Michigan Operations

The Dow Chemical Company
Midland, MI 48674

December 20, 2006

George W. Bruchmann, Chief
Waste and Hazardous Materials Division
State of Michigan Department of Environmental Quality
Constitution Hall
525 West Allegan Street
Lansing, MI 48909-7741

RE: Reach O Plan and Pilot Corrective Action Plan

Enclosed with this letter please find enclosed the Reach O Plan and Pilot Corrective Action Plan, prepared by ATS, along with a cover letter prepared by ATS.

Dow is committed to working collaboratively and cooperatively with MDEQ to further define, design and implement a detailed plan, once approved, for the removal of the Reach O in-channel high concentration material as quickly and as is safely possible, as described in the attached timeline included in plan. Dow is also committed to working cooperatively and collaboratively with MDEQ to further develop the plan to address the other high concentration locations in the other reaches of the upper Tittabawassee River as outlined in the Pilot Corrective Action Plan in an expeditious manner as outlined in the Pilot Corrective Action Plan.

I will be out of the office for the remainder of the year. Please contact Ben Baker if you have any questions.

Sincerely,

on behalf of Greg Cochran

Greg Cochran
Director Michigan Dioxin Initiative
The Dow Chemical Company
1790 Building
Midland, MI 48674

cc: Jim Sygo
Cheryl Howe
Ben Baker
Phil Simon

Enclosures

December 20, 2006

Mr. Allan Taylor
Michigan Department of Environmental Quality
Waste and Hazardous Materials Division
Constitution Hall
525 W. Allegan St.
Lansing, MI 48933

RE: Pilot Corrective Actions - Upper Tittabawassee River, Michigan

Dear Mr. Taylor:

Recent findings from the on-going Upper Tittabawassee River (UTR) site characterization have revealed elevated concentrations of chlorinated furans and dioxins in eroding levees and in-channel deposits within certain reaches of the 6.5 mile UTR study area. These newly available data have been reviewed in recent days by MDEQ staff and Dow consultants, and there is consensus that these areas warrant proceeding as expeditiously as possible to develop and implement a corrective action plan to address them. Attached please find two technical memoranda, which result from our collaborative efforts with MDEQ over the past two weeks.

<u>Reach O 322+50 In-Channel Deposit Memo</u>

Recently available site characterization data have revealed elevated concentrations of chlorinated furans and dioxins (4,000 to 87,000 ppt TEQ) within a buried in-channel deposit in Reach O, from 322+50 to 327+50. The attached Reach O memo addresses the information we presently have regarding this deposit, and the plans we have made to address it on a priority basis.

<u>Pilot Corrective Actions Plan Memo</u>

This memorandum outlines the objectives, approach and schedule for developing focused Pilot Corrective Action Plans (PCAP) to address the Reach O in-channel deposit, plus additional areas of concern identified during the 2006 site characterization in Reaches D, J, K, L, M, N and O.

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Consultants in Chemistry & Environmental Science
290 South Wagner Road, Ann Arbor, Michigan 48103 Tel 734/995-0995 Fax 734/995-3731

As with the activities we have undertaken in 2006, we look forward to working with you and the MDEQ to develop and implement these Pilot Corrective Action Plans on a priority basis, as soon as possible in 2007.

Sincerely,

ANN ARBOR TECHNICAL SERVICES, INC.

Peter M. Simon
Project Manager

Philip B. Simon
President/Project Director

PBS/

Attachments: (1) PCAP Memo (December 18, 2006)
(2) Reach O Memo (December 19, 2006)

MEMORANDUM

To: Mr. Allan Taylor, MDEQ Waste and Hazardous Materials Division

From: Philip B. Simon, ATS
Peter M. Simon, ATS
James F. Braithwaite, Vector Resolutions, LLC

Date: December 18, 2006

RE: Background for Pilot Corrective Actions – Upper Tittabawassee River, Michigan

Recent findings from the on-going Upper Tittabawassee River (UTR) site characterization have revealed elevated concentrations of chlorinated furans and dioxins in eroding levees and in-channel deposits within certain reaches of the 6.5 mile UTR study area. These newly available data have been reviewed in recent days by MDEQ staff and Dow consultants, and there is consensus that these areas warrant proceeding as expeditiously as possible to develop and implement a corrective action plan to address them. This memorandum outlines the objectives, approach and schedule for a focused Pilot Corrective Action Plan (PCAP) to address these areas, as developed in collaborative working sessions on December 14-15, 2006.

PCAP Objectives

The PCAP will provide a comprehensive evaluation and presentation of each identified area of concern, including contaminant concentration in both bank and in-channel deposits, and shear stress at these locations under a variety of storm conditions. The plan will address areas in a rational, sequential approach, designed to achieve the greatest benefit with the least risk of exacerbating existing conditions. It will provide a path forward based on sound science and engineering that avoids doing additional environmental harm, minimizes net environmental resource damages, and where possible improves ecological habitat.

The PCAP will form the conceptual basis and provide the necessary supporting documentation to apply for necessary state and federal permits. The PCAP will include work to support the following objectives and deliverables for each area of concern:

- Develop detailed river bottom profile, including stability rationale, geologic and bathymetric cross-sections, and streamline/shear stress modeling under a broad range of flow conditions;

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- Identify recent data, including erosion scar data, from eroding banks with elevated levels of furans and dioxins using sheer stress analysis and field mapping of erosion scars;
- Include mapping that identifies priority areas;
- Identify pilot corrective action alternatives for removal and/or stabilization at each location of concern;
- Provide numerical modeling of the selected approaches, presenting anticipated streamlines, velocities, shear stresses, and particle transport pathways under a variety of flow conditions;
- Identify recommended methods for removal and/or stabilization of soils and sediments, including an assessment of the strengths and weaknesses of the recommended corrective action method along with other reasonable alternative methods;
- Propose strategies that sequence tasks to achieve schedule compression and the greatest net environmental benefit during construction (e.g. initial work in Reach O to remove contaminated cut banks will prepare the area for removal of in-channel deposits, plus widen the channel cross-section and draw the Thalweg to the southwest, both of which stabilize the in-channel deposits until they can be removed.).

The PCAP will integrate elements of interim measures with components of a final remedy master plan for each area of concern. Implementing the anticipated pilot corrective actions will:

- Address in-channel deposits with higher contaminant concentrations to prevent re-introduction into the aquatic environment;
- Address eroding levee deposits with elevated contaminant concentrations to prevent re-introduction into the aquatic environment;
- Support an on-going professional evaluation of the technologies chosen for these pilot studies, including their efficacy in a given setting and their net environmental impact on biota;
- Provide a basis to adapt these technologies to improve their effectiveness when used in subsequent phases of remediation of the Tittabawassee River and Upper Saginaw River;
- Eliminate, to the maximum possible extent, unforeseen outcomes from the application of remediation tools that do not take river morphology into account.

Pilot corrective actions developed in the UTR PCAP may have value for reaches in the middle and lower Tittabawassee River, which are scheduled for site characterization in 2007 and 2008.

UTR PCAP Focus Areas

Areas with the UTR identified to date for focused Pilot Corrective Actions have been grouped into Operable Units (OU) based on river morphology, and factors relevant to remediation. They are as follows:

- OU-1: Reach D (RD-55+00, in-channel within sheet piling; owned by Dow)
- OU-2: Reaches J & K (RJ-192+00 through RK-232+00, banks/over-banks; northeast side owned by Dow, southwest side not owned by Dow)
- OU-3: Reach L (RL-232+00 through RL-261+00, banks and in-channel; not owned by Dow)
- OU-4: Reaches M through O (RM-261+00 though RO-333+00, banks and in-channel; some owned by Dow, some owned by others)

The location of these OUs is shown on the UTR Reach print in Attachment 1.

Sampling of the last phase of the UTR site characterization, the Consumers Energy property, has just been completed. Analytical results are just becoming available for the more than 150 locations sampled on that property, and these results will issue throughout December 2006 and into early 2007. If additional areas of concern are identified as these results become available, the PCAP will be amended as required to address these areas.

Schedule

The PCAP will be prepared and implemented as soon as possible, and as soon as the weather permits for each phase of activity. Given the "flashy" nature of the Tittabawassee River, worker safety will be paramount in scheduling work on the river itself. The plan will include a path forward to maximize those work opportunities early in the process that require the least amount of time for permit issuance (e.g., maximize work above ordinary high water mark in the initial stages).

The plan will anticipate the use of multiple construction and QA/QC crews addressing different priority areas concurrently, in order to optimize the field/construction weather windows and similar time constraints (e.g., fish spawning, other ecological sensitivities, etc.). Attachment 2 provides a rough schedule for the UTR PCAP, including necessary steps and estimated time frame.

ATTACHMENT 1

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UTR Reach and OU Locations


A
B
C
D
OU 1
E
F
G
H
I
J
OU 2
K
L
OU3
M
N
OU4
O
N
0
1,500
3,000 Feet
Reach Overview
Tittabawassee River Project

ATTACHMENT 2

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UTR PCAP Schedule

UTR Pilot Corrective Action Plan Timeline (December 2006 - November 2007)

Rev. 12/19/06

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Identify specific areas for corrective action	■	■										
Precise Bathymetry	■	■	■									
Precise Topo Mapping within 200 feet of shoreline/corrective action area	■	■	■									
Characterization of soil/sediment physical properties	■	■	■									
Identify specific areas for corrective action	■	■	■									
Boundary definition of elevated concentrations horizontally and vertically	■	■	■	■	■	■						
Modeling of existing conditions, velocity, shear stress and streamlines	■	■	■									
Biology Layer –sensitive species habitat/needed habitat	■	■	■									
Access, legal and physical	■	■	■	■	■	■						
Development of feasible alternatives	■	■	■	■								
Modeling of selected alternatives		■	■	■								
Construction Plans Completed			■	■								
Plans for long term monitoring/maintenance of corrective action			■	■								
Permit Applications Submitted	■	■	■	■								
Quarterly Public Participation			■			■			■			■
HASP specific to corrective action		■	■	■	■							
Background data on water quality for performance monitoring		■	■	■	■	■						
Biological restoration plan		■	■	■								
Field QA/QC plan and staff in place			■	■	■							
Cost estimates/bids in hand		■	■	■								
Contractors ready to go		■	■	■								
Permit Review/Approval		■	■	■	■							
Monitoring plan for water quality and biota during and after corrective action		■	■	■								
Materials secured for capping/armoring				■	■	■						
Disposal arrangements made				■	■							
Protocols for compiling closure report (photo's, field notes, data, drawings)					■							
Consensus on selected alternatives (RAP)		■	■	■	■							
Contingency plan for bad weather		■	■	■	■							
Walleye spawning period (3/15 – 6/1)				■	■	■						
Raptor/other bird nesting period			?	?	?	?						
Good weather window corrective action activities		■	■	■	■	■	■	■	■			
Restoration and monitoring					■	■	■	■	■	■	■	■

Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

MEMORANDUM

To: Mr. Allan Taylor, MDEQ Waste and Hazardous Materials Division

From: Philip B. Simon, ATS
Peter M. Simon, ATS

Date: December 19, 2006

RE: Reach O 322+50 In-Channel Deposit – Upper Tittabawassee River, Michigan

Recent findings from the on-going Upper Tittabawassee River (UTR) site characterization have revealed elevated concentrations of chlorinated furans and dioxins (4,000 to 87,000 ppt TEQ) within a buried in-channel deposit in Reach O, from 322+50 to 327+50 (see Attachment 1). This contamination occurs in three of 21 borings completed in this reach of the UTR (see Attachment 2). The contamination is not present in borings immediately upstream at 316+00, nor in borings immediately downstream at 333+00. This contamination appears to have been co-deposited with a black, woody organic layer which is visually distinct in the core samples. At each location where the deposit occurs it is buried beneath 0.4 to 0.6 feet of well-graded, brown sand. This sand layer areally extensive throughout this section of the river, and is present in all locations where unconsolidated sediments occur.

Contaminant Fingerprint

The chlorinated furans predominate the contaminant fingerprint, indicating the contamination source is likely to be graphic carbon waste from brine electrolysis. The chemical fingerprint matches contaminant deposits in adjacent levees along Reaches N and O, where broad spectrum Appendix IX analysis has been completed. In these deposits the only contaminants found are chlorinated furans and polynuclear aromatic hydrocarbons. No chlorophenols or other chlorinated benzenes occur in these deposits. Based on all available data, it appears that this material was deposited more 75 years ago.

Deposit Stability

A hydrodynamic model has been built and calibrated for the UTR. Shear stresses have been calculated using calibration data sets for 3-year, 7-year and 8-year storm events. The 3-year storm event constitutes a "bank-full" condition, while the 8-year storm event constitutes a substantial flooding event (see Attachment 3). Both are considered highly erosive conditions for the Tittabawassee River. Under both conditions, the peak bottom shear stresses in the section of the river where this deposit occurs range from 10 to 50 dynes/cm^2, which is insufficient to erode the medium grained sand. Unlike the shear stresses on the banks in that section of the river,

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shear stresses on the bottom do not change appreciably as a function of flow or storm intensity (see Attachment 4). Under these conditions the sand layer can be considered a relatively competent self-armoring capping layer for deposits buried beneath it.

Deposit Delineation

Based on existing data, the contaminated deposit is estimated to consist of approximately 2,500 to 3,500 cubic yards in-place volume, including the overlying sand capping layer. However, the precise location, shape and volume of the deposit is not presently known because the poling and sampling techniques used were not intended for this purpose. Lacking better information about the location and dimensions of the deposit will require over-excavation, which increases the estimated in-place removal volume to approximately 35,000 cubic yards.

To prepare for removal, we propose the location and dimensions of the deposit be established using precision bathymetric techniques and spatially continuous geophysical survey tools. This delineation can be done during winter conditions, so long there is limited ice cover and the river is accessible by boat.

Alternatives for Remediation

The deposit may be removed using one of the following techniques:

- Underwater mechanical dredging (e.g. dragline crane, or equivalent)
- Underwater hydraulic dredging (with or without cutter head)
- Semi-dry mechanical excavation (e.g. coffer dam isolation, mechanical excavator removal)

Underwater mechanical dredging techniques could be implemented in winter conditions; however they are not suited for removal of contaminated material. Underwater mechanical dredging is not a precision technique, and will result in loss of dredged material. This loss of dredged material is exacerbated in a flowing water setting such as a river. If a high flow event occurs during the dredging, the loss of material may be catastrophic.

Underwater hydraulic dredging generally provides better precision in removal and control of dredged material as compared to underwater mechanical dredging. However, it is difficult to implement during winter conditions because of the large volumes of carriage water generated and the problems associated with freezing. Some loss of material from the dredging zone will occur, and this will be exacerbated by flowing water conditions. As in the case of underwater mechanical dredging, if a high flow event occurs during the dredging, the loss of material may be catastrophic. Because the dredged material must be fluidized for removal, hydraulic dredging will increase the removal volumes by a factor of approximately two, and will require some provision for discharging the substantial volume of carriage water once the solids have been removed from it (e.g. discharge to WWTP, POTW or NPDES).

Mechanical excavation under semi-dry conditions is the most precise and safest means of removal for a number of reasons, including positional control of the excavation equipment, elimination of the flowing water release pathway, and ability to complete verification sampling contemporaneously with the removal itself. The potential for catastrophic loss of material is greatly reduced over other techniques by coordinating the scope and timing of removal appropriately with weather opportunities between the inevitable storm events.

It is our considered opinion that risks associated with underwater removal of this deposit during winter conditions, including both safety and re-mobilization of dredged material, greatly outweigh the relatively minimal risk that this deposit will be eroded under natural conditions in the next few months. We propose to remediate this deposit by performing a "surgical" excavation under semi-dry conditions using a coffer dam approach, as soon as the weather allows after the deposit has been properly located and dimensioned (see Attachment 5). Given the "flashy" nature of the Tittabawassee River, worker safety will be paramount in scheduling work of the river itself.

ATTACHMENT 1

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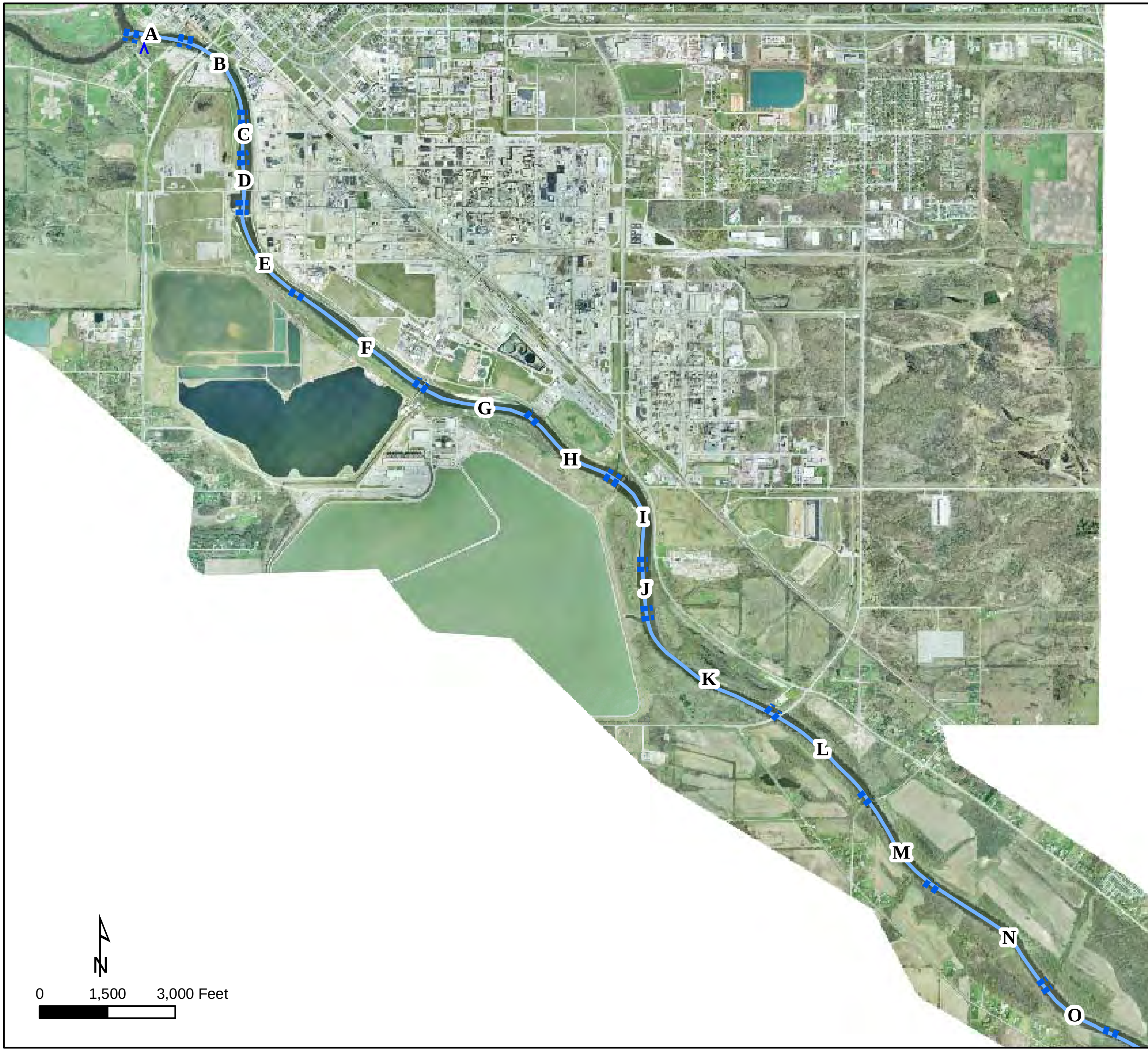
UTR Reach Locations



Reach Overview

Tittabawassee River Project

June 1, 2006

ATTACHMENT 2

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Boring Logs and Geologic Cross-Section

290 South Wagner Road
Ann Arbor, Michigan 48103
Tel. 734/995-0995 Fax. 734/995-3731
Michigan Laboratory ID: 9604
Wisconsin Laboratory ID: 998321720

GeoMorph Site Characterization Data Summary
Upper Tittabawassee River: Reach O
Midland, Michigan

Transect Location/Sample Identification	Collection Date	Depth Interval (ft,bgs)	Geomorphic Setting	Physical Description	Soil Horizon	USCS	Moisture Content (%)	2,3,7,8-TCDD (ng/kg)	2,3,7,8-TCDF (ng/kg)	1,2,3,7,8-PeCDF (ng/kg)	2,3,4,7,8-PeCDF (ng/kg)	1,2,3,4,7,8 + 1,2,3,6,7,8-HxCDF (ng/kg)	Aggregate Indicator Congener Concentration (ng/kg)	Estimated Total TEQ (ppt)	Laboratory
RN-316+00-IC-C	10/11/06	0.0-0.3	In-Channel	10YR 5/2 grayish brown fine sand, moist, loose, single grain, non-plastic, very few angular glossy course sand subrounded grains Well sorted	1	SP	3.2	<4	19	4	4	6	34*	<10*	Alta
RN-316+00-IC-C	10/11/06	0.3-0.8	In-Channel	10YR 4/2 dark grayish brown fine sand, moist, loose, single grain, non-plastic, few coarse sand very few medium fine gravel, very few angular glossy coarse black sand, subrounded grains, somewhat well sorted	2	SP	8.5	<4	43	8	7	14	71	11	Alta
RN-316+00-IC-C	10/11/06	0.8-1.6	In-Channel	10YR 4/1 dark gray sand, moist, loose, single grain, non-plastic, very few medium roots, few fine gravel, few shell fragments, very few angular glossy black coarse sand, subrounded grains	3	SM	10.9	<4	28	7	7	18	59	10	Alta
RN-316+00-IC-NE	10/11/06	0.0-0.4	In-Channel	10YR 4/2 dark grayish brown fine sand, loose, single grain, non-plastic, very few medium roots, very few coarse sand, very few shell fragments, very few angular glossy black, coarse sand well sorted	1	SP	30.3	<4	88	300	73	650	1,100	120	Alta
RN-316+00-IC-NE	10/11/06	0.4-1.2	In-Channel	10YR 4/2 dark grayish brown sand, loose, single grain, non-plastic, common, fine, medium gravel, few shell fragments, few angular, glossy black coarse sand, subrounded, sub-angular grains	2	SM	11.7	<4	39	10	9	18	76	12	Alta
RN-316+00-IC-SW	10/11/06	0.0-1.1	In-Channel	10YR 5/2 grayish brown fine sand, moist, loose, single grain, non-plastic, very few fine gravel, subrounded grains, well sorted	1	SP	3.8	<4	9	<4	<4	<4	<20*	<10*	Alta
RN-316+00-IC-SW	10/11/06	1.1-1.4	In-Channel	10YR 4/1 dark gray loamy fine sand, moist, loose, single grain, non-plastic, very few fine gravel, few shell fragments, subrounded grains	2	SM	14.9	<4	10	<4	<4	5	<20*	<10*	Alta
RN-316+00-IC-SW	10/11/06	1.4-2.0	In-Channel	10YR 4/1 dark gray sand, moist, loose, single grain, non-plastic, very few fine gravel, subrounded grains, very few shell fragments	3	SM	14.4	<4	23	11	9	14	56	<10	Alta
RO-321+50-IC-SW75	12/6/06	0.0-0.9	In-Channel	2.5Y 4/3 olive brown sand, 15<35% gravel, SW, sands, wet single grain, moist loose, non-plastic, none, coarse gravel near top of core, fine and medium below, few shell fragments	1	SW	15.4	<4	20	4	5	7	37*	<10*	Dow
RO-321+50-IC-SW75	12/6/06	0.0-0.9 Lab Duplicate	In-Channel	As Above	1	SW	16.0	<4	23	5	6	5	38*	<10*	Dow
RO-321+50-IC-SW75	12/6/06	0.9-1.5	In-Channel	10YR 2/1 black, wet, All wood	2	--	67.6	$<8^{LSV}$	$<14^{LSV}$	$<20^{LSV}$	$<21^{LSV}$	$<42^{LSV}$	<100	<10	Dow
RO-322+00-IC-SW75	12/6/06	0.0-0.2	In-Channel	2.5Y 4/3 olive brown, coarse sand, 35<60% gravel, SW, sands, wet, single grain, moist loose, non-plastic, many shell fragments, fine subrounded gravel, few coarse sand grains	1	SW	12.9	<4	33	8	8	7	56	<10*	Dow
RO-322+00-IC-SW75	12/6/06	0.2-0.9	In-Channel	2.5Y 4/3 olive brown sand, <15% gravel, SW, sands, wet single grain, moist loose, non-plastic, some coarse sand as matrix, mostly coarse subrounded gravel	2	SW	15.8	<4	36	9	12	22	78	13	Dow
RO-322+50-IC-C	10/16/06	0.0-0.5	In-Channel	10YR 4/2 dark grayish brown sand with <15% gravel, moist, loose, single grain, non plastic, very few angular glossy black coarse sand, few fine gravel, very few shell fragments, subrounded and subangular grains	1	SW	8.1	<4	830	380	310	260	1800	230	Alta
RO-322+50-IC-C	10/16/06	0.5-1.1	In-Channel	10YR 2/1 black , moist, non-plastic, many medium roots, wood/black material	2	--	44.2	44	280000	160000	130000	100000	660000	87000	Alta
RO-322+50-IC-C	10/16/06	0.5-1.1 Lab Duplicate	In-Channel	As Above	2	--	44.2	74	380000	140000	140000	83000	740000	100000	Alta
RO-322+50-IC-C	10/16/06	0.5-1.1 Lab Duplicate	In-Channel	As Above	2	--	44.2	15	100000	33000	30000	18000	180000	24000	Alta
RO-322+50-IC-C	10/16/06	1.1-1.3	In-Channel	10YR 4/1 dark gray loamy fine sand with <15% gravel, moist, loose, single grain, non-plastic, few medium roots, few SM shell fragmernts, very few fine gravel, very few angular glossy black coarse sand, subrounded grains	3	SM	36.5	<4	570	130	130	59	890	120	Alta
RO-322+50-IC-SW	10/16/06	0.0-0.8	In-Channel	10YR 4/2 dark grayish brown loamy fine sand, moist, loose, single grain, non-plastic, common coarse sand, few fine gravel, very few shell fragments, very few angular glossy black coarse sand, subrounded grains	1	SM	10.7	<4	28	6	6	8	48*	<10*	Alta
RO-322+50-IC-SW	10/16/06	0.8-1.0	In-Channel	10YR 4/1 dark gray sand with <15% gravel, moist, loose, single grain, non-plastic, few fine gravel, very few shell fragments, subrounded and subangular grains	2	SW	26.6	<4	41	8	8	7	64	10	Alta
RO-322+50-IC-SW	10/16/06	1.0-1.2	In-Channel	10YR 4/1 dark gray silt loam, moist, friable, granular, slightly plastic, common medium roots	3	SM	45.0	<4	<4	<4	<4	<4	<20	<10	Alta
RO-322+50-IC-SW	10/16/06	1.2-1.5	In-Channel	10YR 4/1 dark gray sand with <15% gravel, moist, loose, single grain, non-plastic, few medium roots, few coarse sand, very few fine gravel, few shell fragments, few angular glossy black coarse sand, subrounded grains	4	SW	15.9	<4	<4	<4	<4	<4	<20	<10	Alta

\\project\D052-TRP.06\Draft Reach O with Soil Descriptions.xls\Reach O

WORKING DRAFT
Rev. 121006

ANN ARBOR TECHNICAL SERVICES, INC.
290 South Wagner Road
Ann Arbor, Michigan 48103
Tel. 734/995-0995 Fax. 734/995-3731
Michigan Laboratory ID: 9604
Wisconsin Laboratory ID: 998321720

Transect Location/Sample Identification	Collection Date	Depth Interval (ft,bgs)	Geomorphic Setting	Physical Description	Soil Horizon	USCS	Moisture Content (%)	2,3,7,8-TCDD (ng/kg)	2,3,7,8-TCDF (ng/kg)	1,2,3,7,8-PeCDF (ng/kg)	2,3,4,7,8-PeCDF (ng/kg)	1,2,3,4,7,8 + 1,2,3,6,7,8-HxCDF (ng/kg)	Aggregate Indicator Congener Concentration (ng/kg)	Estimated Total TEQ (ppt)	Laboratory
RO-322+50-IC-SW25	12/6/06	0.0-0.2	In-Channel	2.5YR 3/2 very dark grayish brown and 2.5Y 3/3 dark olive brown loamy fine sand with 15<35% gravel, wet, very friable, slightly plastic, coarse gravel throughout layer, fine gravel near boundary with next layer	1	SM	21.2	<4	88	38	44	49	220	33	Dow
RO-322+50-IC-SW25	12/6/06	0.2-0.5	In-Channel	2.5Y 4/1 dark gray silty clay loam, wet, very firm, massive, very plastic	2	CL	28.5	<4	23	<8	6	4	34*	<10*	Dow
RO-322+50-IC-SW50	12/6/06	0.0-0.3	In-Channel	2.5Y 4/2 dark grayish brown fine sand, 15<35% gravel, SW, sands, wet, single grain, moist, loose, non-plastic, lucustrine clay	1	SW	7.8	<4	17	4	<5	4	25*	<10*	Dow
RO-322+50-IC-SW50	12/6/06	0.3-0.8	In-Channel	2.5Y 4/1 dark gray clay, CL, fine-grained/not organic, wet, massive, moist, extremely, firm very plastic, fine sand matrix with some coarse sand, fine and medium subrounded and subangular gravel	2	CL	22.7	<4	<4	<4	<5	<8	<25	<10	Dow
RO-322+50-IC-SW75	12/6/06	0.0-0.6	In-Channel	10YR 4/2 dark grayish brown sand, 15<35% gravel, SW, sands, wet, single grain, moist, loose, non-plastic, few coarse sand, subrounded, fine medium and coarse gravel	1	SW	11.6	<4	18	<4	4	6	28*	<10*	Dow
RO-322+50-IC-SW75	12/6/06	0.6-1.4	In-Channel	10YR 4/1 dark gray sand, 15<35% gravel, SW, sands, wet, single grain, moist, loose, non-plastic few coarse sand, very few shell fragments, fine and medium gravel	2	SW	11.9	<4	24	5	7	11	47*	<10*	Dow
RO-322+50-IC-SW100	12/6/06	0.0-0.3	In-Channel	2.5Y 4/2 dark grayish brown sand, 15<35% gravel, SW, sands, wet, single grain, moist, loose, non-plastic, very few shell fragments, few wood fragments at very bottom of core, common coarse sand fine and medium subrounded gravel	1	SW	14.0	<23[MI]	36	<26[MI]	<37[MI]	16	52	<18	Dow
RO-322+50-IC-SW100	12/6/06	0.3-0.8	In-Channel	2.5Y 4/1 dark gray sand, 15<35% gravel, SW, sands, wet, single grain, moist, loose, non-plastic, common shell fragments, few coarse sand, fine and medium subrounded gravel	2	SW	10.2	<4	230	42	68	46	390	57	Dow
RO-322+50-IC-SW125	12/6/06	0.0-0.6	In-Channel	2.5Y 4/2 dark grayish brown coarse sand, 35<60% gravel, SW, sands, wet, single grain, moist loose, non-plastic, few small wood fragments throughout, few shells, subrounded, fine medium and coarse gravel	1	SW	11.0	<4	33	12	13	24	83	30	Dow
RO-322+50-IC-NE	10/11/06	0.0-0.2	In-Channel	10YR 4/3 brown loamy fine sand, SM, sands, moist single grain, moist, loose, non-plastic, very few shell fragments, very few angular, glossy black coarse sand, subrounded grains	1	SM	14.5	<4	28	11	10	14	63	10	Alta
RO-322+50-IC-NE	10/11/06	0.2-0.7	In-Channel	10YR 4/2 dark grayish brown sand, SM, sands, moist single grain, moist, loose, non plastic, few fine gravel, few shell fragments, very few angular glossy black coarse sand, subrounded and subangular grains	2	SM	10.2	<4	73	17	17	16	120	18	Alta
RO-322+50-IC-NE	10/11/06	0.7-1.6	In-Channel	10YR 4/1 dark gray sand, SM, sands, moist single grain, moist, loose, non-plastic, fine, few common fine gravel, few angular glossy black coarse sand, few shell fragments, subrounded and subangular grains	3	SM	15.8	<4	20	5	5	7	37*	<10*	Alta
RO-323+00-IC-SW75	12/6/06	0.0-0.6	In-Channel	2.5Y 4/3 olive brown sand, <15% gravel, SW, sands, wet, single grain, moist, loose, non-plastic few medium and coarse rounded and subrounded gravel	1	SW	15.6	<4	47	7	10	11	75	12	Dow
RO-323+00-IC-SW75	12/6/06	0.6-0.9	In-Channel	2.5Y 2/1 black, wet, structureless, Almost entirely decompoosing wood fragments, few shell fragments, few medium and coarse sand grains	2	--	34.5	13	11000	6900	6000	4900	29000	4000	Dow
RO-323+00-IC-SW75	12/6/06	0.9-1.0	In-Channel	2.5Y 4/2 dark grayish brown sand, <15% gravel, SW, sands, wet, single grain, moist, loose, non-plastic, Large muscle shells	3	SW	17.6	<4	500	180	190	120	990	140	Dow
RO-323+50-IC-SW75	12/6/06	0.0-0.3	In-Channel	2.5Y 4/3 olive brown sand, <15% gravel, SW, sands, wet single grain, moist, loose, non-plastic, fine subrounded gravel, few shell fragments	1	SW	12.7	<4	18	5	5	11	39*	<10*	Dow
RO-323+50-IC-SW75	12/6/06	0.3-0.5	In-Channel	2.5Y 4/1 dark gray sand, <15% gravel, SW, sands, wet single grain, moist, loose, non-plastic, fine subrounded gravel, few shell fragments	2	SW	14.0	<4	27	10	8	20	65	11	Dow
RO-323+50-IC-SW75	12/6/06	0.5-1.3	In-Channel	10YR 2/1 black, wet, horizon almost entirely wood, 1.1-1.2' layer of sand, (2.5Y 4/1), 0.8-0.9' silty material, mixed in with wood few shell fragments	3	--	33.8	<4	<5	<4	<6	<9	<28	<10	Dow
RO-327+50-IC-C	10/16/06	0.0-0.4	In-Channel	10YR 5/2 grayish brown sand with <15% gravel, moist, loose, single grain, non-plastic, few fine gravel, very few angular glossy black coarse sand, very few shell fragments, subrounded grains	1	SW	8.1	<4	67	16	16	22	120	18	Alta
RO-327+50-IC-C	10/16/06	0.4-1.0	In-Channel	10YR 2/1 black, moist, many medium roots, few fine gravel, very few angular glossy black coarse sand, very few shell fragments, subrounded grains	2	--	44.0	8	30000	5400	7400	3300	46000	6300	Alta
RO-327+50-IC-C	10/16/06	1.0-1.3	In-Channel	10YR 4/1 dark gray loamy fine sand with <15% gravel, moist, loose, single grain, non-plastic, very few fine roots, few fine gravel, very few angular glossy black coarse sand, very few shell fragments, subrounded grains	3	SM	13.8	<4	180	53	44	45	320	43	Alta

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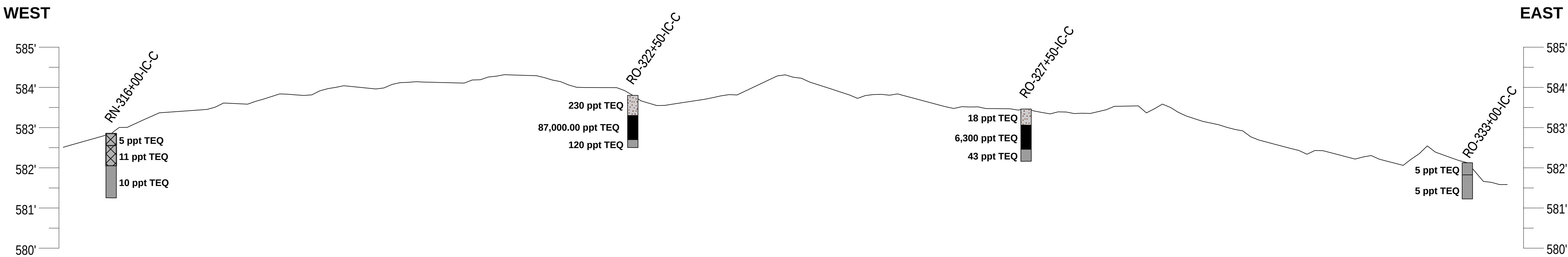
GeoMorph Site Characterization Data Summary
Upper Tittabawassee River: Reach O
Midland, Michigan

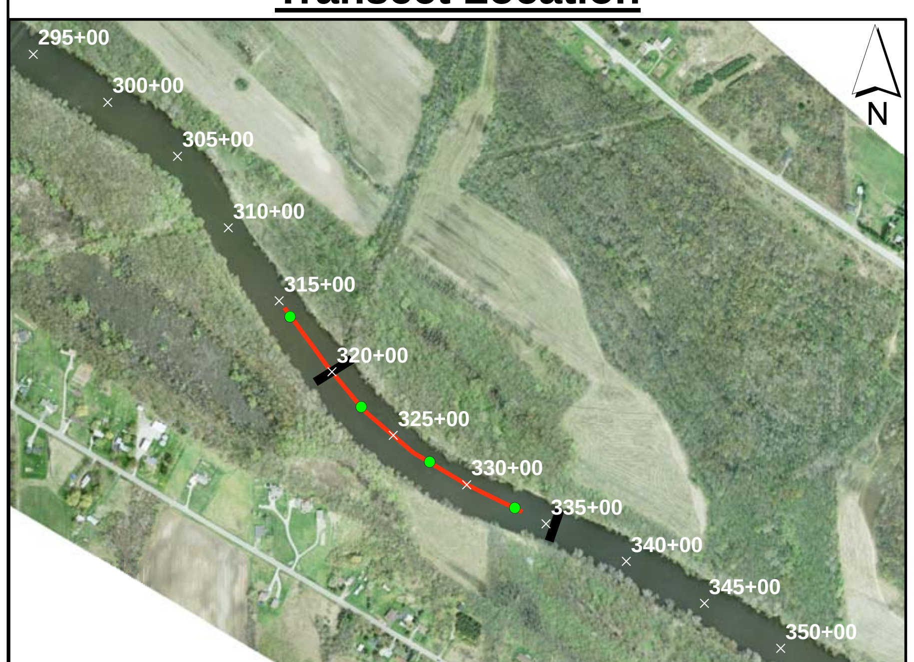
Transect Location/Sample Identification	Collection Date	Depth Interval (ft,bgs)	Geomorphic Setting	Physical Description	Soil Horizon	USCS	Moisture Content (%)	2,3,7,8-TCDD (ng/kg)	2,3,7,8-TCDF (ng/kg)	1,2,3,7,8-PeCDF (ng/kg)	2,3,4,7,8-PeCDF (ng/kg)	1,2,3,4,7,8 + 1,2,3,6,7,8-HxCDF (ng/kg)	Aggregate Indicator Congener Concentration (ng/kg)	Estimated Total TEQ (ppt)	Laboratory
RO-327+50-IC-NE	10/16/06	0.0-0.7	In-Channel	10YR 4/2 dark grayish brown sand with <15% gravel, moist, loose, single grain, non-plastic, very few fine roots, few fine and medium gravel, few shell fragments, few angular glossy black coarse sand, subrounded grains	1	SM	6.8	<4	30	7	9	21	67	11	Alta
RO-327+50-IC-NE	10/16/06	0.7-1.3	In-Channel	10YR 4/1 dark gray loamy fine sand, moist, loose, single grain, non-plastic, common medium roots, subrounded grains, wood layer at 0.8' and 1.2'	2	SM	32.3	<4	<4	<4	<4	<4	<20	<10	Alta
RO-327+50-IC-SW	10/16/06	0.0-0.3	In-Channel	10YR 4/2 dark grayish brown loamy fine sand, moist, loose, single grain, non-plastic, very few fine roots, very few angular glossy black coarse sand, subrounded grains, very few shell fragments	1	SM	14.3	<4	11	<4	<4	10	21*	<10*	Alta
RO-327+50-IC-SW	10/16/06	0.3-1.1	In-Channel	10YR 4/1 dark gray loamy fine sand with <15% gravel, moist, loose, single grain, non-plastic, few fine roots, very few angular glossy black coarse sand, subrounded grains, very few shell fragments	2	SM	15.7	<4	27	5	5	11	48*	<10*	Alta
RO-327+50-IC-SW	10/16/06	1.1-1.2	In-Channel	10YR 4/1 dark gray loamy very fine sand with <15% gravel, moist, friable, subangular blocky, slightly plastic, few medium roots, very few angular glossy black coarse sand, subrounded grains, very few shell fragments	3	SM	37.3	<4	<4	<4	<4	<4	<20	<10	Alta
RO-333+00-IC-C	10/16/06	0.0-0.3	In-Channel	10YR 4/2 dark grayish brown sand with 15<35% gravel, moist, loose, single grain, non-plastic, common fine gravel, very few angular glossy black coarse sand, very few shell fragments, subrounded grains	1	SM	8.8	<4	11	<4	<4	4	<20*	<10*	Alta
RO-333+00-IC-C	10/16/06	0.3-0.9	In-Channel	10YR 4/1 dark gray loamy fine sand, moist, loose, single grain, non-plastic, few coarse sand, very few fine gravel, few shell fragments, few angular glossy black coarse sand, subrounded grains	2	SM	14.4	<4	22	4	4	6	35*	<10*	Alta
RO-333+00-IC-NE	10/16/06	0.0-0.3	In-Channel	10YR 4/2 dark grayish brown loamy fine sand with <15% gravel, moist, loose, single grain, non-plastic, few coarse sand, few fine gravel, few angular glossy black coarse sand, very few shell fragments, subrounded grains	1	SM	12.1	<4	14	<4	<4	5	<52*	<10*	Alta
RO-333+00-IC-NE	10/16/06	0.3-0.9	In-Channel	N 2/0 black loamy fine sand, moist, loose, single grain, non-plastic, very few fine roots, very few coarse sand, few shell fragments, few angular glossy black coarse sand, subrounded grains	2	SM	19.2	<4	71	15	13	32	130	18	Alta
RO-333+00-IC-NE	10/16/06	0.9-1.1	In-Channel	10YR 4/2 dark grayish brown sand with <15% gravel, moist, loose, single grain, non-plastic, very few fine gravel, few shell fragments, subrounded and subangular grains	3	SM	8.4	<4	54	9	22	33	120	19	Alta
RO-333+00-IC-SW	10/16/06	0.0-0.6	In-Channel	10YR 4/2 dark grayish brown coarse sand with <15% gravel, moist, loose, single grain, non-plastic, very few medium roots, very few fine gravel, few angular glossy black coarse sand, subrounded grains, somewhat well sorted	1	SP	6.7	<4	23	7	5	11	46*	<10*	Alta
RO-333+00-IC-SW	10/16/06	0.6-1.3	In-Channel	10YR 4/1 dark gray loamy fine sand with <15% gravel, moist, loose, single grain, non-plastic, few coarse sand, very few fine gravel, very few angular glossy black coarse sand, subrounded grains, few shell fragments	2	SM	15.2	<4	21	<4	4	10	35*	<10*	Alta

NOTES:
All concentrations are expressed on a dry weight basis.
"Estimated Total TEQ" is aggregate indicator congener TEQ multiplied by correlation factor of 1.1x.
DATA FLAGS:
Asterisk (*) indicates estimated concentration.
"LSV" indicates elevated reporting limit due to limited sample volume.
"LISR" indicates elevated reporting limit due to low internal standard recovery.

REACH O - LONGITUDINAL CROSS-SECTION



Transect Location

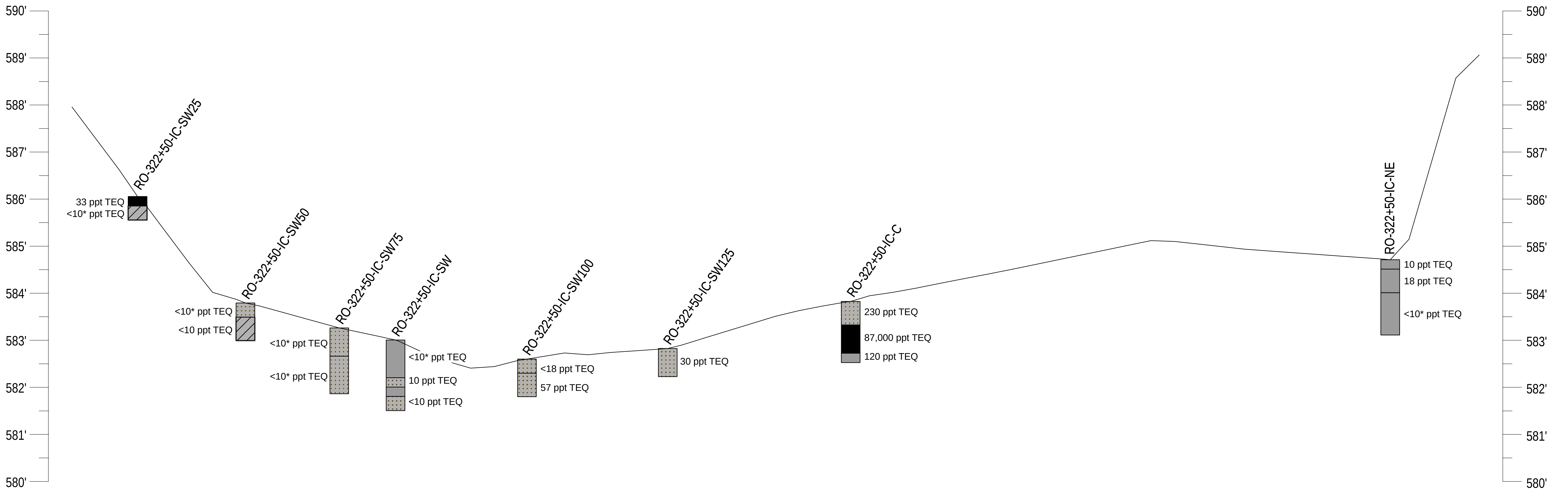


Legend

Physical Description

- SM: Dark gray sand / loamy sand
- SP: Dark gray / brown fine sand
- SW: Gray / brown sand
- Wood / Black Material
- River Bed Elevation

TRANSECT 322+50-IC CROSS-SECTION



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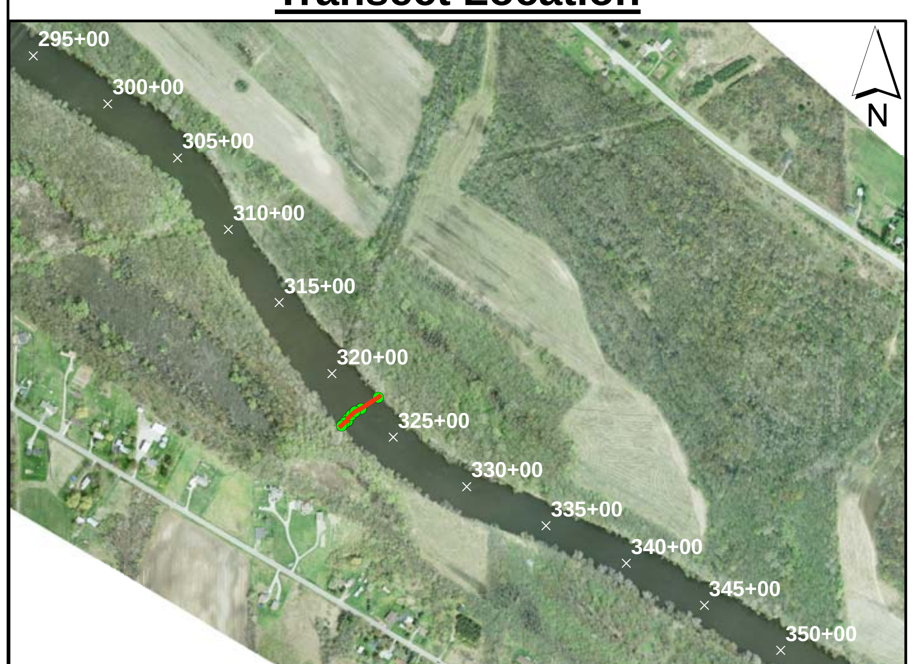
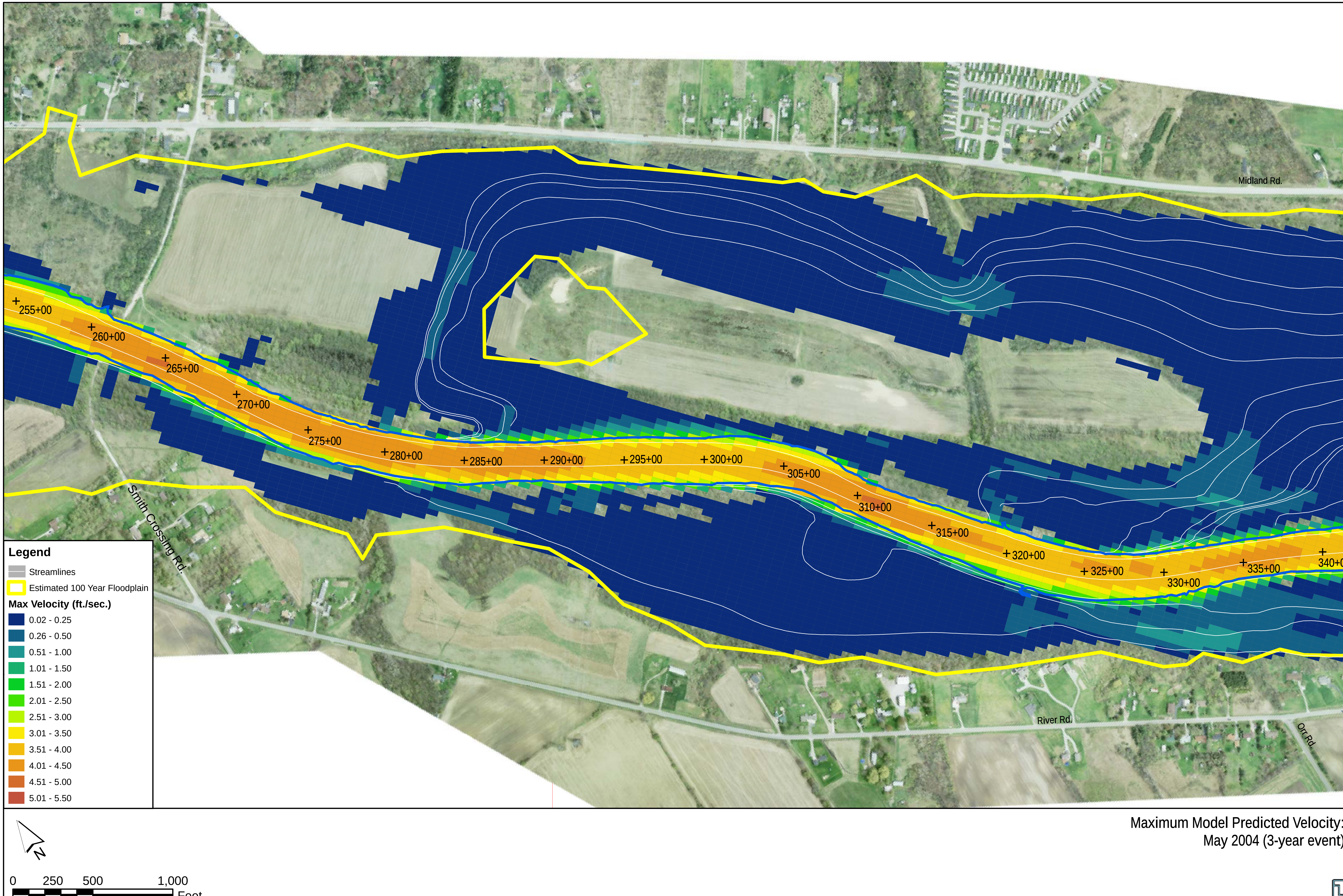


ATTACHMENT 3

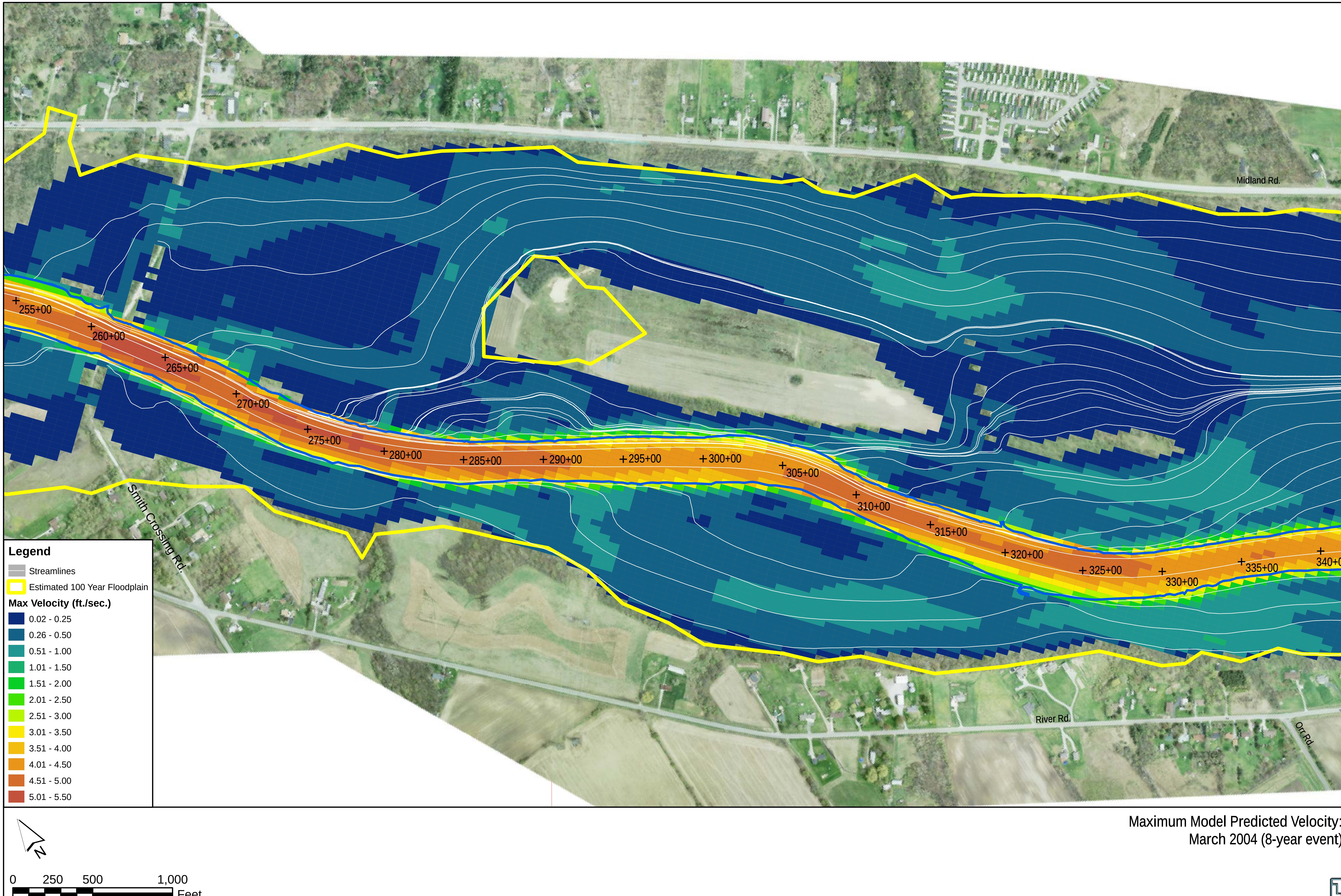
Model Predicted Stream Lines
3-Year and 8-Year Storm Events



Maximum Model Predicted Velocity:
May 2004 (3-year event)

Filename: x:\blord\arcinfo\tittabawassee_spcs\efdc_files\Reach_MtoO_Maximum_Velocity_May_2004.mxd

Revision Date: 121206



Maximum Model Predicted Velocity:
March 2004 (8-year event)

Filename: x:\blord\arcinfo\tittabawassee_spcs\efdc_files\Reach_MtoO_Maximum_Velocity_March_2004.mxd

Revision Date: 121206

ATTACHMENT 4

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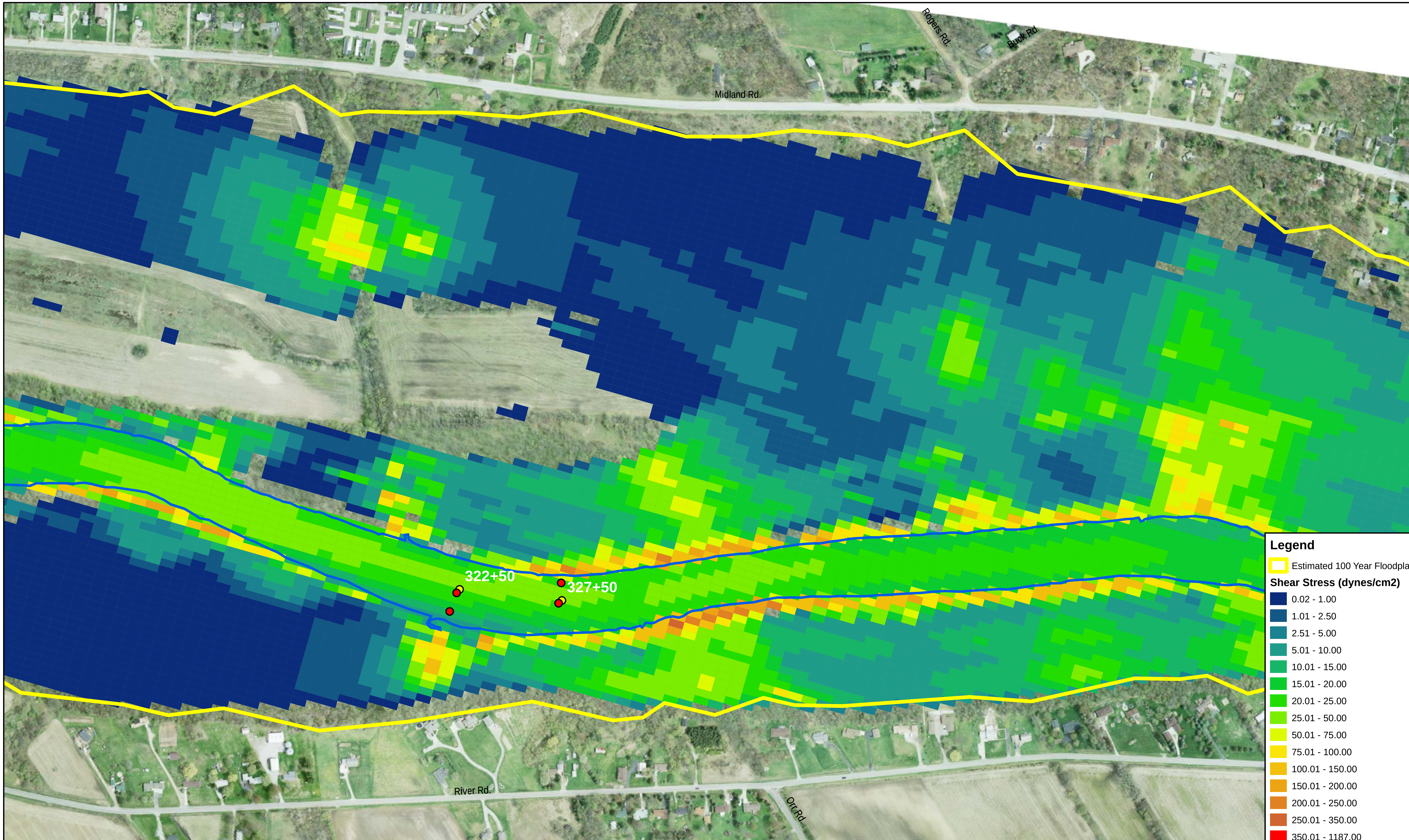
Maximum Model Predicted Shear Stress
3-Year and 8-Year Storm Events

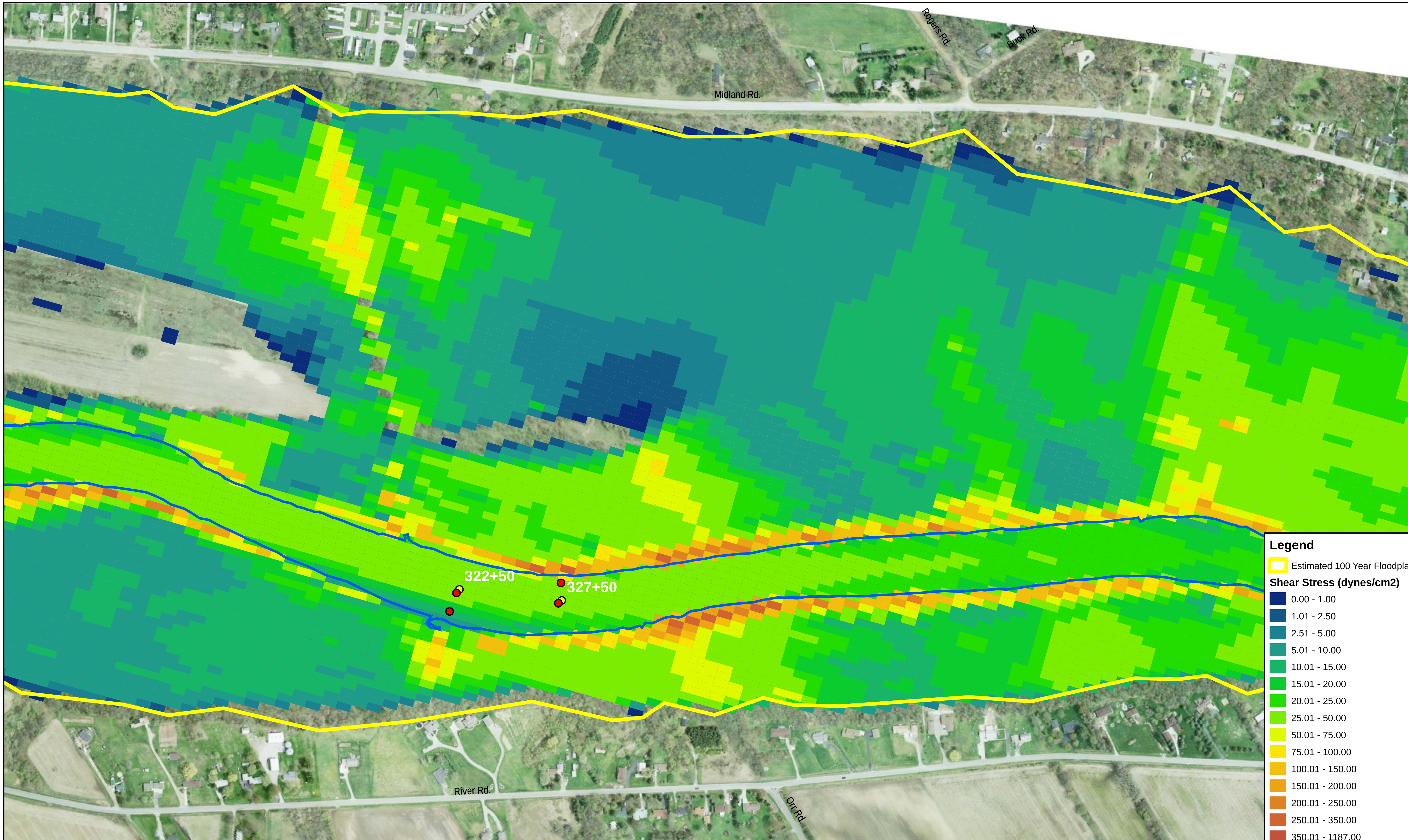


Maximum Model Predicted Shear Stress:
May 2004 (3-year event)

0 250 500 1,000
Feet

Filename: e:\arcinfo\tittabawassee_spcs\efdc_files\area1_EFDC_Velocity_May_2004.mxd

Revision Date: 10/27/06



Maximum Model Predicted Shear Stress:
March 2004 (8-year event)

0 250 500 1,000
Feet

Filename: e:\arcinfo\tittabawassee_spcs\efdc_files\area1_EFDC_Velocity_May_2004.mxd

Revision Date: 10/27/06

ATTACHMENT 5

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Project Schedule

UTR Pilot Corrective Action Plan Timeline (December 2006 - November 2007)

Rev. 12/19/06

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Identify specific areas for corrective action	■	■										
Precise Bathymetry	■	■	■									
Precise Topo Mapping within 200 feet of shoreline/corrective action area	■	■	■									
Characterization of soil/sediment physical properties	■	■	■									
Identify specific areas for corrective action	■	■	■									
Boundary definition of elevated concentrations horizontally and vertically	■	■	■	■	■	■						
Modeling of existing conditions, velocity, shear stress and streamlines	■	■	■									
Biology Layer –sensitive species habitat/needed habitat	■	■	■									
Access, legal and physical	■	■	■	■	■	■						
Development of feasible alternatives	■	■	■	■								
Modeling of selected alternatives		■	■	■								
Construction Plans Completed			■	■								
Plans for long term monitoring/maintenance of corrective action			■	■								
Permit Applications Submitted	■	■	■	■								
Quarterly Public Participation			■			■			■			■
HASP specific to corrective action		■	■	■	■							
Background data on water quality for performance monitoring		■	■	■	■	■						
Biological restoration plan		■	■	■								
Field QA/QC plan and staff in place			■	■	■							
Cost estimates/bids in hand		■	■	■								
Contractors ready to go		■	■	■								
Permit Review/Approval		■	■	■	■							
Monitoring plan for water quality and biota during and after corrective action		■	■	■								
Materials secured for capping/armoring				■	■	■						
Disposal arrangements made				■	■							
Protocols for compiling closure report (photo's, field notes, data, drawings)					■							
Consensus on selected alternatives (RAP)		■	■	■	■							
Contingency plan for bad weather		■	■	■	■							
Walleye spawning period (3/15 – 6/1)				■	■	■						
Raptor/other bird nesting period			?	?	?	?						
Good weather window corrective action activities		■	■	■	■	■	■	■	■			
Restoration and monitoring					■	■	■	■	■	■	■	■
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov