TRANSCANADA HYDRO NORTHEAST INC.

ILP Study 8
Channel Morphology and Benthic Habitat Study

Study Report

In support of Federal Energy Regulatory Commission Relicensing of:

Wilder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

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List of Abbreviations

CRWC	Connecticut River Watershed Council
DS	Downstream
FERC	Federal Energy Regulatory Commission
FGS	Field Geology Services, LLC.
GPS	Global Positioning System
ILP	Integrated Licensing Process
NHDES	New Hampshire Department of Environmental Services
NHGFD	New Hampshire Fish and Game Department
Normandeau	Normandeau Associates, Inc.
RSP	Revised Study Plan
SSR	Site Selection Report
Stantec	Stantec Consulting Services Inc.
TransCanada	TransCanada Hydro Northeast Inc.
US	Upstream
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VANR	Vermont Agency of Natural Resources

1.0 INTRODUCTION

The New Hampshire Department of Environmental Services (NHDES), New Hampshire Fish and Game Department (NHFGD), Vermont Agency of Natural Resource (VANR), and Connecticut River Watershed Council (CRWC) described, in their study requests, concerns regarding the potential for the Wilder, Bellows Falls, and Vernon Project facilities and operations to affect fluvial processes related to movement of coarse sediment (e.g., gravel and cobble) in the project-affected areas. Specific concerns were identified related to sediment supply, sediment composition and transport, and associated effects on fluvial processes including channel formation. Potentially affected resources include habitat for resident and anadromous fish and benthic habitat for aquatic invertebrates.

In response to stakeholder requests, the goal of Integrated Licensing Process (ILP) Study 8 – Channel Morphology and Benthic Habitat (Study 8) is to understand how operations of the Wilder, Bellows Falls and Vernon hydroelectric projects affect bedload distribution, particle size, and composition in relation to habitat availability for different life-history stages of anadromous and riverine fish, and for aquatic invertebrates. Following on the study requests filed by NHDES, NHFGD, VANR, and CRWC and discussions during stakeholder meetings, Study 8 is specifically focused on identifying and evaluating areas of coarse-grained substrates in the study area. The study area extends from the upstream limit of the Wilder impoundment to approximately 1.5 miles downstream from Vernon dam and includes tributaries that discharge to this reach of the Connecticut River.

This study report addresses the findings to date including distribution of coarse-grained substrates within the study area; apparent influences on the characteristics, distribution, and mobility of coarse-grained sediment within the study area; and availability of coarse-grained benthic habitat for relevant life-stages of dependent aquatic biota.

Additional components of Study 8, including assessment of project affects, are contingent upon review of other studies not yet completed including Study 3 – Riverbank Erosion Study, Study 4 – Hydraulic Modeling Study, and Study 5 – Operations Modeling Study.

2.0 STUDY GOALS AND OBJECTIVES

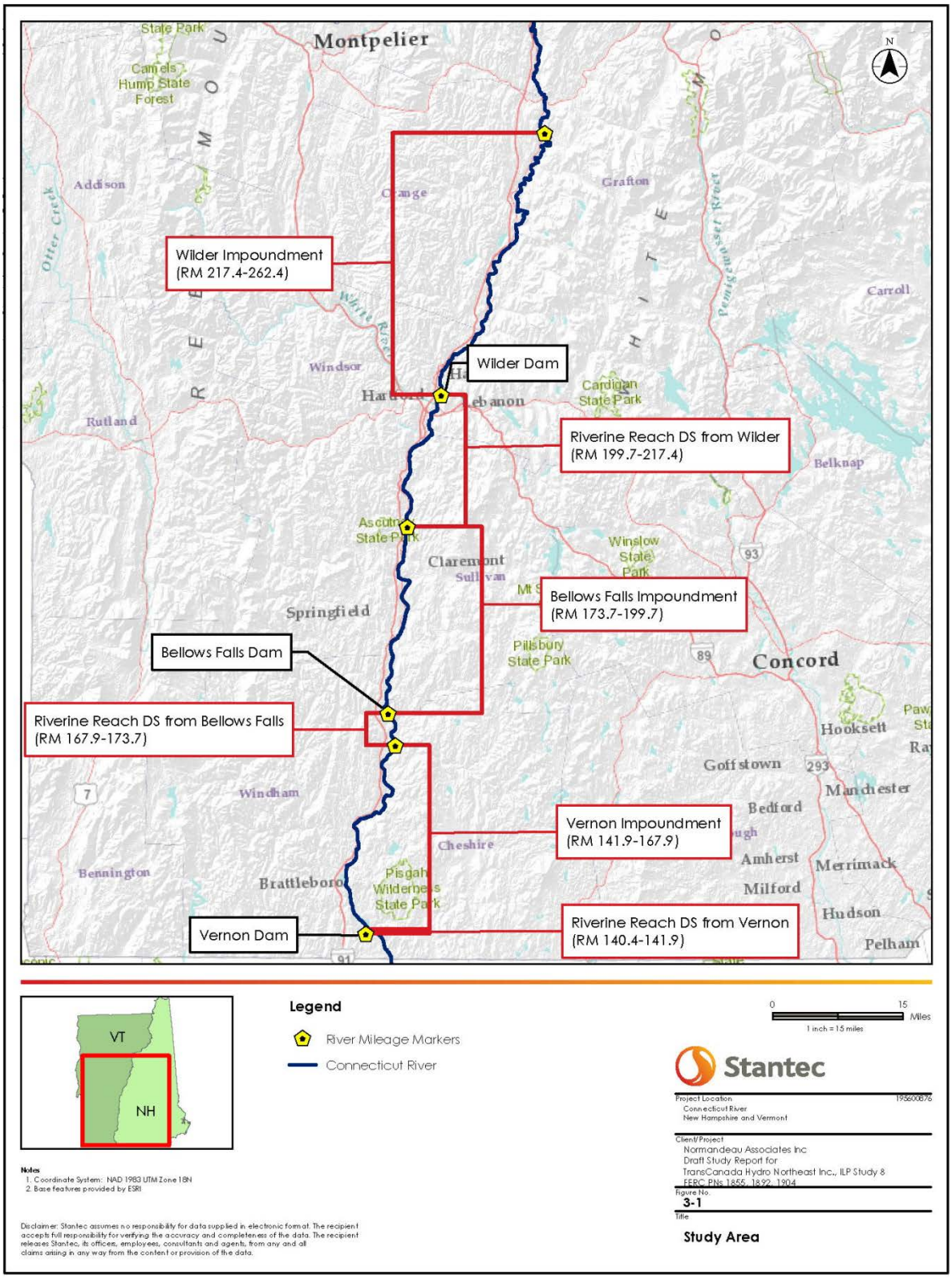
As described in the Revised Study Plan (RSP) for Study 8, the goal of this study is to understand how the Wilder, Bellows Falls, and Vernon projects affect bedload distribution, particle size, and composition in relation to habitat availability for different life-history stages of invertebrates and anadromous and riverine fish. The RSP identifies that the specific objectives of this study are to:

- Assess the distribution and extent of the existing substrate types including gravel and cobble bars within the project-affected areas; and
- Identify the current conditions of the channel and determine the stability of the present substrate/benthic habitat and potential project-related effects on these habitats.

3.0 STUDY AREA

The study area includes areas that may be project-affected along the Connecticut River from the upstream limit of the Wilder impoundment to approximately 1.5 miles downstream of Vernon Dam. In addition, the study area includes project-affected reaches of tributaries that discharge to the project-affected area of the Connecticut River.

The study area excludes the portions of tributaries outside of project influence as these are influenced by non-project related inflow. The approximate 1.5-mile reach downstream from Vernon Dam is included in the study area, consistent with the geographic scope of other ILP studies (Figure 3-1).



Source: ESRI

Figure 3-1. Study area.

Eighteen study sites are located with the study area, including 12 sites along the mainstem of the Connecticut River (mainstem sites) and 6 sites along tributaries to the project-affected reaches of the Connecticut River (tributary sites). Mainstem sites include 8 sites in the riverine reach downstream of Wilder Dam, 3 sites in the riverine reach downstream of Bellows Falls Dam, and one site in the riverine reach downstream of Vernon Dam. Tributary sites are located on the Ompompanoosuc River and on the 5 tributaries suggested by the aquatics working group during development of the RSP, including the White River, Mascoma River, Williams River, Saxtons River, and Cold River. Mainstem and tributary study sites are summarized in Table 3-1 and Table 3-2, respectively, and depicted in Figures 3-2 through 3-4. Geo-referenced study site locations were filed with FERC as part of the Initial Study Report filing on September 15, 2014, in Volume VII – TransCanada Initial Study Report Supporting Geodatabase (on DVD).

Table 3-1. Mainstem study sites.

Study Site #	Coordinates		Reach	Distance (river miles) from Project Dam	Site Position (MC / RR / RL)	Site Description	Site Notes	# of Tran-sects
	Long.	Lat.						
08-M01	-72.304398	43.666479	Riverine reach below Wilder	0.05 DS from Wilder	RL	Mid-channel bar	Adjacent to Wilder spillway	1
08-M04	-72.331375	43.622827	Riverine reach below Wilder	2.91 DS from Wilder	MC	DS end of island	Adjacent to Johnston Island	2
08-M05	-72.339288	43.59342	Riverine reach below Wilder	6.28 DS from Wilder	MC	US end of Burnaps Island	0.36 mi US from Ottauquechee River; 1.13 mi DS from Bloods Brook	3
08-M07	-72.378234	43.573896	Riverine reach below Wilder	8.67 DS from Wilder	MC	Mid-channel bar	0.67 mi US from Sumner Falls	2
08-M08	-72.379872	43.54648	Riverine reach below Wilder	10.7 DS from Wilder	MC	Mid-channel bar	1.20 mi DS from Sumner Falls	3
08-M10	-72.386584	43.502201	Riverine reach below Wilder	14.2 DS from Wilder	RR	Point bar	0.85 mi DS from Bashan Brook	2
08-M12	-72.390753	43.466903	Riverine reach below Wilder	16.9 DS from Wilder	MC	US end of Chase Island	0.39 mi DS from Mill Brook (VT) and Mill Brook (NH)	3
08-M13	-72.389651	43.456049	Riverine reach below Wilder	17.7 DS from Wilder	MC	Mid-channel bar	0.37 mi DS from Chase Island; in vicinity of US limit of Bellows Falls impoundment	2
08-M15	-72.438594	43.129847	Riverine reach below Bellows Falls	0.83 DS from Bellows Falls	RL	Side bar	0.15 mi DS from Bellows Falls bypass reach	1
08-M16	-72.43217	43.113009	Riverine reach below Bellows Falls	2.19 DS from Bellows Falls	RL	Point bar	0.44 mi. DS from Cold River	2
08-M17	-72.434228	43.085665	Riverine reach below Bellows Falls	4.34 DS from Bellows Falls	RR	Point bar	0.10 mi US from Dwinnell Street bridge; in vicinity of US limit of Vernon impoundment	1
08-M20	-72.505433	42.768868	Riverine reach below Vernon	1.0 DS from Vernon	MC	US end and RL side of Stebbins Island	0.83 - 1.10 mi DS from Vernon	3

Abbreviations: DS (Downstream); mi. (mile); MC (Mid Channel); RL (River Left); RR (River Right); Long. (longitude); Lat. (latitude). Directionals “right” and “left” are based on an observer facing downstream.

Table 3-2. Tributary study sites.

Study Site #	**Coordinates**		**Reach**	**Distance from Project Dam** (river miles)	**Site Position** (MC / RR / RL)	**Site Description**	**Site Notes**	**# of Trans-ects**
	Long.	**Lat.**						
08-T01	-72.2392	43.765942	Impounded reach above Wilder	7.78 US from Wilder	RR of tributary	Point bar	Ompompanoosuc River; 1.34 mi US from confluence with Connecticut River	3
08-T02	-72.315542	43.648778	Riverine reach below Wilder	1.46 DS from Wilder	MC of tributary	Mid-channel bar	White River; at confluence with Connecticut River	3
08-T04	-72.322871	43.635913	Riverine reach below Wilder	2.71 DS from Wilder	MC of tributary	Mid-channel bar	Mascoma River; 0.16 mi US from confluence with Connecticut River	2
08-T12	-72.46574	43.184855	Impounded reach above Bellows Falls	2.71 US from Bellows Falls	MC of tributary	Point bar on island	Williams River; 1.1 mi US from confluence with Connecticut River	2
08-T14	-72.437139	43.124782	Riverine reach below Bellows Falls	1.21 DS from Bellows Falls	RR of mainstem	Delta bar	Saxtons River; at confluence with Connecticut River	3
08-T16	-72.431758	43.117739	Riverine reach below Bellows Falls	1.79 DS from Bellows Falls	RL of mainstem	Delta bar	Cold River; at confluence with Connecticut River	3

Abbreviations: DS (Downstream); mi. (mile); MC (Mid Channel); RL (River Left); RR (River Right); Long.(longitude); Lat. (latitude). Directionals “right” and “left” are based on an observer facing downstream.

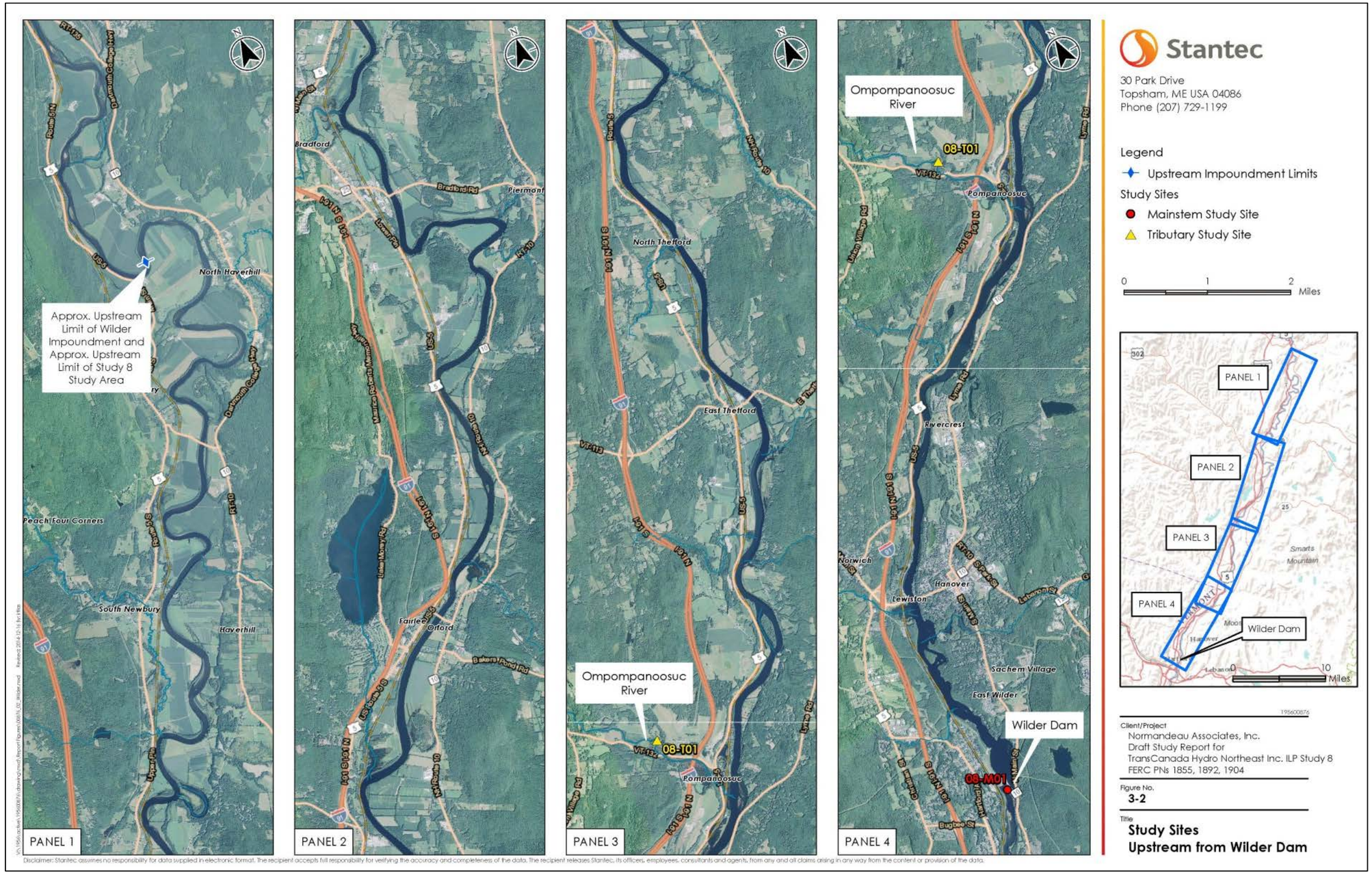


Figure 3-2. Study sites upstream of Wilder Dam.

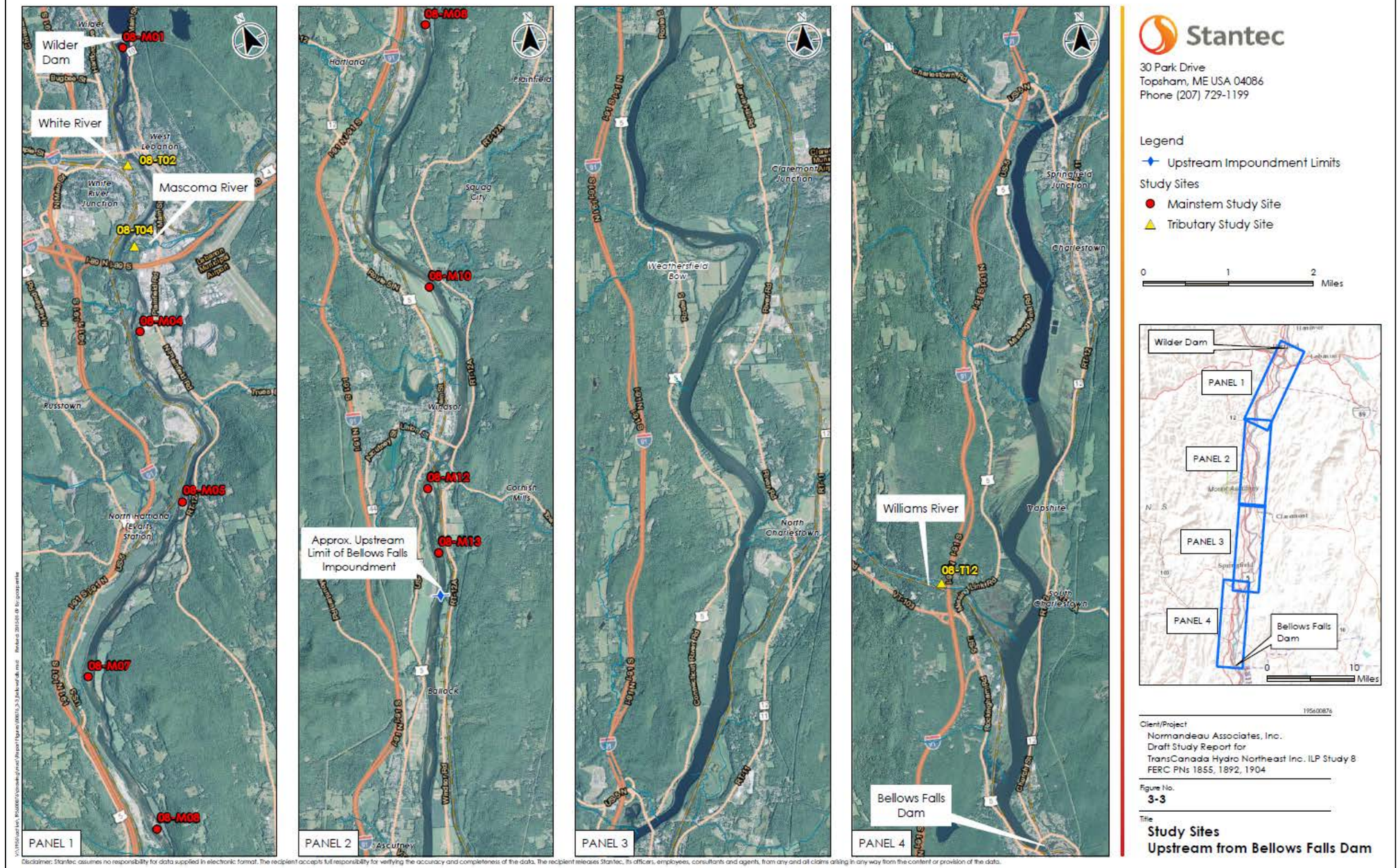


Figure 3-3. Study sites upstream of Bellows Falls Dam.

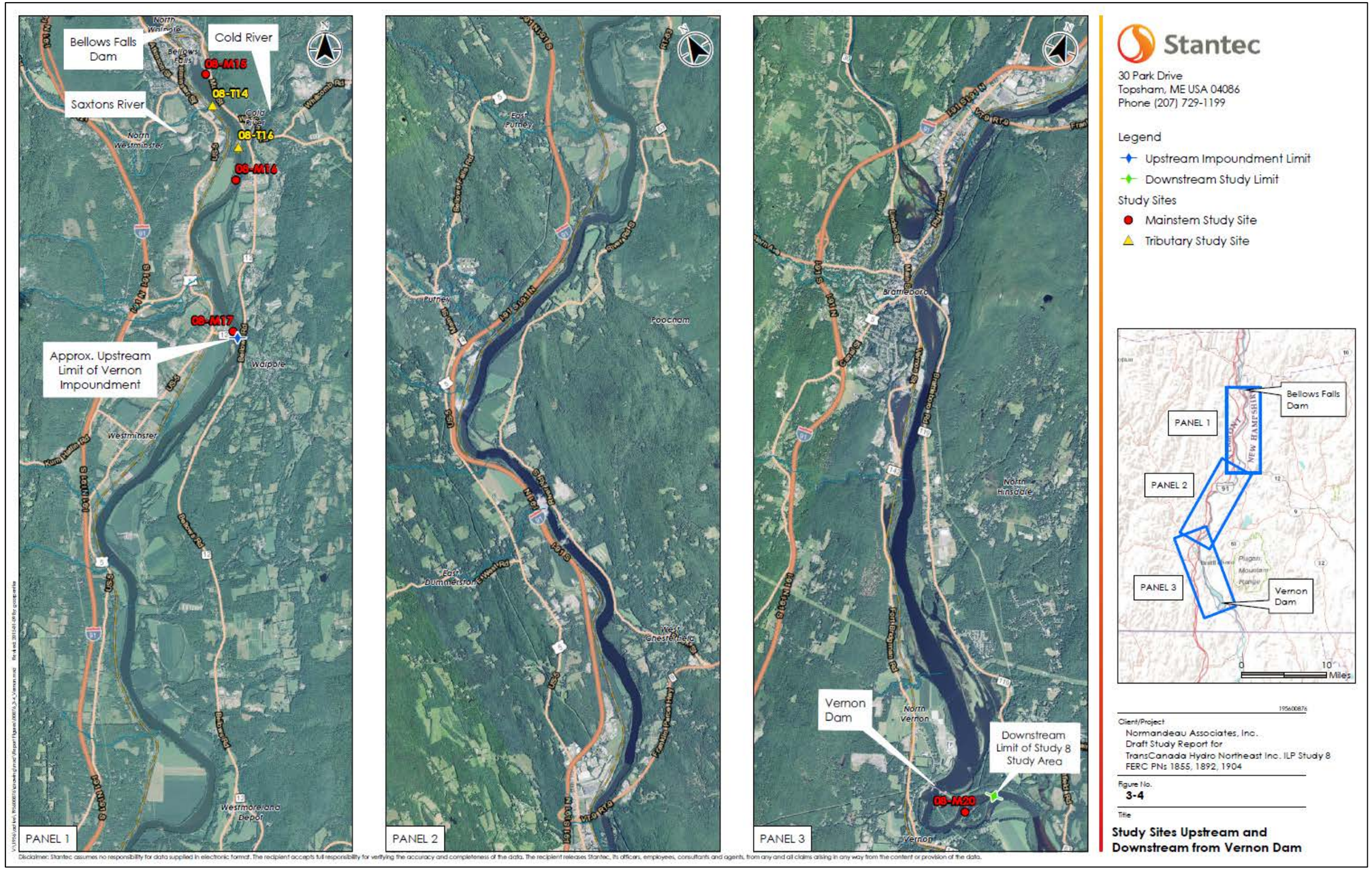


Figure 3-4. Study sites upstream and downstream of Vernon Dam.

The 12 mainstem study sites include a variety of geomorphic features, including mid-channel bars (Photo 3-1), point bars, and side bars. Some of these features are relatively persistent and include named islands in the Connecticut River (Photo 3-2). The exposed extent of the mainstem study sites varies between sites and with water levels.

Photo 3-1. Mainstem study site 08-M07 (mid-channel bar located upstream from Sumner Falls). Photograph taken facing upstream along the Connecticut River. (Stantec 10/8/2014)

Photo 3-2. Mainstem study site 08-M05, facing across the upstream end of Burnaps Island, towards the right bank of the Connecticut River. (Stantec 10/8/2014)

The six tributary study sites include two tributaries that discharge to the Wilder and Bellows Falls impoundments, and four tributaries that discharge to riverine reaches of the Connecticut River downstream of the project dams. The study sites on impoundment tributaries (08-T01 and 08-T12) are located near the upstream limit of the project influence on each tributary. These sites were selected to obtain information on coarse-grained sediments that are expected to accrete in the vicinity of the confluence of the tributary with the impoundment (Photo 3-3). The four study sites at tributaries that discharge to riverine reaches of the Connecticut River (08-T02, 08-T04, 08-T14, and 08-T16) are located at or immediately adjacent to the Connecticut River (Photo 3-4).

Photo 3-3. Tributary study site 08-T12 facing downstream along the Williams River. (Stantec 10/31/2014)

Photo 3-4. Tributary study site 08-T14 facing downstream across the confluence of the Saxtons River with the Connecticut River. (Stantec 10/9/2014)

4.0 METHODS

4.1 Site Selection

The RSP described three types of study sites located in three general areas:

- Upstream (US)-type study sites, located on riverine reaches of the Connecticut River upstream from the TransCanada Project impoundments;
- Downstream (DS)-type study sites, located on riverine reaches of the Connecticut River downstream from the Wilder and Bellows Falls dams; and
- Tributary study sites, located on select tributaries to the Connecticut River in the riverine reaches downstream from the Wilder and Bellows Fall dams and in tributaries to the TransCanada Project impoundments.

The RSP called for establishing approximately 12 US- and DS-type study sites (collectively referred to as mainstem study sites) and up to 6 tributary study sites, including tributaries with and without flood control dams. Five tributaries were also specifically suggested by the working group, including the White River, Mascoma River, Williams River, Saxtons River, and Cold River.

Site selection was based on desktop studies, including review of:

- Aerial photographic imagery;
- U.S. Geological Survey (USGS) topographic maps;
- Data collected as part of Study 2 – Riverbank Transect Study;
- Flood control facilities on tributaries to the Connecticut River within the study area; and
- Available, applicable substrate data collected as part of Study 7 – Aquatic Habitat Mapping.

The primary method for study site selection was identification of areas with accumulations of apparently coarse sediment using aerial photographs. Aerial photographs depicting periods of lower water surface elevations were used to identify sites expected to be exposed or having shallow depths (less than knee deep) to allow for field sampling. Preliminary data collected as a part of Study 2, including site photographs, was also reviewed to inform site selection and corroborate assumptions developed based on review of aerial photography. Following desktop identification of potential study sites, available substrate information collected as a part of Study 7 was reviewed to qualitatively evaluate the identified sites and confirm their apparent suitability in relation to the relevant Study 8 substrate criteria.

The primary selection criterion included observation of apparent depositional areas of coarse-grain sediments. Additional criteria included apparent site access, ability to obtain relevant information, and site safety. The site selection process also considered selection of a suite of sites that, as a whole, appeared generally spatially and physically representative of the study area. Potential tributary site identification also included consideration of the five tributaries listed in the RSP; the apparent sediment supply based on the presence of exposed bars and submerged bedforms on aerial photographs; observation of locations where accumulated sediment appear to have been deposited by tributaries; and the presence of flood control facilities.

Using the methodology described in the RSP and the Site Selection Report (SSR) (Stantec and Normandeau, 2014), a total of 38 potential study sites were identified, including 20 mainstem sites and 18 tributary sites. The SSR presented recommendations for 12 mainstem study sites and 6 tributary study sites and recommended that the balance of the potential study sites be identified as contingency sites, for use in the event that a recommended site was deemed unsuitable for use in the course of implementation of field work.

The SSR was presented to the aquatics working group in a consultation meeting on May 23, 2014. The working group made no requests for changes to the SSR and approved the recommended and contingency sites.

4.2 Field Methods

Field methods for this study included verification of study site suitability, establishment of survey transects, documentation of transect locations, and performance of two rounds of sampling along each transect. Field data was recorded on standardized field forms (Appendix D).

4.2.1 Confirmation of Study Site Suitability

The suitability of each recommended study site was evaluated during the first round of site visits by visual assessment of the presence of coarse-grained sediment. Contingency study sites in close proximity to the recommended study sites were also assessed. The field evaluation of one of the recommended mainstem study sites (08-M15) determined that this site was poorly suited for study. This site is located along the river left (New Hampshire) side of the Connecticut River approximately 800 ft downstream of the Bellow Falls bypassed reach and consists of a homogeneous mix of sand and finer material, rather than coarse-grained sediment. A survey was performed to identify a potentially more suitable, representative mainstem study site immediately downstream of Bellows Falls, but one was not identified. Based on the objectives of this study, it was determined that the recommended mainstem study site would therefore be used.

The suitability of five of the six recommended tributary sites was confirmed as part of the field evaluation. During the first round of field data collection, one contingency tributary site (site 08-T04) was selected to replace a recommended tributary site (site 08-T03). Both sites are located in the vicinity of the confluence

of the Mascoma River with the Connecticut River. Field observations and comparison of the sites indicated that the depositional feature at site 08-T04 consisted of a more heterogeneous mix of coarse-grained sediments than site 08-T03 (which was composed primarily of sand). Based on these observations, site 08-T04 was determined to be better suited for study and was selected to replace site 08-T03.

Following the confirmation of each site for study, the approximate limits of each site were established and the locations recorded using a Global Positioning System (GPS) receiver. The recorded limits of each site generally included the upstream and downstream limits and lateral (perpendicular to flow) limits. Photographs were obtained at each of the demarked limits, including photographs facing upstream and downstream at both the upstream and downstream limits, and photographs facing towards the study site from the lateral limits of the site.

4.2.2 Establishment of Survey Transects

Survey transects were established at each study site prior to implementation of detailed field surveys. Transects were established following visual surveys of each site and were, in most cases, established along the upstream ends of bars to provide information on coarser-grained material since the downstream ends of bars and islands had, in some cases, large accumulations of homogeneous, sand-size material.

The number of survey transects was determined based on a preliminary characterization of each site. In general, a single transect was established at sites with homogeneous characteristics and multiple transects were established at sites with heterogeneous characteristics. The length of survey transects was established to obtain a representative sampling of coarse-grained sediment based on observed conditions. Transect lengths ranged from 100 to 300 feet.

Transects were generally aligned either parallel to the channel ("stream-wise transects") or perpendicular to the channel ("perpendicular transects"). Stream-wise transects were used in areas where the elevation may vary but the feature has a consistent geometry, such as along the crest of bars of accumulated sediment; or, along lines of similar elevation relative to the water surface, including along the sides of bars and around the upstream edge of bars. Perpendicular transects were used only along relatively flat bars. At sites where multiple transects were established at varying elevations, transects were numbered progressing from the water/water's edge to higher elevations at each site (i.e., Transect 1 [T1] generally is the lowest transect).

The locations of transects were limited by the depth of water that could be effectively sampled (e.g., less than 1.5 ft). For this reason, data collection was coordinated with TransCanada Operations to provide for low-flow conditions during data collection. The start and end locations of each transect were recorded with a GPS during the first site visit. During both rounds of data collection, photographs were taken along each transection from the start and end points of each transect and a representative photograph was taken of the substrate along each transect.

Transect locations at each study site are depicted in the figures in Appendix A and photographs are provided in Appendix B.

4.2.3 Pebble Count Method

Coarse-grained substrates were quantified at each study site using pebble counts. The pebble count methodology is based on Wolman (Wolman, 1954). The applied pebble count method included measurement of the median axis of 100 random samples collected at regular intervals along each survey transect. Pebble sizes were categorized based on a simplified Wentworth scale (Wentworth, 1922) (Table 4-1). The field sampling team was comprised of two people, with one person performing the sampling and the other person recording sample measurements. For consistency, the same person performed the sampling at every transect at each site during each site visit.

The pebble count method was performed based on the first particle touched by the sampler with the exception of sites where algal mats were present on top of coarse grained substrates. In this case, substrate particles underlying the algal mat were selected in lieu of fine-grained material (e.g., silt, sand) that was loosely embedded in the algal mat. Pebble count data was recorded on a standardized field data form (Appendix D).

Table 4-1. Simplified Wentworth scale.

Wentworth Class		Size Range (mm)
Silt/Clay	Silt/Clay	<0.062
Sand	Sand	0.062 - 2.0
Gravel	Very Fine	2-4
	Fine	4-8
	Medium	8-16
	Coarse	16-32
	Very Coarse	32-64
Cobble	Small	64-128
	Large	128-256
Boulder	Small	256-512
	Medium	512-1024
	Large - Very Large	1024-4096
Bedrock	Bedrock	-

4.2.4 Embeddedness Method

Embeddedness was quantified using methods as generally described in Chapter 5 of "Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers" (Barbour et al., 1999) that was prepared on behalf of the U.S. Environmental Protection Agency. Embeddedness was defined as the fraction of a gravel, cobble, or boulder particle surface that is surrounded by sand or finer sediments. Embeddedness was not evaluated for sand and finer particles.

Embeddedness was visually estimated at 10 sample points at decile intervals (e.g., 10%, 20% of the total transect length) along each survey transect. At each sample plot, percent embeddedness of gravel, cobble, and boulder particles was evaluated and an embeddedness score between 1 and 20 was recorded (Table 4-2).

Table 4-2. Embeddedness scores and condition categories.

Condition Category	Poor	Marginal	Suboptimal	Optimal
Embeddedness Score	1–5	6–10	11–15	16–20
% Embeddedness	>75%	75–50%	50–25%	25–0%
Description	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50–75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 25–50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 0–25% surrounded by fine sediment.

Embeddedness surveys were performed coincident with the pebble counts. In addition to the 10 visual embeddedness estimates along each transect, an overall visual estimate of embeddedness was recorded following completion of each transect. The overall estimate was made by the person performing the embeddedness estimates, and is intended to provide a single estimate of embeddedness generally representative of embeddedness along the entire transect. Embeddedness data was recorded on a standardized field data form (Appendix D).

4.2.5 Sampling Rounds

Project field work was conducted in two rounds during the summer and fall of 2014. The summer sampling round was conducted on July 11–15 and August 12, 2014; and the fall sampling round on October 6–9 and 31, 2014. Table 4-3 and Table 4-4 present sampling dates for the mainstem and tributary sites, respectively.

Table 4-3. Mainstem study site sampling dates.

Study Site	Summer 2014 Site Visit	Fall 2014 Site Visit
08-M01	7/12	10/8
08-M04	7/12	10/8
08-M05	7/12	10/8
08-M07	7/12	10/8
08-M08	7/13	10/7
08-M10	7/13	10/7
08-M12	7/15	10/6
08-M13	7/15	10/6
08-M15	7/14	10/6
08-M16	7/14	10/9
08-M17	7/14	10/9
08-M20	8/12	10/31

Table 4-4. Tributary study site sampling dates.

Study Site	Summer 2014 Site Visit	Fall 2014 Site Visit
08-T01	7/11	10/7
08-T02	7/12	10/7
08-T04	7/12	10/8
08-T12	7/13	10/31
08-T14	7/14	10/9
08-T16	7/14	10/9

4.3 Field Data Reduction and Analysis

Field data reduction included transcription of field data into standardized electronic forms (Microsoft Excel spreadsheet format) and analysis of the pebble count and embeddedness data.

Material size gradation curves were developed from the pebble count data and an average embeddedness was calculated based on the 10 individual embeddedness scores for each transect and site visit. Qualitative evaluation of the pebble count data was facilitated by comparison of material size gradation curves for each transect during the two site visits; and material size gradation curves for each

transect at each study site. The former comparison is intended to provide insight into potential temporal variations in sediment size along a given transect that may have occurred between the two site visits. The latter comparison is intended to providing insight into spatial variation of sediment at each site.

Tables and gradation curves of the reduced pebble count data are provided in Appendix C.

4.3.1 Dependent Biota

This study evaluates the availability of benthic habitat for relevant life-history stages of coarse-substrate-dependent aquatic invertebrates and anadromous and resident fish. As described below, the selection of species for consideration in this study included a review of the specific, coarse-substrate-dependent biota that were identified in the Study 8 study requests and in other project studies.

Aquatic Invertebrates

Invertebrates identified in the Study 8 study requests and in other project studies include:

- Freshwater mussels including Dwarf Wedgemussel (*Alasmidonta heterodon*), (Study 24);
- Dragonflies and damselflies (Study 25); and
- Cobblestone and Puritan Tiger Beetles (*Cicindela marginipennis* and *C. puritana*) (Study 26).

Freshwater mussel species, including Dwarf Wedgemussel, are not specifically dependent on coarse-grained habitat; thus coarse-grained habitat availability for freshwater mussel species is not evaluated as a part of this study.

Aquatic life-stages of the species included in the order Odonata (i.e., dragonflies and damselflies), have a range of aquatic habitat requirements and are not solely dependent on habitat comprised of coarse-grained substrates; thus benthic habitat availability as relates to the order is not evaluated as a part of this study.

Cobblestone and Puritan Tiger Beetles are not aquatic invertebrates; thus benthic habitat availability for these species is not evaluated as part of this study.

Coarse-grained substrate does provide benthic habitat for certain species in the order Odonata and, more generally, for a wide range of benthic macroinvertebrates (e.g., Plecoptera [stonefly] nymphs) that are not specifically addressed in the study requests or other project studies. For these reasons, this study's evaluation of coarse-grained habitat for aquatic invertebrates focuses on the general availability and characteristics (e.g., grain size and embeddedness) of coarse-grained substrate for use by benthic macroinvertebrates within the study area. Evaluation of habitat suitability for benthic macroinvertebrates as part of this study uses the substrate habitat suitability criteria (HSC) provided in the draft Study 9 (Instream Flow Study) HSC Selection Report (dated December 15, 2014). The macroinvertebrate

substrate HSC define increased suitability for coarse-grained substrates relative to finer-grained substrates, including cobble substrate representing optimal conditions as defined by a suitability index of 1.0.

Fish Species

Selection of resident riverine and anadromous fish species for consideration in this study was based on review of habitat-specific needs relative to coarse-grained substrate using information presented in other project studies. Evaluated fish species (and the associated study) included:

- American Shad (*Alosa sapidissima*), (Study 21);
- American Eel (*Anguilla rostrat*e), (Study 11);
- Fallfish (*Semotilus corporalis*), (Study 15);
- Walleye (*Sander vitreus*), (Study 15);
- White Sucker (*Catostomus commersonii*), (Study 15);
- Smallmouth Bass (*Micropterus dolomieu*), (Study 15);
- Tessellated Darter (*Etheostoma olmstedi*), (Study 12); and
- Sea Lamprey (*Petromyzon marinus*), (Study 16).

Coarse-grained substrate dependence of these species was evaluated based on review of information in the above-referenced study plans and the Study 9 draft HSC. Dependency on coarse-grained substrates was identified for this study if substrate suitability indices greater than 0.5 were limited to gravel, cobble, or boulder material based on the habitat suitability criteria presented in Appendix A of the Study 9 HSC report.

Dependence on coarse-grained substrate was identified for Fallfish, Walleye, White Sucker, and Smallmouth Bass. The life-stage-specific dependence of these fish species on coarse-grained substrates is described in Study 15 based on suitable spawning habitat, and the Study 9 HSC Selection Report provides life-stage-specific HSC for these species. Dependence on coarse-grained substrates is identified as for the referenced species. Consistent with Study 15, these four species are assigned into the following two “species groups”, for evaluation of coarse-substrate-dependent habitat needs:

- Early-Spring Riffle Spawners (Walleyes and White Suckers); and
- Late-Spring Island/Bar Spawners (Smallmouth Bass and Fallfish).

Dependence on coarse-grained substrate was also identified for Sea Lamprey based on the Study 9 HSC Selection Report. Dependence on coarse-grained substrate was not identified for American Shad, American Eel, or Tessellated Darter; therefore, this study does not evaluate habitat availability for these species.

4.4 Evaluations Based on Other Studies

Evaluations as part of this study draw on information obtained from other studies, including sediment supply information from the Riverbank Erosion Study (Study 3) and flow speed, depth, and sheer stress, and sediment mobility information developed as part of the Hydraulic Modeling Study (Study 4). Studies 3 and 4 will provide information on potential sediment sources and mobility, respectively. The Operations Modeling Study (Study 5) will help to identify potential project effects on the channel morphology and benthic habitats included in this study.

4.4.1 Riverbank Erosion Study (Study 3)

Information obtained as part of Study 3 (Riverbank Erosion Study) will be used to provide information on sediment supply that may result from erosion of riverbanks of the Connecticut River in the study area. This information will be used to qualitatively assess the impact of riverbank erosion on bedload distribution, particle size, and composition in relation to habitat availability and stability. Specifically, riverbank erosion will be assessed as a source of coarse-grained sediment and as a source of fine-grained sediment that could result in increased embeddedness of coarse-grained sediment in the study area.

4.4.2 Hydraulic Model Study (Study 4)

Information obtained from Study 4 (Hydraulic Model Study), including stage-shear stress and stage-discharge curves will be used to evaluate the stability of coarse-grained substrate at the mainstem sites. Incipient motion criteria for each of the Wentworth size classes presented in Table 4-1 will be compared to calculated shear stresses based on monotonic stage-shear stress curves at each mainstem site. This comparison provides information on the stability of the evaluated sediment size classes. Resulting information on the stability of the evaluated sediment size classes will be referenced to the range of flows that result in mobilization of the sediment size classes; this comparison will provide insight regarding the effects of project operations on stability of sediments relative to higher flows. Information from Study 4 will also be used to assess whether fluctuations in water surface elevations associated with project operations may affect sediment delivery from tributaries. While Study 13 - Tributary and Backwater Fish Access and Habitat Study provides some information on fluctuations in water surface at tributary sites, the broader spectrum of modeled flows in Study 4 provides more relevant information for this study, including high-flow conditions that are not affected by project operations. Information obtained from this element of Study 8 could subsequently be incorporated into the Study 5 Operations Model for evaluation of effects of project operations on the stability of coarse-grained substrates.

5.0 RESULTS AND DISCUSSION

The distribution and extent of coarse-grained substrate in the study area is related to and affected by fluvial processes. This study identifies and characterizes areas of coarse-grained substrate at the study sites; evaluates potential sediment sources, including eroding streambanks (based on information obtained from Study 3) and tributary waterways (based on information obtained at tributary sites as part of this study); and assesses the mobility of substrates in the study area (based on information obtained from Study 4).

The results of this study rely on other studies pending completion. Information from these studies will inform an evaluation of the availability and stability of habitat for coarse-sediment-dependent aquatic invertebrates and anadromous and resident fish identified in Section 4.3.1 of this report and potential project-related effects (from Studies 4 and 5) on these habitats. The results of this evaluation will be presented in the Draft License Applications.

5.1 Distribution and Extent of Existing Coarse-Grained Substrates

This section presents the results of the pebble counts and embeddedness surveys conducted as a part of this study. This data helps inform an understanding of the distribution and extent of coarse-grained substrates within the study area and will be supplemented with information provided in other studies, including Study 3 (Riverbank Erosion Study) and Study 4 (Hydraulic Modeling Study) when those studies are completed.

5.1.1 Pebble Count Data

Pebble count data along each transect provides information on the grain size of substrate at the study sites, including the distribution (gradation) of substrate sizes. This information is used directly in this study to characterize the presence and composition of coarse-grained substrates and indirectly to characterize benthic habitat and stability of coarse-grained substrates using information obtained as part of other project studies.

Pebble count measurements were collected using the simplified Wentworth scale that is described in Section 4.2.3. Use of this scale provides for ready comparison of the pebble count data based on general classes (i.e., sand, gravel, cobble, boulder) and refinement within classes (e.g., “very fine gravel”). This approach provides for qualitative description of the pebble count data (e.g., “median gravel”) in lieu of quantitative descriptions (e.g., 15 mm).

Table 5-1 presents median particle classes based on the pebble count data at the 12 mainstem study sites. It is apparent in this table that coarse gravel is the dominant median substrate size at mainstem sites between Wilder Dam and Bellows Falls Dam, and that very coarse gravel is the dominant median substrate size at mainstem sites downstream from Bellows Falls Dam. Two mainstem sites had markedly different substrate characteristics, however. The median substrate size at site 08-M01, which is immediately downstream from Wilder Dam, was

cobble-sized material along with numerous boulders. Substrate at this site appears to be stable and may be comprised of rock that was excavated and/or placed as part of dam construction. The median substrate size at site 08-M15, which is along the New Hampshire side of the Connecticut River downstream from Bellows Falls Dam and upstream from the first tributary (Saxtons River) is sand which is the predominant substrate at this site.

The median substrate size at the 6 tributary sites varied from silt/clay (site 08-T01, Ompompanoosuc River) to very coarse gravel (site 08-T16, Cold River). The variability of sediment sizes observed at the tributary sites may result from multiple factors, including watershed size, topography and surficial geology; anthropogenic influences in the watersheds; and recent storm events. An example anthropogenic influence includes the presence of the impoundment and flood control dam on the Ompompanoosuc River in Thetford, Vermont upstream from site 08-T01.

Table 5-1. Median particle class for mainstem study sites.

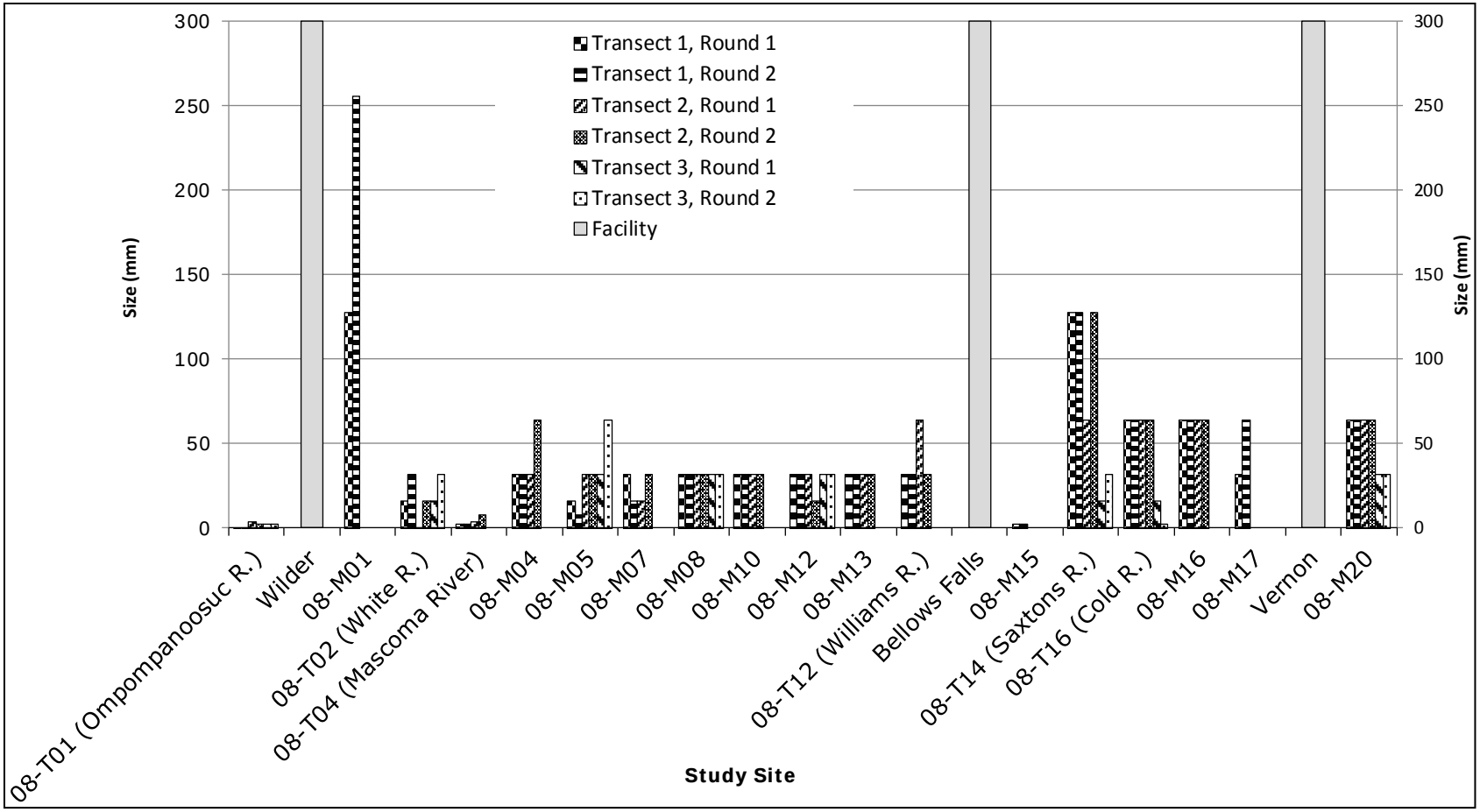
Study Site	Transect 1		Transect 2		Transect 3	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
08-M01	Small Cobble	Large Cobble	-	-	-	-
08-M04	Coarse Gravel	Coarse Gravel	Coarse Gravel	Very Coarse Gravel	-	-
08-M05	Medium Gravel	Fine Gravel	Coarse Gravel	Coarse Gravel	Coarse Gravel	Very Coarse Gravel
08-M07	Coarse Gravel	Medium Gravel	Medium Gravel	Coarse Gravel	-	-
08-M08	Coarse Gravel	Coarse Gravel	Coarse Gravel	Coarse Gravel	Coarse Gravel	Coarse Gravel
08-M10	Coarse Gravel	Coarse Gravel	Coarse Gravel	Coarse Gravel	-	-
08-M12	Coarse Gravel	Coarse Gravel	Coarse Gravel	Medium Gravel	Coarse Gravel	Coarse Gravel
08-M13	Coarse Gravel	Coarse Gravel	Coarse Gravel	Coarse Gravel	-	-
08-M15	Sand	Sand	-	-	-	-
08-M16	Very Coarse Gravel	Very Coarse Gravel	Very Coarse Gravel	Very Coarse Gravel	-	-
08-M17	Coarse Gravel	Very Coarse Gravel	-	-	-	-
08-M20	Very Coarse Gravel	Very Coarse Gravel	Very Coarse Gravel	Very Coarse Gravel	Coarse Gravel	Coarse Gravel

Table 5-2 presents median particle classes based on the pebble count data at the 6 tributary study sites.

Table 5-2. Median particle class for tributary study sites.

Study Site	Transect 1		Transect 2		Transect 3	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
08-T01	Silt/Clay	Silt/Clay	Very Fine Gravel	Sand	Sand	Sand
08-T02	Medium Gravel	Coarse Gravel	Silt/Clay	Medium Gravel	Medium Gravel	Coarse Gravel
08-T04	Sand	Sand	Very Fine Gravel	Fine Gravel	-	-
08-T12	Coarse Gravel	Coarse Gravel	Very Coarse Gravel	Coarse Gravel	-	-
08-T14	Small Cobble	Small Cobble	Very Coarse Gravel	Small Cobble	Medium Gravel	Coarse Gravel
08-T16	Very Coarse Gravel	Very Coarse Gravel	Very Coarse Gravel	Very Coarse Gravel	Medium Gravel	Sand

Figure 5-1 below presents histograms of the median particle size that is presented in Table 5-1 (mainstem study sites) and Table 5-2 (tributary study sites).



Note: The study sites and locations of the three project dams are presented from upstream to downstream.

Figure 5-1. Median-diameter particle size for study sites.

The median-diameter particle sizes in Figure 5-1 indicate similarity of particle sizes at sites between the Wilder and Bellows Falls dams, and between the Bellows Falls and Vernon dams. It is apparent from the figure that the median particle size is larger at sites downstream of Bellows Falls dam relative to the sites upstream of the dam. Apparent causes of the larger size material downstream of Bellows Falls are the input of sediment from the Saxtons and Cold rivers. The median particle size downstream of Vernon dam is similar to the median particle size at sites downstream of Bellows Falls.

Observed conditions and information obtained at the study sites suggest that sediment delivery from tributary streams affects the distribution of coarse-grained substrates in the adjacent downstream reach of the Connecticut River at some locations. For example, information obtained at tributary study sites 08-T14 (Saxtons River) and 08-T16 (Cold River) indicates that the median particle size class is similar to the downstream mainstem study sites (08-M16, 08-M17). However, sampling at tributary study sites 08-T02 (White River) and 08-T04 (Mascoma River) indicates that the median particle size class is smaller than the downstream mainstem study sites (08-M04, 08-M05, 08-M07, 08-M08, 08-M10, 08-M12, and 08-M13) that are upstream of Bellows Falls.

Observations and analysis of data collected during the summer and fall 2014 site visits indicate little variability in coarse-grained substrate at the 18 study sites. Apparent changes along specific sample transects that are apparent in Figure 5-1 are limited to differences between adjacent Wentworth size classes; and such differences between adjacent size classes are not within the resolution of the sample method.

5.1.2 Embeddedness Data

Embeddedness refers to the extent to which coarse-grained substrates are surrounded by fine-grained sediment, such as silt and sand. Generally, increased embeddedness of coarse-grained substrates reduces the interstitial habitat available to benthic macroinvertebrates and to fish for shelter, spawning and egg incubation. Table 5-3 presents the average embeddedness condition categories at each of the 12 mainstem study sites.

Table 5-3. Average embeddedness condition categories for mainstem study sites.

Study Site	Transect 1		Transect 2		Transect 3	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
08-M01	Optimal	Optimal	-	-	-	-
08-M04	Optimal	Optimal	Optimal	Suboptimal	-	-
08-M05	Suboptimal	Marginal	Suboptimal	Marginal	Suboptimal	Suboptimal
08-M07	Marginal	Poor	Marginal	Marginal	-	-
08-M08	Suboptimal	Marginal	Optimal	Suboptimal	Optimal	Suboptimal
08-M10	Suboptimal	Suboptimal	Suboptimal	Suboptimal	-	-
08-M12	Suboptimal	Suboptimal	Marginal	Marginal	Marginal	Marginal
08-M13	Suboptimal	Suboptimal	Suboptimal	Suboptimal	-	-
08-M15	N/A	N/A	-	-	-	-
08-M16	Optimal	Suboptimal	Suboptimal	Marginal	-	-
08-M17	Suboptimal	Suboptimal	-	-	-	-
08-M20	Suboptimal	Suboptimal	Marginal	Marginal	Suboptimal	Optimal

Note: Where the condition category is listed as N/A, the dominant substrate was sand or finer and embeddedness was not assessed.

Spatial variability in embeddedness was apparent in some of the mainstem study site transects but consistent trends related to the respective elevations of the transects were not apparent. Increased embeddedness was often associated with loose fine material (e.g., sand) around coarser substrate at higher elevations at a given site. Note that embeddedness was not assigned along Transect 1 at tributary study site 08-M15 because substrates along this transect were comprised of sand or finer material.

The embeddedness data indicates a small temporal shift from the summer site visits relative to the fall site visits at the mainstem study sites. Reduced embeddedness conditions (i.e., increased embeddedness) were observed at 9 of the 25 mainstem study site transects, whereas improved embeddedness condition (i.e., decreased embeddedness) was observed at one mainstem study site transect. Apparent conditions that may have contributed to reductions in embeddedness condition observed during the fall site visit included observed algal mats and accumulations of finer sediment (e.g., sand) and lower-flow conditions between the summer and fall 2014 site visits.

Table 5-4. Average embeddedness condition categories for tributary study sites.

Study Site	Transect 1		Transect 2		Transect 3	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
08-T01	N/A	N/A	Poor	Poor	Poor	Poor
08-T02	Optimal	Suboptimal	Marginal	Marginal	Suboptimal	Suboptimal
08-T04	Poor	Poor	Poor	Marginal	-	-
08-T12	Marginal	Suboptimal	Optimal	Suboptimal	-	-
08-T14	Optimal	Optimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal
08-T16	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Marginal

Note: Where the condition category is listed as N/A, the dominant substrate was sand or finer and embeddedness was not assessed.

Spatial variability in embeddedness is apparent in four of the six tributary study sites (08-T02, 08-T12, 08-T14, and 08-T16) with transects located at lower elevations having higher embeddedness scores. At sites with multiple transects, embeddedness conditions were generally lower (i.e., embeddedness increased) at the higher-elevation transects.

Tributary study sites 08-T01 and 08-T04 had consistently "poor" and "marginal" embeddedness conditions. These low-quality embeddedness conditions are consistent with the dominance of finer-grained substrates observed at these sites as noted in Table 5-2. Note that embeddedness was not assigned along Transect 1 at tributary study site 08-T01 because substrates along this transect were comprised of sand or finer material.

At the tributary sites, the embeddedness data indicates small temporal shifts from the summer site visits to the fall site visits. Reduced embeddedness conditions (i.e., increased embeddedness) were observed at 4 of the 16 tributary study site transects, and increased embeddedness conditions (i.e., reduced embeddedness) were observed at 2 tributary study site transects. Apparent conditions that may have contributed to reductions in embeddedness condition at tributary study site transects during the fall site visit included accumulation of finer sediment (e.g., sand) during lower-flow conditions between the summer and fall 2014 site visits.

5.1.3 Review of Information Provided in other Studies

Information obtained from other studies will include potential sources of sediment, and hydraulic modeling that provides for evaluation of the stability of coarse-grained substrate in the study area. Riverbank erosion is a potential source of sediment supply to the study area and may supply coarse-grained sediment and finer-grained sediment that can adversely affect habitat associated with coarse-grained substrates by increasing embeddedness. Study 3 (Riverbank Erosion

Study) will present information on eroding streambanks that will be used to inform this study. Information obtained from Study 4, including stage-shear stress and stage-discharge curves will be used to evaluate the stability of coarse-grained substrates over a range of water surface elevations and flows in the vicinity of each mainstem site and the tributary sites, including flows that are affected by project operations. The results of this study's evaluation of pending studies and project effects will be presented in the Draft License Applications.

5.2 Habitat Availability

This study assesses benthic habitat availability and stability for relevant life-stages of coarse-substrate dependent biota, including aquatic macroinvertebrates, fish species groups identified in Section 4.3.1 (Early-Spring Riffle Spawners and Late-Spring Island/Bar Spawners), and Sea Lamprey. Information obtained from pending studies, including Study 3 and Study 4, will inform this study's evaluation of temporal and spatial patterns of habitat availability and stability.

Fieldwork performed in this study indicates that coarse-grained habitat is present at study sites and that gravel and cobble are the median substrate size at 11 of the 12 mainstem sites. In addition, information developed as part of Study 7 (Aquatic Habitat Mapping) indicates that coarse-grained substrates are present in areas that were not evaluated as part of this study. Coarse-grained substrates provides suitable habitat for coarse-grained substrate dependent biota, including habitat for the two fish species groups described in Section 4.3.1, spawning habitat for sea lamprey, and suitable habitat for aquatic macroinvertebrates based on the substrate HSC developed as part of Study 9.

Information obtained from Study 3 will inform this study's assessment of benthic habitat availability and stability as related to recruitment of sediment through riverbank erosion. Information obtained from Study 4 will inform this study's evaluation of the stability and persistence of coarse-grained benthic habitat over a range of flows. The results of this study's evaluation of benthic habitat availability and stability will be presented in the Draft License Applications.

6.0 ASSESSMENT OF PROJECT EFFECTS

An assessment of the potential effects of project operations will be included in the Draft License Applications since results from other studies are needed to complete that assessment. Relevant studies include the erosion studies (Studies 1, 2, and 3), Hydraulic Modeling Study (Study 4), and the Operations Modeling Study (Study 5). None of these studies are complete at this time.

7.0 LITERATURE CITED

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Appendix A

Figures

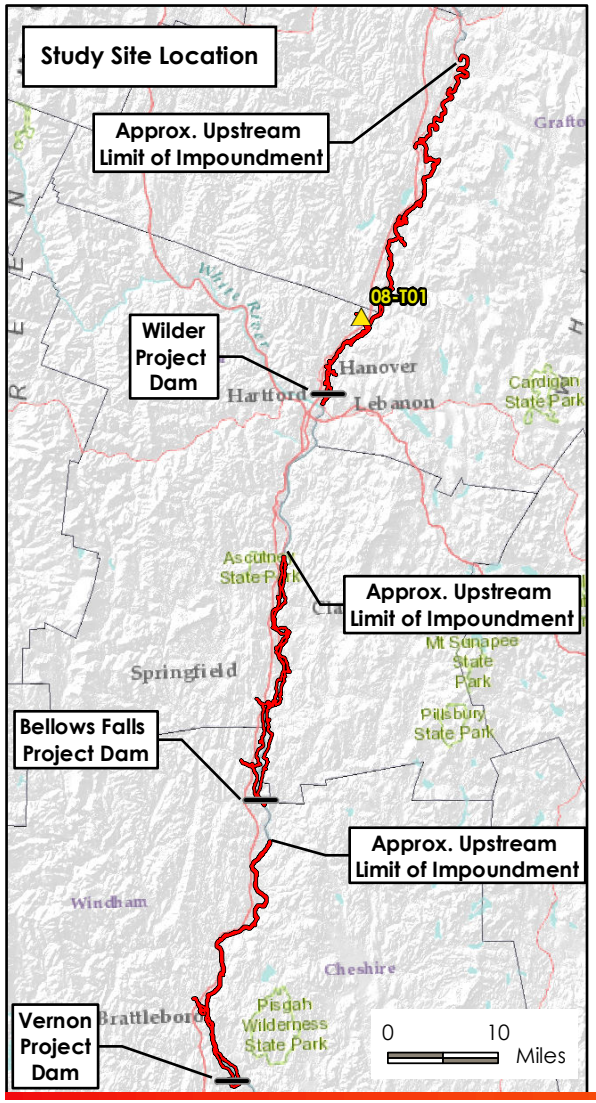

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Figure No.
A-1

Title
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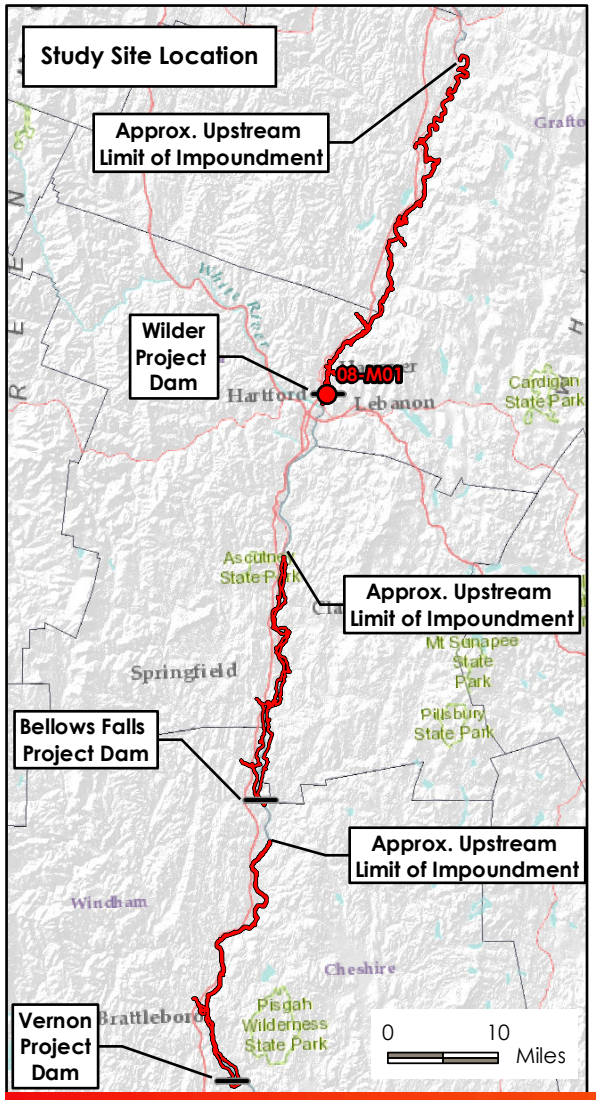

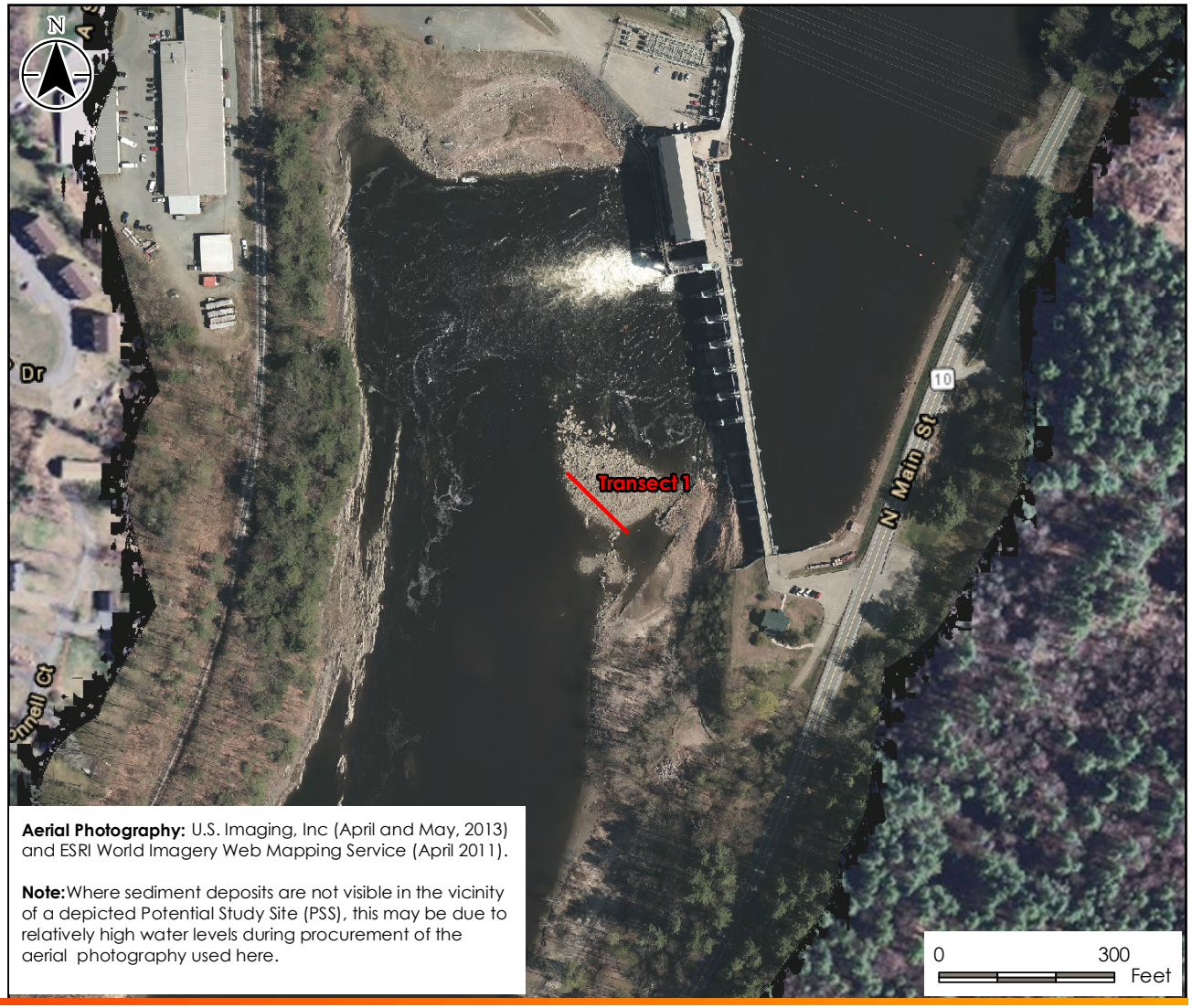

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Figure No.
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Title
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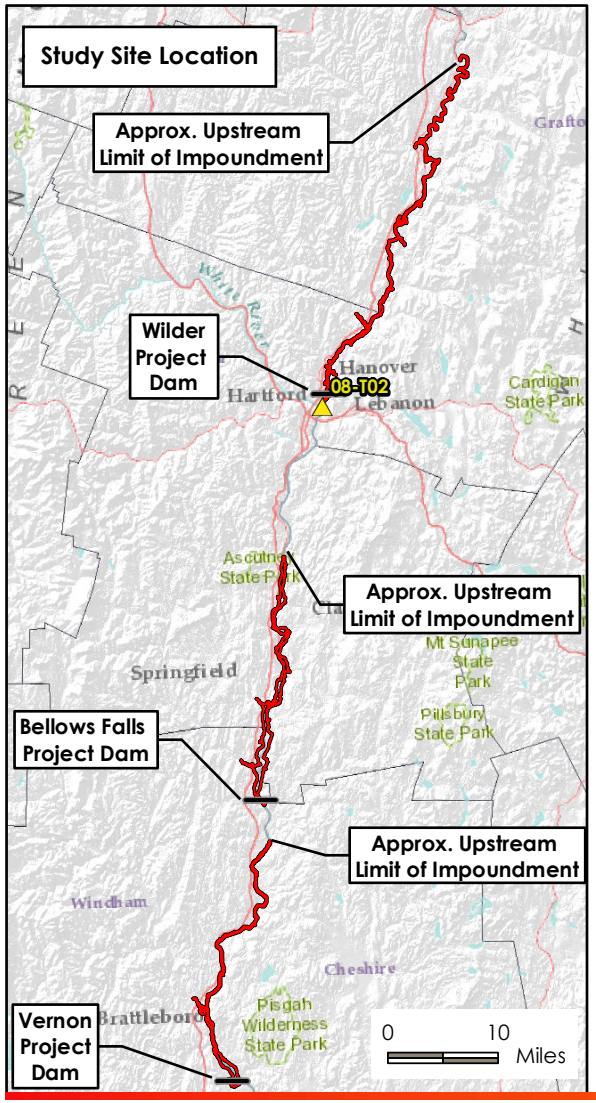

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Figure No.
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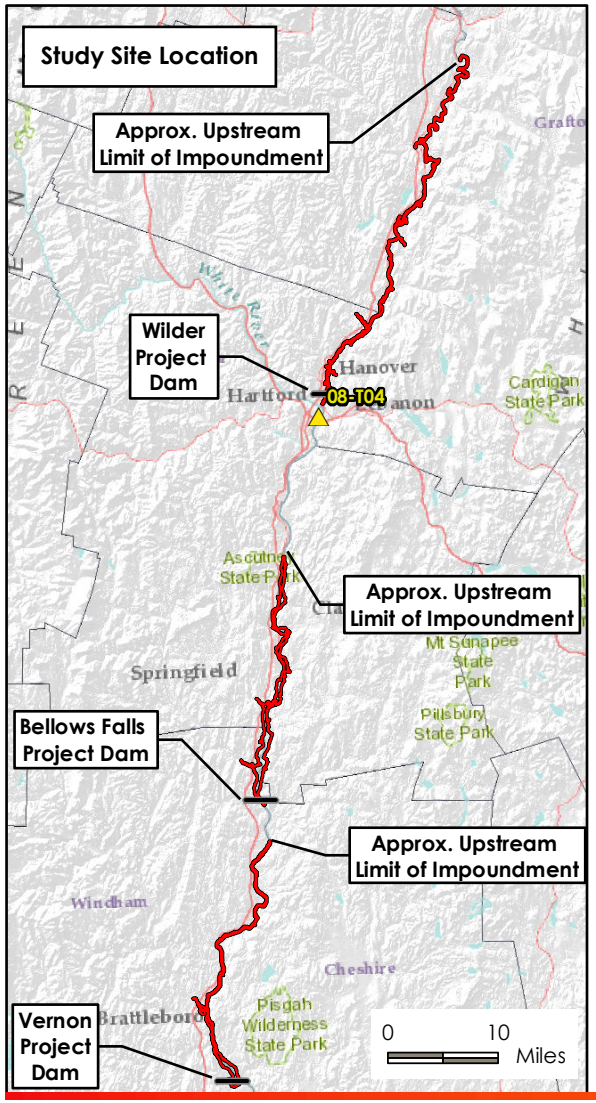

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Figure No.
A-4

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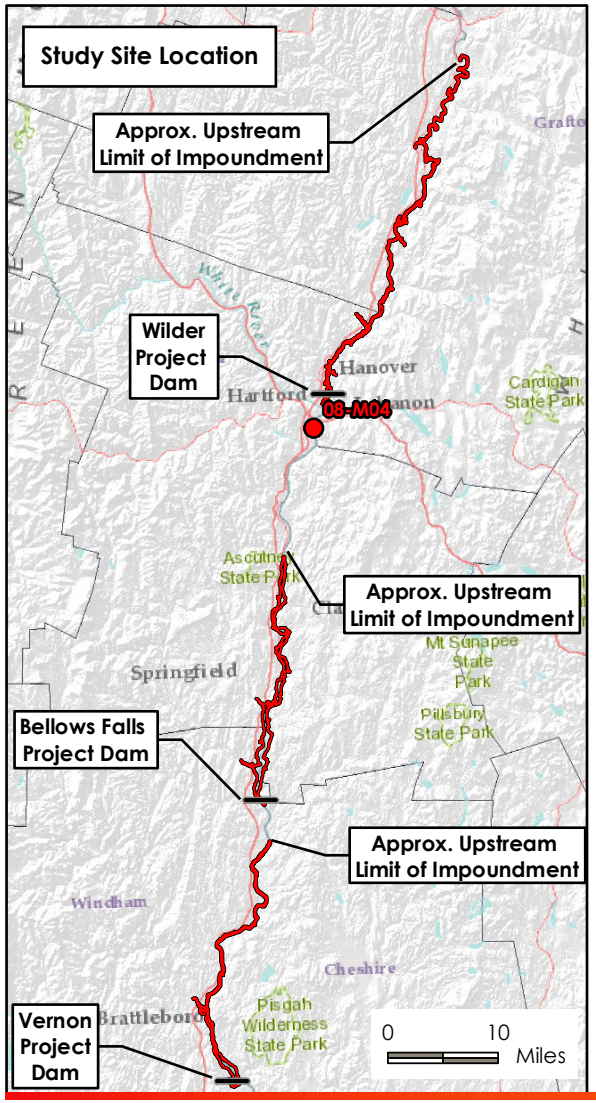

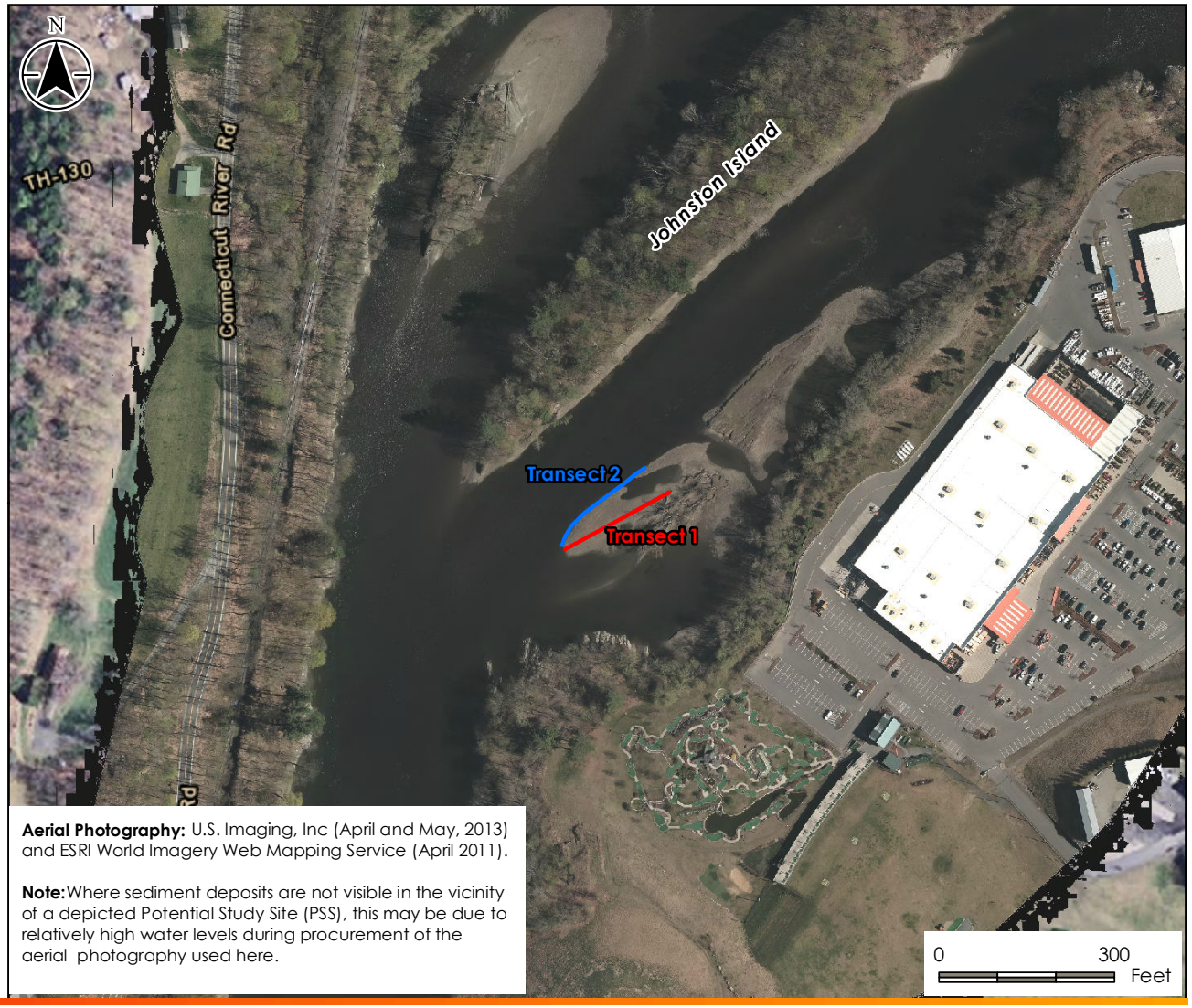

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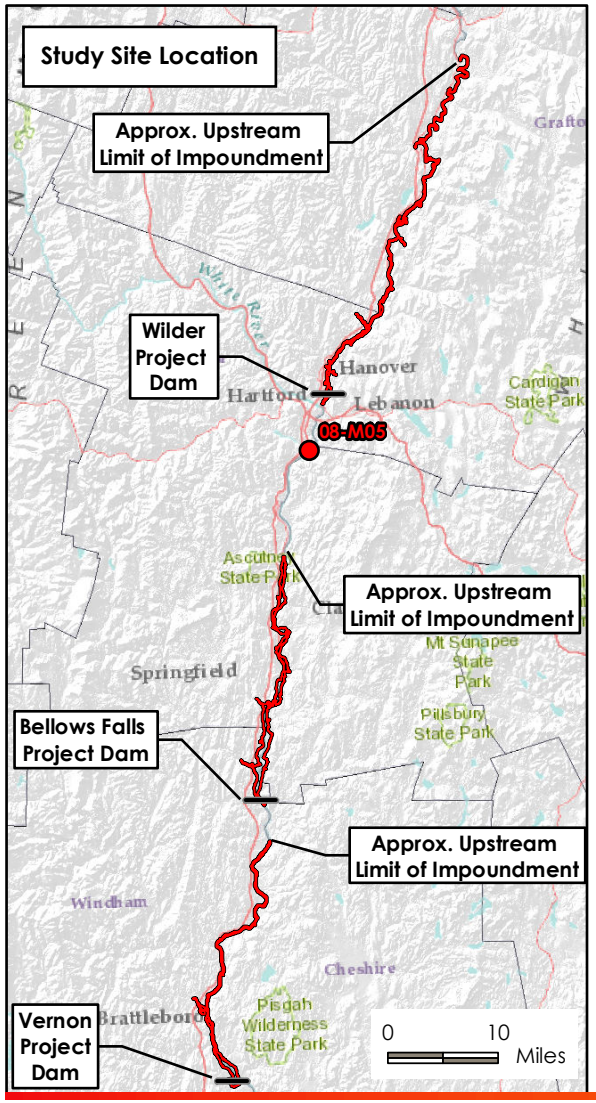

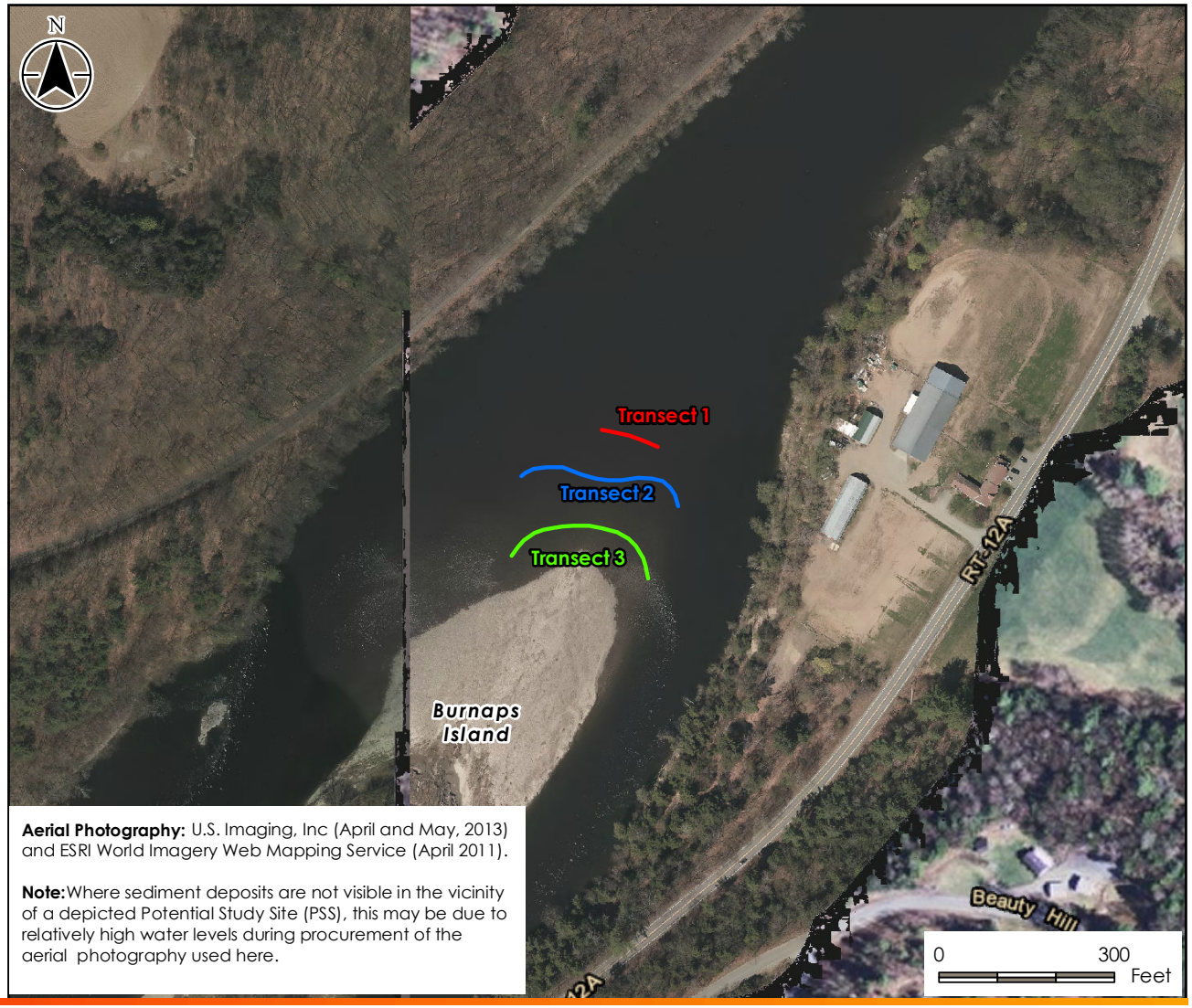

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Figure No.
A-6

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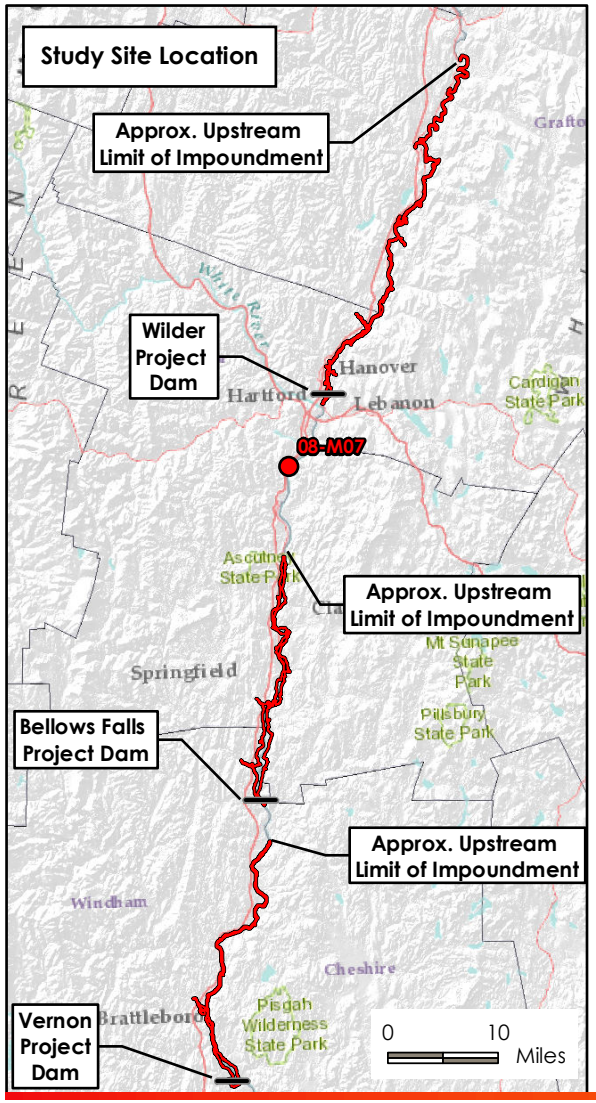

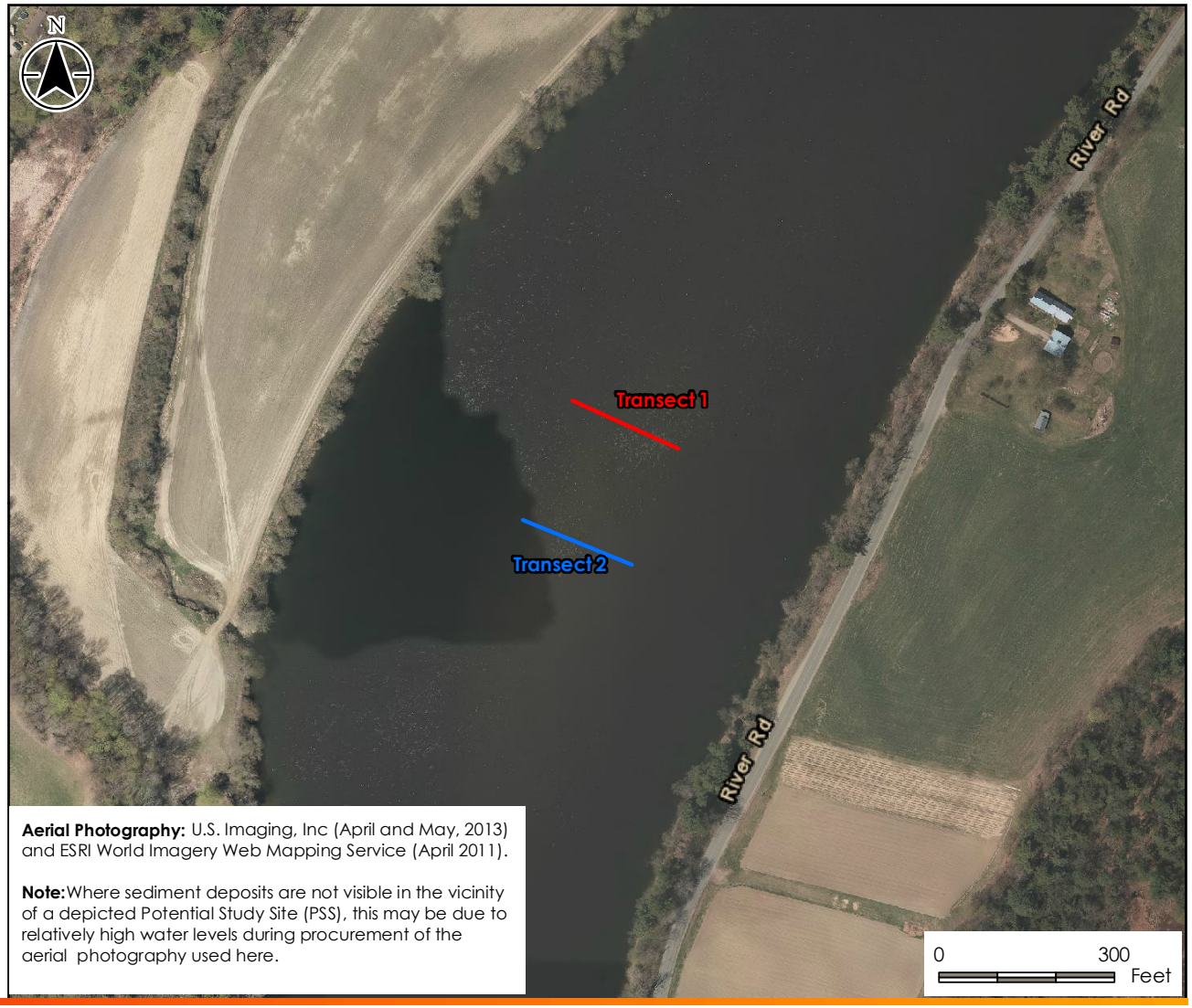

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Note: Where sediment deposits are not visible in the vicinity of a depicted Potential Study Site (PSS), this may be due to relatively high water levels during procurement of the aerial photography used here.

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Figure No.
A-7

Title
Study Site 08-M07
1/9/2015

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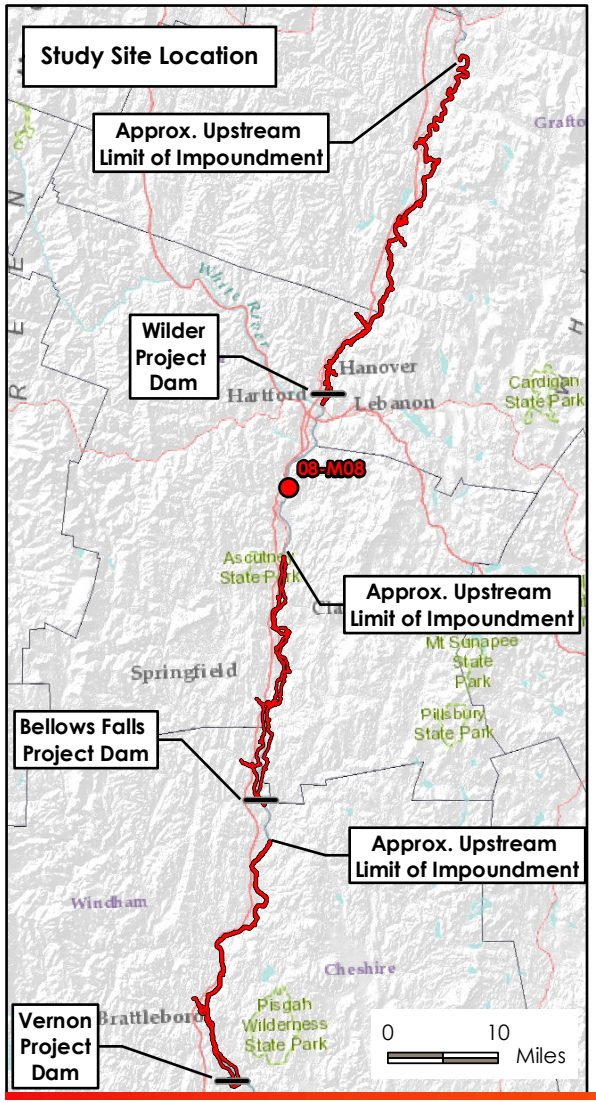

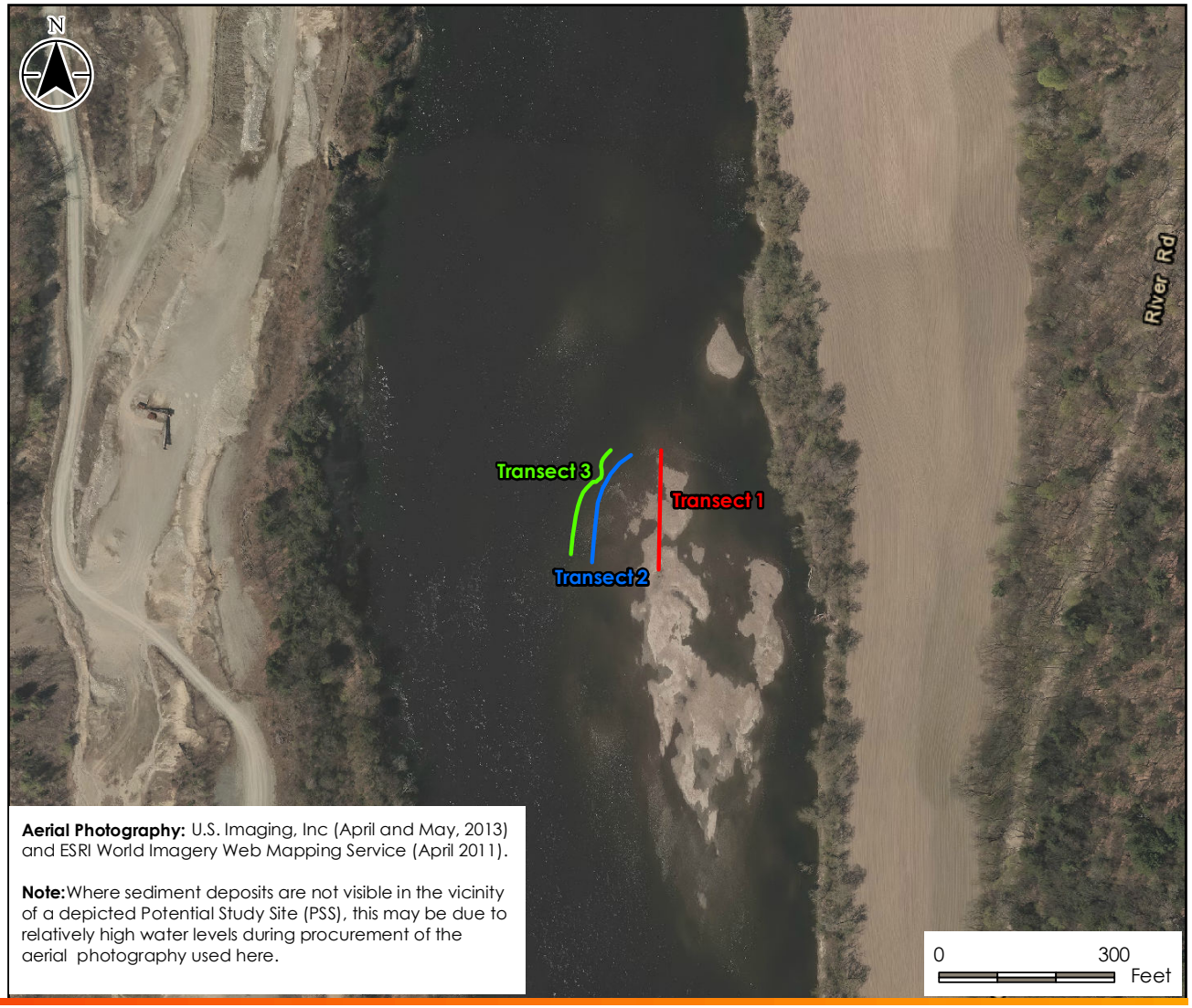

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Figure No.
A-8

Title
Study Site 08-M08
1/9/2015

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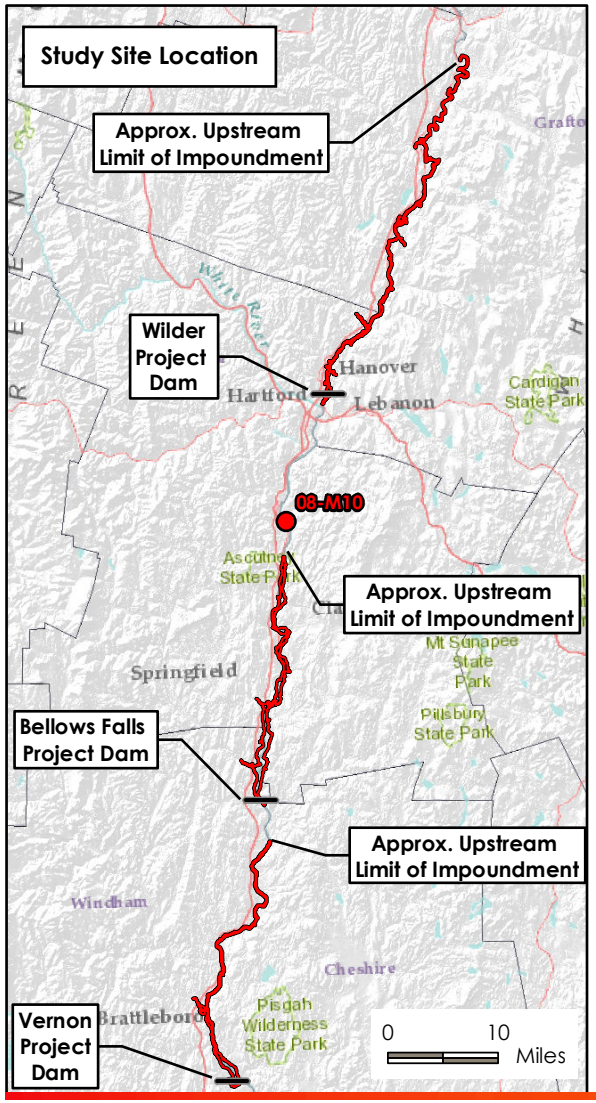

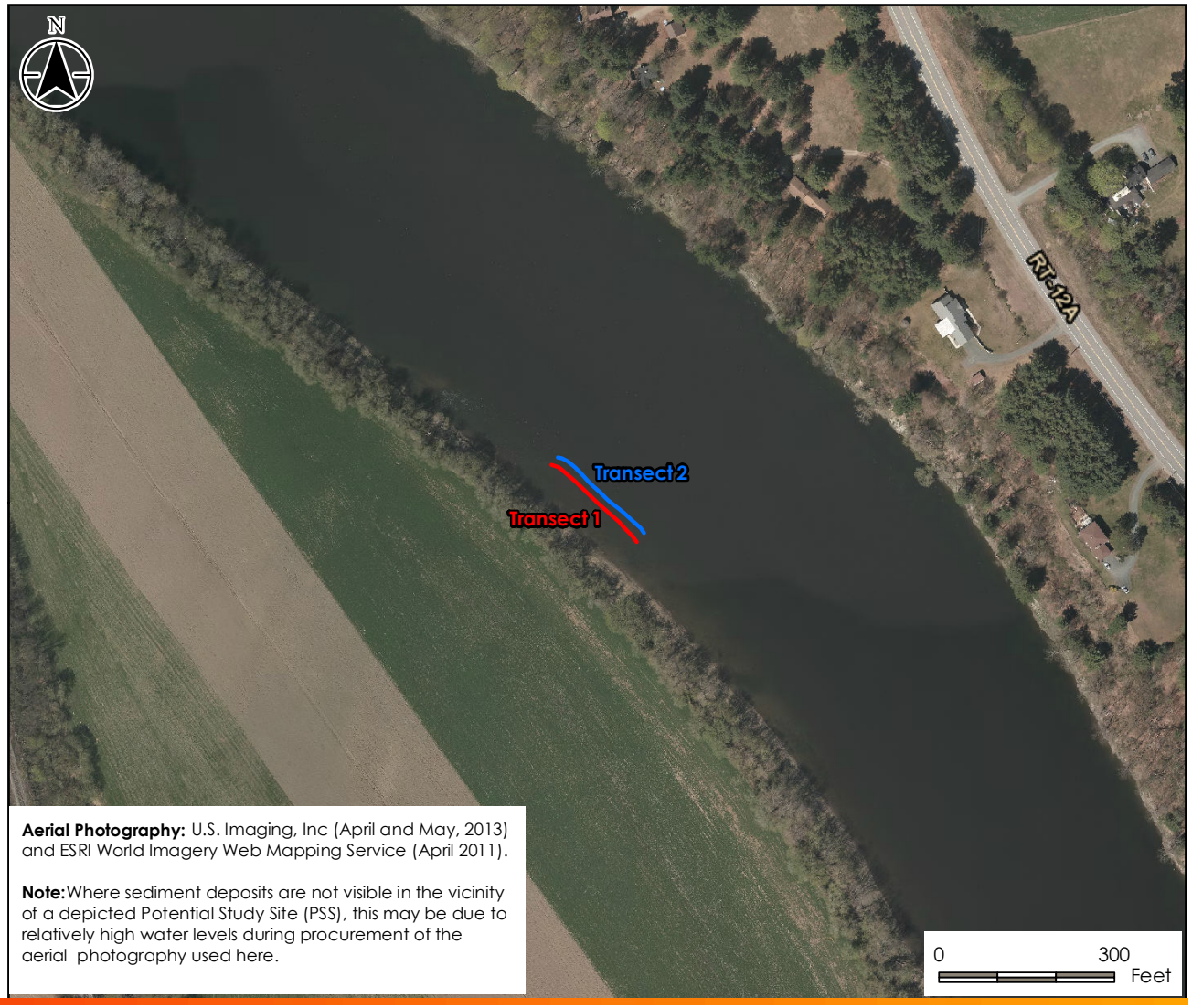

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Figure No.
A-9

Title
Study Site 08-M10
1/9/2015

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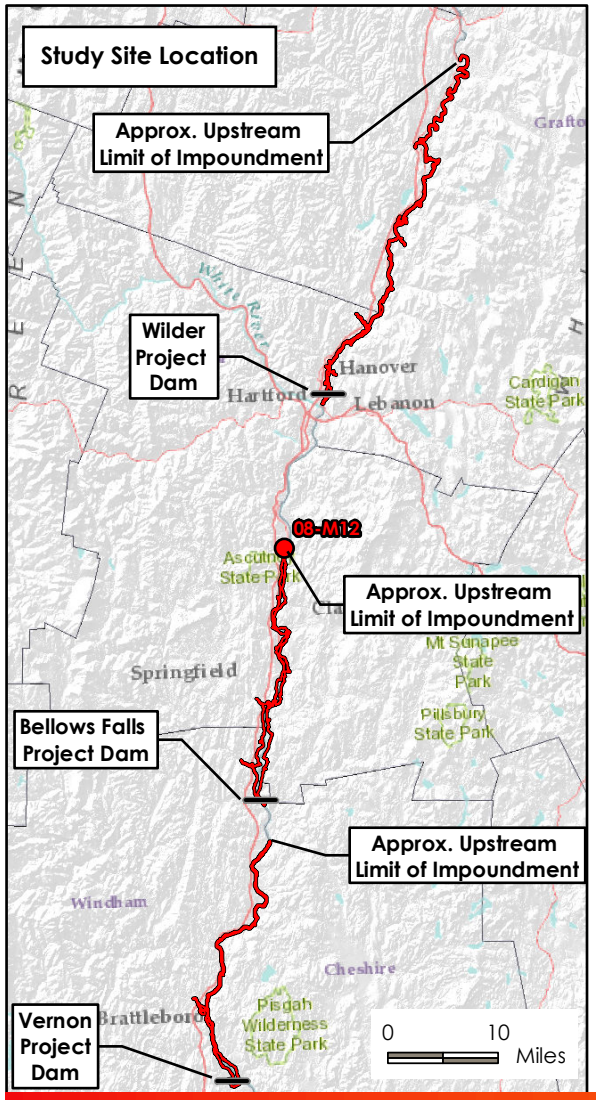

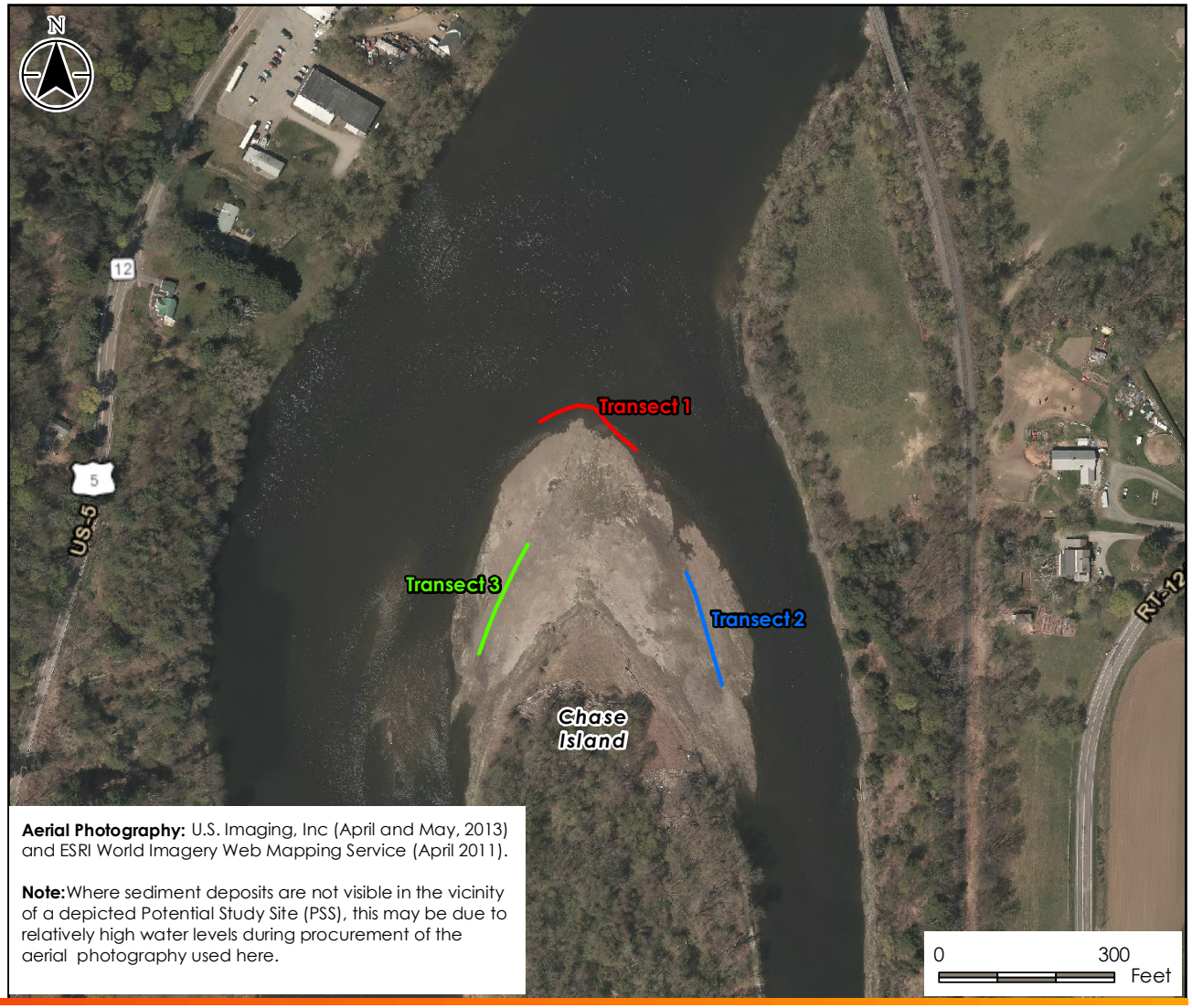

Aerial Photography: U.S. Imaging, Inc (April and May, 2013) and ESRI World Imagery Web Mapping Service (April 2011).

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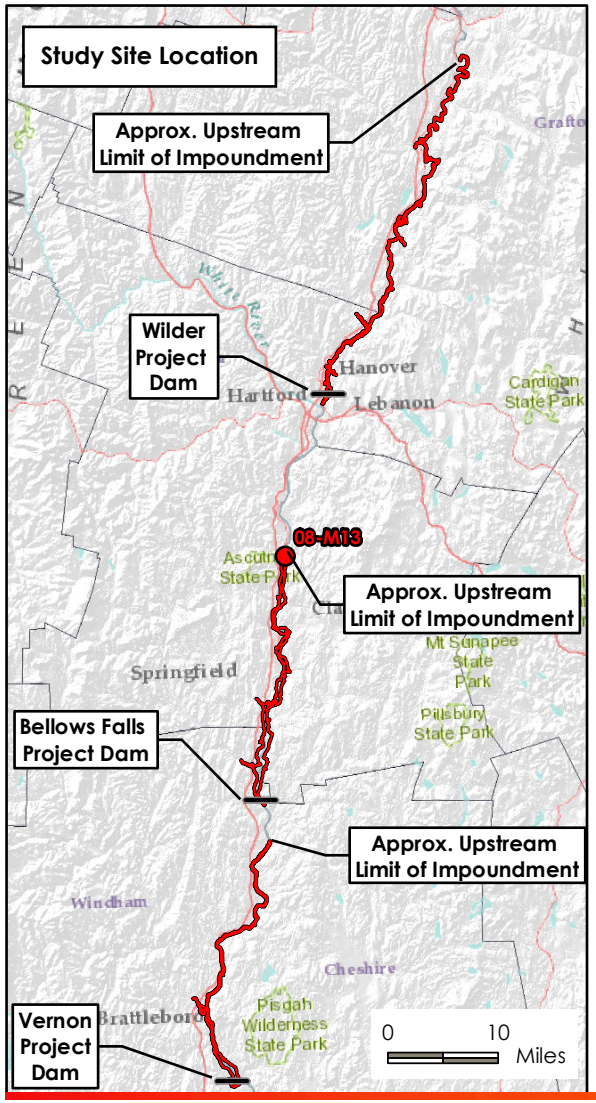
Figure No.
A-10

Title
Study Site 08-M12
1/13/2015

00876_AppA_StudySites.mxd



Aerial Photography: U.S. Imaging, Inc (April and May, 2013) and ESRI World Imagery Web Mapping Service (April 2011).

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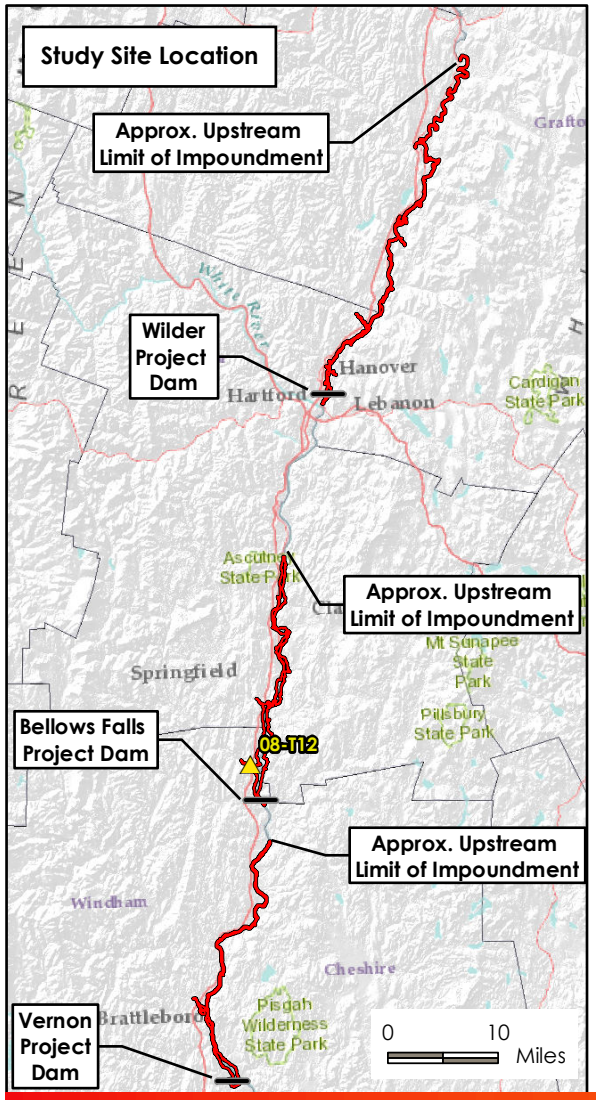
Figure No.
A-11

Title
Study Site 08-M13
1/9/2015

00876_AppA_StudySites.mxd



Aerial Photography: U.S. Imaging, Inc (April and May, 2013) and ESRI World Imagery Web Mapping Service (April 2011).

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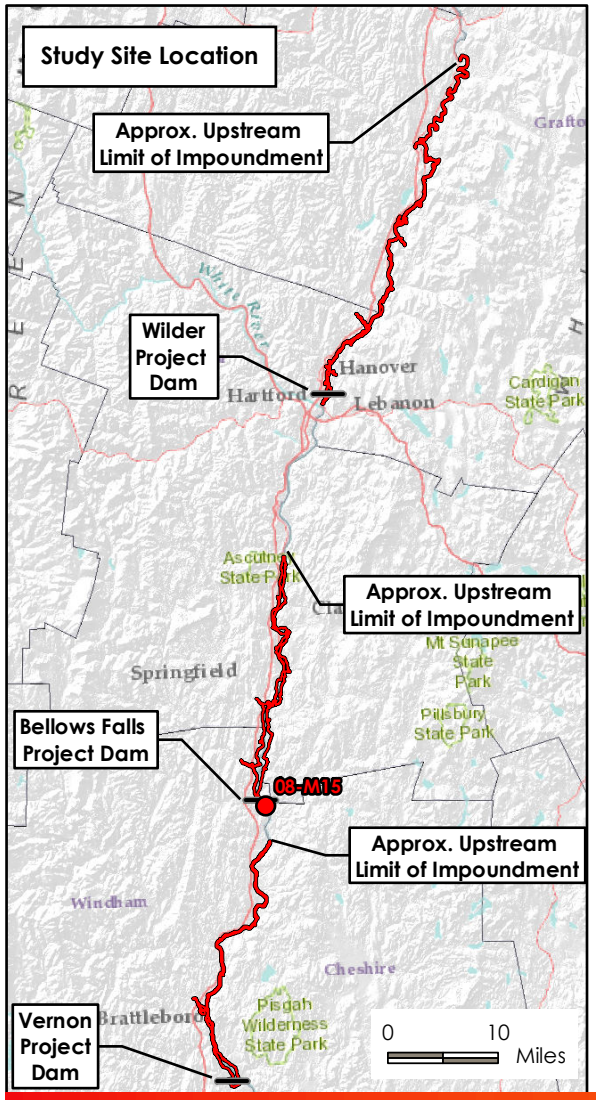
Figure No.
A-12

Title
Study Site 08-T12
1/9/2015

00876_AppA_StudySites.mxd



Aerial Photography: U.S. Imaging, Inc (April and May, 2013) and ESRI World Imagery Web Mapping Service (April 2011).

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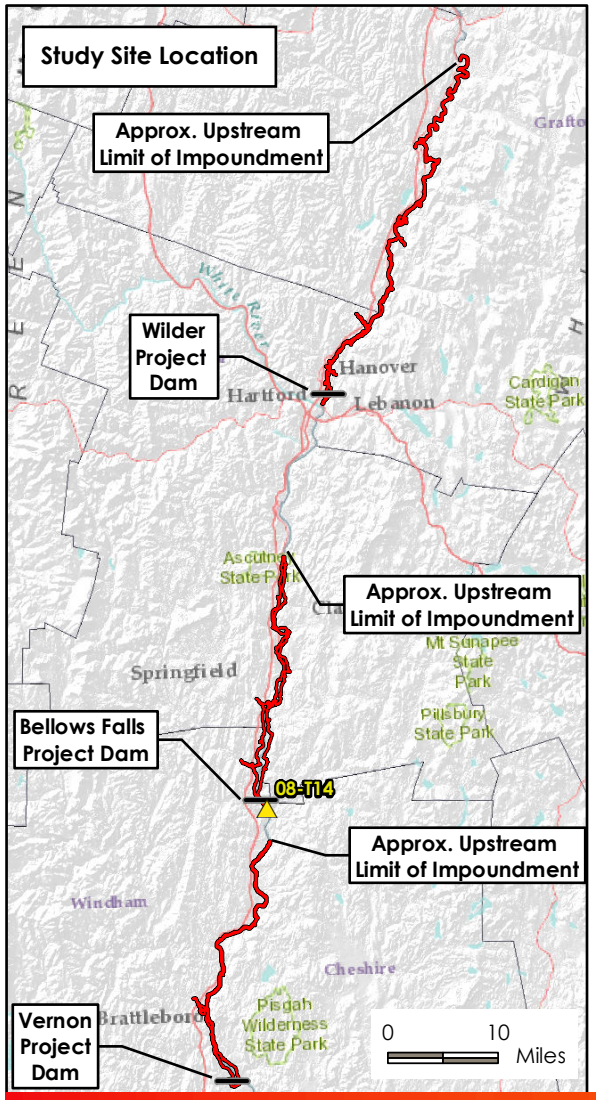
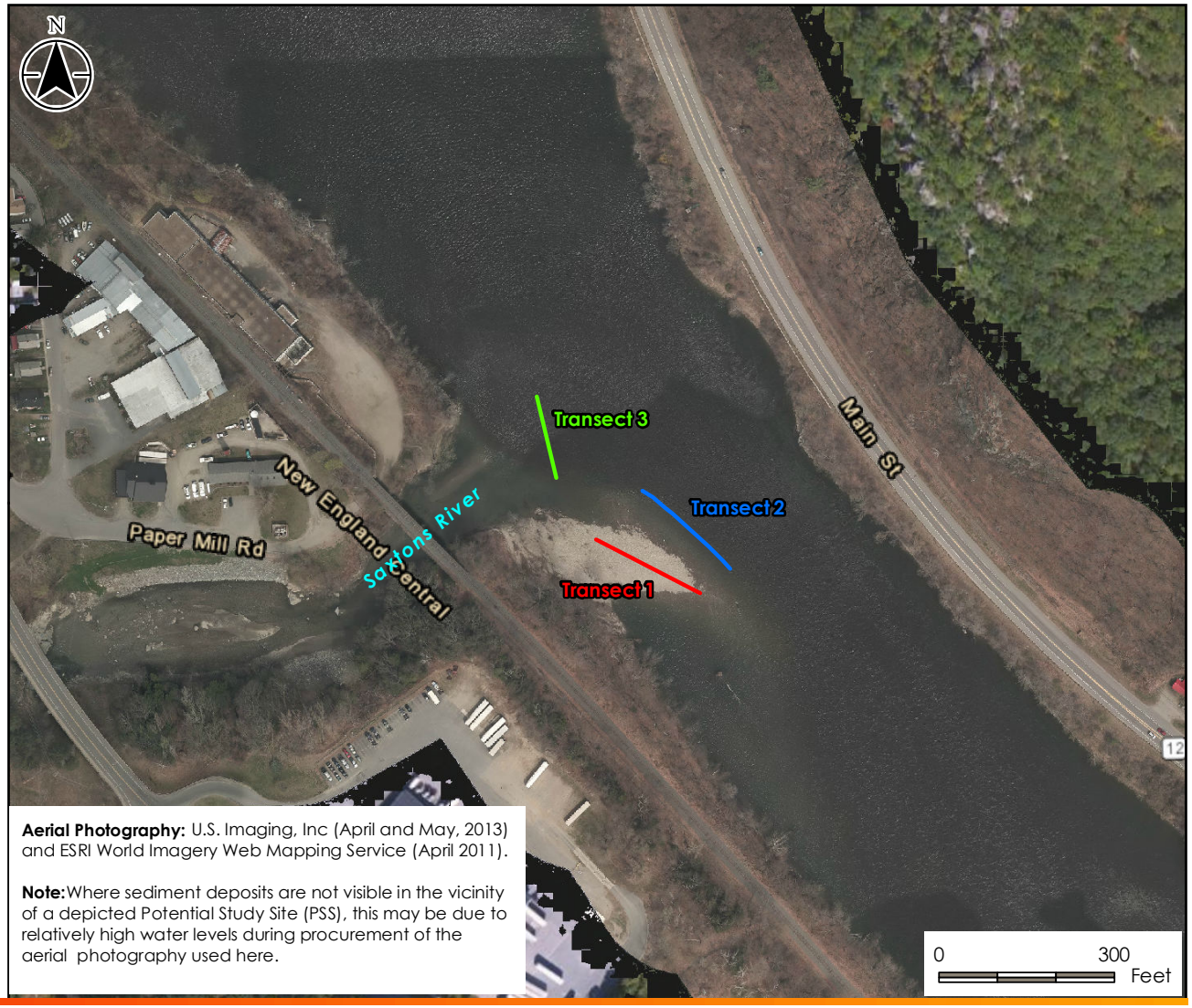
Figure No.
A-13

Title
Study Site 08-M15
1/9/2015

00876_AppA_StudySites.mxd





Aerial Photography: U.S. Imaging, Inc (April and May, 2013) and ESRI World Imagery Web Mapping Service (April 2011).

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Figure No.
A-14

Title
Study Site 08-T14
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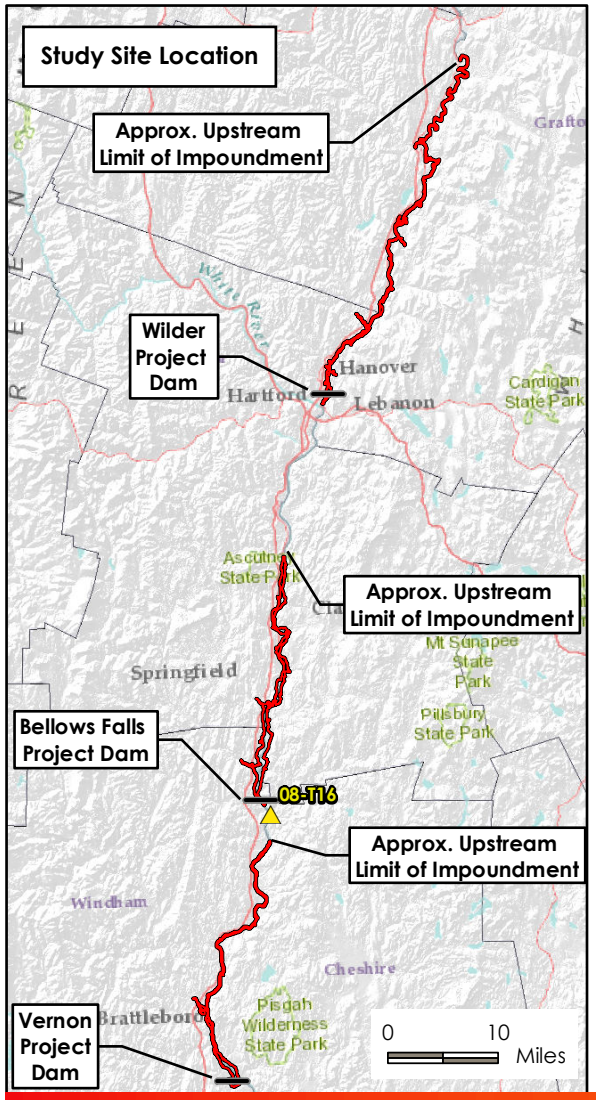

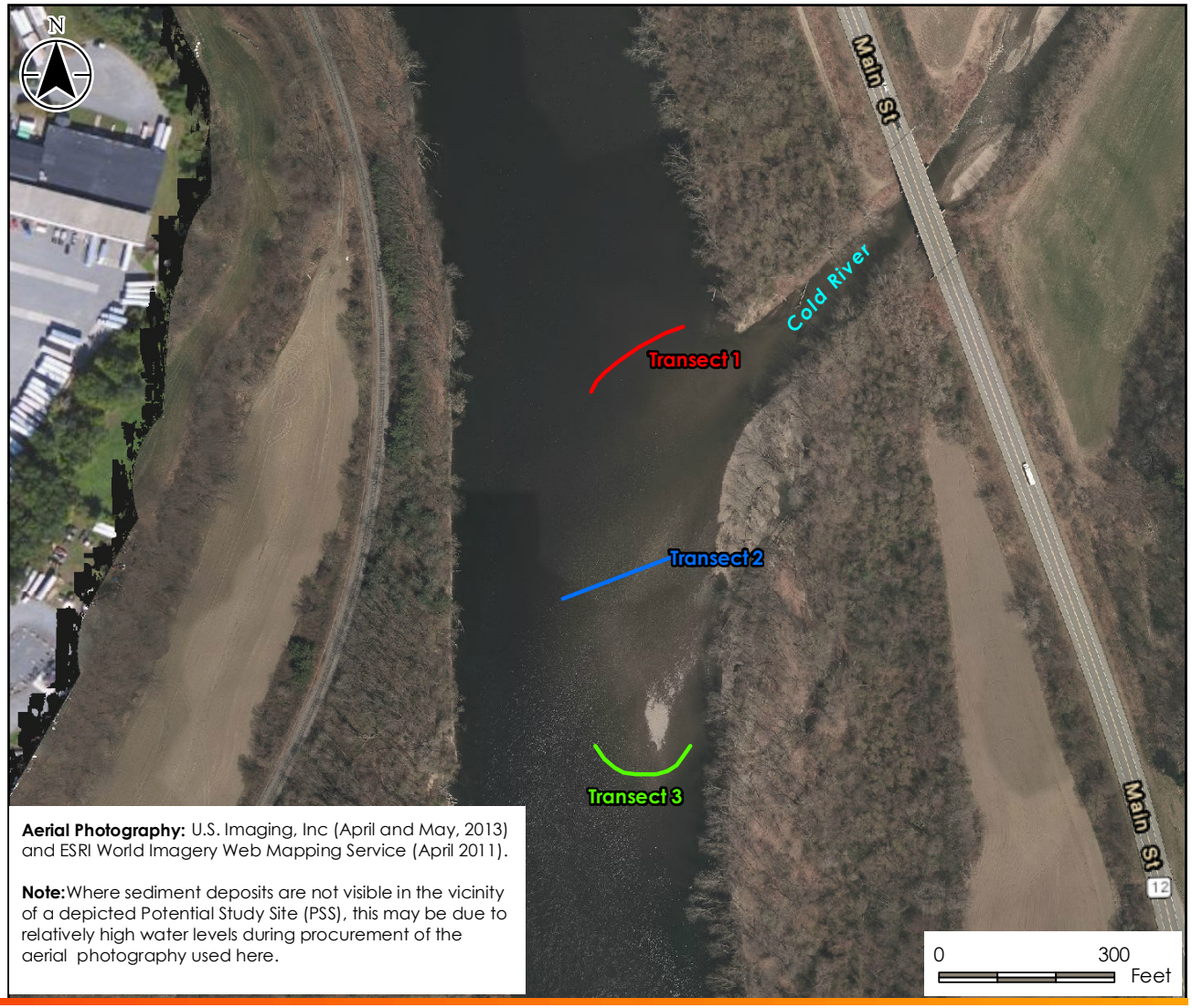

Aerial Photography: U.S. Imaging, Inc (April and May, 2013) and ESRI World Imagery Web Mapping Service (April 2011).

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Figure No.
A-15

Title
Study Site 08-T16
1/9/2015

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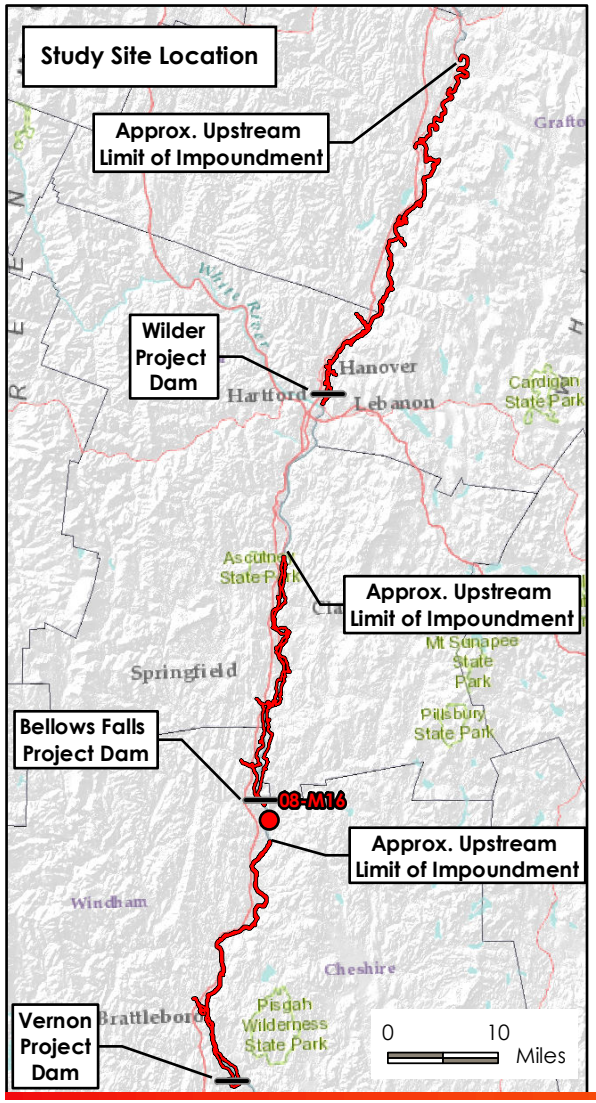

Aerial Photography: U.S. Imaging, Inc (April and May, 2013) and ESRI World Imagery Web Mapping Service (April 2011).

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Figure No.
A-16

Title
Study Site 08-M16
1/9/2015

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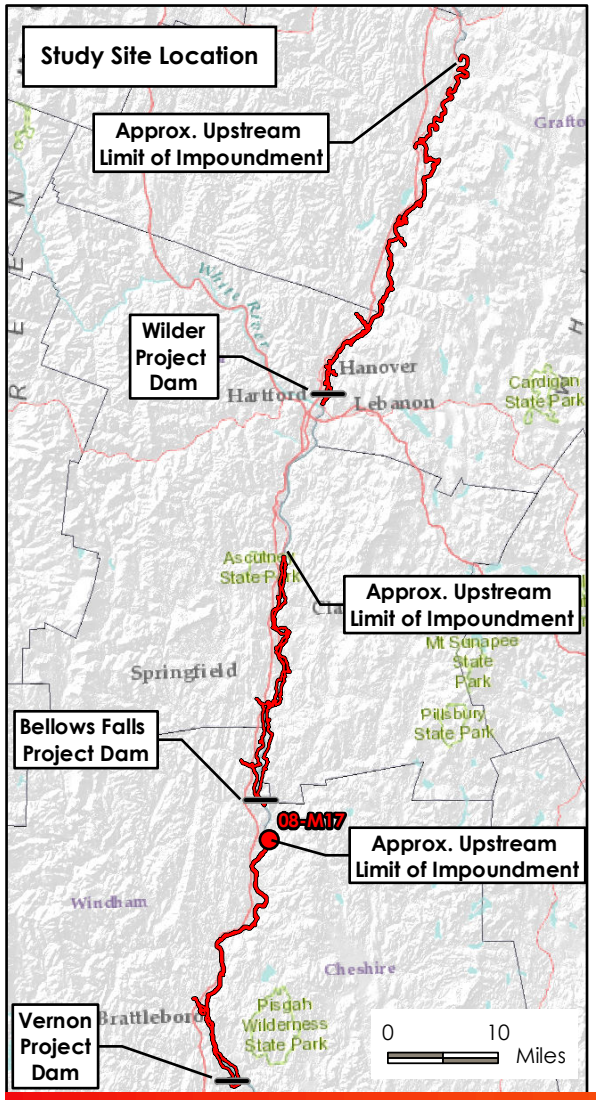

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Figure No.
A-17

Title
Study Site 08-M17
1/9/2015

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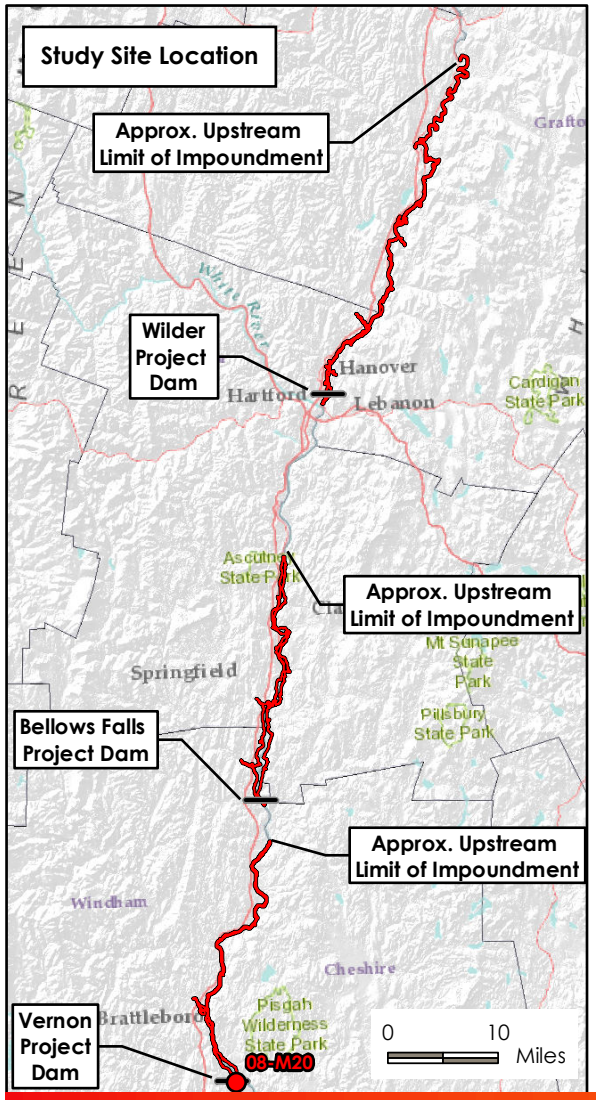

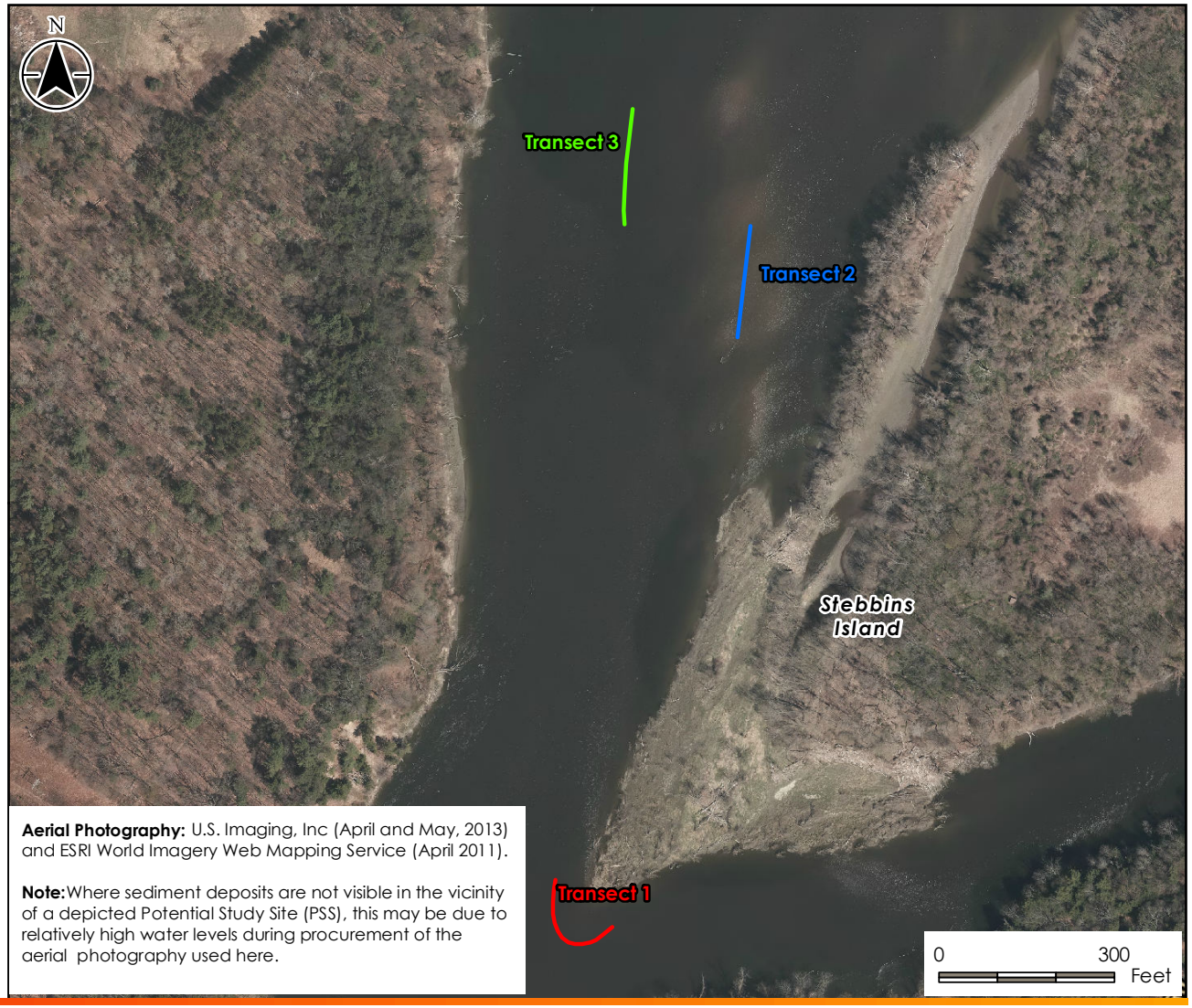

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Figure No.
A-18

Title
Study Site 08-M20
1/9/2015

00876_AppA_StudySites.mxd

Appendix B

Photographs

Transect Locations and Representative Photographs
Mainstem Study Site 08-M01

Figure B-1. Location of Study Site **08-M01** transect below Wilder Dam. [1, 2]

Photo B-1. View across Study Site 08-M01, facing upstream towards Wilder Dam. The location of Transect 1 is indicated by the tape measure visible in the midground of the photograph. (Stantec 07/12/14)

Photo B-2. View across Study Site 08-M01, facing northwest towards the left bank of the Connecticut River (visible in the background of the photo). The location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 07/12/14)

Photo B-3. Representative substrate along Transect 1 (the end point of Transect 1 is located at the end of the tape measure visible in the photograph). (Stantec 07/12/14)

[1] All Appendix B figures are oriented with north at the top of the page.

[2] Aerial imagery source for all figures in Appendix B: U.S. Imaging, Inc. (April and May, 2013) and ESRI World Imagery Web Mapping Service (April 2011).

Transect Locations and Representative Photographs
Mainstem Study Site 08-M04

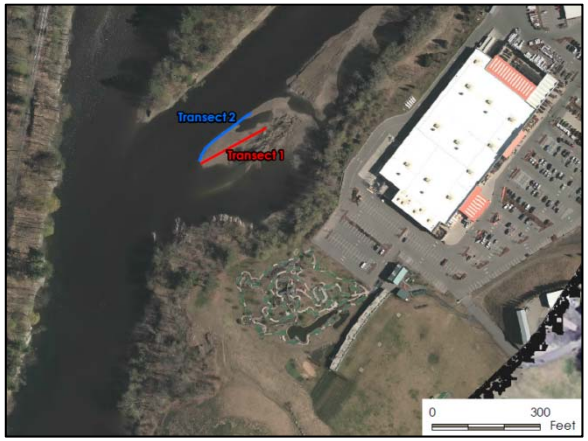

Figure B-2. Location of Study Site **08-M04** transects adjacent to Johnston Island (visible at upper left of photograph).

Photo B-4. View across Study Site 08-M04, facing southeast. The right bank of the Connecticut River is visible in the background of the photograph. (Stantec 07/12/14)

Photo B-5. View across Study Site 08-M04 facing downstream from the end (upstream limit) of Transect 1. The location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 07/12/14)

Photo B-6. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 07/12/14)

Photo B-7. View along Study Site 08-M04 facing upstream from the start (downstream limit) of Transect 2. The location of Transect 2 is indicated by the tape measure visible at edge-of-water in the photograph. (Stantec 07/12/14)

Photo B-8. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the middle of the photograph. (Stantec 07/12/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M05

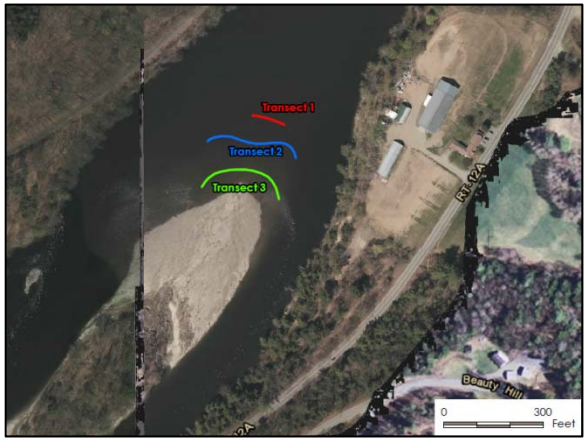

Figure B-3. Location of Study Site **08-M05** transects at upstream end of Burnaps Island.

Photo B-9. View across Study Site 08-M05, facing downstream towards Burnaps Island. Photograph is taken from approximate location of Transect 1. (Stantec 10/08/14)

Photo B-10. View across Study Site 08-M05, facing west. Photograph is taken from the start (east limit) of Transect 1. The location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 10/08/14)

Photo B-11. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the center of the photograph. Note algae present on substrate. (Stantec 10/08/14)

Photo B-12. View across Study Site 08-M05, facing east. Photograph is taken from the end (west limit) of Transect 2. The location of Transect 2 is indicated by the tape measure in the center of the photograph. (Stantec 10/08/14)

Photo B-13. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the center of the photograph. Note algae present on substrate. (Stantec 10/08/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M05 (continued)

Photo B-14. View across Study Site 08-M05, facing northwest (the right bank of the Connecticut River is visible in the background of the photograph. Photograph is taken from the start point (east limit) of Transect 3. The location of Transect 3 is indicated by the tape measure in the center of the photograph. (Stantec 10/08/14)

Photo B-15. Representative substrate along Transect 3. Location of Transect 3 is indicated by the tape measure in center of the photograph. (Stantec 10/08/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M07

Figure B-4. Location of Study Site **08-M07** transects at mid-channel bar upstream from Sumner Falls.

Photo B-16. View across Study Site 08-M07, facing downstream towards Sumner Falls. The photograph is taken from the approximate vicinity of Transect 1. (Stantec 07/12/14)

Photo B-17. View across Study Site 08-M07, facing west from the start (east limit) of Transect 1. The location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 10/08/14)

Photo B-18. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 07/12/14)

Photo B-19. View across Study Site 08-M07, facing east towards end (west limit) of Transect 2. The location of Transect 2 is indicated by the tape measure in the center of the photograph. (Stantec 10/08/14)

Photo B-20. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the middle of the photograph. (Stantec 07/12/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M08

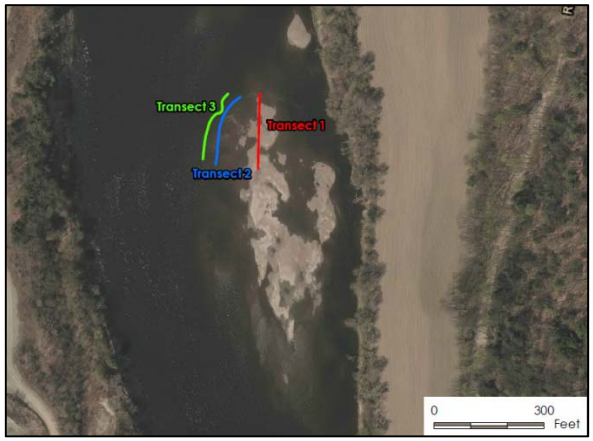

Figure B-5. Location of Study Site **08-M08** transects at mid-channel bar downstream from Sumner Falls.

Photo B-21. View across Study Site 08-M08, facing downstream. (Stantec 07/13/14)

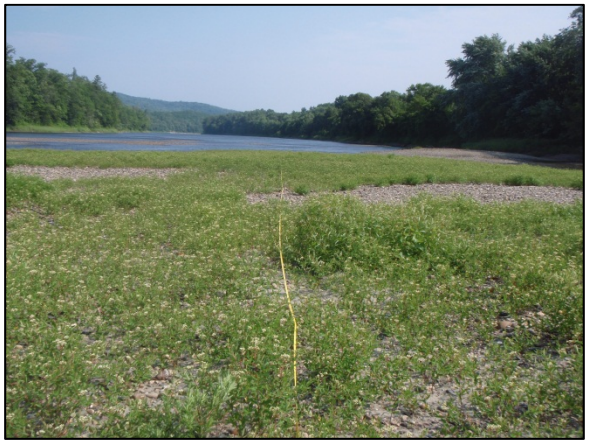

Photo B-22. View across Study Site 08-M08, facing upstream from the start (downstream limit) of Transect 1. The location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 07/13/14)

Photo B-23. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 07/13/14)

Photo B-24. View across Study Site 08-M08, facing upstream from the start (downstream limit) of Transect 2. The location of Transect 2 is indicated by the tape measure in the center of the photograph. (Stantec 07/13/14)

Photo B-25. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the middle of the photograph. (Stantec 07/13/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M08 (continued)

Photo B-26. View across Study Site 08-M08, facing downstream from the end (upstream limit) of Transect 3. The location of Transect 3 is indicated by the tape measure in the center of the photograph. (Stantec 07/13/14)

Photo B-27. Representative substrate along Transect 3. Location of Transect 3 is indicated by the tape measure in the photograph. (Stantec 07/13/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M10

Figure B-6. Location of Study Site **08-M10** transects at point bar on right side of channel.

Photo B-28. View across Study Site 08-M10, facing northeast towards the left bank of the Connecticut River. (Stantec 07/13/14)

Photo B-29. View across Study Site 08-M10, facing upstream the start (downstream limit) of Transect 1. The location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 07/13/14)

Photo B-30. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 07/13/14)

Photo B-31. View across Study Site 08-M10, facing downstream from the end (upstream limit) of Transect 2. The location of Transect 2 is indicated by the tape measure in the center of the photograph. (Stantec 07/13/14)

Photo B-32. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the middle of the photograph. (Stantec 07/13/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M12

Figure B-7. Location of Study Site **08-M12** transects at upstream end of Chase Island.

Photo B-33. View across Study Site 08-M12, facing downstream towards Chase Island from the upstream end of Chase Island. (Stantec 07/15/14)

Photo B-34. View across Study Site 08-M12, facing east towards the left bank of the Connecticut River. Photograph taken from end (west limit) of Transect 1. Location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 07/15/14)

Photo B-35. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 07/15/14)

Photo B-36. View across Study Site 08-M12, facing south from the end (upstream limit) of Transect 2. Location of Transect 2 is indicated by the tape measure in the center of the photograph. (Stantec 07/15/14)

Photo B-37. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the middle of the photograph. (Stantec 07/15/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M12 (continued)

Photo B-38. View across Study Site 08-M12, facing south (downstream) from the end (upstream limit) of Transect 3. Location of Transect 3 is indicated by the tape measure in the center of the photograph. (Stantec 07/15/14)

Photo B-39. Representative substrate along Transect 3. Location of Transect 3 is indicated by the tape measure in the middle of the photograph. (Stantec 07/15/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M13

Figure B-8. Location of Study Site **08-M13**, downstream from Chase Island, in the vicinity of the upstream limit of the Bellows Falls impoundment.

Photo B-40. View across Study Site 08-M13, facing west towards the right bank of the Connecticut River. (Stantec 07/15/14)

Photo B-41. View across Study Site 08-M13, facing upstream from the start (downstream limit) of Transect 1. Location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 07/15/14)

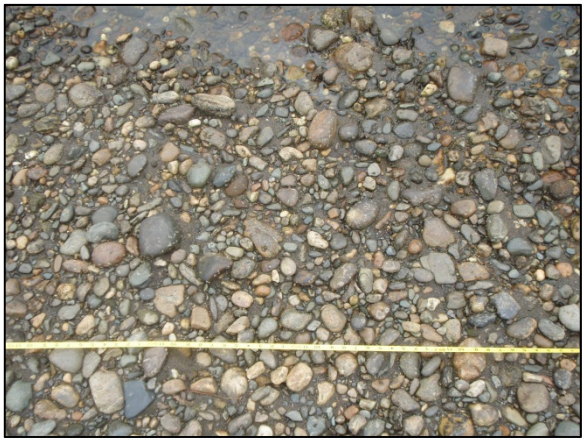

Photo B-42. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 07/15/14)

Photo B-43. View across Study Site 08-M13, facing downstream from the end (upstream limit) of Transect 2. Location of Transect 2 is indicated by the tape measure in the center of the photograph. (Stantec 07/15/14)

Photo B-44. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the middle of the photograph. (Stantec 07/15/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M15

Figure B-9. Location of Study Site **08-M15** transects below Bellows Falls Dam.

Photo B-45. View across Study Site 08-M15, facing upstream. The Bellows Falls facility is visible in the background of the photograph. (Stantec 10/09/14)

Photo B-46. View across Study Site 08-M15, facing downstream from the end (upstream limit) of Transect 1. Location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 10/09/14)

Photo B-47. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 10/09/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M16

Figure B-10. Location of Study Site **08-M16** transects at point bar on river right.

Photo B-48. View across Study Site 08-M16, facing west towards the left bank of the Connecticut River. (Stantec 07/14/14)

Photo B-49. View across Study Site 08-M16, facing downstream from the end (upstream limit) of Transect 1. Location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 07/14/14)

Photo B-50. Representative substrate of Transect 1. Location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 07/14/14)

Photo B-51. View across Study Site 08-M16, facing downstream from the end (upstream limit) of Transect 2. Location of Transect 2 is indicated by the tape measure in the center of the photograph. (Stantec 07/14/14)

Photo B-52. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the middle of the photograph. (Stantec 07/14/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M17

Figure B-11. Location of Study Site **08-M17** transect at point bar on river right near the upstream limit of the Vernon impoundment.

Photo B-53. View across Study Site 08-M17, facing downstream towards the Dwinnell Street Bridge. (Stantec 07/12/14)

Photo B-54. View across Study Site 08-M17, facing upstream from the start (downstream limit) of Transect 1. Location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 07/14/14)

Photo B-55. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 07/14/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M20

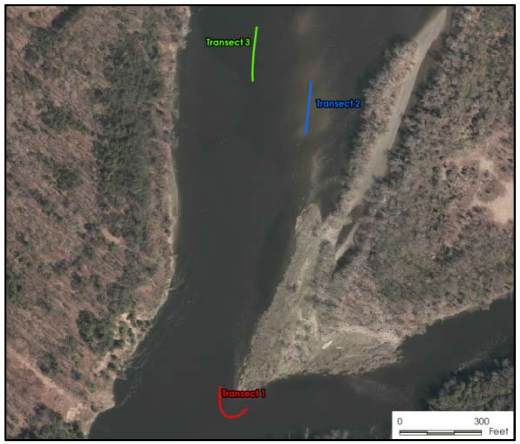

Figure B-12. Location of Study Site **08-M20** transects at Stebbins Island below Vernon Dam.

Photo B-56. View across Study Site 08-M20, facing downstream towards Stebbins Island. The location of Transect 1 is indicated by the tape measure visible in the midground of the photograph. (Stantec 08/12/14)

Photo B-57. View across Study Site 08-M20, facing upstream from the end (downstream limit) of Transect 1. Location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 08/14/14)

Photo B-58. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 08/14/14)

Photo B-59. View across Study Site 08-M20, facing upstream from the start (downstream limit) of Transect 2. Location of Transect 2 is indicated by the tape measure in the center of the photograph. (Stantec 08/14/14)

Photo B-60. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the middle of the photograph. (Stantec 08/14/14)

Transect Locations and Representative Photographs
Mainstem Study Site 08-M20 (continued)

Photo B-61. View across Study Site 08-M20, facing downstream from the end (upstream limit) of Transect 3. Location of Transect 3 is indicated by the tape measure in the center of the photograph. (Stantec 10/31/14)

Photo B-62. Representative substrate along Transect 3. Location of Transect 3 is indicated by the tape measure in the middle of the photograph. (Stantec 08/14/14)

Transect Locations and Representative Photographs
Tributary Study Site 08-T01

Figure B-13. Location of Study Site **08-T01** transects on the Ompompanoosuc River.

Photo B-63. View across Study Site 08-T01, facing upstream. (Stantec 07/11/14)

Photo B-64. View across Study Site 08-T01, facing upstream from the start (downstream limit) of Transect 1. The alignment of Transect 1 is indicated by the tape measure visible in the center of the photograph. (Stantec 07/11/14)

Photo B-65. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure visible in the photograph. (Stantec 07/11/14)

Photo B-66. View across Study Site 08-T01, facing downstream from the end (upstream limit) of Transect 2. The alignment of Transect 2 is indicated by the tape measure visible in foreground of photograph. (Stantec 07/11/14)

Photo B-67. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure visible in the photograph. (Stantec 07/11/14)

Transect Locations and Representative Photographs
Tributary Study Site 08-T01 (continued)

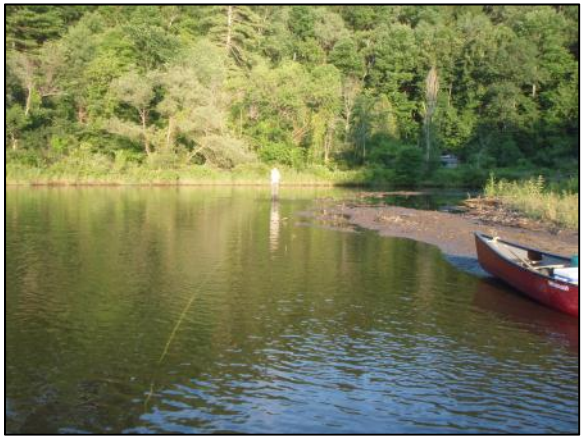

Photo B-68. View across Study Site 08-T01, facing downstream from the end (upstream limit) of Transect 3. The alignment of Transect 3 is indicated by the tape measure visible in foreground of photograph. (Stantec 07/11/14)

Photo B-69. Representative substrate along Transect 3. Location of Transect 3 is indicated by the tape measure in the middle of the photograph. (Stantec 07/11/14)

Transect Locations and Representative Photographs
Tributary Study Site 08-T02

Figure B-14. Location of Study Site **08-T02** transects at the confluence of the White River and Connecticut rivers.

Photo B-70. View across Study Site 08-T02, facing upstream towards railroad and road bridges over the White River. (Stantec 07/12/14)

Photo B-71. View across Study Site 08-T02, facing downstream from the end (upstream limit) of Transect 1. The alignment of Transect 1 is indicated by the tape measure visible in foreground of photograph. (Stantec 07/12/14)

Photo B-72. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 07/12/14)

Photo B-73. View across Study Site 08-T02, facing upstream from the start (downstream limit) of Transect 2. The alignment of Transect 2 is indicated by the tape measure visible in foreground of photograph. (Stantec 07/12/14)

Photo B-74. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the center of the photograph. (Stantec 07/12/14)

Transect Locations and Representative Photographs
Tributary Study Site 08-T02 (continued)

Photo B-75. View across Study Site 08-T02, facing upstream from the start (downstream limit) of Transect 3. The alignment of Transect 3 is indicated by the tape measure visible in foreground of photograph. (Stantec 07/12/14)

Photo B-76. Representative substrate along Transect 3. Location of Transect 3 is indicated by the tape measure in the center of the photograph. (Stantec 10/07/14)

Transect Locations and Representative Photographs
Tributary Study Site 08-T04

Figure B-15. Location of Study Site **08-T04** transects on Mascoma Brook.

Photo B-77. View across Study Site 08-T04, facing upstream along Mascoma Brook. (Stantec 07/12/14)

Photo B-78. View across Study Site 08-T04, facing south from the end (river-right limit) of Transect 1. The alignment of Transect 1 is indicated by the tape measure visible in foreground of photograph. (Stantec 07/12/14)

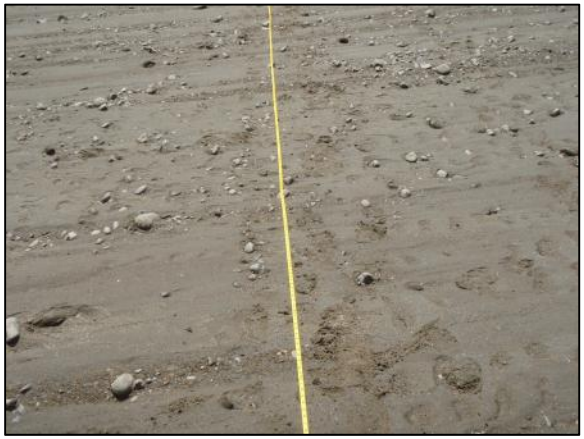

Photo B-79. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 07/12/14)

Photo B-80. View across Study Site 08-T04, facing north from the start (river-left limit) of Transect 2. The alignment of Transect 2 is indicated by the tape measure visible in foreground of photograph. (Stantec 07/12/14)

Photo B-81. Representative substrate along Transect 2. The location of Transect 2 is indicated by the tape measure in the center of the photograph. (Stantec 07/12/14)

Transect Locations and Representative Photographs
Tributary Study Site 08-T12

Figure B-16. Location of Study Site **08-T12** transects on the Williams River.

Photo B-82. View downstream across Study Site 08-T12 along Williams River with Interstate 91 Bridge in background. (Stantec 10/31/14)

Photo B-83. View across Study Site 08-T12, facing upstream from the start (downstream limit) of Transect 1. The alignment of Transect 1 is indicated by the tape measure visible in foreground of photograph. (Stantec 10/31/14)

Photo B-84. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 10/31/14)

Photo B-85. View across Study Site 08-T12, facing downstream from the end (upstream limit) of Transect 2. The alignment of Transect 2 is indicated by the tape measure visible in foreground of photograph. (Stantec 07/13/14)

Photo B-86. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the middle of the photograph. (Stantec 07/13/14)

Transect Locations and Representative Photographs
Tributary Study Site 08-T14

Figure B-17. Location of Study Site **08-T14** transects at the confluence of the Saxtons and Connecticut rivers.

Photo B-87. View across Study Site 08-T14, facing south across the delta bar. The Saxtons River is visible in the midground of the photograph, and its confluence with the Connecticut River is visible at the left side of the photograph. (Stantec 10/9/14)

Photo B-88. View across Study Site 08-T14, facing downstream from the end (upstream limit) of Transect 1. The alignment of Transect 1 is indicated by the tape measure visible in foreground of photograph. (Stantec 10/9/14)

Photo B-89. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the center of the photograph. (Stantec 10/9/14)

Photo B-90. View across Study Site 08-T14, facing upstream from the start (downstream limit) of Transect 2. The location of Transect 2 is indicated by the tape measure. The Bellows Falls facility is visible in the background. (Stantec 07/14/14)

Photo B-91. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the middle of the photograph. (Stantec 07/14/14)

Transect Locations and Representative Photographs
Tributary Study Site 08-T14 (continued)

Photo B-92. View across Study Site 08-T14, facing across the Saxtons River (visible in the middle of the photograph) at its confluence with the Connecticut River (visible in the background of the photograph). The start (southern limit) of Transect 3 is represented by the blue flagging visible in the foreground of the photograph. The end (northern limit) of Transect 3 is in the location of the person visible standing on the bar in the midground of the photograph. The Bellows Falls facility is visible in the background of the photograph. (Stantec 07/14/14)

Photo B-93. Representative substrate along Transect 3. (Stantec 07/14/14)

Transect Locations and Representative Photographs
Tributary Study Site 08-T16

Figure B-18. Location of Study Site **08-T16** transects at the confluence of the Cold and Connecticut rivers.

Photo B-94. View facing south across Study Site 08-T16 from the vicinity of Transect 1. The Cold River is visible in the midground of the photograph, and the right bank of the Connecticut River is visible at the right side of the photograph. (Stantec 10/9/14)

Photo B-95. View across Study Site 08-T16, facing west from the start of Transect 1. The location of Transect 1 is indicated by the tape measure. The right bank of the Connecticut River is visible in the background of the photograph. (Stantec 07/14/14)

Photo B-96. Representative substrate along Transect 1. Location of Transect 1 is indicated by the tape measure in the middle of the photograph. (Stantec 07/14/14)

Photo B-97. View across Study Site 08-T16, facing west from the start of Transect 2. The location of Transect 2 is indicated by the tape measure. The right bank of the Connecticut River is visible in the background of the photograph. (Stantec 07/14/14)

Photo B-98. Representative substrate along Transect 2. Location of Transect 2 is indicated by the tape measure in the middle of the photograph. (Stantec 07/14/14)

Transect Locations and Representative Photographs
Tributary Study Site 08-T16 (continued)

Photo B-99. View across Study Site 08-T16, facing southwest from the start of Transect 3. The location of Transect 3 is indicated by the tape measure. The right bank of the Connecticut River is visible in the background of the photograph. (Stantec 07/14/14)

Photo B-100. Representative substrate along Transect 3. Location of Transect 3 is indicated by the tape measure in visible in the photograph. (Stantec 07/14/14)

Appendix C

Particle Size Distribution

Appendix C.1. Study Site 08-M01

Table C.1-1. Study site 08-M01 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%				
Sand	Sand	0.062 - 2.0	0%	0%				
Gravel	Very Fine	2-4	0%	0%				
	Fine	4-8	0%	0%				
	Medium	8-16	1%	0%				
	Coarse	16-32	3%	2%				
	Very Coarse	32-64	22%	6%				
Cobble	Small	64-128	43%	12%				
	Large	128-256	59%	30%				
Boulder	Small	256-512	74%	59%				
	Medium	512-1024	88%	90%				
	Large - Very Large	1024-4096	92%	99%				
Bedrock	Bedrock	-	92%	99%				

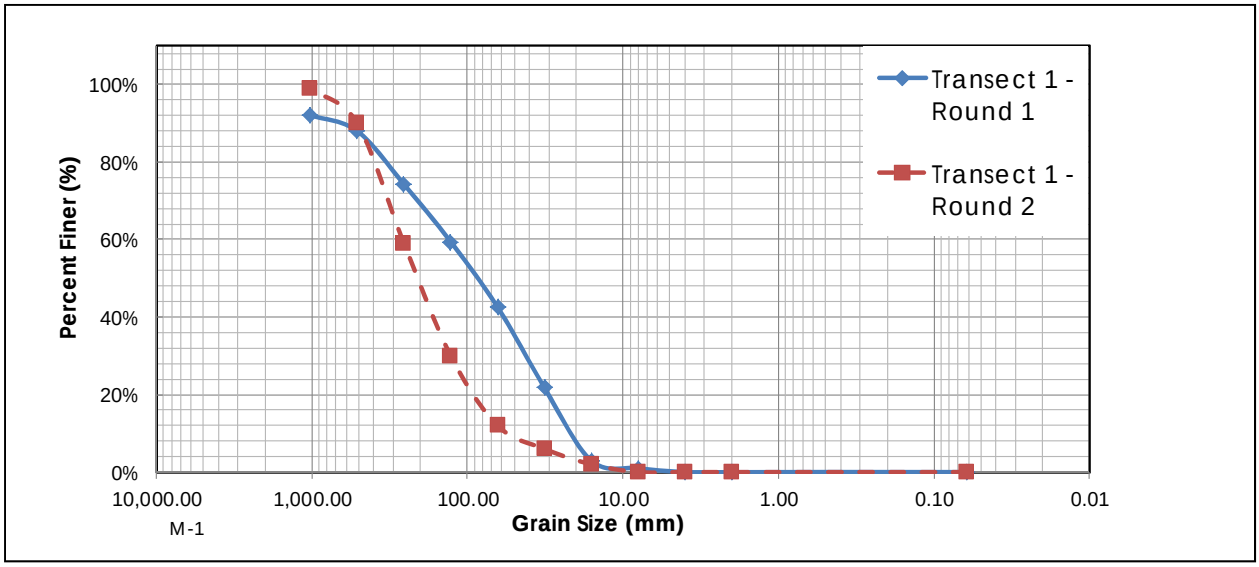

Figure C.1-1. Study site 08-M01 Transect 1 gradation curves.

Appendix C-2. Study Site 08-M04

Table C.2-1. Study site 08-M04 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%		
Sand	Sand	0.062 - 2.0	0%	0%	0%	0%		
Gravel	Very Fine	2-4	6%	30%	0%	4%		
	Fine	4-8	6%	30%	1%	5%		
	Medium	8-16	9%	31%	3%	6%		
	Coarse	16-32	23%	39%	13%	13%		
	Very Coarse	32-64	58%	62%	55%	47%		
Cobble	Small	64-128	86%	87%	85%	88%		
	Large	128-256	99%	99%	100%	100%		
Boulder	Small	256-512	100%	100%	100%	100%		
	Medium	512-1024	100%	100%	100%	100%		
	Large - Very Large	1024-4096	100%	100%	100%	100%		
Bedrock	Bedrock	-	100%	100%	100%	100%		

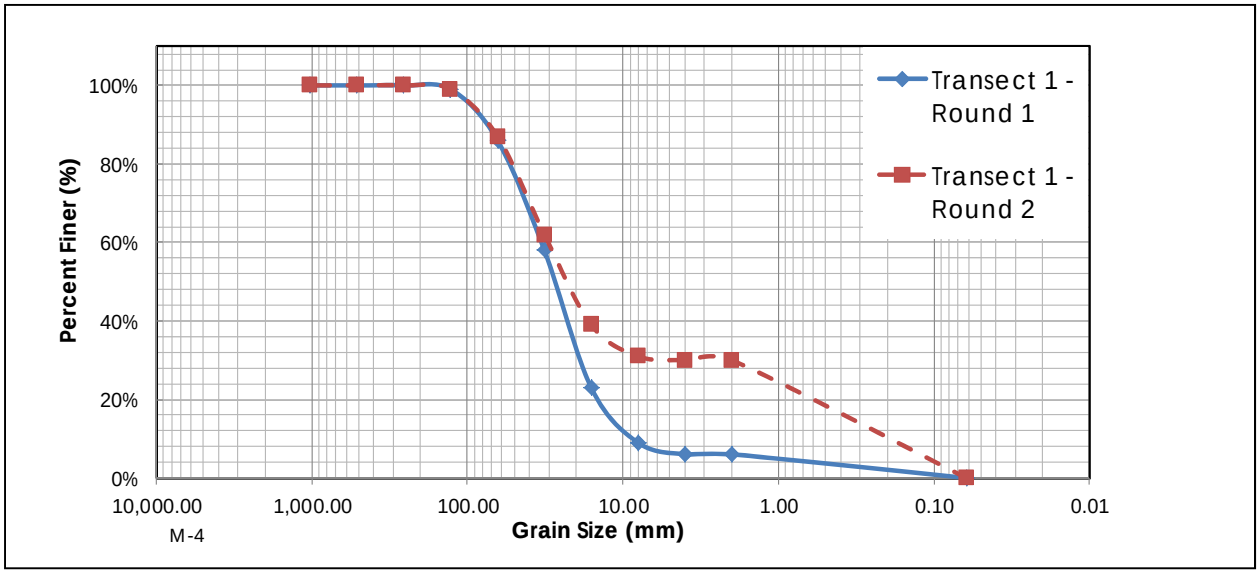

Figure C.2-1. Study site 08-M04 Transect 1 gradation curves.

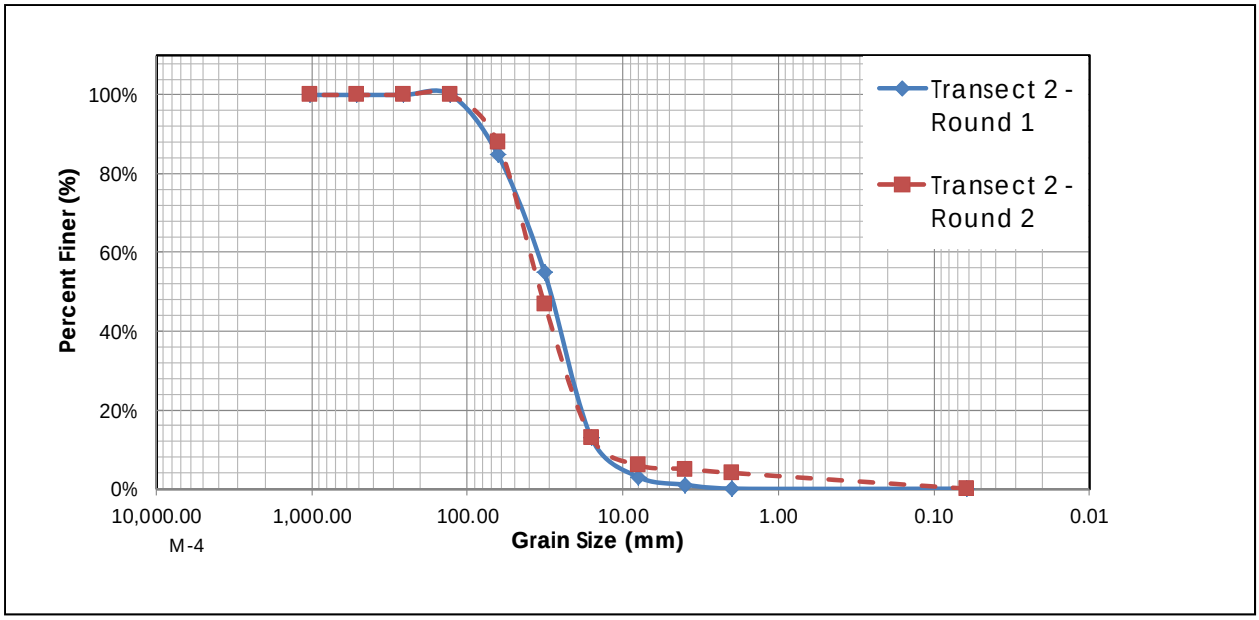

Figure C.2-2. Study site 08-M04 Transect 2 gradation curves.

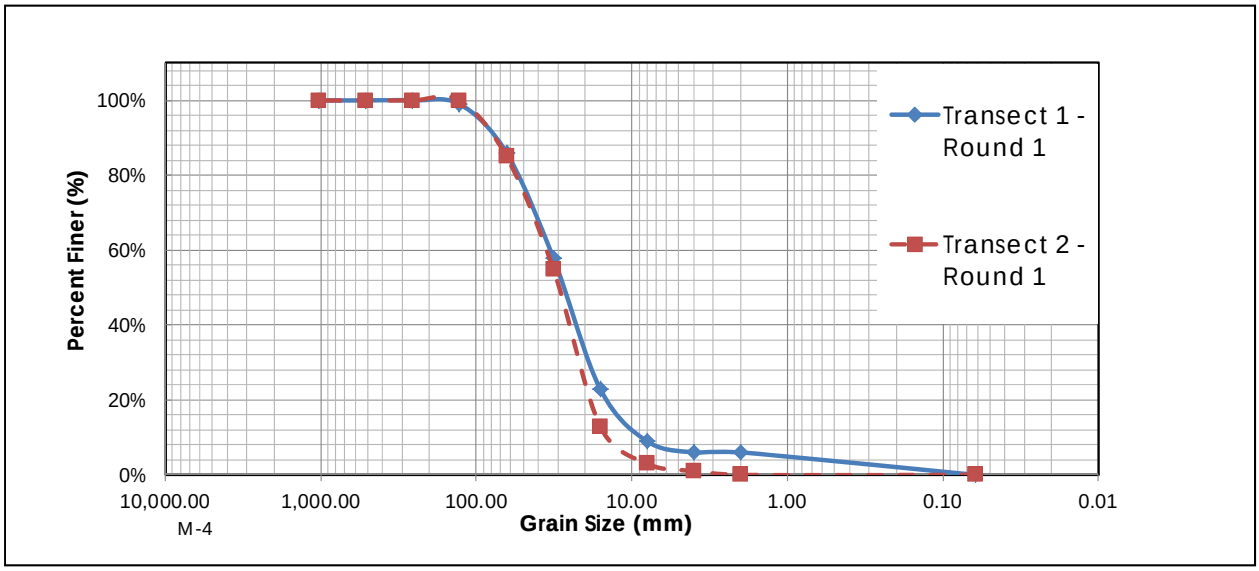

Figure C.2-3. Study site 08-M04 Transects 1 and 2, Round 1 gradation curves.

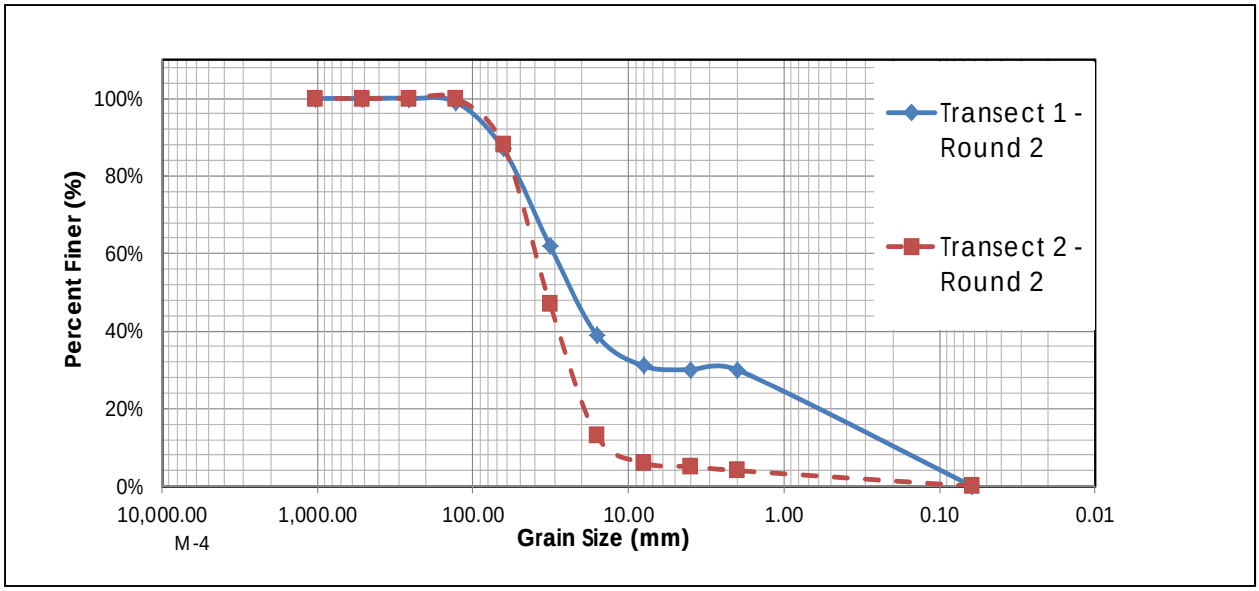

Figure C.2-4. Study site 08-M04 Transects 1 and 2, Round 2 gradation curves.

Appendix C-3. Study Site 08-M05

Table C.3-1. Study site 08-M05 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%	0%	0%
Sand	Sand	0.062 - 2.0	0%	0%	0%	0%	0%	0%
Gravel	Very Fine	2-4	19%	44%	18%	31%	24%	2%
	Fine	4-8	23%	49%	18%	33%	25%	3%
	Medium	8-16	33%	54%	31%	37%	31%	11%
	Coarse	16-32	53%	64%	46%	42%	42%	23%
	Very Coarse	32-64	68%	72%	62%	57%	58%	46%
Cobble	Small	64-128	79%	90%	76%	73%	81%	72%
	Large	128-256	95%	99%	95%	97%	96%	96%
Boulder	Small	256-512	100%	100%	99%	100%	100%	100%
	Medium	512-1024	100%	100%	100%	100%	100%	100%
	Large - Very Large	1024-4096	100%	100%	100%	100%	100%	100%
Bedrock	Bedrock	-	100%	100%	100%	100%	100%	100%

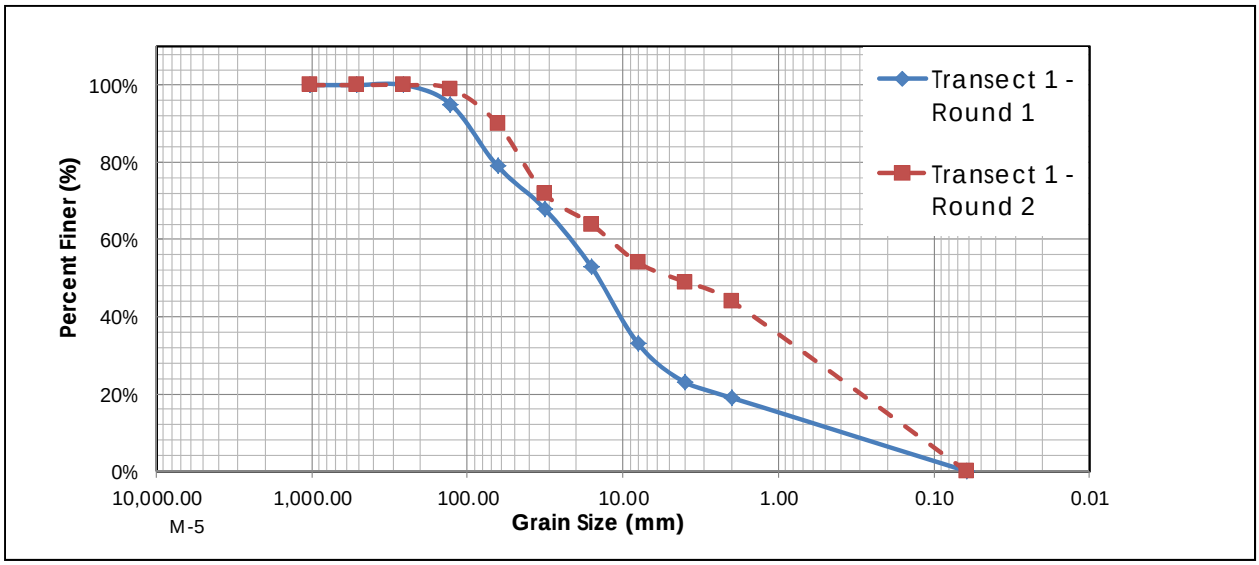

Figure C.3-1. Study site 08-M05 Transect 1 gradation curves.

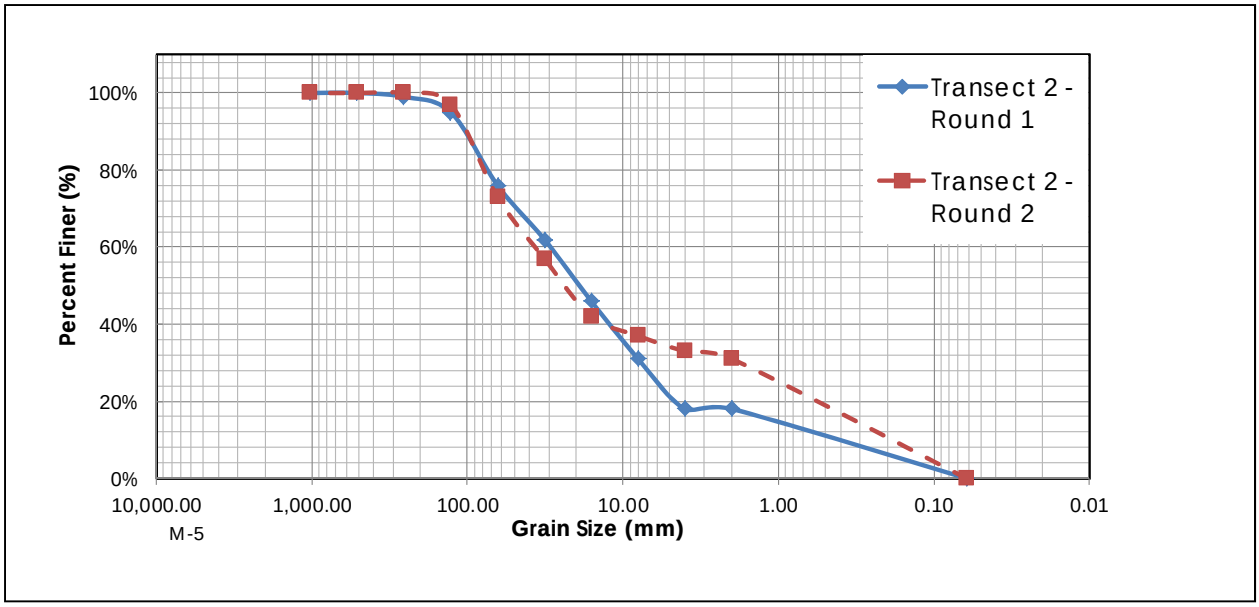

Figure C.3-2. Study site 08-M05 Transect 2 gradation curves.

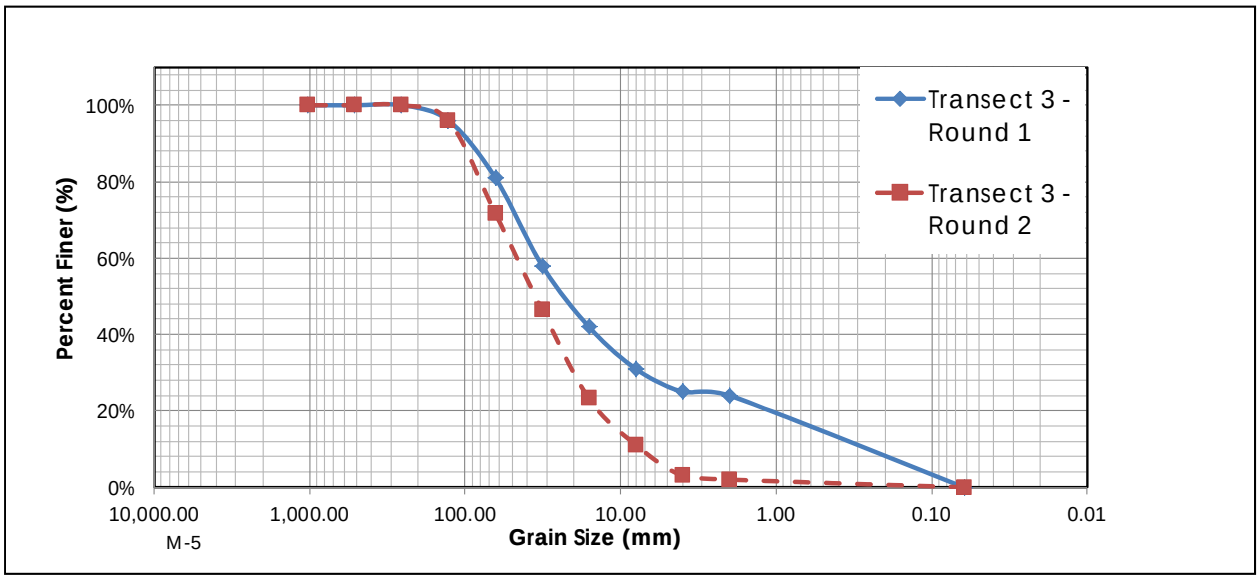

Figure C.3-3. Study site 08-M05 Transect 3 gradation curves.

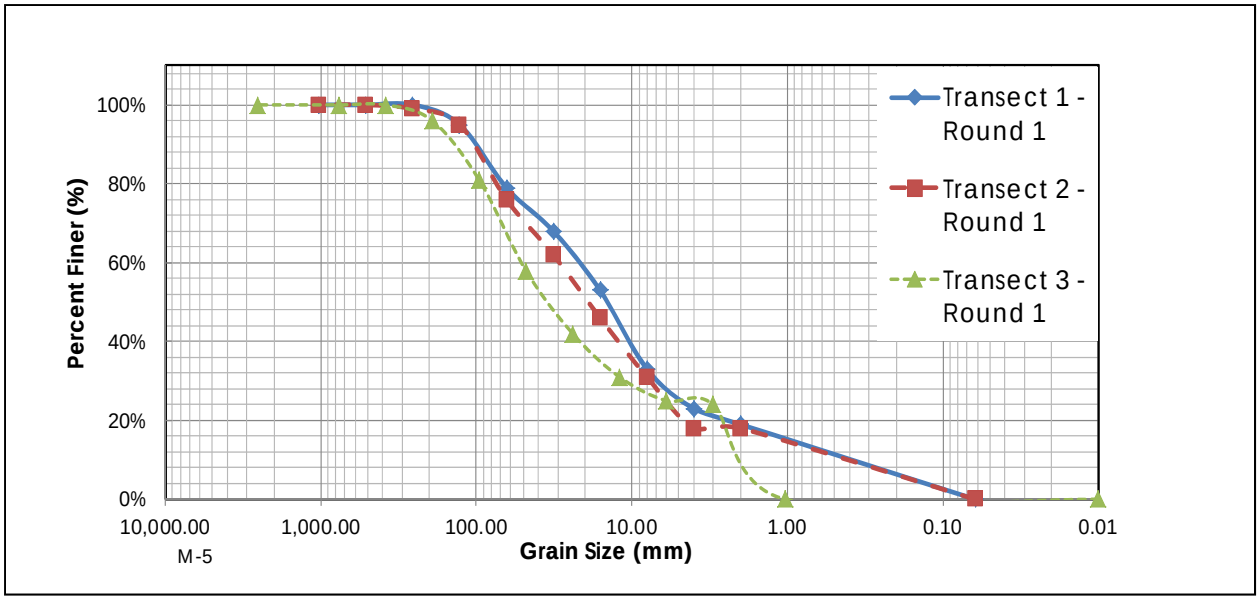

Figure C.3-4. Study site 08-M05 Transects 1, 2, and 3, Round 1 gradation curves.

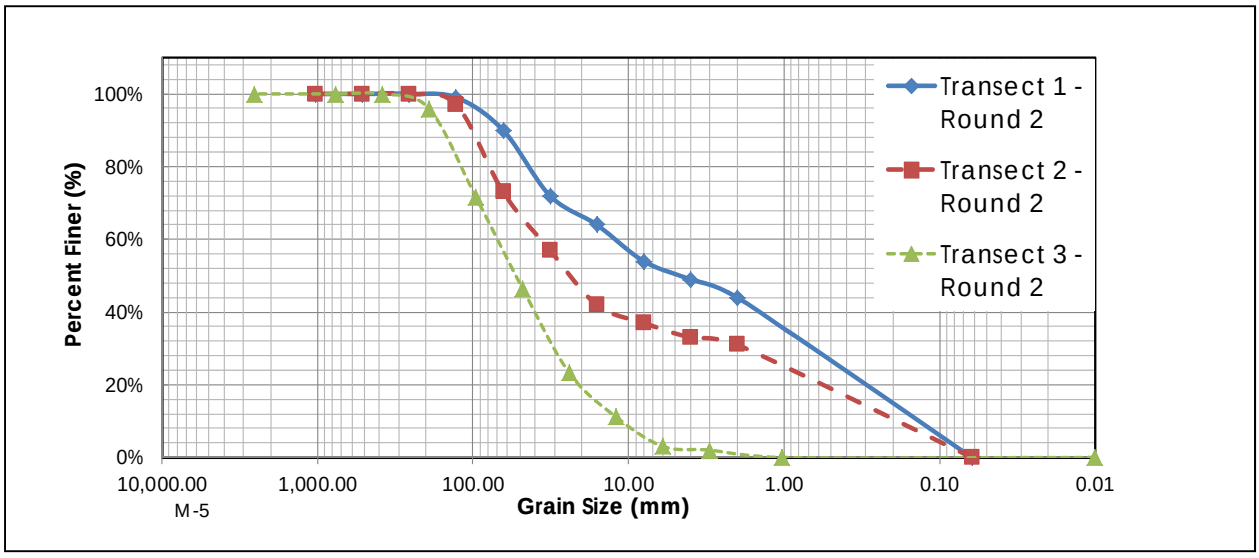

Figure C.3-5. Study site 08-M05 Transects 1, 2, and 3, Round 2 gradation curves.

Appendix C-4. Study Site 08-M07

Table C.4-1. Study site 08-M07 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%		
Sand	Sand	0.062 - 2.0	0%	1%	0%	0%		
Gravel	Very Fine	2-4	24%	57%	23%	42%		
	Fine	4-8	25%	57%	25%	43%		
	Medium	8-16	34%	57%	28%	45%		
	Coarse	16-32	49%	62%	50%	49%		
	Very Coarse	32-64	70%	73%	74%	67%		
Cobble	Small	64-128	91%	92%	94%	90%		
	Large	128-256	100%	100%	100%	100%		
Boulder	Small	256-512	100%	100%	100%	100%		
	Medium	512-1024	100%	100%	100%	100%		
	Large - Very Large	1024-4096	100%	100%	100%	100%		
Bedrock	Bedrock	-	100%	100%	100%	100%		

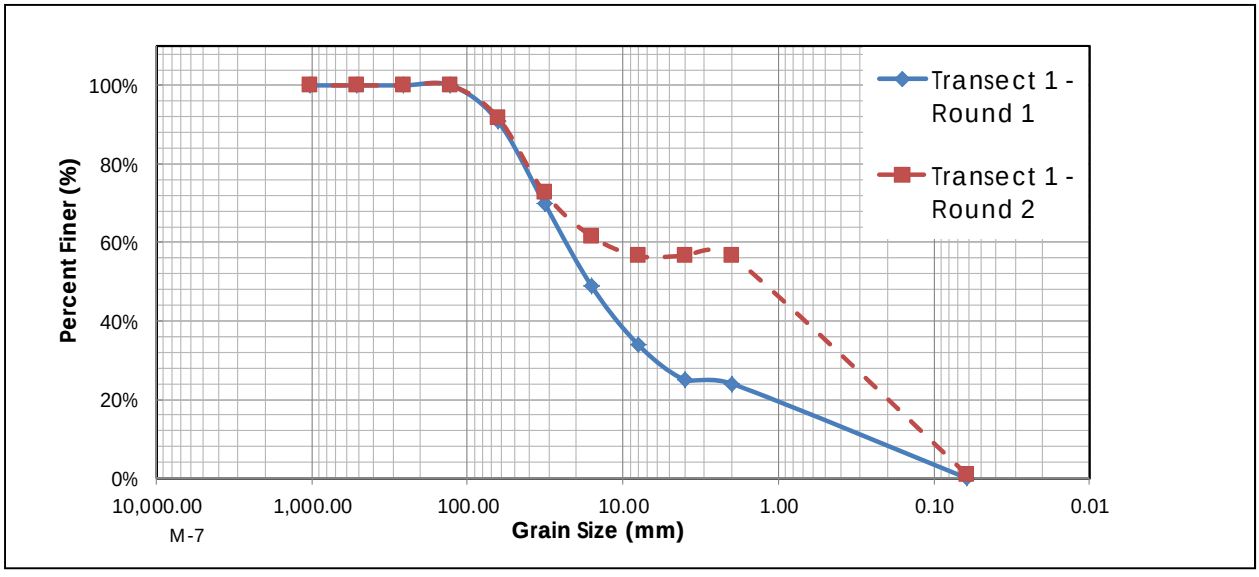

Figure C.4-1. Study site 08-M07 Transect 1 gradation curves.

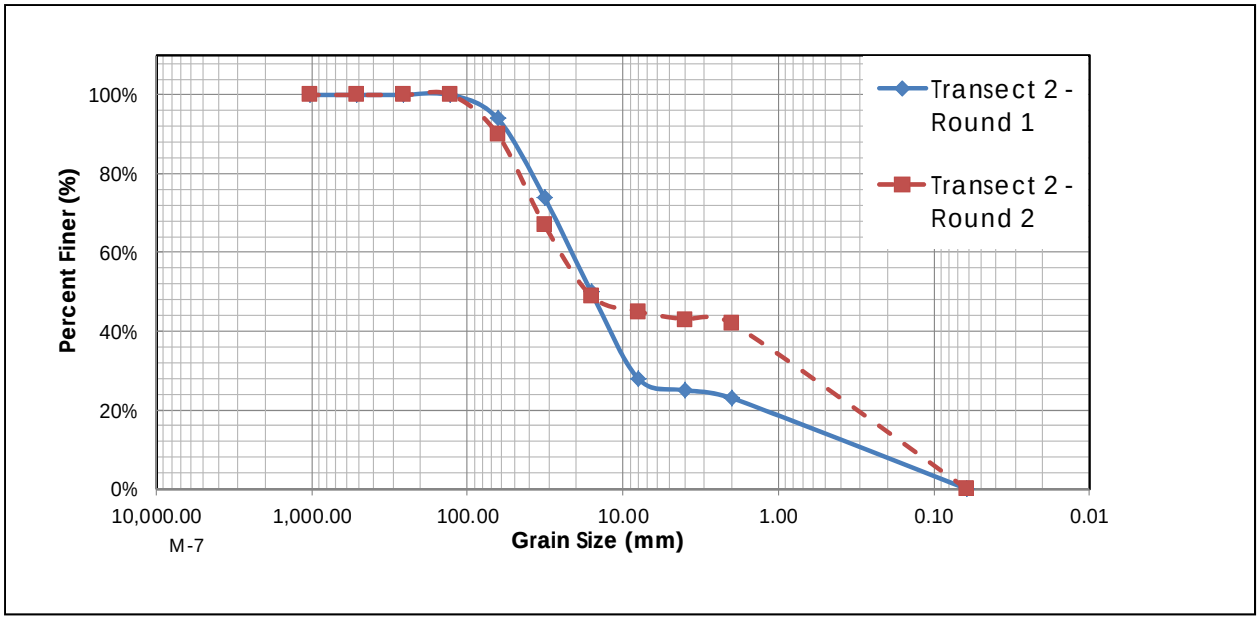

Figure C.4-2. Study site 08-M07 Transect 2 gradation curves.

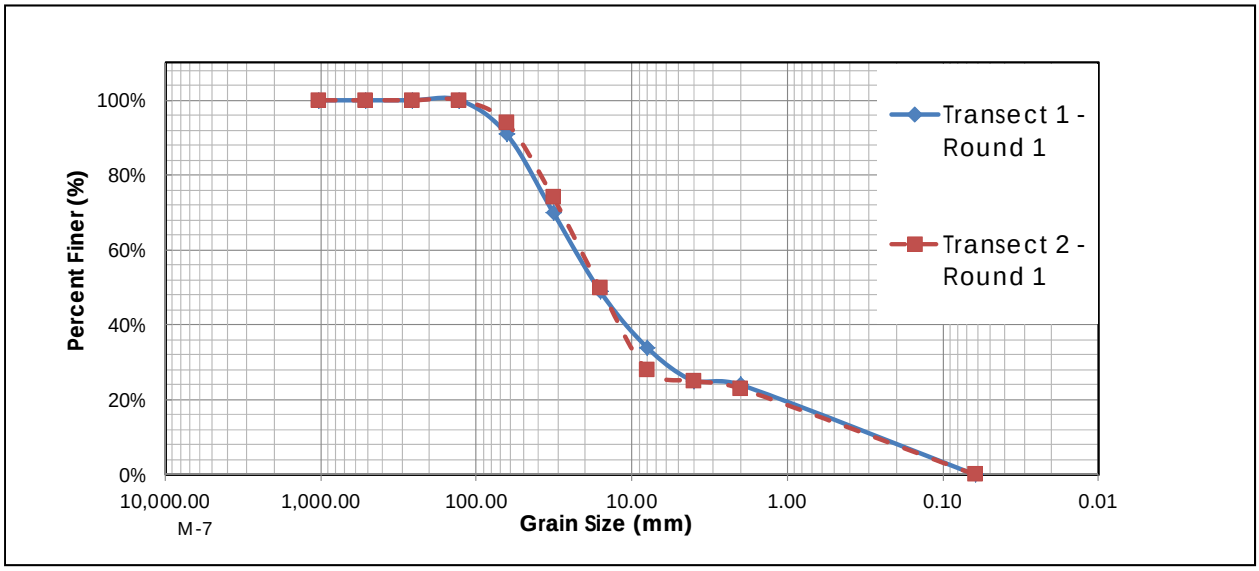

Figure C.4-3. Study site 08-M07 Transects 1 and 2, Round 1 gradation curves.

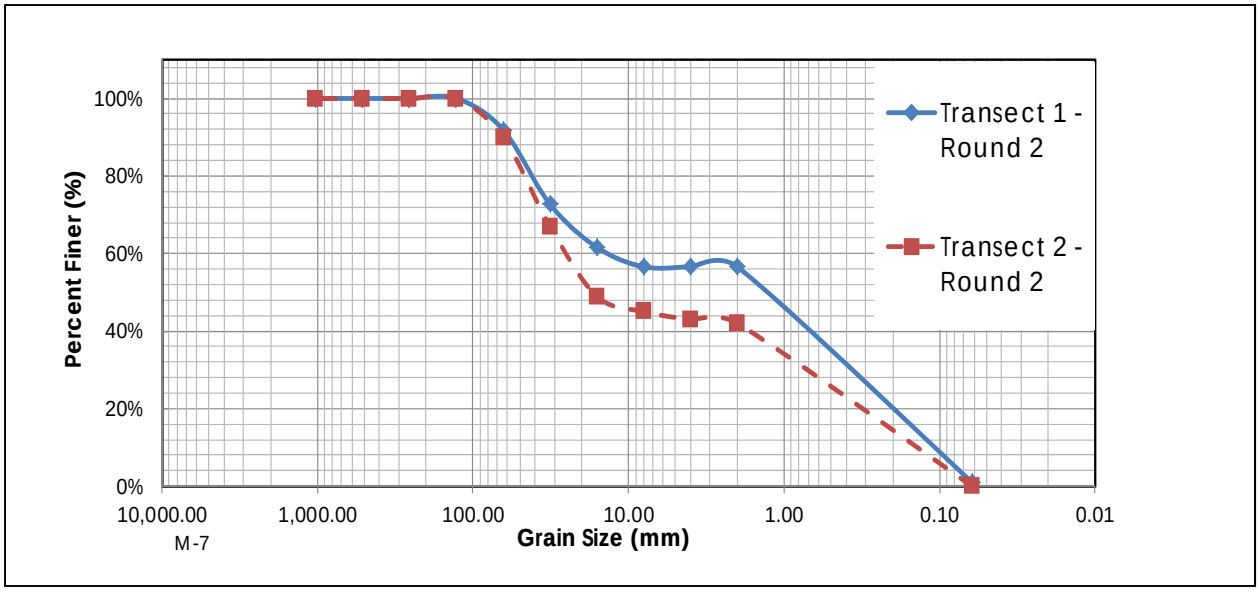

Figure C.4-4. Study site 08-M07 Transects 1 and 2, Round 2 gradation curves.

Appendix C-5. Study Site 08-M08

Table C.5-1. Study site 08-M08 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%	0%	0%
Sand	Sand	0.062 - 2.0	0%	0%	0%	1%	0%	0%
Gravel	Very Fine	2-4	19%	19%	6%	3%	1%	1%
	Fine	4-8	19%	19%	6%	4%	1%	1%
	Medium	8-16	29%	24%	13%	10%	6%	7%
	Coarse	16-32	41%	39%	37%	29%	29%	22%
	Very Coarse	32-64	66%	72%	73%	61%	66%	55%
Cobble	Small	64-128	89%	91%	94%	92%	92%	96%
	Large	128-256	100%	100%	100%	100%	100%	100%
Boulder	Small	256-512	100%	100%	100%	100%	100%	100%
	Medium	512-1024	100%	100%	100%	100%	100%	100%
	Large - Very Large	1024-4096	100%	100%	100%	100%	100%	100%
Bedrock	Bedrock	-	100%	100%	100%	100%	100%	100%

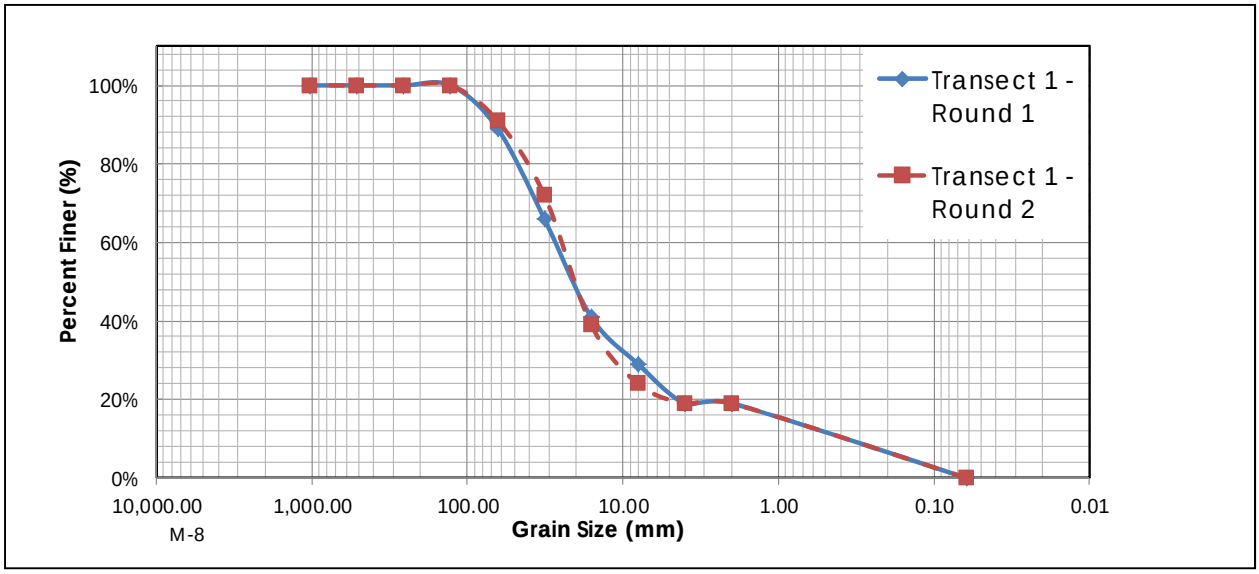

Figure C.5-1. Study site 08-M08 Transect 1 gradation curves.

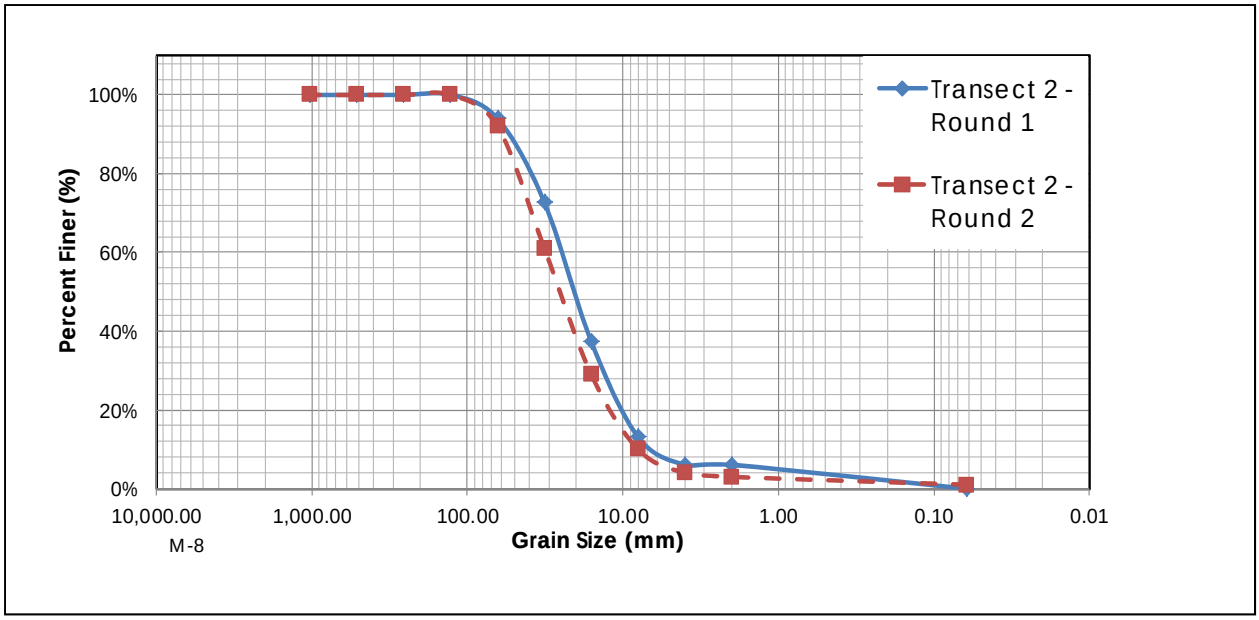

Figure C.5-2. Study site 08-M08 Transect 2 gradation curves.

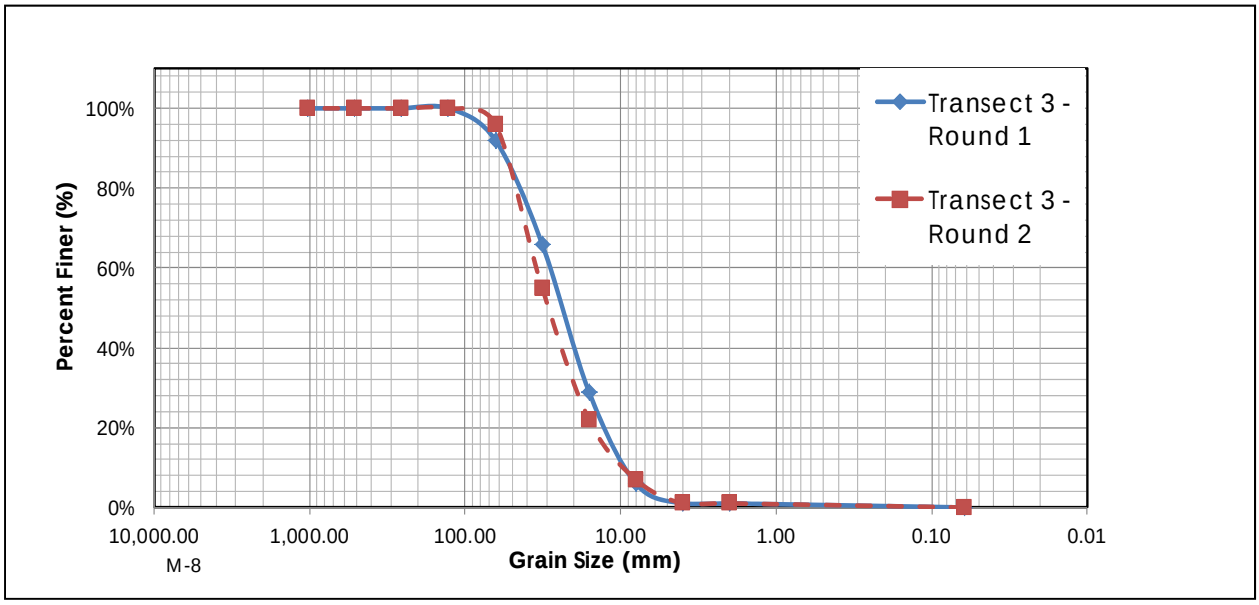

Figure C.5-3. Study site 08-M08 Transect 3 gradation curves.

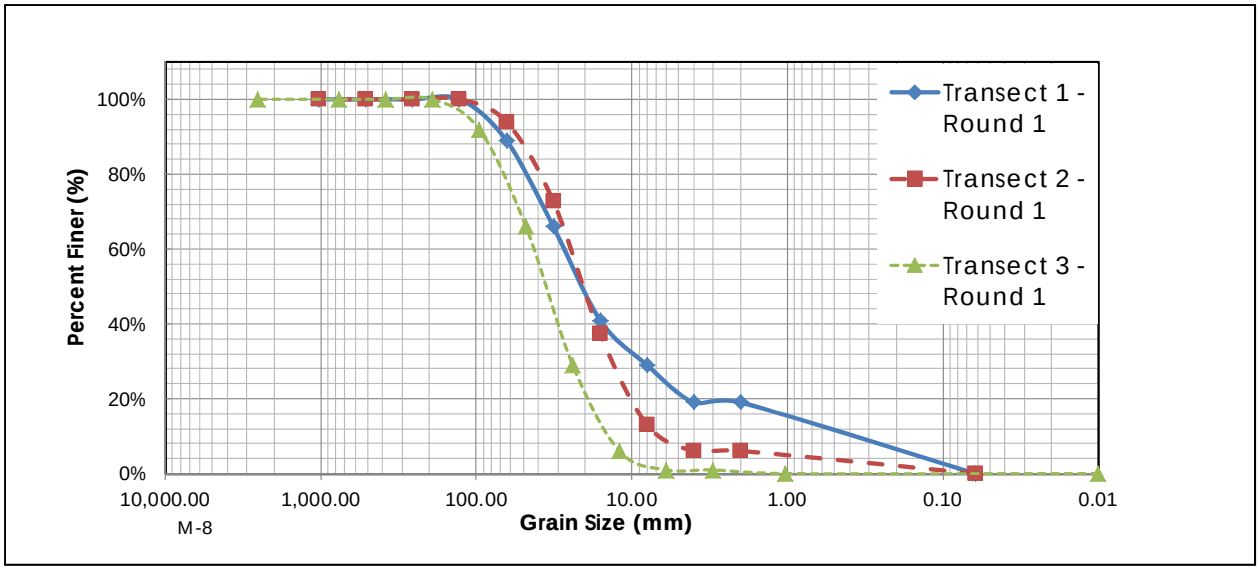

Figure C.5-4. Study site 08-M08 Transects 1, 2, and 3, Round 1 gradation curves.

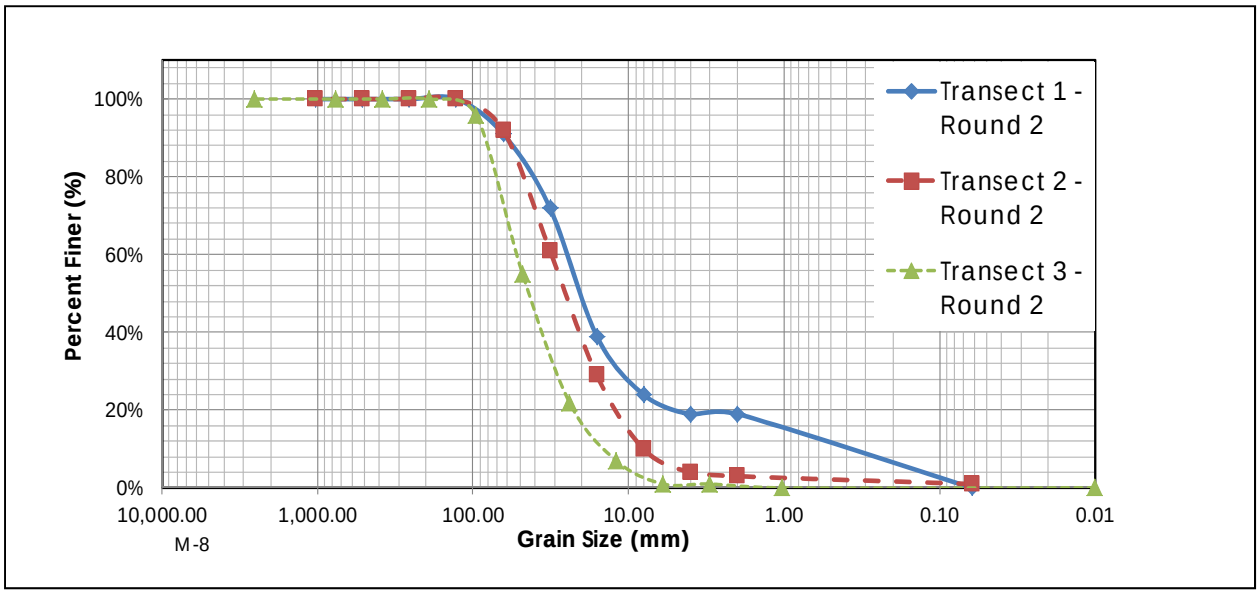

Figure C.5-5. Study site 08-M08 Transects 1, 2, and 3, Round 2 gradation curves.

Appendix C-6. Study Site 08-M10

Table C.6-1. Study site 08-M10 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%		
Sand	Sand	0.062 - 2.0	1%	4%	0%	0%		
Gravel	Very Fine	2-4	8%	4%	3%	5%		
	Fine	4-8	10%	4%	3%	5%		
	Medium	8-16	12%	6%	7%	7%		
	Coarse	16-32	26%	20%	22%	15%		
	Very Coarse	32-64	55%	51%	56%	51%		
Cobble	Small	64-128	92%	89%	84%	79%		
	Large	128-256	99%	99%	100%	99%		
Boulder	Small	256-512	100%	100%	100%	100%		
	Medium	512-1024	100%	100%	100%	100%		
	Large - Very Large	1024-4096	100%	100%	100%	100%		
Bedrock	Bedrock	-	100%	100%	100%	100%		

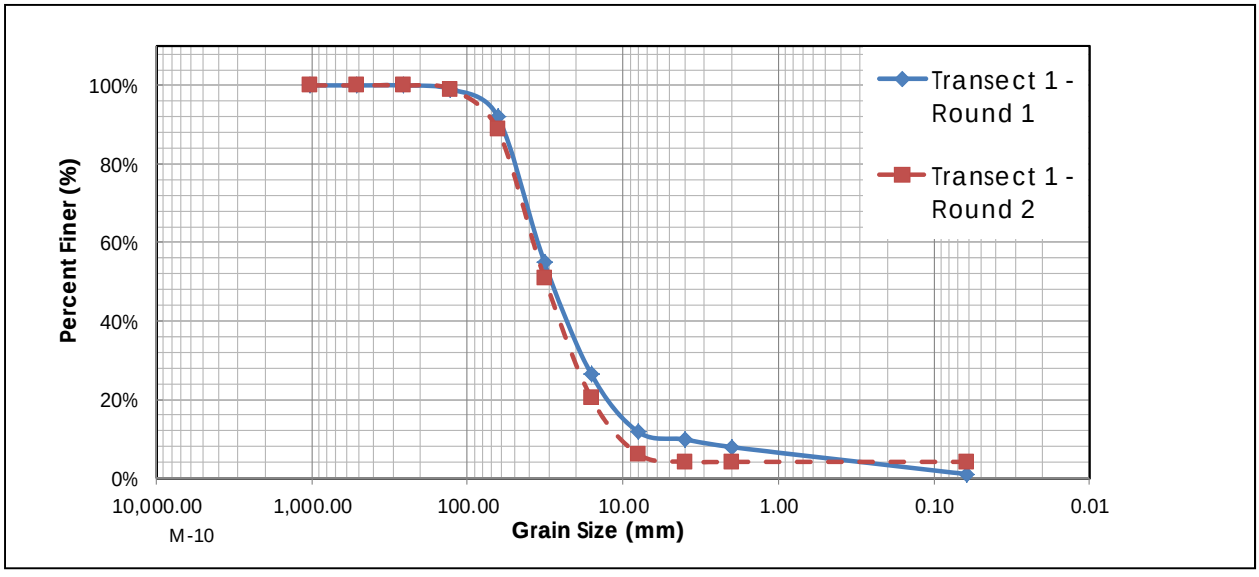

Figure C.6-1. Study site 08-M10 Transect 1 gradation curves.

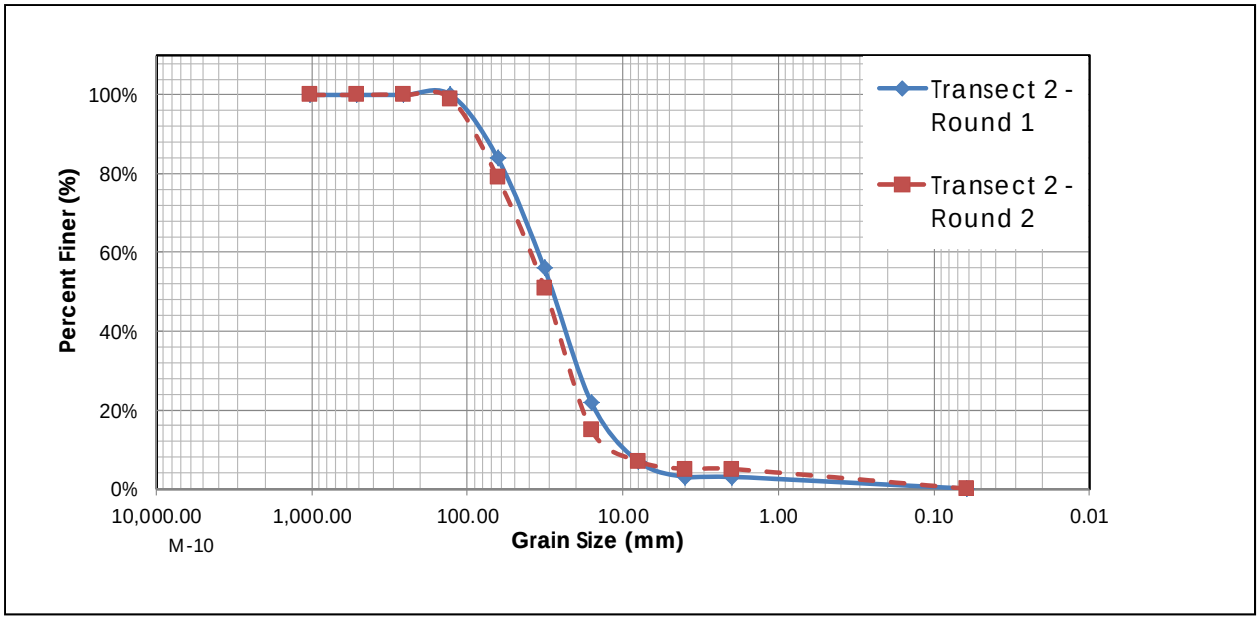

Figure C.6-2. Study site 08-M10 Transect 2 gradation curves.

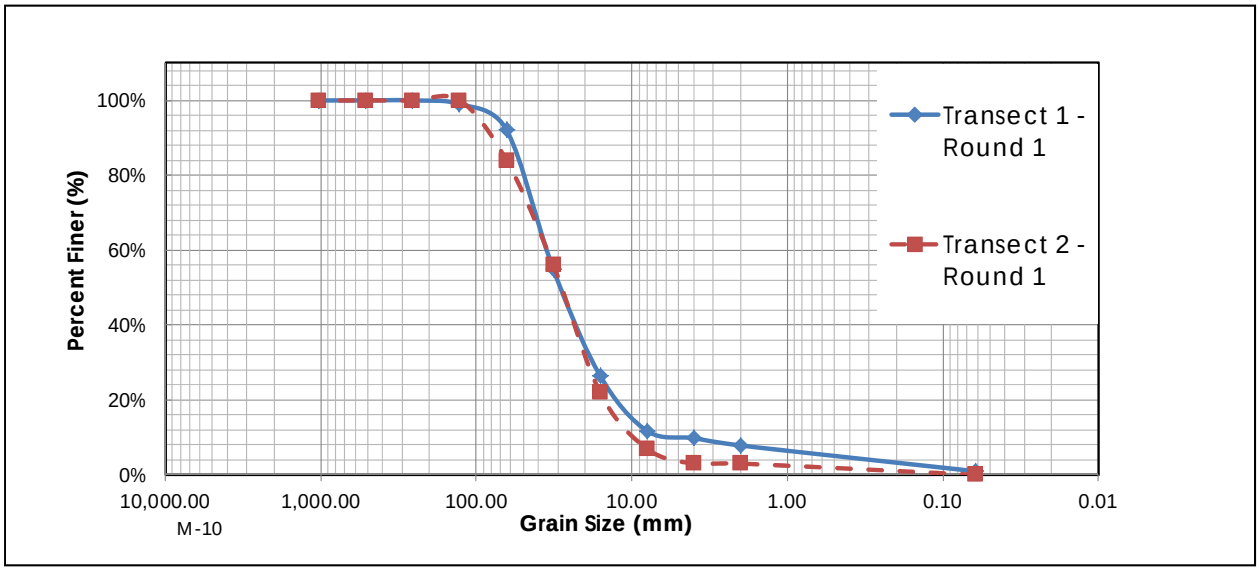

Figure C.6-3. Study site 08-M10 Transects 1 and 2, Round 1 gradation curves.

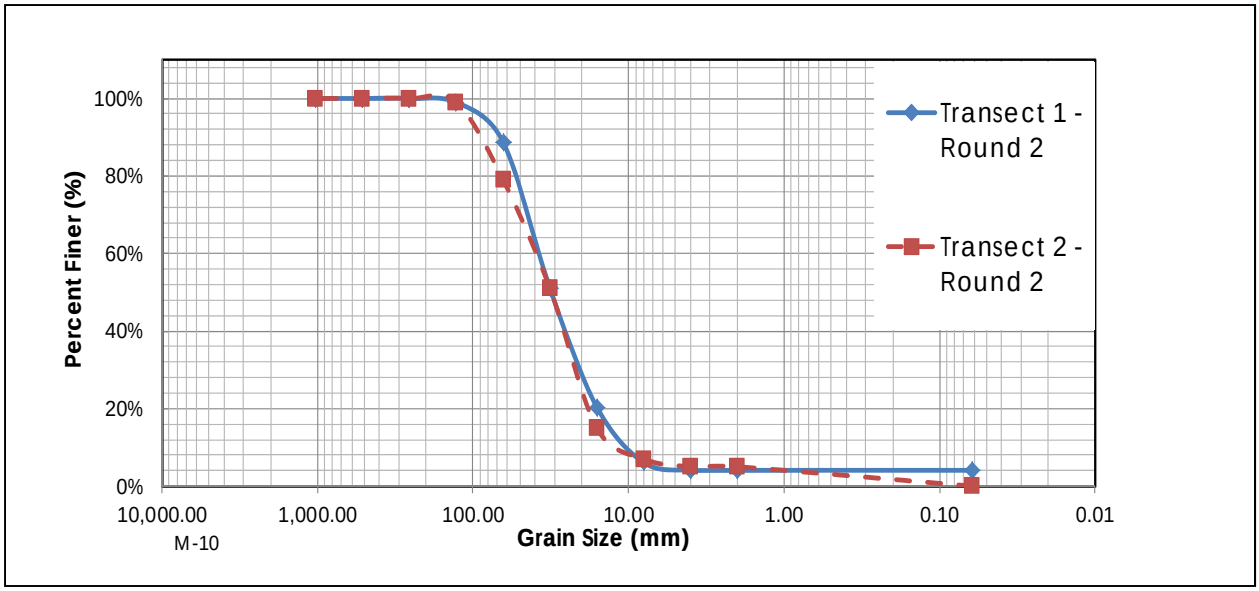

Figure C.6-4. Study site 08-M10 Transects 1 and 2, Round 2 gradation curves.

Appendix C-7. Study Site 08-M12

Table C.7-1. Study site 08-M12 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%	0%	0%
Sand	Sand	0.062 - 2.0	0%	6%	0%	0%	0%	0%
Gravel	Very Fine	2-4	8%	16%	22%	40%	15%	17%
	Fine	4-8	10%	18%	23%	40%	16%	17%
	Medium	8-16	16%	26%	33%	42%	22%	24%
	Coarse	16-32	30%	39%	48%	55%	42%	47%
	Very Coarse	32-64	69%	75%	74%	83%	73%	81%
Cobble	Small	64-128	93%	97%	99%	99%	97%	98%
	Large	128-256	100%	99%	100%	100%	100%	100%
Boulder	Small	256-512	100%	100%	100%	100%	100%	100%
	Medium	512-1024	100%	100%	100%	100%	100%	100%
	Large - Very Large	1024-4096	100%	100%	100%	100%	100%	100%
Bedrock	Bedrock	-	100%	100%	100%	100%	100%	100%

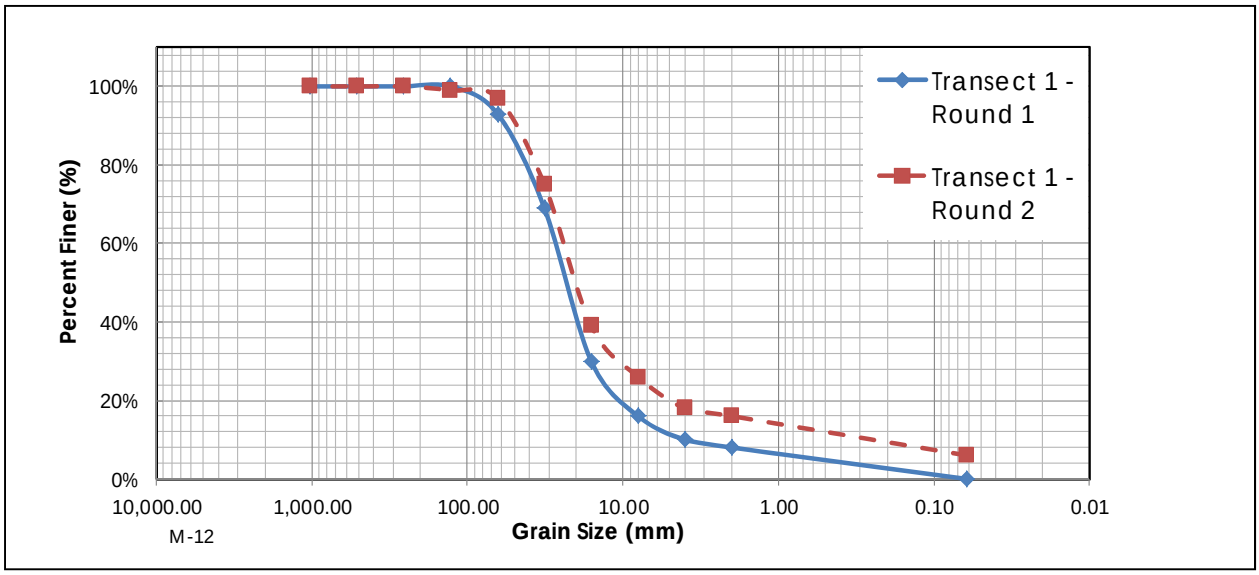

Figure C.7-1. Study site 08-M12 Transect 1 gradation curves.

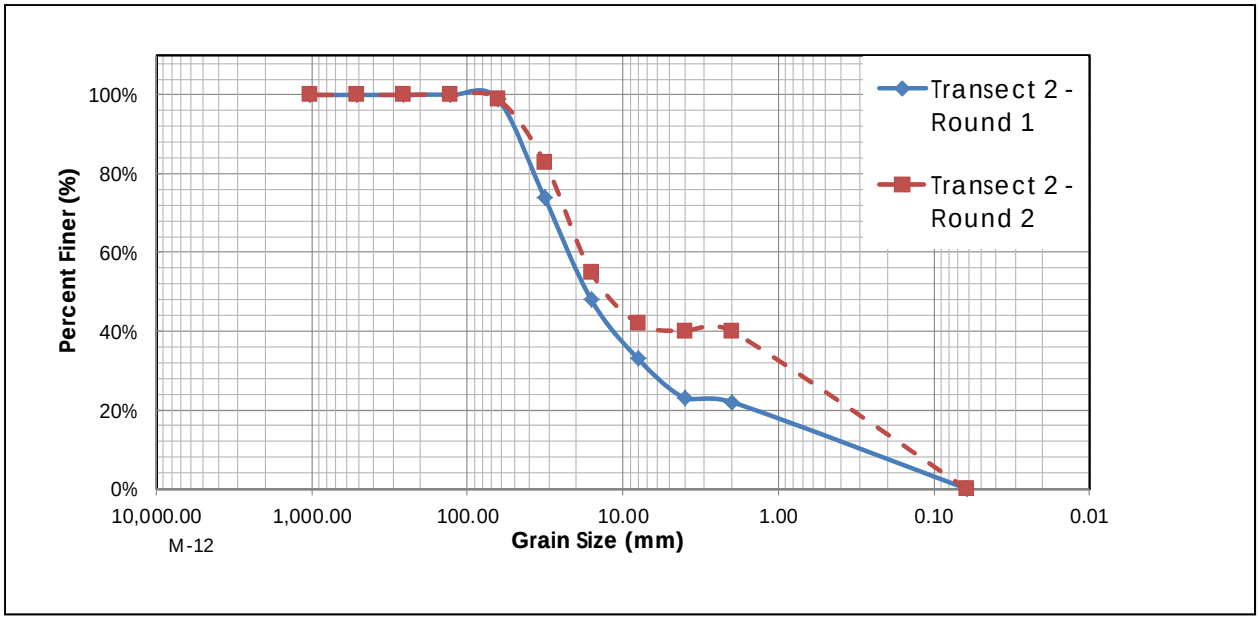

Figure C.7-2. Study site 08-M12 Transect 2 gradation curves.

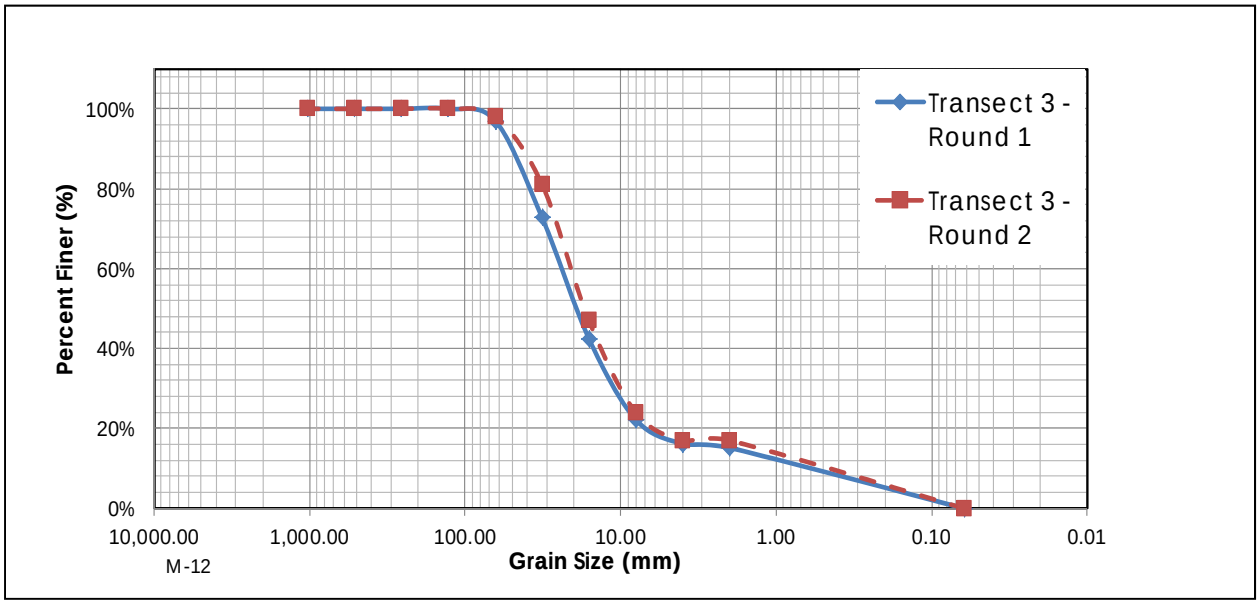

Figure C.7-3. Study site 08-M12 Transect 3 gradation curves.

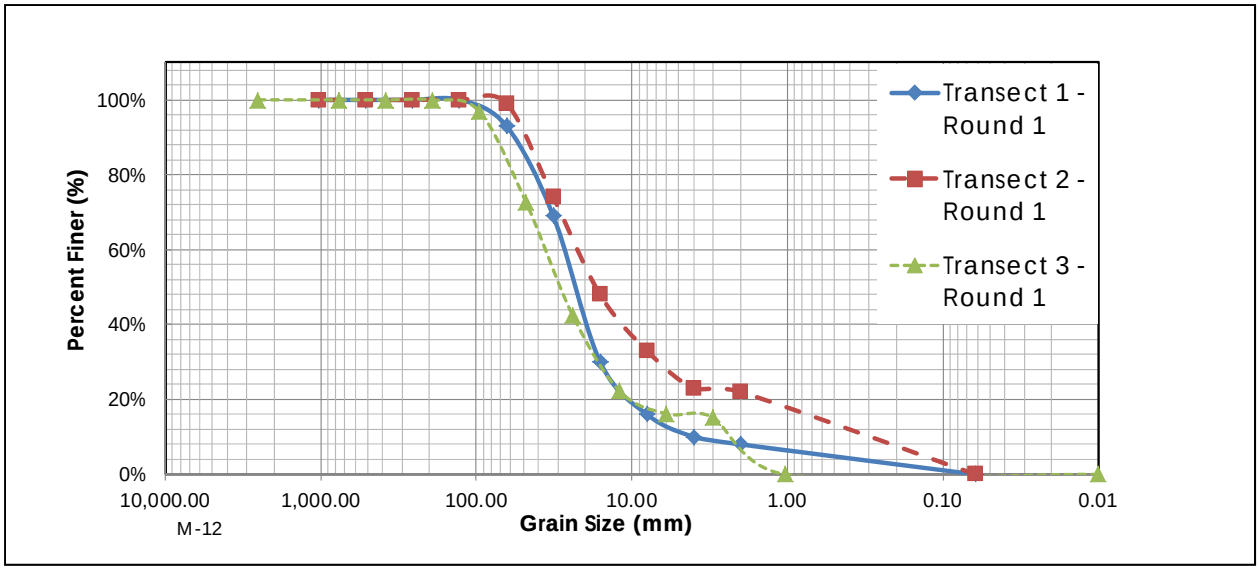

Figure C.7-4. Study site 08-M12 Transects 1, 2, and 3, Round 1 gradation curves.

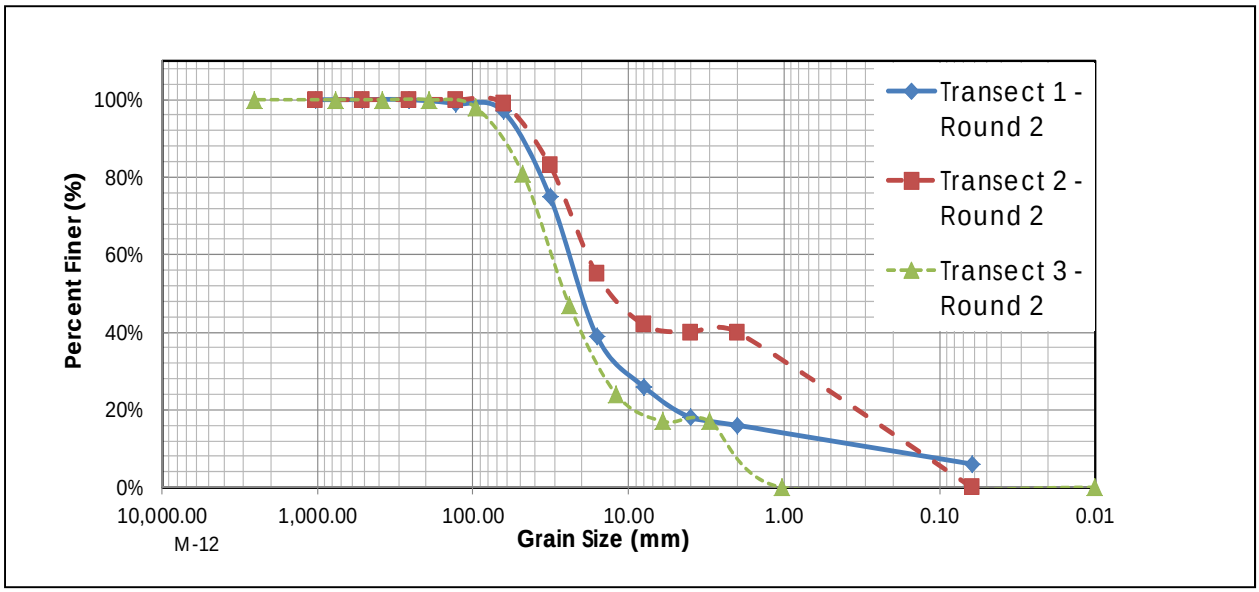

Figure C.7-5. Study site 08-M12 Transects 1, 2, and 3, Round 2 gradation curves.

Appendix C-8. Study Site 08-M13

Table C.8-1. Study site 08-M13 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%		
Sand	Sand	0.062 - 2.0	0%	0%	0%	0%		
Gravel	Very Fine	2-4	18%	2%	12%	9%		
	Fine	4-8	18%	2%	12%	11%		
	Medium	8-16	19%	7%	18%	17%		
	Coarse	16-32	34%	19%	35%	35%		
	Very Coarse	32-64	71%	61%	77%	78%		
Cobble	Small	64-128	91%	91%	98%	98%		
	Large	128-256	100%	100%	100%	100%		
Boulder	Small	256-512	100%	100%	100%	100%		
	Medium	512-1024	100%	100%	100%	100%		
	Large - Very Large	1024-4096	100%	100%	100%	100%		
Bedrock	Bedrock	-	100%	100%	100%	100%		

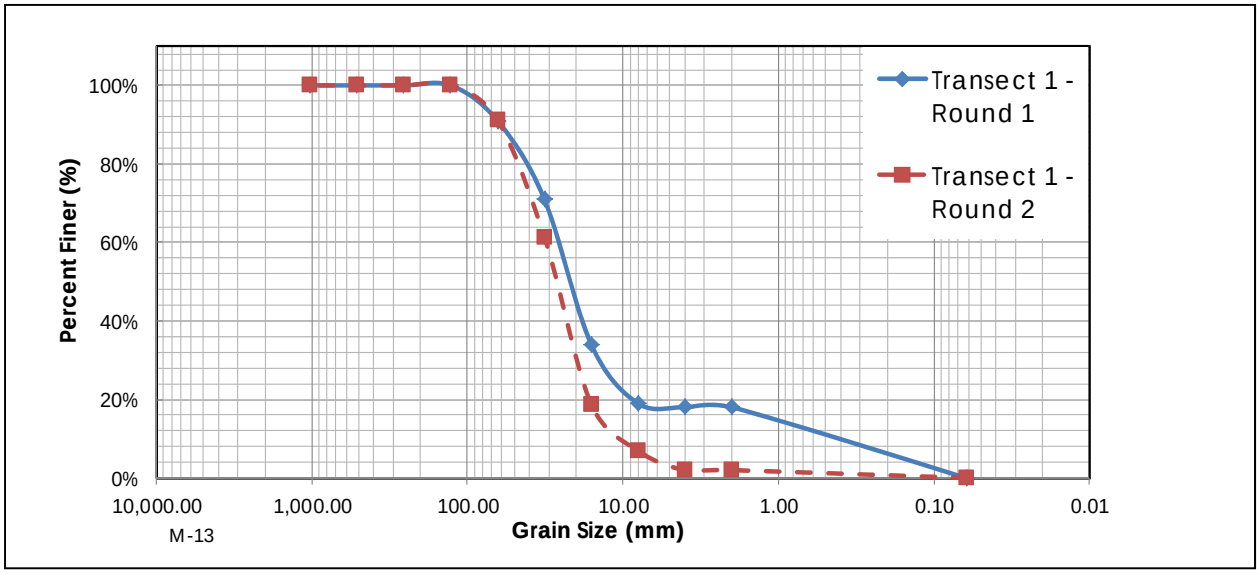

Figure C.8-1. Study site 08-M13 Transect 1 gradation curves.

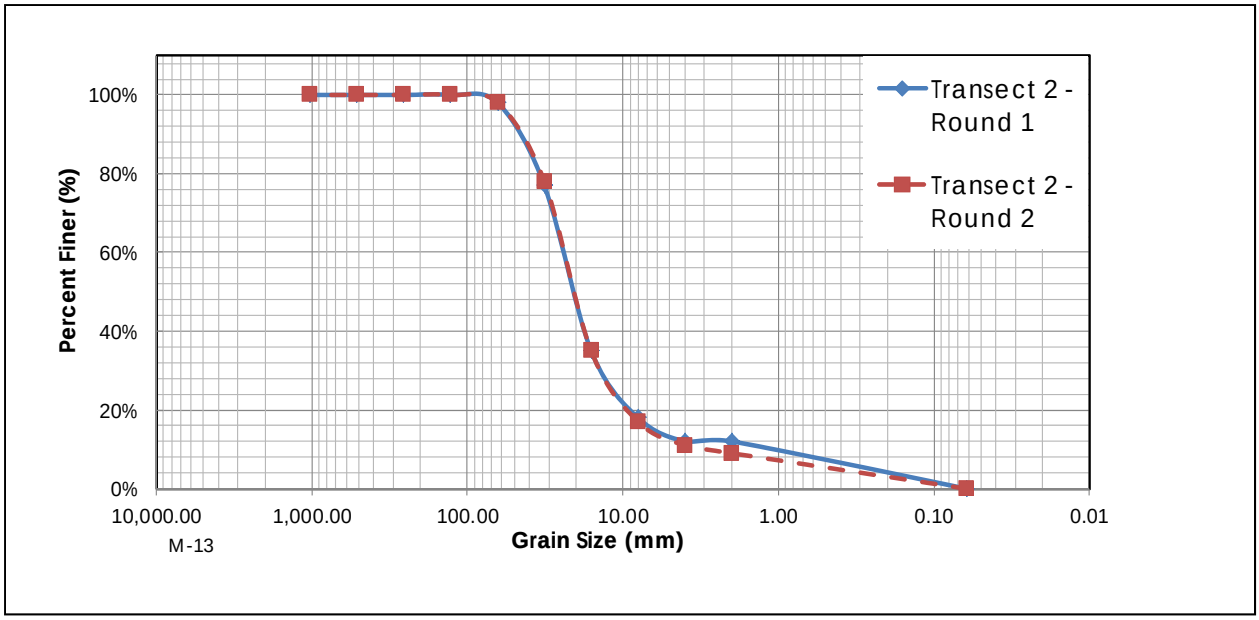

Figure C.8-2. Study site 08-M13 Transect 2 gradation curves.

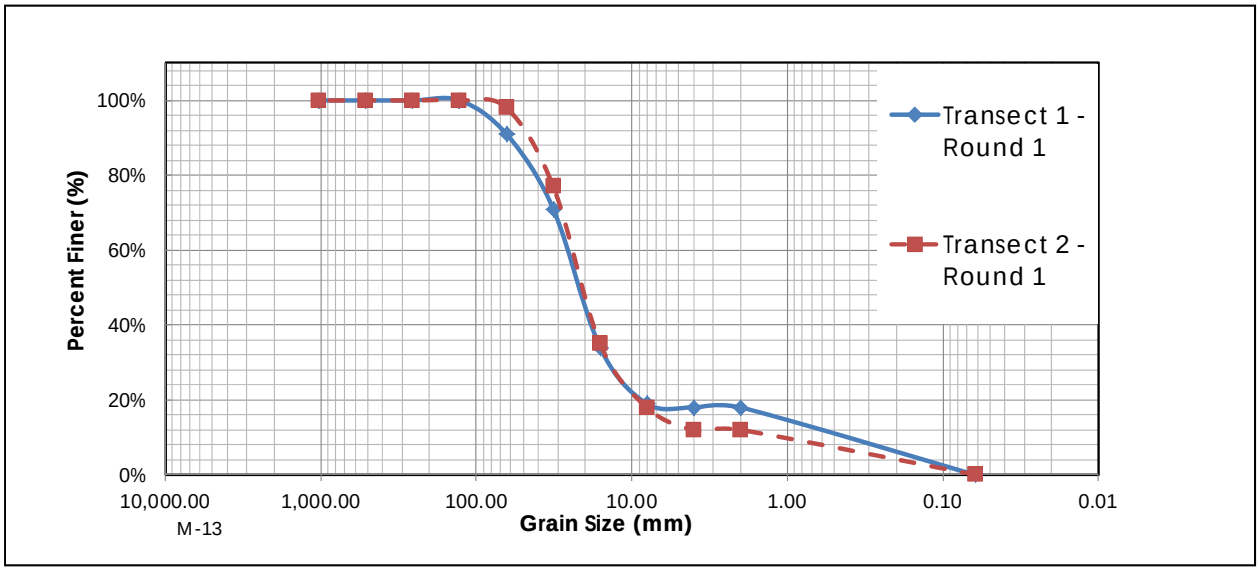

Figure C.8-3. Study site 08-M13 Transects 1 and 2, Round 1 gradation curves.

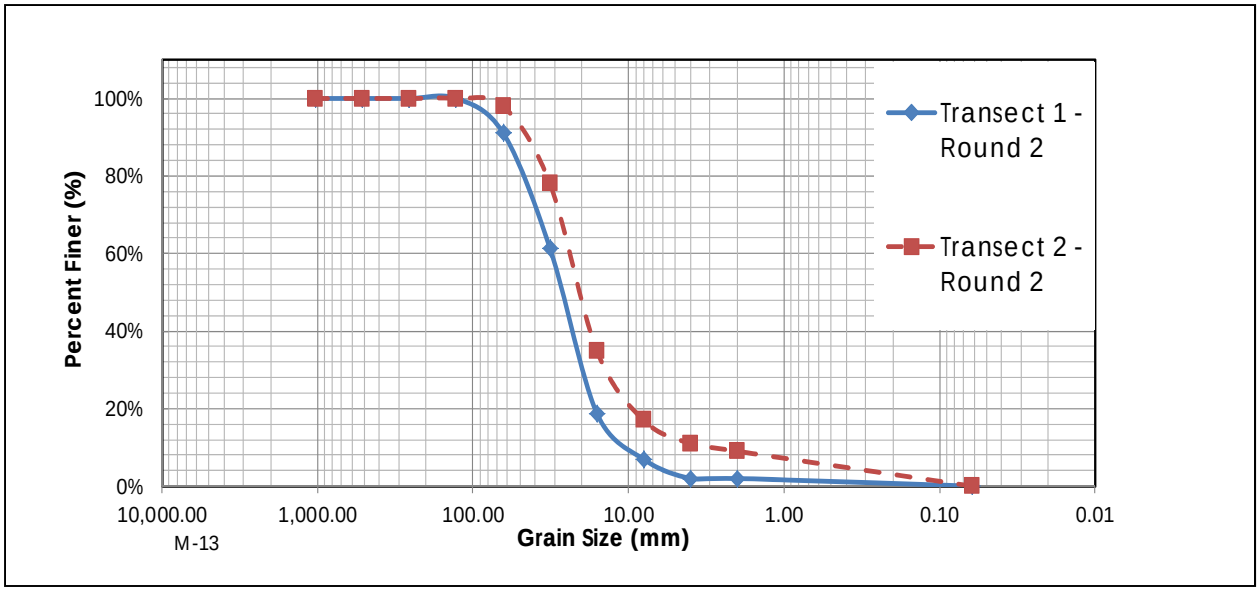

Figure C.8-4. Study site 08-M13 Transects 1 and 2, Round 2 gradation curves.

Appendix C-9. Study Site 08-M15

Table C.9-1. Study site 08-M15 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%				
Sand	Sand	0.062 - 2.0	0%	0%				
Gravel	Very Fine	2-4	100%	100%				
	Fine	4-8	100%	100%				
	Medium	8-16	100%	100%				
	Coarse	16-32	100%	100%				
	Very Coarse	32-64	100%	100%				
Cobble	Small	64-128	100%	100%				
	Large	128-256	100%	100%				
Boulder	Small	256-512	100%	100%				
	Medium	512-1024	100%	100%				
	Large - Very Large	1024-4096	100%	100%				
Bedrock	Bedrock	-	100%	100%				

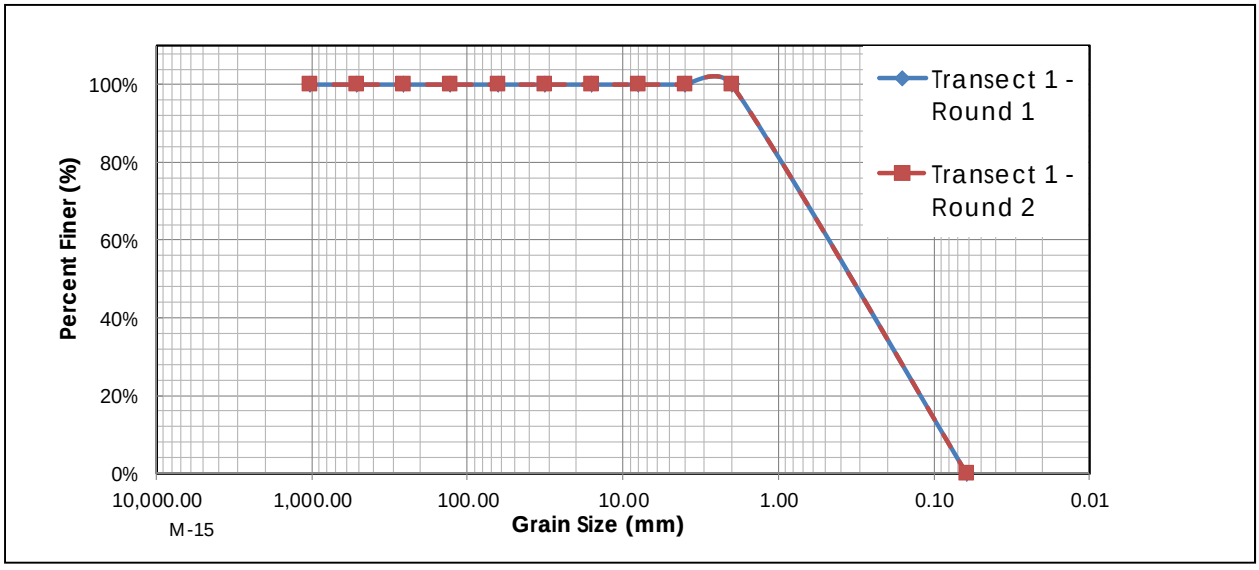

Figure C.9-1. Study site 08-M15 Transect 1 gradation curves.

Appendix C-10. Study Site 08-M16

Table C.10-1. Study site 08-M16 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%		
Sand	Sand	0.062 - 2.0	0%	0%	0%	0%		
Gravel	Very Fine	2-4	10%	9%	15%	35%		
	Fine	4-8	10%	9%	15%	35%		
	Medium	8-16	10%	9%	15%	35%		
	Coarse	16-32	14%	10%	17%	35%		
	Very Coarse	32-64	34%	24%	29%	36%		
Cobble	Small	64-128	69%	54%	63%	53%		
	Large	128-256	91%	93%	99%	94%		
Boulder	Small	256-512	100%	100%	100%	100%		
	Medium	512-1024	100%	100%	100%	100%		
	Large - Very Large	1024-4096	100%	100%	100%	100%		
Bedrock	Bedrock	-	100%	100%	100%	100%		

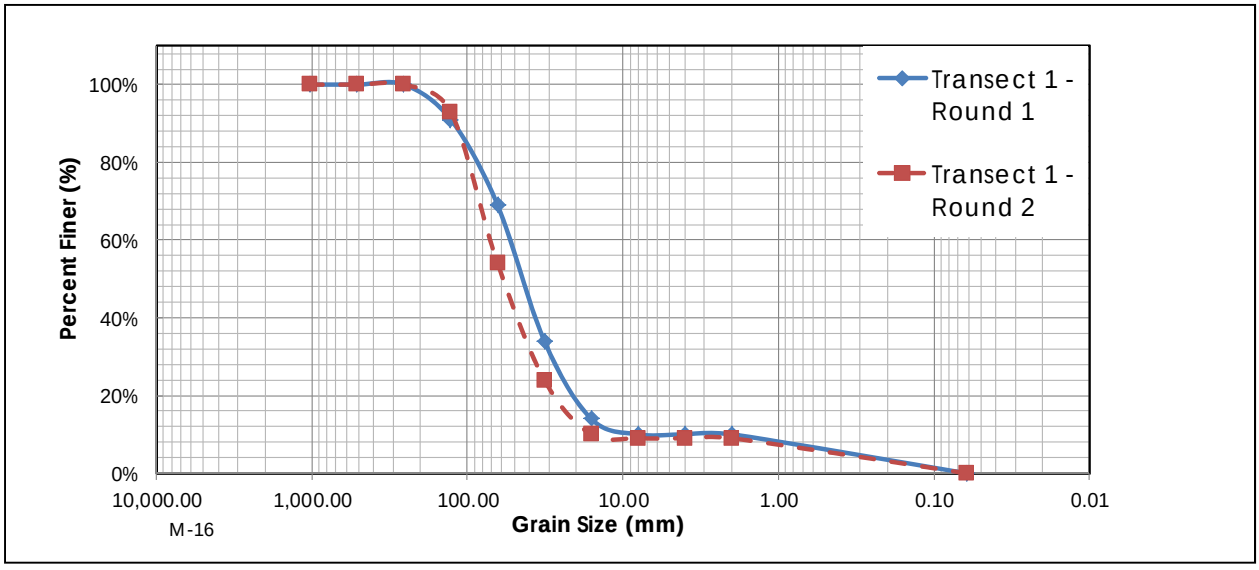

Figure C.10-1. Study site 08-M16 Transect 1 gradation curves.

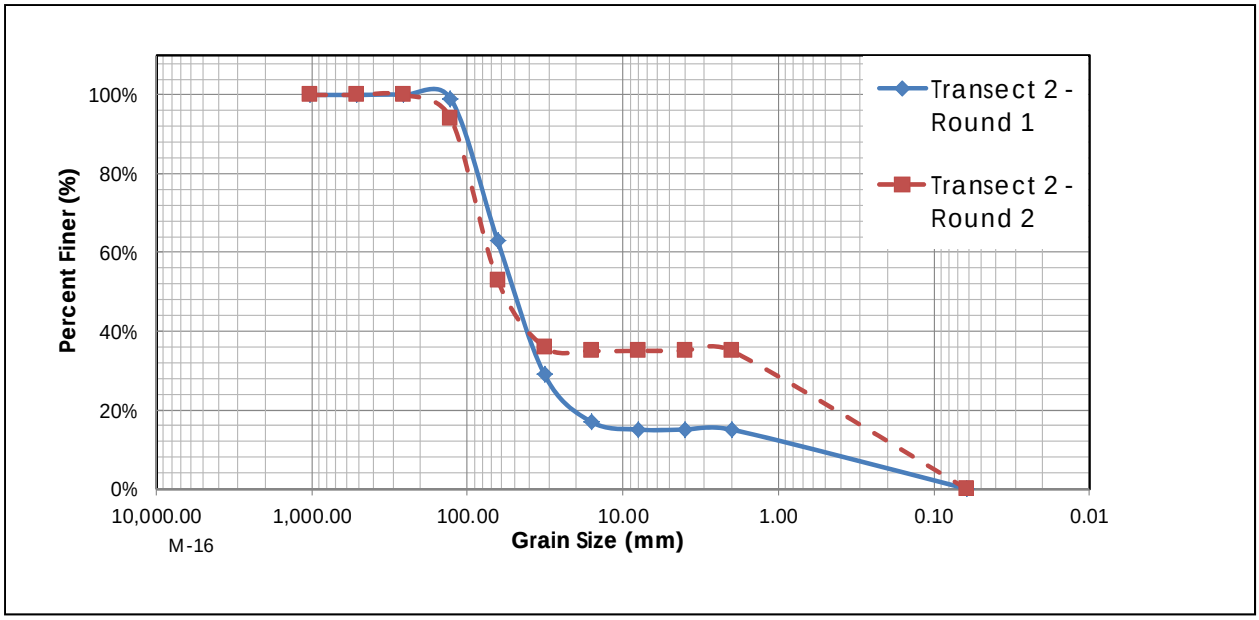

Figure C.10-2. Study site 08-M16 Transect 2 gradation curves.

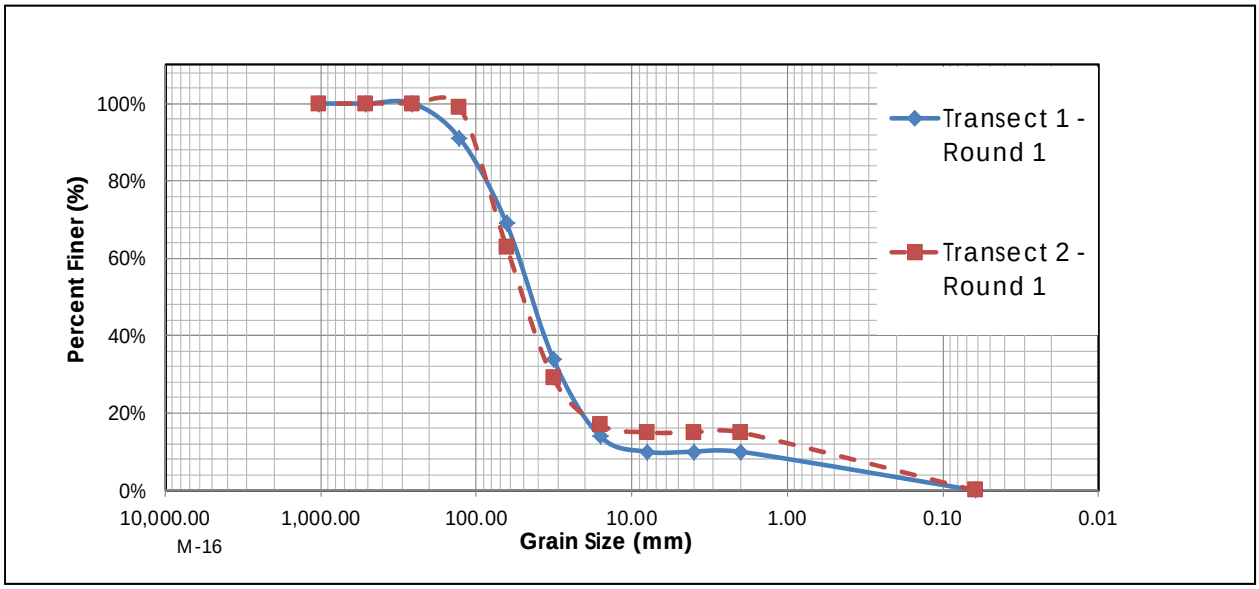

Figure C.10-3. Study site 08-M16 Transects 1 and 2, Round 1 gradation curves.

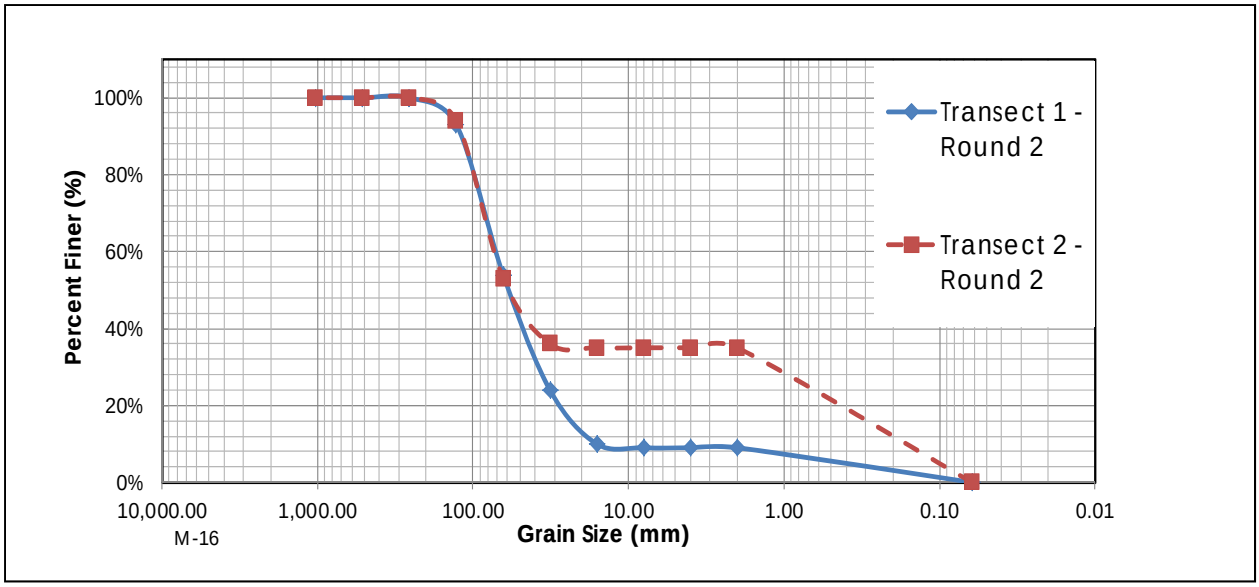

Figure C.10-4. Study site 08-M16 Transects 1 and 2, Round 2 gradation curves.

Appendix C-11. Study Site 08-M17

Table C.11-1. Study site 08-M17 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%				
Sand	Sand	0.062 - 2.0	1%	0%				
Gravel	Very Fine	2-4	6%	2%				
	Fine	4-8	6%	3%				
	Medium	8-16	9%	5%				
	Coarse	16-32	18%	14%				
	Very Coarse	32-64	58%	47%				
Cobble	Small	64-128	94%	97%				
	Large	128-256	100%	100%				
Boulder	Small	256-512	100%	100%				
	Medium	512-1024	100%	100%				
	Large - Very Large	1024-4096	100%	100%				
Bedrock	Bedrock	-	100%	100%				

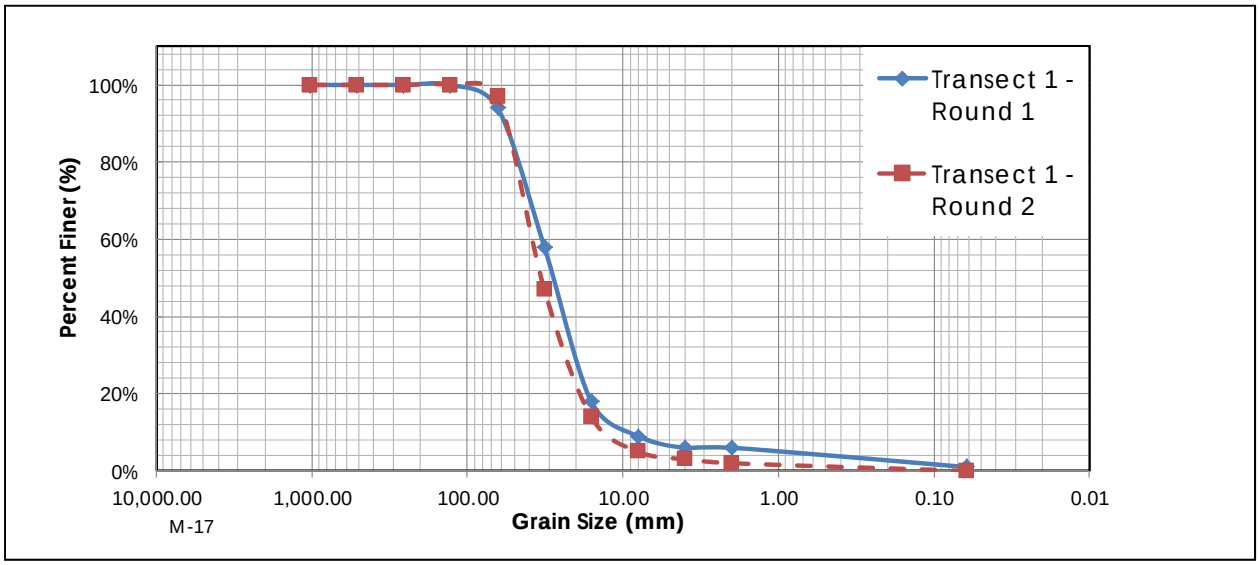

Figure C.11-1. Study site 08-M17 Transect 1 gradation curves.

Appendix C-12. Study Site 08-M20

Table C.12-1. Study site 08-M20 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%	0%	0%
Sand	Sand	0.062 - 2.0	1%	0%	7%	0%	0%	0%
Gravel	Very Fine	2-4	3%	1%	11%	28%	5%	2%
	Fine	4-8	3%	1%	11%	28%	5%	4%
	Medium	8-16	6%	5%	11%	29%	5%	14%
	Coarse	16-32	17%	13%	19%	32%	16%	30%
	Very Coarse	32-64	46%	30%	49%	49%	61%	54%
Cobble	Small	64-128	91%	81%	87%	84%	100%	97%
	Large	128-256	100%	99%	99%	100%	100%	100%
Boulder	Small	256-512	100%	100%	100%	100%	100%	100%
	Medium	512-1024	100%	100%	100%	100%	100%	100%
	Large - Very Large	1024-4096	100%	100%	100%	100%	100%	100%
Bedrock	Bedrock	-	100%	100%	100%	100%	100%	100%

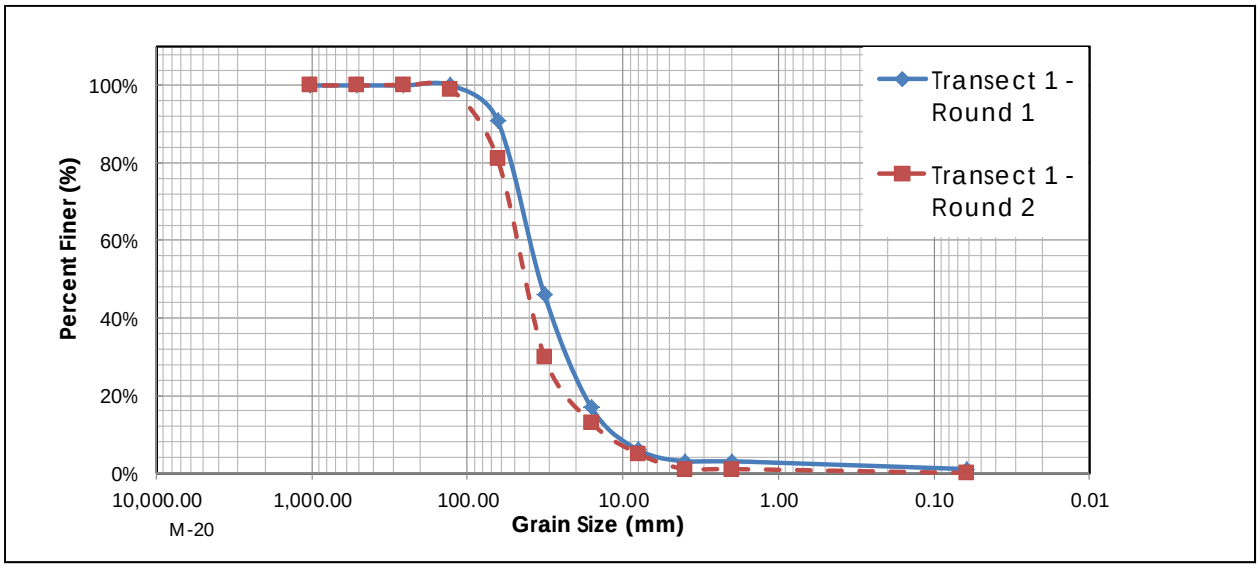

Figure C.12-1. Study site 08-M20 Transect 1 gradation curves.

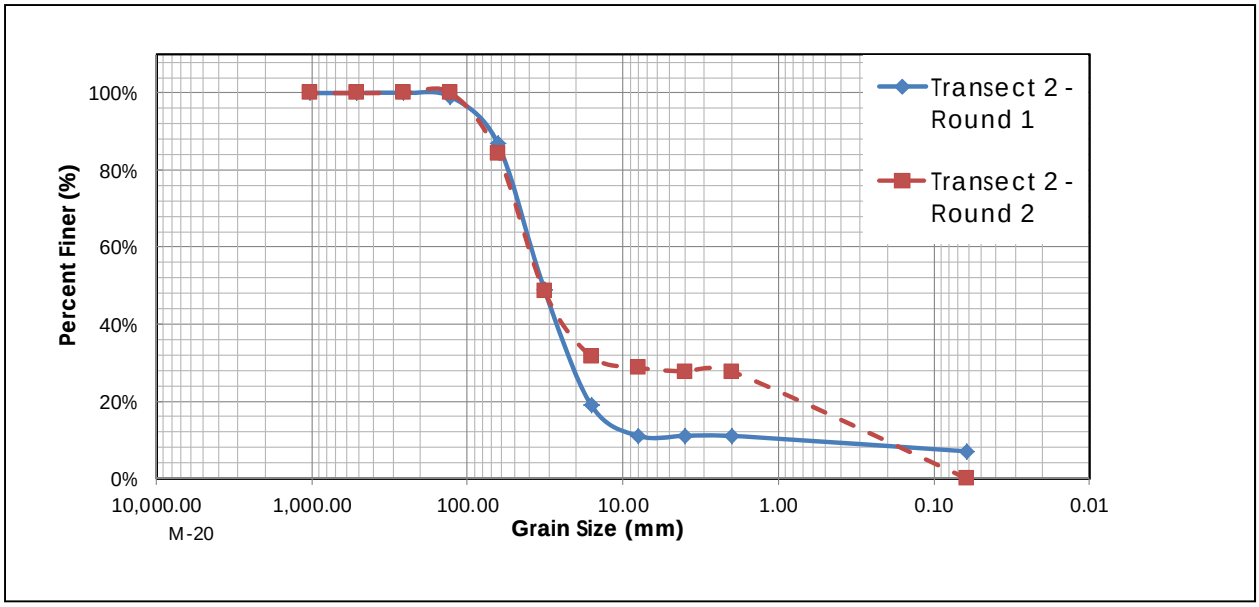

Figure C. 12-2. Study site 08-M20 Transect 2 gradation curves.

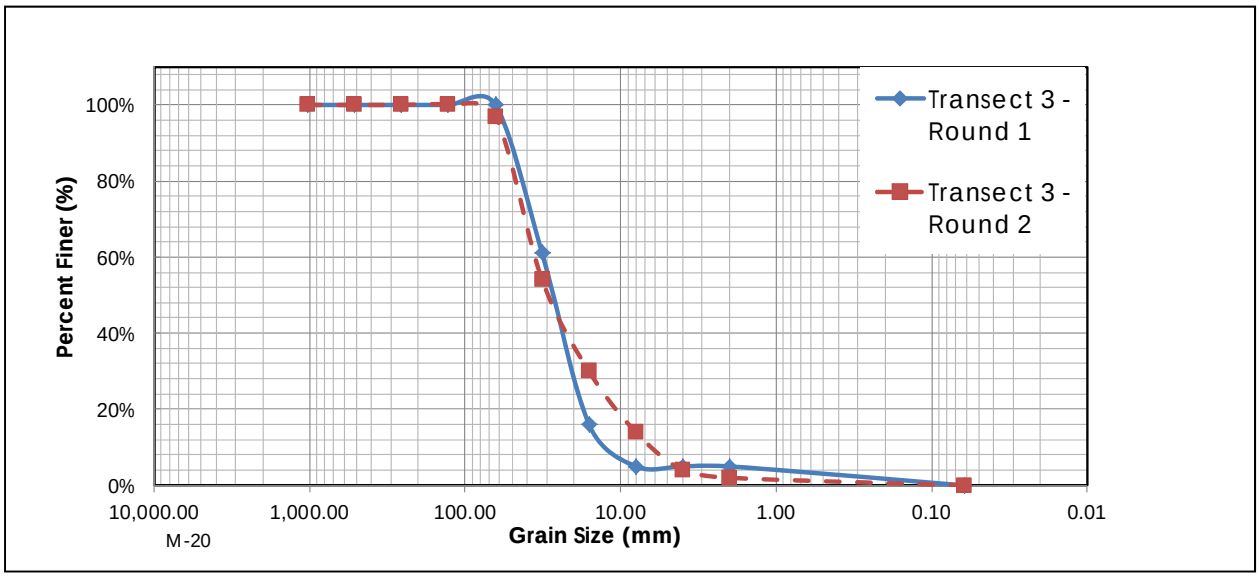

Figure C. 12-3. Study site 08-M20 Transect 3 gradation curves.

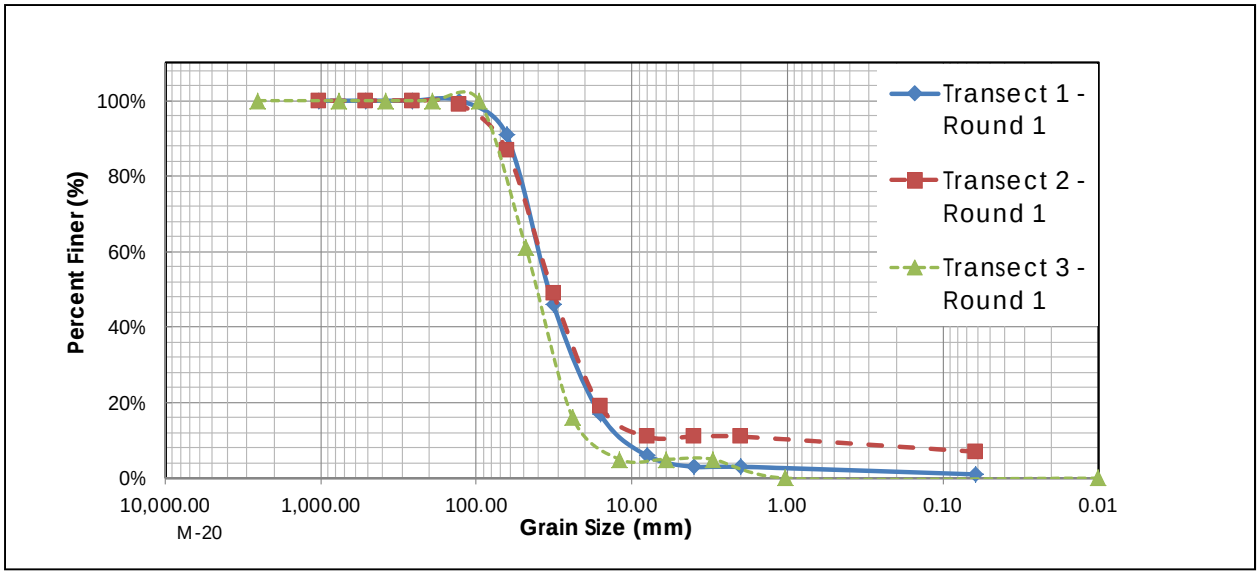

Figure C. 12-4. Study site 08-M20 Transects 1, 2, and 3, Round 1 gradation curves.

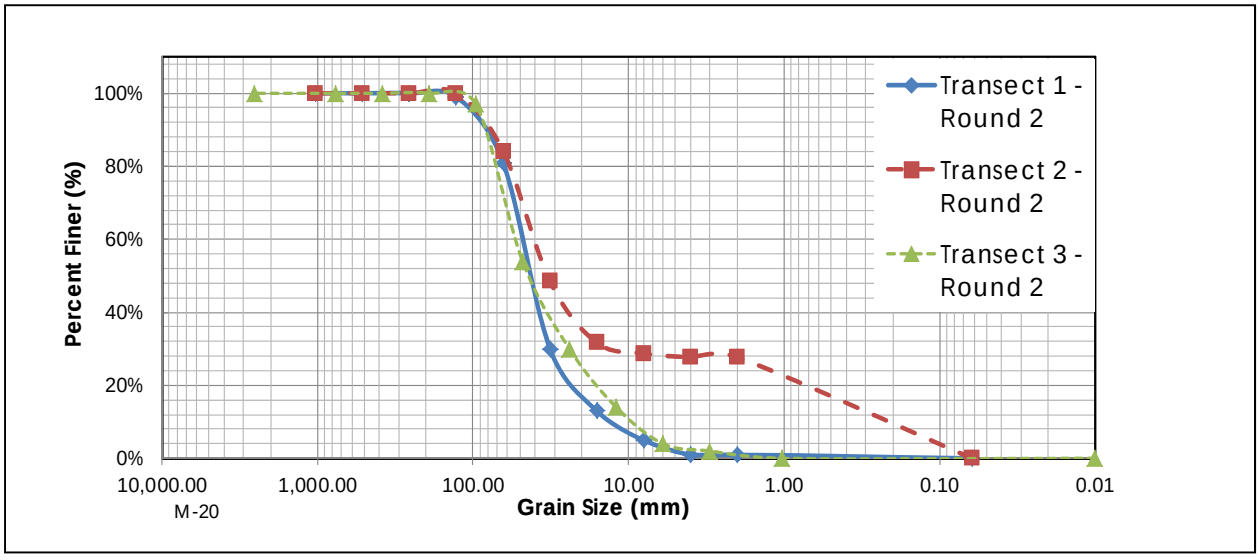

Figure C. 12-5. Study site 08-M20 Transects 1, 2, and 3, Round 2 gradation curves.

Appendix C-13. Study Site 08-T01

Table C.13-1. Study site 08-T01 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%	0%	0%
Sand	Sand	0.062 - 2.0	100%	100%	11%	28%	18%	6%
Gravel	Very Fine	2-4	100%	100%	23%	73%	61%	64%
	Fine	4-8	100%	100%	54%	75%	65%	67%
	Medium	8-16	100%	100%	93%	92%	78%	90%
	Coarse	16-32	100%	100%	100%	100%	97%	99%
	Very Coarse	32-64	100%	100%	100%	100%	100%	100%
Cobble	Small	64-128	100%	100%	100%	100%	100%	100%
	Large	128-256	100%	100%	100%	100%	100%	100%
Boulder	Small	256-512	100%	100%	100%	100%	100%	100%
	Medium	512-1024	100%	100%	100%	100%	100%	100%
	Large - Very Large	1024-4096	100%	100%	100%	100%	100%	100%
Bedrock	Bedrock	-	100%	100%	100%	100%	100%	100%

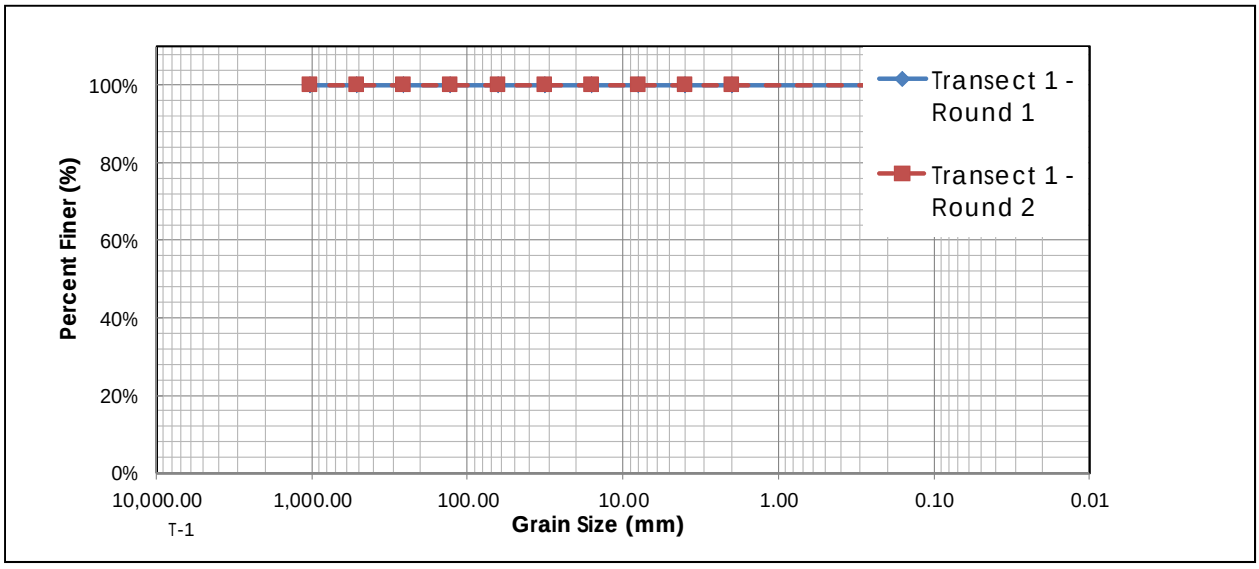

Figure C.13-1. Study site 08-T01 Transect 1 gradation curves.

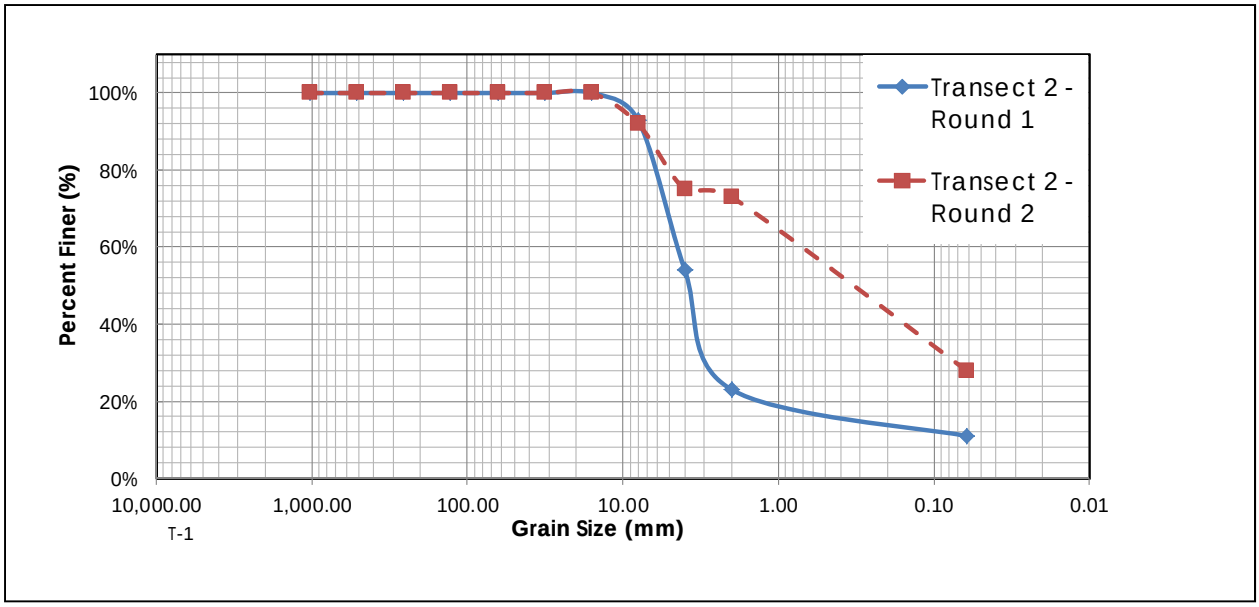

Figure C.13-2. Study site 08-T01 Transect 2 gradation curves.

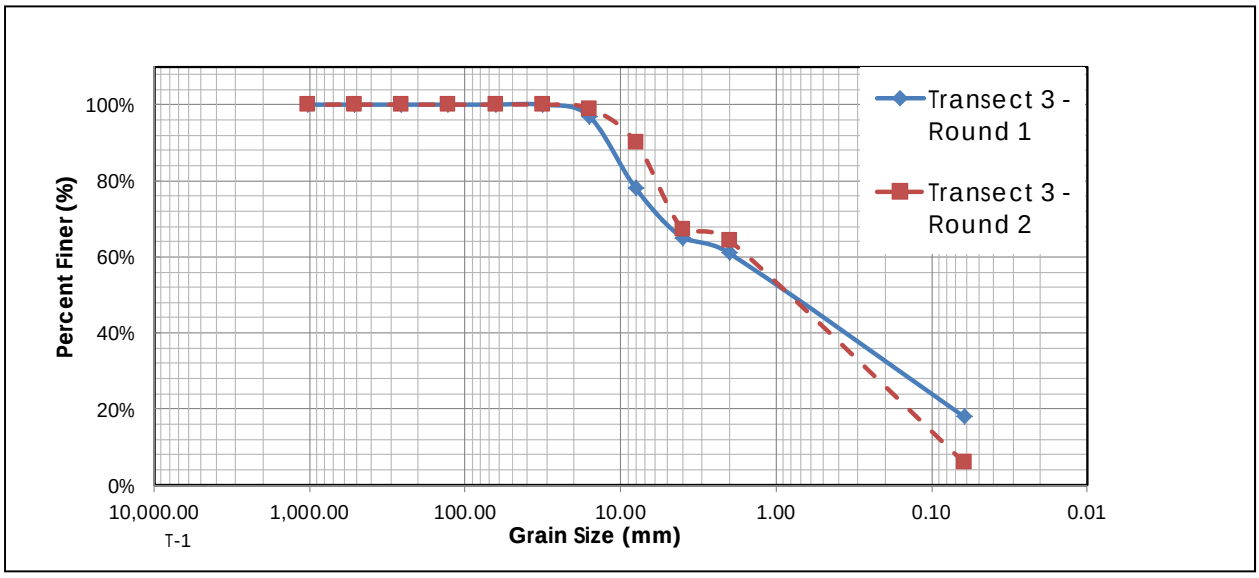

Figure C.13-3. Study site 08-T01 Transect 3 gradation curves.

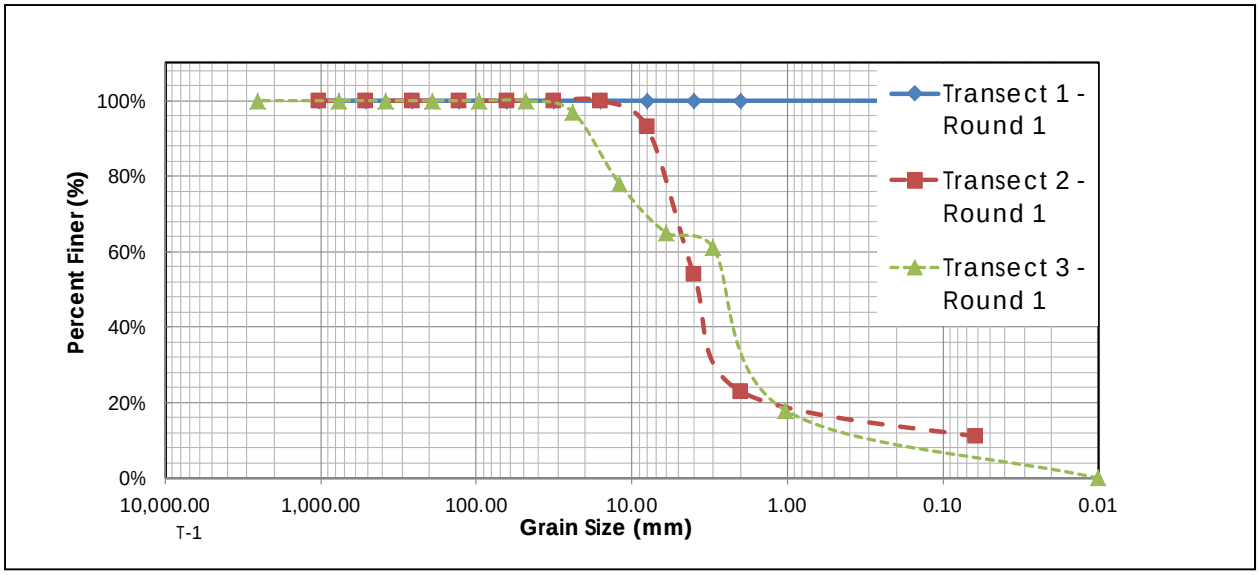

Figure C.13-4. Study site 08-T01 Transects 1, 2, and 3, Round 1 gradation curves.

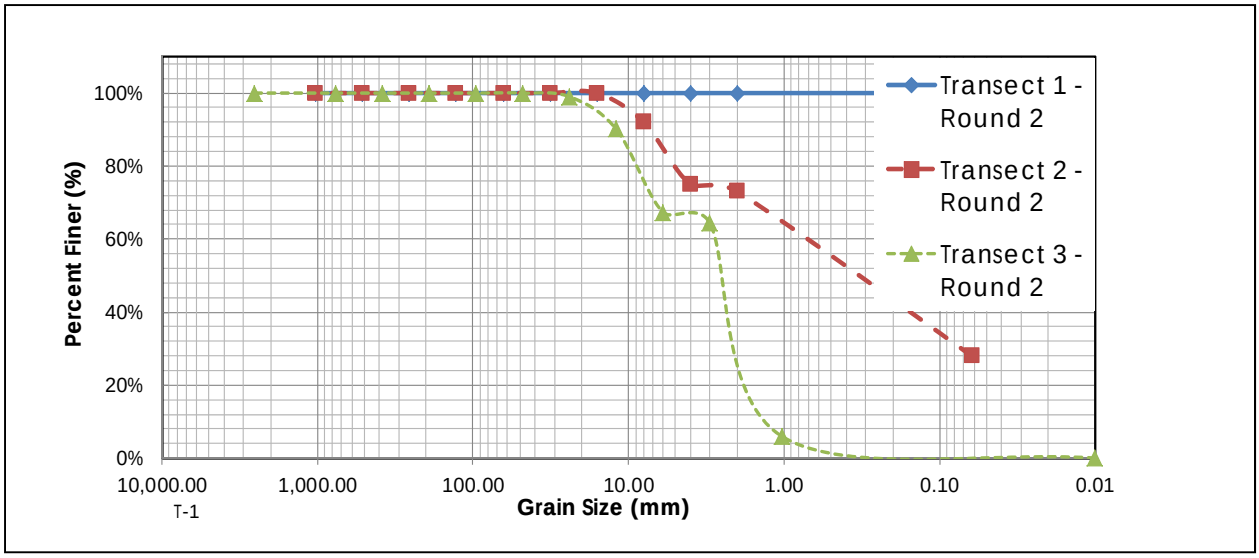

Figure C.13-5. Study site 08-T01 Transects 1, 2, and 3, Round 2 gradation curves.

Appendix C-14. Study Site 08-T02

Table C.14-1. Study site 08-T02 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%	0%	0%
Sand	Sand	0.062 - 2.0	0%	0%	65%	0%	0%	0%
Gravel	Very Fine	2-4	21%	10%	65%	42%	37%	23%
	Fine	4-8	21%	10%	66%	42%	39%	24%
	Medium	8-16	33%	12%	71%	46%	47%	26%
	Coarse	16-32	65%	29%	84%	55%	62%	41%
	Very Coarse	32-64	90%	63%	94%	87%	81%	60%
Cobble	Small	64-128	98%	93%	99%	97%	94%	85%
	Large	128-256	100%	99%	100%	100%	100%	95%
Boulder	Small	256-512	100%	100%	100%	100%	100%	98%
	Medium	512-1024	100%	100%	100%	100%	100%	100%
	Large - Very Large	1024-4096	100%	100%	100%	100%	100%	100%
Bedrock	Bedrock	-	100%	100%	100%	100%	100%	100%

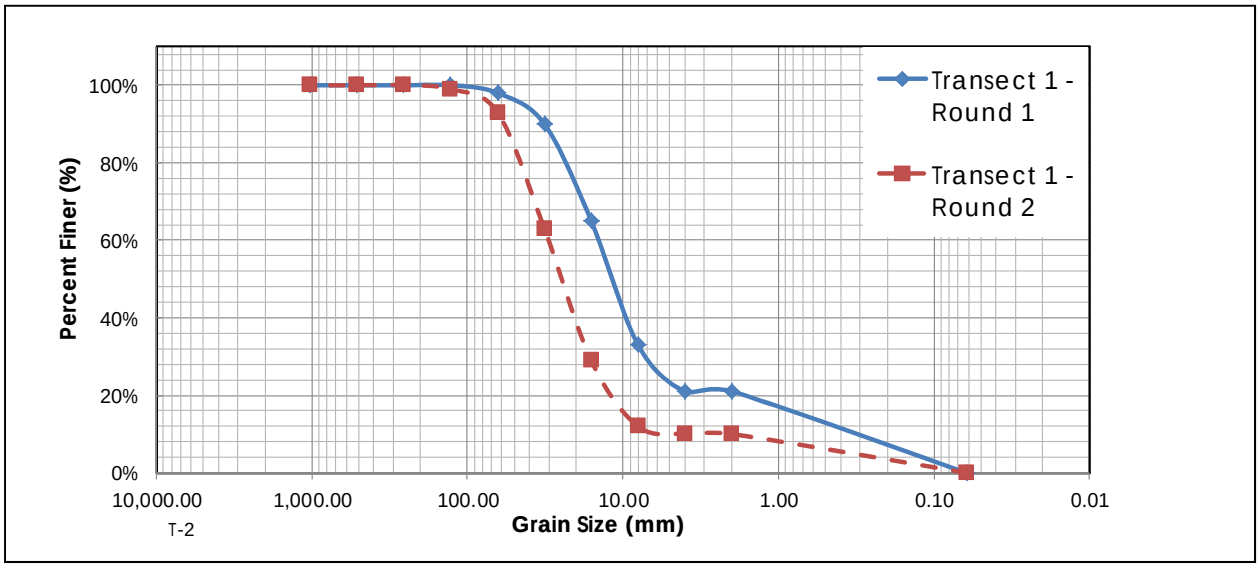

Figure C.14-1. Study site 08-T02 Transect 1 gradation curves.

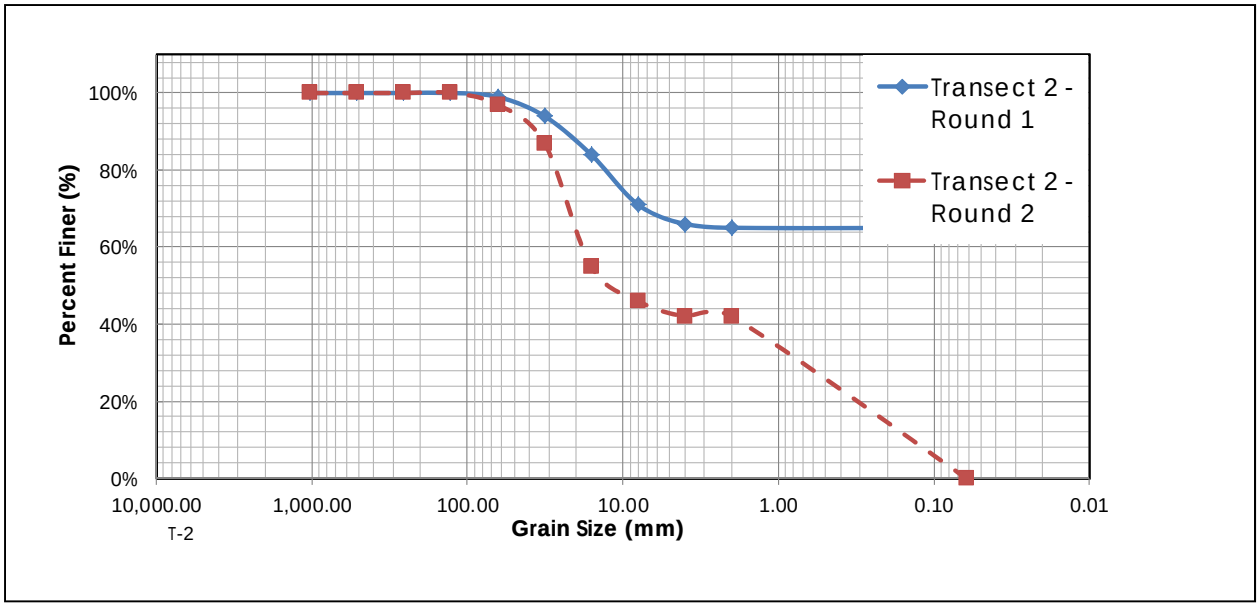

Figure C.14-2. Study site 08-T02 Transect 2 gradation curves.

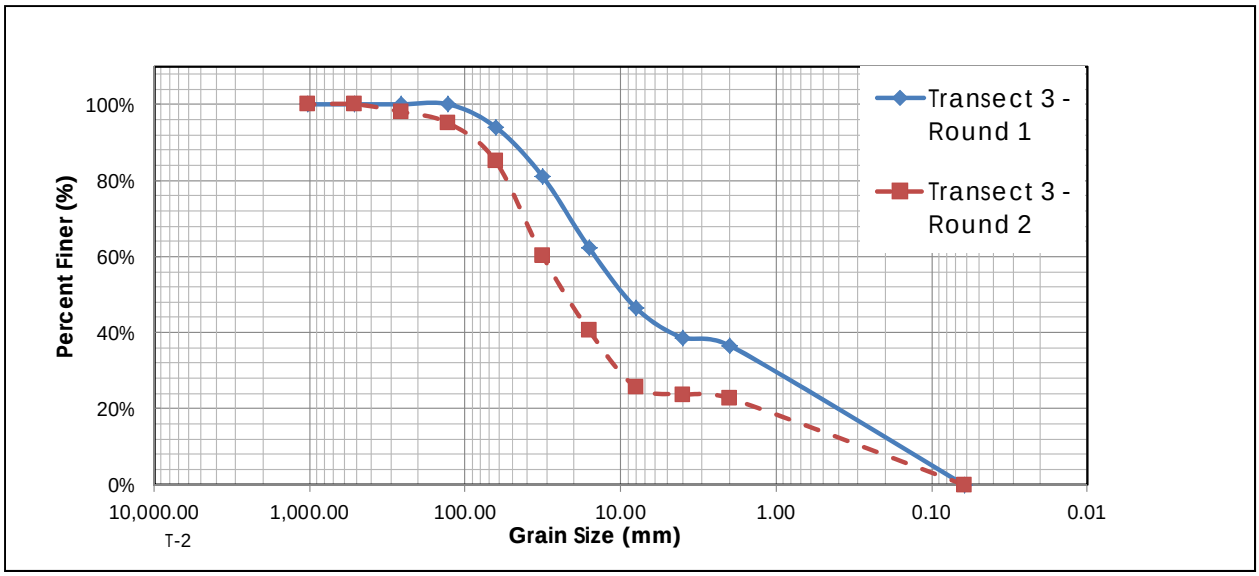

Figure C.14-3. Study site 08-T02 Transect 3 gradation curves.

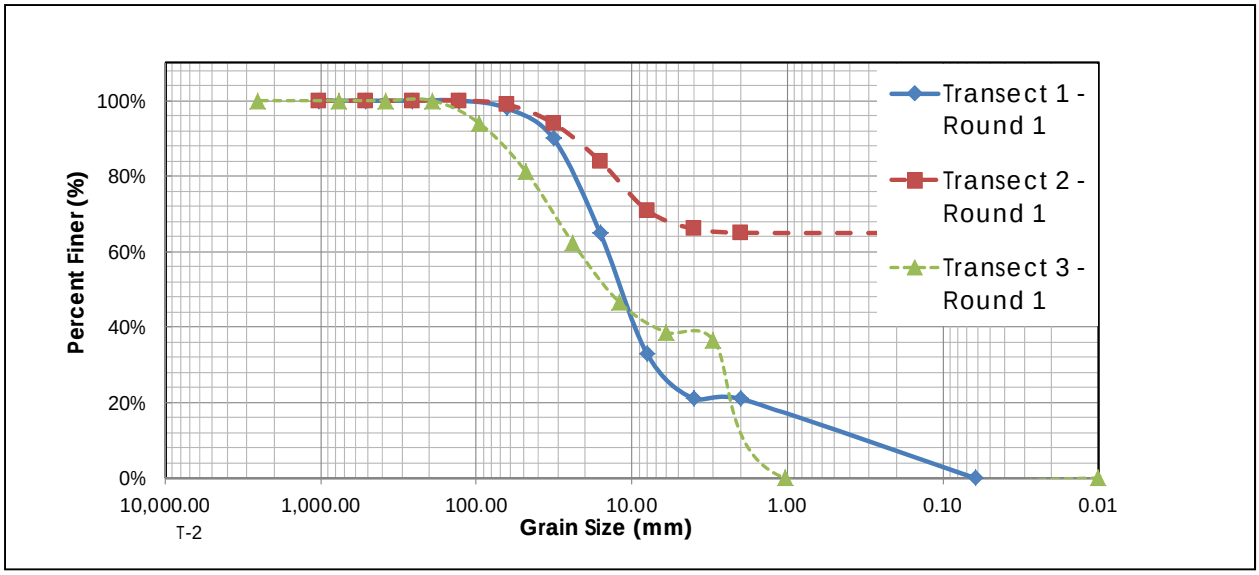

Figure C.14-4. Study site 08-T02 Transects 1, 2, and 3, Round 1 gradation curves.

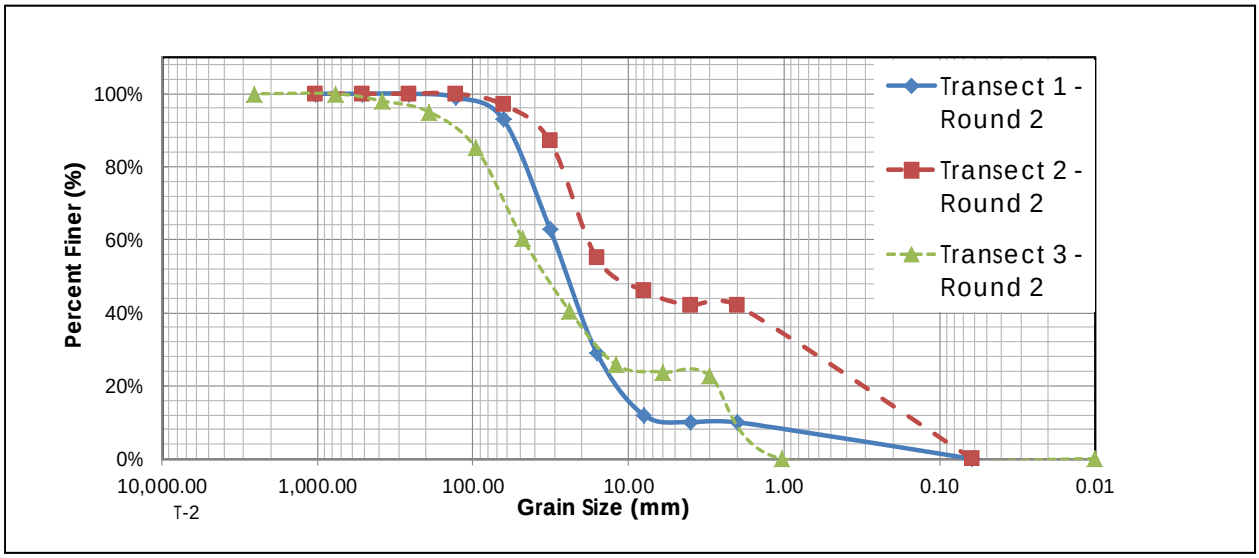

Figure C.14-5. Study site 08-T02 Transects 1, 2, and 3, Round 2 gradation curves.

Appendix C-15. Study Site 08-T04

Table C.15-1. Study site 08-T04 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%		
Sand	Sand	0.062 - 2.0	0%	2%	0%	2%		
Gravel	Very Fine	2-4	80%	63%	48%	41%		
	Fine	4-8	82%	71%	52%	46%		
	Medium	8-16	85%	86%	66%	56%		
	Coarse	16-32	91%	91%	78%	67%		
	Very Coarse	32-64	96%	96%	87%	81%		
Cobble	Small	64-128	99%	99%	95%	91%		
	Large	128-256	100%	100%	100%	99%		
Boulder	Small	256-512	100%	100%	100%	100%		
	Medium	512-1024	100%	100%	100%	100%		
	Large - Very Large	1024-4096	100%	100%	100%	100%		
Bedrock	Bedrock	-	100%	100%	100%	100%		

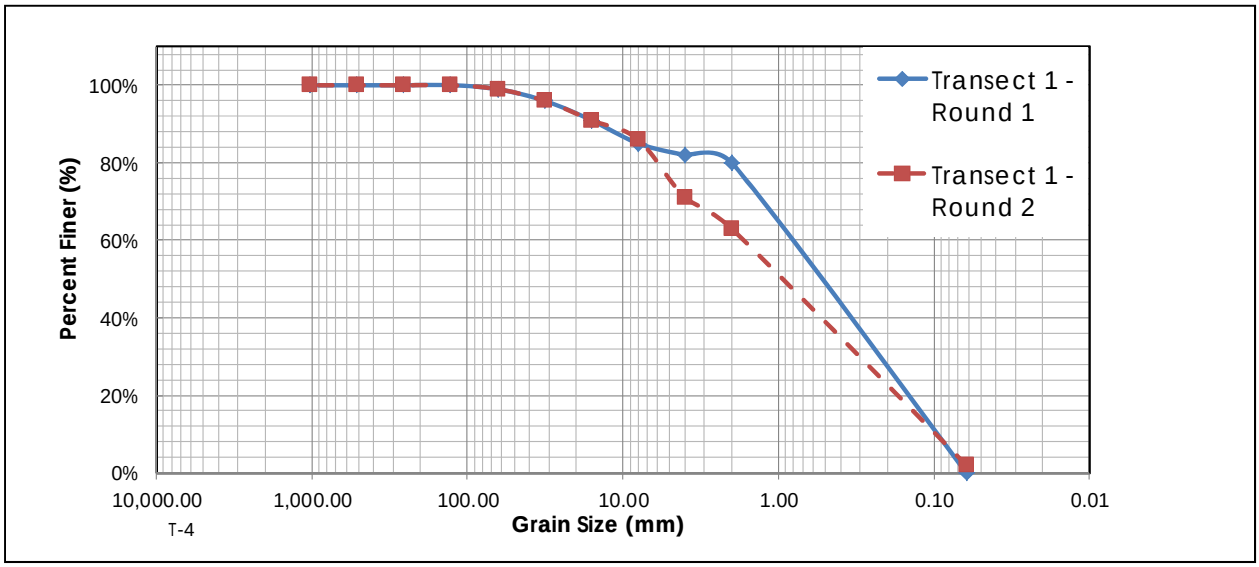

Figure C.15-1. Study site 08-T04 Transect 1 gradation curves.

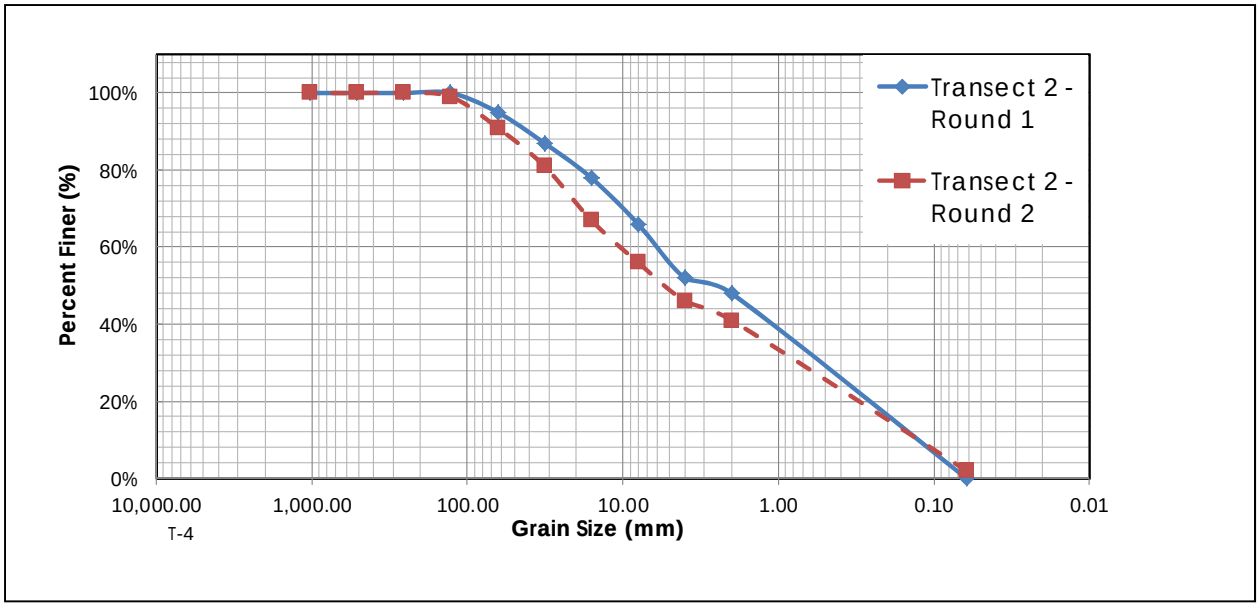

Figure C.15-2. Study site 08-T04 Transect 2 gradation curves.

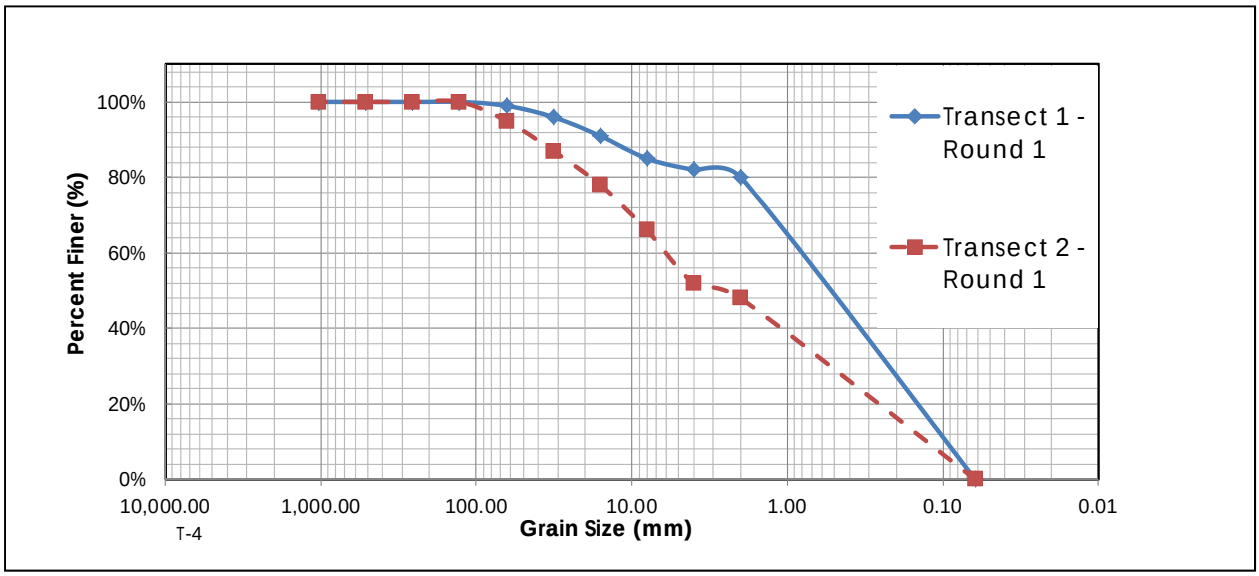

Figure C.15-3. Study site 08-T04 Transects 1 and 2, Round 1 gradation curves.

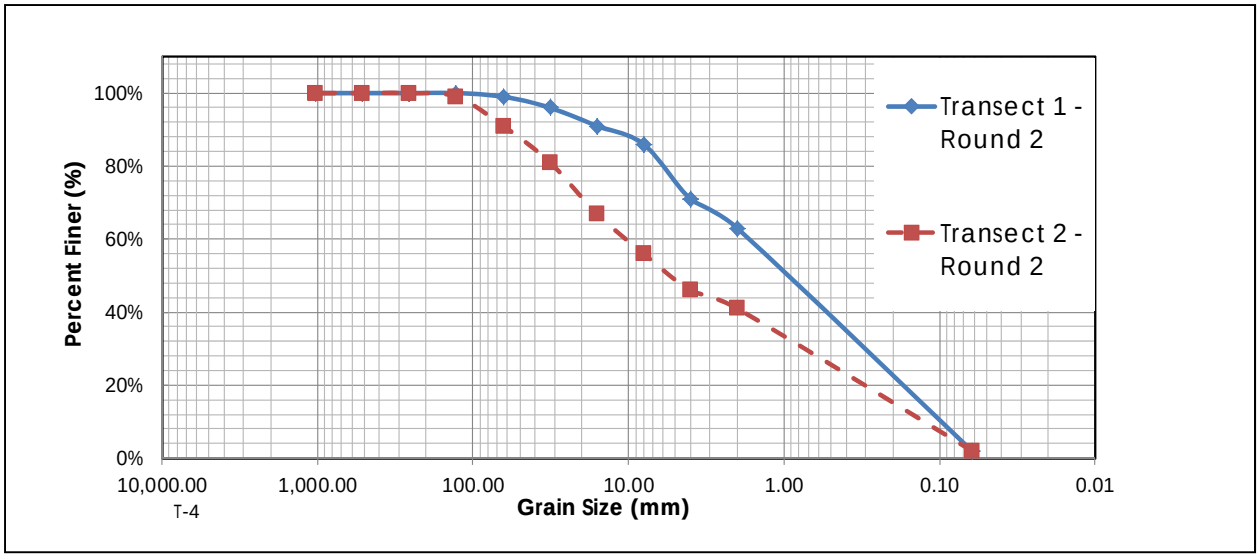

Figure C.15-4. Study site 08-T04 Transects 1 and 2, Round 2 gradation curves.

Appendix C-16. Study Site 08-T12

Table C.16-1. Study site 08-T12 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%		
Sand	Sand	0.062 - 2.0	0%	0%	0%	0%		
Gravel	Very Fine	2-4	21%	15%	12%	22%		
	Fine	4-8	21%	16%	12%	22%		
	Medium	8-16	22%	19%	14%	24%		
	Coarse	16-32	28%	27%	23%	29%		
	Very Coarse	32-64	62%	56%	42%	54%		
Cobble	Small	64-128	82%	87%	74%	83%		
	Large	128-256	94%	96%	96%	96%		
Boulder	Small	256-512	100%	100%	100%	100%		
	Medium	512-1024	100%	100%	100%	100%		
	Large - Very Large	1024-4096	100%	100%	100%	100%		
Bedrock	Bedrock	-	100%	100%	100%	100%		

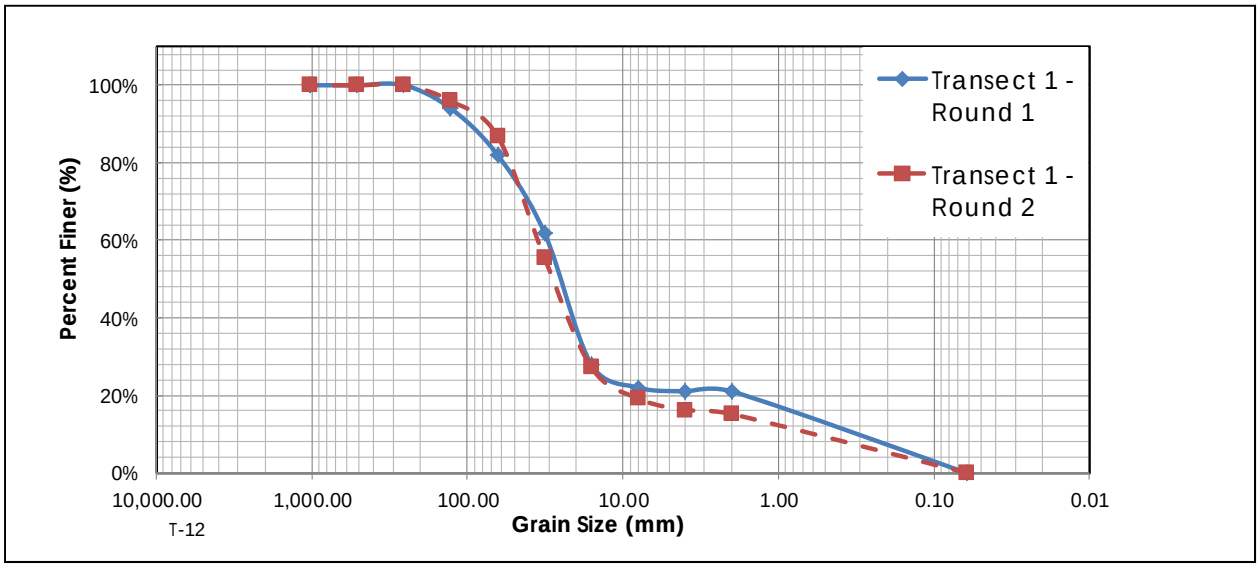

Figure C.16-1. Study site 08-T12 Transect 1 gradation curves.

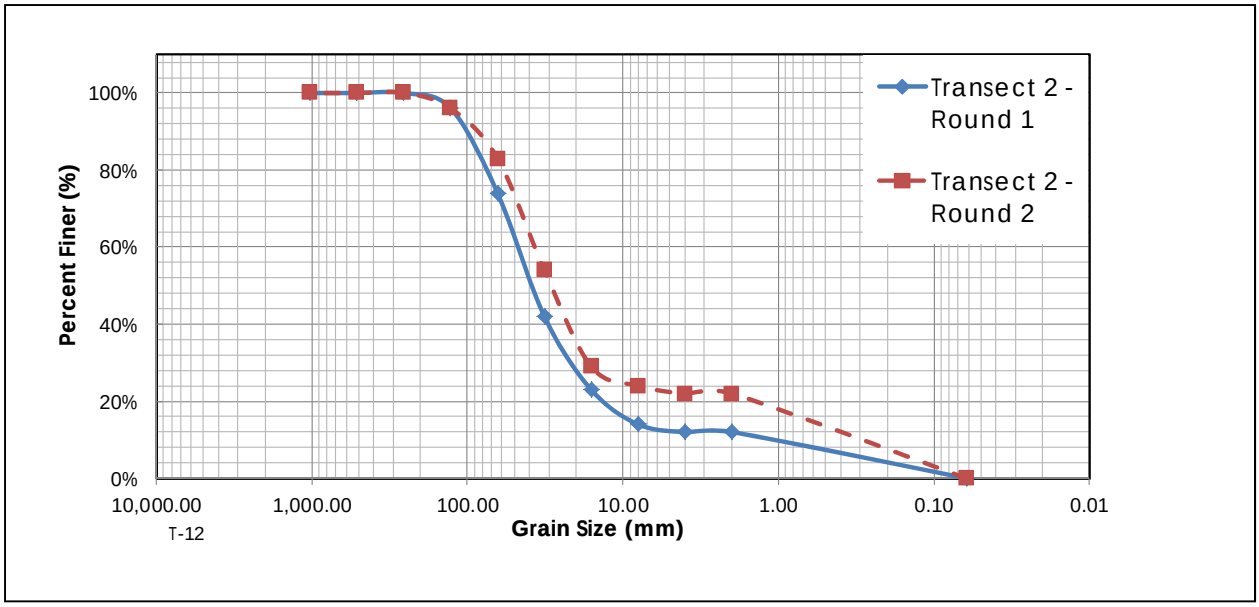

Figure C.16-2. Study site 08- T12 Transect 2 gradation curves.

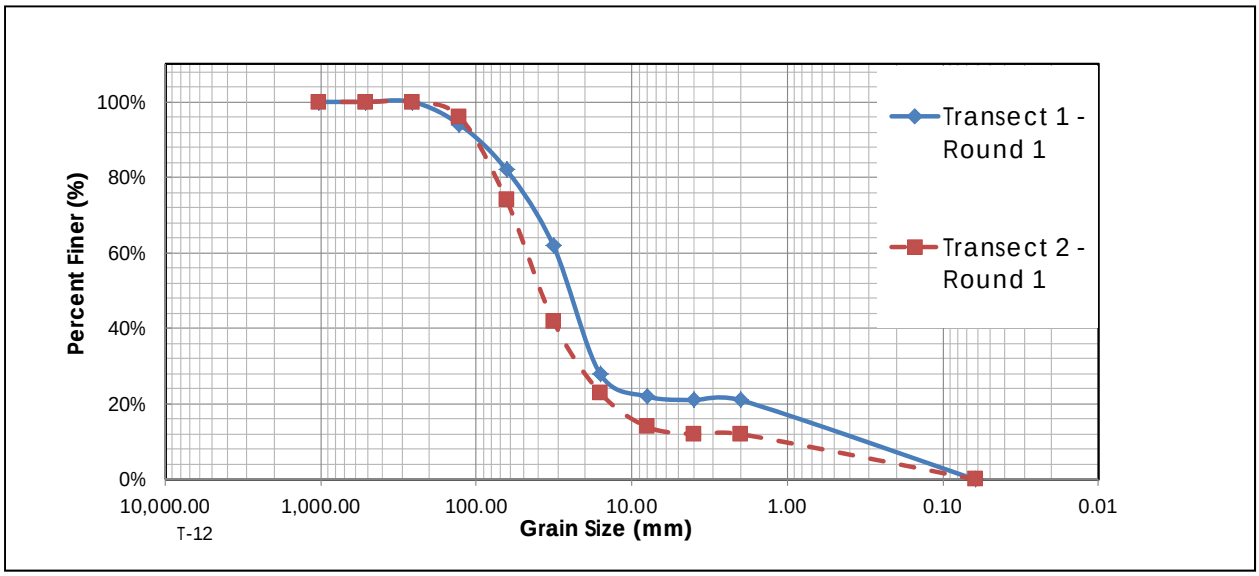

Figure C.16-3. Study site 08- T12 Transects 1 and 2, Round 1 gradation curves.

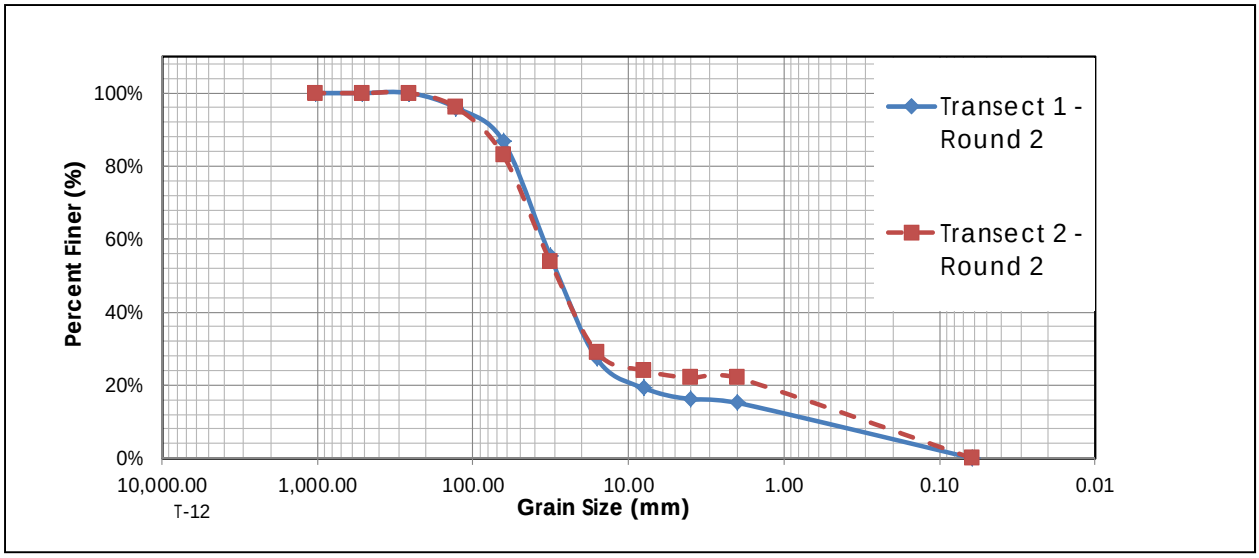

Figure C.16-4. Study site 08- T12 Transects 1 and 2, Round 2 gradation curves.

Appendix C-17. Study Site 08-T14

Table C.17-1. Study site 08-T14 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%	0%	0%
Sand	Sand	0.062 - 2.0	0%	0%	0%	0%	0%	0%
Gravel	Very Fine	2-4	4%	5%	15%	15%	17%	19%
	Fine	4-8	4%	5%	18%	16%	19%	19%
	Medium	8-16	5%	6%	20%	16%	25%	21%
	Coarse	16-32	8%	9%	24%	16%	50%	34%
	Very Coarse	32-64	13%	15%	34%	23%	71%	57%
Cobble	Small	64-128	37%	39%	65%	46%	89%	82%
	Large	128-256	87%	77%	95%	86%	99%	100%
Boulder	Small	256-512	96%	98%	100%	100%	100%	100%
	Medium	512-1024	100%	100%	100%	100%	100%	100%
	Large - Very Large	1024-4096	100%	100%	100%	100%	100%	100%
Bedrock	Bedrock	-	100%	100%	100%	100%	100%	100%

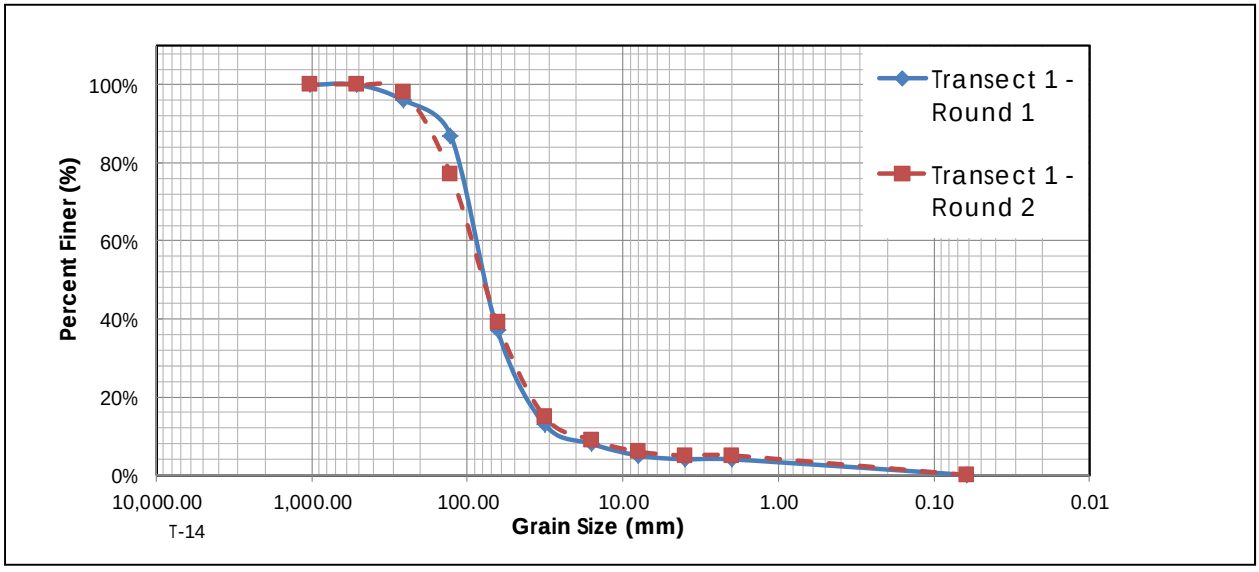

Figure C.17-1. Study site 08-T14 Transect 1 gradation curves.

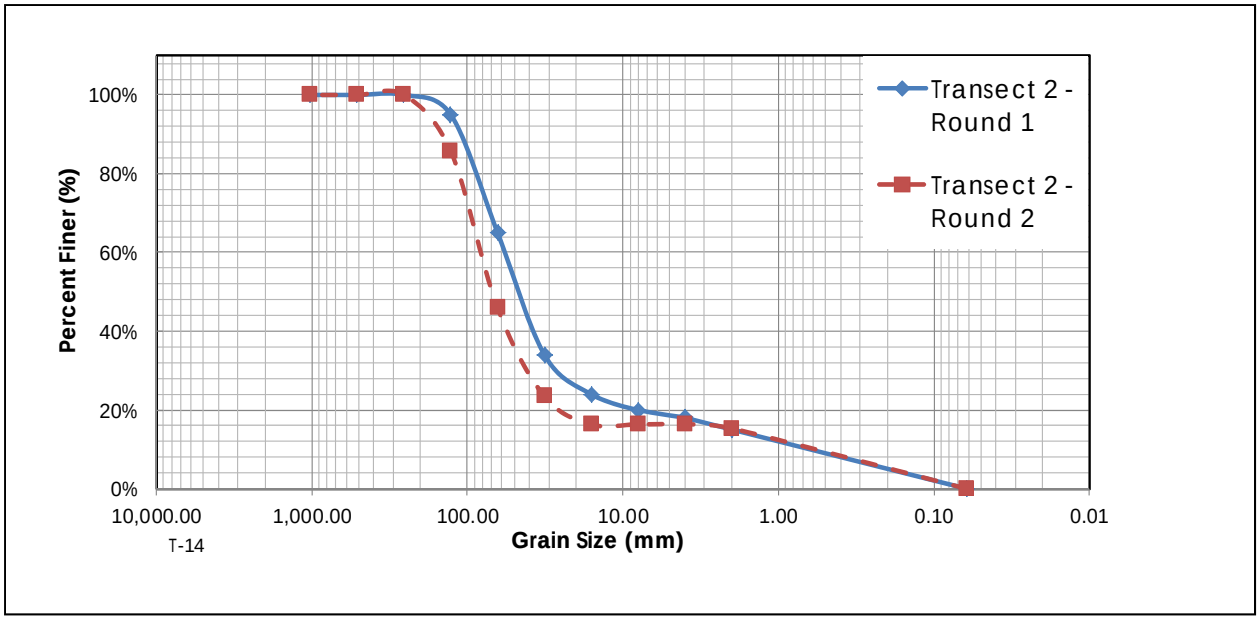

Figure C.17-2. Study site 08-T14 Transect 2 gradation curves.

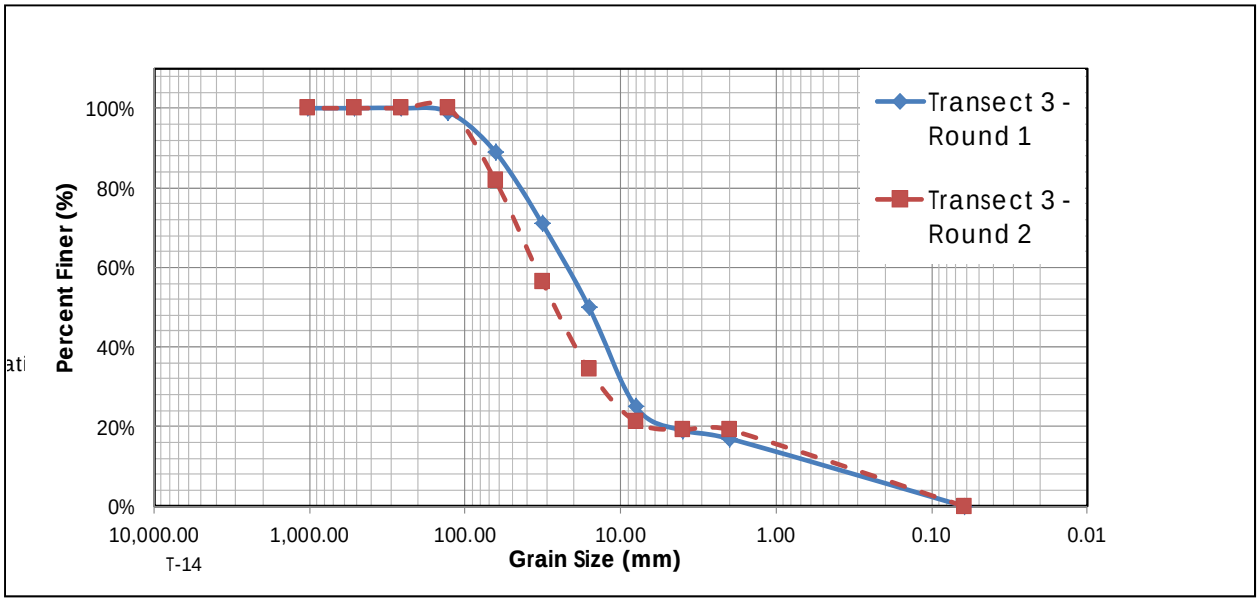

Figure C.17-3. Study site 08-T14 Transect 3 gradation curves.

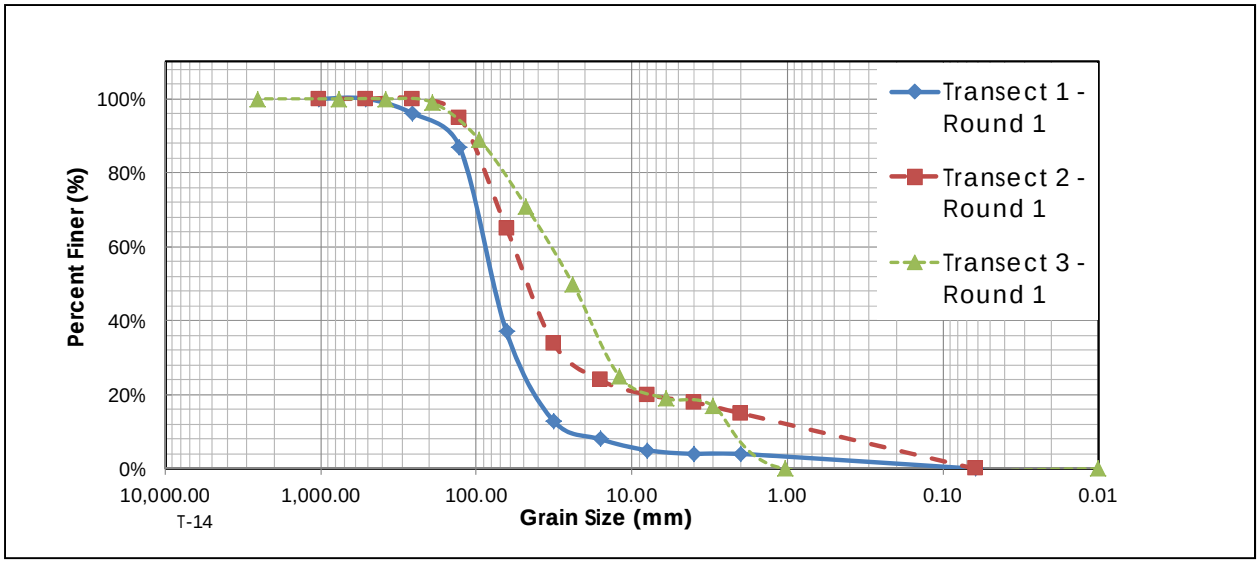

Figure C.17-4. Study site 08-T14 Transects 1, 2, and 3, Round 1 gradation curves.

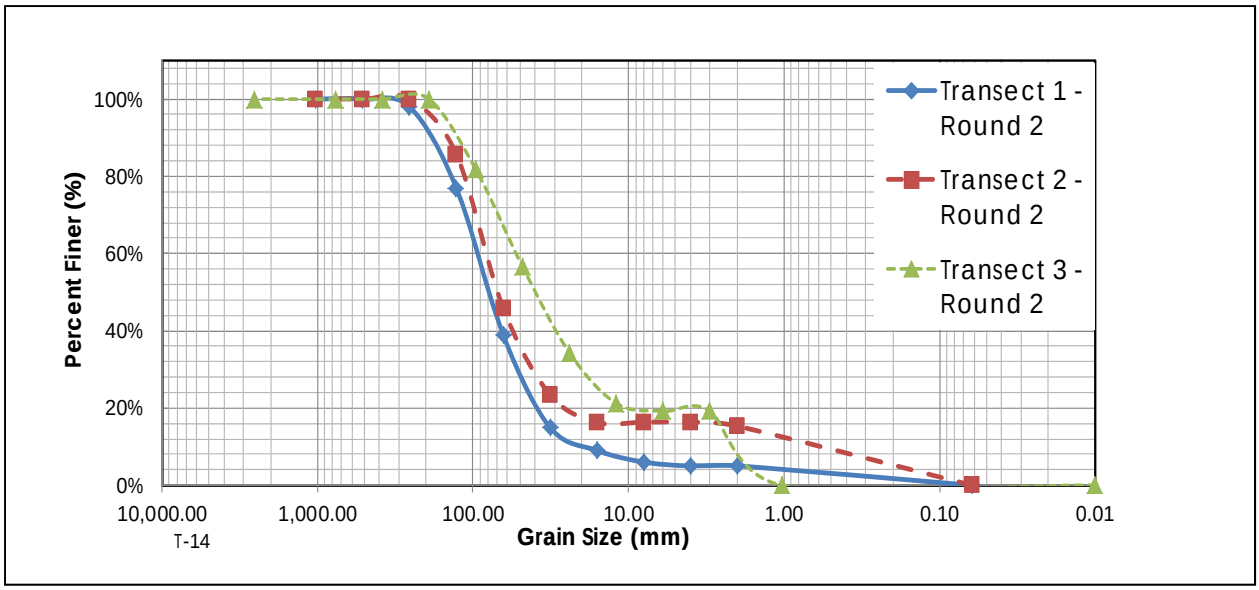

Figure C.17-5. Study site 08-T14 Transects 1, 2, and 3, Round 2 gradation curves.

Appendix C-18. Study Site 08-T16

Table C.18-1. Study site 08-T16 particle size distribution.

PERCENT FINER (By Transect)								
Wentworth Size Class		Size range (mm)	TRANSECT 1		TRANSECT 2		TRANSECT 3	
			Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Silt/Clay	Silt/Clay	<0.062	0%	0%	0%	0%	0%	0%
Sand	Sand	0.062 - 2.0	0%	0%	0%	0%	1%	0%
Gravel	Very Fine	2-4	0%	2%	2%	1%	15%	50%
	Fine	4-8	0%	4%	3%	1%	16%	54%
	Medium	8-16	2%	6%	8%	3%	24%	60%
	Coarse	16-32	8%	12%	16%	10%	50%	68%
	Very Coarse	32-64	39%	29%	31%	26%	75%	83%
Cobble	Small	64-128	79%	69%	55%	54%	96%	95%
	Large	128-256	96%	93%	89%	82%	98%	99%
Boulder	Small	256-512	100%	98%	100%	99%	100%	100%
	Medium	512-1024	100%	100%	100%	100%	100%	100%
	Large - Very Large	1024-4096	100%	100%	100%	100%	100%	100%
Bedrock	Bedrock	-	100%	100%	100%	100%	100%	100%

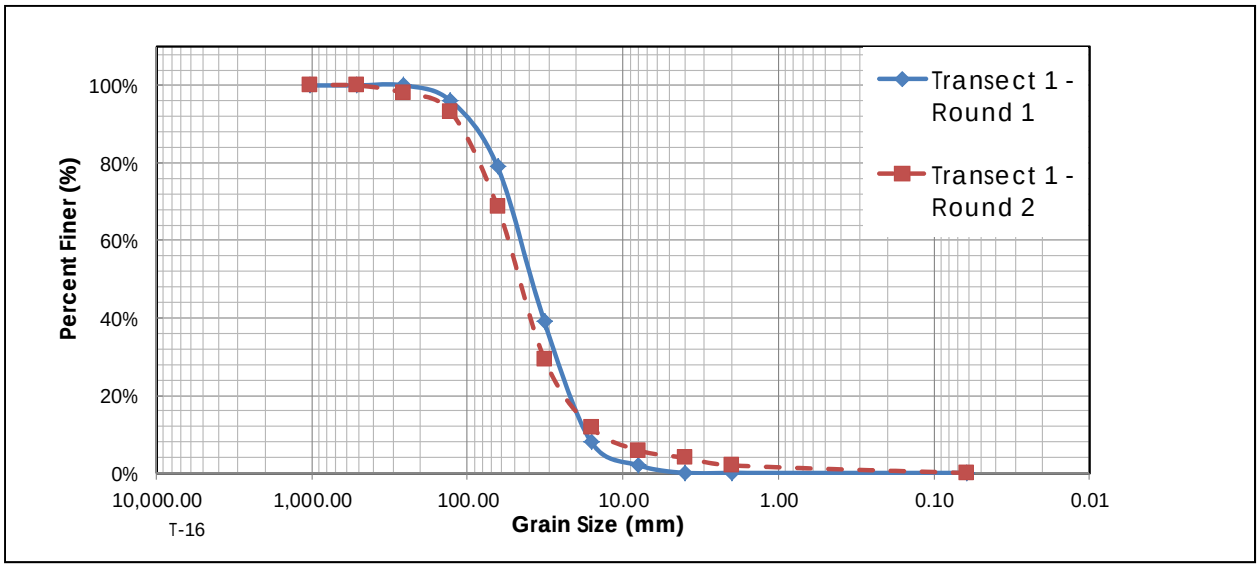

Figure C.18-1. Study site 08-T16 Transect 1 gradation curves.

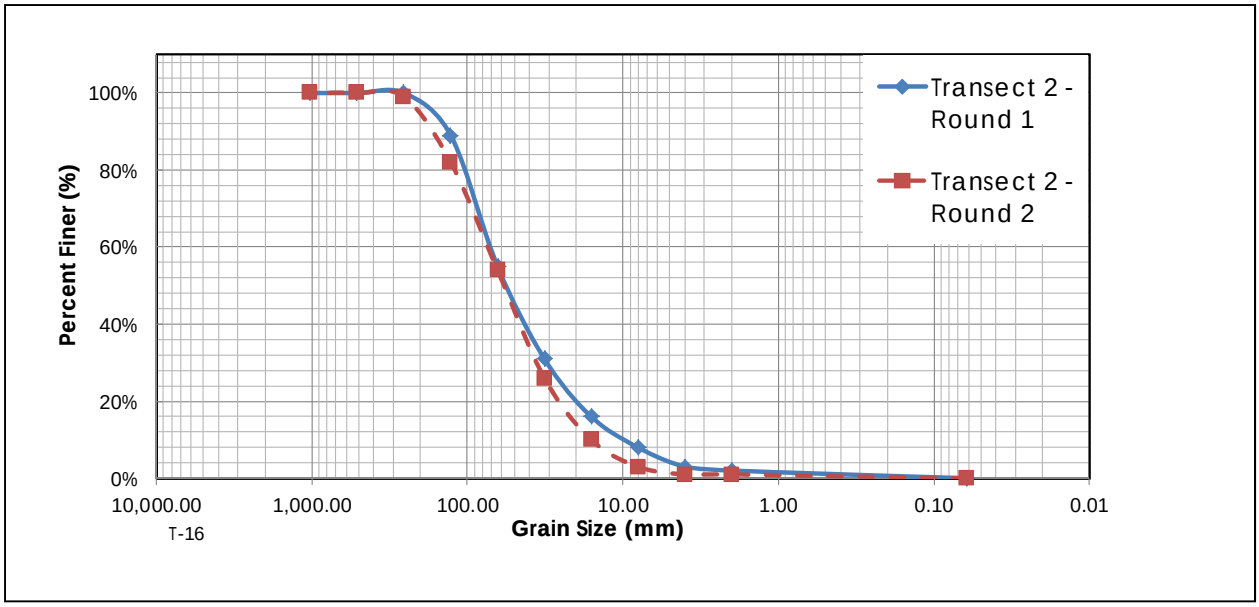

Figure C.18-2. Study site 08-T16 Transect 2 gradation curves.

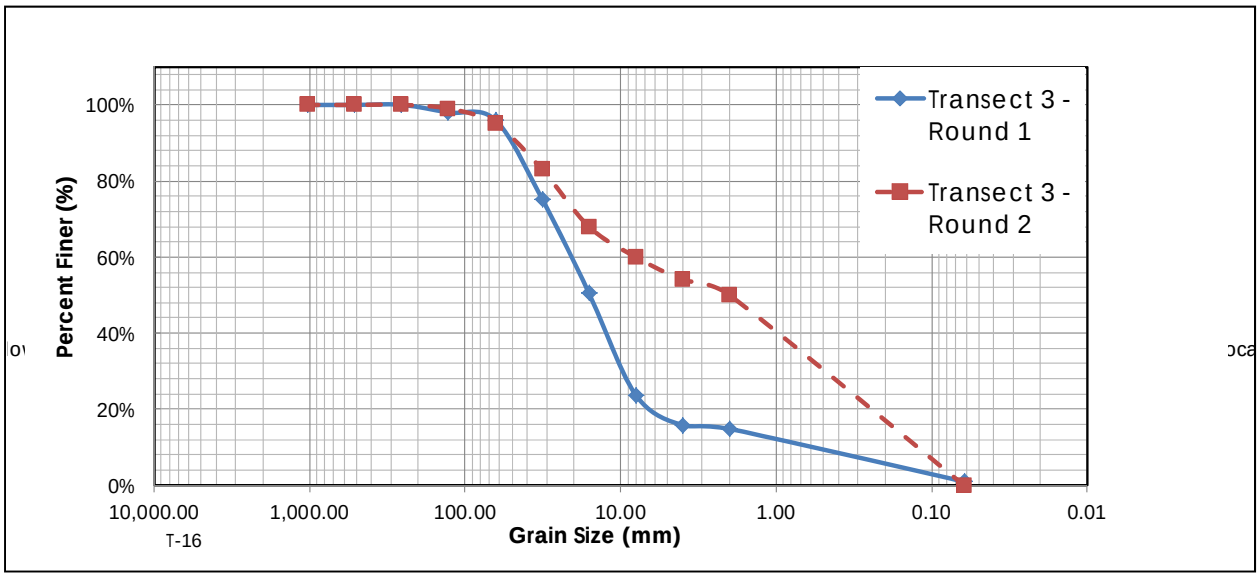

Figure C.18-3. Study site 08-T16 Transect 3 gradation curves.

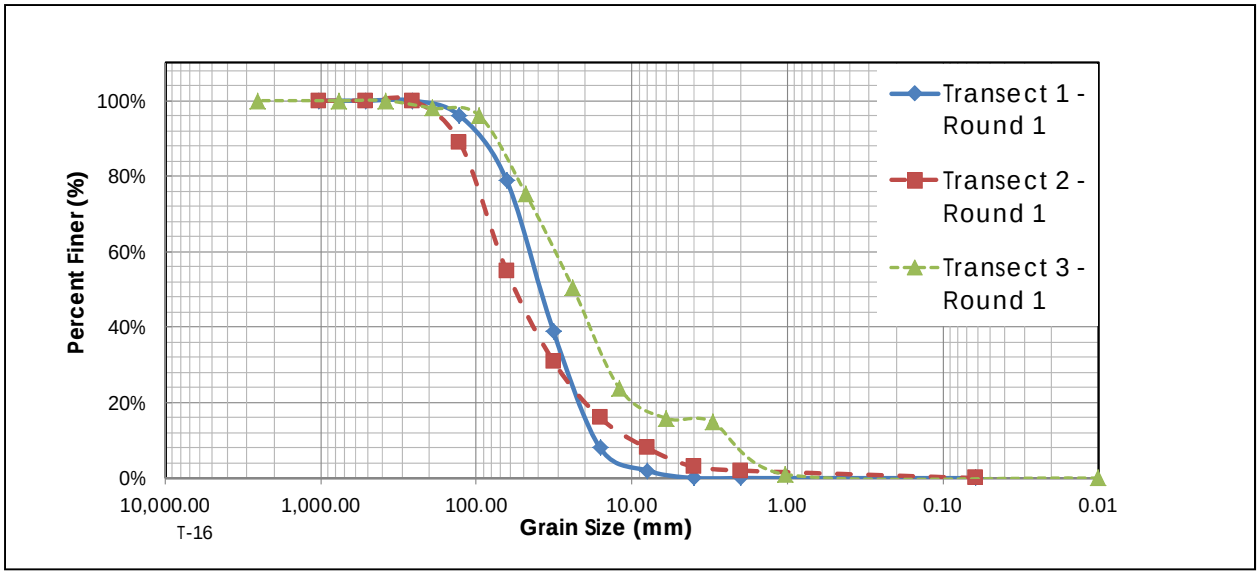

Figure C.18-4. Study site 08-T16 Transects 1, 2, and 3, Round 1 gradation curves.

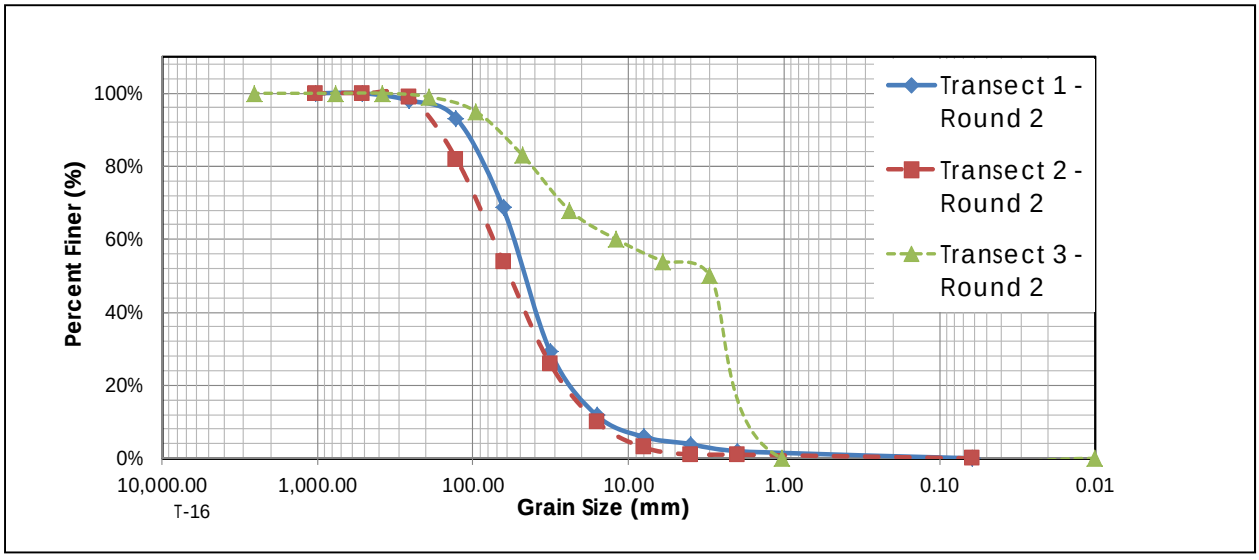

Figure C.18-5. Study site 08-T16 Transects 1, 2, and 3, Round 2 gradation curves.

Appendix D

Field Data Form

STUDY 8 DATA FORM

Study Site # _____

Field Staff: _____ **Date:** _____

PEBBLE COUNT (Tally By Transect)									
Wentworth Size Class		**Size range** (mm)	**Transect**						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Silt/Clay	Silt/Clay	>0.062							
Sand	Sand	0.062 - 2.0							
Gravel	Very Fine	2-4							
	Fine	4-8							
	Medium	8-16							
	Coarse	16-32							
	Very Coarse	32-64							
Cobble	Small	64-128							
	Large	128-256							
Boulder	Small	256-512							
	Medium	512-1024							
	Large - Very large	1024-4096							
Bedrock	Bedrock	-							
		Notes:							

NOTES:

STUDY 8 DATA FORM

Study Site # _____

EMBEDDEDNESS (% by Transect Station and Total Visual Estimate)

Transect Station	Transect						Notes
	1	2	3	4	5	6	
1	-	-	-	-	-	-	
10							
20							
30							
40							
50							
60							
70							
80							
90							
100							
Visual Estimate:							

Instructions: Embeddedness is defined as the fraction of a gravel/cobble/boulder particle surface that is surrounded by (embedded in) sand or finer sediments. Embeddeness is not evaluated for sand and finer particles. Evaluate embeddeness at every 10th pebble count sample point along pebble count transects. At each sample point, evaluate particles in a 10-cm-diameter circle surrounding the sampling point. For each

EPA "Condition Category":	N/A	Poor	Marginal	Suboptimal	Optimal
Embeddedness Score:	N/A	1-5	6-10	11-15	16-20
% Embeddedness:	100%	>75%	75-50%	50-25%	25-0%
Description:	Substrate characterized by lack of gravel, cobble, boulder material.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.

SITE SKETCH

Include: north arrow, major landmarks, study site boundaries, transect / plot locations, and photopoint locations.

NOTES: