SECTION 1: OPPORTUNITY DESCRIPTION

1.A. Program Overview

The Walk-through Rendering from Images of Varying Altitudes (WRIVA) program aims to develop software algorithm-based systems that can create photorealistic, navigable three-dimensional site models using a highly limited corpus of imagery, to include ground level imagery, surveillance height imagery (traffic camera), Unmanned Aerial Vehicle (UAV) altitude imagery, and Satellite imagery. Additionally, where imagery lacks metadata indicating geolocation or time of collection, WRIVA seeks to estimate these metadata parameters using image features and other indicators to incorporate them in site-modelling and other downstream algorithms. Many US Intelligence Community (IC) and Department of Defense (DOD) agencies require this capability to enhance safety while conducting activities where a rich corpus of imagery is unavailable, such as humanitarian and disaster relief (HADR). Expanding site modelling capabilities would allow these activities to be conducted more effectively, with reduced risk to personnel.

Site modelling is highly desired to support missions across the DOD, IC, and law enforcement to allow personnel to train and rehearse prior to executing an activity. Unfortunately, the locations for which site models may be needed is highly limited due to the volume of supportive information that is necessary in build a model using conventional methodologies. Further, the construction of a site model can be challenging due to source imagery having varying environmental conditions, such as clouds, seasonal variation and shadow obscuration.

Recently, there have been advances in volumetric rendering and view synthesis in the machine learning community. These advances indicate that the prediction of spatio-temporally absent views is feasible. Much of the existing demonstrations of this capability rely on exquisite knowledge of collection geometry and a large volume of imagery taken from similar altitudes or proximity. While ground-level electro-optical (EO) imagery for many sites and applications of interest may be rare, other imagery sources may be easier to obtain, such as satellite and traffic camera imagery. The challenge for IC, DOD, and Law Enforcement applications is to develop this prediction capability using a very limited corpus of historical data and viewpoints from a wide range of altitudes, from ground level cameras to satellite imagery. This challenge is compounded by the fact that the metadata, indicating time of collection and camera geolocation for much of this data, may be absent or corrupted. This limits the use of such imagery in many downstream applications, including site modelling. Repairing this metadata will aid in site modelling and allow the imagery to be processed by additional algorithms and tools for analysis.

Figure 1 illustrates the high level WRIVA concept for site modelling. WRIVA will address the need for site modelling through cutting-edge research on the prediction of missing views to create a navigable site model. These site models will also incorporate imagery that lack geolocation and time stamp metadata by estimating these and other camera parameters.

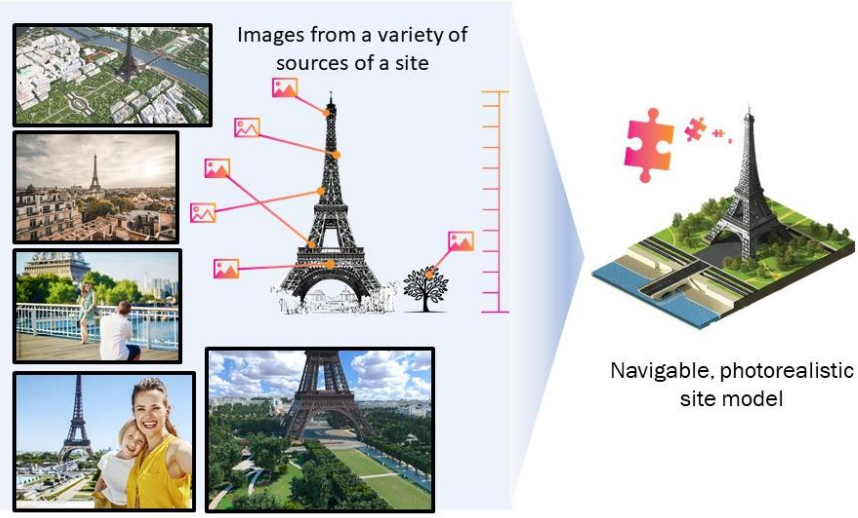

Figure 1: WRIVA site modelling Program Concept

Performers will be expected to pursue two interrelated research areas:

- **Task Area 1 (TA1) -- Site Model Generation:** Predict synthetic views where no true image exists (in time and space) in order to create a seamless, navigable walk-through.
- **Task Area 2 (TA2) -- Image Correction and Repair:** Identify and repair imagery with corrupted metadata or impacted by natural or sensing artifacts and predict camera imaging capabilities.

Performers are expected to conduct research against both technical areas, producing robust software systems. These systems will be required to predict missing imagery or metadata in a test corpus. Additionally, when the test corpus contains imagery corrupted by artifacts, performers will identify these images and attempt to extract and replace the corrupted areas seamlessly with nominal scene content. Performers are also expected to identify whether the imaging cameras have capabilities such as pan-tilt-zoom (PTZ) or nighttime imaging capabilities. Developed capabilities must be compatible with a provided API to facilitate assessment by independent test and evaluation (T&E) according to program metrics described in section 1.F, Program Metrics.

The outcome of WRIVA will be algorithms and methodologies to rapidly create site models without full 360° site coverage and methodologies to repair corrupted imagery, implemented in software. These capabilities will support mission and activity rehearsal and ingestion of imagery into other image processing applications.

The WRIVA T&E Team will compile robust sets of diverse and relevant imagery to support research goals. Some of this data will be made available for Performer Research and Development (R&D) for algorithm training. It will also be used in independent T&E for comparing algorithm accuracy against ground truth. In addition to field data collection, simulated data will also be

created for training and testing. The T&E Team[1] will be conducting several field data collections, laboratory data collections and data simulation exercises throughout the life of the program. A portion of data will be made available to Performers for R&D, but the remainder will be held back to facilitate the testing and validating of performance through a series of challenges. In addition, Performers will be required to assemble their own data collections or simulations for use in algorithm training. Performers shall make that data available to the Program. Additional details on program data can be found in section 1.D. Program Data.

The WRIVA Program will pursue rigorous and comprehensive T&E to ensure that research outcomes are well characterized, deliverables are aligned with program objectives, and that algorithm performance is measured across the full range of architectural, sensor, and environmental conditions. Such T&E activities will not only inform Government stakeholders on WRIVA research progress but will also serve as valuable feedback to the Performers to improve their research approaches, algorithm training practices, and system development. The WRIVA Program will work closely with Government leaders in constructive site modeling to continually refine and improve T&E methodologies.

Performer algorithms will be evaluated quarterly in a series of evaluation events which correspond to the technical challenges identified in 1.A.1. Over the course of the WRIVA program the evaluation challenges will become progressively more difficult. This difficulty will be controlled by adjusting the amount and kinds of data available. Performers will need to continually improve their systems aggressively to meet these challenges.

1.A.1. Technical Challenges and Objectives

Offerors shall address the following technical challenges (TCs) and objectives to meet dual WRIVA goals to advance site modelling with limited ground-level electro-optical imagery and the identification and repair of imagery corrupted in the visually or in metadata.

- Seamless, photorealistic model creation
- Prediction of new site views in spatial gaps in collection dome
- Prediction of new site views in spatio-temporal gaps in collection dome
- Prediction of new site views in low contrast environments
- Prediction of new site views areas with poorly defined structures
- Prediction of new site views using a corpus of imagery with seasonal variations
- Prediction of new site views with 10 ground-level images collected at view angles separated by a minimum of 15 degrees
- Prediction of new site views in absence of ground level imagery, reliant on satellite, traffic cameras, and security cameras
- Prediction of new site views in scenarios with complex architectures (curvature of building, unusual intersection of walls, etc.)
- Prediction of new site views using image corpus highly varying lighting conditions

[1] T&E support for the WRIVA program is being provided by three organizations: Johns Hopkins Applied Physics Laboratory (JHU/APL), MITRE, and the Massachusetts Institute of Technology Lincoln Laboratory (MIT/LL)

- Modelling of interior structures
- Site modelling with total processing cost of under $0.25/sq. m. in cloud based environment
- Estimation of geolocation of ground level image collector within 10m
- Detection of visual image artifacts
- Replacement of visual artifacts with nominal background
- Identification of PTZ camera capabilities
- Identification of IR Camera Capabilities
- Identification of Nighttime imaging camera capabilities

1.A.2. Program Phases and Task areas

The WRIVA program is a 42-month effort, comprised of two (2) Phases. Proposals shall include a solution for Phases 1 and 2, inclusive of all Task Areas. Proposals that do not include a solution for both phases or do not address all Task Areas will be considered non-responsive and will not be evaluated. The phases are designed to drive Performers to develop solutions that are suited to a range of site modelling conditions, robust against image corpus degradations, and computationally efficient. The following paragraphs describe the phases and task areas, while Table 1 summarizes and distinguishes the differences among the program phases. Each phase will encompass two (2) main Task Areas:

- **Task Area 1 (TA1) -- Site Model Generation:** Predict synthetic views where no true image exists (in time and space) in order to create a seamless, navigable walk-through.
- **Task Area 2 (TA2) -- Image Correction and Repair:** Identify and repair imagery with corrupted metadata or impacted by natural or sensing artifacts and predict camera imaging capabilities.

Proposals shall include a solution for Phases 1 and 2, inclusive of all Task Areas. Proposals that do not include a solution for both phases or do not address all Task Areas will be considered non-responsive and will not be evaluated.

Table 1: WRIVA Program Phases and Task Areas

Task Area	Technical Area	Phase 1	Phase 2
Task Area 1 (Site Model Generation)	Site Model Smoothness	Seamless	Seamless
	Site Model accuracy	Highly accurate	Highly accurate
	Environmental complexity in site to be modelled	Limited	Highly complex
	Architectural complexity in site to be modelled	Low to Moderate	Moderate to High

Task Area	Technical Area	Phase 1	Phase 2
	Structural complexity in site to be modelled	Exterior, well defined	Exterior and Interior structures, limited definition
	Spatio-temporal distance between true images in corpus	Moderate	Large
	Lighting variation in corpus of true images	Minimal	Significant
	Seasonal variation in corpus of true images	Limited seasonal variation	Significant seasonal variation with related feature obscuration
	Processing	Cloud based processing	Edge processing
Task Area 2 (Image Correction and Repair)	Geolocation estimation	Accurate	Highly accurate
	Artifact correction	Detection of Artifacts	Mitigation of Artifacts
	Camera capability estimation	PTZ identification	PTZ identification, nighttime imaging capability identification
	Processing	Cloud based processing	Edge processing

The goal of Phase 1, Task Area 1 is to conduct initial algorithm development and to produce a minimum viable product for low to moderate challenge cases due to architectural complexity, environmental conditions and/or the volume of true imagery contributing to the site model. In Phase 2 the goal for Task Area 1, is to advance the algorithm development to address moderate to high challenge cases with increasing complexity in terms of architectural complexity, interior structures, environmental conditions and/or the volume of true imagery contributing to the site model.

The goal of Phase 1, Task Area 2 for metadata repair is to accurately estimate geolocation in low to moderate complexity cases. In Phase 2, challenges will progress to moderate to high complexity environments, with increased accuracy in the collector geolocation. In Phase 2 the goal for Task Area 2, is to advance the algorithm development to address moderate to high challenge cases with increasing complexity in terms of architectural complexity, environmental conditions and/or the volume of true imagery contributing to the site model.

The ultimate goal of WRIVA is to deliver an end-to-end site modelling system capable of creating a seamless, navigable, photorealistic site model in scenarios where a highly limited amount of

ground level imagery is available and to repair imagery by geolocation of images and collectors, estimating time stamps, identifying and removing artifacts, and predicting camera capabilities.

In Task Areas 1 and 2, performers will research volumetric rendering techniques and image repair based on the use of electro-optical images collected from a wide range of altitudes, to include, but not limited to the following:

- Ground-level handheld imagery
- Security camera imagery
- Traffic Camera imagery
- UAV imagery
- Satellite imagery

Additionally, site modelling may be supported by publicly available ancillary data to include:

- Municipal information such as Plats, blueprints, etc.
- Maps
- Semantic segmentation information from external sources, such as Google Street maps

For evaluation events, this data will be obtained by Government T&E and released to performers with evaluation results. Performers are expected to supply this data for training and development

Performer containerized solutions will be exercised and evaluated using the program metrics across quarterly challenge events, beginning 3 months after kick off. Each challenge will be focused on site modelling with the volume and nature of images predicted to be available in a mission requiring rapid site model creation.

IARPA will continue to use WRIVA program API developed by the WRIVA T&E Team in Phase 1 and 2 for both task areas. The T&E teams will collect and curate datasets for the purpose of constructing the evaluation challenges. Following each challenge, performance analysis results and challenge data will provided to performers for review and methodology improvement. The sharing of this data with Performers after the challenges so as to facilitate communication and internal Performer error analyses. Initial development in Phase 1 will be done using Performer self-collected data and previously released data. More details on the datasets are available in 1.D. Program Data and more details on the API are available in **Error! Reference source not found.**.

1.A.2.1. Phase 1

Phase 1 shall have a duration of 18 months. Phase 1 consists of initial algorithm development and results in a minimum viable product. Throughout the phase, quarterly deliveries of containerized software are anticipated and will be tested and evaluated through challenge activities.

Examples of challenges to be included during Phase 1 for both Task Area 1 and Task Area 2 are:

Environmental challenges:

- Urban areas with high contrast
- Daytime imagery

- Haziness
- Limited season related obscuration

Data gap challenges:

- Removal of 10-30 percent of ground level, non-adjacent images
- Removal of 2-5 fifteen degree sections of ground level imagery
- Elimination of UAV imagery
- Elimination of Publicly available information

1.A.2.1.1 Task Area 1 – Site Modelling

The goal in Phase 1 for Task Area 1 is to demonstrate site modelling capability in scenarios of low to moderate environmental, architectural, and spatio-temporal image gaps. Unique examples of challenges to be included during Phase 1 for Task Area 1 are:

Architectural Challenges:

- Buildings with separation of 10 m or less
- Curvature of buildings
- Partially covered structures (ex. porticos)

Research should be focused on developing robust, automated methods of developing 3D volumetric rendering using electro-optical imagery in preparation for these challenges. Methods to foster automation such as cross-view registration should also be researched and integrated. Full automation is required in Phase 1. A fully automated system should be capable of identifying images to be included in rendering, separating images that are corrupted due to absent metadata or corrupting visual artifacts, co-registering imagery if needed, identifying terrain features (sidewalk/street/building) if needed, and constructing the navigable model. Furthermore, Performer solutions must provide visibility into interim steps in site modeling to support error propagation analysis. For example, the solution should be able to trace how errors in cross-view registration propagate to errors in the site model. No human-in-the-loop should be used to identify images to be used, register data, or construct and/or refine the output site model. To mitigate risk and investigate competing approaches, multiple research endeavors in the same subtopic may take place to compare and contrast performance, characteristics, and scientific insights within a given team. Solutions should also be accompanied by a confidence metric that reflects a prediction of similarity of the synthesized view to a true image.

1.A.2.1.1 Task Area 2 -- Geolocation and detection of artifacts.

The goals in Phase 1 for Task Area 1 is to the geolocation of image collectors, geolocation and time stamping of images, and the automated detection artifact. These capabilities will be demonstrated in scenarios of low to moderate environmental, architectural, and spatio-temporal image gaps. Examples of challenges to be included during Phase 1 for Task Area 2 are:

Research should be focused on developing techniques to determine camera position, geolocation, and the detection and extraction of image regions impacted by visual artifacts, and the identification of camera capabilities. Methods to foster automation such as cross view prediction should also be researched and integrated. Geolocation should place the location of an image within

a site region, defined as a 200m x 200m region. Collectors may be located outside of this region. Full automation is required in phase 1. No human-in-the-loop should be used to identify images impacted by artifacts, remove these artifacts, register data, refine the output geolocation or collector position or identify camera capabilities. To mitigate risk and investigate competing approaches, multiple research endeavors in the same subtopic may take place to compare and contrast performance, characteristics, and scientific insights within a given team. Solutions should be accompanied by confidence metrics that indicate the reliability of the predicted camera geometry and presence of an artifact.

1.A.2.2. Phase 2

Phase 2 shall have a duration of 24 months. Phase 2 consists of advanced algorithm development to address moderate to high challenges. Throughout the phase, quarterly deliveries of containerized software are anticipated and will be tested and evaluated through challenge activities.

Examples of challenges to be included during Phase 1 for both Task Area 1 and Task Area 2 are:

Environmental challenges:

- Interior structures
- Daytime, dawn, dusk, and nighttime imagery
- Dense fog
- Seasonal and weather-related obscuration

Data gap challenges:

- Removal of availability of ancillary data
- Removal of 30-100 percent of ground level, non-adjacent images
- Elimination of all but 10 ground level images
- Elimination of publicly available information
- Combinations of multiple data gaps in the presence of architectural and environmental challenges

1.A.2.2.1 Task Area 1

The goals in Phase 2 for Task Area 1 is to further advance site modelling capability in scenarios of moderate to high environmental and architectural challenges, and extremely large spatio-temporal image gaps. Examples of unique challenges to be included during Phase 2 for Task Area 1 are:

Architectural Challenges:

- Interior structures
- Curvature and reflection off of structures
- Poorly defined structures and temporary structures.
- Low contrast areas and buildings that are challenging to segment

Data gap challenges:

- Removal of 5-20 fifteen degree sections of ground level imagery
- Elimination of UAV imagery

Research should be focused on developing robust, automated methods of developing 3D volumetric rendering using electro-optical imagery in preparation for these challenges. Methods to foster automation such as cross view registration should also be researched and integrated. Full automation is required in Phase 2. A fully automated system should be capable of identifying images to be included in rendering, separating images that are corrupted due to absent metadata or corrupting visual artifacts, co-registering imagery if needed, identifying terrain features (sidewalk/street/building) if needed, and constructing the navigable model. No human-in-the-loop should be used to identify images to be used, register data, or construct and/or refine the output site model. To mitigate risk and investigate competing approaches, multiple research endeavors in the same subtopic may take place to compare and contrast performance, characteristics, and scientific insights within a given team. Solutions shall also be accompanied by a confidence metric that reflects a prediction of similarity of the synthesized view to a true image.

1.A.2.2.2 Task Area 2 – Geolocation and Artifact Mitigation

The goals in Phase 2 for Task Area 2 is to the improve geolocation of image collectors, geolocation and the automated mitigation of artifacts. These capabilities will be demonstrated in scenarios of low to moderate environmental, architectural, and spatio-temporal image gaps.

Research should be focused on developing techniques to determine camera position, geolocation, and the detection and extraction of image regions impacted by visual artifacts. Methods to foster automation such as cross view prediction should also be researched and integrated. Geolocation should place the location of an image within a site region, defined as 200mx200m. Collectors may be located outside of this region. Full automation is required in phase 2. No human-in-the-loop should be used to identify images impacted by artifacts, remove these artifacts, register data, or refine the output geolocation or collector position. To mitigate risk and investigate competing approaches, multiple research endeavors in the same subtopic may take place to compare and contrast performance, characteristics, and scientific insights within a given team. Solutions should be accompanied by confidence metrics that indicate the reliability of the predicted camera geometry, presence of an artifact, and mitigation of an artifact.

1.B. Team Expertise

Collaborative efforts and teaming among Offerors are highly encouraged. It is anticipated that teams will be multidisciplinary and may include expertise in one or more of the disciplines listed below. This list is included only to provide guidance for the Offerors; satisfying all the areas of technical expertise below is not a requirement for selection and unconventional or innovative team expertise may be needed based on the proposed research. Proposals should include a description and the mix of skills and staffing that the Offeror determines will be necessary to carry out the proposed research and achieve program metrics.

- Computer vision to include object detection, tracking, camera modeling

- Image processing to address noise, degradations, atmospheric effect compensation, and motion blur
- Optics and sensors
- Photogrammetry
- 3D rendering
- Modeling and simulation
- Machine learning, deep learning, or hierarchical modeling
- Artificial intelligence
- Systems integration
- Systems engineering
- Software engineering
- Data reduction and analysis
- Distributed processing, stream processing

1.C. Program Scope and Limitations

Proposals shall explicitly address all the following:

- **Underlying theory:** Proposed strategies to meet program-specified metrics must have firm theoretical bases that are described with enough detail that reviewers will be able to assess the viability of the approaches. Proposals shall properly describe and reference previous work upon which their approach is founded.
- **Research & Development approach:** Proposals shall describe the technical approach to meeting program metrics.
- **Technical risks:** Proposals shall identify technical risks and proposed mitigation strategies for each.
- **Software development:** Proposals shall describe the approach to software architecture and integration.

The following areas of research are **out of scope** for the WRIVA program:

- Research that does not have strong theoretical and experimental foundations.
- Development of optical sensor hardware.
- Development of sensor platforms, such as UAVs, vehicles, aerostats, towers, or camera systems.
- Development of other hardware.
- Approaches that rely on secondary external data signals, such as cell tower tracking or non-optical sensors, to identify structures and environmental features
- Research that utilizes proprietary data
- Methods that require a human-in-the-loop as part of the integrated end-to-end system
- Approaches that consist merely of integrating currently existing software.
- Approaches that depend on data beyond electro-optical images. Note that approaches may include provisions for leveraging other data, but they must not rely on that data.

- Approaches that require non-cooperative real time augmentation to provided data, e.g., opportunistic imagery from cameras located in handheld devices, computers, or automobiles.
- Research involving use of non-visible band imagery (e.g. radar)
- Approaches involving the use of LiDAR data
- Approaches involving the use of multi-spectral or hyperspectral imagery
- Research involving non-image data, outside of publicly available maps, blueprints, plats, etc.

The use of additional sensors, imaging or sensing modalities, filters, calibration targets, and publicly available ancillary data to assemble training data sets or to support modeling and simulation research is in scope if it is relevant to the proposed research approach.[2] However, testing may be restricted to data collected in the visible spectrum without any additional metadata, data feeds, or sensor inputs.

Delivered software will be evaluated by an independent T&E team on sequestered and shared evaluation datasets. Performers will build prototype algorithms, and subcomponent modules, and/or systems for end-to-end WB and FR under challenging imaging conditions that will be run and evaluated by the T&E Team. Testing protocols do not allow for expert operators, human-in-the-loop operation, or any operations not deemed "turnkey". However, systems or algorithms that have been trained using human-in-the-loop methods may be submitted, provided they run autonomously.

1.D. Program Data

For WRIVA to facilitate innovative R&D and achieve program metrics, diverse program data in sufficient quantities are needed for development and statistically reliable evaluations. As a result, the program will include robust and explicit data collection by the WRIVA T&E Team.

The program will collect and simulate evaluation data from approved sites. The data will consist of imagery collected with a range of conditions, sensors, and platforms involving a diverse group of environmental and architectural conditions. Sites for the WRIVA program are defined to be a 200m x 200m region. Evaluation data will be explicitly excluded from any algorithm training approaches and be withheld from Performers until the completion of evaluation events (challenges).

Cloud-based data storage, such as an Amazon Simplified Storage Solution (S3) Bucket will be used to facilitate the transfer of datasets between the Government, the T&E Team, and Offerors. Offerors will be provided with access to this cloud storage environment. High speed internet connections are needed and hundreds of terabytes (TB) of data are expected to be made available to the Performers over the course of the project. The memory size of each dataset release is estimated to be at least ~20 TB**.**

[2] Includes the use of non-visible imagery to support supplemental research or algorithm training activities.

1.D.1. Development Data

A limited amount of sample data will be provided in advance of evaluation events to performers. Sample data to serve as an example of formatting and facilitate development of ingest tools will be provided, but this data may not be sufficient in volume to facilitate algorithm training and methodology development. It is anticipated that Performers will need supplement sample data with development data specific to each research approach and each subcomponent module of their WRIVA system(s) to achieve program goal, objectives, and metrics. To facilitate system development, performers shall collect, simulate and/or curate and share 8 development data sets. Developmental data sets should/shall have the following attributes:

- Datasets should be representative of sites of minimum size 200m x 200m
- Datasets shall contain multiple objects, features, and/or buildings to be modelled
- Datasets shall contain high quality metadata representing geolocation, accurate timestamps, and true or modelled camera parameters and geolocation.
- Shall be delivered in a government provided format for ingest into the WRIVA data store
- **Shall NOT** include PII information – inadvertent inclusion of identifiable features such as faces or license plates may be blurred or removed.
- All performer curated data sets should be delivered with Unlimited Rights in accordance with FAR 52.227-14, to allow use by the USG.

Performers may utilize, spoil, and curate external datasets and will be provided a list of prospective challenge focus areas in advance of evaluation events. External data are data obtained by Performers that are available from third parties or that have been collected by the Performer outside of the WRIVA program. Data collected by a Performer under a different program are considered external data, even if the other program's data collection was Government-sponsored. All external datasets must be approved for use in the WRIVA program by the cognizant IARPA, in accordance with applicable privacy policies, statutes, and regulations.

Performers may not use proprietary datasets unless these datasets are made available to all R&D Performers and Government T&E in the WRIVA program without restriction. Public release of proprietary datasets is not a requirement; however, release for use within the WRIVA program is required. Moreover, for any dataset not collected under the scope of the WRIVA program, Performers must provide the Government with an accounting of all resources used and sources from which data are drawn and describe how the data will be used for development, testing, and training of algorithms.

All external datasets that are part of an Offeror's proposed research approach must be summarized in the proposal with the following minimum information:

- Dataset Name
- Short Description
- Data Owner
- License or use rights
- Method or URL link to obtain data

1.D.2. Evaluation Data

WRIVA will utilize distinct test data to evaluate the performance of Performer subcomponents, modules, and systems against program goals, objectives, and metrics. Each WRIVA evaluation set will consist of diverse EO Site data, robust metadata annotations, and prescribed evaluation test protocols.

Intended uses of the evaluation datasets include both use by the T&E Team for independent evaluation of program deliverables against target metrics during quarterly challenges and use by Performers after these challenges to refine and improve their algorithms. The evaluation datasets will be provided to Performers to enable internal T&E and exploratory error analysis by Performers and to improve the consistency and communication between Performers and T&E following each challenge. No unreleased evaluation data will be permitted in any aspect of algorithm training or functionality until after it has been used in a challenge. Additional sequestered or external datasets may be used to supplement performance evaluations at the discretion of the WRIVA PM.

Evaluation data will consist of high quality imagery with high fidelity metadata. To fully exercise algorithms in evaluation events this data will be spoiled and may include:

- Removal of increasing percentage of viewpoints from the image corpus
- Removal of whole altitudes of data
- Spoiling or removal of metadata attributes
- Injection of image artifacts that occlude or corrupt the visual interpretation of an image
- Removal of images representing various times of day
- Removal of images representing various time of year
- Addition of images representing areas outside the site to be modelled

Evaluation data and events will be continuously adapted based on observations of algorithm performance during challenge events. Additional spoiling factors added to the list above.

1.E. Test and Evaluation (T&E)

T&E will be conducted by an independent team of Government and contractor staff carrying out evaluation and analyses of Performer research Deliverables using program test datasets and protocols. In addition to independent T&E, the program will regularly gauge interim progress of Performer research activities towards WRIVA objectives and target metrics using T&E results measured and reported by the Performer teams themselves. The WRIVA evaluation data and test protocols (see 1.D.2. Evaluation Data) will be the primary mechanism by which the T&E Team carries out their evaluations.

The WRIVA Program will pursue rigorous and comprehensive T&E to ensure that research outcomes are well characterized, deliverables are aligned with program objectives, and that algorithm performance is measured across the full range of architectural, sensor, and environmental conditions. Such T&E activities will not only inform IARPA and Government stakeholders on WRIVA research progress but will also serve as invaluable feedback to the Performers to improve their research approaches, algorithm training practices, and system development. The WRIVA Program will work closely with Government leaders in remote sensing, image and video processing, and computer vision to continually refine and improve T&E

methodologies. Evaluations will occur quarterly through challenge events that will exercise performer solutions across technical challenges described in section 1.A., independently and in combination.

The Government will provide Performers with an API and container requirements to integrate in a program test harness with relevant scripts to run program test protocols on program datasets and access to a cloud processing environment. Performers are encouraged to develop methodologies with a cloud first design mindset. The evaluation environment will be the platform for independent government testing of Performer Deliverables.

Performers will have specific Deliverable Milestones at which all subcomponent and system algorithms and software will be delivered to IARPA and its designated T&E Team. The T&E Team will then conduct evaluations at the direction of the WRIVA PM and with the objective of characterizing the quality, functionality, and performance of the WRIVA Deliverables. In addition to quantitative measurements, T&E will be carried out to establish a thorough understanding of the progress, status, and limitations of the Performer's research.

T&E results and feedback will be provided to Performers at regular intervals to keep them abreast of current independent performance measurements and to inform and improve their R&D approaches and methods. T&E results from all Performers will be shared with all teams to establish an understanding of the current state and progress of WRIVA research; T&E results will also be shared with USG external stakeholders, including their contractors, for Government purposes. For example, a PI Review Meeting will be held at the phase mid point and at the end of each phase to share research ideas, progress, and results across the WRIVA program (see **Error! Reference source not found.**).

The cognizant IARPA PM may conduct other supplemental evaluations or measurements, at any time and without notice, at her sole discretion to evaluate the Performers' research and Deliverables.

1.F. Program Metrics

Achievement of metrics is a performance indicator under IARPA research contracts. IARPA has defined WRIVA program metrics to evaluate effectiveness of the proposed solutions in achieving the stated program goal and objectives, and to determine whether satisfactory progress is being made. The metrics described in this BAA are shared with the intent to scope the effort, while affording maximum flexibility, creativity, and innovation to Offerors proposing solutions to the stated problem. Proposals with a plan to exceed the defined metrics in one or more categories are desirable, provided that all of the other metrics are met, and provided that the proposals provide clear justification as to why the proposed approach will be able to meet or exceed the enhanced metric(s). Program metrics may be refined during the various phases of the WRIVA program; if metrics change, revised metrics will be communicated in a timely manner to Performers.

At its core, WRIVA is a 3D volumetric rendering and image prediction R&D program with related work for image repair. Performance metrics are focused on the quality of the predicted image and estimated metadata factors. These are balanced with metrics to ensure that solutions can meet the

practical needs and logistical challenges of use cases. Metrics were chosen with the following considerations:

1. What is technically achievable but challenging based on current state-of-the-art in the 3D rendering, computer vision, and image processing R&D communities;
2. What is statistically measurable based on the planned program evaluation data; and
3. What is useful to mission partners based on USG stakeholder needs and use cases?

For Task Area 1, synthesized imagery created in the development of the site models will the assessed as an analog to the overall model quality. Perceptive measures will be used as a measure of quality. This will be assessed through a comparison of a holdout true image and a matching synthesized viewpoint for structural similarity. Structural similarity is a perceptual metric that is designed to measure degradation caused by image and video processing. In both Phase 1 and Phase 2, the goal metric for structural similarity is 0.95, on a scale of 0 to 1. While the similarity target metric remains the same, offerors should note that the complexity of the sites to be modelled will increase between the phases. Additionally, the number of true images will be reduced and the spatio-temporal distance between true images will increase between these phases. Solution performance under these increasing challenges should remain constant.

The time to create the model, performance under edge processing, and the cost to create a model in a cloud processing environment will also be measured. These constraints are designed to make sure that the end solutions are both implementable and affordable to run for mission use cases. Edge processing performance will be evaluated beginning in Phase 2. This metric assumes that some algorithmic tradeoffs may be required to fit processing into edge hardware constraints and specifies the performance loss that is tolerable in this scenario.

Additionally, evaluations will include a study of error propagation to determine the contributions of error from processing components such as cross-view registration, image segmentation, lighting condition normalization, and errors in accurate knowledge of camera viewpoints. Performer solutions are required to provide transparency into these results at these intermediate steps in order to provide insights into error propagation.

Evaluations will occur during each quarterly challenge event to understand the strengths and weaknesses of solutions under different environmental, architectural, and supporting image corpus stressors. Each challenge will include analysis of performance across all metrics that will be shared with Offerors along with challenge data for further solution refinement.

Table 2, below, summarizes metrics that will be used to assess performance in Task Area 1 in Phases 1 and 2.

Table 2: Table describing Task Area 1 relevant metrics

Evaluation point	Description	Phase 1	Phase 2
Synthesized view accuracy	Structural similarity between synthesized image and hold out image	0.95	0.95

Time to create model	Processing wall clock time, not inclusive of data transit or of image corpus assembly	12 hrs	3 hrs
Edge processing	Performance evaluation on edge computer architecture	Not evaluated	No more than 10% performance loss over solution baseline

For Task Area 2, repaired imagery will be evaluated for accurate estimation of absent metadata parameters and identification of and mitigation of artifacts.

Camera geolocation estimation will be evaluated by measuring the mean square error (MSE) distance from true position in challenges. The search space for geolocation will be in a 500m x 500m areas centered at the center of the site model area. Estimation of time stamps is encouraged and accuracy will be measured as an informal metric. Time of day is expected to fall within a window of time, as measured in hours, relative to the true time of day for a percentage of images presented during each challenge. Time stamp month information is expected to fall within a window of time, as measured in months, for a percentage of images presented during each challenge.

Camera capability identification will be focused on determining PTZ camera capabilities and nighttime imaging capabilities. The measure will be true positive rates (TPR) that estimate the ratio of positively identified capabilities to the number of assessed which were positive. False capability detections will not be used to assess performance in this area due to the lack of downrange impact for a false capability identification.

Repair of visual artifacts will be separated into two areas: detection of artifacts and mitigation of artifacts. Artifact detection will be measured by TPR and False Detection Rate (FDR). The goal of these measures is to maximize the accurate detection of areas of the image that are impacted by artifacts that may negatively impact downstream model creation while also maximizing the volume of data used by not inadvertently discarding good imagery through false artifact detection. In phase 2, the accuracy of artifact mitigation will be measured as structural similarity between image areas impacted by artifacts and clean imagery from the same viewpoint. In many cases, artifacts will be injected into imagery to allow for testing. In cases of evaluation with true artifact impacted imagery, non-artifact impacted portions of the imagery will have a structural similarity of no less than 0.95.

Performance under edge processing environment will also be measured. These constraints are designed to make sure that the end solutions are both implementable for mission use cases. Edge processing performance will be evaluated beginning in Phase 2. This metric assumes that some algorithmic tradeoffs may be required to fit processing into edge hardware constraints and specifies the performance loss that is tolerable in this scenario.

Evaluations will occur during each challenge to understand the strengths and weaknesses of solutions under different environmental, architectural, and supporting image corpus stressors. Each challenge will include analysis of performance across all metrics which will be shared with Offerors when along with challenge data for further solution refinement.

Table 3 below summarizes metrics that will be used to assess performance in Task Area 2 in Phases 1 and 2.

Table 3: Metrics for Task Area 2

Evaluation point	Description	Phase 1	Phase 2
Camera geolocation	Accuracy of camera geolocation	12m (MSE)	5m (MSE)
Camera capabilities	Prediction of PTZ capability	TPR=0.85	TPR=0.95
	Prediction of Nighttime Imaging capability	Not Evaluated	TPR=0.95
	Prediction of IR capability	Not Evaluated	TPR=0.95
Artifact detection	Detection of artifact impacted portions of images	FDR=0.05 TPR=0.98	FDR=0.05 TPR=0.98
Artifact mitigation	Structural similarity comparison with impacted portions of true image	Not Evaluated	SSIM=0.85
Edge processing	Performance evaluation on edge emulation computer architecture	Not Evaluated	No more than 10% loss over baseline
Time to process	Processing wall clock time, not inclusive of data transit or of image corpus assembly	12 hrs	3 hrs

1.G. Program Waypoints, Milestones, and Deliverables

Waypoints, Milestones, and Deliverables are established from the program's onset to ensure alignment with WRIVA objectives, organize research activities in a logical and reportable manner, and facilitate consistent and efficient communication among all stakeholders – IARPA, WRIVA T&E, USG Stakeholders, and Research Performers.

1.G.1. Program Milestone, Waypoint, and Deliverables Timeline

Phase	Month	Event	Description	Comment	Deliverable
1-2	All	Waypoint	Monthly Status Report	Due on 15th of each month	MSR
1-3	All	Waypoint	Progress and Status Meeting	Biweekly Teleconference with WRIVA PM	N/A
1	1	Waypoint	Kickoff meeting	DC metro area	N/A

Phase	Month	Event	Description	Comment	Deliverable
1	1	Waypoint	Sample Data	Provided as GFI	NA
1	3	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	3	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	5	Waypoint	Site Visit	At performer site	N/A
1	6	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	6	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	9	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	9	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	11	Waypoint	Site Visit	At performer site	N/A
1	12	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	12	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	12	Waypoint	PI Review Meeting	DC metro area	N/A
1	15	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	15	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	17	Waypoint	End of Phase PI meeting and Demo	At performer site	N/A
1	18	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	18	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	18	Deliverable	Phase 1 Final Report	Any updated software or data is also due	Report
2	18	Deliverable	Kickoff meeting	DC metro area	N/A
2	21	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery

Phase	Month	Event	Description	Comment	Deliverable
2	21	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	23	Waypoint	Site Visit	At performer site	N/A
2	24	Waypoint	PI Review Meeting	DC metro area	N/A
1	24	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
2	24	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	27	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	29	Waypoint	Site Visit	At performer site	N/A
2	30	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	33	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	35	Waypoint	Site Visit	At performer site	N/A
2	36	Waypoint	Site Visit	At performer site	N/A
2	36	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	39	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	42	Waypoint	Final PI meeting and Demo	At performer site	N/A
2	42	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	42	Deliverable	Phase 2 Final Report	Any updated software or data is also due	Report

shows a timeline for the program with defined Milestones, Waypoints and Deliverables. The Offeror may add other Waypoints in addition to the minimum set listed in the table.

Table 2: WRIVA Milestone, Waypoint, and Deliverable schedule

Phase	Month	Event	Description	Comment	Deliverable
1-2	All	Waypoint	Monthly Status Report	Due on 15th of each month	MSR
1-3	All	Waypoint	Progress and Status Meeting	Biweekly Teleconference with WRIVA PM	N/A
1	1	Waypoint	Kickoff meeting	DC metro area	N/A
1	1	Waypoint	Sample Data	Provided as GFI	NA
1	3	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	3	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	5	Waypoint	Site Visit	At performer site	N/A
1	6	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	6	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	9	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	9	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	11	Waypoint	Site Visit	At performer site	N/A
1	12	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	12	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	12	Waypoint	PI Review Meeting	DC metro area	N/A
1	15	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	15	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	17	Waypoint	End of Phase PI meeting and Demo	At performer site	N/A
1	18	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	18	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container

Phase	Month	Event	Description	Comment	Deliverable
1	18	Deliverable	Phase 1 Final Report	Any updated software or data is also due	Report
2	18	Deliverable	Kickoff meeting	DC metro area	N/A
2	21	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
2	21	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	23	Waypoint	Site Visit	At performer site	N/A
2	24	Waypoint	PI Review Meeting	DC metro area	N/A
1	24	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
2	24	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	27	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	29	Waypoint	Site Visit	At performer site	N/A
2	30	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	33	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	35	Waypoint	Site Visit	At performer site	N/A
2	36	Waypoint	Site Visit	At performer site	N/A
2	36	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	39	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	42	Waypoint	Final PI meeting and Demo	At performer site	N/A
2	42	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	42	Deliverable	Phase 2 Final Report	Any updated software or data is also due	Report

A full schedule-based version of the Milestones, Waypoints and Deliverables is also provided graphically in Figure 2.

Phase 1 (18 months)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Kickoff Meeting	X																	
Sample data	●																	
PI Meetings												X					X	
Demos																	X	
Site Visits					X						X							
Data Delivery			♦			♦			♦			♦			♦			♦
Software delivery			♦			♦			♦			♦			♦			♦
Monthly Status Reports	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Phase 1 Final Report																		♦

Phase 2 (24 Months)	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Kickoff Meeting	X																							
PI Meetings						X												X						X
Demos																								X
Site Visits					X						X						X						X	
Data delivery			♦			♦																		
Software Delivery			♦			♦			♦			♦			♦			♦			♦			♦
Monthly Status Reports	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Phase 2 Final Report																								♦

Figure 2: WRIVA Program Full Schedule

1.G.2. Software Deliverable Formatting

Performers will be required to provide algorithm and software Deliverables in a manner that conforms to a standardized industrial method or methods that will be provided at program Kickoff. To facilitate planning, Offerors may assume that the standardized configuration will require the use of software containerization technology (e.g., Docker and a REST API). This means that the entirety of a Performer's system, including pre- and post-processing, must be included within the delivered software container. For models that require training, the expectation is for the initial model training to occur on Performer systems, with the ability for the T&E Team to re-train and test the model with the same and/or other data. Offeror teams that do not include the requisite expertise to conduct such software development should include costs in their proposal to obtain software development support.

Each team is required to include among their key personnel a Lead System Integrator (LSI) who shall be responsible for preparing software Deliverable subcomponents, modules, and systems, performing quality control of Deliverable, and integrating key components into the primary WRIVA system(s). The LSI will also oversee communication and coordination across a Performer's research teams including subcontractors, if applicable, to ensure research products are functional, integrated and following software coding best practices (e.g., inline comments, documentation). Additional team members and roles are dependent on the proposed research, as such, there is no predetermined or required skill mix.

1.G.2.1. Program API

The WRIVA Program will be utilizing a standardized Application Programming Interface (API) for all software deliverables and evaluations. The first version of the WRIVA API will be provided to Performers at the Phase 1 Kick-off Meeting and updated periodically thereafter. The API will define function calls, data structures, and gallery creation and management for operating and evaluating WRIVA software in a standardized manner.

1.H. Meeting and Travel Requirements

Offerors are expected to assume responsibility for administration of their projects and to comply with contractual and program requirements for reporting, attendance at program workshops, and availability for site visits. The following paragraphs describe typical expectations for meetings and travel for IARPA programs as well as the contemplated frequency and locations of such meetings. In addition to ensuring that all necessary details of developed software, algorithm, and operational instructions are clear and complete, each Performer will be required to be available for questions and troubleshooting from the T&E Team in weekly and/or bi-weekly status meetings.

1.H.1. Workshops

All Performer teams are expected to attend workshops, to include key personnel from prime and subcontractor organizations.

The WRIVA program intends to hold a program Kick-off Meeting workshop in the first month of the program and first month of each subsequent program phase. In addition, the program will hold a PI Review Meeting at the end of each phase and at the phase midpoint. Kick-off Meetings and PI Review Meetings may be combined for logistical convenience. The dates and locations of these meetings are to be specified at a later date by the Government, but for planning purposes, Offerors should use the approximate times listed in

Phase	Month	Event	Description	Comment	Deliverable
1-2	All	Waypoint	Monthly Status Report	Due on 15th of each month	MSR
1-3	All	Waypoint	Progress and Status Meeting	Biweekly Teleconference with WRIVA PM	N/A
1	1	Waypoint	Kickoff meeting	DC metro area	N/A
1	1	Waypoint	Sample Data	Provided as GFI	NA
1	3	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	3	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	5	Waypoint	Site Visit	At performer site	N/A
1	6	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery

Phase	Month	Event	Description	Comment	Deliverable
1	6	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	9	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	9	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	11	Waypoint	Site Visit	At performer site	N/A
1	12	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	12	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	12	Waypoint	PI Review Meeting	DC metro area	N/A
1	15	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	15	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	17	Waypoint	End of Phase PI meeting and Demo	At performer site	N/A
1	18	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
1	18	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
1	18	Deliverable	Phase 1 Final Report	Any updated software or data is also due	Report
2	18	Deliverable	Kickoff meeting	DC metro area	N/A
2	21	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
2	21	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	23	Waypoint	Site Visit	At performer site	N/A
2	24	Waypoint	PI Review Meeting	DC metro area	N/A
1	24	Deliverable	Development data	Delivery of collected, simulated, or curated data	Data delivery
2	24	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container

Phase	Month	Event	Description	Comment	Deliverable
2	27	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	29	Waypoint	Site Visit	At performer site	N/A
2	30	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	33	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	35	Waypoint	Site Visit	At performer site	N/A
2	36	Waypoint	Site Visit	At performer site	N/A
2	36	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	39	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	42	Waypoint	Final PI meeting and Demo	At performer site	N/A
2	42	Deliverable	Solution delivery	Containerized solution delivery for quarterly challenge	Software container
2	42	Deliverable	Phase 2 Final Report	Any updated software or data is also due	Report

. Both types of meetings will likely be held in the Washington, D.C. metropolitan area, but IARPA may opt to co-locate the meeting with a relevant external conference or workshop to increase synergy with stakeholders. IARPA reserves the right to hold the meeting virtually for logistical or health and safety reasons.

Kick-off Meetings will typically be one day in duration and will focus on plans for the coming Phase, Performer planned research, and internal program discussions. PI Review Meetings will typically be two days in duration and will have a greater focus on communicating program progress and plans to USG stakeholders. These meetings will include additional time allocated to presentation and discussion of research accomplishments.

In both cases, the workshops will focus on technical aspects of the program and on facilitating open technical exchanges, interaction, and sharing among the various program participants. Program participants will be expected to present the technical status and progress of their projects to other participants and invited guests. Individual sessions for each Performer team with the WRIVA PM and T&E Team may be scheduled to coincide with these workshops. Non-proprietary information will be shared by Performers in the open meeting sessions; proprietary information sharing shall occur during individual breakout sessions with the WRIVA PM and T&E.

1.H.2. Site Visits

Site visits by the Government Team will generally take place semiannually during the life of the program. These visits will occur at the Performer's facility. Reports on technical progress, details of successes and issues, contributions to the program goals, and technology demonstrations will be expected at such site visits. IARPA reserves the right to conduct additional site visits on an as-needed basis or virtually if desired.

1.I. Period of Performance

Anticipated PoP: 42 Months as follows:

Phase 1: November 1, 2022 - April 30, 2024

Phase 2: May 1, 2024 - April 30, 2026

Note: Proposals shall include a solution for Phases 1 and 2, inclusive of all Task Areas.

1.J. Place of Performance

Performance will be conducted at the Performers' sites.