1. OVERVIEW

This Users Guide for the Aurora Storm Simulation Training Program contains information and guidance on how to login to the program and perform the functions of an administrator, instructor, and student. The Guide is broken into sections on:

- Login procedures
- Administrator functions
- Instructor functions
- Student functions

All users receive permissions in one of these three user classification levels by the system administrator and will want to read the section allocated to the capabilities of the user level assigned to the specific user.

The Guide contains extensive use of screen shots to provide a step-by-step discussion of the actions the user needs to take to either set up, monitor, or perform storm scenario training sessions. The student section uses an example of the steps needed to perform a successful storm scenario and includes numerous tips regarding techniques to optimize the student’s performance and avoid pitfalls.

The remainder of this users guide documents all of the functions of the program and how to get the most value out of this training tool.

2. LOGIN PAGE

The Aurora Storm Simulator login page has two components: a Login section and an Introduction to the Storm Simulation Training Program.
2.1. INTRODUCTION

The Introduction on the right portion of the Login Page in Figure 2.1 provides a brief overview of the Storm Simulation program describing:

- The purpose of the simulator and what the program does
- How storm scenarios function and guide a student through the decisions before, during, and after a winter storm
- The techniques used to assess a student’s performance

2.2. ACCESS TO THE STORM SIMULATOR

The Login section on the left side of the login page (Figure 2.2) contains the typical login components and access to a method to retrieve a password if the user has forgotten it. A user needs to enter the User Name and Password that were assigned to the user by an Administrator or Instructor. Within the Storm Simulator a User Name is used to determine what privileges that user has in the program: administrator, instructor, or student. Each of the three user groups has access to different capabilities in the program that will be transparent to other users.

If the user wants the Storm Simulator to remember the login information, he/she needs to click on the box in front of the "Remember my login". If this box is checked, the Storm Simulator will fill in the password once the user has entered a valid User Name. If the user does not want other users to have access to the simulator in this way, the box should not be checked and the user needs to keep access secure by remembering the full user name and password pair. All users should be cautious about using this convenience since each user class has specific functions that might be improperly used by other users. Students need to protect their access to avoid inappropriate use of the system under their user name that may affect the student's performance information. The user needs to click on the Login button after the User Name and Password have been entered. If correct, the Storm Simulator transfers the interface to the appropriate interface associated with the User Name.
Figure 2.2 Login page with Login Assistance note.

If the user enters a valid User Name but an incorrect password, the Storm Simulator displays the Login Assistance message shown in Figure 2.2. If the user knows the correct Password but made a typo, the user may retype the Password and hit Login once more. If the user has forgotten the Password, that user may selectForgot Password.

The Storm Simulator responds to the Forgot Password command by replacing the Login and Forgot Password options with an "Ok, email me" button as shown in Figure 2.3. When the user selects this button, the Storm Simulator looks up the email address and sends an email to that address with instructions on how to change the password. Once the user changes the password and submits it via an email response, the user can return to the simulator program and enter the new password to gain access to the Storm Simulator program.
Figure 2.3 Login page with access to a new password.
3. ADMINISTRATOR INTERFACE

3.1. USER INTERFACE PAGE

The first page an administrator sees is the Welcome Page (Figure 3.1). The introduction directly below the welcome banner defines the rights of the administrator:

- Assign instructors, their credentials, and their classes
- Assign students and their credentials
- Oversee the activity of instructors and their students

![Administrator's Welcome Page](image)

Figure 3.1. Administrator’s Welcome Page

Administrators have access to all of the menus within the Storm Simulator and can perform a set of unique administrative functions as well as the functions assigned to instructors and even students should they desire. Agencies may approach the management of the Storm Simulator training program in two different ways. Agencies may opt to assign one or more administrators who may then assign and oversee a set of instructors who work directly with students – staff who will use the Storm Simulator in a training mode. Or an agency may choose to allow one or more individuals to serve as both an administrator and an instructor. Either approach will work.

The Administrator’s Welcome Page has five menu items and a Logout button on the dark blue banner across the top of the page. The User menu item that is available only to an administrator has a pink background. The three menu items (Class, Scenario, and Assign) are primary instructor command areas; they have a light green background. When students log in to the Storm Simulator, the menu line is limited to the Home menu option with its light blue background. The Logout button exists on the menu banner line for all user classes.
The Administrator’s Welcome Page opens with the User menu features shown in the window below the welcome message. The list of users appears on the left and the profile information for the selected user shows up on the right side of the window. In the example in Figure 1 rdhadm is the highlighted user. The User profile for rdhadm is listed on the right. The profile section contains an entry area for a User Name, Email Address, Name, Agency, Password, and two options to define the type of user. The entry in the User Name is the name that the Storm Simulator uses to identify each user. It must be entered in the User Name box during the initial login. The Email Address allows communication between administrators, instructors, and students. The Name slot and Agency slot are for the user’s given name and employer, respectively. The Storm Simulator stores the user’s password once it is assigned but does not display the password when the profile is shown. If an administrator enters a new password in the password field and selects save, the Storm Simulator stores that new password and subsequently expects that password the next time the user logs in to the simulator. The two check boxes below the Password option allow the administrator to set the class of user. If the administrator clicks on the Admin box, the simulator assigns the user administrator privileges. If the administrator checks the Instructor box, the simulator assigns the user instructor privileges. If neither of the boxes is selected, the simulator assigns the user student privileges. If an administrator makes any changes to a profile and selects Save, the Storm Simulator stores the new values in the simulator database.

**WORD OF CAUTION** -- If an administrator selects a username and pulls up the profile and then deletes the profile and its associated username in the Users’ list that User Name cannot be used again; it is permanently locked from reuse.

### 3.1.1. New Teacher Profile

Administrators have the sole responsibility to add administrator, instructor, and student names to the User list. An instructor cannot establish profiles for new students. An individual with administrator privileges must perform this procedure. Instructors can create classes and add and delete students from classes, but they cannot create new student profiles in the Storm Simulator database. Only administrators can do this. The procedure to add a new teacher is illustrated in Figure 3.2. When an administrator logs in, the first name in the User list is highlighted and its associated profile information is displayed. To add a new teacher the administrator selects the Add User button at the bottom of the User column. This clears all of the entries on the profile section. In the example the administrator has filled in profile information for rdhteacher and put a check mark in the Instructor box. Once the administrator selects Save, the Storm Simulator reverts back to its default startup position and shows the profile for the first user in the list, but now the User list now contains a new entry of rdhteacher in the Instructors section of the Users list (see Figure 3.3). The administrator should make sure that the User Name and Password for are logged for future use and then notify the new user (Bob Hart in this case) at his email address regarding his User Name and Password to gain access to the Storm Simulator as an instructor.

### 3.1.2. New Student Profile

To add a new student the administrator selects the Add User button at the bottom of the User column. This clears all of the entries on the profile section. In the example in Figure 3.3 the administrator has filled in profile information for rdhstudent and left both the Admin and Instructor boxes empty. Once the administrator selects Save, the Storm Simulator reverts back to its default startup position and shows the profile for the first user in the list, but now the User list now contains a new entry of rdhstudent in the Students section of the Users list (see Figure 3.4). The administrator needs to log the User Name and Password for distribution to the student or instructors who may work with the student and have the responsibility to notify the student of his/her Storm Simulator access information.
Figure 3.2. Enrollment of a new instructor.

Figure 3.3. Enrollment of new student user.
3.1.3. Instructor Classes and Class Rosters

Administrators do have the ability to set up classes for an instructor and assign students to the class roster. Instructors may also set up classes themselves and change rosters within classes; however, it is important to note that administrators have the sole capability of creating profiles for instructors and students. Section 4 provides a detailed discussion of instructor capabilities and their management of classes and rosters.

**WORD OF CAUTION**

If an administrator selects an instructor user name in the Users column, the Storm Simulator displays the instructor's profile and classes assigned to that instructor. An example is shown in Figure 3.5. When an administrator selects the "Add class" button at the bottom of the Classes list, the Storm Simulator displays a dialog box requesting a Class Name. This dialog box includes a blank space for user entry of a name for the class. In the example in Figure 3.6 a class name of “Hart Group” has been entered. When the administrator chooses the Save option, the Storm Simulator enters the class name in the Classes column and opens a Roster column to go with the Classes option. If an instructor has more than one class, the Storm Simulator displays all of the available classes and the student names assigned to the class that is highlighted in the Classes column. An administrator can delete a class from the list by highlighting the unwanted class and selecting delete. **NOTE:** [can a deletion be done if a student in the roster has completed a scenario?] Since the Hart Group class was just assigned in the example in Figure 3.7, the Roster list is empty. If the administrator selects the Add More button at the bottom of the Roster list, the Storm Simulator displays a popup window with a list of all students who have been registered in the program arranged in alphabetical order. When the administrator highlights a student not already in the class and clicks on Enroll at the bottom of the popup
Figure 3.5. Selection of an Instructor.
Figure 3.6. The Class Name dialog box.

Figure 3.7. The Classes and Roster options.

Figure 3.8. Student list popup screen for Roster selection.
window, the Storm Simulator copies the User Name of the selected student to the Roster list and closes the student popup window. To add more students to the class, the administrator needs to duplicate this enrollment procedure for each additional student. Figure 3.9 shows the appearance after an administrator adds a new class and enrolls a student in that class.

![Diagram of the Storm Simulator interface showing the user interface for adding classes and students to the roster.]

Figure 3.9. Instructor Classes and Roster display after assignment of new class and roster.

### 3.1.4. Administrator Privileges

Administrators have universal access to all User profiles and may modify any profile whether they originally created the profile, set up a given class, or added students to the roster of a class. Agencies may establish multiple administrators for the management of their Storm Simulator program; however, the agency needs to make certain that the different administrators have separate areas of responsibility or coordinate changes to Instructor and Student manifests and related profiles to avoid confusion. Of particular importance is a consistent method to manage the assignment and distribution of User Name and Password information to new Instructors and Students and to keep track of these security credentials.
4. INSTRUCTOR INTERFACE

4.1. CLASS MENU

When a user with a user name and password that has instructor rights logs in, the Storm Simulator jumps to the instructor interface and displays the page shown in Figure 4.1. This page contains the welcome statement and the functions available under the Class menu option. The welcome message defines the rights of the instructor within the simulator program. These rights include the ability to:

- Assign students to classes
- Assign storm scenarios to specific individuals or all students in a class
- Oversee the activity and progress of all your students
- View the activity and performance of all students within your jurisdiction

![Figure 4.1. Instructor Welcome and Class page.](image)

The Class Interface page has two distinct parts: the Classes section and the Student Simulations Overview section. Although both of these instructor interfaces are on the same interface screen, the Classes section deals with the management of classes and their associated rosters whereas the Student Simulations Overview section allows instructors to view the student performance results. Actions made in the Classes section have no impact on the Student Simulations Overview section and vice-versa.
Figure 4.2. The teacher’s Class Name dialog box.

Figure 4.3. The addition of a new class name.
4.1.1. CLASSES OPTION

The Classes section contains a list of class names in its upper half and a Roster list in the lower half. When an instructor (or administrator using the Class menu option) selects one of the names in the Classes section, the Storm Simulator displays all of the students who have been assigned to that class Roster. A user can add a new class by clicking on the Add Class button in the Classes section. Selection of this option causes the Storm Simulator to bring up the Class Name dialog box. In the example in Figure 4.2, the instructor has entered “Teacher’s Class” as a new class name. When this name is saved the dialog box disappears and the new name appears in the Classes list (see Fig 4.3).

To delete a class an instructor highlights the class name in the Classes list and clicks on Delete. This will delete the class name from the list UNLESS one or more of the students in the class has already started or run through a storm scenario. If this is the case the Storm Simulator will not delete the class; otherwise the performance information on those students would be lost.

![Figure 4.4. The addition of a student to the Roster.](image)

With the “Teacher’s Class” set up in the Classes section; instructors may then add students to the Roster for this class. When an instructor clicks on ‘Add more’, the Storm Simulator brings up the list of students who have been registered to use the Storm Simulator. To enroll a student in the highlighted class under Classes, the instructor highlights the desired registered student in the popup list and then selects the Enroll button at the bottom of the student list. The Storm Simulator removes the class list popup and adds the name to the Roster list as shown in Figure 4.5.

If the instructor opts to delete a student from the Roster, the instructor highlights the student name in the Roster list and selects the Disenroll button. As long as the student has not started a scenario the name will be removed from the Roster. If the student has performed a scenario, the disenroll function will not remove the student’s name.
4.1.2. STUDENT SIMULATIONS OVERVIEW

The Student Simulations Overview is a completely separate function from the Class setup discussed in section 4.1.1. The Overview section permits instructors to review what scenarios students have started or completed and look at the student’s level of performance. Since an individual student’s performance is placed in comparison to the performance of other students, an instructor is able to see the performance level of the entire set of students and use this to evaluate the results achieved by a given student.

The interface for this Overview section is relatively simple. The instructor needs to use the drop down menu selections within the Classes, Scenarios, and Students options to select a student and a scenario. The interface to make these selections is shown in Figure 4.1. It is important to note that the selection of answers in these three categories is not dependent upon anything you select in the Classes section. The performance analysis for a student should actually only require the student's name and the scenario the instructor wants to review. However, the Storm Simulator needs to find a student in a class; therefore, an instructor must select a class that has the student on the roster, then pick the student's name in the Students drop down list, and finally select the scenario of interest. To aid this process it may be helpful for the instructor to keep a list of classes and students within the class in a separate log or listing. If an instructor selects a combination for which there are no completed scenarios, the page will look like Figure 4.1. If on the other hand, an instructor picks a class with a student who has completed the selected scenario, then the Storm Simulator will add a column of detailed post-scenario performance data as shown in Figure 4.6. The example is an analysis of the performance of rdhstudent in the Teacher’s Class in executing the Davenport Three Routes scenario. Note that a new decision option has been added called Attempts. Students may run through a given scenario multiple times; therefore, an instructor must also check to see what attempt number the data to the right represents. An instructor can step through the
attempts for a student to see if the student is improving with experience. There are six (6) sections in the column to the right of the Classes, Scenarios, Students, and Attempts section; the remainder of this section will cover each of these sections.

![Figure 4.6. Performance record in the Student Simulations Overview section.](image)

### 4.1.2.1. Class Overview

The Class Overview contains the name of the class in which the student is enrolled. Directly below that is the number of students enrolled in the class in the previous line. The appearance of this section is shown in Figure 4.7.

### 4.1.2.2. Scenario Overview

The Scenario Overview starts with the name of the scenario under review. The remainder of the section is a summary of the number of attempts students have made to set up, start, or complete the scenario. The summary shown in Figure 4.7 indicates how many times students have:

- Set up but not started a scenario (Not Started)
- Started a scenario but have not completed it (In Progress)
- Finished the entire scenario (Completed)

The overview provides the statistics for the custom scenario selected in the Classes menu and for all classes being run under the Storm Simulation program. An instructor will find this information helpful in determining the popularity of the scenario amongst other classes and instructors.
4.1.2.3. **Performance Distribution Overview**

The Performance Distribution graph (Figure 4.8) plots the measure of level of service efficiency on the vertical (or y) axis and the total cost in dollars to complete the scenario on the horizontal (or x) axis. Both of these parameters are discussed more completely shortly in following sections of this performance overview section. The red dot on the graph represents the intersection point of the level of service efficiency and the total cost for the student selected in the Students menu. The black dots indicate the performance characteristics of the other students who have taken the scenario. If an instructor places the mouse pointer over any of the dots, a tool tip will appear that provides the name of the student associated with that dot, the class, the attempt number, the level of service efficiency, and the total cost. Figure 4.9 provides an example of the Scenario Attempt Details. By hovering the mouse over each dot an instructor can review the performance of every student who has run through the scenario.
One key objective of the Storm Simulation exercise is to complete the maintenance simulation achieving the highest level of service efficiency at the lowest total cost. Graphically the optimal point would be a point that combines a position as high on the graph as possible and still as far to the left as possible. A student could make heavy applications of chemical to keep the level of service very close to 100, but that would push the total cost way to the right side of the graph. Similarly, a student could minimize the total cost by applying little or no chemical and allowing the level of service efficiency to drop drastically. Graphically, this would appear as a point in the lower left portion of the graph. For each scenario the optimal point will vary, but it
is likely that a cluster of points will appear after several students run the scenario and the cluster will encircle a point that represents the best trade-off between level of service efficiency and total costs. Those students who have points scattered far from the cluster may be having issues with the simulation or their approach to maintenance actions.

### 4.1.2.4. Scenario Attempt Description

The Scenario Attempt Description (Figure 4.10) provides the status of the student’s progress on the scenario selected in the Scenarios menu on the left. The first line indicates the Class, the Scenario, and the Attempt and the second line adds the Description of the custom scenario originally entered by the Instructor. The next four lines contain the following information:

- **Launch Time** - When the student first started running the scenario
- **Current Scenario Time** - The time step in the scenario timeline
- **Attempt Status** - Whether the scenario is completed or still in progress
- **Completed Time** - Time when the student completed the scenario

An instructor can use this information to check on the progress of assigned scenarios and to determine how long it is taking to complete the scenario.

![Figure 4.10. Scenario Attempt Description.](image)

### 4.1.2.5. Level of Service Report

The Storm Simulator measures student performance in two ways: level of service efficiency and total cost of materials, labor, and vehicle operation. To measure level of service the Storm Simulator uses a non-dimensional mobility index that is primarily an index of friction or grip. The Storm Simulator computes the amount of snow, ice, slush, and water on the pavement based upon the reported precipitation, the maintenance actions, traffic, and changes in the state of the snow, ice, and water. It then uses the amount of each type of material to compute the mobility index. An index of 100 represents completely dry roads and the index drops based upon the type of materials and their depth. Untreated roads with a layer of ice will have an index of 10 – 20. Using the mobility index it is possible to provide a numerical indication of the state of the road for each hour. Figure 4.11 illustrates the mobility index values that resulted from the maintenance actions entered by rdhstudent in the Davenport Three Routes scenario. The graph has the results of all three routes superimposed on the graph background. Instructors can change the display by clicking on the blue check marks at the bottom of the graph. When only one route is checked, the graph will be limited to that route only.

![Figure 4.11. Level of Service Report.](image)

The Storm Simulator provides an estimate of the level of service by assigning a mobility index value that fits the level of service categories used in defining routes. For example, a defined Very High level of service has a mobility index of 70 and a Low level of service has a mobility of 51. Figure 4.11 has red horizontal lines for the Very High, High, and Low levels of service for the three routes assigned to this scenario. The Storm Simulator compares
the computed mobility index for each time step in the scenario to the expected mobility index for that level of service and then determines what portion of the time the student keeps the mobility index above the level of service criterion line. The last line in the report lists the efficiency in maintaining the desired level of service and the rank of student relative to the performance of all other students performing the scenario.

Figure 4.11. Level of service graph.
4.1.2.6. Total Cost Report

The final panel in the Overview Report is the list of costs accrued during the execution of the scenario. The Storm Simulator uses the rates set up in the configuration files and multiplies these rates by the amount of resource use during the scenario to derive the costs for materials, staff, and vehicles. Figure 4.12 provides an example of the costs associated with rdhstudent running Davenport Three Routes. The Storm Scenario then ranks the costs against all other students who have performed the scenario and provides rdhstudent's rank relative to the others.

![Table of costs](image)

Figure 4.12. Summary of costs to complete the scenario.
4.2. SCENARIO MENU

The first screen (Figure 4.13) that appears when an instructor selects the Scenario menu option has the welcome statement (discussed in section 4.1) and a list of scenarios currently defined in the Storm Simulator. This list may contain:

- Base scenarios that are actual winter storm events saved for the Storm Simulator program, or
- Custom modifications to these base scenarios.

Base scenarios are shown in bold fonts and custom scenarios appear as regular fonts. The base scenarios contain 8 routes, 18 materials, 21 vehicles, and 16 snowplow drivers. Instructors have the ability to create custom scenarios that:

- Reduce the number of resources to keep the execution time of a storm scenario to a reasonable length
- Adjust costs, level of service, and other resource usage values from the default values to the numbers or levels used locally by the Agency.

This section explains the process of creating scenarios that should be more reasonable exercises for students and for creating scenarios that challenge students to deal with abnormal operational situations (e.g., reduced staff, vehicles out of service, limited deicing materials).

When an instructor clicks on one of the base scenarios, the home page adds the Create Custom Scenario and Details boxes shown in Figure 4.14. The Create Custom Scenario page lists the following four resources:

- Routes
- Materials
- Vehicles
- Staff

Under each of these resource headings is a list of all of the items within that resource type. Instructors have the ability to manage which resources will be included within a custom scenario and the specific characteristics of each of the items in all four lists. The lists for a couple of the parameters are
long enough that it is necessary to scroll the display in order to see the entire list. The Details section in the lower left of the screen provides a count of the items in each list. On this page the display is merely a list of resources and the individual items do not provide additional information.

If the instructor chooses one of the custom scenarios in the Scenarios list, the Storm Simulator replaces the Create Custom Scenario section with the Edit Scenario as shown in Figure 4.16.

To create a new Custom Scenario, an instructor needs to enter a name in the New Custom Scenario Name field and then press the ‘Begin Customizing A New Scenario’ button. If you happen to click on ‘Begin Customizing A New Scenario’ before entering a name, the Storm Simulator will respond with the error message “Please name the custom scenario”. The name entered should be something descriptive of the scenario. For example, the name entered in Figure 4.15 is “Davenport Three Routes” since the instructor’s intent is to reduce the Aurora_IA_DVN:2015-02-01 base scenario from 8 routes down to 3 routes to permit students to finish a scenario in 1 hour or less. Once the instructor has clicked on the ‘Begin Customizing A New Scenario’, the Storm Simulator enters the new name in the Scenarios list beneath the base scenario from which it was derived.

The program replaces the Create Custom Scenario section with the Edit Scenario section shown in Figure 4.16. The Details section remains the same. The red menu bar in the Create Custom Scenario section becomes a menu option line with 5 menu choices. Instructors may select any or all of these menu options to:

- Exclude items in the list
- Change costs, level of service, capacities, and units
- Write a description of the scenario

The rest of section 4 discusses these menu options and what they do.
Figure 4.15. New Custom Scenario name

Figure 4.16. Edit Scenario page.
4.2.1. ROUTES

If an instructor selects Routes on the red menu bar on the Edit Scenario interface, the Storm Simulator brings up the ROUTES page as shown in Figure 4.17. Note that this is a list of the 8 routes for the ‘Davenport Three Routes’ custom scenario carried from the Aurora_IA_DVN:2015-02-01 base scenario. The Details section indicates that there are 8 routes, 18 materials, 21 vehicles, and 10 staff available for assignment. The highlight in the Routes section is on Aurora_IA_DVN-1-1; therefore all of the information listed to the right of the Routes list relates to route 1-1 which is more commonly named Route 1, Driving. The information on the next 3 gray-tone lines describes the characteristics of this route. This information is hard-coded and cannot be modified by the instructor. The three items below the gray section have values that are default numbers and the instructor may modify them. Although they may be modified, a word of caution is necessary. The traversal times represent the time it takes to go from the start to the end of the route at a constant speed in an out and back pattern. The traversal time for patrolling is based upon an average truck speed of 37 mph and the time spent maintaining is based upon an average speed of 28 mph. In the evaluation of the maintenance actions, the Storm Simulator allows a 15-minute period between sequential treatment applications to reload the truck with material and stretch. Therefore, modifications to the traversal time should be based upon typical average patrolling and treatment speeds. Once changes are made to any of these 3 items, an instructor may save the changes by clicking the Save Scenario button.

Since the highlight in the Scenarios column is on the Davenport Three Routes scenario and there are 8 routes in the Routes list on Figure 4.17, the instructor needs to select eliminate some of the routes in the Routes column to get down to 3. The routes set up for the Storm Simulator program range from urban, high AADT routes requiring a high level of service at the top of the list to a rural, low AADT traffic volume route requiring a low level of service at the bottom of the list. If an instructor desires to pick three routes with high, medium, and low level of service, the instructor might opt to limit the Routes list to routes 1-1, 3-1, and 6-1. To save those routes the Storm Simulator requires the user to delete or exclude the other routes. To start this exclusion process, the instructor needs to highlight the second route (1-2) and put a check in the Exclude box at the bottom of the Route Details section. An example of this step is shown in Figure 4-18.
To complete the exclusion process, the instructor must click on ‘Save Scenario’. This action causes the Storm Simulator to delete the Aurora_IA_DVN:1-2 entry in the Routes list and return the highlight to the top route in the list as shown in Figure 4.19. In the Davenport Three Routes example an instructor must duplicate the procedure to exclude route 1-2 on routes 2-1, 2-2, 4-1, and 5-1 in order to remove them from the Routes list. When routes 1-2, 2-1, 2-2, 4-1, and 5-1 have been excluded the Routes column will look like the one in Figure 4.20. When students launch this scenario they will have just the three routes in Figure 4.20 as part of their scenario.

**WORD OF CAUTION** -- Instructors should make certain that they want to exclude a route before hitting the ‘Save Scenario’ button. Once a route has been deleted from the list, there is no mechanism to restore it to the list for that custom scenario!

### 4.2.2. MATERIALS

When an instructor selects Materials on the red menu bar in the Edit Scenario section, the Storm Simulator presents the Edit Scenario Materials display that contains the list of materials available within the program. The interface is shown in Figure 4.21. The display will have one of the materials highlighted along with the Material Details associated with that material. Instructors may modify two parameters on the Material Details display: ‘Cost/Unit’ and ‘Available units’. The units of measure used for the highlighted material appears at the right end of the gray line above the Cost/Unit option.
Figure 4.19. Edit Scenario with route Aurora_IA_DVN:1-2 removed.

Figure 4.20. Edit Scenario with route list reduced to 3 routes.
Instructors can change either of these values for the displayed material and then click on Save Scenario to save the values.

**WORD OF CAUTION** -- Instructors can change these values without concern when they are setting up a new scenario; however, it is possible to edit a custom scenario after it has been in use for some time. If an instructor changes material costs after some students have executed the scenario, any changes to the entries on this page will potentially change the performance results of students performing the scenario after the change and negatively impact the ability to compare results between students.

If an agency uses salt or brine predominantly, but does use calcium, magnesium, and sand on occasion the instructor has the ability to go through the list of materials and exclude the ones that he or she does not want students to use in the scenario. The exclude process requires that the instructor highlight an unwanted material, check the Exclude box, and click on the Save Scenario button. If an instructor goes ahead and deletes all of the materials other than the ones listed in the first line of this paragraph then the Materials page will look like the one in Figure 4.22.

**WORD OF CAUTION** -- Instructors should make certain that they want to exclude a material before hitting the ‘Save Scenario’ button. Once a material has been deleted from the list, there is no mechanism to restore it to the list for that custom scenario!
4.2.3. VEHICLES

When the instructor selects VEHICLES on the red menu bar in the Edit Scenario section, the Storm Simulator displays the list of available trucks and the characteristics of the specific truck that is highlighted in the list (see Figure 4.23). The list contains 6 different types of trucks or configurations. The truck classes and their numbering class include:

<table>
<thead>
<tr>
<th>Truck Classification</th>
<th>Number Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanker for liquid applications</td>
<td>100</td>
</tr>
<tr>
<td>Liquid trailer behind tandem axle truck</td>
<td>200 – 201</td>
</tr>
<tr>
<td>16 ton tandem axle truck for solid applications</td>
<td>300 – 305</td>
</tr>
<tr>
<td>8 ton single axle truck for solid applications</td>
<td>500 – 503</td>
</tr>
<tr>
<td>Tandem axle with 6 ton solid &amp; 900 gal wedge tank</td>
<td>600 – 603</td>
</tr>
<tr>
<td>Single axle with 4.4 ton solid &amp; 540 gal wedge tank</td>
<td>700 – 703</td>
</tr>
</tbody>
</table>

The characteristics of the trucks are in the Truck Details section and the information includes:
- The truck number
- A description of the truck
- The cost/mile to run the truck
- The liquid capacity of the truck
- The solid capacity of the truck.
Instructors can modify the values in the cost/mile, liquid capacity, and solid capacity fields. To save any changed values, the instructor must click on Save Scenario. As with the Routes and Materials an instructor can put a check mark in the Exclude box, click on the Save Scenario button, and eliminate that vehicle from the Vehicles list.

**WORD OF CAUTION** -- Instructors should make certain that they want to exclude a vehicle before hitting the ‘Save Scenario’ button. Once a vehicle has been deleted from the list, there is no mechanism to restore it to the list for that custom scenario!

As an example an Agency has 6 tandem axle vehicles and they typically deploy 3 of the vehicles with wedge tanks, so the instructor sets up the custom scenario with 3 tandem axle trucks with plows and the ability to dispense solids and 3 tandem axle trucks with plows and wedge tanks dropped into the bed. Therefore, the instructor opts to keep 3 300-class trucks and 3 600-class trucks. After going through the sequence of excluding the other trucks, the Trucks list takes on the appearance shown in Figure 4.23. When students run the Davenport Three Routes scenario they will have these 6 trucks at their disposal.
4.2.4. STAFF

When the instructor selects STAFF on the red menu bar in the Edit Scenario section, the Storm Simulator displays the list of available drivers and the information about the staff members (see Figure 4.25). The Driver Details section is much simpler than in the other menu options. The section merely contains the name of the driver and the cost per hour, which has been set to $20/hour. Realistically compensation amounts should be different for different drivers; however, it was decided that different salary levels would tempt students to select the lower compensated drivers first in an attempt to minimize staff costs rather than break the driver list into shift groups.

The Storm Simulator has some staffing rules that are important factors in determining the staff levels that an instructor must consider when building the staff list. Call-in times are 2 hours from the time the call is made until a student can assign the driver. Shifts are 8 hours; time beyond that is considered over-time. Students may send a driver home after 4 hours on shift. Once off-shift, drivers must be given 8 hours of rest time before they may be called back in. These rules pretty much dictate that the instructor must plan on sufficient personnel to staff three shifts in order to avoid overtime situations. The STAFF list and Details summary in the bottom left of the Scenarios page indicate that the base number is 10 staff members. This number has been increased to 16 in the most current version.

An instructor may want to reduce the base staff list down to create a smaller list for the custom scenario. Instructors should use the Exclude option and the Save Scenario to delete drivers from the list. As with the other menu items, it is important to make sure that you definitely want to delete a driver before you select the Save Scenario button. Deleted drivers cannot be returned to the list.
4.2.5. DESCRIPTION

When the instructor selects DESCRIPTION on the red menu bar in the Edit Scenario section, the Storm Simulator displays a blank Custom Description box and an Update Custom Description button (see Figure 4.26). The instructor should write a short description of the characteristics of this custom scenario that make it unique similar to the description in Figure 4.26. Once the instructor is satisfied with what was written in the description field and is satisfied with the modifications made to the ROUTES, MATERIALS, VEHICLES, and STAFF configuration pages, the instructor should click on the Update Custom Description button. Once this selection is made, the Storm Simulation program saves all of the resource changes plus the description statement and updates the Details Summary in the bottom left of the Scenarios page as in Figure 27.
Figure 4.26. Edit Scenario – DESCRIPTION page.

Figure 4.27. Edit Scenario – Updated Details summary list.
4.3. ASSIGN MENU

When an instructor selects the Assign menu option, the Storm Simulator presents the page shown in Figure 4.28. The introduction remains the same as the one for the Class and Scenario options and was discussed in section 4.1. To assign a scenario an instructor needs to select the desired scenario from the Scenarios list and then select the class from the Classes list in the Assign Scenario section. Once these two selections reflect the desired scenario assignment, the instructor should click on the Assign Scenario to Class button. In the example in Figure 4.28 the instructor has assigned the Davenport Three Routes scenario to the Teacher’s Class group. The result is shown in Figure 4.29.

Should an instructor want to assign a special custom scenario to one student, the instructor can return to the Class menu and set up a class with that one individual in the Roster for that Class, then return to the Assign menu and assign the scenario to the class name set up for that student.

![Figure 4.28. Assign Scenario page.](image-url)
Figure 4.29. Assign Scenario – Completed scenario assignment.
5. STUDENT INTERFACE

5.1. GETTING STARTED

When a user with a valid student user name and password logs in, the Storm Simulator displays the student interface page shown in Figure 5.1. The page contains the welcome statement, the control panel, and the scenario information panel.

The welcome statement provides the new student user with a brief overview of the Storm Simulator, what actions the student can perform during the simulation, and the fact that the student’s performance after completion of the scenario will be compared to what other students have done on the same scenario. It also advises the student about procedures to properly stop working on the scenario, save the work done so far, so the student can come back and resume the simulation at a later time.

The control panel on the left center of the page provides a list of classes and scenarios in which the student has assignments. To get to the desired scenario, a student highlights the appropriate class name and scenario name. As the student makes these selections, the Storm Simulator changes the content of the scenario information panel.

The scenario information panel (Figure 5.2) contains a control section that permits a student to select which attempt of the scenario chosen in the control panel the student wants to view. Once this is done the scenario information panel gives the student a description of progress on the attempt selected and details on the materials, routes, staff, and vehicles assigned by the instructor for that specific scenario. The Scenario Attempt Description section starts with a heading that restates the class, scenario, and attempt number of the information shown in the remainder of the description table. The heading also includes a description of the scenario entered by the instructor when the scenario was composed. The information in the table beneath the heading includes the:

- Launch time -- The time when the attempt on this scenario started
- Current scenario time -- The time step within the scenario
- Attempt status -- Student’s progress in completing the scenario
- Percent complete -- How much of the scenario has been completed; (number of time step hours done)/(total hours in scenario)

The details section has expandable lists of the resources available within the Material, Route, Staff, and Vehicle categories. Finally, there is a Launch Scenario button. When a student selects this button, the Storm Scenario either starts a new scenario or picks up from the last spot where the user left off.

NOTE: It is recommended that the student review the information in the details section prior to launching the scenario. Although the information in these details summaries shows up for each specific item, the complete list is only available on this Home page.

If a student clicks on the Materials Details line, the Storm Simulator expands the section to show a list of materials that the student will have available during the scenario (see Figure 5.3). The student’s instructor determines the list of materials and can set the amounts available for use in fighting the storm. It is possible for an instructor to limit the amount of one or more materials to challenge students to deal with a short supply, so BE AWARE of the resource amount before starting the scenario. Clicking on the Materials Details line when the list is visible will close the materials list.
Figure 5.1. Student home page.

Figure 5.2. Scenario Information Panel.
If a student clicks on the Route Details line, the Storm Simulator expands the Route list to show the routes set up by the instructor (Figure 5.4). The information in the table spells out key factors that the student needs to consider regarding each of the routes. The Lane Miles distance is the total out and back distance; while the Level of Service specification is related to the traffic volume (AADT counts). There are 5 levels of service classes ranging from very high (VH) down to very low (VL). The Storm Simulator uses these levels of service classes to determine acceptable and unacceptable road conditions as the scenario proceeds. The traversal time assumes that plowing and treatment activities are done at roughly 30 mph and therefore it is...
the time to go out and back at that speed. The student should have an idea of these traversal times since they may impact shift scheduling. For example, there are times when drivers are nearing the end of their shift and the student needs to make a decision to hold off maintenance for an hour or so rather than pay overtime if that driver is sent back out. To remove the route list from the screen, the student merely needs to click on the Route Detail line once more.

When a student selects the Staff Details line, the list of drivers that the instructor assigned to the scenario drop down from the Staff line (Figure 5.5). The cost/hour amount is the same for all drivers merely to keep the focus of the simulation exercise on efficient maintenance of the roads and not on techniques to artificially minimize labor costs. The primary reason to look at the staff list is to see how many drivers are available and make initial plans on how to plan shift assignments. To close an open class display list, the student needs to click on the Staff Details line.

**IMPORTANT STAFF INFORMATION:** The Storm Simulator requires two (2) hours from the time a driver is called in until the driver is available for route assignment. Drivers must work a minimum of four (4) hours before they can be sent home. A driver’s shift is eight (8) hours after which they receive overtime pay at 1.5 times the normal cost/hour.

![Figure 5.5. Details on the staff available for the scenario.](image)

When a student selects the Vehicle Details line, the Storm Simulator expands the vehicle section downward to list the vehicles the instructor assigned to the scenario. The list provides a description of the vehicle, whether it has a plow, its liquid and solids capacity, and the cost/mile. In many scenarios an instructor will assign either just enough vehicles to cover the route or maybe one reserve vehicle. A typical approach will be to assign one truck to one route and change drivers for that truck and route at shift turnover. Thus, during preparation for a scenario a student may want to mentally assign a specific truck to a specified route and follow that pattern through the scenario. In this Davenport Three Route example, the instructor provided tandem axle trucks that could be configured with or without wedge tanks. This would allow the student to decide to use solids only or to use both solids and liquids. The student can close the truck list by clicking on the Vehicle Details line.
5.2. LAUNCH SIMULATION

To start the simulation from the Home page, the student needs to click on the Launch Simulation button located in the right center of the page. This action will bring up the Simulation Interface page. On most monitors the entire interface will not fit on a single screen and the user must use the scroll bar on the right side of the screen to see all the information available on the screen. The student will need to remember this during execution of the scenario. To show the whole screen the Simulation Interface the display is broken into a top screen portion in Figure 5.7 and a bottom portion of the screen in Figure 5.8.

The top line has the Home menu and Logout options. Home takes the student back to the first page (Figure 5.1) and Logout stops the Storm Simulator session and returns the user to the initial Login screen. The second line contains the Class Name, Scenario, and Attempt number.

The green bar is the time line for the scenario. It shows all of the time of all of the crew order actions submitted by the student during the scenario. The time scale collapses to the left as the student gets deeper into the scenario. The time line displays green dots at the time of staff actions and orange dots at the time of treatment actions. The red oval contains the current scenario time. The remainder of the page has two components: a menu on the left and the information display area on the right.

The menu section has areas: Overview, Current Road Weather Info, and Route Conditions. Figure 5.8 shows these menu areas on the menu options. The Overview area contains menu selections to request crew order decision screens each focusing on the conditions and status from the perspective of Routes, Staff, Vehicles, or Materials. The Current Road Weather Info has typical road weather resource information resources a maintenance user would request and the Route Conditions has links to the current and forecast conditions for each of the routes in the scenario.
Figure 5.7. Top portion of the Simulations Interface page.

Figure 5.8. Bottom portion of the Simulations Interface page.
When a student launches a new scenario, the Storm Simulator displays a map of the scenario location with the routes assigned for the scenario in the Display Area on the right portion of the page. The routes are initially shown in white to differentiate them from the map background route network. A student can point and click each of the routes to get the specifics about the route. The student can also zoom into or zoom out of the map to change the area of coverage of the map background or shift the position of the map by using the left, right, up, and down arrows above the zoom slider. As an alternative a user can move the display area by moving the mouse over the map and holding down the left mouse button while moving the mouse to view the desired map position.

5.2.1. Current Road Weather Info

Maintenance personnel have need to look at a number of road weather products to assist in their decision making process. The Storm Simulator provides most of these resources to assist in the student’s decision making processing. The first display option is a presentation of Traffic Speeds on all of the routes assigned for the scenario. In Figure 5.9 the traffic speeds at 4 PM on January 31 are normal for all three routes. As the road conditions deteriorate the average traffic speeds will drop off. The legend in the bottom left of the map display indicates the speed reductions and their associated color designation. The Storm Simulator ties speed reductions to specified road condition classes. The speed reductions provide a quick visual indication of the road conditions on traffic and a potential need for maintenance action to restore traffic speeds closer to normal.

![Figure 5.9. Routes & Traffic Speeds display.](image)

Students may display further information about a route by placing the mouse pointer over the route and left clicking. This will cause the Storm Simulator to overlay a dialog box with information about the route (see Figure 5.10 for an example). The information in the box includes:

- The route number and the actual route name
- The mobility index number and the desired minimum mobility index value for the route level of service
- What trucks are operating on the route
• The number of lane miles for the route and the time to run the route out and back
• The pavement condition (indicated above the camera image)
• A camera image of the road conditions
• A link to the route conditions display for that route (see section 5.3 for discussion of this display)

Figure 5.10. Routes & Traffic Speeds display.

Selection of the Radar menu option brings up the radar image at the time indicated in the red oval on the timeline as an overlay on the route background map (see Figure 5.11). The radar image uses the standard colors to depict the different types of precipitation: green for rain, pink for freezing rain or sleet, and blue for snow. Colors increasing from lighter to darker hues indicate increasingly heavier precipitation. Students may animate the images by selecting the Last 6 Hours or Next 6 Hours buttons at the bottom of the radar image. Once a loop has begun the student may interrupt the loop by clicking on the Stop button. The loop may be restarted by clicking on the Last 6 Hours or Next 6 Hours button that the student had used to start the loop. A student may step through the loop by using the step button. Often times when making decisions it is helpful to get the bigger picture. If a student zooms the image outward using the zoom slider that user can get a better picture of the storm’s impact as it progresses towards the location. Figure 5.12 illustrates this advantage.
Figure 5.11. Radar imagery.

Figure 5.12. Radar image zoomed out.
The student can also view the visible and infrared satellite images. Figures 5.13 and 5.14 show visible and infrared images are zoomed to the same level as the radar image in Figure 5.12.

Figure 5.13. Visible satellite image zoomed out.

Figure 5.14. Infrared satellite image zoomed out.
The Storm Simulator maintains camera images from cameras in and around the area of the scenario. When a student points and clicks on one of the available camera icons, the simulator displays one or a series of images from that camera at the time indicated in the red oval on the timeline. Figure 5.15 provides an example of the type of image supported by the simulator.

![Camera images](image)

**Figure 5.15. Camera images.**

The student has access to the RWIS information by selecting the RWIS menu option. The Storm Simulator places purple circles at the location of all RWIS sites on the map. If a student places the mouse pointer over an RWIS icon and left clicks the mouse, the simulator displays the information from that RWIS site (see Figure 5.16). If data is available from the RWIS site, the purple circles will display the value of the RWIS parameter selected in the drop down list of the RWIS Display Options shown at the bottom of the background map. To view this display option the student may have to use the right-most scroll bar to view the bottom portion of the display area. Students may find the Road Temp and Road Conditions displays as the most helpful display options in assessing road weather conditions in the area around the routes in the scenario.

The student has access to the NWS METAR weather observation data by selecting the METAR menu option. The simulator displays the METAR sites with orange squares and fills the squares with the values of the parameter selected in the Metar Display Options at the bottom of the map. If a student points to one of the METAR sites and left clicks on the mouse, the simulator displays the reported data from that site as shown in Figure 5.17.

The student may view the NWS forecast by selecting the NWS menu option. The simulator overlays the current NWS forecast on the right side of the map display as in Figure 5.18 for the NWS zone that covers the area of the routes. Students can use the scroll bar on the right side of the forecast to view the entire forecast discussion. When finished viewing the forecast, users may remove the forecast by clicking on the red square in the top right of the forecast.
Figure 5.16. RWIS data.

Figure 5.17. NWS METAR data.
5.2.2. Route Conditions

The Route Conditions menu section provides access to a tabular listing of road weather conditions on a scenario route from the current scenario time back 24 hours and a forecast of the same conditions for the next 24 hours. A student may access this display by clicking on the desired route in the Route Conditions menu section or by clicking on the Route Conditions icon on the lower portion of the Routes & Traffic Speeds display as shown in Figure 5.10. When a student requests a route conditions display, the Storm Simulator brings up the Route Conditions page with a table that presents past and forecasted road weather conditions. The heading above the table provides the route identification and the value of the Desired Mobility Index. In Figure 5.19 the desired mobility index is >70 since Route 1 has a very high level of service rating. The road weather conditions and forecast table is expanded and shown in Figure 5.20. The table contains conditions from 24 hours before the current time forward to forecasted conditions out to 24 hours. The conditions at the current time appear as a row with a red background. Previous conditions toward the top of the listing are recent conditions and they are denoted as previous condition using a tan fill around the times; forecasts extend from the red line towards the bottom of the list and their times have a green fill. The simulator presents the headings to the table columns as diagonal descriptors directly above the table. Table 5.1 lists the parameters in the Route Conditions listing and a description of their meaning and significance.

Important Note: The mobility index column in the table displays mobility index values that meet the desired mobility index criterion in black and all mobility index values that do not meet the desired value in red. The values in the mobility index column provide a powerful tool in assessing whether the student is maintaining the roadway to the required level of service. The Storm Simulator projects the effect of the current treatment action through its period of impact, then determines the mobility index assuming that no further treatment will occur. To avoid the projected deterioration in the mobility index when weather is occurring, a student must continue to treat the roads to keep the short-term future conditions from dropping significantly. Students should also pay attention to the Liquid Rate, Ice Rate, and Snow Rate columns. For previous times the values in these three columns provide an excellent summary of what type of material fell and give an estimate of the depth of the layer caused by that type of precipitation. The forecast values in these three columns provide a good estimate of the amount of snow, ice, or liquid a student will need to manage.
The student will find that these route condition displays coupled with the input of crew orders in the Overview menu section become primary tools in making decisions on the most appropriate maintenance response actions.

Table 5.1 Parameters in the Route Conditions analysis and forecast table.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility index</td>
<td>Index used to estimate road condition and its grip factor; non-denominational number between 0 &amp; 100</td>
</tr>
<tr>
<td>Road Temp</td>
<td>Temperature of the top surface of the roadway in degree Fahrenheit</td>
</tr>
<tr>
<td>Road Cond</td>
<td>Condition of the road surface</td>
</tr>
<tr>
<td>Frost Prob</td>
<td>The probability of frost based upon relationship between pavement temp and dew point temperature</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Type of treatment action submitted by the student</td>
</tr>
<tr>
<td>Rate</td>
<td>Application rate(s) tied to the type of treatment in previous column, typically in lb/mile or gal/mile</td>
</tr>
<tr>
<td>Air Temp</td>
<td>Temperature of the air along the route in degrees Fahrenheit</td>
</tr>
<tr>
<td>Dew Pt</td>
<td>Temperature at which the air becomes saturated in degrees Fahrenheit</td>
</tr>
<tr>
<td>Wind Direction</td>
<td>Direction from which the wind is blowing in cardinal points (16 directions)</td>
</tr>
<tr>
<td>Wind Spd</td>
<td>Wind speed in miles/hour</td>
</tr>
<tr>
<td>Precip Type</td>
<td>Type of precipitation in classes such as rain, snow, freezing rain, sleet, mixture</td>
</tr>
<tr>
<td>Liquid Rate</td>
<td>The rate of rainfall in inches/hour</td>
</tr>
<tr>
<td>Ice Rate</td>
<td>The rate of freezing rain, sleet, or mixture of rain/snow in inches/hour</td>
</tr>
<tr>
<td>Snow Rate</td>
<td>The rate of snowfall in inches/hour</td>
</tr>
<tr>
<td>Cloud Cover</td>
<td>The amount of cloud cover in NWS classes (clear, mostly sunny, partly cloudy, mostly cloudy, overcast)</td>
</tr>
</tbody>
</table>
Figure 5.19. Route condition analysis and forecast for Route 1, Driving.

Figure 5.20. Expanded display of Route Condition table.
5.2.3. Overview

The Overview section serves as the primary interface for gathering information about recent treatment actions and then inputting crew orders for the current time step in the scenario. Students have four separate interfaces for gathering information; they include Routes (Figure 5.21), Staff (Figure 5.22), Vehicles (Figure 5.23), and Materials (Figure 5.24). Users may issue treatment orders or staff changes using the first three interfaces and monitor material usage with the Materials interface. All four interfaces retain the basic layout with the timeline across the top, the menu section down the left, and the display area covering the majority of the screen on the right portion of the page below the timeline. The timeline and menu section remain the same for all four interfaces, only the display area changes as the student moves from one interface to the next. Within the display area the Routes, Staff, and Vehicles interfaces have a darker gray command center with three boxes situated next to one another in each row. This command center sits to the left of a time matrix that has vertical time line markers for each of the time steps in the scenario. The Storm Simulator indicates the current scenario time using a vertical red line and an oval time indicator. To the lower right of the time matrix is a set of commands to move the position of the time scale to the right or left. On the Routes interface there are three rows that permit the entry of crew orders for the three routes in the scenario. On the Staff interface, there are nine rows, each row associated with the actions of the nine staff members assigned to the scenario. Finally, the vehicles interface has six rows for the six vehicles assigned to the scenario. The only interface that is different is the Materials interface; it does not have the command center controls or the rows associated with the materials in use in the scenario. Rather, it provides the user with an ongoing assessment of the material resources that are still available for the scenario, both solid and liquid.

The Routes, Staff, and Vehicles interfaces have a final control option in the decision process, the “Save & Step Forward” button. After a student has settled on the crew orders for a specific hour, he/she clicks on the Save and Step Forward button.

![Figure 5.21. Routes Overview page.](image-url)
Figure 5.22. Staff Overview page.

Figure 5.23. Vehicles Overview page.
5.3. RUNNING A STORM SCENARIO

All the discussion up to this point deals with the preparation for running an actual Storm Simulation scenario. Section 5.3 presents the process of running a scenario and points out the steps necessary to successfully complete a scenario. As a new scenario begins, a student will check weather and route conditions to determine when it will become necessary to call in staff to commence pre-treating or treating adverse weather conditions. Thus the first crew action will be the decision to call staff in to start the maintenance action. If a student starts with the Route or Vehicle Overview menu, the Storm Simulator displays a message that indicates the user must Manage Drivers or Step Forward. If the student selects Step Forward, the Storm Simulator will ask the Student to confirm the step forward action and then move forward one hour with no change in the crew orders. If the student selects Manage Drivers, the Storm Simulator changes the interface to the Staff page. Had the student selected the Staff overview option, he/she would have reached the same display to call in the necessary staff. The Staff interface is shown in Figure 5.25. The person icons in the left-most box for each staff member serve as indicators that Staff is available for call-in. If a student clicks on the icon in the left box for driver George Washington, the Storm Simulator displays the “Call Driver In” popup box as shown in Figure 5.25 with a blank call-in time and a list of possible call in times. Once a student selects one of the call in times, the Storm Simulator enters this time in the blank field and closes the list of possible call in times. The student may then select the “Save Maintenance Action” or “Cancel” buttons at the bottom of the “Call Driver In” popup box. The Cancel button clears the call in time and allows the student to start the process over or go back to the “Save and Step Forward” button and move forward with no change. The “Save Maintenance Action” selection causes the Storm Simulator to log the maintenance action in the Pending Maintenance Action section that appears below the control center and display area as shown in Figure 5.26.

NOTE: A student will normally have to use the scroll bar on the right side of the screen to scroll the screen down to view the Pending Maintenance Action section.
Once a student has satisfied all potential maintenance actions that are available at a time step, the Storm simulator asks the student for confirmation to precede with the pending maintenance actions. This step is very important because it is the last step before the simulator executes the actions entered.
by the student and clicking on “Confirm” causes the simulator to perform the pending actions and thereby eliminate any way for the student to go back and change a crew order entry for the previous time step.

Figure 5.27. Confirm Submit Maintenance Actions popup

Figure 5.28. Staff Overview display at 5 PM.
Once a student selects “Confirm” at 4 PM, the new screen appears similar to Figure 5.28. The three yellow lines indicate that the drivers George Washington, John Adams, and Thomas Jefferson are in the midst of their two-hour call in period. If the user scrolls the display area upward to show the remaining drivers, the student would see that the six drivers that were not called in do have icons in the first box. Therefore, the Storm Simulator would permit these six drivers to be called in; however, with just 3 routes, the drivers would have nothing to do.

**NOTE:** The Storm Simulator only allows one truck on a route and trucks must always perform an out and back route cycle. The Storm Simulator will not permit the user to place a second vehicle on the same route where another truck is already active.

At 5 PM the Storm Simulator presents no options for the three drivers since the drivers are still 1 hour away from their start time. Thus no popup window will appear with the “Confirm” option. In this case the student needs to click on the “Save and Step Forward” button to move the Storm Simulator to 6 PM. The Staff Overview page at 6 PM is shown in Figure 5.29. A student can also verify the call in process by pointing to the green dot at the far left of the time line. With the mouse on the dot, the simulator immediately displays a tool tip indicating the call-in information (see Figure 5.30)
Figure 5.30. Timeline Tooltip.

At 6 PM the display area shows the two hours of call in time in yellow and four hours of active shift time for the first three drivers. In addition, there are + signs in the second box in the control center area for these drivers. These + signs indicate the student may click on any one of these and initiate a crew order. If a student points to the + sign underneath George Washington, the Storm Simulator opens the “Assign Maintenance Action” data entry window as shown in Figure 5.31. At this point the window shows an information request for “Available routes:” with the text of “Available – Route Description ...” in the data entry field. If the student clicks on the text in the data entry field or the up/down arrows on the right side of the field, the simulator presents a list of the routes assigned to the scenario and the time of the assignment (see Figure 5.32, an exploded view of the Assign Maintenance Actions window).
Figure 5.31. Assign Maintenance Action window.

Figure 5.32. Available routes drop down list.
When the student points and clicks on one of these routes, the simulator enters the route and time in the box, removes the list, and presents a new request for “Available vehicles;” with a data entry field. When the student clicks on the data entry field or the up/down arrow, the simulator lists the available vehicles as indicated in Figure 5.33.

![Figure 5.33. Available vehicles drop down list.](image)

![Figure 5.34. Set plow position drop down list.](image)
A student selects the desired truck for the “06:00 Route 1, Driving” entry made in the “Available routes” data field immediately above. After clicking on the vehicle in the list, the simulator enters the truck and time in the data field for “Available vehicles:”, removes the list, and adds “Set plow position:” and its associated data entry field. When the student clicks on the text in the data entry field or the up/down arrow, the simulator opens a drop down list containing two options, up or down (see Figure 5.34).

**NOTE:** To avoid confusion in coordinating drivers, trucks, and routes, it is suggested that students create a plan to assign specific trucks to specific routes and stick with that assignment throughout the scenario. Drivers should also be assigned a specific truck for the duration of a shift. Since the route lengths are different, crew action decisions do not occur simultaneously on all routes and it can become tricky determining which driver to assign to which truck without a mental guideline of which driver and vehicle belong on a certain route.

A student may select plow position up or down. Once one is selected, the simulator enters the plow position in the data field for “Set plow position:”, removes the list, and adds “Available Solid Materials:” and its associated data entry field. When the student clicks on the text in the data entry field or the up/down arrow, the simulator opens a drop down list containing the materials the instructor assigned for the scenario (see Figure 5.35).

![Assign Maintenance Action](image)

**Figure 5.35.** Available Solid Materials drop down list.

When the student selects one of the treatment options, the simulator enters the option in the data entry field, removes the list, and adds “Solid Material Rate” and its data entry box as shown in Figure 5.36d. In this case the data entry field is not a drop down selection but an integer amount in lbs/mile. Students may enter the amount in two ways: first by typing in the rate or second using the slider bar below the entry field to vary the amount until it reaches the desired rate. The Storm Simulator calculates the maximum permissible rate for the selected treatment material by dividing the capacity of the truck by the total number of lane miles for the selected route. If a student enters a rate that exceeds the maximum application rate, the simulator
displays an error message and asks the student for an adjusted amount. This is where the slider comes in handy. The scale used by the slider ranges from zero to the maximum permissible amount; therefore, a student can move the slider to the far right to determine the maximum application rate. This can be very handy when working with a vehicle that applies both solids and liquids, such as a truck with a wedge tank.

NOTE: If the vehicle dispenses liquids only, then the simulator replaces the Available Solid Materials option with an Available Liquid Materials and a Liquid Material Rate in gallons per mile. Entry of data is done the same way as for solids. If a vehicle can apply both solids and liquids, then the Storm Simulator has entries Available Solid Materials, Solid Material Rate, Available Liquid Materials, and Liquid Material Rate.

After the student has the desired application rate set, he/she needs to point the mouse to a place just below the slider bar and left-click on the mouse. This causes the simulator to display “Maintenance Start Time” and its associated data entry box. If the student clicks on the text in the box or the up/down arrows, the simulator provides a drop down menu of times. Figure 5.36 shows this menu option. The student may then select a time to start the treatment action for that route. The first time entry in the list represents the shortest turn-around time between the current or previous maintenance cycle and the next one. Since students make decisions on an hourly basis and route cycle times vary, the Storm Simulator will display the + sign in the middle box of the control center up to 30 minutes prior to the completion of a maintenance action. Thus, the number at the top of the list may be up to 45 minutes from the current time-step time.

![Assign Maintenance Action](image)

**Figure 5.36.** Maintenance Start Time drop down list.

Once the user selects a time, the screen looks like the one in Figure 5.37. At this point the user can save the crew orders for the specified route by selecting the “Save Maintenance Action” button. This action closes the Assign Maintenance Action window and transfers the crew orders for that route to the Pending Maintenance Actions list at the bottom of the display area. If a student clicks on the “Save Maintenance Action” button prior to having all
of the fields completed, the simulator responds with an error message. If a student clicks on the “Cancel” button, the simulator wipes the Assign Maintenance Action window from the screen and all entries that have been made are lost.

After a student goes back and opens an Assign Maintenance Action window for the other two routes and saves the maintenance action information to the Pending Maintenance Action list, that list will look like the screen in Figure 5.38. At the same time after the third maintenance action is saved, the Storm Simulator determines that all available maintenance actions in the control center are satisfied and displays the "Submit Maintenance and/or Driver Actions" advisory message shown in Figure 5.39. The message indicates that all resources have been utilized and gives the user the option to “Cancel” any action to step forward in the scenario to allow additional changes or save the pending maintenance actions and allow the simulator to process the actions and step forward one hour. Keep in mind that once the “Save and Step Forward” action is taken, the simulator has no way to go back and make modifications prior to the new current time.

![Completed Maintenance Action entry.](image1)

![Pending Maintenance Actions list.](image2)
Figure 5.39. Submit Maintenance and/or Driver Actions advisory message.

Figure 5.40 illustrates the appearance of the staff overview page after the student selects the “Save and Step Forward” option in Figure 5.39. The vertical red line moves to 7 PM and orange bars indicate the length of the maintenance actions associated with each driver. Since the drivers were assigned sequentially to routes 1, 3, and 6, this display relates the maintenance actions to those routes as well. The green lines indicated the minimum length that each driver must stay on shift before they could conceivably be sent home.

Figure 5.40. Staff Overview page at 7 PM.
Figure 5.40 also illustrates that the length of the maintenance action extends to or beyond the next hour, which is also the next time step. Therefore, there are no + signs in the middle box in the control center panel for the three drivers. In a situation like this, the user needs to recognize that no maintenance actions are needed and the only option is to advance to the next time step to assign new crew orders to the staff.

At 8 PM the student assigned a new set of maintenance actions for all three drivers on their respective routes and then at 10 PM the only driver who was completing his route was John Adams, so the student prepared a set of maintenance actions for John and route 3. By 11 PM George Washington was finishing route 1 and the simulator indicated that a maintenance action was due. There is also house symbol in the third box under George’s name indicating that the student has the option of assigning him a new maintenance action or sending George home. However, by checking the resource information in the Current Road Weather Info section and the forecast in the Route Conditions section, the student recognizes that George needs to pull a full shift and then be replaced after roughly 8 hours by a driver on the second shift.

The lines in the display provide important information by themselves. The splits in the orange lines indicate the down time between actual maintenance actions to allow drivers to reload materials, relax briefly, and discuss conditions with a supervisor or other staff in the garage. The length of the orange lines indicates the duration of the round trip travel time on each of the routes. It becomes obvious that route 3 that John Adams maintains is shorter than the other two. The length of the green lines depict how long each driver has been on shift and may be used to anticipate when drivers on the next shift need to be called to achieve the two-hour call in period. There is additional information embedded in the display. For example, the orange dots on the timeline indicate each of the maintenance actions employed during the scenario. If a student hovers the mouse pointer over an orange dot, the simulator displays a tool tip that provides the start time of the maintenance action on the top line and the route, driver, and truck number on the bottom. Figure 5.42 illustrates the tool tip.

Figure 5.41. Staff Overview page at 11 PM.
If a student moves the mouse and places it over one of the orange maintenance action bars in the display, the simulator software displays a tool tip window (see Figure 5.43) that references all of the information entered during the assignment of information for the route driven by that driver plus the start and end time of the maintenance action.
If the student moves the mouse cursor and lets it hover over a green line, the simulator pops up a tool tip that contains the driver's name, the type of work schedule (normal, overtime), the start and end times of the treatment action, and the duration of the shift up to current time (see Figure 5.44). This feature is handy to monitor how many hours a staff member has been on duty so the student may anticipate when to call in new drivers. The Storm Simulator allows 8-hour shifts before drivers start receiving overtime. Since maintenance runs for two of the three routes in this example are more than 2 hours, a student needs to start planning about 4 or 5 hours into a driver's shift for shift turnover. This requires making sure the new staff is called in a couple of hours before the end of the current driver's shift and at a time break when the current driver completes a maintenance run.

Figure 5.44. Driver schedule tool tip.

Making decisions during the middle of an event requires a good assessment of current and forecasted conditions and where drivers are on their routes. The discussion surrounding Figures 5.41 through 5.44 provide background on where drivers are and what their route cycles look like at 11 PM in the example. In these examples George Washington has just finished a cycle on Route 1 at 10:45 PM and the Storm Simulator is expecting a new crew order on that route at 11:00 PM. One of the best resources to determine the current and forecasted conditions is the route conditions page. From the Staff Overview page, a student will likely need to scroll down the page to get the Route Conditions menu to appear on the left side of the screen and then click on Route 1, Driving to get to the route conditions page for Route 1. Figure 5.45 shows the entire screen and Figure 5.46 isolates just the display area section. The features of the route conditions page are covered in Section 5.2.2, but the value of the page is better demonstrated through its use in an example. Thus at 11 PM a student might be faced with roads that are slushy with a mobility index that has been around 55 to 60 the past couple of hours but is dropping currently due to the heavier snow that has fallen in the last hour. The rain and snow rate columns indicate that the rain that occurred through the afternoon changed to a rain/snow mix at 6 PM and became all snow in the last hour. The snow rate has increased to better than ½ inch an hour in the past hour and the forecast indicates that this snowfall rate should continue the next few hours. The application of pre-wet salt around 7 and 10 PM kept the roads near the desired mobility index level of 70 until the heavier snow arrived the last hour. The forecast indicates that with no further maintenance action that the mobility index will drop rapidly due to the moderate snow.
Figure 5.45. Route 1 route conditions at 11 PM.

Figure 5.46. Display area of the Route 1 road conditions at 11 PM.
To get a handle on the snowfall pattern, the student could opt to look at the radar image at the time. The static image in Figure 5.47 shows moderate snow moving across the Davenport area. By looping the Last 6 Hours and/or the Next 6 Hours, the student confirms that the snowfall area is likely to continue for several hours as indicated in the forecast. Based on the forecast on the route conditions page and the radar image the student fills in the entries on the Assign Maintenance Actions form on the Staff Overview page and issues new crew orders for George Washington on Route 1. Once the simulator processes this maintenance action, the Staff Overview page shifts to a current time of midnight and shows the new maintenance action as an orange line extending to 1:15 AM (see Figure 5.48).

If the student hovers the mouse pointer over the green line for Thomas Jefferson on the Staff Overview page, the simulator shows the tool tip window in Figure 5.48. As of midnight Thomas Jefferson has been on shift for 6 hours; therefore, after 2:00 AM he will start working overtime hours. However, the student needs to send Thomas back out on Route 6 one more time before a member of second shift can arrive and pick up the route. Since the cycle time of the route is 2 hrs and 45 min, Thomas will go into overtime before he completes the route. The other option would be to send Thomas home and call in a new staff member who can pick up the route in two hours. However, this means that Route 6 would not be treated for two hours during a period of moderate snowfall. Students need to make these types of trade-off decisions throughout the scenario, but particularly around shift change times.

One way to minimize the labor cost is to call the second shift in at midnight so all three drivers arrive by 2 AM. The student will need to determine prior to 2 AM whether to send a first shift driver back out on the route and extend that driver's hours beyond 8 total hours or to hold off on maintenance until the second shift drivers are there by 2 AM, the student must click on the person icon in the first box in the control center section of three available drivers. If the student performs this assignment process for James Madison, James Monroe, and John Quincy Adams, then the Pending Driver Actions popup looks like the display in Figure 5.49. At this midnight time step, the simulator indicates that Routes 3 and 6 are at or near the end of a maintenance cycle, thereby allowing the student to input a new crew order.
If the student decides to send Thomas Jefferson back out on Route 6 and accept the overtime at the tag end of Jefferson's route, the new crew order input might look something like Figure 5.50. However, in entering the Solid Material Application Rate, the student inadvertently enters 3000 lbs/mile instead of 300 lbs/mile. The storm simulator recognizes that the truck cannot carry enough material to achieve the application rate entered and displays the error message in red. When the student adjusts the number to a rate within the accepted range, the simulator removes the error message and allows the student to continue entering crew order information. When the student finishes entering crew order information for both routes 3 and 6, the Pending Actions area beneath the display area looks like Figure 5.51.

After the student confirms that the pending actions are what is desired, the student needs to scroll back up to the Submit Maintenance and/or Driver Actions window and click on the Save and Step Forward button. The Storm Simulator processes the pending actions and then displays the Staff Overview at 1:00 AM (see Figure 5.52). If the mouse is hovering over the second yellow bar, the simulator displays the tool tip containing the call-in information for James Monroe.
Figure 5.50. Error message that indicates excessive material rate.

<table>
<thead>
<tr>
<th>Route</th>
<th>Start Time</th>
<th>Driver</th>
<th>Vehicle</th>
<th>Plow Position</th>
<th>Material</th>
<th>Material Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route 3</td>
<td>2015-02-01 12:45:00 AM</td>
<td>John Adams</td>
<td>301</td>
<td>down</td>
<td>NaCl</td>
<td>300</td>
</tr>
<tr>
<td>Route 6</td>
<td>2015-02-01 12:00:00 AM</td>
<td>Thomas Jefferson</td>
<td>302</td>
<td>down</td>
<td>NaCl</td>
<td>300</td>
</tr>
</tbody>
</table>

Figure 5.51. Pending Maintenance and Driver Actions display area expanded.

<table>
<thead>
<tr>
<th>Driver</th>
<th>Action</th>
<th>Start Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>James Madison</td>
<td>Call In</td>
<td>2015-02-01 12:00:00 AM</td>
</tr>
<tr>
<td>James Monroe</td>
<td>Call In</td>
<td>2015-02-01 12:00:00 AM</td>
</tr>
<tr>
<td>John Quincy Adams</td>
<td>Call In</td>
<td>2015-02-01 12:00:00 AM</td>
</tr>
</tbody>
</table>
At 1:00 AM the student decides to not send George Washington back out but wait 45 minutes for James Madison to arrive and then let James handle the route. Since there are no other actions available, the student clicks on the Save and Step Forward button in the top right of the display area and then confirms the action.

Figure 5.53. The Send Driver Home popup window.
With the acceptance of the crew orders the Storm Simulator moves the display forward to 2:00 AM. John Adams and Thomas Jefferson are still out on their routes, but George Washington has finished his last cycle on Route 1 and the three drivers on the second shift are just arriving. Notice that the Storm Simulator indicates that a maintenance action can be initiated. There are + signs in four middle boxes of the control center section indicating that the student could send any of these four drivers to maintain Route 1. Since George Washington has been on shift 8 hours, the student chooses to send him home and clicks on the third button to the right in his control center section row. This causes the simulator to bring up the Send Driver Home window as shown in Figure 5.53. The student selects 02:00 followed by Save Driver Action. Since George Washington's shift is over, the user opts to put James Madison on that route and clicks on the + sign under James Madison. The simulator brings up the Assign Maintenance Actions window and the student works down through the entries creating a crew order for James Madison on Route 1. Once the student saves this maintenance action, the Pending Actions section below the Display Area is shown in Figure 5.54. Since the need to assign a driver to maintain Route 1 is now satisfied, the simulator concurrently displays the Submit Maintenance and/or Driver Actions window on top of the Staff Overview page.

![Table 5.5. Pending maintenance and driver actions at 02:00 AM.](image)

When the student clicks on the Save and Step Forward button, the simulator processes the crew orders and refreshes the screen with the image in Figure 5.55. This display shows a number of the features of the Storm Simulator. On the timeline there are 3 green dots that indicate the times when the first shift was called in, the second shift was called in, and George Washington was sent home. By hovering the mouse pointer over these dots, the student can confirm each of these actions. A row of orange dots is directly below the line of green dots showing when each of the maintenance actions was started during the scenario. And now at 02:00 a red dot has been added below the horizontal line to indicate a driver has gone into an overtime status.

In the staff Overview section George Washington now has a black bar indicating he is off duty and unavailable. Since the student had to hold John Adams and Thomas Jefferson over to complete their routes, they both went into an overtime status, which is shown by the red bars between 2:00 and 3:00. James Madison, James Monroe, and John Quincy Adams have yellow lines during their call-in period followed by green lines showing their active shift period. And since James Madison was assigned to Route 1 at 02:00, he has an orange line above his shift status line.
5.4. STUDENT PERFORMANCE

Figure 5.55. The Staff Overview page at 02:00 AM.

Figure 5.56. Performance Analysis – Top portion as it appears on the Storm Simulator presentation.
When a student gets to the end of the scenario, the Storm Simulator aggregates all of the crew order actions and displays a performance analysis of the maintenance actions done during the scenario. The performance report the student receives is composed of two parts: the Scenario Attempt Description and the Scenario Attempt Report. The Scenario Attempt Report is further divided into the Routes Level of Service Report and the Maintenance and Driver Actions Expense Report. The Scenario Attempt Description section is essentially a heading; it provides a description of the scenario, the start and end times, and an indication that the scenario is complete. The performance analysis is contained in the two subsections of the Scenario Attempt Report. In the Storm Simulator presentation all of these sections reside in the Display Area on the right portion of the screen. A student may view the content by scrolling the page up and down. In this Users Guide the top portion of the screen appears in Figure 5.56 and the bottom portion in Figure 5.57.

When a student completes a scenario and the performance analysis appears the Routes Level of Service graph appears with all routes overlaid on top of one another. The simulator provides the ability to view one route at a time or any composite of the total number of routes assigned in the scenario. A student may select which routes to display and which routes to delete from the display. The legend in the bottom left corner of the Level of Service graph has blue check boxes that allow the student to turn the individual Level of Service graphs on and off. If the student clicks on a blue check mark, the Storm Simulator removes the blue check mark field and turns the graph for that route off. If a student turns off Route 3 and Route 6 in Figure 5.57, the image would look like Figure 5.58. A student may then assess how he/she did on the maintenance actions for that route. Figure 5.57 shows the
lower part of the Routes Level of Service section and shows the Level of Service performance percent and the rank the student achieved relative to the performance level of other student who performed the scenario.

![Performance Analysis for Route 1](image)

Figure 5.58. Performance Analysis for Route 1.

The final section of the performance analysis is the Expense Report. It provides the amount expended for materials, staff, and vehicles plus the total cost of all three of these components. The report also provides how the student ranked for each of these expense categories relative to other students who have completed the scenario. A student may find the ranking numbers helpful in evaluating what cost category may have negatively impacted the total cost expenditure and therefore what adjustments the student might make to improve the student's performance. The relative costs in each of the three cost categories also provide the student with an idea of what factors have the biggest effect on the total cost for this type of event.