TITLE

Author (First Last), Position

Organization

Section/College/Department

Month Year

Research Project

Reporting on Project # (VTrans Assigned)

Final Report YEAR-## (VTrans Assigned)

Notes:

* **Section 508 accessibility requirement:** Add the document properties information (report title, author, subject and tags/keywords) available in the **Info** option of the **File** tab.
* **Section 508 accessibility requirement:** Use a sans-serif typeface such as Calibri (which is used in this template) or Arial throughout the report. *Do not use Times New Roman.*
* **Section 508 accessibility requirement:** When the report is completed, use the accessibility checkers described in*Section 508 Accessibility: Guidelines for Using the Research Report Template* to ensure all elements of the report comply with federal accessibility requirements.
* For more information about completing the research report template, contact [Emily Parkany [emily.parkany@vermont.gov](mailto:emily.parkany@vermont.gov)]

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The information contained in this report was compiled for the use of the Vermont Agency of Transportation. Conclusions and recommendations contained herein are based upon the research data obtained and the expertise of the researchers and are not necessarily to be construed as Agency policy. This report does not constitute a standard, specification, or regulation. The Vermont Agency of Transportation assumes no liability for its contents or the use thereof.

This material is based upon work supported by the Federal Highway Administration under SPR [insert work project]. Any opinions, findings and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the Federal Highway Administration.

Notes:

* Styles:
  + Disclaimer header: Headings Not Included in ToC
  + Text: Normal

Technical Report Documentation Page

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1. Report No.  YEAR-## (VTrans Assigned) | 2. Government Accession No. | | 3. Recipient’s Catalog No. | | |
| 4. Title and Subtitle  [Report Title] | | | 5. Report Date  [Month Year] | | |
| 6. Performing Organization Code | | |
| 7. Author(s)  [Author name (Last, First), ORCID number and ORCID URL] | | | 8. Performing Organization Report No. | | |
| 9. Performing Organization Name and Address  [Organization name]  [Organization address] | | | 10. Work Unit No. (trais) | | |
| 11. Contract or Grant No.  # (VTrans Assigned) | | |
| 12. Sponsoring Agency Name and Address  Vermont Agency of Transportation (SPR)  Research Program  219 N Main St  Barre VT 05641 | | | 13. Type of Report and Period Covered  Final Report YEAR-YEAR | | |
| 14. Sponsoring Agency Code | | |
| 15. Supplementary Notes  Conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration.  HYPERLINK TO REPORT (VTrans Assigned) | | | | | |
| 16. Abstract  [Description of project in 200 to 250 words] | | | | | |
| 17. Key Words  [Keywords] | | 18. Distribution Statement  No restrictions. This document is available through the National Technical Information Service, Springfield, VA 22161. | | | |
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[Title Page: Insert Report Title]

*By*

[Author Name(s)]

[Performing Organization]

*Prepared for*

[Name of Sponsoring Organization]

[Month Year]

**Final Report**

[Report Number, If Applicable]

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Notes:

* Styles for the title page:
  + Report title: Title
  + All other information: Report Header Text

Acknowledgments

[Insert text]

Notes:

* Including acknowledgments is optional.
* Insert a page break at the end of the page.
* Styles:
  + Acknowledgment header: Headings Not Included in ToC
  + Text: Normal

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Notes:

* When the built-in Styles feature is used correctly, the table of contents is automatically generated.
* When the research report is completed, update the table of contents (right-click within the table, select **Update Field** and select **Update Entire Table**).
* Insert a page break at the end of the table of contents.
* Styles:
  + Table of Contents header: Headings Not Included in ToC
  + Text: Normal

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Notes:

* When the caption option of the built-in Styles feature is used correctly, the list of tables is automatically generated.
* When the research report is completed, update the list of tables (right-click within the table, select **Update Field** and select **Update Entire Table**).
* Insert a page break at the end of the list of tables.
* Styles:
  + List of Tables header: Headings Not Included in ToC
  + Text: Normal

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Notes:

* When the caption option of the built-in Styles feature is used correctly, the list of figures is automatically generated.
* When the research report is completed, update the list of figures (right-click within the table, select **Update Field** and select **Update Entire Table**).
* Insert a page break at the end of the list of figures.
* Styles:
  + List of Figures header: Headings Not Included in ToC
  + Text: Normal

List of Equations

[Equation 1. Annualized Cost of Pavement Treatment 12](#_Toc137643007)

Notes:

* When the caption option of the built-in Styles feature is used correctly, the list of equations is automatically generated.
* When the research report is completed, update the list of equations (right-click within the table, select **Update Field** and select **Update Entire Table**).
* Insert a page break at the end of the list of equations.
* Styles:
  + List of Equations header: Headings Not Included in ToC
  + Text: Normal

List of Abbreviations and Acronyms

23 CFR 420 Code of Federal Regulations, Title 23, Part 420

DOT department of transportation

FHWA Federal Highway Administration

NTL National Transportation Library

ROSA P Repository & Open Science Access Portal

Notes:

* Delete the examples above and replace them with relevant abbreviations and acronyms used within the report.
* Insert a page break at the end of the list of abbreviations and acronyms.
* Styles:
  + List of Abbreviations and Acronyms header: Headings Not Included in ToC
  + Text: Normal

# Executive Summary

[Insert the executive summary, which generally ranges in length from one to three pages. It is the only chapter in the report that is not numbered.]

Notes:

* Insert a page break at the end of the executive summary.
* Styles:
  + Executive Summary header: Heading 1
  + Text: Normal

# Chapter 1. Introduction [or Other Appropriate Title]

[Examples of three levels of subheadings are provided below.]

## [Second-Level Subheading]

[Insert paragraphs of text.]

### [Third-Level Subheading]

[Insert paragraphs of text.]

#### [Fourth-Level Subheading]

[Insert paragraphs of text.]

Notes:

* Insert a page break at the end of the chapter.
* Styles:
  + Chapter title: Heading 1
  + Second-level subheading: Heading 2
  + Third-level subheading: Heading 3
  + Fourth-level subheading: Heading 4
  + Text: Normal

# Chapter 2. [Insert Title]

[Below are guidelines for creating tables that meet Section 508 accessibility requirements. Sample tables are provided following these guidelines. Delete the instructions and examples from the research report.]

## Using Tables in a Report

**Section 508 accessibility requirements:**

* Use simple data tables in reports in which the data in each cell corresponds to a single heading level and row (see Table 1). Don’t create complex data tables—those that present data in tables with multilevel headings and split or merged cells. Complex data tables cannot be made accessible.
* Only use tables to display data. Don’t use tables to organize and arrange images or text on a page or to format the layout of a page in any way.
* To create tables in Word, select the **Table** feature from the **Insert** tab. Don’t paste or insert an Excel table or a table as an image.
  + Populate the table with column labels, row labels and the data.
    - Only use one row of column headers and one column of row headers. Don’t merge or split cells.
    - Present all text horizontally. Vertical text in a table (such as in a column header) is not 508-compliant.
  + Create the table header row by selecting the row of column labels and right-clicking on the table.
    - Select **Table Properties**, and then select the **Row** tab.
    - In the **Options** field:
      * Uncheck **Allow row to break across pages**.
      * Check **Repeat as header row at the top of each page**.
      * Click **OK**.
* Don’t leave cells blank. Add a dash (—) or use “N/A” or similar text. ***Note***: “Blank” or “No Data” could be inserted in white font to be visible only to assistive technology.
* Don’t use blank rows or columns for spacing. Instead, adjust the height or width of the rows or columns containing data.
* Add alt text to each table.
  + Right-click on the table and select **Table Properties** from the drop-down menu.
  + Click on the **Alt Text** tab and type a description of the table in the **Title** and **Description** fields.
* Insert a numbered caption above each table, not in the first row of the table.
  + From the **References** tab, select **Insert Caption**.
  + In the **Caption** menu, select the numbering style from the **Numbering** option.
  + Type the table name in the **Caption** field.
  + Select **Table** from the drop-down menu in the **Label** field.
  + Click **OK**.
  + Center the label above the table.
* If color, shading or bolding is used in a table:
  + Convey the information in an additional way to ensure accessibility. Screen readers and assistive technologies only recognize the underlying text, not its physical appearance.
  + Users with partial sight often experience limited color vision. Some older users may not be able to see color well.
  + Users who have color-blindness benefit when information conveyed by color is available in other visual ways. Color cannot be used as the only visual means to convey information.
  + In tables, do not use:
    - Light on light or dark on dark colors
    - Dark labels on a dark segment and/or light segments on a white background
  + Avoid the following color combinations:
    - Blue and grey
    - Blue and purple
    - Green and black
    - Green and brown
    - Green and grey
    - Green and red
    - Light green and yellow
  + More information about using color is available at <https://blog.datawrapper.de/colorblindness-part2/>.
  + Ensure appropriate levels of color contrast—a ratio that represents the difference in brightness of the color of the text and the background color. For example, black text on a white background, has a ratio of 21:1. Specific contrast ratios are recommended depending on the text size:
    - Standard font size: The contrast ratio should be greater than or equal to 4.5:1.
    - Large font size: A contrast ratio of 3:1 should be used for font that is at least 14 point and bolded or 18 point and not bolded.

To review the report for inaccessible color contrast:

* + - Run Word’s accessibility checker and manually check each instance where color is used.
    - Use the [Colour Contrast Analyser](https://www.paciellogroup.com/resources/contrastanalyser) or [WebAIM Contrast Checker](https://webaim.org/resources/contrastchecker/) to check the color contrast.

To use the [Colour Contrast Analyser](https://www.paciellogroup.com/resources/contrastanalyser):

* + - Open and download the tool.
    - Select the **eyedropper** icon in the **Foreground colour** section. A circle will appear with a small square in the center.
    - Use the cursor to drag the small square over a pixel of text in question and select the pixel. The color and its identifier will appear in the **Foreground colour** section.
    - Select the **eyedropper** icon in **the Background colour** section and repeat the previous two steps, selecting a pixel in the background.
    - The contrast ratio will be displayed in the WCAG 2.1 results section. If the contrast ratio is inaccessible, change the font or background color and recheck.

To use the [WebAIM Contrast Checker](https://webaim.org/resources/contrastchecker/):

* + - Open the online tool.
    - Find the hex values of the colors being tested.
    - Select a sampling of the text to be tested.
    - Right-click and select the drop-down menu for font color.
    - Select **More Colors**. The color being identified will show in the box in the lower right corner labeled **Current**.
    - Click on the **Custom** tab. The hex value is at the bottom, preceded by a hashtag. ***Note***: The hex value may contain numerical values and/or letters.
    - Return to the [WebAIM Contrast Checker](https://webaim.org/resources/contrastchecker/). Type the hex value in the **Foreground Color** section.
    - If the background color is other than white (#FFFFFF), repeat the previous steps by right-clicking on the background color instead of selecting a sampling of the text. Return to the [WebAIM Contrast Checker](https://webaim.org/resources/contrastchecker/) and type the hex value in the **Background Color** section.
    - The contrast ratio will appear, indicating whether the color combination is accessible for normal and large text. If the contrast ratio is inaccessible, change the font or background color and recheck.

Below are two sample tables that meet Section 508 accessibility requirements. Examples of alt text for each table are also provided. Alt text may also be viewed within the table by highlighting the table, selecting **Table Properties** and selecting **Alt Text**.

Table 1. Nonstandard Traffic Signs Used for Pedestrian and Cyclist Safety

| **District** | **Bike Lane Signs** | **Bus Stop Signs** | **Flashing Stop Signs** | **Hybrid Beacons** | **Parking/Biking Signs** | **Trail Signs** |
| --- | --- | --- | --- | --- | --- | --- |
| **1** | 17 | 6 | 4 | 12 | 5 | 5 |
| **2** | 22 | 8 | 5 | 15 | 7 | 7 |
| **3** | 5 | 1 | 0 | 2 | 0 | 0 |
| **4** | 14 | 5 | 4 | 10 | 5 | 6 |
| **5** | 9 | 2 | 0 | 4 | 0 | 4 |

[Alt text: Table 1. Nonstandard Traffic Signs Used for Pedestrian and Cyclist Safety]

Table 2. Examples of Accessible Color Contrast

| **Traffic Mode** | **Percentage** |
| --- | --- |
| Automobile | 42% |
| Pedestrian | 15% |
| Transit | 18% |
| Truck | 25% |

| **Traffic Mode** | **Percentage** |
| --- | --- |
| Automobile | 42% |
| Pedestrian | 15% |
| Transit | 18% |
| Truck | 25% |

[Alt text: Table 2. Examples of Accessible Color Contrast]

Notes:

* Insert a page break at the end of the chapter.
* Styles:
  + Chapter title: Heading 1
  + Second-level subheading: Heading 2
  + Text: Normal
  + Bulleted list: List Paragraph

# Chapter 3. [Insert Title]

[Below are guidelines for using figures that meet Section 508 accessibility requirements in a report. This guidance applies to charts, graphs, photos, illustrations, images, objects and other visual elements that are included in a research report. Sample figures are provided following these guidelines. Delete the instructions and examples from the research report.]

## Using Figures in a Report

**Section 508 accessibility requirements:**

* Add alt text to each figure to describe what is shown in the photo.
  + Right-click on the image.
  + Select **View Alt Text** and enter alt text in the blank field. (***Note***: Alt text that is automatically generated doesn’t always accurately describe an image. Review any autogenerated alt text and revise as needed.)
  + If the element is a decorative object, check the **Mark as decorative** box. Don’t enter alt text in the blank field.
* Position each figure in line with text:
  + Right-click on the image.
  + Select **Wrap Text**.
  + Select **In Line with Text**.
* If color is used in a chart or graph to convey meaning, descriptive text or a pattern must also be used to make the document accessible to users with visual impairments. (Note the use of numerical values and a legend in Figure 2.)
  + Users with partial sight often experience limited color vision. Some older users may not be able to see color well.
  + Users who have color-blindness benefit when information conveyed by color is available in other visual ways. Color cannot be used as the only visual means to convey information.
  + In graphs and charts, do not use:
    - Light on light or dark on dark colors
    - Dark labels on a dark segment of a bar graph and/or light segments on a white background
  + Avoid the following color combinations:
    - Blue and grey
    - Blue and purple
    - Green and black
    - Green and brown
    - Green and grey
    - Green and red
    - Light green and yellow
  + More information about using color is available at <https://blog.datawrapper.de/colorblindness-part2/>.
* If color is used in a chart or graph, ensure appropriate levels of color contrast—a ratio that represents the difference in brightness of the color of the text and the background color. For example, black text on a white background has a ratio of 21:1. Specific contrast ratios are recommended depending on the text size:
  + Standard font size: The contrast ratio should be greater than or equal to 4.5:1.
  + Large font size: A contrast ratio of 3:1 should be used for font that is at least 14 point and bolded or 18 point and not bolded.

To review the report for inaccessible color contrast:

* + Run Word’s accessibility checker and manually check each instance where color is used.
  + Use the [Colour Contrast Analyser](https://www.paciellogroup.com/resources/contrastanalyser) or [WebAIM Contrast Checker](https://webaim.org/resources/contrastchecker/) to check the color contrast.

To use the [Colour Contrast Analyser](https://www.paciellogroup.com/resources/contrastanalyser):

* + - Open and download the tool
    - Select the **eyedropper** icon in the **Foreground colour** section. A circle will appear with a small square in the center.
    - Use the cursor to drag the small square over a pixel of text in question and select the pixel. The color and its identifier will appear in the **Foreground colour** section.
    - Select the **eyedropper** icon in **the Background colour** section and repeat the previous two steps, selecting a pixel in the background.
    - The contrast ratio will be displayed in the WCAG 2.1 results section. If the contrast ratio is inaccessible, change the font or background color and recheck.

To use the [WebAIM Contrast Checker](https://webaim.org/resources/contrastchecker/):

* + - Open the online tool.
    - Find the hex values of the colors being tested.
    - Select a sampling of the text to be tested.
    - Right-click and select the drop-down menu for font color.
    - Select **More Colors**. The color being identified will show in the box in the lower right corner labeled **Current**.
    - Click on the **Custom** tab. The hex value is at the bottom, preceded by a hashtag. ***Note***: The hex value may contain numerical values and/or letters.
    - Return to the [WebAIM Contrast Checker](https://webaim.org/resources/contrastchecker/). Type the hex value in the **Foreground Color** section.
    - If the background color is other than white (#FFFFFF), repeat the previous steps by right-clicking on the background color instead of selecting a sampling of the text. Return to the [WebAIM Contrast Checker](https://webaim.org/resources/contrastchecker/) and type the hex value in the **Background Color** section.
    - The contrast ratio will appear, indicating whether the color combination is accessible for normal and large text. If the contrast ratio is inaccessible, change the font or background color and recheck.
* Clearly label all axes and data sets in charts and graphs.
* Insert a numbered caption below each figure.
  + From the **References** tab, select **Insert Caption**.
  + Center the label below the figure.

Below are sample figures that meet Section 508 accessibility requirements. Examples of alt text for each figure are also provided. Alt text may also be viewed by right-clicking within the figure, selecting **Format Figure** and selecting **Alt Text**.

****

Figure 1. Heavy Traffic Outside a Metropolitan Area

Example alt text for Figure 1: Three lanes of a heavily congested highway.

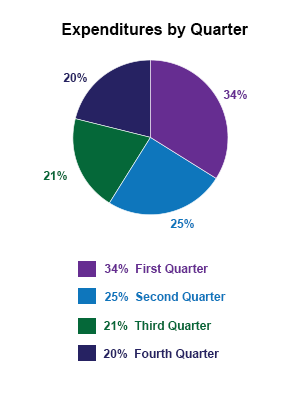
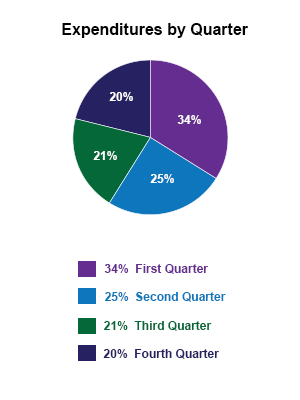
****

Figure 2. Pie Charts Using Color and Descriptive Text to Convey Meaning.   
The color contrast in both charts complies with Section 508 accessibility   
requirements. The first chart places the segment labels outside the pie;  
 the second chart places the segment labels inside the pie.

Example alt text:

**First chart**: An accessible pie chart illustrating expenditures by quarter. First quarter: 34%; second quarter: 25%; third quarter: 21%; and fourth quarter: 20%. The chart includes a legend.

**Second chart**: An accessible pie chart illustrating expenditures by quarter. First quarter: 34%; second quarter: 25%; third quarter: 21%; and fourth quarter: 20%. The chart includes a legend.

Notes:

* Insert a page break at the end of the chapter.
* Styles:
  + Chapter title: Heading 1
  + Second-level subheading: Heading 2
  + Text: Normal
  + Bulleted list: List Paragraph

# Chapter 4. [Insert Title]

[Examples of common research report elements and formatting guidance for these elements are provided below. Delete the instructions and examples from the research report.]

## Columns

* **Section 508 accessibility requirement**: Create columns with Word’s column feature. Don’t use tabs or spaces to create the appearance of columns; the content will not be accessible. To create a column:
  + Select the text to be formatted into columns. Then select the **Layout** tab in the document.
  + Open the drop-down menu under **Columns** and select the desired number of columns. The text will now be displayed in the chosen number of columns.
  + Click **OK**.

## Equations

Computers cannot always recognize symbols and characters in mathematical equations and formulas, and screen readers may struggle to voice the equation properly. Below are guidelines for ensuring equations included in a report are accessible.

**Section 508 accessibility requirements**:

* Insert an equation as an image or figure in a PDF. Don’t use Word’s equation function. To insert an equation as an image:
  + Under the **Insert** tab, select **Picture** and **This Device** in the **Illustrations** group. Don’t use the equation function found under this tab.
  + Locate and select the image on your computer.
  + Select **Insert** and position the image of the equation within the document.
  + Define the terms after the equation (see example below).
* Add alt text for the equation:
  + Right-click on the image and select **Edit Alt Text**.
  + Begin with the title of the equation.
  + Next, insert “**Equation reads:** (Use words and terms instead of symbols to describe the equation’s operators and symbols. For example, use “equals” instead of the equal sign (=).).”
  + End the description with “**Terms are defined in the report narrative.**”
* Insert a numbered caption below each equation.
  + From the **References** tab, select **Insert Caption**.
  + Type the equation name in the **Caption** field.
  + Select **Equation** from the drop-down menu in the **Label** field.
  + Click **OK**.
  + Center the label below the equation.

Below is a sample use of an equation as an image with defined terms, caption and alt text. The alt text can also be viewed by right-clicking on the image, selecting **Format Picture** and selecting **Alt Text**.

The annualized cost of the pavement treatment is first computed using the following equation:

Equation defining the annualized cost of a pavement treatment.

Equation reads: annual cost equals begin fraction C multiplied by R divided by 1 minus begin parenthesis 1 plus R end parenthesis multiplied by N squared end fraction.

Terms are defined in the report narrative.

Where:

C = treatment cost

R = discount rate (as a decimal)

N = expected service life (years)

Equation 1. Annualized Cost of Pavement Treatment

Alt text for the equation:

Equation defining the annualized cost of a pavement treatment. Equation reads: annual cost equals begin fraction C multiplied by R divided by 1 minus begin parenthesis 1 plus R end parenthesis multiplied by N squared end fraction. Terms are defined in the report narrative.

## Hyperlinks

**Section 508 accessibility requirements:**

* Hyperlink a descriptive word or phrase, not phrases such as “Click here” or “this link.” The linked context should describe a destination, function or purpose. To link text in a document:
  + Select the text to be linked.
  + Right-click on the selected item and select **Hyperlink** from the drop-down menu.
  + In the **Insert Hyperlink** menu, check that the descriptive text is in the **Text to display** field. In the **Address field**, type the URL.
  + Click **OK.**
* Don’t spell out hyperlinks.

Below is an example of hyperlinked text that meets federal Section 508 accessibility requirements:

Search for [FHWA research projects](https://highways.dot.gov/research/turner-fairbank-highway-research-center/projects-search) to view recent studies.

## In-Text Citations

Include all cited publications, manuals, journal articles, conference presentations, websites and related resources in the final chapter of the research report (titled “References”). See the **References** chapter of this template for formatting examples.

To cite a reference within the research report, use the author-date system—author’s last name and the publication date; if appropriate, page number.

For example:

Two primary damaging effects caused by frost action include reduction of subgrade support strength during spring thaw and differential frost heaving (MacKay, Hein and Emery 1992, 79-89).

Below are the formatting styles of in-text citations for common resources:

*Books, research reports, manuals, journal articles, conference presentations*:

(Smith 2019, 27)

(Jones 2018, 213-229)

*Websites:*

(Miller 2021)

(Federal Highway Administration, n.d.)

*Personal communication*:

(Anne Hanson, email correspondence to author, Nov. 17, 2022)

## Lists

**Section 508 accessibility requirements**:

* Use the built-in features for bulleted or numbered lists in this research report template.
* Create lists using **Word’s bullet** or **number** feature in the **Styles** group. Don’t use tabs, dashes or asterisks in place of bullets.

Example of the built-in style for bulleted lists:

* Level 1
  + Level 2
    - Level 3

Example of the built-in style for numbered lists:

1. Level 1
   1. Level 2
      1. Level 3

## Text Boxes

* **Section 508 accessibility requirement:** Place text boxes in line with text to make the content accessible.
  + **Click on the text box** to check or remediate a text box. Then select the **Layout** tab in the document.
  + In the **Arrange** group, open the drop-down menu under **Position** and select **In Line with Text**.

Notes:

* Insert a page break at the end of the chapter.
* Styles:
  + Chapter title: Heading 1
  + Second-level subheading: Heading 2
  + Text: Normal
  + Bulleted list: List Paragraph

# Chapter 5. [Insert Title]

[Insert paragraphs of text.]

Notes:

* Insert a page break at the end of the chapter.
* Styles:
  + Chapter title: Heading 1
  + Text: Normal

# Chapter 6. [Insert Title]

[Insert paragraphs of text.]

Notes:

* Insert a page break at the end of the chapter.
* Styles:
  + Chapter title: Heading 1
  + Text: Normal

# References

[Follow the examples below to format publications and other sources cited in the research report. Delete the examples and bracketed copy in the final research report.]

* Provide complete references, including the author name(s); publication date; article title; chapter, publication, journal or report title; conference title; publisher or agency sponsoring research; volume and issue number; page number(s); and publication URL.
* List references in alphabetical order.

[*Federal publications*]

Donnell, Eric, Kersavage, Kristin, and Fontana Tierney, Lisa. January 2018. *Self-Enforcing Roadways: A Guidance Report*. Federal Highway Administration. Accessed March 29, 2023. <https://www.fhwa.dot.gov/publications/research/safety/17098/17098.pdf>.

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Notes:

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# Appendix A: [Insert Appendix Title]

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# Appendix B: [Insert Appendix Title]

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