# **Central Federal Lands Division** Data Collection Packages

# Final Report March 2011

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U.S. Department of Transportation

Federal Highway Administration Commitment to Excellence

Federal Lands Highwa

Department of Transportation Federal Highway Administration Central Federal Lands Division 12300 W. Dakota Avenue Lakewood, CO 80228

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Designated by the U.S. Department of Transportation's Research and Innovative Technology Administration as one of the 10 National University Transportation Centers, we fulfill our charge of advancing the field of transportation and developing the next generation of professionals by conducting cutting-edge, multidisciplinary research.



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| in                  | inches                     | 25.4                        | millimeters                    | mm                |
| ft                  | feet                       | 0.305                       | meters                         | m                 |
| yd                  | yards                      | 0.914                       | meters                         | m                 |
| mi                  | miles                      | 1.61                        | kilometers                     | km                |
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| in²                 | square inches              | 645.2                       | square millimeters             | mm <sup>2</sup>   |
| ft <sup>2</sup>     | square feet                | 0.093                       | square meters                  | m <sup>2</sup>    |
| yd²                 | square yard                | 0.836                       | square meters                  | m <sup>2</sup>    |
| ac                  | acres                      | 0.405                       | hectares                       | ha                |
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|                     |                            | VOLUME                      |                                |                   |
| fl oz               | fluid ounces               | 29.57                       | milliliters                    | mL                |
| gal                 | gallons                    | 3.785                       | liters                         | L                 |
| ft <sup>3</sup>     | cubic feet                 | 0.028                       | cubic meters                   | m <sup>3</sup>    |
| yd³                 | cubic yards                | 0.765                       | cubic meters                   | m <sup>3</sup>    |
|                     | NOTE: volumes gre          | ater than 1000 L sha        | all be shown in m <sup>3</sup> |                   |
|                     |                            | MASS                        |                                |                   |
| oz                  | ounces                     | 28.35                       | grams                          | g                 |
| lb                  | pounds                     | 0.454                       | kilograms                      | kg                |
| Т                   | short tons (2000 lb)       | 0.907                       | megagrams (or<br>"metric ton") | Mg (or<br>"t")    |
|                     | TEMPE                      | RATURE (exact deg           | grees)                         |                   |
| °F                  | Fahrenheit                 | 5 (F-32)/9<br>or (F-32)/1.8 | Celsius                        | °C                |
|                     |                            | ILLUMINATION                |                                |                   |
| fc                  | foot-candles               | 10.76                       | lux                            | lx                |
| fl                  | foot-Lamberts              | 3.426                       | candela/m <sup>2</sup>         | cd/m <sup>2</sup> |
|                     | FORCE a                    | nd PRESSURE or S            |                                |                   |
| lbf                 | poundforce                 | 4.45                        | newtons                        | Ν                 |
| lbf/in <sup>2</sup> | poundforce per square inch | 6.89                        | kilopascals                    | kPa               |

## SI\* (MODERN METRIC) CONVERSION FACTORS

\*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

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### **EXECUTIVE SUMMARY**

The purpose of this research study was to develop a proof of concept, prototype electronic datacollection and reporting system to replace hand-written methods for Emergency Relief for Federally Owned (ERFO) Roads Damage Site Reports (DSR) used by Federal Highway Administration (FHWA) Central Federal Lands Division (CFLD) staff. The prototype system is based largely on the Redding Responder System, previously developed for the California Department of Transportation (Caltrans) by the Western Transportation Institute. The Responder System facilitates documenting and reporting incidents using a Tablet PC, digital camera, GPS, and satellite and cellular modems.

The current method of collecting information and preparing reports for ERFO DSRS involves a clipboard, paper and digital camera. Information is eventually compiled into electronic form at workstations in agency offices. The new method would facilitate more accurate and timely reporting in the field, with most of the information collected onsite at an incident.

The scope of this project was to develop and test the prototype system to include local storage and recall of the ERFO data and creation of a form equivalent to the existing form. The scope did not include server-side storage of the data collected or electronic transmission of the data from the field.

Key functionality of the system includes:

- Summary of basic information, including automatic location via GPS.
- Cost estimation using a list of cost items for emergency and permanent repairs.
- Mapping, including road maps, aerial photos and USGS topographical maps, as well as GPS information.
- Import of photos from a digital camera, including ability to annotate photos using the pen/stylus from the Tablet PC.
- Free-hand sketches using the pen/stylus from the Tablet PC.
- Report generation, to generate a PDF report equivalent to current ERFO DSR reports.

The system was developed as planned and a rugged tablet/laptop was purchased and configured for prototype testing. The system was lab-tested and demonstrated to FHWA at the WTI facility. Unfortunately, no testing was conducted in the field by prospective users, because no prospective users were assigned to this project during its performance period.

The following items were requested during the performance period of the project, but were not addressed:

- Detailed cost estimate items, and mechanism for updating this information.
- Determination of the project champion and a corresponding test location.
- Prototype testing and feedback from real use in the field.

In the absence of these items and considering that the objective of this study was the development of a prototype, the system is not ready for production use.

The system has been prepared for delivery to the sponsor and will be sent to the sponsor at the conclusion of the project.

### **CHAPTER 1. INTRODUCTION**

#### **OVERVIEW**

The work conducted in this project stems from discussions with FHWA CFLD and three prior and on-going efforts at the Western Transportation Institute (WTI). In a project entitled, "Blackfeet Automated Accident Reporting System," WTI researched the problem of underreporting of accidents on Indian reservations in Montana. WTI developed a prototype accident collection and reporting device, which consisted of a Tablet PC and custom-developed software. In the Caltrans-sponsored Redding Responder project, WTI developed a system for the collection and reporting of incidents on California highways by Caltrans maintenance personnel. The Redding Responder system uses satellite and cellular data communication to transmit incident information including photos and sketches from the incident to a transportation management center in near real time. Finally, in the Roadkill Observation Collection System (ROCS) project, WTI developed a system for recording roadkill observations to increase the accuracy and coverage of reported observations. This PDA-based system focused on ease of use, automated location reporting via GPS, and a centralized repository and web interface for access to data collected using the system.

The Responder and ROCS systems were demonstrated to CFLHD representatives at TRB in January 2007, and several potential applications were discussed including a retaining wall inventory program. The general intent was to demonstrate a system that could replace paper-based data collection. In a conference call on July 23, 2007, the list of potential applications was expanded to include:

- Crash data documented by field unit personnel
- ERFO (Emergency Relief on Federal Owned Property) damage assessment
- Wall inventory
- Traffic barriers

Other aspects were discussed including communication system limitations and the desired form factor – laptop versus PDA, tablet-based versus voice activated, etc. It was indicated that the wall inventory and traffic barrier applications might not be ready for development in time, so one of the other two applications (crash data or ERFO) would be selected. Ultimately, the ERFO forms application was selected. It was further determined that data communication capability from the field was not necessary at this time.

#### ERFO DSR FORM EXAMPLES

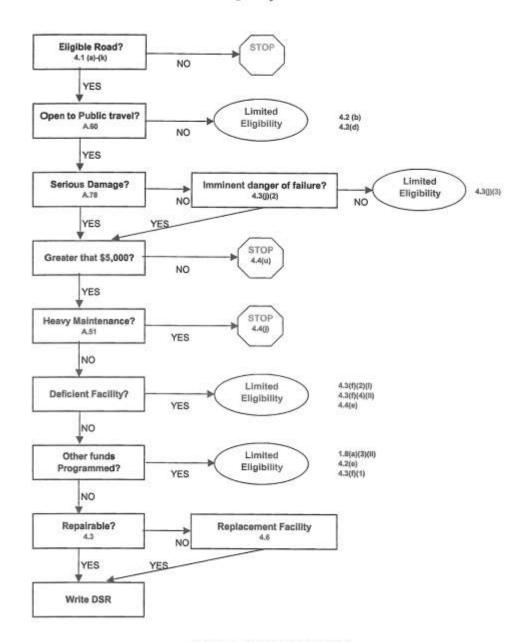
Emergency Relief on Federal Owned Property (ERFO) Damage Survey Reports (DSR) are standard forms used to document incidents and associated repair costs. Typically these forms are completed through a combination of field data collection, including photographs, and in office documentation, potentially including engineering diagrams and detailed cost estimates. A flow chart associated with the process is shown in Figure 1. (However, this flow was not implemented in the logic of the application that was subsequently developed.)

The CFLHD representatives provided four examples of these reports. Figure 2 shows the first page of an ERFO DSR form from the first incident example. This page includes the general information about the location, applicant and cost estimates. Additional information is supplied via supplemental sheets, as shown in Figure 3, where a hand-drawn sketch depicts one aspect of the work to be conducted. Photos can be included on supplemental sheets, as shown in Figure 4. Figure 5, Figure 6, Figure 7, Figure 8 and Figure 9 show a report for the second incident. Figure 6 shows hand-drawn, detailed sketches and Figure 8 shows a topographic map of the area. Figure 10, Figure 11, Figure 12, Figure 13 and Figure 14 show a third incident, including a "Betterment Justification" sub-form (Figure 11), and an annotated map (Figure 14). Figure 15, Figure 16, Figure 17, Figure 18, Figure 19 and Figure 20 show the fourth ERFO DSR example, including diagrams that appear to have been generated using additional software, and an annotated map.

These examples are the extent of the information provided to the development team for this project. It is unknown whether there are other types of information typically included in these reports. The associated necessary functionality apparent from these examples includes:

- Capability to complete form fields, including free-form text entry and potential for prepopulation of location information and agency-specific information associated with the user of the system.
- Drawing/sketching capability, although advanced drawing capability such as CAD was considered outside the scope of the project the ability to import images produced with other packages was considered sufficient.
- Capability to incorporate photos this includes the capability to draw annotations on photos, although that use was not demonstrated in the examples.
- Capability to incorporate maps, including annotations on maps.

4 2/ 21/04



**ERFO Eligibility Flow Chart** 

ERFO Disaster Assistance Manual Reference

Figure 1: ERFI Eligibility Flow Chart

| FED                              |                                | HWAY ADMINISTRATIC<br>DAMAGE SURVEY<br>(Title 23, Federal-Aid System/ | REPORT   | ghway   | DSR Na:  | of <u>3</u>     |
|----------------------------------|--------------------------------|---|--|---|--|-----------------|
| Applicant:                       |                                | (nee 20, redenised of some  | County:  | State:  | Disaster No: CA 2004-1 FS<br>Inspection Date:            |                 |
| Tahoe National                   | Forest                         |   | Nevada   | CA  | 8/23/2004  |                 |
| location of Dar<br>Road 14-1-3 M |                                | No., Name of Road and Mile<br>by Creek                                | Post)  |   | ADT:<br><20  |                 |
| Bridge Data:                     |                                | Road Data:  | Classification:                                    |   | Photograph #:  |                 |
| уре:                             |                                | Traveled Way Width: 12  | Surface Type: Agg                                  | Thickness: 4*                                   |  |                 |
| D#:                              |                                | Shoulder Width: 1'  | Surface Type: Agg                                  |   | 1  |                 |
|                                  | got under a 1<br>nd - The pipe | lamage:<br>72°CMP and lifted the inlet 5°<br>e now points out of the  | Scope/Description of Rep<br>same CMP in same local | tion. Rebed CMP                                 | and replace bands that com<br>gregate that was washed aw |                 |
|                                  |                                | COST E  | STIMATE for EMERGEN                                | CY REPAIRS*                                     |  |                 |
| Quantity                         | Unit                           |   | Item Description                                   |   | Unit Price   | Cost            |
|                                  |                                |   |  |   |  | 5               |
|                                  |                                |   |  |   |  | 5               |
|                                  |                                |   |  |   |  | \$              |
|                                  |                                |   |  |   |  | 5               |
|                                  |                                |   |  |   |  | 5               |
|                                  |                                |   |  |   |  | 5               |
| Proposed:                        | For                            | ce Account Con  | tract  | Total Em  | ergency Repairs  | 5               |
|                                  |                                | COST  | STIMATE for PERMANEI                               | NT REPAIRS*                                     |  |                 |
| Quantity                         | Unit                           |   | Item Description                                   | the serve                                       | Unit Price   | Cost            |
| 1                                | LS                             | Mobilization  |  |   | 1000   | \$1,00          |
| 10                               | CY                             | Borrow and Culvert Bedding  | Material   |   | 15   | \$15            |
| 30                               | CY                             | Aggregate   |  |   | 20   | \$60            |
| 10                               | HR                             | Foreman   |  |   | 35   | \$35            |
| 10                               | HR                             | Laborer<br>Excavator - (Remove and re                                 | had culumets                                       |   | 30   | \$30            |
| 2                                | HR                             | Grader  | bed curverty                                       |   | 150  | \$30            |
| -                                | . Cars                         | Grader  |  |   | 100  |                 |
|                                  |                                |   |  |   |  | 5               |
|                                  |                                |   |  |   |  | \$              |
|                                  |                                |   |  |   |  | 1               |
|                                  |                                |   |  |   |  | 1               |
|                                  |                                |   |  |   |  |                 |
|                                  |                                |   |  |   |  |                 |
|                                  |                                |   |  |   |  | 1               |
|                                  |                                |   | Set  | Intal Permanent I                               | Repairs (continuation sheet)                             |                 |
| Proposed:                        | Fo                             | rce Account X (   | Contract   | and a company of the                            | Total Permanent Repairs                                  | \$3,45          |
|                                  |                                | and provide justification*  | an a           | Preliminary Eng                                 | ineering   | \$50            |
|                                  |                                |   |  | Construction En<br>Right-of-Way<br>Other        | gmeering   |                 |
| Submitted By: (                  | Name and Title                 | 4   |  | TOTAL ESTIMA<br>(Emergency and Pe<br>Signature: |  | \$3,95<br>Date: |
| and all a second second          |                                | ,   |  | all and all all all all all all all all all al  |  | 19500           |
|                                  | Address of the out Without     |   | Eligible Theligible                                | Signature:                                      |  | Date:           |
| Reviewed By: ¢<br>F2 A           |                                | D ENGINEER  | cidore (unordered                                  | 1   |  |                 |
| FLA<br>Recommended               | FIEL                           |   | Eligible ineligible                                | Signature:                                      |  | Date:           |

Figure 2: ERFO DSR Example 1, Page 1

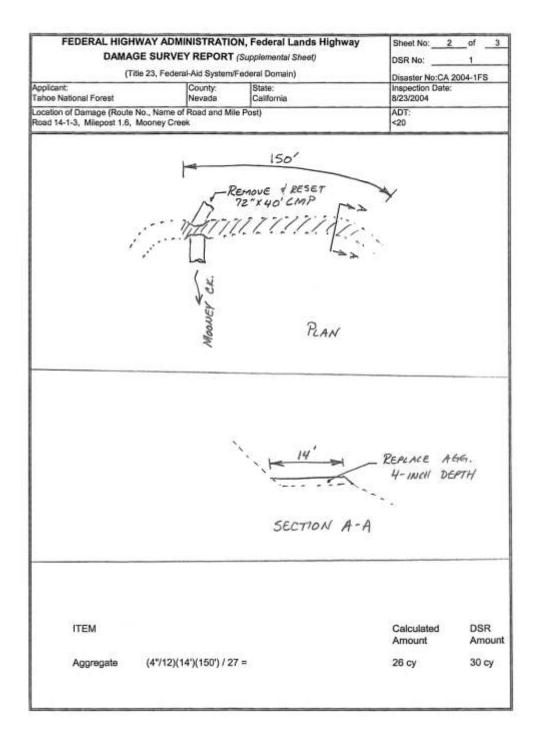


Figure 3: ERFO DSR Example 1, Page 2

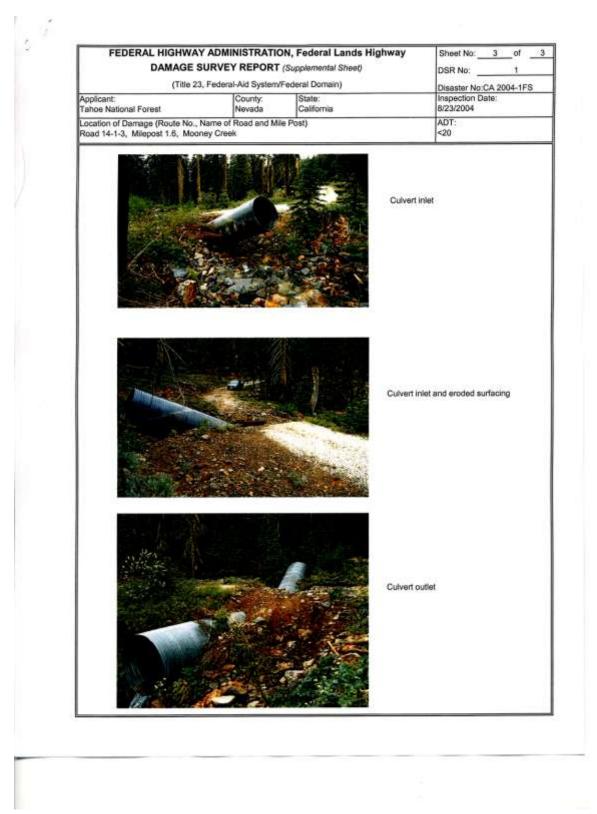


Figure 4: ERFO DSR Example 1, Page 3

| FED                                | ERAL HIG                                 | SHWAY ADMINISTRATI                                  | ON, Federal Land  | s Highway            | Sheet No: 1   | of4   |
|------------------------------------|--|---|---|----------------------|---|-------|
|                                    |  | DAMAGE SURVEY                                       | REPORT  |                      | DSR No:   | 14-1  |
|                                    |  | (Title 23, Federal-Aid System                       | /Federal Domain)  |                      | Disaster No: WA 2004-1 N                                    | NPS   |
| Applicant:<br>Mount Rainier        | NP                                       |   | County:<br>Pierce   | State:<br>WA         | Inspection Date: 11/06/03                                   |       |
|                                    |  | No., Name of Road and Mile<br>ally to Paradise Road |   |                      | ADT:  |       |
| Bridge Data: K                     | nut Crook                                | Road Data:  | Classification:   |                      | Photograph #:   |       |
| Type:                              | BUL OIDDR                                | Traveled Way Width: 24                              | Surface Type: ACP   | Thickness:           |   |       |
| ID#:                               |  | Shoulder Width: 0                                   | Surface Type: Hor   | 111010-000           |   |       |
| Description and                    | 1 Cause of D                             |   | Scope/Description of  | f Repair:            |   |       |
|                                    |  |   |   |                      |   |       |
| 0                                  |  | COST  | ESTIMATE for EMER   |                      |   |       |
| Quantity                           | Unit                                     |   | Item Description  | -                    | Unit Price  | Cost  |
|                                    |  |   |   |                      |   |       |
|                                    |  |   |   |                      |   |       |
|                                    |  |   |   |                      |   |       |
|                                    |  |   |   |                      |   | -     |
|                                    |  |   |   |                      |   |       |
| Proposed:                          | For                                      | ce Account Co                                       | ntract  | Total                | Emergency Repairs   |       |
|                                    |  |   | ESTIMATE for PERM   |                      |   |       |
| Quantity                           | Unit                                     | COST  | Item Description  |                      | Unit Price  | Cost  |
| 580                                | TON                                      | Excavate and install riprap                         | and the second se |                      | 50  | \$29, |
| 1200                               | TON                                      | Excavate and install riprap                         | and the second  |                      | 50  | \$80  |
| 190                                | CY                                       | Drill behind west pier and g                        | rout voids  |                      | 175   | \$33, |
| 80                                 | HRS<br>LS                                | Traffic control<br>Mobilization @ 10%               |   |                      | 40  | \$3   |
|                                    | 10                                       | 1076  |   |                      | 12000   | 312   |
|                                    |  |   |   |                      | 1   |       |
|                                    |  |   |   |                      |   |       |
|                                    |  |   |   |                      |   |       |
|                                    |  |   |   |                      |   |       |
|                                    |  |   |   |                      |   | -     |
|                                    |  |   |   |                      |   |       |
|                                    |  |   |   |                      |   |       |
|                                    |  |   |   |                      |   |       |
|                                    |  |   |   | Subjected Deserved   | ant Danales (parties allos of                               |       |
| Proposed:                          | For                                      | roe Account   | Contract  | outrolar Perman      | ent Repairs (continuation sheet)<br>Total Permanent Repairs |       |
|                                    |  | and provide justification*                          |   | Prelminary           | Engineering   | \$6   |
|                                    |  |   |   |                      | n Engineering   | \$6   |
|                                    |  |   |   | Right-of-Wa<br>Other | lannosensues  |       |
|                                    |  |   |   | (Emergency an        | TIMATED COST<br>ad Permanent Repairs)                       | \$151 |
| C                                  |  | 55  |   | Signature:           |   | Date: |
| Submitted By:                      | And in case of the local division of the | Manual series                                       | 5   | Signature:           |   | Date: |
| Reviewed By:                       | FIELD                                    | ENGINEER  | Eligible Inei   | gible                |   |       |
| Reviewed By:<br>FLH<br>Recommended | FIELD                                    | ENGINICER<br>STRAL<br>COORDINATOR                   | 12  | gible<br>Signature:  |   | Date: |

Figure 5: ERFO DSR Example 2, Page 1

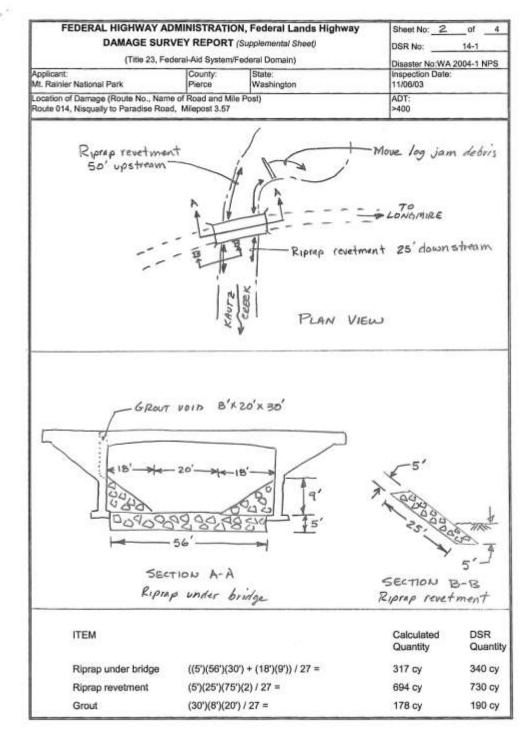


Figure 6: ERFO DSR Example 2, Page 2

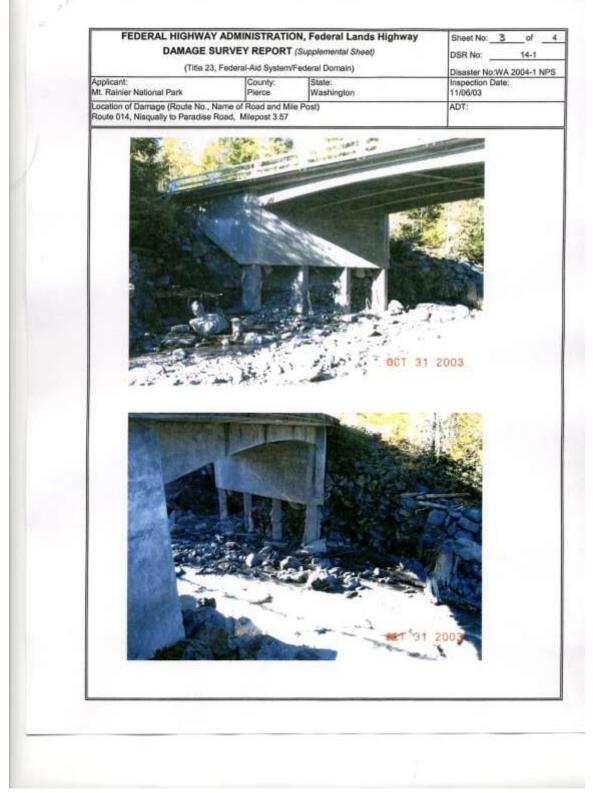


Figure 7: ERFO DSR Example 2, Page 3

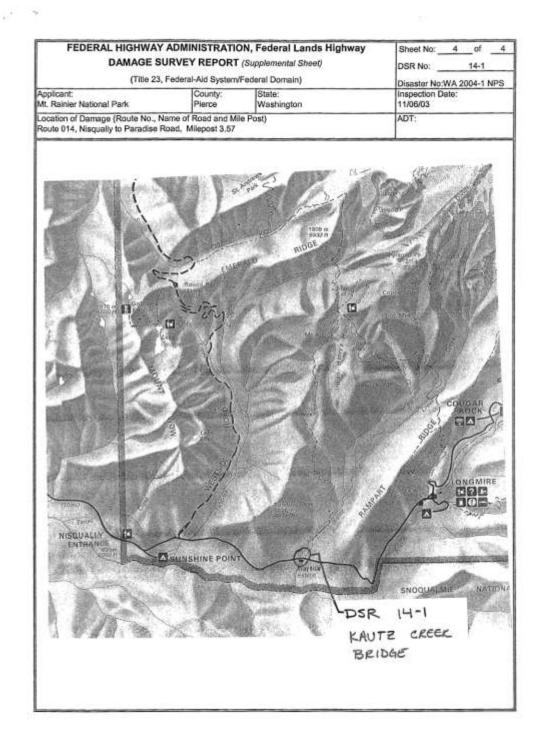


Figure 8: ERFO DSR Example 2, Page 4

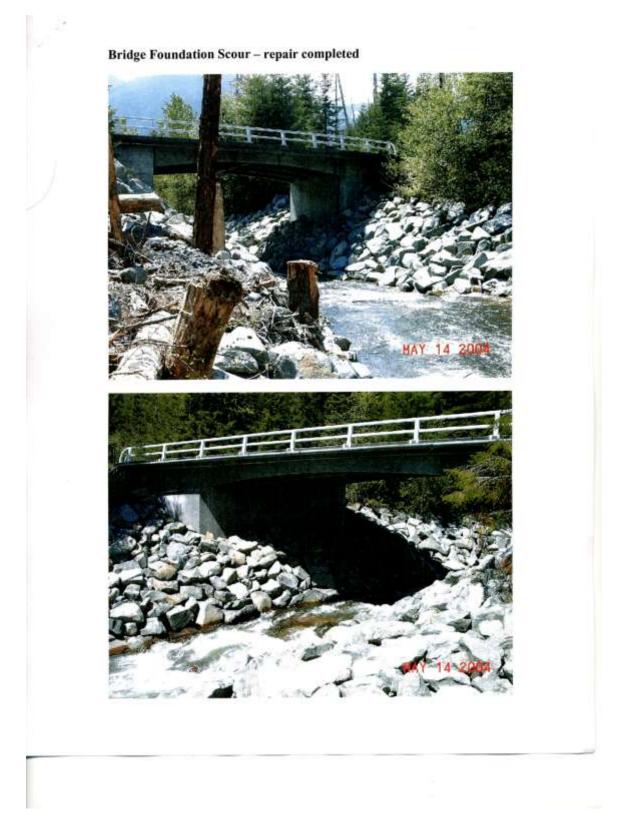


Figure 9: ERFO DSR Example 2, Page 5

| FED                                    | DERAL HI                     | GHWAY ADMINISTRATIO   | DN, Federal Lands Hi  | ghway   | Sheet No:   | 1of   | 4             |  |
|--|------------------------------|---|---|---|---|---|---------------|--|
|  |                              | DAMAGE SURVEY   | REPORT  |   | DSR No:   | OLYM 8  |               |  |
|  |                              | (Title 23, Federal-Ald System   | Federal Domain)   |   |   |   |               |  |
| Applicant                              |                              |   | County:   | State:  | Disaster No: WA<br>Inspection Date:   | 2004-1 NPS  |               |  |
| Olympic Nation                         | nal Park                     |   | Clallam   | Washington  | 10/23/03  |   |               |  |
|  |                              | e No., Name of Road and Mile  | Post)   |   | ADT: 200  | DT: 200   |               |  |
| Park Route No                          | . 103, Sol D                 | uc Road, Milepost 7.2   |   |   |   | Dealearanh #  |               |  |
| Bridge Data:                           |                              | Road Data:  | Classification:   |   | Photograph #;   |   |               |  |
| Гура:                                  |                              | Traveled Way Width: 22'   | Surface Type: ACP   | Thickness: 3*   |   |   |               |  |
| D#                                     |                              | Shoulder Width: 1'  | Surface Type: ACP   |   |   |   |               |  |
| oad prism, clo                         | eroded bank<br>sing one lan  | Jamsas:<br>and washed out part of the<br>e over a length of 100 lineal<br>in was destroyed.   | Scope/Description of Re<br>Install grouted and rock I<br>rock, cap with 11/4" min<br>compact, and lay hot mix | bolted riprap ban<br>us crushed rock,                   |   |   |               |  |
| _                                      |                              |   |   |   |   |   |               |  |
| Quantity                               | Unit                         | COSTE   | STIMATE for EMERGEN<br>Item Description   | GT REPAIRS*   | Unit Pri  | ice   | Cost          |  |
| -avenuel                               |                              |   | nom ceauthaut   |   | Unit Ph   |   | 04/91         |  |
|  |                              |   |   |   |   |   |               |  |
| 14                                     | EA                           | Temporary Concrete Barrier  |   |   | 5   | 50.00   | \$7           |  |
| 1                                      | LS                           | Traffic Control Signs   |   |   | \$  | 200.00  | \$2           |  |
|  |                              | and the second se |   |   |   |   |               |  |
|  |                              |   |   | -   |   |   |               |  |
|  |                              |   |   |   |   |   | -             |  |
| Proposed:                              | For                          | ce Account Con  | tract   | Total En  | nergency Repairs  |   | \$9           |  |
| 1                                      |                              | CORT  | CTRLATE I DEDUALE   |   |   |   |               |  |
| Quantity                               | Unit                         | COSTE   | STIMATE for PERMANE!<br>Item Description  | NT REPAIRS  | Unit Pri  | ice   | Cost          |  |
| 1                                      | LS                           | Mobilization  | Harris Colores Press  |   |   | 000   | \$4,0         |  |
| 1                                      | LS                           | Staking   |   |   |   | 000   | \$1,0         |  |
| 1                                      | LS                           | Quality Control, Schedule   |   |   | and the second se | 000   | \$1,0         |  |
| 240                                    | CY                           | Class 1 riprap  |   |   | the second s  | 40  | \$9,6         |  |
| 350                                    | CY                           | Class 5 riprap  |   |   | 4   | 40  | \$14.0        |  |
| 20                                     | CY                           | 5/8" minus crushed rock   |   |   | 2   | 25  | \$5           |  |
| 40                                     | CY                           | 1 1/4" minus crushed rock   |   |   | 2   | 25  | \$1,0         |  |
| 30                                     | TON                          | Hot mix asphalt   |   |   |   | 50  | \$4,5         |  |
| 1                                      | LS                           | Temp Traffic Control  |   |   | 5   | 00  | \$5           |  |
| 80                                     | Hours                        | Flaggers  |   | ~   | 3   | 35  | \$2,8         |  |
| 1                                      | LS                           | Permanent Traffic Control   | 5   | 7   | 3   | 00  | \$3           |  |
| 1                                      | LS                           | -Relocate Utilities . <   | NOT ELIG  | IBLE )  | 10  | 000   | -\$1,0        |  |
|  |                              |   | Baltermant  |   |   |   |               |  |
| 70                                     | CY                           | Grout for Riprap  |   |   | 3   | 00  | \$21,0        |  |
| 25                                     | EA                           | Rock Dowel  |   |   | 1   | 00  | \$2,5         |  |
| 1                                      | LS                           | Betterment Mobilization   |   |   | 24  | 400   | \$2,4         |  |
|  |                              |   |   | total Permanent   | Repairs (continuatio  | Contraction of the second s | 5             |  |
| Proposed:                              |                              |   | Contract  |   | Total Permanent   | Repairs   | \$88.1        |  |
|  |                              | and provide justification*  | anatas Danksonnat?  | Preliminary Eng   |   |   | \$9,9         |  |
| and repair faile                       | ed. Betterme<br>ded to preve | ing the WA 97-1 NPS ERFO d<br>nt consisting of grouted riprap<br>nt future damage. Site is at a b<br>900.   | and rock dowels into  | Construction En<br>Right-of-Way<br>Other<br>TOTAL ESTIM | ATED COST   | #   | \$6,6<br>,525 |  |
| Cost of Bettern                        |                              |   |   | (Emergency and Po                                       | ernanere Meparx)  | Date:   | ,525          |  |
|  |                              |   |   |   |   | (Date:  |               |  |
| Submitted By:                          |                              | 7 ( 1 )   |   | Signature:  |   | 200   |               |  |
| Submitted By:<br>APP<br>Reviewed By: ( |                              | ή <u>Τ</u>  |   | Signature:  |   | Date:   |               |  |
| Submitted By:<br>APP<br>Reviewed By: ( |                              | 7 ( 1 )   | Eligible ineligible   | Signature:  |   | Date:   |               |  |

\*Attach Supplemental Sheets if necessary

Figure 10: ERFO DSR Example 3, Page 1

DSR No. OLYM8 Betterment Justification Construct grouted riprap revetment with rock dowels

|  |                            | REPAIR                              | REPAIR IN-KIND   |                 |                                | BETTE                     | BETTERMENT                         |          |
|--|----------------------------|-------------------------------------|--|-----------------|--------------------------------|---------------------------|------------------------------------|----------|
|  | Repla                      | ace Embani                          | Replace Embankment and Riprap  | tiprap          | Grout F                        | Riprap and                | Grout Riprap and place Rock Dowels | Dowels   |
|  | UNIT                       | QUANITY                             | QUANITY UNIT PRICE   | COST            | UNIT                           | QUANITY                   | QUANITY UNIT PRICE                 | COST     |
| Repair in-kind w/o Betterment                      | LS<br>LS                   | -                                   | \$57,625   | \$57,625        |                                |                           |                                    |          |
| Betterment   |                            |                                     |  | \$0             | SJ                             | -                         | \$25,900                           | \$25,900 |
|  |                            |                                     |  | \$0             |                                |                           |                                    | \$0      |
|  |                            |                                     |  | \$0             |                                |                           |                                    | 80       |
|  |                            |                                     |  | 8               |                                |                           |                                    | \$0      |
|  |                            |                                     |  | \$0             |                                |                           |                                    | \$0      |
| TOTAL  |                            |                                     |  | \$57,625        |                                |                           |                                    | \$25,900 |
| Cost to Repair damage in the future (w/Betterment) | Assume \$10,000            | 0,000                               |  |                 |                                |                           |                                    |          |
| BENEFIT  | (P/F,7%,10)<br>damage in t | yrs)(Cost to re<br>the future (w/ E | (P/F,7%,10yrs)(Cost to repair damage in the future (w/o Betterment) minus cost to repair damage in the future (w/ Betterment) = (0.5083+0.2584)(\$57,625 - \$10,000) | 0.5083+0.258    | o Betterment<br>34)(\$57,625 - | () minus cost<br>510,000) | to repair                          | \$36,514 |
| COST   | The addition               | al cost to rep.                     | The additional cost to repair the site as a result of adding the Betterment  | result of addir | ng the Betten                  | ment                      |                                    | \$25,900 |
| BENEFIT/COST                                       |                            |                                     |  | 1.4             |                                |                           |                                    |          |

Figure 11: ERFO DSR Example 3, Page 2

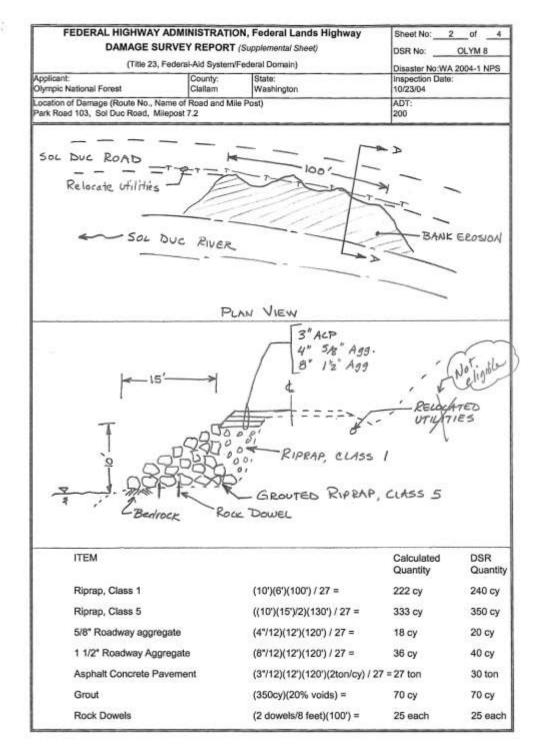


Figure 12: ERFO DSR Example 3, Page 3

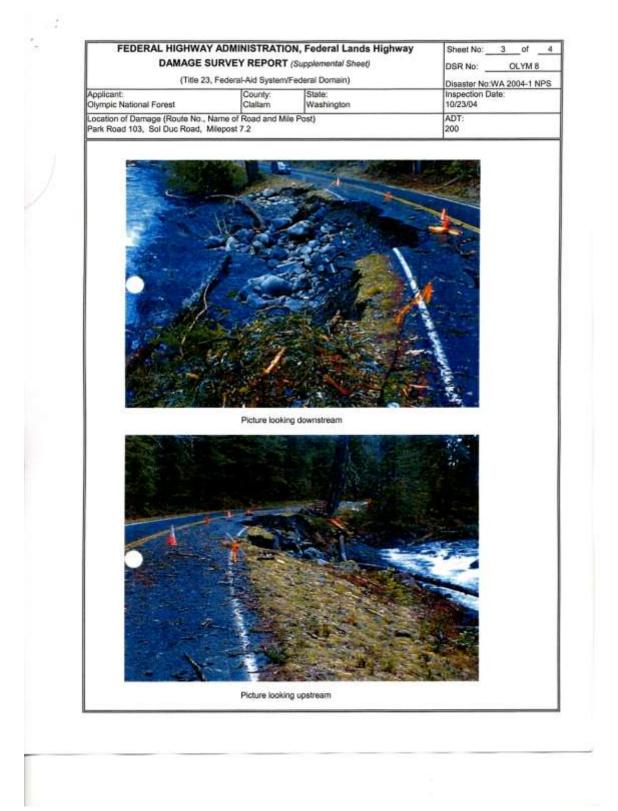


Figure 13: ERFO DSR Example 3, Page 4

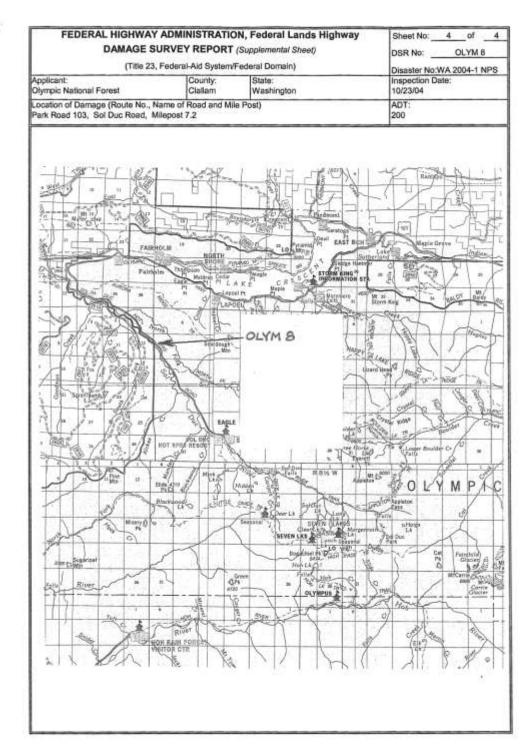


Figure 14: ERFO DSR Example 3, Page 5

|                            | DERAL HI  | GHWAY ADMINISTRATIC  |  | ghway                           | Sheet No: 1   | _of5                 |
|----------------------------|---|--|--|---------------------------------|---|----------------------|
|                            |   | DAMAGE SURVEY  | REPORT                                       |                                 | DSR No: 0   | LYM 6                |
|                            |   | (Title 23, Federal-Aid System/   | Federal Domain)                              |                                 | Disaster No: WA 2004-1  | NPS                  |
| Applicant                  |   |  | County:                                      | State:                          | Inspection Date:  | 14.0                 |
| Olympic Nation             | nal Park  |  | Jefferson                                    | Washington                      | 10/23/03  |                      |
|                            |   | e No., Name of Road and Mile I   | Post)  |                                 | ADT:  |                      |
| Park House No              | , 107, Hoh V  | /alley Road, Milepost 5.0  |  |                                 | 428   |                      |
| Bridge Data:               |   | Road Data:   | Classification:                              |                                 | Photograph #:   |                      |
|                            |   | Traveled Way Width: 20"  | Surface Type: ACP                            | Thickness: 3*                   |   |                      |
| ype:                       |   | and Call Of Store and  |  | Thickness, a                    | -   |                      |
| D#: N/A<br>Vescription and | Cause of f  | Shoulder Width: 2'   | Surface Type: ACP<br>Scope/Description of Re |                                 |   |                      |
| vashed out the             | e road over a<br>e channel ex   | of the Hoh River eroded and<br>length of 100 lineal fact. The<br>dends across the road, and the<br>ea is 8 feet. |  |                                 | ank protection utilizing ripra;<br>compliex interface with future |                      |
|                            |   | COST E   | STIMATE for EMERGEN                          | CY REPAIRS*                     |   |                      |
| Quantity                   | Unit  |  | item Description                             |                                 | Unit Price  | Cost                 |
|                            |   |  | and the second second second                 |                                 |   |                      |
| 1                          | 10  | Temporary Traffic Control  |  |                                 | \$ 500.00   | 5                    |
|                            | LS  | Temporary Traffic Control  |  |                                 | \$ 500.00   | 3                    |
|                            |   |  |  |                                 |   |                      |
|                            |   |  |  |                                 |   |                      |
|                            |   |  |  |                                 |   |                      |
| Proposed:                  | For   | ce Account Cont  | ract   | Total En                        | nergency Repairs  | 5                    |
|                            |   | COST E   | STIMATE for PERMANE                          | NT REPAIRS                      |   |                      |
| Quantity                   | Unit  |  | Item Description                             | Statution Cont.                 | Unit Price  | Cost                 |
| 1                          | LS  | Mobilization   |  |                                 | 8000  | \$8,                 |
| 820                        | CY  | Quarry Spalls  |  |                                 | 25  | \$20,                |
| 650<br>130                 | CY  | Class 5 riprap rock<br>1 1/4" minus crushed rock   |  |                                 | 30  | \$19,                |
| 70                         | TON   | Hot mix asphalt  |  |                                 | 150   | \$10.                |
| 60                         | LF  | 24" rigid plastic culvert pipe   |  |                                 | 40  | \$2                  |
| 1                          | LS  | Log cribbing (logs and revege  | tion materials)                              |                                 | 20000   | \$20,                |
|                            |   |  |  |                                 |   |                      |
|                            |   |  |  |                                 |   |                      |
|                            |   |  |  |                                 |   |                      |
|                            |   |  |  |                                 |   |                      |
|                            |   |  |  |                                 |   | -                    |
|                            |   |  |  | 1.1.1.1                         |   |                      |
|                            |   |  |  |                                 |   |                      |
|                            |   |  |  |                                 |   |                      |
|                            |   |  | Sub  | total Permanent                 | Repairs (continuation sheet                                       |                      |
| Proposed:                  |   | unt Contract<br>and provide lustification*   |  | In the Internet                 | Total Permanent Repain  |                      |
|                            |   | nitigation for riprap to comply w  | th US FWS                                    | Preliminary Eng                 |   | \$4                  |
|                            |   | be beneficial to fish habitat and  |  | Construction Er<br>Right-of-Way | i ga ioaning  |                      |
|                            |   |  |  | Other                           |   |                      |
|                            |   |  |  | TOTAL ESTIM                     |   | \$91                 |
|                            | Name and Title  | 10   |  | Signature:                      |   | Date:                |
| ubmitted By: (             | and the second se | VT   |  | 12.25 (11.2)                    |   | 1755-16 <sup>5</sup> |
| ubmitted By: (<br>APP)     | LICAI   | 47   | ~  | Signature                       |   | Date:                |
| APP                        | LICAI<br>Name and Title<br>FIEL   | DENGINEER (<br>DENGINEER (<br>DOORDINATOR  | Eligible ineligible                          | Signature:                      |   | Date:                |

Figure 15: ERFO DSR Example 4, Page 1

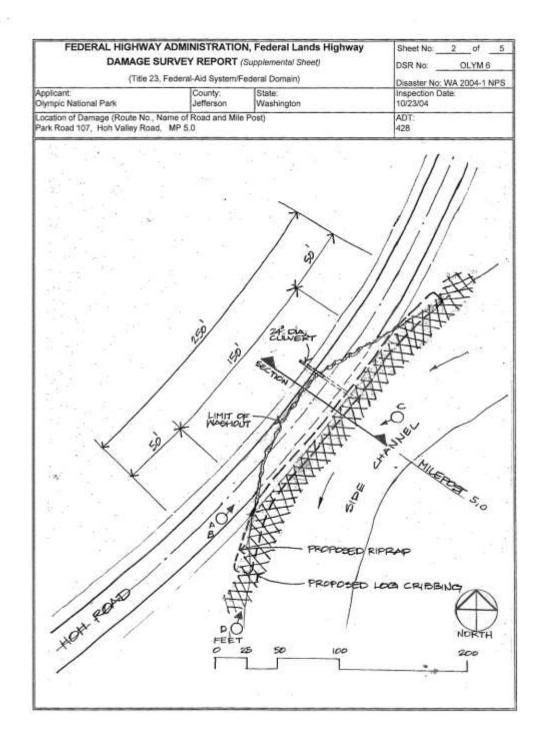


Figure 16: ERFO DSR Example 4, Page 2

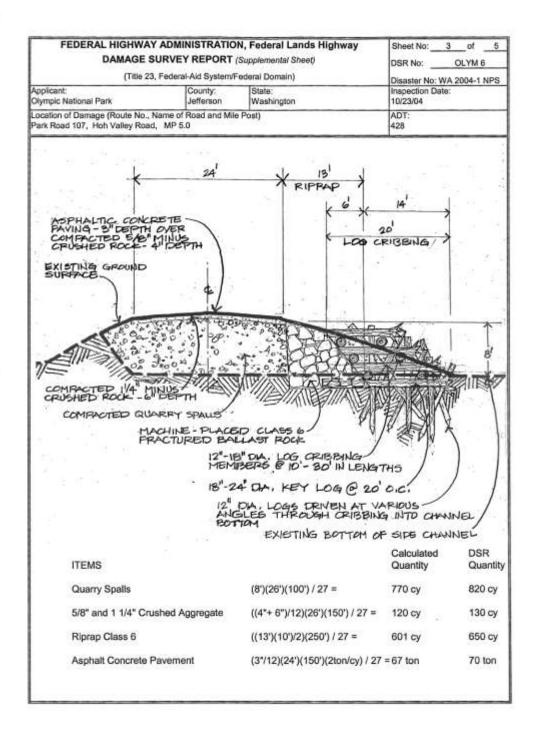


Figure 17: ERFO DSR Example 4, Page 3

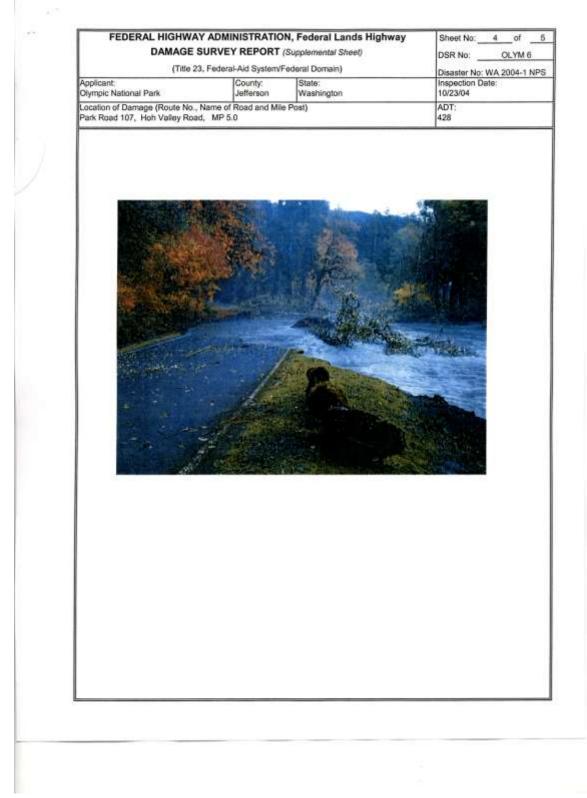


Figure 18: ERFO DSR Example 4, Page 4

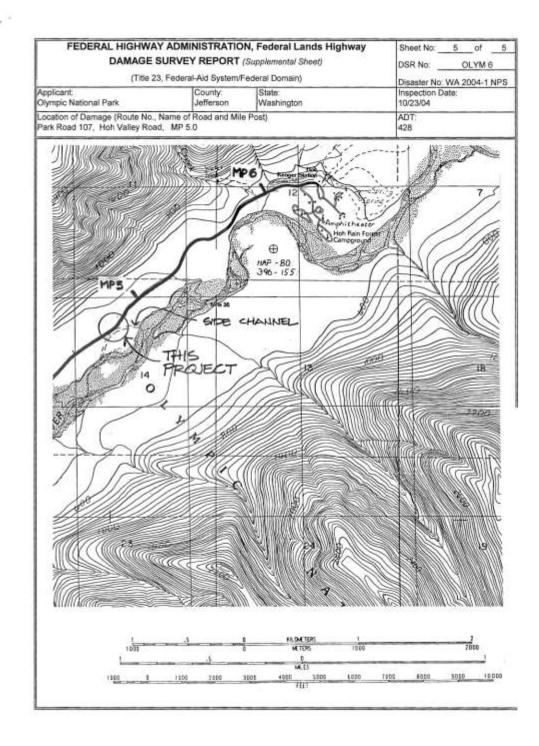
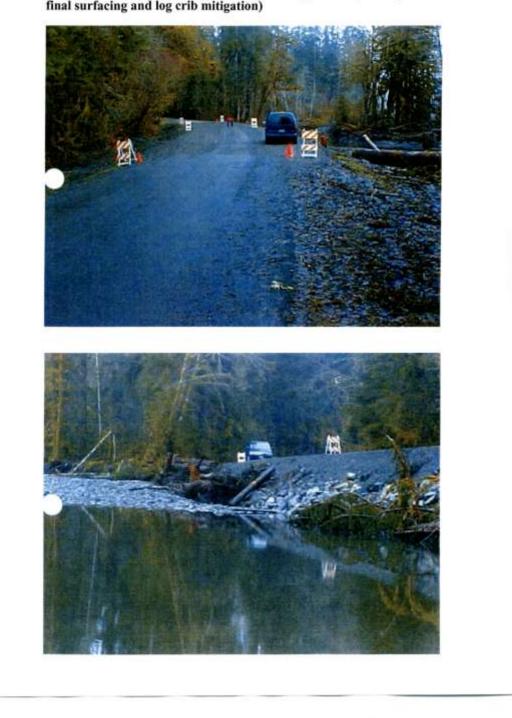


Figure 19: ERFO DSR Example 4, Page 5



Roadway Washout - emergency/permanent repairs completed (without final surfacing and log crib mitigation)



#### **CALTRANS REDDING RESPONDER**

The Caltrans Redding Responder System was developed in two major research and development phases funded by Caltrans, as well as a minor phase funded by the WTI University Transportation Center (UTC). A third major phase from Caltrans is pending, with a goal of fully preparing the system for deployment, including specifications that can be used for procurement and installation of hardware, as well as preparation of software for production deployment, including provisions for maintenance and support of the associated software. Including the pending third phase, total funding for research and development of the Responder system is nearly \$1,000,000. That investment has been of benefit to this project for FHWA CFLD, because it provided a platform and experience upon which to build the associated prototype. It should be noted further that Responder benefited in a similar, although not as significant manner from the WTI UTC "Blackfeet Automated Accident Reporting System." Aside from the difference in the funding associated with these projects, another significant difference and benefit is that the Responder System was thoroughly tested by Caltrans personnel while documenting real incidents. That testing and the associated feedback greatly added to the research team's ability to develop a prototype to meet the needs of CFLHD.

#### **Caltrans Redding Responder Phase 1**

In the first phase of the Caltrans Redding Responder project, WTI developed the system concept and associated requirements, and proceeded to develop a proof-of-concept system that was used for testing by WTI staff and demonstration to Caltrans personnel. The proof-of-concept system demonstrated that such a system was viable and potentially useful, and Caltrans decided to proceed with development in a second phase.

Emphasis was placed on ease of use, because end users would not use an overly-complicated or unreliable system. Functionality focused on tasks used to document an incident and to transmit the information from virtually anywhere in the state, including the most remote, rural areas, to transportation management centers so that resources could be dispatched to clear incidents. The system would automatically pinpoint the user's location and populate the incident record with that location, increasing the accuracy of reporting and reducing the reporting burden of the end user. Pen annotation capability via the tablet stylus was very well received. It was noted that pictures are worth a thousand words, and annotated pictures could convey even more information with minimal effort compared to traditional voice communication or typed information on a mobile data terminal. When information documenting the incident was ready for transmission, the user would simply press a "Send" button in the application, and the system would determine whether to use cellular or satellite communication depending on signal strength and pattern for the given location. If the transmission failed, the system would retry, and information was compressed automatically to maximize information transmitted while reducing the chance of failure.

Generic use for incident reporting was considered essential so that the system could be used by Caltrans as well as other public safety agencies (such as law enforcement and fire) to document nearly any type of incident. As such, the system included a minimal amount of agency-specific information, while favoring more generic capabilities such as mapping, sketching, and inclusion of photos, with the ability the annotate maps and photos.

#### **Caltrans Redding Responder Phase 2**

Five Responder Systems were developed in Phase 2, and four of these systems were tested by Caltrans personnel. The fifth system was kept by WTI for further research and development, as well as for demonstration. At least one of these systems was tested in seven of Caltrans' twelve districts, in environments ranging from urban (San Francisco and Los Angeles) to very rural (Death Valley and the East slope of the Sierra, the Northern Sierra and high desert plains, the Central and Sacramento Valleys, and Coastal areas.) Response from field testing was very positive in terms of utility and usability, and it was estimated that initial demand for Responder Systems throughout Caltrans would be nearly 80 units, if not more. A key to the systems' utility was satellite communication, which was included in the units having a communications briefcase. Figure 21 and Figure 22 show the Responder communications boxes that were pilot tested by Caltrans Personnel. The Responder System for each of these also includes a Panasonic Toughbook<sup>®</sup> Tablet PC. Both boxes include cellular and satellite modems, as well as a wireless router and a GPS. Figure 23 shows the WTI demonstration system, including a Toughbook® Tablet. This system includes a cellular modem and two satellite modems, in addition to a wireless router and GPS. The Toughbook<sup>®</sup> for the WTI demonstration system includes an integrated cellular modem and GPS, allowing for standalone use. The remaining two Responder systems tested by Caltrans consisted of stand-alone Tablets with GPS and communication capability, along with a standard digital camera used for all of the systems.



Figure 21: Responder Communication Box #1



Figure 22: Responder Communication Box #2



**Figure 23: WTI Demonstration Communication Box** 

The Responder software application is shown in Figure 24 through Figure 29. Figure 24 shows the Responder splash screen. Figure 25 shows the summary tab in the Responder Incident Organizer. This tab includes observer, time, location and description information. Again, the intent is that this information will be generic and applicable for use by multiple agencies. Figure 26 shows capability to add a photo from a digital camera to the incident record. Figure 27 shows forecast weather conditions specific to the location of the responder. The system retrieves weather information from the National Weather Service using either cellular or satellite communication. Figure 28 shows an annotated photo. Users annotate photos, maps or new sketches using the tablet stylus. Figure 29 shows status of an incident record transmitted as an email via either cellular or satellite communication.



Figure 24: Responder Initial Screen

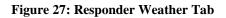
|                                | Responder Incid  |  | Cover                   |
|--------------------------------|--|--|-------------------------|
| mary Mappi                     | ng Photos Weather Sketche                                | s Messaging                                      | Expert<br>Reset         |
|                                |  | Incident Closed                                  | Eait<br>About Responder |
| esponder Sur<br>Irganization   | Caltrans   | Date 9/16/2008 -                                 |                         |
|                                | 30   |  |                         |
| listrict                       | 2  | Time: 10 : 42 AM                                 |                         |
| bserver:                       | Responder  | Battle Cornent Date Time                         |                         |
| escription:                    | Add Timestang to Description                             |  |                         |
|                                |  | 2  |                         |
|                                |  |  |                         |
|                                |  | 5 C  |                         |
|                                |  |  |                         |
| acility                        |  | 2  |                         |
| cident Type:                   | [  | 3  |                         |
| 1000000                        | (As)   |  |                         |
| Resetwith GPS                  | Update asing Latitude:<br>extend Lation ex 38,77621 45.6 | 55571833 Longitude:<br>==:=12145576 -111.0462933 |                         |
| oad / Address<br>lile Marker / | 5  |  |                         |
|                                | Alexander  |  |                         |
| andmark:<br>http://            | Bozeman  |  |                         |
|                                | Bozeman<br>Gallatin                                      | State: Montana                                   |                         |

Figure 25: Responder Incident Organizer



Figure 26: Responder Add Photos Dialog

| Redding Responder Incident Organizer Summary Mapping Photos Weather Sketches Messaging   | Responder Incident Organizer   |                    |
|--|--|--------------------|
| Summary Mapping Photos Weelfler Sketchos Messaging   | Redding Responder Incident Organizer   | GALIDAR (2004 2446 |
| GetConnectivitiefer           Ret Finition           POINT FORECAST FOR THE FOLLOWING LOCATION:           LATTIDE = 45.065/1833333           CONDITION = -0.5000 2000 FM MDT           CONDUCTION = -0.5000 FM MDT           Construction           Orbitotion           Virial Doctoon           Virial Doctoon           OPE-005           OPF-005   |  |                    |
| POINT FORECAST FOR THE FOLLOWING LOCATION  |  |                    |
| POINT FORECAST FOR THE FOLLOWING LOCATION  | Poter Fermant   Note   Nostor Canditions   |                    |
| LONGTUDE111 0462933333<br>ELEVATION - 4004<br>W102008 100 PM MDT<br>Tomperature 87 dag F<br>Dearborn Humathy 31%<br>Sky Cown : 2%<br>Wind Speeds 5 mph<br>Wind Speeds 200 PM MDT<br>Tomperature 72 dag F<br>Dearbornt 36 dag F<br>Perton Humathy 28%<br>Sky Cown 2%<br>Wind Speeds 2 mph<br>Wind Speeds 27%<br>Sky Cown 2%<br>Wind Speeds 2 mph<br>Wind Speeds 3 mph<br>Wind Sp                  |  | -                  |
| LONGTUDE111 0462933333<br>ELEVATION - 4004<br>W102008 100 PM MDT<br>Tomperature 87 dag F<br>Dearborn Humathy 31%<br>Sky Cown : 2%<br>Wind Speeds 5 mph<br>Wind Speeds 200 PM MDT<br>Tomperature 72 dag F<br>Dearbornt 36 dag F<br>Perton Humathy 28%<br>Sky Cown 2%<br>Wind Speeds 2 mph<br>Wind Speeds 27%<br>Sky Cown 2%<br>Wind Speeds 2 mph<br>Wind Speeds 3 mph<br>Wind Sp                  | LATITUDE = 45 655718333333   |                    |
| W182008 1:00 PM MDT           Temporature 07 dag F           DownYout 55 dag F           Relation Humath; 31%           Sky Cover: 2%           Wind Speed: 5 mph           Wind Speed: 5 mph <td>LONGITUDE = -111 04629333333</td> <td></td>  | LONGITUDE = -111 04629333333   |                    |
| Forsporature 07 dag F           DewPoint 35 dag F           Polative Humidty: 31%           Sky Cover: 2%           Wind Speed: 5 mph           VPI-0%           QPF: 0.00 in           Wind Speed: 5 mph  | ELEVATION = 4904   |                    |
| DevPoint 35 deg F<br>Relative Humdhy 31%<br>Sky Cover 2%<br>Wind Speed 5 mph<br>Wind Direction 270 (W)<br>POP- 0%<br>QPF- 000 in<br>WindSpeed 5 mph<br>Wind Speed 5 mph<br>Win | 0/16/2008 1:00 PM MDT  |                    |
| Relative Humathy 31%         Shy Oxwar 2%         Wind Speed 5 mph         Wind Speed 5 mph         QFF: 0.00 m         Writi2000 2:00 PM MDT         Temperature 73 deg F         DewPrint: 36 deg F         Relative Humathy 28%         Shy Oxwar 2%         Wind Speed 5 mph         GPF 0.00 in.  |  |                    |
| Sky Cover 2%<br>Wind Direction 270 (W)<br>POP- 0%<br>QPF: 0.00 in<br>W152008 2:00 PM MDT<br>Temperature 73 deg F<br>DowPoint 36 deg F<br>Relative Humidhy 26%<br>Sky Cover 2%<br>Wind Speed 5 mph<br>Wind Direction 270 (W)<br>POP- 0%<br>QPF: 0.00 in<br>W162008 3:00 PM MDT<br>Temperature 74 deg F<br>Relative Humidhy 28%<br>Sky Cover 2%<br>Wind Speed 5 mph<br>Wind Direction 270 (W)<br>POP- 0%<br>QPF: 0.00 in<br>Wind Direction 270 (W)<br>POP- 0%<br>QPF: 0.00 in   |  |                    |
| Wind Direction 270 (W)           POP-0%           QPF-0.00 in           #162008.2:00 PM MDT           Temperature: 73 deq F           DewPoint: 36 deg F           Relative Humidhy: 28%           Sky Coren: 2%           Wind Speed.5 mph           Wind Speed.5 mph           QPF: 0.00 in           #162008.3:00 PM MDT           Temperature: 74 deg F           DewPoint: 37 deg F           Restative Humidhy: 28%           Sky Cover: 2%           Wind Speed.5 mph           Wind Speed.5 mph           Wind Speed.5 mph           Wind Speed.5 mph           Vind Direction: 270 (W)           POP-0%           QFF: 0.00 in  | Sky Cover 2%   |                    |
| QPF         0.00 in           9/16/2000 2:00 PM MDT           Temperature: 73 deg F           DewPoint: 35 deg F           Relative Humidhy: 28%           SKy Cover: 2%           Wind Speed: 5 mph           Wind Speed: 5 mph           9/16/2008: 3:00 PM MDT           Temperature: 74 deg F           DewSoint: 37 deg F           Resistive Humidhy: 28%           Sky Cover: 2%           Wind Speed: 5 mph           Strip Cover: 2%           Wind Speed: 5 mph           Strip Cover: 2%           Wind Speed: 5 mph           Strip Cover: 2%           Wind Speed: 5 mph  |  |                    |
| 9/16/2008 2:00 PM MDT<br>Temperature: 73 deg F<br>DewPoint: 36 deg F<br>Relative flumidity: 28%<br>Sky Cover: 2%<br>Wind Speed: 5 mph<br>Wind Speed: 5 mph<br>Wind Speed: 5 mph<br>St 16/2008 3:00 PM MDT<br>Temperature: 74 deg F<br>DewPoint: 37 deg F<br>Relative flumidity: 26%<br>Sky Cover: 2%<br>Wind Speed: 5 mph<br>Wind Spee                 |  |                    |
| Temperature 73 deg F<br>DewPoint 36 deg F<br>Relative funcility: 285<br>Sky Cover: 2%<br>Wind Speed: 5 mph<br>Wind Speed: 5 mph<br>Wind Direction: 270 (W)<br>POP- 0%<br>QPF: 0.00 in<br>9:162008:3:00 PM MDT<br>Temperature: 74 deg F<br>DewPoint: 37 deg F<br>Relative fundity: 26%<br>Sky Cover: 2%<br>Wind Speed: 5 mph<br>Wind Speed: 5 mph   | ALL REPORTED IN THE REPORT OF  |                    |
| DewPoint 36 deg F<br>Relative Humidity: 28%<br>Sky Cover: 2%<br>Wind Speed 5 mph<br>Wind Direction: 270 (W)<br>POP-0%<br>QPF: 0.00 is<br>9/16/2008 3:00 PM MDT<br>Temperature: 74 deg F<br>DewPoint 37 deg F<br>Relative Humidity: 28%<br>Sky Cover: 2%<br>Wind Speed 5 mph<br>Wind Speed: 5 mph<br>Wind Speed: 5 mph<br>Wind Speed: 270 (W)<br>POP-0%<br>QPF: 0.00 is<br>   | 9/16/2008 2:00 PM MDT  |                    |
| Relative Humidity 28%<br>Sky Cover 2%<br>Wind Speed 5 mph<br>Wind Direction: 270 (W)<br>POP: 0%<br>QPF: 000 in<br>9:162008 3:00 PM MDT<br>Temperature: 74 deg F<br>DewForint 37 deg F<br>Relative Humidity 28%<br>Sky Cover: 2%<br>Wind Speed 5 mph<br>Wind Speed 5 mph  |  |                    |
| Sky Cover: 2%<br>Wind Speed: 5 mph<br>Wind Speed: 5 mph<br>POP- 0%<br>QPF: 0.00 in<br>St 162008 3:00 PM MDT<br>Temperature: 74 deg F<br>DewPoint: 37 deg F<br>Restore Humidhy: 26%<br>Sky Cover: 2%<br>Wind Speed: 5 mph<br>Wind              |  |                    |
| Wind Direction: 270 (W)           POP: 0%           QPF: 0.00 in:           9r162008 3:00 PM MDT           Temperature: 74 deg F           DewForint: 37 deg F           Resistive Truindity: 20%           Sky Cover: 2%           Wind Speed: 5 mph           Wind Speed: 5 mph           Wind Speed: 5 mph           POP: 0%           QPF: 0.00 in   | Sky Cover: 2%  |                    |
| QFF 0.00 is<br>9:16/2008 3:00 PM MDT<br>Temperature: 74 deg F<br>DewPoint 37 deg F<br>Resative Humidity: 28%<br>Sky Cover. 2%<br>Wind Speed 5 mph<br>Wind Speed 5 mph<br>QFF 0.00 is<br>QFF 0.00 is<br>  |  |                    |
| 9(16/2008 3:00 PM MDT<br>Temperature: 74 deg F<br>DewForint 37 deg F<br>Sestitor Humidity 20%<br>Sky Cover: 2%<br>Wind Speed: 5 mph<br>Wind Speed: 5 mph<br>Wind Speed: 5 mph<br>Wind Direction: 270 (W)<br>POP: 0%<br>GPF: 0.00 in  |  |                    |
| Temperature 74 deg F<br>DewFoint 37 deg F<br>Restrict Humidity 20%<br>Sky Cover 2%<br>Wind Speed 5 mph<br>Wind Speed 5 mph<br>Wind Direction 270 (W)<br>POP 0%<br>GPF 0.00 in  | APP. COVIL   |                    |
| DewPoint 37 deg F<br>Resitive Humidity 20%<br>Sky Cover 2%<br>Wind Speed 5 mpt<br>Wind Direction 270 (W)<br>POP 0%<br>QPF 0.00 m   | 9/16/2008 3:00 PM MDT  |                    |
| Relative Humidity 26%<br>Sky Cover. 2%<br>Wind Speed: 5 mpt.<br>Wind Direction: 270 (W)<br>POP: 0.00 in<br>  |  |                    |
| Wind Speed 5 mph<br>Wind Direction: 270 (W)<br>POP 0%<br>QPF 0.00 m  |  |                    |
| Wind Direction 270 (W)<br>POP 0%<br>QPF 0.00 m   |  |                    |
| QPF 0.00 m   |  |                    |
|  |  |                    |
|  | New York Control of Co |                    |
|  | Point Forecast for Current Location  |                    |



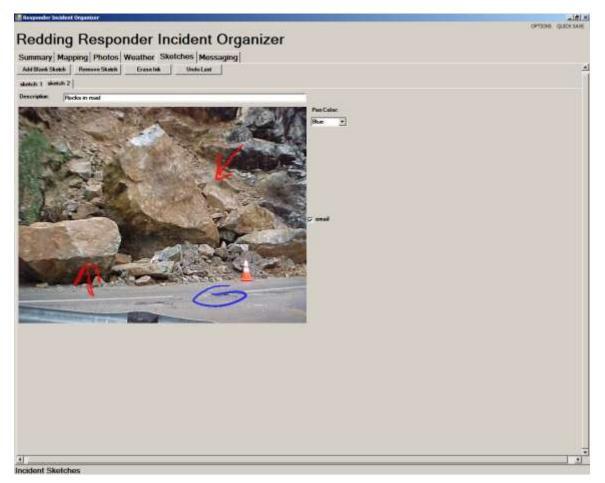


Figure 28: Responder Sketches Tab

| 🔜 Email Status   | IX |
|--|----|
| Sending Email  |    |
| Status:  |    |
| Starting email send<br>Sending Text Email<br>Sending Email With Word Attachment<br>Disconnecting from Internet<br>Disconnected from Internet<br>Done Sending Email |    |
| Ok   | // |

Figure 29: Responder Email Status – Transmission of an Incident Report

# CHAPTER 2. SYSTEM OVERVIEW

# GOALS

The goal of this project for FHWA CFLHD was to:

• Develop a location aware prototype of a system for creating Damage Survey Reports in the field that is intuitive to use and requires minimal training.

## REQUIREMENTS

The high-level requirements of the project were left general, pending further guidance from field-testing feedback:

- The system shall include rugged hardware for field use.
- The system shall easily incorporate photos, sketches and maps.
- The system shall facilitate creation of free-form sketches.
- The system shall facilitate annotation of maps and photos via sketches.
- The system shall facilitate entry of cost estimate information.
- The system shall produce output in pdf format.
- The system shall be capable of saving information collection.

# THE SYSTEM

#### Hardware

The primary hardware for the system is a Panasonic Toughbook<sup>®</sup> 19, Tablet PC version with the following configuration:

- Windows XP<sup>®</sup> Tablet PC Edition
- 64-bit, 1.06 GHz Intel Core 2 Duo
- 80 GB Hard drive
- 1 GB RAM
- 10.4" TFT 1024 x 768 (XGA)
- Lithium Ian 7 Hour Battery
- Gigabit Ethernet Network Adapter
- WLAN : 802.11a/b/g
- Bluetooth<sup>®</sup> 2.0 EDR
- SD Memory Card Reader
- Integrated GPS
- Integrated CDMA<sup>®</sup> 2000 1X EV-DO Rev. A cellular modem

Any digital camera with USB connectivity should work with the system, as long as the USB connection creates a drive letter for the camera. A camera was not purchased to accompany the Toughbook<sup>®</sup>, since the preferences of field users were unknown. It is recommended that a rugged, weather-proof camera be used since primary use is outdoors.

#### Software

The software was developed to run on Windows  $XP^{\text{®}}$ , Tablet Edition. No testing has been conducted to determine if the software will run on Windows Vista<sup>®</sup> or Windows 7<sup>®</sup>. In all likelihood, the code would have to be modified and rebuilt to run on the most recent version of the Windows<sup>®</sup> Operating System. Windows  $XP^{\text{®}}$ , Tablet Edition was the current, stable version of the Windows<sup>®</sup> operating system when this project was initiated, and is the operating system for which the Responder System was developed.

The software does require that Microsoft MapPoint<sup>®</sup> and Microsoft Office<sup>®</sup> are installed on the computer.

The Toughbook<sup>®</sup> should be running in Tablet mode for proper operation of the software, although convertible mode will be necessary for keyboard use.

The initial screen shows a splash page and indicates device availability (GPS) and status of loading maps. If a GPS fix is available, maps will be automatically loaded to correspond to the user location, and the user location will be automatically populated in the applications forms.



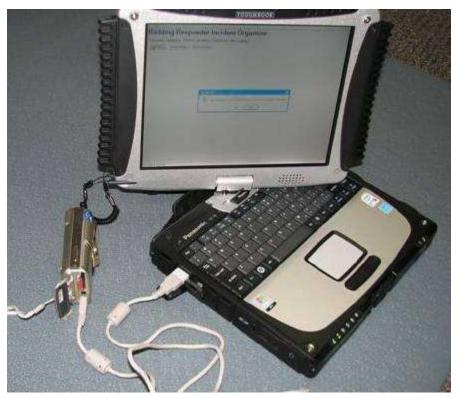
Figure 30: Damage Survey Report Initial Screen

The software application is organized using a tabbed view to break up the form fields into sections that are manageable within a single screen. An effort was made to organize the tabs by functionality, and the result is very similar to what was originally done for Caltrans in the Redding Responder project.

The Summary Tab is the next tab that a user will see. The summary information displayed in this tab corresponds to information on the DSR ERFO form. Note that location and applicant information is pre-populated, if that information is available. Otherwise, the user can enter information for each of the fields by either using the Tablet stylus or the keyboard.

| STRATION, Feder<br>URVEY REPORT<br>Haid System/Federal Domain<br>(Reports)<br>County (Ministration) | Retton  | DSR No. OLV<br>Disaster No. WA3<br>Inspection Date [     State: [Washing]  | 2004-1 NPS<br>3/13/2008 11 34   |  |
|---|---|--|---|--|
| URVEY REPORT<br>Haid System/Federal Domain<br>(Reports)<br>County (14                               | l<br>Nexon  | Disaster No. WA2<br>Inspection Date:   | 2004-1 NPS<br>3/13/2008 11 34 💌   |  |
| County (  | Retton  |  |   |  |
| County (mil   |   | • State Washingt   | an 💌  |  |
|   |   | State: Washings  | on 💌  |  |
| Name ISO  |   |  |   |  |
| ubout 50  |   |  |   |  |
| Phone Inc.  | Latitude 47:847508  | 6111575 ADT  | 428   |  |
| wateboor long   | Longitude: 123 96085  | 6832564 Us   | odate Location Data   |  |
|   | and a second designed as  |  |   |  |
| 4 E   | Classification  |  |   |  |
| Yay Width 20  | Surface Type: ACP   | Thickness: 3"  |   |  |
| vian 2  | Surface Type: ACP   | Photograph #:  |   |  |
| Scope/Description of  | Repair  |  |   |  |
| nd Reconstruct road, of matigation along rips   | construct permanent bank protectio<br>sp to create complex interface with   | n utilizing liptap, and const<br>future licens   | uct log cibbing:  |  |
|   |   |  |   |  |
| P Elgèle 🖺 In   | eligible  |  |   |  |
| F Eligible ( In   | religible   |  |   |  |
|   | Vay Width: 20<br>Vidth: 2<br>nd<br>he the fifth of the solution store the solution of the solution store the solution | Vey Width 207 Surface Type: ACP<br>Surface Type: ACP<br>Surface Type: ACP<br>Second to add, continued permanent bank protection<br>mitigation along tipesp to conside complex interface with | Very Width: 207 Surface Type: ACP Thickness: 37<br>Vidth: 22 Surface Type: ACP Photograph II: 37<br>d he misgation slong tipsp to create complex interface with future licen. | Very Width         207         Surface Type:         ACP         Thickness:         3*           Vidth         2*         Surface Type:         ACP         Photograph II         Image: Comparison of Repair:           nd         Reconstruct road; construct permanent bank protection utilizing sprap, and construct log cibbing mitigation along tipsp to create complex interface with future flows:         Image: Comparison of Complex interface with future flows: |

Figure 31: Summary Tab



The Photos tab allows users to add photos from a digital camera. The photos become part of the incident record and are stored by the application with the incident information.

Figure 32: Camera Connection to Toughbook<sup>®</sup>

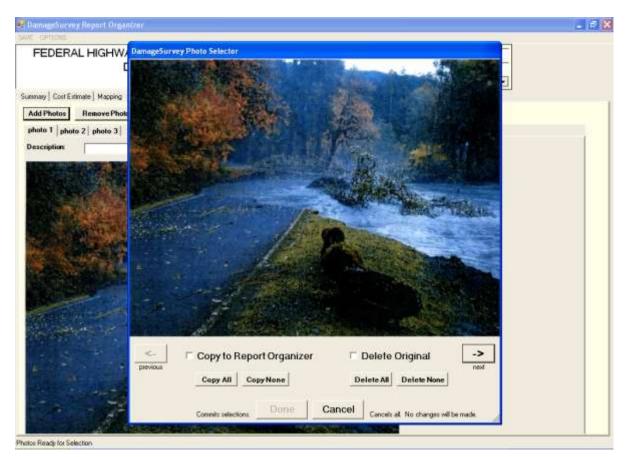


Figure 33: Add Photos Dialog

The Sketches tab allows users to use the Tablet stylus to annotate maps or photos that were previously copied to the "Sketches" area. Users can also add a blank sketch to create a free form drawing to help describe the incident. In addition, a cost estimate can be added to a sketch to indicate permanent or emergency repair costs associated with what is depicted in the sketch.

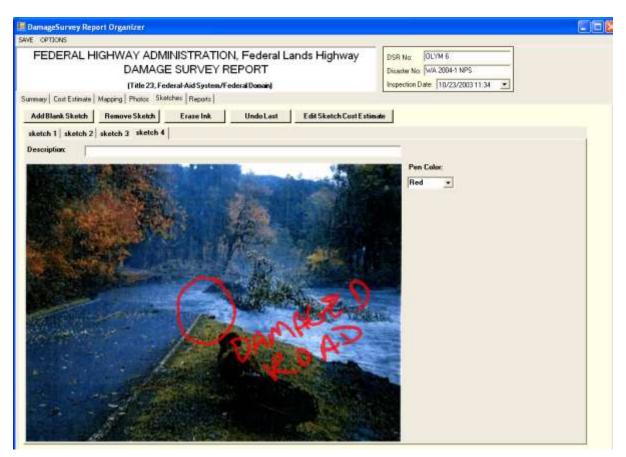


Figure 34: Sketches Tab

| AddC | ostEstimateCalculationDialog |   |                                 |      |   |                        |              |               |
|------|------------------------------|---|---------------------------------|------|---|------------------------|--------------|---------------|
|      | ITEM                         |   | Calculation                     | Unit |   | Calculated<br>Quantity | DSR Quantity | Туре          |
| Þ    | Quarry Spalls                | - | (8')(26')(100')/27 =            | CUYD | - | 770                    | 820          | Permanent R 💌 |
|      | Aggregate                    | • | ((4''+6'')/12)(26')(150')/27 =  | CUYD | - | 120                    | 130          | Permanent R 💌 |
|      | Riprap, Class                | • | ((13')(10')/2)(250')/27 =       | CUYD | - | 601                    | 650          | Permanent R 💌 |
|      | Asphalt concrete pavement    | Ŧ | (3''/12)(24')(150')(2ton/cuyd)/ | TON  | - | 67                     | 70           | Permanent R 💌 |
| *    |                              | • |                                 |      | - |                        |              |               |
|      |                              |   |                                 |      |   |                        |              |               |
|      | ОК                           |   |                                 |      |   |                        |              |               |

Figure 35: Add Cost Estimate Calculation Dialog Box

The Cost Estimate tab allows users to enter costs that are associated with the repairs outlined in the damage survey report. Users can enter items associated with either emergency repairs or permanent repairs. Detailed cost estimate items and a mechanism for updating this information are not included in the prototype system. These items were requested but were not available within the performance period for this project. The information included with the system and shown below are for example only.

| SAVE     | OPTIONS       |           |      |  |  |       |                  |            |                            |            |        |  |  |
|----------|---------------|-----------|------|--|--|-------|------------------|------------|----------------------------|------------|--------|--|--|
| F        | EDERA         | LHIGH     | -W/  | AY ADMINISTRAT                                       | 10N, Federal L   | an    | ds Highwa        | iy 👘       | DSR No. OLYM               | 6          |        |  |  |
|          |               |           | - 0  | DAMAGE SURVEY  | REPORT   |       | 8.5              | 8          | Disaster No: WA 2004 T MPS |            |        |  |  |
|          |               |           | - 8  | (Title 23, Federal-Aid Syster                        | n/FederalDomaini   |       |                  |            | Inspection Date: 1         | /23/20031  | 1:34   |  |  |
| Sumine   | Cost Esta     | nate Mar  |      | Photos   Sketches   Reports                          | and the second |       |                  | - 10       |                            |            |        |  |  |
|          | V Barrana     | 111       |      | COST ESTIMATE for ENE                                | DEENEY DEDADE*   |       |                  |            |                            |            |        |  |  |
|          | Quantity      | Unit      | 1    | Item Description                                     | NUCHCI NERAINS   | -     | Convert          |            | Unit Pice                  | Cost       |        |  |  |
|          | 1             | LS        | +1   | Traffic Control                                      |  | +     | Contrain         |            | \$500.00                   | \$500.00   |        |  |  |
| *        |               |           | -1   |  |  | -     | 1                |            | \$0.00                     | \$0.00     |        |  |  |
|          | Duwrithy      | Umi<br>LS | -    | COST ESTIMATE for PERI<br>Item Description           | MANENT REPARS*   |       | Comment          |            | Unit Price                 | Cert       | -      |  |  |
| 1        | Duenty        |           |      | Item Description                                     |  |       | Conment          |            | Unit Price                 | Cort       |        |  |  |
| <u>۲</u> | 1             | 1         |      | Mobilization   |  | -     |                  |            | \$8,000.00                 | \$8.000.00 | ÷÷     |  |  |
|          | 60            | UNFT      | 1000 | Culvert  |  | - 775 | 24" Rigid Plante |            | \$40.00                    | \$2,400.00 |        |  |  |
|          | 1             | LS        |      | Clearing and Grubbing                                |  | 2     |                  |            | \$20,000.00                | \$20,000.0 |        |  |  |
|          | 8010          | CUID      |      | Quary Spale  |  | •     | Energy works     | 1.27234    | \$25.00                    | \$20,500.0 |        |  |  |
|          | 130           | CUND      | Ŀ    | Aggregale  |  | H     | 5/8" and 1 1/4"  | Crushed    | \$35.00                    | \$4,550.00 |        |  |  |
| 1        |               |           | _    |  |  |       |                  |            |                            |            |        |  |  |
| Propose  | d.            |           | Fe   | arce Account:  | Conhact  |       |                  | Ta         | tal Permanent Repairs      | \$85       | 458.08 |  |  |
|          |               |           |      |  |  |       |                  |            |                            |            |        |  |  |
|          |               |           |      | is hardfic align"<br>I riprap to comply with US FW/S | requirements. Cribbing will f  | be br | eneticial to tah | Preimnas   | Engineering                | 14         | 273.0  |  |  |
|          | and riprap is | not 0     |      |  |  |       |                  |            | on Engineering             |            | .709.0 |  |  |
| habita   |               |           |      |  |  |       |                  | Right-of/a | lw/                        | -          | \$0.0  |  |  |
| habita   |               |           |      |  |  |       |                  | Other      |                            |            | \$0.0  |  |  |
| habita   |               |           |      |  |  |       |                  |            |                            |            |        |  |  |
| habita   |               |           |      |  |  |       |                  | TOTAL ES   | STIMATED COST              | \$91       | .932.0 |  |  |

Figure 36: Cost Estimate tab

The Mapping tab allows users to view Road maps, Aerial photos, and USGS Topographical maps of the damage area. Users can also check the status of the GPS device. The Road Map option shows a road map using Microsoft MapPoint<sup>®</sup>. MapPoint<sup>®</sup> is also used to identify street name and address, given the latitude/longitude location of the user.

| 🖬 DamageSurvey Rep   | oort Organizer                                     |  |                                |  | E 8 🛛 |
|--|--|--|--------------------------------|--|-------|
| SAVE OPTIONS   |  |  |                                |  |       |
| FEDERAL H<br>Summary   Cost Estimate<br>Road Map   Aerial Ph | DAMAGE<br>(Title 23, Fee<br>Mapping   Photos   Ske | E SURVEY REPO<br>lecal Aid System/Federal<br>intes   Reports |                                | DSR No. OLYM 6<br>Disaster No. WA 2004-1 NPS<br>Inspection Date: 3/13/2008 11:34 |       |
| Zoom Out   | Zoom In  | Copy to Sketches   | Use New Location               |  |       |
|  |  | Opmose Rational Pack   | Map<br>Prover Marine<br>Carden | Point<br>3.7 in  |       |
|  |  | 4.9 km   |                                |  |       |
| Zoom Dut   |  |  |                                |  |       |

Figure 37: Mapping Tab

The Reports tab allows users to format the report pages and create the report as a PDF document. By default the first page of the report will contain the Summary and Cost Estimate information. The Reports tab allows users to pick which photos and sketches to include in the PDF report or quickly add all photos and sketches, one per page. When users initially use the Reports tab for a new damage survey report, they will see a list of photos and sketches on the bottom right of the screen and a blank photo Placement area for Page 1 on the left.

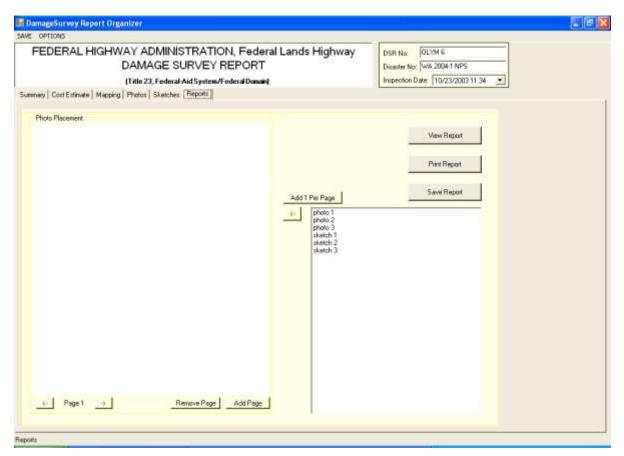


Figure 38: Reports Tab

## EXAMPLE REPORT

The following example report was generated using the prototype system, and is intended to correspond to the format used for actual DSRs. The sample report is displayed in Figures 39 - 46. It was generated using information from an actual hard copy DSR, previously displayed in Chapter 1, Figures 15-20.

Figure 39 shows the front page of the DSR, including cost estimates and a general overview of the incident and associated repairs, along with the date and time. Figure 40, Figure 41 and Figure 42 shows photos that were imported into the incident record. Figure 43 and Figure 44 show sketches of the repairs. Note that these sketches were not generated within the prototype system, but were instead imported as images into the system. Figure 45 shows an annotated map and Figure 46 shows an annotated photo. The annotations were added using the tablet stylus.

This report demonstrates that the system can be used successfully to create an ERFO DSR conforming to the current format.

|   | ERAL HIGH   | IWAY ADMINISTRATION,   | Federal Lands Hig                           | Ihway  | Sheet No:1  | _ of8   |
|---|---|--|---|--|---|---|
|   |   | DAMAGE SURVEY REP  | PORT  |  | DSR No:   | OLYM 6  |
|   | C   | Title 23, Federal-Aid System/Fede  | ral Domain)                                 |  | Disaster No: WA 2004-1  | NPS   |
| Applicant:<br>Dympic National I   | Park  |  | County:<br>Jefferson                        | <b>State:</b><br>Washington  | Inspection Date:<br>10/23/2003 11:34  |   |
|   |   | Name of Road and Mile Post)<br>5.0 (47.8508316166699, -123.95640   | 3359771)                                    |  | ADT:<br>428   |   |
|   |   | ,,   | 1   |  | Photograph #:   |   |
| Bridge Data:  |   | Road Data:   | Classification:                             |  | -   |   |
| Гуре:   |   | Traveled Way Width: 20'  | Surface Type: ACP                           | Thickness: 3"  | -   |   |
| D# N//<br>Description and (   |   | Shoulder Width: 2'   | Surface Type: ACP<br>Scope/Description of R | enair:   |   |   |
|   |   | et. The bend in the side channel<br>depth of the washed out area is 8 feet.  | cribbing mitigation along                   | riprap to create con   | ղplex interface with future fl  | ows.  |
|   |   | COST ESTIMA  | TE for EMERGENC                             | ( REPAIRS*   |   |   |
| Quantity  | Unit  |  | Item Description                            |  | Unit Price  | Cost  |
| 1   | LS  | Traffic Control  |   |  | \$500.00  | \$500.0   |
|   |   |  |   |  |   |   |
|   |   |  |   |  |   |   |
|   |   |  |   |  |   |   |
|   |   |  |   |  |   |   |
|   |   |  |   |  |   |   |
|   |   |  |   |  |   | <u> </u>  |
|   |   |  |   |  |   |   |
| Proposed:   | Eoree /   | Account Contract   |   | Total Emo  | rgency Repairs  | \$500.0   |
|   | TOICE   | Coount Contract  |   |  | rgency repairs  | φ300.   |
| · ·   |   |  |   |  |   |   |
| •   |   | COST ESTIMA  | TE for PERMANEN                             | <b>FREPAIRS</b> *  |   |   |
| Quantity  | Unit  | COST ESTIMA  | TE for PERMANEN                             | FREPAIRS*  | Unit Price  | Cost  |
|   | Unit<br>LS  | COST ESTIMA<br>Mobilization  |   | repairs*   | Unit Price<br>\$8,000.00  |   |
| Quantity  |   |  |   | T REPAIRS*   |   | \$8,000.  |
| Quantity  | LS  | Mobilization   |   | Γ REPAIRS*   | \$8,000.00  | ) \$8,000.0<br>\$2,400.0  |
| Quantity<br>1<br>60<br>1<br>820   | LS<br>LNFT<br>LS<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls  | Item Description                            | repairs*   | \$8,000.00<br>\$40.00   | \$8,000.0<br>\$2,400.0<br>\$20,000.0  |
| Quantity<br>1<br>60<br>1<br>820<br>130  | LS<br>LNFT<br>LS<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed   | Item Description                            | Γ REPAIRS*   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$25.00<br>\$35.00  | \$8,000.           \$2,400.           \$20,000.           \$20,500.           \$4,550.  |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650   | LS<br>LNFT<br>CUYD<br>CUYD<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed<br>Riprap, Class Class 6  | Item Description                            | Γ REPAIRS*   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$30.00   | \$8,000.0<br>\$2,400.0<br>\$20,000.0<br>\$20,500.0<br>\$4,550.0<br>\$19,500.0   |
| Quantity<br>1<br>60<br>1<br>820<br>130  | LS<br>LNFT<br>LS<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed   | Item Description                            | Γ REPAIRS*   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$25.00<br>\$35.00  | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$20,500.<br>\$4,550.<br>\$19,500.   |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650   | LS<br>LNFT<br>CUYD<br>CUYD<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed<br>Riprap, Class Class 6  | Item Description                            | T REPAIRS*   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$30.00   | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$20,500.<br>\$4,550.<br>\$19,500.   |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650   | LS<br>LNFT<br>CUYD<br>CUYD<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed<br>Riprap, Class Class 6  | Item Description                            | T REPAIRS*   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$30.00   | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$20,500.<br>\$4,550.<br>\$19,500.   |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650   | LS<br>LNFT<br>CUYD<br>CUYD<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed<br>Riprap, Class Class 6  | Item Description                            | T REPAIRS*   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$30.00   | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$20,500.<br>\$4,550.<br>\$19,500.   |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650   | LS<br>LNFT<br>CUYD<br>CUYD<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed<br>Riprap, Class Class 6  | Item Description                            | T REPAIRS*   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$30.00   | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$20,500.<br>\$4,550.<br>\$19,500.   |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650   | LS<br>LNFT<br>CUYD<br>CUYD<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed<br>Riprap, Class Class 6  | Item Description                            | T REPAIRS*   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$30.00   | \$8,000<br>\$2,400<br>\$20,000<br>\$20,500<br>\$4,550<br>\$4,550<br>\$19,500  |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650   | LS<br>LNFT<br>CUYD<br>CUYD<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed<br>Riprap, Class Class 6  | Item Description                            | T REPAIRS*   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$30.00   | \$8,000<br>\$2,400<br>\$20,000<br>\$20,500<br>\$4,550<br>\$4,550<br>\$19,500  |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650   | LS<br>LNFT<br>CUYD<br>CUYD<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed<br>Riprap, Class Class 6  | Item Description                            | T REPAIRS*   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$30.00   | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$20,500.<br>\$4,550.<br>\$19,500.   |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650   | LS<br>LNFT<br>CUYD<br>CUYD<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed<br>Riprap, Class Class 6  | Item Description                            | T REPAIRS*   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$30.00   | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$20,500.<br>\$4,550.<br>\$19,500.   |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650   | LS<br>LNFT<br>CUYD<br>CUYD<br>CUYD<br>CUYD  | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed<br>Riprap, Class Class 6  | Item Description                            |  | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$33.00<br>\$150.00  | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$20,500.<br>\$4,550.<br>\$19,500.<br>\$10,500.  |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650<br>70   | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>CUYD<br>TON   | Mobilization<br>Culvert 24" Rigid Plastic<br>Clearing and Grubbing<br>Quarry Spalls<br>Aggregate 5/8" and 1 1/4" Crushed<br>Riprap, Class Class 6  | Item Description                            | ubtotal Permanent R  | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$30.00   | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$4,550.<br>\$19,500.<br>\$10,500.   |
| Quantity           1           60           1           820           130           650           70  | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>CUYD<br>TON<br>TON<br>Force A   | Mobilization Culvert 24" Rigid Plastic Clearing and Grubbing Quarry Spalls Aggregate 5/8" and 1 1/4" Crushed Riprap, Class_Class 6 Asphalt concrete pavement Asphalt concrete pavement Culton Contract Contract provide justification*   | Item Description                            | ubtotal Permanent R  | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$30.00<br>\$150.00<br>Repairs (continuation sheet]<br>Permanent Repairs  | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$20,500.<br>\$4,550.<br>\$19,500.<br>\$10,500.  |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650<br>70<br>Proposed:<br>ientify Bettermen<br>g cribbing is nee  | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>CUYD<br>TON<br>Force A<br>Pent, if any, and f<br>rded as mitigatio  | Mobilization         Culvert 24" Rigid Plastic         Clearing and Grubbing         Quarry Spalls         Aggregate 5/8" and 1 1/4" Crushed         Riprap, ClassClass 6         Asphalt concrete pavement  | Item Description                            | ubtotal Permanent f<br>Total   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$33.00<br>\$150.00<br>Repairs (continuation sheet,<br>I Permanent Repairs<br>ering   | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$4,550.<br>\$19,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.        |
| Quantity           1           60           1           820           130           650           70  | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>CUYD<br>TON<br>Force A<br>Pent, if any, and f<br>rded as mitigatio  | Mobilization         Culvert 24" Rigid Plastic         Clearing and Grubbing         Quarry Spalls         Aggregate 5/8" and 1 1/4" Crushed         Riprap, ClassClass 6         Asphalt concrete pavement  | Item Description                            | ubtotal Permanent f<br>Total<br>Preliminary Engine<br>Construction Engin<br>Right-of-Way   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$33.00<br>\$150.00<br>Repairs (continuation sheet,<br>I Permanent Repairs<br>ering   | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$4,550.<br>\$19,500.<br>\$10,500.<br>\$85,450.<br>\$85,450.<br>\$4,273.<br>\$1,709.<br>\$0.   |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650<br>70<br>Proposed:<br>lentify Bettermen<br>g cribbing is nee  | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>CUYD<br>TON<br>Force A<br>Pent, if any, and f<br>rded as mitigatio  | Mobilization         Culvert 24" Rigid Plastic         Clearing and Grubbing         Quarry Spalls         Aggregate 5/8" and 1 1/4" Crushed         Riprap, ClassClass 6         Asphalt concrete pavement  | Item Description                            | ubtotal Permanent F<br>Total<br>Preliminary Engine<br>Construction Engin   | \$8,000.00<br>\$40.00<br>\$20,000.00<br>\$35.00<br>\$35.00<br>\$33.00<br>\$150.00<br>Repairs (continuation sheet,<br>I Permanent Repairs<br>ering   | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$4,550.<br>\$19,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$4,570.<br>\$4,273.<br>\$4,273.<br>\$1,709.   |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650<br>70<br>Proposed:<br>lentify Bettermen<br>g cribbing is nee  | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>CUYD<br>TON<br>Force A<br>Pent, if any, and f<br>rded as mitigatio  | Mobilization         Culvert 24" Rigid Plastic         Clearing and Grubbing         Quarry Spalls         Aggregate 5/8" and 1 1/4" Crushed         Riprap, ClassClass 6         Asphalt concrete pavement  | Item Description                            | ubtotal Permanent f<br>Total<br>Preliminary Engine<br>Construction Engin<br>Right-of-Way<br>Other<br>TOTAL ESTIMATE                                      | \$8,000.00           \$40.00           \$20,000.00           \$25.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$30.00           \$150.00           \$150.00           \$200.00           \$150.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00 | \$8,000.<br>\$2,400.<br>\$20,000<br>\$4,550.<br>\$19,500.<br>\$10,500.<br>\$85,450.<br>\$42,73.<br>\$1,709.<br>\$0.<br>\$0.<br>\$0.<br>\$0.<br>\$0.<br>\$0.<br>\$0.<br>\$0  |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650<br>70<br>Proposed:<br>lentify Betterme<br>g cribbing is nee   | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>CUYD<br>TON<br>Force A<br>Pent, if any, and f<br>rded as mitigatio  | Mobilization         Culvert 24" Rigid Plastic         Clearing and Grubbing         Quarry Spalls         Aggregate 5/8" and 1 1/4" Crushed         Riprap, ClassClass 6         Asphalt concrete pavement  | Item Description                            | ubtotal Permanent F<br>Total<br>Preliminary Engine<br>Construction Engin<br>Right-of-Way<br>Other  | \$8,000.00           \$40.00           \$20,000.00           \$25.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$30.00           \$150.00           \$150.00           \$200.00           \$150.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00 | \$8,000.<br>\$2,400.<br>\$20,000.<br>\$4,550.<br>\$4,550.<br>\$10,500.<br>\$10,500.<br>\$85,450.<br>\$4,273.<br>\$4,273.<br>\$1,709.<br>\$10,500.<br>\$20,500.<br>\$20,500.<br>\$4,550.<br>\$4,273.<br>\$1,709.<br>\$1,709.<br>\$0,000.<br>\$0,000.<br>\$0,000.<br>\$0,000.<br>\$0,000.<br>\$0,000.<br>\$0,000.<br>\$0,000.<br>\$0,000.<br>\$0,000.<br>\$0,000.<br>\$19,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500.<br>\$10,500. |
| Quantity 1 60 1 820 130 650 70 Proposed: lentify Betterme g cribbing is nee beneficial to fis   | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>TON<br>TON<br>Force A<br>Pant, if any, and rip<br>ded as mitigatio  | Mobilization         Culvert 24" Rigid Plastic         Clearing and Grubbing         Quarry Spalls         Aggregate 5/8" and 1 1/4" Crushed         Riprap, ClassClass 6         Asphalt concrete pavement  | Item Description                            | ubtotal Permanent f<br>Total<br>Preliminary Engine<br>Construction Engin<br>Right-of-Way<br>Other<br>TOTAL ESTIMATE                                      | \$8,000.00           \$40.00           \$20,000.00           \$25.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$30.00           \$150.00           \$150.00           \$200.00           \$150.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00 | \$8,000.<br>\$2,400.<br>\$20,000<br>\$4,550.<br>\$19,500.<br>\$10,500.<br>\$85,450.<br>\$485,450.<br>\$4,273.<br>\$1,709.<br>\$0.<br>\$0.<br>\$0.<br>\$0.<br>\$0.<br>\$0.<br>\$0.<br>\$0  |
| Quantity           1           60           1           820           130           650           70   Proposed:<br>lentify Betterme<br>e beneficial to fis<br>ubmitted By:(National Strength Strengen Strengen Strength Strength Strength Strengen Strengen Streng | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>TON<br>TON<br>Force A<br>Pant, if any, and rip<br>ded as mitigatio  | Mobilization         Culvert 24" Rigid Plastic         Clearing and Grubbing         Quarry Spalls         Aggregate 5/8" and 1 1/4" Crushed         Riprap, ClassClass 6         Asphalt concrete pavement  | Item Description                            | ubtotal Permanent f<br>Total<br>Preliminary Engine<br>Construction Engin<br>Right-of-Way<br>Other<br>TOTAL ESTIMATE<br>(Emergency and Perm               | \$8,000.00           \$40.00           \$20,000.00           \$25.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$30.00           \$150.00           \$150.00           \$200.00           \$150.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00 | \$8,000<br>\$2,400<br>\$20,000<br>\$4,550<br>\$19,500<br>\$10,500<br>\$10,500<br>\$85,450<br>\$4,273<br>\$4,273<br>\$1,709<br>\$0<br>\$0<br>\$91,932  |
| Quantity           1           60           1           820           130           650           70   Proposed:           Identify Bettermed           g cribbing is needed           e beneficial to fis           ubmitted By:(Nat           Applicant   | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>CUYD<br>TON<br>Force /<br>Pont, if any, and j<br>ded as mitigatio<br>th habitat and rip<br>me and Title)                | Mobilization         Culvert 24" Rigid Plastic         Clearing and Grubbing         Quarry Spalls         Aggregate 5/8" and 1 1/4" Crushed         Riprap, ClassClass 6         Asphalt concrete pavement  | Item Description                            | ubtotal Permanent f<br>Total<br>Preliminary Engine<br>Construction Engin<br>Right-of-Way<br>Other<br>TOTAL ESTIMATE<br>(Emergency and Perm<br>Signature: | \$8,000.00           \$40.00           \$20,000.00           \$25.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$30.00           \$150.00           \$150.00           \$200.00           \$150.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00 | \$8,000<br>\$2,400<br>\$20,000<br>\$4,550<br>\$4,550<br>\$19,500<br>\$10,500<br>\$85,450<br>\$4,273<br>\$1,709<br>\$0<br>\$4,273<br>\$1,709<br>\$0<br>\$91,932<br>Date:   |
| Quantity 1 60 1 820 820 130 650 70 Proposed: Intrify Betterme g cribbing is nee beneficial to fis ubmitted By:(Nar Applicant eviewed By:(Nar  | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>CUYD<br>TON<br>Force A<br>ent, if any, and J<br>ent and rip<br>me and Title)<br>me and Title)                           | Mobilization         Culvert 24" Rigid Plastic         Clearing and Grubbing         Quarry Spalls         Aggregate 5/8" and 1 1/4" Crushed         Riprap, ClassClass 6         Asphalt concrete pavement  | Item Description                            | ubtotal Permanent f<br>Total<br>Preliminary Engine<br>Construction Engin<br>Right-of-Way<br>Other<br>TOTAL ESTIMATE<br>(Emergency and Perm               | \$8,000.00           \$40.00           \$20,000.00           \$25.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$30.00           \$150.00           \$150.00           \$200.00           \$150.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00 | \$8,000<br>\$2,400<br>\$20,000<br>\$4,550<br>\$19,500<br>\$10,500<br>\$10,500<br>\$85,450<br>\$4,273<br>\$4,273<br>\$1,709<br>\$0<br>\$0<br>\$91,932  |
| Quantity<br>1<br>60<br>1<br>820<br>130<br>650<br>70<br>70<br>Proposed:<br>lentify Betterme<br>g cribbing is nee<br>e beneficial to fis<br>ubmitted By:(Nai<br>Applicant<br>eviewed By:(Nai  | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>TON<br>TON<br>Force A<br>ent, if any, and j<br>ded as mitigatio<br>ih habitat and rip<br>me and Title)<br>me and Title) | Mobilization Culvert 24" Rigid Plastic Clearing and Grubbing Quary Spalls Aggregate 5/8" and 1 1/4" Crushed Riprap, ClassClass 6 Asphalt concrete pavement Asphalt concrete pavement Contract Contract Drovide justification* n for riprap to comply with US FWS re rap is not.0 | Item Description                            | ubtotal Permanent f<br>Total<br>Preliminary Engine<br>Construction Engin<br>Right-of-Way<br>Other<br>TOTAL ESTIMATE<br>(Emergency and Perm<br>Signature: | \$8,000.00           \$40.00           \$20,000.00           \$25.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$30.00           \$150.00           \$150.00           \$200.00           \$150.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00 | \$8,000         \$2,400         \$20,000         \$20,000         \$20,000         \$20,000         \$10,500         \$10,700         \$0  |
| Quantity 1 60 1 820 130 650 70 Proposed: Intrify Betterme g cribbing is nees beneficial to fis ubmitted By:(Nar Applicant eviewed By:(Nar   | LS<br>LNFT<br>LS<br>CUYD<br>CUYD<br>TON<br>TON<br>Force A<br>ent, if any, and j<br>ded as mitigatio<br>ih habitat and rip<br>me and Title)<br>me and Title) | Mobilization Culvert 24" Rigid Plastic Clearing and Grubbing Quary Spalls Aggregate 5/8" and 1 1/4" Crushed Riprap, ClassClass 6 Asphalt concrete pavement Asphalt concrete pavement Contract Contract Drovide justification* n for riprap to comply with US FWS re rap is not.0 | Item Description                            | ubtotal Permanent f<br>Total<br>Preliminary Engine<br>Construction Engin<br>Right-of-Way<br>Other<br>TOTAL ESTIMATE<br>(Emergency and Perm<br>Signature: | \$8,000.00           \$40.00           \$20,000.00           \$25.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$35.00           \$30.00           \$150.00           \$150.00           \$200.00           \$150.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00           \$200.00 | \$8,000<br>\$2,400<br>\$20,000<br>\$4,550<br>\$4,550<br>\$19,500<br>\$10,500<br>\$85,450<br>\$4,273<br>\$1,709<br>\$0<br>\$4,273<br>\$1,709<br>\$0<br>\$91,932<br>Date:   |

Figure 39: Generated DSR Front Page

| FEDERAL HIGHWAY ADMIN<br>DAMAGE SURVEY   | IISTRATION, Federal Land<br>REPORT (Supplemental Shee |                      | Sheet No: <u>2</u> of <u>8</u><br>DSR No: <u>0</u> LYM 6 |
|--|---|----------------------|--|
| (Title 23, Federal   | Aid System/Federal Domain)                            |                      | Disaster No: WA 2004-1 NPS                               |
| Applicant:<br>Olympic National Park  | County:<br>Jefferson                                  | State:<br>Washington | Inspection Date:<br>10/23/2003 11:34                     |
|  |   | ovasnington          |  |
| Location of Damage (Route No., Name of Road a<br>Hoh Valley Rd Route No. 107, MP 5.0 (47.8508316 | 166699,-123,956403359771)                             |                      | A DT:<br>428   |
|  |   |                      |  |

Figure 40: Generated DSR Supplemental Sheet Including a Photo

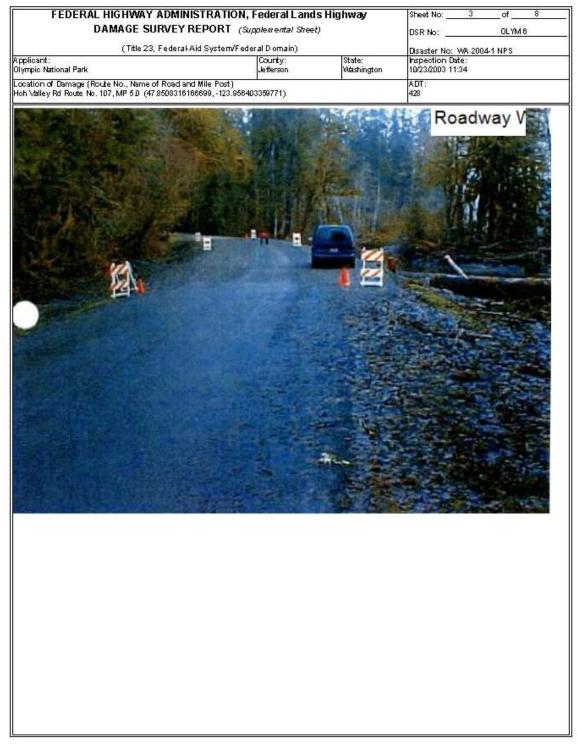


Figure 41 Generated DSR Supplemental Sheet Including a Photo

| FEDERAL HIGHWAY ADMINISTRATI<br>DAMAGE SURVEY REPORT   |                       |                      | Sheet No: <u>4</u> of <u>8</u><br>DSR No: <u>0LYM 6</u>           |
|--|-----------------------|----------------------|---|
| (Title 23, Federal-Aid System  |                       | -                    | Disaster No: WA 2004-1 NPS  |
| Applicant:<br>Olympic National Park  | County:<br>Jefferson  | State:<br>Washington | Disaster No: WA 20041 NPS<br>Inspection Date:<br>10/23/2003 11:34 |
| Location of Damage (Route No., Name of Road and Mile Post<br>Hoh Valley Rd Route No. 107, MP 5.0 (47.8508316166699, -123 | t)<br>2 056403350771) |                      | 4 DT:<br>428  |
|  |                       |                      |   |
|  |                       |                      |   |

Figure 42 Generated DSR Supplemental Sheet Including a Photo

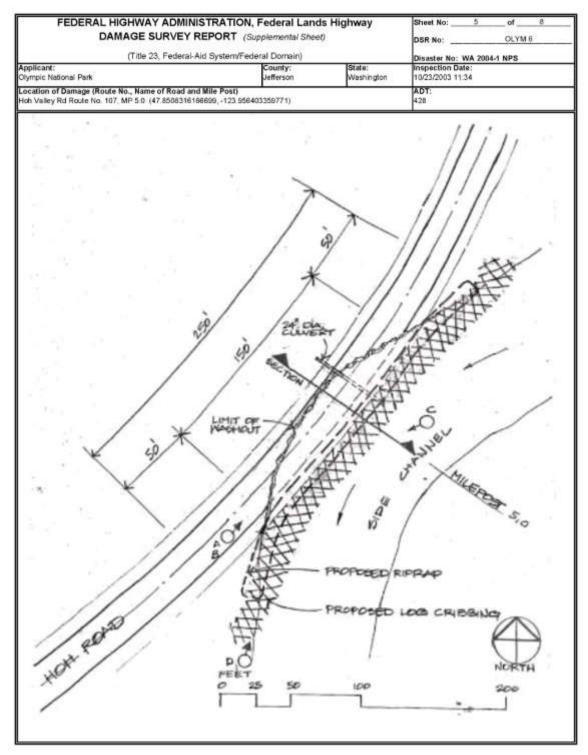


Figure 43: Generated DSR Supplemental Sheet Including a Sketch created with other Software

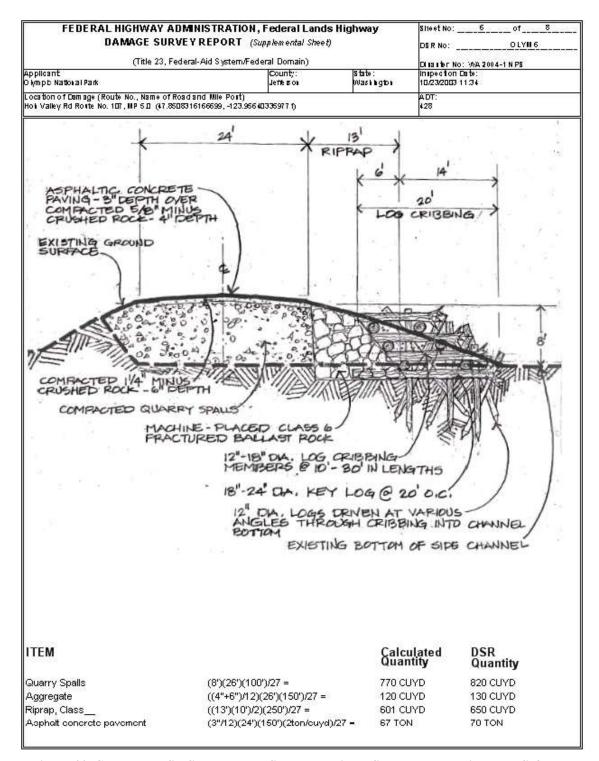


Figure 44: Generated DSR Supplemental Sheet Including a Sketch created with other Software

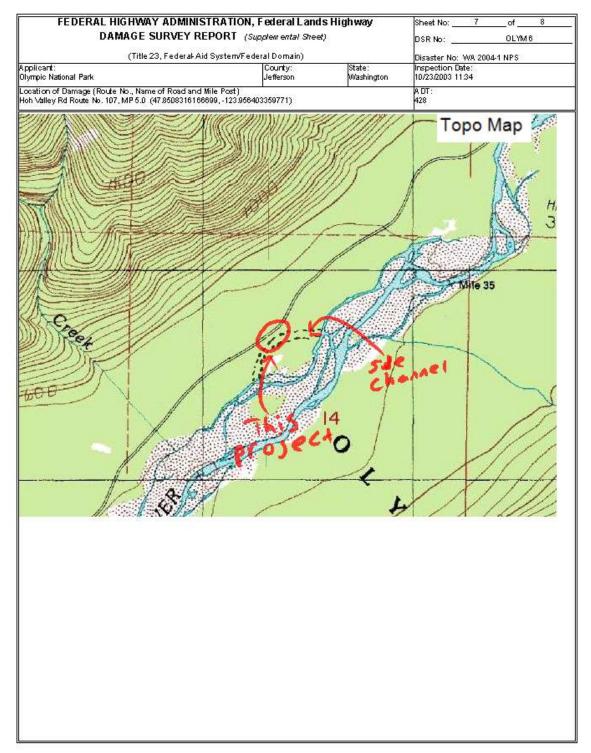


Figure 45: Generated DSR Supplemental Sheet Including a Topographic Map with a Sketched Annotation

| DAMAGE SURVE  | INISTRATION, Federal Land<br>Y REPORT (Supplemental Shee |                      | Sheet No: <u>8</u> of <u>8</u><br>DSR No: <u>0LYM6</u>             |
|---|--|----------------------|--|
| (Title 23, Feder<br>Applicant:<br>Olympic National Park                                       | al-Aid System/Federal Domain)<br>County:<br>Jefferson    | State:<br>Washington | Disaster No: WA 2004-1 NPS<br>Inspection Date:<br>10/23/2003 11:34 |
| Location of Damage (Route No., Name of Road<br>Hoh Valley Rd Route No. 107, MP 5.0 (47.85083) |  |                      | A DT:<br>428   |
|   |  |                      |  |

Figure 46: Generated DSR Supplemental Sheet Including a Photo with a Sketched Annotation

# CHAPTER 3. CONCLUSIONS

Through this scope of work, the research team designed and built a prototype system, and successfully demonstrated it to FHWA CLHD staff. Unfortunately, the prototype system was not field-tested by FHWA CFLHD staff. The project team made numerous requests for field testing, but neither an area nor a crew was identified by CFLHD for testing. As such, the system remains a lab prototype, and is in no way considered ready for production use.

The software developed for this project was based largely on the software developed previously for the Caltrans Redding Responder system. The base code for this prototype system used the Responder base code as a starting point. As such, a bulk of the research and development that was necessary for this project had been conducted within prior research and development for Caltrans. Otherwise, it would not have been possible to develop the system to the extent that it has been developed within the scope and budget of this project. Since this research and development project had a primary outcome of a prototype, formal arrangements for maintenance and support of the code were not considered within this scope. Caltrans would certainly need to be involved in subsequent discussions of how to proceed. As such, the principal deliverables are considered to be the software prototype (executables) and the demonstration hardware on which it has been installed, as well as this report and associated system documentation.

In general, this application does appear to be viable and the prototype system demonstrates its viability. However, it is unclear whether users are receptive to the idea of replacing the current method of producing ERFO DSRs. Other applications such as general incident management and reporting, similar to what Caltrans has used the Redding Responder system for, should be considered for alternate, similar use.