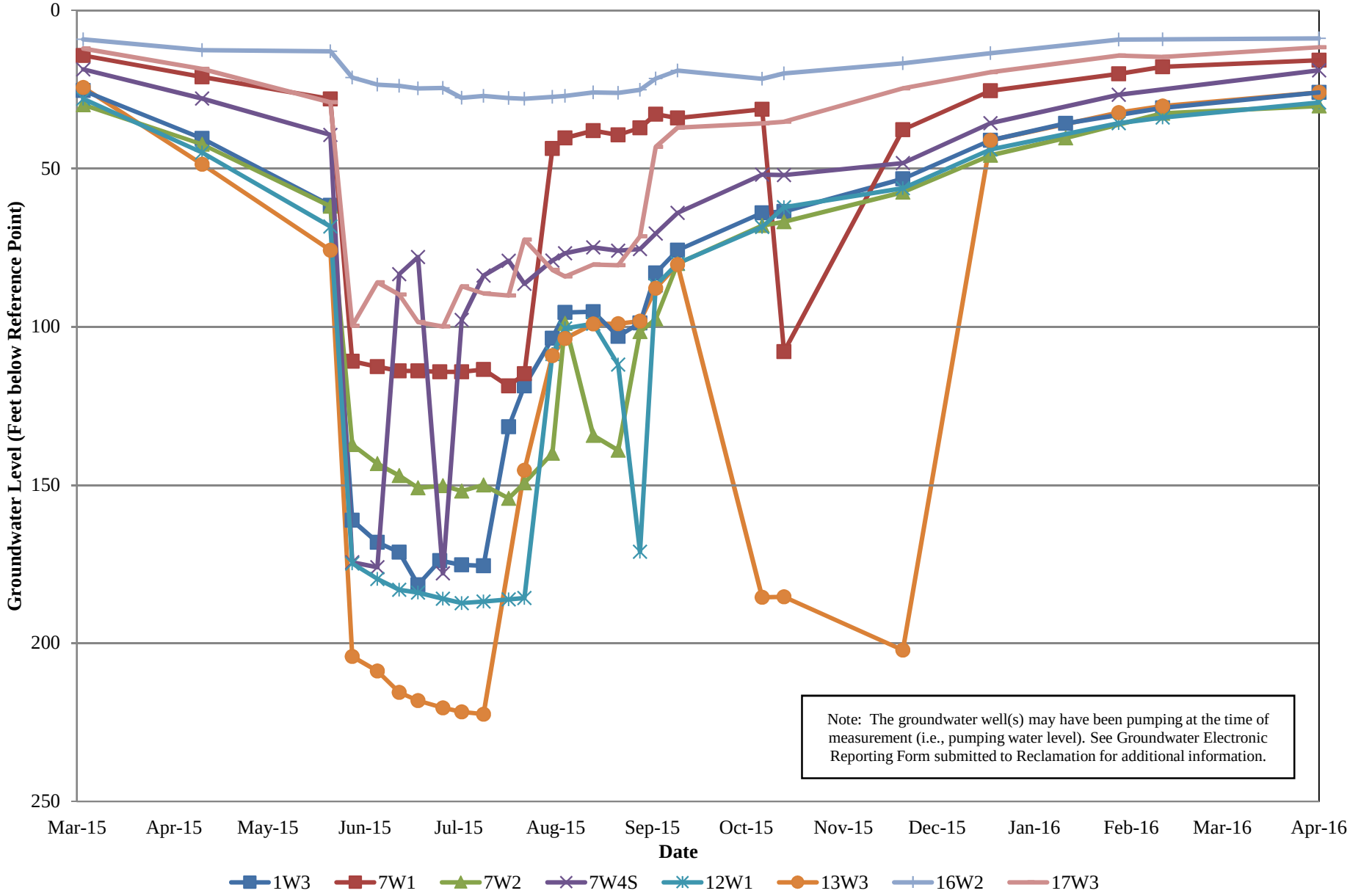
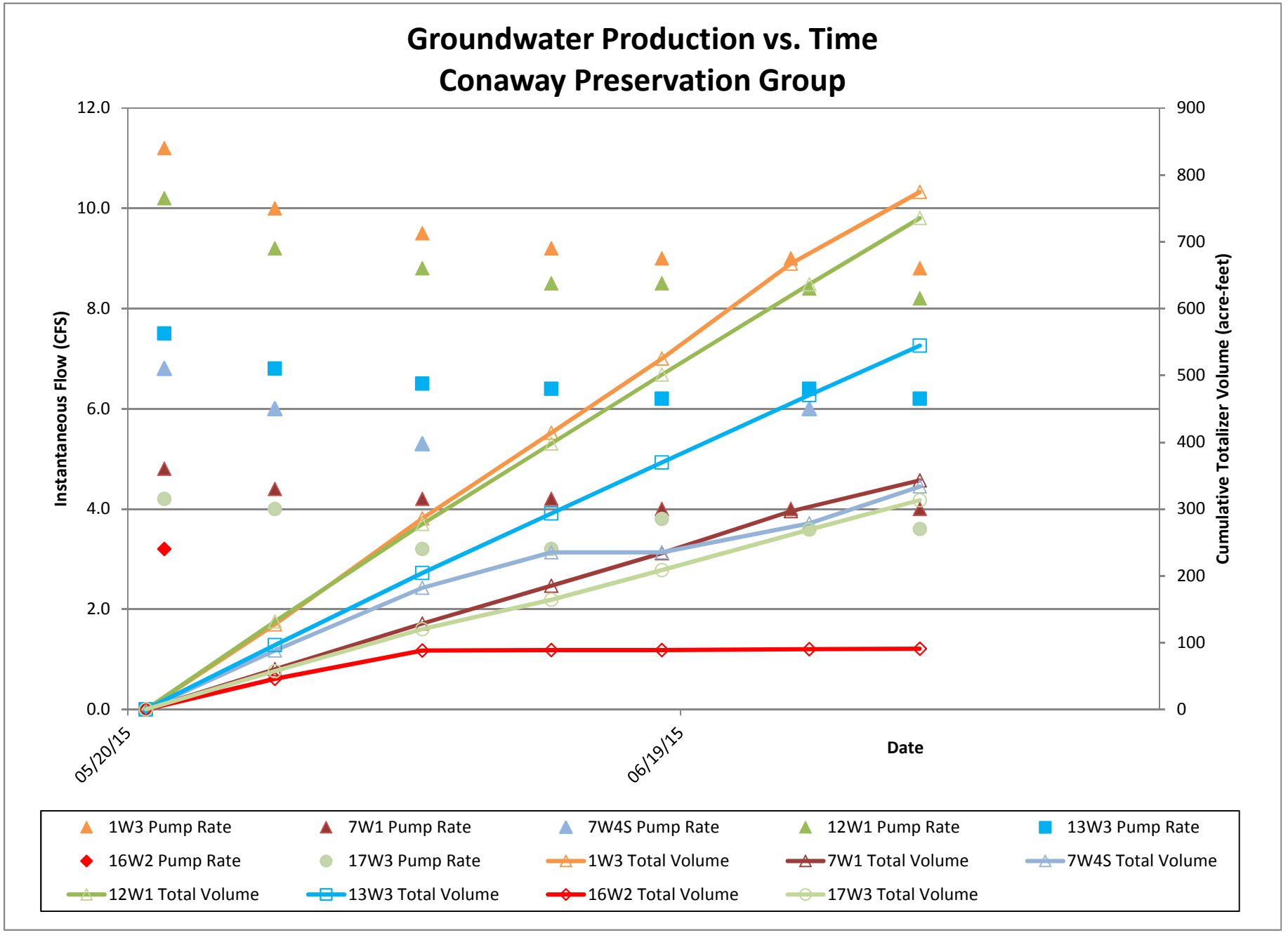
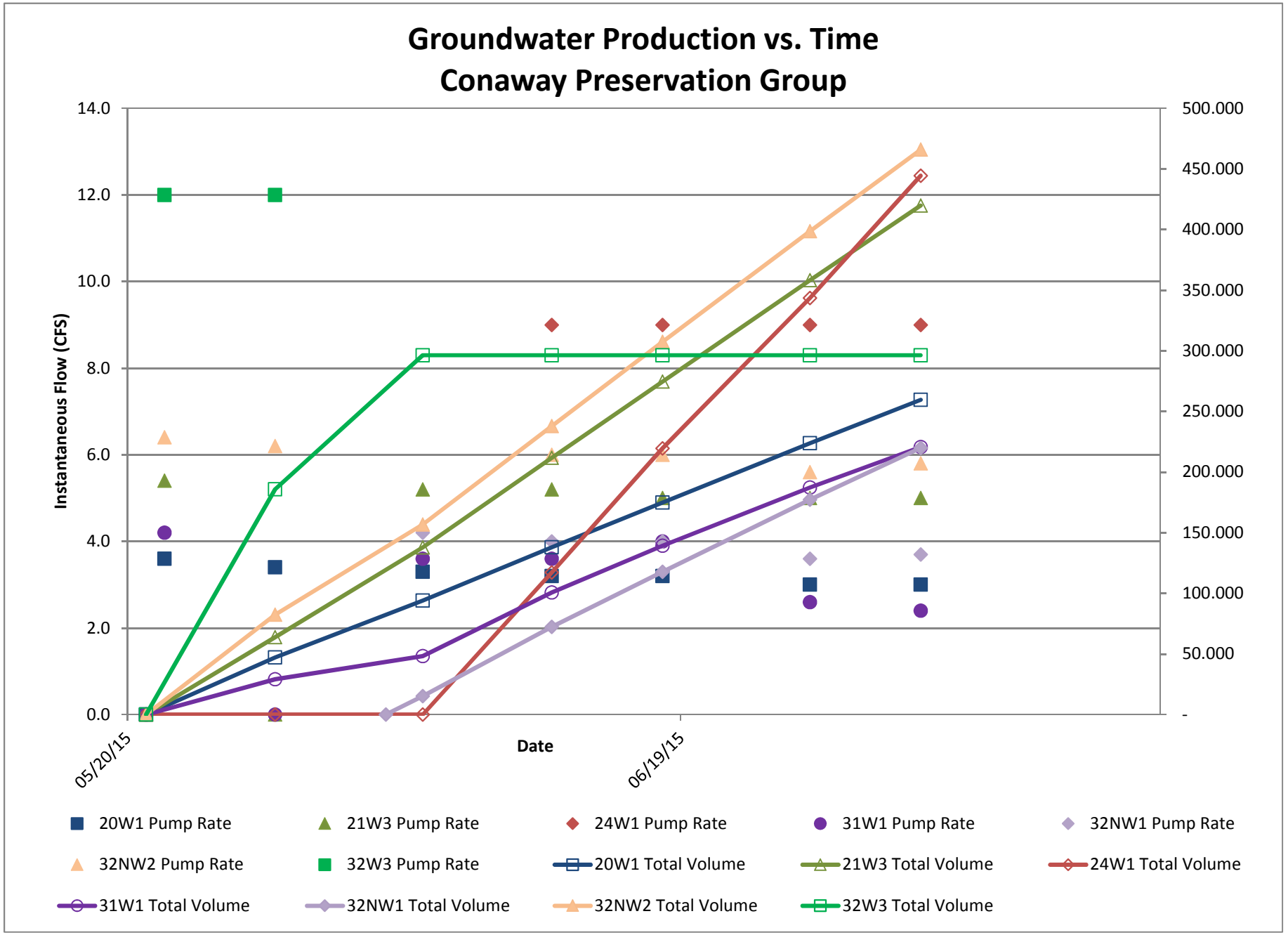
Conaway Preservation Group
Monitoring Well Groundwater Level Data



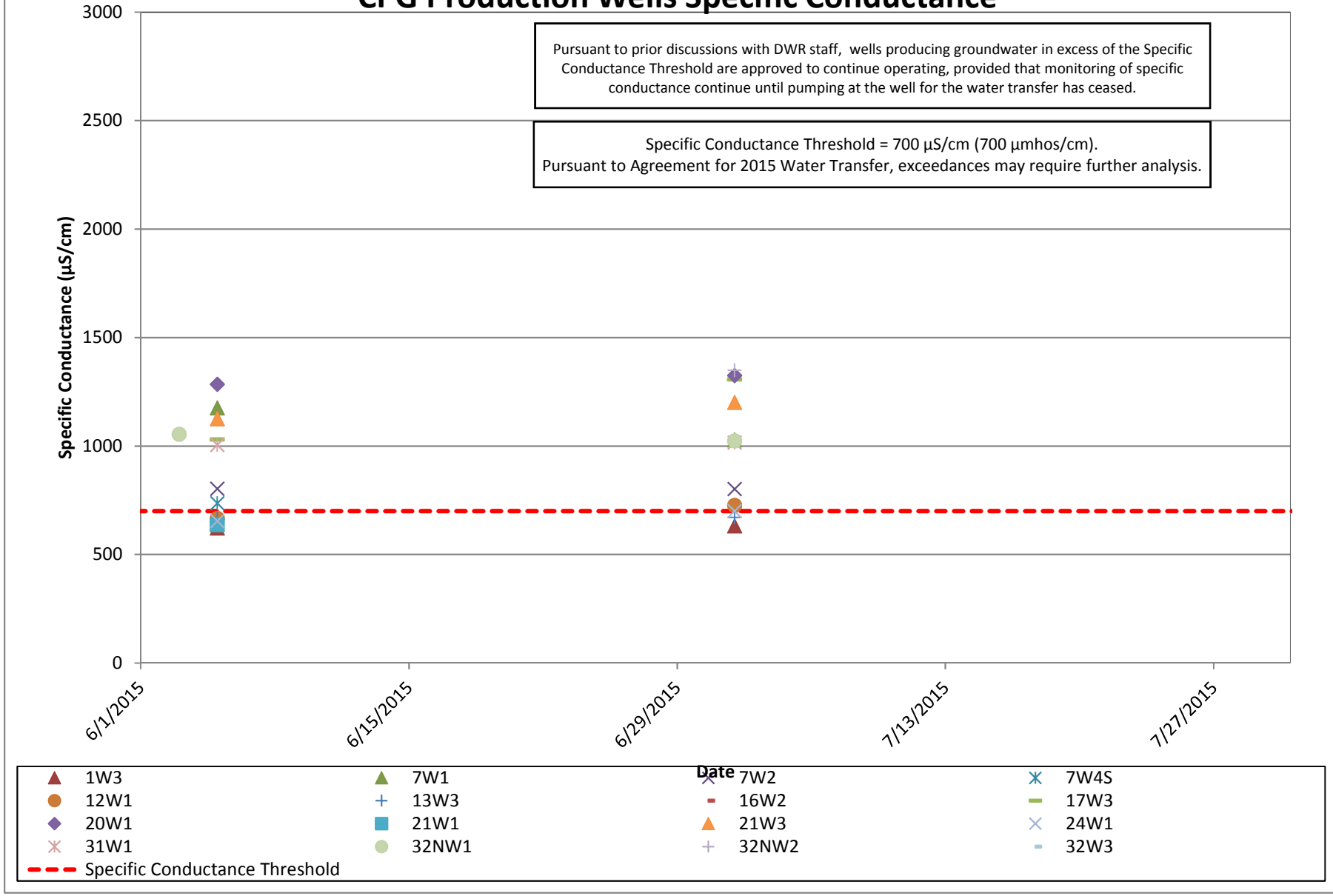
Conaway Preservation Group
Production Well Groundwater Level Data

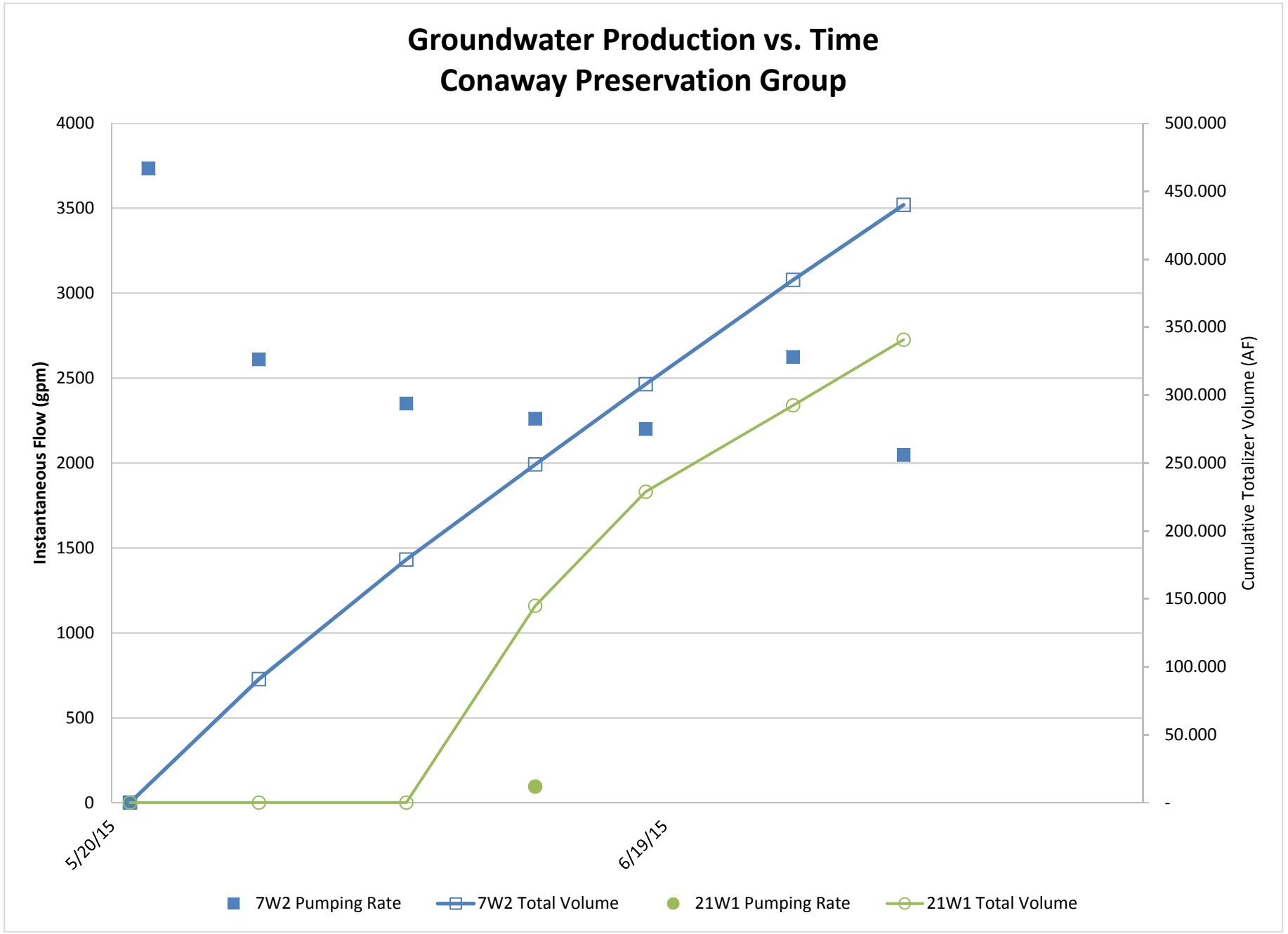



Groundwater Production vs. Time
Conaway Preservation Group
Instantaneous Flow (CFS)
Cumulative Totalizer Volume (acre-feet)
Date
12.0
10.0
8.0
6.0
4.0
2.0
0.0
900
800
700
600
500
400
300
200
100
0
05/20/15
06/19/15
1W3 Pump Rate
7W1 Pump Rate
7W4S Pump Rate
12W1 Pump Rate
13W3 Pump Rate
16W2 Pump Rate
17W3 Pump Rate
1W3 Total Volume
7W1 Total Volume
7W4S Total Volume
12W1 Total Volume
13W3 Total Volume
16W2 Total Volume
17W3 Total Volume

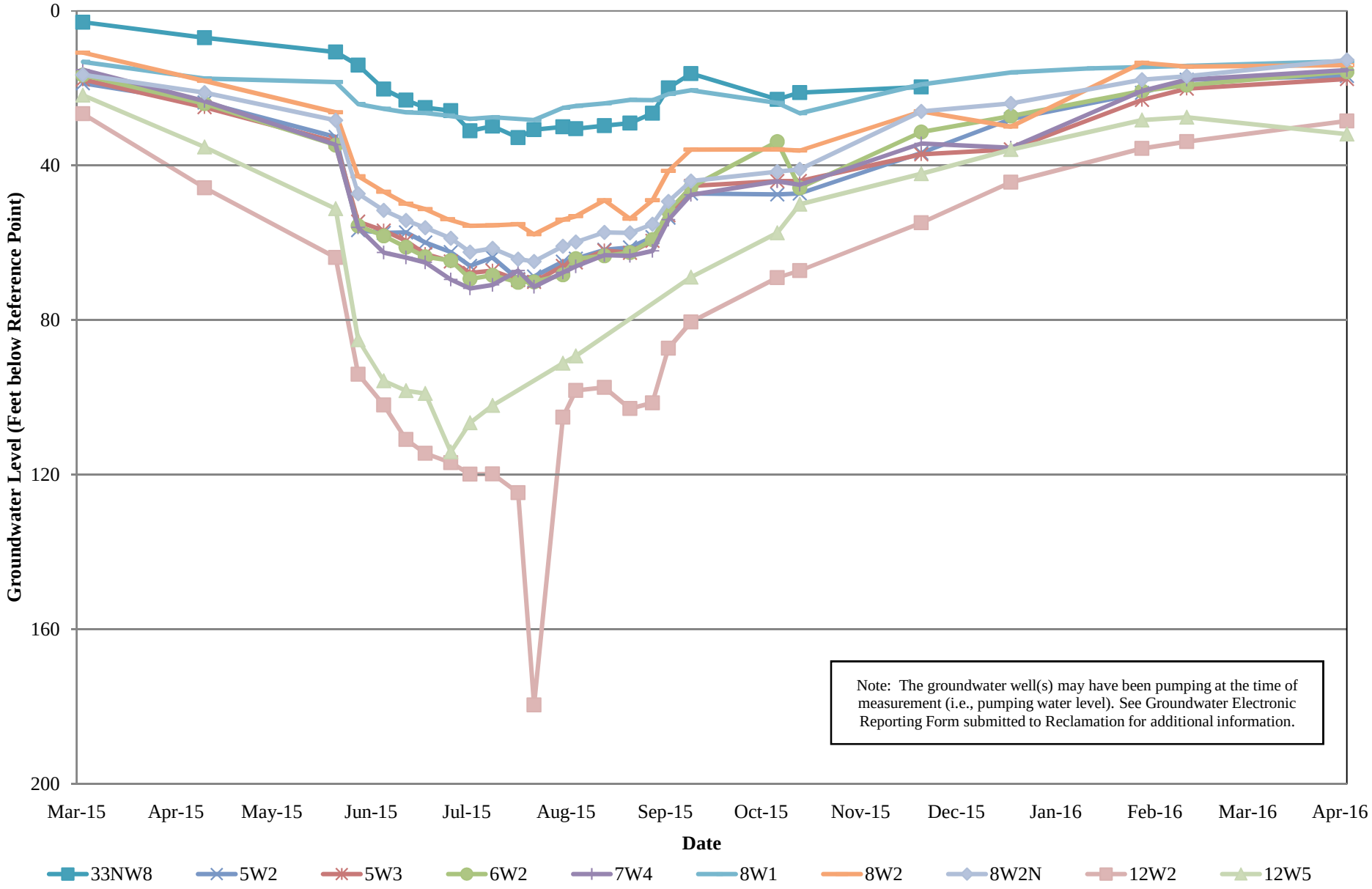

Groundwater Production vs. Time
Conaway Preservation Group
Instantaneous Flow (CFS)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
500.000
450.000
400.000
350.000
300.000
250.000
200.000
150.000
100.000
50.000
-
05/20/15
06/19/15
Date
20W1 Pump Rate
21W3 Pump Rate
24W1 Pump Rate
31W1 Pump Rate
32NW1 Pump Rate
32NW2 Pump Rate
32W3 Pump Rate
20W1 Total Volume
21W3 Total Volume
24W1 Total Volume
31W1 Total Volume
32NW1 Total Volume
32NW2 Total Volume
32W3 Total Volume

Groundwater Quality vs. Time
CPG Production Wells Specific Conductance

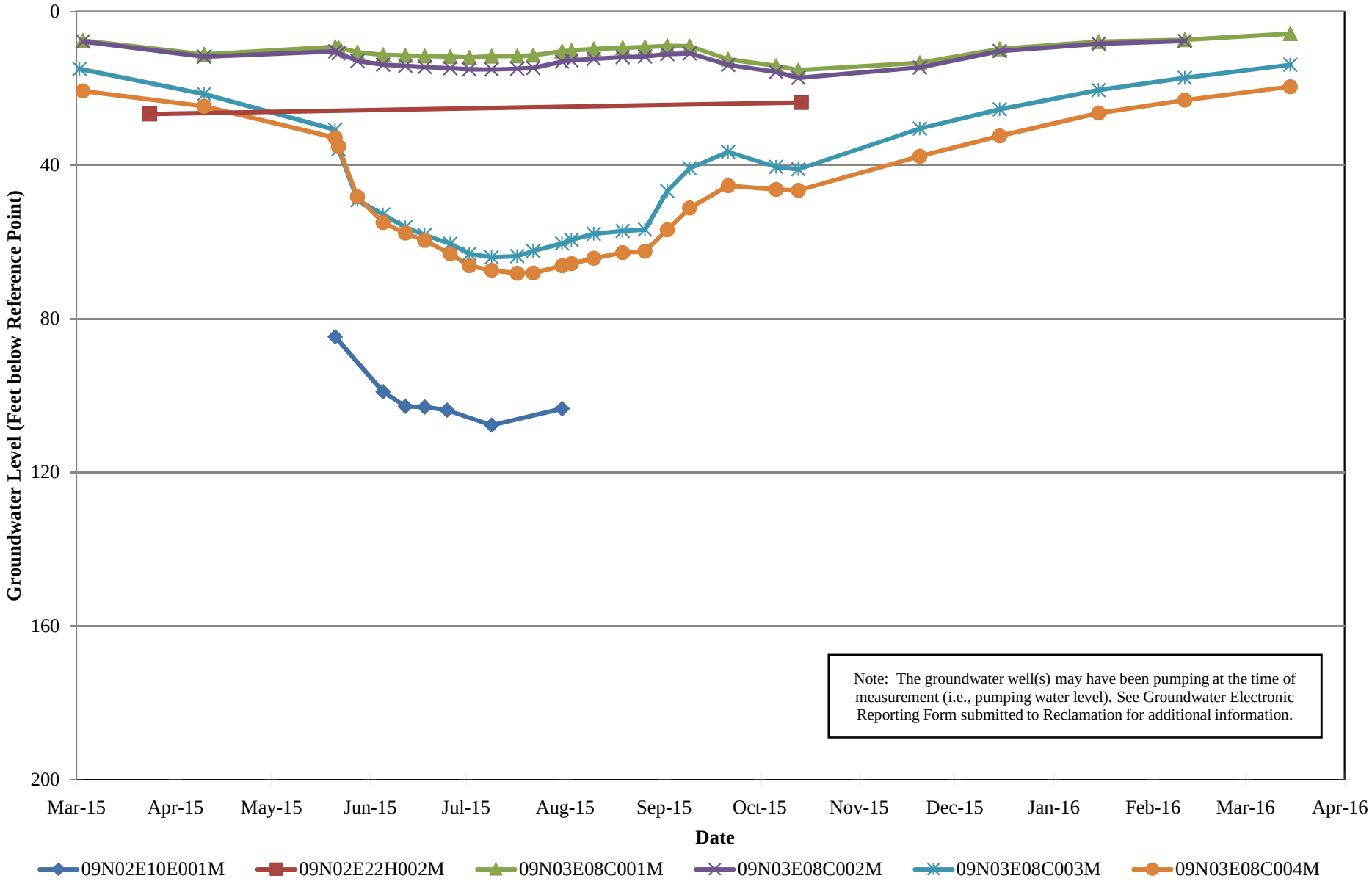



Groundwater Production vs. Time
Conaway Preservation Group
Instantaneous Flow (gpm)
Cumulative Totalizer Volume (AF)
4000
3500
3000
2500
2000
1500
1000
500
0
500.000
450.000
400.000
350.000
300.000
250.000
200.000
150.000
100.000
50.000
-
5/20/15
6/19/15
7W2 Pumping Rate
7W2 Total Volume
21W1 Pumping Rate
21W1 Total Volume

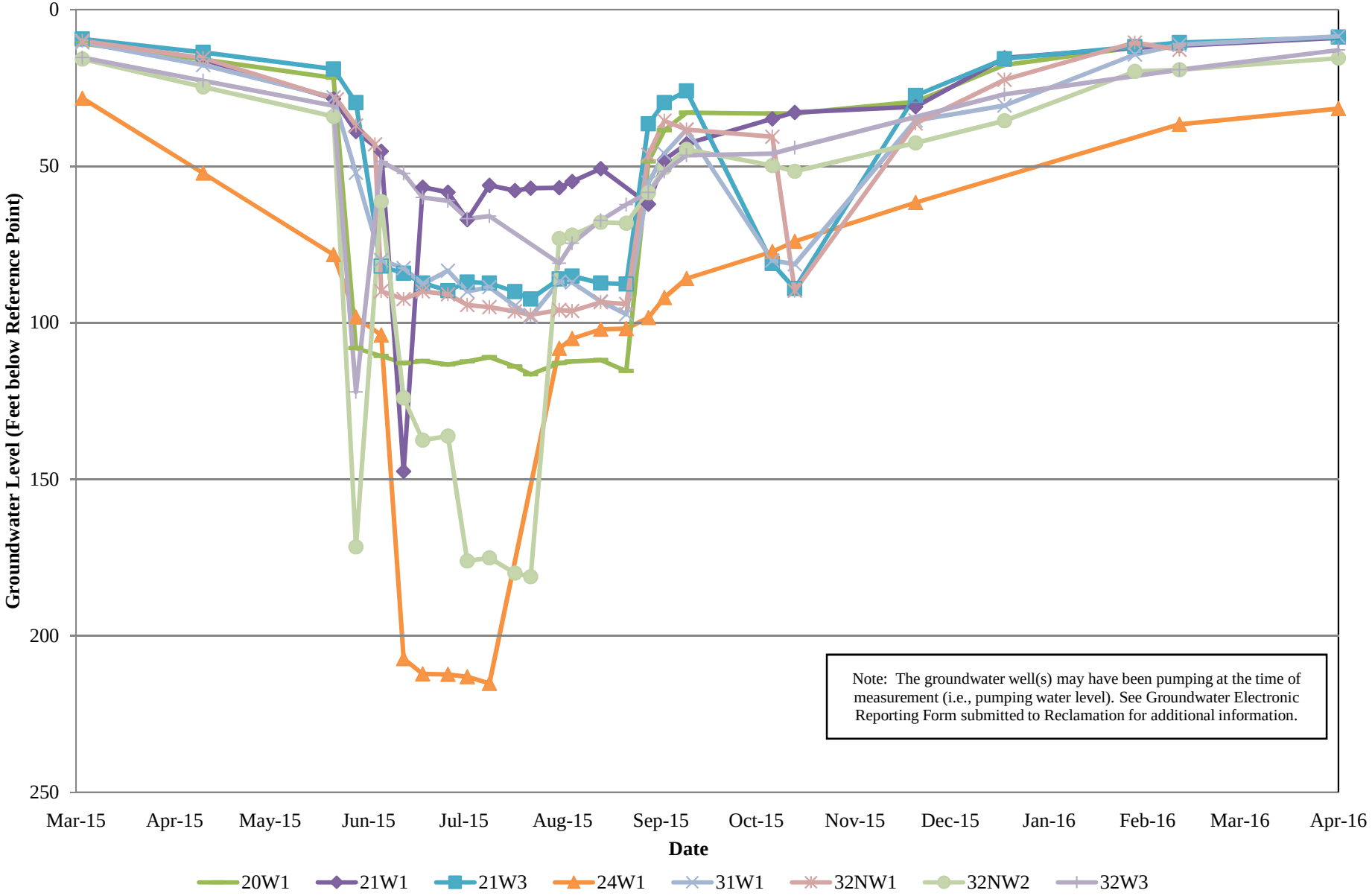
Conaway Preservation Group
Monitoring Well Groundwater Level Data



Conaway Preservation Group
DWR and YCFFWCD Monitoring Well Groundwater Level Data



Conaway Preservation Group
Production Well Groundwater Level Data



Eastside Mutual Water Company

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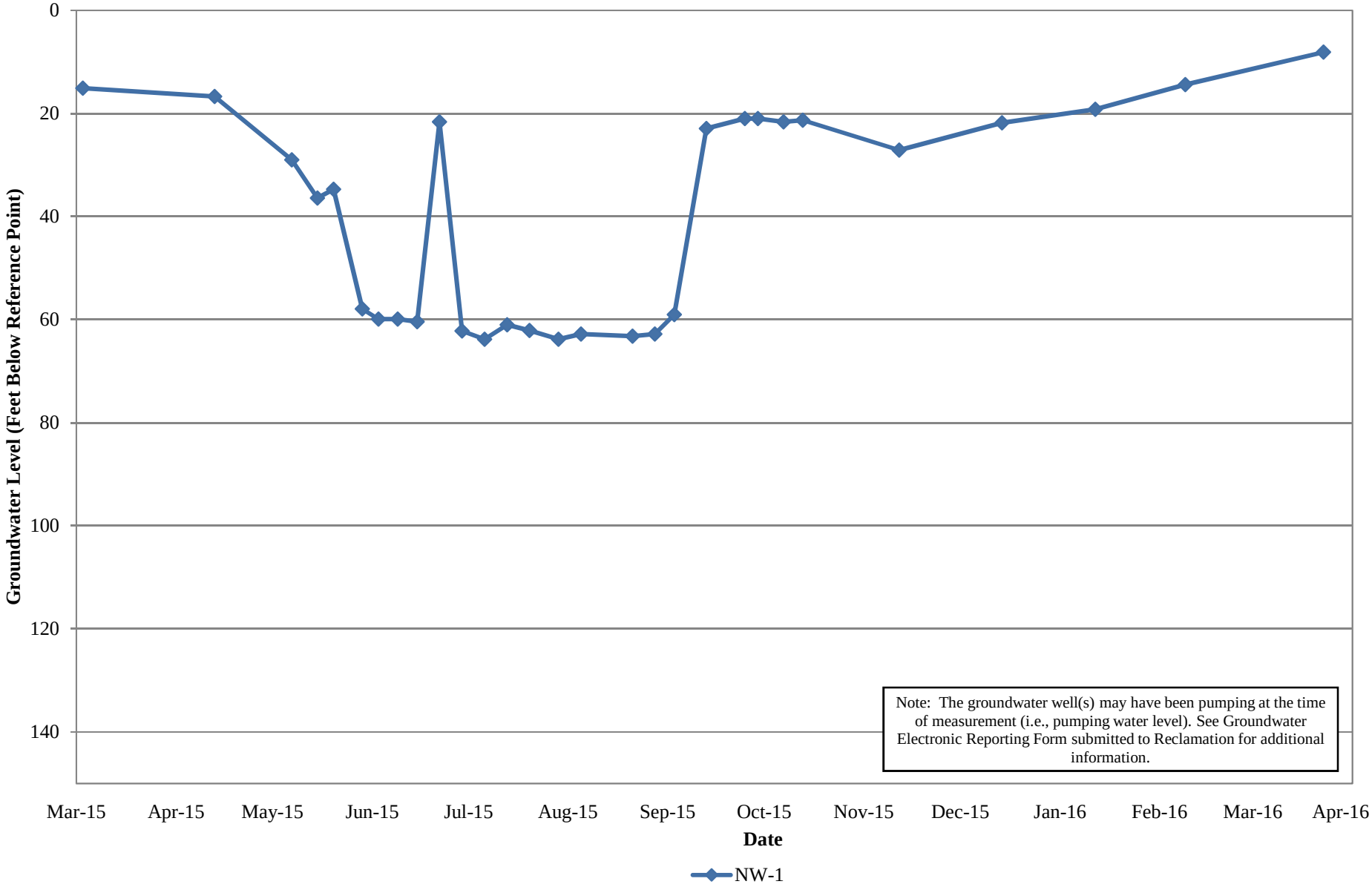
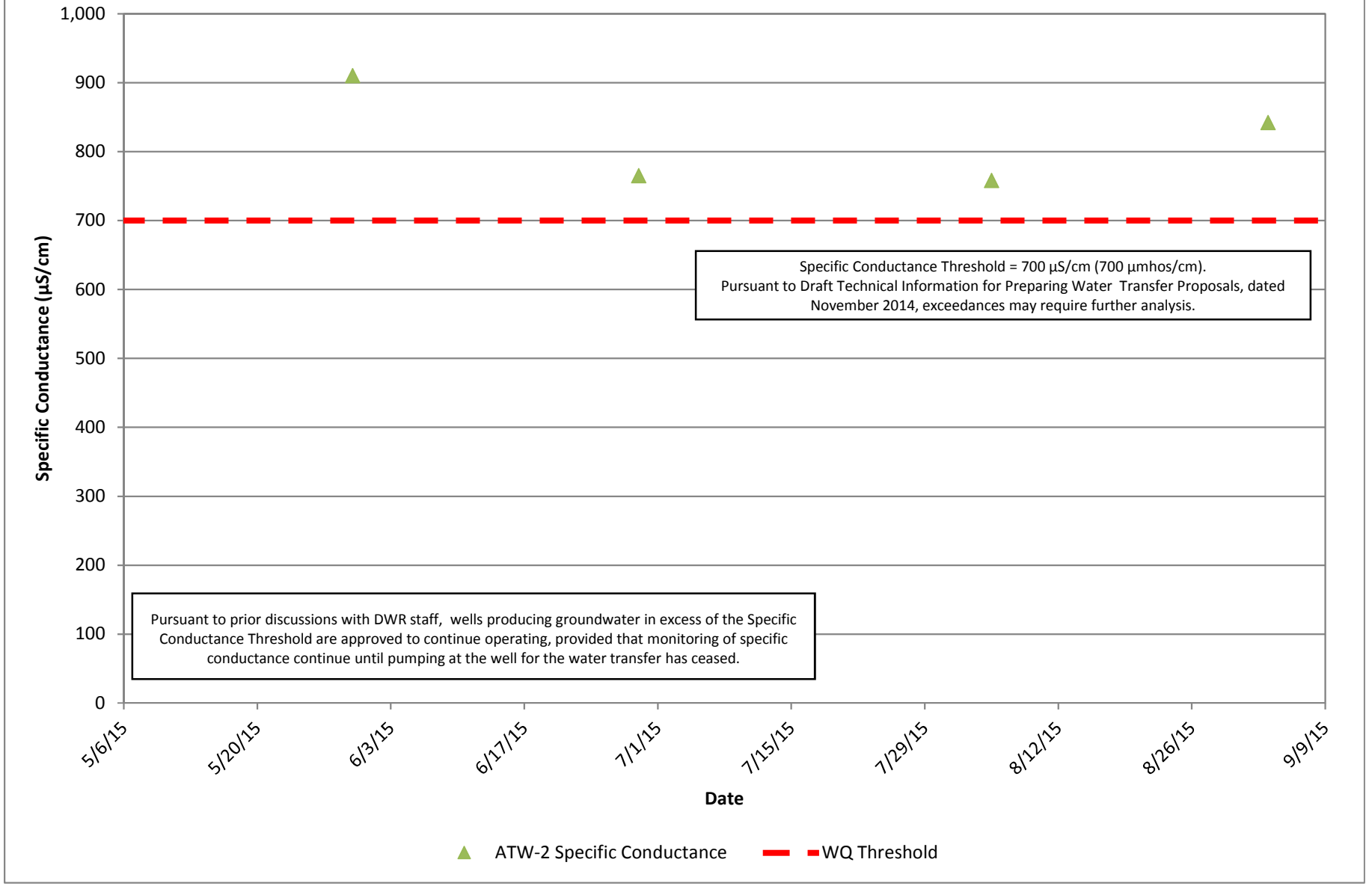
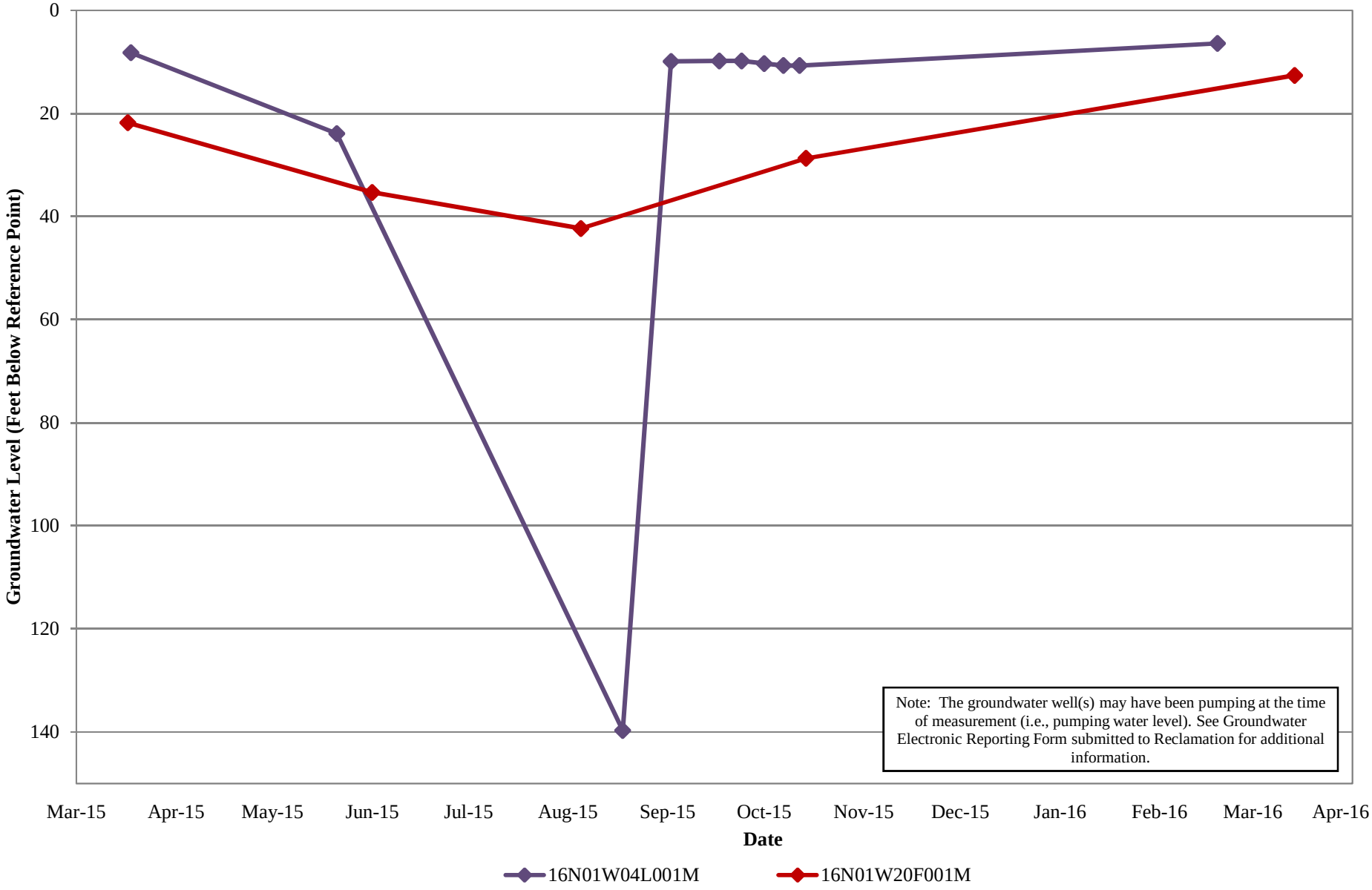
Eastside Mutual Water Company
Monitoring Well Groundwater Level Data



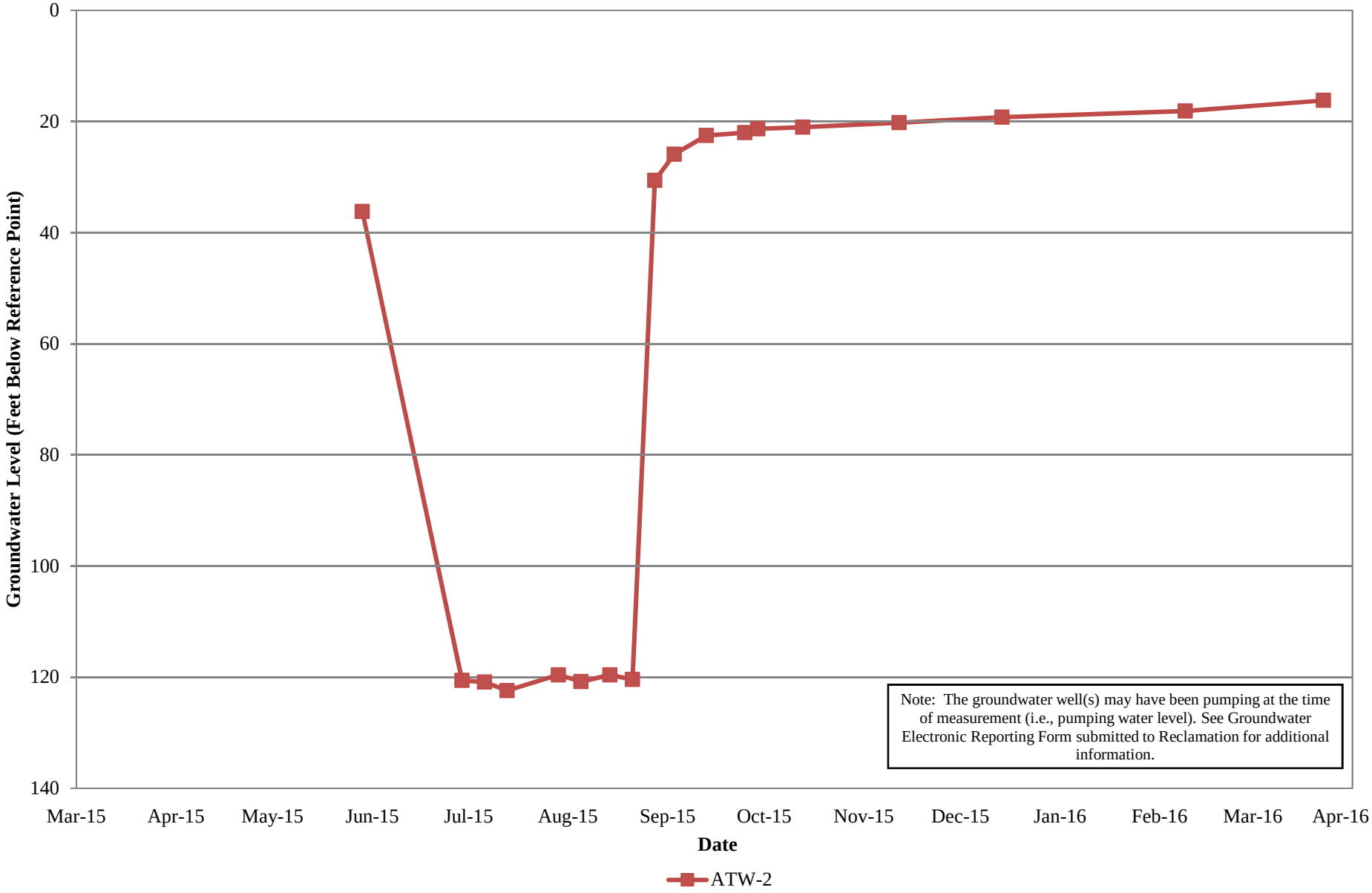
Eastside Mutual Water Company
Groundwater Production Well Specific Conductance

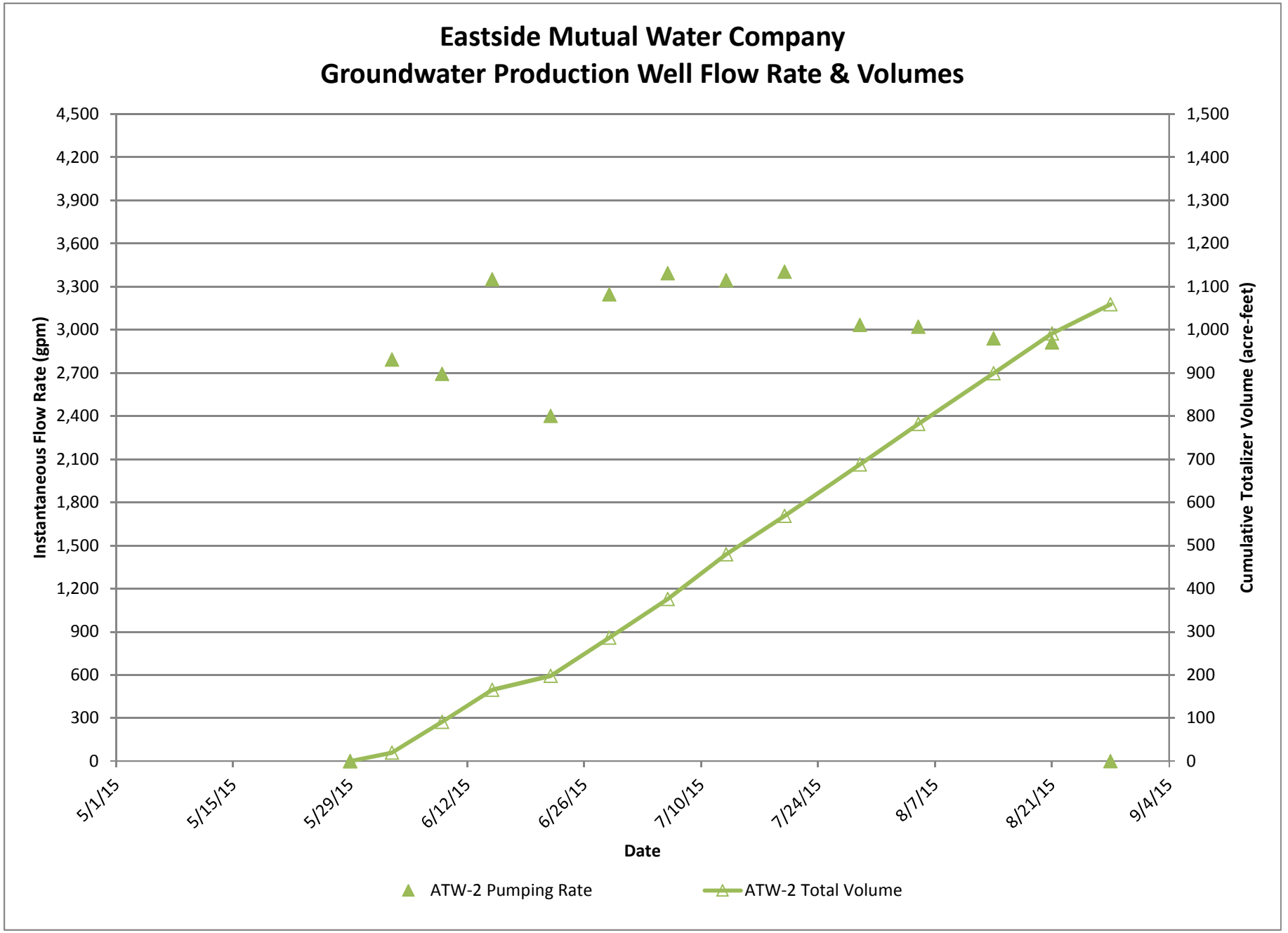


Eastside Mutual Water Company
DWR Monitoring Well Groundwater Level Data



Eastside Mutual Water Company
Production Well Groundwater Collection Data




Eastside Mutual Water Company
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
4,500
4,200
3,900
3,600
3,300
3,000
2,700
2,400
2,100
1,800
1,500
1,200
900
600
300
0
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
5/1/15
5/15/15
5/29/15
6/12/15
6/26/15
7/10/15
7/24/15
8/7/15
8/21/15
9/4/15
Date
ATW-2 Pumping Rate
ATW-2 Total Volume

Glenn-Colusa Irrigation District

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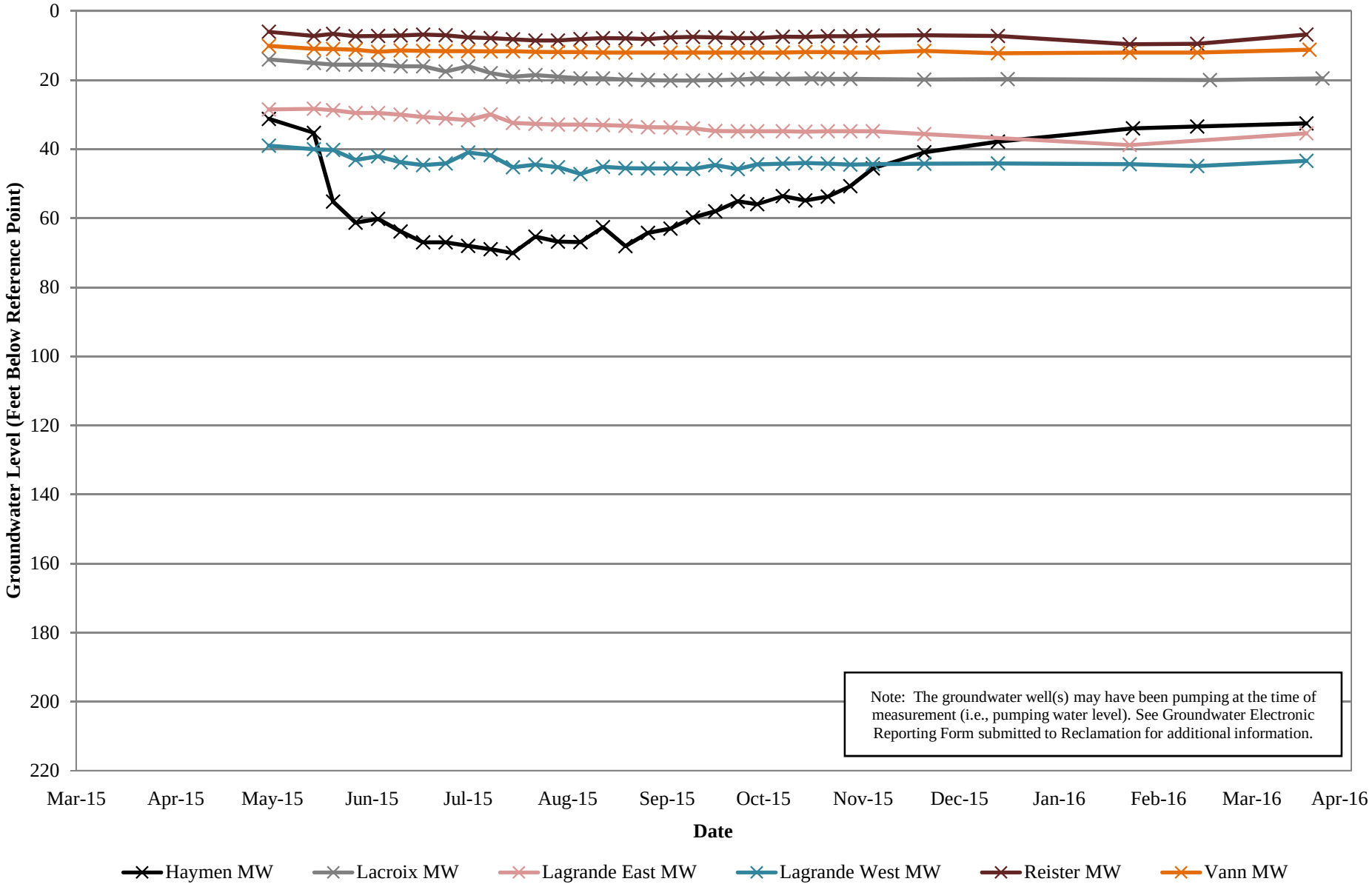
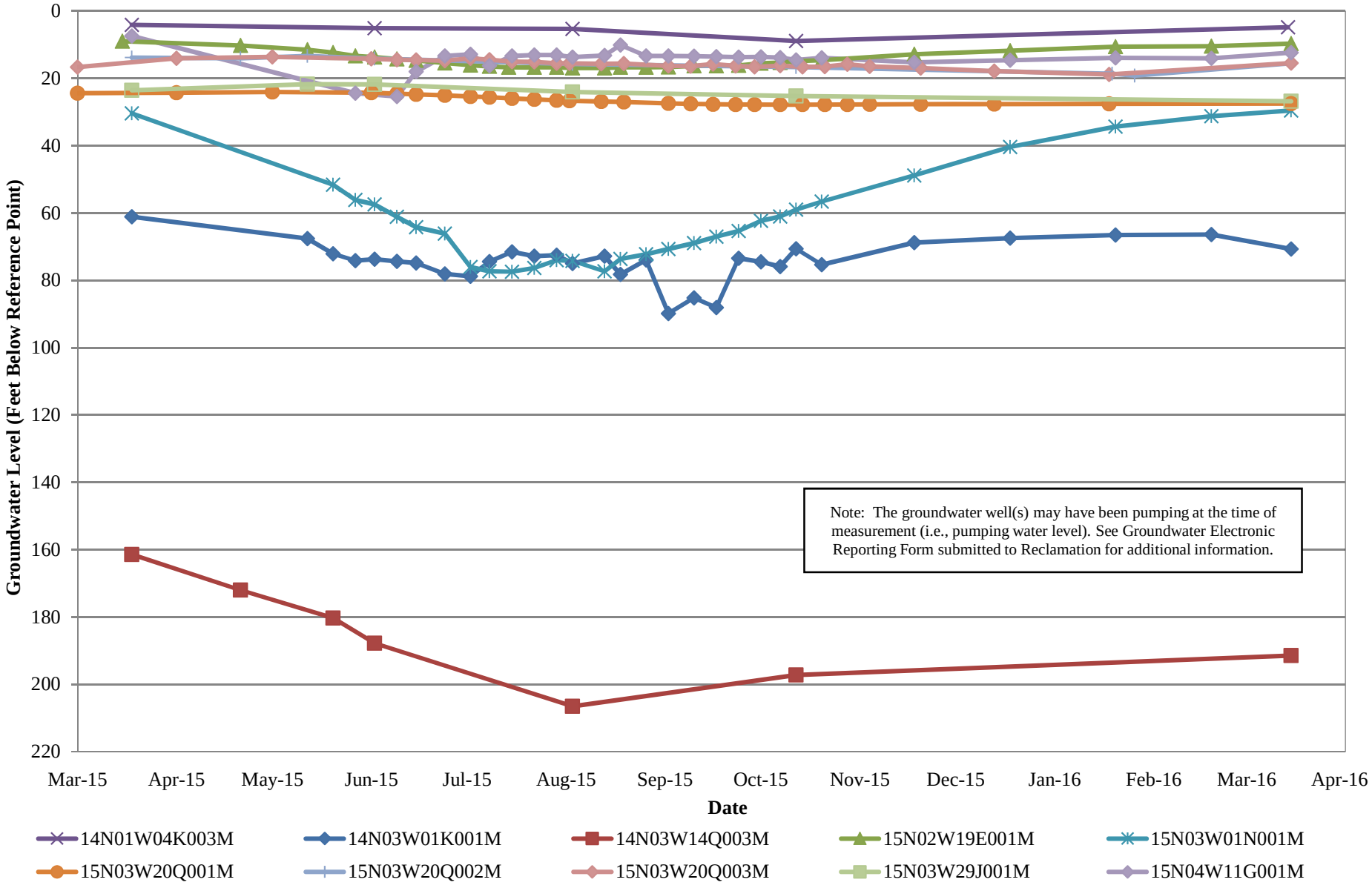
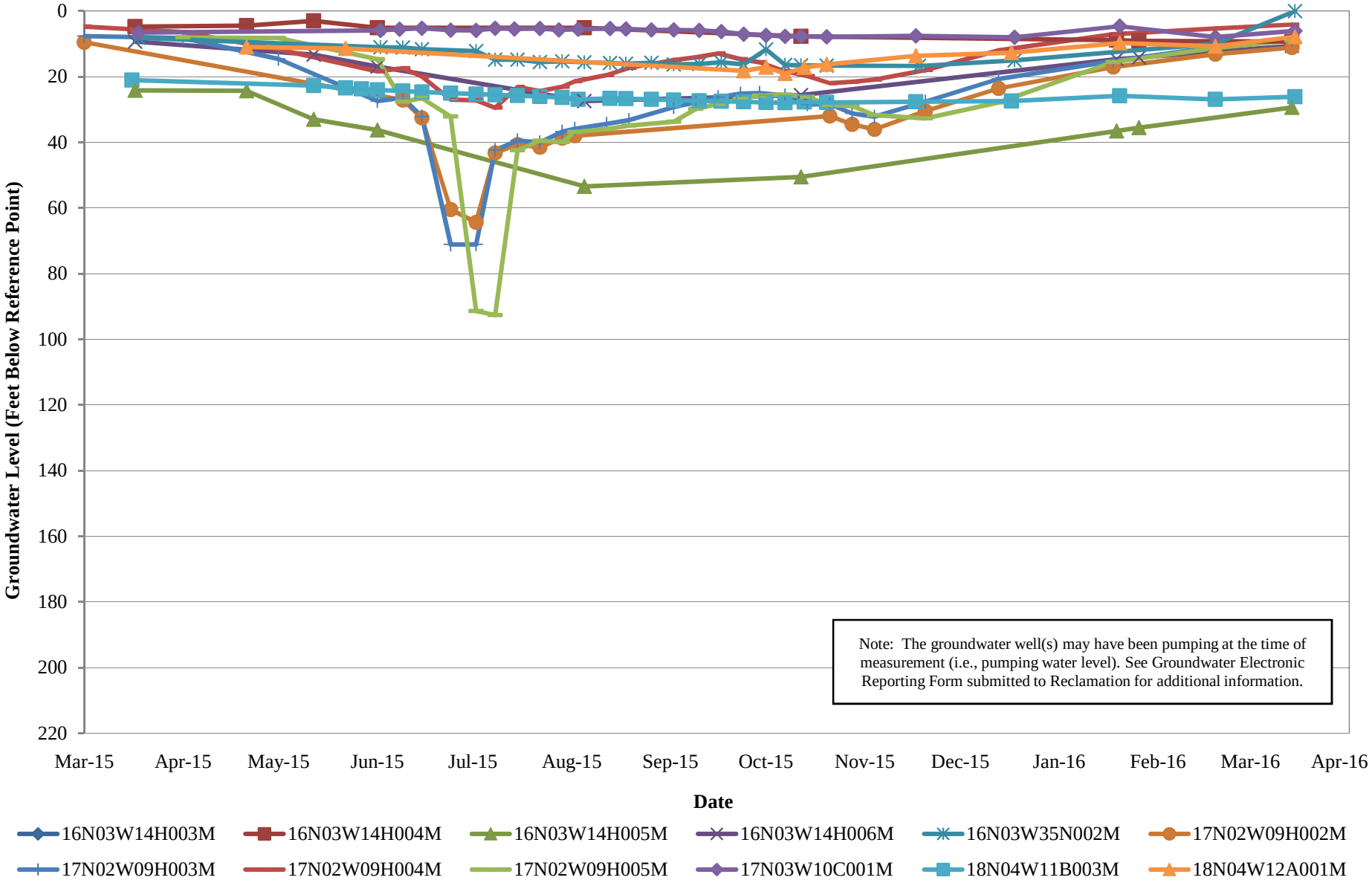
Glenn-Colusa Irrigation District
Monitoring Well Groundwater Level Data



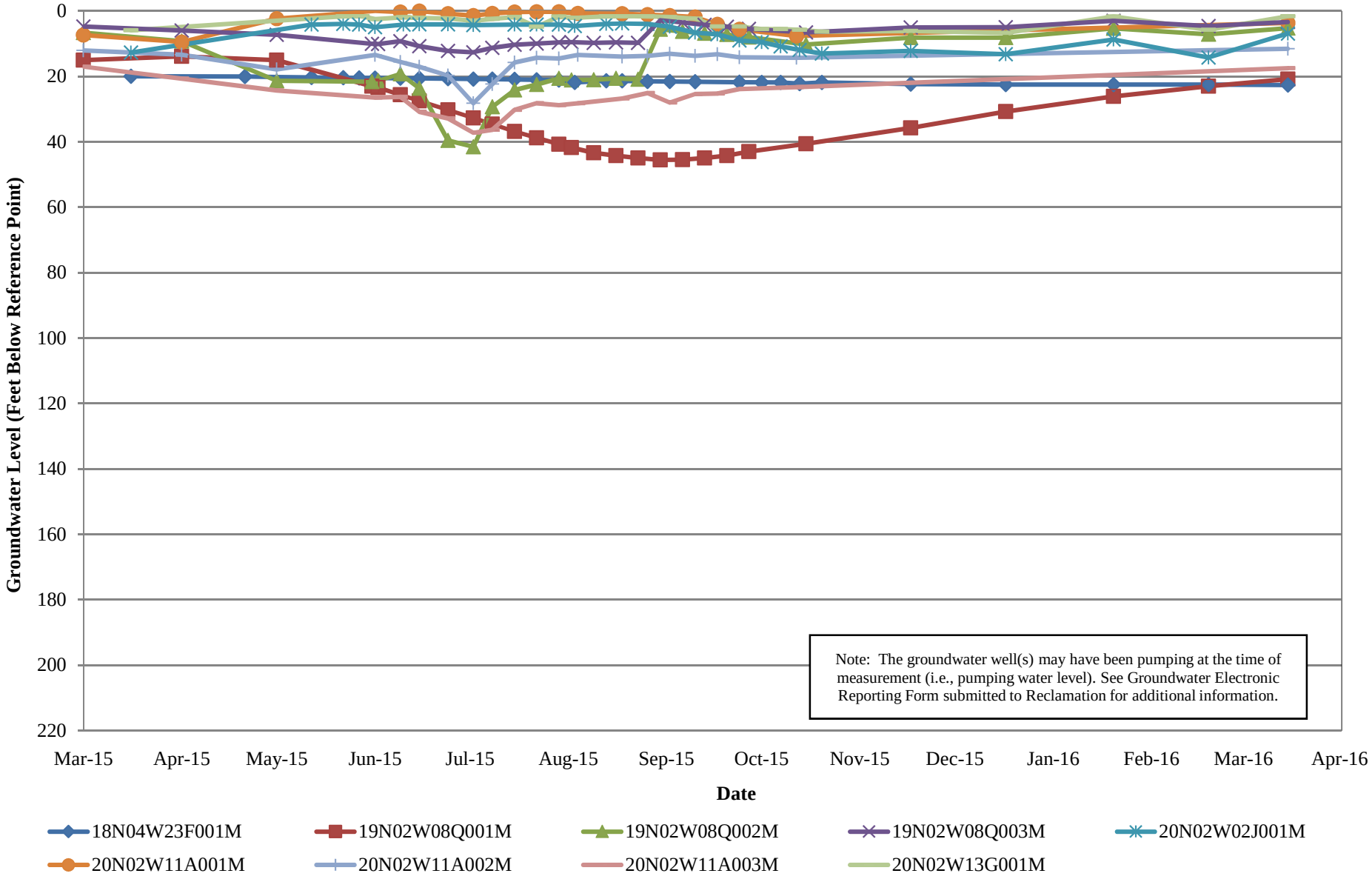
Glenn-Colusa Irrigation District
DWR Monitoring Well Groundwater Level Data



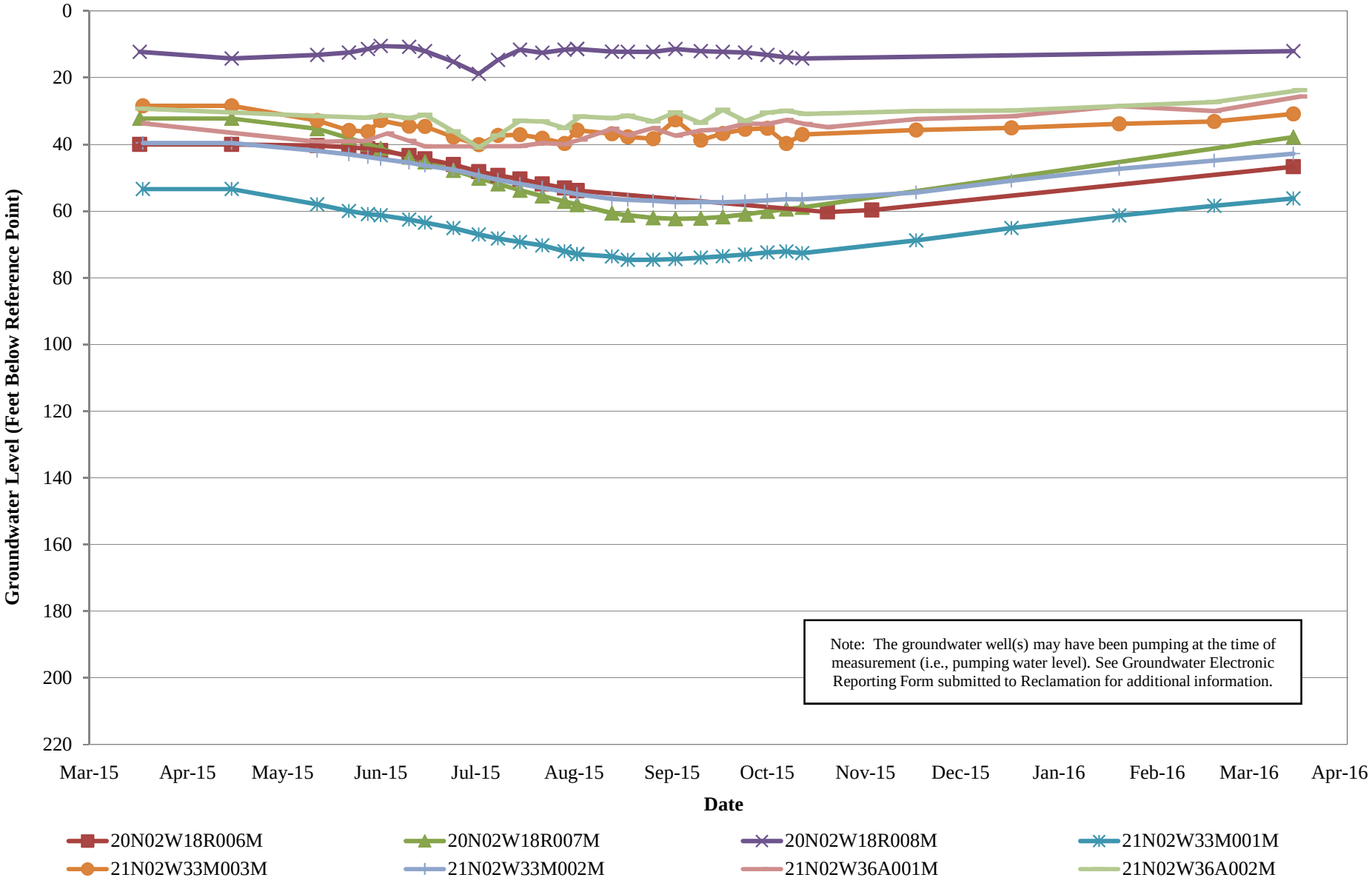
Glenn-Colusa Irrigation District
DWR Monitoring Well Groundwater Level Data



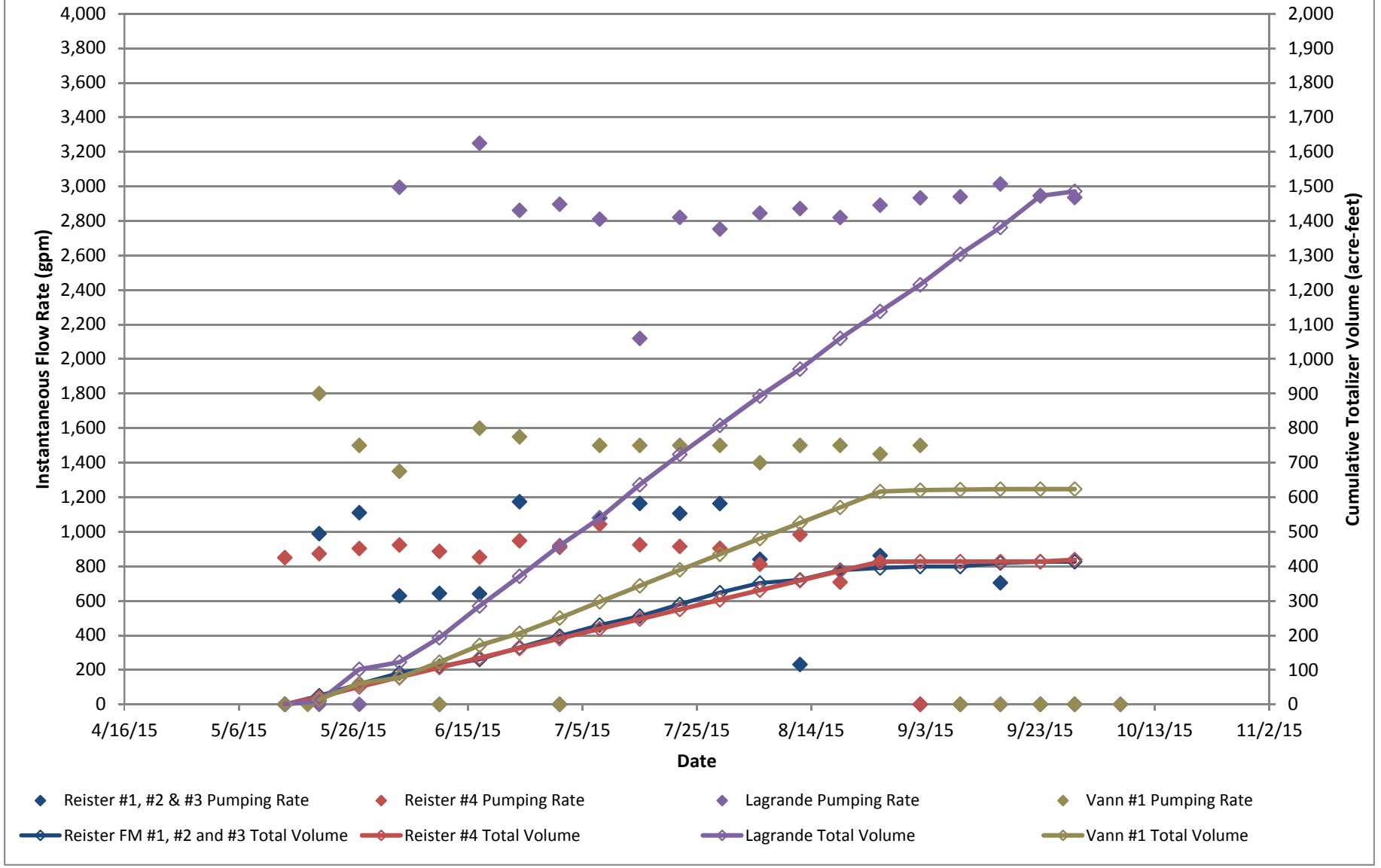
Glenn-Colusa Irrigation District
DWR Monitoring Well Groundwater Level Data

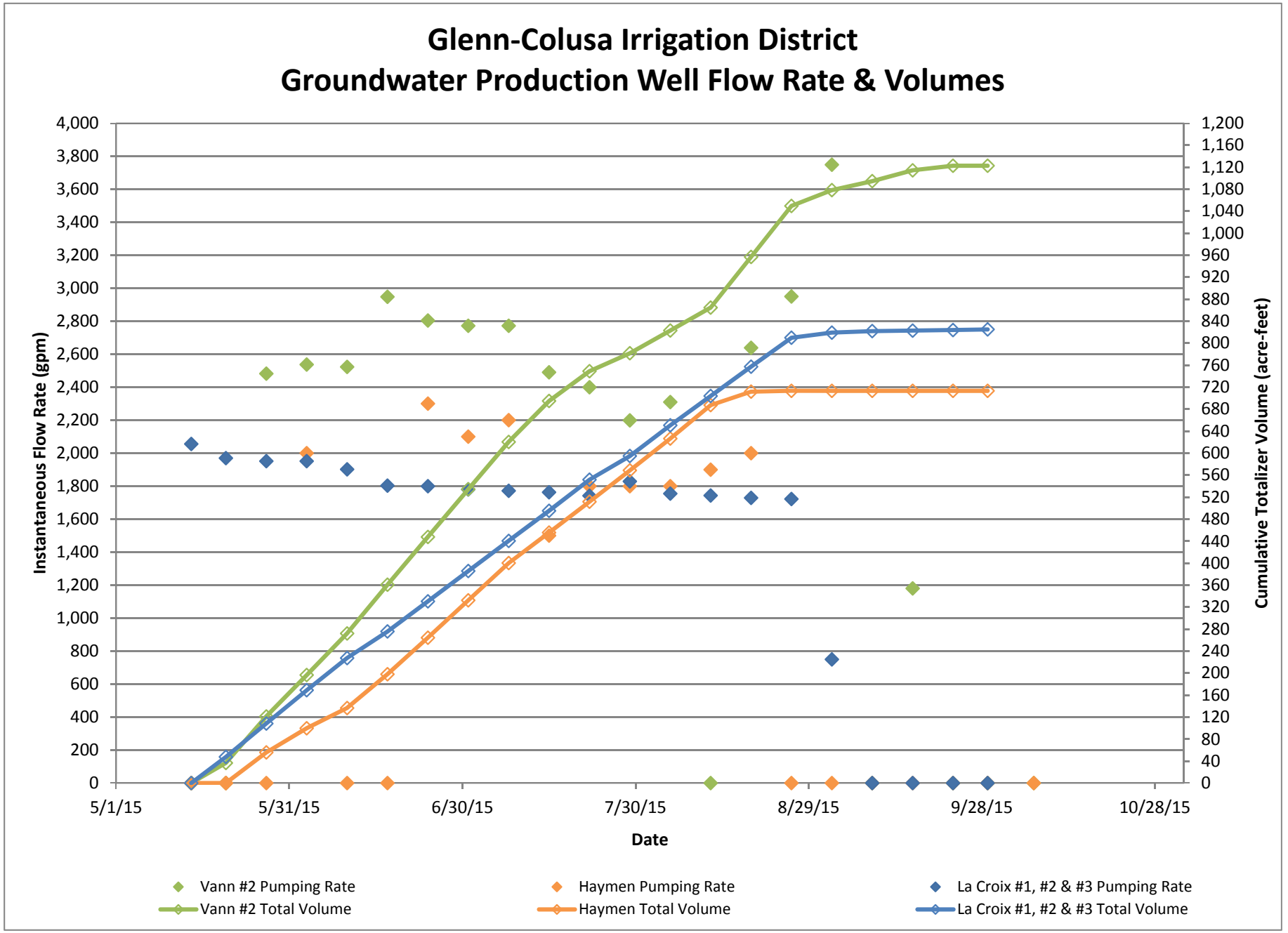


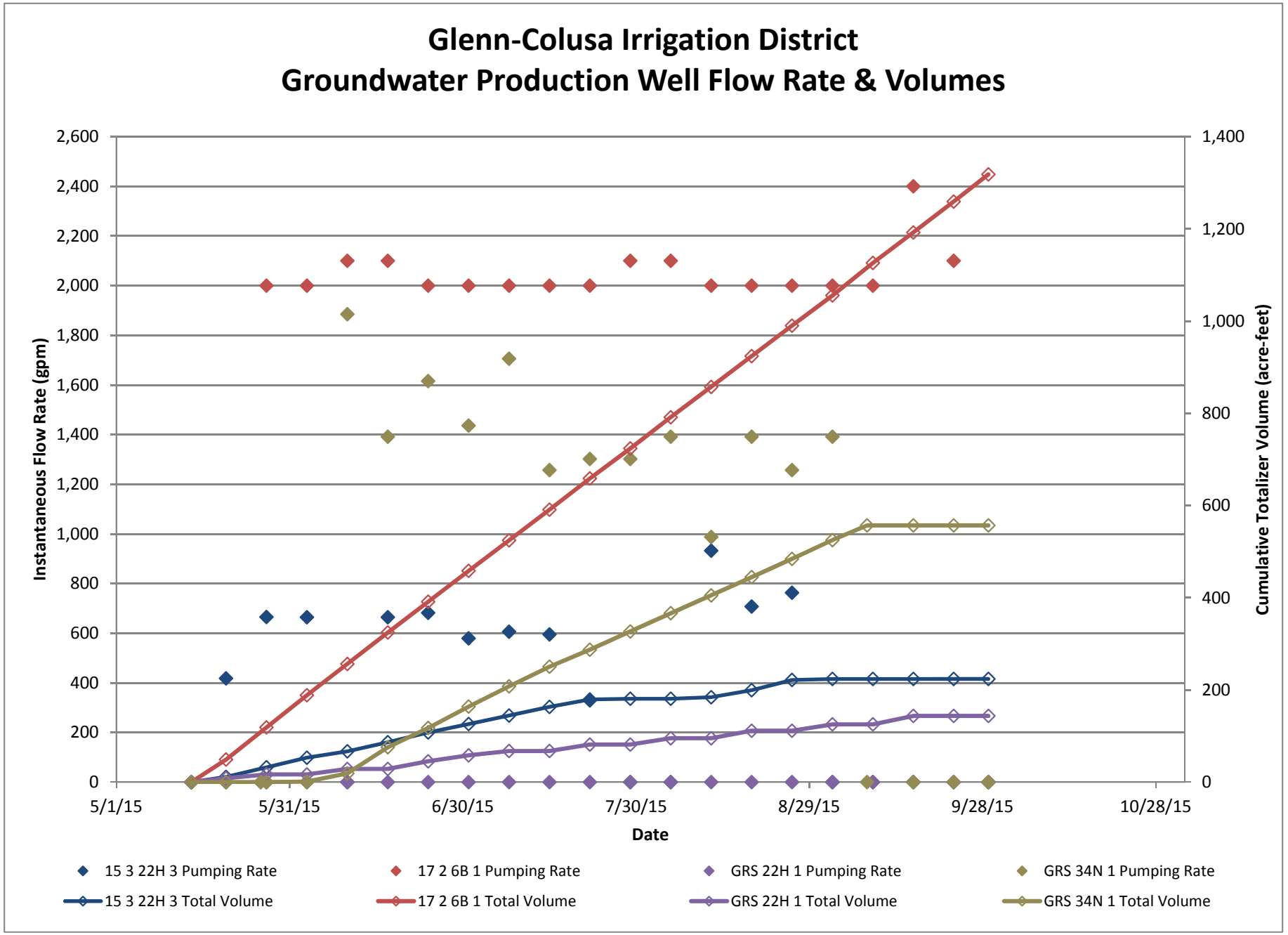
Glenn-Colusa Irrigation District
DWR Monitoring Well Groundwater Level Data



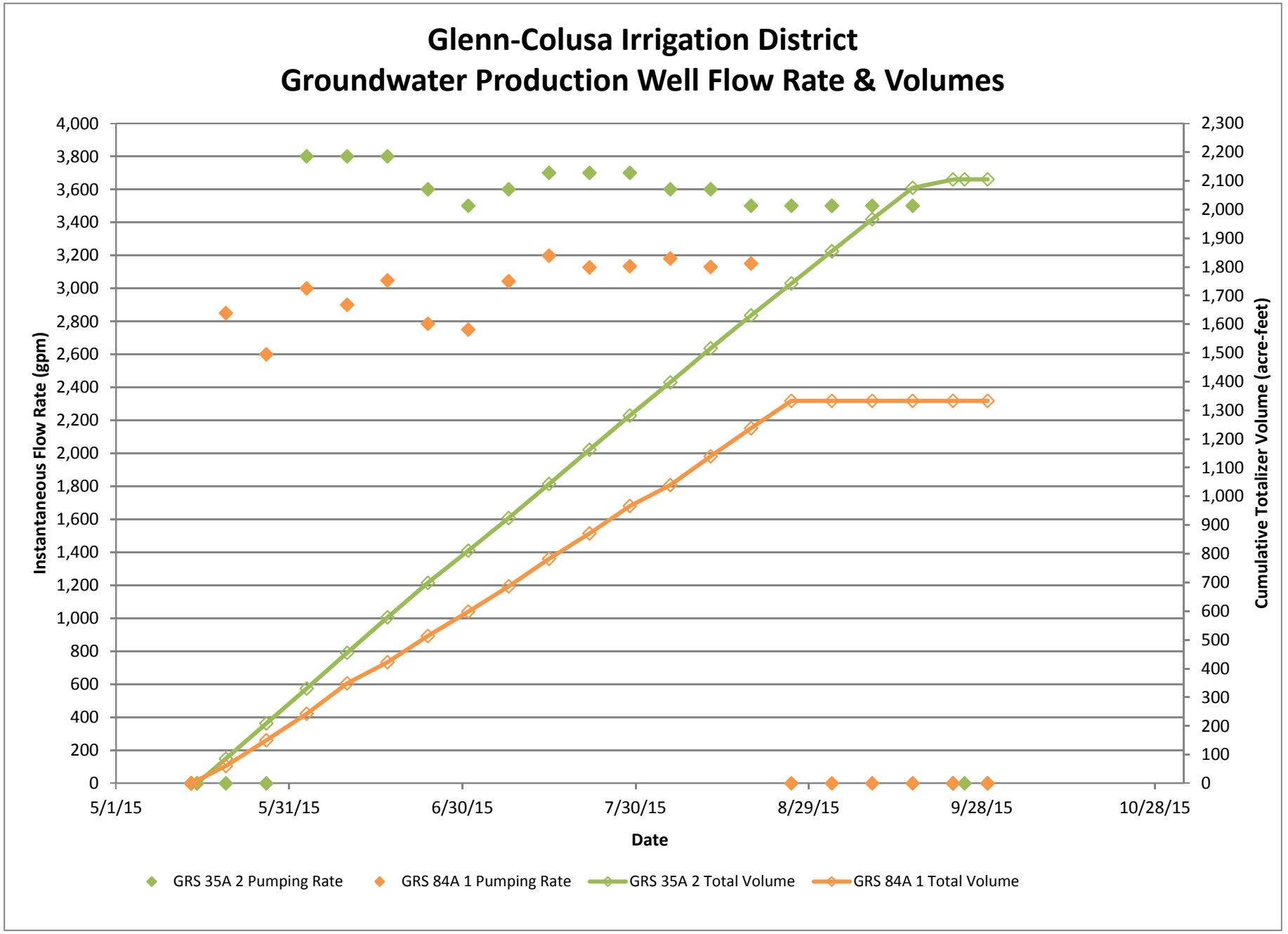
Glenn-Colusa Irrigation District
Groundwater Production Well Flow Rate & Volumes



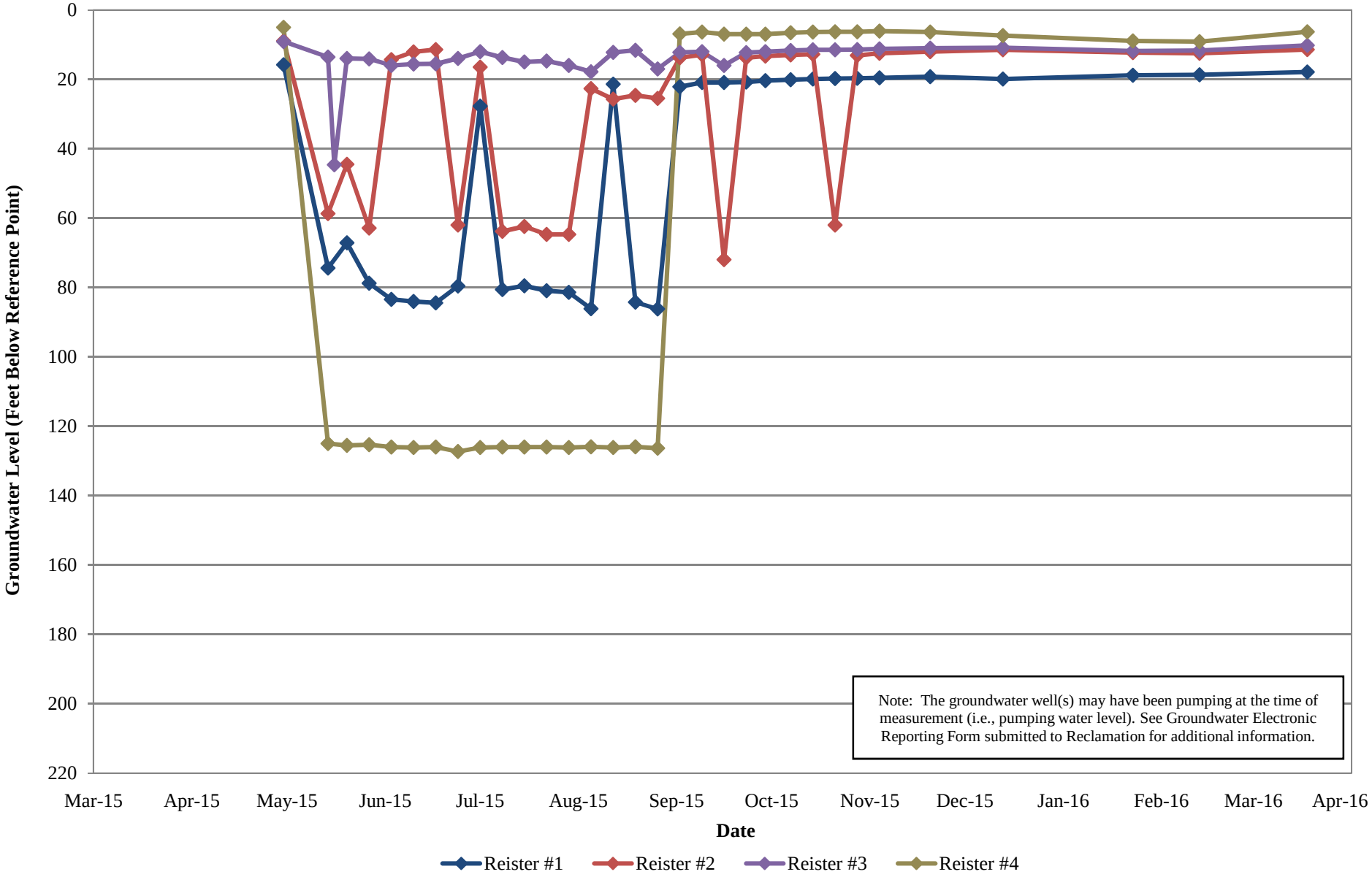

Glenn-Colusa Irrigation District
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1,200
1,160
1,120
1,080
1,040
1,000
960
920
880
840
800
760
720
680
640
600
560
520
480
440
400
360
320
280
240
200
160
120
80
40
0
5/1/15
5/31/15
6/30/15
7/30/15
8/29/15
9/28/15
10/28/15
Date
Vann #2 Pumping Rate
Haymen Pumping Rate
La Croix #1, #2 & #3 Pumping Rate
Vann #2 Total Volume
Haymen Total Volume
La Croix #1, #2 & #3 Total Volume


Glenn-Colusa Irrigation District
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
Date
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1,400
1,200
1,000
800
600
400
200
0
5/1/15
5/31/15
6/30/15
7/30/15
8/29/15
9/28/15
10/28/15
15 3 22H 3 Pumping Rate
17 2 6B 1 Pumping Rate
GRS 22H 1 Pumping Rate
GRS 34N 1 Pumping Rate
15 3 22H 3 Total Volume
17 2 6B 1 Total Volume
GRS 22H 1 Total Volume
GRS 34N 1 Total Volume

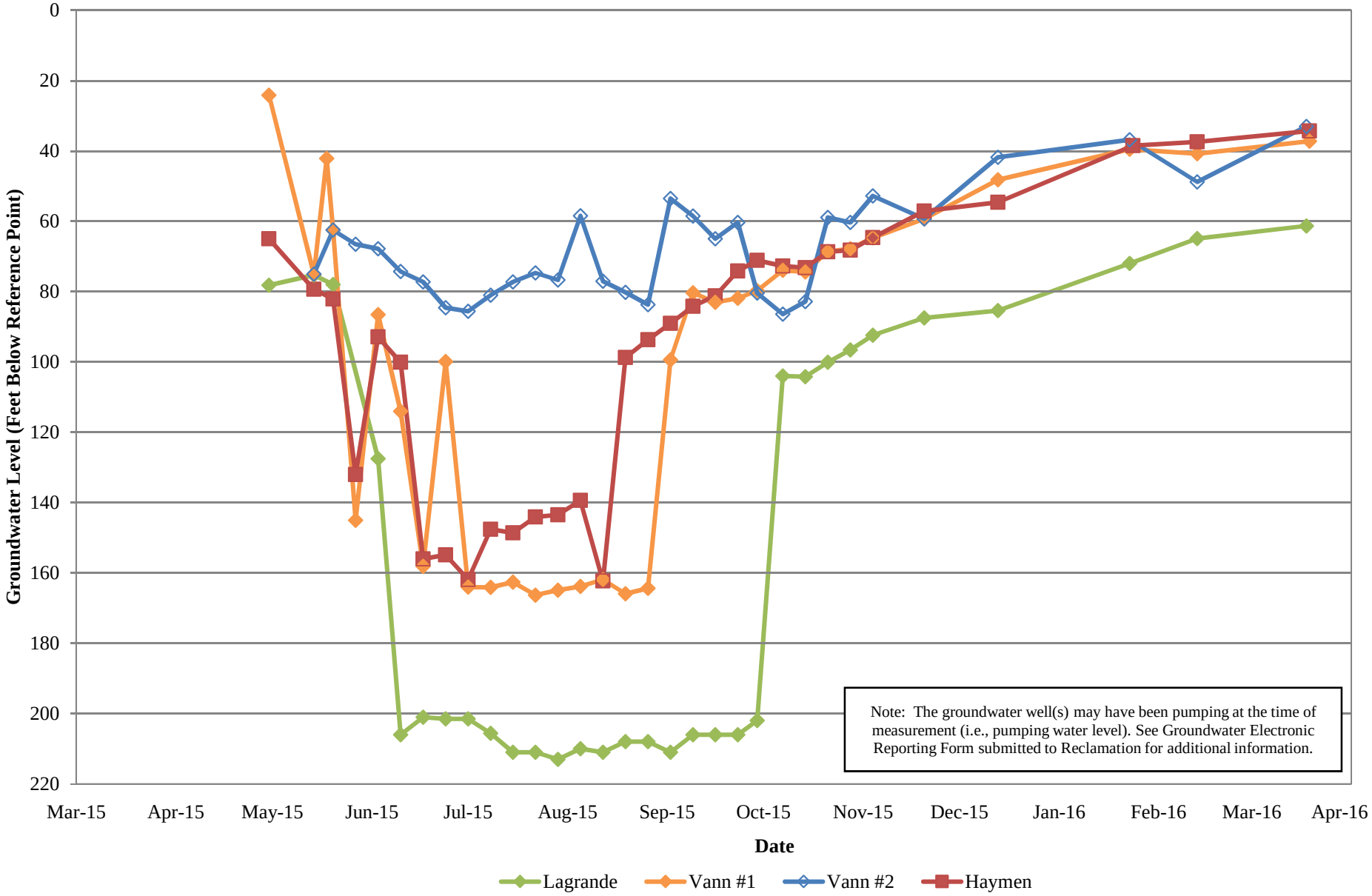
Glenn-Colusa Irrigation District
Groundwater Production Well Flow Rate & Volumes



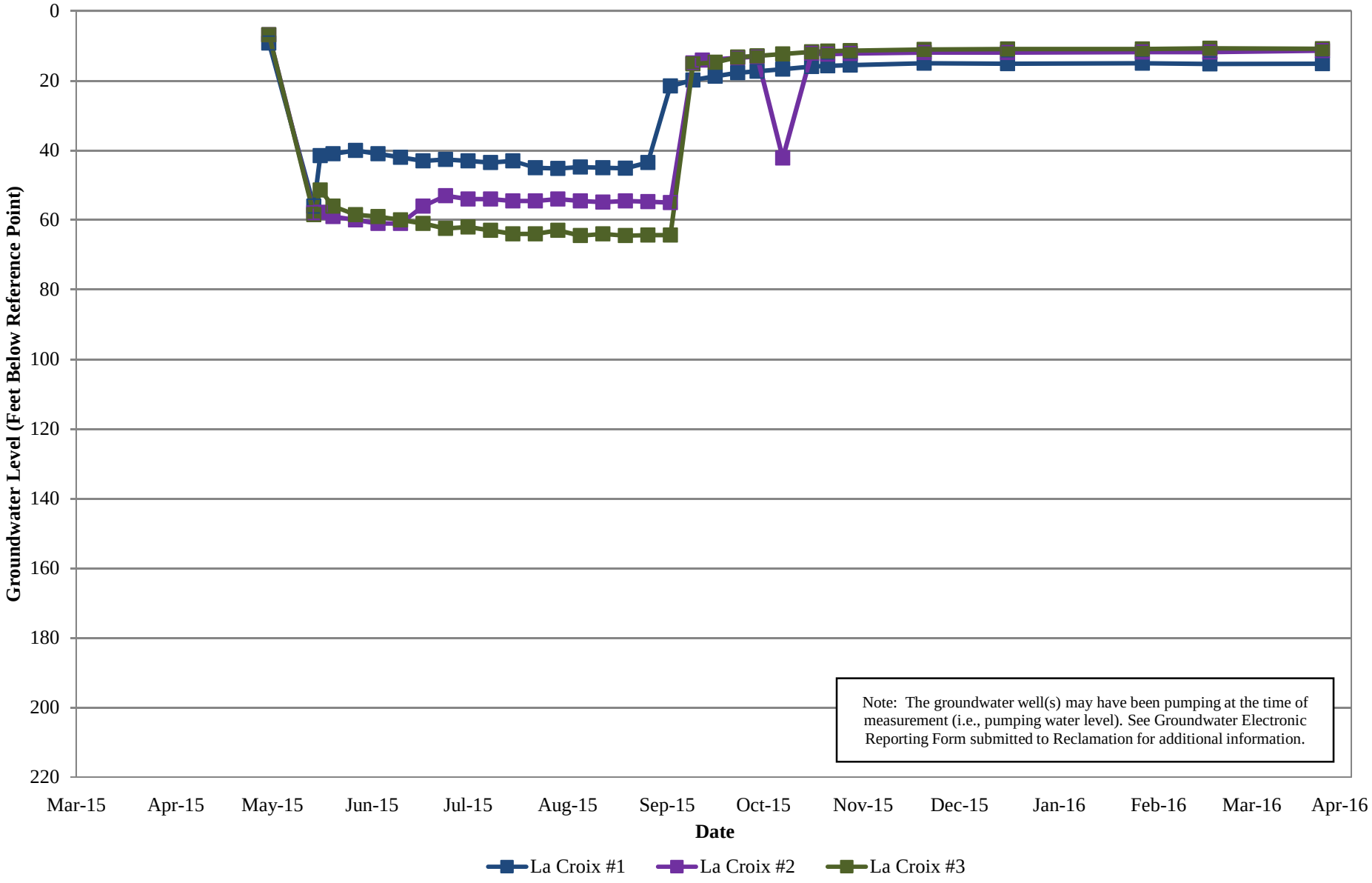
Glenn-Colusa Irrigation District
Production Well Groundwater Level Data



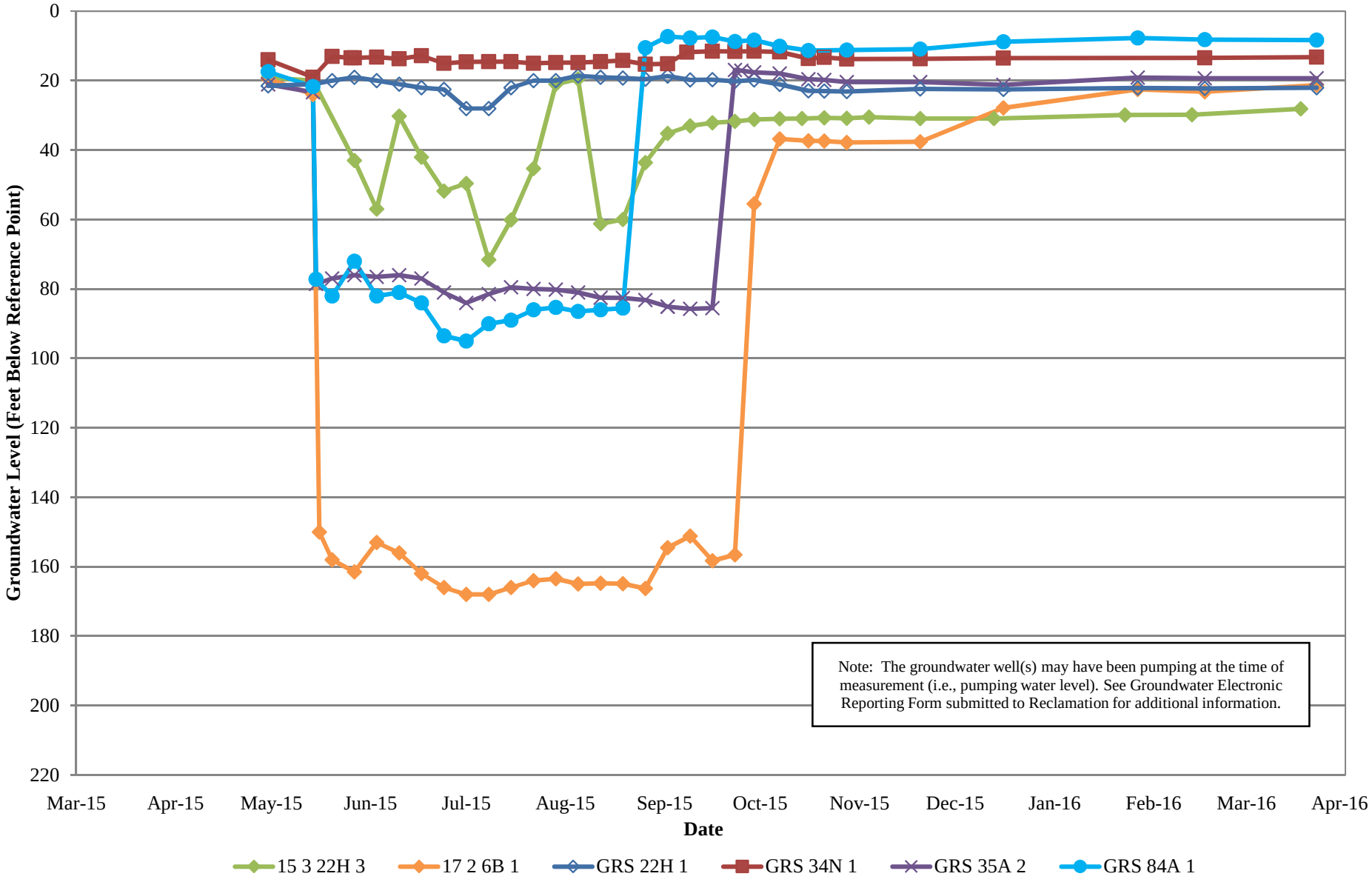
Glenn-Colusa Irrigation District
Production Well Groundwater Level Data



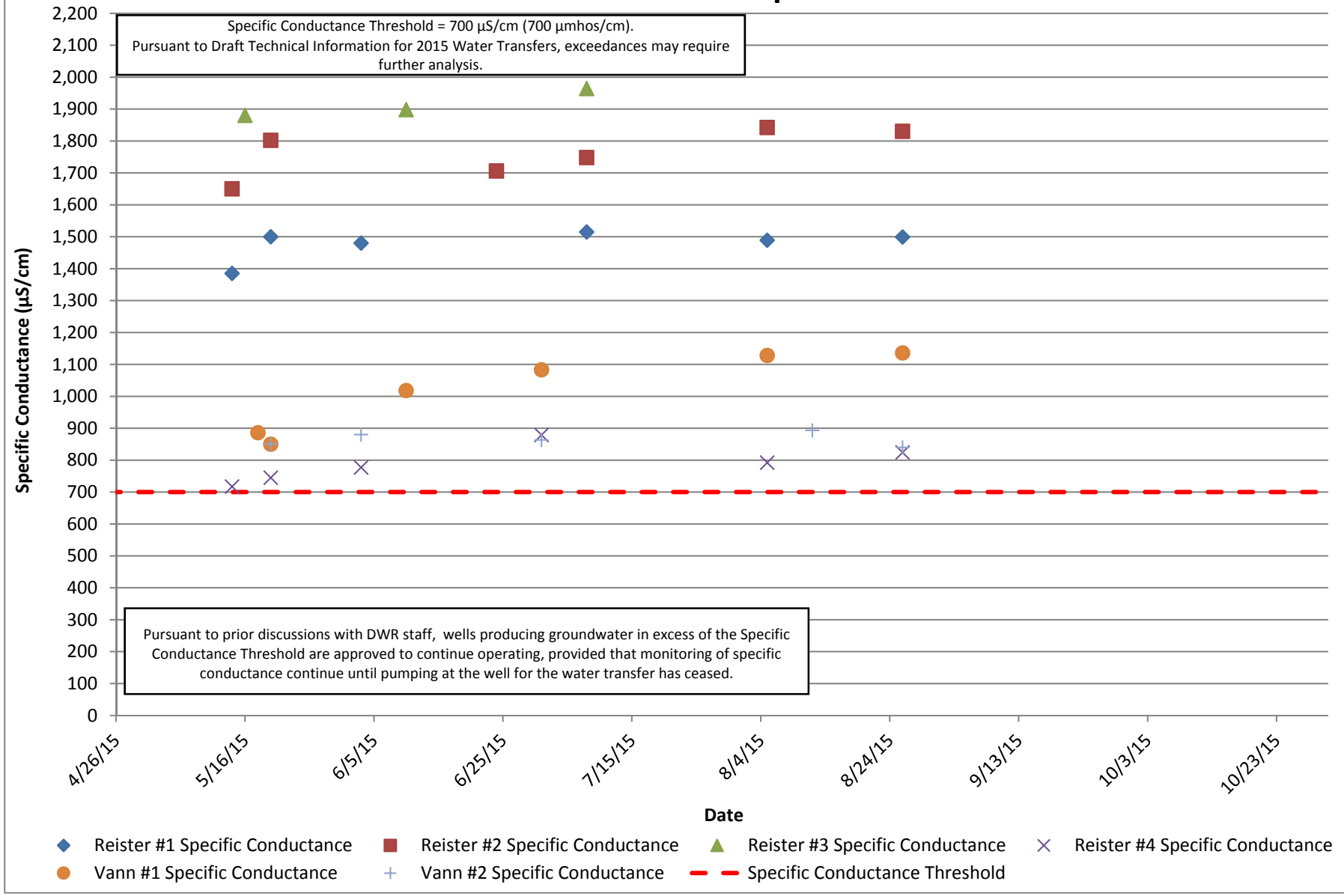
Glenn-Colusa Irrigation District
Production Well Groundwater Level Data



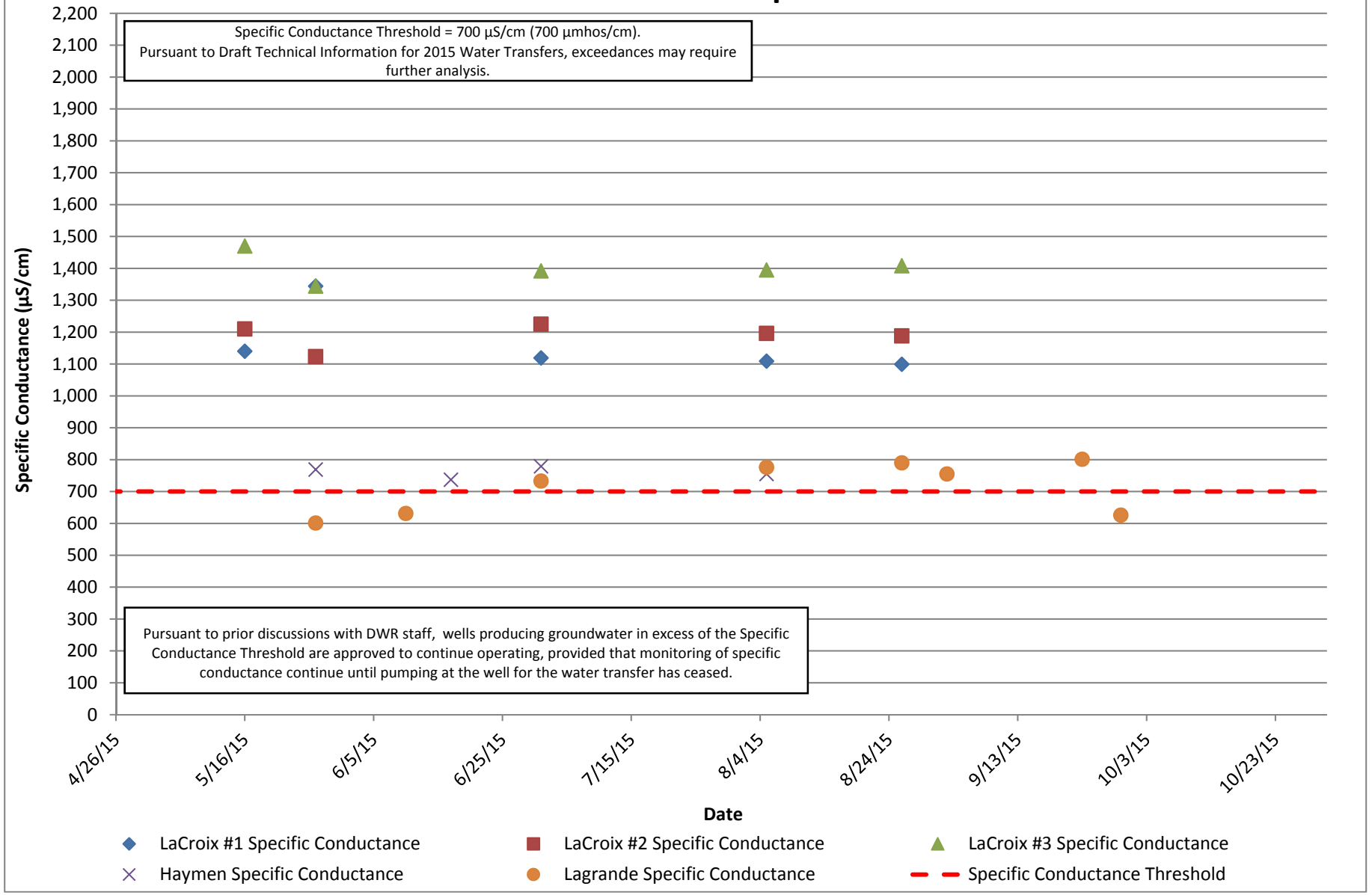
Glenn-Colusa Irrigation District
Production Well Groundwater Level Data



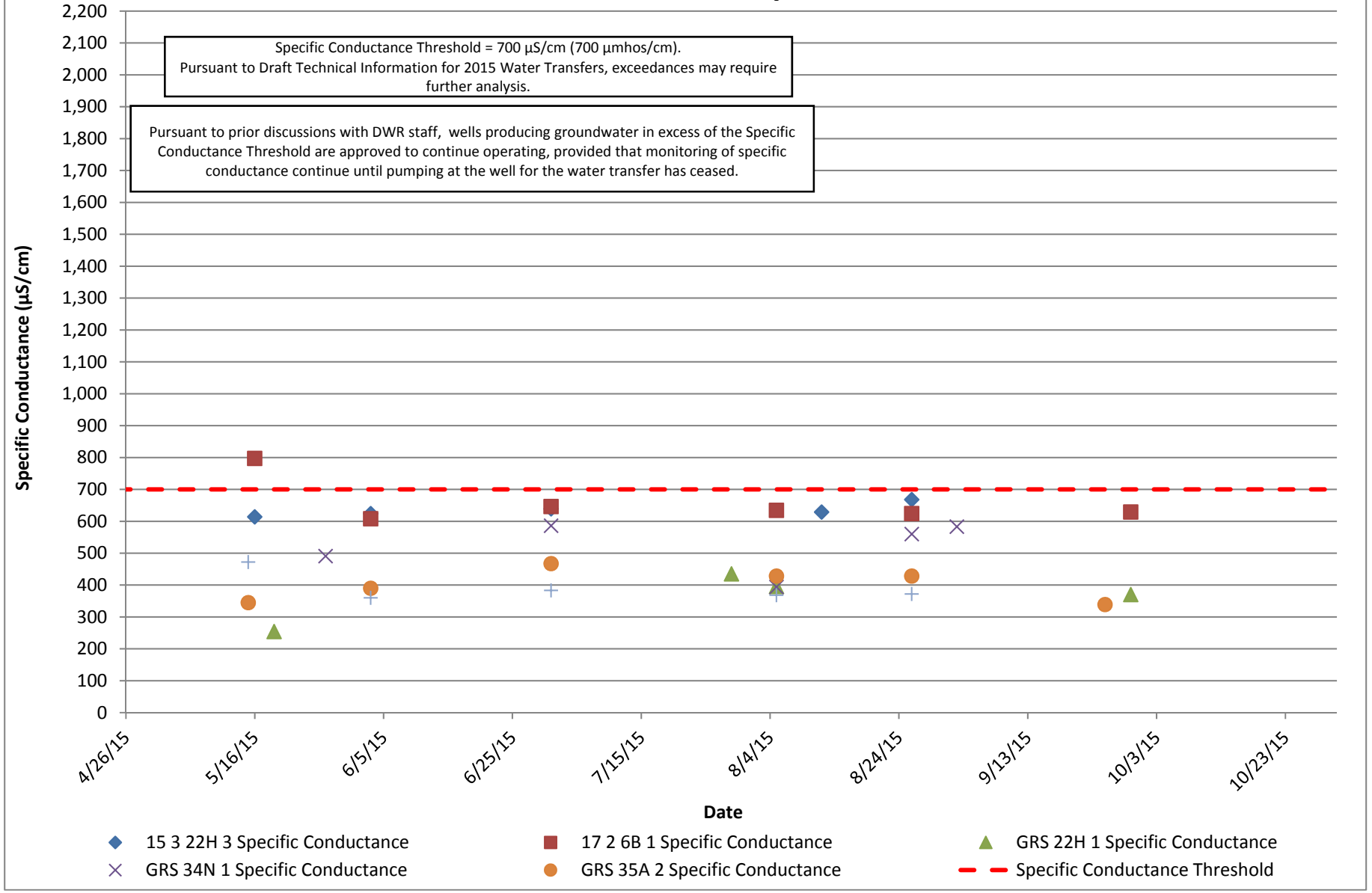
Glenn-Colusa Irrigation District
Groundwater Production Well Specific Conductance



Glenn-Colusa Irrigation District
Groundwater Production Well Specific Conductance



Glenn-Colusa Irrigation District
Groundwater Production Well Specific Conductance



Garden Highway Mutual Water Company

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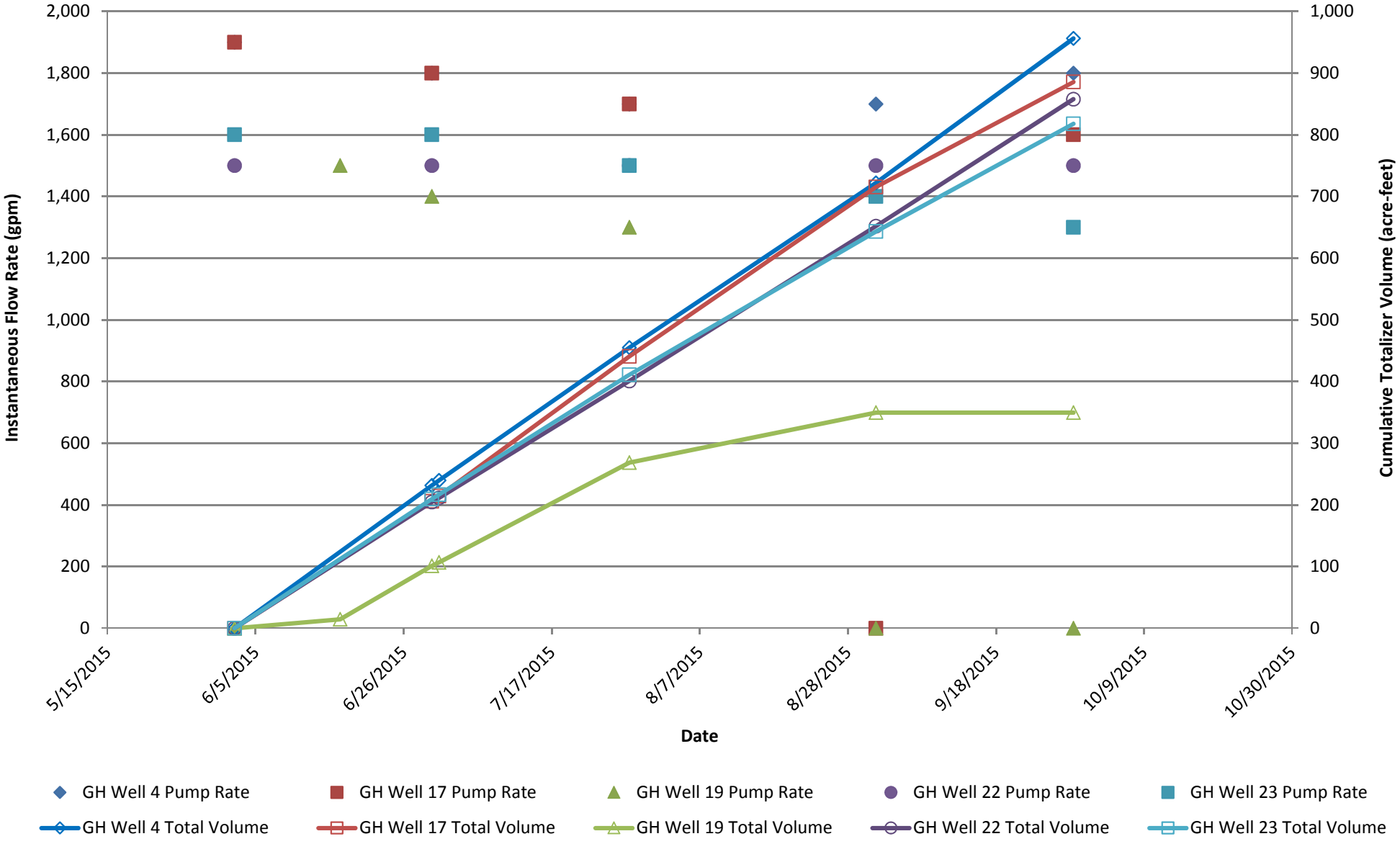
Figure 2
Garden Highway Mutual Water Company
Groundwater Production Well Flow Rates & Volumes



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Tab: Production Data

Figure 3A
Garden Highway Mutual Water Company
Production Well Groundwater Level Data

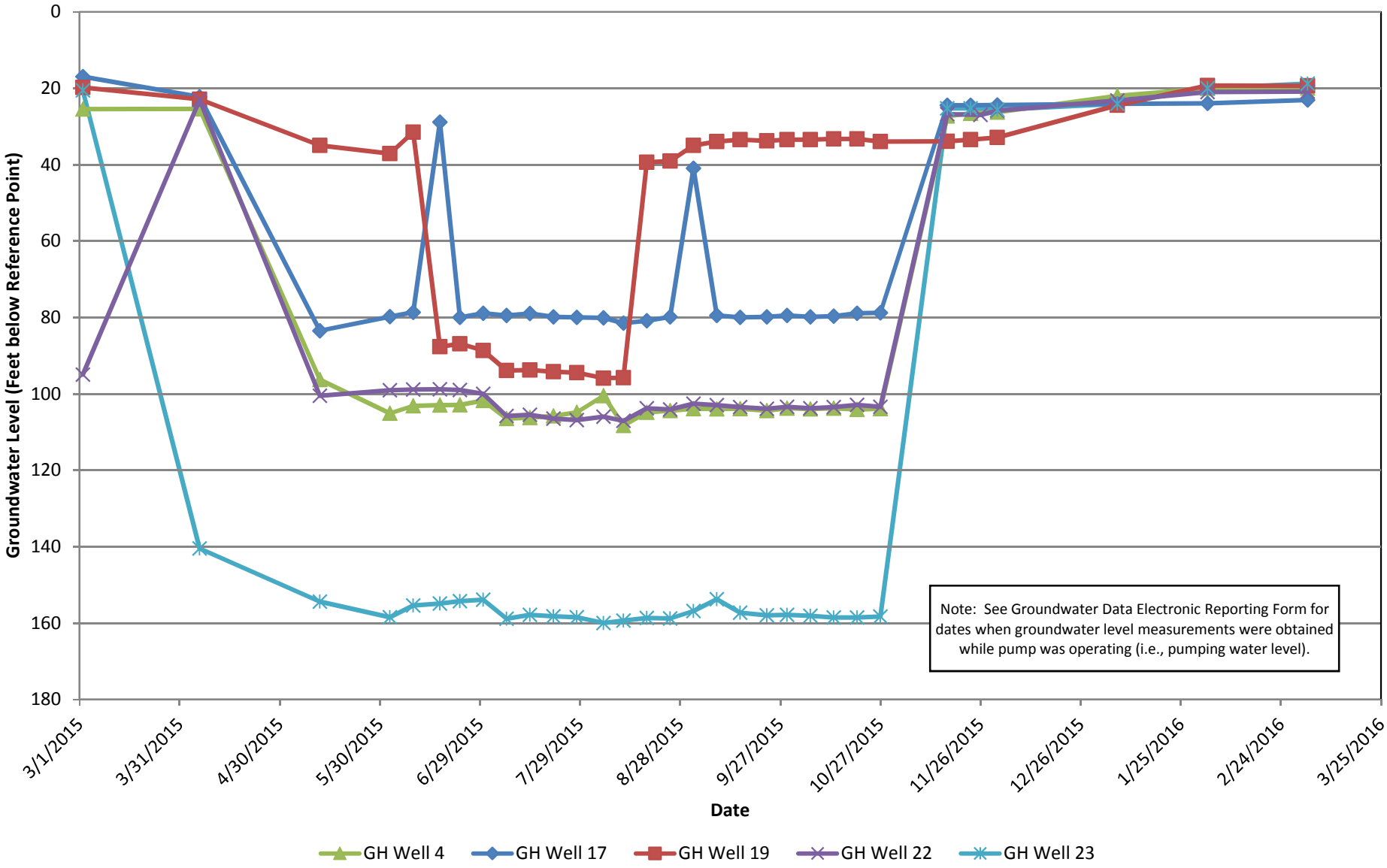

Figure 3B
Garden Highway Mutual Water Company
Monitoring Well Groundwater Level Data

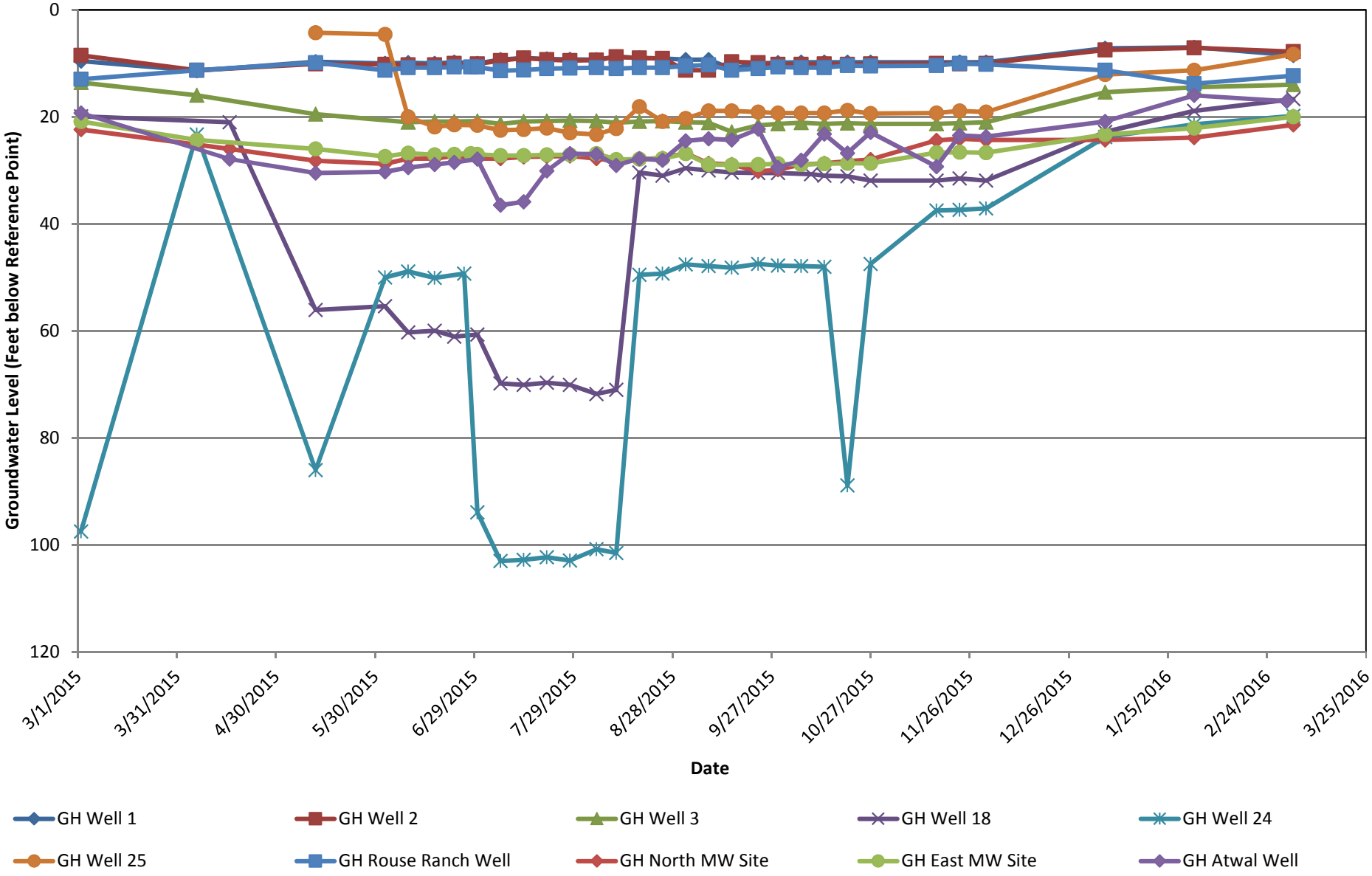

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Figure 3C
Garden Highway Mutual Water Company
Monitoring Well Groundwater Level Data

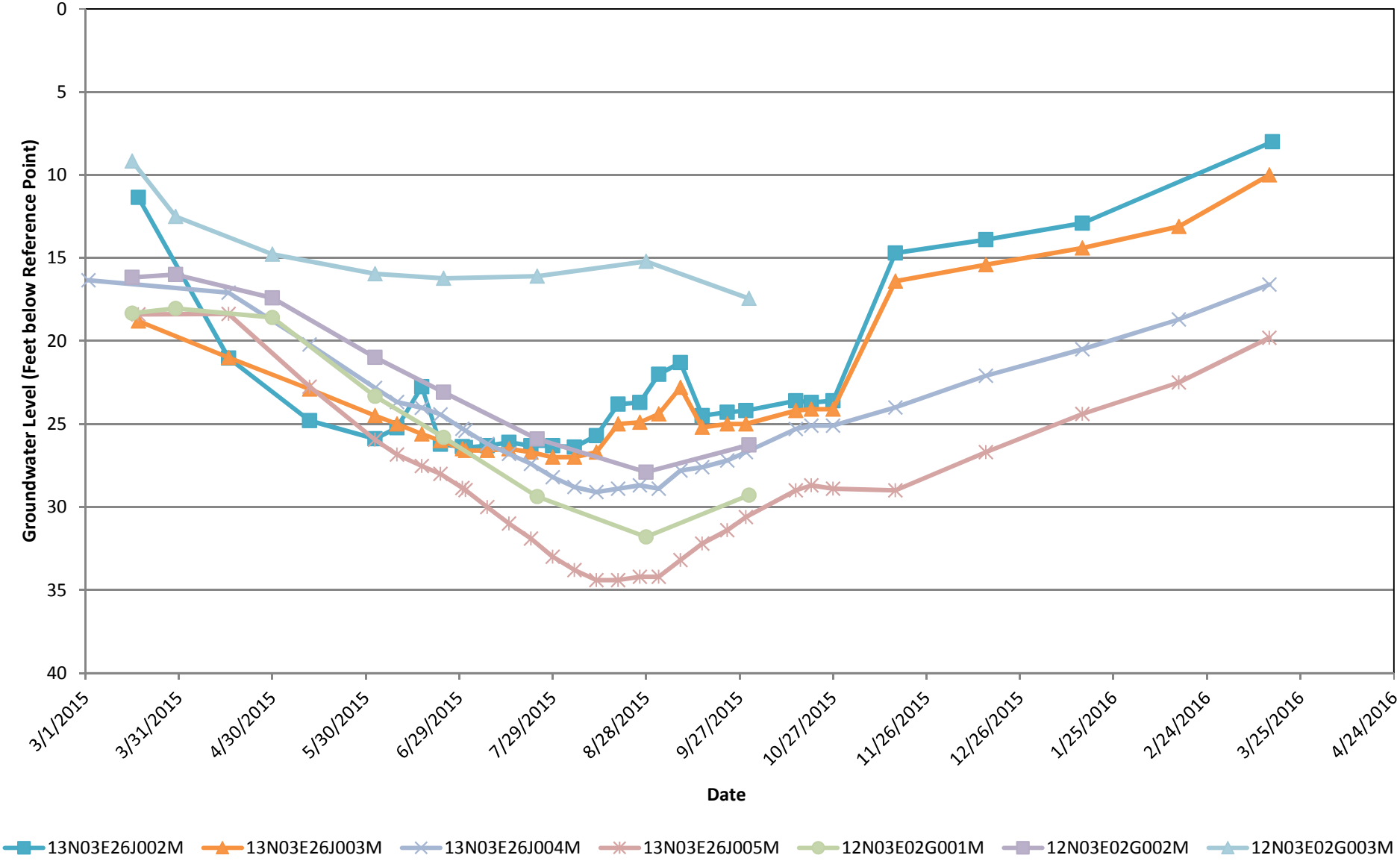
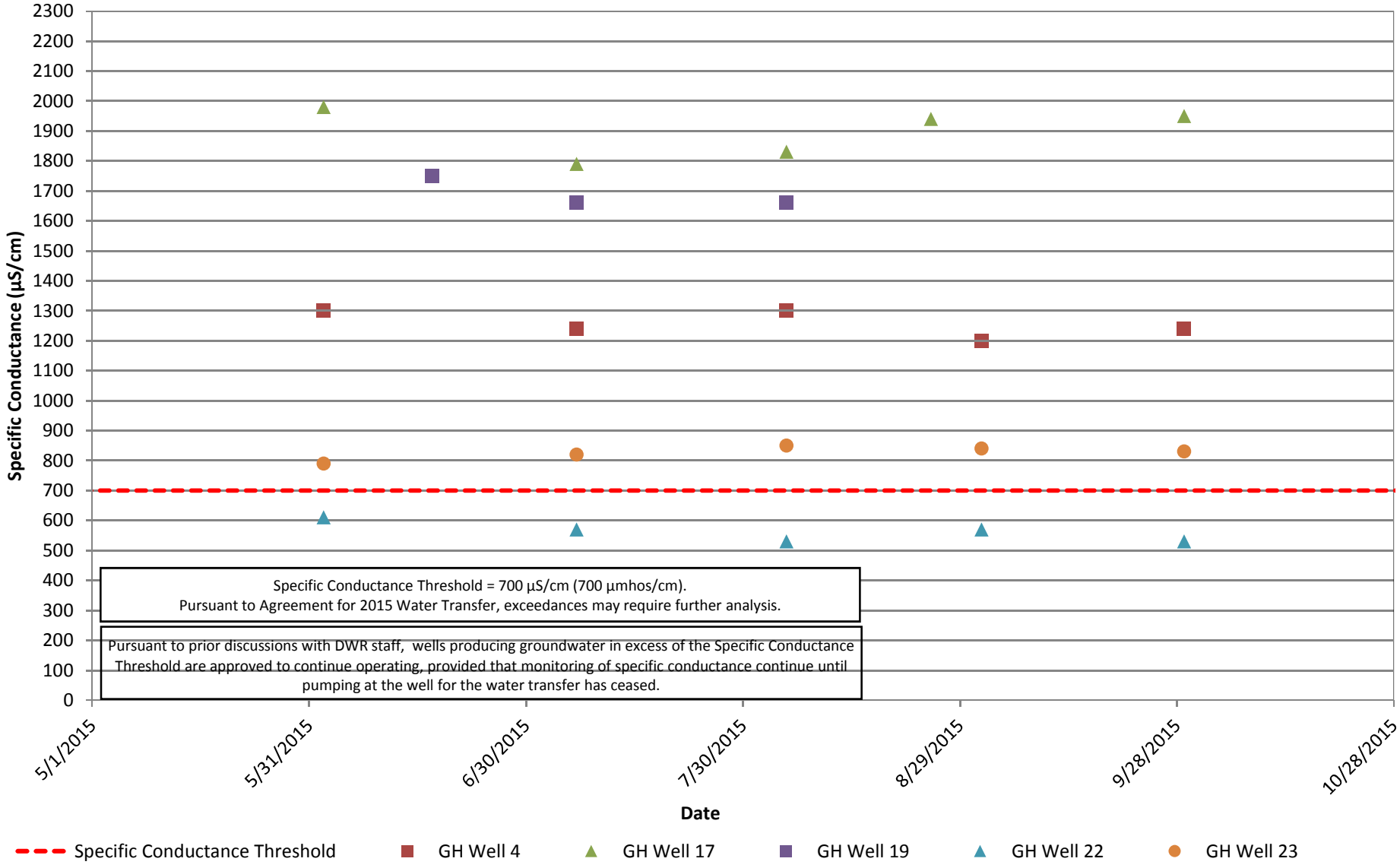


Figure 7
Garden Highway Mutual Water Company
Groundwater Production Well Specific Conductance



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Natomas Central Mutual Water Company

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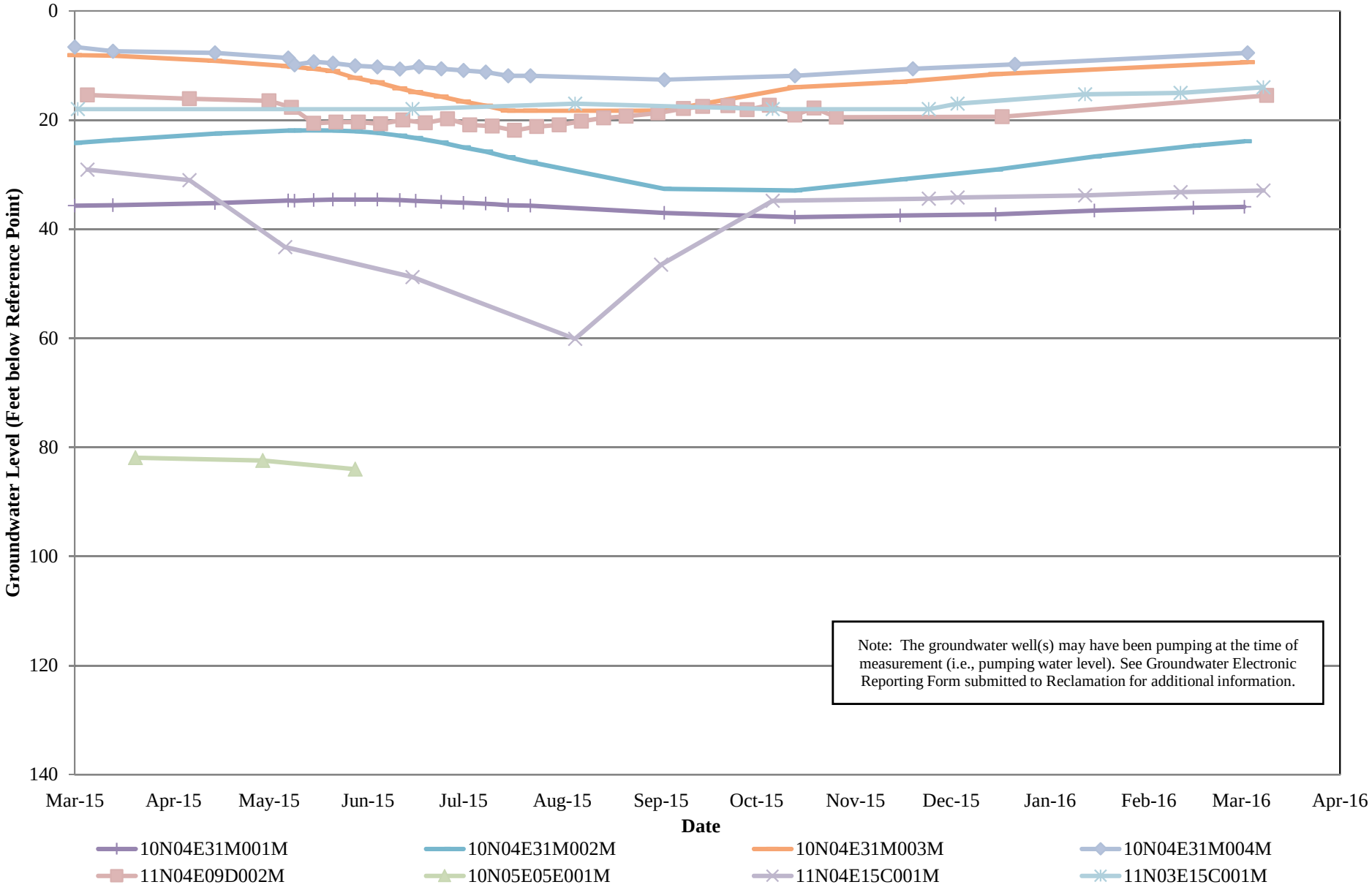
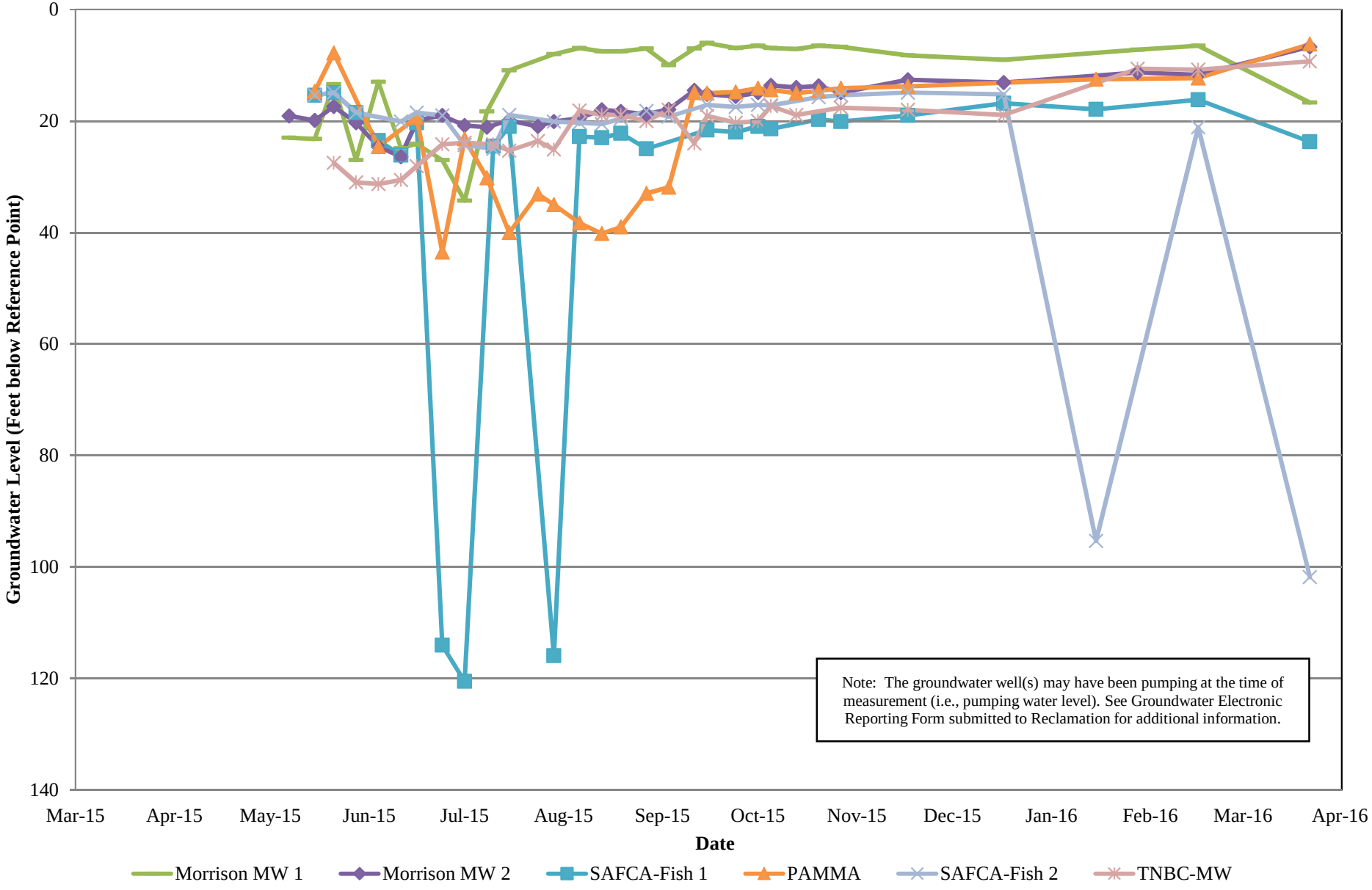
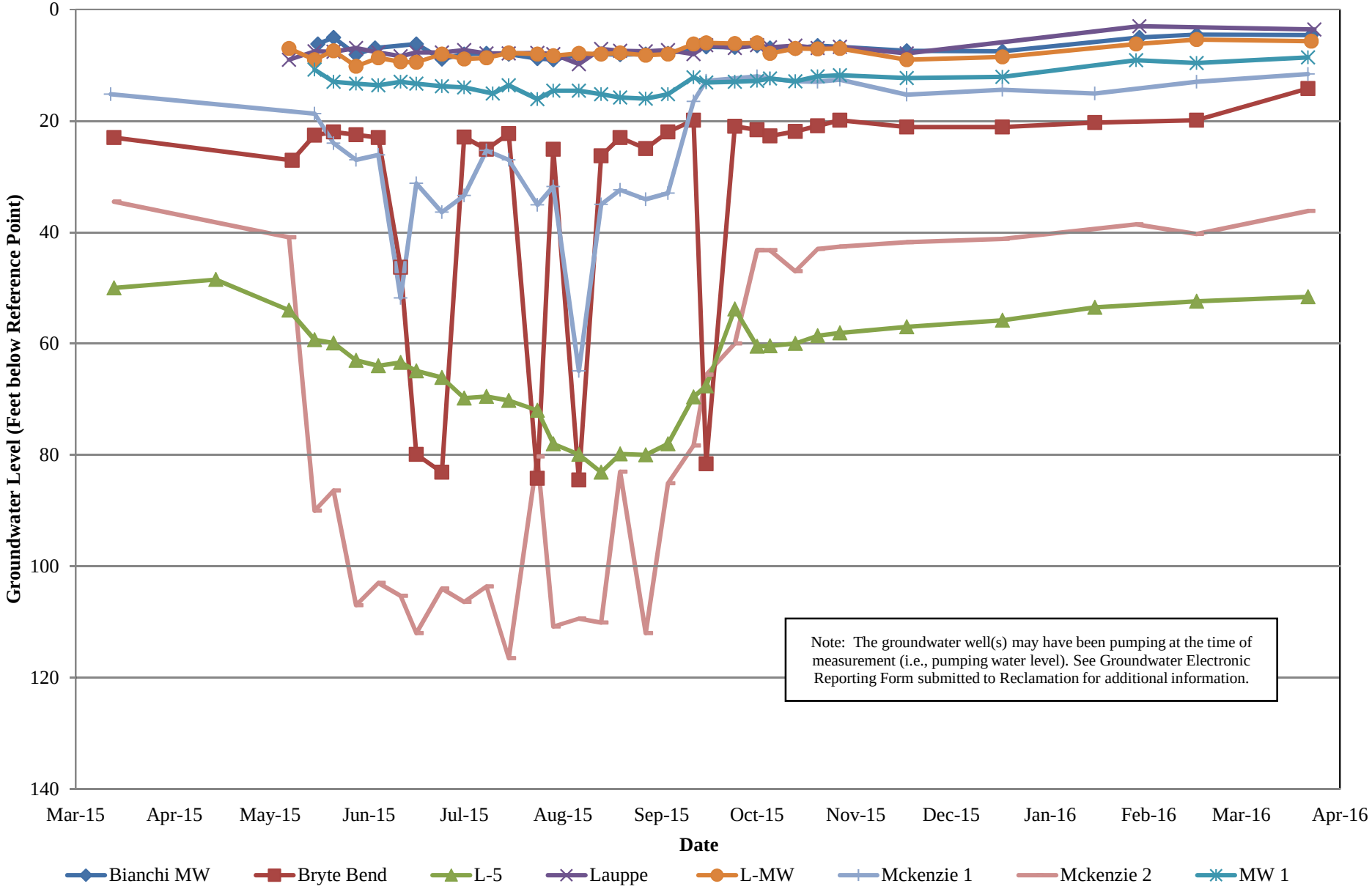
Natomas Central Mutual Water Company
DWR Monitoring Well Groundwater Level Data



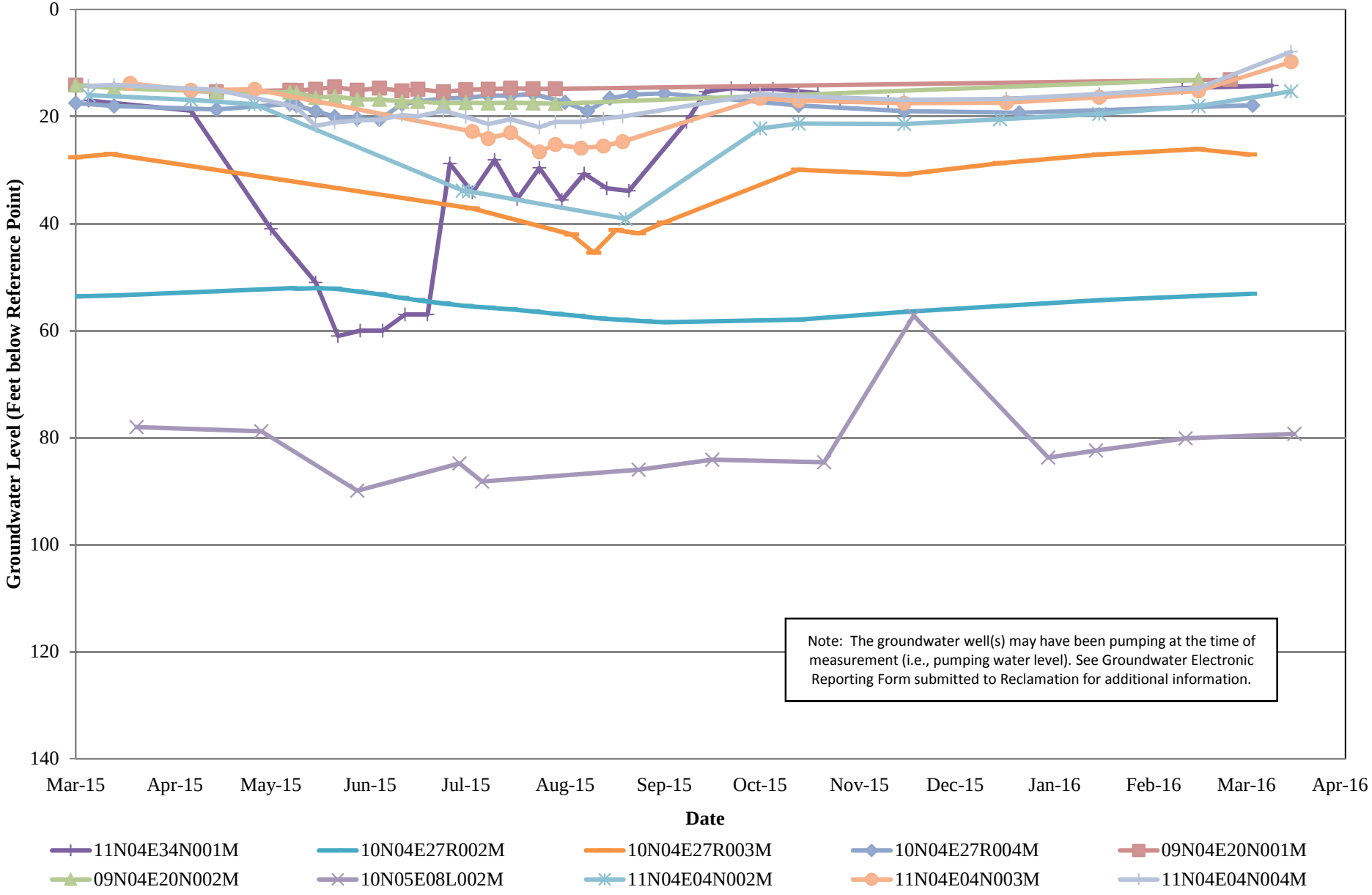
Natomas Central Mutual Water Company
Monitoring Well Groundwater Level Data

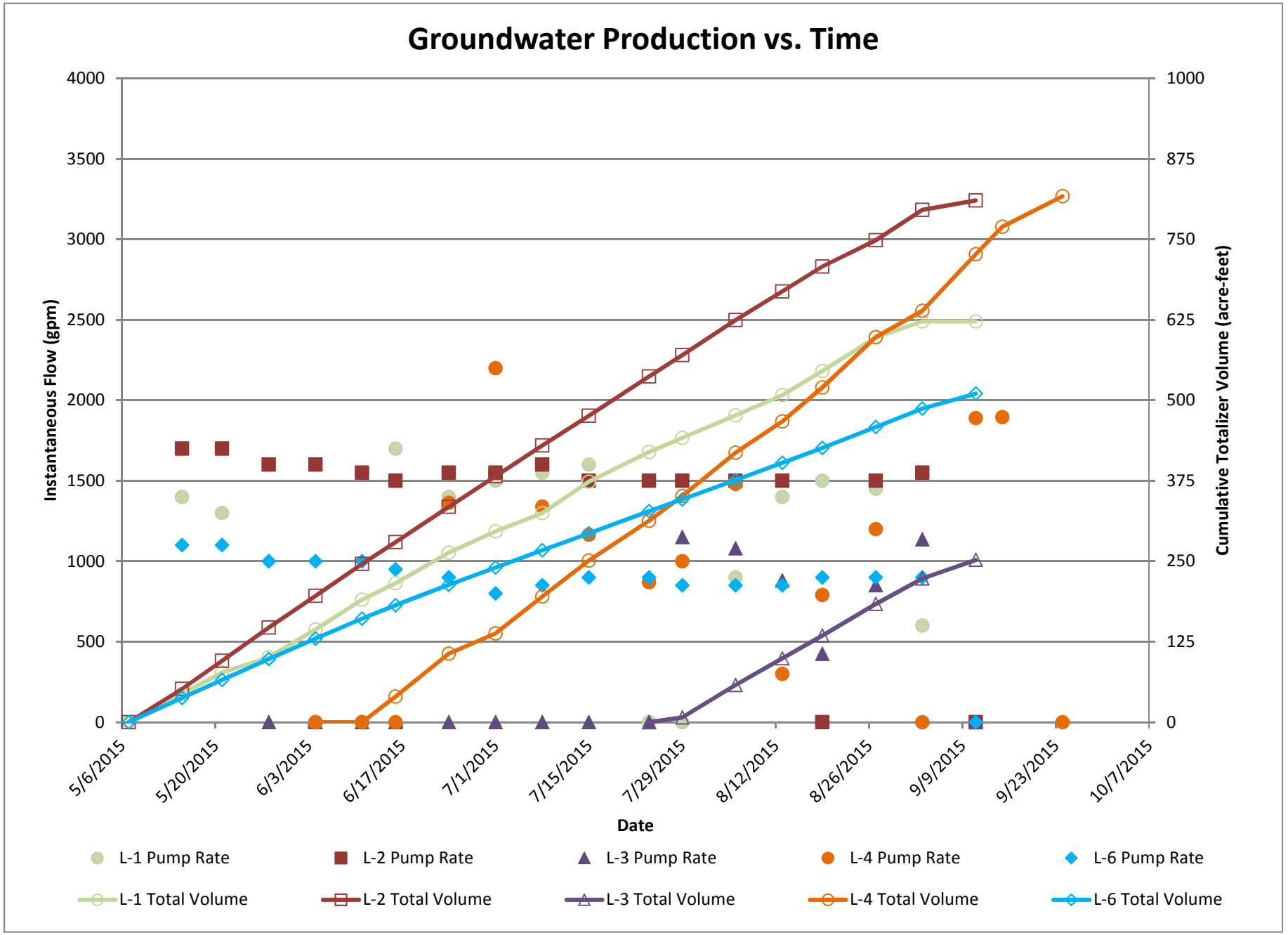


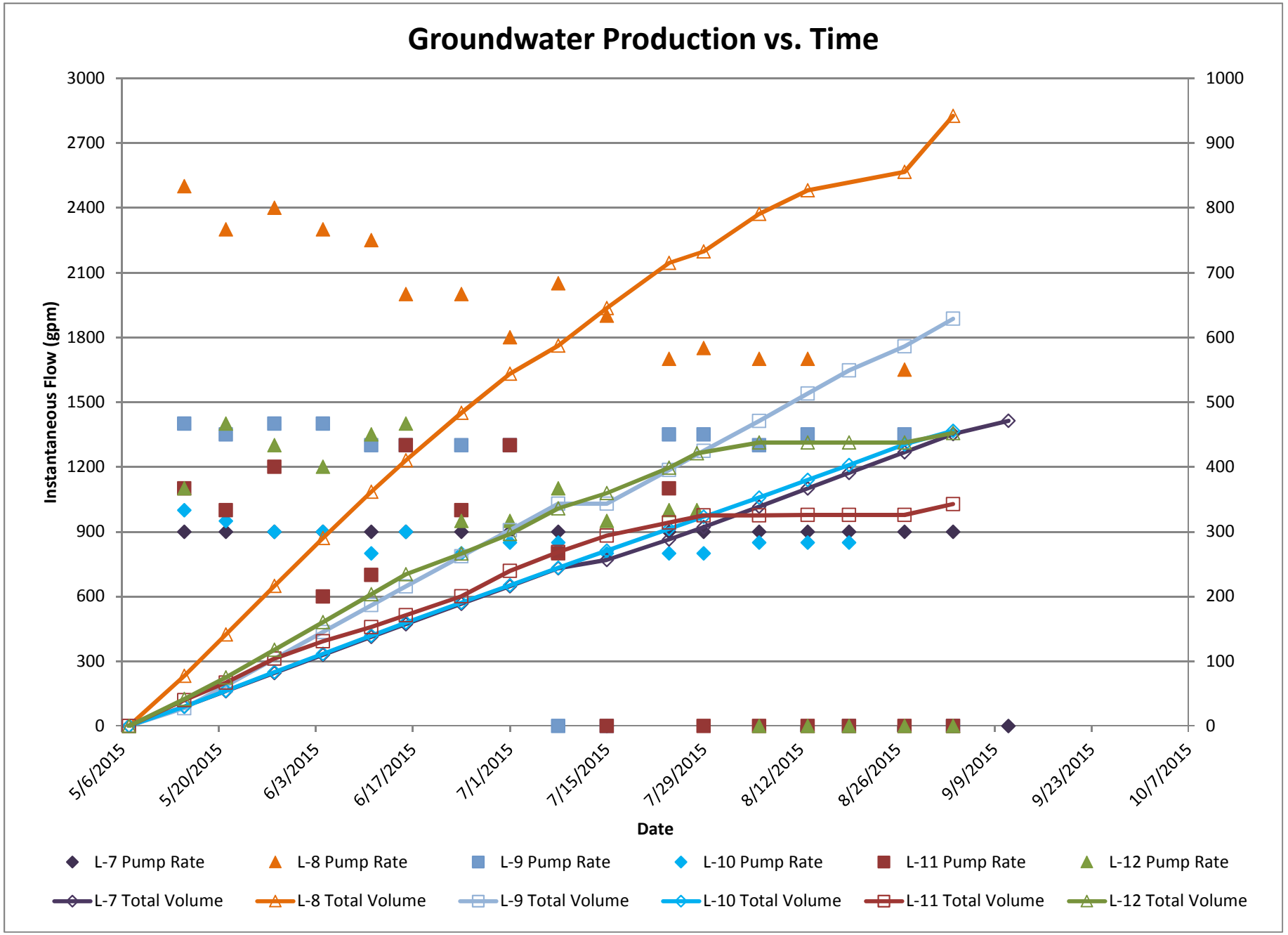
Natomas Central Mutual Water Company
Monitoring Well Groundwater Level Data



Natomas Central Mutual Water Company
DWR Monitoring Well Groundwater Level Data




Groundwater Production vs. Time
Instantaneous Flow (gpm)
Cumulative Totalizer Volume (acre-feet)
4000
3500
3000
2500
2000
1500
1000
500
0
1000
875
750
625
500
375
250
125
0
5/6/2015
5/20/2015
6/3/2015
6/17/2015
7/1/2015
7/15/2015
7/29/2015
8/12/2015
8/26/2015
9/9/2015
9/23/2015
10/7/2015
Date
L-1 Pump Rate
L-2 Pump Rate
L-3 Pump Rate
L-4 Pump Rate
L-6 Pump Rate
L-1 Total Volume
L-2 Total Volume
L-3 Total Volume
L-4 Total Volume
L-6 Total Volume


Groundwater Production vs. Time
Instantaneous Flow (gpm)
3000
2700
2400
2100
1800
1500
1200
900
600
300
0
1000
900
800
700
600
500
400
300
200
100
0
5/6/2015
5/20/2015
6/3/2015
6/17/2015
7/1/2015
7/15/2015
7/29/2015
8/12/2015
8/26/2015
9/9/2015
9/23/2015
10/7/2015
Date
L-7 Pump Rate
L-8 Pump Rate
L-9 Pump Rate
L-10 Pump Rate
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L-7 Total Volume
L-8 Total Volume
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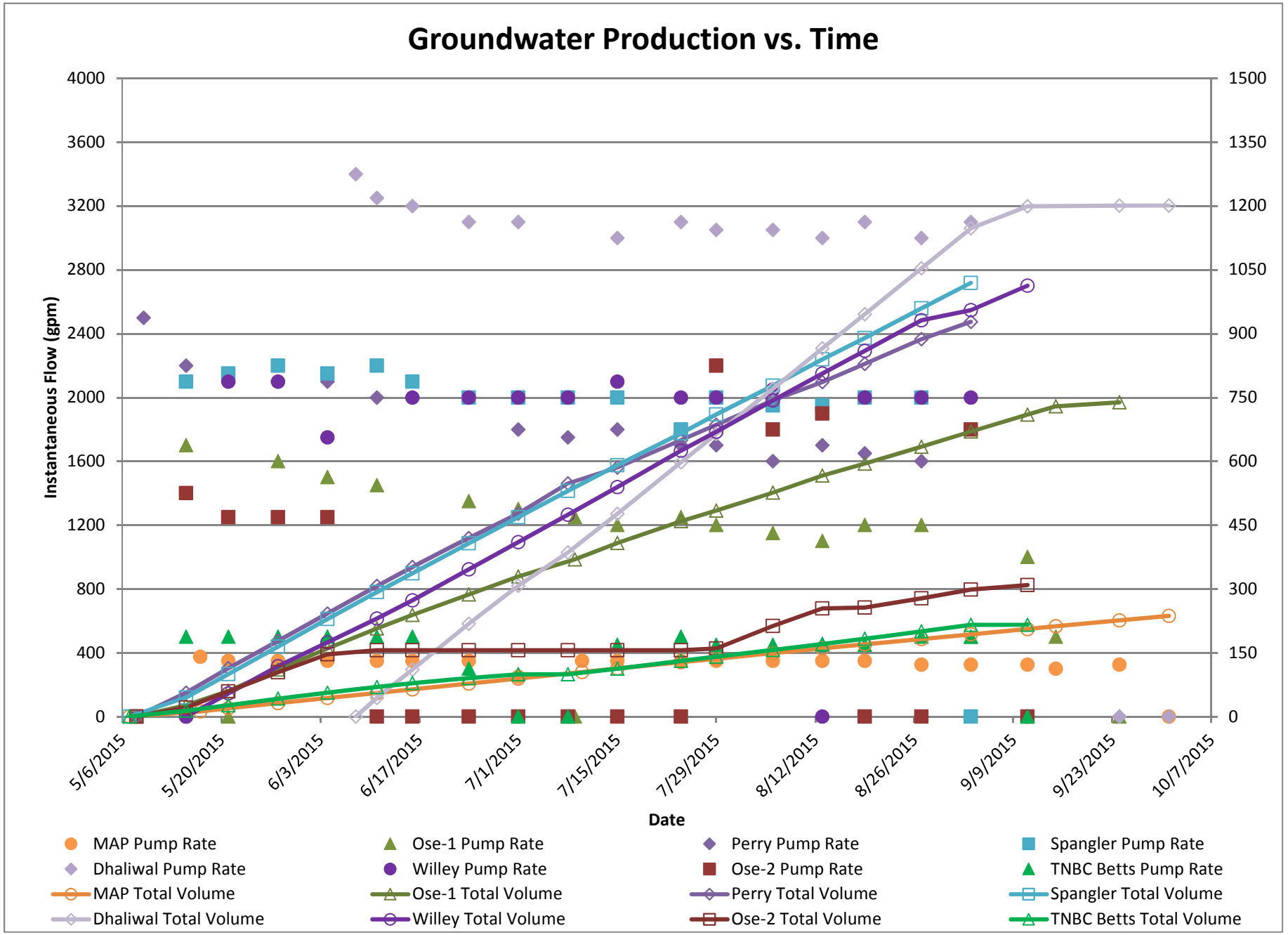
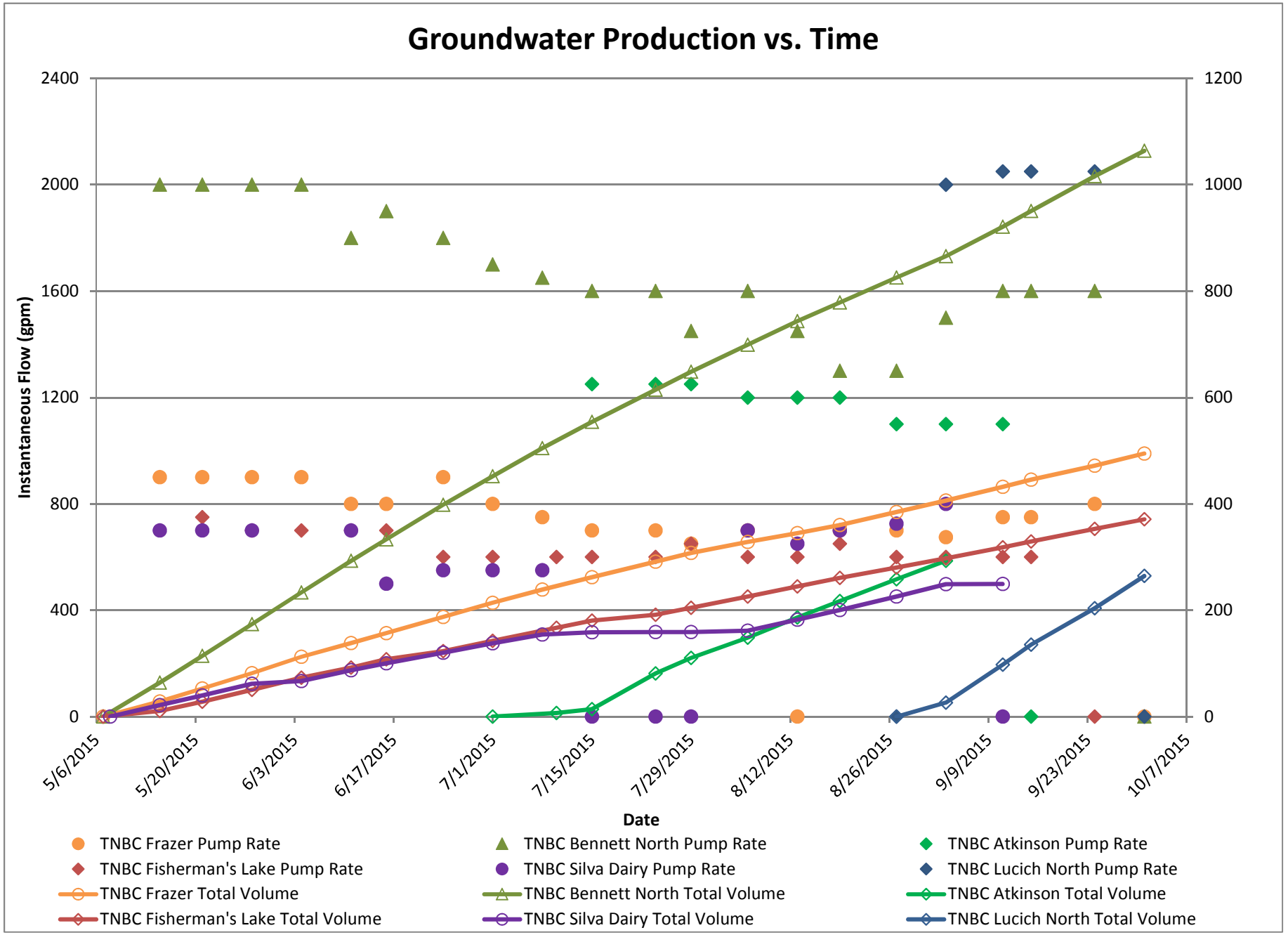
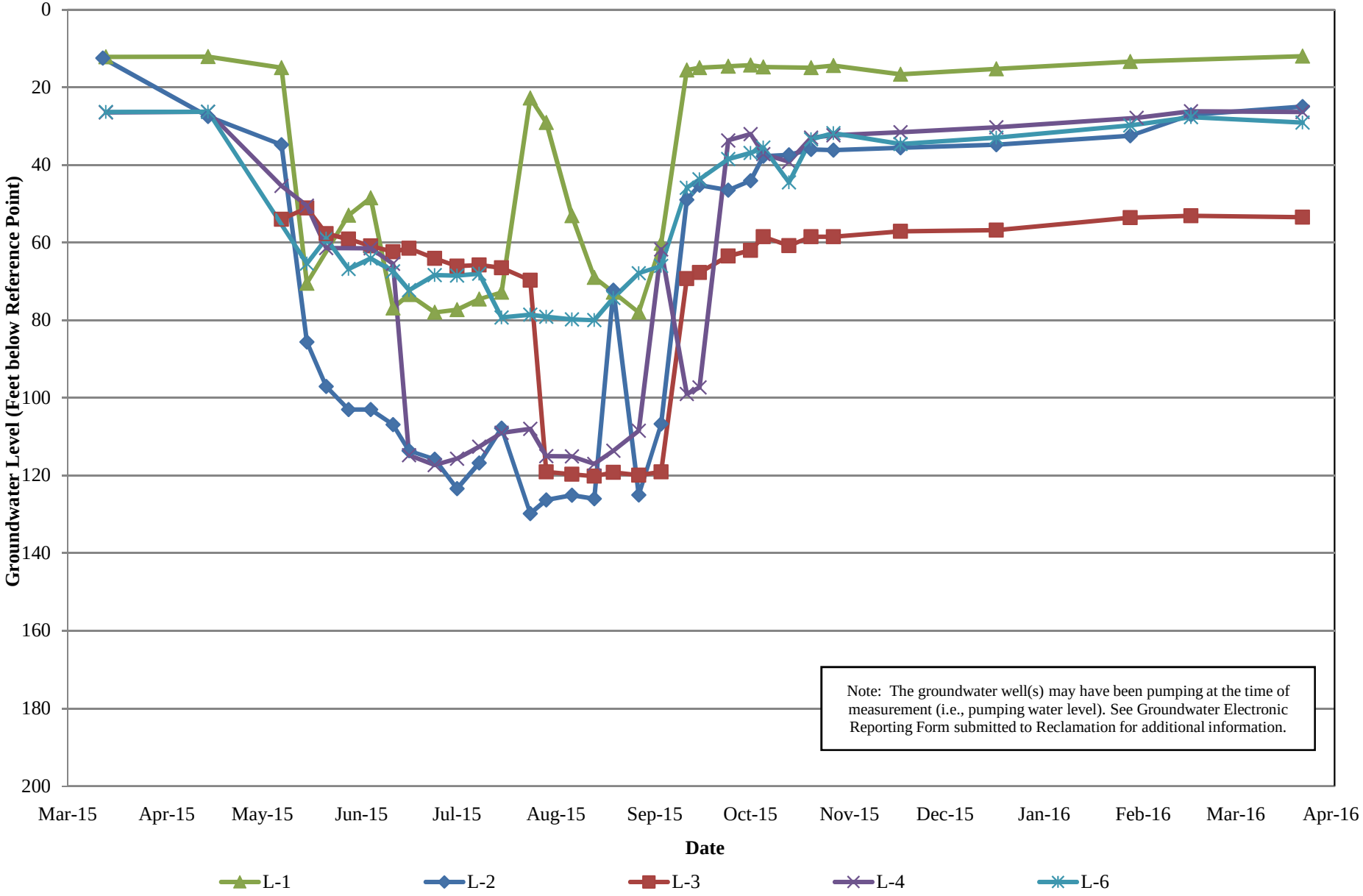
L-11 Total Volume
L-12 Total Volume

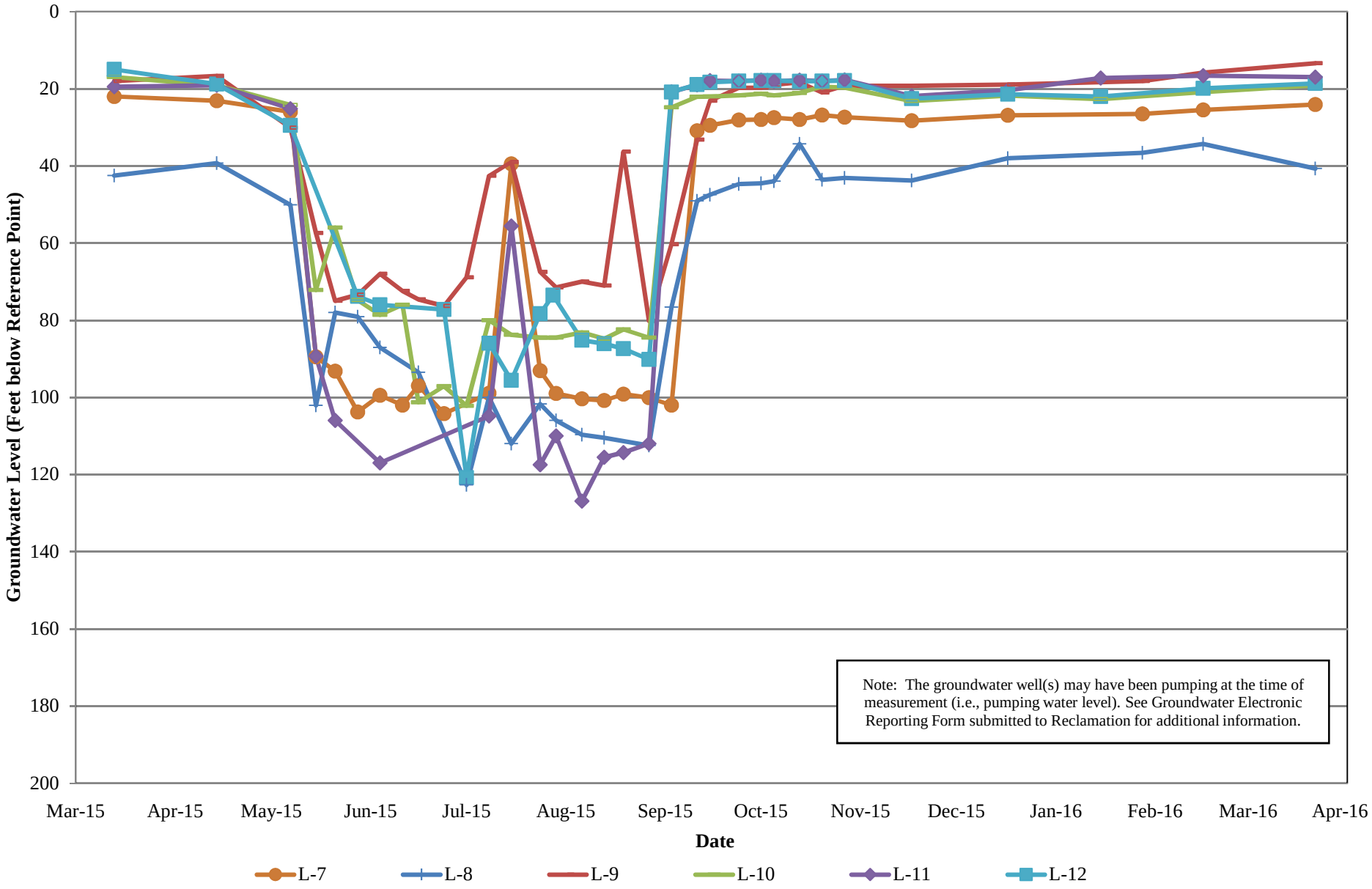

Groundwater Production vs. Time
Instantaneous Flow (gpm)
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
1500
1350
1200
1050
900
750
600
450
300
150
0
5/6/2015
5/20/2015
6/3/2015
6/17/2015
7/1/2015
7/15/2015
7/29/2015
8/12/2015
8/26/2015
9/9/2015
9/23/2015
10/7/2015
Date
MAP Pump Rate
Ose-1 Pump Rate
Perry Pump Rate
Spangler Pump Rate
Dhaliwal Pump Rate
Willey Pump Rate
Ose-2 Pump Rate
TNBC Betts Pump Rate
MAP Total Volume
Ose-1 Total Volume
Perry Total Volume
Spangler Total Volume
Dhaliwal Total Volume
Willey Total Volume
Ose-2 Total Volume
TNBC Betts Total Volume


Groundwater Production vs. Time
Instantaneous Flow (gpm)
2400
2000
1600
1200
800
400
0
1200
1000
800
600
400
200
0
5/6/2015
5/20/2015
6/3/2015
6/17/2015
7/1/2015
7/15/2015
7/29/2015
8/12/2015
8/26/2015
9/9/2015
9/23/2015
10/7/2015
Date
TNBC Frazer Pump Rate
TNBC Bennett North Pump Rate
TNBC Atkinson Pump Rate
TNBC Fisherman's Lake Pump Rate
TNBC Silva Dairy Pump Rate
TNBC Lucich North Pump Rate
TNBC Frazer Total Volume
TNBC Bennett North Total Volume
TNBC Atkinson Total Volume
TNBC Fisherman's Lake Total Volume
TNBC Silva Dairy Total Volume
TNBC Lucich North Total Volume

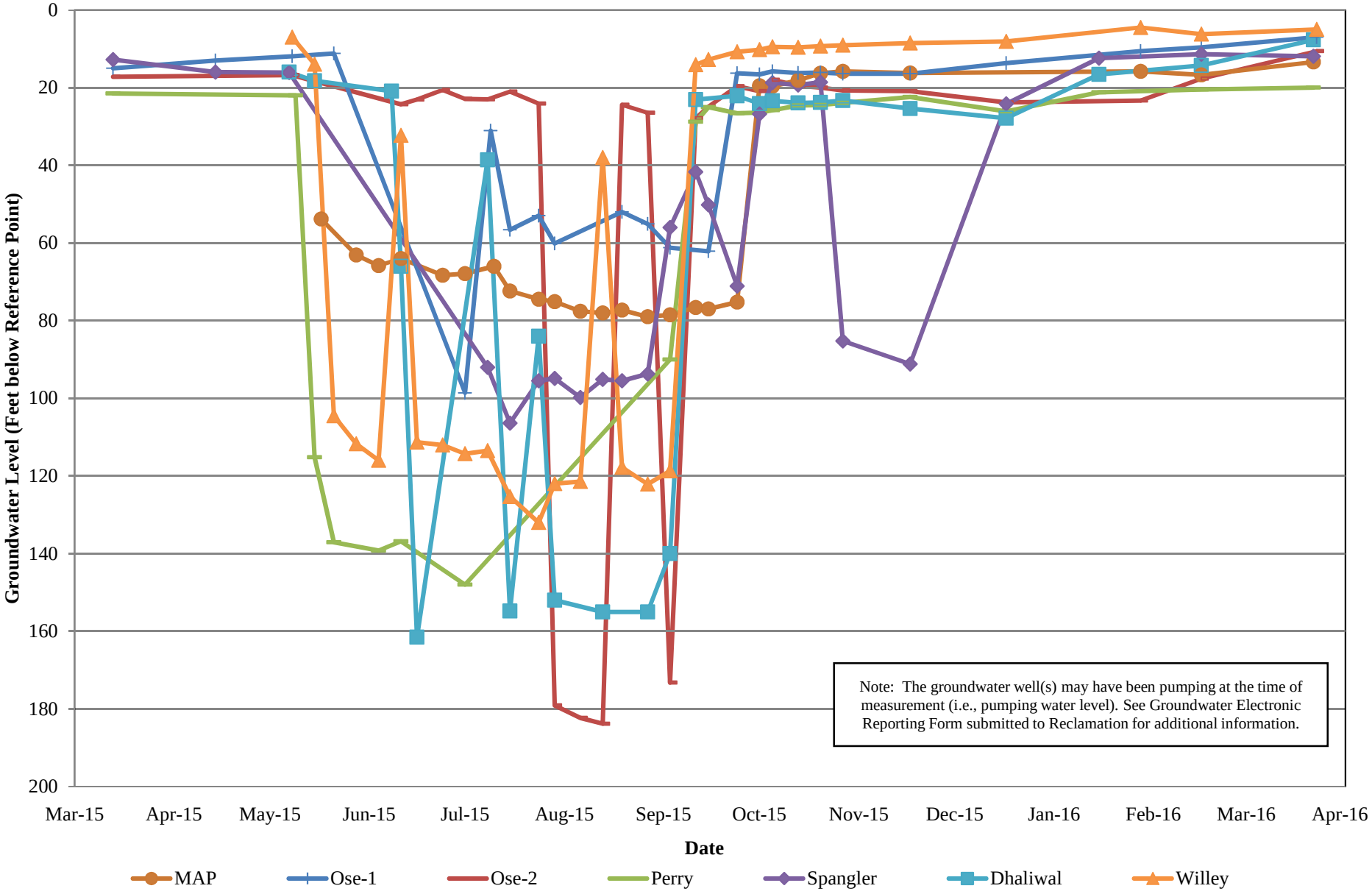
Natomas Central Mutual Water Company
Production Well Groundwater Level Data



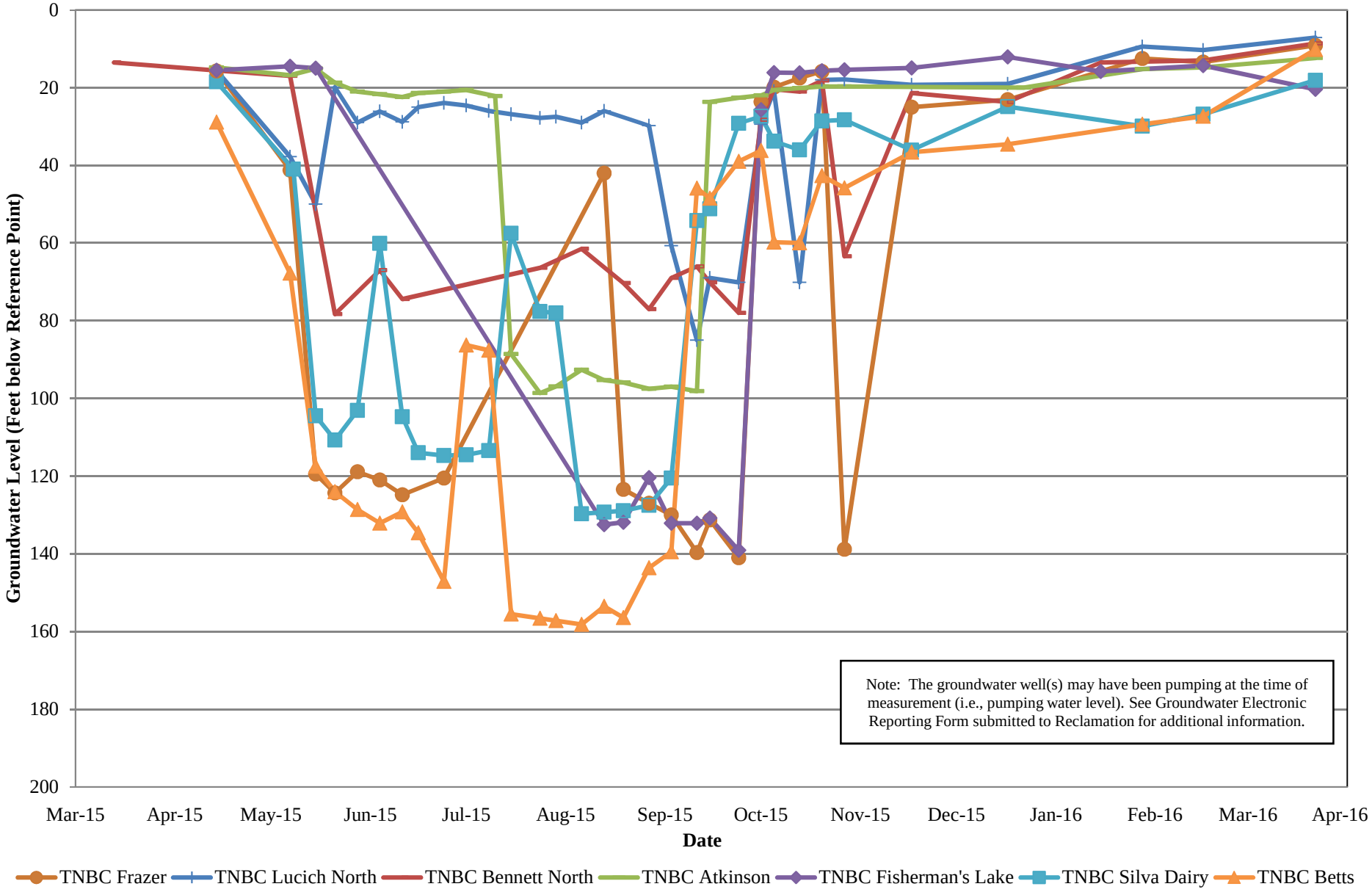
Natomas Central Mutual Water Company
Production Well Groundwater Level Data

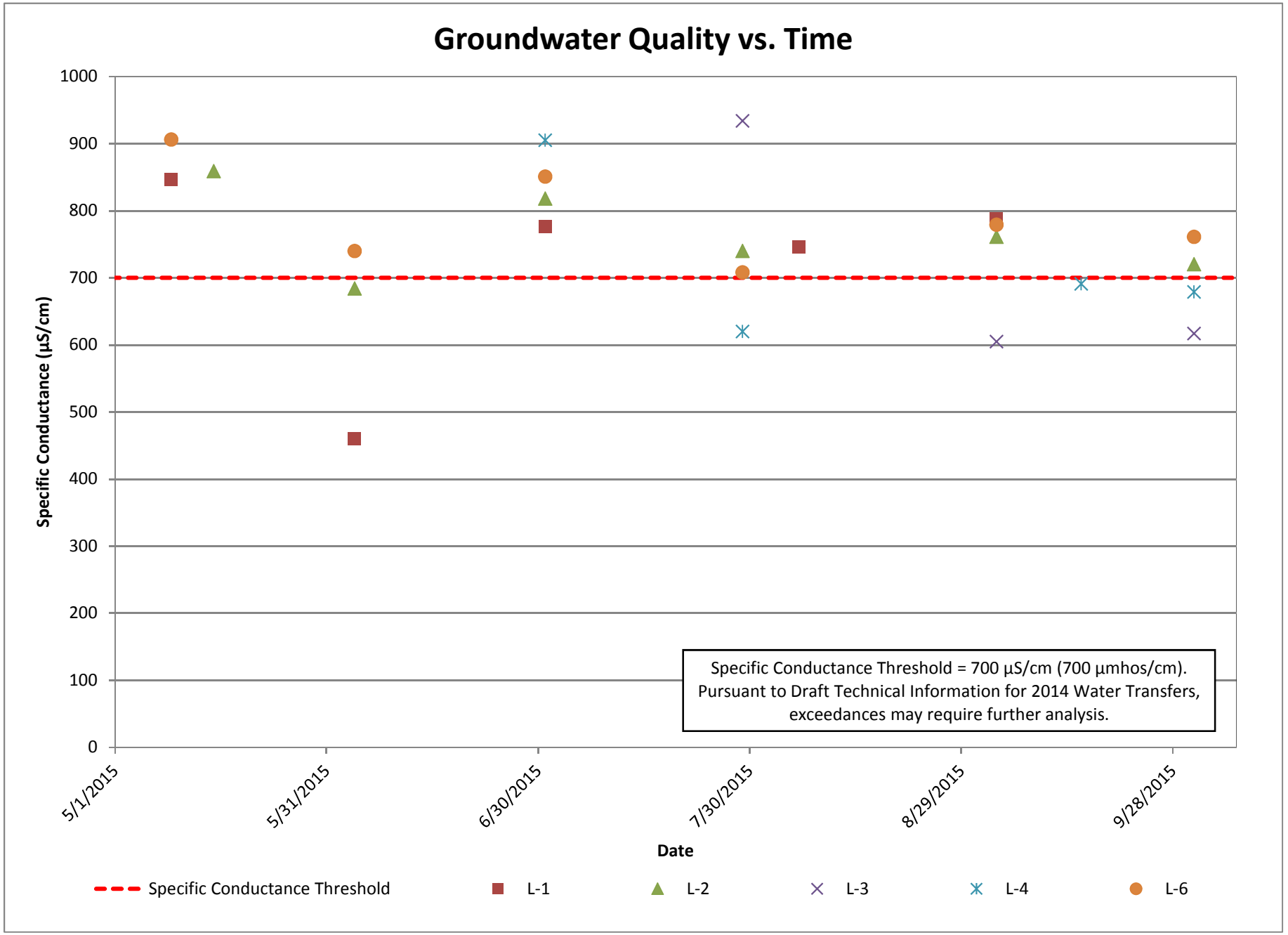


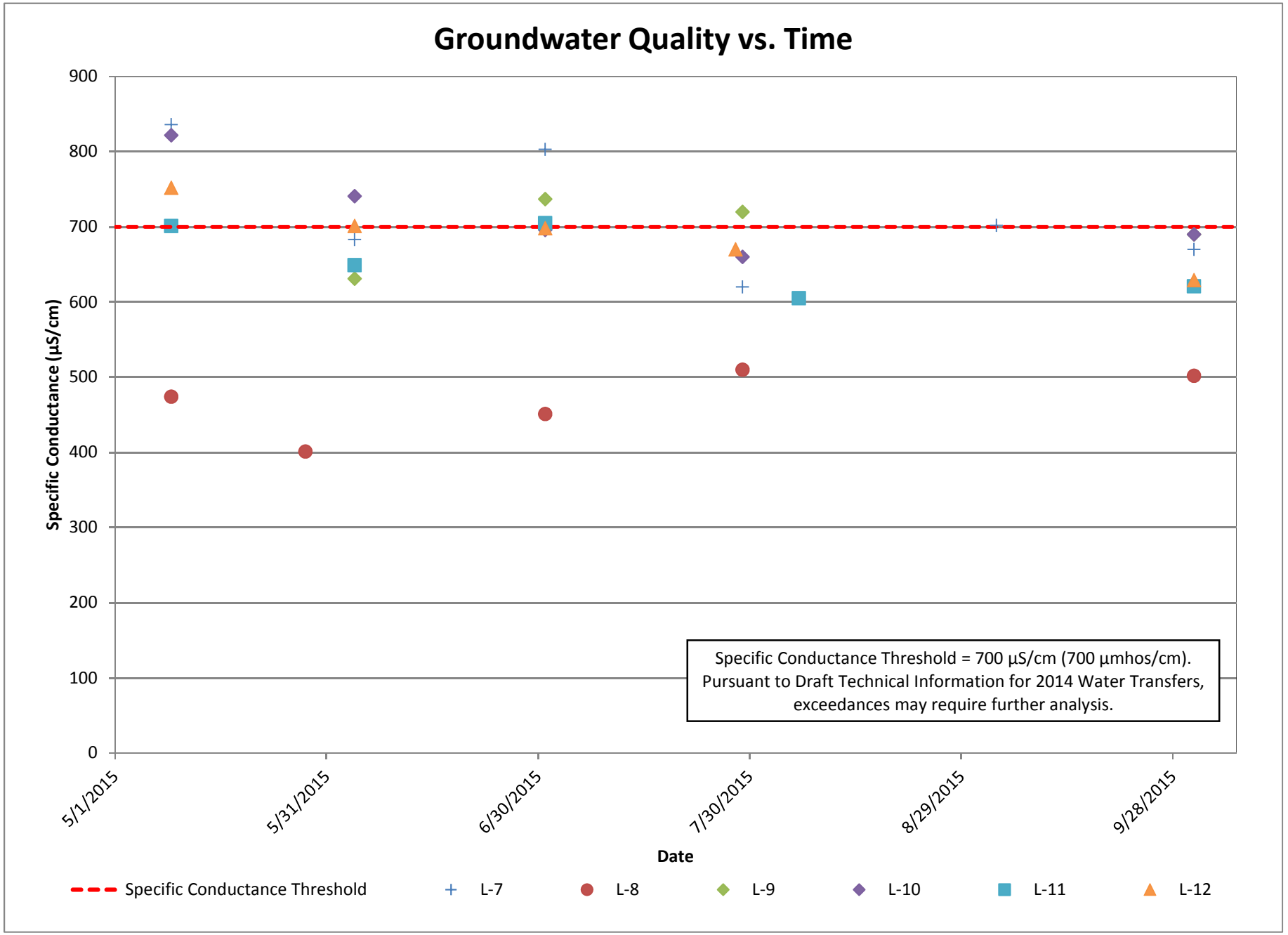
Natomas Central Mutual Water Company
Production Well Groundwater Level Data

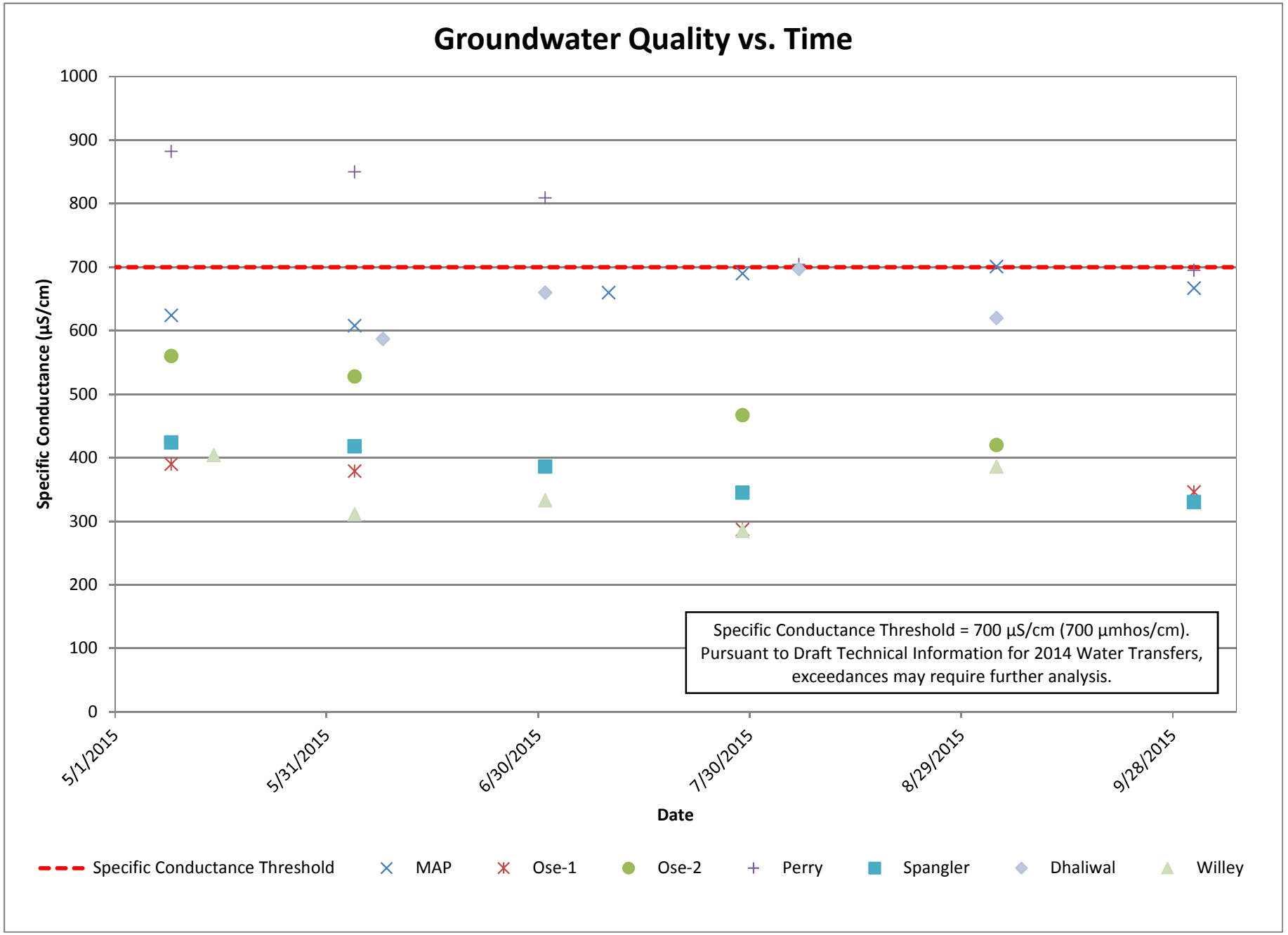


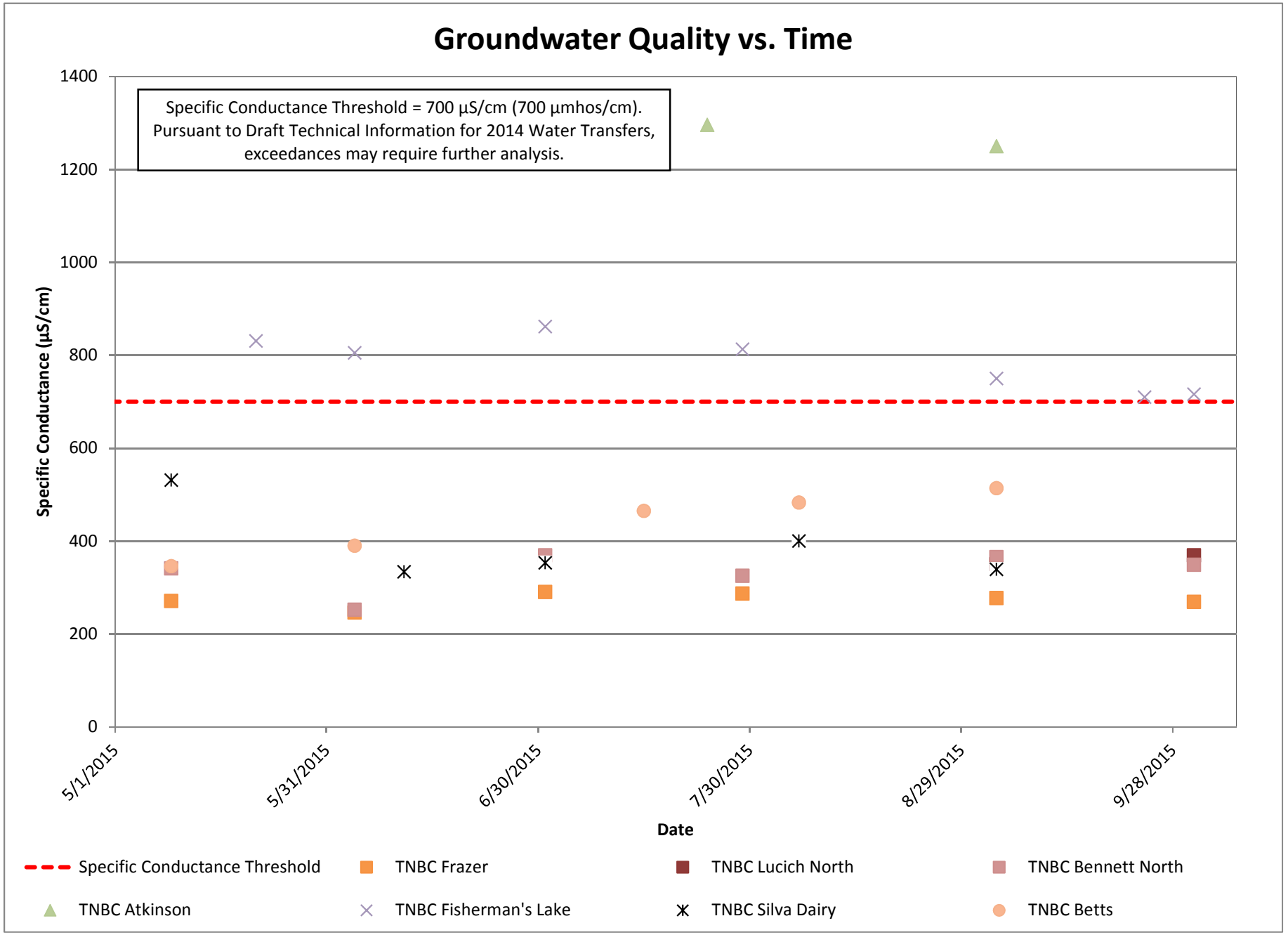
Natomas Central Mutual Water Company
Production Well Groundwater Level Data




Groundwater Quality vs. Time
Specific Conductance (µS/cm)
1000
900
800
700
600
500
400
300
200
100
0
5/1/2015
5/31/2015
6/30/2015
7/30/2015
8/29/2015
9/28/2015
Date
Specific Conductance Threshold = 700 µS/cm (700 µmhos/cm). Pursuant to Draft Technical Information for 2014 Water Transfers, exceedances may require further analysis.
Specific Conductance Threshold
L-1
L-2
L-3
L-4
L-6


Groundwater Quality vs. Time
Specific Conductance (µS/cm)
900
800
700
600
500
400
300
200
100
0
5/1/2015
5/31/2015
6/30/2015
7/30/2015
8/29/2015
9/28/2015
Date
Specific Conductance Threshold = 700 µS/cm (700 µmhos/cm). Pursuant to Draft Technical Information for 2014 Water Transfers, exceedances may require further analysis.
Specific Conductance Threshold
L-7
L-8
L-9
L-10
L-11
L-12


Groundwater Quality vs. Time
Specific Conductance (µS/cm)
1000
900
800
700
600
500
400
300
200
100
0
5/1/2015
5/31/2015
6/30/2015
7/30/2015
8/29/2015
9/28/2015
Date
Specific Conductance Threshold = 700 µS/cm (700 µmhos/cm). Pursuant to Draft Technical Information for 2014 Water Transfers, exceedances may require further analysis.
Specific Conductance Threshold
MAP
Ose-1
Ose-2
Perry
Spangler
Dhaliwal
Willey


Groundwater Quality vs. Time
Specific Conductance Threshold = 700 µS/cm (700 µmhos/cm). Pursuant to Draft Technical Information for 2014 Water Transfers, exceedances may require further analysis.
Specific Conductance (µS/cm)
1400
1200
1000
800
600
400
200
0
5/1/2015
5/31/2015
6/30/2015
7/30/2015
8/29/2015
9/28/2015
Date
Specific Conductance Threshold
TNBC Frazer
TNBC Lucich North
TNBC Bennett North
TNBC Atkinson
TNBC Fisherman's Lake
TNBC Silva Dairy
TNBC Betts

Pelger Mutual Water Company

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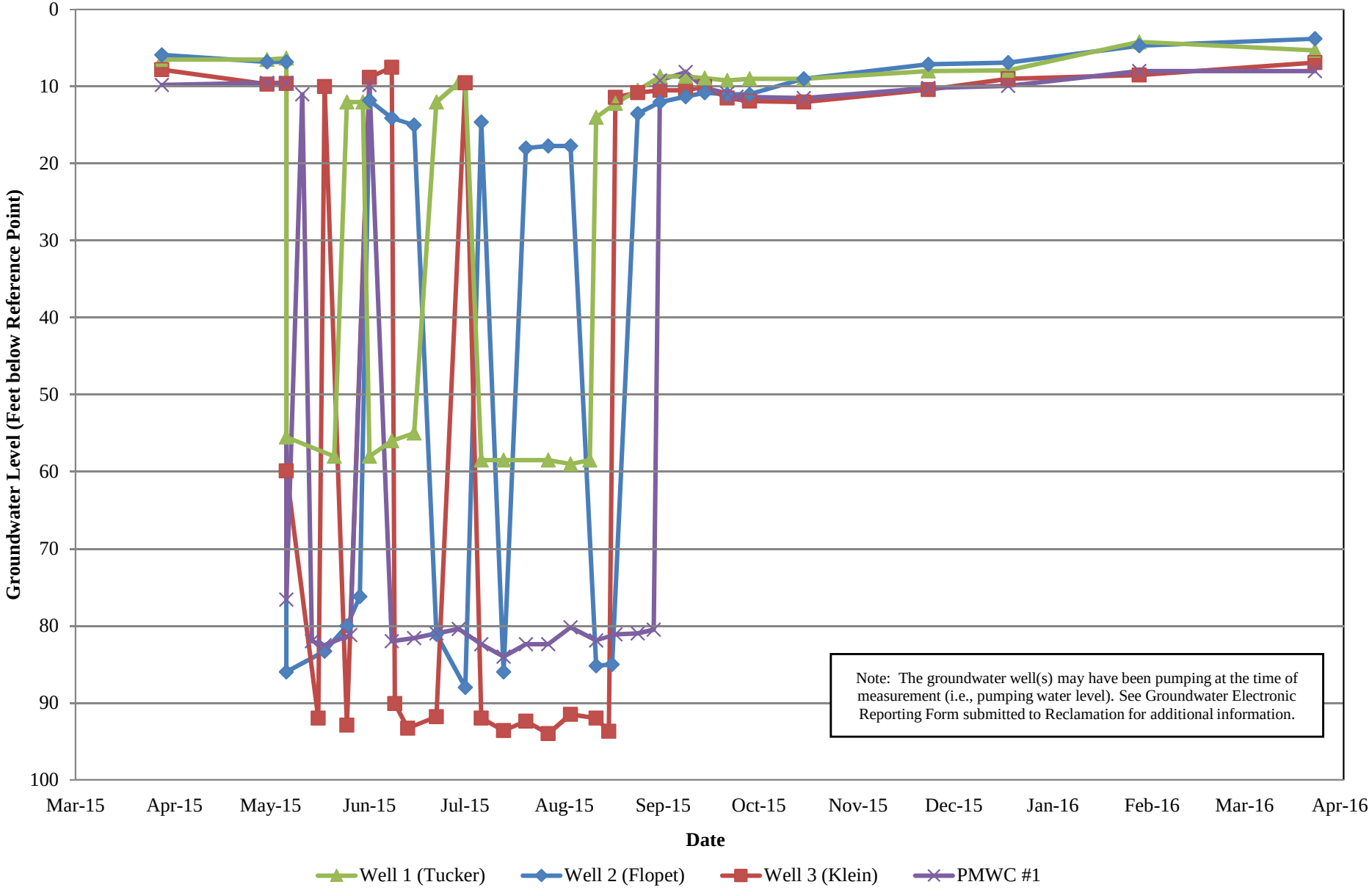
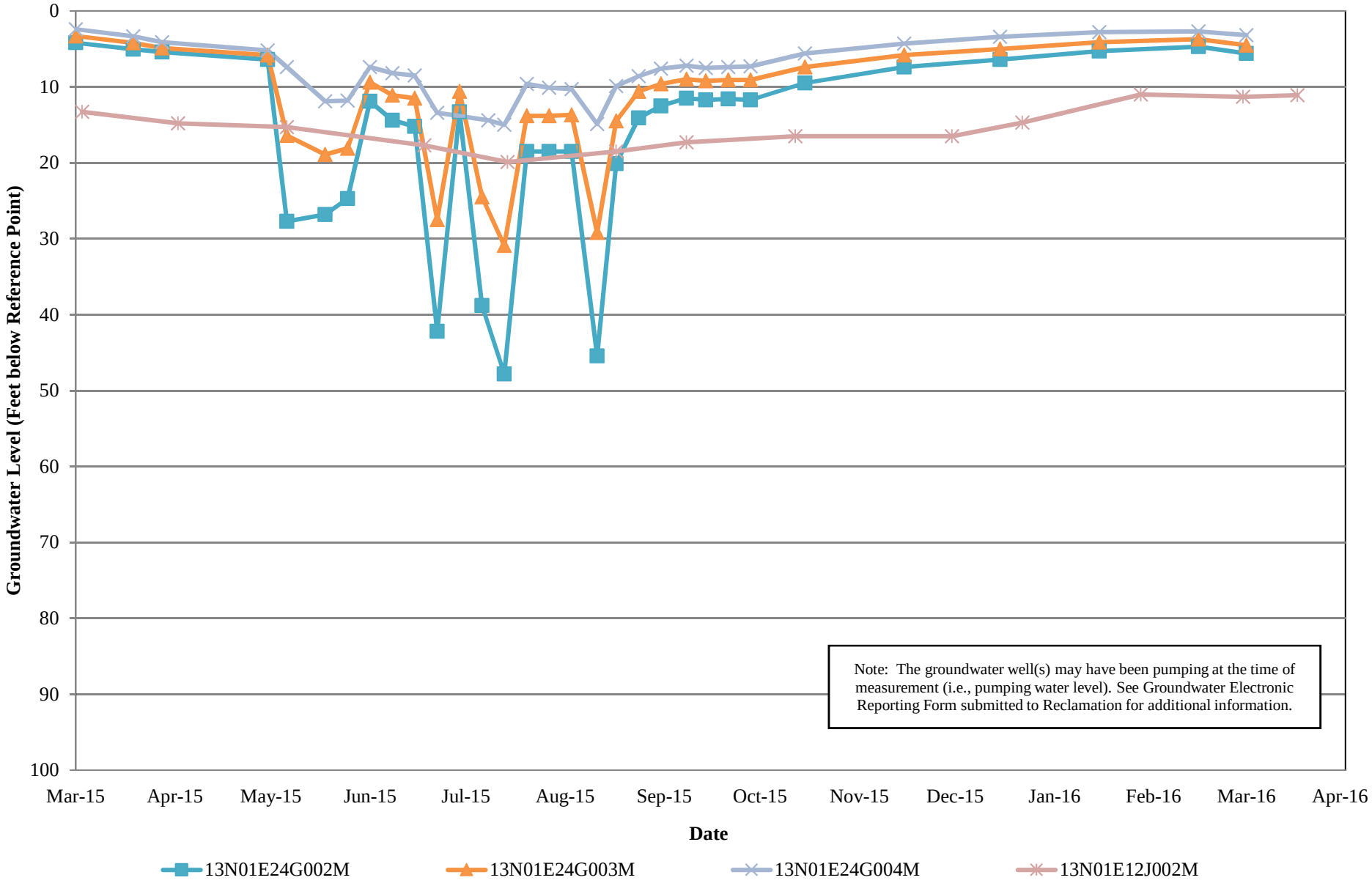
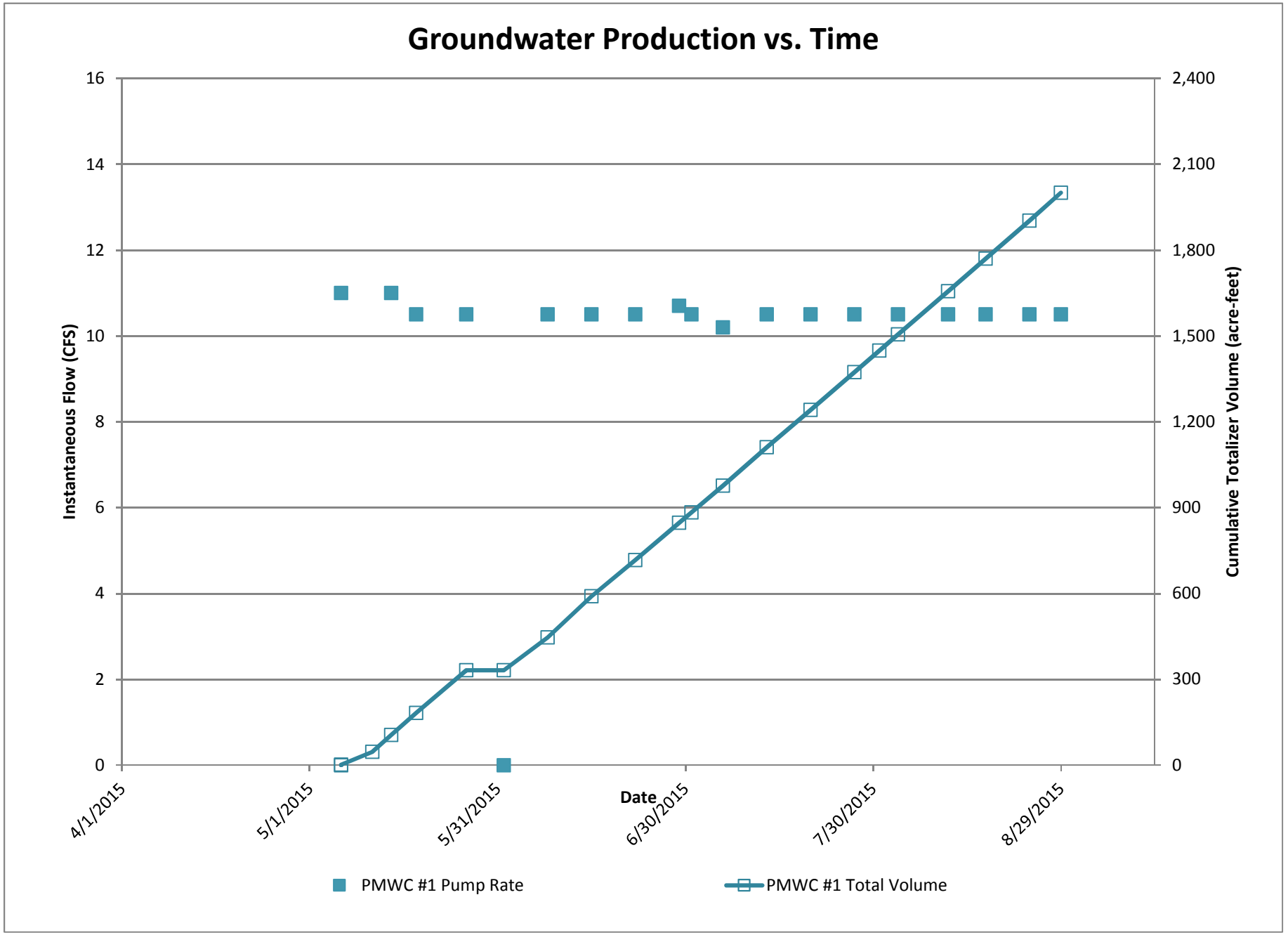
Pelger Mutual Water Company
Production Well Groundwater Level Data

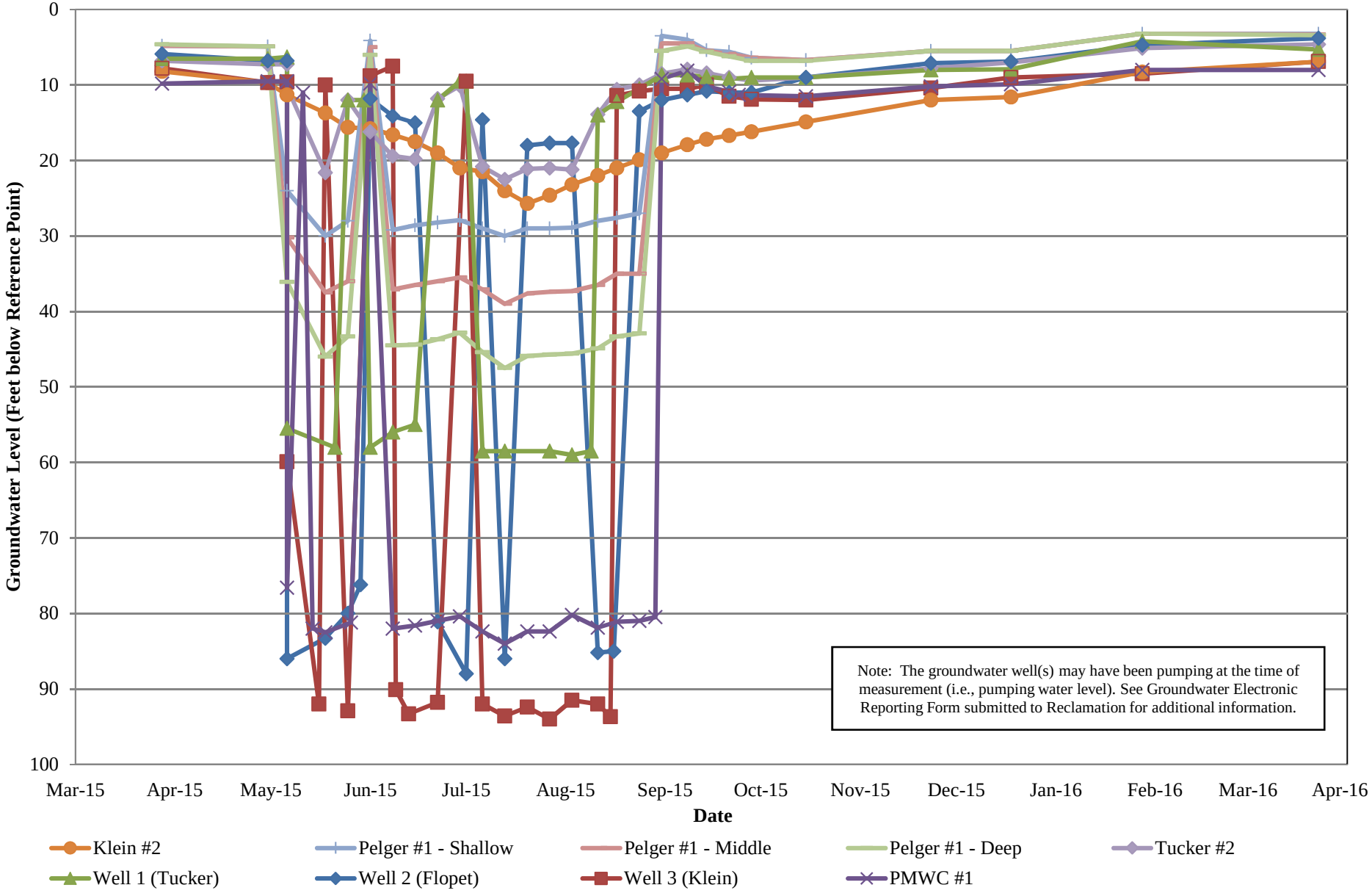


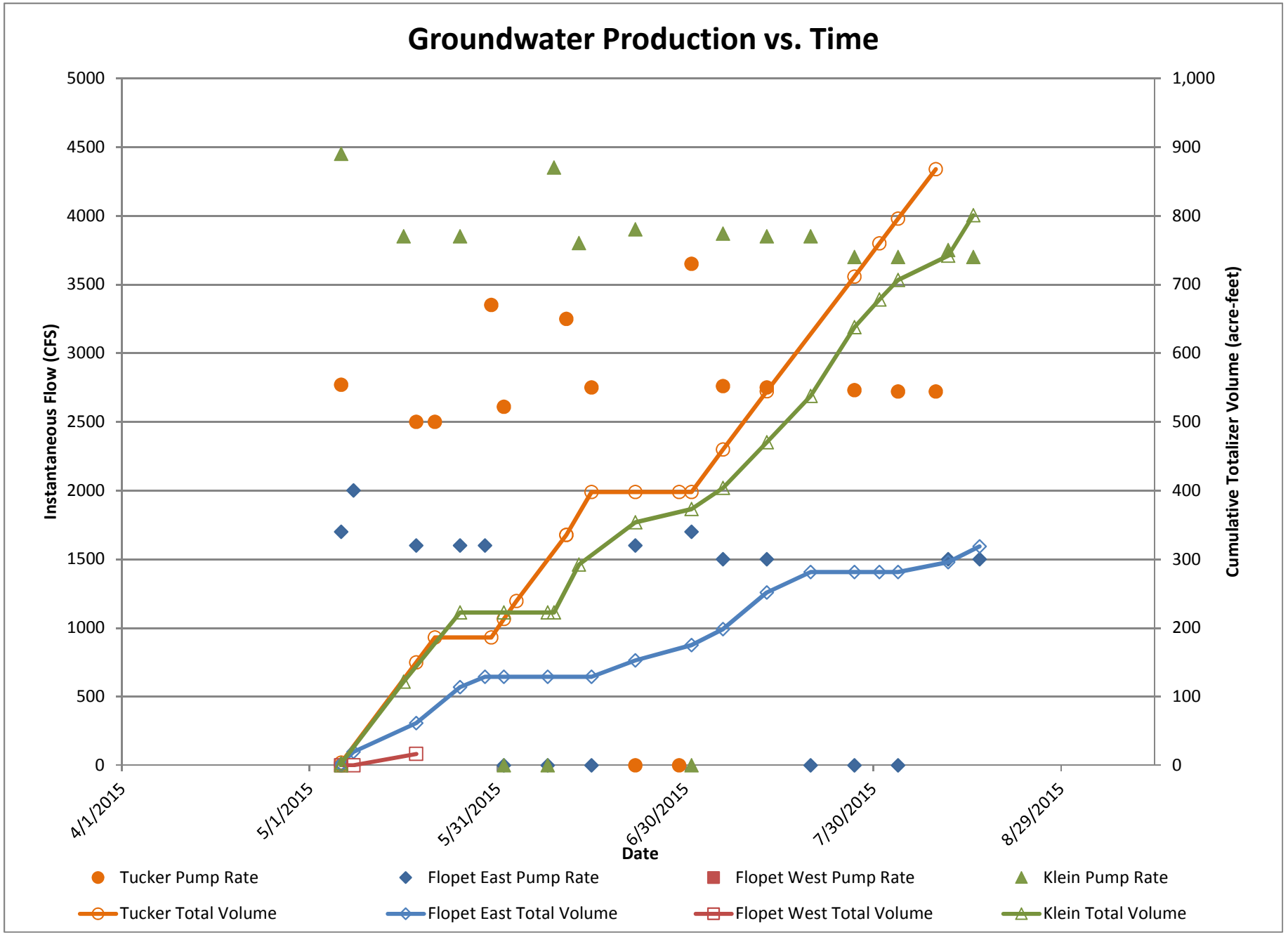
Pelger Mutual Water Company
DWR Monitoring Well Groundwater Level Data

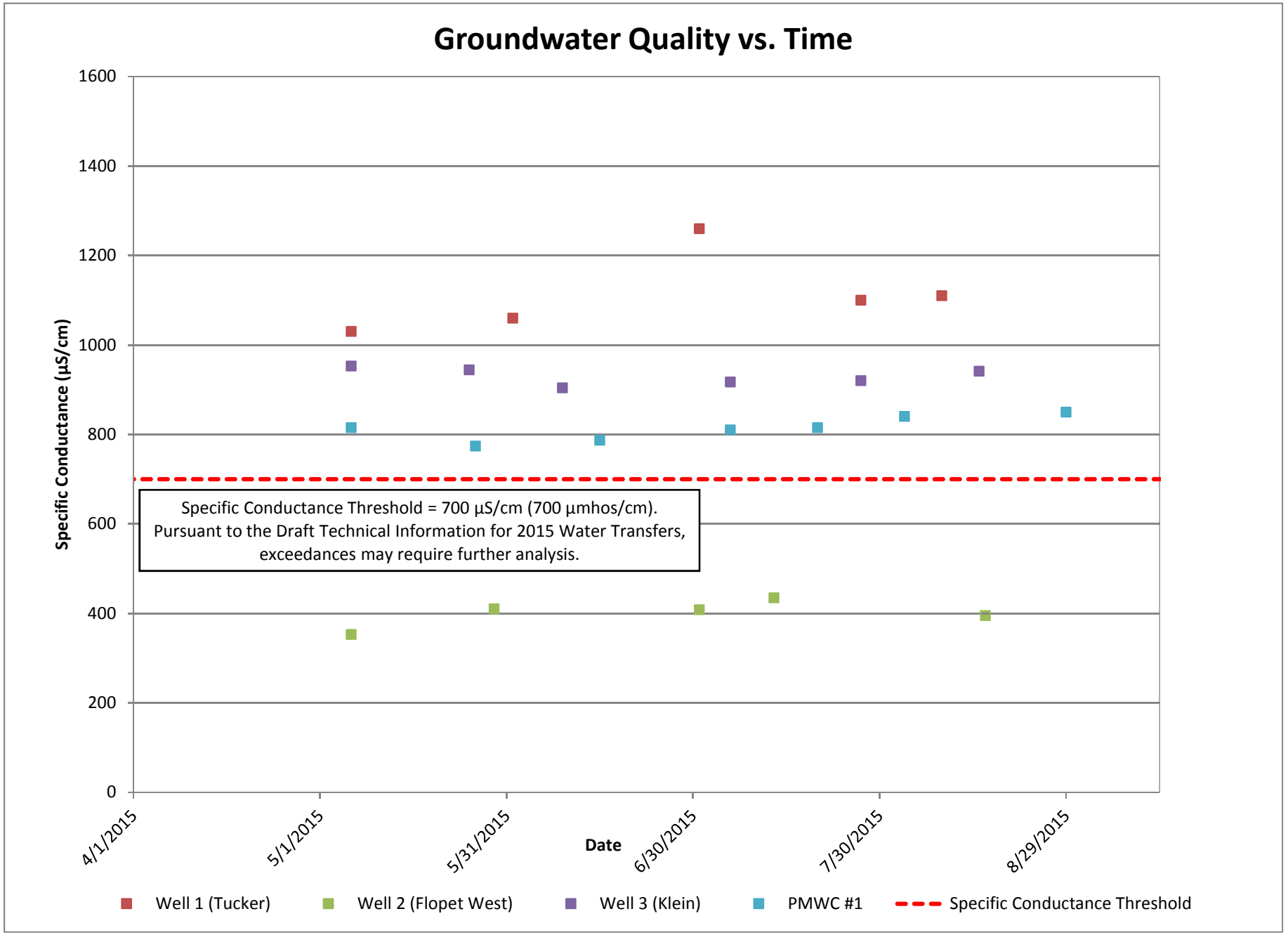



Groundwater Production vs. Time
Instantaneous Flow (CFS)
Cumulative Totalizer Volume (acre-feet)
16
14
12
10
8
6
4
2
0
2,400
2,100
1,800
1,500
1,200
900
600
300
0
4/1/2015
5/1/2015
5/31/2015
6/30/2015
7/30/2015
8/29/2015
Date
PMWC #1 Pump Rate
PMWC #1 Total Volume

Pelger Mutual Water Company
Monitoring Well Groundwater Level Data




Groundwater Production vs. Time
Instantaneous Flow (CFS)
Cumulative Totalizer Volume (acre-feet)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1,000
900
800
700
600
500
400
300
200
100
0
4/1/2015
5/1/2015
5/31/2015
6/30/2015
7/30/2015
8/29/2015
Date
Tucker Pump Rate
Flopet East Pump Rate
Flopet West Pump Rate
Klein Pump Rate
Tucker Total Volume
Flopet East Total Volume
Flopet West Total Volume
Klein Total Volume


Groundwater Quality vs. Time
Specific Conductance (µS/cm)
1600
1400
1200
1000
800
600
400
200
0
4/1/2015
5/1/2015
5/31/2015
6/30/2015
7/30/2015
8/29/2015
Date
Specific Conductance Threshold = 700 µS/cm (700 µmhos/cm). Pursuant to the Draft Technical Information for 2015 Water Transfers, exceedances may require further analysis.
Well 1 (Tucker)
Well 2 (Flopet West)
Well 3 (Klein)
PMWC #1
Specific Conductance Threshold

Pelger Road 1700, LLC

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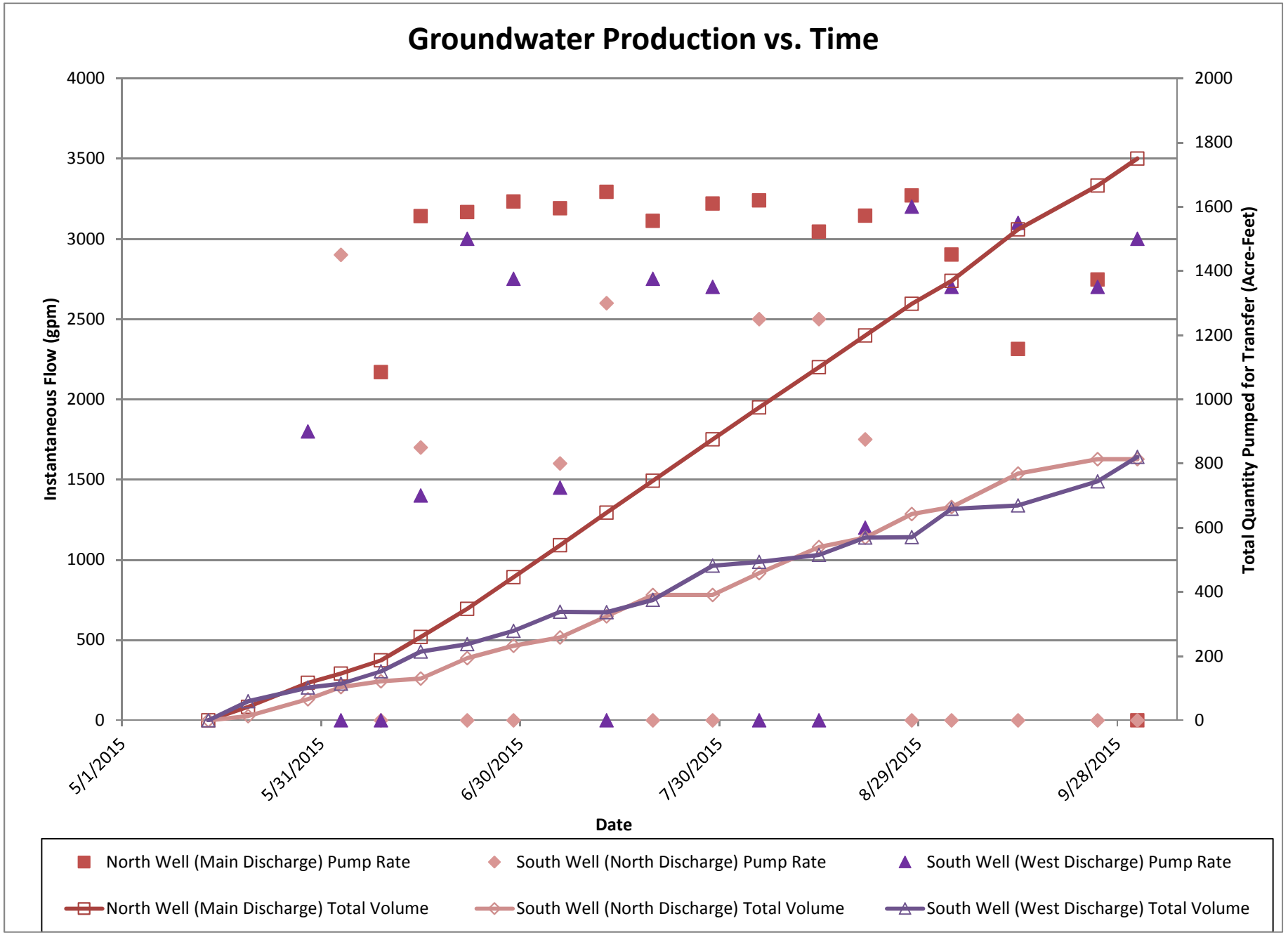
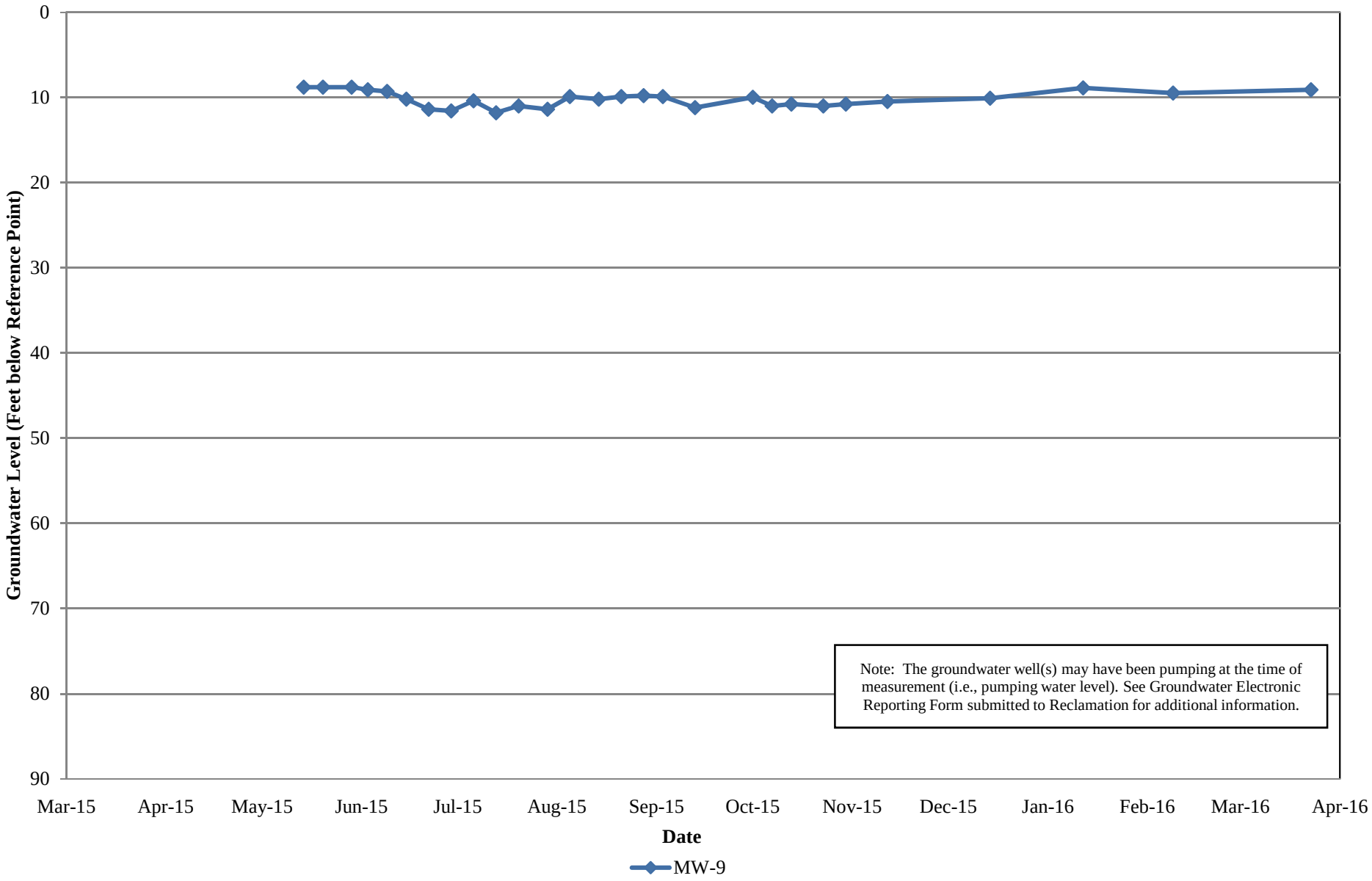
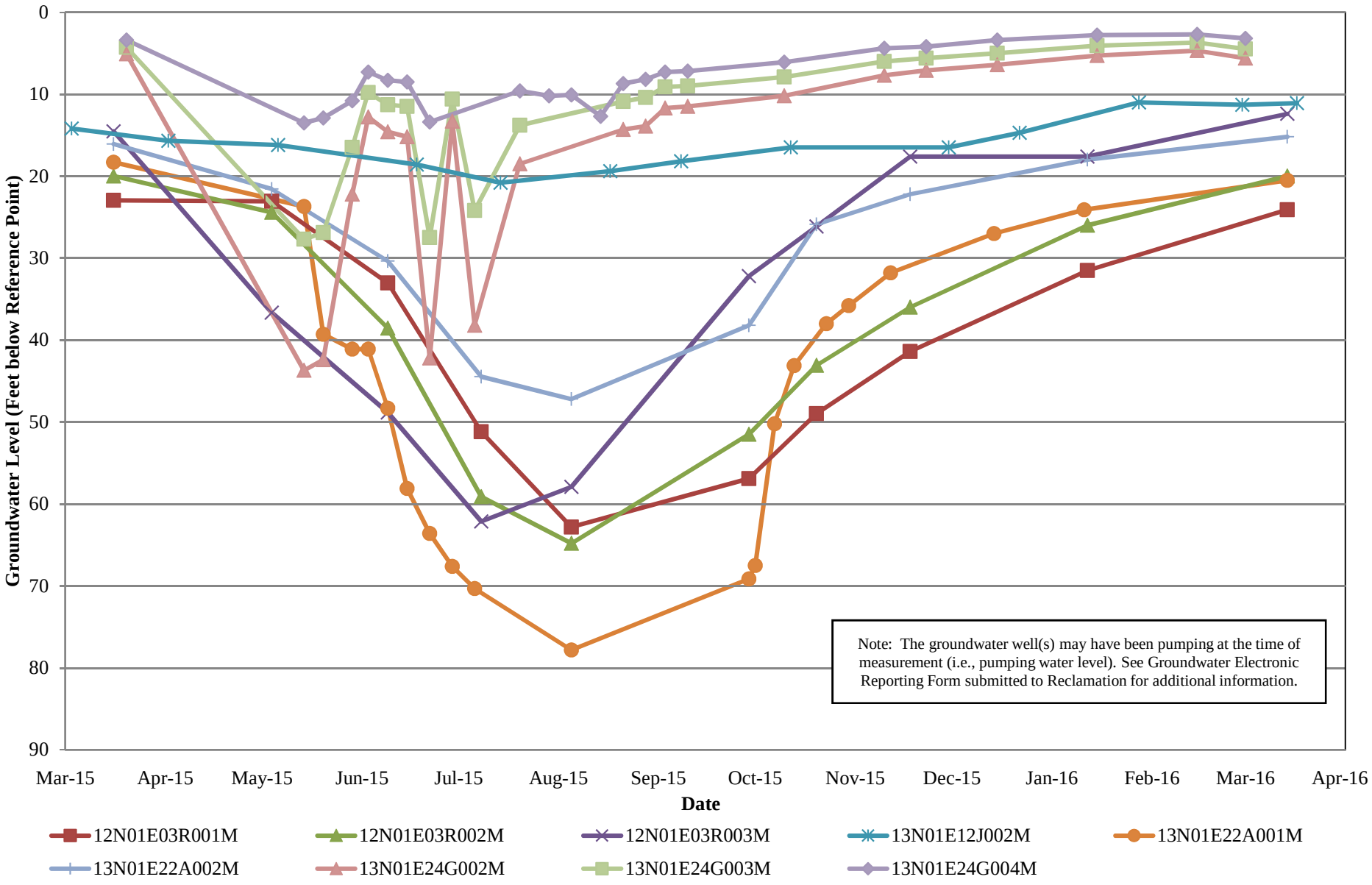
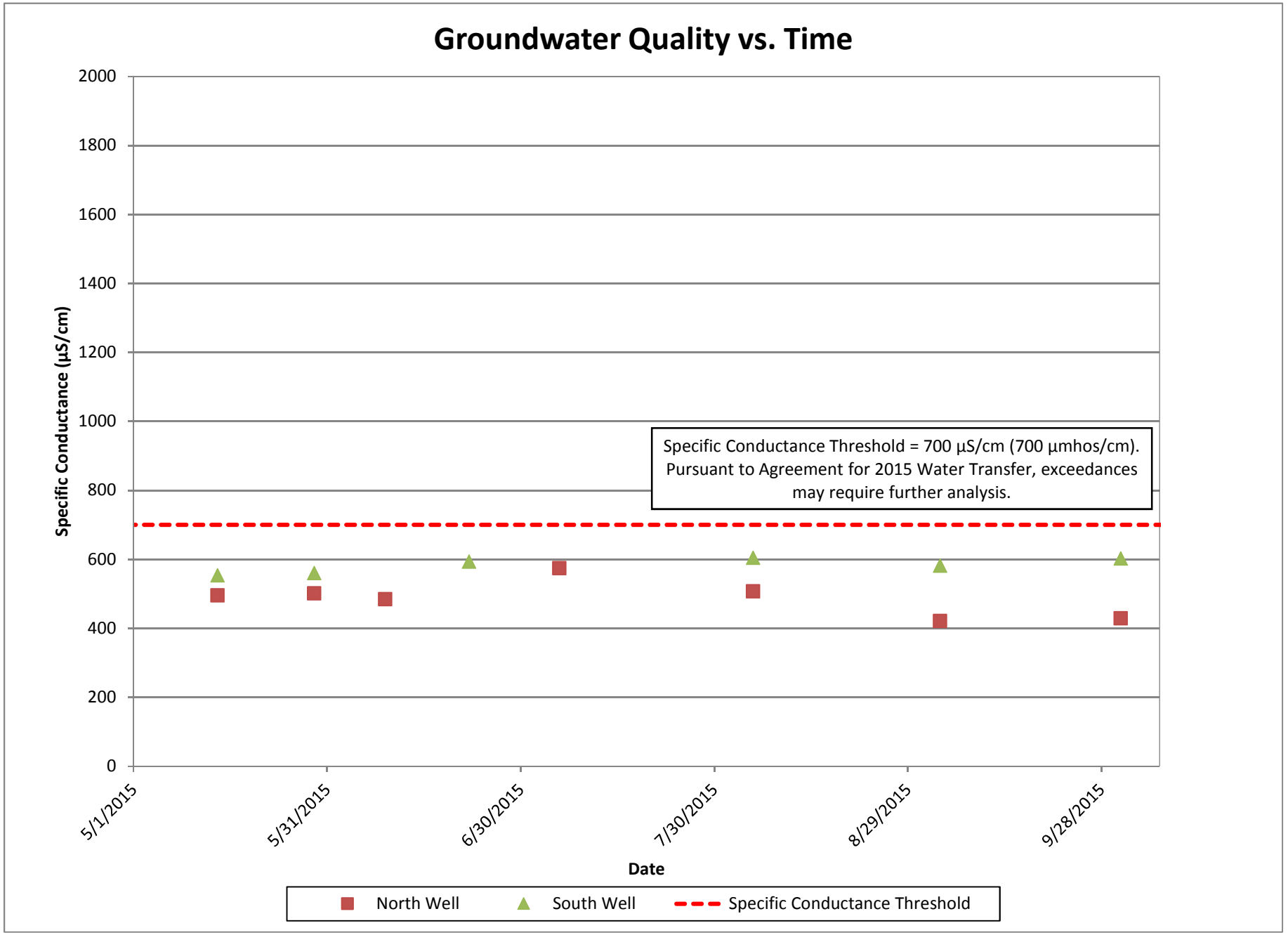

Groundwater Production vs. Time
Instantaneous Flow (gpm)
Total Quantity Pumped for Transfer (Acre-Feet)
Date
4000
3500
3000
2500
2000
1500
1000
500
0
2000
1800
1600
1400
1200
1000
800
600
400
200
0
5/1/2015
5/31/2015
6/30/2015
7/30/2015
8/29/2015
9/28/2015
North Well (Main Discharge) Pump Rate
South Well (North Discharge) Pump Rate
South Well (West Discharge) Pump Rate
North Well (Main Discharge) Total Volume
South Well (North Discharge) Total Volume
South Well (West Discharge) Total Volume

Pelger Road 1700, LLC
Monitoring Well Groundwater Level Data



Pelger Road 1700, LLC
DWR Monitoring Well Groundwater Level Data




Groundwater Quality vs. Time
Specific Conductance (µS/cm)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Specific Conductance Threshold = 700 µS/cm (700 µmhos/cm). Pursuant to Agreement for 2015 Water Transfer, exceedances may require further analysis.
5/1/2015
5/31/2015
6/30/2015
7/30/2015
8/29/2015
9/28/2015
Date
North Well
South Well
Specific Conductance Threshold

Pleasant Grove-Verona Mutual Water Company

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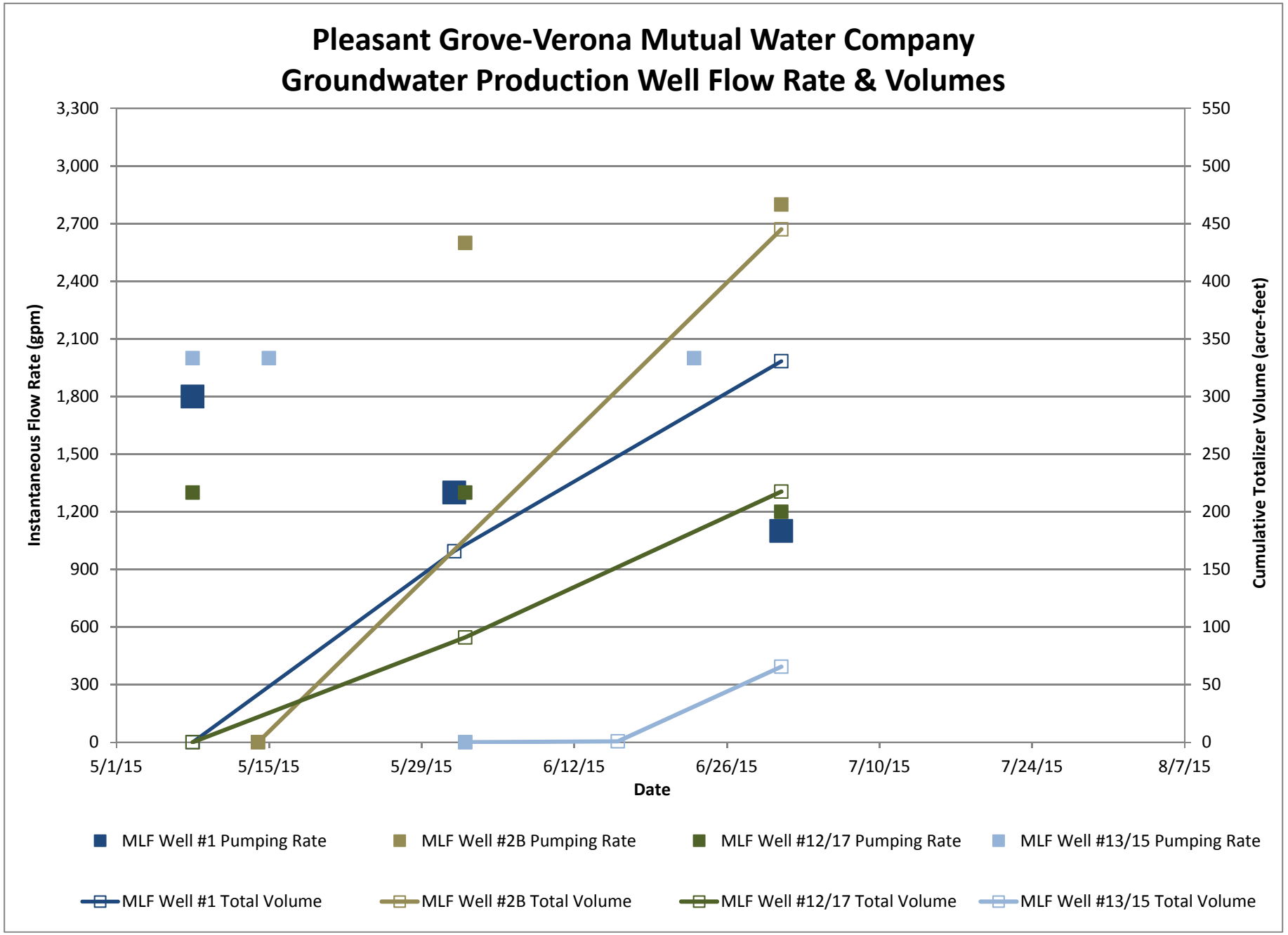
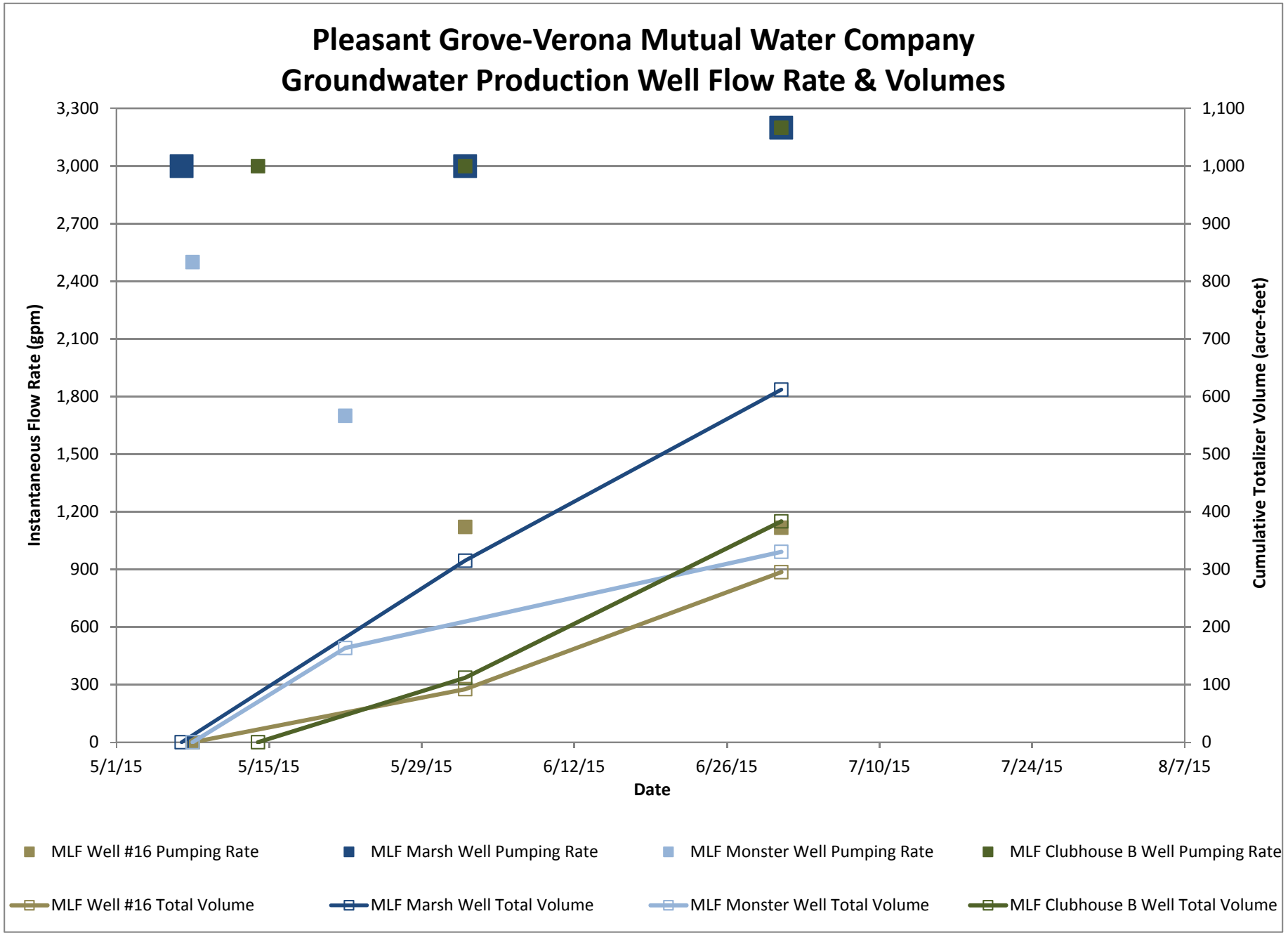
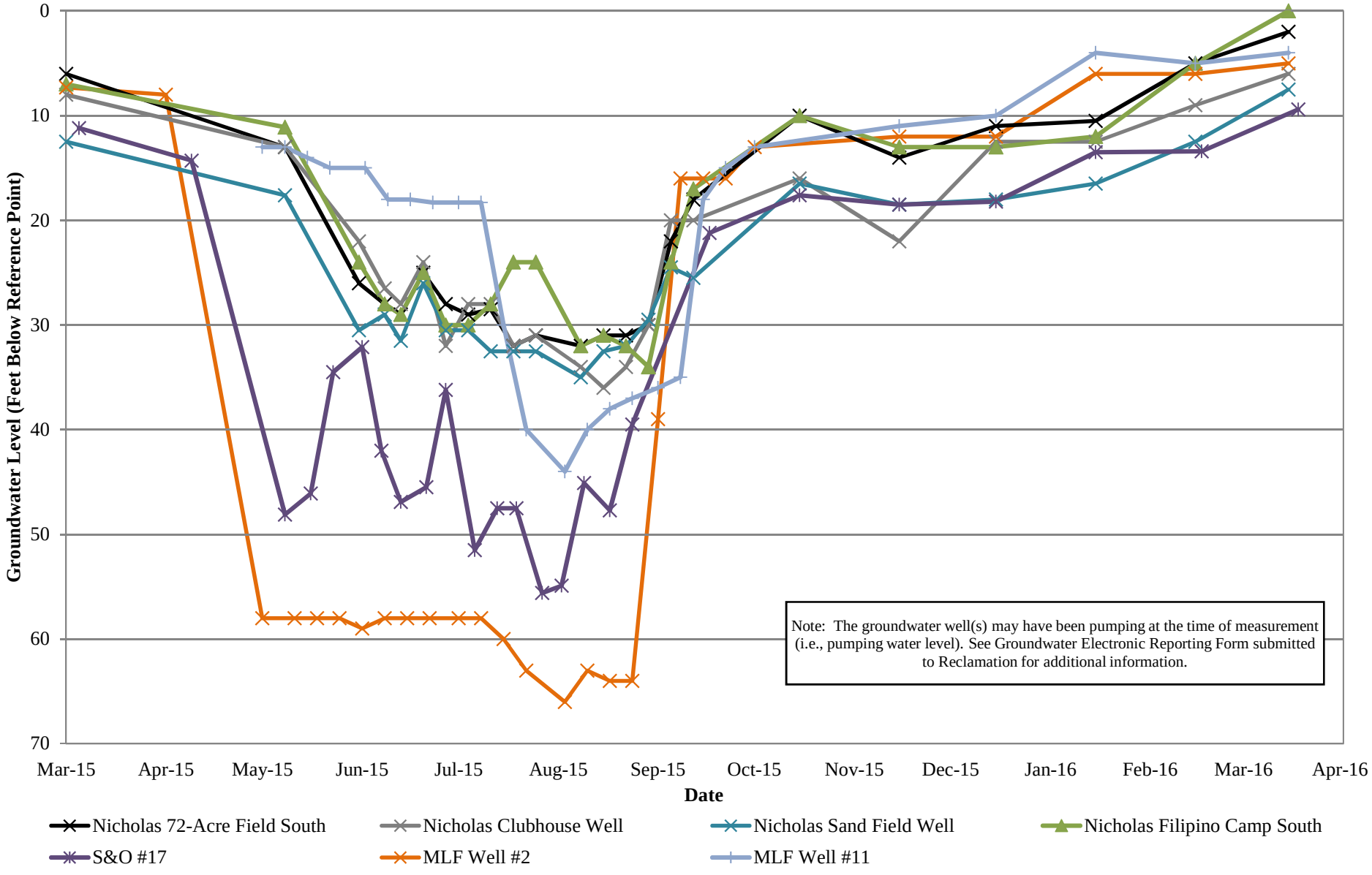
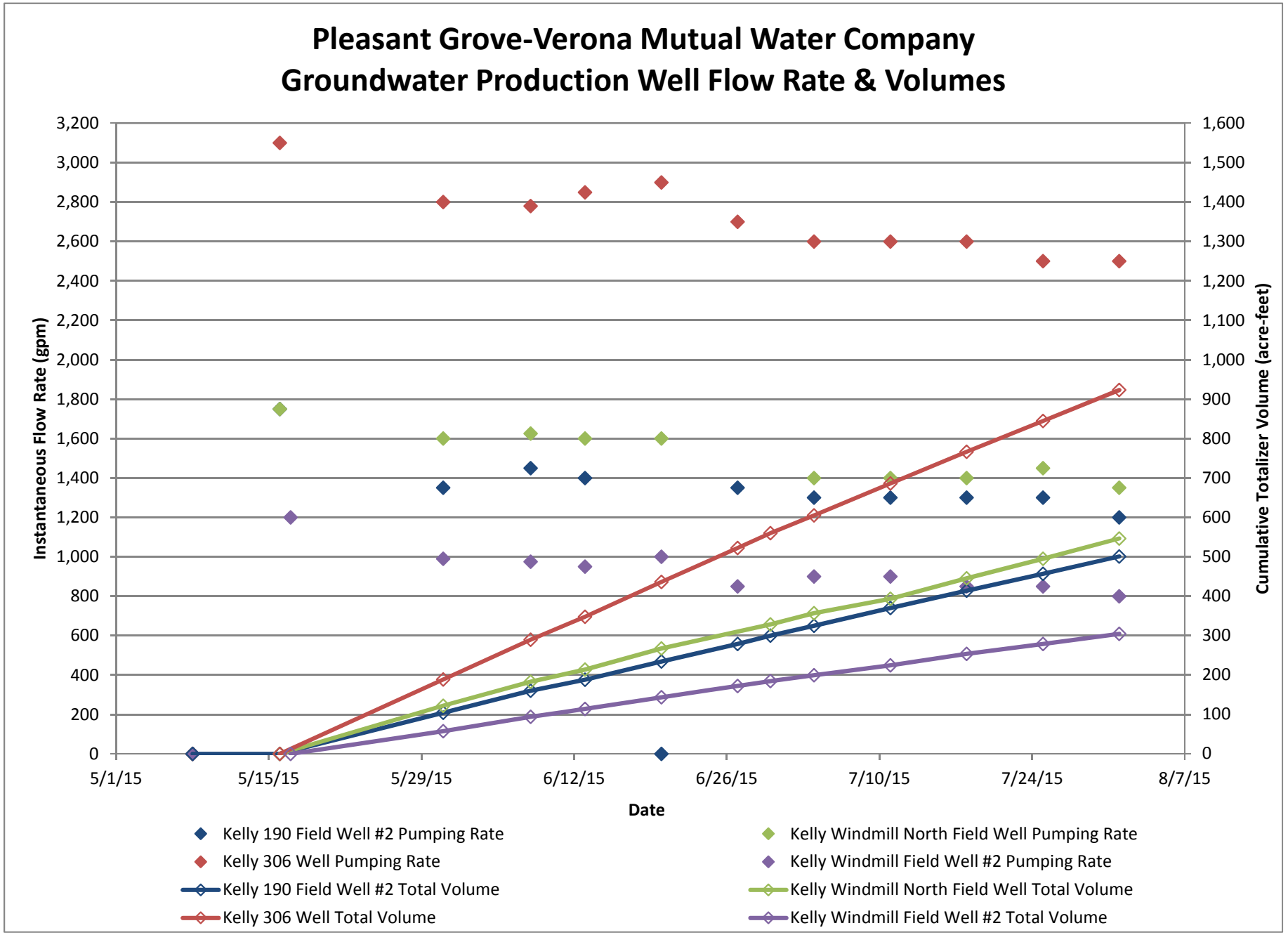
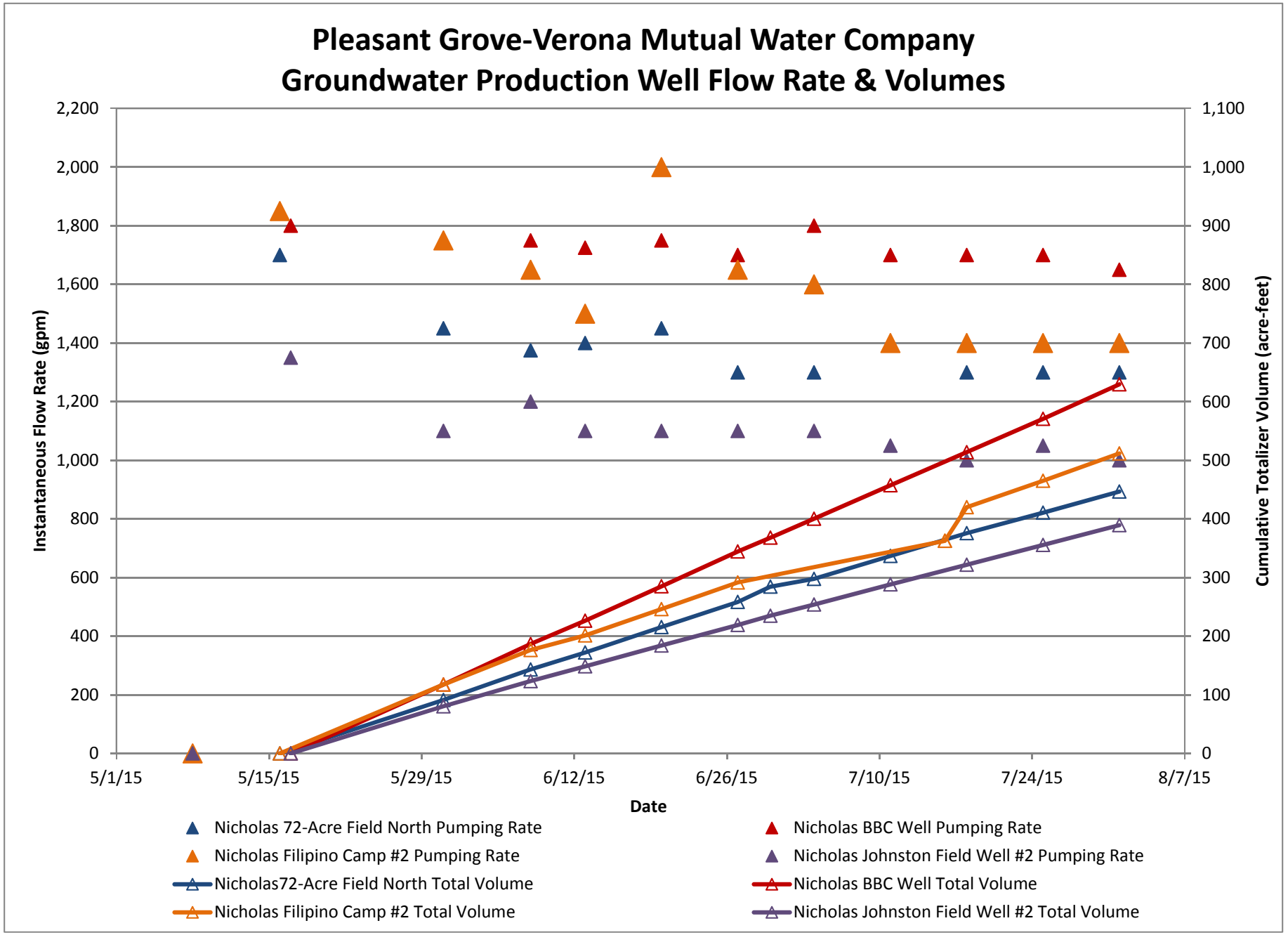

Pleasant Grove-Verona Mutual Water Company
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
3,300
3,000
2,700
2,400
2,100
1,800
1,500
1,200
900
600
300
0
550
500
450
400
350
300
250
200
150
100
50
0
5/1/15
5/15/15
5/29/15
6/12/15
6/26/15
7/10/15
7/24/15
8/7/15
Date
MLF Well #1 Pumping Rate
MLF Well #2B Pumping Rate
MLF Well #12/17 Pumping Rate
MLF Well #13/15 Pumping Rate
MLF Well #1 Total Volume
MLF Well #2B Total Volume
MLF Well #12/17 Total Volume
MLF Well #13/15 Total Volume


Pleasant Grove-Verona Mutual Water Company
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
3,300
3,000
2,700
2,400
2,100
1,800
1,500
1,200
900
600
300
0
1,100
1,000
900
800
700
600
500
400
300
200
100
0
5/1/15
5/15/15
5/29/15
6/12/15
6/26/15
7/10/15
7/24/15
8/7/15
Date
MLF Well #16 Pumping Rate
MLF Marsh Well Pumping Rate
MLF Monster Well Pumping Rate
MLF Clubhouse B Well Pumping Rate
MLF Well #16 Total Volume
MLF Marsh Well Total Volume
MLF Monster Well Total Volume
MLF Clubhouse B Well Total Volume

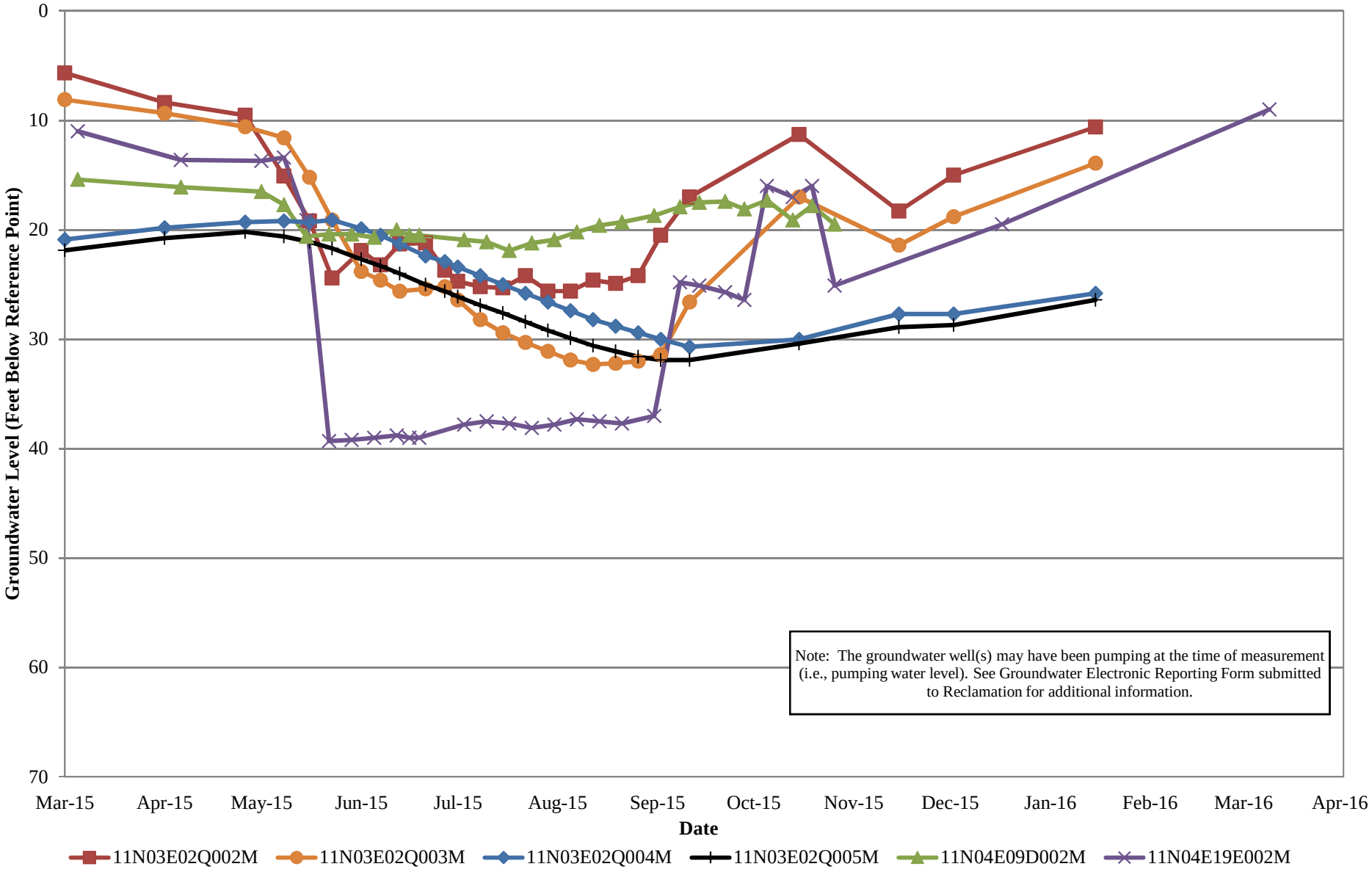
Pleasant Grove-Verona Mutual Water Company
Monitoring Well Groundwater Level Data

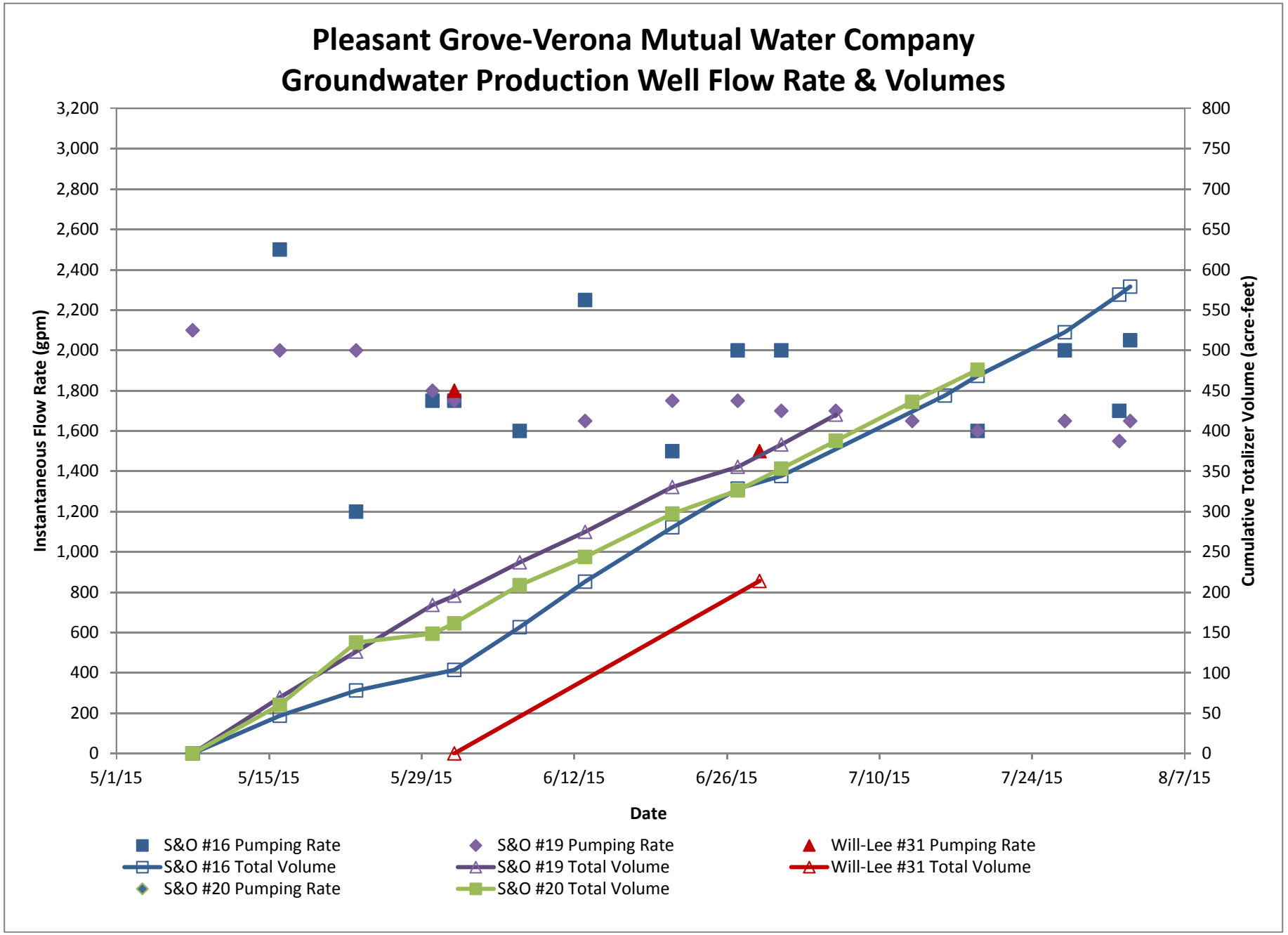



Pleasant Grove-Verona Mutual Water Company
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
Date
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1,600
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
5/1/15
5/15/15
5/29/15
6/12/15
6/26/15
7/10/15
7/24/15
8/7/15
Kelly 190 Field Well #2 Pumping Rate
Kelly 306 Well Pumping Rate
Kelly 190 Field Well #2 Total Volume
Kelly 306 Well Total Volume
Kelly Windmill North Field Well Pumping Rate
Kelly Windmill Field Well #2 Pumping Rate
Kelly Windmill North Field Well Total Volume
Kelly Windmill Field Well #2 Total Volume

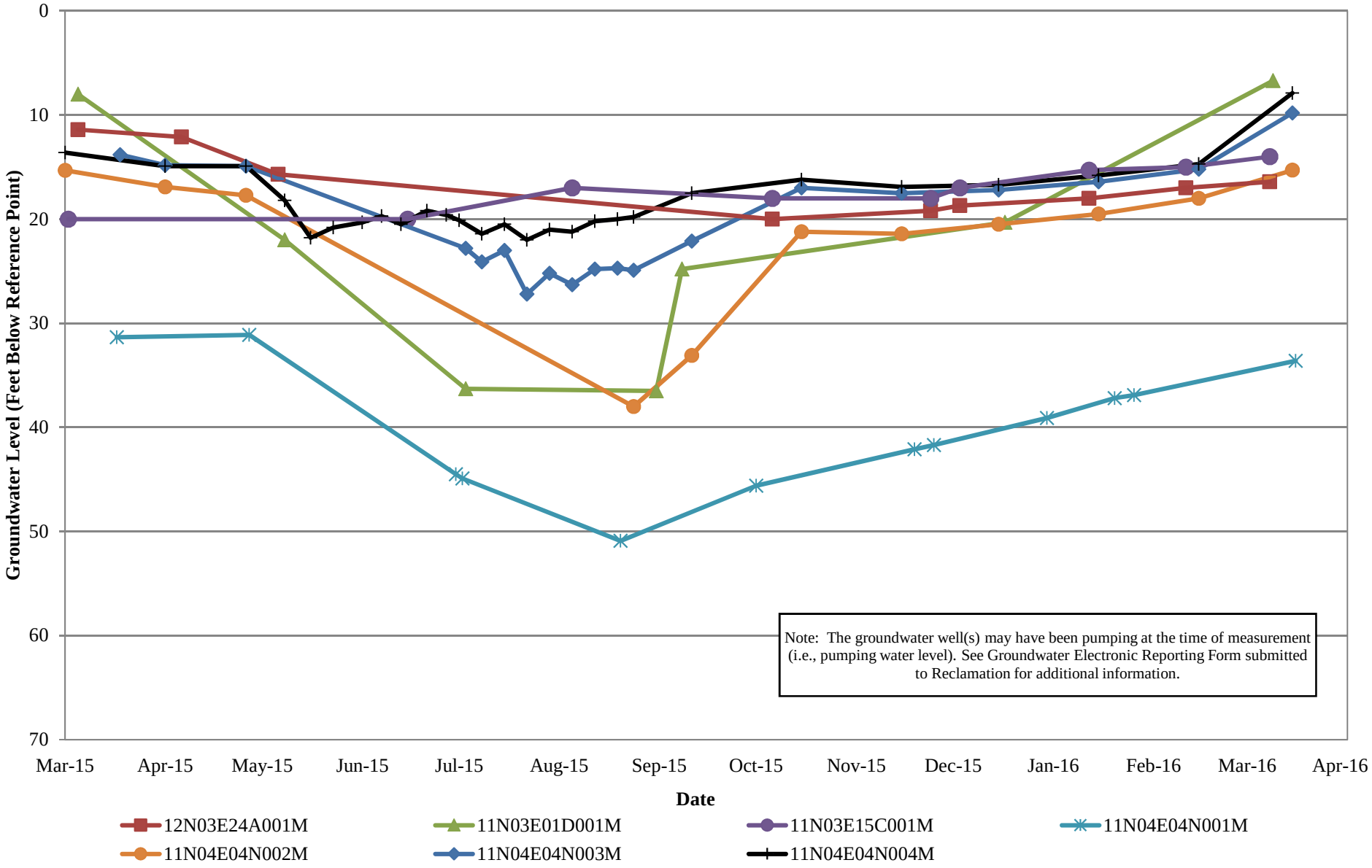

Pleasant Grove-Verona Mutual Water Company
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1,100
1,000
900
800
700
600
500
400
300
200
100
0
5/1/15
5/15/15
5/29/15
6/12/15
6/26/15
7/10/15
7/24/15
8/7/15
Date
Nicholas 72-Acre Field North Pumping Rate
Nicholas BBC Well Pumping Rate
Nicholas Filipino Camp #2 Pumping Rate
Nicholas Johnston Field Well #2 Pumping Rate
Nicholas72-Acre Field North Total Volume
Nicholas BBC Well Total Volume
Nicholas Filipino Camp #2 Total Volume
Nicholas Johnston Field Well #2 Total Volume

Pleasant Grove-Verona Mutual Water Company
DWR Monitoring Well Groundwater Level Data

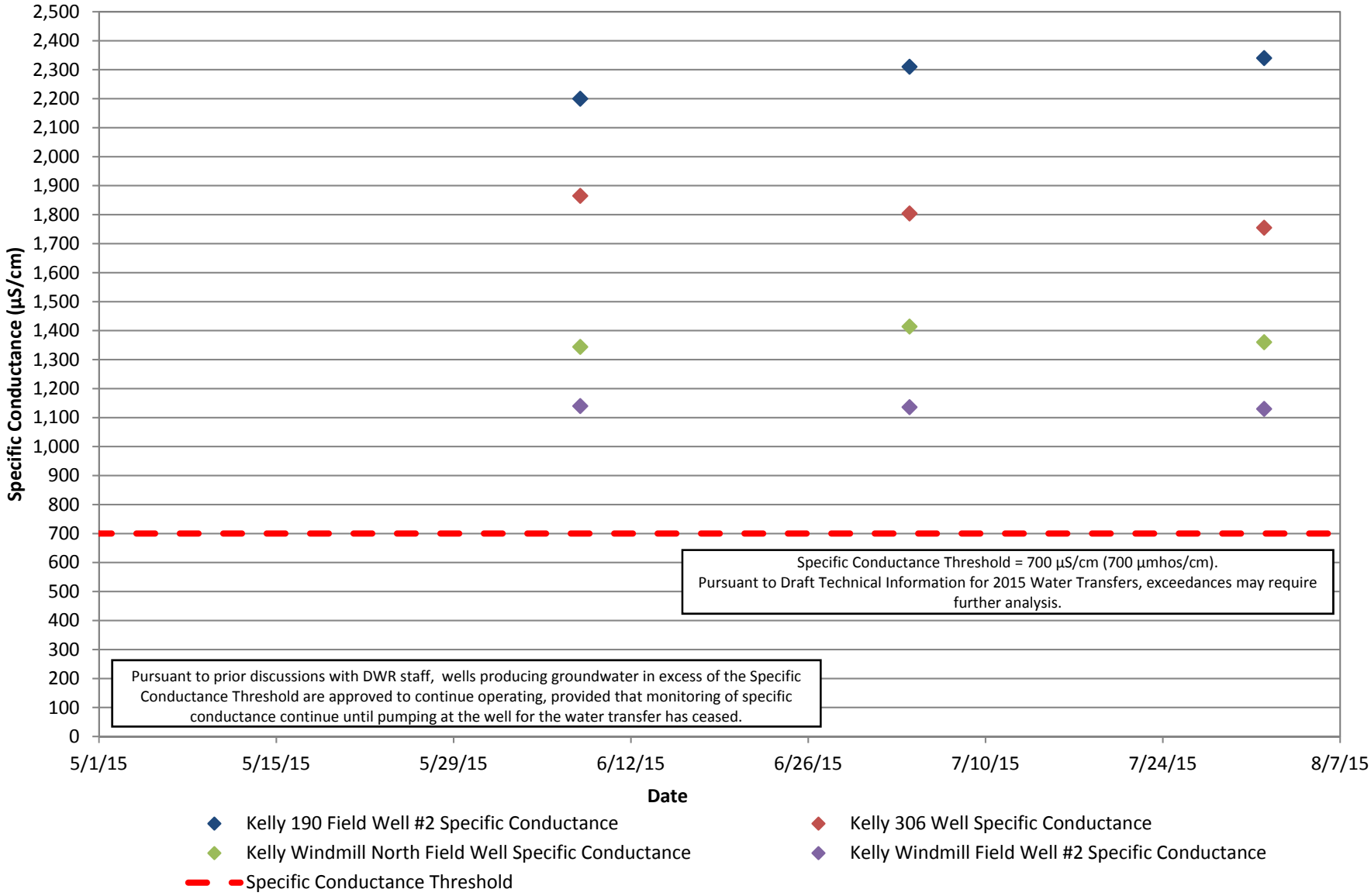



Pleasant Grove-Verona Mutual Water Company
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
5/1/15
5/15/15
5/29/15
6/12/15
6/26/15
7/10/15
7/24/15
8/7/15
Date
S&O #16 Pumping Rate
S&O #19 Pumping Rate
Will-Lee #31 Pumping Rate
S&O #16 Total Volume
S&O #19 Total Volume
Will-Lee #31 Total Volume
S&O #20 Pumping Rate
S&O #20 Total Volume

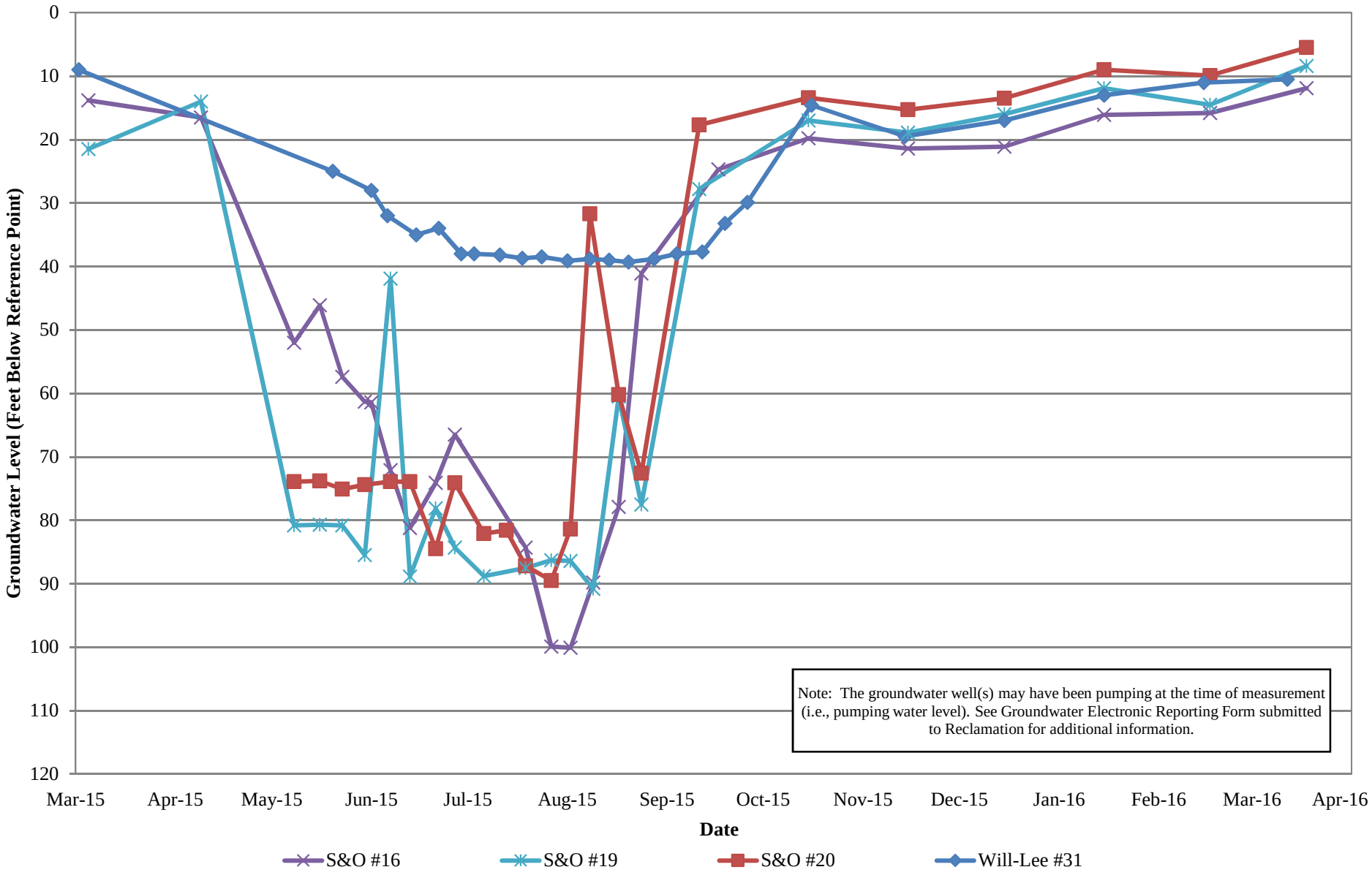
Pleasant Grove-Verona Mutual Water Company
DWR Monitoring Well Groundwater Level Data



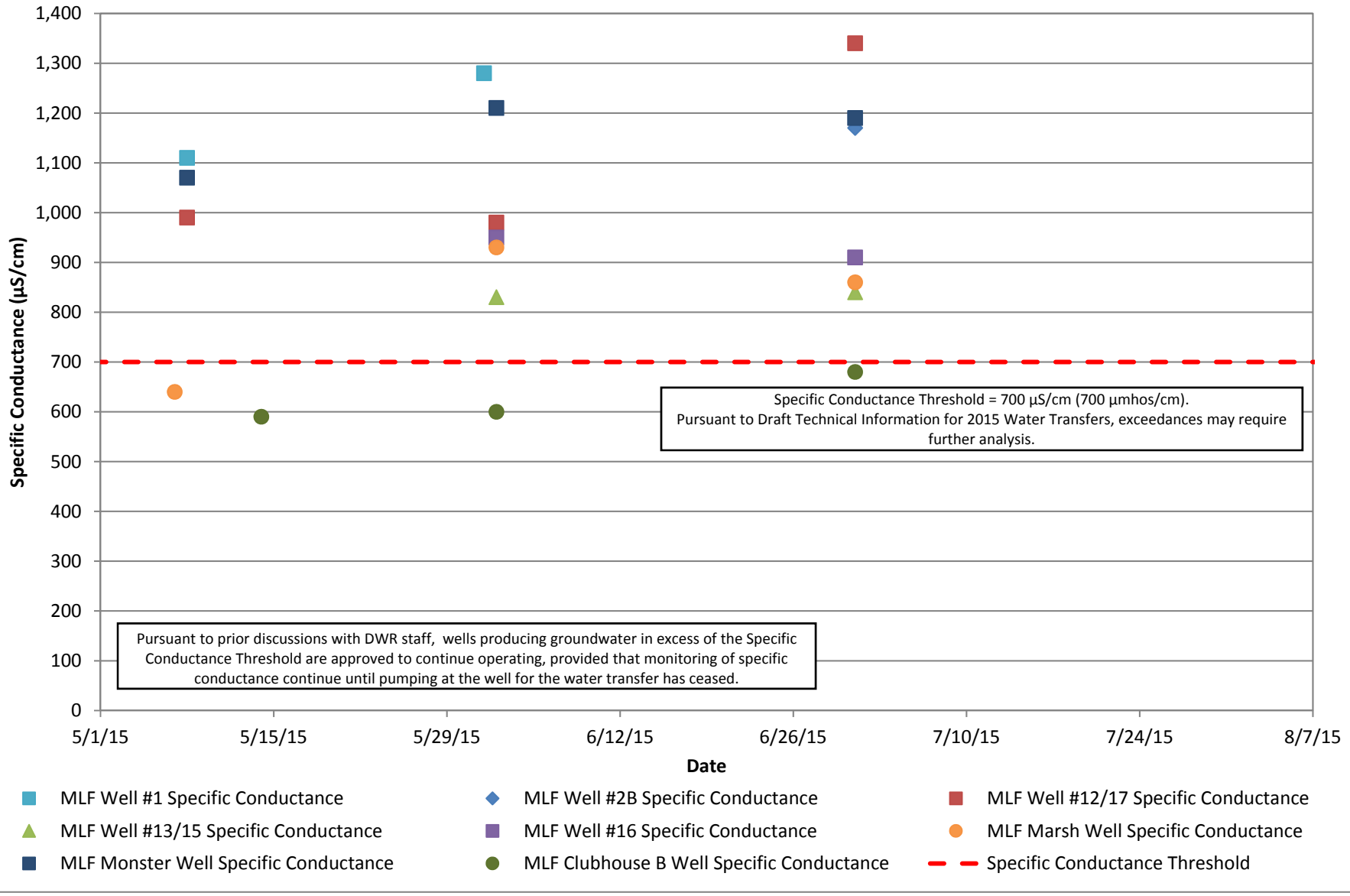
Pleasant Grove-Verona Mutual Water Company
Groundwater Production Well Specific Conductance



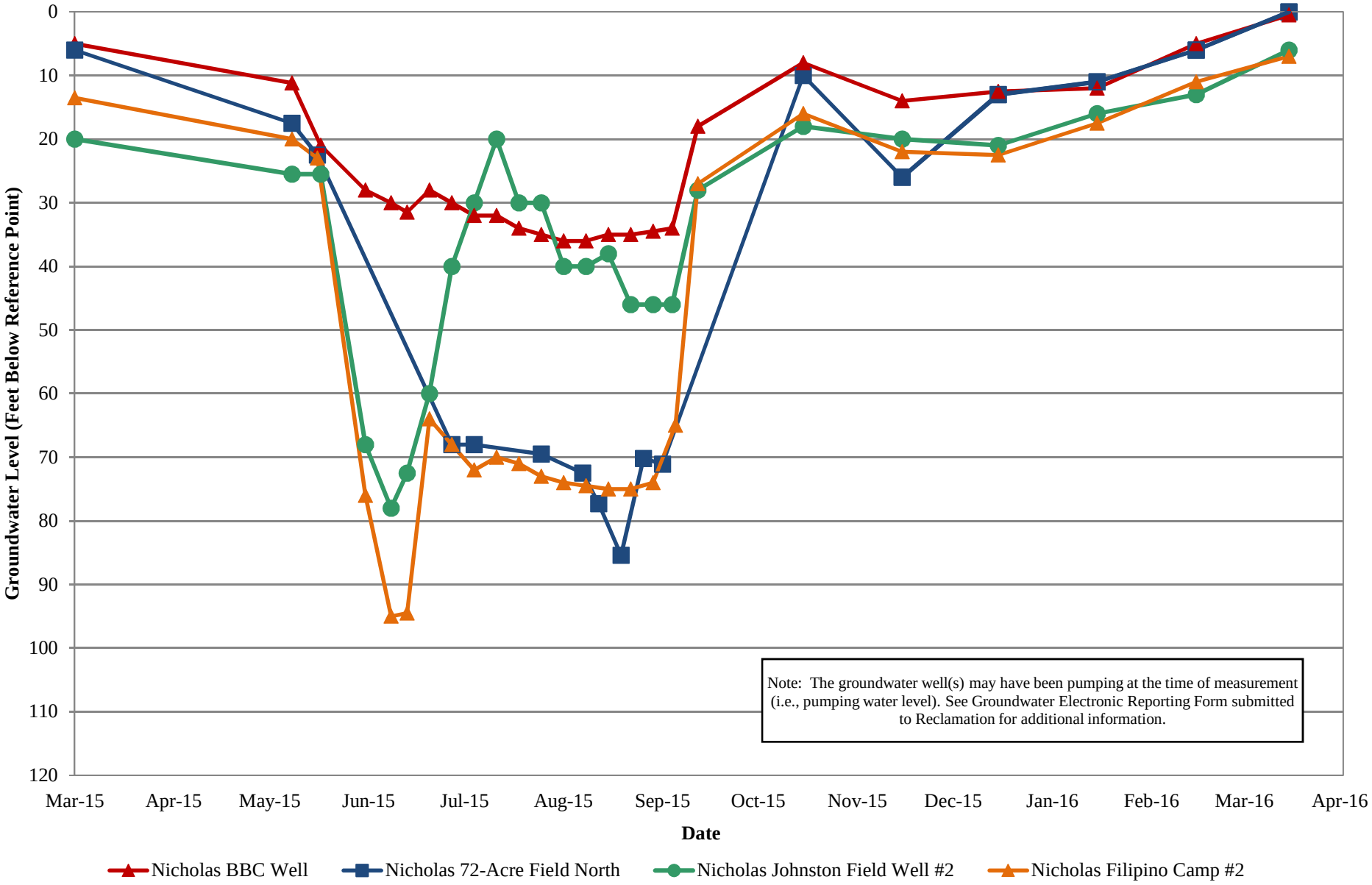
Pleasant Grove-Verona Mutual Water Company
Production Well Groundwater Level Data



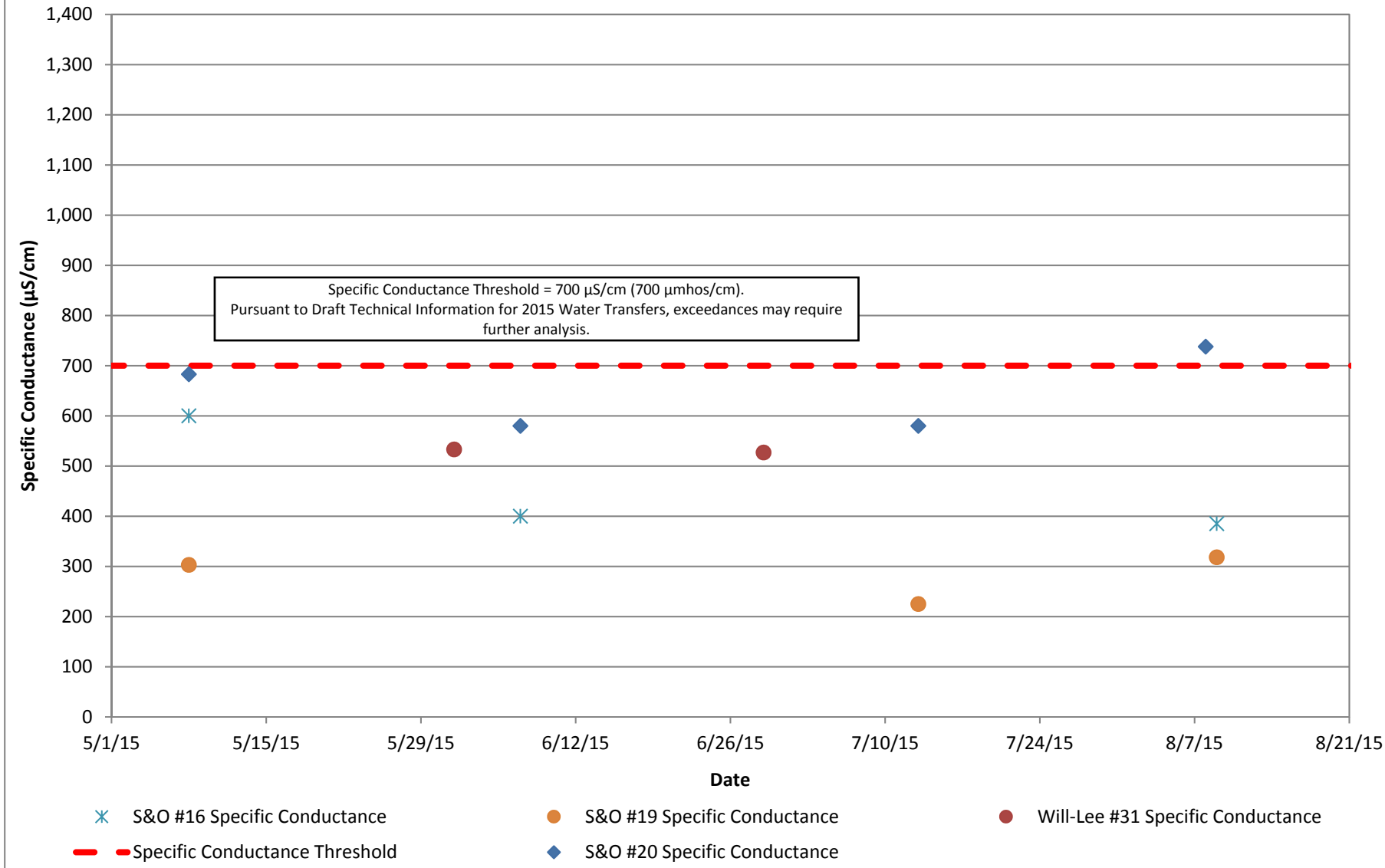
Pleasant Grove-Verona Mutual Water Company
Groundwater Production Well Specific Conductance



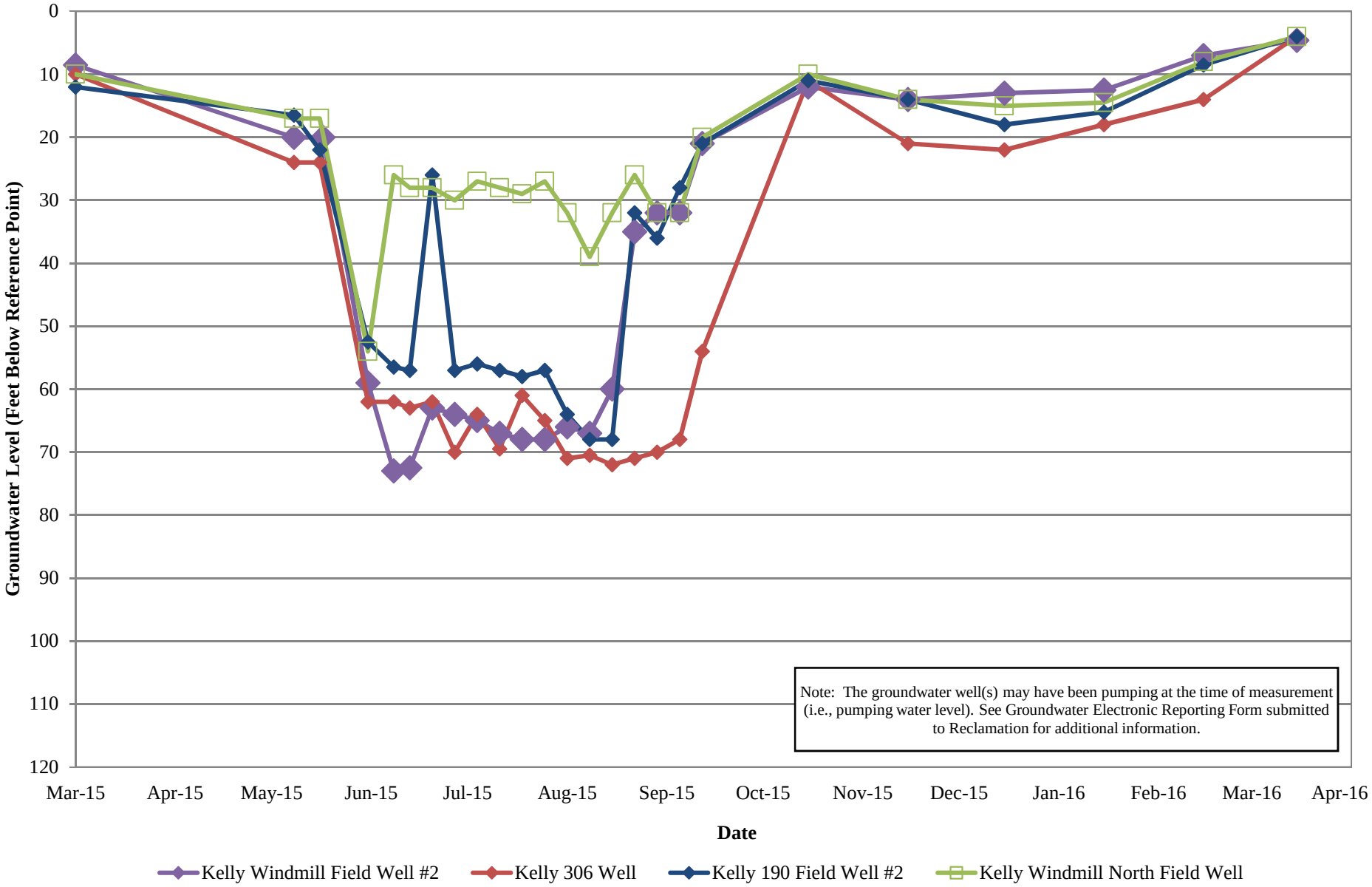
Pleasant Grove-Verona Mutual Water Company
Production Well Groundwater Level Data



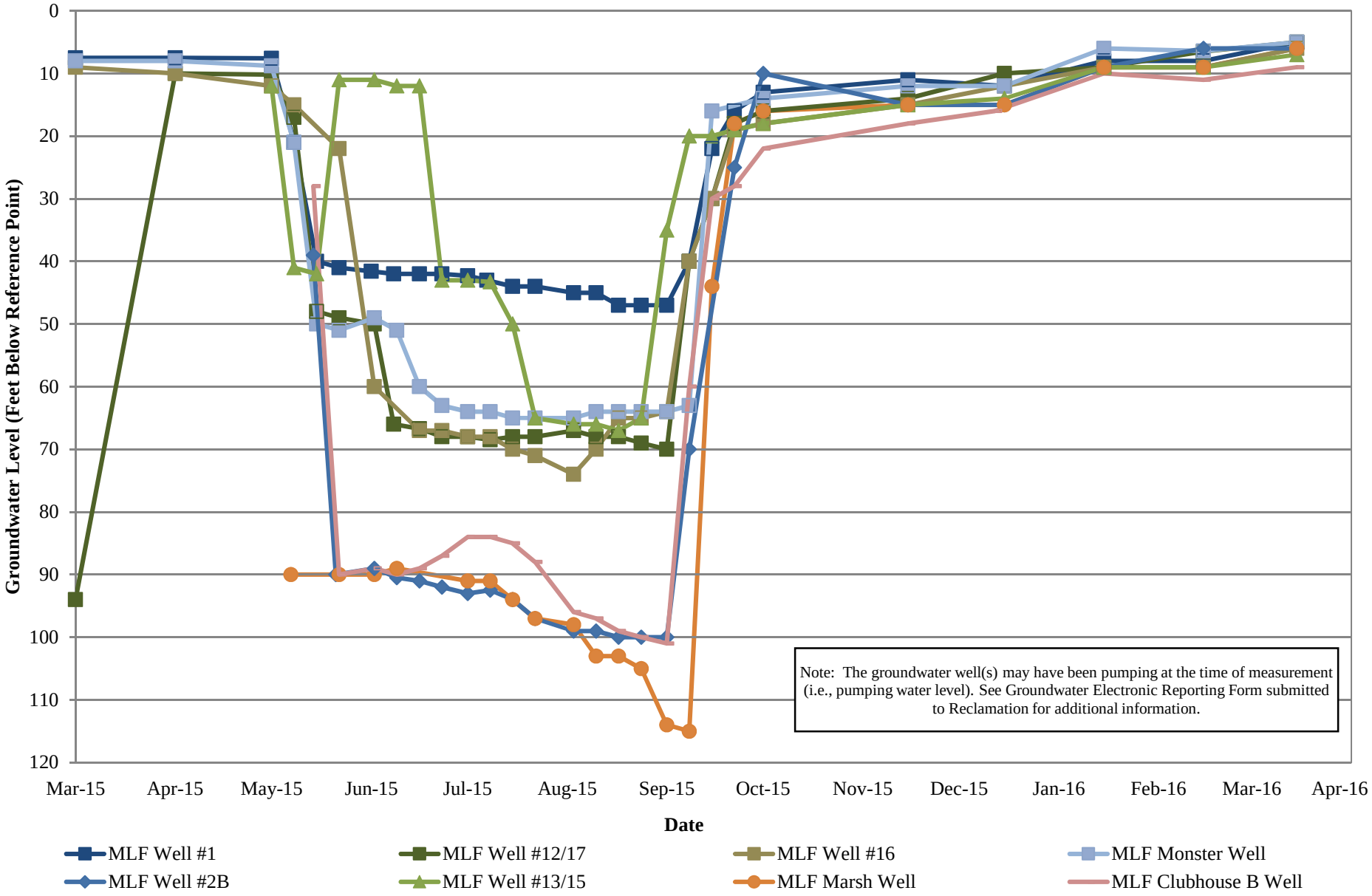
Pleasant Grove-Verona Mutual Water Company
Groundwater Production Well Specific Conductance



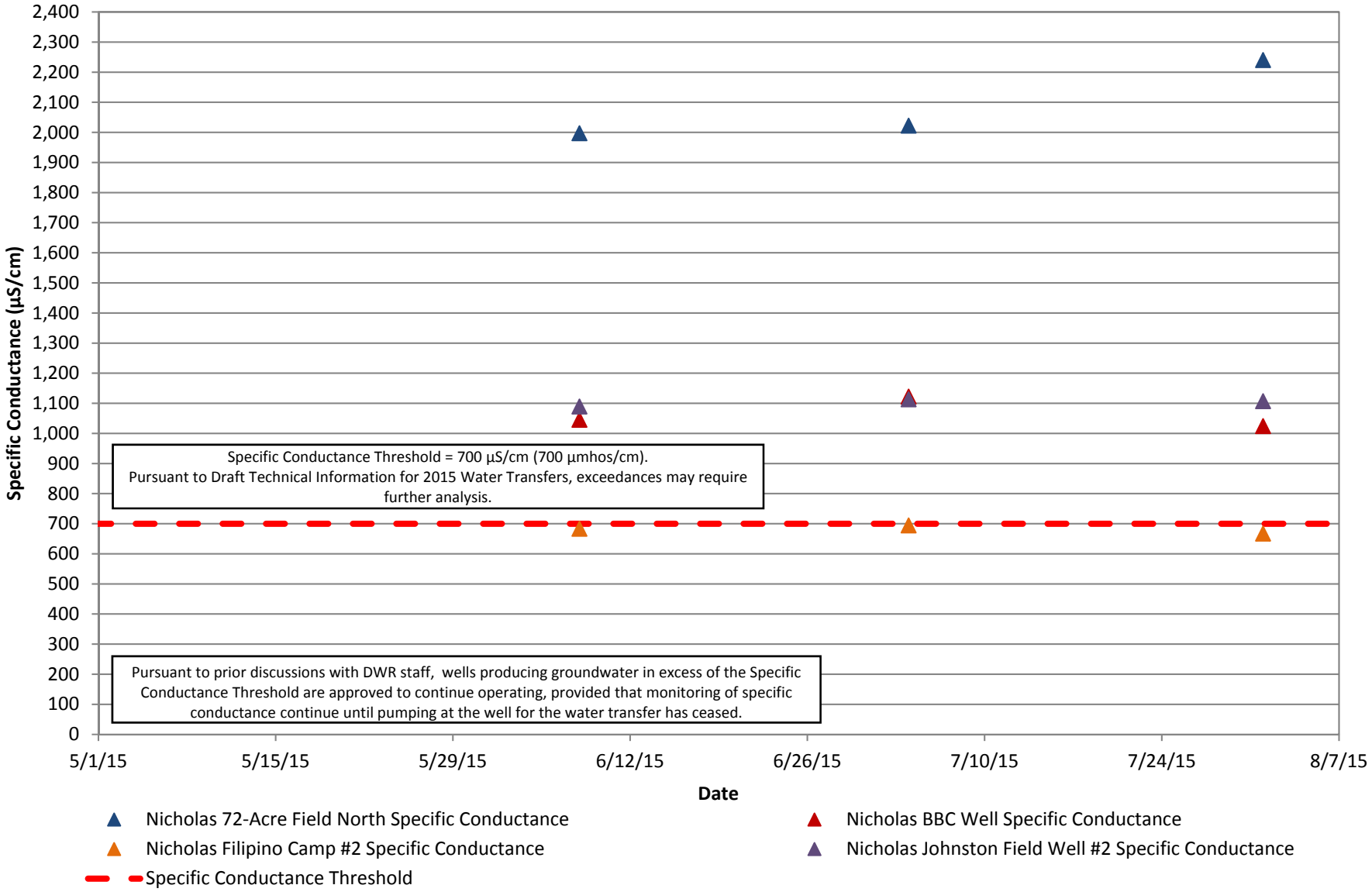
Pleasant Grove-Verona Mutual Water Company
Production Well Groundwater Level Data



Pleasant Grove-Verona Mutual Water Company
Production Well Groundwater Level Data



Pleasant Grove-Verona Mutual Water Company
Groundwater Production Well Specific Conductance



Princeton-Codora-Glenn Irrigation District

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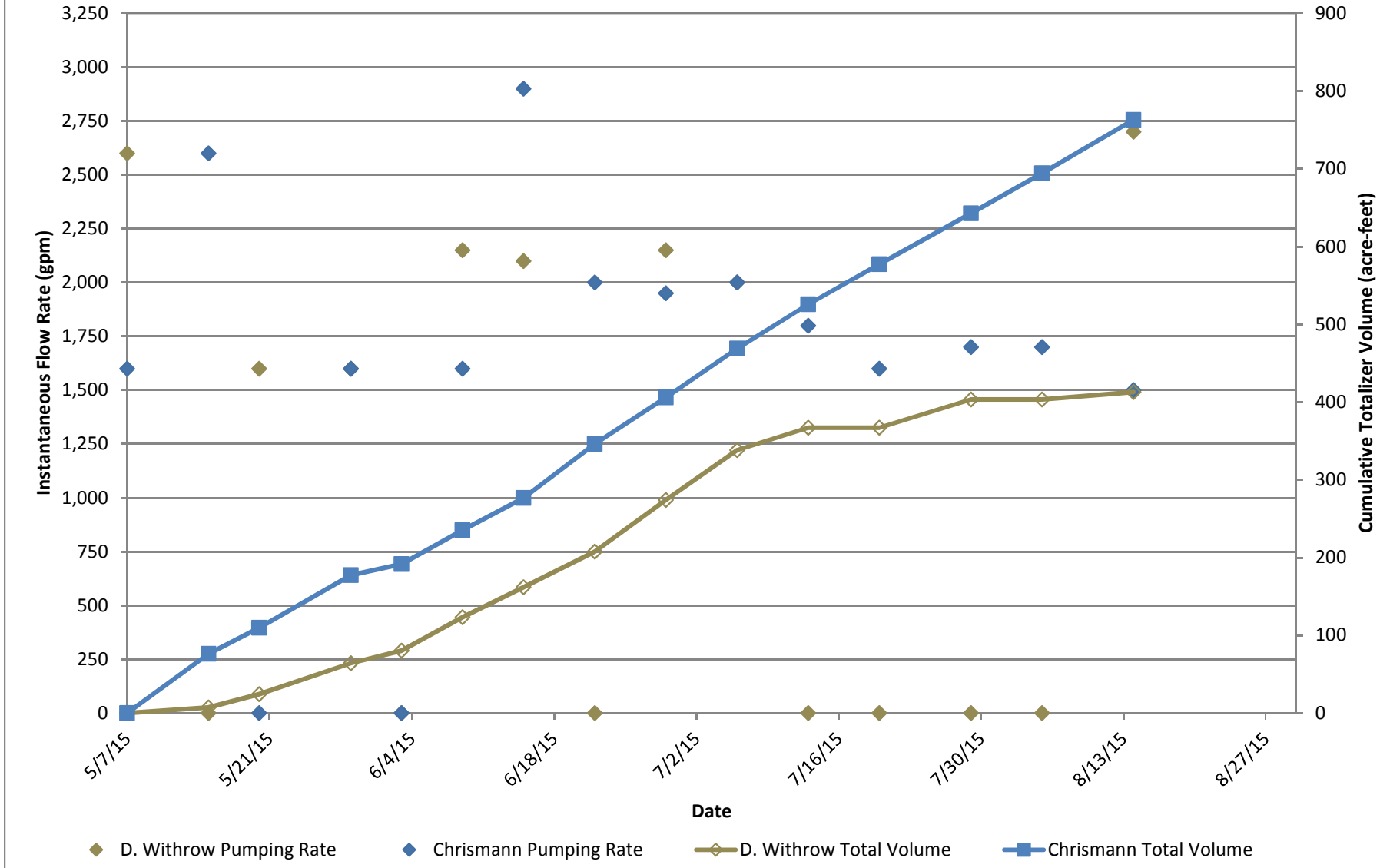
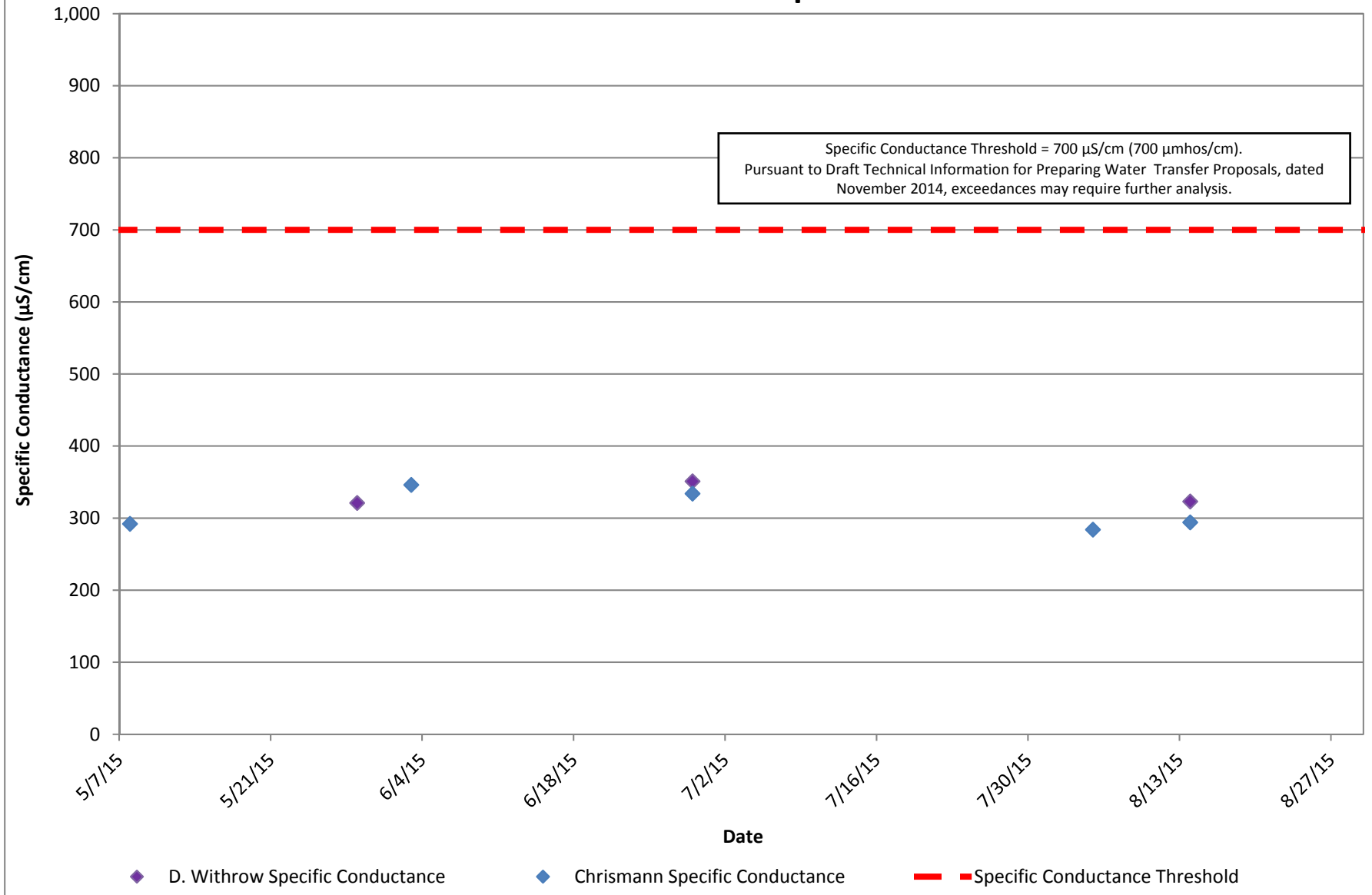
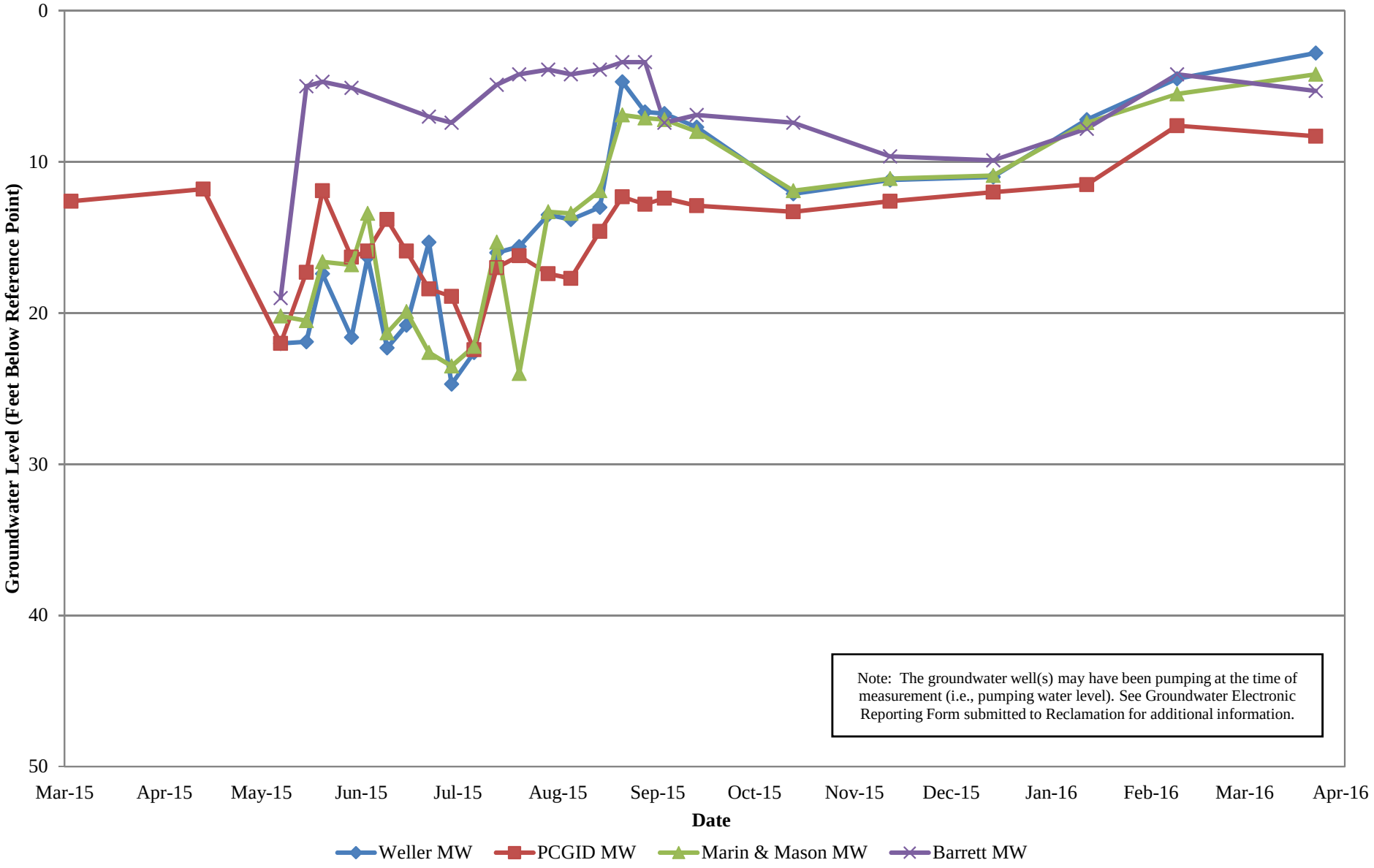
PCGID
Groundwater Production Well Flow Rate & Volumes



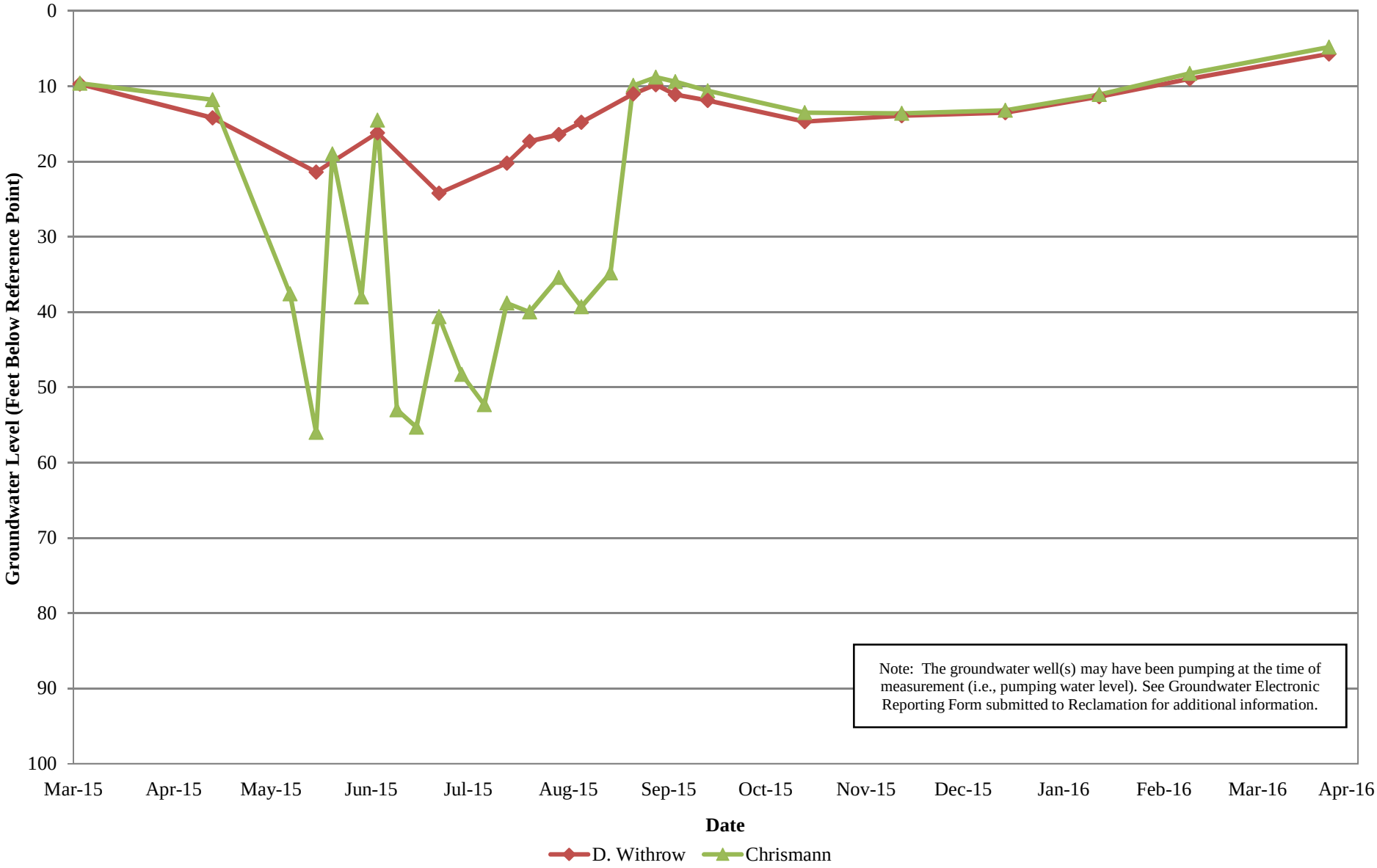
PCGID
Groundwater Production Well Specific Conductance



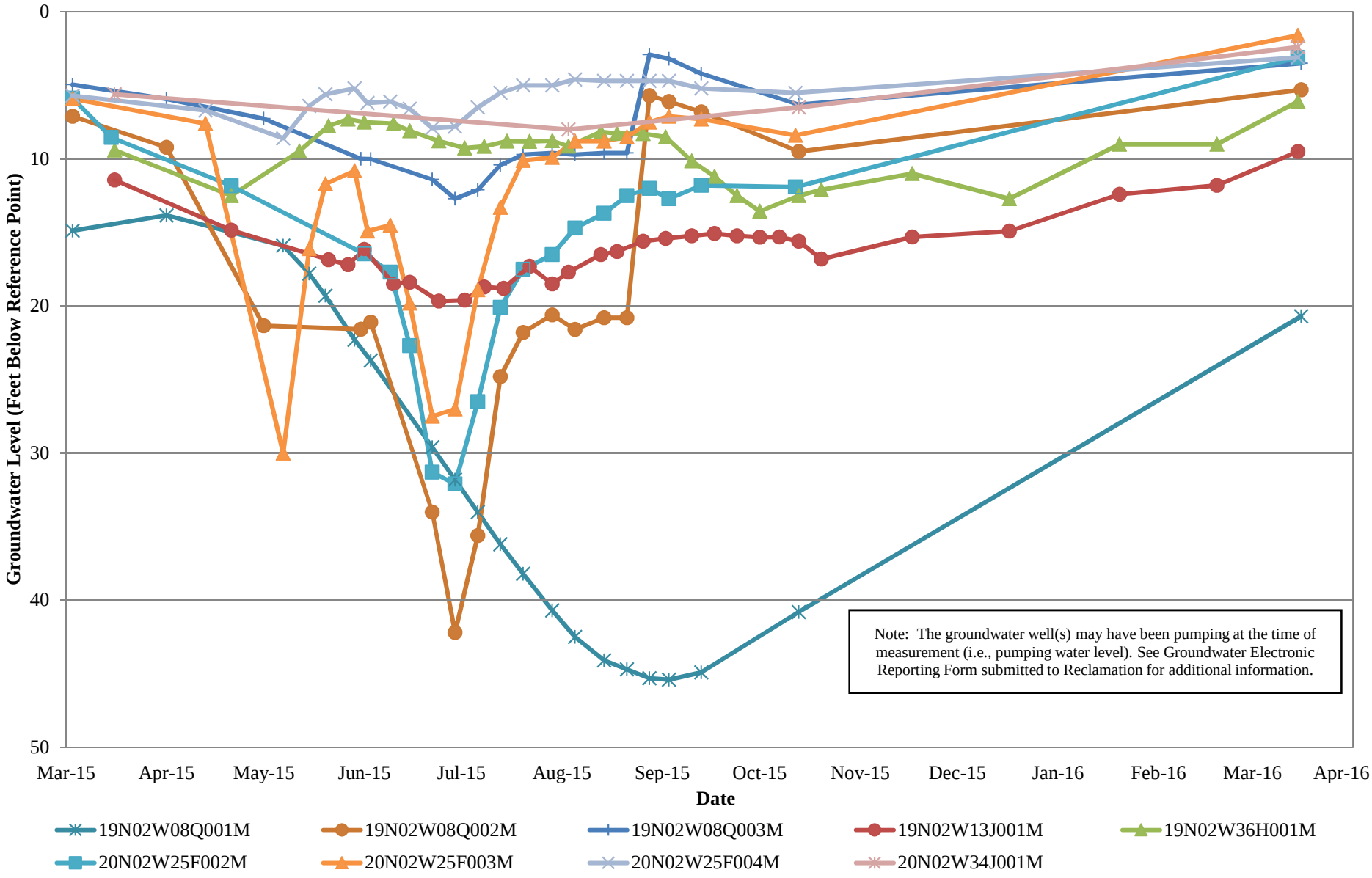
Princeton-Codora-Glenn Irrigation District
Monitoring Well Groundwater Level Data



Princeton-Codora-Glenn Irrigation District
Production Well Groundwater Level Data



Princeton-Codora-Glenn Irrigation District
DWR Monitoring Well Groundwater Level Data



Provident Irrigation District

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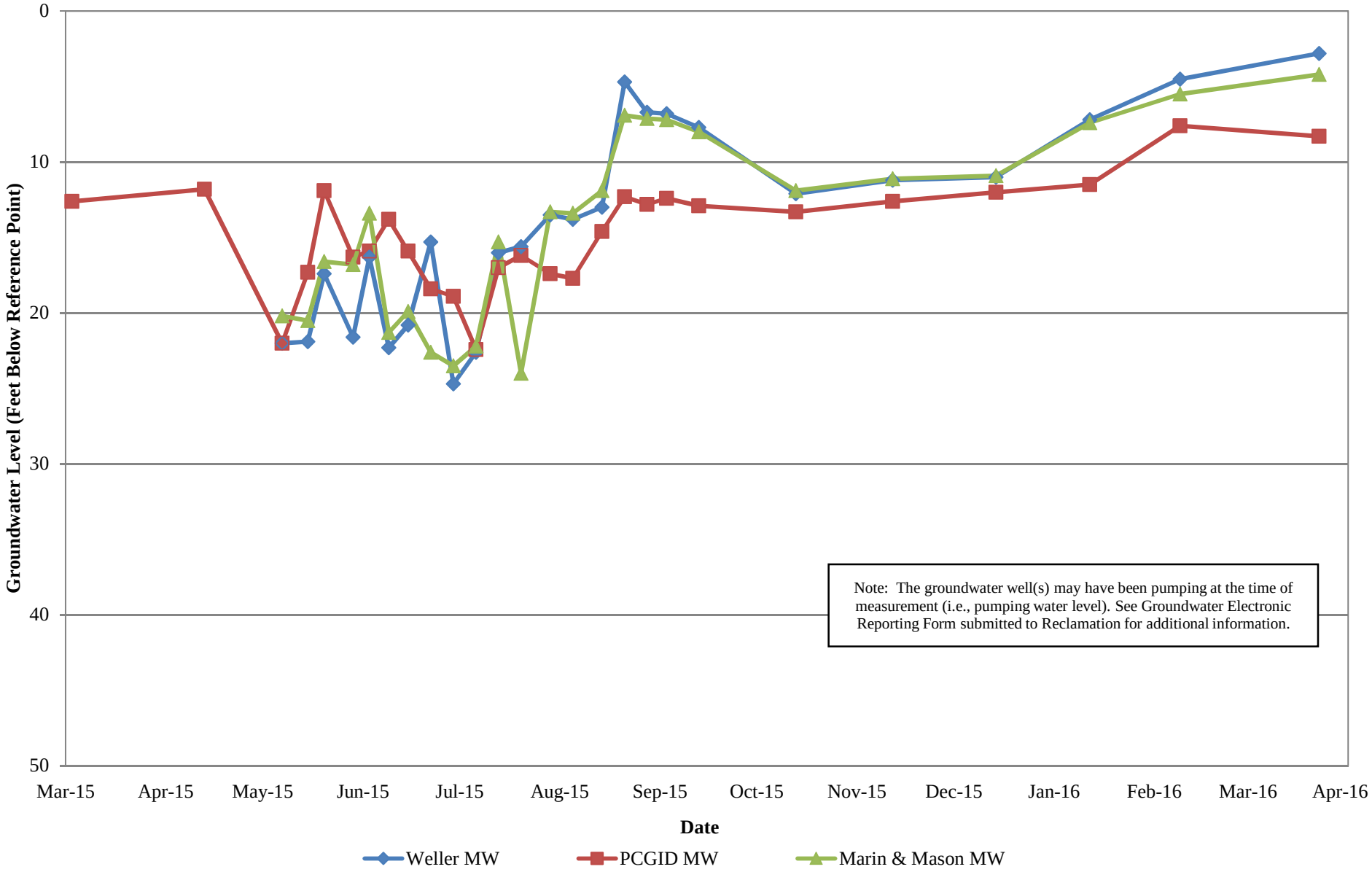
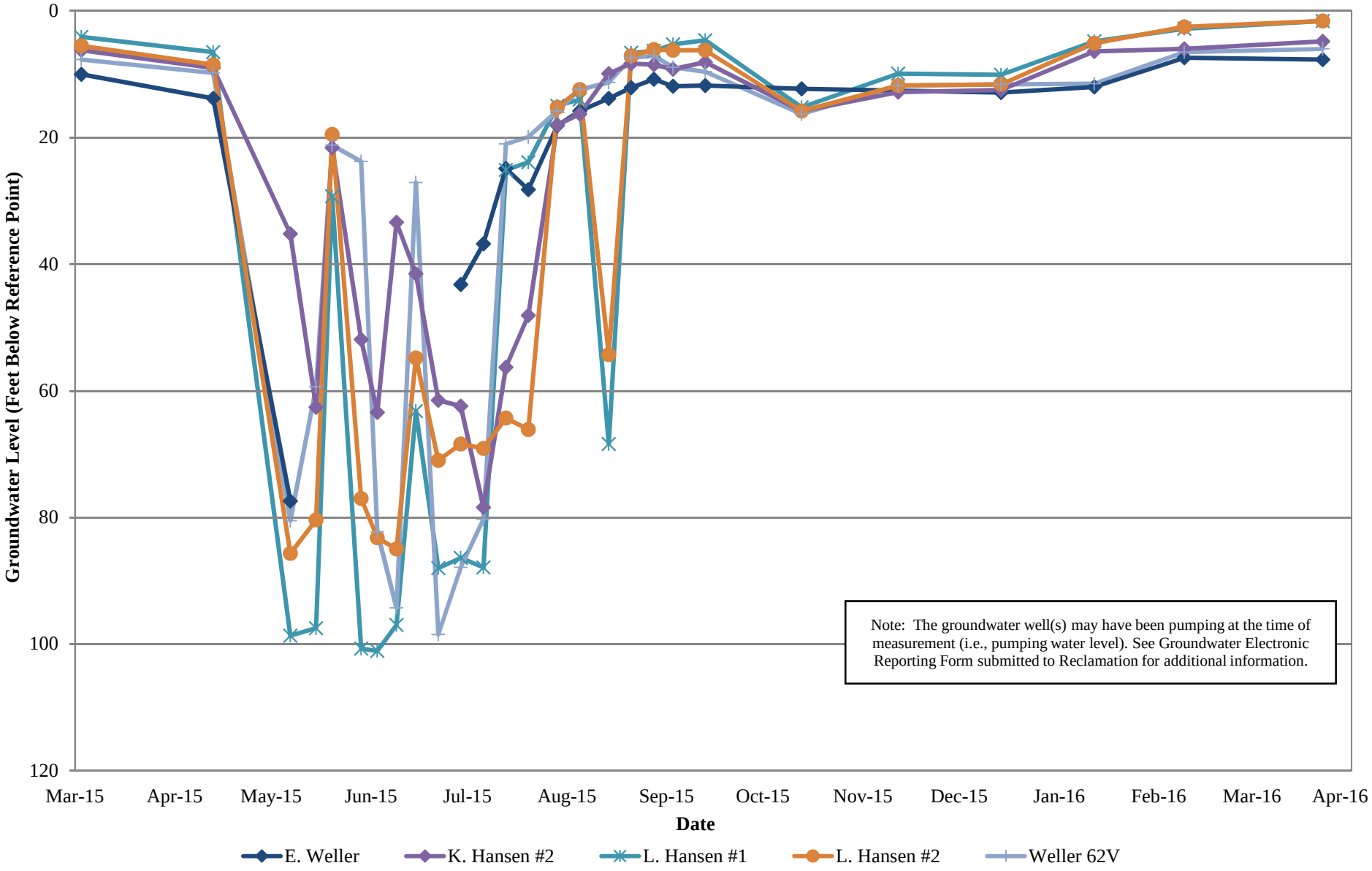
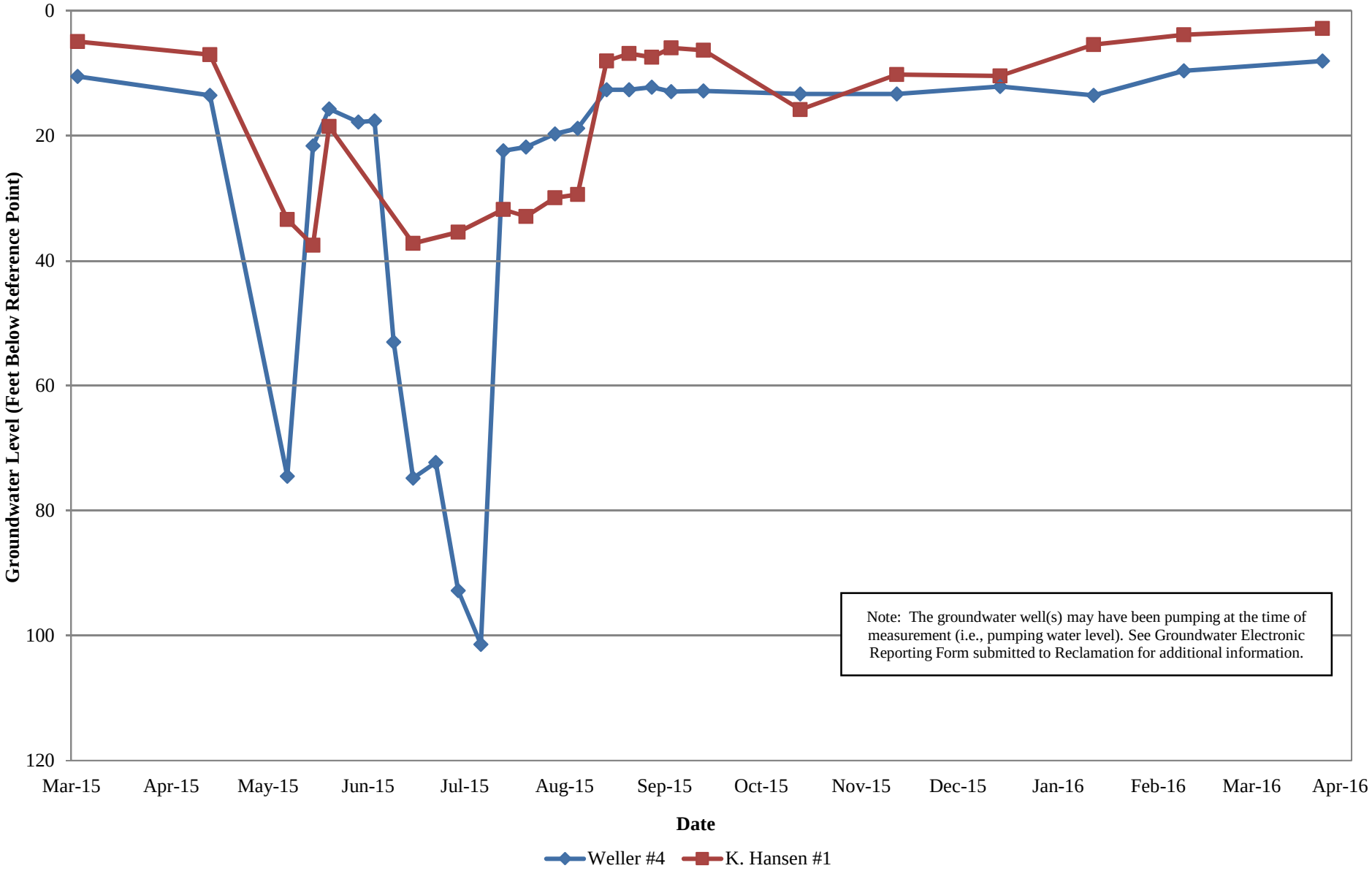
Provident Irrigation District
Monitoring Well Groundwater Level Data

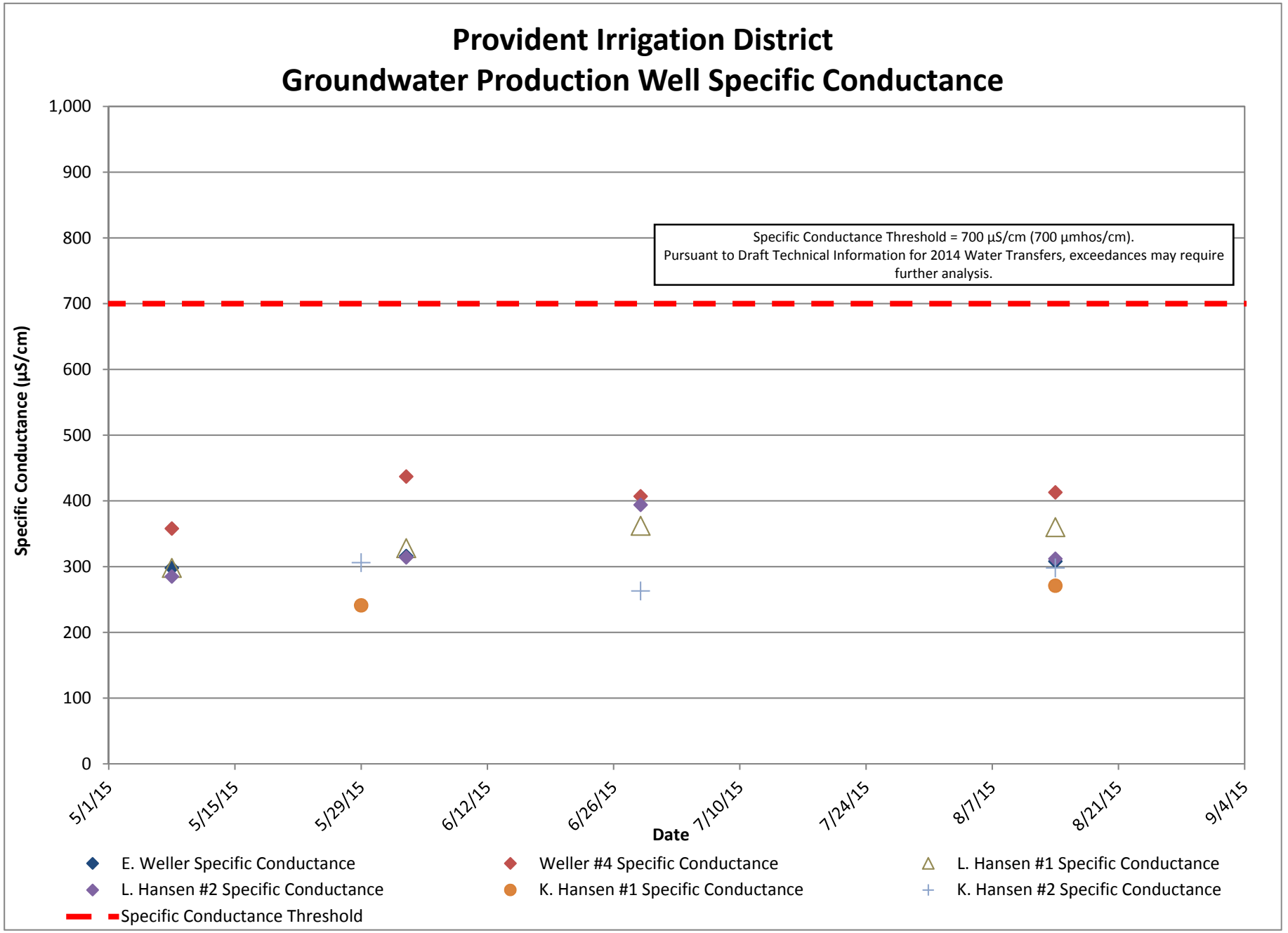


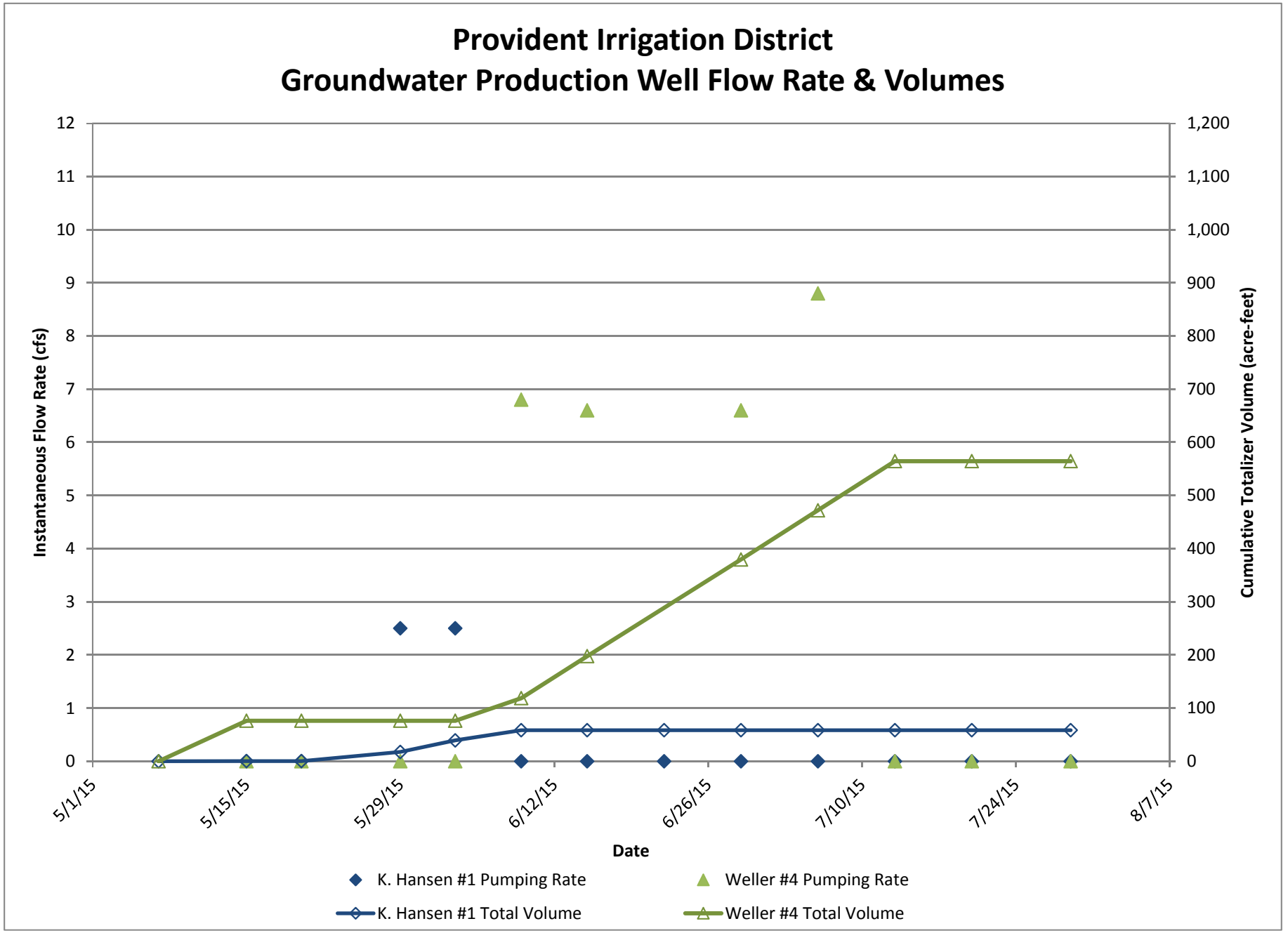
Provident Irrigation District
Production Well Groundwater Level Data

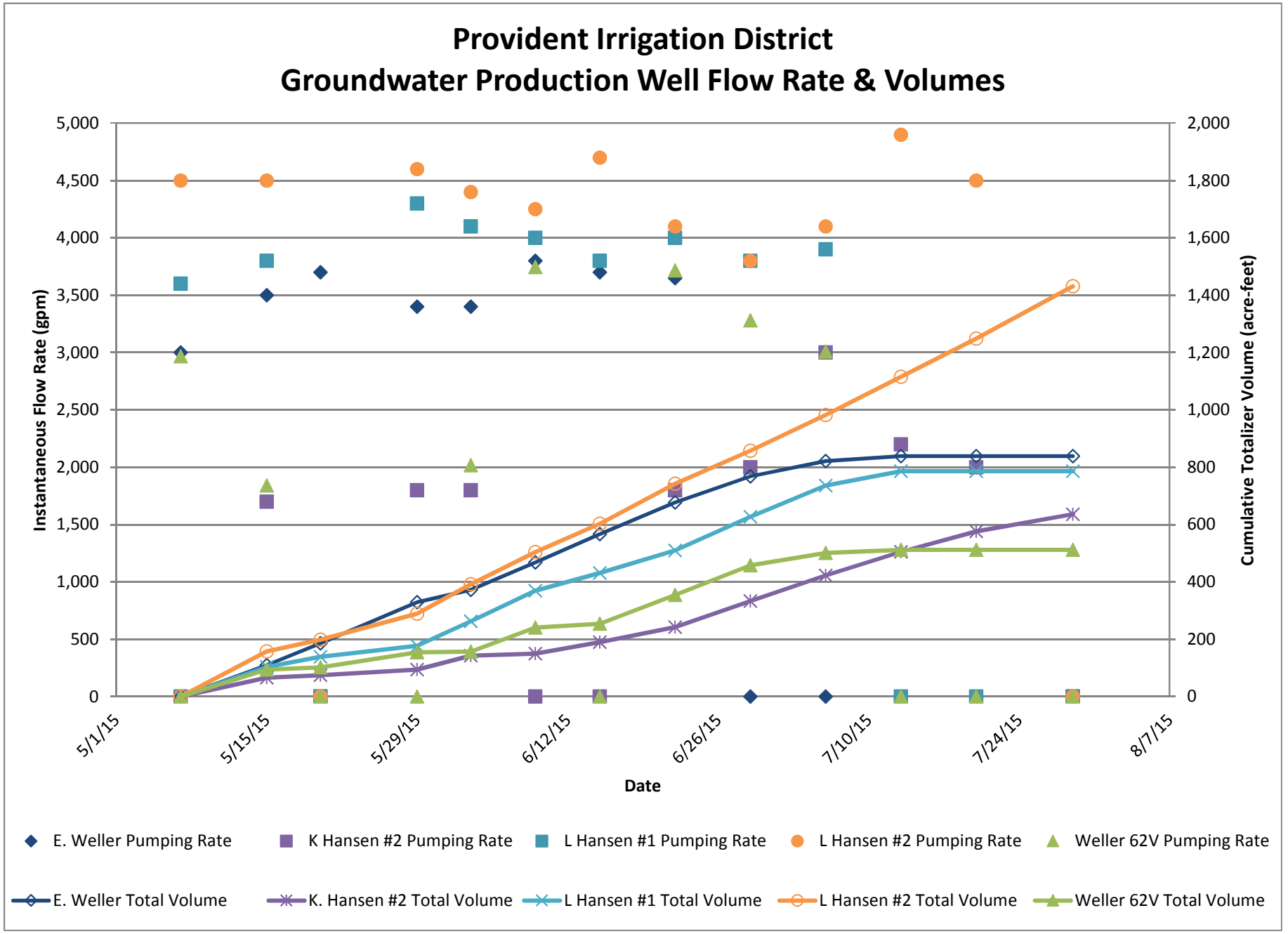


Provident Irrigation District
Production Well Groundwater Level Data

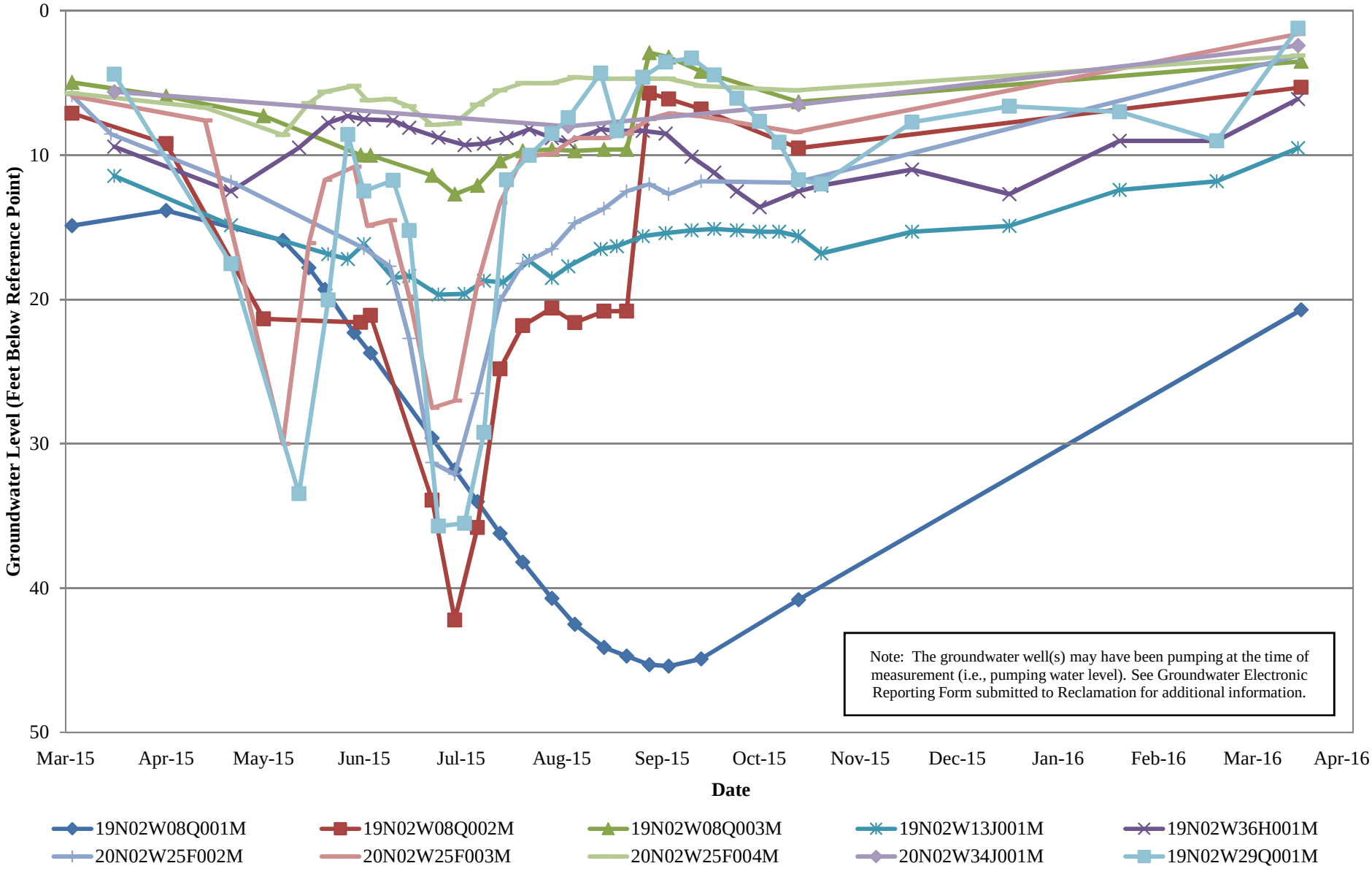



Provident Irrigation District
Groundwater Production Well Specific Conductance
Specific Conductance Threshold = 700 µS/cm (700 µmhos/cm).
Pursuant to Draft Technical Information for 2014 Water Transfers, exceedances may require further analysis.
Specific Conductance (µS/cm)
1,000
900
800
700
600
500
400
300
200
100
0
5/1/15
5/15/15
5/29/15
6/12/15
6/26/15
7/10/15
7/24/15
8/7/15
8/21/15
9/4/15
Date
E. Weller Specific Conductance
Weller #4 Specific Conductance
L. Hansen #1 Specific Conductance
L. Hansen #2 Specific Conductance
K. Hansen #1 Specific Conductance
K. Hansen #2 Specific Conductance
Specific Conductance Threshold


Provident Irrigation District
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (cfs)
Cumulative Totalizer Volume (acre-feet)
12
11
10
9
8
7
6
5
4
3
2
1
0
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
5/1/15
5/15/15
5/29/15
6/12/15
6/26/15
7/10/15
7/24/15
8/7/15
Date
K. Hansen #1 Pumping Rate
Weller #4 Pumping Rate
K. Hansen #1 Total Volume
Weller #4 Total Volume


Provident Irrigation District
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
5/1/15
5/15/15
5/29/15
6/12/15
6/26/15
7/10/15
7/24/15
8/7/15
Date
E. Weller Pumping Rate
K Hansen #2 Pumping Rate
L Hansen #1 Pumping Rate
L Hansen #2 Pumping Rate
Weller 62V Pumping Rate
E. Weller Total Volume
K. Hansen #2 Total Volume
L Hansen #1 Total Volume
L Hansen #2 Total Volume
Weller 62V Total Volume

Provident Irrigation District
DWR Monitoring Well Groundwater Level Data



Reclamation District No. 108

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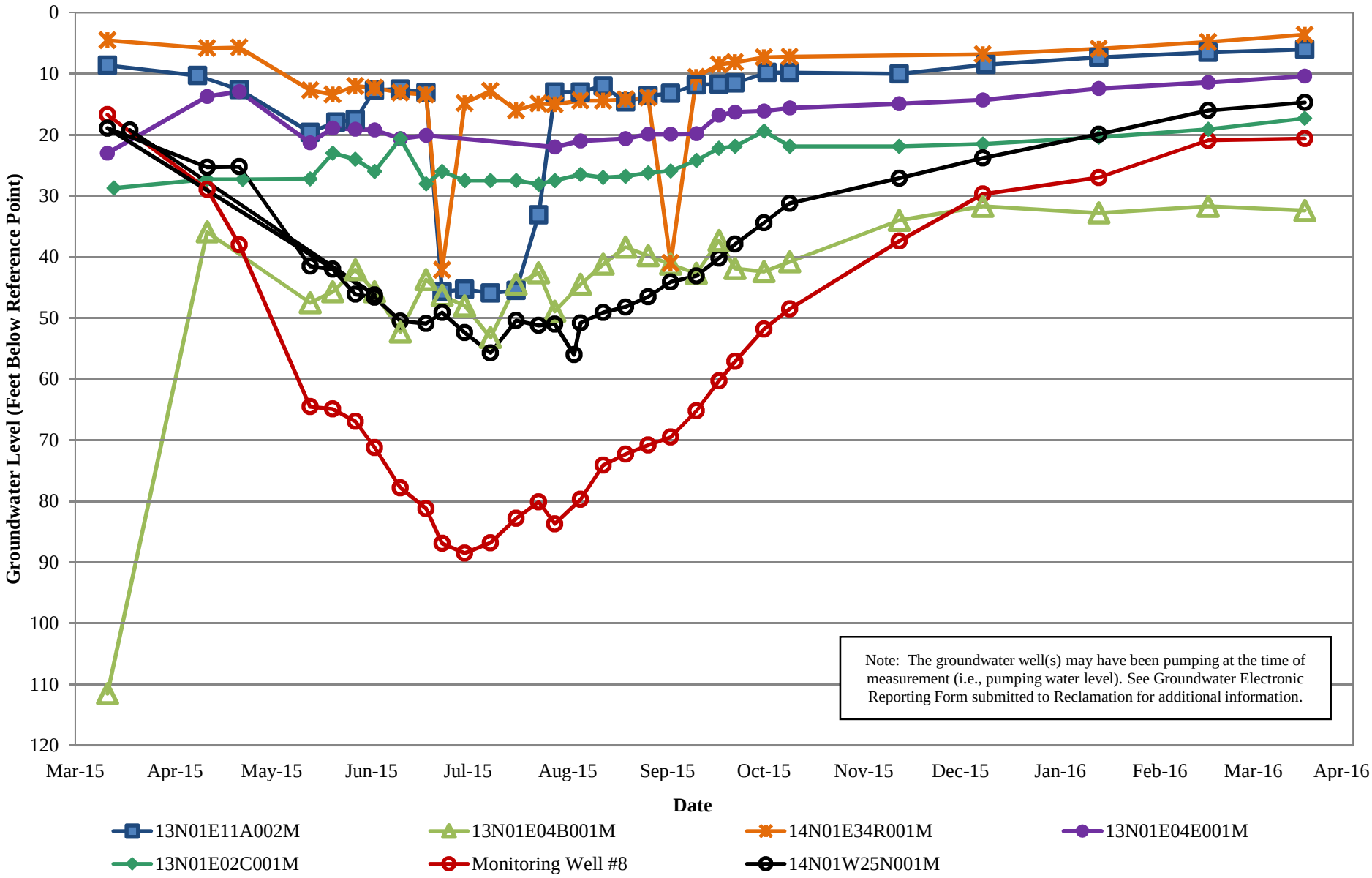
Reclamation District No. 108
Monitoring Well Groundwater Level Data



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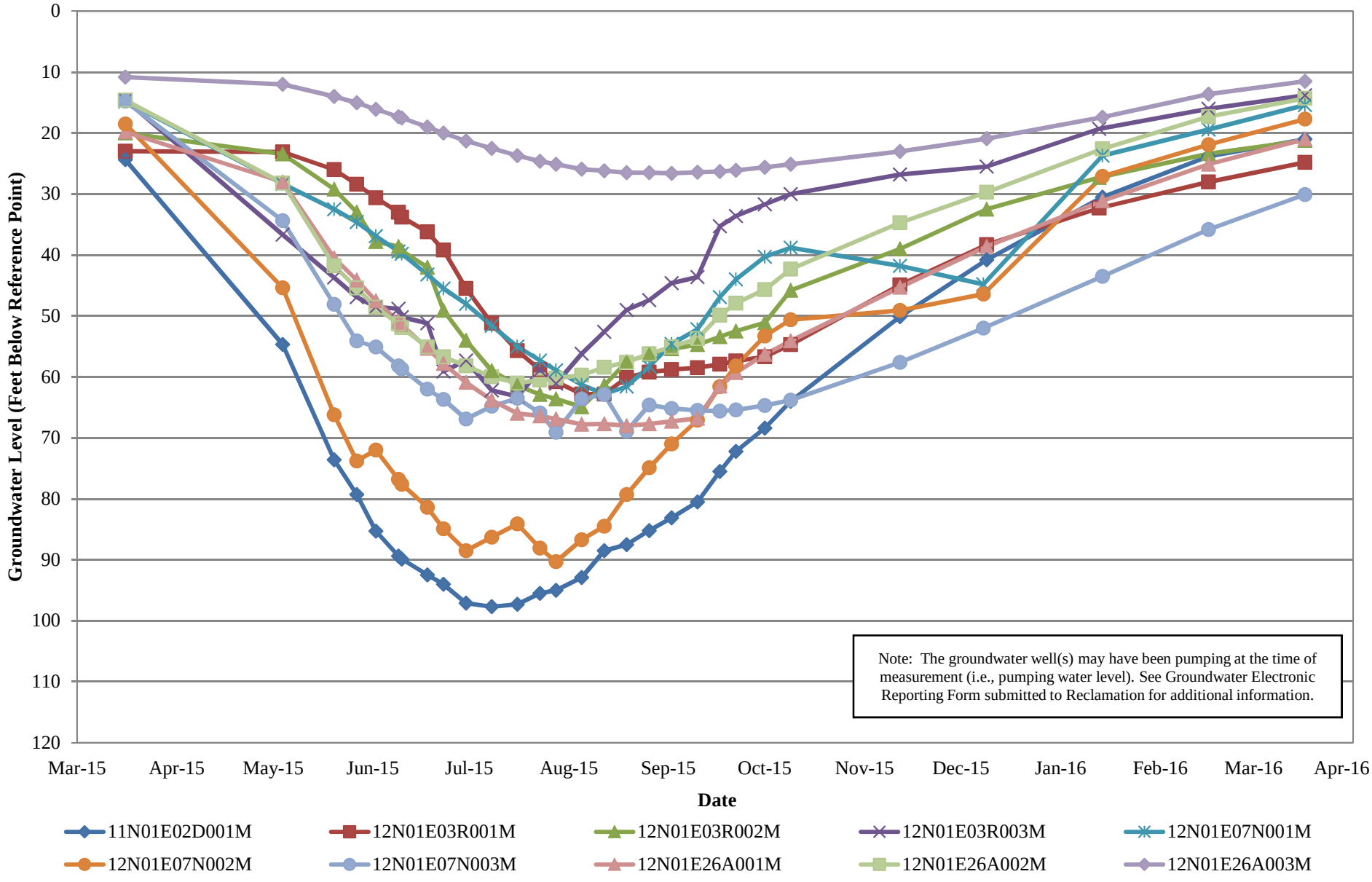
Monitoring Well Groundwater Level Data



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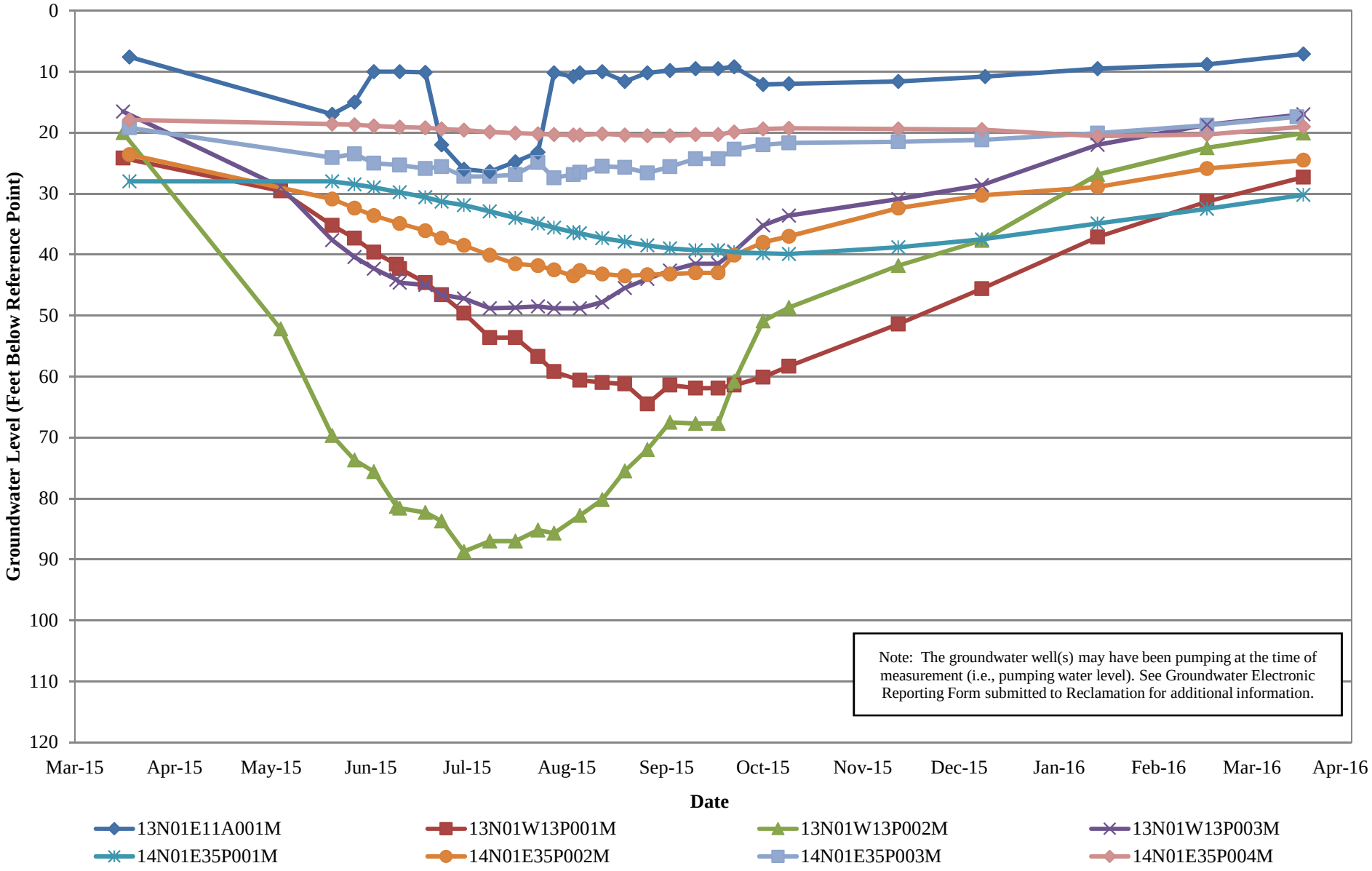
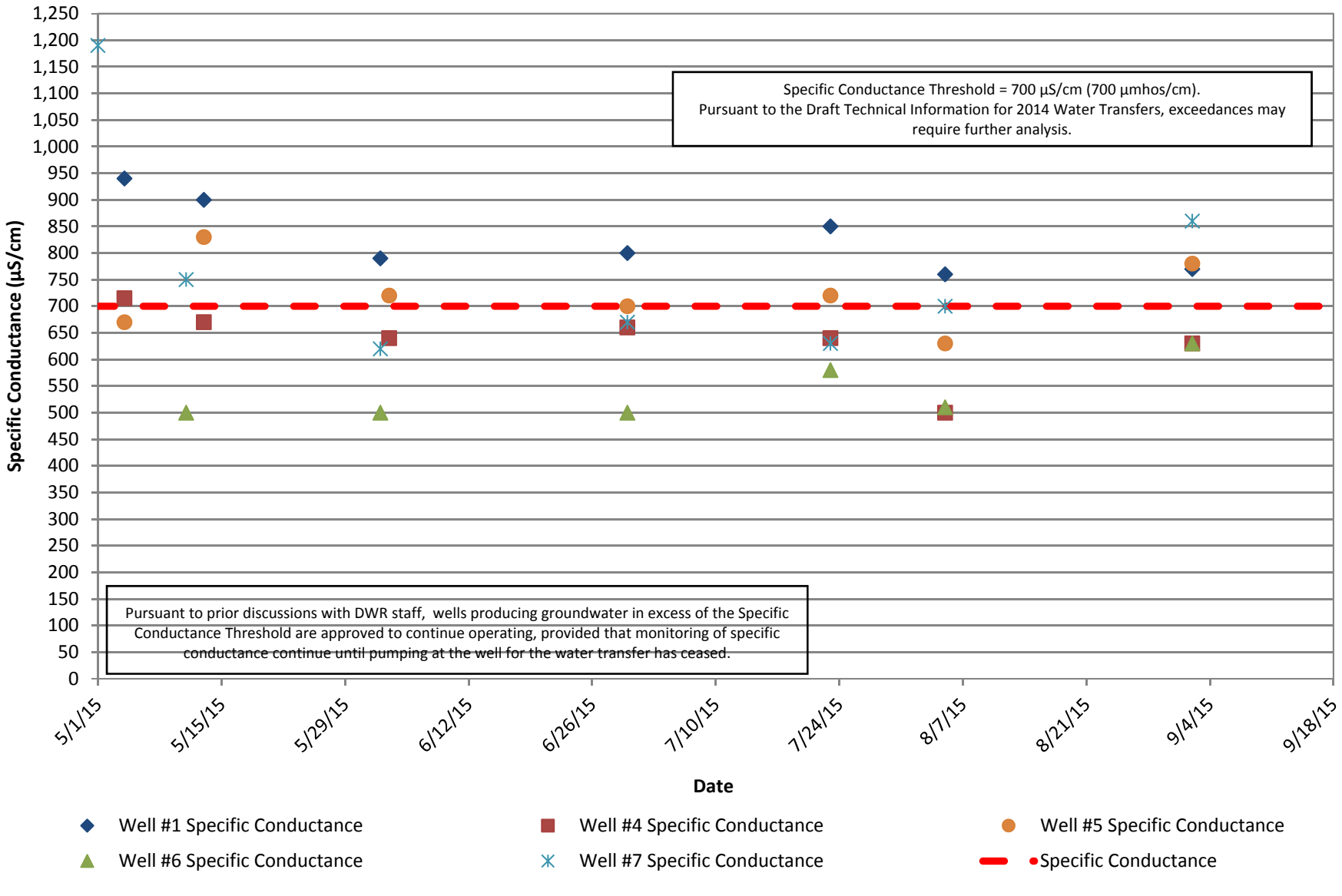
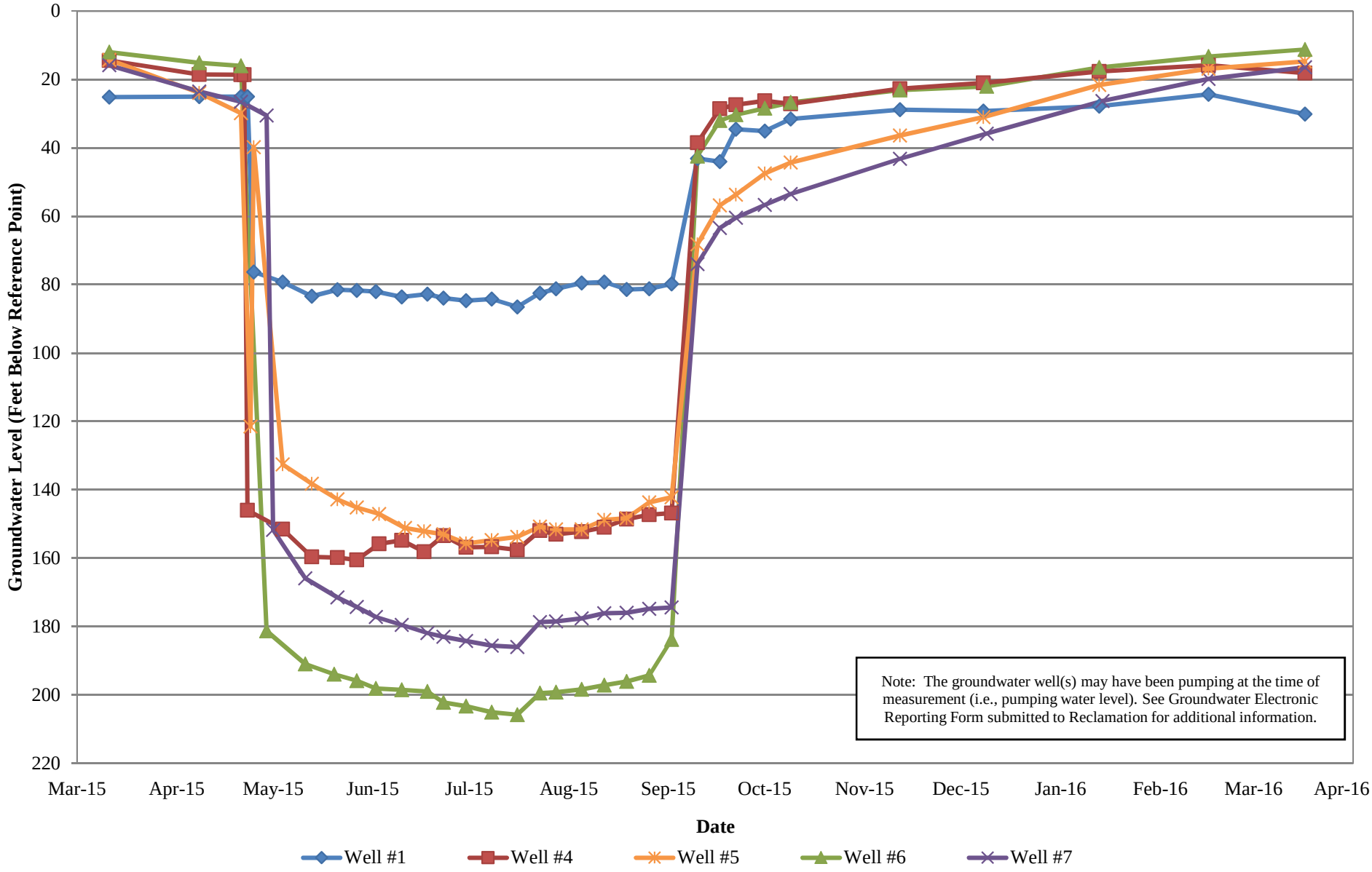
Monitoring Well Groundwater Level Data

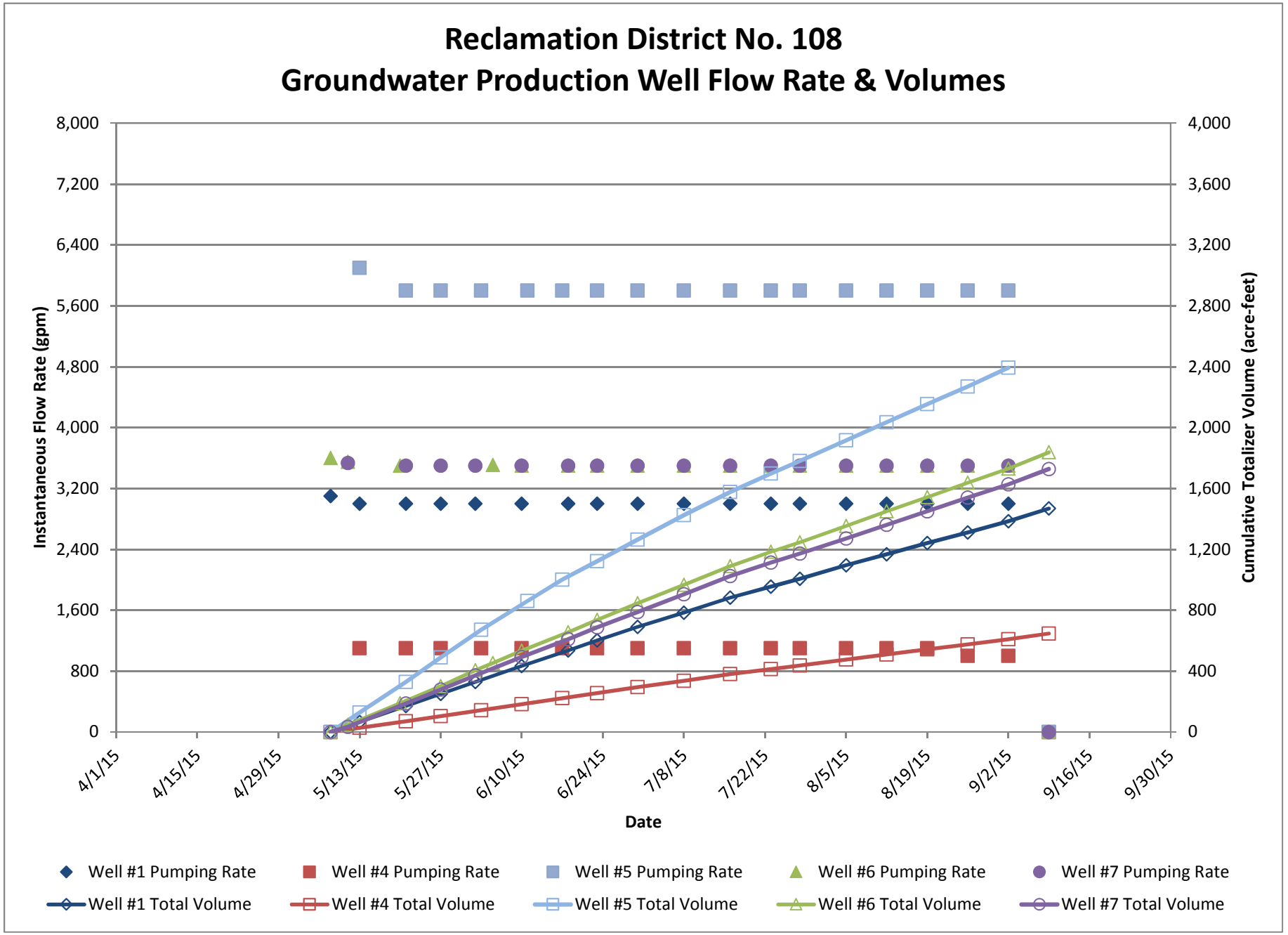


Reclamation District No. 108
Groundwater Production Well Specific Conductance



Reclamation District No. 108
Production Well Groundwater Level Data




Reclamation District No. 108
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
8,000
7,200
6,400
5,600
4,800
4,000
3,200
2,400
1,600
800
0
4,000
3,600
3,200
2,800
2,400
2,000
1,600
1,200
800
400
0
4/1/15
4/15/15
4/29/15
5/13/15
5/27/15
6/10/15
6/24/15
7/8/15
7/22/15
8/5/15
8/19/15
9/2/15
9/16/15
9/30/15
Date
Well #1 Pumping Rate
Well #4 Pumping Rate
Well #5 Pumping Rate
Well #6 Pumping Rate
Well #7 Pumping Rate
Well #1 Total Volume
Well #4 Total Volume
Well #5 Total Volume
Well #6 Total Volume
Well #7 Total Volume

River Garden Farms

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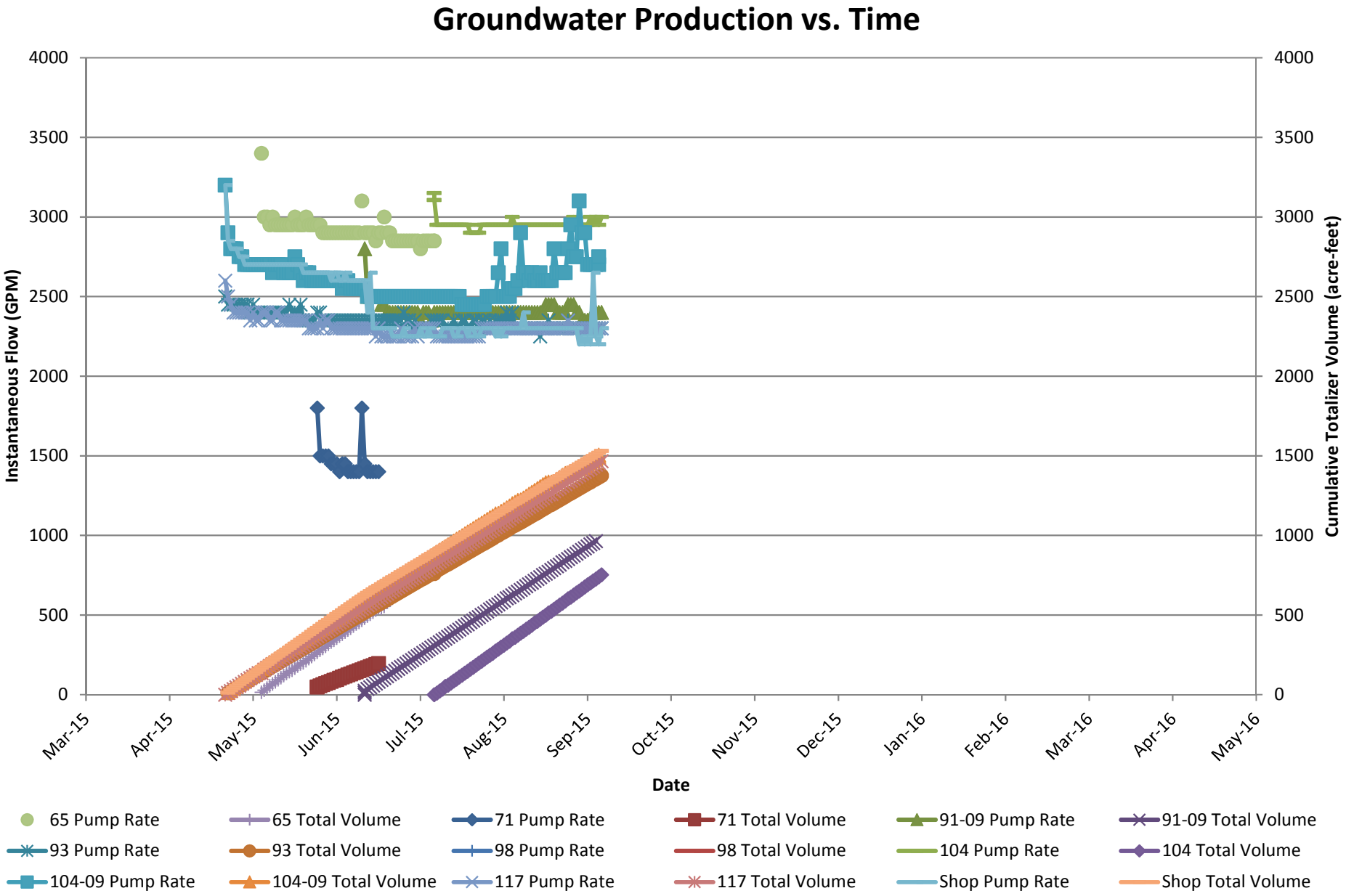

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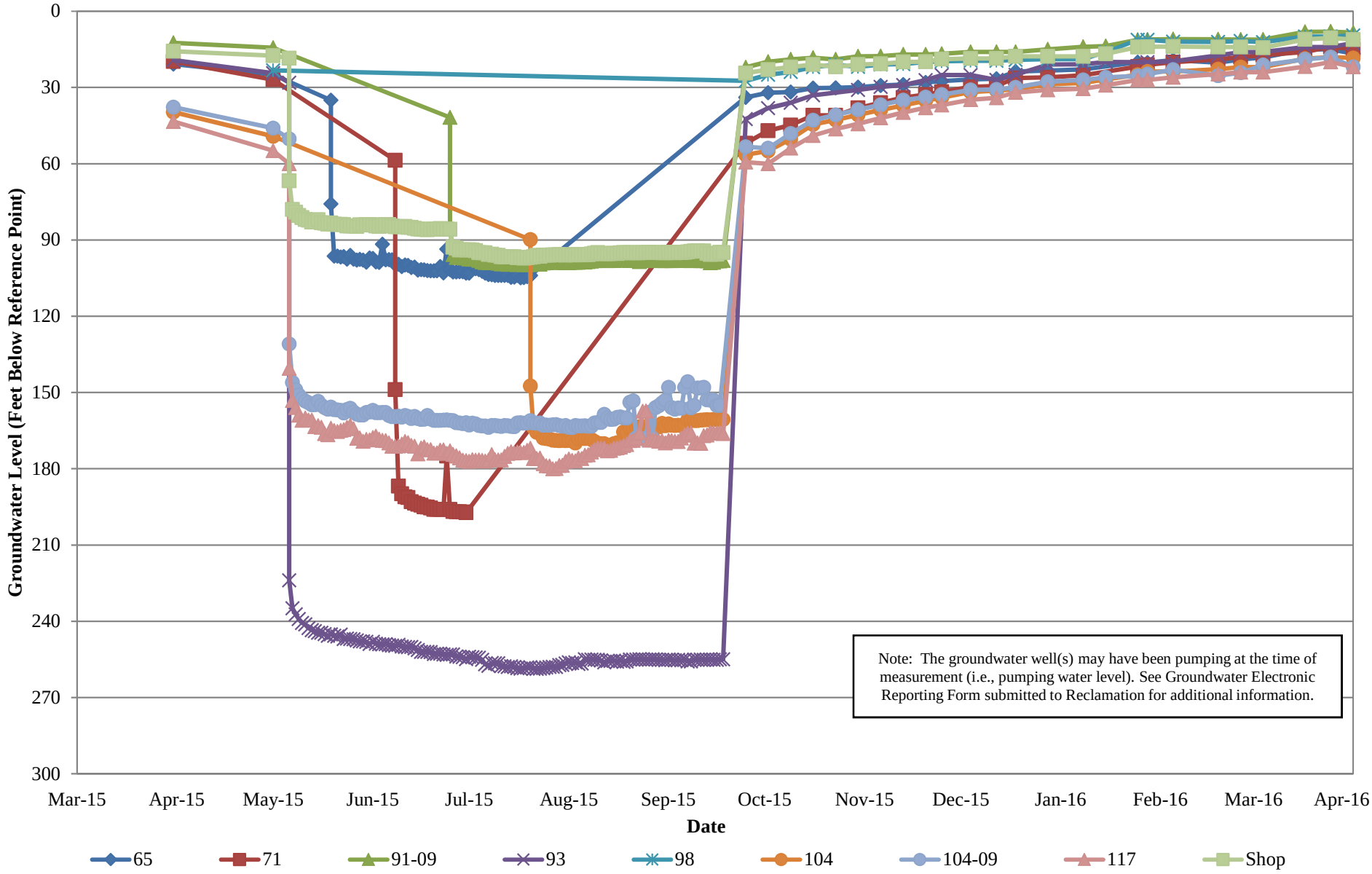
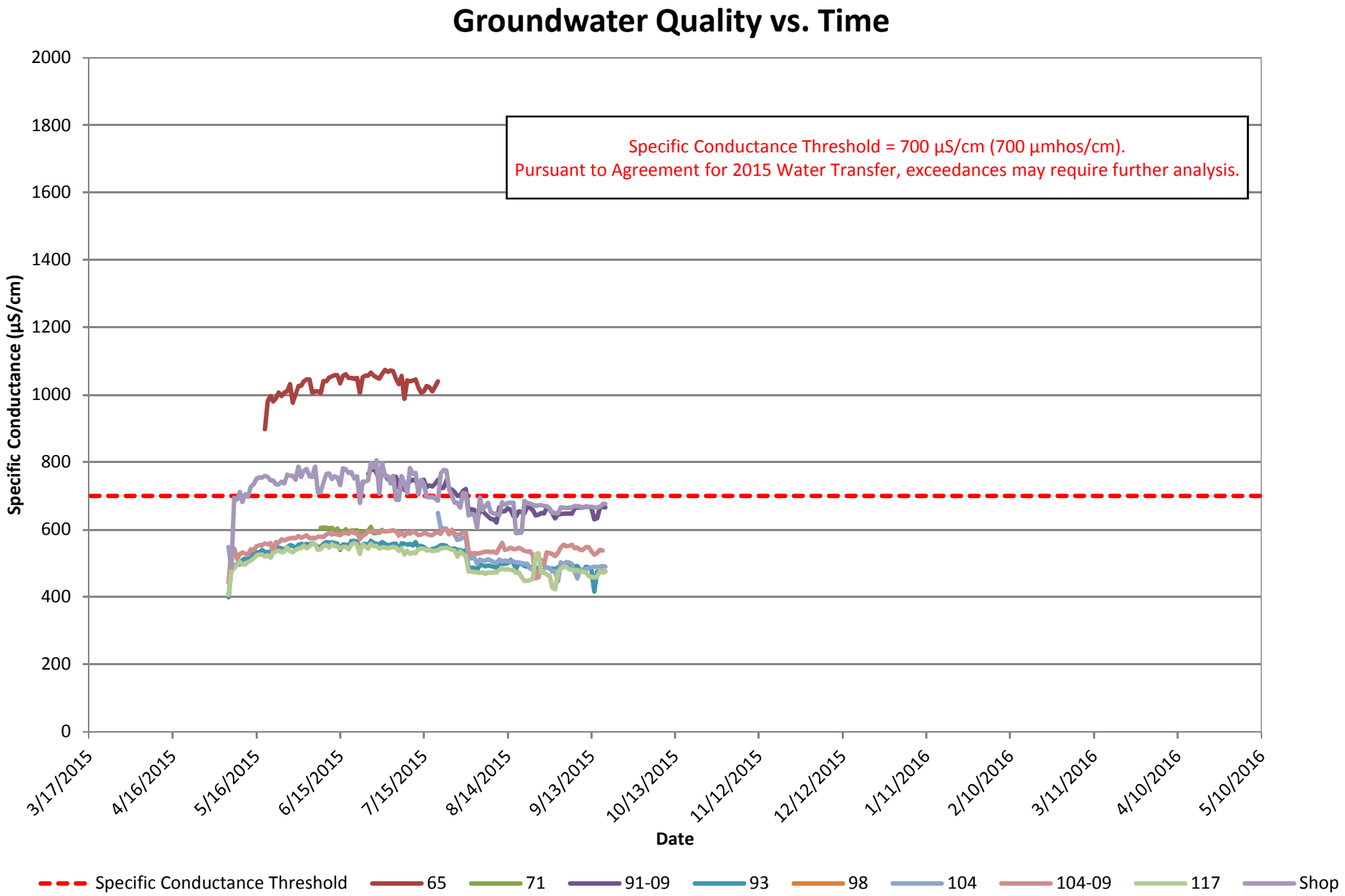
River Garden Farms
Production Well Groundwater Level Data





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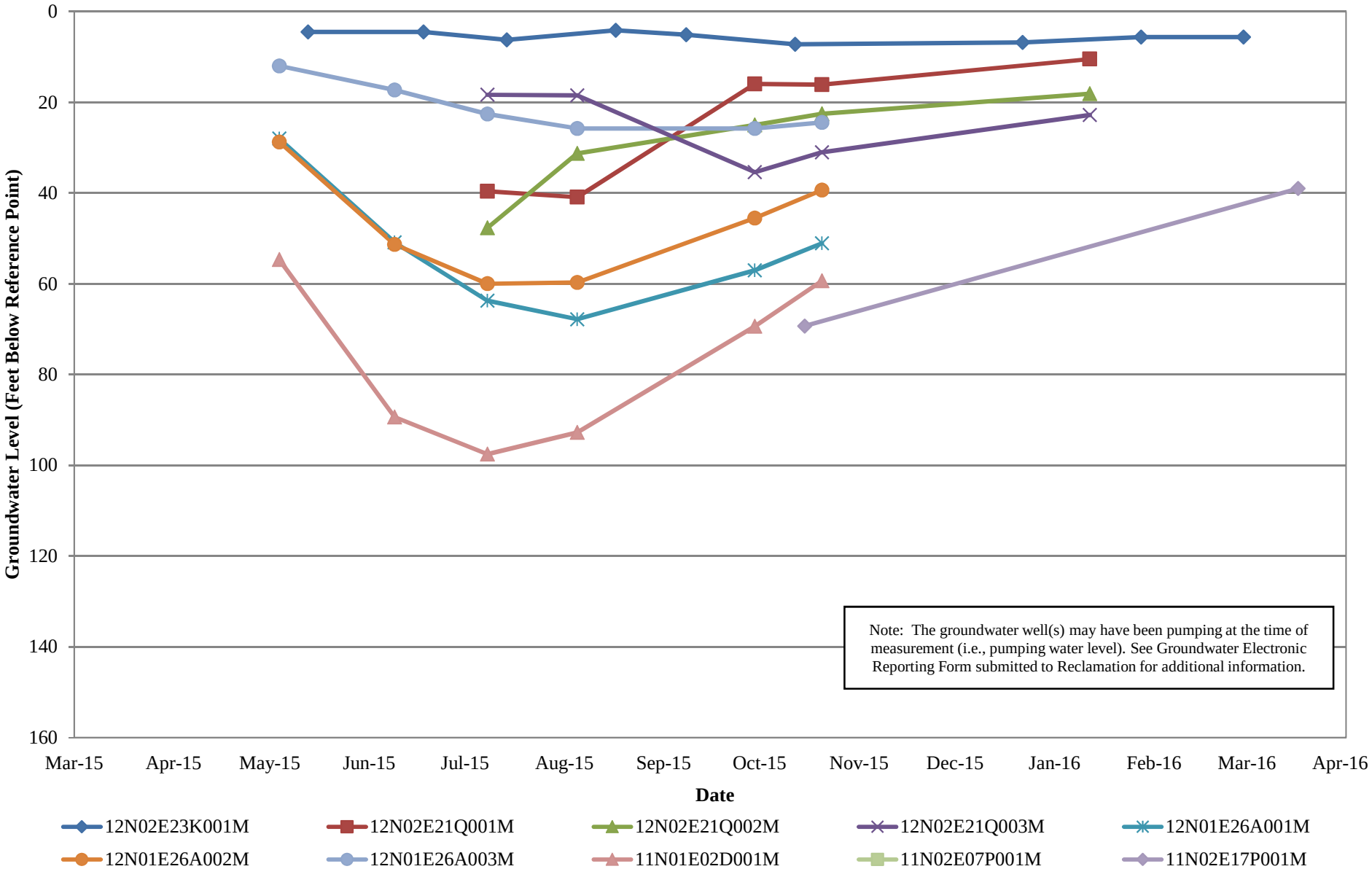
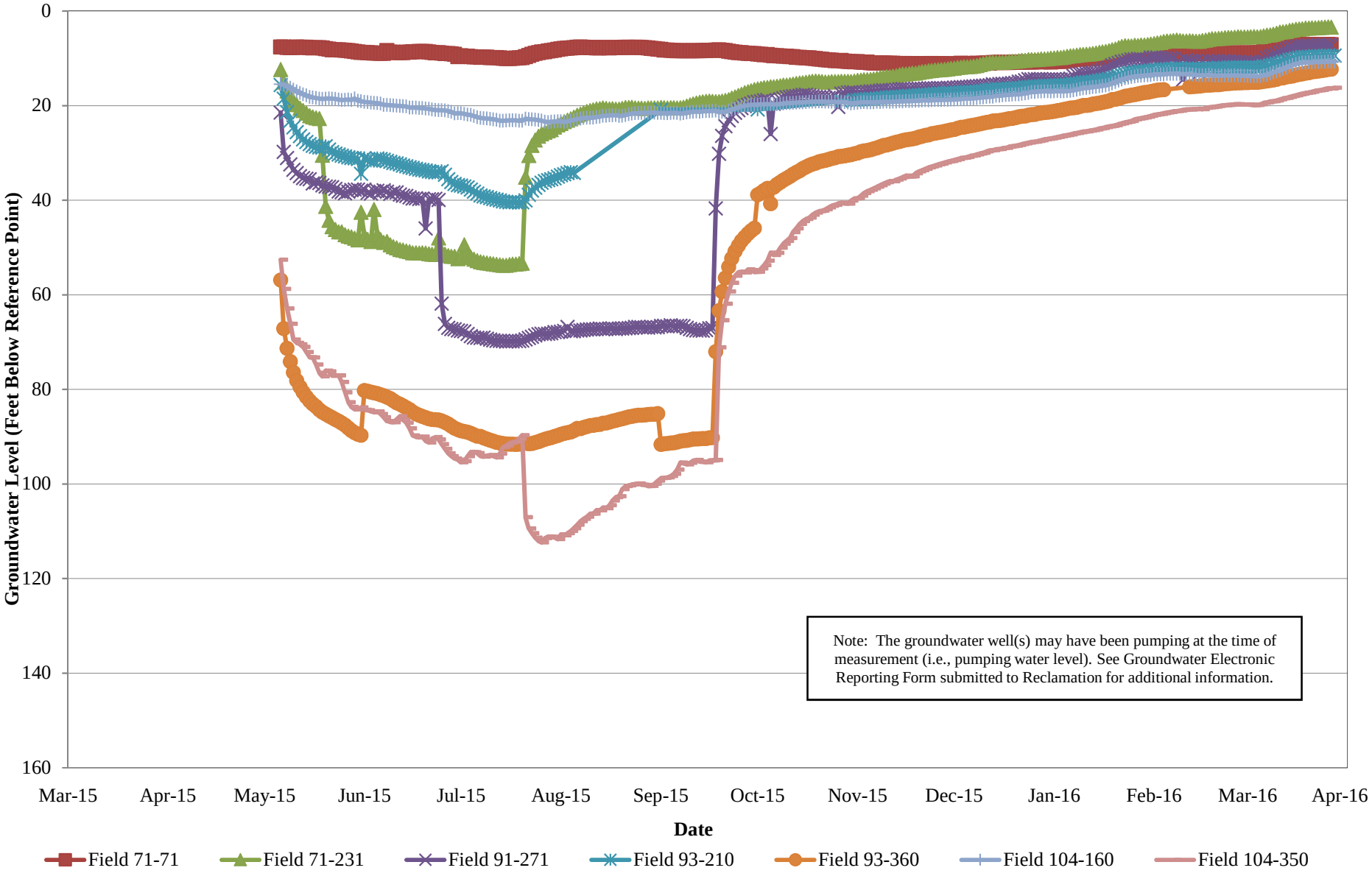
Tab: Water Quality Data

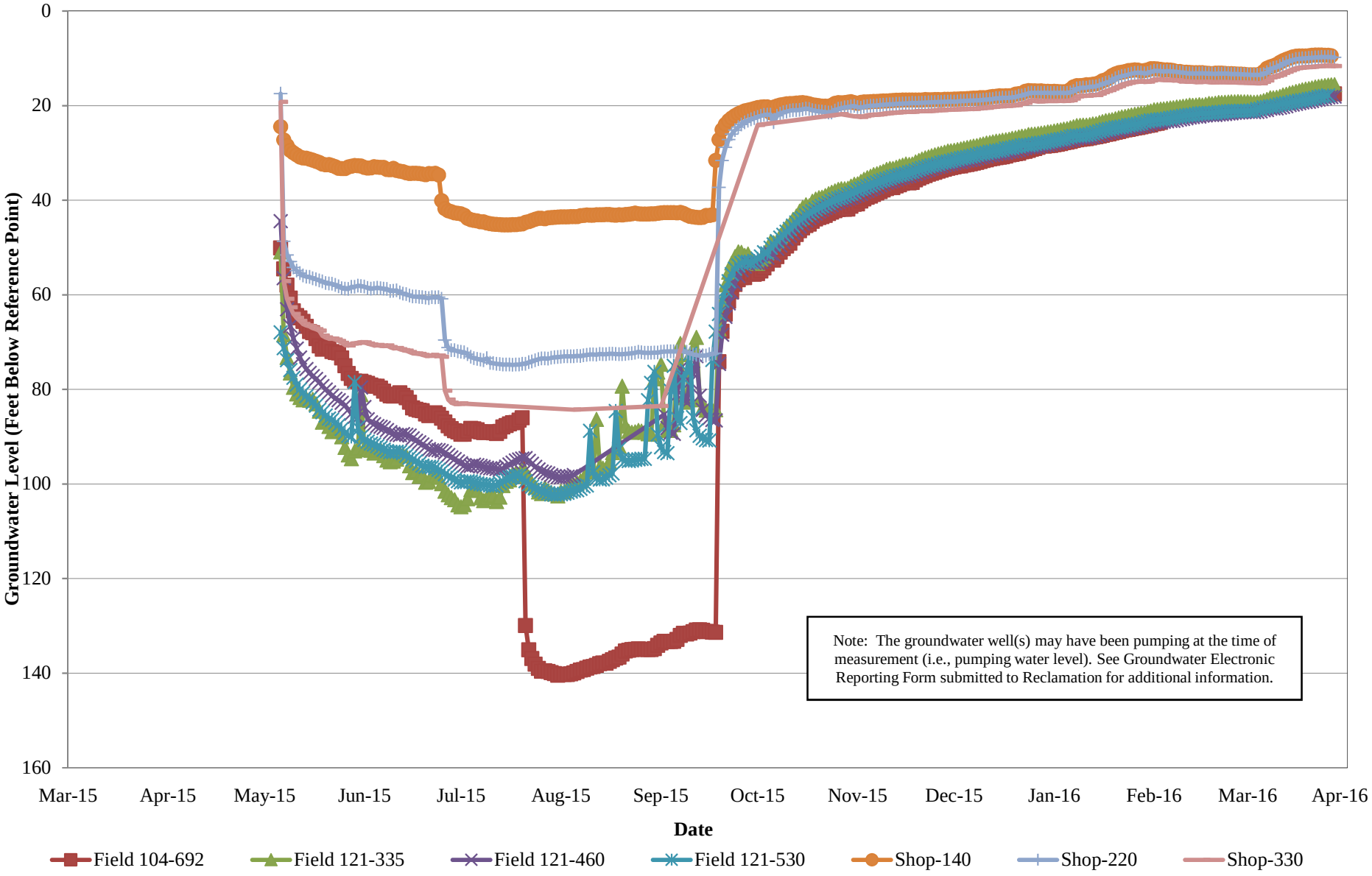
River Garden Farms
DWR Monitoring Well Groundwater Level Data



River Garden Farms
Monitoring Well Groundwater Level Data



River Garden Farms
Monitoring Well Groundwater Level Data



T&P Farms

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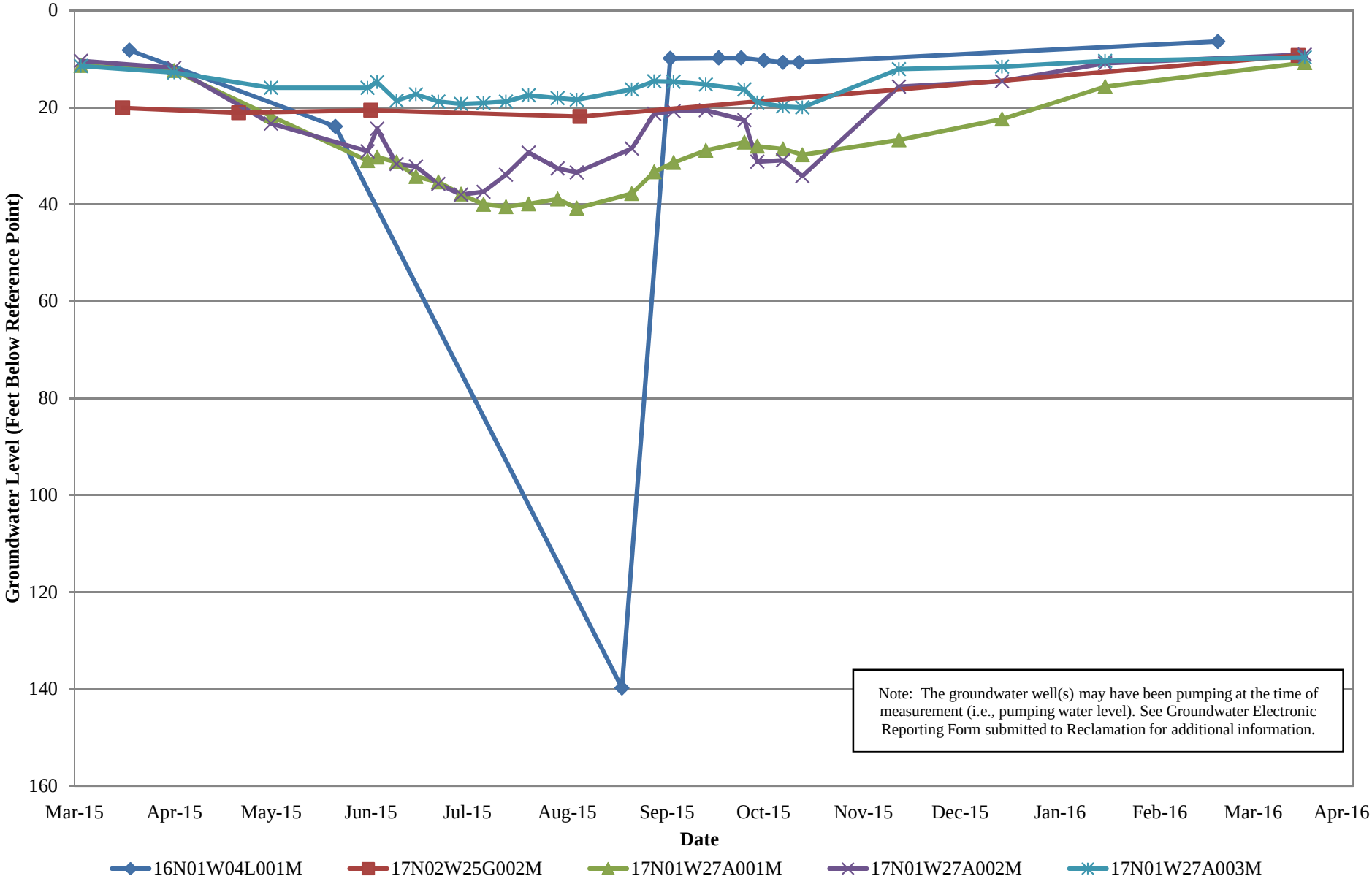
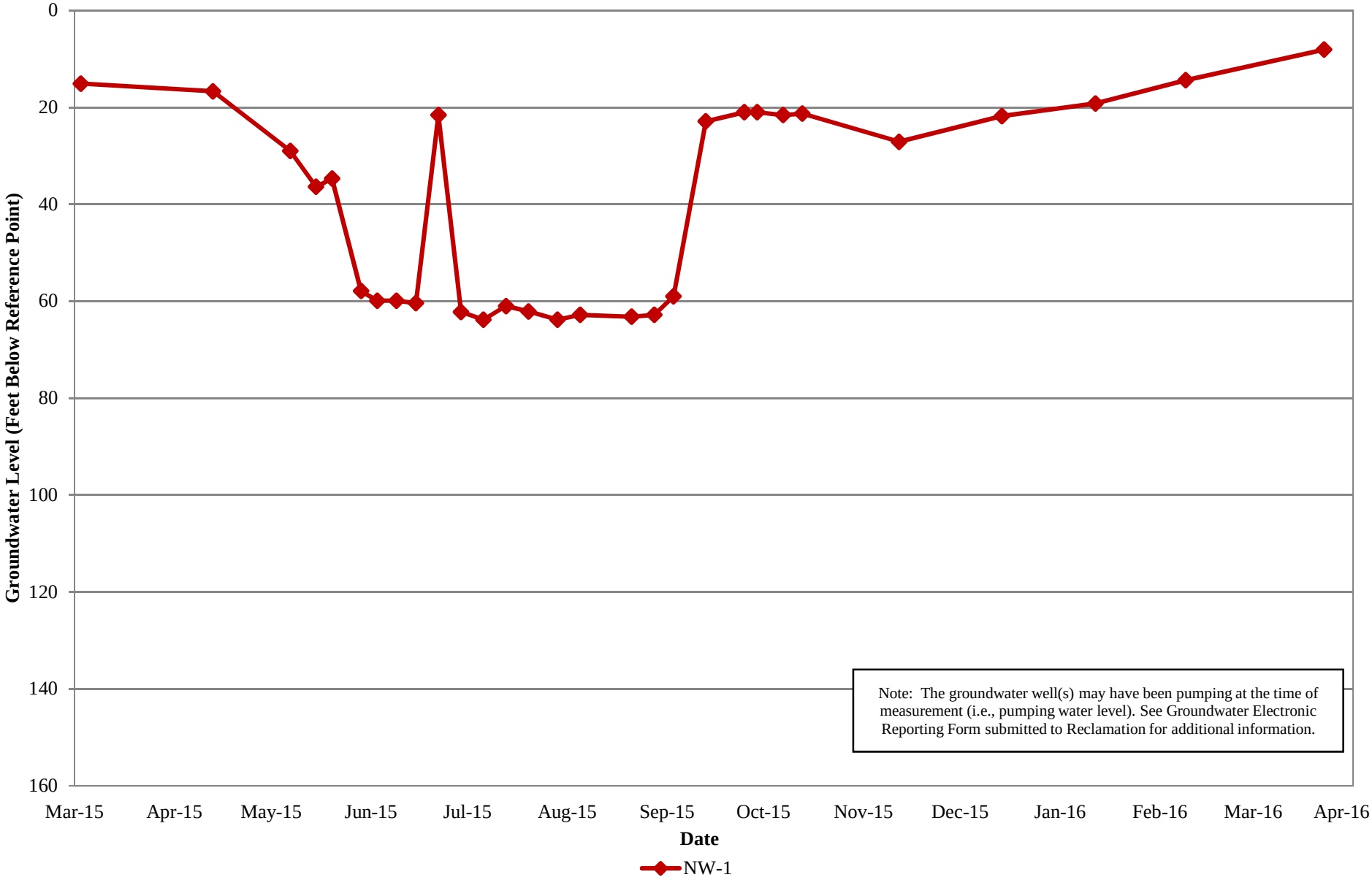
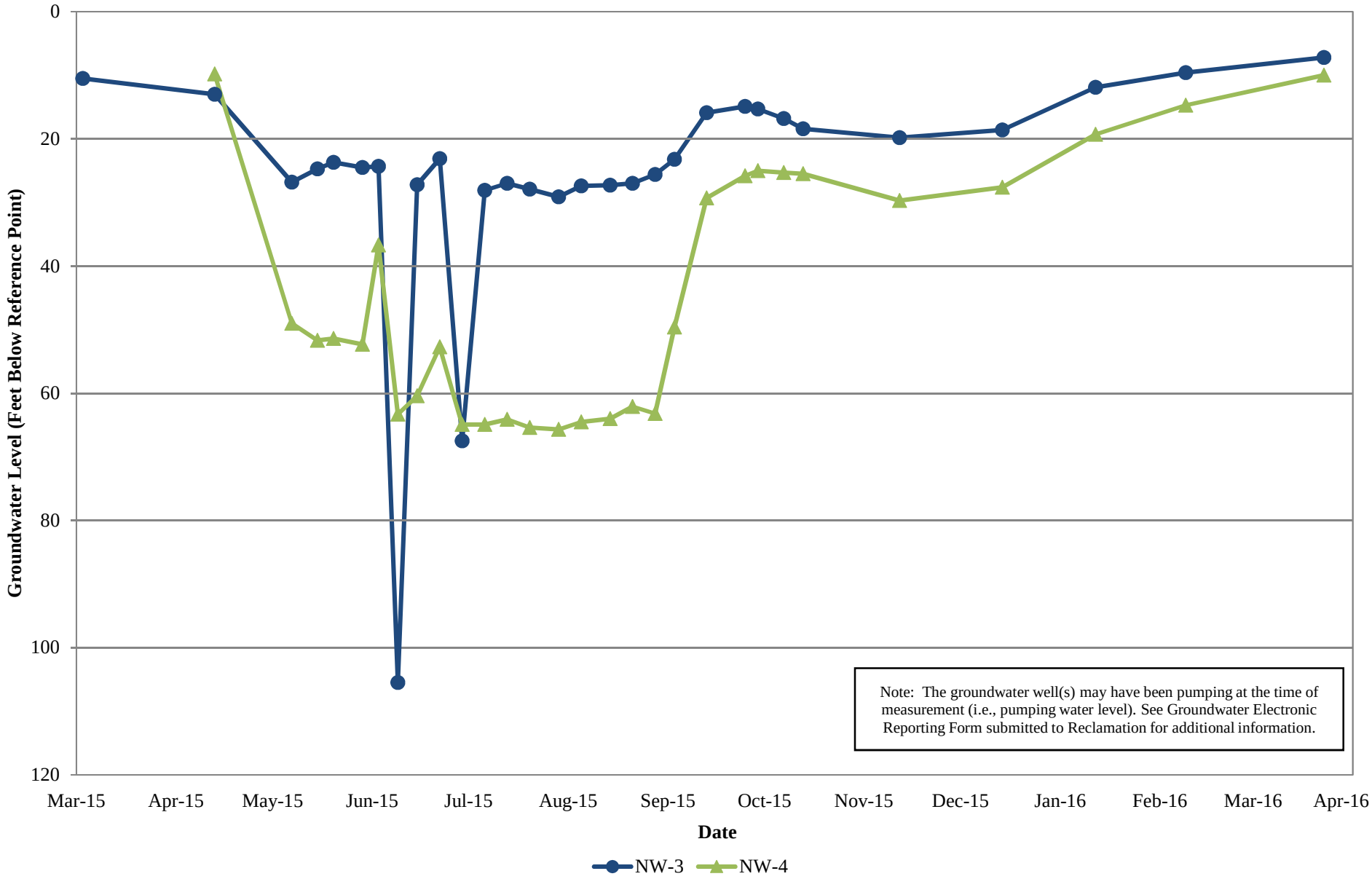
T&P Farms
DWR Monitoring Well Groundwater Level Data



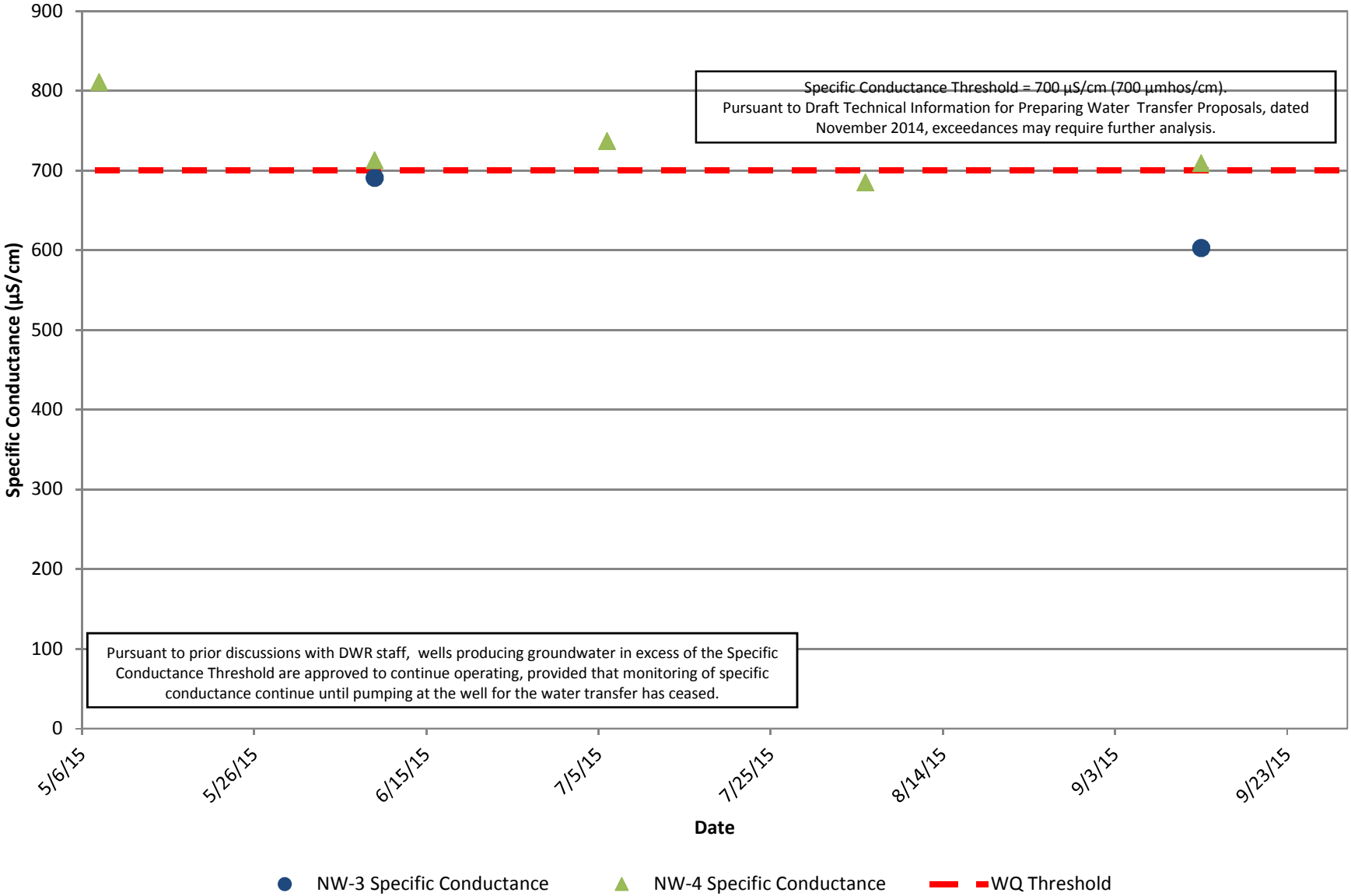
T&P Farms
Monitoring Well Groundwater Level Data

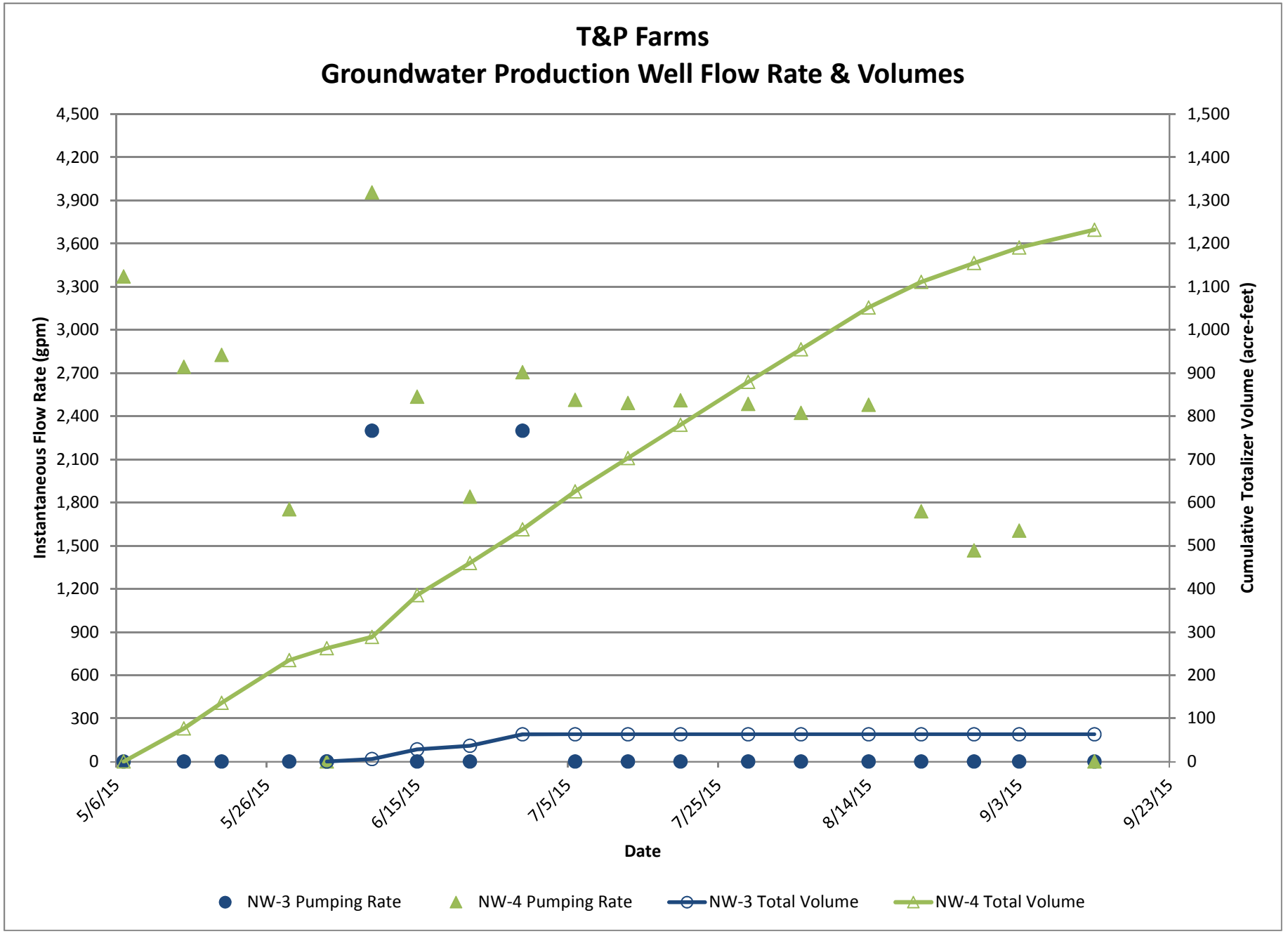


T&P Farms
Production Well Groundwater Level Data



T&P Farms
Groundwater Production Well Specific Conductance




T&P Farms
Groundwater Production Well Flow Rate & Volumes
Instantaneous Flow Rate (gpm)
Cumulative Totalizer Volume (acre-feet)
4,500
4,200
3,900
3,600
3,300
3,000
2,700
2,400
2,100
1,800
1,500
1,200
900
600
300
0
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
5/6/15
5/26/15
6/15/15
7/5/15
7/25/15
8/14/15
9/3/15
9/23/15
Date
NW-3 Pumping Rate
NW-4 Pumping Rate
NW-3 Total Volume
NW-4 Total Volume

Te Velde Revocable Family Trust

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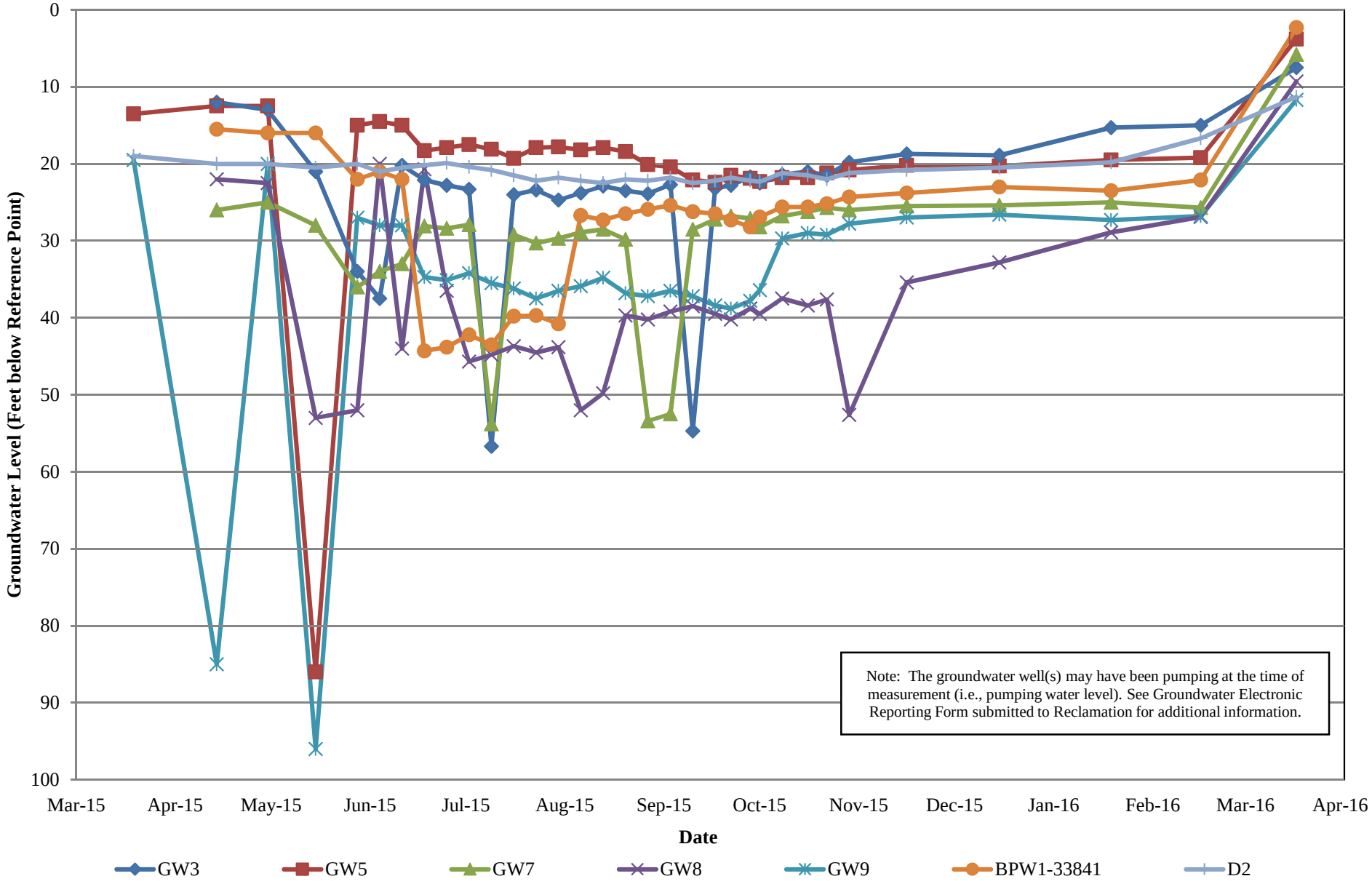
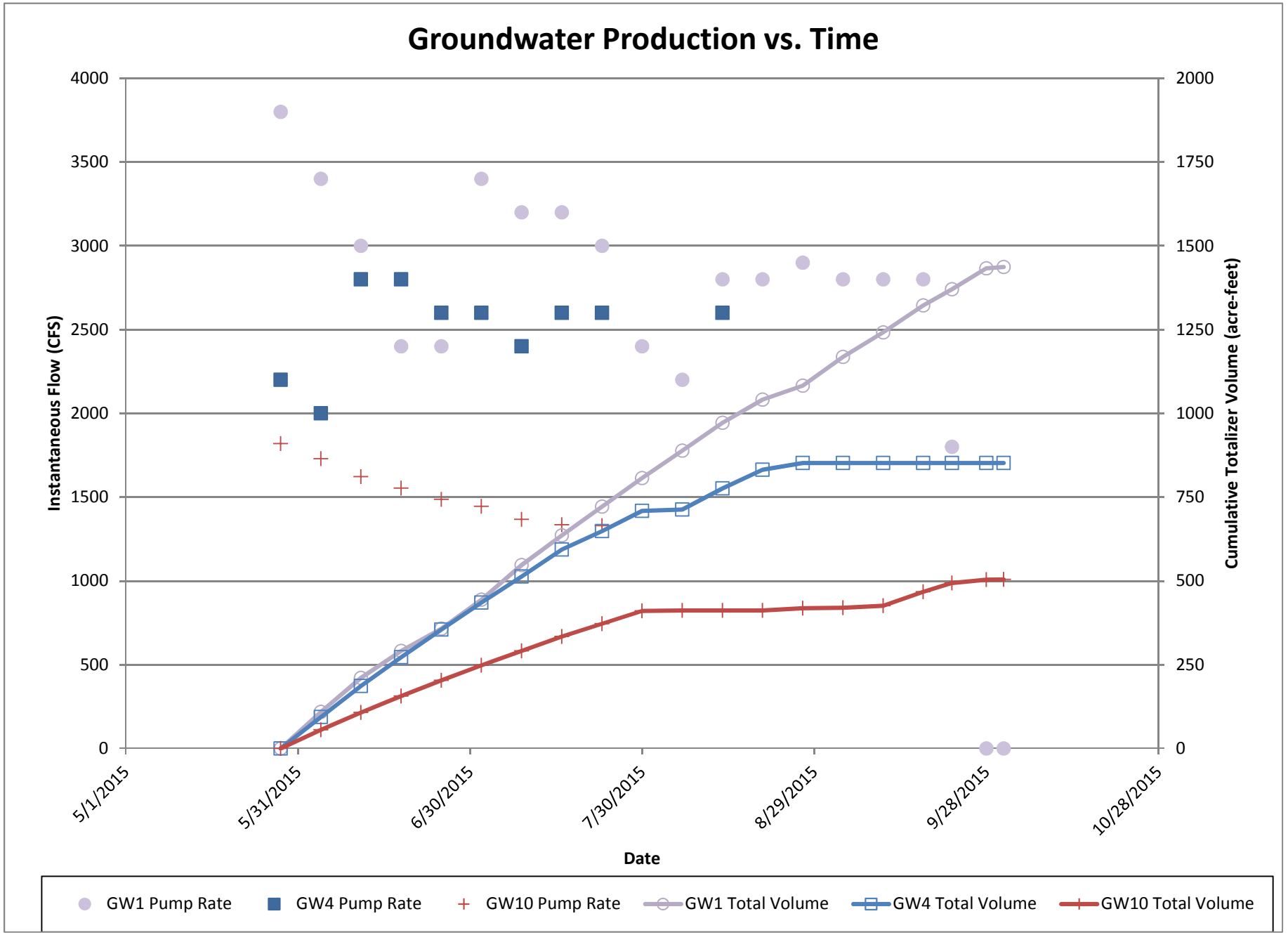
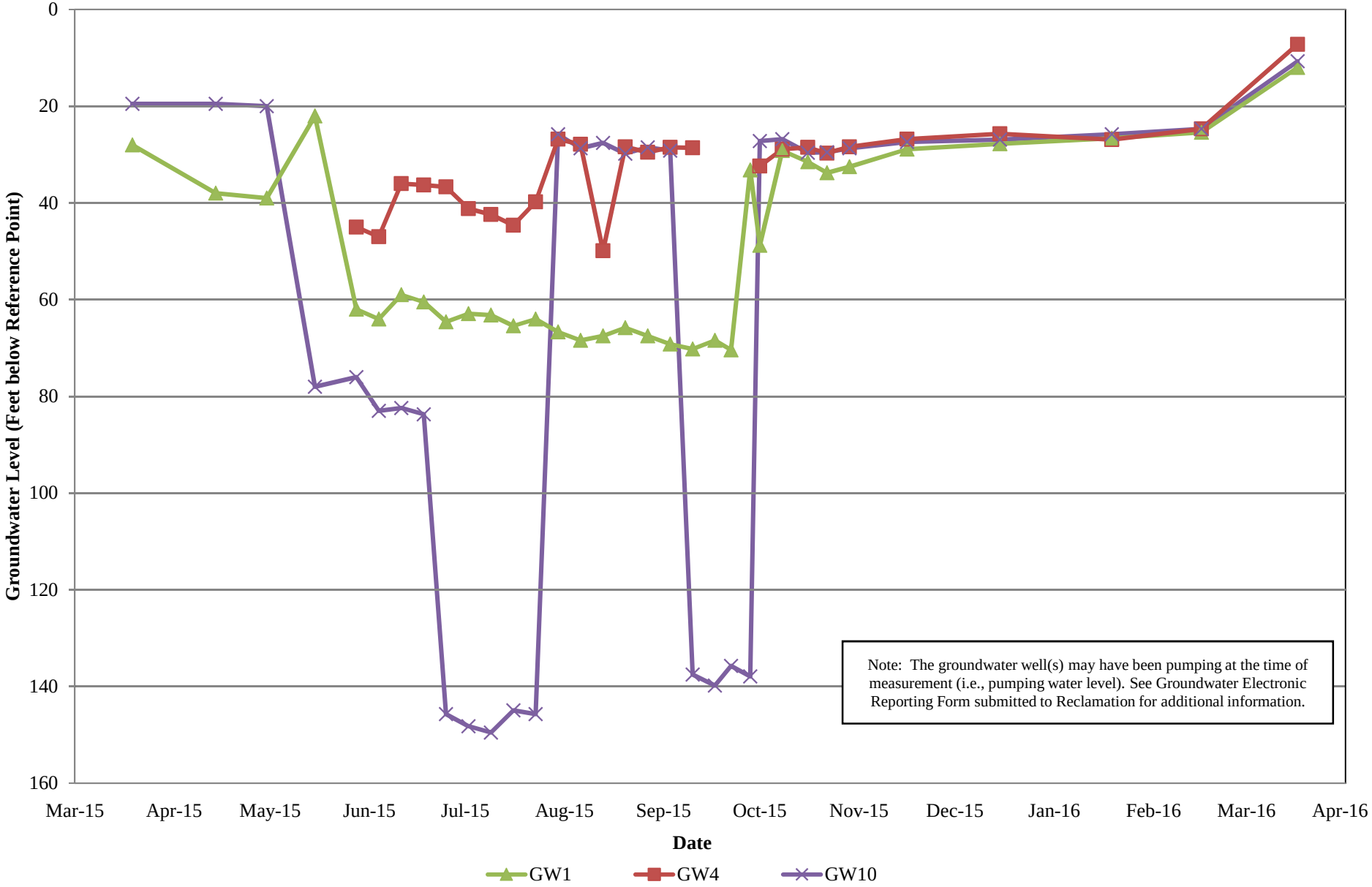
Te Velde Revocable Family Trust
Monitoring Well Groundwater Level Data

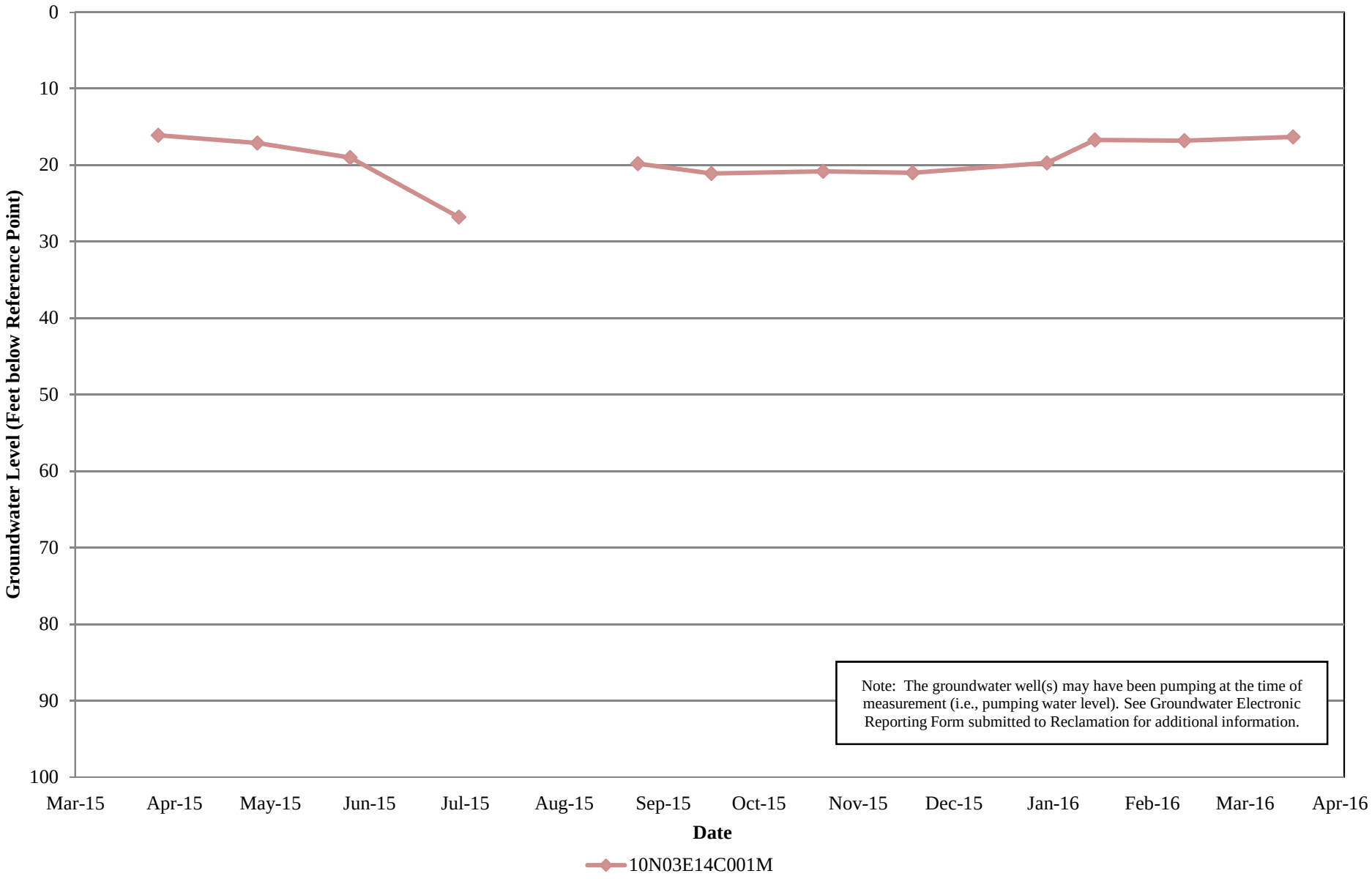


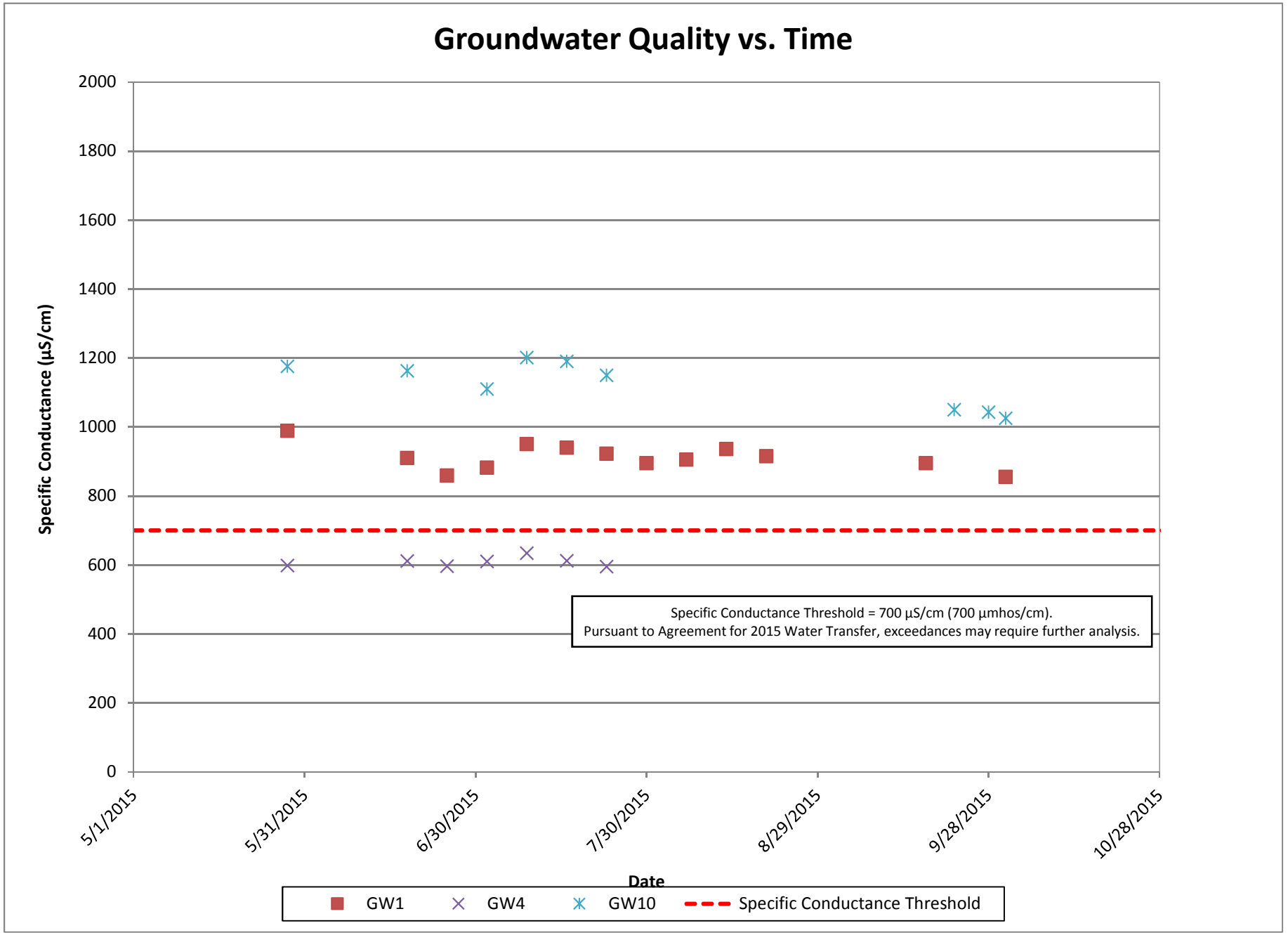

Groundwater Production vs. Time
Instantaneous Flow (CFS)
Cumulative Totalizer Volume (acre-feet)
4000
3500
3000
2500
2000
1500
1000
500
0
2000
1750
1500
1250
1000
750
500
250
0
5/1/2015
5/31/2015
6/30/2015
7/30/2015
8/29/2015
9/28/2015
10/28/2015
Date
GW1 Pump Rate
GW4 Pump Rate
GW10 Pump Rate
GW1 Total Volume
GW4 Total Volume
GW10 Total Volume

Te Velde Revocable Family Trust
Production Well Groundwater Level Data



Te Velde Revocable Family Trust
DWR Monitoring Well Groundwater Level Data




Groundwater Quality vs. Time
Specific Conductance (µS/cm)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
5/1/2015
5/31/2015
6/30/2015
7/30/2015
8/29/2015
9/28/2015
10/28/2015
Date
Specific Conductance Threshold = 700 µS/cm (700 µmhos/cm).
Pursuant to Agreement for 2015 Water Transfer, exceedances may require further analysis.
GW1
GW4
GW10
Specific Conductance Threshold

Appendix J

Cumulative Projects

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Appendix J Cumulative Projects

This appendix provides an analysis of overall cumulative effects of the Proposed Action taken together with other past, present, and reasonably foreseeable probable future projects (or actions) as required by NEPA implementing regulations (40 CFR, Section 1508.7) and CEQA Guidelines (14 CFR, Section 15130). The reasonably foreseeable probable future actions considered in this cumulative effects analysis are actions located within the Seller Service Area that have been identified as potentially having an effect on resources that also may be affected by the Proposed Action. This analysis follows applicable guidance provided by the CEQ in *Considering Cumulative Effects under the National Environmental Policy Act* (1997) and *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (*2005).

J.1 Cumulative Projects

The cumulative analysis considers other potential water transfers that could occur in the 2021 transfer season, including other CVP water transfers, non-CVP water transfers, and additional water transfers. No construction projects within the Seller Service Area were analyzed. Table J-1 lists potential sellers, including those in the Proposed Action, that have indicated interest or have provided water for transfer in the past, including:

- Potential transfers from sellers in the Sacramento River, American River, Yuba River, and north-westerly Delta areas. The majority of these potential sellers, which include the sellers in the Proposed Action, were evaluated in the Long-Term Water Transfers EIS/EIR and subsequent Long-Term Water Transfers Revised DEIR/Supplemental DEIS prepared by SLDMWA and Reclamation that analyzed potential CVP-related transfers from 2019 to 2024. Additional sellers in the Sacramento River area not evaluated in the EIS/EIR have indicated interest in selling water in 2021 and are also included in Table J-1.

- Potential transfers from sellers in the Feather River Region from entities holding settlement agreements with DWR that could make surface water available for CVP or SWP contractors. These transfers would be approved and facilitated by DWR.

The Lower Yuba River Accord (Yuba Accord) transfers were not included in the cumulative condition analysis in Section 3 because water would be made available for transfer in a different geographical area than the Proposed Action. The Yuba Accord provides for both stored water and groundwater substitution transfers ranging from 60,000 AF per year and up to an additional 140,000 AF for state and federal contractors in drier years. From 2007 through 2014, Yuba Accord transfers averaged approximately 129,000 AF. Transfers under the Yuba Accord historically account for a large portion of the DWR approved water transfers and represented 73 percent of the DWR approved transfers in 2015 (DWR 2015). Water made available for transfer through groundwater substitution actions under the Yuba Accord would occur in the North Yuba and South Yuba subbasins and would not affect groundwater levels near the Proposed Action.

J.1.1 Potential transfers analyzed in the cumulative analysis

The cumulative analysis considers other CVP and non-CVP water transfers that could occur in addition to the Proposed Action. Methods of making water available for transfer under these other transfers could include cropland idling and groundwater substitution (the same as described for the Proposed Action). Other methods of making water available for transfer could also include conservation, where a seller takes a conservation action to reduce irrecoverable water losses, and stored reservoir water releases, which includes releases of water that would have remained in storage in non-CVP or SWP reservoirs absent the transfer action.

Water made available for transfer, shown in Table J-1, could be sold to multiple agencies, including, TCCA, East Bay Municipal Utility District (MUD), SWP contractors receiving water from the North Bay Aqueduct, and south of Delta buyers, including SLDMWA and Metropolitan Water District of Southern California. Unlike transfers of water to TCCA and East Bay MUD that would be diverted off the Sacramento River, transfers of water to south of Delta buyers would be exported through the Delta via Banks or Jones Pumping Plants.

Table J-1. Potential Sellers Analyzed in the Cumulative Analysis (Upper Annual Transfer Volume Limits)

Water Agency	Groundwater Substitution[1] (AF)	Cropland Idling/ Crop Shifting[1] (AF)	Stored Reservoir Release[1] (AF)	Conservation[1] (AF)	Maximum Potential Transfer (AF)
Sacramento River Area					
Anderson-Cottonwood Irrigation District	5,225				5,225
Baber, Jack, et al.		2,310			2,310
Canal Farms	1,000	635			1,635
Conaway Preservation Group	35,000	21,349			35,000
Cranmore Farms (Pelger Road 1700 LLC)	8,000	2,500			8,000
Eastside Mutual Water Company	2,230				2,230
Giusti Farms	1,000				1,000
Glenn-Colusa Irrigation District	25,000	66,000			91,000
Henle Family Limited Partnership	700				700
Maxwell Irrigation District	3,000	5,000			8,000
Natomas Central Mutual Water Company	30,000				30,000
Pelger Mutual Water Company	4,670	2,538			4,670
Pleasant Grove-Verona Mutual Water Company	18,000	9,000			18,000
Princeton-Codora-Glenn Irrigation District	6,600	6,600			12,100
Provident Irrigation District	10,000	9,900			16,900
Reclamation District 108	15,000	20,000			35,000
Reclamation District 1004	7,175	12,500			19,675

Water Agency	Groundwater Substitution[1] (AF)	Cropland Idling/ Crop Shifting[1] (AF)	Stored Reservoir Release[1] (AF)	Conservation[1] (AF)	Maximum Potential Transfer (AF)
River Garden Farms	10,000	10,000			16,000
Sutter Mutual Water Company	18,000	18,000			18,000
Sycamore Mutual Water Company	15,000	10,000			20,000
T&P Farms	1,200	890			1,200
Te Velde Revocable Family Trust	7,094	6,975			7,094
Windswept Land & Livestock	2,000				2,000
American River Area					
City of Sacramento	5,000				5,000
Placer County Water Agency			47,000		47,000
Sacramento County Water Agency	15,000				15,000
Sacramento Suburban Water District	30,000				30,000
Yuba River Area					
Browns Valley Irrigation District			5,000	3,100	8,100
Cordua Irrigation District	12,000				12,000
Feather River Area					
Butte Water District	5,500	11,500			17,000
Garden Highway Mutual Water Company	14,000				14,000
Gilsizer Slough Ranch	3,900				3,900
Goose Club Farms and Teichert Aggregates	10,000	10,000			10,000
South Sutter Water District			15,000		15,000
Tule Basin Farms	7,320				7,320
Biggs-West Gridley Water District[2]		32,190			32,190
Richvale Irrigation District[2]		22,345			22,345
Plumas Mutual Water Company[2]	5,000	1,750			4,550
South Feather Water and Power[2]			10,000		10,000
Sutter Extension Water District[2]	4,000	11,000			15,000
Western Canal Water District[2]		37,655			37,655
Total	**337,614**	**330,637**	**77,000**	**3,100**	**661,799**

Notes:

[1] These totals cannot be added together. Agencies could make water available through groundwater substitution, cropland idling, or a combination of the two; however, they will not make the full quantity available through both methods. The last column reflects the total upper limit for each agency and will not equal the sum of all the individual transfer quantities for each agency.

[2] Entity holds Settlement Agreement with DWR.

Table J-1 lists the transfer method and associated maximum annual transfer quantity potentially available from each seller. The actual quantity of water transferred in a given year, as evidenced by

past dry years, is less than the totals shown in Table J-1 and depends on a number of factors, including hydrologic conditions and available conveyance capacity. Cross Delta transfers to south-of-Delta buyers require pumping at the CVP and SWP south Delta export facilities and historically account for the majority of the transfers from sellers listed in Table J-1. Table J-2 lists the total quantities of cross Delta transfers from 2009 to 2015 that ranged from zero to 414,629 AF from 2009 through 2015, or approximately zero to 55 percent of the maximum total shown in Table J-1. In 2014, Sacramento Valley sellers transferred 35,446 AF to TCCA Member Units. In 2015, TCCA Member Units used 23,997 AF of transfer water from Settlement Contractors. TCCA did not engage in water transfers in 2016 – 2020, and cross-Delta water transfers were not implemented.

Table J-2. Historic Cross Delta Water Transfers (2009 – 2015)

Year	Total Acre-Feet
2009	274,551
2010	264,165
2011	0
2012	84,781
2013[1]	351,515
2014[1]	414,629
2015[1]	262,466

Source: DWR and SWRCB 2015

Notes:

[1] Data for 2013, 2014 and 2015 are for quantities made available North of the Delta and include Streamflow Depletion losses (where applicable) but do not include carriage water losses across the Delta. Cross Delta water transfers using facilities operated by DWR in 2014 and 2015 were 305,699 AF and 104,348 AF respectively and Reclamation 73,930 AF and 157,018 AF respectively.

Transfers originating from the Sacramento Valley represent a small portion of the Sacramento Valley's overall water supply. In addition to the transfers described in Table J-1, TCCA may also engage in "Project Water" transfers under the Central Valley Project Improvement Act section 3405(a)(1)(M). Transfers or exchanges of Project Water for contract years 2021 through 2025 are expected to be covered by the Reinitiation of Consultation on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project (Reclamation 2019). The EA identified no effect to biological resources and potentially small, beneficial effects to other resources. Because these transfers would not have adverse effects, they are not included in the cumulative conditions analysis in Section 3.

J.1.2 Voluntary Agreements

On December 12, 2018, the State Water Resources Control Board (Board) adopted Resolution 2018-0059, approving an update to the Bay-Delta Water Quality Control Plan (Bay-Delta Plan). The agreement included flow and non-flow measures to improve water quality in the Bay-Delta watershed to support viability of native fishes. On March 1, 2019, several parties, including the Sacramento River Settlement Contractors, entered into the "*Planning Agreement Proposing Project Description and Procedures for the Finalization of the Voluntary Agreements to Update and Implement the Bay-Delta Water Quality Control Plan* (Planning Agreement).

The flow measures discussed in the Planning Agreement provide instream flows above existing conditions and in a manner that: (a) does not conflict with the requirements of the Sustainable

Groundwater Management Act and (b) maintains reliability of water supply for other beneficial uses, including designated wildlife refuges. These flows above existing conditions will be generated through land fallowing, reservoir reoperation and/or demand reduction, and limited use of groundwater substitution. Table J-3 shows the flow contributions from the Sacramento River watershed.

Table J-3. Contribution of Flow to the Voluntary Agreement in the Sacramento River Watershed

Tributary	Season	Source	Application[2]	Flow Contributions (in TAF)				
				C	D	BN	AN	W
Sacramento	Spring or summer[1]	Land fallowing	Block		100	100	100	
Feather	Spring or summer [1]	Land fallowing	Block		50	50	50	
Yuba	Assume spring likely [1]	Reservoir storage	Block		50	50	50	
American	Spring	Groundwater substitution	Hybrid	10	10			
		Reservoir storage				10	10	
		Reservoir storage and/or groundwater substitution			10			
		Reservoir storage and/or groundwater substitution		20	20			

Key: TAF – Thousand acre-feet
Notes:
[1] Flow represents an instream target, Blocks can be scheduled within constraints, and Hybrid represents a combination.
[2] Subject to coordination with California Department of Fish and Wildlife (DFW) (Yuba) or fisheries agencies (Sacramento, Feather)

J.1.3 Coordinated Operations Agreement

Reclamation and DWR would continue to operate their respective facilities in accordance with the Agreement between the United States and the State of California for Coordinated Operation of the Central Valley Project and the State Water Project executed in 1986 (Coordinated Operations Agreement, hereinafter referred to as COA). The COA defines the project facilities and their water supplies, sets forth procedures for coordinating operations, and identifies formulas for sharing joint responsibilities for meeting Delta standards and other legal uses of water. COA further identifies how unstored flow is shared, sets up a framework for exchange of water and services between the projects, and provides for periodic review of the agreement.

Implementation of the COA principles has evolved since 1986, as changes have occurred to CVP and SWP facilities, operating criteria, and overall physical and regulatory environment. For example, updated water quality and flow standards adopted by the State Water Resource Control Board (SWRCB), CVPIA, and Endangered Species Act (ESA) responsibilities have affected both CVP and SWP operations. The 1986, COA incorporated the SWRCB Water Right Decision 1485 (D-1485) provisions regarding Delta salinity, outflow, and export restrictions. D-1485 included

implementation provisions for the Bay-Delta Water Quality Control Plan (WQCP) that was current at the time, but has since been updated with Water Right Decision 1641 (D-1641). COA envisioned and provided a methodology to incorporate future regulatory changes, such as Delta salinity requirements, but did not explicitly envision or address sharing of export restrictions. D-1641 and the 2008 U.S. Fish and Wildlife Service (USFWS) Biological Opinion (BO) and 2009 National Marine Fisheries Service (NMFS) BO included various export restrictions not explicitly addressed in the 1986 COA. However, the available export capacity as a result of these export restrictions was shared between the CVP and the SWP in absence of a formal update to the COA.

In 2018, Reclamation and DWR amended four key elements of the COA to address changes since the COA was signed: (1) in-basin uses, (2) export restrictions, (3) CVP use of Banks Pumping Plant up to 195,000 acre-feet per year (AFY), and (4) periodic review. The COA sharing percentages for meeting Sacramento Valley in-basin uses now vary from 80 percent responsibility of the United States and 20 percent responsibility of the state of California in wet year types to 60 percent responsibility of the United States and 40 percent responsibility of the state of California in critical year types. In a dry or critical year following two dry or critical years, the United States and state of California will meet to discuss additional changes to the percentage sharing of responsibility to meet in-basin uses. When exports are constrained and the Delta is in balanced conditions, Reclamation may pump up to 65 percent of the allowable total exports with DWR pumping the remaining capacity. In excess conditions, these percentages change to 60/40. The COA defines balanced conditions as periods when it is agreed that releases from upstream reservoirs plus unregulated flow approximately equal the water supply needed to meet Sacramento Valley in-basin uses, plus exports. The COA defines excess conditions as periods when it is agreed that releases from upstream reservoirs plus unregulated flow exceed Sacramento Valley in-basin uses, plus exports.

J.2 References

California Department of Water Resources (DWR). 2015 Transfers Requiring Use of DWR Facilities. Updated October 5, 2015. Available at: http://www.water.ca.gov/watertransfers/docs/Transfer_Proposals.pdf [Accessed on December 10, 2020].

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