STATE OF CALIFORNIA
GRANT REQUEST FORM (GRF)
CEC-270 (Revised 10/2015) CALIFORNIA ENERGY COMMISSION

New Agreement EPC-18-026 (To be completed by CGL Office)

ERDD	Alex Horangic	43	916-327-3494

Spatial Informatics Group LLC	94-3316211

Comprehensive Open Source Development of Next Generation Wildfire Models for Grid Resiliency

	6/28/2019	3/28/2024	$ 5,000,000

☐ ARFVTP agreements under $75K delegated to Executive Director.

Proposed Business Meeting Date	6/12/2019	☐ Consent	☒ Discussion
Business Meeting Presenter	Alex Horangic	Time Needed:	5 minutes

Please select one list serve. EPIC (Electric Program Investment Charge)

Agenda Item Subject and Description

SPATIAL INFORMATICS GROUP LLC. Proposed resolution approving Agreement EPC-18-026 with Spatial Informatics Group LLC for a $5,000,000 grant to develop next-generation wildfire models for grid resiliency and safety, and adopting staff's determination that this action is exempt from CEQA. Phase I of the grant ($4,000,000) will involve advancing fire science and wildfire modeling. Phase II ($1,000,000) would be conducted only if needed to support California's Fifth Climate Change Assessment. This project will illuminate the emerging risks of wildfire on the electricity grid by incorporating the dynamics of tree mortality and extreme fire weather in next-generation fire models. (EPIC Funding) Contact: Alex Horangic. (Staff presentation: 5 minutes).

1. Is Agreement considered a "Project" under CEQA?
   ☒ Yes (skip to question 2) ☐ No (complete the following (PRC 21065 and 14 CCR 15378)):
   Explain why Agreement is not considered a "Project":
   Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because.
2. If Agreement is considered a "Project" under CEQA:
   ☒ a) Agreement **IS** exempt. (Attach draft NOE)
   ☐ Statutory Exemption. List PRC and/or CCR section number:
   ☒ Categorical Exemption. List CCR section number:
   15306 and 15301
   ☐ Common Sense Exemption. 14 CCR 15061 (b) (3)
   Explain reason why Agreement is exempt under the above section:

   This project is exempt under categorical exemption section 15306 Information Collection because the project involves basic data collection, research and resource evaluation activities which do not result in a disturbance to an environmental resource.

   This project is also exempt under categorical exemption section 15301 Existing Facilities because the project will involve the operation of existing laboratory facilities to do fuel testing and will involve negligible or no expansion of that existing use.

   ☐ b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)
   Check all that apply
   ☐ Initial Study
   ☐ Negative Declaration
   ☐ Mitigated Negative Declaration
   ☐ Environmental Impact Report
   ☐ Statement of Overriding Considerations

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Legal Company Name:	Budget
The Regents of the University of California on behalf of the Berkeley	$ 497,493
The Regents of the University of California on behalf of the Merced	$ 484,169
Reax Engineering Inc.	$ 420,240
University Corporation for Atmospheric Research	$ 331,220
Eagle Rock Analytics	$ 150,000
The Brattle Group, Inc.	$ 98,000
Drew Consulting	$ 95,000
US Geological Survey (USGS)	$ 95,000
Salo Sciences, Inc.	$ 95,000
University of New Mexico	$ 94,898
Sonoma Technology, Inc.	$ 90,000
Vibrant Planet	$ 75,000
Clere, Inc.	$ 75,000
University of San Francisco	$ 40,000
Missoula Fire Science Laboratory U.S. Forest Service	$ 40,000
Prometheus Fire Consulting LLC	$ 30,000
Deer Creek Resources, Inc.	$ 30,000
Pyrologix, LLC	(Match only)

Legal Company Name:

Funding Source	Funding Year of Appropriation	Budget List No.	Amount
EPIC	17-18	301.001E	$4,021,416
EPIC	18-19	301.001F	$978,584
R&D Program Area: EGRO: EA			$5,000,000
Explanation for “Other” selection			
Reimbursement Contract #:		Federal Agreement #:	

Name:	Jason Moghaddas	Name:	Shane Romsos
Address:	2529 Yolanda Ct	Address:	2529 Yolanda Ct
City, State, Zip:	Pleasanton, CA 94566-7513	City, State, Zip:	Pleasanton, CA 94566-7513
Phone:	530-927-8009 Fax: - -	Phone:	530-721-7508 Fax: - -
E-Mail:	jmoghaddas@sig-gis.com	E-Mail:	srosmos@sig-gis.com

☒ Competitive Solicitation Solicitation #: GFO-18-301
☐ First Come First Served Solicitation

1. Exhibit A, Scope of Work		☒ Attached
2. Exhibit B, Budget Detail		☒ Attached
3. CEC 105, Questionnaire for Identifying Conflicts		☒ Attached
4. Recipient Resolution	☒ N/A	☐ Attached
5. CEQA Documentation	☒ N/A	☐ Attached

Agreement Manager	Date	Office Manager	Date	Deputy Director	Date

Exhibit A
Scope of Work

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Project Team and Product Management Plan
3		Optimal Configuration of Weather Stations
4	X	Extreme Weather Historical Analysis
5		Advancing Wildfire Science of Tree Mortality
6	X	Near-term Risk Forecast Model Development — Phase I
7		Next-generation of Long-term Fire Risk Projection Models— Phase I
8	X	User Engagement Workshops — Phase I
9		Near-term Risk Forecast Integration — Phase II
10		Long-term Wildfire Projections — Phase II
11		User Engagement Workshops — Phase II
12		Evaluation of Project Benefits
13		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAWFE	Coupled Atmosphere-Wildland Fire Environment
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
DMP	Data Management Plan
Energy Commission	California Energy Commission
CPR	Critical Project Review
GIS	geographic information system
GPL	General Public License
HPC	High Performance Computing
IOU	Investor-owned Utility
LANDIS	Landscape Disturbance and Succession model
LUCAS	Land Use and Carbon Scenario Simulator
LiDAR	Light Detection and Ranging
MaxEnt	Maximum Entropy
PMP	Product Management Plan
TAC	Technical Advisory Committee
WG	Workgroup
WUI	Wildland-Urban Interface
WRF	Weather Research and Forecasting

[1] Please see subtask 1.3 in Part III of the Scope of Work (General Project Tasks) for a description of Critical Project Review (CPR) Meetings.

Exhibit A
Scope of Work

I. PURPOSE OF AGREEMENT, PROBLEM/SOLUTION STATEMENT, AND GOALS AND OBJECTIVES

A. Purpose of Agreement

The purpose of this Agreement is to advance the state of wildfire science, fund the development of the next generation of wildfire models at two or more spatial and temporal scales, support California's Fifth Climate Change Assessment (Fifth Assessment) and transfer technology and knowledge to electricity investor-owned utilities (IOUs).

Phase I of this Agreement will involve advancing fire science and wildfire modeling. Phase II of this Agreement will be conducted by the Recipient if and only if after a Critical Project Review (see subtask 1.3), the CAM determines, in their sole and absolute discretion, that Phase II is needed to support California's Fifth Climate Change Assessment and IOU operations and planning.

B. Problem/ Solution Statement

Problem

Many aspects of wildfires in California and elsewhere in the Western United States have changed in the past several decades, including climate patterns and the development of human infrastructure near wildlands increasing the amount of wildland-urban interface (WUI) in the state. Climate change has led to wildland fuel conditions that have increased the likelihood of fire behavior that exceed the assumptions of existing modeling systems. Wildfire science lacks some of the fundamental underpinnings to forecast risk in a changing climate and at scale. Operational wildfire behavior models are empirical and cannot be adapted to predict extreme fire behaviors typical of modern California forests. The current near-term risk forecasts underestimate extreme weather events, surface fuel loads in elevated tree mortality areas and fire-spread dynamics due to omission of novel driving factors. For long-term planning, there is a lack of a comprehensive modeling framework to make mid- to late-century projections of fire risk. Therefore, IOUs and State agencies and stakeholders relying on the grid lack certain scientifically robust information and actionable insights to make effective near-term management and long-term planning decisions.

Solution

To address these challenges, the Recipient will deliver the comprehensive open-source development of next-generation wildfire models for grid resiliency and safety. The next-generation models will provide actionable information at fine-scale resolution (circa 30m) in the near term (0-7 day forecasts) and coarse-scale resolution (circa 5 kilometers) in the long term (to end-of-century). In Phase I, the Recipient will advance wildfire science by incorporating the dynamics of tree mortality and extreme fire weather in next-generation fire models. Building on the new science, the Recipient will develop computationally efficient wildfire risk forecasting models and deploy to demonstrate the potential of promising technologies to reduce the impacts of wildfire on the electricity grid. At both time horizons, the Recipient will compare different approaches to addressing the multiple technical dimensions and converge on the first best path to the next generation of wildfire models. In Phase II if, following a CPR, the CAM determines in their sole and absolute discretion, and communicates in writing that Phase II is needed to support the Fifth Assessment and IOU operations and planning, the Recipient will then integrate risk forecast models at IOUs and support the Fifth Assessment with future fire projections.

$4,000,000 in funding from this Agreement is available for Phase I. If Phase II is directed by the CAM, then $1,000,000 in funding from this Agreement will be available for Phase II.

The innovation will be to develop zero-to-seven-day risk forecasts for the grid with best-in-class predictive capabilities, computational efficiency and scalability that incorporates the latest wildfire science. To support planning, the Recipient will develop long-term fire projections using a coupled fire-climate-vegetation statistical and dynamical model to integrate the latest climate projections, tree mortality, development in the wildland-urban interface, and adaptation strategies.

To integrate the models into electric utility management and planning, the Recipient will facilitate workshops to understand needs, design the models and provide technical support for deployment and implementation. To support the Fifth Assessment, the Recipient will develop a web-based scenario analysis tool to visualize and manipulate the impacts of climate change and landscape/urban adaptation strategies on the grid.

C. Goals and Objectives of the Agreement

Agreement Goals
The goals of this Agreement are to:

- Advance wildfire science to support improved grid resilience;
- Improve assessment of risks to the electric grid from wildfires now and under climate change; and
- Develop open source models that can feed directly into utility management and planning.

Ratepayer Benefits:[2] This Agreement will result in the ratepayer benefits of greater electricity reliability, lower costs, and increased safety. The first anticipated benefit results from improved decision-making by IOUs to reduce the impacts of wildfire on the grid. The decision-support tools developed during the project will inform IOU operating practices to deliver a more reliable, safe and cost-effective grid. The secondary benefit to ratepayers is from improved planning by State agencies and stakeholders relying on the grid. Mitigating the impacts of wildfires in a changing climate is a multi-stakeholder endeavor. The extent of the adaptation measures requires a new approach to address landscape-level challenges. In response, the project will deliver wildfire risk projections to support the Fifth Assessment and develop a web-based tool to improve long-term planning by State agencies and stakeholders relying on the grid. These products will enable better planning and implementation of adaptation strategies, which will reduce wildfire risk, and consequently reduce the impacts to the grid.

The decision-support tools will support IOU efforts to mitigate the risk of wildfire and reduce the damage from fires spreading onto the grid. Improved data and models for fire behavior prediction, particularly with respect to fuel load reductions, de-energization and fire hardening, will allow for fire mitigation investments to be strategically targeted, increasing marginal risk reduction for each dollar invested. With the use of more granular, dynamic fire-spread models, mitigation activities can be more precisely configured, making them consequently less extensive

[2] California Public Resources Code, Section 25711.5(a) requires projects funded by the Electric Program Investment Charge (EPIC) to result in ratepayer benefits. The California Public Utilities Commission, which established the EPIC in 2011, defines ratepayer benefits as greater reliability, lower costs, and increased safety (See CPUC "Phase 2" Decision 12-05-037 at page 19, May 24, 2012, http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF).

in scope. Such improvement in management would not only bring down management costs, but it would also ultimately reduce fire damage to grid infrastructure and outages that would result from such damage. The lower-cost, more-effectively-designed fuel treatments, de-energization and fire hardening would also yield safety benefits to life and property in communities that are proximate to grid infrastructure.

Technological Advancement and Breakthroughs:[3] This Agreement will lead to technological advancement and breakthroughs to overcome barriers hindering the achievement of the State of California's statutory energy goals by addressing critical fire science gaps and operationalizing the science to provide advanced forecasting capability to IOUs and State agencies. The largest threat is the 'new abnormal' of increasing risk of catastrophic wildfire driven by historically high fuel loads, increasing frequency of extreme weather conditions and extensive population development in the WUI. IOUs, State agencies and stakeholders relying on the grid need better tools and technologies to forecast risk in these circumstances. In the near term, more timely and accurate information will improve situational awareness and enable IOUs to undertake measures to mitigate the impacts of wildfire on the safety and reliability of the grid in a cost-effective manner. For the long-term, more scientifically rigorous and detailed long-term projections will provide stakeholders with the tools to make improved planning decisions for a resilient grid.

Agreement Objectives

The objectives of this Agreement are to:

- Develop new information and knowledge about fire behavior in extreme weather conditions and areas of high tree mortality to inform the next generation of wildfire models;
- Develop computationally efficient fire-spread models in relation to electricity assets and conduct foundational research in anticipation of the Fifth Assessment; and
- Transfer technology and knowledge to IOUs and support the Fifth Assessment.

II. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V).** Products that require a draft version are indicated by marking **"(draft and final)"** after the product name in the "Products" section of the task/subtask. If "(draft and final)" does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, **"days"** means working days.

The Recipient shall:

For products that require a draft version

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part V). The CAM will provide written comments to the Recipient on the draft

[3] California Public Resources Code, Section 25711.5(a) also requires EPIC-funded projects to lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory and energy goals.

product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.

- Submit the final product to the CAM once agreement has been reached on the draft. The CAM will provide written approval of the final product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- If the CAM determines that the final product does not sufficiently incorporate his/her comments, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For products that require a final version only

- Submit the product to the CAM for approval.
- If the CAM determines that the product requires revision, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For all products

- Submit all data and documents required as products in accordance with the following Instructions for Submitting Electronic Files and Developing Software:

    - **Electronic File Format**
      Submit all data and documents required as products under this Agreement in an electronic file format that is fully editable and compatible with the Energy Commission's software and Microsoft (MS)-operating computing platforms, or with any other format approved by the CAM. Deliver an electronic copy of the full text of any Agreement data and documents in a format specified by the CAM, such as memory stick or CD-ROM.

      The following describes the accepted formats for electronic data and documents provided to the Energy Commission as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:
        - Data sets will be in MS Access or MS Excel file format
        - (version 2007 or later), or any other format approved by the CAM.
        - Text documents will be in MS Word file format, version 2007 or later.
        - Documents intended for public distribution will be in PDF file format.
        - The Recipient must also provide the native Microsoft file format.
        - Project management documents will be in Microsoft Project file format, version 2007 or later.

    - **Software Application Development**
      Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:
        - Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
        - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
        - Visual Studio.NET (version 2008 and up). Recommend 2010.
        - C# Programming Language with Presentation (UI), Business Object and Data Layers.
        - SQL (Structured Query Language).

- Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
- Microsoft SQL Reporting Services. Recommend 2008 R2.
- XML (external interfaces).

Any exceptions to the Electronic File Format requirements above must be approved in writing by the CAM. The CAM will consult with the Energy Commission's Information Technology Services Branch to determine whether the exceptions are allowable.

MEETINGS

Subtask 1.2 Kick-off Meeting

The goal of this subtask is to establish the lines of communication and procedures for implementing this Agreement.

The Recipient shall:

- Attend a "Kick-off" meeting with the CAM, the Commission Agreement Officer (CAO), and any other Energy Commission staff relevant to the Agreement. The Recipient will bring its Project Manager and any other individuals designated by the CAM to this meeting. The administrative and technical aspects of the Agreement will be discussed at the meeting. Prior to the meeting, the CAM will provide an agenda to all potential meeting participants. The meeting may take place in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

  The administrative portion of the meeting will include discussion of the following:
  - Terms and conditions of the Agreement;
  - Administrative products (subtask 1.1);
  - CPR meetings (subtask 1.3);
  - Match fund documentation (subtask 1.7);
  - Permit documentation (subtask 1.8);
  - Subcontracts (subtask 1.9); and
  - Any other relevant topics.

  The technical portion of the meeting will include discussion of the following:
  - The CAM's expectations for accomplishing tasks described in the Scope of Work;
  - An updated Project Schedule;
  - Technical products (subtask 1.1);
  - Progress reports and invoices (subtask 1.5);
  - Final Report (subtask 1.6);
  - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
  - Any other relevant topics.

- Provide an *Updated Project Schedule, List of Match Funds,* and *List of Permits*, as needed to reflect any changes in the documents.

The CAM shall:

- Designate the date and location of the meeting.
- Send the Recipient a *Kick-off Meeting Agenda*.

Recipient Products:

- Updated Project Schedule *(if applicable)*

- Updated List of Match Funds *(if applicable)*
- Updated List of Permits *(if applicable)*

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

The goal of this subtask is to determine if the project should continue to receive Energy Commission funding, and if so whether any modifications must be made to the tasks, products, schedule, or budget. CPR meetings provide the opportunity for frank discussions between the Energy Commission and the Recipient. As determined by the CAM, discussions may include project status, challenges, successes, advisory group findings and recommendations, final report preparation, and progress on technical transfer and production readiness activities (if applicable). Participants will include the CAM and the Recipient, and may include the CAO and any other individuals selected by the CAM to provide support to the Energy Commission.

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget will be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the Energy Commission, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

The Recipient shall:

- Prepare a *CPR Report* for each CPR meeting that: (1) discusses the progress of the Agreement toward achieving its goals and objectives; and (2) includes recommendations and conclusions regarding continued work on the project.
- Submit the CPR Report along with any other *Task Products* that correspond to the technical task for which the CPR meeting is required (i.e., if a CPR meeting is required for Task 2, submit the Task 2 products along with the CPR Report).
- Attend the CPR meeting.
- Present the CPR Report and any other required information at each CPR meeting.

The CAM shall:

- Determine the location, date, and time of each CPR meeting with the Recipient's input.
- Send the Recipient a *CPR Agenda* and a *List of Expected CPR Participants* in advance of the CPR meeting. If applicable, the agenda will include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a *Schedule for Providing a Progress Determination* on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. If the CAM concludes that satisfactory progress is not being made, this conclusion will be referred to the Deputy Director of the Energy Research and Development Division.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

Exhibit A
Scope of Work

Recipient Products:

- CPR Report(s)
- Task Products (draft and/or final as specified in the task)

CAM Products:

- CPR Agenda
- List of Expected CPR Participants
- Schedule for Providing a Progress Determination
- Progress Determination

Subtask 1.4 Final Meeting

The goal of this subtask is to complete the closeout of this Agreement.

The Recipient shall:

- Meet with Energy Commission staff to present project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement. This meeting will be attended by the Recipient and CAM, at a minimum. The meeting may occur in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

  The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
  - The administrative portion of the meeting will involve a discussion with the
  - CAM and the CAO of the following Agreement closeout items:
    - Disposition of any state-owned equipment.
    - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
    - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
    - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
    - "Surviving" Agreement provisions such as repayment provisions and confidential products.
    - Final invoicing and release of retention.

- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

Products:

- Final Meeting Agreement Summary *(if applicable)*
- Schedule for Completing Agreement Closeout Activities
- All Draft and Final Written Products

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

The Recipient shall:

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
  - Summarize all Agreement activities conducted by the Recipient for the preceding month, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.
  - Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the "Payment of Funds" section of the terms and conditions. In addition, each invoice must document and verify:
  - Energy Commission funds received by California-based entities;
  - Energy Commission funds spent in California (if applicable); and
  - Match fund expenditures.

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. The CAM will review and approve the Final Report, which will be due at least **two months** before the Agreement end date. When creating the Final Report Outline and the Final Report, the Recipient must use a Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM.
- Submit a draft of the outline to the CAM for review and comment.
- Once agreement has been reached on the draft, submit the final outline to the CAM. The CAM will provide written approval of the final outline within 10 days of receipt.

Recipient Products:

- Final Report Outline (draft and final)

CAM Products:

- Style Manual
- Comments on Draft Final Report Outline
- Approval of Final Report Outline

Subtask 1.6.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline and the Style Manual provided by the CAM.
- Submit a draft of the report to the CAM for review and comment. Once agreement on the draft report has been reached, the CAM will forward the electronic version for Energy Commission internal approval. Once the CAM receives approval, he/she will provide written approval to the Recipient.
- Submit one bound copy of the Final Report to the CAM.

Product:

- Final Report (draft and final)

CAM Product:

- Comments on Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. The Recipient may only spend match funds during the Agreement term, either concurrently or prior to the use of Energy Commission funds. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a *Match Funds Status Letter* that documents the match funds committed to this Agreement. If no match funds were part of the proposal that led to the Energy Commission awarding this Agreement and none have been identified at the time this Agreement starts, then state this in the letter.
  If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter:
  - A list of the match funds that identifies:
    - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
    - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
  - A copy of a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.

- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

Products:

- Match Funds Status Letter
- Supplemental Match Funds Notification Letter *(if applicable)*
- Match Funds Reduction Notification Letter *(if applicable)*

Subtask 1.8 Permits

The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a *Permit Status Letter* that documents the permits required to conduct this Agreement. If no permits are required at the start of this Agreement, then state this in the letter. If permits will be required during the course of the Agreement, provide in the letter:
    - A list of the permits that identifies: (1) the type of permit; and (2) the name, address, and telephone number of the permitting jurisdictions or lead agencies.
    - The schedule the Recipient will follow in applying for and obtaining the permits.

  The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

Products:

- Permit Status Letter
- Updated List of Permits *(if applicable)*
- Updated Schedule for Acquiring Permits *(if applicable)*
- Copy of each Approved Permit *(if applicable)*

Subtask 1.9 Subcontracts
The goals of this subtask are to: (1) procure subcontracts required to carry out the tasks under this Agreement; and (2) ensure that the subcontracts are consistent with the terms and conditions of this Agreement.

The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.
- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of the executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

Products:

- Final Subcontracts *(draft if required by the CAM)*

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)
The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
    - Technical area expertise;
    - Knowledge of market applications; or
    - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.

The TAC may be composed of qualified professionals spanning the following types of disciplines:

- Researchers knowledgeable about the project subject matter;
- Members of trades that will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives);
- Public interest market transformation implementers;
- Product developers relevant to the project;

- U.S. Department of Energy research managers, or experts from other federal or state agencies relevant to the project;
- Public interest environmental groups;
- Utility representatives;
- Air district staff; and
- Members of relevant technical society committees.

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.11.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

Products:

- List of Potential TAC Members
- List of TAC Members
- Documentation of TAC Member Commitment

Subtask 1.11 TAC Meetings

The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

The Recipient shall:

- Discuss the TAC meeting schedule with the CAM at the Kick-off meeting. Determine the number and location of meetings (in-person and via teleconference) in consultation with the CAM.
- Prepare a *TAC Meeting Schedule* that will be presented to the TAC members during recruiting. Revise the schedule after the first TAC meeting to incorporate meeting comments.
- Prepare a *TAC Meeting Agenda* and *TAC Meeting Back-up Materials* for each TAC meeting.
- Organize and lead TAC meetings in accordance with the TAC Meeting Schedule. Changes to the schedule must be pre-approved in writing by the CAM.
- Prepare *TAC Meeting Summaries* that include any recommended resolutions of major TAC issues.

Products:

- TAC Meeting Schedule (draft and final)
- TAC Meeting Agendas (draft and final)
- TAC Meeting Back-up Materials
- TAC Meeting Summaries

III. TECHNICAL TASKS

TASK 2 PROJECT TEAM AND PRODUCT MANAGEMENT PLAN

The goals of this task is to assemble a Project Team and develop a Product Management Plan to be implemented regarding all data and products under this Scope of Work.

The Recipient shall:

- Create and lead a Project Team to consist of four Workgroups (WG), each comprising of a lead and multiple contributors. WGs include: WG #1 Extreme Weather, WG #2 Tree Mortality, WG #3 Near-Term Risk Forecasts, and WG #4 Long-Term Fire Projections.
- Hold 1 in-person Project Team inception meeting to refine strategy for overall project tasks and deliverables at onset of project.
- Hold up to 2 annual in-person Project Team coordination meetings over the course of Phase 1.
- Recipient will develop a *Product Management Plan (PMP)* to be approved by CAM.
    - PMP will cover all data, modeling, and other related products under this Scope of Work, including but not limited to all models, data archives and data sets.
    - PMP will include a description of all data, modeling, and other related products under this Scope of Work, and how each product will be shared with the Energy Commission, made available to stakeholders and the public, and archived.
    - PMP will include a description of how all products under this Agreement will be made available to the public unless application of an exception is justified under the Public Records Act (Government Code section 6250 et seq.). If applicable the CAM can direct the Recipient to prepare confidential and non-confidential versions of any relevant products.
    - The PMP will include a description of how all code developed under this Agreement shall be open source, broadly available for public reuse, published in state repository (code.ca.gov), and provided with the applicable product. PMP shall also address compliance with state policy on open source software, California Department of Technology Letter TL 18-02[4] including State Administrative Manual sections 4819.2, 4984, 4984.1, and 4984.2. Code developed under this Agreement cannot result in proprietary derivative works, unless exceptions apply from State Administrative Manual section 4984.2
    - When possible, all code developed under this Agreement shall be amendable to forming the basis for an operational tool in Cal-Adapt including sufficient documentation and knowledge transfer.
    - Where data produced by third parties are available and accessible and are not possible to store in the relevant product provided under this Scope of Work, guidance on how to access the data will be included in the PMP.

Products:

- Product Management Plan (draft and final)

[4] https://cdt.ca.gov/wp-content/uploads/2018/05/TL-18-02-OSCodeReuse_2018-0419.pdf.

Exhibit A
Scope of Work

TASK 3 OPTIMAL CONFIGURATION OF WEATHER STATIONS

The goals of this task are to: (1) develop a methodology for identifying optimal configurations of weather stations; (2) pilot test an upper-air profiler; and (3) provide recommendations for future siting of weather stations.

The Recipient shall:

- Develop a methodology for identifying the optimal location for future weather station sites to generate maximum information content about wildfire risk, especially wind and complement stations already installed or planned by the IOUs. The methodology will describe a computational method of optimal location based on maximum entropy (MaxEnt) modeling (or similar model approved by the CAM) to combine multiple layers of information to optimize weather station locations. Network of weather stations should be designed for wildfire situations with the potential to affect electrical assets including transmission and distribution lines, substations, and power plants. Factors to be considered also include wind patterns, wildland fuels, access, and proximity of utility assets and other critical assets at risk.
- Hold up to 2 in-person WG #1 Extreme Weather mid-year meetings (occurring annually) to coordinate Task 3 and Task 4 schedule, analysis and work products.
- Prepare a *Site Recommendation Framework and Baseline Needs Assessment Summary* that includes, but is not limited to, the following:
    - Relevant Information or data assembly needed (includes desktop research and meetings with IOUs to gather information see Task 8);
    - Process for evaluating information;
    - Description of the evaluation outcomes
    - Description of considerations to identify priorities;
    - Analysis of the existing weather station(s) and utility-planned network(s);
    - Analysis of expected budget for weather stations at two-year and ten-year cycle; and
    - Assessment of the data gaps and needs.
- Assemble a *Weather Station Network Dataset* that draws from, but is not limited to, the following:
    - Atmospheric analyses and surface data;
    - Data on fuels;
    - Topography;
    - Access (administrative boundaries and property rights);
    - Electric utility assets at risk (public data from Cal-Adapt and information shared by the utilities);
    - Existing weather/telecom/detection towers; and
    - Weather stations.
- Develop an *Upper-air Profiler Test Plan* including, but not limited to:
    - Objectives of the test;
    - Site location; and
    - Procedures for sharing data collected.
- Pilot an upper-air profiler for anticipating extreme weather events.
- Prepare *Guidance on Using Upper-Air Profiler Report* including but not limited to*:*
    - Leveraging upper-air profiler data to improve weather forecasts;
    - Enhance situational awareness of high-wind events;

  - Designing, deploying, and maintaining profiler networks;
  - Integrating upper-air profiler into a data management system, similar to current operating practices in IOUs; and
  - Comparison of data with other meteorological studies on upper-air profilers use in wildfire risk areas.
- Prepare an *Optimal Location of Weather Stations Report* that includes, but is not limited to, the following:
  - Recommendations for improvements to the weather station network;
  - Description of 'warning areas' and 'danger sites';
  - Cost evaluation of surface weather station locations for capital, maintenance and bandwidth costs; and
  - Guidance for expanding the recommended sites.
- Prepare a *Weather Station Network Optimization Data Archive* that includes, but is not limited to, the following:
  - Data layers showing the optimal locations for weather stations;
  - Data layer showing identified 'warning areas' and 'danger sites';
  - Source code for the MaxEnt or similar modeling;
  - Atmospheric (re)analyses and surface data;
  - Data on fuels;
  - Topography;
  - Access (administrative boundaries and property rights);
  - Electric utility assets at risk through collecting public data from Cal-Adapt and from IOUs;
  - Existing weather/telecom/detection towers; and
  - Weather stations.

Products:
- Site Recommendation Framework and Baseline Needs Assessment Summary
- Weather Station Network Dataset
- Upper-air Profiler Test Plan
- Guidance on Using Upper-Air Profiler Report
- Optimal Location of Weather Stations Report
- Weather Station Network Optimization Data Archive

TASK 4 EXTREME WEATHER HISTORICAL ANALYSIS
The goal of this task is to improve understanding of the relationship of extreme weather conditions and wildfire in order to improve forecasting accuracy about future wildfire risk.

The Recipient shall:
- Develop an *Extreme Weather Historical Pre-analysis Spatial Dataset* of historical weather data for major California weather and fire events. Analysis will include the various fuel types found in the three IOUs, e.g. chaparral, coastal forest, and Sierra conifer forest. Emphasis to be placed on wildfires that have damaged electricity system to find regional patterns.
- Review conditions driving major fire events using: 1) a coarse-scale, automated analysis, and 2) a manual, fine-scale and targeted analysis.

- Analyze the relationships of historical fire events with the environmental and weather data.
- Develop an *Extreme Weather Historical Analysis Data Archive* that includes, but is not limited to, the following:
    - Dataset of outputs that identifies environmental conditions associated with major fires in the past overlaid with areas of heightened risk for different types (e.g. wind-driven vs. plume-driven) of fires; and
    - Complete source code, database and analysis outputs.
- Prepare an *Extreme Weather Historical Analysis Report* summarizing the findings from the Task, including the factors influencing wind-driven and plume-driven events for major historical fires in the State.
- Prepare a *CPR Report #1* and participate in CPR meeting per subtask 1.3.

Products:

- Extreme Weather Historical Pre-analysis Spatial Dataset
- Extreme Weather Historical Analysis Data Archive
- Extreme Weather Historical Analysis Report
- CPR Report #1

TASK 5 ADVANCING WILDFIRE SCIENCE OF TREE MORTALITY

The goals of this task are to (1) develop repeatable and controlled fuel materials and mixtures that can be burned at laboratory scales; (2) devise experimental apparatus and test in a laboratory setting the predicted heat release rates across the range of fuel structures and environmental conditions found in wildland areas; (3) develop and employ a new fuel measurement and mapping system to resolve the essential fuel components and spatial heterogeneity in fuels occurring at multiple scales; (4) map current and projected future fuel conditions in areas of elevated tree mortality; and (5) evaluate how to integrate the products into near-term risk forecasts and long-term risk projections with an emphasis on the wildland-urban interface when possible.

The Recipient shall:

- Hold up to 2 in-person WG #2 (Tree Mortality WG) mid-year meetings (occurring annually) to coordinate Task 5 schedule, analysis and work products.
- Prepare a *State of Wildfire Science Report* that includes, but is not limited to, the following:
    - A description of the state of wildfire science and its application for forecasting fire risk in California; and
    - A summary of research objectives and outcomes of Task 5 and how they relate to the development of the next generation of wildfire risk models.
- Develop a Tree Mortality Fuel Conditions in a Pilot Dataset that includes, but is not limited to, the following:
    - An analysis of fuel conditions for plots in Sequoia and Kings Canyon National Parks, or other locations as approved in advance by the CAM, combining ground-based and aerial LiDAR with field-based analysis; and
    - A description of fuel strata as a set of distributions that specify cover, patch size, departure from randomness, and overlap among vertical strata.

- Perform physical experiments to simulate fire conditions that includes, but is not limited to, the following activities:
    - Develop tests to predict heat release rates across the range of fuel structures and environmental conditions found in wildland areas*; and*
    - Construct models of the non-steady wildfire spread and behavior based on the findings of laboratory experiments.
- Develop a *Contemporary Tree Mortality Dataset* including a spatially explicit data layer of areas of elevated tree mortality.
- Develop a *Tree Mortality Fuel Projection Dataset* that includes, but is not limited to, the following:
    - An analysis of woody fuel loads 10 and 20 years in the future using empirical models of tree fall probabilities and wood decay to project; and
    - A spatially explicit dataset projecting fuel loads over 10/20 years for current areas of elevated tree mortality.
- Integrate experimental work with fuel characterizations and tree mortality mapping to determine the variability in fire behavior predictions for the current and projected forest fuel conditions.
- Prepare a *Tree Mortality Evaluation Summary* that includes, but is not limited to, the following:
    - A qualitative evaluation of the impacts of elevated tree mortality and surface fuel buildup on fire risk over 20 years;
    - An evaluation of the opportunities for enhancing near-term and long-term fire risk forecasts and projections using the knowledge developed under Task 5;
    - A description of a new fuel measurement and mapping system and models of non-steady fire spread and behavior;
    - A summary of the findings of the laboratory simulations; and
    - A recommendation on the next research steps for advancing knowledge, tools and technologies for assessing fuel loads, fire spread and locations of elevated tree mortality.
- Develop a *Tree Mortality Data Archive* that includes, but is not limited to, a set of data layers describing areas of elevated tree mortality and current/projected fuel loads.

Products:

- State of Wildfire Science Report
- Contemporary Tree Mortality Dataset
- Tree Mortality Fuel Projection Dataset
- Tree Mortality Evaluation Summary
- Tree Mortality Data Archive

TASK 6 NEAR-TERM RISK FORECASTS MODEL DEVELOPMENT – PHASE I

The goals of this task are to develop the next generation of models to provide near-term risk forecasts at a 0-to-7-day temporal scale and at a fine (circa 30m) spatial scale to simulate spread of extant fire ignitions and enhance current models with best practice in wildfire risk modeling.

Exhibit A
Scope of Work

The Recipient shall:

- Hold up to 2 in-person WG #3 (Near-term Risk Forecast WG) mid-year meetings (occurring annually) to coordinate Task 6 schedule, analysis and work products.
- Prepare a *Near-term Risk Forecast Baseline Needs Assessment Summary* and a *Near-term Risk Forecast Modelling Framework Summary*.
- Develop a *Near-term Risk Forecast Data Archive* to distribute project outputs to IOUs and collect IOU electric asset and analysis information. The web-based platform will include the following features:
    - A feature to upload GIS data, source code, outputs and analysis;
    - A feature for IOUs to upload pertinent data and view Task outputs; and
    - A feature for separating proprietary and public domain data.
- Develop a *Near-term Risk Forecasts Dataset* that includes, but is not limited to, the following:
    - Datasets for fuels, topography and weather across the State;
    - Dataset for a sample of major historical fires including ignition location, fire progression maps and downscaled weather conditions;
    - Maps of electricity assets and damage to electricity assets from wildfire that are publicly accessible;
    - A dataset of building footprints; and
    - Source code and guidance documentation for existing open-source risk forecast models GRIDFIRE and ELMFIRE (or similar models approved by the CAM)
- Run first comparison of near-term risk forecast models. Evaluate “version 1” of risk forecast models — the current generation of surface fire-spread models— for a very large number of simulations to benchmark performance against a set of quantitative and qualitative metrics. Compare against third-party risk forecast models, if available. To the extent possible models and analytics should be tested with observational data on past fires. Additionally, to the extent possible models should be calibrated to the types of wildfires that tend to result in damage to IOU infrastructure.
- Deploy a forecast system for initial testing using version 1 risk forecast models for pilot areas.
- Enhance near-term risk forecasts to incorporate next-generation components developed in previous Tasks or externally.
- Run second comparison of near-term risk forecast models. Evaluate against performance metrics.
- Deploy the next-generation forecast system for testing using version 2 risk forecast models.
- Prepare a *Near-term Risk Forecast Cost-benefit Analysis Factsheet.*
- Prepare a *Decision-support Tool Brief* to describe how Recipient will integrate the Task 6 products into operating practices at IOUs during Phase II.
- Update the *Near-term Risk Forecast Data Archive* to include the following:
    - *Near-Term Risk Forecasts Outputs* for 1) examples of forecasted risk to electric grid assets on a near-term time horizon and 2) estimated fire threat from ignitions from electric assets;
    - Near-Term Risk Forecasts Docker Container which will include a single package to deploy the version 2 near-term risk forecasts on conventional High Performance Computing (HPC) resources;

    - *Near-term Risk Forecasts User's Guide* to provide guidance on deploying, running, analyzing and visualizing the Near-Term Risk Forecast outputs; and
    - Set of open-source code for models.
- Prepare a *CPR Report #2* and participate in CPR meeting per subtask 1.3.
- The CPR meeting #2 will be the Go or No-Go decision point on whether Phase 2 proceeds.

Products:

- Near-term Risk Forecast Baseline Needs Assessment Summary
- Near-term Risk Forecasts Modeling Framework Summary
- Near-term Risk Forecast Data Archive
- Near-term Risk Forecast Dataset
- Near-term Risk Forecast Cost-benefit Analysis Fact Sheet
- Decision-support Tool Brief
- Near-Term Risk Forecasts Outputs
- Near-term Risk Forecasts User's Guide
- CPR Report #2

TASK 7 NEXT-GENERATION OF LONG-TERM FIRE RISK PROJECTION MODELS – PHASE I

The goals of this task are to develop the next generation of coupled statistical/dynamical fire-climate-vegetation models to run long-term (to end-of-century) wildfire risk projections and incorporate best in-class science and technology to enhance the models.

The Recipient shall:

- Hold up to 2 in-person WG #4 (Long-term Projections WG) mid-year meetings (occurring annually) to coordinate Task 7 schedule, analysis and work products.
- Prepare a *Long-term Risk Projections Baseline Needs Assessment Summary* and *Long-term Risk Projections Modeling Framework Summary.*
- Develop a *Long-term Risk Projections Dataset* that includes, but is not limited to, the following:
    - A database of major historical fires including ignition location, fire progression maps and downscaled weather conditions; and
    - A dataset of electricity assets, building footprints and climate projections.
- Run a comparison of current long-term risk projection models (version 1) implemented by Recipient. To the extent possible models and analytics should be tested with observational data on past fires. Additionally, to the extent possible models should be calibrated to the types of wildfires that tend to result in damage to IOU infrastructure.
- The Task 7 schedule is subject to change in the case of the following:
    - Recipient receives the historical dataset used to train the climate projections by third parties more than 12 months after the project start date; and
    - Recipient team receives a full set of climate projections by third parties more than 30 months after the project start date.
    - To facilitate the Task 7 products, the specifications of the data from the third parties for output file formats, as well as specification of the spatial grid and temporal range and frequency of data contained in each file, should be specified

in the RFP and/or published in advance to facilitate preparations by the Recipient of the data.

- Develop two alternative approaches to the next generation of coupled statistical-dynamical fire-climate-vegetation models (version 2) with the following activities:
    - Develop a method to create multiple scenarios based on changing inputs such as global emissions, global climate models, urban growth, and adaptation strategies;
    - Enhance the predictive capability of multiple wildfire risk projection models by addressing tree mortality and fire in the WUI;
    - Integrate the available downscaled climate projections by Scripps or other third party;
    - Compare four distinct coupled statistical-dynamical fire-climate-vegetation models;
    - Develop the modeling framework to produce fire risk projection output layers including probability of low/medium/high-severity fires per pixel; and
    - Host, test and run the models.
- Run a baseline projection for each model (version 2) and two iterations (one for climate and one for adaptation strategy) and output a probability of low/medium/high-severity fires per pixel.
- Run a comparison and validation of long-term risk projection models (version 2).
- Develop a *Long-term Risk Projections Data Archive* to distribute Task 7 outputs including, but not limited to, the following:
    - A dataset containing the modeling outputs from the comparative analysis, baseline projections and iterations as an exemplar of the model outputs;
    - A feature for Recipient to upload information and stakeholders to view project outputs; and
    - A set of open-source code for models.
    - Where datasets produced by third parties are available and accessible, guidance on how to access the dataset to be provided, instead of stored in the dataset.
- Prepare a *Planning Support Tool Design Brief* to describe how the Recipient will integrate the Task 7 products into State Agency and stakeholder planning practices during Phase 2.

Products:

- Long-term Risk Projections Baseline Needs Assessment Summary
- Long-term Risk Projections Modeling Framework Summary
- Long-term Risk Projections Dataset
- Long-term Risk Projections Data Archive
- Planning Support Tool Design Brief

TASK 8 USER ENGAGEMENT WORKSHOPS – PHASE I

The goal of this task is to facilitate workshops with IOUs and other stakeholders to better develop and manage the grid while facing an increased risk of wildfire due to climate change.

The Recipient shall:

- Facilitate up to 7 in-person IOU and stakeholder workshops and 2 virtual IOU workshops, to gather information and communicate project objectives, needs and proposed project outputs.

- Prepare a *User Needs Assessment Summary* to summarize the actionable insights from the workshops.
- Prepare a *CPR Report #3* and participate in a CPR meeting per subtask 1.3 to determine in writing by the CAM that Phase II is needed to support Fifth Assessment and IOU operations and planning.

Products:
- User Needs Assessment Summary
- CPR Report #3 which will act as a Final Report if Phase II is not applicable

TASK 9 NEAR-TERM RISK FORECAST INTEGRATION – PHASE II *To be undertaken ONLY IF directed by the CAM in writing*
The goal of this task is to integrate a decision-support tool into operating procedures at IOUs.

The Recipient shall:
- Hold up to 2 in-person WG #3 (Near-term Risk Forecast WG) mid-year meetings (occurring annually) to coordinate Task 9 schedule, analysis and work products.
- Prepare a *Near-term Risk Forecast Integration Workplan — Phase II* for activities to integrate risk forecasts into IOU operating practices that includes, but is not limited to, the following:
    - Summary of the current products available; and
    - Objectives, outcomes and schedule to integrate near-term forecasts at each of the IOUs.
- Revise the *Near-term Risk Forecast Cost-benefit Analysis Factsheet.*
- Prepare a *Near-term Risk Forecast: Evaluation of Performance and Recommendations Summary* to include, but not limited to, the following:
    - A review of gaps, needs and potential next steps for developing near-term risk forecasting and the wildfire science that supports the forecasts; and
    - A summary of lessons learned and recommendations.
- Develop a *Near-term Risk Forecast Data Archive — Phase II* to include, but not limited to, the following:
    - A revision of the Near-term Risk Forecast Outputs;
    - An update of the Near-term Risk Forecast Docker Container;
    - Update the Near-term Risk Forecast User's Guide Documentation; and
    - A set of open-source code for models.

Products:
- Near-term Risk Forecast Integration Workplan — Phase II
- Near-term Risk Forecast Cost-benefit Analysis Factsheet
- Near-term Risk Forecast: Evaluation of Performance and Recommendations Summary
- Near-term Risk Forecast Data Archive — Phase II

TASK 10 LONG-TERM WILDFIRE PROJECTIONS – PHASE II *To be undertaken ONLY IF directed by the CAM in writing*

The goals of this task are to support the Fifth Assessment by running the models for long-term wildfire projections and develop a planning support tool for IOUs, State agencies and stakeholders relying on the grid to visualize the impacts of wildfire under a changing climate.

The Recipient shall:

- Hold up to 2 in-person WG #4 (Long-term Predictions WG) mid-year meetings (occurring annually) to coordinate Task 10 schedule, analysis and work products.
- Prepare a *Long-term Risk Projections Workplan — Phase II* for activities relating to supporting the Fifth Assessment collaborators with wildfire risk projections that includes, but is not limited to, the following:
    - A summary of the current products and a specification of the scenarios to be run for each of the collaborators; and
    - A specification of the web-based planning support tool.
- Implement the Long-term Risk Projections Workplan — Phase II and run the model developed in Task 7 with downscaled climate projections for the selected set of scenarios. The scenario outputs to include vegetation, fuel characteristics, carbon flux, area burnt and burn severity, with a spatial resolution of minimum 2km (or in line with the spatial resolution of the climate projections) and a monthly temporal resolution.
- Develop a *Long-term Risk Projections Planning Support Tool* and iterate two versions of the tool following feedback from users.
- Prepare a *Long-term Wildfire Risk Projections Planning Support Tool Docker Container* to allow Cal-Adapt or other organizations to deploy the next generation Long-term Risk Projections (version 2) on conventional HPC resources.
- Prepare a *Long-term Risk Projections Planning Support Tool User's Guide Documentation* to provide guidance on deploying, running, analyzing and visualizing the planning support tool outputs.
- Update the *Long-term Risk Projections Data Archive – Phase II* with Task 10 outputs.

Products:

- Long-term Risk Projections Workplan — Phase II
- Long-term Risk Projections Planning Support Tool
- Long-term Risk Projections Planning Support Tool Docker Container
- Long-term Risk Projections Planning Support Tool User's Guide Documentation
- Long-term Risk Projections Data Archive – Phase II

TASK 11 USER ENGAGEMENT WORKSHOPS — PHASE II *To be undertaken ONLY IF directed by the CAM in writing*

The goals of this task are to facilitate workshops to support the Fifth Assessment and integrate risk forecasts into IOU operations and gather user feedback on the Decision-support Tool for IOU risk forecasting and the Planning Support Tool for State agency and stakeholder scenario analysis.

Exhibit A
Scope of Work

The Recipient shall:

- Facilitate up to 6 in-person workshops and up to 4 virtual workshops for IOUs and other stakeholders to plan the integration of risk forecasts into operational practices.
- Prepare an *Integration Workshop Summary* of the actionable insights from the workshops.

Products:

- Integration Workshop Summary

TASK 12: EVALUATION OF PROJECT BENEFITS

The goal of this task is to report the benefits resulting from this project.

The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:
  - <u>For Product Development Projects and Project Demonstrations:</u>
    - Published documents, including date, title, and periodical name.
    - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
    - Greenhouse gas and criteria emissions reductions.
    - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
    - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
    - A discussion of project product downloads from websites, and publications in technical journals.
    - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
    - <u>Additional Information for Product Development Projects</u>:
      - Outcome of product development efforts, such copyrights and license agreements.
      - Units sold or projected to be sold in California and outside of California.
      - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
      - Investment dollars/follow-on private funding as a result of Energy Commission funding.
      - Patent numbers and applications, along with dates and brief descriptions.
    - <u>Additional Information for Product Demonstrations</u>:
      - Outcome of demonstrations and status of technology.
      - Number of similar installations.
      - Jobs created/retained as a result of the Agreement.

- For Information/Tools and Other Research Studies:
  - Outcome of project.
  - Published documents, including date, title, and periodical name.
  - A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
  - The number of website downloads.
  - An estimate of how the project information has affected energy use and cost, or have resulted in other non-energy benefits.
  - An estimate of energy and non-energy benefits.
  - Data on potential job creation, market potential, economic development, and increased state revenue as a result of project.
  - A discussion of project product downloads from websites, and publications in technical journals.
  - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Respond to CAM questions regarding responses to the questionnaires.

The Energy Commission may send the Recipient similar questionnaires after the Agreement term ends. Responses to these questionnaires will be voluntary.

Products:

- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

TASK 13: TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

The goal of this task is to develop a plan to make the knowledge gained, experimental results, and lessons learned available to the public and key decision makers.

The Recipient shall:

- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:
  - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
  - A description of the intended use(s) for and users of the project results.
  - Published documents, including date, title, and periodical name.
  - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
  - A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.

  - The number of website downloads or public requests for project results.
  - Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop on the results of the project.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

Products:

- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Presentation Materials (draft and final)
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

IV. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

RESOLUTION NO: 2019-0612-14

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: SPATIAL INFORMATICS GROUP, LLC

RESOLVED, that the State Energy Resources Conservation and Development Commission (Energy Commission) adopts the staff CEQA findings contained in the Agreement or Amendment Request Form (as applicable); and

RESOLVED, that the Energy Commission approves Agreement EPC-18-014 with Spatial Informatics Group, LLC for a $5,000,000 grant to develop nextgeneration wildfire models for grid resiliency and safety, and adopting staff's determination that this action is exempt from CEQA. Phase I of the grant ($4,000,000) will involve advancing fire science and wildfire modeling. Phase II ($1,000,000) would be conducted only if needed to support California's Fifth Climate Change Assessment. This project will illuminate the emerging risks of wildfire on the electricity grid by incorporating the dynamics of tree mortality and extreme fire weather in next-generation fire models; and

FURTHER BE IT RESOLVED, that the Executive Director or his/her designee shall execute the same on behalf of the Energy Commission.

CERTIFICATION

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on June 12, 2019.

AYE: [List of Commissioners]
NAY: [List of Commissioners]
ABSENT: [List of Commissioners]
ABSTAIN: [List of Commissioners]

Cody Goldthrite,
Secretariat