Proposition: 26-16/17

Title: Proposed redesign of the Bachelor of Science in Surveying Engineering program for a Bachelor of Science in Geomatics

Date Submitted: 1/25/17

Sponsor(s): Rolfe Sassenfeld (Eng), Lynn Kelly (Eng), Thomas Jenkins, Department Head (Eng), Sonya Cooper, Associate Dean (Eng), Lakshmi Reddi, Dean (Eng)

Proposed Committee: Scholastic Affairs

Assigned Committee:

Prior Approvals: Academic Deans Council (ADC), Associate Deans Academic Council (ADAC), Engineering Technology Faculty.

Proposal: The Department of Engineering Technology and Surveying Engineering (ETSE) is requesting Faculty Senate approval to change the name of the Bachelor of Science in Surveying Engineering degree program to Bachelor of Science in Geomatics. Additionally, we seek to redesign the 4-year offering to a degree completion +2 format (58 credits on main campus and 62 preparatory credits available from Community College partners for a total of 120 credits).

Rationale: By rebranding (including name change), redesigning course content to better reflect industry requested knowledge and skill sets, offering courses online, partnering with Community Colleges in a degree completion 2+2 program (58 required credits at NMSU main), and maintaining a path to professional licensure, we believe we can offer an economically sustainable major that meets the needs of our students and industry constituencies.
Proposal Details:

A. **Name and Description:** Bachelor of Science (BS) in *Geomatics* will replace the current degree name of BS in Surveying Engineering.

*Geomatics in the College of Engineering at NMSU will emphasize the techniques and science of measuring the terrestrial and three-dimensional position of points on, above, and below the earth’s surface and the distance and angles between them at a high level of precision to aid in the design of infrastructure including roads, bridges and legal boundaries for ownership as well as to meet the educational requirements for employment in industry and registration as a Professional Land Surveyor in the State of New Mexico.*

When performing this work, professionals must have an understanding of: the science of geomatics measurement and analysis; the legal principles of boundary location; the laws related to boundaries and land use; and applicable mathematical and computational theories and principles. Geomatics professionals may work for private surveying, construction, and engineering firms, for City, County, State or Federal Highway Departments, for State Lands Commissions, for the US Forest Service and for the US Bureau of Land Management as examples.

The mission of the Department of ETSE is to provide men and women with the rigorous, fundamental education needed to enter and succeed in the Geomatics and related professions. To accomplish this mission, the department will introduce students to the theory and application of recognized geomatics principles.

B. **Rationale:** By rebranding (name change), changing course content to better reflect industry requested knowledge and skill sets, offering courses online, partnering with Community Colleges in a 2+2 format, and maintaining a path to professional licensure, we believe we can offer an economically sustainable major that meets the needs of our students and industry constituencies.

C. **Collaboration:**

In the redesign of the major, the department looked closely at two year programs within New Mexico and regional areas for the purpose of articulation. The existing freshman and sophomore level courses will be taught in the two-year programs to provide the necessary foundation to the BS degree completion program at NMSU.

Several upper division courses were added to take advantage of existing expertise. The GEOG, BLAW, PHIL, IE, ET, and MATH prefix courses offer a curriculum in a closely related or supplementary field as required courses.

D. **Potential of Current Student Interest:** The current degree program has averaged 30.3 students during the last six years. It is envisioned that with the rebranding and online delivery format, we can expect an increase to a sustainable level of ~50+ students. A current online program in Nevada has ~80 students.
The current Industrial Advisory Committee which has members from professional organizations, private contractors, and public employers such as NM Department of Transportation, have indicated a very strong market for entry level students and have been instrumental in their support for this redesign.

The program can also take advantage of the WICHE Student Exchange Program where “residents of WICHE states can gain affordable access to programs, states avoid costly and unnecessary duplication of programs and facilities, and colleges and universities can devote their resources to improving the quality of their educational offerings”.

E. **Program Requirements**: This program will meet all NMSU requirements. Please see the degree completion program of study below and list of required courses with their descriptions.

F. **How and When Courses will be taught**: Courses will be offered during the regular semesters (fall and spring) during times when traditional undergraduate courses are offered and via a distance online methodology. For the online delivery courses, laboratories or applied sections may be offered off campus at industry sites, at contributing partner’s locations, or during selected weekends and/or evenings.

G. **Credit hour requirements and other requirements**: The total credit hour requirement will be 120. Other requirements, as described in section E above, can be found in the attached program description.

H. **Resources**: No additional resources (including faculty, library, operating dollars, assistantships, classrooms or other space, etc.) are required.

I. **Administration**: The program will be administered within Department of Engineering Technology and Surveying Engineering, College of Engineering.
Geomatics +2 Core Courses

Note: there is no prefix or course number changes; however, all courses will have some content change to meet the reduced credit count and student outcomes.

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**SUR 222** 3cr. (2+3p) Introduction to Geomatics (not part of +2 Core but still taught as service) Applications of geomatics in civil engineering projects.

Theory and practice of geomatics as applied to plane surveying in the areas of linear measurements, angle measurements, area determination, differential and trigonometric leveling, and topographic mapping. 
Prerequisite: Math 190G

**SUR 285** 3cr. Precise Digital Mapping (fa)
Perform basic photogrammetric mapping, and create digital terrain models.

Photogrammetric Mapping Principles, Orthorectification, Photogrammetric Mapping Principles, Optical camera, digital sensor including Terrestrial, Mobile digital cameras, surveying control, IMU & GPS integration, photogrammetric principles, stereo photography, analytical triangulation., precision and accuracy of each measurement system. sUAS (Small Unmanned Aerial Vehicles) applications to geospatial data collection and practical applications project fight/pre planning, sensor platform, FAA regulations and restrictions.
Co-prerequisite: SUR 222 (or equivalent)
(Needs one field visit if a UAV will be available)

**SUR 312** 3cr. Legal Principles and Boundary Law I (fa)
Legal principles of property boundary retracement, and rights-of-way. Systems of law and legal research. Principles of the U.S. Public Land Survey System and manual of Instructions
Cadastral Surveying & Public Land Survey System (PLSS): History and development of the PLSS, non-rectangular boundaries including Trust Lands and Grant, political, State and Federal, riparian, Indian Reservation, homestead entry, and mineral, easements, legal descriptions, conveyances, surveyor in a court of law, Research, Case Records, Research sources for recorded and un-recorded documents, historical documents, title reports, deed research, right of way research, research within governmental agencies, rail roads.
Prerequisite: SUR 222 (or equivalent)
SUR 322 3cr. (2+2p) Laser Scanning Mapping Technologies (sp)  
Perform basic terrestrial & airborne LiDAR scan, LiDAR Technologies and Applications will include ranging technologies such as LiDAR, SAR, and Bathymetry, point cloud data management & extraction, scan registration and processing  
Prerequisite: SUR 285  
(Need two-three field labs to do terrestrial scans, the rest of the assignments are computer-based)

SUR 328 3cr. (2+3p) Construction Surveying & Automation Technologies (sp)  
Alignments and station/off set, types of construction layout of infrastructure: roads, bridges, utilities (including subsurface), buildings, industrial; reading and interpreting construction plans, data management, horizontal, vertical and spiral curves, slope staking, machine control basics, applications and data managements. Use of electronic files and liability issues. Layout alignments, grades, various infrastructure, buildings. Ability to understand data integration in automated machine control, work flow processes.  
Prerequisites: SUR 222 and (Math 191 or Math 235)

SUR 351 3cr. Spatial Data Adjustment I (sp)  
Theory of observations/measurements, random error theory, applications of statistical data analysis in surveying, confidence intervals and statistical testing, propagation of random errors.  
Prerequisite: SUR 222 and (Math 191 or Math 235) and (ASTAT 311 or STAT 251) (Fa)  
(Need computer based labs only)

ET 355 3cr (2+2p) Site & Land Development (sp)  
Techniques, methods, and takeoffs for infrastructure layout, site plan design, grading, earthwork, utilities, road construction. Subdivision/Site Development concepts, jurisdictional approvals, existing property considerations. Process for development of land including subdivision platting, topographic surveying, existing infrastructure, subservice utilities, zoning and environmental considerations.  
Prerequisite(s): DRFT (143 or 153 or 109) and SUR 222

SUR 361 3cr. (2+2p) Geodesy/Geodetic Control Surveying (sp)  
Horizontal and vertical control network design and consideration. Understand ellipsoid, geoid, horizontal and vertical datum, coordinates, precise leveling, astronomic, establishment of state plane zones, understanding reporting. Transform data between geodetic Latitude/Longitude, state plane, ground data, perform geodetic computations, ability to design GPS networks utilizing CORS stations, network adjustments. Perform a control survey, process data, adjust network, and prepare control report with Meta-data.
Prerequisites: SUR 222 and (Math 191 or Math 235)

**SUR 451 3cr Spatial Data Adjustment II (fa)**
Rigorous analysis of the theory of observations as applied to spatial data, application of least squares adjustments, ability to perform statistical analysis to determine accuracy of final product, constrained/free geospatial data integration, error ellipses, and pre-analysis of spatial data acquisition procedures.
Prerequisite: SUR 351 & Math (280 or 480)
(Need computer based labs only)

**SUR 452 3cr (2+2P) Spatial Data Integration and Analysis (sp)**
Methodologies of geospatial data acquisition and integration, knowledge of applications the source data is intended for, accuracies of acquired spatial data, types and analysis of coordinate transformation models. Integrating datasets for routing analysis, location study analysis, land management and long range plans as well as existing needs related to connectivity and safety.
Prerequisite: SUR 451

**SUR 461 3cr (2+3p) GNSS Positioning (fa)**
Logistics of GNSS data collection, the GPS signal, codes and biases, error sources, differences between relative and autonomous GNSS positioning, code phase carrier phase, DGPS static and RTK surveys. Geodetic and GPS standards and specifications GNSS data processing, network adjustments, and evaluation of spatial data accuracy practical applications of GNSS
Prerequisites: SUR 361

**SUR 464 (3cr.) Legal Principles and Boundary Law II (fa)**
ALTA Surveys and Standards, boundary evidence, order of evidence, Subdivision and Platting Law, Mexican and Spanish land grants, water boundaries, sequential and simultaneous conveyances
Prerequisites: SUR 312 (Fa)

**SUR 498 3cr Emerging Technology in Geomatics (sp)**
Hydrographic/Bathymetric, Altimetry, Space borne Imaging Systems, Mobile Mapping Systems, Mining and Agriculture Surveying Principles, and advanced ranging data acquisition systems.
Prerequisites: senior standards or consent of instruction
(Need computer based labs only)

**GEOG 481 4cr. (3+3p) Fundamentals of Geographic Information Science and Technology (GIS & T)**: Fundamentals of computer-based systems which organize, analyze, and present spatially referenced data. Taught with GEOG 578.
Prerequisite(s): GEOG 281 or GEOG 381.

**Math Elective (fa): Math 280 or 480**
PHIL 323V 3cr. Engineering Ethics – meets one VWW requirement
The moral legal responsibilities of engineers to clients, employers, the public, and the environment. Topics include criteria for judging when risk is acceptable, the duty to safeguard public health and welfare, conflicts of interest, and whistle-blowing.

Viewing a Wider World – 3cr. students will choose from:
MGT (310Vor 315V or 335V or 360Vor 375Vor 388V) or FIN303V or ECON (337Vor 384V)

BLAW 325 (3cr.) Real Estate Principles and Law I
Real estate law and the fundamental aspects of the real estate purchase transaction and the real estate lease agreement. Topics include real estate brokerage, marketing of real estate, fundamental legal aspects of real estate, present and future interests, air and water rights, methods of transfer, basics of financing and liens, and real estate leases.

IE 451 3cr. Engineering Economy

ET 435 3 cr. Senior Project (sp)
Research project with formal presentations.
Prerequisite: Senior Standing

GEOMATIC Courses with lab components:
- SUR 222 cr. (2+3p)
- SUR 285 3cr. Precise Digital Mapping (fa) (only one field visit)
- SUR 322 3cr. (2+2p) Laser Scanning Mapping Technologies (sp) (~3 labs)
- SUR 328 3cr. (2+3p) Construction Surveying & Automation Technologies (sp)
- ET 355 3cr (2+2p) Site & Land Development (sp) (need DE)
- SUR 361 3cr. (2+2p) Geodesy/Geodetic Control Surveying (sp)
- SUR 452 3cr (2+2p) Spatial Data Integration and Analysis (sp) (~3 labs)
- SUR 461 3cr (2+3p) GNSS Positioning (fa) (~3 labs only)
January 21, 2017

To Whom It May Concern:

I am writing on behalf of the NMSU Department of Civil Engineering in support of the Bachelor of Science in Geomatics proposed by the NMSU Department of Engineering Technology and Surveying Engineering. The proposed degree will consist of a redesigned curriculum of the current Bachelor of Science in Surveying Engineering degree to ensure that students are provided the means to “graduate on time” and “get a job”. Total credits will be reduced to 120 and changes will be made in content and delivery methodology based on industry needs.

The proposed degree plays a very important role in the Civil Engineering field particularly in planning the design and construction of public and private facilities (e.g., bridges, buildings, roadways). In addition, advanced technologies in geomatics (such as laser scanning, unmanned aerial vehicles, and close range photogrammetry) are now well-developed and used routinely for purposes such as infrastructure inspection and monitoring. In closing, I have no doubt that the proposed changes of the re-designed degree will effectively lead to an increase in student enrollment and an economically sustainable program. Students will be provided the knowledge and applied skill sets needed to better face today’s challenges, and the proposed degree will amply support the College of Engineering constituencies and Mission.

Sincerely,

David Jáuregui, PhD, PE
Foreman Professor and Head
Department of Civil Engineering
To whom it may concern:

It is with pleasure that I write this letter of support for the Department of Engineering Technology and Surveying Engineering’s redesign proposal of the current Bachelor of Science in Surveying Engineering to a Bachelor of Science in Geomatics, a reduction in total credits to 120, as well as some content changes and delivery methodology.

As a potential partner in this endeavor, it is my sincere believe the proposed changes will work effectively to increase student populations, offer an economically sustainable program, and provide valuable knowledge and applied skill sets, while supporting our shared constituencies and mission.

Sincerely

Amy Ballard

Amy Ballard
Associate Dean, School of Applied Technologies

Central New Mexico Community College
525 Buena Vista SE
Albuquerque, NM 87106
505-224-3368
Aballard1@cnm.edu
To whom it may concern:

It is with pleasure that we write this letter of support for the Department of Engineering Technology and Surveying Engineering’s redesign proposal of the current Bachelor of Science in Surveying Engineering to a Bachelor of Science in Geomatics, a reduction in total credits to 120, as well as content changes and delivery methodology.

This committee which was composed primarily of professional surveying engineers was tasked with investigating how to best rebrand and redesign the current Surveying Engineering program to meet the changes needs of the industry and serve the state of New Mexico requirement for licensed 4-year accredited professionals.

In doing so, this committee polled the literature, industry, constituencies of the profession, and professionals to determine knowledge and skill sets required of the profession as well as provide an educational pathway to licensure. In an effort to attract the quantity and quality of students into this highly valuable professional path, the term Geomatics, which is a new term incorporating the older field of land surveying along with many other aspects of spatial data management, was chosen as the name representing the current state of the industry and in line with the majority of similar university programs.

It is our sincere believe the proposed changes will work effectively to increase the student population, offer an economically sustainable program, provide valuable knowledge and applied skill sets to the industry, and prepare graduates for professional licensure, and continue supporting the College of Engineering’s constituencies and mission.

Sincerely,

Christopher S. Croshaw, PS
Chair

cc: Survey Redesign Curriculum Committee Members
To whom it may concern:

It is with pleasure that I write this letter of support for the Department of Engineering Technology and Surveying Engineering’s redesign proposal of the current Bachelor of Science in Surveying Engineering to a Bachelor of Science in Geomatics, a reduction in total credits to 120, as well as some content changes and delivery methodology.

As a potential partner in this endeavor, it is my sincere belief the proposed changes will work effectively to increase student populations, offer an economically sustainable program, and provide valuable knowledge and applied skill sets, while supporting our shared constituencies and mission.

Sincerely

[Signature]

Saundra Castillo, CC Division Dean DACC saucast@nmsu.edu (575) 527-7599
January 30, 2017

Professor Thomas W. Jenkins, Department Head
Engineering Technology and Surveying Engineering
Box 3001 Dept. 3566
New Mexico State University
Las Cruces, NM 88003-8001

Re: Bachelor of Science in Surveying Engineering

Professor Jenkins:

It is with pleasure that I write this letter of support for the Department of Engineering Technology and Surveying Engineering’s redesign proposal of the current Bachelor of Science in Surveying Engineering. I support the change to a Bachelor of Science in Geomatics, a reduction in total credits to 120, as well as some content changes and delivery methodology.

Geomatics is a new term incorporating the older field of land surveying along with many other aspects of spatial data management, including global navigation satellite systems (GNSS), geographic information systems (GIS), unmanned aerial vehicles (UAV), etc. Following the advanced developments in digital data processing, the nature of the tasks required of the professional land surveyor has evolved and the term "surveying" no longer accurately covers the whole range of tasks of which the profession is responsible. Spatial data becomes more critical to decision-making, both from a personal and an industry perspective, and also from a community and a large-scale governmental viewpoint.

It is my sincere belief the proposed changes will work effectively to increase the student population, offer an economically sustainable program, provide valuable knowledge and applied skill sets to the industry, and prepare graduates for professional licensure.

Sincerely,

Tim Solinski, PS
Vice President
Spatial Data & Survey Technologies

TS/ml
To whom it may concern:

The New Mexico Professional Surveyors (NMPS) would like to show their support to the Department of Engineering Technology and Surveying Engineering's redesign proposal of the current Bachelor of Science in Surveying Engineering to a *Bachelor of Science in Geomatics*, a reduction in total credits to 120, as well as some content changes and delivery methodology.

As the existing Professional Surveyors age and retire the need for new Professional Surveyors in New Mexico and across the US is colossal and that need is growing every year. It is our sincere believe the proposed changes will work effectively to increase the student population, offer an economically sustainable program, provide valuable knowledge and applied skill sets to the industry, and prepare graduates for professional licensure, and continue supporting the College of Engineering's constituencies and mission.

Sincerely

Chris Pappas, PS

President

New Mexico Professional Surveyors

pappassurveyor@gmail.com

(540) 239-8408
August 29, 2016

New Mexico State University
NMSU Faculty Senate
Las Cruces, NM

RE: Surveying Engineering Industrial Advisory Committee Request for Support to Maintain a Four-year Surveying Program at New Mexico State University, College of Engineering

Dear Faculty Senate,

The Surveying Engineering Industrial Advisory Committee (SEIAC) met August 20th, 2016. The focus of this meeting was the current status of New Mexico State University’s (NMSU) Surveying Engineering (SE) program. The approved proposal to cut the SE program is justification to eliminate the three SE faculty positions. We are aware that the low enrollment in the program is the main reason for the proposal. The SEIAC committee has been aware of the low enrollment in the SE program and discussed it in depth during our meeting on March 17th, 2016. At this meeting SEIAC scheduled a meeting for May 5th, 2016 to directly address the low enrollment at which time an outline action plan was developed to address enrollment (please see attached).

SEIAC, along with the surveying profession industry, is well aware of the issues that have led to low enrollment nationwide in surveying programs. With that being said, we know for certain that good paying job opportunities being available to students that graduate from these programs is not one of them. The SE program at NMSU has developed students since the early 90’s with one of the highest employment rates upon graduation. Even during times of low enrollment, graduates had their jobs secured before graduating. The salary’s for graduates coming out of the SE program is equivalent to that of a Civil Engineering graduate, only with a higher employment rate coming out of school.

The value of the SE program leads beyond the high employability of the students graduating from the program. It also serves and protects the public in producing highly qualified graduates seeking professional licensure throughout the nation. The US Department of Labor does not recognize surveying as a profession unless there is a four-year degree entry requirement. Twenty-eight Jurisdictions in the US require a higher education for professional surveying licensure; New Mexico is one of them. Students coming out of this program are not limited in any state to pursue licensure as a recognized professional. I have also attached a document from NCEES supporting a four-year degree requirement for professional licensure. This is mentioned because NMSU is one of six universities in the country that offers an ABET accredited four-year degree in Surveying Engineering. The existing tuition agreement with the 13 western states offering the Surveying Engineering degree for an in state tuition rate is not widely known and has not been promoted to its full potential. Doing so would allow NMSU to be attractive to students in the surrounding states. SEIAC strongly believes that with the right efforts to promote this program, it can become a nationally recognized program in the geospatial engineering and surveying industry. This recognition will draw an increase in enrollment leading to a self-sufficient program serving the industry and the public.
SEIAC is requesting that the SE program be maintained at NMSU and that new student enrollment be reinstated to allow efforts to be implemented to build sustainable enrollment in the program. These efforts include a name change that incorporates more of the true nature of the modern surveyor and to redevelop the program to draw a greater interest from individuals interested in scientific technologies related to geospatial engineering and surveying. These technologies include the use of UAVs (drones), satellites, aerial and terrestrial image processing, and Global Positioning Systems (GPS). A clear understanding of the underlying theory of these applied technologies is necessary for professional oversight. SEIAC understands financial assistance may be required to support the SE program for a two to three year period while the program is built up to being self-sufficient and is acting in good faith on the following financial support efforts.

Financial Support:

- The New Mexico Professional Surveyors (NMPS) will provide a letter of intent to grant the NMSU Surveying Engineering program money to help support the program.

- The National Society of Professional Surveyors (NSPS) is in the process of pursuing a federal grant for a program called Workforce Development. This grant would support the continued education of surveyors throughout the United States. The amount for the grant they are hoping to acquire is 1-7 million dollars. The NSPS is very interested in helping to maintain the NMSU Surveying Engineering program and will provide a letter of intent demonstrating the willing to discuss how they can help monetarily.

- The National Council of Examiners for Engineering and Surveying (NCEES) is willing to match any money the NSPS is able to grant. A letter of intent will be requested at the appropriate time.

- The New Mexico Department of Transportation has shown interest in pursuing a grant for research into the accuracies of drone UAV/UAS technology and how this can support transportation projects and other research efforts to support public services. A letter of intent will be requested at the appropriate time.

- The Western Federation of Professional Surveyors has communicated willingness to assist financially to support the continuance of the Surveying Engineering program.

- The NMPS Educational Foundation will provide a letter of intent to financially support the Surveying Engineering program.

SEIAC is committed to supporting the Surveying Engineering program at NMSU and the value it provides to the industry and the public. We are readily available to discuss questions and concerns in depth upon request. Thank you for your time and consideration.

Respectfully,
NMSU SEIAC Committee
10/21/2016

Dr. Lakshmi N Reddi
Dean of Engineering
New Mexico State University
Las Cruces, NM

RE: Financial support for the restructured Surveying Program at NMSU

Dear Dean Reddi,

This letter is in support of your efforts to restructure the surveying program at NMSU. The New Mexico Professional Surveyors (NMPS) is aware that you are planning to modernize the program to attract increased enrollment. We are also aware that you are in need of two faculty members to support this program. Toward this goal, the NMPS, along with others, will seek financial support to cover one faculty member’s salary. Specifically, we will offer $100k/year for three years starting with Summer ‘2017. During these three years, we will work closely with your office and other entities to secure permanent sources of funding including endowments, etc.

We understand the need to find permanent funding for this position therefore we feel that with the implementation of online education the enrollment has the potential to double within the first two years and would allow NMSU to meet their enrollment goal.

We are also in the process of creating student scholarships to help you recruit students into this program and provide you with the necessary marketing support. We have a EEE Committee (Education Exploration Expansion) that is currently working on producing recruiting and marketing materials to be placed in High Schools and STEM Schools around the state. The NMPS looks forward to working with NMSU marketing efforts.

We hope that you will succeed in leveraging our support by identifying funds for the second position. We thank you for the approach you have taken to support surveying education in the state. Our members are thankful that you have involved industry partners in curriculum redesign and are confident that the restructured program will attract significantly increased enrollment in a very short time frame.

Thank you.

Sincerely,

[Signatures]

Mr. David Acosta  Mr. Chris Pappas  Mr. Conrad Roybal
NMPS President  NMPS President Elect  NMPS Vice President
To whom it may concern:

It is with pleasure that I write this letter of support for the Department of Engineering Technology and Surveying Engineering’s redesign proposal of the current Bachelor of Science in Surveying Engineering to a *Bachelor of Science in Geomatics*, a reduction in total credits to 120, as well as some content changes and delivery methodology.

It is my sincere believe the proposed changes will work effectively to increase the student population, offer an economically sustainable program, and provide valuable knowledge and applied skill sets, while supporting the College of Engineering’s constituencies and Mission.

Sincerely,

Carol Campbell,
Associate Professor
Acad Dept Head, Geography
gobird@ad.nmsu.edu
(575) 646-6480