



# WHRP

## Wisconsin Department of Transportation Wisconsin Highway Research Program

### Request for Proposal

### *Weight-Volume Relationships and Conversion Factors for Soils and Aggregates of Wisconsin*

Questions submitted to [research@dot.wi.gov](mailto:research@dot.wi.gov) regarding the content of this RFP are due no later than 04:30 PM (CST) on January 4, 2021

Responses to questions will be posted to the WisDOT Research and Library website <https://wisconsindot.gov/Pages/about-wisdot/research/researchers.aspx> by 04:30 PM (CST) by January 15, 2021

Proposers must submit a PDF version of their proposal by 4:30 PM (CST) by February 5, 2021 to: [research@dot.wi.gov](mailto:research@dot.wi.gov).

Proposal Preparation Guidelines can be found at: [Proposal Preparation Guidelines](#)

Researchers will be notified of the proposal review decision by April 30, 2021

For more information regarding this RFP contact the WisDOT Research Program at: [research@dot.wi.gov](mailto:research@dot.wi.gov)

This RFP has been posted to the Internet at: <https://wisconsindot.gov/Pages/about-wisdot/research/researchers.aspx>



**Wisconsin Highway Research Program  
Geotechnical Technical Oversight Committee  
Request for Proposals for**

***Weight-Volume Relationships and Conversion Factors for Soils and Aggregates  
of Wisconsin***

**I. Background and Problem Statement**

The need to convert between weight and volume for soils and aggregates is a common problem for geotechnical engineers. This is often needed for earthwork computations, pavement design, material quantity estimates, etc. Most values used for these purposes are based on engineering judgement or from general published values found in literature. General values cover a wide range for like materials found across large geographical areas. A literature search revealed that there is a lack of specific information for weight-volume relationships and conversion factors for the soil and aggregate types found in Wisconsin.

**II. Objectives**

This research project will involve sampling and testing of a variety of soil and aggregate types in Wisconsin including recycled materials. Typical weight-volume relationships for these common construction materials will be developed. The researcher will also be asked to look for correlations between weight-volume relationships and commonly measured properties of soils to reduce the need for complex testing when determining weight-volume relationships. The researcher will be expected to differentiate between natural and processed materials, and determine in-situ unit weights of natural soils and compacted unit weights of in-situ and processed materials.

**III. Scope of Work**

**Task 1: Literature Review**

The researcher will perform a comprehensive literature review regarding the relationships between weight and volume of soils and aggregates. This will include surveying other state DOTs to determine what standard relationships they use for converting between weight and volume. The researcher should also evaluate methods and correlations for determining unit weights of larger materials such as rip-rap.

**Task 2: Sampling and testing**

The researcher will collect samples of various materials from each of the five WisDOT regions covering a wide range of material types across various geographical and geological areas of the state. Laboratory testing of the collected soil samples at a minimum should consist of performing common tests, such as Proctors, gradations,



moisture content testing and any other tests that have shown good relationships between weight-volume conversions along with any methods identified in Task 1. The in-place (bank) density should be measured on natural soils.

### **Task 3: Developing weight to volume conversion factors**

Based on the information obtained from Tasks 1 and 2 the researcher should develop weight-volume relationships and conversion factors for the following materials commonly used by WisDOT:

- a. Granular Backfill – Grade 1 and Grade 2 – (WisDOT Standard Specification) Section 209
- b. Structure Backfill – Section 210
- c. Dense Graded Base – 3 inch, 1 ¼ inch and ¾ inch – Section 305
- d. Open Graded Base – Section 310
- e. Breaker Run – Section 311
- f. Select Crushed Material – Section 312
- g. Pit Run – Section 313
- h. Reclaimed Asphalt – Section 305
- i. Crushed Concrete for Dense Graded Base – Section 305
- j. Riprap – Section 606
- k. Common Excavation Soils such as clays, silts, sand, gravels, and various combinations – Section 205

### **Task 4: Final Report**

The research team will prepare and submit a draft final report that will include project background, data analysis, interpretation and recommendations for weight to volume conversion factors. As part of this report, the research team will include Excel files with curated testing data for future use, analysis and interpretation.

*Note- The selected research team will negotiate a contract that will include a Data Management Plan (DMP) documenting all field/laboratory data and analyses to ensure accessibility and transparency of research data as required by the USDOT per the Public Access Plan (<https://ntl.bts.gov/public-access/creating-data-management-plans-extramural-research>). The DMP will include the following items:*

- *The final research data to be produced during the project;*
- *The standards to be used for data and metadata format and content;*
- *Policies for access and sharing the final research data, including provisions for appropriate protection of privacy, confidentiality, security, intellectual property and other rights or requirements;*
- *Policies and provisions for re-use, re-distribution and the production of derivatives; and*
- *Plans for archiving final research data and other research products, and for preservation of access to them.*

*A Data Management Plan is not required as part of the proposal submission.*



#### **Task 5: Closeout Presentation**

A closeout presentation (COP) will be scheduled by the WHRP in Madison, WI within three months before the end of the contract. At least one representative from the research team is expected to present in-person the results and recommendations from the project.

#### **IV. Required Testing**

At a minimum the following laboratory tests should be performed on the collected soil samples where applicable.

- A.** AASHTO T-99 – Standard Proctor
- B.** AASHTO T-27 – Gradation Testing
- C.** AASHTO T-265 – Moisture Content
- D.** AASHTO T-11 – P200
- E.** AASHTO T-89 – Liquid Limit
- F.** AASHTO T-90 – Plastic Limit
- G.** AASHTO T-236 – Direct Shear

#### **V. WisDOT/TOC Contribution**

WisDOT will provide the following support through the Project Oversight Committee (POC) to support the successful completion of the project:

- A.** Work will be conducted with project oversight by the WisDOT Bureau of Technical Services/Bureau of Structures and WHRP Geotechnics Technical Oversight Committee (TOC).
- B.** The research team will not assume the availability of WisDOT staff or equipment in the proposal. If WisDOT or another entity donates equipment or staff time, a letter of commitment must be included in the proposal.
- C.** WisDOT staff/TOC members can be expected to contribute a maximum of 40 hours over the duration of the project.
- D.** The TOC and POC will coordinate access to applicable/available soil boring logs and project cross sections.
- E.** If field work on or around in-service facilities is anticipated to conduct this research then the researcher shall specify in the proposal the nature and extent of traffic control that will be required for this project including: traffic flagging, signage, barricades, etc., as well as the duration needed (hours/day/location).
- F.** There also needs to be a discussion in the proposal of the specific traffic control support that is being requested from WisDOT. The researcher will need to coordinate the location of the project field work with the POC chair, WisDOT regional personnel and possibly the county personnel. The researcher should make accommodations in their proposal budget for traffic control and should not assume WisDOT will fund traffic control expenses.

#### **VI. Required Travel**

- A.** Travel is required for sampling/testing.
- B.** This project will require travel to Madison, WI to deliver the Close-Out



Presentation.

## **VII. Deliverables**

### **A. Quarterly Progress Reports**

- a. WHRP contracts require quarterly technical progress reports that serve both technical and administrative functions.
- b. Detailed information regarding the content of the progress report can be found at: [Quarterly Progress Reports Guidelines](#)

### **B. Invoices**

- a. Invoices shall be submitted quarterly for partial payments on the project for authorized services completed to date. Invoices may be submitted four times per year, one partial invoice for each specified quarter.
- b. Detailed information regarding invoicing can be found at: [Invoicing Requirements](#)

### **C. Before Close-Out Presentation Report**

- a. A Before Close-Out Presentation report is required to be submitted three months before the contract end date to allow time for review, revision and scheduling of the project Close-Out Presentation.
- b. Reports are expected to have quality technical writing and proper grammar. It is acceptable to dedicate resources from your project for the services of a technical editor to ensure these requirements are met.
- c. The required elements of the Before Close-Out Presentation report can be found at: [Before Close-Out Presentation Requirements](#)

### **D. Project Close-Out Presentation**

- a. The Principal Investigator on the research team is required to give a presentation to the Technical Oversight Committee in-person.
- b. Presentation and formatting requirements can be found at: [Close-Out Presentation Requirements](#)

### **E. After Close-Out Presentation Report**

- a. The After Close-Out Presentation Report is due within three weeks of the Close-Out Presentation for review and comments.
- b. This report details the results of the research project. The final report should be as concise as possible (e.g., a maximum of 50 pages plus supporting appendices) and follow the report guidelines and submission requirements: [After Close-Out Presentation Report Requirements](#)
- c. After revision(s) and oversight committee chair approval, an electronic copy of the Publication-Ready Report must be delivered to WisDOT by the contract end date.
- d. Excel files with curated testing data for future use, analysis and interpretation.

## **VIII. Schedule and Budget**

- A. Project budget shall not exceed \$125,000. Matching funds will not be considered in the proposal evaluation process.



**B.** Proposed project duration is 18 months starting around October 1, 2021.

**IX. Implementation**

**A.** Update WisDOT Manuals including the Facilities Development Manual (earthwork computations) and Geotechnical Manual (expansion/shrinkage factors).

**B.** The research team should discuss the access and storage of completed project data and analyses in a brief data management plan.