the adjacent levee, a 6-foot-deep inspection trench would be excavated, with the purpose of exposing or intercepting any undesirable underground features such as old drain tile, water or sewer lines, other debris, animal burrows, buried logs, or pockets of unsuitable material (e.g., sand lenses). After inspection, the trench would backfilled and compacted as part of the embankment construction. The material from the inspection trench would be stockpiled and used either in the adjacent setback levee or the seepage berm.

- **Construction of adjacent levee, cutoff walls, and seepage berms:** Borrow material would be delivered to the levee construction sites by scrapers or haul trucks where it would be spread by motor graders and compacted by sheepsfoot rollers to build the adjacent levee. In those areas where a cutoff wall is required, the adjacent levee would be built up to a height equal to about one-third of the height of the proposed levee. This would create a working platform for cutoff wall installation using an excavator with a long-stick boom capable of digging a trench to a maximum depth of approximately 85 feet. Bentonite slurry would be pumped into the trench during excavation to prevent caving. The soil excavated from the trench would be mixed with bentonite and backfilled into the trench to create the cutoff wall. The working platform would also be used for cutoff wall installation using a DSM or TRD machine capable of injecting and mixing cement and/or bentonite slurry with the soil simultaneously to a maximum depth of approximately 115 feet. For construction of seepage berms, borrow material would be spread and compacted. However, in areas where seepage berms are extended as a protective cap over cultural resources, special equipment handling methods would be employed, to minimize compaction of the subsurface.

- **Installation of relief wells and monitoring wells:** Between Station 258+00 and Station 293+50 (approximately from Elverta Road to Teal Bend Golf Club), relief wells may be installed adjacent to the seepage berms. Relief wells would be spaced at 60- to 100-foot intervals approximately 20 feet beyond the toe of the berm. However, in areas where seepage berms are extended as a protective cap over cultural resources, no relief wells would be installed, and any monitoring wells or trenches would be located outside of the affected project area.

- **Reconstruction of Garden Highway at intersections:** The Garden Highway intersections at West Elverta Road, West Elkhorn Boulevard, and North Bayou Road would require reconstruction to accommodate the raised adjacent setback levee. It is anticipated that Garden Highway would be extended up and onto the widened adjacent levee at these locations to meet with the secondary roads. Approach embankments at the intersections would be enlarged and the entire intersections would be repaved. The intersecting roads would be raised at a slope of 15H:1V, extending the approach embankment approximately 500 feet outward from the levee. The side slopes of the raised embankments would be at a 3H:1V or 2H:1V slope depending on embankment soil type. Traffic control measures and detours would be required.

- **Installation of surface drainage outlets across Garden Highway:** The portion of levee between the adjacent setback levee and the Garden Highway pavement would include new storm drainage collection facilities to convey surface water beneath Garden Highway and toward the Sacramento River. A grassed surface collection system (drainage swale) would convey runoff water to drop inlets, and new pipe laterals would convey the water beneath Garden Highway to new outfalls in the berm along the east bank of the Sacramento River. In most locations, the outfalls would be placed above the ordinary high water line. The location of the cross culverts would be selected to minimize impacts on existing residential properties and would be located along property lines where feasible. These discharge pipes would require minor landscape improvements to prevent erosion and ensure that applicable water quality standards are met. Rock slope protection (riprap) would be installed to prevent erosion. Excavation of a trench to install the culvert piping across Garden Highway would be required, and those segments where excavation occurs would have to be reconstructed. Single-lane traffic controls and through-traffic detours would be required.

- **Site restoration and demobilization:** Upon completion of construction activities, the levee slopes and the tops of the seepage berms would be hydroseeded. An aggregate base road would be constructed on the crown of the new levee. Any construction debris would be hauled to an appropriate waste facility. Equipment and

materials would be removed from the site, and staging areas and any temporary access roads would be restored to preproject conditions. Demobilization would likely occur in various locations as construction proceeds along the proposed levee alignment.

- **Reclamation of borrow areas:** The borrow sites (mainly the Airport north bufferlands) would be finished graded and planted with grasses after the completion of borrow activities (see "Borrow Sites Reclamation" and **Table H-15**, below, for more details).

Table H-2 shows the quantity of each fill type needed, for a total of 1,785,000 cubic yards (cy) of soil, and 38,500 tons of aggregate base and asphalt concrete. The random fill quantity includes a 25% shrinkage replacement factor to account for volume loss during placement. Note that for some locations, it may be possible to use a scrape-and-place method that would reduce the need for haul trucks. Potential haul routes from the borrow sites to the Sacramento River east levee work area for the Phase 3 Project are shown in **Plate H-2**. The primary haul routes would include Riego Road, West Elverta Road, West Elkhorn Boulevard, and various off-road haul routes.

Table H-2
Quantities of Fill Required for Proposed Improvements to the Sacramento River East Levee in Reaches 5A–9B

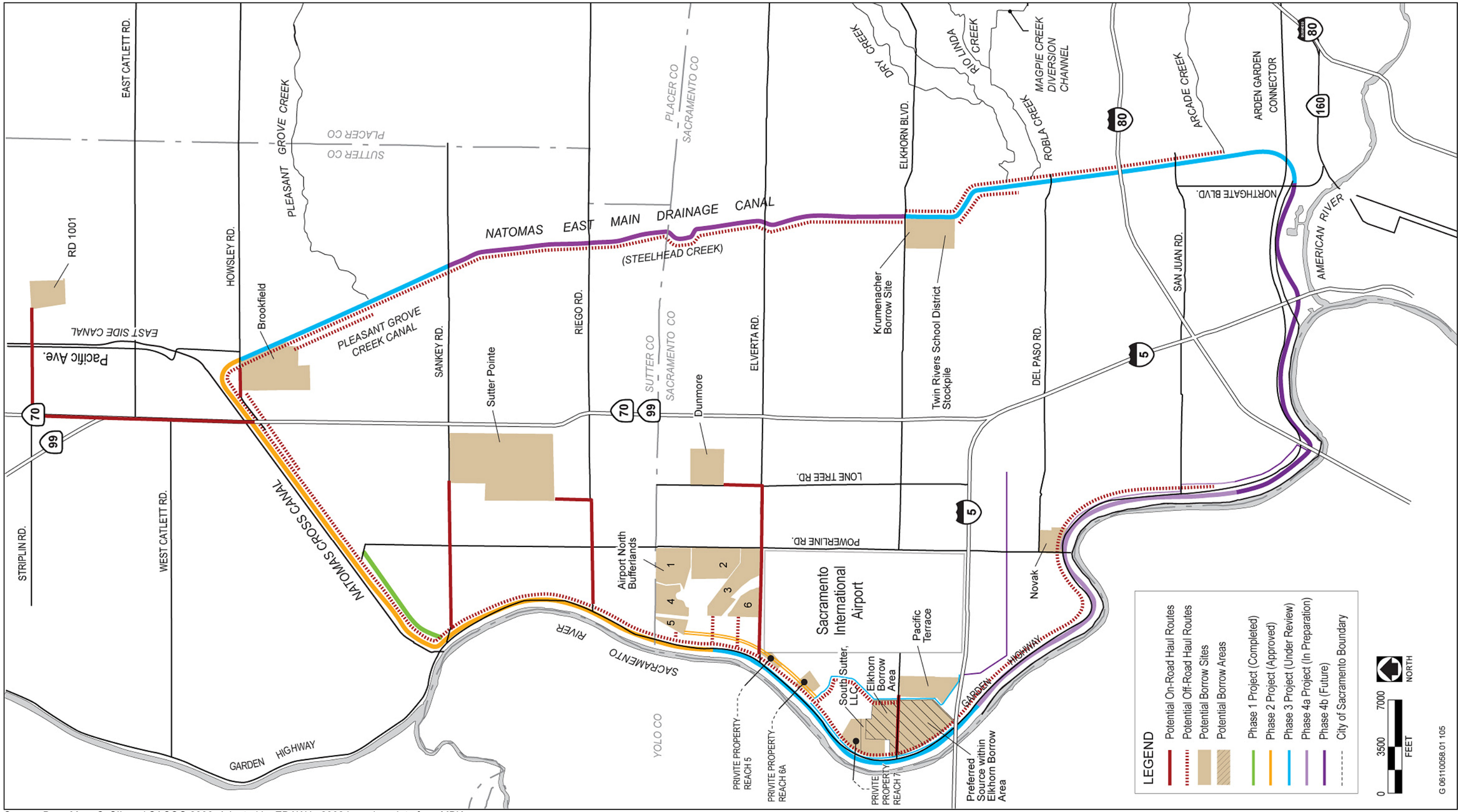
Material Type	Quantity
Soil type 1—select fill	522,000 cy
Soil type 2—random fill	1,039,000 cy
Reusable fill	120,000 cy
Stability berm excavation	104,000 cy
Aggregate base	34,000 tons
Asphalt concrete	4,500 tons
Total	**1,785,000 cy/38,500 tons**

cy = cubic yards
Source: Data provided by HDR in 2008 and compiled by EDAW in 2008

Delivery of the material listed in **Table H-2** would require as many as 900–1,000 haul trips per day during construction of the Phase 3 Project. These estimates are based on the assumption that the work would be done in a 6-month construction period with 140 out of the 156 working day window being used to haul material. These estimates are based on conservative assumptions of truck capacities of 15 cubic yards and 24 tons and the use of haul trucks for moving all borrow material from the Airport north bufferlands (rather than a combination of haul trucks and scrapers). **Table H-3** presents the anticipated construction equipment and duration for the Sacramento River east levee Reaches 5A–9B improvements.

2.3 GARDEN HIGHWAY CLOSURE DURING CUTOFF WALL CONSTRUCTION

For the Proposed Action, the Garden Highway at the I-5 Bridge would be closed for a period of approximately 8 to 12 weeks. The Elkhorn Boat Launch Facility (a public boat ramp, dock, and picnic area operated by Sacramento County) would require closure for approximately 8 to 12 weeks, likely through the summer months, while levee improvements are constructed at the I-5 Bridge. Construction would generally consist of closing the Garden Highway between stations 437+00 to 447+00, which is beneath I-5 and about 500 feet upstream and downstream. The roadway embankment would be degraded to within about 5 feet of the adjacent ground. The cutoff wall would then be constructed along the Garden Highway at this location, and would be tied into the



Source: Base Map: CaSIL and SACOG 2006; Adapted by EDAW in 2008 based on data from MBK

NLIP Construction Phasing and Anticipated Haul Routes from Soil Borrow Areas

Plate H-2

Table H-3
Anticipated Construction Equipment and Duration for Proposed Improvements to the Sacramento River East Levee in Reaches 5A–9B

Construction Phase	Equipment Type and Number of Each Type	Duration (Days)
Mobilization	–	27
Site preparation (tree removal, clearing, grubbing, stripping)	Scrapers (2)	27–54
	Front-end loaders (2)	27–54
	Crawler/tractors (tree pushers) (2)	27–54
	Water trucks (1)	27–54
	Motor graders (2)	27–54
	Chippers/grinders (2)	27–54
	Haul trucks (5)	54
Relocation of canal and removal of landside structures and other facilities	Excavators (2)	48
	Haul trucks (24)	48
	Front-end loaders (1)	48
Excavation of stability berm and inspection trench	Excavators (4)	28
	Scrapers (20)	28
	Haul trucks (8)	28
	Bulldozers (2)	28
	Graders (2)	28
	Water trucks (2)	28
Construction of adjacent levee raise and seepage berms (includes borrow site activities)	Scrapers (2)	140
	Excavators (4)	140
	Front-end loaders (6)	140
	Haul trucks (14 cy) (60)	140
	Bulldozers (4)	140
	Sheepsfoot compactors (3)	140
	Motor graders (3)	140
	Water trucks (4)	140
Cutoff wall construction	Long-reach hydraulic excavators (2)	44
	Front-end loaders (2)	44
	Mixing excavators (2)	44
	Bulldozers (1)	44
	Extended-boom pallet loaders (2)	44
	300-kW generators (2)	44
	Slurry pumps (2)	44
	Pickup trucks (6)	44
	Haul trucks (2)	44
	DSM Rig (2)	44
Installation of relief wells and monitoring wells	Truck-mounted auger (2)	30
	Support trucks (3)	30
	Cement trucks (2)	30
Reconstruction of Garden Highway at two intersections	Backhoes (2)	27
	Smooth drum compactors (2)	27
	Asphalt pavers (1)	27
	Haul trucks (6)	27
	Striping trucks (1)	27
	Truck-mounted augers (1)	27
Installation of surface drainage outlets across Garden Highway	Backhoes (2)	27
	Front-end loaders (2)	27
	Concrete trucks (3)	27
	Roller compactors (2)	27
	Asphalt paver (1)	27
	Haul truck (1)	27
Site restoration and demobilization	Hydroseeding trucks (3)	34
	Water trucks (4)	34
	Haul trucks (3)	34

Source: Data provided by HDR in 2008 and compiled by EDAW in 2008

adjacent levee alignment. The new cutoff wall would need to settle over a period of about 3–4 weeks. North Bayou Road's intersection with the Garden Highway would remain open; however, the roadway would be unpaved (gravel). This will allow access to the two private marinas north of the public boat launch ramp to remain open. Following completion of the cutoff wall, the intersection would be rebuilt, and roadway paving would be replaced.

The Levee Raise-in-Place Alternative would require full closure and demolition of Garden Highway to construct the cutoff wall. The Garden Highway provides primary access to the waterside residences and businesses in Reaches 5A–9B. Closures would affect 1.5 to 2-mile segments of Garden Highway at any one time and the duration of closure for each segment could last for approximately 8 to 12 weeks to allow for degrading the levee, installing the cutoff wall, reconstructing the levee, and reconstructing Garden Highway. This would eliminate land-based access to residences and businesses along Garden Highway and would require that residents relocate and businesses close until access is restored. Residents and businesses with docks may be able to maintain access from the waterside of the levee. Construction of the cutoff wall in the vicinity of the I-5 Bridge would cut off land side access to the two marinas and Sacramento County's public boat launch facility for approximately 8 to 12 weeks, during the summer. This would require temporary closure of the businesses associated with the marinas (restaurants, bars, boat rentals) and the boat launch facility.

2.4 PRIVATE IRRIGATION FACILITIES

Numerous private irrigation facilities along the Sacramento River east levee between the end of the Elkhorn Canal and the beginning of the Riverside Canal (Reaches 9B–12) would be disrupted by the proposed levee improvements and would therefore be relocated as part of the Phase 3 Project. These private structures, consisting of five landside water wells and six private river pumps, service the adjacent fields for agricultural use. The water wells would be relocated outside of the flood damage reduction footprint (by drilling replacement wells and abandoning existing wells) and sited at least 100 feet off of the adjacent levee toe. The pumping plant discharge pipes through the levee would be raised, and new control valves would be added. Piping on the water side of the levee may be replaced to a point adjacent to the existing river pumps. In addition to the wells and river pumps, approximately 3,000 feet of local irrigation canals and approximately 9,400 feet of buried irrigation piping would be relocated. The private irrigation facilities would be replaced with in-kind structures compatible with the new levee footprint to prevent disruption of service in the fields.

3 PLEASANT GROVE CREEK CANAL WEST LEVEE

3.1 CUTOFF WALL CONSTRUCTION

Cutoff walls on the PGCC west levee would be constructed within the footprint of the widened levee. To provide a stable working surface for cutoff wall construction, and to mitigate potential levee through-seepage, the adjacent levee would first be constructed up to an elevation corresponding to the 100-year water surface. The working surface would be constructed by hauling earthen material to the levee from the borrow site using elevating scrapers or trucks. The material would be compacted in approximate 6-inch lifts to 90% of maximum density. The cutoff wall would then be constructed from this working surface, through the adjacent levee, to depths of up to 80 feet from the existing levee crown. The conventional, long reach excavator method would be used to construct approximately 17,400 linear feet of cutoff wall through the entire length of the PGCC.

Depending on the nature of the soils encountered during cutoff wall trench excavation, up to 40,000 cubic yards of import material may be required to supplement SB cutoff wall backfill materials.

Cutoff-wall installation for the PGCC west levee is anticipated to occur using two headings in back-to-back 12-hour work shift, with a total of 22 crew members. 24-hours-per-day operations would be needed to complete work before the flood season. Generally, a 6-day work week (Monday to Saturday) with maintenance on Sunday is

expected, with a total of 50 working days to complete cutoff wall installation. **Table H-4** presents the anticipated construction equipment and duration for PGCC west levee cutoff wall construction.

3.2 LEVEE RAISING, SLOPE FLATTENING, AND WIDENING

Levee raising, slope flattening, and widening along the PGCC west levee is anticipated to require 475,000 cubic yards of import material (including material as described above to construct a cutoff wall working platform). This material is anticipated to be hauled from the Brookfield borrow site using elevating scrapers for the majority of the PGCC west levee. Where the haul distance exceeds the economical range for elevating scrapers (approximately 1 mile for a one-way trip), hydraulic excavators and off-road dump trucks would be used to load and haul import material. **Table H-4** presents the anticipated construction equipment and duration for PGCC west levee widening and slope flattening. This work is expected to involve 15–20 people working a single, 12-hour work shift 6 days a week.

3.3 TOTAL BORROW, HAULING, AND DELIVERIES

The total borrow quantity for the PGCC west levee is 490,000 cy. This earthwork estimate contains a 25% shrinkage replacement factor. In addition, regular deliveries of bentonite would be made to the project site (two deliveries for each week of cutoff wall construction). Regular deliveries would include equipment haul-in and haul-off (two for each unique item listed in **Tables H-4** and **H-5**), and miscellaneous deliveries including erosion control materials.

Table H-4
Anticipated Construction Equipment and Duration for Construction of the PGCC West Levee Cutoff Wall

Construction Phase	Equipment Type and Number of Each Type	Duration (Days)
[1] Clearing and grubbing/stripping	Elevating scrapers (8)	10
	Water trucks (2)	10
	Front-end loaders (4)	10
	Haul trucks (15)	10
	Pickup trucks (5)	10
[2] Borrow site preparation (concurrent with [1])	Elevating scrapers (4)	5
	Water truck (1)	5
[3] Working surface construction (follows [2])	Scrapers (15)	50
	Water trucks (2)	50
[3] Cutoff-wall construction (lags [2] by 14 days)	Long-reach hydraulic excavators (2)	75
	Hydraulic excavators (2)	75
	Front-end loaders (2)	75
	Extended-boom pallet loader (1)	75
	300-kW generators (2)	75
	Slurry pumps (2)	75
	Pickup trucks (5)	75
	Haul trucks (3)	75
[4] Demobilization/cleanup (follows [3])	Water trucks (2)	12
	Hydroseeding trucks (2)	12
	Extended-boom pallet loader (1)	12
	Haul trucks (2)	12

Note: PGCC = Pleasant Grove Creek Canal
Source: Data provided by Wood Rodgers in 2008 and compiled by EDAW in 2008

Table H-5
Anticipated Construction Equipment and Duration for Widening and Slope Flattening of the PGCC West Levee

Construction Phase	Equipment Type and Number of Each Type	Duration (Days)
[1] Clearing and grubbing/stripping	Elevating scrapers (14)	30
	Water truck (2)	30
	Front-end loader (3)	30
	Haul trucks (10)	30
	Pickup trucks (4)	30
[2] Levee raising/slope flattening/widening	Dozer (2)	85
	Loader (2)	85
	Water trucks (2)	85
	Sheepsfoot rollers (3)	85
[3] Borrow site excavation (concurrent with [2])	Excavators (2)	85
	Dozer with ripper (2)	85
	Water truck (2)	85
	Elevating scrapers (17)	85
	Haul trucks (5)	85
[4] Finish grading (follows [3])	Motor graders (3)	10
	Water trucks (2)	10
	Hydraulic excavators (2)	10

Note: PGCC = Pleasant Grove Creek Canal
Source: Data provided by Wood Rodgers in 2008 and compiled by EDAW in 2008

3.4 PRIVATE IRRIGATION FACILITIES

Numerous private irrigation facilities along the PGCC west levee would be disrupted by the proposed levee improvements and would be replaced as part of the Phase 3 Project. These private structures, consisting of eight landside water wells and one private river pump, service the adjacent fields for agricultural use. The water wells would be relocated outside of the flood damage reduction footprint (by drilling replacement wells and abandoning the existing wells). The river pump discharge pipes through the levee would be raised and new positive control valves added. In addition to the wells and river pump, approximately 1,900 feet of local irrigation canals and approximately 2,350 feet of buried irrigation piping would be relocated. The private irrigation facilities would be replaced with in-kind structures compatible with the new levee footprint to prevent disruption of service in the fields. In addition, some RD 1000 drainage facilities would be relocated prior to PGCC construction, including 5,900 feet of drainage canal and 750 feet of pipe.

4 NATOMAS EAST MAIN DRAINAGE CANAL WEST LEVEE

4.1 CUTOFF WALL CONSTRUCTION

A cutoff wall would be constructed along the levee to a depth of up to 80 feet from the levee crown along the NEMDC west levee between Elkhorn Boulevard and Northgate Boulevard. To provide a working platform, at a minimum, the gravel operating road surfacing would be removed and stockpiled for later reuse. East Levee Road

and Ueda Bikeway asphalt pavement would be removed for construction of the cutoff wall. Depending on the equipment used to construct the wall, the levee may be degraded between 5–10 feet to provide additional working width. From the NEMDC Stormwater Pumping Station to Northgate Boulevard, approximately 21,000 linear feet of cutoff wall would be constructed up to a depth of 80 feet. East Levee Road, including the intersection with Sorento Road, would be closed for approximately three months during construction of the cutoff wall. Alternative neighborhood access would be provided for residents north of the NEMDC Pumping Station whose driveways connect to East Levee Road. Following completion of the cutoff wall, the levee crown would be reconstructed and the operating road surface restored to gravel roadway or asphalt pavement depending on the existing road surface. This operation is anticipated to require three headings working two back-to-back 12-hour shifts per day; 24-hours-per-day operation would be required to complete the cutoff wall before the flood season. A 6-day work week (Monday through Saturday) with maintenance on Sunday is expected, with a total of 75 working days to complete cutoff wall installation. If the cutoff wall is constructed with a CB mix, up to 167,000 cy of excess soil from the excavation of the trench would be used to construct the levee improvement between Elkhorn Boulevard and the NEMDC Stormwater Pump Station.

Table H-6 presents the anticipated construction equipment and duration for NEMDC west levee cutoff wall construction.

Table H-6
Anticipated Construction Equipment and Duration for Construction of the NEMDC West Levee Cutoff Wall

Construction Phase	Equipment Type and Number of Each Type	Duration (Days)
[1] Clearing and grubbing/stripping/asphalt paving removal	Asphalt grinder (1)	2
	Elevating scrapers (15)	10
	Front-end loaders (4)	10
	Haul trucks (15)	10
	Pickup trucks (15)	10
[2] Cutoff wall construction (follows [1])	Long-reach hydraulic excavators (3)	75
	Hydraulic excavators (3)	75
	Front-end loaders (3)	75
	Extended-boom pallet loader (2)	75
	300-kW generators (3)	75
	Slurry pumps (3)	75
	Pickup trucks (6)	75
	Haul trucks (15)	75
[3] Levee crown restoration (lags [2] by 2 weeks)	Asphalt paver (1)	1
	Smooth drum rollers (2)	3
	Sheepsfoot rollers (3)	75
	Front-end loaders (3)	75
	Water truck (2)	75
	Haul trucks (3)	75
	Motor graders (3)	75
[4] Demobilization/cleanup (follows [3])	Water trucks (2)	12
	Hydroseeding trucks (2)	12
	Extended-boom pallet loader (1)	12
	Haul trucks (2)	12

Note: NEMDC = Natomas East Main Drainage Canal
Source: Data provided by Wood Rodgers in 2008 and compiled by EDAW in 2008

4.2 LEVEE RECONSTRUCTION

Levee reconstruction may be required along the NEMDC at two locations between the three planned cutoff wall locations. These two segments are about 2,000 and 5,000 feet in length. The existing levee would be removed and reconstructed within the existing footprint.

4.3 LEVEE WIDENING AND SLOPE FLATTENING

Levee widening and slope flattening work at the NEMDC west levee is scheduled to occur between Elkhorn Boulevard and the NEMDC Stormwater Pumping Station. A total of approximately 225,000 cubic yards of imported earthen material would be required. A potential borrow source at the intersection of East Levee Road and Elkhorn Boulevard (Krumenacher property or Twin River Unified School District property) has been identified as the likely source of borrow material for this segment of the project. Where levee improvements are located within 1 mile of the borrow site, elevating scrapers would likely be used to haul the material to the levee. Where the haul distance exceeds this range, hydraulic excavators and off-road dump trucks would be used to load and haul the material from the borrow site.

Table H-7 includes the anticipated construction equipment and duration for NEMDC west levee widening and slope flattening. The crew size during its peak is estimated at 20–25 people, working 10-hour shifts, 6 days a week.

Table H-7
Anticipated Construction Equipment and Duration for Widening and Slope Flattening of the NEMDC West Levee

Construction Phase	Equipment Type and Number of Each Type	Duration (Days)
[1] Clearing and grubbing/stripping	Elevating scrapers (7)	30
	Water truck (1)	30
	Front-end loader (2)	30
	Haul trucks (5)	30
	Pickup trucks (2)	30
[2] Levee raising/slope flattening/widening	Dozer (1)	85
	Loader (1)	85
	Water trucks (1)	85
	Sheepsfoot rollers (2)	85
[3] Borrow site excavation (concurrent with [2])	Excavators (2)	85
	Dozer with ripper (1)	85
	Water truck (1)	85
	Elevating scrapers (9)	85
	Haul trucks (3)	85
[4] Finish grading (follows [3])	Motor graders (2)	10
	Water trucks (1)	10
	Hydraulic excavators (1)	10

Note: NEMDC = Natomas East Main Drainage Canal
Source: Data provided by Wood Rodgers in 2008 and compiled by EDAW in 2008

One to two daily deliveries of cement and two weekly deliveries of bentonite are anticipated for cutoff wall construction. Regular deliveries would include equipment haul-in and haul-off (two for each unique item listed in **Tables H-6** and **H-7**), erosion control materials, aggregate surfacing delivery (70 deliveries), and asphalt concrete paving delivery (250 deliveries).

5 RELOCATED ELKHORN CANAL

Approximately 9,400 feet of the Elkhorn Canal would be relocated and reconstructed several hundred feet east of the landside toe of the Sacramento River east levee. The bottom of the canal would be high enough to raise irrigation water levels above the levels of adjacent fields so that these fields could be fed by gravity flow. The canal would be confined by earthen embankments designed to provide 1 foot of levee height above irrigation water operating levels. To provide for stable banks, the side slopes of the canals would be 3H:1V, 2H:1V in concrete lined areas. To control vegetation and to allow for canal maintenance with minimal disturbance of aquatic habitat along the water's edge, the canals would be concrete-lined only where existing canals are lined for Phase 3 Project improvement reaches. Generally, canals are operated with very flat slopes because of limited available elevation fall between the pumping plants and the service points. The canals also must have sufficient level-control structures (check structures) to maintain specified water levels at service points when flows are at a minimum.

5.1 ALIGNMENT

The Upper Elkhorn Canal (North Drainage Canal to Elkhorn Reservoir) was part of the Phase 2 Project. The Phase 3 Project would include relocation of the remainder of the Elkhorn Canal (Elkhorn Reservoir to just south of Elkhorn Boulevard). The proposed alignment of the new Elkhorn Canal is based primarily on the extent of the planned levee improvements. The canal was cited as close as possible to the projected toe of the new levee (with allowance made for 3H:1V or 5H:1V landside levee slopes). After this initial alignment was determined, a number of site-specific factors were considered and used to refine the alignment. The final alignment minimizes conflicts with known cultural resource sites and existing trees. Based on these site-specific factors and the variations in the proposed seepage remediation methods in different reaches, the alignment is only roughly parallel to the projected levee toe.

Approximately 25 field services (water turnout points), roadway crossings, and diversion boxes are located along the entire length of canal. The turnouts, roadway crossings, and diversion boxes would need to be replaced as part of the Proposed Action. Approximately 4,100 feet of the existing Elkhorn Canal south of the Elkhorn Reservoir sedimentation basin is concrete lined, and the remainder is earth lined.

To minimize project impacts on the Teal Bend Golf Club, the alignment of the Elkhorn Canal through the Teal Bend Golf Club would be piped (approximately 3,200 feet). Two 36-inch pipes would be aligned parallel to the levee toe landside of the flood damage reduction facility corridor (**Plate H-3**). This alignment would avoid existing golf course infrastructure to the largest extent possible. For maintenance purposes, it is assumed that parallel pipelines would be required so that flow could be maintained in one pipeline while the other is being maintained.

South of Teal Bend, the Elkhorn Canal would return to an open channel configuration aligned parallel to the toe of the new levee. The majority of this reach has a design bottom width of 3 feet, with a minimum of 1 foot of levee height and 3H:1V side slopes. A 15-foot-wide patrol road would be located on the top of the field side of the canal. The only portion of the new canal that would have a concrete lined invert would be the section where the existing canal is lined, approximately 4,100 feet. The remaining 1,300 feet of new canal would be earth lined. To reduce impacts on existing residences, a second section (approximately 950 feet through the Mortensen and Breese properties) of the Elkhorn Canal would be piped using a single 36-inch pipe.

5.2 CONSTRUCTION

Timing of the new canal construction would be critical to avoid interruptions in irrigation service. Temporary connections may need to be constructed to avoid agricultural service interruptions to adjacent properties.

Before construction, the canal right-of-way surface would be cleared and stripped to a depth of 4–6 inches, with removal of low-growing vegetation and loose surface soils. Suitable materials removed during this stage could be stockpiled. Unsuitable material would be wasted and hauled off-site. Before any excavation, utility poles in the path of the canal construction would need to be relocated. Natural gas pipelines, wells, and other gas facilities would be avoided or reconfigured in design of the Elkhorn Canal and the proposed drainage canal designed to provide both giant garter snake habitat connectivity and drainage (GGS/Drainage Canal).

During construction, borrow material from the GGS/Drainage Canal excavation would be utilized to build up the embankments of the relocated Elkhorn Canal, which would have a top elevation approximately 4 feet above the channel bottom and 3H:1V side slopes. Concrete-lined sections of the canal would utilize boom trucks and concrete pumps to apply the concrete to the bottom of the channel. Pipe sections would be constructed by excavating open trenches, laying the pipe, and backfilling to provide adequate cover material.

Up to 246,000 cubic yards of material to construct the embankments of the Elkhorn Canal would come primarily from the construction of the GGS/Drainage Canal north of I-5 with the balance obtained from the borrow sites.

New facilities that would be constructed include distribution boxes, gate valves, cast-in-place concrete headwalls and control structures, and culverts. Backhoes and excavators would be used to excavate material for the new facilities. Precast distribution boxes, pipes, and other appurtenances would be transported to the site on trucks. Other concrete facilities would be cast in place and concrete would be transported to the site in redimix trucks. Small compactors would be used to compact fill material around the facilities.

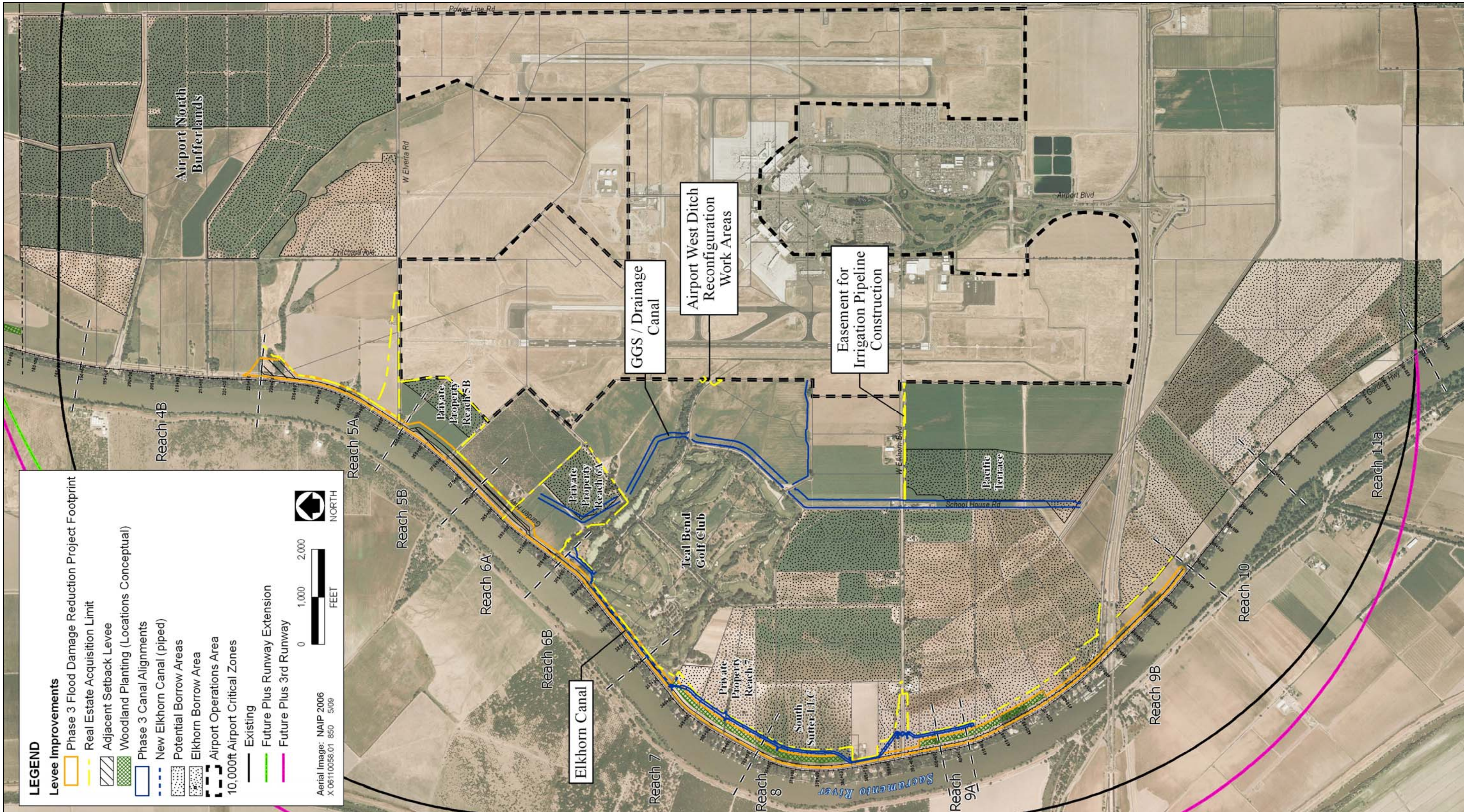
Portions of farm canals and other irrigation canals would be abandoned because of the relocation of the Elkhorn Canal. Such segments that are outside the footprint of the proposed levee improvements would be filled after the relocation of the Elkhorn Canal is completed.

Erosion control measures would be installed prior to the start of construction and maintained throughout the duration of the construction to minimize sedimentation of adjacent waterways. A hydroseeding truck would be used at the end of the construction to seed any disturbed area. Water trucks would be used throughout the construction to control dust in any disturbed areas.

Following construction, all disturbed areas would be vegetated and the construction site would be generally cleaned up including hauling off of unused and waste materials. All construction equipment would be taken off-site.

The anticipated construction labor force would consist of 15–20 people working 10-hour shifts, 6 days per week. The major construction stages are described below. The Phase 3 Project portion of the relocated Elkhorn Canal and the GGS/Drainage Canal would be constructed concurrently. This approach would facilitate the use of material from the GGS/Drainage Canal excavation for use as embankment material along the Elkhorn Canal.

Tables H-8 and **H-9** present the anticipated construction equipment and duration, and hauling requirements, respectively, for the relocated Lower Elkhorn Canal.



Source: Base Map: SACOG 2007; Adapter by EDAW in 2009 based on data from HDR and Mead & Hunt

Elkhorn Canal Alignment **Plate H-3**