# PROJECT SUMMARY


## Overview:

Based on input from Dallas/Fort Worth construction-related industries, there is a need for technicians who possess integrated skills related to the use and analysis of location-based data. This ability to communicate effectively between geospatial and construction engineering technicians is becoming increasingly necessary. Investigation of existing local and state-wide higher education programs indicates transformative changes must be made within the current curricular material to incorporate these skills. Brookhaven College Constructioneering GATEway project will engage industry to identify needed curricular revisions and will create innovative, interdisciplinary learning modules to educate geospatial and engineering technicians on the spatial data technologies that support evolving civil and construction engineering functions. These cross-disciplinary project-based learning modules will incorporate real-world activities that allow student teams to learn and practice the knowledge, skills and abilities now highly valued and sought after on the job and not included in current program and certificate curricula. As a result, these technicians will understand connections between these related geospatial, construction and engineering disciplines and will apply these new methods better preparing them to meet the needs of the workforce.

## Intellectual Merit:

These project-based learning modules will create new resources that will serve to enrich traditional engineering technician courses as well as those included in the geospatial technology program. These activities will close the identified skills gaps between current curricula and real-world technology applications as a result of rapidly advancing technologies. Other colleges will be able to adapt the learning modules to meet the local needs of their own geospatial and engineering technician program needs.

## Broader Impacts:

At the end of this project, all learning module materials will be finalized to be stand-alone infrastructure, independent of any text or curricula. These materials will be available to be used in any location in which engineering technician and geospatial technician education exists. In addition, these modules will be available for use by the incumbent workforce for professional development.

## PROJECT DESCRIPTION

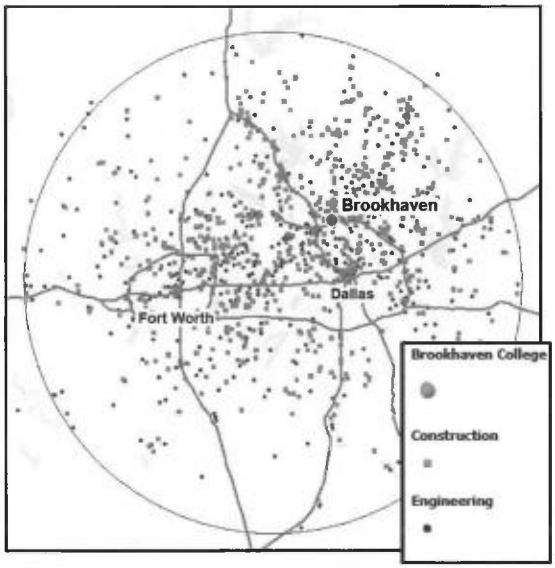
### I. PRIOR NSF SUPPORT

Brookhaven College (BC) collaborated (not as fiscal agent) in two NSF ATE funded grants in the recent ten years. PI, Scott Sires, was a collaborator in the 2013 – 2016, Integrated Geospatial Education and Technology Training (iGETT): Remote Sensing workshops (DUE-1205069). In 2017, BC was selected for the Mentor-Connect: Technical Assistance and Grant Writing project (DUE-1501183).

### II. INTRODUCTION

BC of the Dallas County Community College District (DCCCD), located in the Dallas-Fort Worth (DFW) Metroplex of Texas, is a Hispanic-Serving Institution serving 13,213 credit students in Fall 2017. Within the DFW Metroplex there is a lack of qualified geospatial technicians and engineering technicians to work together in the construction industry. Geospatial technicians collect data to identify, organize and analyze the spatial relationships of interest such as populations, structures, topology, and other forms of field data. Engineering technicians and engineers in civil engineering use that geospatial data to help in the efficient analysis and design of infrastructures. This collaboration, sometimes referred to as **constructioneering**, between geospatial data and construction design allows for a "quicker and more accurate workflow than traditional methods".[1] In addition to the lack of qualified employees, there is an identified skills gap between technology expertise needed on the job and the current knowledge possessed by the available workers.

Bridging the gaps between **construction**, **engineering** and **geospatial** technology, BC's Constructioneering GATEway project (GATEway) will engage industry to conduct a workforce needs analysis to identify curricular revisions and will create interdisciplinary learning modules to educate geospatial and engineering technicians on the spatial data technologies that support evolving and current construction engineering functions. The proposed **learning modules incorporate 2017 technologies which make the modules unique. PI and Co-PI research has not identified any available curriculum utilizing this technology in the state of Texas**. As a result, these technicians will understand connections between the related geospatial and engineering disciplines and will apply these new methods to meet the needs of traditional and non-traditional students as well as incumbent workers in construction within the DFW area.




### III. MOTIVATING RATIONALE

**Current Situation:** Within a 45-mile radius of the center of the metro area, there are 836 non-residential construction companies with 6,579 employees and a 2016 annual sales volume of $2.301B. Within that radius, there are 818 heavy and civil engineering construction companies with 13,108 employees and a 2016 annual sales volume of $3.445B.[2] An industry assessment in

Texas, with 1,358 respondents, showed 88% had difficulty filling hourly or salaried professional positions, 52% had trouble filling project supervising roles and 21% had trouble hiring qualified engineers.[3] Based on input from DFW construction-related industries, there is a need for technicians who possess integrated skills related to the use and analysis of location-based data. Further articulated by author, Larry Trojak in an issue of XYHT professional magazine focused on Constructioneering, "the ability to identify, accept, and then embrace new technologies is a hallmark of most successful business enterprises."[4]

As Darryl Murdock, vice president of professional development at the U.S. Geospatial Intelligence Foundation (USGIF) says "we know that the types of **geospatial analytics applications that organizations want are not being as widely addressed in academic curricula as they should be.**"[5]. For example, traditional terrain mapping techniques are giving way to methods utilizing drones to create 3-D point clouds. According to Drone Analyst, "[Geospatial technology] professionals provide a wide variety of land-related services like identifying property boundaries, subdividing land, and [mapping] construction sites for placement of buildings. They also produce topographic and hydrologic maps, volumetric calculations for stockpiles and flood insurance maps, among other services."[6] Geospatial technicians will partner with civil/construction engineers and engineering technicians on work projects and yet basic knowledge of how their data is used is currently lacking in geospatial technology curriculum in the Dallas/Fort Worth area. This lack of knowledge adversely affects their productivity once employed. In a similar manner, the changing nature of engineering and engineering technician roles often utilizes spatial literacy skills and, based on the PI/Co-PI review of curricula in Texas, there is no **appropriate geospatial technology coursework included in any engineering or engineering technician degree within the state of Texas**.

Within the United States, construction management uses Building Information Modeling (BIM) to visualize and monitor the progress of a construction project throughout the life of the project. The acronym "4D BIM" refers to the xyz spatial descriptors in combination with time. In a March 2017 article, *The First Four Ds of Construction*, "collaboration in [site investigation], engineering, and construction, presented as a real-world implementation of 'constructioneering'" is becoming imperative.[7] With this growing emphasis on 4D managerial approaches, **there is a need for technicians who possess integrated skills related to the use and analysis of location-based data**. In addition to the current gap in skills between academic preparation and industry needs, there is a shortage of skilled entry-level and mid-level technicians. For a 90-day period from May through August, 2017, 431 openings for AAS civil engineering technicians or construction/managers in the DFW area are going unfilled. [8] This shortage of skilled technician and middle-management personnel is slowing the ability of industry to meet construction needs and is also adding to the actual costs of the construction.

Construction firms are seeking alternative mechanisms to meet the demand for filling these positions by providing on-the-job training for specific skills to current employees which in turn reduces the employees' ability to focus on their current duties. Also, the trainers are often using outdated approaches to locate the right people and develop their employees' skills. On-the-job training for spatial intelligence techniques is not available across the industry and those who can train are usually self-taught and not able to provide accurate and effective skills to increase

effectiveness of geospatial services. **This increased need for cross-discipline collaboration is confirmed based on input from Dallas/Fort Worth construction-related industries.**

**Collaborations with Local Industry:** Based on input from commercial construction, civil engineering and geospatial industry advisors, **the ability to communicate between geospatial/engineering technician teams is becoming increasingly necessary**. The PI and Co-PI have found no available resources to teach these cross-disciplinary skills within the public or academic sectors. Skills gaps between current employee expertise and needed expertise as well as unfilled positions require efficient and effective education for engineering technicians and geospatial technicians. These local and national skill and knowledge needs and reviews of the industry requirements for skilled technicians and mid-level project managers serve as the motivation for BC's proposal to create interdisciplinary geospatial and engineering technician learning modules. These **modules, which build upon the general knowledge of the student study, should require no more than two to four hours of time** in and out of the classroom for students to complete. These project-based learning modules simulate on-the-job activities to weave into existing courses and provide geospatial technology students and engineering tech students a chance to collaborate to analyze, with rapid turnaround and required accuracy, real-world local structure designs. As a result, **students will have ongoing experiential and collaborative opportunities** throughout their program studies. These modules will be validated by the BC GATEway Business Industry Leadership Team (BILT) and their associates. Refer to Table 3 for BILT member composition.

BC is uniquely positioned to create the necessary instructional environment given our proven success in building resources that utilize platforms and sensors which together yield new data types and formats. Identified skills gaps can be quickly remedied by appropriate coursework that leverages and improves BC's prior knowledge/experience. As described in the supplemental materials documents--BC's Geospatial Technology Program Advisory Committee meeting minutes dated May 2017, constructioneering-related skills are needed and local industry has demonstrated interest in Brookhaven students who possess these skills. Since 2006 BC has continued to introduce technicians to (1) applications that make it possible for people to pinpoint their geographic location (Global Navigation Satellite Systems [GNSS], the US version commonly known as Global Positioning System [GPS]), (2) data collection practices using new-concept sensors, (3) practices that identify patterns and spatial relationships using geospatial analysis, and (4) the evolving development of 3-D point cloud data. The **next logical step to fill the current skills gap is to develop educational modules** that leverage past experience while adopting commercially viable solutions.

**The Problem Being Addressed:** "Great advances have been made in increasing engineering and production efficiencies in each individual discipline: technology wizardry, automation, mass data capture, real-time management, rules-based 3-D design, and more."[9] BC, with the support of the NSF ATE program, is in the unique position to create needed modules that explain new methodologies which apply new commercial equipment and prepare technicians to meet the spatial literacy requirements of today's civil and commercial construction industry. **Creation of cross-disciplinary modules will integrate cutting-edge skills into the technical curriculum and provide much-needed education that will be utilized on the job.**

## IV. PROJECT GOAL, OBJECTIVES, ACTIVITIES & DELIVERABLES

The goal of GATEway is to **meet industry needs for interdisciplinary geospatial and engineering technician Knowledge, Skills and Abilities (KSA)** through integrated, practical and real-world applications. In order to identify the industry needs, to address the identified skills gaps and to educate technicians to build their understanding of the emerging technologies that now are needed for commercial construction and engineering, five objectives and associated activities necessary for the achievement of that goal have been established. The objectives are

1) Identify specific skills
2) Create content modules
3) Test content modules
4) Refine content module sets, and
5) Disseminate the content modules to higher education peers per the Dissemination Plan.

**OBJECTIVE 1.** Create a focused plan to identify the specific skills needed. The project team **anticipates 4 to 8 content modules** to be specifically determined by the BILT.

**Activity 1.1** Assemble a BILT from the construction, engineering and geospatial industries.
1.1.1 Deliverable - Document listing members on the BILT in which each member will be specifically identified. The following diversity metrics will be included in the documented team: A. Size of business, B. Gender of team member, and C. Years of related experience.

**Activity 1.2** Convene the BILT to participate in a needs assessment workshop to **conduct an industry workforce needs analysis** identifying specific skills gaps and needed education.
1.2.1 Deliverable – Document of identified items that are identified from the workshop. It is anticipated that the workshop will identify a finite number of the following:
A. Needed skills, B. Knowledge areas, C. Abilities, D. Duties, E. Tasks, and F. Tools

**Activity 1.3** Record prioritized workshop results incorporating levels of understanding.
1.3.1 Deliverable – Document prioritizing identified items with level of understanding required.

**Activity 1.4** BILT-identified competencies common to engineering technician or geospatial technology courses will be cross-walked using a table similar to the template suggested in Table 1 following. The crosswalk will indicate the levels of understanding attained by the students by applying them to the table graphic symbols suggested. Students will be formed into **cross-disciplinary teams and participate in collaborative project-based-learning activities**. These activities will foster an environment in which students will integrate concepts from complementary disciplines, developing and integrating both declarative and procedural knowledge.
1.4.1 Deliverable - A matrix (similar to the possible competencies in the following example in Table 1) will be completed and will identify specific courses in which BILT-identified competencies will be taught.
1.4.2 Deliverable –The created matrix will demonstrate levels of instruction, based on Bloom's Taxonomies, from 1 of 5 (Not Applicable, Knowledge, Comprehension, Application or Analysis) by placement of graphic symbols.

| Level of Understanding | Not Applicable | | Knowledge of the concept | | Comprehension of the concept | | Application of the concept | | Analysis of the concept | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| **Proposed Competencies** | **Brookhaven College Course Rubric, Number and Title** | | | | | | | | | |
| | GISC 1145 – GIS for Engineers | GISC 1147 – 3D Analysis in GIS | GISC 1391 – Special Topics in Geography | GISC 1421 Introduction to Raster-Based GIS | GISC 2311 Intermediate GIS | GISC2401 Data Acquisition & Analysis in GIS | ENGR 1201 Introduction to Engineering | ENGR 1304 – Engineering Graphics I | ENGR 2301 – Engineering Mechanics - Statics | ENGR 2302 – Engineering Mechanics - Dynamics |
| 1 – Analyze support structures | | | | | | | | | | |
| 2 – Construction site management | | | | | | | | | | |
| 3 – 8 To be determined | | | | | | | | | | |

Table 1

**Activity 1.5 Join forces with PIs of NSF-funded grants** that have project scopes complementary to GATEway. The Virginia Space Grant Consortium-administered GeoTEd-UAS grant (DUE-1601614) and Palomar College's UASTEP grant (DUE-1700552) are currently-funded projects developing curriculum for geospatial technicians in the use of unmanned aerial systems. Although these two grants are not developing cross-disciplinary engineering, construction and geospatial curricula, it is likely the collaboration will identify aspects of common curriculum development processes from which all three grants may benefit as education partners. The respective PIs have agreed to serve as BILT members of GATEway. Refer to supplemental materials documents for letters of collaboration.

1.5.1 Deliverable – Summary of curriculum development process best practices will be developed. Summary will be available to PIs of other grants.

**Activity 1.6** Acquire technologies necessary to execute the goal and objectives as identified.

1.6.1 Deliverable – identified vendors, orders, and proof of deliveries will be documented.

1.6.2 Deliverable – tools and technologies maintained in the GIS Lab at BC, calibrated and field tested with all results being documented and archived.

**OBJECTIVE 2.** Create content modules related to **application of modern instrumentation and new technologies** to address the knowledge, skills, and competencies needed for the evolving, converging, and emerging technical workplace. Each content module will be drafted using a template adapting the Esri GeoInquiries© ( EGI) model which is permitted via the creative commons copyright status of the EGI. Resources needed to complete modules will be created.

**Activity 2.1** Develop instructional content modules applying a standardized template. Refer to sample template in supplemental materials documents. Each module will provide knowledge, skills and abilities about an individual BILT-identified workflow task needed by DFW metro area constructioneering-related industries. It is anticipated the content modules will stack one upon the other for the purpose of building a broad skill set that begins with foundational concepts and ends with advanced concepts through continued exposure and participation. Each content module will contain the same instructional sections, requisite data and resources, and instructor materials with experiential education pedagogy integrated into each module.

2.1.1 Deliverable –content modules identified and prioritized by the BILT will be created.

2.1.2 Deliverable – each module will be unique given no prior curriculum nor content exists regarding this subject matter. Each module is anticipated to contain sections that will

A. **Engage** the students with a module discussion citing real-world case studies that detail technicians' tasks needed and require collaboration among disciplines,
B. **Explore** varied aspects of said technical tasks and workflows using external and readily-available resources,
C. **Explain** the essential vocabulary of the tools and techniques necessary to understand and successfully complete the BILT identified workflows,
D. **Elaborate** on the breadth of applied methodologies and workflows demonstrating student understanding and providing immediate feedback to the instructor,
E. **Execute** laboratory projects in which the students utilize the emerging or recently-updated tools, technologies and methodologies of constructioneering projects,
F. **Evaluate** student learning in accordance with the content module rubric that lists the linear steps and the potential points for each step which will provide for the assessment of student performance as well as identify areas of concern which, based on student performance, may require additional focus,
G. **Extend** the concept by providing suggested reading materials and ancillary resources.

**Activity 2.2** Apply tools and technologies to collect sample datasets

2.2.1 Deliverable – The GATEway project team will conduct a number of field exercises in order to utilize tools and technologies while collecting data necessary to execute the laboratory project tasks. The number of field exercises and the hours invested in the field by the project team will be documented as a measure of activity 2.2. As appropriate and following vetting by the BILT, participating students, as a part of the instructional module process, will deploy to the field to apply the tools and technologies affording the student the experience of field data collection and application of the identified tools and technologies.

2.2.2 Deliverable – The project team, as a part of preparing content module resources, will create a number of datasets in the formats specific to the identified laboratory project requirements. The prepared datasets will include as many formats as are necessary to support the content module; (1) raw data will be maintained for use in instruction that requires students process the field data, and (2) post-processed data will be maintained for use in instruction that requires students to analyze data in such a format.

2.2.3 Deliverable – The project team will perform the workflows expected of the students to test the collected and processed data and will make edits as needed to make data instruction-

ready. The results of tests will be a data dictionary that will serve as a "centralized repository of information about data such as meaning, relationships to other data, origin, usage, and format". [10]

**OBJECTIVE 3.** Review and test content modules in order to **assess and evaluate the viability of each module**. Each content module will be reviewed by members of the BILT and will be alpha tested by the project team and then beta tested by students.

**Activity 3.1** Convene the BILT to review each module for accuracy of tasks and workflow, for knowledge, skills and abilities involved, and for overall relevance to active constructioneering project needs. Module sets will be produced and will be provided to the assembled BILT members. Review is intended to either identify any deficiencies or to approve the module. Each module will be reviewed for intention, application, accuracy of scope, adherence to BILT-identified skills gaps and related skills needed.
3.1.1 Deliverable - The review process will be documented and either the approval, or suggested enhancements, will be noted. Appropriate changes will be utilized in Objective 4.

**Activity 3.2** BILT members (includes PIs of DUE-1601614, DUE-1700496 and DUE-1700552) will assist Project Team with the alpha test for application of tasks, workflow, knowledge, skills and abilities involved, and for adherence to intended scope of instruction within content modules. In return for their assistance, BILT members will have first access to the materials and all content.
3.2.1 Deliverable - The alpha test process will be documented and either the approval, or needed enhancements, will be noted. Appropriate change orders will be utilized in Objective 4.

**Activity 3.3** Each module will be beta tested by advanced students familiar with similar technology instruction to assess appropriate flow of instruction aligned to expectations as established by the BILT and the members of the alpha testers, and to gauge time requirements.
3.3.1 Deliverable - The beta test process will be documented and either the approval or suggested enhancements will be noted. Appropriate changes will be utilized in Objective 4.

**OBJECTIVE 4. Revise the concept modules** in order to produce a final, sharable, module set. All suggested edits will be reviewed and incorporated as appropriate into the concept modules.

**Activity 4.1** Revise content modules by incorporating appropriate edits as suggested by the activities of Objective 3.
4.1.1 Deliverable – a final content module set will be created.

**Activity 4.2** Project team will assess the revised content modules to gauge improvements.
4.2.1 Deliverable – the testing experience and results will be documented as to time requirements and number of concerns and issues, if any.

**OBJECTIVE 5. Disseminate the final content modules** by (1) posting each to easily-accessible source points in alignment with BC capacity and commitment from supporters and (2) presenting modules and related materials at select conferences.

**Activity 5.1** Design and produce a brochure describing our project to market to potential students, employers and colleagues at other institutions.
5.1.1 Deliverable – brochure content evaluation
5.1.2 Deliverable – document outlining number of brochures and distribution methods

**Activity 5.2** Create a webpage to house constructioneering concept modules and interpretive materials, information and resources
5.2.1 Deliverable – website will be live and will be easily accessed with any internet browser

**Activity 5.3** Post revised content modules, materials and resources to the GATEway webpage.
5.3.1 Deliverable – visitors to the GATEway webpage will be able to access, review and download modules, explanatory materials and ancillary resources.

**Activity 5.4** Post revised, final content modules, materials and resources to a variety of websites including the GeoTech Center webpage for Curriculum Resources. Permission will be secured from appropriate web managers and content posted.
5.4.1 Deliverable – visitors to the GeoTech Center Curriculum Resources webpage will be able to access, review and download modules, explanatory materials and ancillary resources.
5.4.2 Deliverable – Document listing number of websites to which content modules are posted and the number of hits per website or the number of downloads per website.

**Activity 5.5** Attend, present and share modules and related materials at varied professional development conferences and events. Potential events might include the following: High Impact Technology Exchange Conference (HI-TEC), GeoTech Center's GeoEd Conference, Esri Education Conference and International User Conference, South Central Arc User Group (SCAUG) regional conference and similar events.
5.5.1 Deliverable – Each event attended will be documented.
5.5.2 Deliverable – The number of distributed content packets will be accounted.
5.5.3 Deliverable – A point of contact list will be documented.
5.5.4 Deliverable – Presentations will be made at some or all of the events and audience feedback will be gauged using an easily-available mobile device application. The feedback will be compiled and archived.

## V. PROJECT TIMELINE AND KEY ACTIVITIES

In the table below the key activities are listed and in each cell the team member responsible for each activity is listed by his/her initials (**SS** = PI, Scott Sires and **KW** = Co-PI, Kathryn Wetzel).

| **GOAL: MEET INDUSTRY NEEDS FOR GEOSPATIAL AND ENGINEERING TECHNICIAN KNOWLEDGE SKILLS AND ABILITIES** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Year 1 2018/19** | | | **Year 2 2019/20** | | | **Year 3 2020/21** | | |
| **Objective 1 Activities** | **SU** | **FA** | **SP** | **SU** | **FA** | **SP** | **SU** | **FA** | **SP** |
| 1.1 Assemble a commercial construction, engineering and geospatial BILT | SS | | | | | | | | |
| 1.2 Convene the BILT and conduct workshop | KW | | | | | | | | |
| 1.3 Document workshop results | SS | | | | | | | | |
| 1.4 Crosswalk identified items | KW | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1.5 Join forces with PIs of NSF funded grants | SS | | | SS | | | SS | | |
| 1.6 Acquire tools & technologies | SS | | | SS | | | SS | | |
| **Objective 2 Activities** | | | | | | | | | |
| 2.1 Develop content modules | SS | SS | SS | SS | SS | SS | SS | | |
| 2.2 Apply tools and technologies to collect sample datasets | | SS | SS | SS | SS | | | | |
| **Objective 3 Activities** | | | | | | | | | |
| 3.1 Review and test content modules to identify deficiencies | | | | KW | KW | KW | | | |
| 3.2 Conduct summer validation workshop - industry review and test revised modules to identify workflow, KSA and adherence to scope; on-going testing | | | | SS | KW | KW | | | |
| 3.3 Conduct summer validation workshop - advanced student review and test revised content modules to assess logical, linear flow; on-going testing | | | | | | KW | SS | | |
| **Objective 4 Activities** | | | | | | | | | |
| 4.1 Revise content modules by incorporating appropriate edits | | | | | SS | SS | SS | | |
| 4.2 Assess the revised content modules to gauge improvements | | | | | KW | KW | KW | | |
| **Objective 5 Activities** | | | | | | | | | |
| 5.1 Create a brochure | | | | KW | | | | | |
| 5.2 Create a GATEway webpage | | | | | KW | | | | |
| 5.3 Post content modules, materials & resources to the GATEway webpage | | | | | | SS | KW | SS | KW |
| 5.4 Post content modules & resources to external webpages | | | | | | | SS | SS | SS |
| 5.5 Present and share modules and materials at conferences | | | SS | SS | SS | SS | SS | SS | SS |

Table 2

## VI. PROJECT MANAGEMENT PLAN

Successfully completing project deliverables will be the responsibility of the PI and Co-PI and are detailed in Table 2 above. The PI, Co-PI and external evaluator will assemble in person or virtually at least once every month to review project activities and progress towards planned outcomes, accountable to the Vice President of Academic Affairs and to the President of the College. Also, the project team will meet with the advisory committee (BILT members), at least bi-annually and, with electronic technologies, will communicate quarterly during the grant period.

### Project Team Roles and Responsibilities

1. J. Scott Sires: PI, Professor, Geospatial Technology Program
2. Dr. Kathryn Wetzel: Co-PI, Adjunct Professor, Engineering & Executive Dean, Mathematics & Sciences
3. To be determined by bid per college-required policy and process: External Evaluator

Serving as the PI, Professor Sires will lead the project. He will lead all objectives. Since 2006 he has served as the chair of the Geospatial Technology Program responsible for developing curricular standards for associate degree programs in applied geospatial technology.

Dr. Wetzel will serve as the Co-PI responsible for assisting with curriculum development. With numerous teaching awards and experience in curriculum redesign, she will provide experience and guidance in representative activities and analysis of construction appropriate for students at these freshman and sophomore levels.

The external evaluator, with a background in curricular development for geospatial technology, will evaluate GATEway and will be responsible for assessing the project performance, pace and achievements. The external evaluator will document findings, share insight and provide recommendations. See the Evaluation Plan for more details.

**Business & Industry Leadership Team (BILT)**

| **Legend of Roles** | 1 – Advisor, 2 – Needs Assessment, 3 – Instrumentation Insight, 4 – Module Review, 5 – Hire Candidates, 6 – Share Curriculum, 7 – Labor Market Intelligence, 8 – Planning, 9 – Dissemination, 10 – Conference Invitation, 11 – Field Testing, 12 – Share DACUM, 13 – Recruiting, 14 – Share Findings, 15 – Bi-annual Review, 16 – Provide Field Data | | |
|---|---|---|---|
| **Member** | **Title** | **Company** | **Support Role** |
| Mr. George Dailey | Education Manager | Esri **(TX)** | 1, 2 |
| Mr. Peter Palacios | Asst. Dir., Facilities Mngmt. | UNT **(TX)** | 1, 2, 3, 4, 11, 15, 16 |
| Mr. Michael Lewis | Surveyor | Pacheco Koch **(TX)** | 1, 2 |
| Ms. Tessa Allberg | Chief Technology Officer | City of Grapevine **(TX)** | 1, 2, 15 |
| Mr. Brent Long | Project Manager LBJ Express | Jacobs Engineering **(TX)** | 1, 4, 15 |
| Ms. Nancy Cline, P.E. | Practice Leader - Transportation | Pape-Dawson Eng. **(TX)** | 1, ,2 |
| Mr. Kelly Klose | GIS Manager | City of Mansfield **(TX)** | 1, 2, 5, 15 |
| Mr. Josh Sires | Project Manager | Gracon Constr. Inc. **(TX)** | 1, 2, 3, 4, 9, 11, 15, 16 |
| Mr. Robert Hinkle | Corporate Affairs | LBJ Express **(TX)** | 1, 2 |
| Mr. Erin Atkinson, P.E. | Vice President | Halff & Associates **(TX)** | 1, 2, 3, 4, 5, 10, 15 |
| Mr. Daniel Harris | Design Constr. Coord. | Vaughn Construction **(TX)** | 1, 3, 4, 11, 15 |
| Mr. Ben Pierson | Project Manager | Vaughn Construction **(TX)** | 1, 3, 4, 11, 15 |
| Mr. Robert Wachal | GIS Implementations SPC | Black & Veatch **(TX)** | 1, 2, 4 |
| Mr. Seth Bullis | BHC GIS Grad., GIS Tech | Dallas Aerial Surveys **(TX)** | 1, 2, 3, 4, 11 |
| Mr. Mark Hays | Vice Chancellor of Workforce and Economic Development | DCCCD **(TX)** | 2, 7, 8, 15 |
| Mr. Vincent A. DiNoto Jr. | Professor<br>Director and PI DUE-1700496 | Jefferson Com. & Tech. College / Geospatial Center of Excellence **(KY)** | 1, 2, 6, 9, 10, 12, 15 |
| Dr. Wing Cheung | Professor<br>PI DUE-1700552 | Palomar College<br>UASTEP **(CA)** | 1, 2, 6, 9 |
| Mr. Chris Carter | Deputy Director and PI DUE-1601614 | Virginia Space Grant Consortium<br>GeoTEd-UAS **(VA)** | 1, 2, 4, 6, 9, 10, 12 |
| Dr. Amy Ballard | Associate Dean, School of Applied Technologies | Central New Mexico Community College **(NM)** | 3, 4, 11, 12, 14 |
| Mr. James Walker | Manager, GIS Department | Garland ISD **(TX)** | 1, 2 |
| Mr. Roger Palmer | Dir. Of Operations<br>Chair of Sciences | GISetc.<br>Bishop Dunne H. S. **(TX)** | 1, 2, 3, 4, 10, 11, 14, 15, |
| Mr. Erik Bushland | Faculty & Tech. Ed. Dept. Chair, Animation and GIS | Sachse HS, Garland ISD **(TX)** | 2, 8, 13 |

Table 3

## VII. TARGET AUDIENCE & RECRUITMENT

The project team proposes to recruit participants for GATEway from two primary sources. **The foremost source is students enrolled in the existing geospatial technology program and from the existing engineering courses**. The annual enrollment from both disciplines averaged 370 during the two previous academic years.

The second of the primary recruiting sources is the students not yet invested in either engineering or geospatial technology study. The new content modules, their scope of study, the related technology devices, and the instructional methodologies will be leveraged at campus and community events to garner increased interest beyond the prior academic years' enrollments. These modules will be showcased in campus events such as GIS Day, the STEM club meetings, the STEM Fair and within the college Career Development Center events. The project team anticipates an increase of 37 enrollments across the engineering and geospatial technology courses over the three-year period of the grant.

Beyond the two primary recruitment sources will be employers of incumbent workers identified through our communications with industry professionals who seek retraining.

## VIII. EVALUATION PLAN

The proposed evaluation design is based on a presentation at the 2015 NSF EPSCoR (Established Program to Stimulate Competitive Research) meeting for Project Administrators, Directors and Evaluators. "The mission of EPSCoR is to advance excellence in science and engineering research and education in order to achieve sustainable increases in research, education, and training capacity and competitiveness that will enable [...] increased engagement in areas supported by the NSF." [11] EPSCoR recommends that evaluation be composed of three parts: Goals, Questions and the Plan.

The goal of the BC-proposed ATE project is the creation, delivery and refinement of competency-based learning modules for engineering and geospatial technicians in the application of spatial data technologies that support construction engineering functions.

The questions that must be answered to accomplish that goal are the following:

- Are the advisors (BILT members) representative of the area workforce and educational needs? How many advisors participated in each engagement?
- Did the project team develop comprehensive, research-based content modules that were reviewed and piloted?
- How many students piloted the content modules? Are levels of understanding assessed?
- Is the progress toward stated goal on pace with the time line and is progress documented?
- Do BILT members support demonstrated applied technologies? Do BILT members agree that accomplishments demonstrate evidence of broader impacts?
- Does participating student demographic data provide proof of diversity? Do outreach efforts provide proof of reaching a diverse audience?
- Do periodic progress assessments indicate need for changes or adjustments?
- Is project team participating in any evaluation activities requested by NSF ATE?

The evaluation will be led and managed by the external evaluator. DCCCD Business Policy & Procedures identify grant evaluators as professional services contractors to be selected through an open, equitable process that encourages competitive participation by at least three competent independent contractors. This policy prevents selection of an external evaluator prior to grant award. BC's criteria for selection of an evaluator after the award is made include expertise in geospatial technology curriculum development, related instructional content delivery and research, and experience as a PI or Co-PI of NSF funded projects.

The evaluation plan of GATEway includes both formative and summative components. The external evaluator will serve as a resource to the project's leaders at all phases of the evaluation by employing a systematic approach to data collection, summation, and adjustment.

Using a holistic evaluation design, the external evaluator will build a complete picture of the project as it takes shape over the course of three years. With the project team, the evaluator will develop the tools to evaluate all objectives thoroughly and ensure that data collection is maintained at rigorous standards. The evaluator will work with the project team to secure approval for evaluation instruments from the College's Institutional Review Board. The evaluator will draw from the following multiple data sources:

- Project records and meeting notes will be reviewed throughout the course of the project.
- Curriculum and technical materials for the proposed content modules developed will be assessed as they become available.
- Student performance data related to module completion, grades and basic demographics will be compiled by BC's Office of Planning and Research and shared in a secure manner with the external evaluator for analysis and interpretation.
- BILT advisory committee member interviews will be conducted semi-annually.
- On-site visits will allow the evaluator to assess the project "in action," and provide a dynamic framework to understand the context within which the project operates.
- Surveys will be administered to participating students and BILT members. Survey responses will yield valuable feedback for improving the content and relevancy of materials and experiences as well as student engagement.

Evaluation reports will be generated semi-annually in addition to any ad-hoc reporting that may be required. The proposed evaluation has been designed to establish the impact–both projected and unanticipated–on stakeholders as well as guide decisions about sustainability and replication. The external evaluator will chronicle project activities and design including curriculum development, field methodologies, student recruitment, and the establishment of experiential service-learning opportunities students. In addition, the formative evaluation reports will assess the adequacy of program staffing, describe the characteristics of participants served, and demonstrate changes in organizational capacity.

Summative evaluation reports will describe the organic nature of the collaboration and uncover the project's collateral impacts on the engineering and commercial construction industries. Evidence-based recommendations intended to strengthen project elements and improve student success will be presented, and the parties will strategize the most effective ways to address identified challenges.

| EVALUATION OF CONTRUCTIONEERING GATEWAY – LOGIC MODEL | | | | | |
|---|---|---|---|---|---|
| INPUTS | ACTIVITIES | OUTPUTS | OUTCOMES | | |
| | | | SHORT-TERM | MID-TERM | LONG-TERM |
| Project team<br><br>BILT | Conduct needs assessment workshop. | Identification of needed skills related to the use and analysis of location-based data. | Needs assessment completed providing guidelines for content modules. | Faculty understands needed instructional content and technology. | Partnerships are created and provide long-term opportunities for educated technicians. |
| PI<br><br>Student participants<br><br>BILT advisors | Provide field tests experiences of advanced technology tools for spatial intelligence data collection. | Tools applied and understood. Field technologies documented. Datasets created. | Faculty learn to use technology Students gain technical knowledge. | Students learn to apply technological skills. | Knowledge, skills and abilities education applied to on-the-job experiences. |
| Project team<br><br>BILT advisors<br><br>Participating students | Create and test content modules and develop curricular materials. | Curriculum materials developed. | Students interests in technical field increases. | Students persist in their program study. | Technicians skilled with career-ready skills.<br>Students gain employment. |
| Project team<br><br>BILT<br><br>Industry members | Conduct Summer validation workshops. | Industry insight and feedback created. Curriculum materials vetted by industry. | Content modules are enhanced. | Content modules tested in instructional environments. | Students apply knowledge and skills in the industry. |
| Project team<br><br>BILT<br><br>External evaluator | Formative and summative evaluation activities will involve key stakeholders from BC and its partners. Establish articulation agreements. | Findings from evaluation reports will be used to inform project implementation, collaboration, and outcomes, and assist with mid-course correction. | Content Modules will incorporate appropriate edits and will then be applied and re-evaluated. | Findings and recommendations will be presented at regional and/or national conferences of STEM experiential education or technician education. | Evaluations– The summative evaluation in Year 3 will make a case for project sustainability post-award. |

## IX. DISSEMINATION PLAN

The project team will ensure the content module curriculum and ancillary resources (data sets, process models, and expected outcomes) are shared with higher education peers for the purpose of providing instructional materials for other community colleges. These materials will be disseminated by three primary methods. The largest distribution will be via website (the GATEway web page and the GeoTech Center curriculum webpage) postings of instructional resource sets that include written modules, data sets, rubrics, and videos. Second, presentations will be made at a variety of professional development events including workshops and conferences. With the support of the NSF the project team will attend the ATE PI Conference and the GeoTech Education Forum. BC, within its ongoing capacity and as an element of the sustainability plan, supports the following events at which the project team will seek to conduct presentations: the Esri Petroleum User Group (PUG) conference, the South Central Arc User Group (SCAUG) regional conference, the Esri Education conference and the

Esri International User conference. Third, the GATEway team will work with the Dallas/Ft. Worth area chapters of the American Society of Civil Engineers (ASCE) and with the Associated General Contractors of America chapter in Dallas to present GATEway concepts and findings.

## X. PLAN FOR INSTITUTIONAL SUSTAINABILITY

Sustainability will be achieved through the institutionalization of the curriculum at BC. Based on prior success in building and maintaining a Geospatial Technology program, creating transfer degree options from this program and starting engineering courses, the institutional commitment to cross-discipline constructioneering education is in place. The content modules do not need to be approved through a formal process allowing easy integration into existing courses offered at BC. Ongoing for-credit enrollment, in addition to workforce incumbent training, will help sustain the new curricular content modules. The content modules, incorporated into both engineering courses and geospatial awards will be offered through the Mathematics & Science Division. The existing GIS lab will support the constructioneering content modules and all related tools and technologies. The Co-PI is the Executive Dean of the Mathematics & Science Division and will, along with the president and vice president of academic affairs, maintain college-wide support of GATEway and evolution beyond the scope of the NSF ATE funding. Software and hardware maintenance and updates will be part of routine semester GIS lab imaging, and the annual renewal and addition of software licenses and equipment upgrades will be planned for the GIS Dept. of the Math & Science Division budget supported partially by Carl Perkins Grant funds.

As demonstrated in the supplemental materials letters of collaboration, the GATEway project team will receive additional support from BC in numerous forms as follows:

- increased efforts in the college advising department from which student candidates will be directed to the opportunities afforded in the engineering and geospatial technology courses,
- increased marketing resources from the marketing and creative services department,
- increased resources from the college career development center showcasing constructioneering jobs,
- increased awareness and exposure of constructioneering technology offerings from the college's Workforce and Continuing Education Division.

All degree-seeking students in the geospatial technology program are required to successfully complete an internship in which the students work with industry professionals. The internships provide opportunities to apply learned KSA, therefore internships will provide students the opportunity to apply constructioneering methodologies and tools within the community. This interaction will serve to advance the application of constructioneering technologies.

The two instructional disciplines that serve as the foundation of GATEway--engineering and geospatial technology--are experienced in creating partnerships as is evidenced by the supplemental materials letters of collaboration and the BILT membership. These disciplines will continue leveraging prior successes to increase relationships that benefit and sustain GATEway. Industry members have stated their interest in hiring candidates with the knowledge, skills and abilities that result from GATEway. The project team, with the support of the college, will seek sustaining funds and support from industry partners to grow GATEway.

BC's Division of Mathematics & Sciences intends to leverage GATEway success to develop an engineering technician degree program. The college's capacity for developing programs, coupled with the influence of the GATEway BILT, will play strong roles in the development of the planned engineering technician degree program.

Executive administrators of the Dallas County Community College District (DCCCD) have interests in extended program potential. The project team will leverage the NSF ATE grant-funded achievements to promote potential expansion with the DCCCD administration.

## XI. INTELLECTUAL MERIT

GATEway proposes a single project goal: to meet industry needs for interdisciplinary Geospatial and Engineering Technician Knowledge, Skills and Abilities (KSA) through integrated, practical and real-world applications to build technician understanding of the emerging technologies that now are needed for commercial construction and engineering in the Dallas/Ft. Worth area.

The intellectual merit of GATEway includes investigating recent advances in imaging, spatial intelligence techniques and analysis technologies for the purpose of adopting and adapting those technologies into new instructional materials in two ways: first by creating new content modules that serve the needs of engineering and commercial construction industries, and second by integrating cross-discipline field experiences throughout the content modules. Our project team proposes a series of modules that promote higher forms of learning culminating in advanced knowledge, skills and abilities necessary to gain successful employment in constructioneering-related industries. Upon completion of the modules, students will be well-prepared to apply new technologies in the workforce. Our new, pioneering GATEway project creates an environment that allows students to demonstrate their interdisciplinary knowledge and technical skills learned in both engineering and geospatial technology courses, as well as demonstrate 21st century career-ready abilities integrating emerging and advanced technologies that improve efficiency and cost reduction potential in regional companies' goals.

## XII. BROADER IMPACTS OF THE PROPOSED WORK

By incorporating real-world, service-learning experiences into the proposed content module curriculum, our project is designed to prepare technician candidates to enter the well-paying industries of heavy civil engineering, commercial construction and geospatial technology. At least 35% of students will be identified as a population traditionally under-represented in STEM fields (e.g., female, African American and Hispanic and low-income). Additional broader impacts of GATEway include the national dissemination of our curricular and service-learning materials specifically developed for both engineering and geospatial technicians. GATEway has great potential to serve as a model of cross-disciplinary approaches to applying evolving technology education for other community colleges. Brookhaven College graduates who participate in this program will become resources and role models, and as alumni will further solidify and expand community partnerships as they themselves become citizens of the community served.

**CITATIONS AND FOOTNOTE REFERENCES:**

[1] Heimgartner, Jeffrey. "Constructioneering: The New AEC Buzzword." Engineering.com. 22 November 2016. Referenced from http://www.engineering.com/BIM/ArticleID/13745/Constructioneering-The-New-AEC-Industry-Buzzword.aspx
[2] Business Analyst Online Data. Methodology Statement: 2017 Esri US Business Locations and Business Summary Data. January 2017. Referenced from http://downloads.esri.com/esri_content_doc/dbl/us/J9940_Methodology_Stmt_Business_Locations_Summary_2017.pdf
[3] Turmail, Brian. "Nationwide survey finds 86 percent of contractors have difficulty filling key craft and salaried jobs as demand for construction increases." Agc.com. Associated General Contractors of America. September 10, 2015. Referenced from https://www.agc.org/news/2015/09/10/nationwide-survey-finds-86-percent-contractors-have-difficulty-filling-key-craft-and
[4] Trojak, Larry. "Caught (Mobile) Mapping." XYHT, 47-49, March 2017.
[5] Shacklett, Mary E. "Developing the Next Generation of Geospatial Skills." Pobonline.com. 19 July 2016. Referenced from http://www.pobonline.com/articles/100497-developing-the-next-generation-of-geospatial-skills
[6] McNeil, Bill and Chris Snow. "The Truth About Drones in Mapping and Surveying." Skylogic Research. July 2016. Referenced from http://droneanalyst.com/2016/07/27/the-truth-about-drones-in-mapping-and-surveying/
[7] Schrock, Gavin. "Looking Forward." XYHT, 3, March 2017.
[8] Burning Glass Technologies. (2017) "Labor Insight Real-Time Labor Market Information Tool." [Data File]. Retrieved September 10, 2017.
[9] Schrock, Gavin. "Constructioneering." XYHT, 15-17, March 2017. Print.
[10] IBM. 1993. IBM Dictionary of Computing (10th ed.). McGraw-Hill, Inc., New York, NY, USA.
[11] Peterson, Nicole. Characteristics of EPSCoR Evaluations. PowerPoint presentation at NSF EPSCoR Project Directors' and Project Administrators' Meeting, Arlington, Va. 2016. Referenced from https://www.nsf.gov/od/oia/programs/epscor/presentations/PDPA_May_2016/spring_pdpa_meeting_2016.jsp

## Facilities, Equipment, and Other Resources

Located at Brookhaven College (BC) is the Ellison Miles Building (Miles Building), a facility housing programming initially designed to promote Earth system's science and geotechnology education and training for students, educators and industry professionals which has now expanded to also promote science, technology, engineering and math education among other functions. BC intends the Constructioneering GATEway project (GATEway) be executed primarily at the Miles Building--a 20,000 square foot facility that offers a large gallery/lobby, a conference room that accommodates 28 people and two large event facilities one of which can serve 100 people and the other 240 people. Also housed in the Miles Building are the offices, faculty and staff of the Geospatial Technology Program which includes the PI. In addition to the industry-use facilities there are four large instructional rooms--two lecture rooms, one 20-seat PC lab and the GIS Lab.

The Geospatial Technology Program (GTP) offices, facilities and GIS lab will be the chief environment utilized to develop and deliver the GATEway content modules and materials. The GTP has been housed in the Miles Building for twelve years and includes three offices, a server and plotter room and the instructional GIS lab which has been continually updated, most recently in 2016, and includes the following:

- 18-seat high-end PC lab with dual flat screen, large monitors, 2 GB Video RAM, 16 GB system RAM, large storage capacity and 2x hyperthreaded hexa core processors with a 64-bit OS,
- A dedicated gigabit network,
- Audio visual resources include a high resolution projector, surround sound, a document camera, VCR, DVD and class monitoring/screen sharing capabilities,
- 8 Microsoft Surface Pro 3 tablets,
- 1 Dedicated inward-facing GIS Lab Server, 1 Dedicated public-facing GIS web server, and an unlimited Cloud GIS Server and Online Organizational Portal,
- 1 40-inch width high resolution flat bed roll scanner,
- 1 42-inch width high resolution color plotter and 1 network tabloid color printer,
- 4 Trimble GeoExplorer XT high-accuracy professional GPS units with external antenna, Digital Laser Range Finder, 2-meter range poles with bi-pod legs, targets, cases and field materials,
- Trimble education software license,
- Esri Unlimited Education Institution License,
- 1 DJI Phantom 3 Pro sUAS
- 1 Humminbird 997c SI SONAR Unit,
- 5 short range 3D-space sensor scanners,
- 10 each, or more, of several environmental sensors for air, water, soil and similar science data collection methods.

The GTP staff includes a program-leading full-time faculty, two adjuncts and a full-time lab coordinator. Within the scope of on-going responsibilities, the GIS Lab coordinator will provide support for GATEway. GTP faculty and staff will maintain GATEway resources and materials. In addition, the Mathematics & Sciences Division, led by the Co-PI, offers administrative staff support and additional instructional space to augment the two labs within the Miles Building. BC is a 190-acre site affording ample space to provide requisite infrastructure to aid in the development and testing of GATEway content modules.

In addition to President Thom Chesney and Vice President of Academic Affairs Don Smith, there will be active BC involvement from the Development Office with grant executive support from Associate Vice President for Development Marilyn K. Lynch and Coordinator of Grants Management and Compliance Sheila Brock. Other BC commitments have also been made by Executive Dean Brenda Dalton and Directors Meridith Danforth, Dominica McCarthy, and Associate Vice President Vernon Hawkins.

External to BC, a number of collaborators, the GTP BILT and GATEway partners intend to commit resources to GATEway should the project be funded by the NSF. As detailed in the supplemental materials' letters of collaborations the following people, while not funded with the NSF grant, intend to collaborate on GATEway:

> BILT members George Dailey, Peter Palacios, Michael Lewis, Tessa Allberg, Brent Long, Nancy Klein, Kelly Klose, Josh Sires, Robert Hinkle, Erin Atkinson, Daniel Harris, Ben Pierson, Robert Wachal, Seth Bullis, Vince DiNoto Jr., Dr. Wing Cheung, Chris Carter, Dr. Amy Ballard, James Walker, Roger Palmer, and Erik Bushland, DCCCD Workforce and Economic Development representative Mark Hays.

These collaborators detail in their letters the varied contributions each intends to provide. The aggregate list of contributions includes the following:

- Be a member of the Business and Industry Leadership Team (BILT) and act as an advisor
- Attend needs assessment workshop to identify existing gaps and skills needed
- Identify modern instrumentation and new technologies relevant to construction and engineering
- Participate in biannual advisory committee meetings to guide content development
- Willing to participate in an initial review of content modules and provide feedback
- Willing to assess modules in order to validate modules and provide project review, feedback and insights
- Willing to participate in field testing
- Provide data access or access to construction site and feedback on potential application
- Provide on-the-job site shadowing for module developers to simulate on the job activities
- PI willing to share appropriate findings of NSF funded grant
- Assist with design and development of brochure
- Assist with design and development of DCCCD website
- Willing to post modules to website
- Willing to invite GATEway PI to conference to share findings and present results
- Willing to invite GATEway PI to write an article for industry publication
- Interested in hiring candidates with GATEway knowledge, skills set and abilities

# DATA MANAGEMENT PLAN

## Introduction

Project data will be gathered and maintained by the Principal Investigator (PI). This will include minutes for all Brookhaven College (BC) Constructioneering GATEway (GATEway) team meetings and all Business and Industry Leadership Team (BILT) meetings. A log of activities (workshops, field events, module assessments, career fairs, and recruiting events) will be maintained. Data will be kept in electronic form and regularly backed up to a separate, secure, storage device. This data will be used in creating project reports, to assist the external evaluation and to document the GATEway project. The data will also be used to create the presentations planned as stated in the dissemination plan. There is no expectation that particular students will be individually identifiable in the data.

## Data Collection Types

Data collection will be in one of two primary types—(1) Project data gathered for evaluation and assessment of this project, or (2) Field data collected for application of technology and use in the development of instructional content modules.

Evaluation and assessment data will be collected largely by aggregated surveys and institutional data regarding enrollment and completion counts documenting project activities and outcomes. This primary data type will be documents, spreadsheet tables and databases. Following the practice of BC these documents will be in Microsoft (MS) Office formats unless otherwise dictated by the NSF.

Field data will be collected by field notes, which will be transferred to digital formats or collected as raw data in the format dictated by the applied technologies. Technology-collected raw data formats will be maintained for instructional functions and will also be processed into consumable formats as suggested by the BILT. Both raw and processed data sets will be maintained and made available.

BC, as part of the Dallas County Community College District (DCCCD), adheres to the DCCCD Privacy Commitment. This commitment is based on two principles. The DCCCD promises (1) to comply with all the applicable local, state and federal laws and regulations; and (2) To protect a students' privacy while still offering relevant, personalized service. BC is a public higher education institution and therefore bound by the Texas Public Information Act and the Family Education Rights and Privacy Act (FERPA). In the event of surveys conducted with students the PI, Co-PI and External Evaluator will collaborate with the BC Office of Planning and Research to collect any and all data in accordance with federal, state, and college policies.

## Metadata and Data Format

All data collected, surveyed, raw, gathered, maintained and processed will include metadata that will include descriptions of environmental factors, scenarios or suitable citations of experiments, apparatuses, raw materials, computational codes, and computer calculation input conditions, purpose of data, date or dates generated, identification of project team primarily

responsible for data, filename, format and archive path. Software utilized in collection, processing or archiving will be identified.

Raw data, not initially in digital form, will be entered into spreadsheets or other appropriate digital formats for analysis, archiving, and dissemination.

Data formats will conform to MS Office applications formats, applied technology raw formats and processed data formats commonly used in industry applications as identified by the GATEway BILT.

**Data Access**
A file structure will be created to allow the PI, Co-PI, and evaluator as well as other investigators to easily access data and the relevant data bases.

The BC ArcGIS Online for Organization server environment (AGO2) will be utilized for data access. The AGO2 affords secure, credential-required, and unsecure, open to the public access. AGO2 is an industry common platform portal intended to share all formats of data. The AGO2 environment will have an open data site intended to present public content. The AGO2 will have a credential-requiring group intended to present secure content to the project team.

**Data Archive and Sharing**
All data will be stored on a secure network drive at the college, which is regularly backed up, and will be accessible only to the PI, Co-PI and designated Senior Personnel. Off-line copies with be stored on external drives, where appropriate, and maintained at a separate college facility in accordance with data archive security standards. These data will include copies of all digital documents related to the development of this proposal and the execution of the grant.

Per BC's standard, and as required by the Texas Higher Education Coordinating Board (THECB) copies of any of this data or documents will be archived and freely shared through contact with the PI or Co-PI for at least seven years after the award period.

BC intends to widely share all materials and data for the benefit of students, colleagues, institutions of education, the NSF and their stakeholders. As detailed in the Dissemination Plan, BC will present materials and information at professional events and conferences. BC will widely share access points (BC GATEway webpage, GeoTech Center website, SCAUG website) as detailed in the Dissemination Plan.

**Intellectual Property**
BC does not anticipate that there will be any intellectual property issues associated with either the acquisition or the dissemination of the data associated with this proposal. Any such issues that may occur will be documented and shared transparently. The data gathered and archived in the course of this project will also be governed by BC general policies and agreements with regard to intellectual property and data management.

# SUMMARY PROPOSAL BUDGET

YEAR 1

| | | | | | |
|---|---|---|---|---|---|
| ORGANIZATION<br>**Dallas County Community College Dist Brookhaven College** | | | | FOR NSF USE ONLY<br>PROPOSAL NO. | DURATION (months)<br>Proposed / Granted |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR<br>**Jeffery Sires** | | | | AWARD NO. | |

| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | NSF Funded Person-months CAL | ACAD | SUMR | Funds Requested By proposer | Funds granted by NSF (if different) |
|---|---|---|---|---|---|
| 1. **Jeffery S Sires - PI** | 0.00 | 1.80 | 1.00 | [redacted] | |
| 2. **Kathryn C Wetzel - Co-PI** | 1.20 | 0.00 | 0.00 | [redacted] | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. ( 0 ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | 0.00 | 0.00 | 0.00 | 0 | |
| 7. ( 2 ) TOTAL SENIOR PERSONNEL (1 - 6) | 1.20 | 1.80 | 1.00 | 25,905 | |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | |
| 1. ( 0 ) POST DOCTORAL SCHOLARS | 0.00 | 0.00 | 0.00 | 0 | |
| 2. ( 0 ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | 0.00 | 0.00 | 0.00 | 0 | |
| 3. ( 0 ) GRADUATE STUDENTS | | | | 0 | |
| 4. ( 0 ) UNDERGRADUATE STUDENTS | | | | 0 | |
| 5. ( 0 ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | 0 | |
| 6. ( 0 ) OTHER | | | | 0 | |
| TOTAL SALARIES AND WAGES (A + B) | | | | 25,905 | |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | 7,253 | |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | 33,158 | |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)<br>**Handheld Class 1 Lidar Sensor** $ 22,500<br>**Professional Grade UAS with RGB Camera** 5,100 | | | | | |
| TOTAL EQUIPMENT | | | | 27,600 | |
| E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS) | | | | 3,900 | |
| 2. INTERNATIONAL | | | | 0 | |
| F. PARTICIPANT SUPPORT COSTS<br>1. STIPENDS $ 0<br>2. TRAVEL 0<br>3. SUBSISTENCE 520<br>4. OTHER 0 | | | | | |
| TOTAL NUMBER OF PARTICIPANTS ( 26 ) TOTAL PARTICIPANT COSTS | | | | 520 | |
| G. OTHER DIRECT COSTS | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | 16,800 | |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | 300 | |
| 3. CONSULTANT SERVICES | | | | 5,250 | |
| 4. COMPUTER SERVICES | | | | 2,000 | |
| 5. SUBAWARDS | | | | 0 | |
| 6. OTHER | | | | 0 | |
| TOTAL OTHER DIRECT COSTS | | | | 24,350 | |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | 89,528 | |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)<br>**Negotiated Indirect Cost Rate (Rate: 50.0000, Base: 25905)** | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | 12,953 | |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | 102,481 | |
| K. SMALL BUSINESS FEE | | | | 0 | |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | 102,481 | |
| M. COST SHARING PROPOSED LEVEL $ 0 | AGREED LEVEL IF DIFFERENT $ | | | | |

| | | | |
|---|---|---|---|
| PI/PD NAME<br>**Jeffery Sires** | FOR NSF USE ONLY<br>INDIRECT COST RATE VERIFICATION | | |
| ORG. REP. NAME*<br>**Marilyn Kolesar-Lynch** | Date Checked | Date Of Rate Sheet | Initials - ORG |

1 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

# SUMMARY PROPOSAL BUDGET

YEAR 2

| | | | | | |
|---|---|---|---|---|---|
| ORGANIZATION<br>**Dallas County Community College Dist Brookhaven College** | | | | FOR NSF USE ONLY<br>PROPOSAL NO. | DURATION (months)<br>Proposed / Granted |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR<br>**Jeffery Sires** | | | | AWARD NO. | |

| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | NSF Funded Person-months CAL | ACAD | SUMR | Funds Requested By proposer | Funds granted by NSF (if different) |
|---|---|---|---|---|---|
| 1. **Jeffery S Sires - none** | 0.00 | 1.80 | 1.00 | [redacted] | |
| 2. **Kathryn C Wetzel - none** | 1.20 | 0.00 | 0.00 | [redacted] | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. ( 0 ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | 0.00 | 0.00 | 0.00 | 0 | |
| 7. ( 2 ) TOTAL SENIOR PERSONNEL (1 - 6) | 1.20 | 1.80 | 1.00 | 26,682 | |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | |
| 1. ( 0 ) POST DOCTORAL SCHOLARS | 0.00 | 0.00 | 0.00 | 0 | |
| 2. ( 0 ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | 0.00 | 0.00 | 0.00 | 0 | |
| 3. ( 0 ) GRADUATE STUDENTS | | | | 0 | |
| 4. ( 0 ) UNDERGRADUATE STUDENTS | | | | 0 | |
| 5. ( 0 ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | 0 | |
| 6. ( 0 ) OTHER | | | | 0 | |
| TOTAL SALARIES AND WAGES (A + B) | | | | 26,682 | |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | 7,471 | |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | 34,153 | |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) | | | | | |
| TOTAL EQUIPMENT | | | | 0 | |
| E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS) | | | | 3,900 | |
| 2. INTERNATIONAL | | | | 0 | |
| F. PARTICIPANT SUPPORT COSTS<br>1. STIPENDS $ 0<br>2. TRAVEL 0<br>3. SUBSISTENCE 520<br>4. OTHER 0 | | | | | |
| TOTAL NUMBER OF PARTICIPANTS ( 26 ) TOTAL PARTICIPANT COSTS | | | | 520 | |
| G. OTHER DIRECT COSTS | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | 1,000 | |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | 300 | |
| 3. CONSULTANT SERVICES | | | | 5,250 | |
| 4. COMPUTER SERVICES | | | | 2,000 | |
| 5. SUBAWARDS | | | | 0 | |
| 6. OTHER | | | | 0 | |
| TOTAL OTHER DIRECT COSTS | | | | 8,550 | |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | 47,123 | |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)<br>**Negotiated Indirect Cost Rate (Rate: 50.0000, Base: 26682)** | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | 13,341 | |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | 60,464 | |
| K. SMALL BUSINESS FEE | | | | 0 | |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | 60,464 | |
| M. COST SHARING PROPOSED LEVEL $ 0 | AGREED LEVEL IF DIFFERENT $ | | | | |

| | | | |
|---|---|---|---|
| PI/PD NAME<br>**Jeffery Sires** | FOR NSF USE ONLY<br>INDIRECT COST RATE VERIFICATION | | |
| ORG. REP. NAME*<br>**Marilyn Kolesar-Lynch** | Date Checked | Date Of Rate Sheet | Initials - ORG |

 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

# SUMMARY PROPOSAL BUDGET

YEAR 3

| | | | | | |
|---|---|---|---|---|---|
| ORGANIZATION<br>**Dallas County Community College Dist Brookhaven College** | | | | FOR NSF USE ONLY<br>PROPOSAL NO. | DURATION (months)<br>Proposed / Granted |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR<br>**Jeffery Sires** | | | | AWARD NO. | |

| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | NSF Funded Person-months CAL | ACAD | SUMR | Funds Requested By proposer | Funds granted by NSF (if different) |
|---|---|---|---|---|---|
| 1. **Jeffery S Sires - none** | 0.00 | 1.80 | 1.00 | [redacted] | |
| 2. **Kathryn C Wetzel - none** | 1.20 | 0.00 | 0.00 | [redacted] | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. ( 0 ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | 0.00 | 0.00 | 0.00 | 0 | |
| 7. ( 2 ) TOTAL SENIOR PERSONNEL (1 - 6) | 1.20 | 1.80 | 1.00 | 27,482 | |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | |
| 1. ( 0 ) POST DOCTORAL SCHOLARS | 0.00 | 0.00 | 0.00 | 0 | |
| 2. ( 0 ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | 0.00 | 0.00 | 0.00 | 0 | |
| 3. ( 0 ) GRADUATE STUDENTS | | | | 0 | |
| 4. ( 0 ) UNDERGRADUATE STUDENTS | | | | 0 | |
| 5. ( 0 ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | 0 | |
| 6. ( 0 ) OTHER | | | | 0 | |
| TOTAL SALARIES AND WAGES (A + B) | | | | 27,482 | |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | 7,695 | |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | 35,177 | |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) | | | | | |
| TOTAL EQUIPMENT | | | | 0 | |
| E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS) | | | | 3,900 | |
| 2. INTERNATIONAL | | | | 0 | |
| F. PARTICIPANT SUPPORT COSTS<br>1. STIPENDS $ 0<br>2. TRAVEL 0<br>3. SUBSISTENCE 520<br>4. OTHER 0 | | | | | |
| TOTAL NUMBER OF PARTICIPANTS ( 26 ) TOTAL PARTICIPANT COSTS | | | | 520 | |
| G. OTHER DIRECT COSTS | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | 1,000 | |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | 300 | |
| 3. CONSULTANT SERVICES | | | | 5,250 | |
| 4. COMPUTER SERVICES | | | | 2,000 | |
| 5. SUBAWARDS | | | | 0 | |
| 6. OTHER | | | | 0 | |
| TOTAL OTHER DIRECT COSTS | | | | 8,550 | |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | 48,147 | |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)<br>**Negotiated Indirect Cost Rate (Rate: 50.0000, Base: 27482)** | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | 13,741 | |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | 61,888 | |
| K. SMALL BUSINESS FEE | | | | 0 | |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | 61,888 | |
| M. COST SHARING PROPOSED LEVEL $ 0 | AGREED LEVEL IF DIFFERENT $ | | | | |

| | | | |
|---|---|---|---|
| PI/PD NAME<br>**Jeffery Sires** | FOR NSF USE ONLY<br>INDIRECT COST RATE VERIFICATION | | |
| ORG. REP. NAME*<br>**Marilyn Kolesar-Lynch** | Date Checked | Date Of Rate Sheet | Initials - ORG |

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

# SUMMARY PROPOSAL BUDGET

Cumulative

| | | | | | |
|---|---|---|---|---|---|
| ORGANIZATION<br>**Dallas County Community College Dist Brookhaven College** | | | | FOR NSF USE ONLY<br>PROPOSAL NO. | DURATION (months)<br>Proposed / Granted |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR<br>**Jeffery Sires** | | | | AWARD NO. | |

| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | NSF Funded Person-months CAL | ACAD | SUMR | Funds Requested By proposer | Funds granted by NSF (if different) |
|---|---|---|---|---|---|
| 1. **Jeffery S Sires - PI** | 0.00 | 5.40 | 3.00 | [redacted] | |
| 2. **Kathryn C Wetzel - none** | 3.60 | 0.00 | 0.00 | [redacted] | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | 0.00 | 0.00 | 0.00 | 0 | |
| 7. ( 2 ) TOTAL SENIOR PERSONNEL (1 - 6) | 3.60 | 5.40 | 3.00 | 80,069 | |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | |
| 1. ( 0 ) POST DOCTORAL SCHOLARS | 0.00 | 0.00 | 0.00 | 0 | |
| 2. ( 0 ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | 0.00 | 0.00 | 0.00 | 0 | |
| 3. ( 0 ) GRADUATE STUDENTS | | | | 0 | |
| 4. ( 0 ) UNDERGRADUATE STUDENTS | | | | 0 | |
| 5. ( 0 ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | 0 | |
| 6. ( 0 ) OTHER | | | | 0 | |
| TOTAL SALARIES AND WAGES (A + B) | | | | 80,069 | |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | 22,419 | |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | 102,488 | |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)<br>$ 27,600 | | | | | |
| TOTAL EQUIPMENT | | | | 27,600 | |
| E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS) | | | | 11,700 | |
| 2. INTERNATIONAL | | | | 0 | |
| F. PARTICIPANT SUPPORT COSTS<br>1. STIPENDS $ 0<br>2. TRAVEL 0<br>3. SUBSISTENCE 1,560<br>4. OTHER 0 | | | | | |
| TOTAL NUMBER OF PARTICIPANTS ( 78 ) TOTAL PARTICIPANT COSTS | | | | 1,560 | |
| G. OTHER DIRECT COSTS | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | 18,800 | |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | 900 | |
| 3. CONSULTANT SERVICES | | | | 15,750 | |
| 4. COMPUTER SERVICES | | | | 6,000 | |
| 5. SUBAWARDS | | | | 0 | |
| 6. OTHER | | | | 0 | |
| TOTAL OTHER DIRECT COSTS | | | | 41,450 | |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | 184,798 | |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | 40,035 | |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | 224,833 | |
| K. SMALL BUSINESS FEE | | | | 0 | |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | 224,833 | |
| M. COST SHARING PROPOSED LEVEL $ 0 | AGREED LEVEL IF DIFFERENT $ | | | | |

| | | | |
|---|---|---|---|
| PI/PD NAME<br>**Jeffery Sires** | FOR NSF USE ONLY<br>INDIRECT COST RATE VERIFICATION | | |
| ORG. REP. NAME*<br>**Marilyn Kolesar-Lynch** | Date Checked | Date Of Rate Sheet | Initials - ORG |

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

**Brookhaven College Budget Justification for Constructioneering GATEway.**

A. **Senior Personnel:** For Year 1 this budget category ties to all activities. In order for PI Sires to devote time to implement and steward the grant, assemble the BILT and lead the workshop, to acquire BILT-identified tools and technologies, to develop and test the content modules, and to document the progress of Year 1, he is budgeted for a 20% release during Fall and Spring semesters. A 20% release is a standard Brookhaven College (BC) policy structure for faculty. Year 1 academic calculation: 9-month salar[redacted] 9 months = [redacted] 20% release equates to 1.8 academic months. 1.8 x [redacted] PI Sires is also budgeted for a 1-month compensation for Year 1 summer. Summer month calculation: 9-month salary of [redacted] 9 months = [redacted] Year 1 salary for PI Sires = [redacted] Adjunct faculty will be hired to make this possible. In order for Co-PI Wetzel to share responsibilities to execute Year 1 tasks, assist in assembling the BILT, participate in the workshop, create the cross-walk matrix and assist in testing the content modules she is budgeted for a calendar-based 10% release. A 10% calendar-month release equates to 1.2 calendar month's compensation. Year 1 calendar-year calculation: annual salary [redacted] 12 months = [redacted] 1.2 months = [redacted] BC will provide Dean support to make this possible.

   **Year 1 Total Senior Personnel = $25,905.** Years 2 and 3 are identical to senior personnel to that of Year 1 with the addition of a 3% cost of living increase.

   **Year 2 Total Senior Personnel = $26,682. Year 3,** adding 3% to Year 2, has a **Total Senior Personnel = $27,482.**

   **Total Senior Personnel** of $25,905. + $26,682. + $27,483 = **$80,070**

B. **Other Personnel:** None for all three years of the grant.

   **Total Other Personnel for the 3 years = $0**

C. **Fringe Benefits** Fringe benefits are calculated at 28% of salaries and wages per year (Year 1 = $25,905, Year 2 = $27,482, Year 3 = $27,482)

   **Total Fringe Benefits: $7,253 + $7,471 + $7,695 = $22,420**

D. **Equipment (over $5,000 per item):** For Year 1 this budget category is tied to Activity numbers 1.2, 1.6, 2.1, 2.2, 3.1, 3.2, and 3.3. Projected, pending needs assessment workshop results: 1 hand-held mobile LiDAR sensor $22,500, and 1 professional-grade UAV and sensor (RGB composite camera) $5,100 will be acquired. These technologies are anticipated to address the BILT-identified needs; the technologies will be used to perform field tests, collect site data and be used in the development of content modules. In all 3 years these technologies will be used by project staff, participants and advisors. In Years 2 and 3 these items will additionally be used by students. The data collected with these technologies will be disseminated and used by any who download the modules.

   Year 1 Total Equipment = **$27,600**. In Years 2 and 3 there are no equipment items requested.

   **Total Equipment: $27,600 + $0 + $0 = $27,600**

E. **Travel:** For Year 1 this budget category is tied to Activity numbers 1.5, as we meet NSF PIs at varied conferences and activity 5.5 as PI or Co-PI travel to share findings and results at conferences. The following travel expenses are **estimated** because future venues/locations for 2018, 2019 and 2020 for all events are not known. Budget includes estimated costs:

   - Applicable registration costs are budgeted at the 2017 published,

- **hotel ($250 per night),**
- **airfare ($400),**
- **bag fees ($100),**
- **meals ($40/day),**
- **parking fees ($40), and**
- **local transportation ($85).**

The following conferences are planned:

- the ATE PI conference ($2,400 for 2 people [PI and Co-PI] to attend for 3 days/2 nights),
- the GeoEd forum ($1,500 for 1 person [PI] to attend 4 days/3nights). Year 1 **Total Travel = $3,900**. In Years 2 and 3 travel is requested exactly as that of Year 1, thus $3,900 is requested for each of Years 2 and 3.

**Total Travel: $3,900 + $3,900 + $3,900 = $11,700**

F. **Participant Support Costs:** For Year 1 this budget category is tied to Activity number 1.2. Food for needs assessment workshop, $20 @ 26 participants = **$520**. Year 2 is tied to activity 3.2. Food for summer validation workshop, $20 @ 26 participants = **$520.** Year 3 is tied to activity 3.3. Food for Year 3 summer validation workshop, $20 @ 26 participants = **$520.**

**Total Participant Support Costs: $520 + $520 + $520 = $1,560**

G. **Other Direct Costs:** For Year 1 this budget category is tied to Activity numbers 1.2, 1.5, 1.6, 2.1, 2.2, 3.1, 3.2, 3.3, 4.2, and 5.5.

1. Materials and Supplies Costs, projected, pending needs assessment workshop results, might include virtual reality goggles and required mobile computing device, mobile GNSS receiver, platform devices (UAS, tripods, robotics), FLIR sensor, laser measure device for mobile technology, brochures and flash drives. Like Item D: Equipment these technologies will be used to preform field tests, collect site data and be used in the develop of content modules. In Year 1 these technologies will be used by project staff, participants and advisors. In Years 2 and 3 these items will be used by students. The data collected with these technologies will be disseminated and used by any who download the modules. = **$16,800**
2. Publication Costs/Documents/Dissemination Costs include producing posters, handouts, and marketing materials for the needs assessment workshop, activity 1.2 = **$300**
3. Consultant Services, external evaluator fee = $87.50 per hour @ 60 hours = **$5,250**. External evaluator travel for site visits is the responsibility of the external evaluator.
4. Software *CAD/BIM* software suite for existing computer lab, 22-user license to be used primarily by project staff in Year 1 for development and for testing and preparation for delivery to students. = **$2,000**

**Year 1 Total Other Direct Costs = $24,350**.

For Year 2 this budget category is tied to Activity numbers 1.5, 1.6, 2.1, 2.2, 3.1, 3.2, 3.3, 4.2, and 5.5.

1. Materials and Supplies Costs include Year-2 network renewal for the mobile GNSS receiver. This technology will be used to preform field tests, increasing precision of collected site data and be used in the continued development of content modules. These items will be used by project team and by students. The data collected with these

technologies will be disseminated and used by any who download the modules. = **$1,000.**

2. Publication Costs/Documents/Dissemination Costs include producing posters, handouts, and marketing materials for the summer validation workshop, activity 3.2 = **$300.**
3. Consultant Services, external evaluator fee = $87.50 per hour @ 60 hours = **$5,250** External evaluator travel for site visits is the responsibility of the external evaluator.
4. Software *CAD/BIM* software suite license renewal from Year 1 = **$2,000**

**Year 2 Total Other Direct Costs = $8,550**

For Year 3 this budget category is tied to Activity numbers 1.5, 1.6, 2.1, 2.2, 3.1, 3.2, 3.3, 4.2, 5.1 and 5.5.

1. Materials and Supplies Costs include 1 network renewal for the mobile GNSS receiver. This technology will be used as in Year 2. = **$1,000**
2. Publication Costs/Documents/Dissemination Costs include producing posters, handouts, and marketing materials for the summer validation workshop, activity 3.3 = **$300**
3. Consultant Services, external evaluator fee = $87.50 per hour @ 60 hours = **$5,250** External evaluator travel for site visits is the responsibility of the external evaluator.
4. Software *CAD/BIM* software suite license renewal from Year 2 = **$2,000.**

**Year 3 Total Other Direct Costs = $8,550**

**Total Other Direct Costs: $24,350 + $8,550 + $8,550 = $41,450**

H. **Direct Costs for Year 1 = $89,529**. Total Direct Costs for Year 2 = **$47,123**.
Total Direct Costs for Year 3 = **$48,148**.
**Total Direct Costs**: **$89,529 + $47,123 + $48,148 = $184,800**

I. **Total Indirect Costs:** For Year 1, Brookhaven College's federally negotiated indirect cost rate of 50% of salaries and wages ($25,905.12) = **$12,952**. For Year 2 the federally negotiated indirect cost rate of salaries and wages ($26,682.27) = **$13,341**. For Year 3 the federally negotiated indirect cost rate of salaries and wages ($27,482.74) = **$13,741.**
**Total Indirect Costs: $12,953 + $13,341 + $13,741 = $40,035.**

J. **Amount of Request:** For Year 1 = **$102,481**. For Year 2 = **$60,464** For Year 3 = **$61,889.**
**Total Amount of Request: $102,481 + $60,464 + $61,889 = $224,834.**

**Brookhaven College (BC) is requesting $224,834** from the NSF over the course of a 3-year small grant for institutions new to the ATE program. BC is requesting $102,48 for Year 1, $60,464 for Year 2, and $61,889 for Year 3. The funds will be used in the following manner: Total Senior Personnel of $25,905 for Year 1, $26,682 for Year 2 and $27,482 = $80,070.
Total Other Personnel for the 3 years = $0.00. Total Fringe Benefits of $7,253 for Year 1, $7,471 for Year 2 and $7,695 for Year 3 = $22,419. Total Equipment of $27,600 for Year 1 and $0.00 for each of Years 2 and 3 = $27,600. Total Travel of $3,900 per year * 3 years = $11,700. Total Participant Support Costs of $520 for each of the three years = $1560. Total Other Direct Costs of $24,350 in Year 1, $8,550 in Years 2 and 3 = $41,450. Total Indirect Costs of $12,952 for Year 1, $13,341 for Year 2 and $13,741 for Year 3 = $40,035.