MEMORANDUM

TO: Authority Board Members

FROM: Claude Miller
Director of Procurement

DATE: July 28, 2015

RE: Authorization to Execute Agreement with the
University of Central Florida (UCF) for
Wrong-Way Driving Study Phase III: Allocating and Evaluating Countermeasures on CFX Roadway Network
Contract No. 001143

Board approval is requested to enter into an agreement with the University of Central Florida in the not-to-exceed amount of $200,000.00 for Phase III of a study of wrong-way driving incidents on the Authority's System. This will be a two-year study.

Under Phase III, UCF will: study wrong-way driving countermeasures that will be deployed at ramps and medians throughout the system; help the Authority determine the best way to warn right-way drivers of intentional wrong-way drivers that do not correct their behavior before entering the system; study potential technologies that can prevent wrong-way drivers from entering the system in the first place.

Under the Procurement Policy, paragraph Q, Article XII, this contract is exempt from competitive procurement requirements; however, Board approval is required since the contract amount will equal $50,000.00.

INTERLOCAL AGREEMENT BETWEEN
CENTRAL FLORIDA EXPRESSWAY AUTHORITY
AND
UNIVERSITY OF CENTRAL FLORIDA

THIS AGREEMENT is made and entered into as of the _____day of _____, 2015 ("Effective Date"), by and between the CENTRAL FLORIDA EXPRESSWAY AUTHORITY, a body and corporate politic and agency of the State of Florida, hereinafter referred to as "AUTHORITY" and the UNIVERSITY OF CENTRAL FLORIDA, by and on behalf of its Board of Trustees, hereinafter referred to as "UNIVERSITY"

WHEREAS, the UNIVERSITY is authorized by Section 1004.22, Florida Statutes, to enter into interlocal agreements providing for the performance by one governmental unit on behalf of another of any function which either agency is authorized to perform; and

WHEREAS, the AUTHORITY was created and established to acquire, hold, construct, improve, maintain and operate the Central Florida Expressway Authority System, pursuant to Part IV, Chapter 348, Florida Statutes; and

WHEREAS, pursuant to Section 348.754, Florida Statutes, the AUTHORITY has been granted the power to make and enter into contracts or other transactions and to do all acts and things necessary or convenient for the conduct of its business and for carrying out the purposes of the AUTHORITY; and

WHEREAS, the AUTHORITY desires that the UNIVERSITY to perform a study entitled "Wrong-Way Driving Study Phase III: Allocating and Evaluating Countermeasures on CFX Roadway Network".

NOW, THEREFORE, in consideration of the promises herein made and the benefits to accrue to the parties, and for good and valuable consideration, the parties agree as follows:

1. Services to be provided by the UNIVERSITY shall begin upon the Effective Date and shall be completed no later than two (2) years from the Effective Date, unless extended by written modification and signed by the parties.

2. The UNIVERSITY shall provide the services outlined in the attached Exhibit A Any changes must be approved in writing by the authorized representatives of the parties.

3. Anything contained herein to the contrary notwithstanding, the AUTHORITY shall have final approval of the study product as it relates to its implementation on the AUTHORITY system.

4. The AUTHORITY shall pay the UNIVERSITY for its services as outlined in the budget included in Exhibit A. The payment for all work shall, in no event, exceed $200,000.00. Invoices shall be submitted in a format acceptable to the AUTHORITY with detail sufficient for a proper pre-audit and post-audit thereof. Invoices submitted for pre-authorized travel expenses shall be paid in accordance with the rates specified in Section 112.061, Florida Statutes. Payment will be remitted to:

University of Central Florida
Finance and Accounting

5. ADMINISTRATIVE PERSONNEL

AUTHORITY:

Technical and Contractual:
Corey Quinn, P.E.
Central Florida Expressway Authority
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Orlando, FL 32807

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E-mail: Corey.Quinn@CFXway.com

UNIVERSITY

Technical:
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Contractual:
Jessica Maass
University of Central Florida
Office of Research and Commercialization
12201Research Parkway, Suite 501
Orlando, FL 32826-3252
Phone: (407) 823-1294
Fax: (407) 823-1379
e-mail: Jessica.Maass@ucf.edu

6. The UNIVERSITY agrees to keep and maintain accounts in order to record complete and correct entries as to all costs and expenditures. No funds provided by the AUTHORITY shall be expended for expenses other than for the study. Such books and records shall be available at all reasonable times during normal business hours for examination and audit by the AUTHORITY. Incomplete or incorrect entries in such books and records will be grounds for disallowance by the AUTHORITY of any fees, expenses or costs based upon such entries.

7. Both parties and any subconsultants to this Agreement shall comply with the provisions of Chapter 119, Florida Statutes, and shall permit public access to all documents, papers, letters or other material subject to the provisions of Chapter 119, Florida Statutes, and made or received in conjunction with this Agreement. If either party claims such material to be exempt from public inspection such party shall provide the other party written citation to the appropriate statutory exemption.

8. The AUTHORITY and the UNIVERSITY agree that at future dates this Agreement may be extended or supplemented for future services, as mutually agreed to and signed by the authorized representatives of the parties.

9. UNIVERSITY assumes any and all risks of personal injury and property damage attributable to the negligent acts or omissions of its officers, agents or employees while acting within the scope of their employment by UNIVERSITY. Neither the UNIVERSITY, nor any of its agents or employees will be liable under this section for damages arising out of injury or damage to persons or property directly caused or resulting from the negligence of the AUTHORITY or any of its officers, agents or employees. In no event will UNIVERSITY be responsible for any incidental damages, consequential damages, exemplary damages of any kind, lost goodwill, lost profits, lost business and/or any indirect economic damages whatsoever regardless of whether such damages arise from claims based upon contract, negligence, tort (including strict liability or other legal theory), a breach of any warranty or term of this agreement, and regardless of whether it was advised or had reason to know of the possibility of incurring such damages in advance.

10. The UNIVERSITY warrants that it has not employed or obtained any company or person, other than bona fide employees or consultants of the UNIVERSITY to solicit or to secure this Agreement, and it has not paid or agreed to pay any company, corporation, individual or firm, other than bona fide employees employed by the UNIVERSITY. For the breach or violation of this provision, the AUTHORITY shall have the right to terminate the Agreement at its discretion.

11. This Agreement or any interest herein shall not be assigned, transferred or otherwise encumbered under any circumstances by either party without the prior written consent of the other party. However, the Agreement shall run to the AUTHORITY and its successors.

This Agreement may be terminated by the either party upon 30 days written notice to the other. In the event of termination by the parties the AUTHORITY will pay the UNIVERSITY for all costs incurred and any non-cancellable obligations properly incurred through the date of termination.

12. The parties agree that UNIVERSITY may publish the results of the work in its own form.

13. Except for ownership of Intellectual Property pursuant to Section 14, and publications pursuant to Section 12, AUTHORITY is and shall be and remain the sole owner of all deliverable documents, software, data and items developed with respect to and in connection with the performance of this Agreement. UNIVERSITY may not use such materials in any way, other than in performance of its services under the terms of this Agreement, without the prior written consent of AUTHORITY, which may be granted or denied in the AUTHORITY's sole discretion. Deliverable information and work product generated in connection with this Agreement shall be the property of AUTHORITY. UNIVERSITY shall not transfer, disclose or otherwise use such information or work product for any purpose other than in performance of its duties hereunder, without AUTHORITY's prior written consent, which may be withheld or granted in the sole discretion of AUTHORITY. Information and materials with respect to the AUTHORITY and this Agreement obtained by UNIVERSITY during the Term of this Agreement shall remain confidential for a period of three (3) years from the Effective Date. Notwithstanding the foregoing, both parties will be subject to the requirements of the Florida Public Records law and any valid court order.

14. The term "Intellectual Property" means individually and collectively all inventions, improvements and/or discoveries, patentable or unpatentable, copyrightable or uncopyrightable, including but not limited to mask works, computer software, both object and source code, data bases and works of authorship.

Intellectual Property developed solely by UNIVERSITY shall be solely and exclusively owned by UNIVERSITY ("UNIVERSITY Intellectual Property"). Intellectual Property developed solely by AUTHORITY shall be solely and exclusively owned by AUTHORITY ("AUTHORITY Intellectual Property"). "Joint Intellectual Property" means any Intellectual Property developed jointly by the AUTHORITY and UNIVERSITY under this Agreement. Joint Intellectual Property will be owned jointly by AUTHORITY and UNIVERSITY, who agree to jointly determine proper inventorship, authorship,and ownership subject to Title 35 of the United States Code for inventions and Title 17 of the United States Code for works of authorship, and to jointly determine filing and licensing.

"Background Intellectual Property" means Intellectual Property which was in existence, prior to the Effective Date of this Agreement, or which is subsequently created or developed by a party so long as such creation or development was not in the course of this project. The parties agree that Background Intellectual Property of AUTHORITY and UNIVERSITY is their separate property, respectively, and are not affected by this Agreement. Neither party shall acquire any claims to or rights in the Background Intellectual Property of the other party.

Nothing in the Agreement shall circumvent or restrict either party's pre-existing obligations with the U.S. government pertaining to any kind of intellectual property or any copyrightable material or other Intellectual Property, including but not limited to such pre-existing obligations contained in grants, contracts and other types of agreements or arrangements between either parties, and the U.S. government. These obligations may include granting licenses to the U.S. government for certain Intellectual Property or any copyrightable material or other intellectual property which is being developed.

Notwithstanding any provision to the contrary in the Agreement, UNIVERSITY shall retain the right to practice any invention, discovery and copyright developed hereunder for its own academic, non-commercial research and teaching purposes.

15. The parties will attempt in good faith to resolve any controversy or claim arising out of or relating to this Agreement promptly by negotiations between senior executives of the parties who have authority to settle the controversy.

The disputing party shall give the other party written notice of the dispute. Within twenty days after receipt of said notice or longer with the prior written approval from the disputing party, the receiving party shall submit to the other a written response. The notice and response shall include (a) a statement of each party's position and a summary of the evidence and arguments supporting its position, and (b) the name and title of the executive who will represent that party. The executives shall meet at a mutually acceptable time and place within thirty days of the date of the disputing party's notice and thereafter as often as they reasonably deem necessary to exchange relevant information and to attempt to resolve the dispute.

In the event a dispute arising out of or related to this Agreement (on the Services performed thereunder) has not been resolved pursuant to the aforesaid mediation procedure within sixty days of the initiation of such procedures, the parties shall be free to pursue any available legal remedies.

This Agreement and the rights of the parties will be governed and construed in accordance with the laws of the State of Florida and the United States, without regard to its choice of law principles. The parties agree that jurisdiction and venue for any action arising under this Agreement shall lie exclusively within either the state courts of Florida located in Orange County, Florida or the United States District Court for the Middle District of Florida, Orlando Division. The parties specifically waive the right to any other jurisdiction and venue, and the defense based on inconvenient forum.

16. The AUTHORITY and the UNIVERSITY recognize that time is of the essence with respect to the Agreement and UNIVERSITY shall meet the date specified in Exhibit A attached hereto.

17. No failure or delay by a party hereto to insist on the strict performance of any term of this Agreement, or to exercise any right or remedy consequent to a breach thereof, shall constitute a waiver of any breach or any subsequent breach of such term. No waiver of any breach hereunder shall affect or alter the remaining terms of this Agreement, but each and every term of this Agreement shall continue in full force and effect with respect to any other then existing or subsequent breach thereof.

18. Neither party shall be liable in damages or have the right to terminate this Agreement for the delay or default in performing hereunder if such delay or default is caused by conditions beyond its control including, but not limited to, Acts of God, government restrictions, wars, insurrections and/or any other cause beyond the reasonable control of the party whose performance is affected.

19. Both parties are subject to United States laws and regulations controlling the export of technical data, computer software, laboratory prototypes and other commodities, and that its obligations hereunder are contingent on compliance with applicable U.S. export laws and regulations (including the Arms Export Control Act, as amended, and the Export Administration Act of 1979). The transfer of certain technical data and commodities may require a license from the cognizant agency of the United States Government and/or written assurances by the parties that they will not re-export data or commodities to certain foreign countries without prior approval of the cognizant government agency. While UNIVERSITY agrees to cooperate in securing any license which the cognizant agency deems necessary in connection with this Agreement, UNIVERSITY cannot and does not guarantee that such licenses will be granted.

20. UNIVERSITY is a NON-PROFIT EDUCATIONAL INSTITUTION. UNIVERSITY MAKES NO REPRESENTATIONS AND EXTENDS NO WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED WITH REGARD TO THE RESEARCH AND WORK PERFORMED UNDER THIS AGREEMENT. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY

OR FITNESS FOR A PARTICULAR PURPOSE, OR THAT ANY RESEARCH DELIVERABLES OR INTELLECTUAL PROPERTY DEVELOPED By UCF UNDER THIS AGREEMENT WILL NOT INFRINGE ANY THIRD PARTY PATENT, COPYRIGHT, TRADEMARK, OR OTHER THIRD PARTY RIGHTS. UNIVERSITY MAKES NO REPRESENTATION AS TO THE USEFULNESS OF RESEARCH DELIVERABLES OR INTELLECTUAL PROPERTY. IF THE AUTHORITY CHOOSES TO EXPLOIT RESEARCH DELIVERABLES OR INTELLECTUAL PROPERTY IN ANY MANNER WHATSOEVER, IT DOES SO AT ITS OWN RISK.

21. UNIVERSITY and the AUTHORITY may not use each other's name or trademarks in any promotion, statement, advertisement, press release or communications to the general public or any third party without each other's express written consent. Any proposed public statement, advertisement, press release or communications by either party shall be submitted to the other party for its review and written approval at least thirty (30) days prior to the planned dissemination or publication.

22. UNIVERSITY shall provide services under this Agreement as an independent contractor and as such shall maintain complete control over and be responsible for all of its operations and personnel. This Agreement shall not be deemed to create any other form of employment relationship or business organization between the parties.

23. If any one or more of the provisions of this Agreement shall be held to be invalid, illegal or unenforceable, the validity, legality or enforceability of the remaining provisions of this Agreement shall not be in any way affected or impaired thereby and shall remain in full force and effect.

24. This Agreement may be executed in counterparts, each of which shall be considered an original, but which together shall constitute but one and the same Agreement.

25. This Agreement and its Exhibit(s) constitute the entire agreement of the parties and supersedes all prior communications, understandings and agreements relating to the subject matter hereof, whether oral or written.

IN WITNESS WHEREOF, the parties hereto set their hands and seals the day and year first above written.

UNIVERSITY OF CENTRAL FLORIDA

BY:_____
Authorized Signature

_____
Print Name

Title:_____

Legal Content Approved for the University:

_____
Name:

Date:_____

CENTRAL FLORIDA EXPRESSWAY AUTHORITY

BY:_____
Director of Procurement

Approved as to form and execution, only.

General Counsel for the AUTHORITY

_____

FINAL VERSION
RESEARCH PROPOSAL
Version 8.0

Submitted to

Central Florida Expressway Authority (CFX)

WRONG-WAY DRIVING PHASE-3 STUDY: ALLOCATING AND EVALUATING COUNTERMEASURES ON CFX ROADWAY NETWORK

Proposed Contract Period	**24 months**
Proposed Project Duration	**08/17/2015-08/17/2017**
Total Contract Amount	**$200,000**

Proposal Submitted By

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And

Adrian Sandt, UCF PhD Student and Graduate Student Researcher
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Originally Submitted in April 2015
Revised Version Submitted in June 2015
Final Version Submitted in July 2015

WRONG-WAY DRIVING PHASE-3 STUDY: ALLOCATING AND EVALUATING COUNTERMEASURES ON CFX ROADWAY NETWORK

Principal Investigator:
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1. RESEARCH GOAL AND OBJECTIVES

Research Main Goal

The main goal of this proposed study is to evaluate wrong-way driving (WWD) countermeasures that will be deployed at ramps and medians throughout the CFX toll road network, help CFX determine the best way to warn right-way drivers of intentional wrong-way drivers that do not correct their behavior before entering the mainline, and study potential technologies that can prevent these wrong-way drivers from entering the mainline in the first place.

Research Objectives

To achieve the main goal of this research, the following objectives need to be achieved:

1) Collect a sufficient sample of WWD data for the entire CFX system to evaluate their implemented WWD countermeasures. Examples of this data include WWD crashes, 911 calls, citations, traffic management center (TMC) logs, SunGuide reports, and detections (TAPCO logs and video recordings, Wavetronix or similar detections from other devices, etc.), as well as geometric design of interchange types that are known to have higher than normal frequency of WWD events as reported in the literature and FDOT design documents (examples of this include partial cloverleaf interchanges);
2) Develop a scoring methodology to identify locations where deployment of Rapid Rectangular Flashing Beacons (RRFBs) would be beneficial. This methodology will consider many factors, including WWD history (crashes, 911 calls, citations, etc.),

interchange design (partial cloverleaf, extended left turn lanes, etc.), and other factors driven by CFX (e.g., infrastructure readiness in terms of ITS equipment at these sites and budget considerations);

3) Study the effects of WWD countermeasures implemented at medians. The types of median countermeasures to be studied will be determined based on the results of literature review;
4) Study various methods of warning right-way drivers about WWD events to determine the most appropriate methods for the CFX roadway network;
5) Evaluate technologies that can physically prevent wrong-way vehicles from entering the mainline (e.g., nets or barriers) to see if these technologies are feasible and effective;
6) Analyze the WWD detection data collected from the RRFBs installed at the CFX pilot test locations to understand how drivers react to these devices (correct themselves or keep driving the wrong way).

2. EXECUTIVE SUMMARY

CFX has been proactively involved in understanding and combatting wrong-way driving (WWD) since they contracted with the University of Central Florida (UCF) in 2012 to explore the extent of WWD problem on its toll road network as part of a Phase-1 study. The results of this study, "*Wrong-Way Driving Incidents on OOCEA Toll Road Network, Phase-1 Study: What is the Extent of this Problem?*" showed that WWD is a significant problem in Central Florida and has been growing in recent years.

To reduce WWD, and based on suggestions from UCF in Phase 1 final report, CFX decided to test the use of Rapid Rectangular Flashing Beacons (RRFBs) as WWD countermeasures in a

Phase-2 study. This technology had previously been used for pedestrian crossings; it had never been used as a WWD countermeasure. During the Phase-2 study, "*Wrong-Way Driving Incidents on CFX Toll Road Network, Phase-2 Study: Developing Countermeasures,*" the RRFB technology was successfully tested, first in the CFX headquarters parking lot, then at the SR 528 and SR 520 ramp. Since the RRFBs were implemented at this location in January 2015, CFX have successfully detected several vehicles driving the wrong way on the exit ramp, as verified by the TAPCO camera and the numerous images taken of the wrong-way vehicles.

The success of this technology has convinced CFX to implement it at additional ramps along their toll road network. A methodology will be developed by UCF in this proposed Phase 3 that will estimate WWD risk values for roadway segments including interchanges throughout the CFX network. This methodology will use real-life WWD data, examples of which include WWD crash data, 911 call data, citation data, TMC logs, SunGuide reports, TAPCO BlinkLink detection data, TAPCO video logs, and Wavetronix (and/or similar) detection data. Other considerations, such as the presence of partial cloverleaf interchanges, extended left turn bays, and other CFX practical constraints (e.g., budget and infrastructure ITS equipment readiness/limitations) will also be considered when developing this methodology. It is believed that no methodology like this has ever been developed that focuses solely on WWD.

In addition to exit ramps, another potential source of WWD events is median crossovers. These types of events can occur on stretches of roadway where there is only a paved or grassy median or in spaces in barriers designated for emergency or law enforcement use. To prevent these types of WWD events, various potential median WWD countermeasures will be studied to see which would be effective for CFX. The types of median countermeasures to be

studied will be determined based on the results of literature review. The best locations to implement these countermeasures will also be determined and detection data will be collected at these implementation sites to evaluate how effective these countermeasures are.

While WWD countermeasures can help prevent confused wrong-way drivers from entering the mainline, these devices may not be effective at preventing intentional wrong-way drivers, such as suicidal drivers, from entering the mainline. Additionally, extremely intoxicated drivers might not comprehend that they are driving the wrong way when they encounter the WWD countermeasures. Therefore, it is important for CFX to be able to notify right-way drivers when a wrong-way driver has entered the system. There are many possible ways to notify these drivers of WWD events, including DMS, smartphone applications, and in-vehicle notifications. These various methods will be examined to determine the most effective options for CFX based on roadway characteristics and driver preferences. To obtain driver preferences, a customer survey will be developed, then reviewed and approved by the CFX's Deputy Executive Director before implementation. This survey will ask CFX customers how they would like to receive WWD notifications, along with other WWD related questions. An analysis of potential ways to physically prevent intentional or intoxicated drivers from entering the mainline will also be performed to see if these technologies, which can include barriers, nets, or other similar devices, are feasible and would be effective for the CFX to implement at its ramps.

This is a fixed lump sum 24 months Phase-3 study proposal with requested total budget of $200,000. This will be billed in 8 equal invoices, $25,000 each, every three months (the last invoice will be billed at the end of the 24th month). Details of the budget are provided on the last page of this proposal.

3. UNDERSTANDING OF THE PROBLEM

Wrong-way driving (WWD) is a rare but serious event which often occurs during late night hours and typically involves impaired drivers (intoxicated, tired, or confused). Crashes caused by WWD often result in severe injuries or fatalities, especially on toll roads or other limited access facilities due to the high travel speeds. The low frequency of WWD crashes presents a difficult challenge to researchers, so other WWD data is needed to accurately research and effectively prevent WWD events. This data includes WWD 911 call data, citation data, TMC logs, and detection data (e.g., video, camera, or radar). A sufficient quantity of data (at least one year or more) is also necessary to properly understand the effects of WWD countermeasures. WWD countermeasures can prevent confused drivers from entering the mainline while traveling the wrong direction, but they will not prevent intentional wrong-way drivers (suicidal or extremely intoxicated drivers) from entering the mainline. However, the risk of crashes due to these wrong-way drivers can be reduced by notifying right-way drivers that a wrong-way driver has been spotted or by implementing technologies, such as barriers or nets, that could physically prevent a wrong-way driver from entering the mainline. These preventative technologies require a lot of study before implementation to ensure there are no adverse effects to traffic operations, safety, or emergency response and to make sure these technologies are feasible and appropriate. Methods of notifying right-way drivers can include DMS, highway advisory radio, smartphone applications, or in-vehicle devices; these methods need to be evaluated and CFX customer preferences need to be determined to decide which methods would be the most effective. These potential methods will be discussed and approved by the CFX Deputy Executive Director before they can be released or included in the customer survey.

4. BENEFITS TO CFX

The main benefits of this Phase-3 study to CFX are:

- Saving lives of CFX customers from the danger they could face if wrong way drivers continue to pursue their behavior to the mainline without being detected in time and/or stopped.
- Demonstrating that CFX is using their budget carefully and wisely by installing RRFBs and other effective countermeasures where they are mostly needed.
- Providing notifications to right-way drivers about WWD events that can allow the right-way drivers to be aware of and potentially avoid collisions.
- Evaluating the effects of RRFBs and median WWD countermeasures to understand which countermeasures are effective in which locations.
- Developing potential innovative technologies to prevent wrong-way drivers from entering the mainline.
- Demonstrating to CFX's customers that their safety is priority.

5. PLAN FOR IMPLEMENTATION OF RESULTS

From this Phase-3 study, CFX will understand how the implemented WWD countermeasures at ramps and medians affect WWD. CFX will also gain valuable insight on right-way driver notification methods and potential technologies to prevent wrong-way drivers from entering the mainline. With this knowledge, CFX can effectively decide on what types of technologies to test and/or implement to reduce WWD crashes on the mainline.

6. PROPOSED RESEARCH APPROACH

Tasks

To achieve the stated goal and objectives of this proposed project, the University of Central Florida's (UCF) research team members under the guidance of Professor Haitham Al-Deek, Ph.D., P.E., (UCF Principal Investigator, PI), will perform the proposed project tasks listed in this section. Their aim will be to assist CFX in implementing WWD countermeasures at ramps and medians and assessing their performance, as well as determining ways to notify right-way drivers and prevent intentional wrong-way drivers from entering the mainline. Professor Al-Deek will be assisted by some of his students: Adrian Sandt, a UCF Ph.D. student and Trustees Fellowship recipient; and Ahmad Alomari, a UCF Ph.D. candidate with 3+ years industry experience, in addition to other outstanding engineering students not yet identified in this project. Additionally, Dr. Grady Carrick of Enforcement Engineering Inc., who is a former Chief of FHP in Jacksonville area (for a period of 30 + years) with very important hands on experience in first response to WWD incidents, will also be subcontracted by UCF to assist in critical data collection on the performance of WWD countermeasures, and will provide law enforcement perspective concerning UCF innovative WWD countermeasures, right-way driver notification methods, and technologies to stop wrong-way drivers.

Tasks to be performed by the UCF research team include the following:

1. *Phase-3 kick-off meeting between UCF research team and CFX.*
2. *Methodology development.* A methodology will be developed to identify locations at the highest risk for WWD activity. This methodology may use some or all of the following: historic WWD data, including crashes, 911 calls, citations, TMC reports, and detection data, as well as design characteristics (interchange type and presence of potentially

confusing features) to estimate the WWD risk of the selected ramps and other potential ramps that were not selected.

3. *Collection and analysis of WWD data.* Accurate and reliable data is crucial for this project. A variety of WWD data will be collected and analyzed for the entire CFX system. Examples of this data include WWD crash data, 911 call data, citation data, TMC logs, and Sunguide reports. Additionally, WWD detection data obtained from the installed RRFBs at the pilot ramps will also be analyzed. This data includes TAPCO BlinkLink logs and video as well as Wavetronix (or similar devices) detection logs. Data will also be collected from the median WWD countermeasures that will be implemented as part of Task 7. It is highly recommended to collect a minimum of one year of data after implementation for each site to accurately evaluate the countermeasures.
4. *Literature review on median WWD countermeasures.* To determine the most effective countermeasures at preventing median crossovers, previous research will be reviewed. Many types of countermeasures ranging from signs and pavement markings to ITS technologies will be analyzed to determine which would be most effective for CFX.
5. *Examination of right-way driver notification systems.* There are many ways that CFX could potentially alert right-way drivers of WWD events. To determine the most effective notification methods, a literature review and a customer survey, with its questions being pre-approved by the CFX Deputy Executive Director, will be conducted as part of this task.
   5.1. *Literature review on WWD notifications.* A literature review will be conducted on ways other agencies currently warn about wrong-way drivers. Based on this review, potential notification methods for CFX will be identified.

5.2. *Customer survey on WWD notifications.* In addition to the literature review, a customer survey will also be developed, reviewed and pre-approved by the CFX Deputy Executive Director, then implemented to obtain the opinions of CFX's customers regarding WWD notifications and countermeasures. This survey will be implemented online and will ask customers about their preferences concerning WWD notification methods and messages, as well as about WWD countermeasures.

5.3. *Determination of notification methods.* Based on Tasks 5.1 and 5.2, the most appropriate notification methods for the CFX system will be determined. Additional research will be performed to determine the optimal deployment methods for these notification methods.

6. *Review of technologies to stop intentional wrong-way drivers.* Since intentional wrong-way drivers, such as suicidal drivers, will not correct themselves when they encounter WWD countermeasures, additional technologies could be necessary to prevent these drivers from entering (or continuing on) the mainline. A literature review will be conducted on potential technologies that can physically prevent wrong-way drivers from entering the mainline to see if these technologies are feasible or would be effective for CFX to implement. Other innovative technologies that have not previously been used as WWD countermeasures will also be evaluated to see if they would be appropriate. If feasible technologies are found, testing plans and appropriate documentation for the MUTCD's Request to Experiment (RTE) will be developed.

7. *Determination of appropriate median crossover countermeasures.* Based on the literature review conducted in Task 4, appropriate countermeasures to prevent median crossovers will be determined. Appropriate sites for implementation of these countermeasures will be

determined using a methodology similar to the methodology developed in Task 2, but customized for medians. Once the median locations have been selected and the countermeasures installed, WWD data at these sites will be collected, as described in Task 3.

8. *Progress reports for FHWA RTE.* Every six months, a progress report will be written for the FHWA RTE of all RRFBs installed on the CFX system at the time of each report. These progress reports will indicate the progress of this experiment, including any important observations and issues that occurred or were resolved.
9. *Recommendations for CFX.* Based on the results of the previous tasks, recommendations will be provided to CFX. Recommendations on the use of RRFBs and the applied median countermeasures will be made based on the results of Task 3. Effective methods to notify right-way drivers of WWD events will be made based on the results of Task 5 and potential preventative technologies will be recommended based on the results of Task 6. These recommendations will include the types of technologies and potential testing and/or implementation methods.
10. *Final report and presentation of results to CFX.* At the end of the project, a final report will submitted in electronic format and a final presentation will be made to CFX.
11. *Progress Presentations.* A progress presentation will be made to CFX approximately once every three months. These progress presentations are deliverables by themselves. They shall occur such that their results can be incorporated into the Director of Expressway Operations' quarterly safety briefing to the CFX Board of Directors. CFX will notify UCF about the date of each of their Board of Directors' meetings six weeks before each meeting date. Then, UCF will set up a progress presentation with the CFX project manager two weeks before the Board of Directors' meeting. Each progress

presentation shall contain a summary of CFX WWD statistics for the previous quarter, previous twelve months, and pilot inception to date (i.e., January 2015). The last progress presentation is the same as the final presentation.

7. QUALIFICATIONS OF THE UCF PI AND HIS RESEARCH TEAM AS EVIDENCED BY PAST EXPERIENCE IN THE FIELD

Professor Al-Deek, Ph.D., P.E., is the Principal Investigator of Phase-1 and Phase-2 WWD studies sponsored by CFX. He has more than **twenty nine years** of experience in transportation engineering, planning, and operations. He is **nationally recognized in his field and received the best paper award on wrong way driving granted to him and his research team by the Freeway Operations Committee of the National Research Council-Transportation Research Board (TRB) in April 2015. He also received two Chairman Awards from TRB for his significant contributions to the fields of *Freeway Operations*, and *Regional Transportation Systems Management and Operations* in January 2012. In addition, he received the best TRB freeway operations paper award in 2010, which was about the impact of Dynamic Message Signs on OOCEA drivers. He also received the best paper award on smart event management by the TRB Regional Transportation Systems Management and Operations Committee in 2012, and another best paper award by the TRB Freeway Operations Committee on travel time prediction in 2003.** Recently, he won a competitive national research project in collaboration with Texas Transportation Institute (TTI) on wrong way driving countermeasures (NCHRP 03-117). Professor Al-Deek was invited as keynote speaker to talk about innovative research methodology and countermeasures for combating wrong way driving at the 7th Traffic Safety Conference in Amman, Jordan, May 12-13, 2015. He was featured as a

distinguished researcher by the UCF College of Engineering and Computer Science in 2003. He received the Research Incentive Award in 2001 and the UCF Researcher of the Year 1999 Award (this is a very prestigious award given to the best professor researcher of the year out of the entire UCF's 1300+ faculty). He graduated from the University of California at Berkeley in 1991. Professor Al-Deek was the principal (or co-principal) investigator of more than **70** applied research projects at UCF and elsewhere, and a large number of them were sponsored by CFX. Since joining UCF in 1992, the total budget of applied research projects he attracted to UCF exceeded $7 million. He has published more than 310 papers and technical reports in peer-reviewed journals and conferences, and nearly half of these publications are related to traffic operations and **CFX toll roads**. He chaired 9 Ph.D. dissertations and 26 MS theses to completion. Presently, and for the past 15 years, he is the Chair of TRB's paper review for all papers submitted to two key Transportation Research Board committees: *Freeway Operations*, and the *Regional Transportation Systems Management and Operations*. These two committees review nearly all papers submitted to TRB's annual meeting on freeway and toll operations and management every year. Professor Al-Deek has been an associate editor of the Journal of Intelligent Transportation Systems (J-ITS) since 2007.

Professor Al-Deek teaches undergraduate and graduate courses at UCF. He developed *new* courses such as Intelligent Transportation Systems (ITS), Highway Capacity, Traffic Operations, Mass Transit, Transportation Engineering Systems, and Highway Engineering. He also teaches Urban Systems Design and Transportation Engineering courses on a regular basis. Professor Al-Deek has been an active registered professional engineer in Florida since 1998. Professor Al-Deek has completed three federally mandated training courses required for all principal investigators and key personnel working on projects dealing with human subjects in surveys

and/or interviews.

Adrian Sandt, Ph.D. student, is currently a graduate research assistant at the University of Central Florida. He obtained his B.S. in Civil Engineering from UCF and is currently pursuing his Ph.D. under supervision of Professor Al-Deek. Mr. Sandt is a recipient of the UCF Trustees Fellowship. He is extremely proficient in technical writing, and he has been involved with CFX's Phase-1 and Phase-2 WWD studies.

Ahmad Alomari, Ph.D. candidate, is a Ph.D. Candidate and a graduate research assistant at the University of Central Florida. His background includes over three years of industry experience with the private sector as a traffic engineer and transportation planner. He has experience in traffic engineering and transportation planning studies including but not limited to the following: analysis and design of intersections/interchanges, traffic impact studies, road safety audit, and development of public transportation studies. Also, he was involved in lecturing at training programs for the following topics: traffic modeling and simulation, public transportation concepts, urban transportation planning, and computer software applications in transportation engineering (e.g., VISSIM, VISUM, CORSIM, HCS+ and SIDRA). Mr. Alomari has M.S. degree in transportation engineering from Jordan University of Science and Technology. His thesis topic focused on evaluation of strategies for traffic management using simulation. Presently, Mr. Alomari is pursuing his Ph.D. dissertation at UCF under supervision of Professor Al-Deek.

Grady Carrick, Ph.D., is a thirty year plus veteran of the Florida Highway Patrol, who retired at the rank of Chief in 2012. Dr. Carrick has spent his career building bridges between the law enforcement and transportation professions. He has a national reputation as an advocate for traffic safety and traffic incident management. His leadership in the Florida Strategic Highway Safety Plan, the Florida Bicycle and Pedestrian Advisory Board, and numerous Community Traffic Safety Teams are a few accomplishments. Carrick has participated in several traffic safety initiatives as a member of The International Association of Chiefs of Police (IACP). In his current position as principal for the firm Enforcement Engineering Inc., he seeks to improve transportation safety through the integration of transportation engineering, research and enforcement operations. He has extensive experience in traffic safety analysis and the development of law enforcement countermeasures. In addition to his professional accomplishments, Dr. Carrick holds a Ph.D. in Transportation Engineering from the University of Florida. He has published and presented at numerous state, national, and international conferences on traffic safety and operations.

Roles and Responsibilities of Project Team

The roles and responsibilities of the project team are listed below. Additional information on the team can be found in the qualifications of the UCF research team section in this proposal.

Professor Haitham Al-Deek, Ph.D., P.E., *UCF Principal Investigator.* He will be responsible for the entire project management and coordination with CFX, budget control, submitting the final report, conducting progress and final presentations to CFX, and attending project meetings with CFX.

Adrian Sandt, *Graduate Research Assistant and UCF Ph.D. Student.* He will be responsible for editing of reports, presentations, as well as other products submitted to CFX during the course of this study. He will also help with methodology development and data analysis, as well as work on the literature reviews, final report and progress presentations and will attend some of the project meetings with CFX.

Ahmad Alomari, *Graduate Research Assistant and UCF Ph.D. Candidate.* He will help with literature reviews and data analysis, as well as the methodology development.

Grady Carrick, Ph.D., *Enforcement Engineering Inc.* He will provide the research team with vital WWD 911 call and citation data in a timely fashion to evaluate the implemented WWD countermeasures (RRFBs and median treatments) and meet the project deadlines on time. He will also provide the perspective of law enforcement and input on the median treatments and the feasibility of innovative technologies to stop intentional wrong-way drivers.

8. DELIVERABLES

a. **Kick Off Meeting.** A kick off meeting will be conducted with CFX's project manager and the UCF research team within the first 30 days of contract execution. The meeting will discuss the research plan.

b. **Progress Presentations.** A progress presentation will be made to CFX approximately once every three months. These progress presentations are deliverables by themselves. They shall occur such that their results can be incorporated into the Director of Expressway Operations' quarterly safety briefing to the CFX Board of

Directors. CFX will notify UCF about the date of each of their Board of Directors' meetings six weeks before each meeting date. Then, UCF will set up a progress presentation with the CFX project manager two weeks before the Board of Directors' meeting. Each progress presentation shall contain a summary of CFX WWD statistics for the previous quarter, previous twelve months, and pilot inception to date (i.e., January 2015). The last progress presentation is the same as the final presentation.

c. **Final Report.** A final report will be submitted to CFX in MS Word or PDF format. The final report will be provided in electronic format only.

d. **Project Final Presentation to CFX.** The UCF research team will make a final presentation at CFX's office with their conclusions and recommendations. The final presentation represents the last progress presentation in this project.

9. TRAVEL

Travel includes **8 meetings** in addition to **a kick-off meeting** with CFX, the project sponsor, in their Orlando office. Estimate of local travel cost is included in the budget where only mileage and tolls will be charged.

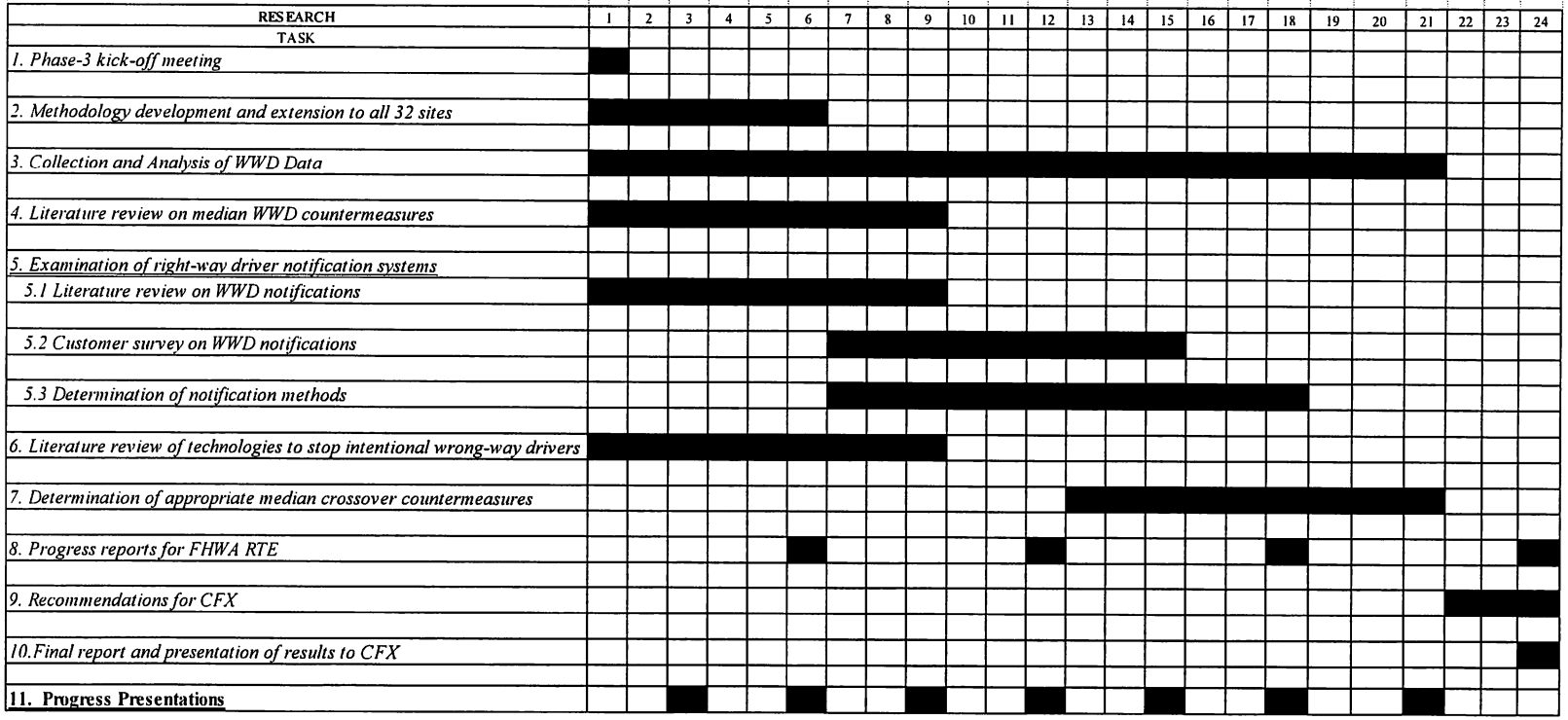
10. PROJECT SCHEDULE

Central Florida Expressway Authority

CFX

PROJECT SCHEDULE

Project Title	WRONG-WAY DRIVING PHASE-3 STUDY: ALLOCATING COUNTERMEASURES ON CFX ROADWAY NETWORK
Start - Finish	August 17, 2015 to August 17, 2017
Research Agency	University of Central Florida
Principal Investigator	Professor Haitham Al-Deek, Ph.D., P.E., University of Central Florida



11. BUDGET SHEET

WRONG-WAY DRIVING PHASE-3:				
ALLOCATING COUNTERMEASURES ON CFX ROADWAY NETWORK				
PROJECT PERIOD (AUGUST 17, 2015- AUGUST 17, 2017)				
	PROJECT DURATION IS 24 MONTHS			**TOTAL**
PERSONNEL	Hours	Rate	Subtotal	
P.I. (Professor Al-Deek, Ph.D., P.E.)	400	$87.48	$34,992	$34,992
Graduate Research Assistant (1.5 student)	3120	$20.50	$63,960	$63,960
OPS	1040	$20.50	$21,320	$21,320
Undergraduate student	476	$10.00	$4,760	$4,760
PERSONNEL BENEFITS				
P.I. (Professor Al-Deek, Ph.D., P.E.)		28.60%	$10,008	$10,008
Students		0.40%	$275	$275
OPS		1.85%	$394	$394
EXPENSES				
Local travel for CFX project meetings	Trips	Each Trip		
	9	$30.0	$270	$270
WWD Survey			$6,500	$6,500
Enforcement Engineering, Inc. Subcontract			$10,000	$10,000
	Months	Cost/Month		
Supplies	24	$29	$696	$696
Student tuition (1.5 student)			$28,644	$28,644
DIRECT COST PER TIME PERIOD			$181,819	$181,819
INDIRECT COST (10%)				$18,181
TOTAL COST				**$200,000**

*Hours and hourly rates are included in this budget for estimating purposes only. Faculty and Administrative and Professional personnel of the University of Central Florida are salaried employees that do not complete time cards. Invoicing for services rendered will be based on percentage of total professional effort, in amounts not to exceed the total budgeted salary.

** Budget does not include cost of any equipment or installation of WWD countermeasure devices. These will be procured and installed by CFX.*