Agenda Item: 9.

MEMORANDUM

TO: Programs, Projects and Operations Subcommittee

FROM: Martin P. Cleveland, Construction Engineer

SUBJECT: Little Papio Channel (Center Street to Grover Street) Stabilization Project Professional Services Contract with HDR Engineering

DATE: May 5, 2015

In mid-September 2014, District staff noticed a major 500 ft. long bank slough, downstream of Center Street on the right bank of Little Papio Channel, looking downstream. Enclosed are location map and photos of the slough. This slough likely occurred due to multiple high water events in 2014, one of which occurred in early September 2014.

The Little Papio Channel is a federal project, built by USACE and operated/maintained by the District. District staff asked the US Army Corps of Engineers (USACE) to evaluate the slough and provide guidance on geotechnical investigation and repairs. Enclosed is a copy of the USACE report dated November 4, 2014. However, as noted in the report, the slough doesn't qualify for federal Corps assistance. Therefore, District is responsible for repair design and construction. This location experienced slope instability during construction in the 1960's and required special construction techniques such as subsurface drainage facilities and pile/batter system.

Subsequently, HDR Engineering was retained by Management in fall 2014 to conduct a channel instability investigation. In February 2015, the District submitted the Channel Instability Investigation Report for Little Papio Channel, south of West Center Road, to the US Army Corps of Engineers (USACE) for evaluation. The USACE comment letter dated March 20, 2015 is enclosed. The Investigation Repair Concept was found to be acceptable, with a number of items to be addressed during design.

Management has requested that HDR Engineering prepare a proposed contract for professional engineering services to provide design and construction administration services for repairing the slough and stabilizing the channel. Enclosed is a proposed professional services contract with HDR for a not to exceed total cost of $134,754. The rough cost estimate for the slough repair/bank stabilization work is $500,000.

The Board Policy 15.2 Purchasing Professional Services specifies a request for proposals (RFP) process for selection of professional engineering firms when the estimated contract costs exceed

$30,000. It is management's recommendation that this policy be waived in this instance due to the following reasons:

1. HDR Engineering is the most experienced/knowledgeable with this project due to this and past investigations they have conducted on the Little Papio Channel Project.

2. HDR has past experience with other Papio Creek slope failures (sloughs) such as Big Papio Channel Stabilization Project near 105th Street and are most knowledgeable of the Papio Creek system and stability repairs.

3. Time is of the essence, as this channel slough will likely worsen with significant rainfall/runoff events, potentially blocking the creek and costing more to repair if left unattended for long period of time.

It is Management's recommendation that the Subcommittee recommend to the Board of Directors that Board Policy 15.2 Purchasing Professional Services be waived and the General Manager be authorized to execute the proposed professional services contract with HDR Engineering Inc. to design and construct the Little Papio Channel (Center Street to Grover Street) stabilization project for an hourly, not to exceed amount of $134,754, subject to changes as deemed necessary by the General Manager and approval as to form by District legal counsel.

18815 MC:pb file 532 Reach 7-5


Project Location
I 80-E
I-80 W
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL,
S 67th St
Center Frontage Rd
S 65th Ave
W Center Rd
Project Location
Little Papillion Creek
Project Location Map
Askarben/ Little Papillion Creek Area
N
Aerial Source: Google
No Scale


Little Papio Channel (Center to Grover)
Slough Station 285+00 to 282+00R
Looking Downstream from Center Street
Sept. 23, 2014
67th Street Bridge Construction
UNO Arena
Slough
Downstream


67th Street Bridge Construction
1 to 2 FT.
Downstream
Sloughed Soil
Slough
Failure Plane
Little Papio Channel (Center to Grover)
Slough Station 285+00 to 282+00R
Looking Downstream from Center
Sept. 23, 2014

This is **EXHIBIT A**, consisting of 12 pages, referred to in and part of the **Agreement between Owner and Engineer for Professional Services** dated _____, 2015.

Engineer's Services

Article 1 of the Agreement is supplemented to include the following agreement of the parties.

Engineer shall provide Basic and Additional Services as set forth below.

PART 1 – BASIC SERVICES

For Papio-Missouri River Natural Resources District
Little Papillion Creek South of West Center Road
Right Bank Channel Stabilization
Douglas County, NE

PAPIO-MISSOURI RIVER NATURAL RESOURCES DISTRICT
OMAHA, NE

HDR

ENGINEERING PROPOSAL

BACKGROUND AND BASIS OF PROPOSAL

The purpose of this effort is to provide final design services, obtain permits and provide construction observation and adminsitration for the Little Papillion Creek Right Bank Channel Stabilization Project. The stabilization effort will extend along the disturbed areas of the right bank between Little Papillion Creek Station 282+50 R and 285+50 R.

SCOPE OF SERVICES – Little Papillion Creek Right Bank Channel Stabilization

The objective of this Project is to provide professional services to the P-MRNRD. The scope of work is segmented into four (4) task series:

Task Series 100 – Project Management
Task Series 200 – Stabilization Design
Task Series 300 – Bidding Assistance
Task Series 400 – Construction Contract Administration

The HDR Team proposes to provide the following professional services.

TASK SERIES 100 – PROJECT MANAGEMENT

Task Objectives: Coordinate work effort, administer contract, and provide quality control.

HDR Activities: Task 110 Project Management. Conduct general project management tasks. Includes development of project initiation forms including the development of a project guide, monthly invoicing, monthly progress reports, project close out activities and other administration project activities.

Task 120 Meetings. Conduct coordinating meetings to discuss Project tasks and present findings.

Subtask 120.1 Coordination Meetings. Six coordination meetings are planned with P-MRNRD, USACE and City of Omaha (City) Staff. The anticipated meetings are:

1) Pre-notification meeting to discuss Section 404 compliance issues;
2) Meeting after the Section 404 and Section 408 submittals prior to contract document development;
3) Meeting after development of contract documents;
4) Construction kickoff meeting;

5) Construction progress meeting; and
6) Substantial construction completion meeting.

Task Deliverables:

- Monthly invoices and progress reports

Key Understandings:

- Coordination Meetings will be held at the offices of the P-MRNRD, USACE, or at the Project site.

TASK SERIES 200 – DESIGN OF CHANNEL STABILIZATION

Task Objectives: HDR will perform slope stability analysis for the existing condition and the proposed stabilization measure. HDR will also develop final design details of the proposed stabilization measures and perform Section 404 and 408 permitting.

HDR Activities:

Task 210 Geotechnical Investigation. Conduct supplemental laboratory testing on samples taken from Channel Instability Investigation. No new borings will be required. Samples retrieved from Channel Instability Investigation will be used for lab testing.

Subtask 210.1 Laboratory Testing. Perform laboratory tests on the samples obtained during drilling. Conduct the following tests:

- 6 Atterberg limits
- 6 sieve analysis with hydrometer
- 10 Density and moisture contents
- 6 UU triaxial compression tests
- Obtain 2 additional water level readings in the existing piezometer installed during the Channel Instability Investigation.

Task 220 Permitting. Coordinate with regulatory agencies and prepare documentation.

Subtask 220.1 Agency Coordination. Conduct a pre-notification meeting with USACE to discuss compliance with Section 404 of the Clean Water Act. Conduct a file search (Nebraska State Historical Preservation Office data base) for any previously recorded sites within the project area. Prepare a letter to Nebraska SHPO that reports the results of the file search and based on project area condition as previously disturbed, request confirmation that an inventory for cultural resoruces is not warrented.

Subtask 220.2 Section 404 Documentation. Prepare Pre-Construction Notification for authorization under the Nationwide Permit Program for Section 404 compliance and for joint 401 Water Quality Certification. Conduct a wetland delineation and associated documentation.

Subtask 220.3 Section 408 Documentation. Prepare Section 408 submittal to USACE-Omaha District indicating that the integrity of the flood control channel will be maintained during and after construction. The 408 submittal will include the following items:

- Project description of existing condition and proposed stabilization measure.
- Slope stability analyses and material compatibility evaluation.
- Results of the geotechnical investigation.
- Statement that the proposed stabilization measures will not impact the integrity of the channel improvement project during and after the proposed construction.
- Preliminary design plans. Final plans will be provided upon acceptance of the Section 408 submittal.
- Draft and final specifications for construction.
- Requirements for the contractor's Emergency Action Plan.

Task 230 Design. Conduct preliminary and final design.

Subtask 230.1 Preliminary Design. Prepare preliminary design drawings. Drawings in AutoCAD, Version 2014 format. A preliminary list of sheets may include:

- Cover Sheet
- Site Plan (1 sheet)
- Typical Sections/Typical Details (2 sheets)

Subtask 230.2 Final Design. Prepare final design drawings and technical specifications. Specifications will be based on EJCDC technical specifications. Prepare opinion of approximate construction cost.

Deliverables:

- Wetland Delineation Report (Draft, electronic submittal, Final, electronic and hard copy)
- Section 404 Pre-Construction Notification (Draft and Final)
- Section 408 Submittal. All pertinent geotechnical information and analysis will be included with this submittal.
- Preliminary Design Documents (drawings, technical specifications, opinion of approximate construction cost)
- Final Design Documents (drawings, technical specifications, opinion of approximate construction cost)

Key Understandings:

- The geotechnical information will accompany the Section 408 submittal. No separate final geotechnical report will be prepared.
- The design is to stabilize the channel where slope distress has occurred as detailed in "Channel Instability Investigation, Little Papillion Creek – South of West Center Road" Final Report dated February 12, 2015. Any modifications to the design concept after work has been completed resulting from unforeseen conditions or requirements will be considered Additional Services.
- The Project limits will extend from Little Papillion Creek Stations 282+50R and 285+50R. Limits may be extended based on pre-construction survey.
- Hydrologic or hydraulic modeling is not included in this scope of services. The HEC-RAS model prepared for the no-rise certification of Little Papillion Creek for the 67th Street Bridge will be obtained and channel hydraulic parameters will be used to assess scour. If hydrologic/hydraulic modeling is required, it can be provided as Additional Services.
- P-MRNRD to provide access to/across private property for site visits and geotechnical investigation.
- It is assumed that the construction and staging areas are located within P-MRNRD right-of-way. If land acquisition is required, it can be provided as Additional Services.
- Thiele Geotech, as a subconsultant to HDR, will provide supplemental laboratory testing, and 2 readings of the piezometer.
- An evaluation of potential contamination on or near the site is not included, but can be provided as Additional Services.
- It is assumed that the existing Regional General Permit (NE 1998-11497) cannot be used for authorization as they have expired and timing of re-issuance is unknown. If the Regional General Permit is re-authorized, it is assumed that this work would be covered under that authorization and that a notice of intent will be submitted to the District Engineer per the conditions of the re-authorized Regional General Permit.
- It is assumed that the project would qualify for an existing Nationwide Permit (#3 or #13). However, a coordination meeting with USACE would determine if the project qualifies for coverage under either of these Nationwide Permits. Permanent wetland impacts are not anticipated to exceed 0.1 acres and no mitigation would be required.

- No stream functional assessment would be required.
- It is assumed that no cultural resources are present at the site and only consultation with SHPO will be required (no on-site inventory for cultural resources will be required.
- It is assumed that a City of Omaha Post Construction Stormwater Management Plan permit is not required.
- P-MRNRD is exempt from city and county zoning and building regulations including floodplain permitting regulations. Relevant submissions to the City should state that they are for information only.
- It is assumed that the total area disturbed by grading is less than 1 acre and will not require and NPDES permit or City of Omaha grading permit.
- It is assumed the proposed design will reestablish channel cross-sections to conditions that existed when the floodplain was delineated and no additional hydraulic modeling will be required.
- P-MRNRD will provide front end bidding documents. HDR to provide the technical specifications.
- The Section 408 submittal will require 3 hard copies and one electronic copy or a CD. The 408 review will be performed by the USACEOmaha District. The proposed construction will require information consistent with the former Minor 408 submittal, and will be limited to a District-level review.
- All plans and specification deliverables will be electronic. No hard copies will be printed.
- Schedule is based on obtaining permits in a timely fashion. If obtaining permits are delayed, bidding and construction will be delayed.
- LRA as a subconsultant will provide pre-construction topographic survey of the proposed repair. This will consist of a re-survey of the Channel Instability Investigation cross sections at STA 284+25.73 and STA 283+26.39 and relocation of the limits of the scarp area. This information and the survey performed for Channel Instability Investigation will be used for design and development of quantities. In addition, the upstream and downstream end of the scarp will be re-surveyed.
- LRA will provide post-construction topographic survey. This will consist of a re-survey of the Channel Instability Investigation cross sections at STA 284+25.73 and STA 283+26.39.
- LRA will provide construction staking.
- Grade staking – provide lath along proposed new grades at approximate 50 foot spacing;
- Provide lath at location of stone filled trenches;
- Place lath adjacent to the existing bike path at 100' intervals with USACE stationing for reference of field personnel. It is assumed that a total of two trips, 4 hours per trip, will be required by the survey crew, and one trip for initial grading and one trip for verification or checks. Re-staking required as a result of Contractor's actions will be considered Additional Services;
- HDR will provide LRA with an AutoCAD model of the proposed design for use with staking of the items listed above.
- Horizontal datum will be Nebraska State Plane.
- Vertical datum will be NAVD 88.

TASK SERIES 300 – BIDDING ASSISTANCE

Task Objectives: Assist P-MRNRD in preparing the invitation for bids, attend the pre-bid meeting provide replies to prospective bidder inquiries, attend the bid opening, assist with review of the bids received, and prepare a recommended action for board consideration.

HDR Activities:

Task 310 Bid Modifications. Receive and respond to questions from plan holders concerning interpretations of the bidding procedure. HDR to provide technical interpretations on the design. Inquires that can be addressed by referring to information in the Bidding Documents will be recorded in telephone conservation records. Address inquiries that require a modification of the Bidding Documents by preparing an addendum item. HDR to prepare appropriate addenda for P-MRNRD distribution.

Task 320 Pre-Bid Meeting. Attend pre-bid meeting with prospective bidders. Prepare agenda and minutes for the pre-bid portion of the meeting. Address inquiries that require a modification of the Bidding Documents by preparing an addendum item.

Task 330 Bid Opening. Attend the Bid Opening to assist in the initial screening of bids regarding Bidder's use of required Bid Forms, inclusion of Bid Security and inclusion of other qualifying information to accompany the Bid. Tabulate bids. Evaluate bids and prepare a letter of recommendation.

Task Deliverables:

- Electronic copy of addenda(um) to be distributed by P-MRNRD to all plan holders.
- Pre-bid meeting agenda and minutes
- Tabulation of bids and letter of recommendation of award

Key Understandings:

- P-MRNRD will be the contact agency in the bidding documents for questions and will coordinate with HDR on responses.
- P-MRNRD is responsible for bid solicitation, document distribution (including addendum) and bid opening.
- P-MRNRD is responsible for advertising the project and payment of any fees.

TASK SERIES 400 – CONSTRUCTION ADMINISTRATION

Task Objectives: Provide full-time on-site observation and document construction activities.

HDR Activities:

Task 410 Preconstruction Meeting. HDR will assist P-MRNRD with organizing and holding a preconstruction meeting. This meeting will be attended by representatives from HDR, P-MRNRD, Contractor, and other interested parties. The main purpose of this meeting will be to establish lines of communication, discuss areas of responsibility, establish operational constraints, and to discuss and clarify items.

Task 420 Shop Drawing Review. HDR to review shop drawings and samples for compliance with contract documents.

Task 430 Construction Observation. HDR to conduct full-time on-site observation of work in progress to determine if work is generally proceeding in accordance with the Contract Documents. Anticipated duration of construction is 20 working days from contractor mobilization. The level of construction observation effort included in this scope equates to 200 hours (10-hour days for 20 days) for a full-time resident project representative (RPR) for the anticipated duration. Reasonable variations in work days and schedules are anticipated, but no protracted overtime, work stoppages or extended work schedules are anticipated. A geotechnical engineer will observe the start of construction and will provide periodic visits to observe the progress of the construction. If the construction schedule exceeds the estimated effort, all parties agree that the contract will be adjusted.

The following activities are to be conducted:

- HDR to provide clarifications and interpretations of Contract Documents to Contractor.
- HDR to assist in negotiating change orders.

- HDR to maintain files for correspondence, shop drawings and samples, change orders and other project related documents.
- HDR to maintain log book to record working days; weather conditions; weekly activities; decisions; and general observations.
- HDR to review and verify applications for payment with Contractor. HDR will provide a recommendation and forward payment application to P-MRNRD.
- HDR to conduct a substantial completion inspection and submit a list of observed items requiring completion or correction. After items on list have been completed or corrected, HDR to issue Certificate of Substantial Completion.
- HDR to conduct a final inspection and submit a list of observed items requiring completion or correction. After items on list have been completed or corrected, HDR to review final payment application.

Task 440 Construction Closeout. HDR to compile construction documentation and prepare record drawing, which will be the final record drawings, corrected to reflect field conditions observed and changes documented by the contractor during the construction period. An addendum to the Operations and Maintenance (O&M) Manual for the Little Papillion Channel Improvement Project will be prepared and submitted to USACE.

Task Deliverables:

- Construction documentation
- Record drawings
- Addendum to O&M Manual

Key Understandings:

- The Contractor will be responsible for marking up a set of prints as changes are identified. Upon completion of construction, the marked-up drawings will be used in making "record" revisions to the original drawings.

Thiele Geotech Inc

13478 Chandler Road
Omaha, Nebraska 68138-3716
402.556.2171 Fax 402.556.7831
www.thielegeotech.com

May 5, 2015

Mr. Patrick Poepsel, P.E.
HDR, Inc.
8404 Indian Hills Drive
Omaha, NE 68114

**RE: PROPOSAL FOR SOIL TESTING SERVICES (REVISION 1)
LITTLE PAPIO CREEK STABILIZATION, PAPILLION CREEK AT WEST CENTER ROAD, OMAHA, NEBRASKA**

Dear Mr. Poepsel:

Enclosed is our proposal for soil testing services for the Little Papio Creek Stabilization project in Omaha, Nebraska. The accompanying proposal describes the testing services that will be provided, the estimated cost, and the contract terms.

Thiele Geotech is a service oriented firm offering client focused geotechnical and material engineering from project start to finish. We have a capable staff who has experience with all of the testing required on this project.

Thiele Geotech is an accredited laboratory as required by virtually all governing agencies and specifications. Thiele Geotech participates in the AASHTO Materials Reference Laboratory (AMRL) program and the Cement and Concrete Reference Laboratory (CCRL) program. Our laboratory accreditation covers numerous test methods for the analysis of soils, aggregates, concrete, masonry and asphalt testing. Thiele Geotech has nationwide approval (validation) by the Department of the Army Corps of Engineers to provide construction materials testing.

We look forward to working with you on this project. If you have any questions, please call. If the accompanying proposal is acceptable, please return a signed copy to our office.

Respectfully,
Thiele Geotech, Inc.

Kristle Beaudet

Kristle P. Beaudet, P.E.

Enclosures

R:\PROPOSAL\LITTLE PAPIO CREEK - SOIL TESTING REV 1.DOCX

GEOTECHNICAL ▪ MATERIAL ▪ ENVIRONMENTAL ▪ ENGINEERING

Soil Testing Proposal
Little Papio Creek Stabilization
Papillion Creek at West Center Road
Omaha, Nebraska
May 5, 2015

Thiele Geotech, Inc. is pleased to submit our proposal for soil testing services for the Little Papio Creek Stabilization project. The following sections detail our proposed scope of services. A breakdown of estimated costs is attached in Exhibit A.

SCOPE OF SERVICES

Soil testing on this project will consist of the following services:

1. Six (6) UU Triaxial compression Tests
2. Six (6) Sieve and Hydrometer Tests (on the UU traixal samples)
3. Six (6) Atterberg Limits (on the UU traixal samples)
4. Ten (10) Unit Weight and Moisture Tests
5. Two (2) measurement readings of existing Piezometer P-1

ESTIMATED COST & BILLING

Testing services will be billed at the unit rates listed in Exhibit A. Any tests not listed will be billed at our normal fee schedule rates in effect at the time of the test. Based on the number of tests in Exhibit A, the total cost for testing services is estimated at $2,332. This cost estimate is not intended as a not-to-exceed or lump-sum cost. We will bill only for the tests actually performed, and not on any lump sum or minimum cost basis.

EXHIBITS

Exhibit A - Cost Estimate

THIELE GEOTECH, INC.

By: Robert K Lapke

Robert K. Lapke, P.E.

13478 Chandler Road

Omaha, Nebraska 68138-3716

402/556-2171 Fax 402/556-7831

COST ESTIMATE

Description	Estimated Quantity	Unit Rate	Estimated Cost
Overexcvation and Grading			
Field Measurements			
Level II Technician (/hr.)	2.0	59.00	118.00
Trip Charge - Zone 1 (/trip)	2.0	55.00	110.00
Soil Testing			
Moisture Content (ea.)	-	6.00	-
Unit Weight Test with Moisture Content (ea.)	10.0	18.00	180.00
UU Triaxial Compression Test (ea.)	6.0	110.00	660.00
Atterberg Limits (/set)	6.0	75.00	450.00
Sieve Analysis (ea.)	-	70.00	-
Sieve Analysis with Hydrometer Analysis (ea.)	6.0	100.00	600.00
Project Management			
Project Engineer (/hr.)	2.0	107.00	214.00
	Estimated Total		2,332.00

Thiele Geotech Inc

LAMP RYNEARSON
& ASSOCIATES
ENGINEERS | SURVEYORS | PLANNERS

14710 W. Dodge Rd., Ste. 100
Omaha, Nebraska 68154
[P] 402.496.2498
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www.LRA-Inc.com

May 5, 2015

EMAIL

Mr. Pat Engelbert
HDR Engineering, Inc.
8404 Indian Hills Drive
Omaha, NE 68114

Pat.Engelbert@hdrinc.com

REFERENCE: Proposal for Surveying Services
Pre-post Construction Survey Little Papillion Creek
Omaha, Nebraska

Dear Mr. Engelbert:

Lamp, Rynearson & Associates, Inc. (LRA) is pleased to present this proposal to HDR Engineering. Inc. (HDR) to provide surveying services associated with the Little Papillion Creek embankment stabilization project. We understand that the scope of our services for this project will follow the survey requirements as shown on the attached RFP with the following exceptions and or revisions:

1) Pre- construction topographic survey of the proposed repair of the west slope between the existing trail and creek from the existing Center Street Bridge to the new bridge currently under construction to the south.
    - Re-survey cross sections at STA. 284+25.73 and STA. 283+26.39 and re-locate limits of scarp area
    - The survey will be tied into the USACE Little Papillion Creek Channel Improvement stationing
2) Post construction topographic survey.
    - Re-survey cross sections at STA. 284+25.73 and STA. 283+26.39
    - The survey will be tied into the USACE Little Papillion Creek Channel Improvement stationing
3) Provide Construction staking
    - Grade staking – provide lath along proposed new grades at approximate fifty-foot (50') spacing
    - Provide lath at location of stone filled trenches
    - Place lath adjacent to the existing bike path at one hundred foot (100') intervals with USACE stationing for reference of field personnel.

Our proposal is based on the following assumptions:

1) Horizontal datum will be Nebraska State Plane
2) Vertical Datum will be NAVD88
3) HDR will provide LRA with an AutoCAD model of the proposed design for use with staking of the items listed above.

Leaving a Legacy of Enduring Improvements to Our Communities - PURPOSE STATEMENT

ENGINEERS SURVEYORS PLANNERS

4) For estimating purposes we estimated two (2) trips to the site at 4hours each (on site) to provide grade stakes.
   a. One (1) trip for initial grading and one (1) trip for verification or checks.

SCHEDULE

We are prepared to begin work on the project upon the return of the signed proposal and or contract. The field survey will be completed within approximately two (2) business days from the date of commencement dependent upon any weather events, AutoCAD and PDF files will be delivered within one (1) week of commencement of the field work.

COMPENSATION

We propose to bill for our services on the basis of hourly charge rates plus reimbursable expenses incurred. For the tasks listed above, our fees will not exceed $6,500.00.

Additional services beyond the scope of services outlined above will be billed on the basis of hourly charge rates plus reimbursable expenses incurred.

SUPPLEMENTAL TERMS AND CONDITIONS

This fee estimate is provided to HDR for proposal purposes only, if LRA is selected to provide survey services for this project we will then enter into a professional services agreement with negotiated terms and conditions.

We appreciate the opportunity to present this proposal, and we look forward to assisting you in the successful completion of this project. We would be glad to discuss any questions you may have on our proposal. If this proposal is acceptable, we ask that you acknowledge by signing below and returning one (1) signed copy to us.

Sincerely,

LAMP, RYNEARSON & ASSOCIATES, INC.

Todd L. Whitfield, R.L.S.
Principal, Survey Group Leader

Enclosure

Accepted By:

HDR Engineering, Inc. Date

cls\L:\Engineering_Proposals & Agreements\SURVEY\2015\PROP HDR Pre-Post Construction Survey Little Papillion Creek 150505.docx

PAPIO - MISSOURI RIVER NATURAL RESOURCES DISTRICT
LITTLE PAPILLION CREEK RIGHT BANK CHANNEL STABILIZATION SOUTH OF WEST CENTER ROAD
SCHEDULE

TASKS		JUN '15	JUL	AUG	SEPT	OCT	NOV
TASK SERIES 100 – PROJECT MANAGEMENT							
Task 110	Project Management						
Task 120	Meetings						
Subtask 120.1	Coordination Meetings (5 meetings)						
TASK SERIES 200 – DESIGN OF CHANNEL STABILIZATION							
Task 210	Geotechnical Investigation						
Subtask 210.1	Laboratory Testing						
Task 220	Permitting						
Subtask 220.1	Agency Coordination						
Subtask 220.2	Section 404 Documentation						
Subtask 220.3	Section 408 Documentation						
Task 230	Design						
Subtask 230.1	Preliminary Design						
Subtask 230.2	Final Design						
TASK SERIES 300 – BIDDING ASSISTANCE							
Task 310	Bid Modifications						
Task 320	Pre-Bid Meeting						
Task 330	Bid Opening						
TASK SERIES 400 – CONSTRUCTION CONTRACT ADMINISTRATION							
Task 410	Preconstruction Meeting						
Task 420	Shop Drawing Review						
Task 430	Construction Observation						
Task 440	Construction Closeout						

PAPIO - MISSOURI RIVER NATURAL RESOURCES DISTRICT
LITTLE PAPILLION CREEK RIGHT BANK CHANNEL STABILIZATION SOUTH OF WEST CENTER ROAD
FEE ESTIMATE

TASKS		Labor								Expenses				Subconsultants (LRA, Donovan, Thiele)	Est. Total Cost
		Project Manager	Sr Engr/ Technical	Project Engineer/ Scientist	Technical Support	Clerical	Total Hours	Total Labor Cost	Tech. Fee	Printing	Travel	Misc.	Total Expenses		
TASK SERIES 100 – PROJECT MANAGEMENT															
Task 110	Project Management	30				10	40	$7,230	$148				$148		$7,378
Task 120	Meetings														
Subtask 120.1	Coordination Meetings (6 meetings)	24	15	15		3	57	$10,704	$211		$47	$55	$313		$11,017
	Estimated Task Hours Subtotal	54	15	15	0	13	97								
	Estimated Task Cost Subtotal	$11,178	$3,195	$2,235	$0	$1,326		$17,934	$359	$0	$47	$55	$461	$0	$18,395
TASK SERIES 200 – DESIGN OF CHANNEL STABILIZATION															
Task 210	Geotechnical Investigation														
Subtask 210.1	Laboratory Testing		2	2			4	$724	$15		$13		$27	$2,332	$3,083
Task 220	Permitting														
Subtask 220.1	Agency Coordination	4		4	4	2	14	$1,948	$52				$52		$2,000
Subtask 220.2	Section 404 Documentation	4		6	36	2	48	$4,806	$178		$13		$190		$4,996
Subtask 220.3	Section 408 Documentation	8	32	80	8		128	$21,032	$474		$13		$486	$500	$22,018
Task 230	Design														
Subtask 230.1	Preliminary Design	8	8	40	60	8	124	$14,936	$459	$110		$110	$679	$6,500	$22,115
Subtask 230.2	Final Design	8	8	48	8	2	74	$11,356	$274				$274		$11,630
	Estimated Task Hours Subtotal	32	50	180	116	14	392								
	Estimated Task Cost Subtotal	$6,624	$10,650	$26,820	$9,280	$1,428		$54,802	$1,450	$110	$38	$110	$1,708	$9,332	$65,842
TASK SERIES 300 – BIDDING ASSISTANCE															
Task 310	Bid Modifications	2	2	16	4	2	26	$3,748	$98	$55			$151		$3,899
Task 320	Pre-Bid Meeting	4	4				8	$1,680	$30	$11	$16		$56		$1,736
Task 330	Bid Opening	2	2	2		2	8	$1,342	$30		$16		$45		$1,387
	Estimated Task Hours Subtotal	8	8	18	4	4	42								
	Estimated Task Cost Subtotal	$1,656	$1,704	$2,682	$320	$408		$6,770	$155	$66	$32	$0	$253	$0	$7,023
TASK SERIES 400 – CONSTRUCTION CONTRACT ADMINISTRATION															
Task 410	Preconstruction Meeting	4	4	8		2	18	$3,076	$67	$11	$16	$110	$203		$3,279
Task 420	Shop Drawing Review	2	4	4	4	2	16	$2,386	$59				$59		$2,445
Task 430	Construction Observation	8	16	40	200		264	$27,024	$977		$1,086	$110	$2,173		$29,197
Task 440	Construction Closeout	4	8	24	24	2	62	$8,232	$229	$110			$339		$8,571
	Estimated Task Hours Subtotal	18	32	76	228	6	360								
	Estimated Task Cost Subtotal	$3,726	$6,816	$11,324	$18,240	$612		$40,718	$1,332	$121	$1,102	$220	$2,775	$0	$43,493
	TOTAL HOURS	112	105	289	348	37	891								
	TOTAL COST	$ 23,184	$ 22,365	$ 43,061	$ 27,840	$ 3,774		$120,224	$3,297	$297	$1,219	$385	$5,198	$9,332	$134,754

Reimbursable Expenses Markup (excludes Tech Fee) 10%

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

NOV 04 2014

Readiness Branch

Mr. Martin Cleveland
Papio-Missouri River Natural Resources District
8901 S. 154th Street
Omaha, Nebraska 68138

Dear Mr. Cleveland:

The Omaha District received a request for technical assistance on September 17, 2014 concerning the Little Papio Channel downstream of West Center Road, Station 283+00R. Omaha District personnel visited the site on September 23, 2014, to inspect the slope failure and to meet with the local non-federal sponsor.

A memorandum was prepared by our Geotechnical Engineering and Sciences Branch and includes observations and recommendations for repair.

If you have any questions please contact Mr. Ryan Buckley at (402) 995-2446.

Sincerely,

Erik Karstensen
Major, Acting Chief, Readiness Branch
U.S. Army Corps of Engineers

Enclosure

cc:
CENWO-OD-MR (Barry)
CENWO-ED-GA (Hall)

CENWO-ED-GA October 31, 2014

MEMORANDUM FOR CENWO-OD-E (Buckley/Gitt)

SUBJECT: Channel Slope Failure
Little Papio Creek RB, Omaha, Nebraska

1. The U.S. Army Corps of Engineers, Omaha District (Corps) received a letter, dated September 17, 2014, from Martin P. Cleveland, Construction Engineer with Papio-Missouri River NRD (P-MR NRD), requesting technical assistance for a recently identified slope failure along the right bank (West side) of Little Papio Creek downstream of West Center Road (Station 283+00R). Temporary Access Road design sheet and several photos were also submitted.

2. USACE personnel visited the site on September 23, 2014, to inspect the slope failure and meet with the non-federal sponsor. Discussions with the sponsor and initial field investigation revealed the following: P-MR NRD were informed of the slope failure by Hawkins Construction, who is building a new 67th Street Bridge over Little Papio Creek. The slope failure has occurred in the time frame of recent heavy rain events in Little Papio Creek watershed. During the field visit, USACE personnel observed longitudinal cracks and sloughs of the channel's right bank. The slough is approximately 300 feet long, but the full length of the slough was difficult to determine due to stock piles of soil on the channel berm at the bridge construction site, covering the full extent of the slope failure. It appears that sloughing stops at the construction site, and does not continue downstream of construction activities. The height of slough origination is almost at the upper limits of the channel bank, approximately 25 feet away from the Keystone bike trail. At the upstream end of the slope failure, there is an eroded area of channel embankment. Visually inspecting the scour area, the soil appears to consist of: poorly-graded sand with silt and gravel (SP-SM), intermixed with layers of silty sand with gravel (SM), and topsoil. The lower extents of the slough were not clearly visible at the time of the field visit. The channel berm appears to have rotated into the direction of the channel centerline. It was observed that several timber piles were constructed into the bottom of the creek channel in a longitudinal orientation, spaced approximately 5 feet on center with pile tops above the current water flow line. The piles appear to have acquired a distinct slant, pointing away from the slough, potentially from slope failure forces. Furthermore, a temporary channel crossing was constructed and used by Hawkins Construction for bridge erection. Four 48-inch diameter CMP culverts were placed along the centerline of the channel within a riprap envelope to form a dry channel crossing. It appears that during higher flows the temporary crossing acts as a low dam. The constructed channel crossing has the potential to increase channel bank and bedgrade erosion/scouring.

3. Upon review of original design documents:
   - Little Papillion Creek, Omaha, Nebraska – Plans for Channel Improvement – Stability Measures – December 1970;
   - Operation and Maintenance Manual – Papillion Creek and Tributaries, Nebraska – Little Papillion Creek Channel Improvements through the City of Omaha and Douglas County, Nebraska – July 1984.

   The following observations were made:

4. A 12-inch thick riprap layer on the channel banks was originally installed from Sta. 282+50 to 286+50, downstream from West Center Road Bridge.

5. To control existing seepage, a subdrain system was originally installed on the channel right bank from Sta. 283+00R to Sta. 285+00R. The subdrain system incorporates a 2-foot thick pervious fill layer, underlain on the native material within the pre-construction embankment, and covered with a new 1V on 3H embankment. At the bottom of pervious fill layer a continuous 6-inch perforated subdrain pipe was installed, sloping at 0.003 grade towards an outlet pipe. One 6-inch outlet pipe was connected to a perforated subdrain pipe at Sta. 285+00R, extended to a 12-foot timber pile for outflow, and installed with a flap gate one foot above low water surface at the time of construction.

6. The channel section constructed with the subdrain system consisted of a 1V on 3H right bank upper slope with the lower 5 feet consisting of a 1V on 2H slope with 12-inch thick riprap layer.

7. Riprap and timber pile features for channel section stability was originally installed from Sta. 286+20R to 289+60R. 35-foot long timber piles were driven vertically into the channel bottom on 5-foot centers at the toe of the right bank with the upper 3 feet of timber piles embedded into the riprap section that consisted of a 3.5-foot wide bottom and 1V on 1H sloped sides connecting into a one-foot thick riprap protection layer. All vertical piles were interconnected with horizontal stringer piles and terminated at channel bottom, not to impede flow.

8. The channel section from Sta. 286+52.37 to Sta. 299+96.46 was originally designed and built as follows:
   - Low flow channel is 30 feet wide.
   - Channel's right bank contained multiple slope changes:
     - 1V on 2H for the first 10 vertical feet from the channel bottom;
     - 1V on 20H 10-foot wide berm;
     - 1V on 3H upper bank;
     - Total bank height from channel bottom is approximately 26 feet.

9. Recent field observations, original design documents, and historic aerial photography provide support to the following conclusions:
   - The subdrain system potentially has failed and is not providing adequate bank seepage control, as was originally intended. The outlet pipe could not be located in the channel section at the time of the field visit.
   - Timber piles are exposed above water line, indicating that they have lost their riprap cover and most of the stringer piles. Most of the timber piles also are leaning from vertical, away from the right bank, indicating that the timber piles have been displaced within the area adjacent to the channel embankment slope failure.
   - Channel bank riprap protection was not observed during the field inspection and is not present to protect the channel embankment from erosion during high water events.
   - The slope failure with erosion scour hole has been developing for at least four years, as visible from historic aerial photography, and has increased in size with successive high water events.

10. Recommendations to repair the recent channel slope failure include the following:
    - Repair the original project design features to as-built conditions, as documented in the as-built plans within the O&M Manual, or provide USACE with the proposed modification from A/E to repair the channel embankment section.

11. The Corps recommends that all above comments be addressed by the Engineer-of-Record to the satisfaction of the sponsor and current USACE criteria.

12. The Corps has a congressionally-mandated responsibility to ensure that the federally-constructed project is appropriately operated and maintained. No improvements shall be passed over, under or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior approval of the Corps.

13. The Sponsor and Engineer-of-Record are responsible for ensuring that any modification adheres to the plans and specifications approved by the Corps of Engineers.

14. The Sponsor and Engineer-of-Record are responsible for amending the O&M Manual for the project to reflect the as-built conditions for any permanent modifications or encroachments. The amendment to the O&M Manual is required to be provided to the Corps for record keeping purposes within 60 days of completion of construction. The Corps can provide guidance on developing an addendum to the O&M Manual, upon request.

15. The comments herein pertain only to the geotechnical and levee safety issues related to the modification's potential impacts to the flood control works. If you have any questions, please contact Klaidas Hall at 402-995-2252 or the undersigned at 402-995-2227.

Bryan P. Flere

BRYAN P. FLERE
Levee Safety Program Manager
Geotechnical Engineering and Sciences Branch
Engineering Division

KGH Hall/CENWO-ED-GA/2252
BJ Jones/CENWO-ED-GA/2231
BPF Flere/CENWO-ED-GA/2227

CENWO-ED-GA October 31, 2014

MEMORANDUM FOR CENWO-OD-E (Buckley/Gitt)

SUBJECT: Channel Slope Failure
Little Papio Creek RB, Omaha, Nebraska

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10. Recommendations to repair the recent channel slope failure include the following:
    - Repair the original project design features to as-built conditions, as documented in the as-built plans within the O&M Manual, or provide USACE with the proposed modification from A/E to repair the channel embankment section.

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BRYAN P. FLERE
Levee Safety Program Manager
Geotechnical Engineering and Sciences Branch
Engineering Division

KGH Hall/CENWO-ED-GA/2252
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HDR

PAPIO-MISSOURI RIVER
NATURAL
RESOURCES
DISTRICT
OMAHA, NE

Final Report

Channel Instability Investigation

Little Papillion Creek - South of West Center Road

Omaha, NE

February 12, 2015

Table of Contents

Figures

Appendices

Channel Instability Investigation
Little Papillion Creek - South of West Center Road
Omaha, Nebraska

1.0 BACKGROUND AND PURPOSE

This report presents the results of HDR's channel stabilization investigation for a 300-foot reach of Little Papillion Creek in Omaha, Nebraska. The project site is situated along Little Papillion Creek just south of West Center Road and west of the new University of Nebraska Omaha (UNO) Arena development. The Site Plan is shown in Figure 1.

Following a series of late summer heavy rainfall events in 2014 and subsequent high water levels in the Little Papillion Creek, distress to the right (west) bank of the channel was noted. This distress consisted of downward slope movements that produced a 1- to 3-foot-high vertical scarp on the upper portion of the channel bank, minor sloughing of the lower portion of the channel bank, and a deep scour hole near the creek level.

The purpose of this study was to review available information pertaining to the site and its history, to evaluate the potential cause(s) of the slope distress, to compile a summary of findings, and to recommend short- and long-term remedial measures to stabilize the channel. Specifically, HDR reviewed and evaluated the following:

- Site history and development
- Geologic setting of the project site
- Subsurface soil and groundwater conditions from a supplemental investigation completed for this study
- Existing geotechnical data (borings and laboratory testing) and instrumentation readings from other projects in the area
- Field observations and topographic survey of the slope distress
- Water-level measurements from a new monitoring well installed for this study and from vibrating wire piezometers from other projects in the vicinity
- Potential cause(s) of the slope distress

This work was performed under contract with the Papio-Missouri River Natural Resources District (P-MRNRD), the local sponsor. This report was prepared by a registered professional civil engineer in the state of Nebraska specializing in geotechnical engineering.

2.0 HISTORY OF LITTLE PAPILLION CREEK CHANNELIZATION

Prior to the 1970s, the Little Papillion Creek experienced significant flash flooding from high intensity rainfall, which caused subsequent bank erosion and property damage (U.S. Army Corps of Engineers [USACE] 1984). To reduce the potential for overflow and further damage, and to convey storm runoff more efficiently, the USACE Omaha District designed and constructed Dam Site #11 and made channel improvements to the downstream portion of Little Papillion Creek. Both of these projects were completed in 1975.

The channel improvement project consisted of straightening 6.9 miles of the creek alignment with a series of excavations, slope flattening, and fill placements to form a more efficient means to convey flow. Rock riprap was placed in high velocity areas and at bends in the channel alignment. In fill areas where seepage was observed during construction, a blanket drain and outlet or brush mattress was constructed to alleviate this potentially unstable condition. In areas where slope instability had occurred or was suspected, timber piles were installed at the base of the channel slope to "pin" the unstable areas.

3.0 DESCRIPTION OF PROJECT SITE

The project site is situated along the right (west) bank of Little Papillion Creek between Stations 282+50R and 285+50R (see Figure 1). The Operation & Maintenance (O&M) Manual prepared by the USACE-Omaha District (USACE, 1984) indicates that the construction just downstream of this reach consisted of the placement of fill on the right (west) bank of the creek and the excavation of material on the left (east) bank to form the relocated channel (USACE 1984). A 2-foot-thick blanket drain composed of sand and a 6-inch diameter perforated pipe was constructed between Stations 283+00R and 285+00R. A 6-inch diameter solid outlet pipe with flap gate was connected to the perforated pipe at Station 285+00R, approximately 1 foot above the low water surface at the time of construction. Just downstream of the project site, "timber pile treatment" consisting of a keyed-in riprap section supported by 35-foot-long timber piles was constructed between Stations 286+20R and 289+60R. In addition, four rock drains were constructed within this reach.

Additional details of the project site and channel features from the O&M Manual are provided in Appendix A.

4.0 GEOTECHNICAL INVESTIGATIONS

4.1 Previous Studies

Prior to this study, several geotechnical investigations were completed in the vicinity of the project site. In 2013, Terracon performed a series of test borings, cone penetration test (CPT) soundings, and laboratory materials testing for the new access road leading to the new UNO Arena. The UNO Arena project consists of a new bridge over Little Papillion Creek (67th Street Bridge) supported on H-Piles and mechanically stabilized earth (MSE) walls for the approach fills. As shown in the Terracon report, borings B-201 and B-202 were drilled in the vicinity of the project site and were advanced to a depth of 100 feet (Terracon 2013).

A second investigation was completed by Terracon in November 2014 after slope movements and distress at Bent No. 1 of the new bridge were observed. This investigation consisted of test borings, CPTs, and lab materials testing. In addition, an instrumentation program was developed to monitor slope movements. This program consisted of inclinometers to measure lateral movements of the ground to a depth of 50 feet, and vibrating wire piezometers to measure the pore water pressure in the underlying sand stratum (Terracon 2014).

Excerpts from the 2013 study and a full copy of the 2014 report referenced above are provided in Appendices B and C, respectively.

4.2 Current Investigation

A supplemental geotechnical investigation was completed for this study that consisted of a test boring (PZ-1) at the approximate location shown in the Site Plan (see Figure 1). The boring was advanced using a CME 55 drill rig equipped with 4.25-inch hollow stem augers. Soil samples were retrieved using a Standard Penetration Test (SPT) drive sampler (ASTM D 1586) and thin-walled tube samplers (ASTM D 1587). Following the completion of the drilling and sampling, the drill hole was converted into a monitoring well (designated as PZ-1). Details of the well installation are provided on the boring log in Appendix D.

A topographic survey of the site was completed by Lamp Rynearson & Associates (LRA) between Stations 282+50R and 285+50R (LRA 2014). The survey also included the top and bottom elevations of the scarps and washouts, cross-sections at Stations 283+26R and 284+25R, and the locations of channel features such as wood piling and rock riprap. A copy of this survey is provided in Appendix E.

5.0 SITE CONDITIONS

5.1 Regional Geology

The surface geology of the Papillion Creek Basin is Pleistocene in age and consists of eolian (wind blown) deposits of Peoria and Loveland loess. The loess overlies Pleistocene glacial deposits of Kansan and Nebraskan till. The till generally consists of lean-to-fat clays mixed with sand, gravel, and occasional cobbles. The glacial deposits are generally fairly deep and can contain outwash deposits of sand and gravel. Cretaceous sandstone or Pennsylvania limestone and shale form the bedrock unit below the glacial deposits. The depth to bedrock is normally great, and rock is rarely encountered during construction.

Along drainageways, alluvial and colluvial deposits are typically present. These soils were formed by erosion of the adjoining loess-mantled hills. Alluvial deposits are generally present along creeks and in major drainageways. The upper several feet of alluvium are usually stiffer due to the effects of desiccation. Colluvial soils are usually located at the base of steep slopes and in upland draws, and are formed by local creep and sloughing.

5.2 Subsurface Conditions

The primary geologic strata encountered in this investigation include the following:

- Existing fill soils
- Fine alluvium
- Coarse alluvium
- Glacial till and outwash

A brief description of these units and their engineering characteristics are presented below. A subsurface profile is provided in Figure 2.

Boring PZ-1 from this study (see Appendix D) and Terracon Borings B-201 and B-202 (see Appendix B) were used in the evaluation of the subsurface conditions at the project site.

5.2.1 Existing Fill

The existing fill soils encountered in this study generally consisted of dark grayish brown and black, stiff to very stiff, lean clay (CL). The thickness of the existing fills was about 5 to 6 feet at the boring locations.

A thin layer of topsoil (less than 1 foot) and native grass vegetation were present over the existing fill soils and fine alluvium within the entire project site.

5.2.2 Fine Alluvium

Fine alluvium was encountered below the existing fills and consisted of light and dark brown and olive gray, soft to firm, lean clay (CL). The thickness of the fine alluvium was about 31 to 38 feet at the boring locations.

5.2.3 Coarse Alluvium

Coarse alluvium was encountered below the fine alluvium in all borings. The coarse alluvium was found to consist of brown to dark olive gray, loose to medium dense, silty sand (SM) and poorly graded sand (SP). SPT blowcounts (uncorrected) in this material ranged from 4 to 28 blows per foot (bpf). The thickness of the coarse alluvium ranged from 12 feet to over 30 feet at the boring locations.

5.2.4 Glacial Till and Outwash

Glacial till soils were encountered in Terracon Borings B-201 and B-202 at a depth of 55 feet. The glacial till was found to consist of olive brown, very stiff to hard, lean clay (CL) with a trace of gravel. The thickness of the lean clay till was about 38 feet at these boring locations.

Glacial outwash soils were encountered below the glacial till and consisted of brown, medium dense to very dense, poorly graded sand with a trace of gravel. SPT blowcounts (uncorrected) ranged from 25 to 52 bpf.

5.2.5 Groundwater and Artesian Pressure

During the drilling and sampling in the fine alluvium in Boring PZ-1, no groundwater was encountered. Once the fine alluvium was fully penetrated and the drill stem entered the coarse alluvium, the water level immediately rose 25.5 feet to Elevation 1009.8 feet, indicating an artesian pressure of about 1600 pounds per square foot (psf) in the underlying sand. The clay till soils and the upper fine alluvium form the confining layers for the artesian pressure.

Groundwater measurements from the piezometers installed by Terracon (2013 and 2014) indicate similar artesian pressure conditions. The artesian pressures were found to range from 1300 to 2300 psf in Terracon Piezometers P-1W and P-2W, corresponding to groundwater levels at Elevations 1012.8 and 1008.8 feet, respectively (Terracon, 2014).

A groundwater seep was observed on the west bank at Elevation 1008.8 feet at approximate Station 287+50R.

6.0 ENGINEERING EVALUATIONS

6.1 Sequence of Events

Photo documentation of the project site from December 2006 through September 2014 is provided in Appendix F. As depicted in Photos 1 through 5, 7, 9, 10, and 13, there were no observable signs of slope distress on the right (west) bank at the project site prior to September 2014.

As shown in Photos 7 and 9, 30-inch corrugated metal pipe (CMP) discharge pipe is present on the left (east) bank near Station 283+00L. Prior to construction of the 67th Street bridge, some right (west) bank erosion was evident across from a 30-inch CMP outlet (see Photos 7 and 9) likely due to the concentrated flow discharging from the CMP.

During summer 2014, several consecutive heavy rainfall events occurred in the Papillion Creek Basin, producing high water in Papillion Creek and its tributaries, including Little Papillion Creek. The dates and precipitation amounts for each storm event between August 21 and October 22, 2014, are summarized in Table 1. The values were obtained from the High Plains Regional Climate Center for Eppley Airfield (High Plains Regional Climate Center 2015). Values in parentheses, obtained from the Weather Underground website for the at UNO's Department of Geography/Geology station (Weather Underground 2014), are provided if different from values at Eppley Airfield.

Table 1. Precipitation Amounts, 08/21/2014 to 10/22/2014

Date	Precip (in.)	Date	Precip (in.)	Date	Precip (in.)
08/21/2014	0.29 (0.02)	09/05/2014	0.26 (0.40)	09/30/2014	1.66
08/22/2014	0.78	09/09/2014	3.43 (3.50)	10/01/2014	0.75 (1.94)
08/23/2014	0.59	09/10/2014	0.00 (0.30)	10/02/2014	0.02 (0.06)
08/26/2014	1.71	09/11/2014	0.01 (0.05)	10/06/2014	0.00 (0.01)
08/27/2014	1.84	09/12/2014	0.41 (0.45)	10/12/2014	0.23 (0.25)
08/28/2014	1.55	09/15/2014	0.02	10/13/2014	0.46
08/29/2014	0.64	09/20/2014	0.27 (0.12)	10/22/2014	1.02 (0.63)
08/31/2014	0.10 (0.0)	09/23/2014	0.05		

The channel instability at the project site was first noted by the 67th Street bridge construction observation representatives on September 10, 2014. As shown in Table 1 for Eppley Airfield, approximately 11.19 inches of rainfall occurred over the 20 days that preceded the first sign of channel instability, which included 3.43 inches on the previous day. Approximately 3.17 inches of rainfall occurred over the 21 days after the first sign of channel instability. Photo 13 shows no sign of scarping on August 28, 2014, while Photo 14 shows significant scarp development on September 10, 2014.

The extent of the right (west) bank erosion across from the 30-inch CMP appears to have significantly increased as a result of the rainfall events. This erosion hole extends from approximate Station 283+10R to 283+25R located at the upstream end of the project site.

6.2 Suspected Cause(s) of Slope Movements

Based on review of available photographs and the sequence of events at the project site, as well as the findings from this study and the investigations completed by Terracon (2013 and 2014), the following observations of potential contributing cause(s) of the slope movements have been identified:

- The observed slope distress occurred within the existing fill along the blanket drain and fine alluvium strata which are comprised of soft to firm lean clay with high moisture contents and relatively low shear strengths. This stratum within the Papillion Creek Basin has exhibited a history of slope movements in re-channelized reaches where vegetation was removed and cuts and fills were made to form the relocated channel.
- The slope movements occurred after a series of three very heavy rainfall events in August and September 2014, which saturated and softened the fill and fine alluvium within the channel, as follows:
    - The slope distress generally occurred following saturation of the soils on the slope from high water followed by the rapid drawdown of the creek level.
    - The subsequent sloughing, sliding, and cracking of the surficial soils allowed additional water from subsequent high water events and surface runoff from the adjacent area west of the bike trail to further saturate the soils.
    - This wetting, sloughing, cracking, and additional movement continued with each subsequent high water and drawdown event.
    - The slope distress generally occurred within the same limits as the blanket drain.
- At the time of this study, the 6-inch solid outlet pipe for the blanket drain could not be located. If this outlet pipe was damaged or obstructed, water pressure could build in the blanket drain, which could have contributed to the slope distress.

- In absence of a properly functioning blanket drain system, the artesian pressures acting on the sloughed soils further exacerbate the slope instability by moistening and softening the fill and fine alluvium, especially along previous zones of slope movements. The artesian pressures reduce the effective weight of the slide mass along the failure plane of movement, thus allowing the mass to continue its gradual and progressive downslope sliding.
- A scour hole was observed between Stations 283+10R and 283+25R (see Figure 2 and Photos 19, 21, 23, and 25). The scour hole is situated directly across from the 30-inch CMP. It is our understanding that water discharging at a high velocity from the 30-inch CMP during a heavy rain event caused this erosion.
- The slope distress is generally contained within what is termed a "landslide complex," meaning that there are several slides within the mass occurring at various depths. This condition is depicted on the Subsurface Profile in Figure 2.

The potential impact of the golf course pond located west of the channel (see Figure 1) was also evaluated. Because such ponds are typically lined with compacted clay to minimize seepage losses, the golf course pond is not believed to be a contributing factor to the slope distress.

6.3 Evaluation of Short-Term Stabilization Alternatives

Several alternatives for the short-term stabilization of the slope movements were considered as a part of this study and evaluated for applicability to the conditions at this site. Potential short-term measures include:

- *Grading of the upper slope to flatten the vertical material along the scarps and seal the open cracks with this material.* This grading activity may temporarily reduce further infiltration of water into the slide mass and improve the surface water drainage in this area.
- *Fill in the scour hole located at approximate Station 283+10.* The hole should be filled with compacted lean clay and covered with an anchored, non-woven geotextile and rock riprap to protect the slope in this area.

It should be noted that these measures will provide only a temporary means to minimize the infiltration and future slope movements. Additional slope distress can be expected following future high water events due to rapid drawdown and continued artesian pressures.

6.4 Evaluation of Long-Term Stabilization Alternatives

Several alternatives were identified as potential long-term stabilization measures. Potential measures include:

- *The complete excavation of the slide mass and the replacement with compacted sand and gravel.* This method has been successfully used on several stabilization efforts by USACE along Mosquito Creek and within the Papillion Creek Basin.
- *The installation of stone-filled trenches.* This method was developed by the USACE – Vicksburg District and involves the excavation of deep trenches with a long reach backhoe that extend below the slide mass (USACE n.d.). The trenches are immediately backfilled with rock following the excavation. Trenches that run perpendicular to the alignment of the channel and are typically 2 to 3 feet in width and are spaced at a center-to center distance of 10 to 15 feet. A 2- to 3-foot-thick layer of riprap is placed over the completed trenches to provide erosion protection of the exposed fine alluvium and to provide additional drainage.

Based on cost and performance considerations, the rock-filled trenches would provide the most economical method to stabilize the channel within the project site. The trenches would provide strength to the slide mass because they would replace portions of the existing soft failed materials and would be keyed in undisturbed, stable soil. The trenches also would provide internal drainage of the stabilized material following high water events, which would provide a controlled outlet for the artesian pressures and facilitate long-term stability. Compared to the complete replacement alternative, the rock-filled trenches would be considerably less expensive and would not require extensive dewatering and pressure relief of the underlying sands during construction.

A copy of the technical paper on the rock-filled trench concept and case history prepared by USACE is provided in Appendix G.

If the stone-filled trench alternative is selected for the long-term stabilization, the final width, depth, and spacing of the trenches and the gradation of the stone backfill will be established from iterative slope stability analyses. The final slope condition will be analyzed during final design for the following conditions:

- End of construction
- Rapid drawdown
- Long term

6.5 USACE Site Visit and Assessment

At the request of the P-MRNRD, personnel from the USACE-Omaha District visited the site on September 17, 2014 and performed a reconnaissance of the slope distress. The USACE observed the 300-foot long slough, the scour hole and the timber piles that have rotated from the slope movement. The primary conclusions from this visit are as follows:

- The subdrain system has potentially failed and is not providing adequate bank seepage control.
- The timber piles are exposed above the water line and they have lost the riprap cover and stringer piles.
- The channel bank riprap protection was not present to provide erosion resistance for the channel embankment during high water events.
- The erosion hole has been developing for at least 4 years and has increased in size with successive high water events.

Based on these assessments, the USACE recommended "to repair the original project design features to as built conditions, as documented in the O&M Manual, or provide the USACE with the proposed modification to repair the channel section" (USACE, 2014). A copy of the report from the USACE (2014) is provided in Appendix H.

7.0 LIMITATIONS

This report presents the preliminary findings, conclusions, and recommendations for the short- and long-term stabilization of the slope movements occurring at the project site. It has been prepared in accordance with the generally accepted engineering practice and in a manner consistent with the level of care and skill for this type of project within this geographical area. No warranty, expressed or implied, is made.

The geotechnical evaluations presented herein are based on information provided, geotechnical information from other investigations, the results of supplemental geotechnical information obtained for this study, field reconnaissance, the engineering evaluations and analyses results from the current investigation, and HDR's judgment and experience.

Geotechnical engineering and the geologic sciences are characterized by uncertainty. Professional judgments presented herein are based partly on HDR's understanding of the proposed construction, partly on our general experience, and the state-of-the-practice at the time of this writing.

8.0 REFERENCES

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1. 12/13/2006 View of Project Site looking East.

9. 8/8/2013 View of channel from Center Street Bridge.

10. 8/8/2013 View of right (west) bank of channel from Center Street Bridge.

14. 9/10/2014 View of slope distress and 67th Street Bridge construction.

SLIDE STABILIZATION WITH STONE-FILL TRENCHES

George L. Sills[1] M.ASCE and
Robert L. Fleming, Jr.,[2] M.ASCE

ABSTRACT: The U. S. Army Engineer District, Vicksburg developed a different method of slide stabilization using gravel-fill or stone-fill trenches. A number of slides have been successfully stabilized with this method. The design, construction, and performance monitoring of one of these repairs is discussed, along with, a history of the slide, description of the soils, and mechanism of failure. The applications of this method of slide stabilization are also evaluated.

INTRODUCTION

The U.S. Army Engineer District, Vicksburg has successfully used gravel-fill or stone-fill trenches to stabilize a number of slides. In 1982, a long shallow translatory slide in a medium to stiff highly plastic clay was stabilized with a technique using trenches excavated below the slip plane and partially filled with a washed gravel aggregate (Wardlaw 1984). The slide which had closed one lane of a county road and had destroyed a timber bridge, has remained essentially stable since it was stabilized in 1982. Only a small amount of strain cracking in the pavement has been evident. Since that time a number of other slides have been successfully stabilized using washed

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gravel and more recently quarry run graded stone. Two of the more recent applications involving the use of stone-fill trenches to stabilize slides were on the inlet channel at John H. Overton Lock and Dam on the Red River Waterway and on the Ouachita River at Rilla, Louisiana. The Rilla slide was located 9 miles downstream of Monroe, Louisiana, at approximate River Mile 166 on the Ouachita River and is shown in plan on Figure 1. The slide had involved a portion of the Ouachita River Levee and was considered to be an endangerment to the flood control system. The repairs were made under emergency conditions in December 1988.

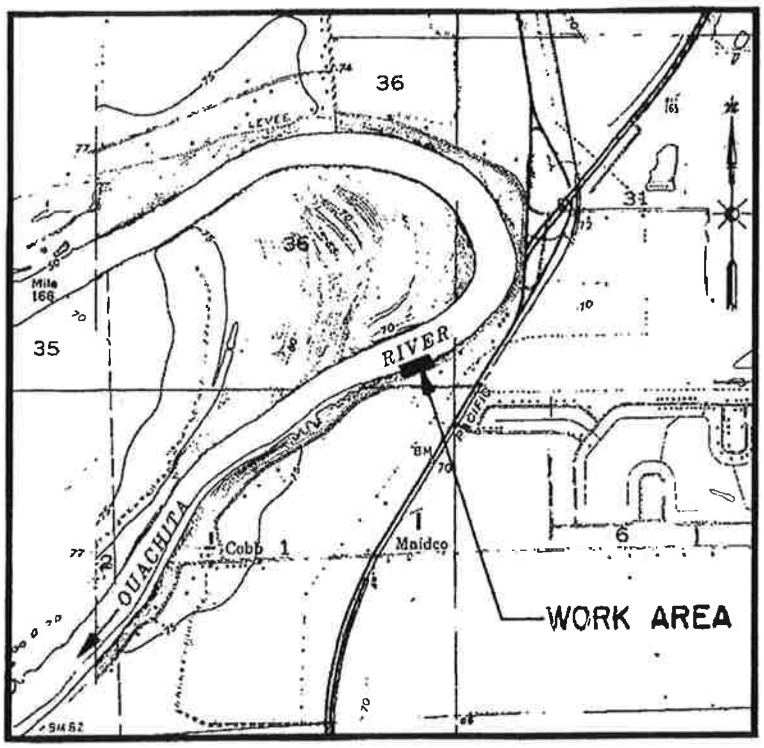

Figure 1. Site Location

A method of repair, not materially affected by the weather conditions, that could be completed prior to the next high water season was selected. In addition, the repair method could not extend into the navigation portion of the channel.

This paper summarizes the nature and history of the Rilla Slide, the design of the stabilization measures, construction of the stone-filled trenches and the results of post construction monitoring.

BACKGROUND

The slide location, in the outside channel slope of a meander of the Ouachita River, has been subjected to active scour. The lower portion of the river channel slope consists of highly erodible sands and silty sands. The upper portion of the channel slope consists of clays and silts. Prior to 1983, the levee had been set back because of bank caving problems in this reach. In the summer of 1983 scouring had caused an instability in the upper clay slope. During low river stages, the slide scarp had propagated into the riverside toe of the previous levee setback. At this time, further setback of the levee was not considered feasible because of existing houses and structures located landside of the levee toe. A field and laboratory investigation program was initiated to design a section to stabilize the slide and to stop further degradation of the river bank by scour. The recommended repair consisted of a large stone toe dike and a sand berm. The stone dike would serve to buttress the sand fill as well as provide scour protection. Construction of the dike and sand fill was initiated in the fall of 1984. Because of problems, such as extended high water and an extremely compressed work area, the slide was never properly stabilized and continued to slowly move. By the summer of 1988, the slide movement had reached a point where it was considered an endangerment to the levee and needed to be repaired prior to the next high water in the spring.

Because of these problems only those methods that would not be affected by fluctuations of the river, by wet weather conditions or which would not impact the navigation channel were considered. This led to the use of stone-fill trenches to stabilize the slide. Because of the emergency nature of the project and problems with the previous construction, the specifications were very specific in terms of the order and the compressed timing of the work. Construction was initiated on December 7, 1988 and was completed on December 19, 1988. As of the time of this paper in December 1991, there has been no evidence of further movements along the slip plane.

SLIDE ASSESSMENT

<u>Geology</u>. The area is located in the western part of the Mississippi Alluvial Valley in a region known as the Ouachita lowland. Fleetwood (1969) presented a detailed study of the area geology. The alluvial deposits in the area consist of an upper fine grained unit called the topstratum and a lower coarse grained unit called the substratum. The alluvial topstratum deposits of the Ouachita River Valley are classified according to depositional environment. The topstratum at the Rilla site, located 9 miles downstream of Monroe, Louisiana, at approximate River Mile 166 on the Ouachita River, consists of a 2- to 5-foot thick sequence of natural levee silt (ML) which overlies a 20- to 25-foot thick deposit of medium to very stiff backswamp clay (CL and CH). Natural levee deposits form broad low ridges that flank both sides of the river and are a result of overbank deposition during periods of flooding. Backswamp deposits consist of fine grained sediments laid down in broad shallow basins within the floodplain during major periods of stream flooding. The topstratum deposits rest directly on a 40- to 50-foot thick layer of highly erodible substratum sand (SP and SM) with a 2- to 5-foot gravel strata at the base. These alluvial deposits in turn lie directly on the Tertiary age material that consists of a hard, dark gray clay (CH).

<u>Exploration Program</u>. The investigation of the soil conditions at the site consisted of three undisturbed borings taken in September 1983 and two undisturbed borings taken in June 1988. The borings indicated a silt layer of the natural levee deposit and a backswamp clay deposit consisting of a layer of very stiff clay (CL) overlying a medium to very stiff clay (CH). The generalized soil and slide profile is presented in Figure 2. The borings which were made through the existing levee are shown in plan on Figure 3.

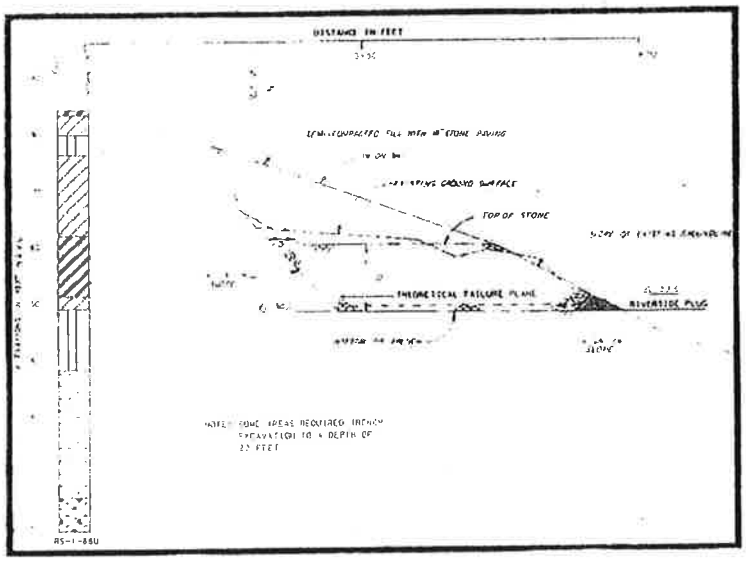

Figure 2. Typical Section of Slide Area

Laboratory Testing. Laboratory testing consisted of water content determinations, Atterberg limit tests, and unconfined compression (UC) tests. The UC tests indicated the shear strengths range from a cohesion of 250 psf to 780 psf with an average value of 500 psf. The water contents varied from a low of 21 to a high of 42. It should be noted that the slickensided nature of the backswamp clay help to contribute to the lower UC values.

Conditions Contributing to Slide. The site investigations in 1983 and 1988, cross sections of the area taken on regular intervals and familiarity with the construction problems associated with the 1984-85 repair led to the conclusions that the initial triggering mechanism for the slide was the steepening of the river bank due to erosion of the silty sand substratum. This in turn caused sliding to occur in the backswamp clays. The initial attempt to stabilize the slide using the stone dike and sand berm was to

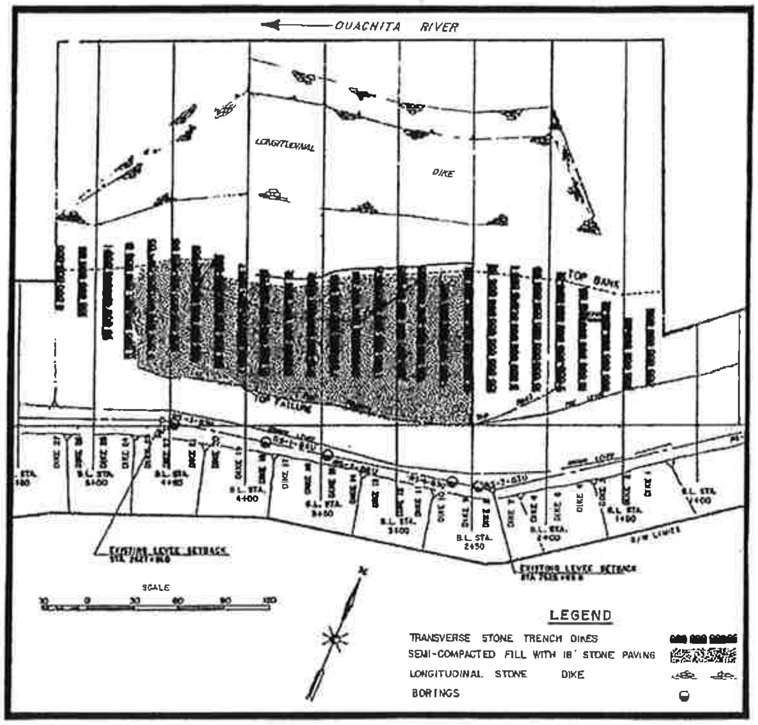

Figure 3. Site Plan

consist of building a stone dike to elevation 62 and rebuilding the slope to a 1V on 3H with sand fill. The sand fill would be protected from scour with engineering fabric and riprap. In November 1984, high water conditions existed at the construction site. The contractor chose to place the sand fill prior to completion of the stone dike. The weight of the additional sand fill caused the slide to experience further movement in the backswamp clay. The contract was modified to ensure the stone dike was completed before any more sand fill was placed. The modification also allowed placement of the riprap in other than dry conditions which was precluded in the original contract. The work was completed in January 1985 and the section continued to experience some movement. This movement was assumed to be occurring along a remolded slip plane that existed in the backswamp clay. The movement was more than strain cracking, but did not seem to be endangering the levee. In the summer of 1988, the movement had reached the point that it was considered to be an endangerment to the levee. It was also clear at this time that the slip plane was located in the backswamp clay and that further attempts to stabilize the slide must plan for this condition.

REMEDIAL MEASURES

The selection of stone-fill trenches as the method of stabilization at Rilla was based on considerations that the use of a berm large enough to stabilize the slope would be both a hinderance to navigation as well as be extremely expensive because of the large quantity of stone required. Slope flattening was not a feasible alternative because the levee could not be set back further. This left only some form of insitu stabilization as an acceptable alternative. An additional consideration was the emergency nature of the work and the short time frame allowed for plans and specifications. A method that could use readily available equipment and be bid by local contractors was highly desirable. A first consideration was to use trenches to stabilize the slide. Because the slide area was already protected with 18 inches of stone paving, it was decided to use this stone to fill the trenches. Quarry run stone would further provide a material whose strength was less susceptible to degradation due to contamination from clay and silt fines. Quarry run stone would be much larger and more angular than rounded, pit run washed gravel. The concept of stone-fill trenches is similar to stone column replacement and is applicable where digging of the trenches is within the capability of the digging equipment and conditions. In this case the maximum trench depth required to extend the trench below the bottom of the backswamp clay was 22 feet. This depth is below the theoretical depth an open trench will stand in this type of material. The depth of cut could be reduced by leveling or removing material from the top of the slide zone where possible. However, it was decided to minimize the double handling of material and modify the construction technique by only opening a small portion of the trench before backfilling.

Design of remedial measures consisted of detailed analyses of the existing conditions to determine a strength acting upon the inferred slip surface at the base of the backswamp clay. Figure 2 represents the cross section of the slide, with the boring log plot, and the location of the inferred slip surface which was used in the analyses.

A computer program utilizing a wedge method was selected to analyze the slip surface, assuming the sliding was to be in a state of limiting equilibrium. This program was written by Cheek (1975). Even though no slope indicator data was available to define the slip surface, assuming the slip plane at the bottom of the clay layer was considered conservative. These analyses also assumed a phreatic profile of 5-feet below the ground surface.

Drained strength parameters of $\phi' = 16^{\circ}$ $c' = 0$ psf were backfigured as an average strength acting on the slip surface producing a safety factor of unity.

Once the strength acting on the slip surface was determined, it was necessary to determine the average strength required to provide a factor of safety of 1.25 for the repaired slope. Analyses indicated that an average drained shear strength of $\phi' = 20^{\circ}$ and $c' = o$ psf would provide the shear strength required to yield the required factor of safety.

It was decided that the existing riprap on the slope would be used in the trenches. The shear strength was estimated for this material as $\phi' = 40^{0}$ and $c' = 0$ psf. The trenches were to be excavated to the bottom of the backswamp clay and filled with a minimum of 12 feet of rock. Semicompacted fill would be placed on top of the repair to restore the section back to the original section.

Assuming that a 2.5-foot-wide bucket would be used to excavate the trenches, and with the shear strength parameters for the slip surface and stone-fill known, the next step was to determine a trench spacing that would provide the composite shear strength required to raise the computed factor of safety to 1.25. To determine the trench spacing, an equation was developed using a weighted average principle. In the equation the ϕ' of the existing soil mass is multiplied by the distance between trenches. This term is then added to the ϕ' of the trench backfill material multiplied by the width of the trench. These terms are equal to the ϕ' of the composite section multiplied by the total distance between the trench plus the width of the trench. The Sills/Fleming equation used is as follows:

$$\phi'_r \times S + \phi'_f \times W = \phi'_a (S+W) \qquad (1)$$

where

ϕ'_r = the average ϕ' acting on the slide mass
S = distance between trenches
$\phi'_f = \phi'$ of the trench backfill material
W = width of trench
ϕ'_a = the average ϕ' of the composite section

Since the trench spacing is generally measured center to center

$$S+W = T_s \qquad (2)$$

where
T_s = trench spacing measured center to center

Therefore equation (1) can be rewritten

$$\phi'_r \times S + \phi'_f \times W = \phi'_a \times T_s \qquad (3)$$

Solving equation 3 it was determined that a center to center trench spacing of 15 feet would provide the required average strength parameters of $\phi' = 20°$ and c' = 0 psf. It should be noted that since arching of the soil should occur between the stone-fill trenches the actual factor of safety should be greater than 1.25. A typical design section is shown on Figure 4.

CONSTRUCTION

Construction of the stone-fill trench stabilization was accomplished by contract for the U.S. Army Engineer District, Vicksburg, in December 1988. The contract required that 27 transverse stone-fill trenches (Figure 3) be constructed beginning downstream and proceeding upstream. The work area was within the Columbia Lock and Dam Pool which maintained a minimum river of 52 feet NGVD. Since the trenches were required to be excavated to elevation 50 a soil plug was left in place on the riverside of the trench, Figure 2. The trenches were constructed beginning at the riverside plug and proceeding landward toward the levee toe.

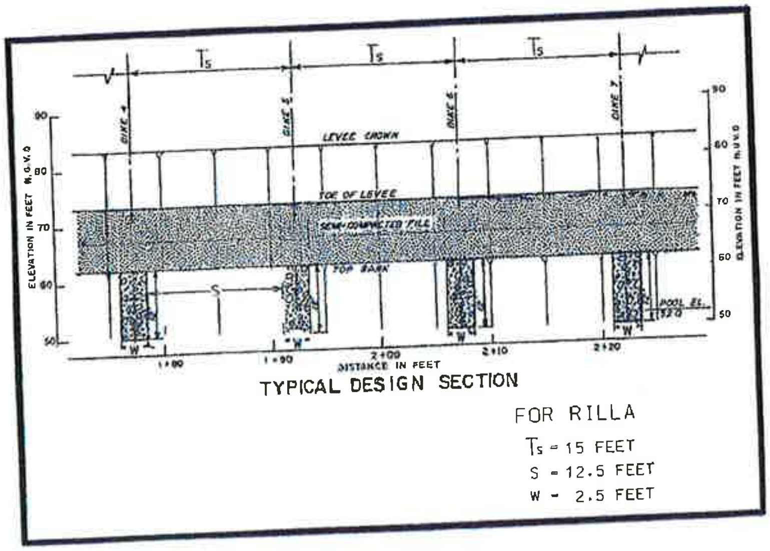

Figure 4. Typical Design Section

Prior to trench construction, existing bank paving was removed along the trench where excavated material would be placed. Trench excavation was performed using a tracked backhoe. The trenches were excavated to full depth. Excavated material was placed downstream of the trench in a manner not to overload the bank. This also ensured the excavated material was placed on a stabilized section and was not mixed with the surface stone. As the backhoe moved upslope, the existing bank paving was placed in the trench as backfill. This allowed the backhoe to both excavate and backfill the trench. The contractor was required to have less than 5 feet of unfilled trench open at any time. The backhoe moved upslope until the vertical scarp was encountered, the trench was backfilled, the backhoe turned 180° and finished the trench, digging from the top of the scarp to the previously complete portion of the trench. Figure 5 is a photo of the slide area.

Figure 5. Slide Area

This procedure was repeated for each of the 27 trenches. The soil excavated from the trenches was used to backfill the slide area to the original section. Finally, 18 inches of bank paving was added to the repair area. Figure 6 is a photo of the completed work. The construction of the repair was completed in only 12 days with a final total cost of less than $100,000.

MONITORING AND PERFORMANCE

After completion of this repair in December 1988, there has been no visual movement of this slide. During the spring of 1991, the Ouachita River reached record stages in this area. After flood stages rapidly decreased, the repaired area was still intact.

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CONCLUSIONS

The stone-fill trench method of slide stabilization has a definite application in appropriate situations. These situations are shallow slides in soil masses with enough integrity to remain stable when trenches are excavated below the slip

Figure 6. Completed Repair.

plane with near vertical side slopes. This application has several definite advantages when compared to other methods of stabilization. Some of the merits are relatively low construction costs, moderate level of design complexity, and the ability to be performed with conventional, readily available, construction equipment.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

MAR 20 2015

RECEIVED
MAR 23 2015

Readiness Branch

Mr. Martin Cleveland
Papio-Missouri River Natural Resources District
8901 S. 154th Street
Omaha, Nebraska 68138

Dear Mr. Cleveland:

The Omaha District of the U.S. Army Corps of Engineers (USACE) has performed an evaluation of your request, dated February 13, 2015 to review the preliminary investigation and proposed repair methods for the channel instability between Stations 282+50R and 285+50R of the Little Papio Channel. The proposed project is located within the critical area of the Little Papio Channel (Center Street to Grover Street) Flood Risk Reduction Project (FRRP) operated and maintained by the Papio-Missouri River Natural Resources District pursuant to Section 14 of the Rivers and Harbors Act of 1899, 33 U.S.C. § 408 (Section 408).

The preliminary review was performed by the Engineering Division (Geotechnical Engineering and Sciences Branch). The enclosed comments are provided for incorporation in to the final design to be submitted to this office for review and comment.

For any questions regarding this evaluation, please contact Jen Gitt at (402) 995-2443 or Jennifer.L.Gitt@usace.army.mil.

Sincerely,

Kimberly S. Thomas

Kimberly S. Thomas, P.E.
Chief, Readiness Branch
Operations Division

Enclosure

cc:
CENWO-ED-GA (Hall)
CENWO-OD-MR (Barry)

CENWO-ED-GA March 10, 2015

MEMORANDUM FOR CENWO-OD-E (Gitt)

SUBJECT: Proposed Short-term and Long-term Repair Methods
Channel Instability Investigation (between Stations 282+50R and 285+50R)
Little Papio Creek RB, Omaha, Nebraska

1. The U.S. Army Corps of Engineers, Omaha District (Corps) received a letter from Martin P. Cleveland, Construction Engineer, on February 17, 2015, requesting Corps feedback on the proposed repair concept for channel slope instability at Little Papio Creek between Station 282+50R and 285+50R. A final report "Channel Instability Investigation – Little Papillion Creek – South of West Center Road – Omaha, NE – February 12, 2015" prepared by HDR was submitted for review.

2. Little Papio Creek LB & RB – Spaulding Street to Big Papio Confluence Segment, Omaha, Nebraska, is a congressionally authorized and federally constructed flood damage reduction project. Papio-Missouri River NRD is the local sponsor that maintains and operates this segment per agreement with the Corps.

3. The Corps has a congressionally mandated responsibility to ensure that the federally constructed project is appropriately operated and maintained. No improvements shall be passed over, under or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior approval of the Corps.

4. Comments from the review are as follows: The proposed repair method (installation of stone-filled trenches) appears to be an acceptable method to stabilize the failed channel slope.

5. The width, length, depth, number and spacing of trenches, gradation of rock backfill, materials used for slope construction, plan view and cross sections, construction sequencing and other pertinent design and repair details should be addressed in the final submittal.

6. The design should also include slope stability analysis and seepage analysis pertaining to filter criteria to provide data to prove that stone filled trenches will not pipe fine material from channel embankment and not be susceptible to clogging.

7. The Corps has a congressionally-mandated responsibility to ensure that the federally-constructed project is appropriately operated and maintained. No improvements shall be passed over, under or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior approval of the Corps.

8. The Sponsor and Engineer-of-Record are responsible for ensuring that any modification adheres to the plans and specifications approved by the Corps of Engineers.

9. The Sponsor and Engineer-of-Record are responsible for amending the O&M Manual for the project to reflect the as-built conditions for any permanent modifications or encroachments. The amendment to the O&M Manual is required to be provided to the Corps for record keeping

purposes within 60 days of completion of construction. The Corps can provide guidance on developing an addendum to the O&M Manual, upon request.

10. The comments herein pertain only to the geotechnical and levee safety issues related to the modification's potential impacts to the flood control works. If you have any questions, please contact Klaidas Hall at 402-995-2252 or the undersigned at 402-995-2227.

BRYAN P. FLERE
Levee Safety Program Manager
Geotechnical Engineering and Sciences Branch
Engineering Division

KGH Hall/CENWO-ED-GA/2252

BJ Jones/CENWO-ED-GA/2231

BPF ~~Flere~~/CENWO-ED-GA/2227