The focus of this project was to further develop the capabilities of WeatherShare to include those of ScanWeb, ScanSentry, and other desirable but currently unavailable functionality into WeatherShare through further development of WeatherShare–Phase 3. At the conclusion of this phase, the capabilities of ScanWeb have been developed into WeatherShare 3. The capabilities of ScanSentry remain to be implemented in Phase 4 in conjunction with user profiles and subsequent testing of system functionality during the bad weather season.

WeatherShare has been enhanced to include the external data specified for this phase and display that data via a Google Maps-based, web interface as well as tabular listings of sites and data, and graphical views of data over time. Standard map navigation and selection controls are included. Data layers are selected via menus at the top of the screen and are shown as markers and, for some layers, raster images on top of the map. Markers can be selected to show further detail for a particular item. Sites may be selected from tabular listings, and historical data can be viewed either by tabular display or graphs. Navigation between various display types is facilitated by hyperlinks.

The system includes RWIS data that is pushed via Caltrans Information Relays. At the present time, Information Relays have been implemented in Caltrans District 2 and District 3. Other districts will provide data to the system via Information Relays in the future. Weather alerts and surface information are provided by the National Weather Service. Current conditions are provided by MesoWest and MADIS. Caltrans Closed Circuit Television images are provided via the Caltrans CWWP2.
DISCLAIMER STATEMENT

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ACKNOWLEDGEMENTS

The authors are thankful to members of the Caltrans Project Technical Advisory Panel for their support on this project.
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1. INTRODUCTION

The WeatherShare prototype was developed as a component of the Redding Incident Management Enhancement (RIME) program, which consists of technology initiatives designed to improve public safety in the Redding area. RIME organizations include: Caltrans Division of Research and Innovation, Caltrans District 2, Caltrans Redding Transportation Management Center, California Department of Forestry & Fire Protection, California Highway Patrol, Shasta Area Safety Communications Agency, and NorCal Emergency Medical Services. WeatherShare covers 7 counties in District 2 and 13 counties in the adjacent Caltrans districts.

The goal of the WeatherShare project has been to streamline and integrate available road weather data in the Northern California area into a single source that is easily accessible by incident responders and potentially the traveling public.

Based upon Caltrans’ specifications, the Western Transportation Institute (WTI) at Montana State University – Bozeman utilized technology to provide Caltrans District 2 with a proof-of-concept surface transportation weather system (Phase 1) that allowed users to view a compilation of available road weather data from various sources in the region. This proof-of-concept system showed promise to increase the efficiency of situation assessments for a variety of purposes including incident management, highway maintenance, emergency medical services and traveler information.

While the Phase 1 proof-of-concept system covered seven counties in District 2 and 13 counties in the adjacent Caltrans districts, the Phase 2 prototype system expanded on this to include the full state of California with all 12 districts and 58 counties. The Phase 2 prototype system showed promise to provide maintenance and operations personnel with a complete picture of the current and recent weather as well as detailed forecast weather. While making extensive use of Caltrans RWIS data, the prototype system's coverage went far beyond that provided by RWIS sites alone, incorporating sensor readings from more than one thousand weather stations in California. Through a user-friendly, intuitive, map-based interface, the prototype system provided users with detailed weather information state-wide and at milepost resolution.

Caltrans currently uses the ScanWeb application to aggregate and present weather information from RWIS sites to maintenance and operations personnel. Other applications such as SCAN Sentry are used by individual districts to provide additional capabilities such as weather-based alerting. There is a desire to combine these functionalities into a single, open system. The purpose of WeatherShare Phase 3 was to further develop the capabilities of WeatherShare to include those of ScanWeb, SCAN Sentry, and other desirable but currently unavailable functionality into WeatherShare through further development of WeatherShare – Phase 3. Phase 3 was not considered as a deployment phase within the Caltrans organization, but rather a mechanism to research further and refine the prototype completed earlier in Phases 1 and 2.

A fourth phase has been scoped and was scheduled to start on December 1st, 2015. Delays in funding transfers have caused the start date to slip to January 1st, 2016. Phase 4 is intended to complete several tasks that were not completed in Phase 3, including testing of all functionality during the bad weather season.

This document summarizes work conducted in Phase 3 of the research project, which ends December 31st, 2015. Following are descriptions of major project tasks and associated deliverables:
Task 1: Project Management

This task covered all activities related to project management. Prior to the kick-off meeting, a Project Technical Advisory Panel (PTAP) was formed to oversee project work and progress. The PTAP consisted of the Caltrans project champion, project manager and a small number of representative project stakeholders from Caltrans’ Districts. The PTAP determined the acceptance criteria and performance standards for each task.

Deliverables:

- A kickoff meeting was held via teleconference on Wednesday, February 13th.
- Other meetings were held as needed via teleconference and web conference.
- Quarterly Reports were sent via email approximately midway through the months of January, April, July and October throughout the duration of the project.
- Final Project Report (this document) will be delivered prior to the conclusion of the project: December 31st, 2015. No project presentations were made at the National Rural Intelligent Transportation Systems (NRITS) conference or other conferences. Project presentations at conferences may be conducted in Phase 4.
- The project web presence for background and updates is located at the following address: http://www.westernstates.org/Projects/Weathershare/Default.html.

Task 2: Prototype System Concept and Requirements

Prototype System Review

Scanweb was reviewed to document system functionality, as used by Caltrans and in general. The interface was also be reviewed to determine strengths and weaknesses to be addressed by the new prototype system. Scan Sentry, a tool used by District 3 for alert generation and notification, was reviewed to document system functionality, as used by Caltrans and in general. It was recognized that Scan Sentry has a number of deficiencies to be addressed by the new prototype system.

Results from WeatherShare Phase 2 were also reviewed in terms of architecture and performance. Recognizing that WeatherShare had not not been updated over two years pending this contract, subsequent efforts such as the Western States One-Stop-Shop for Rural Traveler Information and COATS Deployment Assistance were also reviewed in regard to architectural or performance issues, and particularly in regard to interface. The One-Stop-Shop was considered state of the art in terms of a multi-layered map display.

Stakeholder Input

Input was requested from stakeholders by way of the project technical committee to determine requirements for the new prototype system. Email and teleconferences were used to solicit input. No site visits were conducted.

Prototype System Concept

The System Concept from Phases 1 and 2 of WeatherShare were used as a baseline to further develop the system concept for the new system. It was recognized that there would be significant changes and enhancements determined through the System Review and Stakeholder Input.
subtasks since the system will now be focused primarily on operations as opposed to traveler information.

Prototype System Requirements

The Prototype System Requirements from Phases 1 and 2 of WeatherShare were used as a baseline to further develop the prototype system concept for the new prototype system. Requirements from other systems such as the One-Stop-Shop were also incorporated. It was recognized that there would be significant changes and enhancements determined through the Prototype System Review and Stakeholder Input subtasks since the prototype system will now be focused primarily on operations as opposed to traveler information.

Deliverables:

- WeatherShare Phase 3 Prototype System Operational Concept (OpsCon), by Douglas Galarus and Daniell Richter, Western Transportation Institute, Montana State University. Finalized October 11, 2013.
- WeatherShare Phase 3 Prototype System Software Requirements Specification (SRS), by Douglas Galarus and Daniell Richter, Western Transportation Institute, Montana State University. Finalized March 12, 2014.

Task 3: Prototype System Design

A prototype system design was developed based on the Prototype System Concept and System Requirements. The prototype system was designed to use a multi-tiered architecture.

Data Retrieval

Data retrieval processes were designed in a flexible manner to accept information pushed from information relay devices, as developed by Caltrans District 2, to provide RWIS data to the system. The system does not directly interface with RWIS RPUs. Other third party data is retrieved by the system. The system integrates weather data from MesoWest and MADIS as well as the National Weather Service. However, unlike the Phase 2 prototype system, this external data is not be archived for an extended period of time. This external data augments Caltrans RWIS data by providing greater spatial coverage and can serve as a basis for quality control assessment.

Storage

Data is stored in flat files. Caltrans RWIS data is retained for an extended period of time – at least 5 years, although longer may be desired. Derived data (quality control flags, alert definitions and activations, etc.) will also be stored. Third-party data will not be stored for an extended period of time.

Processing

Processing includes not only the processing involved with the retrieval and storage of data, but also that for quality control assessment, alert processing and preparation of data for display. The processing design takes into account various interactions, in conjunction with the algorithms identified to perform each processing task.

User Management
The WeatherShare Phase I prototype system included a user management component which was subsequently dropped due to limited functionality and unnecessary overhead in terms of development. In WeatherShare Phase 2, users are able to save links to particular views, but are not required to authenticate to the prototype system for primary functionality. An exception is quality control reports, which are not linked to via the public interface. User management functionality is necessary for the new prototype system, principally because of desired alert functionality. User management can determine who can view what and particularly who can change what, which will be very important with alert capability. General personalization is desired in which users can save preferences and/or be assigned particular views of data.

Interface

The principal user interface to the prototype system is implemented using web-based HTML, with CSS and JavaScript. Map interfaces were developed on the Google Maps platform. The intent has been to develop a standards-compliant interface that would work in "modern browsers" – recent versions of Internet Explorer, Firefox, Safari or Chrome. No attempt has been made to facilitate use with non-PC devices such as smartphones and tablets. It was noted that ScanWeb currently makes extensive use of a tabular and graph-based displays for data, and this approach was adopted by the new prototype system.

Deliverables:


Task 4: Prototype System Development

The prototype system has been developed at WTI, although the long-term goal (beyond the scope of this project) will be a system that will reside at Caltrans and will operate within the Caltrans network. It is understood that the sponsoring program is responsible to develop an enterprise integration plan should the desire to deploy this system exists subsequent to the completion of this research project. At no time during this research phase has the prototype system been located within the Caltrans network.

Server Setup

The prototype system is Linux-based, with the intent of the prototype system being entirely open-source / free software.

Establish Repository for Code and Specs

It will be desirable to establish a repository for source code and specifications associated with the prototype system such that they can be accessed by Caltrans and other entities. An SVN archive has been implemented on the server. Access can be provided to Caltrans. Note that an SVN archive for the project is setup internal to WTI.

Prototype(s) / Rapid Prototyping

The prototype system has been developed using a rapid-prototyping approach. Functionality was developed and demonstrated throughout the development process rather than solely at completion of the prototype system.

Prototype System
The prototype system is the principal end product of this effort, and has been demonstrated as such. It should be noted, however, that there is no intent that the host hardware for the prototype system be migrated to Caltrans. As mentioned previously, it is assumed that Caltrans will eventually purchase hardware for a production system, and will implement the system based on prototype development from this project. WTI will subsequently provide a specification of the host system and its Linux configuration.

Software Specification and Source Code (deliverable)

System software is considered a deliverable, with delivery to consist of stand-alone copies of code on disk or other media and in the dedicated repository. Prototype system software source code and documentation can be provided to Caltrans, although it has not been requested at this point.

Prototype System Management and Maintenance Guide

A technical system management and maintenance guide for the prototype system will be created for both electronic (Microsoft Word and/or Adobe Acrobat) and print distribution in Phase 4, deferred from Phase 3. The purpose of this document will be to provide technical guidance in maintaining the prototype system. Electronic and print copies of this document will be submitted to the Caltrans project manager. Draft copies of the prototype system management and maintenance guide will be submitted for approval prior to finalization of the user guide. The format and extent of this document will be determined in cooperation with Caltrans as part of this task. This has been deferred until Phase 4.

Deliverables:

- Prototypes for Review (multiple iterations)
- Prototype System (the last prototype within this scope)
- Software Specification and Source Code (Deferred to Phase 4)
- Prototype System Management and Maintenance Guide (Deferred to Phase 4)

Task 5: Prototype System Testing and Evaluation

This task has been deferred to Phase 4 to allow for testing of all functionality during the bad weather season.

User Guide

A user guide will be updated for electronic (HTML and or PDF) distribution, and will be incorporated into the prototype system website. This guide will be comparable to the current ScanWeb user guide. The format and extent of this document will be determined in cooperation with Caltrans as part of this task. This has been deferred until Phase 4.

Prototype System Testing

The prototype system has been tested for performance under realistic but limited circumstances. Further testing is deferred until Phase 4.

Evaluation

The WTI project team will work with Caltrans to determine the appropriate criteria and evaluation instruments to provide an accurate and unbiased assessment of prototype system
performance and deployment. Criteria will likely include measures of prototype system ease of use, performance and utility, where available and applicable. All aspects of the prototype system will be covered including the interface and functionality. Evaluation will include a set of representative users. This task has been deferred to Phase 4.

Evaluation Summary
An evaluation summary report will be prepared and included in the final report. This report will summarize the results of the testing and evaluation. Included will be a summary of the evaluation procedure and results of surveys, interviews and other evaluation instruments. This task has been deferred to Phase 4.

Deliverables:
- User Guide (Deferred to Phase 4)
- Evaluation Summary (Deferred to Phase 4)
1.1. **Definitions, acronyms, and abbreviations**

The following abbreviations are used in this document:

- **Caltrans**: California Department of Transportation
- **CCTV**: Closed Circuit Television (Camera)
- **COATS**: California Oregon Advanced Transportation Systems
- **CSS**: Cascading Style Sheets
- **CWWP2**: Caltrans Commercial Wholesale Web Portal, version 2
- **D2**: (Caltrans) District 3 (similar for D1-D12)
- **DOT**: Department of Transportation
- **EMS**: Emergency Medical Services
- **ESS**: Environmental Sensor Station
- **HTML**: HyperText Markup Language
- **I-5**: Interstate 5 (similar for other Interstate roadways)
- **IT**: Information Technology
- **ITS**: Intelligent Transportation Systems
- **JSON**: JavaScript Object Notation
- **KML**: Keyhole Markup Language
- **MADIS**: Meteorological Assimilation Data Ingest System
- **MesoWest**: MesoWest at the University of Utah
- **mi**: miles
- **MSU**: Montana State University
- **NDFD**: National Digital Forecast Database
- **NOAA**: National Oceanic and Atmospheric Administration
- **NRITS**: National Rural Intelligent Transportation Systems Conference
- **NWS**: National Weather Service
- **OpsCon**: Operational Concept
- **OSS**: One-Stop-Shop (for rural traveler information)
- **PDF**: Portable Document Format
- **PTAP**: Project Technical Advisory Panel
- **QC**: Quality Control
- **RIME**: Redding Incident Management Enhancement program
- **RPU**: Remote Processing Unit
- **RWIS**: Road Weather Information System
- **SVN**: SubVersioN
- **SR**: State Route
- **SRS**: System Requirements Specification
- **TXT**: Text
- **URL**: Universal Resource Locator
- **US**: United States
- **WTI**: Western Transportation Institute
1.2. Organization of This Report

In Section 2 we present an overview of the prototype system including a summary of data retrieval and presentation mechanisms for the system. In Section 3 we present a summary.

For further information, refer to the documents listed in the following references section, the project website, and the project updates website.

1.3. References

The following project documents were also used to develop this document:


- WeatherShare Phase 3 Prototype System Operational Concept (OpsCon), by Douglas Galarus and Daniell Richter, Western Transportation Institute, Montana State University. Finalized October 11, 2013.

- WeatherShare Phase 3 Prototype System Software Requirements Specification (SRS), by Douglas Galarus and Daniell Richter, Western Transportation Institute, Montana State University. Finalized March 12, 2014.

2. THE PROTOTYPE SYSTEM

In this section we document the prototype system from a high level, primarily by way of screenshots. Certainly the best way to understand the system is to use it. However, there are times when certain displays will be more interesting and relevant than others. We have made an effort to present screenshots here of all of the displays during relevant times such as winter weather events. For the sake of reference and overview we also present a high-level listing for the data sources and the general processing and presentation mechanisms used to present application information to end users.

2.1. Data Retrieval and Processing

The System consists of server-side scripts that retrieve and process data from numerous sources, format the data as JSON, KML and image files, a web server that serves the data via a web server to web clients, and a browser-based client that presents the data on top of Google Maps.

The data retrieved and presented dynamically in the system is summarized by the following data sources and data layers:

- Caltrans CWWP2:
  - Caltrans Closed Circuit Television (CCTV)
- National Oceanic and Atmospheric Administration (NOAA)'s National Weather Service Public Alerts:
  - National Weather Service (NWS) Alerts
- National Weather Service National Digital Forecast Database:
  - Surface Forecasts
- Caltrans Information Relay:
  - Caltrans RWIS
- Meteorological Assimilation and Data Ingest System (MADIS):
  - Surface Conditions
- MesoWest:
  - Surface Conditions

2.2. Presentation

The application is presented to users via a Google Maps-based, web interface as well as tabular listings of sites and data, and graphical views of data over time. Standard map navigation and selection controls are included. Data layers are selected via menus at the top of the screen and are shown as markers and, for some layers, raster images on top of the map. Markers can be selected to show further detail for a particular item. Sites may be selected from tabular listings, and historical data can be viewed either by tabular display or graphs. Navigation between various display types is facilitated by hyperlinks. See the following figures captured from the prototype system for further detail.
Figure 1: Index of District 2 RWIS Sites

Figure 2: Atmospheric Overview of District 2 RWIS Sites

Figure 3: Graphical Overview of District 2 RWIS Sites
Figure 7: Current Conditions Display for District 2 Weed Airport
WeatherShare Phase 3
The Prototype System

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**Figure 8:** Historical Atmospheric Data for District 2 Weed Airport

**Figure 9:** Historical Surface Data for District 2 Weed Airport (no surface sensors at this site)
WeatherShare Phase 3

The Prototype System

Figure 10: Air Temperature, Air Temperature and Dewpoint Graphs for District 2 Weed Airport

Figure 11: Precipitation, Precipitation Situation, and Humidity Graphs for District 2 Weed Airport
Figure 12: Wind Arrow Graph for District 2 Weed Airport

Figure 13: Wind Direction and Velocity Graph for District 2 Weed Airport
Figure 14: for District 2 Hatchet Mountain
### Hatchet Mtn Atmospheric Data: 12/21/2015

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<th>Air Temp (°F)</th>
<th>Wind Speed (mph)</th>
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<th>Relative Humidity (%)</th>
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<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>12:00</td>
<td>32.5</td>
<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>13:00</td>
<td>32.5</td>
<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>14:00</td>
<td>32.5</td>
<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>15:00</td>
<td>32.5</td>
<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>16:00</td>
<td>32.5</td>
<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>17:00</td>
<td>32.5</td>
<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>18:00</td>
<td>32.5</td>
<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>19:00</td>
<td>32.5</td>
<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>20:00</td>
<td>32.5</td>
<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>21:00</td>
<td>32.5</td>
<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>22:00</td>
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<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
<tr>
<td>23:00</td>
<td>32.5</td>
<td>10</td>
<td>S</td>
<td>82</td>
<td>0.00</td>
<td>20</td>
</tr>
</tbody>
</table>

**Figure 15:** Historical Atmospheric Data for District 2 Hatchet Mountain
Figure 16: Historical Surface Data for District 2 Hatchet Mountain

Figure 17: Air Temperature, Air Temperature and Dewpoint Graphs for District 2 Hatchet Mountain
Figure 18: Precipitation, Precipitation Situation, and Humidity Graphs for District 2 Hatchet Mountain

Figure 19: Wind Arrow Graph for District 2 Hatchet Mountain

Figure 20: Wind Direction and Velocity Graph for District 2 Hatchet Mountain
Figure 21: Surface Temperature and Surface Status Graphs for District 2 Hatchet Mountain
WeatherShare Phase 3

The Prototype System

![Current Conditions Display for District 2 Snowman Summit](image)

Figure 22: Current Conditions Display for District 2 Snowman Summit

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Degree</td>
</tr>
<tr>
<td>Wet Bulb</td>
<td>Galli</td>
</tr>
<tr>
<td>Dewpoint</td>
<td>Galli</td>
</tr>
<tr>
<td>24-hr Max</td>
<td>Galli</td>
</tr>
<tr>
<td>24-hr Min</td>
<td>Galli</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Situation</td>
</tr>
<tr>
<td>Avg</td>
</tr>
<tr>
<td>Max</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Precipitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Situation</td>
</tr>
<tr>
<td>Rate</td>
</tr>
<tr>
<td>1 hr</td>
</tr>
<tr>
<td>6 hr</td>
</tr>
<tr>
<td>24 hr</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Visibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visibility Situation</td>
</tr>
<tr>
<td>Unknown</td>
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<table>
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<tr>
<th>Surface Sensors</th>
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<tr>
<td>Sensor #</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Surface Status</th>
</tr>
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<tbody>
<tr>
<td>Ice Warning</td>
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<tr>
<td>50.00°F</td>
</tr>
<tr>
<td>51.00°F</td>
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</table>

<table>
<thead>
<tr>
<th>Surface Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Temperature</td>
</tr>
<tr>
<td>30.36°F</td>
</tr>
<tr>
<td>31.18°F</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Surface Water Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Water Depth</td>
</tr>
<tr>
<td>6.00 ft</td>
</tr>
<tr>
<td>9.16 ft</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Surface Salinity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Salinity</td>
</tr>
<tr>
<td>20.00°F</td>
</tr>
<tr>
<td>21.00°F</td>
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<table>
<thead>
<tr>
<th>Surface Ice Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Ice Signal</td>
</tr>
<tr>
<td>75.00°F</td>
</tr>
<tr>
<td>73.00°F</td>
</tr>
</tbody>
</table>
Figure 23: Historical Atmospheric Data for District 2 Snowman Summit

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
<th>Relative Humidity</th>
<th>Wind Speed</th>
<th>Wind Direction</th>
<th>Visibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/21/2015 05:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 06:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 07:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 08:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 09:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 10:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 11:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 12:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 13:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 14:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 15:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 16:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 17:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 18:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 19:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 20:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 21:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 22:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
<td>SSW</td>
<td>2 miles</td>
</tr>
<tr>
<td>12/21/2015 23:00</td>
<td>32°F</td>
<td>35%</td>
<td>20 mph</td>
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<td>2 miles</td>
</tr>
</tbody>
</table>
### SnowmanRWIS Surface Data: 12/21/2015

<table>
<thead>
<tr>
<th>Time/Date</th>
<th>Surface Status</th>
<th>Temperature</th>
<th>Depth</th>
<th>Salinity</th>
<th>Temperature</th>
<th>Point</th>
<th>Black Signal</th>
<th>Temperature</th>
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</thead>
<tbody>
<tr>
<td>12/20/15</td>
<td>Low Warning</td>
<td>Cold</td>
<td>20.60</td>
<td>26.60</td>
<td>12.50</td>
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<tr>
<td>12/21/15</td>
<td>Low Warning</td>
<td>Cold</td>
<td>20.60</td>
<td>26.60</td>
<td>12.50</td>
<td></td>
<td>20.60</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 24: Historical Surface Data for District 2 Snowman Summit**
Figure 25: Air Temperature, Air Temperature and Dewpoint Graphs for District 2 Snowman Summit

Figure 26: Precipitation, Precipitation Situation, and Humidity Graphs for District 2 Snowman Summit
Figure 27: Wind Arrow Graph for District 2 Snowman Summit

Figure 28: Wind Direction and Velocity Graph for District 2 Snowman Summit
Figure 29: Surface Temperature and Surface Status Graphs for District 2 Snowman Summit
Figure 30: Current Conditions Display for District 3 Donner Lake
**Figure 31: Historical Atmospheric Data for District 3 Donner Lake**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Pressure</th>
<th>Wind Speed</th>
<th>Wind Direction</th>
<th>Humidity</th>
<th>Visibility</th>
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<tbody>
<tr>
<td>Date</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>12/21/2015</td>
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</table>

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### Figure 32: Historical Surface Data for District 3 Donner Lake

<table>
<thead>
<tr>
<th>Timestamp</th>
<th>Surface Status</th>
<th>Surface Temperature 1</th>
<th>Surface Temperature 2</th>
<th>Pavement Temperature</th>
<th>Surface Water Depth</th>
<th>Surface Salinity</th>
<th>Surface Freeze Point</th>
<th>Surface Slack</th>
<th>Subsurface Temperature 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/21/2015 12:00 AM</td>
<td>Dry</td>
<td>30.36</td>
<td>30.36</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Other</td>
<td>Other</td>
</tr>
<tr>
<td>12/21/2015 12:30 AM</td>
<td>Dry</td>
<td>30.36</td>
<td>30.36</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Other</td>
<td>Other</td>
</tr>
<tr>
<td>12/21/2015 12:30 AM</td>
<td>Dry</td>
<td>30.36</td>
<td>30.36</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Other</td>
<td>Other</td>
</tr>
<tr>
<td>12/21/2015 12:30 AM</td>
<td>Dry</td>
<td>30.36</td>
<td>30.36</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Other</td>
<td>Other</td>
</tr>
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</table>

### Figure 33: Air Temperature, Air Temperature and Dewpoint Graphs for District 3 Donner Lake
Figure 34: Precipitation, Precipitation Situation, and Humidity Graphs for District 3 Donner Lake

Figure 35: Wind Arrow Graph for District 3 Donner Lake

Figure 36: Wind Direction and Velocity Graph for District 3 Donner Lake
Figure 37: Surface Temperature and Surface Status Graphs for District 3 Donner Lake
Figure 38: Current Conditions Display for District 3 Echo Summit
### Figure 39: Historical Atmospheric Data for District 3 Echo Summit

<table>
<thead>
<tr>
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<th>Wind</th>
<th>Visibility</th>
</tr>
</thead>
<tbody>
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<td>Date/Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/21/2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/22/2015</td>
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</tr>
<tr>
<td>1/24/2015</td>
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</tbody>
</table>

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Figure 40: Historical Surface Data for District 3 Echo Summit

Figure 41: Air Temperature, Air Temperature and Dewpoint Graphs for District 3 Echo Summit
Figure 42: Precipitation, Precipitation Situation, and Humidity Graphs for District 3 Echo Summit

Figure 43: Wind Arrow Graph for District 3 Echo Summit

Figure 44: Wind Direction and Velocity Graph for District 3 Echo Summit
Figure 45: Surface Temperature and Surface Status Graphs for District 3 Echo Summit
Figure 46: Map Display of RWIS Sites
Figure 47: Map Display of RWIS Sites – Part 2
Figure 48: District 2 Weed Airport Atmospheric Summary from Map Display
Figure 49: District 2 Weed Airport RWIS Surface Summary from Map Display (no surface sensors at this site)
Figure 50: District 2 Weed Airport RWIS Graphical Summary from Map Display
Figure 51: District 2 Snowman Summit RWIS Atmospheric Summary from Map Display
Figure 52: District 2 Snowman Summit RWIS Surface Summary from Map Display
Figure 53: District 2 Snowman Summit RWIS Graphical Summary from Map Display
Figure 54: District 2 Hatchet Mountain RWIS Atmospheric Summary from Map Display
Figure 55: District 2 Hatchet Mountain RWIS Surface Summary from Map Display
Figure 56: District 2 Hatchet Mountain RWIS Graphical Summary from Map Display
Figure 57: District 3 Donner Lake RWIS Atmospheric Summary from Map Display
Figure 58: District 3 Donner Lake RWIS Surface Summary from Map Display
Figure 59: District 3 Donner Lake RWIS Graphical Summary from Map Display
Figure 60: District 3 Echo Summit RWIS Atmospheric Summary from Map Display
Figure 61: District 3 Echo Summit RWIS Surface Summary from Map Display
Figure 62: District 3 Echo Summit RWIS Graphical Summary from Map Display
Figure 63: Current Conditions Temperature Map Display (includes non-RWIS sites)
Figure 64: Current Conditions Temperature Map Display (includes non-RWIS sites)
Figure 65: Current Conditions Temperature Map Display (includes non-RWIS sites)
Figure 66: Current Conditions Temperature Map Display (includes non-RWIS sites)
Figure 67: Current Conditions Humidity Map Display (includes non-RWIS sites)
Figure 68: NWS Alerts Map Display
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Figure 69: Winter Weather Advisory Detail from Map Display
Figure 70: Winter Weather Advisory and Wind Advisory Detail from Map Display
Figure 71: Wind Advisory Detail from Map Display
Figure 72: Winter Storm Warning Detail from Map Display
Figure 73: Winter Storm Warning Detail from Map Display
Figure 74: Winter Weather Advisory Detail from Map Display
Figure 75: Winter Weather Advisory and Hazardous Weather Outlook Detail from Map Display
WeatherShare Phase 3
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Figure 76: Hazardous Weather Outlook Detail from Map Display
Figure 77: District 2 Weed Airport CCTV Image from Map Display
Figure 78: District 2 Snowman Summit CCTV Image from Map Display
Figure 79: District 2 Hatchet Mountain CCTV Image from Map Display
Figure 80: District 3 Donner Lake CCTV Image from Map Display
Figure 81: District 3 Echo Summit CCTV Image from Map Display
Figure 82: Air Temperature Forecast Map Display
Figure 83: Wind Forecast Map Display
Figure 84: Wind Gust Forecast Map Display
Figure 85: Humidity Forecast Map Display
Figure 86: Sky Cover Forecast Map Display
Figure 87: 12-Hour Chance of Precipitation Forecast Map Display
Figure 88: 6-Hour Precipitation Forecast Map Display
Figure 89: Snow Forecast Map Display
Figure 90: Weather Forecast Map Display
3. SUMMARY

The focus of this project was to further develop the capabilities of WeatherShare to include those of ScanWeb, SCAN Sentry, and other desirable but currently unavailable functionality into WeatherShare through further development of WeatherShare – Phase 3. At the conclusion of this phase, the capabilities of ScanWeb have been developed into WeatherShare 3. The capabilities of SCAN Sentry remain to be implemented in Phase 4 in conjunction with user profiles and subsequent testing of system functionality during the bad weather season.

WeatherShare has been enhanced to include the external data specified for this phase and display that data via a Google Maps-based, web interface as well as tabular listings of sites and data, and graphical views of data over time. Standard map navigation and selection controls are included. Data layers are selected via menus at the top of the screen and are shown as markers and, for some layers, raster images on top of the map. Markers can be selected to show further detail for a particular item. Sites may be selected from tabular listings, and historical data can be viewed either by tabular display or graphs. Navigation between various display types is facilitated by hyperlinks.

Emphasis was given to facilitating information at a glance in all of the displays with the ability to drill down for detail. Color-coding was used not only on map displays and in graphs, but in tabular displays as well to indicate condition types and changing conditions. For instance, freezing and near-freezing temperatures are distinguished in graphs and tabular displays using easy to recognize colors. As such, users can spot important data without having to first read and interpret the specific values. Once important data is identified, users can drill down to specific values.

The system includes RWIS data that is pushed via Caltrans Information Relays. At the present time, Information Relays have been implemented in Caltrans District 2 and District 3. Other districts will provide data to the system via Information Relays in the future. Weather alerts and surface information are provided by the National Weather Service. Current conditions are provided by MesoWest and MADIS. Caltrans Closed Circuit Television images are provided via the Caltrans CWWP2.

The prototype system has been operational since the summer of 2015 and is accessible for use by Caltrans. The project team has monitored operation of the site to ensure its availability for use and evaluation by Caltrans. With the exception of SCAN Sentry function, user profiles and subsequent testing of system functionality during the bad weather season, the prototype system is operating as planned.

A fourth phase of the project has been scoped and was scheduled to start on December 1st, 2015. Delays in funding transfers have caused the start date to slip to January 1st, 2016. Phase 4 is intended to complete several tasks that were not completed in Phase 3, including testing of all functionality during the bad weather season.