Statement of Work - Tasks

I. INTRODUCTION/OBJECTIVES
The California Integrated Waste Management Board (CIWMB) is faced with the significant challenge of diverting or safely managing more than 40 million waste tires generated each year in California. California has millions of waste tires that have been illegally dumped or stockpiled. These stockpiles pose threats to public health, safety and the environment. Because of the potential to use large quantities of waste tires in construction projects, CIWMB is focusing marketing efforts on using waste tires in rubberized asphalt concrete (RAC) and civil engineering (CE) applications (i.e. levee slurry walls, slope stabilization, light weight fills, landfill leachate, etc.). One way of reaching the goal of using all tires generated in California is teaching civil engineers, both students and professionals, about using tires in RAC and CE applications. This project teaches civil engineers, students and others involved in engineering projects the attributes of using waste tires in asphalt roads, fills and other applications.

II. WORK TO BE PERFORMED
Specifically, this project will provide two (2) educational products:

1. Continuing education programs for engineers and technicians involved in using waste tires in RAC and in other CE applications.

2. Offering curricula about using recycled tire rubber in RAC and in other CE applications at all California Universities and Community Colleges that offer civil engineering courses.

III. TASKS IDENTIFIED
CONTINUING EDUCATION
This contract will be used to develop a program for awarding continuing education units to engineers and others for taking new or refresher courses regarding the use of waste tires for RAC and for other civil engineering applications.

Preparation:
Task 1. Identify key sources of resource information
Contractor will identify the major sources of information on the use of recycled rubber in RAC and CE applications. Key sources of information include the following:
- RAC - work with MACTEC, Rubber Pavement Association, Federal Highway Administration, and others
- CE applications - work with Professor Dana Humphrey, Richard Holman CSU, CSU staff and others

Task 2. Develop detailed course outlines
Contractor will design one eight-hour course outline for each RAC and CE course. The topics to be covered shall include, but not be limited to, the following:
- **RAC 101** - design, construction, performance, sound reduction, cost benefit, case histories, etc.
- **CE 101** - lightweight fills, backfills, levees, sound reduction, case histories, and other applications, etc.

**Task 3. Mock Class Feedback**
Prior to delivering the courses statewide, a mock class shall be given to select members of the CIWMB, Contractor’s technical advisors, and to other invited engineers to solicit feedback on the content, appropriateness, and effectiveness of the courses. The mock courses would be offered in Sacramento or Chico and the feedback from the courses would be used to make any needed changes to the course content.

**Task 4. Identifying locations for course delivery and developing course brochure**
Up to eight courses will be delivered statewide, the number to be determined in consultation with the CIWMB Contract Manager. The possible locations for the courses are summarized, but are subject to change, as follows:

- Northern California - Chico, Sacramento Bay Area, San Luis Obispo
- Central Valley - Fresno, Bakersfield
- Southern California - Los Angeles, San Bernardino, San Diego

All courses shall be one or two days, depending on the demand for RAC vs. CE applications. For each course, a marketing brochure or flyer will be developed describing the content and location of the courses. The availability of each course shall be announced and distributed statewide using the Registered Civil Engineer Network and will be marketed using both the American Public Works Association and American Society of Civil Engineers newsletters. The Contractor’s Civil Engineering department maintains a database of 1,200 alumni, to which the courses would also be publicized. Contractor shall access alumni lists of the other 22 universities to send information to civil engineers in California.

**Task 5. Presentations**
Deliverables will include, but not be limited to, Power Point presentation handouts, at least two qualified lecturers, and a reference manual handout for each of the eight (8) courses delivered throughout the State. Contractor shall coordinate efforts with the other contractors working for the CIWMB on RAC (MACTEC) and CE applications (Professor Dana Humphrey). MACTEC and Professor Dana Humphrey will be involved as technical advisors to Contractor’s team to ensure the materials developed are consistent with the materials being produced on existing CWIMB contracts.

**Task 6. Evaluations**
Contractor will create an evaluation component for each course and will obtain approval from the CIWMB Contract Manager prior to its implementation in each course. The evaluation forms shall be distributed at the end of each course and be used to provide feedback on the quality and effectiveness of the course presentation and course materials.
Adjustments will be made to the course as needed, based on the feedback before the next course presentation.

**CURRICULA AND MATERIALS FOR CE STUDENTS**
Contractor shall add course curricula on RAC and other CE applications to existing modules for CE students at the University of California, the California State University System, and California community colleges using California waste tire products. This section describes what Contractor will do to ensure success in delivering these materials.

**Task 7. Develop detailed outlines for each module**
Contractor will add modules to existing courses to introduce students to the RAC and other CE applications topics in a variety of courses required to earn their degrees. Modules shall be developed for the following core courses in the CE programs:
- Introduction to Civil Engineering Design - introduce the concept for recycling and sustainability and discuss civil engineering applications of utilizing waste tires.
- Materials Science - include modules for developing the mechanical properties of crumb rubber for asphalt and concrete applications.
- Transportation - include modules on RAC in pavement design and rehabilitation.
- Geotechnical - include modules on the use of RAC in fills, backfills, and levees and to develop the appropriate engineering properties of crumb rubber.
- Construction - include modules for special methods needed to handle these materials on construction projects.
- Environmental class - reasoning for recycling tires and the reduction in land fill requirements.
- Capstone design class - design project where crumb rubber is used as a pavement material or in other CE applications.

**Task 8. Develop the lecture materials/visual aids for the modules**
This task includes the development of the course materials and visual aids for each of the modules. The Contractor will be responsible for coordinating with existing CIWMB expert Contractors to ensure that the information included in the course materials is the most current available and is consistent with other Board-approved materials and publications.

**Task 9. Collaborate with community colleges to introduce material in the freshman or sophomore years.**
The initial focus of this effort will be to work with Butte, Shasta, and Yuba community colleges, which are the primary feeder schools to the civil engineering programs. Contractor will also include one of the Sacramento area colleges in this process. The methods to be implemented in this effort will include, but not be limited to, the following:
1. Meet with the junior colleges in the local area at their locations to describe the project and establish participation and to coordinate of this effort.
2. Invite participating junior college staff to the Contractor’s campus to collaborate on the curriculum plan, provide information on the environmental benefits, and offer expert assistance on the implementation of the effort.
Task 10. Work with the State University System to introduce course modules
Contractor is one of 23 state universities and has a good working relationship with other state university engineering programs. Furthermore, the State University System produces more engineers than any other system in California. Objectives of this task include, but are not limited to, the following:

- Identify the best way to interact with the other state universities, for example, inviting the primary “individuals” to a seminar to explain the project and goals of the proposed collaboration, possibly as part of a retreat at one of the state university facilities. Traveling to some of the state universities to teach the modules on their campuses is another possible approach.
- Focus shall begin on the largest engineering programs - Contractor has identified Sacramento State, San Jose State, Cal-Poly San Luis Obispo, Cal-Poly Pomona, Fresno State, and San Diego State as the primary engineering institutions.

Task 11. Work with the University of California System
This task will focus on introducing these modules to the University of California System. Contractor has worked with some of these universities (Davis and Berkeley), but their missions are different than the State University System. Their focus is on graduate education and research. It may be more difficult to introduce these modules into courses taught at University of California campuses. Contractor’s approach will include, but not be limited to, the following:

- Invite the key faculty to a seminar to explain the project and how they can support it in their classrooms. This could be held at a retreat at one of the UC campuses.
- The effort will focus on the largest engineering programs first - Berkeley, Davis, Los Angeles, and San Diego.
- Integrate any appropriate UC research results in the course modules. Contractor has a working relationship through the pavement research centers at UC Davis and UC Berkeley.

Deliverables shall include, but not be limited to, the following:

- To use recycled tires as a construction material in CE applications, students must first study and understand the mechanical properties of the material. This topic would be introduced at freshman year in the Introduction to Civil Engineering Design class (CIVL 131). The need for recycling and sustainability could also be introduced in this class.

- In the sophomore level Materials Science course (MECH 210), which is a course common to most universities and community colleges offering engineering curricula, students would study the mechanical characteristics of crumb rubber or crumb rubber composites. Tests would be conducted to determine the rheological, mechanical and other properties to support the lecture discussion of these topics.

- The next required class that would incorporate an educational module is the Materials Testing Laboratory (CIVL 312). In this junior level class, the mechanical properties of RAC samples would be studied and tested to determine Poisson’s ratio, modulus of elasticity, and the shear modulus (modulus of rigidity).
At the junior and senior levels, students take Contracts Specifications and Technical Reports (CIVL 402), Transportation Engineering (CIVL 441), Soil Mechanics and Foundations (CIVL 411), Environmental Engineering (CIVL 431), and Reinforced Concrete Design (CIVL 415) as required courses for graduation. The use of recycled tire products would be covered in all these courses. CIVL 402, Contracts Specifications and Technical Reports, includes a major writing project related to civil engineering. RAC and CE applications of waste tires would be the topic for this required project. This could be assigned Fall 2007, and the students’ work in this area could be useful in identifying other CE applications for recycled tires as well as providing a literature review on this topic. The students can also research and study contract and specification aspects of utilizing waste tires in RAC and other CE applications. In CIVL 411, Soil Mechanics and Foundations, the engineering properties of crumb rubber would be further investigated. Tests would be conducted to determine porosity and void ratios, as well as internal angle of friction. Compaction characteristics would also be evaluated. Retaining wall design using crumb rubber as a light weight fill would be compared to designs with traditional aggregate backfills. It would be interesting to cover actual case studies on the application of crumb rubber fill and crumb rubber based concrete used in slurry walls for levy reconstruction. Finally, in the environmental class, the importance of recycling tires and using them in value added applications could be covered. CIVL 441, the Transportation Engineering class, would be the appropriate place to introduce the use of recycled rubber tires in RAC applications for pavements. An introduction and overview of RAC applications will be the topic of a lecture to the class. Students will learn the benefits and limitations of the RAC over traditional HMA application. Students will learn to utilize RAC in pavement engineering, including Mix design, structure pavement design, and construction guidelines. The QA/QC components of RAC construction would also be taught in this class. These components shall include mix design certification, inspection at the plant, job site inspections, and trouble shooting. The examples of best practices and case studies shall also be introduced.

In the senior year, the required capstone design course for the transportation or structures curriculum would be used to develop a project for the students on the use of recycled rubber products. For example, a module could be created that would be a required design project using crumb rubber based portland cement concrete as a pavement or structural material. The students would be required to develop a mix design using crumb rubber as a coarse aggregate in place of gravel and manufacture and test concrete cylinders. This data could then be used to develop theories on the behavior of structural elements constructed of crumb rubber concrete (CRC). They could then design and construct structural elements using some reinforcing material (most likely rebar) that could be subsequently tested to validate the models developed. Similar projects could be developed for the environmental capstone design course.
All modular course outlines shall be submitted to the CIWMB Contract Manager for review prior to initiation of the development of the course materials.

**EVALUATION COMPONENT**

**Task 12: Evaluation And Final Report**
An important part of any successful project includes an evaluation component to measure the success of the program. Both segments of this project have a separate evaluation component.

*Continuing Education:*
Contractor will create an evaluation component to be provided during each course and will obtain approval from the CIWMB Contract Manager prior to its implementation in each course. The evaluation forms shall be distributed at the end of each course and be used to provide feedback on the quality and effectiveness of the course presentation and course materials. The baseline data must include professional, geographical, and other important evaluation data. Adjustments will be made to the courses as needed based on the feedback before the next course presentation.

*Curriculum:*
At the end of each course, Contractor will request information from graduating CE students ranking their interest in the RAC and CE applications. This survey will also include a statement on the important affect CE students can have on the environment. Forms currently used for surveying graduating students will be modified for use in evaluating the continuing education and course modules.

Additionally, Contractor must also provide data on the number of students trained under the newly-created curriculum courses.

*Both:*
All evaluation forms will be subject to approval by the CIWMB Contract Manager.

The data collected during the evaluation periods will be collected and presented throughout the contract and to the CIWMB Contract Manager. By the end of the contract, it will be compiled in a Final Report with options or recommendations for further action.

**IV. CONTRACT/TASK TIME FRAME**
The Contract term is estimated to be as follows:

| Project Close | May 15, 2009 |

Details of the contract time frame by task number for this project will be included as an attachment to the contract.