

**NCHRP Project 20-107**

# **Effective Construction Project Staffing Strategies for Transportation Agencies**

**Electronic Workforce Optimization Workbook (e-WOW) User Guide**

Prepared for  
National Cooperative Highway Research Program  
Transportation Research Board

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**DISCLAIMER**

This is an uncorrected draft as submitted by the research agency. The opinions and conclusions expressed or implied in the report are those of the research agency. They are not necessarily those of the Transportation Research Board, the National Research Council, the Federal Highway Administration, the American Association of State Highway and Transportation Officials, or the individual states participating in the National Cooperative Highway Research Program.

## Overview

The objective of NCHRP Project 20-107 was to develop guidance for construction staffing levels to adequately manage highway construction projects. This objective was accomplished through literature review, staffing strategy case studies (7 states), review of staff forecasting methods (10 states), project surveys (305 projects across 16 states), and a validation workshop (22 participants across 14 states). The results of this research are operationalized in the Workforce Optimization Workbook (WOW) whose content includes:

- Staffing level recommendations based on project type, work type risk projections, consultant construction and engineering inspection staff,
- Methods for planning project staffing allocation at the project specific and regional level,
- Various contracting methods and associated staffing used by transportation agencies,
- 35 specific staffing strategies that may help alleviate construction staff challenges linked by work type and staffing function to assist agency personnel with specific strategy selection,
- Knowledge, skills, and abilities required for construction oversight staff based on construction administration, engineering, inspection, and human resources.

This wealth of information while valuable is organized in a user friendly format but its vastness could be daunting to those desiring quick solutions or feedback. To accommodate the use of this information, a decision support tool was developed, the Electronic Workforce Optimization Workbook (e-WOW). The e-WOW contains the same wealth of information as the WOW but provides user assisted progression through the optimal uses of this information. The e-WOW entails three modules which can be used in sequence or independently.

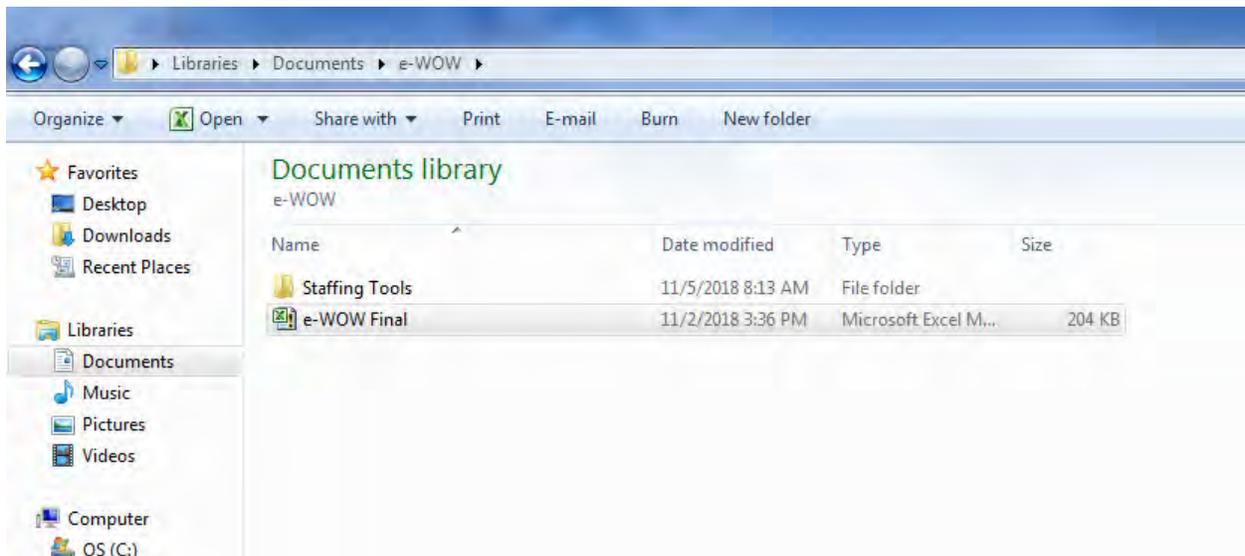
- **Module 1:** Provides general guidance regarding the Engineering and Inspection Full Time Equivalent (FTE) needs for a project. These needs are influenced by project characteristics and the FTE estimate is determined from NCHRP 20-107 project data. The project information and that of subsequent projects can be input into Module 2 for further analysis.
- **Module 2:** Allows the user to input project information (or as uploaded through Module 1) and assign project priorities in order to view the FTE Engineering and Inspection needs on a bar chart diagram. This allows the user the opportunity to attempt several leveling techniques and determine peaks in FTE needs. These needs can influence the use of Module 3.
- **Module 3:** The maximum FTE deficit is indicated from Module 2 to assist in selection of tools for mitigating staff shortages. By indicating the types of work included in an office/district portfolio and the associated risks with those work types, tools are highlighted according to their applicability. The assignment of the work type risk is

experience based when considering the quantity of work, the complexity, the need of FTE presence during installation, and other factors.

While the e-WOW was designed and annotated to provide guidance, explanation, and instructions throughout its progression of steps, some additional guidance is useful for describing the potential use of this tool and how it can be useful in estimating staffing needs and approaches. The e-WOW is designed for PC use only. Mac users will have difficulties using the program successfully. The following document provides guidance on the setup, use, and key features of e-WOW.

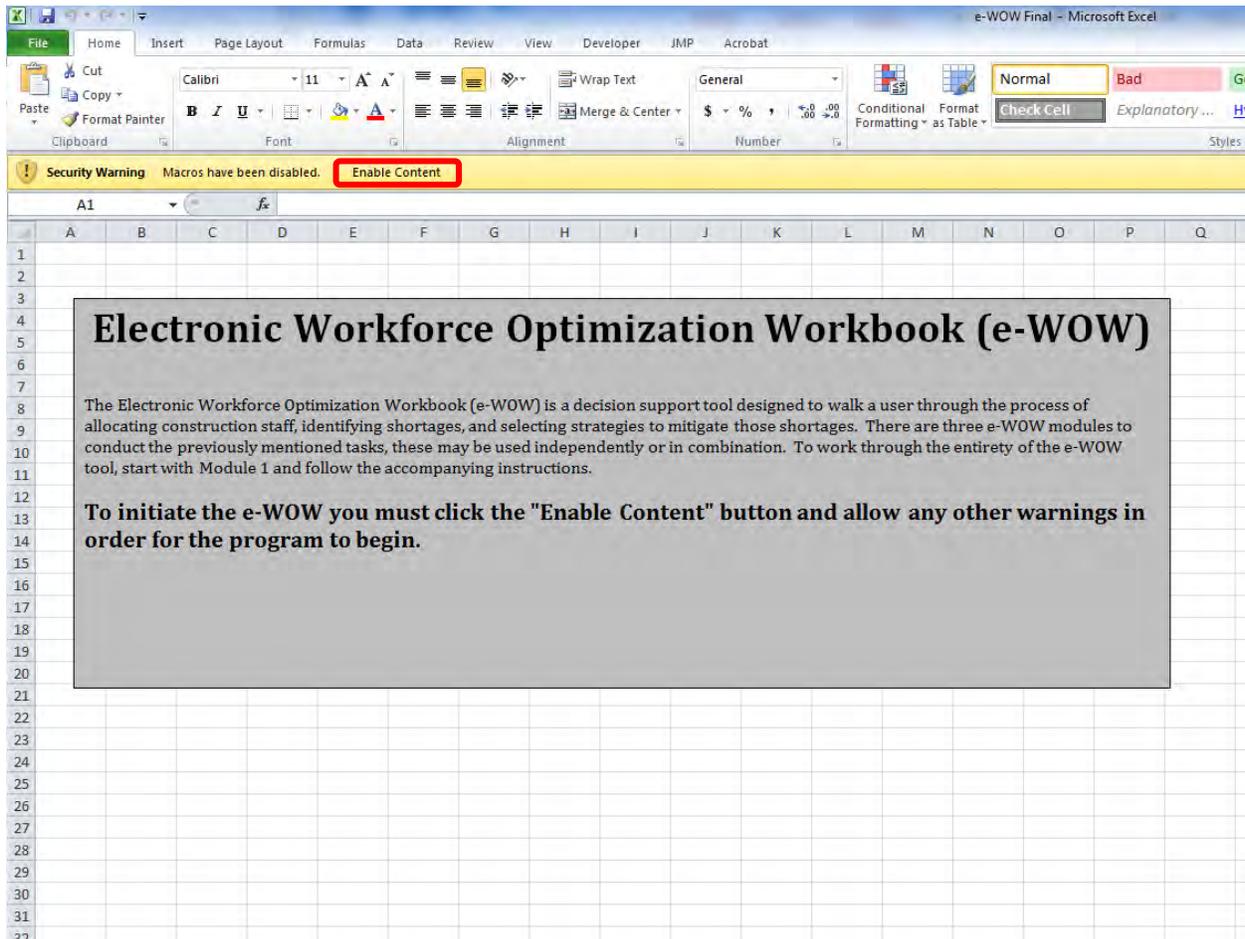
## Initialization of the Electronic Workforce Optimization Workbook (e-WOW)

Before you begin using the e-WOW tool, be sure to download the e-WOW and the “Staffing Tools” folder to your computer. The “Staffing Tools” folder should contain over 30 PDF files each detailing a staffing tool that may be applicable to your project. Do not change the name of the “Staffing Tools” folder or any of the PDF files it contains. The naming conventions are important to ensure the links to these tools in e-WOW remain active. The e-WOW file itself must be in the same location on your computer as the “Staffing Tools” folder. For instance, Figure 1 below shows that the “Staffing Tools” folder and the “e-WOW Final” file are located in a “Documents/e-WOW” folder on the example computer.



*Figure 1: Folder Structure for e-WOW and Staffing Tools*

With the files in the proper location, the user can open the e-WOW file. The e-WOW is a Microsoft Excel Macro-Enabled Worksheet (.xlsm). Because these files could contain malicious software if not from a trusted source, most computer settings require the user to enable the content of these files. In most cases, the first time you open the e-WOW you can expect to see a screen similar to Figure 2. The red highlighting around the “Enable Content” button is added for emphasis. In order to begin using the e-WOW, click the “Enable Content” button.



*Figure 2: e-WOW Enable Content Screen*

Depending on the user settings and version of Microsoft Excel there may be additional steps to enabling the content and macros within the e-WOW file. You may, for instance, be prompted to close and reopen the file in order to get the above warning. If you are not given the option to enable the file content, you may need to change the security settings for macros within Microsoft Excel. If needed, this will also likely be a prompted step. To change the Trust Center Macro Settings, progress through the following steps:

- File—Options—Trust Center—Trust Center Settings—Macro Settings

These steps should lead you to the screens as seen in Figures 3 and 4.

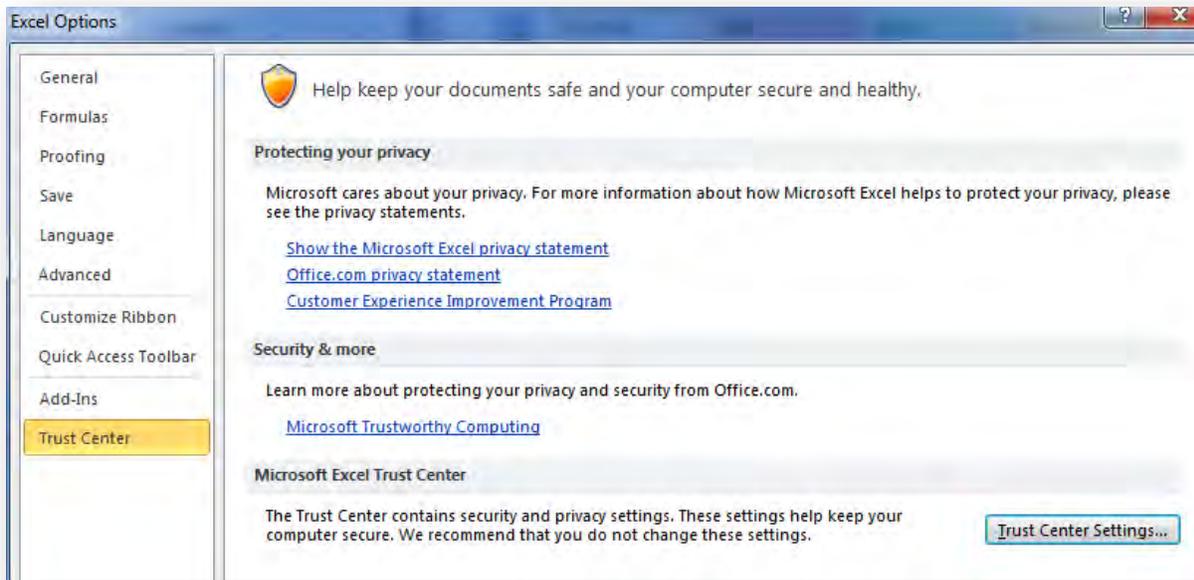


Figure 3: Excel Options Screen

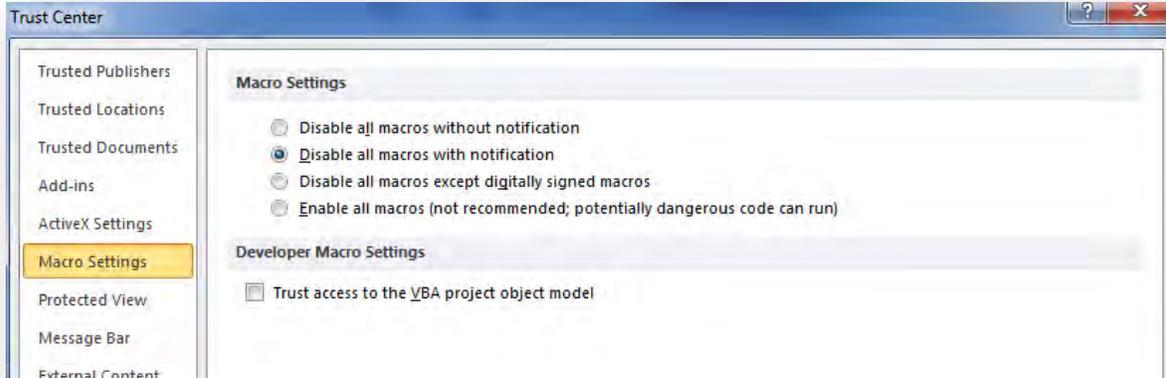
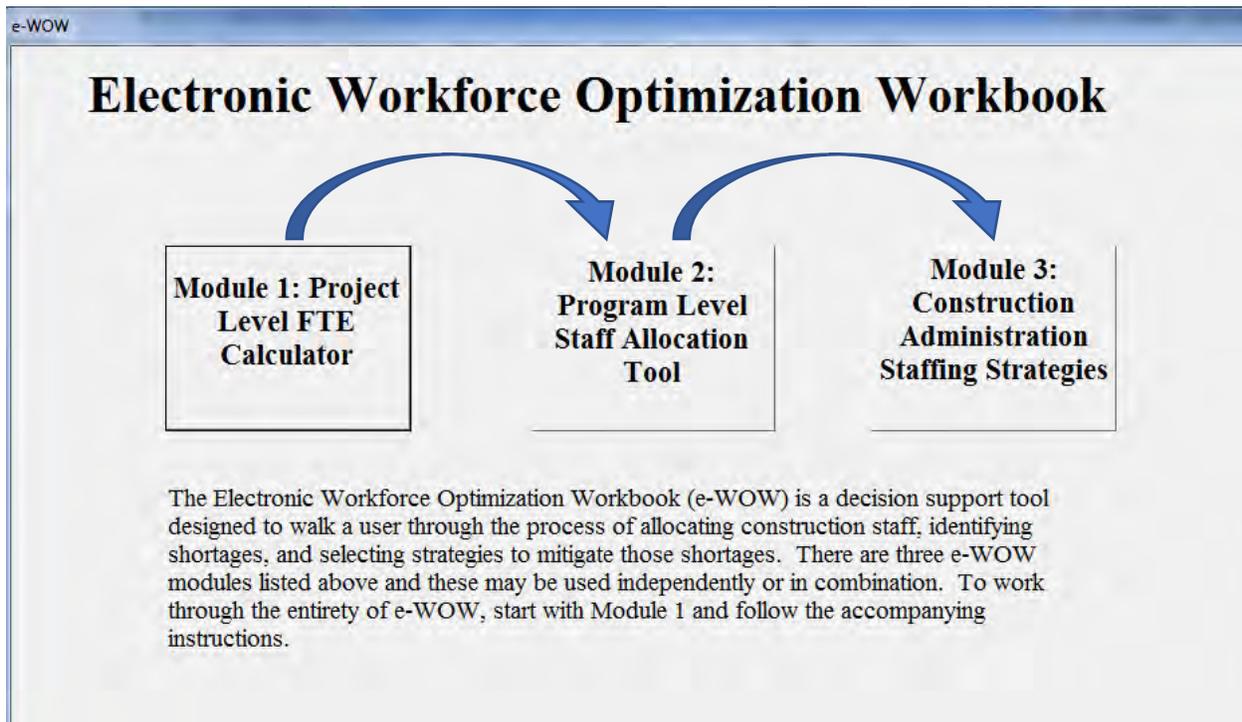


Figure 4: Excel Trust Center, Macro Settings

Change the Macro Settings to “Disable all macros with notification.” Once these settings are applied, the user should be able to “Enable Content” for e-WOW, though this may require closing and reopening the file. If the user is unable to change these settings or continues to not be able to access e-WOW, contact your technology administrator for assistance.

## Beginning to Use the e-WOW

Once the e-WOW content is enabled and functioning properly, the user should see Figure 5 as the opening screen (blue arrows added to show progression of modules). This screen is also referred to as the “Main Menu” within the e-WOW modules; the user can return to this screen by clicking any of the “Main Menu” buttons. The user can use these buttons to reenter the macro guidance if they happen to click the “X” in the top right of any of the macro screens. User input cells are indicated by yellow or light green backgrounds.



*Figure 5: e-WOW Opening Screen*

The e-WOW includes three modules (Figure 5):

- **Module 1** estimates the required staffing level at each position (Project Engineer, Surveyor, Inspector and Administrative Staff) on a project-by-project basis according to the data collected by the research team or as entered by the DOT user. Project characteristics such as project type, size (construction estimate), complexity, and use of CEI consultants are taken into consideration. Users may choose to modify these estimates according to considerations of location (rural versus urban), union status, technology usage, or other factors; these modifications are at the discrimination of the experienced user. If desired, modifications to these estimations should occur outside of the e-WOW

system if using Module 1 independently or modified within Module 2 if used. If a DOT has established its own standard project staffing levels, users may enter this data to be used in Module 1 or skip to manual entry of staffing needs in Module 2.

- **Module 2** allows the user to import a list of scheduled construction projects to review their scheduled staffing needs. Required construction staffing, either estimated through Module 1 or defined by users, can be input or modified within the project schedules. The user then prioritizes the projects in order to represent staffing precedence. The module calculates the month-by-month construction staffing requirements by aggregating all staffing needs of the prioritized projects. Peak and non-peak staffing requirements can be identified given individual project schedules; this allows DOT users to shift projects with flexible schedules to attempt staff balancing or consider other staffing measures such as consultant inspection, temporary staff transfers, or other approaches. Project prioritization, staffing needs, and schedules can be adjusted or modified to determine the most appropriate scenario for the portfolio of projects. After all adjustments are completed, the staffing needs and any shortfalls for the portfolio of projects are identified. The user can use this information independently or continue into Module 3 to review staffing strategies to assist in alleviating any staffing shortages.
- **Module 3** contains the electronic version of Construction Staffing Strategy Matrix. Regardless of having shortages in construction staff or not, the user can use the matrix to maximize efficiencies in the use of staffing resources based on the relative level of risk for each function/work type. The e-WOW Construction Staffing Strategy Matrix provides a framework to help make decisions based on the risk the user assigns to the work types within the portfolio of projects. Based on the work included in the portfolio and the risk assigned to that work, strategies are highlighted according to their applicability. The assignment of risk to the work types is a qualitative measure and based on the knowledge of the work by the user. Considerations would include the need for direct supervision of the work, the amount of the work, and ability to post-inspect that work, and other considerations. In cases of staffing shortages, users can locate potential solutions to reduce required staff by targeting specific functions or work types. Users aiming to reduce staffing for a given work type can locate that work type in the rank ordered table according to their risk.

The three modules of the e-WOW follow the progression of the WOW as described in Figure 6 below yet provide electronic decision support for following this progression. The WOW and e-WOW offer the same information; the e-WOW simply integrates the flowchart in Figure 6 into a decision support tool as a Macro-Enabled Microsoft Excel file.

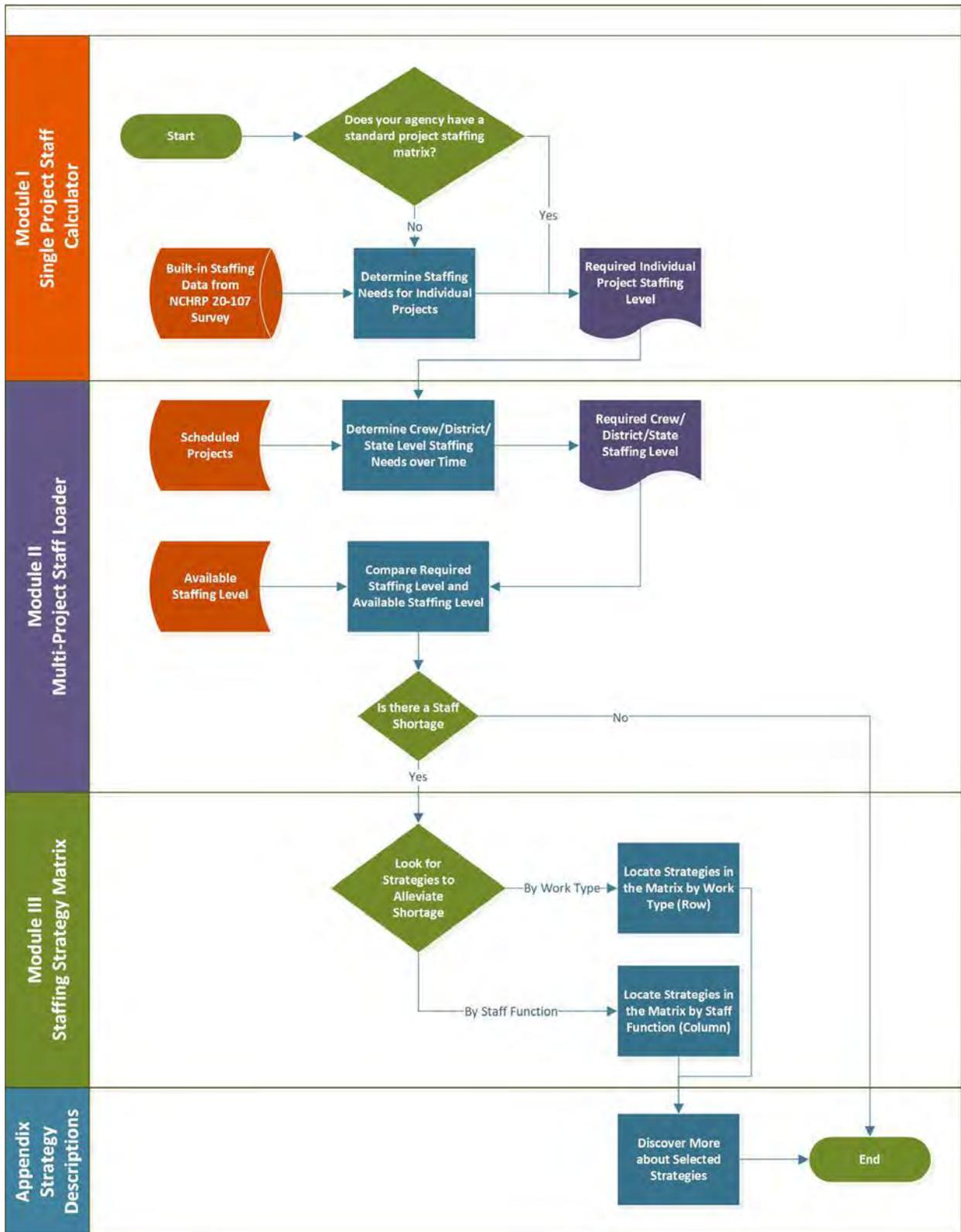
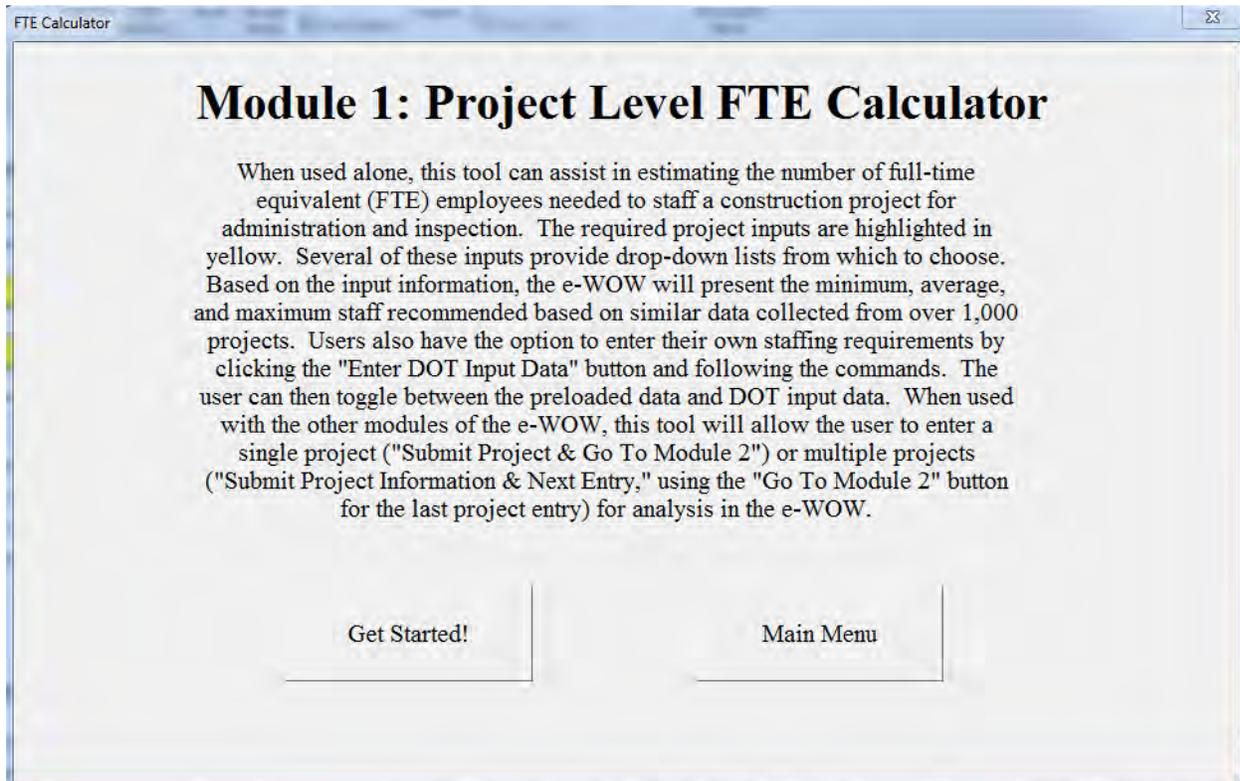


Figure 6 Process of Using the Workforce Optimization Workbook

## Using the e-WOW: Module 1

Module 1 estimates the required staffing level of each position (Project Engineer, Surveyor, Inspector and Administrative Staff) on a project-by-project basis according to the data collected by the research team or as entered by the DOT user. Project characteristics such as project type, size (construction estimate), complexity, and use of CEI consultants are taken into consideration. Users may choose to modify these estimates according to considerations of location (rural versus urban), union status, technology usage, or other factors; these modifications are at the discrimination of the experienced user. If desired, modifications to these estimates should occur outside of the e-WOW system if using Module 1 independently or modified within Module 2 if used. If a DOT has established its own standard project staffing levels, users may enter this data to be used in Module 1 or skip to manual entry of staffing needs in Module 2.

When the user elects to use Module 1 from the Main Menu, the FTE Calculator Welcome Screen will appear as seen in Figure 7.



*Figure 7 Module 1 FTE Calculation Welcome Screen*

Clicking the “Get Started!” button will take the user to the FTE Calculator while the “Main Menu” button returns the user to the Main Menu screen. The FTE Calculator is seen in Figure 8.

**Project Level FTE Calculator**

Project Description			
Project Name	Anticipated Start Date	Anticipated Completion Date	
Project Type	Construction Estimate	Complexity	Use of CEI

Project Level FTE	Engineer	Surveyor	Admin Staff	Inspectors	Total Insp. Staff & Eng.
Minimum	#N/A	#N/A	#N/A	#N/A	#N/A
Average	#N/A	#N/A	#N/A	#N/A	#N/A
Maximum	#N/A	#N/A	#N/A	#N/A	#N/A

**Enter DOT Input Data**

Which dataset would you like to use for estimating staffing needs for this project?  
 Preloaded Data  DOT Input Data

**Average FTE Requirement by Position and Project Type**

Project Type	Project Count	Engineer	Surveyor	Sr. Inspector	Inter. Inspector	Jr. Inspector	Admin	Total Insp. Staff & Eng
Road - New Construction / Expansion	19	1.27	0.71	1.69	1.95	0.63	1.16	5.54
Road - Rehabilitation / Resurfacing	69	0.94	0.2	0.9	1.01	0.71	0.69	3.56
Bridge - New & Replacement	12	1.08	0.42	1.17	0.92	0.5	0.75	3.67
Bridge - Rehabilitation	24	0.85	0.42	0.81	0.92	0.23	0.57	2.81
Other Projects	47	0.82	0.26	0.68	0.66	0.32	0.65	2.48
Special Structures (Rest Areas, Weigh Stations, Toll Stations, etc.)	3	1.00	1.33	0.67	1.67	0.33	1.67	3.67
<b>All</b>	<b>174</b>	<b>0.94</b>	<b>0.34</b>	<b>0.93</b>	<b>1.01</b>	<b>0.51</b>	<b>0.74</b>	<b>3.29</b>

**Submit Project Information & Next Entry**    **Submit Project & Go To Module 2: Staff Allocation**    **Go To Main Menu**

**NOTES:**

- The engineering and inspection staffing needs will be used in Module 2. This can be modified in Module 2.
- FTE estimates are based on a national database of over 1000 projects.
- If you would like to use your own DOT's staffing needs in the FTE calculation, please click the "Enter DOT Input Data" button.
- Projects details vary so alteration of these estimates may be necessary (in Module 2).
- Project location and union status should be considered but minimally affect staffing needs.

Figure 8 Module 1 FTE Calculator

The FTE Calculator has several functions and options to describe. The “Notes” section describes some information to consider when using the tool, where the data used in the calculations comes from, and the interaction with Module 2. The “Average FTE Requirement by Position and Project Type” represents the overall average of the data set used and the breakdown of project types used in the preloaded data. This table was developed from the database of projects that were provided with a complete data set.

For the FTE Calculator to provide an estimate of staffing needs, the user must provide input in the yellow cells according to the following format:

- Project Name:** The user may enter the name of the project in normal text format; an abbreviated name is preferred.
- Anticipated Start Date:** The date format used is MM/DD/YYYY.
- Anticipated Completion Date:** The date format used is MM/DD/YYYY.
- Project Type:** Do not manually type an entry. The project type is selected from a dropdown list according to the following:
  - Road – New Construction/Expansion
  - Road - Rehabilitation/Resurfacing (**NOTE:** resurfacing projects should be input as a bundle of projects, such as the resurfacing for a construction season within one office or business unit.)
  - Bridge – New Bridge/Replacement
  - Bridge – Rehabilitation
  - Other Projects (Curbs, Sidewalks, Shoulders, Guardrails, Signs, Lighting, Signals, Striping, Landscaping, etc.)

5. **Construction Estimate:** Do not use a “\$,” simply enter the construction estimate as a number for the project.
6. **Complexity:** Do not manually type an entry. The project complexity is selected from a dropdown list. This is a judgement selection based on the project details according to the user but the following may provide some guidance in the selection.

Complex (Major) Projects	Moderately Complex Projects	Non-Complex (Minor) Projects
<ul style="list-style-type: none"> <li>• New highways; major relocations</li> <li>• New interchanges</li> <li>• Capacity adding/major widening</li> <li>• Major reconstruction (4R; 3R with multiphase traffic control)</li> <li>• Congestion management studies are required</li> <li>• Environmental Impact Statement or complex Environmental Assessment required</li> </ul>	<ul style="list-style-type: none"> <li>• 3R and 4R projects which do not add capacity</li> <li>• Minor roadway relocations</li> <li>• Non-complex bridge replacements with minor roadway approach work</li> <li>• Categorical Exclusion or non-complex Environmental Assessment required</li> </ul>	<ul style="list-style-type: none"> <li>• Maintenance betterment projects</li> <li>• Overlay projects, simple widening without right-of-way (or very minimum right-of-way take) little or no utility coordination</li> <li>• Non-complex enhancement projects without new bridges (e.g. bike trails)</li> <li>• Categorical Exclusion</li> </ul>

7. **Use of CEI:** Do not manually type an entry. The “Use of CEI” is a selection of “Yes” or “No” from the dropdown list in response to the question: “Will the project be using Consultant Engineering and Inspection services?”

At this point, the FTE Calculator provides the project level estimated FTE needs as seen in Figure 9. By default the FTE Calculator will use the preloaded data for the staffing estimate. The user has the option to input DOT specific staffing data and toggle between the two datasets for the FTE estimate. DOT specific data entry and use is described in a later section of this guide.

**Project Level FTE Calculator**

Project Description			
Project Name	Anticipated Start Date	Anticipated Completion Date	
Mountain Parkway Example	6/1/2017	12/30/2019	
Project Type	Construction Estimate	Complexity	Use of CEI
Road - New Construction / Expansion	\$80,000,000	Moderate	Yes

Project Level FTE	Engineer	Surveyor	Admin Staff	Inspectors	Total Insp. Staff & Eng.
Minimum	0.00	0.00	1.15	4.61	4.61
Average	1.47	1.47	2.29	9.23	10.70
Maximum	2.10	4.89	4.59	23.07	25.18

Enter DOT Input Data

Which dataset would you like to use for estimating staffing needs for this project?

Preloaded Data       DOT Input Data

**Average FTE Requirement by Position and Project Type**

Project Type	Project Count	Engineer	Surveyor	Sr. Inspector	Inter. Inspector
Road - New Construction / Expansion	19	1.27	0.71	1.69	1.95
Road - Rehabilitation / Resurfacing	69	0.94	0.2	0.9	1.01
Bridge - New & Replacement	12	1.08	0.42	1.17	0.92
Bridge - Rehabilitation	24	0.85	0.42	0.81	0.92
Other Projects	47	0.82	0.26	0.68	0.66
Special Structures (Rest Areas, Weigh Stations, Toll Stations, etc.)	3	1.00	1.33	0.67	1.67
<b>All</b>	<b>174</b>	<b>0.94</b>	<b>0.34</b>	<b>0.93</b>	<b>1.01</b>

Submit Project Information & Next Entry

Submit Project & Go To Module 2: Staff Allocation

Go To Main Menu

Figure 9 FTE Calculator Project Example

## Steps Following the FTE Estimate

Once the required information is put into the FTE Calculator, the user has multiple options for using the estimate.

- **Independent use:** If the user is only interested in using the e-WOW for estimating FTE staffing needs for a single project, their use of the e-WOW may be complete. Taking the estimate provided by Module 1, the user can accept the estimate or use the output as a baseline and modify it based on their understanding of the project and their experience. The user could also return to the e-WOW “Main Menu” and skip to Module 3 if there were staffing concerns for the project and they were interested in staffing strategies.
- **Enter the Project as a Single Project:** If the user is only entering one project in the e-WOW but wishes to progress through the entire tool, at this point they would click “Submit Project & Go To Module 2: Staff Allocation.” Module 2 is where the user can make modifications to the project and review the staffing needs versus the staff available.

Unless the user will be inserting DOT input data or entering more projects, they should skip to the “Using the e-WOW: Module 2” section of this manual.

- **Enter the Project as Part of a Portfolio:** If the user intends to enter multiple projects for review in the e-WOW, they may enter the current project information into Module 2 by clicking “Submit Project Information & Next Entry.” This button enters the project information into the listing in Module 2 and clears Module 1 in preparation of entering the information for the next project. Upon keying the information in the final project of the portfolio into Module 1, click “Submit Project & Go To Module 2: Staff Allocation.” This will take the user to Module 2 for reviewing the portfolio of projects. Alternatively, the user can submit the information by clicking “Submit Project Information & Next Entry” and advance to Module 2 by using the “Main Menu” button.

### Input and Use of Specific DOT Staffing Data

As an option, if a user or DOT has their own guidance regarding staffing allocations for projects, they may enter this data as an option for use in the FTE calculator. The user enters this data by clicking “Enter DOT Input Data” and following the prompts to the spreadsheet seen in Figure 10.

FTE by Project Type and Position														
Project Type	Cost Range	Engineer			Surveyor			Admin Staff			Inspectors			
		Low	Avg	High	Low	Avg	High	Low	Avg	High	Low	Avg	High	
Road - New Construction / Expansion	\$0-\$5,000,000													
	\$5,000,000 - \$25,000,000													
	\$25,000,000 and up													
Road - Rehabilitation / Resurfacing	\$0-\$1,000,000													
	\$1,000,000 - \$5,000,000													
	\$5,000,000 and up													
Bridge - New & Replacement	\$0-\$1,000,000													
	\$1,000,000 - \$10,000,000													
	\$10,000,000 and up													
Bridge - Rehabilitation	\$0-\$1,000,000													
	\$1,000,000 - \$5,000,000													
	\$5,000,000 and up													
Other Projects	< \$500,000													
	\$500,000 - \$1,000,000													
	\$1,000,000 and up													
Special Structures (Rest Areas, Weigh Stations, Toll Stations, et	< \$500,000													
	\$500,000 - \$1,000,000													
	\$1,000,000 and up													

Return to the FTE Calculations	Adjustment Factors for Using CEI Consultants							
	Engineer		Surveyor		Admin		Inspectors	
	ST Only	wCons	ST Only	wCons	ST Only	wCons	ST Only	wCons
Road - New Construction / Expansion	0.90	1.08	1.14	0.90	0.76	1.18	0.68	1.23
Road - Rehabilitation / Resurfacing	0.98	1.06	1.18	0.52	0.83	1.44	0.79	1.56
Bridge - New & Replacement	0.92	1.05	0.48	1.37	1.33	0.76	0.85	1.11
Bridge - Rehabilitation	0.83	1.10	0.29	1.43	0.91	1.05	1.08	0.95
Other Projects	0.90	1.13	1.16	0.78	1.00	1.00	1.05	0.94
Special Structures (Rest Areas, Weigh Stations, Toll Stations, et	1	1	1	1	1	1	1	1

Adjustment Factors for Project Complexity				
	Eng.	Surveyor	Admin	Inspectors
Non-Complex	0.93	0.55	0.89	0.77
Moderate	0.98	1.36	0.97	0.94
Complex	1.39	2.64	1.54	2.29

Figure 10 DOT Staffing Input Sheet

This sheet will allow users to enter their own recommendations according to staff type, project type, and size/cost. The staffing should be entered at low, average, and high levels where indicated by the yellow highlighted fields. The adjustment factors for CEI usage and project complexity can also be modified but this should be done with care. Once complete, click the

"Return to the FTE Calculation" button. This staffing data can be modified by revisiting this sheet. An example of a completed table is seen in Figure 11.

		FTE by Project Type and Position											
Project Type	Cost Range	Engineer			Surveyor			Admin Staff			Inspectors		
		Low	Avg	High	Low	Avg	High	Low	Avg	High	Low	Avg	High
Road - New Construction / Expansion	\$0-\$5,000,000	0.00	0.96	2.00	0.00	0.03	0.25	0.00	0.55	3.00	1.00	1.72	3.00
	\$5,000,000 - \$25,000,000	1.00	1.20	2.00	0.00	0.75	2.00	0.00	1.18	2.00	2.00	3.90	6.00
	\$25,000,000 and up	0.00	1.40	2.00	0.00	1.20	4.00	1.00	2.00	4.00	4.00	8.00	20.00
Road - Rehabilitation / Resurfacing	\$0-\$1,000,000	0.00	0.79	1.00	0.00	0.17	1.00	0.00	0.53	2.00	0.10	1.57	3.00
	\$1,000,000 - \$5,000,000	0.00	0.86	1.00	0.00	0.16	1.00	0.00	0.75	2.95	1.00	2.73	5.00
	\$5,000,000 and up	0.25	1.25	4.25	0.00	0.42	2.75	0.00	0.94	5.25	1.25	4.83	15.00
Bridge - New & Replacement	\$0-\$1,000,000	0.00	0.80	1.00	0.00	0.20	1.00	0.00	1.00	2.00	1.00	1.60	3.00
	\$1,000,000 - \$10,000,000	0.00	0.97	2.00	0.00	0.42	2.00	0.00	0.67	2.00	0.70	2.53	7.00
	\$10,000,000 and up	1.00	1.38	2.00	0.00	0.63	3.00	0.00	1.13	2.00	1.00	9.13	21.00
Bridge - Rehabilitation	\$0-\$1,000,000	0.00	0.92	1.00	0.00	0.00	0.00	0.52	2.50	1.00	1.29	2.00	
	\$1,000,000 - \$5,000,000	0.00	0.71	1.00	0.00	0.17	4.00	0.00	0.67	1.00	1.00	2.00	5.00
	\$5,000,000 and up	0.25	1.04	2.00	0.00	0.41	1.00	0.00	0.73	2.00	2.25	4.38	7.00
Other Projects	< \$500,000	0.00	0.82	1.35	0.00	0.22	1.35	0.00	0.68	3.00	1.00	1.41	2.35
	\$500,000 - \$1,000,000	0.00	0.85	1.95	0.00	0.16	1.95	0.00	0.63	1.95	0.05	1.57	3.95
	\$1,000,000 and up	0.00	0.94	2.00	0.00	0.49	2.90	0.00	0.73	3.00	0.00	2.08	4.45
Special Structures (Rest Areas, Weigh Stations, Toll Stations, etc.)	< \$500,000		1.00			1.33			1.67			2.67	
	\$500,000 - \$1,000,000		1.00			1.33			1.67			2.67	
	\$1,000,000 and up		1.00			1.33			1.67			2.67	

Figure 11 Example DOT Input Table

The FTE Calculations sheet will allow the user to toggle between the preloaded data and the DOT Input Data, as well as select the most appropriate option prior to entering the project information into Module 2. The toggle selection is seen in Figure 12.

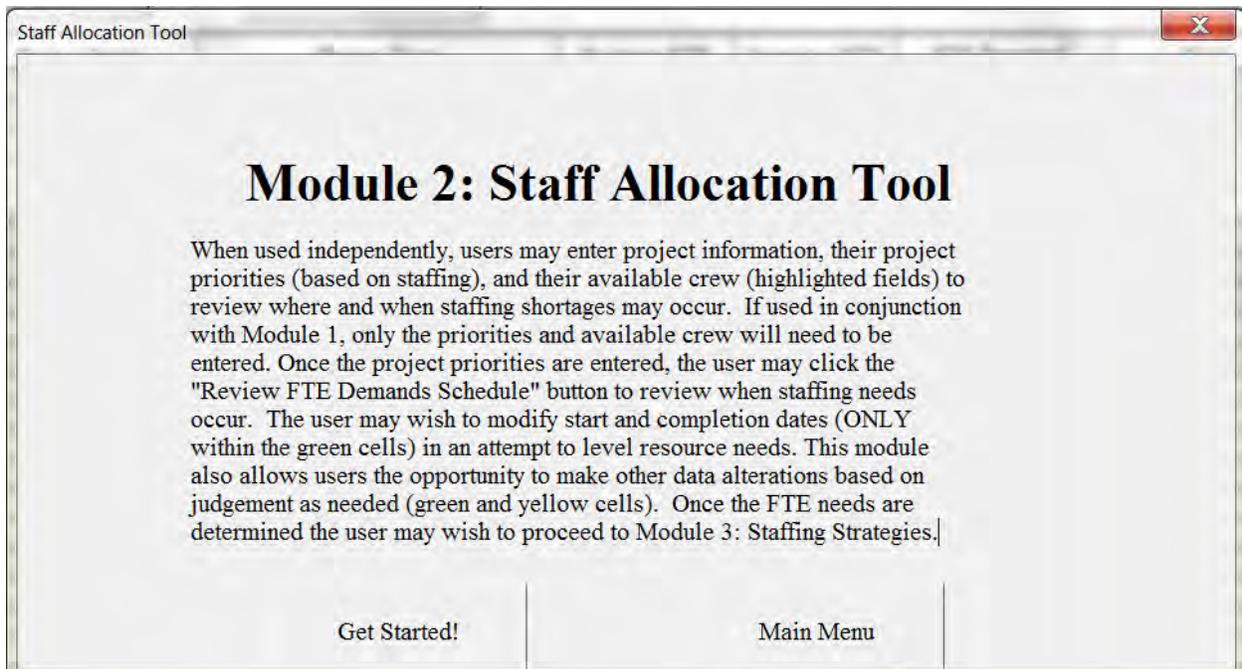
Which dataset would you like to use for estimating staffing needs for this project?

Preloaded Data
  DOT Input Data

Figure 12 FTE Calculator Data Toggle Switch

## Using the e-WOW: Module 2

Module 2 allows the user to import a list of scheduled construction projects from Module 1 to review their scheduled staffing needs. The list of projects can also be input manually into Module 2 without using Module 1 when using the Staff Allocation module independently. The required construction staffing, either estimated through Module 1, or defined by the user, can be input or modified within the light green cells. The user then prioritizes the projects (yellow cells; numeric entry 1 as the top priority) in order to represent staffing precedence. The module calculates the month-by-month construction staffing requirements by aggregating all engineering and inspection staffing needs of the prioritized projects according to their scheduled work dates. Peak and non-peak staffing requirements can be identified given individual project schedules; this allows a user to shift projects with flexible schedules to attempt staff balancing or consider other staffing measures such as consultant inspection, temporary staff transfers, or other approaches and gives an estimated duration of those needs. Project prioritization, staffing needs, and schedules can be adjusted or modified to determine the most appropriate scenario for the portfolio of projects. After all adjustments are completed, the staffing needs and any shortfalls for the portfolio of projects are identified. The user can use this information independently or continue into Module 3 to review staffing strategies to assist in alleviating any staffing shortages. When the user elects to use Module 2 from the Main Menu or within Module 1, the Staff Allocation Tool Welcome Screen will appear as seen in Figure 13.



*Figure 13 Module 2 Staff Allocation Tool Welcome Screen*

Clicking the “Get Started!” button will take the user to the Staff Allocation tool (Module 2) while the “Main Menu” button returns the user to the Main Menu screen. The Staff Allocation Tool is seen in Figure 14.

Program Level Staff Allocation										
Program of Projects					Crew Available					
Go To Main Menu			Review FTE Demands Schedule		Go To Module 3: Staffing Strategies			Review FTE Calc (Enter Project # Below, Before Clicking)		
					Crew FTE Available	3	Project # to Review	1		
Prioritization	Project Name	Project Type	Engineer FTE	Inspector FTE	FTE Required <sup>1</sup>	Start	Completion	Project #		
								1		
								2		
								3		
								4		
								5		
								6		
								7		
								8		
								9		
								10		
								11		
								12		
								13		
								14		
								15		
								16		
								17		
								18		
								19		
								20		
								21		
								22		
								23		
								24		
								25		
								26		
								27		
								28		

**NOTES:**

- FTE Required is total needed inspectors and engineers
- All data in this sheet may be modified according to judgement
- This module is intended for broadly reviewing staffing needs, for instance on a season basis
- This module is not intended to balance

Figure 14 Staff Allocation Tool

The Staff Allocation Tool entails many features. The “Notes” section provides some guidance for its use and information regarding the tool features. If the user has progressed from Module 1 in the e-WOW, the light green fields will be populated by project information. Module 1 users will still need to complete step 8 below. If starting from Module 2 or using Module 2 independently, the user will need to input this information according to the following format:

- Project Name:** The user may enter the name of the project in normal text format; an abbreviated name is preferred.
- Anticipated Start Date:** The date format used is MM/DD/YYYY.
- Anticipated Completion Date:** The date format used is MM/DD/YYYY.
- Project Type:** In Module 2, the user may enter any project type desired in normal text format. If the user wishes to remain consistent with the e-WOW project types, use one of the following:
  - Road – New Construction/Expansion
  - Road - Rehabilitation/Resurfacing (**NOTE:** resurfacing projects should be input as a bundle of projects, such as the resurfacing for a construction season within one office or business unit.)
  - Bridge – New Bridge/Replacement
  - Bridge – Rehabilitation

- Other Projects (Curbs, Sidewalks, Shoulders, Guardrails, Signs, Lighting, Signals, Striping, Landscaping, etc.)
5. **Engineer FTE:** This is the number of engineer FTEs required to staff the project. Enter the number in general number format; decimals are allowed.
  6. **Inspector FTE:** This is the number of inspector FTEs required to staff the project. Enter the number in general number format; decimals are allowed.
  7. **FTE Required:** As relayed in Note 1, this is the number of engineer and inspector FTEs required to staff the project. Enter the number in general number format; decimals are allowed.
  8. **Prioritization:** Once the project information is input. The prioritization indicates the priority of staffing the project in order to rank them for review in the staff-scheduling element of Module 2. The prioritization is a simple whole number starting from 1, which indicates top priority.
  9. **Crew Available:** This is the total number of engineer and inspector FTEs available to staff the projects entered as a whole number. This is strictly for informing the user of what the maximum staffing deficit is for the portfolio and is helpful when considering staffing strategies within Module 3.

An example of Module 2 completed for a portfolio of projects is seen in Figure 15.

Program Level Staff Allocation				Crew Available			Review FTE Calc <small>(Enter Project # Below, Before Clicking)</small>		
Program of Projects		Review FTE Demands Schedule	Go To Module 3: Staffing Strategies	Crew FTE Available	3	Project # to Review	1		
Go To Main Menu	Prioritization	Project Name	Project Type	Engineer FTE	Inspector FTE	FTE Required <sup>1</sup>	Start	Completion	Project #
Clear Project	1	Mountain Parkway Examp	Road - New Construction / Expansion	1.47	9.23	10.70	6/1/2017	12/30/2019	1
	6	A	Bridge - Rehabilitation	0.58	2.02	2.59	3/1/2018	9/30/2018	2
	4	B	Road - New Construction / Expansion	1.20	2.68	3.88	5/1/2018	7/30/2020	3
	3	C	Bridge - New & Replacement	0.88	2.01	2.89	3/1/2018	9/30/2018	4
Project # to Clear	5	D	Bridge - New & Replacement	0.88	2.01	2.89	6/1/2018	11/30/2018	5
	2	E	Road - New Construction / Expansion	0.80	0.90	1.70	10/1/2017	9/30/2018	6
	7	F	Road - Rehabilitation / Resurfacing	0.78	1.66	2.44	6/1/2018	9/30/2018	7
Clear All Projects									8
									9

Figure 15 Example Portfolio for Module 2

Once the portfolio of projects is input, the user can click “Review FTE Demands Schedule” to view the staffing demands along the schedule of projects. This function will zoom out and pan right on the sheet. The view for the example portfolio is seen in Figure 16. From this view, the user can see the maximum staffing demands or attempt to shift the schedule (change the start and completion dates in the light green cells from figure 15) of the projects to attempt to balance the staffing demands. Once satisfied with any balancing, the user may use this information independently or choose to click “Go To Module 3: Staffing Strategies” to investigate strategies to assist with staffing needs.

Staff Allocation																																												
Eng FTE Req	0	0	0	0	0	1.5	1.5	1.5	1.5	2.3	2.3	2.3	2.27	2.3	3.7	3.7	4.9	6.6	6.6	6.6	6.6	3.5	2.7	2.67	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	1.2	1.2	1				
Insp FTE Req	0	0	0	0	0	9.2	9.2	9.2	9.2	10	10	10	10.1	10	14	14	17	21	21	21	21	14	14	14	12	11.9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	2.68	2.7	2
FTE Required	0	0	0	0	0	11	11	11	11	12	12	12	12.4	12	18	18	22	27	27	27	27	17	17	15	14.6	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	3.88	3.9	3	
FTE Available	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
FTE Needs	0	0	0	0	0	7.7	7.7	7.7	7.7	9.4	9.4	9.4	9.4	9.4	15	15	19	24	24	24	24	14	14	12	11.6	12	12	12	12	12	12	12	12	12	12	12	12	12	12	0.88	0.9	0		
Year	2017					2018											2019											2020																
Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5			
Priority																																												
1	Main Parkway Example																																											
Eng Needs	1.47																																											
Insp Needs	9.23																																											
FTE Needs	10.70																																											
Start	6/1/2017																																											
Complete	12/30/2019																																											
2	E																																											
Eng Needs	0.80																																											
Insp Needs	0.90																																											
FTE Needs	1.70																																											
Start	10/1/2017																																											
Complete	9/30/2018																																											
3	C																																											
Eng Needs	0.88																																											
Insp Needs	2.01																																											
FTE Needs	2.89																																											
Start	3/1/2018																																											
Complete	9/30/2018																																											
4	B																																											
Eng Needs	1.20																																											
Insp Needs	2.68																																											
FTE Needs	3.88																																											
Start	5/1/2018																																											
Complete	7/30/2020																																											
5	D																																											
Eng Needs	0.88																																											
Insp Needs	2.01																																											
FTE Needs	2.89																																											
Start	6/1/2018																																											
Complete	11/30/2018																																											
6	A																																											
Eng Needs	0.50																																											

Figure 16 Example Staffing Needs by Schedule for Module 2

### Steps Following the Staff Allocation Review

Once the required information is input and the desired modifications have been made in the Staff Allocation tool, the user may choose to do one of the following:

- Independent use:** If the user is only interested in using the e-WOW for reviewing the allocation of staff, their use of the e-WOW may be complete. The information provided through Module 2 can be very useful independently for planning staff assignments for crews, offices, or larger business units. The output can be saved, printed, and shared for further discussion and planning purposes.
- Highlighting Needs and Staffing Strategies:** If the user is interested in understanding their staffing needs and applicable tools for addressing them, they can proceed within the e-WOW to Module 3. The maximum staff deficit will be highlighted in Module 3 and the user will have access to over 30 staffing strategies to mitigate these needs.

### Other Features of Module 2

There are two main features of Module 2 that have not been discussed; a review of FTE calculations for projects and clearing out project information.

To review a particular project’s staffing calculation, input the project number in question (blue cells) into the yellow “Project # to Review” field and then click “Review FTE Calc.” An example is seen in Figure 17.

Project Level FTE Review					
Project Description					
Project Name	Anticipated Start Date	Anticipated Completion Date			
Mountain Parkway Example	6/1/2017	12/30/2019			
Project Type	Construction Estimate	Complexity	Use of CEI		
Road - New Construction / Expansion	\$80,000,000	Moderate	Yes		
Project Level FTE	Resident Engineer	Surveyor	Admin Staff	Inspectors	Total Insp. Staff & RE
Minimum	0.00	0.00	1.15	4.61	4.61
Average	1.47	1.47	2.29	9.23	10.70
Maximum	2.10	4.89	4.59	23.07	25.18
Done with Review, Return to Project List			Which dataset would you like to use for estimating staffing needs for this project? <input checked="" type="radio"/> Preloaded Data <input type="radio"/> DOT Input Data		

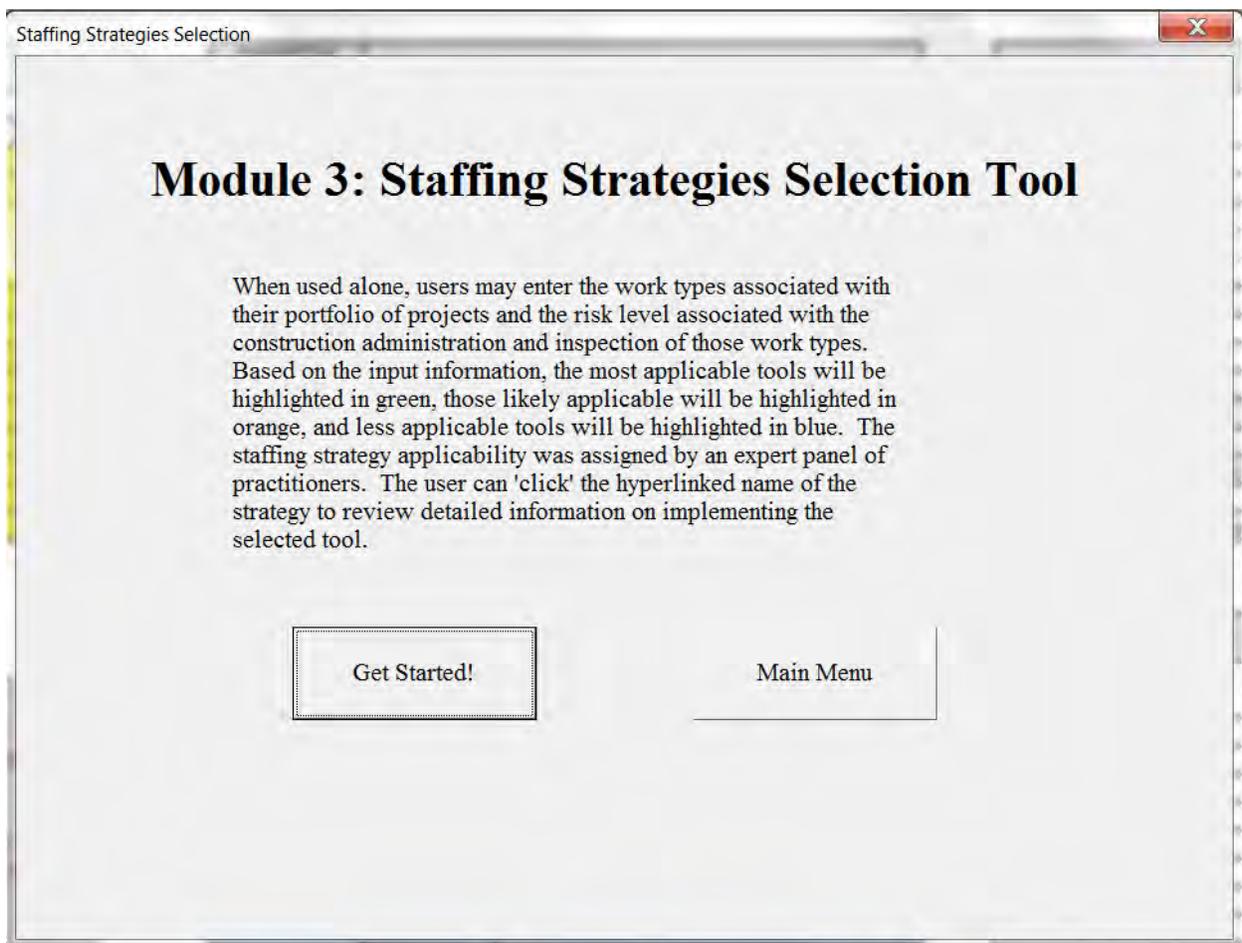
Figure 17 FTE Calculation Review in Module 2

When complete with the review, the user can click “Done with Review, Return to Project List.” Any desired changes to the project within the portfolio needs to be made manually within the green cells of Module 2 (this includes FTE needs modifications).

The last feature of Module 2 includes the clearing of project data. The user can clear a single project by entering the project # (blue cells) into the yellow field “Project # to Clear” and clicking “Clear Project.” This feature is useful if the decision has been made to delay a project or use some other mitigation approach that negates the needs for staffing demand. The user may clear all the projects at once by clicking “Clear All Projects” and following the prompts. This is necessary for restarting the use of the e-WOW without opening a new version. **The “Clear Project” and “Clear All Project” features cannot be undone.**

## Using the e-WOW: Module 3

Module 3, the final e-WOW module, allows the user to input a staffing deficit (or use the maximum deficit determined in Module 2) in determining staffing strategies that may mitigate that deficit. The deficit represents the number of FTE engineers and inspectors needed to meet the recommended staffing for the portfolio of projects. The user must complete the “Work Type Survey” table by indicating the work types applicable within the portfolio of projects and the risks associated with each work type. All of these inputs are selected from dropdown lists. When the user initially selects Module 3, they view the welcome screen seen in Figure 18. A completed Module 3 “Work Survey” and resulting sheet is seen in Figure 19.



*Figure 18 e-WOW Module 3 Welcome Screen*

The completion of the Work Type Survey will use the work types applicable for the portfolio of projects and the user defined inspection risks of that work to identify the applicability of the staffing strategies within the e-WOW. These are the same strategies as within the WOW and the applicability is defined according to tables 1 through 4 (which can also be seen in module 3) showing the level of applicability of the strategies for each of the staff functions and work types. Each strategy is identified as either directly applicable to a specific work type for alleviating construction staffing demand, indirectly applicable, or not applicable. This is noted by the stars within the tables. The linkages between strategies and work types is based on the literature review and staffing strategy interviews associated with NCHRP 20-107. These linkages are recommendations and should be carefully considered given a project’s specific context when selecting strategies. Furthermore, the Work Type Survey uses the user risk assignment (low, medium, or high) to weight the applicability of the tools and assist in differentiating the applicability among the tables. This is further described in a following section.

*Table 1 Staffing Strategy Matrix (Construction Administration Functions)*

Construction Staff Function Strategy (Tool) Work Type	Construction Administration (A)											
	A-1	A-2	A-2-1	A-2-2	A-2-3	A-3	A-3-1	A-3-2	A-3-3	A-3-4	A-4	A-5
Pavement Surface	★	☆	☆	☆	☆	☆	☆	☆	☆	☆	★	★
Superstructure	★	☆	☆	☆	☆	☆	☆	☆	☆	★	★	☆
Excavation / Embankment	★	☆			☆	☆	☆	☆	☆	☆	★	☆
Pipe / Drainage	☆	★	★	★	☆	☆	☆	☆	☆	☆	★	☆
Roadway Base	★	★	★	★	☆	☆	☆	☆	☆	☆	★	☆
Pavement Base	★	★	★	★	☆	☆	☆	☆	☆	☆	★	☆
Substructure	★	☆	☆	☆	☆	☆	☆	☆	☆	★	★	☆
Temporary Traffic Control	☆				☆	☆	☆	☆	☆	☆	★	★
Structural Foundation	★	☆	☆	☆	☆	☆	☆	☆	☆	★	★	☆
Strips / Signs / Signals	☆				☆	☆	☆	☆	☆	★	★	★
Roadside					☆	☆	☆	☆	☆	☆	★	★
Utilities (In contract relocations)	☆	★	★	★	☆	☆	☆	☆	☆	★	★	★
Roadway Lighting	☆	★	★	★	☆	☆	☆	☆	☆	★	★	★
Intelligent Transportation Systems		☆	☆	☆	☆	☆	☆	☆	☆	★	★	☆

Note: ★ – directly applicable and ☆ – indirectly applicable. Otherwise, not applicable.

Table 2 Staffing Strategy Matrix (Construction Engineering Functions)

Construction Staff Function Strategy (Tool) Work Type	Construction Engineering (E)													
	E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-8-1	E-8-2	E-8-3	E-9	E-10	
Pavement Surface	★	★	★	★	★	★	★	★	★	★	★	★	★	☆
Superstructure	☆	☆	☆	★	★	★		★	★	★	★	★	★	☆
Excavation / Embankment	★	★	★	★	☆	★	★	★	★	★	★	★	★	☆
Pipe / Drainage	★	★	★	★	☆	★	★	★	★	★	★	★	★	☆
Roadway Base	★	★	★	★	☆	★	★	★	★	★	★	★	★	★
Pavement Base	★	★	★	★	☆	★	★	★	★	★	★	★	★	★
Substructure	☆	☆	☆	★		★		★	★	★	★	★	★	★
Temporary Traffic Control	☆	☆	☆	★		★	☆	★	★	★	★	★	★	
Structural Foundation	☆	☆	☆	★	☆	★		★	★	★	★	★	★	★
Strips / Signs / Signals	☆		☆	★		★	☆	★	★	★	★	★	★	★
Roadside	★	★	★	★		★	★	★	★	★	★	★	★	★
Utilities (In contract relocations)	★	☆	★	★	☆	★		★	★	★	★	★	★	☆
Roadway Lighting	☆		☆	★		★		★	★	★	★	★	★	★
Intelligent Transportation Systems	☆		☆	★		★		★	★	★	★	★	★	☆

Note: ★ – directly applicable and ☆ – indirectly applicable. Otherwise, not applicable.

Table 2 Staffing Strategy Matrix (Construction Inspection Functions)

Construction Staff Function Strategy (Tool) Work Type	Construction Inspection (I)																		
	I-1	I-2	I-2-1	I-2-2	I-2-3	I-3	I-4	I-5	I-6	I-7	I-8	I-9	I-10	I-11	I-12	I-13	I-14	I-15	I-16
Pavement Surface	☆	☆	☆	☆	☆	☆	★	★	★	★		★	★	★	★	☆	★	☆	☆
Superstructure	★	☆	☆	☆	☆	☆	★	★	★			★				☆	★	☆	☆
Excavation / Embankment		☆	☆		☆	☆	★	☆	★		★	★	★	★	★	★	★	☆	☆
Pipe / Drainage		★	★	★	☆	☆	★	☆	★			★	☆	☆	☆	★	★	☆	☆
Roadway Base		★	★	★	☆	☆	★	☆	★	★	★	★	★	★	★	★	★	★	☆
Pavement Base		★	★	★	☆	☆	★	☆	★	★	☆	★	★	★	★	★	★	★	☆
Substructure	★	☆	☆	☆	☆	☆	★		★			★				☆	★	★	☆
Temporary Traffic Control					☆	☆	★		★			★		★	★		★		★
Structural Foundation	★	☆	☆	☆	☆	☆	★	☆	★			★				☆	★	★	☆
Strips / Signs / Signals					☆	☆	★		★			★	☆	☆	☆	★	★	★	☆
Roadside					☆	☆	★		★		☆	★	☆	☆	☆	★	★	★	☆
Utilities (In contract relocations)		★	★	★	☆	☆	★	☆	★			★				★	★	☆	☆
Roadway Lighting		★	★	★	☆	☆	★		★			★	☆	☆	☆	★	★	★	☆
Intelligent Transportation Systems		☆	☆	☆	☆	☆	★		★			★	☆	☆	☆	★	★	☆	☆

Note: ★ – directly applicable and ☆ – indirectly applicable. Otherwise, not applicable.

Table 4 Staffing Strategy Matrix (Staff Resource Management & Public Relations Functions)

Construction Staff Function Strategy (Tool)	Staff Resource Management & Public Relations (R)							
Work Type	R-1	R-2	R-3	R-3-1	R-3-2	R-3-3	R-4	R-5
Pavement Surface	★	☆	★	★	★	★	★	☆
Superstructure	★		★	★	★	★	★	☆
Excavation / Embankment	★	☆	★	★	★	★	★	☆
Pipe / Drainage	★	☆	★	★	★	★	★	☆
Roadway Base	★	☆	★	★	★	★	★	☆
Pavement Base	★	☆	★	★	★	★	★	☆
Substructure	★		★	★	★	★	★	☆
Temporary Traffic Control	★	★	★	★	★	★	★	☆
Structural Foundation	★		★	★	★	★	★	☆
Strips / Signs / Signals	★	★	★	★	★	★	★	☆
Roadside	★	★	★	★	★	★	★	☆
Utilities (In contract relocations)	★	★	★	★	★	★	★	☆
Roadway Lighting	★	☆	★	★	★	★	★	☆
Intelligent Transportation Systems	★	☆	★	★	★	★	★	☆

Note: ★ – directly applicable and ☆ – indirectly applicable. Otherwise, not applicable.

For the e-WOW to assist in highlighting staffing strategy applicability, the user needs to input and understand the following elements of the “Work Type Survey:”

- **Work Type Survey—Applicability:** the applicability of a work type is simply whether or not the work type exists within the portfolio of projects. This applicability activates the specific work type within table 1 through 4 as shown above.
- **Work Type Survey—Risk:** the risk within the Work Type Survey is a user defined qualitative measure to weight the importance of certain work types within the portfolio of projects. The user should assign their level of risk (high, medium, or low) based upon their assessment of the work type according to the amount of the work included in the portfolio of projects, the risk of that work not being directly inspected, the complexity of the work involved, or other issues assessed by the user. The risk is a subject measure in this case and is used to highlight the most important work types to be directly observed within the portfolio of project. Only the user will have the best understanding of these associated risks.

Using the applicability from the Work Survey Table and Tables 1 through 4, combined with the user defined risk, a weighted score is assigned to each staffing strategy. This weighted score is used to highlight the tools within Module 3, as seen in Figure 19. Specific to the portfolio of projects and the user’s input, green highlighted tools are potentially the most applicable, orange highlighted tools are somewhat applicable, and blue highlighted tools are likely not applicable.

Your maximum staffing deficit is:		24.09
Work Type Survey	Applicable?	Risk Level
Pavement Surface	Yes	High
Superstructure	Yes	Medium
Excavation / Embankment	Yes	High
Pipe / Drainage	Yes	Low
Roadway Base	Yes	Medium
Pavement Base	Yes	Low
Substructure	Yes	High
Temporary Traffic Control	Yes	Medium
Structural Foundation	Yes	High
Strips / Signs / Signals	Yes	Low
Roadside	No	
Utilities (In contract relocations)	No	
Roadway Lighting	No	
Intelligent Transportation Systems	No	

Potential Tool Applicability	Construction Administration (A)
3.80	A-1 <a href="#">Accelerated Construction Methods</a>
2.20	A-2/I-2 <a href="#">Contract Requirements</a>
1.90	A-2-1/I-2-1 <a href="#">Operations &amp; Maintenance (by Contractor)</a>
1.90	A-2-2/I-2-2 <a href="#">Warranty</a>
2.10	A-2-3/I-2-3 <a href="#">Performance Based Specifications</a>
2.10	A-3 <a href="#">Electronic Business Processes</a>
2.10	A-3-1 <a href="#">Change Orders</a>
2.10	A-3-2 <a href="#">Document Storage/Management/Work Flow</a>
2.10	A-3-3 <a href="#">e-Signature</a>
3.00	A-3-4 <a href="#">Electronic RFI</a>
4.20	A-4/E-4/I-4 <a href="#">Electronic Field Books</a>
2.70	A-5 <a href="#">Geographic Information Systems (GIS)</a>

Potential Tool Applicability	Construction Engineering (E)
3.10	E-1 <a href="#">3D Engineered Models for Construction</a>
3.00	E-2 <a href="#">Automated Machine Guidance</a>
3.10	E-3 <a href="#">Digital Terrain Models (DTMs)</a>
4.20	A-4/E-4/I-4 <a href="#">Electronic Field Books</a>
2.00	E-5/I-5 <a href="#">Ground Penetrating Radar (GPR)</a>
4.20	E-6/I-6 <a href="#">Global Navigation Satellite Systems (GNSS)</a>
2.30	E-7 <a href="#">Light Detection and Ranging (LIDAR)</a>
4.20	E-8 HR-3 <a href="#">Resource Allocation/Leveling--</a>
4.20	E-8-1 HR-3-1 <a href="#">District &amp; Project Level</a>
4.20	E-8-2 HR-3-2 <a href="#">Project Phasing</a>
4.20	E-8-3 HR-3-3 <a href="#">Shifting Letting Dates</a>
4.20	E-9/I-14 <a href="#">Robotic Total Stations</a>
2.90	E-10/I-15 <a href="#">Project Inspection Test Plan</a>

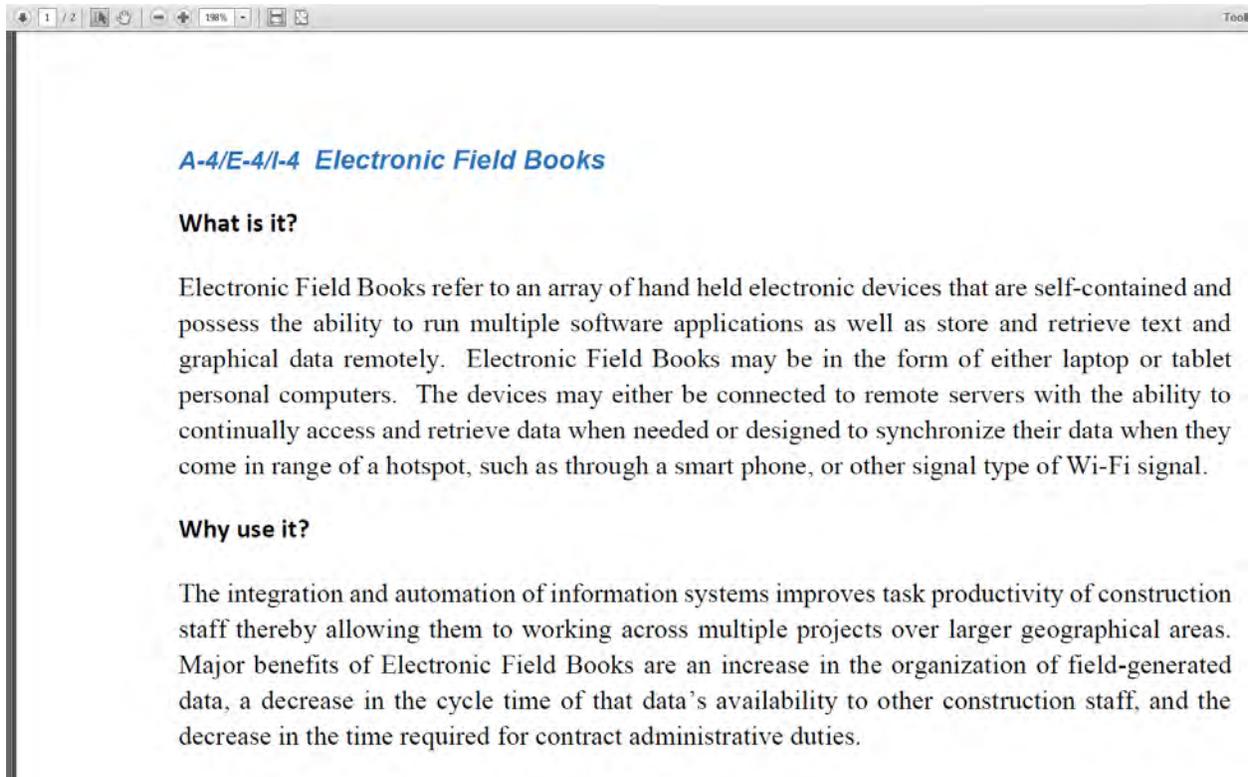
**Go To Main Menu**

**NOTES:**

- Select the applicability of the work types based on your portfolio of projects.
- Assign risk to those work types according to quantity of work involved, the risk of it not being inspected, complexity, etc.
- Tool colors assigned according to practitioner feedback. Green are applicable tools, orange are likely applicable, and blue are likely not applicable.

Figure 19 Example of e-WOW Module 3 Staffing Strategies

Once the tools have been highlighted, the user can begin to review the tools and select those they wish to use to alleviate staffing needs or issues they may be having. Each staffing strategy name is a hyperlink to the details for using that specific strategy. For example, if the user in the above example clicked, “Electronic Field Books,” the details for strategy A-4/E-4/I-4 would be displayed as seen in Figure 20.



*Figure 20 Example Details from Staffing Strategy Hyperlink*

## **Conclusions**

The objective of NCHRP 20-107 was to develop guidance for construction staffing levels to adequately manage highway construction projects. The results are operationalized in the Workforce Optimization Workbook (WOW). The guidance includes staffing level recommendations, methods for planning project staffing allocation, and staffing strategies for alleviating construction staff challenges, among other resources. The Electronic Workforce Optimization Workbook (e-WOW) is a decision support tool containing the same wealth of information as the WOW but provides an assisted progression through the optimal uses of this information. The e-WOW entails three modules which can be used in sequence or independently; the FTE Calculation Tool, the Staffing Allocation Tool, and the Staffing Strategies Tool. While the e-WOW was designed and annotated to provide guidance, explanation, and instructions throughout its progression of steps, this user guide provides guidance on the setup, use, and key features of e-WOW. While the e-WOW can function as a standalone resource, it is best to use it in conjunction with the WOW documentation. This approach provides better understanding for the operation and output of the e-WOW system. As with any decision support tool, experience based judgement of the unique characteristics involved with a user's portfolio of projects should be carefully considered and not outweighed by the systems output.

## e-WOW Example & Training

Understanding the e-WOW Capabilities:

- Modules can be used in sequence or independently
  - Module 1: Provides general guidance regarding the Engineering and Inspection FTE needs for a project. These needs are influenced by project characteristics and the FTE estimate is determined from NCHRP 20-107 project data. The project information and that of subsequent projects can be input into Module 2 for further analysis.
  - Module 2: Allows the user to input project information (or as uploaded through Module 1) and assign project priorities in order to view the FTE Engineering and Inspection needs on a bar chart diagram. This allows the user the opportunity to attempt several leveling techniques and determine peaks in FTE needs. These needs can influence the use of Module 3.
  - Module 3: The maximum FTE deficit is indicated from Module 2 to assist in selection of tools for mitigating staff shortages. By indicating the types of work included in an office/district portfolio and the associated risks with those work types, tools are highlighted according to their applicability. The assignment of the work type risk is experience based when considering quantity of work, complexity, need of FTE presence during installation, and other factors.

### 1. e-WOW Project Example—Module 1:

- Recall the previous example & follow along in inputting the project information.
  - Project Name: **Mountain Parkway Example**
  - Anticipated Start Date: **6/1/2017**
  - Anticipated End Date: **12/30/2019**
  - Project Type: **Road – New Construction/Expansion**
  - Construction Estimate: **\$80,000,000**
  - Complexity: **Moderate**
  - Use of CEI: **Yes**

### 2. e-WOW Project Example—Module 1 ~ additional projects:

- **Submit Project Information & Next Entry**
  - This allows you to enter a full portfolio of projects if you wish to use Module 2 for allocating and leveling your resources.
- **Submit Project & Go To Module 2: Staff Allocation**
  - Enters the project information and initiates Module 2.

### 3. e-WOW Project Exercise—Module 1 ~ Enter the portfolio of projects in the following table:

**\*Click the “Submit Project Information & Next Entry” Button** following the entry of each project until Project “F.”

**\*Once you enter the project information for Project “F,” click the “Submit Project & Go To Module 2: Staff Allocation” button.**

*List of Projects*

Project Name	Project Type	Construction Estimate	Complexity	CEI Use	Start	End
A	Bridge-Rehabilitation	\$2 million	Moderate	No	3/1/2018	9/30/2018
B	Road-New Construction	\$4.2 million	Complex	No	5/1/2018	7/30/2020
C	Bridge-Replacement	\$1.5 million	Moderate	No	3/1/2018	9/30/2018
D	Bridge-Replacement	\$1 million	Moderate	No	6/1/2018	11/30/2018
E	Road-Expansion	\$800k	Non-complex	No	10/1/2017	9/30/2018
F	Road-Resurfacing (Bundle)	\$3 million	Non-complex	No	6/1/2018	9/30/2018

*Project Descriptions*

A—Twin five span bridges for rehabilitation involving the blasting and repainting of steel beams, barrier wall retrofitting, the replacement of bridge joints, and latex overlay.

B—A 1.2 mile new rural connector route, three-lanes with full shoulders, involving complete drainage and minor guardrail installation.

C & D—Each project is a three span PCI beam bridge replacement.

E—A widening of an existing route (1.5 miles) to add an additional lane in each direction.

F—A bundle of resurfacing projects that will be completed in a single construction season. NOTE: Bundled due to e-WOW constraints.

4. e-WOW Project Exercise—Module 2:

- Module 2 allows for modifications to all of the project information according to experience, judgement, or availability.

- Prior to making modifications, SAVE the file as a BASELINE so you can return to the original portfolio if you desire
  - Enter the Project Priorities as you desire and review the “FTE Demands Schedule” to see where the FTE Needs are the greatest.
  - Enter the Crew FTEs you have available. (Use 15 for the exercise)
  - Balance your resources by:
    - Reducing FTE’s required for a project
    - Shifting start and completion dates for projects (altering lettings to balance staff)
    - Adjust the Project FTE needs within individual months (start or completion of projects may require fewer FTEs)
5. e-WOW Project Exercise—Module 3:
- Once you have balanced your resources or are simply ready to use Module 3, **click the “Go To Module 3: Staffing Strategies” button.**
  - Your maximum staffing deficit from Module 2 is indicated at the top of the page as a reminder.
  - Complete the Work Type Survey considering your entire portfolio of projects:
    - Indicate whether a work type is part of the portfolio or not.
    - Assign a risk level to the applicable work types according to quantity, risk of not having oversight at installation, complexity, or other experienced based factors.
  - Upon completing the Work Type Survey, the Staffing Tools will be highlighted according to their applicability.
    - Green—are tools that are applicable for your portfolio
    - Orange—are tools that are likely applicable for your portfolio
    - Blue—are tools that are likely not applicable for your portfolio
  - Each tool can be reviewed by clicking the hyperlinked name in the highlighted tables.