ABSTRACT

The new 18.8 mile new alignment Intercounty Connector (ICC) highway in Montgomery County, Maryland is the most environmentally regulated project in Maryland’s history and obtaining the necessary approvals required the Maryland State Highway Administration to commit to unprecedented levels of environmental management, review and oversight. The ICC traverses through special protection area watersheds, large forested parkland tracts, numerous stream corridors and urban and suburban residential neighborhoods. Over 500 permit conditions and project commitments were made to protect and preserve the natural, cultural and socio-economic resources along the project corridor. In 2007 the Intercounty Constructors (IC) was awarded the design/build contract of the first 7.2 mile segment of the ICC. The IC Environmental Compliance Team (ECT), working for the contractor and in partnership with the client and regulatory agencies’, found itself developing new environmental processes, approaches and applications to maintain open communication and meet the stringent compliance standards and oversight demands.

The ECT developed a web-based application that controlled the capabilities of Google Earth and Microsoft SharePoint and integrated document management and online collaboration with GIS. The application incorporated the ability to display spatial data and engineering drawings, GeoRSS feeds for weather data, standard RSS feeds for water quality gauges, and document management and workflow. The capability to complete custom forms in real-time from anywhere at any time assisted the design/build team to provide collaborative solutions in an efficient manner. Natural resource avoidance and minimization accounting and resource impact tracking was a crucial need during the Design/Build process and the GeoFusion Center management application was continually improved throughout the project to integrate, organize and share multiple agency, contractor and consultant data in geographic relation to spatial features on the project site as they were developed. The GeoFusion Center system was an invaluable tool for permit compliance and avoidance and minimization analysis and kept the contractor, client and reviewing agencies immediately informed to avoid critical time delays in resource protection. To date, avoidance and minimization of natural resources throughout the design/build process will result in contractor incentives in excess of $1.7 million. Real-time tracking of current and forecasted environmental conditions enabled the contractor to plan for best management practices of adverse weather conditions and therefore maintained an A rating in Maryland’s new Erosion and Sediment control rating system. To date, the IC has been awarded erosion control bonuses in excess of $2.75 million for maintaining an A rating.

The Contract A Section of the ICC roadway is now open to the public. This presentation will discuss in detail, including lessons learned, the environmental management and partnering process, the web-based GeoFusion Center application that was developed to meet the stringent environmental compliance requirements and how the data management integration with real-time, online collaboration was such a critical tool in the overwhelming success in environmental resource protection and preservation. Use of this real-time data viewing and solution based management resulted in successful partnering between the contractor, client and regulatory agencies and allowed further reduction of permitted environmental impacts. This has the potential to award the contractor environmental incentives and bonuses in excess of $4.5 Million.

1.0 INTRODUCTION

1.1 Mobility in Environmental Management

With today’s fast paced world where everyone is tracking with GIS and uploading information on the world-wide web, environmental management strategies must be coordinated among regulatory and owner partnerships in a quick,
easily accessible and user friendly way to expedite issue resolution and maintain compliance standards. Environmental awareness has educated the public and they have an increased voice for protection standards in their neighborhoods.

1.2 Project History

The Intercounty Connector (ICC) was first proposed in the 1950s as part of the outer beltway around Washington, DC. Planning documents were updated and presented in three separate federal National Environmental Policy Act (NEPA) studies, completed in a Draft EIS, public hearings were held in 1983 and 1997 then was subsequently abandoned over agency and public concerns of environmental impacts. The increased need for mobility became paramount as the area was experiencing congestion and population growth and the only east-west highway (I-495) that encircles Washington, DC is stop-and-go much of the time, even on weekends. A new NEPA study resulted in a Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) in 2006. The current NEPA study focused on interagency coordination, public scoping and involvement, and inter-agency coordination and resulted in a focused purpose and need, comprehensive avoidance and minimization and cumulative impact studies, and a substantial mitigation and environmental stewardship package.

Figure 1.1 ICC Contract Construction Sequencing

1.3 Selected ICC Alignment

Due to the magnitude of the design/build scope, size and sensitivity of environmental, cultural and social issues, the ICC was separated into five Contract Sections; A-E. The 18.8 mile east-west managed roadway is a controlled access highway with electronic toll collection at highway speeds. There are three traffic lanes in each direction.

1.4 Individual Contract Mitigation and Environmental Stewardship

Each contract section of the ICC encounters individual environmental, cultural and social impacts and is required to not only avoid and minimize impacts based on the ROD, permit conditions, and project commitments, but is also required to conduct mitigation of additional environmental and stewardship items based on its’ geographic location within the watersheds that it crosses. The items that affected ICC Contract A include the following:
• wildlife passage
• reforestation
• vernal pool replacement
• community improvements including:
  o additional screening using earthen berms, noise walls, vegetation or combination
  o Individual resident coordination and landscape improvements
  o hike/bike trails
• eastern box turtle collection/relocation program
• M-NCPPC Parkland coordination/integration of specifications

1.5 Required Environmental Compliance Oversight

The State of Maryland made a promise to deliver the most environmentally sensitive roadway project ever constructed and plan to leave the area in better condition than before the project onset. In order to meet this commitment and make sure the ICC project stays in compliance with all permit conditions and project commitments, the owner established the following mechanisms for quality control and assurance:

• Memorandum of understanding (MOU) between federal, state and local agencies to address details of coordination, monitoring and enforcement of commitments
• Creation of a commitment tracking database (CTD)
• Hiring of an independent environmental monitor (IEM) to report directly to and make recommendations to the regulatory and lead agencies
• Hiring of a general engineering consultant (GEC) to coordinate all of the Contracts (A-E) and require the GEC to provide project wide environmental management.
• Require the design/build contractor of each contract section to provide environmental compliance management and quality control oversight.

2.0 ICC CONTRACT A

2.1 Contract A Project Details

Contract A extends from the western nexus of the ICC at the I-370/I-270 interchange and the Metro Access Road to Georgia Avenue (MD 97) and is 7.2 miles long. ICC Contract A was awarded to the Intercounty Constructors (IC) design/build team on March 27, 2007. The IC is a joint venture team comprised of Parsons Inc. and Jacobs Inc. for design and Granite Construction Inc., Corman Construction Inc., and G.A. & F. C. Wagman, Inc. for construction. KCI Technologies, Inc. (KCI) provided environmental compliance management and quality control oversight for the design/build team. Contract requirements for the Environmental Management team key personnel included an Environmental Manager and Environmental Specialists. Since permit conditions and project commitments on the project were so numerous and the project was so sensitive, KCI added an Environmental Compliance Specialist position to the Environmental Compliance Team (ECT). This value added position strengthened the overall approach towards making sure the design/build team maintained environmental compliance standards. The Full Notice to Proceed (NTP) was issued on November 13, 2007. The limited access 7.2 mile highway was open to the public and generating revenue on February 22, 2011. Project close-out is expected in July 1, 2011 and post-construction monitoring will extend to July 1, 2012.

2.2 Contract A Environmental Resources

The ICC Contract A crosses numerous federal, state and locally regulated environmental resources including:

• 29 Wetland Systems
• 16 perennial/intermittent stream systems
  o Mill Creek Tributaries
  o Rock Creek
  o North Branch Rock Creek and Tributaries
• 3 Maryland National Capital Park & Planning Commission Parks
  o Mill Creek Stream Valley Park
  o Rock Creek Park
  o North Branch Rock Creek Park
• 1 Special Protection Area
Numerous Forest Protection Areas
4 Reforestation Areas
5 Rare, Threatened and Endangered Species
   4 Plants
   1 Fish

INTERCOUNTY CONSTRUCTORS APPROACH TO ENVIRONMENTAL COMPLIANCE MANAGEMENT

The ROD, permit conditions, environmental stewardship items, request for proposal and commitment tracking database (CTD) provided by the State listed all requirements for the ICC project, both project wide and individual Contract. Compilation of all of these requirements for environmental protection strategies determined that this project would demand stringent environmental management, oversight, environmental resource A&M and protection during both the design and construction phases. KCI as the environmental managers for the design/build team needed to develop a flexible data sharing management system that could document daily design and construction interaction for A&M purposes and provide permit and commitment compliance standards in order to lead the environmental aspects of the design/build project to a successful end. The system had to incorporate modification capabilities for unforeseen events and provide coordination features so multiple users could use the system, modify documentation or forms and coordinate for quick issue resolution. The system also had to be able to transfer easily from the design phase where design compliance was the main focus to the construction phase where more coordination of design overlay of field activities, and water quality and real-time data viewing would become critical for issue resolution.

This was the first time the state required the contractor to include environmental compliance management and quality control as part of their project role. This was going to be very challenging as contractors deal with cost codes, volumes and movement schedules. They are typically uncomfortable with the many normal, but often unknown factors of reviewer/comment/revision/re-submittal procedures, negotiating changes in environmental permit conditions, natural resource impact A&M tracking, environmental re-evaluation summaries related to NEPA and wildlife protection issues. KCI had to work with the contractors to change the more traditional reactive approach towards environmental issues towards a more proactive approach.

3.1 Environmental Compliance Elements

3.1.1 Environmental Compliance Principles

The KCI Environmental Compliance Team (ECT) approach to achieve full compliance of project commitments and considerations, permit conditions and approval requirements for design and construction consisted of three key elements; compliance, communication and documentation. The ECT developed an Environmental Compliance
Implementation Plan (ECIP) that outlined how the IC was going to meet and exceed environmental compliance standards. Each chapter of the ECIP was updated throughout the life of the project to reflect modifications made to protocols, personnel changes, and project design refinements.

For Project Success, the ECIP is comprised of:

**Compliance:**
- interactive design review processes
- resource management programs, and protocols

**Communication:**
- contractor/subcontractor training
- continuing education program

**Documentation:**
- document control and data management system – GeoFusion Center

3.1.2 Compliance: Environmental Compliance Implementation Plan (ECIP)

The ECIP outlines in detail the plan and approach used to achieve full compliance of the commitments, considerations, permit conditions, and approval requirements for design and construction. In order to comply with the project requirements, the IC ECT must:

- Ensure permit authorizations and conditions are strictly obeyed during design and construction;
- Monitor compliance with environmental commitments in the Final Environmental Impact Statement (FEIS), Record of Decision (ROD), Section 4(f) Evaluation, and other pertinent documents during design and construction;
- Continually evaluate the project during design and construction and as site conditions change to explore additional A&M measures; and
- Look for other environmental stewardship opportunities and enhancements within the project.
- Meet daily/weekly with the designers and attend task force meetings to address any concerns or questions before submittals.

The ECIP consisted of the following chapters:

- ECIP Overall Process
- IC Environmental Compliance Team Structure, Staff Experience
- IC Environmental Compliance Team General and Incident Communication Process
- Commitment Tracking Database
- Environmental Compliance and Awareness Training
- Avoidance and Minimization Plan
- Water Quality Monitoring Plan
- Wildlife Management Plan
- Forest Impact Plan
- Air Quality Plan
- Spill Prevention Control and Countermeasures Plan & Stormwater Pollution Prevention Plan
- Hazardous Material Plans
- Noise Monitoring and Work Hours Plan
- Vibration Monitoring Control Plan
- Construction Access and Mobility Plan
3.1.2.1 Commitment Tracking Database. The State compiled the entire ICC project federal, state and local environmental permit conditions and added project wide and Contract specific project commitments and entered them into a Commitment Tracking Database (CTD). The database could be queried by individual Contracts for specific environmental regulations and commitments that govern that Contract section for A&M and environmental compliance purposes. KCI took the CTD provided by the state and added a more specific key word list and tagged highway stationing so the user could query the database for a specific station or structure. This tool was useful for verification of detailed A&M of natural resources and permit/project commitment tracking. The CTD was used for each design milestone review submittal to ensure that all compliance standards were met and/or exceeded. KCI would submit a CTD that was queried in the specific area of the design for all items in the CTD for that area. If the design was specific to a structure the CTD could be queried for all structure related requirements as well as any other environmental or cultural requirements specific to the location at the structure.

3.1.3 Communication

Communication on a project that is 7.2 miles long, that involves multiple tiers of regulatory oversight, is environmental sensitive and is in close proximity to existing well educated communities was going to be extremely important. Open communication between the ECT, the design team, contractor team, regulatory and GEC team and venders coming and going from the site was paramount to keep the project in environmental compliance. The ECT developed communication aids for environmental awareness and was actively involved in every aspect of the project design and construction to ensure project compliance standards were met. Main forms of communication included environmental compliance and awareness training, task force meetings, over the shoulder meetings, continued education and a pocket guide.

3.1.3.1 Environmental Compliance Awareness Training (ECAT). In order to educate the design and contractor team of the environmental sensitivity of the ICC project and how the traditional design and construction practices had to be modified to incorporate redundant and redundant erosion and sediment control, stringent water quality BMPs and wildlife management strategies, the ECT developed an Environmental Compliance and Environmental Awareness Training program (ECAT). The ECAT was primarily developed for the construction work force and presented pertinent information on the project regarding specific BMPs used on the project to stay in environmental compliance for E&S control, air, noise, hazardous materials, wildlife protection, wetlands and streams, protocols for pumping operations, who to call for assistance. All people working within the limit of disturbance (LOD) were required to attend the ECAT program.

3.1.3.2 Task Force Meetings. In the design phase the ECT actively participated in weekly task-force meetings where design and constructability, impact A&M, permit conditions and project commitments issues were raised and addressed. The task force meetings were broken into logical design categories such as Structures, Earthwork, Roadway, Drainage, Environmental, Utilities and Lighting among others. Personnel of various types of expertise would attend the weekly meetings and would discuss the design status and tackle the current issues and work toward a design solution. Partnering was encouraged and members from IC and ICC attended these meetings which often quickly resolved many design issues related to specification questions. If additional information was required that required a separate meeting, the ECT often attended breakout meetings.

3.1.3.3 Over the Shoulder Meetings. Besides formal submittals at key design intervals, IC would often conduct informal over-the-shoulder review meetings with the ICC. These meetings were held to present a design idea, review it in person with the ICC and get immediate feedback prior to full design completion and submittal. This saved a huge amount of time over the typical review/revision and resubmittal process. This was especially true when a new idea was presented that was an alternative design to what was specified in the request for proposal (RFP) or in the State Highway Administration (SHA) specifications.

3.1.3.4 Continuing Education. When construction got underway, inconsistency in the way pumping operations were handled and how turbidity and pH standards were understood for water quality arose. This resulted in several water quality issues and the ECT found that additional training and education was required to stay in compliance with the ICC permit water quality standards for turbidity (average <50 NTU with no spike >150 NTU) and pH (6.0-8.5). A continuing education program was developed to inform the contractors on changing pumping protocols in particular concrete pouring operations for pH management. The ECT trained the supervisors and foremen of the IC contractor team in order to gain consistency in pumping operations and educate them to conduct their own oversight of concrete pouring operations especially when the concrete trucks clean their trucks. A second continuing education training program was developed and presented to the supervisors and foremen about noxious weeds. A project commitment is to treat for three noxious weed species and the contractor team was educated in ways they could use BMPs on and with their equipment to reduce the potential for spreading the weed species throughout the site or on/off site.
3.1.3.5 Pocket Guide. Many environmental regulations and environmental stewardship items govern the ICC Contract A that were never required on a project prior to the ICC. Many individuals expressed incredulity after the ECAT training program of the amount of redundancy of BMPS for environmental protection, wildlife protection protocols and E&S requirements. The ECT developed a pocket field guide that the contractor team could keep and refer to if there was a question of compliance in the project area they were working in. The pocket guide included contacts, specific environmental regulations governing the ICC project such as stream closure dates, pumping operation protocols, E&S BMPs and a reminder of the consequences if they do not follow the established project protocols. The pocket guide was provided to all supervisors and foremen.

3.1.4 Documentation: GeoFusion Center

KCI developed a web-based application (KCI GeoFusion Center©) that leverages the capabilities of Google Earth to display spatial data; Microsoft SharePoint to provide document management; and standard html to provide data input capabilities. The GeoFusion Center allows users to view project specific GIS data with respect to the base data of Google Earth along with GeoRSS feeds providing real-time information such as weather. The integration with Google Earth allows the user to relate documents in SharePoint to spatial features on the project site. The GeoFusion Center also includes the capability to complete custom forms in real-time to document whatever project information is necessary and is able to establish critical workflows and approvals. The ECT could collect project data on the project site, access the management system from the field for project data sharing and compliance management, transfer data in real-time for multiple user viewing and could obtain collaborative regulatory, owner and designer issue resolution. The system could integrate with multiple systems and programs and easily transfer data in real-time which was extremely important when working with multiple organizations and consultants to track design modifications.

The real time data entry and retrieval was crucial for GIS data management and analysis, water quality and compliance tracking and CTD reviews for impact A&M. The document management process helped to avoid critical time delays and allowed the ECT flexibility while keeping the agencies and owner informed throughout the design and construction process. Key components of the GeoFusion Center include:

- Geo-referenced with Google Earth
- Layers can be turned on/off
- Ability for document histories and queries by station, segment, structure, date, inspector, document
- Real-time data entry and retrieval
- Geo-referenced with design plans
- GeoRSS Feeds
- RSS Feeds
- Provides the manager customization & client access for viewing

Figure 3.2 GeoFusion Center
Customized forms were developed for the ES to use in the field in order to conduct environmental permitting compliance checks. These included the daily IDRs, pumping operation monitoring for water quality, noise monitoring, opacity, OOC62 for E&S and field issues that would send flags to the E&S manager and Environmental Manager until closed out by the ES.

- Create customized forms for environmental compliance tracking
- Workflow customization
- Conduct design reviews
- Conduct QA/QC
- Permit tracking
- Create map book
- Bookmarks
- Hyperlinks to other documents
- Features can be exported into shape files to load into GIS back into an office environment

The GeoFusion Center system so quickly became an integral part of the design review for compliance and A&M; that the ECT dedicated an Environmental Specialist (ES) to conduct the document management, GIS data management and analysis, water quality tracking and CTD reviews for impact A&M.

4.0 DESIGN/BUILD

4.1 Design Phase

The intensive design phase of the ICC Contract A project extended approximately 18 months from the award of the project. During this time the IC Design team of Parsons, Inc. and Jacobs, Inc. were the predominate active partners of the IC Team and the IC ECT was active in environmental compliance review, recommendation and oversight as well as A&M guidance. The only early construction activities during this period was survey work for LOD and ROW boundaries, hazardous material review of residences that were to be removed as part of the ICC Contract A project and geotechnical drilling in support of roadway and structure design.

It was during this period when the design/build team learned the seriousness of the environmental commitment of the owner towards A&M of impacts, redundancy in BMP requirements and water quality protection. The ECT also learned that their role as quality control environmental management had little authority in comparison to the ICC quality assurance inspection team.

4.1.1 Compliance

Most areas that the geotechnical drilling crews were working in were not yet cleared and grubbed, therefore were still viewed as being outside of the LOD. The ECT had to be diligent in working with the geotechnical crews to avoid and minimize environmental impacts to environmental resources even though the area was going to be cleared in the near future. The temporarily disturbed areas had to be stabilized each day and erosion control measures were required for slopes, wetland and stream crossings. New protocols for drill rig usage in floodplains, on slopes and in environmentally sensitive areas were developed. The ECT also worked with the survey crews to avoid and minimize impacts to trees; in
particular to a MNCPPC specified rare, threatened and endangered species shingle oak (*Quercus imbricaria*). Resistance to the time and cost required for these protocols was extremely difficult to surmount until an incident occurred that caused the project to almost be shut down. After the agencies and owner outlined potential consequences for any future noncompliance activities, the contractor started to understand that the ECT was there to assist in compliance management as well as maintain and educate the work force on the myriad of environmental regulations, requirements and commitments surrounding the ICC project.

The designers quickly learned to coordinate with the ECT to query the CTD for regulatory, specification and environmental stewardship constraints in their designs. This was extremely useful as there were often multiple layers of restrictions at bridge locations in sensitive parkland stream valleys. Resistance often occurred to what seemed to some as trivial data however, it was this data that often was the key element of a design. Wildlife passage elements for culverts including height restrictions, fencing requirements for large mammal, small mammal and amphibian protections all became topics of much debate.

As part of the environmental stewardship commitment, the ECT coordinated with the Box Turtle Advisory Group (BTAG) and developed the eastern box turtle collection and relocation program for the ICC Contract A. Collection of turtles began prior to the formal Notice to Proceed (NTP) and after turtles began to hibernate in October 2007, therefore a solution was required for what to do with the turtles once they were found. IC was not authorized to install the proposed exclusion fence prior to NTP therefore transmitters were purchased and attached to found turtles in order to relocate them again after entering hibernation. Prior to the clearing and grubbing of an area, the turtles were located using radio telemetry and GPS then relocated outside of the LOD.

In-stream water quality monitoring stations were installed to collect pre-construction water quality data and regular maintenance and data download was begun. The water quality data was continually collected every 15 minutes and could be seen online, which was a new innovation to some of the owner and agency personnel. This data share went a long way towards proof of compliance standards as a user could go to the website to see the water quality data at a specific water quality station within 15 minutes of the last reading.

4.1.2 Communication

During the design phase meetings partnership between IC and ICC personnel was a major effort. The ECT attended weekly task force meetings for all of the various categories of design elements, additional break-out meetings for more detailed discussions and over-the-shoulder review meetings with the ICC team to review and discuss interim design packages prior to formal submittals in order to get direction and approval of ideas and/or modifications from the RFP specifications. When requested by the owner, the ECT also presented design elements to the Inter-Agency Working Group (IAWG) that is overseeing and reviewing the regulatory side of the entire ICC project.

The ECT conducted weekly ECAT training to all new design personnel and hazardous material review, geotechnical and survey personnel that were starting on the project. Each person was given a personal identification card with an individual number that was stored in the ECAT database by name, number, date and company.

A&M of environmental resources beyond the permitted impacts to meet the IC incentive goals was a discussion at every task force meeting. Ways to reduce impacts through design innovation was always a priority.

4.1.3 Documentation

The ECT tracked A&M reduction in a master table that was separated into detailed classification and/or conversion, location and acreage or linear feet of wetlands, streams, forest, parkland and SPA. Each design submittal included a CTD review for impact compliance and an A&M calculation table and supplemental graphic that depicted the RFP ROW and minimized LOD if feasible. All CTD, A&M, ECAT database, Inspector Daily Reports (IDR) completed by the ES, water quality reporting and other project reporting was uploaded into the GeoFusion Center for data share, view and review as well as archive.

4.2 Construction Phase

When the project moved from the design phase into the construction phase, the ECT spent more time on the project site. Data sharing using the GeoFusion Center was often for immediate coordination now that the owner and agencies wanted to view real-time data. The ECT were responsible for the annual and seasonal biological monitoring, water quality stream monitoring, coordination of all in-stream construction activities for fish relocation, pumping operations for water quality and pH compliance, erosion and sediment control compliance, and making sure that the contractor
adhered to all permit conditions and wildlife protection, collection and relocation protocols. Design was continuing for various parts of the project and modifications and field design changes (FDC) were also occurring so the ECT was still attending task force meetings, OTS meetings and coordinating with the ICC team and the owner for design and modification issues.

4.2.1 Compliance

The ECT continued to managed the eastern box turtle collection and relocation program throughout the project and the overwhelming success of the project resulted in Towson University obtaining federal funding for an eastern box turtle study using 92 ICC Contract A turtles. The United States Humane Society (HSUS) also began a soft release study using a number of ICC displaced turtles. Compliance issues occurred when the LOD temporary fencing was continually modified to accommodate changing clearing phases and inevitably there would be gaps in the fence, and turtles would be found within the LOD. The fencing would require continual repairs due to tree fall, construction equipment or vandalism. The ECT was required to walk the LOD fence lines on a daily basis to note repairs.

The ECT conducted natural resource inventories of rare, threatened and endangered species (RTE), vernal pools and wetlands in accordance with yearly and/or seasonal requirements. Sediment traps became instant vernal pool habitat in the spring and the ECT had to relocate egg masses out of the vernal pools if concrete wash from concrete pouring operations was pumped to the sediment traps. The concrete wash would instantly raise the pH level in the sediment traps to very high levels which would kill the egg masses if not removed.

The ES continued to monitor geotechnical and survey operations, but now provided daily field compliance and erosion and sediment control (E&S) reviews and water quality monitoring of all pumping operations. The ES met with the E&S foremen each morning to review the daily proposed construction then walked their portion of the construction corridor with the erosion and sediment control foreman to document any erosion and sediment control issues that needed maintenance or modification. They also coordinated on an as needed basis for pumping operations, mud or dust maintenance, or any other stabilization or permitting issues that arose. The weekly OOC61 form; the Maryland erosion control rating form completed by the E&S inspector was copied to the foremen and ES in order for them to follow up on completing the stabilization items listed on the form. These items were required to be completed within the next three days.

Compliance issues in construction vary according to time of year, weather conditions and the type of equipment used, however there are common themes based on basic ways that roadways and streams are crossed, pumping operations and erosion and sediment control methods. Calls were made to the governor and videos were uploaded onto U-tube each time a local resident was unhappy with sediment tracking, runoff or dust. The ECT found that staying in compliance involved a great deal of interaction with designers, contractors, the owner and the ICC team inspectors on a daily basis and the Maryland Department of the Environment (MDE) on a regular basis. Erosion and sediment control and water quality, air quality, sediment tracking, tree A&M and wildlife management, were the main areas of compliance issues.

4.2.1.1 Erosion and Sediment Control and Water Quality. Hand held data loggers, the same as those used for in-stream monitoring, were used to monitor water quality parameters, specifically turbidity and pH in sediment traps, sumps and dewatering operations. All pumping operations were monitored for water quality standards prior to discharge to any waters of the US. To be in compliance with the Code of Maryland Regulations (COMAR) standards, the turbidity could not exceed 50 NTUs and pH had to be within the range of 6.0-8.5. When a concrete pouring operation was underway, special attention was paid to pH as it immediately rose when in contact with water. Concrete truck operators are used to cleaning their truck chutes off as soon as they are done and the ECT had to be diligent to educate the operators to use the specialized locations made for them outside of wetlands, floodplains and streams.

Getting the right amount of moisture in the soils or drying out soils enough to meet compaction standards was difficult due to soil characteristics and excessive amounts of rain in the spring of 2009 and 2010. Soil amendments such Portland cement increase pH as does the use of limestone based stone. These components are common materials used in roadway construction. Due to the sensitivity of the adjacent receiving waters, testing and approval for use of methods to neutralize pH was investigated. Hardwood mulch in clean water swales, rock salt in sediment bags when discharging sump water and the use of carbon dioxide gas were all tested and used to reduce pH. Also, when feasible, water was allowed to settle in sediment traps since pH gradually neutralizes if left undisturbed. Maryland typically has “flashy” storm events where water quickly falls and runs off before having the chance to infiltrate. This results in the need for dewatering operations in an accelerated timeframe. Full sediment traps that have high turbidity often do not have time for sediment to settle before they need to be pumped down and in many cases the turbidity will not drop to within the Code of Maryland Regulations (COMAR) standards due to clay or coluvial sediments. IC researched and
gained approval for the use of the flocculent enzyme Chitosan, which adheres to the sediment and forces a quick
reduction in turbidity. This greatly increased the rate of dewatering on the construction site.

![Figure 4.1 Rain for Rent ® Unit Using Flocculents](image)

4.2.1.2 Air Quality. Dust was an environmental concern, especially when existing communities were immediately
adjacent to the construction site. ECT personnel obtained Opacity certification and a yearly re-certification to determine
the percentage of dust particles within the LOD and at the right-of-way (ROW).

![Figure 4.2 Water Truck](image)

Fugitive dust must be 0% at the ROW therefore stringent strategies for dust control was followed. Water trucks and tractors fitted with a scraper box maintained tight schedules in areas of high volumes of earth movement or vehicular traffic. Tackifiers such as sodium chloride were used in areas where earth was not being moved for several days and temporary seeding was used on all stockpiles and areas that were not scheduled for disturbance for extended periods.

4.2.1.3 Sediment Tracking. As part of water quality protection and safety commitment to the local communities, IC
needed to make sure that construction vehicles did not trail dirt and mud onto the public roadways. The stabilized
construction entrances (SCE) were extended to 100 feet and power wash stations were added on days after storm
events. Personnel were stationed at the SCEs to brush and/or scrape the road crossings and sweeper trucks regularly
swept the crossings to keep the public roadways dirt free. Later in the project large wash racks were installed at the main
road crossings. The ECT were often called upon to document tracking and to become the enforcers of vehicle cleaning.

4.2.1.4 Tree Avoidance and Minimization. Tree avoidance and minimization along the LOD was a concern as there are
many considerations including ownership, size, species requirements, sun scald, wind throw and root pruning
requirements. The Maryland Department of Natural Resources (MDNR) approved the removal of 209.1 acres of forest
with the condition that IC would avoid as many trees as possible, specifically specimen size trees (>30”). Special
consideration was paid to minimize impacts to trees along edges through communities, sensitive natural resource
habitats, Special Protection Areas (SPA) and parkland. The owner provided incentives to encourage the contractor to
make preservation of trees a priority.
The IC Maryland certified Arborist made the determination of which trees along the LOD should be saved or removed based on proximity to the LOD, species health, habitat requirements and access in the future for removal if it died. IC also conducted additional reviews with M-NCPPC personnel along the parkland LOD to obtain concurrence for the removal of any trees along their LOD. When new areas were cleared, the ECT often had to re-coordinate with the ICC team and the arborist numerous times to review new tree fall over the LOD, root pruning issues in areas of cut slopes and LOD changes.

4.2.1.5 Wildlife Management. The main design goal for wildlife was to reconnect the habitat corridors using designs that maintain the aquatic and terrestrial wildlife passage. The bridge and culvert structures specifically incorporated wildlife corridor connectivity and protection features. Bridges are located in the large stream valley parks and are greatly oversized to encompass not only the required hydraulic requirements, but the entire 100 year floodplain. Culverts are strategically placed in habitat corridors and in three locations use a "bio sensitive" bottomless arch culvert design. In several locations pipe culverts were designed and installed specifically for small mammal passage.

The permanent wildlife fence system is a double layer fence. The outer layer eight foot high metal chain link fence will deter deer from entering the roadway and the inner fence three foot high quarter inch diameter vinyl coated fence is attached to the deer fence. This fence will deter small mammals from entering the highway and will protect the sensitive skins on amphibians. Both fences are buried to deter wildlife from burrowing under them. To reduce roadway mortality, earthen escape ramps were installed approximately every quarter mile in case a deer does get into the roadway system.

The ECT found that the temporary fence placed at the LOD was not sufficient to deter wildlife as some wildlife would chew through it then others would follow through the holes. There was also insufficient fencing in place as it was only installed in certain locations. Arrangements had to be made to replace the temporary fencing with a more robust fence that could be stapled to the ground to keep turtles from entering into the construction area. This did not deter groundhogs from chewing through it however.

Vandalism was also a factor in certain residential locations. Signs were created that informed the public that the fencing was installed for wildlife protection and the vandalism decreased to some degree.

Figure 4.3 Eastern Box Turtle Protection Sign

Adherence to stream closure dates for in-stream construction activities to allow for fish spawning was an important construction scheduling consideration. The ECT was sometimes given only a few hours notification an in-stream construction activity and would need to quickly coordinate a fish collection/relocation operation. This was sometimes difficult when the operation required electroshocking, the stream was wide, the pump around operation encompassed a long stretch of stream, and there were numerous aquatic species to identify.

The ECT found that if you “build it they will come”. All sorts of wildlife gravitated to the sediment ponds and traps. The ECT was often called to remove a snapping turtle, painted turtle and during the spring season the frogs would use the traps and ponds for breeding and egg laying habitat. In efforts to preserve the wood frog (Rana sylvatica) and spotted salamander (Ambystoma maculatum) species from high pH in the sediment traps, IC relocated the egg masses to viable vernal pools in offsite locations and monitored those vernal pool locations to determine the success of the egg relocation effort. IC created a vernal pool as part of the project environmental stewardship commitments and wood frogs and American toads (Bufo bufo) utilized the vernal pool habitat the first year it was constructed.

The eastern box turtle collection and relocation program was very successful. A combination of turtle tracking dog teams and human tracking teams were used each spring and fall during the optimal turtle movement times to locate existing turtles within the ICC corridor. The ECAT training informed the contractors of the program and they were
intrigued. The ECT was often called by a contractor to collect a box turtle from within the ROW. The ECT knew success when we got a call to relocate a turtle and found that the contractors had halted earth moving construction until the ECT had arrived to collect the animal.

4.2.2 Communication

Since the owner and IC share space in a centrally located office, general coordination occurred at the convenience of both teams which stream-lined the review and comment process. One example of stream-lining is the use of the SHA E&S OOC62 form. This is where erosion control design modification is made with an email form and line drawing that is submitted via email. The owner can review, approve and forward the email to the regulatory agency for approval. Generally approvals were received within a day and sometimes within hours which saved a huge amount of time for minor E&S design changes.

The ECT found that staying in compliance involved daily interaction with the design team to discuss and resolve A&M issues, the contractor management team making structural, earthwork and pumping operation modifications, the owner to discuss and resolve any permit modification or other natural resource issues and the ICC QA inspection team to discuss any E&S control or environmental regulatory permit issues. Often the ECT would meet with the ICC QA inspector at a particular site and discuss stabilization alternatives to a water quality issue to obtain a quick consensus to an issue.

4.2.3 Documentation

During construction the ECT continued to submit each design or modification with a CTD review for impact compliance, an A&M calculation table with supplemental graphic that depicted the RFP ROW and minimized LOD if feasible. All CTD, A&M, ECAT database, IDRs, water quality reporting and other project reporting was uploaded into the GeoFusion Center for data share, view and review as well as archive. The ECT ES completed IDRs for each area and structure within their designated segment within the ICC. All construction activities, E&S control issues and supporting photographs were included in each IDR. Pumping operation monitoring forms were also submitted daily. Field issues were added to the IDRs by the ES that would send notices to the E&S manager under they were closed out by the ES.

As the project neared close-out, the ECT in coordination with the ICC QA team and Independent Environmental Monitor (IEM) developed an Environmental Stabilization Punch-Out list that identified each drainage area according to water quality monitoring station. Every item needing to be completed in order for that drainage area to reach “Final Stabilization” was listed. The IC ECT team, IEM, ICC QA team and IC E&S Manager met every week to review and edit the list. Once a drainage area reached Final Stabilization, the Post-Construction monitoring phase could begin. Post-construction monitoring is expected to begin for all drainage areas in July 2011.

5.0 ENVIRONMENTAL MANAGEMENT SUCCESS BASED ON AVOIDANCE AND MINIMIZATION AND INCENTIVE PERFORMANCE

5.1 Contractor Incentives

One way to ensure the design/build team approached the project with the impetus to strive towards making the maximum effort in A&M of natural resource impacts was to provide incentives. Incentives are provided for erosion and sediment control and A&M to wetland, stream, forest and parkland impacts.

5.2 ICC Contract A Avoidance and Minimization Success

Environmental Management using the GeoFusion Center management system made impact and compliance tracking in a very complicated, fast paced and highly sensitive project an environmental success. The project was never shut down, IC received positive feedback from the owner, regulatory agencies and ultimately from the adjacent communities and media. The environmental management was rated highly in partnering meetings. The regulatory agencies recognized the effort the contractor took to be in compliance as the project progressed and as the project progressed were quicker to discuss and resolve new issues.

The total projected cost for the Contract A design/build contract was $480 Million and the environmental management portion of the contract was approximately $4.8 Million or 1.0 percent. The IC has earned $3,250,000 in erosion and sediment control incentives. Natural resource impact reduction has the potential to earn over $3.1 Million at final project acceptance of the avoidance and minimization, restoration and enhancement calculations.
In total the IC will have earned approximately $6.3 Million in environmental Incentives. This proves that that environmental management provided by the contractor on a large contract is extremely beneficial and can pay for itself over the life of the project. The continued education of regulatory processes and A&M and use of the web based interactive technologies for data sharing made the difference between a compliant project and a successful project.

### Table 5.1 ICC Contract A Natural Resource Avoidance and Minimization

<table>
<thead>
<tr>
<th>Natural Resource</th>
<th>Perennial/Interstitial Stream</th>
<th>Ephemeral Stream</th>
<th>Wetland</th>
<th>Wetland Buffer</th>
<th>Open Water</th>
<th>Floodplains</th>
<th>FIDS Habitat</th>
<th>Forest</th>
<th>Parkland</th>
<th>SPA Forest</th>
<th>Specimen Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided</td>
<td>(LF)</td>
<td>(LF)</td>
<td>(Ac)</td>
<td>(Ac)</td>
<td>(Ac)</td>
<td>(Ac)</td>
<td>(Ac)</td>
<td>(Ac)</td>
<td>(Ac)</td>
<td>(Ac)</td>
<td>(Ac)</td>
</tr>
<tr>
<td>Restored</td>
<td>4,813</td>
<td>481</td>
<td>1.78</td>
<td>0.81</td>
<td>0.11</td>
<td>3.6</td>
<td>5.8</td>
<td>21.4</td>
<td>11.0</td>
<td>2.1</td>
<td>24</td>
</tr>
<tr>
<td>Incentive Increment</td>
<td>100 LF @ $150/LF</td>
<td>0</td>
<td>0.25 Ac @ $100,000/Ac</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.25 Ac @ $75,000/Ac</td>
<td>0.25 Ac @ $50,000/Ac</td>
<td>0.25 Ac @ $100,000/Ac</td>
<td>0</td>
</tr>
<tr>
<td>Incentive Totals A</td>
<td>$721,950</td>
<td>$0,000</td>
<td>$175,000</td>
<td>$0,000</td>
<td>$0,000</td>
<td>$0,000</td>
<td>$0,000</td>
<td>$0,000</td>
<td>$0,000</td>
<td>$0,000</td>
<td>$0,000</td>
</tr>
<tr>
<td>E&amp;S Incentive Totals R</td>
<td>$3,126,200</td>
<td>$0,000</td>
<td>$105,000</td>
<td>$550,000</td>
<td>$200,000</td>
<td>$0,000</td>
<td>$0,000</td>
<td>$0,000</td>
<td>$0,000</td>
<td>$0,000</td>
<td>$0,000</td>
</tr>
</tbody>
</table>

### 6.0 LESSONS LEARNED

**6.1 What Worked Well**

The GeoFusion Center program was a critical management tool for compliance reviews. The ECT could overlay designs with the regulatory design requirements, specifications, special conditions, environmental stewardship and other social and cultural commitment layers at a station, segment or structure. This was instrumental in keeping the project in compliance. During construction the regulatory agencies, owner and contractor could all view real time data for water quality at any time, but during storm events and could track the status of erosion and sediment control measures without being onsite, yet could be immediately warned if a noncompliance issue arose. Being able to query the system at any time to view data, designs or photograph of current conditions was essential for modifications to resolve any issue.

The State conducted thorough wildlife corridor studies in order to determine where existing habitat corridors were located to determine the placement of large mammal, small mammal and aquatic passage. Maintenance of existing corridors and sustainability was a priority and the consideration of the type of resident animal movement was taken
into account for bridge or culvert placement resulting in numerous specifications and permit special conditions. The pre-RFP planning proved successful as the adage “build it and they will come” is true within the ICC corridor. Footprints of large and small mammals (deer, fox, raccoon, possum) are present within all of the culverts and under all of the bridges. Horses are using Culvert DD and all of the stream channels have large schools of year-of-young and adults and macroinvertebrates thrive under the rocks. Without this level of pre-planning, some of the corridor connections may have been lost resulting in fragmentation and genetic isolation.

6.1 What Could Work Better

There was a difference in the way the owner intended the ICC to be managed and how the contractor viewed the RFP intent. The owner outlined the environmental concepts not the expectations and the contractor was not informed of the level of effort that would be required to maintain compliance standards to meet incentive goals. If the regulatory permits were in the contractor’s name they may have taken a more pro-active approach from the beginning of the project to avoid and minimize impacts as the risk would have been all theirs and would have tried harder to stay in compliance rather than learn from enforcement from the ICC QA team.

The environmental management contract was approximately 1% of the project and the ECT reported directly to the design/build project manager which provided little authority and control to the ECT. If the environmental management contract reported to either the owner or an executive committee comprised of a board made up of owner, designer and builder, it would be more like a P3; a public, private partnership established for the duration of the project. This would eliminate the “conflict of interest”. The environmental manager of the ECT was one of two people given the authority to shut the job down, however had to receive support from the design/build project manager first. The owner in the QA role on the ICC had more authority in relation to E&S control guidance as they controlled the E&S control ratings and incentives.

The linear nature of the project coupled with a narrow RFP LOD, environmental constraints, urban setting and limited MOT for earth movement, forced phasing of design packages into sometimes awkward sequencing. IC/ICC was so focused on A&M and further reducing the permitted impacts to meet incentive goals, that constructability was compromised. When construction began, the contractors had to expand the LOD in places to accommodate equipment movement. An example is crane movement to construct bridge beams. This was not considered well in the design phase. Earth movement was also very different than initially expected or intended due to soil conditions. A general supervisor review of LOD and sequence of earth operations, especially at sensitive locations where multiple equipment resources were to be utilized would have been beneficial in the design phase. Field design changes (FDC) and OOC62 forms were necessary and the ECT had to be extra diligent for compliance issues.

Many requirements governed permanent fencing for wildlife protection; however, no requirements governed temporary fencing for wildlife protection. Specifications for temporary fencing for a linear project that crosses numerous wildlife corridors should consider several important factors; clearly defining the permanent LOD even if it will not be cleared until a later phase, protection of wildlife during construction phases and existing pedestrian routes and vandalism. Temporary fencing is as important as permanent fencing as it avoids and minimizes impacts, keeps the contractor in compliance with permit conditions and keeps the public safe from the construction area. Typical orange safety fencing does not provide sufficient protection for wildlife. Temporary fencing evolved over time on the ICC as a result of the necessity to protect the eastern box turtle and the type of fencing and installation protocols were developed to obtain consistency in fence installation. Between LOD phasing where the fence was installed or removed resulting in gaps and maintenance issues requiring repair was difficult for the ECT to enforce. Erosion control and water quality was tied to permits and incentives, and the wildlife fence maintenance was an environmental stewardship item therefore a low priority. If temporary fence were installed at the permanent LOD rather than at the phased LOD and constructed of more a durable material, the wildlife could be protected and the contractor could use the normal orange construction fence for the phased LOD.

7.0 SUMMARY

Great environmental management success is achievable on a large scale project that has natural resource, cultural and social sensitivity coupled with extensive layers of agency oversight, community coordination and owner/designer/contractor coordination. The IC ECT used sound management techniques of compliance, communication and documentation using the GeoFusion Center interactive web-based management system to ensure that compliance standards were met. This open data sharing enhanced the owner-design/build team relationship and forged a partnership that helped expedite issues related to design changes and modifications when issues arose. The IC ECT demonstrated that permit conditions, environmental stewardship and further A&M of environmental impacts beyond permitted impacts can be achieved throughout the design/build process.
Holly P. Shipley, Senior Associate, KCI Technologies, Inc., has over 25 years of experience in the environmental consulting field and specializes in natural resources analyses and management, permit negotiation, compliance management and environmental training. Her analysis skills have spanned complex needs and changing goals of projects in both public and private sectors and on the federal, state and local levels and in the design and construction environment. She has the experience working with regulatory issues from the inception of the Chesapeake Bay Critical Area to the new Environmental Protection Agency rules for construction NPDES turbidity effluent discharge limits. She was a key member of the environmental compliance team that developed a web-based environmental management application (GeoFusion Center®) that increased the level of communication and partnership between owner, designer and contractor resulting in greater than $4 Million in environmental incentives compensation.
M ONITORING E NVIRONMENTAL C OMPLIANCE IN THE C ONSTRUCTION OF THE CUYUTLAN LAGOON RAILROAD IN MANZANILLO, MÉXICO

Norma Fernández Buces, PhD Science (52 (55) 55 56 87 27 00, norma@selome.com.mx), Scientific Director, Grupo Selome S.A. de C.V., Louisiana 104 Col. Nápoles 03810 México
Ana Gisela Santiago Pensado, Civil Engineer (52 (55) 314 33 52 112, gisela.sp@selome.com.mx), Ecological Supervision Manager, Grupo Selome S.A. de C.V., Edificio Mercadal, Dep. 9. Fraccionamiento Villas de Menorca, Club Santiago, Manzanillo, Colima México
Sergio López Noriega, Biologist (52 (55) 55 56 87 27 00, sergio@selome.com.mx), CEO, Grupo Selome S.A. de C.V., Louisiana 104 Col. Nápoles 03810 México

ABSTRACT

Environmental impact assessment does not end when a project is approved by the government and its construction starts. Compliance with mitigation measures and regulation policies is crucial for a project to be successful within a framework of environmental conservation and social benefit. Nevertheless, compliance with all ecological regulations can be difficult to follow by the contractor, basically because projects always include several small changes during their execution and need constant adjustment of permits and update.

Some construction companies are reluctant to comply and avoid spending money on mitigation measures as much as possible. As a consequence, projects are stopped and sanctioned by the authorities, with important repercussions in project budget and timing, as well as the environmental damage. Involved supervision is needed to assure action coordination, compliance and updating of all environmental requirements.

In the case of the Cuyutlan railroad, our job, as the environmental supervisors, was to make sure that the project had no setbacks, as it was running under a very tight execution schedule. Jointly with the Ministry for the Environment and Natural Resources (SEMARNAT), the Ministry of Communications and Transportation (SCT), the Federal Transportation Department in Colima (SCT-Colima Center), and TRADECO (contractor), we had to make sure that mitigation measures were properly executed so that environment, specially mangroves and fauna, were kept safe.

Monitoring of the compliance of all environmental issues in the construction of the Cuyutlán railroad can be separated in three parts: A) Follow-up of environmental authorizations, B) Observance and register of in site compliance by the contractor for all mitigation measures concerning construction, C) Observance and register of compliance with the mitigation programs for the rescue and conservation or restoration of flora, fauna and soil, as well as ecological training course for the construction workers. The railroad was built under strong environmental restrictions, with little damage to the environment, and is still under restoration programs.

In our experience, compliance of environmental regulations has to involve all stakeholders in order to have a successful project. Environmental protection is not only the responsibility of the contractor or the Ministry for the Environment and Natural Resources (SEMARNAT), but a shared environmental value in a gain-gain relationship for environment, society and development.

INTRODUCTION

Some Regulatory Background and Problem

As in many other countries, all infrastructure projects in Mexico are required to apply for and obtain an environmental impact authorization and a land use change permission. This authorization is obtained by the submission and approval of an Environmental Impact Statement (EIS), which deals with environmental fragility, project impacts during construction and operation, and the proposal of several mitigation, control and compensation measures, to be executed to the satisfaction of authorities having environmental jurisdiction.

Environmental impact assessment process does not end when a project is approved by the government and construction starts. Compliance with mitigation measures and regulation policies is crucial for a project to be successful within a framework of environmental conservation and social benefit. Nevertheless, compliance with all ecological regulations can be difficult to obtain by the contractor, basically because projects always include several small changes during their execution and need constant regulation adjustment and update. Another problem is that sometimes these companies are reluctant to comply and try to avoid spending money on mitigation measures as much as possible. As a consequence, projects are stopped and sanctioned by the authorities, with important negative effects
in project budget and timing, as well as environmental damage involved. Therefore, supervision is needed to assure action coordination, compliance and updating of all environmental requirements.

The Cuyutlan Lagoon railroad in Manzanillo, Mexico, is an example of how a well-designed project and site analysis can prevent environmental and social conflicts, with a significant reduction of impacts under a new project design. It is also a successful experience in terms of legality and accomplishment of mitigation measures, such as rescue and compliance with legal issues of flora and fauna, as well as soil ecological restoration programs, intended to restore and enhance the surrounding environment in this lagoon.

**Study Site and Project Description**

The projected railroad runs along the northern coast of the Cuyutlan coastal Lagoon southeast of Manzanillo, state of Colima, Mexico (Figure 1). It is a very important infrastructure project in Mexico, as it is needed so that a power plant can operate under more ecological conditions (using natural gas instead of coal and fuel oil), which will be translated in a significant reduction of pollutant emissions. This railroad implies a new route and modernization of actual railroad, which needs to be removed in order to widen the lagoon channel (Tepalcates Channel), into the ocean, allowing the entrance of tanker ships that will deliver natural gas into a gas terminal destined to supply the Manzanillo power plant.

![Figure 1. Railroad project along the northern margin of the Cuyutlan Lagoon. Circles show the Tepalcates channel opening design and the fuel oil operated power plant.](image)

The original project was approved by the Mexican Ministry for the Environment and Natural Resources (SEMARNAT) in June 2009, to be built over a stone based surface at the lagoon´s northern margin. The project considered the construction of a 12.074 km long railroad within a period of 24 months and an approximate of 176.5 million dollars cost. Such design implied the extraction and movement of 4,510,856 m$^3$ of rocks from nearby banks and its deposit inside the lagoon surface to a depth of 6 to 10 m (depending on the organic matter contents of the lagoon sediments), forming a platform of about 8 to 12 m high above the lagoon sediment. Also, in order to allow water flux at both sides of the stone based surface and to reduce the environmental impact, 37 drainage structures were included to reduce the environmental impacts. Jointly with the environmental mitigation, social aspects had to be considered, as this railroad was going to obstruct the direct entry to local fishermen docks. Therefore, new docks had to be included in the project to mitigate this problem. Nevertheless, the fishermen were not completely satisfied with the proposed solution, because of the need to move their products and boats about 1 km away from their original location every day; and negotiations were harsh. The original design implied that the strongest impacts: sediment trap, rising of oxygen-poor sediments by the rock structure and reduced water flow among railroad sides, were partially mitigated, but residual impacts were presumably going to be high.
Under this scenario, it also turned out that the opening of the Tepalcates Channel had to be finished before 24 months and the timing for the movement of such an amount of rocks could not be increased, therefore, a new project conception had to be developed. The design was modified to a more environment-friendly alternative, with better social acceptance, considering 11 km railroad raised above the lagoon surface (Figure 2).

This new design implied an approximate cost of 217.39 million dollars, but could be done faster, in 14 months, and with lower residual environmental impacts.

The construction of this railroad is very important for the import and export of products on the western coast of Mexico, through the port of Manzanillo. It was built on overpasses along the northern margin of the Cuyutlan Lagoon, involving both terrestrial and aquatic ecosystems, with possible impact on mangroves, which are protected by Mexican laws. Therefore, compliance with all mitigation measures, especially those regarding mangrove ecosystem protection, conservation and restoration, was very important. Several rare or endangered fauna species were present at the area, including crocodiles, and their protection and relocation previous and during the construction, had to be made carefully.

OBJECTIVE

In the case of the Cuyutlan railroad, our job, as the environmental supervisors, was to make sure that the project had no setbacks, as it was running under a very tight execution schedule. Jointly with the environmental authority, the ministry of communications and transportation (SCT) and the contractor, we had to make sure that mitigation measures were properly executed so that mangroves and fauna were kept safe. We have to assure full compliance by the contractor with environmental authorizations and regulations.

METHODS

We integrated a multidisciplinary supervision team including flora, fauna and soil experts, as well as civil and environmental engineers; supported by GIS and legal departments. An Environmental Mitigation Program (EMP) was designed, and included the appropriate timing for mitigation measures in accordance to project schedule, as well as an economic evaluation of all mitigation measures, to make sure that financial and technical resources for mitigation were available before construction started.

In our experience, mitigation of environmental impacts in developing countries, are sometimes partially done, because mitigation actions are not properly applied and budgets are underestimated. Contractors are not aware of the importance of environmental issues and there is a strong resistance for spending money in mitigation measures. The
Cuyutlan Lagoon railroad is not such case. In this project, authorities involved, as well as the contractor, lined up to produce an environmental successful project.

Once the EMP and the ETE were approved by the environmental authorities, the contractor had to obtain a bail in order to assure the SEMARNAT, that enough economic resources were put apart to allow mitigation actions. As soon as this was done, project construction began.

Economic resources were made available and a solvent consulting company was hired to take care of the mitigation measures. Our company oriented such actions, served as a communication link between stakeholders and built the environmental supervision plan for this project.

Daily supervision of both working shifts was done by our technical staff, and monthly and semiannual reports had to be presented to the authorities, accounting for the percentage of construction and mitigation measures advances. Monitoring forms had to be specifically designed for this project, including all environmental regulations, permission conditions, scope and times. Qualitative and quantitative observations were made and registered. As a result, a complete logbook of the project as an environmental compliance success was obtained.

RESULTS

During construction work, changes are very common and many features need to be modified due to environmental, technical or economical situations that could not be forecasted. The Cuyutlan railroad was not an exception and therefore, the project logbook also allowed us to keep track of arising problems and to make sure that appropriate emergence actions were considered for upwelling situations where new or modified mitigation measures were needed. As the environmental supervisors, we had to make sure that all modifications were approved by the Ministry for the Environment and Natural Resources (SEMARNAT) and that permissions were updated accordingly.

The monitoring of the compliance of all environmental issues in the construction of the Cuyutlan railroad could be stated in three parts: A) Follow-up of environmental authorizations, B) Observe and register of in site compliance of the contractor for all mitigation measures concerning construction, C) Observe and register of compliance with the mitigation programs for the rescue and conservation or restoration of flora, fauna and soil; as well as ecological training course for the construction workers.

A) Follow-Up of Environmental Authorizations

Continuous follow-up of bureaucratic work for obtaining permits and regulations had to be done, as part of our work. Data management concerning the ecological aspects of the project was an important task during the monitoring.

Infrastructure projects in Mexico, like this railroad, constructed on terrestrial and aquatic environments, need to comply with at least 4 environmental related laws: 1) Ley General del Equilibrio Ecológico y la Protección al Ambiente (LEEGEPA 1988)(The Law for General Ecological Equilibrium And Environmental Protection Law); 2) Ley General de Desarrollo Forestal Sustentable (LGDFS 2003)(The Law for Sustainable Forestry Development) 3) Ley General de Vida Silvestre (LGVS 2000) (The Law for General Wildlife Protection Law); 4) Ley General de Bienes Nacionales (LGBN 2004)(The Law for General National Property); as well as other regulations and laws.

Each one of these laws require the project to be authorized by the corresponding authorities, and each authorization points out additional environmental protection measures (mitigation, compensation and restoration) that need to be considered an executed along with the EIS proposed mitigation measures. Under this framework, the compliance of all legal and ecological requirements is a difficult task. Therefore, our work as the environmental supervisors was to follow up all project modifications and to produce documental requirements needed to comply.

B) Observe and Register of Compliance of the Contractor for All Mitigation Measures Concerning Construction

Some of the mitigation measures for this project involved a good management of construction residues; including water, concrete, iron residues, etc. Our job was to evaluate compliance of all of EIA requirements and mitigation measures at each one of the nine work fronts, as well as provisional offices, equipment platforms and all of the construction related occupied sites (Figure 3). When people are used to work without environmental concern, it is frequent to observe residues everywhere and lack of environmental protection actions. As the environmental supervisors, it was a hard task to achieve that the construction workers and the company retired and recycled construction residues; but we came to an understanding and compliance has so far being satisfactory.
Special layouts were designed to check compliance for all mitigation measures and EIA requirements and allowed us to keep track of percentage of compliance (see appendices 1 and 2). In part the ecological awareness workshops helped our work, as most of the workers were more cautious in the way they disposed of such residues. Also, special care was taken for flammable or dangerous residues, as they were separated and placed in specific sites, defined by the constructor, as requested by the authorities.

**Figure 3. Environmental supervision (green vest) at two different work fronts.**

C) Observance and Register of Compliance with Mitigation Programs for the Rescue and Conservation or Restoration of Flora, Fauna and Soil; as well as Ecological Training Course for the Construction Workers

As previously pointed out, the railroad was built under strong environmental restrictions, in order to reduce damage to the environment as much as possible. As part of the mitigation measures, several programs needed to be applied in order to recover and restore soil, flora and fauna, as well as a program for the management and disposal of solid and liquid residues. Also, ecological awareness workshops were given to all construction workers in site. Compliance with these programs was very important in obtaining an environmental successful project like this railroad; as described in the following paragraphs.

Our company was in charge of making the guidelines for each one of these programs, so that, as the environmental supervisors, we could make sure that they were followed thoroughly. These programs focused on four main environmental actions that were closely reviewed and surveyed by our staff, in coordination with the contractor and the Ministry of Transportation, to assure optimal performance and results within environmental compliance. These four environmental actions were as follows: 1) Ecological conscience-building courses for the construction workers, 2) Plant rescue, conservation and vegetation restoration program; 3) Wildlife rescue and relocation program; 4) Soil conservation and restoration program.

C.1) Ecological Conscience-building Course For The Construction Workers

Environmental protection recommendation action courses were given to workers from all shifts (night and day shifts), and positions within the contractor; including administrative and construction workers, as well as construction helpers from the local population. To make it available to all personnel, the course was given on a flipchart to all of the construction fronts during resting periods under an organized scheduled, and especially design triptychs were delivered to all attendants (Figure 4). As some of the construction workers could not read or write, triptychs were designed in a graphic way that they all could understand the concepts and the importance of complying with mitigation measures. As shifts and workers changed periodically along the 14 months of project duration, the courses were given every three months, in order to be able to reach all of the contractor personnel.
Courses for environmental protection recommendations were given on a flipchart along all of the construction fronts, day/night shifts, and all company personnel, as well as specifically designed triptychs.

As a result, people involved in the construction of this railroad were more aware of the importance of environmental protection and even more helpful in the application of mitigation measures.

C.2) Compliance with the Plant rescue, conservation and vegetation restoration program

Before the plant rescue, conservation and restoration program could be applied; a plant nursery had to be constructed in the nearby area. A 2 hectare site was rented close to the contractor’s temporary offices for building a nursery. As the environmental supervisors, we made sure that the nursery was accurately built and ready before plant rescue started (Figure 5).

For the second part of the plant rescue program, native plants fruits and seeds were collected from the surrounding area (Figure 6) and were taken to germinate inside the nursery. The project crossed along its first 3 km through a tropical deciduous forest with some plant species that are under law protection, therefore, we had to monitor the recovery of all kinds of plant producing structures like seeds and stakes of different native plants, as well as small plants.
Seeds were cleaned and classified according to the species and a seed bank was established as stated in the program (Figure 7). Construction worker’s women were hired for such purposes, helping to increase family income.

As the railroad crosses through a coastal lagoon, < 1 ha of mangrove vegetation had to be removed, and two species of mangrove (*Rizophora mangle* and *Laguncularia racemosa*) are being germinated in the nursery to restore damaged sites in the nearby future. Trial plots of mangrove plantations are already being studied to identify the best conditions for reforestation.

As railroad construction is to be finished by the end of the summer 2011, plants are being cared for and grown in order to obtain healthy individuals to use in the Plant Restoration Program, which will restore all surfaces that have been damaged by the construction. A total of 120,000 plants will be used for the restoration of damaged sites, including both species of mangroves. By June 2011, the contractor reported a total of 108,549 plants being kept in the nursery, as shown in Table 1.

**Table 1. Total rescued and produced plants by June 2011. Source: Tradeco Contractor. June 2011, report of compliance with mitigation measures.**

<table>
<thead>
<tr>
<th>TYPE OF PLANTS</th>
<th>INDIVIDUALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rescued plants</td>
<td>12,423</td>
</tr>
<tr>
<td>Cactus and Bromelias</td>
<td>3,882</td>
</tr>
<tr>
<td>Plants produced from seeds (including mangroves)</td>
<td>92,244</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>108,549</strong></td>
</tr>
</tbody>
</table>
There are 79,034 plants being germinated nowadays. Successful ones will be added to the former for a maximum total of 187,583 available plants. This mitigation will reduce residual impact on vegetation caused by deforestation for the railroad construction and will help site recovery in a shorter time, as an approximate proportion of 1:4 is being considered between removed and reforested plants.

C.3) Wildlife Rescue and Relocation Program

Wild animals were rescued from all construction sites prior to and during construction. Rescued animals were mostly reptiles, as they are the most abundant group, with the highest numbers of law protected organisms (Figure 8). Actions were coordinated with the contractor following a Fauna Rescue and Relocation Program, in which veterinaries as well as fauna management experts and trained construction workers collaborated. As a result, 2,606 animals were rescued (Table 2) and relocated in nearby areas with the same kind of habitat characteristics as those where the animals were taken from (Figure 9).

Table 2. Total rescued animals before and during the construction of the railroad.

<table>
<thead>
<tr>
<th>GROUP</th>
<th>TOTAL RESCUED INDIVIDUALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reptiles</td>
<td>2507</td>
</tr>
<tr>
<td>Amphibians</td>
<td>32</td>
</tr>
<tr>
<td>Birds</td>
<td>34</td>
</tr>
<tr>
<td>Mammals</td>
<td>33</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>2606</strong></td>
</tr>
</tbody>
</table>

Relocation sites were chosen considering technical and ecological criteria, in which maximization of survival possibilities were our priority. Selected sites were far away from the construction, but near enough for a vehicle to relocate animals as fast as possible in order to reduce stress caused by captivity and transportation. Site quality (vegetation type, physiognomy, water availability, patch extension, available food, reduce competition, presence of the species, etc.) was revised to define adequate sites for each group of animals.

Figure 8. Some rescued and relocated animals. Courtesy of Tradeco Contractor: Report of compliance with mitigation measures. September 2010.
Particular measures and protection actions had to be taken with crocodiles, as they are abundant in the lagoon. Mostly they were scared away using different sounds and human presence, but sometimes, individuals returned and were persistent in certain construction sites. This behavior made them dangerous for the workers and put the animals in a high risk of being hunted by them, therefore they had to be captured and relocated in a nearby lagoon at relocation site alpha (Figure 10). Relocation permission for crocodiles and other protected animals had to be obtained before capturing and transporting such organisms; relocation was closely supervised by our staff.

C.4) Soil conservation and restoration program

Soil is a very important natural resource that needs to be recovered and preserved to be used in restoration actions, as its formation may take thousands of years. Piles or rescued organic soil horizon were kept aside the construction front, they were covered with grass or plastic to conserve their humidity and protect them from wind and water erosion. Crushed residues of plant removal and workers leftovers were used to make a compost (soil conservation will last for at least 14 months) and increase soil nutrients (Figure 11), also reducing costs of disposal and transportation of soil material to a disposal site.
A total of 656 m$^3$ of soil and 253 m$^3$ of fallen leaves from the tropical deciduous forest were rescued, as this type of vegetation produces a good quantity of leaves and a seed bank that will eventually be, jointly with the top soil, used in the restoration of all sites that were affected by the railway construction as the final part of the mitigation measures.

![Figure 11. Piles of rescued soil and composting actions with crushed residues from clearing to increase its nutrient contents. Courtesy of Tradeco Contractor: Report of compliance with mitigation measures. October 2010.](image)

**CONCLUSIONS**

A) **Follow-Up of Environmental Authorizations.**

This railroad project is still under construction, mitigation measures are being taken into consideration as well as EIA requirements stated by all the environmental authorities involved. All permits are in force and project modifications have been taken care of in regulation matters. Environmental supervision compliance reports are being delivered every month to the SCT and every six months to the SEMARNAT.

B) **Observance and Register of Compliance of the Contractor for All Mitigation Measures Concerning Construction.**

Compliance of regulations dealing with construction itself is not yet finished due to different factors, mainly attributed to a historical misunderstanding of the importance of environmental issues in construction.

Up to now, the average compliance of all supervised work fronts is around 70%; still some work fronts are not observing all of the measures that need to be taken into account for a proper management of residues; nevertheless, are working on improving their environmental performance. Environmental supervisor evaluates and ensures that all mitigation measures are fulfill, if our supervision detects any inadequacies we will request the contractor to do what is needed to resolved the issue immediately.

C) **Observance and Register of Compliance with Mitigation Programs for the Rescue and Conservation or Restoration of Flora, Fauna and Soil; as well as Ecological Training Course for the Construction Workers.**

Best compliance results are being obtained in the execution of all the required programs:

Adequate management of plants and the increase in native plant numbers within nursery will be very useful in the ecological restoration of affected sites, once the construction will be finished.

Mangrove species being reproduced within the nursery have already been tested in plantation plots, in order to optimize plant survival during restoration.

Fauna has been rescued before and during construction and relocated at specially evaluated sites, including several species protected by law.
Soil is being conserved and its nutrients and texture improved for future use during ecological restoration activities.

In our experience, compliance of environmental regulations has to involve all stakeholders (see acknowledgments) in order to have a successful project. Environmental protection is not only the responsibility of the contractor, but a shared environmental value in a gain-gain relationship for environment, society and development.

The role of the Environmental supervision does not end when construction is finished, as it has to make sure that ecological restoration programs are applied to all of the affected sites and all types of residues removed. In this case, a 6 year monitoring of program actions was required by the authorities.

AKNOWLEDGMENTS

Ministry of Transportation Center at Colima (SCT-Colima)
Ministry for the Environment and Natural Resources (SEMARNAT)
TRADECO Contractor

BIOGRAPHICAL SKETCHES

Norma Fernández Buces has a Masters in Ecology and Applied Sciences and a PhD in Science from the UNAM. She has been working on Environmental Impact Assessment issues since 1988, mainly related to infrastructure projects. She has worked at the Mexican Ministry for the Environment and Natural Resources (SEMARNAT) and at different environmental consulting companies. In 1993 she co-founded Grupo Selome, an environmental consulting firm in Mexico City and is currently the Science Director of the firm.

Ana Gisela Santiago Pensado has a Master in Environmental Engineering from the IPN. She is currently studying Law at the UNAM. She has worked in known construction companies as an Environmental Supervisor, and at present she is the Ecological Supervision Manager of Grupo Selome in Manzanillo, Colima.

Sergio López Noriega is the Executive Director of Grupo SELOME, an environmental consulting firm that operates in Mexico City since 1990. He has a large amount of experience with Environmental Impact Assessment related to infrastructure projects, as well as in urban impact, remote sensing, GIS, environmental diagnosis and ecological restoration projects.

REFERENCES


## APPENDICES

### Appendix 1. Environmental Supervision Form for compliance of 6 of the EIA requirements (example for work front No.II).

<table>
<thead>
<tr>
<th>REQUIREMENT 6</th>
<th>COMPLIANCE</th>
<th>ADDITIONAL COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water quality monitoring</td>
<td>1.00</td>
<td>Monthly samples are being analyzed</td>
</tr>
<tr>
<td><strong>COMPLIANCE EVALUATION</strong></td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REQUIREMENT 7</th>
<th>COMPLIANCE</th>
<th>ADDITIONAL COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal and disposal of concrete residues.</td>
<td>0.00</td>
<td>Residues have not been removed from site. Issue will be pointed out at next weekly meeting.</td>
</tr>
<tr>
<td>Removal, recycling and disposal of iron bars, aluminum, wood, wire, etc.</td>
<td>0.80</td>
<td>Residues have been removed almost completely from this work front.</td>
</tr>
<tr>
<td><strong>COMPLIANCE EVALUATION</strong></td>
<td>0.40</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REQUIREMENTS 8 y 13</th>
<th>COMPLIANCE</th>
<th>ADDITIONAL COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation of signs for protection of flora, fauna and environment in work front.</td>
<td>1.00</td>
<td>Sings have been installed</td>
</tr>
<tr>
<td>Environmental conscience-building talks.</td>
<td>0.00</td>
<td>Environmental conscience building course must have been done in May, there is a one month delay. Issue will be pointed out at next weekly meeting.</td>
</tr>
<tr>
<td><strong>COMPLIANCE EVALUATION</strong></td>
<td>0.50</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REQUIREMENT 9</th>
<th>COMPLIANCE</th>
<th>ADDITIONAL COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable sanitary installations in work front.</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Adequate maintenance of portable sanitary installations.</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Adequate use of sanitary installations.</td>
<td>0.40</td>
<td>Workers are still using nearby terrain for sanitary purposes. Issue will be pointed out at next weekly meeting</td>
</tr>
<tr>
<td>Adequate disposal of sanitary residues from portable installations.</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td><strong>COMPLIANCE EVALUATION</strong></td>
<td>0.85</td>
<td></td>
</tr>
</tbody>
</table>
COMPLIANCE RESUME FOR RAILROAD CONSTRUCTION (EXAMPLE)
JUNE, 2011

<table>
<thead>
<tr>
<th>EIA REQUIREMENTS / MITIGATION MEASURES</th>
<th>COMPLIANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORK FRONT I</td>
<td>0.60</td>
</tr>
<tr>
<td>WORK FRONT II</td>
<td>0.66</td>
</tr>
<tr>
<td>WORK FRONT III</td>
<td>0.33</td>
</tr>
<tr>
<td>WORK FRONT IV</td>
<td>0.53</td>
</tr>
<tr>
<td>WORK FRONT V</td>
<td>0.73</td>
</tr>
<tr>
<td>WORK FRONT VI</td>
<td>0.42</td>
</tr>
<tr>
<td>WORK FRONT VII</td>
<td>0.53</td>
</tr>
<tr>
<td>WORK FRONT VIII</td>
<td>0.60</td>
</tr>
<tr>
<td>WORK FRONT IX</td>
<td>0.67</td>
</tr>
<tr>
<td>WORK FRONT X</td>
<td>0.61</td>
</tr>
<tr>
<td>WORK FRONT XI</td>
<td>0.41</td>
</tr>
<tr>
<td>CONCRETE PREFABRICATED PIECES PLANT AT WORK FRONT I</td>
<td>0.00</td>
</tr>
<tr>
<td>CONCRETE PREFABRICATED PIECES PLANT AT WORK FRONT X</td>
<td>0.68</td>
</tr>
<tr>
<td>CONCRETE PREFABRICATED PIECES PLANT AT PLATFORM 1 AND ROAD ACCESS</td>
<td>0.79</td>
</tr>
<tr>
<td>CONCRETE PREFABRICATED PIECES PLANT AT PLATFORM 1 AND ROAD ACCESS</td>
<td>0.48</td>
</tr>
<tr>
<td>EQUIPMENT REPAIR AND DANGEROUS RESIDUES PLATFORM</td>
<td>0.53</td>
</tr>
<tr>
<td>TRADECO’S PROVISIONAL OFFICES</td>
<td>0.66</td>
</tr>
<tr>
<td><strong>AVERAGE COMPLIANCE BY JUNE 2011</strong></td>
<td><strong>0.54</strong></td>
</tr>
</tbody>
</table>

**NOTE:** 1.00 stands for a total compliance of all requirements and mitigation measures.
ESTABLISHING NATIVE PLANTS ON ROADSIDES: AN INTEGRATED APPROACH

David Steinfeld (541-552-2912, dsteinfeld@fs.fed.us), Revegetation Specialist, USDA Forest Service-Region 6, 645 Washington St., Ashland OR 97520 USA
George Fekaris (360-619-7766, George.Fekaris@dot.gov), Transportation Planner, Federal Highway Administration- Western Federal Lands, 610 E Fifth Street, Vancouver, WA 98661 ISA

ABSTRACT

Revegetating highly disturbed sites associated with road construction can be challenging. While many tools, products, and methods exist for restoring native plants to roadsides, appropriately integrating these practices into the road building process is often the weak link. Over 10 years ago, the Western Federal Lands Highway Division (WFHLD) initiated a different approach and began including revegetation specialists from the USDA Forest Service into all phases of the road building process. Beginning in the early phase of the road project, engineers, environmental specialists, and revegetation specialists work together to meet revegetation goals within the context of the road plans. A revegetation plan is the outcome of this collaboration. During the construction phase, the revegetation specialist, construction engineer, and road-building contractor partner to implement the revegetation plan. When the project is completed, the revegetation specialist monitors the results and reports back to the WFHLD. This partnership has not only increased our understanding of available restoration tools – when to use them, their effectiveness and costs, how they are realistically implemented on road projects – but also advanced the development of new methods and strategies for restoring native plants to highly disturbed sites. The integration of road building and revegetation schedules and expertise has resulted in a larger number of successful roadside revegetation projects.

INTRODUCTION

Revegetating roadsides is a unique challenge in the western US because of steep erosive slopes, lack of topsoil, shallow soil depths, soil compaction, and difficulty in locating commercially available appropriate plant materials. Compounding these challenges, revegetation is often conducted in a “one size fits all” approach, where specifications are broadly applied without regard to the uniqueness of the project environment. These and other factors impact attempts to revegetate roadsides. Aside from being an eyesore, failed revegetation projects often result in increased soil erosion, sediment runoff to streams, and invasive plant establishment. While there are many restoration tools, products, and methods available, appropriately integrating these practices into the road building process is often the weak link in achieving a successful project.

In the late 1990’s the Western Federal Lands Highway Division (WFHLD), like other transportation departments, was facing increased scrutiny over the impacts of roadsides on the environment. State and Federal water quality laws were requiring greater vegetative cover and effectiveness on roadsides. Federal agencies, like the USDA Forest Service (FS), were applying stricter oversight on the origins of native plant materials being used on public lands, and the spread of invasive species was an increasing concern. Although faced with these challenges, the WFHLD also saw opportunities to minimize environmental impacts, including designing roads that would also enhance wildlife, improve scenic quality, and sequester carbon through the manipulation of roadside vegetation.

At the time the WFHLD lacked a natural resource staff to address these concerns and opportunities, so over 10 years ago they turned to the FS as potential partners. It seems like a good fit because many of the WFHLD road projects were being constructed on FS lands where a range of FS natural resource specialists could be tapped for their expertise. This cooperative effort has evolved over time, and several years ago resulted in the creation of the FS Pacific Northwest Restoration Services Team (hereafter ‘RST’). The team is composed of revegetation specialists with backgrounds in botany, soil science, nursery management, genetics, erosion control, and riparian restoration who focus specifically on restoration projects dealing with road construction, mine reclamation, and riparian restoration.

Moving away from a “one size fits all” or “off the shelf specification” driven approach to revegetation, the RST and WFHLD developed a strategy that integrated revegetation expertise into all phases of the road building timeline (see Figure 1). This paper addresses how integration and collaboration between the RST and the WFHLD is conducted at the various phases of the road project.
CONDUCTING A SITE INVENTORY

The western US encompasses a wide diversity of soils, vegetation, and climates, and understanding how these factors affect plant establishment will determine the success of a revegetation project. During the Road Planning and Programming phase, the FS revegetation specialist becomes familiar with the soils, vegetation, and climate of the road project area by assembling available sources of information pertinent to the project site. The internet is a great source for readily obtainable information. A website commonly used by the RST is the USDA Natural Resource Conservation Service (NRCS) Web Soil Survey (http://websoilsurvey.nrcs.usda.gov). On this website you delineate the road project area and a soils report, which includes a soils map, is created. Climate information can be obtained from the PRISM Climate Group website (http://www.prism.oregonstate.edu) by providing the latitude and longitude of the road project site. This website extrapolates weather data from surrounding weather stations, incorporates an elevation model, and applies expert knowledge to report out temperature and precipitation data for the past 30 years to that location. Not all reports are accessible on the internet, but contacting federal, state, and local land management agencies can also uncover applicable sources of information.

With this background information and the road plans in hand, the revegetation specialist visits the project site and makes a more thorough assessment of the project’s environment. Identifying those site factors that will hinder plant establishment (“limiting factors”) is a critical step in the process. In addition, the revegetation specialist also identifies resources that can be used in revegetation (site resources), and locates reference sites that will serve as models in designing the desired plant community.

DEVELOPING A REVEGETATION PLAN

The revegetation plan is assembled during the Road Project Development phase using the road engineering design, project objectives and the gathered information on soils, vegetation, and climate. The written plan is the outcome of collaborative planning between WFLHD and the FS and serves as a framework for the entire revegetation effort.

A final revegetation plan typically contains these elements:

- road project objectives
- revegetation objectives
- overview of vegetation, soil, climate
- description and delineation of revegetation units
Since the revegetation planning phase begins several years prior to road construction, it is often an opportune time to test revegetation methods on a small scale before selecting the most appropriate techniques. For example, in 2004, the RST established a small trial to evaluate the effects of different rates of hydromulch on seed germination and plant establishment at a high-elevation site in central Oregon. One year after the trial was installed, we found that grass seedlings hadn’t established on any of the treatment plots, even the plots with the highest rates of hydromulch (3,000 pounds per acre). This invaluable information steered us away from a failure and gave us time to consider other, more effective, seed covering methods. As an alternative, the WFHLG staff suggested using a chipper to grind up slash created during road clearing and placing the fibers over seeds to create a thicker mulch layer. We had time test this idea and found that grass plants became successfully established when seeds were covered with an inch of chipped wood fiber (Figure 2).

![Figure 2. Woody material generated from road right-of-way clearing (left photo) is ground into mulch, then applied over seeded slopes. The photo on the right shows an Eriogonum lanatum (Oregon sunshine) seedling emerging through a mulch cover.](image)

OBTAINING APPROPRIATE PLANT MATERIALS

The FS has developed guidelines that require the use of genetically appropriate native plant materials when revegetating disturbed lands. The direction is that plant materials (e.g., seeds, cuttings, bulbs, seedlings) used on a revegetation site must be started from a reproductive source that is ‘local’, and presumably adapted to a revegetation site. A useful public website that the RST uses for determining appropriate seed movement guidelines (e.g., seed zones) is the Seed Zone Mapper (http://www.fs.fed.us/wwetac/threat_map/SeedZones_Intro.html). These species-specific seed zones are based on empirical results from gynecological analyses of common garden studies.

Over the years the FS along with other federal agencies have collected and stored seeds from a variety of seed zones and these sources are often available for use on highway projects. When seeds from appropriate sources are not available, wild seeds are collected in or adjacent to the project site by experienced seed collectors who are overseen by a botanist. This occurs in the summer or early fall as seeds ripen. Because seeds from different species occur in different locations and ripen at different times, collecting seeds from multiple species in any given year involves good planning and execution.
Production of larger quantities of seeds from wild-collected sources can be administered through an IDIQ (indefinite delivery/indefinite quantity) contract or at federal nurseries (Figure 3). These facilities receive the wild-collected seeds in the fall and field-sow them that fall or the following spring. Most farmers sow many species at their facilities and utilize well-defined industry standards to maintain the genetic integrity of the various seed sources. Seeds are harvested the following summer; first year harvest quantities are typically low for many species. It is not until the second and third years that the fields produce optimum quantities of harvestable seeds. Following harvesting, seeds are cleaned, tested, and stored until needed for revegetation. The timeline for having adequate quantities of seeds available for a revegetation project typically spans two to three years (see Figure 1).

Roadside projects often call for shrub and tree seedlings to be planted in areas such as obliterated roadways and bottom of fill slopes. These plants are grown from wild-collected seeds sent to private growers or federal nurseries. Many native shrub and tree species grow very slowly the first year and require two growing seasons in the nursery before they are large enough to plant on the project. Although bareroot plants are occasionally used, container plants have proven superior to the challenging conditions of most road projects. Many restoration projects call for seedlings grown in large containers which typically require two to three years in a nursery to reach a plantable size.

CONTROLLING WEEDS

Weed control begins during Road Project Development when populations of invasive species are located. From these findings, the RST and WFLHD develop a strategy to reduce invasive species through chemical and mechanical control methods. We involve local highway vegetation management specialists because they have years of experience controlling invasive species of the area and will ultimately be responsible for maintaining the vegetation once the project is completed. We often develop agreements with these agencies to have them control weeds on and near the proposed road sections before, during, and after the projects have been completed. During the Road Construction phase, contract specifications are enforced that require equipment to be steam cleaned prior to entering the site. Materials brought into the site, including fill material, topsoil sources, rock, and hay, must be certified or approved by a botanist to insure they are free of invasive species.

We take the view that stemming weed invasion begins with the soil; that a healthy, productive soil is more conducive to establishing perennial native plants than a poor soil. Weedy annuals out-compete native perennial grasses and forbs on soils that are compacted, lack topsoil, or are low in organic matter and this is why native perennials are not typically found on highly disturbed sites. We implement practices that salvage topsoil, increase organic matter, reduce the amount of nitrogen during seedling establishment, increase rooting depth, and reduce compaction in order to encourage the establishment of perennial species over annual weeds. We also apply seeds at the most optimum period of the year for seedling establishment, using a seed mix that contains multiple species. By rapidly establishing a dense stand of the desired native plants, invasive species are discouraged from gaining a foothold.

ADVISING DURING ROAD CONSTRUCTION

As the project timeline moves from the Road Project Development into the Road Construction phase, the role of the revegetation specialist transitions into an advisory role. Collaborating with the project engineer, the revegetation specialist assures that the revegetation plan is understood and implemented appropriately on the ground. The revegetation specialist reviews the plan with the project engineer and develops a timeline for how road building and revegetation activities will interface. The revegetation specialist also advises on road contract specifications including placement of salvaged topsoil, soil treatments, road right-of-way disposal, and temporary/permanent erosion control measures. In addition, the revegetation specialist often reviews the source of materials, such as road fill, topsoil, mulch, and erosion control products, to prevent the introduction of invasive weed seeds. As often happens during road construction projects, changes occur as the project is implemented so the RST and the WFLHD must work together to assure that the revegetation plans are adjusted to any changes in the highway project plans.
SEEDING AND PLANTING

Seeding and planting occur near the end of the Road Construction phase when slopes are finished. In the past, FWHA included this work in the road building contract. It is now conducted by the RST either through an IDIQ contract or by FS employees. The advantage of separating revegetation work from the road contract is that the revegetation specialist has direct control over plant installation operations, assuring that the revegetation plan is being implemented accordingly. The RST has developed a pool of restoration companies that are highly skilled and who collaborate in developing more efficient and better ways of accomplishing restoration work.

The RST employs several different seeding and planting methods that are most appropriate to the specific site conditions. For example, an ATV with mechanical seeder and chain harrow can be an inexpensive means of applying seeds on large areas with gentle slopes. Hand seeding is used where a specific seed mix needs to be strategically placed. For large areas of steep slopes, hydraulic seeding is an economic application method. There are also a variety of methods to plant seedlings depending on the size of the seedling container and soil conditions—especially the amount of rock. Appropriate planting tools range from shovel and augers to larger planting equipment such as the expandable stinger or waterjet stinger.

The application of mulch is integrated into the seeding and planting operations. Where precipitation rates are high and fall temperatures are mild (e.g. Coast Range), hydromulch with tackifier is often sufficient for adequate seed germination and plant establishment; on more arid sites, including those east of the Cascade Mountains, a deeper mulch covering is required. Applying shredded wood fiber (wood chips) derived from ground road right-of-way material over seeds creates a stable, moist environment for germination (see Figure 2). Planted seedlings also require mulching, especially on dry, hot sites where competing vegetation is an issue. A variety of mulches are available, from synthetic sheets to a thick layer (2 to 3 inches) of ground wood fiber.

CARING FOR ESTABLISHED PLANTS

Established plants will require some form of care for several years after seeding and planting depending on site conditions. Planted seedlings may require protection from deer browsing using fencing, repellants, or netting around each seedling. For seeded sites, one or two fertilizer applications are also useful in the years following seeding. One innovative approach that the RST developed for projects where soil nutrients are very limiting is to use a fertilizer schedule that is based on when plants can best use the nutrients. Rather than applying a large dose of fertilizer during seeding, which is the traditional method, the RST comes back months or years after the plants are established with larger applications of fertilizer. This strategy developed from our experience that fertilizers applied during seeding are not needed by the young germinating plants and often encourage weed development. In addition, surplus nitrogen and phosphorus leaches into ground water or streams and decrease water quality.

MONITORING

Following seeding and planting, the revegetation timeline moves into the monitoring phase. During this period, the revegetation specialist develops a monitoring plan, selects monitoring protocols, collects field data, analyzes findings, and presents results in a monitoring report. The RST has developed a set of monitoring protocols that address the unique challenges of roadside revegetation projects (Figure 4). The protocols are designed to be easy to use and statistically based. One innovative monitoring program called the Cover Monitoring Assistant (CMA) was developed collaboratively by the RST and WFLHD and requires a digital camera. Instead of taking data in the field, the revegetation specialist takes a digital photograph of each plot and analyzes the photographs back in the office using the CMA program. This protocol reduces expensive field time as well as increases accuracy. The program also runs a statistical analysis of the data.

Figure 4. Monitoring roadsides presents a unique set of challenges. Protocols, such as the use of digital imagery, are helpful monitoring tools. Photo: G. Carey.
The revegetation specialist writes a monitoring report that outlines the revegetation work that was conducted on the highway project, summarizes the monitoring data, and addresses whether the revegetation objectives that were developed in the planning phase were met. The report is presented to the WFLHD and signals the completion of the revegetation project. The monitoring report provides other benefits. For example, if new revegetation practices were implemented on the project, the monitoring report will determine how successful such practices were and how they could be improved. Such findings can expand the revegetation toolbox if shared with other practitioners.

ADVANCING THE FIELD OF APPLIED RESTORATION

Although considerable progress has been made in the relatively new field of native plant restoration, we believe that this field is still in its infancy. There are many practitioners who are developing very interesting techniques or approaches to revegetation throughout the western US however, there is often little communication of results or findings from each other’s projects. The WFLHD and the FS have made a concerted effort over the past decade to bridge this gap and share what they have learned with larger audiences. In 2007 we published a practitioner’s guide to revegetating roadways called “Roadside Revegetation – an Integrated Approach to Establishing Native Plants.” The attempt was to present a practical and integrated approach to establishing native plants on highly disturbed sites. Since this publication was written, more has been learned and we plan to update the report in future years. To obtain a pdf copy of this report visit: www.nativerevegetation.org.

Another way in which we are sharing information is through an interactive website, where a practitioner can submit a “Learning Summary” that outlines new and innovative techniques. Information on how to submit a Learning Summary can be found at www.resource.nativerevegetation.org. At this site, you will find the learning summaries that others have submitted, pertinent restoration literature (published and unpublished), contract specifications, spreadsheets and programs, implementation guides, and other, not commonly available resources for restoring highly disturbed lands in the western US. This site is in its infancy and depends on volunteers to add and update reports; so expect to see the website expand and improve with time.

In addition to sharing information, we believe that our highway projects are great testing grounds for evaluating new approaches and techniques to revegetation. Whenever possible, we try to test something new on our projects. Currently we are evaluating the effects of different types of soil amendments, such as aged wood chips, biochar, and compost, on capturing road pollutants that originate from road surface runoff. In the same analysis, we are evaluating how plants respond in growth to each soil amendment over time. Testing these amendments in the lab and under field conditions creates a greater understanding of how they will function when applied operationally.

CONCLUSION

The outcome of integrating revegetation into the road process has led to more successful roadside revegetation projects. Typical problems in the past are averted through collaborative planning and implementation. The WFLHD and FS partnership has increased our understanding of the restoration tools that are available, when to use them, their effectiveness and costs, and how they are realistically implemented on road projects. The partnership has helped advance the development of new methods and strategies for restoring native plants on highly disturbed sites.

ACKNOWLEDGEMENTS

The authors would like to thank members of the RST and Erin Halcomb for reviewing this document and providing helpful edits.

BIOGRAPHICAL SKETCHES

David Steinfeld is revegetation specialist with the USDA Forest Service in the Pacific Northwest Region. He has worked for the FS in Oregon for most of his 35 year as a field soil scientist, assistant nursery manager, and revegetation specialist. For the past decade he has worked on Federal Highway Administration and Forest Service projects that focus on revegetating highly disturbed sites with native plants. He holds a soil science degree from Oregon State University.

George Fekaris is a transportation planner with the Western Federal Lands Highway Division of the Federal Highway Administration. During his 32 year engineering career, he has been engaged in the delivery of transportation projects that range from urban multilane interstate designs to pristine National Park environments. He has a Bachelor of Science in Civil Engineering from Wayne State University (Detroit, MI) and is a Registered Professional Engineer in the state of Oregon.
CULTURALLY-SENSITIVE DOGBANE TRANSPLANTING, COLLABORATION AND PUBLIC OUTREACH

Kurt W. Roedel (503-986-6571, kurt.roedel@odot.state.or.us), Archaeologist, Oregon Department of Transportation, Geo-Environmental Section, 4040 Fairview Industrial Drive SE, Salem, Oregon 97302 USA

ABSTRACT

In 2009, the Oregon Department of Transportation (ODOT) partnered with the Confederated Tribes of Siletz Indians (Siletz Tribes) and the Oregon Department of Fish and Wildlife (ODFW) to preserve and transplant a culturally-significant population of dogbane in the Willamette Valley of western Oregon. Dogbane was, and continues to be, an important traditional plant to the Siletz Tribes. Tribal members who harvest dogbane along the shoulder of Oregon Highway 99 West (OR 99W) are subject to fast-moving vehicular traffic while highway runoff and annual herbicide spraying produces stunted dogbane marginally useful to the tribes. ODOT, the Siletz Tribes, and ODFW identified a nearby wildlife refuge in which to transplant the dogbane. The new location afford Tribal members guaranteed access for plant harvesting, provided ODFW a community dedicated to maintaining and encouraging native plant species, and aided ODOT in meeting one of its core missions, improving public safety along state highways.

In 2010, the Federal Highway Administration (FHWA) awarded the Siletz Tribes, ODFW, and ODOT the 2009 Exemplary Human Environment Initiatives (EHEI) and the Exemplary Ecosystem Initiatives (EEI) designation. FHWA also provided financial support for ODOT to document the transplant and interview members from multiple Oregon tribes, and state and federal agencies. The video will provide different points of view on access to natural and cultural resources on public land and the value of collaboration. In fall of 2011, ODOT will post the video on the agency’s website as an educational tool to create awareness of continued Tribal use of native plants along state highways and to help guide others in achieving positive results when working with multiple parties on unique issues.

TRIBAL RELATIONSHIPS

ODOT and Oregon’s nine resident federally-recognized tribes have a long history of consultation, coordination, and collaboration for various highway-related projects. Section 106 of the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA) provide an overall structure for ODOT’s interaction with tribes. However, Oregon Revised Statue 182.162, which promotes communication and positive government-to-government relations between state agencies and tribes, also mandates that ODOT shall make a reasonable effort to cooperate with tribes in the development and implementation of programs that affect tribes when no federal nexus is applicable. It is this state law that fosters and promotes equitable relationships between ODOT and the tribes on highway projects, and provided the foundation to complete this project.

ODOT’s Archaeology Program consults with sixteen tribes, each with their own unique identity, government, traditions and beliefs. Some tribes view natural and cultural resources as the same resource while other tribes manage these resources independent of each other. ODOT’s Natural Resources Unit has yet to develop a strong relationship with the agency’s tribal partners, so concerns about natural resources initially fall upon archaeologists to address during project development.

Over the past few years, the Siletz Tribes have increasingly brought issues of natural resources concerns to meetings that previously were limited to archaeological discussions. For example, conversations focused on recommendations for plantings of certain types of culturally-significant vegetation during stream restoration projects. More recently, ODOT has invited tribes to manage some of the agency’s wetland mitigation banks. However, as ODOT better understands and incorporates various Tribal viewpoints into highway projects, the agency realizes that outcomes can be mutually beneficial.

PROJECT HISTORY

In 2008, Robert Kentta, Cultural Resources Director, Siletz Tribes, contacted ODOT’s Archaeology Program to discuss an important traditional plant, dogbane (Apocynum cannabinum), within ODOT right-of-way along OR 99W north of Corvallis in Benton County (Figure 1). The tribes harvest dogbane and process it into cordage for basketry, fish netting, and elk snares, among other uses. Mr. Kentta stressed that this location is important to the tribes because it is one of the few large and accessible dogbane populations in the Willamette Valley, due in large part to agricultural practices and private property limitations.

Mr. Kentta’s immediate concern was the gradual decline of the dogbane population over the past several years, likely caused, in part, to ODOT’s annual herbicide program that maintains line-of-sight for drivers by eliminating plant growth
along road shoulders. Agency representatives and Mr. Kentta visited the dogbane location to better understand the tribes’ views and concerns, and strategized on means to promote plant growth. Mr. Kentta suggested that an end to herbicide application in the vicinity of the dogbane would likely reverse the stunted growth and improve the overall health of the dogbane. Most of the dogbane was in the gravel shoulder of the road, dangerously close to traffic and near a slight curve in the road that limited visibility for motorists (Figure 2). ODOT District 4 Maintenance, which applies the herbicide spray, would not agree to permanently stop spraying because of the increased potential for accidents and a feeling that the agency would encourage an already precarious activity. In addition, a reduction or elimination of herbicide application may not be the only factor in a declining dogbane community. Dogbane was also vulnerable to stormwater runoff, which may include gasoline, diesel, oil, lead, copper, and other contaminants that could contribute to its stunted growth. Tribal members may also be exposed to these pollutants during harvesting and processing activities.

Another potential solution was ODOT’s Special Management Area (SMA) Program. In 1994, ODOT established a program designed to protect threatened and endangered plant species within state rights-of-way. This program helps ODOT apply the appropriate levels of protection within SMAs, and enables the agency to maintain or increase population numbers and assist long-term conservation of these resources on public lands. Special signage designates SMAs which have restrictions on the types of maintenance activities allowed. The SMA Program has expanded since its inception and now includes aquatic plant and animal species as well as archaeological sites and graves. Again, due to the close proximity of dogbane to the highway, an SMA was not deemed feasible by Maintenance, which oversees the SMA Program.
The Siletz Tribes and ODOT pursued a third option, a nearly 100 percent transfer of dogbane from the highway right-of-way to a more suitable location. This suggestion had the support of Maintenance, which agreed to stop spraying herbicide along this section of OR 99W for one year to allow the dogbane population to grow healthy enough to survive a transplant. ODOT examined the potential to transfer a portion of the population to several different locations owned by the agency, including a wetland mitigation bank near the Siletz Reservation. However, the ODOT biologist considered dogbane to be an aggressive species and, therefore, had the potential to overwhelm other native species and potentially violate the conditions of an existing permit.

Figure 2. View of dormant dogbane removed from gravel shoulder along OR 99W.

AGENCY COLLABORATION

ODOT volunteered to contact outside entities for partnership opportunities. In sum, thirteen local, county, state, and federal agencies were called or e-mailed to identify potential transplant sites in the Willamette Valley. Limiting factors included a suitable environment for dogbane (which thrives in low-lying, wet but sunny locations), an area with no plans for future development, an environment free from spraying and mowing, preferred proximity to the existing dogbane population, and accessibility for Siletz Tribal members and elders to safely harvest the resource. These criteria quickly narrowed the list to three agencies willing to further explore the transplant proposal: the Oregon Department of Fish and Wildlife (ODFW), Benton County Natural Areas and Parks Department, and the Oregon Parks and Recreation Department (OPRD).

On-site meetings among the Siletz Tribes, partnering agencies, and ODOT were held to discuss project details and to view and select appropriate transplant locations. Ultimately, an ODFW wildlife reserve a few miles from the existing dogbane population met all of the criteria described above. Coordination with Benton County Natural Areas and Parks Department and OPRD laid a foundation for future coordination as well as the identification of other dogbane populations the Siletz Tribes may be able to use.

At the suggestion of Mr. Kentta, ODOT invited the Siletz Tribes’ youth group and students from Oregon State University, in Corvallis, to participate in the transplant. In March 2009, two ODOT Archaeologists and Mr. Kentta spent one day transplanting roughly 150 plants from the OR 99W right-of-way to the wildlife refuge (Figure 3). Mr. Kentta also demonstrated how Siletz Tribal members process dogbane stem into twine (Figures 4, 5, 6, 7, and 8). The twine is strong and durable and can be used for basketry, fish netting, and elk snares.
Figure 3. Robert Kentta (right), Cultural Resources Director, Siletz Tribes, Mary Turner (center), Archaeologist, ODOT, and Kurt Roedel (left), Archaeologist, ODOT, removing dogbane from the OR 99W shoulder for transplant to a nearby wildlife refuge.

Figure 4. Robert Kentta processing dogbane from stem to twine.
Figure 5. Robert Kentta processing dogbane from stem to twine.

Figure 6. Robert Kentta processing dogbane from stem to twine.
Figure 7. Robert Kentta processing dogbane from stem to twine.

Figure 8. Robert Kentta processing dogbane from stem to twine.
The transplanted dogbane supplemented an existing dogbane population. Subsequent visits to the transplant location by the Siletz Tribes and agency personnel resulted in observations of a healthy and expanding dogbane community (Figure 9).

Figure 9. View of young dogbane growing at the ODFW wildlife refuge, spring 2011.

PUBLIC OUTREACH

In 2009, the Federal Highway Administration chose twenty-two exemplary projects and programs as recipients of its EHEI and EEI designations (Federal Highway Administration 2011). EHEIs recognize outstanding examples of transportation projects that create or improve conditions for human activities while protecting the natural environment, while EEIs identify ecosystem and habitat projects that are unique or highly unusual in their geographic scope, use cutting edge science or technology, have a high level of environmental standards, achieve high quality results, and/or are recognized by environmental interests as particularly valuable or noteworthy. The dogbane transplant project was one of six projects to earn both distinctions.

Although the Siletz Tribes, ODFW, and ODOT view the project as successful collaboration, the public remains largely unaware of the importance of dogbane to the Siletz Tribes or why state agencies expend public funds to undertake projects of this type. ODOT partnered with the Siletz Tribes and FHWA to produce a short video to help explain these issues. The video will include transplant activities, feature interviews with Tribal members speaking about traditional and contemporary plant use and its continuing significance to Oregon’s tribes, and the importance of collaboration among state and federal agencies and tribes when dealing with natural and cultural resources. The video will be used within ODOT for training and will be available to the public on ODOT’s website as an outreach and educational tool.

SUMMARY

In 2009, the Siletz Tribes, ODFW, and ODOT partnered to transfer a declining population of culturally-significant dogbane from a section of busy state highway to a nearby public wildlife preserve, enabling tribal members to safely access and harvest healthy dogbane and continue their traditional practices.

Although small in scope and scale compared to most ODOT projects, the dogbane transplanting effort demonstrated that successful partnerships can be forged and good will built when a concerted effort is made to work together for a mutually-beneficial outcome.
BIOGRAPHICAL SKETCH

Kurt Roedel has been an Archaeologist with the Oregon Department of Transportation in Salem since 2005. He received his Bachelor of Arts in Anthropology from Boise State University in 1997 and his Master of Arts in Anthropology from Colorado State University in 2000. Mr. Roedel has practiced archaeology in Idaho, Washington, and Oregon, and enjoys sharing his enthusiasm for his profession by developing outreach projects for the public.

REFERENCES


This page intentionally left blank.