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Victoria F. Sheehan
Commissioner

THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION



William Cass, P.E.
Assistant Commissioner

Bureau of Materials & Research
December 5, 2016

Her Excellency, Governor Margaret Wood Hassan
and the Honorable Council
State House
Concord, New Hampshire 03301

REQUESTED ACTION

Authorize the Department of Transportation to enter into a **SOLE SOURCE** Agreement with the University of Vermont Sponsored Project Administration (Vendor #160344), Burlington, VT, for a total fee not to exceed \$85,000, for an investigation of the costs, benefits, and barriers to integrating the use of Unmanned Aircraft Systems (UAS) into Department operations (SPR 26962J) effective upon Governor and Council approval through March 3, 2019. 100% Federal Funds.

Funding is available as follows:

04-96-96-962015-3036	<u>FY 2017</u>
SPR Research Funds	
046-500464 General Consultants Non-Benefit	\$85,000.00

EXPLANATION

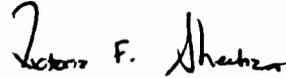
The Department is collaborating with the Spatial Analysis Lab at the University of Vermont (UVM) to conduct a research study that will address opportunities to use Unmanned Aircraft Systems (UAS) in Department activities to improve safety and reduce costs in the delivery of an effective transportation system for the state of New Hampshire. UVM is uniquely qualified to conduct this study because of their extensive experience with UAS having carried out over 450 missions. In addition, they possess a FAA Section 333 exemption, which enables them to operate UAS for commercial and research purposes. As such, the proposed work does not lend itself to a selection process that includes private industry or in-state organizations, and it is in the Department's and the State's best interest to work directly with UVM.

This project will evaluate the capabilities and limitations, including costs and benefits, to use Unmanned Aircraft Systems for NHDOT activities. The project will also outline policies, procedures, staffing, and information technology infrastructure needed to develop a UAS capability at the New Hampshire Department of Transportation.

This Agreement has been approved by the Attorney General as to form and execution. Copies of the fully-executed Agreement are on file at the Secretary of State's Office and the Department of Administrative Services, and subsequent to Governor and Council approval will be on file at the Department of Transportation.

It is respectfully requested that authority be given to enter into this **sole source** Agreement for consulting services as outlined above.

Sincerely,

A handwritten signature in black ink, appearing to read "Victoria F. Sheehan". The signature is written in a cursive style with a large initial "V".

Victoria F. Sheehan
Commissioner

Attachments

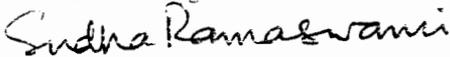
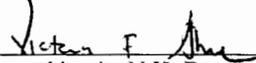
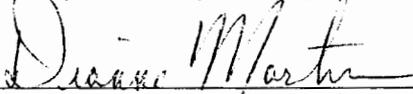
Notice: This agreement and all of its attachments shall become public upon submission to Governor and Executive Council for approval. Any information that is private, confidential or proprietary must be clearly identified to the agency and agreed to in writing prior to signing the contract.

AGREEMENT

The State of New Hampshire and the Contractor hereby mutually agree as follows:

GENERAL PROVISIONS

1. IDENTIFICATION.

1.1 State Agency Name New Hampshire Department of Transportation		1.2 State Agency Address 7 Hazen Drive Concord, NH 03302	
1.3 Contractor Name University of Vermont		1.4 Contractor Address Sponsored Project Administration 85 South Prospect Street Burlington, VT 05405-0160	
1.5 Contractor Phone Number 802-656-3324	1.6 Account Number 04-96-96-962015-3036-046	1.7 Completion Date 3/3/2019	1.8 Price Limitation \$85,000.00
1.9 Contracting Officer for State Agency Peter E. Stannas		1.10 State Agency Telephone Number 603-271-1486	
1.11 Contractor Signature 		1.12 Name and Title of Contractor Signatory Sudha Ramaswami Director, Sponsored Project Administration	
1.13 Acknowledgement: State of <u>Vermont</u> , County of <u>Chittenden</u> On <u>Oct. 17, 2016</u> , before the undersigned officer, personally appeared the person identified in block 1.12, or satisfactorily proven to be the person whose name is signed in block 1.11, and acknowledged that s/he executed this document in the capacity indicated in block 1.12.			
1.13.1 Signature of Notary Public or Justice of the Peace 			
1.13.2 Name and Title of Notary Public or Justice of the Peace <div style="border: 2px solid black; padding: 5px; display: inline-block;"> ANITA B. LAVOIE NOTARY PUBLIC VERMONT </div>		Expiration: <u>2-19-19</u>	
1.14 State Agency Signature 		1.15 Name and Title of State Agency Signatory VICTORIA SHERIDAN COMMISSIONER	
1.16 Approval by the N.H. Department of Administration, Division of Personnel (if applicable) By: _____ Director, On: _____			
1.17 Approval by the Attorney General (Form, Substance and Execution) (if applicable) By:  On: <u>11/30/16</u>			
1.18 Approval by the Governor and Executive Council (if applicable) By: _____ On: _____			

2. EMPLOYMENT OF CONTRACTOR/SERVICES TO BE PERFORMED. The State of New Hampshire, acting through the agency identified in block 1.1 ("State"), engages contractor identified in block 1.3 ("Contractor") to perform, and the Contractor shall perform, the work or sale of goods, or both, identified and more particularly described in the attached EXHIBIT A which is incorporated herein by reference ("Services").

3. EFFECTIVE DATE/COMPLETION OF SERVICES.

3.1 Notwithstanding any provision of this Agreement to the contrary, and subject to the approval of the Governor and Executive Council of the State of New Hampshire, if applicable, this Agreement, and all obligations of the parties hereunder, shall become effective on the date the Governor and Executive Council approve this Agreement as indicated in block 1.18, unless no such approval is required, in which case the Agreement shall become effective on the date the Agreement is signed by the State Agency as shown in block 1.14 ("Effective Date").

3.2 If the Contractor commences the Services prior to the Effective Date, all Services performed by the Contractor prior to the Effective Date shall be performed at the sole risk of the Contractor, and in the event that this Agreement does not become effective, the State shall have no liability to the Contractor, including without limitation, any obligation to pay the Contractor for any costs incurred or Services performed. Contractor must complete all Services by the Completion Date specified in block 1.7.

4. CONDITIONAL NATURE OF AGREEMENT.

Notwithstanding any provision of this Agreement to the contrary, all obligations of the State hereunder, including, without limitation, the continuance of payments hereunder, are contingent upon the availability and continued appropriation of funds, and in no event shall the State be liable for any payments hereunder in excess of such available appropriated funds. In the event of a reduction or termination of appropriated funds, the State shall have the right to withhold payment until such funds become available, if ever, and shall have the right to terminate this Agreement immediately upon giving the Contractor notice of such termination. The State shall not be required to transfer funds from any other account to the Account identified in block 1.6 in the event funds in that Account are reduced or unavailable.

5. CONTRACT PRICE/PRICE LIMITATION/PAYMENT.

5.1 The contract price, method of payment, and terms of payment are identified and more particularly described in EXHIBIT B which is incorporated herein by reference.

5.2 The payment by the State of the contract price shall be the only and the complete reimbursement to the Contractor for all expenses, of whatever nature incurred by the Contractor in the performance hereof, and shall be the only and the complete compensation to the Contractor for the Services. The State shall have no liability to the Contractor other than the contract price.

5.3 The State reserves the right to offset from any amounts otherwise payable to the Contractor under this Agreement those liquidated amounts required or permitted by N.H. RSA 80:7 through RSA 80:7-c or any other provision of law.

5.4 Notwithstanding any provision in this Agreement to the contrary, and notwithstanding unexpected circumstances, in no event shall the total of all payments authorized, or actually made hereunder, exceed the Price Limitation set forth in block 1.8.

6. COMPLIANCE BY CONTRACTOR WITH LAWS AND REGULATIONS/ EQUAL EMPLOYMENT OPPORTUNITY.

6.1 In connection with the performance of the Services, the Contractor shall comply with all statutes, laws, regulations, and orders of federal, state, county or municipal authorities which impose any obligation or duty upon the Contractor, including, but not limited to, civil rights and equal opportunity laws. This may include the requirement to utilize auxiliary aids and services to ensure that persons with communication disabilities, including vision, hearing and speech, can communicate with, receive information from, and convey information to the Contractor. In addition, the Contractor shall comply with all applicable copyright laws.

6.2 During the term of this Agreement, the Contractor shall not discriminate against employees or applicants for employment because of race, color, religion, creed, age, sex, handicap, sexual orientation, or national origin and will take affirmative action to prevent such discrimination.

6.3 If this Agreement is funded in any part by monies of the United States, the Contractor shall comply with all the provisions of Executive Order No. 11246 ("Equal Employment Opportunity"), as supplemented by the regulations of the United States Department of Labor (41 C.F.R. Part 60), and with any rules, regulations and guidelines as the State of New Hampshire or the United States issue to implement these regulations. The Contractor further agrees to permit the State or United States access to any of the Contractor's books, records and accounts for the purpose of ascertaining compliance with all rules, regulations and orders, and the covenants, terms and conditions of this Agreement.

7. PERSONNEL.

7.1 The Contractor shall at its own expense provide all personnel necessary to perform the Services. The Contractor warrants that all personnel engaged in the Services shall be qualified to perform the Services, and shall be properly licensed and otherwise authorized to do so under all applicable laws.

7.2 Unless otherwise authorized in writing, during the term of this Agreement, and for a period of six (6) months after the Completion Date in block 1.7, the Contractor shall not hire, and shall not permit any subcontractor or other person, firm or corporation with whom it is engaged in a combined effort to perform the Services to hire, any person who is a State employee or official, who is materially involved in the procurement, administration or performance of this

Agreement. This provision shall survive termination of this Agreement.

7.3 The Contracting Officer specified in block 1.9, or his or her successor, shall be the State's representative. In the event of any dispute concerning the interpretation of this Agreement, the Contracting Officer's decision shall be final for the State.

8. EVENT OF DEFAULT/REMEDIES.

8.1 Any one or more of the following acts or omissions of the Contractor shall constitute an event of default hereunder ("Event of Default"):

8.1.1 failure to perform the Services satisfactorily or on schedule;

8.1.2 failure to submit any report required hereunder; and/or

8.1.3 failure to perform any other covenant, term or condition of this Agreement.

8.2 Upon the occurrence of any Event of Default, the State may take any one, or more, or all, of the following actions:

8.2.1 give the Contractor a written notice specifying the Event of Default and requiring it to be remedied within, in the absence of a greater or lesser specification of time, thirty (30) days from the date of the notice; and if the Event of Default is not timely remedied, terminate this Agreement, effective two (2) days after giving the Contractor notice of termination;

8.2.2 give the Contractor a written notice specifying the Event of Default and suspending all payments to be made under this Agreement and ordering that the portion of the contract price which would otherwise accrue to the Contractor during the period from the date of such notice until such time as the State determines that the Contractor has cured the Event of Default shall never be paid to the Contractor;

8.2.3 set off against any other obligations the State may owe to the Contractor any damages the State suffers by reason of any Event of Default; and/or

8.2.4 treat the Agreement as breached and pursue any of its remedies at law or in equity, or both.

9. DATA/ACCESS/CONFIDENTIALITY/PRESERVATION.

9.1 As used in this Agreement, the word "data" shall mean all information and things developed or obtained during the performance of, or acquired or developed by reason of, this Agreement, including, but not limited to, all studies, reports, files, formulae, surveys, maps, charts, sound recordings, video recordings, pictorial reproductions, drawings, analyses, graphic representations, computer programs, computer printouts, notes, letters, memoranda, papers, and documents, all whether finished or unfinished.

9.2 All data and any property which has been received from the State or purchased with funds provided for that purpose under this Agreement, shall be the property of the State, and shall be returned to the State upon demand or upon termination of this Agreement for any reason.

9.3 Confidentiality of data shall be governed by N.H. RSA chapter 91-A or other existing law. Disclosure of data requires prior written approval of the State.

10. TERMINATION. In the event of an early termination of this Agreement for any reason other than the completion of the Services, the Contractor shall deliver to the Contracting Officer, not later than fifteen (15) days after the date of termination, a report ("Termination Report") describing in detail all Services performed, and the contract price earned, to and including the date of termination. The form, subject matter, content, and number of copies of the Termination Report shall be identical to those of any Final Report described in the attached EXHIBIT A.

11. CONTRACTOR'S RELATION TO THE STATE. In the performance of this Agreement the Contractor is in all respects an independent contractor, and is neither an agent nor an employee of the State. Neither the Contractor nor any of its officers, employees, agents or members shall have authority to bind the State or receive any benefits, workers' compensation or other emoluments provided by the State to its employees.

12. ASSIGNMENT/DELEGATION/SUBCONTRACTS. The Contractor shall not assign, or otherwise transfer any interest in this Agreement without the prior written notice and consent of the State. None of the Services shall be subcontracted by the Contractor without the prior written notice and consent of the State.

13. INDEMNIFICATION. The Contractor shall defend, indemnify and hold harmless the State, its officers and employees, from and against any and all losses suffered by the State, its officers and employees, and any and all claims, liabilities or penalties asserted against the State, its officers and employees, by or on behalf of any person, on account of, based or resulting from, arising out of (or which may be claimed to arise out of) the acts or omissions of the Contractor. Notwithstanding the foregoing, nothing herein contained shall be deemed to constitute a waiver of the sovereign immunity of the State, which immunity is hereby reserved to the State. This covenant in paragraph 13 shall survive the termination of this Agreement.

14. INSURANCE.

14.1 The Contractor shall, at its sole expense, obtain and maintain in force, and shall require any subcontractor or assignee to obtain and maintain in force, the following insurance:

14.1.1 comprehensive general liability insurance against all claims of bodily injury, death or property damage, in amounts of not less than \$1,000,000 per occurrence and \$2,000,000 aggregate; and

14.1.2 special cause of loss coverage form covering all property subject to subparagraph 9.2 herein, in an amount not less than 80% of the whole replacement value of the property.

14.2 The policies described in subparagraph 14.1 herein shall be on policy forms and endorsements approved for use in the State of New Hampshire by the N.H. Department of Insurance, and issued by insurers licensed in the State of New Hampshire.



14.3 The Contractor shall furnish to the Contracting Officer identified in block 1.9, or his or her successor, a certificate(s) of insurance for all insurance required under this Agreement. Contractor shall also furnish to the Contracting Officer identified in block 1.9, or his or her successor, certificate(s) of insurance for all renewal(s) of insurance required under this Agreement no later than thirty (30) days prior to the expiration date of each of the insurance policies. The certificate(s) of insurance and any renewals thereof shall be attached and are incorporated herein by reference. Each certificate(s) of insurance shall contain a clause requiring the insurer to provide the Contracting Officer identified in block 1.9, or his or her successor, no less than thirty (30) days prior written notice of cancellation or modification of the policy.

15. WORKERS' COMPENSATION.

15.1 By signing this agreement, the Contractor agrees, certifies and warrants that the Contractor is in compliance with or exempt from, the requirements of N.H. RSA chapter 281-A (*"Workers' Compensation"*).

15.2 To the extent the Contractor is subject to the requirements of N.H. RSA chapter 281-A, Contractor shall maintain, and require any subcontractor or assignee to secure and maintain, payment of Workers' Compensation in connection with activities which the person proposes to undertake pursuant to this Agreement. Contractor shall furnish the Contracting Officer identified in block 1.9, or his or her successor, proof of Workers' Compensation in the manner described in N.H. RSA chapter 281-A and any applicable renewal(s) thereof, which shall be attached and are incorporated herein by reference. The State shall not be responsible for payment of any Workers' Compensation premiums or for any other claim or benefit for Contractor, or any subcontractor or employee of Contractor, which might arise under applicable State of New Hampshire Workers' Compensation laws in connection with the performance of the Services under this Agreement.

16. WAIVER OF BREACH. No failure by the State to enforce any provisions hereof after any Event of Default shall be deemed a waiver of its rights with regard to that Event of Default, or any subsequent Event of Default. No express failure to enforce any Event of Default shall be deemed a waiver of the right of the State to enforce each and all of the provisions hereof upon any further or other Event of Default on the part of the Contractor.

17. NOTICE. Any notice by a party hereto to the other party shall be deemed to have been duly delivered or given at the time of mailing by certified mail, postage prepaid, in a United States Post Office addressed to the parties at the addresses given in blocks 1.2 and 1.4, herein.

18. AMENDMENT. This Agreement may be amended, waived or discharged only by an instrument in writing signed by the parties hereto and only after approval of such amendment, waiver or discharge by the Governor and Executive Council of the State of New Hampshire unless no

such approval is required under the circumstances pursuant to State law, rule or policy.

19. CONSTRUCTION OF AGREEMENT AND TERMS.

This Agreement shall be construed in accordance with the laws of the State of New Hampshire, and is binding upon and inures to the benefit of the parties and their respective successors and assigns. The wording used in this Agreement is the wording chosen by the parties to express their mutual intent, and no rule of construction shall be applied against or in favor of any party.

20. THIRD PARTIES. The parties hereto do not intend to benefit any third parties and this Agreement shall not be construed to confer any such benefit.

21. HEADINGS. The headings throughout the Agreement are for reference purposes only, and the words contained therein shall in no way be held to explain, modify, amplify or aid in the interpretation, construction or meaning of the provisions of this Agreement.

22. SPECIAL PROVISIONS. Additional provisions set forth in the attached EXHIBIT C are incorporated herein by reference.

23. SEVERABILITY. In the event any of the provisions of this Agreement are held by a court of competent jurisdiction to be contrary to any state or federal law, the remaining provisions of this Agreement will remain in full force and effect.

24. ENTIRE AGREEMENT. This Agreement, which may be executed in a number of counterparts, each of which shall be deemed an original, constitutes the entire Agreement and understanding between the parties, and supersedes all prior Agreements and understandings relating hereto.

EXHIBIT A – Scope of Work

PROJECT TITLE: THE INTEGRATION OF UNMANNED AIRCRAFT SYSTEMS TO INCREASE SAFETY AND DECREASE COSTS OF TRANSPORTATION PROJECTS AND/OR RELATED TASKS

PROJECT PERFORMANCE PERIOD: GOVERNOR AND COUNCIL APPROVAL – DECEMBER 31, 2018

OBJECTIVES

Unmanned Aircraft Systems (UAS) are a new capability that has the potential to dramatically reduce costs and increase safety for transportation operations ranging from bridge inspections to construction monitoring (Gheisari et al., 2015). The vast amount of transportation research into UAS has understandably, been focused on integrating UAS into the national airspace (e.g. Dalamagkidis et al., 2011). Now that the FAA has revised and clarified its UAS regulations, many of the barriers that existed for commercial and government entities to operate UAS have been removed, making this an ideal time for NH DOT to explore the technology. A number of projects have demonstrated the utility of UAS for the transportation sector. The Vermont Agency of Transportation and the University of Vermont carried out a broad range of highly successful transportation-related UAS projects (VTrans, 2016). Bridge inspections have proved a popular UAS case study (e.g. Khan et al., 2015), with the Minnesota Department of Transportation reporting that UAS inspection of bridges can offer cost savings on an order of magnitude compared to traditional approaches (Lovelace, 2016).

Despite the considerable amount of existing research and case studies surrounding UAS, there appear to be few, if any, that have focused on the analyzing the costs, benefits, and barriers associated with integrating UAS into a state department of transportation's operations. The overall objective of this project is to evaluate UAS technology for a broad range of case studies relating to the specific needs of the New Hampshire Department of Transportation (NH DOT). Specifically, this project seeks to:

1. Determine the types of transportation projects for which UAS are best suited for.
2. Evaluate the capabilities and limitations, along with the costs and benefits, of using UAS technology for a variety of transportation projects.
3. Outline the policies, procedures, staffing, and information technology infrastructure required for NH DOT to fully implement UAS technology.
4. Develop NH DOT's UAS capabilities.

This project will partner NH DOT with the University of Vermont's (UVM) UAS Team. UVM's UAS Team is one of the most experienced in the nation, having carried out over 450 missions. They possess a FAA Section 333 exemption, enabling them to operate UAS for commercial and research purposes. The UAS Team has received over \$750,000 in funding for UAS research from the US Department of Transportation (DOT). This project will leverage the equipment and expertise gained as part of the US DOT project.

EXHIBIT A – Scope of Work

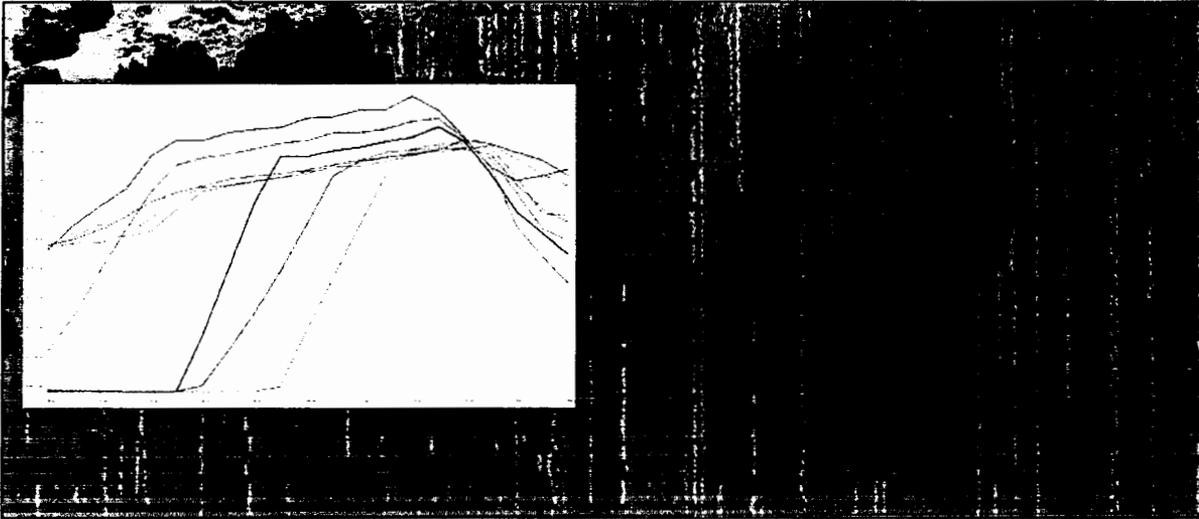


Figure 1. Cross-sections of a portion of a simulated road wash-out generated from a 3D model produced from a UAS data collect.

TASKS

This project will be comprised of eight general tasks. Each task will be carried out in collaboration with NH DOT so as to develop NH DOT's familiarity and expertise with all aspects of UAS operations.

TASK 1: ESTABLISH A STAKEHOLDER ADVISORY COMMITTEE

The advisory committee will consist of stakeholders from within NH DOT. It will be a combination of personnel who have, or plan to have, operational or contractual authority over UAS (e.g. aviation section) and those who be the end-user of UAS products (e.g. asset management).

TASK 2: UAS CASE STUDIES

Working with a stakeholder advisory committee, a list of case studies will be established. The case studies will serve the purpose of evaluating the applicability of UAS for NH DOT, comparing UAS to existing methods and analyzing the barrier to UAS implementation. The UAS case studies will be broad ranging. A specific focus will be on those case studies in which UAS have the greatest potential to improve safety, decrease costs, and improve decision-making. Examples of such case studies include:

- Airport inspection
- Environmental compliance mapping (e.g. wetland delineation)
- Environmental risk assessment (e.g. stream geomorphic change and woody debris mapping)
- Construction phasing monitoring and analysis
- Bridge inspection
- Disaster response
- Right-of-way mapping
- Pavement condition

The stakeholder advisory committee will be responsible for selecting the UAS case studies. Approximately 10 case studies will be selected for inclusion in the project. Each case study will have a primary end-user point of contact. This end-user will serve as the principal liaison for Task 8.

EXHIBIT A – Scope of Work



Figure 2. A multirotor UAS used for inspection operations taking off.

TASK 3: UAS MISSION PLANNING PROFILES

For each of the case studies, detailed mission planning profiles will be generated. These profiles will identify the appropriate personnel, UAS platform(s), UAS sensor(s), supporting equipment, operating procedures, safety procedures, and regulatory requirements to operate the UAS successfully. Landowner approval along with internal and external agency coordination will be carried out in this task. As privacy issues are one of the most cited concerns in UAS operations, particular attention will be paid to this issue. In addition to consulting all applicable regulations, privacy analyses for each study will determine if any personally identifiable information (PID), is being acquired. An additional standard will be used to determine, for any data captured over private land, if there exists a precedent in the form of data that are similar in nature. An example includes the right-of-way analysis in which front lawns of landowners may be mapped. If this mapping is consistent with the type of imagery available for freely available commercial sources (e.g. Google Maps) or carried out by the state (e.g. imagery available through NH GRANIT) there exists a precedent.

In collaboration with the primary end-user point of contact, detailed specifications on the desired end products and their formats will be developed. Preliminary flight plans will be constructed and the mission planning profiles will be presented to NH DOT Aviation for approval. All flight checks and logs will be stored and will be made available to NH DOT upon request.

EXHIBIT A – Scope of Work

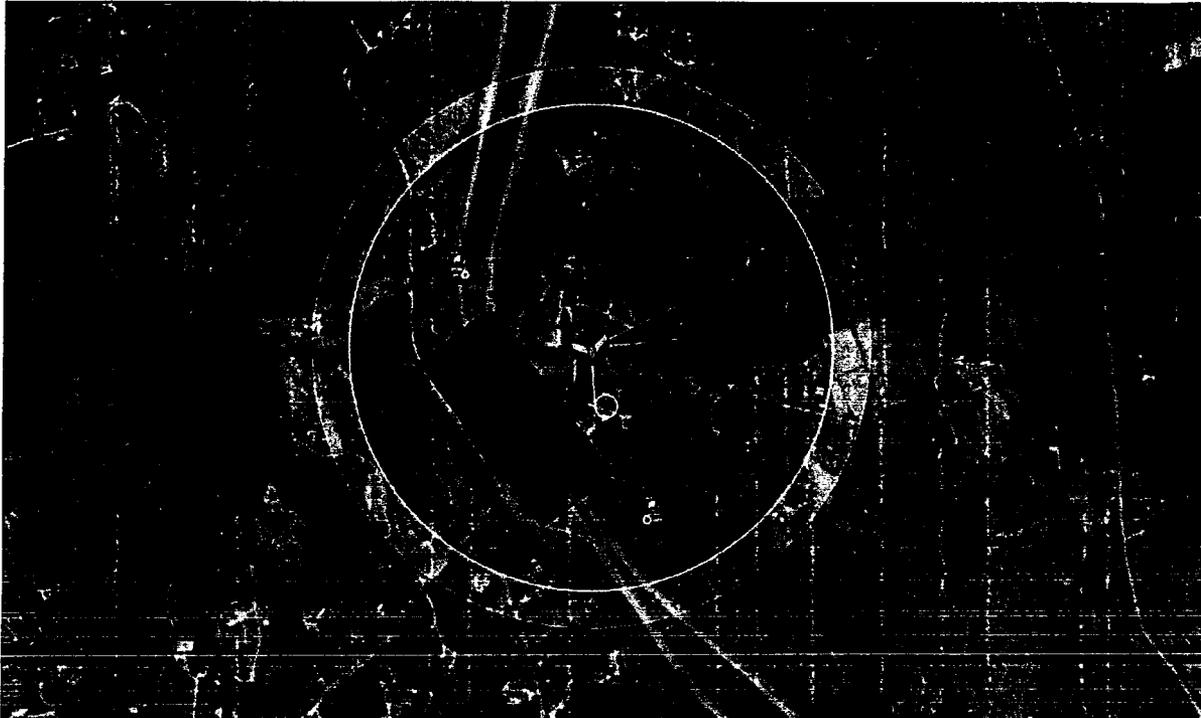


Figure 3. Sample UAS flight plan

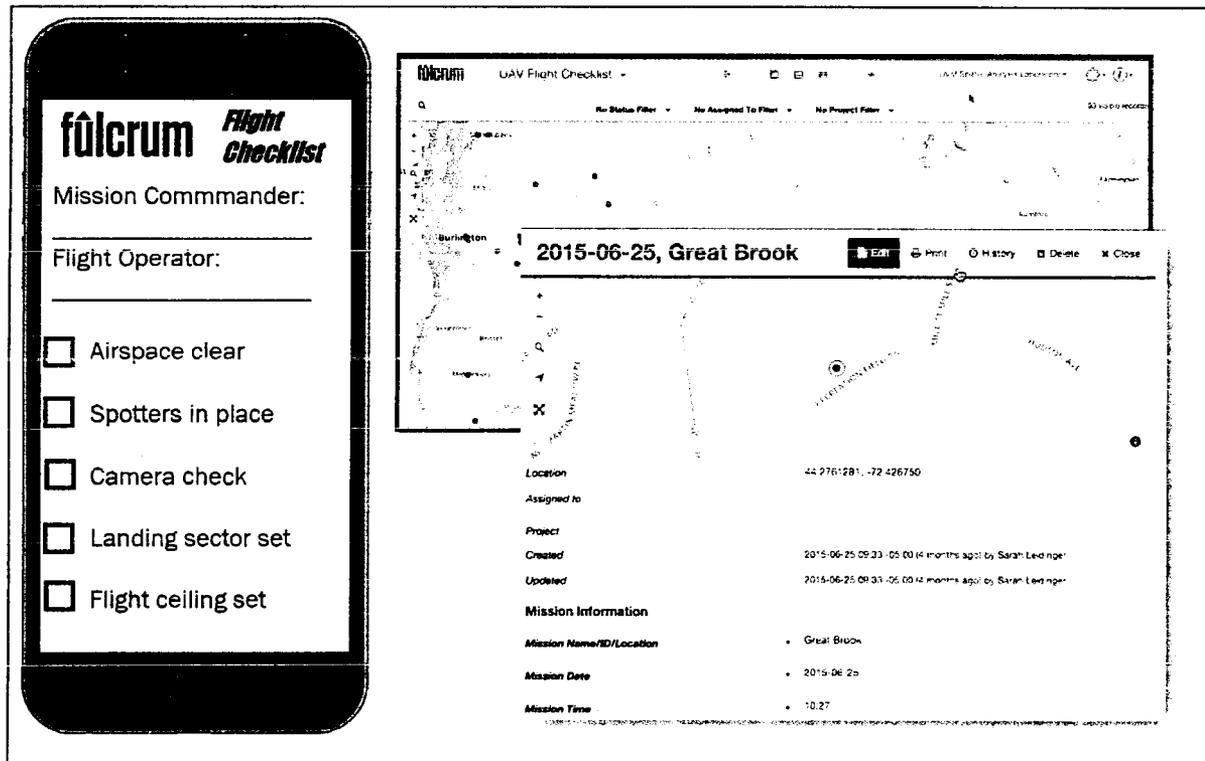


Figure 4. UAS mobile app flight checklist developed by the UVM UAS Team. The checklist geo-tags the location of the flight and stores the records in a cloud-based system. Authorized users can query and review flight operations in a tabular or map format.

EXHIBIT A – Scope of Work

TASK 4: UAS OPERATIONS

UAS flight operations will be conducted for each one of the case studies. Flight operations will consist of launch, capture, and recovery, along with any gathering of other ancillary information (e.g. ground control reference points) that may be required for the specific case study. All UAS operations will be carried out in accordance with federal, state, and local regulations. NH DOT Aviation will approve all flight operations prior to execution. During this task select NH DOT personnel will be invited to participate in order to familiarize themselves with UAS flight operations, processes, and procedures.



Figure 5. UVM UAS Team's fixed-wing UAS during landing. Photo credit: Matt Bansak.

TASK 5: UAS PRODUCTS

The UAS data captured in Task 4 will be processed, and user-requested products will be generated. Processing of the UAS data will generate primary products. UAS processing can range from compiling, editing, and posting video data for review to the photogrammetric processing of hundreds of individual geo-tagged images. Examples of primary products include:

- Orthophoto mosaics
- 3D models
- Videos
- Still pictures

EXHIBIT A – Scope of Work

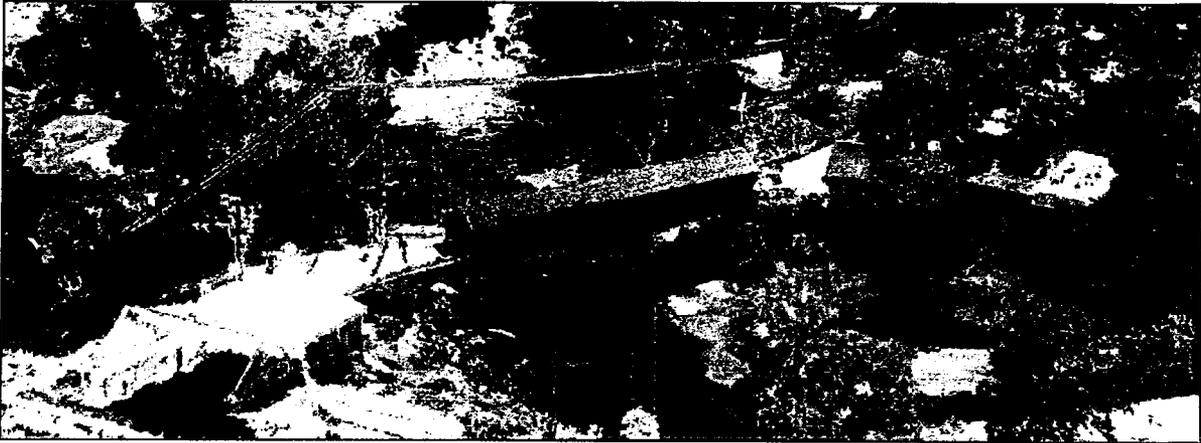


Figure 6. 3D model generated from hundreds of photos captured by a multirotor UAS

Secondary products involve subsequent processing and/or manipulation of the UAS data to meet specific user-defined needs, case study objectives, and decision support activities. Examples include:

- Web-based maps
- Volumetric analysis
- Vegetation height mapping
- Feature extraction
- Condition assessment
- CAD/GIS integration
- Areal measurements

TASK 6: PROVIDE UAS PRODUCTS TO NH DOT

This task will focus on providing UAS products to NH DOT stakeholders for evaluation, integration, and implementation. This task will likely involve an iterative approach in which the precise format and delivery mechanisms of the products are adjusted accordingly to meet stakeholder needs and IT system requirements. Part of this task may involve generating supplementary materials for the purposes of education and outreach. Supplementary materials may include deliverables such as tutorial videos, white papers, and instructional manuals. The need for the supplementary materials will be established by working with the stakeholder group. All UAS products will be provided to NH DOT via electronic transfer or external hard drive. All data will be maintained by UVM on a secured network server that is backed up daily to tapes that are stored in a fireproof vault. General release of the data to external agencies or the public will only be done with approval from NH DOT.

EXHIBIT A – Scope of Work



Figure 7. Web map decision support tool developed by the UVM UAS Team. UAS imagery appears on the right compared to the best available existing imagery (left). The recent removal of vegetation is clearly visible in the UAS imagery.

TASK 7: IMPLEMENTATION ASSESSMENT

The implementation assessment will consist of three components: 1) cost-benefit analyses, 2) the identification of the capabilities and limitations, and 3) barriers to use. The desired end state of this task is to be able to recommend to NH DOT those situations in which it is advantageous to use UAS in place of existing methods or how UAS could be combined with existing approaches to improve efficiency and/or safety.

For each UAS case study, a cost-benefit analysis will be carried out. The cost-benefit analysis will focus on both on quantitative metrics and qualitative metrics. The quantitative metrics will center on comparing the projected costs of using UAS technology for a given case study when compared to traditional methods. The UAS costs will be determined for both internal (the cost of NH DOT establishing its own program) and external (contracting the work out) scenarios. The quantitative metrics will center on gathering stakeholder feedback to document the safety and informational benefits that UAS may provide as compared to existing approaches.

The capabilities and limitations assessment will document strengths and weaknesses, along with the specific operational considerations the need to be taken account when employing UAS for each one of the case studies. This assessment will help to highlight factors that may affect the deployment of UAS technology that are not captured by traditional cost-benefit analysis.

The barriers to use analysis will look at any difficulties that NH DOT may have in actually implementing UAS for the case studies. Examples of such barriers range from human resources to regulations to the IT infrastructure required to store, view, and manipulate UAS data.

TASK 8: REPORTING

A final comprehensive compiled report will summarize the findings of this project. In addition, a final briefing will be presented to the technical advisory group.

EXHIBIT A – Scope of Work

RESPONSIBILITIES

PRINCIPAL INVESTIGATOR

- Assist in the development of the case studies
- Operate UAS in a manner consistent with federal, state, and local regulations
- Maintain UAS platforms (drones) in serviceable condition necessary to perform the project
- Maintain licenses for all geospatial software products needed to process US data and administer the associated IT infrastructure
- Generate UAS products
- Distribute UAS products to NH DOT
- Perform a cost-benefit analysis and capabilities and limitations assessment
- Submit a quarterly and final report

NH DOT

- Assemble the stakeholder advisory committee
- Assist in the development of the case studies
- Review and approve UAS operations
- Participate in UAS operations
- Provide supporting personnel for UAS operations (e.g. flaggers)
- Review and provide feedback on UAS products
- Provide information that can be used in the cost-benefit analysis
- Schedule meetings with stakeholder groups
- Review quarterly and final reports

SCHEDULE

The project is anticipated to take 18 months. A breakdown of the number of workdays for each task is summarized below. Figure 8 displays the schedule in Gantt chart format. It should be noted that many of the task overlap. For example, UAS operations (Task 4) for one case study could be going on during the same time period at which the implementation analysis (Task 8) is being done for a separate case study.

- Task 1: 20 workdays
- Task 2: 40 workdays
- Task 3: 30 workdays
- Task 4: 214 workdays
- Task 5: 235 workdays
- Task 6: 235 workdays
- Task 7: 43 workdays
- Task 8: 35 workdays

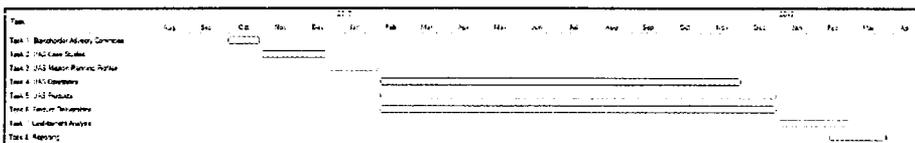


Figure 8. Anticipated schedule for the project

EXHIBIT A – Scope of Work

QUARTERLY REPORTING

The Principal Investigator will provide an update on the progress of research, quarterly or more frequently, using the SPR2 Program Project Report Form.

DELIVERABLES

The following deliverables will be provided to DOT as part of this project:

- UAS mission plans
- UAS data products
- UAS decision support products
- Supplemental UAS training/outreach materials
- Quarterly reports
- Final report
- Final presentation

MATERIAL, RESOURCES, AND DATA REQUIREMENTS

The platforms, sensors, and supporting equipment required for UAS operations along with the software and hardware necessary to process the data will be provided by the University of Vermont. NH DOT should be prepared to provide the following:

- Personnel to assist in the selection and evaluation of the case studies.
- Personnel to review the UAS mission plans.
- Personnel to ensure the safe operation of UAS at select sites (e.g. flagger).
- The equipment needed to support the safe operation of UAS at select sites (e.g. cones).
- Existing CAD or GIS data (e.g. construction plans) to support the UAS data integration work.

REFERENCES CITED

Dalamagkidis, K., Valavanis, K. P., & Piegler, L. A. (2011). On integrating unmanned aircraft systems into the national airspace system: issues, challenges, operational restrictions, certification, and recommendations (Vol. 54). Springer Science & Business Media.

Gheisari, M., Karan, E. P., Christmann, H. C., Irizarry, J., & Johnson, E. N. (2015). Investigating Unmanned Aerial System (UAS) Application Requirements within a Department of Transportation. In Transportation Research Board 94th Annual Meeting (No. 15-1430).

Khan, F., Ellenberg, A., Mazzotti, M., Kotsos, A., Moon, F., Pradhan, A., & Bartoli, I. (2015, April). Investigation on Bridge Assessment Using Unmanned Aerial Systems. In Structures Congress 2015 (pp. 404-413).

Lovelace, B. (2015, July). Unmanned Aerial Vehicle Bridge Inspection Project. Minnesota Department of Transportation, Research and Services Library. Retrieved from <http://www.dot.state.mn.us/research/TS/2015/201540.pdf>

Vermont Agency of Transportation. [VTrans TV]. (2016, March 8). Unmanned Aircraft Systems in Transportation [Video file]. Retrieved from <https://youtu.be/nPRkiTjBLJg>

VTrans TV. "Unmanned ." Online video clip. YouTube. YouTube, 22 Apr. 2006. Web. 9 Sept. 2010.

EXHIBIT B – Budget and Payment Terms

PROJECT TITLE: THE INTEGRATION OF UNMANNED AIRCRAFT SYSTEMS TO INCREASE SAFETY AND DECREASE COSTS OF TRANSPORTATION PROJECTS AND/OR RELATED TASKS

BUDGET

Budget Items	State Funding	Cost Sharing	Total
1. Salaries & Wages	36,374	0	36,374
2. Employee Fringe Benefits	15,770	0	15,770
3. Travel	0	0	0
4. Supplies & Services	9,450	0	9,450
5. Equipment	0	0	0
6. Facilities & Admin Costs	23,406	0	23,406
Subtotals	85,000		85,000
Total Project Costs:			85,000

The Facilities & Administration (F&A) rate applied to this project is 38% for "public service on campus" and is applied the modified direct cost (MDC). The MDC does not include equipment, tuition, or subawards in excess of \$25,000. All items within this project are included in the MDC so the F&A rate applies to the entire project.

PAYMENT TERMS

UVM will submit invoices to State on regular UVM invoice forms no more frequently than monthly and no less frequently than quarterly. Invoices will be based on actual project expenses incurred during the invoicing period, and shall show current and cumulative expenses.

State will pay UVM within 30 days of receipt of each invoice. UVM will submit its final invoice not later than 60 days after the Project Performance Period End Date. State may withhold 10% of funds until receipt of final deliverables from UVM. State will provide final payment within 30 days of receipt of the accepted final deliverables.

EXHIBIT C – Special Provisions

PROJECT TITLE: THE INTEGRATION OF UNMANNED AIRCRAFT SYSTEMS TO INCREASE SAFETY AND DECREASE COSTS OF TRANSPORTATION PROJECTS AND/OR RELATED TASKS

This contract shall be administered in general accordance with the general provisions of the Agreement found in Form Number P-37 as modified by the terms below.

9. DATA/ACCESS/CONFIDENTIALITY/PRESERVATION

- 9.1 No changes
- 9.2 shall be deleted and replaced with the following:

All data developed by Contractor under this Agreement shall be owned by the Contractor. Upon request made by the State, the contractor shall provide, free of cost, copies of all such data no later than 30 days from the date of the request. The State shall have a nonexclusive, nontransferable, irrevocable, royalty-free paid-up license to use or have used the data for or on behalf of the State during the pendency of the agreement and thereafter. The State may provide the data to its contractors, grantees, community partners, and to other local, state, and federal governmental entities for their non-commercial use.

- 9.3 No changes

19. CONSTRUCTION OF AGREEMENT AND TERMS

This section shall be deleted and replaced with the following:

This Agreement shall be construed in accordance with all applicable laws and is binding upon and inures to the benefit of the parties and their respective successors and assigns. The wording used in this Agreement is the wording chosen by the parties to express their mutual intent, and no rule of construction shall be applied against or favor any party.



The University of Vermont

DELEGATION OF AUTHORITY

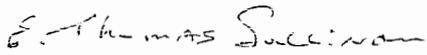
By means of this letter, I, E. Thomas Sullivan, President, delegate the authority described below to the Vice President for Research, on the following terms and conditions:

1. The Vice President for Research may review and execute those documents that are usual, necessary, and appropriate for the operation of the University's Technology Commercialization program. Those documents include licenses, options, confidentiality agreements, material transfer agreements, documents required by the U.S. Patent and Trademark Office or the U.S. Copyright Office, and other similar agreements that are developed by the Office of Technology Commercialization and that typically run for the life of a patent.
2. The Vice President for Research may review and execute those documents that fall within the general sphere of authority of Sponsored Project Administration. Those documents include grant and contract applications and agreements, supplements, subawards, confidentiality agreements, material transfer agreements, and requests for extensions.
3. The Vice President for Research may act as the lead institutional official for human subject and animal welfare protection and may review and execute those documents that fall within the general sphere of authority of the Research Protections Office. Those documents include those requiring approval of the Institutional Official for the protection of human research subjects, for the animal care and use program, and for the institutional biosafety committee, such as inter-institutional agreements, committee appointment letters, and certifications sought by governmental agencies. The Vice President for Research is authorized to sign, on behalf of the University, the Federal-Wide Assurance, the Animal Welfare Assurance, and other federal-wide regulatory assurance documents in the areas of human subject and animal welfare protection.
4. The Vice President for Research may review and execute, and may act on behalf of the University relative to, documents that otherwise fall within the sphere of responsibility of his office. A representative list of those sorts of documents is attached to this delegation.
5. This delegation is intended to recognize the authority formerly granted by the Board of Trustees to the officials responsible for Technology Commercialization and Sponsored Project Administration, and to formalize the authority of the Vice President for Research, as their supervisor, to exercise that same authority and execute the relevant documents. This delegation recognizes and formalizes the authority inherent in the Vice President for Research by virtue of his office, and is intended to supplement and clarify, not limit or supplant, that authority.

DELEGATION OF AUTHORITY
(page 2)

6. The Vice President for Research may sub-delegate signatory authority, in writing, to those officials responsible for Technology Commercialization and Sponsored Project Administration. However, neither the Vice President's exercise nor the sub-delegation of signatory may exceed the restrictions set forth in (a) the Board's Resolution Regarding Delegation and Retention of Board Authority, (b) the University's Contract Approval and Signatory Authority Policy, (c) the University's Procurement Contract Approval and Signatory Authority Policy, or (d) this delegation.

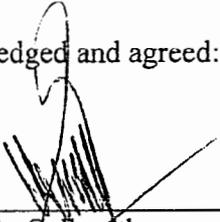
7. This delegation shall take effect on June 3, 2016, and shall run until (a) it is revoked by the President or Provost, (b) the successor of the delegating official is appointed, or (c) the delegate is no longer serving in the position to which the authority was assigned.



Date: 7-24-16

E. Thomas Sullivan
President

Acknowledged and agreed:



Date: 7/25/16

Richard A. Galbraith
Vice President for Research

Acknowledged:



Date: 7/27/16

David V. Rosowsky
Provost and Senior Vice President

cc: Jennifer Gagnon, Associate Vice President for Research Administration
Corine Farewell, Director, Office of Technology Commercialization

DOCUMENTS WITHIN THE AUTHORITY OF THE VICE PRESIDENT FOR RESEARCH

Business Associate Agreements

Clinical Trial Agreements

Co-Development Agreements (for work done outside UVM)

Co-Location Agreements

Confidentiality (or Non-Disclosure) Agreements

Data Use Agreements

Documents associated with domestic and foreign patent prosecution

Documents associated with the Office of Animal Care Management

Equipment Transfer Agreements

Exchange of Materials or Information

Export Controls – Technology Management (or Control) Plans

Facility Use Agreements

Income- (or Revenue-) Generating Agreements (Consulting Archaeology, Spatial Analysis Lab)

Intellectual Property Assignment, License, and Option Agreements

Intellectual Property Management Plans

Inter-Institutional Agreements

Material Transfer Agreements

Research Collaboration Agreements

Research Consortium Agreements

Research Protections Agreements

SBIR Subcontract Agreements

Software License Agreements

Sponsored Instruction Agreements

Sponsored Public Service Agreements

STTR Subcontract Agreements

Technical Services Program (TSP) Service Agreements

Vermont Advanced Computing Core Agreements

Vermont Center for Emerging Technologies Agreements

Vermont Child Health Improvement Program (VCHIP) Participating Provider Agreements

Vermont Mammography Registry Participating Provider Agreements

Vermont Oxford Network Research Collaboration Agreements

Vermont Regional Perinatal Health Program Participating Provider Agreements

Visiting Scientist Agreements



The University of Vermont
Sponsored Project Administration

To whomsoever it may concern

This is to certify that Sudha Ramaswami has the authority to execute on my behalf sponsored project proposals and associated certifications, award documents, sub-awards, financial reports, invoices and related closeout documents when such documents have gone through the University's standard process for review and approval prior to submission or receipt.

This delegation is current and is made pursuant to the University Contract Approval and Signatory Authority Policy and is subject thereto.

Richard Galbraith
Vice President for Research

10/17/16

Sudha Ramaswami
Director, Sponsored Project Admin

10/17/2016



The University of Vermont

Richard A. Galbraith, MD, PhD
Vice President for Research

October 10, 2016

To Whom It May Concern:

By means of this letter, I, Richard Galbraith, Vice President for Research, delegate the authority herein described to the Director of Sponsored Project Administration.

The scope of this delegation is limited as follows. This individual may execute on my behalf sponsored project proposals and associated certifications, award documents, sub-awards, financial reports, invoices, and related closeout documents when such documents have gone through the University's standard process for review and approval prior to submission or receipt.

This delegation is effective immediately and shall run until revoked by the delegating official, the successor of the delegating official is appointed, or the delegate is no longer serving in the position as to which the delegation occurred. The authority delegated in this document shall not be sub-delegated.

This delegation is made pursuant to the University Contract Approval and Signatory Authority Policy and is subject thereto.

Richard Galbraith, M.D. Ph.D.
Vice President for Research

Date: OCT 12 2016

Acknowledged and agreed (delegate):

Sudha Ramaswami

Date: OCT 11 2016

Sudha Ramaswami
Director, Sponsored Project Administration

Approved:

Date: OCT 12 2016

David V. Rosowsky, Ph.D., P.E., F. ASCE
Provost and Senior Vice President

cc. University Controller
General Counsel

Delegate
The File



CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)
11/23/2016

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER Marsh USA Inc. 1717 Arch Street Philadelphia, PA 19103-2797 J09254-verm-caspi-16-17	CONTACT NAME: _____	
	PHONE (A/C, No, Ext): _____	FAX (A/C, No): _____
E-MAIL ADDRESS: _____		
INSURER(S) AFFORDING COVERAGE		NAIC #
INSURER A : Pinnacle Consortium of Higher Ed VT RRRG		11980
INSURER B : N/A		N/A
INSURER C : N/A		N/A
INSURER D : Safety National Casualty Corporation		15105
INSURER E :		
INSURER F :		

COVERAGES **CERTIFICATE NUMBER:** CLE-005270120-01 **REVISION NUMBER:** 2

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL/SUBR INSD WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
A	<input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: <input checked="" type="checkbox"/> POLICY <input type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC <input type="checkbox"/> OTHER: _____ <input type="checkbox"/> AUTOMOBILE LIABILITY <input type="checkbox"/> ANY AUTO <input type="checkbox"/> SCHEDULED AUTOS <input type="checkbox"/> ALL OWNED AUTOS <input type="checkbox"/> NON-OWNED AUTOS <input type="checkbox"/> HIRED AUTOS		PCHE2016-15	07/01/2016	07/01/2017	EACH OCCURRENCE \$ 2,000,000 DAMAGE TO RENTED PREMISES (Ea occurrence) \$ 2,000,000 MED EXP (Any one person) \$ 10,000 PERSONAL & ADV INJURY \$ 2,000,000 GENERAL AGGREGATE \$ 5,000,000 PRODUCTS - COMP/OP AGG \$ 2,000,000 COMBINED SINGLE LIMIT (Ea accident) \$ BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$
	<input type="checkbox"/> UMBRELLA LIAB <input type="checkbox"/> OCCUR <input type="checkbox"/> EXCESS LIAB <input type="checkbox"/> CLAIMS-MADE DED _____ RETENTION \$ _____					EACH OCCURRENCE \$ AGGREGATE \$
D	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	Y/N <input checked="" type="checkbox"/> N	SP 4055192 (VT) SIR: \$650,000 SEE ATTACHED PAGE	07/01/2016	07/01/2017	<input checked="" type="checkbox"/> PER STATUTE <input type="checkbox"/> OTH-ER E.L. EACH ACCIDENT \$ 1,000,000 E.L. DISEASE - EA EMPLOYEE \$ 1,000,000 E.L. DISEASE - POLICY LIMIT \$ 1,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

Re: University of Vermont's Rubenstein School of Environment & Natural Resources to participate in a project with the New Hampshire Department of Transportation through June 30, 2017.

CERTIFICATE HOLDER New Hampshire Department of Transportation 7 Hazen Drive Concord, NH 03301	CANCELLATION SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS. AUTHORIZED REPRESENTATIVE of Marsh USA Inc. Manashi Mukherjee <i>Manashi Mukherjee</i>
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ADDITIONAL REMARKS SCHEDULE

AGENCY Marsh USA Inc.		NAMED INSURED UNIVERSITY OF VERMONT & STATE AGRICULTURAL COLLEGE 284 EAST AVENUE BURLINGTON, VT 05405-1705	
POLICY NUMBER		EFFECTIVE DATE:	
CARRIER	NAIC CODE		

ADDITIONAL REMARKS

THIS ADDITIONAL REMARKS FORM IS A SCHEDULE TO ACORD FORM,
FORM NUMBER: 25 FORM TITLE: Certificate of Liability Insurance

COVERAGE: WC - STATUTORY BENEFITS (AOS)
 UNDERWRITER COMPANY NAME: SAFETY NATIONAL CASUALTY CORPORATION
 POLICY NUMBER: PRP4054851
 POLICY PERIOD: 07/01/2016 - 07/01/2017
 EMPLOYERS LIABILITY LIMITS:
 BODILY INJURY BY ACCIDENT - \$500,000 EACH ACCIDENT
 BODILY INJURY BY DISEASE - \$500,000 POLICY LIMIT
 BODILY INJURY BY DISEASE - \$500,000 EACH EMPLOYEE