REQUEST FOR PROPOSAL

RFP NUMBER: **18-02**

RFP SUBJECT: **PINEY BRANCH STREAM RESTORATION**

PROPOSALS SHOULD BE SUBMITTED TO:

Purchasing Agent
Town of Vienna – Vienna Town Hall
127 Center Street S
Vienna, Virginia 22180

SEALED PROPOSALS DUE DATE AND TIME: **August 30, 2017 at 11:00 AM**

All inquiries should be made, in writing, to Gina Gilpin, Purchasing Agent, at ggilpin@viennava.gov by **August 24, 2017 at 2:00 PM.**

In compliance with this Request For Proposal and to all the conditions imposed herein, the undersigned offers and agrees to furnish the services in accordance with the attached signed proposal or as mutually agreed upon by subsequent negotiations.

Name & Address of Offeror:

_____

_____

_____ EEI/FIN: _____

Signature: _____ Title: _____

(Date)

Printed Name: _____

Phone: _____ Email: _____

ADVERTISEMENT

Sealed proposals will be received by the Town of Vienna, Virginia at the Purchasing Office, 127 Center Street, South, Vienna, Virginia 22180, for:

- **RFP 18-03 PINEY BRANCH STREAM RESTORATION**
- **Proposals Due: August 30, 2017 at 11:00 AM**

Copies of solicitations are available online at www.viennava.gov and from the Purchasing Agent at the above address or by calling (703) 255-6359 OR TTY 711, during normal business hours (8:00 AM - 4:30 PM), Monday-Friday.

PUBLICATION:
August 11, 2017
Washington Times

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*RETURN THESE PAGES WITH YOUR PROPOSAL RESPONSE

SECTION 1. PURPOSE

The purpose of this RFP is to solicit proposals for the subject project. The purpose of the project is to assess approximately 1,400 linear feet of the Piney Branch, Difficult Run watershed, and recommend stream restoration of degraded channels, enhancements to wetlands, improvements to storm drain outfalls. The project assessment limits include all of the stream channels, storm drain outfalls and drainage ways as specified, located at 600 Mill Street NE. Please see attached map showing the project limits.

The Consultant must assess stability within the project limits, develop a concept, conduct public meetings, complete project designs, complete cost estimates, obtain permit approvals, and administer construction phase services.

SECTION 2. BACKGROUND

The Town of Vienna is located approximately 15 miles west of Washington D.C., and is called home by approximately 16,000 residents. With a geographic area of slightly over 4 square miles, the Town is one of a handful of incorporated areas within Fairfax County. The Town was primarily developed during the 1950's and 60's without the environmental benefits of Stormwater Management and Water Quality Treatment. Further subdivision development in the 1980's throughout the Town of Vienna increased impervious areas, enclosed tributaries, straightened streams, removed riparian buffers and steepened stream banks to allow more homes to be built. Recently, the Town has experienced a re-development boom leading to a further increase in impervious surfaces and a further burden on the receiving water courses. Predictably, the receiving streams and channels have experienced incision, erosion and widening in response to the increase in water quantity as a result of 50 plus years of development. Within Vienna's four plus square miles is the watershed for the Piney Branch section of the Difficult Run watershed.

SECTION 3. SCOPE OF SERVICES

The following is list of the minimum tasks in order to complete the Piney Branch Stream Restoration. The proposals are to indicate the applicants experience and expertise in the following items, expand on the items and give a more detailed project management and design philosophy:

1. Stakeholders Meetings and Public Outreach

   Town staff and the Consultant will meet with community leaders to discuss the Piney Branch Stream restoration project. The consultant shall present their assessment and design approach. The goal of this meeting is to collect and understand community issues so that they may be factored into the project as well as educate the public about the means methods and reasons for the project.

2. Geomorphic Assessment

   The Engineer may use the Rosgen Stream Classification System (levels I-III), or similar, for assessing the Stream Channel. The length of stream to be assessed is approximately 1,400 linear feet. The preliminary assessment data will provide information on the current stream conditions and is to be electronically sent to DPW when completed. All methods, data collection, and analysis must be followed as directed in the United States Department of Agriculture, Natural Resources Conservation Service, Part 654 Stream Restoration Design National Engineering Handbook, unless otherwise directed or agreed to by the Town.

3. Surveys

   Survey cross-sections of the stream channel necessary for the HEC-RAS model, installation of bank pins and geomorphic analysis of the streams etc.

   The Consultant shall review background data on the project area including the Watershed Study (Fairfax), TR-20, USGS SIR 2011-5143 and 2011-5144, topography, soils, storm drains, land use, property line information, gas main plans and utility design plans.

   A tree survey that pertains to trees sizes (DBH) must be created for this project. The applicant is to outline the proposed requirements of the tree survey to be performed.

It is anticipated that survey will be required for the design, such as additional topography and details of significant features within 25-feet on each side of the storm drain outfall channel banks (50-foot strip) and all with critical root zones extending into the limits of disturbance. Geomorphic data needed includes thalweg (location and elevation), bankfull height, channel slope, top of bank, debris in stream, existing grade control structures and rifle and pool features.

It may be necessary to enter private property to obtain all of the necessary survey information. It is the Consultant's responsibility to obtain any necessary permission to obtain access.

The offeror's proposal is to outline all agreed requirements as listed above and provide any additional known or possible requirements that will be performed as a scope of the work.

4. Concept Meetings

The Consultant shall conduct a site walk with representatives from the Town to review the stream restoration design concepts, discuss storm drain channel erosion problems, habitat improvement needs, outfall mitigation approaches and repair methods, wetland enhancement opportunities, sanitary sewer protection if required, reforestation, site constraints and project access.

After the field walk there shall be an office meeting to review the scope of the project, review schedule, review outstanding data needs and identify any concerns.

The offeror's RFP is to include concept items in the project schedule.

5. Permitting

The offeror's RFP is to include information pertaining to the experience and expertise in obtaining, including but not limited to: Wetland delineations, Natural and Cultural Resource Studies, Threatened and Endangered Species evaluation and clearance, Phase 1 Archeology Studies, Federal Permitting, identifying the Small Whorled Pogonia.

6. Stream Restoration Plan Submissions

It is anticipated that the offeror's RFP may include 30, 60, 90% , Easement Plat preparation and final plan submissions. The offeror may alter these interim submissions but is to provide for the submissions on the project schedule. The RFP is to include a list of deliverables for each milestone in conjunction with the schedule.

7. Construction Phase and Pre-Bid and Post Construction Monitoring Services

Review and approve schedule of values, shop drawings, material certifications, samples and other submissions of construction contractor (Contractor) that relate specifically to stream restoration, storm drain and landscaping. Additional items may include on-call construction oversight and inspection at critical points in the project. The offeror's Proposal is to include information about the availability, staff and experience of individuals to perform the aforementioned tasks for Pre Bid and Construction phase services.

8. Schedule

Time is of the essence. The consultant shall allocate the necessary resources to achieve and maintain the schedule and provide a preliminary but detailed estimated schedule from project origination through construction completion as a part of the proposal.

SECTION 4. PROPOSAL PREPARATION AND SUBMISSION REQUIREMENTS

1. General Requirements

RFP Response: In order to be considered for selection, Offerors must submit a complete response to the RFP. One (1) original and four (4) copies of each proposal must be submitted to the Procurement Division. The Offeror shall make no other distribution of the proposal.

Proposal Preparation

a. An authorized representative of the Offeror shall the sign proposal. All information requested

should be submitted. Failure to submit all information requested may result in the Procurement Division requiring prompt submission of missing information and/or giving lowered evaluation of the proposal. Proposals which are substantially incomplete or lacking key information may be rejected by the purchasing agency. Mandatory requirements are those required by law or regulation or are such that they cannot be waived and are not subject to negotiation.

b. Proposals should be prepared simply and economically, providing a straightforward, concise description of capabilities to satisfy the requirements of the RFP. Emphasis should be placed on completeness and clarity of content.

c. Each copy of the proposal should be bound or contained in a single volume where practical. All documents submitted with the proposal should be contained in that single volume. *Please do not use hard cover three ring binders.*

d. Ownership of all data, materials and documentation originated and prepared for the Owner pursuant to the RFP will belong exclusively to the Owner and be subject to public inspection in accordance with the Virginia Freedom of Information Act (FOIA). Trade secrets or proprietary information submitted by an Offeror shall not be subject to public disclosure under the Virginia FOIA; however, the Offeror must invoke the protections of Section 2.2-4342(D) of the Code of Virginia, in writing, on the form provided within this RFP (Reference page 18) either before or at the time the data or other material is submitted. As noted on the form, Offerors must specifically identify the data or materials to be protected and state the reasons why protection is necessary. The Owner reserves the right to ask for additional clarification prior to establishing protection.

2. Specific Submittal Requirements

Qualified consultants interested in performing the work described in this request for proposals should submit the following information to the Town:

a. Qualifications of your firm and staff proposed to perform the work on Town of Vienna projects. This should include resumes of staff and any recommendation/commendation letters received for past projects of similar nature. The Project Staff assigned to this project and future work is critical.
b. Provide a detailed proposed scope of work and potential innovation solutions for the design and construction of the restoration of the describe portion of Piney Branch.
c. References from at least three other similar stream restoration projects with similar requirements that have been completed within the past eight years and that have involved the staff proposed to work on this project.
d. Detail sub consultants that you plan to use on this and other work, and their relationship with your firm and staff, past experience together and define the role of the sub consultants in the project.
e. Detail any experience your firm has in using a formal partnering process on construction projects.

SECTION 5. EVALUATION CRITERIA

An Evaluation Committee will evaluate the proposals using the following criteria.

1. Understanding of the project objective, methodology to be used and results that are desired from the project. 20%
2. Offeror's (including personnel who will be assigned to this contract) expertise, qualifications, and experience in providing services of similar size and scope. 30%
3. Firm's approach to providing services. 40%
4. Quality and completeness of proposal including impact of any exceptions taken regarding the scope and terms and conditions. 10%

SECTION 6. AWARD OF CONTRACT

The Town of Vienna Evaluation Committee shall engage in individual discussions with two (2) or more of the Offerors deemed fully qualified by the Evaluation Committee. Repetitive informal interviews shall be permissible. Such Offerors shall be encouraged to elaborate on their qualifications and performance data or staff qualifications pertinent to the proposed project, as well as alternate concepts.

At the discussion stage, the Town may discuss non-binding estimates of total project costs including, but not limited to non-binding estimates of cost of services.

Proprietary information from competing Offerors shall not be disclosed to the public or to the competitors.

At the conclusion of the informal interviews, on the basis of evaluation factors published in the Request for Proposals and all information developed in the selection process to this point, the Evaluation Committee, shall select, in the order of preference, two or more Offerors whose professional qualifications and proposed services are deemed more meritorious. Negotiations shall then be conducted, beginning with the offeror ranked first. If a contract satisfactory and advantageous to the Town of Vienna can be negotiated at a price considered fair and reasonable, the Town Council shall be advised and make the award to that offeror. Otherwise, negotiations with the offeror ranked first shall be formally terminated and negotiations conducted with the offeror ranked second, and so on until such a contract can be negotiated at a fair and reasonable price.

Should the Evaluation Committee determine in writing that only one (1) offeror is fully qualified, or that one (1) offeror is clearly more highly qualified and suitable than the others under consideration, a contract may be negotiated and awarded to that Offeror.

The award will be made to the responsible Offeror whose proposal, conforming to the solicitation, is the most advantageous and represents the best value to the Town of Vienna, costs and other factors considered.

The Town, as a municipal corporation of the Commonwealth of Virginia, is obligated and bound by the terms of this Agreement only to the extent that funds are lawfully appropriated therefore and are allocated and available to pay its obligations hereunder. In the event that and at such time as funds have not been appropriated or are not allocated and available to pay the Town's obligations under this Agreement, then the Town shall not be liable for any obligation to pay for the services referred to in this Agreement.

It is expressly agreed and understood that the selected firm is in all respects an independent Contractor as to work and is in no respect any agent, servant, or employee of the Town. The contract specifies the work to be done by the firm, but the method to be employed to accomplish the work shall be the responsibility of the firm.

SECTION 7. CONTRACT TERM

The term of this contract shall be from the date of award until completion of construction phase services, which will be bid out separately, and termination of all related permits.

SECTION 8. SPECIAL TERMS AND CONDITIONS

Precedence of Terms: In the event that there is a conflict between the General Terms and Conditions and any Special Terms and Conditions used in this section, the Special Terms and Conditions shall apply.

A. Mandatory Use of Town Forms and Terms and Conditions: Failure to submit a proposal accompanied by the signed and dated Cover Sheet provided shall be a cause for rejection of the proposal. Return of the complete document is required. Modification of or additions to any portion of the solicitation may be cause for rejection of the proposal; however, the Town of Vienna reserves the right to decide, on a case-by-case basis, in its sole discretion, whether or not such a proposal should be considered as non-responsive.

Offerors are reminded that changes to the RFP, in the form of addenda, are often issued between the issue date and within three business (3) days before the closing of the RFP. Offerors are solely

responsible for checking the Town website to ensure that they have the most current information regarding the RFP.

All addenda must be signed and submitted with your bid.

B. Ownership of Material: Ownership of all data, materials and documentation originated and prepared for the Town of Vienna pursuant to the RFP shall belong exclusively to the Town and be subject to public inspection in accordance with the Virginia Freedom of Information Act. Trade secrets and proprietary information submitted by an offeror shall not be subject to public disclosure under the Virginia Freedom of Information Act; however, the offeror must invoke the protections of this section prior to or upon submission of the data or other materials, and must identify the data or other materials to be protected and state the reasons why protection is necessary.

C. Default: In case of failure to deliver services in accordance with the contract terms and conditions, the Town of Vienna, after due oral or written notice, may procure them from other sources and hold the Consultant responsible for any resulting additional purchase and administrative costs. This remedy shall be in addition to any other remedies which the Town of Vienna may have.

D. Obligation of Offeror: By submitting a proposal, the offeror covenants and agrees that he has satisfied himself, from his own investigation of the conditions to be met, that he fully understands his obligation and that he will not make any claim for, or have right to cancellation or relief from the contract because of any misunderstanding or lack of information.

E. Withdrawal/Modification of Proposals: Proposals may be withdrawn or modified by written notice received from Offerors prior to the time fixed for proposal receipt.

F. Receipt and Opening of Proposals: In the case of proposals received in response to a Request for Proposals, public openings are not required; however, if a public opening is held, only the names of the Offerors are read aloud.

G. Qualifications of Offerors: The Town of Vienna may make such reasonable investigations as deemed proper and necessary to determine the ability of the offeror to perform the work, and the offeror shall furnish to the Town of Vienna all such information and data for this purpose as may be requested. The Town of Vienna reserves the right to inspect the Offeror's physical facilities prior to award to satisfy questions regarding the Offeror's capabilities. The Town of Vienna further reserves the right to reject any proposal if the evidence submitted by, or investigations of, such offeror fails to satisfy the Town that such offeror is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein.

H. Debarment Status: By submitting their proposals, all Offerors certify that they are not currently debarred from submitting proposals on contracts by any agency of the Commonwealth of Virginia, nor are they an agent of any person or entity that is currently debarred from submitting proposals on contracts by any agency of the Commonwealth of Virginia.

I. Cancellation of Contract: The Town of Vienna reserves the right to cancel and terminate any resulting contract, in part or in whole, without penalty upon ten (10) days written notice to the consultant. Any contract cancellation notice shall not relieve the consultant of the obligation to deliver and/or perform on all outstanding orders issued prior to the effective date of cancellation.

J. Rights of the Town of Vienna: The Town of Vienna further reserves the right to request information relative to experience, reference and/or financial status of a firm.

K. Conflict of Interest: The Offeror certifies that to the best of its knowledge no employee of the Owner nor any member thereof, nor any public agency or official affected by the proposal, has a pecuniary interest in the business of the Offeror, and that no person associated with the Offeror has any interest that

would conflict in any manner with the performance of the proposal.

L. Insurance: By signing and submitting a proposal under this solicitation, the Offeror certifies that if awarded the contract, it will have the insurance coverage specified on the Insurance Checklist within ten (10) days of notification of award. Additionally, the Offeror certifies that it will maintain all required insurance coverage during the entire term of the contract and that all insurance coverage will be provided by insurance companies authorized to sell insurance in Virginia by the Virginia State Corporation Commission.

During the period of the contract the Owner reserves the right to require the Firm to furnish the certificates of insurance for coverage required to the Procurement Division.

Insurance Coverages and Limits Required:

a. Worker's Compensation - Statutory requirements and benefits.

b. Employers Liability - $100,000.00

c. General Liability - $500,000.00 combined single limit. The Town of Vienna is to be named as an additional insured with respect to the services being procured. This coverage is to include Premises/Operations Liability, Products and Completed Operations Coverage, Independent Contractor's Liability, Owner's and Contractor's Protective Liability and Personal Injury Liability.

d. Automobile Liability - $500,000.00

e. Professional Liability/Errors and Omissions Coverage - Proof of professional liability coverage must accompany the Consultant's written proposal.

Additionally, it will maintain these during the entire term of the contract and that all insurance coverages will be provided by insurance companies authorized to sell insurance in Virginia by the Virginia State Corporation Commission.

During the period of the contract, the Town reserves the right to require the consultant to furnish certificates of insurance for the coverage required.

The Town of Vienna, Virginia is to be named as an additional insured and this is to be so noted on Certificate of Insurance. The policy shall be delivered to the Town of Vienna PRIOR to the commencement of any work.

A thirty (30) day written notice of cancellation or non-renewal shall be furnished by certified mail to the purchasing office at the address indicated on the solicitation.

M. Ownership of documents: Any reports, studies, photographs, negatives or other documents prepared by the Offeror in the performance of its obligations under this contract shall be the exclusive property of the Owner, and all such materials shall be remitted, without restriction, to the Owner by the Offeror upon completion, termination or cancellation of the contract. Offeror shall not use, willingly allow, or cause to have such materials used for any purpose other than performance of the Offeror’s obligations under this contract without the prior written consent of the Owner.

SECTION 9. GENERAL TERMS AND CONDITIONS

VENDOR: THE GENERAL TERMS AND CONDITIONS WHICH FOLLOW APPLY TO ALL PURCHASES AND BECOME A DEFINITE PART OF EACH FORMAL INVITATION FOR BID, REQUEST FOR PROPOSALS, PURCHASE ORDER AND/OR OTHER AWARD ISSUED BY THE TOWN OF VIENNA, VIRGINIA, UNLESS OTHERWISE SPECIFIED IN THE SOLICITATION DOCUMENTS. BIDDERS/OFFERORS OR THEIR AUTHORIZED REPRESENTATIVES ARE EXPECTED TO FULLY INFORM THEMSELVES AS TO THE CONDITIONS, REQUIREMENTS, AND SPECIFICATIONS BEFORE SUBMITTING BIDS/PROPOSALS; FAILURE TO DO SO WILL BE AT THE BIDDERS'/OFFERORS' OWN RISK AND HE CANNOT SECURE RELIEF ON THE PLEA OF ERROR.

SUBJECT TO STATE, COUNTY AND LOCAL LAWS AND ALL RULES, REGULATIONS AND LIMITATIONS IMPOSED BY LEGISLATION OF THE FEDERAL GOVERNMENT, BIDS/PROPOSALS ON ALL SOLICITATIONS ISSUED BY THE PURCHASING OFFICE WILL BIND BIDDERS/OFFERORS TO APPLICABLE CONDITIONS AND REQUIREMENTS HEREIN SET FORTH UNLESS OTHERWISE SPECIFIED IN THE SOLICITATION.

1. **CLARIFICATION OF TERMS:** If any prospective bidder/offeror has questions about the specifications or other solicitation documents, the prospective bidder/offeror should contact the Purchasing Agent or the person whose name appears on the face of solicitation NO LATER THAN SEVEN (7) WORKING DAYS BEFORE opening/closing date. Any revisions to the solicitation will be made only by addendum issued by the Purchasing Agent.

2. **PREPARATION & SUBMISSION:** In order to be considered for selection, the bidder/offeror must submit a complete response to the Invitation For Bid/Request For Proposals. One (1) original and one (1) copy of each bid/proposal must be submitted on the Town of Vienna Bid/Proposal Forms provided. The bid/proposal shall be signed by an authorized representative of the bidders'/offerors' firm and delivered to the proper location by the time and date specified on the cover page.

3 **ENVELOPE IDENTIFICATION:** The signed bids must be returned in a sealed envelope and identified as follows: "SEALED BID", show the IFB number, IFB subject, opening time, opening date, and bidder's name and address. In the case of proposals, the signed proposal cover page and proposal must be returned in a sealed envelope, marked clearly on the outside "SEALED COMPETITIVE NEGOTIATION", show the RFP number, RFP subject, closing time, closing date, and offeror's name and address.

   If a bid/proposal is mailed in an envelope, not identified as specified, the bidder/offeror takes the risk that the envelope may be inadvertently opened and the information compromised which may cause the bid/proposal to be disqualified. The Town reserves the right to declare such a bid/proposal as non-responsive. Bids/proposals may be hand delivered to the designated location.

4. **LATE BIDS/PROPOSALS:** LATE bids/proposals will be returned to bidder/offeror UNOPENED, if the IFB/RFP number and return address is shown on the envelope.

5. **QUOTATIONS TO BE F.O.B. DESTINATION:** Quote F.O.B. DESTINATION for all competitive sealed bids. If otherwise, show exact cost to deliver.

6. **PRICING ERRORS:** In case of an error in price extension, the firm fixed unit price shall govern.

7. **BID/PROPOSAL ACCEPTANCE PERIOD:** Bids shall be binding upon the bidder for sixty (60) days following the bid opening date. Proposals shall be binding upon the offeror for ninety (90) days following the proposal due date. Any bid/proposal on which the bidder/offeror shortens the acceptance period may be rejected.

8. **CORRECTION OR WITHDRAWAL OF BIDS AND CANCELLATION OF AWARDS UNDER COMPETITIVE SEALED BIDDING:** Correction or withdrawal of inadvertently erroneous bids before or after award, or cancellation of awards or contracts based on such bid mistakes, shall be permitted. After bid opening, no changes in bid prices or other provisions of bids prejudicial to the interest of the Town or fair competition shall be permitted. Except as otherwise provided by regulation, all decisions to permit the correction or withdrawal of bids, or to cancel awards or contracts based on bid mistakes, shall be supported by a written determination made by the Purchasing Agent. No bid may be withdrawn when the result would be to award the contract on another bid of the same bidder or of another bidder in which the ownership of the withdrawing bidder is more than five percent (5%). If a bid is withdrawn, the lowest remaining bid shall be deemed to be the low bid. If the Purchasing Agent, the Using Department, or a designee of such, denies the withdrawal of a bid, he shall notify the bidder in writing stating his decision.

9. **TAX EXEMPTION:** The Town of Vienna is exempt from State Sales Tax and Federal Excise Tax. The Town's Federal Tax ID Number is 54-6001654. DO NOT INCLUDE TAX IN BID. Tax Exemption Certificate furnished by the Town of Vienna on request.

10. **USE OF BRAND NAME OR EQUAL:** Unless otherwise provided in the solicitation, the name of a certain brand, make or manufacturer does not restrict bidders/offerors to the specific brand, make or manufacturer named, but conveys the general style, type, character, and quality of the article desired. Any article which the Town of Vienna, in its sole discretion, determines to be equal to that specified, considering quality, workmanship, economy of operation, and suitability for the purpose intended, shall be accepted. The bidder/offeror is responsible to clearly and specifically indicate the product being offered and to provide sufficient descriptive literature, catalogs and technical details to enable the Town of Vienna to determine if the product offered meets the requirements of the solicitation. This is required even if offering the exact brand, make or manufacturer specified. Normally in competitive sealed bidding only the information furnished with the bid will be considered in the evaluation. Failure to furnish adequate data for evaluation purposes may result in declaring a bid non-responsive. Unless the bidder/offeror clearly indicates in its bid/proposal that the product offered is an "EQUAL" product, such bid/proposal will be considered to offer the brand name product referenced in the solicitation.

11. **SAMPLES:** Samples, if required, must be furnished free of expense to the Town of Vienna on or before date specified; if not destroyed in examination, they will be returned to bidder, if requested, at his expense. Each sample must be marked with the bidder's name and address, Town's request number and opening date. DO NOT ENCLOSE IN OR ATTACH BID TO SAMPLE.

12. **DELIVERY:** Bids must show number of days required to place material in using agency's receiving area under normal conditions. Proposal must show the number of days required to provide the services/reports as specified.

    Failure to state delivery time obligates bidder/offeror to complete delivery in fourteen (14) calendar days or as specified. A five (5) day difference in delivery promise may break a tie bid. An unrealistically short or long delivery promise may cause a bid/offer to be disregarded. Consistent failure to meet delivery

promise without valid reason may cause removal from bid list. Delivery shall be made during normal working hours, 8:00 am to 4:30 pm Monday through Friday, unless prior approval for another time period has been obtained from Consignee.

13. **DEFAULT:** In case of failure to deliver goods/services in accordance with the contractual terms and conditions, the Town of Vienna, Virginia, after due oral or written notice, may procure them from other sources and hold the defaulting Contractor responsible for any resulting additional purchase and administrative costs. This remedy shall be in addition to any other remedies which the Town of Vienna may have.

14. **CONDITION OF ITEMS:** All items bid/proposed shall be new and in first class condition, including containers suitable for shipments and storage, unless otherwise indicated in bid invitation/proposal request. Verbal agreements to the contrary will not be recognized.

15. **SUBSTITUTIONS:** No substitutions or cancellations permitted without prior written approval by the Purchasing Agent.

16. **RIGHTS OF THE TOWN OF VIENNA:** The Town reserves the right to accept or reject all or any part of bids/proposals, waive minor technicalities/informalities and award the contract to the lowest responsive and responsible bidder or most qualified and best suited offeror to best serve the interest of the Town.

17. **ANTI-TRUST:** By entering into a contract, the bidder/offeror conveys, sells, assigns, and transfers to the Town of Vienna all rights, title and interest in and to all causes of the action it may now have or hereafter acquire under the antitrust laws of the United States and the Commonwealth of Virginia, relating to the particular goods or services purchased or acquired by the Town of Vienna under said contract. Consistent and continued tie bidding could cause rejection of bids by the Purchasing Agent and/or investigation for Anti-Trust violations.

18. **INDEMNIFICATION:** The Contractor agrees to indemnify, defend and hold harmless the Town of Vienna, Virginia, its officers, agents, and employees from any claim, damages and actions of any kind or nature, whether at law or in equity, arising from or caused by the use of any materials, goods, or equipment of any kind or nature furnished by the contractor or any services of any kind or nature furnished by the contractor, provided that such liability is not attributable to the sole negligence of the using department or to failure of the using department to use the materials, goods or equipment in the manner already and permanently described by the contractor on the materials, goods or equipment delivered. The vendor agrees to protect the Town from claims involving infringement of patent or copyrights.

19. **TIE BIDS:** If there is a tie for low bid and all other considerations are equal, and if the public interest will not permit the delay of re-advertising for bids, the award shall be determined by drawing lots in public.

20. **PROHIBITION AS SUBCONTRACTORS UNDER COMPETITIVE SEALED BIDDING:** No bidder who is permitted to withdraw a bid shall, for compensation, supply any material or labor to or perform any subcontract or other work agreement for the person or firm to whom the contract is awarded or otherwise benefit, directly or indirectly, from the performance of the project for which the withdrawn bid was submitted.

21. **ASSIGNMENT OF CONTRACT:** A contract shall not be assignable by the Contractor, in whole or in part, without the prior written consent of the Town of Vienna, Virginia.

22. **CONTRACT DOCUMENTS:** The contract entered into by the parties shall consist of the Invitation For Bid/Request For Proposal, the signed bid/proposal submitted by the Contractor, the Town of Vienna's standard Purchase Order, the Mandatory/Special Specifications, Terms and Conditions, and the General Terms and Conditions, all of which shall be referred to collectively as the Contract Documents.

    If the contractor has a standard contract form, this form shall be submitted with the bid/proposal submittal for the Town's review of its terms and conditions.

23. **LICENSE REQUIREMENT:** All firms doing business in the Town of Vienna are required to be organized or authorized to transact business in the Commonwealth of Virginia or include in its bid or proposal a statement describing why the bidder or offeror is not required to be so authorized. Additionally all firms doing business in the Town of Vienna are required to be licensed in accordance with the Town's "Business, Professional and Occupational Licensing (BPOL) Tax" Ordinance. Wholesale and retail merchants without a business location in the Town are exempt from this requirement. Questions concerning the BPOL Tax should be directed to the Finance Department, Business License Office, Telephone number (703) 255-6321. The BPOL License number must be indicated on the submitted bid form.

24. **AWARD:** The contract shall be awarded to the lowest responsive and responsible bidder or the most qualified and best suited offeror.

    The Town Council will award all contracts in the amount of twenty thousand dollars ($20,000.00) or more.

    The Purchasing Agent will award all contracts less than twenty-thousand dollars ($20,000.00).

    The Purchasing Agent shall sign all contract documents, with the exception of "Construction" contracts, and issue a purchase order to the successful bidder/offeror.

25. **METHOD OF PAYMENT:** Upon satisfactory delivery of the merchandise and/or satisfactory completion of the services, all invoices and statements shall reference the purchase order number and be submitted to:

    Town of Vienna
    ATTN: ACCOUNTS PAYABLE
    127 Center St., S.
    Vienna, VA 22180.

    The prices and payments shall be full compensation for the labor, tools, equipment, transportation and all other incidentals necessary to complete the specified terms and conditions.

26. **ANTI-DISCRIMINATION:** By submitting their bids/proposals all bidders/offerors certify to the Town of Vienna that they will conform to the provisions of the Federal Civil Rights Act of 1964, as amended, where applicable, and Section 2.2-4311 of the Virginia Public Procurement Act which provides:

In every contract over $10,000.00 the provisions in A and B below apply:

a. During the performance of this contract, the contractor agrees as follows:

The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin except where religion, sex or national origin is a bona fide occupational qualification reasonably necessary to the normal operation of the contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such Contractor, is an equal opportunity employer.

Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

b. The Contractor will include the provisions of the foregoing paragraphs in every subcontract or purchase order of over $10,000.00, so that the provisions will be binding upon each subcontractor or vendor.

27. **ETHICS IN PUBLIC CONTRACTING:** The provisions contained in Sections 2.2-4367 through 2.2-4377 of the Virginia Public Procurement Act as set forth in the Code of Virginia (1950), as amended, shall be applicable to all contracts solicited or entered into by the Town of Vienna. A copy of these provisions may be obtained from the Purchasing Agent upon written request.

    By submitting their bids/proposals, all bidders/offerors certify that their bids/proposals are made without collusion or fraud and that they have not offered or received any kickbacks or inducements from any other bidder/offeror, supplier, manufacturer or subcontractor in connection with their bid/proposal, and that they have not conferred on any public employee having official responsibility for this procurement transaction any payment, loan, subscription, advance, deposit of money, services or anything of more than nominal value, present or promised unless consideration of substantially equal or greater value was exchanged.

28. **CRIMINAL SANCTIONS:** The provisions referenced in Item 27 supplement, but do not supersede, other provisions of law including, but not limited to, the State and Local Government Conflict of Interests Act (§§ 2.2-3100 et seq.), the Virginia Governmental Frauds Act (§§ 18.2-498.1 et seq.), and Articles 2 (§§ 18.2-438 et seq.) and 3 (§§ 18.2-446 et seq.) of Chapter 10 of Title 18.2. The provisions apply notwithstanding the fact that the conduct described may not constitute a violation of the State and Local Government Conflict of Interests Act.

29. **APPLICABLE LAW AND COURTS:** Any contract resulting from this solicitation shall be governed in all respects by the laws of the Commonwealth of Virginia and any litigation with respect thereto shall be brought in the courts of the Commonwealth. The Contractor shall comply with applicable federal, state and local laws and regulations.

30. **LABELING OF HAZARDOUS SUBSTANCES:** If the items or products requested by this solicitation are "Hazardous Substances" as defined by 10.1-1400 of the Code of Virginia (1950), as amended, 42 U.S.C. § 11001 et seq., or 42 U.S.C. § 9601 et seq., then the bidder/offeror, by submitting his bid/proposal, certifies and warrants that the items or products to be delivered under this contract shall be properly labeled as required by the foregoing sections and that by delivering the items or products that the bidder/offer does not violate any of the prohibitions of Sec. 10.1-1400 et seq., or the Code of Virginia or Title 15 U.S.C. Sec. 1263.

31. **MATERIAL SAFETY DATA SHEETS:** Material Safety Data Sheets (MSDS) and descriptive literature shall be provided with the bid/proposal or delivered materials for each chemical and/or compound offered. Failure of the bidder/offeror to submit such data sheets may be cause for declaring the bid/proposal as non-responsive.

32. **DEBARMENT STATUS:** By submitting their bids, Bidders certify that they are not currently debarred by the Commonwealth of Virginia or any Political Subdivision from submitting bids on contracts for the type of services covered by this solicitation, nor are they an agent of any person or entity that is currently so debarred.

33. **COOPERATIVE PROCUREMENT:** As authorized in Section 2.2-4304 of the Code of Virginia this procurement is being conducted on behalf of and may be used by public bodies, agencies, institutions and localities of the several states, territories of the United States, and the District of Columbia with the consent of the Contractor.

PROPRIETARY INFORMATION:

Ownership of all data, materials, and documentation originated and prepared for the Owner pursuant to the REQUEST FOR PROPOSAL shall belong exclusively to the Owner and be subject to public inspection in acc ordnance with the Virginia Freedom of Information Act. Trade secrets or proprietary information submitted by an Offeror shall not be subject to public disclosure under the Virginia Freedom of Information Act, however, the Offeror must invoke the protections of Section 2.2-4342F of the Code of Virginia, in writing, either before or at the time the data or other material is submitted. The written notice must specifically identify the data or materials to be protected and state the reasons why protection is necessary. The proprietary or trade secret material submitted must be identified by some distinct method such as highlighting or underlining and must indicate only the specific words, figures, or paragraphs that constitute trade secret or proprietary information.

NOTICE OF PROPRIETARY INFORMATION

Section Title	Page Number	Reason(s) for Withholding from Disclosure

Confidentiality References Protection in Accordance with the Code of Virginia, Section 2.2-4342F

NOTICE OF PROPRIETARY INFORMATION (CONTINUED):

INSTRUCTIONS: Identify the data or other materials to be protected and state the reasons by using the codes listed below. Indicate die specific words, figures, or paragraphs that constitute trade secrets or proprietary materials.

A- This page contains information relating to "trade secrets', and "proprietary information" including processes. Operations, style of work, or apparatus, identify confidential statistical data, amount or source of any income... of any person (or) partnership. "See Virginia Public Procurement Act. Section 2.2-4342F. Unauthorized disclosure of such information would violate the Trade Secrets Act 18 U.S.C. 1905.

B- This page contains proprietary information including confidential, commercial or financial information which was provided to the Government on a voluntary basis and is of the type that would not customarily be released to the public. See Virginia Public Procurement Act, Section 2.2-4342F; 5 U.S.C. 552 (b)(4); 12 C.F.R. 309.5(c)(4).

C- This page contains proprietary information including confidential, commercial or financial information. This disclosure of such information would cause substantial harm to competitive position and impair the Government's ability to obtain necessary information from contractors in die future. 5 U.S.C. See Virginia Public Procurement Act. Section 2.2-4342F; 552 (b)(4); 12 C. F. R 309.5(c)(4).

Return this page

EXCEPTIONS TO RFP

Name of Offeror: _____

RFP Title: _____

Please list any deviations to RFP specifications below:

Section Title	**Page Number**	Explanation of exception and any proposed language

Return this Page

PROOF OF AUTHORITY TO TRANSACT BUSINESS IN VIRGINIA

THIS FORM MUST BE SUBMITTED WITH YOUR PROPOSAL/BID. FAILURE TO INCLUDE THIS FORM MAY RESULT IN REJECTION OF YOUR PROPOSAL/BID

Pursuant to Virginia Code §2.2-4311.2, an Offeror/Bidder organized or authorized to transact business in the Commonwealth pursuant to Title 13.1 or Title 50 of the Code of Virginia shall include in its proposal/bid the identification number issued to it by the State Corporation Commission ("SCC"). Any Offeror/Bidder that is not required to be authorized to transact business in the Commonwealth as a foreign business entity under Title 13.1 or Title 50 of the Code of Virginia or as otherwise required by law shall include in its proposal/bid a statement describing why the Offeror/Bidder is not required to be so authorized. Any Offeror/Bidder described herein that fails to provide the required information shall not receive an award unless a waiver of this requirement and the administrative policies and procedures established to implement this section is granted by the County Administrator or School Superintendant, as applicable.

If this quote for goods or services is accepted by the County of Fauquier, Virginia, the undersigned agrees that the requirements of the Code of Virginia Section 2.2-4311.2 have been met.

Please complete the following by checking the appropriate line that applies and providing the requested information.

A._____Offeror/Bidder is a Virginia business entity organized and authorized to transact business in Virginia by the SCC and such vendor's Identification Number issued to it by the SCC is_____.

B._____Offeror/Bidder is an out-of-state (foreign) business entity that is authorized to transact business in Virginia by the SCC and such vendor's Identification Number issued to it by the SCC is _____

C._____Offeror/Bidder does not have an Identification Number issued to it by the SCC and such vendor is not required to be authorized to transact business in Virginia by the SCC for the following reason(s):

Please attach additional sheets if you need to explain why such Offeror/Bidder is not required to be authorized to transact business in Virginia.

_____
Legal Name of Company (as listed on W-9)

_____
Legal Name of Offeror/Bidder

_____
Date

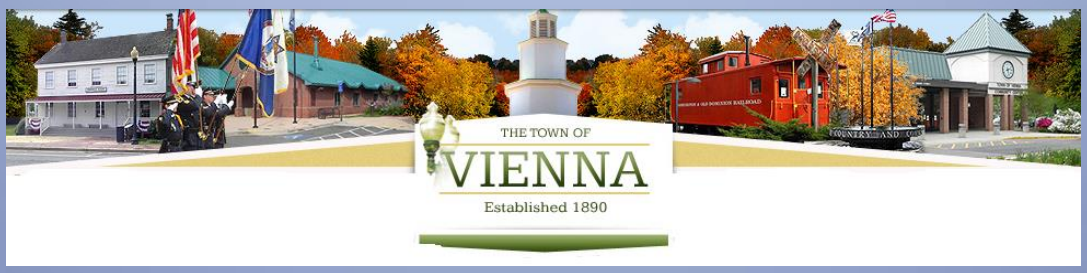
_____
Authorized Signature

_____
Print or Type Name

Return This Page

Figure 1 – Location Map and Extents of Proposed Project

Attachment B



Northside Park Piney Branch /Difficult Run– Stream Restoration Grant Application

Stormwater Local Assistance Fund 2017

Town of Vienna Grant Application for a Stream Restoration Project to the 2017 Stormwater Local Assistance Fund

Contents

A: Background:

The Town of Vienna is located approximately 15 miles west of Washington D.C. and is called home by approximately 16,000 residents. With a geographic area of slightly over 4 square miles the Town is one of a handful of incorporated areas within Fairfax County. The Town was primarily developed during the 1950s and 60s without the environmental benefits of Stormwater Management and Water Quality Treatment. Further subdivision development in the 1980's throughout the Town of Vienna increased impervious areas, enclosed tributaries, straightened streams, removed riparian buffers and steepened stream banks to allow more homes to be built. Recently the Town has experienced a re-development boom leading to a further increase in impervious surfaces and a further burden on the receiving water courses. Predictably the receiving streams and channels have experienced incision, erosion and widening in response to the increase in water quantity as a result of 50 plus years of development. Within Vienna's four plus square miles is the watershed for the Piney Branch section of the Difficult Run watershed and subject of this application.

The portion of Piney Branch impacted by this proposed project is unassessed and categorized as a 3C in the Virginia 2014 Impaired Waters – 303(d) category list; however, other downstream assessed sections are listed as type 5 (the most severe impairments). The proposed restoration section shares many of the same issues of assessed sections. Additionally Piney Branch flows to Difficult Run, the Potomac River, and the Chesapeake Bay which are all under a TDML.

Municipal maintenance funds are only available for occasional dredging of sediment but not for corrective action to prevent the erosion and to naturally stabilize the stream. Stream bank armoring and dredging have been used for years as the standard repair method by Vienna stream maintenance crews. Funding is tight; therefore, problems are not addressed preventatively, but only in reactive mode. This project will show local staff and residents the practical aspects of correcting the problem of stream bank erosion before sediment must be dredged from the stream. As it ages, the stabilization of the problem area will demonstrate how carefully preparing for natural restoration is cheaper in the long run with the elimination of costly dredging. This project will extend closer to the ultimate headwaters and additional action on this stream will help maintain the previously restored downstream section by reducing the sediment load.

In 2013 additional regulation in response to the continuing challenges faced by the Chesapeake Bay went into effect and the Town of Vienna, as a MS4 permitee, will experience additional requirements relating to the water quality in its streams. The town has executed a cooperative agreement with Fairfax County to share responsibility for implementing a joint Chesapeake Bay TDML Action Plan. As a function of these requirements and the cooperative agreement with the Fairfax County the amount of Phosphorus, Nitrogen and Total Suspended Solids will need to be reduced. Vienna, in conjunction with Fairfax County, has a role and responsibility in meeting these requirements. Formal correspondence with Fairfax County has indicated available construction funding for the restoration to constitute the matching funds required for the grant, (Appendix F, Letter from Fairfax County). This application also makes multiple references to Fairfax's Difficult Run Watershed Management Plan. This plan describes the needs and requirements for the future of the watershed, and a path to meeting the requirements of the coming regulations.

B: Environmental Benefit

The primary aim and quantified requirement in meeting the grant application standards is establishing the amount of Total Phosphorus to be removed as a result of the proposed project. This project proposes to stabilize approximately 1,400 feet of stream bank within the borders of the Town of Vienna, see Figure 1. The Piney Branch section proposed for restoration is in the Difficult Run watershed and is located entirely on Town property and is close to the headwater of the stream. The total drainage area for the proposed restoration is 1.1 square miles. A Piney Branch Drainage Area Map is attached in Appendix A.

The erosion of stream banks causes suspended solids, which may be laden with phosphorus, to be suspended in runoff. Additionally, the restoration of stream banks provides a means of pretreatment for runoff and removal of phosphorus prior to reaching the stream. As outlined in the grant application the Protocols defined in the *Recommendations of the Expert Panel to Define Removal Rate for Individual Stream Restoration Projects* (September 2014) were used to determine a total phosphorus reduction of **301.77 lbs TP per year**. The Piney Branch Methodology for Calculating Total Phosphorus Reduction including the Bank Assessment of Non-point source Consequences of Sediment (BANCS) model using Protocol I is attached in Appendix B.

Figure 1 – Location Map and Extents of Proposed Project

C: Statement of Need

Condition of the Stream Sections

The current condition of the stream sections have been evaluated onsite and photographed as shown to the right, additional photographs are included in Appendix E. As shown on the Piney Branch Stream Erosion Evaluation Map included in Appendix C, there are multiple portions of the stream rated extreme for both bank hazard erosion index (BEHI) and near-bank stress risk (NBS). In addition to the site visits and photographs taken, the Fairfax County Watershed Plan for Difficult Run was reviewed for insight into the phosphorus loads arising from the drainage areas. Figure 2 to the right shows the degree of incision and erosion along the banks. While walking the stream several areas of 2 feet to 13 feet high eroded banks are clearly visible. Details for each field investigated bank can be found in Appendix C. In many of these areas existing trees have been undermined and overturned. The condition of the stream appears to be a Type III as described by Figure 3 below and indicated in Figure 4 of the Fairfax Difficult Run Watershed Management Plan Chapter 2 Watershed Condition report.

Figure 2 - BEHI #2 showing 5' - 6' of eroded bank

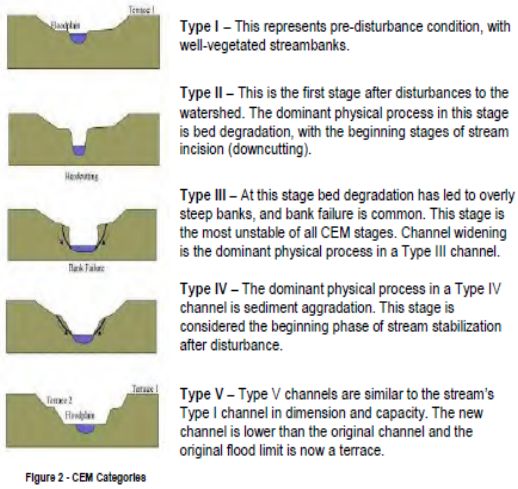


Figure 4 - Stream Condition Types

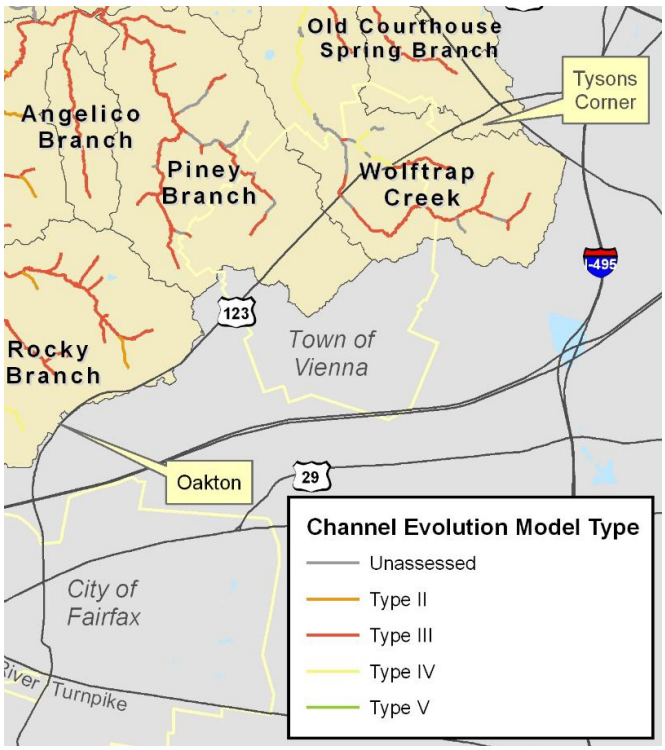


Figure 3 - Difficult Run Channel Evolution Model Map

TP (Total Phosphorus)

In reviewing the Difficult Run Watershed Management Plan, as produced by Fairfax County, several items reference the condition of the streams in the Piney Branch portion of the watershed. From chapter 2 of the report:

> "Table 2.17 shows results of the hydrologic and water quality modeling, normalized by area, so that the sub watersheds and be compared directly. There is a correlation between the amount of development and the hydrologic results. Old courthouse Spring Branch has the highest level of imperviousness and the highest runoff volume. Snakeden branch, Wolftrap Creek, Colvin Run and Piney Branch also show high runoff volume and high levels of imperviousness. The same five sub watersheds also have the highest peak flows.
>
> Old Courthouse Spring Branch also shows up with the highest levels of TSS, TN and TP from runoff. Wolftrap Creek, Colvin Run and Snakenden branch also have high levels of these pollutants."

Table 2.17 Existing Conditions Watershed Model Results

Subwatershed	% Imperviousness	Runoff Volume (in/yr)	Peak (cfs/ac)	TSS (lb/ac/yr)	Runoff TN (lb/ac/yr)	Runoff TP (lb/ac/yr)
Angelico Branch	10.5	2.1	1.6	19.1	1.0	0.2
Captain Hickory Run	11.1	2.1	1.2	24.5	1.2	0.2
Colvin Run	22.8	5.1	2.1	108.6	4.3	0.5
Upper Difficult Run	18.3	3.7	1.8	60.6	2.5	0.3
Middle Difficult Run	14.4	3.3	1.7	41.2	1.9	0.3
Lower Difficult Run	9.3	1.9	1.4	17.5	0.9	0.2
Dog Run	15.7	3.0	1.5	35.7	1.8	0.3
The Glade	16.1	3.3	1.6	45.5	2.3	0.4
Little Difficult Run	10.5	2.0	1.4	20.2	1.1	0.2
Old Courthouse	42.7	9.3	2.7	192.9	7.7	0.9
Piney Branch	22.8	4.6	2.1	73.7	3.6	0.6
Piney Run	16.3	3.2	1.6	48.8	2.1	0.3
Rocky Branch	17.4	3.4	1.6	47.9	2.3	0.4
Rocky Run	19.9	4.0	1.9	64.5	2.9	0.4
Snakeden Branch	27	6.1	2.1	126.5	5.0	0.7
South Fork Run	12.3	2.1	1.3	23.4	1.3	0.2
Sharpers Run	9.3	1.7	1.2	21.3	1.2	0.2
Wolftrap Creek	23.1	5.1	2.3	80.8	3.7	0.6

Figure 5 - Difficult Run Sub Watershed Modeling Results

As seen above in the table the Phosphorus load in the Piney Branch watershed is considered high. This high rating for phosphorus further supports the need for stream mitigation.

The field investigated stream condition and completed BANCS model indicates a significant need for restoration and stabilization. In conjunction with the watershed's plan finding that Piney Branch is inundated with high levels of total phosphorus and the significant drainage area for this restoration present a prime opportunity to achieve the Total Phosphorus reduction goal of the SLAF grant.

Stream Restoration Description

The goal of stream restoration is to return the stream to a stable state in which it; neither significantly erodes or fills with sediment, is connected to its floodplain and has an improved habitat condition. In doing so a connection to the floodplain is created, reducing total phosphorus discharge, as well as preventing further erosion and bound total phosphorus discharge to the stream.

For incised urban channels, such as this one, there are several options available depending on the severity of the section and the extent of adjacent land. The most extensive restoration portions may move the stream itself, creating a new channel on a new alignment at the original floodplain elevation. Other sections could involve adjusting the cross-section, reducing bank slopes, or creating a new floodplain bench within an over-widened channel. For portions with restricted availability of adjacent land where there is no room to increase meander width, the restoration design will use grade controls to flatten the slope of the stream and dissipate stream energy. In the small sections where it is infeasible to recreate a natural channel less extensive restoration approaches will be undertaken. Such measures include armoring stream banks with rock or bioengineering materials to prevent further erosion and grading to lay back over-steepened banks to create a more stable cross-section.

Maintenance

Provisions for the long-term maintenance responsibility of the restored stream, including an inspection and maintenance schedule, will be included in the project. Project documents will indicate the specific maintenance requirements for the project as well as the duration and ongoing requirements and responsibilities.

The project falls within public land owned by the Town.

D: Grant Application Summary

I. POLLUTION REDUCTION

"Points will be based on the calculated reduction of total phosphorus (TP) as a result of the proposed project. TP is the representative pollutant for stormwater in the Commonwealth and serves as a surrogate for other pollutants of concern. The established methodology for calculating the TP reduction for stormwater management projects is outlined in Attachment A. For the purchase of non-point source nutrient credits, the number of pounds of TP proposed for purchase will be the pollutant reduction amount."

The project proposes a total of 1,400 linear feet of stream restoration with a total of **301.77 lbs of removed Phosphorus**. Piney Branch methodology for calculating total phosphorus reduction per Protocol 1 of The *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects* (September 2014) is attached in Appendix B.

II. COST EFFECTIVENESS

"Points will be based on the projected cost of the project divided by the calculated amount of TP reduction or the proposed pounds of TP to be purchased for non-point source nutrient credits."

Project Cost as included on the Grant Application	=	$**1,320,000**
Total Phosphorus Removed	=	**301.77 lbs**
Cost Effectiveness Ratio	**=**	**$4,374/lb**

III. IMPAIRED WATER BODIES

"Points will be based on the location and impact of the proposed project in relation to priority water bodies in the state. . Note: These categories (a – b) are additive.

a. Project is directly related to the requirements of the Chesapeake Bay TMDL 60 pts.

b. Project is directly related to requirements of a local impaired stream TMDL 40 pts.

or

Project is directly related to a local impaired stream without a TMDL 20 pts."

The project is not directly in a TDML plan, the project does however flow to Difficult Run, which has some TDMLs, and then flows onto the Potomac and the Chesapeake Bay both of which have TDMLs.

IV. FISCAL STRESS

"50 of the points for county and city applicants will be based on the latest available Commission on Local Government composite fiscal stress index. Town applicants will be assigned the points of the surrounding county. Any applicant with a project serving more than one jurisdiction (such as public service authorities or towns located in two counties) will be assigned a weighted average from the component scores. An additional 25 points will be awarded to applicants that have established a dedicated local funding/revenue mechanism for stormwater capital projects "

The Town of Vienna has a dedicated local funding/revenue mechanism. The Stormwater Tax is collected via Fairfax County and portions thereof are then passed onto Vienna for use in implementing The Town of Vienna's responsibilities.

V. READINESS TO PROCEED

"Because it is important that grant recipients proceed quickly with their proposed projects, applicants that can proceed immediately with their proposed projects, or demonstrate an advanced state of readiness, will be given the highest points under this category.

Final design plans approved by the locality	*75 pts.*
Design plans submitted and under review by the locality	*70 pts.*
Preliminary / Concept engineering completed	*55 pts.*
Executed engineering contract with approved task order and notice to proceed issued for this project	*40 pts.*
Project included in current year Capital Improvement Plan	*25 pts.*
Project identified in Comprehensive Stormwater Management plan, Watershed Management Plan, or TMDL Action Plan	*15 pts.*

An additional 15 points will be awarded if all funding is in place for the local match and another 10 points will be awarded if land and easements necessary for the project have already been acquired or if land and easement acquisitions are not required."

The proposed project is in the beginning stages of coordination. Fairfax County has committed to providing the local matching funds for this project (see letter of commitment from Fairfax County in Appendix F. The project will be administered by the Town. Upon notice of award of the grant, the Town will immediately acquire a design engineer and begin the project. It can be expected that an engineer could be under contract within three months of the notice a grant award.

No acquisition of property is required for this project. The land for the project is already owned by the Town of Vienna.

VI. PHASE II (SMALL) MS4

"Applicants that are regulated under the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems will receive 25 points."

The Town of Vienna is regulated under a General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer systems.

E: Closing

In closing the Town of Vienna appreciates the opportunity to apply for grant match funds for a critical and sorely needed Stormwater management project that will benefit the State, Fairfax County, the Chesapeake Bay, and the Town while meeting our MS4 responsibilities.

Appendix A –Piney Branch Drainage Area Map

Total Drainage Area of Piney Branch at Vienna Northside Property Yard: 1.1 Square Miles

Vienna Northside Property Yard

Piney Branch

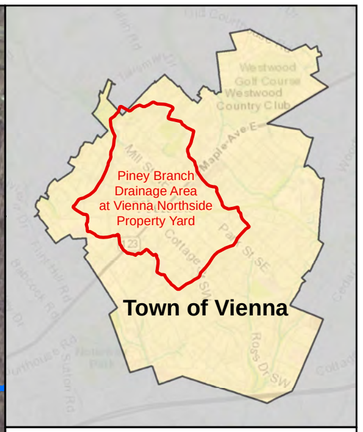
Park St

Mill St

Maple Ave

Wolftrap Creek

123



Legend

Stream

Piney Branch Drainage Area at Vienna Northside Property Yard

N

0 250 500 1,000

Feet

amec foster wheeler

Piney Branch Drainage Area Vienna Northside Property Yard Vienna, Virginia

Appendix B –Piney Branch Methodology for Calculating Total Phosphorus Reduction

Per the Stormwater Local Assistance Fund program guidelines dated December 2016, the pollutant removal computations provided are based on the guidance in the *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects* (prepared by Chesapeake Stormwater Network and Center for Watershed Protection), accepted by Urban Stormwater Work Group on February 19, 2013.

According to the SLAF guidelines, the Urban Stream Restoration Protocol 1: Credit for Prevented Sediment during Storm Flow are used to compute the credits. This Protocol provides an annual mass nutrient and sediment reduction credit for qualifying stream restoration practices that prevent channel or bank erosion that would otherwise be delivered downstream from an actively enlarging or incising urban stream. The drainage map can be found in Appendix A and computations are provided below.

The process is as follows:

1. Estimate stream sediment erosion rates (from BANCS assessment)
2. Convert erosion rates to phosphorus loadings
3. Estimate reduction efficiency attributed to restoration

The BANCS model was used to predict streambank erosion. The BANCS model evaluates bank characteristics and flow distribution along river reaches and maps Bank Erosion Hazard Index (BEHI) and Near-Bank Stress (NBS) risk ratings commensurate with streambank and channel changes. A field investigation was performed on January 18, 2017 by Amec Foster Wheeler and the Town of Vienna in order to determine the bank locations exhibiting erosion throughout the length of the project reach (approximately 1,400 ft). The BEHI method was used to determine the erosion susceptibility at each bank location, based on parameters such as bank height, root depth, bank angle, surface protection, etc. Since the project reach is out of equilibrium and bankfull identification was difficult, a stable section was used to determine the bankfull depth which trended closely with rural regional curve data. The NBS assessment was based on field observations to determine the associated energy against streambanks. Level I assessment methods were used to estimate the NBS. The results from the BANCS assessment are included in Appendix C.

Based on the expert panel, the nutrient levels in the sediments are to use 1.05 pounds of TP per ton of sediment (Walter et. al, 2007). In order to convert erosion rates from feet per year to tons per year, a soil bulk density needs to be determined. For this project reach, 4 separate bank samples were taken in the field and stored in gallon plastic bags. The average moisture content was determined from laboratory analysis and a composite sample was then mixed and the bulk density was determined to be 108 lb/cf. Bulk density calculations can be found in Appendix D. The same bulk density value was determined by taking 4 separate in situ samples along the stream banks with a probe and averaging the values. The bank

erosion rate curve for Hickey Run (USFWS 2005) was used for determining the amount of sediment eroded from the streambank, see Figure 6. Hickey Run is a tributary stream of the Anacostia River in Washington, D.C. Hickey Run is in a highly urbanized area and its watershed consists of a large amount of impervious surfaces and piped tributaries similar to the Piney Branch watershed.

Total Reduction (TP) based on BANCS Method:

$$Sediment\ Load = \left[\left(10{,}644.60\frac{cf}{yr}\right) \times \left(108\frac{lb}{cf}\right)\right] \div 2{,}000\frac{lb}{ton} = 574.81\frac{tons}{yr}$$

Using conservative 50% reduction efficiency:

$$\boldsymbol{Sediment\ Load} = 50\% \times 574.81\frac{tons}{yr} = \mathbf{287.40}\frac{\boldsymbol{tons}}{\boldsymbol{yr}}$$

$$\boldsymbol{Total\ Phosphorous\ Reduction} = 1.05\frac{lb\ TP}{ton} \times 287.40\frac{ton}{yr} = \mathbf{301.77}\frac{\boldsymbol{lb\ TP}}{\boldsymbol{yr}}$$

Using an estimated design, permitting, and construction cost of $1,320,000:

$$\boldsymbol{Cost\ per\ lb\ of\ TP\ Removal} = \frac{\$1{,}320{,}000}{301.77\ lb\ TP} = \boldsymbol{\$4{,}374.13\ per\ lb\ TP}$$

In summary:

- **Pollutant Reduction = 301.77 lbs TP**
- **Cost Effectiveness = $4,374 / lb TP**

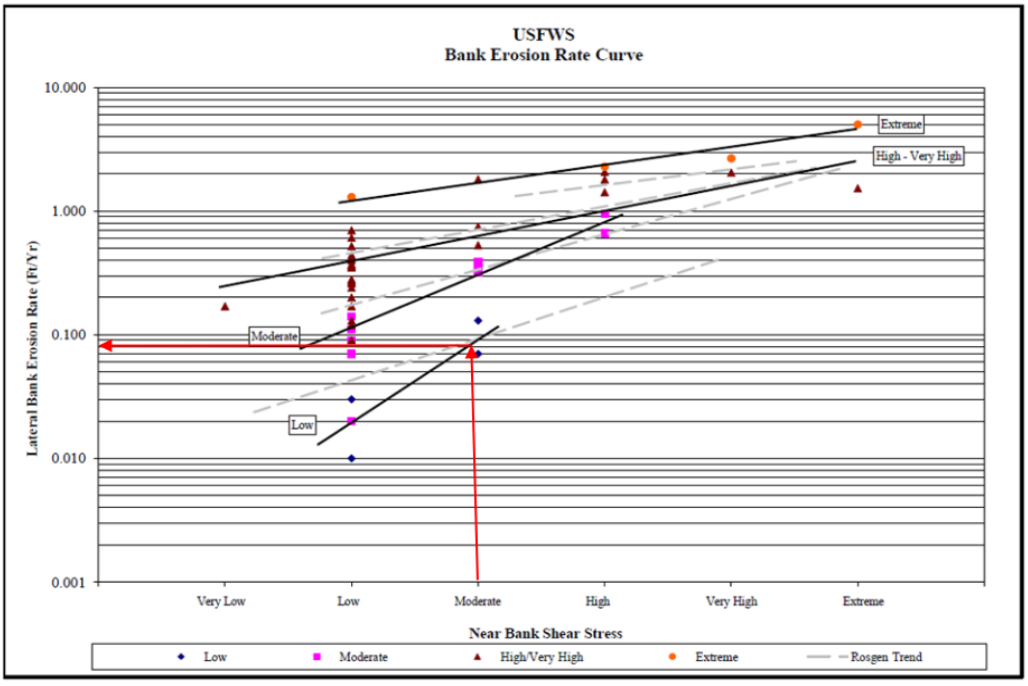


Figure 6 - Bank Erosion Rate Curve Developed by the USFWS

Appendix C – BEHI/ NBS Worksheets and Erosion Evaluation Map

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	**Piney Branch**	Location:	**BEHI #1_L**
Station:	**97 ft (Left Bank)**	Observers:	**Horner/Biggs**
Date:	**1/18/17**	Stream Type: **G4**	Valley Type: **-**

				Study Bank Height / Bankfull Height (C)			**BEHI Score (Fig. 3-7)**
Study Bank Height (ft) =	**5.00 (A)**	**Bankfull Height** (ft) =	**1.00 (B)**	(**A**) / (**B**) =	**5.00 (C)**		**10.0**
				Root Depth / Study Bank Height (E)			
Root Depth (ft) =	**4.00 (D)**	**Study Bank Height** (ft) =	**5.00 (A)**	(**D**) / (**A**) =	**0.80 (E)**		**2.5**
				Weighted Root Density (G)			
		Root Density as **%** =	**40.00 (F)**	(**F**) × (**E**) =	**32 (G)**		**5.5**
				Bank Angle (H)			
				Bank Angle as *Degrees* =	**90 (H)**		**7.5**
				Surface Protection (I)			
				Surface Protection as **%** =	**50% (I)**		**4.0**

Bank Material Adjustment:

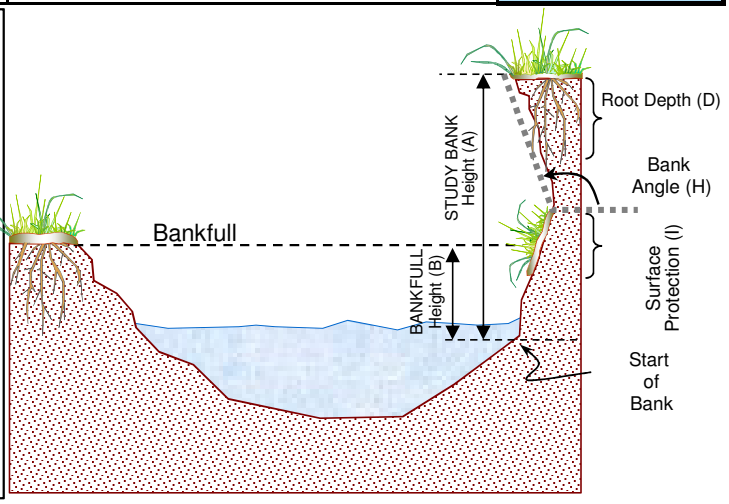
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment **0**

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

0

Very Low	Low	Moderate	High	Very High	Extreme	**Adjective Rating** and **Total Score**	**Moderate** / **29.5**
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Piney Branch** Location: **BEHI #1_L**

Station: **97 ft** Stream Type: **G4** Valley Type: **-**

Observers: **Horner/Biggs** Date: **1/18/17**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1) Transverse and/or central bars-short and/or discontinuous…… ……..NBS = High / Very High
Extensive deposition (continuous, cross-channel)……..…….. ……....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…… ……...NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

Low

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
8	**4**	**2**	

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40
		Overall Near-Bank Stress (NBS) rating				**Low**	

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream: **Piney Branch** Location: **BEHI #1_R**

Station: **44 ft (Right Bank)** Observers: **Horner/Biggs**

Date: **1/18/17** Stream Type: **G4** Valley Type: **-**

Study Bank Height / Bankfull Height (C)						**BEHI Score (Fig. 3-7)**
Study Bank Height (ft) =	**5.00 (A)**	**Bankfull Height** (ft) =	**1.00 (B)**	(A) / (B) =	**5.00 (C)**	**10.0**
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	**4.00 (D)**	**Study Bank Height** (ft) =	**5.00 (A)**	(D) / (A) =	**0.80 (E)**	**2.5**
Weighted Root Density (G)						
		Root Density as % =	**40.00 (F)**	(F) × (E) =	**32 (G)**	**5.5**
Bank Angle (H)						
				Bank Angle as *Degrees* =	**90 (H)**	**7.5**
Surface Protection (I)						
				Surface Protection as % =	**50% (I)**	**4.0**

Bank Material Adjustment:

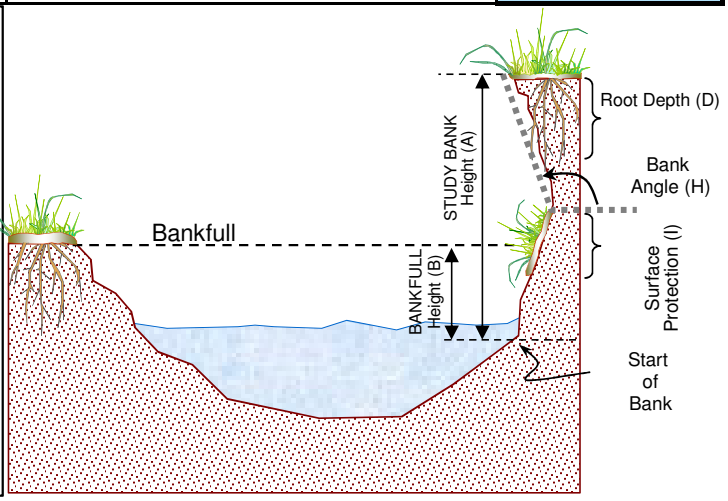
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment **0**

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

0

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Moderate / 29.5
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Piney Branch** Location: **BEHI #1_R**

Station: **44 ft** Stream Type: **G4** Valley Type: **-**

Observers: **Horner/Biggs** Date: **1/18/17**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1) Transverse and/or central bars-short and/or discontinuous…… ……..NBS = High / Very High
Extensive deposition (continuous, cross-channel)……..…….. ……....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…… ……....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

Low

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
8	**4**	**2**	

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40
		Overall Near-Bank Stress (NBS) rating				**Low**	

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream: **Piney Branch** Location: **BEHI #2**

Station: **110 ft (Left Bank)** Observers: **Horner/Biggs**

Date: **1/18/17** Stream Type: **G4** Valley Type: **-**

Study Bank Height / Bankfull Height (C)							**BEHI Score (Fig. 3-7)**
Study Bank Height (ft) =	**6.50 (A)**	**Bankfull Height** (ft) =	**1.00 (B)**	(A) / (B) =	**6.50 (C)**		**10.0**
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	**5.00 (D)**	**Study Bank Height** (ft) =	**6.50 (A)**	(D) / (A) =	**0.77 (E)**		**2.5**
Weighted Root Density (G)							
		Root Density as % =	**30.00 (F)**	(F) × (E) =	**23.0769 (G)**		**6.5**
Bank Angle (H)							
				Bank Angle as *Degrees* =	**90 (H)**		**7.5**
Surface Protection (I)							
				Surface Protection as % =	**50% (I)**		**4.0**

Bank Material Adjustment:

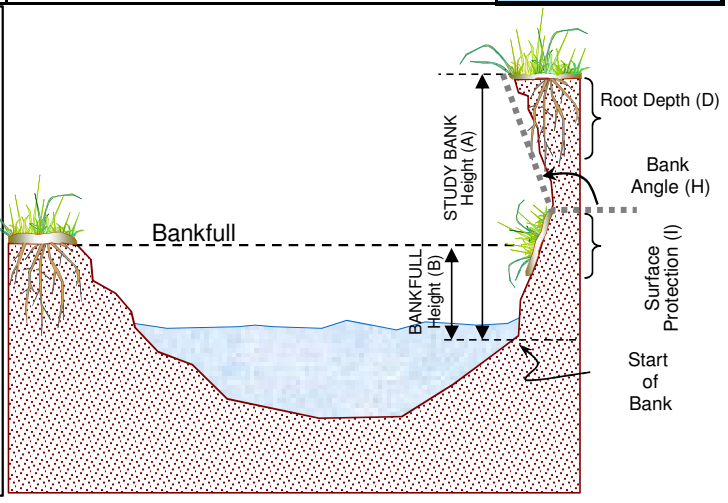
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment **0**

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

0

Very Low	Low	Moderate	High	Very High	Extreme	**Adjective Rating** and **Total Score**	**High** / **30.5**
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Piney Branch** Location: **BEHI #2**

Station: **110 ft (Left Bank)** Stream Type: **G4** Valley Type: **-**

Observers: **Horner/Biggs** Date: **1/18/17**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)

Transverse and/or central bars-short and/or discontinuous…… ……..NBS = High / Very High

Extensive deposition (continuous, cross-channel)……..…….. ……....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…… ……..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

Extreme

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
8	**4**	**2**	

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40
		Overall Near-Bank Stress (NBS) rating				**Extreme**	

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream: **Piney Branch** Location: **BEHI #3**

Station: **50 ft (Right Bank)** Observers: **Horner/Biggs**

Date: **1/18/17** Stream Type: **G4** Valley Type: **-**

Study Bank Height / Bankfull Height (C)							**BEHI Score (Fig. 3-7)**
Study Bank Height (ft) =	**3.00 (A)**	**Bankfull Height** (ft) =	**1.00 (B)**	(A) / (B) =	**3.00 (C)**		**9.5**
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	**1.00 (D)**	**Study Bank Height** (ft) =	**3.00 (A)**	(D) / (A) =	**0.33 (E)**		**5.1**
Weighted Root Density (G)							
		Root Density as % =	**5.00 (F)**	(F) × (E) =	**1.66667 (G)**		**9.5**
Bank Angle (H)							
				Bank Angle as *Degrees* =	**130 (H)**		**10.0**
Surface Protection (I)							
				Surface Protection as % =	**5% (I)**		**10.0**

Bank Material Adjustment:

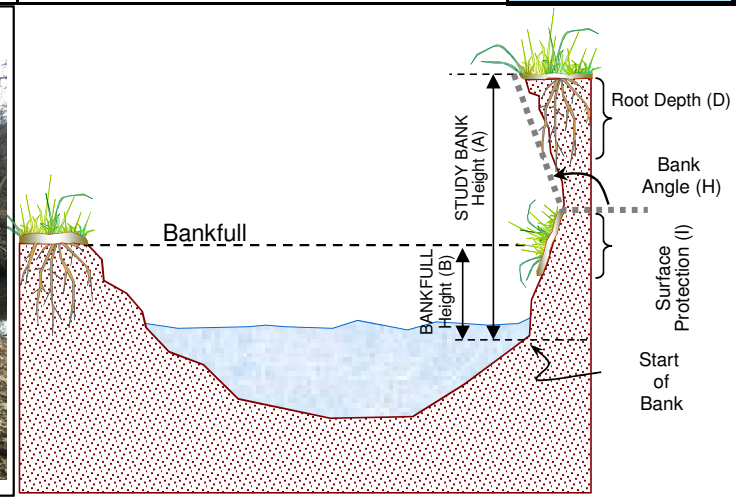
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment **0**

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

0

Very Low	Low	Moderate	High	Very High	Extreme		
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	**Adjective Rating and Total Score**	**Very High** **44.1**



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Piney Branch** Location: **BEHI #3**

Station: **50 ft (Right Bank)** Stream Type: **G4** Valley Type: **-**

Observers: **Horner/Biggs** Date: **1/18/17**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)

Transverse and/or central bars-short and/or discontinuous…… ……..NBS = High / Very High

Extensive deposition (continuous, cross-channel)……..…….. ……....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…… ……..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

Extreme

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
8	**4**	**2**	

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40
	Overall Near-Bank Stress (NBS) rating					**Extreme**	

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream: **Piney Branch** Location: **BEHI #4**

Station: **45 ft (Left Bank)** Observers: **Horner/Biggs**

Date: **1/18/17** Stream Type: **G4** Valley Type: **-**

				Study Bank Height / Bankfull Height (C)		**BEHI Score (Fig. 3-7)**
Study Bank Height (ft) =	**6.50 (A)**	**Bankfull Height** (ft) =	**1.00 (B)**	(A) / (B) =	**6.50 (C)**	**10.0**
				Root Depth / Study Bank Height (E)		
Root Depth (ft) =	**3.00 (D)**	**Study Bank Height** (ft) =	**6.50 (A)**	(D) / (A) =	**0.46 (E)**	**4.0**
				Weighted Root Density (G)		
		Root Density as % =	**15.00 (F)**	(F) × (E) =	**6.92308 (G)**	**8.7**
				Bank Angle (H)		
				Bank Angle as *Degrees* =	**60 (H)**	**3.9**
				Surface Protection (I)		
				Surface Protection as % =	**5% (I)**	**10.0**

Bank Material Adjustment:

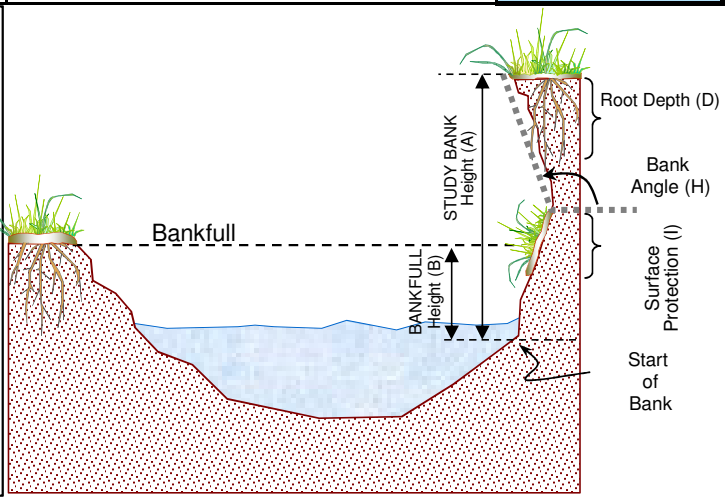
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment **0**

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

0

Very Low	Low	Moderate	High	Very High	Extreme	**Adjective Rating** and **Total Score**	**High** / **36.6**
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Piney Branch** Location: **BEHI #4**

Station: **45 ft (Left Bank)** Stream Type: **G4** Valley Type: **-**

Observers: **Horner/Biggs** Date: **1/18/17**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)

Transverse and/or central bars-short and/or discontinuous…… ……..NBS = High / Very High

Extensive deposition (continuous, cross-channel)……..…….…… ……....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…… ……...NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
20	**15**	**1.3**	**Extreme**

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

High

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
8	**4**	**2**	

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40
		Overall Near-Bank Stress (NBS) rating					**High**

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream: **Piney Branch** Location: **BEHI #5**

Station: **55 ft (Right Bank)** Observers: **Horner/Biggs**

Date: **1/18/17** Stream Type: **G4** Valley Type: **-**

Study Bank Height / Bankfull Height (C)							**BEHI Score (Fig. 3-7)**
Study Bank Height (ft) =	**11.00 (A)**	**Bankfull Height** (ft) =	**1.00 (B)**	(A) / (B) =	**11.00 (C)**		**10.0**
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	**3.00 (D)**	**Study Bank Height** (ft) =	**11.00 (A)**	(D) / (A) =	**0.27 (E)**		**6.0**
Weighted Root Density (G)							
Root Density as % =		**40.00 (F)**		(F) × (E) =	**10.9091 (G)**		**8.5**
Bank Angle (H)							
Bank Angle as *Degrees* =		**70 (H)**					**5.0**
Surface Protection (I)							
Surface Protection as % =		**0% (I)**					**10.0**

Bank Material Adjustment:

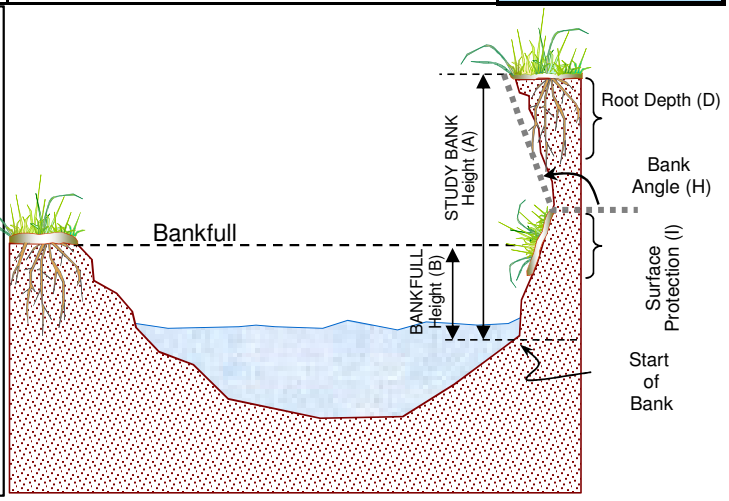
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment **0**

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

0

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	High / 39.5
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Piney Branch** Location: **BEHI #5**

Station: **55 ft (Right Bank)** Stream Type: **G4** Valley Type: **-**

Observers: **Horner/Biggs** Date: **1/18/17**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)

Transverse and/or central bars-short and/or discontinuous…… ……..NBS = High / Very High

Extensive deposition (continuous, cross-channel)……..…….…… ……....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…… ……...NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

High

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
8	**4**	**2**	

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40
		Overall Near-Bank Stress (NBS) rating				**High**	

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	**Piney Branch**	Location:	**BEHI #6**
Station:	**45 ft (Left Bank)**	Observers:	**Horner/Biggs**
Date:	**1/18/17**	Stream Type: **G4**	Valley Type: **-**

				Study Bank Height / Bankfull Height (C)		**BEHI Score (Fig. 3-7)**
Study Bank Height (ft) =	**11.00 (A)**	**Bankfull Height** (ft) =	**1.00 (B)**	(A) / (B) =	**11.00 (C)**	**10.0**
				Root Depth / Study Bank Height (E)		
Root Depth (ft) =	**3.00 (D)**	**Study Bank Height** (ft) =	**11.00 (A)**	(D) / (A) =	**0.27 (E)**	**6.0**
				Weighted Root Density (G)		
		Root Density as % =	**40.00 (F)**	(F) × (E) =	**10.9091 (G)**	**8.5**
				Bank Angle (H)		
				Bank Angle as *Degrees* =	**70 (H)**	**5.0**
				Surface Protection (I)		
				Surface Protection as % =	**0% (I)**	**10.0**

Bank Material Adjustment:

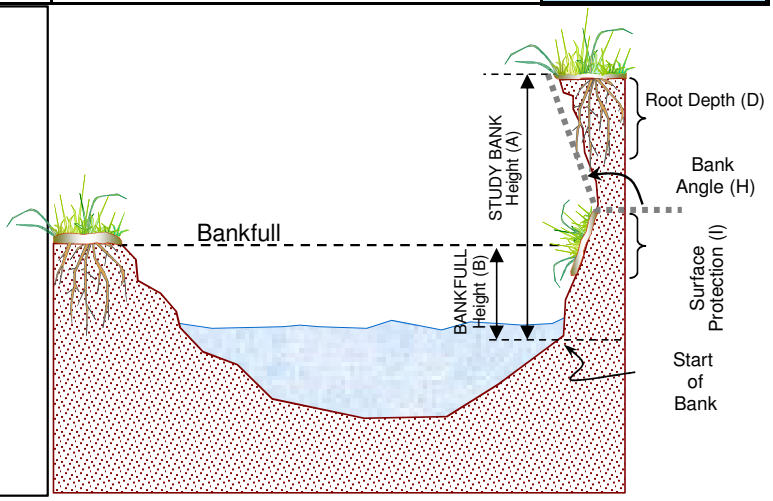
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment **0**

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

0

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	High
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		39.5



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Piney Branch** Location: **BEHI #6**

Station: **45 ft (Left Bank)** Stream Type: **G4** Valley Type: **-**

Observers: **Horner/Biggs** Date: **1/18/17**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)

Transverse and/or central bars-short and/or discontinuous…… ……..NBS = High / Very High

Extensive deposition (continuous, cross-channel)……..…….…….. ……....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…… ……...NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

High

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
8	**4**	**2**	

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40
		Overall Near-Bank Stress (NBS) rating					**High**

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	**Piney Branch**	Location:	**BEHI #7**
Station:	**100 ft (Right Bank)**	Observers:	**Horner/Biggs**
Date:	**1/18/17**	Stream Type: **G4**	Valley Type: **-**

							BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)							
Study Bank Height (ft) =	8.50 (A)	Bankfull Height (ft) =	1.00 (B)	(A) / (B) =	8.50 (C)		10.0
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	2.00 (D)	Study Bank Height (ft) =	8.50 (A)	(D) / (A) =	0.24 (E)		6.5
Weighted Root Density (G)							
		Root Density as % =	10.00 (F)	(F) × (E) =	2.35294 (G)		9.5
Bank Angle (H)							
				Bank Angle as *Degrees* =	90 (H)		7.5
Surface Protection (I)							
				Surface Protection as % =	10% (I)		7.0

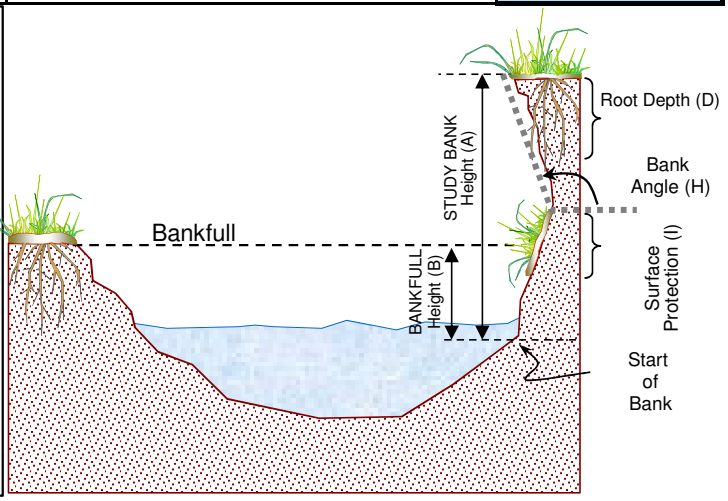
Bank Material Adjustment:

Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment 0

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 0

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Very High / 40.5
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Piney Branch** Location: **BEHI #7**

Station: **100 ft (Right Bank)** Stream Type: **G4** Valley Type: **-**

Observers: **Horner/Biggs** Date: **1/18/17**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)

Transverse and/or central bars-short and/or discontinuous…… ……..…NBS = High / Very High

Extensive deposition (continuous, cross-channel)……..……..…… ……....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…… ……..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

Extreme

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
8	**4**	**2**	

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40
		Overall Near-Bank Stress (NBS) rating				**Extreme**	

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	**Piney Branch**	Location:	**BEHI #8**
Station:	**133 ft (Right Bank)**	Observers:	**Horner/Biggs**
Date:	**1/18/17**	Stream Type: **G4**	Valley Type: **-**

							BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)							
Study Bank Height (ft) =	14.00 (A)	Bankfull Height (ft) =	1.00 (B)	(A) / (B) =	14.00 (C)		10.0
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	1.50 (D)	Study Bank Height (ft) =	14.00 (A)	(D) / (A) =	0.11 (E)		8.5
Weighted Root Density (G)							
		Root Density as % =	5.00 (F)	(F) × (E) =	0.53571 (G)		9.5
Bank Angle (H)							
				Bank Angle as *Degrees* =	90 (H)		7.5
Surface Protection (I)							
				Surface Protection as % =	20% (I)		7.0

Bank Material Adjustment:

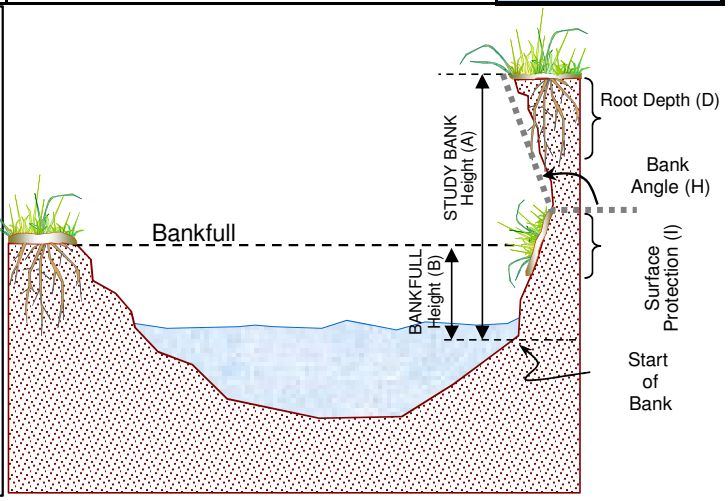
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment 0

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

0

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Very High / 42.5
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Piney Branch** Location: **BEHI #8**

Station: **133 ft (Right Bank)** Stream Type: **G4** Valley Type: **-**

Observers: **Horner/Biggs** Date: **1/18/17**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1) Transverse and/or central bars-short and/or discontinuous…… ……..…NBS = High / Very High
Extensive deposition (continuous, cross-channel)……..……..…… ……....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…… ……..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
20	**15**	**1.3**	**Extreme**

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress
Extreme

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
8	**4**	**2**	

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40
		Overall Near-Bank Stress (NBS) rating				**Extreme**	

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating. Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	**Piney Branch**	Location:	**BEHI #9**
Station:	**10 ft (Left Bank)**	Observers:	**Horner/Biggs**
Date:	**1/18/17**	Stream Type: **G4**	Valley Type: **-**

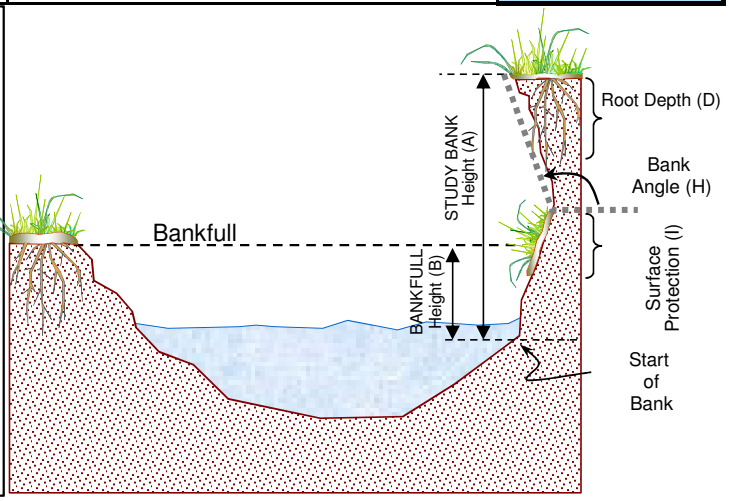
							BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)							
Study Bank Height (ft) =	5.00 (A)	Bankfull Height (ft) =	1.00 (B)	(A) / (B) =	5.00 (C)		10.0
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	0.50 (D)	Study Bank Height (ft) =	5.00 (A)	(D) / (A) =	0.10 (E)		8.5
Weighted Root Density (G)							
		Root Density as % =	20.00 (F)	(F) × (E) =	2 (G)		9.5
Bank Angle (H)							
				Bank Angle as *Degrees* =	90 (H)		7.5
Surface Protection (I)							
				Surface Protection as % =	0% (I)		10.0

Bank Material Adjustment:

Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment	0
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		50.5



Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Piney Branch** Location: **BEHI #9**

Station: **10 ft (Right Bank)** Stream Type: **G4** Valley Type: **-**

Observers: **Horner/Biggs** Date: **1/18/17**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1) Transverse and/or central bars-short and/or discontinuous…… ……..NBS = High / Very High
Extensive deposition (continuous, cross-channel)……..…….. ……....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…… ……...NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
15	**20**	**0.75**	**Extreme**

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

Extreme

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
8	**4**	**2**	

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40
	Overall Near-Bank Stress (NBS) rating					**Extreme**	

Worksheet 3-13. Summary form of annual streambank erosion estimates for various study reaches.

Stream:	**Piney Branch**			Location: **Town of Vienna, VA**			
Graph Used:	**USFWS Hickey Run**	Total Stream Length (ft): **689**				Date: **1/18/2017**	
Observers:	**Biggs/Horner**		Valley Type: **-**			Stream Type: **G4**	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Station (ft)	**BEHI rating (Worksheet 3-11) (adjective)**	**NBS rating (Worksheet 3-12) (adjective)**	**Bank erosion rate (Figure 3-9 or 3-10) (ft/yr)**	**Length of bank (ft)**	**Study bank height (ft)**	**Erosion subtotal [(4)×(5)×(6)] (ft^3/yr)**	**Erosion Rate (tons/yr/ft)**
BEHI #1_Left	**Moderate**	**Low**	**0.120**	**97.0**	**5.0**	**58.20**	**0.03240**
BEHI #1_Right	**Moderate**	**Low**	**0.120**	**44.0**	**5.0**	**26.40**	**0.03240**
BEHI #2	**High**	**Extreme**	**2.500**	**110.0**	**6.5**	**1787.50**	**0.87750**
BEHI #3	**Very High**	**Extreme**	**2.500**	**50.0**	**3.0**	**375.00**	**0.40500**
BEHI #4	**High**	**High**	**1.000**	**45.0**	**6.5**	**292.50**	**0.35100**
BEHI #5	**High**	**High**	**1.000**	**55.0**	**11.0**	**605.00**	**0.59400**
BEHI #6	**High**	**High**	**1.000**	**45.0**	**11.0**	**495.00**	**0.59400**
BEHI #7	**Very High**	**Extreme**	**2.500**	**100.0**	**8.5**	**2125.00**	**1.14750**
BEHI #8	**Very High**	**Extreme**	**2.500**	**133.0**	**14.0**	**4655.00**	**1.89000**
BEHI #9	**Extreme**	**Extreme**	**4.500**	**10.0**	**5.0**	**225.00**	**1.21500**
Sum erosion subtotals in Column (7) for each BEHI/NBS combination					**Total Erosion (ft^3/yr)**	**10644.60**	
Convert erosion in ft^3/yr to yds^3/yr {divide Total Erosion (ft^3/yr) by 27}					**Total Erosion (yds^3/yr)**	**394.24**	
Convert erosion in yds^3/yr to tons/yr {multiply Total Erosion (yds^3/yr) by 1.3}					**Total Erosion (tons/yr)**	**574.81**	
Calculate erosion per unit length of channel {divide Total Erosion (tons/yr) by total length of stream (ft) surveyed}					**Total Erosion (tons/yr/ft)**	**0.8343**	

	Ratings	
Station	BEHI	NBS
BEHI #8	Extreme	Extreme

	Ratings	
Station	BEHI	NBS
BEHI #8	Very High	Extreme

	Ratings	
Station	BEHI	NBS
BEHI #7	Very High	Extreme

	Ratings	
Station	BEHI	NBS
BEHI #5	High	High

	Ratings	
Station	BEHI	NBS
BEHI #3	Very High	Extreme

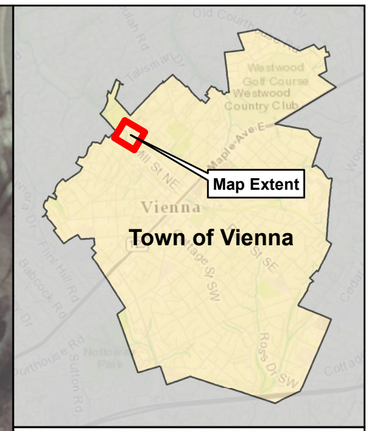
	Ratings	
Station	BEHI	NBS
BEHI #1 Right	Moderate	Low

	Ratings	
Station	BEHI	NBS
BEHI #6	High	High

	Ratings	
Station	BEHI	NBS
BEHI #4	High	High

	Ratings	
Station	BEHI	NBS
BEHI #2	High	Extreme

	Ratings	
Station	BEHI	NBS
BEHI #1 Right	Moderate	Low



Legend

Piney Branch (Stream)

Erosion Evaluation Area

	Ratings	
Station	BEHI	NBS
BEHI #7	Very High	Extreme

Station Identifier — BEHI Rating — NBS Rating

N

0 30 60 120

Feet

amec foster wheeler

Piney Branch Stream Erosion Evaluation Vienna Northside Property Yard Vienna, Virginia

Appendix D – Bulk Density Computations

JOB NO. _____ SHEET 1 OF 2
PHASE _____ TASK _____
JOB NAME PINEY BRANCH SLAF
BY _____ DATE _____
CHECKED BY _____ DATE 1/24/16

amec foster wheeler
14424 Albemarle Point Place, Suite 115
Chantilly, VA 20151
+1 (703) 488-3700 Fax +1 (703) 488-3701

PINEY BRANCH COMPOSITE SAMPLING

SITES – # 3, 5, 7, 8

CREATE COMPOSITE SAMPLE

RING TARE WEIGHT = 7 lbs - 9 oz

RING VOLUME = $\pi/4 \left(4''/12\right)^2 \times (1.2''/12)$
depth of RING = 1.2"
= 0.00827 ft^3

MEASured Weight = 8 lbs - 10 oz

Soil Weight = 8 lbs - 10 oz - 7 lbs - 9 oz
= 116 - 10 z
= 1.062516

DENSITY OF THE WET COMPOSITE SOIL BANK MATL = 1.062516 lb / 0.00827 ft^3
= 121.8 lb/ft^3
≈ 122 #/ft^3

JOB NO. _____ SHEET 2 OF 2
PHASE _____ TASK _____
JOB NAME PINEY BRANCH SLAF
BY _____ DATE _____
CHECKED BY _____ DATE 1/24/16

amec foster wheeler
14424 Albemarle Point Place, Suite 115
Chantilly, VA 20151
+1 (703) 488-3700 Fax +1 (703) 488-3701

FOR THE 4 SAMPLES

THE AVE. MOISTURE CONTENT = 4.7 + 17.8 + 14.1 + 14.8

AVE mc = 12.9%

w = 12.9%

DRY BULK DENSITY

$$\rho = \frac{\gamma}{1+w} = \frac{(M/V)}{1+w}$$

$$\rho = \frac{(M/V)}{1+w}$$

$$= \frac{122\ lb/ft^3}{1 + 0.129}$$

$$= \underline{108\ lb/ft^3}$$

Appendix E –Site Photographs

Appendix F – Letter from Fairfax County

County of Fairfax, Virginia

To protect and enrich the quality of life for the people, neighborhoods and diverse communities of Fairfax County

February 8, 2017

Mike Gallagher, P.E.
Deputy Director of Public Works
Town of Vienna
127 Center Street, South
Vienna, VA 22180

Reference: Northside Park-Piney Branch Stream Restoration Project/Stormwater Local Assistance Fund (SLAF) Grant

Dear Mike,

In response to your September 19, 2016 e-mail, and as we have discussed, we will take the necessary steps to obtain approval to fund the local share for the Northside Park-Piney Branch Stream Restoration Project. This would provide the local match of SLAF grant funds to the town if awarded.

This is in accordance with Paragraph 25 of the new Cooperative Agreement between Fairfax County, the Town of Herndon and the Town of Vienna. The nutrient and sediment removal credits will be shared in accordance with Paragraph 27 of the agreement.

This is an exciting project and we will provide any support we can.

Should you have any questions, I can be reached at 703.324.5732 or e-mail: randybartlett@fairfaxcounty.gov.

Sincerely,

Randolph W. Bartlett, P.E.
Deputy Director
Department of Public Works and Environmental Services

Department of Public Works and Environmental Services
Stormwater Planning Division
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