UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS

UNITED STATES OF AMERICA	)	
Plaintiff,	)	
	)	Civil Action No. 16-5654
v.	)	
PILKINGTON NORTH AMERICA, INC.,	)	
Defendant.	)	

REMEDIAL ACTION CONSENT DECREE

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I. BACKGROUND

A. The United States of America ("United States"), on behalf of the Administrator of the United States Environmental Protection Agency ("EPA"), filed a Complaint in this matter pursuant to Sections 106 and 107 of the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. §§ 9606 and 9607.

B. The United States in its Complaint seeks, *inter alia*: (1) reimbursement of costs incurred by EPA and the Department of Justice ("DOJ") for response actions at the Ottawa Township Flat Glass Site ("Site"), located in LaSalle County, Illinois, in and around portions of the Village of Naplate and the City of Ottawa, Illinois, together with accrued interest; and (2) performance of response actions by the Settling Defendant at the Operable Unit No. 3 ("OU3") of the Site consistent with the National Contingency Plan, 40 C.F.R. Part 300 (NCP).

C. In accordance with the NCP and Section 121(f)(1)(F) of CERCLA, 42 U.S.C. § 9621(f)(1)(F), EPA notified the State of Illinois (the "State") on April 23, 2015, of negotiations with potentially responsible parties ("PRPs") regarding the implementation of the remedial action ("RA") for the Site, and EPA has provided the State with an opportunity to participate in such negotiations and be a party to this Consent Decree.

D. In accordance with Section 122(j)(1) of CERCLA, 42 U.S.C. § 9622(j)(1), EPA notified the United States Department of the Interior and the United States Fish and Wildlife Service on October 26, 2010 and on April 23, 2015, of negotiations with PRPs regarding the release of hazardous substances that may have resulted in injury to the natural resources under federal trusteeship and encouraged the trustees to participate in the negotiation of this Decree.

E. The defendant that has entered into this Decree ("Settling Defendant") does not admit any liability to Plaintiff arising out of the transactions or occurrences alleged in the Complaint, nor does the Settling Defendant acknowledge that the release or threatened release of hazardous substances at or from the Site constitutes an imminent and substantial endangerment to the public health or welfare or the environment.

F. In response to a release or a substantial threat of a release of a hazardous substance at or from the Site, and pursuant to an Administrative Order on Consent entered into with EPA on September 28, 2001, Settling Defendant completed the Remedial Investigation ("RI") for OU3 in August 2008, and the Feasibility Study ("FS") in June 2009 in accordance with 40 C.F.R. § 300.430.

G. Pursuant to Section 117 of CERCLA, 42 U.S.C. § 9617, EPA published notice of the completion of the FS and of the proposed plan for remedial action on August 19, 2009, in Ottawa Times, a major local newspaper of general circulation. EPA provided an opportunity for written and oral comments from the public on the proposed plan for remedial action. A copy of the transcript of the public meeting is available to the public as part of the administrative record upon which the Director of the Superfund Division, EPA Region 5, based the selection of the response action.

H. The decision by EPA on the RA to be implemented at OU3 is embodied in an Interim Record of Decision ("IROD"), executed on September 29, 2010, on which the State had a reasonable opportunity to review and comment. The IROD includes a responsiveness summary to the public comments. Notice of the final plan was published in accordance with Section 117(b) of CERCLA, 42 U.S.C. § 9617(b).

I. In February 2012, EPA and Settling Defendant entered into an Administrative Settlement Agreement and Order on Consent for Remedial Design ("Order"). The Order required the Settling Defendant to undertake a Remedial Design ("RD") to produce a detailed set of plans and specifications for implementation of the Remedial Action ("RA") selected in the IROD. The final RD report prepared by the Settling Defendant is attached to this Consent Decree as Appendix A.

J. Based on the information presently available to EPA, EPA believes that the Work will be properly and promptly conducted by the Settling Defendant if conducted in accordance with this Decree and its appendices.

K. Solely for the purposes of Section 113(j) of CERCLA, 42 U.S.C. § 9613(j), the remedy set forth in the IROD and the Work to be performed by Settling Defendant shall constitute a response action taken or ordered by the President for which judicial review shall be limited to the administrative record.

L. The Parties recognize, and the Court by entering this Decree finds, that this Consent Decree has been negotiated by the Parties in good faith and implementation of this Decree will expedite the cleanup of the Site and will avoid prolonged and complicated litigation between the Parties, and that this Decree is fair, reasonable, and in the public interest.

M. NOW, THEREFORE, it is hereby Ordered, Adjudged, and Decreed:

II. JURISDICTION

1. This Court has jurisdiction over the subject matter of this action pursuant to 28 U.S.C. § 1331 and 42 U.S.C. §§ 9606, 9607, and 9613(b). This Court also has personal jurisdiction over Settling Defendant. Solely for the purposes of this Consent Decree and the

underlying complaints, Settling Defendant waives all objections and defenses that it may have to jurisdiction of the Court or to venue in this District. Settling Defendant shall not challenge the terms of this Consent Decree or this Court's jurisdiction to enter and enforce this Consent Decree.

III. PARTIES BOUND

2. This Consent Decree is binding upon the United States and upon Settling Defendant and its successors and assigns. Any change in ownership or corporate or other legal status of Settling Defendant, including, but not limited to, any transfer of assets or real or personal property, shall in no way alter such Settling Defendant's responsibilities under this Consent Decree.

3. Settling Defendant shall provide a copy of this Consent Decree to each contractor hired to perform the Work and to each person representing Settling Defendant with respect to the Site or the Work, and shall condition all contracts entered into hereunder upon performance of the Work in conformity with the terms of this Consent Decree. Settling Defendant or its contractors shall provide written notice of the Consent Decree to all subcontractors hired to perform any portion of the Work. Settling Defendant shall nonetheless be responsible for ensuring that its contractors and subcontractors perform the Work in accordance with the terms of this Consent Decree. With regard to the activities undertaken pursuant to this Consent Decree, each contractor and subcontractor shall be deemed to be in a contractual relationship with Settling Defendant within the meaning of Section 107(b)(3) of CERCLA, 42 U.S.C. § 9607(b)(3).

IV. DEFINITIONS

4. Unless otherwise expressly provided in this Consent Decree, terms used in this Consent Decree that are defined in CERCLA or in regulations promulgated under CERCLA shall have the meaning assigned to them in CERCLA or in such regulations. Whenever terms listed below are used in this Consent Decree or its appendices, the following definitions shall apply solely for purposes of this Consent Decree:

A. "Affected Property" means all real property at the Site and any other real property where EPA determines, at any time, that access, land, water, or other resource use restrictions, and/or ICs are needed to implement the Remedial Action, including but not limited to properties located at: 1546 North 2725th Road, Ottawa, Illinois; 1540 North 2725th Road, Ottawa, Illinois; and 1548 4H Road, Ottawa, Illinois.

B. "CERCLA" means the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601-9675.

C. "Consent Decree" means this consent decree and all appendices attached hereto (listed in Section XXII). In the event of conflict between this Consent Decree and any appendix, this Consent Decree shall control.

D. "Day" or "day" means a calendar day. In computing any period of time under this Consent Decree, where the last day would fall on a Saturday, Sunday, or federal or State holiday, the period shall run until the close of business of the next working day.

E. "DOJ" means the United States Department of Justice and its successor departments, agencies, or instrumentalities.

F. "Effective Date" means the date upon which the approval of this Consent Decree is recorded on the Court's docket.

G. "EPA" means the United States Environmental Protection Agency and its successor departments, agencies, or instrumentalities.

H. "EPA Hazardous Substance Superfund" means the Hazardous Substance Superfund established by the Internal Revenue Code, 26 U.S.C. § 9507.

I. "Future Response Costs" means all costs, including, but not limited to, direct and indirect costs, that the United States incurs in reviewing or developing deliverables submitted pursuant to this Consent Decree, in overseeing implementation of the Work, or otherwise implementing, overseeing, or enforcing this Consent Decree, including, but not limited to, payroll costs, contractor costs, travel costs, laboratory costs, the costs incurred pursuant to ¶ 11 (Emergencies and Releases), ¶ 12 (Community Involvement) (including the costs of any technical assistance grant under Section 117(e) of CERCLA, 42 U.S.C. § 9617(e)), ¶ 26 (Access to Financial Assurance), Section VII (Remedy Review), Section VIII (Property Requirements) (including the cost of attorney time and any monies paid to secure access and/or to secure, implement, monitor, maintain, or enforce Institutional Controls including the amount of just compensation), and Section XIII (Dispute Resolution), and all litigation costs. Future Response Costs include Interim Response Costs.

J. "Institutional Controls" or "ICs" means Proprietary Controls and state or local laws, regulations, ordinances, zoning restrictions, or other governmental controls or notices that: (a) limit land, water, or other resource use to minimize the potential for human exposure to Waste Material at or in connection with the Site; (b) limit land, water, or other resource use to implement, ensure non-interference with, or ensure the protectiveness of the RA; and/or (c) provide information intended to modify or guide human behavior at or in connection with the Site.

K. "Interest" means interest at the rate specified for interest on investments of the EPA Hazardous Substance Superfund, compounded annually on October 1 of each year, in accordance with 42 U.S.C. § 9607(a). The applicable rate of interest shall be the rate in effect at the time the interest accrues. The rate of interest is subject to change on October 1 of each year. Rates are available online at http://www.epa.gov/ocfopage/finstatement/superfund/int_rate.htm.

L. "Interim Record of Decision" or "IROD" means the EPA Interim Record of Decision related to OU3 at the Site signed on September 29, 2010, by the Director of the Superfund Division, EPA Region 5, and all attachments thereto. The IROD is attached as Appendix B to this Decree.

M. "Interim Response Costs" shall mean all costs, including, but not limited to, direct and indirect costs, (a) paid by the United States in connection with the Site between February 22, 2016, and the Effective Date, or (b) incurred prior to the Effective Date but paid after that date.

N. "National Contingency Plan" or "NCP" means the National Oil and Hazardous Substances Pollution Contingency Plan promulgated pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605, codified at 40 C.F.R. Part 300, and any amendments thereto.

O. "Non-Settling Owner" means any person, other than Settling Defendant, that owns or controls any Affected Property. The clause "Non-Settling Owner's Affected Property" means Affected Property owned or controlled by a Non-Settling Owner.

P. "Operation or Maintenance" or "O&M" means all activities required to operate, maintain, and monitor the effectiveness of the RA as specified in the SOW or any EPA-approved O&M Plan.

Q. "Paragraph" or "¶" means a portion of this Consent Decree identified by an Arabic numeral or an upper or lower case letter. References to paragraphs or sections of Appendices will be identified as such.

R. "Parties" means the United States and the Settling Defendant.

S. "Performance Standards" means the cleanup levels and other measures of achievement of the remedial action objectives, as set forth in Section VIII of the IROD.

T. "Plaintiff" means the United States.

U. "Proprietary Controls" means easements or covenants running with the land that (a) limit land, water, or other resource use and/or provide access rights and (b) are created pursuant to common law or statutory law by an instrument that is recorded in the appropriate land records office.

V. "RCRA" means the Solid Waste Disposal Act, 42 U.S.C. §§ 6901-6992 (also known as the Resource Conservation and Recovery Act).

W. "Remedial Action" or "RA" means the remedial action selected in the IROD.

X. "Remedial Design" or "RD" means those activities undertaken by Settling Defendant as specified in the Administrative Settlement Agreement and Order on Consent for Remedial Design of the OU3 Interim Remedial Action. Final report for the RD is attached to this Consent Decree as Appendix A.

Y. “Section” means a portion of this Consent Decree identified by a Roman numeral.

Z. “Settling Defendant” means Pilkington North America, Inc.

AA. “Site” means the Ottawa Township Flat Glass Site, located in unincorporated areas of LaSalle County, Illinois, and in and around portions of the Village of Naplate and the City of Ottawa, Illinois, as described in the IROD and the Administrative Order on Consent for RI/FS, and depicted generally on the map attached as Appendix C to this Consent Decree.

BB. “State” means the State of Illinois.

CC. “Statement of Work” or “SOW” means the document describing the activities that the Settling Defendant must perform to implement the RA, and O&M regarding the Site, which is attached as Appendix D to this Consent Decree.

DD. “Supervising Contractor” means the principal contractor retained by Settling Defendant to supervise and direct the implementation of the Work under this Decree.

EE. “Transfer” means to sell, assign, convey, lease, mortgage, or grant a security interest in, or where used as a noun, a sale, assignment, conveyance, or other disposition of any interest by operation of law or otherwise.

FF. “United States” means the United States of America and each department, agency, and instrumentality of the United States, including EPA.

GG. “Waste Material” means (1) any “hazardous substance” under Section 101(14) of CERCLA, 42 U.S.C. § 9601(14); (2) any pollutant or contaminant under Section 101(33) of CERCLA, 42 U.S.C. § 9601(33); and (3) any “solid waste” under Section 1004(27) of RCRA, 42 U.S.C. § 6903(27).

HH. "Work" means all activities and obligations Settling Defendant is required to perform under this Consent Decree, except the activities required under Section XIX (Retention of Records).

V. GENERAL PROVISIONS

5. Objectives of the Parties. The objectives of the Parties in entering into this Consent Decree are to protect public health or welfare or the environment by the implementation of the RA at the OU3 of the Site by Settling Defendant, to pay unreimbursed response costs of the Plaintiff, and to resolve the claims of the Plaintiff against Settling Defendant.

6. Commitments by Settling Defendant. Settling Defendant shall finance and perform the Work in accordance with this Consent Decree and all deliverables developed by Settling Defendant and approved or modified by EPA pursuant to this Consent Decree. Settling Defendant shall pay the United States for its response costs as provided in this Consent Decree.

7. Compliance with Applicable Law. Nothing in this Consent Decree limits Settling Defendant's obligations to comply with the requirements of all applicable federal and state laws and regulations. Settling Defendant must also comply with all applicable or relevant and appropriate requirements of all federal and state environmental laws as set forth in the IROD and the SOW. The activities conducted pursuant to this Consent Decree, if approved by EPA, shall be deemed to be consistent with the NCP as provided in Section 300.700(c)(3)(ii) of the NCP.

8. Permits.

a. As provided in Section 121(e) of CERCLA, 42 U.S.C. § 9621(e), and Section 300.400(e) of the NCP, no permit shall be required for any portion of the Work conducted entirely on-site (*i.e.*, within the areal extent of contamination or in very close proximity to the contamination and necessary for implementation of the Work). Where any portion of the Work that is not on-site requires a federal or state permit or approval, Settling Defendant shall submit timely and complete applications and take all other actions necessary to obtain all such permits or approvals.

b. Settling Defendant may seek relief under the provisions of Section XII (Force Majeure) for any delay in the performance of the Work resulting from a failure to obtain, or a delay in obtaining, any permit or approval referenced in ¶ 8.a and required for the Work, provided that it has submitted timely and complete applications and taken all other actions necessary to obtain all such permits or approvals.

c. This Consent Decree is not, and shall not be construed to be, a permit issued pursuant to any federal or state statute or regulation.

VI. PERFORMANCE OF THE WORK

9. Coordination and Supervision.

a. Project Coordinators.

(1) Settling Defendant's Project Coordinator must have sufficient technical expertise to coordinate the Work. Settling Defendant's Project Coordinator may not be an attorney representing Settling Defendant in this matter and may not act as the Supervising Contractor. Settling Defendant's Project Coordinator may assign other representatives, including other contractors, to assist in coordinating the Work.

(2) EPA shall designate and notify Settling Defendant of its Project Coordinator and Alternate Project Coordinator. EPA may designate other representatives, which may include its employees, contractors and/or consultants, to

oversee the Work. EPA's Project Coordinator/Alternate Project Coordinator will have the same authority as a remedial project manager and/or an on-scene coordinator, as described in the NCP. This includes the authority to halt the Work and/or to conduct or direct any necessary response action when he or she determines that conditions at the Site constitute an emergency or may present an immediate threat to public health or welfare or the environment due to a release or threatened release of Waste Material.

(3) Settling Defendant's Project Coordinator shall meet with EPA's Project Coordinator at least monthly. Such meetings may take place via telephone or electronic means.

b. Supervising Contractor. Settling Defendant's proposed Supervising Contractor must have a quality assurance system that complies with ANSI/ASQC E4-2004, Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use (American National Standard).

c. Procedures for Disapproval/Notice to Proceed.

(1) Settling Defendant shall designate, and notify EPA, within 10 days after the Effective Date, of the name, contact information, and qualifications of the Settling Defendant's proposed Project Coordinator and Supervising Contractor.

(2) EPA, after a reasonable opportunity for review and comment by the State, shall issue notices of disapproval and/or authorizations to proceed regarding the proposed Project Coordinator and Supervising Contractor, as applicable. If EPA issues a notice of disapproval, Settling Defendant shall, within 30 days, submit to EPA a list of supplemental proposed Project Coordinators and/or Supervising Contractors, as

applicable, including a description of the qualifications of each. EPA shall issue a notice of disapproval or authorization to proceed regarding each supplemental proposed coordinator and/or contractor. Settling Defendant may select any coordinator/contractor covered by an authorization to proceed and shall, within 21 days, notify EPA of Settling Defendant's selection.

(3) Settling Defendant may change its Project Coordinator and/or Supervising Contractor, as applicable, by following the procedures of ¶¶ 9.c(1) and 9.c(2).

(4) Notwithstanding the procedures of ¶¶ 9.c(1) through 9.c(3), Settling Defendant has proposed, and EPA has authorized Settling Defendant to proceed regarding the following Project Coordinator and Supervising Contractor: James Lavrich (Project Coordinator) and Hull and Associates (Supervising Contractor).

10. Performance of Work in Accordance with SOW. Settling Defendant shall: (a) perform the RA; and (b) operate, maintain, and monitor the effectiveness of the RA; all in accordance with the SOW and all EPA-approved, conditionally-approved, or modified deliverables as required by the SOW. All deliverables required to be submitted for approval under the Consent Decree or SOW shall be subject to approval by EPA in accordance with ¶ 5.6 (Approval of Deliverables) of the SOW.

11. Emergencies and Releases. Settling Defendant shall comply with the emergency and release response and reporting requirements under ¶ 3.3 (Emergency Response and Reporting) of the SOW. Subject to Section XV (Covenants by Plaintiff), nothing in this Consent Decree, including ¶ 3.3 of the SOW, limits any authority of Plaintiff: (a) to take all appropriate

action to protect human health and the environment or to prevent, abate, respond to, or minimize an actual or threatened release of Waste Material on, at, or from the Site, or (b) to direct or order such action, or seek an order from the Court, to protect human health and the environment or to prevent, abate, respond to, or minimize an actual or threatened release of Waste Material on, at, or from the Site. If, due to Settling Defendant's failure to take appropriate response action under ¶ 3.3 of the SOW, EPA and/or the State takes such action instead, Settling Defendant shall reimburse EPA and/or the State under Section X (Payments for Response Costs) for all costs of the response action.

12. Community Involvement. If requested by EPA, Settling Defendant shall conduct community involvement activities under EPA's oversight as provided for in, and in accordance with, the SOW. Such activities may include, but are not limited to, designation of a Community Involvement Coordinator. Costs incurred by the United States under this Section constitute Future Response Costs to be reimbursed under Section X (Payments for Response Costs).

Within 30 days after a request by EPA, Settling Defendant also shall provide EPA with a Technical Assistance Plan ("TAP") for arranging (at Settling Defendant's own expense, up to $50,000) for a qualified community group: (a) to receive services from (an) independent technical advisor(s) who can help group members understand Site cleanup issues; and (b) to share this information with others in the community during the Work conducted pursuant to this Consent Decree. The TAP shall state that Settling Defendant will provide and arrange for any additional assistance needed if the selected community group demonstrates such a need as provided in the SOW. Upon its approval by EPA, the TAP shall be incorporated into and enforceable under this Consent Decree.

Costs incurred by the United States under this Section, including the costs of any technical assistance grant under Section 117(e) of CERCLA, 42 U.S.C. § 9617(e), shall be considered Future Response Costs that Settling Defendant shall pay pursuant to Section X (Payments for Response Costs).

13. Modification of SOW or Related Deliverables.

a. If EPA determines that it is necessary to modify the work specified in the SOW and/or in deliverables developed under the SOW in order to achieve and/or maintain the Performance Standards or to carry out and maintain the effectiveness of the RA, and such modification is consistent with the Scope of the Remedy set forth in ¶ 1.3 of the SOW, then EPA may notify Settling Defendant of such modification. If Settling Defendant objects to the modification it may, within 30 days after EPA's notification, seek dispute resolution under Section XIII.

b. The SOW and/or related work plans shall be modified: (1) in accordance with the modification issued by EPA; or (2) if Settling Defendant invokes dispute resolution, in accordance with the final resolution of the dispute. The modification shall be incorporated into and enforceable under this Consent Decree, and Settling Defendant shall implement all work required by such modification. Settling Defendant shall incorporate the modification into the deliverable required under the SOW, as appropriate.

c. Nothing in this Paragraph shall be construed to limit EPA's authority to require performance of further response actions as otherwise provided in this Consent Decree.

14. Nothing in this Decree, the SOW, or any deliverable required under the SOW constitutes a warranty or representation of any kind by Plaintiff that compliance with the work requirements set forth in the SOW or related deliverable will achieve the Performance Standards.

VII. REMEDY REVIEW

15. Periodic Review. Settling Defendant shall conduct, in accordance with ¶ 5.7(h) (Periodic Review Support Plan) of the SOW, studies and investigations to support EPA's reviews under Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), and applicable regulations, of whether the RA is protective of human health and the environment.

VIII. PROPERTY REQUIREMENTS

16. Agreements Regarding Access and Non-Interference.

a. To the extent EPA determines that access to any Non-Settling Owner's Affected Property is necessary, Settling Defendant shall, with respect to any Non-Settling Owner's Affected Property, use best efforts to secure from such Non-Settling Owner an agreement, enforceable by Settling Defendant and EPA, providing that such Non-Settling Owner shall:

(1) Provide EPA and Settling Defendant, and their representatives, contractors, and subcontractors with access at all reasonable times to such Affected Property to conduct any activity regarding the Consent Decree, including those listed in ¶ 16.b (Access Requirements); and

(2) Refrain from using such Affected Property in any manner that EPA determines will: (i) pose an unacceptable risk to human health or to the environment due

to exposure to Waste Material, or (ii) interfere with or adversely affect the implementation, integrity, or protectiveness of the Remedial Action.

b. Access Requirements. The following is a list of activities for which access may be required regarding any Affected Property:

(1) Monitoring the Work;

(2) Verifying any data or information submitted to the United States;

(3) Conducting investigations regarding contamination at or near the Site;

(4) Obtaining samples;

(5) Assessing the need for, planning, or implementing additional response actions at or near the Site;

(6) Assessing implementation of quality assurance and quality control practices as defined in the approved construction quality assurance quality control plan as provided in the SOW;

(7) Implementing the Work pursuant to the conditions set forth in ¶ 62 (Work Takeover);

(8) Inspecting and copying records, operating logs, contracts, or other documents maintained or generated by Settling Defendant or its agents, consistent with Section XVIII (Access to Information);

(9) Assessing Settling Defendant's compliance with the Consent Decree;

(10) Determining whether Settling Defendant's Affected Property is being used in a manner that is prohibited or restricted, or that may need to be prohibited or restricted under the Consent Decree; and

(11) Implementing, monitoring, maintaining, reporting on, and enforcing any Institutional Controls.

c. Settling Defendant shall not Transfer its Affected Property without first securing EPA's approval of, and transferee's consent to, an agreement that: (i) is enforceable by Settling Defendant and Plaintiff; and (ii) requires the transferee to provide access to and to refrain from using the Affected Property to the same extent as is provided under ¶ 16.a.

17. Proprietary Controls. Defendant shall comply with all the requirements of the Institutional Control Implementation and Assurance Plan ("ICIAP") applicable to OU3. ICIAP, developed pursuant to Section 5.7(i) of the SOW, is attached to this Consent Decree as Appendix E.

18. Best Efforts. As used in this Section, "best efforts" means the efforts that a reasonable person in the position of Settling Defendant would use so as to achieve the goal in a timely manner, including the cost of employing professional assistance and the payment of reasonable sums of money to secure Proprietary Controls, agreements, releases, subordinations, modifications, or relocations of Prior Encumbrances that affect the title to the Affected Property, as applicable. If Settling Defendant is unable to accomplish what is required through "best efforts" in a timely manner, it shall notify the United States, and include a description of the

steps taken to comply with the requirements. If the United States deems it appropriate, it may assist Settling Defendant, or take independent action, in obtaining such Proprietary Controls, agreements, releases, subordinations, modifications, or relocations of Prior Encumbrances that affect the title to the Affected Property, as applicable. All costs incurred by the United States in providing such assistance or taking such action, including the cost of attorney time and the amount of monetary consideration or just compensation paid, constitute Future Response Costs to be reimbursed under Section X (Payments for Response Costs).

19. Notice to Successors-in-Title.

a. Settling Defendant shall, within 15 days after the Effective Date, submit for EPA approval a notice to be filed regarding Settling Defendant's Affected Property in the appropriate land records. The notice must: (1) include a proper legal description of the Affected Property; (2) provide notice to all successors-in-title: (i) that the Affected Property is part of, or related to, the Site; (ii) that EPA has selected a remedy for OU3; and (iii) that Settling Defendant and the United States have entered into a Consent Decree requiring implementation of such remedy; and (3) identify the U.S. District Court in which the Consent Decree was filed, the name and civil action number of this case, and the date the Consent Decree was entered by the Court. Settling Defendant shall record the notice within 10 days after EPA's approval of the notice and submit to EPA, within 10 days thereafter, a certified copy of the recorded notice.

b. Settling Defendant, prior to entering into a contract to Transfer its Affected Property, or 60 days prior to Transferring its Affected Property, whichever is earlier:

(1) Notify the proposed transferee that EPA has selected a remedy regarding OU3, that Settling Defendant and the United States have entered into a

Consent Decree requiring implementation of such remedy, and that the United States District Court has entered the Consent Decree (identifying the name and civil action number of this case and the date the Consent Decree was entered by the Court); and

(2) Notify EPA of the name and address of the proposed transferee and provide EPA with a copy of the notice that it provided to the proposed transferee.

20. In the event of any Transfer of the Affected Property, unless the United States otherwise consents in writing, Settling Defendant shall continue to comply with its obligations under the Consent Decree, including its obligation to provide and/or secure access, to implement, maintain, monitor, and report on Institutional Controls, and to abide by such Institutional Controls.

21. Notwithstanding any provision of the Consent Decree, Plaintiff retains all of its access authorities and rights, as well as all of its rights to require Institutional Controls, including enforcement authorities related thereto, under CERCLA, RCRA, and any other applicable statute or regulations.

IX. FINANCIAL ASSURANCE

22. In order to ensure completion of the Work, Settling Defendant shall secure financial assurance, initially in the amount of $1,171,000 ("Estimated Cost of the Work"), for the benefit of EPA. The financial assurance must be one or more of the mechanisms listed below, in a form substantially identical to the relevant sample documents available from the "Financial Assurance" category on the Cleanup Enforcement Model Language and Sample Documents Database at http://cfpub.epa.gov/compliance/models/, and satisfactory to EPA. Settling

Defendant may use multiple mechanisms if they are limited to surety bonds guaranteeing payment, letters of credit, trust funds, and/or insurance policies.

a. A surety bond guaranteeing payment and/or performance of the Work that is issued by a surety company among those listed as acceptable sureties on federal bonds as set forth in Circular 570 of the U.S. Department of the Treasury;

b. An irrevocable letter of credit, payable to or at the direction of EPA, that is issued by an entity that has the authority to issue letters of credit and whose letter-of-credit operations are regulated and examined by a federal or state agency;

c. A trust fund established for the benefit of EPA that is administered by a trustee that has the authority to act as a trustee and whose trust operations are regulated and examined by a federal or state agency;

d. A policy of insurance that provides EPA with acceptable rights as a beneficiary thereof and that is issued by an insurance carrier that has the authority to issue insurance policies in the applicable jurisdiction(s) and whose insurance operations are regulated and examined by a federal or state agency;

e. A demonstration by Settling Defendant that it meets the relevant financial test criteria of 40 C.F.R. § 264.143(f) and reporting requirements of this Section for the sum of the Estimated Cost of the Work and the amounts, if any, of other federal, state, or tribal environmental obligations financially assured through the use of a financial test or guarantee, accompanied by a standby funding commitment, which obligates Settling Defendant to pay funds to or at the direction of EPA, up to the amount financially assured through the use of this demonstration in the event of a Work Takeover; or.

f. A guarantee to fund or perform the Work executed in favor of EPA by one of the following: (1) a direct or indirect parent company of Settling Defendant; or (2) a company that has a "substantial business relationship" (as defined in 40 C.F.R. § 264.141(h)) with Settling Defendant; provided, however, that any company providing such a guarantee must demonstrate to EPA's satisfaction that it meets the relevant financial test criteria of 40 C.F.R. § 264.143(f) and reporting requirements of this Section for the sum of the Estimated Cost of the Work and the amounts, if any, of other federal, state, or tribal environmental obligations financially assured through the use of a financial test or guarantee.

23. Settling Defendant has selected, and EPA has found satisfactory, as an initial financial assurance a letter of credit prepared in accordance with Paragraph 22. Within 30 days after the Effective Date, or 30 days after EPA's approval of the form and substance of Settling Defendant's financial assurance, whichever is later, Settling Defendant shall secure all executed and/or otherwise finalized mechanisms or other documents consistent with the EPA-approved form of financial assurance and shall submit such mechanisms and documents to the EPA Regional Financial Management Officer, to the United States, and to EPA as specified in Section XX (Notices and Submissions).

24. If Settling Defendant provides financial assurance by means of a demonstration or guarantee under ¶ 22.e or 22.f, it shall also comply and shall ensure that their guarantors comply with the other relevant criteria and requirements of 40 C.F.R. § 264.143(f) and this Section, including, but not limited to: (a) the initial submission to EPA of required documents from the affected entity's chief financial officer and independent certified public accountant no later than 30 days after the Effective Date; (b) the annual resubmission of such documents within 90 days after the close of each such entity's fiscal year; and (c) the notification of EPA no later than 30

days, in accordance with ¶ 25 after any such entity determines that it no longer satisfies the relevant financial test criteria and requirements set forth at 40 C.F.R. § 264.143(f)(1). Settling Defendant agrees that EPA may also, based on a belief that an affected entity may no longer meet the financial test requirements of ¶ 22.e or 22.f, require reports of financial condition at any time from such entity in addition to those specified in this Paragraph. For purposes of this Section, references in 40 C.F.R. Part 264, Subpart H, to: (1) the terms "current closure cost estimate," "current post-closure cost estimate," and "current plugging and abandonment cost estimate" include the Estimated Cost of the Work; (2) the phrase "the sum of the current closure and post-closure cost estimates and the current plugging and abandonment cost estimates" includes the sum of all environmental obligations (including obligations under CERCLA, RCRA, and any other federal, state, or tribal environmental obligation) guaranteed by such company or for which such company is otherwise financially obligated in addition to the Estimated Cost of the Work under this Consent Decree; (3) the terms "owner" and "operator" include Settling Defendant making a demonstration or obtaining a guarantee under ¶ 22.e or 22.f; and (4) the terms "facility" and "hazardous waste management facility" include the Site.

25. Settling Defendant shall diligently monitor the adequacy of the financial assurance. If Settling Defendant becomes aware of any information indicating that the financial assurance provided under this Section is inadequate or otherwise no longer satisfies the requirements of this Section, Settling Defendant shall notify EPA of such information within seven days. If EPA determines that the financial assurance provided under this Section is inadequate or otherwise no longer satisfies the requirements of this Section, EPA will notify Settling Defendant of such determination. Settling Defendant shall, within 30 days after notifying EPA or receiving notice from EPA under this Paragraph, secure and submit to EPA for

approval a proposal for a revised or alternative financial assurance mechanism that satisfies the requirements of this Section. EPA may extend this deadline for such time as is reasonably necessary for Settling Defendant, in the exercise of due diligence, to secure and submit to EPA a proposal for a revised or alternative financial assurance mechanism, not to exceed 60 days. Settling Defendant shall follow the procedures of ¶ 27 (Modification of Amount, Form, or Terms of Financial Assurance) in seeking approval of, and submitting documentation for, the revised or alternative financial assurance mechanism. Settling Defendant's inability to secure and submit to EPA financial assurance in accordance with this Section shall in no way excuse performance of any other requirements of this Consent Decree, including, without limitation, the obligation of Settling Defendant's to complete the Work in accordance with the terms of this Consent Decree.

26. Access to Financial Assurance.

a. If EPA issues a notice of implementation of a Work Takeover under ¶ 62.b, then, in accordance with any applicable financial assurance mechanism EPA is entitled to: (1) the performance of the Work; and/or (2) require that any funds guaranteed be paid in accordance with ¶ 26.d.

b. If EPA is notified by the issuer of a financial assurance mechanism that it intends to cancel such mechanism, and Settling Defendant fails to provide an alternative financial assurance mechanism in accordance with this Section at least 30 days prior to the cancellation date, the funds guaranteed under such mechanism must be paid prior to cancellation in accordance with ¶ 26.d.

c. If, upon issuance of a notice of implementation of a Work Takeover under ¶ 62.b, either: (1) EPA is unable for any reason to promptly secure the resources guaranteed under any applicable financial assurance mechanism, whether in cash or in kind, to continue and complete the Work; or (2) the financial assurance is provided under ¶ 22.e or 22.f, then EPA may demand an amount, as determined by EPA, sufficient to cover the cost of the remaining Work to be performed. Settling Defendant shall, within 15 days of such demand, pay the amount demanded as directed by EPA.

d. Any amounts required to be paid under this ¶ 26 shall be, as directed by EPA: (i) paid to EPA in order to facilitate the completion of the Work by EPA or by another person; or (ii) deposited into an interest-bearing account, established at a duly chartered bank or trust company that is insured by the FDIC, in order to facilitate the completion of the Work by another person. If payment is made to EPA, EPA may deposit the payment into the EPA Hazardous Substance Superfund or into the Ottawa Township Flat Glass Superfund Site Special Account within the EPA Hazardous Substance Superfund to be retained and used to conduct or finance response actions at or in connection with the Site, or to be transferred by EPA to the EPA Hazardous Substance Superfund.

e. All EPA Work Takeover costs not paid under this ¶ 26 must be reimbursed as Future Response Costs under Section X (Payments for Response Costs).

27. Modification of Amount, Form, or Terms of Financial Assurance. Settling Defendant may submit, on any anniversary of the Effective Date or at any other time agreed to by the Parties, a request to reduce the amount, or change the form or terms, of the financial assurance mechanism. Any such request must be submitted to EPA in accordance with ¶ 23, and must include an estimate of the cost of the remaining Work, an explanation of the bases for the cost calculation, and a description of the proposed changes, if any, to the form or terms of the

financial assurance. EPA will notify Settling Defendant of its decision to accept or reject a requested reduction or change pursuant to this Paragraph. Settling Defendant may reduce the amount of the financial assurance mechanism only in accordance with: (a) EPA's approval; or (b) if there is a dispute, the agreement, final administrative decision, or final judicial decision resolving such dispute under Section XIII (Dispute Resolution). Any decision made by EPA on a request submitted under this Paragraph to change the form or terms of a financial assurance mechanism shall be made in EPA's sole and unreviewable discretion, and such decision shall not be subject to challenge by Settling Defendant pursuant to the dispute resolution provisions of this Consent Decree or in any other forum. Within 30 days after receipt of EPA's approval of, or the agreement or decision resolving a dispute relating to, the requested modifications pursuant to this Paragraph, Settling Defendant shall submit to EPA documentation of the reduced, revised, or alternative financial assurance mechanism in accordance with ¶ 23.

28. Release, Cancellation, or Discontinuation of Financial Assurance. Settling Defendant may release, cancel, or discontinue any financial assurance provided under this Section only: (a) if EPA issues a Certification of Work Completion under ¶ 3.7 (Certification of Work Completion) of the SOW; (b) in accordance with EPA's approval of such release, cancellation, or discontinuation; or (c) if there is a dispute regarding the release, cancellation or discontinuance of any financial assurance, in accordance with the agreement, final administrative decision, or final judicial decision resolving such dispute under to Section XIII (Dispute Resolution).

X. PAYMENTS FOR RESPONSE COSTS

29. Payments by Settling Defendant for Future Response Costs. Settling Defendant shall pay to EPA all Future Response Costs not inconsistent with the NCP.

a. Future Response Costs. Payment shall be made in accordance with Paragraph 30 (instructions for future response costs and stipulated penalties). The total amount paid shall be deposited by EPA in the Ottawa Township Flat Glass Superfund Special Account. These funds shall be retained and used by EPA to conduct or finance future response actions at or in connection with the Site.

b. On a periodic basis, EPA will send Settling Defendant a bill requiring payment that includes an Itemized Cost Summary, which includes direct and indirect costs incurred by EPA, its contractors, subcontractors, and DOJ. Settling Defendant shall make all payments within 30 days after Settling Defendant's receipt of each bill requiring payment, except as otherwise provided in ¶ 32, in accordance with ¶ 30.a (instructions for future response cost payments).

c. Deposit of Future Response Costs Payments. The total amount to be paid by Settling Defendant pursuant to ¶ 29.b shall be deposited by EPA in the Ottawa Township Flat Glass Superfund Site Special Account to be retained and used to conduct or finance response actions at or in connection with the Site, or to be transferred by EPA to the EPA Hazardous Substance Superfund, provided, however, that EPA may deposit a Future Response Costs payment directly into the EPA Hazardous Substance Superfund if, at the time the payment is received, EPA estimates that the Ottawa Township Flat Glass Superfund Site Special Account balance is sufficient to address currently anticipated future response actions to be conducted or financed by EPA at or in connection with the Site. Any decision by EPA to deposit a Future Response Costs payment directly into the EPA Hazardous Substance Superfund for this reason shall not be subject to challenge by Settling Defendant pursuant to the dispute resolution provisions of this Consent Decree or in any other forum.

d. After EPA issues the Certification of RA Completion pursuant to ¶ 3.6 (Certification of RA Completion) of the SOW and a final accounting of the Ottawa Township Flat Glass Superfund Site Special Account (including crediting Settling Defendant for any amounts received under ¶¶ 29.a (prepayment) or 29.b (periodic bill), EPA will apply any unused amount paid by Settling Defendant pursuant to ¶¶ 29.a or 29.b to any other unreimbursed response costs or response actions remaining at the Site. Any decision by EPA to apply unused amounts to unreimbursed response costs or response actions remaining at the Site shall not be subject to challenge by Settling Defendant pursuant to the dispute resolution provisions of this Consent Decree or in any other forum.

30. Payment Instructions for Future Response Costs Payments and Stipulated Penalties.

a. For all payments of Future Response Costs, Settling Defendant shall make such payment by Fedwire EFT, referencing the Site ID and DJ numbers. The Fedwire EFT payment must be sent as follows:

Federal Reserve Bank of New York
ABA = 021030004
Account = 68010727
SWIFT address = FRNYUS33
33 Liberty Street
New York NY 10045
Field Tag 4200 of the Fedwire message should read
"D 68010727 Environmental Protection Agency"

b. For all payments of Future Response Costs, Settling Defendant must include references to the Site ID number and DJ number. At the time of any payment required to be made Settling Defendant shall send notices that payment has been made to the United States, EPA, and the EPA Cincinnati Finance Center, all in accordance with ¶ 83. All notices must include references to the Site ID number and DJ number.

31. Contesting Future Response Costs. Settling Defendant may submit a Notice of Dispute, initiating the procedures of Section XIII (Dispute Resolution), regarding any Future Response Costs billed under ¶ 29 (Payments by Settling Defendant for Future Response Costs) if it determines that EPA has made a mathematical error or included a cost item that is not within the definition of Future Response Costs, or if it believes EPA incurred excess costs as a direct result of an EPA action that was inconsistent with a specific provision or provisions of the NCP. Such Notice of Dispute shall be submitted in writing within 30 days after receipt of the bill and must be sent to the United States pursuant to Section XX (Notices and Submissions). Such Notice of Dispute shall specifically identify the contested Future Response Costs and the basis for objection. If Settling Defendant submits a Notice of Dispute, Settling Defendant shall pay all uncontested Future Response Costs to the United States within 30 days after Settling Defendant's receipt of the bill requiring payment. Simultaneously, Settling Defendant shall establish, in a duly chartered bank or trust company, an interest-bearing escrow account that is insured by the Federal Deposit Insurance Corporation (FDIC), and remit to that escrow account funds equivalent to the amount of the contested Future Response Costs. Settling Defendant shall send to the United States, as provided in Section XX (Notices and Submissions), a copy of the transmittal letter and check paying the uncontested Future Response Costs, and a copy of the correspondence that establishes and funds the escrow account, including, but not limited to, information containing the identity of the bank and bank account under which the escrow account is established as well as a bank statement showing the initial balance of the escrow account. If the United States prevails in the dispute, Settling Defendant shall pay the sums due

(with accrued interest) to the United States within seven days after the resolution of the dispute. If Settling Defendant prevails concerning any aspect of the contested costs, Settling Defendant shall pay that portion of the costs (plus associated accrued interest) for which it did not prevail to the United States within seven days after the resolution of the dispute. Settling Defendant shall be disbursed any balance of the escrow account. All payments to the United States under this Paragraph shall be made in accordance with ¶ 30.a (instructions for future response cost payments). The dispute resolution procedures set forth in this Paragraph in conjunction with the procedures set forth in Section XIII (Dispute Resolution) shall be the exclusive mechanisms for resolving disputes regarding Settling Defendant's obligation to reimburse the United States for its Future Response Costs.

32. Settling Defendant may contest the final accounting of the Ottawa Township Flat Glass Superfund Special Account issued under ¶ 29.d if it determines that the United States has made a mathematical error. Such objection shall be made in writing within 30 days after receipt of the final accounting and must be sent to the United States pursuant to Section XX (Notices and Submissions). Any such objection shall specifically identify the alleged final mathematical error and the basis for objection. EPA will review the alleged mathematical error and either affirm the initial accounting or issue a corrected final accounting within 30 days. If a corrected final accounting is issued, EPA will take such action as may be necessary to correct the final disposition of unused amounts paid in accordance with ¶ 29.d. If Settling Defendant disagrees with EPA's decision, Settling Defendant may, within seven days after receipt of the decision, appeal the decision to the Director of the Superfund Division, EPA Region 5. The Director of the Superfund Division will issue a final administrative decision resolving the dispute, which shall be binding upon Settling Defendant and shall not be subject to challenge by Settling

Defendant pursuant to the dispute resolution provisions of this Consent Decree or in any other forum.

33. Interest. In the event that any payment for Future Response Costs required under this Section is not made by the date required, Settling Defendant shall pay Interest on the unpaid balance. The Interest on Future Response Costs shall begin to accrue on the date of the bill. The Interest shall accrue through the date of Settling Defendant's payment. Payments of Interest made under this Paragraph shall be in addition to such other remedies or sanctions available to Plaintiffs by virtue of Settling Defendant's failure to make timely payments under this Section including, but not limited to, payment of stipulated penalties pursuant to ¶ 49 (Stipulated Penalty Amounts – Work).

XI. INDEMNIFICATION AND INSURANCE

34. Settling Defendant's Indemnification of the United States.

a. The United States does not assume any liability by entering into this Consent Decree or by virtue of any designation of Settling Defendant as EPA's authorized representative under Section 104(e) of CERCLA, 42 U.S.C. § 9604(e). Settling Defendant shall indemnify, save, and hold harmless the United States and its officials, agents, employees, contractors, subcontractors, and representatives for or from any and all claims or causes of action arising from, or on account of, negligent or other wrongful acts or omissions of Settling Defendant, its officers, directors, employees, agents, contractors, subcontractors, and any persons acting on Settling Defendant's behalf or under its control, in carrying out activities pursuant to this Consent Decree, including, but not limited to, any claims arising from any designation of Settling Defendant as EPA's authorized representative under Section 104(e) of CERCLA. Further, Settling Defendant agrees to pay the United States all costs it incurs including, but not limited to, attorneys' fees and other expenses of litigation and settlement arising from, or on account of, claims made against the United States based on negligent or other wrongful acts or omissions of Settling Defendant, its officers, directors, employees, agents, contractors, subcontractors, and any persons acting on their behalf or under its control, in carrying out activities pursuant to this Consent Decree. The United States shall not be held out as a party to any contract entered into by or on behalf of Settling Defendant in carrying out activities pursuant to this Consent Decree. Neither Settling Defendant nor any such contractor shall be considered an agent of the United States.

b. The United States shall give Settling Defendant timely notice of any claim for which the United States plans to seek indemnification pursuant to this Paragraph, and shall consult with Settling Defendant prior to settling such claim.

35. Settling Defendant covenants not to sue and agrees not to assert any claims or causes of action against the United States for damages or reimbursement or for set-off of any payments made or to be made to the United States, arising from or on account of any contract, agreement, or arrangement between Settling Defendant and any person for performance of Work on or relating to the Site, including, but not limited to, claims on account of construction delays. In addition, Settling Defendant shall indemnify, save and hold harmless the United States with respect to any and all claims for damages or reimbursement arising from or on account of any contract, agreement, or arrangement between Settling Defendant and any person for performance of Work on or relating to the Site, including, but not limited to, claims on account of construction delays.

36. Insurance. No later than 15 days before commencing any on-site Work, Settling Defendant shall secure, and shall maintain until the first anniversary after the issuance of EPA's Certification of RA Completion pursuant to ¶ 3.6 (Certification of RA Completion) of the SOW commercial general liability insurance with limits of $2,000,000, for any one occurrence, and automobile liability insurance with limits of $2,000,000, combined single limit, naming the United States as an additional insured with respect to all liability arising out of the activities performed by or on behalf of Settling Defendant pursuant to this Consent Decree. In addition, for the duration of this Consent Decree, Settling Defendant shall satisfy, or shall ensure that their contractors or subcontractors satisfy, all applicable laws and regulations regarding the provision of worker's compensation insurance for all persons performing the Work on behalf of Settling Defendant in furtherance of this Consent Decree. Prior to commencement of the Work, Settling Defendant shall provide to EPA certificates of such insurance and a copy of each insurance policy. Settling Defendant shall resubmit such certificates and copies of policies each year on the anniversary of the Effective Date. If Settling Defendant demonstrates by evidence satisfactory to EPA that any contractor or subcontractor maintains insurance equivalent to that described above, or insurance covering the same risks but in a lesser amount, then, with respect to that contractor or subcontractor, Settling Defendant need provide only that portion of the insurance described above that is not maintained by the contractor or subcontractor.

XII. FORCE MAJEURE

37. "Force majeure," for purposes of this Consent Decree, is defined as any event arising from causes beyond the control of Settling Defendant, of any entity controlled by Settling Defendant, or of Settling Defendant's contractors that delays or prevents the performance of any obligation under this Consent Decree despite Settling Defendant's best efforts to fulfill the

obligation. The requirement that Settling Defendant exercise "best efforts to fulfill the obligation" includes using best efforts to anticipate any potential force majeure and best efforts to address the effects of any potential force majeure (a) as it is occurring and (b) following the potential force majeure such that the delay and any adverse effects of the delay are minimized to the greatest extent possible. "Force majeure" does not include financial inability to complete the Work or a failure to achieve the Performance Standards.

38. If any event occurs or has occurred that may delay the performance of any obligation under this Consent Decree for which Settling Defendant intends or may intend to assert a claim of force majeure, Settling Defendant shall notify EPA's Project Coordinator orally or, in his or her absence, EPA's Alternate Project Coordinator or, in the event both of EPA's designated representatives are unavailable, the Director of the Superfund Division, EPA Region 5, within seven days of when Settling Defendant first knew that the event might cause a delay. Within seven days thereafter, Settling Defendant shall provide in writing to EPA an explanation and description of the reasons for the delay; the anticipated duration of the delay; all actions taken or to be taken to prevent or minimize the delay; a schedule for implementation of any measures to be taken to prevent or mitigate the delay or the effect of the delay; Settling Defendant's rationale for attributing such delay to a force majeure; and a statement as to whether, in the opinion of Settling Defendant, such event may cause or contribute to an endangerment to public health or welfare, or the environment. Settling Defendant shall include with any notice all available documentation supporting its claim that the delay was attributable to a force majeure. Settling Defendant shall be deemed to know of any circumstance of which Settling Defendant, any entity controlled by Settling Defendant, or Settling Defendant's contractors or subcontractors knew or should have known. Failure to comply with the above

requirements regarding an event shall preclude Settling Defendant from asserting any claim of force majeure regarding that event, provided, however, that if EPA, despite the late or incomplete notice, is able to assess to its satisfaction whether the event is a force majeure under ¶ 37 and whether Settling Defendant has exercised its best efforts under ¶ 37, EPA may, in its unreviewable discretion, excuse in writing Settling Defendant's failure to submit timely or complete notices under this Paragraph.

39. If EPA agrees that the delay or anticipated delay is attributable to a force majeure, the time for performance of the obligations under this Consent Decree that are affected by the force majeure will be extended by EPA for such time as is necessary to complete those obligations. An extension of the time for performance of the obligations affected by the force majeure shall not, of itself, extend the time for performance of any other obligation. If EPA does not agree that the delay or anticipated delay has been or will be caused by a force majeure, EPA will notify Settling Defendant in writing of its decision. If EPA agrees that the delay is attributable to a force majeure, EPA will notify Settling Defendant in writing of the length of the extension, if any, for performance of the obligations affected by the force majeure.

40. If Settling Defendant elects to invoke the dispute resolution procedures set forth in Section XIII (Dispute Resolution) regarding EPA's decision, it shall do so no later than 15 days after receipt of EPA's notice. In any such proceeding, Settling Defendant shall have the burden of demonstrating by a preponderance of the evidence that the delay or anticipated delay has been or will be caused by a force majeure, that the duration of the delay or the extension sought was or will be warranted under the circumstances, that best efforts were exercised to avoid and mitigate the effects of the delay, and that Settling Defendant complied with the requirements of ¶¶ 37 and 38. If Settling Defendant carries this burden, the delay at issue shall

be deemed not to be a violation by Settling Defendant of the affected obligation of this Consent Decree identified to EPA and the Court.

41. The failure by EPA to timely complete any obligation under the Consent Decree or under the SOW is not a violation of the Consent Decree, provided, however, that if such failure prevents Settling Defendant from meeting one or more deadlines in the SOW, Settling Defendant may seek relief under this Section.

XIII. DISPUTE RESOLUTION

42. Unless otherwise expressly provided for in this Consent Decree, the dispute resolution procedures of this Section shall be the exclusive mechanism to resolve disputes regarding this Consent Decree. However, the procedures set forth in this Section shall not apply to actions by the United States to enforce obligations of Settling Defendant that have not been disputed in accordance with this Section.

43. A dispute shall be considered to have arisen when one party sends the other party a written Notice of Dispute. Any dispute regarding this Consent Decree shall in the first instance be the subject of informal negotiations between the parties to the dispute. The period for informal negotiations shall not exceed 20 days from the time the dispute arises, unless it is modified by written agreement of the parties to the dispute.

44. <u>Statements of Position.</u>

a. In the event that the parties cannot resolve a dispute by informal negotiations under the preceding Paragraph, then the position advanced by EPA shall be considered binding unless, within 15 days after the conclusion of the informal negotiation period, Settling Defendant invokes the formal dispute resolution procedures of this Section by serving on the United States a written Statement of Position on the matter in dispute, including, but not limited to, any factual data, analysis, or opinion supporting that position and any supporting documentation relied upon by Settling Defendant. The Statement of Position shall specify Settling Defendant's position as to whether formal dispute resolution should proceed under ¶ 45 (Record Review) or 46.

b. Within 30 days after receipt of Settling Defendant's Statement of Position, EPA will serve on Settling Defendant its Statement of Position, including, but not limited to, any factual data, analysis, or opinion supporting that position and all supporting documentation relied upon by EPA. EPA's Statement of Position shall include a statement as to whether formal dispute resolution should proceed under ¶ 45 (Record Review) or 46. Within 30 days after receipt of EPA's Statement of Position, Settling Defendant may submit a Reply.

c. If there is disagreement between EPA and Settling Defendant as to whether dispute resolution should proceed under ¶ 45 (Record Review) or 46, the parties to the dispute shall follow the procedures set forth in the Paragraph determined by EPA to be applicable. However, if Settling Defendant appeals to the Court to resolve the dispute, the Court shall determine which Paragraph is applicable in accordance with the standards of applicability set forth in ¶¶ 45 and 46.

45. Record Review. Formal dispute resolution for disputes pertaining to the selection or adequacy of any response action and all other disputes that are accorded review on the administrative record under applicable principles of administrative law shall be conducted pursuant to the procedures set forth in this Paragraph. For purposes of this Paragraph, the adequacy of any response action includes, without limitation, the adequacy or appropriateness of

plans, procedures to implement plans, or any other items requiring approval by EPA under this Consent Decree, and the adequacy of the performance of response actions taken pursuant to this Consent Decree. Nothing in this Consent Decree shall be construed to allow any dispute by Settling Defendant regarding the validity of the IROD's provisions.

a. An administrative record of the dispute shall be maintained by EPA and shall contain all statements of position, including supporting documentation, submitted pursuant to this Section. Where appropriate, EPA may allow submission of supplemental statements of position by the parties to the dispute.

b. The Director of the Superfund Division, EPA Region 5, will issue a final administrative decision resolving the dispute based on the administrative record described in ¶ 45.a. This decision shall be binding upon Settling Defendant, subject only to the right to seek judicial review pursuant to ¶¶ 45.c and 45.d.

c. Any administrative decision made by EPA pursuant to ¶ 45.b shall be reviewable by this Court, provided that a motion for judicial review of the decision is filed by Settling Defendant with the Court and served on all Parties within 10 days after receipt of EPA's decision. The motion shall include a description of the matter in dispute, the efforts made by the parties to resolve it, the relief requested, and the schedule, if any, within which the dispute must be resolved to ensure orderly implementation of this Consent Decree. The United States may file a response to Settling Defendant's motion.

d. In proceedings on any dispute governed by this Paragraph, Settling Defendant shall have the burden of demonstrating that the decision of the Superfund Director is arbitrary and capricious or otherwise not in accordance with law. Judicial review of EPA's decision shall be on the administrative record compiled pursuant to ¶ 45.a.

46. Formal dispute resolution for disputes that neither pertain to the selection or adequacy of any response action nor are otherwise accorded review on the administrative record under applicable principles of administrative law, shall be governed by this Paragraph.

a. The Director of the Superfund Division, EPA Region 5, will issue a final decision resolving the dispute based on the statements of position and reply, if any, served under ¶ 44. The Superfund Division Director's decision shall be binding on Settling Defendant unless, within 10 days after receipt of the decision, Settling Defendant files with the Court and serves on the parties a motion for judicial review of the decision setting forth the matter in dispute, the efforts made by the parties to resolve it, the relief requested, and the schedule, if any, within which the dispute must be resolved to ensure orderly implementation of the Consent Decree. The United States may file a response to Settling Defendant's motion.

b. Notwithstanding ¶ K (CERCLA § 113(j) record review of IROD and Work) of Section I (Background), judicial review of any dispute governed by this Paragraph shall be governed by applicable principles of law.

47. The invocation of formal dispute resolution procedures under this Section does not extend, postpone, or affect in any way any obligation of Settling Defendant under this Consent Decree not directly in dispute, except as provided in ¶ 31 (Contesting Future Response Costs), as agreed by EPA, or as determined by the Court. Stipulated penalties with respect to the disputed matter shall continue to accrue in accordance with the schedules and other requirements established prior to the invocation of Dispute Resolution, but payment shall be stayed pending

resolution of the dispute, as provided in ¶ 55. Notwithstanding the stay of payment, stipulated penalties shall accrue from the first day of noncompliance with any applicable provision of this Consent Decree. In the event that Settling Defendant does not prevail on the disputed issue, stipulated penalties shall be assessed and paid as provided in Section XIV (Stipulated Penalties).

XIV. STIPULATED PENALTIES

48. Settling Defendant shall be liable for stipulated penalties in the amounts set forth in ¶¶ 49 and 50 to the United States for failure to comply with the requirements of this Consent Decree specified below, unless excused under Section XII (Force Majeure). "Compliance" by Settling Defendant shall include completion of all activities and obligations, including payments, required under this Consent Decree, or any deliverable approved under this Consent Decree, in accordance with all applicable requirements of law, this Consent Decree, the SOW, and any deliverables approved under this Consent Decree and within the specified time schedules established by and approved under this Consent Decree.

49. Stipulated Penalty Amounts - Work (Including Payments and Excluding Deliverables).

a. The following stipulated penalties shall accrue per violation per day for any noncompliance identified in ¶ 49.b:

Period of Noncompliance	Penalty Per Violation Per Day
1st through 14th day	$750
15th through 30th day	$1,500
31st day and beyond	$3,000

b. Compliance Milestones.

(1) Payment of response costs in accordance with Section X.

(2) Selection of Project Coordinator in accordance with Paragraph 9.

(3) Performance of Work in accordance with Paragraph 10, including compliance with all the requirements set forth in the SOW (Appendix D to this Consent Decree).

(4) Compliance with emergency and release response requirements in accordance with Paragraph 11.

(5) Compliance with community involvement requirements in Paragraph 12.

(6) Compliance with property requirements set forth in Section VIII, including securing agreements regarding access and non-interference (Paragraph 16), and notifying successors-in-title (Paragraph 19).

(7) Establishment and maintenance of financial assurance in compliance with the timelines and other substantive and procedural requirements of Section IX (Financial Assurance).

(8) Provision of access to information in accordance with Section XVIII.

(9) Retention records in accordance with Section XIX.

50. Stipulated Penalty Amounts - Deliverables.

a. Material Defects. If an initially submitted or resubmitted deliverable contains a material defect, and the deliverable is disapproved or modified by EPA under ¶ 5.6(a)

(Initial Submissions) or 5.6.b (Resubmissions) of the SOW due to such material defect, then the material defect shall constitute a lack of compliance for purposes of ¶ 48 . The provisions of Section XIII (Dispute Resolution) and Section XIV (Stipulated Penalties) shall govern the accrual and payment of any stipulated penalties regarding Settling Defendant's submissions under this Consent Decree.

b. The following stipulated penalties shall accrue per violation per day for failure to submit timely or adequate deliverables pursuant to the Consent Decree:

Period of Noncompliance	Penalty Per Violation Per Day
1st through 14th day	$500
15th through 30th day	$1,000
31st day and beyond	$1,500

51. In the event that EPA assumes performance of a portion or all of the Work pursuant to ¶ 62 (Work Takeover), Settling Defendant shall be liable for a stipulated penalty in the amount of $30,000. Stipulated penalties under this Paragraph are in addition to the remedies available under ¶¶ 26 (Access to Financial Assurance) and 62 (Work Takeover).

52. All penalties shall begin to accrue on the day after the complete performance is due or the day a violation occurs and shall continue to accrue through the final day of the correction of the noncompliance or completion of the activity. However, stipulated penalties shall not accrue: (a) with respect to a deficient submission under ¶ 5.6 (Approval of Deliverables) of the SOW, during the period, if any, beginning on the 31st day after EPA's receipt of such submission until the date that EPA notifies Settling Defendant of any deficiency; (b) with respect to a decision by the Director of the Superfund Division, EPA Region 5, under

¶ 45.b or 46.a of Section XIII (Dispute Resolution), during the period, if any, beginning on the 21st day after the date that Settling Defendant's reply to EPA's Statement of Position is received until the date that the Director issues a final decision regarding such dispute; or (c) with respect to judicial review by this Court of any dispute under Section XIII (Dispute Resolution), during the period, if any, beginning on the 31st day after the Court's receipt of the final submission regarding the dispute until the date that the Court issues a final decision regarding such dispute. Nothing in this Consent Decree shall prevent the simultaneous accrual of separate penalties for separate violations of this Consent Decree.

53. Following EPA's determination that Settling Defendant has failed to comply with a requirement of this Consent Decree, EPA may give Settling Defendant written notification of the same and describe the noncompliance. EPA may send Settling Defendant a written demand for payment of the penalties. However, penalties shall accrue as provided in the preceding Paragraph regardless of whether EPA has notified Settling Defendant of a violation.

54. All penalties accruing under this Section shall be due and payable to the United States within 30 days after Settling Defendant's receipt from EPA of a demand for payment of the penalties, unless Settling Defendant invokes the Dispute Resolution procedures under Section XIII (Dispute Resolution) within the 30-day period. All payments to the United States under this Section shall indicate that the payment is for stipulated penalties and shall be made in accordance with ¶ 30.a (instructions for future response cost payments).

55. Penalties shall continue to accrue as provided in ¶ 52 during any dispute resolution period, but need not be paid until the following:

a. If the dispute is resolved by agreement of the parties or by a decision of EPA that is not appealed to this Court, accrued penalties determined to be owed shall be paid to EPA within 15 days after the agreement or the receipt of EPA's decision or order;

b. If the dispute is appealed to this Court and the United States prevails in whole or in part, Settling Defendant shall pay all accrued penalties determined by the Court to be owed to EPA within 60 days after receipt of the Court's decision or order, except as provided in ¶ 55.c;

c. If the District Court's decision is appealed by any Party, Settling Defendant shall pay all accrued penalties determined by the District Court to be owed to the United States into an interest-bearing escrow account, established at a duly chartered bank or trust company that is insured by the FDIC, within 60 days after receipt of the Court's decision or order. Penalties shall be paid into this account as they continue to accrue, at least every 60 days. Within 15 days after receipt of the final appellate court decision, the escrow agent shall pay the balance of the account to EPA or to Settling Defendant to the extent that it prevails.

56. If Settling Defendant fails to pay stipulated penalties when due, Settling Defendant shall pay Interest on the unpaid stipulated penalties as follows: (a) if Settling Defendant has timely invoked dispute resolution such that the obligation to pay stipulated penalties has been stayed pending the outcome of dispute resolution, Interest shall accrue from the date stipulated penalties are due pursuant to ¶ 55 until the date of payment; and (b) if Settling Defendant fails to timely invoke dispute resolution, Interest shall accrue from the date of demand under ¶ 54 until the date of payment. If Settling Defendant fails to pay stipulated penalties and

Interest when due, the United States may institute proceedings to collect the penalties and Interest.

57. The payment of penalties and Interest, if any, shall not alter in any way Settling Defendant's obligation to complete the performance of the Work required under this Consent Decree.

58. Nothing in this Consent Decree shall be construed as prohibiting, altering, or in any way limiting the ability of the United States to seek any other remedies or sanctions available by virtue of Settling Defendant's violation of this Consent Decree or of the statutes and regulations upon which it is based, including, but not limited to, penalties pursuant to Section 122(*l*) of CERCLA, 42 U.S.C. § 9622(*l*), provided, however, that the United States shall not seek civil penalties pursuant to Section 122(*l*) of CERCLA for any violation for which a stipulated penalty is provided in this Consent Decree, except in the case of a willful violation of this Consent Decree.

59. Notwithstanding any other provision of this Section, the United States may, in its unreviewable discretion, waive any portion of stipulated penalties that have accrued pursuant to this Consent Decree.

XV. COVENANTS BY PLAINTIFF

60. <u>Covenants for Settling Defendant by United States.</u> Except as provided in ¶ 61 (General Reservations of Rights), the United States covenants not to sue or to take administrative action against Settling Defendant pursuant to Sections 106 and 107(a) of CERCLA for the Work. These covenants shall take effect upon the Effective Date. These covenants are conditioned upon the satisfactory performance by Settling Defendant of its obligations under this Consent

Decree. These covenants extend only to Settling Defendant and do not extend to any other person.

61. General Reservations of Rights. The United States reserves, and this Consent Decree is without prejudice to, all rights against Settling Defendant with respect to all matters not expressly included within Plaintiff's covenants. Notwithstanding any other provision of this Consent Decree, the United States reserves all rights against Settling Defendant with respect to:

a. liability for failure by Settling Defendant to meet a requirement of this Consent Decree;

b. liability arising from the past, present, or future disposal, release, or threat of release of Waste Material outside of the Site;

c. liability based on the ownership of the Site by Settling Defendant when such ownership commences after signature of this Consent Decree by Settling Defendant;

d. liability based on the operation of the Site by Settling Defendant when such operation commences after signature of this Consent Decree by Settling Defendant and does not arise solely from Settling Defendant's performance of the Work;

e. liability based on Settling Defendant's transportation, treatment, storage, or disposal, or arrangement for transportation, treatment, storage, or disposal of Waste Material at or in connection with the Site, other than as provided in the IROD, the Work, or otherwise ordered by EPA, after signature of this Consent Decree by Settling Defendant;

f. liability for damages for injury to, destruction of, or loss of natural resources, and for the costs of any natural resource damage assessments;

g. criminal liability;

h. liability for violations of federal or state law that occur during or after implementation of the Work; and

i. liability, prior to achievement of Performance Standards, for additional response actions that EPA determines are necessary to achieve and maintain Performance Standards or to carry out and maintain the effectiveness of the remedy set forth in the IROD, but that cannot be required pursuant to ¶ 13 (Modification of SOW or Related Deliverables);]

j. liability for work that may be required by the final response action for OU3 and liability for additional operable units at the Site, except for work addressed by the Administrative Order on Consent dated September 28, 2001, docket number V-W-01-C-663;

k. liability for costs that the United States will incur regarding the Site but that are not within the definition of Future Response Costs;

62. <u>Work Takeover.</u>

a. In the event EPA determines that Settling Defendant: (1) has ceased implementation of any portion of the Work; (2) is seriously or repeatedly deficient or late in their performance of the Work; or (3) is implementing the Work in a manner that may cause an endangerment to human health or the environment, EPA may issue a written notice ("Work Takeover Notice") to Settling Defendant. Any Work Takeover Notice issued by EPA will specify the grounds upon which such notice was issued. Any Work Takeover Notice issued by EPA under circumstances (1) or (2) described above in this subparagraph will provide Settling Defendant a period of 30 days within which to remedy the circumstances giving rise to EPA's issuance of such notice. Any Work Takeover Notice issued by EPA under circumstance (3) described above in this subparagraph will provide Settling Defendant a period of 10 days within which to remedy the circumstances giving rise to EPA's issuance of such notice.

b. If, after expiration of the notice period specified in ¶ 62.a, Settling Defendant has not remedied to EPA's satisfaction the circumstances giving rise to EPA's issuance of the relevant Work Takeover Notice, EPA may at any time thereafter assume the performance of all or any portion(s) of the Work as EPA deems necessary ("Work Takeover"). EPA will notify Settling Defendant in writing (which writing may be electronic) if EPA determines that implementation of a Work Takeover is warranted under this ¶ 62.b. Funding of Work Takeover costs is addressed under ¶ 26 (Access to Financial Assurance).

c. Settling Defendant may invoke the procedures set forth in ¶ 45 (Record Review), to dispute EPA's implementation of a Work Takeover under ¶ 62.b. However, notwithstanding Settling Defendant's invocation of such dispute resolution procedures, and during the pendency of any such dispute, EPA may in its sole discretion commence and continue a Work Takeover under ¶ 62.b until the earlier of (1) the date that Settling Defendant remedies, to EPA's satisfaction, the circumstances giving rise to EPA's issuance of the relevant Work Takeover Notice, or (2) the date that a final decision is rendered in accordance with ¶ 45 (Record Review) requiring EPA to terminate such Work Takeover.

63. Notwithstanding any other provision of this Consent Decree, the United States retains all authority and reserves all rights to take any and all response actions authorized by law.

XVI. COVENANTS BY SETTLING DEFENDANT

64. Covenants by Settling Defendant. Subject to the reservations in ¶ 66, Settling Defendant covenants not to sue and agrees not to assert any claims or causes of action against the United States with respect to:

a. the Work, and past response actions regarding the Site, and Future Response Costs.

b. any direct or indirect claim for reimbursement from the EPA Hazardous Substance Superfund through CERCLA §§ 106(b)(2), 107, 111, 112 or 113, or any other provision of law;

c. any claims under CERCLA §§ 107 or 113, RCRA Section 7002(a), 42 U.S.C. § 6972(a), or state law regarding the Work, past response actions regarding the Site, Future Response Costs; and this Consent Decree;

d. any claims arising out of response actions at or in connection with the Site, including any claim under the United States Constitution, the Tucker Act, 28 U.S.C. § 1491, the Equal Access to Justice Act, 28 U.S.C. § 2412, or at common law.

65. Except as provided in ¶ 74 (Res Judicata and Other Defenses), the covenants in this Section shall not apply if the United States brings a cause of action or issues an order pursuant to any of the reservations in Section XV (Covenants by Plaintiff), other than in ¶¶ 61.a (claims for failure to meet a requirement of the Consent Decree), 61.g (criminal liability), and 61.h (violations of federal/state law during or after implementation of the Work), but only to the extent that Settling Defendant's claims arise from the same response action, response costs, or damages that the United States is seeking pursuant to the applicable reservation.

66. Settling Defendant reserves, and this Consent Decree is without prejudice to, claims against the United States, subject to the provisions of Chapter 171 of Title 28 of the United States Code, and brought pursuant to any statute other than CERCLA or RCRA and for which the waiver of sovereign immunity is found in a statute other than CERCLA or RCRA, for money damages for injury or loss of property or personal injury or death caused by the negligent or wrongful act or omission of any employee of the United States, as that term is defined in 28 U.S.C. § 2671, while acting within the scope of his or her office or employment under circumstances where the United States, if a private person, would be liable to the claimant in accordance with the law of the place where the act or omission occurred. However, the foregoing shall not include any claim based on EPA's selection of response actions, or the oversight or approval of Settling Defendant's deliverables or activities.

67. Nothing in this Consent Decree shall be deemed to constitute approval or preauthorization of a claim within the meaning of Section 111 of CERCLA, 42 U.S.C. § 9611, or 40 C.F.R. § 300.700(d).

68. Settling Defendant agrees not to seek judicial review of the final rule listing the Site on the National Priorities List based on a claim that changed site conditions that resulted from the performance of the Work in any way affected the basis for listing the Site.

XVII. EFFECT OF SETTLEMENT; CONTRIBUTION

69. Nothing in this Consent Decree shall be construed to create any rights in, or grant any cause of action to, any person not a Party to this Consent Decree. Except as provided in Section XVI (Covenants by Settling Defendant), each Party expressly reserves any and all rights (including, but not limited to, pursuant to Section 113 of CERCLA, 42 U.S.C. § 9613), defenses,

claims, demands, and causes of action that each Party may have with respect to any matter, transaction, or occurrence relating in any way to the Site against any person not a Party hereto. Nothing in this Consent Decree diminishes the right of the United States, pursuant to Section 113(f)(2) and (3) of CERCLA, 42 U.S.C. § 9613(f)(2)-(3), to pursue any such persons to obtain additional response costs or response action and to enter into settlements that give rise to contribution protection pursuant to Section 113(f)(2).

70. The Parties agree, and by entering this Consent Decree this Court finds, that this Consent Decree constitutes a judicially-approved settlement pursuant to which Settling Defendant has, as of the Effective Date, resolved liability to the United States within the meaning of Section 113(f)(2) of CERCLA, 42 U.S.C. § 9613(f)(2), and is entitled, as of the Effective Date, to protection from contribution actions or claims as provided by Section 113(f)(2) of CERCLA, or as may be otherwise provided by law, for the "matters addressed" in this Consent Decree. The "matters addressed" in this Consent Decree are the Work, and Future Response Costs.

71. The Parties further agree, and by entering this Consent Decree this Court finds, that the complaint filed by the United States in this action is a civil action within the meaning of Section 113(f)(1) of CERCLA, 42 U.S.C. § 9613(f)(1), and that this Consent Decree constitutes a judicially-approved settlement pursuant to which Settling Defendant has, as of the Effective Date, resolved liability to the United States within the meaning of Section 113(f)(3)(B) of CERCLA, 42 U.S.C. § 9613(f)(3)(B).

72. Settling Defendant shall, with respect to any suit or claim brought by it for matters related to this Consent Decree, notify the United States in writing no later than 60 days prior to the initiation of such suit or claim.

73. Settling Defendant shall, with respect to any suit or claim brought against it for matters related to this Consent Decree, notify in writing the United States within 10 days after service of the complaint on the Settling Defendant. In addition, Settling Defendant shall notify the United States within 10 days after service or receipt of any Motion for Summary Judgment and within 10 days after receipt of any order from a court setting a case for trial.

74. Res Judicata and Other Defenses. In any subsequent administrative or judicial proceeding initiated by the United States for injunctive relief, recovery of response costs, or other appropriate relief relating to the Site, Settling Defendant shall not assert, and may not maintain, any defense or claim based upon the principles of waiver, res judicata, collateral estoppel, issue preclusion, claim-splitting, or other defenses based upon any contention that the claims raised by the United States in the subsequent proceeding were or should have been brought in the instant case; provided, however, that nothing in this Paragraph affects the enforceability of the covenants not to sue set forth in Section XV (Covenants by Plaintiff).

XVIII. ACCESS TO INFORMATION

75. Settling Defendant shall provide to EPA, upon request, copies of all records, reports, documents, and other information (including records, reports, documents, and other information in electronic form) (hereinafter referred to as “Records”) within Settling Defendant’s possession or control or that of its contractors or agents relating to activities at the Site or to the implementation of this Consent Decree, including, but not limited to, sampling, analysis, chain of

custody records, manifests, trucking logs, receipts, reports, sample traffic routing, correspondence, or other documents or information regarding the Work. Settling Defendant shall also make available to EPA, for purposes of investigation, information gathering, or testimony, their employees, agents, or representatives with knowledge of relevant facts concerning the performance of the Work.

76. Privileged and Protected Claims.

a. Settling Defendant may assert that all or part of a Record requested by Plaintiff is privileged or protected as provided under law, in lieu of providing the Record, provided Settling Defendant complies with ¶ 76.b, and except as provided in ¶ 76.c.

b. If Settling Defendant asserts a claim of privilege or protection, it shall provide Plaintiff with the following information regarding such Record: its title; its date; the name, title, affiliation (e.g., company or firm), and address of the author, of each addressee, and of each recipient; a description of the Record's contents; and the privilege or protection asserted. If a claim of privilege or protection applies only to a portion of a Record, Settling Defendant shall provide the Record to Plaintiff in redacted form to mask the privileged or protected portion only. Settling Defendant shall retain all Records that it claims to be privileged or protected until Plaintiff has had a reasonable opportunity to dispute the privilege or protection claim and any such dispute has been resolved in Settling Defendant's favor.

c. Settling Defendant may make no claim of privilege or protection regarding: (1) any data regarding the Site, including, but not limited to, all sampling, analytical, monitoring, hydrogeologic, scientific, chemical, radiological or engineering data, or the portion of any other Record that evidences conditions at or around the Site; or (2) the portion of any Record that Settling Defendant is required to create or generate pursuant to this Consent Decree.

77. Business Confidential Claims. Settling Defendant may assert that all or part of a Record provided to Plaintiff under this Section or Section XIX (Retention of Records) is business confidential to the extent permitted by and in accordance with Section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7), and 40 C.F.R. § 2.203(b). Settling Defendant shall segregate and clearly identify all Records or parts thereof submitted under this Consent Decree for which Settling Defendant asserts business confidentiality claims. Records submitted to EPA determined to be confidential by EPA will be afforded the protection specified in 40 C.F.R. Part 2, Subpart B. If no claim of confidentiality accompanies Records when they are submitted to EPA, or if EPA has notified Settling Defendant that the Records are not confidential under the standards of Section 104(e)(7) of CERCLA or 40 C.F.R. Part 2, Subpart B, the public may be given access to such Records without further notice to Settling Defendant.

78. If relevant to the proceeding, the Parties agree that validated sampling or monitoring data generated in accordance with the SOW and reviewed and approved by EPA shall be admissible as evidence, without objection, in any proceeding under this Consent Decree.

79. Notwithstanding any provision of this Consent Decree, Plaintiff retains all of its information gathering and inspection authorities and rights, including enforcement actions related thereto, under CERCLA, RCRA, and any other applicable statutes or regulations.

XIX. RETENTION OF RECORDS

80. Until 10 years after EPA's Certification of Work Completion under ¶ 3.7 (Certification of Work Completion) of the SOW, Settling Defendant shall preserve and retain all

non-identical copies of Records (including Records in electronic form) now in its possession or control or that come into its possession or control that relate in any manner to its liability under CERCLA with respect to the Site, provided, however, that Settling Defendant must retain, in addition, all Records that relate to the liability of any other person under CERCLA with respect to the Site. Settling Defendant must also retain, and instruct its contractors and agents to preserve, for the same period of time specified above all non-identical copies of the last draft or final version of any Records (including Records in electronic form) now in its possession or control or that come into its possession or control that relate in any manner to the performance of the Work, provided, however, that Settling Defendant (and its contractors and agents) must retain, in addition, copies of all data generated during the performance of the Work and not contained in the aforementioned Records required to be retained. Each of the above record retention requirements shall apply regardless of any corporate retention policy to the contrary.

81. At the conclusion of this record retention period, Settling Defendant shall notify the United States at least 90 days prior to the destruction of any such Records, and, upon request by the United States, and except as provided in ¶ 76 (Privileged and Protected Claims), Settling Defendant shall deliver any such Records to EPA.

82. Settling Defendant certifies that, to the best of its knowledge and belief, after thorough inquiry, it has not altered, mutilated, discarded, destroyed, or otherwise disposed of any Records (other than identical copies) relating to its potential liability regarding the Site since notification of potential liability by the United States or the State and that it has fully complied with any and all EPA and State requests for information regarding the Site pursuant to Sections 104(e) and 122(e)(3)(B) of CERCLA, 42 U.S.C. §§ 9604(e) and 9622(e)(3)(B), and Section 3007 of RCRA, 42 U.S.C. § 6927, and state law.

XX. NOTICES AND SUBMISSIONS

83. All approvals, consents, deliverables, modifications, notices, notifications, objections, proposals, reports, and requests specified in this Consent Decree must be in writing unless otherwise specified. Whenever, under this Consent Decree, notice is required to be given, or a report or other document is required to be sent, by one Party to another, it must be directed to the person(s) specified below at the addresses specified below. Any Party may change the person and/or address applicable to it by providing notice of such change to all Parties. All notices under this Section are effective upon receipt, unless otherwise specified. Notices required to be sent to EPA, and not to the United States, should not be sent to the DOJ. Except as otherwise provided, notice to a Party by email (if that option is provided below) or by regular mail in accordance with this Section satisfies any notice requirement of the Consent Decree regarding such Party.

As to the United States:	EES Case Management Unit U.S. Department of Justice Environment and Natural Resources Division P.O. Box 7611 Washington, D.C. 20044-7611 eescdcopy.enrd@usdoj.gov Re: DJ # 90-11-3-11237

As to EPA:	Director, Superfund Division U.S. Environmental Protection Agency Region 5 77 West Jackson Blvd. Chicago, IL 60604
	Erik Olson Associate Regional Counsel U.S. Environmental Protection Agency Region 5 Mail Code C-14J 77 West Jackson Blvd. Chicago, IL 60604 olson.erik@epa.gov
	Jennifer Elkins EPA Project Coordinator U.S. Environmental Protection Agency Region 5 Mail Code SR-6J 77 West Jackson Blvd. Chicago, IL 60604 elkins.jennifer@epa.gov
As to the Regional Financial Management Officer:	Regional Financial Manager U.S. Environmental Protection Agency 77 West Jackson Blvd. Chicago, IL 60604
At to EPA Cincinnati Finance Center:	EPA Cincinnati Finance Center 26 W. Martin Luther King Drive Cincinnati, Ohio 45268 cinwd_acctsreceivable@epa.gov

As to Settling Defendant:

James Lavrich
Settling Defendant's Project Coordinator
Remediation Manager
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140 Dixie Highway
Rossford, OH 43460
Telephone: (419) 247-4538
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Southfield, MI 48075
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sanforda@pepperlaw.com

XXI. RETENTION OF JURISDICTION

84. This Court retains jurisdiction over both the subject matter of this Consent Decree and Settling Defendant for the duration of the performance of the terms and provisions of this Consent Decree for the purpose of enabling any of the Parties to apply to the Court at any time for such further order, direction, and relief as may be necessary or appropriate for the construction or modification of this Consent Decree, or to effectuate or enforce compliance with its terms, or to resolve disputes in accordance with Section XIII (Dispute Resolution).

XXII. APPENDICES

85. The following appendices are attached to and incorporated into this Consent Decree:

"Appendix A" is the Final Remedial Design for Drainage Improvements at Operable Unit 3, September 2014.

"Appendix B" is the Interim Record of Decision/Selected Remedial Alternative for the "Source Areas and Groundwater South of the Illinois River" Operable Unit 3 (OU3), dated September 2010.

"Appendix C" is the map of the Ottawa Township Flat Glass Superfund Site.

"Appendix D" is the Statement of Work for the Remedial Action for OU3, dated February 2016.

"Appendix E" is the Institutional Control Implementation and Assurance Plan for Operable Units 1, 2 and 3, Ottawa Township Flat Glass Site.

XXIII. MODIFICATION

86. Except as provided in ¶ 13 (Modification of SOW or Related Deliverables), material modifications to this Consent Decree, including the SOW, shall be in writing, signed by the United States and Settling Defendant, and shall be effective upon approval by the Court. Except as provided in ¶ 13, non-material modifications to this Consent Decree, including the SOW, shall be in writing and shall be effective when signed by duly authorized representatives of the United States and Settling Defendant. A modification to the SOW shall be considered material if it implements an IROD amendment that fundamentally alters the basic features of the selected remedy within the meaning of 40 C.F.R. § 300.435(c)(2)(ii). Before providing its approval to any modification to the SOW, the United States will provide the State with a reasonable opportunity to review and comment on the proposed modification.

87. Nothing in this Consent Decree shall be deemed to alter the Court's power to enforce, supervise, or approve modifications to this Consent Decree.

XXIV. LODGING AND OPPORTUNITY FOR PUBLIC COMMENT

88. This Consent Decree shall be lodged with the Court for at least 30 days for public notice and comment in accordance with Section 122(d)(2) of CERCLA, 42 U.S.C. § 9622(d)(2), and 28 C.F.R. § 50.7. The United States reserves the right to withdraw or withhold its consent if

the comments regarding the Consent Decree disclose facts or considerations that indicate that the Consent Decree is inappropriate, improper, or inadequate. Settling Defendant consents to the entry of this Consent Decree without further notice.

89. If for any reason the Court should decline to approve this Consent Decree in the form presented, this agreement is voidable at the sole discretion of any Party and the terms of the agreement may not be used as evidence in any litigation between the Parties.

XXV. SIGNATORIES/SERVICE

90. Each undersigned representative of Settling Defendant to this Consent Decree and the Assistant Attorney General for the Environment and Natural Resources Division of the Department of Justice certifies that he or she is fully authorized to enter into the terms and conditions of this Consent Decree and to execute and legally bind such Party to this document.

91. Settling Defendant agrees not to oppose entry of this Consent Decree by this Court or to challenge any provision of this Consent Decree unless the United States has notified Settling Defendant in writing that it no longer supports entry of the Consent Decree.

92. Settling Defendant shall identify, on the attached signature page, the name, address, and telephone number of an agent who is authorized to accept service of process by mail on behalf of the Settling Defendant with respect to all matters arising under or relating to this Consent Decree. Settling Defendant agrees to accept service in that manner and to waive the formal service requirements set forth in Rule 4 of the Federal Rules of Civil Procedure and any applicable local rules of this Court, including, but not limited to, service of a summons. Settling Defendant need not file an answer to the complaint in this action unless or until the Court expressly declines to enter this Consent Decree.

XXVI. FINAL JUDGMENT

93. This Consent Decree and its appendices constitute the final, complete, and exclusive agreement and understanding among the Parties regarding the settlement embodied in the Consent Decree. The Parties acknowledge that there are no representations, agreements, or understandings relating to the settlement other than those expressly contained in this Consent Decree.

94. Upon entry of this Consent Decree by the Court, this Consent Decree shall constitute a final judgment between and among the United States and Settling Defendant. The Court enters this judgment as a final judgment under Fed. R. Civ. P. 54 and 58.

SO ORDERED THIS __ DAY OF _______, 20__.

____
United States District Judge

Signature Page for Consent Decree regarding the Ottawa Township Flat Glass Superfund Site

FOR THE UNITED STATES OF AMERICA:

Thomas A. Mariani, Jr.
Acting Section Chief
Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice

/s/ Iva Ziza

Iva Ziza
Trial Attorney
U.S. Department of Justice
Environment and Natural Resources Division
Environmental Enforcement Section
P.O. Box 7611
Washington, D.C. 20044-7611
Phone: (202) 514-3211
Fax: (202) 616-6584
iva.ziza@usdoj.gov

Signature Page for Consent Decree regarding the Ottawa Township Flat Glass Superfund Site

for Richard C. Karl
Director, Superfund Division
U.S. Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, IL 60604

Erik H. Olson
Associate Regional Counsel
U.S. Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, IL 60604

Signature Page for Consent Decree regarding the Ottawa Township Flat Glass Superfund Site

FOR PILKINGTON NORTH AMERICA, INC.:

3/24/16
Dated

Name : Alan R. Graham
Title: Vice President and Secretary
Address: 811 Madison Avenue
Toledo, OH 43604-5684

Agent Authorized to Accept Service
on Behalf of Above-signed Party:

Company:	CT Corporation
Address:	208 S. LaSalle St.
	Chicago, IL 60604
Phone:	(312) 263-1414

United States vs. Pilkington North America, Inc.

APPENDIX A TO REMEDIAL ACTION CONSENT DECREE

Final Remedial Design for Drainage Improvements at Operable Unit 3, September 2014

FINAL REMEDIAL DESIGN
FOR
DRAINAGE IMPROVEMENTS
AT
OPERABLE UNIT 3

FOR THE:
OTTAWA TOWNSHIP FLAT GLASS SITE
CITY OF OTTAWA, LASALLE COUNTY, ILLINOIS
CERCLA DOCKET NO. V-W-11-C-989

PREPARED FOR:
PILKINGTON NORTH AMERICA, INC.
140 DIXIE HIGHWAY
ROSSFORD, OHIO 43460

PREPARED BY:
HULL & ASSOCIATES, INC.
6397 EMERALD PARKWAY, SUITE 200
DUBLIN, OHIO 43016

SEPTEMBER 2014

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1.0 INTRODUCTION

1.1 General

Hull & Associates, Inc. (Hull) has been retained by Pilkington North America, Inc. (PNA) to coordinate, on behalf of PNA, the Remedial Design (RD) for Operable Unit 3 (OU3, Source Areas and Groundwater south of the Illinois River) at the Ottawa Township Flat Glass Site (Site) located in LaSalle County, Illinois. A Site location map is shown on Figure 1. The layout of OU3 is shown on Figure 2. The RD is being performed in accordance with the provisions of the Administrative Order (the Order) and the supporting Statement of Work (SOW)[1], which requires that PNA undertake various procedures and technical analyses to produce a detailed set of plans and technical specifications for implementation of the Remedial Action (RA) selected in the United States Environmental Protection Agency's (USEPA's) September 29, 2010 Interim Record of Decision (IROD) for OU3. The Final Remedial Design builds upon the Preliminary Remedial Design (Hull document PNA103.300.0047), Remedial Design Work Plan [(RD Work Plan), Hull document PNA103.300.0039] and the Pre-Design Investigation (PDI) Technical Memorandum (Hull document PNA103.300.0035) which were approved by USEPA on December 18, 2013 (with modifications) and June 6, 2013, respectively. The Final Remedial Design has been prepared on behalf of PNA, for the USEPA, its subcontractors, and other representatives in accordance with Section III (E)(1) of the SOW.

1.2 Document Organization

This document focuses on the drainage modification component of the OU3 remedy and addresses the items outlined in Section 3(E)(1) of the SOW. The table below lists the SOW item with the corresponding section of this document where that item is addressed.

SOW Item Number in Section III(E)(1)	SOW Item Description	Final Design Document Section Number
a.	Drawings and specifications	Drawings under separate cover
b.	Performance Standard Verification Plan (PSVP)	Appendix D
c.	Construction Quality Assurance Plan (CQAP)	Appendix E
d.	Draft Operation and Maintenance (O&M) Plan	Section 2.2.4 of the PSVP in Appendix D
e.	Project Schedule for construction and implementation of the remedial action	Figure 3
f.	Health and Safety Plan (HSP) and Contingency Plan - The final Contingency Plan will be submitted prior to the start of construction, in accordance with the approved construction schedule.	To be submitted prior to the start of construction, in accordance with the approved construction schedule

[1] Administrative Order on Consent (the Order), Docket No. V-W-11-C-989, effective February 6, 2012, and the corresponding Statement of Work designated as Appendix A of the Order.

2.0 FINAL DESIGN PLANS AND SPECIFICATIONS

2.1 Additional Field Information

2.1.1 Addendum to the Ecological Resource Assessment

Hull personnel visited the Site on July 30, 2014 and performed surface water delineation in an additional area around Quarry 2 that will potentially be disturbed during construction of the surface water drainage modifications based on the Final Remedial Design. The work also included identification of potential bat habitat in this area. The Ecological Resource Assessment Addendum is provided in Appendix A.

2.1.2 Construction Considerations

Construction considerations include:

1. Ensuring the work area is secure. The area where construction will take place is fenced and gated.

2. Minimize removal of material from the existing drainage ditch along Quarry 1. Excavation will be limited to removing high points in the drainage ditch and regrading the last 700 feet of the ditch to flow to the inlet of the storm sewer that will bypass Quarry 2 and 3.

3. Manage materials on-site. Excess excavated material not used for leveling within the ditch and storm water pumped from the ditch during construction will be diverted to Quarry 2.

4. Minimize disturbance of existing vegetation. Vegetation removal for the access roads and staging areas will require cutting of vegetation for clearance of vehicles; however, the roots will not be removed. Vegetation less than 5 inches (dbh) and loose debris will be removed from the existing ditch; however, the grubbing or reshaping of the ditch embankments will not be necessary. This will allow existing vegetation and root masses to remain in place to help stabilize the work area.

5. Avoidance of potential bat habitat. Potential bat habitat trees are noted on the plans and shall not be disturbed. If disturbance is necessary, it must occur after October 1, 2014 after obtaining permission from USEPA.

6. A decontamination pad will be used to wash the portions of the construction equipment that come in contact with excavated ditch sediment.

2.2 Design Rationale and Calculations

2.2.1 Overall Drainage Considerations

As shown on Figure 2, the drainage ditch originates at the former G&P slurry pipe discharge at the southwest corner of the Site and currently flows into Quarry 2 near the central portion of the Site. At the origin, one section of ditch goes around the south end of Quarry 1 and one section of the ditch goes across Quarry 1 before combining to form one ditch along Quarry 1. The section of ditch across Quarry 1 formerly carried wastewater pumped from the PNA property on the north side of the Illinois River in accordance with the

State Operating Permit. The State Operating Permit remains in place, but wastewater flow ceased in 2006 when PNA connected to the City of Ottawa sanitary sewer system.

The drainage ditch receives surface water flow from a drainage area of 169 acres. The drainage modifications are designed to reduce surface water infiltration in the drainage ditch located to the south of Quarry 1 and in Quarry 2 by bypassing flow around Quarry 2 to Quarry 4. The remedy will not alter surface water drainage on other portions of the PNA property or off-property areas within the drainage area. The modifications are not designed to eliminate infiltration and convey all surface runoff to Quarry 4. Rather, the modifications are designed to minimize the surface water infiltration component contributing to groundwater sufficiently to achieve the objective of the remedy.

The lined portion of the ditch cross-section will be designed to contain the peak flow from a design storm that is determined to capture the majority of rainfall events for this location. The ditch lining will be installed on the base of the ditch and extend up each side embankment, as needed, to create a lined cross-sectional area sufficient to carry the peak flow from the design storm. The liner will be constructed using AquaBlok© - Blended Barrier™. Material specifications for AquaBlok© - Blended Barrier™ are provided in Appendix B. A storm sewer will be installed to bypass the peak flow around Quarry 2 to Quarry 4.

If the peak flow of the design storm is exceeded (larger rain events on average are less frequent), the excess surface water flow will be diverted through Quarry 2 and allowed to flow through the existing drainage system. During this time, the surface water elevation in the ditch may be above the lined section of the ditch, but a majority of the infiltration will be controlled by the lined section. This design approach will reduce the majority of the infiltration in the ditch and Quarries 2 and 3 by containing runoff up to and including the design storm, yet allow the drainage system to handle less frequent, larger flow events as it does now.

2.2.2 Existing Ditch Across Quarry 1

The existing ditch across Quarry 1 serves little purpose since wastewater flow from PNA property on the north side ceased in 2006. The surface of Quarry 1 is flat and heavily vegetated, which limits surface flow to this section of ditch. Although this section of ditch carries minimal flow, this section of ditch will be lined using the same design rationale for the existing ditch along Quarry 1.

2.2.3 Existing Ditch Along Quarry 1

Design calculations are provided in the Stormwater Calculation Report provided in Appendix C.

The lined portion of the ditch cross-section will be designed to contain the peak flow during a 2-year, 24-hour rainfall event. A 2-year, 24-hour rainfall event is a nationally accepted rate that represents the amount of rainfall expected over a 24-hour period during a 2-year recurrence interval. A graph was prepared showing average daily rainfall in Ottawa, Illinois between 1993 and 2013 compared to the 2-year, 24-hour rainfall event (see Appendix A of the Stormwater Calculation Report). These data support the selection of the 2-year, 24-hour rainfall event as a design point by illustrating that the 2-year, 24-hour rainfall event captures the majority of the daily average rainfall for a typical year (over 99 percent of the rainfall).

To determine the portion of the ditch cross section that will be lined, the peak discharge from the design storm was calculated using the Soil Conservation Service TR-55 method. Once the peak flow was determined, the U.S. Army Corp of Engineers River Analysis System (HEC-RAS) was used to determine the water surface profile of the existing ditch. The elevation of the liner was determined by adding 6 inches to the water surface profile to account for construction tolerances.

2.2.4 Drainage Bypass Around Quarry 2

The storm sewer was designed using the peak flow from the design storm and establishing a hydraulic grade line within the sewer. Once the hydraulic grade line was established, it was used as the known surface water elevation for the most downstream cross section in the HEC-RAS model, after factoring in the losses for the inlet to the storm sewer.

Inlet protection to the storm sewer was calculated using maximum channel bottom shear stress using Federal Highway Administration's Design of Roadside Channels with Flexible Lining (Hydraulic Engineering Circular, 2005).

The water surface elevation from the peak flow of the design storm at the inlet to the storm sewer was used as the elevation of an extended wing wall from the headwall of the storm sewer. This extended wing wall will divert the peak flow of the design storm into the storm sewer allowing it to bypass Quarry 2 and 3 and discharge directly to Quarry 4. For larger rain events (less frequent), the water will rise above this elevation and discharge to Quarry 2 through the same channel that currently exists at the site. The drainage system for a bypass event will function as it currently does (i.e., Quarry 2 discharges to Quarry 3, which discharges to Quarry 4).

2.3 Final Design Plans and Specifications

Final design plans and specifications are included under separate cover.

2.4 Preliminary Construction Schedule

A preliminary construction schedule is provided on Figure 3. The preliminary construction schedule shows general timelines. In general, construction will be planned to occur during dryer months when foliage is not in full bloom (i.e., fall to early winter). This will reduce the need for water management in the ditch during construction and allow increased visibility for ditch preparation and lining.

3.0 PERFORMANCE STANDARD VERIFICATION PLAN

A draft Performance Standard Verification Plan (PSVP), revised in accordance with USEPA's comments on the Preliminary Remedial Design, is provided in Appendix D. In accordance with the SOW, the draft PSVP is intended to describe the performance monitoring that will be conducted to ensure that both the short-term and long-term Performance Standards for the Remedial Action are met. In addition, the PSVP lays out the maintenance requirements for the Surface Water Drainage Modifications.

4.0 CONSTRUCTION QUALITY ASSURANCE PROJECT PLAN

As required by Section III(E)(1), the CQAP for the surface water drainage modifications is provided in Appendix E.

5.0 REFERENCES

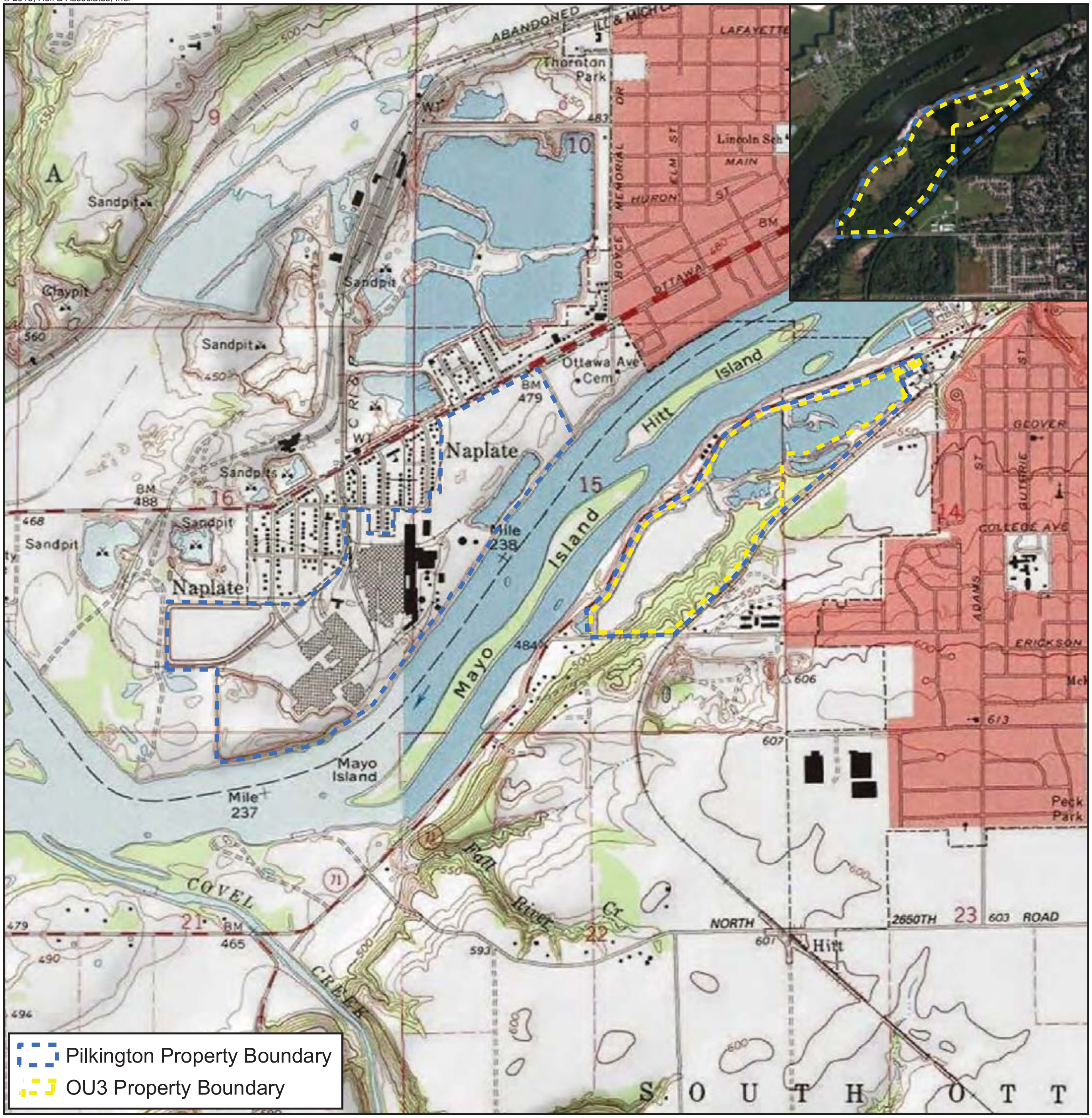
Hull & Associates, Inc. 2014. Preliminary Remedial Design Remedial Design for Drainage Improvements at Operable Unit 3 at the Ottawa Township Flat Glass Site, Ottawa, LaSalle County, Illinois (Hull document PNA103.300.0047).

Hull & Associates, Inc. 2013a. Remedial Design Work Plan for Operable Unit 3 at the Ottawa Township Flat Glass Site, Ottawa, LaSalle County, Illinois (Hull document PNA103.300.0045).

Hull & Associates, Inc. 2013b. Final Pre-Design Investigation Technical Memorandum of Operable Unit 3 at the Ottawa Township Flat Glass Site, Ottawa, LaSalle County, Illinois (Hull document PNA103.300.0035).

USEPA. 2010. Interim Record of Decision Selected Remedial Alternative for the "Source Areas and Groundwater South of the Illinois River" Operable Unit (OU3) of the Ottawa Township Flat Glass Site.

FIGURES



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0 500 1,000 2,000 Feet
1:24,000

Quad: Starved Rock/Ottawa

Source: The topographic map was acquired through the USGS Topographic Map web service.

The aerial photo in the inset was acquired through the ESRI Image web service. Aerial photography dated 2011.

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Final Remedial Design for Drainage Improvements at Operable Unit 3

Site Location Map

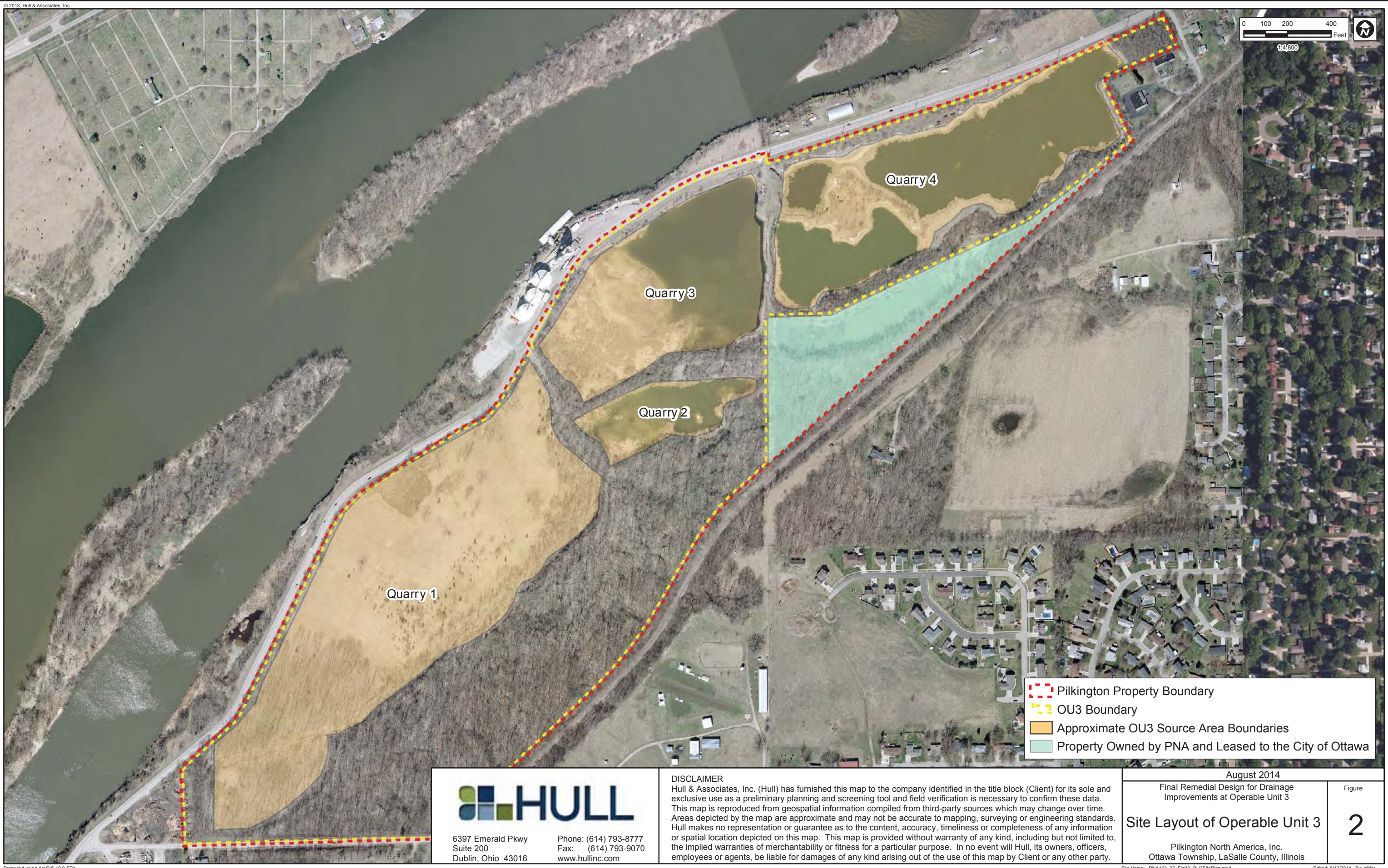
Pilkington North America, Inc.
Ottawa Township, LaSalle County, Illinois

Date:
August 2014

File Name:
PNA103_37_Fig01_SiteLocMap.mxd
Edited: 8/12/2014 By: jslifer

Figure
1

Produced using ArcGIS 10.0 SP1



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August 2014

Final Remedial Design for Drainage
Improvements at Operable Unit 3

Site Layout of Operable Unit 3

Figure 2

Pilkington North America, Inc.
Ottawa Township, LaSalle County, Illinois

File Name: PNA103_37_Fig02_OU3SitePlan.mxd
Edited: 8/12/2014 By: jslifer

Produced using ArcGIS 10.0 SP1

FINAL REMEDIAL DESIGN FOR DRAINAGE IMPROVEMENTS AT OPERABLE UNIT 3 (OU3)
OTTAWA TOWNSHIP FLAT GLASS SITE
CITY OF OTTAWA, LASALLE COUNTY, ILLINOIS

FIGURE 3

ESTIMATED TIMELINE FOR IMPLEMENTATION OF REMEDIAL ACTION
SURFACE WATER DRAINAGE MODIFICATIONS

Phase	Task	Week																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Remedial Action - Drainage Channel Improvements																										
Bidding	Prepare Bid Documents		30 days																							
	Provide a Request for Bid to Select Contractors							30 days																		
	Receive Bids and Select Contractor											30 days														
Construction	Construction of Drainage Channel Improvements																			90 days						

Notes:
PNA is proposing the option of implementing the drainage improvements in 2014. This will require an acceleration of the above timeline with the following approximate milestone dates:
August 15 - September 5, 2014 - Bidding with concurrent USEPA review
September 6, 2014 - December 2, 2014 - Construction.

APPENDIX A

Ecological Resource Assessment Addendum

ADDENDUM TO
DRAFT TECHNICAL MEMORANDUM

ECOLOGICAL RESOURCE ASSESSMENT
APPLICABLE AND RELEVANT OR APPROPRIATE REQUIREMENTS
REMEDIAL DESIGN FOR OPERABLE UNIT 3

FOR THE
PILKINGTON NORTH AMERICA, INC.
OTTAWA TOWNSHIP FLAT GLASS SITE
CITY OF OTTAWA 24
LASALLE COUNTY, ILLINOIS

PREPARED BY:
HULL & ASSOCIATES, INC.
6397 EMERALD PARKWAY
DUBLIN, OHIO 43016

AUGUST 2014

HULL

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1.0 INTRODUCTON

1.1 General

Hull & Associates, Inc. (Hull) has been retained by Pilkington North America, Inc. (PNA) to coordinate, on behalf of PNA, the Remedial Design (RD) for Operable Unit 3 (OU3, Source Areas and Groundwater south of the Illinois River) at the Ottawa Township Flat Glass Site located in LaSalle County, Illinois (Site; Figure 1). The RD is being performed in accordance with the provisions of the Administrative Order (the Order) and the supporting Statement of Work (SOW), which provides that PNA undertake various procedures and technical analyses to produce a detailed set of plans and technical specifications for implementation of the Remedial Action (RA) selected in the United States Environmental Protection Agency's (U.S. EPA's) September 29, 2010 Interim Record of Decision (IROD) for OU3.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires selection of RAs that comply with applicable, or relevant and appropriate requirements (ARARs) of the Resource Conservation and Recovery Act (RCRA), Clean Water Act (CWA), Endangered Species Act (ESA), Clean Air Act (CAA), and other federal and state laws. To ensure that implementation of RD actions associated with surface water flow modifications at OU3 comply with ARARs pertaining to regulation of surface water and ecological resources, Hull conducted a field investigation of OU3 on December 18, 2013. The objective of this assessment was to determine the presence and extent of regulated surface waters under the CWA and the potential for occurrence of listed threatened and endangered (T&E) species and/or their habitat(s) under the federal ESA. Compliance with additional ARARs, including the State of Illinois Interagency Wetland Policy Act of 1989 (IWPA), Illinois Rivers, Lakes and Stream Act (RLSA), and the Illinois Endangered Species Protection Act (ESPA), was also considered.

Additional assessment of OU3 was conducted prior to the submission of the Final Remedial Design. This additional assessment was conducted to assess the final planned work area for implementation of the Remedial Design and address comments on the Preliminary Remedial Design for OU3 provided by USEPA on May 21, 2014.

2.0 ADDITIONAL ECOLOGICAL RESOURCE ASSESSMENT

Hull's additional assessment of proposed RD surface water flow modifications for compliance with ARARs was accomplished by conducting a field survey of OU3 on July 30, 2014. The field survey focused on those portions of OU3 where surface water flow modifications were proposed in the *Pre-Design Investigation Technical Memorandum for the Remedial Design of Operable Unit 3* (Hull 2013), and based on subsequent revisions to the Final Remedial Design. The remainder of the Site was not evaluated for this field survey.

Prior to conducting the field survey, Hull performed due diligence review of existing information pertaining to ecological resources on the Site as described in the February 2014 Draft Technical Memorandum: Ecological Resource Assessment. Additional material reviewed prior to the July 30, 2014 field assessment included the results of a review of OU3 using the Ecological Assessment Compliance Tool (EcoCAT) maintained by the Illinois Department of Natural Resources (Appendix A). Hull used this preliminary information to perform screening of the Site to assist with planning and focus of the onsite investigations.

Hull conducted additional surface water determinations in accordance with the three-criteria (wetland hydrology, hydrophytic vegetation, and hydric soils) method outlined in the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987), the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual for the Midwest Region (v. 2.0)* (USACE 2010), and subsequent guidance issued by the U.S. Army Corps of Engineers (USACE). Surface water determinations were conducted within the entire limit of disturbance of the Final Remedial Design, including the project alignment, construction staging areas and access roads. Where the potential presence of wetlands was suspected, surface water determination data forms were completed and the data sample point was recorded using a sub-foot accuracy Global Positioning System (GPS) receiver. The location of streams in proximity to the survey area was confirmed in the field using United States Geological Survey (USGS) stream mapping, and additional data was recorded for each stream including a measured stream cross section, substrates present, and photographs. The existing drainage ditch was mapped in detail by McClure Engineering Associates, Inc. as part of the RD for Site surface water flow modifications.

Evaluation of the survey area for the potential presence of threatened and endangered (T&E) species was accomplished by making observations of the general condition, vegetative species composition, and ecological quality of habitats on the Site and comparing these observations to known habitat preferences of T&E species of interest. Of particular concern in LaSalle County is the presence of forest habitat that could potentially be used by the federally listed endangered Indiana bat (*Myotis sodalis*) and proposed endangered northern long-eared bat (*Myotis septentrionalis*). These two bat species utilize forest habitat for foraging, roosting, and nesting during spring and summer months. Living and dead trees with features such as cavities, split trunks and limbs, and peeling and exfoliating bark could be used by these listed bat species for roosting and nesting. Therefore, Hull mapped the locations of all potential listed bat roost and maternity nest trees within 50 feet of proposed RD actions with a portable, sub-foot accuracy GPS unit. Living potential bat habitat trees were identified to species, their diameter-at-breast height (dbh) was obtained, and each tree was photographed. Because these listed bats hibernate in caves, abandoned mines, and fissures in rock outcrops during winter, the Site was also examined for suitable areas that could be used as winter hibernacula.

3.0 RESULTS OF ADDITIONAL ECOLOGICAL RESOURCE ASSESSMENT

3.1 Surface Waters

3.1.1 Wetlands

Hull did not identify any additional wetlands within the modified survey area of the RD for surface water flow modifications. Hull initially identified each of the proposed construction staging areas (SA-1 and SA-2) as potentially containing a hydrophytic plant community based on the observed presence of one or more hydrophytic plant species. Wetland Determination Data Forms were completed within each of the proposed construction staging areas and each staging area was determined to be an upland plant community with none of the three wetland criteria (i.e., hydrology, hydric soils and hydrophytic plant community) present. The data point locations UPL-SA1 and UPL-SA2 are depicted on Figure 1, photographs appear in Appendix B and Wetland Determination Data Forms demonstrating the presence of upland at these points appear in Appendix C.

In response to USEPA comments, Hull collected additional data on the upland plant community surrounding previously delineated Wetland A. Hull found that the surrounding forested upland community was dominated by red oak (*Quercus rubra*), sugar maple (*Acer sacharrum*) and hackberry (*Celtis occidentalis*). Hull notes that the final RD alignment will not be constructed in the vicinity of Wetland A.

3.1.2 Streams

Streams identified within the RD survey area included several ephemeral, intermittent and perennial streams located on the slope on the southwestern portion of the Site (Figure 1). These streams conduct surface flow from up-gradient portions of the slope into the drainage channel proposed for RD modifications (Figure 1). These streams are included in the USGS National Hydrologic Database.

Stream 1 – Stream 1 is a perennial stream that flows into the drainage channel. Stream 1 is dominated by sand and gravel substrates. It has an ordinary high water mark (OHWM) width and depth of 5’10” and 13”, respectively. No fish or benthic macroinvertebrates were observed based on a 5-minute observational effort.

Stream 2 – Stream 2 is an ephemeral tributary to Stream 1. Stream 2 does not flow directly to the drainage channel. Stream 1 is dominated by silt substrate and woody debris/leaf litter. Stream 2 has an OHWM width and depth of 4’10” and 3”, respectively. No flow was present at the time of observation, so observation of fish and benthic macroinvertebrates was not conducted.

Stream 3 - Stream 3 is an intermittent stream that flows into the drainage channel. Stream 3 is dominated by sand and silt substrate. Stream 3 has an OHWM width and depth of 5'4" and 4", respectively. No fish or benthic macroinvertebrates were observed based on a 5-minute observational effort.

A non-jurisdictional drainage swale also enters the drainage channel (Figure 1). This swale does not possess bed and bank or an ordinary high water mark, and was therefore found to be outside federal surface water jurisdiction.

3.2 Threatened and Endangered Species

A thorough review of federal and state-listed threatened and endangered species potentially present at OU3 was conducted within the Draft Technical Memorandum: Ecological Resource Assessment (February 2014). This Addendum specifically addresses protected resources identified by EcoCAT as potentially being in the vicinity of the project location (Appendix A).

EcoCAT identified four protected resources as potentially being in the vicinity of the project location: The Fox River Illinois Natural Area Inventory (INAI) site, Banded Killifish, Blacknose Shiner and Indiana Bat. The Fox River INAI (No. 1444) will not be affected by the proposed remedy. The Banded Killifish and Blacknose Shiner may be present in the Illinois River, but the project will have no impact on the River. The potential for the project to adversely affect the Indiana Bat was thoroughly discussed in the Draft Technical Memorandum: Ecological Resource Assessment (February 2014), and further assessment of OU3 for Indiana bat and Northern Long-eared Bat habitat was conducted to support the Final Remedial Design on July 30, 2014.

During the December 18, 2013 assessment, Hull identified fourteen (14) trees that contain features suitable for roosting for the Indiana bat and northern long-eared bat within approximately 50 feet of the RD centerline (LBAT1 through LBAT13, Figure 1). During the July 30, 2014 additional assessment, five additional suitable bat roosting trees were identified (LBAT15 through LBAT19). [NOTE: No LBAT-14 was identified.] Although not specifically assessed, additional potential roost trees are likely to occur throughout forested portions of OU3 outside of the RD survey area. No suitable sites that could function as winter hibernacula for listed bat species were identified on the Site.

4.0 IMPLICATIONS OF FINAL REMEDIAL DESIGN IMPLEMENTATION FOR COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Implementation of RAs associated with the revised RD for surface flow modifications will account for ecological resources on the Site to comply with potential federal and state ARARs. Potential effects to ecological resources and implications for ARAR compliance are discussed below.

4.1 Surface Waters

A single wetland (Wetland A) was identified and delineated during the December 18, 2013 ecological field assessment (Figure 1). Based on the presence of Wetland A, the RD was revised to install a pipe around the north side of Quarry 2 to carry surface water flow to Quarry 4 and therefore avoid all disturbance to Wetland A.

Federally jurisdictional streams occur in proximity to the RD area, but do not extend within it (see Figure 1). No riprap, structures or other permanent or temporary fill material will be placed within these streams in constructing the RD. With appropriate avoidance measures in place during construction of the RD, including detailed plan notes, the project will not impact federally jurisdictional streams.

4.2 Threatened and Endangered Species

Two federally listed T&E species, the Indiana bat and northern long-eared bat, could potentially be affected by proposed RD surface water flow modifications as a consequence of tree cutting. Given the proximity of a large USFWS-designated critical habitat for Indiana bat (the Pecumsaugen Creek-Blackball Mines Nature Preserve, 9 miles from Site), clearing of trees in proximity to the RD area with any roost habitat features may adversely affect the Indiana bat.

Hull has identified a total of seventeen trees in proximity to the revised RD area that could be used by either or both of these listed bats for summer roosting (LBAT-1, 2, 3, 4, 5, 6, 7a, 7b, 8, 9, 10, 15, 16, 17, 18a, 18b and 19). One potential maternity roost tree (LBAT-11) is no longer within the RD area due to realignment. Based on the final RD alignment, one potential bat roost tree (LBAT-16) must be cut for construction of the RD. This tree will be cut during the Indiana bat winter hibernation period (October 1 through March 31). Cutting of this tree in winter is likely to avoid direct impacts and minimize indirect impacts to listed bats. Because winter tree clearing will be implemented, the likely federal determination is that the project 'may affect, but is not likely to adversely affect' listed bats. Clearing of trees during the summer roosting and breeding period (April 1 through September 30) may result in direct adverse effects to listed bats.

Activities that may adversely affect federally listed species are regulated under the federal Endangered Species Act (ESA) and typically require coordination between the lead agency (USEPA) and the USFWS prior to project implementation. Initiation of expedited consultation by the USEPA with USFWS (e.g., through the SLOPES process) would serve to confirm the potential occurrence of the Indiana bat and northern long-eared bat on the Site and to confirm suitable ESA compliance measures for avoiding adverse effects to listed bat species (e.g., winter tree clearing).

Due to the limited number of trees identified as potential Indiana bat and northern long-eared bat habitat, the final RD will specify that all such trees, with the exception of LBAT-16, will not be disturbed during RA activities.

5.0 REFERENCES

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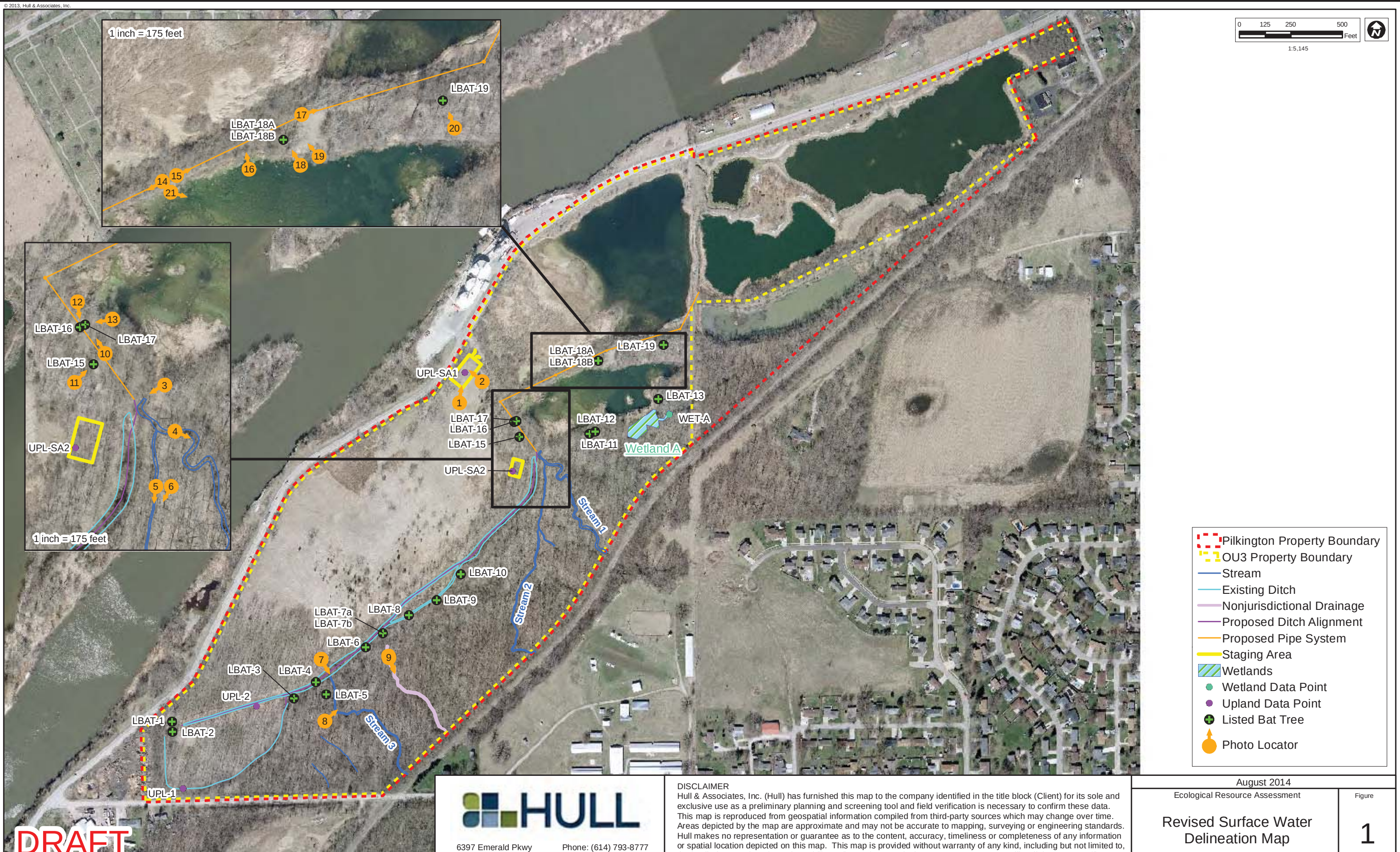
FIGURES



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August 2014

Ecological Resource Assessment

Revised Surface Water Delineation Map

Ottawa Township, LaSalle County, Illinois

Figure 1

Produced using ArcGIS 10.2

File Name: PNA103_36_Fig01_SWDelin.mxd

Edited: 8/12/2014 By: mopel

APPENDIX A

EcoCAT Search Results

EcoCAT
Ecological Compliance Assessment Tool

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Applicant:	Hull & Associates, Inc.	*IDNR Project Number:*	1411798
Contact:	Dan Kelly	*Date:*	05/30/2014
Address:	6397 Emerald Parkway Dublin, OH 43016	*Alternate Number:*	1411793

Project: Ecological Assessment of Ottawa Flat Glass Site OU3
Address: 1200 Hitt Street, Ottawa

Description: Assessment of regulated surface waters and potentially occurring threatened and endangered species for site drainage modification project.

Natural Resource Review Results

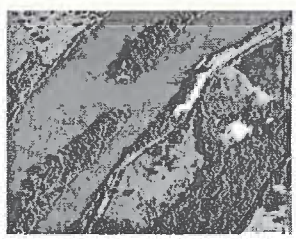
This project was submitted for information only. It is not a consultation under Part 1075.

The Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

Fox River INAI Site
Banded Killifish *(Fundulus diaphanus)*
Blacknose Shiner *(Notropis heterolepis)*
Indiana Bat *(Myotis sodalis)*

Location

The applicant is responsible for the accuracy of the location submitted for the project.



County: LaSalle

Township, Range, Section:
33N, 3E, 14
33N, 3E, 15

IL Department of Natural Resources Contact
Impact Assessment Section
217-785-5500
Division of Ecosystems & Environment

Disclaimer

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, compliance with applicable statutes and regulations is required.

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APPENDIX B

Photographs

PHOTO 1: View to the north from southeast corner of Staging Area 1 (SA-1)

PHOTO 2: Photo of data point UPL- SA1

HULL 6397 Emerald Parkway Suite 200 Dublin, Ohio 43016 © 2013, Hull & Associates, Inc. Phone: (614) 793-8777 Fax: (614) 793-9070 www.hullinc.com	Pilkington N.A., Ottawa Township Flat Glass Site, OU3 Addendum to RD Ecological Resource Assessment Site Photographs State Route 71 Ottawa Township, LaSalle County, OH	Date: AUGUST 2014 Project Number: PNA103 File Name: PNA103.300.0075.XLS

PHOTO 3: View to west of structures in place at eastern end of drainage ditch.

PHOTO 4: Stream 1 (perennial) looking upstream. Width at ordinary high water mark is 5' 10".

PHOTO 5: Stream 2 (ephemeral) looking west or upslope.

PHOTO 6: Stream 2 showing width at ordinary high water mark at 4' 10"

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Pilkington N.A., Ottawa Township Flat Glass Site, OU3
Addendum to RD Ecological Resource Assessment

Site Photographs

State Route 71
Ottawa Township, LaSalle County, OH

Date: AUGUST 2014

Project Number: PNA103

File Name: PNA103.300.0075.XLS

PHOTO 7: Stream 3 looking upstream with culvert in foreground

PHOTO 8: Stream 3 showing width at ordinary high water mark at 5' 4"

PHOTO 9: Nonjurisdictional drainage, with no bed and bank, & no ordinary high water mark

PHOTO 10: Looking northwest along access road from the overflow pipe to Pond 2.
This is the approximate alignment of the proposed pipeline.

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Site Photographs

State Route 71
Ottawa Township, LaSalle County, OH

Date: AUGUST 2014

Project Number: PNA103

File Name: PNA103.300.0075.XLS

PHOTO 11: LBAT 15 - American basswood with multiple crevices.

PHOTO 12: LBAT-16 - Standing dead with exfoliating bark.

PHOTO 13: LBAT-17- American basswood with broken branches and exfoliating bark.

PHOTO 14: Looking southwest along proposed pipe alignment between Ponds 2 & 3

PHOTO 15: Looking north/northeast along proposed pipe alignment between Ponds 2 & 3.

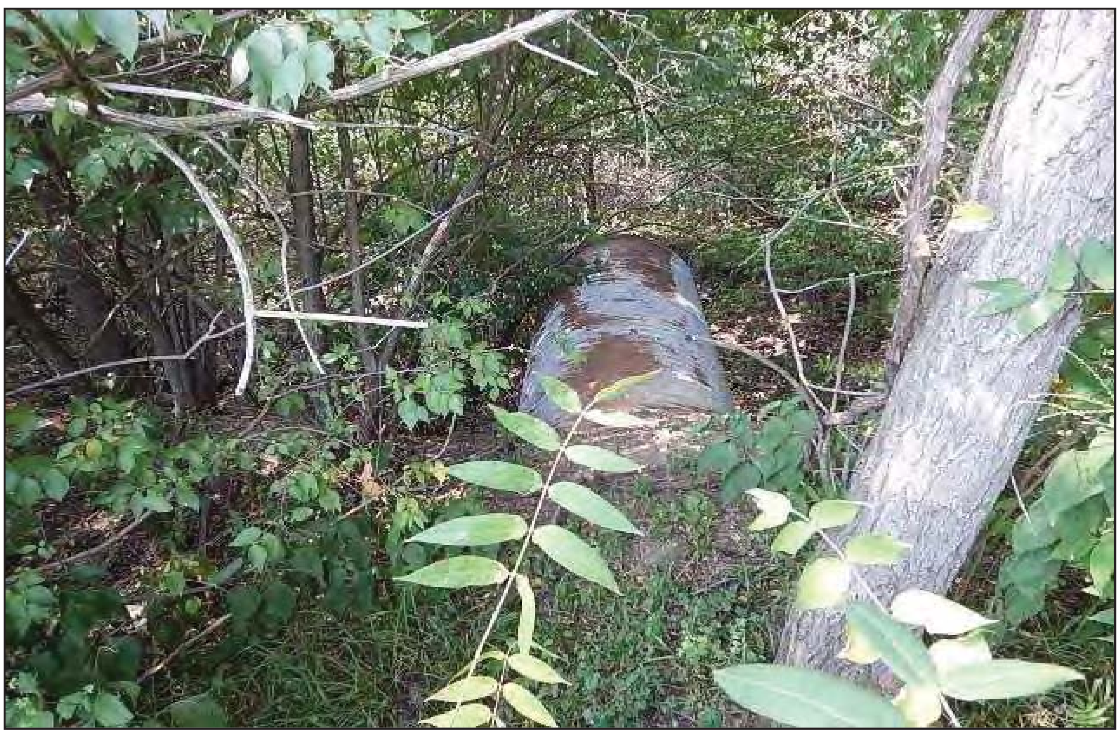

PHOTO 16: Overflow to Pond 3 from Pond 2.

PHOTO 17: Typical woody vegetation along alignment between Ponds 2 & 3, dominated by tree of heaven.

PHOTO 18: LBAT 18A - 26" standing dead cottonwood w/fissures.

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Pilkington N.A., Ottawa Township Flat Glass Site, OU3
Addendum to RD Ecological Resource Assessment

Site Photographs

State Route 71
Ottawa Township, LaSalle County, OH

Date:
AUGUST 2014

Project Number: PNA103
File Name:
PNA103.300.0075.XLS

PHOTO 19: LBAT-18B - 26" standing dead cottonwood w/fissures.

PHOTO 20: LBAT-19 - Standing dead tree with exfoliating bark, broken branches and fissures.

PHOTO 21: Pond 2 looking east from dike between Ponds 2 & 3.

PHOTO 22:

APPENDIX C

Wetland Determination Data Forms

Staging area 1

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: Pilkington NA City/County: Ottawa IL Sampling Date: 7/30/14
Applicant/Owner: ________ State: ________ Sampling Point: UPL-SA1
Investigator(s): H. Crowell (HVJ) Section, Township, Range: S27 T22E R3E
Landform (hillslope, terrace, etc.): sand deposit Local relief (concave, convex, none): none
Slope (%): 0 Lat: 41° 19' 59" Long: 88° 51' 37" Datum: NAD83
Soil Map Unit Name: 864 - Quarry pits NWI classification: N/A
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)
Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? N Are "Normal Circumstances" present? Yes ✓ No ___
Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? N (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___ No ✓	Is the Sampled Area within a Wetland? Yes ___ No ✓
Hydric Soil Present?	Yes ___ No ✓	
Wetland Hydrology Present?	Yes ___ No ✓	

Remarks: This is an upland plant community growing on grinding & polishing sand waste!

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ___)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
= Total Cover			
Herb Stratum (Plot size: 5')			
1. Phragmites australis	30	Y	FACW
2. Securigera varia	40	Y	UPL
3. Festuca rubra	30	Y	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
= Total Cover			
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
= Total Cover			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)
Total Number of Dominant Species Across All Strata: 3 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 33% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	___	x 1 = ___
FACW species	___	x 2 = ___
FAC species	___	x 3 = ___
FACU species	___	x 4 = ___
UPL species	___	x 5 = ___
Column Totals:	___ (A)	___ (B)

Prevalence Index = B/A = ___

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation N
___ 2 - Dominance Test is >50% N
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No ✓

Remarks: (Include photo numbers here or on a separate sheet.)

Staging Area (1)

7/30/14

SOIL

Sampling Point: UPL-SA-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-20	10YR 5/3	100	—	—	—	—	fine sand	dry

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

__ Histosol (A1)
__ Histic Epipedon (A2)
__ Black Histic (A3)
__ Hydrogen Sulfide (A4)
__ Stratified Layers (A5)
__ 2 cm Muck (A10)
__ Depleted Below Dark Surface (A11)
__ Thick Dark Surface (A12)
__ Sandy Mucky Mineral (S1)
__ 5 cm Mucky Peat or Peat (S3)

None

__ Sandy Gleyed Matrix (S4)
__ Sandy Redox (S5)
__ Stripped Matrix (S6)
__ Loamy Mucky Mineral (F1)
__ Loamy Gleyed Matrix (F2)
__ Depleted Matrix (F3)
__ Redox Dark Surface (F6)
__ Depleted Dark Surface (F7)
__ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

__ Coast Prairie Redox (A16)
__ Dark Surface (S7)
__ Iron-Manganese Masses (F12)
__ Very Shallow Dark Surface (TF12)
__ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: N/A

Depth (inches): ______

Hydric Soil Present? Yes ____ No ✓

Remarks:

no redox features or organic matter; this is a waste mineral material.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

__ Surface Water (A1)
__ High Water Table (A2)
__ Saturation (A3)
__ Water Marks (B1)
__ Sediment Deposits (B2)
__ Drift Deposits (B3)
__ Algal Mat or Crust (B4)
__ Iron Deposits (B5)
__ Inundation Visible on Aerial Imagery (B7)
__ Sparsely Vegetated Concave Surface (B8)

__ Water-Stained Leaves (B9)
__ Aquatic Fauna (B13)
__ True Aquatic Plants (B14)
__ Hydrogen Sulfide Odor (C1)
__ Oxidized Rhizospheres on Living Roots (C3)
__ Presence of Reduced Iron (C4)
__ Recent Iron Reduction in Tilled Soils (C6)
__ Thin Muck Surface (C7)
__ Gauge or Well Data (D9)
__ Other (Explain in Remarks)

None

Secondary Indicators (minimum of two required)

__ Surface Soil Cracks (B6)
__ Drainage Patterns (B10)
__ Dry-Season Water Table (C2)
__ Crayfish Burrows (C8)
__ Saturation Visible on Aerial Imagery (C9)
__ Stunted or Stressed Plants (D1)
__ Geomorphic Position (D2)
__ FAC-Neutral Test (D5) N

Field Observations:

Surface Water Present? Yes ____ No ✓ Depth (inches): ______
Water Table Present? Yes ____ No ✓ Depth (inches): ______
Saturation Present? Yes ____ No ✓ Depth (inches): ______
(includes capillary fringe)

Wetland Hydrology Present? Yes ____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

N/A

Remarks:

Staging area 2

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: Pilkington NA / OU3 City/County: Ottawa IL Sampling Date: 7/30/14

Applicant/Owner: Pilkington NA State: IL Sampling Point: UPL-5A-2

Investigator(s): H Cantwell / Mull Section, Township, Range: S27 T22E R3E

Landform (hillslope, terrace, etc.): flat sand pond Local relief (concave, convex, none): none

Slope (%): 0 Lat: 41° 19' 55.29 Long: 88° 51' 34.21" Datum: NAD83

Soil Map Unit Name: 864 - Quarry pits NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? N Are "Normal Circumstances" present? Yes ✓ No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? N (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___ No ✓	Is the Sampled Area within a Wetland? Yes ___ No ✓
Hydric Soil Present?	Yes ___ No ✓	
Wetland Hydrology Present?	Yes ___ No ✓	

Remarks: This is an upland plant community growing on grinding & polishing sand waste.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Robinia pseudoacacia	50	Y	UPL
2. Ulmus americana	30	Y	FACW
3.			
4.			
5.			
		= Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1. Autumn olive	20	Y	UPL
2.			
3.			
4.			
5.			
		= Total Cover	
Herb Stratum (Plot size: 5')			
1. Hackelia virginiana	40	Y	FACU
2. Phragmites australis	10	N	FACW
3. Urtica dioica	10	N	FACW
4. Glyceria melicaria	40	Y	FACW
5.			
6.			
7.			
8.			
9.			
10.			
		= Total Cover	
Woody Vine Stratum (Plot size: —)			
1.			
2.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 40 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	___	x 1 = ___
FACW species	___	x 2 = ___
FAC species	___	x 3 = ___
FACU species	___	x 4 = ___
UPL species	___	x 5 = ___
Column Totals:	___ (A)	___ (B)

Prevalence Index = B/A = ___

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation N

___ 2 - Dominance Test is >50% N

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No ✓

Remarks: (Include photo numbers here or on a separate sheet.)

Staging Area (2)

SOIL

7/30/14 Sampling Point: UPL-SA-2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	7.5YR 5/3	100	—	—	—	—	G & P sand	— dry

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

none

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Coast Prairie Redox (A16)
- ___ Dark Surface (S7)
- ___ Iron-Manganese Masses (F12)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):

Type: N/A

Depth (inches): ______

Hydric Soil Present? Yes ____ No ✓

Remarks:

This is a mineral waste material. No redox features or organic matter.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

none

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Gauge or Well Data (D9)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No ✓	Depth (inches): ______
Water Table Present?	Yes ____	No ✓	Depth (inches): ______
Saturation Present? (includes capillary fringe)	Yes ____	No ✓	Depth (inches): ______

Wetland Hydrology Present? Yes ____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

APPENDIX B

Aquablok® - Blended Barrier™ Specifications

General Information and Permeability of Blended Barrier Technology

TEST REPORT #12 HYDRAULIC CONDUCTIVITY OF A BLENDED BARRIER AQUABLOK FORMULATION

Background

AquaBlok® is a patented, composite-aggregate technology resembling small stones and typically comprised of a dense aggregate core, clay or clay sized materials, and polymers (Figure 1). For typical formulations, AquaBlok's clay (sealant) component consists largely of bentonite clay. However, other clay minerals can be incorporated to meet project-specific needs.

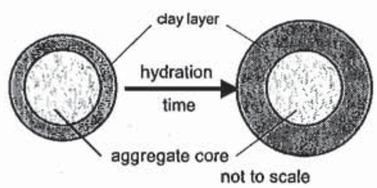

Figure 1. Configuration of Typical AquaBlok Particle.

AquaBlok particles expand when hydrated, with the degree of net vertical expansion determined largely by the formulation, application thickness, and salinity of hydrating water. When a mass of particles is hydrated, it coalesces into a continuous and relatively soft body of material. Once developed, the hydrated AquaBlok can act as an effective physical, hydraulic, and chemical barrier by virtue of its relatively cohesive and homogeneous character, low permeability to water, and chemically active (sorptive) nature, which can be enhanced by the addition of reactive amendments.

Typical Use of AquaBlok

For many projects, AquaBlok use generally involves applying dry masses of AquaBlok through the water and across the surface of contaminated sediments.

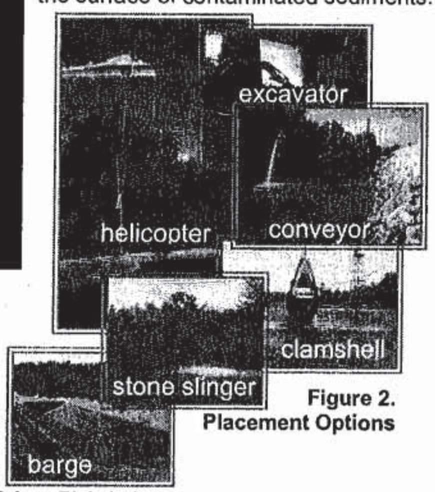

Figure 2. Placement Options

A variety of application methods have been implemented, such as: barges, clamshells, stone slingers, conveyors, and many more (Figure 2). The ease of placement and low permeability make AquaBlok a practical method for addressing contaminated sediments. A conventional AquaBlok cap consists entirely of AquaBlok particles and typically displays a permeability of approximately $5x10^{-9}$ cm/s.

Blended Barrier Technology

A Blended Barrier cap is a cost-effective solution for:

- ***situations where sediment contaminant levels are relatively low,***
- ***for post-dredging capping of residual sediments.***

It has been established that mixing AquaBlok with readily available aggregates can create a "Blended Barrier" that does not significantly increase the permeability as compared to an AquaBlok only cap.

Figure 3. Permeability of Select Blended Barrier Formulations

AquaBlok Formulation	Aggregate Size	Resulting Blended Barrier Formulation[1]
#8 3070 FW	AASHTO #8	$2.32x10^{-8}$
#8 3070 FW	AASHTO #57	$1.71x10^{-8}$

1. Blended Barrier is comprised of 50% AquaBlok and 50% aggregate

This results in a very effective contaminated sediment cap for most applications that may be more cost effective than a standard AquaBlok only cap. Implementation of a Blended Barrier AquaBlok cap for lower budget applications, and/or in conjunction with dredging, can provide a barrier for contaminated residual sediment remaining in the uppermost biologically active layer of sediment, and help reestablish altered bottom contours.

Additionally, by varying AquaBlok and aggregate particle size, control over various properties of the cap can be obtained, thus creating a more versatile cap that can be easily engineered for project specific applications. Some examples of such caps are providing a low permeability layer at the sediment/cap interface with an armored layer at the cap/water interface, a geotechnically stable layer at the sediment cap interface with a low permeability layer at the water cap interface, or a semi-permeable cap with pathways targeting contaminants to a treatment surface.

Placement of a Blended Barrier Cap

Any of the previously noted placement methods are applicable for the placement of the "Blended Barrier" AquaBlok cap (Figure 2). For shallow water applications (<40 ft.), the mixing of AquaBlok and aggregate particles obtained from a local source is necessary prior to placement. For deep-water applications (>40 ft.) it may be necessary to utilize a modified placement method, alternating layers of AquaBlok and aggregate particles. When hydrated, the AquaBlok particles will infill the aggregate particles creating a relatively uniform barrier layer.

An Application for Your Project

The innovation of Blended Barrier Technology creates a cost-effective, extremely versatile AquaBlok cap. Whether the goal is to create a barrier over contaminated sediments, reestablish bottom contours post-dredging, establish a contaminant free habitat for benthic organisms, create a semi-permeable reactive cap to treat contamination, or address the inflow of contaminated ground water into an aquatic system, an AquaBlok cap can be engineered for your unique application.

AquaBlok®
Composite Particle System

For more information, including the complete test reports, call AquaBlok, Ltd. at (800) 688-2649 or fax us at (419) 385-2990.

The test reports are also available on our website at: www.aqublokinfo.com.

Last Revised 02/03/06

APPENDIX C

Stormwater Calculation Report

STORMWATER CALCULATION REPORT

FOR THE:
OTTAWA TOWNSHIP FLAT GLASS SITE
CITY OF OTTAWA, LASALLE COUNTY, ILLINOIS
CERCLA DOCKET NO. V-W-11-C-989

PREPARED FOR:
PILKINGTON NORTH AMERICA, INC.
140 DIXIE HIGHWAY
ROSSFORD, OHIO 43460

PREPARED BY:
HULL & ASSOCIATES, INC.
6397 EMERALD PARKWAY, SUITE 200
DUBLIN, OHIO 43016

AUGUST 2014

HULL

TABLE OF CONTENTS

LIST OF APPENDICES

1.0 HYDROLOGIC AND HYDRAULIC CALCULATIONS

1.1 Purpose

The purpose of these calculations was to design the components of the Final Remedial Design for Operable Unit 3 (OU3) at the Ottawa Township Flat Glass Site located in La Salle County, Illinois. The OU3 selected remedy includes drainage modifications designed to reduce surface water infiltration in the drainage ditch located to the south of Quarry 1 as well as in Quarry 2 by lining the existing drainage ditch and bypassing the flow around Quarry 2 into Quarry 4 through a new storm sewer. The remedy will not alter surface water drainage on other portions of the PNA property or off-property areas within the drainage area. The design will reduce the surface water infiltration component contributing to groundwater sufficiently to achieve the objective of the remedy.

1.2 Design Criteria

The lined portion of the drainage ditch cross-section will be designed to contain the peak flow during a 2-year, 24-hour rainfall event. A 2-year, 24-hour rainfall event is a nationally accepted rate that represents the amount of rainfall expected over a 24-hour period during a 2-year recurrence interval. The selection of the 2-year, 24-hour rainfall event captures the majority of the daily average rainfall for a typical year (over 99 percent of the rainfall).

The ditch lining will be installed on the base of the ditch and extend up each side embankment, as needed, to create a lined cross-sectional area sufficient to carry the peak design flow from a 2-year, 24-hour rainfall event. The ditch liner shall be sufficient to provide a hydraulic conductivity of 1×10^{-5} cm/s or less.

If the peak flow of a 2-year, 24-hour rain event is exceeded (larger rain events on average are less frequent), the excess surface water flow will be diverted through Quarry 2 and allowed to flow through the existing drainage system. During this time, the surface water elevation in the ditch may be above the lined section of the ditch, but a majority of the infiltration will be controlled by the lined section. This design approach will reduce the majority of the infiltration in the ditch and Quarries 2 and 3 by containing runoff up to and including a 2-year, 24-hour rain event, yet allow the drainage system to handle less frequent, larger flow events as it does now.

1.3 Design Approach

The design of the proposed storm sewer and the lining of the existing ditch were based on the peak rate of runoff calculated for the drainage area of the existing ditch. Factors affecting the peak rate of runoff include rainfall data, drainage area, and surface and soil conditions. The Soil Conservation Service TR-55 method was used to determine the peak discharge for the drainage area. Once the peak discharge was determined, the U.S. Army Corps of Engineers River Analysis System (HEC-RAS) was used to determine the water surface profile of the existing ditch. The storm sewer was designed based on the peak discharge and the hydraulic grade line calculations. Modeling of the system with HEC-RAS was performed to calculate the proposed elevation of the liner as it relates to the water surface profile throughout the existing ditch.

1.4 Design Storm Peak Discharge

Available rainfall data from 1993 to 2013 near the project site indicated that there were only 3 rainfall events that exceeded a precipitation depth of 3.04 inches. Refer to **Appendix A** for the Daily Rainfall Graph. The Illinois State Water Survey (Huff and Angel, 1997), Bulletin 70 correlates this to a 2-year, 24-hour precipitation event. Refer to **Appendix B** for the Bulletin 70 Table and Map data. Based on this data, the 2-year, 24-hour precipitation event was used as the design storm.

The drainage area of the existing ditch was determined using LiDAR contours and the City of Ottawa's existing storm sewer network. The total drainage area consisted of 169 acres divided into thirteen sub-basin areas. **Appendix C** includes the Stormwater Drainage Map, which displays LiDAR contours, City of Ottawa's storm sewer system, soil groups, and the sub-basin areas.

The thirteen sub-basin areas were evaluated to determine the Runoff Curve Number (CN), Time of Concentration (T_c) and Graphical Peak Discharge for each sub-basin using the TR-55 methodology. A Custom Soil Resource for La Salle County Illinois (USDA Natural Resources Conservation Survey, 2012) was obtained to determine the soil hydrologic group (A, B, C, D) for each sub-basin. Surface cover (i.e. brush, wooded forest, open grass and residential areas) for each sub-basin was evaluated based on field visits and aerial imagery. Using tables 2-2a, 2-2b, 2-2c, and 2-2d from the TR-55 manual, sub-basin areas, and the hydrologic soil groups, a composite CN value was calculated for each sub-basin. **Appendix D** includes the individual sub-basins' TR-55 Worksheet 2, Runoff Curve Numbers.

The Time of Concentration, T_c, consists of the sum of sheet flow, shallow concentrated flow and channel flow calculations based on surface cover and flow regimes. Flow regimes (i.e. surface slope and travel path) were based on LiDAR information. The T_c utilized to calculate the storm sewer consisted of individual T_c values calculated through the TR-55 method for each individual sub-basin area. This method produces multiple peak discharges from the sub-basins that are overlaid for an accumulative peak discharge at the entrance of the storm sewer. It is assumed that there is a minimum of 10 minutes for each sub-basin area. Refer to **Appendix D** for the sub-basins' TR-55 Worksheet 3, Time of Concentration (T_c).

The peak discharge is calculated based on the T_c, drainage area, rainfall distribution, 24-hour rainfall, and weighted CN values. Refer to **Appendix D** for the sub basins' TR-55 Worksheet 4, Graphical Peak Discharge Method, and the summary sheet for the Peak Discharge values.

1.5 Stormwater Conveyance

HEC-RAS models a one-dimensional steady flow of the main drainage ditch for a 2-year, 24-hour precipitation event. Calculations were based on a one-dimensional energy equation with energy losses from friction losses accounted for by Manning's Equation and contraction/expansion losses calculated by multiplying the changes in velocity head by the contraction/expansion coefficient. During a mixed flow regime or when the water surface profile was rapidly varied, the momentum equation was utilized. Please refer to the HEC-RAS Hydraulic Reference Manual (Hydraulic River Analysis System, 2010) for a more detailed explanation of the calculations.

The design of the storm sewer is an iterative process. The peak flow, pipe slope, and pipe roughness coefficient were utilized to determine the design capacity for the system using Manning's equation and hydraulic grade line calculations. The calculations resulted in a pipe diameter of approximately 42 inches. The storm sewer sizing calculations are included in **Appendix E**.

Once the storm sewer size was determined, the corresponding hydraulic grade line was used as the known water surface elevation for the most downstream cross section in the HEC-RAS model, factoring in the losses for the inlet to the storm sewer. The water surface calculated in the model was utilized to determine the liner elevation for each station on the main drainage ditch. For the full HEC-RAS report, refer to **Appendix F**, HEC-RAS Report 1. To calculate the total surface area of the liner, an additional 6 inches of freeboard was added to the HEC-RAS water surface elevation to account for construction tolerances.

1.6 Inlet Protection

The storm sewer inlet protection was based on the methodology for calculating the maximum channel bottom shear stress as described in the Federal Highway Administration's Design of Roadside Channels with Flexible Lining (Hydraulic Engineering Circular, 2005). These guidelines were followed to determine the size and thickness of the rock channel protection. The Illinois Urban Manual Practice Standard from the Natural Resources Conservation Service (Illinois Urban Manual, 2002) was utilized to determine the appropriate Illinois standards on gradation and thickness. Refer to **Appendix G** for detailed calculations.

2.0 REFERENCES

HEC-RAS River Analysis System. *Hydraulic Reference Manual, Version 4.1*, US Army Corps of Engineers Hydrologic Engineering Center. 2010.

Huff, F. A., and J.R. Angel. *Rainfall Distributions and Hydroclimatic Characteristics of Heavy Rainstorms in Illinois (Bulletin 70)*, Illinois State Water Survey. 1997.

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Illinois Urban Manual. *A Technical Manual Design for Urban Ecosystem Protection and Enhancement*, Natural Resources Conservation Service. 2002.

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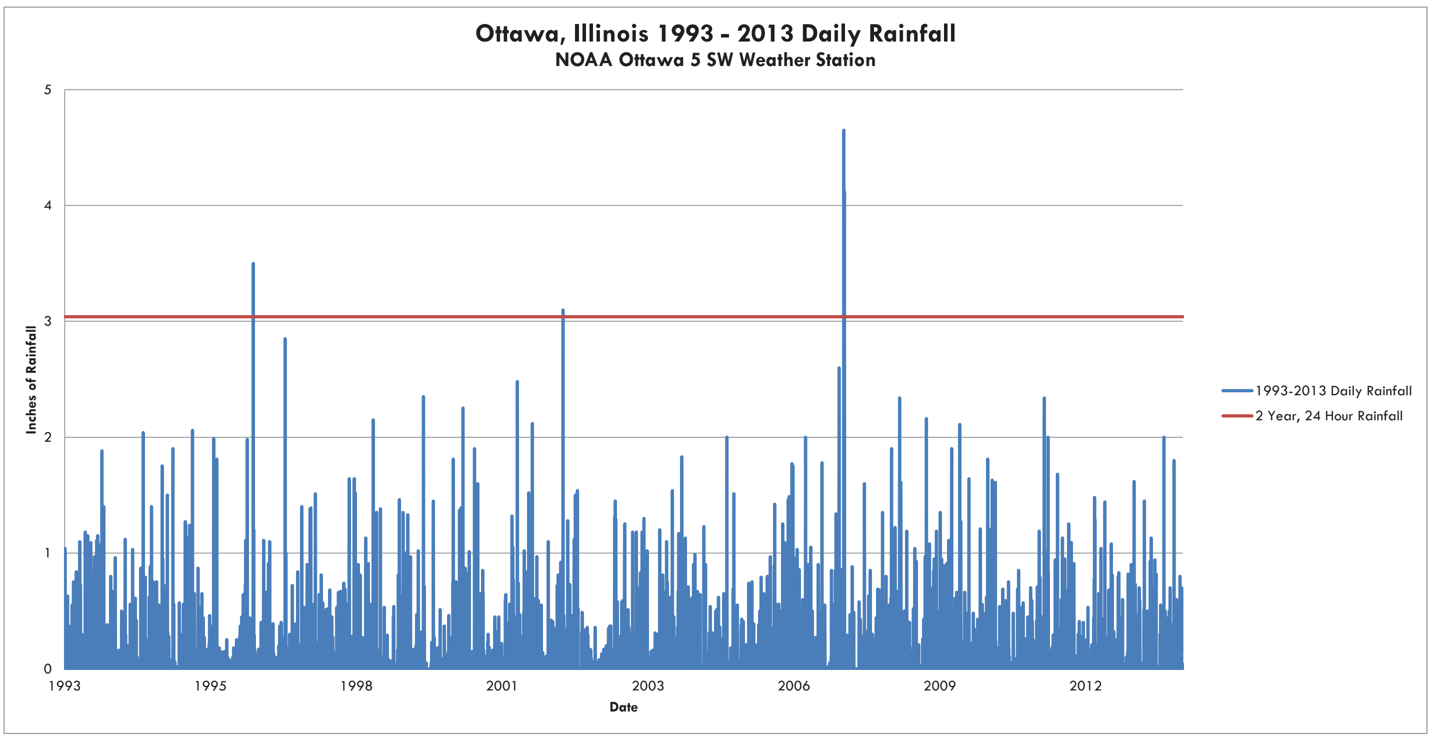
USDA Natural Resources Conservation Survey. *Web Soil Survey*. United States Department of Agriculture. 2012.

APPENDIX A

Daily Rainfall Graph



Ottawa, Illinois 1993 - 2013 Daily Rainfall
NOAA Ottawa 5 SW Weather Station
Inches of Rainfall
0
1
2
3
4
5
1993
1995
1998
2001
2003
2006
2009
2012
Date
1993-2013 Daily Rainfall
2 Year, 24 Hour Rainfall

APPENDIX B

Bulletin 70 Rainfall Data

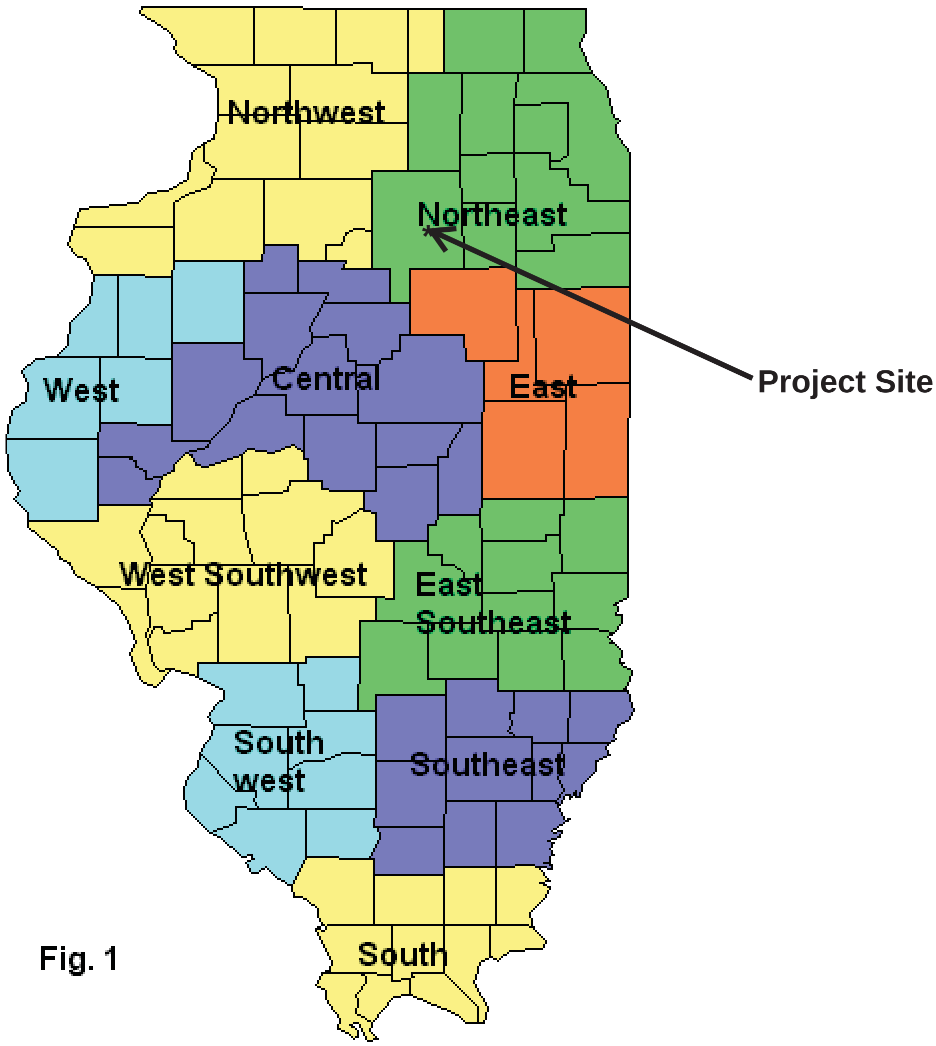

Northwest
Northeast
Project Site
West
Central
East
West Southwest
East
Southeast
South
west
Southeast
South

Fig. 1

Table 1. Sectional Mean Frequency Distributions for Storm Periods of 5 Minutes to 10 Days and Recurrence Intervals of 2 Months to 100 Years in Illinois. Units are in inches.

Sectional code

01 - Northwest
02 - Northeast
03 - West
04 - Central
05 - East
06 - West Southwest
07 - East Southeast
08 - Southwest
09 - Southeast
10 - South

Section	Duration	2-month	3-month	4-month	6-month	9-month	1-year	2-year	5-year	10-year	25-year	50-year	100-year
01	10-day	2.14	2.60	2.97	3.50	4.02	4.37	5.23	6.30	7.14	8.39	9.64	11.09
01	5-day	1.76	2.12	2.38	2.76	3.17	3.45	4.13	5.10	5.91	7.21	8.36	9.97
01	72-hr	1.58	1.90	2.11	2.45	2.82	3.06	3.73	4.67	5.42	6.59	7.64	8.87
01	48-hr	1.47	1.74	1.93	2.24	2.58	2.80	3.42	4.28	4.96	6.07	7.02	8.07
01	24-hr	1.40	1.64	1.80	2.08	2.36	2.57	3.11	3.95	4.63	5.60	6.53	7.36
01	18-hr	1.30	1.52	1.66	1.92	2.18	2.37	2.86	3.63	4.26	5.15	6.01	6.92
01	12-hr	1.23	1.43	1.57	1.81	2.06	2.24	2.71	3.43	4.03	4.88	5.66	6.51
01	6-hr	1.06	1.24	1.37	1.56	1.77	1.93	2.33	2.96	3.48	4.20	4.90	5.69
01	3-hr	0.91	1.06	1.16	1.33	1.52	1.65	1.99	2.53	2.97	3.59	4.18	4.90
01	2-hr	0.84	0.97	1.06	1.23	1.40	1.52	1.83	2.33	2.74	3.31	3.86	4.47
01	1-hr	0.67	0.78	0.86	0.98	1.11	1.21	1.46	1.86	2.18	2.63	3.07	3.51
01	30-min	0.52	0.61	0.68	0.77	0.87	0.95	1.15	1.46	1.71	2.07	2.42	2.77
01	15-min	0.38	0.45	0.50	0.57	0.64	0.70	0.84	1.07	1.25	1.51	1.76	1.99
01	10-min	0.31	0.36	0.40	0.46	0.52	0.57	0.68	0.87	1.02	1.23	1.44	1.62
01	5-min	0.17	0.20	0.22	0.25	0.29	0.31	0.37	0.47	0.56	0.67	0.78	0.89
02	10-day	2.02	2.48	2.80	3.30	3.79	4.12	4.95	6.04	6.89	8.18	9.38	11.14
02	5-day	1.66	1.98	2.24	2.60	2.99	3.25	3.93	4.91	5.70	6.93	8.04	9.96
02	72-hr	1.53	1.83	2.02	2.34	2.70	2.93	3.55	4.44	5.18	6.32	7.41	8.78
02	48-hr	1.44	1.70	1.90	2.18	2.49	2.70	3.30	4.09	4.81	5.88	6.84	8.16
02	24-hr	1.38	1.61	1.76	2.03	2.31	2.51	3.04	3.80	4.47	5.51	6.46	7.58
02	18-hr	1.26	1.47	1.61	1.86	2.12	2.30	2.79	3.50	4.11	5.06	5.95	6.97
02	12-hr	1.20	1.40	1.53	1.77	2.01	2.18	2.64	3.31	3.89	4.79	5.62	6.59
02	6-hr	1.03	1.21	1.32	1.52	1.74	1.88	2.28	2.85	3.35	4.13	4.85	5.68
02	3-hr	0.88	1.02	1.13	1.30	1.47	1.60	1.94	2.43	2.86	3.53	4.14	4.85
02	2-hr	0.81	0.95	1.05	1.20	1.36	1.48	1.79	2.24	2.64	3.25	3.82	4.47
02	1-hr	0.65	0.76	0.84	0.96	1.09	1.18	1.43	1.79	2.10	2.59	3.04	3.56
02	30-min	0.51	0.60	0.65	0.75	0.86	0.93	1.12	1.41	1.65	2.04	2.39	2.80
02	15-min	0.37	0.44	0.48	0.55	0.63	0.68	0.82	1.03	1.21	1.49	1.75	2.05
02	10-min	0.30	0.35	0.39	0.45	0.51	0.55	0.67	0.84	0.98	1.21	1.42	1.67
02	5-min	0.17	0.19	0.21	0.24	0.28	0.30	0.36	0.46	0.54	0.66	0.78	0.91

Table 1. Continued

Section	Duration	2-month	3-month	4-month	6-month	9-month	1-year	2-year	5-year	10-year	25-year	50-year	100-year
03	10-day	2.27	2.78	3.13	3.68	4.23	4.60	5.60	6.91	7.89	9.24	10.36	11.90
03	5-day	1.92	2.30	2.56	2.97	3.41	3.71	4.57	5.80	6.65	7.90	8.95	10.50
03	72-hr	1.72	2.05	2.28	2.64	3.02	3.30	4.08	5.11	5.87	6.97	7.95	9.48
03	48-hr	1.61	1.88	2.09	2.42	2.76	3.01	3.68	4.56	5.50	6.45	7.56	8.80
03	24-hr	1.53	1.77	1.95	2.24	2.56	2.79	3.45	4.29	4.93	6.07	7.04	8.20
03	18-hr	1.41	1.64	1.80	2.07	2.36	2.57	3.18	3.95	4.53	5.59	6.47	7.55
03	12-hr	1.34	1.56	1.70	1.94	2.22	2.43	2.98	3.73	4.29	5.28	6.13	7.14
03	6-hr	1.15	1.34	1.47	1.67	1.91	2.10	2.58	3.22	3.70	4.55	5.28	6.15
03	3-hr	0.98	1.15	1.26	1.44	1.65	1.79	2.21	2.75	3.15	3.89	4.51	5.25
03	2-hr	0.91	1.06	1.17	1.32	1.50	1.65	2.02	2.53	2.91	3.58	4.15	4.84
03	1-hr	0.72	0.84	0.92	1.06	1.21	1.31	1.60	2.02	2.32	2.86	3.31	3.85
03	30-min	0.57	0.66	0.73	0.83	0.95	1.03	1.27	1.59	1.82	2.25	2.61	3.03
03	15-min	0.41	0.48	0.53	0.61	0.69	0.75	0.91	1.16	1.33	1.64	1.90	2.21
03	10-min	0.34	0.39	0.43	0.49	0.56	0.61	0.74	0.94	1.08	1.33	1.55	1.81
03	5-min	0.18	0.21	0.23	0.26	0.30	0.33	0.40	0.51	0.59	0.73	0.84	0.98
04	10-day	2.10	2.58	2.92	3.43	3.93	4.29	5.12	6.27	7.10	8.19	9.10	10.18
04	5-day	1.77	2.12	2.37	2.78	3.20	3.48	4.17	5.11	5.84	6.96	7.98	9.21
04	72-hr	1.59	1.91	2.12	2.44	2.80	3.05	3.70	4.55	5.26	6.15	7.25	8.16
04	48-hr	1.48	1.76	1.95	2.25	2.58	2.81	3.38	4.19	4.86	5.78	6.62	7.51
04	24-hr	1.39	1.63	1.80	2.04	2.32	2.52	3.02	3.76	4.45	5.32	6.08	6.92
04	18-hr	1.27	1.51	1.66	1.88	2.12	2.28	2.75	3.46	4.09	4.90	5.59	6.37
04	12-hr	1.19	1.40	1.53	1.77	2.01	2.17	2.62	3.27	3.87	4.63	5.29	6.02
04	6-hr	1.03	1.21	1.34	1.53	1.74	1.89	2.26	2.82	3.33	3.99	4.56	5.19
04	3-hr	0.89	1.03	1.13	1.30	1.47	1.61	1.93	2.41	2.85	3.41	3.89	4.43
04	2-hr	0.82	0.95	1.04	1.19	1.37	1.48	1.78	2.22	2.62	3.14	3.59	4.08
04	1-hr	0.65	0.76	0.83	0.95	1.09	1.18	1.42	1.77	2.09	2.50	2.86	3.25
04	30-min	0.52	0.60	0.66	0.75	0.86	0.93	1.12	1.39	1.64	1.97	2.25	2.56
04	15-min	0.37	0.44	0.49	0.56	0.63	0.68	0.81	1.02	1.20	1.44	1.64	1.87
04	10-min	0.30	0.35	0.39	0.45	0.50	0.55	0.66	0.83	0.98	1.17	1.34	1.52
04	5-min	0.17	0.19	0.21	0.24	0.28	0.30	0.36	0.45	0.53	0.64	0.73	0.83
05	10-day	2.13	2.62	2.96	3.48	4.00	4.35	5.15	6.21	6.97	8.04	8.90	9.92
05	5-day	1.75	2.10	2.37	2.75	3.15	3.42	4.12	4.96	5.67	6.76	7.65	8.78
05	72-hr	1.61	1.93	2.16	2.48	2.85	3.10	3.71	4.57	5.20	6.17	6.97	7.83
05	48-hr	1.51	1.77	1.95	2.26	2.57	2.82	3.40	4.16	4.77	5.66	6.40	7.16
05	24-hr	1.36	1.58	1.75	2.00	2.27	2.47	3.01	3.71	4.26	5.04	5.83	6.61
05	18-hr	1.25	1.47	1.62	1.84	2.09	2.27	2.77	3.41	3.92	4.63	5.37	6.08
05	12-hr	1.18	1.38	1.53	1.74	1.98	2.15	2.62	3.23	3.71	4.38	5.08	5.75
05	6-hr	1.00	1.18	1.32	1.49	1.70	1.85	2.26	2.78	3.20	3.78	4.38	4.96
05	3-hr	0.87	1.02	1.12	1.28	1.46	1.58	1.93	2.37	2.73	3.22	3.74	4.23
05	2-hr	0.79	0.93	1.03	1.17	1.34	1.46	1.78	2.19	2.52	2.97	3.44	3.90
05	1-hr	0.64	0.74	0.81	0.93	1.07	1.16	1.41	1.74	2.00	2.39	2.74	3.11
05	30-min	0.50	0.58	0.64	0.74	0.84	0.91	1.11	1.37	1.57	1.87	2.16	2.45
05	15-min	0.37	0.43	0.47	0.54	0.62	0.67	0.81	1.00	1.14	1.37	1.60	1.85
05	10-min	0.30	0.35	0.38	0.43	0.49	0.54	0.66	0.81	0.94	1.12	1.28	1.46
05	5-min	0.17	0.19	0.21	0.24	0.28	0.30	0.36	0.44	0.51	0.61	0.70	0.79

Table 1. Continued

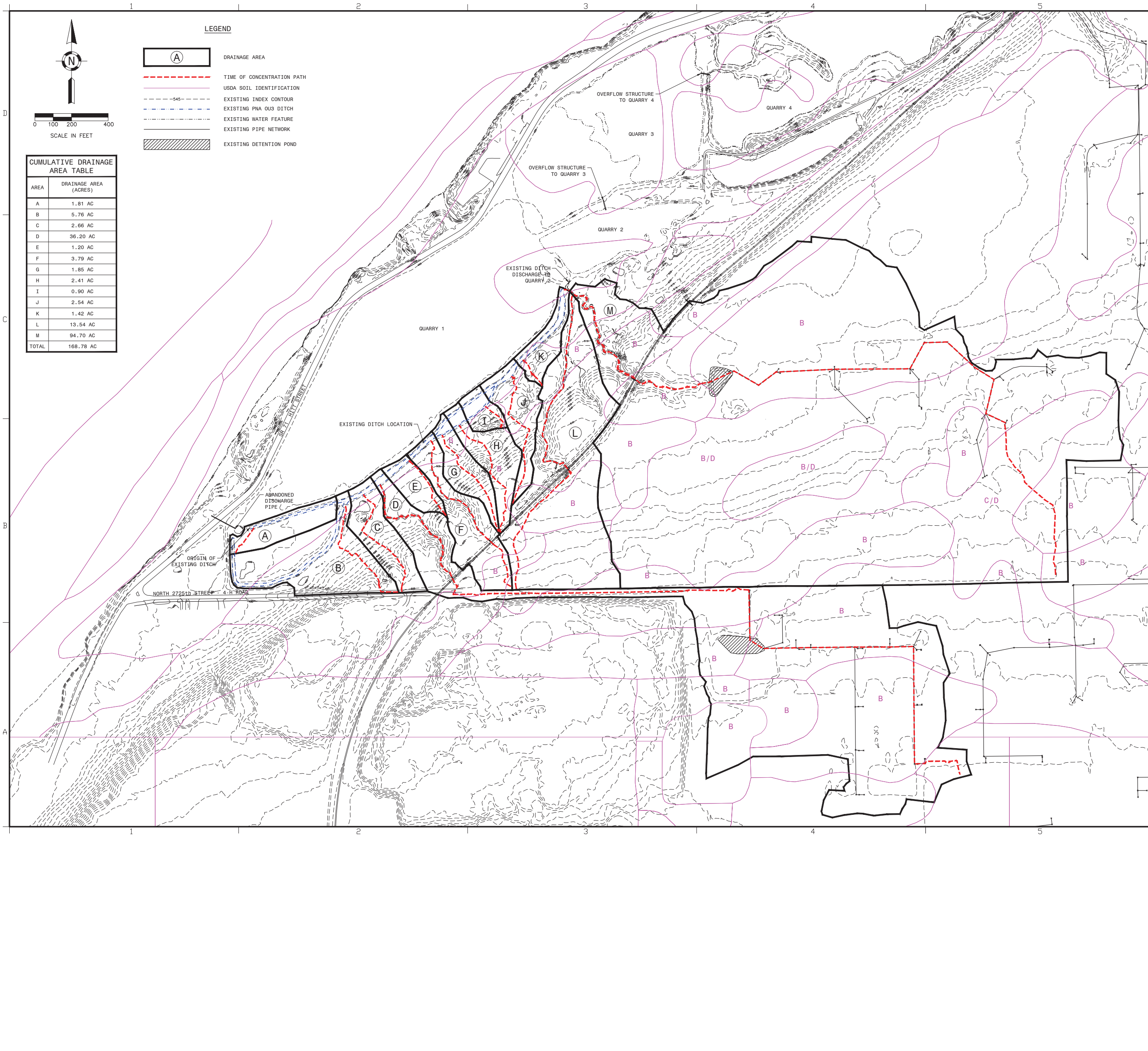
Section	Duration	2-month	3-month	4-month	6-month	9-month	1-year	2-year	5-year	10-year	25-year	50-year	100-year
06	10-day	2.16	2.65	2.99	3.52	4.05	4.40	5.35	6.62	7.45	8.66	9.79	11.26
06	5-day	1.77	2.13	2.39	2.78	3.19	3.47	4.19	5.32	6.20	7.44	8.53	9.93
06	72-hr	1.63	1.95	2.16	2.50	2.88	3.13	3.81	4.85	5.68	6.84	7.76	8.92
06	48-hr	1.52	1.81	2.00	2.30	2.64	2.87	3.49	4.45	5.21	6.28	7.12	8.19
06	24-hr	1.42	1.66	1.84	2.10	2.38	2.59	3.11	3.93	4.65	5.57	6.46	7.45
06	18-hr	1.31	1.53	1.68	1.93	2.19	2.38	2.86	3.61	4.28	5.12	5.95	6.85
06	12-hr	1.24	1.44	1.57	1.82	2.07	2.25	2.71	3.39	3.97	4.84	5.62	6.48
06	6-hr	1.07	1.24	1.37	1.57	1.78	1.94	2.33	2.95	3.48	4.18	4.85	5.59
06	3-hr	0.91	1.07	1.18	1.34	1.52	1.66	1.99	2.51	2.98	3.56	4.14	4.77
06	2-hr	0.84	0.98	1.08	1.24	1.41	1.53	1.84	2.32	2.74	3.28	3.81	4.39
06	1-hr	0.67	0.79	0.87	0.99	1.12	1.21	1.46	1.85	2.19	2.62	3.04	3.50
06	30-min	0.53	0.61	0.68	0.78	0.88	0.96	1.15	1.46	1.72	2.06	2.39	2.75
06	15-min	0.38	0.45	0.49	0.57	0.64	0.70	0.84	1.06	1.26	1.52	1.75	2.01
06	10-min	0.31	0.36	0.40	0.46	0.52	0.57	0.68	0.87	1.02	1.22	1.42	1.64
06	5-min	0.17	0.20	0.22	0.25	0.29	0.31	0.37	0.47	0.56	0.67	0.78	0.89
07	10-day	2.30	2.80	3.16	3.70	4.27	4.64	5.58	6.80	7.61	8.66	9.70	10.87
07	5-day	1.85	2.22	2.50	2.90	3.31	3.63	4.34	5.33	6.11	7.28	8.37	9.65
07	72-hr	1.62	1.90	2.15	2.50	2.87	3.12	3.73	4.64	5.32	6.39	7.35	8.54
07	48-hr	1.52	1.78	1.98	2.30	2.64	2.87	3.42	4.26	4.88	5.84	6.75	8.00
07	24-hr	1.40	1.63	1.78	2.07	2.35	2.55	3.03	3.80	4.44	5.37	6.23	7.41
07	18-hr	1.29	1.50	1.64	1.90	2.16	2.35	2.79	3.49	4.08	4.94	5.73	6.81
07	12-hr	1.21	1.42	1.55	1.80	2.04	2.22	2.63	3.30	3.86	4.67	5.42	6.45
07	6-hr	1.06	1.23	1.37	1.55	1.74	1.87	2.27	2.85	3.33	4.03	4.67	5.56
07	3-hr	0.89	1.05	1.15	1.32	1.50	1.63	1.94	2.43	2.84	3.44	3.99	4.74
07	2-hr	0.83	0.97	1.07	1.22	1.38	1.50	1.79	2.24	2.62	3.17	3.67	4.39
07	1-hr	0.66	0.77	0.85	0.97	1.10	1.20	1.42	1.78	2.09	2.52	2.93	3.48
07	30-min	0.52	0.60	0.66	0.76	0.86	0.93	1.12	1.41	1.64	1.99	2.31	2.74
07	15-min	0.38	0.44	0.49	0.56	0.63	0.69	0.82	1.03	1.20	1.45	1.68	2.00
07	10-min	0.31	0.36	0.40	0.45	0.51	0.56	0.66	0.83	0.98	1.18	1.37	1.63
07	5-min	0.17	0.20	0.22	0.25	0.29	0.31	0.36	0.46	0.54	0.64	0.75	0.89
08	10-day	2.22	2.74	3.09	3.63	4.18	4.54	5.54	6.80	7.80	9.20	10.44	11.81
08	5-day	1.85	2.21	2.49	2.90	3.31	3.62	4.40	5.46	6.34	7.68	8.88	10.68
08	72-hr	1.67	1.97	2.20	2.54	2.93	3.22	3.94	4.92	5.74	6.97	8.12	9.55
08	48-hr	1.57	1.85	2.06	2.38	2.75	2.97	3.59	4.52	5.26	6.43	7.36	8.81
08	24-hr	1.49	1.73	1.90	2.20	2.48	2.71	3.28	4.13	4.76	6.02	7.07	8.21
08	18-hr	1.35	1.59	1.74	2.00	2.29	2.49	3.02	3.80	4.38	5.54	6.51	7.55
08	12-hr	1.28	1.50	1.64	1.88	2.15	2.35	2.86	3.60	4.14	5.24	6.15	7.14
08	6-hr	1.12	1.30	1.44	1.64	1.87	2.03	2.45	3.10	3.57	4.52	5.30	6.16
08	3-hr	0.95	1.12	1.22	1.40	1.59	1.73	2.10	2.63	3.08	3.86	4.52	5.25
08	2-hr	0.88	1.02	1.13	1.28	1.47	1.60	1.94	2.44	2.87	3.55	4.20	4.84
08	1-hr	0.70	0.81	0.89	1.02	1.15	1.26	1.54	1.93	2.27	2.84	3.32	3.86
08	30-min	0.55	0.64	0.71	0.81	0.92	1.00	1.22	1.53	1.78	2.25	2.62	3.03
08	15-min	0.40	0.47	0.52	0.59	0.67	0.73	0.89	1.12	1.29	1.63	1.91	2.22
08	10-min	0.33	0.38	0.42	0.49	0.55	0.60	0.72	0.91	1.05	1.32	1.55	1.81
08	5-min	0.18	0.21	0.23	0.26	0.30	0.33	0.40	0.50	0.58	0.72	0.85	0.99

Table 1. Concluded

Section	*Duration*	*2-month*	*3-month*	*4-month*	*6-month*	*9-month*	*1-year*	*2-year*	*5-year*	*10-year*	*25-year*	*50-year*	*100-year*
09	10-day	2.30	2.88	3.23	3.80	4.33	4.75	5.74	7.09	8.07	9.54	10.68	11.79
09	5-day	1.90	2.29	2.59	3.00	3.45	3.75	4.48	5.57	6.50	7.91	9.16	10.57
09	72-hr	1.73	2.02	2.25	2.62	3.00	3.27	3.92	4.92	5.75	7.05	8.23	9.40
09	48-hr	1.59	1.87	2.07	2.40	2.76	3.00	3.60	4.52	5.28	6.48	7.58	8.62
09	24-hr	1.44	1.68	1.85	2.12	2.41	2.62	3.16	4.00	4.62	5.79	6.71	7.73
09	18-hr	1.33	1.55	1.71	1.95	2.22	2.41	2.91	3.68	4.25	5.33	6.17	7.11
09	12-hr	1.25	1.46	1.60	1.85	2.10	2.28	2.75	3.48	4.02	5.04	5.84	6.72
09	6-hr	1.08	1.27	1.41	1.60	1.81	1.97	2.37	3.00	3.47	4.34	5.03	5.80
09	3-hr	0.92	1.08	1.21	1.37	1.55	1.68	2.02	2.56	2.96	3.71	4.29	4.95
09	2-hr	0.85	1.00	1.12	1.26	1.43	1.55	1.85	2.36	2.72	3.41	3.96	4.56
09	1-hr	0.68	0.79	0.88	1.00	1.13	1.23	1.49	1.88	2.20	2.72	3.15	3.63
09	30-min	0.53	0.62	0.68	0.78	0.89	0.97	1.17	1.47	1.73	2.14	2.48	2.86
09	15-min	0.39	0.46	0.50	0.58	0.65	0.71	0.85	1.08	1.25	1.56	1.81	2.09
09	10-min	0.32	0.37	0.41	0.47	0.53	0.58	0.70	0.88	1.02	1.27	1.48	1.70
09	5-min	0.18	0.20	0.22	0.26	0.29	0.32	0.38	0.48	0.55	0.69	0.81	0.93
10	10-day	2.55	3.15	3.58	4.21	4.84	5.26	6.36	7.81	8.90	10.34	11.36	12.50
10	5-day	2.09	2.52	2.83	3.29	3.77	4.10	4.99	6.20	7.21	8.45	9.45	10.82
10	72-hr	1.88	2.25	2.49	2.87	3.30	3.59	4.36	5.48	6.34	7.53	8.54	9.52
10	48-hr	1.75	2.08	2.31	2.65	3.02	3.30	4.00	5.03	5.80	6.93	7.86	8.79
10	24-hr	1.63	1.91	2.10	2.41	2.74	2.97	3.62	4.51	5.21	6.23	7.11	8.27
10	18-hr	1.51	1.77	1.95	2.22	2.52	2.74	3.33	4.15	4.79	5.74	6.54	7.61
10	12-hr	1.42	1.66	1.83	2.10	2.38	2.59	3.15	3.93	4.53	5.42	6.19	7.20
10	6-hr	1.23	1.44	1.58	1.71	2.05	2.23	2.73	3.39	3.91	4.68	5.31	6.21
10	3-hr	1.06	1.23	1.35	1.54	1.75	1.90	2.32	2.89	3.33	3.99	4.55	5.29
10	2-hr	0.97	1.13	1.25	1.43	1.62	1.76	2.14	2.66	3.07	3.68	4.20	4.88
10	1-hr	0.77	0.90	0.99	1.13	1.29	1.40	1.70	2.12	2.45	2.93	3.34	3.89
10	30-min	0.61	0.70	0.77	0.89	1.01	1.10	1.34	1.66	1.93	2.31	2.63	3.06
10	15-min	0.43	0.51	0.56	0.65	0.74	0.80	0.98	1.22	1.41	1.68	1.92	2.23
10	10-min	0.36	0.42	0.46	0.53	0.60	0.65	0.80	0.99	1.14	1.37	1.56	1.82
10	5-min	0.20	0.23	0.25	0.29	0.33	0.36	0.43	0.54	0.62	0.75	0.85	0.99

APPENDIX C

Stormwater Drainage Map



CUMULATIVE DRAINAGE AREA TABLE	
AREA	DRAINAGE AREA (ACRES)
A	1.81 AC
B	5.76 AC
C	2.66 AC
D	36.20 AC
E	1.20 AC
F	3.79 AC
G	1.85 AC
H	2.41 AC
I	0.90 AC
J	2.54 AC
K	1.42 AC
L	13.54 AC
M	94.70 AC
TOTAL	168.78 AC

HULL
BROWNFIELDS
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ALTERNATIVE ENERGY

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Phone: (614) 793-8777
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www.hullinc.com

Project Title:

FINAL REMEDIAL DESIGN FOR DRAINAGE IMPROVEMENTS AT OPERABLE UNIT 3

OTTAWA TOWNSHIP FLAT GLASS SITE
LASALLE COUNTY, ILLINOIS
CERCLA DOCKET NO. V-W-11-C-989

Owner:

PILKINGTON NORTH AMERICA, INC.

140 DIXIE HIGHWAY
ROSSFORD, OHIO 43460

Mark	Description	Date
	STORMWATER MAP	07/22/14

Project No.:	PNA103
CAD DWG File:	PNA103_APP C
Plot Date:	07/22/14
Layout By:	EJK
Drawn By:	EJK
Check By:	MJB
Scale:	AS NOTED
Issue Date:	JULY 2014

Sheet Title:

APPENDIX C
STORMWATER
DRAINAGE MAP

APPENDIX D

TR-55 Summary and Worksheets

TR-55 Method Worksheet Summary						
Peak Flow for Proposed AquaBlok© Blended Barrier™						
Tc from Individual Drainage Areas						
Area	CN	Tc (hours)	Area (acres)	qp 2-yr (cfs)	qp 5-yr (cfs)	qp 10-yr (cfs)
A	55	0.37	1.81	0.1386	0.4995	0.93075
B	55	0.31	5.76	0.4725	1.62	3.1536
C*	55	0.166	2.66	0.273	1.035	1.9272
D	65	1.01	36.2	7.5712	15.624	23.8336
E*	55	0.166	1.2	0.1365	0.5175	0.9636
F	54	0.19	3.79	0.306	1.2	2.475
G	55	0.24	1.85	0.1764	0.64125	1.21545
H	55	0.24	2.41	0.2352	0.855	1.6206
I*	55	0.166	0.897	0.09555	0.36225	0.67452
J	55	0.41	2.54	0.1764	0.648	1.2264
K	55	0.17	1.42	0.1365	0.5175	0.9636
L	55	0.3	13.54	1.0584	4.01625	7.665
M	67	0.644	94.695	30.37025	59.1658	87.087
Sum			168.772	41.1465	86.70205	133.73632

*Assuming a minimum Tc value of 10 minutes or 0.166 hours

Sub-Basin Area A

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/]			Area ▣ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
B	100% Wooded	55			1.8	99.5
				Totals =	1.8	99.5

[1/] Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{99.5}{1.8} = 55$ Use CN = $\boxed{55}$

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... years	2	5	10
Rainfall, P (24 hour) .... in.	3.0	3.8	4.5
Runoff, Q .... in.	0.2	0.5	0.7

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area B

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Fig. 2-3	CN [1/] Fig. 2-4	Area ☑ acres ☐ mi² ☐ %	Product of CN x area
B	100% Wooded	55			5.8	316.8
				Totals =	5.8	316.8

[1/] Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{316.8}{5.8} = 55$ Use CN = $\boxed{55}$

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... years	2	5	10
Rainfall, P (24 hour) .... in.	3.0	3.8	4.5
Runoff, Q .... in.	0.2	0.5	0.7

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area C

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: ______ Date: ______

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Fig. 2-3	CN [1/] Fig. 2-4	Area ☑ acres ☐ mi^2 ☐ %	Product of CN x area
B	94% Wooded	55			2.5	137.6
B	6% Brush	48			0.2	7.7
				Totals =	2.7	145.3

[1/] Use only one CN source per line.

CN (weighted) = total product / total area = 145.3 / 2.7 = 55 Use CN = 55

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... years	2	5	10
Rainfall, P (24 hour) .... in.	3.0	3.8	4.5
Runoff, Q .... in.	0.2	0.4	0.7

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area D

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Fig. 2-3	CN [1/] Fig. 2-4	Area ▣ acres ☐ mi^2 ☐ %	Product of CN x area
B	10% Wooded	55			3.7	204.5
B	30% Open Field	61			10.8	661.2
B	58% Subdivision Ave Subdivision Lot Size = 0.42 ac	70			20.9	1,462.0
B	2% Brush	48			0.7	34.9
				Totals =	36.2	2,362.7

[1/] Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{2{,}362.7}{36.2} = 65$ Use CN = $\boxed{65}$

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... years	2	5	10
Rainfall, P (24 hour) .... in.	3.0	3.8	4.5
Runoff, Q .... in.	0.5	0.9	1.3

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area E

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: ______ Date: ______

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Fig. 2-3	CN [1/] Fig. 2-4	Area ☑ acres ☐ mi^2 ☐ %	Product of CN x area
B	100% Wooded	55			1.2	67.7
				Totals =	1.2	67.7

[1/] Use only one CN source per line.

CN (weighted) = total product / total area = 67.7 / 1.2 = 55 Use CN = $\boxed{55}$

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... years	2	5	10
Rainfall, P (24 hour) .... in.	3.0	3.8	4.5
Runoff, Q .... in.	0.2	0.5	0.7

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area F

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: ______ Date: ______

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Fig. 2-3	CN [1/] Fig. 2-4	Area ☑ acres ☐ mi^2 ☐ %	Product of CN x area
B	63% Wooded	55			2.4	130.4
B	10% Open Field	61			0.4	23.7
B	27% Brush	48			1.0	49.5
				Totals =	3.8	203.7

[1/] Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{203.7}{3.8} = 54$ Use CN = $\boxed{54}$

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... years	2	5	10
Rainfall, P (24 hour) .... in.	3.0	3.8	4.5
Runoff, Q .... in.	0.2	0.4	0.7

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area G

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: ______ Date: ______

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	Fig. 2-3	Fig. 2-4	Area ☒ acres ☐ mi^2 ☐ %	Product of CN x area
B	99% Wooded	55			1.8	100.6
B	1% Brush	48			0.0	0.8
				Totals =	1.8	101.4

[1/] Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{101.4}{1.8} = 55$ Use CN = $\boxed{55}$

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... years	2	5	10
Rainfall, P (24 hour) .... in.	3.0	3.8	4.5
Runoff, Q .... in.	0.2	0.5	0.7

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area H

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Fig. 2-3	CN [1/] Fig. 2-4	Area ☑ acres ☐ mi^2 ☐ %	Product of CN x area
B	96% Wooded	55			2.3	127.5
B	4% Brush	48			0.1	4.3
				Totals =	2.4	131.7

[1/] Use only one CN source per line.

CN (weighted) = total product / total area = 131.7 / 2.4 = 55 Use CN = 55

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... years	2	5	10
Rainfall, P (24 hour) .... in.	3.0	3.8	4.5
Runoff, Q .... in.	0.2	0.4	0.7

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area I

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: ______ Date: ______

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1] Table 2-2	CN [1] Fig. 2-3	CN [1] Fig. 2-4	Area ▣ acres ☐ mi^2 ☐ %	Product of CN x area
B	100% Wooded	55			0.9	49.3
				Totals =	0.9	49.3

[1] Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{49.3}{0.9} = 55$ Use CN = $\boxed{55}$

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... years	2	5	10
Rainfall, P (24 hour) .... in.	3.0	3.8	4.5
Runoff, Q .... in.	0.2	0.5	0.7

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area J

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1]			Area ☒ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
B	100% Wooded	55			2.5	139.7
				Totals =	2.5	139.7

[1] Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{139.7}{2.5} = 55$ Use CN = 55

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	years	2	5	10
Rainfall, P (24 hour)	in.	3.0	3.8	4.5
Runoff, Q	in.	0.2	0.5	0.7

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area K

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/]			Area ☑ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
B	100% Wooded	55			1.4	78.1
				Totals =	1.4	78.1

[1/] Use only one CN source per line.

CN (weighted) = total product / total area = 78.1 / 1.4 = 55 Use CN = 55

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	years	2	5	10
Rainfall, P (24 hour)	in.	3.0	3.8	4.5
Runoff, Q	in.	0.2	0.5	0.7

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area L

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: _____ Date: _____

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Fig. 2-3	CN [1/] Fig. 2-4	Area ☒ acres ☐ mi^2 ☐ %	Product of CN x area
B	29% Wooded	55			4.0	217.9
B	40% Open Field	61			5.5	333.0
B	31% Brush	48			4.1	197.8
				Totals =	13.5	748.7

[1/] Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{748.7}{13.5} = 55$ Use CN = 55

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... years	2	5	10
Rainfall, P (24 hour) .... in.	3.0	3.8	4.5
Runoff, Q .... in.	0.2	0.5	0.7

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

Sub-Basin Area M

TR 55 Worksheet 2: Runoff Curve Number and Runoff

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked: Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number (CN)

Soil name and hydrologic group (Appendix A)	Cover description (Cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/]			Area ☑ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
B	25% Wooded, 22% Open Field, 43% Subdivision Ave Subdivision Lot Size = 0.42 ac, 10% Brush	62			50.9	3,155.8
B/D	1% Wooded, 53% Open Field, 46% Subdivision Ave Subdivision Lot Size = 0.42 ac	70			33.8	2,366.0
C/D	100% Subdivision Ave Subdivision Lot = 0.42 ac	80			10.0	800.0
					94.7	6,321.8

[1/] Use only one CN source per line. Totals =

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{6{,}321.8}{94.7} = 67$ Use CN = $\boxed{67}$

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... years	2	5	10
Rainfall, P (24 hour) .... in.	3.0	3.8	4.5
Runoff, Q .... in.	0.6	1.0	1.4

(Use P and CN with Table 2-1, Figure 2-1, or equations 2-3 and 2-4.)

U.S. Department of Agriculture
Natural Resources Conservation Service

Sub-Basin Area A

FL-ENG-21B
06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa   Designed By: KAH   Date: 7/1/14

Location: LaSalle County, Illinois   Checked By: ______   Date: ______

Check one: ✔ Present   Developed

Check one: ✔ T_c T_t through subarea ______

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Units	Segment 1	Segment 2	Total
Segment ID		Sheet Flow		
1. Surface description (Table 3-1)		Wooded Light		
2. Manning's roughness coeff., n (Table 3-1)		0.40		
3. Flow length, L (total L ≤ 100 ft)	ft	100		
4. Two-year 24-hour rainfall, P_2	in	3.0		
5. Land slope, s	ft/ft	0.020		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.37	+	= 0.37

Shallow Concetrated Flow	Units	Segment 1	Segment 2	Total
Segment ID		To Stream		
7. Surface description (paved or unpaved)		Unpaved		
8. Flow length, L	ft	72		
9. Watercourse slope, s	ft/ft	0.028		
10. Average velocity, V (Figure 3-1)	ft/s	2.7		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.01	+	= 0.01

Channel Flow	Units	Segment 1	Segment 2	Total
Segment ID				
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, P_w	ft			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft			
15. Channel Slope, s	ft/ft			
16. Manning's Roughness Coeff., n				
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s			
18. Flow length, L	ft			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr **0.37**

U.S. Department of Agriculture
Natural Resources Conservation Service

Sub-Basin Area B

FL-ENG-21B
06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ____ Date: ____

Check one: ✔ Present ☐ Developed

Check one: ✔ T_c ☐ T_t ☐ through subarea ____

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment 1	Segment 2		Total
Segment ID	Sheet Flow			
1. Surface description (Table 3-1)	Wooded Light			
2. Manning's roughness coeff., n (Table 3-1)	0.40			
3. Flow length, L (total L ≤ 100 ft) ... ft	100			
4. Two-year 24-hour rainfall, P_2 ... in	3.0			
5. Land slope, s ... ft/ft	0.040			
6. $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_t ... hr	0.28	+	=	0.28

Shallow Concetrated Flow

	Segment 1	Segment 2		Total
Segment ID	To Ditch	To Stream		
7. Surface description (paved or unpaved)	Unpaved	Unpaved		
8. Flow length, L ... ft	38	455		
9. Watercourse slope, s ... ft/ft	0.340	0.066		
10. Average velocity, V (Figure 3-1) ... ft/s	9.5	4.2		
11. $T_t = \frac{L}{3600 V}$ Compute T_t ... hr	0.00	+ 0.03	=	0.03

Channel Flow

	Segment 1	Segment 2		Total
Segment ID	Ditch			
12. Cross sectional flow area, a ... ft^2	8.2			
13. Wetted perimeter, P_w ... ft	18.4			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4			
15. Channel Slope, s ... ft/ft	0.256			
16. Manning's Roughness Coeff., n ...	0.04			
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V ... ft/s	11.0			
18. Flow length, L ... ft	141			
19. $T_t = \frac{L}{3600 V}$ Compute T_t ... hr	0.00	+	=	0.00

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.31**

U.S. Department of Agriculture
Natural Resources Conservation Service

Sub-Basin Area C

FL-ENG-21B
06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: Date:

Check one: ✔ Present Developed

Check one: ✔ T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID	Sheet Flow			
1. Surface description (Table 3-1)	Wooded Light			
2. Manning's roughness coeff., n (Table 3-1)	0.40			
3. Flow length, L (total L ≤ 100 ft) ... ft	36			
4. Two-year 24-hour rainfall, P_2 ... in	3.0			
5. Land slope, s ... ft/ft	0.139			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.07	+		= 0.07

Shallow Concetrated Flow

Segment ID	To Ditch		To Stream	
7. Surface description (paved or unpaved)	Unpaved		Unpaved	
8. Flow length, L ... ft	86		317	
9. Watercourse slope, s ... ft/ft	0.128		0.044	
10. Average velocity, V (Figure 3-1) ... ft/s	5.8		3.4	
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.00	+	0.03	= 0.03

Channel Flow

Segment ID	Ditch			
12. Cross sectional flow area, a ... ft^2	4.8			
13. Wetted perimeter, P_w ... ft	10.7			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4			
15. Channel Slope, s ... ft/ft	0.162			
16. Manning's Roughness Coeff., n	0.04			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	8.7			
18. Flow length, L ... ft	253			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.01	+		= 0.01

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.11**

Minimum Tc value of 10 minutes or 0.166 hours.

U.S. Department of Agriculture
Natural Resources Conservation Service

Sub-Basin Area D

FL-ENG-21B
06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ______ Date: ______

Check one: ✔ Present ☐ Developed

Check one: ✔ T_c ☐ T_t ☐ through subarea ______

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Segment ID	Sheet Flow			
1. Surface description (Table 3-1)		Bermudagrass			
2. Manning's roughness coeff., n (Table 3-1)		0.41			
3. Flow length, L (total L ≤ 100 ft)	ft	100			
4. Two-year 24-hour rainfall, P_2	in	3.0			
5. Land slope, s	ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.49	+	=	0.49

Shallow Concetrated Flow	Segment ID	To Catch Basin			
7. Surface description (paved or unpaved)		Unpaved			
8. Flow length, L	ft	605			
9. Watercourse slope, s	ft/ft	0.033			
10. Average velocity, V (Figure 3-1)	ft/s	2.9			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	=	0.06

Channel Flow	Segment ID	SE of RR	NW of RR		
12. Cross sectional flow area, a	ft^2	1.5	2.5		
13. Wetted perimeter, P_w	ft	8.0	7.5		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.2	0.3		
15. Channel Slope, s	ft/ft	0.009	0.081		
16. Manning's Roughness Coeff., n		0.04	0.04		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	1.2	5.1		
18. Flow length, L	ft	1,644	926		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.39	+ 0.05	=	0.44

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr **1.00**

Sub-Basin Area D Pipe Sizing

*See pipe network layout on the next sheet as provided by the City of Ottawa on 11/7/2012.

Assume: Pipe Size
HDPE
Average Grade

$$V = \left[\frac{0.590 * D^{\frac{2}{3}} * s^{\frac{1}{2}}}{n}\right]$$

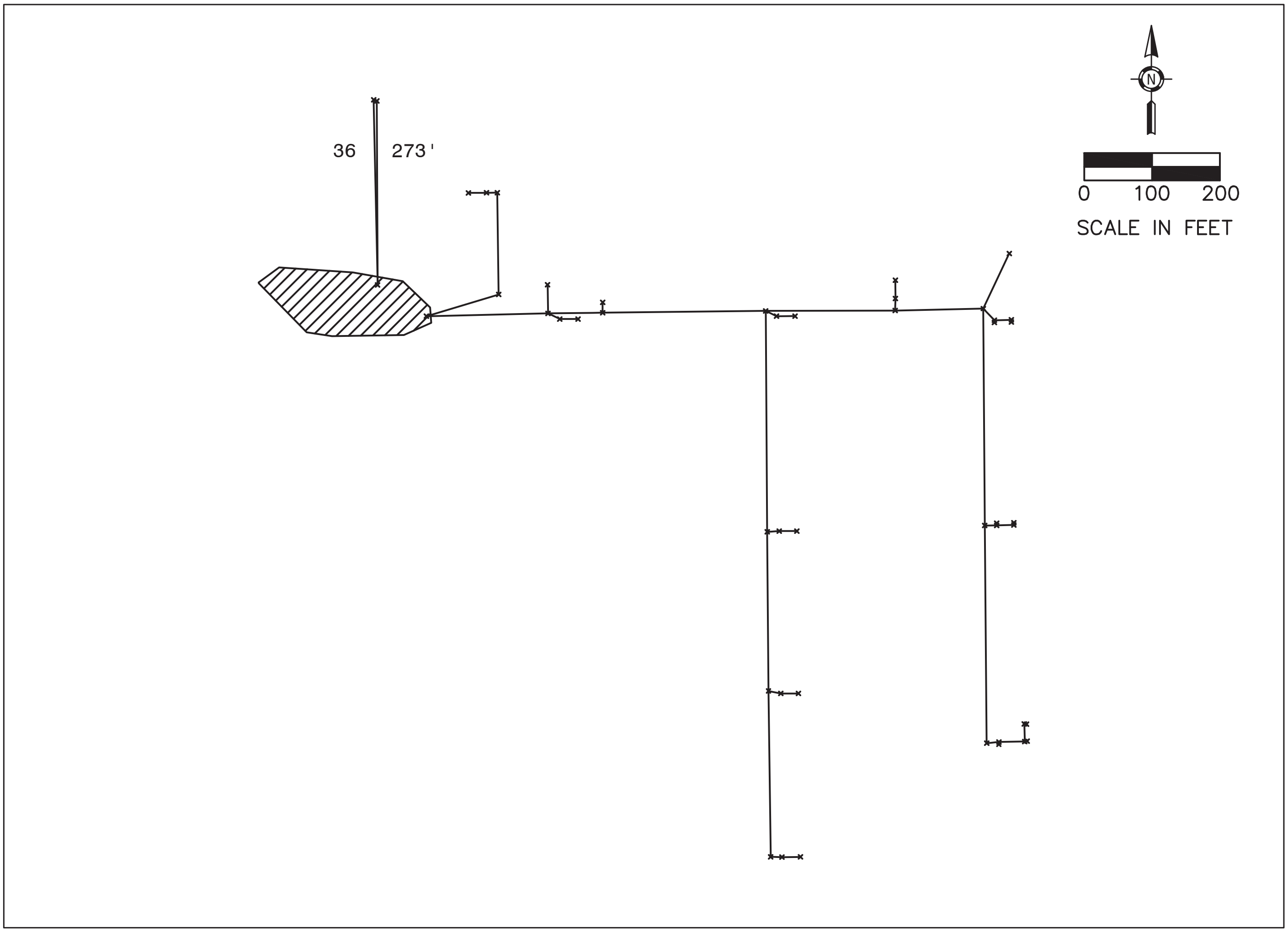
n = 0.012
s = 0.013 ft/ft

Size	V	L	T(s)
36	11.66	273	23.41

23.41 s = 0.3902 min = 0.0065 hr

Tc (Pipe Network) = 0.0065 hr
Tc (Sub-Basin D) = 1.00 hr
Tc (Existing Ditch) = 1.0065 hr

Total Tc = 1.01 hr


36
273'
N
0
100
200
SCALE IN FEET

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa   Designed By: KAH   Date: 7/1/14

Location: LaSalle County, Illinois   Checked By: ______   Date: ______

Check one: ✔ Present   Developed

Check one: ✔ T_c T_t through subarea ______

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)				
2. Manning's roughness coeff., n (Table 3-1)				
3. Flow length, L (total L ≤ 100 ft) ... ft				
4. Two-year 24-hour rainfall, P_2 ... in				
5. Land slope, s ... ft/ft				
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t ... hr		+		=

Shallow Concetrated Flow

Segment ID	To Stream			
7. Surface description (paved or unpaved)	Unpaved			
8. Flow length, L ... ft	374			
9. Watercourse slope, s ... ft/ft	0.136			
10. Average velocity, V (Figure 3-1) ... ft/s	6.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.02	+		= 0.02

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2				
13. Wetted perimeter, P_w ... ft				
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft				
15. Channel Slope, s ... ft/ft				
16. Manning's Roughness Coeff., n				
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s				
18. Flow length, L ... ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.02**

Minimum Tc value of 10 minutes or 0.166 hours.

U.S. Department of Agriculture
Natural Resources Conservation Service

Sub-Basin Area F

FL-ENG-21B
06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa   Designed By: KAH   Date: 7/1/14

Location: LaSalle County, Illinois   Checked By: ________   Date: ________

Check one: ✔ Present   ☐ Developed

Check one: ✔ T_c ☐ T_t ☐ through subarea ________

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment 1		Segment 2		Total
Segment ID		Sheet Flow				
1. Surface description (Table 3-1)		Short Grass				
2. Manning's roughness coeff., n (Table 3-1)		0.15				
3. Flow length, L (total L ≤ 100 ft)	ft	100				
4. Two-year 24-hour rainfall, P_2	in	3.0				
5. Land slope, s	ft/ft	0.030				
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.14	+		=	0.14

Shallow Concetrated Flow

		Segment 1		Segment 2		Total
Segment ID		To Ditch		To Stream		
7. Surface description (paved or unpaved)		Unpaved		Unpaved		
8. Flow length, L	ft	185		102		
9. Watercourse slope, s	ft/ft	0.059		0.069		
10. Average velocity, V (Figure 3-1)	ft/s	3.9		4.2		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.01	+	0.01	=	0.02

Channel Flow

		Segment 1		Segment 2		Total
Segment ID		Ditch				
12. Cross sectional flow area, a	ft^2	6.6				
13. Wetted perimeter, P_w	ft	14.7				
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4				
15. Channel Slope, s	ft/ft	0.091				
16. Manning's Roughness Coeff., n		0.04				
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	6.6				
18. Flow length, L	ft	638				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.03	+		=	0.03

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr **0.19**

Sub-Basin Area G

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ____ Date: ____

Check one: ✔ Present Developed

Check one: ✔ T_c T_t through subarea ____

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID	Sheet Flow			
1. Surface description (Table 3-1)	Wooded Light			
2. Manning's roughness coeff., n (Table 3-1)	0.40			
3. Flow length, L (total L ≤ 100 ft) ... ft	100			
4. Two-year 24-hour rainfall, P_2 ... in	3.0			
5. Land slope, s ... ft/ft	0.080			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t ... hr	0.21	+		= 0.21

Shallow Concetrated Flow

Segment ID	To Stream			
7. Surface description (paved or unpaved)	Unpaved			
8. Flow length, L ... ft	539			
9. Watercourse slope, s ... ft/ft	0.109			
10. Average velocity, V (Figure 3-1) ... ft/s	5.3			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.03	+		= 0.03

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2				
13. Wetted perimeter, P_w ... ft				
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft				
15. Channel Slope, s ... ft/ft				
16. Manning's Roughness Coeff., n ...				
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s				
18. Flow length, L ... ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.24**

U.S. Department of Agriculture
Natural Resources Conservation Service

Sub-Basin Area H

FL-ENG-21B
06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: Date:

Check one: ✔ Present Developed

Check one: ✔ T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Segment ID	Sheet Flow			
1. Surface description (Table 3-1)		Wooded Light			
2. Manning's roughness coeff., n (Table 3-1)		0.40			
3. Flow length, L (total L ≤ 100 ft)	ft	100			
4. Two-year 24-hour rainfall, P_2	in	3.0			
5. Land slope, s	ft/ft	0.090			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.20	+	=	0.20

Shallow Concetrated Flow	Segment ID	To Stream			
7. Surface description (paved or unpaved)		Unpaved			
8. Flow length, L	ft	624			
9. Watercourse slope, s	ft/ft	0.095			
10. Average velocity, V (Figure 3-1)	ft/s	5.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.03	+	=	0.03

Channel Flow	Segment ID				
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, P_w	ft				
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft				
15. Channel Slope, s	ft/ft				
16. Manning's Roughness Coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+	=	

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr **0.24**

Sub-Basin Area I

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa | Designed By: KAH | Date: 7/1/14

Location: LaSalle County, Illinois | Checked By: | Date:

Check one: ✔ Present ☐ Developed

Check one: ✔ T_c ☐ T_t ☐ through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)				
2. Manning's roughness coeff., n (Table 3-1)				
3. Flow length, L (total L ≤ 100 ft)	ft			
4. Two-year 24-hour rainfall, P_2	in			
5. Land slope, s	ft/ft			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr		+	=

Shallow Concetrated Flow

	Segment ID	To Stream		
7. Surface description (paved or unpaved)		Unpaved		
8. Flow length, L	ft	162		
9. Watercourse slope, s	ft/ft	0.191		
10. Average velocity, V (Figure 3-1)	ft/s	7.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.01	+	= 0.01

Channel Flow

	Segment ID			
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, P_w	ft			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft			
15. Channel Slope, s	ft/ft			
16. Manning's Roughness Coeff., n				
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s			
18. Flow length, L	ft			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr **0.01**

Minimum Tc value of 10 minutes or 0.166 hours.

Sub-Basin Area J

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ____ Date: ____

Check one: ✔ Present ☐ Developed

Check one: ✔ T_c ☐ T_t ☐ through subarea ____

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment 1	Segment 2		Total
Segment ID	Sheet Flow			
1. Surface description (Table 3-1)	Wooded Light			
2. Manning's roughness coeff., n (Table 3-1)	0.40			
3. Flow length, L (total L ≤ 100 ft) ... ft	100			
4. Two-year 24-hour rainfall, P_2 ... in	3.0			
5. Land slope, s ... ft/ft	0.020			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t ... hr	0.37	+	=	0.37

Shallow Concetrated Flow

	Segment 1	Segment 2		Total
Segment ID	To Stream			
7. Surface description (paved or unpaved)	Unpaved			
8. Flow length, L ... ft	703			
9. Watercourse slope, s ... ft/ft	0.080			
10. Average velocity, V (Figure 3-1) ... ft/s	4.6			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+	=	0.04

Channel Flow

	Segment 1	Segment 2		Total
Segment ID				
12. Cross sectional flow area, a ... ft^2				
13. Wetted perimeter, P_w ... ft				
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft				
15. Channel Slope, s ... ft/ft				
16. Manning's Roughness Coeff., n ...				
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s				
18. Flow length, L ... ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr		+	=	

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.41**

U.S. Department of Agriculture
Natural Resources Conservation Service

Sub-Basin Area K

FL-ENG-21B
06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa — Designed By: KAH — Date: 7/1/14

Location: LaSalle County, Illinois — Checked By: ______ — Date: ______

Check one: ✔ Present ☐ Developed

Check one: ✔ T_c ☐ T_t ☐ through subarea ______

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment 1	Segment 2		Total
Segment ID	Sheet Flow			
1. Surface description (Table 3-1)	Wooded Light			
2. Manning's roughness coeff., n (Table 3-1)	0.40			
3. Flow length, L (total L ≤ 100 ft) ... ft	75			
4. Two-year 24-hour rainfall, P_2 ... in	3.0			
5. Land slope, s ... ft/ft	0.080			
6. $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_t ... hr	0.17	+	=	0.17

Shallow Concetrated Flow

	Segment 1	Segment 2		Total
Segment ID	To Stream			
7. Surface description (paved or unpaved)	Unpaved			
8. Flow length, L ... ft	103			
9. Watercourse slope, s ... ft/ft	0.214			
10. Average velocity, V (Figure 3-1) ... ft/s	7.5			
11. $T_t = \frac{L}{3600 V}$ Compute T_t ... hr	0.00	+	=	0.00

Channel Flow

	Segment 1	Segment 2		Total
Segment ID				
12. Cross sectional flow area, a ... ft^2				
13. Wetted perimeter, P_w ... ft				
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft				
15. Channel Slope, s ... ft/ft				
16. Manning's Roughness Coeff., n ...				
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V ... ft/s				
18. Flow length, L ... ft				
19. $T_t = \frac{L}{3600 V}$ Compute T_t ... hr		+	=	

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.17**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ____ Date: ____

Check one: ✔ Present Developed

Check one: ✔ T_c T_t through subarea ____

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Segment ID	Sheet Flow			
1. Surface description (Table 3-1)		Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)		0.24			
3. Flow length, L (total L $\leq$ 100 ft)	ft	100			
4. Two-year 24-hour rainfall, P_2	in	3.0			
5. Land slope, s	ft/ft	0.050			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.17	+	=	0.17

Shallow Concetrated Flow	Segment ID	To Ditch			
7. Surface description (paved or unpaved)		Unpaved			
8. Flow length, L	ft	675			
9. Watercourse slope, s	ft/ft	0.036			
10. Average velocity, V (Figure 3-1)	ft/s	3.1			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	=	0.06

Channel Flow	Segment ID	Ditch			
12. Cross sectional flow area, a	ft^2	4.5			
13. Wetted perimeter, P_w	ft	10.1			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4			
15. Channel Slope, s	ft/ft	0.043			
16. Manning's Roughness Coeff., n		0.04			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	4.5			
18. Flow length, L	ft	1,135			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.07	+	=	0.07

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr **0.30**

U.S. Department of Agriculture
Natural Resources Conservation Service

Sub-Basin Area M

FL-ENG-21B
06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: Date:

Check one: ✔ Present Developed

Check one: ✔ T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID	Sheet Flow		
1. Surface description (Table 3-1)		Bermudagrass		
2. Manning's roughness coeff., n (Table 3-1)		0.41		
3. Flow length, L (total L ≤ 100 ft)	ft	100		
4. Two-year 24-hour rainfall, P_2	in	3.0		
5. Land slope, s	ft/ft	0.020		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.38	+	= 0.38

Shallow Concetrated Flow

	Segment ID	To Catch Basin		
7. Surface description (paved or unpaved)		Unpaved		
8. Flow length, L	ft	830		
9. Watercourse slope, s	ft/ft	0.025		
10. Average velocity, V (Figure 3-1)	ft/s	2.4		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.10	+	= 0.10

Channel Flow

	Segment ID	SE of RR	NW of RR	
12. Cross sectional flow area, a	ft^2	3.0	7.0	
13. Wetted perimeter, P_w	ft	11.0	17.0	
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.3	0.4	
15. Channel Slope, s	ft/ft	0.050	0.025	
16. Manning's Roughness Coeff., n		0.04	0.04	
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	3.5	3.3	
18. Flow length, L	ft	453	791	
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.04	+ 0.07	= 0.10

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ..... hr **0.58**

Sub-Basin Area M Pipe Sizing

*See pipe network layout on the next sheet as provided by the City of Ottawa on 11/7/2012.

Assume: Pipe Size
HDPE
Average Grade

$$V = \left[\frac{0.590 * D^{\frac{2}{3}} * s^{\frac{1}{2}}}{n}\right]$$

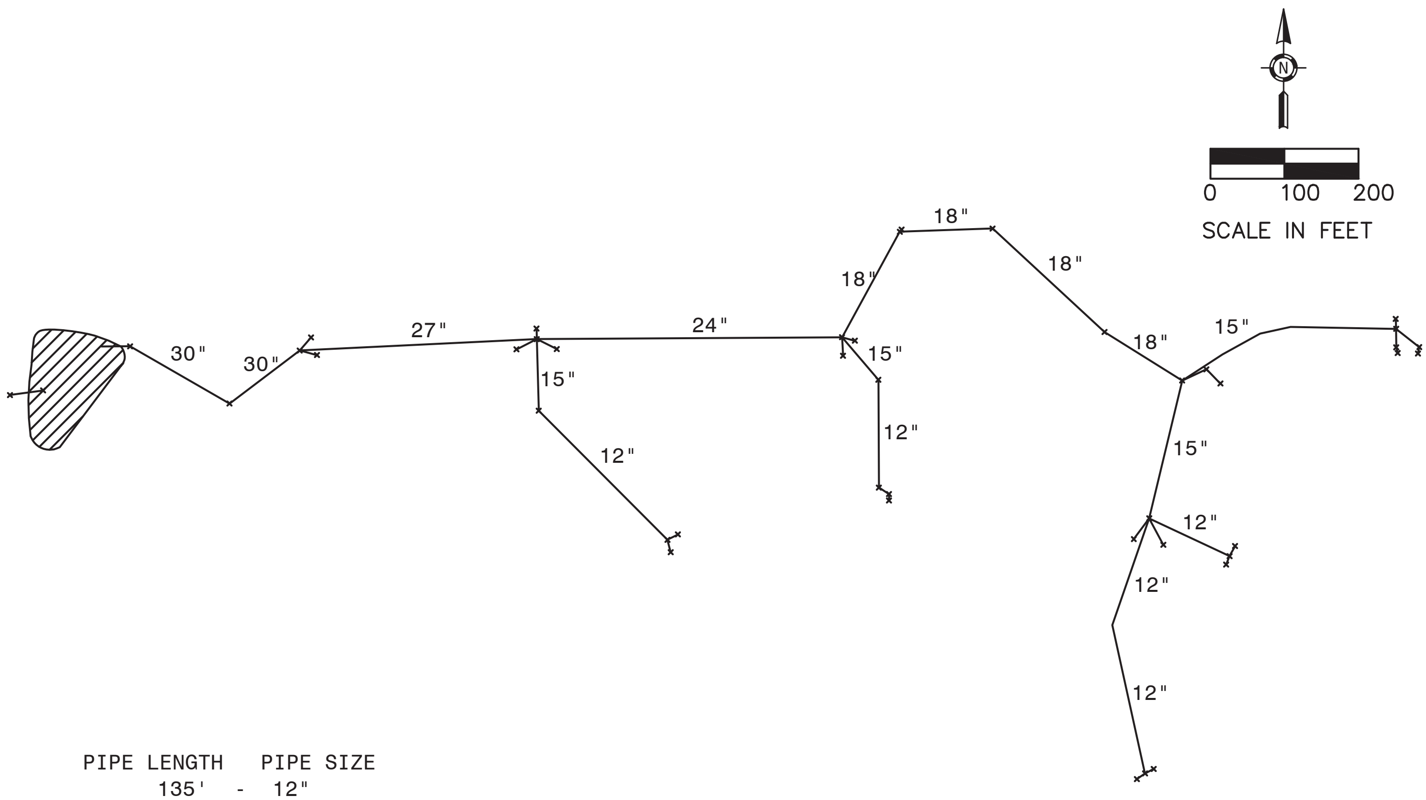
n = 0.012
s = 0.0105 ft/ft

Size	V	L	T(s)
12	6.01	135	22.46
15	6.97	191	27.40
18	7.87	616	78.27
24	9.54	412	43.19
27	10.31	320	31.04
30	11.06	311	28.12

230.48 s ~ 231 s = 0.064 hr

Tc (Pipe Network) = 0.064 hr
Tc (Sub-Basin D) = 0.58 hr
Tc (Existing Ditch) = 0.644 hr

Total Tc = 0.644 hr



PIPE LENGTH		PIPE SIZE
135'	-	12"
191'	-	15"
616'	-	18"
412'	-	24"
320'	-	27"
311'	-	30"

Sub-Basin Area A

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ______ Date: ______

Check one: ✔ Present ____ Developed

1. Data:

   Drainage area .... A_m = 0.00 mi^2 (acres/640)

   Runoff curve number .... CN = 55 (From Worksheet 2)

   Time of concentration ..... T_c = 0.37 hr (From Worksheet 3)

   Rainfall distribution type ...... = II (II, III, DMVIII)

   Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency..	yr	2	5	10
3. Rainfall, P (24-hour)................................	in	3.0	3.8	4.5
4. Initial abstraction, I_a.................................. (Use CN with Table 4-1.)	in	1.636	1.636	1.636
5. Compute I_a/P..		0.54	0.43	0.37
6. Unit peak discharge, q_u......................... (Use T_c and I_a/P with exhibit 4- II)	csm/in	220	370	425
7. Runoff, Q .... (From Worksheet 2)	in	0.21	0.45	0.73
8. Pond and swamp adjustment factor, F_p........ (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p.................................. (Where $q_p = q_u A_m Q F_p$)	cfs	0	0	1

Sub-Basin Area B

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ____ Date: ____

Check one: ✔ Present ____ Developed

1. Data:

Drainage area .... A_m = 0.01 mi^2 (acres/640)

Runoff curve number .... CN = 55 (From Worksheet 2)

Time of concentration ..... T_c = 0.31 hr (From Worksheet 3)

Rainfall distribution type ...... = II (II, III, DMVIII)

Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency...	yr	2	5	10
3. Rainfall, P (24-hour).................................	in	3.0	3.8	4.5
4. Initial abstraction, I_a.................................. (Use CN with Table 4-1.)	in	1.636	1.636	1.636
5. Compute I_a/P..		0.54	0.43	0.37
6. Unit peak discharge, q_u......................... (Use T_c and I_a/P with exhibit 4- II)	csm/in	250	400	480
7. Runoff, Q .... (From Worksheet 2)	in	0.21	0.45	0.73
8. Pond and swamp adjustment factor, F_p........ (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p.................................. (Where $q_p = q_u A_m Q F_p$)	cfs	0	2	3

Sub-Basin Area C

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ______ Date: ______

Check one: ✔ Present ____ Developed

1. Data:

   Drainage area .... A_m = 0.00 mi^2 (acres/640)

   Runoff curve number .... CN = 55 (From Worksheet 2)

   Time of concentration ..... T_c = 0.17 hr (From Worksheet 3)

   Rainfall distribution type ...... = II (II, III, DMVIII)

   Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency...	yr	2	5	10
3. Rainfall, P (24-hour)..................................	in	3.0	3.8	4.5
4. Initial abstraction, I_a.................................. (Use CN with Table 4-1.)	in	1.636	1.636	1.636
5. Compute I_a/P..		0.54	0.43	0.37
6. Unit peak discharge, q_u......................... (Use T_c and I_a/P with exhibit 4- II)	csm/in	325	575	660
7. Runoff, Q .... (From Worksheet 2)	in	0.21	0.45	0.73
8. Pond and swamp adjustment factor, F_p........ (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p.................................. (Where $q_p = q_u A_m Q F_p$)	cfs	0	1	2

Sub-Basin Area D

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ____ Date: ____

Check one: ✔ Present ____ Developed

1. Data:

   Drainage area .... A_m = 0.06 mi^2 (acres/640)

   Runoff curve number .... CN = 65 (From Worksheet 2)

   Time of concentration ..... T_c = 1.01 hr (From Worksheet 3)

   Rainfall distribution type ...... = II (II, III, DMVIII)

   Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency...	yr	2	5	10
3. Rainfall, P (24-hour)................................	in	3.0	3.8	4.5
4. Initial abstraction, I_a.................................. (Use CN with Table 4-1.)	in	1.077	1.077	1.077
5. Compute I_a/P...		0.35	0.28	0.24
6. Unit peak discharge, q_u......................... (Use T_c and I_a/P with exhibit 4- II)	csm/in	260	300	320
7. Runoff, Q .... (From Worksheet 2)	in	0.52	0.93	1.33
8. Pond and swamp adjustment factor, F_p........ (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p.................................. (Where $q_p = q_u A_m Q F_p$)	cfs	8	16	24

Sub-Basin Area E

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ______ Date: ______

Check one: ✔ Present ____ Developed

1. Data:

Drainage area .... A_m = 0.00 mi^2 (acres/640)

Runoff curve number .... CN = 55 (From Worksheet 2)

Time of concentration ..... T_c = 0.17 hr (From Worksheet 3)

Rainfall distribution type ...... = II (II, III, DMVIII)

Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	2	5	10
3. Rainfall, P (24-hour)	in	3.0	3.8	4.5
4. Initial abstraction, I_a (Use CN with Table 4-1.)	in	1.636	1.636	1.636
5. Compute I_a/P		0.54	0.43	0.37
6. Unit peak discharge, q_u (Use T_c and I_a/P with exhibit 4- II)	csm/in	325	575	660
7. Runoff, Q (From Worksheet 2)	in	0.21	0.45	0.73
8. Pond and swamp adjustment factor, F_p (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p (Where $q_p = q_u A_m Q F_p$)	cfs	0	1	1

Sub-Basin Area F

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: _____ Date: _____

Check one: ✔ Present ____ Developed

1. Data:

Drainage area .... A_m = 0.01 mi^2 (acres/640)

Runoff curve number .... CN = 54 (From Worksheet 2)

Time of concentration ..... T_c = 0.19 hr (From Worksheet 3)

Rainfall distribution type ...... = II (II, III, DMVIII)

Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency...	yr	2	5	10
3. Rainfall, P (24-hour)................................	in	3.0	3.8	4.5
4. Initial abstraction, I_a.................................. (Use CN with Table 4-1.)	in	1.704	1.704	1.704
5. Compute I_a/P..		0.56	0.45	0.38
6. Unit peak discharge, q_u.......................... (Use T_c and I_a/P with exhibit 4- II)	csm/in	300	500	625
7. Runoff, Q .... (From Worksheet 2)	in	0.17	0.40	0.66
8. Pond and swamp adjustment factor, F_p........ (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p.................................. (Where $q_p = q_u A_m Q F_p$)	cfs	0	1	2

Sub-Basin Area G

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ________ Date: ________

Check one: ✔ Present ____ Developed

1. Data:

Drainage area .... A_m = 0.00 mi^2 (acres/640)

Runoff curve number .... CN = 55 (From Worksheet 2)

Time of concentration ..... T_c = 0.24 hr (From Worksheet 3)

Rainfall distribution type ...... = II (II, III, DMVIII)

Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency...	yr	2	5	10
3. Rainfall, P (24-hour)................................	in	3.0	3.8	4.5
4. Initial abstraction, I_a................................ (Use CN with Table 4-1.)	in	1.636	1.636	1.636
5. Compute I_a/P..		0.54	0.43	0.37
6. Unit peak discharge, q_u......................... (Use T_c and I_a/P with exhibit 4- II)	csm/in	280	475	555
7. Runoff, Q .... (From Worksheet 2)	in	0.21	0.45	0.73
8. Pond and swamp adjustment factor, F_p........ (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p................................. (Where $q_p = q_u A_m Q F_p$)	cfs	0	1	1

Sub-Basin Area H

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ______ Date: ______

Check one: ✔ Present ____ Developed

1. Data:

   Drainage area .... A_m = 0.00 mi^2 (acres/640)

   Runoff curve number .... CN = 55 (From Worksheet 2)

   Time of concentration ..... T_c = 0.24 hr (From Worksheet 3)

   Rainfall distribution type ...... = II (II, III, DMVIII)

   Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency..	yr	2	5	10
3. Rainfall, P (24-hour).................................	in	3.0	3.8	4.5
4. Initial abstraction, I_a.................................. (Use CN with Table 4-1.)	in	1.636	1.636	1.636
5. Compute I_a/P..		0.54	0.43	0.37
6. Unit peak discharge, q_u......................... (Use T_c and I_a/P with exhibit 4- II)	csm/in	280	475	555
7. Runoff, Q .... (From Worksheet 2)	in	0.21	0.45	0.73
8. Pond and swamp adjustment factor, F_p........ (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p.................................. (Where $q_p = q_u A_m Q F_p$)	cfs	0	1	2

Sub-Basin Area I

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa — Designed By: KAH — Date: 7/1/14

Location: LaSalle County, Illinois — Checked By: ______ — Date: ______

Check one: ✔ Present ____ Developed

1. Data:

Drainage area .... A_m = 0.00 mi^2 (acres/640)

Runoff curve number .... CN = 55 (From Worksheet 2)

Time of concentration ..... T_c = 0.17 hr (From Worksheet 3)

Rainfall distribution type ...... = II (II, III, DMVIII)

Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency..	yr	2	5	10
3. Rainfall, P (24-hour).................................	in	3.0	3.8	4.5
4. Initial abstraction, I_a.................................. (Use CN with Table 4-1.)	in	1.636	1.636	1.636
5. Compute I_a/P...		0.54	0.43	0.37
6. Unit peak discharge, q_u......................... (Use T_c and I_a/P with exhibit 4- II)	csm/in	325	575	660
7. Runoff, Q .... (From Worksheet 2)	in	0.21	0.45	0.73
8. Pond and swamp adjustment factor, F_p........ (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p.................................. (Where $q_p = q_u A_m Q F_p$)	cfs	0	0	1

Sub-Basin Area J

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa   Designed By: KAH   Date: 7/1/14

Location: LaSalle County, Illinois   Checked By: ____   Date: ____

Check one: ✔ Present ____ Developed

1. Data:

Drainage area .... A_m = 0.00 mi^2 (acres/640)

Runoff curve number .... CN = 55 (From Worksheet 2)

Time of concentration ..... T_c = 0.41 hr (From Worksheet 3)

Rainfall distribution type ...... = II (II, III, DMVIII)

Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency..	yr	2	5	10
3. Rainfall, P (24-hour).................................	in	3.0	3.8	4.5
4. Initial abstraction, I_a.................................. (Use CN with Table 4-1.)	in	1.636	1.636	1.636
5. Compute I_a/P..		0.54	0.43	0.37
6. Unit peak discharge, q_u......................... (Use T_c and I_a/P with exhibit 4- II)	csm/in	210	360	420
7. Runoff, Q .... (From Worksheet 2)	in	0.21	0.45	0.73
8. Pond and swamp adjustment factor, F_p........ (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p.................................. (Where $q_p = q_u A_m Q F_p$)	cfs	0	1	1

Sub-Basin Area K

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ______ Date: ______

Check one: ✔ Present ___ Developed

1. Data:

Drainage area .... A_m = 0.00 mi^2 (acres/640)

Runoff curve number .... CN = 55 (From Worksheet 2)

Time of concentration ..... T_c = 0.17 hr (From Worksheet 3)

Rainfall distribution type ...... = II (II, III, DMVIII)

Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency..	yr	2	5	10
3. Rainfall, P (24-hour)................................	in	3.0	3.8	4.5
4. Initial abstraction, I_a.................................. (Use CN with Table 4-1.)	in	1.636	1.636	1.636
5. Compute I_a/P..		0.54	0.43	0.37
6. Unit peak discharge, q_u......................... (Use T_c and I_a/P with exhibit 4- II)	csm/in	325	575	660
7. Runoff, Q .... (From Worksheet 2)	in	0.21	0.45	0.73
8. Pond and swamp adjustment factor, F_p........ (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p.................................. (Where $q_p = q_u A_m Q F_p$)	cfs	0	1	1

Sub-Basin Area L

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ______ Date: ______

Check one: ✔ Present ____ Developed

1. Data:

   Drainage area .... A_m = 0.02 mi^2 (acres/640)

   Runoff curve number .... CN = 55 (From Worksheet 2)

   Time of concentration ..... T_c = 0.30 hr (From Worksheet 3)

   Rainfall distribution type ...... = II (II, III, DMVIII)

   Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	2	5	10
3. Rainfall, P (24-hour)	in	3.0	3.8	4.5
4. Initial abstraction, I_a (Use CN with Table 4-1.)	in	1.636	1.636	1.636
5. Compute I_a/P		0.54	0.43	0.37
6. Unit peak discharge, q_u (Use T_c and I_a/P with exhibit 4- II)	csm/in	240	425	500
7. Runoff, Q (From Worksheet 2)	in	0.21	0.45	0.73
8. Pond and swamp adjustment factor, F_p (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p (Where $q_p = q_u A_m Q F_p$)	cfs	1	4	8

Sub-Basin Area M

Tr 55 Worksheet 4: Graphical Peak Discharge Method

Project: Pilkington Ottawa Designed By: KAH Date: 7/1/14

Location: LaSalle County, Illinois Checked By: ______ Date: ______

Check one: ✔ Present ____ Developed

1. Data:

Drainage area .... A_m = 0.15 mi^2 (acres/640)

Runoff curve number .... CN = 67 (From Worksheet 2)

Time of concentration ..... T_c = 0.64 hr (From Worksheet 3)

Rainfall distribution type ...... = II (II, III, DMVIII)

Pond and swamp areas spread throughout watershed .... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency...	yr	2	5	10
3. Rainfall, P (24-hour).................................	in	3.0	3.8	4.5
4. Initial abstraction, I_a.................................. (Use CN with Table 4-1.)	in	0.985	0.985	0.985
5. Compute I_a/P...		0.32	0.26	0.22
6. Unit peak discharge, q_u......................... (Use T_c and I_a/P with exhibit 4- II)	csm/in	355	400	420
7. Runoff, Q .... (From Worksheet 2)	in	0.59	1.01	1.43
8. Pond and swamp adjustment factor, F_p........ (Use percent pond and swamp area with Table 4-2. Factor is 1.0 for zero percent pond and swamp area.)	in	1.0	1.0	1.0
9. Peak discharge, q_p.................................... (Where $q_p = q_u A_m Q F_p$)	cfs	30	59	87

APPENDIX E

Storm Sewer Sizing Calculations

Pilkington Ottawa Operable Unit 3 Storm Sewer Sizing

$$D = \left(\frac{4^{5/8}}{(\pi \times 1.49)^{3/8}}\right)\left(\frac{Qn}{s^{1/2}}\right)^{3/8}$$

2 Year Storm Culvert Size	
2-Year Peak Flow (Q)	41.147 ft^3/s
Slope (s)	0.0015 ft/ft
Mannings (n)	0.012
*Diameter (D)	3.49 ft
*Diameter (D)	41.82 in

*Required diameter to carry the 2-year peak flow

Pilkington Ottawa Operable Unit 3 Storm Sewer Calculations

Station	b	Θ	TW	D_0	Q_o	L_o	n	V_o	$V_o^2/2g$	H_o	SF_o	H_f	K_o	C_D	C_d	C_Q	C_p	C_B	K	$K(V_o^2/2g)$	EGL_0	EGL_i	HGL	TOC Elev	Head
1	60	133	481.48	3.5	41	200	0.012	4.999	0.388	0	0.0014	0.287	1.12	1.00	0.50	1.00	1.00	1.00	0.559	0.217	481.87	482.37	481.98		
2	60	171	483.88	3.5	41	375	0.012	4.999	0.388	0	0.0014	0.537	0.35	1.00	0.50	1.00	1.00	1.00	0.176	0.068	484.27	484.88	484.49		
3	60	180	486.39	3.5	41	275	0.012	4.999	0.388	0	0.0014	0.394	0.14	1.00	0.50	1.00	1.00	1.00	0.071	0.028	486.78	487.20	486.81		
4	96	79	488.71	3.5	41	300	0.012	4.999	0.388	0	0.0014	0.430	1.56	1.00	0.50	1.00	1.00	1.00	0.780	0.303	489.10	489.83	489.44		
5	-	-	491.34	3.5	41	300	0.012	4.999	0.388	0	0.0014	0.430							1.000	0.388	491.73	492.55	492.16	492.00	0.16

Design Criteria
Inlet Elevation: 488.50
Outlet Elevation: 478.73
42" Critical Depth: 1.992'
$(D+d_c/2)$: 2.746
V: 4.999 ft/s flowing 79.78% full

APPENDIX F

HEC-RAS Report 1

PilkingtonNorth.rep

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX   XXXX        XXXX     XX     XXXX
X     X  X       X    X       X   X   X  X   X
X     X  X       X            X   X  X    X  X
XXXXXXX  XXXX    X      XXX   XXXX   XXXXXX   XXXX
X     X  X       X            X X    X    X       X
X     X  X       X    X       X  X   X    X       X
X     X  XXXXXX   XXXX        X   X  X    X  XXXXX
```

PROJECT DATA
Project Title: Pilkington North
Project File : PilkingtonNorth.prj
Run Date and Time: 8/6/2014 4:13:49 PM

Project in English units

PLAN DATA

Plan Title: Plan 34
Plan File :
f:\Clients\PNA\PNA103\DRAWING\Stormwater\HEC-RAS\HEC-RAS\PilkingtonNorth.p34

```
           Geometry Title: Pilkington North 7-2 HGL REV AQUABLOK
           Geometry File :
f:\Clients\PNA\PNA103\DRAWING\Stormwater\HEC-RAS\HEC-RAS\PilkingtonNorth.g11

           Flow Title    : Flow 15 Known WS Elev
           Flow File     :
f:\Clients\PNA\PNA103\DRAWING\Stormwater\HEC-RAS\HEC-RAS\PilkingtonNorth.f15

Plan Summary Information:
Number of:  Cross Sections =   55    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Mixed Flow
```

FLOW DATA

Flow Title: Flow 15 Known WS Elev
Flow File :
f:\Clients\PNA\PNA103\DRAWING\Stormwater\HEC-RAS\HEC-RAS\PilkingtonNorth.f15

Flow Data (cfs)

River	Reach	RS	PF 1
Pilkington North	Main	23	.1386
Pilkington North	Main	20	.6111
Pilkington North	Main	19	.8841
Pilkington North	Main	17	8.4553
Pilkington North	Main	16	8.5918
Pilkington North	Main	15	8.8978
Pilkington North	Main	13	9.0742
Pilkington North	Main	12	9.3094
Pilkington North	Main	11	9.40495
Pilkington North	Main	7	9.58135
Pilkington North	Main	5	9.71785
Pilkington North	Main	0.5	41.1465
Pilkington North	Main	0.4	41.1465

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Pilkington North	Main	PF 1	Critical	Known WS = 492.35

GEOMETRY DATA

Geometry Title: Pilkington North 7-2 HGL REV AQUABLOK
Geometry File :
f:\Clients\PNA\PNA103\DRAWING\Stormwater\HEC-RAS\HEC-RAS\PilkingtonNorth.g11

CROSS SECTION

RIVER: Pilkington North
REACH: Main RS: 23

INPUT
Description: MC-A 00+97
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	498.0968	18.5787	493.5067	29.0797	495.1215	46.2045	496.3733

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	46.2045	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	46.2045	145	149	153	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

```
  E.G. Elev (ft)           494.70    Element                   Left OB     Channel
Right OB
  Vel Head (ft)              0.00    Wt. n-Val.                              0.040
  W.S. Elev (ft)           494.70    Reach Len. (ft)           145.00      149.00
 153.00
  Crit W.S. (ft)           493.65    Flow Area (sq ft)                        7.48
  E.G. Slope (ft/ft)     0.000001    Area (sq ft)                             7.48
  Q Total (cfs)              0.14    Flow (cfs)                               0.14
  Top Width (ft)            12.57    Top Width (ft)                          12.57
  Vel Total (ft/s)           0.02    Avg. Vel. (ft/s)                         0.02
  Max Chl Dpth (ft)          1.19    Hydr. Depth (ft)                         0.60
  Conv. Total (cfs)         194.3    Conv. (cfs)                             194.3
  Length Wtd. (ft)         149.00    Wetted Per. (ft)                        12.80
  Min Ch El (ft)           493.51    Shear (lb/sq ft)                         0.00
  Alpha                      1.00    Stream Power (lb/ft s)     46.20         0.00
   0.00
  Frctn Loss (ft)            0.00    Cum Volume (acre-ft)                     0.70
  C & E Loss (ft)            0.00    Cum SA (acres)                           1.12
```

CROSS SECTION

```
RIVER: Pilkington North
REACH: Main                 RS: 22

INPUT
Description: MC-B 02+46
Station Elevation Data    num=        3
     Sta    Elev     Sta    Elev      Sta    Elev
       0495.1015 14.7832493.5339 38.2698 499.933

Manning's n Values        num=        3
     Sta    n Val     Sta    n Val     Sta    n Val
       0      .04       0      .04 38.2698     .04

Bank Sta: Left   Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0 38.2698             120.99  117.99      114                .1        .3
```

CROSS SECTION OUTPUT Profile #PF 1

```
  E.G. Elev (ft)           494.70    Element                   Left OB     Channel
Right OB
  Vel Head (ft)              0.00    Wt. n-Val.                              0.040
  W.S. Elev (ft)           494.70    Reach Len. (ft)           120.99      117.99
```

```
 114.00
  Crit W.S. (ft)                        Flow Area (sq ft)                         8.87

  E.G. Slope (ft/ft)      0.000000      Area (sq ft)                              8.87

  Q Total (cfs)               0.14      Flow (cfs)                                0.14

  Top Width (ft)             15.25      Top Width (ft)                           15.25

  Vel Total (ft/s)            0.02      Avg. Vel. (ft/s)                          0.02

  Max Chl Dpth (ft)           1.16      Hydr. Depth (ft)                          0.58

  Conv. Total (cfs)          227.5      Conv. (cfs)                              227.5

  Length Wtd. (ft)          117.99      Wetted Per. (ft)                         15.46

  Min Ch El (ft)            493.53      Shear (lb/sq ft)                          0.00

  Alpha                       1.00      Stream Power (lb/ft s)      38.27         0.00
   0.00
  Frctn Loss (ft)             0.00      Cum Volume (acre-ft)                      0.67

  C & E Loss (ft)             0.00      Cum SA (acres)                            1.07



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 21

INPUT
Description: MC-C 03+64
Station Elevation Data    num=       3
     Sta     Elev     Sta     Elev     Sta     Elev
       0495.0058  9.5164493.3576 23.9453499.5937

Manning's n Values        num=       3
     Sta    n Val     Sta    n Val     Sta    n Val
       0      .04       0      .04 23.9453      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0 23.9453             24.8      25    24.4               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.70      Element                    Left OB     Channel
Right OB
  Vel Head (ft)               0.00      Wt. n-Val.                               0.040

  W.S. Elev (ft)            494.70      Reach Len. (ft)              24.80       25.00
  24.40
  Crit W.S. (ft)                        Flow Area (sq ft)                         7.26

  E.G. Slope (ft/ft)      0.000000      Area (sq ft)                              7.26

  Q Total (cfs)               0.14      Flow (cfs)                                0.14

  Top Width (ft)             10.84      Top Width (ft)                           10.84
```

Vel Total (ft/s)	0.02	Avg. Vel. (ft/s)		0.02
Max Chl Dpth (ft)	1.34	Hydr. Depth (ft)		0.67
Conv. Total (cfs)	201.7	Conv. (cfs)		201.7
Length Wtd. (ft)	25.00	Wetted Per. (ft)		11.23
Min Ch El (ft)	493.36	Shear (lb/sq ft)		0.00
Alpha	1.00	Stream Power (lb/ft s)	23.95	0.00
0.00				
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)		0.65
C & E Loss (ft)	0.00	Cum SA (acres)		1.03

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Pilkington North
REACH: Main RS: 20.8*

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	495.11	18.17	493.83	21.8	493.4	37.34	499.68

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	37.34	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	37.34	24.8	25	24.4	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	494.70	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.00	Wt. n-Val.		0.040
W.S. Elev (ft)	494.70	Reach Len. (ft)	24.80	25.00
24.40				
Crit W.S. (ft)		Flow Area (sq ft)		11.35
E.G. Slope (ft/ft)	0.000000	Area (sq ft)		11.35
Q Total (cfs)	0.14	Flow (cfs)		0.14
Top Width (ft)	19.16	Top Width (ft)		19.16
Vel Total (ft/s)	0.01	Avg. Vel. (ft/s)		0.01
Max Chl Dpth (ft)	1.30	Hydr. Depth (ft)		0.59

```
  Conv. Total (cfs)           294.5    Conv. (cfs)                        294.5

  Length Wtd. (ft)            25.00    Wetted Per. (ft)                   19.46

  Min Ch El (ft)             493.40    Shear (lb/sq ft)                    0.00

  Alpha                        1.00    Stream Power (lb/ft s)     37.34    0.00
   0.00
  Frctn Loss (ft)              0.00    Cum Volume (acre-ft)                0.64

  C & E Loss (ft)              0.00    Cum SA (acres)                      1.02



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 20.6*

INPUT
Description:
Station Elevation Data      num=       4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   495.21    28.41   494.03    34.08   493.45    50.73   499.76

Manning's n Values          num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    50.73      .04

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
              0    50.73             24.8      25     24.4                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)             494.70    Element                     Left OB    Channel
Right OB
  Vel Head (ft)                0.00    Wt. n-Val.                          0.040

  W.S. Elev (ft)             494.70    Reach Len. (ft)            24.80    25.00
  24.40
  Crit W.S. (ft)                       Flow Area (sq ft)                   12.85

  E.G. Slope (ft/ft)       0.000000    Area (sq ft)                        12.85

  Q Total (cfs)                0.14    Flow (cfs)                           0.14

  Top Width (ft)              25.03    Top Width (ft)                      25.03

  Vel Total (ft/s)             0.01    Avg. Vel. (ft/s)                     0.01

  Max Chl Dpth (ft)            1.25    Hydr. Depth (ft)                     0.51

  Conv. Total (cfs)           303.7    Conv. (cfs)                         303.7

  Length Wtd. (ft)            25.00    Wetted Per. (ft)                    25.31

  Min Ch El (ft)             493.45    Shear (lb/sq ft)                     0.00

  Alpha                        1.00    Stream Power (lb/ft s)     50.73     0.00
```

```
 0.00
 Frctn Loss (ft)             0.00    Cum Volume (acre-ft)              0.64

 C & E Loss (ft)             0.00    Cum SA (acres)                    1.01



CROSS SECTION


RIVER: Pilkington North
REACH: Main                RS: 20.4*

INPUT
Description:
Station Elevation Data     num=        4
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
       0  495.31    38.65  494.23    46.36  493.49    64.12  499.85

Manning's n Values         num=        3
     Sta    n Val     Sta    n Val     Sta    n Val
       0      .04       0      .04   64.12      .04

Bank Sta: Left   Right     Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   64.12              24.8      25    24.4              .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


 E.G. Elev (ft)            494.70    Element                  Left OB    Channel
Right OB
 Vel Head (ft)               0.00    Wt. n-Val.                          0.040

 W.S. Elev (ft)            494.70    Reach Len. (ft)            24.80    25.00
 24.40
 Crit W.S. (ft)                      Flow Area (sq ft)                   12.40

 E.G. Slope (ft/ft)      0.000000    Area (sq ft)                        12.40

 Q Total (cfs)               0.14    Flow (cfs)                           0.14

 Top Width (ft)             27.81    Top Width (ft)                      27.81

 Vel Total (ft/s)            0.01    Avg. Vel. (ft/s)                     0.01

 Max Chl Dpth (ft)           1.21    Hydr. Depth (ft)                     0.45

 Conv. Total (cfs)          267.4    Conv. (cfs)                         267.4

 Length Wtd. (ft)           25.00    Wetted Per. (ft)                    28.07

 Min Ch El (ft)            493.49    Shear (lb/sq ft)                     0.00

 Alpha                       1.00    Stream Power (lb/ft s)     64.12     0.00
 0.00
 Frctn Loss (ft)             0.00    Cum Volume (acre-ft)                 0.63

 C & E Loss (ft)             0.00    Cum SA (acres)                       1.00
```

```
CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 20.2*

INPUT
Description:
Station Elevation Data     num=       4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   495.41    48.88   494.43    58.64   493.54    77.51   499.93

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    77.51      .04

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0    77.51             24.8      25    24.4               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.70    Element                    Left OB    Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                             0.040

  W.S. Elev (ft)            494.70    Reach Len. (ft)              24.80      25.00
  24.40
  Crit W.S. (ft)                      Flow Area (sq ft)                      10.72

  E.G. Slope (ft/ft)      0.000000    Area (sq ft)                           10.72

  Q Total (cfs)               0.14    Flow (cfs)                              0.14

  Top Width (ft)             26.52    Top Width (ft)                         26.52

  Vel Total (ft/s)            0.01    Avg. Vel. (ft/s)                        0.01

  Max Chl Dpth (ft)           1.16    Hydr. Depth (ft)                        0.40

  Conv. Total (cfs)          216.4    Conv. (cfs)                            216.4

  Length Wtd. (ft)           25.00    Wetted Per. (ft)                       26.76

  Min Ch El (ft)            493.54    Shear (lb/sq ft)                        0.00

  Alpha                       1.00    Stream Power (lb/ft s)       77.51      0.00
   0.00
  Frctn Loss (ft)             0.00    Cum Volume (acre-ft)                    0.62

  C & E Loss (ft)             0.00    Cum SA (acres)                          0.98



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 20

INPUT
Description: MC-D 04+89
```

```
Station Elevation Data    num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0495.5149 59.1228494.6246 70.9195493.5837 90.8991500.0149

Manning's n Values        num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 90.8991      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0 90.8991                  43    43.6    41.6               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)             494.70     Element                   Left OB    Channel
Right OB
  Vel Head (ft)                0.00     Wt. n-Val.                             0.040

  W.S. Elev (ft)             494.70     Reach Len. (ft)             43.00      43.60
  41.60
  Crit W.S. (ft)                        Flow Area (sq ft)                       9.10

  E.G. Slope (ft/ft)       0.000010     Area (sq ft)                            9.10

  Q Total (cfs)                0.61     Flow (cfs)                              0.61

  Top Width (ft)              20.09     Top Width (ft)                         20.09

  Vel Total (ft/s)             0.07     Avg. Vel. (ft/s)                        0.07

  Max Chl Dpth (ft)            1.11     Hydr. Depth (ft)                        0.45

  Conv. Total (cfs)           198.0     Conv. (cfs)                            198.0

  Length Wtd. (ft)            43.60     Wetted Per. (ft)                       20.31

  Min Ch El (ft)             493.58     Shear (lb/sq ft)                        0.00

  Alpha                        1.00     Stream Power (lb/ft s)      90.90       0.00
   0.00
  Frctn Loss (ft)              0.00     Cum Volume (acre-ft)                    0.62

  C & E Loss (ft)              0.00     Cum SA (acres)                          0.97



CROSS SECTION


RIVER: Pilkington North
REACH: Main                RS: 19.8*

INPUT
Description:
Station Elevation Data    num=        6
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   495.84    48.75   494.53    58.47   493.58    59.35   493.58    60.26   493.58
   79.43   499.35

Manning's n Values        num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04   79.43      .04
```

```
Bank Sta: Left    Right    Lengths: Left Channel    Right     Coeff Contr.    Expan.
             0    79.43                43     43.6    41.6                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.70    Element                    Left OB     Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                              0.040

  W.S. Elev (ft)            494.70    Reach Len. (ft)             43.00       43.60
 41.60
  Crit W.S. (ft)                      Flow Area (sq ft)                       10.83

  E.G. Slope (ft/ft)      0.000006    Area (sq ft)                            10.83

  Q Total (cfs)               0.61    Flow (cfs)                               0.61

  Top Width (ft)             21.44    Top Width (ft)                          21.44

  Vel Total (ft/s)            0.06    Avg. Vel. (ft/s)                         0.06

  Max Chl Dpth (ft)           1.12    Hydr. Depth (ft)                         0.51

  Conv. Total (cfs)          253.6    Conv. (cfs)                             253.6

  Length Wtd. (ft)           43.60    Wetted Per. (ft)                        21.65

  Min Ch El (ft)            493.58    Shear (lb/sq ft)                         0.00

  Alpha                       1.00    Stream Power (lb/ft s)      79.43        0.00
   0.00
  Frctn Loss (ft)             0.00    Cum Volume (acre-ft)                     0.61

  C & E Loss (ft)             0.00    Cum SA (acres)                           0.95



CROSS SECTION


RIVER: Pilkington North
REACH: Main                  RS: 19.6*

INPUT
Description:
Station Elevation Data    num=       6
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   496.16    38.37   494.44    46.03   493.58    47.78   493.58    49.59   493.58
   67.96   498.69

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    67.96      .04

Bank Sta: Left    Right    Lengths: Left Channel    Right     Coeff Contr.    Expan.
             0    67.96                43     43.6    41.6                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1
```

```
  E.G. Elev (ft)              494.70     Element                     Left OB     Channel
Right OB
  Vel Head (ft)                 0.00     Wt. n-Val.                                0.040

  W.S. Elev (ft)              494.70     Reach Len. (ft)              43.00        43.60
  41.60
  Crit W.S. (ft)                         Flow Area (sq ft)                         12.22

  E.G. Slope (ft/ft)        0.000004     Area (sq ft)                              12.22

  Q Total (cfs)                 0.61     Flow (cfs)                                 0.61

  Top Width (ft)               20.97     Top Width (ft)                            20.97

  Vel Total (ft/s)              0.05     Avg. Vel. (ft/s)                           0.05

  Max Chl Dpth (ft)             1.12     Hydr. Depth (ft)                           0.58

  Conv. Total (cfs)            314.5     Conv. (cfs)                               314.5

  Length Wtd. (ft)             43.60     Wetted Per. (ft)                          21.17

  Min Ch El (ft)              493.58     Shear (lb/sq ft)                           0.00

  Alpha                         1.00     Stream Power (lb/ft s)       67.96         0.00
   0.00
  Frctn Loss (ft)               0.00     Cum Volume (acre-ft)                       0.59

  C & E Loss (ft)               0.00     Cum SA (acres)                             0.93



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 19.4*

INPUT
Description:
Station Elevation Data    num=       6
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   496.49    27.99   494.35    33.58   493.58    36.21   493.58    38.93   493.58
   56.48   498.03

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    56.48      .04

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0    56.48               43     43.6    41.6                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)              494.70     Element                     Left OB     Channel
Right OB
  Vel Head (ft)                 0.00     Wt. n-Val.                                0.040

  W.S. Elev (ft)              494.70     Reach Len. (ft)              43.00        43.60
  41.60
  Crit W.S. (ft)                         Flow Area (sq ft)                         13.31
```

```
  E.G. Slope (ft/ft)      0.000003    Area (sq ft)                        13.31

  Q Total (cfs)               0.61    Flow (cfs)                           0.61

  Top Width (ft)             19.88    Top Width (ft)                      19.88

  Vel Total (ft/s)            0.05    Avg. Vel. (ft/s)                     0.05

  Max Chl Dpth (ft)           1.12    Hydr. Depth (ft)                     0.67

  Conv. Total (cfs)          375.8    Conv. (cfs)                         375.8

  Length Wtd. (ft)           43.60    Wetted Per. (ft)                    20.08

  Min Ch El (ft)            493.58    Shear (lb/sq ft)                     0.00

  Alpha                       1.00    Stream Power (lb/ft s)     56.48     0.00
   0.00
  Frctn Loss (ft)             0.00    Cum Volume (acre-ft)                 0.58

  C & E Loss (ft)             0.00    Cum SA (acres)                       0.91



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 19.2*

INPUT
Description:
Station Elevation Data     num=       6
     Sta     Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   496.81   17.62  494.26   21.13  493.58   24.63  493.58   28.27  493.58
   45.01   497.37

Manning's n Values         num=       3
     Sta    n Val     Sta   n Val     Sta   n Val
       0      .04       0     .04   45.01     .04

Bank Sta: Left   Right     Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0   45.01                43     43.6   41.6                .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.70    Element                  Left OB    Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                          0.040

  W.S. Elev (ft)            494.70    Reach Len. (ft)            43.00    43.60
  41.60
  Crit W.S. (ft)                      Flow Area (sq ft)                   14.11

  E.G. Slope (ft/ft)      0.000002    Area (sq ft)                        14.11

  Q Total (cfs)               0.61    Flow (cfs)                           0.61

  Top Width (ft)             18.60    Top Width (ft)                      18.60
```

```
  Vel Total (ft/s)            0.04    Avg. Vel. (ft/s)                    0.04

  Max Chl Dpth (ft)           1.12    Hydr. Depth (ft)                    0.76

  Conv. Total (cfs)          432.6    Conv. (cfs)                        432.6

  Length Wtd. (ft)           43.60    Wetted Per. (ft)                   18.82

  Min Ch El (ft)            493.58    Shear (lb/sq ft)                    0.00

  Alpha                       1.00    Stream Power (lb/ft s)    45.01     0.00
   0.00
  Frctn Loss (ft)             0.00    Cum Volume (acre-ft)                0.57

  C & E Loss (ft)             0.00    Cum SA (acres)                      0.89



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 19

INPUT
Description: MC-E 07+07
Station Elevation Data      num=        5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0497.1382    8.686 493.575 13.0628 493.575 17.6019 493.575 33.5421496.7132

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 33.5421      .04

Bank Sta: Left   Right      Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0 33.5421                  38   38.33   39.33               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.70    Element                 Left OB    Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                         0.040

  W.S. Elev (ft)            494.70    Reach Len. (ft)          38.00     38.33
  39.33
  Crit W.S. (ft)                      Flow Area (sq ft)                  14.73

  E.G. Slope (ft/ft)      0.000003    Area (sq ft)                       14.73

  Q Total (cfs)               0.88    Flow (cfs)                          0.88

  Top Width (ft)             17.35    Top Width (ft)                     17.35

  Vel Total (ft/s)            0.06    Avg. Vel. (ft/s)                    0.06

  Max Chl Dpth (ft)           1.12    Hydr. Depth (ft)                    0.85

  Conv. Total (cfs)          484.3    Conv. (cfs)                        484.3

  Length Wtd. (ft)           38.33    Wetted Per. (ft)                   17.68
```

```
  Min Ch El (ft)            493.58    Shear (lb/sq ft)                       0.00

  Alpha                       1.00    Stream Power (lb/ft s)     33.54       0.00
   0.00
  Frctn Loss (ft)             0.00    Cum Volume (acre-ft)                   0.55

  C & E Loss (ft)             0.00    Cum SA (acres)                         0.87



CROSS SECTION


RIVER: Pilkington North
REACH: Main                  RS: 18.6666*

INPUT
Description:
Station Elevation Data     num=       7
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
       0  497.09      2.8  495.73    12.38  493.58     15.3  493.58    18.33  493.58
   29.45  495.41    38.17   497.4

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04        0     .04    38.17     .04

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
             0    38.17               38    38.33   39.33               .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.70    Element                       Left OB    Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                             0.040

  W.S. Elev (ft)            494.70    Reach Len. (ft)              38.00     38.33
  39.33
  Crit W.S. (ft)                      Flow Area (sq ft)                      13.20

  E.G. Slope (ft/ft)      0.000005    Area (sq ft)                           13.20

  Q Total (cfs)               0.88    Flow (cfs)                              0.88

  Top Width (ft)             17.71    Top Width (ft)                         17.71

  Vel Total (ft/s)            0.07    Avg. Vel. (ft/s)                        0.07

  Max Chl Dpth (ft)           1.12    Hydr. Depth (ft)                        0.75

  Conv. Total (cfs)          400.2    Conv. (cfs)                            400.2

  Length Wtd. (ft)           38.33    Wetted Per. (ft)                       17.92

  Min Ch El (ft)            493.58    Shear (lb/sq ft)                        0.00

  Alpha                       1.00    Stream Power (lb/ft s)     38.17       0.00
   0.00
  Frctn Loss (ft)             0.00    Cum Volume (acre-ft)                   0.54

  C & E Loss (ft)             0.00    Cum SA (acres)                         0.85
```

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CROSS SECTION


RIVER: Pilkington North
REACH: Main                   RS: 18.3333*

INPUT
Description:
Station Elevation Data    num=       7
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  497.04    3.64  495.13   16.08  493.58   17.54  493.58   19.05  493.58
   32.36  495.49   42.81  498.09

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .04       0     .04   42.81     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0   42.81               38   38.33   39.33               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.70    Element                     Left OB    Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                               0.040

  W.S. Elev (ft)            494.70    Reach Len. (ft)              38.00       38.33
  39.33
  Crit W.S. (ft)                      Flow Area (sq ft)                        12.65

  E.G. Slope (ft/ft)      0.000006    Area (sq ft)                             12.65

  Q Total (cfs)               0.88    Flow (cfs)                                0.88

  Top Width (ft)             19.71    Top Width (ft)                           19.71

  Vel Total (ft/s)            0.07    Avg. Vel. (ft/s)                          0.07

  Max Chl Dpth (ft)           1.12    Hydr. Depth (ft)                          0.64

  Conv. Total (cfs)          348.1    Conv. (cfs)                              348.1

  Length Wtd. (ft)           38.33    Wetted Per. (ft)                         19.85

  Min Ch El (ft)            493.58    Shear (lb/sq ft)                          0.00

  Alpha                       1.00    Stream Power (lb/ft s)       42.81        0.00
   0.00
  Frctn Loss (ft)             0.00    Cum Volume (acre-ft)                      0.53

  C & E Loss (ft)             0.00    Cum SA (acres)                            0.84



CROSS SECTION
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```
RIVER: Pilkington North
REACH: Main                   RS: 18

INPUT
Description: MC-F 08+22
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0496.9881  4.4778494.5351 19.7793493.5775 35.2795495.5647 47.4397498.7842

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 47.4397      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0 47.4397             47.67       44      44               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.70    Element                     Left OB    Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                               0.040

  W.S. Elev (ft)            494.70    Reach Len. (ft)              47.67       44.00
  44.00
  Crit W.S. (ft)                      Flow Area (sq ft)                        14.69

  E.G. Slope (ft/ft)      0.000005    Area (sq ft)                             14.69

  Q Total (cfs)               0.88    Flow (cfs)                                0.88

  Top Width (ft)             24.32    Top Width (ft)                           24.32

  Vel Total (ft/s)            0.06    Avg. Vel. (ft/s)                          0.06

  Max Chl Dpth (ft)           1.12    Hydr. Depth (ft)                          0.60

  Conv. Total (cfs)          388.4    Conv. (cfs)                              388.4

  Length Wtd. (ft)           44.00    Wetted Per. (ft)                         24.46

  Min Ch El (ft)            493.58    Shear (lb/sq ft)                          0.00

  Alpha                       1.00    Stream Power (lb/ft s)       47.44        0.00
   0.00
  Frctn Loss (ft)             0.00    Cum Volume (acre-ft)                      0.52

  C & E Loss (ft)             0.00    Cum SA (acres)                            0.82



CROSS SECTION


RIVER: Pilkington North
REACH: Main                   RS: 17.6666*

INPUT
Description:
Station Elevation Data    num=       7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   497.07     4.66   494.53     5.54   494.33    20.58   493.58    35.95   495.29
```

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   37.33  495.57   48.01  499.06

Manning's n Values          num=        3
      Sta    n Val      Sta    n Val      Sta    n Val
        0      .04        0      .04    48.01      .04

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0    48.01              47.67       44       44               .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)             494.70    Element                    Left OB    Channel
Right OB
  Vel Head (ft)                0.00    Wt. n-Val.                            0.040

  W.S. Elev (ft)             494.70    Reach Len. (ft)             47.67       44.00
  44.00
  Crit W.S. (ft)                       Flow Area (sq ft)                     16.99

  E.G. Slope (ft/ft)       0.000004    Area (sq ft)                          16.99

  Q Total (cfs)                0.88    Flow (cfs)                             0.88

  Top Width (ft)              26.25    Top Width (ft)                        26.25

  Vel Total (ft/s)             0.05    Avg. Vel. (ft/s)                       0.05

  Max Chl Dpth (ft)            1.12    Hydr. Depth (ft)                       0.65

  Conv. Total (cfs)           470.7    Conv. (cfs)                           470.7

  Length Wtd. (ft)            44.00    Wetted Per. (ft)                      26.40

  Min Ch El (ft)             493.58    Shear (lb/sq ft)                       0.00

  Alpha                        1.00    Stream Power (lb/ft s)      48.01       0.00
   0.00
  Frctn Loss (ft)              0.00    Cum Volume (acre-ft)                   0.50

  C & E Loss (ft)              0.00    Cum SA (acres)                         0.79



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 17.3333*

INPUT
Description:
Station Elevation Data      num=        7
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0   497.16     4.84   494.53     5.75   494.17    21.38   493.58    36.62   495.02
    37.99   495.21    48.58   499.33

Manning's n Values          num=        3
      Sta    n Val      Sta    n Val      Sta    n Val
        0      .04        0      .04    48.58      .04

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
```

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           0   48.58             47.67      44      44              .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.70    Element                   Left OB    Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                            0.040

  W.S. Elev (ft)            494.70    Reach Len. (ft)            47.67      44.00
44.00
  Crit W.S. (ft)                      Flow Area (sq ft)                     19.75

  E.G. Slope (ft/ft)      0.000002    Area (sq ft)                          19.75

  Q Total (cfs)               0.88    Flow (cfs)                             0.88

  Top Width (ft)             28.65    Top Width (ft)                        28.65

  Vel Total (ft/s)            0.04    Avg. Vel. (ft/s)                       0.04

  Max Chl Dpth (ft)           1.12    Hydr. Depth (ft)                       0.69

  Conv. Total (cfs)          570.3    Conv. (cfs)                           570.3

  Length Wtd. (ft)           44.00    Wetted Per. (ft)                      28.83

  Min Ch El (ft)            493.58    Shear (lb/sq ft)                       0.00

  Alpha                       1.00    Stream Power (lb/ft s)     48.58       0.00
   0.00
  Frctn Loss (ft)             0.00    Cum Volume (acre-ft)                   0.48

  C & E Loss (ft)             0.00    Cum SA (acres)                         0.76



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 17

INPUT
Description: MC-G 09+54
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0497.2397  5.9686494.0108 22.1867493.5757  38.645494.8546 49.1452499.5995

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 49.1452      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0 49.1452                 43      44      46              .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.69    Element                   Left OB    Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                            0.040
```

```
  W.S. Elev (ft)            494.69    Reach Len. (ft)           43.00       44.00
  46.00
  Crit W.S. (ft)                      Flow Area (sq ft)                     22.99

  E.G. Slope (ft/ft)      0.000153    Area (sq ft)                          22.99

  Q Total (cfs)               8.46    Flow (cfs)                             8.46

  Top Width (ft)             31.83    Top Width (ft)                        31.83

  Vel Total (ft/s)            0.37    Avg. Vel. (ft/s)                       0.37

  Max Chl Dpth (ft)           1.12    Hydr. Depth (ft)                       0.72

  Conv. Total (cfs)          684.3    Conv. (cfs)                           684.3

  Length Wtd. (ft)           44.00    Wetted Per. (ft)                      32.05

  Min Ch El (ft)            493.58    Shear (lb/sq ft)                       0.01

  Alpha                       1.00    Stream Power (lb/ft s)    49.15        0.00
   0.00
  Frctn Loss (ft)             0.01    Cum Volume (acre-ft)                   0.46

  C & E Loss (ft)             0.00    Cum SA (acres)                         0.73


CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 16.5*

INPUT
Description:
Station Elevation Data    num=        7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   497.29     4.88   494.66     8.71   493.79    18.13   493.58    33.59    494.9
   34.35   495.12    43.45   499.18

Manning's n Values        num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    43.45      .04

Bank Sta: Left    Right    Lengths: Left Channel    Right     Coeff Contr.    Expan.
             0    43.45               43      44       46               .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.68    Element                  Left OB     Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                            0.040

  W.S. Elev (ft)            494.68    Reach Len. (ft)           43.00       44.00
  46.00
  Crit W.S. (ft)                      Flow Area (sq ft)                     18.23

  E.G. Slope (ft/ft)      0.000255    Area (sq ft)                          18.23
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  Q Total (cfs)              8.46    Flow (cfs)                          8.46

  Top Width (ft)            26.18    Top Width (ft)                     26.18

  Vel Total (ft/s)           0.46    Avg. Vel. (ft/s)                    0.46

  Max Chl Dpth (ft)          1.10    Hydr. Depth (ft)                    0.70

  Conv. Total (cfs)         529.9    Conv. (cfs)                        529.9

  Length Wtd. (ft)          44.00    Wetted Per. (ft)                   26.34

  Min Ch El (ft)           493.58    Shear (lb/sq ft)                    0.01

  Alpha                      1.00    Stream Power (lb/ft s)     43.45    0.00
   0.00
  Frctn Loss (ft)            0.01    Cum Volume (acre-ft)                0.44

  C & E Loss (ft)            0.00    Cum SA (acres)                      0.70



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 16

INPUT
Description: MC-H 10+42
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0497.3308  6.7667493.7023 14.0805493.5755  29.245495.0127 37.7526498.7619

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 37.7526      .04

Bank Sta: Left   Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0 37.7526                    97       88       97               .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)           494.67    Element                    Left OB    Channel
Right OB
  Vel Head (ft)              0.01    Wt. n-Val.                          0.040

  W.S. Elev (ft)           494.66    Reach Len. (ft)            97.00    88.00
  97.00
  Crit W.S. (ft)                     Flow Area (sq ft)                  14.63

  E.G. Slope (ft/ft)     0.000402    Area (sq ft)                       14.63

  Q Total (cfs)              8.59    Flow (cfs)                          8.59

  Top Width (ft)            20.60    Top Width (ft)                     20.60

  Vel Total (ft/s)           0.59    Avg. Vel. (ft/s)                    0.59

  Max Chl Dpth (ft)          1.09    Hydr. Depth (ft)                    0.71
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  Conv. Total (cfs)            428.4    Conv. (cfs)                              428.4

  Length Wtd. (ft)             88.00    Wetted Per. (ft)                         20.90

  Min Ch El (ft)              493.58    Shear (lb/sq ft)                          0.02

  Alpha                         1.00    Stream Power (lb/ft s)      37.75         0.00
   0.00
  Frctn Loss (ft)               0.03    Cum Volume (acre-ft)                      0.42

  C & E Loss (ft)               0.00    Cum SA (acres)                            0.68



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 15

INPUT
Description: MC-I 11+40
Station Elevation Data      num=        5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0497.0367  4.3467493.8974 12.8365493.5754  21.324 493.832 34.5374498.2132

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 34.5374      .04

Bank Sta: Left   Right      Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0 34.5374                  105       98     105              .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)              494.64    Element                     Left OB    Channel
Right OB
  Vel Head (ft)                 0.00    Wt. n-Val.                               0.040

  W.S. Elev (ft)              494.64    Reach Len. (ft)             105.00       98.00
 105.00
  Crit W.S. (ft)                        Flow Area (sq ft)                        16.92

  E.G. Slope (ft/ft)        0.000264    Area (sq ft)                             16.92

  Q Total (cfs)                 8.90    Flow (cfs)                                8.90

  Top Width (ft)               20.43    Top Width (ft)                           20.43

  Vel Total (ft/s)              0.53    Avg. Vel. (ft/s)                          0.53

  Max Chl Dpth (ft)             1.06    Hydr. Depth (ft)                          0.83

  Conv. Total (cfs)            547.7    Conv. (cfs)                              547.7

  Length Wtd. (ft)             98.00    Wetted Per. (ft)                         20.81

  Min Ch El (ft)              493.58    Shear (lb/sq ft)                          0.01

  Alpha                         1.00    Stream Power (lb/ft s)      34.54         0.00
   0.00
```

```
  Frctn Loss (ft)            0.02    Cum Volume (acre-ft)                 0.39

  C & E Loss (ft)            0.00    Cum SA (acres)                       0.64



CROSS SECTION


RIVER: Pilkington North
REACH: Main              RS: 14

INPUT
Description: MC-J 12+45
Station Elevation Data    num=       8
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0496.8937  3.6223493.4621  9.3775 493.395  15.466493.3262 18.5864494.4335
 24.1675493.9971 32.3869494.7101 42.1579496.4948

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 32.3869      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0 32.3869                 98     105      97              .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)           494.62    Element                      Left OB    Channel
Right OB
  Vel Head (ft)              0.00    Wt. n-Val.                              0.040

  W.S. Elev (ft)           494.62    Reach Len. (ft)               98.00    105.00
  97.00
  Crit W.S. (ft)                     Flow Area (sq ft)                       21.96

  E.G. Slope (ft/ft)     0.000177    Area (sq ft)                            21.96

  Q Total (cfs)              8.90    Flow (cfs)                               8.90

  Top Width (ft)            28.91    Top Width (ft)                          28.91

  Vel Total (ft/s)           0.41    Avg. Vel. (ft/s)                         0.41

  Max Chl Dpth (ft)          1.29    Hydr. Depth (ft)                         0.76

  Conv. Total (cfs)         668.2    Conv. (cfs)                             668.2

  Length Wtd. (ft)         105.00    Wetted Per. (ft)                        29.61

  Min Ch El (ft)           493.33    Shear (lb/sq ft)                         0.01

  Alpha                      1.00    Stream Power (lb/ft s)        42.16      0.00
   0.00
  Frctn Loss (ft)            0.02    Cum Volume (acre-ft)                     0.35

  C & E Loss (ft)            0.00    Cum SA (acres)                           0.58
```

```
CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 13

INPUT
Description: MC-K 13+44
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0496.5611  6.2656 493.487  14.016493.5949 21.5918493.7046  42.768495.6324

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04   42.768      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0  42.768              22   24.75    20.5               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.60    Element                   Left OB    Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                             0.040

  W.S. Elev (ft)            494.60    Reach Len. (ft)            22.00       24.75
  20.50
  Crit W.S. (ft)                      Flow Area (sq ft)                      21.00

  E.G. Slope (ft/ft)      0.000196    Area (sq ft)                           21.00

  Q Total (cfs)               9.07    Flow (cfs)                              9.07

  Top Width (ft)             27.40    Top Width (ft)                         27.40

  Vel Total (ft/s)            0.43    Avg. Vel. (ft/s)                        0.43

  Max Chl Dpth (ft)           1.11    Hydr. Depth (ft)                        0.77

  Conv. Total (cfs)          648.8    Conv. (cfs)                            648.8

  Length Wtd. (ft)           24.75    Wetted Per. (ft)                       27.70

  Min Ch El (ft)            493.49    Shear (lb/sq ft)                        0.01

  Alpha                       1.00    Stream Power (lb/ft s)     42.77        0.00
   0.00
  Frctn Loss (ft)             0.01    Cum Volume (acre-ft)                    0.30

  C & E Loss (ft)             0.00    Cum SA (acres)                          0.52



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 12.75*

INPUT
Description:
```

```
Station Elevation Data    num=       7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   496.54     2.18   495.32     5.76   494.42     9.36   493.51    16.85   493.68
   24.17   493.86    44.63   495.57

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    44.63      .04

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0    44.63               22    24.75     20.5               .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)             494.59    Element                     Left OB    Channel
Right OB
  Vel Head (ft)                0.00    Wt. n-Val.                              0.040

  W.S. Elev (ft)             494.59    Reach Len. (ft)               22.00      24.75
  20.50
  Crit W.S. (ft)                       Flow Area (sq ft)                       18.98

  E.G. Slope (ft/ft)       0.000278    Area (sq ft)                            18.98

  Q Total (cfs)                9.07    Flow (cfs)                               9.07

  Top Width (ft)              27.84    Top Width (ft)                          27.84

  Vel Total (ft/s)             0.48    Avg. Vel. (ft/s)                         0.48

  Max Chl Dpth (ft)            1.08    Hydr. Depth (ft)                         0.68

  Conv. Total (cfs)           544.0    Conv. (cfs)                             544.0

  Length Wtd. (ft)            24.75    Wetted Per. (ft)                        28.01

  Min Ch El (ft)             493.51    Shear (lb/sq ft)                         0.01

  Alpha                        1.00    Stream Power (lb/ft s)        44.63      0.00
   0.00
  Frctn Loss (ft)              0.01    Cum Volume (acre-ft)                     0.29

  C & E Loss (ft)              0.00    Cum SA (acres)                           0.50



CROSS SECTION


RIVER: Pilkington North
REACH: Main               RS: 12.5*

INPUT
Description:
Station Elevation Data    num=       7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   496.52     2.91   494.79     7.66   494.16    12.46   493.53    19.69   493.77
   26.75   494.01     46.5    495.5

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
```

```
       0      .04        0      .04     46.5       .04

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0     46.5                 22    24.75     20.5                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)              494.59     Element                    Left OB     Channel
Right OB
  Vel Head (ft)                 0.00     Wt. n-Val.                               0.040

  W.S. Elev (ft)              494.58     Reach Len. (ft)             22.00       24.75
  20.50
  Crit W.S. (ft)                         Flow Area (sq ft)                        18.02

  E.G. Slope (ft/ft)        0.000362     Area (sq ft)                             18.02

  Q Total (cfs)                 9.07     Flow (cfs)                                9.07

  Top Width (ft)               29.87     Top Width (ft)                           29.87

  Vel Total (ft/s)              0.50     Avg. Vel. (ft/s)                          0.50

  Max Chl Dpth (ft)             1.05     Hydr. Depth (ft)                          0.60

  Conv. Total (cfs)            477.1     Conv. (cfs)                              477.1

  Length Wtd. (ft)             24.75     Wetted Per. (ft)                         29.97

  Min Ch El (ft)              493.53     Shear (lb/sq ft)                          0.01

  Alpha                         1.00     Stream Power (lb/ft s)      46.50         0.00
   0.00
  Frctn Loss (ft)               0.01     Cum Volume (acre-ft)                      0.28

  C & E Loss (ft)               0.00     Cum SA (acres)                            0.48



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 12.25*

INPUT
Description:
Station Elevation Data    num=       7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0    496.5     3.63   494.26     9.57   493.91    15.56   493.55    22.52   493.86
   29.33   494.17    48.37   495.44

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    48.37      .04

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0    48.37                 22    24.75     20.5                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1
```

```
  E.G. Elev (ft)            494.58     Element                    Left OB     Channel
Right OB
  Vel Head (ft)               0.00     Wt. n-Val.                              0.040

  W.S. Elev (ft)            494.57     Reach Len. (ft)              22.00       24.75
  20.50
  Crit W.S. (ft)                       Flow Area (sq ft)                        19.14

  E.G. Slope (ft/ft)      0.000329     Area (sq ft)                             19.14

  Q Total (cfs)               9.07     Flow (cfs)                                9.07

  Top Width (ft)             32.28     Top Width (ft)                           32.28

  Vel Total (ft/s)            0.47     Avg. Vel. (ft/s)                          0.47

  Max Chl Dpth (ft)           1.02     Hydr. Depth (ft)                          0.59

  Conv. Total (cfs)          500.3     Conv. (cfs)                              500.3

  Length Wtd. (ft)           24.75     Wetted Per. (ft)                         32.41

  Min Ch El (ft)            493.55     Shear (lb/sq ft)                          0.01

  Alpha                       1.00     Stream Power (lb/ft s)       48.37        0.00
   0.00
  Frctn Loss (ft)             0.01     Cum Volume (acre-ft)                      0.26

  C & E Loss (ft)             0.00     Cum SA (acres)                            0.47



CROSS SECTION


RIVER: Pilkington North
REACH: Main                    RS: 12

INPUT
Description: MC-L 14+31
Station Elevation Data     num=        5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0496.4785   4.3503 493.733 11.4737 493.655 18.6524493.5652 50.2307 495.374

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 50.2307      .04

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0 50.2307               12.78     9.67    13.11                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.57     Element                    Left OB     Channel
Right OB
  Vel Head (ft)               0.00     Wt. n-Val.                              0.040

  W.S. Elev (ft)            494.57     Reach Len. (ft)              12.78        9.67
  13.11
  Crit W.S. (ft)                       Flow Area (sq ft)                        22.46
```

```
  E.G. Slope (ft/ft)      0.000212    Area (sq ft)                         22.46
  Q Total (cfs)               9.31    Flow (cfs)                            9.31
  Top Width (ft)             33.15    Top Width (ft)                       33.15
  Vel Total (ft/s)            0.41    Avg. Vel. (ft/s)                      0.41
  Max Chl Dpth (ft)           1.00    Hydr. Depth (ft)                      0.68
  Conv. Total (cfs)          640.1    Conv. (cfs)                          640.1
  Length Wtd. (ft)            9.67    Wetted Per. (ft)                     33.42
  Min Ch El (ft)            493.57    Shear (lb/sq ft)                      0.01
  Alpha                       1.00    Stream Power (lb/ft s)      50.23     0.00
   0.00
  Frctn Loss (ft)             0.00    Cum Volume (acre-ft)                  0.25
  C & E Loss (ft)             0.00    Cum SA (acres)                        0.45


CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 11.8888*

INPUT
Description:
Station Elevation Data    num=       7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0    496.5     3.97   493.99    10.47    493.8    17.03    493.6    32.09   494.36
   47.48   495.14    49.87   495.34

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    49.87      .04

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0    49.87            12.78    9.67    13.11                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.57    Element                    Left OB    Channel
Right OB
  Vel Head (ft)               0.00    Wt. n-Val.                           0.040
  W.S. Elev (ft)            494.57    Reach Len. (ft)             12.78     9.67
  13.11
  Crit W.S. (ft)                      Flow Area (sq ft)                    19.52
  E.G. Slope (ft/ft)      0.000335    Area (sq ft)                         19.52
  Q Total (cfs)               9.31    Flow (cfs)                            9.31
  Top Width (ft)             33.08    Top Width (ft)                       33.08
```

```
  Vel Total (ft/s)              0.48    Avg. Vel. (ft/s)                     0.48
  Max Chl Dpth (ft)             0.97    Hydr. Depth (ft)                     0.59
  Conv. Total (cfs)            508.3    Conv. (cfs)                         508.3
  Length Wtd. (ft)              9.67    Wetted Per. (ft)                    33.28
  Min Ch El (ft)              493.60    Shear (lb/sq ft)                     0.01
  Alpha                         1.00    Stream Power (lb/ft s)     49.87     0.00
   0.00
  Frctn Loss (ft)               0.00    Cum Volume (acre-ft)                 0.25
  C & E Loss (ft)               0.00    Cum SA (acres)                       0.44


CROSS SECTION


RIVER: Pilkington North
REACH: Main                  RS: 11.7777*

INPUT
Description:
Station Elevation Data    num=       7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   496.52     3.59   494.24     9.48   493.95     15.4   493.64    31.05   494.33
   47.03   495.04    49.51   495.31

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    49.51      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
             0   49.51              12.78    9.67   13.11                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)              494.56    Element                  Left OB    Channel
Right OB
  Vel Head (ft)                 0.00    Wt. n-Val.                          0.040
  W.S. Elev (ft)              494.56    Reach Len. (ft)            12.78     9.67
  13.11
  Crit W.S. (ft)                        Flow Area (sq ft)                   16.94
  E.G. Slope (ft/ft)        0.000538    Area (sq ft)                        16.94
  Q Total (cfs)                 9.31    Flow (cfs)                           9.31
  Top Width (ft)               33.14    Top Width (ft)                      33.14
  Vel Total (ft/s)              0.55    Avg. Vel. (ft/s)                     0.55
  Max Chl Dpth (ft)             0.92    Hydr. Depth (ft)                     0.51
  Conv. Total (cfs)            401.2    Conv. (cfs)                         401.2
  Length Wtd. (ft)              9.67    Wetted Per. (ft)                    33.27
```

```
  Min Ch El (ft)            493.64    Shear (lb/sq ft)                   0.02

  Alpha                       1.00    Stream Power (lb/ft s)     49.51   0.00
   0.00
  Frctn Loss (ft)             0.01    Cum Volume (acre-ft)               0.24

  C & E Loss (ft)             0.00    Cum SA (acres)                     0.43



CROSS SECTION


RIVER: Pilkington North
REACH: Main                RS: 11.6666*

INPUT
Description:
Station Elevation Data     num=        7
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  496.53    3.21  494.49    8.48  494.09   13.78  493.68      30   494.3
   46.58  494.95   49.16  495.28

Manning's n Values         num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .04       0     .04   49.16     .04

Bank Sta: Left   Right     Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   49.16             12.78    9.67   13.11              .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.56    Element                    Left OB    Channel
Right OB
  Vel Head (ft)               0.01    Wt. n-Val.                           0.040

  W.S. Elev (ft)            494.55    Reach Len. (ft)            12.78       9.67
  13.11
  Crit W.S. (ft)                      Flow Area (sq ft)                   14.84

  E.G. Slope (ft/ft)      0.000840    Area (sq ft)                        14.84

  Q Total (cfs)               9.31    Flow (cfs)                           9.31

  Top Width (ft)             33.31    Top Width (ft)                      33.31

  Vel Total (ft/s)            0.63    Avg. Vel. (ft/s)                     0.63

  Max Chl Dpth (ft)           0.87    Hydr. Depth (ft)                     0.45

  Conv. Total (cfs)          321.2    Conv. (cfs)                         321.2

  Length Wtd. (ft)            9.67    Wetted Per. (ft)                    33.38

  Min Ch El (ft)            493.68    Shear (lb/sq ft)                     0.02

  Alpha                       1.00    Stream Power (lb/ft s)     49.16     0.00
   0.00
  Frctn Loss (ft)             0.01    Cum Volume (acre-ft)                 0.24
```

```
  C & E Loss (ft)              0.00     Cum SA (acres)                     0.42



CROSS SECTION


RIVER: Pilkington North
REACH: Main                  RS: 11.5555*

INPUT
Description:
Station Elevation Data       num=        7
     Sta    Elev      Sta    Elev     Sta    Elev      Sta    Elev      Sta    Elev
       0  496.55     2.84  494.74    7.48  494.24    12.16  493.72    28.96  494.27
   46.13  494.85     48.8  495.25

Manning's n Values           num=        3
     Sta   n Val      Sta   n Val     Sta   n Val
       0     .04        0     .04    48.8     .04

Bank Sta: Left    Right      Lengths: Left Channel    Right       Coeff Contr.    Expan.
             0     48.8              12.78     9.67   13.11                 .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)             494.55     Element                      Left OB    Channel
Right OB
  Vel Head (ft)                0.01     Wt. n-Val.                             0.040

  W.S. Elev (ft)             494.54     Reach Len. (ft)                12.78       9.67
  13.11
  Crit W.S. (ft)                        Flow Area (sq ft)                     13.30

  E.G. Slope (ft/ft)       0.001161     Area (sq ft)                          13.30

  Q Total (cfs)                9.31     Flow (cfs)                             9.31

  Top Width (ft)              32.29     Top Width (ft)                        32.29

  Vel Total (ft/s)             0.70     Avg. Vel. (ft/s)                       0.70

  Max Chl Dpth (ft)            0.82     Hydr. Depth (ft)                       0.41

  Conv. Total (cfs)           273.2     Conv. (cfs)                           273.2

  Length Wtd. (ft)             9.67     Wetted Per. (ft)                      32.35

  Min Ch El (ft)             493.72     Shear (lb/sq ft)                       0.03

  Alpha                        1.00     Stream Power (lb/ft s)         48.80       0.00
   0.00
  Frctn Loss (ft)              0.01     Cum Volume (acre-ft)                   0.24

  C & E Loss (ft)              0.00     Cum SA (acres)                         0.42



CROSS SECTION
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```
RIVER: Pilkington North
REACH: Main                 RS: 11.4444*

INPUT
Description:
Station Elevation Data    num=       7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   496.57     2.46      495     6.48   494.38    10.53   493.76    27.92   494.24
   45.68   494.75    48.44   495.22

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    48.44      .04

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0    48.44            12.78     9.67    13.11               .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)              494.54    Element                    Left OB    Channel
Right OB
  Vel Head (ft)                 0.01    Wt. n-Val.                              0.040

  W.S. Elev (ft)              494.53    Reach Len. (ft)              12.78       9.67
  13.11
  Crit W.S. (ft)                        Flow Area (sq ft)                       12.53

  E.G. Slope (ft/ft)        0.001424    Area (sq ft)                            12.53

  Q Total (cfs)                 9.31    Flow (cfs)                               9.31

  Top Width (ft)               32.40    Top Width (ft)                          32.40

  Vel Total (ft/s)              0.74    Avg. Vel. (ft/s)                         0.74

  Max Chl Dpth (ft)             0.77    Hydr. Depth (ft)                         0.39

  Conv. Total (cfs)            246.7    Conv. (cfs)                             246.7

  Length Wtd. (ft)              9.67    Wetted Per. (ft)                        32.47

  Min Ch El (ft)              493.76    Shear (lb/sq ft)                         0.03

  Alpha                         1.00    Stream Power (lb/ft s)       48.44       0.00
   0.00
  Frctn Loss (ft)               0.01    Cum Volume (acre-ft)                     0.23

  C & E Loss (ft)               0.00    Cum SA (acres)                           0.41



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 11.3333*

INPUT
Description:
Station Elevation Data    num=       7
```

```
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   496.59     2.08   495.25     5.48   494.53     8.91   493.79    26.87   494.21
   45.22   494.65    48.08   495.18

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    48.08      .04

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0    48.08               12.78    9.67    13.11                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.52    Element                    Left OB    Channel
Right OB
  Vel Head (ft)               0.01    Wt. n-Val.                              0.040

  W.S. Elev (ft)            494.51    Reach Len. (ft)              12.78       9.67
  13.11
  Crit W.S. (ft)                      Flow Area (sq ft)                       12.32

  E.G. Slope (ft/ft)      0.001602    Area (sq ft)                            12.32

  Q Total (cfs)               9.31    Flow (cfs)                               9.31

  Top Width (ft)             33.92    Top Width (ft)                          33.92

  Vel Total (ft/s)            0.76    Avg. Vel. (ft/s)                         0.76

  Max Chl Dpth (ft)           0.72    Hydr. Depth (ft)                         0.36

  Conv. Total (cfs)          232.6    Conv. (cfs)                             232.6

  Length Wtd. (ft)            9.67    Wetted Per. (ft)                        34.01

  Min Ch El (ft)            493.79    Shear (lb/sq ft)                         0.04

  Alpha                       1.00    Stream Power (lb/ft s)       48.08       0.00
   0.00
  Frctn Loss (ft)             0.02    Cum Volume (acre-ft)                     0.23

  C & E Loss (ft)             0.00    Cum SA (acres)                           0.40



CROSS SECTION


RIVER: Pilkington North
REACH: Main                RS: 11.2222*

INPUT
Description:
Station Elevation Data     num=        7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   496.61      1.7    495.5     4.48   494.67     7.29   493.83    25.83   494.18
   44.77   494.55    47.72   495.15

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    47.72      .04
```

```
Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0    47.72              12.78     9.67    13.11               .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)              494.51    Element                      Left OB     Channel
Right OB
  Vel Head (ft)                 0.01    Wt. n-Val.                                 0.040

  W.S. Elev (ft)              494.50    Reach Len. (ft)               12.78         9.67
  13.11
  Crit W.S. (ft)                        Flow Area (sq ft)                          12.41

  E.G. Slope (ft/ft)        0.001752    Area (sq ft)                               12.41

  Q Total (cfs)                 9.31    Flow (cfs)                                  9.31

  Top Width (ft)               36.96    Top Width (ft)                             36.96

  Vel Total (ft/s)              0.75    Avg. Vel. (ft/s)                            0.75

  Max Chl Dpth (ft)             0.67    Hydr. Depth (ft)                            0.34

  Conv. Total (cfs)            222.4    Conv. (cfs)                                222.4

  Length Wtd. (ft)              9.67    Wetted Per. (ft)                           37.07

  Min Ch El (ft)              493.83    Shear (lb/sq ft)                            0.04

  Alpha                         1.00    Stream Power (lb/ft s)        47.72         0.00
   0.00
  Frctn Loss (ft)               0.02    Cum Volume (acre-ft)                        0.23

  C & E Loss (ft)               0.00    Cum SA (acres)                              0.39



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 11.1111*

INPUT
Description:
Station Elevation Data    num=       7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   496.63     1.32   495.76     3.48   494.82     5.66   493.87    24.79   494.15
   44.32   494.45    47.36   495.12

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    47.36      .04

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0    47.36              12.78     9.67    13.11               .1        .3

CROSS SECTION OUTPUT  Profile #PF 1
```

```
  E.G. Elev (ft)            494.49     Element                   Left OB     Channel
Right OB
  Vel Head (ft)               0.01     Wt. n-Val.                              0.040

  W.S. Elev (ft)            494.48     Reach Len. (ft)            12.78        9.67
  13.11
  Crit W.S. (ft)                       Flow Area (sq ft)                      12.94

  E.G. Slope (ft/ft)      0.001708     Area (sq ft)                           12.94

  Q Total (cfs)               9.31     Flow (cfs)                              9.31

  Top Width (ft)             40.20     Top Width (ft)                         40.20

  Vel Total (ft/s)            0.72     Avg. Vel. (ft/s)                        0.72

  Max Chl Dpth (ft)           0.61     Hydr. Depth (ft)                        0.32

  Conv. Total (cfs)          225.3     Conv. (cfs)                            225.3

  Length Wtd. (ft)            9.67     Wetted Per. (ft)                       40.33

  Min Ch El (ft)            493.87     Shear (lb/sq ft)                        0.03

  Alpha                       1.00     Stream Power (lb/ft s)     47.36        0.00
   0.00
  Frctn Loss (ft)             0.02     Cum Volume (acre-ft)                    0.23

  C & E Loss (ft)             0.00     Cum SA (acres)                          0.39



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 11

INPUT
Description: MC-M 15+47
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0496.6472   4.038493.9071 23.7422 494.125 43.8733494.3542 47.0065495.0885

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 47.0065     .04

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0 47.0065                 101     116      105                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.47     Element                   Left OB     Channel
Right OB
  Vel Head (ft)               0.01     Wt. n-Val.                              0.040

  W.S. Elev (ft)            494.47     Reach Len. (ft)           101.00      116.00
 105.00
  Crit W.S. (ft)                       Flow Area (sq ft)                      13.64
```

```
  E.G. Slope (ft/ft)      0.001509    Area (sq ft)                        13.64
  Q Total (cfs)               9.40    Flow (cfs)                           9.40
  Top Width (ft)             41.13    Top Width (ft)                      41.13
  Vel Total (ft/s)            0.69    Avg. Vel. (ft/s)                     0.69
  Max Chl Dpth (ft)           0.56    Hydr. Depth (ft)                     0.33
  Conv. Total (cfs)          242.1    Conv. (cfs)                         242.1
  Length Wtd. (ft)          116.00    Wetted Per. (ft)                    41.32
  Min Ch El (ft)            493.91    Shear (lb/sq ft)                     0.03
  Alpha                       1.00    Stream Power (lb/ft s)     47.01     0.00
   0.00
  Frctn Loss (ft)             0.19    Cum Volume (acre-ft)                 0.22
  C & E Loss (ft)             0.00    Cum SA (acres)                       0.38


CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 10

INPUT
Description: MC-N 16+49
Station Elevation Data    num=       6
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0496.5162    3.624493.5883 19.4739493.8246 28.1849494.6256 46.8185494.2469
 66.0217500.2168

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 66.0217      .04

Bank Sta: Left    Right    Lengths: Left Channel    Right     Coeff Contr.    Expan.
             0 66.0217                  56       56       62               .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.27    Element                  Left OB    Channel
Right OB
  Vel Head (ft)               0.01    Wt. n-Val.                          0.040
  W.S. Elev (ft)            494.26    Reach Len. (ft)            56.00    56.00
  62.00
  Crit W.S. (ft)                      Flow Area (sq ft)                   10.09
  E.G. Slope (ft/ft)      0.001819    Area (sq ft)                        10.09
  Q Total (cfs)               9.40    Flow (cfs)                           9.40
  Top Width (ft)             22.11    Top Width (ft)                      22.11
  Vel Total (ft/s)            0.93    Avg. Vel. (ft/s)                     0.93
```

```
  Max Chl Dpth (ft)           0.67    Hydr. Depth (ft)                 0.46
  Conv. Total (cfs)          220.5    Conv. (cfs)                     220.5
  Length Wtd. (ft)           56.00    Wetted Per. (ft)                22.38
  Min Ch El (ft)            493.59    Shear (lb/sq ft)                 0.05
  Alpha                       1.00    Stream Power (lb/ft s)   66.02   0.00
   0.00
  Frctn Loss (ft)             0.08    Cum Volume (acre-ft)             0.19
  C & E Loss (ft)             0.00    Cum SA (acres)                   0.29


Warning: Divided flow computed for this cross-section.

CROSS SECTION


RIVER: Pilkington North
REACH: Main               RS: 9

INPUT
Description: MC-O 17+05
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0496.2361  4.4397493.3889 12.2493493.5549 19.9405493.7225 45.3392503.4437

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 45.3392      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0 45.3392                   35       35   38.96              .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            494.19    Element                 Left OB    Channel
Right OB
  Vel Head (ft)               0.01    Wt. n-Val.                          0.040
  W.S. Elev (ft)            494.18    Reach Len. (ft)          35.00      35.00
  38.96
  Crit W.S. (ft)                      Flow Area (sq ft)                   10.40
  E.G. Slope (ft/ft)      0.001253    Area (sq ft)                        10.40
  Q Total (cfs)               9.40    Flow (cfs)                           9.40
  Top Width (ft)             17.92    Top Width (ft)                      17.92
  Vel Total (ft/s)            0.90    Avg. Vel. (ft/s)                     0.90
  Max Chl Dpth (ft)           0.79    Hydr. Depth (ft)                     0.58
  Conv. Total (cfs)          265.7    Conv. (cfs)                         265.7
  Length Wtd. (ft)           35.00    Wetted Per. (ft)                    18.24
```

```
  Min Ch El (ft)             493.39    Shear (lb/sq ft)                      0.04

  Alpha                        1.00    Stream Power (lb/ft s)     45.34      0.00
   0.00
  Frctn Loss (ft)              0.07    Cum Volume (acre-ft)                  0.18

  C & E Loss (ft)              0.00    Cum SA (acres)                        0.27



Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance)
is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Pilkington North
REACH: Main                RS: 8

INPUT
Description: MC-P 17+40
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0496.3147  3.4331493.6636  15.098493.5851 29.9794494.6397 41.1273503.5678

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 41.1273      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0 41.1273                 33      36      40               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)             494.11    Element                     Left OB    Channel
Right OB
  Vel Head (ft)                0.03    Wt. n-Val.                            0.040

  W.S. Elev (ft)             494.09    Reach Len. (ft)            33.00      36.00
  40.00
  Crit W.S. (ft)                       Flow Area (sq ft)                     7.30

  E.G. Slope (ft/ft)       0.004441    Area (sq ft)                          7.30

  Q Total (cfs)                9.40    Flow (cfs)                            9.40

  Top Width (ft)              19.31    Top Width (ft)                       19.31

  Vel Total (ft/s)             1.29    Avg. Vel. (ft/s)                      1.29

  Max Chl Dpth (ft)            0.50    Hydr. Depth (ft)                      0.38

  Conv. Total (cfs)           141.1    Conv. (cfs)                          141.1

  Length Wtd. (ft)            36.00    Wetted Per. (ft)                     19.47

  Min Ch El (ft)             493.59    Shear (lb/sq ft)                      0.10

  Alpha                        1.00    Stream Power (lb/ft s)     41.13      0.00
```

```
 0.00
 Frctn Loss (ft)            0.15     Cum Volume (acre-ft)                 0.17

 C & E Loss (ft)            0.00     Cum SA (acres)                       0.25



CROSS SECTION


RIVER: Pilkington North
REACH: Main               RS: 7

INPUT
Description: MC-Q 17+76
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  495.504  3.0627493.7716 20.9801493.4054 39.2722 494.493  53.424 504.815

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04  53.424      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  53.424             30.5      31      32                .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


 E.G. Elev (ft)           493.97     Element                   Left OB    Channel
Right OB
 Vel Head (ft)              0.02     Wt. n-Val.                            0.040

 W.S. Elev (ft)           493.95     Reach Len. (ft)             30.50     31.00
 32.00
 Crit W.S. (ft)                      Flow Area (sq ft)                      8.94

 E.G. Slope (ft/ft)     0.003709     Area (sq ft)                           8.94

 Q Total (cfs)              9.58     Flow (cfs)                             9.58

 Top Width (ft)            27.35     Top Width (ft)                        27.35

 Vel Total (ft/s)           1.07     Avg. Vel. (ft/s)                       1.07

 Max Chl Dpth (ft)          0.54     Hydr. Depth (ft)                       0.33

 Conv. Total (cfs)         157.3     Conv. (cfs)                           157.3

 Length Wtd. (ft)          31.00     Wetted Per. (ft)                      27.42

 Min Ch El (ft)           493.41     Shear (lb/sq ft)                       0.08

 Alpha                      1.00     Stream Power (lb/ft s)      53.42      0.00
 0.00
 Frctn Loss (ft)            0.11     Cum Volume (acre-ft)                   0.16

 C & E Loss (ft)            0.00     Cum SA (acres)                         0.23
```

CROSS SECTION

RIVER: Pilkington North
REACH: Main RS: 6.5*

INPUT
Description:
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	495.64	2.55	494.16	4.83	493.58	17.48	493.25	27.02	493.75
34.53	495.62	47.72	503.65						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	47.72	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	47.72	30.5	31	32	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	493.86	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.040	
W.S. Elev (ft)	493.84	Reach Len. (ft)	30.50	31.00	32.00
Crit W.S. (ft)		Flow Area (sq ft)		8.84	
E.G. Slope (ft/ft)	0.003158	Area (sq ft)		8.84	
Q Total (cfs)	9.58	Flow (cfs)		9.58	
Top Width (ft)	23.60	Top Width (ft)		23.60	
Vel Total (ft/s)	1.08	Avg. Vel. (ft/s)		1.08	
Max Chl Dpth (ft)	0.59	Hydr. Depth (ft)		0.37	
Conv. Total (cfs)	170.5	Conv. (cfs)		170.5	
Length Wtd. (ft)	31.00	Wetted Per. (ft)		23.66	
Min Ch El (ft)	493.25	Shear (lb/sq ft)		0.07	
Alpha	1.00	Stream Power (lb/ft s)	47.72	0.00	0.00
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)		0.16	
C & E Loss (ft)	0.00	Cum SA (acres)		0.22	

CROSS SECTION

RIVER: Pilkington North
REACH: Main RS: 6

INPUT

```
Description: MC-R 18+38
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0495.7847   3.8609493.4489 13.9735493.0955 22.8241493.4888 42.0112502.4859

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 42.0112      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
            0 42.0112                    89       89      86               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)              493.78    Element                    Left OB    Channel
Right OB
  Vel Head (ft)                 0.02    Wt. n-Val.                              0.040

  W.S. Elev (ft)              493.76    Reach Len. (ft)              89.00      89.00
  86.00
  Crit W.S. (ft)                        Flow Area (sq ft)                        9.31

  E.G. Slope (ft/ft)        0.002158    Area (sq ft)                             9.31

  Q Total (cfs)                 9.58    Flow (cfs)                               9.58

  Top Width (ft)               20.07    Top Width (ft)                          20.07

  Vel Total (ft/s)              1.03    Avg. Vel. (ft/s)                         1.03

  Max Chl Dpth (ft)             0.67    Hydr. Depth (ft)                         0.46

  Conv. Total (cfs)            206.2    Conv. (cfs)                             206.2

  Length Wtd. (ft)             89.00    Wetted Per. (ft)                        20.24

  Min Ch El (ft)              493.10    Shear (lb/sq ft)                         0.06

  Alpha                         1.00    Stream Power (lb/ft s)       42.01       0.00
   0.00
  Frctn Loss (ft)               0.22    Cum Volume (acre-ft)                     0.15

  C & E Loss (ft)               0.00    Cum SA (acres)                           0.20



CROSS SECTION


RIVER: Pilkington North
REACH: Main               RS: 5

INPUT
Description: MC-S 19+27
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0495.9346   2.8495493.4936 11.6938492.6578 20.5133493.4809 37.7047502.4343

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 37.7047      .04
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0 37.7047                91      90      88                .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)           493.57    Element                     Left OB    Channel
Right OB
  Vel Head (ft)              0.02    Wt. n-Val.                              0.040

  W.S. Elev (ft)           493.54    Reach Len. (ft)              91.00      90.00
  88.00
  Crit W.S. (ft)                     Flow Area (sq ft)                        8.34

  E.G. Slope (ft/ft)     0.002731    Area (sq ft)                             8.34

  Q Total (cfs)              9.72    Flow (cfs)                               9.72

  Top Width (ft)            17.85    Top Width (ft)                          17.85

  Vel Total (ft/s)           1.16    Avg. Vel. (ft/s)                         1.16

  Max Chl Dpth (ft)          0.89    Hydr. Depth (ft)                         0.47

  Conv. Total (cfs)         186.0    Conv. (cfs)                             186.0

  Length Wtd. (ft)          90.00    Wetted Per. (ft)                        17.96

  Min Ch El (ft)           492.66    Shear (lb/sq ft)                         0.08

  Alpha                      1.00    Stream Power (lb/ft s)       37.70       0.00
   0.00
  Frctn Loss (ft)            0.31    Cum Volume (acre-ft)                     0.13

  C & E Loss (ft)            0.00    Cum SA (acres)                           0.16



CROSS SECTION


RIVER: Pilkington North
REACH: Main                RS: 4

INPUT
Description: MC-T 20+17
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0496.4655   4.794493.5793 13.7705492.2133 22.8021493.7962 37.3725 506.196

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 37.3725      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0 37.3725                47      48    48.5                .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)           493.26    Element                     Left OB    Channel
```

```
Right OB
  Vel Head (ft)              0.04    Wt. n-Val.                        0.040

  W.S. Elev (ft)           493.23    Reach Len. (ft)          47.00    48.00
  48.50
  Crit W.S. (ft)                     Flow Area (sq ft)                 6.30

  E.G. Slope (ft/ft)     0.004351    Area (sq ft)                      6.30

  Q Total (cfs)              9.72    Flow (cfs)                        9.72

  Top Width (ft)            12.43    Top Width (ft)                   12.43

  Vel Total (ft/s)           1.54    Avg. Vel. (ft/s)                  1.54

  Max Chl Dpth (ft)          1.01    Hydr. Depth (ft)                  0.51

  Conv. Total (cfs)         147.3    Conv. (cfs)                      147.3

  Length Wtd. (ft)          48.00    Wetted Per. (ft)                 12.60

  Min Ch El (ft)           492.21    Shear (lb/sq ft)                  0.14

  Alpha                      1.00    Stream Power (lb/ft s)   37.37    0.00
   0.00
  Frctn Loss (ft)            0.21    Cum Volume (acre-ft)              0.12

  C & E Loss (ft)            0.00    Cum SA (acres)                    0.13



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 3.5*

INPUT
Description:
Station Elevation Data    num=       7
     Sta     Elev      Sta     Elev     Sta     Elev     Sta     Elev      Sta     Elev
       0   496.95     5.33   493.61    5.72   493.45    15.3   491.97    25.04   494.01
   25.91   494.46    40.74   505.76

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val     Sta    n Val
       0      .04        0      .04   40.74      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   40.74                47      48   48.5               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)           493.05    Element                 Left OB   Channel
Right OB
  Vel Head (ft)              0.04    Wt. n-Val.                        0.040

  W.S. Elev (ft)           493.01    Reach Len. (ft)          47.00    48.00
  48.50
  Crit W.S. (ft)                     Flow Area (sq ft)                 6.12
```

```
  E.G. Slope (ft/ft)      0.004452    Area (sq ft)                         6.12

  Q Total (cfs)               9.72    Flow (cfs)                           9.72

  Top Width (ft)             11.73    Top Width (ft)                      11.73

  Vel Total (ft/s)            1.59    Avg. Vel. (ft/s)                     1.59

  Max Chl Dpth (ft)           1.04    Hydr. Depth (ft)                     0.52

  Conv. Total (cfs)          145.6    Conv. (cfs)                         145.6

  Length Wtd. (ft)           48.00    Wetted Per. (ft)                    11.92

  Min Ch El (ft)            491.97    Shear (lb/sq ft)                     0.14

  Alpha                       1.00    Stream Power (lb/ft s)     40.74     0.00
   0.00
  Frctn Loss (ft)             0.22    Cum Volume (acre-ft)                 0.11

  C & E Loss (ft)             0.00    Cum SA (acres)                       0.12



CROSS SECTION


RIVER: Pilkington North
REACH: Main                RS: 3

INPUT
Description: MC-U 21+13
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0497.4251   6.2881493.3673 16.8356491.7364 28.2037494.4412 44.1081505.3258

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 44.1081      .04

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0 44.1081                 23     25.5    30.25                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            492.83    Element                    Left OB    Channel
Right OB
  Vel Head (ft)               0.04    Wt. n-Val.                           0.040

  W.S. Elev (ft)            492.79    Reach Len. (ft)              23.00     25.50
  30.25
  Crit W.S. (ft)                      Flow Area (sq ft)                    5.95

  E.G. Slope (ft/ft)      0.004639    Area (sq ft)                         5.95

  Q Total (cfs)               9.72    Flow (cfs)                           9.72

  Top Width (ft)             11.27    Top Width (ft)                      11.27

  Vel Total (ft/s)            1.63    Avg. Vel. (ft/s)                     1.63
```

```
  Max Chl Dpth (ft)            1.06    Hydr. Depth (ft)                      0.53

  Conv. Total (cfs)           142.7    Conv. (cfs)                          142.7

  Length Wtd. (ft)            25.50    Wetted Per. (ft)                     11.47

  Min Ch El (ft)             491.74    Shear (lb/sq ft)                      0.15

  Alpha                        1.00    Stream Power (lb/ft s)     44.11      0.00
   0.00
  Frctn Loss (ft)              0.11    Cum Volume (acre-ft)                  0.11

  C & E Loss (ft)              0.00    Cum SA (acres)                        0.10



CROSS SECTION


RIVER: Pilkington North
REACH: Main                  RS: 2.75*

INPUT
Description:
Station Elevation Data     num=       7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   497.39     4.73   494.23     6.49   493.32    17.38   491.61    28.74   494.17
    32.1   496.05    44.64   504.23

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    44.64      .04

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
             0    44.64                 23     25.5    30.25             .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)             492.72    Element                    Left OB    Channel
Right OB
  Vel Head (ft)                0.04    Wt. n-Val.                            0.040

  W.S. Elev (ft)             492.68    Reach Len. (ft)             23.00     25.50
  30.25
  Crit W.S. (ft)                       Flow Area (sq ft)                     6.24

  E.G. Slope (ft/ft)       0.004126    Area (sq ft)                          6.24

  Q Total (cfs)                9.72    Flow (cfs)                            9.72

  Top Width (ft)              11.61    Top Width (ft)                       11.61

  Vel Total (ft/s)             1.56    Avg. Vel. (ft/s)                      1.56

  Max Chl Dpth (ft)            1.07    Hydr. Depth (ft)                      0.54

  Conv. Total (cfs)           151.3    Conv. (cfs)                          151.3

  Length Wtd. (ft)            25.50    Wetted Per. (ft)                     11.81

  Min Ch El (ft)             491.61    Shear (lb/sq ft)                      0.14
```

```
  Alpha                        1.00    Stream Power (lb/ft s)     44.64        0.00
   0.00
  Frctn Loss (ft)              0.09    Cum Volume (acre-ft)                    0.10

  C & E Loss (ft)              0.00    Cum SA (acres)                          0.10



CROSS SECTION


RIVER: Pilkington North
REACH: Main                RS: 2.5*

INPUT
Description:
Station Elevation Data     num=        7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   497.35     4.88   493.99      6.7   493.28    17.93   491.48    29.28   493.89
   32.64   495.36    45.17   503.13

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    45.17      .04

Bank Sta: Left   Right     Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0   45.17                23    25.5   30.25               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)             492.63    Element                     Left OB     Channel
Right OB
  Vel Head (ft)                0.03    Wt. n-Val.                               0.040

  W.S. Elev (ft)             492.60    Reach Len. (ft)             23.00       25.50
  30.25
  Crit W.S. (ft)                       Flow Area (sq ft)                        6.82

  E.G. Slope (ft/ft)       0.003270    Area (sq ft)                             6.82

  Q Total (cfs)                9.72    Flow (cfs)                               9.72

  Top Width (ft)              12.22    Top Width (ft)                          12.22

  Vel Total (ft/s)             1.42    Avg. Vel. (ft/s)                         1.42

  Max Chl Dpth (ft)            1.12    Hydr. Depth (ft)                         0.56

  Conv. Total (cfs)           169.9    Conv. (cfs)                             169.9

  Length Wtd. (ft)            25.50    Wetted Per. (ft)                        12.43

  Min Ch El (ft)             491.48    Shear (lb/sq ft)                         0.11

  Alpha                        1.00    Stream Power (lb/ft s)     45.17        0.00
   0.00
  Frctn Loss (ft)              0.07    Cum Volume (acre-ft)                    0.10

  C & E Loss (ft)              0.00    Cum SA (acres)                          0.09
```

```
CROSS SECTION


RIVER: Pilkington North
REACH: Main                    RS: 2.25*

INPUT
Description:
Station Elevation Data     num=        7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   497.31     5.03   493.75      6.9   493.24    18.48   491.35    29.83   493.62
   33.18   494.67     45.7   502.03

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04     45.7      .04

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0     45.7                 23     25.5    30.25                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)              492.56    Element                       Left OB     Channel
Right OB
  Vel Head (ft)                 0.02    Wt. n-Val.                                  0.040

  W.S. Elev (ft)              492.53    Reach Len. (ft)                 23.00       25.50
  30.25
  Crit W.S. (ft)                        Flow Area (sq ft)                            7.77

  E.G. Slope (ft/ft)        0.002340    Area (sq ft)                                 7.77

  Q Total (cfs)                 9.72    Flow (cfs)                                   9.72

  Top Width (ft)               13.15    Top Width (ft)                              13.15

  Vel Total (ft/s)              1.25    Avg. Vel. (ft/s)                             1.25

  Max Chl Dpth (ft)             1.18    Hydr. Depth (ft)                             0.59

  Conv. Total (cfs)            200.9    Conv. (cfs)                                 200.9

  Length Wtd. (ft)             25.50    Wetted Per. (ft)                            13.36

  Min Ch El (ft)              491.35    Shear (lb/sq ft)                             0.08

  Alpha                         1.00    Stream Power (lb/ft s)          45.70        0.00
   0.00
  Frctn Loss (ft)               0.05    Cum Volume (acre-ft)                         0.09

  C & E Loss (ft)               0.00    Cum SA (acres)                               0.08



CROSS SECTION


RIVER: Pilkington North
```

```
REACH: Main                RS: 2

INPUT
Description: MC-V 22+15
Station Elevation Data    num=        5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0497.2661  5.1806493.5126 19.0265491.2246 33.7185493.9756 46.2298500.9263

Manning's n Values        num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 46.2298      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
              0 46.2298                  40     38.5      36                .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            492.51     Element                   Left OB    Channel
Right OB
  Vel Head (ft)               0.02     Wt. n-Val.                             0.040
  W.S. Elev (ft)            492.49     Reach Len. (ft)             40.00      38.50
 36.00
  Crit W.S. (ft)                       Flow Area (sq ft)                      9.09
  E.G. Slope (ft/ft)      0.001560     Area (sq ft)                           9.09
  Q Total (cfs)               9.72     Flow (cfs)                             9.72
  Top Width (ft)             14.39     Top Width (ft)                        14.39
  Vel Total (ft/s)            1.07     Avg. Vel. (ft/s)                       1.07
  Max Chl Dpth (ft)           1.26     Hydr. Depth (ft)                       0.63
  Conv. Total (cfs)          246.0     Conv. (cfs)                           246.0
  Length Wtd. (ft)           38.50     Wetted Per. (ft)                      14.61
  Min Ch El (ft)            491.22     Shear (lb/sq ft)                       0.06
  Alpha                       1.00     Stream Power (lb/ft s)      46.23      0.00
   0.00
  Frctn Loss (ft)             0.05     Cum Volume (acre-ft)                   0.09
  C & E Loss (ft)             0.00     Cum SA (acres)                         0.07



CROSS SECTION


RIVER: Pilkington North
REACH: Main                RS: 1.5*

INPUT
Description:
Station Elevation Data    num=        7
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   496.43     5.11   493.74     6.16   493.49    18.76   491.03    31.27   493.79
   33.23    494.3    45.55   499.77
```

```
Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04    45.55      .04

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0    45.55                40     38.5       36              .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)             492.45     Element                   Left OB     Channel
Right OB
  Vel Head (ft)                0.02     Wt. n-Val.                              0.040

  W.S. Elev (ft)             492.44     Reach Len. (ft)             40.00       38.50
  36.00
  Crit W.S. (ft)                        Flow Area (sq ft)                        9.54

  E.G. Slope (ft/ft)       0.001239     Area (sq ft)                             9.54

  Q Total (cfs)                9.72     Flow (cfs)                               9.72

  Top Width (ft)              13.57     Top Width (ft)                          13.57

  Vel Total (ft/s)             1.02     Avg. Vel. (ft/s)                         1.02

  Max Chl Dpth (ft)            1.41     Hydr. Depth (ft)                         0.70

  Conv. Total (cfs)           276.1     Conv. (cfs)                             276.1

  Length Wtd. (ft)            38.50     Wetted Per. (ft)                        13.86

  Min Ch El (ft)             491.03     Shear (lb/sq ft)                         0.05

  Alpha                        1.00     Stream Power (lb/ft s)      45.55        0.00
   0.00
  Frctn Loss (ft)              0.04     Cum Volume (acre-ft)                     0.08

  C & E Loss (ft)              0.00     Cum SA (acres)                           0.06



CROSS SECTION


RIVER: Pilkington North
REACH: Main                 RS: 1

INPUT
Description: MC-W 22+92
Station Elevation Data      num=        5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0495.5853  6.0739493.6437 18.5006490.8427 30.8108493.9843 44.8687498.6066

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04  44.8687      .04

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0  44.8687                68       78       87              .1        .3
```

```
CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            492.41    Element                    Left OB    Channel
Right OB
  Vel Head (ft)               0.01    Wt. n-Val.                             0.040

  W.S. Elev (ft)            492.39    Reach Len. (ft)             68.00      78.00
  87.00
  Crit W.S. (ft)                      Flow Area (sq ft)                      10.06

  E.G. Slope (ft/ft)      0.000985    Area (sq ft)                           10.06

  Q Total (cfs)               9.72    Flow (cfs)                              9.72

  Top Width (ft)             12.96    Top Width (ft)                         12.96

  Vel Total (ft/s)            0.97    Avg. Vel. (ft/s)                        0.97

  Max Chl Dpth (ft)           1.55    Hydr. Depth (ft)                        0.78

  Conv. Total (cfs)          309.6    Conv. (cfs)                            309.6

  Length Wtd. (ft)           78.00    Wetted Per. (ft)                       13.33

  Min Ch El (ft)            490.84    Shear (lb/sq ft)                        0.05

  Alpha                       1.00    Stream Power (lb/ft s)      44.87       0.00
   0.00
  Frctn Loss (ft)             0.04    Cum Volume (acre-ft)                    0.07

  C & E Loss (ft)             0.00    Cum SA (acres)                          0.05


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance)
is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Pilkington North
REACH: Main                  RS: 0.5

INPUT
Description: 23+45.78
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0    493.7      1.8    493.2     18.9    489.4     40.9    494.2     46.6    496.2

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04     46.6      .04

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
             0     46.6                 9    24.22       45                .1        .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)            492.37    Element                    Left OB    Channel
```

```
Right OB
  Vel Head (ft)              0.02     Wt. n-Val.                        0.040

  W.S. Elev (ft)           492.35     Reach Len. (ft)          9.00      24.22
  45.00
  Crit W.S. (ft)                      Flow Area (sq ft)                 39.50

  E.G. Slope (ft/ft)     0.000484     Area (sq ft)                      39.50

  Q Total (cfs)             41.15     Flow (cfs)                        41.15

  Top Width (ft)            26.79     Top Width (ft)                    26.79

  Vel Total (ft/s)           1.04     Avg. Vel. (ft/s)                   1.04

  Max Chl Dpth (ft)          2.95     Hydr. Depth (ft)                   1.47

  Conv. Total (cfs)        1871.2     Conv. (cfs)                      1871.2

  Length Wtd. (ft)          24.22     Wetted Per. (ft)                  27.43

  Min Ch El (ft)           489.40     Shear (lb/sq ft)                   0.04

  Alpha                      1.00     Stream Power (lb/ft s)    46.60     0.00
   0.00
  Frctn Loss (ft)            0.01     Cum Volume (acre-ft)               0.03

  C & E Loss (ft)            0.00     Cum SA (acres)                     0.01


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance)
is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Pilkington North
REACH: Main                  RS: 0.4

INPUT
Description: 23+70
Station Elevation Data    num=       5
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0495.6063 19.9645490.6152 34.8271488.7029 38.9234489.5134 38.9234     494

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .04        0      .04 38.9234      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0 38.9234          1487.04 1487.04 1487.04               .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (ft)           492.36     Element                      Left OB    Channel
Right OB
  Vel Head (ft)              0.01     Wt. n-Val.                        0.040

  W.S. Elev (ft)           492.35     Reach Len. (ft)
```

Crit W.S. (ft)	489.90	Flow Area (sq ft)		59.29
E.G. Slope (ft/ft)	0.000135	Area (sq ft)		59.29
Q Total (cfs)	41.15	Flow (cfs)		41.15
Top Width (ft)	25.90	Top Width (ft)		25.90
Vel Total (ft/s)	0.69	Avg. Vel. (ft/s)		0.69
Max Chl Dpth (ft)	3.65	Hydr. Depth (ft)		2.29
Conv. Total (cfs)	3536.0	Conv. (cfs)		3536.0
Length Wtd. (ft)		Wetted Per. (ft)		29.15
Min Ch El (ft)	488.70	Shear (lb/sq ft)		0.02
Alpha	1.00	Stream Power (lb/ft s)	38.92	0.00
0.00				
Frctn Loss (ft)		Cum Volume (acre-ft)		
C & E Loss (ft)		Cum SA (acres)		

SUMMARY OF MANNING'S N VALUES

River:Pilkington North

Reach	River Sta.	n1	n2	n3
Main	23	.04	.04	.04
Main	22	.04	.04	.04
Main	21	.04	.04	.04
Main	20.8*	.04	.04	.04
Main	20.6*	.04	.04	.04
Main	20.4*	.04	.04	.04
Main	20.2*	.04	.04	.04
Main	20	.04	.04	.04
Main	19.8*	.04	.04	.04
Main	19.6*	.04	.04	.04
Main	19.4*	.04	.04	.04
Main	19.2*	.04	.04	.04
Main	19	.04	.04	.04
Main	18.6666*	.04	.04	.04
Main	18.3333*	.04	.04	.04
Main	18	.04	.04	.04
Main	17.6666*	.04	.04	.04
Main	17.3333*	.04	.04	.04
Main	17	.04	.04	.04
Main	16.5*	.04	.04	.04
Main	16	.04	.04	.04
Main	15	.04	.04	.04
Main	14	.04	.04	.04
Main	13	.04	.04	.04
Main	12.75*	.04	.04	.04
Main	12.5*	.04	.04	.04
Main	12.25*	.04	.04	.04

Main	12	.04	.04	.04
Main	11.8888*	.04	.04	.04
Main	11.7777*	.04	.04	.04
Main	11.6666*	.04	.04	.04
Main	11.5555*	.04	.04	.04
Main	11.4444*	.04	.04	.04
Main	11.3333*	.04	.04	.04
Main	11.2222*	.04	.04	.04
Main	11.1111*	.04	.04	.04
Main	11	.04	.04	.04
Main	10	.04	.04	.04
Main	9	.04	.04	.04
Main	8	.04	.04	.04
Main	7	.04	.04	.04
Main	6.5*	.04	.04	.04
Main	6	.04	.04	.04
Main	5	.04	.04	.04
Main	4	.04	.04	.04
Main	3.5*	.04	.04	.04
Main	3	.04	.04	.04
Main	2.75*	.04	.04	.04
Main	2.5*	.04	.04	.04
Main	2.25*	.04	.04	.04
Main	2	.04	.04	.04
Main	1.5*	.04	.04	.04
Main	1	.04	.04	.04
Main	0.5	.04	.04	.04
Main	0.4	.04	.04	.04

SUMMARY OF REACH LENGTHS

River: Pilkington North

Reach	River Sta.	Left	Channel	Right
Main	23	145	149	153
Main	22	120.99	117.99	114
Main	21	24.8	25	24.4
Main	20.8*	24.8	25	24.4
Main	20.6*	24.8	25	24.4
Main	20.4*	24.8	25	24.4
Main	20.2*	24.8	25	24.4
Main	20	43	43.6	41.6
Main	19.8*	43	43.6	41.6
Main	19.6*	43	43.6	41.6
Main	19.4*	43	43.6	41.6
Main	19.2*	43	43.6	41.6
Main	19	38	38.33	39.33
Main	18.6666*	38	38.33	39.33
Main	18.3333*	38	38.33	39.33
Main	18	47.67	44	44
Main	17.6666*	47.67	44	44
Main	17.3333*	47.67	44	44
Main	17	43	44	46
Main	16.5*	43	44	46
Main	16	97	88	97
Main	15	105	98	105
Main	14	98	105	97
Main	13	22	24.75	20.5
Main	12.75*	22	24.75	20.5

Main	12.5*	22	24.75	20.5
Main	12.25*	22	24.75	20.5
Main	12	12.78	9.67	13.11
Main	11.8888*	12.78	9.67	13.11
Main	11.7777*	12.78	9.67	13.11
Main	11.6666*	12.78	9.67	13.11
Main	11.5555*	12.78	9.67	13.11
Main	11.4444*	12.78	9.67	13.11
Main	11.3333*	12.78	9.67	13.11
Main	11.2222*	12.78	9.67	13.11
Main	11.1111*	12.78	9.67	13.11
Main	11	101	116	105
Main	10	56	56	62
Main	9	35	35	38.96
Main	8	33	36	40
Main	7	30.5	31	32
Main	6.5*	30.5	31	32
Main	6	89	89	86
Main	5	91	90	88
Main	4	47	48	48.5
Main	3.5*	47	48	48.5
Main	3	23	25.5	30.25
Main	2.75*	23	25.5	30.25
Main	2.5*	23	25.5	30.25
Main	2.25*	23	25.5	30.25
Main	2	40	38.5	36
Main	1.5*	40	38.5	36
Main	1	68	78	87
Main	0.5	9	24.22	45
Main	0.4	1487.04	1487.04	1487.04

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Pilkington North

Reach	River Sta.	Contr.	Expan.
Main	23	.1	.3
Main	22	.1	.3
Main	21	.1	.3
Main	20.8*	.1	.3
Main	20.6*	.1	.3
Main	20.4*	.1	.3
Main	20.2*	.1	.3
Main	20	.1	.3
Main	19.8*	.1	.3
Main	19.6*	.1	.3
Main	19.4*	.1	.3
Main	19.2*	.1	.3
Main	19	.1	.3
Main	18.6666*	.1	.3
Main	18.3333*	.1	.3
Main	18	.1	.3
Main	17.6666*	.1	.3
Main	17.3333*	.1	.3
Main	17	.1	.3
Main	16.5*	.1	.3
Main	16	.1	.3
Main	15	.1	.3
Main	14	.1	.3

Main	13	.1	.3
Main	12.75*	.1	.3
Main	12.5*	.1	.3
Main	12.25*	.1	.3
Main	12	.1	.3
Main	11.8888*	.1	.3
Main	11.7777*	.1	.3
Main	11.6666*	.1	.3
Main	11.5555*	.1	.3
Main	11.4444*	.1	.3
Main	11.3333*	.1	.3
Main	11.2222*	.1	.3
Main	11.1111*	.1	.3
Main	11	.1	.3
Main	10	.1	.3
Main	9	.1	.3
Main	8	.1	.3
Main	7	.1	.3
Main	6.5*	.1	.3
Main	6	.1	.3
Main	5	.1	.3
Main	4	.1	.3
Main	3.5*	.1	.3
Main	3	.1	.3
Main	2.75*	.1	.3
Main	2.5*	.1	.3
Main	2.25*	.1	.3
Main	2	.1	.3
Main	1.5*	.1	.3
Main	1	.1	.3
Main	0.5	.1	.3
Main	0.4	.1	.3

ERRORS WARNINGS AND NOTES
Errors Warnings and Notes for Plan : Plan 34

River: Pilkington North Reach: Main   RS: 21   Profile: PF 1
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
River: Pilkington North Reach: Main   RS: 10   Profile: PF 1
     Warning:Divided flow computed for this cross-section.
River: Pilkington North Reach: Main   RS: 9   Profile: PF 1
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
River: Pilkington North Reach: Main   RS: 1   Profile: PF 1
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
River: Pilkington North Reach: Main   RS: 0.5   Profile: PF 1
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.

HEC-RAS Plan: Plan 34 River: Pilkington North Reach: Main Profile: PF 1

Reach	River Sta	Profile	W.P. Total	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(ft)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main	23	PF 1	12.80	0.14	493.51	494.70	493.65	494.70	0.000001	0.02	7.48	12.57	0.00
Main	22	PF 1	15.46	0.14	493.53	494.70		494.70	0.000000	0.02	8.87	15.25	0.00
Main	21	PF 1	11.23	0.14	493.36	494.70		494.70	0.000000	0.02	7.26	10.84	0.00
Main	20.8*	PF 1	19.46	0.14	493.40	494.70		494.70	0.000000	0.01	11.35	19.16	0.00
Main	20.6*	PF 1	25.31	0.14	493.45	494.70		494.70	0.000000	0.01	12.85	25.03	0.00
Main	20.4*	PF 1	28.07	0.14	493.49	494.70		494.70	0.000000	0.01	12.40	27.81	0.00
Main	20.2*	PF 1	26.76	0.14	493.54	494.70		494.70	0.000000	0.01	10.72	26.52	0.00
Main	20	PF 1	20.31	0.61	493.58	494.70		494.70	0.000010	0.07	9.10	20.09	0.02
Main	19.8*	PF 1	21.65	0.61	493.58	494.70		494.70	0.000006	0.06	10.83	21.44	0.01
Main	19.6*	PF 1	21.17	0.61	493.58	494.70		494.70	0.000004	0.05	12.22	20.97	0.01
Main	19.4*	PF 1	20.08	0.61	493.58	494.70		494.70	0.000003	0.05	13.31	19.88	0.01
Main	19.2*	PF 1	18.82	0.61	493.58	494.70		494.70	0.000002	0.04	14.11	18.60	0.01
Main	19	PF 1	17.68	0.88	493.58	494.70		494.70	0.000003	0.06	14.73	17.35	0.01
Main	18.6666*	PF 1	17.92	0.88	493.58	494.70		494.70	0.000005	0.07	13.20	17.71	0.01
Main	18.3333*	PF 1	19.85	0.88	493.58	494.70		494.70	0.000006	0.07	12.65	19.71	0.02
Main	18	PF 1	24.46	0.88	493.58	494.70		494.70	0.000005	0.06	14.69	24.32	0.01
Main	17.6666*	PF 1	26.40	0.88	493.58	494.70		494.70	0.000004	0.05	16.99	26.25	0.01
Main	17.3333*	PF 1	28.83	0.88	493.58	494.70		494.70	0.000002	0.04	19.75	28.65	0.01
Main	17	PF 1	32.05	8.46	493.58	494.69		494.69	0.000153	0.37	22.99	31.83	0.08
Main	16.5*	PF 1	26.34	8.46	493.58	494.68		494.68	0.000255	0.46	18.23	26.18	0.10
Main	16	PF 1	20.90	8.59	493.58	494.66		494.67	0.000402	0.59	14.63	20.60	0.12
Main	15	PF 1	20.81	8.90	493.58	494.64		494.64	0.000264	0.53	16.92	20.43	0.10
Main	14	PF 1	29.61	8.90	493.33	494.62		494.62	0.000177	0.41	21.96	28.91	0.08
Main	13	PF 1	27.70	9.07	493.49	494.60		494.60	0.000196	0.43	21.00	27.40	0.09
Main	12.75*	PF 1	28.01	9.07	493.51	494.59		494.59	0.000278	0.48	18.98	27.84	0.10
Main	12.5*	PF 1	29.97	9.07	493.53	494.58		494.59	0.000362	0.50	18.02	29.87	0.11
Main	12.25*	PF 1	32.41	9.07	493.55	494.57		494.58	0.000329	0.47	19.14	32.28	0.11
Main	12	PF 1	33.42	9.31	493.57	494.57		494.57	0.000212	0.41	22.46	33.15	0.09
Main	11.8888*	PF 1	33.28	9.31	493.60	494.57		494.57	0.000335	0.48	19.52	33.08	0.11
Main	11.7777*	PF 1	33.27	9.31	493.64	494.56		494.56	0.000538	0.55	16.94	33.14	0.14
Main	11.6666*	PF 1	33.38	9.31	493.68	494.55		494.56	0.000840	0.63	14.84	33.31	0.17
Main	11.5555*	PF 1	32.35	9.31	493.72	494.54		494.55	0.001161	0.70	13.30	32.29	0.19
Main	11.4444*	PF 1	32.47	9.31	493.76	494.53		494.54	0.001424	0.74	12.53	32.40	0.21
Main	11.3333*	PF 1	34.01	9.31	493.79	494.51		494.52	0.001602	0.76	12.32	33.92	0.22
Main	11.2222*	PF 1	37.07	9.31	493.83	494.50		494.51	0.001752	0.75	12.41	36.96	0.23
Main	11.1111*	PF 1	40.33	9.31	493.87	494.48		494.49	0.001708	0.72	12.94	40.20	0.22
Main	11	PF 1	41.32	9.40	493.91	494.47		494.47	0.001509	0.69	13.64	41.13	0.21
Main	10	PF 1	22.38	9.40	493.59	494.26		494.27	0.001819	0.93	10.09	22.11	0.24
Main	9	PF 1	18.24	9.40	493.39	494.18		494.19	0.001253	0.90	10.40	17.92	0.21
Main	8	PF 1	19.47	9.40	493.59	494.09		494.11	0.004441	1.29	7.30	19.31	0.37
Main	7	PF 1	27.42	9.58	493.41	493.95		493.97	0.003709	1.07	8.94	27.35	0.33

HEC-RAS Plan: Plan 34 River: Pilkington North Reach: Main Profile: PF 1 (Continued)

Reach	River Sta	Profile	W.P. Total	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(ft)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main	6.5*	PF 1	23.66	9.58	493.25	493.84		493.86	0.003158	1.08	8.84	23.60	0.31
Main	6	PF 1	20.24	9.58	493.10	493.76		493.78	0.002158	1.03	9.31	20.07	0.27
Main	5	PF 1	17.96	9.72	492.66	493.54		493.57	0.002731	1.16	8.34	17.85	0.30
Main	4	PF 1	12.60	9.72	492.21	493.23		493.26	0.004351	1.54	6.30	12.43	0.38
Main	3.5*	PF 1	11.92	9.72	491.97	493.01		493.05	0.004452	1.59	6.12	11.73	0.39
Main	3	PF 1	11.47	9.72	491.74	492.79		492.83	0.004639	1.63	5.95	11.27	0.40
Main	2.75*	PF 1	11.81	9.72	491.61	492.68		492.72	0.004126	1.56	6.24	11.61	0.37
Main	2.5*	PF 1	12.43	9.72	491.48	492.60		492.63	0.003270	1.42	6.82	12.22	0.34
Main	2.25*	PF 1	13.36	9.72	491.35	492.53		492.56	0.002340	1.25	7.77	13.15	0.29
Main	2	PF 1	14.61	9.72	491.22	492.49		492.51	0.001560	1.07	9.09	14.39	0.24
Main	1.5*	PF 1	13.86	9.72	491.03	492.44		492.45	0.001239	1.02	9.54	13.57	0.21
Main	1	PF 1	13.33	9.72	490.84	492.39		492.41	0.000985	0.97	10.06	12.96	0.19
Main	0.5	PF 1	27.43	41.15	489.40	492.35		492.37	0.000484	1.04	39.50	26.79	0.15
Main	0.4	PF 1	29.15	41.15	488.70	492.35	489.90	492.36	0.000135	0.69	59.29	25.90	0.08

HEC-RAS Plan: Plan 34 River: Pilkington North Reach: Main Profile: PF 1

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Main	23	PF 1	494.70	494.70	0.00	0.00	0.00		0.14		12.57
Main	22	PF 1	494.70	494.70	0.00	0.00	0.00		0.14		15.25
Main	21	PF 1	494.70	494.70	0.00	0.00	0.00		0.14		10.84
Main	20.8*	PF 1	494.70	494.70	0.00	0.00	0.00		0.14		19.16
Main	20.6*	PF 1	494.70	494.70	0.00	0.00	0.00		0.14		25.03
Main	20.4*	PF 1	494.70	494.70	0.00	0.00	0.00		0.14		27.81
Main	20.2*	PF 1	494.70	494.70	0.00	0.00	0.00		0.14		26.52
Main	20	PF 1	494.70	494.70	0.00	0.00	0.00		0.61		20.09
Main	19.8*	PF 1	494.70	494.70	0.00	0.00	0.00		0.61		21.44
Main	19.6*	PF 1	494.70	494.70	0.00	0.00	0.00		0.61		20.97
Main	19.4*	PF 1	494.70	494.70	0.00	0.00	0.00		0.61		19.88
Main	19.2*	PF 1	494.70	494.70	0.00	0.00	0.00		0.61		18.60
Main	19	PF 1	494.70	494.70	0.00	0.00	0.00		0.88		17.35
Main	18.6666*	PF 1	494.70	494.70	0.00	0.00	0.00		0.88		17.71
Main	18.3333*	PF 1	494.70	494.70	0.00	0.00	0.00		0.88		19.71
Main	18	PF 1	494.70	494.70	0.00	0.00	0.00		0.88		24.32
Main	17.6666*	PF 1	494.70	494.70	0.00	0.00	0.00		0.88		26.25
Main	17.3333*	PF 1	494.70	494.70	0.00	0.00	0.00		0.88		28.65
Main	17	PF 1	494.69	494.69	0.00	0.01	0.00		8.46		31.83
Main	16.5*	PF 1	494.68	494.68	0.00	0.01	0.00		8.46		26.18
Main	16	PF 1	494.67	494.66	0.01	0.03	0.00		8.59		20.60
Main	15	PF 1	494.64	494.64	0.00	0.02	0.00		8.90		20.43
Main	14	PF 1	494.62	494.62	0.00	0.02	0.00		8.90		28.91
Main	13	PF 1	494.60	494.60	0.00	0.01	0.00		9.07		27.40
Main	12.75*	PF 1	494.59	494.59	0.00	0.01	0.00		9.07		27.84
Main	12.5*	PF 1	494.59	494.58	0.00	0.01	0.00		9.07		29.87
Main	12.25*	PF 1	494.58	494.57	0.00	0.01	0.00		9.07		32.28
Main	12	PF 1	494.57	494.57	0.00	0.00	0.00		9.31		33.15
Main	11.8888*	PF 1	494.57	494.57	0.00	0.00	0.00		9.31		33.08
Main	11.7777*	PF 1	494.56	494.56	0.00	0.01	0.00		9.31		33.14
Main	11.6666*	PF 1	494.56	494.55	0.01	0.01	0.00		9.31		33.31
Main	11.5555*	PF 1	494.55	494.54	0.01	0.01	0.00		9.31		32.29
Main	11.4444*	PF 1	494.54	494.53	0.01	0.01	0.00		9.31		32.40
Main	11.3333*	PF 1	494.52	494.51	0.01	0.02	0.00		9.31		33.92
Main	11.2222*	PF 1	494.51	494.50	0.01	0.02	0.00		9.31		36.96
Main	11.1111*	PF 1	494.49	494.48	0.01	0.02	0.00		9.31		40.20

HEC-RAS Plan: Plan 34 River: Pilkington North Reach: Main Profile: PF 1 (Continued)

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Main	11	PF 1	494.47	494.47	0.01	0.19	0.00		9.40		41.13
Main	10	PF 1	494.27	494.26	0.01	0.08	0.00		9.40		22.11
Main	9	PF 1	494.19	494.18	0.01	0.07	0.00		9.40		17.92
Main	8	PF 1	494.11	494.09	0.03	0.15	0.00		9.40		19.31
Main	7	PF 1	493.97	493.95	0.02	0.11	0.00		9.58		27.35
Main	6.5*	PF 1	493.86	493.84	0.02	0.08	0.00		9.58		23.60
Main	6	PF 1	493.78	493.76	0.02	0.22	0.00		9.58		20.07
Main	5	PF 1	493.57	493.54	0.02	0.31	0.00		9.72		17.85
Main	4	PF 1	493.26	493.23	0.04	0.21	0.00		9.72		12.43
Main	3.5*	PF 1	493.05	493.01	0.04	0.22	0.00		9.72		11.73
Main	3	PF 1	492.83	492.79	0.04	0.11	0.00		9.72		11.27
Main	2.75*	PF 1	492.72	492.68	0.04	0.09	0.00		9.72		11.61
Main	2.5*	PF 1	492.63	492.60	0.03	0.07	0.00		9.72		12.22
Main	2.25*	PF 1	492.56	492.53	0.02	0.05	0.00		9.72		13.15
Main	2	PF 1	492.51	492.49	0.02	0.05	0.00		9.72		14.39
Main	1.5*	PF 1	492.45	492.44	0.02	0.04	0.00		9.72		13.57
Main	1	PF 1	492.41	492.39	0.01	0.04	0.00		9.72		12.96
Main	0.5	PF 1	492.37	492.35	0.02	0.01	0.00		41.15		26.79
Main	0.4	PF 1	492.36	492.35	0.01				41.15		25.90

APPENDIX G

Inlet Protection Calculations

Inlet Protection Calculations

Maximum Channel Bottom Shear Stress

Federal Highway Administration
Design of Roadside Channels with Flexible Linings

Equation 2.4:

$$\tau_d = \gamma d S_o$$

Where:

$$\gamma = 62.4\left(\frac{lb}{ft^3}\right)$$
$$d = Water\ Depth\ (ft)$$
$$S_o = slope\ \left(\frac{ft}{ft}\right)$$

$$\tau_d = (62.4\left(\frac{lb}{ft^3}\right))(3.84\ (ft))(0.02\ \left(\frac{ft}{ft}\right))$$
$$\tau_d = 4.79\ \left(\frac{lb}{ft^2}\right)$$

Table 2.3

Rock RipRap $D_{50} = 12" \ = \ 4.8\ \left(\frac{lb}{ft^2}\right)$

RipRap Design

NRCS – Illinois Urban Manual Practice Standards

IDOT Gradation = RR – 5, D_{50} = 12”

Thickness = 28”

APPENDIX D

Performance Standard Verification Plan

PERFORMANCE STANDARD VERIFICATION PLAN FOR OPERABLE UNIT 3

AT THE:

OTTAWA TOWNSHIP FLAT GLASS SITE
CITY OF OTTAWA, LASALLE COUNTY, ILLINOIS
CERCLA DOCKET NO. V-W-11-C-989

PREPARED FOR:

PILKINGTON NORTH AMERICA, INC.
140 DIXIE HIGHWAY
ROSSFORD, OHIO 43460

PREPARED BY:

HULL & ASSOCIATES, INC.
6397 EMERALD PARKWAY, SUITE 200
DUBLIN, OHIO 43016

AUGUST 2014

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1.0 INTRODUCTION

1.1 General

The purpose of this Performance Standard Verification Plan (PSVP) is to describe the measures of achievement of the goals of the Remedial Action for Operable Unit 3 (OU3) of the Ottawa Township Flat Glass Site, set forth by United States Environmental Protection Agency (USEPA) in Section VIII of the Interim Record of Decision (IROD) for OU3 and Section II of the corresponding Statement of Work (SOW)[1]. These Performance Standards are evaluated in terms of progress toward meeting Remedial Action Objectives (RAOs), described in Section 1.2, below. Verification of these performance standards is therefore achieved by monitoring environmental conditions following implementation of remedial activities.

1.2 Remedial Action Objectives

Groundwater in the St. Peter Sandstone formation at the site is contaminated with arsenic above the Maximum Contaminant Level (MCL) of 10 micrograms per liter (ug/L). The groundwater is not currently used as a drinking water source in the vicinity of the impact; however, a potential adverse health risk exists if residents consume the impacted water in the future. The Remedial Action Objectives (RAOs) of the interim cleanup action at OU3 are to:

1. Prevent the potable use of groundwater contaminated with arsenic above 10 ug/L; and
2. Reduce the concentration of arsenic in the groundwater over time.

Although the human health risks calculated for a site maintenance worker or trespassers did not exceed EPA's target risk ranges, a secondary interim RAO is to:

1. Prevent future contact with the grinding and polishing (G&P) slurry material in Quarry 1, as well as arsenic-impacted sediment in all of the quarries.

1.3 Components of the Selected Remedy

The selected interim remedy for OU3 specifies response actions that will address the source areas and groundwater south of the Illinois River. The major components of the selected response actions for OU3 include:

1. Implementing surface water drainage improvements to reduce infiltration in the drainage ditch along Quarry 1 and within the footprint of Quarry 2;

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[1] Administrative Order on Consent (the Order), Docket No. V-W-11-C-989, effective February 6, 2012, and the corresponding Statement of Work designated as Appendix A of the Order.

2. Constructing an extension of the municipal water line to homes impacted by the arsenic contamination in groundwater;

3. Implementing institutional controls on certain area properties to prevent future redevelopment for residential use and/or to prevent future potable use of groundwater as described in the Institutional Control Implementation and Assurance Plan [(ICIAP), submitted under separate cover];

4. Monitoring groundwater quality over time; and

5. Conducting long term operation, monitoring and maintenance.

As described in the Preliminary Design document (Hull Document No. PNA103.300.0047), the areal extent of arsenic in groundwater at concentrations above the MCL became smaller since the Feasibility Study [(FS) Hull Document No. PNA012.300.0020, dated June 2009] , possibly due to the termination of wastewater discharges into the ditch running along Quarry 1 and emptying into Quarry 2 in March 2006. Arsenic concentrations exceeding the MCL currently do not extend beyond the PNA property's southeast boundary and are interpolated to extend only a short distance (approximately 175 feet) south of the PNA property's southern boundary and a portion of land between the Site and the Illinois River (Figure 1). Given the contraction of the plume and protectiveness of the overall remedy accomplished by the water line and institutional controls, the objective of the surface water management component remedy is therefore to maintain or improve upon the baseline conditions such that human health and the environment remain protected.

2.0 PERFORMANCE STANDARDS

The following paragraphs summarize the performance standard for each task.

2.1 Municipal Water Line Extension and Institutional Controls

This component of the remedy will satisfy the RAOs to prevent the potable use of groundwater contaminated with arsenic above 10 ug/L and to prevent future contact with the G&P slurry material in Quarry 1, as well as arsenic-impacted sediment in all of the quarries.

2.1.1 Performance Standards for Municipal Water Line Extension and Institutional Controls

Performance standards to be applied to the municipal water line extension and institutional controls include:

1. Prevent any inappropriate development of the source areas within OU3, all of which are located on PNA's property, through the development of a deed restriction.
2. Prevent trespassing on source areas within OU3 by maintaining secure access and conducting regular inspections.
3. Prevent potable use of groundwater within the St. Peter Sandstone aquifer on PNA's property within OU3, by implementing a deed restriction on the withdrawal of water for potable purposes.
4. Prevent potable use of any groundwater in the St. Peter Sandstone aquifer beyond the boundaries of PNA's property wherever the groundwater contains arsenic at levels above the MCL, including a buffer zone, by extending the municipal water supply line and implementing a groundwater ordinance precluding the installation of wells within the St. Peter Sandstone aquifer within the buffer zone, as discussed in ICIAP, submitted under separate cover.

Unlike remedial actions that may result in incremental progress toward achievement of RAOs, the extension of the municipal water line and prohibition of groundwater withdrawal from the St. Peter Sandstone within the buffer zone will result in immediate achievement of the RAOs. Therefore, it is not necessary to devise a method of evaluating incremental progress toward achievement of this portion of the remedy. Once implemented and abided by, this portion of the remedy will remain protective of human health. Once constructed, the City of Ottawa will maintain the responsibility for providing water service to the affected properties using standard procedures applicable to operation and maintenance of the municipal water supply infrastructure. The method for ensuring the protectiveness of the Institutional Controls is described in detail in the discussion of long term monitoring of in the ICIAP.

2.2 Surface Water Drainage Modifications

As discussed in Section 1.3, the areal extent of arsenic in groundwater at concentrations above the MCL became smaller since the FS, possibly due to the termination of wastewater discharges into the ditch running along Quarry 1 and emptying into Quarry 2 in March 2006. The surface water drainage modifications are intended to maintain or enhance this observed trend and assist in attaining the RAO of reducing arsenic concentrations in groundwater over time. This component of the remedy is intended to influence groundwater flow patterns by reducing mounding in the area of the ditch along Quarry 1 to allow groundwater to flow back toward the Illinois River and allow reduction of arsenic concentrations in groundwater outside of PNA's property to the southeast. The scope of the proposed surface water drainage modifications is described in detail in the Prefinal/Final Remedial Design Document (Hull Document No. PNA103.300.0065).

2.2.1 Performance Standards Related to Surface Water Drainage Modifications

Performance standards applicable to this portion of the remedy include substantially reducing surface water recharge to groundwater from the ditch along Quarry 1 and within the footprint of Quarry 2 to reduce the degree of groundwater mounding near Quarry 1 and maintain or reduce the areal extent of arsenic at concentrations above the MCL in groundwater, off of PNA's property to the southeast. Retraction of the plume is an extra layer of protectiveness in the overall remedy, which precludes the potential for contact with impacted groundwater by current and future residents through the extension of the municipal water line in conjunction with the implementation of institutional controls.

2.2.2 Short-Term Monitoring

The Performance Standards related to the Surface Water Drainage Modifications will be evaluated via the following short-term monitoring requirements:

1. groundwater sampling of existing monitoring wells that are currently sampled during the semi-annual Site-wide sampling events (Figure 2), laboratory analysis of arsenic and mapping of arsenic distributions (twice per year for two years);

2. measurement of water levels within monitoring wells, mapping of potentiometric surfaces and comparison of head differentials for selected monitoring wells over time (twice per year for two years; and

3. inspection of the drainage improvements (twice per year for two years).

Twice per year for two years, the improved and AquaBlok™-lined segment of the ditch and the piped segments will be visually inspected to determine and document that these elements are performing as designed. The inspections will identify evidence of disturbance of the AquaBlok™ liner in the improved and lined ditch segment or blockage of pipes in the bypass storm sewer around Quarry 2. AquaBlok™, by its nature, is a self-healing liner material which swells when hydrated. Therefore, cracks, animal burrows or other relatively minor disturbances will be noted but will likely not require repair. More significant disturbances (i.e., large areas in which the AquaBlok™ has been completely removed exposing the native material below) will be evaluated and additional material will be applied as needed.

2.2.3 Long-Term Monitoring

The Performance Standards related to the Surface Water Drainage Modifications will be evaluated via the following long-term monitoring requirements:

1. groundwater sampling of selected existing monitoring wells, laboratory analysis of arsenic and mapping of arsenic distributions;
2. measurement of water levels within monitoring wells, mapping of potentiometric surfaces and comparison of head differentials for selected monitoring wells over time; and
3. inspection of the drainage improvements.

On an annual basis, the improved and lined segment of the ditch and the piped segments will be visually inspected to determine and document that these elements are performing as designed. Consistent with the short-term monitoring criteria, the inspections will identify evidence of disturbance of the liner in the improved and lined ditch segment or blockage of pipes in the bypass storm sewer around Quarry 2. The inspection techniques and criteria will be conducted as described in Section 2.2.2.

Although it is anticipated that long-term monitoring of the remedy will begin with the selected monitoring wells that are currently sampled during the semi-annual monitoring of OU3 groundwater and will be sampled semi-annually during short-term monitoring, the network of included wells will be evaluated over time to ensure that the remedy is effectively evaluated. The results of the semi-annual performance monitoring will be summarized in semi-annual letter reports. Any changes to the monitoring well network used for long-term monitoring or reporting frequency will be submitted to USEPA for review and approval.

2.2.4 Maintenance Requirements

The need for maintenance of the Surface Water Drainage Modifications will be determined during the inspections as described in Section 2.2.2 and Section 2.2.3, above. Maintenance activities related to the drainage modifications may include the following:

1. removal of large obstructions such as fallen trees taking care to not gouge or scrape the liner;
2. placement of additional liner material (consistent with design specifications) wherever it has been significantly damaged by removal or erosion; and

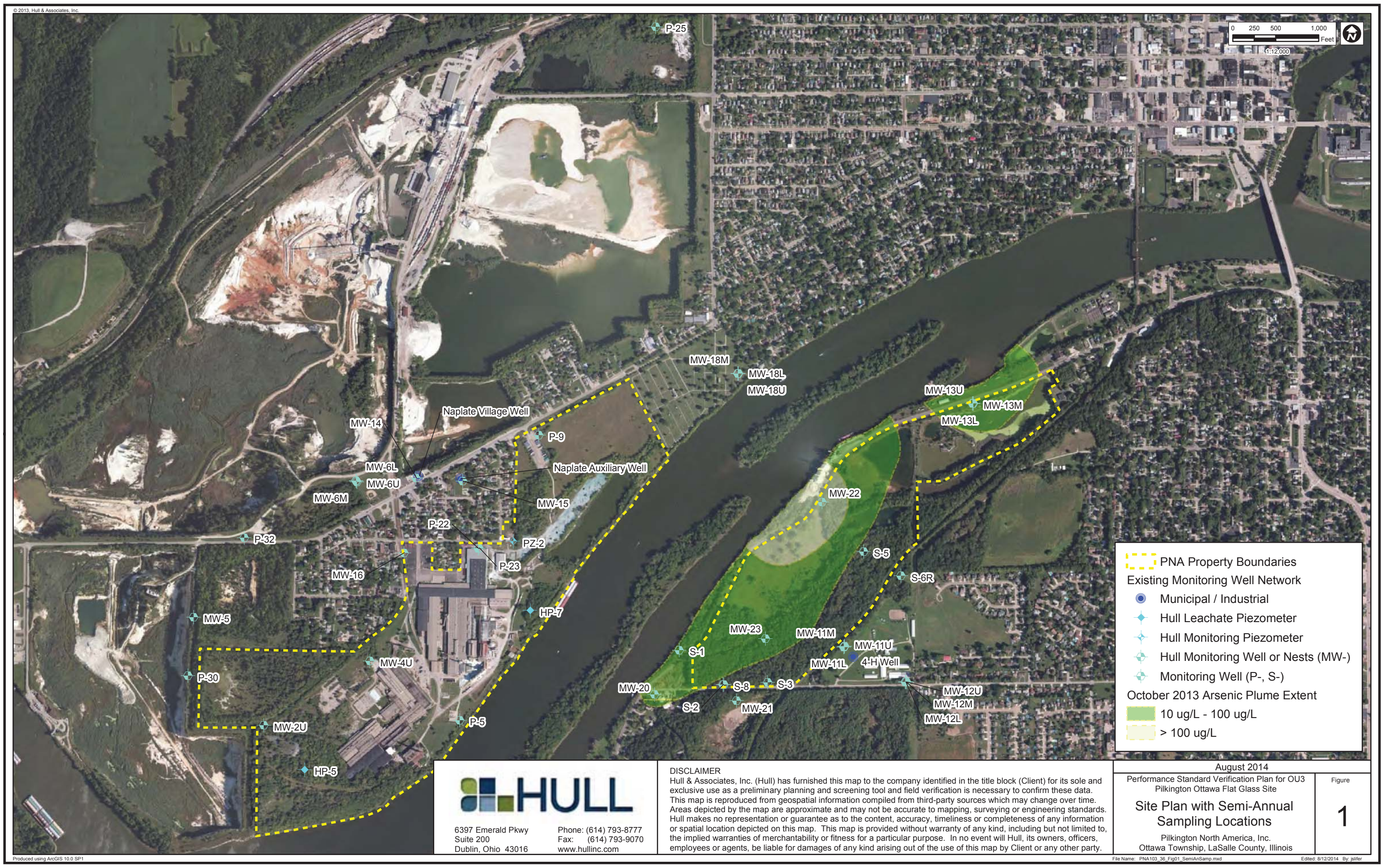
3. removal of sediment or debris from the storm sewer.

3.0 REFERENCES

Hull & Associates, Inc. 2009. Feasibility Study for Operable Unit 3 of the Ottawa Township Flat Glass Site; Hull document PNA012.300.0020.

USEPA. 2010. Interim Record of Decision Selected Remedial Alternative for the "Source Areas and Groundwater South of the Illinois River" Operable Unit (OU3) of the Ottawa Township Flat Glass Site.

FIGURE



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MW-6L
MW-6U
MW-6M
MW-15
MW-22
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P-32
PZ-2
P-23
S-5
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MW-16
HP-7
MW-5
MW-23
MW-11M
MW-11U
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MW-11L
4-H Well
P-30
MW-20
S-8
S-3
MW-12U
MW-12M
MW-12L
S-2
MW-21
MW-2U
P-5
HP-5
PNA Property Boundaries
Existing Monitoring Well Network
Municipal / Industrial
Hull Leachate Piezometer
Hull Monitoring Piezometer
Hull Monitoring Well or Nests (MW-)
Monitoring Well (P-, S-)
October 2013 Arsenic Plume Extent
10 ug/L - 100 ug/L
> 100 ug/L
HULL
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August 2014
Performance Standard Verification Plan for OU3
Pilkington Ottawa Flat Glass Site
Site Plan with Semi-Annual Sampling Locations
Pilkington North America, Inc.
Ottawa Township, LaSalle County, Illinois
Figure
1
Produced using ArcGIS 10.0 SP1
File Name: PNA103_36_Fig01_SemiAnSamp.mxd
Edited: 8/12/2014 By: jslifer

APPENDIX E

Construction Quality Assurance Plan

CONSTRUCTION QUALITY ASSURANCE PLAN FOR SURFACE WATER DRAINAGE MODIFICATIONS AT OPERABLE UNIT 3

AT THE:
OTTAWA TOWNSHIP FLAT GLASS SITE
CITY OF OTTAWA, LASALLE COUNTY, ILLINOIS
CERCLA DOCKET NO. V-W-11-C-989

PREPARED FOR:
PILKINGTON NORTH AMERICA, INC.
140 DIXIE HIGHWAY
ROSSFORD, OHIO 43460

PREPARED BY:
HULL & ASSOCIATES, INC.
6397 EMERALD PARKWAY, SUITE 200
DUBLIN, OHIO 43016

AUGUST 2014

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1.0 INTRODUCTION

On behalf of Pilkington North America, (PNA), Hull & Associates, Inc. (Hull) has prepared this Construction Quality Assurance Plan (CQAP) to develop and implement a program to ensure, with a reasonable degree of certainty, that the completed Remedial Action (RA) for Operable Unit 3 (OU3) of the Ottawa Township Flat Glass Site (Site) meets or exceeds design criteria, plans, specifications, and performance standards. The CQAP introduces personnel, defines responsibilities, and details activities in the quality assurance and quality control (QA/QC) program, such as inspections, testing, monitoring and potential corrective actions, if necessary. The Remedial Design (RD) activities are based on the remedy selected by the United States Environmental Protection Agency (USEPA) in the Interim Record of Decision (IROD) for the Site (USEPA, 2010) and the Administrative Order on Consent (the Order), Docket No. V-W-11-C-989, effective February 6, 2012, and the corresponding Statement of Work designated as Appendix A of the Order. The Consent Decree includes a Statement of Work (SOW) for implementation of the RD, Remedial Action (RA), and operation and maintenance (O&M) requirements for the remedy and long-term performance monitoring of the efficacy of the remedy at OU3.

This CQAP includes the requirements established by the Consent Decree and Task IV.E of the SOW as follows:

1. *Responsibilities and authorities of all organizations and key personnel involved in the design and construction of the Remedial Action.*

2. *Qualifications of the Quality Assurance Official (QAO) to demonstrate he/she possesses the training and experience necessary to fulfill his/her identified responsibilities.*

3. *Protocols for sampling and testing used to monitor construction.*

4. *Identification of proposed quality assurance sampling activities including the sample size, locations, frequency of testing, acceptance and rejection data sheets, problem identification and corrective measures reports, evaluation reports, acceptance reports, and final documentation.*

5. *Reporting requirements for CQA activities must be described in detail in the CQAP. This must include such items as daily summary reports, inspection data sheets, problem identification and corrective measures reports, design acceptance reports, and final documentation.*

2.0 QUALITY MANAGEMENT AND ORGANIZATION

2.1 Qualifications and Responsibilities of Quality Management Personnel

An organization chart showing the reporting relationships of persons involved in the overall project management is shown on Figure 1. The preliminary relationships of potential persons involved with the QA/QC for the RA are discussed in this section and will be further developed at a later date, when an RA contractor is selected.

Members of the project team will have the required qualifications, a good professional and ethical reputation, previous experience in the related QA/QC activities to be implemented, and a demonstrated capability to perform the required activities. The title, qualifications, general responsibilities and authorities of each personnel assigned a quality management function are provided in the following paragraphs. The responsibility and/or authority of a given party may be modified or expanded as dictated by specific project needs and shall be updated accordingly.

2.1.1 Regulatory Agency

As the Regulatory Agency, USEPA is authorized to access the Site to observe and monitor the progress of any activity, review and approve all submittals or require modifications as per the terms and conditions of the Consent Order. The USEPA's Remedial Project Manager (RPM) has the authority to halt any work required by this Consent Decree and may take any necessary response action when he or she determines the conditions at OU3 constitute an emergency situation or may present an immediate threat to public health or welfare or the environment. The RPM currently assigned to the Site is Ms. Jennifer Cheever.

2.1.2 Respondent

As the Respondent, PNA is responsible for coordinating the design and construction of the RA. The PNA Project Coordinator is the representative of PNA responsible for oversight of daily operations during remedial activities. The current Project Coordinator for USEPA is PNA's Environmental Manager, Mr. James Lavrich.

2.1.3 Supervising Contractor

As the current Supervising Contractor, Hull is responsible for the direction and supervision of all aspects of the Work to be performed by the Settling Defendant pursuant to the Consent Decree.

2.1.4 Supervising Professional Engineer (SPE)

The Supervising Professional Engineer (SPE) will prepare RD documents for acceptance by the USEPA. The RD documents provide for design of the remedy set forth in the IROD, in accordance with the SOW and for achievement of the Performance Standards and other requirements set forth in the IROD, the Consent Decree, and/or the SOW.

The SPE is the official representative of PNA responsible for coordinating schedules, meetings, and field activities. This responsibility includes communications to PNA, Construction Quality Assurance Officer (CQAO), Contractors, Manufacturers, and other involved parties. The SPE has the authority to select and dismiss parties charged with construction activities.

The SPE will have appropriate experience in construction, remediation, and engineering consulting. The SPE will satisfy the following qualifications or otherwise satisfy to PNA and the USEPA that his or her education and experience are appropriate to conduct the duties of the SPE:

1. college degree in engineering, construction management, or related field, and professional registration, as appropriate;
2. minimum of 5 years of project management experience, with a minimum of 3 years in functional work area of the specific project; and
3. working knowledge of applicable federal, state, and local laws, regulations, and guidance.

The SPE's specific responsibilities will include the following:

1. completing the construction activities in accordance with the contract specifications and drawings and approved planning documents;
2. ensuring that the work is conducted in a safe and environmentally sound manner;
3. maintaining close communication and coordinating with USEPA for the duration of the project;
4. preparing the required reports and submitting them to the appropriate persons in a timely manner;
5. immediately notifying PNA of problems with construction or safety and health procedures; and
6. ensuring the site personnel follow the approved procedures presented in the site-specific project plans.

The SPE will be the Supervising Contractor point of contact for the remedial work and is responsible for the management and execution of activities in accordance with SOW, approved work plans, and federal, state, and local laws and regulations. This includes coordinating the activities of the groups, subcontractors, or teams working on the RA. The currently identified SPE is Mr. Mark Bonifas, P.E. from Hull.

The SPE has the authority to stop work on any part of the project if it is found to be noncompliant with contract specifications or project plans. The SPE is authorized to institute corrective actions, as necessary, and to implement these changes, with USEPA approval, if necessary, in accordance with the provisions of the contract. All groups, subcontractors, and teams working on the RA will report to the SPE and act as his direction.

2.1.5 Construction Quality Assurance Officer

The Construction Quality Assurance Officer (CQAO) is responsible for conducting the quality assurance program during the construction phase of the project. The CQAO will be responsible for review of submittals, performance of field and office audits, review of construction specifications, and review of analytical data submittals. The CQAO is responsible for ensuring compliance with the requirements identified in the CQAP. He or she is responsible for the overall quality management related to the remedial action. The qualifications of the CQAO include the following:

1. minimum of 3 years of working experience in the construction industry, preferably in environmental construction;

2. expertise in the construction techniques and processes required for the remedial action; and

3. working knowledge of applicable federal, state, and local laws, regulations, and guidance.

The CQAO may delegate some of his or her quality management responsibilities to another qualified person with prior approval from the SPE. The CQAO, with the assistance of the QA personnel, has the authority for ensuring the implementation of the CQAP as it applies to sampling, testing, monitoring, and analysis performed for the duration of the project. He or she has the authority and responsibility to stop work on activities related to, or affected by, noncompliant conditions until actions can be taken to correct the noncompliant condition or prevent it from affecting related or subsequent work. The current CQAO for the project is Mr. David Baltzer of Hull.

2.1.6 On-Site Quality Assurance Inspector

The On-Site Quality Assurance Inspector will work under the supervision of the SPE and the CQAO. The persons performing the inspections or tests will be qualified to do so through training and/or experience. The QA personnel will be present at the Site when work activities in their designated area are occurring and have the complete authority to stop work and resolve the actions necessary to ensure compliance with the RD.

QA Inspectors are responsible for generating applicable signed documentation for their work using standard forms/formats. The duties include periodic inspections of the work being produced and/or materials and equipment delivered to the site, and verification of the adherence to this CQAP by subcontractors.

2.1.7 Subcontractors

The Subcontractor will be pre-qualified and approved by PNA. The Subcontractor will be capable of assigning the personnel and equipment required to perform the work within the project schedule. The Subcontractor will be trained and qualified to perform the remedial action work. Prior to execution of contractual agreements with PNA, the Subcontractor will provide the SPE with a statement of qualifications and documented procedures to ensure safety and the environment are protected.

The Subcontractor will designate one representative as a Superintendent who will represent the contractor on-Site. The Superintendent will be qualified by experience and must also exhibit good management skills. The Subcontractor is responsible for all activities assigned by PNA. These activities may include: moving earth to and from borrow areas, placement of piping and valves, placement of the low permeability material, or other related work items. The Subcontractor may also be responsible for construction of sedimentation and erosion controls, access road installation, and other support activities outside the immediate project area.

It is the responsibility of the Subcontractor to supply equipment and perform work that results in completed project components that are in conformance with the CQAP.

2.1.8 Manufacturer/Vendor

The Manufacturer/Vendor is responsible for the production of materials that meet the requirements of the CQAP. Each Manufacturer/Vendor is also responsible for providing adequate documentation regarding the characteristics of the material, the specifications, all recommendations, the testing performed for verifications as described in Table 1 of the CQAP, the production procedures and the quality control measures taken during manufacturing.

Each Manufacturer/Vendor is responsible for the safe transportation of the material between the manufacturing plant and the Site, as applicable. The Manufacturer is responsible for carefully loading and transporting the material and accepts full responsibility for any damage to the material that may occur during these operations.

3.0 CONSTRUCTION MATERIALS AND METHODS

The RD documents establish the limits, type, and details of the RA, and all other components of the site. Detailed specifications, including relevant construction materials and methods, are presented on Figure C10 and Figure C2.0 of the Prefinal/Final Remedial Design Plan Set. Components and associated materials of the RD for the Surface Water Drainage Modifications include Site preparation (i.e., clearing), low-permeability cover placement (i.e., Aquablok™), installation of piping to convey surface water to Quarry 4 (ADS ST pipe system, and pre-cast and cast concrete).

Table 1 presents the laboratory and field inspections and test methods that will be used to characterize and evaluate the material quality of the RD components. The tests will be conducted in accordance with the current versions of the corresponding standard methods referenced. Table 1 also provides minimum test frequencies, acceptance/rejection criteria and corrective measures.

During construction, the SPE may prepare applications to the USEPA for approval of substantive changes to the design drawings or specifications of the RA, if needed. Substantive changes include any changes that modify or impact the technical basis for any engineered component of the RD. Such changes will require the approval of the USEPA.

4.0 CONSTRUCTION QA/QC TESTING, INSPECTION AND REPORTING

4.1 Construction QA/QC Testing and Inspection

QA/QC tests and checks will be performed during the RA activities to check the validity of the collected data and to confirm site conditions. The SPE (or his designee), Subcontractor or Manufacturer/Vendor will perform QA/QC tests as appropriate. Examples of typical QA/QC tests and checks that may be used during project are listed below.

1. visual inspection of soil placement activities;
2. trench stability tests; and
3. low permeability cover installation depths.

4.1.1 Inspection Types and Frequencies

4.1.1.1 Initial Inspection

An initial inspection will be conducted following Site preparation and Subcontractor mobilization, prior to commencement of work by the SPE, CQAO, Subcontractor or other qualified designee. The initial inspection will include:

1. review of contract requirements;
2. check to ensure that all materials and/or equipment have been tested or vendor has been reviewed and approved;
3. check to ensure that provisions have been made to conduct required work, including substantive requirements of any relevant permits;
4. examination of work area to ascertain that Site preparation work has been completed; and
5. review of safety and quality requirements most relevant to the work, including their Method Statement (Section 2.1.7).

4.1.1.2 Follow-up Inspection

Follow-up inspections will be conducted during implementation of each phase of work (e.g., drainage pipe installation, AquaBlok™ placement), until completion of the RA work.

4.1.1.3 Pre-certification Inspection

After the RA has been fully performed and performance standards have been achieved, PNA will conduct a pre-certification inspection. After completion of the pre-certification inspection and receipt and review of the written certification report, the USEPA will determine if the RA or any portion thereof has been completed or not. If the USEPA approves the completion report, USEPA will certify completion.

4.1.2 Testing Locations and Frequencies

Table 1 contains a description of the testing locations and frequencies for each element of the remedy.

4.1.3 Acceptance and Rejection Criteria

Table 1 contains a description of the acceptance and rejection criteria for each element of the remedy.

4.1.4 Corrective Measures

To identify services or activities that do not comply with the RA requirements, the following mechanisms may be performed:

- CQAP inspections; and
- Field tests and samples.

The SPE and/or CQAO or his designee will identify and document any noncompliance issue and will notify all relevant parties of the noncompliance. The SPE and/or CQAO has the authority and responsibility to stop work related to, or affected by, the noncompliance condition until action can be taken to correct it or prevent it from affecting related or subsequent work. The SPE and/or CQAO may require that the work be re-tested and/or re-inspected to confirm or disprove the noncompliance condition. The SPE and/or CQAO will prepare a written report providing the cause and effect of the noncompliance condition.

4.2 Construction QA/QC Documentation

An effective CQAP depends largely on recognition of all construction activities that should be monitored and on assigning responsibilities for the monitoring of each construction activity. This is most effectively accomplished by the documenting of QA activities. The CQAO or his designee will document that QA requirements have been addressed and satisfied.

The CQAO or his designee will provide the SPE with daily field reports, data sheets, and logs to document that all monitoring activities have been accomplished. The CQAO or his designee will also maintain at the job site a complete file of design drawings, design specifications, the CQAP, checklists, test procedures, daily logs, and other pertinent documents.

Throughout the construction project, various forms of recordkeeping will be used, including daily field reports, test data sheets, and photographs. These data will be used to compile the final construction certification report for submittal to the USEPA. The SPE or his designee will conduct daily QA/QC duties on-site. The on-Site personnel (including subcontractors and visitors), their time spent at the site, major equipment on-site, and materials delivered or removed from the Site will be recorded in a daily construction QA/QC report. The report will also include a summary of work performed and the results of any inspections of QA/QC tests performed that day. Summaries will be sent to the USEPA RPM with the monthly reports, as required.

4.2.1 Inspection Reports

Completed inspections will be recorded on standard inspection forms and included in any applicable reports. Documentation will be used to track any deficiencies and corrective actions. Completed forms will be reviewed by the SPE and the CQAO prior to becoming part of the Site records. Items not meeting the criteria will require additional testing, measurement, re-sampling, and reanalysis to comply with corrective action procedures outlined in Table 1.

4.2.2 Test Results

Field test results will be submitted in the daily field reports. Pre-construction testing results related to the quality of materials provided by the Subcontractor or Manufacturer/Vendor will be submitted with the final documentation, as described in Section 4.2.3.

4.2.3 Final Documentation

At the completion of the work, the CQA Consultant will submit to the USEPA the signed final construction certification report. At a minimum, the report will include the following:

1. summaries of all construction activities and involved parties;
2. observation logs and test data sheets including sample location drawings, supporting field and laboratory test results, and effects of weather and equipment limitations on construction;
3. changes from design and material specifications;
4. record drawings (results of surveying);
5. notarized statement; and
6. Professional Engineer's Certification.

The record drawings will include scaled drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, drawing dimensions, elevations, and cover thickness).

Surveying required for development of the record drawings will be prepared by a qualified land surveyor.

4.2.4 Record Storage and Retention

Retention of records will be performed in accordance with Section Retention of records will be performed in accordance with Section XIII of the Consent Decree. PNA and Hull will preserve and retain all non-identical electronic or hard copy records that "relate in any manner to the Work or the liability of any person under CERCLA with respect to the Site" for a period of 10 years after receipt of USEPA's Certification of Completion of the Work, pursuant to Paragraph 76 of Section XIII. Records include reports, documents, and other information related to the implementation of the RD/RA.

Electronic files will be maintained on Hull's network. Hard copy documents will be maintained in a project-specific location. All records and reports will be retained in the physical project file located at a Hull & Associates, Inc. office at either 6397 Emerald Parkway, Suite 200, Dublin, Ohio 43016 during the active phase of the project. Once the project has been completed, the physical project file is archived off-site at Cintas Document Management (Cintas), located at 2500 Charter St., Columbus, OH 43228 until such time that Cintas is authorized by Hull to destroy the files. As required by paragraph 77 of the Consent Decree, PNA will provide the United States with notification at least 90 days prior to the destruction of hardcopy or electronic records required to be retained for the 10-year period after receipt of USEPA's Certification of Completion of the Work.

5.0 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

ARARs are designed to assure that the selected remedial alternative at the Site will be protective of human health and the environment. In accordance with the National Contingency Plan (NCP) and the Comprehensive Environmental Response Compensation Liability Act (CERCLA) Compliance with Other Laws Manual (1988), applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Section 121(d)(2)(A) of the CERCLA requires that federal standards, requirements, criteria or limitations that are determined to be legal ARARs must be met by the selected remedial alternative. CERCLA also requires that state ARARs (i.e., legal ARARs for the State of Illinois) must be met if the ARARs are more stringent than federal ARARs.

Because the remedy selected by IROD is an interim action, USEPA waived compliance with the chemical-specific ARAR [i.e., the Maximum Contaminant Level (MCL) for arsenic] in accordance with Section 121(d)(4)(A) of CERCLA, 42 U.S.C. §121(d)(4)(A). However, as noted in the IROD, the interim remedy requires compliance with location-specific ARARs, including: Occupational Safety and Health Administration (OSHA) worker protection standards; National Pollutant Discharge Elimination System (NPDES) permitting requirements for discharge to surface water; off-site MCLs; Water Quality Criteria(40 C.F.R. Part 131); General Use Water Quality Standard for Protection of Aquatic Life; Secondary Contact and Indigenous Aquatic Life Standard; Water Pollution, Pollution Control Board, Monitoring and Reporting; and Institutional Controls (ICs.) Table 2 summarizes the ARARs for the Surface Water Drainage Modifications, along with a description of how location-specific and activity-specific ARARs will be achieved for the interim remedy.

6.0 REFERENCES

USEPA. 2010. Interim Record of Decision Selected Remedial Alternative for the "Source Areas and Groundwater South of the Illinois River" Operable Unit (OU3) of the Ottawa Township Flat Glass Site.

TABLES

CONSTRUCTION QUALITY ASSURANCE PLAN
OTTAWA TOWNSHIP FLAT GLASS SITE
LASALLE COUNTY, ILLINOIS

TABLE 1

SUMMARY OF QA/QC ACTIVITIES FOR REMEDIAL ACTION CONSTRUCTION

Remedial Action Component	Test Standard	Test Description	Alternate/Additional QA/QC Criteria	Testing Frequency and Location	Acceptance or Rejection Criteria	Corrective Action
ADS (ST) Pipe System						
Trench Bottom	NA[a]	NA	Ensure trench is dewatered and base is stable by probing	Entirety of pipe installation trench	Work can proceed if trench is dry and stable.	If probing indicates unstable base, then areas will need to be undercut and replaced with suitable materials.
Bedding	AASHTO T27/ASTM C136	Sieve analysis	NA	NA	If bedding material meets specified project specifications it can be installed.	Obtain suitable material to meet project specifications, if needed.
Backfill	ASTM D 2487 (Classification) or AASHTO T27/ASTM C136 (Sieve analysis)	Classification of soils or sieve analysis of granular materials	Once laboratory tests conducted (AASHTO T99/ASTM D698), in place field testing with a nuclear gauge will be required	Field density and moisture content shall be determined with a nuclear densitometer at a frequency no less than one test for every 250 cubic yards, or fraction thereof, of compacted material, but in no case less than three per area.	Compaction of 95% for areas outside of roadways or parking areas and 100% for areas within roadways or parking areas	Remove material and rework existing material or obtain suitable material to meet project specifications
	AASHTO T99/ASTM D698	Test Methods for Moisture Density				
ADS (ST) pipe	NA	Deflection testing	Verify product data during shop drawing review	NA	Can be expected to perform satisfactorily when installed in accordance with Practice D 2321 and deflection is measured in not less than 30 days following completion of installation. Maximum limit of vertical deflection shall not exceed 5 % of the base inside diameter of the pipe	Identify areas that are non-conforming and re-excavate and replace the pipe
Precast concrete manholes	ASTM C1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test	Vacuum testing to be performed after installation via ASTM C1244	Verify precast manholes during shop drawing review	NA	Meet specified vacuum test per ASTM C1244	Rework structure in place or replace unit if unable to rework
Cast in place concrete						
Mix design	IDOT 1020	NA	Review mix design to ensure it satisfies specified compressive strength, water cement ratio and number of bags of cement per cubic yard.	NA	Meet specified compressive strength along with addition of admixtures	Rework mix design to align with project specifications
Reinforcing steel	IDOT 508	NA	Ensure product satisfies ASTM A 706 Grade 60, deformed	NA	Meet requirements of ASTM A 706 Grade 60, deformed	Obtain suitable material to meet project specifications
Cement	IDOT 1001 and AASHTO M85	NA	Verify cement during shop drawing review	NA	Meet requirements of IDOT 1001 and AASHTO M85	Obtain suitable material to meet project specifications
Admixtures			Verify admixtures during shop drawing review	NA		
Concrete	AASHTO T199/ASTM C143	Slump	NA	Test every truck	not exceed specified slump of 4 inches	Obtain suitable material to meet project specifications
	AASHTO T196/ASTM C173	Air	NA	Test every truck	fall within specified air range (5 - 8%)	Obtain suitable material to meet project specifications
	NA	Temperature	NA	Test every truck	maximum temperature of 95°F	Obtain suitable material to meet project specifications
	AASHTO T23/ASTM C31 and AASHTO T22/ASTM C39	Compressive strength tests	NA	One set of four standard cylinders for each compressive strength test, unless otherwise directed. One set for each day's pour exceeding 5 cy plus additional sets for each 50 cy more than the first 25 cy of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.	meet specified compressive strength (3,500 psi) at 28 days	Obtain suitable material to meet project specifications
AquaBlok© - Blended Barrier™						
Mix	NA	NA	Ensure the Blended Barrier™ is prepared by mixing 50% AquaBlok© #8 3070 FW with 50% AASHTO #8 by weight.	Obtain weigh tickets or other means of verifying the weight of each component used in each batch.	Fall within specified mixture range (±5%)	Obtain suitable mix to meet project specifications
Extent of Placement	NA	NA	Extent of Blended Barrier™ placement on each bank of the ditch shall be identified with survey grade stakes	Survey grade stakes to be set at intervals of 25' for the entire length of Blended Barrier™ placement	Grade stake elevations shall indicate project specified elevations of Blended Barrier™ placement	Set grade stakes at project specified elevations
Thickness	NA	NA	During Blended Barrier™ placement, the specified thickness will be documented by observing the thickness on the grade stakes in each direction.	Test entire area of Blended Barrier™ placement	Thickness shall meet the project requirements	If insufficient material has been placed, additional material shall be placed to meet project specifications. If excessive material has been placed, the excessive material shall be removed to meet project specifications.
Aggregate Cover	NA	NA	During placement of the AASHTO #57 aggregate, the specified thickness will be documented by observing the thickness on the grade stakes in each direction.	Test entire area of AASHTO #57 aggregate placement	Thickness shall meet the project requirements	If insufficient material has been placed, additional material shall be placed to meet project specifications. If excessive material has been placed, the excessive material shall be removed to meet project specifications without affecting the thickness of the Blended Barrier™
Hydrating	NA	NA	When hydrating Blended Barrier™, fresh water shall be applied at a rate of 1 gallon per square foot and shall be documented. Hydration shall not displace the Blended Barrier™ or aggregate cover.	Per 1,000 SF of hydrated area	Hydration shall fall within -20/+200% of specified rate per square foot of Blended Barrier™ area. Hydration shall not displace the Blended Barrier™ and aggregate cover in place.	No corrective action is required if excessive water is applied. If insufficient water is applied, additional water shall be applied to meet specifications. If Blended Barrier™ or aggregate cover is displaced, the displaced material shall be removed and re-installed according the procedures herein.

Notes:
a. NA - Not applicable.

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CONSTRUCTION QUALITY ASSURANCE PLAN
OTTAWA TOWNSHIP FLAT GLASS SITE
LASALLE COUNTY, ILLINOIS

TABLE 2

SUMMARY OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) FOR THE OPERABLE UNIT 3 SURFACE WATER DRAINAGE MODIFICATIONS

Name	Citation	ARAR Type: Action-Specific	ARAR Type: Location-Specific	Description	Notes
Water Quality Criteria	40 CFR Part 131	Y		Sets water quality criteria based on toxicity to aquatic organisms and human health.	The design of the system will not result in run-off to a water of the state of Illinois (i.e., Illinois River).
National Pollutant Discharge Elimination System (NPDES) Permit for Stormwater Runoff	40 CFR 122, 125	Y		Establishes permitting requirements, criteria and standards for technology-based treatment requirements of effluent discharge and stormwater runoff.	NA - The remedy does not include treatment or stormwater runoff from an industrial facility.
Particulate Matter National Ambient Air Quality Standard (NAAQS)	40 CFR Part 50.6	Y		Applicable to alternatives for which there may be potential release of particulate matter to ambient air during soil moving or material handling actions.	PM NAAQS do not apply to work at the facility. The contractor will employ industry standard dust suppression methods when necessary (e.g., water for dust suppression).
Ambient Air Monitoring Reference and Equivalent Methods	40 CFR 53	Y		Portion of regulation pertaining to PM10 is applicable to alternatives which may impact air quality due to either disturbing soils or handling materials.	The contractor will employ industry standard dust suppression methods when necessary (e.g., water for dust suppression).
Endangered Species Act of 1973 and Regulations	16 USAC 1531 50 CFR 200, 402		Y	Actions must not adversely impact endangered or threatened species or their habitats, but their presence must first be determined.	Fourteen potential Indiana Bat roosting trees were identified in the project area during the Preliminary Ecological Resource Assessment. It is anticipated that these trees will be avoided during implementation of the remedy. Additional detail regarding the potential bat habitat is located in the revised Ecological Resource Assessment.
USEPA Administered Permit Programs: The National Pollutant Discharge Elimination System	40 CFR 122.26	Y		Relevant to storm water runoff associated with construction activities on certain sized sites.	A notice of intent (NOI) to be covered under the general stormwater permit for construction activities under the State of Illinois. A Stormwater Pollution Prevention Plan (SWPPP) will be prepared.
Land Disposal Restrictions for Off-Site Disposal	40 CFR 268	Y		USEPA has concluded that soil and wastes can be consolidated onsite without triggering the Land Disposal regulations or other hazardous waste rules. If soil or wastes are disposed of off-Site the Land Disposal Restriction may apply if the other jurisdictional requirements of the land disposal regulations legally apply.	NA - No hazardous waste will be generated during implementation of the remedy.
Solid Waste Disposal Act, as amended - Regulated Levels for Toxic Characteristic Leaching Procedure (TCLP) Constituents	40 CFR 261	Y		Specifies TCLP constituent levels for identifying wastes that exhibit toxicity characteristics.	NA - hazardous materials will not be encountered during the remedial work.
OSHA --Hazardous Waste Operations and Emergency Response	29 CFR 1910	Y		Establishes health and safety requirements for clean up operations at contaminated sites.	Contractor is responsible for ensuring operations are consistent with all applicable OSHA guidelines and standards. Contractor is responsible for developing a site-specific Health and Safety Plan.
OSHA --Hazardous Waste Operations and Emergency Response	29 CFR 1926	Y		Specifies type of safety equipment and procedures to be followed during remediation.	Contractor is responsible for ensuring operations are consistent with all applicable OSHA guidelines and standards. Contractor is responsible for developing a site-specific Health and Safety Plan.

CONSTRUCTION QUALITY ASSURANCE PLAN
OTTAWA TOWNSHIP FLAT GLASS SITE
LASALLE COUNTY, ILLINOIS

TABLE 2

SUMMARY OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) FOR THE OPERABLE UNIT 3 SURFACE WATER DRAINAGE MODIFICATIONS

Name	Citation	ARAR Type: Action-Specific	ARAR Type: Location-Specific	Description	Notes
General Use Water Quality Standard for Protection of Aquatic Life: Chronic	35 IAC 302.201	Y		General use water quality standards must be met in waters of the state for which there is no specific designation. General use standards will protect the state's aquatic life, wildlife, agricultural use, secondary contact use and most industrial uses and ensures aesthetic quality of the state's aquatic environment. Groundwater is not required to meet the general use standards.	The remedy does not result in discharge to the Illinois River.
Secondary Contact and Indigenous Aquatic Life Standard	35 IAC 302.401	Y		Standards represent secondary contact and indigenous aquatic life standards. These standards must only be met by certain waters specifically designated in 35 IAC 303. The general use, public and food processing standards do not apply to waters designated for secondary contact and indigenous aquatic life.	The remedy does not result in discharge to the Illinois River.
Air Quality Standards	35 IAC 243	Y		Ambient air quality standards to be maintained at all times.	The contractor will employ industry standard dust suppression methods when necessary (e.g., water for dust suppression).
Institutional Controls	35 IAC 742	Y		Specifies requirements related to establishing institutional controls.	A detailed discussion of institutional controls is included in the Institutional Control Implementation and Assurance Plan (ICIAP), submitted under separate cover.
Land Disposal Restrictions	35 IAC 728	Y		Specifies hazardous wastes prohibited from land disposal. Also specifies administrative requirements for disposal.	NA - Hazardous waste will not be generated during implementation of the remedy.
Special Waste Classification	35 IAC 808	Y		Specifies declassified wastes that are not subject to 35 IAC 809	NA - Special waste will not be generated during implementation of the remedy.
Standards and Specifications for Soil Erosion and Sediment Control	IEPA/WPC/87-012	Y		Provides standards and specifications for design and construction of erosion control measures.	A SWPPP will be completed for the project.

FIGURES

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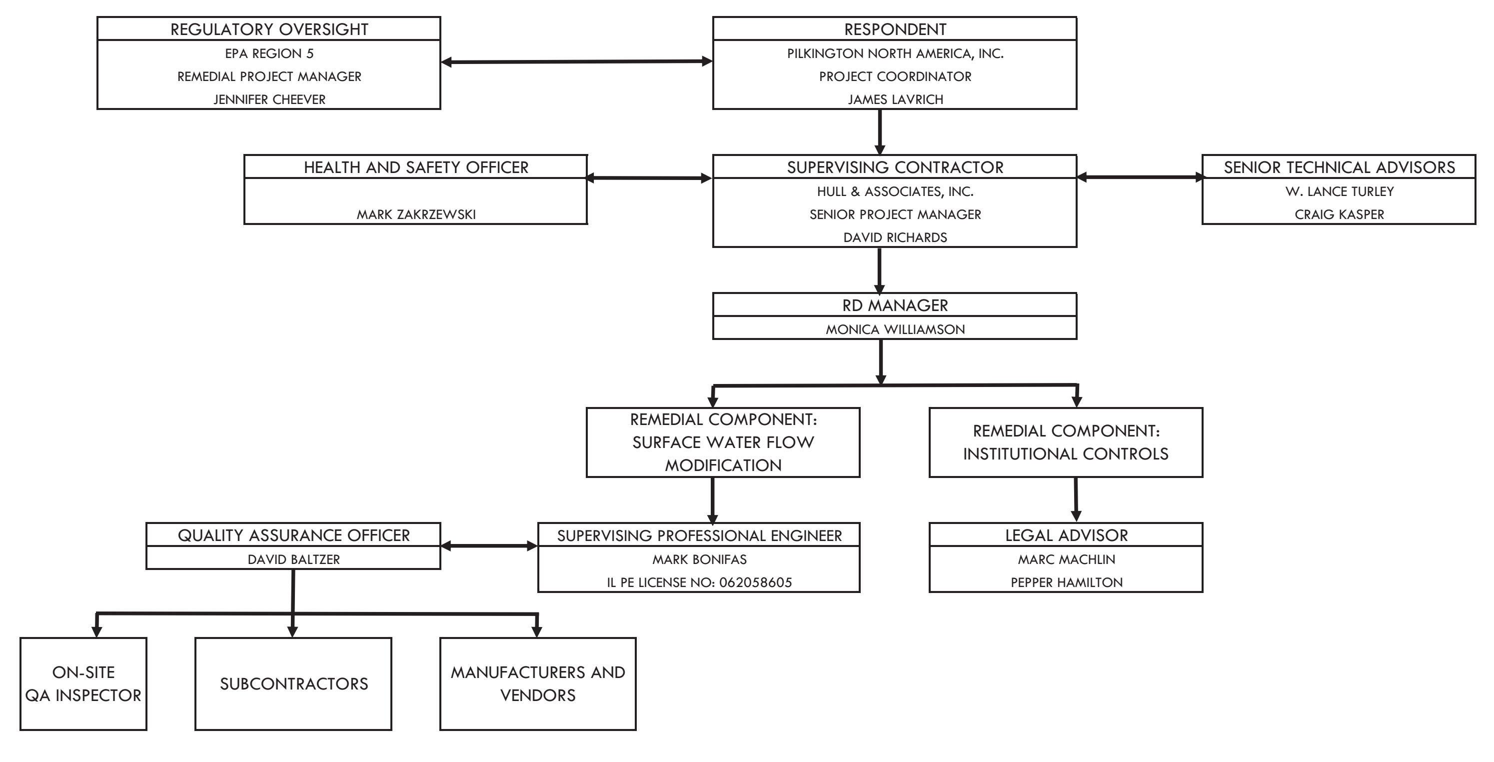

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CONSTRUCTION QUALITY ASSURANCE PLAN FOR SURFACE WATER DRAINAGE MODIFICATIONS
OTTAWA TOWNSHIP FLAT GLASS SITE OPERABLE UNIT 3 (OU3)

ORGANIZATIONAL CHART

OTTAWA TOWNSHIP
LASALLE COUNTY, ILLINOIS

August-14

Project Number: PNA103
File Name:
PNA103.300.0080.xlsx

United States vs. Pilkington North America, Inc.

APPENDIX B TO REMEDIAL ACTION CONSENT DECREE

Interim Record of Decision/Selected Remedial Alternative for the "Source Areas and Groundwater South of the Illinois River" Operable Unit 3 (OU3), dated September 2010

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

INTERIM RECORD OF DECISION

Ottawa Township Flat Glass Superfund Site
La Salle County, Illinois

Selected Remedial Alternative for the "Source Areas and Groundwater South of the Illinois River" Operable Unit (OU 3)

September 2010

Cover photo credit: Pilkington North America, Inc. (Hull and Associates, Inc.)

This aerial photo shows the northern portion of the Ottawa Township Flat Glass site, formerly known as the "Libbey-Owens-Ford (LOF) Plants 5 & 7" site, in La Salle County, Illinois. North is at the top of the frame. The flat glass manufacturing facility, now owned by Pilkington North America, Inc. (PNA), is located in the center of the image (PNA-owned property is outlined in red). The Village of Naplate is located immediately north of the plant. U.S. Silica's sand quarries can be seen to the west and north of the facility and the Illinois River is south of the plant. A site feature known as the "Original Sand Pond" (OSP) is shown outlined in yellow on the PNA property. The OSP is an area where flat glass manufacturing process wastes containing arsenic were stored and/or disposed of by LOF and other past site operators prior to 1970.

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DECLARATION

Selected Remedial Alternative for the
"Source Areas and Groundwater South of the Illinois River" Operable Unit (OU 3)

Site Name and Location

Ottawa Township Flat Glass (OTFG) site, La Salle County, Illinois

CERCLIS identification number: ILD005468616

The "Source Areas and Groundwater South of Illinois River" operable unit (OU) is the third of four operable units at the OTFG site.

The OTFG site is also known as the "Libbey-Owens-Ford Plants 5&7" site.

Statement of Basis and Purpose

This decision document presents the selected interim remedial action for the "Source Areas and Groundwater South of the Illinois River" operable unit (OU 3) of the OTFG site in La Salle County, Illinois. The U.S. Environmental Protection Agency (EPA) [1] chose the remedy in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan. This decision is based on the Administrative Record for the OTFG site.

Assessment of the Site

The response action selected in this Interim Record of Decision (ROD) is necessary to protect the public health or welfare or the environment from the actual or threatened release of hazardous substances, pollutants, or contaminants into the environment.

Description of the Selected Remedy

EPA selects the following interim remedial action tasks for OU 3 of the OTFG site:

- Conduct drainage pathway modifications around Quarry 1 and Quarry 2 to redirect storm water flow away from the quarries;
- Place institutional controls on certain area properties to prevent future redevelopment for residential use and/or to prevent future potable use of contaminated groundwater;

[1] See State Concurrence section, below.

- Provide municipal water to properties with private wells penetrating the contaminated portion of the St. Peter Sandstone aquifer (and provide delivered bottled water until the municipal water line extension is complete); and
- Monitor groundwater quality over time.

Note: This ROD does not address the "Source Areas and Groundwater North of the Illinois River" operable unit (OU 4) of the OTFG site, nor is it a final remedy for OU 3. EPA will address OU 4 and finalize the remedy for OU 3 in a subsequent ROD for the OTFG site.

Future Use Considerations

Implementation of the selected interim remedial action will require use-restrictions (in the form of institutional controls) to be placed on certain area properties, which will restrict the future use of arsenic-contaminated groundwater as a potential drinking water source and/or prevent the redevelopment of the land for residential use. The use-restrictions will likely remain for a long period of time. Thus, the interim remedial action will not allow for unlimited use or unlimited exposure at OU 3.

Statutory Determinations

EPA has determined that for OU 3, an interim remedial action is necessary to protect public health or welfare or the environment until a final cleanup approach is selected. This interim action: is protective of human health and the environment in the short term and is intended to provide adequate protection until a final ROD is signed; complies with or waives those federal and state requirements that are applicable or relevant and appropriate for this limited-scope action; and is cost effective.

This action is an interim solution only, and is not intended to utilize permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable for OU 3. Because this action does not constitute the final remedy for OU 3, the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal component will be fully addressed by the final response action. Subsequent actions will fully address the potential health threats posed by the site.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, EPA will conduct a review to ensure that the remedy continues to provide adequate protection of human health and the environment every five years after commencement of the remedial action. Because this is an Interim ROD, review of this site and remedy will be ongoing as EPA continues to develop remedial alternatives for the remaining contamination on-site.

ROD Data Certification Checklist

EPA has included the following information in the Decision Summary section of this Interim ROD; more detailed site information is included in the Administrative Record for OU 3 (see page viii):

- The chemical of concern (see page 17);
- Baseline risks represented by the chemical of concern (see pages 22-23);
- Cleanup level established for the chemical of concern and the basis for this level (see page 24);
- How source materials constituting principal threats are addressed (see page 34);
- Potential land use that will be available at the site as a result of the selected remedy (see page 16);
- Estimated capital and operation and maintenance costs for the remedy, including present worth and discount rates (see page 36); and
- Key factor(s) that led to selection of the interim remedial action for OU 3 (see page 32-33).

State Concurrence

EPA provided Illinois EPA an opportunity to participate at the OTFG site and sought the State's concurrence on this Interim ROD. Illinois EPA has not established a formal position regarding the remedy set forth in this Interim ROD.

Approved by: Richard C Karl 9-29-10

Richard C. Karl
Director
Superfund Division

Date

U.S. ENVIRONMENTAL PROTECTION AGENCY

ADMINISTRATIVE RECORD
FOR
OTTAWA TOWNSHIP FLAT GLASS SITE
OPERABLE UNIT 3 - SOURCE AREAS AND GROUNDWATER SOUTH OF THE ILLINOIS RIVER
NAPLATE, LASALLE COUNTY, ILLINOIS

AUGUST 31, 2010

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION
1	04/00/08	Hull & Associates, Inc.	Pilkington North America, Inc.	Work Plan for Residential Soils Excavation Operable Unit 1 for the Ottawa Township Flat Glass Site
2	06/06/08	Karl, R., U.S. EPA	Fleener, C., Pilkington North America, Inc.	Letter re: U.S. EPA's Approval of RI Reports for Residential Soils and Illinois River Sediment Operable Units and of the Work Plan for Residential Soils Excavation for the Ottawa Township Flat Glass Site
3	08/00/08	Hull & Associates, Inc.	Pilkington North America, Inc.	Remedial Investigation and Baseline Human Health and Ecological Risk Assessment of Operable
Units 3				& 4 for the Ottawa Town-ship Flat Glass Site
4	12/00/08	Hull & Associates, Inc.	Pilkington North America Inc.	Summary Report for Resi-dential Soils Excavation Operable Unit 1 for the Ottawa Township Flat Glass Site
5	06/00/09	Hull & Associates, Inc.	Pilkington North America, Inc.	Feasibility Study for Operable Unit 3: Source Areas and Groundwater South Side for the Ottawa Township Flat Glass Site
6	08/00/09	U.S. EPA	Public	Proposed Plan Fact Sheet: Interim Clean Up for Polluted Undergroundwater Supply

7	09/15/09	Fleener, C., Pilkington North America, Inc.	Adler, K., U.S. EPA	Letter re: comments to U.S. EPA Record of Decision for Operable Unit 3 at the Ottawa Township Flat Glass site
8	09/23/09	Albarracin, R., IL EPA	U.S EPA	Letter re: ARARs Review on on Feasibility Study for Operable Unit 3: Source Areas and groundwater - South Side

ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
CDI	Chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CFR	Code of Federal Regulations
COC	Chemical of concern
COPC	Chemical of potential concern
CTE	Central tendency exposure
ELCR	Excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
HHRA	Human health risk assessment
HI	Hazard Index
IC	Institutional control
IAC	Illinois Administrative Code
Illinois EPA	Illinois Environmental Protection Agency
IRIS	Integrated Risk Information System
L	Liter
LOF	Libbey-Owens-Ford
MCL	Maximum contaminant level
mg/kg	Milligrams per kilogram (parts per million)
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
OTFG	Ottawa Township Flat Glass site
OU	Operable unit
PNA	Pilkington North America, Inc.
POTW	Publicly-owned treatment works
ppb	Parts per billion (µg/kg or µg/L)
ppm	Parts per million (mg/kg or mg/L)
PRP	Potentially responsible party
RAO	Remedial action objective
RCRA	Resource Conservation and Recovery Act
RfD	Reference dose
RI	Remedial Investigation
RME	Reasonable maximum exposure
ROD	Record of Decision
SF	Slope factor
TACO	Tiered Approach to Cleanup Objectives (Illinois Administrative Code)
UE	Unlimited exposure
USACE	United States Army Corps of Engineers
UU	Unlimited use
µg/kg	Micrograms per kilogram (parts per billion)
µg/L	Micrograms per liter (parts per billion)
yd^3	Cubic yards

DECISION SUMMARY

"Source Areas and Groundwater South of the Illinois River" Operable Unit (OU 3) of the

Ottawa Township Flat Glass Site
La Salle County, Illinois

I. Site Location and Description

The Ottawa Township Flat Glass (OTFG) site is located in and around the Village of Naplate, in La Salle County, Illinois, about 60 miles southwest of downtown Chicago. The OTFG site is owned by Pilkington North American, Inc. (PNA); it is also known as the "Libbey-Owens-Ford Plants 5&7" site. The site includes PNA parcels on the north and south sides of the Illinois River, but does not include the areas used for manufacturing, manufacturing support and other operations or the undeveloped land designated as Parcels 4 and 5 (see Figure 4).

Figure 1: Site location map

The OTFG site CERCLIS identification number is ILD005468616.

Figure 2: Aerial view of the northern portion of the OTFG site. The red line denotes the glass manufacturing facility property boundaries and the yellow outlines the "Original Sand Pond" (see text). Naplate residential areas are at the top of the frame and the Illinois River is at the lower right.

The LOF glass manufacturing plant has been making flat glass products in Naplate, Illinois since about 1908. Arsenic trioxide was a minor ingredient in the manufacturing process from 1908 until 1970, when its use was discontinued. The final step in the flat glass manufacturing process involved grinding and polishing (G&P) the raw surfaces of the cast glass with fine silica sand and water. The process generated waste in the form of a slurry (G&P slurry) consisting of mostly sand, water, and glass particles containing arsenic. LOF discharged the G&P slurry into the nearby former quarries and other areas such as the "Original Sand Pond" (see Figure 2) for settling of solids and discharge of overflow water into the Illinois River. The G&P slurry in the settling areas contains appreciable levels of arsenic and is the primary source of arsenic at the site.

The U.S. Environmental Protection Agency (EPA) is the lead agency and the Illinois Environmental Protection Agency (Illinois EPA) is the support agency at the OTFG site. The site is a potentially responsible party (PRP)-lead site; to date, the PRP, PNA, has performed a time critical removal action, a remedial investigation and baseline human health and ecological risk assessments under EPA oversight. In addition, the PRP has conducted a feasibility study for potential groundwater cleanup actions.

EPA has divided the OTFG site into four portions, called "operable units" (OUs), for ease of investigating and addressing site contaminant levels and potential health risks. The four OUs are: "Residential Soils" (OU 1), "Illinois River Sediment" (OU 2), "Source Areas and Groundwater South of the Illinois River" (OU 3), and "Source Areas and Groundwater North of the Illinois River" (OU 4). This Interim Record of Decision (ROD) pertains only to OU 3 (Source Areas and Groundwater South of the Illinois River).

II. Site History and Enforcement Activities

A. Site History

The Federal Plate Glass Company built and began operating the glass manufacturing facility in 1908. The next owner, National Plate Glass (for which the Village of Naplate is named), bought the facility in 1921. National Plate Glass had become a subsidiary of Fisher Body in 1920 and Fisher Body, in turn, became a wholly-owned subsidiary of General Motors Corporation in 1926. National Plate Glass sold the Naplate glass plant to the Libbey-Owens-Ford (LOF) Company of Toledo, Ohio, in 1931.

From 1908 to 1970, the facility's glass-making recipe contained less than one percent arsenic (as arsenic trioxide) to reduce discoloration caused by trace amounts of iron in the melt. The final step in the flat glass manufacturing process involved grinding and polishing the raw glass surfaces with fine silica sand and water. The process generated waste in the form of a slurry consisting of mostly sand, water and glass particles containing arsenic. The G&P slurry was discharged into nearby former silica sand quarries and other areas (termed "sand ponds") for settling of solids and discharge of the decanted waters into the Illinois River. In 1970, the facility converted over to the recently invented Pilkington "float glass" manufacturing method to make its flat glass products. The float method did not require the use of arsenic or a grinding and polishing step; thus, the discharge of arsenic-containing G&P slurry material into sand ponds was discontinued.

PNA purchased the glass manufacturing facility from LOF in 1986, about 16 years after the use of arsenic in the glass-making process was discontinued, and still operates it today.

B. Enforcement

Illinois EPA managed the initial OTFG site investigations from the mid-1980s until 1999 when it referred the site to EPA. EPA has managed the site in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund), as amended by the Superfund Amendments and Reauthorization Act of 1986, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). In September 2001, EPA reached an agreement with PNA, the current site owner, whereby the OTFG site would be handled as a Superfund Alternative Site, or as if it were listed on the Superfund National Priorities List (NPL) even though it did not go through the formal

NPL site-listing process. EPA and PNA also signed an Administrative Order on Consent (AOC) in September 2001, under which PNA agreed to conduct a remedial investigation and feasibility study at the site under EPA oversight. PNA has been conducting remedial investigation activities at the OTFG site in accordance with the AOC to determine the nature and extent of (arsenic) contamination in area groundwater, surface water, soil and sediment.

C. Previous Site Cleanup Actions

The "Residential Soils" operable unit (OU 1) is located in the Village of Naplate. PNA conducted soil sampling in several Naplate residential areas in late 2002 and discovered elevated levels of arsenic in shallow (0 to 6 inches) and deep (greater than 12 inches) sampling points on two residential lots located close to the factory. Soil arsenic levels were found to be as high as 44,800 milligrams per kilogram (mg/kg or "parts per million" or "ppm") on parts of these lots. EPA's removal action trigger point for arsenic levels in residential soil is about 100 ppm. PNA later determined that fill material containing G&P slurry solids had been taken from the facility and used to fill in low spots so that a home could be built on one of the lots.

Under the terms of the AOC, PNA conducted a time-critical removal action at the two residences. In December 2003, PNA began digging up soil and G&P slurry material that contained arsenic levels generally above about 20-40 ppm instead of the 100 ppm trigger value. The lower value was used as the target cleanup level because PNA reasoned that a potential future remedial action at the site might need to achieve a lower cleanup standard than 100 ppm; therefore, it would be more cost effective to complete a single cleanup action rather than potentially having to come back and re-open the excavations to complete a second cleanup action.

Under EPA oversight, PNA excavated a total of 3,325 cubic yards of soil and G&P slurry material from the two lots and disposed of it in an off-site landfill. While this work was being done, the residents of the two homes were temporarily relocated to a local hotel. After sampling the edges and bottoms of the excavations to confirm that all impacted soils had been removed, PNA placed clean soil backfill into the excavations and reseeded the lots. The removal action was completed in June 2004. The homes were also found to have above-normal levels of arsenic-laden dust inside and PNA conducted a cleanup inside the homes to reduce the interior arsenic levels to safe levels.

From 2003 through 2005, PNA measured soil arsenic levels at a total of 210 residential or commercial properties in Naplate (over 90 percent of the village) by taking five soil samples from each yard. The majority of the village properties were found to have an average arsenic level at or below the average naturally occurring soil arsenic level (11 ppm) for rural counties in Illinois. EPA issued a ROD in September 2008 (see Section IV) that called for no further cleanup action at OU 1 because the estimated human health risk due to arsenic levels measured in the soils did not exceed EPA's target risk range. Meanwhile, PNA noted that eight of the residential properties (of the total 210 tested) had a single soil sample that had an arsenic test result above 50 ppm. The slightly higher arsenic readings resulted in a slightly higher average arsenic level in the soil at these properties than at the remainder of the properties in the village. Although not deemed harmful by EPA, PNA excavated these eight properties to remove the 50 ppm arsenic "hot spots," thereby bringing the average soil arsenic levels on these eight properties in line with those of the rest of the village. PNA completed this last residential soil cleanup effort in October 2008.

III. Community Participation

EPA, in consultation with Illinois EPA, issued a proposed plan fact sheet for OU 3 of the OTFG site to the public for review and comment in August 2009. EPA placed the proposed plan and other site documents into the Administrative Record file and the information repository maintained at EPA's Records Center (U.S. EPA Region 5, 77 W. Jackson Blvd., Chicago, IL) and at the Reddick Library (1010 Canal St., Ottawa, IL). EPA also placed a notice of the availability of the proposed plan and other documents in the *Ottawa Times*, an area newspaper of wide circulation, in August 2009.

EPA opened a public comment period on the proposed plan from August 19, 2009, to September 18, 2009. EPA held a public meeting on August 26, 2009, at the La Salle County Government complex in Ottawa, Illinois, to present the proposed plan and take public comment. EPA and Illinois EPA answered questions at the meeting about the actual or potential health risks posed by arsenic at the site and why the agencies believe that Modified Alternative 4 is the appropriate response action for OU 3. EPA's response to the public comment it received during the comment period is included in the Responsiveness Summary section of this interim ROD.

IV. Scope and Role of the Operable Units

As described in Section I, above, EPA divided the OTFG site into four operable units for ease of investigating and addressing site contaminant levels and potential health risks.

The response action taken at OU 1 under EPA's CERCLA removal authority removed arsenic-contaminated soil from the residential area, leaving residual arsenic levels in the soil at or below general background levels for rural counties in Illinois. EPA found that no further response activity was necessary to protect human health or the environment at OU 1. Additionally, EPA found that no response activity is necessary to protect human health or the environment at OU 2. Thus, EPA, with Illinois EPA concurrence, issued a ROD in September 2008 that selected the "No Action" alternative for both OU 1 and OU 2. EPA plans no further cleanup activity at either of these two operable units.

This Interim ROD addresses the third operable unit – "Source Areas and Groundwater South of the Illinois River." In addition to implementing this Interim ROD, EPA will continue to evaluate conditions in OU 3 so that it can propose for public comment a final response action for OU 3 when appropriate.

EPA and Illinois EPA are beginning to evaluate potential response actions for OU 4. The response actions will address the arsenic contamination in the upper aquifer beneath the site and the potential sources of arsenic in the former settling ponds. As in OU 3, ingestion of water contaminated with arsenic could pose a current and potential future risk to human health because EPA's acceptable risk range is exceeded and the concentration of arsenic is greater than the maximum contaminant level (MCL) for drinking water (as specified under the Safe Drinking Water Act). The response actions for OU 4, as well as the final response action for OU 3, would represent the final response actions for this site.

Note: The operable units do not address conditions inside the plant buildings or the buildings themselves because the plant is an operating facility regulated under the Solid Waste Disposal Act (also known as the Resource Conservation and Recovery Act).

V. Site Characteristics and Investigation Results

The OTFG site is situated on both sides of the Illinois River near Ottawa, Illinois. The north side property is 228 acres area and contains a glass manufacturing facility ("Plant #5" (active) and "Plant #7" (currently inactive)), plus former silica sand quarries, wastewater disposal areas and a 56-acre undeveloped parcel of land. The "Residential Soils" (OU 1) and "Source Areas and Groundwater North of the Illinois River" (OU 4) operable units are located on the north side of the river. (OU 2 is the "Illinois River Sediment" operable unit.) OU 3, "Source Areas and Groundwater South of the Illinois River," is on the south side of the river and consists of a 122-acre parcel containing four former silica sand quarries ("Quarry 1," "Quarry 2," etc.) located due east of the manufacturing facility (see Figure 3). The 56-acre undeveloped parcel, Parcel 4, is located in the northeast corner of the property and has been called the "old golf course." It is unknown if this parcel was ever used as a golf course. An additional undeveloped parcel, Parcel 5, is located in the southeast corner of the Village of Naplate. This parcel is 0.97 acres and was never sold or developed as residential property (see Figure 4).

As recounted above, from 1908 through 1970, the facility's glass-making formula contained one percent or less arsenic to reduce discoloration caused by trace amounts of iron in the melt. The final step in the manufacturing process involved grinding and polishing the cast glass with fine silica sand and water. The process generated G&P slurry waste, mostly consisting of silica sand, glass particles containing arsenic and water. LOF discharged G&P slurry into Quarry 1 from about 1954 until March 1970 and pumped clarified water from the quarry into the Illinois River. In 1970, LOF covered the eastern two-thirds of Quarry 1 with about 1,700 tons of sludge from the City of Chicago's publicly owned treatment works (POTWs) and covered the remaining one-third with topsoil from the site.

A prominent ridge runs along the southeastern property boundary of OU 3, roughly paralleling the Illinois River. The top of the ridge is about 60 feet above the quarries, where the land surface is about 30 feet above the river water level. The depth of the Illinois River adjacent to OU 3 is 18 to 20 feet.

Figure 3: Site features

Figure 4: Parcels 4 and 5

Surrounding the OU 3 property are residential areas, both incorporated (South Ottawa) and unincorporated. To the southwest along the river and below the bluff are several properties on private wells. To the southeast and above the bluff are the 4-H fairgrounds and further east is a subdivision that is on municipal water. The 4-H facility has a private well that serves the fairgrounds. Historically, about six wells in the unincorporated area have been impacted by arsenic contamination in the groundwater, as well as the well on the 4-H fairgrounds. A June 2010 sampling event found two residential wells and one business well in the unincorporated area impacted by arsenic groundwater contamination. The Cargill grain terminal just west of Quarry 3 on the river is on a private well, drilled into an unaffected aquifer.

A. Hydrogeology

There are two groundwater aquifers of immediate concern below OU 3. The upper aquifer, the St. Peter Sandstone, is a regional unconfined aquifer that averages 150 feet in thickness below the site. The St. Peter Sandstone is a massive, fine to medium-grained, well sorted, white quartz sandstone formation. Upper portions of the aquifer are friable (crumbles easily), while at depth, the sandstone is well-cemented with limestone and silica cements. Locally, groundwater flow in the upper portion of the aquifer generally discharges into the Illinois River while in the middle and lower portions of the formation groundwater flow is under the river towards the northwest. Previous wastewater discharge into Quarry 2 created a groundwater mounding effect, which may have caused the arsenic plume to expand to the east near the residential areas. The mounding effect should wane now that discharge to Quarry 2 has stopped.

The lower aquifer, the New Richmond Sandstone, is about 100 feet thick and is used locally for industrial and municipal water supplies. Both aquifers contain naturally occurring levels of radium above the MCL.

Between the two aquifers lies the Shakopee Dolomite, a 150-200 foot thick aquitard that forms an effective barrier between the St. Peter and New Richmond Sandstones. The Shakopee Dolomite unit is generally encountered at about 180 feet below ground surface and the top of the formation is marked by a 3- to 7-foot soft shale deposit. Figure 5 presents the generalized stratigraphy in the vicinity of the site. Figure 6 depicts the groundwater elevations in the vicinity of the site, including OU 3.

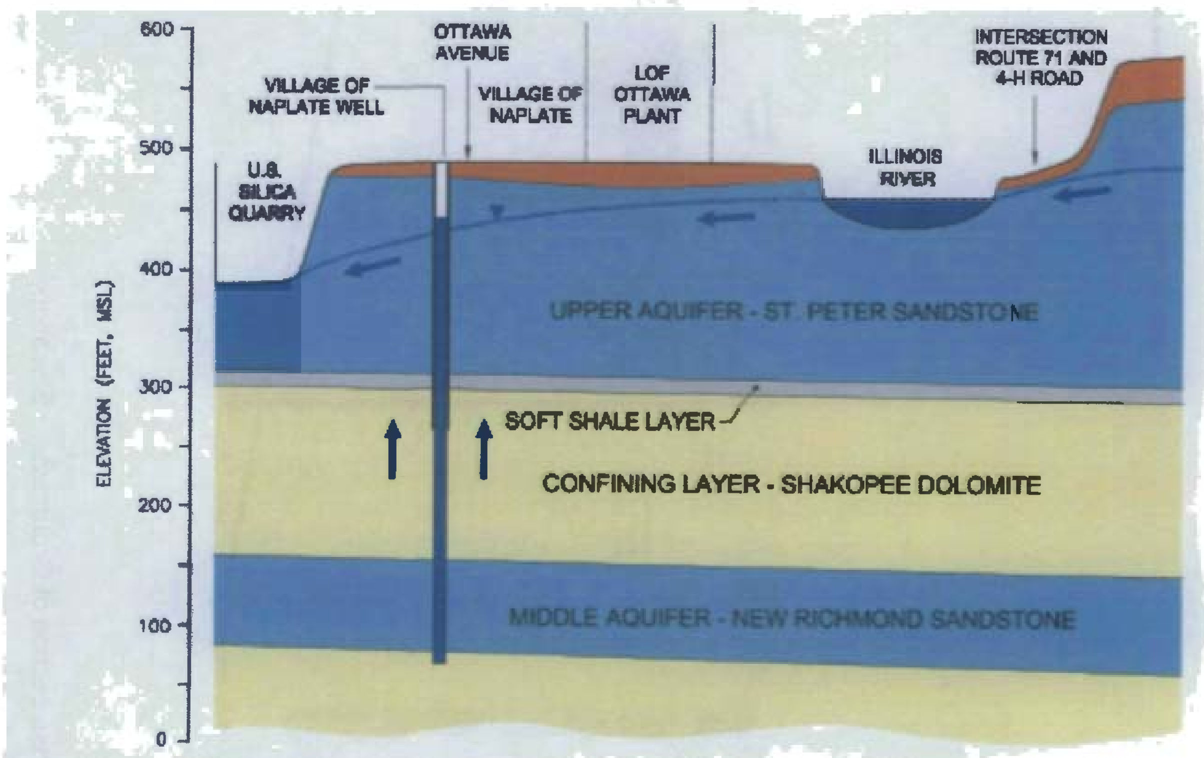

Figure 5: Stratigraphy in the Naplate area.

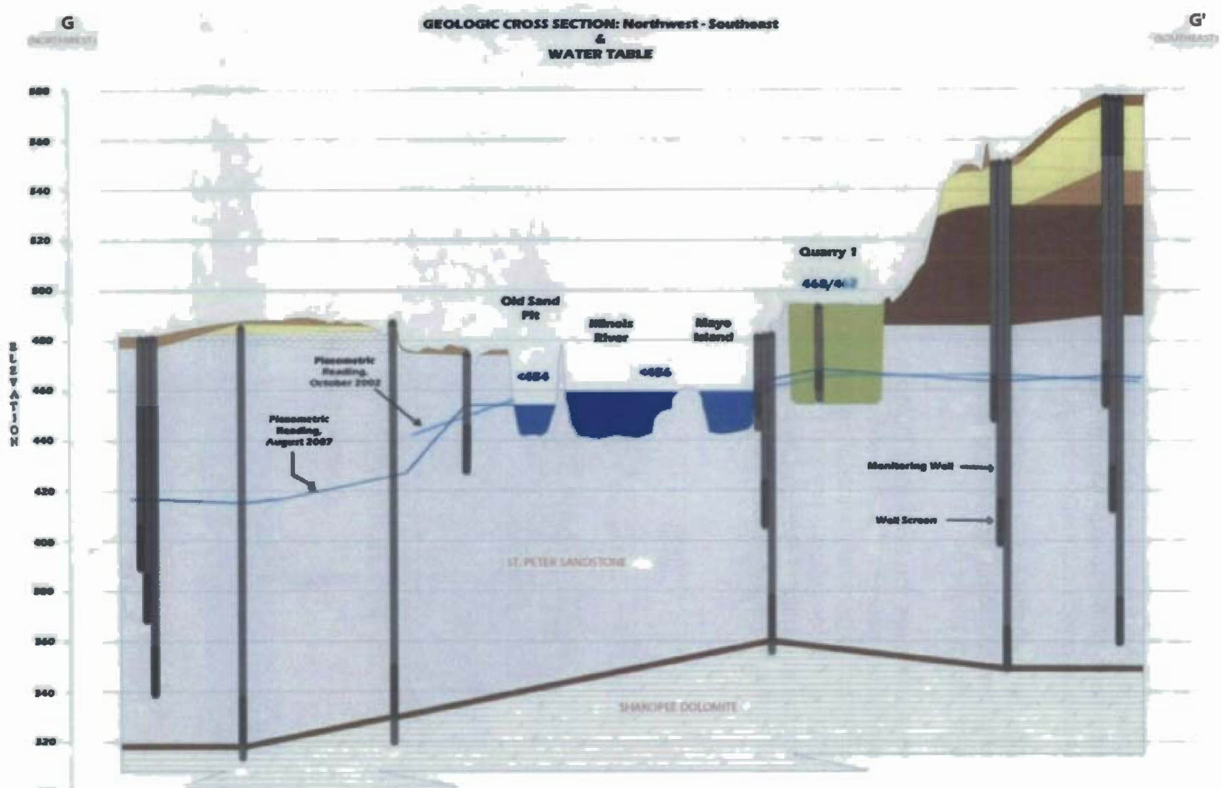

Figure 6: Cross-section of Groundwater Elevation

B. Conceptual Site Model

EPA's conceptual site model (see Figure 7) for OU 3 demonstrates that the G&P slurry in Quarry 1 and, to a lesser extent, Quarry 3 is the major source of arsenic contamination in the groundwater beneath the site, leading to potential human exposure by ingestion or dermal contact from potable uses such as drinking, cooking or bathing. Surface water in the remaining three quarries could also be impacted by arsenic derived from the G&P slurry in Quarry 1 and Quarry 3, which could lead to human and ecological receptor exposure by ingestion or dermal contact. The natural background concentration of arsenic in area soils is an insignificant source of arsenic contamination at OU 3.

Based on the conceptual site model, the remedial investigation focused on answering the question of whether unsafe levels of arsenic were released from the G&P slurry in Quarry 1 into the area soil, sediment, groundwater and surface water. In addition, the investigation focused on whether arsenic was discharging into the Illinois River due to contaminated groundwater infiltration from OU 3. Therefore, OU 3 area soil, sediment, surface water and groundwater were sampled and tested for contaminant levels. Based on the groundwater sampling results, calculations were run to determine whether arsenic levels in the groundwater could adversely impact Illinois River water quality. Water column sampling results were also available to be evaluated for a stretch of river a few miles upstream (to determine background conditions) and a few miles downstream of the site to determine impacts, if any, to river water quality.

1. Source Areas

The four quarries were investigated as potential contaminant source areas due to the placement of G&P slurry into Quarry 1 and the management of clarified water and other plant wastewaters in the remaining three quarries. Soil, sediment and surface water samples were taken to determine the nature and extent of arsenic contamination. (Groundwater results are discussed separately.)

Quarry 1

Quarry 1 is about 33 acres in size and contains between 35 and 45 feet of fill material consisting of G&P slurry. Surface soils were sampled on Quarry 1 at four locations and arsenic concentrations ranged from 6.5 ppm to 20 ppm. These levels are the same as those found in the residential soils of the Village of Naplate and are similar to background concentrations. A literature search revealed a range of 1 ppm to 24 ppm for reported statewide naturally occurring or background arsenic values in soil. Site-specifically, Parcel 4, the 56-acre open parcel of land adjacent to the "Old Sand Quarry" (see Figures 3 and 4) was selected as an area potentially not impacted by arsenic contamination and thus a source of background samples for the site. This parcel reportedly was used as a golf course in the past, although it is not in use today. PNA took 23 soil borings from this area for arsenic analysis. Results ranged from 1.5 ppm to 8.7 ppm, confirming that the 56-acre parcel is not impacted by potential arsenic

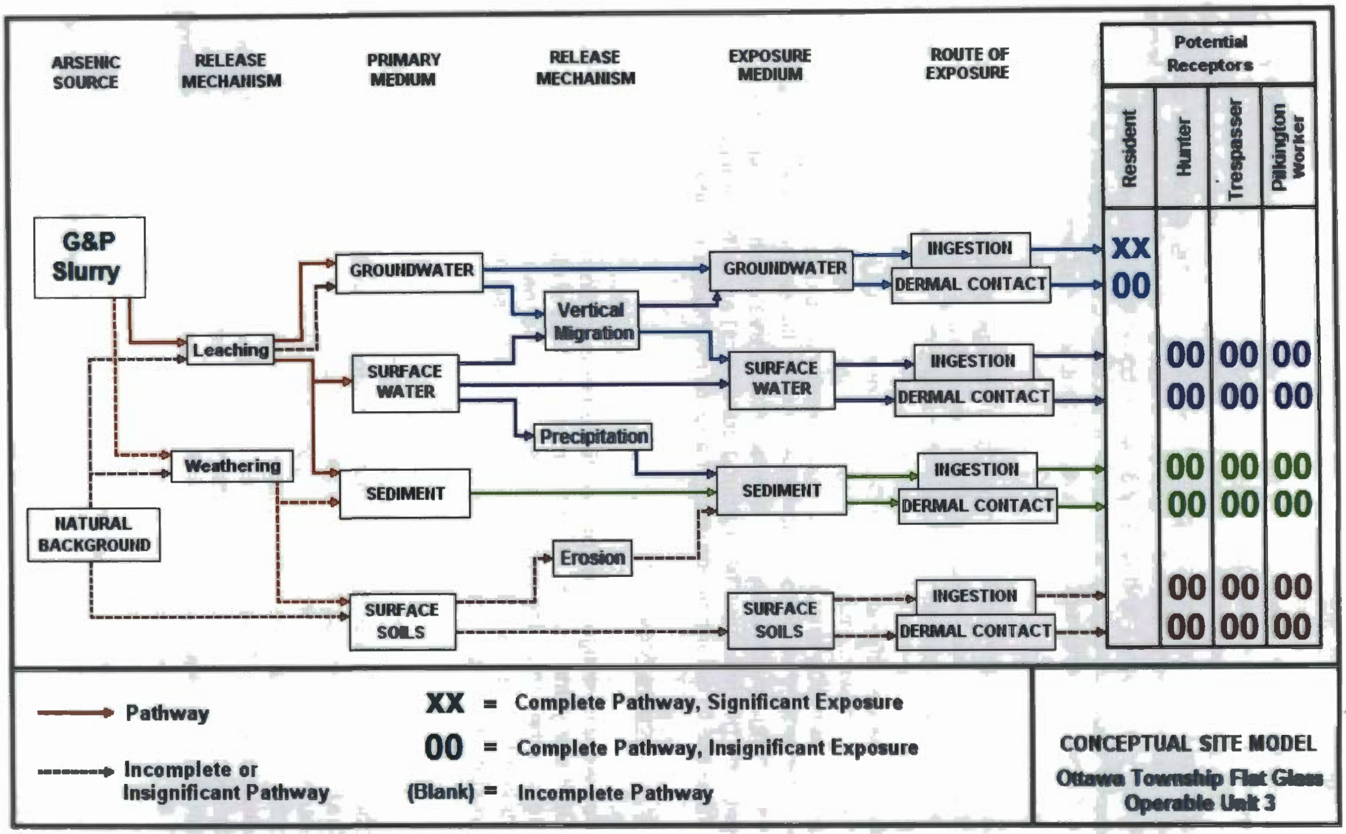

Figure 7: Conceptual Site Model for the "Source Areas and Groundwater South of the Illinois River" Operable Unit. Ecological receptors are not depicted in this figure. They will be included in the final remedy document.

releases from the plant. The calculated 95 percent upper confidence limit value was 9.8 ppm for this data set, meaning that the site-specific background arsenic level is considered to be 9.8 ppm. The state's published background level is 11 mg/kg (ppm).[2]

There are an estimated 2 million cubic yards of G&P slurry in Quarry 1. Two soil borings were advanced through the fill material until bedrock was reached at about 45 feet below ground surface. Arsenic concentrations in the G&P slurry material ranged from 16.7 ppm to 259 ppm, with higher concentrations at depth. PNA conducted a synthetic precipitation leaching procedure analysis on the G&P slurry material and found that the material would leach arsenic into solution. Based on water level measurements taken in wells screened in the St. Peter Sandstone around the quarry, about 30 percent of the G&P slurry sits in the water table.

Quarry 2

Quarry 2 is about 4 acres in size and contains open water at depths ranging from 1 foot to 12 feet. Until March 2006, PNA pumped wastewater across the Illinois River and discharged it into a ditch that originates at the southwestern end of Quarry 1. The ditch runs along the southern edge of Quarry 1 and discharges directly into Quarry 2. Sampling results showed that there was no G&P slurry in Quarry 2.

The surface water in Quarry 2 was sampled at three discrete depths at a single sampling point. Arsenic levels ranged from 25 ppb to 28 ppb. Surface water in the ditch was also measured. Here, arsenic was measured at 31 ppb and 33 ppb for the two samples collected.

Sediment in the ditch was measured at 25 ppm and 26 ppm arsenic for the two samples collected. Sediment in Quarry 2 was measured at a range of 9 ppm to 53 ppm for 10 samples. Where measurable, the thickness of sediment in Quarry 2 ranged from 0 to 3 feet.

Quarry 3

Quarry 3 is about 14 acres in size and is water-filled on the eastern side. Some G&P slurry material appears to have overflowed from Quarry 1 into Quarry 3 on the western side. Thickness of the sediment ranges from 10 feet to as much as 30 feet. Sample results ranged from 14 ppm arsenic to as high as 130 ppm for the eight samples. The surface water in Quarry 3 was also sampled at three discrete depths at a single sampling point. Arsenic levels ranged from 58 ppb to 66 ppb. A volume estimate of G&P slurry in Quarry 3 was not made.

[2] This applies to regional soil arsenic concentrations in counties within rural areas (source: Illinois EPA, Part 742 Tiered Approach to Corrective Action Objectives (TACO) program).

Quarry 4

Quarry 4 is about 19 acres in size and ranges in depth from 1 to 30 feet of water. Thickness of the sediment ranges from 0 to 10 feet, appearing to be mostly slough-off from the sides of the quarry. Sediment sample results ranged from 10 ppm arsenic to as high as 92 ppm for the nine samples. As above, the surface water in Quarry 4 was sampled at three discrete depths at a single sampling point. Arsenic levels ranged from 37 ppb to 38 ppb.

2. Groundwater

St. Peter Sandstone

PNA has installed monitoring wells in about 20 locations at OU 3. Many locations have a cluster of wells screened at multiple depths (upper, middle, and lower) in the St. Peter Sandstone. Sampling results range from < 5 ppb to 350 ppb arsenic, with the higher levels associated with the G&P slurry in Quarry 1. Water quality is marginal (aside from any arsenic concentrations in the water); radium was measured at levels above its MCL and the high levels of iron, sulfate and magnesium, among others, can make for very hard, and reportedly foul-smelling[3] water in the aquifer. The St. Peter Sandstone has been identified as a potential source of drinking water and in areas up-gradient of the site, as well as areas not contaminated by the site, the St. Peter Sandstone is used as a source of drinking water.

New Richmond Sandstone

The nine wells screened in the New Richmond Sandstone in the entire site area, including municipal and industrial supply wells, do not display detectable levels of arsenic, although the water is hard and contains appreciable levels of radium. Specifically, the Village of Naplate has its municipal water well screened in the New Richmond Sandstone, as does the Cargill grain terminal well, and these wells are not impacted by the arsenic plume at OU 3.

Drinking Water Wells

PNA conducted a residential well survey prior to the 2001 AOC and identified a total of 48 private wells in the entire site area. Thirty-three were found to be completed in the St. Peter Sandstone and the others were found to be completed in the New Richmond Sandstone or in other aquifers not impacted by arsenic from the site. A small number of the 33 wells had detectable levels of arsenic in the water; two had levels above 50 ppb (the MCL for arsenic that was in effect at the time of sampling). Near OU 3, PNA currently supplies three area residences and one small business with bottled water due to their proximity to the site or measured arsenic levels in their wells. On June 29, 2010, EPA resampled wells near the site. As of the sampling date, two wells exceeded

[3] A local resident at the August 26, 2009, proposed plan public meeting in Ottawa remarked to EPA representatives that her water "stinks."

the MCL for arsenic, which is now 10 ppb.[4] One residential well had an arsenic level of 11 ppb and the small business' well (which exceeded the arsenic MCL in 2002) had an arsenic level of 112 ppb.

Illinois River

PNA took more than 30 sediment samples from the Illinois River in the vicinity of the OTFG site. Upstream or background samples had arsenic values that ranged from not detected to 13 ppm, averaging about 5 ppm. The only river sediment area found to be impacted by arsenic from the site was at the base of the "Original Sand Pond" a site feature of OU 4. Sediment near OU 3 was not found to be impacted by arsenic.

PNA evaluated water quality data for the Illinois River from samples taken by others in the 1990s. These sample results showed that there were no measurable levels of arsenic from the site in the river water. In 2002, PNA took three samples of Illinois River water down-gradient of the site at the request of EPA. Each sample was not-detect for arsenic (less than 5 ppb).

PNA conducted a flux modeling effort to estimate the potential impact of groundwater discharge from OU 3 on Illinois River water quality. Although the maximum groundwater arsenic concentration measured to date at OU 3 is 350 ppb, PNA used a more conservative concentration of 1,000 ppb arsenic in the model and calculated that the maximum concentration of arsenic in the river water attributable to the site would be 0.5 ppb, which is well below the drinking water MCL (10 ppb) and the Illinois General Use Surface Water Quality Standard for chronic exposure (190 ppb).

In 2002, PNA conducted river water toxicity testing on benthic organisms and data showed some chronic effects; however, there was no discernible difference between the upstream and downstream chronic toxicity effects on test benthic organisms. Thus, no fish sampling was done because literature suggests that health impacts on fish occur at arsenic levels that are at least an order-of-magnitude above that of benthic organisms.

3. Conclusions

Sampling evidence shows that the G&P slurry in Quarry 1 (and perhaps Quarry 3) is a source of arsenic contamination to the groundwater in the St. Peter Sandstone formation. Although some local residents may have wells screened in the impacted aquifer, none are drinking contaminated water at this time. The G&P slurry also has impacted surface water quality and slightly contaminated sediments in the other three quarries; however, area soil is not contaminated. Because sample results showed high arsenic concentrations in the groundwater and G&P slurry at OU 3, the results were evaluated with respect to actual or potential human health or ecological risks as discussed in Section VII, below.

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[4] On January 22, 2001, EPA adopted an MCL of 10 ppb for arsenic, effective January 23, 2006. *See* 66 Fed. Reg. 6976 (January 22, 2001).

VI. Current and Potential Future Land and Resource Uses

OU 3 is PNA-owned property located in unincorporated LaSalle County, adjacent to the City of Ottawa. Under a LaSalle County zoning ordinance enacted in 2006, land outside any city or town is zoned for agricultural use until a change is made in the use of the property—then a zoning change is made. Thus, the quarries in OU 3 will be zoned for agricultural use until there is a change in the land use. OU 3 formerly was used for mining silica sand and then for management of the G&P slurry and wastewaters from plant operations. The property is now vegetated and generally out of use. Land surrounding the PNA property is primarily residential, with some commercial use also evident. Future land use is reasonably assumed to remain the same as current use. PNA has not announced any changes to or plans to change the way it manages the property.

VII. Summary of Site Risks

EPA generally follows a four-step process for preparation of the baseline human health risk assessment (HHRA) at Superfund sites:

1. Identify chemicals of concern (COCs)
2. Conduct an Exposure Assessment for COCs
3. Conduct a Toxicity Assessment of COCs
4. Characterize Risk and Evaluate Uncertainties

EPA evaluated the levels of chemical contaminants found at OU 3 to determine the actual or potential risks to human health and the environment. As noted above, EPA first identified "chemicals of potential concern" (COPCs) - those compounds that exceeded health-based levels at the site - using screening levels or preliminary remediation goals published by the State of Illinois and/or EPA. EPA then winnowed down the list of COPCs to "chemicals of concern" (COCs) – those compounds that are most pervasive at the site or most representative of a chemical class.

EPA next evaluated chemical fate and transport factors to determine whether the COCs were potential short-, medium-, or long-term risks at the site. EPA then examined potential pathways of concern to human health and the environment under current and future site-use scenarios in an exposure assessment and applied the results of the above steps to quantify actual or potential risks to human health and the environment by combining exposure level assumptions with estimated carcinogenic risk or toxicity factors for the COCs. The human health and ecological risk assessment work is fully presented in the "Remedial Investigation and Baseline Human Health and Ecological Risk assessment of Operable Units 3 & 4 for the Ottawa Township Flat Glass Site," which is in the Administrative Record for the site.

A. Chemical of Concern

Chemicals of concern are contaminants that potentially present the greatest human health concerns (*i.e.*, those present in the highest concentrations, with the widest distribution over the site, or that exhibit the highest mobility or the highest toxicity). The purpose of identifying COCs is to focus the risk assessment on the most important contaminants found at a site.

The only COC at OU 3 is arsenic. Arsenic trioxide is the chemical that was previously used in the flat glass formulation at the glass plant site and it is in the G&P slurry material that was disposed off in Quarry 1 (and perhaps Quarry 3). There is no information derived from on-site sampling or historical company information indicating that other hazardous chemicals were used at the facility or were disposed of at OU 3.

1. Fate and Transport

Arsenic tends to adhere to soil and sediment particles and the mobility of this compound on these media is usually low. Arsenic is soluble in water, where its mobility can be moderate to high. Arsenic bioaccumulation is moderately likely to occur in receptors and it does not biodegrade. Arsenic is found in the site groundwater. Thus, this COC, if not addressed, will persist for years to come and be readily available for people and animals to become exposed to it.

B. Exposure Assessment for Arsenic

The baseline HHRA evaluated the carcinogenic and non-carcinogenic risks at OU 3 associated with a future exposure by residential use of contaminated drinking water, and current and future exposure to PNA site workers, adult trespassers (hunters) and adolescent trespassers.[5] The potential exposure routes that were quantified include ingestion (through hand-to-mouth activities), inhalation and dermal contact (through the skin).

1. Current Pathways

Exposure to arsenic at OU 3 could occur if people were to come onto the PNA property and come into contact with the G&P slurry in Quarry 1 and Quarry 3, arsenic-impacted sediment at the bottom of the quarries or arsenic-impacted surface waters in the quarries. A person could be exposed to arsenic by dermal contact if one were to touch the G&P slurry or sediment, by ingestion if one were to put one's hand into the mouth after touching the G&P slurry or sediment or by inhalation if dust particles were suspended into the air. Swimming in the surface water could expose someone to arsenic by dermal contact or by ingestion if the water was swallowed.

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[5] The quarries are surrounded by fences and patrolled by PNA security. In addition, they have steep banks and are surrounded by thick brush and other vegetation; therefore, they are not easily accessible by trespassers.

Ingestion of groundwater is not occurring on the PNA property because there are no wells producing groundwater for potable use on the property. In addition, area residents with private wells screened in the St. Peter Sandstone either have wells in areas not impacted by arsenic from the site or are being provided with bottled water and are not using their well water as a potable supply.

2. Future Pathways

Except for groundwater, future exposure pathways to arsenic would be the same as current pathways as no projected land-use changes are noted. EPA's groundwater cleanup policy requires the Agency to determine potential human health risks by assuming that for potentially useable aquifers, the contaminated water would be used for potable purposes in the future. Because the St. Peter Sandstone produces a potentially useable water supply (despite the hard water, iron taste and radium levels), the residential use of groundwater is a future exposure pathway.

C. Toxicity Assessment for Arsenic

EPA evaluated the relationship between the magnitudes of actual or potential exposure to arsenic at the site with corresponding adverse health effects. An estimate of the increased likelihood and severity of the adverse effects was calculated and used in the assessment of risk for arsenic at the site.

Generally, adverse health effects are divided into two categories – non-cancer causing (non-carcinogenic) and cancer causing (carcinogenic). Arsenic is considered to be carcinogenic but it also causes noncarcinogenic effects. Risk calculations were performed separately for arsenic as a carcinogen and a non-carcinogen because the adverse health effects are different (*e.g.*, cancer-causing versus causing kidney failure).

1. Non-carcinogenic Effects

Non-carcinogenic effects are evaluated using reference doses (RfD) developed by EPA. Reference doses for non-carcinogens are developed on the assumption that certain levels of contaminants may not pose ill effects to, for example, the liver or kidney, due to daily exposure at threshold levels over a lifetime of exposure. The RfD for arsenic is based on human chronic oral exposure studies and includes a safety factor of 3. The RfD is based on the lowest observed adverse effect level and the critical health effects caused by arsenic include hyperpigmentation, keratosis and possible vascular complications.

Combined with the results of the exposure assessment, EPA is able to calculate the Hazard Index (HI) quotient for a COC. An HI quotient is the ratio of the amount of a non-carcinogenic chemical contaminant that an individual may be exposed to at a site to the amount of the contaminant that causes an adverse toxic reaction within the body. An HI quotient of 1 or more would mean that there is enough contaminant at the site to cause a toxic reaction (likely an adverse impact to the target organs) in a person should one be exposed to the contaminant. An HI quotient of less than 1 indicates no adverse health effects would be expected due to exposure to a chemical at site concentrations.

2. Carcinogenic Effects

Similarly, RfDs for carcinogens are developed based on published cancer slope factors extrapolated from animal testing or other means. To calculate risk, arsenic was assigned a toxicity value in accordance with EPA's Integrated Risk Information System (IRIS). IRIS provides a database of human health effects that may result from exposure to arsenic (as well as from many other chemicals).

Studies have shown that arsenic intake can be associated with certain types of cancer such as of the lung, liver, kidney, bladder and skin. Arsenic is a human carcinogen that can be inhaled, ingested or absorbed; however, toxicity values provided in IRIS typically reflect doses to study subjects only via inhalation or ingestion exposure.

Using reasonable maximum exposure (RME) rates based on the results of the exposure assessment, EPA can calculate an excess lifetime cancer risk (ELCR) value for arsenic. An ELCR is an estimate of one's chances of contracting cancer due to lifelong exposure to a chemical at site concentrations and is usually expressed as an exponential value (*e.g.* a risk value of 1×10^{-2} is 1 in 100).

D. Human Health Risk

Carcinogenic risks are generally expressed as the incremental increase in the probability of an individual's developing cancer over a lifetime as a result of lifetime exposure to the carcinogen. For example, an excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure to a carcinogen has a 1 in 1,000,000 (one in one million) chance of developing cancer as a result of site-related exposure to the chemical.

Note: calculated risk values are referred to as an "excess lifetime cancer risks" because the risks would be in addition to the more prevalent risks of cancer that individuals face due to other factors such as smoking or exposure to too much sunlight. The chance of an individual's developing cancer during one's lifetime from all other causes has been estimated to be as high as 1 in 3 (3.3×10^{-1}).

Excess lifetime cancer risk (ELCR) is calculated from the following equation:

$$ELCR = CDI \times SF$$

where: ELCR = a unit-less probability (*e.g.*, 1×10^{-2})
CDI = chronic daily intake level (mg/kg-day)
SF = slope factor, expressed as $(\text{mg/kg-day})^{-1}$

Non-carcinogenic health effects are expressed as an HI quotient. A calculated HI that is less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely to occur. A total HI quotient can be generated by adding the HI quotient for all site-wide COCs that affect the same target organ (*e.g.*, liver) to which a given individual may reasonably be exposed. An HI that is less than 1 indicates that, based on the sum of all HI's from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health.

The HI is calculated as follows:

HI = CDI/RfD

where: CDI = Chronic daily intake
RfD = reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period.

1. Target Risk

EPA generally cleans up Superfund sites to reduce contaminant levels or exposure to contaminants so that the estimated ELCRs posed by carcinogenic contaminants fall within a risk range of 1×10^{-4} to 1×10^{-6} (1 in 10,000 to 1 in 1,000,000) and/or the calculated HI values for non-carcinogenic compounds fall to less than 1. EPA may use the term "unacceptable risk" when referring to contaminants at concentrations above levels that yield estimated an ECLR greater than 1×10^{-4} or an HI greater than 1 after a risk assessment is performed.

2. Uncertainties

Calculated ELCRs and HI values are estimates of potential upper-bound risks that are useful in regulatory decision-making. However, it is improper to consider the risk estimates to be representative of actual risk to potentially exposed individuals because the risks were estimated by making numerous conservative assumptions (that is, assumptions that over-estimate potential exposure levels and thus, potential risk) due to uncertainties inherent in the HHRA process. For example, some exposure and toxicity value assumptions have greater amounts of scientific data supporting them than others (that is, a widely-used chemical may be well-studied whereas a newer compound may not yet have any testing data associated with it). Uncertainty is also introduced into the risk assessment process every time an exposure assumption is made based on current or potential site uses.

One example of uncertainty at the OTFG site is the estimated site-specific soil (or sediment) ingestion rate. Estimates may vary widely. Thus, a higher EPA-recommended rate was used to yield a more conservative risk value than may be actually occurring. Another uncertainty is the assumption that future use of the contaminated groundwater for potable purposes will occur.

PNA conducted bioavailability tests on the G&P slurry material. These tests are used to determine how much arsenic is taken up by the body if the contaminated material is consumed and how much merely "passes through" without causing an impact. Testing showed that about 50 percent of the arsenic in the G&P slurry is available to be absorbed into the body if it is consumed. EPA reviewed the testing data and concurs with the interpretation of the results. Usually arsenic is conservatively considered to be 95 percent bioavailable in the HHRA process. Thus, the site-specific bioavailability factor of 50 percent may yield a less conservative risk value for arsenic exposures at the OTFG site.

There are many potential man-made sources of arsenic making it potentially available to receptors beyond the naturally occurring levels in soil or sediment. These include: rat poison and other pesticides, green-treated wood (copper arsenate), coal ash, certain fertilizers, automobile batteries, tobacco smoke and pigments found in old paint or wallpaper. Potential use of any of these materials at one's residence during one's lifetime could result in exposure to higher levels of arsenic than from naturally occurring or "background" sources.

3. Human Health Risk Assessment Results

EPA used an exposure point concentration for arsenic using a reasonable maximum exposure (RME) scenario and the central tendency exposure (CTE) scenario to estimate human health risks at OU 3. The term "RME" generally refers to exposure to the highest contaminant concentration found and is usually used as the basis for cleanup action at a Superfund site because it is the most conservative exposure assumption. The term "CTE" generally refers to an average exposure level that is more likely to occur at a site and can provide a mitigating factor towards remedy selection.

For OU 3, EPA used RME and CTE values to estimate health risks for residents (adults and children), for glass plant maintenance workers and for recreational users (trespassers), as discussed above (Exposure Pathways).

a. Residential Groundwater (Future Use)

ELCR and HI quotients were calculated for adult and child residential exposure to arsenic in groundwater if it were to be used for drinking or other potable purposes in the future. Children were assumed to consume less water than adults; however, deleterious effects of hazardous chemicals are usually higher for children than adults. Table 1a presents the calculated risks for potable groundwater use.

RECEPTOR	RME ELCR	RME HI	CTE ELCR	CTE HI
Adult	*4×10^{-4}*	*3*	1×10^{-5}	0.3
Child	*3×10^{-4}*	*8*	1×10^{-5}	1

Table 1a. HHRA results for potable groundwater use at OU 3. Results in ***red italics*** exceed the target risk ranges.

The HHRA identified that arsenic is present at concentrations in the groundwater contaminant plume that result in estimated human health risks above EPA's target risk levels.

b. Trespassers and Site Maintenance Workers

An HHRA was performed for the soil, sediment and surface water media at each of the quarries. It was assumed that only intermittent exposures would occur rather than residential exposures because the site is not used for housing. Potential trespassers were assumed to be adults during the yearly, approximately 14-day deer hunting season and adolescents (exploring, swimming, etc.) about twice a month during the warm weather months. Exposure to company workers could occur during routine maintenance activities such as mowing on or around Quarry 1 (only) or fence repair. Exposures would be through dermal contact, ingestion, and inhalation of dust. Tables 1b – 1f present the calculated risks for each exposure scenario for the above receptors.

RECEPTOR	RME ELCR	RME HI	CTE ELCR	CTE HI
Company worker	7×10^{-6}	0.04	3×10^{-7}	0.005

Table 1b. HHRA results for company workers (surface soil/G&P slurry) at Quarry 1.

RECEPTOR	RME ELCR	RME HI	CTE ELCR	CTE HI
Hunter	1×10^{-6}	0.09	6×10^{-8}	0.001
Adolescent	5×10^{-6}	0.05	2×10^{-7}	0.007

Table 1c. HHRA results for trespassers (surface soil/G&P slurry) at Quarry 1.

RECEPTOR	RME ELCR	RME HI	CTE ELCR	CTE HI
Hunter – soil/sediment	1×10^{-6}	0.01	1×10^{-7}	0.003
Hunter - water	4×10^{-7}	0.003	6×10^{-8}	0.001
Adolescent – soil/sediment	3×10^{-6}	0.09	4×10^{-7}	0.02
Adolescent – water	1×10^{-6}	0.02	2×10^{-7}	0.01

Table 1d. HHRA results for trespassers (surface soil/surface water) at Quarry 2.

RECEPTOR	RME ELCR	RME HI	CTE ELCR	CTE HI
Hunter – soil/sediment	3×10^{-6}	0.03	2×10^{-7}	0.004
Hunter - water	1×10^{-6}	0.007	1×10^{-7}	0.003
Adolescent – soil/sediment	1×10^{-5}	0.2	5×10^{-7}	0.02
Adolescent – water	4×10^{-6}	0.05	5×10^{-7}	0.03

Table 1e. HHRA results for trespassers (surface soil/surface water) at Quarry 3.

RECEPTOR	RME ELCR	RME HI	CTE ELCR	CTE HI
Hunter – soil/sediment	1×10^{-6}	0.01	1×10^{-7}	0.002
Hunter - water	6×10^{-7}	0.004	9×10^{-8}	0.002
Adolescent – soil/sediment	4×10^{-6}	0.1	3×10^{-7}	0.02
Adolescent – water	2×10^{-6}	0.03	3×10^{-7}	0.02

Table 1f. HHRA results for trespassers (surface soil/surface water) at Quarry 4.

The calculated ELCR risks and HI quotients for recreational users (trespassers) and company workers are less than EPA's target risk levels.

4. <u>Ecological Risk Characterization</u>

EPA conducted a survey of aquatic, avian, and terrestrial species living at OU 3. Both plants and animals were inventoried and no sensitive or endangered species were identified, which is to be expected because of the heavy industrial use in the past (mining) had caused a great degree of habitat degradation. No ecologically sensitive niches were noted due to the previously disturbed lands. Communities of common species, including deer, burrowing animals and avian species were observed on the PNA property and numerous (bullfrog) tadpoles, snails and leeches were found in the aquatic areas. Both plants and animals seem to be thriving due to the lack of heavy human use of the property.

EPA examined the potential risks to ecological receptors based upon the arsenic levels documented at OU 3. EPA assumed that aquatic, terrestrial and avian species observed at the site could be exposed to contaminants through external direct contact or ingestion of impacted sediment or food. The arsenic concentrations observed in the surface waters of the quarries (25-66 ppb) do not exceed the chronic ambient water quality level for arsenic (150 ppb). Using recommended dose limits of various arsenic compounds for terrestrial and avian biota to calculate HI quotients, EPA concluded that there is no potential for adverse effects to terrestrial and avian species caused by arsenic in the soil, sediment or surface water at OU 3 because none of the calculated HI values were greater than one. However, the risk assessment did not look at wading birds such as herons, egrets and cranes, nor did it evaluate fish-eating gulls, ducks and their nestlings. The environmental risk characterization will be revisited to include ecologic receptors of concern in the final ROD.

5. Conclusions

The calculated risk levels for the trespasser and site worker scenarios do not exceed EPA action levels; however, the potential residential use of OU 3 area groundwater from the St. Peter Sandstone results in calculated risk levels that exceed EPA action levels. Therefore, active cleanup measures may be necessary to protect human health and the environment. Accordingly, PNA conducted a feasibility study for OU 3 to evaluate potential cleanup remedies for the site. Further ecological risk characterization will be conducted to support the final remedy for OU 3.

VIII. Remedial Action Objectives

Groundwater in the St. Peter Sandstone formation at the site is contaminated with arsenic above the drinking water standard (MCL) of 10 ppb. Therefore, a potential adverse health risk exists if residents consume the contaminated water in the future. The remedial action objectives (RAOs) of an interim cleanup action at OU 3 are to:

- Prevent the potable use of groundwater contaminated with arsenic above 10 ppb; and,
- Reduce the concentration of arsenic in the groundwater over time.

Although the human health risks calculated for a site maintenance worker or trespassers did not exceed EPA's target risk ranges, a secondary interim RAO is to:

- Prevent future contact with the G&P slurry material in Quarry 1, as well as arsenic-impacted sediment in all of the quarries.

IX. Description of Alternatives

EPA evaluated the following alternatives, proposed by PNA in the feasibility study, which were designed to achieve the remedial action objectives at OU 3. In calculating the costs of each of the alternatives, the feasibility study used an average of the costs of the proposed alternate water supplies, which is reflected below. Section X.7 sets forth the estimated costs of each proposed alternate water supply and Section XII.B includes the estimated cost of the preferred alternate water supply remedy.

Alternative 1: No Action

Under the No Action alternative, EPA would take no further action to remove, control, mitigate or minimize exposure to arsenic-contaminated media in OU 3. This alternative establishes a baseline against which to compare the other alternatives. Under the No Action alternative, EPA estimates that the arsenic groundwater contaminant plume will remain at levels above 10 ppb for many decades. Thus, there would be no reduction in potential health risks if contaminated groundwater were to be consumed in the future. This alternative costs nothing to implement.

Alternative 2: Alternate Water Supply, Institutional Controls and Monitored Natural Attenuation

Under Alternative 2, EPA would take action to ensure that residences with private wells within or very near the impacted portion of the St. Peter Sandstone aquifer would receive an alternate water supply until arsenic levels in the aquifer decline to 10 ppb or below. Five alternatives for providing an alternate water supply were proposed: 1) drilling an individual drinking water well for each affected residence in a location on the property that is not contaminated or likely to be contaminated by the arsenic plume; 2) providing bottled water to each affected residence; 3) providing a point-of-use treatment system, such as reverse osmosis, of the residential water; 4) extending the City of Ottawa drinking water service line to provide access to the City of Ottawa drinking water; or 5) constructing a community drinking water supply well for more than one residence. The average cost of these alternatives is $590,000.

In addition, the use of institutional controls (ICs), such as an ordinance to restrict consumption of groundwater, would be pursued, as well as placing environmental covenants on certain area properties to prevent their use as residential land. The use of ICs and alternate water supplies would reduce the potential health risks that could occur if the contaminated groundwater were to be consumed.

EPA also would track the arsenic contaminant plume at OU 3 over time, through monitored natural attenuation (MNA), until the arsenic levels no longer exceed the MCL of 10 ppb. This alternative would require that additional monitoring wells be drilled and then periodically sampled for arsenic over a minimum 20-year timeframe until the MCL is met outside the PNA property boundaries. It would take approximately 12 months to implement the remedy and not more than two years. EPA estimates that it may take many decades to achieve the MCL because no action is taken to remove or control the arsenic contamination in this alternative. The cost to construct the remedy is estimated to be $800,000, with an annual cost of $50,000 due to monitoring groundwater and reporting results. The total present worth cost is estimated at $1.45 million.

Alternative 3: Plume Containment via Pump and Treat, Surface Flow Measures and Alternative 2

Under Alternative 3, EPA would implement the provisions of Alternative 2 and take measures to contain the arsenic plume in the area around Quarry 1 by installing pumping wells to the east of the quarries and altering the surface water drainage pathways around the quarries. The additional work would change groundwater flow in the upper portion of the aquifer back towards the Illinois River by reducing the mounding effect that occurred due to previous discharge of wastewater to Quarry 2. This would enhance the rate at which the arsenic levels in the plume on the eastern and southern PNA property boundaries fall to below 10 ppb. This alternative would require that additional monitoring wells be drilled and periodically sampled for arsenic over a minimum 20-year timeframe until the MCL is met outside the PNA property boundaries. It would take approximately 12 months to implement the remedy and not more than two years. EPA estimates that it would take approximately 20 years to achieve the groundwater RAO because it would take time for the pump and treat system to operate properly and efficiently. ICs and alternate water supplies would reduce the potential health risks that could occur if contaminated groundwater were to be consumed.

Pumped water could be discharged to Quarry 4 without treatment, discharged to the City of Ottawa POTW or treated on-site to remove arsenic before discharge to the Illinois River. The cost to construct the remedy is estimated to range from $2 million (pump to Quarry 4) to as much as $9 million (treat on-site), with an annual cost of $335,000 to as much as $1.2 million, depending on the treatment method. The total present worth cost is estimated at $6.25 million (pump to Quarry 4) to as much as $25 million (on-site treatment).

Alternative 4: Surface Flow and Infiltration Reduction Measures plus Alternative 2

Alternative 4 generally consists of the same remedial measures evaluated under Alternative 3, above, except that the pump-and-treat remedial component would not be conducted. Specifically, EPA would alter the paths of surface water drainage around Quarries 1 and 2. The surface work would reduce the rate of groundwater recharge in the quarries, which would slow the movement of arsenic from the source material into the groundwater below. The surface flow work also would change groundwater flow in the upper portion of the aquifer back towards the Illinois River by reducing the mounding effect that occurred due to previous discharge of wastewater to Quarry 2. This would enhance the rate at which the arsenic levels in the plume on the eastern and southern PNA property boundaries fall. The use of ICs and alternate water supplies would reduce the potential health risks that could occur if contaminated groundwater were to be consumed.

This alternative would require that additional monitoring wells be drilled and periodically sampled for arsenic over a minimum 10 to 20-year timeframe until the MCL is met outside the PNA property boundaries. It would take approximately 12 months to implement the remedy and not more than two years. EPA estimates that it would take approximately 20 years to meet the groundwater RAO because it will take time to determine if the groundwater flow has been changed by the remedy. The cost to construct the remedy is estimated to be $2.2 million with an annual cost of $62,500 due to monitoring groundwater and reporting results. The total present worth cost is estimated at $3 million.

Modified Alternative 4: Surface Flow and Infiltration Reduction Measures and Alternative 2 except for Monitored Natural Attenuation (this is the preferred alternative)

Modified Alternative 4 consists of the same remedial measures evaluated under Alternative 4, but excludes MNA. As noted above, EPA would alter the paths of surface water drainage around Quarries 1 and 2. The surface work would reduce the rate of groundwater recharge in the quarries, which would slow the movement of arsenic from the source material into the groundwater below. The surface flow work also would change groundwater flow in the upper portion of the aquifer back towards the Illinois River by reducing the mounding effect that occurred due to previous discharge of wastewater to Quarry 2. This would enhance the rate at which the arsenic levels in the plume on the eastern and southern PNA property boundaries fall.

At the time that it issued the proposed plan, EPA supported a remedy that included surface flow and infiltration reduction measures, as described above, implementation of ICs and provision of alternate water supplies, but had concluded that not enough information was available to include MNA as part of the cleanup remedy. Despite excluding MNA, this remedial approach includes the same drilling and sampling of new monitoring wells as presented in Alternatives 2 through 6. The cost to implement the remedy is the same as Alternative 4–approximately $3 million.

Alternative 5: Groundwater Pump and Treat plus Alternative 2 (except MNA)

Under Alternative 5, EPA would implement the provisions of Alternative 2 (except for MNA) and install a groundwater pump-and-treat system along the Illinois River on PNA property to address the entire arsenic plume in OU 3. Pumped water would be sent to the Ottawa POTW or treated on-site and discharged to the Illinois River. About 600 gallons of water would be pumped per minute until arsenic levels in the bulk of the plume fall to below 10 ppb. This alternative would require that additional monitoring wells be drilled and periodically sampled for arsenic over a minimum 10 to 20-year timeframe until the MCL is met outside the PNA property boundaries. The use of ICs and alternate water supplies in the interim would reduce the potential health risks that could occur if contaminated groundwater were to be consumed.

It would take approximately 12 months to implement the remedy and not more than two years. EPA estimates that it would take approximately 20 years to meet the groundwater RAO because, like with Alternative 3, it will take time for the pump and treat system to operate properly and efficiently. The cost to construct the remedy is estimated to be $2.2 million (POTW) or $ 8.4 million (on-site treatment) with an annual operating cost of $1.3 million (POTW) or $ 2.2 million (on-site treatment). The total present worth cost is estimated at $18 million (POTW) or $36 million (on-site treatment).

Alternative 6: Source Material Removal plus Alternative 2

Under Alternative 6, EPA would implement the provisions of Alternative 2 and excavate and dispose off-site the G&P slurry material from Quarry 1. Removing the source material would enhance the rate at which the arsenic levels in the bulk of the plume fall to below 10 ppb. This alternative would require that additional monitoring wells be drilled and periodically sampled for arsenic over a 10 to 20-year timeframe until the MCL is met. In the interim, the use of ICs and alternate water supplies would reduce potential health risks that could occur if contaminated groundwater were to be consumed.

There are about 2.1 million cubic yards of G&P slurry in Quarry 1, which would require over two years of excavation and transportation work to remove. EPA estimates that it would take approximately 20 years to meet the groundwater RAO, depending on the amount of the source area that is excavated and monitoring results. The estimated cost to construct the remedy is $219 million with an annual cost of $50,000 due to monitoring groundwater and reporting results. The total present worth cost is estimated to be $220 million.

X. Comparative Analysis

EPA evaluated the proposed alternatives using the Nine Criteria outlined in 40 C.F.R. § 300.430(e)(9):

<u>1. Overall protection of human health and the environment</u> - This criterion addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

The No Action alternative is not protective over the long term because it does not address the groundwater plume or prevent consumption of contaminated groundwater. Each of the remaining alternatives would be protective over the short-term because steps would be taken to protect human health (ICs and alternate water supply). Alternatives that include surface water diversion, pump and treat or excavation would be protective in the long-term because they would reduce arsenic levels in the plume to or below the arsenic MCL. EPA does not have enough evidence at this time to support a determination that MNA would be protective in the long-term.

With regard to the alternate water supplies, bottled water is not protective because residents may chose to not use the bottled water, the bottled water may not get delivered on time, and contaminated water would still be available from inside water sources, such as taps, shower and bath water, and water used for washing clothes. Similarly, a point-of-use treatment system, such as reverse osmosis, would not be protective because the system may not be placed appropriately to treat all incoming water and may have long-term maintenance issues.

A community well, new individual wells and the municipal water line are protective because they would provide permanent, reliable, clean water to all properties with private wells penetrating the contaminated portion of the St. Peter Sandstone aquifer. However, a community well and individual wells would require ongoing maintenance by the community or individuals. The best overall protection is the municipal water supply because it is maintained in perpetuity by the municipality.

2. Compliance with ARARs (Applicable or Relevant and Appropriate Requirements) – This criterion addresses whether a remedy will meet all applicable or relevant and appropriate requirements of federal and state environmental laws or provides a basis for invoking a waiver of any of the requirements.

The primary chemical-specific ARARs associated with OU 3 are the relevant and appropriate requirements of the Safe Drinking Water Act. Specifically, the arsenic MCL, at 10 ppb, is the target cleanup level for the St. Peter Sandstone aquifer wherever residential use may or could occur. In addition, depending on the remedial alternative, compliance with location-specific ARARs such as: OSHA worker protection standards; NPDES permitting requirements for discharge to surface water; off-site MCLs; Water Quality Criteria (40 C.F.R. Part 131); General Use Water Quality Standard for Protection of Aquatic Life; Secondary Contact and Indigenous Aquatic Life Standard; and Water Pollution, Pollution Control Board, Monitoring and Reporting; may be required.

The No Action alternative does not comply with ARARs. Because the remedy selected by this Interim ROD is an interim action, and attaining the MCL for arsenic will be part of the final remedy for OU 3, EPA is waiving compliance with this ARAR for the purposes of this Interim ROD in accordance with Section 121(d)(4)(A) of CERCLA, 42 U.S.C. § 121(d)(4)(A). For each of the other alternatives, compliance with the location-specific ARARs associated with the alternative is required. The final ROD for OU 3 will identify all of the ARARs with which the final remedy complies.

3. Long-term effectiveness and permanence – This criterion refers to the ability of a remedy to maintain reliable protection of human health and the environment over time after clean-up goals have been met.

The No Action alternative is not effective because cleanup goals would not be met under the alternative. Alternative 2 is not effective because EPA currently does not have enough information to include MNA in the cleanup remedy and it does not remove or contain the arsenic contamination. The remainder of the alternatives would provide reliable protection of human health and the environment over the long term because active measures would be taken to contain or remove the arsenic contamination and prevent exposure to arsenic by preventing the consumption of contaminated groundwater beneath the site. Alternative 6 would provide for the greatest measure of long-term effectiveness because the G&P slurry would be removed from Quarry 1 and would no longer be a long-term source of arsenic contamination to the aquifer, although the contaminant would not be destroyed and would be moved from the site to a more secure location (landfill) for management.

With regard to the alternate water supplies, bottled water is not protective in the long-term because residents may chose to not use the bottled water, the bottled water may not get delivered on time, and contaminated water would still be available from inside water sources, such as taps, shower and bath water, and water used for washing clothes. Similarly, a point-of-use treatment system, such as reverse osmosis, would not be protective because the system may not be placed appropriately to treat all incoming water and requires ongoing maintenance by the user.

A community well, new individual wells and the municipal water line are protective in the long-term because they would provide reliable, clean water to all water sources inside and outside the affected properties. However, a community well and individual wells would require ongoing maintenance by the community or individuals. The best overall protection is the municipal water supply because it is maintained in perpetuity by the municipality.

4. Reduction of toxicity, mobility, or volume – This criterion refers to the anticipated performance of the treatment technologies that a remedy may employ with respect to principal threat wastes at a site.

EPA has not made a determination about whether the G&P slurry or quarry sediment is a principal threat waste (see also Section XI).

5. Short-term effectiveness – This criterion evaluates the period of time needed to achieve protection and any adverse impacts on human health and environment that may be posed during construction and implementation of a clean-up action.

The no action alternative is not effective in the short term. Because of the time it will take to implement a permanent source of drinking water under the various alternate water supply alternatives, during which there is still a potential for exposure to the contaminated water, under the rest of the alternatives, bottled water would continue to be provided to properties with private wells penetrating the contaminated portion of the St. Peter Sandstone aquifer until a permanent alternate water supply is in place. At 28 months, Alternative 6 would take the most time to complete; in addition, there could be adverse short-term effects associated with the large-scale removal of the G&P slurry from Quarry 1 and shipment off-site.

6. Implementability – This criterion refers to the technical and administrative feasibility of a remedy, including availability of goods and services needed to carry out the chosen option.

Most of the alternatives are easily implemented and the goods and services needed to conduct the work are readily available. Extending the municipal water line poses a number of logistical and procedural hurdles (e.g., developing property owner support, municipal annexation); however, the municipal water line remedy is implementable and provides the most permanent clean water supply to properties with private wells penetrating the contaminated portion of the St. Peter Sandstone aquifer.

7. Cost – This criterion evaluates the estimated capital and operation and maintenance costs and estimated present-worth costs of each proposed alternative.

The No Action alternative costs nothing to implement. Alternative 2 is the least expensive of the remaining alternatives, but no active work is conducted to achieve cleanup goals and there is insufficient information to support a remedy that incorporates MNA. Alternative 3 takes action to reduce arsenic levels in the plume but is more costly than Alternative 4 and Modified Alternative 4 and yields no time advantage for the extra cost. Alternative 5 and Alternative 6 take the most action to reduce the arsenic plume; however, they are overly costly in relation to Alternative 4 and Modified Alternative 4.

With regard to the alternate water supply alternatives, the extension of the municipal water line eliminates the cost of maintaining a well and is the most cost effective. Until the selected permanent water supply is constructed and operational, bottled water must be supplied to properties with private wells penetrating the contaminated portion of the St. Peter Sandstone aquifer. Table 2 sets forth the estimated costs of the proposed alternate water supplies.

Table 2: Costs of Alternate Water Supply Alternatives

Alternate Water Supply	Cost to implement
Bottled water	$ 531,000
Municipal water extension	$ 427,000
Point-of-use (reverse osmosis) system	$ 300,000
Community well	$ 1,141,000
New individual wells	$ 550,000

8. State agency acceptance – This criterion evaluates whether a support agency, based on comments submitted after its review of the Proposed Plan, concurs, opposes, or has no comment on the preferred alternative.

EPA sought Illinois EPA's concurrence on this Interim ROD; however, the State has not established a formal position regarding the remedy set forth in this Interim ROD.

9. Community acceptance – This criterion refers to the assessment of public comments received on the Proposed Plan.

EPA has addressed public comments received on the proposed plan for OU 3 in the attached Responsiveness Summary.

Table 3: Evaluation of Remedial Alternatives Using the Nine Criteria

Criterion	1 No Action	2 Alternate Water Supply, ICs, MNA	3 Pump-and-Treat, Surface Flow Work, and Alternative 2	4 Surface Flow Work and Alternative 2	4 (modified)**** Surface Flow Work and Alternative 2 (except MNA)	5 Pump-and-Treat, Surface Flow Work, and Alternative 2 (except MNA)	6 Excavate Quarry 1 and Alternative 2
Protective of human health and the environment	Not Protective	Not Protective	Protective***	Protective***	Protective***	Protective***	Protective***
Meets chemical-specific ARARs **Meets location-specific ARARs**	No No	Waived Yes	Waived Yes	Waived Yes	Waived Yes	Waived Yes	Waived Yes
Long-term effectiveness	Not Effective	Not Effective	Effective***	Effective***	Effective***	Effective***	Effective***
Reduction of toxicity, mobility, or volume	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Short-term effectiveness	No construction	> 12 months to complete	> 12 months to complete	> 12 months to complete	> 12 months to complete	< 12 months to complete	28 months to complete
Implementability	Easily implemented	Easily implemented	Easily implemented	Easily implemented	Easily implemented	Easily implemented	Easily implemented
Cost	None	$1.45 million*	$6-25 million*	$3 million*	$ 2.72 million**	$18-36 million*	$220 million*
State acceptance	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Public acceptance	No	No	No	Yes	Yes	No	No

* Average cost
** Actual cost
*** See Table 4 for the evaluation of alternate water supply alternatives using the Nine Criteria
**** Modified Alternative 4 is the preferred remedy and includes municipal water as the alternate water supply.

Table 4: Evaluation of Alternate Water Supply Alternatives Using the Nine Criteria

Criterion	Bottled Water	Point-of-Use (Reverse Osmosis) System	Community Well	New Individual Wells	Municipal Waterline
Protective of human health and the environment	Not Protective	Not Protective	Protective	Protective	Protective
Meets chemical-specific ARARs **Meets location-specific ARARs**	Waived Yes	Waived Yes	Waived Yes	Waived Yes	Waived Yes
Long term effectiveness	Not Effective	Not Effective	Effective	Effective	Effective
Reduction of toxicity, mobility, or volume	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Short-term effectiveness	No construction	> 12 months to complete	> 12 months to complete	> 12 months to complete	< 12 months to complete
Implementability	Easily implemented	Easily implemented	Easily implemented	Easily implemented	Easily implemented
Cost	$531,107	$300,000	$1.14 million	$ 550,000	$ 427,200
State acceptance	Unknown	Unknown	Unknown	Unknown	Unknown
Public acceptance	yes	yes	yes	yes	yes

XI. Principal Threat Waste

The NCP establishes an expectation that EPA will use treatment technology to address the principal threat wastes at a site wherever practicable *(See* 40 C.F.R. § 300.430(a)(1)(iii)(A)). Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant threat to human health or the environment should exposure occur. Remedies that involve treatment of principal threat wastes likely will satisfy the statutory preference for treatment as a principal element.

EPA will make a determination on whether the G&P slurry or arsenic-impacted sediments in the quarries are principal threat waste in a final remedy for OU 3.

XII. Selected Remedy

EPA selects Modified Alternative 4 – Surface Flow and Infiltration Reduction Measures plus Alternative 2 (except MNA) – to be implemented at OU 3 because it is protective of human health and the environment. The remedy specifically requires:

- Placing institutional controls on certain area properties to prevent future redevelopment for residential use and/or to prevent future potable use of contaminated groundwater;
- Implementing surface flow and infiltration reduction measures;
- Providing municipal water with bottled water in the interim;
- Monitoring groundwater quality over time.

Several different institutional controls will be used to prevent access to contaminated groundwater. Environmental covenants will be placed on properties with private wells penetrating the contaminated portion of the St. Peter Sandstone aquifer to prevent redevelopment for residential use and prevent future use of the groundwater. In addition to the environmental covenants, the City of Ottawa intends to enact a municipal ordinance that requires properties with private wells penetrating the contaminated portion of the St. Peter Sandstone aquifer to be plugged and prohibits the construction of new wells in the contaminated aquifer. Similarly, LaSalle County intends to enact a county-wide ordinance that prohibits the installation or use of water supply wells in the contaminated portion of the aquifer. These ICs will be enforced by LaSalle County and the City of Ottawa to ensure the long-term reliability of the ICs.

EPA will gather additional groundwater data and evaluate the impact of the surface flow and infiltration reduction measures that will be implemented as part of this interim remedy to make a more informed decision about the final remedy for OU 3. The need for this additional data is supported by recently released EPA guidance on groundwater-surface water interface considerations, which suggests that more work may be needed at OU 3 with regard to the actual or estimated arsenic concentration in the pore water of the Illinois River bottom next to the site.

Figure 8: OU 3 and the location of surface water drainage modifications

A. Rationale for Selection

EPA selected this interim remedy by evaluating the nine criteria specified in the NCP and site specific risks. A remedy selected for a site will be protective of human health and the environment, comply with ARARs (or justify a waiver) and offer the best balance of tradeoffs with respect to the balancing and modifying criteria in the NCP. Through the analyses conducted for the remedial investigation/feasibility study, EPA has determined that there is an unacceptable risk to human health and the environment from the consumption of arsenic-contaminated groundwater beneath OU 3.

In selecting Modified Alternative 4, EPA determined that the No Action alternative is not protective because it does nothing to prevent the potential consumption of contaminated groundwater. Alternative 2 is less desirable than Modified Alternative 4 because it takes no action to contain or reduce arsenic levels in the plume. Alternative 3 does take action to reduce arsenic levels in the plume but it is much more costly than Modified Alternative 4 and yields no time advantage for the extra cost. Alternatives 5 and 6 take the most action to reduce the arsenic plume; however, they are overly costly in relation to Alternative 4 and further studies are needed to determine their effectiveness. The excavation of the source material under Alternative 6 may have adverse short term effects because the work would take more than two years to conduct and the excavated materials would have to be trucked through the City of Ottawa on the way to an off-site landfill for disposal. Providing municipal water is permanent, cost effective and protective of human health and the environment.

B. Cost Estimate for the Selected Remedy

The present worth cost Modified Alternative 4 is estimated to be $2,720,000 over a 30-year timeframe. The major cost elements of the selected remedy are shown in Table 5.

Table 5: Major Cost Elements of Selected Remedy

Capital Cost Items	**Estimated Costs***
Alternate water supply (municipal line)	305,000
Abandon current well	50,000
Additional monitor wells	50,000
Bottled water for one year	40,000
Install drainage ditch	45,000
Clay liner in ditch	195,000
Site prep	25,000
Diversion around Quarry 2	50,000
Install fencing	110,000
Install culvert to Quarry 4	435,000
Miscellaneous construction work	25,000
Subtotal:	$ 1,330,000
Project management, design, and on-site construction management (20%)	265,000
Subtotal	$ 1,595,000
Bid contingency (10%)	160,000
Scope contingency (10 %)	160,000
Subtotal	$ 1,915,000
Operation, maintenance, and monitoring years 1 to 30, present worth at 7%	(Annual 65,000) PW: 770,000
Five-year reviews	35,000
Total:	**$ 2,720,000**

* Rounded to nearest $5,000. Estimates are from the feasibility study. Accuracy is within +50% or – 30%. Volume estimates may be refined during the remedial design, potentially impacting cost estimates.

C. Expected Outcomes of the Selected Remedy

EPA estimates that it will take less than 12 months to complete the surface flow modifications at OU 3, thereby enhancing the rate at which groundwater flow in the upper part of the aquifer reverts to discharging into the Illinois River rather than spreading the arsenic contaminant plume around the groundwater mound in the Quarry 2 area. Receiving necessary municipal approvals, annexing properties with private wells penetrating the contaminated portion of the St. Peter Sandstone aquifer and construction of the municipal water supply line is expected to take approximately 12 months and will prevent contaminated water from reaching any drinking water sources. Bottled water will be provided to properties with private wells penetrating the contaminated portion of the St. Peter Sandstone aquifer until the line is fully installed. The use of ICs will provide protection by helping to prevent the use of the contaminated groundwater for potable purposes. In addition, EPA will continue to gather groundwater data and evaluate the impact of the surface flow and infiltration reduction measures implemented as part of this interim remedy to make a more informed decision about the final remedy for OU 3.

XIII. Statutory Determinations

Section 121 of CERCLA (42 U.S.C. § 9621) and the NCP state that the lead agency must select remedies for Superfund sites that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how Modified Alternative 4 meets these statutory requirements.

1. Protection of Human Health and the Environment

The selected cleanup remedy, Modified Alternative 4, is an interim action and will protect human health and the environment from the groundwater consumption exposure pathway. Municipal water provides a safe and permanent source of drinking water to properties with private wells penetrating the contaminated portion of the St. Peter Sandstone aquifer. The use of ICs will reduce potential exposure to contaminated groundwater through existing wells and will prevent any future installation of wells into contaminated groundwater. Surface flow and infiltration reduction measures to divert surface water flow into the quarries will reduce surface water recharge into the underlying aquifers. The selected alternative presents no short-term threats to human health or the environment that cannot be readily controlled while the cleanup approaches are being implemented.

2. Compliance with Applicable or Relevant and Appropriate Requirements, Including Other Criteria, Advisories, or Guidance To Be Considered (TBCs)

Because this is an interim remedy, chemical-specific ARARs under the Safe Drinking Water Act are waived; however, the interim remedy will comply with location-specific ARARs, including: OSHA worker protection standards; NPDES permitting requirements for discharge to surface water; off-site MCLs; Water Quality Criteria (40 C.F.R. Part 131); General Use Water Quality Standard for Protection of Aquatic Life; Secondary Contact and Indigenous Aquatic Life Standard; Water Pollution, Pollution Control Board, Monitoring and Reporting; and ICs. The final ROD for OU 3 will contain a complete list of ARARs with which the final remedial action complies.

3. Cost-Effectiveness

EPA has determined that the interim remedy is cost-effective and represents a reasonable value for the estimated expenditure. Although it is not the least costly alternative, it achieves the remedial action objectives established in this Interim ROD within a reasonable timeframe at less cost than the pump and treat or excavation alternatives.

4. Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

None of the alternatives considered use of permanent solutions and alternative treatment technologies to address the arsenic in the groundwater or G&P slurry. It is not cost-effective to treat the large volume of G&P slurry at the site or to conduct a groundwater pump-and-treat remedy.

5. Preference for Treatment as a Principal Element

(See also Section XI) Because this action does not constitute the final remedy for OU 3, the statutory preference for remedies that employ treatment that reduces toxicity, mobility or volume as a principal component will be fully addressed by the final response action selected for OU 3.

6. Five-Year Review Requirement

EPA will perform a statutory five-year review of the remedial action after it is implemented to determine whether the remedy is or will be protective of human health and the environment because the cleanup will result in a hazardous substance, pollutant or contaminant (arsenic) remaining on site in excess of levels allowing for unlimited use and unrestricted exposure.

XIV. Documentation of Significant Changes

The proposed plan for the OTFG Site was released for public comment in August 2009. The proposed plan identified Modified Alternative 4 – Surface Flow and Infiltration Reduction Measures plus Alternative 2 (except MNA) – as the preferred alternative. EPA reviewed all written and verbal comments submitted during the public comment period and determined that no significant changes to the remedy, as originally indentified in the proposed plan, were necessary or appropriate.

RESPONSIVENESS SUMMARY

Ottawa Township Flat Glass Site
La Salle County, Illinois

EPA met the public participation requirements of Sections 113(k)(2)(B)(i-v) and 117(b) of CERCLA (42 U.S.C. §§ 9613(k)(2)(B)(i-v) and 9617(b)) during the remedy selection process for the "Source Areas and Groundwater South of the Illinois River" operable unit (OU 3) of the Ottawa Township Flat Glass (OTFG) site. Sections 113(k)(2)(B)(iv) and 117(b) require EPA to respond "...to each of the significant comments, criticisms, and new data submitted in written or oral presentations" on a proposed plan for a remedial action. This Responsiveness Summary addresses those concerns expressed by the public, potentially responsible parties (PRPs), and governmental bodies in written and oral comments we've received regarding the proposed remedy for the site.

EPA has established information repositories for the OTFG site at the following locations:

- U.S. EPA - Region 5, Records Center, 77 W. Jackson Blvd., Chicago, Illinois
- Reddick Library, 1010 Canal St., Ottawa, Illinois

The Administrative Record containing all information EPA used to select the interim cleanup remedy for OU 3 is also available to the public at these locations.

Background

EPA signed an administrative order on consent (AOC) with Pilkington North America, Inc. (PNA), the current site owner, to begin a remedial investigation and feasibility study at the OTFG site in fall 2001. For OU 3, PNA sampled and analyzed contaminant levels in soil, sediment, surface water and groundwater. A human health and an ecological risk assessment was then conducted using the sampling data to determine actual or potential risks to human health and the environment posed by site contaminants. PNA completed the remedial investigation for OU 3 in August 2008 and completed a feasibility study to evaluate potential cleanup remedies for OU 3 in June 2009.

On August 19, 2009, EPA issued a proposed plan fact sheet to the public to summarize the results of the remedial investigation and baseline risk assessment for OU 3. EPA also presented its recommended interim remedial action in response to the estimated health risks. The proposed plan was available for public comment from August 19 through September 18, 2009. EPA placed an advertisement announcing the availability of the proposed plan and the start of the comment period in the *Ottawa Times,* a local newspaper of wide circulation in the site area. Each fact sheet contained an EPA-self-addressed comment page to facilitate receipt of mailed comments. EPA indicated in the fact sheet that it would accept written, e-mailed, or faxed comments during the public comment period.

EPA held a public meeting and public hearing at the La Salle County government complex on August 26, 2009 to discuss the results of the remedial investigation and feasibility study, to answer any questions regarding the proposed remedial action alternatives, and to take oral comments regarding the proposed actions. About 20 people, including local residents, attended the public meeting. A court reporter documented the proceedings of the public meeting. EPA placed a verbatim transcript of the meeting into the information repositories and the Administrative Record. EPA received no oral comments about the proposed plan during the public meeting.

EPA received one written comment concerning the proposed plan during the comment period. A summary of that comment and EPA's response to the comment is included in this Responsiveness Summary, which is a part of the Interim Record of Decision for OU 3 of the OTFG site.

Summary of Significant Comment

Pilkington North America, Inc., submitted a comment letter to EPA on September 15, 2009, the conclusion of which is set forth below:

> PNA is agrees with EPA's selection of the requirements specified in Alternative 4 (and Modified Alternative 4). These actions are the appropriate remedial approach for this site and are consistent with the NCP.
>
> However, PNA believes the evidence and requirements of the NCP support selection of Alternative 4 (including MNA) as the final remedy for the source areas and groundwater at OU 3. EPA has sufficient information to select MNA as the remedy now. PNA agrees with the EPA that more data must be gathered and that the remedial approach for the entire Site will be implemented in as integrated manner when the remedy for Operable Unit 4 is selected. However, all Superfund RODs require additional information to be gathered and it is unlikely new information will change the basic approach.
>
> Nonetheless, PNA has worked cooperatively with EPA to solve the problems that it inherited when it purchased this property in 1986. We look forward to working with the EPA to implement the appropriate remedy for OU 3 and on determining the remedy for OU 4.

PNA's letter is included in the Administrative Record for the OTFG site; therefore, it is not reproduced in its entirety here.

EPA Response

PNA presented several remedial alternatives in a feasibility study dated June 2009. After evaluating the alternatives set forth in the feasibility study, EPA proposed

Alternative 4, modified to exclude modified natural attenuation (MNA), as the preferred interim remedy. EPA excluded MNA from Alternative 4 because it had determined that not enough information is available to support a remedy at OU 3 that includes MNA as a component. In addition, recently released EPA guidance on groundwater-surface water interface considerations suggests that more work may be needed at OU 3 to determine the actual or estimated arsenic concentration in the pore water of the Illinois River bottom next to the site.

EPA will continue to gather additional groundwater data to make a more informed decision about the final remedy for OU 3.

United States vs. Pilkington North America, Inc.

APPENDIX C TO REMEDIAL ACTION CONSENT DECREE

Map of the Ottawa Township Flat Glass Superfund Site

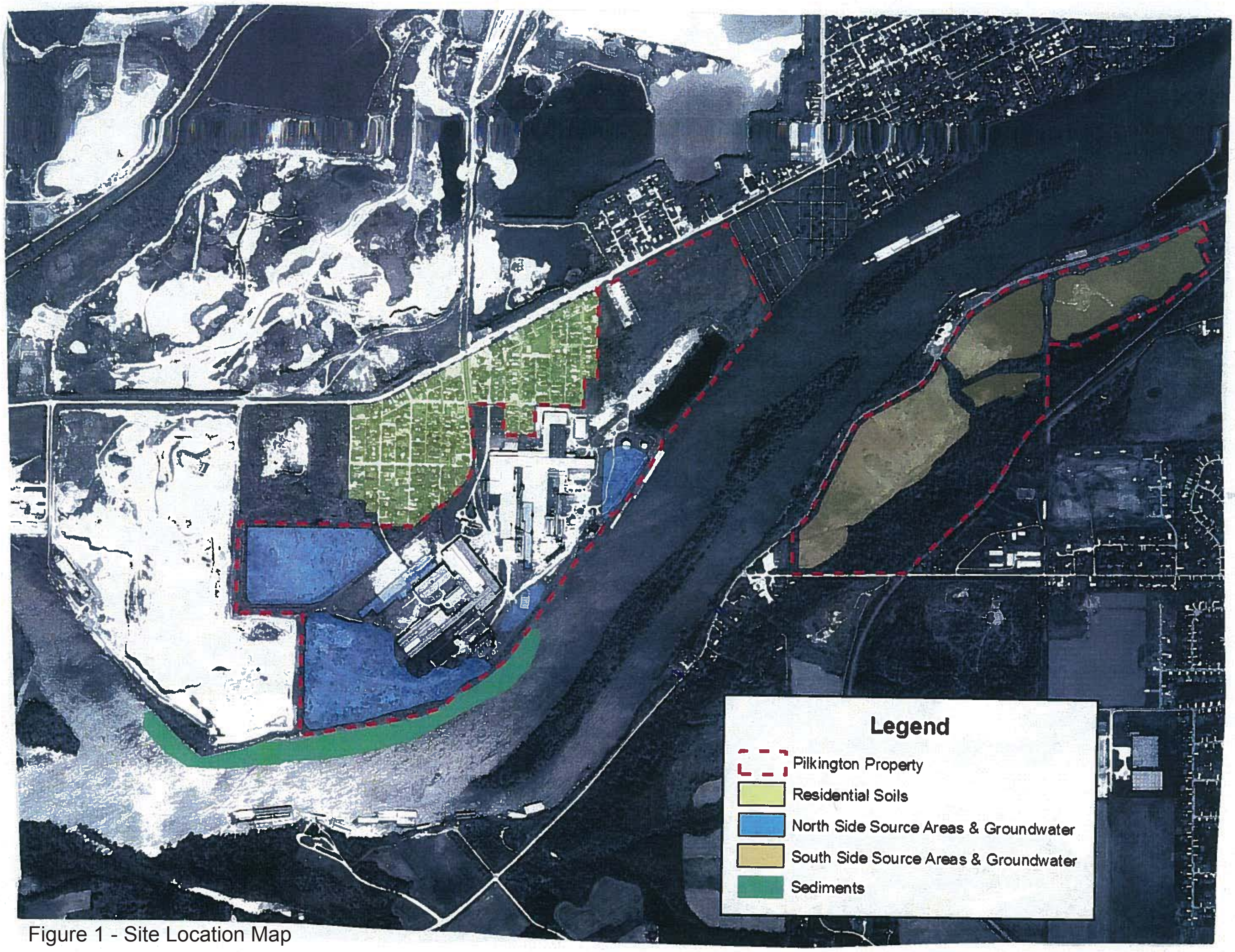


Figure 1 - Site Location Map
Ottawa Township Flat Glass
Five-Year Review, September 2013

United States vs. Pilkington North America, Inc.

APPENDIX D TO REMEDIAL ACTION CONSENT DECREE

Statement of Work
for the Remedial Action for OU3,
dated February 2016

REMEDIAL ACTION

STATEMENT OF WORK

OPERABLE UNIT 3

OTTAWA TOWNSHIP FLAT GLASS SUPERFUND SITE

Naplate, LaSalle County, State of Illinois

EPA Region 5

February 2016

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Purpose of the SOW. This Statement of Work (SOW) sets forth the procedures and requirements for implementing the Work. This SOW is part of the Consent Decree and is subject to all of the terms of the Consent Decree.

1.2 Structure of the SOW. Section 2 (Community Involvement) sets forth EPA's and Settling Defendant's responsibilities for community involvement. Section 3 (Remedial Action) sets forth requirements regarding the completion of the RA, including primary deliverables related to completion of the RA. Section 4 (Reporting) sets forth Settling Defendant's reporting obligations. Section 5 (Deliverables) describes the content of the supporting deliverables and the general requirements regarding Settling Defendant's submission of, and EPA's review of, approval of, comment on, and/or modification of, the deliverables. Section 6 (Schedules) sets forth the schedule for submitting the primary deliverables, specifies the supporting deliverables that must accompany each primary deliverable, and sets forth the schedule of milestones regarding the completion of the RA. Section 7 (State Participation) addresses State participation, and Section 8 (References) provides a list of references, including URLs.

1.3 The Scope of the Remedy includes the actions described in Section XII of the Interim Record of Decision (IROD) for the Ottawa Township Flat Glass Superfund Site dated September 2010 and Administrative Settlement Agreement and Order on Consent for Remedial Design (V-W-II-C-987, effective 2/6/2012), including placement of institutional controls on certain areas to prevent future redevelopment for residential use and/or to prevent future potable use of contaminated groundwater; implementation of surface flow and infiltration reduction measures; providing municipal water to impacted properties with bottled water in the interim; and monitoring of groundwater quality over time.

1.4 The terms used in this SOW that are defined in CERCLA, in regulations promulgated under CERCLA, or in the Consent Decree, have the meanings assigned to them in CERCLA, in such regulations, or in the Consent Decree, except that the term "Paragraph" or "¶" means a paragraph of the SOW, unless otherwise stated.

2. COMMUNITY INVOLVEMENT

2.1 Community Involvement Responsibilities

(a) EPA has the lead responsibility for developing and implementing community involvement activities at the Site. Previously, EPA developed a Community Involvement Plan (CIP) for the Site. Pursuant to 40 C.F.R. § 300.435(c), EPA shall review the existing CIP and determine whether it should be revised to describe further public involvement activities during the Work that are not already addressed or provided for in the existing CIP.

(b) If requested by EPA, Settling Defendant shall support EPA's community involvement activities. This may include providing online access to initial submissions and updates of deliverables to (1) Community Advisory Groups, (2) Technical Assistance Grant recipients and their advisors, and (3) other entities to provide them with a reasonable opportunity for review and comment. EPA may describe in its CIP Settling Defendant's responsibilities for community involvement activities. All community involvement activities conducted by Settling Defendant's at EPA's request are subject to EPA's oversight.

(c) **Settling Defendant's CI Coordinator**. If requested by EPA, Settling Defendant shall, within 15 days, designate and notify EPA of Settling Defendant's Community Involvement Coordinator (Settling Defendant's CI Coordinator). Settling Defendant may hire a contractor for this purpose. Settling Defendant's notice must include the name, title, and qualifications of the Settling Defendant's CI Coordinator. Settling Defendant's CI Coordinator is responsible for providing support regarding EPA's community involvement activities, including coordinating with EPA's CI Coordinator regarding responses to the public's inquiries about the Site.

3. REMEDIAL ACTION

3.1 RA Work Plan. Settling Defendant shall submit a RA Work Plan (RAWP) for EPA approval that includes:

(a) A proposed RA Construction Schedule in the format of a Gantt chart; and

(b) An updated health and safety plan that covers activities during the RA.

3.2 Meetings and Inspections

(a) **Preconstruction Conference**. Settling Defendant shall hold a preconstruction conference with EPA and others as directed or approved by EPA and as described in the *Remedial Design/Remedial Action Handbook*, EPA 540/R-95/059 (June 1995). Settling Defendant shall prepare minutes of the conference and shall distribute the minutes to all Parties.

(b) **Periodic Meetings**. During the construction portion of the RA (RA Construction), Settling Defendant shall meet regularly with EPA, and others as directed or determined by EPA, to discuss construction issues. Settling Defendant shall distribute an agenda and list of attendees to all Parties prior to each meeting. Settling Defendant shall prepare minutes of the meetings and shall distribute the minutes to all Parties. Such meetings may take place by telephone or other electronic means.

(c) **Inspections**

(1) EPA shall conduct periodic inspections of the Work. At EPA's request, the Supervising Contractor or other designee shall accompany EPA during inspections.

(2) Upon notification by EPA of any deficiencies in the RA Construction, Settling Defendant shall take all necessary steps to correct the deficiencies and/or bring the RA Construction into compliance with the approved Final RD, any approved design changes, and/or the approved RAWP. If applicable, Settling Defendant shall comply with any schedule provided by EPA in its notice of deficiency.

3.3 Emergency Response and Reporting

(a) **Emergency Response and Reporting**. If any event occurs during performance of the Work that causes or threatens to cause a release of Waste Material on, at, or from the Site and that either constitutes an emergency situation or that may present an immediate threat to public health or welfare or the environment, Settling Defendants shall: (1) immediately take all appropriate action to prevent, abate, or minimize such release or threat of release; (2) immediately notify the authorized EPA officer (as specified in ¶ 3.3(c)) orally; and (3) take such actions in consultation with the authorized EPA officer and in accordance with all applicable provisions of the Health and Safety Plan, the Emergency Response Plan, and any other deliverable approved by EPA under the SOW.

(b) **Release Reporting**. Upon the occurrence of any event during performance of the Work that Settling Defendant is required to report pursuant to Section 103 of CERCLA, 42 U.S.C. § 9603, or Section 304 of the Emergency Planning and Community Right-to-know Act (EPCRA), 42 U.S.C. § 11004, Settling Defendant shall immediately notify the authorized EPA officer orally.

(c) The "authorized EPA officer" for purposes of immediate oral notifications and consultations under ¶ 3.3(a) and ¶ 3.3(b) is the EPA Project Coordinator, the EPA Alternate Project Coordinator (if the EPA Project Coordinator is unavailable), or the EPA Emergency Response Unit, Region 5 (if neither EPA Project Coordinator is available).

(d) For any event covered by ¶ 3.3(a) and ¶ 3.3(b), Settling Defendant shall: (1) within 14 days after the onset of such event, submit a report to EPA describing the actions or events that occurred and the measures taken, and to be taken, in response thereto; and (2) within 30 days after the conclusion of such event, submit a report to EPA describing all actions taken in response to such event.

(e) The reporting requirements under ¶ 3.3 are in addition to the reporting required by CERCLA § 103 or EPCRA § 304.

3.4 Off-Site Shipments

(a) Settling Defendant may ship hazardous substances, pollutants, and contaminants from the Site to an off-Site facility only if it complies with Section 121(d)(3) of CERCLA, 42 U.S.C. § 9621(d)(3), and 40 C.F.R. § 300.440. Settling Defendant will be deemed to be in compliance with CERCLA § 121(d)(3) and 40 C.F.R. § 300.440 regarding a shipment if Settling Defendant obtains a prior determination from EPA that the proposed receiving facility for such shipment is acceptable under the criteria of 40 C.F.R. § 300.440(b). Settling Defendant may ship Investigation Derived Waste (IDW) from the Site to an off-Site facility only if they comply with EPA's *Guide to Management of Investigation Derived Waste*, OSWER 9345.3-03FS (Jan. 1992).

(b) Settling Defendant may ship Waste Material from the Site to an out-of-state waste management facility only if, prior to any shipment, it provides notice to the appropriate state environmental official in the receiving facility's state and to the EPA Project Coordinator. This notice requirement will not apply to any off-Site shipments when the total quantity of all such shipments does not exceed 10 cubic yards. The notice must include the following information, if available: (1) the name and location of the receiving facility; (2) the type and quantity of Waste Material to be shipped; (3) the schedule for the shipment; and (4) the method of transportation. Settling Defendant also shall notify the state environmental official referenced above and the EPA Project Coordinator of any major changes in the shipment plan, such as a decision to ship the Waste Material to a different out-of-state facility. Settling Defendant shall provide the notice after the award of the contract for RA construction and before the Waste Material is shipped.

3.5 RA Construction Completion

(a) For purposes of this ¶ 3.5, "RA Construction" comprises, for any RA that involves the construction and operation of a system to achieve Performance Standards (for example, groundwater or surface water restoration remedies), the construction of such system and the performance of all activities necessary for the system to function properly and as designed.

(b) **Inspection of Constructed Remedy**. Settling Defendant shall schedule an inspection to review the construction and operation of the system and to review whether the system is functioning properly and as designed. The inspection must be attended by Settling Defendant and EPA and/or their representatives. A re-inspection must be conducted if requested by EPA.

(c) **Shakedown Period**. There shall be a shakedown period of up to one year from the date EPA inspects, or re-inspects if applicable, the construction pursuant to ¶ 3.5 (b)for EPA to review whether the remedy is functioning properly and performing as designed in accordance with the criteria outlined in the Performance Standards Verification Plan (PSVP), approved by EPA on September 15, 2014. Settling Defendant shall provide such information as EPA requests for such review.

(d) **RA Report**. Following the shakedown period, Settling Defendant shall submit an "RA Report" requesting EPA's determination that RA Construction has been completed. The RA Report must: (1) include statements by a registered professional engineer and by Settling Defendant's Project Coordinator that construction of the system is complete and that the system is functioning properly and as designed; (2) include a demonstration, and supporting documentation, that construction of the system is complete and that the system is functioning properly and as designed; (3) include as-built drawings signed and stamped by a registered professional engineer; (4) be prepared in accordance with Chapter 2 (Remedial Action Completion) of EPA's *Close Out Procedures for NPL Sites* guidance (May 2011); and (5) be certified in accordance with ¶ 5.5 (Certification).

(e) If EPA determines that RA Construction is not complete, EPA shall so notify Settling Defendant. EPA's notice must include a description of, and schedule for, the activities that Settling Defendant must perform to complete RA Construction. EPA's notice may include a schedule for completion of such activities or may require Settling Defendant to submit a proposed schedule for EPA approval. Settling Defendant shall perform all activities described in the EPA notice in accordance with the schedule.

(f) If EPA determines, based on the initial or any subsequent RA Report, that RA Construction is complete, EPA shall so notify Settling Defendant.

3.6 Certification of RA Completion

(a) **Monitoring Report**. Following the inspection, Settling Defendant shall submit a Monitoring Report to EPA requesting EPA's Certification of RA Completion. The report must: (1) include certifications by a registered professional engineer and by Settling Defendant's Project Coordinator that the RA is complete; (3) be prepared in accordance with Chapter 2 (Remedial Action Completion) of EPA's *Close Out Procedures for NPL Sites* guidance (May 2011); and (4) be certified in accordance with ¶ 5.5 (Certification).

(b) If EPA concludes that the RA is not Complete, EPA shall so notify Settling Defendant. EPA's notice must include a description of any deficiencies. EPA's notice may include a schedule for addressing such deficiencies or may require Settling Defendant to submit a schedule for EPA approval. Settling Defendant shall perform all activities described in the notice in accordance with the schedule.

(c) If EPA concludes, based on the initial or any subsequent RA Report requesting Certification of RA Completion, that the RA is Complete, EPA shall so certify to Settling Defendant. This certification will constitute the Certification of RA Completion for purposes of the Consent Decree, including Section XV of the Consent Decree (Covenants by Plaintiff). Certification of RA Completion will not affect Settling Defendant's remaining obligations under the Consent Decree.

3.7 Certification of Work Completion

(a) **Work Completion Inspection**. Settling Defendant shall schedule an inspection for the purpose of obtaining EPA's Certification of Work Completion. The inspection must be attended by Settling Defendants and EPA and/or their representatives.

(b) **Work Completion Report**. Following the inspection, Settling Defendant shall submit a report to EPA requesting EPA's Certification of Work Completion. The report must: (1) include certifications by a registered professional engineer and by Settling Defendant's Project Coordinator that the Work, including all O&M activities, is complete; and (2) be certified in accordance with ¶ 5.5 (Certification). If the Monitoring Report submitted under ¶ 3.6(a) includes all elements required under this ¶ 3.7(b), then the Monitoring Report suffices to satisfy all requirements under this ¶ 3.7(b).

(c) If EPA concludes that the Work is not complete, EPA shall so notify Settling Defendant. EPA's notice must include a description of the activities that Settling Defendant must perform to complete the Work. EPA's notice must include specifications and a schedule for such activities or must require Settling Defendant to submit specifications and a schedule for EPA approval. Settling Defendant shall perform all activities described in the notice or in the EPA-approved specifications and schedule.

(d) If EPA concludes, based on the initial or any subsequent report requesting Certification of Work Completion, that the Work is complete, EPA shall so certify in writing to Settling Defendant. Issuance of the Certification of Work Completion does not affect the following continuing obligations: (1) activities under the Periodic Review Support Plan; (2) obligations under Sections VIII (Property Requirements), XIX (Retention of Records), and XVIII (Access to Information) of the Consent Decree; and (5) reimbursement of EPA's Future Response Costs under Section X (Payments for Response Costs) of the Consent Decree.

4. REPORTING

4.1 Progress Reports. Commencing with the month following lodging of the Consent Decree and until EPA approves the RA Construction Completion, Settling Defendant shall submit progress reports to EPA on a monthly basis, or as otherwise requested by EPA. The reports must cover all activities that took place during the prior reporting period, including:

(a) The actions that have been taken toward achieving compliance with the Consent Decree;

(b) A summary of all results of sampling, tests, and all other data received or generated by Settling Defendant;

(c) A description of all deliverables that Settling Defendant submitted to EPA;

(d) A description of all activities relating to RA Construction that are scheduled for the next month;

(e) An updated RA Construction Schedule, together with information regarding percentage of completion, delays encountered or anticipated that may affect the future schedule for implementation of the Work, and a description of efforts made to mitigate those delays or anticipated delays;

(f) A description of any modifications to the work plans or other schedules that Settling Defendant has proposed or that have been approved by EPA; and

(g) A description of all activities undertaken in support of the Community Involvement Plan (CIP) during the reporting period and those to be undertaken in the next month.

4.2 **Notice of Progress Report Schedule Changes**. If the schedule for any activity described in the Progress Reports, including activities required to be described under ¶ 4.1(d), changes, Settling Defendant shall notify EPA of such change at least 7 days before performance of the activity.

5. DELIVERABLES

5.1 **Applicability**. Settling Defendant shall submit deliverables for EPA approval or for EPA comment as specified in the SOW. If neither is specified, the deliverable does not require EPA's approval or comment. Paragraphs 5.2 (In Writing) through 5.4 (Technical Specifications) apply to all deliverables. Paragraph 5.5 (Certification) applies to any deliverable that is required to be certified. Paragraph 5.6 (Approval of Deliverables) applies to any deliverable that is required to be submitted for EPA approval.

5.2 All deliverables under this SOW must be in writing unless otherwise specified.

5.3 All deliverables must be submitted by the deadlines in the RD Schedule or RA Schedule, as applicable. Settling Defendant shall submit all deliverables to EPA in electronic form. If any deliverable includes maps, drawings, or other exhibits that are larger than 8.5" by 11", Settling Defendant shall also provide EPA with paper copies of such exhibits.

5.4 **Technical Specifications**

(a) Sampling and monitoring data should be submitted in standard regional Electronic Data Deliverable (EDD) format. The standard EDD format for Region 5 is the EXES Excel file. Other delivery methods may be allowed if electronic direct submission presents a significant burden or as technology changes.

(b) Spatial data, including spatially-referenced data and geospatial data, should be submitted: (1) in the ESRI File Geodatabase format; and (2) as unprojected geographic coordinates in decimal degree format using North American Datum

1983 (NAD83) or World Geodetic System 1984 (WGS84) as the datum. If applicable, submissions should include the collection method(s). Projected coordinates may optionally be included but must be documented. Spatial data should be accompanied by metadata, and such metadata should be compliant with the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata and its EPA profile, the EPA Geospatial Metadata Technical Specification. An add-on metadata editor for ESRI software, the EPA Metadata Editor (EME), complies with these FGDC and EPA metadata requirements and is available at https://edg.epa.gov/EME/.

(c) Each file must include an attribute name for each site unit or sub-unit submitted. Consult http://www.epa.gov/geospatial/policies.html for any further available guidance on attribute identification and naming.

(d) Spatial data submitted by SETTLING DEFENDANT does not, and is not intended to, define the boundaries of the Site.

5.5 Certification. All deliverables that require compliance with this ¶ 5.5 must be signed by the Settling Defendant's Project Coordinator, or other responsible official of Settling Defendant, and must contain the following statement:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

5.6 Approval of Deliverables

(a) **Initial Submissions**

(1) After review of any deliverable that is required to be submitted for EPA approval under the Consent Decree or the SOW, EPA shall: (i) approve, in whole or in part, the submission; (ii) approve the submission upon specified conditions; (iii) disapprove, in whole or in part, the submission; or (iv) any combination of the foregoing.

(2) EPA also may modify the initial submission to cure deficiencies in the submission if: (i) EPA determines that disapproving the submission and awaiting a resubmission would cause substantial disruption to the Work; or (ii) previous submission(s) have been disapproved due to material defects and the deficiencies in the initial submission under consideration indicate a bad faith lack of effort to submit an acceptable deliverable.

(b) **Resubmissions**. Upon receipt of a notice of disapproval under ¶ 5.6(a) (Initial Submissions), or if required by a notice of approval upon specified conditions under ¶ 5.6(a), Settling Defendant shall, within 45 days or such longer time as specified by EPA in such notice, correct the deficiencies and resubmit the deliverable for approval unless Settling Defendant has invoked the Dispute Resolution provisions under Section XIII of the Consent Decree. After review of the resubmitted deliverable, EPA may: (1) approve, in whole or in part, the resubmission; (2) approve the resubmission upon specified conditions; (3) modify the resubmission; (4) disapprove, in whole or in part, the resubmission, requiring Settling Defendant to correct the deficiencies; or (5) any combination of the foregoing.

(c) **Implementation**. Upon approval, approval upon conditions, or modification by EPA under ¶ 5.6(a) (Initial Submissions) or ¶ 5.6(b) (Resubmissions), of any deliverable, or any portion thereof: (1) such deliverable, or portion thereof, will be incorporated into and enforceable under the Consent Decree; and (2) Settling Defendant shall take any action required by such deliverable, or portion thereof. The implementation of any non-deficient portion of a deliverable submitted or resubmitted under ¶ 5.6(a) or ¶ 5.6(b) does not relieve Settling Defendants of any liability for stipulated penalties under Section XIV (Stipulated Penalties) of the Consent Decree.

5.7 **Supporting Deliverables**. Settling Defendant has submitted the supporting deliverables for EPA approval identified in ¶ 5.7(a), ¶ 5.7(c), ¶ 5.7(d), ¶ 5.7(f), ¶ 5.7(g), and ¶ 5.7(i). Settling Defendant shall submit for EPA approval the supporting deliverables identified in ¶ 5.7(b), ¶ 5.7(e), and ¶ 5.7(h). Settling Defendant shall update each of these supporting deliverables as necessary or appropriate during the course of the Work, and/or as requested by EPA.

(a) **Health and Safety Plan**. The Health and Safety Plan (HASP) describes all activities to be performed to protect on site personnel and area residents from physical, chemical, and all other hazards posed by the Work. Settling Defendant shall develop the HASP in accordance with EPA's Emergency Responder Health and Safety and Occupational Safety and Health Administration (OSHA) requirements under 29 C.F.R. §§ 1910 and 1926. The HASP was submitted to EPA as a component of the draft Remedial Action Work Plan in March 2015. EPA does not approve the HASP, but will review it to ensure that all necessary elements are included and that the plan provides for the protection of human health and the environment.

(b) **Emergency Response Plan**. The Emergency Response Plan (ERP) must describe procedures to be used in the event of an accident or emergency at the Site (for example, power outages, water impoundment failure, treatment plant failure, slope failure, etc.). The ERP must include:

(1) Name of the person or entity responsible for responding in the event of an emergency incident;

(2) Plan and date(s) for meeting(s) with the local community, including local, State, and federal agencies involved in the cleanup, as well as local emergency squads and hospitals;

(3) Spill Prevention, Control, and Countermeasures (SPCC) Plan (if applicable), consistent with the regulations under 40 C.F.R. Part 112, describing measures to prevent, and contingency plans for, spills and discharges;

(4) Notification activities in accordance with ¶ 3.3(b) (Release Reporting) in the event of a release of hazardous substances requiring reporting under Section 103 of CERCLA, 42 U.S.C. § 9603, or Section 304 of the Emergency Planning and Community Right-to-know Act (EPCRA), 42 U.S.C. § 11004; and

(5) A description of all necessary actions to ensure compliance with Paragraph 11 (Emergencies and Releases) of the Consent Decree in the event of an occurrence during the performance of the Work that causes or threatens a release of Waste Material from the Site that constitutes an emergency or may present an immediate threat to public health or welfare or the environment.

(c) **Field Sampling Plan**. The Field Sampling Plan (FSP) supplements the QAPP and addresses all sample collection activities. The FSP must be written so that a field sampling team unfamiliar with the project would be able to gather the samples and field information required. Settling Defendant will build upon the existing EPA-approved FSP in the event that additional sampling may be conducted for the purpose of the RA.

(d) **Quality Assurance Project Plan**. The Quality Assurance Project Plan (QAPP) addresses sample analysis and data handling regarding the Work. The QAPP must include a detailed explanation of Settling Defendant's quality assurance, quality control, and chain of custody procedures for all treatability, design, compliance, and monitoring samples. Settling Defendant will rely on the existing EPA-approved QAPP in the event that additional environmental sampling may be conducted for the as part of the RA.

(e) **Operable Unit 3 (OU3) Groundwater Monitoring Summary Reports**. On-going groundwater monitoring at OU3 is being conducted at the Site in accordance with the Administrative Order on Consent for the Remedial Investigation/Feasibility Study, Docket No. V-W-01-C-663, effective September 28, 2001, and the corresponding Scope of Work designated as Attachment A of the Order. This monitoring includes a subset of wells in OU3 and Operable Unit 4 and is conducted on a semi-annual basis. The purpose of the OU3 groundwater monitoring is to obtain information, through short- and long- term monitoring, about the movement of and changes in contamination throughout OU3, before and during implementation of the RA; to obtain information regarding contamination levels to determine whether Performance Standards are achieved; and to obtain information to determine whether to perform additional actions, including further monitoring at OU3.

(f) **Construction Quality Assurance/Quality Control Plan (CQA/QCP)**. The purpose of the Construction Quality Assurance Plan (CQAP) is to describe planned and systemic activities that provide confidence that the RA construction will satisfy all plans, specifications, and related requirements, including quality objectives. The purpose of the Construction Quality Control Plan (CQCP) is to describe the activities to verify that RA construction has satisfied all plans, specifications, and related requirements, including quality objectives. This document was submitted with the Final Remedial Design in August 2014 and approved by EPA on September 15, 2014.

(g) **Maintenance Activities**. The Performance Standard Verification Plan (PSVP) submitted as a component of the Final Remedial Design in August 2014 and approved by EPA on September 15, 2014 describes the requirements for Performance Standards required to be met to implement the IROD and procedures for inspecting and maintaining the RA.

(h) **Periodic Review Support Plan**. The Periodic Review Support Plan addresses the studies and investigations that Settling Defendant shall conduct to support EPA's reviews of whether the RA is protective of human health and the environment in accordance with Section 121(c) of CERCLA, 42 U.S.C. § 9621(c) (also known as "Five-year Reviews"). Settling Defendant shall develop the plan in accordance with *Comprehensive Five-year Review Guidance*, OSWER 9355.7-03B-P (June 2001), and any other relevant five-year review guidances.

(i) **Institutional Controls Implementation and Assurance Plan.** The Institutional Controls Implementation and Assurance Plan (ICIAP) submitted to EPA in February 2016 describes plans to implement, maintain, and enforce the Institutional Controls (ICs) at the Site. Settling Defendant shall develop the ICIAP in accordance with *Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites*, OSWER 9355.0-89, EPA/540/R-09/001 (Dec. 2012), and *Institutional Controls: A Guide to Preparing Institutional Controls Implementation and Assurance Plans at Contaminated Sites*, OSWER 9200.00-77, EPA/540/R-09/02 (Dec. 2012). The ICIAP must include the following additional requirements:

(1) Locations of recorded real property interests (e.g., easements, liens) and resource interests in the property that may affect ICs (e.g., surface, mineral, and water rights) including accurate mapping and geographic information system (GIS) coordinates of such interests: and

(2) Legal descriptions and survey maps that are prepared according to current American Land Title Association (ALTA) Survey guidelines and certified by a licensed surveyor.

6. SCHEDULE

6.1 Applicability and Revisions. All deliverables and tasks required under this SOW must be submitted or completed by the deadlines or within the time durations listed in the RA Schedule set forth below. Settling Defendant may submit a proposed revised RA Schedule for EPA approval. Upon EPA's approval, the revised RA Schedule supersedes the RA Schedule set forth below, and any previously-approved RA Schedule.

6.2 RA Schedule

	Description of Deliverable / Task	**¶ Ref.**	**Deadline**
1	Award RA contract		30 days after EPA Notice of Authorization to Proceed with RA
2	RAWP	3.1	30 days after EPA Notice of Authorization to Proceed with RA
3	Pre-Construction Conference	3.2(a)	30 days after Approval of RAWP
4	Start of Construction		30 days after Approval of RAWP
5	Completion of Construction		90 days after EPA's authorization to proceed with construction, or as approved by EPA in the RA construction schedule
6	Pre-final Inspection	3.5(b)	45 days after completion of construction
7	Pre-final Inspection Report	3.5(d)	15 days after completion of Pre-final Inspection
8	Final Inspection		45 days after Completion of Work identified in Pre-final Inspection Report
9	RA Report	3.5(d)	30 days after Final Inspection
10	Monitoring Report	3.6(a)	Upon achievement of Performance Standards
11	Work Completion Report	3.7(b)	30 days after Completion of Work
12	Periodic Review Support Plan	5.7(h)	Five years after Start of RA Construction

7. STATE PARTICIPATION

7.1 Copies. Settling Defendant shall, at any time it sends a deliverable to EPA, send a copy of such deliverable to the State. EPA shall, at any time it sends a notice, authorization, approval, disapproval, or certification to Settling Defendant, send a copy of such document to the State.

7.2 Review and Comment. The State will have a reasonable opportunity for review and comment prior to:

(a) Any EPA approval or disapproval under ¶ 5.6 (Approval of Deliverables) of any deliverables that are required to be submitted for EPA approval; and

(b) Any approval or disapproval of the Construction Phase under ¶ 3.5 (RA Construction Completion), any disapproval of, or Certification of RA Completion under ¶ 3.6 (Certification of RA Completion), and any disapproval of, or Certification of Work Completion under ¶ 3.7 (Certification of Work Completion).

8. REFERENCES

8.1 The following regulations and guidance documents, among others, apply to the Work. Any item for which a specific URL is not provided below is available on one of the two EPA Web pages listed in ¶ 8.2:

(a) A Compendium of Superfund Field Operations Methods, OSWER 9355.0-14, EPA/540/P-87/001a (Aug. 1987).

(b) CERCLA Compliance with Other Laws Manual, Part I: Interim Final, OSWER 9234.1-01, EPA/540/G-89/006 (Aug. 1988).

(c) Guidance for Conducting Remedial Investigations and Feasibility Studies, OSWER 9355.3-01, EPA/540/G-89/004 (Oct. 1988).

(d) CERCLA Compliance with Other Laws Manual, Part II, OSWER 9234.1-02, EPA/540/G-89/009 (Aug. 1989).

(e) Guidance on EPA Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties, OSWER 9355.5-01, EPA/540/G-90/001 (Apr.1990).

(f) Guidance on Expediting Remedial Design and Remedial Actions, OSWER 9355.5-02, EPA/540/G-90/006 (Aug. 1990).

(g) Guide to Management of Investigation-Derived Wastes, OSWER 9345.3-03FS (Jan. 1992).

(h) Permits and Permit Equivalency Processes for CERCLA On-Site Response Actions, OSWER 9355.7-03 (Feb. 1992).

(i) Guidance for Conducting Treatability Studies under CERCLA, OSWER 9380.3-10, EPA/540/R-92/071A (Nov. 1992).

(j) National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule, 40 C.F.R. Part 300 (Oct. 1994).

(k) Guidance for Scoping the Remedial Design, OSWER 9355.0-43, EPA/540/R-95/025 (Mar. 1995).

(l) Remedial Design/Remedial Action Handbook, OSWER 9355.0-04B, EPA/540/R-95/059 (June 1995).

(m) EPA Guidance for Data Quality Assessment, Practical Methods for Data Analysis, QA/G-9, EPA/600/R-96/084 (July 2000).

(n) Operation and Maintenance in the Superfund Program, OSWER 9200.1-37FS, EPA/540/F-01/004 (May 2001).

(o) Comprehensive Five-year Review Guidance, OSWER 9355.7-03B-P, 540-R-01-007 (June 2001).

(p) Guidance for Quality Assurance Project Plans, QA/G-5, EPA/240/R-02/009 (Dec. 2002).

(q) Institutional Controls: Third Party Beneficiary Rights in Proprietary Controls (Apr. 2004).

(r) Quality Systems for Environmental Data and Technology Programs -- Requirements with Guidance for Use, ANSI/ASQ E4-2004 (2004).

(s) Uniform Federal Policy for Quality Assurance Project Plans, Parts 1-3, EPA/505/B-04/900A though 900C (Mar. 2005).

(t) Superfund Community Involvement Handbook, EPA/540/K-05/003 (Apr. 2005).

(u) EPA Guidance on Systematic Planning Using the Data Quality Objectives Process, QA/G-4, EPA/240/B-06/001 (Feb. 2006).

(v) EPA Requirements for Quality Assurance Project Plans, QA/R-5, EPA/240/B-01/003 (Mar. 2001, reissued May 2006).

(w) EPA Requirements for Quality Management Plans, QA/R-2, EPA/240/B-01/002 (Mar. 2001, reissued May 2006).

(x) USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis, ILM05.4 (Dec. 2006).

(y) USEPA Contract Laboratory Program Statement of Work for Organic Analysis, SOM01.2 (amended Apr. 2007).

(z) EPA National Geospatial Data Policy, CIO Policy Transmittal 05-002 (Aug. 2008), available at http://www.epa.gov/geospatial/policies.html and http://www.epa.gov/geospatial/docs/National_Geospatial_Data_Policy.pdf.

(aa) Summary of Key Existing EPA CERCLA Policies for Groundwater Restoration, OSWER 9283.1-33 (June 2009).

(bb) Principles for Greener Cleanups (Aug. 2009), available at http://www.epa.gov/oswer/greenercleanups/.

(cc) [**If Technical Assistance Plan provided for in SOW:** Providing Communities with Opportunities for Independent Technical Assistance in Superfund Settlements, Interim (Sep. 2009).]

(dd) USEPA Contract Laboratory Program Statement of Work for Inorganic Superfund Methods (Multi-Media, Multi-Concentration), ISM01.2 (Jan. 2010).

(ee) Close Out Procedures for National Priorities List Sites, OSWER 9320.2-22 (May 2011).

(ff) Groundwater Road Map: Recommended Process for Restoring Contaminated Groundwater at Superfund Sites, OSWER 9283.1-34 (July 2011).

(gg) Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance," OSWER 9355.7-18 (Sep. 2011).

(hh) Construction Specifications Institute's MasterFormat 2012, available from the Construction Specifications Institute, www.csinet.org/masterformat.

(ii) Updated Superfund Response and Settlement Approach for Sites Using the Superfund Alternative Approach , OSWER 9200.2-125 (Sep. 2012)

(jj) Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites, OSWER 9355.0-89, EPA/540/R-09/001 (Dec. 2012).

(kk) Institutional Controls: A Guide to Preparing Institutional Controls Implementation and Assurance Plans at Contaminated Sites, OSWER 9200.0-77, EPA/540/R-09/02 (Dec. 2012).

(ll) EPA's Emergency Responder Health and Safety Manual, OSWER 9285.3-12 (July 2005 and updates), http://www.epaosc.org/_HealthSafetyManual/manual-index.htm

(mm) Broader Application of Remedial Design and Remedial Action Pilot Project Lessons Learned, OSWER 9200.2-129 (Feb. 2013).

(nn) Guidance for Evaluating Completion of Groundwater Restoration Remedial Actions, OSWER 9355.0-129 (Nov. 2013).

(oo) Groundwater Remedy Completion Strategy: Moving Forward with the End in Mind, OSWER 9200.2-144 (May 2014).

8.2 A more complete list may be found on the following EPA Web pages:

Laws, Policy, and Guidance	http://www.epa.gov/superfund/policy/index.htm
Test Methods Collections	http://www.epa.gov/fem/methcollectns.htm

8.3 For any regulation or guidance referenced in the CD or SOW, the reference will be read to include any subsequent modification, amendment, or replacement of such regulation or guidance. Such modifications, amendments, or replacements apply to the Work only after Settling Defendant's receive notification from EPA of the modification, amendment, or replacement.

United States vs. Pilkington North America, Inc.

APPENDIX E TO REMEDIAL ACTION CONSENT DECREE

Institutional Control Implementation and Assurance Plan for Operable Units 1, 2 and 3, Ottawa Township Flat Glass Site

INSTITUTIONAL CONTROL IMPLEMENTATION AND ASSURANCE PLAN

OPERABLE UNITS 1, 2 AND 3
OTTAWA TOWNSHIP FLAT GLASS SITE
CITY OF OTTAWA, LASALLE COUNTY, ILLINOIS
CERCLA DOCKET NO. V-W-11-C-989

FEBRUARY 2016

SECTION 1

INTRODUCTION

This Institutional Control Implementation and Assurance Plan ("ICIAP") was prepared by Pilkington North America, Inc. ("PNA") for the Ottawa Township Flat Glass Site ("Site") (CERCLIS #ILD005468616) (Figure 1) located near the Village of Naplate, adjacent to the City of Ottawa in Ottawa Township, LaSalle County, Illinois, along the north and south sides of the Illinois River, U.S. Environmental Protection Agency ("EPA") Region 5. The Site has been divided into four operable units ("OUs") (Table 1-1). This ICIAP addresses OU1 Residential Soils, OU2 Illinois River Sediment and OU3 Source Areas and Groundwater South of the Illinois River. The remedy for OU4 Source Areas and Groundwater North of the Illinois River has not been selected yet. If institutional controls are selected as part of the remedy for OU4, PNA will prepare an addendum to this ICIAP to incorporate those controls.

This ICIAP identifies and documents activities that are designed to implement, maintain, and enforce institutional controls ("ICs") at OU1, OU2 and OU3, and this ICIAP identifies the organizations responsible for conducting these activities. This ICIAP will help ensure that the ICs for OU1, OU2 and OU3 are properly implemented and will continue to operate as intended. The remedy for OU4 has not been selected yet, but if ICs are selected as part of the remedy for OU4, this ICIAP will be amended to incorporate them. Oversight of ICs will be conducted by EPA.

Table 1.1 Operable Units

OU#	NAME
1	Residential Soils
2	Illinois River Sediment
3	Source Areas and Groundwater South of the Illinois River
4	Source Areas and Groundwater North of the Illinois River

SECTION 2.0 SITE DETAILS

2.1 SITE DESCRIPTION

The Site is located about 60 miles southwest of downtown Chicago.

PNA owns and operates a glass manufacturing plant near the Village of Naplate, adjacent to the City of Ottawa in Ottawa Township, LaSalle County, Illinois, along the north and south sides of the Illinois River. The north side property is a 228-acre area and contains a glass manufacturing facility ("Plant #5" (active) and "Plant #7" (currently inactive)), former silica sand quarries, wastewater disposal areas and a 56-acre undeveloped parcel of land. The 56-acre undeveloped parcel, Parcel 4, is located in the northeast corner of the property and has been called the "old golf course." The manufacturing facility now in use and the 56-acre undeveloped parcel are not included in the Site, as defined in the AOC.

As stated above, the Site consists of four operable units. The "Residential Soils" (OU 1) and "Source Areas and Groundwater North of the Illinois River" (OU 4) operable units are located on the north side of the Illinois River. OU 2 is the "Illinois River Sediment" operable unit. OU 3, "Source Areas and Groundwater South of the Illinois River," is on the south side of the River and consists of a 122-acre parcel containing four former silica sand quarries (Quarry 1, Quarry 2, etc.) located due east of the manufacturing facility.

2.2 BRIEF SITE HISTORY

2.2.1 PREVIOUS SITE USES

Glass manufacturing has been conducted at the Site since 1908. The Federal Plate Glass Company built and began operating the glass manufacturing facility in 1908. National Plate Glass bought the facility in 1921. National Plate Glass became a subsidiary of Fisher Body in 1920 and Fisher Body, in turn, became a wholly-owned subsidiary of General Motors Corporation in 1926. National Plate Glass sold the Naplate glass plant to the Libbey-Owens-Ford ("LOF") Company of Toledo, Ohio, in 1931. PNA purchased the glass manufacturing facility from LOF in 1986, about 16 years after the use of arsenic in the glass-making process was discontinued. PNA still operates the glass plant today.

From 1908 to 1970, the facility manufactured glass using the flat glass manufacturing process. The final step in the flat glass manufacturing process involved grinding and polishing the raw glass surfaces with fine silica sand and water. The process generated waste in the form of a slurry consisting of mostly sand, water and glass particles ("G&P slurry"). During that time (1908 – 1970), the facility's glass-making recipe contained less than one percent arsenic (as arsenic trioxide) to reduce discoloration caused by trace amounts of iron in the melt. Arsenic usage declined over time, as the glass-making formulas changed. Nevertheless, through 1970, the glass particles in the G&P slurry contained low concentrations of arsenic.

Starting in 1908, the G&P slurry was pumped to areas (termed "sand ponds") located on the north side of the Illinois River, and the clarified water decanted from the sand ponds was discharged into the Illinois River. Some G&P slurry also was pumped into a plaster pit located on Site. From about 1954 until March 1970, LOF piped stormwater and G&P slurry across the River into a former silica sand quarry located on the south side of the River; water from that quarry ran into three other nearby quarries, all located on the south side of the River. In 1970, the facility converted to a "float glass" manufacturing method that does not generate any G&P slurry. Thus, the discharge of arsenic-containing G&P slurry material ended in 1970. Following the conversion to the float glass manufacturing method, in 1970 LOF covered the eastern two-thirds of Quarry 1 with approximately 1,700 tons of waste water treatment sludge and the remaining third with topsoil from the Site. Quarry 1 then solidified and became vegetated with trees, grasses, and other plants. From 1970 to 2006, some wastewater not containing G&P material was piped across the River into Quarry 2; this ended in 2006, when infrastructure changes were completed. Since 2006, Quarries 2, 3, and 4 have begun to dry out, but still contain some water.

Surrounding the Site property are residential areas, both incorporated (South Ottawa) and unincorporated. To the southwest along the River and below the bluff are several properties on private wells. To the southeast and above the bluff are the 4-H fairgrounds and further east is a subdivision that is on municipal water. The 4-H facility has a private well that serves the fairgrounds with non-potable water. Historically, a small number of wells in the unincorporated area have been impacted by arsenic in the groundwater, along with the well on the 4-H fairgrounds. Municipal water service was extended to these properties with impacted wells and the wells were decommissioned. The Cargill grain terminal located just west of Quarry 3 on the River is on a private well that is drilled into an unaffected aquifer.

The Site sits above three aquifers. The upper St. Peter Sandstone aquifer, which is approximately 110 feet to 140 feet thick within OU3, is separated from the approximately 100 foot thick New Richmond middle aquifer by the confining Shakopee Dolomite; this confining layer that is approximately 125 feet to 205 feet thick. The lower aquifer is called the Ironton-Galesville Sandstone aquifer. The middle and lower aquifers have not been impacted by the Site.

Sampling results from the St. Peter Sandstone ranged from <5 part per billion ("ppb") to 350 ppb arsenic. In certain areas, the St. Peter Sandstone is a potential source of drinking water. In areas up-gradient of the Site, as well as areas not impacted by the Site, it is used as a source of drinking water.

The G&P slurry in Quarry 1 and, to a lesser extent, Quarry 3 is the major source of arsenic in the groundwater water beneath the Site. Surface-water in the remaining two quarries could be impacted by arsenic from Quarries 1 and 3. The background concentration of arsenic in area soils is an insignificant source of arsenic at OU 3.

2.2.2 CONTAMINANT OF CONCERN ("COC")

The only COC at OU1, OU2 and OU3 is arsenic. Arsenic trioxide is the chemical that was previously used in the flat glass formulation at the glass plant site and which is present in the G&P slurry material.

2.2.3 RISK EXPOSURE PATHWAYS

Ingestion of groundwater is the only relevant exposure pathway associated with arsenic present at the Site. At the present time, there is no human ingestion of impacted groundwater at this Site. As part of the remedy selected by EPA, a public water line was extended to all three of the properties that had wells in the affected portion of the upper aquifer and their wells were decommissioned, ensuring that a safe water supply is available on a long-term basis. Bottled water had been supplied to the occupants of these properties prior to the installation of the public water line.

The mobility of arsenic in soil and sediment particles is low; however, some forms of arsenic are soluble in water, where its mobility may be relatively high. Arsenic left in the groundwater at the Site will persist for many years and may be readily available if any humans or animals are exposed to it through ingestion.

Non-carcinogenic effects of arsenic exposure include hyperpigmentation, keratosis and possible vascular complications. Arsenic exposure also is associated with lung, liver, kidney, bladder and skin cancers.

Based on the human health risk assessment, arsenic is present at concentrations in the groundwater contaminant plume that result in estimated human health risks to adults and children, through potable groundwater use, that exceed EPA's target risk levels. Excess lifetime cancer risks and hazard index quotients for trespassers, such as hunters or exploring adolescents, and company workers are less than EPA's target risk levels.

Theoretically, exposure to arsenic at OU3 could occur if people were to trespass onto the PNA property and come into contact with the G&P slurry in Quarry 1 and Quarry 3, arsenic-impacted sediment at the bottom of the quarries or arsenic-impacted surface waters in the quarries. A person could be exposed to arsenic by dermal contact if one were to touch the G&P slurry or sediment, by ingestion if one were to put one's hand into the mouth after touching the G&P slurry or sediment or by inhalation if dust particles were suspended into the air. Swimming in the surface water could expose someone to arsenic by dermal contact or by ingestion if the water was swallowed.

To prevent trespassers from accessing the Site, PNA has installed fencing, locked gates and signage around the OU3 source areas, and PNA routinely inspects these to verify they are intact. In addition to such inspections, PNA security personnel also conduct unscheduled patrols, either by vehicle or on foot, around the OU3 source areas to prevent trespassing.

Ingestion of groundwater in not occurring on the PNA property because there are no wells producing groundwater for potable use on the property. In addition, the area residents with private wells screened in the St. Peter Sandstone have wells in areas not impacted by arsenic from the Site. Because the St. Peter Sandstone produces a potentially usable water supply (despite the naturally-occurring hard water, iron taste and radium levels), the residential use of groundwater is a potential future exposure pathway.

2.2.4 RESPONSE ACTION SUMMARY

The Illinois Environmental Protection Agency ("IEPA") managed the initial Site investigations from the mid-1980s until 1999, when it referred the Site to EPA.

PNA and EPA entered into an AOC (U.S. EPA Docket No. V-W-'01-C-663) on September 28, 2001, which required PNA to conduct a Remedial Investigation ("RI") and feasibility study ("FS") and to pay past response and oversight costs. PNA completed RIs for each of the Operable Units: OU1 (August 2007), OU2 (September 2007) and OUs 3 and 4 (August 2008). In October 2011, PNA developed a draft addendum to the RI to further characterize ecological risks posed by the arsenic in OU 3. In addition, a FS for OU 3 was completed in June 2009. EPA issued the Interim Record of Decision ("IROD") on September 29, 2010.

The "Residential Soils" OU1 is located in the Village of Naplate. PNA conducted soil sampling in several Naplate residential areas in late 2001 and discovered elevated levels of arsenic on two residential lots located close to the factory. PNA determined that fill material containing G&P slurry solids had been taken from the facility and was used to fill in low spots so that a home could be built on one of the lots.

Under the terms of the AOC, PNA conducted a time-critical removal action at the two residences. In December 2003, PNA began excavating soil and G&P slurry material that contained arsenic. Under EPA oversight, PNA excavated a total of 3,325 cubic yards of soil and G&P slurry material from the two lots and disposed of it in an off-site landfill. PNA placed clean soil backfill into the excavations and reseeded the lots. The removal action was completed in June 2004. The homes also were found to have above-normal levels of arsenic-laden dust inside and PNA conducted a cleanup inside the homes to reduce the interior arsenic levels to safe levels.

From 2003 through 2005, PNA measured soil arsenic levels at a total of 210 residential or commercial properties in Naplate (over 90 percent of the Village). The majority of the Village properties were found to have an average arsenic level at or below the average naturally occurring soil arsenic level (11 parts per million ("ppm")) for rural counties in Illinois. Eight of the residential properties (of the 210 tested) had a single soil sample that had an arsenic test result above 50 ppm. Although not determined harmful by EPA, PNA excavated these eight properties to remove the 50 ppm arsenic hot spots. PNA completed the residential soil cleanup effort in October 2008. A single sample representing elevated arsenic remains below a structure located at 417 22nd Avenue in LaSalle County, Ottawa, Illinois due to the infeasibility of removing soil located proximate to the building foundation. The deed to this property and a recorded Environmental Covenant provide PNA and EPA the right to access the property and to conduct response actions.

EPA issued a Record of Decision ("ROD") in September 2008 that called for no further cleanup action at OU1 because the estimated human health risk due to arsenic levels measured in the soils did not exceed EPA's target risk range. Additionally, the ROD also found that no response activity was necessary to protect human health or the environment at OU2, Illinois River Sediment; however, EPA recommended that "NO TRESPASSING" signs be placed along the bank of the Illinois River to help prevent trespasser exposures.

In 2006, PNA discontinued piping wastewater across the River to Quarry 2. As a result, Quarries 2, 3, and 4 have started to dry out and the aerial extent of the arsenic-impacted groundwater plume has shrunk.

2.2.5 CLEANUP OBJECTIVES

Groundwater in the St. Peter Sandstone formation at the Site contains arsenic above the drinking water standard (MCL) of 10 ppb. Therefore, a potential adverse health risk exists if residents consume the arsenic-impacted water in the future. The remedial action objectives ("RAOs") of an interim cleanup action at OU3 are to:

- Prevent the potable use of groundwater with arsenic above 10 ppb; and,
- Reduce the concentration of arsenic in the groundwater over time.

Although the human health risks calculated for a Site maintenance worker or trespassers did not exceed EPA's target risk ranges, a secondary interim RAO is to:

- Prevent future contact with the G&P slurry material in Quarry 1, as well as arsenic-impacted sediment in all of the quarries.

2.2.6 SUBSTANTIVE USE RESTRICTIONS IDENTIFIED IN THE DECISION DOCUMENTS – IC OBJECTIVES

Based on the 2008 ROD and 2010 IROD, PNA has identified six objectives to be addressed through ICs (if any institutional control objectives are identified for OU4, they will be incorporated into this plan). These objectives are as follows:

1. Prevent human exposure to arsenic containing material that may be located below the foundation of the house at 417 22nd Avenue, Ottawa, Il.
2. Prevent trespasser exposure to arsenic present in sediments along the bank of the Illinois River.
3. Prevent any inappropriate development of the source areas within OU3, all of which are located on PNA's property.
4. Prevent trespassing on source areas within OU3.
5. Prevent potable use of groundwater within the St. Peter Sandstone aquifer on PNA's property within OU3, wherever the groundwater contains arsenic at levels above the MCL.
6. Prevent potable use of any groundwater in the St. Peter Sandstone aquifer beyond the boundaries of PNA's property wherever the groundwater contains arsenic at levels above the MCL.

2.2.7 CURRENT AND REASONABLE ANTICIPATED FUTURE LAND USE

Currently, OU1 consists of residential areas and it is anticipated that these areas would remain residential in the future.

OU2 consists of river sediment next to the Site and no change in use is anticipated in the future.

OU3 is PNA-owned property located in unincorporated LaSalle County, adjacent to the City of Ottawa. Under a LaSalle County zoning ordinance enacted in 2006, land outside any city or town is zoned for agricultural use until a change is made in the use of the property. If a change to the use is proposed, a zoning change would need to be proposed. Thus, the quarries in OU3 will be zoned for agricultural use until there is a change in the land use. OU3 formerly was used for the mining of silica sand and then for management of the G&P slurry and wastewaters from plant operations. The property is now vegetated and generally out of use. Land surrounding the PNA property is primarily residential, with some commercial use also evident. Future land use is reasonably assumed to remain the same as current use. PNA has not announced any changes to, or plans to change, the way it manages the property.

2.3 PROPERTY INFORMATION AND IC STAKEHOLDER CONTACTS

2.3.1 PARCEL OWNERSHIP/OCCUPANCY INFORMATION

The parcel in OU1 that is covered by the IC (417 22nd Avenue, Ottawa, IL) currently is owned by Shane Vogel. Figure 1 shows the location of this parcel.

PNA owns the property where the IC for OU2 has been implemented.

All the quarries or source areas within OU3 are owned by PNA.
Figure 2 shows the location of the arsenic-impacted groundwater plume, which is wholly located within the boundaries of LaSalle County.

2.3.2 PROPERTY INTEREST AND RESOURCE OWNERSHIP

There are no additional property interests at OU1, OU2 or OU3 that may impact the ICs. Several utility easements have been recorded on the OU3 property that allowed for installation and maintenance of various utilities. None of these easements, however, will impact the ICs on OU3. The remedy for OU4 has not been selected yet, but if ICs are selected as part of the remedy for OU4, they will be incorporated into this ICIAP.

2.3.3 RESPONSIBLE PARTY

As of this date, PNA is the responsible party. The point of contact for PNA is:

James Lavrich
Environmental Manager
Pilkington North America, Inc.
140 Dixie Highway
Rossford, OH 43460
(419) 247-4538
james.lavrich@nsg.com

2.3.4 TRIBAL, STATE, AND/OR LOCAL GOVERNMENT CONTACTS

Illinois EPA
Robin Ambrose

Illinois Environmental Protection Agency
1001 North Grand Avenue E
Springfield, IL 62702
Telephone (217) 785-6309

LaSalle County Health Department
717 East Etna Road,
Ottawa, IL 61350
Telephone (815) 433-3366

City of Ottawa
301 West Madison Street
Ottawa, IL 61350
Telephone (815) 433-0161

2.3.5 OTHER RELEVANT STAKEHOLDERS

There are no community groups involved with this Site.

2.4 ACCURATE MAPPING OF RESIDUAL CONTAMINATION, IC BOUNDARIES, AND OTHER SITE FEATURES

See Figures 1 through 6.

3.0 KEY ELEMENTS FOR ALL PLANNED/IMPLEMENTED ICs

The following provides the elements to achieve each of the IC objectives provided in Section 2.2.6. PNA anticipates that it will record one environmental covenant to achieve Objectives 3 and 5.

Table 3.1 Summary of IC Implementation to Achieve IC Objective 1: Prevent Human Exposure to Arsenic Containing Material That May Be Located Below the House at 417 22nd Avenue, Ottawa, Il

IC ELEMENT	DESCRIPTION
Instrument name	Environmental Covenant pursuant to Illinois Uniform Environmental Covenants Act, 765 Ill. Comp. Stat. 122
Entity responsible for implementation	PNA Point of Contact for PNA: James Lavrich, Environmental Manager Pilkington North America, Inc. 140 Dixie Highway Rossford, OH 43460 (419) 247-4538 james.lavrich@nsg.com
Implementation event and date	Recorded on 11/6/2015
Use restriction	In the event the Grantor ever plans to raze or demolish the existing home or garage, the homeowner shall provide 30 days advanced written notice to PNA and EPA, and, subject to EPA's oversight, PNA will remove any soil containing arsenic at elevated levels and PNA will install clean replacement soil.
Legal description of restricted area	Lots Fourteen (14) and Fifteen (15) in Block One Hundred Fifty-two (152) in Division Two (2) of Valley Addition in the Town of Ottawa, County of LaSalle, in the State of Illinois
IC instrument lifespan	In perpetuity or until such time as any arsenic-impacted soils are removed

Table 3.2 Summary of IC Implementation to Achieve IC Objective 2: Prevent Trespasser Exposure to Arsenic Present in Sediments Along the Bank of the Illinois River

IC ELEMENT	DESCRIPTION
Instrument name	"NO TRESPASSING" signage
Entity responsible for implementation	PNA Point of Contact forPNA: James Lavrich, Environmental Manager Pilkington North America, Inc. 140 Dixie Highway Rossford, OH 43460 (419) 247-4538 james.lavrich@nsg.com
Implementation event and date	Already in place
Use restriction	Prohibit trespassing
Description of restricted area	Signs located along bank of Illinois River next to Site
IC instrument lifespan	In perpetuity

Table 3.3 Summary of IC Implementation to Achieve IC Objective 3: Prevent Inappropriate Development of OU3 Source Areas

IC ELEMENT	DESCRIPTION
Instrument name	Environmental Covenant pursuant to Illinois Uniform Environmental Covenants Act, 765 Ill. Comp. Stat. 122
Entity responsible for implementation	PNA Point of Contact for PNA: James Lavrich, Environmental Manager Pilkington North America, Inc. 140 Dixie Highway Rossford, OH 43460 (419) 247-4538 james.lavrich@nsg.com
Implementation event and date	The Environmental Covenant will be recorded in the Office of the Recorder or Registrar of Titles of LaSalle County; PNA anticipates recording this during the RA phase of work for OU3
Use restriction	Prohibit residential development
Legal description of restricted area	See Exhibit 1
IC instrument lifespan	In perpetuity
Potential barriers to IC implementation	No significant barriers; EPA approval required

Table 3.4 Summary of IC Implementation to Achieve IC Objective 3: Prevent Inappropriate Development of OU3 Source Areas

IC ELEMENT	DESCRIPTION
Instrument name	Governmental Control – LaSalle County Zoning Ordinance # 08-69, as amended
Entity responsible for implementation	LaSalle County Planning and Zoning Commission
Implementation event and date	Enacted February 9, 2006, effective April 1, 2006
Use restriction	Limits future development of the OU3 source areas
Legal description of restricted area	See Exhibit 1
IC instrument lifespan	In perpetuity

Table 3.5 Summary of IC Implementation to Achieve IC Objective 5: On-Site Groundwater

IC ELEMENT	DESCRIPTION
Instrument name	Environmental Covenant pursuant to Illinois Uniform Environmental Covenants Act, 765 Ill. Comp. Stat. 122
Entity responsible for implementation	PNA Point of contact for PNA: James Lavrich, Environmental Manager Pilkington North America, Inc. 140 Dixie Highway Rossford, OH 43460 (419) 247-4538 james.lavrich@nsg.com
Implementation event and date	The Environmental Covenant will be recorded in the Office of the Recorder or Registrar of Titles of LaSalle County; PNA anticipates recording this during the RA phase of work for OU3
Use restriction	Prohibit any installation or operation of drinking water wells in the St. Peter Sandstone Aquifer
Legal description of restricted area	See Exhibit 1
IC instrument lifespan	In perpetuity
Potential barriers to IC implementation	No significant barriers; EPA approval required

Table 3.6 Summary of IC Implementation to Achieve IC Objective 5: On-Site Groundwater

IC ELEMENT	DESCRIPTION
Instrument name	Ordinance
Entity responsible for implementation	PNA will assist LaSalle County in drafting an ordinance Point of contact for PNA: James Lavrich, Environmental Manager Pilkington North America, Inc. 140 Dixie Highway Rossford, OH 43460 (419) 247-4538 james.lavrich@nsg.com LaSalle County contact: Board Chair LaSalle County Board Etna Road Complex 707 East Etna Road Ottawa, IL 61350-1047 (815) 434-8242
Implementation event and date	The ordinance will need to be enacted by the LaSalle County Board and PNA will be working with the Board on the ordinance during the RA phase of work for OU3
Use restriction	Prohibit any potable water use of groundwater from existing wells within the affected areas of the St. Peter Sandstone Aquifer and prohibit the installation of any new groundwater wells within these areas of the St. Peter Sandstone Aquifer
Legal description of restricted area	See Exhibit 1
IC instrument lifespan	In perpetuity
Potential barriers to IC implementation	EPA and LaSalle County Board approval required

Table 3.7 Summary of IC Implementation to Achieve IC Objective 6: Off-Site Groundwater

IC ELEMENT	DESCRIPTION
Instrument name	Ordinance
Entity responsible for implementation	PNA will assist LaSalle County in drafting an ordinance Point of contact for PNA: James Lavrich, Environmental Manager Pilkington North America, Inc. 140 Dixie Highway Rossford, OH 43460 (419) 247-4538 james.lavrich@nsg.com LaSalle County contact: Board Chair LaSalle County Board Etna Road Complex 707 East Etna Road Ottawa, IL 61350-1047 (815) 434-8242
Implementation event and date	The ordinance will need to be enacted by the LaSalle County Board and PNA will be working with the Board on the ordinance during the RA phase of work for OU3
Use restriction	Prohibit any potable water use of groundwater from existing wells within the affected areas of the St. Peter Sandstone Aquifer, except any such wells that meet drinking water standards for arsenic, and prohibit the installation of any new groundwater wells within these areas of the St. Peter Sandstone Aquifer
Description of restricted area	See Figure 3
IC instrument lifespan	In perpetuity or until such time as EPA determines that an ordinance is no longer necessary based upon the then-current location of the plume and buffer zone as identified by the most recent five (5)-year Site review
Potential barriers to IC implementation	EPA and LaSalle County Board approval required

Table 3.8 Summary of IC Implementation to Achieve IC Objective 6: Off-Site Groundwater

IC ELEMENT	DESCRIPTION
Instrument name	Ordinance Ottawa, Illinois Code Sec. 106-1 (Ord. No. 002-2007)
Entity responsible for implementation	City of Ottawa, Illinois 301 West Madison Street Ottawa, IL 61350 (815) 433-0161
Implementation event and date	Passed January 16, 2007
Use restriction	Prohibit the installation of wells within the City limits
Description of restricted area	See Figure 3
IC instrument lifespan	In perpetuity

Table 3.9 Summary of IC Implementation to Achieve IC Objective 6: Off-Site Groundwater

IC ELEMENT	DESCRIPTION
Instrument name	Restrictive Covenants
Entity responsible for implementation	City of Ottawa, Illinois 301 West Madison Street Ottawa, IL 61350 (815) 433-0161
Implementation event and date	Recorded on 12/16/2015 and 1/8/2016
Use restriction	Prohibit installation of any groundwater well on the identified properties.
Legal description of restricted area	See Exhibit 2
IC instrument lifespan	In perpetuity

Table 3.9 IC Relationship Matrix

PROPERTY LOCATION	AREA OF INTEREST (See Figure)	CONTAMINANTS REMAINING	CONTAMINATED MEDIA	ENGINEERING CONTROLS	CLEANUP OBJECTIVE	USE RESTRICTION/IC OBJECTIVE	CONDITIONS FOR TERMINATION	IC INSTRUMENTS (PLANNED OR IMPLEMENTED)
Source areas within OU3	4	Arsenic	Surface soil Subsurface soil	Fencing to limit access	Prevent inappropriate development Prevent trespassing	Prevent unacceptable risks due to residential exposures	ICs needed in perpetuity; levels allowing for unlimited use and unrestricted exposure will not be met by response actions	Environmental Covenant recorded with the LaSalle County Office of Recorder or Registrar of Title Local zoning designation as agricultural
PNA's property	4	Arsenic	Groundwater	Alter path of surface drainage around Quarries 1 and 2 to reduce rate of groundwater recharge and reduce aerial extent of plume	Prohibit potable use of arsenic-impacted groundwater	No wells for potable use installed on PNA's property	ICs needed in perpetuity; levels allowing for unlimited use and unrestricted exposure will not be met by response actions	County ordinance prohibiting potable use of groundwater in St. Peter Sandstone Aquifer Environmental Covenant recorded with the LaSalle County Office of Recorder or Registrar of Title
Off-site property	3	Arsenic	Groundwater	Alter path of surface drainage around Quarries 1 and 2 to reduce rate of groundwater recharge and reduce aerial extent of plume	Prohibit drinking of arsenic-impacted groundwater	Prevent installation of new wells	Once MCLs are attained	County ordinance prohibiting installation of new wells and prohibiting use of existing wells for drinking water, unless meets MCL (planned)
Off-site property	6	Arsenic	Groundwater	Municipal water service extended to 3 properties and existing wells decommis sioned.	Prohibit drinking of arsenic-impacted groundwater	Prevent installation of new wells	ICs will remain in perpetuity as City ordinance prohibits properties supplied with municipal water from installing groundwater wells.	Restrictive covenant recorded with the LaSalle County Office of Recorder or Registrar of Title

417 22nd Ave	1	Arsenic	Soils	Potentially-impacted soils located beneath a building	Remove any arsenic-impacted soils if structure is razed	Prevent unacceptable risks due to residential exposures	IC needed in perpetuity or until such time as any arsenic-impacted materials are removed	Environmental Covenant recorded with the LaSalle County Office of Recorder or Registrar of Title
Illinois River Sediment	5	Arsenic	Sediment	Signage to prevent trespassers	Prevent trespassing	Prevent unacceptable risks due to residential exposures	In perpetuity	Signage

SECTION 4.0 MAINTENANCE ELEMENTS

Institutional control maintenance consists of periodic monitoring and reporting to confirm that ICs are in place and providing protection as intended. Maintenance activities consist of notifications to new land owners or lessees and periodic review of the property and ICs.

4.1 IC ASSURANCE MONITORING

PNA is responsible for IC monitoring. The PNA contact for the IC assurance monitoring is:

James Lavrich,
Environmental Manager
Pilkington North America, Inc.
140 Dixie Highway
Rossford, OH 43460
(419) 247-4538
james.lavrich@nsg.com

PNA annually will review the LaSalle County's zoning classification for OU3 to confirm that it remains zoned agricultural. PNA also will request the LaSalle County zoning board to advise PNA of any proposed zoning changes that may significantly alter land use at OU3.

Semi-annually, PNA will inspect the fencing, locked gates and signage around the OU3 source areas to verify they are intact. In addition to such semi-annual inspections, PNA security personnel also conduct unscheduled patrols, either by vehicle or on foot, around the OU3 source areas to prevent trespassing.

The terms of the Remedial Action Consent Decree impose limits or restrictions on any future sale or transfer of the PNA property containing the OU3 source areas. In the event of a future sale or transfer, PNA would provide the recorded Environmental Covenants to any such transferee.

As part of each five (5)-year Site review, PNA will identify the locations of the then-current plume and buffer zone and survey any landowners in the affected areas in the buffer zone to confirm that any potable use of groundwater and any well installation activities have been undertaken in compliance the contemplated LaSalle County groundwater use ordinance. If the groundwater plume continues to shrink, subject to EPA review and approval, it may be possible to work with LaSalle County to shrink the geographic area covered by any ordinance prohibiting the installation of wells in the upper aquifer (the St. Peter Sandstone).

In the event Environmental Covenants are recorded on any properties in the affected areas of the then-current buffer zone as identified as part of the five (5)-year Site review, PNA will monitor property transfers in these areas. Here again, if the groundwater plume continues to shrink, subject to EPA review and approval, it may be possible to modify the geographic scope of any Environmental Covenants. PNA also will monitor any transfer of 417 22nd Avenue, Ottawa, Illinois.

4.2 REPORTING

PNA will develop a procedure and format for recording IC monitoring activities. Every five years, PNA will provide a report to EPA documenting IC monitoring and specifically identifying any zoning changes, property transfers and breaches of ICs that occurred during the reporting period.

SECTION 5 IC ENFORCEMENT ELEMENTS

LaSalle County will be responsible for enforcing the zoning classifications and the proposed groundwater use ordinance once it is enacted. If PNA becomes aware of any breaches of either the zoning classification or the groundwater use ordinance, it will timely report such breach to the appropriate LaSalle County official.

PNA will be responsible for complying with the Environmental Covenants recorded on its property.

SECTION 6 MODIFICATION & TERMINATION ELEMENTS

At the Site, modification of the ICs may be required in the event of a change in land use or ownership. Further, since the remedy for OU4 has not been selected yet, this ICIAP may be modified if ICs are selected as part of the remedy for OU4. If an event occurs that could lead to a modification, this plan should be reviewed and revised accordingly to ensure the ICs at the Site continue to provide adequate protection. Termination of ICs may occur if all remaining arsenic at the Site is removed to a level below that which poses a risk to health and the environment. EPA is responsible for termination of ICs related to this Site.

SECTION 7 APPENDICES

Figure 1: Operable Unit 1 (Village of Naplate) Institutional Control

Figure 2: October 2013 Extent of Arsenic in Groundwater

Figure 3: Off-Site Groundwater Subject to Institutional Control

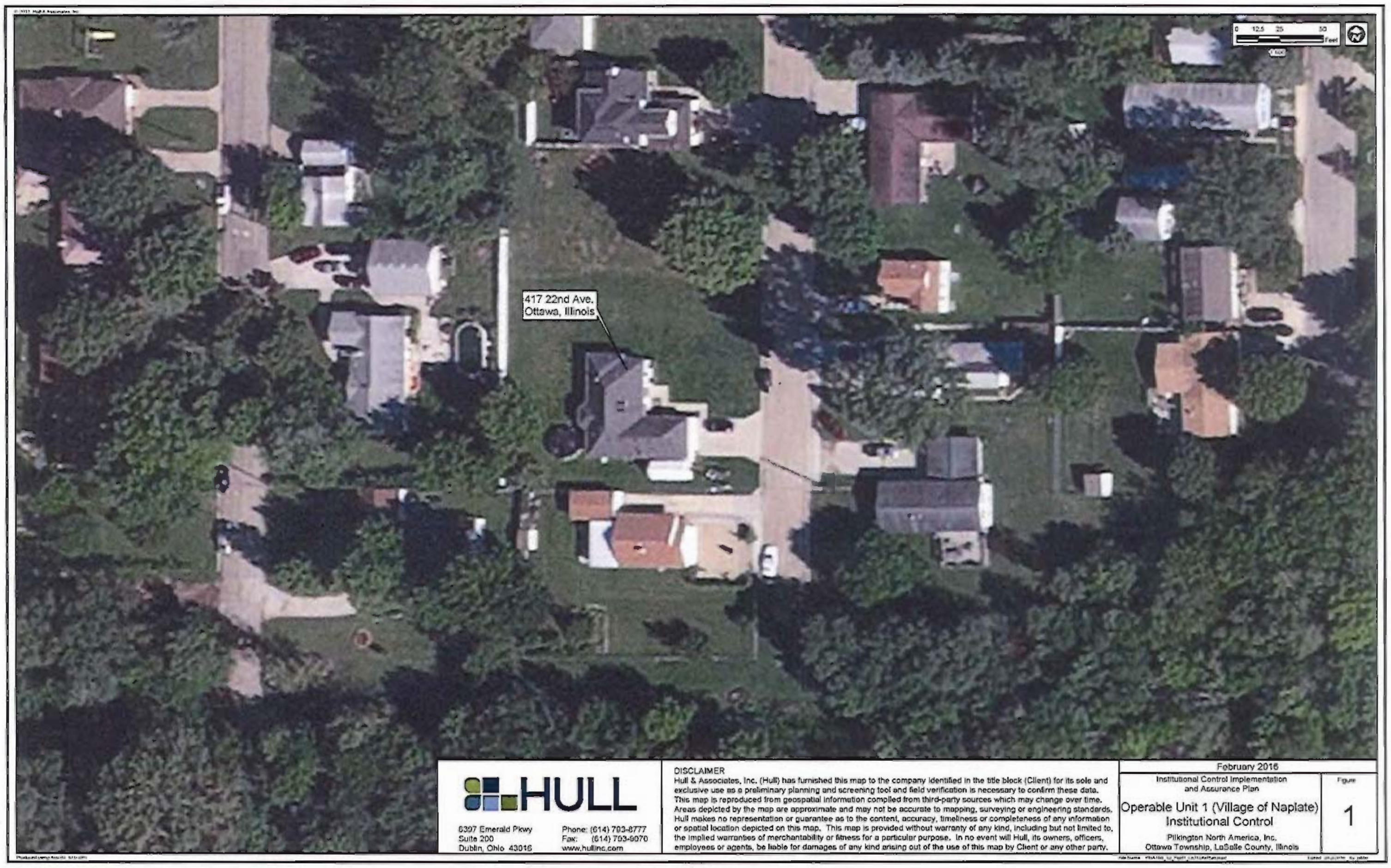
Figure 4: Site Layout of Operable Unit 3

Figure 5: Operable Unit 2 (Illinois River) Institutional Control

Figure 6: Off-Site Institutional Controls

Exhibit 1: Legal Description of PNA property located within OU3

Exhibit 2: Legal Description of Three Off-Site Properties Subject to Institutional Controls


417 22nd Ave.
Ottawa, Illinois
HULL
6397 Emerald Pkwy
Suite 200
Dublin, Ohio 43016
Phone: (614) 793-8777
Fax: (614) 793-9070
www.hullinc.com
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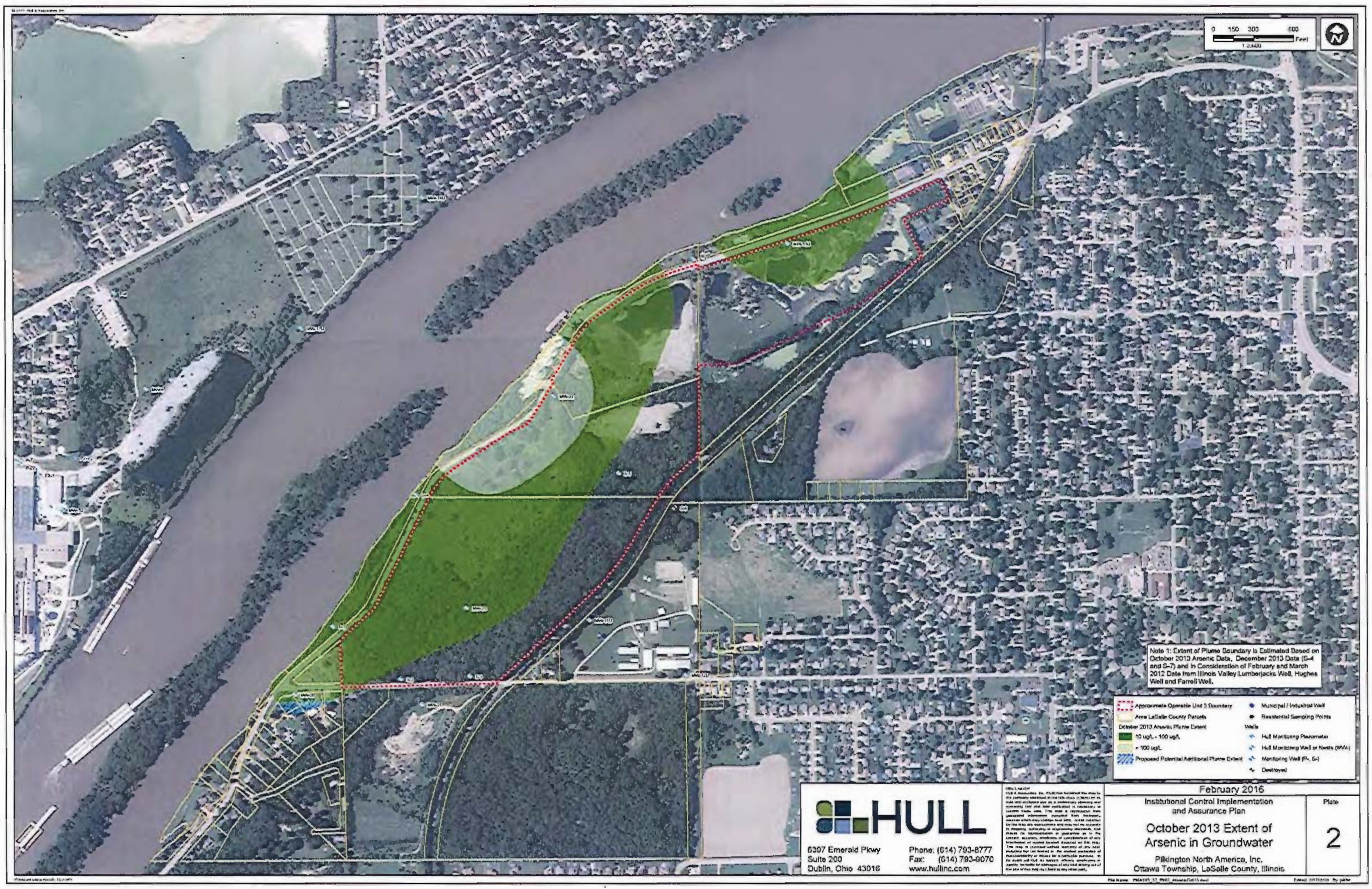
February 2016
Institutional Control Implementation and Assurance Plan
Operable Unit 1 (Village of Naplate) Institutional Control
Pilkington North America, Inc.
Ottawa Township, LaSalle County, Illinois
Figure
1


Note 1: Extent of Plume Boundary is Estimated Based on October 2013 Arsenic Data, December 2013 Data (S-4 and S-7) and in Consideration of February and March 2012 Data from Illinois Valley Lumberjacks Well, Hughes Well and Farrell Well.
Approximate Operable Unit 3 Boundary
Area LaSalle County Parcels
October 2013 Arsenic Plume Extent
10 ug/L - 100 ug/L
> 100 ug/L
Proposed Potential Additional Plume Extent
Municipal / Industrial Well
Residential Sampling Points
Wells
Hull Monitoring Piezometer
Hull Monitoring Well or Nests (MW-)
Monitoring Well (P-, G-)
Destroyed
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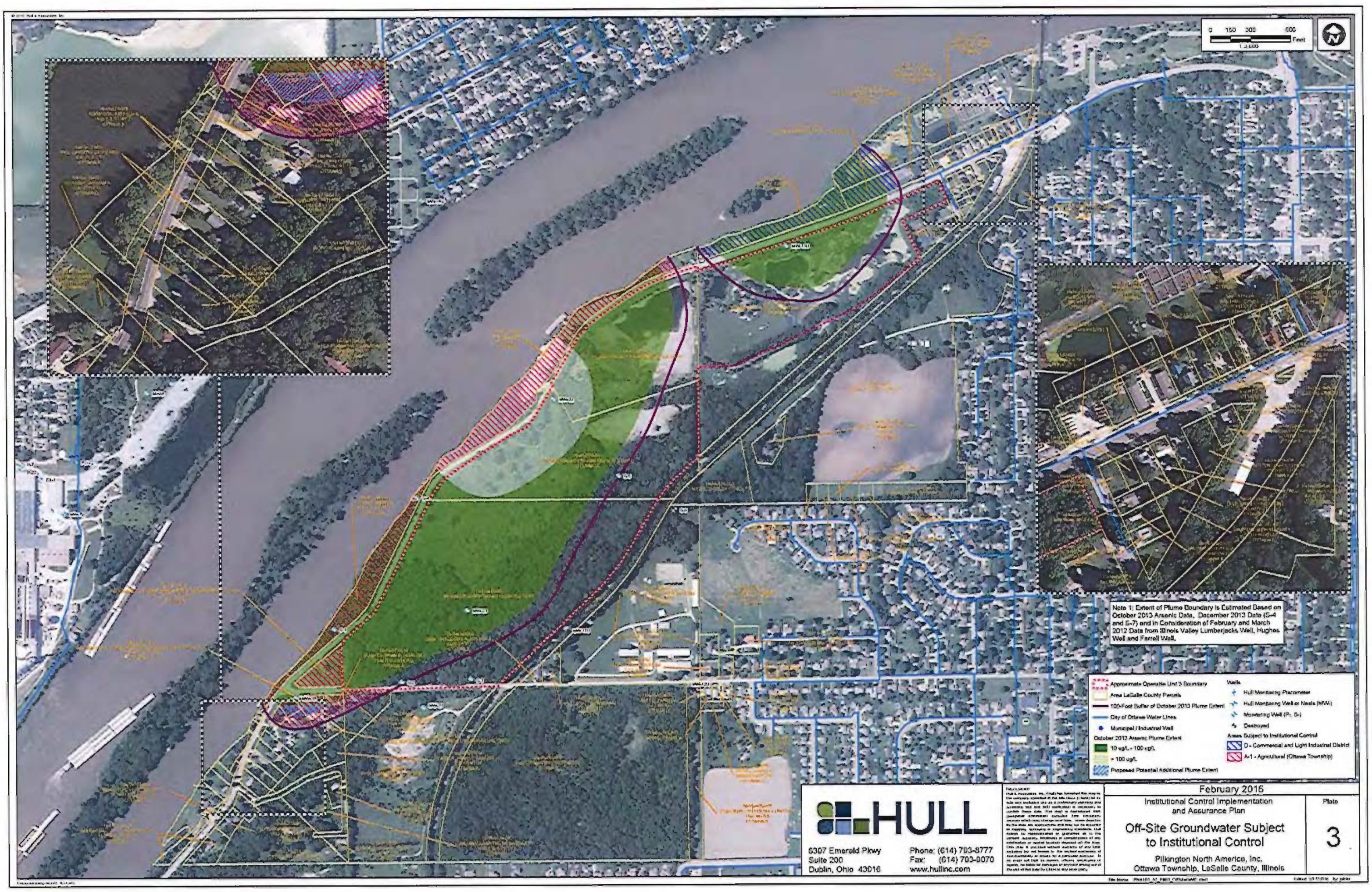
Suite 200
Dublin, Ohio 43016
Phone: (614) 793-8777
Fax: (614) 793-9070
www.hullinc.com
February 2016
Institutional Control Implementation
and Assurance Plan
October 2013 Extent of
Arsenic in Groundwater
Pilkington North America, Inc.
Ottawa Township, LaSalle County, Illinois
Plate
2


Note 1: Extent of Plume Boundary is Estimated Based on October 2013 Arsenic Data, December 2013 Data (S-4 and S-7) and in Consideration of February and March 2012 Data from Illinois Valley Lumberjacks Well, Hughes Well and Ferrell Well.
Approximate Operable Unit 3 Boundary
Area LaSalle County Parcels
100-Foot Buffer of October 2013 Plume Extent
City of Ottawa Water Lines
Municipal / Industrial Well
October 2013 Arsenic Plume Extent
10 ug/L - 100 ug/L
> 100 ug/L
Proposed Potential Additional Plume Extent
Wells
Hull Monitoring Piezometer
Hull Monitoring Well or Nests (MW-)
Monitoring Well (P-, B-)
Destroyed
Areas Subject to Institutional Control
D - Commercial and Light Industrial District
A-1 - Agricultural (Ottawa Township)
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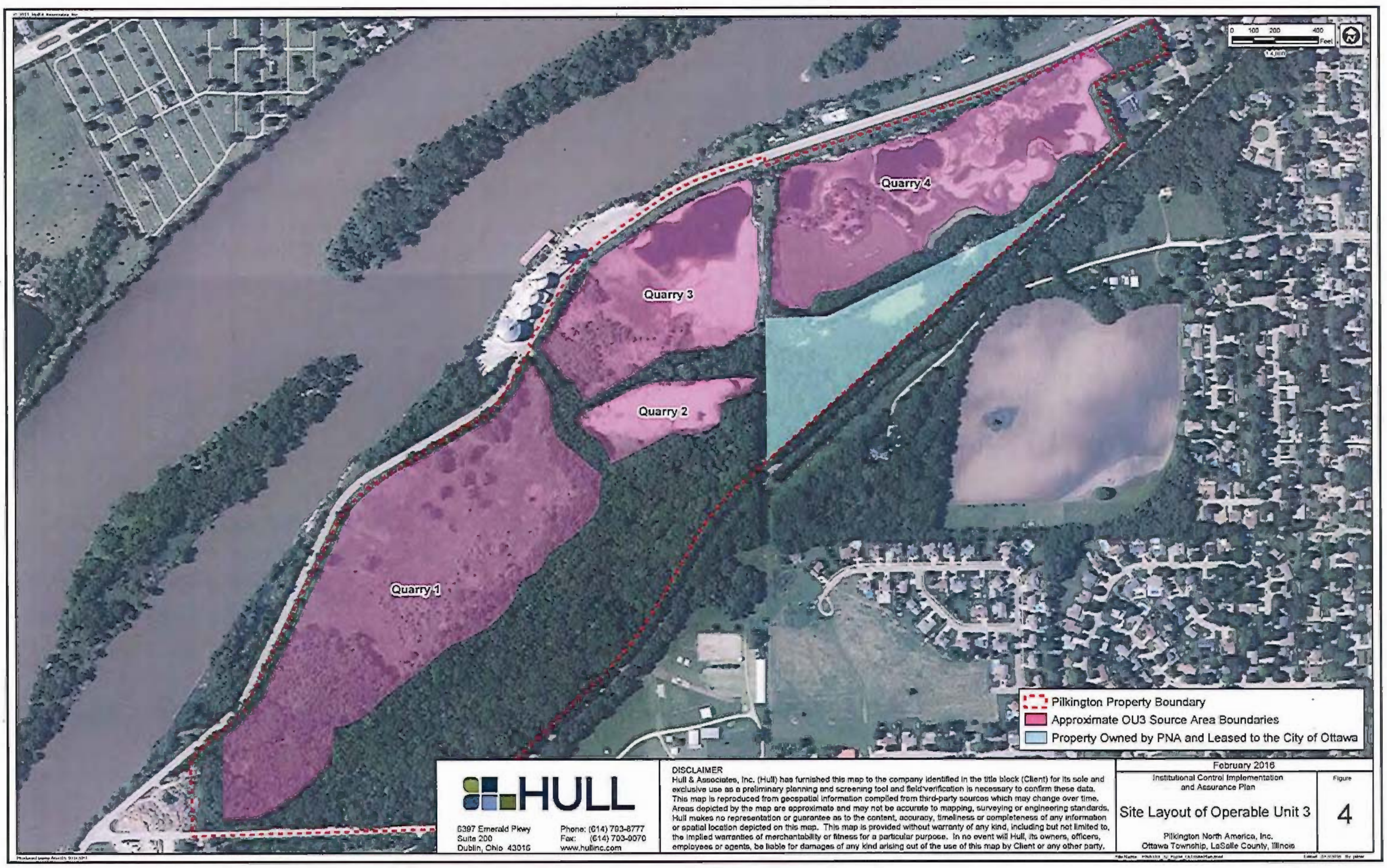
6307 Emerald Pkwy
Suite 200
Dublin, Ohio 43016
Phone: (614) 793-8777
Fax: (614) 793-0070
www.hullinc.com
February 2016
Institutional Control Implementation and Assurance Plan
Off-Site Groundwater Subject to Institutional Control
Pilkington North America, Inc.
Ottawa Township, LaSalle County, Illinois
Plate
3


Quarry 4
Quarry 3
Quarry 2
Quarry 1
Pilkington Property Boundary
Approximate OU3 Source Area Boundaries
Property Owned by PNA and Leased to the City of Ottawa
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Fax: (614) 793-9070
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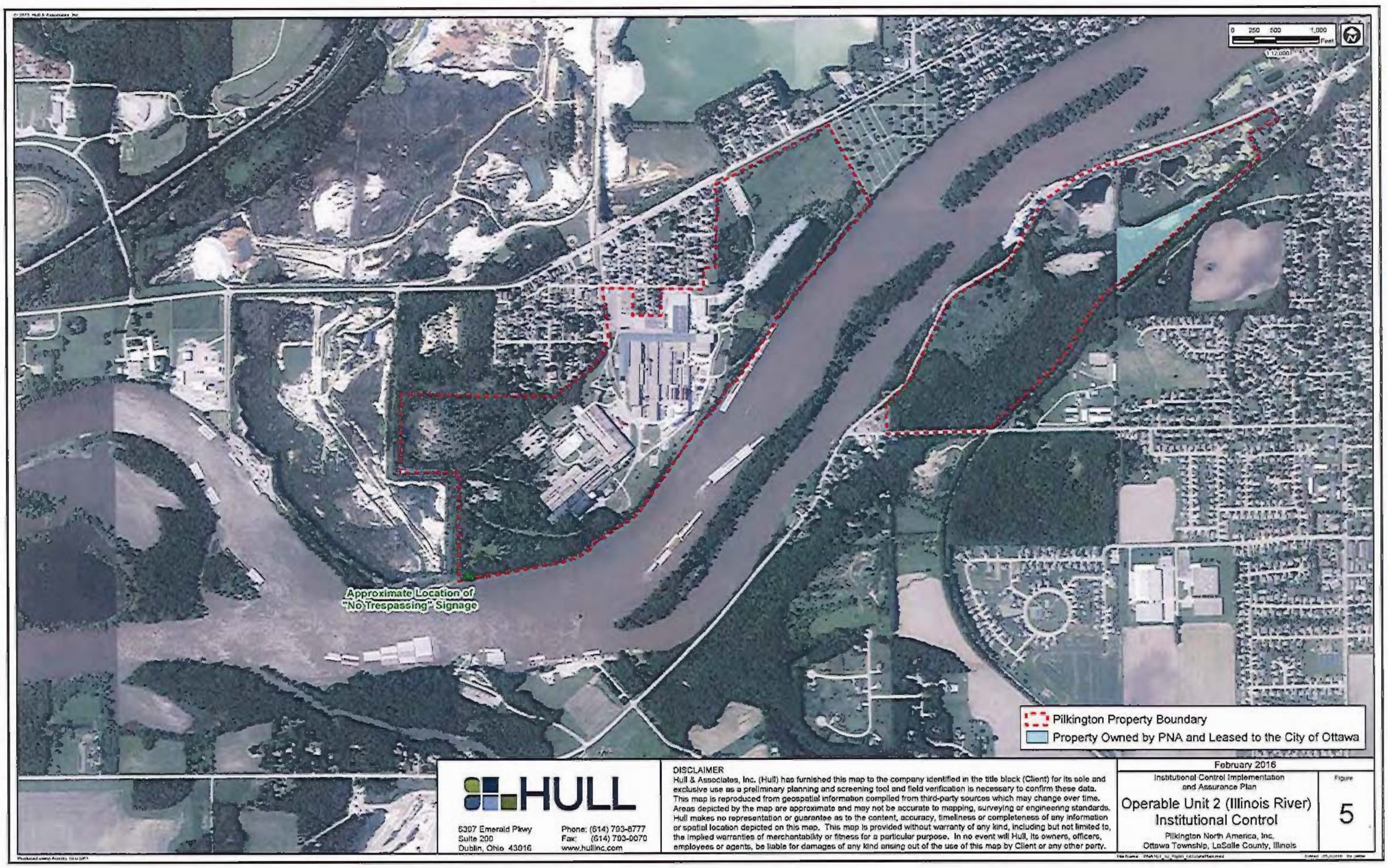
Institutional Control Implementation and Assurance Plan
Site Layout of Operable Unit 3
Figure
4
Pilkington North America, Inc.
Ottawa Township, LaSalle County, Illinois


0 250 500 1,000 Feet
Approximate Location of "No Trespassing" Signage
Pilkington Property Boundary
Property Owned by PNA and Leased to the City of Ottawa
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6397 Emerald Pkwy
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Dublin, Ohio 43016
Phone: (614) 793-8777
Fax: (614) 793-9070
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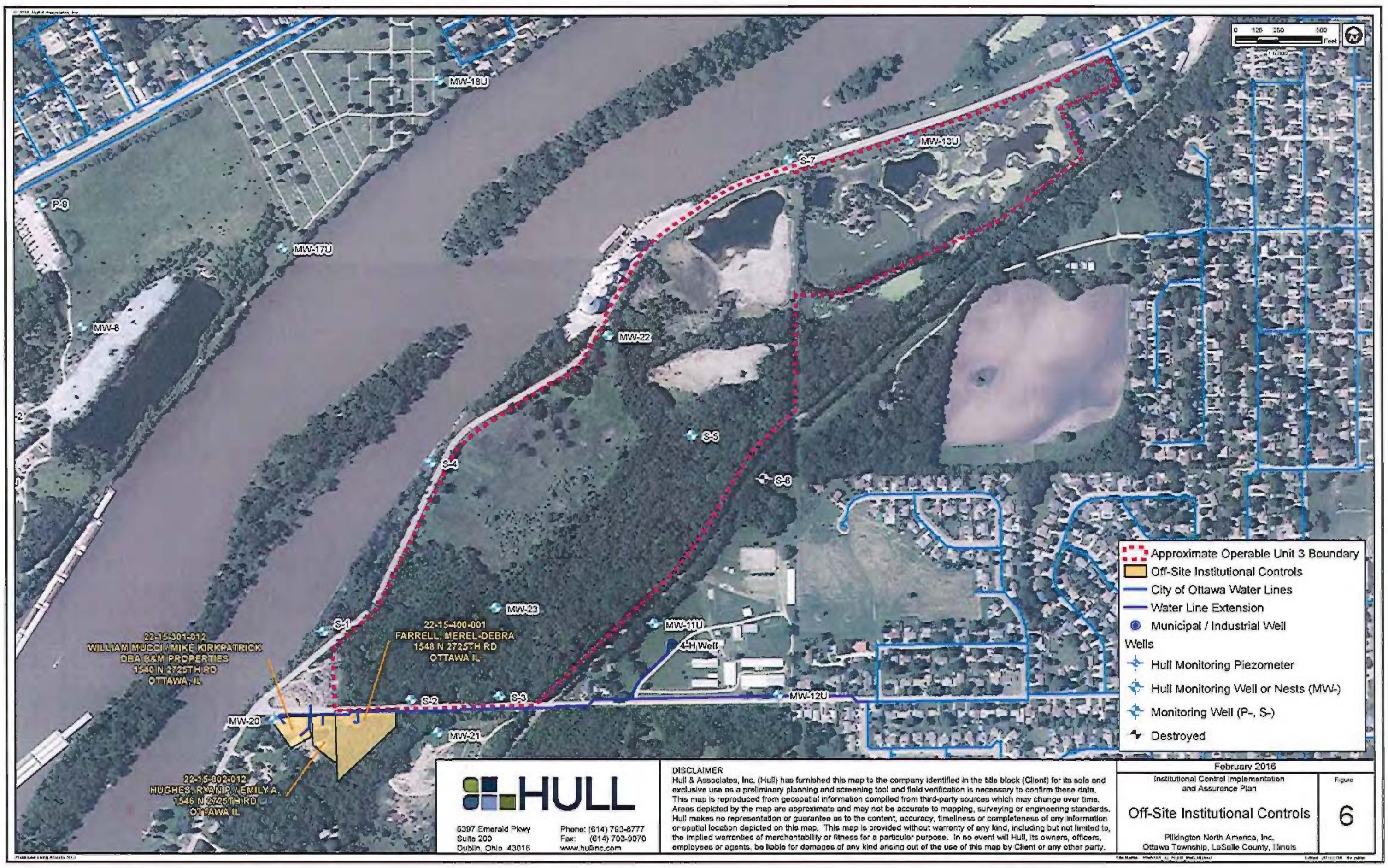
Institutional Control Implementation and Assurance Plan
Operable Unit 2 (Illinois River) Institutional Control
Pilkington North America, Inc.
Ottawa Township, LaSalle County, Illinois
Figure
5



MW-18U
MW-13U
S-7
P-9
MW-17U
MW-8
MW-22
S-5
S-4
S-6
MW-23
S-1
22-15-301-012
WILLIAM MUCCI / MIKE KIRKPATRICK
DBA B&M PROPERTIES
1540 N 2725TH RD
OTTAWA, IL
22-15-400-001
FARRELL, MEREL-DEBRA
1548 N 2725TH RD
OTTAWA IL
MW-11U
4-H Well
S-2
S-3
MW-12U
MW-20
MW-21
22-15-302-012
HUGHES, RYAN P. / EMILY A.
1546 N 2725TH RD
OTTAWA IL
Approximate Operable Unit 3 Boundary
Off-Site Institutional Controls
City of Ottawa Water Lines
Water Line Extension
Municipal / Industrial Well
Wells
Hull Monitoring Piezometer
Hull Monitoring Well or Nests (MW-)
Monitoring Well (P-, S-)
Destroyed
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February 2016
Institutional Control Implementation and Assurance Plan
Off-Site Institutional Controls
Figure
6
Pilkington North America, Inc.
Ottawa Township, LaSalle County, Illinois

EXHIBIT 1

LEGAL DESCRIPTION OF PNA PROPERTY LOCATED WITHIN OU3

PARCEL 1:
That part of the East Half of Fractional Section 15, Township 33 North, Range 3 East of the Third Principal Meridian in La Salle County, Illinois described as follows: Commencing at a point on the East line of said Section 15, 952.7 feet North of the Northeast corner of the Southeast Quarter of said Section 15 being also the point of intersection of the said East line of Section 15 with the Southeasterly line of Blackhawk Beach Property, thence running South 72 degrees 40 minutes West along said Southeasterly line 988.7 feet; thence North 27 degrees 51 minutes West along the Southwesterly line of said Blackhawk Beach property, 348.1 feet to the centerline of State Highway Number 71; thence Southerly following the centerline of said State Highway Number 71 to a point where the centerline intersects the West line of the East Half of said Section 15; thence South along the West line of the East Half of said Section 15, 359.0 feet to the Southwest corner of the North Half of the Southeast Quarter of said Section 15; thence South 89 degrees 59 minutes East along the South line of the North Half of the Southeast Quarter of said Section 15 to the Northwesterly Right of Way line of the Chicago Burlington & Quincy Railroad; thence Northeasterly along said Northwesterly Right of Way line to the East line of Section 15; thence North along the East line of Section 15 to the Point of Beginning;

PARCEL 2:
That part of the Northeast Fractional Quarter of Section Fifteen (15), Township Thirty-three (33) North, Range Three (3) East of the Third Principal Meridian, LaSalle County, Illinois, lying Southeasterly of the center line of State Highway Number 71, described as follows: Beginning at a point on the East line of said Section Fifteen (15), which point is 952.7 feet North of the Quarter corner of said Section, thence South 72 degrees 40 minutes West 988.7 feet, thence North 27 degrees 51 minutes West 320.1 feet to the center line of State Highway Number 71, thence along said center line North 30 degrees 45 minutes East 361.7 feet, thence North 44 degrees 38 minutes East 274.6 feet, thence North 55 degrees 55 minutes East 267.5 feet, thence North 63 degrees 48 minutes East 293.1 feet, thence North 71 degrees 58 minutes East 240.6 feet, and to a point at the intersection of the center line of State Highway Number 71 and the East line of said Section Fifteen (15), thence South along said East line 849.5 feet, and to the Point of Beginning;

PARCEL 3:
That part of the Northwest Quarter of Section Fourteen (14), Township Thirty-three (33) North, Range Three (3) East of the Third Principal Meridian, described as follows: Commencing at the intersection of the center line of State Highway Number 71 and the Section line between said Section Fourteen (14) and Section Fifteen (15) and running thence South on said line to the center of the Chicago, Burlington and Quincy Railroad, thence Northeasterly along said center line to the center line of Bane Street in Hitt's Addition to Ottawa, thence Northerly to the center of Blanchard Street, thence Easterly along the center line of Blanchard Street to the West line of Swanson Street, thence Northerly along said West line of Swanson Street to the center line of said State Highway Number 71, thence Southwesterly along the center line of said State Highway Number 71, to the Place Of Beginning; and EXCEPTING THEREFROM THE FOLLOWING DESCRIBED TRACT:

"That part of the Northwest Quarter of Section 14, Township 33 North, Range 3 East of the Third Principal Meridian described as follows: Beginning at the intersection of the Northerly Right of Way line of the Chicago, Burlington and Quincy Railroad and the West line of Section 14; thence due North 454.752 feet on the West line of the said Section 14 to the True Point of Beginning; thence due North 219.42 feet on the West line of the said Section 14; thence South 85 degrees 05 minutes East 234.74 feet; thence North 79 degrees 12 minutes 49 seconds East 94.20 feet; thence North 63 degrees 07 minutes East 305.32 feet; thence North 64 degrees 03 minutes 28 seconds East 264.80 feet; thence North 64 degrees 10 minutes 15 seconds East 80.00 feet; thence South 41 degrees 20 minutes 35 seconds East 120.35 feet to the said Northerly Right of Way line; thence South 48 degrees 39 minutes 25 seconds West 1016.39 feet on the said Northerly Right of Way line; thence North 41 degrees 20 minutes 35 seconds West 341.06 feet to the True Point of Beginning;

all being situated in COUNTY OF LASALLE, STATE OF ILLINOIS.***

EXHIBIT 2

LEGAL DESCRIPTION OF THREE OFF-SITE PROPERTIES

SUBJECT TO INSTITUTIONAL CONTROLS

PROPERTY LOCATED AT 1540 N. 2725TH ROAD:

Part of the East fractional part of the Southwest Quarter of Section 15, Township 33 North, Range 3, East of the Third Principal Meridian described as follows: Commencing at the Southeast corner of the Southwest Quarter of said Section 15, thence North 1 degree 34 minutes 00 seconds West 1271.03 feet along the East line of the Southwest Quarter of Section 15 to a point on the South Right-of-way line of the public road; thence North 89 degrees 50 minutes 38 seconds West 176.0 feet along the South Right-of-way line to the Point of Beginning, thence South 1 degree 34 minutes 00 seconds East 85.17 feet along a line parallel with said East line of Section 15, thence South 58 degrees 48 minutes 39 seconds West 130.36 feet to a point; thence North 31 degrees 11 minutes 21 seconds West 64.86 feet to a point, thence North 35 degrees 54 minutes 46 seconds West 89.82 feet to a point, thence North 79 degrees 40 minutes 17 seconds East 137.04 feet to a point on the South Right-of-way of the Public Road, thence South 89 degrees 50 minutes 38 seconds East 60.68 feet along the South Right-of-way line to the Point of Beginning, all situated in LaSalle County, Illinois and commonly known as 1540 N. 2725th Road (PIN 22-15-301-012).

PROPERTY LOCATED AT 1546 N. 2725TH ROAD:

That part of the East fractional part of the Southwest Quarter of Section 15, Township 33 North, Range 3, East of the Third Principal Meridian described as follows: Commencing at the Southeast corner of the Southwest Quarter of Section 15, Township 33 North, Range 3, East of the Third Principal Meridian, thence North 1 degree 34 minutes West 1009.7 feet to the place of beginning; thence from said point of beginning North 1 degree 34 minutes West 263.4 feet to the South Right of Way line of the public road; thence North 89 degrees 50 minutes West along said South right of way line a distance of 138 feet to a point, thence South 1 degree 34 minutes East 169.6 feet to a point; thence South 52 Degrees 11 minutes East 163.1 feet to a point; thence North 59 degrees 34 minutes East 13.7 feet to the place of beginning, (except the East 5 feet thereof) in LaSalle County, Illinois and commonly known as 1546 N. 2725th Road (PIN 22-15-302-012).

PROPERTY LOCATED AT 1548 N. 2725TH ROAD:

Lot 1 in Gravely Acres, according to the Plat thereof recorded October 8, 2002 as Document #02-28378; being a part of that part of the Southwest Quarter of the Southeast Quarter of Section 15, Township 33 North, Range 3, East of the Third Principal Meridian, lying South of an East-West public highway, now known as 4-H Road, and West of the Chicago, Burlington and Quincy Railroad right-of-way situated in LaSalle County, Illinois, and commonly known as 1548 N. 2725th Road (PIN 22-15-400-001).