1.0 BACKGROUND

Each year, personnel from the U.S. Army Corps of Engineers (Corps), Sacramento District, and their local sponsor, the California Department of Water Resources (DWR), conduct a field reconnaissance review of the Sacramento River Flood Control System. Since 1998, Ayres Associates has assisted the Corps and their local sponsors with this annual review and inventory of erosion sites. **Figure 1** shows the overall extent of waterways in this field review.

The primary purposes of the review are to; a) monitor and document the condition of previously identified erosion sites, b) inventory any new erosion sites and c) identify critical erosion sites that appear to be a threat to the structural integrity of the flood control system.

Specific criteria are used to identify erosion sites within the system, which are described in a subsequent section of this report. In most cases the criteria are consistent from year to year and are based on bank and levee conditions that are threatening the function of the flood control system. An **erosion site** is defined as:

> **A site that is at risk of an erosional failure during floods and/or normal flow conditions; the term "critical" and "potentially critical" are used to indicate erosion sites that are of highest priority.**

The project team identifies erosion sites as being critical based on familiarity with the system and experience with levee failures by erosion.

2.0 AUTHORIZATION AND WORK REQUIREMENTS

Ayres Associates' work requirements for this project are set forth in the Supplemental Scope of Work (SSOW) issued on April 16, 2003, under Contract DACW05-01-D-0016. The technical point of contact at the Sacramento District was Mr. Stanley Soliday in the Engineering Division.

Prior to the field reconnaissance, a master list of all 2002 erosion sites within the Sacramento River Flood Control System was developed by Ayres Associates for use by those participating in the review. The list contained pertinent data associated with the characteristics of each erosion site, and its approximate position, located during previous reconnaissance trips. The list was used by Ayres Associates personnel to identify past erosion sites. Ayres Associates was also required to identify any new erosion sites and add them to the inventory. New sites were located using a portable Global Positioning System (GPS) receiver. Digital photos were provided for the existing and newly identified erosion sites under a separate submittal to the Corps.

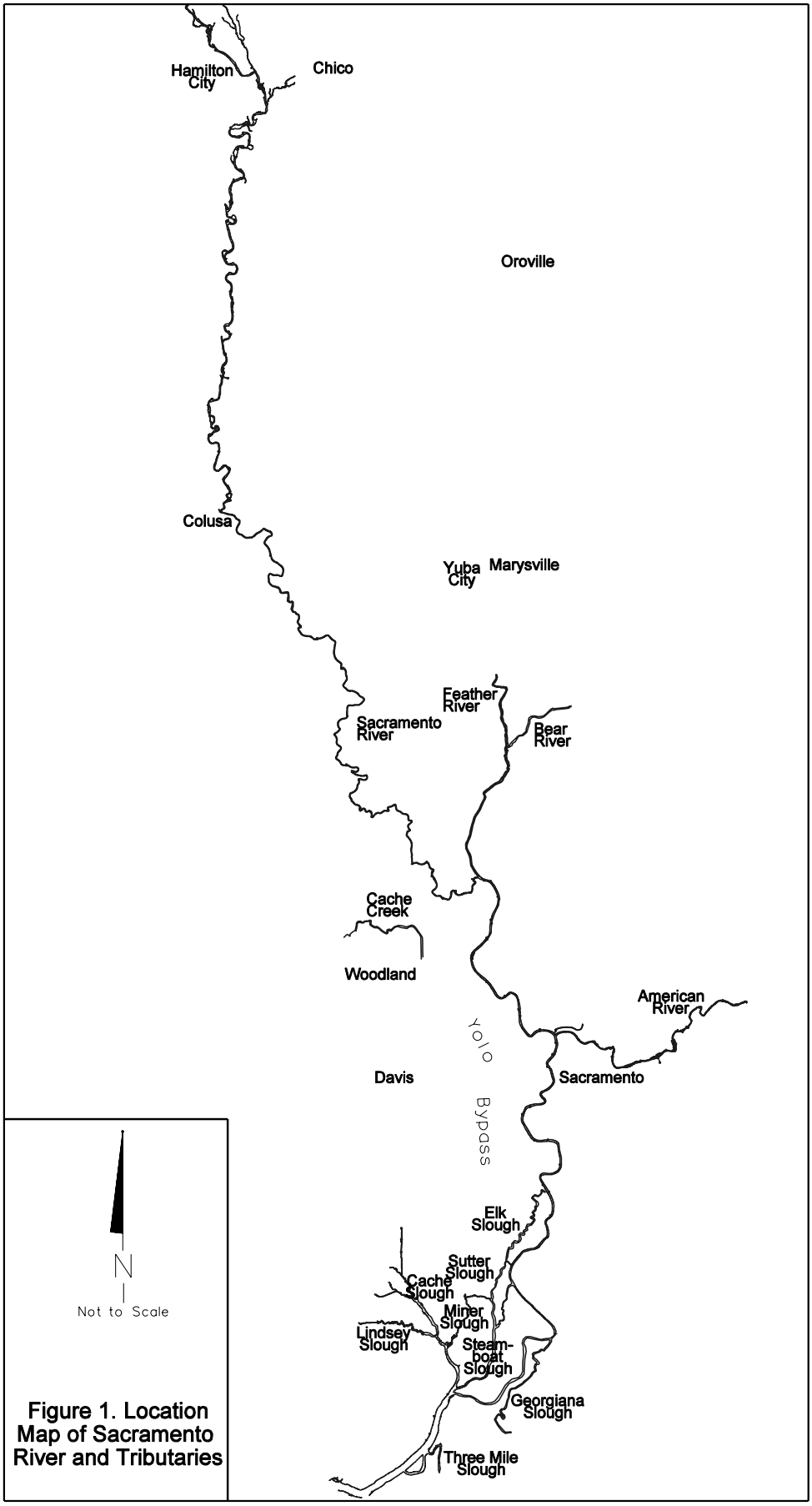

Figure 1. Location Map of Sacramento River and Tributaries

In addition to the inventory list, the 2002 Reconnaissance Trip Maps were used to aid in the 2003 field review. These maps depicted the water's edge of the Sacramento River, from RM 0 to RM 197, as well as the tributaries of the Sacramento River reviewed during this reconnaissance. Those maps contained all of the erosion sites from the 2002 inventory.

3.0 RECONNAISSANCE COVERAGE AND PROCEDURES

The field reconnaissance of the Sacramento River Flood Control System was conducted by boat during a 5-day period extending from September 15 - 19, 2003. Sacramento District COE and California DWR personnel accompanied Ayres Associates personnel. The areas covered included:

- Main Sacramento River from Collinsville (RM 4) to Chico Landing (RM 199)
- Steamboat Slough
- Sutter Slough
- Portions of Lindsey Sloughs
- Cache Slough
- Georgiana Slough
- Threemile Slough
- Miner Slough
- Feather River (RM 0 to RM 25)
- Cache Creek (Viewed on October 3, 2003)

The Lower American River was not field reviewed as part of this task order. However, it was reviewed earlier in the year under a separate task order to Ayres Associates from the Corps. As a result of that review, the preliminary results from that draft report (Ayres Associates, 2003) on potential bank erosion sites (12 sites) and the draft recommendations from the Corps (US Army, 2004) have been included in this inventory. The previously shown 14 sites (originating document and date unknown) have not been reviewed as part of this study and have been deleted from the inventory. Only the newly designated sites are now shown.

Due to scheduling conflicts, the inspections of the Bear River and Upper Feather River (above RM 25) have not been completed and no updated information is available for this version of the report. The information and observations from the 2002 report have been carried forward since no repairs have been performed.

The field reconnaissance was performed along the rivers and sloughs using a 17-foot boat powered by a 75-Hp prop-driven motor in most of the system. A 16-foot boat with a 50-Hp jet-driven motor was used in the upper reaches of the Sacramento River above Colusa and on the Feather River where a shallow draft boat was required.

In addition to the boat trips, a driving reconnaissance was performed on Cache Creek, where the water was too low for a boat, on October 3, 2003.

Erosion site positions were located and new positional information was logged using a portable Eagle® UltraMap™ GPS receiver. Specific sites are identified by waypoints, and recorded on the GPS receiver by latitude and longitude. Previously identified sites (Ayres Associates 2002) were located by navigating via the GPS receiver to the waypoints associated with that particular site. New positions were located by setting new waypoints on the GPS receiver.

The lengths of new sites were estimated visually and the river mile locations were estimated using the Sacramento River, 1991 Aerial Atlas (US Army, 1991).

4.0 EROSION INVENTORY CRITERIA AND SITE DATA COLLECTED

The criteria for including a bank erosion site into the inventory included some judgement as to the severity of the erosion and the threat to the levee but most always included one of the following two items:

a) Bank erosion into the projection of the levee slope,
b) Berm width of less than 35 feet (original criteria was 10 meters)

Figure 2 shows a schematic illustrating these two criteria.

Specific data collected at each site includes:

a) Approximate River Mile as per 1991 Corps River Atlas
b) Right or left bank
c) GPS Waypoint designation
d) Estimate site length (visual estimate)
e) Erosion location on the bank (toe, mid bank, upper slope, etc.)
f) Erosion mechanism
g) Existing revetment type, if any
h) Proximity of erosion to the levee slope
i) Remaining berm width
j) Field notes or comments for each inspection year.

There have been discussions between the Corps and Ayres Associates that the criteria should be reviewed and made more objective. No changes were made for this report. Any revisions will be included in next years inventory.

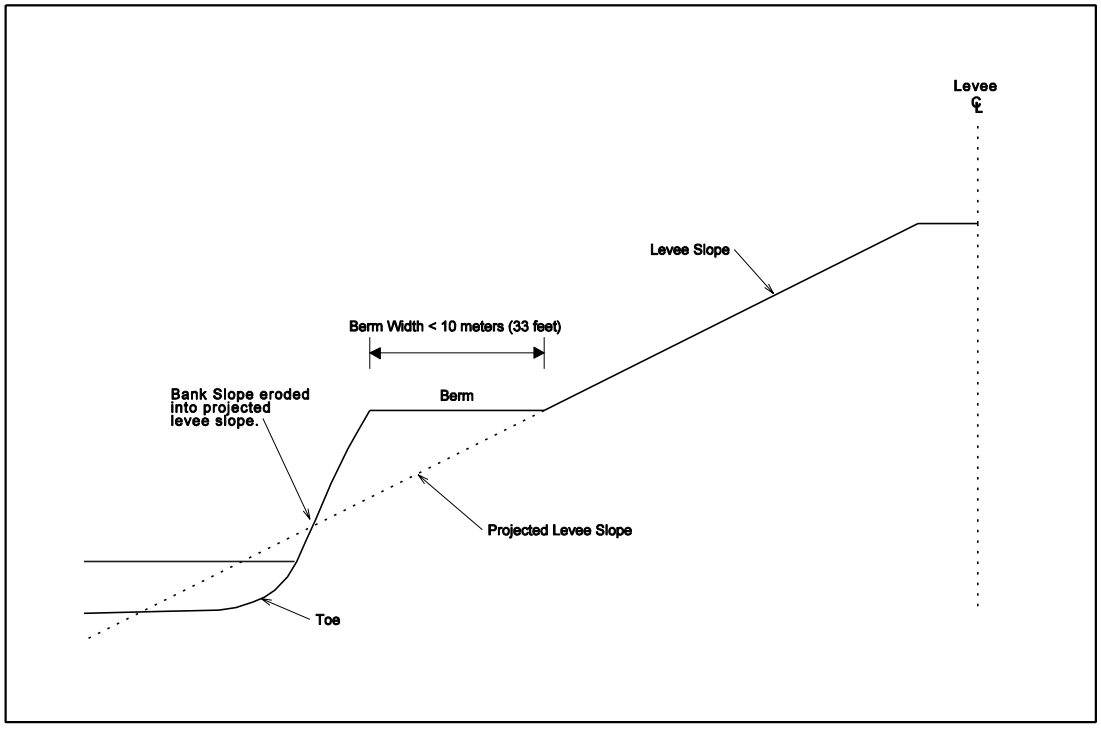

Figure 2. Schematic of Inventory Erosion Site Criteria

5.0 SUMMARY OF 2003 FIELD RECONNAISSANCE OBSERVATIONS

Based upon our 2003 reconnaissance summary, the number of documented sites in the inventory is the same as 2002, however twenty-one (21) new sites were added and twenty (20) sites were removed. The added sites are areas of new erosion or areas that had minor erosion before and have grown large enough to be included in the inventory. The deleted sites included those that could be more appropriately handled by maintenance activities or upon further review did not meet the basic criteria. The repair of the site at RM 149.0 has been completed and that site has also been deleted from the inventory.

Many of the sites showed an increased amount of erosion and the number of critical and potentially critical sites has increased from 24 to 37 for this reporting period. The total number of 2003 erosion sites by river, stream or slough and changes from the 2002 inventory are summarized in the table below.

Summary of Erosion Sites by River, Creek or Slough

River, Creek or Slough	2002 Erosion Sites	2003 Erosion Sites	Sites Added in 2003	Sites Deleted in 2003	Critical* Sites in 2002	Critical* Sites in 2003
Sacramento River	101	102	6	5	17	20
Bear River	3	3**	0	0	2	2
Cache Creek	10	10	0	0	4	4
Cache Slough	2	3	1	0	1	1
Elk Slough	1	1	0	0	0	0
Feather River	5	7	2	0	0	2
Georgiana Slough	33	33	0	0	0	0
Lower American River	14	12***	12***	14	0	8***
Steamboat Slough	10	9	0	1	0	0
Sutter Slough	4	4	0	0	0	0
Totals	183	184	21	20	24	37

*This includes Critical and Potentially Critical classifications.
**The Bear River was not inspected at the time of this report and the numbers from last year's inventory have been carried forward.
***The Lower American River numbers are from a separate draft report (Ayres Associates, 2003), which looked at erosion potential for the 100-year runoff event. These numbers are preliminary and the assessment methodology was based on computer hydraulic models and visual observations.

Spreadsheets containing site observations for the inventoried erosion sites have been organized into tables as described below and are included in the **Appendix** to this report.

Tables of Inventoried Erosion Sites for 2003

Table No.	Title	No. of sites
1	Sacramento River Levee System - Erosion Sites – 2003	184
2	Sacramento River Levee System - Newly Identifies Erosion Sites - 2003	21
3	Sacramento River Levee System - Sites Removed from Inventory - 2003	20
4	Sacramento River Levee System - Potentially Critical and Critical Erosion Sites – 2003	37

The following terminology has been used throughout these tables to describe the condition of the different sites. A general explanation of each term is as follows:

- Critical Site: Sites where further erosion may result in a bank failure, which encroaches near or into the levee crown and is recommended as the highest priority for repair.
- Potentially Critical Site: If the erosion pattern continues, the site will become a critical site.
- Monitor Closely: Denotes sites that are not currently at a potentially critical stage but may become so in the near future if the current erosion rate continues.
- Maintenance Site: Sites that contain small pockets of erosion that can be handled by maintenance activities and do not recommended for a project level approach to complete the repair.

6.0 DISCUSSION OF 2003 FIELD RECONNAISSANCE OBSERVATIONS

General

An increase in the amount of erosion over the past runoff season is demonstrated by the number of new sites and the increase in the number of sites in the critical and potentially critical classification.

However, observed erosion above the water line is not the sole indicator for potential bank failures. Erosion of the bank slope below the water, geotechnical factors, effects from debris and overturned trees on the berm can all play a part in contributing to bank failure. Other sites within the system may be critical based on these additional considerations, which are beyond the scope of this reconnaissance level review.

The 2002–2003 runoff year did not contain any large events and for the most part was close to an average annual runoff year as shown in the following tabulation of the three highest mean daily flows on the Sacramento River (CDEC, 2004) during this period. The table also shows the 2-year runoff (Corps, 1999), where available, and the design capacity for that particular reach of the levee system (DWR, 1985).

Summary of High Flows in the Sacramento River for Runoff Year 2002 – 2003

Stream Gage and Location	Mean Daily Flow (Date)	Mean Daily Flow (Date)	Mean Daily Flow (Date)	2-Year Flow	Design Capacity
Ord Ferry RM 184	77,245 cfs (01/01/2003)	74,526 cfs (01/14/2003)	52,808 cfs (05/04/2003)	Not Available.	150,000 cfs
Colusa RM 143.5	41,800 cfs (01/01/2003)	42,274 cfs (01/15/2003)	41,688 (05/05/2003)	39,000 cfs	65,000 cfs
Verona RM 78.8	58,204 cfs (01/03/2003)	58,342 cfs (01/17/2003)	58,383 cfs (05/07/2003)	Not Available	107,000 cfs

Specific comments on a reach-by-reach basis with photographs of representative sites are provided in the following sections.

Upper Sacramento River, RM 199 to 144, Setback Levee Reach above Colusa

This reach of the river above Colusa is generally characterized by set back levees of varying distances on both sides of the river. Near bank full flows from the previous runoff season have been adequate to provide some general erosion and deposition patterns within this setback leveed reach of river but in most cases there is no threat to the levees. However the active river channel does come close to the levees in several locations, and the inventory lists ten (10) erosion sites in this reach. Eleven sites were originally documented in the 1997-98 inventory, one has been repaired, and no new sites have developed. Overall there has been little change to these sites but they continue to slowly erode and encroach into the levee cross section. The following photographs, from the 2003 reconnaissance show representative sites within this reach.

Photograph 1. Bank Erosion into the Levee Toe at RM 182R

Photograph 1 shows the inventory erosion site at RM 182R on the day of the 2003 review. The river is immediately adjacent to the levee and is cutting into the riverside slope of the levee toe. Erosion is slow at this location but continues to worsen each year.

Photograph 2. Bank Erosion at RM 164R at Princeton

Photograph 2 shows one of the Contract 42F sites that plans and specifications have been prepared for but no construction activity is planned at this time. This erosion site is adjacent to the small town of Princeton. The riverbank soils appear to the somewhat erosion resistant and have slowed the encroachment rate into the levee cross section.

Photograph 3. Completed Bank Repair at RM 149L

Photograph 3 is of the completed repair at RM 149L. This site has been removed from the inventory.

Sacramento River, RM 144 to 80, Colusa to Verona

This reach of the river is characterized by levees that for the most part are located very close to the main river channel. Only a few sections have areas where setback levees exist. These are located between RM 131 to RM 126 and river reach adjacent to the Fremont weir, RM 84 to RM80. Short reaches of minor setback levees exist at RM 139R, RM 120R&L, RM 107R, RM 105R, RM 103R&L, RM 100L, RM 97R&L, and RM 88R&L. This reach of the Sacramento River contains 30 inventoried erosion sites. This is one less than last year. A small site under a bridge abutment (RM 134.0L) was removed because it was considered to be a maintenance item.

The following series of photographs show typical inventoried erosion sites within this reach of the river.

Photograph 4. Bank Erosion at RM 141.4R.

Photograph 4 shows a critical site at RM 141.4R as it looks on the 2003 inventory trip. The downstream portion of the original site was repaired between the 1998 and 1999 inventory inspections but the upstream area continues to worsen. It is very possible that the large tree within the erosion site will overturn during the next high flow taking an additional volume of soil with it. This site needs to be monitored closely during any high flow event.

Photograph 5. Bank Erosion at RM 136.9R.

Photograph 5 shows a site that has a very steep bank where the cohesive soils in the bank appear to be slowing the erosion process. This site is located at RM 136.9R. The bank is very steep and appears unstable from a geotechnical standpoint. We have estimated the berm width at approximately 35 feet which should provide some safety factor before the bank slope encroaches into the levee crown. This site appears particularly bad because all of the vegetation has been removed by grazing with goats, which makes the site further susceptible to surface erosion.

Photograph 6. Contract 42F Erosion Site at RM 130.8R.

Photograph 6 is a critical erosion site at RM 130.8R and is part of Contract 42F. This was one of the identified high priority sites following the 1997 high runoff event.

Photograph 7. Critical Erosion Site at RM 125.8L.

Photograph 7 shows damage at RM 125.8L and is a critical site. Emergency repairs were performed under PL84-99 sometime in the 1999-2000 runoff season.

Sacramento River, RM 80 to RM 60, Verona to Sacramento

This reach of river extends from the Feather River to the mouth of the Lower American River. This reach is also very confined with levees placed close to the main channel of the river. The other element that differentiates this reach of the Sacramento River is the large influx of a sand bed load from the Feather River.

There are 16 erosion sites in this reach of the river, which are three less than last year. Two sites at RM 63.3R were removed because they did not fit the basic criteria and another at RM 60.7R because it was on oversized levee section. Two sites, RM 72.2R and RM 69.9R, were reclassified from "potentially critical" to "critical" based on further erosion into the riverbank. The following photographs show typical erosion sites.

Photograph 8. Potentially Critical Inventory Erosion Site at RM 78L.

The site in **Photograph 8** is characterized as potentially critical in the inventory because the erosion appears to be slow moving and the levee top width is wide (Garden Highway is on the levee crown). However as part of another study of this area (Ayres Associates, 2002), recent bathymetric surveys of the site shows 7 feet of degradation at the toe of the slope since 1997. So while the erosion on the slope above the water line appears slow, the degradation at the toe may greatly increase the risk of a larger mass failure of the entire waterside slope.

Photograph 9. Potentially Critical Inventory Erosion Site at RM 73R.

Photograph 9 is representative of the right bank of the river in this reach. Soil types in the riverbank are a mix of fine-grained silts and clays. The overall erosion rates are low but continue to encroach toward or into the projection of the levee cross section. At this particular site it appears that a tree may have overturned and caused the initial erosion scar.

Sacramento River, RM 60 to RM 0, Sacramento to Collinsville

This reach of the river starts at the junction with the Lower American River and extends to the junction of the San Joaquin River near Collinsville. There are 46 inventoried erosion sites in this reach of the river, which are three more than last year. One site was removed (oversized levee at RM 57.2L)) and five new sites were added (RM 50.8L, RM 55.1L, RM 35.4L, RM 33.0R and RM 26.4L).

The levee banks are heavily revetted along this entire reach and the levees are at or very near the active river channel. The velocities in this reach are lower than upstream reaches and there is daily tidal influence. The following photographs illustrate typical inventoried erosion sites in this reach.

Photograph 10. Inventory Erosion Site at RM 60L.

Photograph 10 shows an erosion site on the left bank immediately downstream of the confluence with the Lower American River. Notes from past reconnaissance trip (2000) state that this may be caused by turbulence from the old City water intake tower. Subsequent two-dimensional hydraulic modeling performed for the Corps showed that the tower has little influence on the velocities at the riverbank (Ayres Associates, 2001).

Photograph 11. Inventory Erosion Site At RM 56.5R.

Photograph 11 shows erosion of the mid-bank portion of the levee. Levee soils at this location are typically fine silty sandy materials.

Photograph 12. New Inventory Erosion Site at RM 34.5R

Photograph 12 shows new erosion at an old erosion site that was at one time dropped from the inventory because it was small enough to be considered a maintenance site. Last years flows produced this new erosion pocket and this is now recommended as a high priority for repair.

Steamboat Slough, RM 26.5 to RM 14

Streamboat Slough is a connector channel that comes off the Sacramento River at approximate RM 32.5 and rejoins at about RM 14. Levees in this reach are immediately adjacent to the active channel and are typically composed of silts and fine sands. This reach contains 9 erosion sites, one less than last year. RM 15.4 L was removed because it is located downstream of the end of the project levee.

Photograph 13. Inventory Erosion Site on Steamboat Slough, RM 23.9R

Photograph 13 shows a typical erosion site in this part of the system.

Georgiana Slough, RM 12.5 to RM 0

Georgiana Slough is a connector channel between the Sacramento and Mokelumne Rivers. RM 0 is at the junction with the Mokelumne River and the upstream end joins with the Sacramento River at RM 26.5R, immediately downstream of Walnut Grove. There are 33 erosion sites on Georgiana Slough, the same number as last year. This slough appears very similar to last year with the exception of some increased activity installing biotechnical bank protection (see description following photograph 14).

Levee soils appear to be predominantly a mix of fine-grained silts and clays. Bank erosion is slow and overall channel velocities are believed to be very low (we have no knowledge of any hydraulic modeling data for this slough). However, there is heavy recreational boat traffic in Georgiana Slough, which creates waves that break against the toe of the levee slope contributing to the erosion problem. Wind wave runup may also be contributing factor. This area has one of the highest concentrations of erosion sites within the Sacramento River Flood Control system with a total of 33 sites over a 12.5-mile reach.

The following photographs show the typical erosion pattern on Georgiana Slough along with some recently installed biotechnical bank protection.

Photograph 14. Inventoried Erosion Site on Georgiana Slough, RM 2.3L.

The site depicted in **Photograph 14** shows significant erosion into the toe of the levee slope and a subsequent repair using a biotechnical approach. These repairs have been initiated by R.D. 563 and have been placed within the last two years. The repair consists primarily of a matrix of staked brush or branches (trade name "brush box") with selected live plantings behind this windrow. The purpose is to break the wave action, preventing further erosion of the slope and to trap sediments near the slope to rebuild the eroded bank. The roots from the live vegetation help to reinforce the eroded area and hold the sediments in place.

Even though these sites have been repaired, we have left them in the inventory. The repairs have gone a long way in preventing further erosion but do not address the loss of structural stability due to erosion into the levee slope. The possibility for additional slumping failures on the levee slope still exists. There is also some question as to the availability of sediments from the river to deposit and re-establish the levee banks.

Feather River, RM 0 to RM 37.9

The Feather River is more difficult to boat because it is a wide, shallow, sand bed stream. The extent of the inventory was also limited by the falls at Shanghai Bend (RM 25) that restricted further boat travel coming from the downstream reach. The Feather River has 7 inventoried erosion sites with 2 new sites added this year, RM 17.8 L and RM 19.7L. The others sites remained about the same since the first reconnaissance by Ayres Associates in 1998. For most of this reach of the Feather, the levees are set back on one side or the other, which greatly reduces the erosion pressure. The following photograph shows the typical erosion observed on the left bank of the lower reach of the river.

Photograph 15. Inventory Erosion Site, Feather River at RM 7L.

Photograph 15 is typical of the inventoried erosion sites in the lower reach of the Feather River and consists of toe erosion in and around old cobble revetment sites.

Photograph 16. Looking Upstream at RM 19.7L

Photograph 16 shows a new site at RM 19.7L. This site has a large mass failure that extends up most of the exposed river bank and appears to encroach into the projection of the levee slope.

Photograph 17. Looking Upstream at a Headcut on Feather River at RM 25.6

Photograph 17 shows the headcut that is moving thought the old hydraulic mining slickens layer at RM 25.6. This headcut is actively moving upstream and should be monitored to see if there is an effect on the upstream levees as this channel degradation continues upstream.

Bear River, RM 11 to RM 0.5 (both levees)

Due to scheduling conflicts, the Bear River has not been reviewed at the time of this report. The inventory numbers from last year, three sites, have been carried forward at this time.

Cache Creek, LM 11 to LM 0 Left, LM 8.8 to LM 0 Right

Cache Creek was added to the erosion inventory in 2002. This creek joins the Sacramento River though the Yolo Bypass and is part of the Sacramento Flood Control System. This creek could not be observed by boat since there was little (<1 ft) to no water in the channel during the inventory. These sites were identified by driving the levees and through recent aerial photography and first listed in the 2002 Erosion Inventory (Ayres Associates, 2002). These sites are identified by levee mile (not river miles). A total of 10 erosion sites were identified, four of which are considered critical. All these sites have erosion patterns that started at the toe of the creek bank proceeding to bank failure and are characterized by near vertical banks and decreasing berm widths.

Three of the critical sites (LM 0.8L, LM 1.1L and LM 2.4L) were field reviewed in 2003 from a landside vantage point with the Corps and DWR personnel. All three showed some additional erosion but overall, looked similar to the 2002 photographs which have been used in this report since our 2003 photographs did not come out.

Photograph 18. 2002 Inventory Erosion Site on Cache Creek, LM 0.8 L

Photograph 18 shows the actively eroding bank of a typical critical site on Cache Creek. This bank failure is encroaching on the berm and decreasing the distance to the levee toe.

Photograph 19. 2002 Inventory Erosion Site on Cache Creek, LM 3.4 L

Photograph 19 shows a typical non-critical site in this part of the system. The banks are steep (> 2:1 slope) and eroding but still have some vegetation growing in the upper bank.

7.0 CONCLUSIONS

Based upon our observations from this field reconnaissance and our previous experience on the Sacramento River Flood Control System, we offer the following conclusions:

1. Bank and levee erosion within the Sacramento River Flood Control System continues to be a threat to the levees even though this past years flows were on the order of a 2-year runoff event. The overall condition of many sites continues to worsen in a slow, steady fashion.

2. The total number of erosion sites remains at 184 for all waterways reviewed. While 21 sites were added and 20 deleted, most were associated with updating the information for the sites on the Lower American River (14 deleted and 12 were new) to reflect the most recent data available (Ayres Associates, 2003 and US Army, 2004).

3. The number of sites characterized as "Critical" and "Potentially Critical" has increased from 24 in 2002 to 36 in 2003. The 2001 inventory listed 17 and the 2000 inventory listed 10.

4. This report provides a reconnaissance level of detail and indicates where obvious erosion problems are present. Closer inspections at sites at RM 78L (Ayres Associates, 2002) and RM 56.7L (US Army, 2003), have shown that these two site have additional erosion below the waterline that makes them even more vulnerable to potential failure. This additional level of detail has not been possible with the time and resources allotted to this reconnaissance

5. This inventory should not be thought of as the only locations where a failure to the system may occur. This inventory is limited to what is visible above the waterline. Other major factors that can affect the integrity of the levees include other factors such as; below water scour and geotechnical considerations such as large slope failures along with potential seepage and piping problems.

6. Repair work continues to be difficult to complete. Relying on emergency action as the last line of defense will become more difficult as the number of sites continues to grow. The role of monitoring the erosion sites and providing early warning will become more important.

7. The biotechnical repairs on Georgiana Slough are helping to prevent further damage at these sites, however due to a low sediment load from the river, the long term stability of these repairs is uncertain at this time.

8.0 RECOMMENDATIONS

Based upon our field reconnaissance and conclusions above, we offer the following recommendations:

1. The potentially critical and critical inventory sites are recommended as the highest priority for repair and work should begin on preparing designs.

2. Additional investigation should be done on the high priority sites to determine if other factors below the waterline may contribute to an even higher risk of failure. These sites should be re-inspected and a higher level of data collected at each site such as, site bathymetry, slope cross-sections and soil types. Geotechnical consideration and river hydraulics should also be included in this review.

3. The criteria used for the classification of critical and potentially critical sites should be reviewed. It is currently based on visual observations and judgment by those participating in the review. A more objective criteria could be developed based on site geometry, geomorphology, hydraulics, flow duration, soils, seepage, site vegetation, performance history, economics and professional judgment.

4. With bank protection projects taking many years to complete, a renewed emphasis should be placed of performing maintenance activities. This will extend the life of the existing sites and may prevent further damage at others.

5. It is very likely that severe damage and possibly a failure will occur at one for more of the potentially critical and critical erosion sites when the next high flow period occurs. Some planning and designs should be prepared for an emergency response. Existing monitoring procedures during significant runoff events (2-year and greater) should be reviewed for adequacy.

6. Further study and analysis of the biotechnical repairs on Georgiana Slough should be completed to verify their long-term effectiveness and possible use for other sites within the system.

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