

# **Recycled Material Network: Connecting Consumers and Producers**

## **Phase II: Upgrades and Maintenance**

Prepared for the

Recycled Materials Resource Center

by

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<p><b>16. Abstract:</b> An online Geographic Information System (GIS) web application that connects producers and consumers of recyclable material was developed in Phase I of this research project to assist engineers and contractors in the beneficial reuse of recycled materials. Phase II of this project focused on Upgrades and Maintenance of the Recycled Material Network website. The upgrades included the addition of two new layers: recycled products and approved materials, as well as a tool to check hyperlinks and the addition of new data. The Recycled Material Network website is comprised of six layers: producers/facilities, stockpiles, case studies, recycled products, approved materials, and specifications/regulations. Producers of recycled material can locate their facility and enter contact information. The producers/facilities layer is populated with over 160 facilities. The stockpile layer, connected to the facility layer, allows producers to add or update information about their recycled material stockpiles. The case study layer locates projects that utilized recycled materials and includes information regarding the material type, application, volume data, and any additional documentation. A total of 40 case studies are included on the Recycled Material Network website. The new recycled products layer has over 150 transportation products that contain at least 50% recycled material content. These products are divided into categories such as barricades or signs and each product list company contact information as well as the type and percentage of recycled material used. The new approved material layer contains over 350 recycled materials that have been approved by state DOTs for use in transportation applications. These materials can be searched by approving state, material, and application. Each approved material is associated with a manufacturer and contact information. The specification layer now includes both Department of Transportation (DOT) specifications and environmental regulations for 23 states. A methodology for a nationwide comparison of state specifications was developed and tested on three recycled material-application combinations. As potential consumers of recycled material, engineers and contractors can pinpoint the location of a construction project, search for sources and quantities of recycled material that meet project specifications, and contact material producers. The Recycled Material Network provides key information that engineers and contractors need to successfully utilize recycled materials, thereby preserving limited natural resources and benefiting the project and society as a whole. The web map is available at <a href="http://rmwm.caps.ua.edu">http://rmwm.caps.ua.edu</a>.</p>			
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## Executive Summary

An online Geographic Information System (GIS) web application that connects producers and consumers of recyclable material was developed in Phase I of this research project to assist engineers and contractors in the beneficial reuse of recycled materials in transportation projects. Phase II of this project focused on Upgrades and Maintenance of the Recycled Material Network website. The upgrades included the addition of two new layers: recycled products and approved materials, as well as a tool to check hyperlinks in the site. The Recycled Material Network website is comprised of six layers: producers/facilities, stockpiles, case studies, recycled products, approved materials, and specifications/regulations. Producers of recycled material can locate their facility and enter contact information. The producers/facilities layer is populated with over 160 facilities located and described on the site. The stockpile layer, connected to the facility layer, allows producers to add or update information about their recycled material stockpiles including material type(s), application(s), availability, and cost. The case study layer locates projects that utilized recycled materials and includes information regarding the material type, application, volume data, and any additional documentation. A total of 40 case studies are now included on the Recycled Material Network website. The new recycled products layer has over 150 transportation products that contain at least 50% recycled material content. These products are divided into categories such as barricades or signs and each product list company contact information as well as the type and percentage of recycled material used. The new approved material layer contains over 350 recycled materials that have been approved by state DOTs for use in transportation applications. These materials can be searched by approving state, material, and application. Each approved material is associated with a manufacturer and contact information. The specification layer includes both Department of Transportation (DOT) specifications and environmental regulations pertaining to the beneficial reuse of nonhazardous recycled material based on specific location, material type, and application. Additional regulations and specifications were added to the site and a total of 23 states are now represented. A methodology for a nationwide comparison of state specifications was developed and tested on three recycled material-application combinations. As potential consumers of recycled material, engineers and contractors can pinpoint the location of a construction project, search for sources and quantities of recycled material that meet project specifications, and contact material producers. The Recycled Material Network provides key information that engineers and contractors need to successfully utilize recycled materials, thereby preserving limited natural resources and benefiting the project and society as a whole. The web map is available at <http://rmwm.caps.ua.edu>.

## **1.0 Introduction**

### *Project Overview*

The Recycled Material Network (RMN) web map is a geographic information system website that connects producers and consumers of non-hazardous recyclable material being used in transportation construction projects. The site provides engineers and contractors the opportunity to find recycled materials and allows producers to locate and describe recycled materials. The RMN is comprised of six different layers: Producers, Stockpiles, Case Studies, Recycled Products, Approved Materials, and Specifications/Regulations. The Producers layer allows producers of recycled materials to upload information about their facility including the name, type, address, contact information, and associated links. Stockpiles, which are connected to the producers layer, allows facility managers to add and edit available information about the type of material, application, quantity and cost. While only one producer may appear in a certain location, multiple stockpiles can be associated with one producer. The stock pile layer is less populated because this information is temporal and requires ongoing interaction with the site to stay current, where facility information is far less temporal. Case Studies can be uploaded to specific locations that detail the project, year, materials used, and associated links and documents. These case studies allow users to see past projects that successfully utilized recyclable materials. The Recycled Products layer lists manufactured products on the market for transportation construction projects that are made with more than 50% recycled material. This layer is sorted by category (Parking and Traffic Control, Signage, Delineator, Construction, Cones, Barricades, Channelizers, and Sound Barriers) where the user can quickly select which category is desired. The recycled material, recycled content, company, and contact information is provided as well. The Approved Materials displays data about raw recycled materials for each

state and provides users with a way to quickly and easily identify materials approved by each state, the facility where the material is produced, the source, the address, the application, the grade, the unity number, and approved products that are made from these materials if applicable. Finally, the Specifications/Regulations layer displays information from state DOT sites and environmental regulations pertaining to the beneficial reuse of non-hazardous recyclable material on the basis of specific location, material type, and application. The RMWM site can be found at [rmwm.caps.ua.edu](http://rmwm.caps.ua.edu).

The goal of the Recycled Material Network web map is to promote the reuse of non-hazardous recyclable material. Through the development of a methodology to compare allowable recycled material allowance levels in specific material-application combinations, states can identify new recycling opportunities used in other states. This comparison allows states to observe how the state aligns nationally against other states as well as provide information about successful projects that used those recycled materials.

## 2.0 Recycled Material Network Website Additions

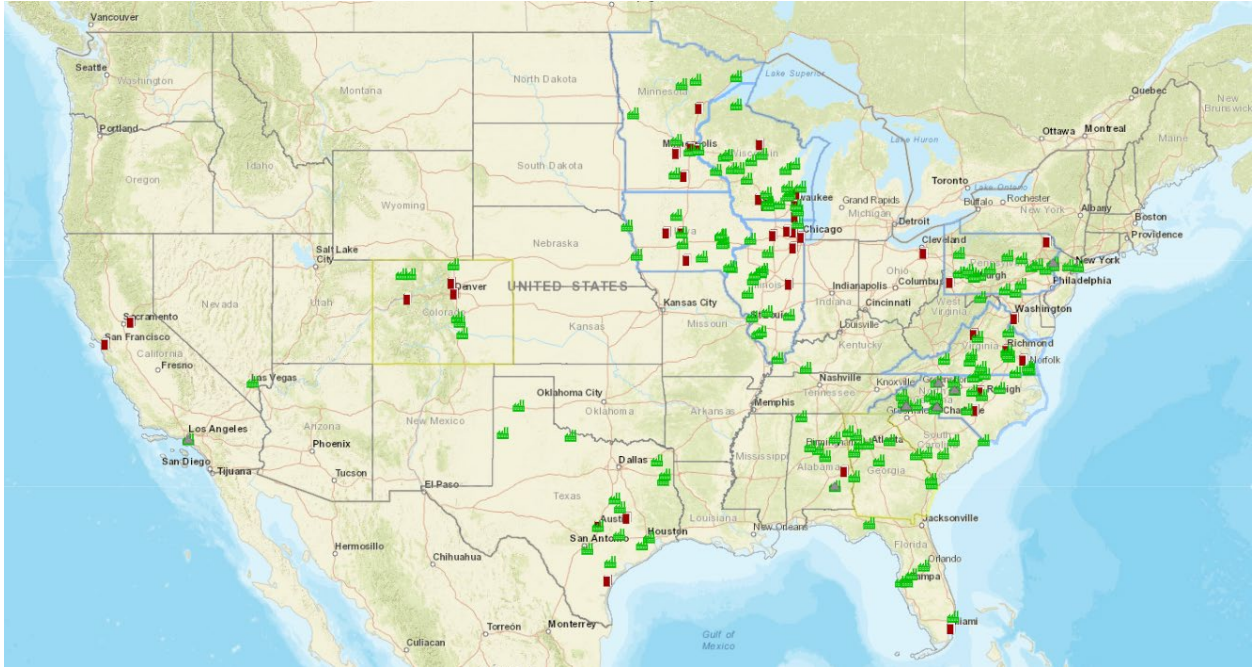
This phase of the research focused on adding data and functionality to the RMN website. This included: Task 1 - incorporating additional data into the site, Task 2 - adding two new layers (recycled material and approved products), and Task 3 - developing a hyperlink checking tool to automatically identify broken links in the site. Details of these tasks are presented in this section.

### *Task 1: Integrate Additional Data into the Website*

The original layers of the RMN website included: Producers/Facilities, Stockpiles, Case Studies, and Specifications/Regulations. Limited data were added to these layers for development, testing, and debugging purposes during Phase I of this project. As part of Phase II, each layer was evaluated and new data was uploaded. The RMN website opens with a login page for: 1) general users (no login required), 2) facility owners (login required), and 3) site administrators (login required). Once in the site, a map is displayed showing pooled fund states outlined in blue, past pooled fund states are outlined in yellow, facilities are shown in green, case studies in red, and stockpiles are gray as shown in Figure 1.

Through extensive web research the RMW now contains over 160 producers/facilities located primarily in pooled fund states, although some facilities are located in states that are not part of the pooled fund. It was determined that producers/facilities are relative stable data, meaning that location and information about recycled material producers and their facilities does not change often. Therefore, once entered in the RMN site, facility data remains current and relevant. In addition, any web link associated with a producer will be automatically opened and checked each week with the link-check tool described later in this report and developed as part of this work.





*Figure 1 Recycled Material Network front screen showing attritional facilities in green and case studies in red.*

While stockpiles were originally considered a key layer in the RMN, it was determined that the level of effort to input and maintain the temporal nature of stockpile information is very high. Producers and facility managers of recycled material are not interested in maintaining and sharing up-to-date stockpile information. Also, the research team found no instance where this information was available through a web service that could be connected to the RMN to automatically update stockpile information. This is a classic granularity problem that is well known in computer science. Users ask for highly granular data that makes searching and retrieving data convenient, but granularity comes at a cost. The cost of inputting and maintaining data must be compared to the end use of the data. In the case of the RMN, most users will contact a local producer and obtain current quantities and costs of stockpile data. Therefore, a solution to this situation is to simply combine the recycled material types with facilities and encourage engineers and contractors to contact the nearby facility.

The case study layer presents transportation projects that successfully utilized recycled material. Case studies are uploaded to the site through a data entry form that requires a location for the project as well as the recycled material used in the project. Additional information about the case study can include a synopsis of the project, pictures, and any other project documentation such as final reports or presentations. There are currently 40 case studies uploaded to the site which are primarily associated with pooled fund states as shown in Figure 1.

During this phase of the research project, specifications and regulations were updated for states previously in the RMN and new specifications and regulations were collected for the new pooled fund states as well as many other states. A number of states have contributed to funding this research through a Federal Highway Transportation Pooled Fund studies: Colorado and Georgia via TPH-5(270) only, and current member states Iowa, Illinois, Minnesota, North Carolina, Pennsylvania, Virginia, Washington, and Wisconsin as part of current project TPH-5(352). Specifications and regulations for current and past pooled fund states were added, evaluated, and updated as needed. Additional specifications and regulations from states outside of the pooled fund states were collected and verified including: Alabama, California, Delaware, Florida, Idaho, Indiana, Kentucky, Michigan, Nevada, Oregon, Tennessee, Texas, and West Virginia. Currently, 23 state specifications and regulations are included in the RMN.

### *Task 2: Development of Recycled Products and Approved Materials Layers*

The addition of two new tabs, Recycled Products and Approved Materials, added new functionality and substantial amounts of new data to the site. The Recycled Products are transportation products such as barricades or signs made with a minimum of 50% recycled content. The recycled products tab is shown in Figure 2. Products are described on the site, assigned a product category, the recycled material employed and percentage of recycled content

is listed along with company information including name, phone, and website. A dropdown menu, shown in Figure 3, is in the upper left of the Recycled Products tab allows users to select a product category and search only that product type. Product categories include: parking and traffic control devices, signs, delineators, construction products, cones, barricades, channelizers, and sound barriers. New products are added to the site by the site administrator, but the recycled products tab includes a feature for users to recommend new products as seen to the right of the dropdown menu shown in Figure 3.

Product	Category	Recycled Material	Recycled Content	Company	Contact	Website
'One Base' Universal Portable Base	Signage	recycled rubber	100% recycled rubber	Impact Recovery Systems	1-800-736-5256	<a href="http://www.impactrecovery.com/products/one-base">http://www.impactrecovery.com/products/one-base</a>
4 Foot Recycled Plastic Parking Stop	Parking and Traffic Control	Recycled Plastic	100% recycled plastic	Parking Zone	1-800-292-7275	<a href="https://www.parkingzone.com/yellow-recycled-plastic-parking-stop-with-mounting-hardware-4-ft.html">https://www.parkingzone.com/yellow-recycled-plastic-parking-stop-with-mounting-hardware-4-ft.html</a>
4 ft Parking Stop	Parking and Traffic Control	recycled plastic	100% recycled plastic	Monster Motion Safety	1-877-384-6103	<a href="https://monster-safety.com/products/traffic-parking-lot-safety/parking-stops/4-ft-parking-stop/">https://monster-safety.com/products/traffic-parking-lot-safety/parking-stops/4-ft-parking-stop/</a>
4 ft Speed Bump	Parking and Traffic Control	recycled plastic	100% recycled plastic	Monster Motion Safety	1-877-384-6103	<a href="https://monster-safety.com/products/traffic-parking-lot-safety/speed-bumps-humps/4-ft-speed-bump/">https://monster-safety.com/products/traffic-parking-lot-safety/speed-bumps-humps/4-ft-speed-bump/</a>
4" Portable Bollard Base	Parking and Traffic Control	post-consumer recycled tire rubber and recycled plastic	100% post-consumer recycled tire rubber and recycled plastic	RubberForm Recycled Products, LLC	716-245-7455	<a href="https://rubberform.com/">https://rubberform.com/</a>
48" Universal Vertical Panel	Delineator	recycled rubber/recycled materials	Base:100% Post-Consumer Rubber, Panel:UV Stabilized Polymers from RM	Traffic Safety Warehouse	1-877-786-6281	<a href="https://www.trafficsafetywarehouse.com/48-Universal-Vertical-Panel/productinfo/123/">https://www.trafficsafetywarehouse.com/48-Universal-Vertical-Panel/productinfo/123/</a>
6 Foot Recycled Plastic Parking Stop	Parking and Traffic Control	Recycled Plastic	100% recycled plastic	Parking Zone	1-800-292-7275	<a href="https://www.parkingzone.com/6-foot-recycled-plastic-parking-stop.html">https://www.parkingzone.com/6-foot-recycled-plastic-parking-stop.html</a>
6 Foot Yellow Recycled Plastic Speed Bump	Parking and Traffic Control	Recycled Plastic	100% recycled plastic	Parking Zone	1-800-292-7275	<a href="https://www.parkingzone.com/6-foot-yellow-recycled-plastic-speed-bumps.html">https://www.parkingzone.com/6-foot-yellow-recycled-plastic-speed-bumps.html</a>
6 ft Parking Stop	Parking and Traffic Control	recycled plastic	100% recycled plastic	Monster Motion Safety	1-877-384-6103	<a href="https://monster-safety.com/products/traffic-parking-lot-safety/parking-stops/6-ft-parking-stop/">https://monster-safety.com/products/traffic-parking-lot-safety/parking-stops/6-ft-parking-stop/</a>

Figure 2 New Recycled Products Tab

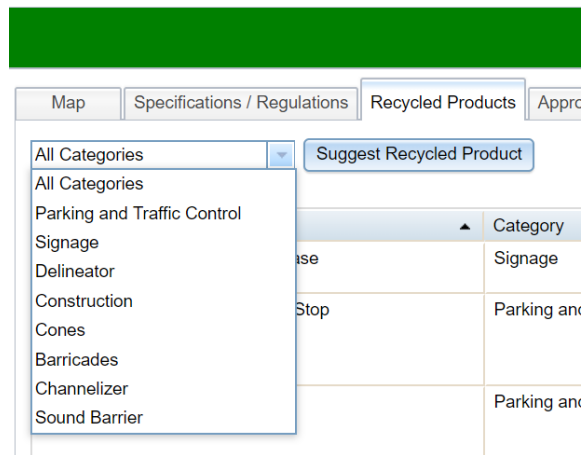


Figure 3 Dropdown menu for recycled product categories

The approved materials tab, shown in Figure 4, lists materials that have been approved by a state DOT. Each material and producer can be associated with one or multiple states. The materials are described with a material name, producer, source, address, application, and key information that allows engineers and contractors to better understand a recycled material. Approved materials can be searched by state by clicking on the map and also by material category as shown in the dropdown menu in Figure 5. The new approved material layer contains over 350 recycled materials that have been approved by state DOTs for use in transportation applications. The intent of this new tab is to allow engineers and contractors working in a state quick and easy access to approved materials and also provide information from neighboring states that may be beneficial.

Material	Producer/Manufacturer	Source	Address	Application	Class/Grade/Type	UnitNo	Approved Products	Remarks
Crumb Rubber Modifier (CRM) Additive	Liberty Tire Recycling, LLC	Liberty Tire Recycling, LLC	490 Ohio Street, Lockport, NY Lockport New York U.S.A.	Asphalt Pavement				
Crumb Rubber Modifier (CRM) Additive	Liberty Tire Recycling, LLC	Liberty Tire Recycling, LLC	100 Talbot Avenue, Bradnock, PA Bradnock Pennsylvania U.S.A.	Asphalt Pavement				
Crumb Rubber Modifier (CRM) Additive	Lehigh Technologies, Inc.	Lehigh Technologies, Inc.	120 Royal Woods Court SW, Tucker, GA Tucker Georgia U.S.A.	Asphalt Pavement			MicroDyne 400-TR (40 Mesh GTR)	
Crumb Rubber Modifier (CRM) Additive	Mahantango Enterprises, Inc.	Mahantango Enterprises, Inc.	Rr #2, P.O. Box 680, Liverpool, PA Liverpool Pennsylvania U.S.A.	Asphalt Pavement				
Crumb Rubber Modifier (CRM) Additive	Edge Rubber	Edge Rubber	1711 Opportunity Avenue, Chambersburg, PA Chambersburg Pennsylvania U.S.A.	Asphalt Pavement				
Crumb Rubber Modifier (CRM) Additive	Sparton Enterprises, Inc.	Sparton Enterprises, Inc.	3717 Clark Mill Road, Barberton, OH Barberton Ohio U.S.A.	Asphalt Pavement				
Crumb Rubber Modifier (CRM), Treated	Duroplas Corporation	Duroplas Corporation	101 Peninsula Drive, North East, Maryland North East Maryland U.S.A.	Asphalt Pavement			TYRSOLV	This Provisional Specification or any manufacturer or product may be withdrawn immediately, if experience demonstrates a problem with the use of Treated Crumb Rubber Modifier (CRM)
Fly Ash	Ash Venture, LLC	Duke Energy Plant	188 Summerfield Ct #101, Roanoke, VA Belews Creek, North Carolina U.S.A.	Mineral Admixtures for Portland Cement Concrete	Class F			
Fly Ash	Boral Resources	Bowen Plant	45 N.E. Loop 410, Suite 700 San	Mineral Admixtures for Portland Cement	Class F			

Figure 4 New Approved Material Tab

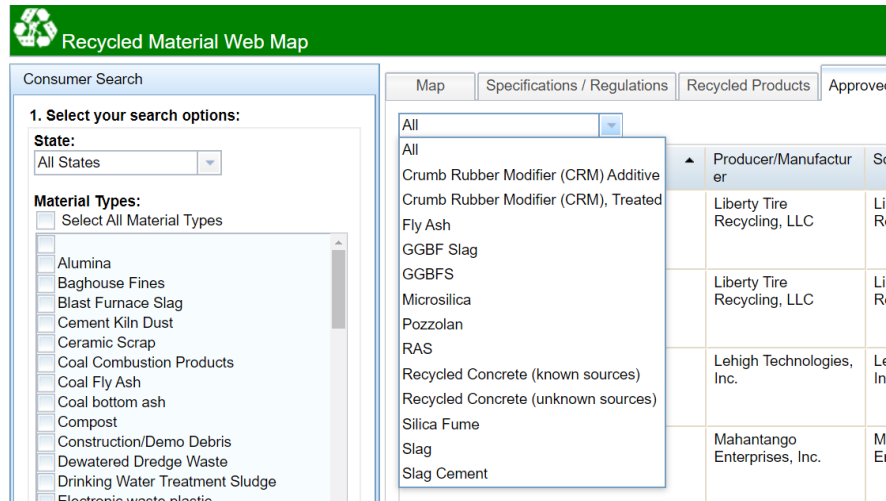


Figure 5 Dropdown menu to select DOT approved materials

### Task 3: Hyperlink Checking Tool to Automatically Identify Broken Links

A Link-Check Tool was successfully developed and implemented in the RMN website. Screenshots of each hyperlinked web page are automatically captured and stored. When the Link-Check Tool runs, the tool checks for consistency of web pages. If the current web page matches the stored screenshot, then the tool continues on with the next link as seen in Figure 6. Adversely, when the screenshots do not match or an error appears, the Link-Check Tool returns an error message, as seen in Figure 7. Each Sunday the Link-Check Tool runs overnight and emails the results to a designated team member. A list of all the Specs/Regs that have changed or come back as a broken link, 404 error, are listed in the email for further review as seen in Figure 8.

## Current Destination



## Stored RMWM Screenshot



Figure 6 Example of properly working link checked by the Link-Check Tool

## Current Destination



## Stored RMWM Screenshot



Figure 7 Example of broken link checked by the Link-Checker Tool

Link Checker Results Inbox x

**RECYCLED MATERIAL** <no-reply@us.edu>  
to me

Mon, Jan 7, 11:01 AM (4 days ago) ☆ ↶ ⋮

Some URLs may be false positives.

**Issues connecting to the following URLs:**

- <https://lowadot.gov/erl/current/GS/content/2507.htm>
- <https://legislature.idaho.gov/ldstat/Title39/T39CH65SECT39-6502.htm>
- <https://legislature.idaho.gov/ldstat/Title39/T39CH65SECT39-6506.htm>
- <https://www.netl.doe.gov/research/coal/crosscutting/environmental-control/solid-waste/state-regulations/iowa>

**The following RegSpecs are affected:**

<a href="https://lowadot.gov/erl/current/GS/content/2507.htm">https://lowadot.gov/erl/current/GS/content/2507.htm</a>					
Id	State	Agency	Group	Section	Title
99782e4b-1199-4447-ae71-9c482243e5ff	IA	Iowa Department of Transportation	Standard Specifications for Highway and Bridge Construction	Division 25: Miscellaneous Construction	ISS Division 25 Section 2507.02 B-3 Concrete and Stone Revetment - Materials
3c9190e0-86fa-41c7-bacd-cacbe98a1e2a	IA	Iowa Department of Transportation	Standard Specifications for Highway and Bridge Construction	Division 25: Miscellaneous Construction	ISS Division 25 Section 2507.03 E-4 Concrete and Stone Revetment - Grouting

<a href="https://legislature.idaho.gov/ldstat/Title39/T39CH65SECT39-6502.htm">https://legislature.idaho.gov/ldstat/Title39/T39CH65SECT39-6502.htm</a>					
Id	State	Agency	Group	Section	Title
422ae2a4-c1bd-475c-bc65-d8d97624d39d	ID	Idaho Department of Environmental Quality	Idaho Statutes	CHAPTER 65 WASTE TIRE DISPOSAL	39-6502 WASTE TIRE STORAGE SITES

<a href="https://legislature.idaho.gov/ldstat/Title39/T39CH65SECT39-6506.htm">https://legislature.idaho.gov/ldstat/Title39/T39CH65SECT39-6506.htm</a>					
Id	State	Agency	Group	Section	Title
551e2512-85a6-4de1-8f59-6f3b1f1a1812	ID	Idaho Department of Environmental Quality	Idaho Statutes	CHAPTER 65 WASTE TIRE DISPOSAL	39-6506 RECYCLING AND REUSE OF WASTE TIRES

<a href="https://www.netl.doe.gov/research/coal/crosscutting/environmental-control/solid-waste/state-regulations/iowa">https://www.netl.doe.gov/research/coal/crosscutting/environmental-control/solid-waste/state-regulations/iowa</a>					
Id	State	Agency	Group	Section	Title
235dc7db-ec65-4175-b103-3e19f6fda35	IA	Iowa Department of Natural Resources	Coal Combustion Byproducts - Chapter 141	IAC Chapter 567-141.2	141.2 Current Regulations Governing Coal Combustion Byproducts

*Figure 8 Example weekly email sent by the Link-Check Tool to provide feedback*



### 3.0 Recycled Material Network Maintenance and Upgrades

As part of Phase II, several changes were made to the structure and appearance of the website. Visually, changes were made including an update to the home map and a button to hide the selected data grid, as seen by the green circle in Figure 9. Clicking the “Hide Selected Tabs” button hides the data grid at the bottom of the screen which provides a larger map window.

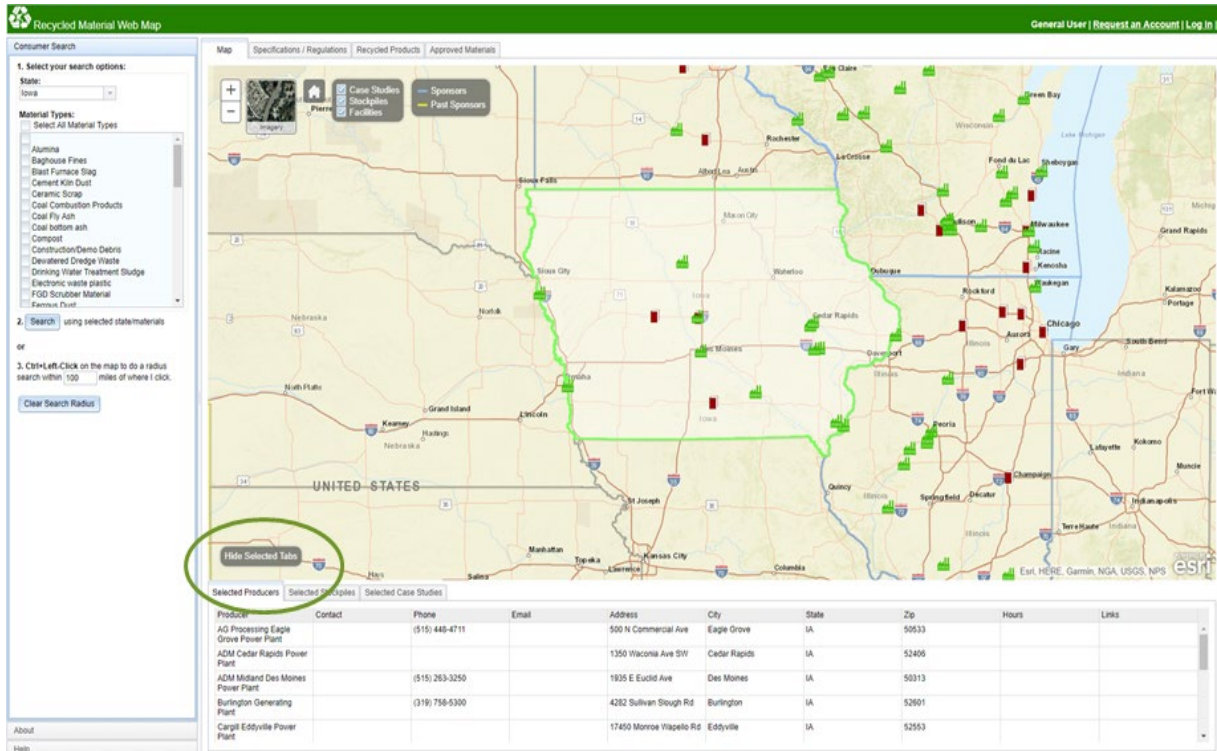


Figure 9 Added feature to minimize ‘Selected Tabs’ window on Home Map

As seen in the green circle in Figure 10, new tutorial videos were added to the ‘Help’ tab of the site as well during this phase of work. These videos provide an overview of how to use the site and address frequently asked questions from both general and account-holding users.



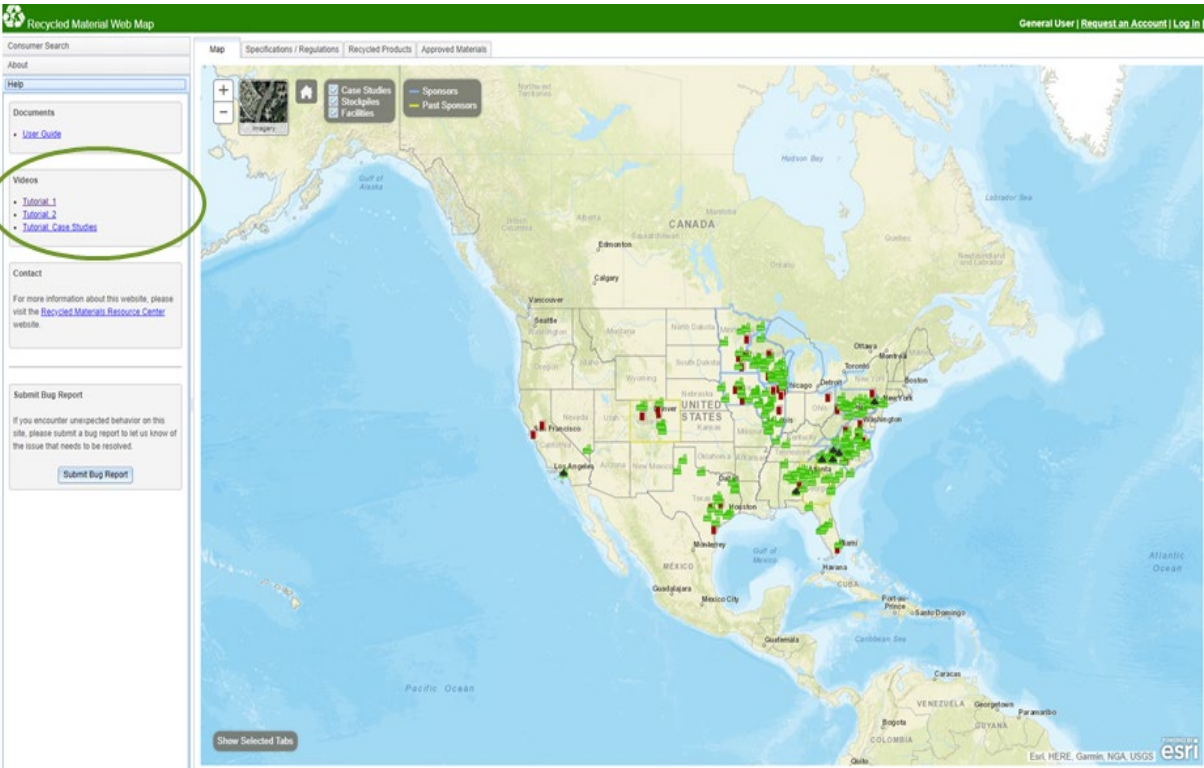


Figure 10 Updated 'Help' Tab with 3 new tutorial videos

## **4.0 Expanding and Promoting the Recycled Material Network**

### *Tasks 4 and 5: Expand and Promote the Recycled Material Network*

In an effort to expand and promote the RMN, Producers, Stockpiles, Case Studies, and Specifications and Regulations were identified and uploaded to the site for the two new pooled fund states, Iowa and North Carolina, as well as other states that are not part of the pooled fund. During this effort it was observed that DOT specifications vary widely across state lines. Some state specifications do not allow a material to be used in a specific transportation application while other states do. Some states require a minimum amount of recycled material while other states set a maximum amount of material in the same application. To help states understand and compare specifications, with the goal of increasing the amount of recycled material used in transportation applications, a methodology to present and compare specifications was developed and tested on three material-application combinations. It should be noted that only DOT specifications were included in the evaluation of this methodology, which may leave out the permissible use of recycled material that could be covered by environmental regulations.

For the development and testing of the state comparison methodology, States Standard Specification (SS) for Road and Bridge Construction were reviewed to determine the allowable recycled material content. The allowable content of a specific recycled material in a specific application was recorded. The comparison methodology was developed and tested on three material-applications found in DOT specifications: Recycled/Reclaimed Asphalt Pavement (RAP) used in hot mix, fly ash used in Portland Cement Concrete (PCC) Pavements (PCCP), and fly ash used in Structural PCC.

## *Data Collection*

Data for the comparison methodology were collected through a series of steps to ensure accurate data was identified within DOT specification documents. The SS used for each state was the most recently posted version available on the respective state's Department of Transportation website. If the SS was out of date, with the previous version being posted more than six years ago, further research went into ensuring that the available SS was the most current publication. The SS was reviewed for specifications pertaining to the allowable recyclable material content allowed within hot mix asphalt, PCCP, and structural PCC.

Oftentimes, these recycled content specifications were not found within the application design section. When this occurred within the SS, the SS were searched systematically to identify the allowable recycled content. Once the relevant section was located, the allowable percentages were recorded along with a comment noting the location of the specification within the SS. All collected data for RAP and fly ash can be found in the Appendix in Table 4, Table 5, and Table 6.

The "path" within the SS to locate the hot mix asphalt, PCCP, and structural PCC section containing the relevant specification information was determined and recorded. For example, if the hot mix asphalt section referenced a 'Materials' section with information regarding RAP that referenced a table in the appendix that listed allowable RAP percentages, the "path" between these three locations in the SS was noted. The recorded information lists each section and page number. An example of this path notation is: *211.02 pg 137 → 342.05.3 pg 245 → 451 Table 4.6 pg 311*. The "path" to each specification is recorded in the specification column of Table 4, Table 5, and Table 6 in the Appendix.

In addition to collecting the “path” to the allowable recycled material content, links to the relevant SS web pages were collected and stored. If more than one link was necessary, which often happened if external references were listed in the SS, all relevant links were collected and stored. A flowchart detailing steps for finding allowable content within SS is provided in Figure 11. It should be noted that in some states environmental regulations control the permissible levels of recycled material and therefore the regulations should be reviewed in a similar manner as the specifications.

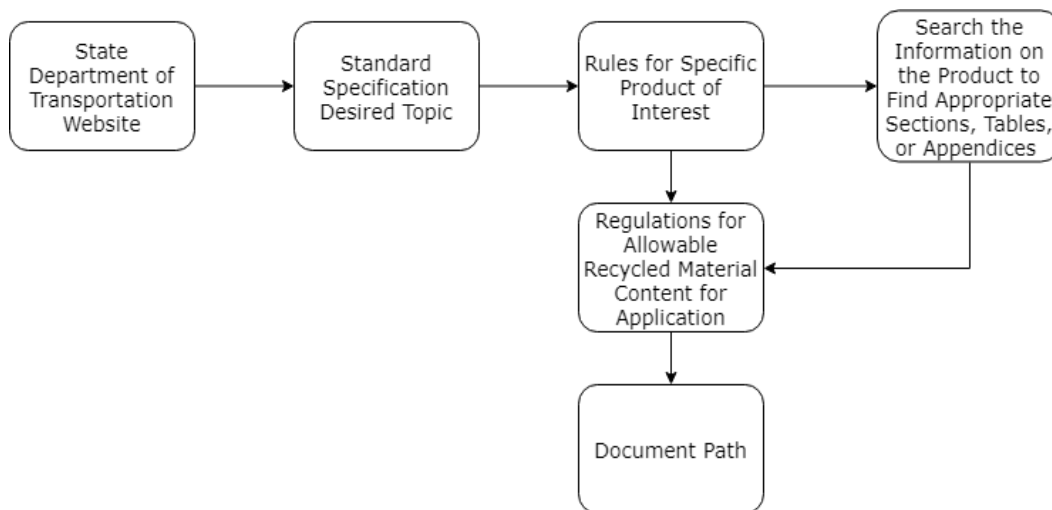


Figure 11 Flowchart for Creating a Document Path

### *Specification Comparison Methodology*

The intent of the specification comparison methodology is to increase transparency of allowable levels of recyclable material among states. A detailed description of how states are compared is provided. The following steps present the methodology followed when assessing a states’ recycled content allowability from the respective specifications.

The allowable recycled material content for each state was compiled and sorted. The collected data was analyzed for observable grouping patterns. With an end goal of grouping the states into a relatively small number of categories for comparison, distribution trends were noted

and basic mathematical averages (mean, median, mode, etc.) were calculated. States were separated into quartile groups based on an approximate division of the number of states into lower quartile, middle two quartile, and top quartile. This procedure was done for two reasons: first, presenting information in a clear and easy to understand form was essential; therefore, data was broken down into categories such as 0-15% 20-25%, and, 30-35%, and states that were slightly outside of these categories were included into the closest group. Second, these groupings also divided the allotted states into approximate quartile groups. Groupings may be slightly skewed, for example 17, 23, and 10 states in the three groups, but this variation is consistent from a logical standpoint.

Finally, a method for comparing these state specifications in a clear and concise way was established. The quartile system was selected which provide users with information on which state specifications allow more or less recycled material content. Specifications allowing less recycled material fall between the minimum and 1<sup>st</sup> quartile. The middle-state specifications fall between the 1<sup>st</sup> quartile and the 3<sup>rd</sup> quartile. State specifications allowing the most recycled material fall between the 3<sup>rd</sup> quartile and the maximum. If smaller divisions are desired, then the median or 2<sup>nd</sup> quartile can be used.

## Results

The data set used for comparison came from state DOT specifications. For RAP and fly ash applications, data were compiled into spreadsheets and analyzed. The average, median, minimum, maximum, and the 1<sup>st</sup> and 3<sup>rd</sup> quartiles were calculated. Specifications with zero recycled material allotment were excluded from the statistical calculations. The results of the analysis are shown in Table 1.

*Table 1 Comparison Statistics for Specifications*

<b>Application</b>	<b>Average (%)</b>	<b>Median (%)</b>	<b>Minimum (%) excluding zero</b>	<b>Maximum (%)</b>	<b>1<sup>st</sup> Quartile</b>	<b>3<sup>rd</sup> Quartile</b>
RAP	29.5	30	1.5	65	20	30
Structural PCC	25.7	25	15	30	20	30
PCCP	25.6	25	15	35	20	30

Specifications were sorted based on the allowable percentage of recycled material and assigned a quartile. The quartile assignment for structural PCC, PCCP, and RAP are color coded and shown in Table 2. State specifications in the 3<sup>rd</sup> quartile received a score of 2, specifications in the middle quartile received a score of 1, and specifications in the 1<sup>st</sup> quartile received a score of 0. Three state specifications, Nevada, New Hampshire, and New Mexico, list a minimum required percentage of recycled material. Because these specifications require a minimum amount of recycled material, they were generally moved into the next higher quartile. The specifications with a minimum require amount of recycled material are boxed in Table 2.

Table 2 Color coded quartile assignment of a state based on the allowable recycled material content listed in DOT specifications

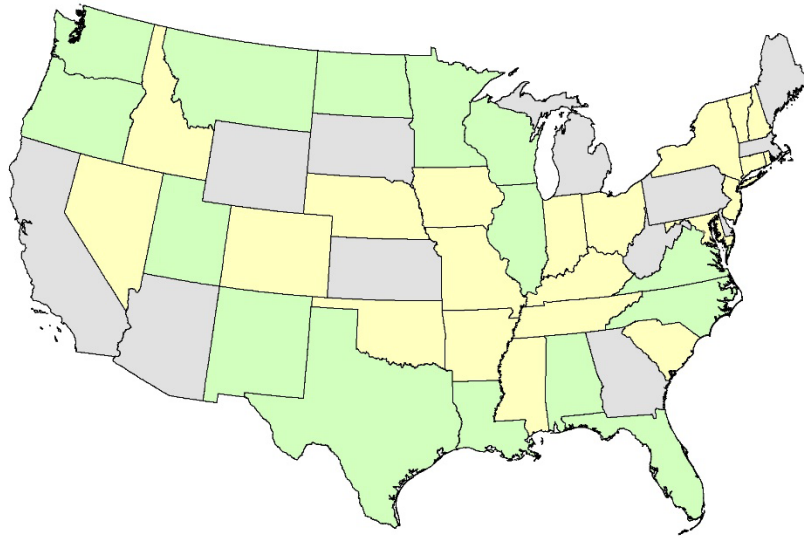
Structural PCC			PCCP			RAP (surface course)		
State	%	Score	State	%	Score	State	%	Score
ALASKA	35	2	TEXAS	35	2	NEBRASKA	65	2
TEXAS	35	2	WASHINGTON	35	2	DELAWARE	50	2
WASHINGTON	35	2	MINNESOTA	33	2	NEW JERSEY	50	2
ALABAMA	30	2	ALABAMA	30	2	VERMONT	50	2
COLORADO	30	2	COLORADO	30	2	GEORGIA	40	2
FLORIDA	30	2	FLORIDA	30	2	MISSOURI	40	2
ILLINOIS	30	2	ILLINOIS	30	2	WASHINGTON	40	2
KENTUCKY	30	2	KENTUCKY	30	2	NEW MEXICO (min)	35	2
LOUISIANA	30	2	LOUISIANA	30	2	MINNESOTA	35	2
MINNESOTA	30	2	MONTANA	30	2	VIRGINIA	35	2
MONTANA	30	2	NORTH CAROLINA	30	2	ARKANSAS	30	1
NORTH CAROLINA	30	2	OREGON	30	2	CONNECTICUT	30	1
OREGON	30	2	RHODE ISLAND	30	2	IDAHO	30	1
RHODE ISLAND	30	2	UTAH	30	2	ILLINOIS	30	1
UTAH	30	2	VIRGINIA	30	2	IOWA	30	1
VIRGINIA	30	2	WISCONSIN	30	2	LOUISIANA	30	1
WISCONSIN	30	2	NORTH DAKOTA	29	2	MAINE	30	1
NORTH DAKOTA	29	2	NEW HAMPSHIRE (min)	25	2	MARYLAND	30	1
NEW HAMPSHIRE (min)	25	2	NEW MEXICO (min)	25	2	MISSISSIPPI	30	1
NEW MEXICO (min)	25	2	ARIZONA	25	1	MONTANA	30	1
ARIZONA	25	1	IDAHO	25	1	NORTH CAROLINA	30	1
IDAHO	25	1	KANSAS	25	1	OREGON	30	1
KANSAS	25	1	MARYLAND	25	1	TEXAS	30	1
MARYLAND	25	1	MISSISSIPPI	25	1	ALABAMA	25	1
MISSISSIPPI	25	1	MISSOURI	25	1	ALASKA	25	1
MISSOURI	25	1	NEBRASKA	25	1	CALIFORNIA	25	1
NEBRASKA	25	1	NEW JERSEY	25	1	INDIANA	25	1
NEW JERSEY	25	1	OHIO	25	1	NORTH DAKOTA	25	1
OHIO	25	1	SOUTH DAKOTA	25	1	OKLAHOMA	25	1
SOUTH DAKOTA	25	1	TENNESSEE	25	1	UTAH	25	1
TENNESSEE	25	1	WYOMING	25	1	WISCONSIN	25	1
NEW YORK	21	1	NEW YORK	21	1	FLORIDA	20	1
NEVADA (min)	20	1	NEVADA (min)	20	1	NEW YORK	20	1
ARKANSAS	20	1	ARKANSAS	20	1	OHIO	20	1
CONNECTICUT	20	1	CONNECTICUT	20	1	SOUTH CAROLINA	20	1
INDIANA	20	1	INDIANA	20	1	TENNESSEE	20	1
IOWA	20	1	IOWA	20	1	NEVADA (min)	15	1
OKLAHOMA	20	1	MICHIGAN	20	1	MASSACHUSETTS	15	0
SOUTH CAROLINA	20	1	OKLAHOMA	20	1	PENNSYLVANIA	15	0
VERMONT	20	1	SOUTH CAROLINA	20	1	NEW HAMPSHIRE (min)	1.5	0
WYOMING	20	1	GEORGIA	15	0	ARIZONA	0	0
GEORGIA	15	0	PENNSYLVANIA	15	0	COLORADO	0	0
PENNSYLVANIA	15	0	ALASKA	0	0	HAWAII	0	0
CALIFORNIA	0	0	CALIFORNIA	0	0	KANSAS	0	0
DELAWARE	0	0	DELAWARE	0	0	KENTUCKY	0	0
HAWAII	0	0	HAWAII	0	0	MICHIGAN	0	0
MAINE	0	0	MAINE	0	0	RHODE ISLAND	0	0
MASSACHUSETTS	0	0	MASSACHUSETTS	0	0	SOUTH DAKOTA	0	0
MICHIGAN	0	0	VERMONT	0	0	WEST VIRGINIA	0	0
WEST VIRGINIA	0	0	WEST VIRGINIA	0	0	WYOMING	0	0

An overall score can be produced by summing the scores from each recycled material-application combination. For the three recycled material-application combinations used for testing this methodology, the score ranges from six to zero. The recycled material-application score is shown in Table 3. Data are sorted by score in descending order followed by name in alphabetical order. Although not part of the RMN website, the results of comparison methodology can also be displayed on graphs or maps as seen in Figure 12. An individual state page could be generated to provide a detailed explanation of the state specification compared to national trends.

*Table 3 Overall specification and for of fly ash in structural PCC and PCCP, and the use of RAP in hot mix asphalt*

State	Overall Score	State	Overall Score
MINNESOTA	6	IDAHO	3
NEW MEXICO	6	INDIANA	3
VIRGINIA	6	IOWA	3
WASHINGTON	6	MARYLAND	3
ALABAMA	5	MISSISSIPPI	3
FLORIDA	5	NEVADA	3
ILLINOIS	5	NEW YORK	3
LOUISIANA	5	OHIO	3
MONTANA	5	OKLAHOMA	3
NORTH CAROLINA	5	SOUTH CAROLINA	3
NORTH DAKOTA	5	TENNESSEE	3
OREGON	5	VERMONT	3
TEXAS	5	ARIZONA	2
UTAH	5	DELAWARE	2
WISCONSIN	5	GEORGIA	2
COLORADO	4	KANSAS	2
KENTUCKY	4	SOUTH DAKOTA	2
MISSOURI	4	WYOMING	2
NEBRASKA	4	CALIFORNIA	1
NEW HAMPSHIRE	4	MAINE	1
NEW JERSEY	4	MICHIGAN	1
RHODE ISLAND	4	HAWAII	0
ALASKA	3	MASSACHUSETTS	0
ARKANSAS	3	PENNSYLVANIA	0
CONNECTICUT	3	WEST VIRGINIA	0





*Figure 12 Map of specification comparison results*

#### *Data Outliers*

Throughout the process of developing this methodology to compare specifications related to the use of recycled material in transportation projects, outliers and uncertain results were identified and tracked. These outliers were individually verified by a secondary researcher to ensure quality.

For future reference, contact should be made to the state DOTs to confirm accurate data collection. After verification of findings, any states with non-specified or zero allowance of recycled material in the application in question should be contacted to ensure accuracy. An email or survey should be sent to the DOT in question, requesting a confirmation of the allowances determined. If the DOT corrects the recorded findings, then data should be changed in the collection log; otherwise, the input is marked as accurate and verified.

## 5.0 Conclusions and Future work

### *Conclusions*

As a result of Phase II, new specifications and regulations, case studies, producers, and stockpiles were added to the site. Additionally, changes to the RMN website increased accessibility and user-friendly status. Tabs like the new ‘Recycled Products’ and ‘Approved Material’ populated the site with more data for users to access and utilize for transportation construction projects. A state specification comparison methodology was developed and tested with the ultimate goal of providing additional information to state DOTs for the purpose of promoting the use of recycled material. The increase in information will allow states to be more interactive with the site as well as increase awareness of possible uses for recyclable materials in transportation projects, and therefore, reduce the amount of waste going into landfills each year.

### *Future Work*

The continued collection and analysis of state specifications for the allowable limits of recycled material will provide a valuable comparison of material and usage. This analysis can be used to inform decision makers when determining future allowable limits. While the framework for the state specification comparison methodology was developed and implemented on three material-application combinations, many more material application pairs exist that need additional research and analysis. As was noted in the development of this methodology, only state DOT specifications were evaluated; therefore, future work should also include a review of environmental regulations that may include allowable recycling levels. As additional recycled material-application combinations are included in the specification comparison methodology, a more complete understanding of how specifications promote the use of recycled material will be known. In future work, this comparison could be included in the RMN website as a new layer.

In addition to the specification comparison layer, a recycled material usage layer could provide real-time information about DOT projects that used recycled materials and/or products. This tab could also provide a tracking tool for states with respect to their recycled material usage for transportation projects. A mockup of a future Usage Tab is shown in Figure 13. This mockup also displays the feature for users to submit a project to be reviewed and approved by the administrator of the site.

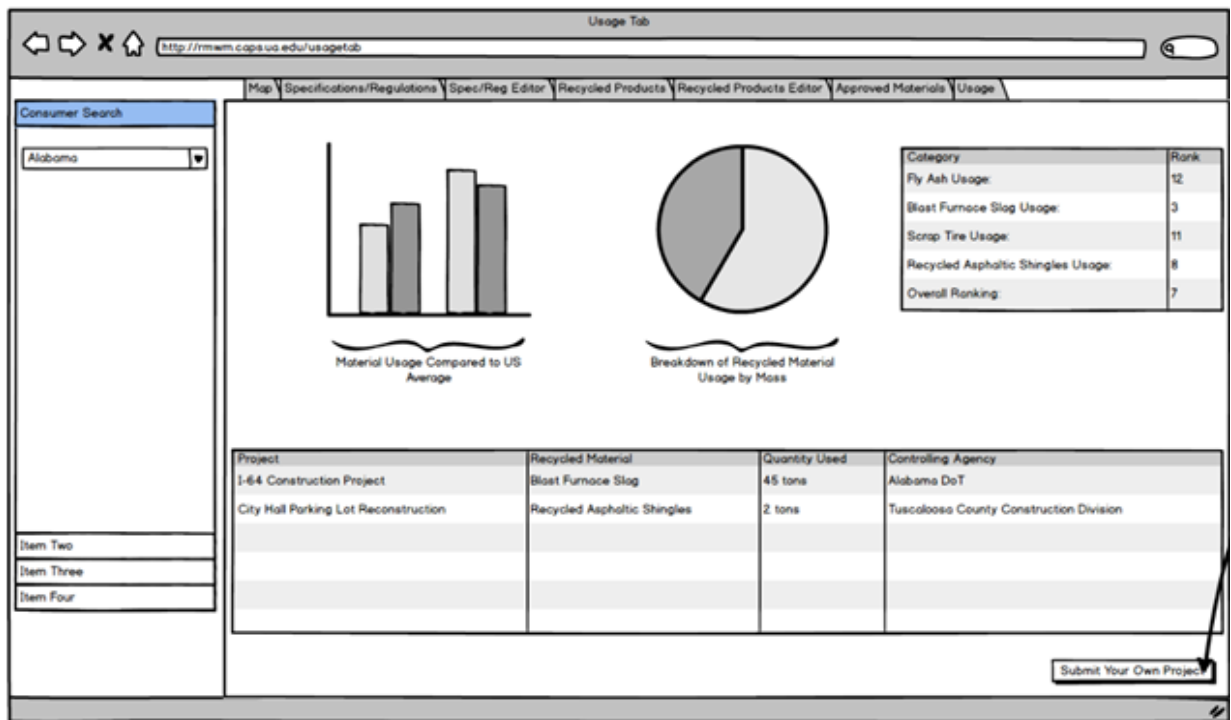


Figure 13 Usage Tab Mockup

## Appendix

### Table 4 RAP Spreadsheet

STATE	ALLOWANCE	UNIT	SPECIFICATION	LINK	Link 2	
ALABAMA		25 % replacement by mass	410.02(e)	<a href="https://www.dot.state.al.us/conweb/p">https://www.dot.state.al.us/conweb/p</a>		Automatic Calculations
ALASKA	ClassA15/ClassB25	% replacement by mass	401-2.09	<a href="http://www.dot.state.ak.us/stwddes/d">http://www.dot.state.ak.us/stwddes/d</a>		AVERAGE (of non-zeros) 29.52564103
ARIZONA	N.S.	% replacement by mass	N.S.	<a href="https://www.azdot.gov/docs/business">https://www.azdot.gov/docs/business</a>		MEDIAN 30
ARKANSAS		30 % replacement by mass		416.03 <a href="https://www.arkansashighways.com/st">https://www.arkansashighways.com/st</a>		MAXIMUM 65
CALIFORNIA		25 % replacement by mass	39-2.02B(5)	<a href="http://ppmoe.dot.ca.gov/hq/esc/oe/cc">http://ppmoe.dot.ca.gov/hq/esc/oe/cc</a>		MINIMUM 1.5
COLORADO	N.S.	% replacement by mass	N.S.	<a href="https://www.codot.gov/business/desig">https://www.codot.gov/business/desig</a>		
CONNECTICUT		30 % replacement by mass	M.04.02-1(a)	<a href="https://www.ct.gov/dot/lib/dot/docun">https://www.ct.gov/dot/lib/dot/docun</a>		
DELAWARE		50 % replacement by mass	1014.02.4 -> 823.26	<a href="https://deldot.gov/Publications/man">https://deldot.gov/Publications/man</a>		
FLORIDA		20 % replacement by mass	334-2.3.1-1	<a href="https://fdotwww.blob.core.windows.n">https://fdotwww.blob.core.windows.n</a>		Chosen Based on Data
GEORGIA		40 % binder replacement by mass	402.2 (A)-2	<a href="http://www.dot.ga.gov/PartnerSmart/">http://www.dot.ga.gov/PartnerSmart/</a>		
HAWAII	N.S.	% binder replacement by mass	401.02 C	<a href="http://hidot.hawaii.gov/highways/files">http://hidot.hawaii.gov/highways/files</a>		SUGGESTED 1st %ILE 20
IDAHO		30 % binder replacement by mass	720.07-2(A)	<a href="http://apps.itd.idaho.gov/apps/manua">http://apps.itd.idaho.gov/apps/manua</a>		SUGGESTED 2nd %ILE 30
ILLINOIS		30 % binder replacement by mass	1031.06 (C)1	<a href="http://www.idot.illinois.gov/Assets/up">http://www.idot.illinois.gov/Assets/up</a>		SUGGESTED 3rd %ILE 30
INDIANA		25 % binder replacement by mass	401.06 pg 263	<a href="https://www.in.gov/dot/div/contracts">https://www.in.gov/dot/div/contracts</a>		
IOWA		30 % binder replacement by mass	2303.02 C-6	<a href="https://iowadot.gov/enr/current/GS/co">https://iowadot.gov/enr/current/GS/co</a>		
KANSAS	N.S.	% binder replacement by mass	602.3e	<a href="https://www.ksdot.org/Assets/wwwk">https://www.ksdot.org/Assets/wwwk</a>		
KENTUCKY	N.S.	% binder replacement by mass	Section 409	<a href="https://transportation.ky.gov/Constr">https://transportation.ky.gov/Constr</a>		
LOUISIANA		30 % binder replacement by mass	Table 502-6 pg 265	<a href="http://www.wsp.dotd.la.gov/Inside_LaDC">http://www.wsp.dotd.la.gov/Inside_LaDC</a>		
MAINE		30 % binder replacement by mass	703.081 Table 4 pg 7-15	<a href="https://www.maine.gov/mdot/contrac">https://www.maine.gov/mdot/contrac</a>		
MARYLAND		30 % binder replacement by mass	904.02 pg 820 -> MSMT 412 pg 3	<a href="https://www.roads.maryland.gov/ohd/">https://www.roads.maryland.gov/ohd/</a> <a href="https://www.roads.maryland.gov/O/">https://www.roads.maryland.gov/O/</a>		
MASSACHUSETTS		15 % binder replacement by mass	Table M3.4 pg 284	<a href="https://www.mass.gov/files/document">https://www.mass.gov/files/document</a>		
MICHIGAN	N.S.	% binder replacement by mass	pg 19	<a href="https://www.michigan.gov/documents">https://www.michigan.gov/documents</a>		
MINNESOTA		35 % binder replacement by mass	Table 2360-8 pg 183	<a href="http://www.dot.state.mn.us/pre-lettin">http://www.dot.state.mn.us/pre-lettin</a>		
MISSISSIPPI		30 % binder replacement by mass	401.02.3.1 pg 240	<a href="http://sp.mdot.ms.gov/Construction/S">http://sp.mdot.ms.gov/Construction/S</a>		
MISSOURI		40 % binder replacement by mass	401.2.2 pg 163	<a href="https://www.mdot.org/sites/default/">https://www.mdot.org/sites/default/</a>		
MONTANA		30 % binder replacement by mass	401.02.5 pg 170	<a href="https://www.mdt.mt.gov/other/webd">https://www.mdt.mt.gov/other/webd</a>		
NEBRASKA		65 % binder replacement by mass	Table 1028.01 pg 825	<a href="https://dot.nebraska.gov/media/1034/">https://dot.nebraska.gov/media/1034/</a>		
NEVADA		15 % binder replacement by mass	402.02.02 pg 159	<a href="https://www.nevadadot.com/home/sh">https://www.nevadadot.com/home/sh</a>		
NEW HAMPSHIRE		1.5 % binder replacement by mass	2.10.1	<a href="https://www.nh.gov/dot/org/projectd">https://www.nh.gov/dot/org/projectd</a>		
NEW JERSEY		50 % binder replacement by mass	901.10.03 pg 321	<a href="https://www.state.nj.us/transportati">https://www.state.nj.us/transportati</a>		
NEW MEXICO		35 % binder replacement by mass	417.2.3 pg 206	<a href="http://dot.state.nm.us/content/dam/n">http://dot.state.nm.us/content/dam/n</a>		
NEW YORK		20 % binder replacement by mass	401-2.05 pg 302 -> MM 5.16 pg 21	<a href="https://www.dot.ny.gov/main/busines">https://www.dot.ny.gov/main/busines</a> <a href="https://www.dot.ny.gov/divisions/er">https://www.dot.ny.gov/divisions/er</a>		
NORTH CAROLINA		30 % binder replacement by mass	610-3 pg 616 -> Table 1012.4 pg 10-35	<a href="https://connect.ncdot.gov/resources/S">https://connect.ncdot.gov/resources/S</a> <a href="https://connect.ncdot.gov/projects/">https://connect.ncdot.gov/projects/</a>		
NORTH DAKOTA		25 % binder replacement by mass	430.03-E Page 238	<a href="https://www.dot.nd.gov/divisions/envi">https://www.dot.nd.gov/divisions/envi</a>		
OHIO		20 % binder replacement by mass	Table 401.04-1 pg 172	<a href="http://www.dot.state.oh.us/districts/D">http://www.dot.state.oh.us/districts/D</a>		
OKLAHOMA		25 % binder replacement by mass	Table 708-5 pg 605	<a href="http://www.okladot.state.ok.us/c_mar">http://www.okladot.state.ok.us/c_mar</a>		
OREGON		30 % binder replacement by mass	00744.10 (b) pg 705	<a href="https://www.oregon.gov/ODOT/Busin">https://www.oregon.gov/ODOT/Busin</a>		
PENNSYLVANIA		15 % binder replacement by mass	409.2(e)2.a pg 409-6	<a href="https://www.dot.state.pa.us/public/Pu">https://www.dot.state.pa.us/public/Pu</a>		
RHODE ISLAND		0 % binder replacement by mass	401.02.3(f)	<a href="http://www.dot.ri.gov/documents/doi">http://www.dot.ri.gov/documents/doi</a>		
SOUTH CAROLINA		20 % binder replacement by mass	401.2.2.6.5 pg 193	<a href="https://www.scdot.org/business/pdf/2">https://www.scdot.org/business/pdf/2</a>		
SOUTH DAKOTA		0 % binder replacement by mass	320.2(a) pg 125	<a href="http://www.sddot.com/business/contr">http://www.sddot.com/business/contr</a>		
TENNESSEE		20 % binder replacement by mass	Table 411.03-6 pg 361	<a href="https://www.tn.gov/content/dam/tn/t">https://www.tn.gov/content/dam/tn/t</a>		
TEXAS		30 % binder replacement by mass	Table 2 pg 165	<a href="https://ftp.txdot.gov/pub/txdot-info/c">https://ftp.txdot.gov/pub/txdot-info/c</a>		
UTAH		25 % binder replacement by mass	24(C) pg 02741 13 of 18	<a href="https://www.udot.utah.gov/main/ucor">https://www.udot.utah.gov/main/ucor</a>		
VERMONT		50 % binder replacement by mass	704.10(c) pg 7-21	<a href="https://outside.vermont.gov/agency/V">https://outside.vermont.gov/agency/V</a>		
VIRGINIA		35 % binder replacement by mass	Table 11-14A pg 179	<a href="http://www.virginiaidot.org/business/r">http://www.virginiaidot.org/business/r</a>		
WASHINGTON		40 % binder replacement by mass	Table 4 pg 5-19	<a href="http://www.wsdot.wa.gov/publication">http://www.wsdot.wa.gov/publication</a>		
WEST VIRGINIA	N.S.	% binder replacement by mass	410.4.1 pg 195	<a href="https://transportation.wv.gov/highway">https://transportation.wv.gov/highway</a>		
WISCONSIN		25 % binder replacement by mass	460.2.5 pg 177	<a href="https://wisconsinidot.gov/rdwy/stndsp">https://wisconsinidot.gov/rdwy/stndsp</a>		
WYOMING	N.S.	% binder replacement by mass		<a href="http://www.dot.state.wy.us/files/live/">http://www.dot.state.wy.us/files/live/</a>		

Table 5 Structural PCC Spreadsheet

STATE	ALLOWANCE	UNIT	SPECIFICATION	LINK	LINK 2 if appl	Automatic Calculations	
ALABAMA		30 % cement replacement	section 501 pg 283	<a href="https://www.dot.state.al.us/cor">https://www.dot.state.al.us/cor</a>			
ALASKA		35 % cement replacement	Table 501-2 pg 148	<a href="http://www.dot.state.ak.us/stw">http://www.dot.state.ak.us/stw</a>		<b>AVERAGE (of non-zeros)</b>	25.67567568
ARIZONA		25 % cement replacement	table 1006-A pg 970	<a href="https://www.azdot.gov/docs/bl">https://www.azdot.gov/docs/bl</a>		<b>MEDIAN</b>	25
ARKANSAS		20 % cement replacement	802.02-a pg 659	<a href="https://www.arkansashighways">https://www.arkansashighways</a>		<b>MAXIMUM</b>	30
CALIFORNIA		0 % cement replacement		<a href="http://www.dot.ca.gov/hq/esc/">http://www.dot.ca.gov/hq/esc/</a>		<b>MINIMUM</b>	15
COLORADO	20C/30F	% cement replacement	601.05 pg 498	<a href="https://www.codot.gov/business">https://www.codot.gov/business</a>			
CONNECTICUT		20 % cement replacement	6.01.02 pg 314 -> M.03.01 -c1 pg 575	<a href="https://www.ct.gov/dot/lib/dot">https://www.ct.gov/dot/lib/dot</a>			
DELAWARE	N.S.	% cement replacement	610.02 pg 610-1 -> 1022.03 pg 1022-2	<a href="https://www.deldot.gov/Publica">https://www.deldot.gov/Publica</a>			
FLORIDA		30 % cement replacement	400-2 pg 376 -> Table 2 pg 324	<a href="https://fdotwww.blob.core.winc">https://fdotwww.blob.core.winc</a>			
GEORGIA		15 % cement replacement	500.1.03 pg 471 -> 500.3.04.D.4 pg 482	<a href="http://www.dot.ga.gov/Partner">http://www.dot.ga.gov/Partner</a>			
HAWAII	N.S.	% cement replacement	---	<a href="http://hidot.hawaii.gov/highwa">http://hidot.hawaii.gov/highwa</a>		<b>SUGGESTED 1st %ILE</b>	20
IDAHO		25 % cement replacement	502.01-1(F) pg 279	<a href="http://apps.itd.idaho.gov/apps/">http://apps.itd.idaho.gov/apps/</a>		<b>SUGGESTED 2nd %ILE</b>	25
ILLINOIS	30C/25F	% cement replacement	503.02(A) pg 218-> 1020.05-C-1(B,C) pg 813	<a href="https://idot.illinois.gov/Assets/">https://idot.illinois.gov/Assets/</a>		<b>SUGGESTED 3rd %ILE</b>	30
INDIANA		20 % cement replacement	702.03 pg 526 -> 901.01-B-1(A) pg 848	<a href="https://www.in.gov/dot/div/cor">https://www.in.gov/dot/div/cor</a>			
IOWA		20 % cement replacement	2403.02-B(5)	<a href="https://iowadot.gov/erl/current">https://iowadot.gov/erl/current</a>			
KANSAS		25 % cement replacement	710.2 pg 1 -> Table 401-2 pg 400-3	<a href="https://www.ksdot.org/Assets/">https://www.ksdot.org/Assets/</a>	<a href="https://www.ksdot.org/A">https://www.ksdot.org/A</a>		
KENTUCKY	30C/20F	% cement replacement	601.03.03-2(A) pg 601-11	<a href="https://transportation.ky.gov/C">https://transportation.ky.gov/C</a>			
LOUISIANA		30 % cement replacement	805.02 pg 619 -> 901.08.2-F pg 921	<a href="http://www.sp.dotd.la.gov/Insid">http://www.sp.dotd.la.gov/Insid</a>			
MAINE		0 % cement replacement		<a href="https://www.maine.gov/mdot/c">https://www.maine.gov/mdot/c</a>			
MARYLAND		25 % cement replacement	520.02 pg 561 -> Table 902 B pg 801	<a href="https://www.roads.maryland.gc">https://www.roads.maryland.gc</a>			
MASSACHUSETTS	N.S.	% cement replacement		<a href="https://www.mass.gov/files/dot">https://www.mass.gov/files/dot</a>			
MICHIGAN	N.S.	% cement replacement	Section 701	<a href="https://mdotboss.state.mi.us/S">https://mdotboss.state.mi.us/S</a>			
MINNESOTA		30 % cement replacement	Section 2411.2A -> Table 2461-6	<a href="http://www.dot.state.mn.us/pr">http://www.dot.state.mn.us/pr</a>			
MISSISSIPPI		25 % cement replacement	601.02.1 pg 377 -> 804.2 -> 714.05 -> 701.02.2 pg 719	<a href="http://sp.mdot.ms.gov/Constru">http://sp.mdot.ms.gov/Constru</a>			
MISSOURI		25 % cement replacement	703.2 pg 400 -> 501.14.1 pg 232	<a href="https://www.modot.org/sites/d">https://www.modot.org/sites/d</a>			
MONTANA		30 % cement replacement	552.02 pg 251 -> 551.03.2 pg 229	<a href="https://www.mdt.mt.gov/other">https://www.mdt.mt.gov/other</a>			
NEBRASKA		25 % cement replacement	1002.02-3 pg 775 -> 1004.02-2 pg 787	<a href="https://dot.nebraska.gov/media">https://dot.nebraska.gov/media</a>			
NEVADA	20M	% cement replacement	502.02.01 pg 219 -> 501.02.03 pg 208	<a href="https://www.nevadadot.com/hc">https://www.nevadadot.com/hc</a>			
NEW HAMPSHIRE	25M	% cement replacement	520: 2.11.1.1.2	<a href="https://www.nh.gov/dot/org/pr">https://www.nh.gov/dot/org/pr</a>			
NEW JERSEY		25 % cement replacement	504.02.01 pg 231 -> 903.01 pg 429	<a href="https://www.state.nj.us/transpc">https://www.state.nj.us/transpc</a>			
NEW MEXICO	25M	% cement replacement	511.2.1 pg 351 -> 509.2.7.2 Option 2 pg 326	<a href="http://dot.state.nm.us/content/">http://dot.state.nm.us/content/</a>			
NEW YORK		21 % cement replacement	555-2.01 pg 474 -> 501-2.02 pg 392 -> 701-3 pg 960	<a href="https://www.dot.ny.gov/main/t">https://www.dot.ny.gov/main/t</a>			
NORTH CAROLINA		30 % cement replacement	420-2 pg 4-24 -> 1000-3(I) pg 10-7	<a href="https://connect.ncdot.gov/reso">https://connect.ncdot.gov/reso</a>			
NORTH DAKOTA		29 % cement replacement	602.03 pg 299 -> 802.01(G) pg 456	<a href="https://www.dot.nd.gov/divisio">https://www.dot.nd.gov/divisio</a>			
OHIO		25 % cement replacement	511.02 pg 342 -> Table 499.03-2 pg 302	<a href="http://www.dot.state.oh.us/Div">http://www.dot.state.oh.us/Div</a>			
OKLAHOMA		20 % cement replacement	509.02 pg 346 -> Table 701:2 pg 552	<a href="http://www.okladot.state.ok.us">http://www.okladot.state.ok.us</a>			
OREGON		30 % cement replacement	00540.10 pg 439 -> 02001.31(B) pg 985	<a href="https://www.oregon.gov/ODOT">https://www.oregon.gov/ODOT</a>			
PENNSYLVANIA		15 % cement replacement	1001.2 pg 1001-1 -> 704.1(C)-2 pg 704-3	<a href="https://www.dot.state.pa.us/pu">https://www.dot.state.pa.us/pu</a>			
RHODE ISLAND		30 % cement replacement	Table 2 Footnotes:2 pg 6-7	<a href="http://www.dot.ri.gov/documer">http://www.dot.ri.gov/documer</a>			
SOUTH CAROLINA		20 % cement replacement	702.2.1 pg 538 -> 701.4.9-C pg 535	<a href="https://www.scdot.org/business">https://www.scdot.org/business</a>			
SOUTH DAKOTA		25 % cement replacement	460.3 Table 1*3 pg 308	<a href="http://www.sddot.com/business">http://www.sddot.com/business</a>			
TENNESSEE		25 % cement replacement	Table 604.03-3 pg 524	<a href="https://www.tn.gov/content/da">https://www.tn.gov/content/da</a>			
TEXAS		35 % cement replacement	529.2 pg 733 -> 421.4.2.6 pg 471	<a href="https://ftp.txdot.gov/pub/txdot">https://ftp.txdot.gov/pub/txdot</a>			
UTAH		30 % cement replacement	03310-1.2 -> 03055-2.2-A-2(1)	<a href="https://www.udot.utah.gov/mai">https://www.udot.utah.gov/mai</a>			
VERMONT		20 % cement replacement	541.03 pg 5-161	<a href="https://outside.vermont.gov/ag">https://outside.vermont.gov/ag</a>			
VIRGINIA		30 % cement replacement	302.02(h) pg 327 -> 217.02(a) pg 201	<a href="http://www.virginiadot.org/bus">http://www.virginiadot.org/bus</a>			
WASHINGTON		35 % cement replacement	6-02.2 pg 6-4 -> 9-01.2(1)B-1 pg 9-2	<a href="https://www.wsdot.wa.gov/pub">https://www.wsdot.wa.gov/pub</a>			
WEST VIRGINIA		0 % cement replacement		<a href="https://transportation.wv.gov/h">https://transportation.wv.gov/h</a>			
WISCONSIN		30 % cement replacement	501.2.1 pg 193	<a href="https://wisconsin.dot.gov/rdwv/">https://wisconsin.dot.gov/rdwv/</a>			
WYOMING		20 % cement replacement	513.4.4 pg 518	<a href="http://www.dot.state.wy.us/file">http://www.dot.state.wy.us/file</a>			

Table 6 PCCP Spreadsheet

STATE	ALLOWANCE	UNIT	SPECIFICATION	LINK	LINK 2 IF appl	
ALABAMA		30 % cement replacement	450.02-D	<a href="https://www.dot.state.al.us/com">https://www.dot.state.al.us/com</a>		Automatic Calculations
ALASKA	N.S.	% cement replacement	----	<a href="http://www.dot.state.ak.us/stwc">http://www.dot.state.ak.us/stwc</a>		AVERAGE (of non-zeros) 25.63888889
ARIZONA		25 % cement replacement	Table 1006-A pg 970	<a href="https://www.azdot.gov/docs/bus">https://www.azdot.gov/docs/bus</a>		MEDIAN 25
ARKANSAS		20 % cement replacement	501.02-A pg 318	<a href="https://www.arkansashighways.c">https://www.arkansashighways.c</a>		MAXIMUM 35
CALIFORNIA		0 % cement replacement		<a href="http://www.dot.ca.gov/hq/esc/o">http://www.dot.ca.gov/hq/esc/o</a>		MINIMUM 15
COLORADO	20C/30F	% cement replacement	412.04 pg 355 -> 601.05 pg 498	<a href="https://www.codot.gov/business">https://www.codot.gov/business</a>		
CONNECTICUT		20 % cement replacement	4.01.02 pg 314 -> M.03.01-C1 pg 575	<a href="https://www.ct.gov/dot/lib/dot/">https://www.ct.gov/dot/lib/dot/</a>		
DELAWARE	N.S.	% cement replacement	501.03.1 pg 501-2 -> 1022.03 pg 1022-2	<a href="https://www.deldot.gov/Publicat">https://www.deldot.gov/Publicat</a>		
FLORIDA		30 % cement replacement	350-2 pg 347 -> Table 2 pg 324	<a href="https://fdotwww.blob.core.wind">https://fdotwww.blob.core.wind</a>		
GEORGIA		15 % cement replacement	430.2-A pg 362	<a href="http://www.dot.ga.gov/PartnerS">http://www.dot.ga.gov/PartnerS</a>		
HAWAII	N.S.	% cement replacement	----	<a href="http://hidot.hawaii.gov/highway">http://hidot.hawaii.gov/highway</a>		SUGGESTED 1st %ILE 20
IDAHO		25 % cement replacement	409.01-1(G) pg 226	<a href="http://apps.itd.idaho.gov/apps/r">http://apps.itd.idaho.gov/apps/r</a>		SUGGESTED 2nd %ILE 25
ILLINOIS	30C/25F	% cement replacement	420.02(A) pg 218 -> 1020.05-C-1(B,C) pg 813	<a href="https://idot.illinois.gov/Assets/ur">https://idot.illinois.gov/Assets/ur</a>		SUGGESTED 3rd %ILE 30
INDIANA		20 % cement replacement	501.03 pg 340 -> 901.01-B-1(A) pg 848	<a href="https://www.in.gov/dot/div/cont">https://www.in.gov/dot/div/cont</a>		
IOWA		20 % cement replacement	2301.02-B(6)	<a href="https://iowadot.gov/eri/current/">https://iowadot.gov/eri/current/</a>		
KANSAS		25 % cement replacement	501.3 pg 500-4 -> Table 401-2 pg 400-3	<a href="https://www.ksdot.org/Assets/w">https://www.ksdot.org/Assets/w</a>	<a href="https://www.ksdot.org">https://www.ksdot.org</a>	
KENTUCKY	30C/20F	% cement replacement	501.02.01 pg 501-1 -> 601.03.03-C-2(A) pg 601-11	<a href="https://transportation.ky.gov/Co">https://transportation.ky.gov/Co</a>	<a href="https://transportation.ky.gov">https://transportation.ky.gov</a>	
LOUISIANA		30 % cement replacement	601.02 pg 308 -> 901.08.2-F pg 921	<a href="http://wwwvsp.dotd.la.gov/Inside">http://wwwvsp.dotd.la.gov/Inside</a>		
MAINE		0 % cement replacement		<a href="https://www.maine.gov/mdot/cc">https://www.maine.gov/mdot/cc</a>		
MARYLAND		25 % cement replacement	420.02 pg 347 -> Table 902 B pg 801	<a href="https://www.roads.maryland.gov">https://www.roads.maryland.gov</a>		
MASSACHUSETTS	N.S.	% cement replacement		<a href="https://www.mass.gov/files/doci">https://www.mass.gov/files/doci</a>		
MICHIGAN		20 % cement replacement	Table 601-2(M) pg 299	<a href="https://mdotjboss.state.mi.us/Sp">https://mdotjboss.state.mi.us/Sp</a>		
MINNESOTA		33 % cement replacement	Table 2301-4 pg 136	<a href="http://www.dot.state.mn.us/pre">http://www.dot.state.mn.us/pre</a>		
MISSISSIPPI		25 % cement replacement	501.02 pg 338 -> 701.02.2 pg 719	<a href="http://sp.mdot.ms.gov/Construct">http://sp.mdot.ms.gov/Construct</a>		
MISSOURI		25 % cement replacement	502.2 pg 235 -> 501.14.1 pg 232	<a href="https://www.modot.org/sites/de">https://www.modot.org/sites/de</a>		
MONTANA		30 % cement replacement	501.02.1 pg 209 -> 551.02.1 pg 225 -> 551.03.2A-5(a) pg 229	<a href="https://www.mdt.mt.gov/other/">https://www.mdt.mt.gov/other/</a>		
NEBRASKA		25 % cement replacement	1002.02-3 pg 775 -> 1004.02-2 pg 787	<a href="https://dot.nebraska.gov/media/">https://dot.nebraska.gov/media/</a>		
NEVADA	20M	% cement replacement	409.02.01 pg 185 -> 501.02.03 pg 208	<a href="https://www.nevadadot.com/ho">https://www.nevadadot.com/ho</a>		
NEW HAMPSHIRE	25M	% cement replacement	520. 2.11.1.1.2	<a href="https://www.nh.gov/dot/org/prc">https://www.nh.gov/dot/org/prc</a>		
NEW JERSEY		25 % cement replacement	405.02.01 pg 172 -> 903.01 pg 429	<a href="https://www.state.nj.us/transpo">https://www.state.nj.us/transpo</a>		
NEW MEXICO	25M	% cement replacement	450.2 pg 235 -> 509.2.7.2 Option 2 pg 326	<a href="http://dot.state.nm.us/content/c">http://dot.state.nm.us/content/c</a>		
NEW YORK		21 % cement replacement	502-2 pg 411 -> 501-2.02 pg 392 -> 701-03 pg 960	<a href="https://www.dot.ny.gov/main/bu">https://www.dot.ny.gov/main/bu</a>		
NORTH CAROLINA		30 % cement replacement	710-2 pg 7-12 -> 1000-3(I) pg 10-7	<a href="https://connect.ncdot.gov/resou">https://connect.ncdot.gov/resou</a>		
NORTH DAKOTA		29 % cement replacement	550.03 pg 261 -> 802.01(G) pg 456	<a href="https://www.dot.nd.gov/division">https://www.dot.nd.gov/division</a>		
OHIO		25 % cement replacement	452.02 pg 288 -> 451.02 pg 267 -> Table 499.03-2 pg 302	<a href="http://www.dot.state.oh.us/Divi">http://www.dot.state.oh.us/Divi</a>		
OKLAHOMA		20 % cement replacement	414.02 pg 232 -> Table 701:2 pg 552	<a href="http://www.okladot.state.ok.us/">http://www.okladot.state.ok.us/</a>		
OREGON		30 % cement replacement	00756.13 pg 768 -> 02001.31(B) pg 985	<a href="https://www.oregon.gov/ODOT/">https://www.oregon.gov/ODOT/</a>		
PENNSYLVANIA		15 % cement replacement	501.2 pg 501-1 -> 704.1(C)-2 pg 704-3	<a href="https://www.dot.state.pa.us/pu">https://www.dot.state.pa.us/pu</a>		
RHODE ISLAND		30 % cement replacement	501.03.1 pg 5-1 -> Table 2 Footnotes:2 pg 6-7	<a href="http://www.dot.ri.gov/documen">http://www.dot.ri.gov/documen</a>		
SOUTH CAROLINA		20 % cement replacement	501.2.1 pg 251 -> 701.4.9-C pg 535	<a href="https://www.scdot.org/business">https://www.scdot.org/business</a>		
SOUTH DAKOTA		25 % cement replacement	380.3A pg 194	<a href="http://www.sddot.com/business">http://www.sddot.com/business</a>		
TENNESSEE		25 % cement replacement	Table 501.03-3 pg 397	<a href="https://www.tn.gov/content/dar">https://www.tn.gov/content/dar</a>		
TEXAS		35 % cement replacement	360.2.1 pg 389 -> 421.4.2.6 pg 471	<a href="https://ftp.txdot.gov/pub/txdot-i">https://ftp.txdot.gov/pub/txdot-i</a>		
UTAH		30 % cement replacement	02752-1.2 -> 03055-2.2-A-2(1)	<a href="https://www.udot.utah.gov/mair">https://www.udot.utah.gov/mair</a>		
VERMONT		0 % cement replacement	N.S.	<a href="https://outside.vermont.gov/age">https://outside.vermont.gov/age</a>		
VIRGINIA		30 % cement replacement	316.02(a) pg 415 -> 217.02(a) pg 201	<a href="http://www.virginiadot.org/busir">http://www.virginiadot.org/busir</a>		
WASHINGTON		35 % cement replacement	5-05.2 pg 5-43 -> 9-01.2(1)B-1 pg 9-2	<a href="https://www.wsdot.wa.gov/publ">https://www.wsdot.wa.gov/publ</a>		
WEST VIRGINIA		0 % cement replacement		<a href="https://transportation.wv.gov/hj">https://transportation.wv.gov/hj</a>		
WISCONSIN		30 % cement replacement	415.2.1 pg 146 -> 501.2.1 pg 193	<a href="https://wisconsindot.gov/rdwy/s">https://wisconsindot.gov/rdwy/s</a>		
WYOMING		25 % cement replacement	414.4.7 pg 377	<a href="http://www.dot.state.wy.us/files">http://www.dot.state.wy.us/files</a>		