

Operations and Maintenance Manual

For

Smith Canal Closure Device & Dad's

Point Levee

Stockton, California

March 2010

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1. Introduction:

1.1 Background

The Smith Canal is a backwater slough of the Sacramento-San Joaquin Delta (Delta) and is located in the city of Stockton, just north of the Deep Water Ship Channel (Figure 1). Smith Canal is leveed to prevent back-flooding from the Delta rather than to confine upland riverine flows. The Smith Canal levees are not accredited by FEMA and to provide flood protection at the Base Flood Elevation (BFE) the Smith Canal Closure Device (SCCD) is operated at the mouth of Smith Canal. The SCCD is to provide a level of protection related to the 1% occurrence in any given year or defined by FEMA as the BFE. The north bank levee of Smith Canal is maintained by Reclamation District No. 1614 (RD 1614) and the south bank levee is maintained by Reclamation District No. 828 (RD 828). Both reclamation districts are organized under provisions of the California Water Code for the purpose of providing a means of flood control to the lands they encompass. Their main function is to adequately maintain the system of levees which are major components of the Districts' Flood Control Systems (FCS). RD 1614 also maintains a number of drainage pumps. Since the Smith Canal levee are not accredited to FEMA standards, the SCCD at the mouth of Smith Canal will be operated in order to control BFE back-flooding from the Delta during winter months (November 1st to April 30th) when high tides typically occur in the Smith Canal area.

The closure device has a fixed flood wall segment and an operable opening segment to allow for navigation. The fixed portion of the closure structure consists of a dual sheet pile wall. The alignment extends northerly from the tip of the existing land bar (Dad's Point Levee) separating the Louis Park boat launch area from the Deep Water Ship Channel, to a tie-in point with the RD1614 San Joaquin River levee at the Stockton Golf and Country Club.

To maintain navigation to and from Smith Canal through the closure structure, a 50-foot wide opening is located approximately 1/3 of the way between Dad's Point and the Stockton Golf and Country Club. The opening is comprised of a reinforced concrete, pile supported bottom slab, reinforced concrete side walls, and an inflatable bladder-actuated, stainless steel plate faced, Obermeyer flood control gate. The gate will be raised during defined flood events and lowered at other periods to allow boat traffic to pass through the SCCD.

This Operations and Maintenance Manual (Manual) has been prepared to assist the Smith Canal Closure Device operator (Operator) in operating and maintaining the closure device and the Dad's Point Levee. The duties and responsibilities of the Operator are defined for routine operations and maintenance of the closure device and Dad's Point Levee, and also for flood emergencies. This Manual is a supplement to the RD 1614's and RD 828's operations and maintenance manuals used for other components of their FCS.

As well as giving guidance for routine operations and maintenance, this Manual also includes information to guide and aid the Operator in the case of a flood emergency situation. It provides emergency telephone numbers, levee patrol procedures, instructions for possible hazardous levee conditions, evacuation maps, sources of emergency supplies and resources, and a list of government agencies along with their function that may be able to assist the District during a flood emergency. It also provides sources of river stage gauging and forecasting information.

It is the intention that adoption of this Manual satisfies the Federal Emergency Management Agency (FEMA) requirements for operation and maintenance of the SCCD which includes the Dad's Point Levee. FEMA requirements for an Emergency Operations Plan, describing specific actions and assignments relating to flood warning, interior drainage, closures, and levee systems, are addressed in this Manual.

1.2 Ownership:

District

1.3 Operator

Superintendent

1.4 District Engineer

To oversee and assure the gate and Dad's Point Levee are maintained as indicated in this Manual

1.5 Location:

Smith Canal Closure Device and Dad's Point Levee are located in the city of Stockton, just north of the Deep Water Ship Channel (see Figure1).

1.6 Purpose:

This manual describes the operations and maintenance of the Smith Canal Closure Device and Dad's Point Levee.

1.7 Protection Provided:

The Smith Canal Closure Device and Dad's Point Levee provide flood protection from BFE back-flooding from the Delta and the San Joaquin River, and provide flood protection for local residents and businesses.

Figure 1 – Location



2. Maintenance and Operation – General Procedure

2.1 Purpose of Manual

This Manual provides details of the operation and maintenance requirements applicable to this particular project and indicates methods of flood fighting operations and procedures for emergency repairs.

2.2 Responsibility of the Operator

The Operator is responsible for the development and maintenance of, and directly in charge of the organization responsible for flood control facilities during flood periods. The Operator is also responsible for scheduled inspections and maintenance of the project works during periods of low water. The Operator shall test and operate the gate and all systems once a month in each month of the year to assure the systems are properly functional. If any of the systems are not functional they shall be repaired in a timely manner.

The Operator shall ensure that:

- A reserve supply of flood fight materials needed during a flood emergency shall be available at all times.
- The District Engineer or his/her authorized representative shall have access at all times to all portions of the protective works.
- Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made.

The general duties of the Operator include the following:

- **Training of Key Personnel:** Key personnel shall be trained in order that regular maintenance work may be performed efficiently and to insure that unexpected problems related to flood control can be handled in an expeditious and orderly manner. The Operator should have available the names, addresses, and telephone numbers of all his/her key personnel and a reasonable number of substitutes. These key personnel should, in turn, have similar data on all of the personnel who will assist them in the discharge of their duties. The organization of key personnel should include the following:
 - Assistant to act in the place of the Operator in case of his absence or indisposition
 - Sector foreperson in sufficient number to lead maintenance patrol work of the levee and inspect the channel.
- **Coordination of Local Activities:** The Operator will, during periods of flood flow, coordinate with impacted agencies, both public and private, that are connected with the protective works. In cooperation with the San Joaquin

County Office of Emergency Services, arrangements shall be made with the local law enforcement agencies, street departments and utility companies for developing a coordinated flood-fighting program.

- **Inspection:** Periodic inspections shall be made by the Operator to insure that maintenance measures are being effectively carried out. Such inspections shall be made prior to the beginning of the flood season and following each major high water period.
- **Maintenance:** The Operator shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod as required, exterminate burrowing animals, and to provide for removal of wild growth and drift deposits and repair of damage caused by erosion or other forces that could significantly impact flood protection. Steps will be taken to implement corrective actions to address significant deficiencies disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Operator.

Full responsibility for making the repairs and the methods used is placed on the Operator but the experience and facilities of the District Engineer will be available to the Operator for advice and consultation.

All repairs shall be made in accordance with standard engineering practice. No significant change or alteration shall be made in any feature of the project works without prior determination by the District Engineer that such alteration will not adversely affect the stability and functioning of the protective facilities. Plans and specifications of any significant changes or alterations that may be proposed by the Operator shall be submitted to the District Engineer for investigation and approval before prosecution of the work.

Reporting: Reports of maintenance activities shall be kept at the District Engineer's office.

2.3 Inspection Procedures

The following measures shall be reviewed during the inspection:

1. That reasonable steps have been taken to assure brush, trees and wild growth other than sod are removed from levee crown and slopes.
2. That all burrowing animals have been exterminated and a reasonable rodent management program is in place.
3. That all caves, sloughs, burrows, holes, slips, or other damaged portions of the levee have been repaired.

4. That no revetment work or riprap have been displaced, washed out or removed.
5. That the crown of the levee is well shaped and maintained, and that unauthorized vehicular travel is restricted.
6. That encroachments are not being erected on the levee which would hinder travel by authorized patrol vehicles.
7. The channel or floodway is clear of debris, weeds, and wild growth that would present a flood hazard.
8. The channel or floodway is not being significantly impacted by the depositing of waste materials, building of unauthorized structures or other encroachments.
9. Banks are not being damaged by rain or wave wash and that no sloughing of banks has occurred.
10. The sheet piles are not misaligned. There is no horizontal or vertical deviation from the design alignment.
11. There is no corrosion visible.
12. There is no settlement behind or adjacent to the sheet piles.
13. There is no interlock separation between the sheet piles.
14. There are no holes, cracks or dents in the sheet piles.

2.4 Levee Maintenance Procedures

Repairs to Dad's Point Levee Embankment: The methods used for repair or reconstruction of the levee fill will depend on the extent of the damaged section. If of small extent, the most suitable method will be to bring the levee back to line and grade by fill made in 6-inch layers of earth free from brush, roots sod or deleterious materials. If of larger extent, the fill should be made in the same manner as the original construction, of selected material from borrow pits approved for the project, placed in uniform layers of loose material and not more than 6 inches in depth and compacted according to approved construction practices, the Operator shall provide at all times such maintenance as may be required to insure serviceability of the levees in time of flood.

Depredations of Burrowing Animals: Dens and runways formed within the levee by burrowing animals are frequently the causes of levee failures during flood stages. Burrowing animals such as muskrats, ground hogs, ground squirrels, moles and gophers, found in the levee should be exterminated. The dens and runways should be opened up and thoroughly compacted as they are backfilled. Levees kept properly cleared are not seriously menaced by burrowing animals as they prefer areas where a protective cover, such as high grass, weeds, and brush is found. Several methods of extermination are found effective, such as trapping, and baiting, depending on the type of animal present and the time of year work is done. Advice concerning the best methods can be obtained from the County Agricultural Agent.

Access Roads: Access roads to the levees shall be maintained in such condition that they will be accessible at all times to trucks used to transport equipment and supplies for maintenance or flood fighting.

Revetment or Riprap: Dumped rock or other suitable types of protection should be placed at locations found by experience to be critical trouble points, with a view to stabilizing the channel alignment and preserving the general uniformity of the bank lines. The stone used shall be, as far as possible, similar to the kind and gradation as originally used, and shall be placed to similar thickness. When stone is not available, sand bags or bags filled with gravel may be used for temporary repair measures.

Debris Removal: Sediment and debris plugs or other obstructions should be removed from the channel to prevent any tendency for the flows to be deflected within the channel. Significant accumulation of heavy material in the channel and at the mouths of tributaries should be removed to keep the channel clear.

Weed Removal: Weeds and other vegetal growth in the channel shall be cut in advance of flood season and together with all debris, removed from the channel.

2.5 Closure Device Maintenance Procedures

See Appendix 4 for maintenance procedures for the Obermeyer Gate closure device.

2.6 Closure Device Activation Procedures

2.6.1 Background

The purpose of the Smith Canal Closure Device (SCCD) is to provide flood protection from a 1% event in any given year for the Smith Canal area by preventing backwater flows from the San Joaquin River and Delta entering into Smith Canal. To ensure that the SCCD is activated appropriately, a set of operating rules are established for the SCCD. These operating rules will utilize tide forecasting data provided by the National Oceanic and Atmospheric Administration (NOAA) and the California Department of Water Resources (DWR).

2.6.2 DWR Delta Tide Forecasting

DWR through the California Data Exchange Center (CDEC), issues near term tide forecasts for the San Joaquin River gauging station at Venice Island. The tide forecasts can be obtained from the CDEC web page using the following link.
<http://cdec.water.ca.gov/cgi-progs/rivfcst/TIDES>

Venice Island is located on the San Joaquin River approximately 14 miles downstream from Smith Canal. These forecasts are updated each morning,

typically by 8 AM, and provide a 48-72 hour look ahead. The forecasts are based upon astronomical tides with wind, pressure, and flow effects also taken into account.

DWR also maintains a San Joaquin River gauging station on the San Joaquin River at Rough and Ready Island which is in close proximity to the proposed SCCD. DWR does not produce tide or river stage forecasts for the Rough and Ready Island station. However, a review of a sample of historical river stage records for the Venice Island and Rough and Ready Island indicate that the high tides at these locations are very similar in magnitude, with the Rough and Ready Island high tide event lagging the Venice Island high tide by 30-45 minutes. Therefore the Venice Island tide forecasts can be used as a predictor of high water events at the SCCD location.

2.6.3 NOAA Tide Predictions

NOAA publishes annual Tide Prediction Tables based on astronomical tide forecasts without taking into wind, pressure, or flow effects that typically drive base flood events for Delta. Therefore their value in predicating base flood events for Smith Canal is limited. For the Stockton area NOAA bases their Tide Predictions Tables on data pertaining to the Port of Chicago in Suisun Bay. Lag time and height corrections are applied to the Port of Chicago Tide Predictions to arrive at tide predictions for Stockton. NOAA's Tide Prediction Tables are published as "Feet above Mean Low Low Water". NOAA does not provide a datum reference for converting Mean Low Low Water (MLLW) to the NAVD 88 datum. However by comparing the NOAA Prediction Tables data from past years to actual tide measurements from the DWR's Rough and Ready Island San Joaquin River stage gage (as reported by DWR through the California Data Exchange Center), we were able to estimate that for Stockton, NOAA's MLLW is approximately elevation 2 NAVD. NOAA does not provide near term tide forecasting that takes into account barometric pressure, wind, or flood events. Therefore another source must be used for near term forecasting information

2.6.4 Interior Drainage

Currently an urban area of approximately 3,430 acres drains into Smith Canal via nine storm drain pump stations. In the event that a local area rainfall event occurs simultaneously with a high water event in the San Joaquin River, the SCCD must be operated to allow for urban storm drainage runoff to be evacuated from Smith Canal between high tides.

2.6.5 Rainfall Forecasting

Forecasts of rain events for the Stockton area can be obtained from the NOAA web page <http://www.wrh.noaa.gov/sto/> and a variety of other sources.

DWR operates a rain gauging station in Stockton that tracks hourly accumulation of rainfall. Called the Stockton Fire Station gauge (SFS), it tracks hourly accumulation of rainfall and be monitored through CDEC at http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=SFS. Using this information, the Operator will be able to determine if storm drainage runoff is being pumped into Smith Canal during a SCCD closure.

2.6.6 Closure Device Operating Rules

2.6.6.1 Monitoring Stage

- M-1. High tides in the Smith Canal area typically occur between November 1st and April 30th. Each year, prior to November 1st, the Operator will obtain and review the NOAA Tide Predication Tables published for Stockton for the period of the upcoming flood season.
- M-2. The Operator will highlight and note all predicted high tides in excess of elevation 7.0. These events will be referred to *Plus 7 Tides*. (The Operator will need to add 2 feet to the tide heights shown in the NOAA Tide Predication Tables for an approximate conversion to the NAVD 88 datum.)
- M-3. The Operator will develop a calendar of *Alert Periods* based upon the Plus 7 Tides contained in NOAA Tide Predication Tables. The Alert Period will commence seven days prior to the 7 Plus Tide and continue for 3 days after the Plus 7 Tides. Therefore the minimum Alert Period will be 10 days. Alert Periods may exceed 10 days if multiple Plus 7 Tides occur close together.
- M-4. The Operator will distribute the calendar of Alert Periods to all interested parties by October 21st each year.
- M-5. The Operator shall prepare a log of the DWR Tide Forecasts for daily distribution to interested parties.
- M-6. The 'actual' data for Venice Island and Rough and Ready Island shall be obtained from DWR CDEC and added to the log the next day.
- M-7. Operator shall record actual water surface elevations at the SCCD obtained from the SCCD water elevation auto-sensors and verified by actual staff reading from the staff gauges located on the upstream and downstream faces of the SCCD.
- M-8. Daily from November 1st to April 30th, the Operator will obtain and review tide perditions from the DWR tide gauge Venice Island. The BFE for the Smith Canal area is elevation 10.0. If the Venice Island Tide Forecast indicates that a tide in excess of the 8.0 will occur within the forecasting period, the Operator will declare an 'Activation Stage' and shall initiate procedures to activate the SCCD. Tides in excess of 8.0 will be referred to as *Plus 8 Tides*.

ALERT PERIOD TIDE LOG - FROM (Insert date) TO (Insert Date)

Date & Day	NOAA Predication			DWR Venice Island Forecast			Venice Island Actual			Rough & Ready Actual		
	High	Low	Time	High	Low	Time	High	Low	Time	High	Low	Time
Day 1												
Day 2												
Day 3												
Day 4												
Day 5												
Day 6												
Day 7												
Day 8												
Day 9												
Day 10												

2.6.6.2 Activation Stage

- A-1. The Operator shall notify all interested parties that a tide in excess of 8.0 has been forecast and that the SCCD is to be deployed. Deployment of the SCCD for Plus 8 Tides is to allow for tide forecasting inaccuracies and to ensure the SCCD is deployed should a base flood event occur.
- A-2. The Operator shall deploy the SCCD in advance of the forecasted Plus 8 Tide. For any Plus 8 tide predictions, the gate will be closed on the lowest predicted tide in the 12 hours period prior to the predicted Plus 8 tide.
- A-3. While the deployment will be automatic, the operator shall be present at the SCCD. Using the 48 hour Tide Forecasts, the Operator will program the SCCD operating system to actuate the SCCD once water level sensors indicate water levels have reached the lowest predicted tide in the 12 hours period prior to the predicted Plus 8 tide.
- A-4. Operator shall ensure the activation warning systems are operating during deployment to warn the public and boaters that the SCCD is being deployed.
- A-5. The SCCD will remain closed until the Plus 8 Tide has subsided.
- A-6. During SCCD closure, the Operator will monitor any rainfall accumulation using DWR's Stockton Fire Station gauge.
- A-7. During SCCD closure, the operator shall monitor and record actual water surface elevations at the SCCD obtained from the SCCD water elevation auto-sensors, and will verify these elevations from actual staff reading from the staff gauges located on the upstream and downstream faces of the SCCD.
- A-8. Upon the receding tide, the SCCD will be opened automatically. It will be triggered by water level sensors located on the downstream side of the SCCD once the downstream water surface drops below elevation 8.0. This will allow any rainfall runoff that may have entered Smith Canal to be evacuated.
- A-9. The Operator shall notify all interested parties that the SCCD has been opened and that the SCCD has returned to *Monitoring Stage*.
- A-10. If a second Plus 8 Tide is forecasted to occur with 24 hours and no storm drainage runoff has entered Smith Canal during the closure, the Operator may override the automatic opening and leave the SCCD closed during the ebbing tide.

2.6.6.3 Emergency Activation

At anytime the Operator may deploy the SCCD in the event of emergency. Emergency deployment can be triggered remotely via the SCCD SCADA system, or onsite via the onsite controls. Upon emergency deployment, the Operator shall notify all interested parties and shall comply with Activation Stage Operating Rules A-4, A-6, and A-7.

2.6.6.4 Activation for Routine Maintenance

The SCCD will need to be deployed periodically for routine maintenance and inspections. Prior to such deployments, the Operator shall notify all interested parties and shall comply with Activation Stage Operating Rules A-4, A-6, and A-7.

2.6.7 Interested Parties List

The following list of interested parties shall be notified in advance of deployment of the SCCD:

San Joaquin County Office of Emergency Services
 San Joaquin County Sheriff's Department
 San Joaquin County Public Works Department
 City of Stockton Police Department
 City of Stockton Fire Department
 City of Stockton Public Works Department
 City of Stockton Municipal Utilities Department
 United States Coast Guard
 California Department of Boating & Waterways
 Smith Canal resident boat owners located upstream of the Closure Device
 Local marinas including:
 River Point Landing Marina
 Paradise Point Marina
 5 Star Marina
 Village West Marina
 Ladd's Marina
 Downtown Stockton Marina
 Stockton Yacht Club
 H & H Marina
 Windmill Cove Marina

2.7 Maintenance Records

Maintenance records are saved in spreadsheet form at the District Engineer's office. Maintenance activities are recorded using codes that depict what activities took place. These codes and the description of the abbreviations in the header row of the records are described below:

Date: Date of maintenance.

Func#. Function codes are used to identify various maintenance activities. The following table presents the function codes along with a description of the corresponding activity.

Last Name: Last name of the employee that completed the work.

Hr: Number of hours the employee spent on maintenance activity.

Veh#: Identifies the vehicle used in the maintenance activity. The first two digits represent the year the vehicle was made and the last three digits represent the vehicle number.

V Hr: Number of hours the vehicle was used.

Eq#: Identifies the type of equipment/vehicle used in the maintenance activity.

E Hr: Number of hours equipment was used.

Eq#2: Identifies the secondary equipment/vehicle used in the maintenance activity.

E Hr: Number of hours secondary equipment was used.

Job#: Internal accounting job reference number.

Done: Quantity of activity completed.

Qnty: Unit of activity completed.

3. Emergency Operations Plan

3.1 Flood Warning System

The stream gauge located on the Sacramento River at Rio Vista is maintained and continually monitored by DWR and is relied on as a pre-flood indicator by the Operator. It provides the Operator with several hours warning of tidally influenced exterior flood waters approaching. When DWR's Chief of Flood Operations calls a flood alert, flood stage forecasting for this gauging station is provided on a 24-hour basis. The Operator is supplied with continuous stage and forecasting information through the Flood Operations Center. Compliance with operations and procedures outlined in this Manual will afford the District ample time to activate emergency operations.

3.2 Interior Drainage System

The interior drainage system consists of pumping stations, operated and maintained by RD 1614 and the City of Stockton. FEMA requires that the Emergency Operations Plan provide for manual operations of automated systems in the event the automatic systems fail. In such an event, the Operator will monitor interior drainage pumps and manually operate the controls as required. It is unlikely that the occurrence of peak interior runoff would occur simultaneously with high exterior floodwaters. Normally, the occurrence of peak exterior flood stage follows the storm event by up to several days, owing to retention and travel time in upstream tributaries. This would allow ample time to monitor and respond to interior drainage problems before a flood alert from exterior flooding occurs.

3.3 Alerting and Warning of the Public

The County has three means of alerting affected residents that there is an emergency and that they should take at least the minimal action of staying tuned to the Emergency Broadcast System (EBS):

- Broadcasts over the EBS and other available news media.
 - KFBK, 530 A.M., & 92.5 F.M. (*Sacramento primary*)
 - KSTN, 1420 A.M. & 107.3 F.M. (*Stockton backup*)
- Sweeps of the affected area by law enforcement and other emergency responders using loudspeakers and personal contact.

3.4 Evacuation Maps

Attached in Appendix 2 are evacuation maps of the area prepared by the San Joaquin County Office of Emergency Services. The Operator shall coordinate

with the San Joaquin County Office of Emergency Services to ensure that the evacuation maps are updated over time as required.

3.5 Levee Patrols

When a flood alert is called, the exterior levee system must be patrolled with increasing frequency as flood conditions worsen. The Operator is required to prepare a patrol schedule that assigns specific levee sections and shifts to individual patrol units. Enough patrol units should be available on standby to cover the entire exterior levee system every half hour under full flood stage conditions. A sample of a levee Patrol Schedule is presented below:

Levee Patrol Schedule

Smith Canal – Emergency Operations Plan – Levee Patrol

Patrol Units	Patroller	Phone Number	Station Assignments	Patrol Period
			Start – Stop	Start - Stop
1			All	0000-0800 hrs
2			All	0800-1600 hrs
3			All	1600-2400 hrs

3.6 Emergency Contact List

Prior to commencement of the annual flood season, the Operator shall review and update as needed the emergency contact list. This list shall be used to log initial contacts at the onset of the flood fighting emergency.

EMERGENCY CONTACT CHECKLIST

Contact	Information needed, Action	Who Contacted	Date/Time	Initials
District Operator	Where, what, severity, other contacts (District Engineer, County Office of Emergency Services, DWR)			
911	Immediate – Life Threatening			
District Engineer:	Where, what, severity, current actions to be taken, by whom. Contacts (In place of District Manager and Attorney)			
County Emergency Operations Center 24 Hours (209) 468-3962	Where, what, severity, current actions being taken, if assistance required. Initiate EOC			
State of California Department of Water Resources (800)952-5530	Report status and request assistance			
Attorney:	Report existence of an Emergency, and direct course of action to follow.			
Trustees	Report existence of an Emergency, status			

3.7 Emergency Activity Log

This Emergency Activity log is to be used to log contacts/activities after initial Emergency Contacts Log for the duration of the emergency situation

SMITH CANAL EMERGENCY ACTIVITY LOG

Emergency Date _____ Start Time _____

Time/Initial	Message	Response	Action taken
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			

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4. Flood Fighting

The main causes of levee failure during high water are:

- Excessive seepage through or under levees is caused by rodent holes, sand lenses or leaks that result in a boil on the land side slope.
- Levee erosion by currents or wave action.
- Levee over topping by flood flows that exceed levee height.

Emergency measures used to prevent levee failure from these causes are known as “Flood Fight Methods”. Attached in Appendix 1 are descriptions prepared by the Department of Water Resources of flood fighting methods that been proven effective during many years of use by the Department of Water Resources and the U.S. Army Corps of Engineers.

Structures other than levees may also require protection from high water. Methods for protecting structures other than levees are also described in Appendix 3.

It should be noted that while the flood fighting methods described in Appendix 3 have proven effective in the past, they are temporary measures and cannot be expected to last for extended periods of time.

4.1 Emergency Flood Fighting Assistance

There are a number of agencies available to assist the District during a flood fighting emergency. Below is a list of such agencies with a brief summary of their capabilities.

4.1.1 Government Agencies

4.1.1.1 Local Agencies

San Joaquin County Office of Emergency Services

The San Joaquin County Office of Emergency Services is responsible for coordinating County operations during a flood crisis. It maintains control of County flood-fight materials and supervises emergency purchases. It is also responsible for coordinating with State and Federal agencies operating in the County, or providing mutual aid.

(209) 468-3962

San Joaquin County Sheriff's Department

The Sheriff's Department is responsible for public safety in unincorporated areas of the San Joaquin County. This department will assist in rescue activities, evacuations, and will provide general security for impacted areas.

Non-Emergency Dispatch (209) 468-4400
Emergency 911

City of Stockton Police Department

The City of Stockton's Police Department is responsible for public safety in incorporated areas of the City of Stockton. This department will assist in rescue activities, evacuations, and will provide general security for impacted areas.

Non-Emergency Dispatch (209) 937-8377
Emergency 911

City Of Stockton Fire Department

The City of Stockton Fire Department is responsible for fire protection services in the incorporated areas and unincorporated areas of the District. Fire Station No. 6 is located within the District at 1501 Picardy Drive, Stockton, CA 95203. This department will assist in rescue activities, and evacuations.

Non-Emergency Contact (209) 937-8801
Emergency 911

San Joaquin County Public Works Department

The San Joaquin County Public Works Department is responsible for maintaining County roads and facilities. It may transport personnel and material at the request of the Emergency Services Coordinator to assist floodlight operations.
(209) 468-3000.

City of Stockton Public Works Department

The City of Stockton Public Works Department is responsible for maintaining City streets and parks. It may transport personnel and material at the request of the Emergency Services Coordinator to assist floodlight operations.
(209) 937-8411.

City of Stockton Municipal Utilities Department

The City of Stockton Municipal Utilities Department is responsible for City water, sewer and storm drainage utilities. It may transport personnel and material at the request of the Emergency Services Coordinator to assist floodlight operations.
(209) 937-8700.

4.1.1.2 State Agencies

Department Of Water Resources

The Department of Water Resources provides:

Flood warnings and information on real and potential flooding;
Coordinates local, state and federal flood fight efforts during a major flood emergency;
Provides experienced personnel to advise and direct flood fight efforts;
Furnishes flood fight crews with experienced personnel to supervise and direct their work;
Provides Flood Fight training.

(800) 952-5530 24-hour Flood Operations Center

State Office of Emergency Services

The State Office of Emergency Services (OES) coordinates State action during emergencies under the California Emergency Services Act and administers the State Natural Disaster Assistance Act by providing financial assistance to local agencies for repairing and restoring flood damaged facilities.

(916) 874-4670

<http://www.oes.ca.gov>

California Highway Patrol

The Highway Patrol is responsible for traffic control during all emergencies. Direct assistance to State and Federal organizations engaged in flood fighting includes use of Highway Patrol communication facilities.

(209) 874-4670

California National Guard

The California National Guard functions as a reserve force for the national armed forces, and is also the State's reserve source of emergency manpower, equipment and transportation during times of local disaster or disorder.

Headquarters National Guard (916) 854-3000

California Conservation Corps

The Flood Operations Center of the Department of Water Resources depends heavily upon the California Conservation Corps (CCC) to provide personnel for flood fighting and levee patrolling during emergency situations. Standby crews are frequently stationed near sites where

problems are anticipated due to storm activity, high river stages, high tides or heavy reservoir releases.
(916) 948-7110

4.1.1.3 Federal Agencies

Federal Emergency Management Agency

The Federal Emergency Management Agency coordinates the disaster relief functions of all federal agencies during a presidentially declared emergency or major disaster.
(415) 923-7100

U. S. Army Corps of Engineers

During a flood alert the U. S. Army Corps of Engineers gives local authorities the benefit of the Corps' flood fighting experience and answers requests for assistance in flood fighting received through the Department of Water Resources. In addition, the Corps is responsible for operating certain flood control reservoirs and maintaining surveillance over the flood control operations of other reservoirs having federal flood control reservation space.

Flood Information – Weekdays (916) 557-5366

Flood Information – After hours (916) 452-1535

U. S. Army

Assistance from the U. S. Army may consist of manpower, equipment, and supplies for flood fighting, rescue, and relief work. Such assistance may be sought only when local and State facilities are unable to prevent extensive loss of life or property.

Requests for U. S. Army assistance in flood fighting must be made to the Corps of Engineers through the Department of Water Resources.

National Weather Service

The National Weather Service disseminates river forecasts, which have been produced at the joint Federal-State River Forecast Center in Sacramento, to its district offices located in Eureka, Reno, San Francisco, Fresno and Redding. The National Weather Service operates on a 24-hour schedule when emergency high water conditions exist or are anticipated.

(916) 979-3051

www.wrh.noaa.gov/sacramento

4.1.2 Non Governmental Agencies

American RED CROSS

The American Red Cross provides assistance for food, clothing, shelter and supplemental medical needs to disaster victims. Assistance is in the form of an outright gift and repayment is not required nor requested. The Red Cross provides emergency mass care to congregate groups, and also provides individual/family assistance. Upon the request of government, and resources permitting, the Red Cross may assist with warnings, rescue or evacuations. (209) 466-6971

Salvation Army

During an emergency, the Salvation Army may be called upon to provide food, clothing, furniture and housing, emergency communication, mobile canteen services, and spiritual ministry for disaster victims. (209) 948-8956 Del Oro Division Sacramento

4.2 Additional Resources Request

The Operator will use the sample form below to log requests made for additional resources during an emergency.

(INSERT OWNER'S NAME & ADDRESS)

ADDITIONAL RESOURCES REQUEST

Date _____

Time _____

Personnel (How Many?) _____

Equipment (What?) _____

Materials (What?) _____

Requested from: _____

Reason for the request:

Date/time required: _____

Authorized by _____

Signature, Title

Additional Remarks:

4.3 Directory of Materials, Equipment & Labor Suppliers

Prior to the annual flood season, the Operator shall review and update as needed the directory of materials, equipment and labor suppliers that are available to assist the District in the event of a flood emergency.

Sandbags

Sacramento Bay Mfg. Co. (800) 287-2247

(209) 441-6121

Calosso & Sons (Stockton) (209) 466-8994

Bags & Barrels (Hayward) (925) 732-1333

Sandbag Fillers

HMI's Speed Sandbagger (209) 838-7323

The Go Bagger (Piner Products) (877) 462-2488

EZ Bagger (805) 895-1742

Lumber & Stakes

San Joaquin Lumber (209) 465-5651

Valley Lumber & Supply Co. (209) 464-4565

Central Valley Hardware (209) 464-7305

Visquine Plastic, Canvas And Tarps

Performance Packaging (209) 467-6833

California Industrial Rubber Co. (209) 833-3250

Bonanza Industrial Supply (Oakley) (925) 625-1000

Capitol Tarpaulin Co. (800) 282-8277

Tie Buttons

Sto-Cote Products (800) 435-2621

Rental Equipment

United Rentals (209) 948-9500

Sunstate Equipment Co. (209) 463-1682

The CAT Rental Store (209) 462-3660

Hertz Equipment Rental (209) 982-9670

RSC Equipment Rental (209) 942-1000

Construction Equipment

DDM Crane and Rigging (707) 374-2000

Ford Construction Co. Inc (209) 333-1116

AM Stephens Construction (209) 333-0136

Robert Burns Construction Inc. (209) 943-6969

Granite Construction Co (209) 982 0123

Western Power and Equipment (Stockton) (209) 464-9600

DA Archer Excavating (209) 601-3745

Niles Freeman (925) 766-4490
Teichert Construction (209) 983-2300
DSS Company (209) 948-0302

Rock, Sand & Gravel

Granite Construction Co./ Tracy Gravel Plant (209) 982-4750
Foothill Materials (209) 728-3473
Teichert Aggregates (Stockton) (209) 983-2300
Mr. Trucker (Stockton) (209) 462-9168
FTG Construction Materials (Stockton) (209) 334-4038
Vaz Trucking (Lodi) (209) 334-9001
George Reed Construction (209) 334-0790

Dredging & Barge Equipment

Dutra Dredging (Delta) (707) 374-6339
(415) 459-7740
Mid Cal Construction (Barge in Discovery Bay) (209) 832-4400
Pager (209) 397-1962
Docks and Decks (Barge in Discovery Bay) (925) 634-3128
Mobile (925) 216-2141

Labor

California Conservation Corps (916) 445-8183

4.4 Suggested Flood Fight Supplies

An ample supply of the following tools, materials, and equipment should be readily available in a convenient location. These supplies should be regularly inventoried or restocked.

Items	Quantity
Visquine plastic sheeting, 10 mil, 100 X 20 feet.	10 rolls
OR	
Canvas, 100 X 20 feet	5 rolls
Sandbags	5,000
Twine or baling wire	8 boxes
Stakes, 2-foot, 2" x 4", W/V points	200
Laths, 4-foot	1 bundle
Tie buttons or stones	200
Flagging (fluorescent)	6 rolls
Lineman's pliers	8
Sledge hammers	8
Shovels	10
Life jackets (for personnel)	20
Logbook (To document trouble spots)	1
Tire chains	2
Jumper cables	2
Highway flares	2 bundles
Tow chains	2
Axes	2
Chain saws	1
Electric lanterns	2
Batteries for lanterns	1 box
Maps	1
Lighting system for night patrol	3
Two-way car radio or car telephone	2

Appendix 1 – Closure Device Design & Dad's Point Levee Drawings

**(AS BUILT DRAWINGS WILL BE INCLUDED IN FINAL O&M
MANUAL)**

DRAFT

Appendix 2 - Flood Evacuations Maps

DRAFT

EMERGENCY BROADCASTS TO THE PUBLIC

Public safety officials will broadcast warnings and instructions to threatened neighborhoods through local commercial broadcast stations using the Emergency Alert System (EAS). EAS messages will define what area the message is directed to by listing the roads, streets, or other topographical features that surround it. The primary EAS station for San Joaquin County is KFBK Radio, 1530 AM. Residents should tune to that station in an emergency for initial warnings of neighborhoods that are significantly threatened by the event and any protective actions being ordered for the public.

In addition, public safety officials have the capability to broadcast continuous information and instructions to neighborhoods for which a protective action has been ordered with mobile emergency Advisory Radio Stations. The EAS message that identifies a threatened area will mention the AM radio frequency that residents can tune to for ongoing information. Potential frequencies that can be used are 530AM, 1030AM, and 1300AM. These radio broadcasts can be received by vehicle radios up to 3 or 4 miles away from the transmitter but signals may be shielded if you are inside a building. If you are using a portable AM radio in your home, consider moving next to a window or moving outside to receive these broadcasts if it is safe to do so. AREAS NOT SIGNIFICANTLY THREATENED OR UNDER AN EVACUATION ORDER WILL NOT RECEIVE TRANSMISSIONS.

GENERAL SAFETY CONSIDERATIONS

In the event of an evacuation order, move in the direction of the evacuation routes shown on the map. Specific instructions will be broadcast on the Emergency Advisory Radio Stations and police and fire officials will direct traffic to safe areas.

Do not drive through flooded areas. Standing water is often much deeper than it looks. Additionally, flood currents can result in unseen damage to the road surface.

In the event that flooding keeps you from safely evacuating your neighborhood, attempt to get above the floodwaters. Move to the top of levees or elevated locations in your neighborhood. Some larger elevated locations may be shown on the map. Have a plan where your family would go and how you would access the location(s). If it is too dangerous to move far from your residence, move to upper or higher portions of the structure. Make sure you can exit the structure if necessary. For example, if forced to shelter in your attic due to a flood, have tools available that you would need to access the roof if rescue is delayed. In such a situation, also have a bright cloth or portable light with you to signal rescuers.

EMERGENCY PREPAREDNESS - Don't Wait Until It's Too Late

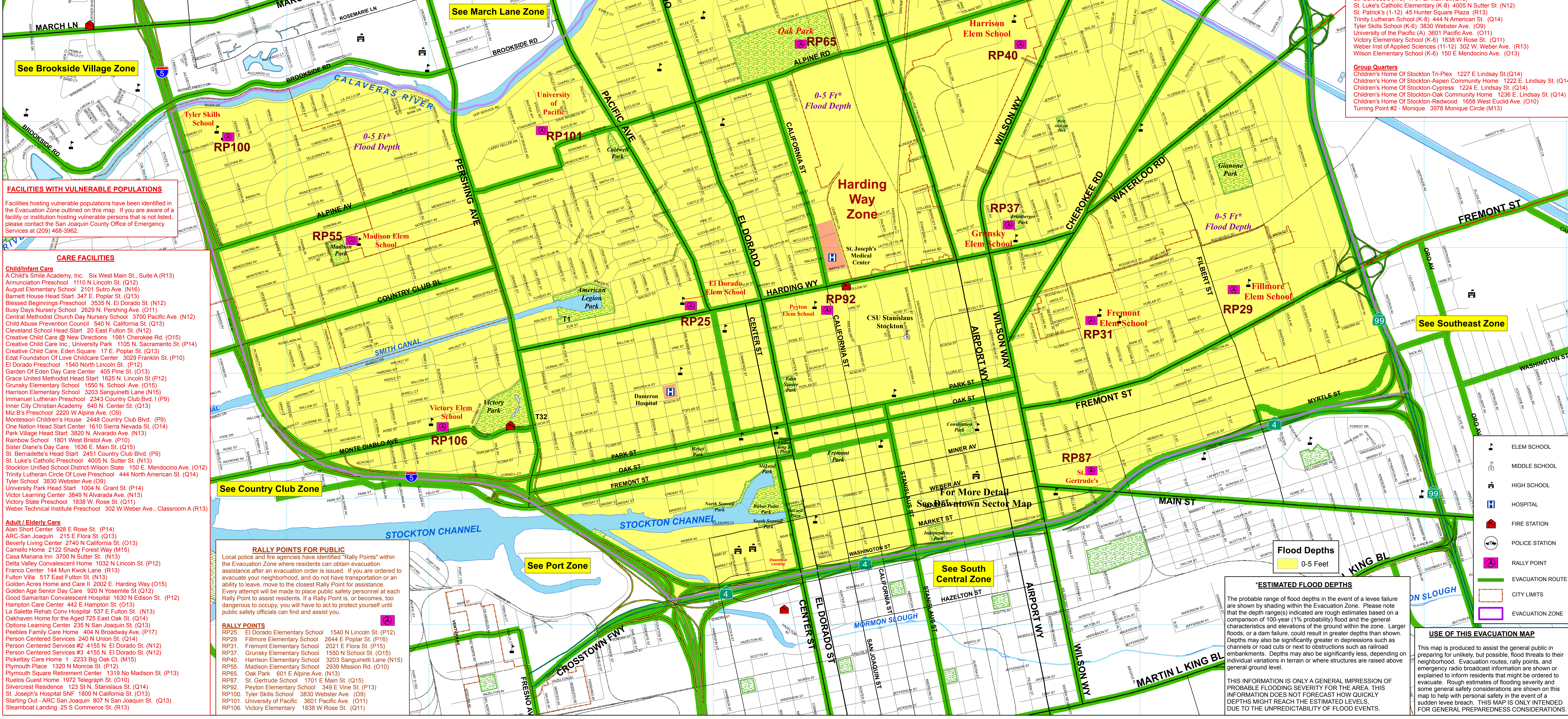
Start now to ensure that you have the best chance to survive in case of an emergency. Do not wait until an emergency happens to make plans. While this map is a useful tool, it is only a part of what should go into an effective personal or family plan to stay safe in a state prone to a variety of natural and manmade disasters. Start now by reviewing information available both at your public library and the Internet. The following links are good starting points.

<http://www.siqov.org> (See "Learn How To Protect Your Home From Flooding")
<http://www.co.siqov.org/oes> (See Family Preparedness Links)
<http://www.floodsmart.gov> (FEMA flood preparedness website)
FLOOD INSURANCE IS STRONGLY ENCOURAGED.

SCHOOLS/GROUP QUARTERS

- Schools**
Annunciation School (K-8) 1110 N Lincoln Rd. (Q12)
August Elementary School (K-7) 2101 Suito Ave. (N16)
California State University Stanislaus 612 E. Magnolia St. (Q14)
Children's Home of Stockton NPS (11-12) 430 North Pligman St. (Q14)
Cleveland Elementary School (K-6) 20 E Fulton St. (N12)
Community Day School (6-12) 1144 E. Channel St. (Q14)
District Special Education 701 N. Madison St. (Q13)
El Dorado Elementary School (K-6) 1540 N Lincoln Rd. (P12)
Evangelical Methodist Preschool (K-8) 2235 E Fremont St. (P16)
Fillmore Elementary School (K-6) 2644 E Poplar St. (P16)
Fremont Elementary School (K-6) 2021 E Flora St. (P15)
Golden Valley Elementary Community Day (K-6) 3203 Sanguinetti Lane (N15)
Grunsky Elementary School (K-8) 1550 N School St. (O18)
Harrison Elementary School (K-6) 3203 Sanguinetti Lane (N15)
Inner City Christian Academy (K-12) 640 N Center St. (Q13)
Madison Elementary School (K-6) 2939 Mission Rd. (O10)
Model Alternative/Continuation (9-12) 22 S Van Buren St. (R13)
Montessori School (P-6) 2448 W Country Club Blvd. (P9)
New Harvest Christian School (K-12) 1950 E. Cherokee Rd. (O16)
Peyton Elementary School (K-6) 349 E Vine St. (P13)
Pittman Academy (K-6) 701 E. Park St. (Q13)
Rosa Parks Academy (K-4) 444 N. American St. (Q14)
Samuel N. Hancock School (K-12) 1616 E Main St. (Q15)
Sierra Christian School (K-8) 4368 N Sutter St. (M13)
St. Gertrude's (K-8) 1701 E. Main St. (Q15)
St. Luke's Catholic Elementary (K-8) 4005 N Sutter St. (N12)
St. Patrick's (1-12) 45 Hunter Square Plaza (R13)
Trinity Lutheran School (K-8) 444 N American St. (Q14)
Tyler Skills School (K-6) 3830 Webster Ave. (O9)
University of the Pacific (A) 3601 Pacific Ave. (O11)
Victory Elementary School (K-6) 1838 W Rose St. (Q11)
Weber Inst of Applied Sciences (11-12) 302 W. Weber Ave. (R13)
Wilson Elementary School (K-6) 150 E Mendocino Ave. (O13)

- Group Quarters**
Children's Home of Stockton Tri-Plex 1227 E Lindsay St. (Q14)
Children's Home of Stockton-Aspen Community Home 1222 E. Lindsay St. (Q14)
Children's Home of Stockton-Cypress 1224 E. Lindsay St. (Q14)
Children's Home of Stockton-Oak Community Home 1236 E. Lindsay St. (Q14)
Children's Home of Stockton-Redwood 1658 West Euclid Ave. (O10)
Turning Point #2 - Monique 3978 Monique Circle (M13)



FACILITIES WITH VULNERABLE POPULATIONS

Facilities hosting vulnerable populations have been identified in the Evacuation Zone outlined on this map. If you are aware of a facility or institution hosting vulnerable persons that is not listed, please contact the San Joaquin County Office of Emergency Services at (209) 468-3962.

CARE FACILITIES

- Child/Infant Care**
A Child's Smile Academy, Inc. Six West Main St., Suite A (R13)
Annunciation Preschool 1110 N Lincoln St. (Q12)
August Elementary School 2101 Suito Ave. (N16)
Barnett House Head Start 347 E. Poplar St. (Q13)
Blessed Beginnings Preschool 3535 N. El Dorado St. (N12)
Busy Days Nursery School 2629 N. Pershing Ave. (O11)
Central Methodist Church Day Nursery School 3700 Pacific Ave. (N12)
Child Abuse Prevention Council 540 N. California St. (Q13)
Cleveland School Head Start 20 East Fulton St. (N12)
Creative Child Care @ New Directions 1981 Cherokee Rd. (O15)
Creative Child Care Inc., University Park 1105 N. Sacramento St. (P14)
Creative Child Care, Eden Square 17 E. Poplar St. (Q13)
Edat Foundation of Love Childcare Center 3029 Franklin St. (P10)
El Dorado Preschool 1540 North Lincoln St. (P12)
Garden Of Eden Day Care Center 405 Pine St. (Q13)
Grace United Methodist Head Start 1625 N. Lincoln St. (P12)
Grunsky Elementary School 1550 N. School Ave. (O15)
Harrison Elementary School 3203 Sanguinetti Lane (N15)
Immanuel Lutheran Preschool 2343 Country Club Blvd. (P9)
Inner City Christian Academy 640 N. Center St. (Q13)
Miz B's Preschool 2220 W Alpine Ave. (O9)
Montessori Children's House 2448 Country Club Blvd. (P9)
One Nation Head Start Center 1610 Sierra Nevada St. (Q14)
Park Village Head Start 3820 N. Alvarado Ave. (N13)
Rainbow School 1801 West Bristol Ave. (P10)
Sister Diane's Day Care 1636 E. Main St. (Q15)
St. Bernadette's Head Start 2451 Country Club Blvd. (P9)
St. Luke's Catholic Preschool 4005 N. Sutter St. (N13)
Stockton Unified School District-Wilson State - 150 E. Mendocino Ave. (O12)
Trinity Lutheran Circle Of Love Preschool 444 North American St. (Q14)
Tyler School 3830 Webster Ave. (O9)
University Park Head Start 1004 N. Grant St. (P14)
Victor Learning Center 3940 N Alvarado Ave. (N13)
Victory State Preschool 1838 W. Rose St. (Q11)
Weber Technical Institute Preschool 302 W. Weber Ave., Classroom A (R13)
- Adult / Elderly Care**
Alan Short Center 928 E Rose St. (P14)
ARC-San Joaquin 215 E Flora St. (Q13)
Beverly Living Center 2740 N California St. (O13)
Camello Home 2122 Shady Forest Way (M15)
Casa Manana Inn 3700 N Sutter St. (N13)
Delta Valley Convalescent Home 1032 N Lincoln St. (P12)
Franco Center 144 Mun Kwok Lane (R13)
Fulton Villa 517 East Fulton St. (N13)
Golden Acres Home and Care II 2002 E. Harding Way (O15)
Golden Age Senior Day Care 920 N Yosemite St (Q12)
Good Samaritan Convalescent Hospital 1630 N. Edison St. (P12)
Hampton Care Center 442 E Hampton St. (O13)
La Salette Rehab Conv Hospital 537 E Fulton St. (N13)
Oakhaven Home for the Aged 725 East Oak St. (Q14)
Options Learning Center 235 N San Joaquin St. (Q13)
Pebbles Family Care Home 404 N Broadway Ave. (P17)
Person Centered Services 240 N Union St. (Q14)
Person Centered Services #2 4155 N. El Dorado St. (N12)
Person Centered Services #3 4155 N. El Dorado St. (N12)
Pickett's Care Home 2233 Big Oak St. (M15)
Plymouth Place 1320 N Monroe St. (P12)
Plymouth Square Retirement Center 1319 No Madison St. (P13)
Ruelos Guest Home 1972 Telegraph St. (O10)
Silvercrest Residence 123 St. N. Stanislaus St. (Q14)
St. Joseph's Hospital SNF 1800 N California St. (Q13)
Starting Out - ARC San Joaquin 807 N San Joaquin St. (Q13)
Steamboat Landing 25 S Commerce St. (R13)

RALLY POINTS FOR PUBLIC

Local police and fire agencies have identified "Rally Points" within assistance after an evacuation order is issued. If you are ordered to evacuate your neighborhood, and do not have transportation or an ability to leave, move to the closest Rally Point for assistance. Every attempt will be made to place public safety personnel at each Rally Point to assist residents. If a Rally Point is, or becomes, too dangerous to occupy, you will have to act to protect yourself until public safety officials can find and assist you.

- RALLY POINTS**
RP25. El Dorado Elementary School 1540 N Lincoln St. (P12)
RP29. Fillmore Elementary School 2644 E Poplar St. (P16)
RP31. Fremont Elementary School 2021 E Flora St. (P15)
RP37. Grunsky Elementary School 1550 N School St. (O15)
RP40. Harrison Elementary School 3203 Sanguinetti Lane (N15)
RP55. Madison Elementary School 2939 Mission Rd. (O10)
RP65. Oak Park 601 E Alpine Ave. (N13)
RP87. St. Gertrude School 1701 E Main St. (Q15)
RP92. Peyton Elementary School 349 E Vine St. (P13)
RP100. Tyler Skills School 3830 Webster Ave. (O9)
RP101. University of the Pacific 3601 Pacific Ave. (O11)
RP106. Victory Elementary 1838 W Rose St. (Q11)

USE OF THIS EVACUATION MAP

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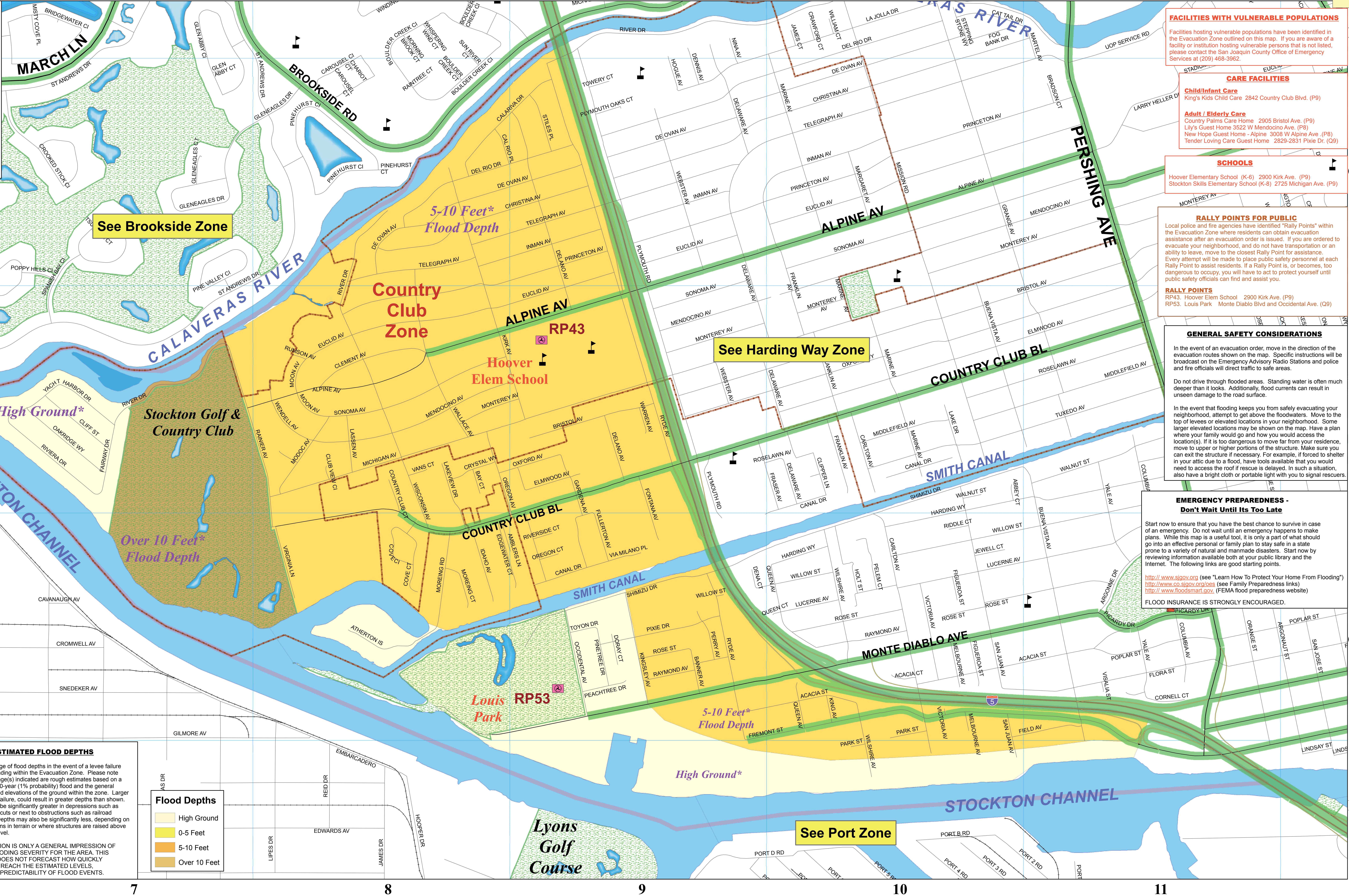
***ESTIMATED FLOOD DEPTHS**
The probable range of flood depths in the event of a levee failure are shown by shading within the Evacuation Zone. Please note that the depth range(s) indicated are rough estimates based on a comparison of 100-year (1% probability) flood and the general characteristics and elevations of the ground within the zone. Larger floods, or a dam failure, could result in greater depths than shown. Depths may also be significantly greater in depressions such as channels or road cuts or next to obstructions such as railroad embankments. Depths may also be significantly less, depending on individual variations in terrain or where structures are raised above general ground level.

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CARE FACILITIES

Child/Infant Care
King's Kids Child Care 2842 Country Club Blvd. (P9)

Adult / Elderly Care
Country Palms Care Home 2905 Bristol Ave. (P9)
Lily's Guest Home 3522 W Mendocino Ave. (P9)
New Hope Guest Home - Alpine 3008 W Alpine Ave. (P9)
Tender Loving Care Guest Home 2829-2831 Pixie Dr. (Q9)

SCHOOLS

Hoover Elementary School (K-6) 2900 Kirk Ave. (P9)
Stockton Skills Elementary School (K-8) 2725 Michigan Ave. (P9)

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RALLY POINTS
RP43. Hoover Elem School 2900 Kirk Ave. (P9)
RP53. Louis Park Monte Diablo Blvd and Occidental Ave. (Q9)

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<http://www.sjgov.org> (see "Learn How To Protect Your Home From Flooding")
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- ELEM SCHOOL
- MIDDLE SCHOOL
- HIGH SCHOOL
- HOSPITAL
- CORRECTIONAL FACILITIES
- FIRE STATION
- POLICE STATION
- RALLY POINT
- EVACUATION ROUTE
- CITY LIMITS
- EVACUATION ZONE

***ESTIMATED FLOOD DEPTHS**

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Flood Depths

- High Ground
- 0-5 Feet
- 5-10 Feet
- Over 10 Feet

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Appendix 3 - Obermeyer Gate Maintenance Manual

DRAFT

**SMITH CANAL CLOSURE DEVICE
INFLATABLE FLOOD CONTROL GATE
OPERATION & MAINTENANCE
MANUAL**

March 2010

SMITH CANAL PROJECT

OPERATION & MAINTENANCE MANUAL

******NOTE – THIS IS A SAMPLE DRAFT OF AN OBERMEYER GATE OPERATIONS AND MAINTENANCE MANUAL. ONCE THE SMITH CANAL CLOSURE DEVICE IS CONSTRUCTED, AN OPERATIONS AND MAINTENANCE MANUAL WILL BE DEVELOPED SPECIFICALLY FOR THE SMITH CANAL CLOSURE DEVICE. THE PURPOSE OF THIS SAMPLE DRAFT IS TO GIVE AN INDICATION OF THE CONTENTS OF THE FINAL OBERMEYER GATE OPERATIONS AND MAINTENANCE MANUAL . ******

TABLE of CONTENTS

SECTION 1 SAFETY PRECAUTIONS

SECTION 2 GATE ASSEMBLIES

SECTION 3 COMPRESSED AIR SUPPLY SYSTEM

SECTION 4 CONTROL SYSTEMS

SECTION 5 OPERATIONS

SECTION 6 REPAIR AND MAINTENANCE

SECTION 7 WARRANTY

SECTION 8 INSTALLATION

SECTION 9 SPECIFICATION SHEETS

SECTION 10 DRAWINGS

SECTION 1

SAFETY PRECAUTIONS

Safe operating practices must be the first priority. Water level control equipment can cause rapid and sudden changes in water level and flow rates both upstream and downstream. Anyone using the upstream river or downstream water channels for recreation or other purposes, is at risk when the flow is changed. It is the responsibility of the operator to do the following:

- Post warning signs near the gate that explain the potential hazard
- If sudden changes in water level cannot be avoided, use a warning system that sounds before the equipment is operated. The warning system allows people upstream and downstream time to reach safer ground.
- Make sure there are no personnel near the gate system

SECTION 2

GATE ASSEMBLIES

The gate assembly comprises the components found on the closure device and included the air bladders, gate panels, anchor bolts, etc. The air bladders inflate to raise the gate system and deflate to lower the gate system.

2.1 GATE PANEL

The gate panel acts as a movable, rigid barrier to the water. The gate panels attach along the upstream edge to the hinge flap portion of the air bladder. Two adjacent gate panels are fastened together using the interpanel seal.

2.2 MAIN ANCHOR ASSEMBLY

The gate and bladder system are anchored to the rectangular channel's concrete floor with the main anchor assembly. The main anchor assembly is a continuous fabricated steel unit that spans the channel's width and has a series of anchor bolts that fasten the assembly to the channel floor. There are large stud bolts extending upwards from the assembly which are used to fasten the clamp castings firmly. The main anchor assembly therefore evenly transmits the larger hydrostatic forces generated by the gate panel downward into the concrete. It also provides for water stop under the bladder.

2.3 AIR BLADDER and HINGE FLAP

The air bladder and hinge flap rest on top of the foundation and are held in place by clamp castings that mount to the foundation. When inflated, the air bladder imparts the upward and upstream force on the gate panel that impounds the water. The air control system is connected to the underside of the air bladder by means of a threaded fitting and flexible hose.

The hinge flap connects the gate panel to the dam surface and acts as a water seal. The upstream wedge section is compressed along with the air bladder wedge sections in the clamp casting. The downstream portion of the hinge flap connects to the gate panel using the bottom row of gate panel studs, hinge retainers, and hex nuts. In the fully raised position, with the air bladder inflated, the hinge flap transmits a compressive force from the clamp casting to the bottom edge of the gate panel.

NOTE: Inflation of an air bladder, even under low pressure, without clamps securely tightened, can cause permanent damage or rupture of the air bladders. The air bladder should never be inflated unless properly installed.

2.4 CLAMP CASTING

The clamp casting is positioned over the main anchor bolts and retains the air bladder and hinge flap. The clamp casting transmits a force to the bottom edge of the gate panel through the hinge flap. This force, and the force imparted to the gate panel by the inflated portion of the air bladder, provides the moment

required to support the cantilevered gate panel. The clamp castings also provide the sealing mechanism for the air bladder. The anchor bolts are in their most highly stressed state when low water conditions exist. To minimize the loading conditions, air bladder pressures should be kept to a minimum during low water conditions.

2.5 HINGE RETAINER

The hinge retainer clamps the hinge flap portion of the air bladder to the upstream edge of the gate panel. With the gate fully raised or fully lowered, the forces tending to pull the hinge flap out from under the hinge retainer are low. At intermediate gate positions, high forces occur, which requires the hinge retainer be kept tightly clamped.

2.6 INNER-PANEL SEAL

The Inner-Panel seal is the reinforced rubber strip that joins two adjacent gate panels. The Inner-Panel Seal provides a watertight seal in the area between adjacent gate panels. The standard Inner-Panel seal width is 8". For normal installations two adjacent hinge flaps are trimmed back 4" each. The Inner-Panel seal is then installed between the two adjacent hinge flaps.

2.7 INNER-PANEL SEAL RETAINER

The Inner-Panel seal retainer clamps the Inner-Panel seal to the gate panel along the upstream-downstream edges. The retainers should be tightly clamped to provide a watertight and leak free seal.

2.8 RESTRAINING STRAPS

The restraining straps are the reinforced rubber strips that attach to the foundation and to the bottom side of the gate panel. The restraining strap limits the upstream travel of the gate and insures that the gate panel does not flip over upstream when the gate system is fully raised and the water elevation is less than full pond depth.

2.9 RESTRAINING STRAP CLAMPS

The restraining strap clamp fastens the restraining strap to the foundation and to the gate panel. The anchor bolts used to fasten the clamp to the foundation and the hex head bolts used to fasten the clamp to the gate panel should be kept tight at all times.

2.10 NAPPE BREAKERS or SPLITTERS

The nappe breakers (splitters) divide the water flowing over the top edge of the raised gate system. This creates an air path to the otherwise closed off space behind the water flowing over the gate. Without the nappe breaker, a vacuum could occur behind the water and high gate loads or vibration may occur.

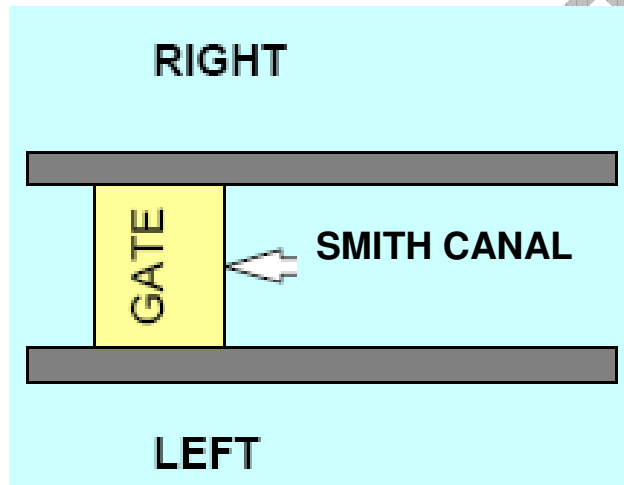
2.11 ABUTMENT PLATES

The abutment plate for this project will consist of finished concrete, that is painted with a marine based coating to allow for smooth surface contact between abutment seal and wall

2.12 ABUTMENT SEALS

The abutment seal is the reinforced rubber strip that seals the end gates to the abutment plates.

2.13 ORIENTATION



SECTION 3

COMPRESSED AIR SUPPLY SYSTEM

The compressed air supply system provides a constant supply of clean, dry, compressed air to the gate system. The air supply system components are located within the mechanical room and provide a constant supply of clean, dry, compressed air to the gate system.

3.1 AIR COMPRESSOR

The Obermeyer Pneumatic Gate System utilizes compressed air as the actuating medium. Because of this, the air supply system is one of the most important components of the system and will be determined by others. The compressor used for the supplied air is a rotary screw, Ingersoll-Rand UP6-10TAZ-125.

3.2 FILTERS

The filter unit is used for general clean-up of the bulk contaminants that may be present in the compressor system. It enhances the life of the air bladder and should be maintained in proper working condition. A second air filter is positioned after the air dryer. The filters used are part of the UP6-10TAZ-125 system.

3.3 AIR DRYER

The dryer removes moisture from low flow or infrequently used compressed air systems. The air dryer used for the system is a built in refrigerated air dryer for the UP6-10TAZ-125.

3.4 CONDENSATE PURGE VALVE

The condensate purge valve is used to purge any water from the receiver tank or that may become trapped in the pneumatic system. Checking for and draining any condensation is particularly important if the normal air supply equipment has been bypassed for any reason.

SECTION 4

CONTROL SYSTEMS

The Obermeyer Hydro, Inc. gate system is designed to maintain a constant water level upstream of the gate system. It can be controlled manually or automatically. Component specification sheets can be found in Section 9.

Reference Figure 4A

4.1 INLET PRESSURE GAUGE

The inlet pressure gauge displays the pressure of the air line from the compressor into the system.

4.2 SET PRESSURE GAUGE

The set pressure gauge indicates the pressure that will be sent to the air bladder as set by the regulator. This particular system has a set pressure gauge located next to the air bladder set pressure regulator inside the cabinet. This gauge reads accurately in a static state, there may be vibration during inflate and deflate.

4.3 AIR BLADDER PRESSURE GAUGE

This gauge indicates the pressure on each bladder in the system. The gauge reads accurately in the static state, however there may be vibration or the gauge may indicate slightly lower or higher pressure readings, during inflate and deflate.

FIGURE 4A
APC CONTROL CABINET (EXTERNAL)
(*SAMPLE PICTURE – REPLACE WITH ACTUAL PICTURE ONCE**
CONSTRUCTED)

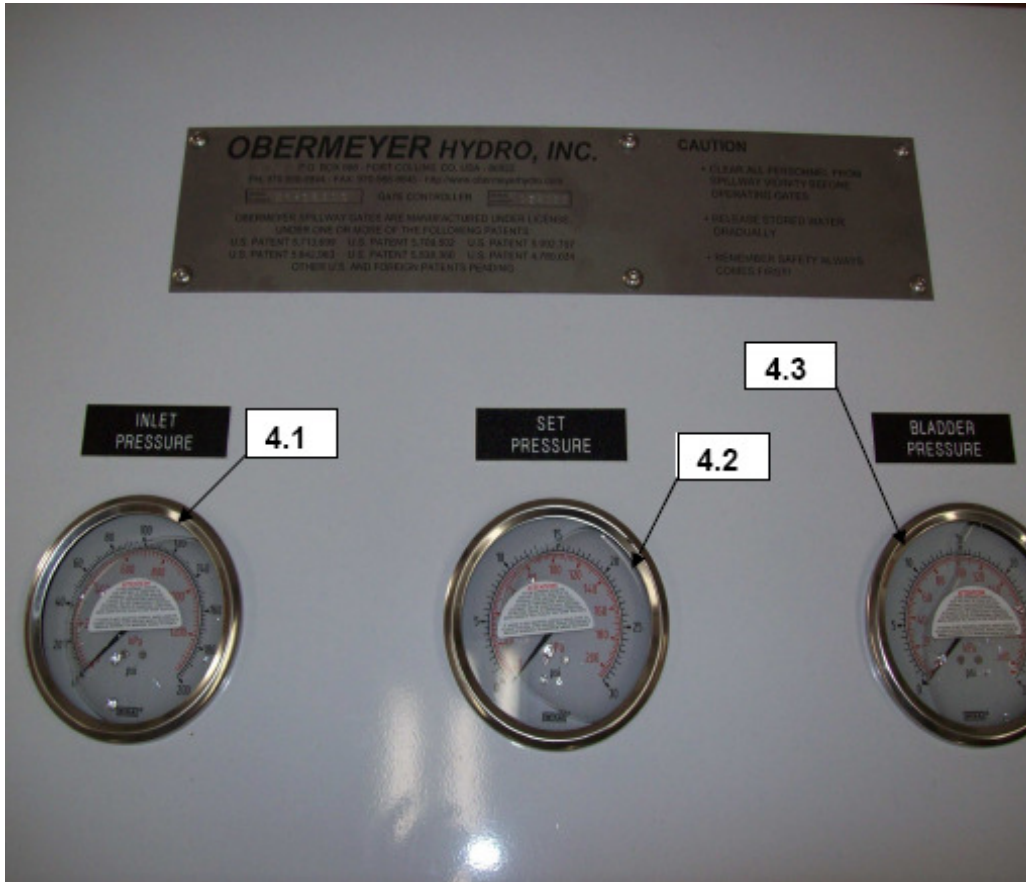
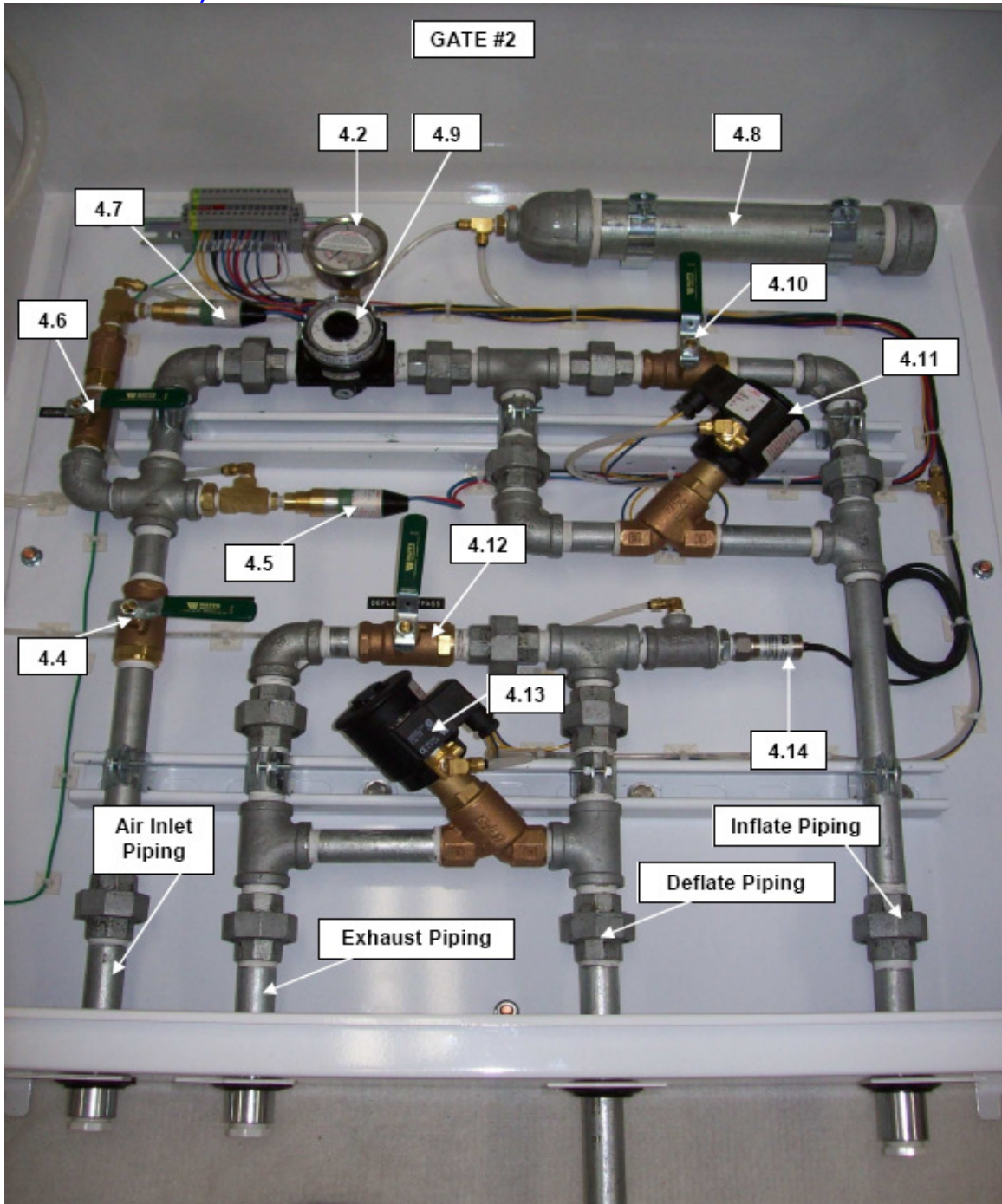


FIGURE 4B
APC CONTROL CABINET (INTERNAL)
 (**SAMPLE PICTURE – REPLACE WITH ACTUAL PICTURE ONCE
 CONSTRUCTED)



Reference Figures 4B & 4C

4.4 INLET ISOLATION VALVE

During maintenance this isolation valve can be shut off to switch out any of the control cabinet components, for normal operation this valve should be left open.

4.5 INLET PRESSURE SWITCH

The inlet pressure switch is set at 45psi. This pressure switch provides feedback to the PLC when the inlet pressure is low.

4.6 ACCUMULATOR ISOLATION VALVE

During maintenance this isolation valve can be shut off to switch out the accumulator tank or any of the solenoid valves for normal operation this valve should be left open.

4.7 ACCUMULATOR TANK PRESSURE SWITCH

The accumulator tank pressure switch is set at 45psi. This pressure switch provides feedback to the PLC when the accumulator tank pressure is low.

4.8 ACCUMULATOR TANK

The pilot pressure accumulator tank is used to maintain a volume of air to be used with the pilot operated solenoid valves.

4.9 SET PRESSURE REGULATOR

This device is used to set and adjust the gate operating pressure. To increase system operating pressure – turn to the right. To decrease system operating pressure – turn to the left. The pressure regulator should never be set at a pressure greater than the control system pressure relief valve setting, which is 30 psi. System operating pressure is 28.916 psi.

4.10 INFLATE BYPASS VALVE

The inflation bypass valve is used to inflate the air bladder. It isolates the inflate solenoid in the system. It will be used in the instance of manual inflation of the gate system. To raise the gate:

- Close the gate inflate valve and the gate deflate valve
- Set the pressure regulator to the desired air bladder pressure
- Open the gate inflate valve
- Inflate the gate system

4.11 INFLATE SOLENOID

The inflate solenoid is used with the PLC to control the gate system. This normally closed solenoid is used with a 24V DC discrete output.

4.12 DEFLATE BYPASS VALVE

The deflation valve is used to deflate the air bladder. It isolates the deflate solenoid in the system. It will be used in the instance of manual deflation of the

gate system. The gates can be lowered by manipulation of the pressure regulator or the gate deflate valve.

To completely lower a gate:

- Close the inflate gate valve
- Open the gate deflate valve

To lower a gate to an intermediate position, between full up and full down:

- Close the inflate gate valve
- Open the gate deflate valve until the desired position is reached
- Adjust the pressure regulator, while the gate inflate valve is open and the gate deflate valve is closed, until air flow through the regulator stops

4.13 DEFLATE SOLENOID

The deflate solenoid is used with the PLC to control the gate system. This normally closed solenoid is used with a 24V DC discrete output.

4.14 PRESSURE TRANSDUCER

The air bladder pressure transducer uses 24 VDC to power the loop which creates a 4-20mA signal which can be scaled to electronically read the air bladder pressure.

4.15 PRESSURE RELIEF VALVES

The pressure relief valve protects the air bladder from over-pressurization, which is set at 25psi (Located outside the APC), Figure 4C.

FIGURE 4C
APC CONTROL CABINET – EXTERNAL PIPING
(*SAMPLE PICTURE – REPLACE WITH ACTUAL PICTURE ONCE**
CONSTRUCTED)

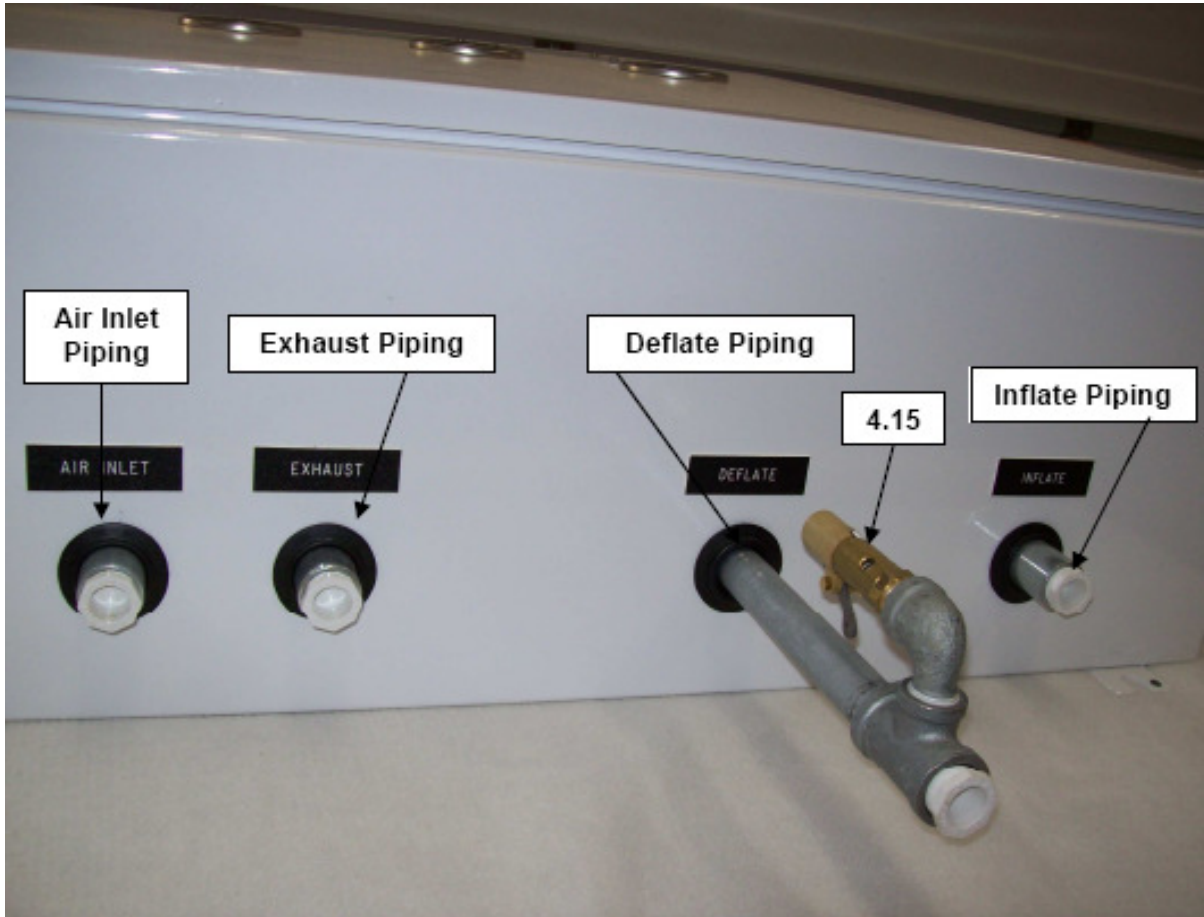


FIGURE 4D PLC (FRONT DOOR)

(**SAMPLE PICTURE – REPLACE WITH ACTUAL PICTURE ONCE CONSTRUCTED)



Reference Figure 4D

4.1 HMI CONTROL CONSOLE

Human Machine Interface for set points and automatic control programming

4.2 POWER INDICATOR LIGHT

Light indicates system power.

4.3 MANUAL INDICATOR LIGHT

Light indicates system on manual mode.

4.4 AUTOMATIC INDICATOR LIGHT

Light indicates system on automatic mode

4.5 ALARM INDICATOR LIGHT

Refer to the HMI touch panel to determine which alarm condition is activated.

4.6 MANUAL TO AUTOMATIC SELECTOR SWITCH

Changes system from automatic mode to manual mode.

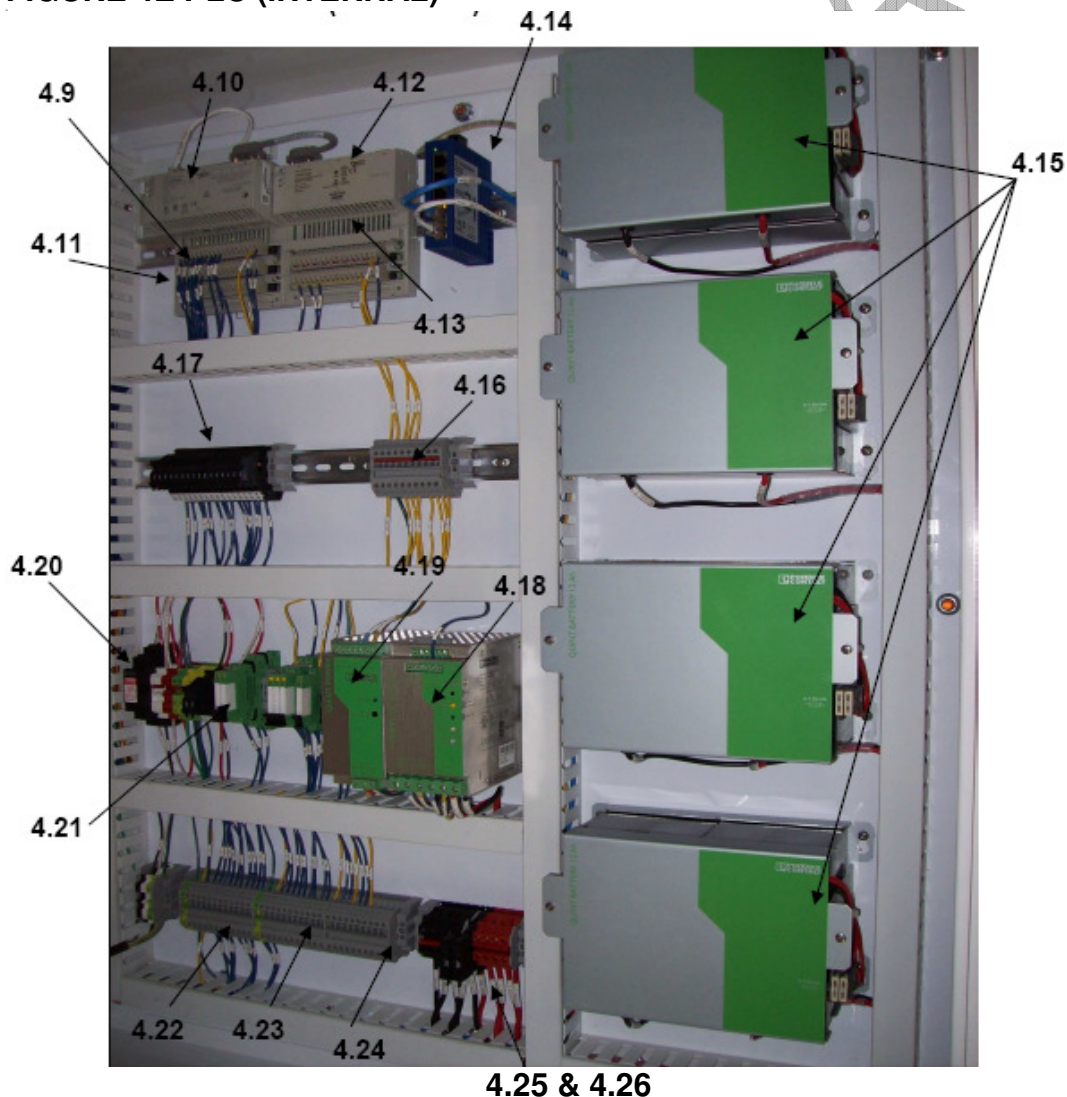
4.7 STATUS ENABLE BUTTON

The button is for the HMI/monitor during UPS operation. It will enable the HMI for 10 minutes to conserve battery power. (This is the only time the switch has any effect).

4.8 EMERGENCY STOP BUTTON

Emergency stop button stop all action.

FIGURE 4E PLC (INTERNAL)



- 4.9 Communication Adaptor w/battery
- 4.10 PLC CPU
- 4.11 Input/Output Base
- 4.12 Communication Adaptor
- 4.13 Analog Input Base
- 4.14 Ethernet, 5-port
- 4.15 UPS Battery
- 4.16 24 Volt Common BUS
- 4.17 24 Distribution Fuses
- 4.18 Uninterruptible Power Supply (UPS) Module
- 4.19 24Volt Power Supply
- 4.20 Line Voltage Surge Protector
- 4.21 Control Relays
- 4.22 Connection to Front Panel
- 4.23 Connection to Air Cabinet
- 4.24 Connection to External
- 4.25 24Volt Battery Terminal Block w/positive & negative sides
- 4.26 24Volt Battery Fuses (fused to 10Amps)

SECTION 5 OPERATIONS

5.1 MANUAL OPERATION

INFLATING the GATE

- Close the gate inflate valve
- Close the gate deflate valve
- Set the pressure regulator to the desired air bladder pressure
- Open the gate inflate valve
- Inflate the system to 16 psi set pressure for startup, and 28.916 psi for operating.

DEFLATING the STRUCTURE

- Close the gate inflate valve
- Open the gate deflate valve

To deflate the structure to an intermediate position, between full up and full down, adjust the pressure regulator while the gate inflate valve is open and the gate deflate valve is closed.

5.2 AUTOMATIC OPERATION

Automatic operation and programming of the gates will take place in the field, and adjustments with set points to be done at time of installation.

SECTION 6 REPAIR AND MAINTENANCE

6.1 INSPECTIONS AND MAINTENANCE

The following list of inspection and maintenance items should be checked as outlined. Also consult individual catalog sheets in for other manufacturers recommended O&M procedures.

ITEM	FREQUENCY
Air Compressor Oil	Weekly, change per manufacture recommendation
Air Compressor Belt	Weekly
Inspect abutment seals	Yearly*
Inspect inter-panel seals	Yearly*
Inspect air bladders	Yearly*
Inspect restraining straps	Yearly*
Inspect coalescing filter	Yearly, replace as needed
Inspect air dryer	Yearly, maintain as needed per manufacture
Torque main anchor bolts	3 times to 1200 ft-lbs during installation and then any time required after installation, once in the spring and once in the fall, or as needed
Operate purge valves	Dependant on the moisture content build-up for local area

** Procedures for inspecting underwater equipment will be developed once project design is advanced to 60% stage of completion.*

6.2 SYSTEM REPAIR

6.2.1 GATE PANEL REMOVAL AND INSTALLATION

The proper procedure for removal of a gate panel is as follows:

- Deflate gate section.
- Unbolt hinge retainers, inner-panel seal retainers and remove.
- Use the lifting holes found on the outside ribs to lift the gate panel off the air bladder.

The procedure for reinstalling a gate panel is as follows:

- Use the lifting holes found on the outside ribs to lift the gate panel
- into position under the air bladder hinge.
- Line up hinge retainer holes and bolt hinge retainers in place.

6.2.2 REPLACING GATE ABUTMENT/INNER-PANEL SEAL

The procedure for replacing an abutment seal is as follows:

- a. Locate the abutment seal to be replaced.
- b. Unbolt the abutment seal retainers.
- c. Remove the abutment seal and scrape off any access silicone caulk off of the gate panels.
- d. Position a new abutment seal on the gate panel and mark the new bolt holes on j-bulb seal.
- e. Remove abutment seal.
- f. Apply silicone caulk in areas of the gate panel that contact the abutment seal.
- g. Reposition abutment seal on gate panel with cut-out bolt hole pattern.
- h. Position abutment seal retainers over j-bulb seal and torque bolts to 75 ft-lbs.

6.2.3 AIR BLADDER INSTALLATION

To replace or install an air bladder the following sequence of events should take place.

- a. Locate the air bladder to be replaced.
- b. Follow steps found in section 6.2.1 to remove the gate panel from the air bladder.
- c. Remove main anchor bolt nuts and set aside clamp castings.
- d. Lift up air bladder and unscrew air bladder connection hose from air bladder connection fitting.
- e. Remove air bladder from foundation.
- f. Center the new air bladder in the opening and rollup to expose the air supply connection.
- g. Connect the air supply line (Always use Teflon tape or other thread sealant.) and unroll the air bladder.
- h. Replace the clamp castings and torque anchor bolts to 1200 ft-lbs. (Make sure to use Never-Seize or equal anti-seize compound on all bolts).
- i. Slide the gate panel into original place between hinge flap and air bladder.
- j. Replace and tighten down hinge flap with original hinge flap retainers and bolts to 150 ft-lbs
- k. Re-attach inner-panel seal (if removed) with original retainers and bolts.
- l. Fully inflate the gate section and verify correct movement of the gate panel and hinge flap.
- m. Deflate the gate section, wait 24-hours, and re-torque the anchor bolts to 1200 ft-lbs.

6.2.4 REPAIRING MINOR LEAKS

If a minor leak should be found in any air bladder the following sequence should be followed.

- a. Determine where leak is occurring on the air bladder.
- b. Determine if the section of bladder in which the leak is occurring accessible with the gate panel attached.
- c. If the leak is accessible, inflate the crest gate section high enough to access the leak and fix by following the directions found on included patch kit.
- d. If the leak can only be fixed by removing the gate panel then remove gate panel as described above, repair the leak, and replace the gate panel.

6.2.5 REPAIRING MAJOR LEAKS AND TEARS

If a major leak or tear is found in an air bladder consult Obermeyer Hydro, Inc. for advice on repair or replacement of air bladder.

6.2.7 AIR BLADDER CLAMPING FORCE

The importance of maintaining the air bladder clamping force cannot be stressed enough. The result of not maintaining proper air bladder clamping force can be the catastrophic failure of an air bladder. To insure that the air bladder clamping force is sufficient, the crest gate system should never be used unless the main anchor bolts are torqued to 1200 ft-lbs.

6.2.8 REPLACEMENT BLADDERS AND DELIVERY

Consult Obermeyer Hydro factory for replacement bladders and delivery time. Air bladders are generally available with a four-week delivery schedule depending on time of year.

6.3 MAINTENANCE SCHEDULE

WARNING: DISCONNECT, LOCK AND TAG MAIN POWER SUPPLY AND RELEASE AIR PRESSURES FROM SYSTEM BEFORE PERFORMING MAINTENANCE

Note: All compressed air systems contain maintenance parts (e.g. lubricating oil, filters, and separators) which are periodically replaced. These used parts may be, or may contain, substances that are regulated and must be disposed of in accordance with local, state, and federal laws and regulations.

Daily	Check for unusual noise and vibration
Weekly	Ensure air piping and electrical wires have good connections
	Clean gauges of dust and debris
	Clean regulators of dust and debris
	Check safety/relief valves by pulling rings or lifting arms.

Replace safety/relief valves that do not operate freely.

Rotate and return all pressure regulators slightly to ensure that they are still operating properly

Monthly

Inspect for air leaks

Check tightness of screws and bolts. Tighten as needed

Clean interior and exterior of cabinet of dust and debris

Check filters elements.

Check operation of dump valve and verify that system begins to deflate

Tap all gauges with finger and vibrate indicator and verify that they return to original position

Develop a written schedule to maintain the system. Write down any problems that occurred and how they were corrected during the operation.

6.4 TROUBLE SHOOTING

PROBLEM

ACTION

GATE NOT INFLATING

Check compressors and see if they are operating
Check air filters and verify that the air pressure is reaching the control system
Read the inlet pressure gauge on the cabinet and verify inlet pressure
Check the bladder pressure regulator, verify it is set to proper level
Verify the inflate valve is open and deflate valve is closed
Verify all bypass and isolation valves are in their proper position
Check for signs of leakage and repair

GATE NOT DEFLATING

Check compressors and see if they are operating
Check air filters and verify that the air pressure is reaching the control system
Read the inlet pressure gauge on the cabinet and verify inlet pressure
Check the bladder pressure regulator, verify it is set to proper level
Verify the deflate valve is open and inflate valve is closed
Verify all bypass and isolation valves are in their proper position
Check for signs of leakage and repair
Check for blockage in the exhaust line

Check for blockage in the air bladder line

6.5 TORQUE REQUIREMENTS

The following Torque settings will be used for the system:

Diameter	Thread UNC	Torque (ft-lbs)	Notes
Ø 2-1/2"	4	1200	Main Anchors
Ø 1-1/4"	7	300	Restraining Strap Anchors
Ø 1-1/4"	7	300	Restraining Strap Bolts (Gate)
Ø 1"	8	250	Inter-Panel Bolt
Ø 1"	8	150	Hinge Flap Retainer
Ø 5/8"	11	75	Inner-Panel/Abutment Seal
Ø 1/2"	13	35	Nappe Breaker

SECTION 7 WARRANTY

7.1 OBERMEYER HYDRO INC. –GATE WARRANTY

PROJECT: SMITH CANAL CLOSURE DEVICE

OWNER: ?

SYSTEM START-UP DATE: ?

WARRANTY – Company warrants title to the product(s) and also warrants the product(s) on date of delivery to Purchaser to be of the kind and quality described herein, merchantable, and free of defects in workmanship and material.

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THOSE EXPRESSED IN THIS CONTRACT.

If within two years from the date of initial operation, but not more than two years and six months from the date of shipment by Company of any item of the product(s), Purchaser discovers that such item was not as warranted and promptly notifies Company in writing thereof, Company shall remedy such non-conformance by, at Company's option, adjustment or repair or replacement of the item or any affected part of the product(s). Purchaser shall assume all responsibility and expense for removal, reinstallation, and freight in connection with the foregoing remedies. The same obligations and conditions shall extend to replacement parts furnished by Company there under. Company shall have the right of disposal of parts replaced by it. The Company shall not be liable for any repairs, replacements, or adjustments to the Product(s) or any cost of labor performed by the Purchaser or others without the Company's prior written approval.

The Purchaser shall not operate the Product(s) which is considered to be defective, without first notifying the Company in writing of its intention to do so. Any such use of the Product(s) will be at the Purchaser's sole risk and liability unless Company gives Purchaser approval to operate the Product(s). Such approval will not be unreasonably withheld.

The effects of corrosion, erosion, and normal wear-and-tear are specifically excluded from the Company's warranty.

Company's liability to Purchaser relating to the product(s) whether in contract or in tort arising out of warranties, representations, instructions, installations, or

defects from any cause, shall be limited exclusively to correcting the product(s) and under the conditions aforesaid.

Any separately listed item of the product(s) that is not manufactured by the Company shall be covered only by the express warranty of the manufacturer thereof.

7.2 COMPANY CONTACT INFORMATION

OBERMEYER HYDRO, INC.
P O BOX 668
FORT COLLINS CO 80522
TELEPHONE: 970-568-9844 FAX: 970-568-9845
WESITE: www.obermeyerhydro.com

SECTION 8 INSTALLATION

Note: This is a general guide only. Actual field conditions may dictate different construction methods.

This procedure is to be used by the Contractor installing the OHI gate system. This document is divided into several sections:

- Civil works: Abutment wall finishing, anchor bolts, foundation concrete, and pneumatic piping.
- Gates: Installation of the gates, bladders, hinges, clamps, seals and other associated hardware.
- Installation of air controls including compressor and APC cabinet.
- OHI field inspection responsibilities
- Site specific data including tolerance, required tools, torque values

General Notes: Never connect brass to stainless steel. Use anti-seize compound on all threads. Use Teflon tape and pipe joint compound on all air fittings. Caulk must be 100% silicone or aquarium grade. Silicone will not bond to wet surfaces, so keep them clean and dry. Keep sharp objects and surfaces away from rubber parts.

1.0 ABUTMENT WALLS

1. The stainless steel abutment plates must be mounted to the existing concrete
2. abutment surface as shown on OHI drawing 06-208-112 & 113.
3. The abutment plates must be adjusted, using the hardware provided and prior to grouting behind the abutment plates, so that they are plumb to within 1/8" and are perpendicular to the anchor bolt centerline. The abutment plate to abutment plate distance must be maintained pursuant to the construction drawings to within 1/4". The seal contact plate (abutment plate) must be installed so that it is coplanar within 1/8".
4. The plates must be secure and capable of withstanding the hydrostatic force the grout placed behind the plates creates. Any shifting of the abutment plates during grouting may require the removal of the plate and reinstallation, at the Contractor's cost.
5. The abutment plates are delivered in complete sections at the job site. The surface mounted brackets used to adjust the abutment plates are to be ground off flush and smooth.

6. Grinding wheels must be new. Previous use on carbon steel alloys is forbidden.
7. After the grout behind the plates has hardened, the complete surface of all abutment plates will be buffed using a new buffing disk. The abutment plates will be buffed until shiny swirl patterns are formed. The plates will be smooth to the bare hand and free of any metal projections.

2.0 MAIN ANCHOR BOLT INSTALLATION

1. Formation of the concrete cross section where the main anchor clamp casting sits will be made using OHI provided steel forms. Steel forms must be prepped with a separation agent before use.
2. Contractor will secure into place the provided steel forms. Contractor will check that form placement does not interfere with any expansion joints in the concrete foundation.
3. The forms will provide lateral rigidity and maintain the exact location of embed angles and anchor bolts. The heel and wedge embeds are fastened to the forms with studs that are welded to the heel and wedge embeds. The concrete forms can be bolted together to form longer sections.
4. Contractor to ensure the forms are firmly secured using tie rods that are embedded in concrete. Contractor to finalize method of fastening tie rods. Contractor to apply extra vibration near the forms to ensure no air pockets form under the steel forms. Honeycomb formation under the heel and wedge embeds or around the anchors bolts shall be avoided.
5. After pouring, the Contractor to remove the steel forms carefully and prepare for shipping back to OHI.
6. After forms are removed, embed studs to be ground off flush.
7. Anchor bolts should be installed using the provided form pan and centering spacer. Proper use of the centering spacer and form pan will ensure proper positioning. See drawing 06-208-101, 06-208-102, and 06-208-111.
8. The anchor bolts should also be firmly secured to a mud mat to meet anchor bolt tolerances found on the drawings. Anchor bolts to be 5-5/8" above finished concrete surface. Movement in any direction shall not exceed 1/8".

9. Contractor will secure form work in place. Contractor can submit anchorage methods to Obermeyer Hydro for ideas and approval.
10. Under no circumstances will welding of any metal to the anchor bolts be allowed. Unapproved heating of the bolts could lead to failure of the anchoring system.

3.0 FOUNDATION FINISH, EMBEDDED PNEUMATIC PIPING, and CONDUIT PIPING.

1. The concrete area along the foundation crest to which the clamping assembly is to be bolted shall be made level and flat with a high quality smooth surface. The area that supports the bladders will be made smooth and shall be free of sharp or abrasive objects or protrusions, which could damage the air bladder.
2. The pneumatic piping shall be placed in accordance with the drawings. Contractor to review drawing to ensure that pneumatic piping is in correct location and is correct size.
3. Particular attention should be made to the location of the air purge line location. Contractor to locate lowest point in air supply line to air bladders and position air purge line accordingly.
4. Contractor's scope to include piping stub out into the air-connection block-out and terminates with a female threaded coupling.

4.0 GATES

Bladders, Hinges, Inner-Panel Seals and Gates

1. **Foundation Prep:** Clean foundation of dirt & debris, especially wedge area. Wire brush anchor bolt threads to remove any concrete splatter. Repair damaged threads with 3-corner file. Dry fit clamp bars.
2. Locate gate panels and air bladder hinge flaps.
3. Install air bladder hinges onto gates panel using hinge retainers and stainless steel fastening hardware. Set aside.
4. Locate air bladders and miscellaneous plumbing hardware.
5. Attach 3/4" brass elbow to brass bulkhead fitting located on bottom surface of air bladder (Use Teflon tape and paste on all screw type pipe fittings). Connect brass barb.
6. Connect 3/4" stainless steel elbow to end of Contractor supplied air piping.

7. Position upstream edge of air bladder (the edge with the wedge profile) on foundation just downstream of main anchor bolts. Make sure the air bladder fitting fits correctly into air connection trench.
8. Roll up the edge of air bladder to expose air bladder connection trench.
9. Locate 3/4" Poly reinforced hose. Measure length of air hose needed, making sure hose has stainless steel insert and plastic tube inside as per drawing. Install between the two 3/4" hose nipples using (1) stainless steel, Mikalor hose clamps on each fitting
10. Roll air bladder into final position
11. Repeat steps 6 thru 10 for each air bladder.
12. Place assembled gate panels/air bladder hinges onto bladders. Align the upstream edge of hinge flap with the air bladder wedges. The upstream profile of the two 30 degree air bladder wedges and the single hinge flap 30 degree wedge should follow a circular arc.
13. Locate main anchor clamp castings. Position main anchor clamp castings over the air bladder and hinge flap wedges.
14. Leave the outermost main anchor clamp castings on each air bladder off. Place the middle castings only at this time.
15. Snug stainless steel hex bolts on interior clamp castings. Make sure to use generous amounts of copper or nickel-based anti-seize lubricant on all stainless steel threads and on bearing surfaces of stainless steel nuts.
16. Repeat steps 12 through 15 for each gate section. Double check the abutment-to-abutment direction measurement after placing each gate, to ensure that gate panels and air bladders are set correctly.
17. Locate Inner-Panel seal. Place a small amount of never-seize or other marking substance on ends of Inner-Panel seal studs.
18. Re-position Inner-Panel seal on top of Inner-Panel seal studs with Inner-Panel seal spaced evenly between the two gates.
19. Mark Inner-Panel seal hole locations by tapping Inner-Panel seal with a hammer at each Inner-Panel seal stud position. The never seize will mark the hole location.
20. Remove Inner-Panel seal and punch holes using an arch punch or hole-saw

21. With Inner-Panel seal in place trim the hinge flaps or Inner-Panel seal to make a tight fit between the two parts. Use a concrete demolition saw, a saws-all, or utility knife to cut the hinge flap.
22. Test fit Inner-Panel seal and remove.
23. Place a bead of silicone caulk on gate panel just to the left and to the right of each row of Inner-Panel seal studs (Include a bead on top of Inner-Panel seal).
24. Install abutment seals. See Section 5.0.
25. Cold vulcanize seals at joint areas. Install all Inner-Panel and Abutment seals before vulcanizing in order to maximize the time sensitive materials involved in the process. See vulcanization technique in OHI-SPEC-3004.
26. Locate Inner-Panel/Abutment seal retainers, washers and nuts. Install Inner-Panel/Abutment seal retainers and stainless steel fastening hardware. Torque 5/8" nuts to 75 ft-lbs.
27. After vulcanized seals have cured, place remaining clamp castings in position, beginning at the middle anchor bolt on the air bladder and working toward each end of the air bladder, torque each anchor bolt to 1200 ft-lbs.
28. Starting at one end re-torque all main anchor bolts to 1200 ft-lbs.
29. Wait 24 hours and again torque all anchor bolts 1200 ft-lbs. (Note 1200 ft-lbs is an estimated only; temperature affects on the rubber may require a higher torque value to seat rubber into casting). Torque all hardware and main anchors a minimum of 3 times.
30. Inflate gate system to proper height.
31. Install Nappe Breakers on downstream top edge of each gate panel.

5.0 INSTALLATION OF ABUTMENT SEALS

1. The abutment seals incorporate a 30 degree wedge section at the upstream end (same as the hinge flap). Trim back hinge flap so the abutment seal wedge section fits snugly against the hinge flap section. Allowing 1/8" interference on each side works well. Test fit abutment seal, securely positioning the wedges between the hinge wedge.

2. Using anti-seize lubricant or some other marking paint, coat the tops of the studs holding the abutment seal. By hand, push the abutment seal against the abutment plate so the flat sealing surface of the seal is flush with the stainless steel abutment plate. This is so the seal will have tension on the abutment plate and make a seal. Holding in place, hit the seal with the sledge hammer directly over the stud, marking the underside.
3. Remove the seal and either punch or cut the holes in the seal. A slight oblong hole is preferred for adjustment. A good reference point for locating the holes is the location of the first stud mark from the wedge of the seal.
4. Install seal using generous amount of 100% silicone caulk between the seal and the gate panel.
5. Test seal by checking for any visual gaps between the seal and the abutment plate with the gates in the fully closed position. Adjust seal as required so that no visual gap is present.

6.0 AIR PIPING

1. The piping between the compressors and Air Plumbing Cabinet (APC) should have a working pressure of at least 150 psig. The piping between the bladders and the Air Control Cabinet will normally contain pressures less than 50 psig.
2. All piping should be blown out with air to remove any scale or debris prior to connection to the APC or the bladders.
3. Providing all piping and wiring and the installation of all piping and wiring is the responsibility of the Contractor. Installation of the compressors, dryers, filters, tanks, drain valves, air control cabinet and associated equipment is the responsibility of the Contractor.
4. Contractor to provide means of removing condensate from air line at low point
5. of air pipe system or at control side abutment. Any exposed portions of the piping shall be securely supported on 6' centers using 14 gauge stainless steel unistrut. A minimum of two ½" stainless steel epoxy type anchor bolts per 6-foot section shall be used to mount the unistrut.
6. All air piping shall utilize welded fittings. All welding to be in accordance with AWS Structural Welding Specifications. All pipe joints to be leak proof.

7. Before installation of gate system, the entire run of pipe and connections shall be inspected and pressure tested to 50 psig and each joint checked for leaks with the owner's representative present.
8. Contractor to provide for and construct condensate purge valve at low point in piping system.
9. All electrical conduit shall be from zinc coated rigid steel conduit meeting ANSI C80.1
10. Piping at expansion joints to be sleeved to allow for movement of concrete.
11. All piping and conduit shall be rigid, except that flexible metal conduit may be used in short lengths where needed to connect to vibrating equipment.

7.0 LOCATING AND ANCHORING COMPRESSOR, APC and PLC

Place APC into its final position.

Using a marker, mark the holes on the wall or floor accordingly. Move the cabinet away from the marked holes.

Using the concrete drill, bore holes which match the manufacturers recommended depth and diameter for the stainless steel wedge type anchors.

Install the wedge type anchors.

Place the cabinet in the appropriate position. Tighten anchors until the cabinet is firmly anchored.

Connect the pipes to appropriate ports per the project drawings.

Repeat the process for both the air compressor equipment and Program Logic Controller (PLC).

8.0 ELECTRICAL

Contractor to supply and install control wiring between the APC and PLC per applicable building codes.

All electrical conduit shall be from zinc coated rigid steel conduit meeting ANSI C80.1

Contractor to supply and install power supply conduit and wiring between the circuit breaker and compressor motor per project drawings.

Contractor to supply and install sensor cabling between external termination boxes and the PLC cabinet per project drawings.

5. Contractor to procure circuit breaker panel per project drawings and install in accordance with appropriate building codes.

9.0 FIELD TESTING

1. An OHI field representative should be on site for system start up as per contract or tests should be performed by general contractor.
2. The air supply pipes shall be tested prior to covering with concrete, backfilled, or otherwise concealed. The air piping between the gate and the air control cabinet shall be tested by pressurizing to 50 psi for 24-hours. Pressure readings and ambient air temperature shall be recorded at six different times during the test. Any joints or fittings exhibiting leakage during this time shall be repaired or replaced.
3. The air piping between the air control cabinet and high pressure equipment shall be tested by pressurizing to 150 psi for 24-hours.
4. Pressure readings and ambient air temperature shall be recorded at six different times during the test. Any joints or fittings exhibiting leakage during this time shall be repaired or replaced.
5. After installation of the gate system, before removing the cofferdam the gates shall be fully raised and lowered three (3) times using a portable air supply. The gate shall operate smoothly with no binding.
6. Do not inflate air bladder past the operating pressure found in the hydraulic calculations.

10.0 TORQUES AND TOOLS

10.1 Torque Values: The following Torque settings will be used for the project:

Main Anchor Bolt (Ø 2-1/2" – 4UNC):	200 ft-lbs
Restraining Strap Anchor (Ø 1-1/4" – 7UNC):	300 ft-lbs
Restraining Strap Bolt (Gate: Ø 1-1/4" – 7UNC):	300 ft-lbs
Inter-Panel Attachment of Gates (Ø 1" – 8UNC):	250 ft-lbs
Hinge Flap (Ø 1" – 8UNC):	150 ft-lbs
Abutment/Inner-Panel Seal (Ø 5/8" – 11UNC):	75 ft-lbs
Nappe Breaker (Ø 1/2" – 13UNC):	35 ft-lbs

10.2 Required Tools

Controls & Compressor (tools)

- Adjustable wrenches
- Pipe wrenches
- Screw driver
- Fine point permanent marker
- 6 – Stainless steel ½" diameter x 6" length wedge anchors
- Concrete drill for ½" diameter wedge anchor
- Lifting/moving apparatus

Gate System Installation (tools)

- Wrench and socket for main anchor bolts. Air impact wrench in combination with manual torque wrench is satisfactory. A hydraulic torque wrench is more convenient if available.
- Sockets and ratchet wrenches for seal retainer nuts and for hinge flap nuts.
- Wrenches for gate panel flange bolts.
- Utility knives for cutting rubber 1kg hammer and (7/8"=22mm) rubber punches for inter-panel seals and abutment seals.
- Anti-seize compound sufficient for all nuts and washers.
- 32 tubes of 100% silicone or aquarium grade caulk and 2 caulk guns.
- Rags for cleaning up silicone messes.
- Abrasive cutoff saw and motorized reciprocating saw (e.g. "Sawzall") for trimming hinge flaps to length.
- Air bladder lifting clamps (designed by OHI).
- Hand held angle grinder.
- Lifting shackles to fit gate panel lifting holes, spreader bar for bladders.
- 2 Pry bars approximately 1m long
- 1 or 2 drift pins for aligning gate panel flange holes.
- Electric drills.
- Pipe joint compound and teflon tape for air fittings.
- Pipe wrenches for air fittings.
- Pliers
- Shackles to fit crane hook to L shaped clamp casting lifting bracket.
- Thread File.
- Thread cutting dies to fit all smaller threads for repair if required.

SECTION 9 - SPECIFICATION SHEETS

To be developed.

SAMPLE DRAFT

SECTION 10 DRAWINGS

To be developed.

SAMPLE DRAFT

Appendix 4 – Flood Fighting Methods

DRAFT

STATE OF CALIFORNIA / THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

FLOOD FIGHTING METHODS



Division of Flood Management
Flood Operations Branch

Revised August 2003

FLOOD FIGHTING METHODS ON LEVEES AND ALONG RIVER BANKS

The main causes of levee failure during periods of high water are:

1. Seepage through or under the levee heavy enough to cause a “boil”. This can be caused by burrowing animals or decomposing tree roots.
2. Erosion of the levee due to swift moving water or wave action.
3. Overtopping resulting from river water-surface elevations higher than the levee.

The emergency measures used to prevent levee failure from these causes are known as “Flood Fight Methods.” The flood fight methods described in this booklet have proven effective during many years of use by the Department of Water Resources, Division of Flood Management and the United States Army Corps of Engineers. However, all measures shown are temporary and cannot be expected to last for extended periods of time.

Structures other than levees may also require flood protection.

Levee Patrol

When water levels reach a predetermined height (Monitor Stage), two person mobile patrols should be assigned to those areas for observation. Patrols should look for wavewash, boils, seepage, cracks, or sloughing. Personnel should maintain communications with the local Incident Command Post (ICP) and report problem areas too large or time consuming to repair with the minimal amount of flood fight equipment and material carried in patrol vehicles.

Filling Sandbags

When filling sandbags you should work in pairs, with one person holding the bag while the other shovels in the fill material. The first shovel of fill should be placed on the lip of the bag to help hold the bag open. The bag holder should find the most comfortable position while holding the bag open.



Figure 1

- The most common mistake made is overfilling bags. The shoveler should use rounded scoops of fill until the bag is approximately 1/3 full. While shoveling or holding, avoid extra movements (turning or twisting of the back) to prevent injury.

Sandbag Construction

The use of sandbags is a simple but effective method of preventing or reducing damage from floodwater and debris. (see Figure 2) Suggestions for constructing sandbag structures are:

1. Close weave burlap bags are recommended for all sandbag construction when available.
2. Fold the empty top of the bag at a 45-degree angle to keep sand from leaching out.
3. Place each bag over the folded top of the preceding bag and stomp into place.
4. Stagger the second layer of bags over the preceding layer seams.
5. Stomp all bags to form a tight seal.
6. The last sandbag in a line is referred to as a Key Sack. This bag is folded under and stomped into place.

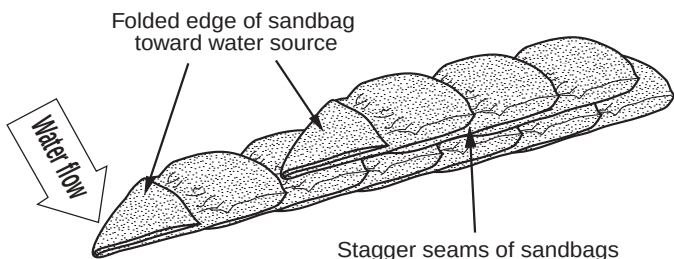


Figure 2

Fill sandbags 1/3 full, folded edge of sandbag toward water source, stagger seams of sandbags.

Tying Sandbags

Most sandbags are used with the open end folded. In some cases sandbags will have to be tied. Fill the bag $\frac{1}{4}$ to $\frac{1}{3}$ full of material. Hold one open corner (see Figure 3).

Figure 3

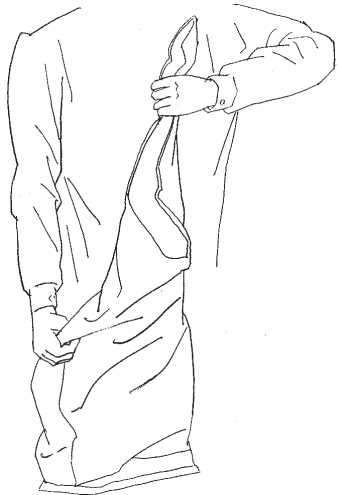
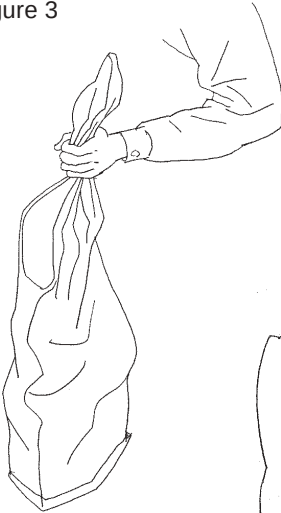


Figure 4

With your other hand take the lower portion of the opposite side and spin it

Figure 5

The long tail should be twisted tightly and look like a piece of rope.



Figure 6

Tie an overhand knot (pretzel knot) as low as possible on the bag.

CONTROL OF LEVEE OVERTOPPING

If any levee reach is lower than the anticipated high water elevation, an emergency topping should be constructed to raise the levee grade to the forecast flood height. Levee topping may be required at road or stock crossings, low levee sections, or railroad crossings. The following paragraphs discuss various methods for increasing levee elevation.

Sack Topping

The most common form of flood control work is the use of sandbags for construction of temporary walls (see Figure 7). The use of sandbag walls to increase the height of a levee section is called “sack topping.” The sacks are laid “stretcherwise,” or along the levee for the first layer, crosswise for the the second layers, and so on. The sacks should be lapped at least one-third either way and stomped firmly into place. When properly sacked and tamped, one sack will provide about 3 to 4 inches of topping.

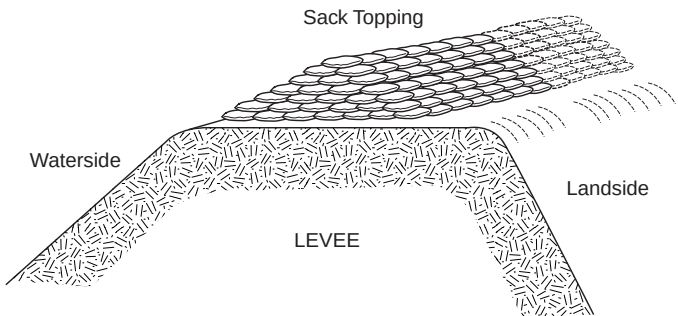


Figure 7

CONTROL OF BOILS (Away from Levee)

A boil is a condition that occurs when water is “piped” through or under a levee and resurfaces on the landside. These weak points are generally caused by burrowing rodents or decomposed tree roots. High water pressure can begin to erode the interior of the levee and weaken the structure. Levee material will deposit around the exit point as the water discharges on the landside. If the boil is determined to be **“carrying material”** then corrective action is required to control the situation. If left unattended the material that makes up the levee can be eroded at an accelerated pace, causing subsidence and overtopping of the levee. This could result in a levee break.

The common method for controlling a boil is to create a watertight sack ring around it. The sandbag structure should be high enough to slow the velocity and prevent further discharge of material from the boil (see Figure 8 and 8A). The flow of water should never be stopped completely, since this may cause the boil to “break out” in an area near the existing sack ring. A spillway must be constructed to direct water away from all boil sites.

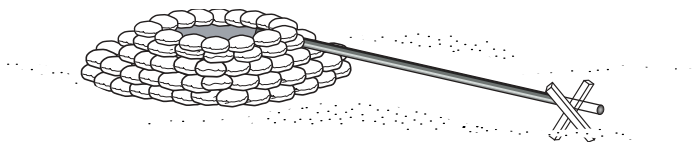


Figure 8

Bottom width should be at least $1\frac{1}{2}$ times the height. Do not sack boils that are not carrying material, but continue to monitor. Boils can begin to carry material after first located.

The sack ring should be large enough to encompass the area immediately surrounding the discharge point (3 to 4 feet diameter). If several boils carrying material are found, a single large sack ring may be constructed around the entire “nest” of boils.

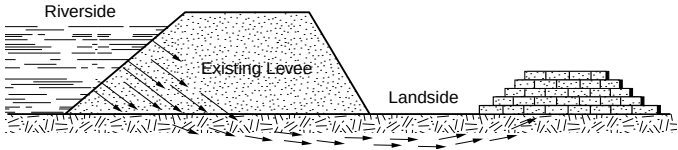


Figure 8A

NEVER completely stop the flow from a boil. This may cause the boil to “break out” in an adjacent area. ALWAYS control the boil to a point where it ceases to carry material and the water runs clear.

CONTROL OF BOILS (On Levee Slope)

If the boil is close to or on the levee slope, a U-shaped sack ring may be built around the boil and sealed into the slope (see Figure 8B). Construction of this method can be difficult and requires substantial shoring up of the U-shaped sack ring structure.

A spillway must be constructed to direct water away from all boil sites.

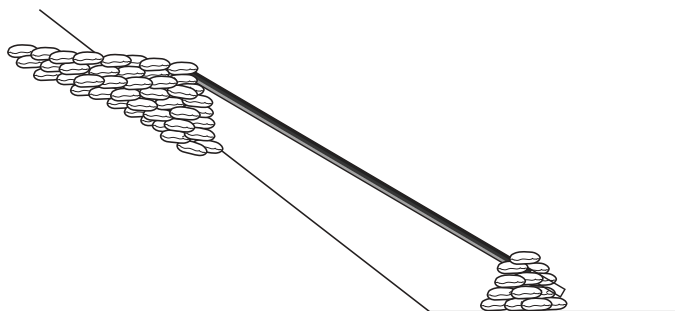


Figure 8B

Spillways can be constructed by nailing two 2"x 6" boards together to form a V notch; PVC pipe; two parallel sandbag rows; visquine, etc.

Waterside Boil Inlet Detection

Water running through a levee and carrying material can sometimes be stopped on the waterside, thus eliminating the building of sack rings on the landside (see Figure 9). A six foot long section of 2" diameter pipe secured to a 5'x 6' foot piece of plastic or canvas can be rolled over the inlet hole on the waterside. Drive 1"x 3"x 2' stakes into the shoulder of the levee. Suspend half filled sandbags on top of rolled-out material with twine and tie off to stakes. It can be difficult to locate the waterside inlet of boils. Sometimes a swirl is observed at the water's edge.

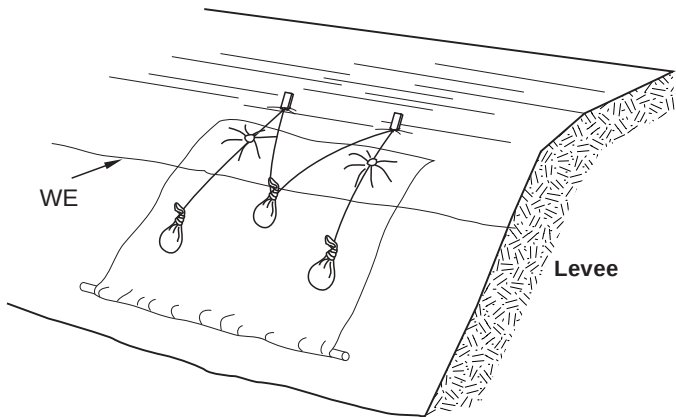


Figure 9

WAVEWASH PROTECTION

Wavewash

All levees adjacent to wide stretches of water should be watched during periods of strong wind to detect the early stages of wavewash erosion. If the slope is well sodded, short periods of high wind should cause little damage. However during sustained periods of strong wind and high water, ample labor should stand by, and experienced personnel should observe and monitor the effected areas.

Wavewash Protection

Envelope Method

When used correctly, plastic sheeting (Visquine) is useful for wavewash protection. Visquine should be purchased in rolls; 10 mil, 20 feet wide by 100 feet long. 1"x3"x2' wooden stakes are driven into the ground just above the levee shoulder on the side you wish to protect. Place the stakes 4 feet apart and staggered 1 foot as shown in Figure 10.

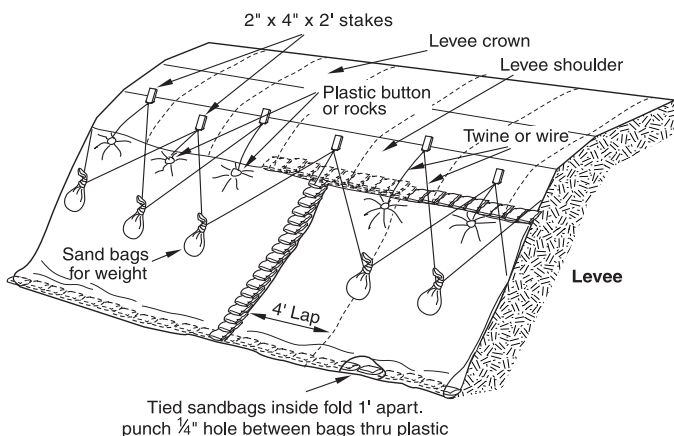


Figure 10
Wavewash Protection

Avoid driving stakes in a straight line; this tends to cause cracking and sloughing of the slope. To provide added strength and leverage, drive stakes at a slight angle away from the water source with the wide (3") side facing the water. Be sure the stakes are well into the ground and are secure.

When rolling out the plastic sheeting it is helpful to use a shovel or similar long-handled tool. Eight to ten people should assist in shaking out the folds of the envelope. Be sure that both layers are held while the envelope is shaken out. Hold on tight! Use caution in strong winds. If the wind catches the plastic it could billow out and pull you along with it.

While flood workers hold the plastic securely, toss tied sandbags into the envelope. The tied sandbags are thrown into the bottom of the envelope with a one-foot gap between bags. The tied bags provide weight to hold the plastic against the levee slope.

A tie-down button or small stone (preferably round) is secured through both layers of visquine. (If a stone is used, tie a slip knot and double half-hitch to secure it.) Fasten buttons to the visquine and tie off to the stakes using a minimum 250 lb tensil strength twine with these points in mind: (See Figure 10A.)

1. Fasten button at least 1 foot from the edge of the plastic.
2. Fasten buttons to both layers of plastic.
3. Fasten buttons directly below stakes (one button per stake).
4. Tie twine low on stake for strength and to prevent a tripping hazard.

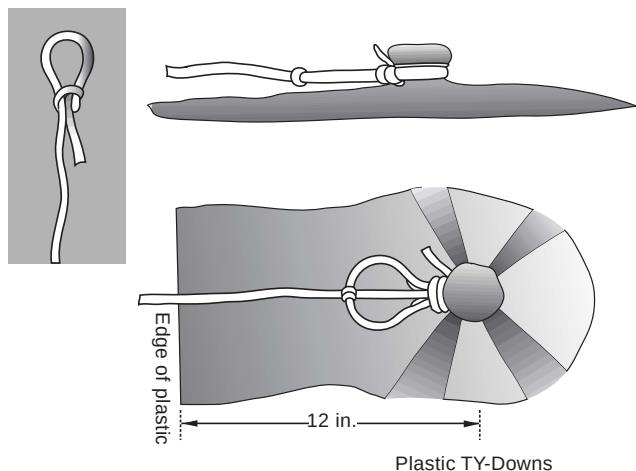


Figure 10A
Eliminate slipknot insert

Visquene is secured using tie down buttons. To attach plastic buttons to the visquene, tie a slipknot on the end of the twine; slip loop over button and plastic and draw tight. Tie two half hitch knots around the throat of main body. Extend twine to large end of main body, tie a half hitch knot around the end, and secure twine to stake. (see figure 10A)

With the visquine secured to the stakes, punch a small hole between each tied bag in the envelope, (a pencil works well). These holes release water trapped in the envelope. DO NOT use a knife because a slice or slit will tear and spread in the plastic.

If further slope protection is necessary insert an additional envelope into the existing wavewash protection overlapping at least four feet. To secure the overlap to the

stakes attach the two top layers with one button and the two bottom layers with another. The buttons line up with the stakes that are four feet apart. There should be four buttons securing the two envelopes.

Using a continuous piece of twine, hang tied-bags from stakes in a zigzag fashion as shown, in Figure 10. Tie a double half-hitch knot below the knot in each sandbag. Place each bag so that it hangs at the middle of the plastic directly below the stake between the two stakes from which it is suspended. Attach twine to every other stake with a double half-hitch. Add a second row of tied bags suspended from the stakes previously skipped. These bags will keep the visquine lying flat against the levee slope in windy conditions.

If the upper portion of the slope needs protection, use an additional envelope. Be sure to place the upper layer over the lower layer by 2 to 3 feet. Finally place sandbags along all seams to prevent wind and water from entering the envelope. To prevent slippage, make sure the top seam cap is half on the plastic and half on the levee as shown in Figure 10. If the levee slope is too steep, some of the bags on the seam may be tied off with twine to the stake above the envelope for support.

Remember, wind is your worst enemy. When using visquine, be sure all seams are secured with sandbags, and make needed repairs as soon as possible.

Protection of Slopes

Raincoat Method

The raincoat method is used to prevent further saturation of levee or hillside slopes. Visquine is laid out flat on the slope, and stakes are driven into the ground just above the area to be protected. The stakes are 4 feet apart with a 1-foot stagger. The visquine is secured to the stakes with tie-down buttons or small round rocks (see Figure 11).

Use a crisscross method of placing the sandbags (Figure 11) on the plastic. Place a solid row of sandbags on all edges of the visquine (half on ground, half on the visquine).

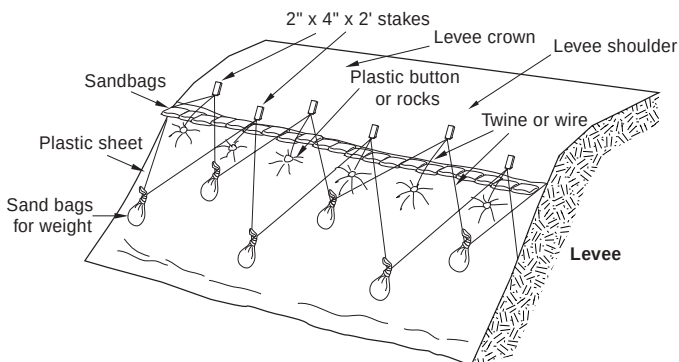


Figure 11

Temporary Levee

This method is used to raise low areas using plastic sheeting and fill material (sand, gravel, dirt, etc.) to prevent overtopping of levees, stream, river banks, small earthen dams, roadways etc. To raise low areas, unfold a 20'x100'x10 mil roll of visquine and lay out flat (see Figures 12).

Lay plastic flat on area to be raised. Place fill material (dirt, sand, gravel, etc.) on plastic. Fold plastic over material, lay a single row of sandbags on the backside lip of plastic and on all seams. Place fill material on the visquine using dump bed trucks, front-end loaders, or manually.

When this method is used in overtopping of small earthen dams, a spillway must be constructed.

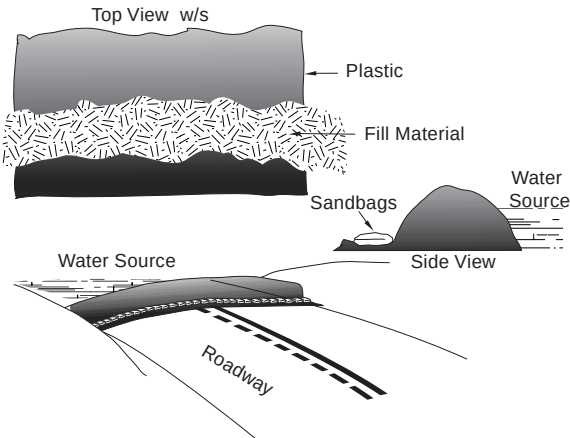


Figure 12

Wooden Panels

Many tools and materials are used in flood control efforts. A very versatile material is the wooden panel (see Figure 13). Wooden panels can be used for wavewash protection, lumber and sack toppings, and mud boxes. Wooden panels should be prefabricated and can be easily transported to the work site. The panels are generally 3 feet high with a minimum length of 12 feet. They are made of 1" x 12" x 12' boards. The boards are nailed to 1" x 4" x 3' slats at 6-foot intervals. A 1/4 inch gap is left between each board in the panel.

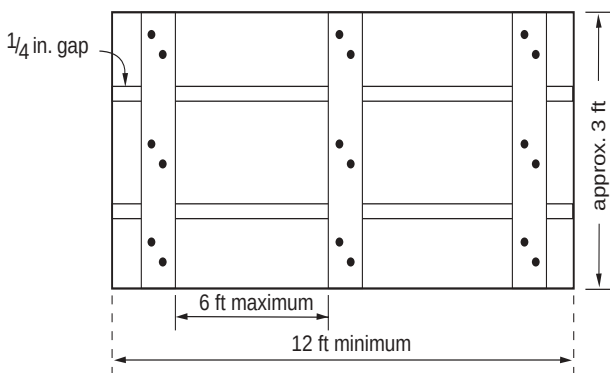
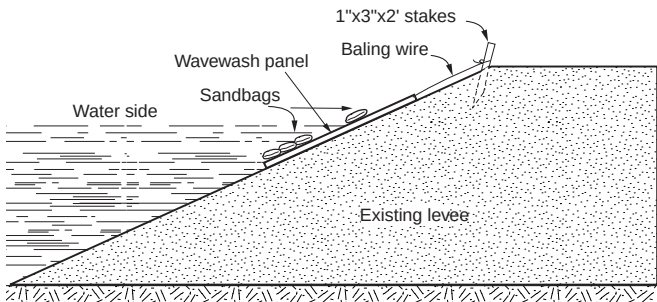


Figure 13

Wooden Panel Wavewash Protection

Although visquine is the preferred method of wavewash protection, wooden panels can be used (see Figure 14). When the water current is very fast or swift, wooden panels will hold up better than plastic sheeting. Drive wooden stakes (1" x 3" x 2") into the levee shoulder in the same manner as visquine (4 ft apart with a stagger of 1 ft between rows).

Baling wire is tied to the wooden panels through the 1/4 inch gap between the 1"x 12" boards. Sandbags are wired to the bottom half of the panels to weigh them down. Push the panels into the water with pike poles. The baling wire is then tied to the stakes as low as possible. Adjust the length of the baling wire to secure the panels in the proper position. If more panels are added, the overlap area must be 1 foot and facing downstream. One or more panels can be wired together if more than 3 feet of slope protection is needed.



NOTE: Panels may be placed in a vertical position, depending on existing conditions.

Figure 14

Lumber and Sack Topping

With this method, wooden panels are used on the waterside shoulder and reinforced on the opposite side with sandbags. The method is used to raise low reaches during high water (see Figure 15). Stakes 2"x 4"x 6' should be driven on the waterside shoulder 6 feet apart. Dig a shallow trench and line it with empty sandbags to provide a seal. Pre-constructed wooden panels are placed in the trench and nailed to the landside of the stakes. This wall should then be backed with enough sandbags to support the panels against the expected high water. In some cases, it may be practical to back the panels with tamped earth in lieu of sandbags. Attach 2"x 4"x 10' lumber kickers to the stakes that support the panels, and drive 2' stakes into the levee crown. Use at least two nails at each joint to ensure rigid construction.

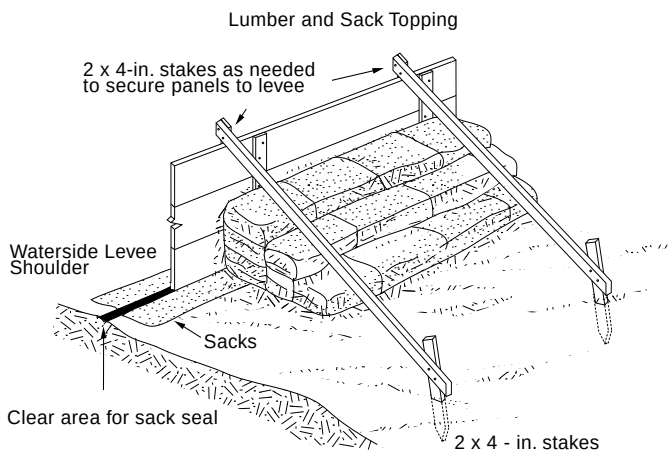


Figure 15

Mud Boxes

With this method, two parallel wooden walls are placed and supported near the waterward levee shoulder and filled with available material (see Figure 16). Spacing of the walls will vary with height but should be proportional to a box 3 feet high and 30 inches wide.

Mud boxes may be used when the available fill material is too wet for a sandbag sack topping, providing the boxes are lined with canvas, visquine, or burlap. If visquine is used, punch pencil-size holes in the bottom of the visquine to allow water to seep out. Close the open ends of the mud box with sandbags and tie into high ground.

NOTE

Mud boxes can also be used to divert mud flows from structures. If it is used for this purpose, plywood should be nailed to the face of the mud box, thereby creating a smooth surface.

(See Figure 16 on next page)

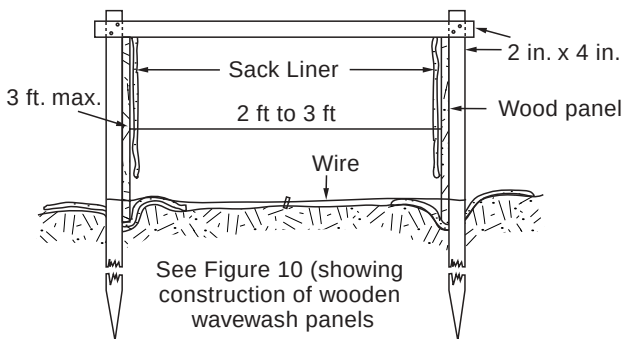
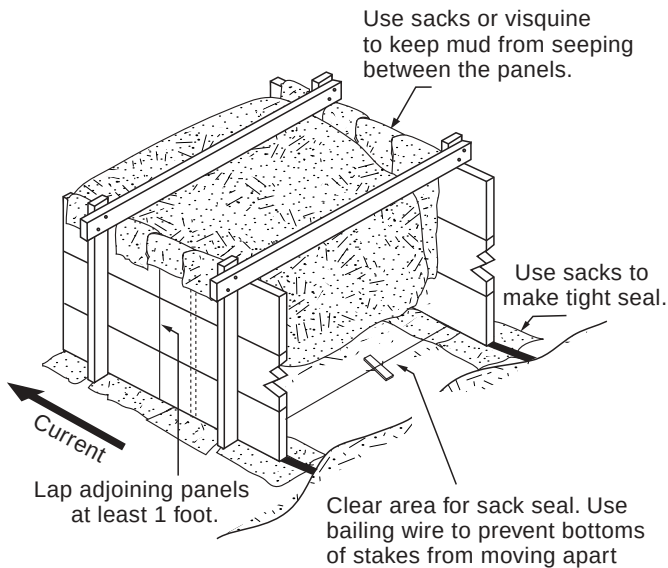


Figure 16

Emergency Spillway Using Visquine and Sandbags

Place plastic sheeting over area to be used for spillway. Line all sides with at least a single row of sandbags. Tie in *Sack Topping* sandbag wall at top of structure on both sides to high ground. Use additional tied sandbags on plastic for weight if needed.

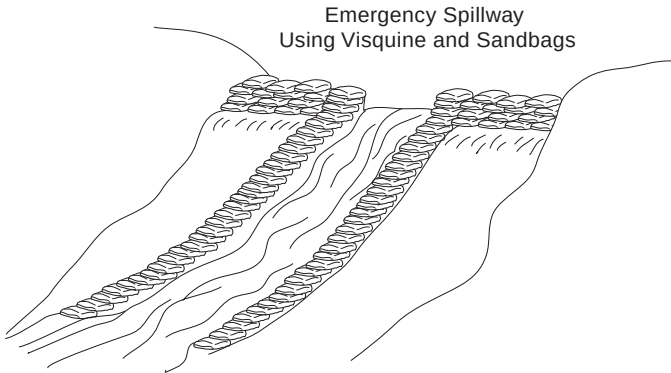


Figure 17

METHODS OF FLOOD FIGHTING AROUND STRUCTURES

The main causes of damage to structures, homes and property during heavy rains or flood flows are:

1. Flood water from overwhelmed storm drains and urban diversions, particularly on sloping streets.
2. Flood flows onto property through driveway openings, and low spots in curbs.
3. Debris flow from hillsides that have been cleared of vegetation by fire or real estate development.

The flood fighting methods described in the following paragraphs have proved effective in combating floodwaters and flood flows.

Diverting Water Away from Homes

To prevent or reduce property damage, the following methods can be effective.

Homes and structures can be protected from floodwater by redirecting the water flow as shown in Figure 18. Sandbag or wooden barriers must be placed at an angle and must be long enough to divert the flowing water away from all structures.

Barriers constructed of sandbags or lumber can also be used to channel mud and debris away from property improvements.

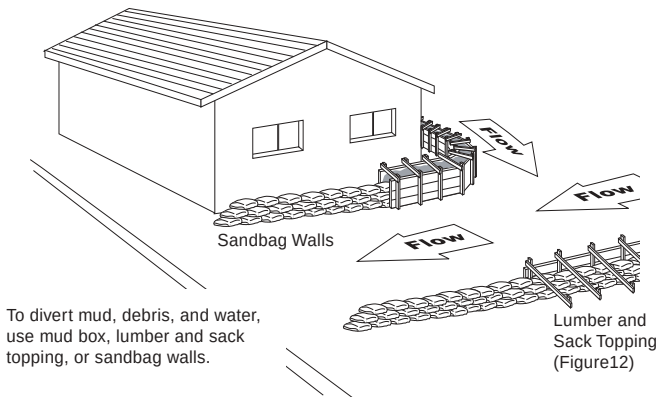


Figure 18

Home / Structure Protection

The following method is used for protection of buildings and other structures along lake shores and in similar situations where water is rising with little or no current.

Lay plastic sheeting on the ground and up the building walls to a point at least 1 foot above the predicted water elevation, and far enough out on the ground to form a half pyramid of sandbags (see Figure 19). Secure plywood over doors and vents. Overlap visquine and sandbags at corners of buildings.

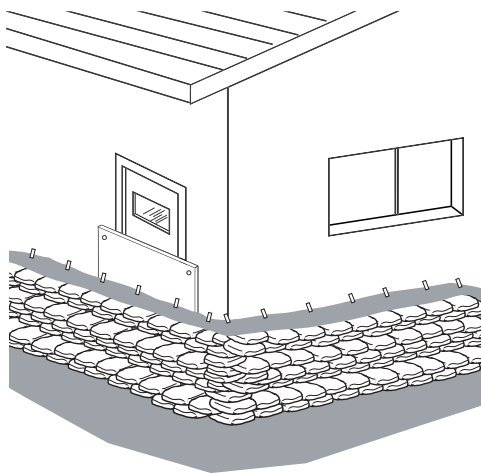
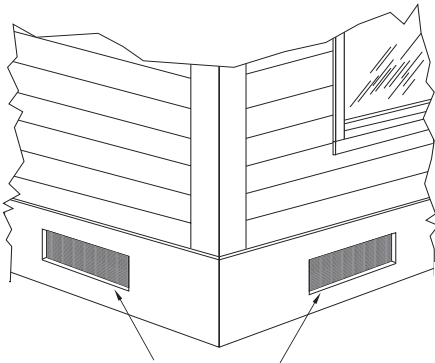


Figure 19

Wet Flood Proofing Requirements for Structures Located Within Special Flood Hazard Areas

National Flood Insurance Program regulations require that buildings on extended wall foundations or that have enclosures below the base flood elevation must have foundation or enclosure wall openings. These openings prevent the foundation or enclosure walls from weakening or collapsing under pressure from hydrostatic forces during a 100 year flood event. The openings allow flood waters to reach equal levels on both sides of the foundation or enclosure wall and minimize the potential for damage from hydrostatic pressure.



Foundation or wall openings must be kept open within special flood hazard areas

Figure 20

These Openings Must Not Be Blocked If The Building Is Located Within A Special Flood Hazard Area.

For details refer to FEMA Technical Bulletins TB1-93 and TB-7.

These bulletins may be obtained from the FEMA web site at:

<http://www.fema.gov>

For additional information contact DWR Floodplain Management at (916) 653-9902.

Protection of Water or Sewer System

Water or sewer systems can be protected by placing corrugated metal pipe (CMP) over the manhole (see Figure 21). Lay visquine up the walls of the CMP and place sandbags in the form of a half pyramid around the CMP to seal it to the pavement. This method will prevent mud and debris from entering the system and also act as a surge chamber.

Using corrugated metal pipe (CMP) over manhole to isolate sewer line or prevent contamination of water system.

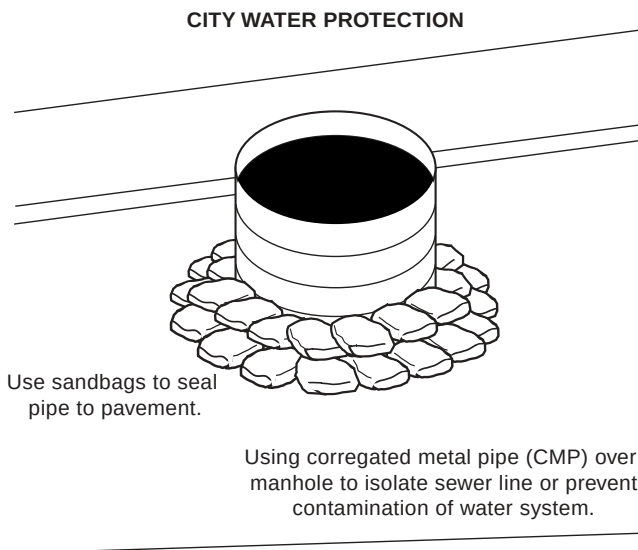


Figure 21

FLOODFIGHT SAFETY

Numerous potential hazards exist during flood events. These hazards are manageable if identification and communication occurs on an ongoing basis. Personal safety requires a conscious effort that every flood fighter must consider in their various duties and activities.

- **Changing Weather Patterns:** This occurrence can affect existing conditions and create more serious situations. Always know the forecast and how it affects vulnerable areas, workers and the public.
- **Changing Water Patterns:** The rise and fall of water can occur gradually or very quickly. Knowledge of high water and how it relates to levees, communities and workers is essential. Continuous monitoring and communication of water level influences, (i.e. reservoir releases, tides and drainage inflow) is very important. Always know your area and the *flood history* around you.
- **Swift Water:** High velocities of water are common during flooding events. Extreme caution should be used when anyone is exposed to high water. Workers should have floatation devices, throw ropes and lifelines in the immediate area. Swift water rescue teams may be available. Use common sense and sound judgement around swift water. Know your resources and how to activate them prior to the event.

FLOODFIGHT SAFETY

- **Climate Related Illness:** During a flood fight, weather patterns can change constantly. Climate changes present the potential for hypothermia and heat prostration. Flood fighters should know the signs of distress for these types of illnesses and how to treat them. During cold, wet weather it is recommended that workers layer clothing, stay warm and dry. A dry blanket and warm clear fluids should be on the work site for emergency use. In warm, hot weather lightweight clothing is recommended. If skin is exposed, a sun block agent may need to be applied. Plenty of drinking water should be on site and consumed regularly. In both hot and cold situations headgear is recommended.
- **Insect/Animal Exposure:** Flooded areas force a variety of animals to evacuate to high ground. Workers in these areas should be aware of these animals or reptiles and not handle them. If animal removal is needed, contact a local professional. Stinging and biting insects are prominent in certain flood prone areas. Chemical repellents can be useful as a deterrent. A complete first aid kit should be on site.
- **Sandpile Safety:** When shovels are used for filling bags a safe distance for workers is essential. Sandbags and sand may contain contaminants. Have disinfectant available. Safety glasses or goggles are recommended for protection from blowing sand particles.

FLOODFIGHT SAFETY

- **Contamination:** Flooded areas can potentially carry high levels of contaminants. Local Haz-Mat teams should be contacted if needed. Always wear protective clothing to help limit contact with water. Carry antibiotic hand soap and wash thoroughly after working around floodwater.
- **Exhaustion:** Stress combined with long, physically demanding hours can have an adverse effect on the flood worker. It is very important to recognize exhaustion or sleep deprivation and treat them immediately. Operation of vehicles, machinery or equipment should be avoided. A shift rotation of personnel will help eliminate fatigue factors.
- **Body Mechanics:** Proper body mechanics while working on floods is very important. The body is expected to work long, physical, hours during the event. Each individual must make a conscious effort to use safe lifting and weight distribution techniques. Watch your footing, surfaces can be slippery and cluttered with tripping hazards.
- **Construction Equipment:** There are times when equipment and people will occupy the same work area. Workers should wear safety vests, hard hats and be aware of their surroundings. Safety warning devices, (i.e. backup alarms and lights) should be in-tact and working on all equipment. Communication and alertness is vital! All operators must be certified for their equipment.

FLOODFIGHT SAFETY

- **Boat travel:** Materials and/or personnel will sometimes need to be transported to work sites by boat. Operators of the watercraft must be certified. Floatation devices must be available for every passenger. Extreme care should be taken while loading and off loading. Watchful eyes are needed.
- **Patrolling:** Patrolling is the key to effective floodfighting. Patrols will identify, initiate control and monitor trouble spots in affected areas. Vehicle patrols should travel in two person teams with dependable communication devices. Lifelines, floatation devices and a blanket should be in the vehicle for possible water related accidents. Foot patrols should also have the same considerations. Extreme caution should be exercised when travelling saturated, cracking or sluffing areas.
- **Vehicle Placement:** Vehicles in work areas along the levee should remain parked on high ground. This is usually the crown roadway. Vehicles should also be parked facing their access point. An escape plan should be communicated to all flood workers.
- **Structure Considerations:** When working around structures, be aware of downed power lines, natural gas or propane leaks and unstable structure supports. Communicate with the structure owner if possible.
- **Safety Gear:** Rain gear, warm clothing, handheld lights, gloves, goggles, hardhat, boots, first aid kit, ropes, floatation devices, hip boots.

FOR ADDITIONAL INFORMATION CONTACT:

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