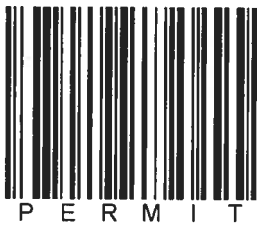
Revision



QATESTOCR

TOD
TAK

COLORADO DIVISION OF RECLAMATION, MINING AND SAFETY

1313 Sherman Street, Room 215, Denver, Colorado 80203 ph(303) 866-3567

TR04

REQUEST FOR TECHNICAL REVISION (TR) COVER SHEET

File No.: M- 1982-147 Site Name: Nyholt Pit (aka Mann)

County Adams TR# *(DRMS Use only)*

Permittee: Adams County

Operator (If Other than Permittee):

Permittee Representative: Kurt Carlson

Please provide a brief description of the proposed revision:
Update to reclamation plan to account for repairs and aromoring of areas damaged during September 2013 flooding in Adams County.

As defined by the Minerals Rules, a Technical Revision (TR) is: "a change in the permit or application which does not have more than a minor effect upon the approved or proposed Reclamation or Environmental Protection Plan." The Division is charged with determining if the revision as submitted meets this definition. If the Division determines that the proposed revision is beyond the scope of a TR, the Division may require the submittal of a permit amendment to make the required or desired changes to the permit.

The request for a TR is not considered "filed for review" until the appropriate fee is received by the Division (as listed below by permit type). Please submit the appropriate fee with your request to expedite the review process. After the TR is submitted with the appropriate fee, the Division will determine if it is approvable within 30 days. If the Division requires additional information to approve a TR, you will be notified of specific deficiencies that will need to be addressed. If at the end of the 30 day review period there are still outstanding deficiencies, the Division must deny the TR unless the permittee requests additional time, in writing, to provide the required information.

There is no pre-defined format for the submittal of a TR; however, it is up to the permittee to provide sufficient information to the Division to approve the TR request, including updated mining and reclamation plan maps that accurately depict the changes proposed in the requested TR.

Required Fees for Technical Revision by Permit Type - Please mark the correct fee and submit it with your request for a Technical Revision.

Permit Type	**Required TR Fee**	**Submitted** (mark only one)
110c, 111, 112 construction materials, and 112 quarries	$216	☑
112 hard rock (not DMO)	$175	☐
110d, 112d(1, 2 or 3)	$1006	☐

RECEIVED
OCT 21 2014
DIVISION OF RECLAMATION MINING AND SAFETY

✓AF & RPT 4-20-15 ✓Violation MV2002011

Shannon McDowell
INTERIM PARKS DIRECTOR

ADAMS COUNTY
COLORADO

Parks & Community
Resources Department
9755 Henderson Road
Brighton, CO 80601
PHONE 303.637.8000
FAX 303.637.8015
www.adcogov.org

October 15, 2014

State of Colorado
Division of Reclamation, Mining and Safety
Tyler V. O'Donnell
1313 Sherman Street, Room 215
Denver, CO 80203

Tyler,

On September 30, 2014, Chris Muller with Leonard Rice Engineers, Inc. contacted you on our behalf in regard to the Inspection Report for M-1982-147 Nyholt Pit (aka Mann), dated April 23, 2014. Your inspection report indicated that a Technical Revision (TR) to the reclamation plan needs to be submitted for the proposed work at the site. Chris mentioned that the initial technical revision submittal will include the design drawings and design report which includes the geotechnical report. If additional information is required it can be provided upon request. Attached are the Request for Technical Revision (TR) Cover Sheet, design drawings, and the design report that includes the geotechnical report. If you have any questions or require additional information please let me know.

Thanks,

Kurt Carlson, MAS
Regional Park Manager
303.637.8013

Memorandum

To:	Kurt Carlson, Adams County
From:	Todd Street, LRE
Reviewed by:	Monica Bortolini, LRE
Date:	September 26, 2014
Project:	Mann Lakes Flood Damage Repairs
Subject:	Project Design Report

Introduction

At the request of Adams County, Leonard Rice Engineers Inc. has prepared a repair design for damage incurred by the Mann Lakes Reservoir Complex during the September 2013 flooding. This memo includes the analysis methods, assumptions, and recommendations used to develop repair plans for the Mann Lakes Reservoir Complex.

Background

The Mann Lakes Reservoir Complex is comprised of three below grade reservoirs, located approximately 500 feet west of the South Platte River; bounded by 120th Avenue to the south and 124th Avenue to the north. The three reservoirs have a combined storage capacity of approximately 3,080 acre feet and each reservoir is isolated from surrounding groundwater with a clay liner. Water is managed between the three reservoirs using a system of interconnects. An ungated 48-inch diameter reinforced concrete pipe is located in the northeast corner of Lake 1 and acts as a spillway for the three reservoirs. This site is included in the Adams County Regional Park Master Plan and will eventually be incorporated into the Adams County Regional Park. A site plan showing the lake and facility locations is presented in Figure 1.

The Mann Lakes Reservoir Complex was previously operated by Lafarge North America as a series of gravel pits. After completion of mining operations, the pits were reclaimed using compacted slope clay liners covered by a gravelly clay protective zone. Between 2006 and 2009 all three lakes passed 90 day leak tests and were certified by the Colorado State Engineer's Office (SEO). In 2011 a series of interconnects were installed which required breaching the liners in all three lakes. Subsequent to the interconnect project, lining of the three lakes was again approved by the SEO based on results of modified 30 day leak testing. In 2012 a breach was discovered in Lake #2. The breach was repaired using a buttress and dewatering drain. In spring of 2014 flow was observed entering Lake 2 at the repaired breach location; the breach was repaired a second time. Leak tests were performed on Lake 2 following each of the breach repairs and both leak tests indicated the reservoir was repaired to SEO design standards. All three lakes are currently certified by the SEO as lined reservoirs in accordance with the August 1999 State Engineer Guidelines for Lining Criteria for Gravel Pits (Colorado Division of Water Resources, 1999).

Observed Damage

At the time of the September 2013 Front Range flooding, all three reservoirs were empty. During flooding, water flowed down the reservoir side slopes, causing erosion at seven isolated locations. The most significant damage occurred at the Lake 1 spillway, the northwest corner of Lake 1, the northern edge of Lake 2 and the northwest corner of Lake 2. Less significant damage occurred in two locations around the southern tip of Lake 1 and one location at the southern shore of Lake 3. Photos of the damaged areas are included in Appendix B.

During the flood, a significant volume of water flowed into the Lake 1 from Branter Gulch to the northwest and the South Platte River to the east. Observations from county staff indicate the water surface in Lake 1 remained relatively unchanged through the winter and spring months of 2014. Net evaporation would be expected, however, ice cover and lower evaporation rates may have reduced the anticipated net evaporation during the winter months. The water level in Lake 1 has steadily decreased during the summer of 2014.

Design Considerations

The general goals of the repair project are to restore the side slopes to their original condition and place blanket riprap over the repaired areas to mitigate future damage. Key considerations for the repair design are the extent of erosion to the clay liner and a reduction of risk of similar damage should a similar event occur in the future. The clay liner is comprised of a two zone core and cover design. Zone 1A is a low permeability clay soil and Zone 1B is a protective cover placed over Zone 1A. If side slope erosion extends through Zone 1B and into Zone 1A, reducing its thickness to less than the original Zone 1A design, slopes will be repaired with select clay liner material. If the Zone 1A design thickness remains intact, erosion will be repaired using general fill, similar to existing Zone 1B soil.

A riprap blanket will be placed on all repaired slopes to reduce the risk of future erosion at those locations. Additionally, in locations where concentrated flows are anticipated, a riprap rundown has been incorporated into the design. In general, recommend soil gradations and side slopes match pre-flood site conditions.

Analysis

The analysis was conducted to determine if the clay liner was impacted to a degree that may increase seepage beyond the design standard of 0.03 cubic feet per day per square foot. Maximum allowable groundwater inflow criteria are outlined in the State Engineer Guidelines for Lining Criteria for Gravel Pits (Colorado Division of Water Resources, 1999). Flood damage to the reservoir liners was evaluated using a combination of a topographic survey, a geotechnical investigation, and seepage modeling. Investigations were generally focused on areas A1 through A5. Erosion at areas A6 and A7 was found to be less severe; zone 1A clay liner was not visible in those areas.

Topographic Survey

A post-flood topographic survey was conducted to evaluate the extent of flood damage at Mann Lakes. The survey was limited to the seven damaged areas shown in Figure 1. It was conducted using the same benchmark and datum as previous site surveys. Topographic mapping from the post-flood survey was compared to pre-flood topographic mapping and the original clay liner design plans to evaluate the depth of erosion relative to pre-flood conditions and the Zone 1A location. Clay liner design geometry for Lakes 2 and 3 was obtained from the July 2007 Tetra Tech drawing set titled "Construction Plans for Mann Lakes Slope Liner Project" (Tetra Tech, 2007). Drawings were not available for the Lake 1 liner; therefore it was assumed that the Lake 1 liner was constructed utilizing a cross section similar to Lake 2. The topographic data comparison provided an indication of the extent that Zone 1A was impacted by the side slope erosion.

Cross-sections through each damaged location showing pre-flood topography, post-flood topography and clay liner design locations are presented in Figures 2 through 6. The depth of erosion was found to be on average approximately 4 feet deep, relative to pre-flood conditions. With the exception of minor areas near the top of slope, erosion did not extend into Zone 1A of the clay liner as shown on the Tetra Tech Design plans.

Geotechnical Investigation

Detailed subsurface investigations were performed by Cesare and Associates, Inc (Cesare) at locations A-1 through A-5, as shown on Figure 1. At each area, three locations along the eroded slope were observed and samples were taken from exposed Zone 1a and Zone 1b materials for laboratory testing. A summary of the laboratory testing results is shown in Appendix A. The thickness of the Zone 1B layer was measured at each location. In addition, three exploratory pits were excavated in Lake 2 to find potential borrow material for repairs. Test pit locations are shown on Figure 1. The three exploratory pits were excavated with a backhoe to a depth of 5 feet. A complete geotechnical report including damage photos and laboratory test results is included in Appendix A. Results of the geotechnical investigation are summarized below.

Area A-1

Damage Area A-1 is located at the northwest corner of Lake 2 and corresponds with the cross section at Station 1+00 from the Tetra Tech design plans (Tetra Tech, 2007). At area A-1 the eroded scarp was observed to be approximately 4 feet high and the erosion extended approximately 1.5 feet into the Zone 1A liner. Zone 1b soil was classified as clayey sand with gravel (SC) with a liquid limit of 28 and a plasticity index of 15. Zone 1a soil was classified as sandy lean clay (CL) with a liquid limit of 48 and a plasticity index of 24.

Area A-2

Damage Area A2 is located at the northern edge of Lake 2 and is approximately 1,000 feet east of A-1. At the upper portion of Area A-2, the scarp is approximately 4 feet high. The lower 1.5 feet of the scarp is in Zone 1A liner and the upper 2.5 feet is Zone 1B liner. Midway down the slope, the scarp is approximately 2 feet high and the erosion extends approximately 0.5 feet into the Zone 1A liner. At the bottom of the slope the scarp is approximately 1.5 feet high and the Zone 1A liner was encountered in a boring several inches below the surface. At Area 2, Zone 1b was classified as well graded sand with silt, clay, and gravel (SW-SC) with a liquid limit of 19 and a plasticity index of 7. Zone 1A soil was classified as sandy lean clay (CL), with a liquid limit of 43, and a plasticity index of 25.

Area A-3

Damage Area A-3 is located in the northwestern corner of Lake 1. Erosion at damage area A-3 is approximately 4 feet deep. The depth of exposed Zone 1A liner ranges from 0.5 feet at the top of the slope to 2 feet midway down the slope. Zone 1A soil was classified as sandy lean clay (CL) with a liquid limit of 36 and a plasticity index of 19. Zone 1B soil was classified as silty, clayey, sand (SC-SM) with a liquid limit of 18 and a plasticity index of 4.

Area A-4

Damage Area A-4 is located at the northeastern corner of Lake 1. Erosion at Damage Area A-4 resulted from backflow through the spillway and does not extend above the spillway inlet. Scarp faces at Area A-4 range from 4 to 6 feet high and extend an average of 1.5 feet into the Zone 1A liner. Area A-4 Zone 1A was classified as clayey sand (SC) with a liquid limit of 24 and a plasticity index of 8. Zone 1B was classified as clayey sand with gravel (SC) with a liquid limit of 25 and a plasticity index of 12.

Area A-5

Location A-5 is located along the southwestern shoreline of Lake 1 approximately 500 feet north of the Lake 3 interconnect. The scarp at Area A-5 is an average of 5 feet high. Zone 1A liner is not exposed in the upper slope. It was encountered in a soil boring approximately 0.5 feet below the eroded surface. Midway down the slope, approximately one foot of Zone 1A liner is exposed in the scarp. Area A-5 Zone 1A was classified as silty, clayey sand (SC-SM) with a liquid limit of 2, and a plasticity index of 4. Zone 1B was classified as silty, clayey sand, with gravel (SC-SM) with a liquid limit of 19 and a plasticity index of 2.

Areas A-6 and A-7

The erosion observed at damage locations A-6 and A-7 was generally less severe than other locations. A detailed subsurface investigation was not conducted at these locations. Damage at location A-6 is a narrow gully, approximately 6 feet wide and four feet deep and occurred as a result of concentrated surface flow from the stockpile area. Damage at Location A-7 was limited to the lower portion of the slope, below the existing wave protection riprap band. Zone 1A material was not observed in either of these locations.

Borrow Areas

Exploratory pits 1 and 2 encountered weathered claystone. Exploratory pit 3 encountered competent claystone bedrock. All three pits were difficult to process in the laboratory, indicating these materials

will be difficult to process during construction for use in repairs. The samples from exploratory pits 1 and 2 are sandy lean clays that had liquid limits of 42 and 43, respectively, and plastic limits of 25 and 23, respectively. The sample from exploratory pit 3 is sandy fat clay that has a liquid limit of 52 and a plastic limit of 24.

Seepage Analysis

To estimate seepage conditions, a seepage analysis was conducted using Seep/W, a finite element software program used for modeling groundwater seepage, published by Geo-Slope International and contained in the Geostudio 2007 suite of applications (Version 7.20, build 5033). The seepage analysis was conducted utilizing the Area A-1 cross sections. Erosion at Area A-1 was more severe than other areas, however it is representative of the materials found throughout the site. The seepage analysis was conducted assuming an empty reservoir condition at two different groundwater elevations in the native materials behind the clay liners. The normal groundwater elevation was assumed to be 9 feet below ground surface and about 16 feet above bedrock. This was derived from the average groundwater elevations from the *Geotechnical Engineering Study, Park Boulevard Subgrade, Mann Lakes Gravel Pit, Adams County, Colorado,* by Tetra Tech, dated April 2009 (Tetra Tech 2009). The high water table was assumed to be 4 feet below the ground surface and about 21 feet above bedrock.

Two seepage scenarios were evaluated. The existing condition (post-flood) cross section and the same cross section using proposed repair conditions. The repaired scenario followed original construction plans with Zone 1b having a slope of 3H:1V and the innermost edge of Zone 1a having a slope of 0.5H:1V. The top width of each zone was assumed to be 10 feet, respectively. This is more conservative than the actual conditions observed where it appears that Zone 1A actually is thicker then depicted in the construction plans.

Hydraulic conductivity values for the analysis were developed for each material. To do the volumetric water conductivity, functions were first developed using grain size analysis and the liquid limits of each material found through our laboratory testing and our experience with these materials. By classifying each material, respective K-values were then chosen for the hydraulic conductivity functions. Zone 1a is classified as sandy lean clay. Zone 1b is a clayey sand with gravel. The bedrock is part of the Denver Blue Claystone formation. The native soils consist of sands and gravels. Table 1 shows the engineering properties assigned to each material.

Table 1 – Seepage Analysis Material Properties

Material	Hydraulic Conductivity (ft/sec)	Liquid Limit	Plasticity Index	Percent Fines	Percent Gravel
Zone 1b	1e-6	28	15	20	27
Zone 1a	1e-8	48	24	60	3
Bedrock	1e-9	52	24	3	0
Native soils	1e-2	15	6	5	45

Table 2 presents the leakage requirements from the SEO gravel pit lining criteria (Colorado Division of Water Resources, 1999) It contains both a design standard and a performance standard with respective maximum allowable groundwater inflow from the perimeter of a lined reservoir.

Table 2 - State Engineer Guidelines for Maximum Allowable Inflow

Location	Design Standard	Performance Standard
Liner perimeter	0.03 ft^3/day/ft^2	0.09 ft^3/day/ft^2

The seepage analyses were performed for a 90 day period which corresponds with the time needed for a leak test. A summary of the seepage analysis results is presented in Table 3 and the Seep/W output is provided in Appendix A. Flux for each condition was converted to ft^3/day/ft^2 in order to compare with the state standards. Both the existing eroded condition and the proposed repair condition meet the more stringent state design standard.

Table 3 – Modeled Flux

Liner Condition	Flux (ft^3/day/ft^2)	
	High Water Table	Normal Water Table
Eroded Liner	0.012	0.007
Repaired Liner	0.010	0.006

Slope Protection

Each eroded area will be covered with blanket riprap to reduce the risk of future erosion. Riprap was sized using the U.S. Bureau of reclamation method for shoreline protection with a design wind speed of

90 mph and a fetch distance of 0.5 mile (USBR, 2014). Due to concentrated flow conditions at Damage Area A6, a riprap rundown was included at this location.

Discussion

Laboratory testing results of Zone 1A and Zone 1B liner fill are consistent with gradations specified in the original Tetra Tech liner design (Tetra Tech, 2007). Our analysis indicates the Zone 1A liner was overbuilt to a thickness greater than shown on the Tetra Tech design plans. Zone 1A material was encountered in the eroded areas however; after a comparison of the design liner sections from the Tetra Tech construction plans with the damage survey, the Zone 1A design thickness remains intact. Zone 1A material exposed by erosion appears to be the overbuilt portion of Zone 1A. As-built design plans for the original construction were not available to verify the constructed clay liner cross sections. Additionally, results of the seepage model indicate the reservoir liners meet the state seepage design criteria of 0.03 $ft^3/day/ft^2$ in their post-flood condition. Repair of the slope with Zone 1B fill will reduce the calculated flux by 0.002 $ft^3/day/ft^2$.

Based on these results, we recommend repairing all eroded slopes at Mann Lakes with fill that meets the Zone 1B gradation requirement from the original Tetra Tech liner design. Zone 1B fill should have 25 – 80 percent passing the #200 sieve with a maximum liquid limit of 40 and a maximum plasticity index of 8. The entire repair area should be excavated to an even depth across the slope. The slopes should be benched with minimum horizontal benches of 4 feet. The vertical dimension of the bench should be high enough to allow the benches to follow the slope of the excavated surface but should not exceed 4 feet. The Zone 1b material should be placed in maximum 8 inch loose lifts and compacted to a minimum of 95% of maximum dry density as determined from ASTM D698 (standard Proctor) within 2 percent of optimum moisture content.

In Damage Areas A-1, A-3, and A-7 a significant volume of eroded soil was deposited at the base of the slope. We recommend removing the deposited soil at the base of the slopes in these locations. The soil is suitable for reuse as repair fill. However, due to excessive moisture content, the eroded soil may require additional processing to meet moisture content specifications.

Each eroded area should be covered with a riprap blanket to protect against future damage should a similar event occur. The riprap blanket should extend 10 feet beyond lateral damage extents and be placed with the lateral extents parallel to the slope. Rip rap should be placed with a minimum thickness of two feet and meet the Type M (12-inch D_{50}) requirements as outlined in the Urban Drainage Design Criteria Manual (UCFCD, 2001). Riprap should be underlain by a six inch thick layer of Type II bedding material as specified in the Urban Drainage Criterial Manual. The recommended Type M riprap gradation is provided in Table 4 and the recommended Type I bedding gradation is provided in Table 5.

Table 4 - Type M Riprap Gradation

Intermediate Rock Dimensions (in)	% Smaller by Weight
21	70-100
18	50-70
12	35-50
4	2-10

Table 5 - Bedding Gradation

U.S. Standard Sieve Size	Percent Passing by Weight
3-inch	90-100
3/4 inch	20-90
#4	0-20
#200	0-3

References

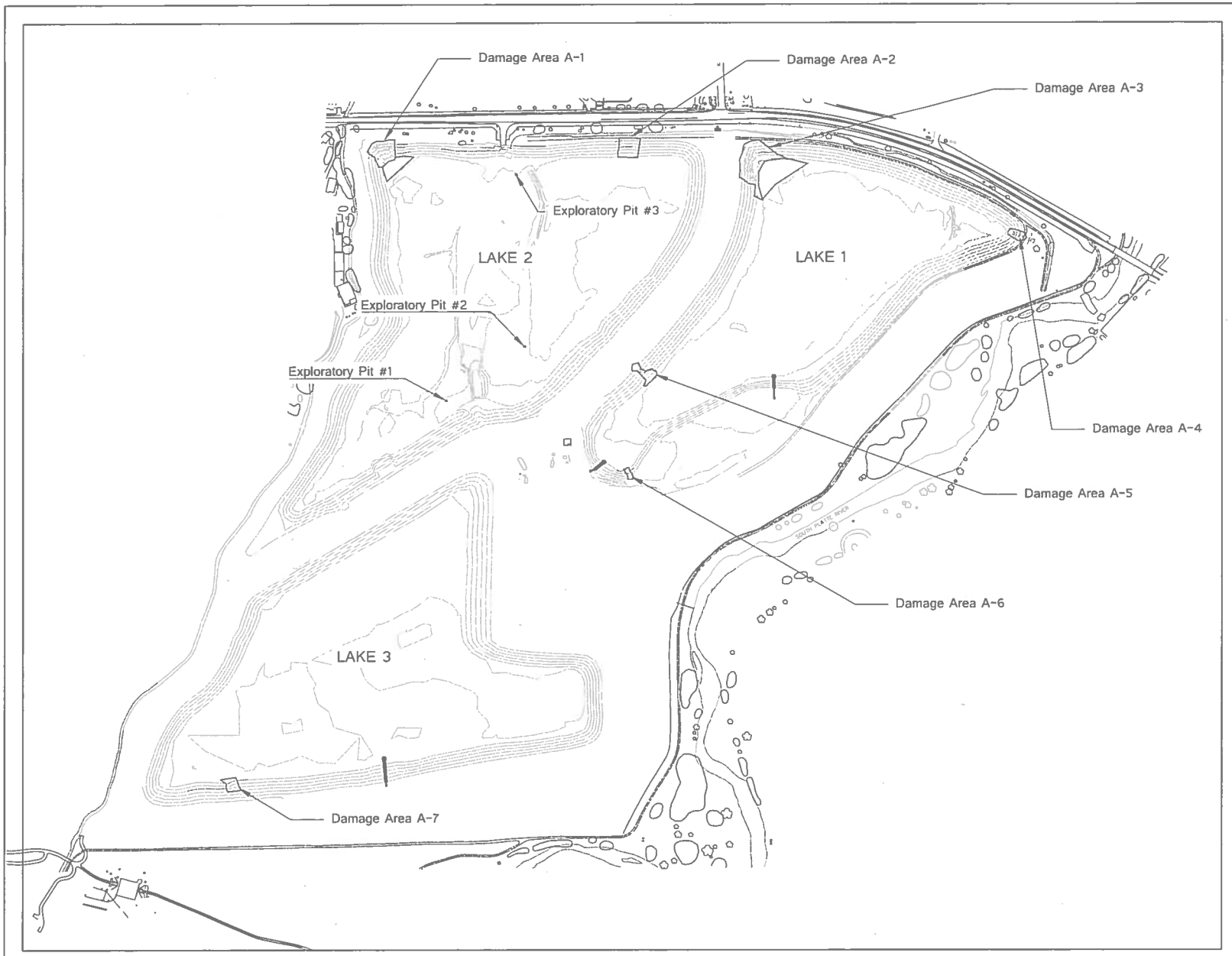
Colorado Division of Water Resources, State Engineer Guidelines for Lining Criteria For Gravel Pits, August 1999.

Tetra Tech, Construction Plans for Mann Lakes Slope Liner Project, December 2007.

U.S. Bureau of Reclamation, Design Standard 13 Embankment Dams, May 2014.

Urban Drainage and Flood Control District, Criterial Manual, June 2001.

Report Figures



Mann Lakes Reservoir Flood Damage Repair

Figure 1
Site Plan

N

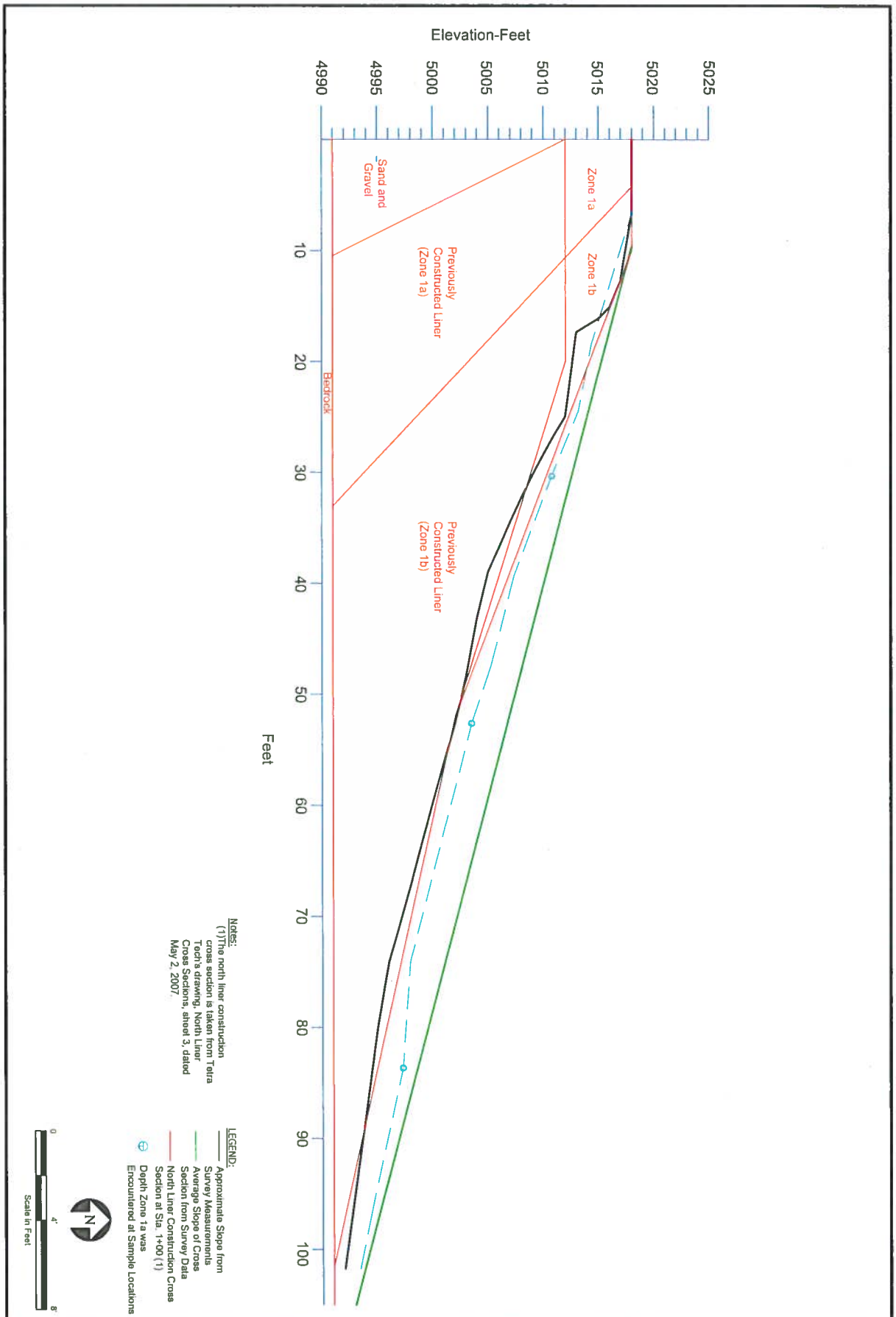
Scale: 1" = 500'

0 500 1000

Contour Interval = 5'

LeonardRice ENGINEERS, INC.

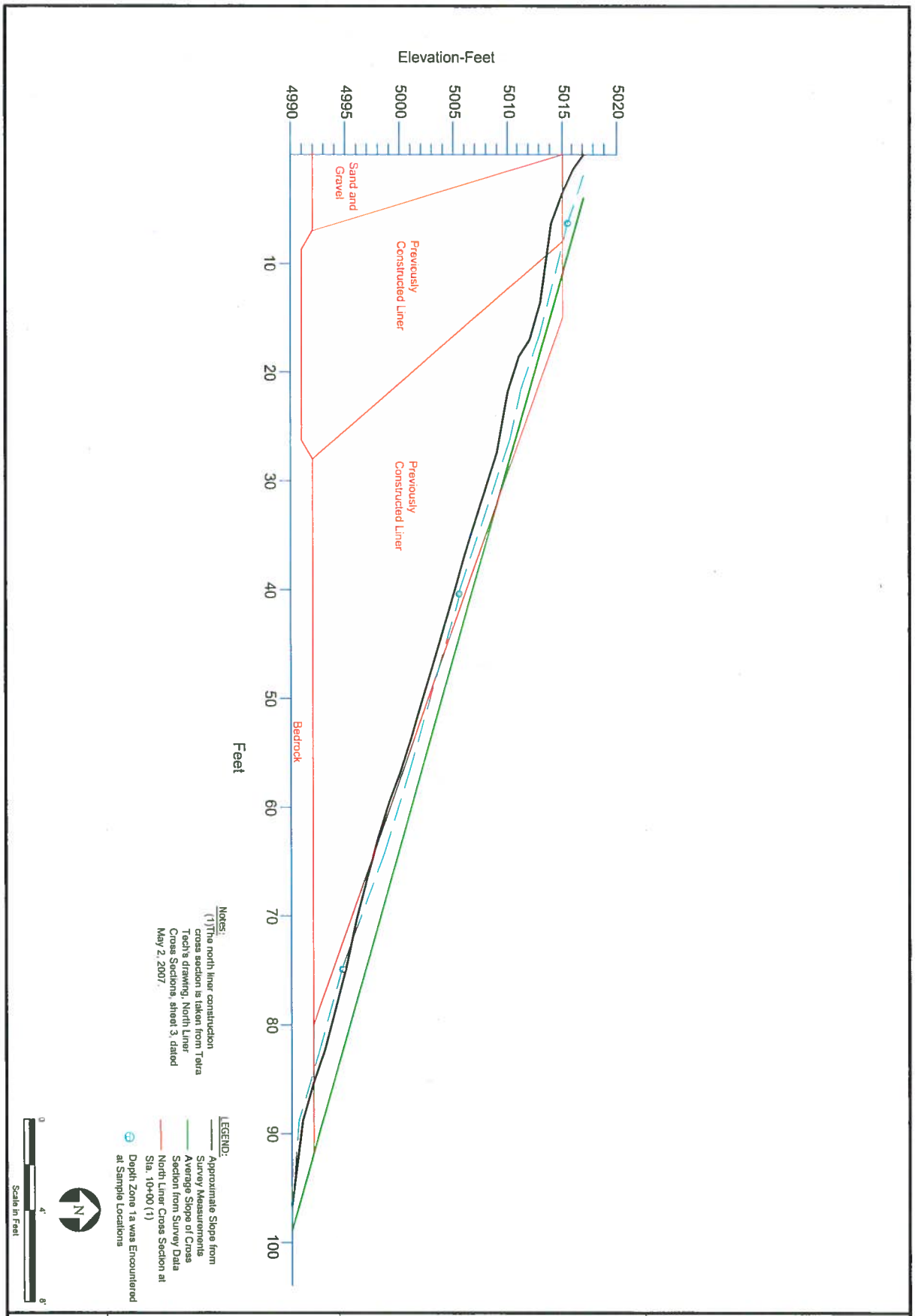
PROJECT: 1413ADC02
09/10/2014



PROJECT NO:	14.155		
PROJECT NAME:	Mann Lakes Flood Repair		
DRAWN BY:	AMC2	CHECKED BY:	DRD
DWG DATE:	08.12.14	REV. DATE:	--

Figure 2
Damage Area A-1 Cross-section

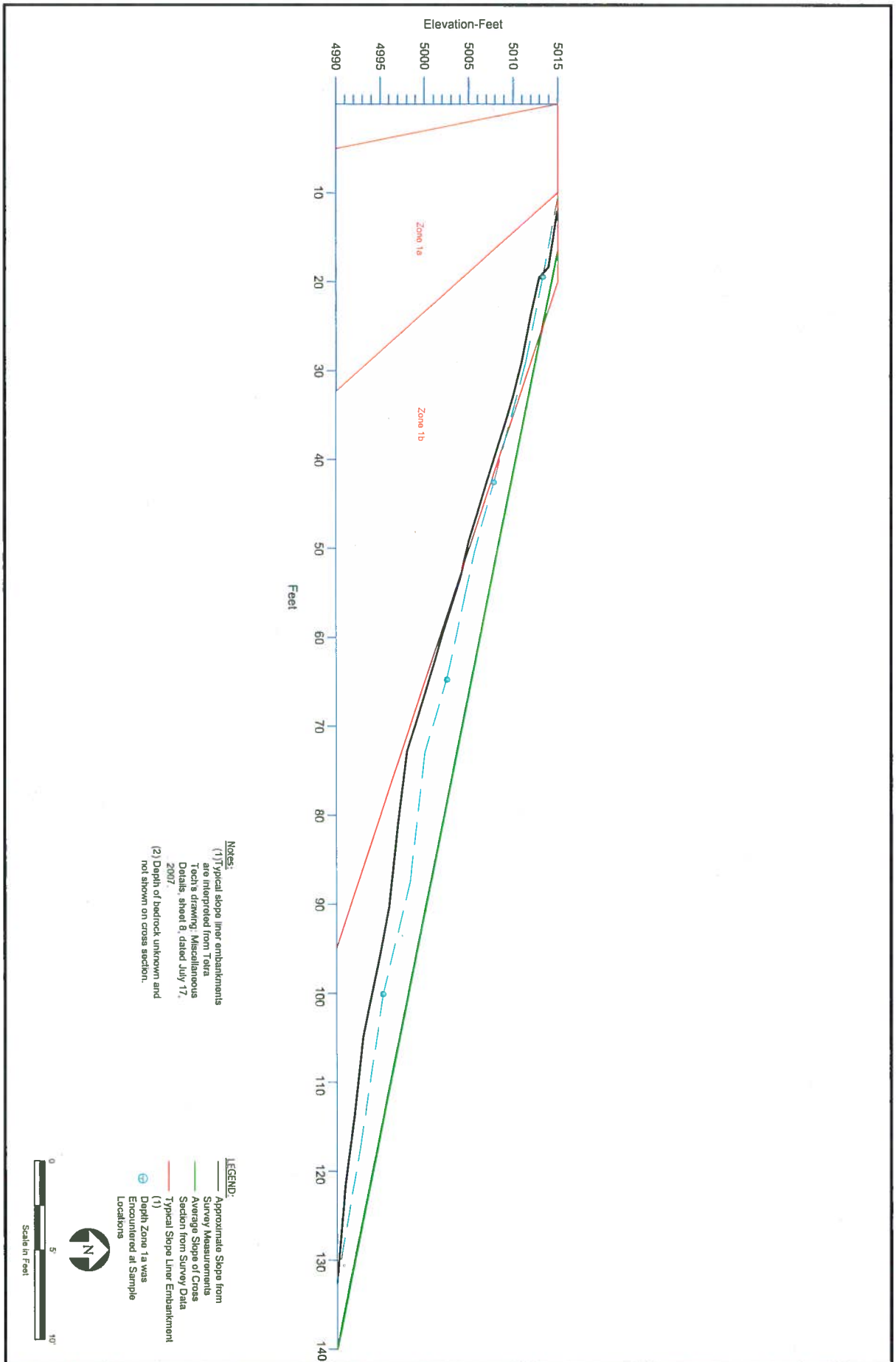
CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants



PROJECT NO:	14.155		
PROJECT NAME:	Mann Lakes Flood Repair		
DRAWN BY:	AMC2	CHECKED BY:	DRD
DWG DATE:	08.12.14	REV. DATE:	--

Figure 3
Damage Area A-2 Cross-section

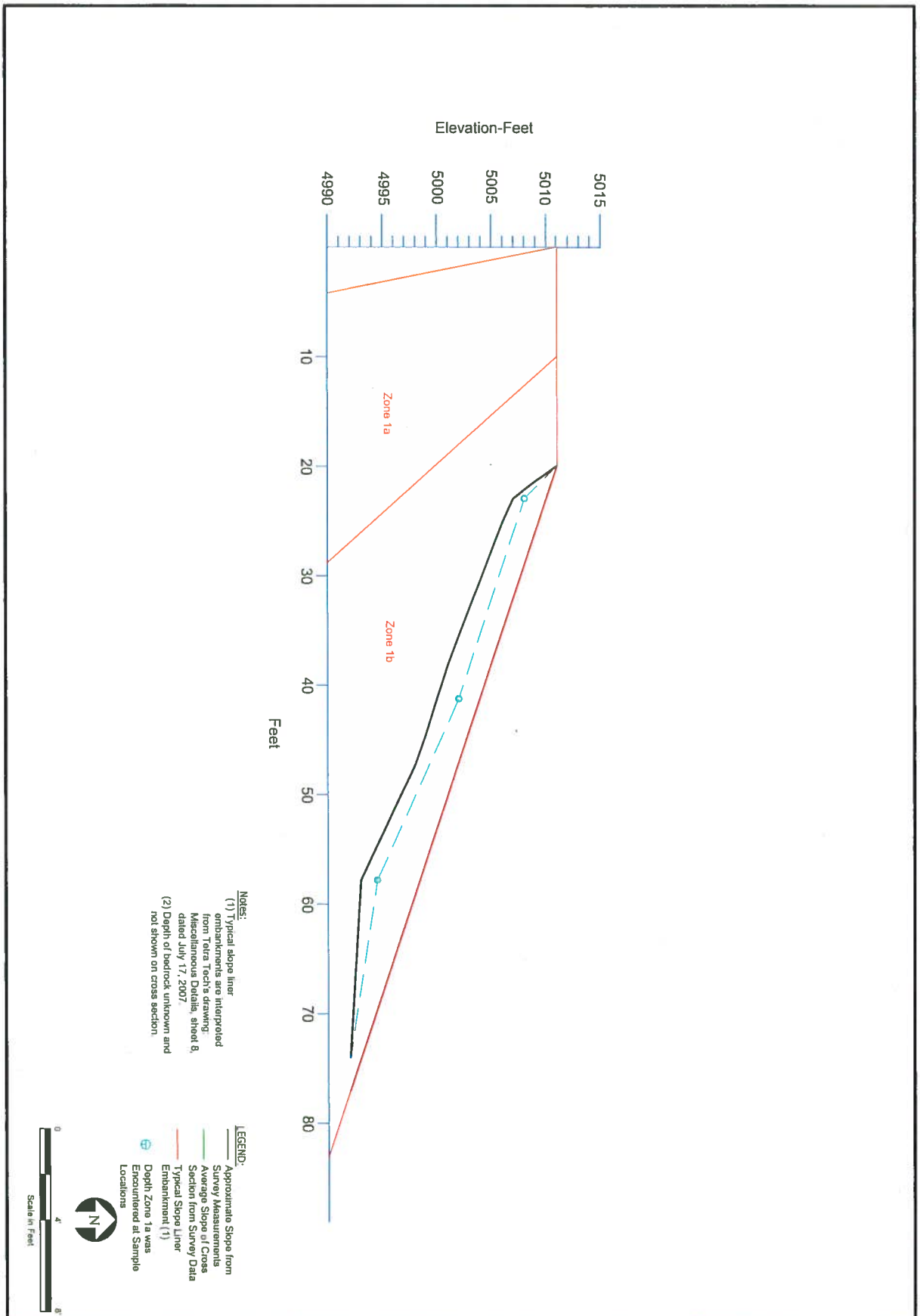
CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants



PROJECT NO:	14.155		
PROJECT NAME:	Mann Lakes Flood Repair		
DRAWN BY:	AMC2	CHECKED BY:	DRD
DWG DATE:	08.12.14	REV. DATE:	--

Figure 4
Damage Area A-3 Cross-section

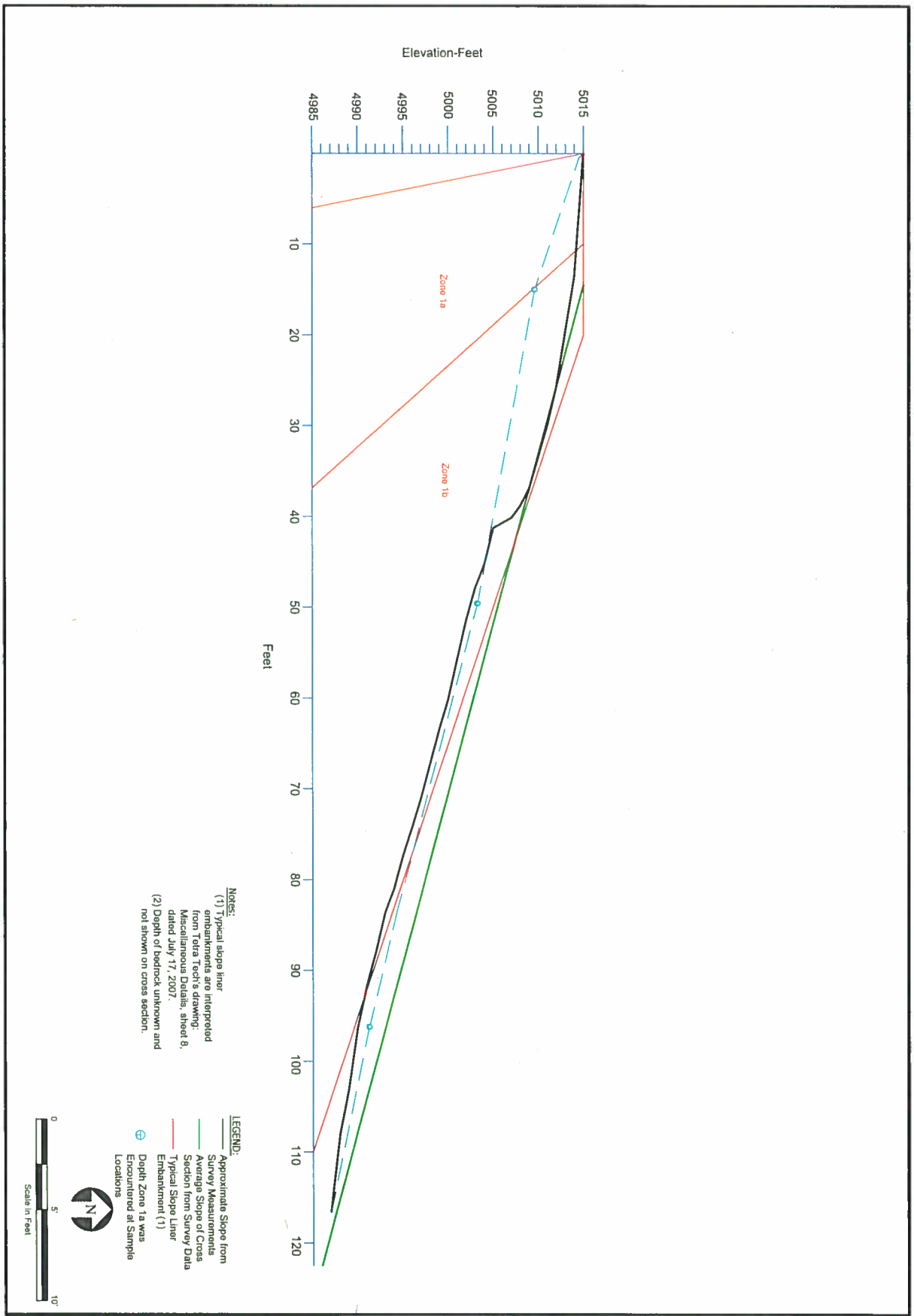
CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants



PROJECT NO:	14.155		
PROJECT NAME:	Mann Lakes Flood Repair		
DRAWN BY:	AMC2	CHECKED BY:	DRD
DWG DATE:	08.12.14	REV. DATE:	--

Figure 5
Damage Area A-4 Cross-section

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants



PROJECT NO:	14.155		
PROJECT NAME:	Mann Lakes Flood Repair		
DRAWN BY:	AMC2	CHECKED BY:	DRD
DWG DATE:	08.12.14	REV. DATE:	--

Figure 6
Damage Area A-5 Cross-section

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

Appendix A

Geotechnical Investigation Report

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

August 29, 2014

Mr. Todd Street, P.E.
Leonard Rice Engineers, Inc.
1221 Auraria Parkway
Denver, CO 80204

Subject: Geotechnical Study Report
Mann Lakes Flood Repair
Brighton, Colorado
Project No. 14.155

Dear Mr. Street:

The following is a summary of the geotechnical data and analysis concerning the flood damage at Mann Lakes. Five areas were studied at Mann Lakes, locations A-1 through A-5. These locations are shown on Figure 1. At each area, three locations along the eroded slope were observed and samples were taken from exposed Zone 1a and Zone 1b materials for laboratory testing. A summary of the laboratory testing is shown on Table 1. Depths of the Zone 1b layer were measured. In addition, three exploratory pits were excavated in Lake 2 to find potential borrow source for repair. The three exploratory pits were excavated with a backhoe to a depth of 5 feet. Using the data obtained in the field and available documents provided to Cesare from Adams County, we developed cross sections and conducted a seepage analysis of the existing and repaired slopes.

1.0 SUBSURFACE CONDITIONS

1.1 LAKE 2 (AREAS A-1 AND A-2)

In Lake 2 we observed two areas of erosion. Area A-1 corresponds with Tetra Tech's cross section at Sta 1+00 from their drawing *Site Plan North and Central Liners Mann Lake 2*. Cesare's findings at this cross section and all the others varied significantly with the construction plans prepared by Tetra Tech. Zone 1a was found to be nearer to the surface than in the drawings and Zone 1b was not as thick as it was in the drawings. Photographs of site observations are shown in Appendix A.

1.1.1 Area A-1

Photos 1 and 2 show a general view of this location. At A-1 there was an initial eroded step down of 3 feet 7 inches, with approximately 1 foot 9 inches of Zone 1a exposed. This can be seen in Photo 3. Another 1 foot 6 inches in depth was investigated and a clay, described as silty, with some gravel, slightly moist to moist was encountered. Midway down the slope there was a 4 foot 7 inch eroded wall of exposed soil, with 1 foot 7 inches of Zone 1a exposed. This is shown in Photo 4. Zone 1a, continued after excavating down another 1 foot 6 inches. The clay was silty with some gravel and was moist. Near the bottom of the slope was a 4 foot eroded wall of exposed soil. The bottom 1 foot 4 inches consisted of Zone 1a. This is shown in Photo 5. Again, Zone 1a was encountered after excavating another 1 foot 6 inches. The clay was moist. There was 2 to 4 feet of

Zone 1b eroded, and on average, 1 foot 6 inches of Zone 1a eroded. Zone 1b was classified as a clayey sand with gravel (SC), with a liquid limit of 28, and a plasticity index of 15. Zone 1a was classified as a sandy lean clay (CL), with a liquid limit of 48, and a plasticity index of 24.

1.1.2 Area A-2

Location A-2 was the second area of Lake 2 studied, which was about 1,000 feet east of A-1 at Sta 11+00, according to Tetra Tech's drawing. Photo 6 shows a general view of the damage. At the top of the slope there was 2 feet 7 inches of Zone 1-b exposed, with 1 foot 6 inches of Zone 1a exposed. This is shown in Photos 7 and 8. Midway down the slope there was 1 foot 6 inches of Zone 1b exposed, with the bottom 5 inches being of Zone 1a. This is shown in Photo 9. Near the bottom of the slope there was 15 inches of Zone 1b exposed. Zone 1a encountered several inches deeper than the exposed soil. This is shown in Photos 10 and 11. Here Zone 1b was classified as a well graded sand with silt, clay, and gravel (SW-SC), with a liquid limit of 19, and a plasticity index of 7. Zone 1a was classified as a sandy lean clay (CL), with a liquid limit of 43, and a plasticity index of 25.

1.2 LAKE 1 (AREAS A-3, A-4, AND A-5)

1.2.1 Area A-3

Location A-3 was at the northwest corner of the lake. Cesare, Inc. (Cesare) could not identify a specific station or cross section corresponding with this location from the plans. Photos 12 and 13 show a general view of the location. The initial eroded step down was 1 foot 7 inches deep with 4 inches of Zone 1a exposed. Near the top there was a 3 foot wall of eroded Zone 1b exposed, with the bottom 10 inches being of Zone 1a. This is shown in Photo 14. Midway down the slope was an approximately 4 foot wall of exposed soil, with the bottom 2 feet being of Zone 1a. This is shown in Photo 15. At another section midway, a 4 foot 6 inch wall with a layer of recompacted siltstone was noted between the zones as seen in Photo 16. Near the bottom of the slope there was a 4 foot 4 inch wall of exposed soil, with 1 feet 2 inches of Zone 1a exposed. This is shown in Photo 17. On average, approximately 2 to 3 feet of Zone 1b overlaid Zone 1a. The sample from Zone 1b was classified as a silty, clayey, sand (SC-SM), with a liquid limit of 18, and a plasticity index of 4. Zone 1a was classified as a sandy lean clay (CL), with a liquid limit of 36, and a plasticity index of 19.

1.2.2 Area A-4

Location A-4 was at the outlet from Lake 1 to the South Platte River. The erosion at this location included several step downs. The general view is shown in Photos 18 and 19. Near the top of the slope there was a 4 foot 3 inch wall of soil exposed, with the bottom 16 inches being of Zone 1a that stepped down another 30 inches towards the center of the erosion. This is shown in Photos 20 and 21. Midway down the slope there was an eroded area that was a total of 6 feet deep with 2 feet of Zone 1a exposed. This is shown in Photo 22. Near the bottom there was a 4 foot 10 inch wall of soil eroded with 16 inches of Zone 1a exposed. This is shown in Photo 23. The sample from Zone 1b was classified as a clayey sand with gravel (SC), with a liquid limit of 25, and a plasticity index of 12. Zone 1a was classified as a clayey sand (SC), with a liquid limit of 24, and a plasticity index of 8.

1.2.3 Area A-5

Location A-5 was several hundred feet north of the inlet from Lake 3 to Lake 1. A general view of the area is shown in Photos 26 and 27. There were several other places near the inlet that showed some erosion. These areas are shown in Photos 24 and 25. One was about 150 feet east of the inlet that had a 3 foot 6 inch deep eroded area, with 16 inches of Zone 1a exposed, but no samples were taken at these areas. At the top of the slope at location A-5 was an initial step down of 4 feet 10 inches. Zone 1a was encountered at a depth of 5 feet 5 inches. This is shown in Photo 28. Midway down the slope there was 4 feet 8 inches of exposed soil, with 8 inches of Zone 1a exposed. This is shown in Photo 29. The middle of the erosion track dipped down another 6 to 12 inches in the center. Near the bottom of the slope was a 5 foot wall of soil, with Zone 1a encountered at a depth of 3 feet 8 inches. This is shown in Photo 30. The sample taken from Zone 1b was classified as a silty, clayey sand, with gravel (SC-SM), with a liquid limit of 19, and a plasticity index of 2. Zone 1a was classified as a silty, clayey sand (SC-SM), with a liquid limit of 24, and a plasticity index of 4.

1.3 POTENTIAL BORROW SOURCE (LAKE 2 BOTTOM)

The locations of exploratory pits 1, 2, and 3, are shown in Figure 1. Exploratory pits 1 and 2 encountered weathered claystone. Exploratory pit 3 encountered competent claystone bedrock. All three pits were difficult to process in the laboratory, indicating these materials will be difficult to process during construction for use in repairs. The samples from exploratory pits 1 and 2 are sandy lean clays that had liquid limits of 42 and 43, respectively, and plastic limits of 25 and 23, respectively. The sample from exploratory pit 3 is a sandy fat clay that has a liquid limit of 52 and a plastic limit of 24.

1.4 CROSS SECTIONS

Using the data collected in the field and available cross sections from Tetra Tech, we developed cross sections at each area depicting the following:

1. The proposed cross sections from available Tetra Tech construction drawings. No drawings were available for Lake 1, so we assumed Lake 1 was constructed utilizing similar cross sections as Lake 2.
2. The average eroded slope in the erosion channels.
3. The average non-eroded slope.
4. Observed depth to Zone 1a.

These cross sections are shown in Figures 2 to 6.

2.0 SEEPAGE ANALYSIS

Cesare conducted the seepage analysis utilizing the Area A-1 cross sections. This area's erosion was more severe than other areas, but is representative of the materials found throughout the site. The seepage analysis was conducted assuming an empty reservoir condition at two different groundwater elevations in the native materials behind the clay liners. The normal groundwater elevation was assumed to be 9 feet below ground surface and about 16 feet above bedrock and was derived from the average groundwater elevations from the *Geotechnical Engineering Study, Park Boulevard Subgrade, Mann Lakes Gravel Pit, Adams County, Colorado,* by Tetra Tech, dated

April 2009. The high water table was assumed to be 4 feet below the ground surface and about 21 feet above bedrock.

We analyzed the eroded cross section and that same cross section after repairing to pre-flood damage conditions according to the available original construction plans. The repaired scenario followed the original construction plans with Zone 1b having a slope of 3H:1V and the innermost edge of Zone 1a having a slope of 0.5H:1V. The top width of each zone is 10 feet, respectively. This is more conservative than the actual conditions observed where it appears that Zone 1a is thicker then depicted in the plans.

Hydraulic conductivity values for analysis were developed for each material. To do this volumetric water conductivity, functions were first developed using grain size analysis and the liquid limits of each material found through our laboratory testing and experience with these materials. Through the classifications of each material, respective K-values were then chosen for the hydraulic conductivity functions. Zone 1a is classified as a sandy lean clay. Zone 1b is a clayey sand with gravel. The bedrock is a part of the Denver Blue Claystone formation. The native soils consist of sands and gravels. Table 2 shows engineering properties assigned to each material.

TABLE 2. Material Properties

Material	Hydraulic Conductivity (ft/sec)	Liquid Limit	Plasticity Index	Percent Fines	Percent Gravel
Zone 1b	1e-6	28	15	20	27
Zone 1a	1e-8	48	24	60	3
Bedrock	1e-9	52	24	3	0
Native soils	1e-2	15	6	5	45

The seepage analyses were performed using SEEP/W software published by Geo-Slope International and contained in the Geostudio 2007 suite of applications (Version 7.20, build 5033).

Table 3 gives the leakage requirements contained in the State of Colorado's *State Engineer Guidelines for Lining Criteria of Gravel Pits,* and contains both a design standard and a performance standard with respective maximum allowable groundwater inflow from the perimeter of a lined reservoir.

Table 3. State Engineer Guidelines for Maximum Allowable Inflow

Location	Design Standard	Performance Standard
Liner perimeter	0.03 ft^3/day/ft^2	0.09 ft^3/day/ft^2

The seepage analyses were performed for a 90 day time period which corresponds with the time needed for a leak test. Figures 1 through 4 in Appendix B show each condition with the total head contours, vector arrows, and flux across the toe of the slope where water would enter the reservoir. The flux in Figure 1 and 2 of the eroded condition was measured where the original toe of the slope would have been. The fan of sand and rock that extended past the toe would have a

high permeability and differ from the original material properties of Zone 1b and would not be representative of the actual flux. The flux for each condition was converted to $ft^3/day/ft^2$ in order to compare with the state standards. Each condition meets the state standards for both design and performance. Table 4 shows the flux under each condition analyzed.

TABLE 4. Flux

Liner Condition	Flux ($ft^3/day/ft^2$)	
	High Water Table	Normal Water Table
Eroded Liner	0.012	0.007
Repaired Liner	0.010	0.006

3.0 CONCLUSIONS

In our opinion, the eroded slopes can be repaired by excavating the slopes to the bottom of the eroded surface and replacing with material that meets Zone 1b specifications. The entire area to be repaired should be excavated down to the same depth. The slopes should be benched with minimum horizontal benches of 4 feet. The vertical dimension of the bench should be a height to allow for the benches to follow the slope of the excavated surface,e but should not exceed 4 feet. The Zone 1b material shall be placed in maximum 8 inch loose lifts and compacted to a minimum of 95% of maximum dry density as determined from ASTM D698 (standard Proctor) within 2 percent of optimum moisture content.

Please contact us with any questions or comments regarding this information.

Sincerely,
CESARE, INC.

COLORADO REGISTERED DARIN R. DURAN 33919 8/29/14 PROFESSIONAL ENGINEER

Anna M. Casady, E.I.
Staff Engineer

Darin R. Duran, P.E.
Principal, Geotechnical Engineering Manager

AMC/ksm

Attachments

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

TABLE 1
Summary of Laboratory Test Results
Mann Lakes Flood Repair
Project No. 14.155

Sample Location		Standard Proctor (ASTM D698)		Gradation			Atterberg Limits		
Boring	Depth (feet)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	Gravel (%)	Sand (%)	Silt/ Clay (%)	Liquid Limit (%)	Plasticity Index (%)	Material Type
A-1	Zone 1b			27	53	20	28	15	(SC) SAND: clayey, with gravel; A-2-6 (0)
A-1	Zone 1a			2	37	61	48	24	(CL) CLAY: sandy, lean; A-7-6 (13)
A-2	Zone 1b			29	61	10	19	7	(SW-SC) Well graded SAND: with silt, clay, and gravel; A-2-4 (0)
A-2	Zone 1a			10	32	58	43	25	(CL) CLAY: sandy, lean; A-7-6 (11)
A-3	Zone 1b			14	61	25	18	4	(SC-SM) SAND: silty, clayey; A-1-b (0)
A-3	Zone 1a			7	30	63	36	19	(CL) CLAY; sandy, lean; A-6 (9)
A-4	Zone 1b			34	50	16	25	12	(SC) SAND: clayey, with gravel; A-2-6 (0)
A-4	Zone 1a			5	53	42	24	8	(SC) SAND: clayey; A-4 (0)
A-5	Zone 1b			23	57	20	19	2	(SC-SM) SAND: silty, clayey, with gravel; A-1-b (0)
A-5	Zone 1a			4	53	43	24	4	(SC-SM) SAND: silty, clayey; A-4 (0)
Pit 1	0-5	104.0	20.0	0	20	80	42	25	(CL) CLAY: lean, with sand; A-7-6 (19) [Claystone]
Pit 2	0-5	99.2	22.7	0	45	55	43	23	(CL) CLAY: sandy, lean; A-7-6 (9) [Claystone]
Pit 3	0-5	92.6	28.2	0	32	68	52	24	(CH) CLAY, sandy, fat; A-7-6 (16) [Claystone]

APPENDIX A

Photographs

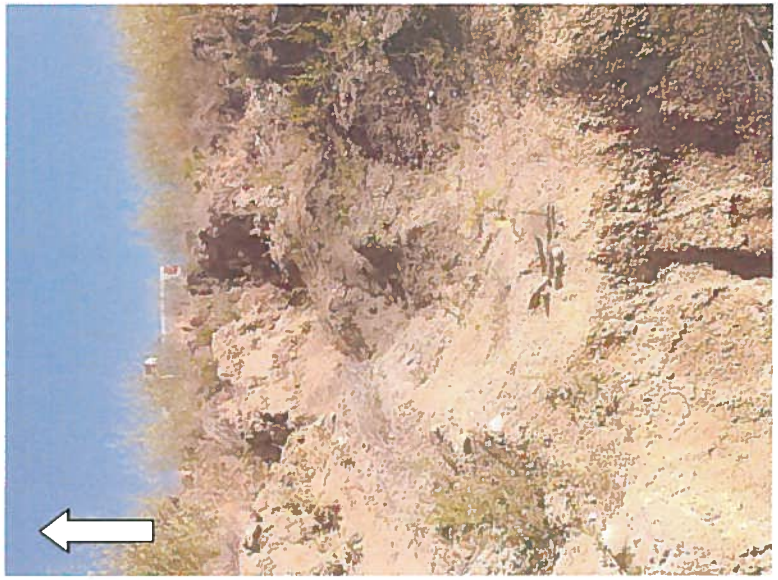


Photo 1 General view of location A-1.

Photo 2 Additional view of location A-1.

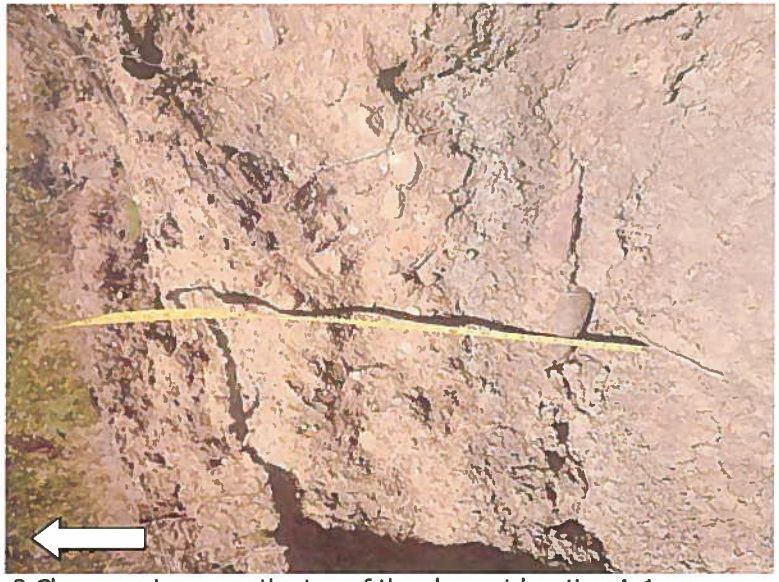


Photo 3 Close-up view near the top of the slope at location A-1.

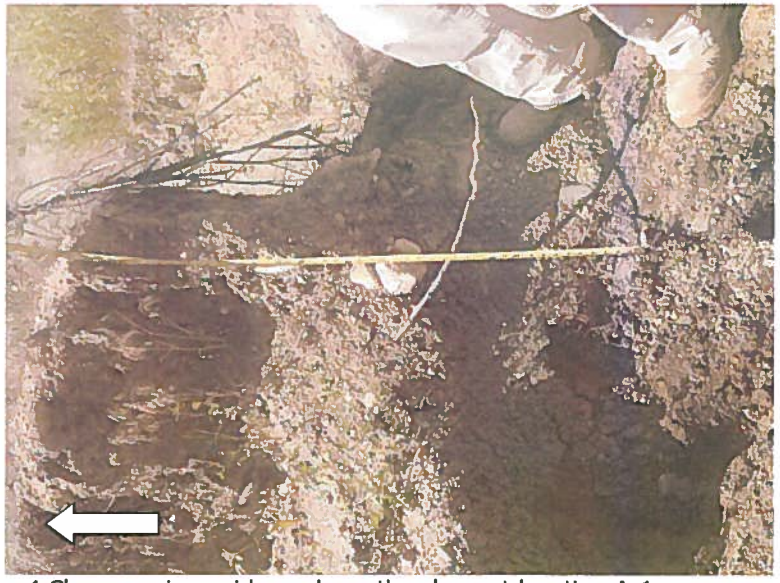


Photo 4 Close up view midway down the slope at location A-1.

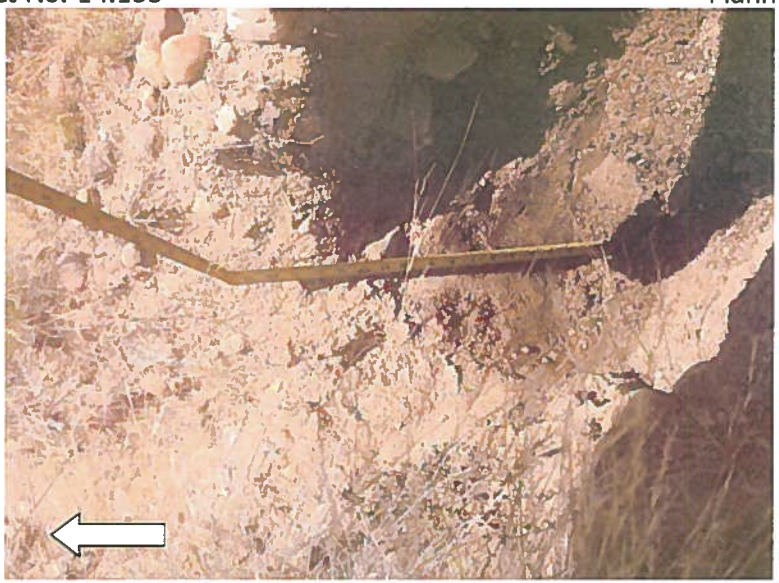


Photo 5 Close-up view near the bottom of the slope at location A-1.

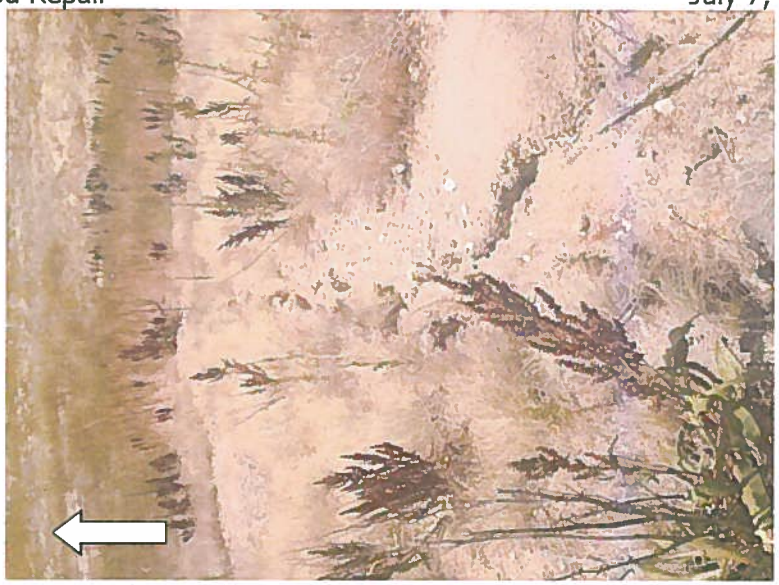


Photo 6 General view of location A-2.

Photo 7 Additional view of the top section at location A-2.

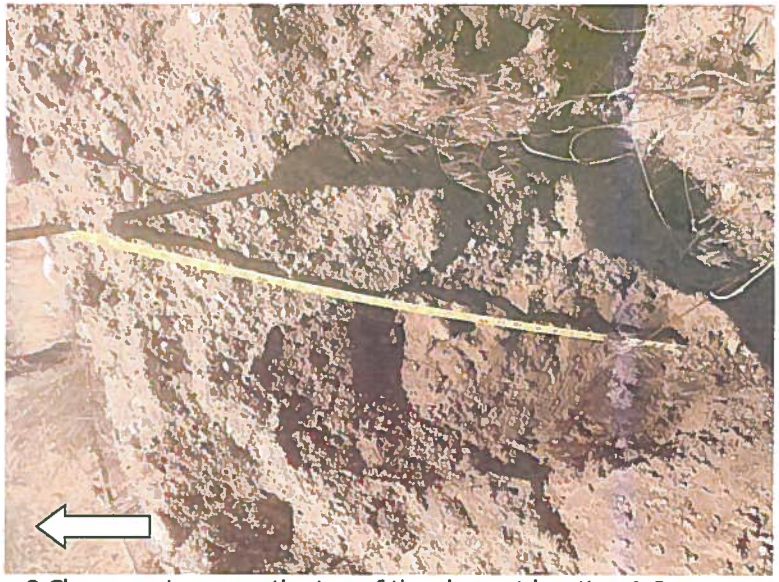


Photo 8 Close-up view near the top of the slope at location A-2.

Photo 9 Close-up view midway down the slope at location A-2.

Photo 10 Close-up view near the bottom of the slope at location A-2.

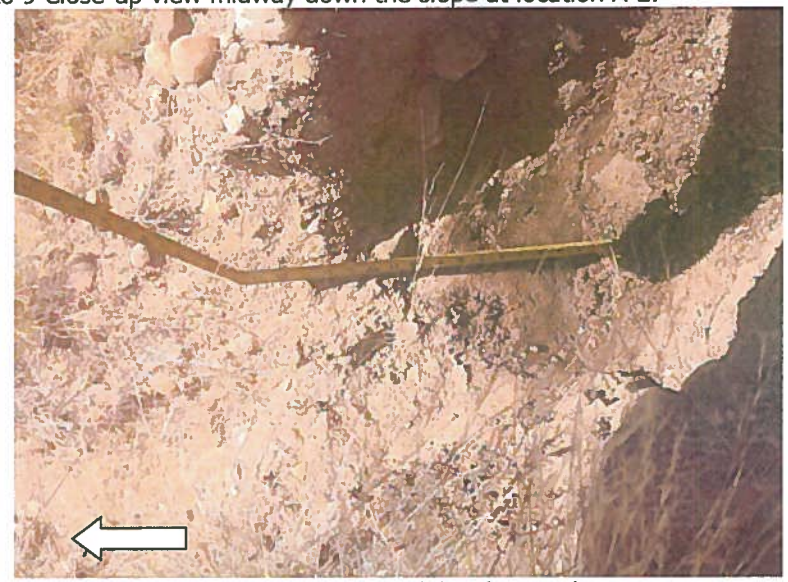


Photo 11 Additional view of the bottom of the slope at location A-2.

Photo 12 General view of location A-3.

Photo 13 Additional view of location A-3.

Photo 14 Close-up view near the top of the slope at location A-3.

Photo 15 Close-up view midway down the slope at location A-3.

Photo 16 Close-up view of the siltstone intrusion midway down the slope at location A-3.

Photo 17 Close-up view near the bottom of the slope at location A-3.

Photo 18 General view of the step downs at location A-4.

Photo 19 General view of location A-4.

Photo 20 Close-up view near the top of the slope at location A-4.

Photo 21 Close-up view near the top of the slope with the step down at location A-4.

Photo 22 Close-up view midway down the slope at location A-4.

Photo 23 Close-up view near the bottom of the slope at location A-4.

Photo 24 General view of the erosion between Lake 1 and Lake 3.

Photo 25 General view of the erosion 150 feet east of inlet between Lake 3 and Lake 1.

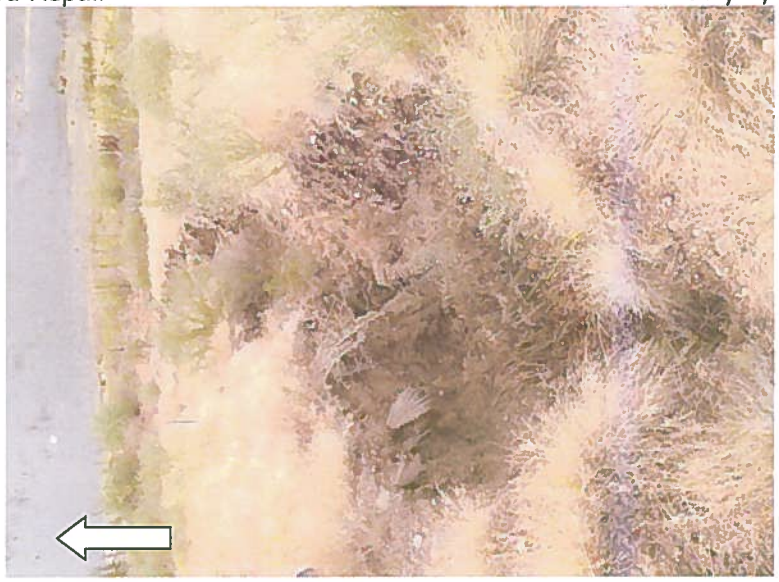


Photo 26 General view of location A-5.

Photo 27 Additional view of location A-5.

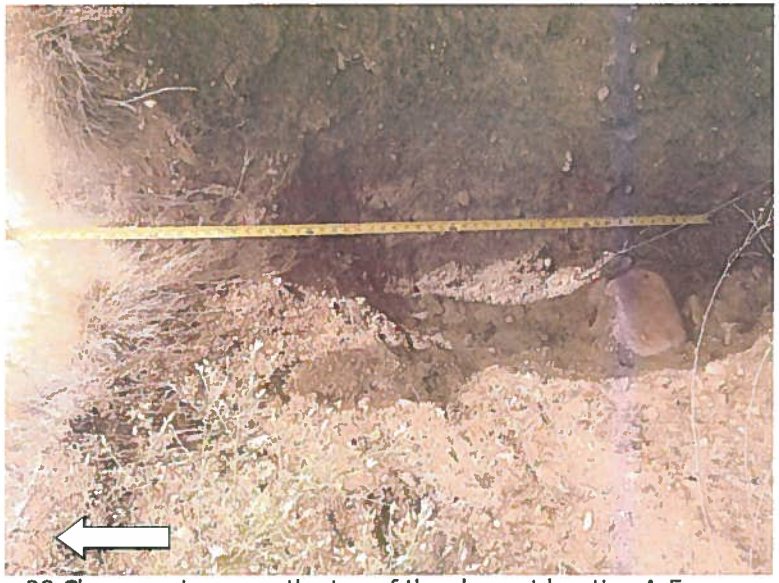


Photo 28 Close-up view near the top of the slope at location A-5.

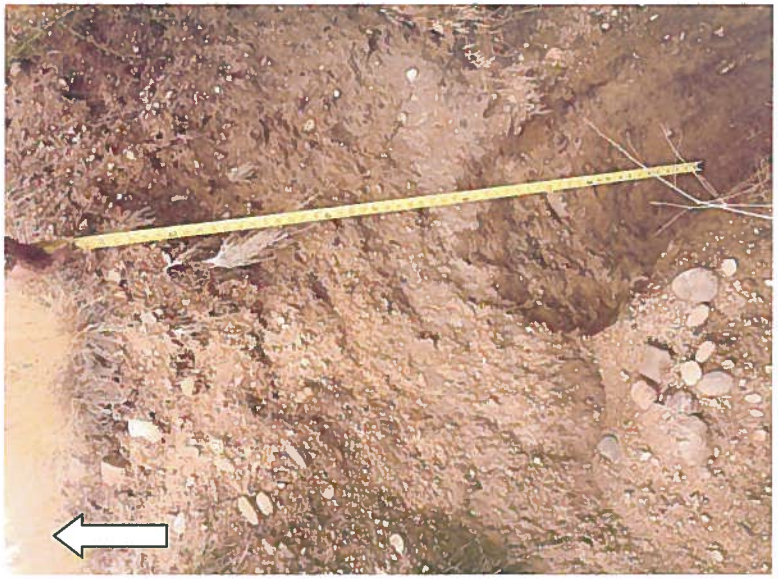
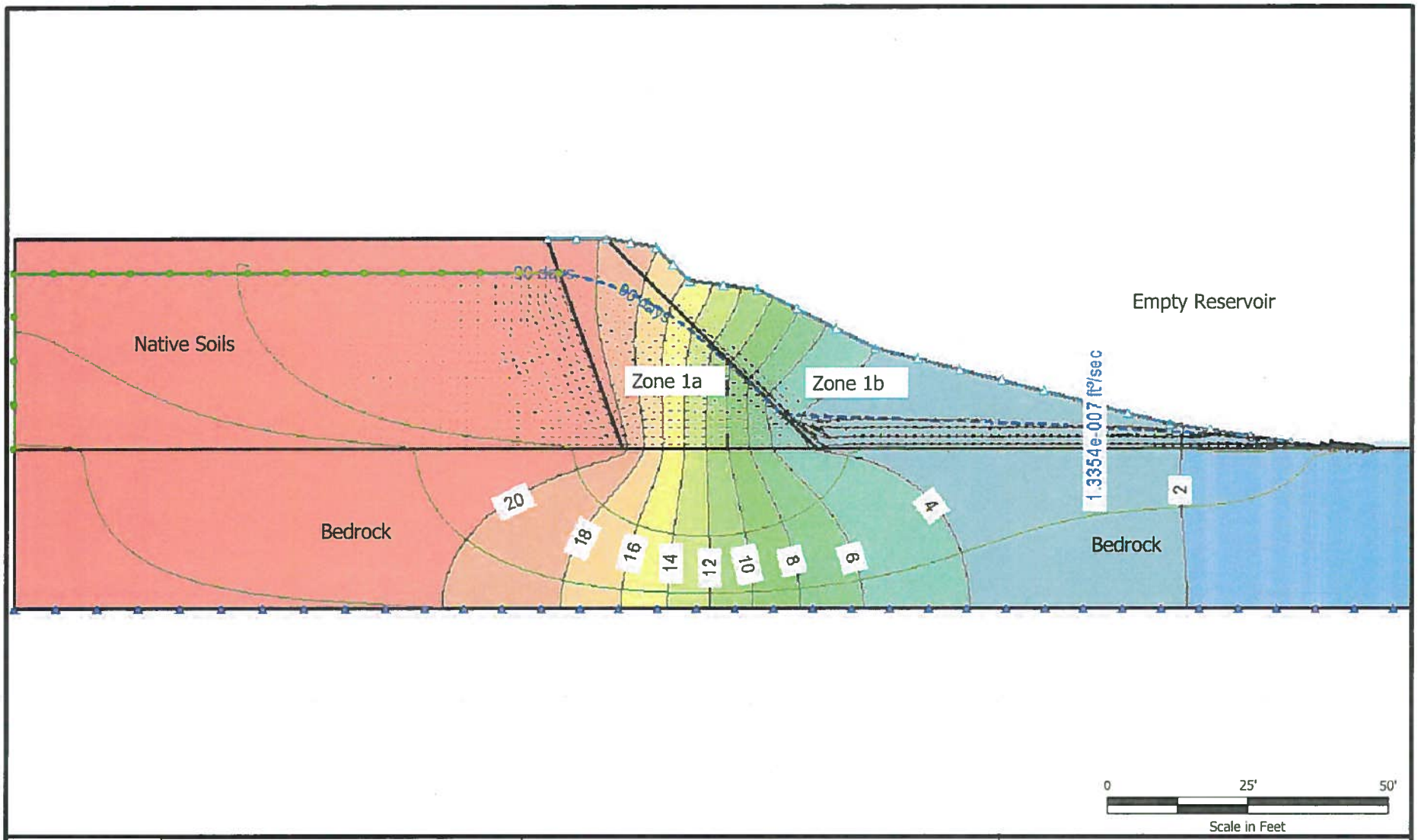


Photo 29 Close-up view midway down the slope at location A-5.

Photo 30 Close-up view near the bottom of the slope at location A-5.

APPENDIX B

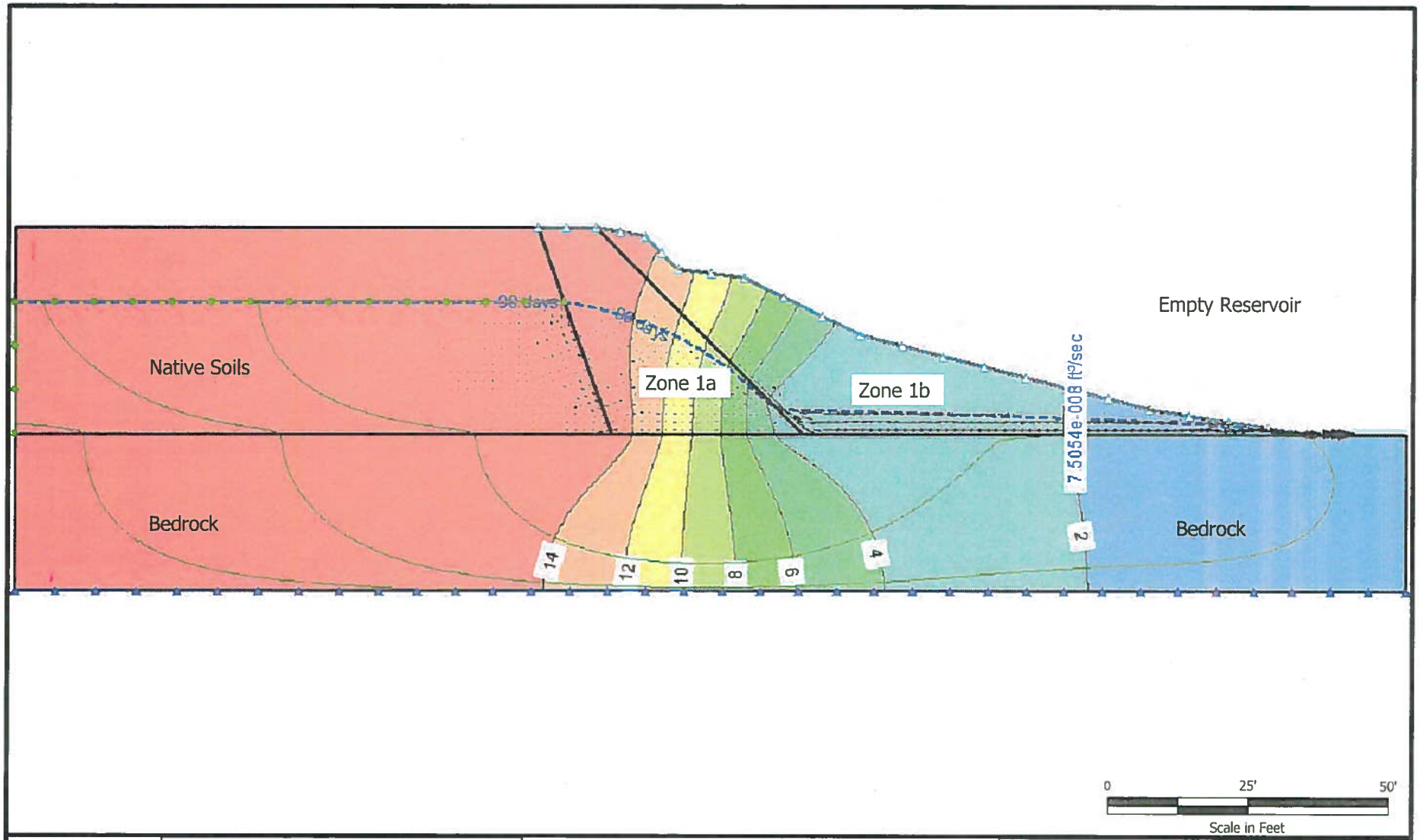
Seepage Analysis



PROJECT NO:	14.155		
PROJECT NAME:	Mann Lakes Flood Repair		
DRAWN BY:	AMC2	CHECKED BY:	DRD
DWG DATE:	08.27.14	REV. DATE:	--

FIGURE 1
Seepage for the Eroded Liner at a High Water Table

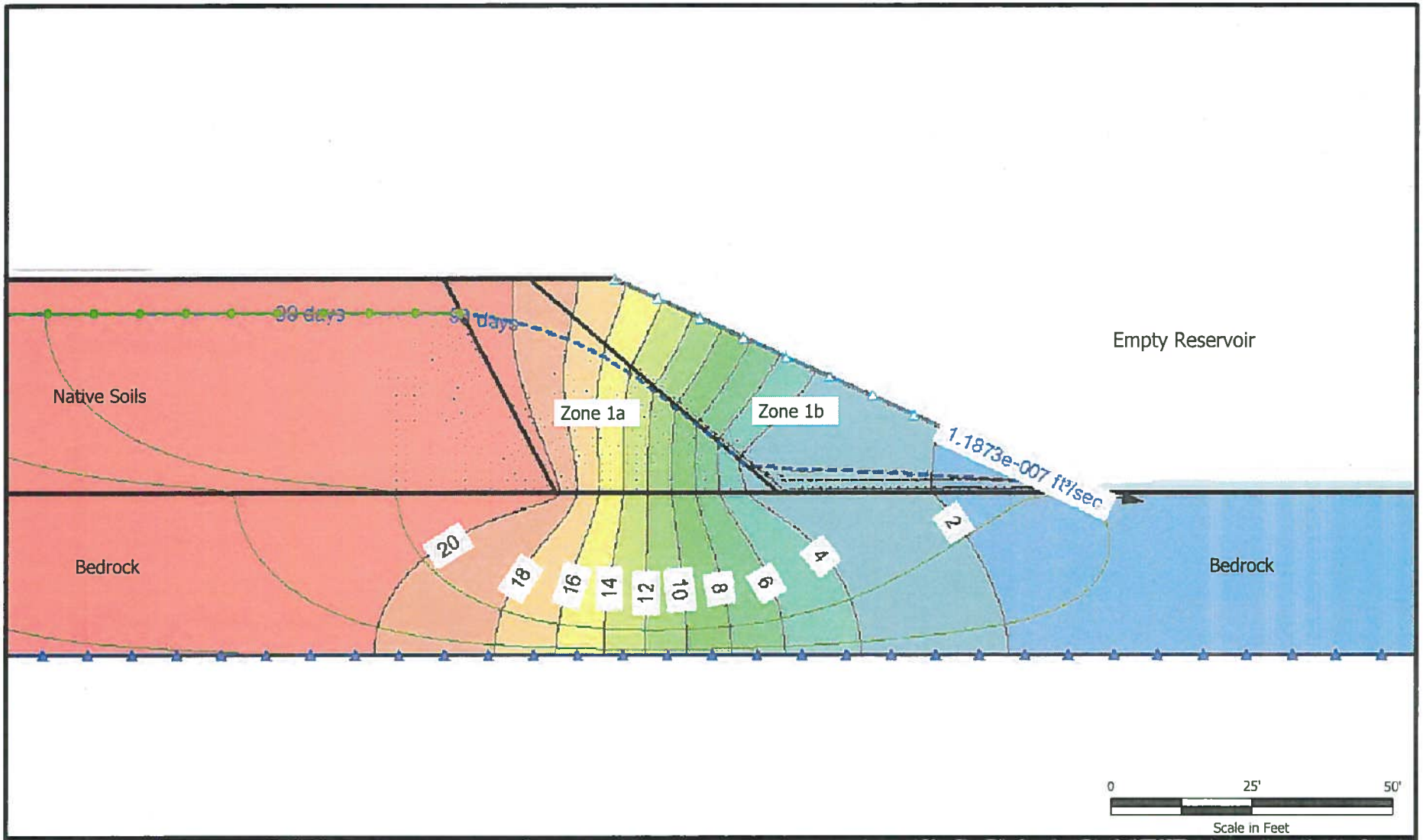
CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants



PROJECT NO:	14.155		
PROJECT NAME:	Mann Lakes Flood Repair		
DRAWN BY:	AMC2	CHECKED BY:	DRD
DWG DATE:	08.27.14	REV. DATE:	--

FIGURE 2
Seepage for the Eroded Liner at a Normal Water Table

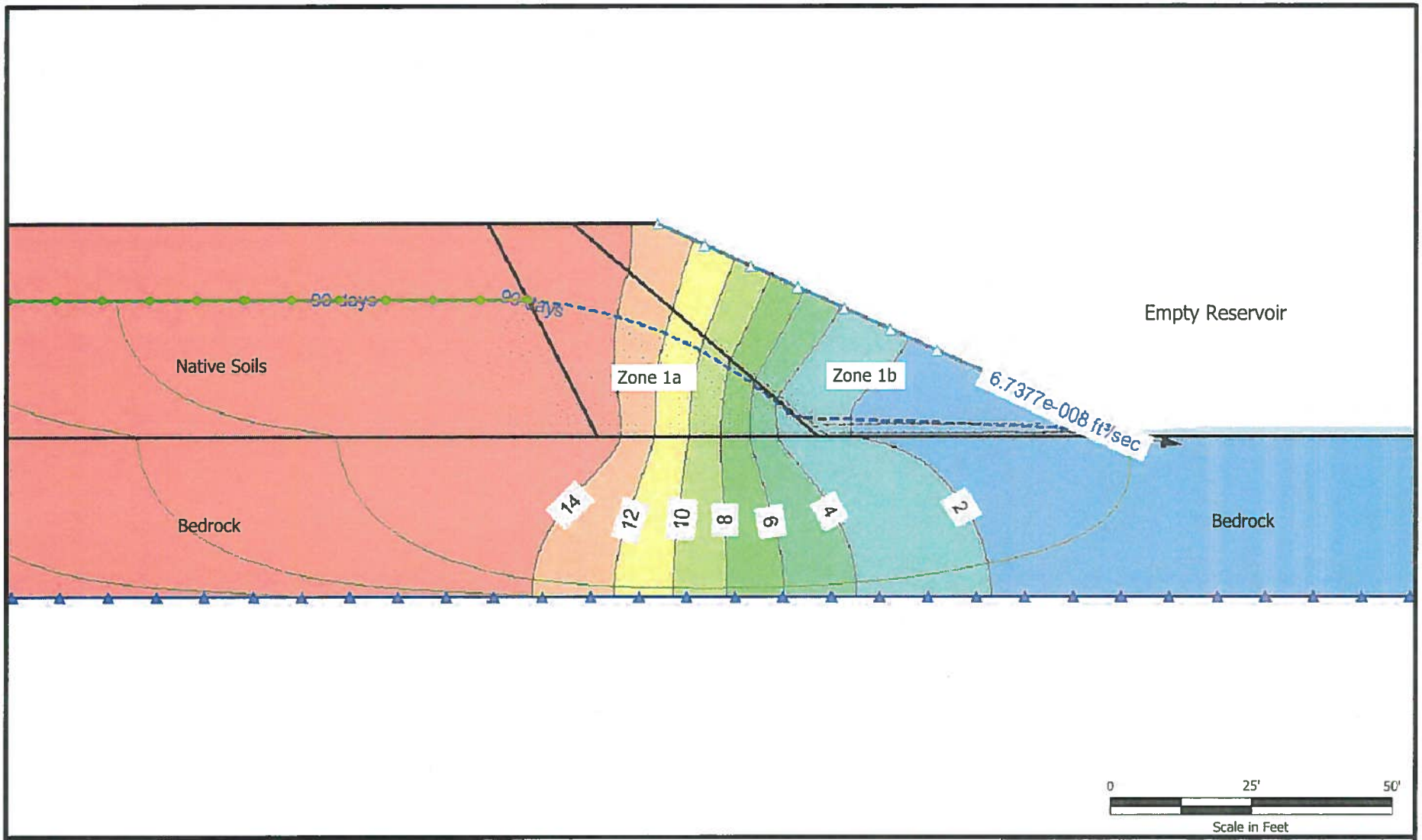
CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants



PROJECT NO:	14.155		
PROJECT NAME:	Mann Lakes Flood Repair		
DRAWN BY:	AMC2	CHECKED BY:	DRD
DWG DATE:	08.27.14	REV. DATE:	--

FIGURE 3
Seepage for a Repaired Liner at a High Water Table

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants



PROJECT NO:	14.155		
PROJECT NAME:	Mann Lakes Flood Repair		
DRAWN BY:	AMC2	CHECKED BY:	DRD
DWG DATE:	08.27.14	REV. DATE:	--

FIGURE 4
Seepage for a Repaired Liner at a Normal Water Table

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

Appendix B

Damage Photos

Photo 1 – Damage Area A-1 Facing Southeast

Photo 2 – Damage Area A-1 Facing Northwest

Photo 3 – Damage Area A-2 Facing West

Photo 4 – Damage Area A-2 Facing East

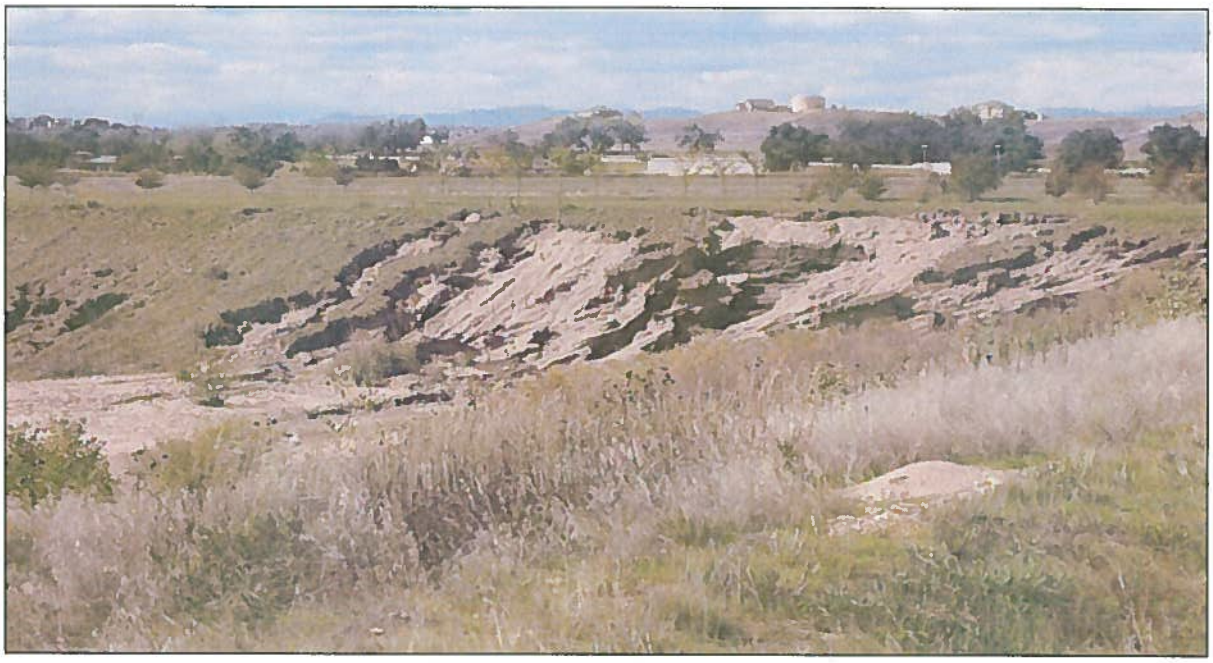


Photo 5 – Damage Area A-3 Facing West

Photo 6 – Damage Area A-4 Facing West

Photo 7 – Damage Area A-4 and Spillway Inlet Facing East

Photo 8 – Damage Area A-5 Facing Southeast

Photo 9 – Damage Area A-6 Facing Northwest

Photo 10 – Damage Area A-6 Facing Southeast

Photo 11 – Damage Area A-7 Facing South

SPECIFICATIONS AND DRAWINGS FOR THE

MANN LAKES RESERVOIR FLOOD DAMAGE REPAIRS

FOR

ADAMS COUNTY

SEPTEMBER 2014

VICINITY MAP

NOT TO SALCE

SHEET LIST	DWG NO	SHEET NO
COVER SHEET	C100	1
GENERAL NOTES	C110	2
SITE AND GRADING PLAN	C200	3
GRADING REPAIR SECTIONS	C230	4
GRADING REPAIR SECTIONS	C231	5
GRADING REPAIR SECTIONS	C232	6
GRADING REPAIR SECTIONS	C233	7
DETAILS	C250	8

LeonardRice ENGINEERS, INC.
1221 Auraria Parkway | Denver, CO 80204
303-455-9589 | 800-453-9589 | Fax: 303-455-0115
www.LREwater.com

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

DESIGNED BY: TSS
DRAWN BY: JES
CHECKED BY: TSS
DRAWING SCALE: NA

LINE IS 2 INCHES AT FULL SCALE

(IF LINE IS NOT 2 INCHES - SCALE ACCORDINGLY)

REV	DESCRIPTION	DATE
1	30% DESIGN DRAWINGS	08/19/14
2	90% DESIGN DRAWINGS	09/10/14
3	BID SET	09/24/14
4		
5		
6		
7		
8		
9		

NOT FOR CONSTRUCTION

ADAMS COUNTY COLORADO

MANN LAKES RESERVOIR FLOOD DAMAGE

COVER SHEET

PROJECT NO: 1413ADC02

DATE: 09/24/2014

C100

SHEET 1 OF 8

GENERAL NOTES FOR THE

MANN LAKES RESERVOIR FLOOD DAMAGE REPAIRS

FOR

ADAMS COUNTY

SEPTEMBER 2014

GENERAL NOTES:

1. THE CONTRACTOR SHALL HAVE ONE (1) SIGNED COPY OF THE APPROVED CONSTRUCTION PLANS, ONE (1) COPY OF THE PROJECT SPECIFICATIONS, ONE (1) COPY OF CURRENT JURISDICTIONAL STANDARDS AND SPECIFICATIONS, AND A COPY OF ANY PERMITS AND AGREEMENTS NEEDED AT THE JOB SITE AT ALL TIMES.
2. THE CONTRACTOR SHALL MAINTAIN AN AS-BUILT SET OF PLANS ON THE SITE AT ALL TIMES.
3. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING ANY AND ALL REQUIRED LOCAL, STATE, AND FEDERAL PERMITS FOR THIS PROJECT.
4. THE LOCATION OF ALL KNOWN UNDERGROUND UTILITIES IN THE CONSTRUCTION AREA HAVE BEEN SHOWN PER THE BEST AVAILABLE UTILITY RECORDS. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE EXISTENCE AND LOCATION OF ALL UNDERGROUND UTILITIES LOCATED WITHIN THE CONSTRUCTION LIMITS AND TO COORDINATE WITH THE UTILITY OWNERS. THE CONTRACTOR SHALL CONTRACT THE UTILITY NOTIFICATION CENTER OF COLORADO (UNCC) AT 1.800.922.1987 PRIOR TO THE START OF CONSTRUCTION. THE CONTRACTOR IS RESPONSIBLE FOR THE REPAIR AND ANY COST ASSOCIATED WITH THE REPAIR OF ANY UTILITIES DAMAGED DURING CONSTRUCTION. LEONARD RICE ENGINEERS (LRE) ASSUMES NO LIABILITY FOR UTILITY LOCATED. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THE EXISTENCE AND LOCATION OF ALL UTILITIES IN THE FIELD PRIOR TO CONSTRUCTION.
5. THE CONTRACTOR SHALL VERIFY ALL HORIZONTAL AND VERTICAL CONTROL, BASE ELEVATIONS, AND CONDITIONS AT THE JOB SITE AND PROMPTLY NOTIFY THE ENGINEER OF DIMENSION ERRORS, CHANGED SITE CONDITIONS FROM THOSE SHOWN ON THE PLANS, OMISSIONS, OR DISCREPANCIES BEFORE STARTING ANY WORK ON THE SITE.
6. ANY DISCREPANCIES, INCONSISTENCIES, OR AMBIGUITIES FOUND BETWEEN THE DRAWINGS AND SITE CONDITIONS SHALL BE IMMEDIATELY REPORTED TO IN WRITING TO THE ENGINEER, WHO WILL RESOLVE SUCH INCONSISTENCIES, OR AMBIGUITIES IN WRITING. WORK DONE BY THE CONTRACTOR AFTER THEIR DISCOVERY OF SUCH DISCREPANCIES, INCONSISTENCIES, OR AMBIGUITIES SHALL BE DONE AT THE CONTRACTOR'S OWN RISK.
7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING A STATE OF COLORADO DEWATERING PERMIT PRIOR TO CONSTRUCTION AND COMPLYING WITH ALL CRITERIA FOR THE DURATION OF THE CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ACCEPTANCE AND CONTROL OF ALL WATER FLOWING INTO OR ON TO THE CONSTRUCTION SITE INCLUDING SURFACE WATER, STORM SEWER FLOWS, AND GROUND WATER DURING CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING ANY GROUND WATER ENCOUNTERED DURING THE CONSTRUCTION OF ANY PORTION OF THE PROJECT. GROUND WATER SHALL BE PUMPED, PIPED, REMOVED, AND DISPOSED OF IN A MANNER WHICH DOES NOT CAUSE FLOODING OR EROSION ON ABUTTING PROPERTIES. NO INFRASTRUCTURE OR CONCRETE SHALL BE PLACED WHERE GROUND WATER IS VISIBLE UNTIL THE GROUND WATER HAS BEEN LOWERED BELOW THE PROPOSED IMPROVEMENTS. ANY UNSTABLE AREAS, AS A RESULT OF GROUND WATER, ENCOUNTERED DURING THE CONSTRUCTION OF THE PROPOSED IMPROVEMENTS SHALL BE STABILIZED BY THE CONTRACTOR, IN ACCORDANCE WITH THE SPECIFICATIONS.
8. ANY CONSTRUCTION SEDIMENT, DEBRIS, OR MUD TRACKING IN THE PUBLIC RIGHT-OF-WAY RESULTING FROM THE CONTRACTOR'S WORK SHALL BE REMOVED IMMEDIATELY BY THE CONTRACTOR. SEDIMENT, DEBRIS, AND MUD SHALL FIRST BE REMOVED BY SHOVEL OR SWEEPING FOLLOWED BY STREET WASHING. STREET SWEEPING SHALL BE PROVIDED ON A DAILY BASIS.
9. THE CONTRACTOR SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY. THESE REQUIREMENTS SHALL APPLY CONTINUOUSLY, AND NOT BE LIMITED TO NORMAL WORKING HOURS AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY, AND HOLD HARMLESS LEONARD RICE ENGINEERS (LRE), THE OWNER, AND GOVERNING JURISDICTIONS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF THE WORK AND SAFETY CONDITIONS ON THIS PROJECT.
10. OBSERVATIONS OF WORK IN PROGRESS AND ON-SITE VISITS ARE NOT TO BE CONSTRUED AS APPROVAL OR A GUARANTEE BY LEONARD RICE ENGINEERS, THE OWNERS, OR GOVERNING JURISDICTIONS OF THE CONTRACTOR'S CONFORMANCE WITH CONTRACTUAL COMMITMENTS.
11. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING TEMPORARY SERVICE FOR ALL UTILITIES TO ALL BUILDINGS DURING ALL PHASES OF CONSTRUCTION UNTIL PERMANENT SERVICE HAS BEEN PROVIDED.
12. THE CONTRACTOR SHALL RESTORE ALL DISTURBED AREAS TO THEIR ORIGINAL CONDITION
13. THE CONTRACTOR SHALL ADJUST ALL SURFACE FEATURES TO FINAL GRADE (LANDSCAPED AREAS, PAVEMENT, ETC.) PRIOR TO FINAL ACCEPTANCE OF WORK.
14. WRITTEN DIMENSIONS ON THE PLANS SHALL TAKE PRECEDENCE OVER SCALED DIMENSIONS
15. THE CONTRACTOR IS RESPONSIBLE FOR ARRANGING ACCESS, PARKING, AND STAGING/STORAGE AREAS.
16. ALL WORK SHALL BE CONSTRUCTED TO THE STANDARDS AND SPECIFICATIONS FOR THE GOVERNING JURISDICTION. IF A CONFLICT IS FOUND BETWEEN THE CONSTRUCTION PLANS AND THE GOVERNING JURISDICTION'S STANDARDS THE ENGINEER SHALL BE NOTIFIED IMMEDIATELY. THE ENGINEER WILL RESOLVE THE CONFLICT.

CLEAN UP NOTES:

17. THE CONTRACTOR SHALL KEEP THE SITE CLEAN AND FREE OF DEBRIS AND WASTE MATERIALS. THE CONTRACTOR IS RESPONSIBLE FOR PROPERLY DISPOSING OF ALL WASTE MATERIALS.
18. ALL CONSTRUCTION MATERIALS SHALL BE STORED PROPERLY AND SAFELY WHEN NOT IN USE,
19. THE CONTRACTOR IS RESPONSIBLE FOR REMOVING ANY SPLATTERED CONCRETE, ASPHALT, OIL, PAINT, CORROSIVE LIQUIDS, AND CHEMICALS FROM SURFACES TO PREVENT DAMAGE.
20. ALL WASTES SHALL BE PROPERLY REMOVED FROM THE SITE IN A MANNER THAT COMPLIES WITH LOCAL AND FEDERAL LAWS AND REGULATIONS. WASTE IS NOT TO BE DUMPED INTO STORM DRAINS, SANITARY SEWERS, DITCHES, STREAMS, RIVERS, LAKES, OR ANY WATERWAY.
21. PAYMENT APPLICATIONS WILL DEPEND UPON ADEQUATE CLEANUP.

WATER AND EROSION NOTES:

22. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONTROL OF ALL FLOWS WHICH INCLUDE, BUT ARE NOT LIMITED TO GROUND WATER AND STORM WATER THAT IS ENTERING AND EXITING THE SITE. THE CONTRACTOR IS RESPONSIBLE FOR PREVENTING POLLUTION TO ANY DRAINAGE WAYS.
23. THE CONTRACTOR SHALL BE RESPONSIBLE FOR EROSION CONTROL PER DESIGN DRAWING. EROSION AND SEDIMENT CONTROL DEVICE FEATURES SHALL BE INSTALLED PRIOR TO THE START OF CONSTRUCTION AND SHALL BE MAINTAINED THROUGHOUT THE DURATION OF THE PROJECT.

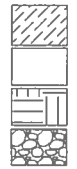
CONSTRUCTION STAKING:

24. ALL SURVEY WORK SHALL BE COMPLETED UNDER THE SUPERVISION OF A SURVEYOR LICENSED (PLS) IN THE STATE OF COLORADO.
25. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING ANY STAKES, CONTROL POINTS, AND MONUMENTS INSTALLED AND THE COST OF ANY RE-SURVEYS NECESSITATED BY THE CONTRACTORS OPERATIONS.

EARTHWORK

26. DAMAGED SLOPES SHOULD BE EXCAVATED WITH MINIMUM 4 FEET HORIZONTAL BENCHES PRIOR TO PLACEMENT OF FILL.
27. MINIMUM COMPACTION REQUIREMENTS SHALL BE TO 95% STANDARD PROCTOR DENSITY +/- 2% OPTIMUM MOISTURE OR AS REQUESTED BY THE ENGINEER.

LEGEND



ZONE 1B FILL

6" TYPE II BEDDING

NATIVE SOIL

TYPE M RIPRAP

LeonardRice ENGINEERS, INC.
1221 Auraria Parkway | Denver, CO 80204
303-455-9589 | 800-453-9589 | Fax: 303-455-0115
www.LREwater.com

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

DESIGNED BY TSS			
DRAWN BY JES			
CHECKED BY TSS			
DRAWING SCALE NA			
LINE IS 2 INCHES AT FULL SCALE			
(IF LINE IS NOT 2 INCHES - SCALE ACCORDINGLY)			

REV	DESCRIPTION	DATE
1	30% DESIGN DRAWINGS	08/19/14
2	90% DESIGN DRAWINGS	09/10/14
3	BID SET	09/24/14
4		
5		
6		
7		
8		
9		

NOT FOR CONSTRUCTION

ADAMS COUNTY COLORADO

MANN LAKES RESERVOIR FLOOD DAMAGE

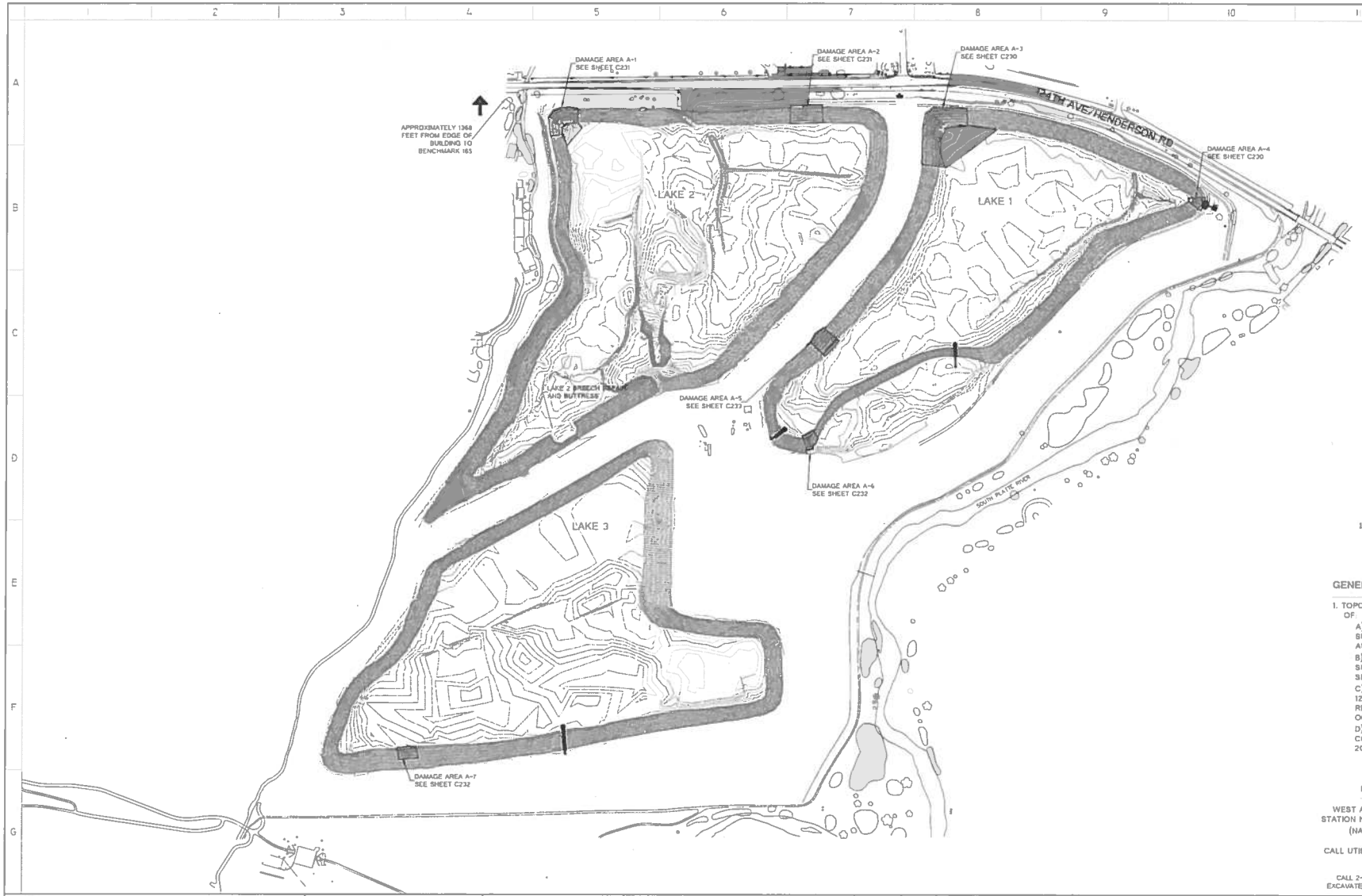
GENERAL NOTES

PROJECT NO 1413ADC02

DATE 09/24/2014

C110

SHEET 2 OF 8



Scale: 1" = 250' Horiz.
Half DRAWINGS AT HALF SCALE
0 250 500
Contour Interval - 5 ft.

GENERAL NOTES

1. TOPOGRAPHIC MAPPING IS A COMBINATION OF:
   - A) PARK BOULEVARD ROADWAY AS-BUILT SURVEY BY TETRA TECH, INC., DATED AUGUST 2009.
   - B) MANN LAKES 1, 2, AND 3 AS-BUILT SURVEY BY TETRA TECH, INC. DATED SEPTEMBER 2009
   - C) AERIAL TOPOGRAPHY ALONG EAST 124TH AVENUE AND THE SOUTH PLATTE RIVER BY FLATIRONS, INC. DATED OCTOBER 2003.
   - D) DAMAGE AREA SURVEY BY CCS CONSULTANTS, INC. DATED JUNE 25, 2014

MANN LAKES RESERVOIR DATUM:

WEST ADAMS COUNTY DENSIFICATION (WACD), STATION NO. 165 HAVING AN ELEVATION OF 5054.33' (NAVD '88) AS PER GPS OBSERVATION.

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND UTILITIES.

LeonardRice ENGINEERS, INC.
1221 Auraria Parkway | Denver, CO 80204
303-455-9589 | 800-453-9589 | Fax: 303-455-0115
www.LREwater.com

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

DESIGNED BY TSS			
DRAWN BY JES			
CHECKED BY TSS			
DRAWING SCALE 1"= 250'			
LINE IS 2 INCHES AT FULL SCALE			
(IF LINE IS NOT 2 INCHES - SCALE ACCORDINGLY)			

REV	DESCRIPTION	DATE
1	30% DESIGN DRAWINGS	08/19/14
2	90% DESIGN DRAWINGS	09/10/14
3	BID SET	09/24/14
4		
5		
6		
7		
8		
9		

NOT FOR CONSTRUCTION

ADAMS COUNTY
COLORADO

MANN LAKES RESERVOIR FLOOD DAMAGE

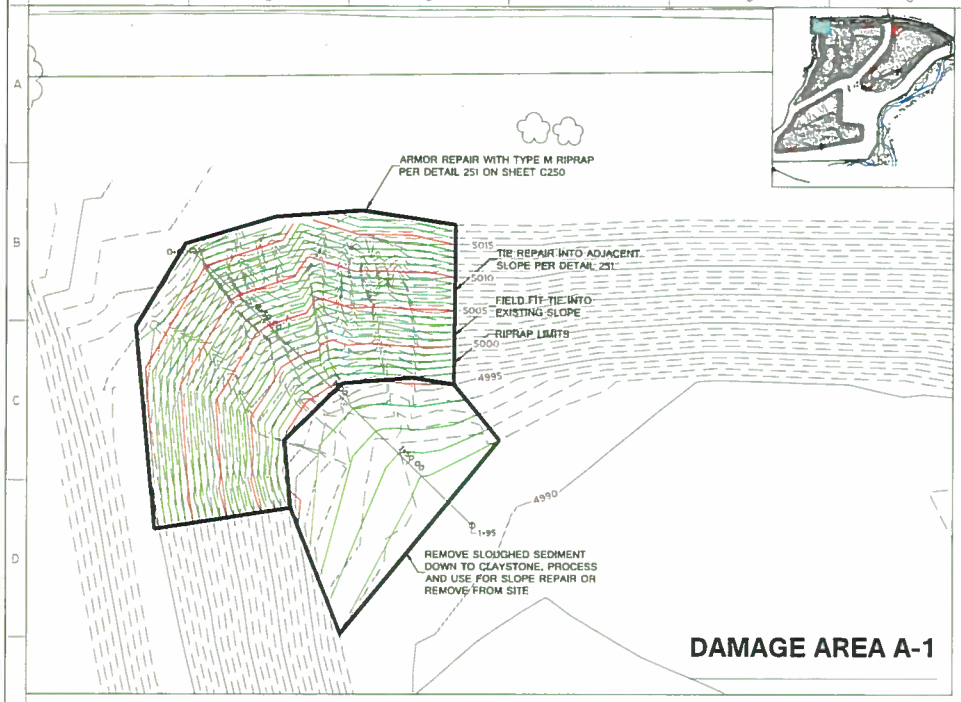
SITE AND GRADING PLAN

PROJECT NO. 1413ADC02

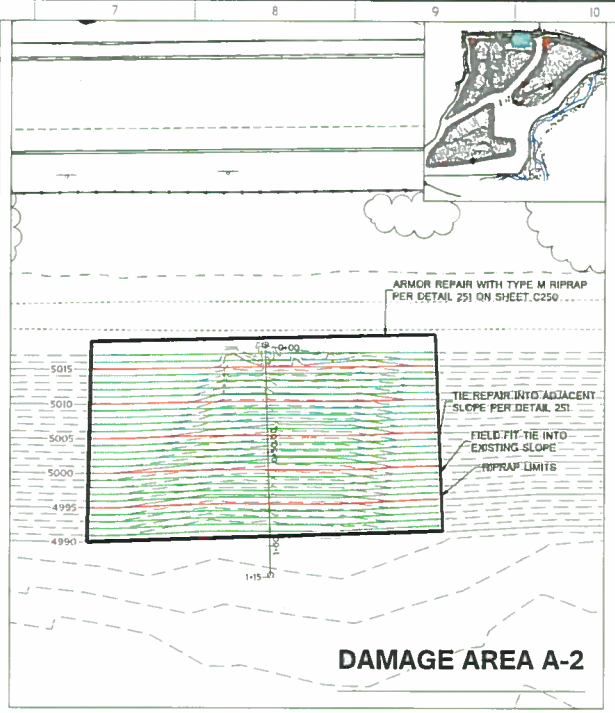
DATE 09/24/2014

C200

SHEET 3 OF 8



DAMAGE AREA A-1

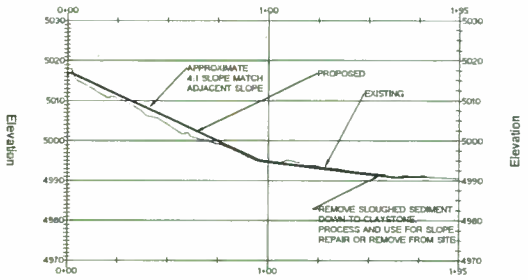


DAMAGE AREA A-2

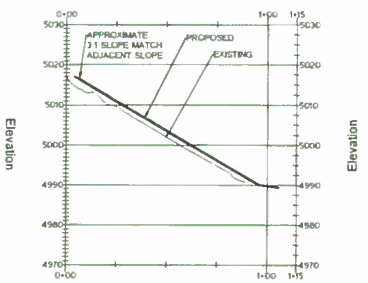
N

Scale: 1" = 30' Horiz.
11x17 DRAWINGS AT HALF SCALE
0 30 60
Contour Interval - 1 ft.

DAMAGE AREA A-1 STA: 0+00 TO 1+95



DAMAGE AREA A-2 STA: 0+00 TO 1+15



GENERAL NOTES

1. TOPOGRAPHIC MAPPING IS A COMBINATION OF:
   A) PARK BOULEVARD ROADWAY AS-BUILT SURVEY BY TETRA TECH, INC., DATED AUGUST 2009.
   B) MANN LAKES 1, 2, AND 3 AS-BUILT SURVEY BY TETRA TECH, INC. DATED SEPTEMBER 2009.
   C) AERIAL TOPOGRAPHY ALONG EAST 124TH AVENUE AND THE SOUTH PLATTE RIVER BY FLATIRONS, INC. DATED OCTOBER 2003.
   D) DAMAGE AREA SURVEY BY CCS CONSULTANTS, INC. DATED JUNE 25, 2014

MANN LAKES RESERVOIR DATUM:

WEST ADAMS COUNTY DENSIFICATION (WACD), STATION NO. 165 HAVING AN ELEVATION OF 5054.33' (NAVD '88) AS PER GPS OBSERVATION.

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND UTILITIES.

LeonardRice ENGINEERS, INC.
1221 Auraria Parkway | Denver, CO 80204
303-455-9589 | 800-453-9589 | Fax: 303-455-0115
www.LREwater.com

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

DESIGNED BY: TSS	1	30% DESIGN DRAWINGS	08/19/14
DRAWN BY: JES	2	90% DESIGN DRAWINGS	09/10/14
CHECKED BY: TSS	3	BID SET	09/24/14
DRAWING SCALE: 1"= 30'	4		
LINE IS 2 INCHES AT FULL SCALE	5		
(IF LINE IS NOT 2 INCHES - SCALE ACCORDINGLY)	6		
	7		
	8		
	9		

NOT FOR CONSTRUCTION

ADAMS COUNTY COLORADO

MANN LAKES RESERVOIR FLOOD DAMAGE

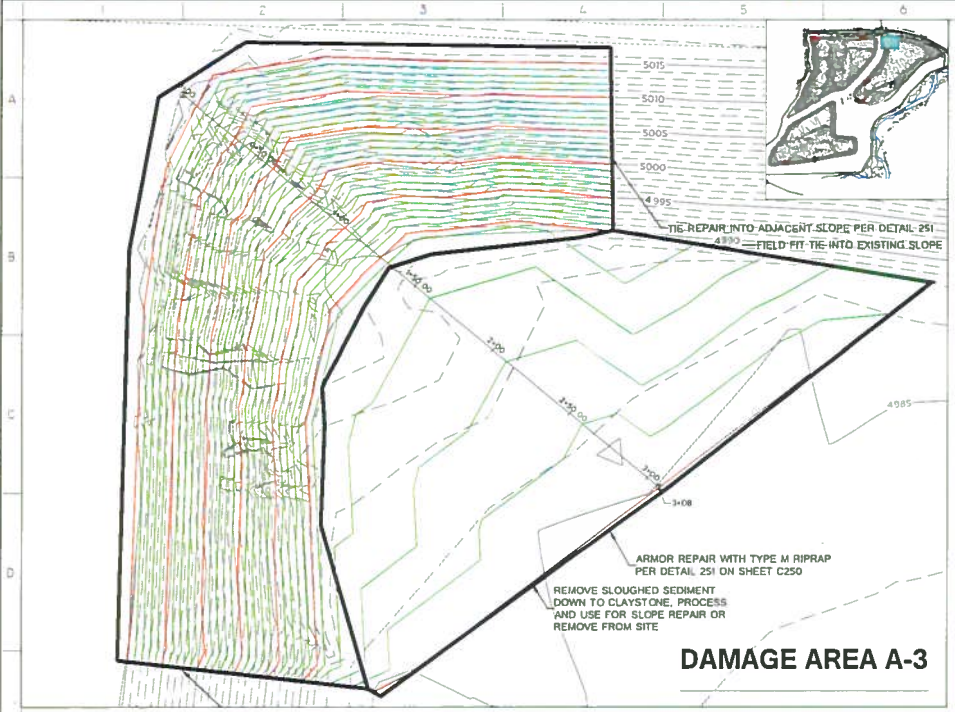
GRADING REPAIR SECTIONS

PROJECT NO: 14I3ADC02

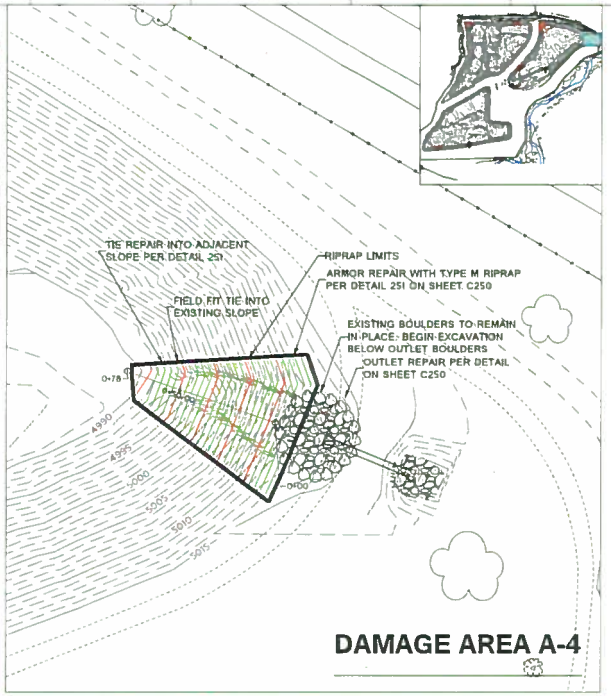
DATE: 09/24/2014

C230

SHEET 4 OF 8

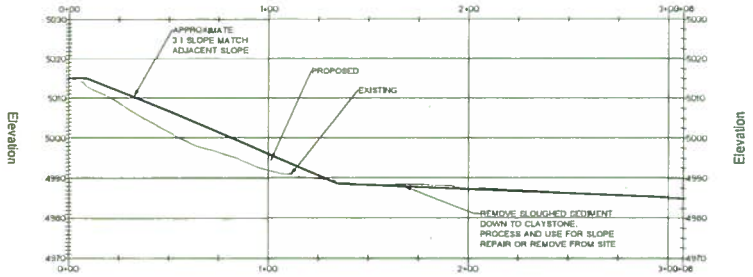


DAMAGE AREA A-3

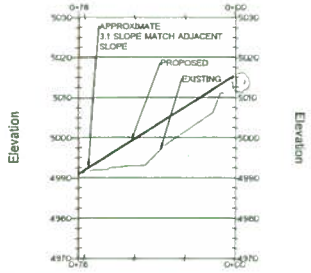


DAMAGE AREA A-4

DAMAGE AREA A-3 STA. 0+00 TO 3+08
Station



DAMAGE AREA A-4 STA. 0+00 TO 0+78
Station



Scale: 1" = 30' Horiz.
11x17 DRAWINGS AT HALF SCALE
0 30 60
Contour Interval = 1 ft.

GENERAL NOTES

1. TOPOGRAPHIC MAPPING IS A COMBINATION OF:
   A) PARK BOULEVARD ROADWAY AS-BUILT SURVEY BY TETRA TECH, INC., DATED AUGUST 2009
   B) MANN LAKES 1, 2, AND 3 AS-BUILT SURVEY BY TETRA TECH, INC. DATED SEPTEMBER 2009.
   C) AERIAL TOPOGRAPHY ALONG EAST 124TH AVENUE AND THE SOUTH PLATTE RIVER BY FLATIRONS, INC. DATED OCTOBER 2003.
   D) DAMAGE AREA SURVEY BY CCS CONSULTANTS, INC. DATED JUNE 25, 2014

MANN LAKES RESERVOIR DATUM:

WEST ADAMS COUNTY DENSIFICATION (WACD), STATION NO. 165 HAVING AN ELEVATION OF 5054.33' (NAVD '88) AS PER GPS OBSERVATION.

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND UTILITIES.

LeonardRice ENGINEERS, INC.
1221 Aurora Parkway | Denver, CO 80204
303-455-9589 | 800-453-9589 | Fax: 303-455-0115
www.LREwater.com

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

DESIGNED BY: TSS			
DRAWN BY: JES			
CHECKED BY: TSS			
DRAWING SCALE: 1"= 30'			
LINE IS 2 INCHES AT FULL SCALE			
(IF LINE IS NOT 2 INCHES - SCALE ACCORDINGLY)			

REV	DESCRIPTION	DATE
1	30% DESIGN DRAWINGS	08/19/14
2	90% DESIGN DRAWINGS	09/10/14
3	BID SET	09/24/14
4		
5		
6		
7		
8		
9		

NOT FOR CONSTRUCTION

ADAMS COUNTY COLORADO

MANN LAKES RESERVOIR FLOOD DAMAGE

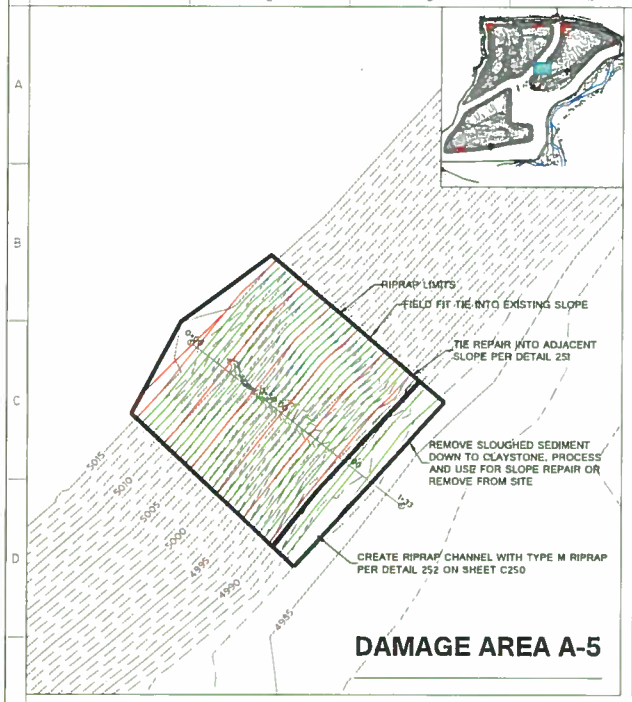
GRADING REPAIR SECTIONS

PROJECT NO: 1413ADC02

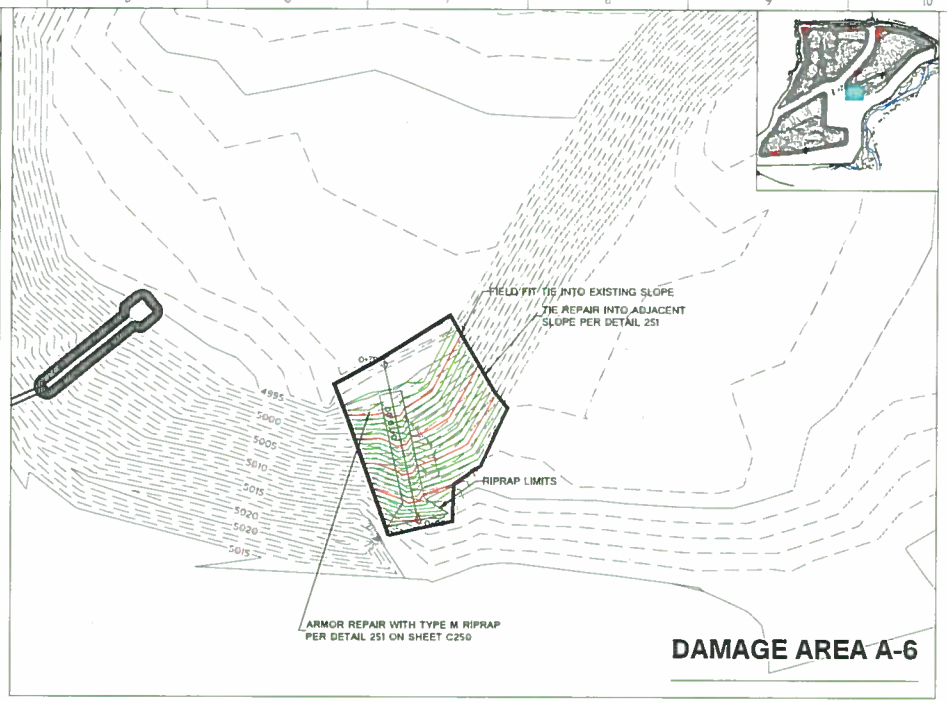
DATE: 09/24/2014

C231

SHEET 5 OF 8

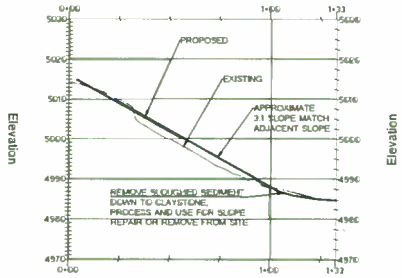


DAMAGE AREA A-5

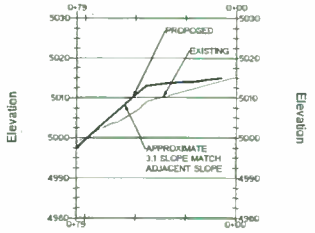


DAMAGE AREA A-6

DAMAGE AREA A-5 STA: 0+00 TO 1+33
Station



DAMAGE AREA A-6 STA: 0+00 TO 0+79
Station



Scale: 1" = 30' Horiz.
11x17 DRAWINGS AT HALF SCALE
0 30 60
Contour Interval - 1 ft.

GENERAL NOTES

1. TOPOGRAPHIC MAPPING IS A COMBINATION OF:
   A) PARK BOULEVARD ROADWAY AS-BUILT SURVEY BY TETRA TECH, INC., DATED AUGUST 2009.
   B) MANN LAKES 1, 2, AND 3 AS-BUILT SURVEY BY TETRA TECH, INC. DATED SEPTEMBER 2009.
   C) AERIAL TOPOGRAPHY ALONG EAST 124TH AVENUE AND THE SOUTH PLATTE RIVER BY FLATIRONS, INC. DATED OCTOBER 2003.
   D) DAMAGE AREA SURVEY BY CCS CONSULTANTS, INC. DATED JUNE 25, 2014

MANN LAKES RESERVOIR DATUM:

WEST ADAMS COUNTY DENSIFICATION (WACD), STATION NO. 165 HAVING AN ELEVATION OF 5054.33' (NAVD '88) AS PER GPS OBSERVATION.

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND UTILITIES.

LeonardRice ENGINEERS, INC.
1221 Auraria Parkway Denver, CO 80204
303-455-9589 | 800-453-9589 | Fax: 303-455-0115
www.LREwstec.com

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

DESIGNED BY: TSS	REV	DESCRIPTION	DATE
DRAWN BY: JES	1	30% DESIGN DRAWINGS	08/19/14
CHECKED BY: TSS	2	90% DESIGN DRAWINGS	09/10/14
DRAWING SCALE: 1"= 30'	3	BID SET	09/24/14
LINE IS 2 INCHES AT FULL SCALE	4		
	5		
(IF LINE IS NOT 2 INCHES - SCALE ACCORDINGLY)	6		
	7		
	8		
	9		

NOT FOR CONSTRUCTION

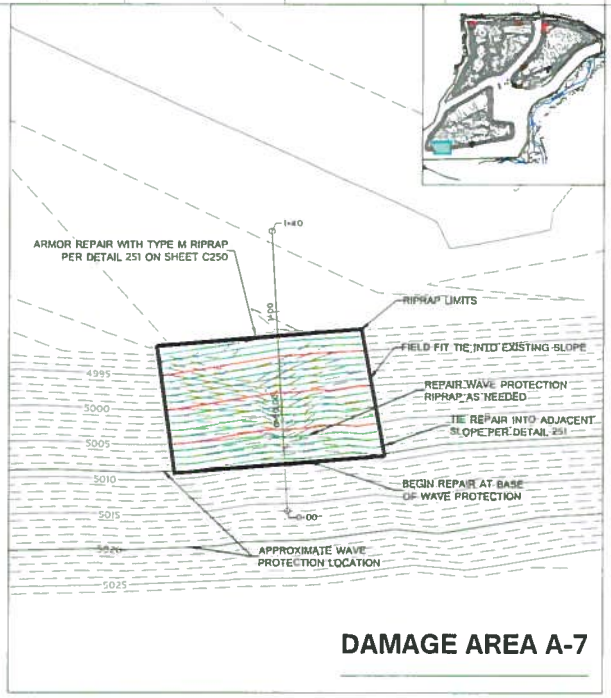
ADAMS COUNTY COLORADO

MANN LAKES RESERVOIR FLOOD DAMAGE

GRADING REPAIR SECTIONS

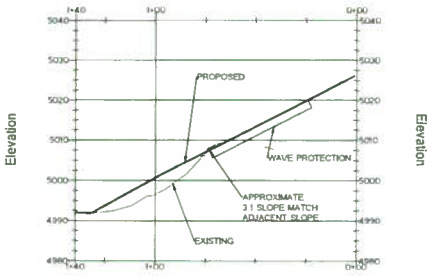
PROJECT NO: 1413ADC02 | C232

DATE: 09/24/2014 | SHEET 6 OF 8



DAMAGE AREA A-7

DAMAGE AREA A-7 STA. 0+00 TO 1+40



N

Scale: 1" = 30' Horiz.
11x17 DRAWINGS AT HALF SCALE
0 30 60
Contour Interval = 1 ft.

GENERAL NOTES

1. TOPOGRAPHIC MAPPING IS A COMBINATION OF:
   A) PARK BOULEVARD ROADWAY AS-BUILT SURVEY BY TETRA TECH, INC., DATED AUGUST 2009.
   B) MANN LAKES 1, 2, AND 3 AS-BUILT SURVEY BY TETRA TECH, INC. DATED SEPTEMBER 2009.
   C) AERIAL TOPOGRAPHY ALONG EAST 124TH AVENUE AND THE SOUTH PLATTE RIVER BY FLATIRONS, INC. DATED OCTOBER 2003.
   D) DAMAGE AREA SURVEY BY CCS CONSULTANTS, INC. DATED JUNE 25, 2014

MANN LAKES RESERVOIR DATUM:

WEST ADAMS COUNTY DENSIFICATION (WACD), STATION NO. 165 HAVING AN ELEVATION OF 5054.33 (NAVD 88) AS PER GPS OBSERVATION.

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND UTILITIES

LeonardRice ENGINEERS, INC.
1221 Auraria Parkway | Denver, CO 80204
303-455-9589 | 800-453-9589 | Fax: 303-455-0115
www.LREwater.com

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

DESIGNED BY: TSS	REV	DESCRIPTION	DATE
DRAWN BY: JES	1	30% DESIGN DRAWINGS	08/19/14
CHECKED BY: TSS	2	90% DESIGN DRAWINGS	09/10/14
DRAWING SCALE: 1"= 30'	3	BID SET	09/24/14
LINE IS 2 INCHES AT FULL SCALE	4		
(IF LINE IS NOT 2 INCHES - SCALE ACCORDINGLY)	5		
	6		
	7		
	8		
	9		

NOT FOR CONSTRUCTION

ADAMS COUNTY
COLORADO

MANN LAKES RESERVOIR FLOOD DAMAGE

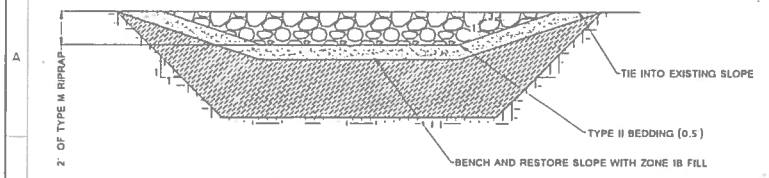
GRADING REPAIR SECTIONS

PROJECT NO. 1413ADC02

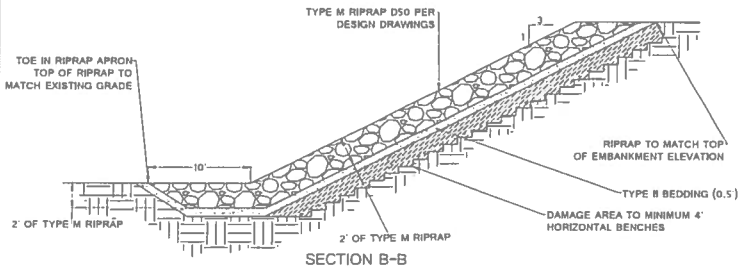
DATE: 09/24/2014

C233

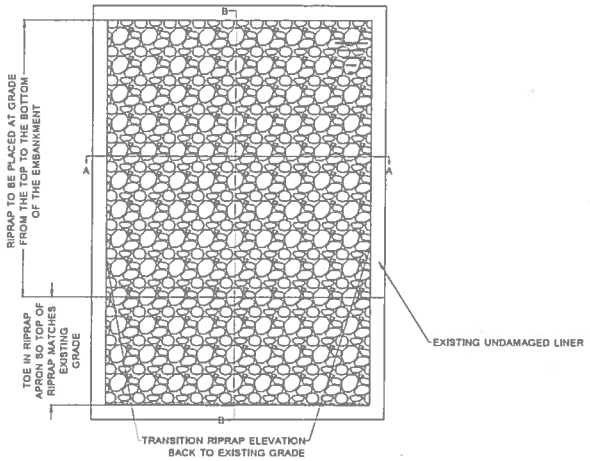
SHEET 7 OF 8



SECTION A-A



SECTION B-B

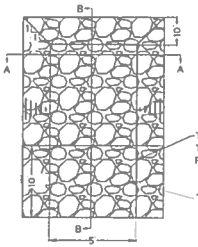


PLAN VIEW

RESERVOIR SLOPE ARMORING 251

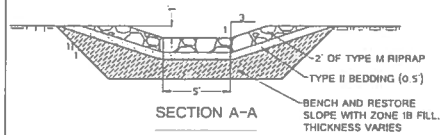
SCALE: N.T.S.

ZONE 1B FILL			
UNIFIED SOILS CLASS AND REQUIREMENTS	MINIMUM PLACEMENT COMPACTION REQUIREMENTS	TESTING REQUIREMENTS	MINIMUM TESTING INTERVAL
CL, SC, GC	95% OF ASTM D698	DENSITY BY NUCLEAR GAGE, ASTM 2922	EACH 200 CUBIC YARDS
MINIMUM PI= 8%	+/- 2% OPTIMUM MOISTURE CONTENT	ATTERBERG LIMITS ASTM D424	
MAXIMUM LL= 40%		-200 SIEVE ASTM D 1140	
25%-80% PASSING THE NO. 200 SIEVE			

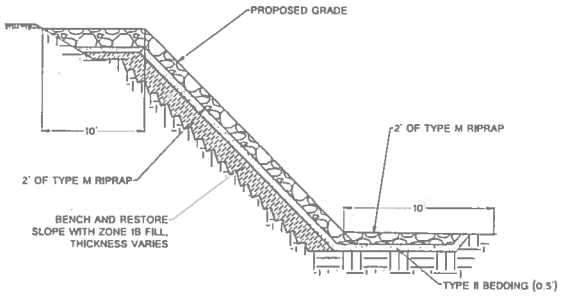


PLAN VIEW

GRANULAR BEDDING	
PERCENT WEIGHT BY PASSING SQUARE-MESH SIEVES	
U.S. STANDARD SIEVE SIZE	TYPE II CDOT SECT. 703.09 CLASS A
3 INCHES	90-100
1 1/2 INCHES	---
¾ INCHES	20-90
⅜ INCHES	---
#4	0-20
#16	---
#50	---
#100	---
#200	0-3



SECTION A-A



SECTION B-B

RIPRAP RUN DOWN CHANNEL 252

SCALE: N.T.S.

LeonardRice ENGINEERS, INC.
1221 Auraria Parkway | Denver, CO 80204
303-455-9589 | 800-453-9589 | Fax: 303-455-0115
www.LREwater.com

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

DESIGNED BY: TSS			
DRAWN BY: JES			
CHECKED BY: TSS			
DRAWING SCALE: NA			
LINE IS 2 INCHES AT FULL SCALE			
(IF LINE IS NOT 2 INCHES - SCALE ACCORDINGLY)			

REV	DESCRIPTION	DATE
1	30% DESIGN DRAWINGS	08/19/14
2	90% DESIGN DRAWINGS	09/10/14
3	BID SET	09/24/14
4		
5		
6		
7		
8		
9		

NOT FOR CONSTRUCTION

ADAMS COUNTY COLORADO

MANN LAKES RESERVOIR FLOOD DAMAGE

DETAILS

PROJECT NO: 1413ADC02

DATE: 09/24/2014

C250

SHEET 8 OF 8

Adams County Parks and
Community Resource
9755 Henderson Road
Brighton, CO 80601-8114

State of Colorado
DRMS
Tyler V. O'Donnell
1313 Sherman St Room 215
Denver, Co 80203

Division of Reclamation, Mining, and Safety

Fee Receipt for M1982147

Adams County

000000000

Receipt #: 18425
Date: 10/21/2014
Permit: M1982147

Payment Method	Revenue Code	Fee Description/Notes	Amount
667480 SMS	4300-MTR0	Minerals Technical Revision M1982-147	$216.00
		Receipt Total:	**$216.00**